HARDWARE MANUAL

PLC Automation

System assembly and device specifications

AC500 V2, AC500-eCo V2, AC500-XC V2

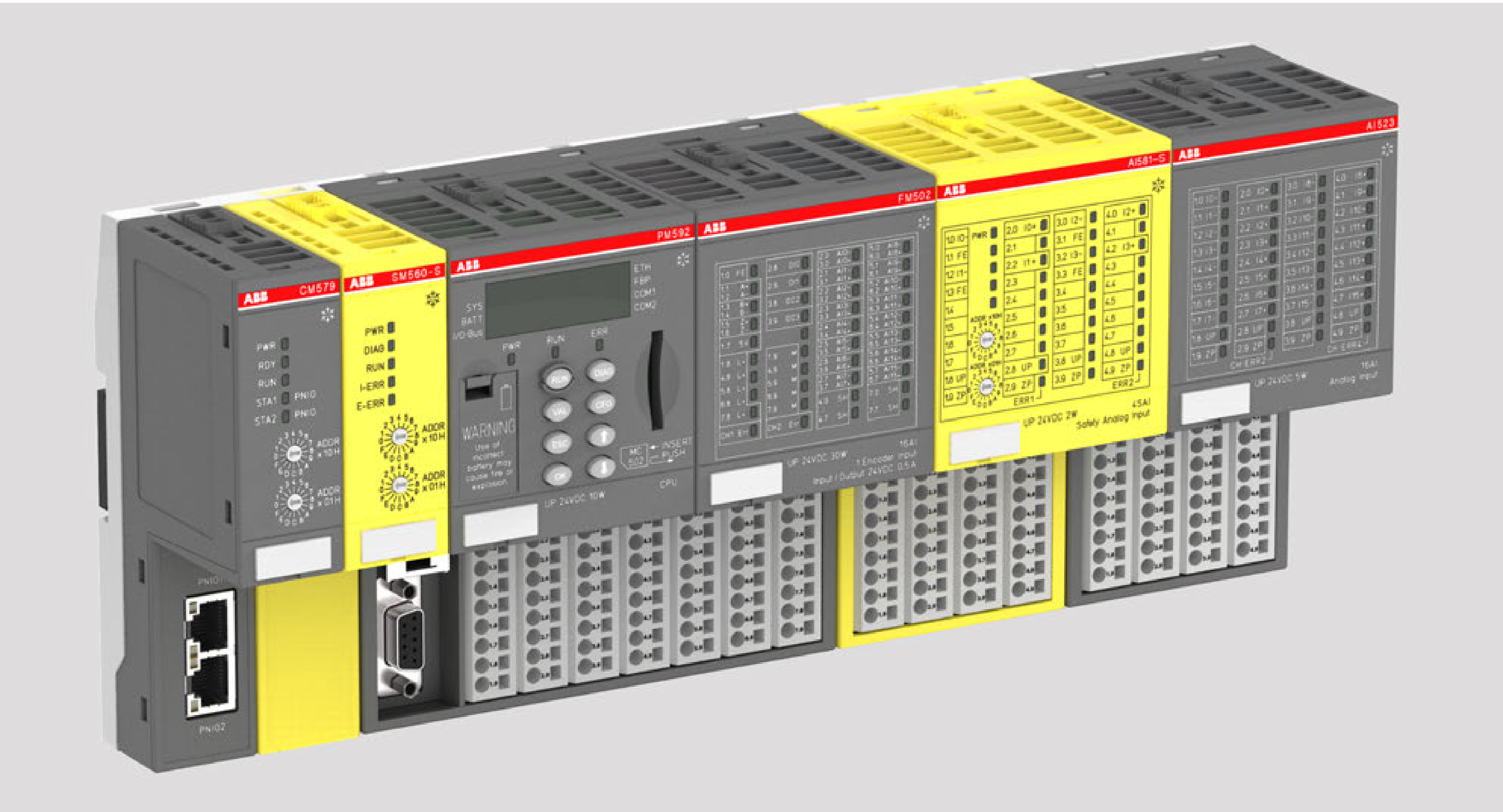


Table of contents

1 Device specifications

1.1 Status LEDs, display and control elements

Depending on the device type, various operating elements provided on the front panel can be used to control the devices of the PLC system and/or to change the operating mode.

Operating elements:

- Status LEDs:
  Indicates the availability of devices and components such as communication modules, communication interface modules or function modules. Functionality and diagnosis of the status LEDs depends on the specific module and is described in the device description of the appropriate module. Possible status: on/off/blinking
- I/O LEDs:
  Displays the status of the inputs and outputs.
- Display:
  Available for some processor modules. It can be used for simple configurations and for reading out diagnosis information.
- Function keys and switches:
  Allows to change the current operating modes/status manually.

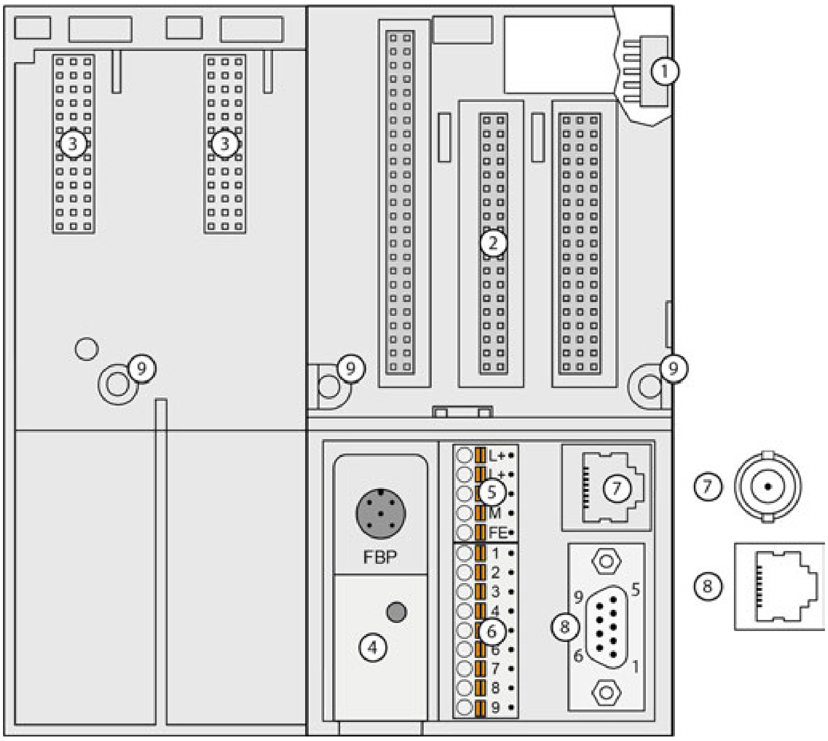
1.2 Terminal bases (AC500 standard)

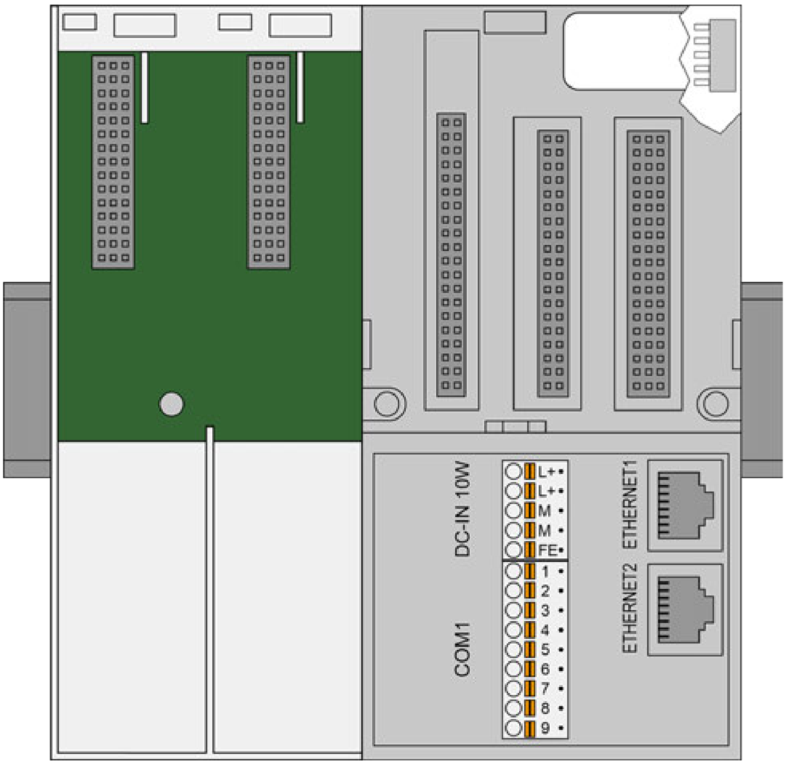
On AC500-eCo processor modules and special AC500 (Standard) processor modules the terminal base cannot be removed.

1.2.1 TB51x-TB54x

- TB511-ARCNET: 1 processor module, 1 communication module, with network interface ARCNET BNC
- TB511-ETH: 1 processor module, 1 communication module, with network interface Ethernet RJ45
- TB521-ARCNET: 1 processor module, 2 communication modules, with network interface ARCNET BNC
- TB521-ETH: 1 processor module, 2 communication modules, with network interface Ethernet RJ45
- TB523-2ETH: 1 processor module, 2 communication modules, with 2 network interface Ethernet RJ45
- TB541-ETH: 1 processor module, 4 communication modules, with network interface Ethernet RJ45
- XC version for use in extreme ambient conditions available (-ETH versions only)

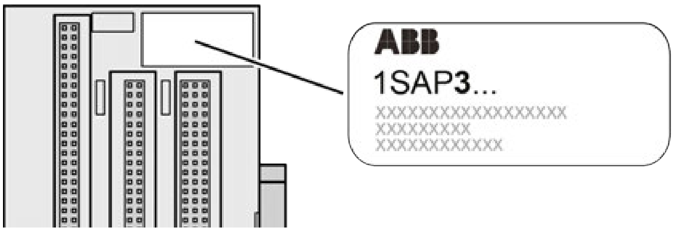
The following figure shows the TB521-ETH as example.





1 I/O bus (10-pin, female) to connect the I/O terminal units
2 One available slot for the processor module
3 Slots for communication modules (TB511-xxx: 1 slot, TB521-xxx: 2 slots, TB541-xx: 4 slots)
4 Interface for FieldBusPlug, not for terminal base TB523-2ETH
5 Power supply (5-pin terminal block, removable)
6 Serial interface COM1 (9-pin terminal block, removable)
7 Network interfaces: TB5xx-ETH: Ethernet, TB5xx-ARCNET: ARCNET
8 TB5x1: Serial interface COM2 (D-sub 9, female), TB523-2ETH: second Ethernet network interface
9 Holes for screw mounting

XC version **XC** = e**X**treme **C**onditions



> ***Extreme conditions***
>
> *Terminal bases for use in extreme ambient conditions have no ❄ sign for XC version.*
>
> *The figure **3** in the Part no. 1SAP**3**... (label) identifies the XC version.*

1.2.1.1 Short description

Terminal bases TB5xx are used as sockets for AC500 CPUs and communication modules.

Up to 10 I/O terminal units for I/O expansion modules can be added to these terminal bases.

The terminal bases have slots for one processor module and for communication modules as well as terminals and interfaces for power supply, expansion and networking.

Terminal Base	TB51x	TB52x	TB54x
Slots for processor modules	1	1	1
Slots for communication modules	1	2	4

> **NOTICE!**
> **Risk of malfunctions!**
> Unused slots for communication modules are not protected against accidental physical contact.
>
> – Unused slots for communication modules must be covered with dummy communication modules to achieve IP20 rating ➾ *Chapter 2.6.5.6 “TA524 - Dummy communication module” on page 1469*.
> – I/O bus connectors must not be touched during operation.

Terminal Base		TB511-		TB521-		TB523-	TB541-
		ETH	ARCNET	ETH	ARCNET	2ETH	ETH
I/O bus	I/O interface for direct connection of up to 10 I/O terminal units	x	x	x	x	x	x
Power supply	removable 5-pin terminal block	x	x	x	x	x	x

Terminal Base		**TB511-**		**TB521-**		**TB523-**	**TB541-**
		ETH	**ARCNET**	**ETH**	**ARCNET**	**2ETH**	**ETH**
COM1	Serial interface, removable 9-pin terminal block	x	x	x	x	x	x
COM2	Serial interface, 9-pin D-sub connector (female)	x	x	x	x	-	x
Network interface [1])	Ethernet RJ45	x	-	x	-	-	x
	ARCNET BNC	-	x	-	x	-	-
	2 Ethernet RJ45	-	-	-	-	x	-
Neutral FBP interface	Neutral FBP interface (M12, 5-pin, male, fastening with screw)	x	x	x	x	-	x
CAN interface	CAN 2 A/B	-	-	-	-	-	-
[1]) Type must be equal to the type of the used processor module.							

PM57x-ETH, PM58x-ETH and PM59x-ETH with part No. 1SAPxxxxxxR0271 can only be used with terminal bases with part No. 1SAPxxxxxxR0270.

PM5xx-2ETH can only be used with TB5x3-2ETH terminal bases.

For use in extreme ambient conditions (e.g. wider temperature and humidity range), a special XC version of the device is available.

1.2.1.2 Connections

1.2.1.2.1 I/O Bus

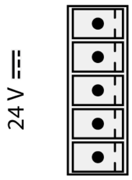
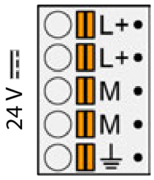
The I/O bus is the I/O data bus for the I/O modules. Through this bus, I/O and diagnosis data are transferred between the processor module and the I/O modules. Up to 10 I/O modules can be added.

Chapter 2.4.1 “I/O bus” on page 1368

1.2.1.2.2 Power supply

The supply voltage of 24 V DC is connected to a removable 5-pin terminal block. L+/M exist twice. It is therefore possible to feed e.g. external sensors (up to 8 A max. with 1.5 mm^2 conductor) via these terminals.

Pin assignment

Pin Assignment		Label	Function	Description
 Terminal block removed	 Terminal block inserted	L+	+24 V DC	Positive pin of the power supply voltage
		L+	+24 V DC	Positive pin of the power supply voltage
		M	0 V	Negative pin of the power supply voltage
		M	0 V	Negative pin of the power supply voltage
		⏚	FE	Functional earth

Faulty wiring on power supply terminals

NOTICE!
Risk of damaging the PLC due to improper voltage levels!

– Never exceed the maximum tolerance values for process and supply voltages.
– Never fall below the minimum tolerance values for process and supply voltages.
  Observe the **system data** *Chapter 2.6.1 “System data AC500” on page 1408* and the **technical data** of the module used.

NOTICE!
Risk of damaging the terminal base and power supply!
Short circuits might damage the terminal base and power supply.

Make sure that the four clamps L+ and M (two of each) are not wrongly connected (e. g. +/- of power supply is connected to both L+/L+ or both M/M).

NOTICE!
Risk of damaging the terminal base!
Terminal base can be damaged by connecting the power supply terminal block (L+/M) to COM1.

Make sure that the COM1 terminal block is always connected to the terminal base even if you do not use COM1 to prevent this.

NOTICE!
Risk of damaging the terminal base!
Excessive current might damage the clamp and terminal base.

Make sure that the current flowing through the removable clamps never exceeds 8 A (with 1.5 mm^2 conductor).

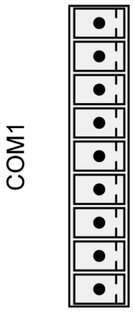
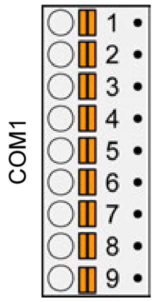
1.2.1.2.3 Serial interfaces COM1/COM2

Serial interface COM1

The serial interface COM1 is connected to a removable 9-pin terminal block. It is configurable for RS-232 and RS-485 and can be used (depending on the processor module) for:

- Online access (RS-232 programming interface for Automation Builder)
- A free protocol
- Modbus RTU, client and server
- CS31 bus (RS-485), as master only *Chapter 2.6.4.9.2 “Wiring” on page 1442*

Pin assignment (RS-485 / RS-232)

		Pin	Signal	Interface	Description
 Terminal block removed	 Terminal block inserted	1	Terminator P	RS-485	Terminator P
		2	RxD/TxD-P	RS-485	Receive/Transmit, positive
		3	RxD/TxD-N	RS-485	Receive/Transmit, negative
		4	Terminator N	RS-485	Terminator N
		5	RTS	RS-232	Request to send (output)
		6	TxD	RS-232	Transmit data (output)
		7	SGND	Signal Ground	Signal Ground
		8	RxD	RS-232	Receive data (input)
		9	CTS	RS-232	Clear to send (input)

NOTICE!
Unused connector!
Make sure that the terminal block is always connected to the terminal base or communication module, even if you do not use the interface.

For further information on connection and wiring please refer to 'Serial interfaces COM1 of the terminal bases' *Chapter 2.6.4.7 “Serial interface COM1 of the terminal bases” on page 1437.*

Serial interface COM2

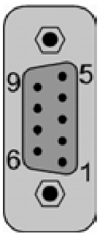
The serial interface COM2 is connected to a 9-pin D-sub connector. It is configurable for RS-232 and RS-485 and can be used (depending on the processor module) for:

- Online access (RS-232 programming interface for Automation Builder)
- A free protocol
- Modbus RTU, client and server

COM2 is not intended to establish a CS31 bus.

TB5x3-2ETH terminal bases have no COM2 D-sub.

Pin assignment

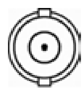
Serial Interface	Pin	Signal	Interface	Description	
	1	FE	-	Functional earth	
	2	TxD	RS-232	Transmit data	Output
	3	RxD/TxD-P	RS-485	Receive/Transmit	Positive
	4	RTS	RS-232	Request to send	Output
	5	SGND	Signal ground	0 V supply out	
	6	+5 V	-	5 V supply out	
	7	RxD	RS-232	Receive data	Input
	8	RxD/TxD-N	RS-485	Receive/Transmit	Negative
	9	CTS	RS-232	Clear to send	Input
	Shield	FE	-	Functional earth	

NOTICE!
Risk of corrosion!
Unused connectors and slots may corrode if XC devices are used in salt-mist environments.

Protect unused connectors and slots with TA535 protective caps for XC devices ↯ *Chapter 1.9.3.6 “TA535 - Protective caps for XC devices” on page 1362*.

For further information on connection and wiring please refer to 'Serial interfaces COM2 of the terminal bases' ↯ *Chapter 2.6.4.8 “Serial interface COM2 of the terminal bases ” on page 1439.*

1.2.1.2.4 ARCNET interface



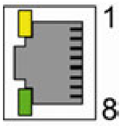
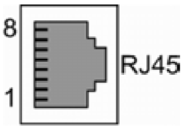
1.2.1.2.5 Ethernet interface

This interface is used for the connection of processor modules with onboard Ethernet e.g. AC500 CPU with an Ethernet interface.

Terminal bases TB5x3-2ETH for processor modules PM5xx-2ETH provide 2 independent Ethernet interfaces.

For structured Ethernet cabling only use cables in accordance with TIA/EIA-568-A, ISO/IEC 11801 or EN 50173.

Pin assignment

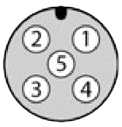
Interface	Pin	Signal	Description
 or 	1	TxD+	Transmit data +
	2	TxD-	Transmit data -
	3	RxD+	Receive data +
	4	NU	Not used
	5	NU	Not used
	6	RxD-	Receive data -
	7	NU	Not used
	8	NU	Not used
	Shield	Cable shield	Functional earth

> **NOTICE!**
> **Risk of corrosion!**
> Unused connectors and slots may corrode if XC devices are used in salt-mist environments.
>
> Protect unused connectors and slots with TA535 protective caps for XC devices *Chapter 1.9.3.6 “TA535 - Protective caps for XC devices” on page 1362*.

1.2.1.2.6 Neutral FieldBusPlug interface

Via a 5-pin neutral FBP interface, a processor module can be connected as a slave to a fieldbus master. The FieldBusPlug is fastened using a screw.

Pin assignment in serial mode

FieldBusPlug	Pin	Signal	Description
	1	+24 V	Standard power supply
	2	Diagnosis pin	
	3	0 V	Standard power supply
	4	Serial data	
	5	Serial data	

> **NOTICE!**
> **Risk of corrosion!**
> Unused connectors and slots may corrode if XC devices are used in salt-mist environments.
>
> Protect unused connectors and slots with TA535 protective caps for XC devices *Chapter 1.9.3.6 “TA535 - Protective caps for XC devices” on page 1362.*

Terminal bases TB5x3-2ETH for processor modules PM5xx-2ETH do not provide an neutral FBP interface.

1.2.1.3 Technical data

The system data of AC500 and S500 are applicable to the standard version *Chapter 2.6.1 “System data AC500” on page 1408*.

The system data of AC500-XC are applicable to the XC version *Chapter 2.7.1 “System data AC500-XC” on page 1475*.

Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

Parameter	Value
Connection of the supply voltage 24 V DC at the terminal base of the processor module	Removable 5-pin terminal block spring type
Max. current consumption from 24 V DC	TB511: 0.35 A [1]) TB521: 0.4 A [1]) TB523: 0.4 A [1]) TB541: 0.6 A [1])
Melting integral of a fuse at 24 V DC	Min. 1 A^2s [2])
Peak inrush current from 24 V DC	55 A [2])
Slots	TB511: 1 processor module, 1 communication module
	TB521: 1 processor module, 2 communication modules
	TB523: 1 processor module, 2 communication modules
	TB541: 1 processor module, 4 communication modules
Processor module interfaces at TB5x1	I/O bus, COM1, COM2, FBP
Processor module interfaces at TB5x3	I/O bus, COM1
Processor module network interfaces	TB5x1-ETH / AC500 CPU with Ethernet interface
	TB523-2ETH / PM591-2ETH: 2x Ethernet
	TB5x1-ARCNET / AC500 CPU with ARCNET interface
Net weight (terminal base without processor module)	TB511: 175 g
	TB521: 200 g
	TB541: 250 g
Mounting position	Horizontal or vertical

[1]) Including processor modules, communication modules and communication interface modules

[2]) The inrush current and the melting integral depends on the internal power supply of the processor module and the number and type of communication modules and I/O modules connected to the I/O bus.

1.2.1.4 Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 111 100 R0260	TB511-ARCNET, terminal base AC500, slots: 1 processor module, 1 communication module, ARCNET COAX connector	Active
1SAP 111 100 R0270	TB511-ETH, terminal base AC500, slots: 1 processor module, 1 communication module, Ethernet RJ45 connector	Active
1SAP 311 100 R0270	TB511-ETH-XC, terminal base AC500, slots: 1 processor module, 1 communication module, Ethernet RJ45 connector, XC version	Active
1SAP 112 100 R0260	TB521-ARCNET, terminal base AC500, slots: 1 processor module, 2 communication modules, ARCNET COAX connector	Active
1SAP 112 100 R0270	TB521-ETH, terminal base AC500, slots: 1 processor module, 2 communication modules, with network interface Ethernet RJ45	Active
1SAP 312 100 R0270	TB521-ETH-XC, terminal base AC500, slots: 1 processor module, 2 communication modules, with network interface Ethernet RJ45, XC version	Active
1SAP 112 300 R0277	TB523-2ETH, teminal base AC500, slots: 1 processor module, 2 communication modules, with 2 network interfaces Ethernet RJ45	Active
1SAP 114 100 R0270	TB541-ETH, slots: 1 processor module, 4 communication modules, with network interface Ethernet RJ45	Active
1SAP 314 100 R0270	TB541-ETH-XC, slots: 1 processor module, 4 communication modules, with network interface Ethernet RJ45, XC version	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

Processor modules PM57x-ETH(-XC), PM58x-ETH(-XC) and PM59x-ETH(-XC) with ordering No. 1SAPxxxxxxR0271 can only be used with terminal bases TB5x1-ETH(-XC) with ordering No. 1SAPxxxxxxR0270.

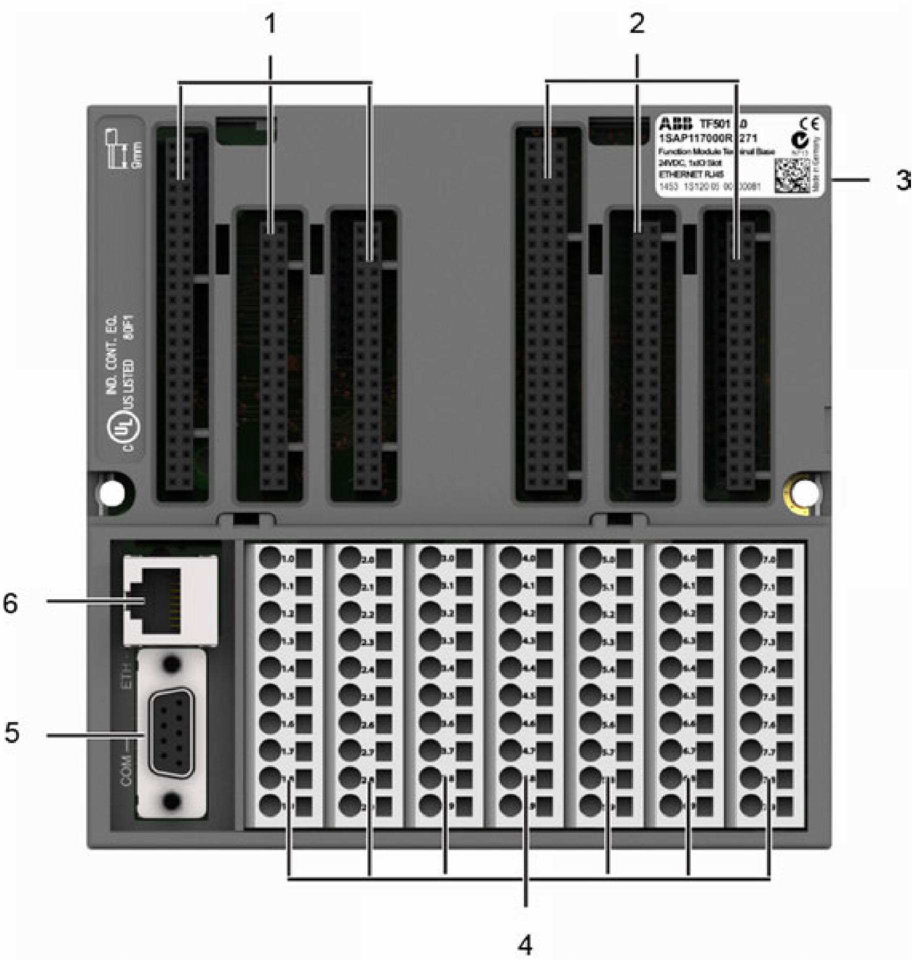
Processor module PM591-2ETH can only be used with TB523-2ETH.

Table 1: Accessories

Part no.	Description
1SAP 180 200 R0001	TK501, programming cable D-sub / D-sub, length: 5 m
1SAP 180 200 R0101	TK502, programming cable terminal block / D-sub, length: 5 m
1SAP 180 800 R0001	TA526, wall mounting accessory

1.2.2 TF501-CMS and TF521-CMS - Function module terminal bases

- For function module FM502-CMS
- TF501-CMS: 1 processor module, 1 FM502-CMS, with network interface Ethernet RJ45
- TF521-CMS: 1 processor module, 1 FM502-CMS, 2 communication modules, with network interfaces Ethernet RJ45
- XC version for use in extreme ambient conditions available



1 Slots for PM592-ETH
2 Slots for FM502-CMS
3 I/O bus to galvanically connect the terminal units
4 Terminal blocks for analog/digital inputs/outputs
5 Serial interface COM1
6 Ethernet network interface

All I/O channels (digital and analog) are protected against reverse polarity, reverse supply and temporary overvoltage up to 30 VDC.

The TF5x1-CMS are used as terminal bases for FM502-CMS, PM592-ETH and communication modules *Chapter 1.7.2.2 “FM502-CMS - Analog measurements” on page 895* *Chapter 1.3.2.1 “PM57x (-y), PM58x (-y) and PM59x (-y)” on page 23*.

1.2.2.1 Short description

The function module terminal bases have slots for one FM502-CMS, one processor module and for communication modules as well as terminals and interfaces for power supply, expansion, networking and IO. The number of slots differs depending on the type of terminal base.

Table 2: Number of slots

Slot	TF501-CMS	TF521-CMS
Slots for processor modules	1	1
Slots for function modules	1	1
Slots for communication modules	0	2

NOTICE!
Risk of malfunctions!
Unused slots for communication modules are not protected against accidental physical contact.

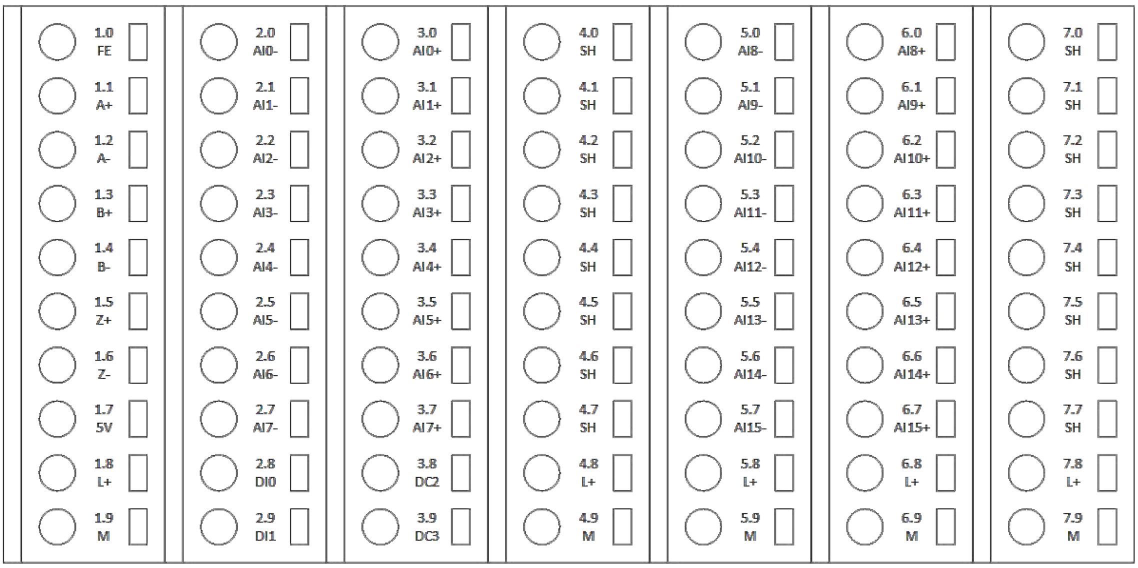
– Unused slots for communication modules must be covered with dummy communication modules to achieve IP20 rating *Chapter 2.6.5.6 “TA524 - Dummy communication module” on page 1469*.
– I/O bus connectors must not be touched during operation.

1.2.2.2 Connections

The connection is set up using the terminals of the TF5x1-CMS.

Mounting, disassembling and connection for the terminal function block and the I/O modules are described in the system assembly chapter, as well as the serial I/O bus *Chapter 2.4 “Overall information (valid for complete AC500 product family)” on page 1368.*

Terminal assignment of the TF5x1-CMS



Terminal	Signal	Description
1.0	FE	Functional earth for encoder shield connection
1.1	A+	Input signal A of encoder 0
1.2	A-	Inverted input signal A of encoder 0
1.3	B+	Input signal B of encoder 0

Terminal	Signal	Description
1.4	B-	Inverted input signal B of encoder 0
1.5	Z+	Input signal Z of encoder 0
1.6	Z-	Inverted input signal Z of encoder 0
1.7	5 V	+5 V DC power supply output for encoder
1.8	L+	Process voltage L+ (24 V DC)
1.9	M	Process voltage M (0 V DC)
2.0 ... 2.7	AI0- ... AI7-	Negative input signal AI0...AI7 for analog channel 0...7
2.8/2.9	DI0/DI1	Input signal I0/I1 (standard digital input)
3.0 ... 3.7	AI0+ ... AI7+	Positive input signal AI0 ... AI7 for analog channel 0 ... 7
3.8/3.9	DC2/DC3	Signal of configurable digital input/output C2/C3
4.0 ... 4.7	SH	Shield connection
4.8	L+	Process voltage L+ (24 V DC)
4.9	M	Process voltage M (0 V DC)
5.0 ... 5.7	AI8- ... AI15-	Negative input signal AI0AI7 for analog channel 8 ... 15
5.8	L+	Process voltage L+ (24 V DC)
5.9	M	Process voltage M (0 V DC)
6.0 ... 6.7	AI8+ ... AI15+	Positive input signal AI0...AI7 for analog channel 8 ... 15
6.8	L+	Process voltage L+ (24 V DC)
6.9	M	Process voltage M (0 V DC)
7.0 ... 7.7	SH	Shield connection
7.8	L+	Process voltage L+ (24 V DC)
7.9	M	Process voltage M (0 V DC)

CAUTION!
Risk of damaging the PLC modules!

The PLC modules must not be removed while the plant is connected to a power supply.

Make sure that all voltage sources (supply and process voltage) are switched off before you remove or replace a module.

Analog signals must be transmitted through shielded cables. The analog cable shield must only be connected to the side of the module (SH terminals) to avoid isothermal relaxation currents influencing the measuring results and for optimal robustness against external noise. The shield connection must be as short as possible (< 3 cm). The analog shield is capacitive and internally coupled with the functional earth (FE). To avoid unacceptable potential differences between different parts of the installation, low-resistance equipotential bonding conductors must be laid.

CAUTION!
Risk of damaging the processor module and terminal base!
Voltages surpassing the permitted range might damage the processor module and terminal base.

Never connect supply and process voltages > 30 V DC to the terminal base.

NOTICE!
Risk of damaging the terminal base and power supply!
Short circuits might damage the terminal base and power supply.

Make sure that the four clamps L+ and M (two of each) are not wrongly connected (e. g. +/- of power supply is connected to both L+/L+ or both M/M).

NOTICE!
Risk of damaging terminal base!
Excessive current might damage the clamp and terminal base.

Make sure that the current flowing through the spring terminals never exceeds 10 A.

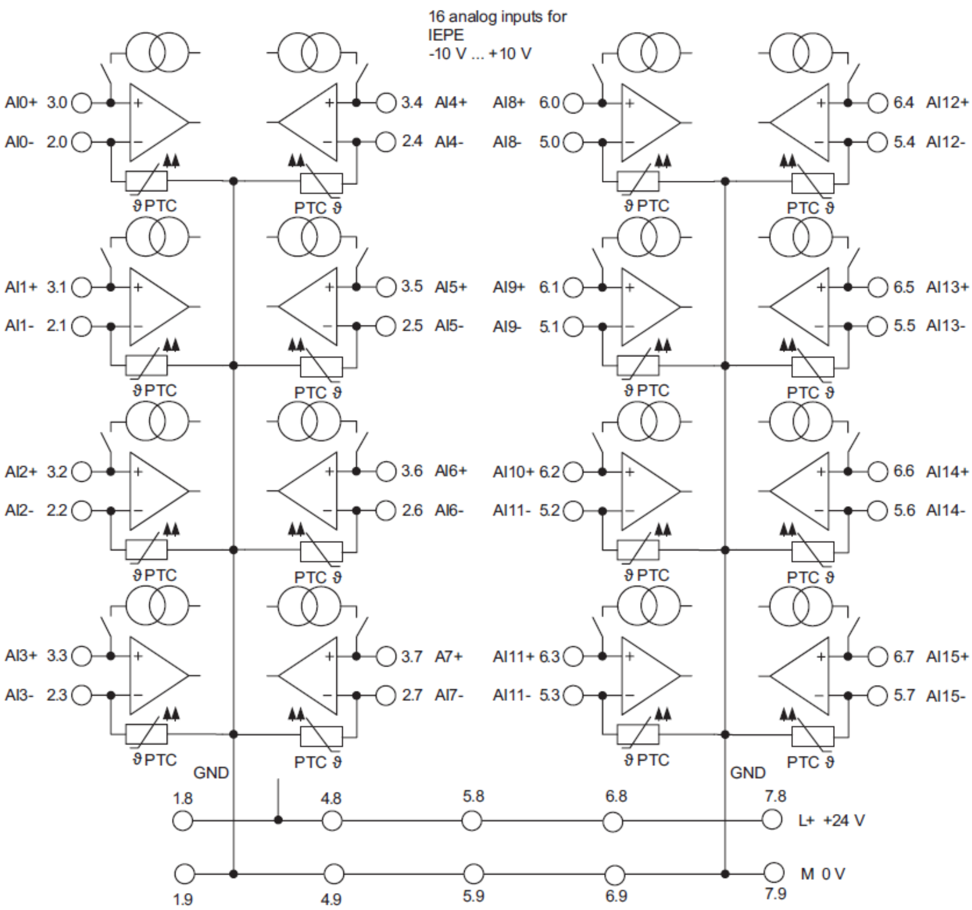


Fig. 1: Terminal assignment and connection

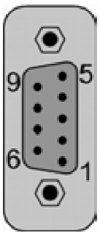
1.2.2.2.1 Serial interface COM1

The serial interface COM1 can be used for:

- Online access (RS-232 programming interface for Automation Builder software)
- Free protocol
- Modbus RTU, client and server
- CS31 bus (RS-485), as master only

Chapter 2.6.4.7 "Serial interface COM1 of the terminal bases" on page 1437.

Pin assignment

Serial Interface	Pin	Signal	Interface	Description	
	1	FE	-	Functional earth	
	2	TxD	RS-232	Transmit data	Output
	3	RxD/TxD-P	RS-485	Receive/Transmit	Positive
	4	RTS	RS-232	Request to send	Output
	5	SGND	Signal ground	0 V supply out	
	6	+5 V	-	5 V supply out	
	7	RxD	RS-232	Receive data	Input
	8	RxD/TxD-N	RS-485	Receive/Transmit	Negative
	9	CTS	RS-232	Clear to send	Input
	Shield	FE	-	Functional earth	

> **NOTICE!**
> **Risk of corrosion!**
> Unused connectors and slots may corrode if XC devices are used in salt-mist environments.
>
> Protect unused connectors and slots with TA535 protective caps for XC devices *Chapter 1.9.3.6 "TA535 - Protective caps for XC devices" on page 1362*.

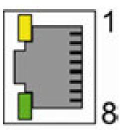
1.2.2.2.2 Ethernet interface

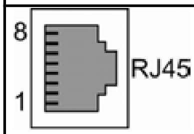
This interface is the connection to the internal Ethernet communication module of the processor modules.

Applications:

- TCP/IP for PC/Automation Builder (programming)
- UDP: communication via function blocks
- Modbus on TCP/IP, master and slave

Pin assignment

Interface	Pin	Signal	Description
	1	TxD+	Transmit data +
	2	TxD-	Transmit data -
	3	RxD+	Receive data +
or	4	NU	Not used
	5	NU	Not used
	6	RxD-	Receive data -

Interface	Pin	Signal	Description
	7	NU	Not used
	8	NU	Not used
	Shield	Cable shield	Functional earth

> **NOTICE!**
> **Risk of corrosion!**
> Unused connectors and slots may corrode if XC devices are used in salt-mist environments.
>
> Protect unused connectors and slots with TA535 protective caps for XC devices ⇘ *Chapter 1.9.3.6 “TA535 - Protective caps for XC devices” on page 1362*.

1.2.2.3 Technical data

The system data of AC500 and S500 are applicable to the standard version ⇘ *Chapter 2.6.1 “System data AC500” on page 1408*.

The system data of AC500-XC are applicable to the XC version ⇘ *Chapter 2.7.1 “System data AC500-XC” on page 1475*.

Only additional details are therefore documented below.

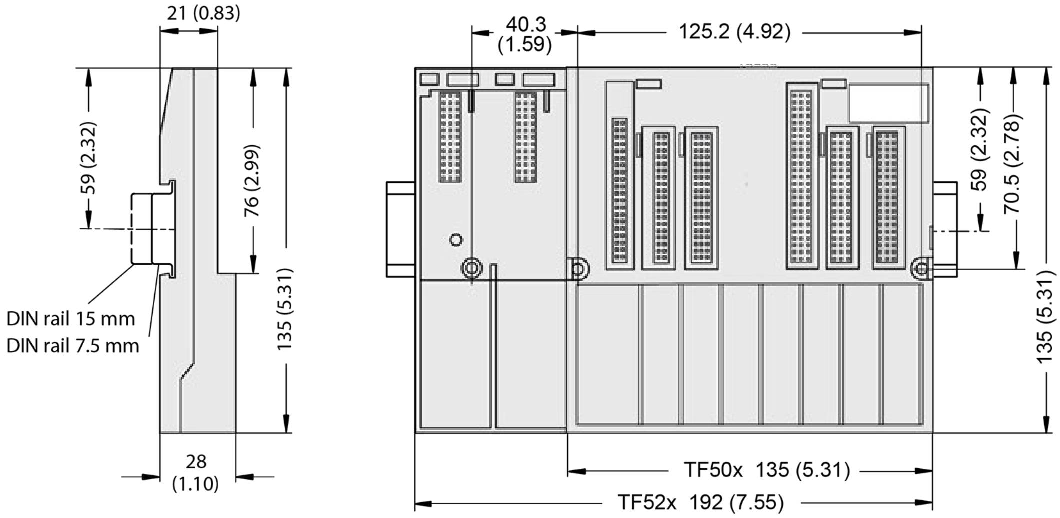
The technical data are also applicable to the XC version.

Parameter		Value
Connection of the supply voltage 24 V DC at the TF5x1-CMS		The terminals 1.8, 4.8 ... 7.8, 1.9, 4.9 ... 7.9, 4.0 ... 4.7, 7.0 ... 7.7 are electrically interconnected within the TF5x1-CMS. Terminals 1.8, 4.8 ... 7.8: process voltage L+ = +24 V DC Terminals 1.9, 4.9 ... 7.9: process voltage M = 0 V Terminals 4.0 ... 4.7, 7.0 ... 7.7: analog shield clamps SH Terminal 1.0: FE shield clamp of encoder
Rated voltage		24 V DC
Max. permitted total current		10 A (between terminals 1.8, 4.8 ... 7.8 and 1.9, 4.9 ... 7.9)
Slots		
	TF501-CMS	1 function module FM502-CMS, 1 processor module PM592-ETH, 0 communication modules
	TF521-CMS	1 function module FM502-CMS, 1 processor module PM592-ETH, 2 communication modules
Processor module interfaces		I/O bus, COM1
Weight		TF501-CMS: 350 g
		TF521-CMS: 400 g
Mounting position		Horizontal or vertical

Table 3: Connection of the TF5x1-CMS

Parameter	Value
I/O bus	I/O interface for directly adding up to 10 terminal units
Terminal block	70 clamps for I/O, shield and power supply connection
COM1	Serial interface, 9-pin D-sub connector, female
Network interface (type must be equal to the type of the used processor module)	Ethernet RJ45

1.2.2.4 Dimensions



The dimensions are in mm and in brackets in inch.

1.2.2.5 Ordering data

Part No.	Scope of delivery	Product life cycle status
1SAP 117 000 R0271	TF501-CMS, function module terminal base, slots: 1 function module FM502-CMS, 1 processor module PM592-ETH, 1 communication module, Ethernet RJ45 connector	Active
1SAP 317 000 R0271	TF501-CMS-XC, function module terminal base, slots: 1 function module FM502-CMS, 1 processor module PM592-ETH, 1 communication module, Ethernet RJ45 connector, XC version	Active

Part No.	Scope of delivery	Product life cycle status
1SAP 117 200 R0271	TF521-CMS, function module terminal base, slots: 1 function module FM502-CMS, 1 processor module PM592-ETH, 2 communication modules, Ethernet RJ45 connector	Active
1SAP 317 200 R0271	TF521-CMS-XC, function module terminal base, slots: 1 function module FM502-CMS, 1 processor module PM592-ETH, 2 communication modules, Ethernet RJ45 connector, XC version	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

1.3 Processor modules

The AC500 product family consists of the product groups:

- AC500 (Standard):
  AC500 standard PLCs offer a wide range of performance levels and scalability. The PLCs are highly capable of communication and extension for flexible application.
- AC500-eCo:
  AC500-eCo PLCs are cost-effective, high-performance compact PLCs that offer total interoperability with the core AC500 range and provide battery-free uninterrupted output. All I/O modules can be freely connected in a simple, stable and reliable manner.
- AC500-S:
  AC500-S PLCs are designed for safety applications in factory, process or machine automation.
- AC500-XC:
  AC500 (Standard) and AC500-S provide devices with -XC extension as a product variant.
  These variants operate according to their product group and can, in addition, be operated under extreme conditions. AC500-XC PLCs can be used at high altitudes, extended operating temperature and in humid conditions. The devices also provids a high level of resistance to vibration and corrosive gases. The AC500-XC series is consistent with standard devices concerning the overall dimensions, the control function and the software compatibility *Chapter 2.7.1 “System data AC500-XC” on page 1475*.

The AC500 product family is characterized by functional modularity. As the complete AC500 product family shares the same hardware platform and programming software tool, the devices of the AC500 product groups can be flexibly combined.

S500 devices represent the I/O modules of the product group AC500 (Standard), whereas S500-eCo devices represent the I/O modules of the product group AC500-eCo. Both S500 and S500-eCo devices can be flexibly combined with devices of the AC500 product family.

1.3.1 AC500-eCo

PM55x-xP and PM56x-xP

The devices have the life status "limited" and are no longer described here. Information about this series can be found in the manual for "PLC Automation with AC500 V2 and Automation Builder 2.6.1".

PLC Automation with AC500 V2 and Automation Builder 2.6.1

1.3.2 AC500 (standard)

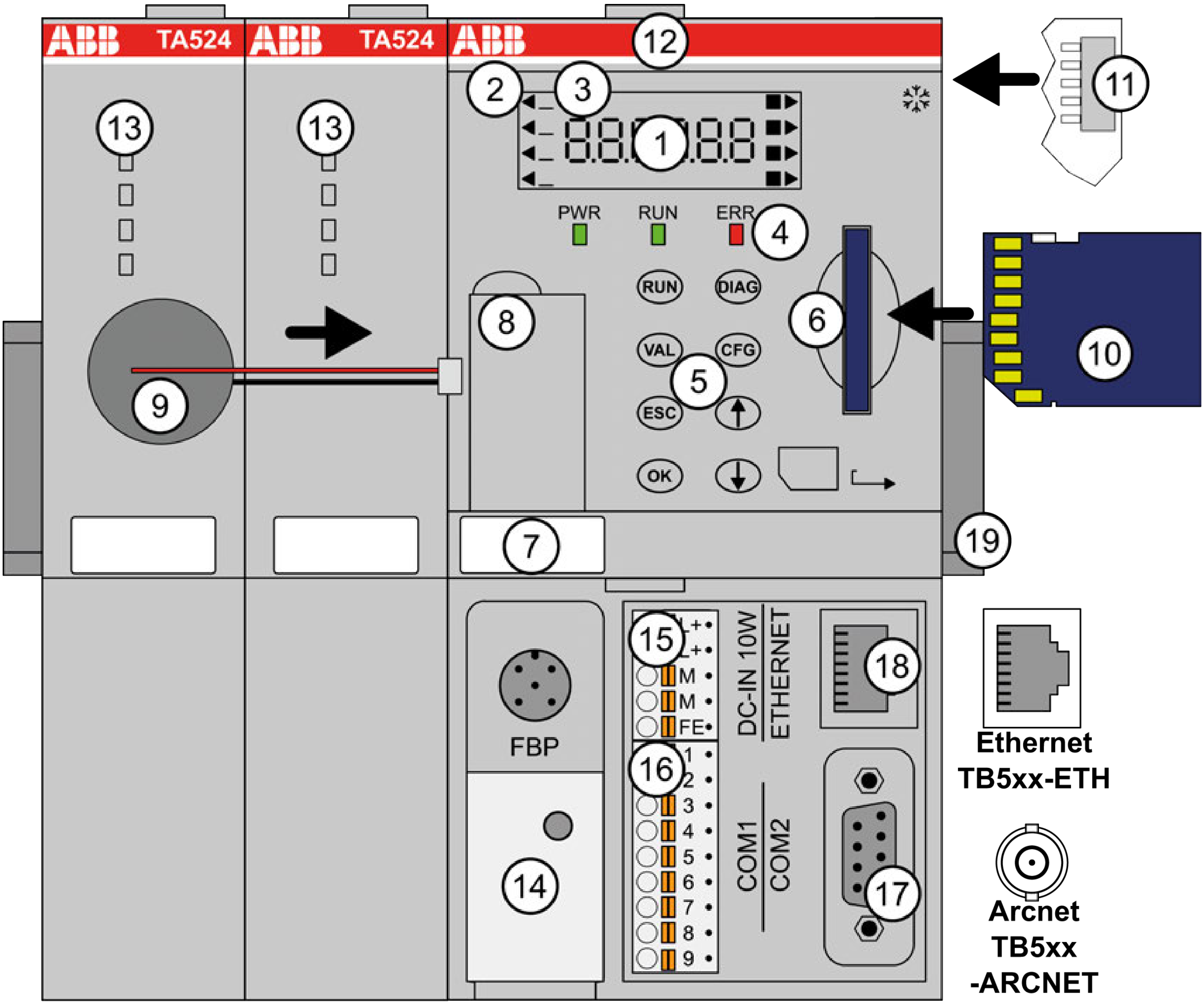
1.3.2.1 PM57x (-y), PM58x (-y) and PM59x (-y)

Processor modules without onboard interfaces:

- PM57x, PM58x, PM59x: processor module without Ethernet support
- The processor module PM595 is described in a seperate device description *Chapter 1.3.2.2 “PM595-4ETH” on page 37*
- XC version for usage in extreme ambient conditions available (some models versions only)

Processor modules with onboard interfaces:

- PM5xy-ETH: processor module with Ethernet support (onboard Ethernet) - 1 network interface RJ45 on the terminal base
- PM5xy-2ETH: processor module with Ethernet support (onboard Ethernet) - 2 network interfaces RJ45 on the terminal base
- PM5xy-ARC: processor module with ARCNET support (onboard ARCNET) - 1 network interface ARCNET BNC on the terminal base



1 6 7-segment state displays with backlight
2 "Triangle" displays for "item"
3 "Square" displays for "state"
4 3 state LEDs
5 8 function keys
6 Slot for memory card
7 Label
8 Compartment for lithium battery TA521
9 Lithium battery TA521
10 Memory card
11 I/O bus for connection of I/O modules
12 Slot for processor module (processor module mounted on terminal base)
13 Slots for communication modules (multiple, depending on terminal base; unused slots must be covered with TA524)
14 Interface for FieldBusPlug
15 Power supply (5-pin terminal block, removable)
16 Serial interface COM1 (9-pin terminal block, removable)
17 PM5xy-ETH and PM5xy-ARCNET: D-sub 9 for serial interface COM2. PM5xy-2ETH: RJ45 female connector for 2nd Ethernet connection
18 RJ45 female connector for Ethernet connection / BNC female connector for ARCNET connection (depending on terminal base)
19 DIN rail
❄ Sign for XC version

1.3.2.1.1 Short description

The processor modules are the central units of the control system AC500. The types differ in their performance (memory size, speed etc.). Each processor module must be mounted on a suitable terminal base.

The terminal base type (TB5xx) depends on the number of communication modules which are used together with the processor module and on the processor module's network interface type (1 Ethernet, 2 Ethernet or ARCNET).

Each processor module can operate multiple communication modules through its communication module interface (defined by the terminal base).

The communication modules are mounted on the left side of the processor module on the same terminal base.

On the right side of the processor module, up to 10 digital or analog I/O expansion modules can be connected to the I/O bus. Each I/O module requires a suitable terminal unit depending on the module type.

Terminal bases, terminal units, I/O modules, communication modules and accessories have their own technical descriptions.

Each processor module can be used as:

- Stand-alone processor module
- Stand-alone processor module with local I/Os
- Remote IO server
- Remote IO client

All processor modules V2 (except PM591-2ETH) have a FieldBusPlug interface (FBP).

This interface is no more supported and in limited state.

The processor modules are powered with 24 V DC.

WARNING!

Removal/Insertion under power

The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

The processor module PM595 is described in a separate device description *Chapter 1.3.2.2 “PM595-4ETH” on page 37.*

1.3.2.1.2 Assortment

Processor Module	Suitable Terminal Base	Network Interface		Other Interfaces
		Ethernet	ARCNET	
PM572	TB5x1-ETH	-	-	3)
PM573-ETH	TB5x1-ETH (1SAP11x100R0270 only)	Onboard Ethernet	-	3)
PM582	TB5x1-ETH	-	-	3)
PM583-ETH	TB5x1-ETH (1SAP11x100R0270 only)	Onboard Ethernet	-	3)
PM585-ETH	TB5x1-ETH (1SAP11x100R0270 only)	Onboard Ethernet	-	3)
PM590-ETH 1)	TB5x1-ETH	Integrated communication module	-	3)
PM590-ARCNET (R0261)	TB5x1-ARCNET	-	Integrated communication module	3)
PM591-ETH	TB5x1-ETH	Integrated communication module	-	3)
PM591-ETH	TB5x1-ETH (1SAP11x100R0270 only)	Onboard Ethernet	-	3)
PM591-2ETH	TB5x3-2ETH	2x Onboard Ethernet	-	2)
PM592-ETH	TB5x1-ETH (1SAP11x100R0270 only)	Onboard Ethernet	-	3)

Remarks:

1) The processor modules PM59x-ETH can only be used with terminal bases with product index C6 or higher. Otherwise, they should be updated to that index. *Chapter 1.2.1 “TB51x-TB54x” on page 4*

2) Serial interface COM1, Communication Interface Module, I/O bus

3) Serial interface COM1, Serial interface COM2, Communication Interface Module, FieldBus-Plug (FBP), I/O bus

1.3.2.1.3 Connections

All terminals for connection are available on the terminal base. For information on connection and available interfaces see the descriptions for

- *Chapter 1.2.1 “TB51x-TB54x” on page 4*.

Processor modules PM57x-ETH, PM58x-ETH and PM59x-ETH with ordering No. 1SAPxxxxxxR0271 can only be used with terminal bases with ordering No. 1SAPxxxxxxR0270.

Processor modules PM5xx-2ETH can only be used with TB5x3-2ETH terminal bases.

1.3.2.1.4 Storage elements

Lithium battery

The processor modules are supplied without lithium battery. It must be ordered separately. The TA521 lithium battery is used for data (SRAM) and RTC buffering while the processor module is not powered.

The CPU monitors the discharge degree of the battery. A warning is issued before the battery condition becomes critical (about 2 weeks before). Once the warning message appears, the battery should be replaced as soon as possible.

The technical data, handling instructions and the insertion/replacement of the battery is described in detail in the chapter TA521 lithium battery *Chapter 2.6.5.3 “TA521 - Battery” on page 1461*.

Memory card

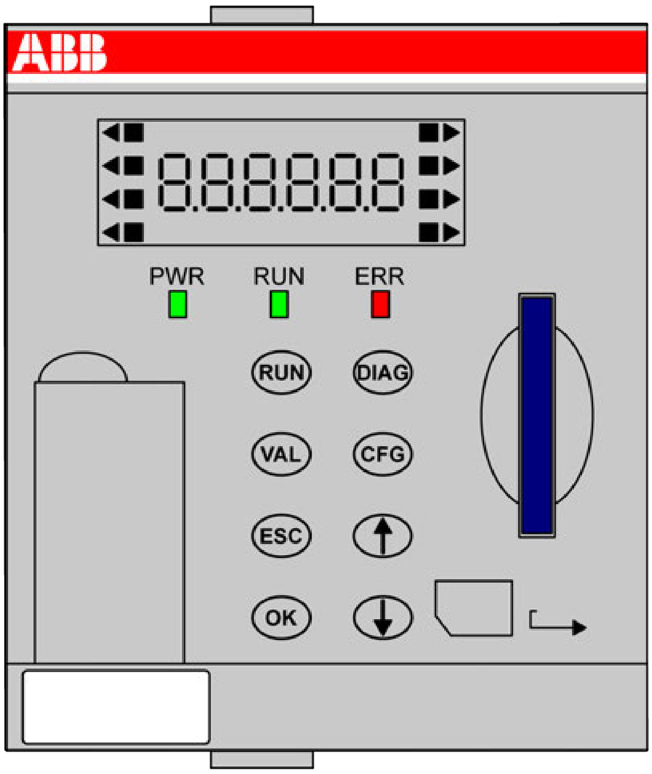
AC500 processor modules are supplied without memory card. It must be ordered separately.

The memory card can be used

- to read and write user files,
- to download a user program,
- for firmware updates,
- for program source code storage.

AC500 processor modules can be operated with and without memory cards. The processor module uses a standard file system (FAT; filenames stored in 8.3 format). This allows standard card readers to read and write the memory cards.

1.3.2.1.5 LEDs, display and function keys on the front panel



1.3.2.1.6 Technical data

The system data of AC500 and S500 are applicable to the standard version ➫ *Chapter 2.6.1 “System data AC500” on page 1408*.

The system data of AC500-XC are applicable to the XC version ➫ *Chapter 2.7.1 “System data AC500-XC” on page 1475*.

Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

Processor module and terminal base

Parameter	Value
Connection of the supply voltage 24 V DC at the terminal base of the processor module	Removable 5-pin terminal block with spring connection
Current consumption from 24 V DC	PM57x: 50 mA PM57x-ETH: 110 mA
	PM58x: 50 mA PM58x-ETH: 110 mA PM58x-ARCNET: 110 mA
	PM59x: 90 mA PM59x-ETH: 150 mA PM59x-2ETH: 150 mA PM59x-ARCNET: 150 mA
Slots on the terminal bases	TB511: 1 processor module, 1 communication module
	TB521: 1 processor module, 2 communication modules
	TB523: 1 processor module, 2 communication modules
	TB541: 1 processor module, 4 communication modules
Processor module interfaces at the terminal bases TB5x1	I/O bus, COM1, COM2, FBP
Processor module interfaces at the terminal bases TB5x3	I/O bus, COM1
Processor module network interfaces at the terminal bases	TB5x1-ETH ➫ *Chapter 1.2.1 “TB51x-TB54x” on page 4* / AC500 CPU with Ethernet interface
	TB5x3-ETH ➫ *Chapter 1.2.1 “TB51x-TB54x” on page 4*/ AC500CPU with two Ethernet interfaces
	TB5x1-ARCNET ➫ *Chapter 1.2.1 “TB51x-TB54x” on page 4*/ AC500 CPU with ARCNET
Connection system	See 'Connection and Wiring' ➫ *Chapter 2.6.4 “Connection and wiring” on page 1431*
Weight (processor module without terminal base)	PM582: 135 g PM58x-ETH: 150 g

Parameter	Value
	PM59x: 135 g PM59x-ETH: 150 g PM59x-2ETH: 150 g PM59x-ARCNET: 160 g
Mounting position	Horizontal or vertical

Detailed data

Table 4: PM57x

Processor Module		PM572	PM573-ETH
Program memory flash EPROM and RAM		128 kB	512 kB
Data memory, integrated		128 kB, incl. 12 kB buffered	512 kB, incl. 288 kB buffered
Expandable memory		None	None
Integrated mass storage memory		None	None
Pluggable memory card for:			
	User data storage	x	x
	Program storage	x	x
	Firmware update	x	x
	Processor type	Freescale ARM Processor 32-bit	
	Processor clock speed	50 MHz	
Cycle time for 1 instruction:			
	Binary	Min. 0.06 µs	Min. 0.06 µs
	Word	Min. 0.09 µs	Min. 0.09 µs
	Floating point	Min. 0.70 µs	Min. 0.70 µs
Max. number of central inputs and outputs (up to 7 exp. modules): ([1])			
	Digital inputs	224	224
	Digital outputs	224	224
	Analog inputs	112	112
	Analog outputs	112	112
Max. number of central inputs and outputs (10 exp. modules):			
	Digital inputs	320	320
	Digital outputs	320	320
	Analog inputs	160	160
	Analog outputs	160	160
Number of decentralized inputs and outputs		Depends on the fieldbus used (as an info on the CS31 bus: up to 31 stations with up to 120 DI / 120 DO each)	
Data backup		Battery	
Data buffering time at +25 °C		Typ. 3 years without power supply	
Battery low indication		Warning issued about 2 weeks before the state of charge becomes critical	

Processor Module		**PM572**	**PM573-ETH**
Real-time clock:			
	With battery backup	x	x
	Accuracy	Typ. ± 2 s / day at +25 °C	
Program execution:			
	Cyclic	x	x
	Time-controlled	x	x
	Multitasking	x	x
Protection of the user program by a password		x	x
Serial interface COM1:			
	Physical link	Configurable for RS-232 or RS-485 (from 0.3 to 187.5 kB/s) pluggable terminal block, spring connection for programming, as Modbus (master/slave), as serial ASCI communication, as CS31 Master	
	Connection		
	Usage		
Serial interface COM2 (not for PM5xy-2ETH models):			
	Physical link	Configurable for RS-232 or RS-485 (from 0.3 to 187.5 kB/s) D-sub for programming, as Modbus (master/slave), as serial ASCII communication	
	Connection		
	Usage		
Integrated communication module:			
	ETH = Ethernet	-	ETH onboard with web server, SNTP and IEC60870-5-104 protocol
	RJ45	-	
	ARCNET = ARCNET BNC	-	
Number of external communication modules		Up to 4 communication modules like PROFIBUS DP, Ethernet, CANopen. There are no restrictions concerning the communication module types and communication module combinations (e.g. up to 4 PROFIBUS DP communication modules are possible)	
Ethernet		-	10/100 base-TX, 1x RJ45 socket, provided on TB5x1-ETH
LEDs, LCD display, 8 function keys		For RUN/STOP switchover, status displays and diagnosis	
Number of timers		Unlimited	
Number of counters		Unlimited	
Programming languages:			
	Structured Text ST	x	x
	Instruction List IL	x	x
	Function Block Diagram FBD	x	x
	Ladder Diagram LD	x	x
	Sequential Function Chart SFC	x	x
	Continuous Function Chart CFC	x	x
[1]): up to 7 I/O terminal units before PS501 V1.2 and processor module firmware before V1.2.0.			

Table 5: PM58x

Processor Module		PM582	PM583-ETH	PM585-ETH
Program memory flash EPROM and RAM		512 kB	1024 kB	1024 kB
Data memory, integrated		416 kB, incl. 288 kB buffered	1024 kB, incl. 288 kB buf-fered	1536 kB, incl. 512 kB buf-fered
Expandable memory		None	None	None
Integrated mass storage memory		None	None	None
Pluggable memory card for:				
	User data storage	x	x	x
	Program storage	x	x	x
	Firmware update	x	x	x
	Processor type	Freescale ARM Processor 32-bit		
	Processor clock speed	84 MHz		400 MHz
Cycle time for 1 instruction:				
	Binary	Min. 0.05 µs		Min. 0.004 µs
	Word	Min. 0.06 µs		Min. 0.008 µs
	Floating point	Min. 0.50 µs		Min. 0.008 µs
Max. number of central inputs and outputs (up to 7 exp. modules): [1])				
	Digital inputs	224		
	Digital outputs	224		
	Analog inputs	112		
	Analog outputs	112		
Max. number of central inputs and outputs (10 exp. modules):				
	Digital inputs	320		
	Digital outputs	320		
	Analog inputs	160		
	Analog outputs	160		
Number of decentralized inputs and outputs		Depends on the fieldbus used (as an info on the CS31 bus: up to 31 stations with up to 120 DI / 120 DO each)		
Data backup		Battery		
Data buffering time at +25 °C		Typ. 3 years without power supply		
Battery low indication		Warning issued about 2 weeks before the state of charge becomes critical		
Real-time clock:				
	With battery backup	x		
	Accuracy	Typ. ±2 s / day at +25 °C		
Program execution:				
	Cyclic	x		
	Time-controlled	x		
	Multitasking	x		

Processor Module		PM582	PM583-ETH	PM585-ETH
Protection of the user program by a password		x		
Serial interface COM1:				
	Physical link	Configurable for RS-232 or RS-485 (from 0.3 to 187.5 kB/s) pluggable terminal block, spring connection for programming, as Modbus (master/slave), as serial ASCI communication, as CS31 master		
	Connection			
	Usage			
Serial interface COM2 (not for PM5xy-2ETH models):				
	Physical link	Configurable for RS-232 or RS-485 (from 0.3 to 187.5 kB/s) D-sub for programming, as Modbus (master/slave), as serial ASCII communication		
	Connection			
	Usage			
Integrated communication module:				
	ETH = Ethernet	-	ETH onboard with web server, SNTP and IEC60870-5-104 protocol	
	RJ45	-		
	ARCNET = ARCNET BNC	-		
Number of external communication modules		Up to 4 communication modules like PROFIBUS DP, Ethernet, CANopen. There are no restrictions concerning the communication module types and communication module combinations (e.g. up to 4 PROFIBUS DP communication modules are possible)		
Ethernet		-	10/100 base-TX, 1x RJ45 socket, provided on TB5x1-ETH	
LEDs, LCD display, 8 Function Keys		For RUN/STOP switchover, status displays and diagnosis		
Number of timers		Unlimited		
Number of counters		Unlimited		
Programming languages:				
	Structured Text ST	x		
	Instruction List IL	x		
	Function Block Diagram FBD	x		
	Ladder Diagram LD	x		
	Sequential Function Chart SFC	x		
	Continuous Function Chart (CFC)	x		
[1]): up to 7 I/O terminal units before PS501 V1.2 and processor module firmware before V1.2.0.				

Table 6: PM59x 2)

Processor Module		**PM59x-ETH**	**PM59x-ARCNET**	**PM59x-ETH** **PM59x-2ETH**
Program memory flash EPROM and RAM		PM590: 2048 kB PM591/PM592: 4096 kB		
Data memory, integrated		PM590: 2560 kB, PM591: 3584 kB, incl. 1536 kB buffered		PM590: 3072 kB, PM591/592: 5632 kB, incl. 1536 kB buffered
Expandable memory		None	None	None
Integrated mass storage memory		None	None	PM592-ETH: 4 GB flash disk
Pluggable memory card for:				
	User data storage	x	x	x
	Program storage	x	x	x
	Firmware update	x	x	x
	Processor type	Freescale ARM Processor 32-bit		
	Processor clock speed	400 MHz		
Cycle time for 1 instruction:				
	Binary	Min. 0.002 µs	Min. 0.002 µs	Min. 0.002 µs
	Word	Min. 0.004 µs	Min. 0.004 µs	Min. 0.004 µs
	Floating point	Min. 0.004 µs	Min. 0.004 µs	Min. 0.004 µs
Max. number of central inputs and outputs (up to 7 exp. modules): 1)				
	Digital inputs	224	224	224
	Digital outputs	224	224	224
	Analog inputs	112	112	112
	Analog outputs	112	112	112
Max. number of central inputs and outputs (10 exp. modules):				
	Digital inputs	320	320	320
	Digital outputs	320	320	320
	Analog inputs	160	160	160
	Analog outputs	160	160	160
Number of decentralized inputs and outputs		Depends on the fieldbus used (as an info on the CS31 bus: up to 31 stations with up to 120 DI / 120 DO each)		
Data backup		Battery		
Data buffering time at +25 °C		Typ. 3 years without power supply		
Battery low indication		Warning issued about 2 weeks before the state of charge becomes critical		
Real-time clock:				
	With battery backup	x	x	x

Processor Module		**PM59x-ETH**	**PM59x-ARCNET**	**PM59x-ETH** **PM59x-2ETH**
	Accuracy	Typ. ±2 s / day at +25 °C	Typ. ±2 s / day at +25 °C	Typ. ±2 s / day at +25 °C
Program execution:				
	Cyclic	x	x	x
	Time-controlled	x	x	x
	Multitasking	x	x	x
Password protection of user program		x	x	x
Serial interface COM1:				
	Physical link	Configurable for RS-232 or RS-485 (from 0.3 to 187.5 kB/s) pluggable terminal block, spring connection for programming, as Modbus (master/slave), as serial ASCII communication, as CS31 master		
	Connection			
	Usage			
Serial interface COM2 (not for PM5xy-2ETH models):				
	Physical link	Configurable for RS-232 or RS-485 (from 0.3 to 187.5 kB/s) D-sub for programming, as Modbus (master/slave), as serial ASCII communication		
	Connection			
	Usage			
Integrated communication module:				
	ETH = Ethernet	ETH	ARCNET	ETH onboard with web server, SNTP and IEC60870-5-104 protocol
	RJ45	ETH	ARCNET	
	ARCNET = ARCNET BNC	ETH	ARCNET	
Number of external communication modules		Up to 4 communication modules like PROFIBUS DP, Ethernet, CANopen. There are no restrictions concerning the communication module types and communication module combinations (e.g. up to 4 PROFIBUS DP communication modules are possible)		
Ethernet		10/100 base-TX, 1x RJ45 socket	-	PM59x-ETH: 10/100 base-TX, 1x RJ45 socket, provided on TB5x1-ETH PM591-2ETH: 10/100 base-TX, independent interfaces, 2x RJ45 socket, provided on TB521-2ETH
LEDs, LCD display, 8 Function Keys		For RUN/STOP switchover, status displays and diagnosis		
Number of timers		Unlimited	Unlimited	Unlimited
Number of counters		Unlimited	Unlimited	Unlimited
Programming languages:				

Processor Module		PM59x-ETH	PM59x-ARCNET	PM59x-ETH PM59x-2ETH
	Structured Text ST	x	x	x
	Instruction List IL	x	x	x
	Function Block Diagram FBD	x	x	x
	Ladder Diagram LD	x	x	x
	Sequential Function Chart SFC	x	x	x
	Continuous Function Chart (CFC)	x	x	x
[1]): up to 7 I/O terminal units before PS501 V1.2 and processor module firmware before V1.2.0.				
[2]): For PM595 see device description for PM595 ⇘ *Chapter 1.3.2.2 “PM595-4ETH” on page 37*.				

1.3.2.1.7 Ordering data

Processor modules for AC500 (Standard) V2 products

Part no.	Description	Product life cycle phase *)
1SAP 130 200 R0200	PM572, processor module, memory 128 kB, 24 V DC, memory card slot, interfaces 2 RS-232/485 (programming, Modbus/CS31), 1 FBP, display	Classic
1SAP 130 300 R0271	PM573-ETH, processor module, memory 512 kB, 24 V DC, memory card slot, interfaces 2 RS-232/485 (programming, Modbus/CS31), 1 FBP, display, onboard Ethernet TCP/IP with web server, SNTP, IEC60870-5-104 protocols	Active
1SAP 330 300 R0271	PM573-ETH-XC, processor module, memory 512 kB, 24 V DC, memory card slot, interfaces 2 RS-232/485 (programming, Modbus/CS31), 1 FBP, display, onboard Ethernet TCP/IP with web server, SNTP, IEC60870-5-104 protocols, XC version	Active
1SAP 140 200 R0201	PM582, processor module, memory 512 kB, 24 V DC, memory card slot, interfaces 2 RS-232/485 (programming, Modbus/CS31), 1 FBP, display	Active
1SAP 340 200 R0201	PM582-XC, processor module, memory 512 kB, 24 V DC, memory card slot, interfaces 2 RS-232/485 (programming, Modbus/CS31), 1 FBP, display, XC version	Active
1SAP 140 300 R0271	PM583-ETH, processor module, memory 1024 kB, 24 V DC, memory card slot, interfaces 2 RS-232/485 (programming, Modbus/CS31), 1 FBP, display, onboard Ethernet TCP/IP with web server, SNTP, IEC60870-5-104 protocols	Active

Part no.	Description	Product life cycle phase *)
1SAP 340 300 R0271	PM583-ETH-XC, processor module, memory 1024 kB, 24 V DC, memory card slot, interfaces 2 RS-232/485 (programming, Modbus/CS31), 1 FBP, display, onboard Ethernet TCP/IP with web server, SNTP, IEC60870-5-104 protocols, XC version	Active
1SAP 140 500 R0271	PM585-ETH, processor module, memory 1024 kB, 24 V DC, memory card slot, interfaces 2 RS-232/485 (programming, Modbus/CS31), 1 FBP, display, onboard Ethernet TCP/IP with web server, SNTP, IEC60870-5-104 protocols	Active
1SAP 150 000 R0261	PM590-ARCNET, processor module, memory 2 MB, 24 V DC, memory card slot, interfaces 2 RS-232/485 (programming, Modbus/CS31), 1 FBP, display, integrated communication module ARCNET	Active
1SAP 150 000 R0271	PM590-ETH, processor module, memory 2 MB, 24 V DC, memory card slot, interfaces 2 RS-232/485 (programming, Modbus/CS31), 1 FBP, display, onboard Ethernet TCP/IP with web server, SNTP, IEC60870-5-104 protocols	Active
1SAP 150 100 R0271	PM591-ETH, processor module, memory 4 MB, 24 V DC, memory card slot, interfaces 2 RS-232/485 (programming, Modbus/CS31), 1 FBP, display, onboard Ethernet TCP/IP with web server, SNTP, IEC60870-5-104 protocols	Active
1SAP 150 100 R0277	PM591-2ETH, processor module, memory 4 MB, 24 V DC, memory card slot, interfaces 1 RS-232/485 (programming, Modbus/CS31), display, 2 onboard Ethernet TCP/IP with web server, SNTP, IEC60870-5-104 protocols	Active
1SAP 350 100 R0271	PM591-ETH-XC, processor module, memory 4 MB, 24 V DC, memory card slot, interfaces 2 RS-232/485 (programming, Modbus/CS31), 1 FBP, display, onboard Ethernet TCP/IP with web server, SNTP, IEC60870-5-104 protocols, XC version	Active

Part no.	Description	Product life cycle phase *)
1SAP 150 200 R0271	PM592-ETH, processor module, memory 4 MB / 4 GB flash disk, 24 V DC, memory card slot, interfaces 2 RS-232/485 (programming, Modbus/ CS31), 1 FBP, display, onboard Ethernet TCP/IP with web server, SNTP, IEC60870-5-104 protocols	Active
1SAP 350 200 R0271	PM592-ETH-XC, processor module, memory 4 MB / 4 GB flash disk, 24 V DC, memory card slot, interfaces 2 RS-232/485 (programming, Modbus/ CS31), 1 FBP, display, onboard Ethernet TCP/IP with web server, SNTP, IEC60870-5-104 protocols, XC version	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

Table 7: Accessories

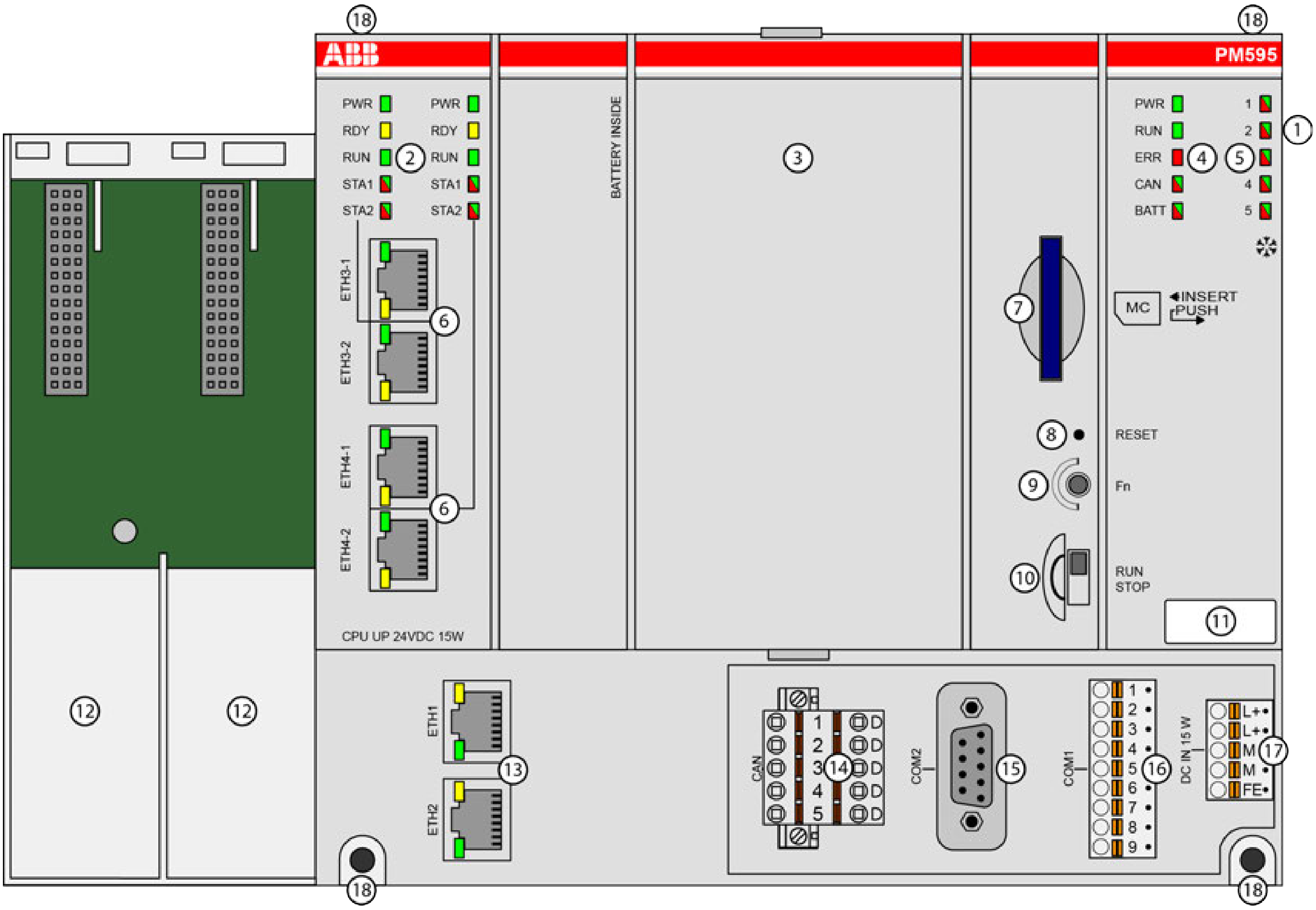
Part no.	Description
1SAP 180 300 R0001	TA521, lithium battery

Processor modules PM57x-ETH(-XC), PM58x-ETH(-XC) and PM59x-ETH(-XC) with ordering No. 1SAPxxxxxxR0271 can only be used with terminal bases TB5x1-ETH(-XC) with ordering No. 1SAPxxxxxxR0270.

Processor module PM591-2ETH can only be used with TB523-2ETH.

1.3.2.2 PM595-4ETH

- High-performance processor module with 1.3 GHz
- XC version with 1 GHz for use in extreme ambient conditions available (maintenance free)



1 I/O bus for connection of I/O modules
2 2x 5 LEDs to display the states of the fieldbuses
3 Cover for battery and display
4 5 LEDs to display the states of the processor module
5 5 LEDs (reserved)
6 2x2 RJ45 interfaces for fieldbuses
7 Slot for memory card
8 Reset button
9 Button (reserved)
10 RUN/STOP switch
11 Label
12 Slots for communication modules (max 2; unused slots must be covered with TA524)
13 2 RJ45 interfaces for Ethernet connection
14 5-pin terminal block (reserved)
15 Serial interface COM2 (D-sub 9)
16 Serial interface COM1 (9-pin terminal block, remov-able)
17 Power supply (5-pin terminal block, removable)
18 5 holes for screw mounting
Sign for XC version

1.3.2.2.1 Short description

The processor module is a central unit for AC500 with high performance.

Each processor module can operate up to 2 communication modules via its communication module interface. The communication modules are mounted on the left side of the processor module. On the right side of the processor module, up to 10 digital or analog I/O expansion modules can be connected to the I/O bus. Each I/O module requires a suitable terminal unit depending on the module type.

Terminal bases, terminal units, I/O modules, communication modules and accessories have their own technical descriptions.

WARNING!

Removal/Insertion under power

The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

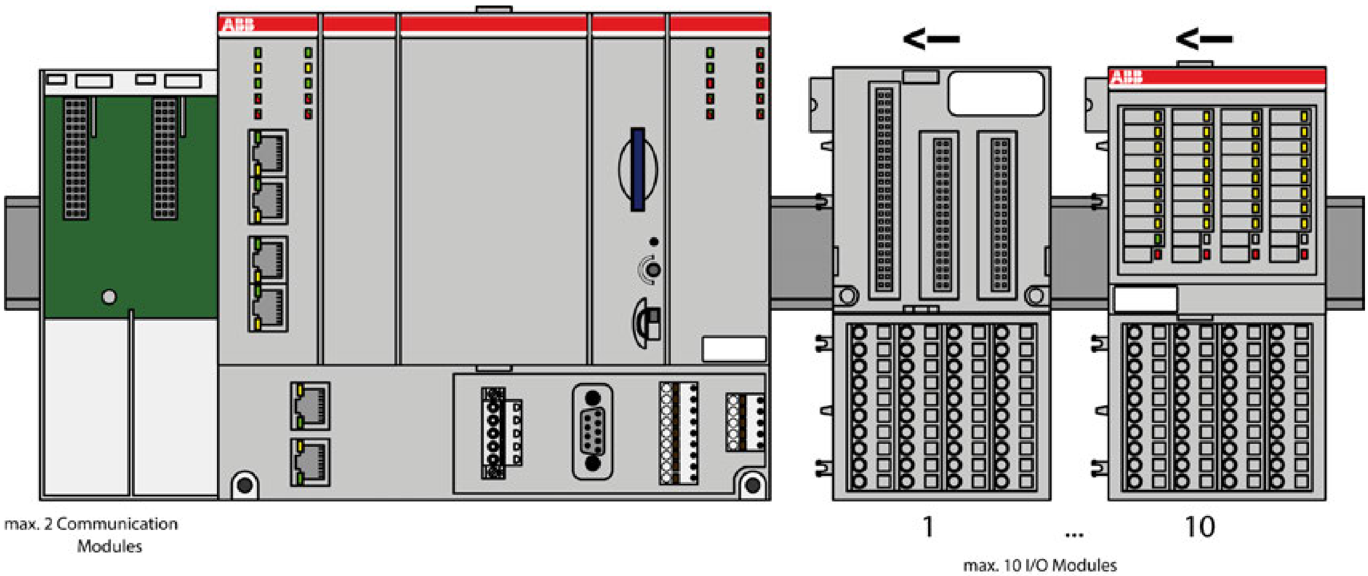


Fig. 2: Processor module, communication modules and I/O modules

For EtherCAT and PROFINET support make sure the following firmware is installed:

– *PROFINET: V 2.8.1.2 or newer*
– *EtherCAT: V 4.2.23 (2) or newer*
– *Ethernet: V 1.2.0.20 or newer*

To update the Firmware of PM595-4ETH, follow the instructions in the chapter 'Firmware identification and update'.

In order to ensure the availability and lifetime of the PM595 CPU, some second source components have been selected and introduced into the factory. These changes may affect some build/download time, but not during the functioning of the product.

Old user flash memory component has been discontinued.

> *The user flash memory has been discontinued and reached EOL and needs to be replaced with new ones (multiple second sources selected).*
>
> *The new used user flash memory components are slower in their erase performance, but not during normal function.*
>
> *Longer time for erasing and creating the boot project file is required, which doesn't affect the function of the CPU during operation.*
>
> *The CPU remains compatible.*

1.3.2.2.2 Assortment

Processor Module	Ethernet Interfaces	Other Interfaces
PM595-4ETH-F PM595-4ETH-M-XC	ETH1 and ETH2 for Ethernet-based system communication ETH3.1 and ETH3.2 for Ethernet-based fieldbuses with switch functionality ETH4.1 and ETH4.2 for Ethernet-based fieldbuses with switch functionality	Serial interface COM1 Serial interface COM2 Communication module interface I/O bus

1.3.2.2.3 Connections

I/O bus

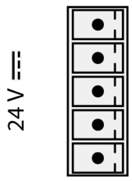
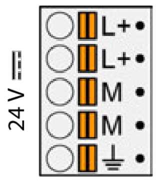
The I/O bus is the I/O data bus for the I/O modules. Through this bus, I/O and diagnosis data are transferred between the processor module and the I/O modules. Up to 10 I/O modules can be added.

Chapter 2.4.1 "I/O bus" on page 1368

Power supply

The supply voltage of 24 V DC is connected to a removable 5-pin terminal block. L+/M exist twice. It is therefore possible to feed e.g. external sensors (up to 8 A max. with 1.5 mm^2 conductor) via these terminals.

Pin assignment

Pin Assignment		Label	Function	Description
 Terminal block removed	 Terminal block inserted	L+	+24 V DC	Positive pin of the power supply voltage
		L+	+24 V DC	Positive pin of the power supply voltage
		M	0 V	Negative pin of the power supply voltage
		M	0 V	Negative pin of the power supply voltage
		⏚	FE	Functional earth

Faulty wiring on power supply terminals

NOTICE!
Risk of damaging the PLC due to improper voltage levels!

– Never exceed the maximum tolerance values for process and supply voltages.
– Never fall below the minimum tolerance values for process and supply voltages.
  Observe the **system data** ➡ *Chapter 2.6.1 “System data AC500” on page 1408* and the **technical data** of the module used.

NOTICE!
Risk of damaging the terminal base and power supply!
Short circuits might damage the terminal base and power supply.

Make sure that the four clamps L+ and M (two of each) are not wrongly connected (e. g. +/- of power supply is connected to both L+/L+ or both M/M).

NOTICE!
Risk of damaging the terminal base!
Terminal base can be damaged by connecting the power supply terminal block (L+/M) to COM1.

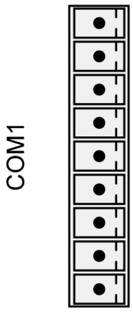
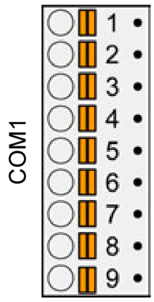
Make sure that the COM1 terminal block is always connected to the terminal base even if you do not use COM1 to prevent this.

NOTICE!
Risk of damaging the terminal base!
Excessive current might damage the clamp and terminal base.

Make sure that the current flowing through the removable clamps never exceeds 8 A (with 1.5 mm^2 conductor).

Serial interface COM1

Pin assignment (RS-485 / RS-232)

		Pin	Signal	Interface	Description
 Terminal block removed	 Terminal block inserted	1	Terminator P	RS-485	Terminator P
		2	RxD/TxD-P	RS-485	Receive/Transmit, positive
		3	RxD/TxD-N	RS-485	Receive/Transmit, negative
		4	Terminator N	RS-485	Terminator N
		5	RTS	RS-232	Request to send (output)
		6	TxD	RS-232	Transmit data (output)
		7	SGND	Signal Ground	Signal Ground
		8	RxD	RS-232	Receive data (input)
		9	CTS	RS-232	Clear to send (input)

> **NOTICE!**
> **Unused connector!**
> Make sure that the terminal block is always connected to the terminal base or communication module, even if you do not use the interface.

The serial interface COM1 is connected to a removable 9-pin terminal block. It is configurable for RS-232 and RS-485.

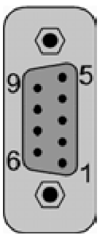
For a detailed description of COM1, refer to 'Serial interface COM1'. *Chapter 2.6.4.7 “Serial interface COM1 of the terminal bases” on page 1437*

Serial interface COM2

The serial interface COM2 is connected to a D-sub 9. It is configurable for RS-232 and RS-485.

> *COM2 cannot be used for communication via CS31 bus. For a detailed description of COM2, refer to Serial interface COM2.* *Chapter 2.6.4.8 “Serial interface COM2 of the terminal bases ” on page 1439*

Pin assignment

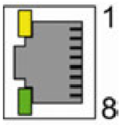
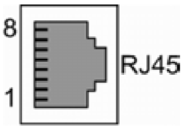
Serial Interface	Pin	Signal	Interface	Description	
	1	FE	-	Functional earth	
	2	TxD	RS-232	Transmit data	Output
	3	RxD/TxD-P	RS-485	Receive/Transmit	Positive
	4	RTS	RS-232	Request to send	Output
	5	SGND	Signal ground	0 V supply out	
	6	+5 V	-	5 V supply out	
	7	RxD	RS-232	Receive data	Input

Serial Interface	Pin	Signal	Interface	Description	
	8	RxD/TxD-N	RS-485	Receive/Transmit	Negative
	9	CTS	RS-232	Clear to send	Input
	Shield	FE	-	Functional earth	

> **NOTICE!**
> **Risk of corrosion!**
> Unused connectors and slots may corrode if XC devices are used in salt-mist environments.
>
> Protect unused connectors and slots with TA535 protective caps for XC devices *Chapter 1.9.3.6 “TA535 - Protective caps for XC devices” on page 1362*.

Network interfaces Ethernet (ETHx)

Pin assignment

Interface	Pin	Signal	Description
 or 	1	TxD+	Transmit data +
	2	TxD-	Transmit data -
	3	RxD+	Receive data +
	4	NU	Not used
	5	NU	Not used
	6	RxD-	Receive data -
	7	NU	Not used
	8	NU	Not used
	Shield	Cable shield	Functional earth

> **NOTICE!**
> **Risk of corrosion!**
> Unused connectors and slots may corrode if XC devices are used in salt-mist environments.
>
> Protect unused connectors and slots with TA535 protective caps for XC devices *Chapter 1.9.3.6 “TA535 - Protective caps for XC devices” on page 1362*.

MAC addresses The MAC addresses of the network interfaces of the PM595-4ETH are printed on the label in the following way:

MAC ETH1

MAC ETH2

MAC ETH3

MAC ETH4

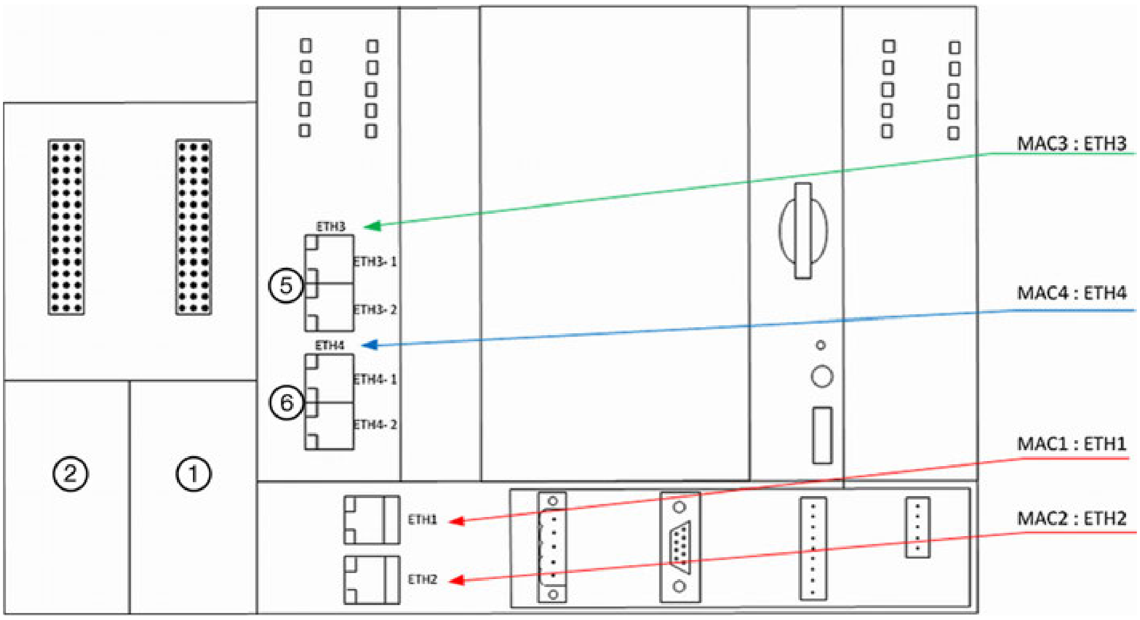


Fig. 3: Assignment of the MAC addresses to the corresponding interface

The figure above also shows the assigned SLOT-Numbers 1, 2, 5 and 6.

1.3.2.2.4 Storage elements

Lithium battery

The processor modules are supplied without lithium battery. It must be ordered separately. The TA521 lithium battery is used for data (SRAM) and RTC buffering while the processor module is not powered (PM595-4ETH-F only).

The processor module monitors the battery's state of charge. If the processor module signals a low state of charge (via the diagnosis system and LED), the battery has to be replaced immediately.

The technical data, handling instructions and the insertion/replacement of the battery is described in detail in the chapter TA521. *Chapter 2.6.5.3 “TA521 - Battery” on page 1461*

> *The processor module PM595-4ETH-M-XC is maintenance-free. The lithium battery TA541 in this processor module type is used only for back-up of the real-time clock (RTC) in case of no power supply. If the RTC is not used, there is no need to install a TA541 lithium battery.*

Memory card

AC500 processor modules are supplied without memory card. It must be ordered separately.

The memory card can be used

- to read and write user files,
- to download a user program,
- for firmware updates,
- for program source code storage.

AC500 processor modules can be operated with and without memory cards. The processor module uses a standard file system (FAT; filenames stored in 8.3 format). This allows standard card readers to read and write the memory cards.

1.3.2.2.5 Operating elements on the front panel

Status LEDs

Table 8: Meaning of the status LEDs (left side)

LED	Color	Status	Description
Power LED (PWR)*	Green	On	Power supply available
		Blinking	---
		Off	Power supply not available or defective hardware
Ready LED (RDY) *	Yellow	On	Boot procedure
		Blinking	Boot failure
		Off	---
Run LED (RUN) *	Green	On	Communication module is operational
		Blinking	---
		Off	Communication module is not operational
System LED (STA1) *	Red	On	Depending on used fieldbus
		Blinking	Depending on used fieldbus
		Off	Depending on used fieldbus
	Green	On	Depending on used fieldbus
		Blinking	Depending on used fieldbus
		Off	Depending on used fieldbus
System LED (STA2) *	Red	On	Depending on used fieldbus
		Blinking	Depending on used fieldbus
		Off	Depending on used fieldbus
	Green	On	Depending on used fieldbus
		Blinking	Depending on used fieldbus
		Off	Depending on used fieldbus

*) These LEDs exist twice.

Table 9: Meaning of the status LEDs (right side)

LED	Color	Status	Description
Power LED (PWR)	Green	On	Power supply available
		Blinking	---
		Off	Power supply not available or defective hardware
Run LED (RUN)	Green	On	Processor module is in RUN mode
		Blinking	---
		Off	Processor module is in STOP mode
Error LED (ERR)	Red/green	On	An error has occurred
		Blinking	Flashing fast (4 Hz): Indicates together with RUN a firmware update process and a flash EEPROM write.
		Off	No errors are encountered or only warnings (E4 errors). This is configurable (for errors 2 - 4, the LED behavior is configurable.

LED	Color	Status	Description
-	Red/green	On	Reserved
		Blinking	Reserved
		Off	Reserved
Batt	Red/green	On	TA541 lithium battery is not installed or is weak
		Blinking	---
		Off	TA541 lithium battery is installed and has sufficient capacity
1	Red/green	On	Reserved
		Blinking	Reserved
		Off	Reserved
2	Red/green	On	Reserved
		Blinking	Reserved
		Off	Reserved
3	Red/green	On	Reserved
		Blinking	Reserved
		Off	Reserved
4	Red/green	On	Reserved
		Blinking	Reserved
		Off	Reserved
5	Red/green	On	Reserved
		Blinking	Reserved
		Off	Reserved

Buttons and switches

The processor module can be operated manually using the buttons and switches at the front panel. Meaning of the buttons and switches:

Button	Description
RESET	If pressed during power-on: Enter serial download of firmware. This is signalized by blinking of the RUN LED with a frequency of 1 Hz. If pressed during normal operation: reserved for future implementation.
Fn	If pressed during power-on: Boot project will not be loaded. This is signalized by blinking of the RUN LED with a frequency of 1 Hz. If pressed during normal operation: reserved for future implementation.
RUN/STOP	Switches the processor module from RUN to STOP mode.

The AC500 processor module can display various errors according to the error classes. The reaction of the Processor Module is different for each type of error.

1.3.2.2.6 Technical data

The system data of AC500 and S500 are applicable to the standard version ➮ *Chapter 2.6.1 “System data AC500” on page 1408*.

The system data of AC500-XC are applicable to the XC version ➮ *Chapter 2.7.1 “System data AC500-XC” on page 1475*.

Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

General data of the processor modules

Parameter		Value
Connection of the supply voltage 24 V DC at the removable terminal block of the processor module		Removable 5-pin terminal block with spring connection
	Current consumption from 24 V DC	400 mA
	Inrush current at 24 V DC	1 A^2s ∗)
	Max. power dissipation within the module	15 W
	Slots for communication modules	2
	Processing module's interfaces	I/O bus, COM1, COM2
	Processing module's network interfaces	ETH1 and ETH2 for Ethernet-based system communication ETH3.1 and ETH3.2 for Ethernet-based fieldbuses with switch functionality ETH4.1 and ETH4.2 for Ethernet-based fieldbuses with switch functionality
Connection system		*Chapter 2.6.4 “Connection and wiring” on page 1431*
Weight		1070 g
Mounting position		Horizontal or vertical with derating (50 % output load, reduction of temperature to +40 °C)

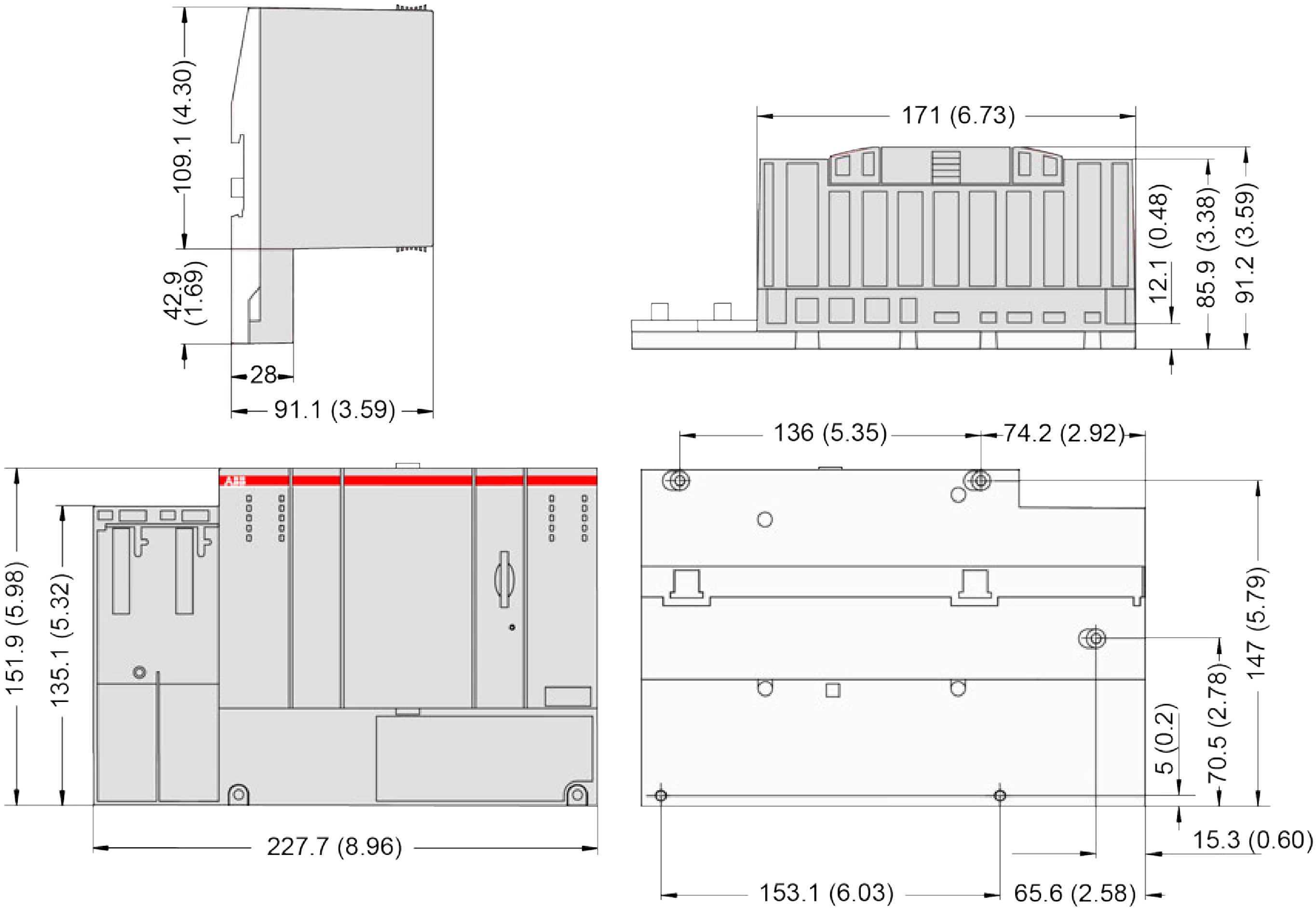
∗) The melting integral of the processor module depends on the processor module's integrated power supply, and the number and type of communication modules and I/O modules connected to the I/O bus.

Detailed data

Parameter		Value
Flash memory for boot projects, symbols and web pages		32768 kB
SDRAM for user program		16384 kB
SDRAM for user data		16384 kB
Expandable memory		None
Integrated mass storage memory		4 GB non rotating flashdisk
Pluggable memory card for:		x
	User data storage	
	Program source code storage	
	Firmware update	
	Processor type	Freescale ARM Processor 32-bit
	Processor clock speed	1 - 1.3 GHz
Cycle time for 1 instruction		
	Binary	Min. 0.0006 µs
	Word	Min. 0.001 µs
	Floating point	Min. 0.001 µs

Parameter		Value
Max. number of central inputs and outputs (10 exp. modules):		
	Digital inputs	320
	Digital outputs	240
	Analog inputs	160
	Analog outputs	160
Number of decentralized inputs and outputs		Depends on the field bus used (as an info on the CS31 bus: up to 31 stations with up to 120 DI / 120 DO each)
Data backup		Battery for PM595-4ETH-F, MRAM for PM595-4ETH-M-XC without battery
Data buffering time at 25 °C		About 3 years
Battery low indication		Warning issued about 2 weeks before the state of charge becomes critical
Real-time clock		
	With battery backup	x
	Accuracy	Typ. ± 2 s / day at +25° C
Integrated Communication Module, ETH = Ethernet RJ45		2x Ethernet, 2x Ethernet interfaces with downloadable protocol e.g. PROFINET IO controller, EtherCAT master
Number of external communication modules		Up to 2 communication modules like PROFIBUS DP, Ethernet, CANopen or functional safety module, e.g., SM560-S. There are no restrictions concerning the communication module types and communication module combinations (e.g. up to 2 PROFIBUS DP communication modules are possible)
LEDs		5 to display states, rest of LEDs reserved
LCD display		Optional
Buttons and switches		1 button for Reset (Reserved) 1 Button (Reserved) 1 Switch for RUN/STOP

1.3.2.2.7 Dimensions



The dimensions are in mm and in brackets in inch.

1.3.2.2.8 Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 155 500 R0279	PM595-4ETH-F, processor module, user progr./data memory 16 MB / 16 MB, 1.3 GHz, 24 V DC, memory card slot, interfaces 2 RS232-485, 2 independent Ethernet interfaces (progr., web server, IEC60870-5-104 protocols), 2 independent Ethernet based interfaces with 2-port switch (between fieldbus protocols PROFINET IO, EtherCAT and Ethernet)	Active
1SAP 351 500 R0279	PM595-4ETH-M-XC, processor module, user progr./data memory 16 MB / 16 MB, 1.0 GHz, 24 V DC, memory card slot, interfaces 2 RS232-485, 2 independent Ethernet interfaces (progr., web server, IEC60870-5-104 protocols), 2 independent Ethernet based interfaces with 2-port switch (between fieldbus protocols PROFINET IO, EtherCAT and Ethernet), XC version	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

Table 10: Accessories

Part no.	Description
1SAP 182 700 R0001	TA541, lithium battery
1SAP 180 200 R0001	TK501, programming cable D-sub / D-sub, length: 5 m
1SAP 180 200 R0101	TK502, programming cable terminal block / D-sub, length: 5 m
1SAP 182 300 R0001	TA535, protective caps for XC devices
1SAP 182 600 R0001	TA540, front cover as spare part (3 pieces)
1SAP 182 800 R0001	TA543, screw mounting accessory (20 pieces)

1.3.3 AC31 adapters

1.3.3.1 Introduction

Replacement devices for AC31

The modular product line of the AC31 adapter series includes modular exchange components for control systems of the Advant Controller 31 (90 series). The simple exchange of individual components allows existing customers to maintain their PLCs in a quick and cost-effective manner. Extensive software modifications are not required.

Each replacement device is based on trend setting technologies of the AC500 series. Therefore, by exchanging components it is not only possible to replace the existing device, but also to profit from new functions and improved product quality.

Note regarding product documentation

During the development of the AC31 adapter series, care was taken to keep the device configuration identical to the configuration of the AC31 devices. Consequently, the technical documents for the AC31 devices are still valid and serve as reference:

- *Software description (only available in English)*
- *System description Advant Controller 31*

Only unavoidable deviations, for example due to technical limitations, are described in this document.

CAUTION!
Installation and maintenance work on the device must be performed by qualified personnel in line with the recognized technical rules, regulations and relevant standards such as EN 60204-1.

For safety instructions, please refer to Regulations for the erection of installations.

1.3.3.2 Overview of AC31 adapters (replacement devices)

An AC31 adapter (replacement device) is available for the following AC31 devices of the 90 series (existing devices):

Existing devices: AC31 (90 series)	Replacement devices: AC31 adapters	Replacement device is based on the following AC500 device
CPU devices:		
07KT94-ARC 07KT98-ARC 07KT98-ARC-DP 07KT98-ARC-ETH 07KT98-ETH-DP --	07KT94-ARC-AD *) 07KT98-ARC-AD 07KT98-ARC-DP-AD 07KT98-ARC-ETH-AD 07KT98-ETH-DP-AD 07KT98-ARC-ETH-DP-AD	PM590, DA501 and DA502

*) Customer specific product not available for current sales

Existing devices: AC31 (90 series)	Replacement devices: AC31 adapters	Replacement device is based on the following AC500 device
I/O modules:		
07DC91	07DC91-AD	DC532
07DC92	07DC92-AD	DO524
07AC91	07AC91-AD (8-Bit)	AO523
07AC91	07AC91-AD2 (12-Bit)	AX522
07AI91	07AI91-AD	AI523
DC501-CS31	DC501-CS31-AD	DC532

1.3.3.3 System data and CS31 bus system data

The system data described in this chapter are valid for the following replacement devices:

- 07KT94-ARC-AD
- 07KT98-ARC-AD
- 07KT98-ARC-DP-AD
- 07KT98-ARC-ETH-AD
- 07KT98-ETH-DP-AD
- 07KT98-ARC-ETH-DP-AD
- 07AC91-AD
- 07AC91-AD2
- 07AI91-AD
- 07DC91-AD
- 07DC92-AD
- DC501-CS31-AD

Please also observe the CS31 bus system data *Chapter 1.3.3.3.2 “CS31 bus system data” on page 58*.

The devices of the AC31 adapter series do not have marine approval.

NOTICE!
AC31 adapter I/O modules must only be used with an ABB CPU with master CS31 bus (e.g. AC31 07KT9x, AC31-Adapter 07KT9x-x-x-AD or AC500 CPU).

1.3.3.3.1 System data of the AC31 adapters

Operating and environmental conditions

Table 11: Supply voltages

Voltages according to IEC 61131-2:		
24 V DC	Process and supply voltage	24 V DC (-15 %, +20 % without residual ripple)
	Absolute limits	19.2 V ... 30 V incl. residual ripple
	Residual ripple	≤ 5 %
	Polarity reversal protection	10 s (test duration), permanently present on AC31 adapters
Bridging time for power interruptions according to IEC 61131-2:		
	DC supply	Interruption < 10 ms Time between 2 interruptions > 1 s

CAUTION!
System damage caused by voltage!
Exceeding the maximum supply or process voltage (>30 V DC) results in permanent system damage (destruction).

Table 12: Operating and environmental conditions

Temperature:	
-> Operation	0 °C ... +55 °C (vertical mounting position, terminals upward and downward)
-> Storage	-40 °C ... +75 °C
-> Transport	-40 °C ... +75 °C
Humidity	max. 95 %, without condensation
Air pressure:	
-> Operation	> 800 hPa / < 2000 m
-> Storage	> 660 hPa / < 3500 m

Creepage distances and clearances

The creepage distances and clearances correspond to overvoltage category II, pollution degree 2.

Test voltages for type test

Test voltages for type test according to IEC 61131-2:

Table 13: Impulse testing

Data	Voltage	Duration
24 V circuits (supply, 24 V inputs/outputs), when galvanically isolated from other circuitry	500 V	1.2 / 50 µs
CS31 interface from other circuitry	500 V	1.2 / 50 µs
Ethernet	500 V	1.2 / 50 µs
ARCNET	500 V	1.2 / 50 µs
COM interfaces, galvanically isolated	500 V	1.2 / 50 µs
Enabling input, galvanically isolated	500 V	1.2 / 50 µs

Table 14: AC voltage tests

Data	Voltage	Duration
24 V circuits (supply, 24 V inputs/outputs), when galvanically isolated from other circuitry	350 V AC	60 s
CS31 interface from other circuitry	350 V AC	60 s
Ethernet	350 V AC	60 s
ARCNET	350 V AC	60 s
COM interfaces, galvanically isolated	350 V AC	60 s
Enabling input, galvanically isolated	350 V AC	60 s

Power supply units

For the supply of devices, use power supply units according to PELV specification.

Electromagnetic compatibility

Table 15: Immunity

Data	Value
Immunity against electrostatic discharge (ESD)	According to EN 61000-4-2, zone B, criterion B
-> Interference voltage with air discharge	8 kV
-> Interference voltage with contact discharge	4 kV
ESD with communication connectors	Ensure that any electrostatic charge is discharged prior to contact with the communication connectors (e.g. by touching an grounded metal object). Otherwise malfunctions may occur.
ESD module carrier connectors	Do not touch the plug connecting the module carrier on the bottom side of the device.
ESD external communication module interface	Do not touch the plug to the flat ribbon cable.
Immunity against the influence of radiated interference (CW radiated)	According to EN 61000-4-3, zone B, criterion A
-> Test field strength	10 V/m (except ITU transmission bands 87 MHz … 108 MHz, 174 MHz … 230 MHz and 470 MHz … 790 MHz -> 3 V/m)
-> Maximum temporary deviation during irradiation	Analog current output signals max. 1.5 %. Devices affected: 07AC91-AD, 07AC91-AD2, 07KT94-ARC-AD, 07KT98-ARC-AD, 07KT98-ARC-DP-AD, 07KT98-ARC-ETH-AD, 07KT98-ETH-DP-AD, 07KT98-ARC-ETH-DP-AD
Immunity against transient interference voltages (burst)	According to EN 61000-4-4, zone B, criterion B
-> Voltage supply	2 kV
-> Enabling input	2 kV
-> Digital inputs/outputs	1 kV
-> Analog inputs/outputs	1 kV
-> CS31 bus	1 kV
-> Serial RS-232 interfaces (COM)	1 kV
-> ARCNET	1 kV
-> Ethernet	1 kV
-> I/O supply, DC out	1 kV
Immunity against the influence of power related interference (CW radiated):	According to EN 61000-4-6, zone B, criterion A
-> Test voltage	Zone B, also according to 10 V
Immunity against transient interference voltages with high energy (surge)	According to EN 61000-4-5, zone B, criterion B
-> Voltage supply DC, enabling input	0.5 kV CM / 0.5 kV DM *)
-> I/O supply, DC out	0.5 kV CM / 0.5 kV DM *)
-> Shielded buses	1 kV CM *)

Data	Value
-> I/O analog, I/O DC unshielded	1 kV CM / 0.5 kV DM *)
Emitted interference (radiation):	-
-> From radiated interferences	According to EN 55011, group 1, class A

*) CM = Common Mode, DM = Differential Mode

The devices of the AC31 adapter series do not have marine approval.

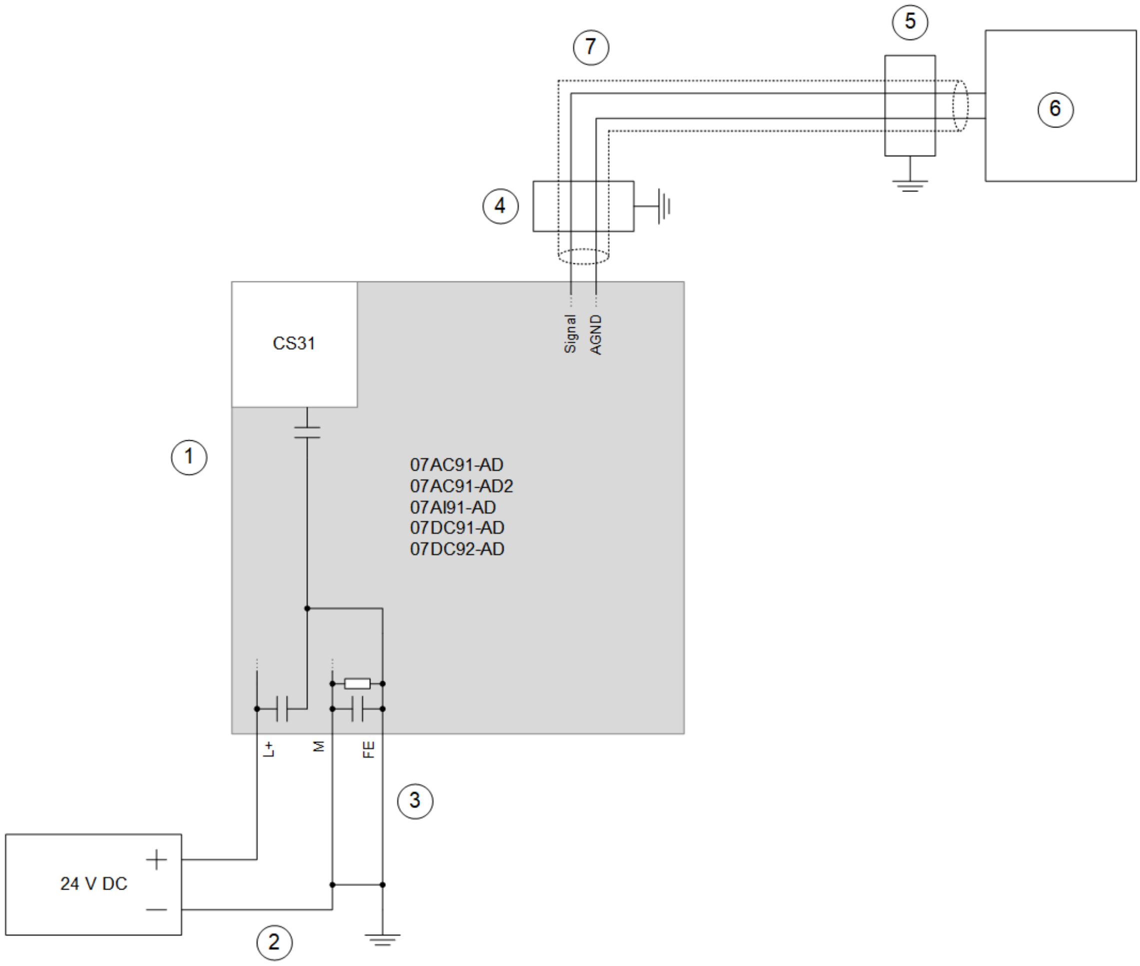
Mechanical data

Data	Value
Degree of protection	IP20
Housing	According to UL 94
Vibration resistance according to EN 61131-2	All three axes 2 Hz ... 15 Hz, continuous 3.5 mm 15 Hz ... 150 Hz, continuous 1 g
Vibration resistance with memory card plugged	15 Hz ... 150 Hz, continuous 1 g
Shock resistance	All three axes 15 g, 11 ms, semi-sinusoidal

Grounding

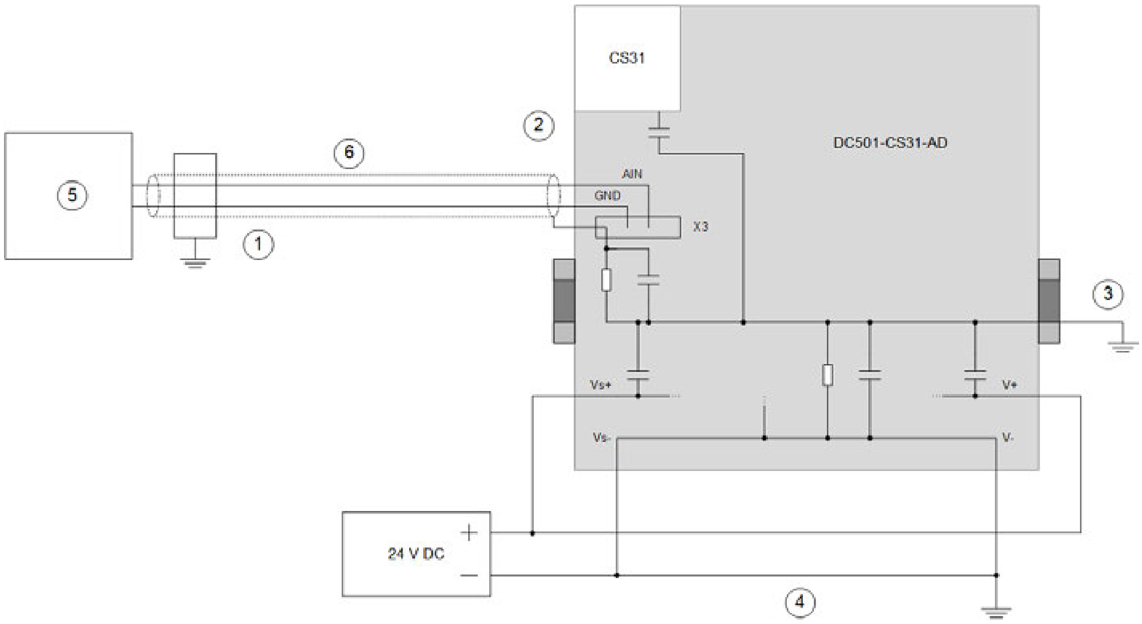
The AC31 adapter devices can be grounded as follows:

Grounding of 07AC91-AD, 07AC91-AD2, 07AI91-AD, 07DC91-AD, 07DC92-AD



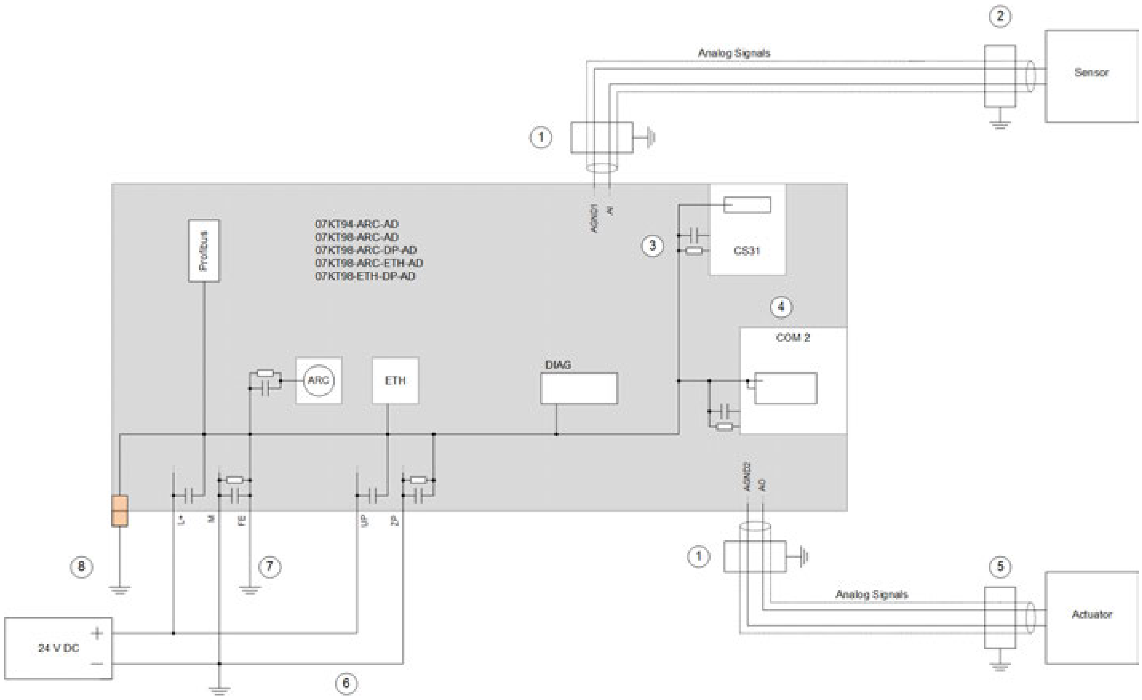
1 Capacitive grounding of the galvanically isolated CS31 interface (ground - surface) -> no grounding of the shield connection of the CS31 bus!
2 The process voltage is to be included in the grounding concept of the control system
3 Short connection (max. 25 cm) cross section 2,5 mm^2
4 Direct grounding with clamp on the mounting plate (as close as possible to the AC31 I/O adapter)
5 Direct grounding with clamp on the mounting plate (as close as possible to the sensor/ actuator)
6 Sensor/ actuator
7 Analog signals

Grounding of DC501-CS31-AD



1 Direct grounding with clamp on the mounting plate (as close as possible to the sensor)
2 Capacitive grounding of the galvanically isolated CS31 interface (ground - surface)
-> no grounding of the shield connection of the CS31 bus!
3 Grounding via top-hat rail (or with 2 screws).
Cross-section area 10 mm^2.
4 The process voltage is to be included in the grounding concept of the control system!
5 Sensor
6 Analog signals

Grounding of CPU



1 Direct grounding with clamp on the mounting plate (as close as possible to the central unit)
2 Direct grounding with clamp on the mounting plate (as close as possible to the sensor)
3 Capacitive grounding of the galvanically isolated CS31 interface (ground – surface)
4 Capacitive grounding of the galvanically isolated COM2 interface (ground – surface)
5 Direct grounding with clamp on the mounting plate (as close as possible to the CS31 slave)
6 The process voltage is to be included in the grounding concept of the control system!
7 Short connection (max. 25 cm).

Cross section area 2,5 mm^2.

8 Short connection (max. 25 cm).
Cross section area 6 mm^2.

NOTICE!
The shield connection of the CS31 interface is connected to the FE!

When grounding the replacement devices, observe the following:

- *Install the AC31 adapter devices onto an grounded mounting plate to ensure a uniform reference potential of all equipment.*
- *Implement the connections between control cabinet, mounting plate, PE rail and shield rail with low impedance.*
- *Install the lines in groups (power lines, power supply lines, signal lines, data lines).*
- *Use lines with braided cable shield for analog signals. Ground the shield on both sides and make sure that no compensation currents flow through the cable shield. For this purpose, use a potential equalization line with current carrying capacity, for instance on systems consisting of several control cabinets.*

Further information concerning CS31 bus grounding *Chapter 1.3.3.3.2.3 “Grounding” on page 60*

1.3.3.3.2 CS31 bus system data

Wiring

Table 16: Bus line

Data	Value
Configuration	2 cores, twisted, with common shield
Cross section	> 0.22 mm^2 (24 AWG) Recommendation: 0.5 mm^2 corresponds to Ø 0.8 mm
Twist rate	> 10/m (symmetrically twisted)
Resistance per core	< 100 Ω/km
Characteristic impedance	approx. 120 Ω (100 ... 150 Ω)
Capacitance between the cores	< 55 nF/km (in case of higher capacitance values, the maximum possible bus length is reduced)
Terminating resistors	120 Ω ¼ W at both ends

The transmission rate used on the CS31 bus is 187.5 kBaud.

Bus topology

A CS31 bus always contains only one CS31 bus master to control the bus. Up to 31 CS31 slaves can be controlled by one bus. The CS31 bus master has no address, whereas the CS31 slaves can accept addresses in the range from 0 - 61, depending on CS31 slave type.

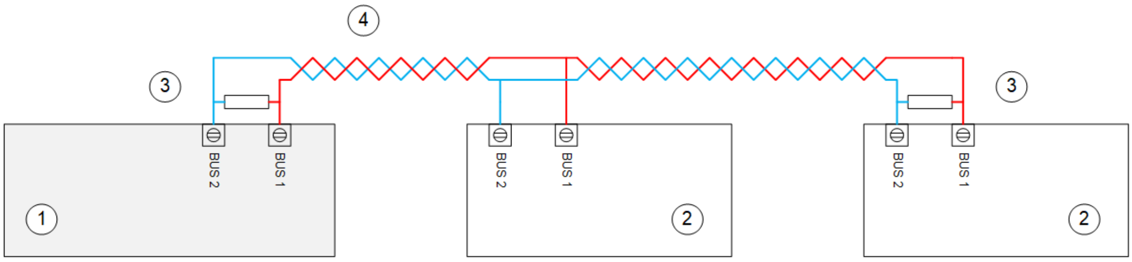
Possible CS31 bus masters:

- 07KT94-ARC-AD, 07KT94
- 07KT98-ARC-AD, 07KT98
- 07KT98-ARC-DP-AD
- 07KT98-ARC-ETH-AD
- 07KT98-ETH-DP-AD
- 07KT98-ARC-ETH-DP-AD

Possible CS31 slaves:

- 07AC91-AD, 07AC91
- 07AC91-AD2
- 07AI91-AD, 07AI91
- 07DC91-AD, 07DC91
- 07DC92-AD, 07DC92
- DC501-CS31-AD, DC501-CS31

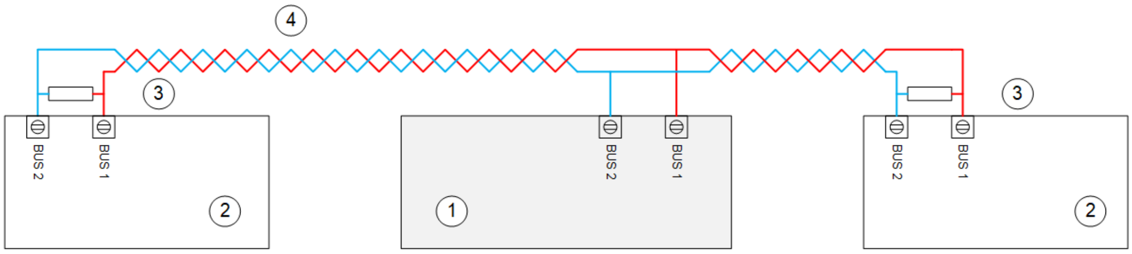
The following diagram shows the bus topology with CS31 bus master on the side without shielding and grounding treatment:



1 CS31 bus master
2 CS31 slave
3 120 Ω terminating resistor
4 CS31 system bus

The CS31 slave DC501-CS31-AD has an internal 120 Ω terminating resistor which can be connected by using a DIP switch. On the other CS31 slaves and the CS31 bus master, the terminating resistor must be installed externally by the user.

The following diagram shows the bus topology with CS31 bus master in the middle without shielding and grounding treatment:

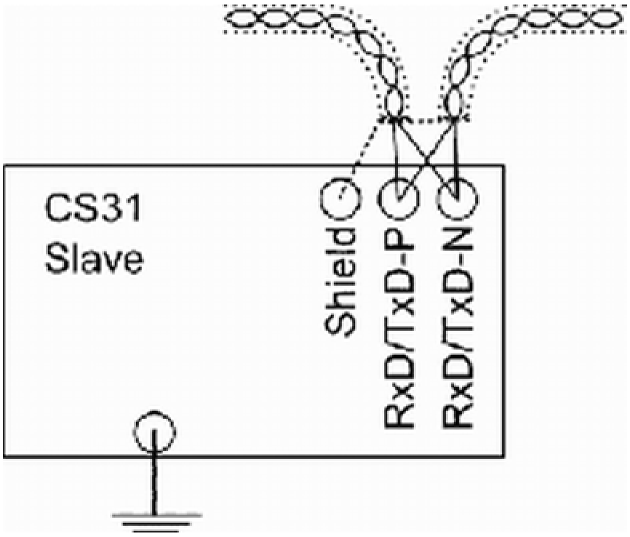


1 CS31 bus master
2 CS31 slave
3 120 Ω terminating resistor
4 CS31 system bus

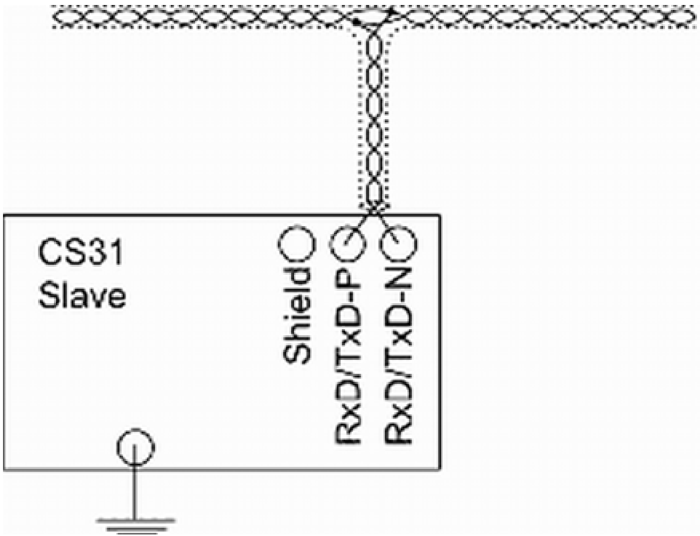
CAUTION!
Risk of malfunctions!
Spur lines are not allowed within the CS31 bus. Loop the bus line from module to module.

CS31 cable laying

Correct cable laying:



Incorrect cable laying:



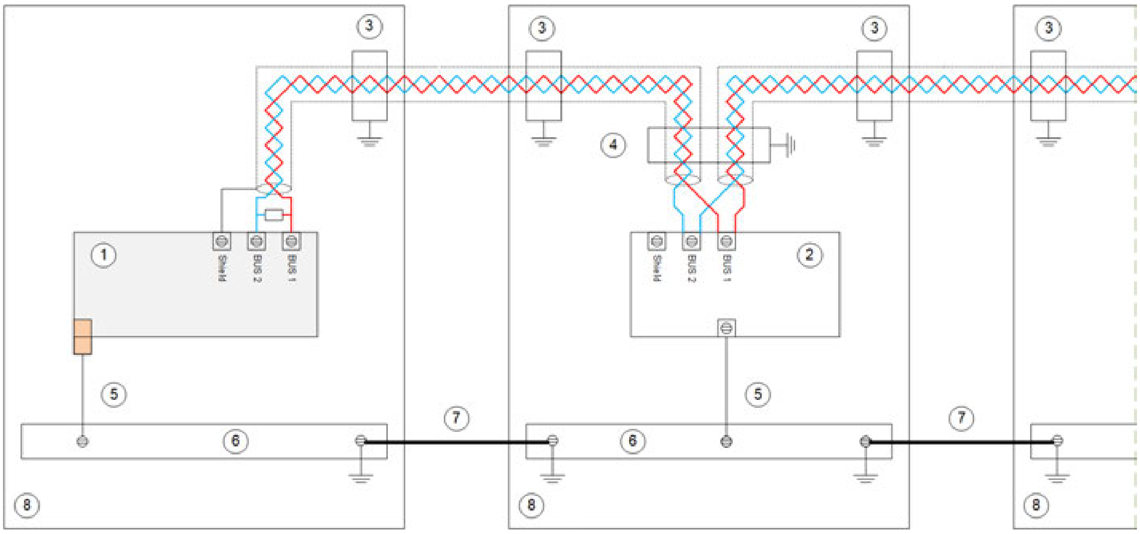
Grounding

In order to avoid disturbances, ground the cable shields directly.

Current carrying capacity

Choose direct grounding if it can be ensured by means of current carrying metal connections (steel constructions, ground bars, etc.) that no potential differences can occur.

Direct grounding of CS31 bus master and CS31 slave:



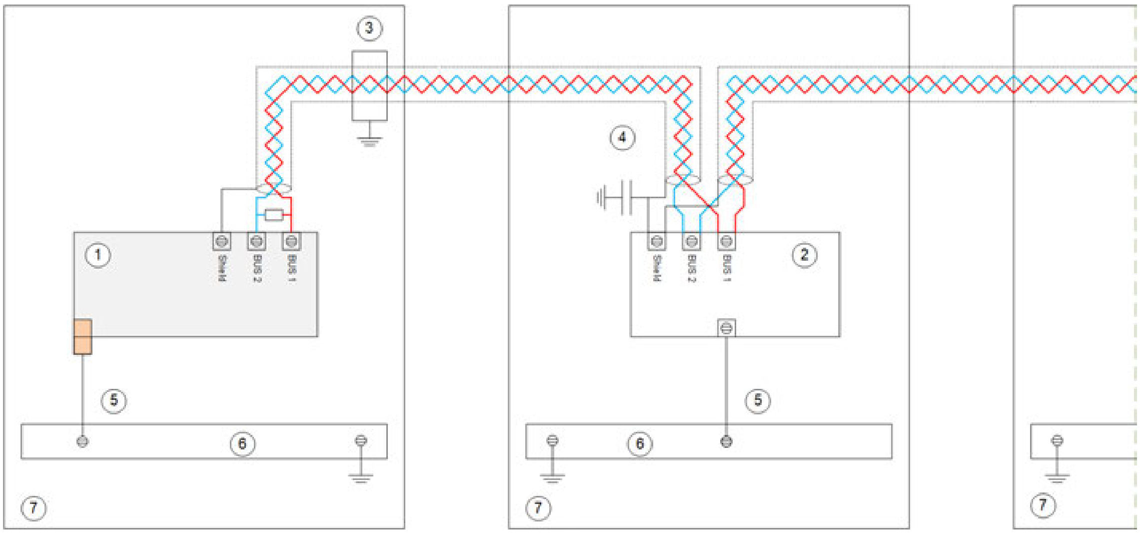
1 CS31 bus master
2 CS31 slave
3 Direct grounding at the control cabinet (entrance)
4 Direct grounding with clamp on the mounting plate (as close as possible to the CS31 slave)
5 Short connection (max. 25 cm).
Cross section area 2,5 mm^2.
6 Ground of the control cabinet
7 Current-conducting connection
8 Control cabinet

The shield connection of the CS31 bus master is internally connected to the ground terminal.

No current carrying capacity

Apply capacitative grounding if system parts are not connected to each other in terms of their current carrying capacity. This prevents the flow of compensation currents through the cable shields.

Direct grounding of CS31 bus master and capacitative CS31 slave:



1 CS31 bus master
2 CS31 slave
3 Direct grounding at the control cabinet (entrance)
4 Capacitive grounding via 100 nF X condensator (directly on the metal sheet of the control cabinet)
5 Short connection (max. 25 cm).
Cross section area 2,5 mm^2.
6 Ground of the control cabinet
7 Control cabinet

On the CS31 slave, the shield connection is not connected internally and thus not grounded. The shield connection can be used to connect the shields of two cables.

VDE 0160 requires that the system's shield is grounded directly at least once.

Bus cycle time and data security

The communication via the CS31 bus is cyclic and controlled by the CS31 bus master.

Fig. 4: Format of request telegram of a CS31 bus master

In each cycle, the CS31 bus master successively polls all existing CS31 slaves at regular intervals, performs a diagnosis on one of the existing CS31 slaves and sends a request to search for added CS31 slaves. Thus, on one hand it is possible to maintain a continuous diagnosis of the proper network function and on the other hand to take all the newly added CS31 slaves into account.

Fig. 5: Format of response telegram of a CS31 slave

The CS31 slaves respond to the telegrams of the CS31 bus master with a response telegram (see diagram above). The data are indicated in the documentation of the individual devices (e.g. 07AC91-AD2). The telegram is ignored when a CS31 slave or a CS31 bus master detects a deviation between the received CRC and the self-calculated CRC. A CS31 bus error exists when 10 faulty telegrams are issued successively.

The bus cycle time is composed of a base time, the bus transmission times of the data of the individual CS31 slaves and the bus idle times between the individual telegrams.

During the base time, the CS31 bus master performs a diagnosis and searches for newly added CS31 slaves. This time depends on the control system (PLC / central unit) and is partially configurable:

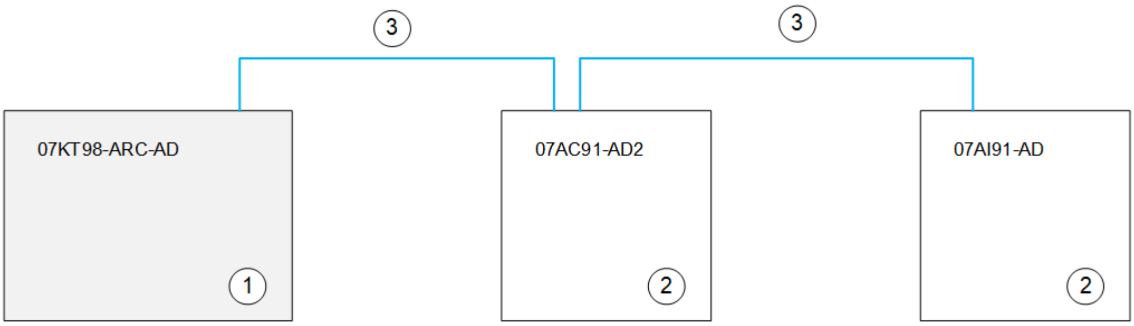
- Devices 07KT94 and 07KT98: base time 2 ms
- Device 07KT94-ARC-AD: base time 10 ms *)
- Devices 07KT98-ARC-AD, 07KT98-ARC-DP-AD, 07KT98-ARC-ETH-AD, 07KT98-ETH-DP-AD,
  07KT98-ARC-ETH-DP-AD:
  Base time 5 ms to 100 ms (configurable in Automation Builder, parameter "Min update time")

*) The base time of device 07KT94-ARC-AD cannot be configured since the old programming environment (907 PC 331) must be used.

The bus transmission times of the data of the individual CS31 slaves can be determined as follows:

- Duration for the transmission of 1 byte = (1/187.5 kBaud) x 8 = 43 µs
- Determine number of data bytes (sending + receiving) from existing documentation
- Add 3 bytes for the transmission of the address and CRCs

Per CS31 slave, approx. 0.5 ms can be assumed as bus idle time. The CS31 bus master needs this time to process the data. This time depends on the computing power and on the implementation of the CS31 bus master. This time can vary between various firmware versions.



1 CS31 bus master
  Min update time = 5 ms
2 CS31 slave
3 CS31 system bus

Table 17: Example: Bus cycle time

Base time	Min. update time = 5 ms		5000 µs
Bus transmission time 07AC91-AD2	Receiving 16 byte data	16 x 43 µs	688 µs
	Sending 16 byte data	16 x 43 µs	688 µs
	3 byte address + CRCs	3 x 43 µs	129 µs
Bus idle time	-	-	500 µs
Bus transmission time 07AI91-AD	Sending 16 byte data	16 x 43 µs	688 µs

	3 byte address + CRCs	3 x 43 µs	129 µs
Bus idle time	-	-	500 µs
Bus cycle time (sum)	-	-	8322 µs ≈ 8500 µs

Configuration

Below is a description of the configuration of the devices 07KT98-ARC-AD, 07KT98-ARC-DP-AD, 07KT98-ARC-ETH-AD and 07KT98-ETH-DP-AD, 07KT98-ARC-ETH-DP-AD in the Automation Builder software .

The configuration of the CS31 slaves takes place only by means of DIP switches *AC500 V2 (online)*, whereby the configuration of the CS31 bus topology is carried out in the CS31 bus master.

> *The configuration of the devices 07KT94 and 07KT94-ARC-AD is carried out with the DOS program "907 PC 331". Further information on configuration is available in the existing documentation.*

Configure the COM1 interface as CS31 bus master:

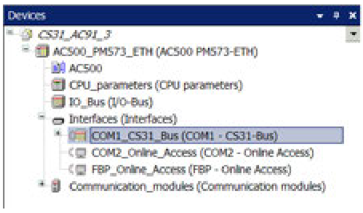


Fig. 6: CS31 bus master

The "Min update time" parameter can also be set on the CS31 bus master:

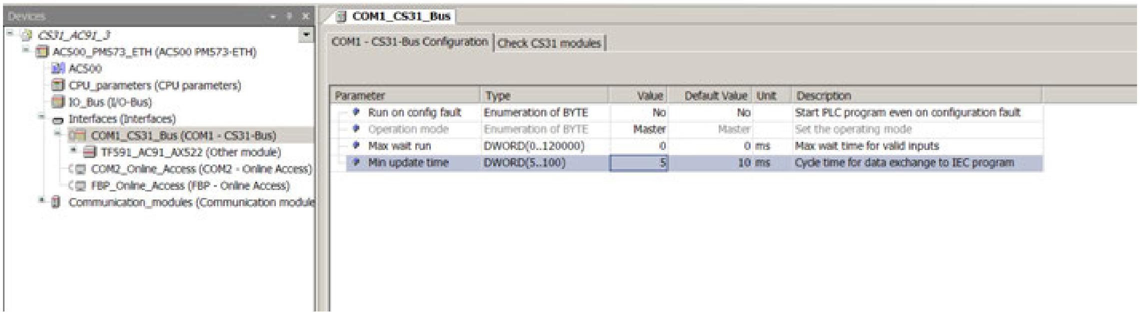


Fig. 7: Parameter configuration

The individual CS31 slaves must be configured in the tree structure under the CS31 bus master:

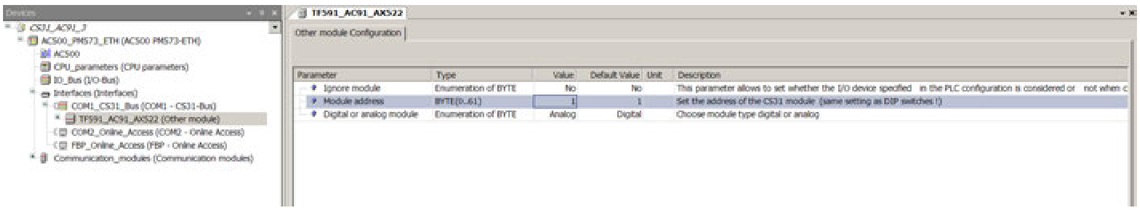


Fig. 8: CS31 slave

The module address must be set on each CS31 slave. Specify the same module address that has been selected with the DIP switches.

Set the CS31 slave type (analog/digital):

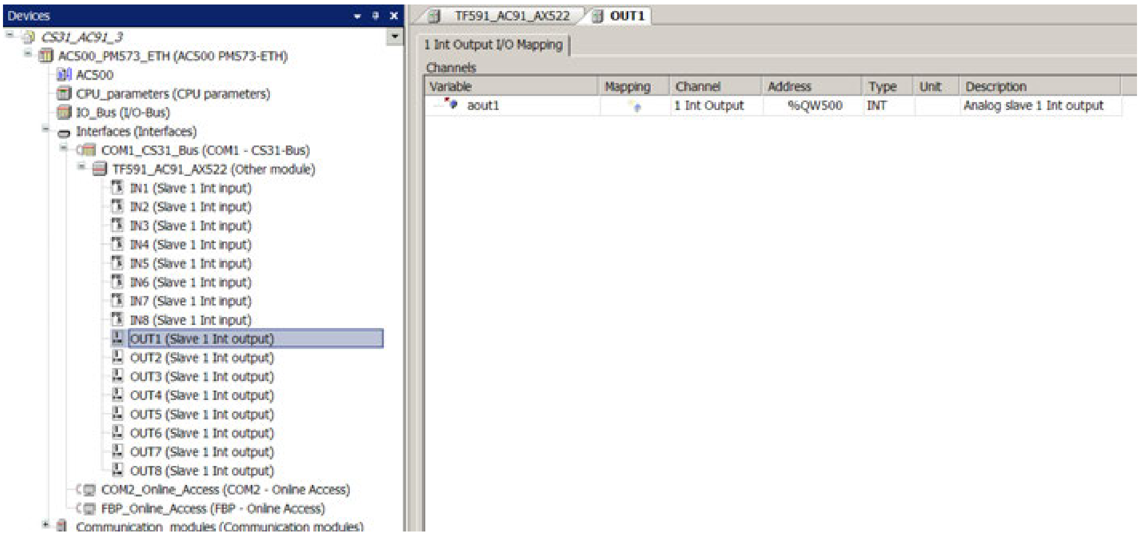


Fig. 9: CS31 bus slave configuration

The data must be configured in the tree structure under the CS31 bus slave. Information about the number of input and output data can be obtained from the respective documentation of the CS31 bus slaves.

> *If the data represent bipolar values (e.g. voltage from -10 V … +10 V), the use of the data type INT is appropriate. In case of unipolar values (e.g. current from 0 mA … 20 mA), the data type WORD can be used.*

Diagnosis

For the diagnosis of the CS31 bus, various mechanisms are available in the CS31 bus master of the devices 07KT98-ARC-AD, 07KT98-ARC-DP-AD, 07KT98-ARC-ETH-AD, 07KT98-ETH-DP-AD and 07KT98-ARC-ETH-DP-AD:

- Diagnosis via the function block `CS31_DIAG`
- Diagnosis system of the AC500 series

For further information on both mechanisms, please refer to 'Diagnosis and debugging for AC500'. Below, only a few special diagnosis functions of the AC31 adapter are addressed.

Function block `CS31_DIAG`:

In the 'State' column, the variable `byStateDiag` of the structure `strCS31_DiagOneModule` is indicated for every CS31 bus slave.

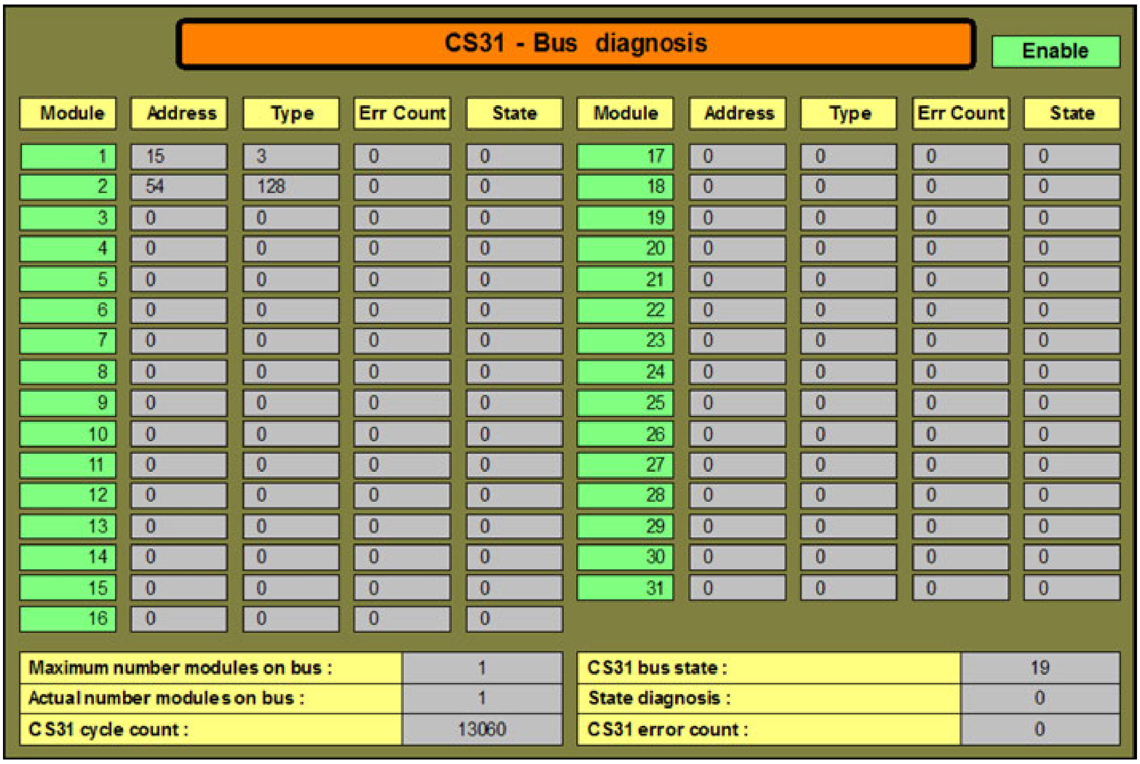


Fig. 10: Visualization: CS31 bus diagnosis

Table 18: Interpretation of variable `byStateDiag`

Bit	Value	Description
0	1	CS31 bus slave disconnected
1	2	Not used
2	4	Slave on CS31 bus bus not configured
3	8	Difference in the number of data bytes between configuration and CS31 bus
4	16	Internal device error
5	32	Channel error
6	64	Not used
7	128	Not used

All bits of `byStateDiag` equal 0 -> no error in CS31 bus slave.

The variables `byDiagChannel` and `byDiagErr` in the structure `strCS31_DiagOneModule` include the error channel and code. The possible values of these variables are indicated in the documentation of the respective CS31 bus slave.

Diagnosis system

The Diagnosis system of the AC500 series provides the errors in the following format:

Table 19: Error messages AC500 series

Format	e.g. name of PLC browser command diagshow all	Description
Error class	Class	1 to 4
Faulty component	Comp	11 (COM1 interface, here for the CS31 bus)
Faulty device	Dev	Address of CS31 bus slave with error
Faulty module	Mod	CS31 bus type of CS31 bus slave with error (e.g. 5 for analog input/output)
Faulty channel	Ch	See existing documentation of CS31 bus slave
Error code	Err	See existing documentation of CS31 bus slave

A CS31 bus slave error is indicated by an error LED on the CS31 bus slave. The error LED remains on even after elimination of the error and is switched off only after the error has been acknowledged by the CS31 bus master.

The acknowledgment of a CS31 bus slave error can take place via the CS31 bus master by means of the function block `CS31QU_EXT` .

1.3.3.4 Replacement devices: CPU

For AC31 devices of the 90 series, AC31 adapters (replacement devices) are available for the exchange of the CPU.

1.3.3.4.1 Replacement device 07KT9x-AD

Introduction

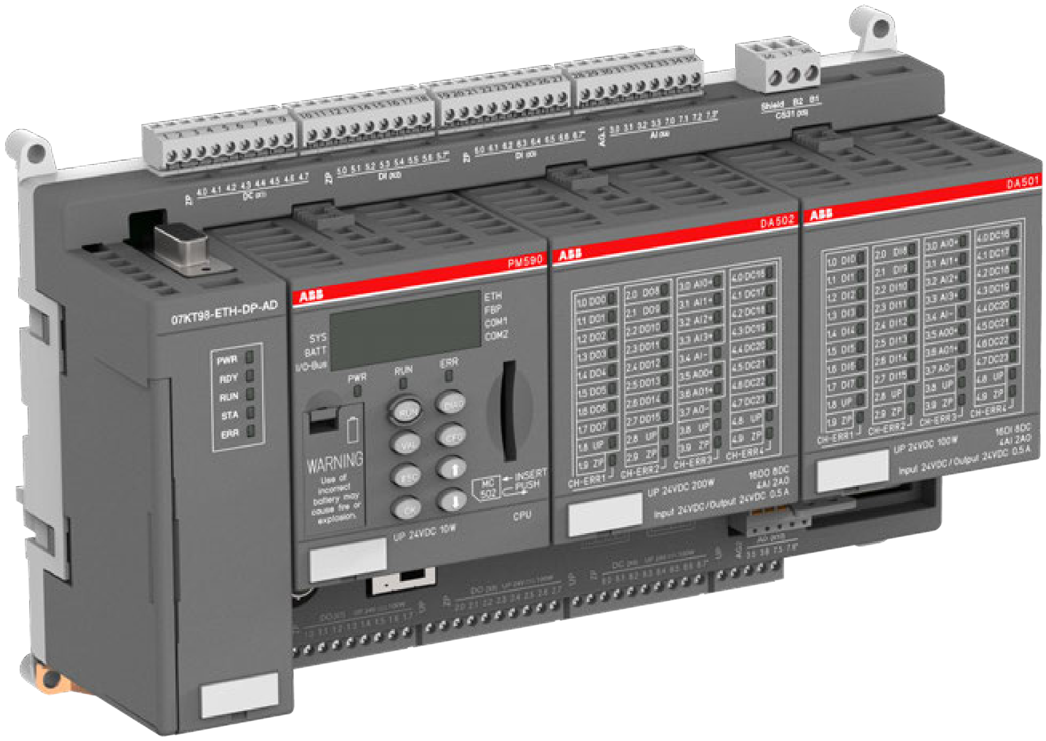


Fig. 11: 3ADR331183S0015

The replacement device versions 07KT9x-AD of the AC31 adapter series replace the existing devices 07KT94 and 07KT98 of the AC31 devices of the 90 series.

Versions:

- 07KT94-ARC-AD: I/O module DA501, I/O module DA502, CPU EC581 *)
- 07KT98-ARC-AD: I/O module DA501, I/O module DA502, CPU PM590-ARC
- 07KT98-ARC-DP-AD: I/O module DA501, I/O module DA502, CPU PM590-ARC
- 07KT98-ARC-ETH-AD: I/O module DA501, I/O module DA502, CPU PM590-ARC-ETH
- 07KT98-ETH-DP-AD: I/O module DA501, I/O module DA502, CPU PM590-ETH
- 07KT98-ARC-ETH-DP-AD: I/O module DA501, I/O module DA502, PM590-ARC-ETH

During the development of the replacement devices, care was taken to keep the device configuration identical to the configuration of the existing device. Thus, the existing documentation of device 07KT98 remains valid and serves as reference *(system description Advant Controller 31)*. The document structure of this document is based on the document structure of the existing documentation.

*) Customer specific product not for standard use

This document adds the following points to the still valid existing documentation:

- Unavoidable device deviations, e.g. due to technical limitations.
- Expansion of documentation as a result of normative requirements.
- Additional contents not described in the existing documentation.

Further information on replacement devices 07KT9x-AD can be found in the operating and assembly instructions of device 07KT9x-AD: 3ADR020082M0401.

Please observe the system data for CS31 bus ↳ *Chapter 1.3.3.3 “System data and CS31 bus system data” on page 52*.

For general information on the CPU, please refer to the AC500 documentation .

> *In addition to the CPU, the replacement devices 07KT9x-AD are based on the modules DA501 and DA502 of the AC500 series. All I/O channels are protected against reverse polarity, reverse supply, short circuit and temporary overvoltages up to 30 V DC. For further information on these modules, please refer to the AC500 documentation.*

> *The description of the protective functions, error indications and diagnosis options contained in the existing documentation are no longer valid. Please refer to the AC500 documentation (DA501-/ DA502 modules and CPU) concerning this information.*

Central unit 07KT98

Short description

The central unit 07KT9x-AD acts as

- bus master in the decentralized automation system.
  Slave operation is not possible.
- Advant Controller 31 or as stand-alone central unit.

Main features

- 16 digital inputs with LED display.
  Caution! Galvanic isolation/potential reference has changed.
- 16 digital outputs with LED display.
  Caution! Galvanic isolation/potential reference has changed.
- 16 digital inputs/outputs with LED display.
  Caution! Galvanic isolation/potential reference has changed.
- 8 individually configurable analog inputs. Available modes can be found in 'Connections' ↳ *Chapter 1.3.3.4.1.3.1.7 “Connection of the 8 configurable analog inputs” on page 82*.
  Caution! Galvanic isolation/potential reference has changed.
- 4 individually configurable analog outputs.
  Caution! Galvanic isolation/potential reference has changed.
- 2 counters for counting frequencies up to 50 kHz, configurable in 10 different modes.
  Caution! Each counting input requires an external resistor of 470 Ω / 1 W that is connected upstream. The potential reference has changed.
- 1 serial interface COM2
  - Modbus RTU, master and slave
  - An online access (RS-232 programming interface for PC/Automation Builder)
  - A free protocol (communication via the blocks COM_SEND and COM_REC)
- 1 serial diagnosis interface DIAG
  Caution! No galvanic isolation to supply voltage L+/M.
- LED LCD display to indicate operating conditions and error messages
- Fastening by screws or snapping onto top-hat rail
- Lithium battery TA521
- Various operating buttons for user input
- Comprehensive diagnosis functions
- Integrated Flash EPROM, RAM and memory for storing programs and data
- Exchangeable memory card

Planning/ commissioning

Software Automation Builder (see AC500 documentation):

- 07KT98-ARC-AD
- 07KT98-ARC-DP-AD
- 07KT98-ARC-ETH-AD
- 07KT98-ETH-DP-AD
- 07KT98-ARC-ETH-DP-AD

Software 907PC331

- 07KT94-ARC-AD

Functionality

Table 20: Existing device vs. replacement device

Designation	Existing device: 07KT98	Replacement device: 07KT9x-AD	Note
User program	1 MB	CPU PM590: 2 MB storage, memory card slot	-
User data	1 MB + 256 kB RETAIN + 128 kB (Flash EPROM)	CPU PM590: 2 MB storage, memory card slot	-
Digital inputs	24 in 3 groups (8 each), galvanically isolated	16 in 2 groups (8 each). Caution: Potential reference/galvanic isolation	Potential reference/galvanic isolation has changed *).
Digital outputs	16 transistor outputs in 2 groups (8 each), galvanically isolated	16 in 2 groups (8 each). Caution: Potential reference/galvanic isolation	Potential reference/galvanic isolation has changed *).
Digital inputs/outputs	8 in 1 group, galvanically isolated	16 in 2 groups (8 each). Caution: Potential reference/galvanic isolation	Potential reference/galvanic isolation has changed *).
Analog inputs	8 in 1 group, individually configurable to 0 V ... 10 V, 0 V ... 5 V, ± 10 V, ± 5 V, 0 mA... 20 mA, 4 mA ... 20 mA, Pt100 (2-wire or 3-wire), differential inputs, digital inputs	8 in 1 group, individually configurable 0 V ...10 V, ±10 V, 0 V ... 20 mA, 4 mA ... 20 mA, Pt100/ PT1000/ Ni1000 (2-wire or 3-wire), differential inputs, digital inputs	Potential reference has changed *). Some wiring adjustments are required in part. 5 V measuring ranges can be shown with 10 V measuring range.
Analog inputs (can also be configured as digital inputs)	Yes	Yes	Caution: AGND reference to ZP no longer M
Analog outputs	4 in 1 group, individually configurable to ± 10 V, 0 mA ... 20 mA, 4 mA ... 20 mA	4 in 1 group, individually configurable to ± 10 V, 0 mA ... 20 mA, 4 mA ... 20 mA	Caution: AGND reference to ZP no longer M *). Some wiring adjustments are required in part.

Designation	**Existing device: 07KT98**	**Replacement device: 07KT9x-AD**	**Note**
Serial Interfaces	COM1, COM2 as Modbus interfaces, for programming and test functions as well as freely programmable interfaces	COM2 (programming function, test function, free protocol) DIAG (diagnosis interface)	The serial COM1 interface of 07KT9x is no longer available. The serial diagnosis interface DIAG has a reduced range of functions and is not galvanically isolated from the supply voltage L+/M.
Parallel interface	For connection to communication module	For connection to communication module	Additional information upon request.
System bus interface	CS31	CS31	Caution: Terminal "Shield" is internally connected to FE (functional earth).
High-speed counter	Integrated, many functions configurable	Integrated, many configurable operating modes	At the counting input, an external resistor of 470 Ω / 1 W must always be connected upstream. For further information on high-speed counters, please refer to the AC500 documentation.
Real-time clock	Integrated	Integrated	-
Memory card	SmartMedia Card: Storage medium for operating system, user program and user data	Memory card: for the backup of user data, storage of the user program and update of the internal CPU firmware	-
Display LEDs	For signal states, operating conditions and error messages	Indication on LEDs and LCD display	-
Supply voltage	24V	24V	-
Data buffering	With lithium battery 07 LE 90	With lithium battery TA521	-
Programming software	907 AC 1131 as of V 4.1 (07KT98 with ARCNET interface) 907 AC 1131 as of V 4.3 (07KT98 with PROFIBUS DP interface)	Automation Builder as of V1.2	-
Processing time	Processing time: 65% bit, 35% word, for 1 kB program, typ. 0.07 ms	Cycle time for 1 instruction (CPU PM590). Binary: min. 0.002 µs, word: min. 0.004 µs, floating point: min. 0.004 µs	-

*) ✎ *Chapter 1.3.3.4.1.3.1 “Connections” on page 74*

Table 21: Comparison: Replacement device versions

	07KT94-ARC-AD	**07KT98-ARC-AD**	**07KT98-ARC-DP-AD**	**07KT98-ARC-ETH-AD**	**07KT98-ETH-DP-AD**	**07KT98-ARC-ETH-DP-AD**
ARCNET	x	x	x	x	-	x
PROFIBUS	-	-	x	-	x	x
Ethernet	-	-	-	x	x	x
CS31	x	x	x	x	x	x
Parallel interface for connection to communication module	-	x	x	x	x	x
Cycle time for 1 instruction	CPU EC581: n.a.	*)	*)	*)	*)	*)

*) CPU PM590: -> Binary: min. 0.002 µs, -> word: min. 0.004 µs, -> floating point: min. 0.004 µs

Available versions

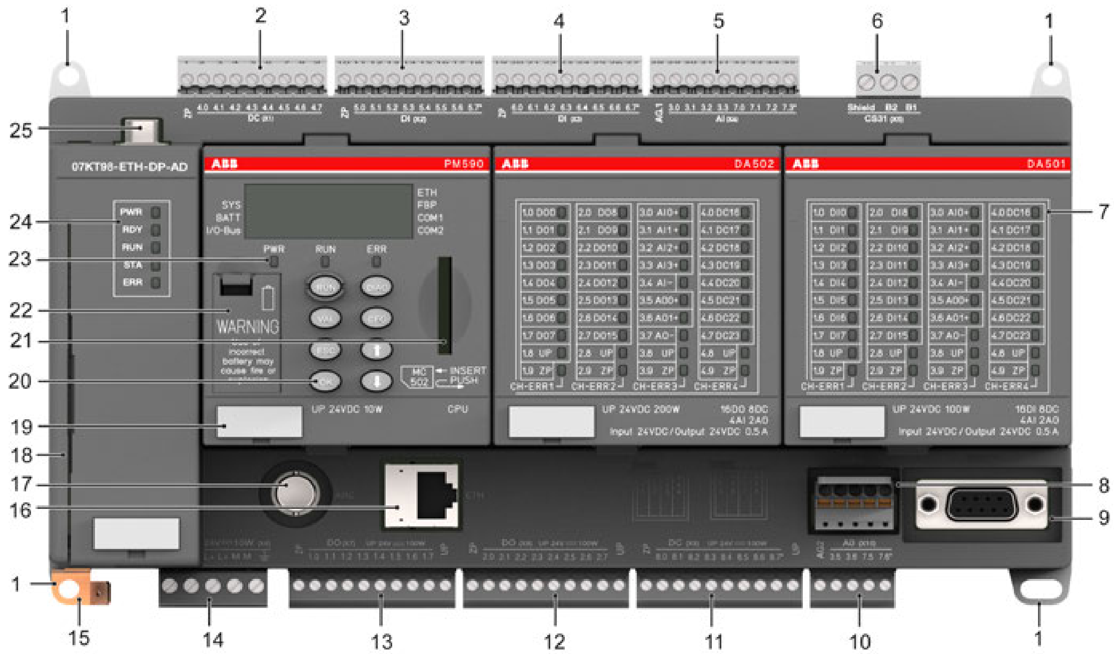
To get an overview of the the available versions for 07 KT 98 central units, please refer to previous chapter ✎ *Table 21 “Comparison: Replacement device versions” on page 72*.

Suitable SmartMedia cards

The 07KT9x-AD systems use memory cards of the type "SD Memory Card MC5141".

✎ *Chapter 1.9.1.2 “MC5141 - Memory card” on page 1348*

Device configuration



1 Hole for screw mounting (screw diameter 4 mm, extension torque 1.2 Nm)
2 Digital inputs/outputs for DA502
3 Digital inputs for DA501
4 Digital inputs for DA501
5 Analog inputs for DA501/DA502
6 CS31 bus Interface
7 Status LEDs for DA501/DA502
8 DIAG: Serial interface (diagnosis)
9 COM2: Serial interface (thread UNC 4-40)
10 Analog outputs for DA501/DA502. ± 10 V, 0 mA ... 20 mA, 4 mA ... 20 mA in one group
11 Digital inputs/outputs for DA501
12 Digital outputs for DA502
13 Digital outputs for DA502
14 Supply voltage connection 24 V DC (CPU and communication module)
15 Ground connection (FE). Connection for 6.3 mm Faston.
16 Ethernet: Network interface (function depends on device version)
17 Interface for ARCNET (BNC)
18 External network interface
19 TA525: Label
20 8 operating buttons
21 Memory card
22 Battery compartment for lithium battery TA521
23 3 system LEDs
24 5 status LEDs (only for PROFIBUS)
25 Connection for PROFIBUS (optional) (function depends on device version)

For information on the available I/O modules DA501 and DA502, please refer to the AC500 documentation. The CPU module used (here: PM590) depends on the model version.

Connections

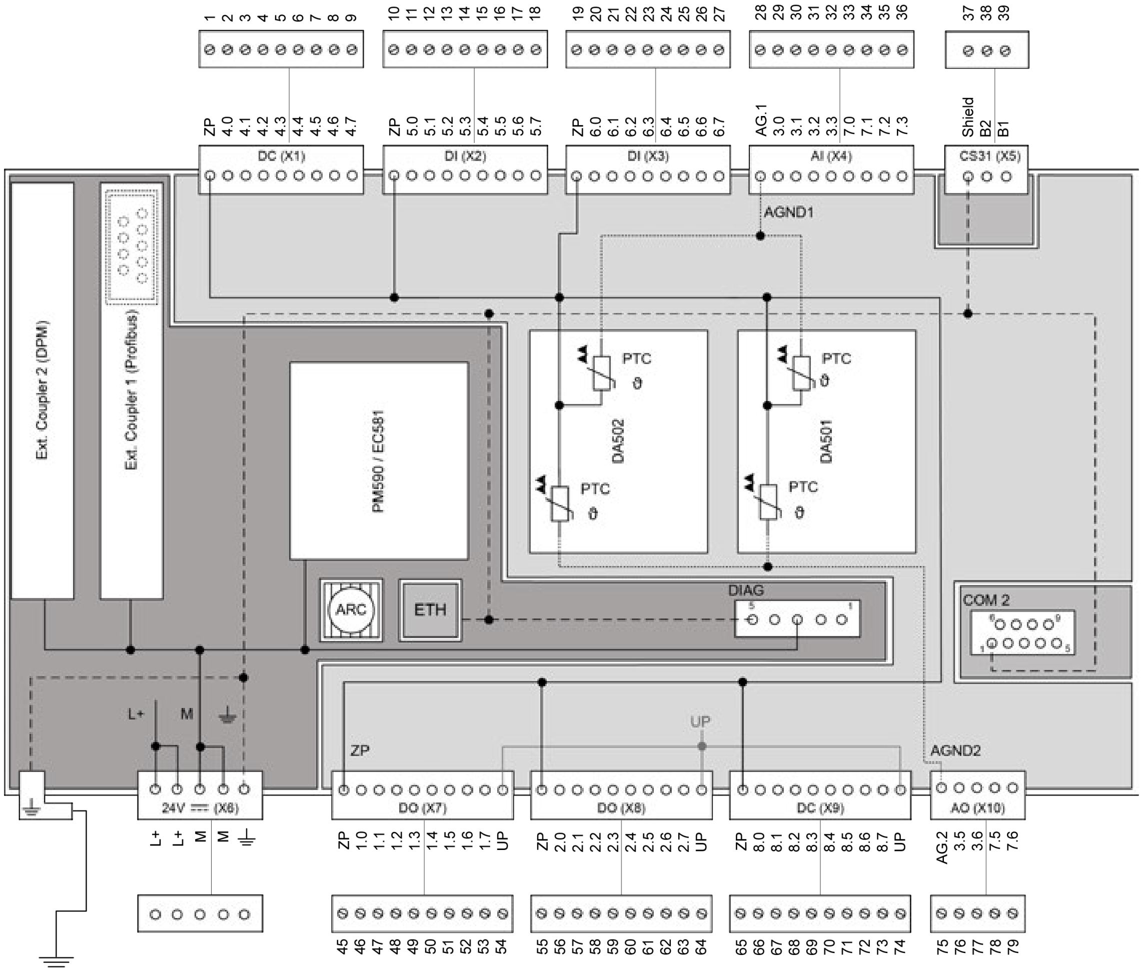


Fig. 12: Terminal assignment 07KT9x-AD

DIAG	No galvanic isolation (M)
COM2	Galvanically isolated
CS31 bus	Galvanically isolated
Ethernet	Galvanically isolated
ARCNET	Galvanically isolated
DA501/DA502	Galvanically isolated

Further information on grounding *Chapter 1.3.3.3.1.7 “Grounding” on page 55*.

Application example for connecting the inputs and outputs

Please observe the following information *Chapter 1.3.3.3 “System data and CS31 bus system data” on page 52*

Connection of the supply voltage

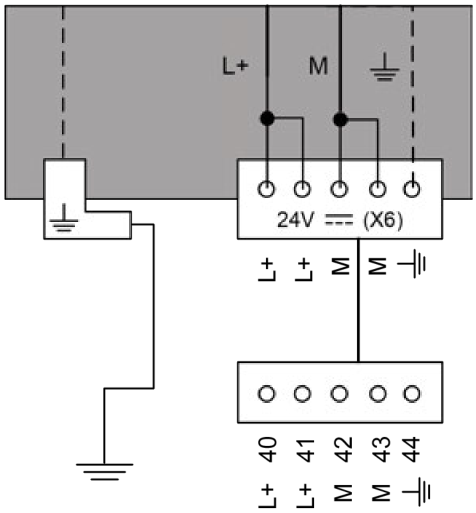


Fig. 13: Connection of the supply voltage

Table 22: Connector (X6)

Connector / Terminal	Pin	Assignment / Signal
X6 / L+	40	Supply voltage +24 V DC
X6 / L+	41	Supply voltage +24 V DC
X6 / M	42	Ground connection (0 V)
X6 / M	43	Ground connection (0 V)
X6 / functional earth	44	The functional earth (FE) is connected to the Faston terminal inside the device. Ensure that no ground loops are created and that FE and Faston are connected to the same ground potential.

NOTICE!
– In addition to connecting the supply voltage (L+/M) to X6, the supply voltage (UP/ZP) must be connected to all connectors.
– ZP must be connected to all connectors (X1, X2, X3, X7, X8, X9).
– UP must be connected to all connectors (X7, X8, X9).
– L+/M and UP/ZP must always be supplied with voltage.

Connection for CS31 bus

Table 23: Connector (X5)

Connector / Terminal	Pin	Assignment / Signal
X5 / shield	37	Shield (functional earth)
X5 / B2	38	BUS2
X5 / B1	39	BUS1

Terminal "Shield" is internally connected to FE. The previous grounding measures, e.g. with clip at the control cabinet, are still required. *Chapter 1.3.3.3 “System data and CS31 bus system data” on page 52*

If 07KT9x-AD is connected to one of the bus ends, a 120 Ω resistor must be connected for bus termination. The device 07KT9x-AD always functions as master. Slave operation is not possible. Further information on CS31 bus *Chapter 1.3.3.3 “System data and CS31 bus system data” on page 52*.

Connection of digital inputs

Chapter 1.3.3.4.1.3.1 “Connections” on page 74 .

Table 24: Connector X2

Connector / Terminal	Pin	Assignment / Signal
X2 / ZP	10	ZP
X2 / 5.0	11	DA501 / DI0
X2 / 5.1	12	DA501 / DI1
X2 / 5.2	13	DA501 / DI2
X2 / 5.3	14	DA501 / DI3
X2 / 5.4	15	DA501 / DI4
X2 / 5.5	16	DA501 / DI5
X2 / 5.6	17	DA501 / DI6
X2 / 5.7	18	DA501 / DI7

Table 25: Connector (X3)

Connector / Terminal	Pin	Assignment / Signal
X3 / ZP	19	ZP
X3 / 6.0	20	DA501 / DI8
X3 / 6.1	21	DA501 / DI9
X3 / 6.2	22	DA501 / DI10
X3 / 6.3	23	DA501 / DI11
X3 / 6.4	24	DA501 / DI12
X3 / 6.5	25	DA501 / DI13
X3 / 6.6	26	DA501 / DI14
X3 / 6.7	27	DA501 / DI15

In contrast to the existing device 07KT98, the function of the digital inputs is only possible if voltage UP is connected.

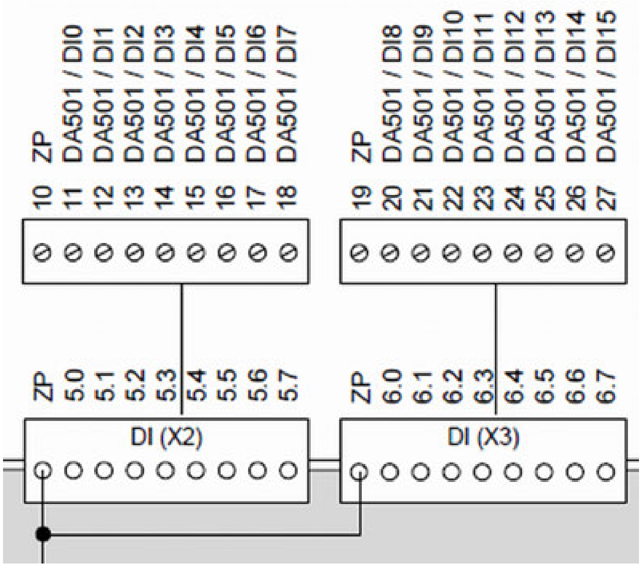


Fig. 14: Arrangement of the 16 digital inputs

The digital input states are always indicated by the LEDs DI0 ... DI15:

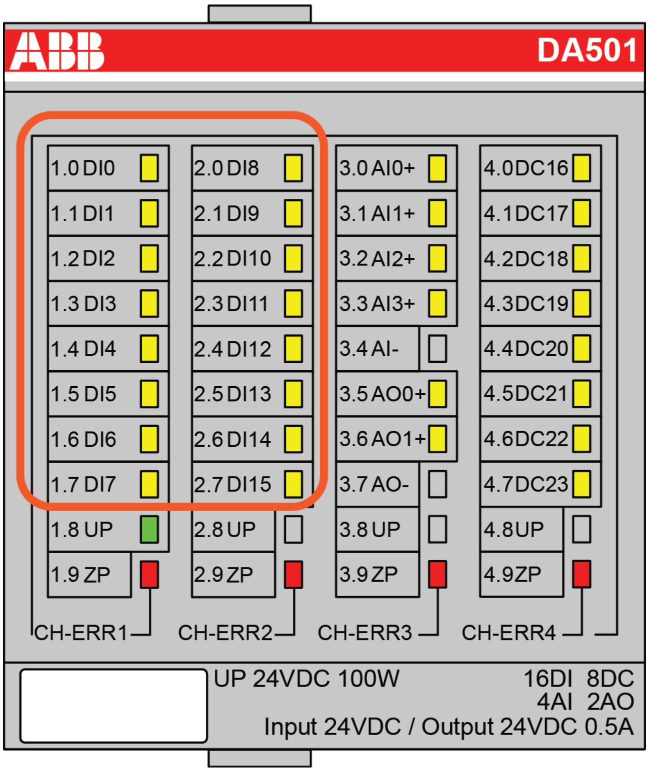


Fig. 15: DA501 LED status indication

Characteristics of the digital inputs:

- All 16 inputs have the same potential ZP as all other inputs/outputs. The galvanic isolation included in the existing devices is no longer available.
- Input delay (0->1 or 1->0): Typically 0.1 ms, configurable from 0.1 to 32 ms.

The signal coupling of the input signals is no longer realized via optocoupler. All channels of the DA501 and DA502 modules have reference to ZP. The AGND1/AGND2 of the analog channels are internally connected to ZP via PTC resistors. For information on terminal assignment, refer to figure 'Terminal assignment 07KT9x'Fig. 12).

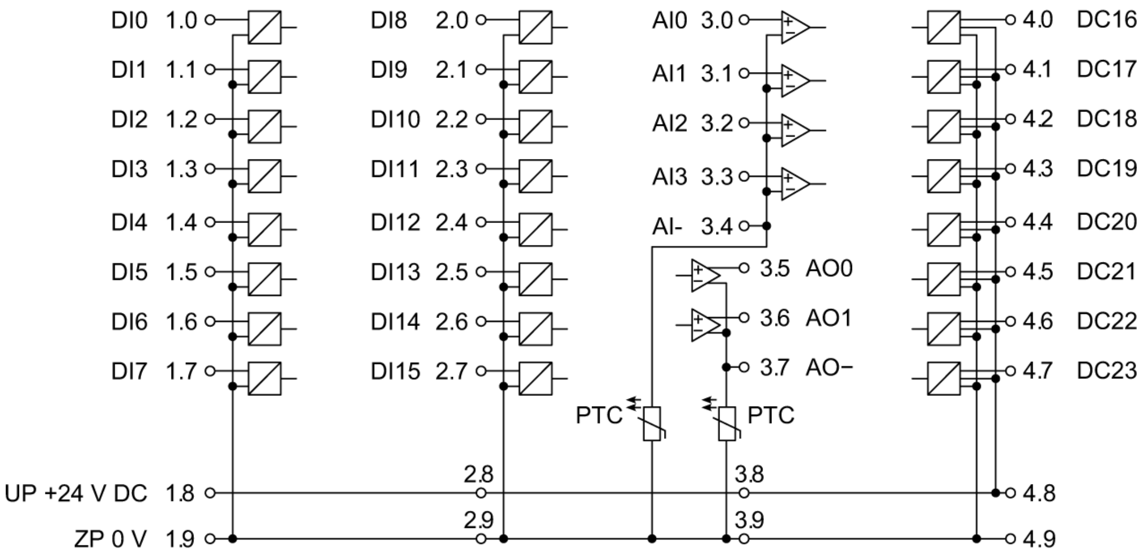


Fig. 16: Circuit arrangement of DA501 module

Connection of the digital outputs

↳ *Chapter 1.3.3.4.1.3.1 “Connections” on page 74*.

Table 26: Connector (X7)

Connector / Terminal	Pin	Assignment / Signal
X7 / ZP	45	ZP
X7 / 1.0	46	DA502 / DO0
X7 / 1.1	47	DA502 / DO1
X7 / 1.2	48	DA502 / DO2
X7 / 1.3	49	DA502 / DO3
X7 / 1.4	50	DA502 / DO4
X7 / 1.5	51	DA502 / DO5
X7 / 1.6	52	DA502 / DO6
X7 / 1.7	53	DA502 / DO7
X7 / UP	54	UP

Table 27: Connector (X8)

Connector / Terminal	Pin	Assignment / Signal
X8 / ZP	55	ZP
X8 / 2.0	56	DA502 / DO8
X8 / 2.1	57	DA502 / DO9
X8 / 2.2	58	DA502 / DO10
X8 / 2.3	59	DA502 / DO11
X8 / 2.4	60	DA502 / DO12
X8 / 2.5	61	DA502 / DO13
X8 / 2.6	62	DA502 / DO14

Connector / Terminal	Pin	Assignment / Signal
X8 / 2.7	63	DA502 / DO15
X8 / UP	64	UP

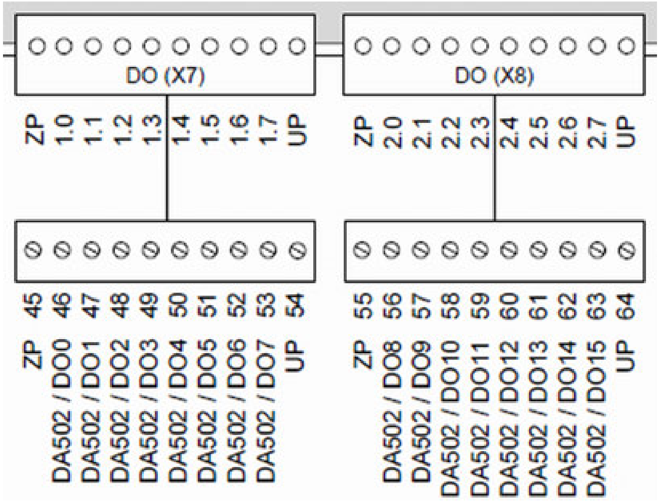


Fig. 17: Arrangement of digital outputs

Characteristics of the digital outputs

- The digital output states are always indicated by the LEDs DO0 ... DO15 on DA501 module.
- All 16 outputs have the same potential ZP as all other inputs/outputs. The galvanic isolation included in the existing devices is no longer available.
- Diagnosis: Stored errors are indicated via an LED and can be accessed by the CPU (see AC500 documentation).

Circuit arrangement of digital outputs

- Fig. 17
- *Further information on page 81*

Connection of the digital inputs/outputs

Table 28: Connector (X1)

Connector / Terminal	Pin	Assignment / Signal
X1 / ZP	1	ZP
X1 / 4.0	2	DA502 / DC16
X1 / 4.1	3	DA502 / DC17
X1 / 4.2	4	DA502 / DC18
X1 / 4.3	5	DA502 / DC19
X1 / 4.4	6	DA502 / DC20
X1 / 4.5	7	DA502 / DC21
X1 / 4.6	8	DA502 / DC22
X1 / 4.7	9	DA502 / DC23

Table 29: Connector (X9)

Connector / Terminal	Pin	Assignment / Signal
X9 / ZP	65	ZP
X9 / 8.0	66	DA501 / DC16
X9 / 8.1	67	DA501 / DC17
X9 / 8.2	68	DA501 / DC18
X9 / 8.3	69	DA501 / DC19
X9 / 8.4	70	DA501 / DC20
X9 / 8.5	71	DA501 / DC21
X9 / 8.6	72	DA501 / DC22
X9 / 8.7	73	DA501 / DC23
X9 / UP	74	UP

The arrangement of the 16 digital inputs/outputs is shown below:

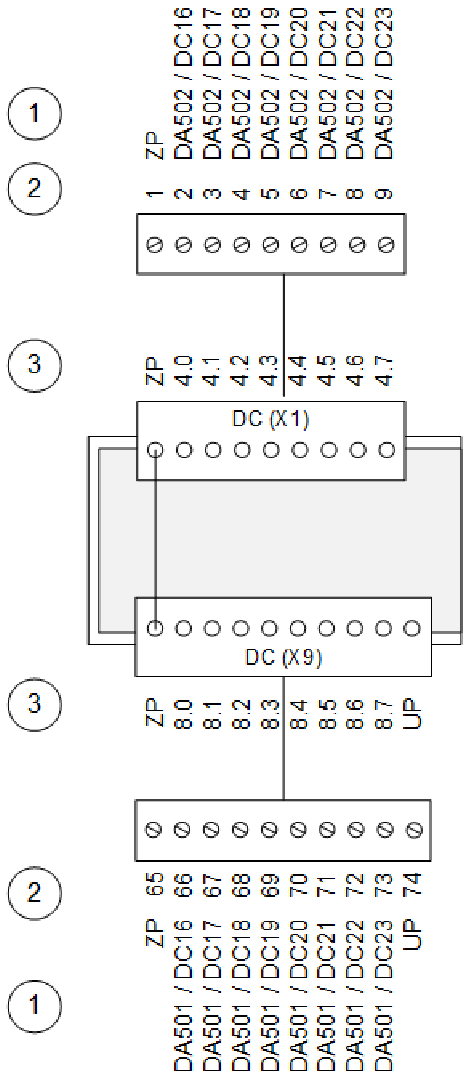


Fig. 18: Digital inputs/outputs

1 Module assignment
2 Terminal number
3 Terminal

Characteristics of the digital inputs/outputs

- The digital input/output states are always indicated via the LEDs DC16 - DC23 on DA501 or DA502.
- All 16 inputs/outputs have the same potential ZP as all other inputs/outputs. The galvanic isolation included in the existing devices is no longer available.
- Diagnosis: Stored errors are indicated via an LED and can be accessed by the CPU (see AC500 documentation).
- The inputs/outputs can be configured as input and as output. The outputs can also be read back.
- Input delay (0->1 or 1->0): Typically 0.1 ms, configurable 0.1 ms ... 32 ms.
- The total current consumption of all 16 DC channels must not exceed 4 A.
- The total current consumption of all 16 DO and 16 DC channels must not exceed 12 A.

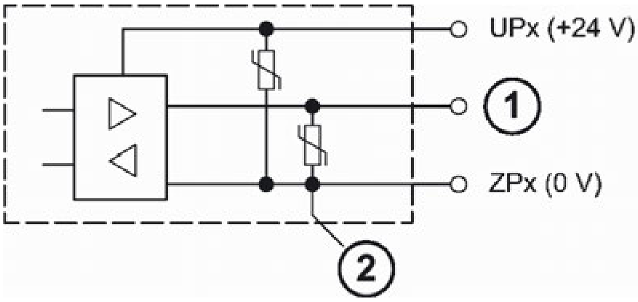


Fig. 19: Circuitry of a digital input/output with varistors for demagnetization when switching off inductive loads

1 Digital input/output
2 For demagnetization when switching off inductive loads

Data	Value
Input signal voltage	24 V DC
0 signal	-3 V ... +5 V
Undefined signal state	> +5 V ... < +15 V
1 signal	+15 V ... +30 V

The technical input data contained in the existing documentation are no longer valid.

The varistor protection circuit has changed. The varistors for demagnetization are no longer located between UP and the respective channel, but rather between ZP and the respective channel. It is no longer possible to connect the voltage supply UP to connector X5 and thus use the input voltage range from -30 V ... 30 V. At the inputs, only voltages -3 V ... +30 V may be applied. UP must always be connected to all connectors (X7, X8, X9).

Connection of the 8 configurable analog inputs

Table 30: Connector (X4)

Connector / Terminal	Pin	Assignment / Signal
X4 / AG.1	28	AGND1
X4 / 3.0	29	DA502 / AI0+
X4 / 3.1	30	DA502 / AI1+
X4 / 3.2	31	DA502 / AI2+
X4 / 3.3	32	DA502 / AI3+
X4 / 7.0	33	DA501 / AI0+
X4 / 7.1	34	DA501 / AI1+
X4 / 7.2	35	DA501 / AI2+
X4 / 7.3	36	DA501 / AI3+

To be able to use the analog inputs, UP must be connected. L+/M and UP/ZP must always be supplied with voltage.

To be able to use the analog inputs, UP must be connected. L+/M and UP/ZP must always be supplied with voltage.

The analog channels offer self-protective functions and diagnosis options in the following situations:

- Above range of analog value (input)
- Above range of analog value (output)
- Below range of analog value (input)
- Below range of analog value (output)
- Wire breakage
- Short circuit

For further information on behavior and indication of these errors, please refer to the AC500 documentation. The arrangement of the 8 analog inputs is shown below on X4.

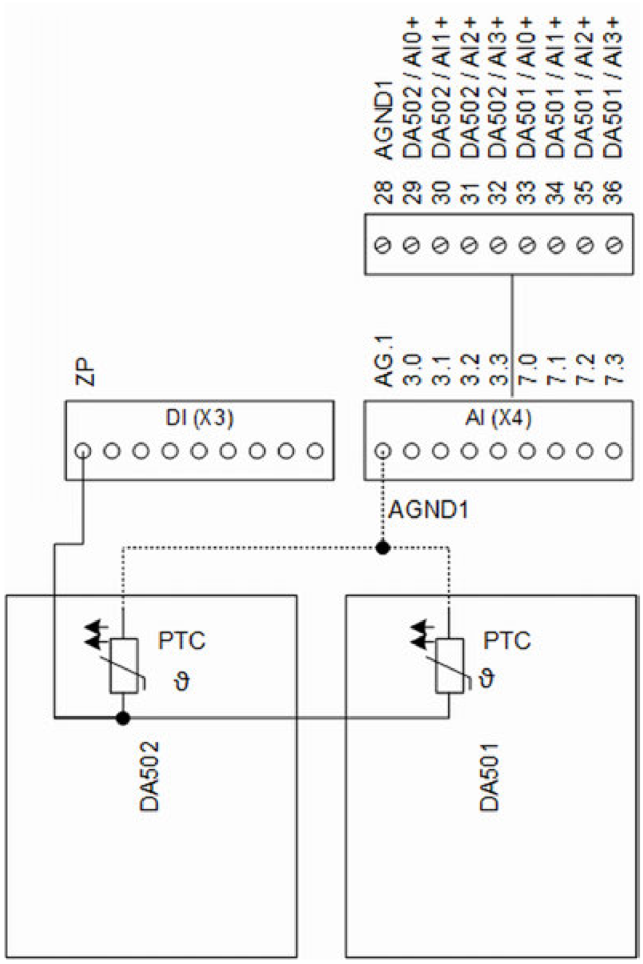


Fig. 20: Arrangement of the analog inputs

> *Reference to ground ZP: connect ZP to several connectors. In the example, ZP is connected to connector X3.*

Characteristics of the analog inputs:

- The 8 analog inputs are not galvanically isolated. The internal PTC connection is connected to ground ZP (existing device: ground M). Depending on sensor type or measuring principle, this may result in wiring adjustments.
- Resolution:
  - Range 0 V ... 10 V: 12 bit
  - Range -10 V ... +10 V: 12 bit + sign
  - Range 0 mA ... 20 mA: 12 bit
  - Range 4 mA ... 20 mA: 12 bit
  - Range RTD (Pt100, PT1000, Ni1000): +0.1 °C

Connection examples for analog transmitters are shown below.

Measuring ranges 07KT98

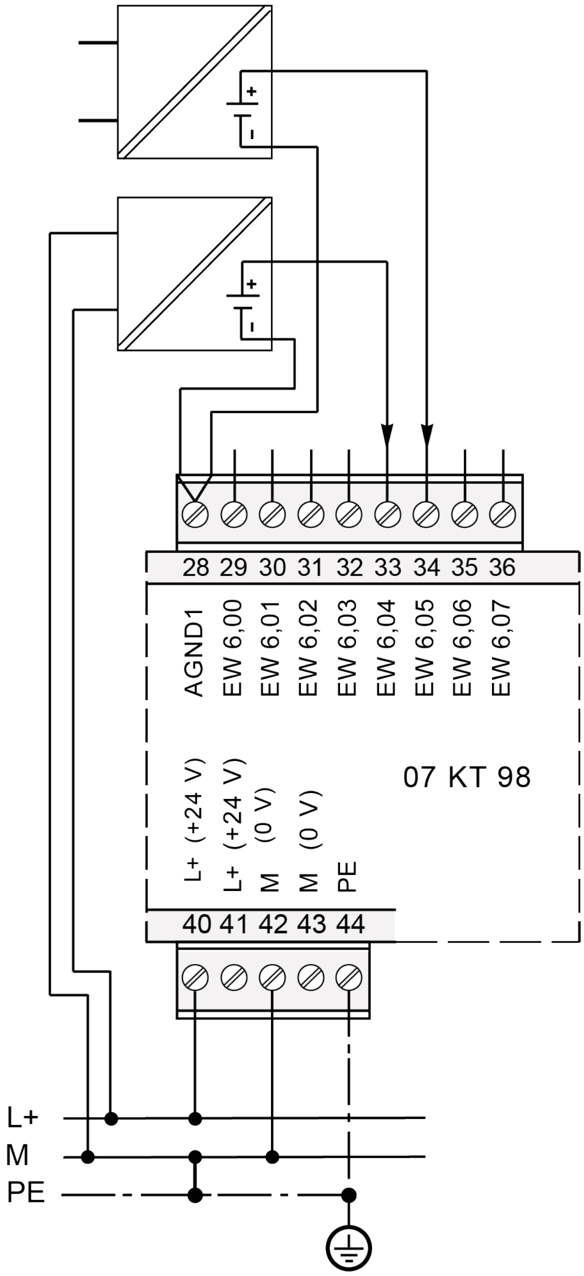


Fig. 21: Measuring ranges ± 10 V / 0 ... 10 V

Due to the internal galvanic isolation of the sensor voltage supply, no change to the wiring is necessary.

UP must be connected to connectors X7, X8 and X9. The internal voltage supply to the ADC channels is no longer provided by L+ but by UP in the modules DA501 and DA502.

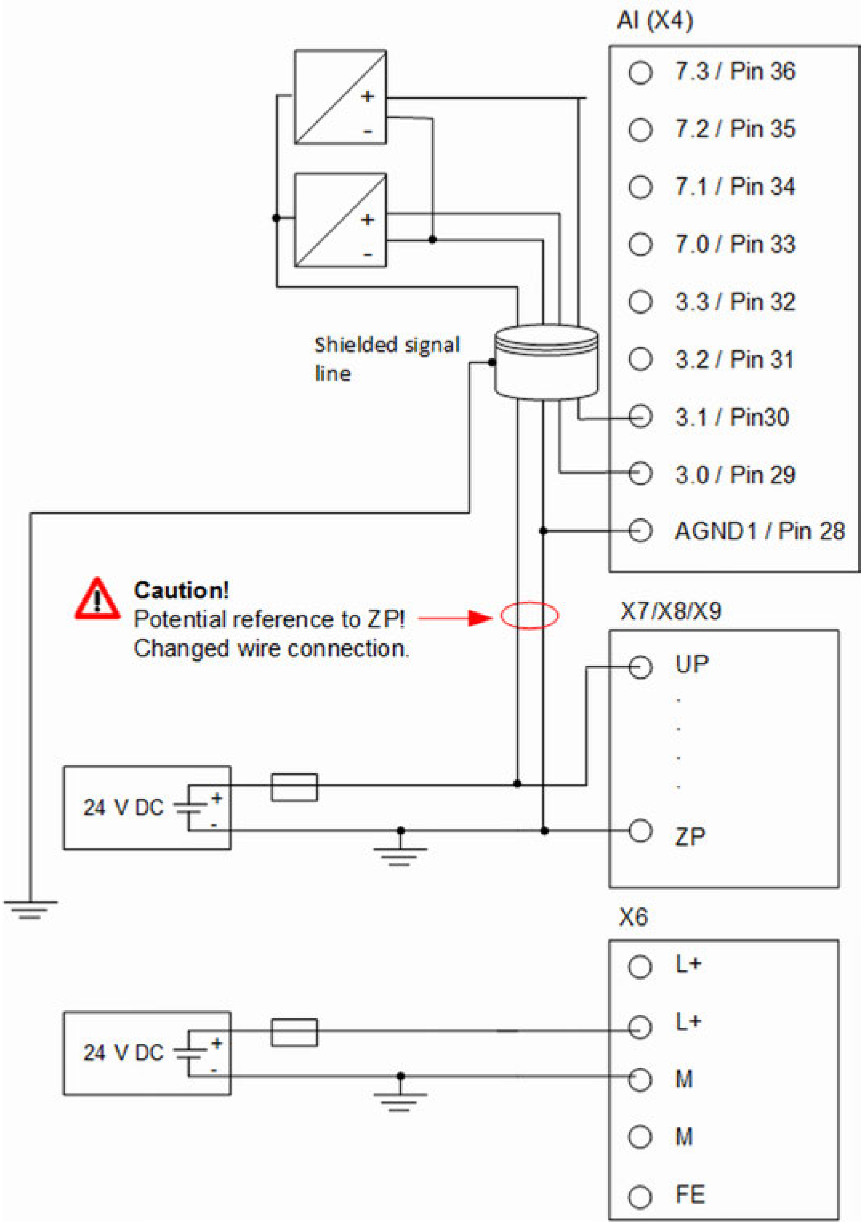


Fig. 22: Voltage input with externally supplied 3-wire voltage sensors

Measuring ranges (passive two pole sensors)

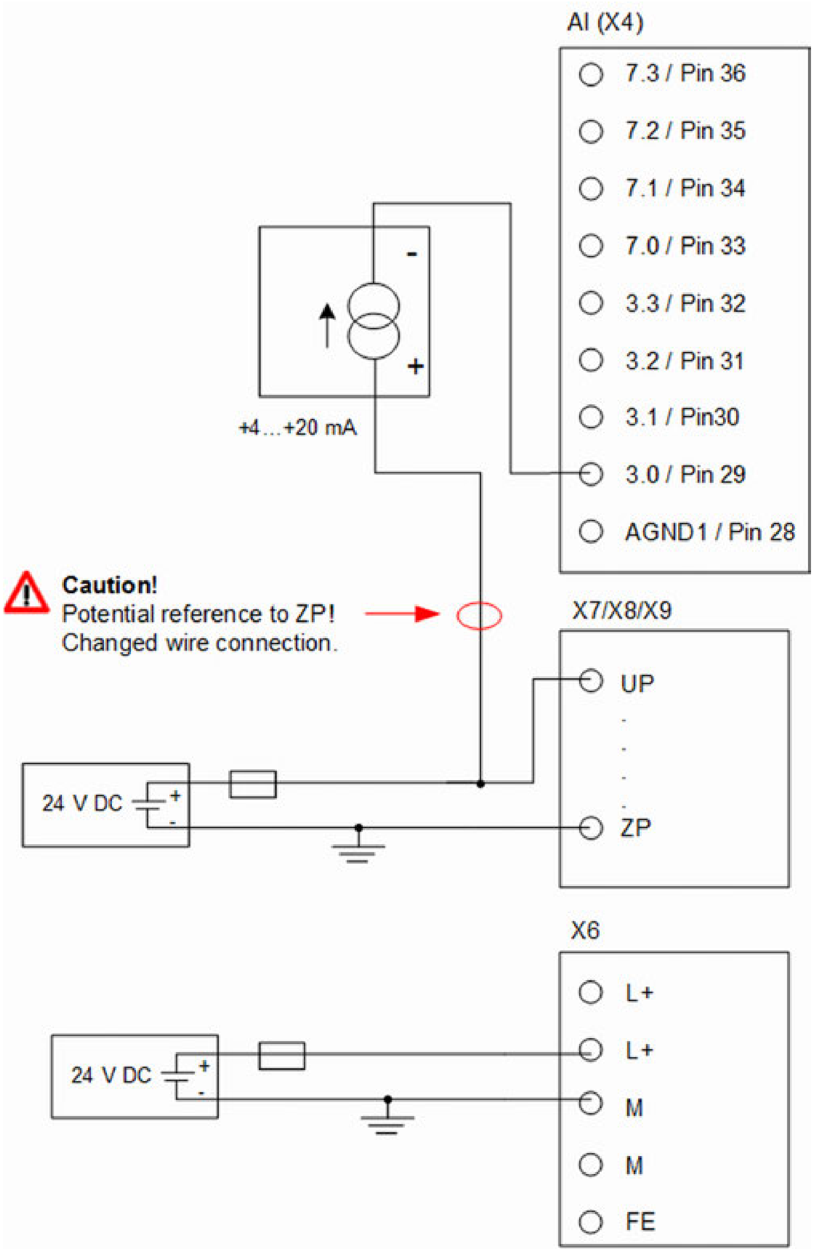


Fig. 23: Connection of current sensors 4 ... 20 mA to the analog inputs

If the analog current sensors 4 mA ... 20 mA are supplied from a separate power supply unit, the 0 V/GND connection of the power supply unit must be connected to the ZP connection of the 07KT9x-AD.

Protective functions

CAUTION!

Risk of overloading the analog input!

If an analog current sensor supplies a current in excess of 25 mA for more than 1 second during initialization, this input is switched off by the module (input protection).

Use only sensors with fast initialization or sensors without current peaks higher than 25 mA. If this is not possible, protect the input by connecting a 10-volt zener diode in parallel to I+ and I-.

For further information on protective function, error indication and diagnosis, please refer to the AC500 documentation.

Measuring range (active sensors with external supply)

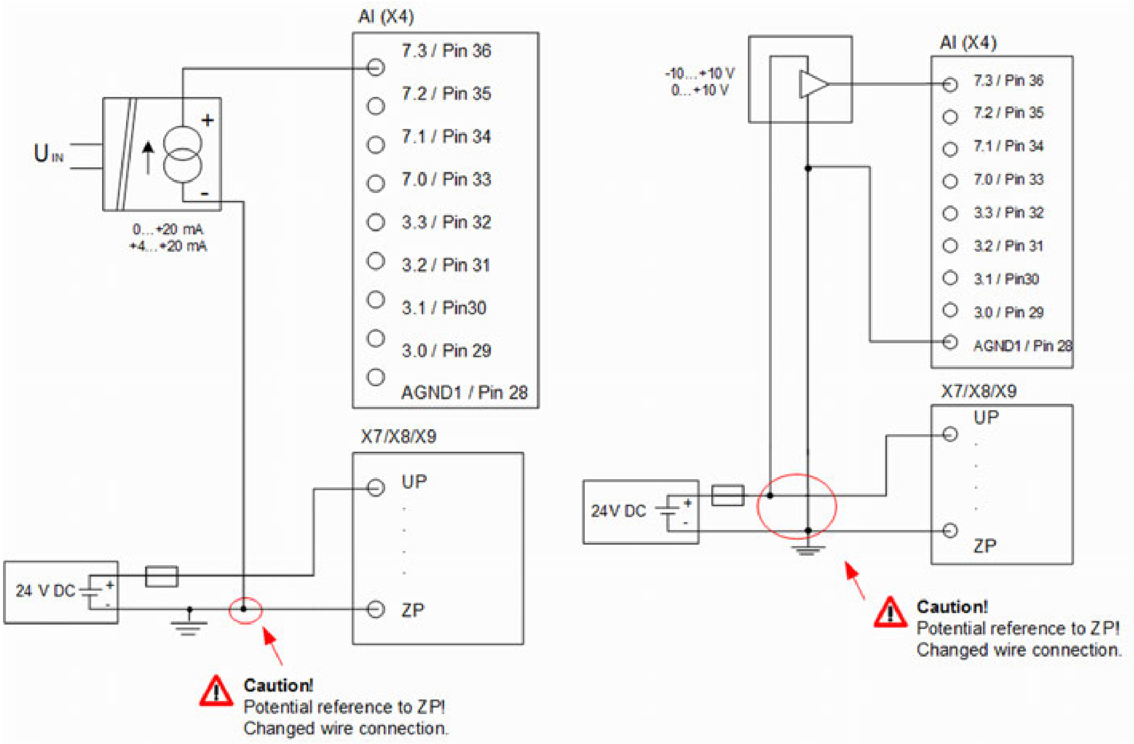


Fig. 24: Connection of current sensors 0 mA ... 20 mA to the analog inputs

Please note that in the example the 0 V supply (ZP) must be used as reference potential.

For further information on protective functions, error indication and diagnosis, please refer to the AC500 documentation.

Measuring ranges ± 10 V / 0 ... 10 V as differential inputs

Differential inputs are very useful when applying analog sensors with non-isolated installation at the site (e.g. if the minus terminal is grounded on site). The measurement via differential inputs considerably improves the measuring accuracy and prevents ground loops.

When configuring differential inputs, always two adjacent analog channels belong together (e.g. the channels 3.0 and 3.1). In this case, both channels are configured according to the desired operating mode. The channel with the lower channel number must be the one with the even number (e.g. channel 3.0).

The converted analog value is available at the odd channel (e.g. channel 3.1) and can be determined by means of the Automation Builder. The analog value is calculated by subtracting the input values: input value at the channel with the higher channel number minus input value on channel with lower channel number.

CAUTION!
Risk of faulty measurements!

The negative pole at the sensors must not have too much potential difference with respect to ZP (max. ± 1 V within the full signal range).

– Ensure that the potential difference never exceeds ± 1 V.
– No change to the wiring is necessary. The connection of the sensor corresponds to the one of the existing device 07KT98.

For further information on protective function, error indication and diagnosis, please refer to the AC500 documentation.

Measuring range with Pt100 2-wire

Table 31: Figure range

Range	Assigned figure range
-50 C ... 400°C	-500 ... +4000
-50 C ... 70°C	-500 ... +700

The following measuring ranges can be configured:

Table 32: Measuring ranges

Pt100	-50 °C ... +400 °C	2-wire configuration, 1 channel used
Pt100	-50 °C ... +70 °C	2-wire configuration, 1 channel used
Pt1000	-50 °C ... +400 °C	2-wire configuration, 1 channel used
Ni1000	-50 °C ... +150 °C	2-wire configuration, 1 channel used

Measuring values above range, below range and wire breaks are monitored and indicated.

For further information on protective function, error indication and diagnosis, please refer to the AC500 documentation.

Measuring range with Pt100 3-wire

Table 33: Figure range

Range	Assigned figure range
-50 C ... +400°C	-500 ... +4000
-50 C ... +70°C	-500 ... +700

The following measuring ranges can be configured:

Table 34: Measuring ranges

Pt100	-50 °C ... +400 °C	3-wire configuration, 2 channels used
Pt100	-50 °C ... +70 °C	3-wire configuration, 2 channels used
Pt1000	-50 °C ... +400 °C	3-wire configuration, 2 channels used
Ni1000	-50 °C ... +150 °C	3-wire configuration, 2 channels used

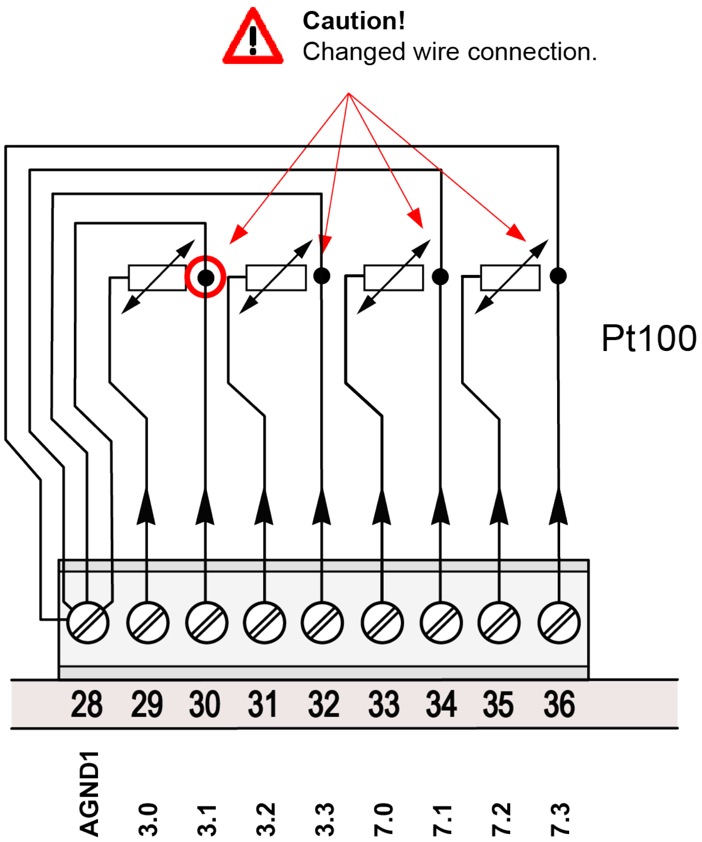


Fig. 25: Connection of Pt100 temperature sensors in 3-wire configuration

In order to keep measuring errors as small as possible, it is necessary to have all the involved conductors in the same cable. All the conductors must have the same cross section.

Measuring values above range, below range and wire breaks are monitored and indicated.

For further information on protective function, error indication and diagnosis, please refer to the AC500 documentation.

Use of analog inputs as digital inputs

Data	Value
Input signal voltage ● Signal 0 ● Undefined signal state ● Signal 1	24 V DC ● -30 V ... +5 V ● +5 V ... +13 V ● +13 V ... +30 V
Input resistance	approx. 3.5 kΩ
Conversion cycle	1 ms (for 4 inputs + 2 outputs) 1 s when measuring with resistance thermometer Pt/Ni

ZP serves as reference signal for the inputs.

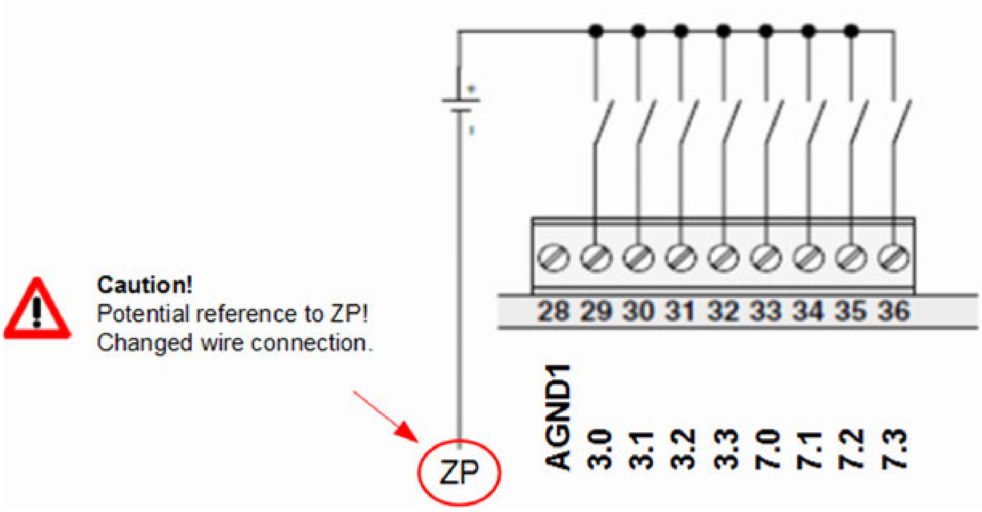


Fig. 26: Use of analog inputs as digital inputs

Connection of the 4 configurable analog outputs

Connector / Terminal	Pin	Assignment / Signal
X10 / AG.2	75	AGND2
X10 / 3.5	76	DA502 / AO0+
X10 / 3.6	77	DA502 / AO1+
X10 / 7.5	78	DA501 / AO0+
X10 / 7.6	79	DA501 / AO1+

UP must be connected to connectors X7, X8 and X9. The internal voltage supply to the ADC channels is no longer provided by L+ but by UP in the modules DA501 and DA502.

The arrangement of the 4 analog outputs is shown below:

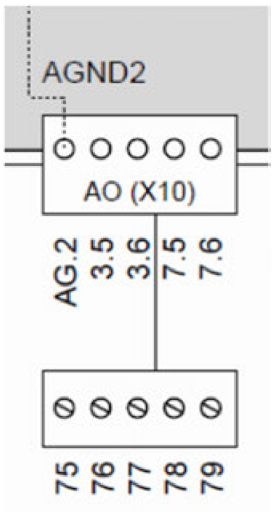


Fig. 27: Arrangement of the analog outputs

Resolution: 12 bit (+ sign)

The 4 analog outputs are not galvanically isolated and have a reference to ZP internally via PTC resistors.

Output areas ±10 V / 0 mA ... 20 mA / 4 mA ... 20 mA

No change to the wiring is necessary. The sensor is connected the same way as with the existing device 07KT98. Output load capability of voltage output: max. ± 10 mA.

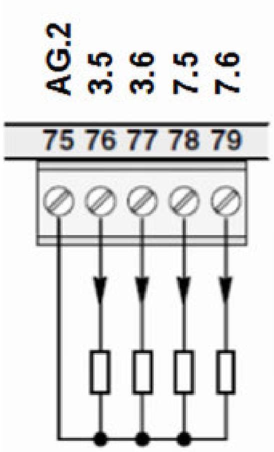


Fig. 28: Connection of output loads (voltage and current) to analog outputs

Battery and battery replacement

The AC31 adapters use another battery (lithium battery TA521).

For further information, please refer to the AC500 documentation.

Serial interface COM1

The serial interface COM1 is no longer available.

Programming can be performed via the serial interface COM2.

Serial interface DIAG

The serial interface DIAG is used for diagnosis and configuration. The DIAG interface is not galvanically isolated and thus only intended for connection with the Automation Builder.

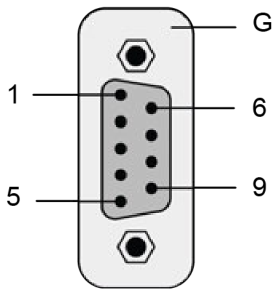
In the CPU or Automation Builder, the DIAG interface is accessed via the neutral FBP interface. Consequently, the information of the DIAG interface appears on the CPU display under the neutral FBP interface.

Connector / Pin	Assignment / Signal
DIAG / 1	Not connected
DIAG / 2	TX
DIAG / 3	M
DIAG / 4	RX
DIAG / 5	FE

Serial interface COM2

Connector / Pin	Assignment / Signal
COM2 / 1	FE
COM2 / 2	TX
COM2 / 3	RX
COM2 / 4	RTS
COM2 / 5	CTS
COM2 / 6	Not connected
COM2 / 7	Signal Ground
COM2 / 8	Signal Ground
COM2 / 9	+5 V

The assignment of the serial interface COM2 has not changed.

<table>
<tr><th></th><th>PIN</th><th>Signal</th><th>Description</th></tr>
<tr><td rowspan="10">COM2
</td><td>G</td><td>Housing</td><td>FE</td></tr>
<tr><td>1</td><td>FE</td><td>FE (shield)</td></tr>
<tr><td>2</td><td>TxD</td><td>Transmit data (output)</td></tr>
<tr><td>3</td><td>RxD</td><td>Receive data (input)</td></tr>
<tr><td>4</td><td>RTS</td><td>Request to send (output)</td></tr>
<tr><td>5</td><td>CTS</td><td>Clear to send (input)</td></tr>
<tr><td>6</td><td>NC</td><td>-</td></tr>
<tr><td>7</td><td>SGND</td><td>Signal ground (SGND)</td></tr>
<tr><td>8</td><td>0 V out</td><td>-</td></tr>
<tr><td>9</td><td>+5 V out</td><td>Reserved</td></tr>
</table>

Network interface

The existing device 07KT9x-AD has a parallel interface for connection to the communication module. Additional information upon request.

SmartMedia Card 07 MC 90

The 07KT9x-AD systems use memory cards of the type "SD Memory Card MC5141".

↳ *Chapter 1.9.1.2 “MC5141 - Memory card” on page 1348*

High-speed counter

DA502

The standard fast counter input in 07KT9x-AD devices is located on connector X1 terminal X1/4.0/4.1 (DA502 /DC16/DC17). When using the counter inputs (X1/ 4.0/4.1), an external resistor 470 Ω / 1 W must be connected upstream. There are 10 operating modes available. The fast counter output is located on connector X1 terminal X1/4.2 (DA502 /DC18).

See also connection of the digital inputs/outputs *Table 28 “Connector (X1)” on page 79*, Technical Data, *Table 35 “Data of the high-speed hardware counter installed (DA502)” on page 103* and connection *Table 35 “Data of the high-speed hardware counter installed (DA502)” on page 103* .

DA501

From configuration point of view that is not forbidden to use also the fast counter coming from DA501 connector X9 terminal X9/8.0/8.1/8.2 (DA501 /DC16/DC17/DC18). When using the counter inputs (X9/ 8.0/8.1), an external resistor 470 Ω / 1 W must be connected upstream. There are 10 operating modes available. The fast counter output is located on connector X9 terminal X9/8.2 (DA501 /DC18).

See also connection of the digital inputs/outputs *Table 28 “Connector (X1)” on page 79*, Technical Data, *Table 36 “Data of the high-speed hardware counter installed (DA501)” on page 103* and connection, *Table 36 “Data of the high-speed hardware counter installed (DA501)” on page 103*.

For further information on high-speed counters, please refer to the AC500 documentation.

Technical data 07KT9x-AD

The technical data described in the existing documentation (chapter 2.2.7) are invalid for the AC31 adapter and are replaced by the following data.

Further information *Chapter 1.3.3.3 “System data and CS31 bus system data” on page 52*

General data

Data	Value
Number of digital inputs	16
Number of digital outputs	16
Number of digital inputs/outputs	16
Number of analog inputs	8
Number of analog outputs	4
Supply voltages:	
-> UP	-> X7 / UP (pin 54), X7 / ZP (pin 45) -> X8 / UP (pin 64), X8 / ZP (pin 55) -> X9 / UP (pin 74), X9 / ZP (pin 65) Fig. 12
-> Fuse for UP	16 A
-> Power consumption for UP	300 W (per 100W on X7, X8 and X9)
-> L+	X6 / L+ (pin 40), X6 / L+ (pin 41) X6 / M (pin 42), X6 / M (pin 43) Fig. 12
-> Fuse for L+	10 A

Data	Value
-> Power consumption for L+	10 A
-> Galvanic isolation between UP and L+	Yes
Number of serial interfaces	1 COM2 (for diagnosis and programming with the Automation Builder software)
Number of serial interfaces (diagnosis)	1 DIAG (for diagnosis with the Automation Builder software)
Number of parallel interfaces	1 special interface for connection of an external communication module
Ethernet	10/100 base-TX, 1x RJ45 socket
Program memory	PM590 2MB
Resolution of the integrated real-time clock	1 s
Data of the high-speed hardware counter installed:	
-> Number of operating modes	-> 10
-> Counting range	-> 0 ... 4,294,967,295 (double word format, 32 bit)
-> Counting frequency	-> Depending on operating mode Note: At the counting input, an external resistor of 470 Ω / 1 W must always be connected upstream.
Cycle time for 1 instruction	Binary: min. 0.002 µs, word: min. 0.004 µs, floating point: min. 0.004 µs
Operating and error indications	Display via LEDs and CPU display. For detailed information, please refer to the AC500 documentation.
Connection technology	Detachable screw-type terminal blocks
Supply terminals, CS31 bus	max. 1 x 2.5 mm² or max. 2 x 1.5 mm²
All other terminals	max. 1 x 1.5 mm²

For further information, please refer to the existing documentation System description Advant Controller 31.

Supply of devices

Data	Value
Rated supply voltage	24 V DC
Supply voltages:	
-> UP	X7 / UP (pin 54), X7 / ZP (pin 45) X8 / UP (pin 64), X8 / ZP (pin 55) X9 / UP (pin 74), X9 / ZP (pin 65) Fig. 12
-> Fuse for UP	10 A
-> Power consumption for UP	300 W (per 100W on X7, X8 and X9)

Data	Value
-> L+	X6 / L+ (pin 40), X6 / L+ (pin 41) X6 / M (pin 42), X6 / M (pin 43) Fig. 12
-> Fuse for L+	10 A
-> Power consumption for L+	10 A
-> Protection against reversed voltage	Yes
-> Galvanic isolation between UP and L+	Yes

For further information, please refer to the existing documentation System description Advant Controller 31.

Lithium battery

Data	Value
Battery for buffering RAM contents and real-time clock	Lithium battery TA521
Buffer time at +25 °C	Typ. 3 years

Digital inputs

Data	Value
Number of channels per device	16
Connections	Connector X2 (terminals X5.0 … X5.7) Connector X3 (terminals X6.0 … X6.7)
Division of channels in groups	2 groups with 8 channels (not galvanically isolated!)
Voltage supply	UP (supplies module DA501 and 502)
Common reference potential:	
-> for group 1 (8 channels)	ZP (terminals 5.0 ... 5.07)
-> for group 2 (8 channels)	ZP (terminals 6.0 ... 6.07)
Galvanic isolation:	● Galvanic isolation from group to group is no longer available. ● Galvanic isolation from DA501 and DA502 (reference ZP) to the rest of the device (reference M) is available. ● On DA501 and DA502, all channels have the same potential ZP. Voltage supply UP/ZP. ● AGND1 and AGND2 of the analog channels are internally connected to ZP via PTC resistors Fig. 12.
Configurability of the inputs	Input delay configurable (0.1 ms, 1 ms, 8 ms and 32 ms). Default: 0.1 ms.

Data	Value
Channels for high-speed counters	*Chapter 1.3.3.4.1.3.4.6 “Digital inputs/outputs” on page 97* Channels for high-speed counters are implemented with the inputs/outputs (channels: 4.0 and 4.1).
Indication of the input signals	One yellow LED each per channel. The LED corresponds functionally to the input signal.
Input signal voltage:	24 V DC
-> 0 signal	-3 V … +5 V
-> Undefined signal state	+5 V ... + 15 V
-> 1 signal	+15 V ... +30 V
Input current per channel:	
-> Input voltage = +24 V	Typ. 5.0 mA
-> Input voltage = + 5 V	> 1 mA
-> Input voltage = +13 V	> 2 mA
-> Input voltage = +30 V	< 8.0 mA
Max. cable length unshielded	600 m
Max. cable length shielded	1000 m

For further information, please refer to the existing documentation System description Advant Controller 31.

Digital outputs

Data	Value
Number of channels per device	16 high-side switches
Connections	Connector X7 (terminals 1.0 ... 1.7) Connector X8 (terminals 2.0 ... 2.7)
Division of channels in groups	2 groups with 8 channels (not galvanically isolated!)
Common voltage supply	UP (supplies module DA501 and 502)
Common reference potential ZP:	
-> for group 1	ZP (terminals 1.0 ... 1.7)
-> for group 2	ZP (terminals 2.0 ... 2.7)

Data	Value
Galvanic isolation	● Galvanic isolation from group to group is no longer available. ● Galvanic isolation from DA501 and DA502 (reference ZP) to the rest of the device (reference M). ● On DA501 and DA502, all channels have the same potential ZP. Voltage supply UP/ZP. ● AGND1 and AGND2 of the analog channels are internally connected to ZP via PTC resistors Fig. 12.
Indication of the output signals	One yellow LED each per channel. The LED corresponds functionally to the output signal.
Output current:	
-> Rated value	500 mA at UP = 24 V
-> Residual current at 0 signal	< 0.5 mA
Demagnetization with inductive load	Internally via varistor
Switching frequency with inductive load	max. 0.5 Hz
Switching frequency with lamp load	max. 11 Hz at max. 5 W
Max. cable length	1000 m (shielded) 600 m (unshielded)
Short-circuit proof / overload proof	Yes
Protection against reversed voltage of process supply voltage	Yes
Resistance to feedback against 24 V signals	Yes
Total load current (all DO channels, 1.0...1.7 max. 4A and 2.0…2.7)	max. 4 A
Total load current (all DC channels, 4.0..4.7 max. 8A and 8.0…8.7)	max. 8 A
Total load current (via UP) 16 DO channels and 16 DC channels	max. 12 A (all UP terminals must be connected)

For further information, please refer to the existing documentation System description Advant Controller 31.

Digital inputs/outputs

Data	Value
Number of channels per device	16 inputs/outputs
Connections	Connector X1 (terminals 4.0 ... 4.7) Connector X9 (terminals 8.0 ... 8.7)
Division of channels in groups	2 groups of 8 channels each Group 1: terminals 4.0 ... 4.7 Group 2: terminals 8.0 ... 8.7

Data	Value
Common reference potential ZP	All digital I/O channels of the DA501 and DA502 module
Common voltage supply	UP (supplies DA501 and DA502 module)
Galvanic isolation	Galvanic isolation from group to group is no longer available. Galvanic isolation from DA501 and DA502 (reference ZP) to the rest of the device (reference M). On DA501 and DA502, all digital channels have the same potential ZP. AGND1 and AGND2 of the analog channels are internally connected to ZP via PTC resistors. Fig. 12
Configurability of the inputs:	
-> Input delay	Typically 0.1 ms, configurable from 0.1 ms to 32 ms
Indication of the input/output signals	1 yellow LED per channel. The LED is ON in "High" signal state (1 signal)
Input signal voltage (when used as input)	*Further information on page 81*.
-> 0 signal	-3 V ... + 5 V
-> 1 signal	+15 V ... + 30 V
Input current per channel	*Chapter 1.3.3.4.1.3.4.4 “Digital inputs” on page 95*.
Output current / switching frequency / inductive loads	*Chapter 1.3.3.4.1.3.4.5 “Digital outputs” on page 96*.
Total load current (all DC channels, 4.0 ... 4.7 max. 8A and 8.0 … 8.7)	max. 8 A
Total load current (all DO channels, 1.0 ... 1.7 max. 4A and 2.0 … 2.7)	max. 4 A
Total load current (via UP) 16 DO channels and 16 DC channels	max. 12 A (all UP terminals must be connected)
Max. cable length	*Chapter 1.3.3.4.1.3.4.4 “Digital inputs” on page 95* *Chapter 1.3.3.4.1.3.4.5 “Digital outputs” on page 96*

For further information, please refer to the existing documentation System description Advant Controller 31.

Analog inputs

Data	Value
Number of channels per device	8
Connections	Connector X4 (terminals 3.0 … 3.3 and 7.0 … 7.3)
Division of channels in groups	1 group with 8 channels (evenly distributed among the modules DA501 and DA502 internally)
Common reference potential for analog inputs (8 channels)	AGND1 (terminals 3.0 … 3.3 and 7.0 … 7.3) Caution: internal reference to ZP via PTC resistors Fig. 12
Galvanic isolation	Fig. 12
Max. permissible potential difference between terminal ZP (minus the supply voltage) and terminals AGND (minus the analog inputs and outputs)	± 1 V Caution: The internal reference is no longer M but ZP. *Chapter 1.3.3.4.1.3.1 “Connections” on page 74*
Indication of the input signals	8 yellow LEDs to indicate the signal states of the analog inputs (4 LEDs per DA501 module and DA502 module)
Configurability (optional per channel) *Chapter 1.3.3.4.1.3.1.2 “Connection of the supply voltage” on page 75*	0 ... 10 V, ± 10 V (also with differential signal), 0 mA ... 20 mA, 4 mA ... 20 mA Pt100 -50 °C ... +400 °C and -50 °C ... +70°C Pt1000 -50 °C … +400 °C (2-wire and 3-wire configuration) Digital input
Input resistance per channel:	
-> Voltage input	> 100 kΩ
-> Current input	approx. 330 kΩ
-> Digital input	approx. 3.5 kΩ
Time constant of the input filter	Voltage: 100 µs, current: 100 µs
Conversion cycle	1 ms (for 4 inputs and 2 outputs) 1 s when measuring with resistance thermometer Pt/Ni

The "Examples for the conversion cycle" from the existing documentation 07KT98 are no longer valid.

Data	Value
Resolution in bits:	
-> Ranges	±10 V, 0 V ... 10 V 12 bit plus sign
-> Ranges	0 mA ... 20 mA, 4 mA ... 20 mA 12 bit without sign

Data	Value
-> Range	Pt100, Pt1000, Ni1000: 0.1 °C
Resolution in mV, µA:	
-> Range	±10 V approx. 2.5 mV
-> Range	0 V ... 10 V approx. 2.5 mV
-> Range	0 mA ... 20 mA approx. 5 µA
-> Range	4 mA ... 20 mA approx. 4 µA
Relationship between input signal and hex code	-100 % ... 0 ... +100 % = 9400H ... 0000H ... 6C00H (-27648 ... 0 ... 27648 decimal)
Conversion error of the analog values due to non-linearity. Adjustment error on delivery and resolution in the nominal range	Typ. 0.5 %, max. 1 %
Use as digital input:	
-> Signal 0	-30 V ... +5 V
-> Undefined signal state	+5 V ... +13 V
-> Signal 1	+13 V ... +30 V
Max. cable length 2-core shielded and conductor cross section > 0.14 mm²	100 m

CAUTION!
Risk of overloading the analog input!
If an analog current sensor supplies a current in excess of 25 mA for more than 1 second during initialization, this input is switched off by the module (input protection).

Use only sensors with fast initialization or sensors without current peaks higher than 25 mA. If this is not possible, protect the input by connecting a 10-volt zener diode in parallel to I+ and I-.

For further information, please refer to the existing documentation System description Advant Controller 31.

Analog outputs

Data	Value
Number of channels per device	4
Connections	Connector X10 (terminals 3.5, 3.6, 7.5 and 7.6)
Reference potential	AGND2 (terminals 3.5, 3.6, 7.5 and 7.6)
Galvanic isolation	No Fig. 12

Data	Value
Max. permissible potential difference between terminal ZP (minus the supply voltage) and terminals AGND (minus the analog inputs and outputs)	± 1 V Caution: The internal reference is no longer M but ZP. Fig. 12
Indication of output signal	4 yellow LEDs to indicate the signal states of the analog outputs (2 LEDs each at DA501 and DA502)
Output signal ranges (configurable)	-10 V ... 0 V, 0 V ... +10 V 0 mA ... 20 mA 4 mA ... 20 mA
Output load capability of voltage output	max. ± 10 mA
Resolution	12 bit (+ sign)
Resolution (1 LSB), range 10 V ... 0, 0 ... +10 V	approx. 5 mV
Relationship between output signal and hex code	-100 % ... 0 ... +100 % = 9400H ... 0000H ... 6C00H (-27648 ... 0 ... 27648 decimal)
Conversion cycle	1 ms (for 4 inputs + 2 outputs) 1 s when measuring with resistance thermometer Pt/Ni
Conversion error of the analog values due to non-linearity Adjustment error on delivery and resolution in the nominal range	Typ. 0.5 %, max. 1 %
Max. cable length, 2-core shielded and conductor cross section > 0.14 mm²	100 m

For further information, please refer to the existing documentation System description Advant Controller 31.

Connection of the serial interfaces COM2

The COM1 interface is no longer available. The assignment of the COM2 interface remains the same as in the existing device. Programming in Automation Builder can be performed via the COM2 interface.

Data	Value
Interface standard	EIA RS-232
Programming	07KT94-ARC-AD: 907 PC 331 07KT98-ARC-AD: Automation Builder
Program change	07KT94-ARC-AD: 907 PC 331 07KT98-ARC-AD: Automation Builder
Man-Machine Communication	Yes, e.g. via Automation Builder

Data	Value
Galvanic isolation	Fig. 12
Potential differences	In order to avoid potential differences between the replacement device 07KT98-AD and the peripheral devices connected to COM2, these devices are supplied by the socket in the con-trol cabinet.
Terminal assignment and description of the COM2 interface	*Chapter 1.3.3.4.1.3.1.11 “Serial interface COM2” on page 92*

For further information, please refer to the existing documentation System description Advant Controller 31.

Serial interface DIAG

Data	Value
Programming	07KT94-ARC-AD: 907 PC 331 07KT98x-AD: Automation Builder
Program change	07KT94-ARC-AD: 907 PC 331 07KT98x-AD: Automation Builder
Galvanic isolation	No Fig. 12

Connection to the CS31 bus

When configuring the CS31 bus interface (connector X5), select the COM1 interface of CPU PM590 in Automation Builder.

The shield connection must be internally connected to FE.

Data	Value
Interface standard	EIA RS-485
Connection:	
-> as master PLC	Yes
-> as slave PLC	No
Setting of the CS31 bus module address	No, the master has no module address
Galvanic isolation	Yes Fig. 12
Terminal assignment and description of the CS31 bus interface	*Chapter 1.3.3.4.1.3.1.3 “Connection for CS31 bus” on page 75* Note that the shield connection is internally connected to FE.

LED display

Data	Value
LEDs for signaling:	
-> State of digital inputs	1 yellow LED per channel
-> State of digital outputs	1 yellow LED per channel
-> State of digital inputs/outputs	1 yellow LED per channel
-> Supply voltage available (Supply)	1 green LED
-> Battery	1 red LED (name: ERR) at the CPU
-> Program is running (RUN)	1 green LED
-> Controller-specific errors	1 red LED (name: ERR) at the CPU
-> CS31 bus	Indication on CPU display under COM1 (CS31 bus is assigned to COM1 within the CPU)
-> Overload / short circuit of digital outputs	Red LEDs on modules DA501/ DA502 and at the CPU via ERR-LED. An indication on the display is possible.

High-speed hardware counter

At the counting input, an external resistor of 470 Ω / 1 W must always be connected upstream. For further information on high-speed counters, please refer to the AC500 documentation.

Table 35: Data of the high-speed hardware counter installed (DA502)

Data	Value
Number of operating modes	10
Counting range	0 ... 4,294,967,295 (double word format, 32 bit)
Counting frequency	Depending on operating mode
Used inputs	Connector X1, terminals 4.0 and 4.1
Used outputs	Connector X1, terminal 4.2

Table 36: Data of the high-speed hardware counter installed (DA501)

Data	Value
Number of operating modes	10
Counting range	0 ... 4,294,967,295 (double word format, 32 bit)
Counting frequency	Depending on operating mode
Used inputs	Connector X9, terminals 8.0 and 8.1
Used outputs	Connector X9, terminal 8.2

Mechanical data

Data	Value
Width x height x depth	Replacement device: 239.5 x 138 x approx. 80.9 mm Existing device: 240 x 140 x 85 mm
Weight	Replacement device 07KT94-ARCNET: 910 g Replacement device 07KT98-ARCNET: 945 g Existing device: 1.6 kg
Dimensions for mounting	See operating and assembly instructions of the replacement device (3ADR020082M0401)

Ordering data

Order No.	Scope of delivery
1SAP 801 000 R0061	CPU: 07KT94-ARC-AD
1SAP 801 400 R0060	CPU: 07KT98-ARC-AD
1SAP 801 100 R0062	CPU: 07KT98-ARC-DP-AD
1SAP 801 200 R0067	CPU: 07KT98-ARC-ETH-AD
1SAP 801 300 R0072	CPU: 07KT98-ETH-DP-AD
1SAP 801 500 R0062	CPU: 07KT98-ARC-ETH-DP-AD

ARCNET communication module

Central units with integrated ARCNET communication module (Attached Resource Computer Network):

- 07KT94-ARC-AD
- 07KT98-ARC-AD
- 07KT98-ARC-DP-AD
- 07KT98-ARC-ETH-AD
- 07KT98-ARC-ETH-DP-AD

Technical data

In the replacement device, addresses cannot be set via DIP switch. Instead, the ARCNET interface is configured in the Automation Builder. The ARCNET address can also optionally be set via the display.

Data	Value
Connector	ARC (BNC connector)
ARCNET interface	For coaxial cable connection

Data	Value
Recommended system cable	Cable RG 62 A/U (characteristic impedance 93 Ω) Cable length 300 m in case of ARCNET bus with 8 stations. For further information, please refer to the AC500 documentation (chapter ARCNET).
Signaling	Indication on CPU display
Galvanic isolation	Yes Fig. 12

ARCNET short description

The ARCNET interface is configured in the Automation Builder. For further information on the ARCNET interface for the respective CPU, please refer to the AC500 documentation.

ARCNET system

The general information about the ARCNET system is still valid. For further information on ARCNET, please refer to the AC500 documentation.

PROFIBUS DP communication module

Central units with an integrated PROFIBUS communication module:

- 07KT98-ARC-DP-AD
- 07KT98-ETH-DP-AD
- 07KT98-ARC-ETH-DP-AD

Technical data

Data	Value
Connector	9 pin D-sub socket
PROFIBUS interface	EIA RS-485 according to EN 50170
Recommended system cable	Dual twisted, shielded pair cable (characteristic impedance 135 Ω ... 165 Ω) Max. line length 1000 m with a transmission rate of 187.5 Kbps For further information, please refer to the AC500 documentation (chapter PROFIBUS).
Signaling	With 5 LEDs
Galvanic isolation	Yes Fig. 12

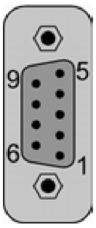
PROFIBUS short description

The PROFIBUS interface is configured in the Automation Builder. For further information on the PROFIBUS interface for the respective CPU used, please refer to theAC500 documentation.

The PROFIBUS system

The general information about the PROFIBUS system is still valid. For further information on PROFIBUS, please refer to the AC500 documentation.

Pin Assignment

	Pin	Signal	Description
	1	NC	Not connected
	2	NC	Not connected
	3	RxD/TxD-P	Receive/Transmit positive
	4	CNTR-P	Control signal for repeater, positive
	5	DGND	Reference potential for data exchange and +5 V
	6	VP	+5 V (power supply for the bus terminating resistors)
	7	NC	Not connected
	8	RxD/TxD-N	Receive/Transmit negative
	9	NC	Not connected

In corrosive environment, please protect unused connectors using the TA535 accessory.

Not supplied with this device.

Ethernet communication module

Central units with an integrated Ethernet communication module:

- 07KT98-ARC-ETH-AD
- 07KT98-ETH-DP-AD
- 07KT98-ARC-ETH-DP-AD

Technical data

Data	Value
Connector	RJ45 socket
Ethernet interface	10/100 Base-TX
Recommended system cable	For detailed information, please refer to the AC500 documentation (Ethernet chapter).
Signaling	Indication on the CPU display
Galvanic isolation	Yes Fig. 12

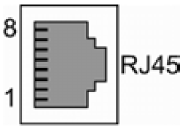
Ethernet short description

The Ethernet interface is configured in the Automation Builder. For further information on the Ethernet interface for the respective CPU used, please refer to the AC500 documentation.

Ethernet system

The general information about the Ethernet system is still valid. For further information on Ethernet, please refer to the AC500 documentation.

Pin assignment

	PIN	Signal	Description
	1	TxD+	Transmit data +
	2	TxD-	Transmit data -
	3	RxD+	Receive data +
	4	NU	Not used
	5	NU	Not used
	6	RxD-	Receive data -
	7	NU	Not used
	8	NU	Not used
	Shield	Cable shield	Functional earth

> **NOTICE!**
> **Risk of corrosion!**
> Unused connectors and slots may corrode if XC devices are used in salt-mist environments.
>
> Protect unused connectors and slots with TA535 protective caps for XC devices *Chapter 1.9.3.6 “TA535 - Protective caps for XC devices” on page 1362*.

1.3.3.5 Replacement devices: I/O modules

For AC31 devices of the 90 series, AC31 adapters (replacement devices) are available for the exchange of individual I/O modules.

1.3.3.5.1 Replacement device 07AC91-AD

Introduction

Fig. 29: 3ADR331193S0015_07AC91-AD

The replacement device 07AC91-AD of the AC31 adapter series replaces the existing device 07AC91 of the AC31/90 series in operating mode **8 bit** and only for the use of **16 outputs**. The replacement device 07AC91-AD2 is available for operating mode **12 bit** with **8 outputs** and **8 inputs**.

During the development of the replacement device, care was taken to keep the device configuration identical to the configuration of the existing device. Thus, the existing documentation of device 07AC91 remains valid and serves as reference *(system description Advant Controller 31)*.

The document structure of this document is based on the document structure of the existing documentation.

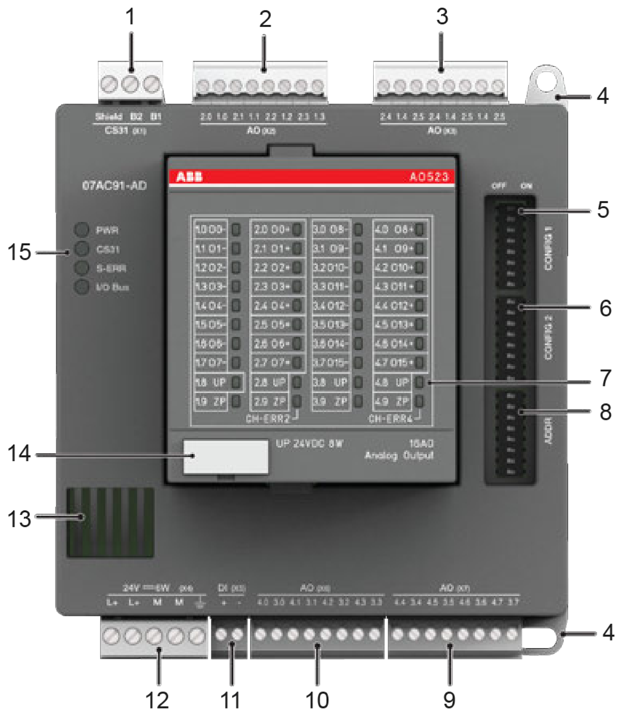
This document adds the following points to the still valid existing documentation:

- Unavoidable device deviations, e.g. due to technical limitations.
- Expansion of documentation as a result of normative requirements.
- Additional contents not described in the existing documentation.

Further information on replacement device 07DC91-AD can be found in the operating and assembly instructions of device 07DC91-AD: 3ADR020084M0401. Please note that for the existing device 07AI91 no separate operating and assembly instructions are available.

Please also observe the system data as well as the information on CS31 bus *Chapter 1.3.3.3 “System data and CS31 bus system data” on page 52*.

Device configuration



1 Connection for CS31 bus (X1)
2 Analog outputs (X2): 0 ... 10 V, 0 ... 20 mA
3 Analog outputs (X3): 0 ... 10 V
4 Hole for screw mounting (screw diameter 4 mm, extension torque 1.2 Nm)
5 DIP switch for CONFIG1
6 DIP switch for CONFIG2
7 Status LEDs for AO523
8 DIP switch for ADDR
9 Analog outputs (X7): 0 ... 10 V
10 Analog outputs (X6): 0 ... 10 V, 0 ... 20 mA
11 Enabling input for analog outputs (X5)
12 Supply 24 V DC (incl. AO523)
13 Ventilation
14 TA525: Label
15 4 Status LEDs

LED display

The LED display on the replacement device is changed:

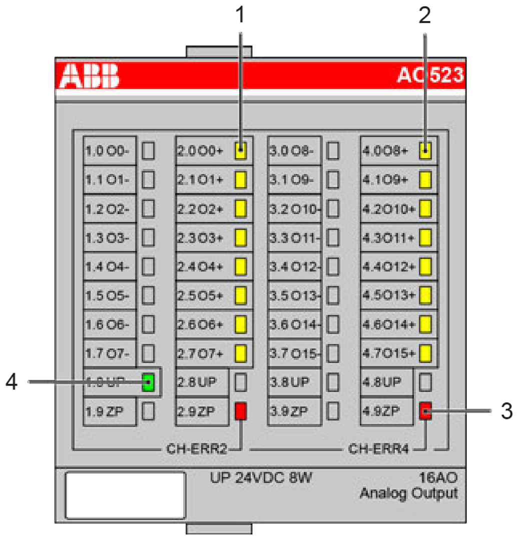


Fig. 30: AO523

No.	Display of module
1	8 yellow LEDs to indicate the signal state of the analog inputs (X2 and X3)
2	8 yellow LEDs to indicate the signal state of the analog inputs (X6 and X7)
3	2 red LEDs to indicate errors (of AO523 module)
4	1 green LED to indicate the status of the supply voltage of the AO523 module (is supplied via X4)

The replacement device does not provide a test button to measure functionality.

Connections

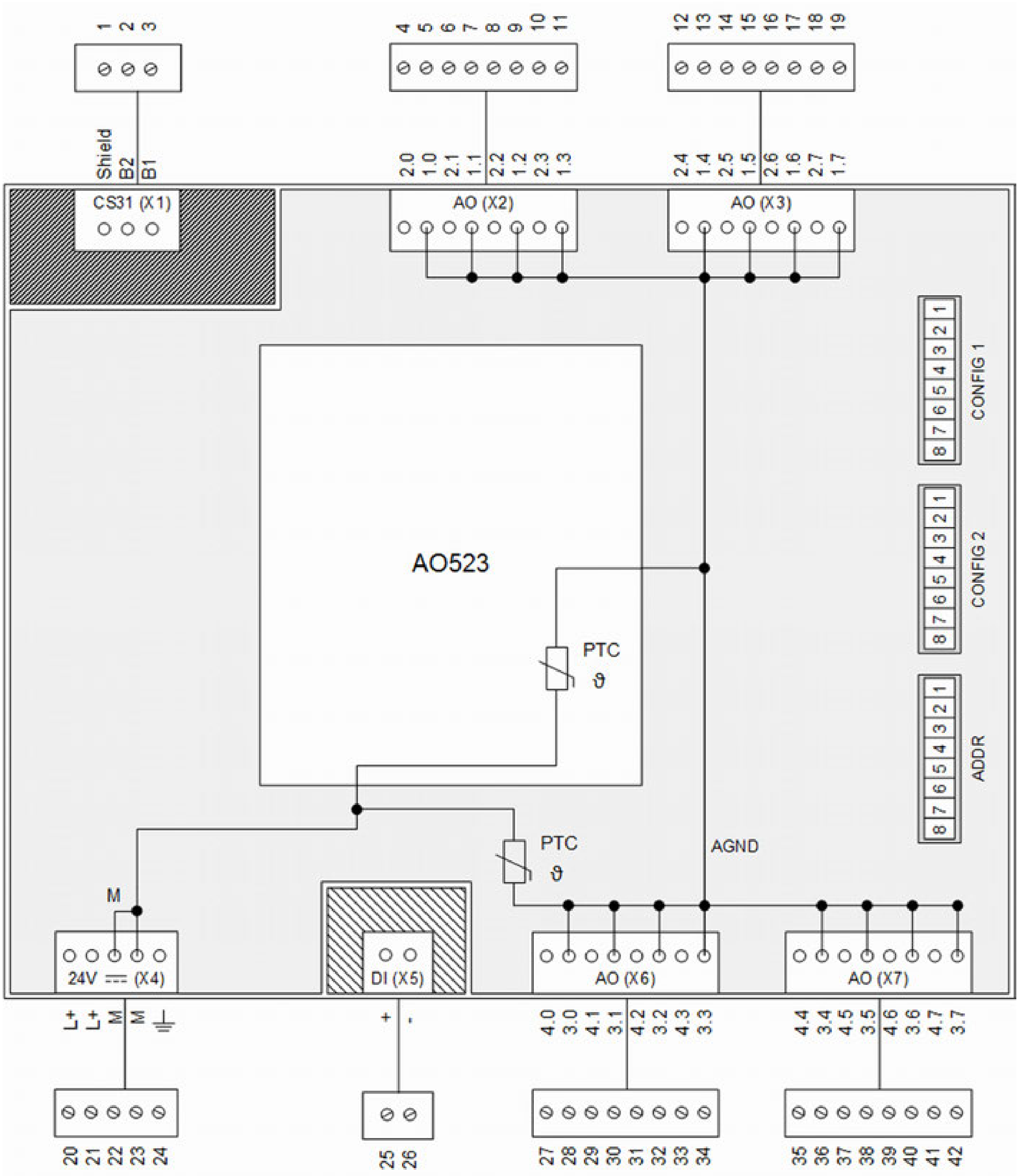


Fig. 31: Connection

> *Please observe the information contained in the existing documentation. In section "Fig. 5.4-2: Connection of the analog input/output module 07AC91", only the information concerning operating mode 8 bit is relevant for the replacement device 07AC91-AD.*

Table 37: Pin assignment CS31 bus (X1)

Connector / Terminal	Pin	Assignment / Signal
X1 / Shield	1	No internal connection
X1 / B2	2	BUS 2
X1 / B1	3	BUS 1

Table 38: Pin assignment AO (X2)

Connector / Terminal	Pin	Assignment / Signal
X2 / 2.0	4	AO523 / O0+
X2 / 1.0	5	AO523 / O0- (AGND)
X2 / 2.1	6	AO523 / O1+
X2 / 1.1	7	AO523 / O1- (AGND)
X2 / 2.2	8	AO523 / O2+
X2 / 1.2	9	AO523 / O2- (AGND)
X2 / 2.3	10	AO523 / O3+
X2 / 1.3	11	AO523 / O3- (AGND)

Table 39: Pin assignment AO (X3)

Connector / Terminal	Pin	Assignment / Signal
X3 / 2.4	12	AO523 / -
X3 / 1.4	13	AO523 / O4- (AGND)
X3 / 2.5	14	AO523 / -
X3 / 1.5	15	AO523 / O5- (AGND)
X3 / 2.6	16	AO523 / -
X3 / 1.6	17	AO523 / O6- (AGND)
X3 / 2.7	18	AO523 / -
X3 / 1.7	19	AO523 / O7- (AGND)

Table 40: Pin assignment 24 V DC 9W (X4)

Connector / Terminal	Pin	Assignment / Signal
X4 / L+	20	L+
X4 / L+	21	L+
X4 / M	22	M
X4 / M	23	M
X4 / FE	24	FE

Table 41: Pin assignment DI (X5)

Connector / Terminal	Pin	Assignment / Signal
X5 / +	25	IN+
X5 / -	26	IN- (galvanic isolated ground)

Table 42: Pin assignment AO (X6)

Connector / Terminal	Pin	Assignment / Signal
X6 / 4.0	27	AO523 / O8+
X6 / 3.0	28	AO523 / O8- (AGND)
X6 / 4.1	29	AO523 / O9+
X6 / 3.1	30	AO523 / O9- (AGND)
X6 / 4.2	31	AO523 / O10+
X6 / 3.2	32	AO523 / O10- (AGND)
X6 / 4.3	33	AO523 / O11+
X6 / 3.3	34	AO523 / O11- (AGND)

Table 43: Pin assignment AO (X7)

Connector / Terminal	Pin	Assignment / Signal
X7 / 4.4	35	AO523 / O12+
X7 / 3.4	36	AO523 / O12- (AGND)
X7 / 4.5	37	AO523 / O13+
X7 / 3.5	38	AO523 / O13- (AGND)
X7 / 4.6	39	AO523 / O14+
X7 / 3.6	40	AO523 / O14- (AGND)
X7 / 4.7	41	AO523 / O15+
X7 / 3.7	42	AO523 / O15- (AGND)

The signals Ox- are internally linked to an AGND area. The potential AGND is connected to the potential M via PTC resistors. Potential difference AGND to M ±1 V (max.).

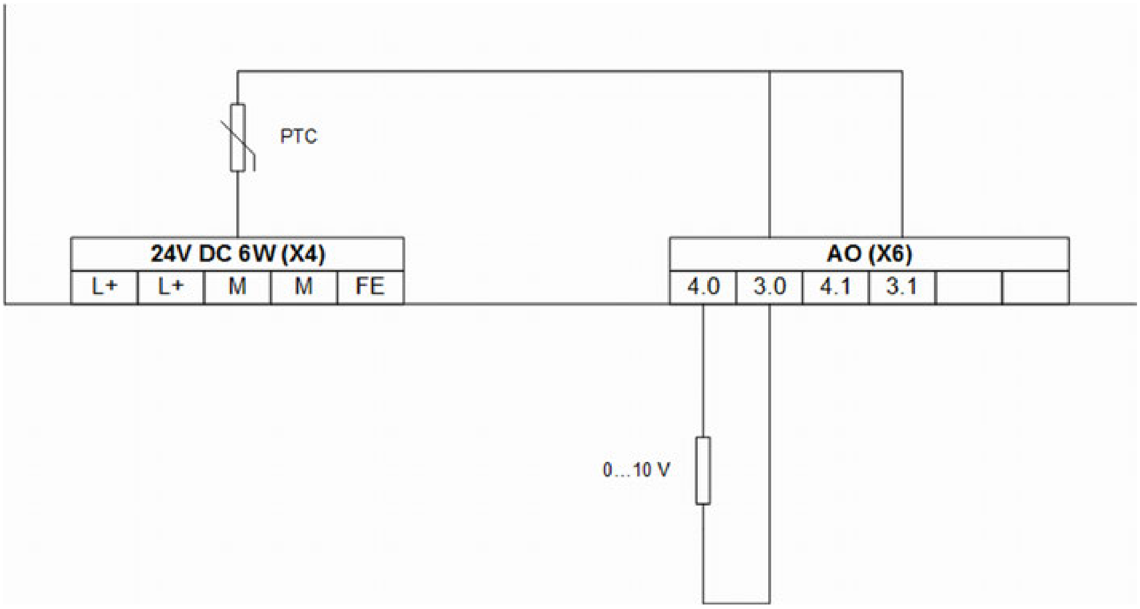


Fig. 32: Voltage output

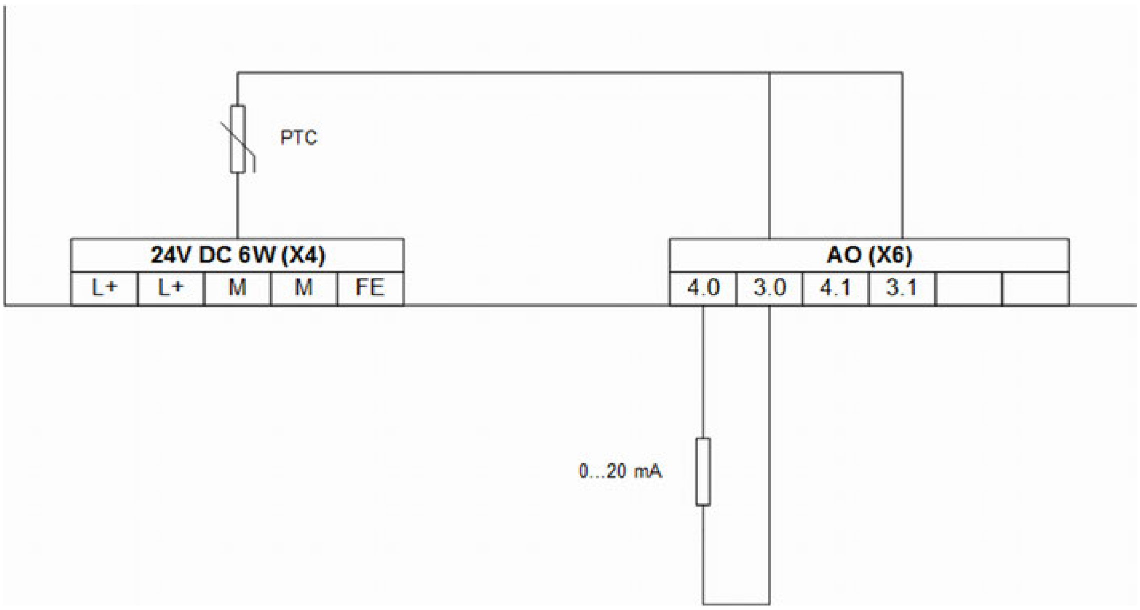


Fig. 33: Current output

> *Analog signal lines must be routed in shielded cables. The shield must be grounded on both sides and should be grounded to replacement device and signal source / signal sink as close as possible.*

Configuration

The existing device had a DIP switch on the upper printed circuit board. Since the replacement device is not equipped with an upper printed circuit board, the white DIP switch is arranged on the lower printed circuit board instead.

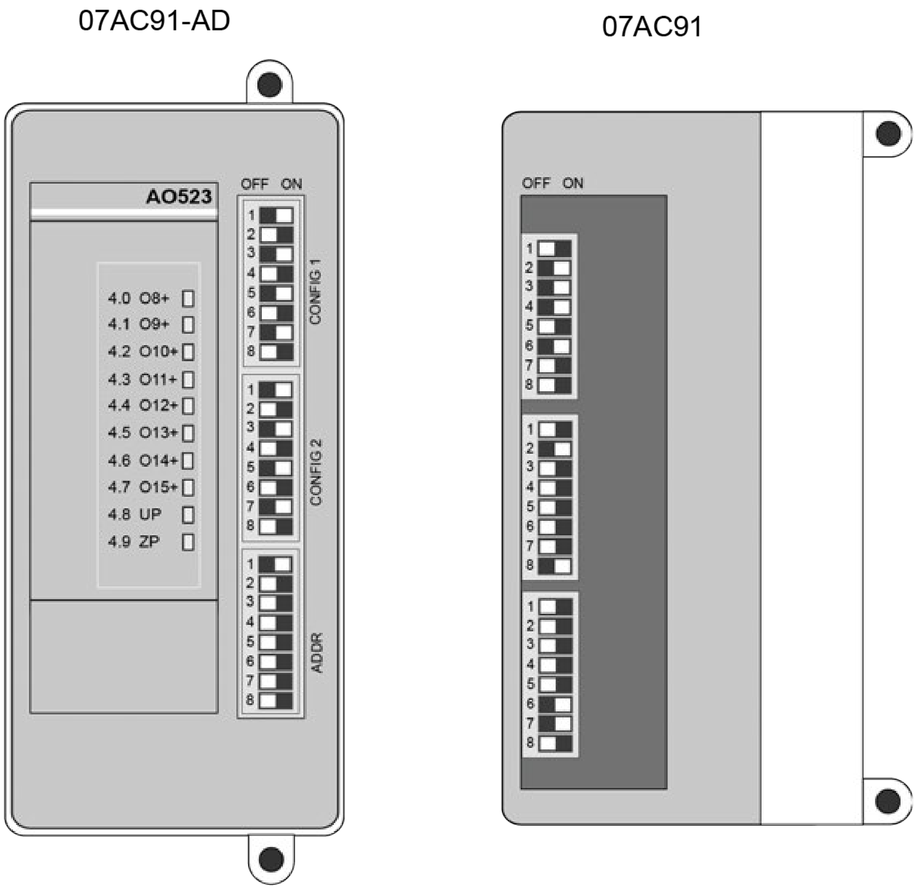


Table 44: Example configuration for 07AC91-AD:

Config 1	All output channels on voltage.
Config 2	All output channels on voltage.
ADDR	8-bit mode, without range monitoring, CS31 address 0 and channel number ≤ 7.

Configuration areas with (white) DIP switches

Please observe the following:

- All channels must be configured as outputs.
- The position of the DIP switches are read by the device only once after the supply voltage has been connected.

Config 1	The DIP switches for the channels 1, 3, 5 and 7 must be set to ON (configu-ration as outputs). **A configuration as inputs is not permitted.**
	The DIP switches for the channels 2 and 4 can be set as desired. The outputs 0..3 may be set to OFF (voltage) or ON (current).
	The DIP switches for channels 6 and 8 must be set to OFF. The outputs 4..7 must be set to OFF (voltage). **The setting to ON (current) is not permitted.**
Config 2	The DIP switches for the channels 1, 3, 5 and 7 must be set to ON (configu-ration as outputs). **A configuration as inputs is not permitted.**
	The DIP switch position for the channels 2 and 4 can be set as desired. The outputs 8..11 may be set to OFF (voltage) or ON (current).
	The DIP switches for the channels 6 and 8 must be set to OFF. The outputs 12..15 must be set to OFF (voltage). **The setting to ON (current) is not permitted.**
ADDR	The DIP switch for channel 1 must be set to ON (8-bit mode).
	The DIP switch for channel 2 can be set as desired (no functionality).
	The DIP switch for channel 3 can be set as desired for range monitoring.
	The DIP switches for the channels 4-7 can be set as desired for the CS31 address.
	The DIP switch for channel 8 must be set to OFF for CS31 channels ≤ 7. **Channels > 7 are not supported. The outputs on connector X3 and X7 cannot be configured as current outputs.**

For further information, please refer to the existing documentation System description Advant Controller 31.

Measuring ranges of the analog channels

For the replacement device 07AC91-AD, only the operating mode "8 bit" is relevant.

The outputs of the S500 module AO523 have a 12 bit resolution. The values that are to be transmitted via the CS31 bus and output by the replacement device have only a 8 bit resolution. For this reason, the overall resolution achieved is only 8 bits.

Addressing

The function of the address DIP switch 8 (channel No. ≤ 7 or channel No. > 7) is no longer supported.

In the following, the information in the "Type" column refers to the data type designation of the Automation Builder (see AC31 system data *Chapter 1.3.3.3 “System data and CS31 bus system data” on page 52*). The information in the "Type" column must be interpreted from the viewpoint of the CS31 bus master. The information in brackets must be interpreted from the viewpoint of the replacement device (CS31 bus slave).

Table 45: CS31 bus

Type	Byte	Position in WORD	Connector / Terminal
WORD output (received) 0	1	High	X2 / 2.1
	2	Low	X2 / 2.0
WORD output (received) 1	3	High	X2 / 2.3
	4	Low	X2 / 2.2
WORD output (received) 2	5	High	X3 / 2.5
	6	Low	X3 / 2.4
WORD output (received) 3	7	High	X3 / 2.7
	8	Low	X3 / 2.6
WORD output (received) 4	9	High	X6 / 4.1
	10	Low	X6 / 4.0
WORD output (received) 5	11	High	X6 / 4.3
	12	Low	X6 / 4.2
WORD output (received) 6	13	High	X7 / 4.5
	14	Low	X7 / 4.4
WORD output (received) 7	15	High	X7 / 4.7
	16	Low	X7 / 4.6

Behavior during normal operation

Interpretation of the LEDs:

- The device initializes automatically after the supply voltage is switched on. During this time, the S-ERR LED flashes.
- The PWR LED lights up as soon as the internal supply voltage of the device is present.
- After successful initialization of the I/O bus communication to the S500 module, the I/O bus LED lights up.
- After successful initialization of the CS31 bus communication, the CS31 bus LED lights up. The S-ERR LED goes out.
- During operation, the yellow LEDs indicate the signal states of the channels.

The RAM is checked during the initialization of the device. In addition, the firmware in the flash memory is checked by means of a checksum during initialization. When the control system (PLC/central unit) is stopped during normal operation, the outputs of the device are switched off. The outputs are also switched off in case of a malfunction of the CS31 bus.

Diagnosis and display

LEDs are used for diagnosis and display purposes. In addition, some diagnosis information can be transmitted via the CS31 bus.

The replacement device does not provide a test button to measure functionality.

Table 46: Diagnosis information of the CS31 bus

Channel	Error code (CODESYS)	Error code (CS31 bus)	Description
Device error:			
0	43	1	Internal error

The error codes that are transferred by the replacement device via the CS31 bus bus are newly displayed in CODESYS. Each error code of the CS31 bus (table column 3) produces the error code in CODESYS (table column 2). As a result, it is possible to operate the replacement device with a new control system (PLC/control unit), e.g. 07KT98-ARC-AD, as well as with an old control system (PLC/central unit), e.g. 07KT98.

Table 47: Device LEDs

LED	Status	Color	LED off	LED on	LED flashes
PWR	Voltage supply	Green	No internal supply voltage	Internal supply voltage	-
CS31 bus	CS31 bus communication	Green	No CS31 bus communication	CS31 bus bus communication	Only diagnosis, no data transfer. Transmission is disturbed.
S-ERR	Error	Red	No error	Static error (must be confirmed by the control system)	No CS31 bus connection or activity
I/O bus	I/O bus communication	Green	No I/O bus communication	I/O bus communication	Error I/O bus communication

The S-ERR LED remains on even if the error no longer occurs. The error must be confirmed by the control system (PLC/central unit), e.g. by means of a function block *Chapter 1.3.3.3 “System data and CS31 bus system data” on page 52*.

Special cases with rapidly flashing LEDs (approx. 5 Hz):

- All 4 LEDs flash rapidly: An incorrect S500 module is connected to the device. The device fails to initialize.
- The LEDs of the CS31 bus, S-ERR bus and I/O bus flash rapidly: Invalid position of DIP switches. The device fails to initialize.
- The LEDs of the S-ERR bus and I/O bus flash rapidly: A checksum error occurred in an internal flash memory.
- The LED of the I/O bus flashes rapidly: An error occurred in an internal RAM.

Table 48: S500 module AO523 LEDs

LED	Status	Color	LED off	LED on	LED flashes
O0+…O7+ O8+…O15+ (see No. 1 + 2 in the following figure)	Analog outputs	Yellow	Output is not activated	Output is activated (brightness depends on value of analog signal).	-
Error indication left (see No. 3 in the following figure)	Error indication	Red	No error	Internal error	-

LED	Status	Color	LED off	LED on	LED flashes
Error indication right (see No. 3 in the following figure)	Error indication	Red	No error	Internal error	-
Indication supply voltage (see No. 4 in the following figure)	Process voltage	Green	Process voltage not available	Process voltage OK	-

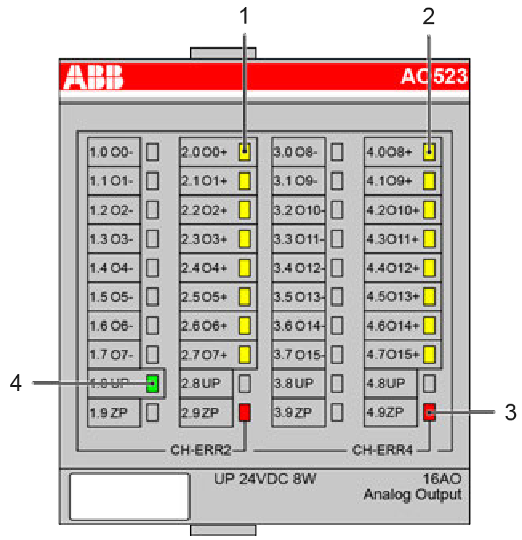


Fig. 34: AO523

Technical data

This section provides additional information on section ✎ *Chapter 1.3.3.3 “System data and CS31 bus system data” on page 52*. In case of doubt, the following information applies.

For the device 07AC91-AD, only the operating mode "8 bit" is relevant.

Technical data of the complete device

Data	Value
Process voltage:	
-> Connections	X4/L+ (pin 20), X4/L+ (pin 21), X4/M (pin 22), X4/M (pin 23)
-> Fuse for L+	10 A, fast acting
- Galvanic isolation	No
Current consumption:	
-> via L+	0.19 A + output load

Data	Value
- Inrush current via L+ (when voltage is switched on)	0.18 A²s
Power consumption	Replacement device: 9 W Existing device: 5 W

For further information, please refer to the existing documentation System description Advant Controller 31.

CAUTION!
System damage caused by voltage!
Exceeding the maximum supply or process voltage (>30 V DC) results in permanent system damage (destruction).

Technical data of the binary input

Data	Value
Input current at input voltage +24 V	Typ. 6 mA
Protection against reversed voltage	Yes
Overvoltage protection	No

The enabling input is a proprietary input.

For further information, please refer to the existing documentation System description Advant Controller 31.

Technical data of the analog outputs

Data	Value
Connections	X2 / 2.0, X2 / 2.1, X2 / 2.2, X2 / 2.3, X3 / 2.4, X3 / 2.5, X3 / 2.6, X3 / 2.7, X6 / 4.0, X6 / 4.1, X6 / 4.2, X6 / 4.3, X7 / 4.4, X7 / 4.5, X7 / 4.6, X7 / 4.7
Reference connections (AGND)	X2 / 1.0, X2 / 1.1, X2 / 1.2, X2 / 1.3, X3 / 1.4, X3 / 1.5, X3 / 1.6, X3 / 1.7, X6 / 3.0, X6 / 3.1, X6 / 3.2, X6 / 3.3, X7 / 3.4, X7 / 3.5, X7 / 3.6, X7 / 3.7
Type of outputs	Voltage unipolar, current unipolar
Configurability	No inputs are available Replacement device: 8 current outputs Existing device: 16 current outputs
Output load capability, as voltage output	Replacement device: ± 10 mA Existing device: +20 mA, -10 mA

Data	Value
Short-circuit-proof	Yes
External supply protection	Up to 30 V DC

For further information, please refer to the existing documentation System description Advant Controller 31.

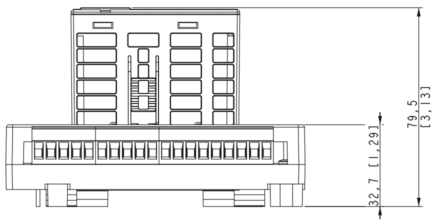
Connection to the CS31 bus

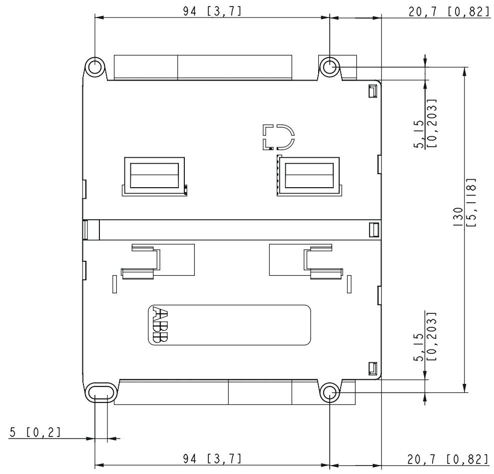
Data	Value
Connections	X1/B2, X1/B1
CS31 bus type	03 (analog output)
Terminating resistor	Not available (must be provided externally if needed)

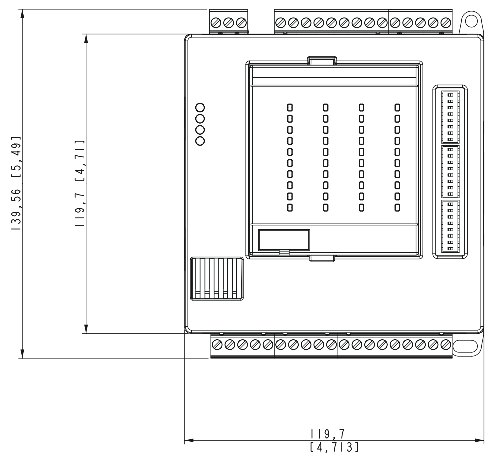
Mechanical data

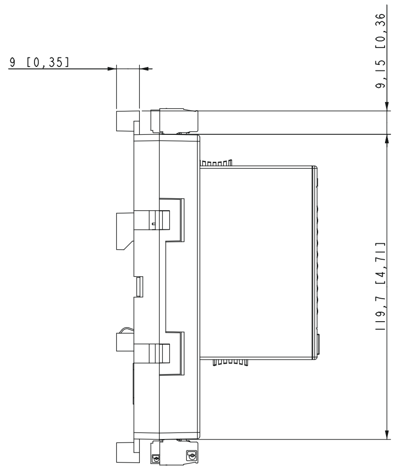
Data	Value
Width x height x depth	Replacement device: 120 x 140 x approx. 80 mm Existing device: 120 x 140 x 85 mm
Weight	Replacement device: 363 g Existing device: 450 g
Dimensions for mounting	See assembly instructions 07AC91-AD (3ADR020084M0401)

Mounting information









The dimensions are in mm and in brackets in inch.

The dimensions for the assembly holes are the same for the replacement device and the existing device.

To assemble or disassemble the replacement device, grab the device at the housing and not directly at the S500 module.

Ordering data

Order No.	Scope of delivery
1SAP 800 000 R0010	Analog output module 07AC91-AD
	1 2-pole terminal block (3.81 mm grid space)
	1 3-pole terminal block (5.08 mm grid space)
	1 5-pole terminal block (5.08 mm grid space)
	4 8-pole terminal blocks (3.81 mm grid space)

1.3.3.5.2 Replacement device 07AC91-AD2

Introduction

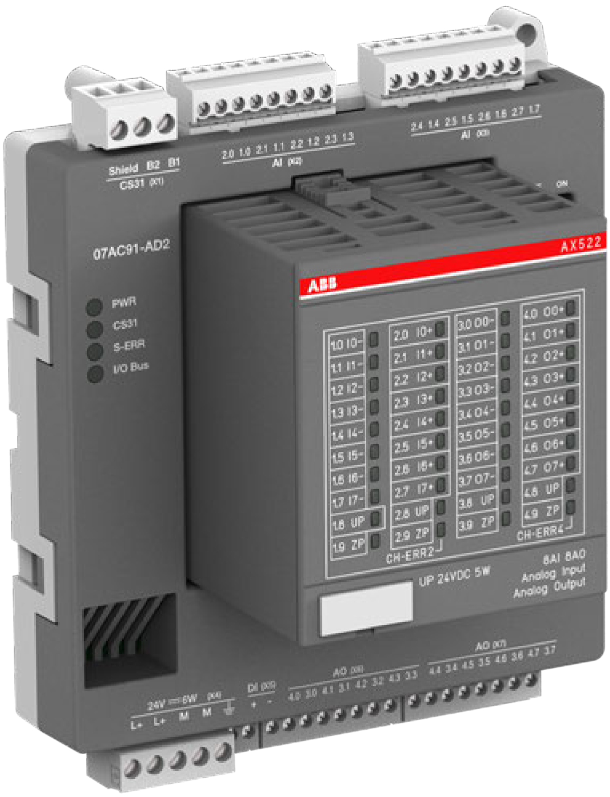


Fig. 35: 3ADR331194S0015_07AC91-AD2

The replacement device 07AC91-AD2 of the AC31 adapter series replaces the existing device 07AC91 of the AC31/90 series in operating mode **12 bit** with **8 outputs** and **8 inputs**. The replacement device 07AC91-AD is available for operating mode **8 bit** and only for the use of **16 outputs**.

During the development of the replacement device, care was taken to keep the device configuration identical to the configuration of the existing device. Thus, the existing documentation of device 07AC91 remains valid and serves as reference *(system description Advant Controller 31)*. The document structure of this document is based on the document structure of the existing documentation.

This document adds the following points to the still valid existing documentation:

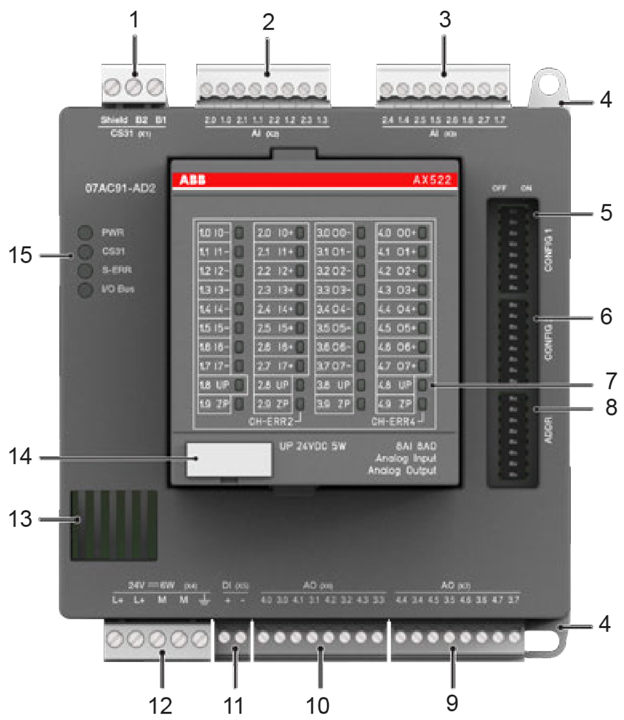
- Unavoidable device deviations, e.g. due to technical limitations.
- Expansion of documentation as a result of normative requirements.
- Additional contents not described in the existing documentation.

Further information on replacement device 07AC91-AD2 can be found in the operating and assembly instructions of device 07AC91-AD2: 3ADR020085M0401. Please note that for the existing device 07AI91 no separate operating and assembly instructions are available.

Please also observe the system data as well as the information on CS31 bus *Chapter 1.3.3.3 “System data and CS31 bus system data” on page 52*.

> *Please observe the information contained in the existing documentation. In section "Fig. 5.4-2: Connection of the analog input/output module 07AC91", only the information concerning operating mode 12 bit is relevant for the replacement device 07AC91-AD2.*

Device configuration



1 Connection for CS31 bus (X1)
2 Analog inputs (X2): -10 V…+10 V, 0…20 mA
3 Analog inputs (X3): -10 V…+10 V, 0…20 mA
4 Hole for screw mounting (screw diameter 4 mm, extension torque 1.2 Nm)
5 DIP switch for CONFIG1
6 DIP switch for CONFIG2
7 Status LEDs for AX522
8 DIP switch for ADDR
9 Analog outputs (X7): -10 V…+10 V
10 Analog outputs (X6): -10 V…+10 V, 0…20 mA
11 Enabling input for analog outputs (X5)
12 Supply 24 V DC (incl. AX522)
13 Ventilation
14 TA525: Label
15 4 Status LEDs

LED display

The LED display on the replacement device is changed:

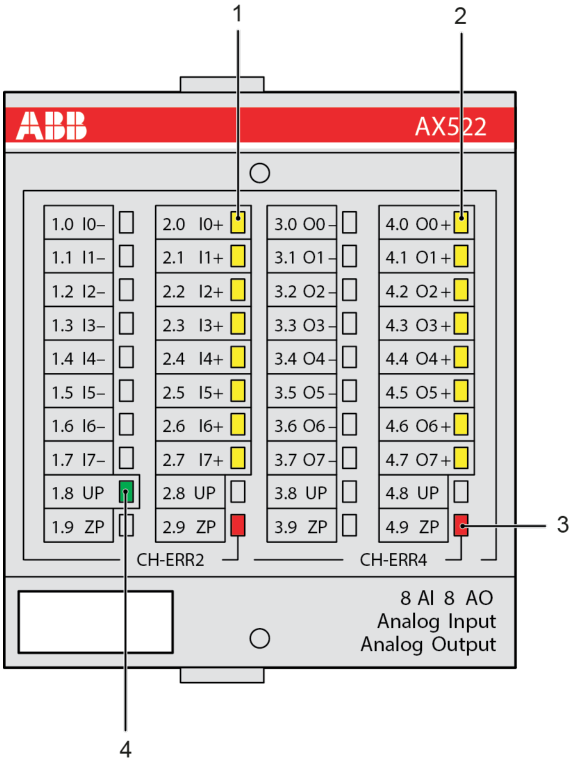


Fig. 36: AX522

No.	Display of module
1	8 yellow LEDs to indicate the signal states of the analog inputs (X2 and X3)
2	8 yellow LEDs to indicate the signal states of the analog inputs (X6 and X7)
3	2 red LEDs to indicate errors (of AX522 module)
4	1 green LED to indicate the status of the supply voltage of the AX522 module (is supplied via X4)

The replacement device does not provide a test button to measure functionality.

Connections

Please observe the information contained in the existing documentation. In section "Fig. 5.4-2: Connection of the analog input/output module 07AC91", only the information concerning operating mode 12 bit is relevant for the replacement device 07AC91-AD2.

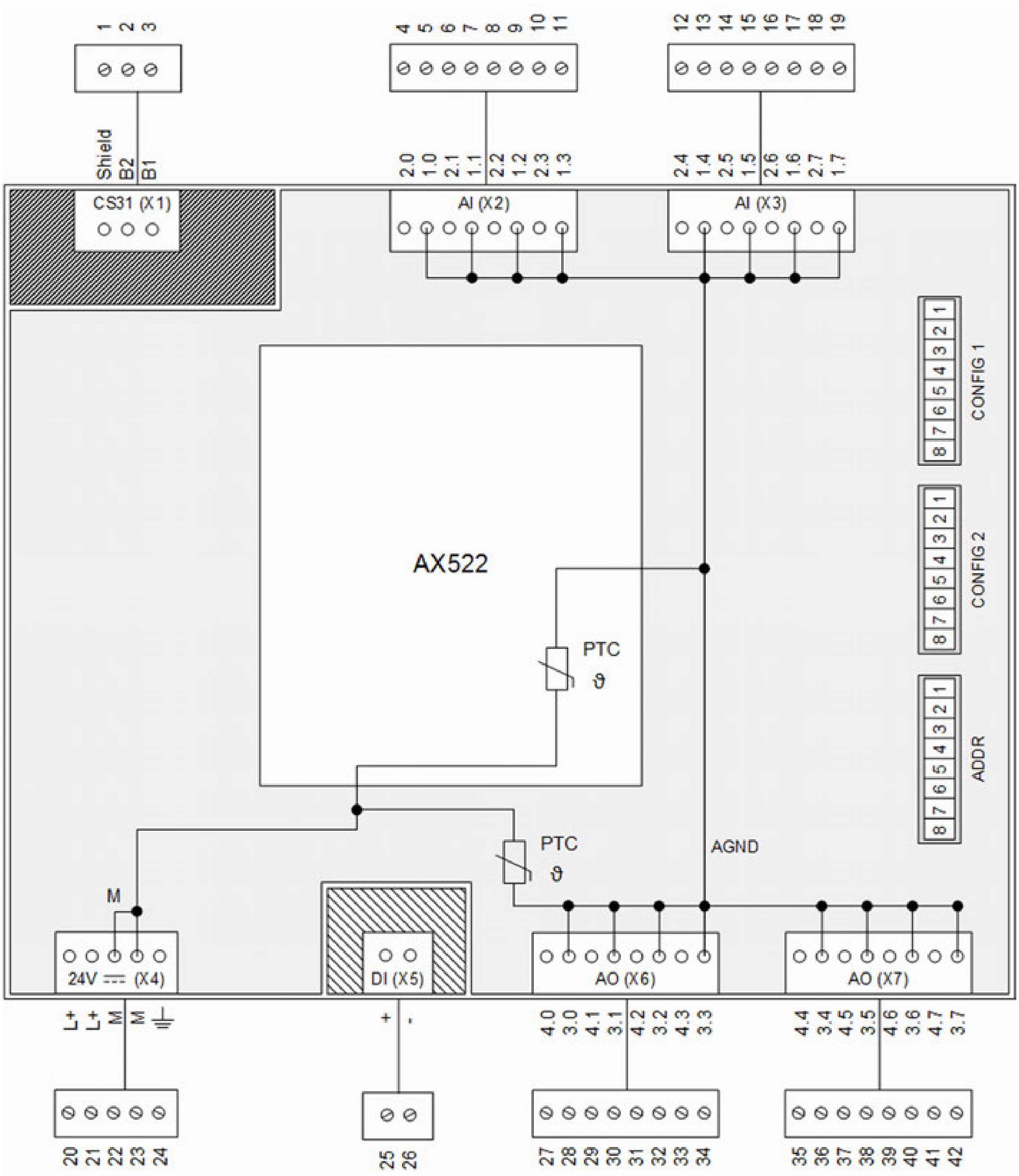


Fig. 37: Connection

Table 49: Pin assignment CS31 bus (X1)

Connector / Terminal	Pin	Assignment / Signal
X1 / Shield	1	No internal connection
X1 / B2	2	BUS 2
X1 / B1	3	BUS 1

Table 50: Pin assignment AI (X2)

Connector / Terminal	Pin	Assignment / Signal
X2 / 2.0	4	AX522 / I0+
X2 / 1.0	5	AX522 / I0- (AGND)

Connector / Terminal	Pin	Assignment / Signal
X2 / 2.1	6	AX522 / I1+
X2 / 1.1	7	AX522 / I1- (AGND)
X2 / 2.2	8	AX522 / I2+
X2 / 1.2	9	AX522 / I2- (AGND)
X2 / 2.3	10	AX522 / I3+
X2 / 1.3	11	AX522 / I3- (AGND)

Table 51: Pin assignment AI (X3)

Connector / Terminal	Pin	Assignment / Signal
X3 / 2.4	12	AX522 / I4+
X3 / 1.4	13	AX522 / I4- (AGND)
X3 / 2.5	14	AX522 / I5+
X3 / 1.5	15	AX522 / I5- (AGND)
X3 / 2.6	16	AX522 / I6+
X3 / 1.6	17	AX522 / I6- (AGND)
X3 / 2.7	18	AX522 / I7+
X3 / 1.7	19	AX522 / I7- (AGND)

Table 52: Pin assignment 24 V DC 6W (X4)

Connector / Terminal	Pin	Assignment / Signal
X4 / L+	20	L+
X4 / L+	21	L+
X4 / M	22	M
X4 / M	23	M
X4 / FE	24	FE

Table 53: Pin assignment DI (X5)

Connector / Terminal	Pin	Assignment / Signal
X5 / +	25	IN+
X5 / -	26	IN- (galvanic isolated ground)

Table 54: Pin assignment AO (X6)

Connector / Terminal	Pin	Assignment / Signal
X6 / 4.0	27	AX522 / O0+
X6 / 3.0	28	AX522 / O0- (AGND)
X6 / 4.1	29	AX522 / O1+
X6 / 3.1	30	AX522 / O1- (AGND)
X6 / 4.2	31	AX522 / O2+
X6 / 3.2	32	AX522 / O2- (AGND)
X6 / 4.3	33	AX522 / O3+
X6 / 3.3	34	AX522 / O3- (AGND)

Table 55: Pin assignment AO (X7)

Connector / Terminal	Pin	Assignment / Signal
X7 / 4.4	35	AX522 / O4+
X7 / 3.4	36	AX522 / O4- (AGND)
X7 / 4.5	37	AX522 / O5+
X7 / 3.5	38	AX522 / O5- (AGND)
X7 / 4.6	39	AX522 / O6+
X7 / 3.6	40	AX522 / O6- (AGND)
X7 / 4.7	41	AX522 / O7+
X7 / 3.7	42	AX522 / O7- (AGND)

The outputs on connector X7 cannot be configured as current outputs.

The signals Ix- and Ox- are internally linked to an AGND area. The potential AGND is connected to the potential M via PTC resistors. Potential difference AGND to M ± 1 V maximal.

To enable wire-break detection, each input is internally pulled to "plus" by means of a high-impedance resistor. As a result, the maximum voltage is read when nothing is connected. Do not replace the AX522 module while voltage is connected.

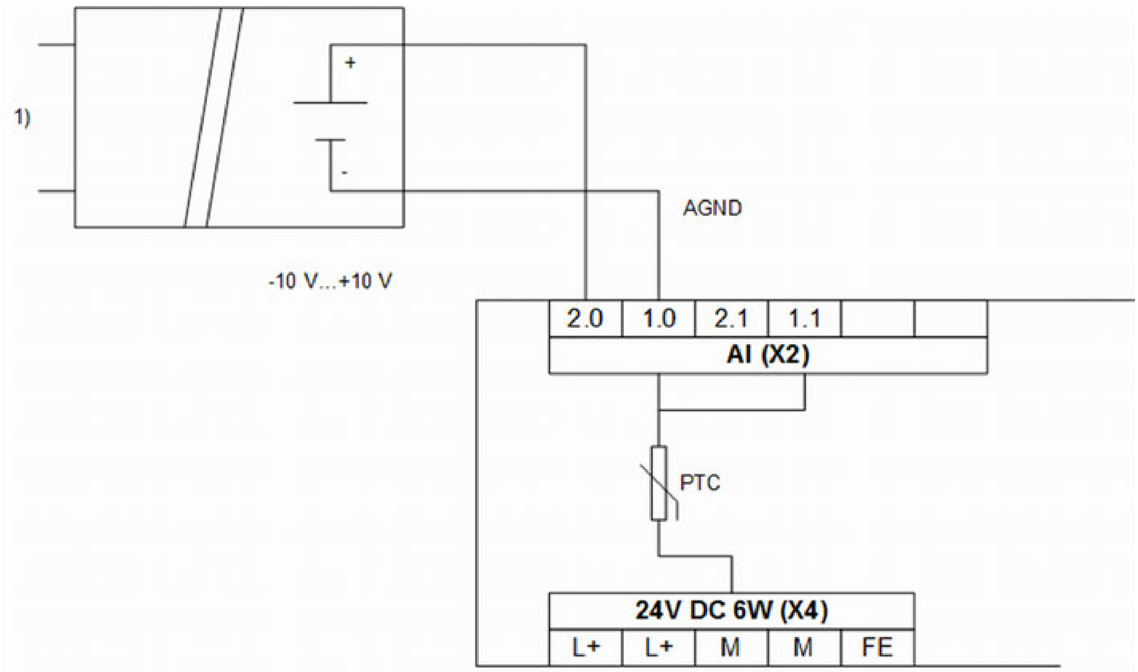


Fig. 38: Voltage input

1) Galvanically isolated power supply of analog sensor

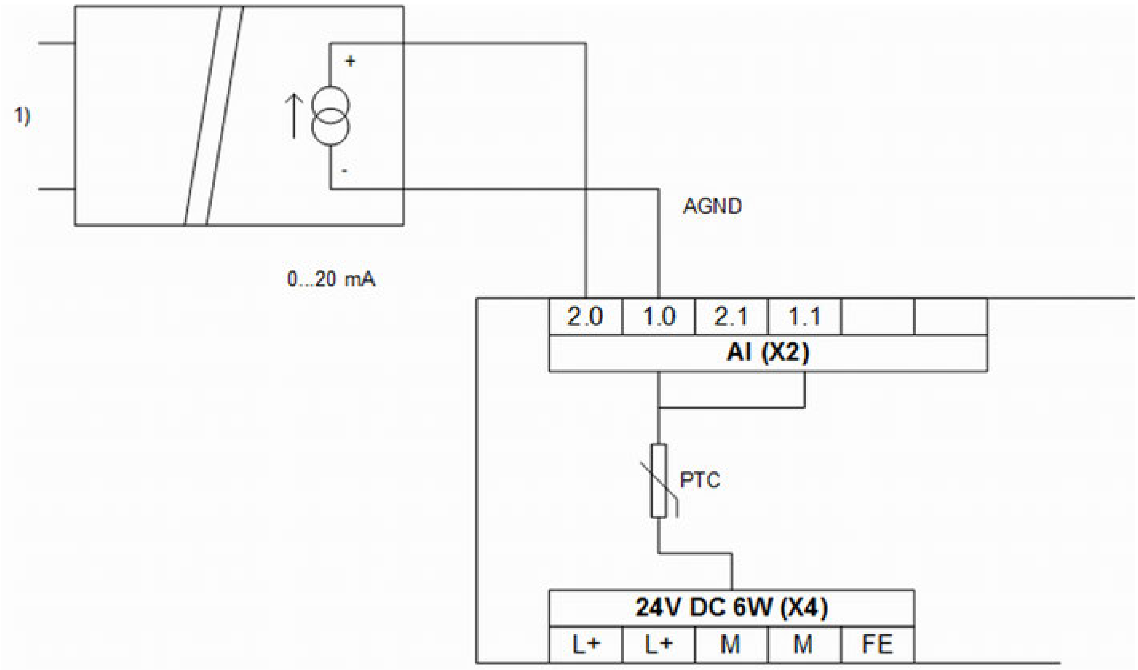


Fig. 39: Current input

1) Galvanically isolated power supply of analog sensor

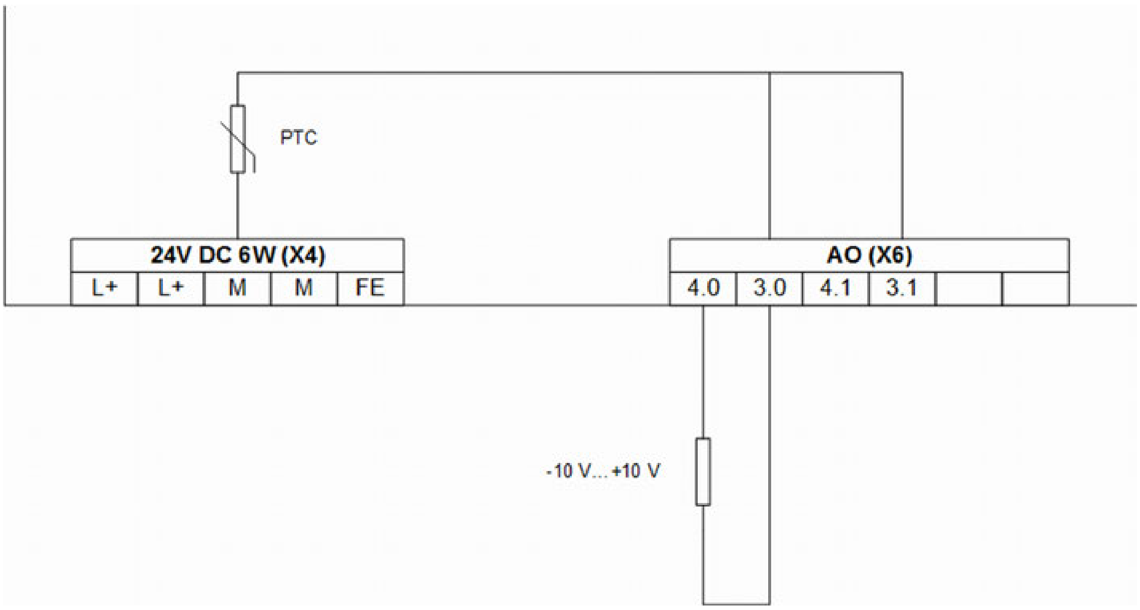


Fig. 40: Voltage output

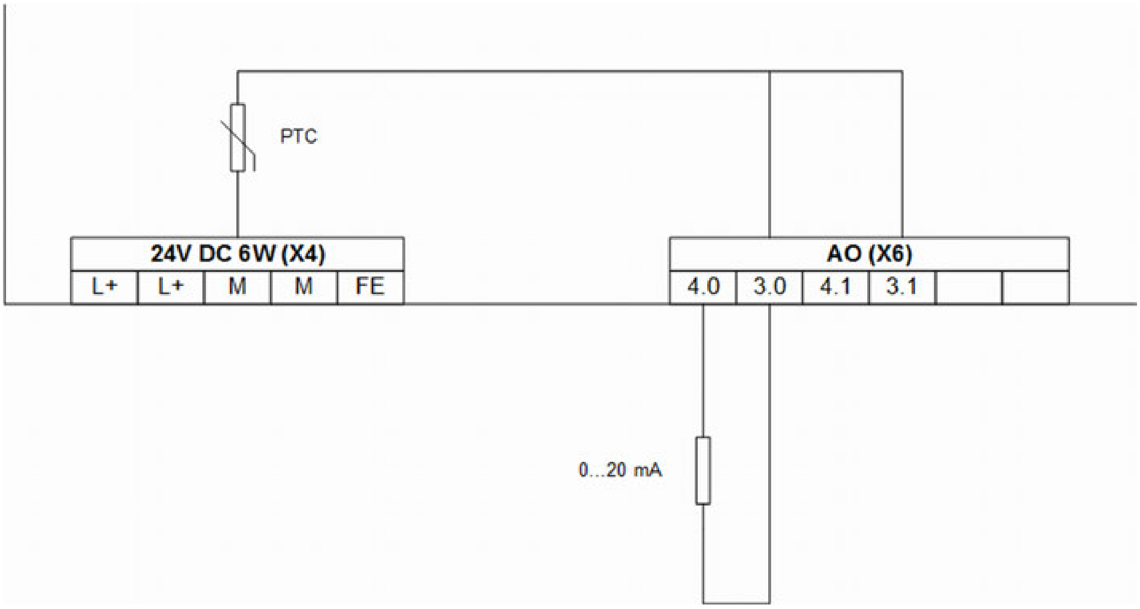


Fig. 41: Current output

Analog signal lines must be routed in shielded cables. The shield must be grounded on both sides and should be grounded to replacement device and signal source / signal sink as close as possible.

Configuration

The existing device had a DIP switch on the upper printed circuit board. Since the replacement device is not equipped with an upper printed circuit board, the white DIP switch is arranged on the lower printed circuit board instead.

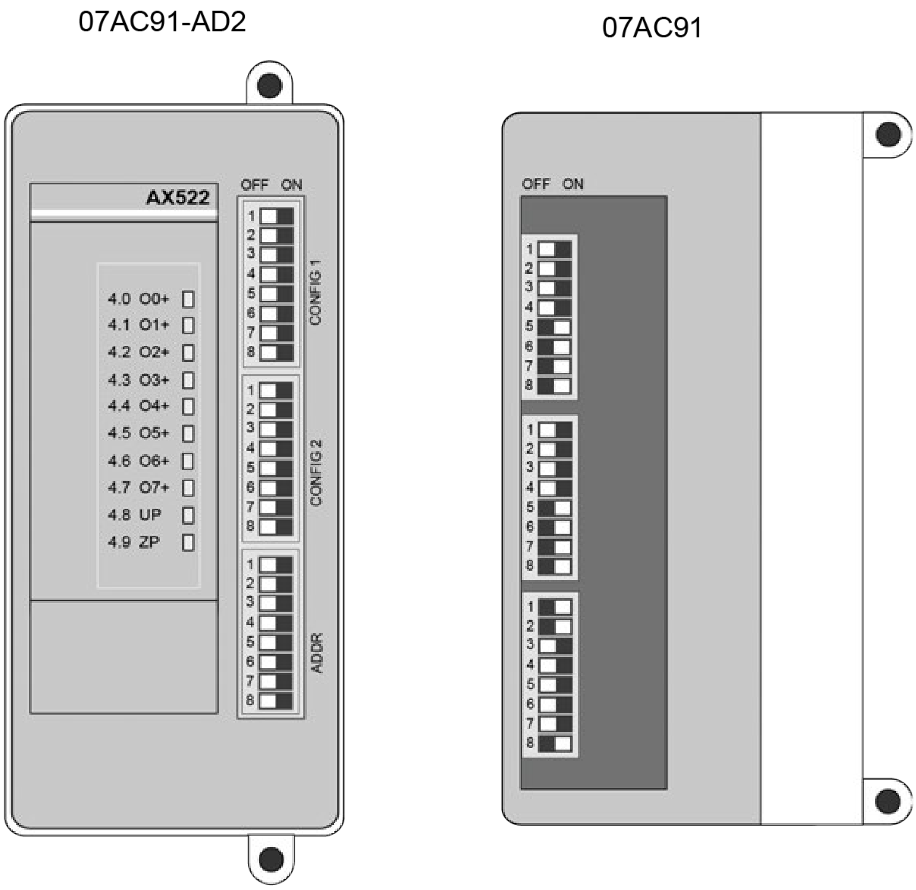


Table 56: Example configuration for 07AC91-AD2:

Config 1	All input channels set to ON (voltage).
Config 2	All output channels set to ON (voltage).
ADDR	12-bit mode, without range monitoring, CS31 address 0 and channel number ≤ 7.

Configuration areas with (white) DIP switches

Please observe the following:

- Unused voltage inputs must be configured as current inputs (due to wire-break detection AX522 S500 module).
- The DIP switches are read by the device only once after the supply voltage has been connected.

Config 1	The DIP switches for all 8 channels (inputs) may be set to ON (current) or OFF (voltage).
Config 2	The DIP switches for the channels 1-4 (outputs 0..3) may be set to ON (current) or OFF (voltage).
	The DIP switches for the channels 5-8 (outputs 4..7) must be set to OFF (voltage). **The setting ON (current) is not permitted.**
ADDR	The DIP switch for channel 1 (operating mode) **must be set to OFF (12-bit mode)**.
	The DIP switch for channel 2 can be set as desired (no functionality).
	The DIP switch for channel 3 can be set as desired for range monitoring.

	The DIP switches for the channels 4-7 can be set as desired for the CS31 address.
	The DIP switch for channel 8 must be set to OFF for CS31 channels ≤ 7. **Channels > 7 are not supported. The outputs on connector X7 cannot be configured as current outputs.**

For further information, please refer to the existing documentation System description Advant Controller 31.

Measuring ranges of the analog channels

For the replacement device 07AC91-AD2, only the operating mode "12 bit" is relevant.

Measuring range:

- Inputs: ± 10 V and 0..20 mA
- Outputs for X6 (AW1.0..AW1.3): ± 10 V and 0..20 mA
- Outputs for X7 (AW1.4..AW1.7): ± 10V

Addressing

The function of the address DIP switch 8 (channel No. ≤ 7 or channel No. > 7) is no longer supported.

In the following, the information in the "Type" column refers to the data type designation of the Automation Builder (see AC31 system data *Chapter 1.3.3.3 “System data and CS31 bus system data” on page 52*). The information in the "Type" column must be interpreted from the viewpoint of the CS31 bus master. The information in brackets must be interpreted from the viewpoint of the replacement device (CS31 bus slave).

When the measuring values are bipolar, it is advisable to use the data type "INT input/output" instead of "WORD input/output".

Table 57: CS31 bus

Type	Byte	Connector / Terminal
WORD (send) 0	1	X2 / 2.0
	2	
WORD input (send) 1	3	X2 / 2.1
	4	
WORD input (send) 2	5	X2 / 2.2
	6	
WORD input (send) 3	7	X2 / 2.3
	8	
WORD input (send) 4	9	X3 / 2.4

Type	Byte	Connector / Terminal
	10	
WORD input (send) 5	11	X3 / 2.5
	12	
WORD input (send) 6	13	X3 / 2.6
	14	
WORD input (send) 7	15	X3 / 2.7
	16	
WORD output (received) 8	17	X6 / 4.0
	18	
WORD output (received) 9	19	X6 / 4.1
	20	
WORD output (received) 10	21	X6 / 4.2
	22	
WORD output (received) 11	23	X6 / 4.3
	24	
WORD output (received) 12	25	X7 / 4.4
	26	
WORD output (received) 13	27	X7 / 4.5
	28	
WORD output (received) 14	29	X7 / 4.6
	30	
WORD output (received) 15	31	X7 / 4.7
	32	

Behavior during normal operation

Interpretation of the LEDs:

- The device initializes automatically after the supply voltage is switched on. During this time, the S-ERR LED flashes.
- The PWR LED lights up as soon as the internal supply voltage of the device is present.
- After successful initialization of the I/O bus communication to the S500 module, the I/O bus LED lights up.
- After successful initialization of the CS31 bus communication, the CS31 bus LED lights up. The S-ERR LED goes out.
- During operation, the yellow LEDs indicate the signal states of the channels.

The RAM is checked during the initialization of the device. In addition, the firmware in the flash memory is checked by means of a checksum during initialization. When the control system (PLC/central unit) is stopped during normal operation, the outputs of the device are switched off. The inputs remain active. The outputs are also switched off in case of a malfunction of the CS31 bus.

Diagnosis and display

LEDs are used for diagnosis and display purposes. In addition, some diagnosis information can be transmitted via the CS31 bus.

The replacement device does not provide a test button to measure functionality.

Table 58: Diagnosis information of the CS31 bus

Channel	Error code (CODESYS)	Error code (CS31 bus)	Description
Device error:			
0	43	1	Internal error
Channel error:			
0 ... 7	49	10	Analog value is out of measuring range (on analog inputs)

The error codes that are transferred by the replacement device via the CS31 bus bus are newly displayed in CODESYS. Each error code of the CS31 bus (table column 3) produces the error code in CODESYS (table column 2). As a result, it is possible to operate the replacement device with a new control system (PLC/control unit), e.g. 07KT98-ARC-AD, as well as with an old control system (PLC/central unit), e.g. 07KT98.

An exceedance of the measuring range is signaled even if nothing is connected to an analog voltage input.

Table 59: Device LEDs

LED	Status	Color	LED off	LED on	LED flashes
PWR	Voltage supply	Green	No internal supply voltage	Internal supply voltage	-
CS31 bus	CS31 bus communication	Green	No CS31 bus communication	CS31 bus bus communication	Only diagnosis, no data transfer. Transmission is disturbed.
S-ERR	Error	Red	No error	Static error (must be confirmed by the control system)	No CS31 bus connection or activity
I/O bus	I/O bus communication	Green	No I/O bus communication	I/O bus communication	Error I/O bus communication

The S-ERR LED remains on even if the error no longer occurs. The error must be confirmed by the control system (PLC/central unit), e.g. by means of a function block *Chapter 1.3.3.3 “System data and CS31 bus system data” on page 52*.

Special cases with rapidly flashing LEDs (approx. 5 Hz):

- All 4 LEDs flash rapidly: An incorrect S500 module is connected to the device. The device fails to initialize.
- The LEDs of the CS31 bus, S-ERR bus and I/O bus flash rapidly: Invalid position of DIP switches. The device fails to initialize.

- The LEDs of the S-ERR bus and I/O bus flash rapidly: A checksum error occurred in an internal flash memory.
- The LED of the I/O bus flashes rapidly: An error occurred in an internal RAM.

Table 60: S500 module AX522 LEDs

LED	Status	Color	LED off	LED on	LED flashes
I0+…I7+ (see No. 1 in the following figure)	Analog inputs	Yellow	Input is not activated	Input is activated (brightness depends on value of analog signal).	-
O0+…O7+ (see No. 2 in the following figure)	Analog outputs	Yellow	Output is not activated	Output is activated (brightness depends on value of analog signal).	-
Error indication left (see No. 3 in the following figure)	Error indication	Red	No error	Internal error	-
Error indication right (see No. 3 in the following figure)	Error indication	Red	No error	Internal error	-
Indication supply voltage (see No. 4 in the following figure)	Process voltage	Green	Process voltage not available	Process voltage OK	-

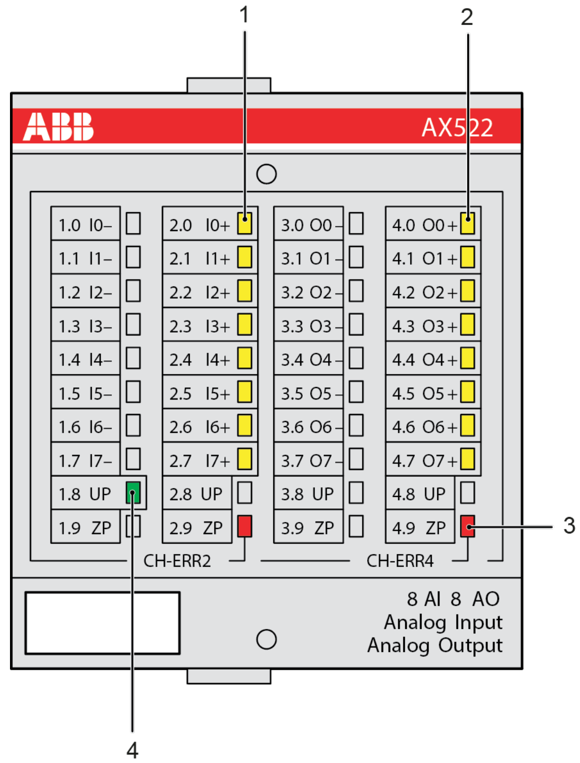


Fig. 42: AX522

Technical data

This section provides additional information on section *Chapter 1.3.3.3 “System data and CS31 bus system data” on page 52*. In case of doubt, the following information applies.

For the device 07AC91-AD2, only the operating mode 12 bit is relevant.

Technical data of the complete device

Data	Value
Process voltage:	
-> Connections	X4/L+ (pin 20), X4/L+ (pin 21), X4/M (pin 22), X4/M (pin 23)
-> Fuse for L+	10 A, fast acting
- Galvanic isolation	No
Current consumption:	
-> via L+	0.19 A + output load
- Inrush current via L+ (when voltage is switched on)	0.16 A²s
Power consumption	Replacement device: 6 W Existing device: 5 W

For further information, please refer to the existing documentation *System description Advant Controller 31.*

CAUTION!
System damage caused by voltage!
Exceeding the maximum supply or process voltage (>30 V DC) results in permanent system damage (destruction).

Technical data of the binary input

Data	Value
Input current at input voltage +24 V	Typ. 6 mA
Protection against reversed voltage	Yes
Overvoltage protection	No

The enabling input is a proprietary input.

For further information, please refer to the existing documentation *System description Advant Controller 31.*

Technical data of the analog inputs

Data	Value
Connections	X2 / 2.0, X2 / 2.1, X2 / 2.2, X2 / 2.3, X3 / 2.4, X3 / 2.5, X3 / 2.6, X3 / 2.7
Reference connections (AGND)	X2 / 1.0, X2 / 1.1, X2 / 1.2, X2 / 1.3, X3 / 1.4, X3 / 1.5, X3 / 1.6, X3 / 1.7
Type of inputs	Voltage bipolar, current unipolar
Time constant of the input filter	Voltage Replacement device: 100 µs Existing device: 470 µs
Conversion cycle *)	Replacement device: 2 ms (over 8 inputs + 8 outputs) Existing device: 8 ms
Resolution: range ± 10 V	Replacement device: 2.4 mV, 12 bit + sign Existing device: 5 mV, 11 bit + sign
Protection against reversed voltage	Yes
Overvoltage protection	Up to 30 V DC

*) Conversion cycle of S500 module AX522. The transmission via serial buses is slower.

Unused voltage inputs must be configured as current inputs (due to wire-break detection AX522 S500 module).

For further information, please refer to the existing documentation System description Advant Controller 31.

Technical data of the analog outputs

Data	Value
Connections	X6 / 4.0, X6 / 4.1, X6 / 4.2, X6 / 4.3, X7 / 4.4, X7 / 4.5, X7 / 4.6, X7 / 4.7
Reference connections (AGND)	X6 / 3.0, X6 / 3.1, X6 / 3.2, X6 / 3.3, X7 / 3.4, X7 / 3.5, X7 / 3.6, X7 / 3.7
Type of outputs	Voltage bipolar, current unipolar
Configurability	Replacement device: 4 current outputs available Existing device: 8 current outputs available
Output load capability, as voltage output	Replacement device: ± 10 mA Existing device: +20 mA, -10 mA
Short-circuit-proof	Yes
External supply protection	Up to 30 V DC

For further information, please refer to the existing documentation System description Advant Controller 31.

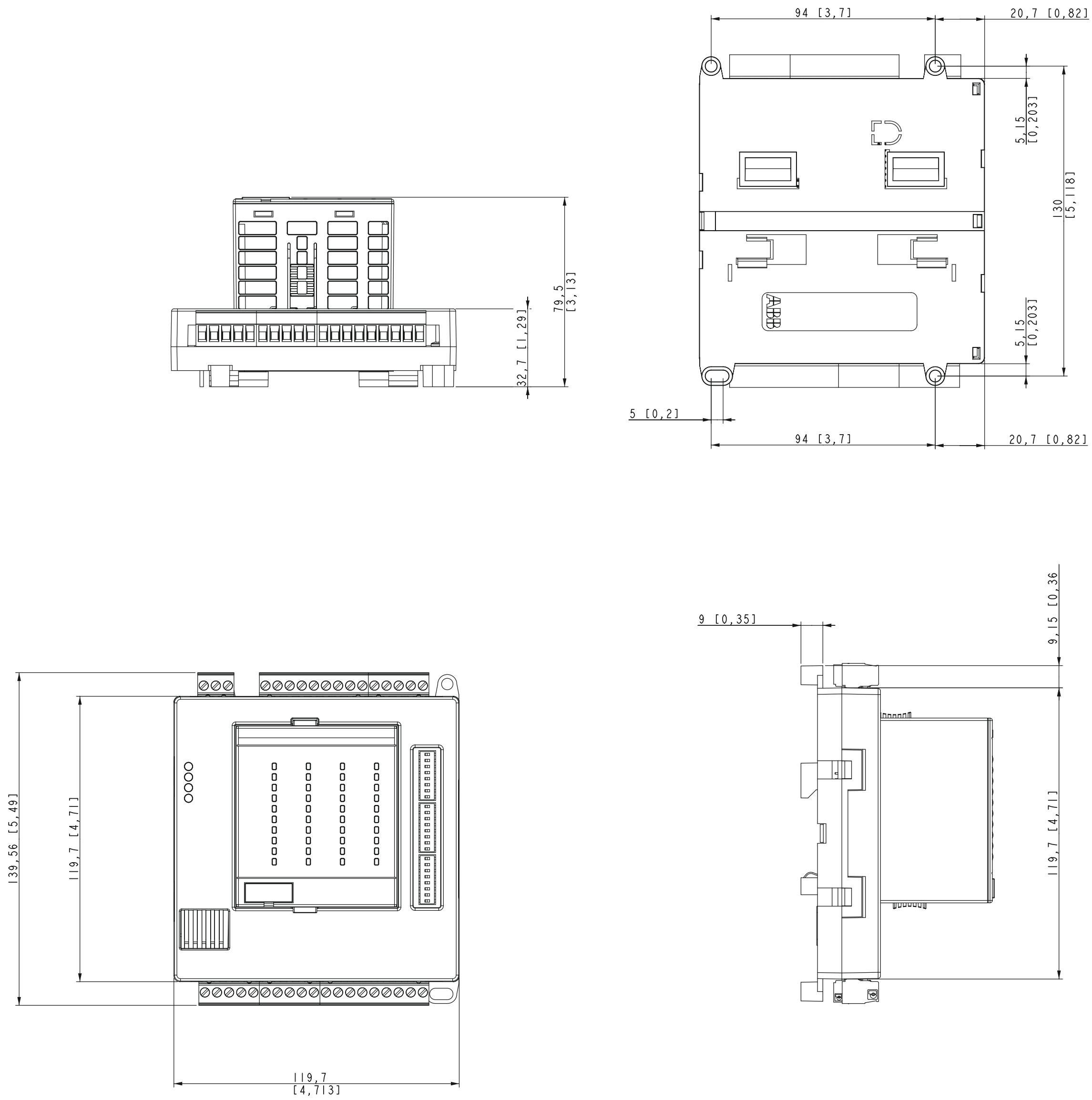
Connection to the CS31 bus

Data	Value
Connections	X1/B2, X1/B1
CS31 bus type	05 (analog input/output)
Terminating resistor	Not available (must be provided externally if needed)

Mechanical data

Data	Value
Width x height x depth	Replacement device: 120 x 140 x approx. 80 mm Existing device: 120 x 140 x 85 mm
Weight	Replacement device: 362 g Existing device: 450 g
Dimensions for mounting	See assembly instructions 07AC91-AD2 (3ADR020085M0401)

Mounting information



The dimensions are in mm and in brackets in inch.

> *The dimensions for the assembly holes are the same for the replacement device and the existing device.*

To assemble or disassemble the replacement device, grab the device at the housing and not directly at the S500 module.

Ordering data

Order No.	Scope of delivery
1SAP 800 100 R0010	Analog input/output module 07AC91-AD2
	1 2-pole terminal block (3.81 mm grid space)
	1 3-pole terminal block (5.08 mm grid space)
	1 5-pole terminal block (5.08 mm grid space)
	4 8-pole terminal blocks (3.81 mm grid space)

1.3.3.5.3 Replacement device 07AI91-AD

Introduction

Fig. 43: 3ADR331191S0015_07AI91-AD

The replacement device 07AI91-AD from the AC31 adapter series replaces the existing device 07DC91 from the 90 series.

During the development of the replacement device, care was taken to keep the device configuration identical to the configuration of the existing device. Thus, the existing documentation of device 07AI91 remains valid and serves as a reference *(system description Advant Controller 31)*. The document structure of this document is based on the document structure of the existing documentation.

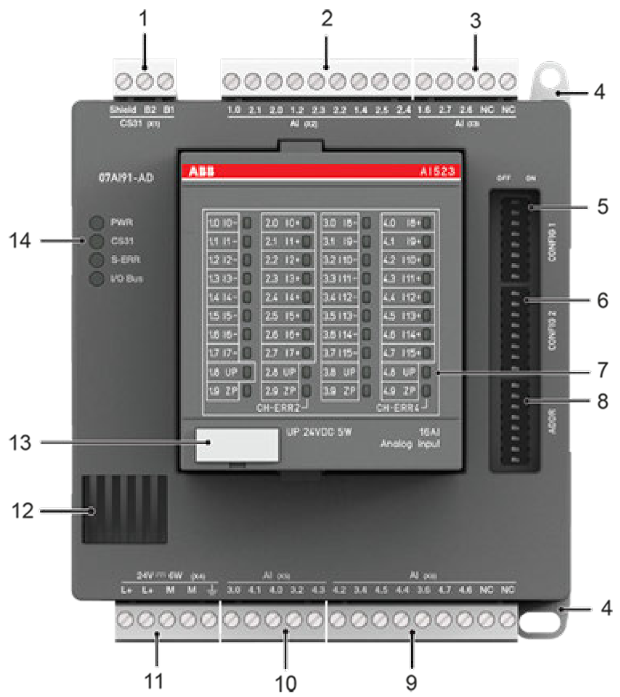
This document adds the following points to the still valid existing documentation:

- Unavoidable device deviations, e.g. due to technical limitations.
- Expansion of documentation as a result of normative requirements.
- Additional contents not described in the existing documentation.

Further information on replacement device 07AI91-AD can be found in the operating and assembly instructions of device 07AI91-AD: 3ADR020086M0401. Please note that for the existing device 07AI91 no separate operating and assembly instructions are available.

Please also observe the system data as well as the information on CS31 bus *Chapter 1.3.3.3 “System data and CS31 bus system data” on page 52*.

Device configuration



1 Connection for CS31 bus (X1)
2 Analog inputs (X2). 2.5 AI (± 10 V differential, ± 5 V differential, temperature measurement PT100 / PT1000, 4…20 mA and 0…20 mA with external resistor)
3 Analog inputs (X3). 1.5 AI (± 10 V differential, ± 5 V differential, temperature measurement PT100 / PT1000, 4…20 mA and 0…20 mA with external resistor)
4 Hole for screw mounting (screw diameter 4 mm, extension torque 1.2 Nm)
5 DIP switch for CONFIG1
6 DIP switch for CONFIG2
7 Status LEDs for AI523
8 DIP switch for ADDR
9 Analog inputs (X6). 2.5 AI (± 10 V differential, ± 5 V differential, temperature measurement PT100 / PT1000, 4…20 mA and 0…20 mA with external resistor)
10 Analog inputs (X5). 1.5 AI (± 10 V differential, ± 5 V differential, temperature measurement PT100 / PT1000, 4…20 mA and 0…20 mA with external resistor)

11 Supply 24 V DC (incl. AI523)
12 Ventilation
13 TA525: Label
14 4 Status LEDs of complete device

In contrast to the existing device, the following measuring ranges are not available in the replacement device: ± 500 mV, ± 50 mV. Temperature measurement with thermocouples is also not possible.

The replacement device does not perform a self-calibration.

LED display

The LED display on the replacement device is changed:

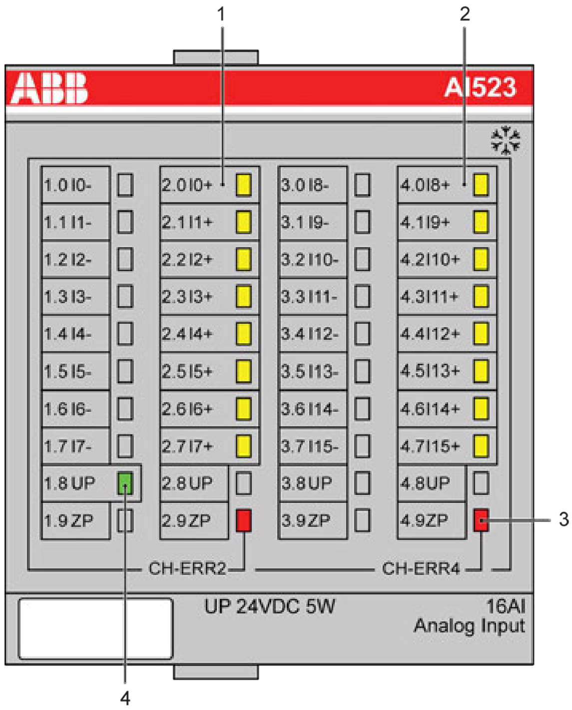


Fig. 44: Front view: 07AI91-AD

No.	Display of module
1	8 yellow LEDs to indicate the signal states of the analog inputs (X2 and X3)
2	8 yellow LEDs to indicate the signal states of the analog inputs (X5 and X6)
3	2 red LEDs to indicate errors (of AI523 module)
4	1 green LED to indicated the status of the supply voltage of the AI523 module (is supplied via X4)

The replacement device does not provide a test button to measure functionality.

Connections

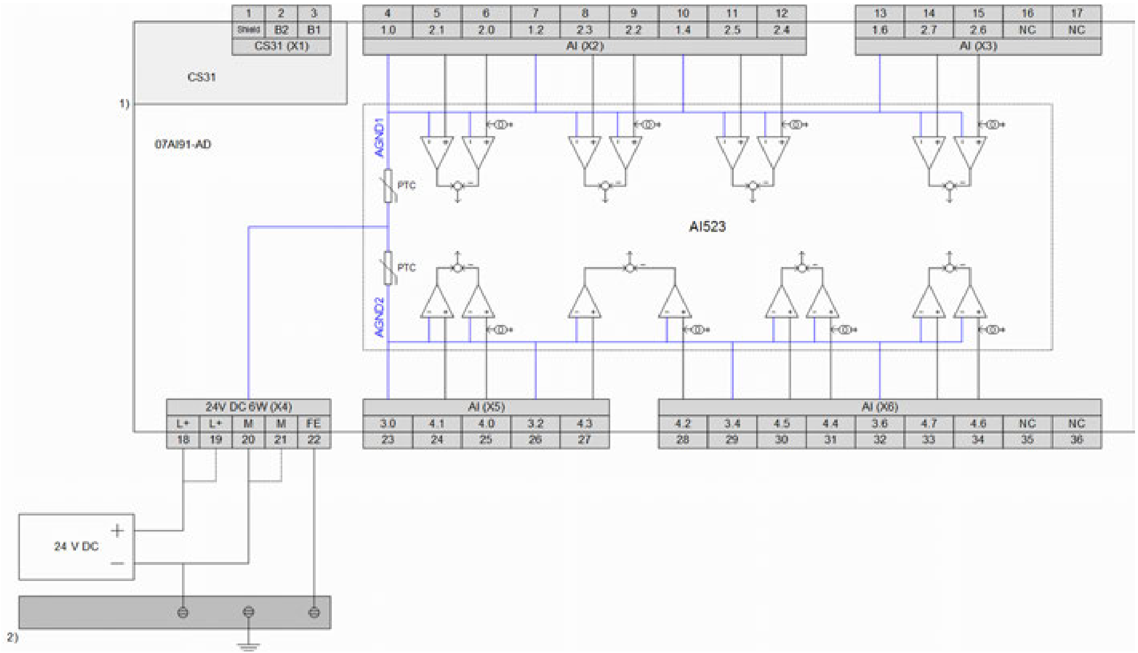


Fig. 45: Connection

1) Galvanic isolation
2) Control cabinet grounding

Please observe the following information:

- The **Shield** connections of the CS31 bus and **FE** of the supply voltage have no connection within the device.
- The process voltage must be included in the grounding concept of the control system (e.g. grounding of the negative pole).
- The connections of all sensors must be galvanically isolated from the mounting environment of the sensors. The cable shields of the temperature sensors are grounded to the control cabinet at the entry into the cabinet. The setting of the module address as well as the configuration of the analog channels are performed by means of DIP switches (see next pages).
- Unused inputs must be configured as "not evaluated" (DIP switch).
- The current sources in AI523 are configurable and therefore not always active. The current sources are connected alternately with the multiplex method. Consequently, the device does not have 8 current sources.
- The module address and the analog channels are set with DIP switches.

Table 61: Pin assignment CS31 bus (X1)

Connector / Terminal	Pin	Assignment / Signal
X1 / Shield	1	No internal connection
X1 / B2	2	BUS 2
X1 / B1	3	BUS 1

Table 62: Pin assignment AI (X2)

Connector / Terminal	Pin	Assignment / Signal
X2 / 1.0	4	AI523 / I0- (AGND1)
X2 / 2.1	5	AI523 / I1+
X2 / 2.0	6	AI523 / I0+

Connector / Terminal	Pin	Assignment / Signal
X2 / 1.2	7	AI523 / I2- (AGND1)
X2 / 2.3	8	AI523 / I3+
X2 / 2.2	9	AI523 / I2+
X2 / 1.4	10	AI523 / I4- (AGND1)
X2 / 2.5	11	AI523 / I5+
X2 / 2.4	12	AI523 / I4+

Table 63: Pin assignment AI (X3)

Connector / Terminal	Pin	Assignment / Signal
X3 / 1.6	13	AI523 / I6- (AGND1)
X3 / 2.7	14	AI523 / I7+
X3 / 2.6	15	AI523 / I6+
X3 / NC	16	Not connected
X3 / NC	17	Not connected

In module AI523, the signals I0-, I2-, I4- and I6- are internally connected to an analog ground. The potential difference of the analog ground to M is ±1 V (max.). The replacement device has no current sources on pins 16 and 17. If necessary, these current sources can be connected to individual measurement channels via the configuration (DIP switch).

Table 64: Pin assignment 24 V DC 6W (X4)

Connector / Terminal	Pin	Assignment / Signal
X4 / L+	18	L+
X4 / L+	19	L+
X4 / M	20	M
X4 / M	21	M
X4 / FE	22	FE

Table 65: Pin assignment AI (X5)

Connector / Terminal	Pin	Assignment / Signal
X5 / 3.0	23	AI523 / I8- (AGND2)
X5 / 4.1	24	AI523 / I9+
X5 / 4.0	25	AI523 / I8+
X5 / 3.2	26	AI523 / I10- (AGND2)
X5 / 4.3	27	AI523 / I11+

Table 66: Pin assignment AI (X6)

Connector / Terminal	Pin	Assignment / Signal
X6 / 4.2	28	AI523 / I10+
X6 / 3.4	29	AI523 / I12- (AGND2)
X6 / 4.5	30	AI523 / I13+
X6 / 4.4	31	AI523 / I12+
X6 / 3.6	32	AI523 / I14- (AGND2)
X6 / 4.7	33	AI523 / I15+
X6 / 4.6	34	AI523 / I14+

Connector / Terminal	Pin	Assignment / Signal
X6 / NC	35	Not connected
X6 / NC	36	Not connected

In module AI523, the signals I8-, I10-, I12- and I14- are internally connected to an analog ground. The potential difference of the analog ground to M is ±1 V (max.). The replacement device does not have current sources on pins 35 and 36. If necessary, these current sources can be connected to individual measurement channels via the configuration (DIP switch).

CAUTION!
System damage caused by voltage!
The exchange of a replacement device under voltage can cause permanent system damage (destruction).

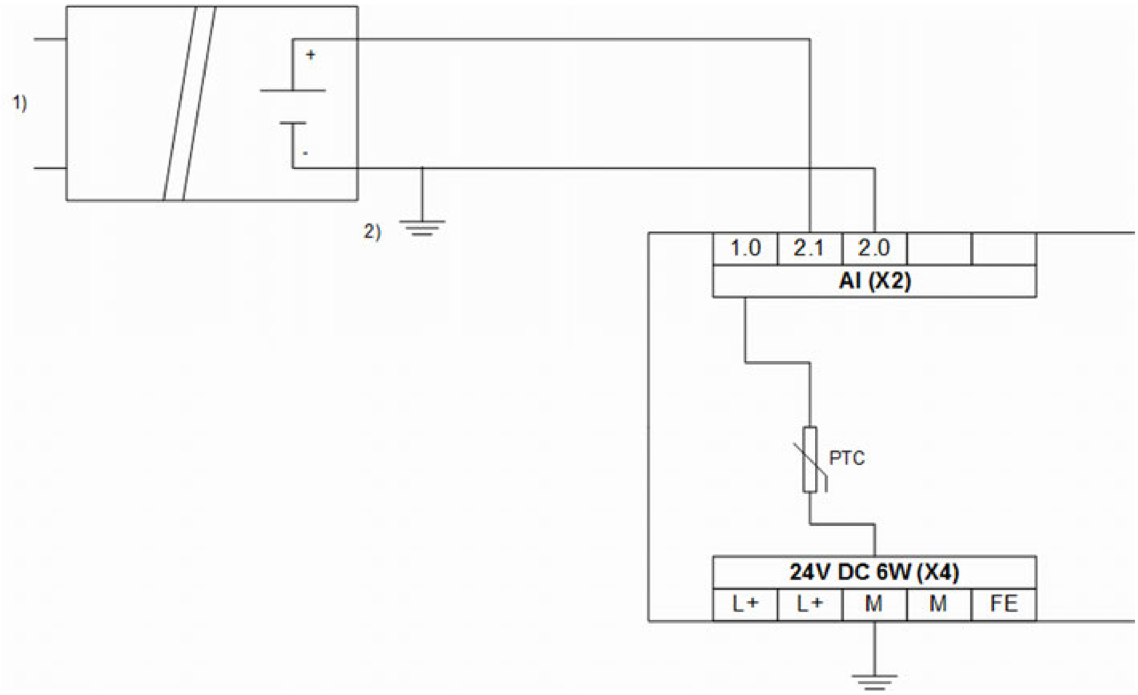


Fig. 46: Differential voltage input

1) Galvanically isolated power supply of analog sensor
2) Grounding at sensor
±10 V or ±5 V at differential inputs

On the replacement devices, the wire-break detection is also active in case of a differential voltage measurement. For this purpose, each measuring channel is internally pulled to "plus" by means of a high-impedance resistor. As a result, the individual potentials of the differential voltage measurement must also be referenced to M. Completely isolated voltages are **not** symmetrized to M by the inputs.

The potential difference of the grounding at the sensor to M must not be too big (max. ± 1 V for the whole signal range). Otherwise problems can occur concerning the common-mode input voltages of the involved analog inputs.

Analog signal lines must be routed in shielded cables. The shield must be grounded on both sides and should be grounded to replacement device and signal source / signal sink as close as possible.

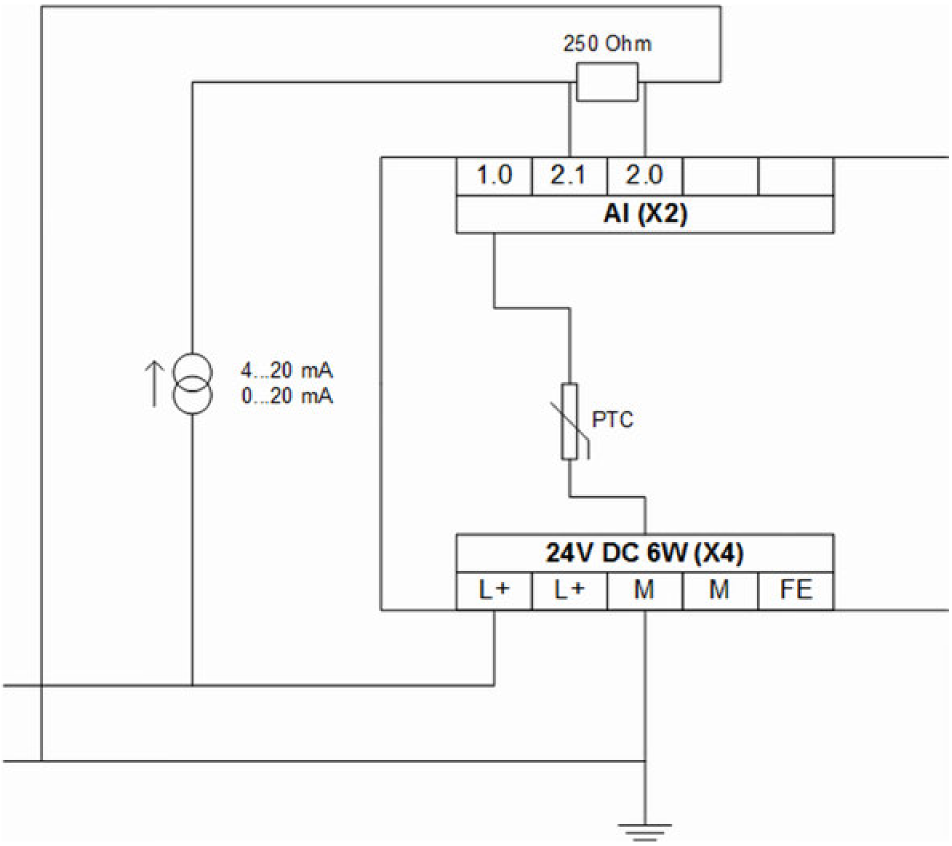


Fig. 47: Current input with external resistor

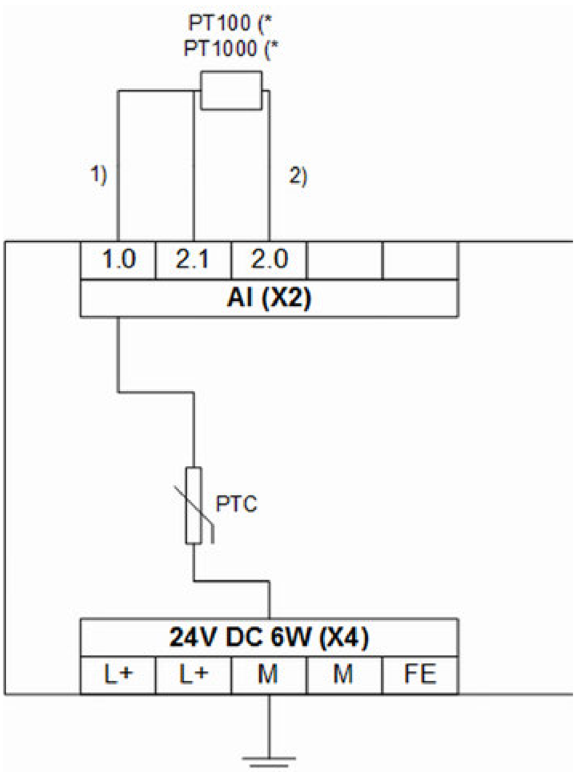


Fig. 48: Resistance thermometer

1) Return conductor
2) Twisted wire pair in the cable
(*) 3-wire

For temperature measurements with PT100/PT1000 resistors, the wiring to the existing device must be changed. A 4-wire temperature measurement is not possible with the replacement device. Based on the above figure, a 3-wire temperature measurement can be implemented.

Configuration

The existing device had a DIP switch on the upper printed circuit board. Since the replacement device is not equipped with an upper printed circuit board, the white DIP switch is arranged on the lower printed circuit board instead.

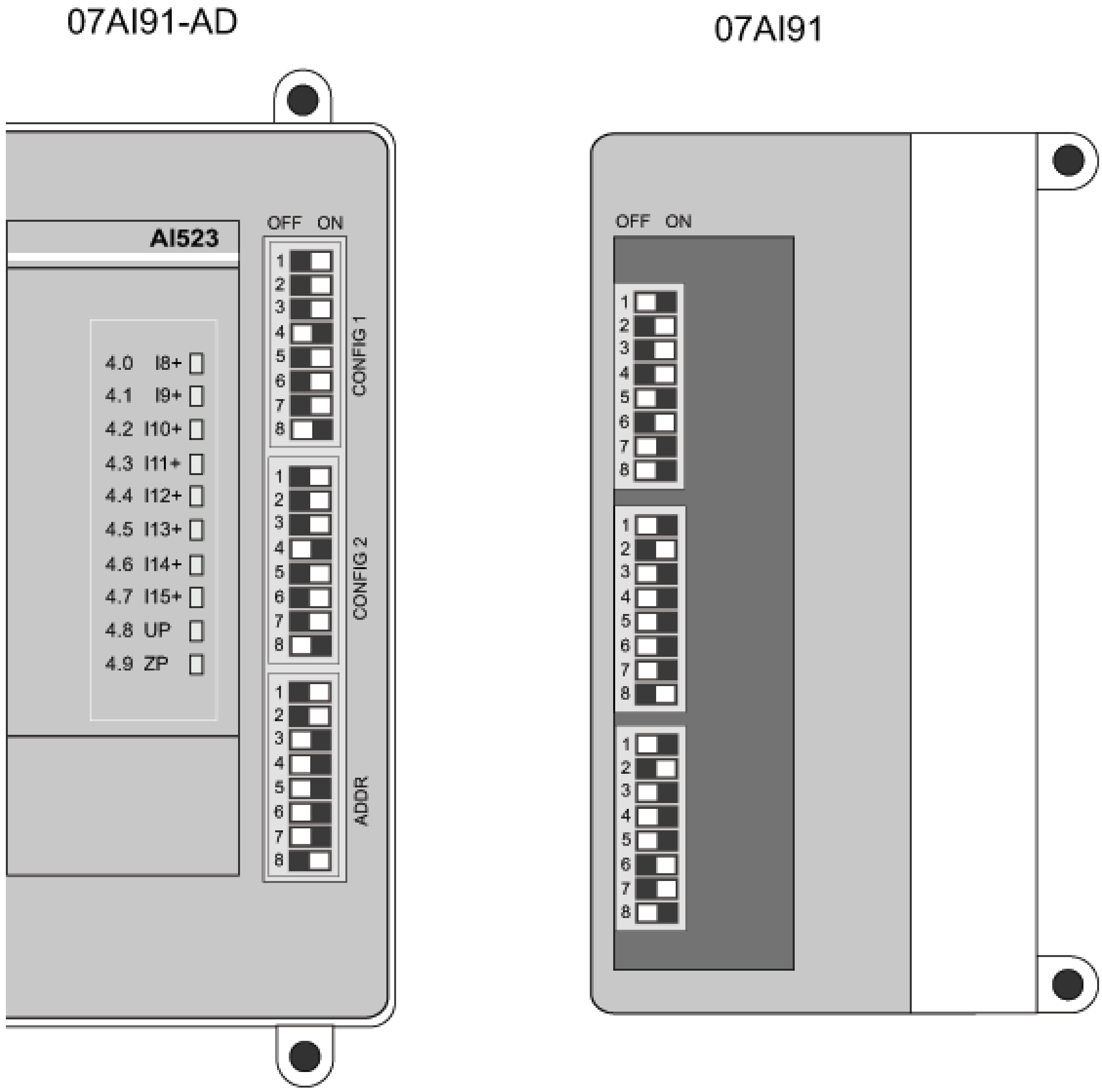


Fig. 49: DIP switch for 07AI91-AD

The function of the address DIP switch 8 (channel No. ≤ 7 or channel No. > 7) is not supported for the replacement device. This DIP switch must be switched off.

On address DIP switch 3 (assignment of analog value), only the CS31 bus format is supported in the replacement device. This DIP switch must be switched on. The setting of the line frequency suppression (address DIP switch 1 and 2) has no effect on the existing device 07AI91.

The following settings of DIP switches CONFIG 1 and CONFIG 2 are not implemented in the replacement device and must not be selected:

- *± 500 mV*
- *± 50 mV*
- *J-type thermocouple with linearization*
- *K-type thermocouple with linearization*
- *S-type thermocouple with linearization*

For further information, please refer to the existing documentation System description Advant Controller 31.

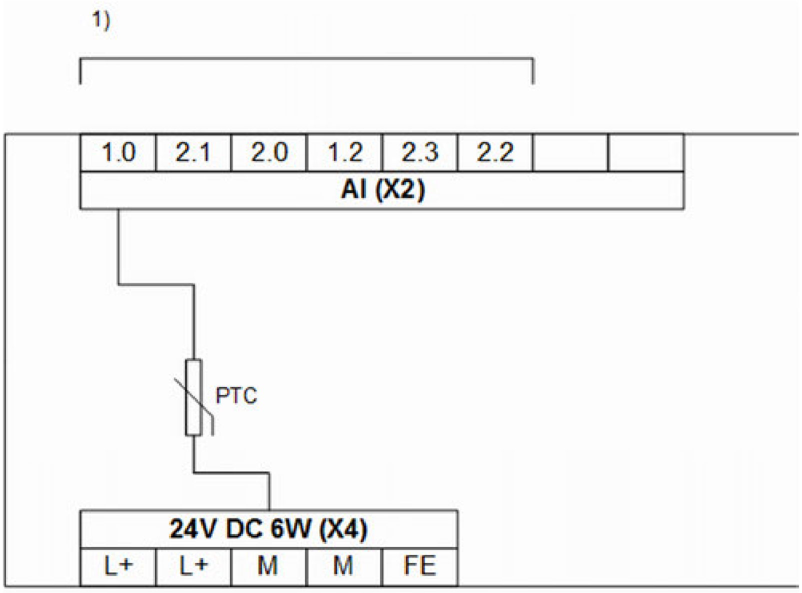


Fig. 50: "Configuration pair" not used

1) Channel 0 and channel 1 are not used -> DIP switch "No evaluation of channels"

If both channels of a "configuration pair" are not used, set the DIP switches to "No evaluation of channels".

The DIP switches are read by the device only once after the supply voltage has been connected.

Measuring ranges of the input channels

All input signals are not evaluated as differential signals. Two input channels are used to implement a differential measurement.

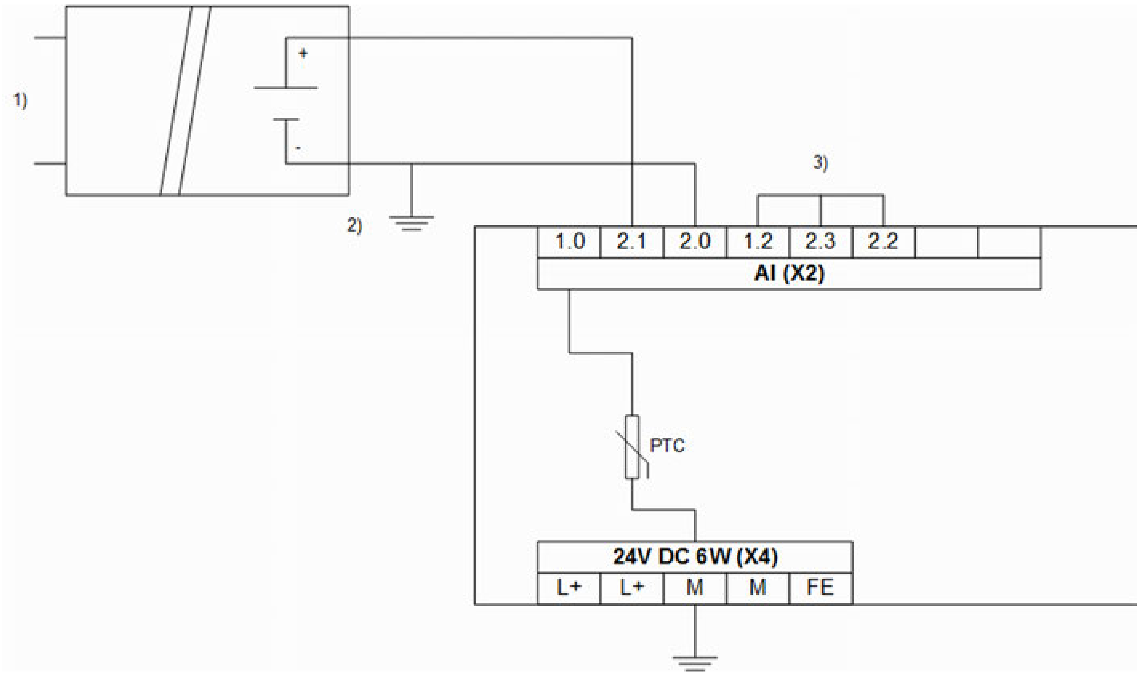


Fig. 51: Only one channel of a "configuration pair" is used

1) Galvanically isolated power supply of analog sensor
2) Grounding at sensor
3) Channel not used
± 10 V, ± 5 V at differential inputs

If only one channel of a "configuration pair" is used (e.g. channel 0 and 1), then the other channel must be short-circuited during a voltage measurement. Short-circuited in this context means that for instance the connections 1.2, 2.3 and 2.2 are connected. Otherwise the channel not used reports that the range has been exceeded.

Measuring ranges

- Measuring ranges ± 10 V / ± 5 V / ± 500 mV and ± 50 mV no longer exist.
- Measuring ranges 4 ... 20 mA / 0 ... 20 mA not changed to existing documentation.

Pt 100 / Pt 1000

To measure the temperature by means of resistors, a constant current is supplied by the replacement device. This imprint no longer occurs at terminals 16, 17, 35 and 36. Therefore the wiring must be changed for the temperature measurement.

Further information:

- Fig. 45
- Fig. 48
- Figures 5.2-4 and 5.2-5 from the existing documentation of the 07AI91 are not valid for the replacement device *System description Advant Controller 31*.
- Terminals 7, 10, 13, 26, 29 and 32 can no longer be used as connection bases. The terminals are only used for the 3-wire temperature measurement *System description Advant Controller 31*.

Wire-breakage

In case of a wire-breakage, the numerical value +32767 is output. This is followed by an error message via the CS31 bus.

Channel use

If only one channel of a "configuration pair" is used (e.g. channel 0 and 1), then the other channel must be connected with a resistor (e.g. 120 Ω Pt100 measuring range, 1200 Ω Pt1000 measuring range). Otherwise an error message is indicated.

NOTICE!

Temperature-dependent resistors

Other temperature-dependent resistors cannot be used for the replacement device.

NOTICE!

Thermocouples type J, type K, type S

Thermocouples cannot be evaluated with the replacement device. The respective section in the existing documentation (incl. figure 5.2-6) is not valid for device 07AI91.

Configuration for unused channels

See existing documentation 07AI91 System description Advant Controller 31.

Relationship between the measuring values and the location of the bits in a 16 bit WORD

- *The measuring ranges ± 500 mV and ± 50 mV no longer exist.*
- *Measuring range ±5 V:*
  - *Replacement device: 11 bit resolution plus sign*
  - *Existing device: 12 bit resolution plus sign*
- *All measuring ranges for thermocouples are no longer available.*

Addressing

In the following, the information in the "Type" column refers to the data type designation of the Automation Builder (see AC31 system data ➪ *Chapter 1.3.3.3 “System data and CS31 bus system data” on page 52*). The information in the "Type" column must be interpreted from the viewpoint of the CS31 bus master. The information in brackets must be interpreted from the viewpoint of the replacement device (CS31 bus slave).

The function of the address DIP switch 8 (channel No. ≤ 7 or channel No. > 7) is no longer supported.

Table 67: CS31 bus

Type	Byte	Connector / Terminal
WORD input (send) 0	1	X2 / 2.1, X2 / 2.0
	2	
WORD input (send) 1	3	X2 / 2.3, X2 / 2.2
	4	
WORD input (send) 2	5	X2 / 2.5, X2 / 2.4
	6	
WORD input (send) 3	7	X3 / 2.7, X3 / 2.6
	8	
WORD input (send) 4	9	X5 / 4.1, X5 / 4.0
	10	
WORD input (send) 5	11	X5 / 4.3, X6 / 4.2
	12	
WORD input (send) 6	13	X6 / 4.5, X6 / 4.4
	14	
WORD input (send) 7	15	X6 / 4.7, X6 / 4.6
	16	

When the measuring values are bipolar, use data type "INT input" instead of "WORD input".

Behavior during normal operation

Interpretation of the LEDs:

- The device initializes automatically after the supply voltage is switched on. During this time, the S-ERR LED flashes.
- The PWR LED lights up as soon as the internal supply voltage of the device is present.
- After successful initialization of the I/O bus communication to the S500 module, the I/O bus LED lights up.
- After successful initialization of the CS31 bus communication, the CS31 bus LED lights up. The S-ERR LED goes out.
- During operation, the yellow LEDs indicate the signal states of the channels.

The RAM is checked during the initialization of the device. In addition, the firmware in the flash memory is checked by means of a checksum during initialization. When the control system (PLC/central unit) is stopped during normal operation, the inputs remain active.

Diagnosis and display

LEDs are used for diagnosis and display purposes. In addition, some diagnosis information can be transmitted via the CS31 bus.

The replacement device does not provide a test button to measure functionality.

Table 68: Diagnosis information of the CS31 bus

Channel	Error code (CODESYS)	Error code (CS31 bus bus)	Description
Device error:			
0	43	1	Internal error
Channel error:			
0 ... 7	45	9	Cut wire (is also indicated if the current in measuring range 4 ... 20 mA is less than 2 mA)
0 ... 7	49	10	Analog value is out of measuring range

The error codes that are transferred by the replacement device via the CS31 bus bus are newly displayed in CODESYS. Each error code of the CS31 bus (table column 3) produces the error code in CODESYS (table column 2). As a result, it is possible to operate the replacement device with a new control system (PLC/control unit), e.g. 07KT98-ARC-AD, as well as with an old control system (PLC/central unit), e.g. 07KT98.

An exceedance of the measuring range is signaled even if nothing is connected to an analog voltage input.

Table 69: Device LEDs

LED	Status	Color	LED off	LED on	LED flashes
PWR	Voltage supply	Green	No internal supply voltage	Internal supply voltage	-
CS31 bus	CS31 bus communication	Green	No CS31 bus communication	CS31 bus bus communication	Only diagnosis, no data transfer. Transmission is disturbed.
S-ERR	Error	Red	No error	Static error (must be confirmed by the control system)	No CS31 bus connection or activity
I/O bus	I/O bus communication	Green	No I/O bus communication	I/O bus communication	Error I/O bus communication

The S-ERR LED remains on even if the error no longer occurs. The error must be confirmed by the control system (PLC/central unit), e.g. by means of a function block *Chapter 1.3.3.3 “System data and CS31 bus system data” on page 52*.

Special cases with rapidly flashing LEDs (approx. 5 Hz):

- All 4 LEDs flash rapidly: An incorrect S500 module is connected to the device. The device fails to initialize.
- The LEDs of the CS31 bus, S-ERR bus and I/O bus flash rapidly: Invalid position of DIP switches. The device fails to initialize.
- The LEDs of the S-ERR bus and I/O bus flash rapidly: A checksum error occurred in an internal flash memory.
- The LED of the I/O bus flashes rapidly: An error occurred in an internal RAM.

Table 70: LEDs of the S500 module AI523

LED	Status	Color	LED off	LED on	LED flashes
I1+, I3+, I5+, I7+ (see No. 1 in the following figure)	Analog inputs	Yellow	Input is not activated	Input is activated (brightness depends on value of analog signal).	-
I9+, I11+, I13+, I15+ (see no. 2 in the following figure)	Analog inputs	Yellow	Input is not activated	Input is activated (brightness depends on value of analog signal).	-
Error indication left (see No. 3 in the following figure)	Error indication	Red	No error	Internal error	Cut wire on a channel of the corresponding group
Error indication right (see No. 3 in the following figure)	Error indication	Red	No error	Internal error	Cut wire on a channel of the corresponding group
Indication supply voltage (see No. 4 in the following figure)	Process voltage	Green	Process voltage not available	Process voltage OK	-

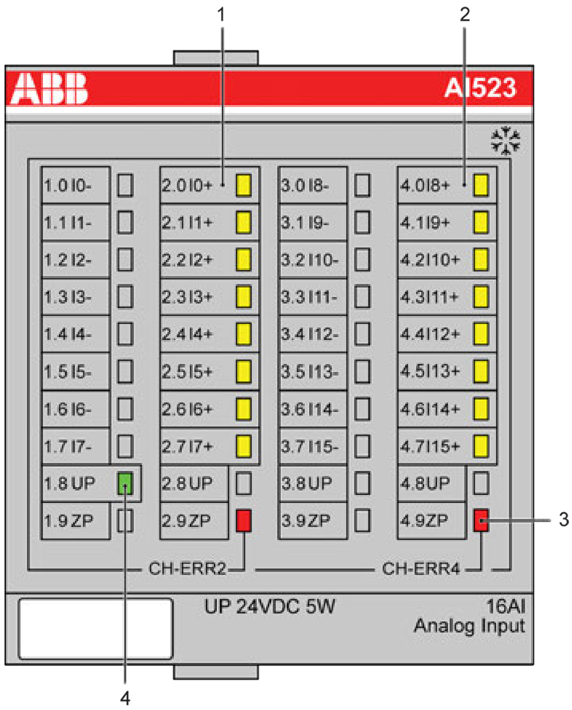


Fig. 52: 07AI91-AD_Front

Technical data

This section provides additional information on section ⇨ *Chapter 1.3.3.3 “System data and CS31 bus system data” on page 52*. In case of doubt, the following information applies.

Technical data of the complete device

Data	Value
Process voltage:	
-> Connections	X4/L+ (pin 18), X4/L+ (pin 19), X4/M (pin 20), X4/M (pin 21)
-> Fuse for L+	10 A, fast acting
- Galvanic isolation	No
Current consumption:	
-> via L+	0.19 A
- Inrush current via L+ (when voltage is switched on)	0.22 A^2s
Power consumption	Replacement device: 6 W Existing device: 3 W
Address setting and configuration	DIP switch right side of housing
Max. line length of analog lines, line cross section > 0.14 mm²	100 m

For further information, please refer to the existing documentation System description Advant Controller 31.

CAUTION!
System damage caused by voltage!
Exceeding the maximum supply or process voltage (>30 V DC) results in permanent system damage (destruction).

Technical data of the analog inputs

Data	Value
Connections	[X2 / 2.1, X2 / 2.0], [X2 / 2.3, X2 / 2.2], [X2 / 2.5, X2 / 2.4], [X3 / 2.7, X3 / 2.6], [X5 / 4.1, X5 / 4.0], [X5 / 4.3, X6 / 4.2], [X6 / 4.5, X6 / 4.4], [X6 / 4.7, X6 / 4.6]
Reference connections (AGND1)	X2 / 1.0, X2 / 1.2, X2 / 1.4, X3 / 1.6
Reference connections (AGND2)	X5 / 3.0, X5 / 3.2, X6 / 3.4, X6 / 3.6
Max. potential difference AGND1/2 <-> M	± 1 V
Type of inputs	Voltage bipolar, current unipolar, temperature measurement
Line frequency suppression	Not available
Time constant of the input filter	Replacement device: Voltage: 100 µs, current 100 µs Existing device: no RC combination available
Conversion cycle	Replacement device: 2 ms over 8 inputs, 1 s during temperature measurement Existing device: 30 ms to 150 ms, depending on configuration
Protection against reversed voltage	Yes
Overvoltage protection	Up to 30 V DC

For further information, please refer to the existing documentation System description Advant Controller 31.

Analog voltage input

Data	Value
Input resistance	Replacement device: > 100 kΩ Existing device: > 1 MΩ
Measuring ranges nominal values	Replacement device: ± 10 V, ± 5 V Existing device: ± 10 V, ± 5 V, ± 500 mV, ± 50 mV

Data	Value
Resolution	12 bit + sign (measuring range ± 10 V) 11 bit + sign (measuring range ± 5 V)
Total error	Replacement device: ± 1 % of full range value Existing device: ± 0.5 % of full range value
Common mode input voltage range (e.g. X2 / 2.1, reference e.g. X2 / 1.0 (AGND1))	-10 V ... +10 V

For further information, please refer to the existing documentation System description Advant Controller 31.

Current input 0 … 20 mA / 4 … 20 mA

Total error:

Replacement device: ±1 % of full range value ± tolerance of current-sensing resistor

Existing device: ±0.5 % of full range value + tolerance of current-sensing resistor

Pt100/Pt1000 input

Data	Value
Measurement method	Replacement device: 3-wire configuration Existing device: 4-wire configuration. It is no longer possible to connect sensors in series.
Evaluation errors in measuring range -50 … +400 °C	Replacement device: ± 1 % of full range value Existing device: ± 0.5 % of full range value at Pt100, ± 1 % of full range value at Pt1000
Current source for Pt100/Pt1000 resistors	The replacement device has a constant current source that is alternately connected to up to 8 analog channels (depending on configuration).

Unused input channels

See existing documentation 07AI91.

Connection of other temperature-dependent resistors

Other temperature-dependent resistors cannot be used in the replacement device.

Input with thermocouples

Thermocouples cannot be used in the replacement device. The existing documentation is no longer valid.

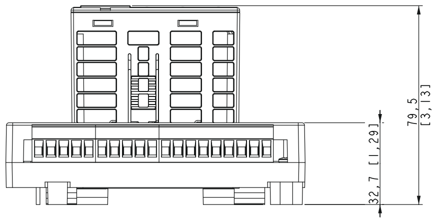
Connection to the CS31 bus

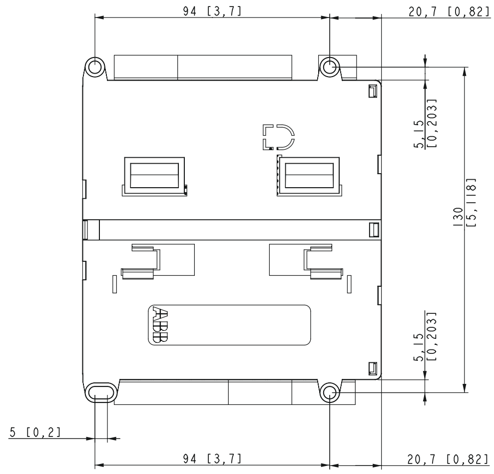
Data	Value
Connections	X1 / B2, X1 / B1
CS31 bus type	01 (analog input)
Terminating resistor	Not available (must be provided externally if needed)

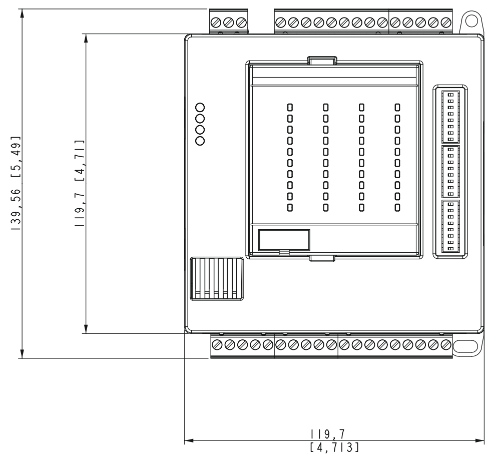
Mechanical data

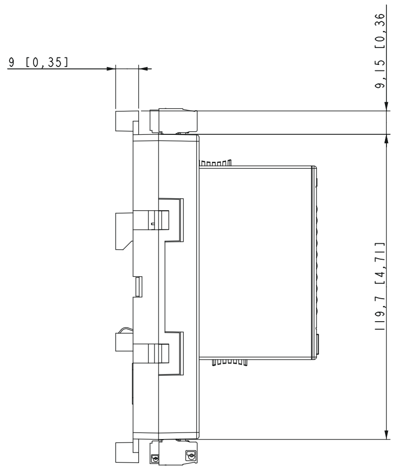
Data	Value
Width x height x depth	Replacement device: 120 x 140 x approx. 80 mm Existing device: 120 x 140 x 85 mm
Weight	Replacement device: 384 g Existing device: 450 g
Dimensions for mounting	See operating and assembly instructions of the replacement device (3ADR020086M0401)

Mounting information









The dimensions are in mm and in brackets in inch.

The dimensions for the assembly holes are the same for the replacement device and the existing device.

To assemble or disassemble the replacement device, grab the device at the housing and not directly at the S500 module.

Ordering data

Order No.	Scope of delivery
1SAP 800 200 R0010	Analog input module 07AI91-AD 1 3-pole terminal block 3 5-pole terminal blocks 2 9-pole terminal blocks

1.3.3.5.4 Replacement device 07DC91-AD

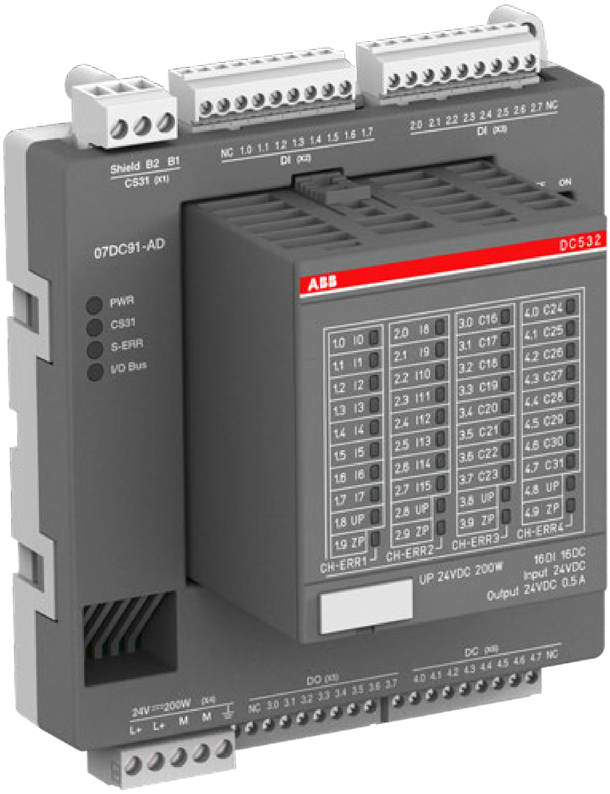


Fig. 53: 3ADR331192S0015_07DC91-AD

The replacement device 07DC91-AD of the AC31 adapter series replaces the existing device 07DC91 of the 90 series.

During the development of the replacement device, care was taken to keep the device configuration identical to the configuration of the existing device. Thus, the existing documentation of device 07DC91 remains valid and serves as reference *(system description Advant Controller 31)*. The document structure of this document is based on the document structure of the existing documentation.

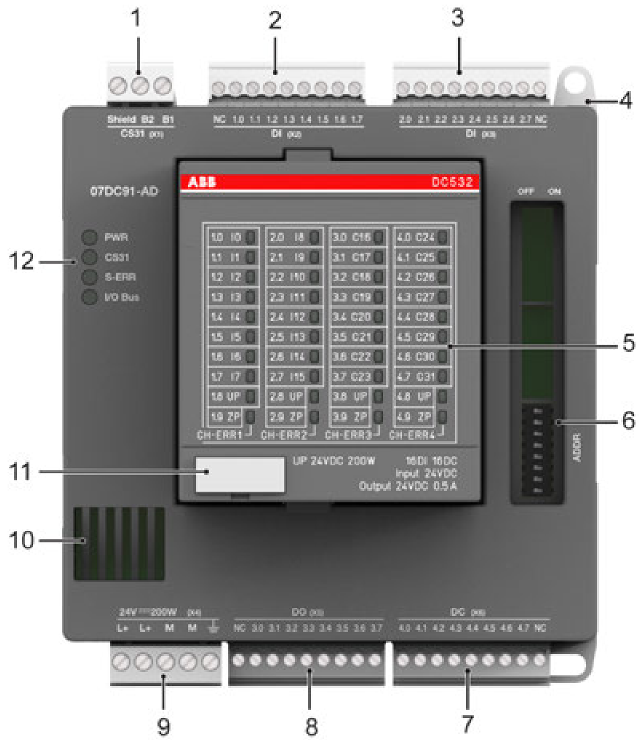
This document adds the following points to the still valid existing documentation:

- Unavoidable device deviations, e.g. due to technical limitations.
- Expansion of documentation as a result of normative requirements.
- Additional contents not described in the existing documentation.

Further information on replacement devices 07DC91-AD can be found in the operating and assembly instructions of device 07DC91-AD: 3ADR020083M0401. Please note that for device 07DC91 no separate operating and assembly instructions are available.

Please also observe the system data as well as the information on CS31 bus *Chapter 1.3.3.3 “System data and CS31 bus system data” on page 52*.

Device configuration



1 Connection for CS31 bus (X1)
2 8 digital inputs 24 V DC (X2)
3 8 digital inputs 24 V DC (X3)
4 Hole for screw mounting (screw diameter 4 mm, extension torque 1.2 Nm)
5 Status LEDs for DC532
6 DIP switch for address setting (ADDR)
7 8 digital inputs/outputs 24 V DC / 0.5 A (X6)
8 8 digital outputs (X5)
9 Supply 24 V DC (X4)
10 Ventilation
11 TA525: Label
12 4 Status LEDs

LED display

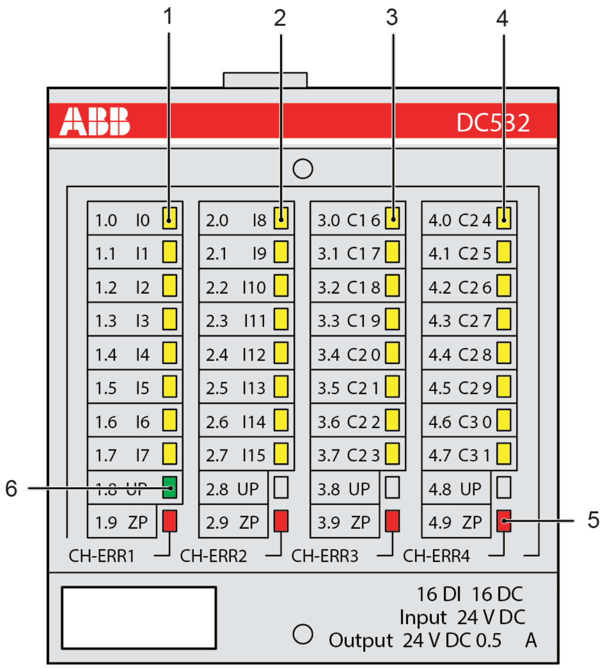


Fig. 54: Front view: DC532

No.	Displays of module
1	8 yellow LEDs to indicate the signal states of the digital inputs (X2).
2	8 yellow LEDs to indicate the signal states of the digital inputs (X3).
3	8 yellow LEDs to indicate the signal states of the digital outputs (X5).
4	8 yellow LEDs to indicate the signal states of the digital inputs/outputs (X6).
5	4 red LEDs to indicate errors (of DC532 module).
6	1 green LED to indicated the status of the supply voltage of the DC532 module (is supplied via X4).

The replacement device does not provide a test button to measure functionality.

Connections

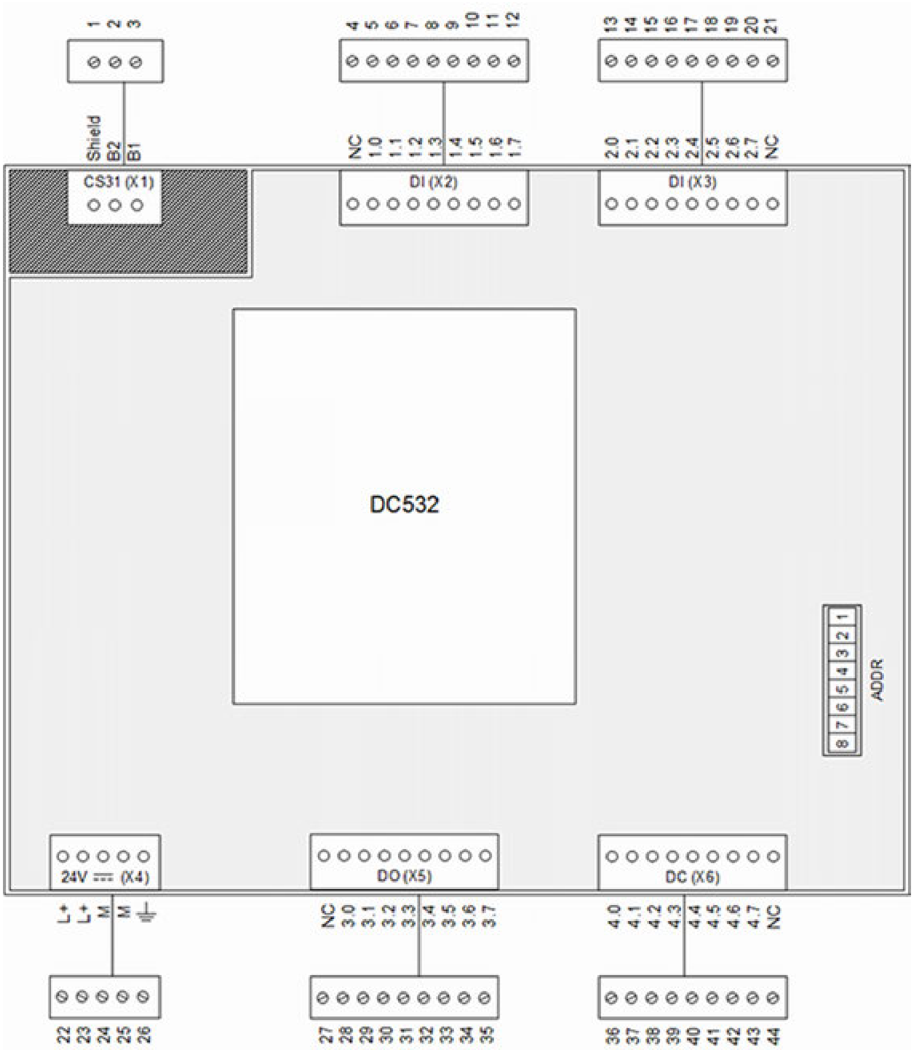


Fig. 55: Connection

Table 71: Pin assignment CS31 bus (X1)

Connector / Terminal	Pin	Assignment / Signal
X1 / Shield	1	No internal connection
X1 / B2	2	BUS 2
X1 / B1	3	BUS 1

The shield connection of the CS31 bus is not galvanically connected to the functional earth of the supply voltage.

Table 72: Pin assignment DI (X2)

Connector / Terminal	Pin	Assignment / Signal
X2 / NC	4	No internal connection
X2 / 1.0	5	DC532 / I0
X2 / 1.1	6	DC532 / I1

Connector / Terminal	Pin	Assignment / Signal
X2 / 1.2	7	DC532 / I2
X2 / 1.3	8	DC532 / I3
X2 / 1.4	9	DC532 / I4
X2 / 1.5	10	DC532 / I5
X2 / 1.6	11	DC532 / I6
X2 / 1.7	12	DC532 / I7

Table 73: Pin assignment DI (X3)

Connector / Terminal	Pin	Assignment / Signal
X3 / 2.0	13	DC532 / I8
X3 / 2.1	14	DC532 / I9
X3 / 2.2	15	DC532 / I10
X3 / 2.3	16	DC532 / I11
X3 / 2.4	17	DC532 / I12
X3 / 2.5	18	DC532 / I13
X3 / 2.6	19	DC532 / I14
X3 / 2.7	20	DC532 / I15
X3 / NC	21	No internal connection

Table 74: Pin assignment DC (X6)

Connector / Terminal	Pin	Assignment / Signal
X6 / 4.0	36	DC532 / C24
X6 / 4.1	37	DC532 / C25
X6 / 4.2	38	DC532 / C26
X6 / 4.3	39	DC532 / C27
X6 / 4.4	40	DC532 / C28
X6 / 4.5	41	DC532 / C29
X6 / 4.6	42	DC532 / C30
X6 / 4.7	43	DC532 / C31
X6 / NC	44	No internal connection

Table 75: Pin assignment DO (X5)

Connector / Terminal	Pin	Assignment / Signal
X5 / NC	27	No internal connection
X5 / 3.0	28	DC532 / C16
X5 / 3.1	29	DC532 / C17
X5 / 3.2	30	DC532 / C18
X5 / 3.3	31	DC532 / C19
X5 / 3.4	32	DC532 / C20
X5 / 3.5	33	DC532 / C21
X5 / 3.6	34	DC532 / C22
X5 / 3.7	35	DC532 / C23

Table 76: Pin assignment 24 V DC 200 W (X4)

Connector / Terminal	Pin	Assignment / Signal
X4 / L+	22	L+
X4 / L+	23	L+
X4 / M	24	M
X4 / M	25	M
X4 / FE	26	FE

The device 07DC91-AD has 16 digital outputs, each with 0.5 A output current. This results in a maximum output current of 8 A. With an output current of 4 A and higher, both terminals (L+) of connector X4 must be used.

CAUTION!

System damage caused by voltage!

The exchange of a replacement device under voltage can cause permanent system damage (destruction).

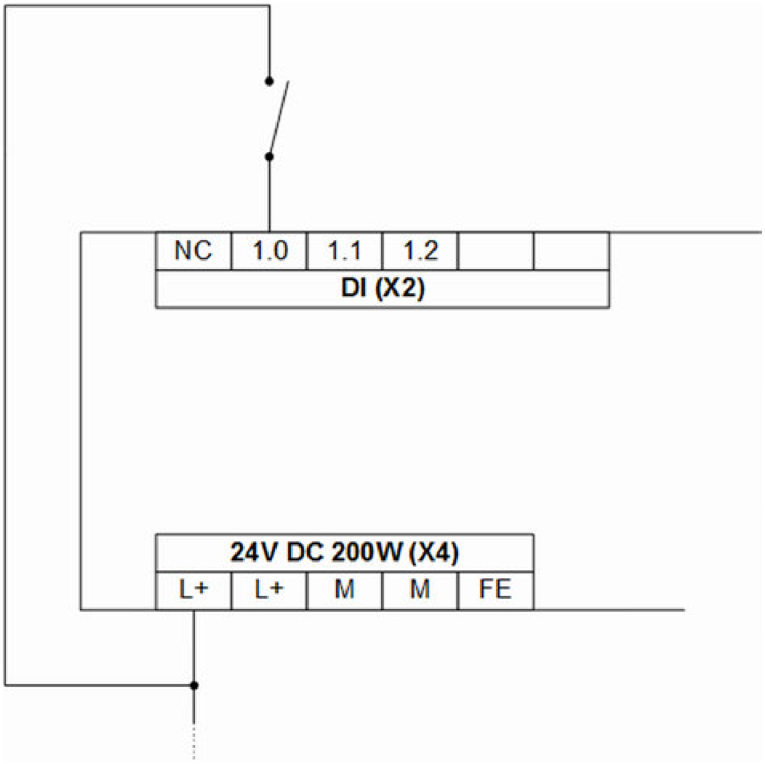


Fig. 56: Connection example: digital input

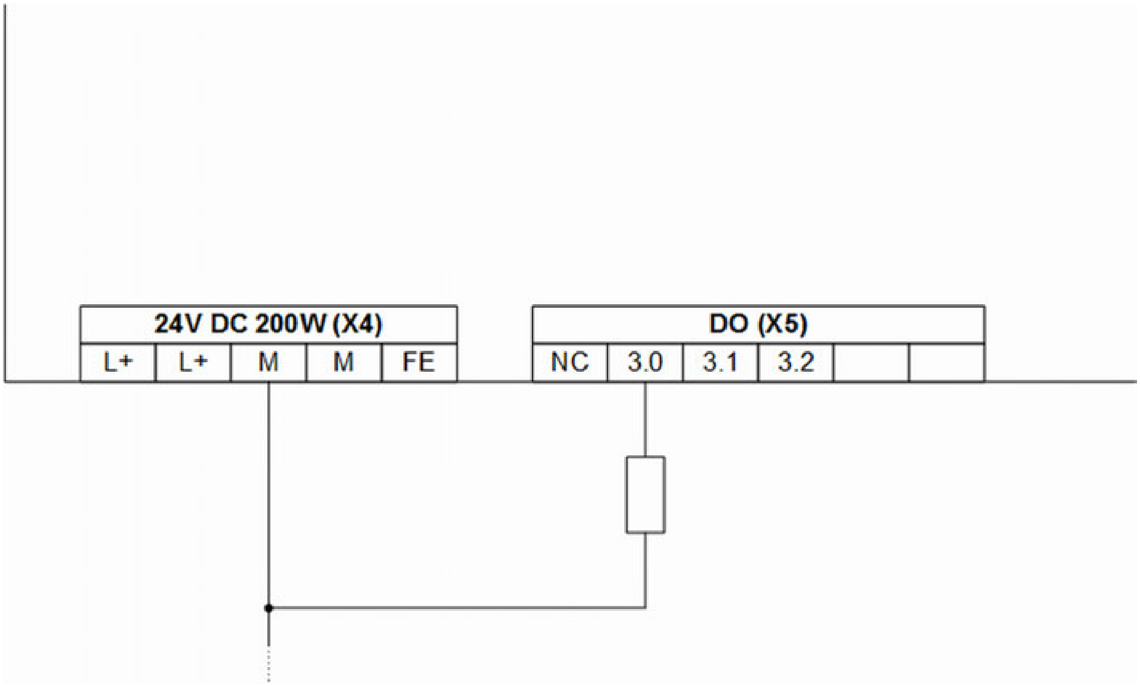


Fig. 57: Connection example: digital output

Addressing

In the following, the information in the "Type" column refers to the data type designation of the Automation Builder (see AC31 system data ⇨ *Chapter 1.3.3.3 "System data and CS31 bus system data" on page 52*). The information in the "Type" column must be interpreted from the viewpoint of the CS31 bus master. The information in brackets must be interpreted from the viewpoint of the replacement device (CS31 bus slave).

Table 77: CS31 bus (16 inputs / 16 outputs)

Byte	Type	Bit	Connector / Terminal
1	8 bit input (send)	0 ... 7	X2 / 1.0
			X2 / 1.1
			X2 / 1.2
			X2 / 1.3
			X2 / 1.4
			X2 / 1.5
			X2 / 1.6
			X2 / 1.7
2	8 bit input (send)	0 ... 7	X3 / 2.0
			X3 / 2.1
			X3 / 2.2
			X3 / 2.3
			X3 / 2.4
			X3 / 2.5
			X3 / 2.6
			X3 / 2.7

Byte	Type	Bit	Connector / Terminal
3	8 bit output (receive)	0 ... 7	X5 / 3.0
			X5 / 3.1
			X5 / 3.2
			X5 / 3.3
			X5 / 3.4
			X5 / 3.5
			X5 / 3.6
			X5 / 3.7
4	8 bit output (receive)	0 ... 7	X6 / 4.0
			X6 / 4.1
			X6 / 4.2
			X6 / 4.3
			X6 / 4.4
			X6 / 4.5
			X6 / 4.6
			X6 / 4.7

Table 78: CS31 bus (24 inputs / 16 outputs)

Byte	Type	Bit	Connector / Terminal
1	8 bit input (send)	0 ... 7	X2 / 1.0 ... 1.7
2	8 bit input (send)	0 ... 7	X3 / 2.0 ... 2.7
3	8 bit output (receive)	0 ... 7	X5 / 3.0 ... 3.7
4	8 bit input (send)	0 ... 7	X6 / 4.0 ... 4.7
5	8 bit output (receive)	0 ... 7	X6 / 4.0 ... 4.7

I/O configuration

The existing device had a DIP switch on the upper printed circuit board. Since the replacement device is not equipped with an upper printed circuit board, the white DIP switch is arranged on the lower printed circuit board instead.

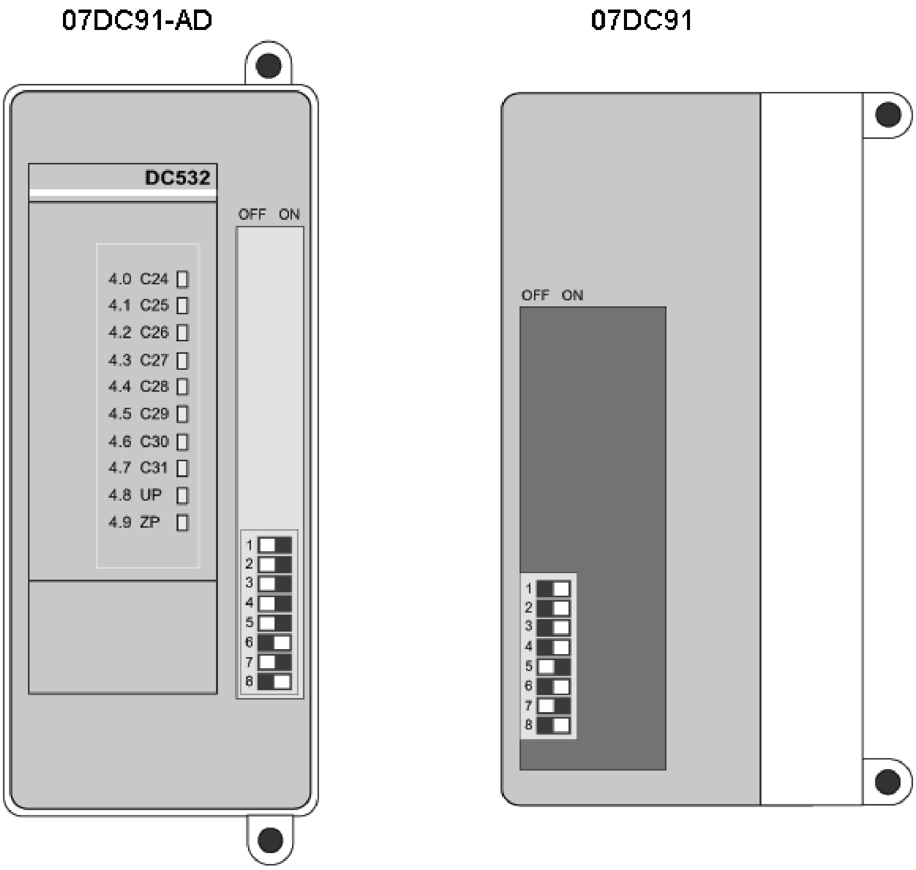


Fig. 58: DIP switch for 07DC91-AD

> *The DIP switches are read by the device only once after the supply voltage has been connected.*

> *For further information, please refer to the existing documentation System description Advant Controller 31.*

Behavior during normal operation

Interpretation of the LEDs:

- The device initializes automatically after the supply voltage is switched on. During this time, the S-ERR LED flashes.
- The PWR LED lights up as soon as the internal supply voltage of the device is present.
- After successful initialization of the I/O bus communication to the S500 module, the I/O bus LED lights up.
- After successful initialization of the CS31 bus communication, the CS31 bus LED lights up. The S-ERR LED goes out.
- During operation, the yellow LEDs indicate the signal states of the channels.

The RAM is checked during the initialization of the device. In addition, the firmware in the flash memory is checked by means of a checksum during initialization. When the control system (PLC/central unit) is stopped during normal operation, the outputs of the device 07DC91-AD are switched off. The inputs remain active. The outputs are also switched off in case of a malfunction of the CS31 bus.

Diagnosis and displays

LEDs are used for diagnosis and display purposes. In addition, some diagnosis information can be transmitted via the CS31 bus.

The replacement device does not provide a test button to measure functionality.

Table 79: Diagnosis information of the CS31 bus

Error description	Channel	Error code (CODESYS)	Error code (CS31 bus)	Description
Device error	0	43	1	Internal error
Channel error	0, 4, 8, 12 *)	46	4	Overload or short circuit on a digital output

*) The channel numbers are grouped as follows:

0 - for X5/3.0, X5/3.1, X5/3.2, X5/3.3

4 - for X5/3.4, X5/3.5, X5/3.6, X5/3.7

8 - for X6/4.0, X6/4.1, X6/4.2, X6/4.3

12 - for X6/4.4, X6/4.5, X6/4.6, X6/4.7

The error codes that are transferred by the replacement device via the CS31 bus bus are newly displayed in CODESYS. Each error code of the CS31 bus (table column 3) produces the error code in CODESYS (table column 2). As a result, it is possible to operate the replacement device with a new control system (PLC/control unit), e.g. 07KT98-ARC-AD, as well as with an old control system (PLC/central unit), e.g. 07KT98.

Table 80: Device LEDs

LED	Status	Color	LED off	LED on	LED flashes
PWR	Voltage supply	Green	No internal supply voltage	Internal supply voltage	-
CS31 bus	CS31 bus communication	Green	No CS31 bus communication	CS31 bus bus communication	Only diagnosis, no data transfer. Transmission is disturbed.
S-ERR	Error	Red	No error	Static error (must be confirmed by the control system)	No CS31 bus connection or activity
I/O bus	I/O bus communication	Green	No I/O bus communication	I/O bus communication	Error I/O bus communication

The S-ERR LED remains on even if the error no longer occurs. The error must be confirmed by the control system (PLC/central unit), e.g. by means of a function block *Chapter 1.3.3.3 “System data and CS31 bus system data” on page 52*.

Special cases with rapidly flashing LEDs (approx. 5 Hz):

- All 4 LEDs flash rapidly: An incorrect S500 module is connected to the device. The device fails to initialize.
- The LEDs of the CS31 bus, S-ERR bus and I/O bus flash rapidly: Invalid position of DIP switches. The device fails to initialize.
- The LEDs of the S-ERR bus and I/O bus flash rapidly: A checksum error occurred in an internal flash memory.
- The LED of the I/O bus flashes rapidly: An error occurred in an internal RAM.

Table 81: LEDs of the S500 module DC532

LED	Status	Color	LED off	LED on	LED flashes
I0…I7 (see No. 1 in the following figure)	Digital inputs	Yellow	Input is not activated	Input is activated (input voltage is indicated even if supply is switched off)	-
- I8…I15 (see No. 2 in the following figure)	Digital inputs	Yellow	Input is not activated	Input is activated (input voltage is indicated even if supply is switched off)	-
C16…C23 (see No. 3 in the following figure)	Digital outputs	Yellow	Output is not activated	Output is activated	-
C24…C31 (see No. 4 in the following figure)	Digital inputs or digital outputs	Yellow	Input or output is not activated	Input is activated (input voltage is indicated even if supply is switched off)	-
Error indications left (see No. 5 in the following figure)	Error indication	Red	No error	Internal error	-
Error indications right (see No. 5 in the following figure)	Error indication	Red	No error	Internal error	Overload or short circuit on a channel of the corresponding group
Indication supply voltage (see No. 6 in the following figure)	Process voltage	Green	Process voltage not available	Process voltage OK	-

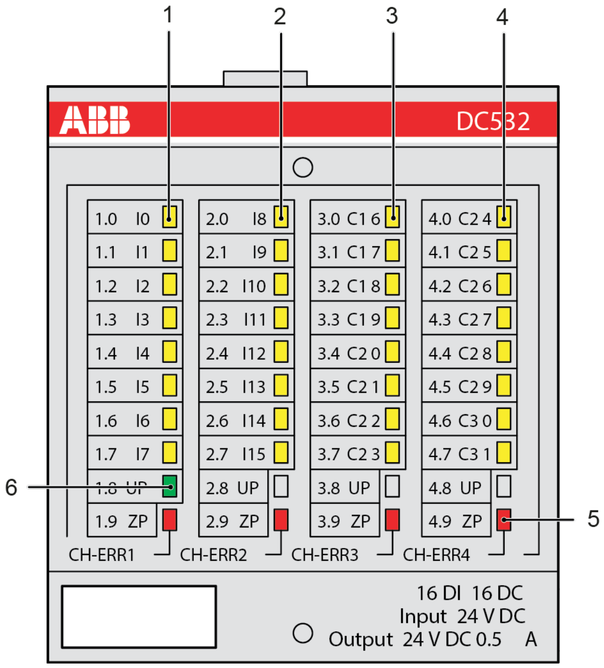


Fig. 59: Front view: DC532

Technical data

This section provides additional information on section ✎ *Chapter 1.3.3.3 “System data and CS31 bus system data” on page 52*. In case of doubt, the following information applies.

Technical Data of the complete device

Data	Value
Process voltage:	
-> Connections	X4/L+ (pin 22), X4/L+ (pin 23), X4/M (pin 24), X4/M (pin 25)
-> Fuse for L+	10 A, fast acting
- Galvanic isolation	No
Current consumption:	
-> via L+	0.19 A and max. 0.5 A per output
- Inrush current via L+ (when voltage is switched on)	0.17 A²s
Power consumption	Replacement device: 200 W Existing device: 202 W
Max. power dissipation within the module (outputs unloaded)	Replacement device: 6 W Existing device: 5 W
Address setting and configuration	DIP switch on right side of the housing
Operating and error indications	Replacement device: 41 LEDs Existing device: 33 LEDs

For further information, please refer to the existing documentation System description Advant Controller 31.

CAUTION!
System damage caused by voltage!
Exceeding the maximum supply or process voltage (>30 V DC) results in permanent system damage (destruction).

Technical data of the digital inputs

Data	Value
Connections	X2/1.0, X2/1.1, X2/1.2, X2/1.3, X2/1.4, X2/1.5, X2/1.6, X2/1.7, X3/2.0, X3/2.1, X3/2.2, X3/2.3, X3/2.4, X3/2.5, X3/2.6, X3/2.7
Input type according to EN 61131-2	Type 1 (realized through current sink)
Input delay: 0 -> 1 or 1 -> 0 *)	Replacement device: Typ. 8 ms Existing device: Typ. 7 ms
Indication of the input signals	Replacement device: One yellow LED per channel. The LED corresponds functionally to the input signal. Existing device: One green LED per channel. The LED corresponds functionally to the input signal.
Input signal voltage:	24 V DC
-> 0 signal	Replacement device: -3 V…+5 V Existing device: -30 V…+5 V
-> Undefined signal	Replacement device: > +5 V…< +15 V Existing device: > +5 V…< +13 V
-> 1 signal	Replacement device: +15 V…+30 V Existing device: +13 V…+30 V
-> Residual ripple at 0 signal	Replacement device: within -3 V…+5 V Existing device: within -30 V…+5 V
-> Residual ripple at 1 signal	Replacement device: within +15 V…+30 V Existing device: within +13 V…+30 V
Input current per channel:	
Input voltage +24 V	Replacement device: Typ. 5 mA Existing device: Typ. 7 mA
Input voltage +5 V	Replacement device: > 1 mA Existing device: ≥ 1 mA
Input voltage +15 V	Replacement device: > 5 mA Existing device: ≥ 2 mA (at input voltage +13 V)

Data	Value
Input voltage +30 V	Replacement device: < 8 mA Existing device: ≤ 9 mA
Maximum cable length:	
-> Shielded	1000 m
-> Unshielded	600 m
Protection against reversed voltage	Yes
Overvoltage protection	Up to 30 V DC

*) Input delay of the S500 module DC532. The transmission rate via serial buses has not been taken into account.

For further information, please refer to the existing documentation System description Advant Controller 31.

Technical data of the digital outputs

Data	Value
Connections	X5/3.0, X5/3.1, X5/3.2, X5/3.3, X5/3.4, X5/3.5, X5/3.6, X5/3.7
Type of digital outputs	High-side switch
Demagnetization with inductive load	With a varistor inside the device (with other circuitry)
Switching frequency with ohmic load	On request
Output voltage at signal 1	X4 / L+ (typ. 24 V) -0.8 V
Output delay: 0 -> 1 or 1 -> 0	On request
Maximum cable length:	
-> Shielded	1000 m
-> Unshielded	600 m

For further information, please refer to the existing documentation System description Advant Controller 31.

Technical data of the configurable inputs/outputs

Data	Value
Connections	X6/4.0, X6/4.1, X6/4.2, X6/4.3, X6/4.4, X6/4.5, X6/4.6, X6/4.7
Use as digital input	See 'Technical data of the digital inputs' *Chapter 1.3.3.5.4.8.2 “Technical data of the digital inputs” on page 170*
Use as digital output	See 'Technical data of the digital outputs' *Chapter 1.3.3.5.4.8.3 “Technical data of the digital outputs” on page 171*

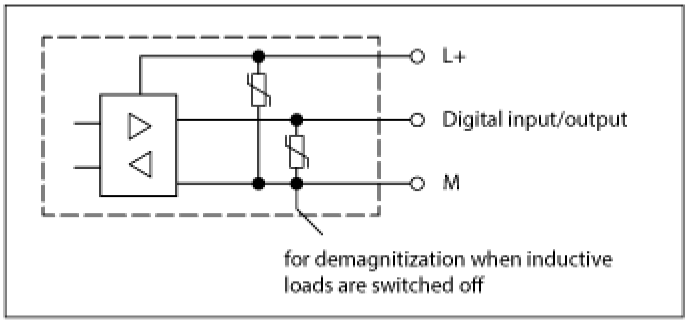


Fig. 60: Protective circuits inputs/outputs

Due to the changed protective circuit on the inputs and outputs, the restrictions concerning the input signal voltage described in the existing documentation no longer apply.

When the channels of connector X6 are to be used as inputs, the respective outputs (high-end switches) must be switched off.

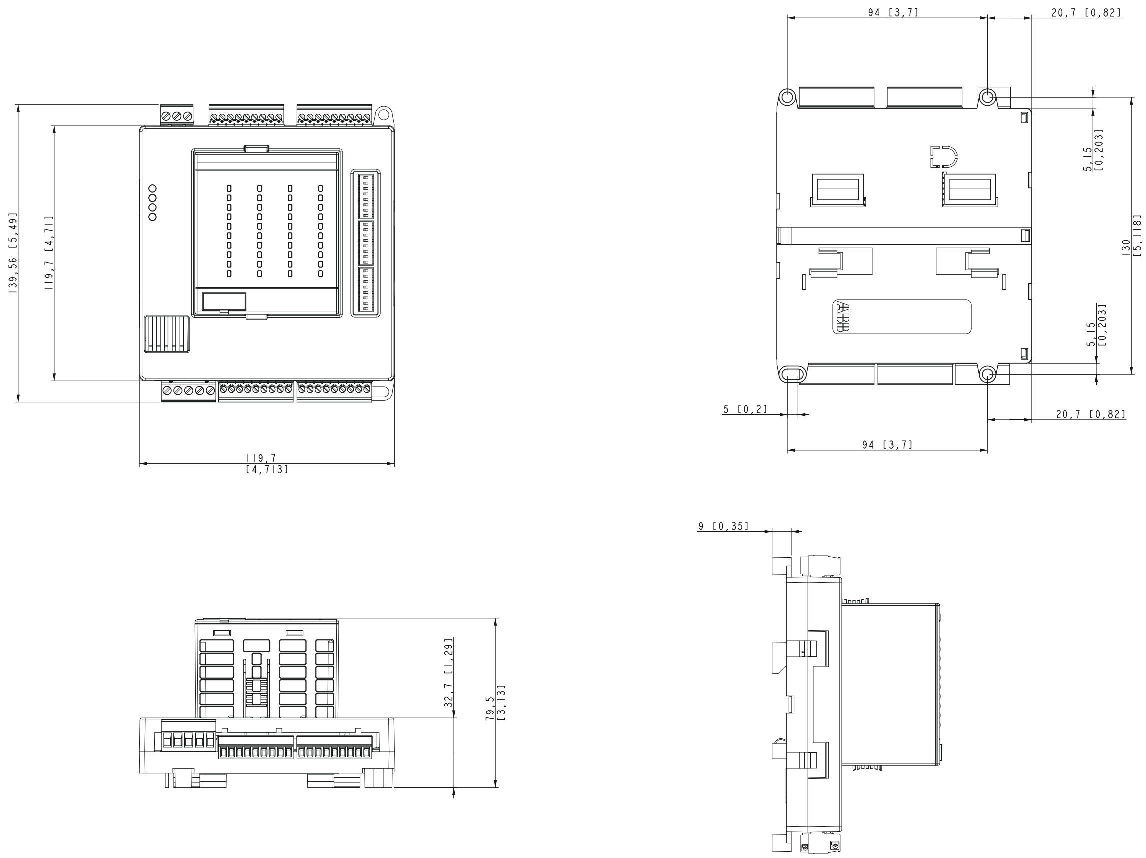
Connection to the CS31 bus

Data	Value
Connections	X1/B2, X1/B1
CS31 bus type	04 (digital input/output)
Terminating resistor	Not available (must be provided externally if needed)

Mechanical data

Data	Value
Width x height x depth	Replacement device: 120 x 140 x approx. 80 mm Existing device: 120 x 140 x 85 mm
Weight	Replacement device: 351 g (incl. terminals) Existing device: 450 g
Dimensions for mounting	See operating and assembly instructions of the replacement device (3ADR020083M0401)

Assembly / Disassembly



The dimensions are in mm and in brackets in inch.

The dimensions for the assembly holes are the same for the replacement device and the existing device.

To assemble or disassemble the replacement device, grab the device at the housing and not directly at the S500 module.

CAUTION!
System damage caused by voltage!
The exchange of a replacement device under voltage can cause permanent system damage (destruction).

Ordering data

Order No.	Scope of delivery
1SAP 800 300 R0010	Digital input/output module 07DC91-AD 1 5-pin terminal block (5.08 mm grid space) 1 3-pin terminal block (5.08 mm grid space) 4 9-pin terminal blocks (3.81 mm grid space)

1.3.3.5.5 Replacement device 07DC92-AD

Fig. 61: 3ADR333196F0015_07DC92-AD

The replacement device 07DC92-AD of the AC31 adapter series replaces the existing device 07DC92 of the 90 series.

During the development of the replacement device, care was taken to keep the device configuration identical to the configuration of the existing device. Thus, the existing documentation of device 07DC92 remains valid and serves as a reference *(system description Advant Controller 31)*. The document structure of this document is based on the document structure of the existing documentation.

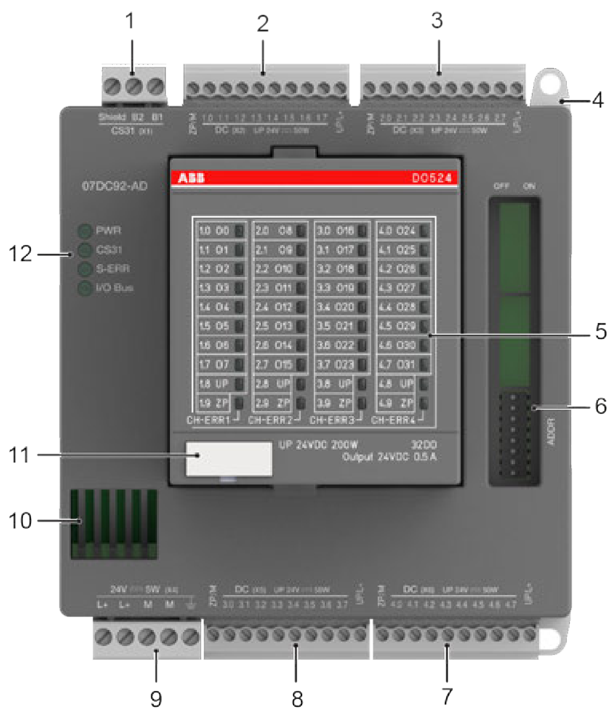
This document adds the following points to the still valid existing documentation:

- Unavoidable device deviations, e.g. due to technical limitations.
- Expansion of documentation as a result of normative requirements.
- Additional contents not described in the existing documentation.

Further information on replacement device 07DC92-AD can be found in the operating and assembly instructions of device 07DC92-AD: 3ADR020151M0401 *operating and assembly instructions of device 07DC92-AD*. Please note that no separate operating and assembly instructions are available for device 07DC92.

Please also observe the system data as well as the information on CS31 bus ➪ *Chapter 1.3.3.3 "System data and CS31 bus system data" on page 52*.

Device configuration



1 Connector X1: CS31 bus
2 Connector X2: 8 DC + voltage supply (incl. DO524)
3 Connector X3: 8 DC + voltage supply (incl. DO524)
4 Hole for screw mounting (screw diameter 4 mm, extension torque 1.2 Nm)
5 Status LEDs for DO524
6 DIP switch for address setting (ADDR)
7 Connector X6: 8 DC + voltage supply (incl. DO524)
8 Connector X5: 8 DC + voltage supply (incl. DO524)
9 Connector X4: Voltage supply (incl. DO524)
10 Ventilation
11 TA525: Label
12 4 LEDs to display the status of the complete 07DC92-AD device

LED display

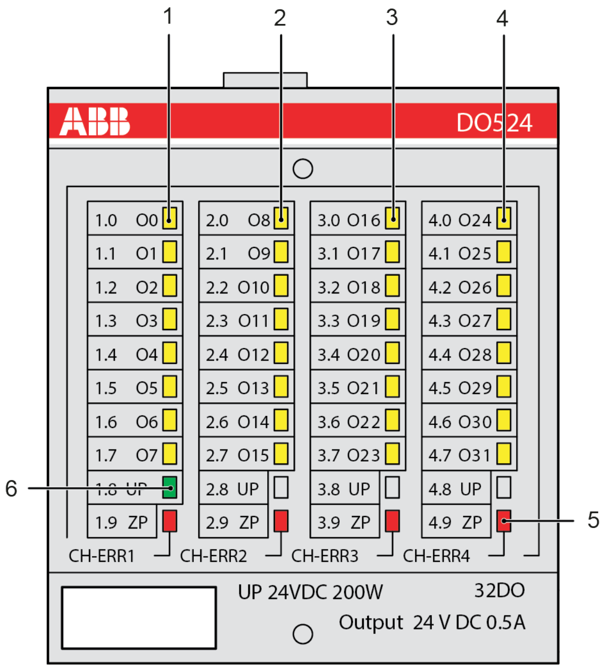


Fig. 62: LEDs DO524

No.	Displays of module
1	8 yellow LEDs to indicate the signal states of the digital inputs/outputs (X2).
2	8 yellow LEDs to indicate the signal statesof the digital inputs/outputs (X3).
3	8 yellow LEDs to indicate the signal states of the digital inputs/outputs (X5).
4	8 yellow LEDs to indicate the signal states of the digital inputs/outputs (X6).
5	4 red LEDs to indicate errors (from the DO524 module).
6	1 green LED to indicate the status of the supply voltage of the DO524 module (is supplied via UP/L+).

The replacement device does not provide a test button to measure functionality.

Connections

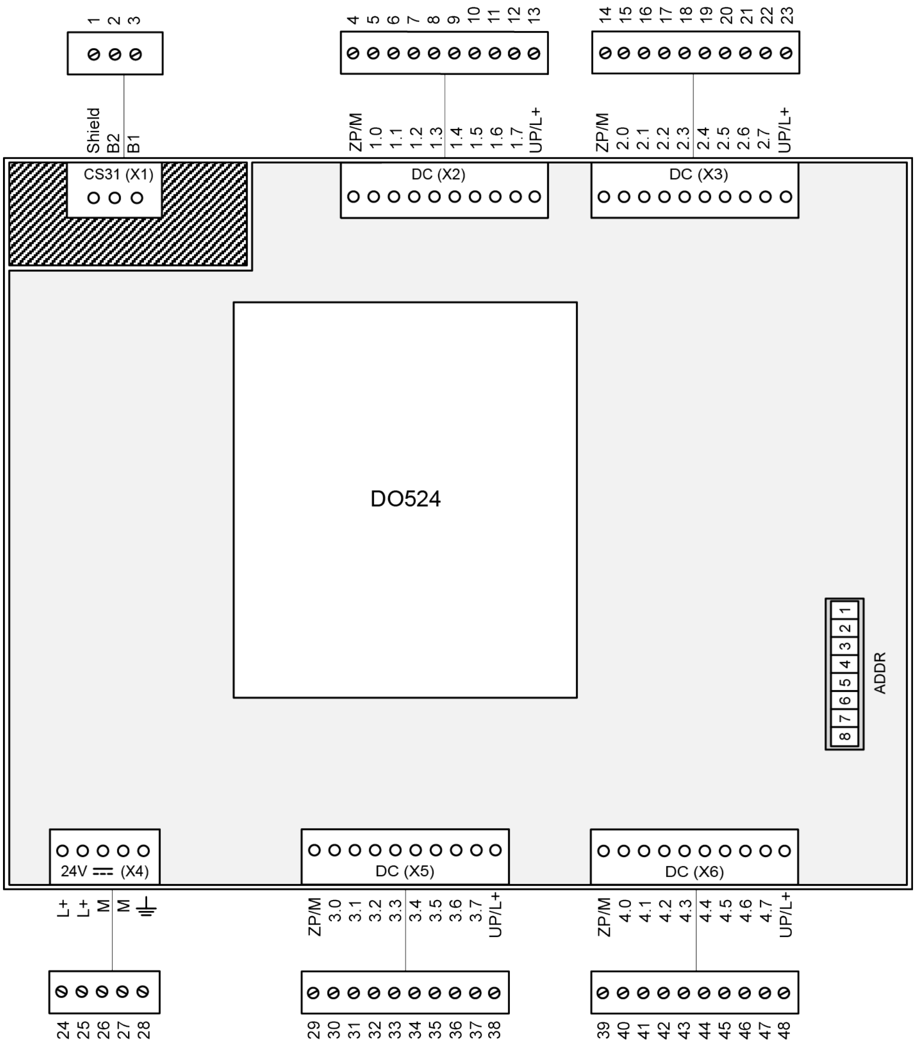


Fig. 63: Connection

Table 82: Pin assignment CS31 bus (X1)

Connector / Terminal	Pin	Assignment / Signal
X1 / Shield	1	No internal connection
X1 / B2	2	BUS 2
X1 / B1	3	BUS 1

The shield connection of the CS31 bus is not galvanically connected to the functional earth of the supply voltage.

Table 83: Pin assignment DC (X2)

Connector / Terminal	Pin	Assignment / Signal
X2 / ZP/M	4	ZP/M
X2 / 1.0	5	DO524 / O0
X2 / 1.1	6	DO524 / O1

Connector / Terminal	Pin	Assignment / Signal
X2 / 1.2	7	DO524 / O2
X2 / 1.3	8	DO524 / O3
X2 / 1.4	9	DO524 / O4
X2 / 1.5	10	DO524 / O5
X2 / 1.6	11	DO524 / O6
X2 / 1.7	12	DO524 / O7
X2 / UP/L+	13	UP/L+

Table 84: Pin assignment DC (X3)

Connector / Terminal	Pin	Assignment / Signal
X3 / ZP/M	14	ZP/M
X3 / 2.0	15	DO524 / O8
X3 / 2.1	16	DO524 / O9
X3 / 2.2	17	DO524 / O10
X3 / 2.3	18	DO524 / O11
X3 / 2.4	19	DO524 / O12
X3 / 2.5	20	DO524 / O13
X3 / 2.6	21	DO524 / O14
X3 / 2.7	22	DO524 / O15
X3 / UP/L+	23	UP/L+

Table 85: Pin assignment 24 V DC (X4)

Connector / Terminal	Pin	Assignment / Signal
X4 / L+	24	L+
X4 / L+	25	L+
X4 / M	26	M
X4 / M	27	M
X4 / FE	28	FE

Table 86: Pin assignment DC (X5)

Connector / Terminal	Pin	Assignment / Signal
X5 / ZP/M	29	ZP/M
X5 / 3.0	30	DO524 / O16
X5 / 3.1	31	DO524 / O17
X5 / 3.2	32	DO524 / O18
X5 / 3.3	33	DO524 / O19
X5 / 3.4	34	DO524 / O20
X5 / 3.5	35	DO524 / O21
X5 / 3.6	36	DO524 / O22
X5 / 3.7	37	DO524 / O23
X5 / UP/L+	38	UP/L+

Table 87: Pin assignment DC (X6)

Connector / Terminal	Pin	Assignment / Signal
X6 / ZP/M	39	ZP/M
X6 / 4.0	40	DO524 / O24
X6 / 4.1	41	DO524 / O25
X6 / 4.2	42	DO524 / O26
X6 / 4.3	43	DO524 / O27
X6 / 4.4	44	DO524 / O28
X6 / 4.5	45	DO524 / O29
X6 / 4.6	46	DO524 / O30
X6 / 4.7	47	DO524 / O31
X6 / UP/L+	48	UP/L+

CAUTION!
System damage caused by voltage!
The exchange of a replacement device under voltage can cause permanent system damage (destruction).

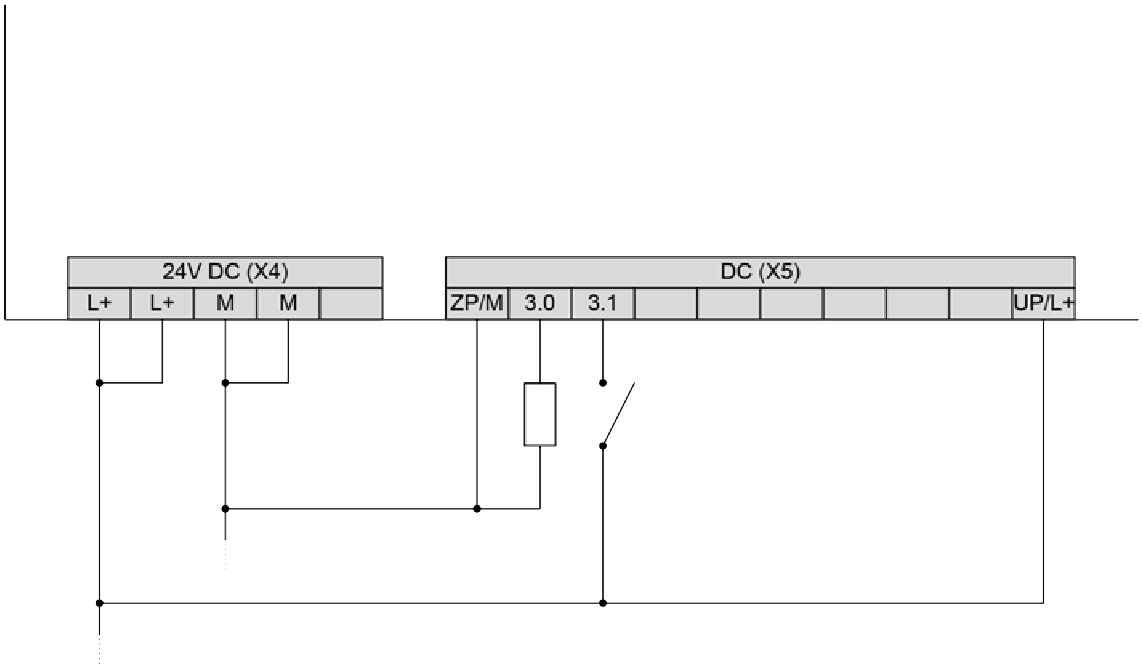


Fig. 64: Connection example: digital output

Addressing

In the following, the information in the "Type" column refers to the data type designation of the Automation Builder (see AC31 system data *Chapter 1.3.3.3 "System data and CS31 bus system data" on page 52*). The information in the "Type" column must be interpreted from the viewpoint of the CS31 bus master. The information in brackets must be interpreted from the viewpoint of the replacement device (CS31 bus slave).

Table 88: CS31 bus (32 inputs / 32 outputs)

Byte	Type	Bit	Connector / Terminal
1	8 bit input (send)	0 ... 7	X2 / 1.0 ... 1.7
2	8 bit input (send)	0 ... 7	X3 / 2.0 ... 2.7
3	8 bit input (send)	0 ... 7	X5 / 3.0 ... 3.7
4	8 bit input (send)	0 ... 7	X6 / 4.0 ... 4.7
5	8 bit output (receive)	0 ... 7	X2 / 1.0 ... 1.7
6	8 bit output (receive)	0 ... 7	X3 / 2.0 ... 2.7
7	8 bit output (receive)	0 ... 7	X5 / 3.0 ... 3.7
8	8 bit output (receive)	0 ... 7	X6 / 4.0 ... 4.7

Table 89: CS31 bus (32 outputs)

Byte	Type	Bit	Connector / Terminal
1	8 bit output (receive)	0 ... 7	X2 / 1.0 ... 1.7
2	8 bit output (receive)	0 ... 7	X3 / 2.0 ... 2.7
3	8 bit output (receive)	0 ... 7	X5 / 3.0 ... 3.7
4	8 bit output (receive)	0 ... 7	X6 / 4.0 ... 4.7

NOTICE!
In case of overloading or a short-circuit, the output limits the electricity and switches off thermally. The LED of the overloaded output is also switched off and the corresponding error indication of the DO524 flashes.

I/O configuration

The existing device had a DIP switch on the upper printed circuit board. Since the replacement device is not equipped with an upper printed circuit board, the white DIP switch is arranged on the lower printed circuit board instead.

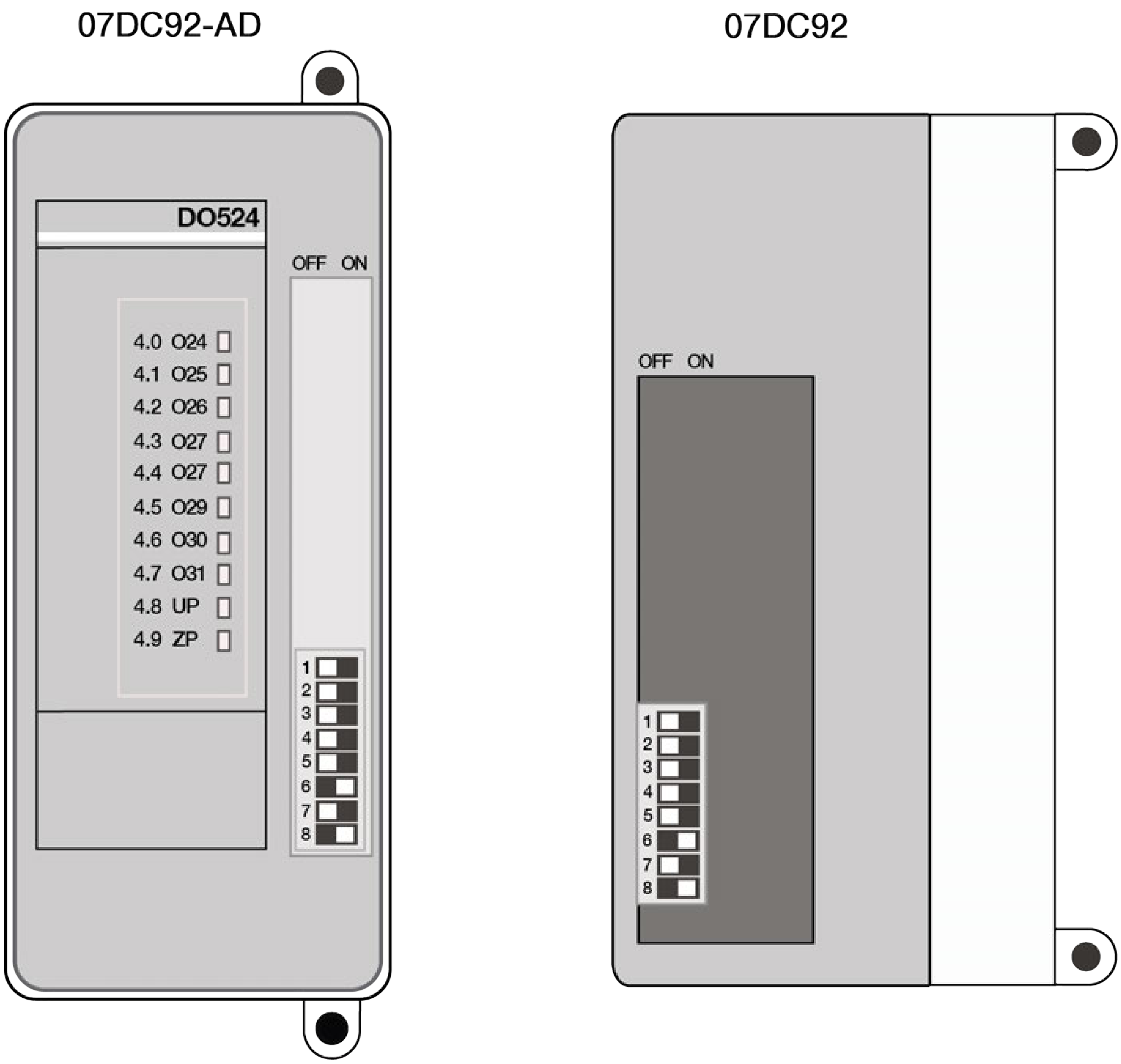


Fig. 65: DIP switch for 07DC92-AD:

> *The DIP switches are read by the device only once after the supply voltage has been connected.*

> *For further information, please refer to the existing documentation System description Advant Controller 31.*

Behavior during normal operation

Interpretation of the LEDs:

- The device initializes automatically after the supply voltage is switched on. During this time, the S-ERR LED flashes.
- The PWR LED lights up as soon as the internal supply voltage of the device is present.
- After successful initialization of the I/O bus communication to the S500 module, the I/O bus LED lights up.

- After successful initialization of the CS31 bus communication, the CS31 bus LED lights up. The S-ERR LED goes out.
- During operation, the yellow LEDs indicate the signal states of the channels.

Diagnosis and Displays

LEDs are used for diagnosis and display purposes. In addition, some diagnosis information can be transmitted via the CS31 bus.

The replacement device does not provide a test button to measure functionality.

Table 90: Diagnosis information of the CS31 bus

Error description	Channel	Error code (CODESYS)	Error code (CS31 bus)	Description
Device error	0	43	1	Internal error
Channel error	0, 8, 15 *)	46	4	Overload or short circuit on a digital output

*) The channel numbers are grouped as follows:

0 - for X2 / 1.0 ... 1.7

8 - for X2 / 2.0 ... 2.7

15 - for X5 / 3.0 ... 3.7 and X6 / 4.0 to 4.7

The error codes that are transferred by the replacement device via the CS31 bus bus are newly displayed in CODESYS. Each error code of the CS31 bus (table column 3) produces the error code in CODESYS (table column 2). As a result, it is possible to operate the replacement device with a new control system (PLC/control unit), e.g. 07KT98-ARC-AD, as well as with an old control system (PLC/central unit), e.g. 07KT98.

Table 91: Device LEDs

LED	Status	Color	LED off	LED on	LED flashes
PWR	Voltage supply	Green	No internal supply voltage	Internal supply voltage	-
CS31 bus	CS31 bus communication	Green	No CS31 bus communication	CS31 bus bus communication	Only diagnosis, no data transfer. Transmission is disturbed.
S-ERR	Error	Red	No error	Static error (must be confirmed by the control system)	No CS31 bus connection or activity
I/O bus	I/O bus communication	Green	No I/O bus communication	I/O bus communication	Error I/O bus communication

The S-ERR LED remains on even if the error no longer occurs. The error must be confirmed by the control system (PLC/central unit), e.g. by means of a function block *Chapter 1.3.3.3 “System data and CS31 bus system data” on page 52*.

Special cases with rapidly flashing LEDs (approx. 5 Hz):

- All 4 LEDs flash rapidly: An incorrect S500 module is connected to the device. The device fails to initialize.
- The LEDs of the CS31 bus, S-ERR bus and I/O bus flash rapidly: Invalid position of DIP switches. The device fails to initialize.
- The LEDs of the S-ERR bus and I/O bus flash rapidly: A checksum error occurred in an internal flash memory.
- The LED of the I/O bus flashes rapidly: An error occurred in an internal RAM.

Table 92: LEDs of the S500 module DO524

LED	Status	Color	LED off	LED on	LED flashes
O0…O7 (see No. 1 in the following figure)	Digital inputs/ outputs	Yellow	Input/output is not activated	Input/output is activated (input voltage is indicated even if supply is switched off)	-
I8 to I15 (see No. 2 in the following figure)	Digital inputs/ outputs	Yellow	Input/output is not activated	Input/output is activated (input voltage is indicated even if supply is switched off)	-
O16 to O23 (see No. 3 in the following figure)	Digital inputs/ outputs	Yellow	Input/output is not activated	Input/output is activated (input voltage is indicated even if supply is switched off)	-
C24 to C31 (see No. 4 in the following figure)	Digital inputs/ outputs	Yellow	Input/output is not activated	Input/output is activated (input voltage is indicated even if supply is switched off)	-
Error indications right (see No. 5 in the following figure)	Error indication	Red	No error	Internal error	Overload or short circuit on a channel of the corresponding group
Indication supply voltage (see No. 6 in the following figure)	Process voltage	Green	Process voltage not available	Process voltage OK	-

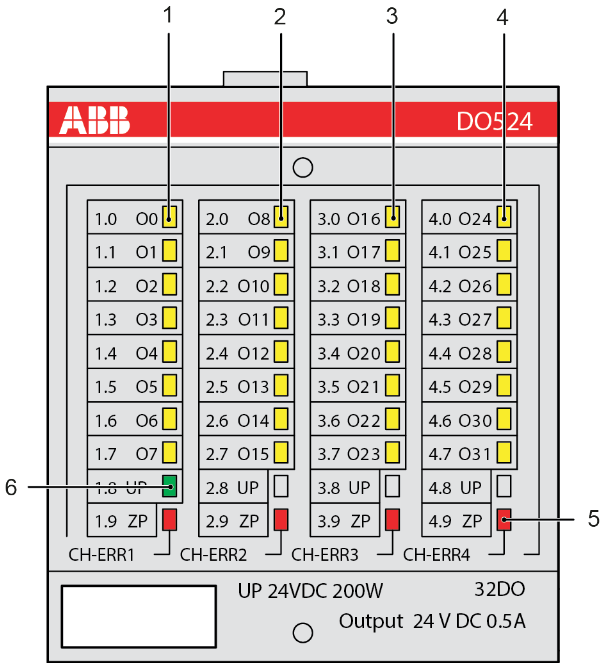


Fig. 66: LEDs DO524

Technical data

This section provides additional information on section ⇘ *Chapter 1.3.3.3 “System data and CS31 bus system data” on page 52*. In case of doubt, the following information applies.

Technical data of the complete device

Data	Value
Process voltage:	
-> Connections L+	X2 (pin 13) X3 (pin 23), X4 (pin 24, pin 25) X5 (pin 38), X6 (pin 48)
-> Connections M	X2 (pin 4) X3 (pin 14) X4 (pin 26, pin 27) X5 (pin 29) X6 (pin 39)
-> Fuse for L+	10 A, fast acting
- Galvanic isolation	None (07DC92: Group against group, all groups in relation to the rest of the device
Current consumption:	
-> via L+	0.19 A and max. 0.5 A per output
- Inrush current via L+ (when voltage is switched on)	0.17 A²s

Data	Value
Power consumption	Replacement device: 200 W Existing device: 394 W
Max. power dissipation within the module (outputs unloaded)	Replacement device: 6 W Existing device: 5 W
Address setting and configuration	DIP switch right side of housing
Operating and error indications	Replacement device: 41 LEDs Existing device: 33 LEDs

For further information, please refer to the existing documentation System description Advant Controller 31.

CAUTION!
System damage caused by voltage!
Exceeding the maximum supply or process voltage (>30 V DC) results in permanent system damage (destruction).

Changes to the process voltage connections

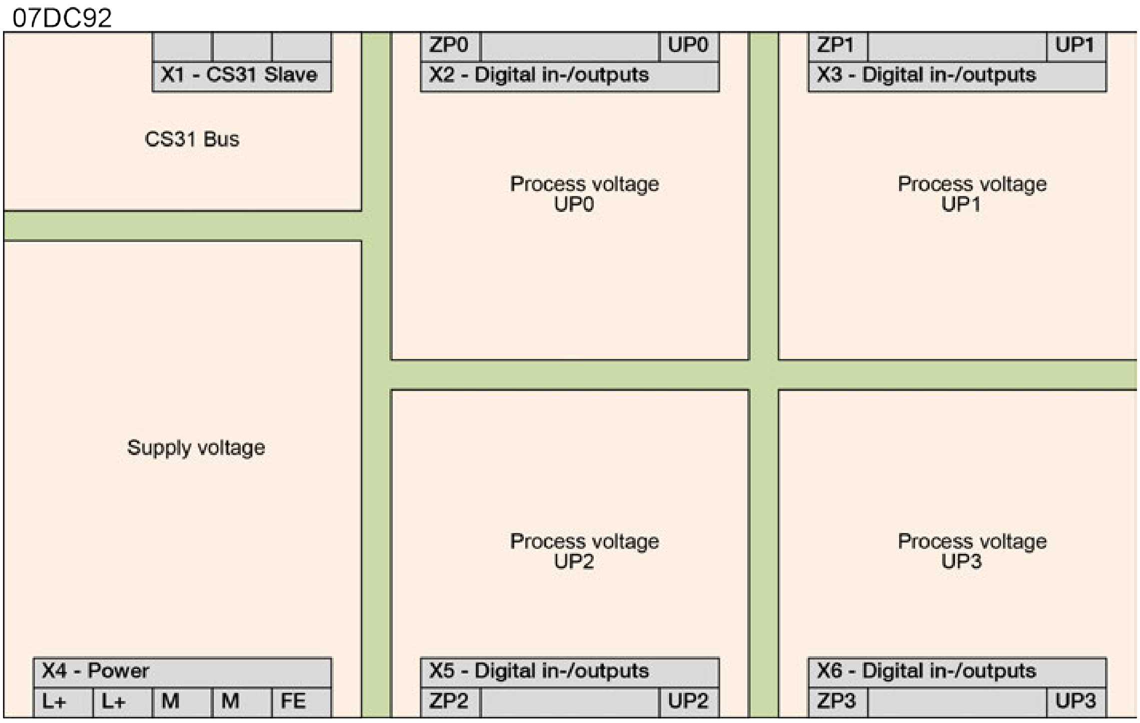


Fig. 67: Process voltage connections - 07DC92

CAUTION!
System damage caused by voltage!
Changed potential ranges!

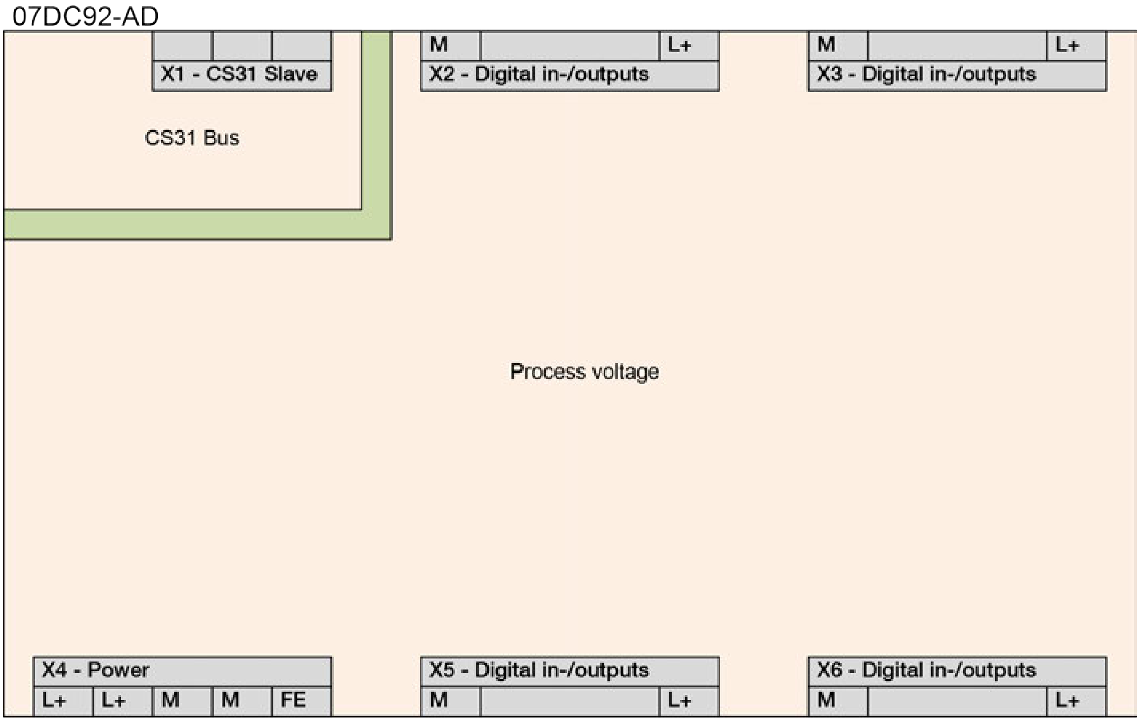


Fig. 68: Process voltage connections - 07DC92-AD

NOTICE!
Process voltage must always be connected to connector X4 on device 07DC92-AD.

Connector X4 also supplies the internal electronics for the device 07DC92-AD with 0.15 A.

Process voltage connections (X2, X3, X5, X6):

- *Maximum current for digital outputs X2 + X3: 4 A / 4 to*
- *Maximum current for digital outputs X5 + X6: 4 A / 4 to*

- *Input currents > 4 A require the connection of the second L+ contact of connector X4.*
- *For input currents > 8 A, additional L+ contacts from X2, X3, X5 or X6 must be used.*
- *The L+ contacts for the connectors X2, X3, X5 or X6 may be loaded with a maximum of 4 A.*

Technical details of the I/O channels as binary inputs

Data	Value
Connections	X2 / 1.0 ... 1.7 X3 / 2.0 ... 2.7 X5 / 3.0 ... 3.7 X6 / 4.0 ... 4.7
Input type according to EN 61131-2	Type 1 (realized through resistors)

Data	Value
Input delay: 0 -> 1 or 1 -> 0 *)	Replacement device: Type. 8 ms Existing device: Type. 7 ms
Indication of the input signals	Replacement device: One yellow LED per channel. The LED corresponds functionally to the input signal. Existing device: One green LED per channel. The LED corresponds functionally to the input signal.
Input signal voltage:	24 V DC
-> 0 signal	Replacement device: -3 V…+5 V Existing device: -6 V…+5 V
-> Undefined signal	Replacement device: > +5 V…< +15 V Existing device: > +5 V…< +13 V
-> 1 signal	Replacement device: +15 V…+30 V Existing device: +13 V…+30 V
-> Residual ripple at 0 signal	Replacement device: within -3 V…+5 V Existing device: within -6 V…+5 V
-> Residual ripple at 1 signal	Replacement device: within +15 V…+30 V Existing device: within +13 V…+30 V
Input current per channel:	
Input voltage +24 V	Replacement device: Type. 3.5 mA / 4 to Existing device: Type. 7 mA / 4 to
Input voltage +5 V	Replacement device: > 0.5 mA Existing device: ≥ 0.2 mA
Input voltage +15 V	Replacement device: > 2 mA Existing device: ≥ 2 mA (at input voltage +13 V)
Maximum cable length:	
-> Shielded	1000 m
-> Unshielded	600 m
Protection against reversed voltage	Yes
Overvoltage protection	Up to 30 V DC

*) Input delay of the S500 module DO524. The transmission rate via serial buses has not been taken into account.

For further information, please refer to the existing documentation System description Advant Controller 31.

Technical details of the I/O channels as digital outputs

Data	Value
Connections	X2 / 1.0 ...1.7 X3 / 2.0 ... 2.7 X5 / 3.0 ... 3.7 X6 / 4.0 ... 4.7
Type of digital outputs	High-side switch
Reference potentials for the outputs	M (07DC92: ZP0, ZP1, ZP2 and ZP3)
Supply voltage for the outputs	L+ (07DC92: UP0, UP1, UP2 and UP3)
Galvanic isolation	No (07DC92: Group against group, all groups in relation to the rest of the device
Output current (maximum value)	X2 + X3 = 4 A, X5 + X6 = 4 A (07DC92: 4 A per group)
Demagnetization with inductive load	Internally with a varistor (with other circuitry)
Switching frequency with ohmic load	On request
Output voltage at signal 1	X4 / L+ (typ. 24 V) -0.8 V
Output delay: 0 -> 1 or 1 -> 0	On request
Maximum cable length:	
-> Shielded	1000 m
-> Unshielded	600 m

For further information, please refer to the existing documentation System description Advant Controller 31.

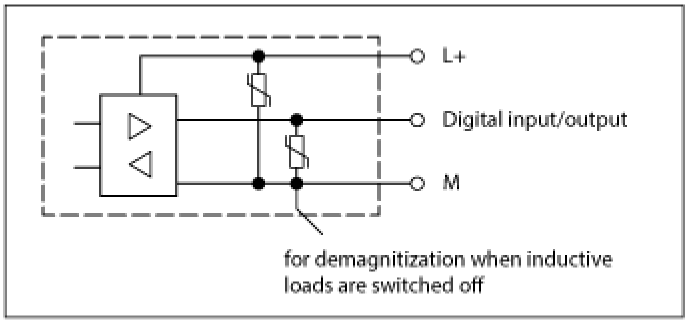


Fig. 69: Protective circuits inputs/outputs

Due to the changed protective circuit on the inputs and outputs, the restrictions concerning the input signal voltage described in the existing documentation no longer apply.

If the channels are to be used as inputs, the respective outputs (high-side switches) must be switched off.

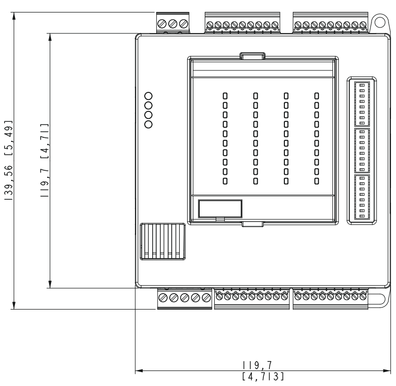
Connection to the CS31 bus

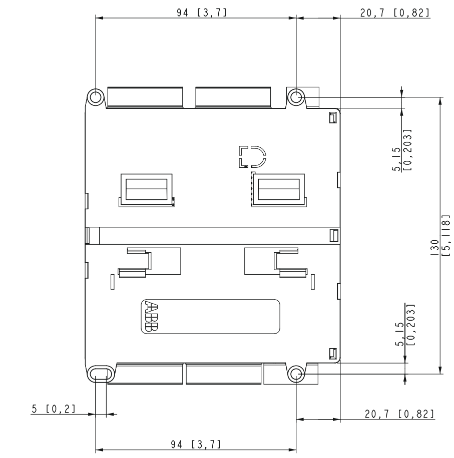
Data	Value
Connections	X1/B2, X1/B1
CS31 bus type	04 (digital input/output)
Terminating resistor	Not available (must be provided externally if needed)

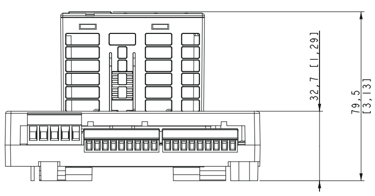
Mechanical data

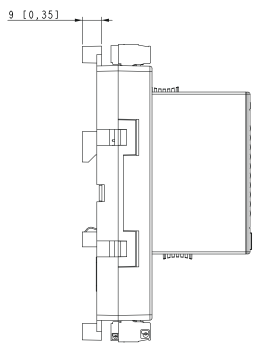
Data	Value
Width x height x depth	Replacement device: 120 x 140 x approx. 80 mm Existing device: 120 x 140 x 85 mm
Weight	Replacement device: 351 g (incl. terminals) Existing device: 450 g
Dimensions for mounting	See operating and assembly instructions of the replacement device (3ADR020151M0401) *operating and assembly instructions of device 07DC92-AD*

Assembly / Disassembly









The dimensions are in mm and in brackets in inch.

The dimensions for the assembly holes are the same for the replacement device and the existing device.

To assemble or disassemble the replacement device, grab the device at the housing and not directly at the S500 module.

CAUTION!
System damage caused by voltage!
The exchange of a replacement device under voltage can cause permanent system damage (destruction).

Ordering data

Order No.	Scope of delivery
1SAP 800 500 R0010	Digital input/output module 07DC92-AD 1 5-pole terminal block (5.08 mm grid space) 1 3-pole terminal block (5.08 mm grid space) 4 10-pole terminal blocks (3.81 mm grid space)

1.3.3.5.6 Replacement unit DC501-CS31-AD

Introduction

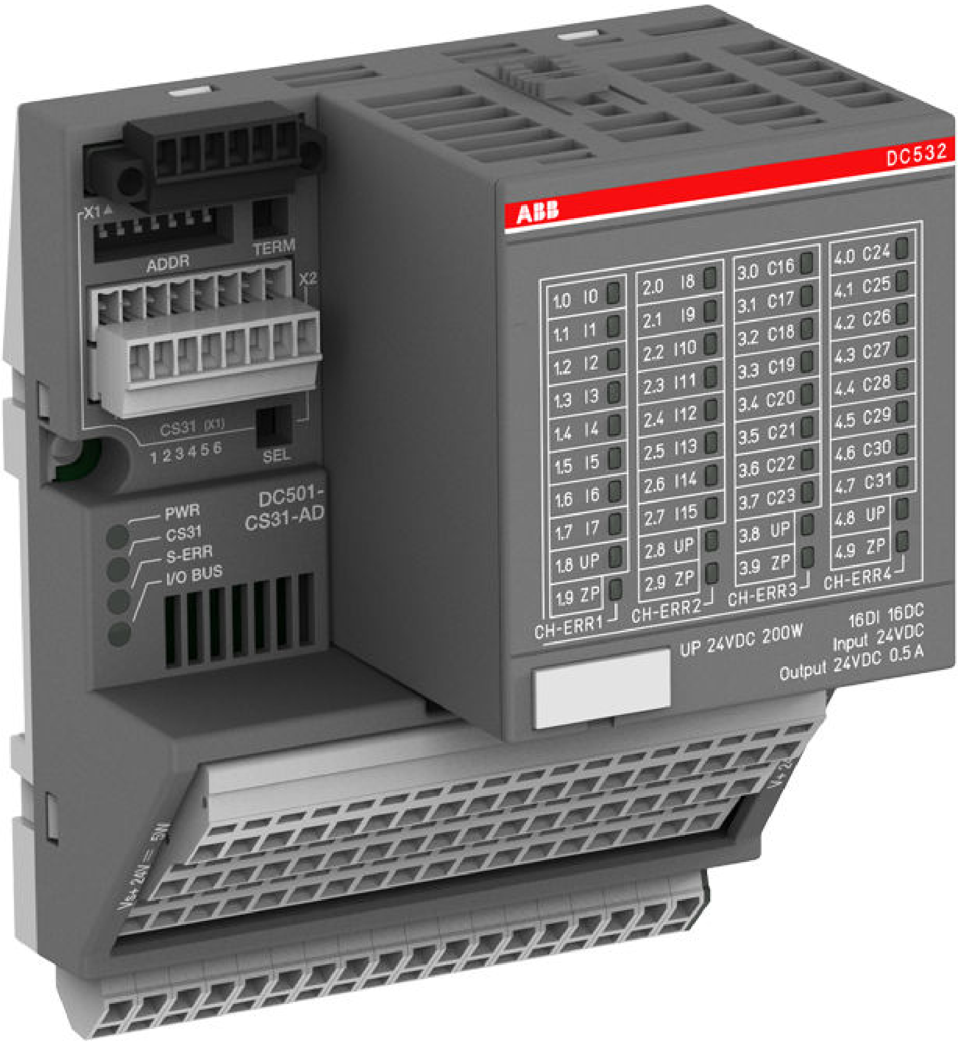


Fig. 70: 3ADR331189S0015_DC501-CS31-AD

The replacement device DC501-CS31-AD of the AC31 adapter series replaces the existing device DC501-CS31.

The existing device DC501-CS31 supported the use of so-called extension box modules to increase I/O functionality. The following modules were supported:

- Module AX501 for analog signals: 3 analog inputs, 1 analog output
- Module DI501 for digital signals: 4 digital inputs
- Module DO501 for relay output: 8 relays

The replacement device DC501-CS31-AD does not support the use of extension box modules. Instead, the functionality of modules AX501 and DI501 is integrated in the replacement device. The functionality of module DO501 is not supported.

This document describes only changes that have been integrated in the replacement device and expansions to the existing device DC501-CS31. Thus, *the existing documentation of device DC501-CS31 remains valid and serves as reference*. The extension box modules are documented in the existing documentation of the I/O-S500 hardware. This description is replaced by this document.

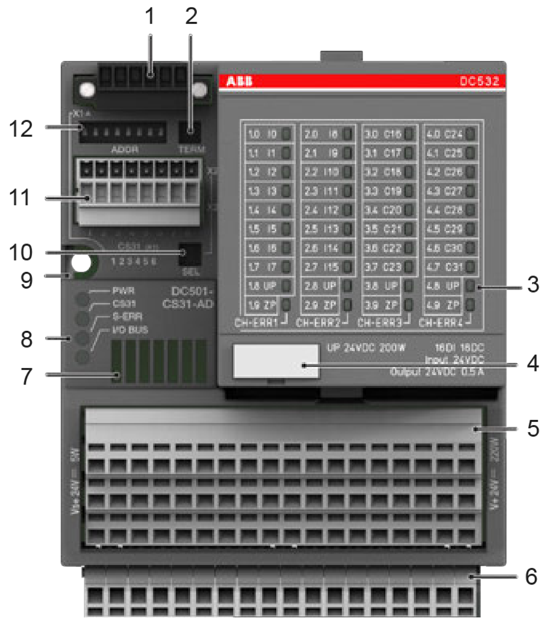
This document adds the following points to the still valid existing documentation:

- Unavoidable device deviations, e.g. due to technical limitations.
- Expansion of documentation as a result of normative requirements.
- Additional contents not described in the existing documentation.

Further information on replacement device DC501-CS31-AD can be found in the operating and assembly instructions of device DC501-CS31-AD: 3ADR020087M0401. Please note that for device DC501-CS31 no separate operating and assembly instructions are available.

Please also observe the system data as well as the information on CS31 bus *Chapter 1.3.3.3 “System data and CS31 bus system data” on page 52*.

Device configuration



1 Connection for CS31 bus (X1)
2 Bus termination (CS31 bus)
3 Status LEDs for DC532
4 TA525: Label
5 Terminals signal level (X4). 16 digital inputs, 8 digital outputs, 8 DC voltage supply (incl. DC532)
6 Terminals signal level (plug-in power bus)
7 Ventilation
8 4 Status LEDs
9 Hole for screw mounting (screw diameter 4 mm, extension torque 1.2 Nm)
10 Function selector switch for I/O extension
11 4 digital inputs (X2): 24 V DC. 3 analog inputs, 1 analog output (X3): 0 V … +10 V.
12 DIP switch for ADDR (X1)

LED display

The LED display on the replacement device is changed:

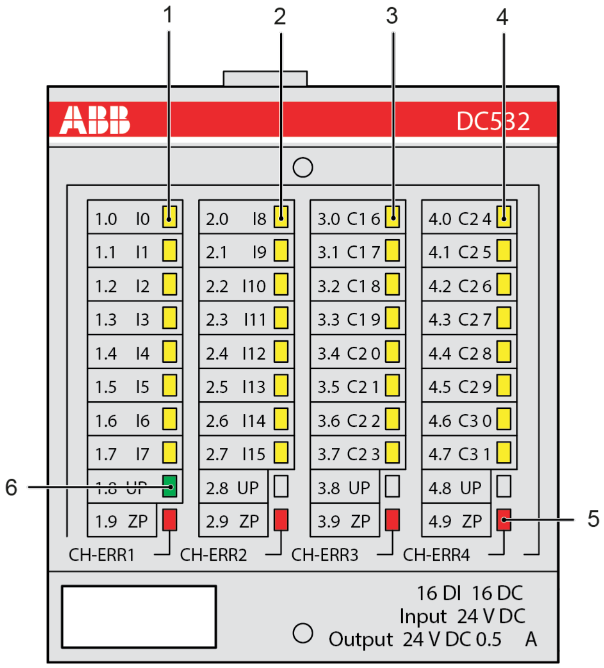


Fig. 71: Front view: DC532

No.	Displays of module
1	8 yellow LEDs to indicate the signal states of the digital inputs (X2).
2	8 yellow LEDs to indicate the signal states of the digital inputs (X3).
3	8 yellow LEDs to indicate the signal states of the digital outputs (X5).
4	8 yellow LEDs to indicate the signal states of the digital inputs/outputs (X6).
5	4 red LEDs to indicate errors (of DC532 module).
6	1 green LED to indicated the status of the supply voltage of the DC532 module (is supplied via X4).

Connections

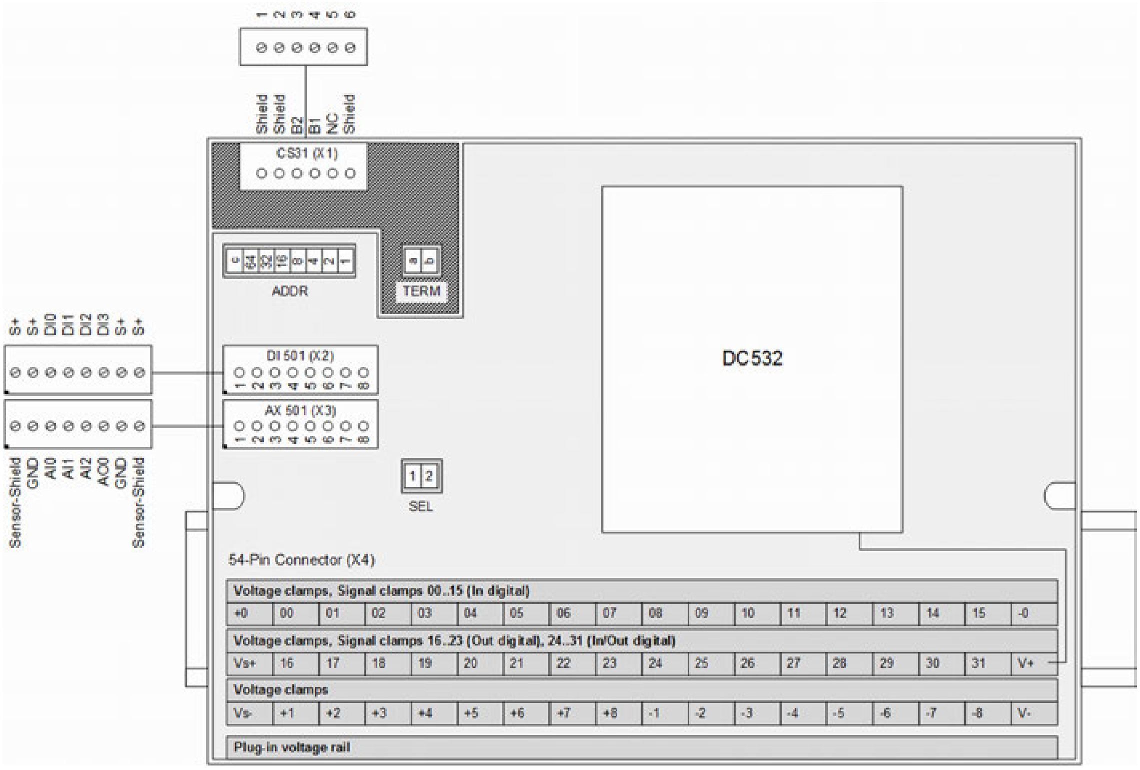


Fig. 72: Connection

Table 93: Pin assignment CS31 bus (X1)

Connector / Terminal	Pin	Assignment / Signal
X1 / Shield	1	Shield (internally connected to pins 2 and 6. No internal connection to functional earth)
X1 / Shield	2	Shield (internally connected to pins 1 and 6. No internal connection to functional earth)
X1 / B2	3	BUS 2
X1 / B1	4	BUS 1
X1 / NC	5	Not connected
X1 / Shield	6	Shield (internally connected to pins 1 and 2. No internal connection to functional earth)

Correction to existing documentation

In the existing documentation, connection X1 / 2 is incorrectly documented as "free / not connected". On the replacement device DC501-CS31-AD, the selection of the pin assignment of connector X1 is identical to the realization of device DC501-CS31. Thus, the pin assignment described in this document is valid for the replacement device and the existing device.

Table 94: Pin assignment DI501 (X2)

Connector / Terminal	Pin	Assignment / Signal
X2 / S+	1	Auxiliary voltage (max. 32 mA total load of S+ permitted) for DI0 - DI3. Voltage derived from input voltage Vs+ (X4)
X2 / S+	2	Auxiliary voltage (max. 32 mA total load of S+ permitted) for DI0 - DI3. Voltage derived from input voltage Vs+ (X4)

Connector / Terminal	Pin	Assignment / Signal
X2 / DI0	3	Digital extension input 0
X2 / DI1	4	Digital extension input 1
X2 / DI2	5	Digital extension input 2
X2 / DI3	6	Digital extension input 3
X2 / S+	7	Auxiliary voltage (max. 32 mA total load of S+ permitted) for DI0 - DI3. Voltage derived from input voltage Vs+ (X4)
X2 / S+	8	Auxiliary voltage (max. 32 mA total load of S+ permitted) for DI0 - DI3. Voltage derived from input voltage Vs+ (X4)

Table 95: Pin assignment AX501 (X3)

Connector / Terminal	Pin	Assignment / Signal
X3 / Sensor shield	1	Sensor shield
X3 / GND	2	GND
X3 / AI0	3	Analog extension input 0
X3 / AI1	4	Analog extension input 1
X3 / AI2	5	Analog extension input 2
X3 / AO0	6	Analog extension output 0
X3 / GND	7	GND
X3 / Sensor shield	8	Sensor shield

The connections X3 / 2 and X3 / 7 (GND) are directly connected to X4 / Vs-, X4 / V-. There is no AGND potential in accordance with module AX501. In module AX501, AGND is connected to GND via a resistor.

Both sensor shield connections of X3 are interconnected and jointly connected to FE via 10 MΩ || 4 nF.

The connections X3 / 2 and X3 / 7 (GND) are directly connected to X4 / Vs-, X4 / V-. There is no AGND potential in accordance with module AX501. In module AX501, AGND is connected to GND via a resistor.

Both sensor shield connections of X3 are interconnected and jointly connected to FE via 10 MΩ || 4 nF.

The terminal blocks of X2 and X3 have the following connection data:

- Conductor cross section, single wire/ flexible: 0.14 mm² to 1.5 mm²
- Conductor cross section, flexible with wire-end ferrule (without plastic ferrule): 0.25 mm² to 1.5 mm²
- Conductor cross section, flexible with wire-end ferrule (with plastic ferrule): 0.25 mm² to 0.5 mm²

Table 96: Pin assignment 54 pin connector (X4)

Connector / Block	Pin	Assignment / Signal
X4 / 1	+0	Auxiliary voltage (max. 200 mA total load of +0/ +1/ …/ +7/ +8 permitted). Voltage derived from input voltage V+ (X4)
X4 / 1	00	DC532 / I0
X4 / 1	01	DC532 / I1

Connector / Block	Pin	Assignment / Signal
X4 / 1	02	DC532 / I2
X4 / 1	03	DC532 / I3
X4 / 1	04	DC532 / I4
X4 / 1	05	DC532 / I5
X4 / 1	06	DC532 / I6
X4 / 1	07	DC532 / I7
X4 / 1	08	DC532 / I8
X4 / 1	09	DC532 / I9
X4 / 1	10	DC532 / I10
X4 / 1	11	DC532 / I11
X4 / 1	12	DC532 / I12
X4 / 1	13	DC532 / I13
X4 / 1	14	DC532 / I14
X4 / 1	15	DC532 / I15
X4 / 1	-0	GND
X4 / 2	Vs+	Voltage supply for electronics system (also for functionality of AX501 and DI501)
X4 / 2	16	DC532 / C16
X4 / 2	17	DC532 / C17
X4 / 2	18	DC532 / C18
X4 / 2	19	DC532 / C19
X4 / 2	20	DC532 / C20
X4 / 2	21	DC532 / C21
X4 / 2	22	DC532 / C22
X4 / 2	23	DC532 / C23
X4 / 2	24	DC532 / C24
X4 / 2	25	DC532 / C25
X4 / 2	26	DC532 / C26
X4 / 2	27	DC532 / C27
X4 / 2	28	DC532 / C28
X4 / 2	29	DC532 / C29
X4 / 2	30	DC532 / C30
X4 / 2	31	DC532 / C31
X4 / 2	V+	Voltage supply of inputs/outputs (module DC532 and auxiliary voltage)
X4 / 3	Vs-	GND
X4 / 3	+1	Auxiliary voltage (max. 200 mA total load of +0/ +1/ …/ +7/ +8 permitted). Voltage derived from input voltage V+ (X4)
X4 / 3	+2	Auxiliary voltage (max. 200 mA total load of +0/ +1/ …/ +7/ +8 permitted). Voltage derived from input voltage V+ (X4)

Connector / Block	Pin	Assignment / Signal
X4 / 3	+3	Auxiliary voltage (max. 200 mA total load of +0/ +1/ …/ +7/ +8 permitted). Voltage derived from input voltage V+ (X4)
X4 / 3	+4	Auxiliary voltage (max. 200 mA total load of +0/ +1/ …/ +7/ +8 permitted). Voltage derived from input voltage V+ (X4)
X4 / 3	+5	Auxiliary voltage (max. 200 mA total load of +0/ +1/ …/ +7/ +8 permitted). Voltage derived from input voltage V+ (X4)
X4 / 3	+6	Auxiliary voltage (max. 200 mA total load of +0/ +1/ …/ +7/ +8 permitted). Voltage derived from input voltage V+ (X4)
X4 / 3	+7	Auxiliary voltage (max. 200 mA total load of +0/ +1/ …/ +7/ +8 permitted). Voltage derived from input voltage V+ (X4)
X4 / 3	+8	Auxiliary voltage (max. 200 mA total load of +0/ +1/ …/ +7/ +8 permitted). Voltage derived from input voltage V+ (X4)
X4 / 3	-1	GND
X4 / 3	-2	GND
X4 / 3	-3	GND
X4 / 3	-4	GND
X4 / 3	-5	GND
X4 / 3	-6	GND
X4 / 3	-7	GND
X4 / 3	-8	GND
X4 / 3	V-	GND

Connection data of spring terminals (X4):

- Conductor cross section, single wire: 0.2 mm² to 2.5 mm²
- Conductor cross section, flexible: 0.2 mm² to 1.5 mm² (existing device: 2.5 mm² flexible)
- Conductor cross section, flexible with wire-end ferrule: 0.25 mm² to 1.5 mm²

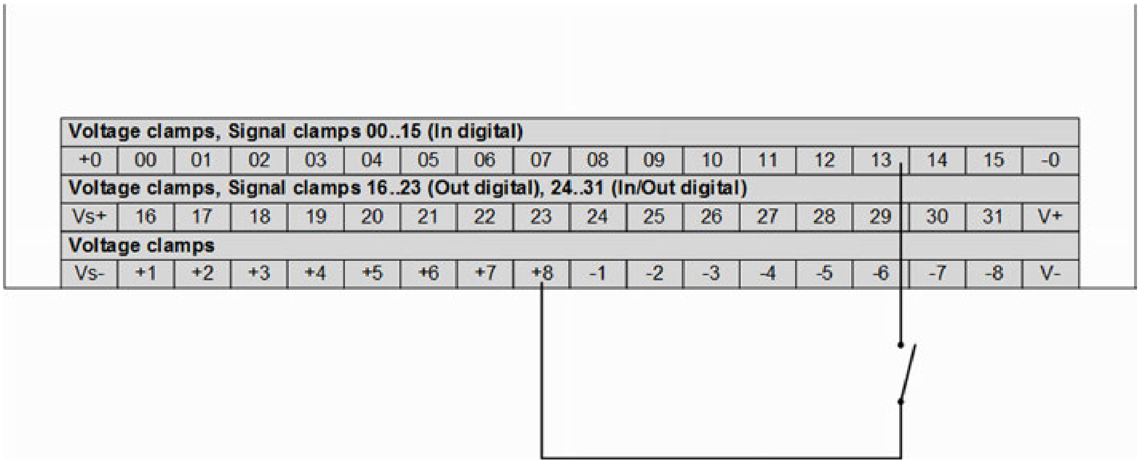


Fig. 73: Connection example: digital input (X4)

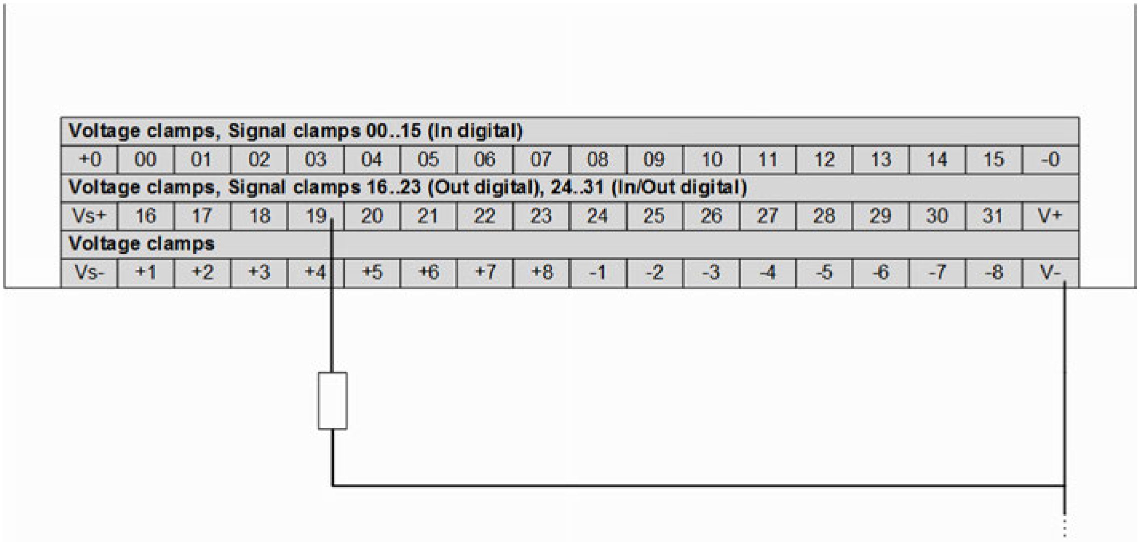


Fig. 74: Connection example: digital output

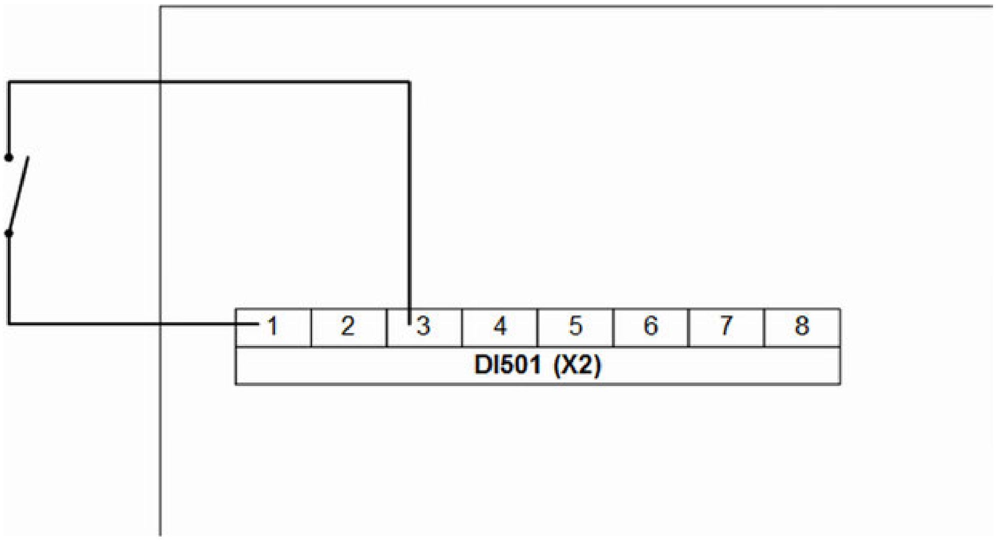


Fig. 75: Connection example: digital input (X2)

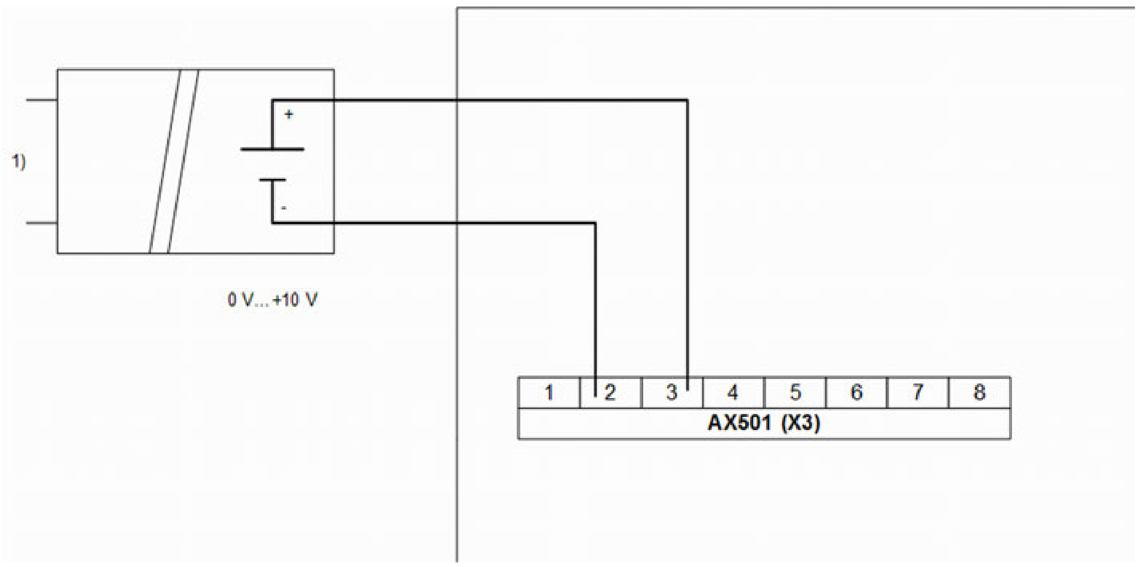


Fig. 76: Connection example: Voltage input

1) Galvanically isolated power supply of analog sensor.

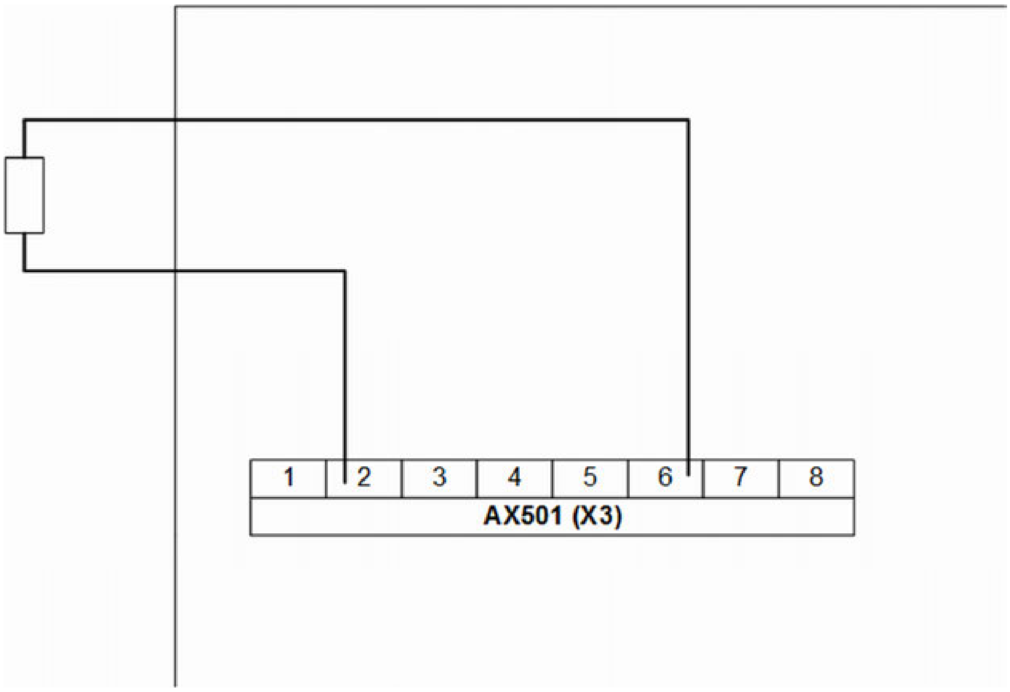


Fig. 77: Connection example: Voltage output

Analog signal lines must be routed in shielded cables. The shield must be grounded on both sides and should be grounded to replacement device and signal source / signal sink as close as possible.

CAUTION!
System damage caused by voltage!
The exchange of a replacement device under voltage can cause permanent system damage (destruction).

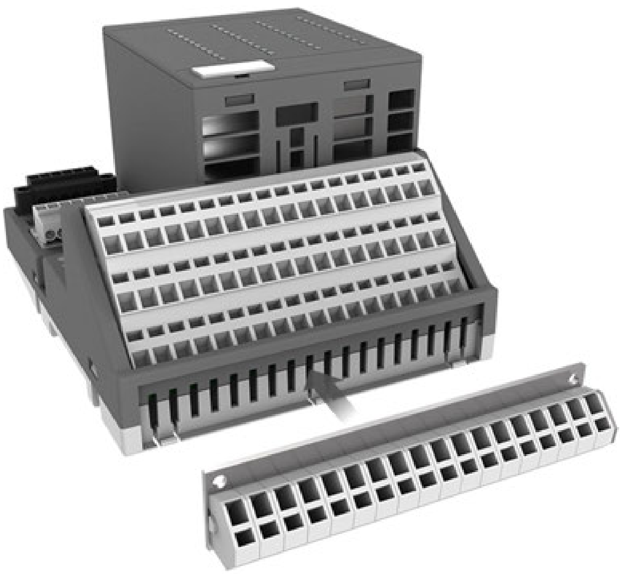


Fig. 78: Plug-in power bus

A power bus can be plugged into the replacement device. The contacts of the power bus have no connection to the electronic system of the replacement device. Furthermore, no FE connection is available.

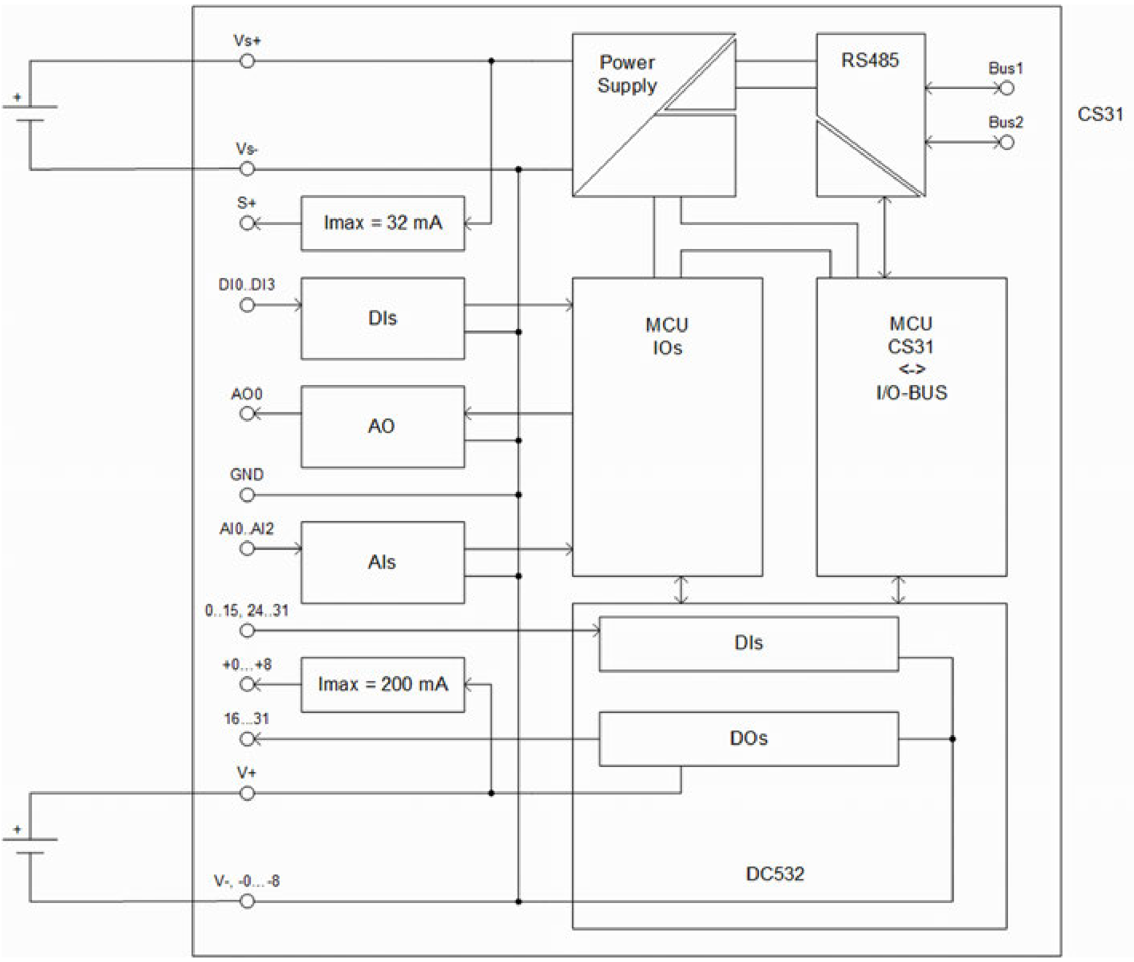


Fig. 79: Schematic diagram

For further information on grounding of the individual connections as well as shielding, please refer to 'System data and CS31 bus system data' *Chapter 1.3.3.3 “System data and CS31 bus system data” on page 52*.

Addressing

In the existing device, the address DIP switch was arranged on the top right of the device. In the replacement device, this DIP switch is located on the left side of the device.

An additional DIP switch (SEL) has been implemented for the selection of the extension (AX501, 3AI1AO or DI501/4DI). Please note that only one extension at a time can be used.

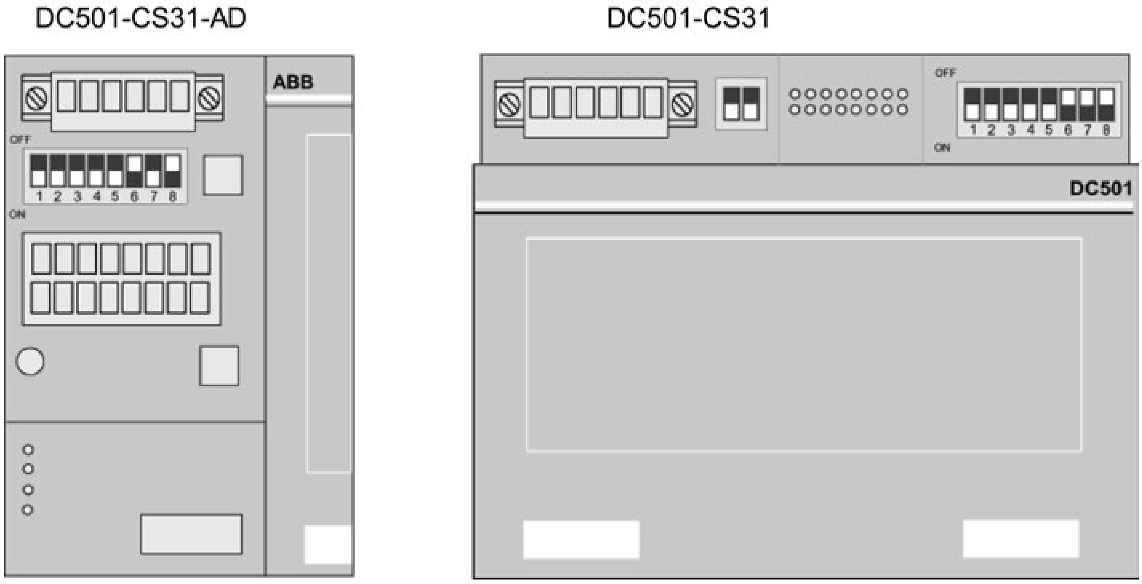


Fig. 80: DIP switch for DC501-CS31-AD

The function of the address DIP switch 1 (channel switch) available in the existing device is no longer supported. This DIP switch must be switched off.

Table 97: Extension DIP switch (SEL)

S1	S2	Description
OFF	OFF	Normal, without extension
OFF	ON	Normal, with 3AI1AO/ AX501 extension
ON	OFF	Normal, with 4DI/ DI501 extension
ON	ON	Version DC501R0100, without extension

The device version DC501R0100 differs only in the data format of the CS31 bus *Chapter 1.3.3.3.2 “CS31 bus system data” on page 58*.

The DIP switches are read by the device only once after the supply voltage has been connected.

For further information, please refer to the existing documentation System description Advant Controller 31.

In the following, the information in the "Type" column refers to the data type designation of the Automation Builder (see AC31 system data *Chapter 1.3.3.3 “System data and CS31 bus system data” on page 52*). The information in the "Type" column must be interpreted from the viewpoint of the CS31 bus master. The information in brackets must be interpreted from the viewpoint of the replacement device (CS31 bus slave).

Table 98: CS31 bus: 16 DI and 16 DO, normal and version DC501R0100

Byte	Type	Bit	Connector / Terminal
1	8 bit input (send)	0 ... 7	X4 / 00 ... 07
2	8 bit input (send)	0 ... 7	X4 / 08 ... 15
3	8 bit output (receive)	0 ... 7	X4 / 16 ... 23
4	8 bit output (receive)	0 ... 7	X4 / 24 ... 31

Table 99: CS31 bus: 24 DI and 16 DO, normal

Byte	Type	Bit	Connector / Terminal
1	8 bit input (send)	0 ... 7	X4 / 00 ... 07
2	8 bit input (send)	0 ... 7	X4 / 08 ... 15
3	8 bit input (send)	0 ... 7	X4 / 24 ... 31
4	8 bit input (send, filling byte)	0 ... 7	-
5	8 bit output (receive)	0 ... 7	X4 / 16 ... 23
6	8 bit output (receive)	0 ... 7	X4 / 24 ... 31

Table 100: CS31 bus: 24 DI and 16 DO, version DC501R0100

Byte	Type	Bit	Connector / Terminal
1	8 bit input (send)	0 ... 7	X4 / 00 ... 07
2	8 bit input (send)	0 ... 7	X4 / 08 ... 15
3	8 bit output (receive)	0 ... 7	X4 / 16 ... 23
4	8 bit input (send)	0 ... 7	X4 / 24 ... 31
5	8 bit output (receive)	0 ... 7	X4 / 24 ... 31

Table 101: CS31 bus: 16 DI, 16 DO, 3AI1AO, normal

Byte	Type	Bit	Connector / Terminal
1	8 bit input (send)	0 ... 7	X4 / 00 ... 07
2	8 bit input (send)	0 ... 7	X4 / 08 ... 15
3	8 bit input (send)	0 ... 7	X3 / 3
4	8 bit input (send)	0 ... 7	X3 / 4
5	8 bit input (send)	0 ... 7	X3 / 5
6	8 bit output (receive)	0 ... 7	X4 / 16 ... 23
7	8 bit output (receive)	0 ... 7	X4 / 24 ... 31
8	8 bit output (receive)	0 ... 7	X3 / 6

Table 102: CS31 bus: 16 DI, 16 DO, 4 DI, normal

Byte	Type	Bit	Connector / Terminal
1	8 bit input (send)	0 ... 7	X4 / 00 ... 07
2	8 bit input (send)	0 ... 7	X4 / 08 ... 15
3	8 bit input (send)	0 ... 3	X2 / 3 ... 6
	8 bit input (send)	4 .. .7	-

Byte	Type	Bit	Connector / Terminal
4	8 bit output (receive)	0 ... 7	X4 / 16 ... 23
5	8 bit output (receive)	0 ... 7	X4 / 24 ... 31

Table 103: CS31 bus: 24 DI, 16 DO, 3AI1AO, normal

Byte	Type	Bit	Connector / Terminal
1	8 bit input (send)	0 ... 7	X4 / 00 ... 07
2	8 bit input (send)	0 ... 7	X4 / 08 ... 15
3	8 bit input (send)	0 ... 7	X4 / 24 ... 31
4	8 bit input (send, filling byte)	0 ... 7	-
5	8 bit input (send)	0 ... 7	X3 / 3
6	8 bit input (send)	0 ... 7	X3 / 4
7	8 bit input (send)	0 ... 7	X3 / 5
8	8 bit input (send, filling byte)	0 ... 7	-
9	8 bit output (receive)	0 ... 7	X4 / 16 ... 23
10	8 bit output (receive)	0 ... 7	X4 / 24 ... 31
11	8 bit output (receive)	0 ... 7	X3 / 6
12	8 bit output (receive, filling byte)	0 ... 7	-

Table 104: CS31 bus: 24 DI, 16 DO, 4 DI, normal

Byte	Type	Bit	Connector / Terminal
1	8 bit input (send)	0 ... 7	X4 / 00 ... 07
2	8 bit input (send)	0 ... 7	X4 / 08 ... 15
3	8 bit input (send)	0 ... 7	X4 / 24 ... 31
4	8 bit input (send, filling byte)	0...7	-
5	8 bit input (send)	0 ... 3	X2 / 3 ... 6
		4 ... 7	-
6	8 bit input (send, filling byte)	0 ... 7	-
7	8 bit output (receive)	0 ... 7	X4 / 16 ... 23
8	8 bit output (receive)	0 ... 7	X4 / 24 ... 31

Table 105: CS31 bus: analog values

Nominal range 0…+10 V	Digital value (decimal)	Digital value (hexadecimal)
9.961 V	255	FF
9.922 V	254	FE
…	…	…
0.039 V	1	01
0.000 V	0	00

Relationship between analog voltage and digital representation (applies to analog inputs and analog output):

$$U_{\text{Signal}} = U_{\text{Ref}} \cdot \frac{\mathit{Digital\ value}_{8\ \text{Bit}}}{256}$$
$$U_{\text{Ref}} = 10\ V$$

Fig. 81: Formula: Voltage

> ***Documentation change***
> *The replacement device does not have an I/O bus. Communication interface module cannot be connected. For this reason, chapter "1.1.3 Addressing" of the technical description of DC501-CS31 concerning the expansion modules (e.g. DX511, DI511, DO511, AX511, AI511, AI512) is not valid for the replacement device. Possible data structures for the replacement device are indicated in the following table.*

Behavior during normal operation

Interpretation of the LEDs:

- The device initializes automatically after the supply voltage is switched on. During this time, the S-ERR LED flashes.
- The PWR LED lights up as soon as the internal supply voltage of the device is present.
- After successful initialization of the I/O bus communication to the S500 module, the I/O bus LED lights up.
- After successful initialization of the CS31 bus communication, the CS31 bus LED lights up. The S-ERR LED goes out.
- During operation, the yellow LEDs indicate the signal states of the channels.

The RAM is checked during the initialization of the device. In addition, the firmware in the flash memory is checked by means of a checksum during initialization. When the control system (PLC/central unit) is stopped during normal operation, the outputs of the device are switched off. The inputs remain active. The outputs are also switched off in case of a malfunction of the CS31 bus.

Diagnosis and display

The replacement device transmits diagnosis information also via the CS31 bus.

Table 106: Diagnosis information CS31 bus

Error description	Channel	Error code (CODESYS)	Error code (CS31 bus)	Description
Device error	0	43	1	Internal error
Device error	1	45	2	No supply voltage V+ available
Channel error	0…15	46	4	Overload or short circuit on a digital output

The error codes that are transferred by the replacement device via the CS31 bus bus are newly displayed in CODESYS. Each error code of the CS31 bus (table column 3) produces the error code in CODESYS (table column 2). As a result, it is possible to operate the replacement device with a new control system (PLC/control unit), e.g. 07KT98-ARC-AD, as well as with an old control system (PLC/central unit), e.g. 07KT98.

Since in the replacement device the functionality of the extension box is integrated in the hardware, error code 6 (failure of extension box) does not occur.

The input/output functions of the extensions (AX501/ 3AI1AO, DI501/ 4DI) have no diagnoses.

Table 107: Device LEDs

LED	Status	Color	LED off	LED on	LED flashes
PWR	Voltage supply	Green	No internal supply voltage	Internal supply voltage	-
CS31 bus	CS31 bus communication	Green	No CS31 bus communication	CS31 bus bus communication	Only diagnosis, no data transfer. Transmission is disturbed.
S-ERR	Error	Red	No error	Static error (must be confirmed by the control system)	No CS31 bus connection or activity
I/O bus	I/O bus communication	Green	No I/O bus communication	I/O bus communication	Error I/O bus communication

The S-ERR LED remains on even if the error no longer occurs. The error must be confirmed by the control system (PLC/central unit), e.g. by means of a function block *Chapter 1.3.3.3 “System data and CS31 bus system data” on page 52*.

Special cases with rapidly flashing LEDs (approx. 5 Hz):

- All 4 LEDs flash rapidly: An incorrect S500 module is connected to the device. The device fails to initialize.
- The LEDs of the CS31 bus, S-ERR bus and I/O bus flash rapidly: Invalid position of DIP switches. The device fails to initialize.
- The LEDs of the S-ERR bus and I/O bus flash rapidly: A checksum error occurred in an internal flash memory.
- The LED of the I/O bus flashes rapidly: An error occurred in an internal RAM.

Table 108: S500 module DC532 LEDs

LED	Status	Color	LED off	LED on	LED flashes
I0…I7 (see No. 1 in the following figure)	Digital inputs	Yellow	Input is not activated	Input is activated (input voltage is indicated even if supply is switched off)	-
I8…I15 (see No. 2 in the following figure)	Digital inputs	Yellow	Input is not activated	Input is activated (input voltage is indicated even if supply is switched off)	-
C16…C23 (see No. 3 in the following figure)	Digital outputs	Yellow	Output is not activated	Output is activated	-

LED	Status	Color	LED off	LED on	LED flashes
C24…C31 (see No. 4 in the following figure)	Digital inputs or digital outputs	Yellow	Input or output is not activated	Input/output is activated (input voltage is indicated even if supply is switched off)	-
Indication supply voltage (see No. 6 in the following figure)	Process voltage	Green	Process voltage not available	Process voltage OK	-
Error indications left (see No. 5 in the following figure)	Error indication	Red	No error	Internal error	
Error indications right (see No. 5 in the following figure)	Error indication	Red	No error	Internal error	Overload or short circuit on a channel of the corresponding group

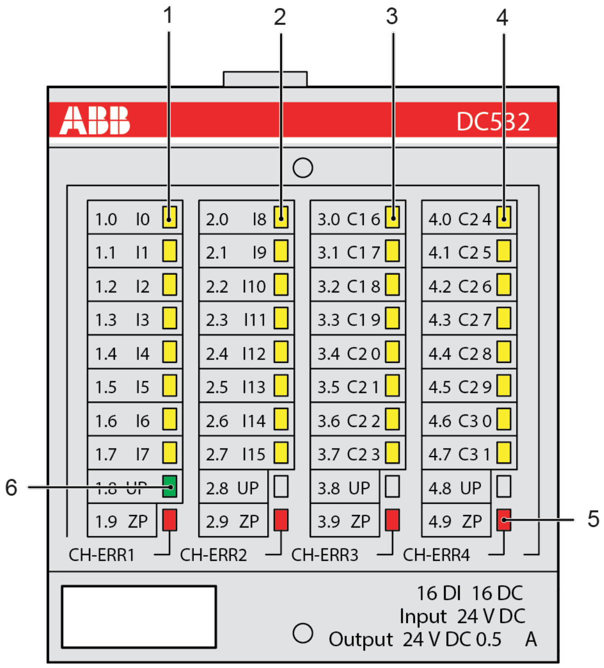


Fig. 82: Front view: DC532

Technical data

This section expands the details provided in the chapter 'System data and CS31 system data' ↳ *Chapter 1.3.3.3 "System data and CS31 bus system data" on page 52* and contains information on electromagnetic compatibility. The conformity is described in the declaration of conformity, which is available on the ABB website.

> *To ensure proper function of the replacement device DC501-CS31-AD, both supply voltages Vs+ and V+ must be applied.*

Technical data of the complete device

Table 109: Supply voltage Vs

Data	Value
Process voltage: Fuse for Vs+	10 A, fast acting
Current consumption:	
-> via Vs+	Replacement device: 0.15 A Existing device DC501-CS31: approx. 60 ... 230 mA
- Inrush current via Vs+ (when voltage is switched on)	0.06 A^2s
Power consumption	5 W

For further information, please refer to the existing documentation System description Advant Controller 31.

CAUTION!
System damage caused by voltage!
Exceeding the maximum supply or process voltage (>30 V DC) results in permanent system damage (destruction).

Table 110: Supply voltage V

Data	Value
Process voltage:	
-> Fuse for V+	10 A, fast acting
-> Additional V-/Vs- connections (GND)	X4 / -0, X4 / -1, X4 / -2, X4 / -3, X4 / -4, X4 / -5, X4 / -6, X4 / -7, X4 / -8
Current consumption:	
-> via V+	Replacement device: 0.15 A incl. load current Existing device DC501-CS31: approx. 100 mA without load current
- Inrush current via V+ (when voltage is switched on)	0.013 A^2s
Power consumption	220 W
Power consumption outputs unloaded	6 W
Sensor supply voltage connections	X4 / +0, X4 / +1, X4 / +2, X4 / +3, X4 / +4, X4 / +5, X4 / +6, X4 / +7, X4 / +8
Current sensor supply voltage (all connections combined)	Replacement device: max. 200 mA Existing device DC501-CS31: Microfuse 8 A, fast acting *)

*) The existing device contained an 8 A fuse to be exchanged by the user. The replacement device has an integrated electronic current limiter instead.

For further information, please refer to the existing documentation System description Advant Controller 31.

CAUTION!
System damage caused by voltage!
Exceeding the maximum supply or process voltage (>30 V DC) results in permanent system damage (destruction).

Connection to the CS31 bus

Data	Value
Connections	X1 / 3, X1 / 4
CS31 bus type	04 (digital input/output)

Expansion interface

The replacement device does not have an expansion interface.

Interface extension box

Table 111: Analog inputs

Data	Value
Number of channels	3
Connections	X3 / 3, X3 / 4, X3 / 5
Reference connections (GND)	X3 / 2, X3 / 7
Type of inputs	Voltage unipolar
Galvanic isolation	Not available
Nominal range	0…10 V
Input resistance per channel	Replacement device: > 100 kΩ Existing device AX501: 95 kΩ
Time constant of the input filter	Replacement device: approx. 8 ms Existing device AX501: approx. 7 ms
Total errors (due to non-linearity, offset, resolution and temperature)	Replacement device: max. 3 % Existing device AX501: 0.6 % ± 1 digit ± 150 ppm/K
Indication of the input signals	Replacement device: not available Existing device AX501: green LED per channel
Conversion cycle *)	Replacement device: 1.5 ms for all three channels Existing device AX501: 1.64 ms for all three channels
Conversion process	Successive approximation

Data	Value
Averaging of measured values	not available
Resolution	8 bit
Unused voltage inputs	Can remain open or be short-circuited after GND or V+ to increase noise immunity
Overvoltage protection	Available
Overload range	± 30 V DC
Max. line length of analog lines, line cross section > 0.14 mm²	100 m

*) Conversion cycle of MCU of I/O processing. The transmission via serial buses is slower.

For further information, please refer to the existing documentation System description Advant Controller 31.

Table 112: Analog output

Data	Value
Number of channels	1
Connections	X3 / 6
Reference connections (GND)	X3 / 2, X3 / 7
Type of outputs	Voltage unipolar
Galvanic isolation	not available
Nominal range	0 ... 10 V
Output load capability	max. ± 5 mA
Indication of the output signals	Replacement device: Not available Existing device AX501: green LED per channel
Resolution	8 bit
Total errors (due to non-linearity, offset, resolution and temperature)	Replacement device: max. 3 % Existing device AX501: 0.6 % ± 1 digit ± 150 ppm/K
Update cycle	1.5 ms
Unused output	remains unconnected
Short-circuit-proof	Yes *)
External supply protection	Up to +30 V DC (no external supply protection available for negative voltages!)
Max. line length of analog lines, line cross section > 0.14 mm²	100 m

For further information, please refer to the existing documentation System description Advant Controller 31.

CAUTION!

System damage caused by short-circuit!

*) A short-circuit can result in up to 2 W additional power dissipation in the device. If this power dissipation cannot be discharged, the replacement device can be damaged.

Table 113: Digital inputs

Data	Value
Number of channels	4
Connections	X2 / 3, X2 / 4, X2 / 5, X2 / 6
Reference connection (GND)	X4 / Vs-
Connections switch supply	X2 / 1, X2 / 2, X2 / 7, X2 / 8
Current switch supply (all connections combined)	Replacement device: max. 32 mA Existing device DI501: max. 30 mA
Input type according to EN 61131-2	Type 1
Galvanic isolation	Not available
Indication of the input signals	Replacement device: Not available Existing device DI501: green LED per channel
Input delay (0->1 or 1->0)	Typ. 3 ms
Scanning cycle	500 µs
Input signal voltage:	
-	24 V DC
-> 0 signal	Replacement device: -3 V … +5 V Existing device DI501: -30 V … +5 V
-> Undefined signal	Replacement device: > +5 V … < +15 V Existing device DI501: > +5 V … < +13 V
-> 1 signal	Replacement device: +15 V … +30 V Existing device DI501: +13 V … +30 V
-> Residual ripple at 0 signal	Within -3 V … +5 V
-> Residual ripple at 1 signal	Within +15 V … +30 V
Input current per channel:	
-> Input voltage +24 V	Typ. 5.5 mA
-> Input voltage +5 V	≥ 0.5 mA
-> Input voltage +15 V	≥ 2 mA
-> Input voltage +30 V	≤ 8 mA
Maximum cable length:	
-> Shielded	1000 m
-> Unshielded	600 m
Overvoltage protection	Available
Overload range	±30 V DC

> *For further information, please refer to the existing documentation <u>System description Advant Controller 31</u>.*

Inputs 24 V DC

Data	Value
Connections	X4 / 00, X4 / 01, X4 / 02, X4 / 03, X4 / 04, X4 / 05, X4 / 06, X4 / 07, X4 / 08, X4 / 09, X4 / 10, X4 / 11, X4 / 12, X4 / 13, X4 / 14, X4 / 15, X4 / 24, X4 / 25, X4 / 26, X4 / 27, X4 / 28, X4 / 29, X4 / 30, X4 / 31
Input type according to EN 61131-2	Type 1
Galvanic isolation	Not available
Status display	Replacement device: 1 yellow LED per input Existing device DC501-CS31: 1 green LED per input
Input delay (0-> 1 or 1-> 0)	Replacement device: Typ. 8 ms Existing device DC501-CS31: Typ. 3 ms
Input signal voltage:	
-	24 V DC
-> 0 signal	Replacement device: -3 V … +5 V Existing device DC501-CS31: -30 V … +5 V
-> Undefined signal	Replacement device: > +5 V … < +15 V Existing device DC501-CS31: > +5 V … < +13 V
-> 1 signal	Replacement device: +15 V … +30 V Existing device DC501-CS31: +13 V … +30 V
-> Residual ripple at 0 signal	Within -3 V … +5 V
-> Residual ripple at 1 signal	Within +15 V … +30 V
Input current per channel:	
-> Input voltage +24 V	Replacement device: typ. 5 mA Existing device DC501-CS31: typ. 4 mA
-> Input voltage +5 V	> 1 mA
-> Input voltage +15 V	> 5 mA
-> Input voltage +30 V	< 8 mA
Maximum cable length:	
-> Shielded	1000 m
-> Unshielded	600 m
Overvoltage protection	Up to 30 V DC
Marking	Replacement device: not possible Existing device DC501-CS31: with label strip possible

For further information, please refer to the existing documentation System description Advant Controller 31.

Outputs 24 V DC

Data	Value
Connections	X4 / 16, X4 / 17, X4 / 18, X4 / 19, X4 / 20, X4 / 21, X4 / 22, X4 / 23, X4 / 24, X4 / 25, X4 / 26, X4 / 27, X4 / 28, X4 / 29, X4 / 30, X4 / 31
Type of digital outputs	High-side switches
Demagnetization with inductive load	Via internal varistor (see following figure)
Status display	Replacement device: 1 yellow LED per output Existing device DC501-CS31: 1 green LED per output
Output delay (0-> 1 or 1-> 0)	On request
Switching frequency:	
-> With ohmic load	Replacement device: on request Existing device DC501-CS31: ≤ 100 Hz
-> With inductive load	Replacement device: max. 0.5 Hz Existing device DC501-CS31: ≤ 2 Hz
-> With lamp load	Replacement device: max. 11 Hz at max. 5 W Existing device DC501-CS31: ≤ 10 Hz at max. 5 W
Inductive cut-off voltage	Replacement device: Typ. -67 V Existing device DC501-CS31: Typ. (voltage V) -55 V
Maximum cable length:	
-> Shielded	1000 m
-> Unshielded	600 m
Marking	Replacement device: not possible Existing device DC501-CS31: with label strip possible

For further information, please refer to the existing documentation System description Advant Controller 31.

The following figure shows the circuitry of a digital input/output with the varistors for demagnetization when switching off inductive loads.

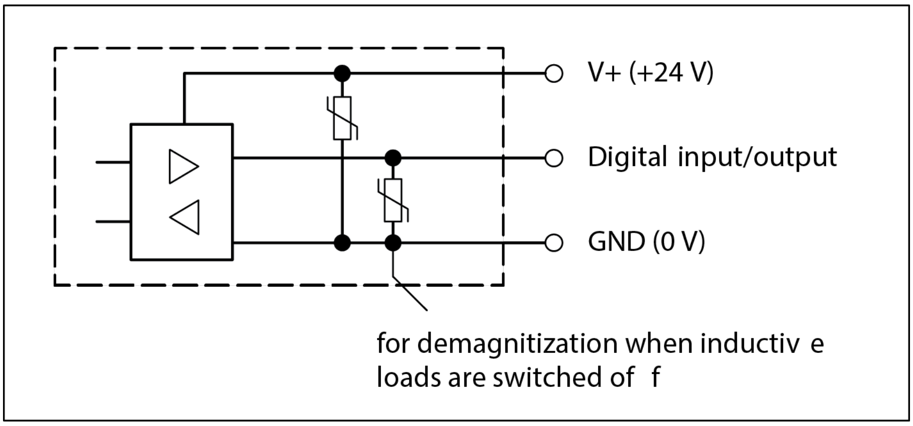


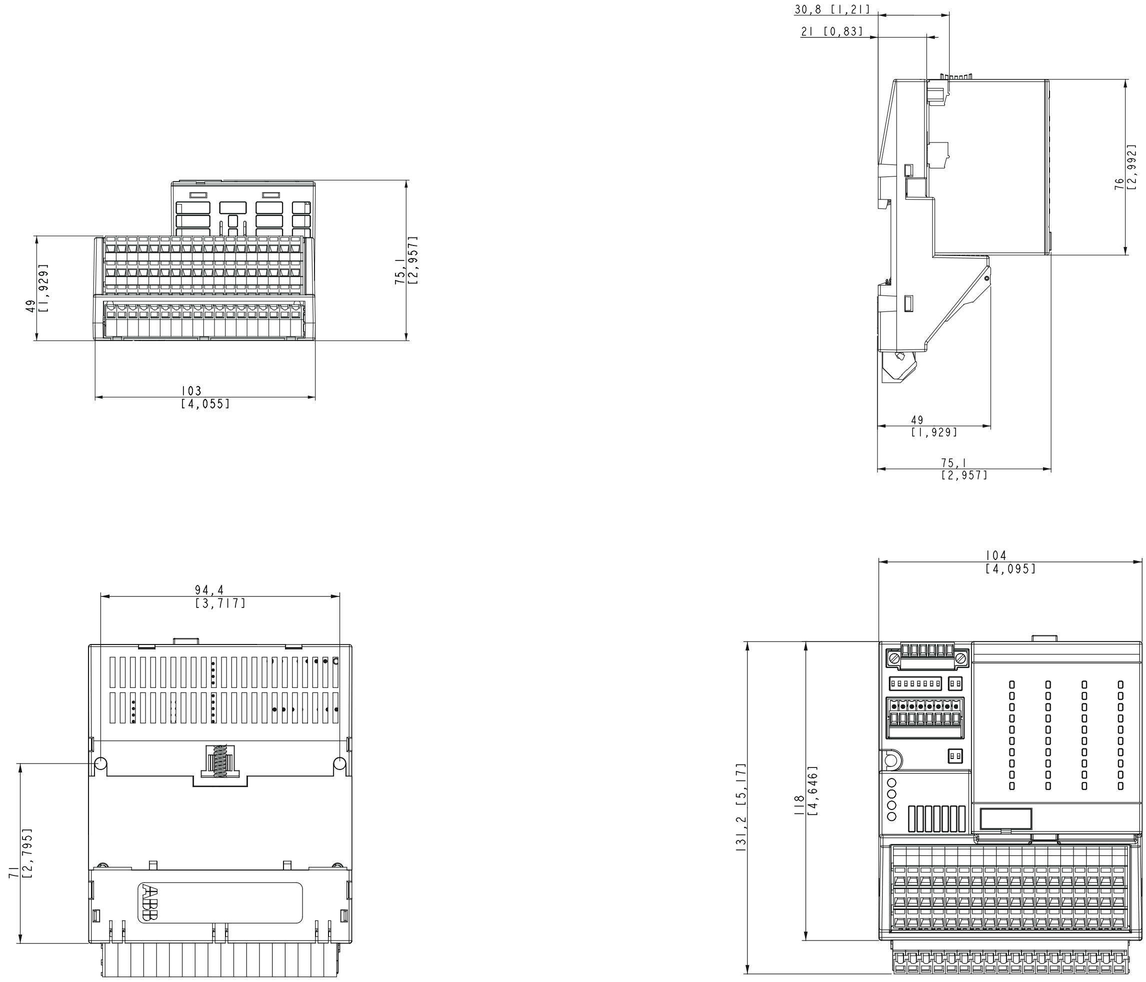
Fig. 83: Protective circuits inputs/outputs

When the channels of X4 / 24 to X4 / 31 are to be used as inputs, the respective outputs (high-end switches) must be switched off.

Mechanical data

Data	Value
Width x height x depth	Replacement device: 104 x 118 x 75.1 mm Existing device DC501-CS31: 102 x 112 x 77 mm
Weight	Replacement device: 354 g Existing device DC501-CS31: approx. 150 g
Dimensions for mounting	See operating and assembly instructions of the replacement device: 3ADR020087M0401

Mounting information



The dimensions are in mm and in brackets in inch.

CAUTION!
System damage caused by voltage!
The exchange of a replacement device under voltage can cause permanent system damage (destruction).

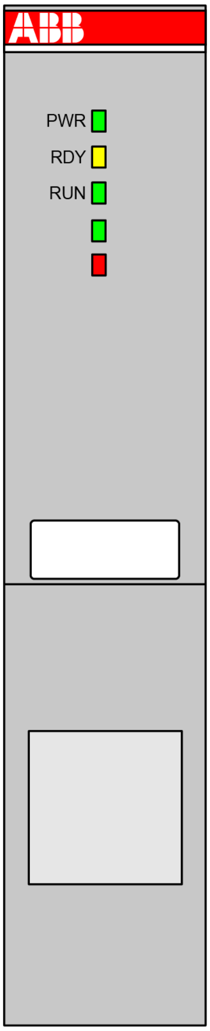
Data	Value
Mounting position	Vertical, terminal block facing downward
Cooling	The natural convection cooling must not be hindered by cable ducts or other control cabinet equipment (clearance between cable duct and device at least 20 mm).

Ordering data

Order No.	Scope of delivery
1SAP 800 400 R0010	Communication interface module CS31 16 DI, 8 DC, 8 DO, DC501-CS31-AD 1 6-pole terminal block 2 8-pole terminal blocks

1.4 Communication modules (AC500 standard)

1.4.1 Features



AC500 communication modules are required for

- a connection to standard fieldbus systems and
- for integration into existing networks.

AC500 communication modules

- enable communication on different fieldbuses.
- are mounted on the left side of the processor module on the same terminal base.
- are directly powered via the internal communication module bus of the terminal base. A separate voltage source is not required.

WARNING!

Removal/Insertion under power

The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

For information on mounting and demounting, please refer to the chapter 'Mounting and demounting the communication modules' *↻ Chapter 2.6.3.6 “Mounting and demounting the communication module” on page 1429.*

The communication between the processor module and the communication modules takes place via the communication module bus, which is integrated in the terminal base. Depending on the used terminal base up to 6 communication modules can be connected.

- *↻ Chapter 1.2.1 “TB51x-TB54x” on page 4*

There are no restrictions concerning which communication modules can be arranged for a processor module.

Within the AC500 control system, the communication modules can be used as

- bus master or
- slave.

It depends on the

- selected protocol,
- the functionality of the communication module and
- the several field buses and networks.

The following name extensions of the device names describe the supported field bus/protocol:

- CM597-ETH: Ethernet
- CM5x2-DP: PROFIBUS
- CM5x9-PNIO: PROFINET
- CM579-ETHCAT: EtherCAT
- CM5x8-CN: CANopen
- CM574-RCOM: RCOM/RCOM+ protocol (and 2 serial interfaces)
- CM574-RS: 2 serial interfaces (COM1/COM2)

If a XC version of the device is available, for use in extreme ambient conditions (e.g. wider temperature and humidity range), this is indicated with a snowflake sign.

1.4.2 Compatibility of communication modules and communication interface modules

Table 114: Modbus TCP

Communication module	Communication interface module	I/O expansion module S500	I/O expansion module S500-eCo	I/O expansion module S500-S	Applications
Onboard Ethernet inter-face	CI521-MODTCP CI522-MODTCP	x	x	--	high availability, remote I/O
Onboard Ethernet inter-face	CI521-MODTCP CI522-MODTCP	x	--	--	hot-swap I/O
CM597-ETH	CI521-MODTCP CI522-MODTCP	x	x	--	high availability, remote I/O
CM597-ETH	CI521-MODTCP CI522-MODTCP	x	--	--	hot-swap I/O

Table 115: PROFIBUS DP

Communication module	Communication interface module	I/O expansion module S500	I/O expansion module S500-eCo	I/O expansion module S500-S	Applications
CM592-DP master	CI541-DP CI542-DP	x	x	--	remote I/O
CM592-DP master	CI541-DP CI542-DP	x	--	--	hot-swap I/O

Table 116: PROFINET IO RT

Communication module	Communication interface module	I/O expansion module S500	I/O expansion module S500-eCo	I/O expansion module S500-S	Applications
CM579-PNIO controller	CI501-PNIO CI502-PNIO	x	x	x	remote I/O, safety I/O
CM579-PNIO controller	CI501-PNIO CI502-PNIO	x	--	--	hot-swap I/O
CM579-PNIO controller	CI504-PNIO CI506-PNIO	x	x	x	remote I/O, safety I/O
CM579-PNIO controller	CI504-PNIO CI506-PNIO	x	--	--	hot-swap I/O

Table 117: CANopen

Communication module	Communication interface module	I/O expansion module S500	I/O expansion module S500-eCo	I/O expansion module S500-S	Applications
CM598-CN master	CI581-CN CI582-CN	x	x	--	remote I/O

Table 118: EtherCAT

Communication module	**Communication interface module**	**I/O expansion module S500**	**I/O expansion module S500-eCo**	**I/O expansion module S500-S**	**Applications**
CM579-ETHCAT master	CI511-ETHCAT CI512-ETHCAT	x	x	--	remote I/O

Table 119: CS31 bus

Communication module	**Communication interface module**	**I/O expansion module S500**	**I/O expansion module S500-eCo**	**I/O expansion module S500-S**	**Applications**
Onboard COM1 interface	DC551-CS31 CI592-CS31	x	x	--	remote I/O
Onboard COM1 interface	CI590-CS31-HA	x	--	--	high availability
CM574-RS	DC551-CS31 CI592-CS31	x	x	--	remote I/O
CM574-RS	CI590-CS31-HA	x	--	--	high availability

1.4.3 RCOM / RCOM+

1.4.3.1 CM574-RCOM for RCOM/RCOM+

Fig. 84: CM574-RCOM

1 5 LEDs for state display
2 Label
3 2 interfaces: 1 RCOM protocol interface, 1 CONSOLE

CAUTION!
Risk of injury and damaging the module when using unapproved terminal blocks!
Only use terminal blocks approved by ABB to avoid injury and damage to the module.

The communication modules with 2 serial interfaces are delivered with two 9-pin terminal blocks TA532 (1SAP 182 000 R0001).

The terminal block listed in the ordering data is for spare part only if needed.

1.4.3.1.1 Purpose

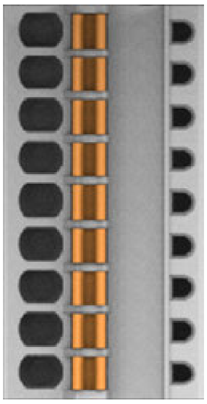
Communication module CM574-RCOM is equipped with 2 serial interfaces (RCOM protocol communication and Console) which provide the remote protocol RCOM/RCOM+.

Depending on the connection, the physical interface of the RCOM protocol interface and of the debugging terminal interface is either RS-232 or RS-485.

1.4.3.1.2 Connections

Serial interfaces

Pin assignment

Pin		Signal	Interface	Description
	1	Term. P	RS-485	Terminator P
	2	RxD/TxD-P	RS-485	Receive/Transmit, positive
	3	RxD/TxD-N	RS-485	Receive/Transmit, negative
	4	Term. N	RS-485	Terminator N
	5	RTS	RS-232	Request to send (output)
	6	TxD	RS-232	Transmit data (output)
	7	SGND	Signal Ground	Signal Ground
	8	RxD	RS-232	Receive data (input)
	9	CTS	RS-232	Clear to send (input)

Bus cable for RS-485

Bus cable

Bus line	
Construction	2 cores, twisted, with common shield
Conductor cross section	> 0.22 mm^2 (24 AWG)
Twisting rate	> 10 per meter (symmetrically twisted)
Core insulation	Polyethylene (PE)
Resistance per core	< 100 Ω/km
Characteristic impedance	ca. 120 Ω (100 Ω ... 150 Ω)
Capacitance between the cores	< 55 nF/km (if higher, the max. bus length must be reduced)
Terminating resistors	120 Ω ¼ W at both line ends
Remarks	Commonly used telephone cables with PE insulation and a core diameter of > 0.8 mm are usually sufficient.
	Cables with PVC core insulation and core diameter of 0.8 mm can be used up to a length of approx. 250 m. In this case, the bus terminating resistor is approx. 100 Ω.

Cable lengths

The maximum possible cable length of a serial connection subnet within a segment depends on the transmission rate (transmission rate).

COM1 - RCOM:

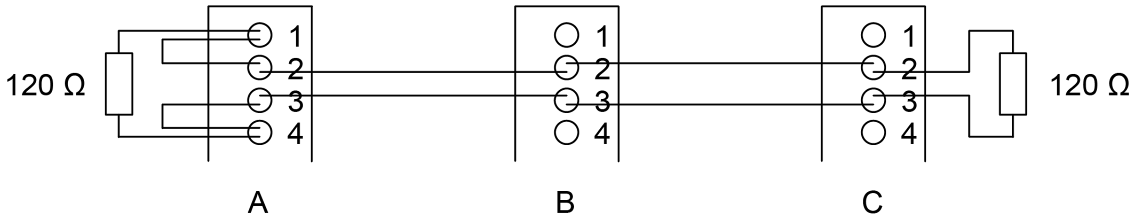
Parameter	Value
Transmission rate	2.4 kbit/s to 19.2 kbit/s
Maximum cable length	On request

COM2 - CONSOLE:

Parameter	Value
Transmission rate	19.2 kbit/s
Maximum cable length	On request

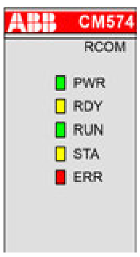
Bus termination (RS-485 only)

The line ends of the bus segment must be equipped with bus terminating resistors. Normally, these resistors are integrated in the interface connectors.



1 Term. P
2 RxD/TxD-P
3 RxD/TxD-N
4 Term. N
A Master at the bus line end, pull-up resistor and pull-down resistor activated, bus terminating resistor 120 Ω
B Slave within the bus line
C Slave at the bus line end, bus terminating resistor 120 Ω

1.4.3.1.3 State LEDs

LED		Color	State	Description
	PWR	Green	ON	Voltage is present
			OFF	Voltage is missing
	RDY	Yellow	ON	Communication module is ready
			Flashes cyclically	Event queue blocked (slave devices only)
			OFF	Hardware defective
	RUN	Green	ON	Normal operation
			Flashes cyclically	Protocol error occurred
			OFF	No communication
	STA	Yellow	Flashes	Traffic detected
	ERR	Red	ON	Error
			OFF	No error

1.4.3.1.4 Technical data

The system data of AC500 and S500 are applicable to the standard version ♯ *Chapter 2.6.1 "System data AC500" on page 1408*.

The system data of AC500-XC are applicable to the XC version ♯ *Chapter 2.7.1 "System data AC500-XC" on page 1475*.

Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

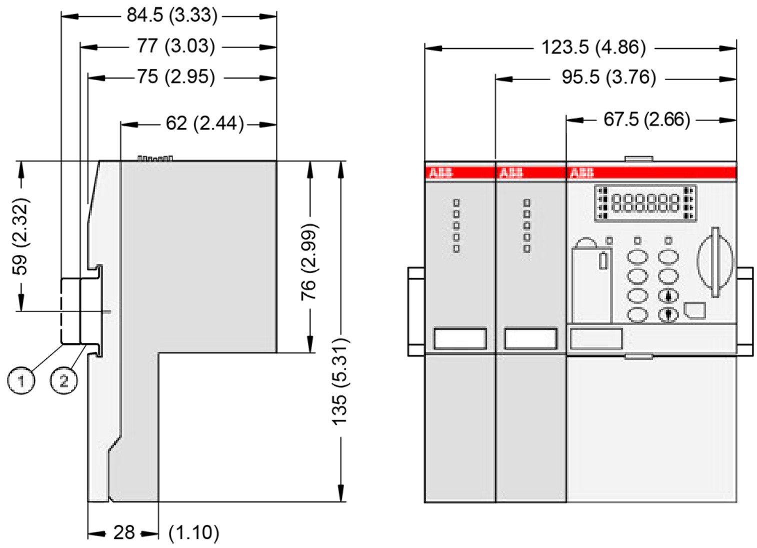
Parameter	Value
Interface	Serial interface
Transmission rate	2.4 kbit/s to 19.2 kbit/s
Protocol	RCOM/RCOM+
Interface connector	MC 0.5/9-G-2.5, 9-pin, male
Processor	PowerPC
Usable CPUs	PM57x, PM58x, PM59x ♯ *Chapter 1.3.2.1 "PM57x (-y), PM58x (-y) and PM59x (-y)" on page 23*
Usable terminal bases	All TB5xx ♯ *Chapter 1.2.1 "TB51x-TB54x" on page 4*
Ambient temperature	see: System data AC500 ♯ *Chapter 2.6.1 "System data AC500" on page 1408* System Data AC500-XC ♯ *Chapter 2.7.1 "System data AC500-XC" on page 1475*
Communication module bus	Dual-port memory, 8 kB
Internal power supply	Through the communication module bus of the terminal base
Current consumption from 24 V DC power supply at the terminal base of the CPU	Typ. 80 mA
Internal RAM memory	256 kB
External RAM memory	-
External flash memory	512 kB (firmware)
State display	PWR, RDY, RUN, STA, ERR
Weight	Ca. 150 g

Table 120: Technical data of the interfaces

Parameter	Value
Serial interface standard	EIA RS-232 or EIA RS-485
Interface connector	Pluggable 9-pin terminal block
Potential separation	Yes, from the CPU, 500 V DC
Serial interface parameters	Protocol interface configurable via PLC configuration. Preset configuration for debugging the terminal interface.
Modes of operation	Data exchange
Protocols supported	RCOM/RCOM+

The pin assignment of the serial interfaces RCOM and OPERATOR is identical to the serial interface COM1 of the processor modules PM57x, PM58x and PM59x.

1.4.3.1.5 Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

1.4.3.1.6 Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 170 401 R0201	CM574-RCOM, communication module, 2 serial RS-232/485, RCOM/RCOM+ protocol	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

Table 121: Spare parts for communication modules with 2 serial interfaces

Part no.	Description
1SAP 182 000 R0001	TA532: 9-pin terminal block set for communication modules CM574-RS and CM574-RCOM, 10 pieces, spring type terminal

The communication modules with 2 serial interfaces are delivered with two 9-pin terminal blocks TA532 (1SAP 182 000 R0001).

The terminal block listed in the ordering data is for spare part only if needed.

1.4.4 Serial

1.4.4.1 CM574-RS with 2 serial interfaces

Fig. 85: CM574-RS

1 5 LEDs for state display
2 2 rotary switches for address setting
3 Label
4 2 serial communication interfaces

CAUTION!
Risk of injury and damaging the module when using unapproved terminal blocks!
Only use terminal blocks approved by ABB to avoid injury and damage to the module.

The communication modules with 2 serial interfaces are delivered with two 9-pin terminal blocks TA532 (1SAP 182 000 R0001).

The terminal block listed in the ordering data is for spare part only if needed.

1.4.4.1.1 Purpose

Communication module CM574-RS is equipped with 2 serial interfaces (COM1 and COM2) which can be used as programming interface or for communication e.g. for communication via Modbus or ASCII.

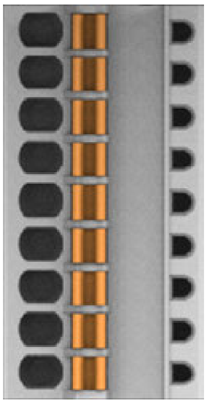
The CM574-RS can be a CS31 master at COM1 and COM2.

Depending on the connection, the physical interface of COM1 and COM2 is either RS-232 or RS-485.

1.4.4.1.2 Connections

Serial interfaces

Pin assignment

Pin		Signal	Interface	Description
	1	Term. P	RS-485	Terminator P
	2	RxD/TxD-P	RS-485	Receive/Transmit, positive
	3	RxD/TxD-N	RS-485	Receive/Transmit, negative
	4	Term. N	RS-485	Terminator N
	5	RTS	RS-232	Request to send (output)
	6	TxD	RS-232	Transmit data (output)
	7	SGND	Signal Ground	Signal Ground
	8	RxD	RS-232	Receive data (input)
	9	CTS	RS-232	Clear to send (input)

Bus cable for RS-485

Bus cable

Bus line	
Construction	2 cores, twisted, with common shield
Conductor cross section	> 0.22 mm^2 (24 AWG)
Twisting rate	> 10 per meter (symmetrically twisted)
Core insulation	Polyethylene (PE)
Resistance per core	< 100 Ω/km
Characteristic impedance	ca. 120 Ω (100 Ω ... 150 Ω)
Capacitance between the cores	< 55 nF/km (if higher, the max. bus length must be reduced)
Terminating resistors	120 Ω ¼ W at both line ends
Remarks	Commonly used telephone cables with PE insulation and a core diameter of > 0.8 mm are usually sufficient.
	Cables with PVC core insulation and core diameter of 0.8 mm can be used up to a length of approx. 250 m. In this case, the bus terminating resistor is approx. 100 Ω.

Cable lengths

The maximum possible cable length of a serial connection subnet within a segment depends on the transmission rate (transmission rate).

RS-232 (for point-to-point connection):

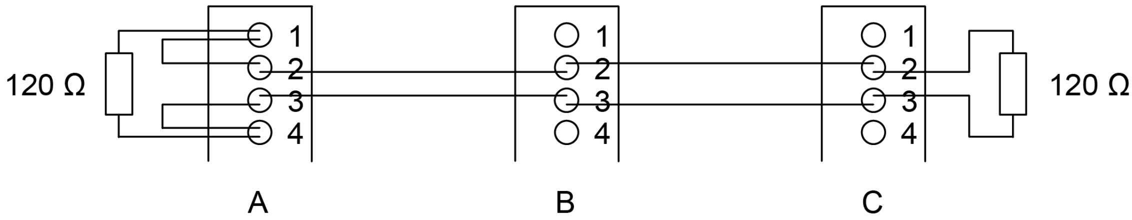
Parameter	Value
Transmission rate	9.6 kbit/s to 187.5 kbit/s
Maximum cable length	On request

RS-485 (for point-to-point or bus connection):

Parameter	Value
Transmission rate	9.6 kbit/s to 187.5 kbit/s
Maximum cable length	On request

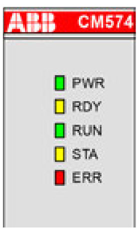
Bus termination (RS-485 only)

The line ends of the bus segment must be equipped with bus terminating resistors. Normally, these resistors are integrated in the interface connectors.



1 Term. P
2 RxD/TxD-P
3 RxD/TxD-N
4 Term. N
A Master at the bus line end, pull-up resistor and pull-down resistor activated, bus terminating resistor 120 Ω
B Slave within the bus line
C Slave at the bus line end, bus terminating resistor 120 Ω

1.4.4.1.3 State LEDs

LED		Color	State	Description
	PWR	Green	ON (light)	Voltage is present
			OFF (dark)	Voltage is missing
	RDY	Yellow	Programmable	Depends on user program
	RUN	Green	Programmable	Depends on user program
	STA	Yellow	Programmable	Depends on user program
	ERR	Red	Programmable	Depends on user program

1.4.4.1.4 Technical data

The system data of AC500 and S500 are applicable to the standard version *Chapter 2.6.1 “System data AC500” on page 1408*.

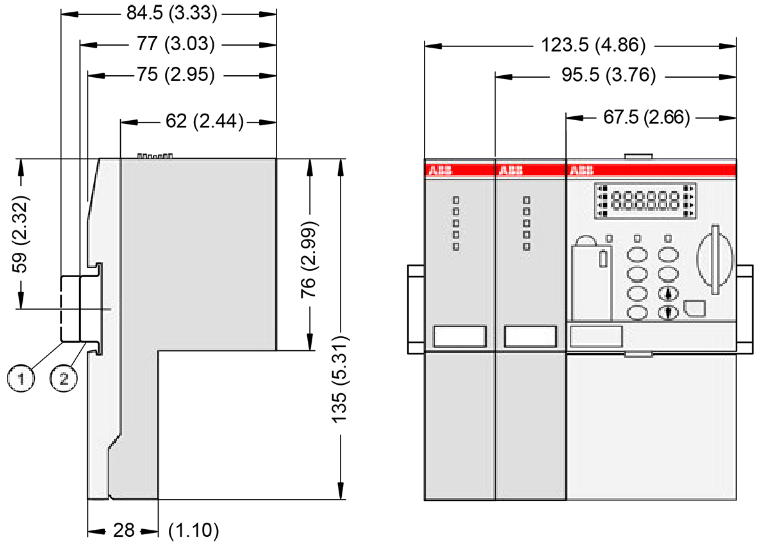
The system data of AC500-XC are applicable to the XC version *Chapter 2.7.1 “System data AC500-XC” on page 1475*.

Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

Parameter	Value
Protocol	Programmable with Automation Builder e.g. Modbus / ASCII via serial interfaces
Interface	Serial interface
Serial interface standard	EIA RS-232 or EIA RS-485
Potential separation	Yes, from the CPU, 500 V DC
Serial interface parameters	Configurable via software
Modes of operation	Programming or data exchange
Transmission rate	9.6 kbit/s to 187.5 kbit/s
Protocol	Programmable
Interface connector	MC 0.5/9-G-2.5, 9-pin, male
Processor	PowerPC
Usable CPUs	PM57x, PM58x, PM59x ↬ *Chapter 1.3.2.1 “PM57x (-y), PM58x (-y) and PM59x (-y)” on page 23*
Usable terminal bases	All TB5xx ↬ *Chapter 1.2.1 “TB51x-TB54x” on page 4*
Ambient temperature	see: System data AC500 ↬ *Chapter 2.6.1 “System data AC500” on page 1408* System Data AC500 XC ↬ *Chapter 2.7.1 “System data AC500-XC” on page 1475*
Communication module bus	Dual-port memory, 8 kB
Internal power supply	Through the communication module bus of the terminal base
Current consumption from 24 V DC power supply at the terminal base of the CPU	Typ. 80 mA
Internal RAM memory	256 kB
External RAM memory	-
External Flash memory	512 kB (firmware) + 2 x 64 kB (user data)
Status display	PWR, RDY, RUN, STA, ERR
Weight	Ca. 150 g

1.4.4.1.5 Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

1.4.4.1.6 Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 170 400 R0201	CM574-RS, communication module, 2 serial RS232/485, free configurable serial interface module	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

Table 122: Spare parts for communication modules with 2 serial interfaces

Part no.	Description
1SAP 182 000 R0001	TA532: 9-pin terminal block set for communication modules CM574-RS and CM574-RCOM, 10 pieces, spring type terminal

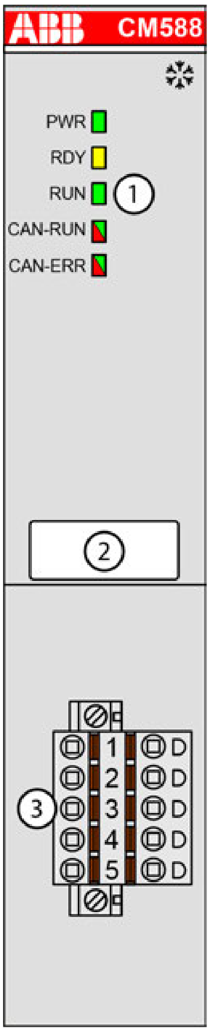
The communication modules with 2 serial interfaces are delivered with two 9-pin terminal blocks TA532 (1SAP 182 000 R0001).

The terminal block listed in the ordering data is for spare part only if needed.

1.4.5 CANopen

1.4.5.1 CM588-CN - CANopen slave

- CANopen slave 1 Mbit/s
- XC version for use in extreme ambient conditions available



1 5 LEDs for state display
2 Label
3 Communication interface, 5-pin, Combicon, male, removable plug with spring terminals
❄ Sign for XC version

1.4.5.1.1 Purpose

Communication module CM588-CN enables communication via the CANopen field bus. CM588-CN *Chapter 1.4.5.1 “CM588-CN - CANopen slave” on page 229* is a slave in a CANopen network. It is connected to the processor module via an internal communication bus. CM588-CN allows communicating of multiple CPUs in a CANopen network.

1.4.5.1.2 Connections

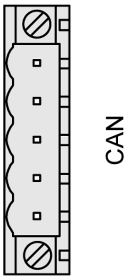
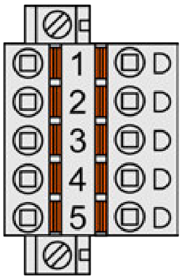
Field bus interface

Field bus interface

Interface socket	5-pin COMBICON
Transmission standard	ISO 11898, potential-free
Transmission protocol	CANopen (CAN), 1 Mbaud max.
Transfer rate (transmission rate)	10 kbit/s, 20 kbit/s, 50 kbit/s, 100 kbit/s, 125 kbit/s, 250 kbit/s, 500 kbit/s, 800 kbit/s and 1 Mbit/s,

Pin assignment

Table 123: Pin assignment of the CANopen connector

Interface		PIN	Signal	Description
 Terminal block removed	 Terminal block inserted	1	CAN_GND	CAN reference potential
		2	CAN_L	Bus line, receive/transmit line, LOW
		3	CAN_SHLD	Shield of the bus line
		4	CAN_H	Bus line, receive/transmit line, HIGH
		5	NC	Not connected

> **NOTICE!**
> **Unused connector!**
> Make sure that the terminal block is always connected to the terminal base or communication module, even if you do not use the interface.

Bus length

The maximum possible bus length of a CAN network depends on bit rate (transmission rate) and cable type. The sum of all bus segments must not exceed the maximum bus length

Bit Rate (speed)	Bus Length
1 Mbit/s	40 m
800 kbit/s	50 m
500 kbit/s	100 m
250 kbit/s	250 m
125 kbit/s	500 m
62.5 kbit/s	1000 m
20 kbit/s	2500 m
10 kbit/s	5000 m

Types of bus cables

For CANopen, only bus cables with characteristics as recommended in ISO 11898 are to be used. The requirements for the bus cables depend on the length of the bus segment. Regarding this, the following recommendations are given by ISO 11898:

Length of segment [m]	Bus cable (shielded, twisted pair)			Max. transmission rate [kbit/s]
	Conductor cross section [mm^2]	Line resistance [Ω/km]	Wave impedance [Ω]	
0...40	0.25 ... 0.34 / AWG23, AWG22	70	120	1000 at 40 m
40...300	0.34 ... 0.60 / AWG22, AWG20	< 60	120	< 500 at 100 m
300...600	0.50 ... 0.60 / AWG20	< 40	120	< 100 at 500 m
600...1000	0.75 ... 0.80 / AWG18	< 26	120	< 50 at 1000 m

Bus terminating resistors

The ends of the data lines have to be terminated with a 120 Ω bus terminating resistor. The bus terminating resistor is usually installed directly at the bus connector.

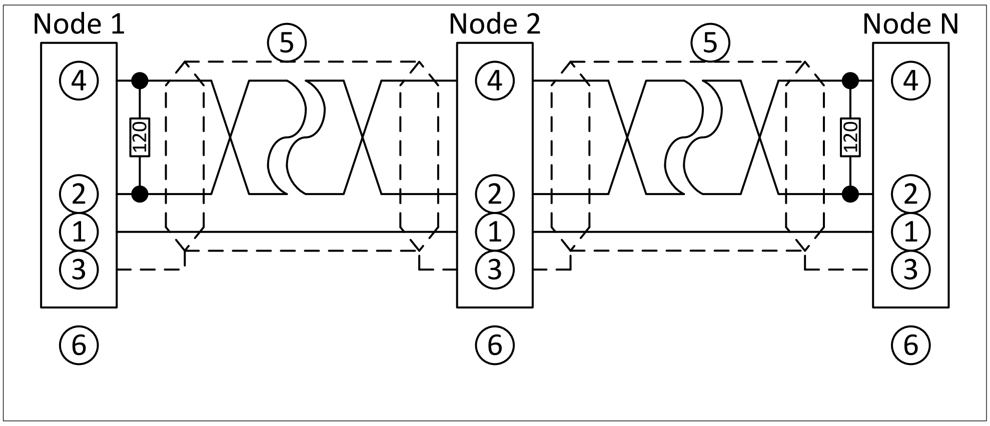


Fig. 86: CANopen interface, bus terminating resistors connected to the line ends

1	CAN_GND
2	CAN_L
3	Shield
4	CAN_H
5	Data line, shielded twisted pair
6	COMBICON connection, CANopen interface

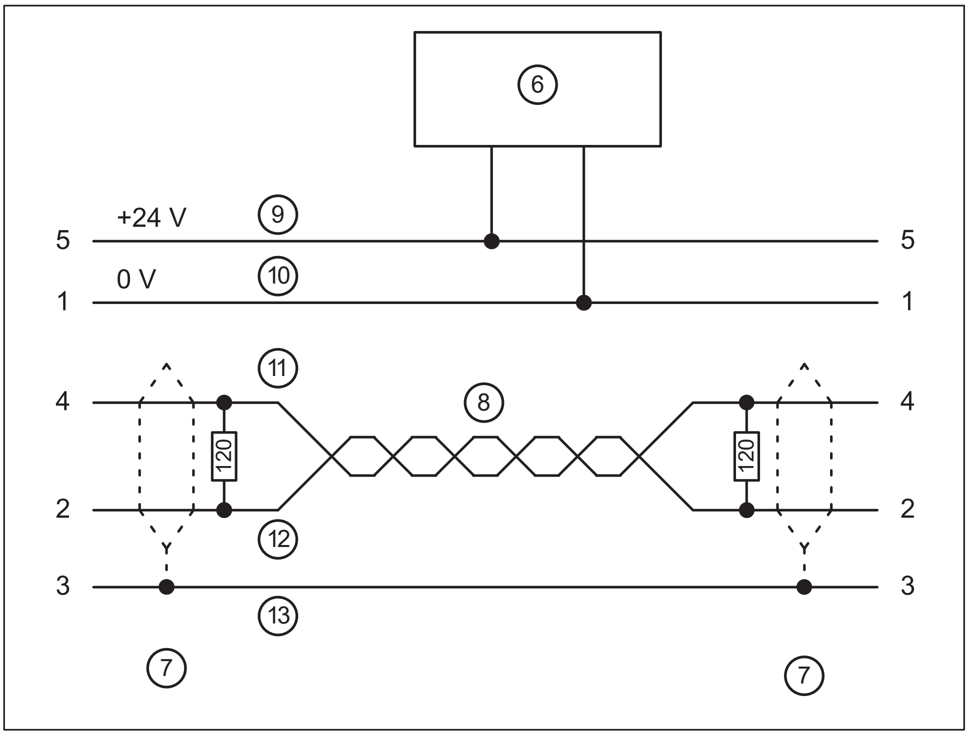


Fig. 87: DeviceNet interface, bus terminating resistors connected to the line ends

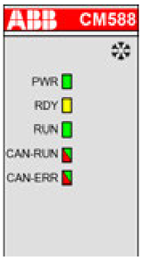
6	DeviceNet power supply
7	COMBICON connection, DeviceNet interface
8	Data lines, twisted pair cables
9	red
10	black
11	white
12	blue
13	bare

The grounding of the shield should take place at the switchgear *⇘ Chapter 2.6.1 “System data AC500” on page 1408.*

1.4.5.1.3 State LEDs

The state of the CANopen communication module is displayed by means of 5 state LEDs.

Table 124: Meaning of the diagnosis LEDs

LED		Color	State	Description
	PWR	Green	ON (light)	Power supply available
			OFF (dark)	Power supply not available or defective hardware
	RDY	Yellow	ON	Boot procedure
			Blinking	Boot failure
	RUN	Green	ON	Communication module is operational
			OFF	Communication module is not operational
	CAN-RUN	Green	ON	Device configured, CANopen bus in OPERATIONAL state and cyclic data exchange running
			Blinking	CANopen bus in PRE-OPERATIONAL state and slave are being configured
	CAN-ERR	Red	ON	CANopen bus is off
			Blinking	Configuration error
			Single flash	Error counter overflow due to too many error frames
			Double flash	A node-guard or a heartbeat event occurred
			OFF	No error
	CAN-RUN	Yellow	Blinking	No production data available,
	CAN-ERR	Yellow	(synchronously)	No bus communication possible.
LED state during firmware update	CAN-RUN	Green	Blinking	Firmware file transfers during communication module firmware update.
	CAN-ERR	Red	(synchronously)	
	CAN-RUN	Green	Blinking	Communication module writes the firmware file to the internal flash.
	CAN-ERR	Red	(alternately)	Do not power off the PLC!

1.4.5.1.4 Technical data

The system data of AC500 and S500 are applicable to the standard version *Chapter 2.6.1 “System data AC500” on page 1408*.

The system data of AC500-XC are applicable to the XC version *Chapter 2.7.1 “System data AC500-XC” on page 1475*.

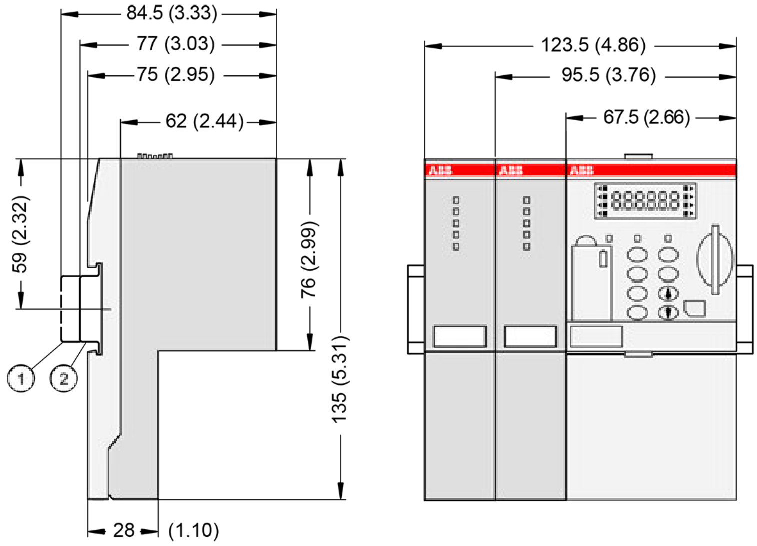
Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

Parameter	Value
Protocol	CANopen slave
Technology	Hilscher NETX 100

Parameter	Value
Usable CPUs	PM57x, PM58x, PM59x ⇘ *Chapter 1.3.2.1 “PM57x (-y), PM58x (-y) and PM59x (-y)” on page 23*
Usable terminal bases	All TB5xx ⇘ *Chapter 1.2.1 “TB51x-TB54x” on page 4*
Bus connection	Pluggable connector COMBICON, 2x5-pin
Internal power supply	Via the communication module Interface of the terminal base
Transfer rate	10 kbit/s to 1 Mbit/s
Transfer method	According to CAN standard
Bus length (segment length max.)	According to table: Maximum cable length within a CANopen field bus
Indicators	5 LEDs
Current consumption from 24 V DC power supply at the terminal base of the CPU	Typ. 65 mA
Weight	Ca. 150 g
Ambient temperature	see: System data AC500 ⇘ *Chapter 2.6.1 “System data AC500” on page 1408* System Data AC500-XC ⇘ *Chapter 2.7.1 “System data AC500-XC” on page 1475*
Adjusting elements	None
Quantity of input and output data per I/O device	Max. 512 byte (respectively for input and output)
Supported protocol services	NMT slave PDO SDO server Heartbeat Nodeguard
Min. bus cycle	1 ms

1.4.5.1.5 Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

> *The dimensions are in mm and in brackets in inch.*

1.4.5.1.6 Ordering data

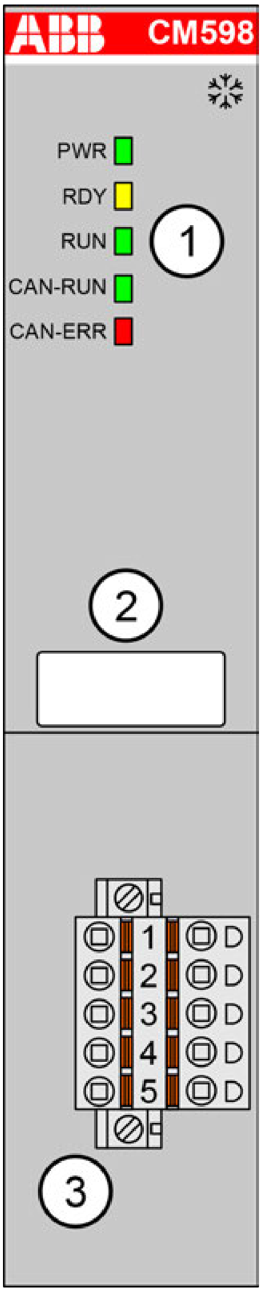
Part no.	Description	Product life cycle phase *)
1SAP 172 800 R0001	CM588-CN, communication module CANopen slave	Active
1SAP 372 800 R0001	CM588-CN-XC, communication module CANopen slave, XC version	Active

> **) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

1.4.5.2 CM598-CN - CANopen master

1.4.5.2.1 Features

- CANopen master 1 Mbit/s
- XC version for use in extreme ambient conditions available



1 5 LEDs for state display
2 Label
3 Communication interface, 5-pin, Combicon, male, removable plug with spring terminals
 Sign for XC version

1.4.5.2.2 Purpose

Communication module CM598-CN enables communication over the CANopen field bus.

For use in extreme ambient conditions (e.g. wider temperature and humidity range), a special XC version of the device is available.

1.4.5.2.3 Connections

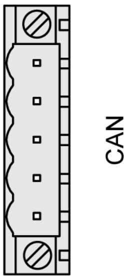
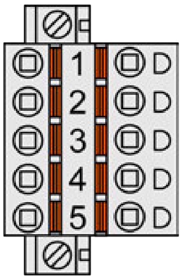
Field bus interface

Interface socket	5-pin COMBICON
Transmission standard	ISO 11898, potential-free

Transmission protocol	CANopen (CAN), 1 Mbaud max.
Transfer rate (transmission rate)	10 kbit/s, 20 kbit/s, 50 kbit/s, 100 kbit/s, 125 kbit/s, 250 kbit/s, 500 kbit/s, 800 kbit/s and 1 Mbit/s,

Pin assignment

Table 125: Pin assignment of the CANopen connector

Interface		PIN	Signal	Description
 Terminal block removed	 Terminal block inserted	1	CAN_GND	CAN reference potential
		2	CAN_L	Bus line, receive/transmit line, LOW
		3	CAN_SHLD	Shield of the bus line
		4	CAN_H	Bus line, receive/transmit line, HIGH
		5	NC	Not connected

> **NOTICE!**
> **Unused connector!**
> Make sure that the terminal block is always connected to the terminal base or communication module, even if you do not use the interface.

Bus length

The maximum possible bus length of a CAN network depends on bit rate (transmission rate) and cable type. The sum of all bus segments must not exceed the maximum bus length

Bit Rate (speed)	Bus Length
1 Mbit/s	40 m
800 kbit/s	50 m
500 kbit/s	100 m
250 kbit/s	250 m
125 kbit/s	500 m
62.5 kbit/s	1000 m
20 kbit/s	2500 m
10 kbit/s	5000 m

Types of bus cables

For CANopen, only bus cables with characteristics as recommended in ISO 11898 are to be used. The requirements for the bus cables depend on the length of the bus segment. Regarding this, the following recommendations are given by ISO 11898:

Length of segment [m]	Bus cable (shielded, twisted pair)			Max. transmission rate [kbit/s]
	Conductor cross section [mm^2]	Line resistance [Ω/km]	Wave impedance [Ω]	
0...40	0.25 ... 0.34 / AWG23, AWG22	70	120	1000 at 40 m
40...300	0.34 ... 0.60 / AWG22, AWG20	< 60	120	< 500 at 100 m
300...600	0.50 ... 0.60 / AWG20	< 40	120	< 100 at 500 m
600...1000	0.75 ... 0.80 / AWG18	< 26	120	< 50 at 1000 m

Bus terminating resistors

The ends of the data lines have to be terminated with a 120 Ω bus terminating resistor. The bus terminating resistor is usually installed directly at the bus connector.

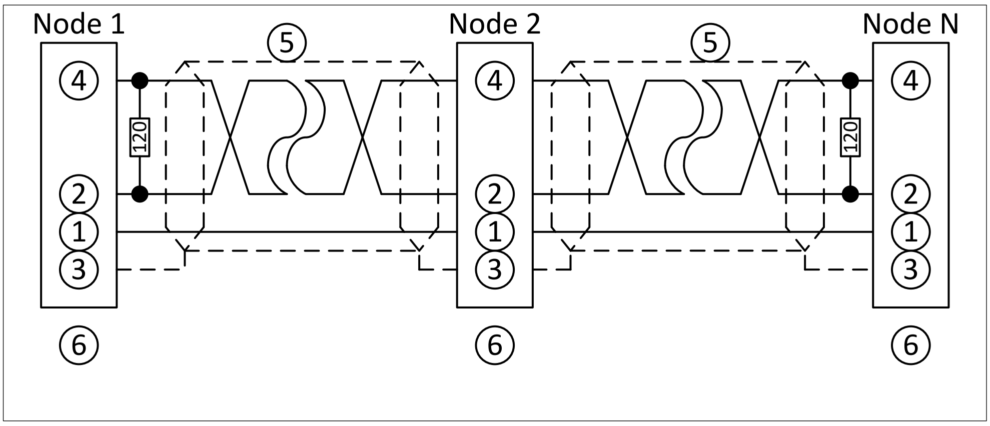


Fig. 88: CANopen interface, bus terminating resistors connected to the line ends

1	CAN_GND
2	CAN_L
3	Shield
4	CAN_H
5	Data line, shielded twisted pair
6	COMBICON connection, CANopen interface

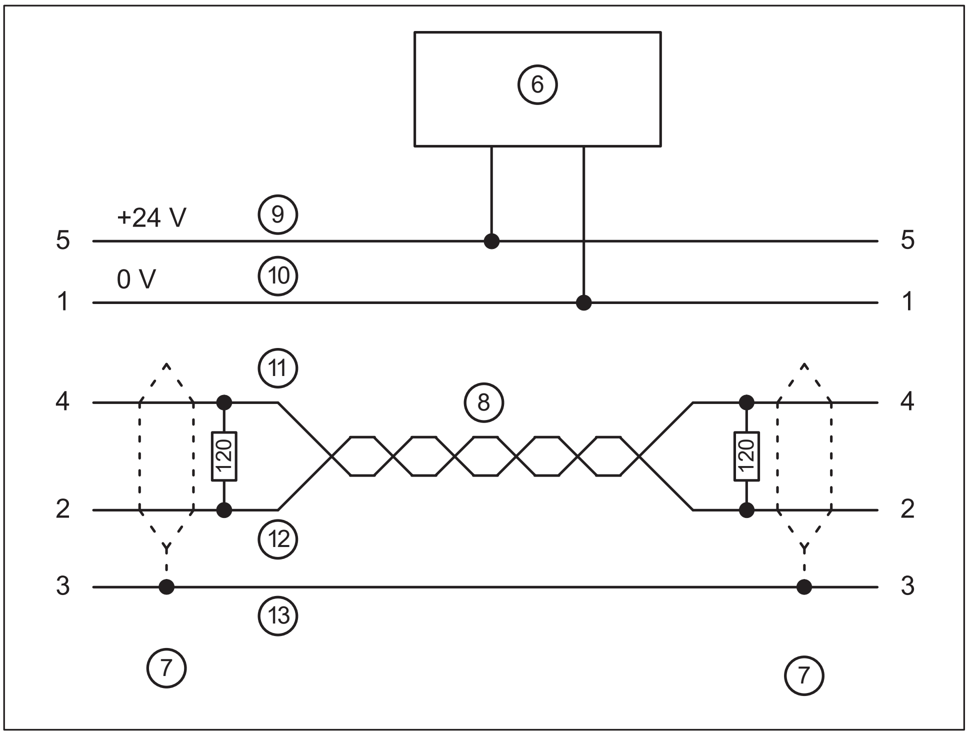


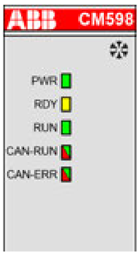
Fig. 89: DeviceNet interface, bus terminating resistors connected to the line ends

6	DeviceNet power supply
7	COMBICON connection, DeviceNet interface
8	Data lines, twisted pair cables
9	red
10	black
11	white
12	blue
13	bare

The grounding of the shield should take place at the switchgear ↬ Chapter 2.6.1 “System data AC500” on page 1408.

1.4.5.2.4 State LEDs

Table 126: Meaning of the diagnosis LEDs

LED		Color	State	Description
	PWR	Green	ON (light)	Power supply available
			OFF (dark)	Power supply not available or defective hardware
	RDY	Yellow	ON	Boot procedure
			Blinking	Boot failure
			OFF	---
	RUN	Green	ON	Communication module is operational
			Blinking	---
			OFF	Communication module is not operational
	CAN-RUN	Green	ON	Operational: Device is in the OPERATIONAL state
			Single Flash	Stopped: Device is in STOPPED state
			Blinking	Pre-operational: Device is in the PREOPERATIONAL state
			OFF	No communication or no power supply
	CAN-ERR	Red	ON	CANopen bus is off
			Single flash	Warning limit reached: At least one of the error counters of the CAN controller has reached or exceeded the warning level (too many error frames)
			Double flash	Error control event: A guard event (NMT Slave or NMTmaster) or a heartbeat event (Heartbeat consumer) has occurred
			OFF	No Error: Device is in working condition
	CAN-RUN	Yellow	Blinking	No production data available,
	CAN-ERR	Yellow	(synchronously)	no bus communication possible.
LED state during firmware update	CAN-RUN	Green	Blinking	Firmware file transfers during communication module firmware update.
	CAN-ERR	Red	(synchronously)	
	CAN-RUN	Green	Blinking	Communication module writes the firmware file to the internal flash.
	CAN-ERR	Red	(alternately)	Do not power off the PLC!

1.4.5.2.5 Technical data

The system data of AC500 and S500 are applicable to the standard version *Chapter 2.6.1 “System data AC500” on page 1408*.

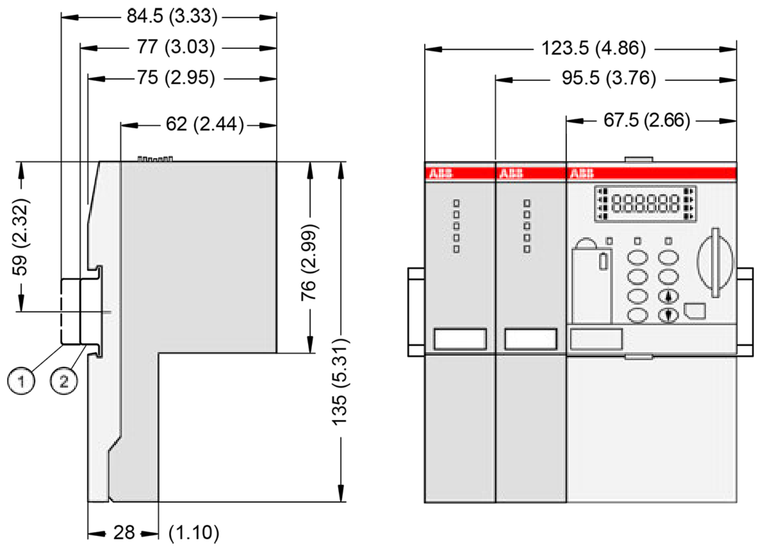
The system data of AC500-XC are applicable to the XC version *Chapter 2.7.1 “System data AC500-XC” on page 1475*.

Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

Parameter	Value
Protocol	CANopen master, CAN2A, CAN2B
Transmission rate	10 kbit/s to 1 Mbit/s
Ambient temperature	see: System data AC500 ➪ *Chapter 2.6.1 “System data AC500” on page 1408* System Data AC500-XC ➪ *Chapter 2.7.1 “System data AC500-XC” on page 1475*
Usable terminal bases	All TB5xx ➪ *Chapter 1.2.1 “TB51x-TB54x” on page 4*
Field bus connector	Pluggable connector COMBICON, 5-pin
Technology	Hilscher NETX 100
Indicators	5 LEDs
Internal power supply	Via the communication module interface of the terminal base
Current consumption from 24 V DC power supply at the Terminal Base of the CPU	Typ. 65 mA
Number of Slaves	Max. 126
Number of receive/transmit PDOs	Max. 512 (respectively for receive and transmit)
Total quantity of input and output data	Max. 3584 byte (respectively for input and output)
Weight	Ca. 150 g

1.4.5.2.6 Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

1.4.5.2.7 Ordering data

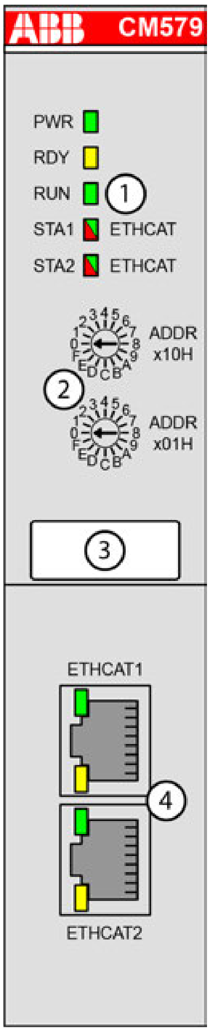
Part no.	Description	Product life cycle phase *)
1SAP 173 800 R0001	CM598-CN, communication module CANopen master	Active
1SAP 373 800 R0001	CM598-CN-XC, communication module CANopen master, XC version	Active

) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.

1.4.6 EtherCAT

1.4.6.1 CM579-ETHCAT - EtherCAT master

1.4.6.1.1 Features



1 5 LEDs for state display
2 2 rotary switches for address setting (not used)
3 Label
4 2 communication interfaces RJ45 (ETHCAT1 and ETHCAT2)

1.4.6.1.2 Intended purpose

Communication module CM579-ETHCAT is for EtherCAT communication.

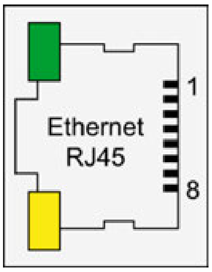
The comunication module is configured via the dual-port memory by means of a system configurator. The configuration is saved on a non-volatile Flash EPROM memory.

1.4.6.1.3 Connections

Field bus interfaces

The EtherCAT communication module provides 2 RJ45 interfaces with the following pin assignment. The pin assignment is used for the EtherCAT slaves (communication interface modules CI5xy-ETHCAT) as well.

Pin assignment

Interface	Pin	Signal	Description
	1	TxD+	Transmit data +
	2	TxD-	Transmit data -
	3	RxD+	Receive data +
	4	NC	Not connected
	5	NC	Not connected
	6	RxD-	Receive data -
	7	NC	Not connected
	8	NC	Not connected
	Shield	Cable shield	Functional earth

In corrosive environment, please protect unused connectors using the TA535 accessory.

Not supplied with this device.

Further information about wiring and cable types

The EtherCAT network differentiates between input-connectors (IN) and output-connectors (OUT):

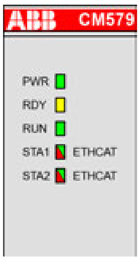
At the EtherCAT slaves (communication interface modules), the ETH1-connector is IN and the ETH2-connector is OUT.

At the EtherCAT master (communication module), the ETHCAT1 connector has to be used. The ETHCAT2 connector is reserved for future extensions.

1.4.6.1.4 State LEDs

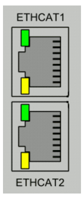
The EtherCAT state is shown by the EtherCAT communication module's LEDs. Some LEDs are two-colored.

Table 127: Meaning of the diagnosis LEDs

LED		Color	State	Description
	PWR	Green	On	Power supply available
			Blinking	---
			Off	Power supply not available or defective hardware
	RDY	Yellow	On	Boot procedure
			Blinking	Boot failure
			Off	---
	RUN	Green	On	Communication module is operational
			Blinking	---
			Off	Communication module is not operational
	STA1	Green	On	No bus error, communication running
			Blinking	Establishing communication
			Off	System error
	STA2	Red	On	Configuration error
			Blinking	---
			Off	No error
	STA1	Yellow	Blinking	No production data available,
	STA2	Yellow	(synchronously)	no bus communication possible.
LED state during firmware update	STA1	Green	Blinking	Firmware file transfers during communication module firmware update.
	STA2	Red	(synchronously)	
	STA1	Green	Blinking	Communication module writes the firmware file to the internal flash. Do not power off the PLC!
	STA2	Red	(alternately)	

The RJ45 Ethernet connector contains two LEDs showing the current Ethernet port connection state.

Table 128: Meaning of the diagnosis LEDs

LED		Color	State	Description
	ETHCAT1 LED "Link"	Green	On	Ethernet connection established
			Off	No Ethernet connection
	ETHCAT1 LED "RX/TX"	Yellow	On	Device sends/receives frames
			Off	No Ethernet connection
	ETHCAT2 LED "Link"	Green		Connector ETHCAT2 is not used
	ETHCAT2 LED "RX/TX"	Yellow		

1.4.6.1.5 Technical data

The system data of AC500 and S500 are applicable to the standard version *Chapter 2.6.1 “System data AC500” on page 1408*.

The system data of AC500-XC are applicable to the XC version *Chapter 2.7.1 “System data AC500-XC” on page 1475*.

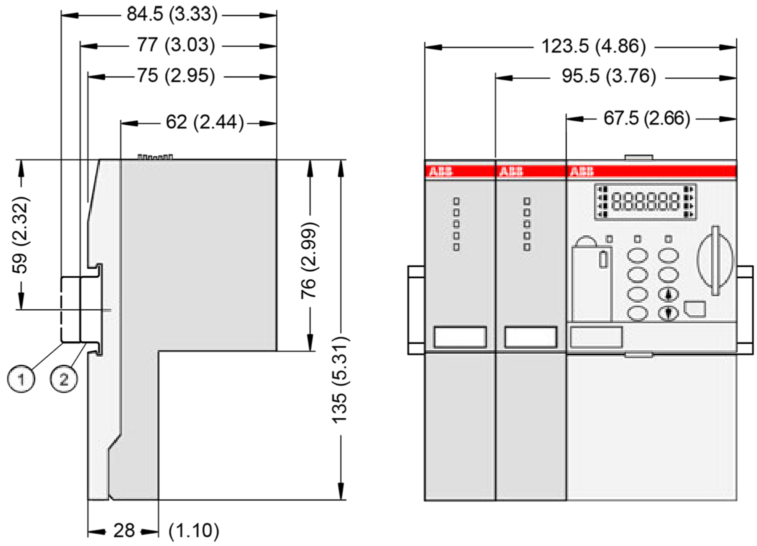
Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

Parameter	Value
Internal Supply	Via the communication module interface of the terminal base
Protocol	EtherCAT
Field bus connector	2 x RJ45 (ETHCAT1 and ETHCAT2)
Technology	Hilscher NETX 100
Transfer rate	10/100 Mbit/s (full-duplex)
Transfer method	According to Ethernet II, IEEE 802.3
Ethernet	100 base-TX, internal switch, 2x RJ45 socket
Bus length (segment length max.)	100 m at 100 Mbit/s
Indicators	5 LEDs
Usable CPUs	PM57x, PM58x, PM59x *Chapter 1.3.2.1 “PM57x (-y), PM58x (-y) and PM59x (-y)” on page 23*
Usable terminal bases	All TB5xx *Chapter 1.2.1 “TB51x-TB54x” on page 4*
Ambient temperature	System data AC500 *Chapter 2.6.1 “System data AC500” on page 1408* System Data AC500 XC *Chapter 2.7.1 “System data AC500-XC” on page 1475*
Current consumption from 24 V DC power supply at the terminal base of the CPU	Typ. 85 mA
Internal supply	Via the communication module interface of the terminal base
Number of slaves	Limited to 200
Quantity of input and output data for a single slave	Max. 5760 bytes (respectively for input and output)
Total quantity of input and output data	Max. 5760 bytes (only valid for asynchronous operation, for synchronous operation the reachable values depends on the additional load of SoE, CoE and EoE, typical reachable values are 1024 bytes).
Supported protocols	RTC - Real-time cyclic protocol, class 1 RTA - Real-time acyclic protocol
Acyclic services	● CoE upload ● CoE download (1500 bytes max.) ● Emergency
Min. bus cycle	1 ms

Parameter	Value
Max. size of the bus configuration file	2 MB
Weight	Ca. 170 g

1.4.6.1.6 Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

> *The dimensions are in mm and in brackets in inch.*

1.4.6.1.7 Ordering data

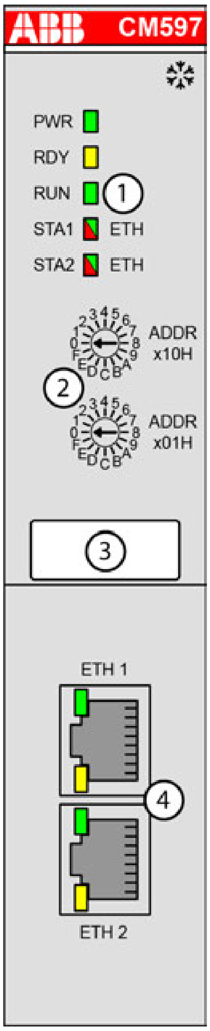
Part no.	Description	Product life cycle phase *)
1SAP 170 902 R0101	CM579-ETHCAT, EtherCAT communication module	Active

> **) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

1.4.7 Ethernet

1.4.7.1 CM597-ETH - Communication module Ethernet

- TCP/IP with integrated 2-port switch
- XC version for use in extreme ambient conditions available



1 5 LEDs for state display
2 2 rotary switches for address setting
3 Label
4 2 communication interfaces Ethernet RJ45
Sign for XC version

1.4.7.1.1 Purpose

The communication module provides communication via the Ethernet bus. Ethernet connection can be established directly to the communication module, an additional switch is not necessary.

The Ethernet communication module is an intelligent 100Base-T-Ethernet communication interface based on the highly integrated netX100 microcontroller. The complete TCP/IP protocol and the application layers are supported.

The user interface is based on a dual-port RAM. The Ethernet communication runs via RJ45 interfaces.

The communication module is configured via the dual-port RAM, the diagnosis interface or a TCP/IP connection by means of a system configurator.

It is not possible to close a RSTP ring by using the two ports of the communication module.

Applications:

- TCP/IP for PC/ Automation Builder (programming)
- UDP (communication via the function blocks ETH_UDP_SEND and ETH_UDP_REC
- Modbus on TCP/IP (Modbus on TCP/IP, client and server)

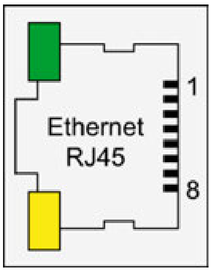
For use in extreme ambient conditions (e.g. wider temperature and humidity range), a special XC version of the device is available.

1.4.7.1.2 Connections

Field bus interfaces

The Ethernet communication module has 2 RJ45 interfaces:

Pin assignment

Interface	Pin	Signal	Description
	1	TxD+	Transmit data +
	2	TxD-	Transmit data -
	3	RxD+	Receive data +
	4	NC	Not connected
	5	NC	Not connected
	6	RxD-	Receive data -
	7	NC	Not connected
	8	NC	Not connected
	Shield	Cable shield	Functional earth

In corrosive environment, please protect unused connectors using the TA535 accessory.

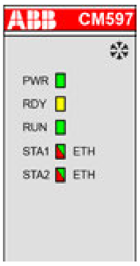
Not supplied with this device.

Further information about wiring and cable types

1.4.7.1.3 State LEDs

The Ethernet state is shown by the Ethernet communication module's LEDs.

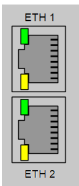
Table 129: Meaning of the diagnosis LEDs

LED		Color	State	Description
	PWR	Green	On	Power supply available
			Off	Power supply not available or defective hardware
	RDY	Yellow	On	Boot procedure
			Blinking	Boot failure
	RUN	Green	On	Communication module is operational
			Off	Communication module is not operational
	STA1	Green	Blinking (1 Hz)	Device ready

LED		Color	State	Description
			Blinking (5 Hz)	Device configured / UDP traffic
			On	Modbus communication established
	STA2	Red	On	Modbus communication error
			Off	No error
	STA1	Yellow	Blinking (synchronously)	No production data available, no bus communication possible.
	STA2	Yellow		
LED state during firmware update	STA1	Green	Blinking (synchronously)	Firmware file transfers during communication module firmware update.
	STA2	Red		
	STA1	Green	Blinking (alternately)	Communication module writes the firmware file to the internal flash. Do not power off the PLC!
	STA2	Red		

The RJ45 Ethernet connector contains two LEDs showing the current Ethernet port connection state.

Table 130: Meaning of the diagnosis LEDs

LED		Color	State	Description
	ETH1 LED "Link"	Green	On	Ethernet connection established
			Off	No Ethernet connection
	ETH1 LED "RX/TX"	Yellow	On	---
			Blinking	Device sends/receives frames
			Off	---
	ETH2 LED "Link"	Green	On	Ethernet connection established
			Off	No Ethernet connection
	ETH2 LED "RX/TX"	Yellow	On	---
			Blinking	Device sends/receives frames
			Off	---

1.4.7.1.4 Technical data

The system data of AC500 and S500 are applicable to the standard version ➥ *Chapter 2.6.1 “System data AC500” on page 1408*.

The system data of AC500-XC are applicable to the XC version ➥ *Chapter 2.7.1 “System data AC500-XC” on page 1475*.

Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

Parameter	Value
Field bus	2 x Ethernet
Transmission rate	10 Mbit/s or 100 Mbit/s
Protocol	Ethernet TCP/IP, UDP/IP, Modbus TCP, ICMP (Ping), DNS, SMTP (email)
Field bus connectors	2 x RJ45, with integrated 2-port switch

Parameter	Value
Processor	Hilscher NETX 100
Usable CPUs	PM57x, PM58x, PM59x *Chapter 1.3.2.1 “PM57x (-y), PM58x (-y) and PM59x (-y)” on page 23*
Usable terminal bases	All TB5xx *Chapter 1.2.1 “TB51x-TB54x” on page 4*
Communication module interface	Dual-port memory, 16 kB
Current consumption from 24 V DC power supply at the terminal base of the CPU	Typ. 85 mA
Internal power supply	Via the communication module interface of the terminal base
External RAM memory	8 MB
External flash memory	8 MB
State display	PWR, RDY, RUN, STA, ERR, 2 x LINK, 2 x ACT
Ethernet	10/100 Base-TX, internal switch, 2 x RJ45 socket
LED indication	State indication via 5 LEDs
Station identification	Rotary switch, 0...255 (00...FFhex)
Transmission mode	Half or full-duplex operation, adjustable
Transmission rate	10 or 100 Mbit/s, adjustable
Auto negotiation	Optionally adjustable
MAC address	Optionally configurable
Ethernet frame types	Ethernet II (RFC 894), IEEE 802.3 receive only (RFC 1042)
Weight	Ca. 170 g

1.4.7.1.5 Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 173 700 R0001	CM597-ETH, communication module Ethernet TCP/IP with integrated 2-port switch	Active
1SAP 373 700 R0001	CM597-ETH-XC, communication module Ethernet TCP/IP with integrated 2-port switch, XC version	Active

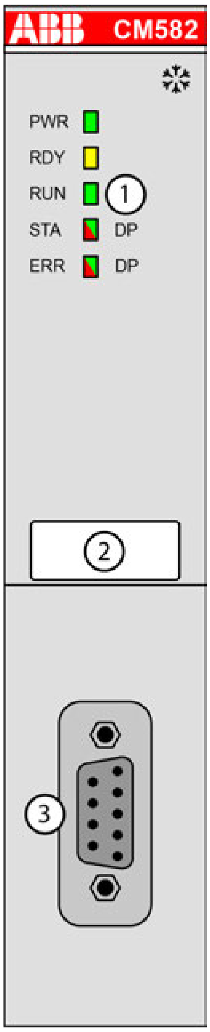
**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

1.4.8 PROFIBUS

1.4.8.1 CM582-DP - PROFIBUS DP slave

1.4.8.1.1 Features

- PROFIBUS DP slave 12 Mbit/s
- Compatible with Automation Builder version starting from V2.0.2, and with CPU firmware version starting from V2.6
- XC version for use in extreme ambient conditions available



1 5 LEDs for state display
2 Label
3 Communication interface PROFIBUS DP D-sub, 9-pin, female
Sign for XC version

1.4.8.1.2 Purpose

Communication module CM582-DP enables communication over the PROFIBUS DP field bus.

For use in extreme ambient conditions (e.g. wider temperature and humidity range), a special XC version of the device is available.

1.4.8.1.3 Connections

Field bus interface

The PROFIBUS DP connector (9-pin, female) has the following pin assignment:

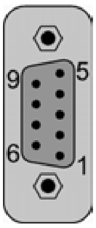
Pin		Signal	Description
	1	NC	Not connected
	2	NC	Not connected
	3	RxD/TxD-P	Receive/Transmit positive
	4	CNTR-P	Control signal for repeater, positive
	5	DGND	Reference potential for data exchange and +5 VI
	6	VP	+5 V (power supply for the bus terminating resistors)
	7	NC	Not connected
	8	RxD/TxD-N	Receive/Transmit negative
	9	NC	Not connected

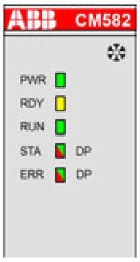
Table 131: Correlation of transmission rate, bit time and cable length:

Tranmission rate in [kbit/s]	Bit time [tBit]	Max. cable length in [m]
9.6	104.2 µs	1200
19.2	52.1 µs	1200
31.25	32 µs	1200
45.45	22 µs	1200
93.75	10.7 µs	1200
187.5	5.3 µs	1000
500	2 µs	400
1500	666.7 ns	200
3000	333.3 ns	100
6000	166.7 ns	100
12000	83.3 ns	100

1.4.8.1.4 State LEDs

The PROFIBUS state is shown by state LEDs.

Table 132: Meaning of the diagnosis LEDs

LED		Color	State	Description
	PWR	Green	ON (light)	Power supply available.
			OFF (dark)	Power supply not available or defective hardware
	RDY	Yellow	ON	Boot procedure
			Blinking	Boot failure
			OFF	---
	RUN	Green	ON	Communication module is operational
			Blinking	---
			OFF	Communication module is not operational
	STA	Green	ON	Communication to all slaves is established
			Flashes cyclic	---
			Flashes non-cyclic	No configuration or stack error
			OFF	No communication
	ERR	Red	Blinking	No data exchange to the master module or the cable is disconnected
			OFF	No error
	STA	Yellow	Blinking	No production data available,
	ERR	Yellow	(synchronously)	no bus communication possible.
LED state during firmware update	STA	Green	Blinking	Firmware file transfers during communication module firmware update.
	ERR	Red	(synchronously)	
	STA	Green	Blinking	Communication module writes the firmware file to the internal flash.
	ERR	Red	(alternately)	Do not power off the PLC!

1.4.8.1.5 Technical data

The system data of AC500 and S500 are applicable to the standard version ↳ *Chapter 2.6.1 “System data AC500” on page 1408*.

The system data of AC500-XC are applicable to the XC version ↳ *Chapter 2.7.1 “System data AC500-XC” on page 1475*.

Only additional details are therefore documented below.

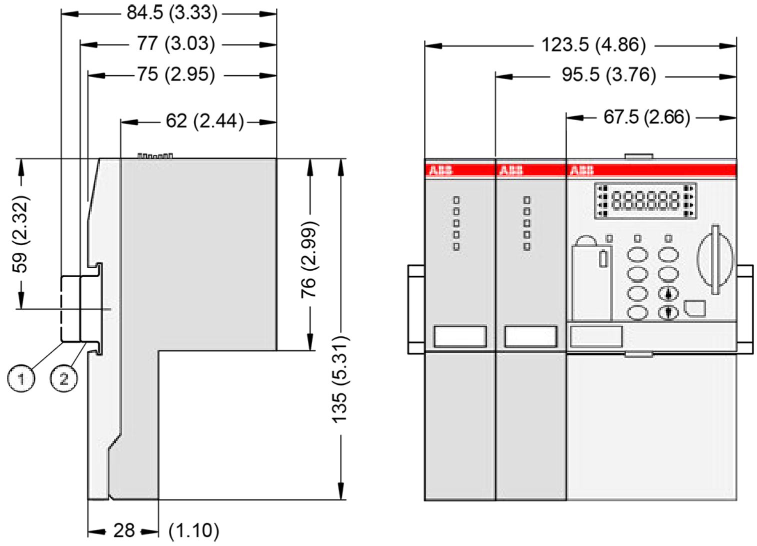
The technical data are also applicable to the XC version.

Parameter	Value
State indication	By 5 LEDs PWR, RDY, RUN, STA, ERR
Usable CPUs	PM57x, PM58x, PM59x ↳ *Chapter 1.3.2.1 "PM57x (-y), PM58x (-y) and PM59x (-y)" on page 23*
Usable terminal bases	All TB5xx ↳ *Chapter 1.2.1 "TB51x-TB54x" on page 4*
Current consumption from 24 V DC power supply at the terminal base of the CPU	Typ. 65 mA
Internal power supply	Through the communication module interface of the terminal base
Maximum number of cyclic input data	244 bytes
Maximum number of cyclic output data	244 bytes
Maximum number of acyclic read/write	240 bytes
Configuration data	max. 244 bytes
Parameter data	237 bytes application specific parameters
Processor	Hilscher NETX 100
Internal RAM memory	8 MB
External Flash memory	8 MB
Weight	Ca. 150 g

Technical data of the interface

Parameter	Value
Interface socket	9-pin, D-sub socket
Transmission standard	EIA RS-485 acc. to IEC 61158/61784, potential-free
Transmission protocol	PROFIBUS DP
Transmission rate	9.6 kbit/s up to 12 Mbit/s

1.4.8.1.6 Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

1.4.8.1.7 Ordering data

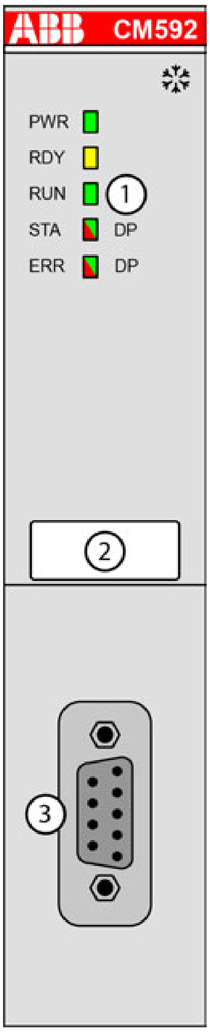
Part no.	Description	Product life cycle phase *)
1SAP 172 200 R0001	CM582-DP, communication module PROFIBUS DP slave, 12 MBit/s	Active
1SAP 372 200 R0001	CM582-DP-XC, communication module PROFIBUS DP slave, 12 MBit/s, XC version	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

1.4.8.2 CM592-DP - PROFIBUS DP master

1.4.8.2.1 Features

- Master 12 Mbit/s
- XC version for use in extreme ambient conditions available



1 5 LEDs for state display
2 Label
3 Communication interface PROFIBUS DP D-sub, 9-pin, female
Sign for XC version

1.4.8.2.2 Purpose

Communication module CM592-DP enables communication over the PROFIBUS DP field bus.

For use in extreme ambient conditions (e.g. wider temperature and humidity range), a special XC version of the device is available.

1.4.8.2.3 Connections

Field bus interface

The PROFIBUS DP connector (9-pin, female) has the following pin assignment:

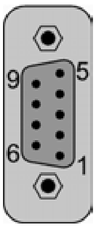
Pin		Signal	Description
	1	NC	Not connected
	2	NC	Not connected
	3	RxD/TxD-P	Receive/Transmit positive
	4	CNTR-P	Control signal for repeater, positive
	5	DGND	Reference potential for data exchange and +5 VI
	6	VP	+5 V (power supply for the bus terminating resistors)
	7	NC	Not connected
	8	RxD/TxD-N	Receive/Transmit negative
	9	NC	Not connected

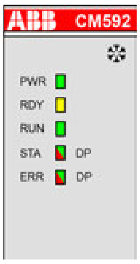
Table 133: Correlation of transmission rate, bit time and cable length:

Tranmission rate in [kbit/s]	Bit time [tBit]	Max. cable length in [m]
9.6	104.2 µs	1200
19.2	52.1 µs	1200
31.25	32 µs	1200
45.45	22 µs	1200
93.75	10.7 µs	1200
187.5	5.3 µs	1000
500	2 µs	400
1500	666.7 ns	200
3000	333.3 ns	100
6000	166.7 ns	100
12000	83.3 ns	100

1.4.8.2.4 State LEDs

The PROFIBUS state is shown by state LEDs.

Table 134: Meaning of the diagnosis LEDs

LED		Color	State	Description
	PWR	Green	ON (light)	Power supply available
			OFF (dark)	Power supply not available or defective hardware
	RDY	Yellow	ON	Boot procedure
			Blinking	Boot failure
			OFF	---
	RUN	Green	ON	Communication module is operational
			Blinking	---
			OFF	Communication module is not operational
	STA	Green	ON	Communication to all slaves is established
			Flashes cyclic	---
			Flashes non-cyclic	No configuration or stack error
			OFF	No communication
	ERR	Red	ON	Communication to one/all slaves is dis-connected
			Flashes cyclic	Communication to at least one slave is disconnected
			OFF	No error
	STA	Yellow	Blinking	No production data available,
	ERR	Yellow	(synchronously)	no bus communication possible.
LED state during firmware update	STA	Green	Blinking	Firmware file transfers during communication module firmware update.
	ERR	Red	(synchronously)	
	STA	Green	Blinking	Communication module writes the firmware file to the user flash memory.
	ERR	Red	(alternately)	Do not power off the PLC!

1.4.8.2.5 Technical data

The system data of AC500 and S500 are applicable to the standard version ⇘ *Chapter 2.6.1 “System data AC500” on page 1408*.

The system data of AC500-XC are applicable to the XC version ⇘ *Chapter 2.7.1 “System data AC500-XC” on page 1475*.

Only additional details are therefore documented below.

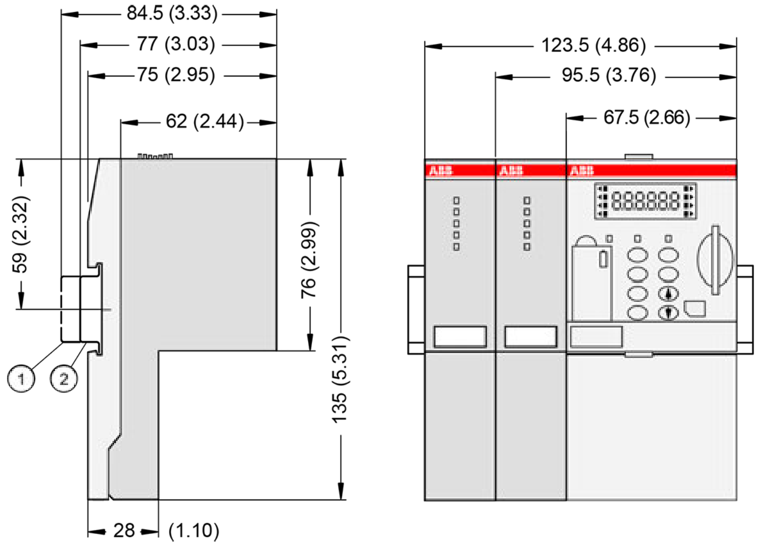
The technical data are also applicable to the XC version.

Parameter	Value
State indication	By 5 LEDs PWR, RDY, RUN, STA, ERR
Usable CPUs	PM57x, PM58x, PM59x ⇘ *Chapter 1.3.2.1 “PM57x (-y), PM58x (-y) and PM59x (-y)” on page 23*
Usable terminal bases	All TB5xx ⇘ *Chapter 1.2.1 “TB51x-TB54x” on page 4*
Current consumption from 24 V DC power supply at the terminal base of the CPU	Typ. 65 mA
Internal power supply	Through the communication module interface of the terminal base
Maximum number of supported slaves	125 (DPV0/DPV1)
Maximum number of total cyclic input data	5712 bytes (Status information is separately managed)
Maximum number of total cyclic output data	5760 bytes
Maximum number of cyclic intput data	244 bytes/slave
Maximum number of cyclic output data	244 bytes/slave
Configuration data	max. 244 bytes per slave
Parameterization data per slave	7 bytes/slave standard parameters 237 bytes/slave application specific parameters
Maximum number of acyclic read/write	240 bytes per slave and telegram
Processor	Hilscher NETX 100
Internal RAM memory	8 MB
External user flash memory	8 MB
Weight	Ca. 150 g

Technical data of the interface

Parameter	Value
Interface socket	9-pin, D-sub socket
Transmission standard	EIA RS-485 acc. to IEC 61158/61784, potential-free
Transmission protocol	PROFIBUS DP
Transmission rate	9.6 kbit/s up to 12 Mbit/s

1.4.8.2.6 Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

1.4.8.2.7 Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 173 200 R0001	CM592-DP, communication module PROFIBUS DP master, 12 MBit/s	Active
1SAP 373 200 R0001	CM592-DP-XC, communication module PROFIBUS DP master, 12 MBit/s, XC version	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

1.4.8.3 PROFIBUS connection details

Attachment plug for the bus cable 9-pin D-sub connector, male

Parameter	Value
Fastening torque	0.4 Nm

Assignment

Pin	Signal	Description
1	Shield	Shielding, protective ground
2	not used	-
3	RxD/TxD-P	Reception / transmission line, positive
4	CBTR-P	Control signal for repeater, positive (optional)
5	DGND	Reference potential for data lines and +5 V
6	VP	+5 V, supply voltage for bus terminating resistors
7	not used	-
8	RxD/TxD-N	Reception / transmission line, negative
9	CNTR-N	Control signal for repeater, negative (optional)

Bus cable

Parameter	Value
Type	Twisted pair (shielded)
Characteristic impedance	135 Ω ... 165 Ω
Cable capacitance	< 30 pF/m
Conductor diameter of the cores	≥ 0.64 mm
Conductor cross section of the cores	≥ 0.34 mm²
Cable resistance per core	≤ 55 Ω/km
Loop resistance (resistance of two cores)	≤ 110 Ω/km

Cable lengths

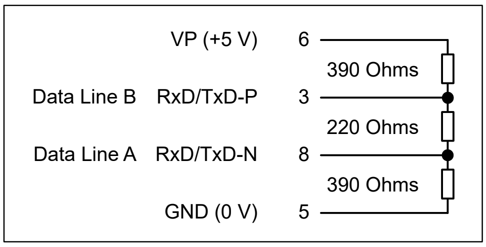
The maximum possible cable length of a PROFIBUS subnet within a segment depends on the tranmission rate (baud rate).

Transmission Rate	Maximum Cable Length
9.6 / 19.2 / 93.75 kBaud	1200 m
187.5 kBaud	1000 m
500 kBaud	400 m
1.5 MBaud	200 m
3 MBaud to 12 MBaud	100 m

Branch lines are generally permissible for transmission rates of up to 1500 kbit/s. But in fact they should be avoided for transmission rates higher than 500 kbit/s.

Bus terminating resistors

The line ends (of the bus segments) have to be terminated using bus terminating resistors according to the drawing below. The bus terminating resistors are usually placed inside the bus connector.



Repeaters

One bus segment can have up to 32 subscribers. Using repeaters a system can be expanded to up to 126 subscribers. Repeaters are also required for longer transfer lines. Please note that a repeater's load to the bus segment is the same as the load of a normal bus subscriber. The sum of normal bus subscribers and repeaters in one bus segment must not exceed 32.

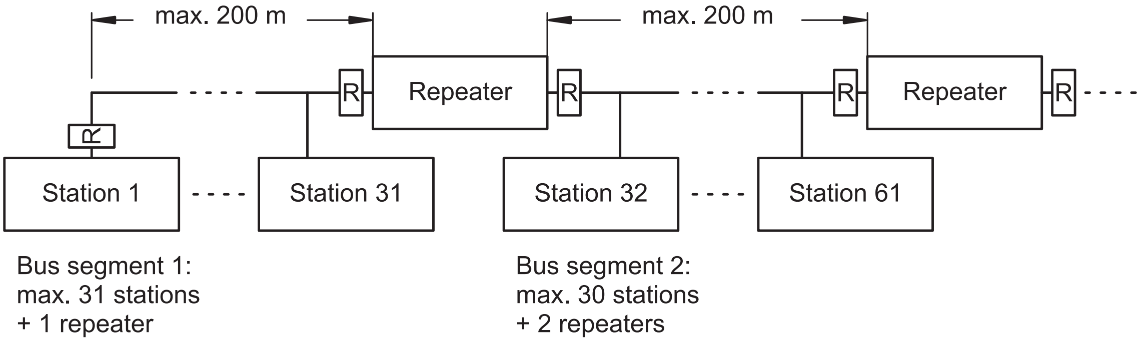


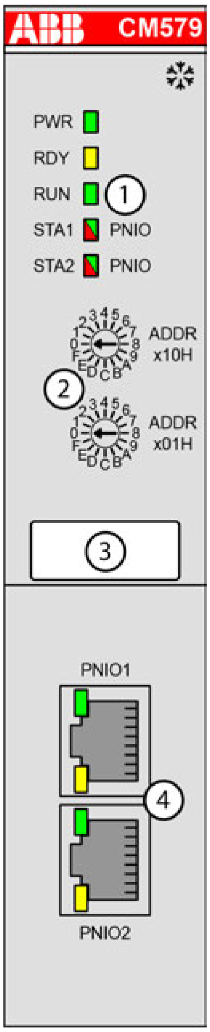
Fig. 90: Principle example for a PROFIBUS-DP system with repeaters (1500 kbit/s baud rate)

1.4.9 PROFINET

1.4.9.1 CM579-PNIO - PROFINET IO RT controller

1.4.9.1.1 Features

- PROFINET IO controller
- Integrated 2-port switch
- XC version for use in extreme ambient conditions available



1 5 LEDs for state display
2 2 rotary switches for address setting (not used)
3 Label
4 2 communication interfaces RJ45 (PNIO1 and PNIO2)
Sign for XC version

1.4.9.1.2 Intended purpose

The communication module is for PROFINET RT communication.

The PROFINET communication module includes an internal Ethernet switch. The connection to the Ethernet can be established directly to the communication module. An additional switch is not necessary.

The communication module is configured via the dual-port memory by means of a system configurator. The configuration is saved on a non-volatile Flash EPROM memory.

For use in extreme ambient conditions (e.g. wider temperature and humidity range), a special XC version of the device is available.

1.4.9.1.3 Functionality

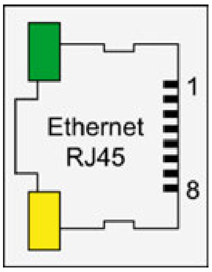
Parameter	Value
Protocol	PROFINET IO RT
Usable CPUs	PM57x, PM58x, PM59x *Chapter 1.3.2.1 “PM57x (-y), PM58x (-y) and PM59x (-y)” on page 23*
Usable terminal bases	All TB5xx *Chapter 1.2.1 “TB51x-TB54x” on page 4*
Field bus connector	2 RJ45 (PNIO1 and PNIO2), with integrated 2-port switch
Internal supply	Via the communication module interface of the terminal base

1.4.9.1.4 Connections

Field bus interfaces

The communication module provides 2 RJ45 interfaces.

Pin assignment

Interface	Pin	Signal	Description
	1	TxD+	Transmit data +
	2	TxD-	Transmit data -
	3	RxD+	Receive data +
	4	NC	Not connected
	5	NC	Not connected
	6	RxD-	Receive data -
	7	NC	Not connected
	8	NC	Not connected
	Shield	Cable shield	Functional earth

In corrosive environment, please protect unused connectors using the TA535 accessory.

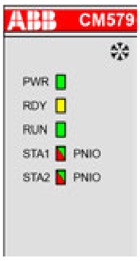
Not supplied with this device.

Further information about wiring and cable types

1.4.9.1.5 State LEDs

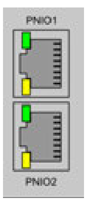
The PROFINET state is shown by the state LEDs.

Table 135: Meaning of the diagnosis LEDs

LED		Color	State	Description
	PWR	Green	On	Power supply available
			Blinking	---
			Off	Power supply not available or defective hardware
	RDY	Yellow	On	Boot procedure
			Blinking	Boot failure
			Off	---
	RUN	Green	On	Communication module is operational
			Blinking	---
			Off	Communication module is not operational
	STA1	Red	On	Diagnosis alarm reported. At least one device is having a diagnosis alarm. In incorporation with STA2 PNIO: License fault.
			Blinking	System error
			Off	No system error
	STA2	Red	On	No connection; in incorporation with STA1 PNIO: license fault
			Blinking	Configuration fault: some configured I/O modules are not connected
			Off	No bus error, communication is running
	STA1	Yellow	Blinking	No production data available,
	STA2	Yellow	(synchronously)	no bus communication possible.
LED state during firmware update	STA1	Green	Blinking	Firmware file transfers during communication module firmware update.
	STA2	Red	(synchronously)	
	STA1	Green	Blinking	Communication module writes the firmware file to the internal flash.
	STA2	Red	(alternately)	Do not power off the PLC!

The RJ45 Ethernet connector contains two LEDs showing the current Ethernet port connection state.

Table 136: Meaning of the diagnosis LEDs

LED		Color	State	Description
	PNIO1 LED "Link"	Green	On	Ethernet connection established
			Off	No Ethernet connection
	PNIO1 LED "RX/TX"	Yellow	On	---
			Blinking	PROFINET device sends/receives frames
			Off	---
	PNIO2 LED "Link"	Green	On	Ethernet connection established

LED		Color	State	Description
			Off	No Ethernet connection
	PNIO2 LED "RX/TX"	Yellow	On	---
			Blinking	PROFINET device sends/receives frames
			Off	---

1.4.9.1.6 Technical data

The system data of AC500 and S500 are applicable to the standard version *Chapter 2.6.1 “System data AC500” on page 1408*.

The system data of AC500-XC are applicable to the XC version *Chapter 2.7.1 “System data AC500-XC” on page 1475*.

Only additional details are therefore documented below.

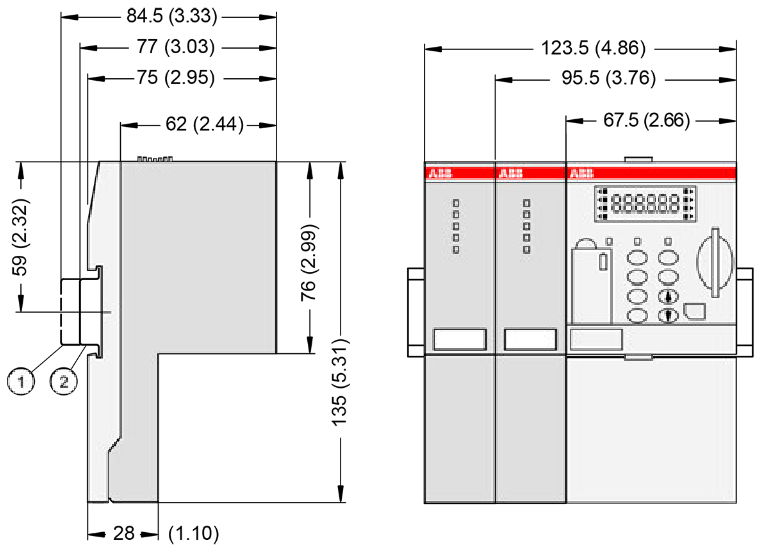
The technical data are also applicable to the XC version.

Parameter	Value
Protocol	PROFINET IO RT
Bus connection	2 RJ45 (PNIO1 and PNIO2), with integrated 2-port switch
Switch	Integrated
Technology	Hilscher NETX 100
Transfer rate	100 Mbit/s (full-duplex)
Transfer method	According to Ethernet II, IEEE 802.3
Ethernet	100 base-TX, internal switch, 2x RJ45 socket
Bus length (segment length max.)	100 m
Indicators	5 LEDs
Usable terminal bases	All TB5xx *Chapter 1.2.1 “TB51x-TB54x” on page 4*
Supported alarm types	Process alarm, diagnostic alarm, return of Sub-Module, plug alarm, pull alarm
Alarm processing	Requires handling in application program
Current consumption from 24 V DC power supply at the terminal base of the CPU	Typ. 85 mA
Internal supply	Via the communication module interface of the terminal base
Weight	Ca. 170 g
Maximum number of remote I/O stations connected	128

Parameter		Value
Supported protocols		RTC - real-time cyclic protocol, class 1 RTA - real-time acyclic protocol DCP - discovery and configuration protocol *) CL-RPC - connectionless remote procedure call Since revision FW 2.4.8.0 additionally LLDP - link layer discovery protocol SNMP - simply network management protocol (SNMP v1)
Acyclic services		PNIO read / write (max. 1392 bytes per telegram, max. 4096 bytes per service request)
Total quantity of input and output data		
	CM579-PNIO < FW 2.4.8.0	1024 bytes per I/O module 3072 bytes in total
	CM579-PNIO = FW 2.4.8.0	1024 bytes per I/O module 4096 bytes in total
	CM579-PNIO > FW 2.4.8.0	1440 bytes per I/O module PM57x, PM58x, PM59x: 4096 bytes in total
Min. bus cycle		1 ms
Conformance class		CC A

*) CM579-PNIO does not allow setting "Station name" by using PROFINET service "DCP SET NameOfStation".

1.4.9.1.7 Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

1.4.9.1.8 Ordering data

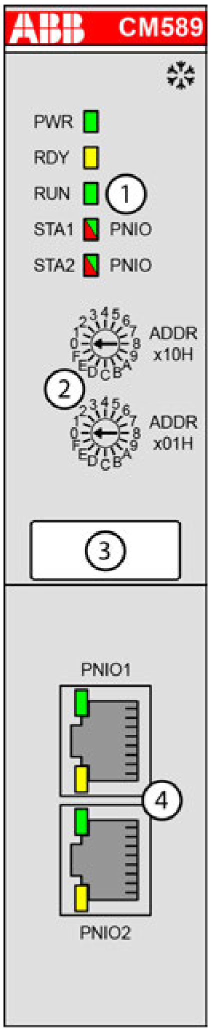
Part no.	Description	Product life cycle phase *)
1SAP 170 901 R0101	CM579-PNIO, PROFINET communication module	Active
1SAP 370 901 R0101	CM579-PNIO-XC, PROFINET communication module, XC version	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

1.4.9.2 CM589-PNIO(-4) - PROFINET IO RT with 4 devices

1.4.9.2.1 Features

- PROFINET IO device
- Integrated 2-port switch
- XC version for use in extreme ambient conditions available



1 5 LEDs for state display
2 2 rotary switches for setting the IO device identifier
3 Label
4 2 communication interfaces RJ45 (PNIO1 and PNIO2)
Sign for XC version

The communication module is for PROFINET RT communication.

The PROFINET communication module includes an internal Ethernet switch. The connection to the Ethernet can be established directly to the communication module. An additional switch is not necessary.

The communication module is configured via the dual-port memory by means of a system configurator. The configuration is saved on a non-volatile Flash EPROM memory.

For use in extreme ambient conditions (e.g. wider temperature and humidity range), a special XC version of the device is available.

CM589-PNIO(-4)

CM589-PNIO supports one application relation to communicate to one single PROFINET IO controller.

CM589-PNIO-4 supports 4 application relations to communicate to up to 4 PROFINET IO controllers in parallel using PROFINET Shared Device technology.

1.4.9.2.2 Functionality

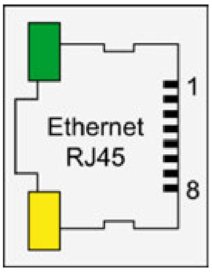
Parameter	Value
Protocol	PROFINET IO RT
Usable CPUs	PM57x, PM58x, PM59x ↳ *Chapter 1.3.2.1 "PM57x (-y), PM58x (-y) and PM59x (-y)" on page 23*
Usable terminal bases	All TB5xx ↳ *Chapter 1.2.1 "TB51x-TB54x" on page 4*
Field bus connector	2 RJ45 (PNIO1 and PNIO2), with integrated 2-port switch
Internal supply	Via the communication module interface of the terminal base

1.4.9.2.3 Connections

Field bus interfaces

The PROFINET communication module provides 2 RJ45 interfaces:

Pin assignment

Interface	Pin	Signal	Description
	1	TxD+	Transmit data +
	2	TxD-	Transmit data -
	3	RxD+	Receive data +
	4	NC	Not connected
	5	NC	Not connected
	6	RxD-	Receive data -
	7	NC	Not connected
	8	NC	Not connected
	Shield	Cable shield	Functional earth

> *In corrosive environment, please protect unused connectors using the TA535 accessory.*
>
> *Not supplied with this device.*

↳ *Further information about wiring and cable types*

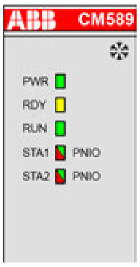
1.4.9.2.4 Addressing

> *The module reads the position of the rotary switches only during power-up, i.e. changes of the switch position during operation will have no effect until the next module initialization.*

1.4.9.2.5 State LEDs

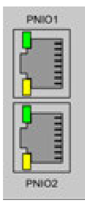
The PROFINET state is shown by the state LEDs.

Table 137: Meaning of the diagnosis LEDs

LED		Color	State	Description
	PWR	Green	On	Power supply available
			Blinking	---
			Off	Power supply not available or defective hardware
	RDY	Yellow	On	Boot procedure
			Blinking	Boot failure
			Off	---
	RUN	Green	On	Communication module is operational
			Blinking	---
			Off	Communication module is not operational
	STA1	Red	On	System error; watchdog timeout
			Blinking	
			Off	No system error
	STA2	Red	On	No connection; no configuration
			Blinking	No data exchange
			Off	No bus error, communication is running
	STA1	Yellow	Blinking	No production data available,
	STA2	Yellow	(synchronously)	no bus communication possible.
LED state during firmware update	STA1	Green	Blinking	Firmware file transfers during communication module firmware update.
	STA2	Red	(synchronously)	
	STA1	Green	Blinking	Communication module writes the firmware file to the internal flash. Do not power off the PLC!
	STA2	Red	(alternately)	

The RJ45 Ethernet connector contains two LEDs showing the current Ethernet port connection state.

Table 138: Meaning of the diagnosis LEDs

LED		Color	State	Description
	PNIO1 LED "Link"	Green	On	Ethernet connection established
			Off	No Ethernet connection
	PNIO1 LED "RX/TX"	Yellow	On	PROFINET device sends/receives frames
			Blinking	PROFINET device sends/receives frames
			Off	---
	PNIO2 LED "Link"	Green	On	Ethernet connection established
			Off	No Ethernet connection
	PNIO2 LED "RX/TX"	Yellow	On	PROFINET device sends/receives frames

LED		Color	State	Description
			Blinking	PROFINET device sends/receives frames
			Off	---

1.4.9.2.6 Technical data

The system data of AC500 and S500 are applicable to the standard version *Chapter 2.6.1 “System data AC500” on page 1408*.

The system data of AC500-XC are applicable to the XC version *Chapter 2.7.1 “System data AC500-XC” on page 1475*.

Only additional details are therefore documented below.

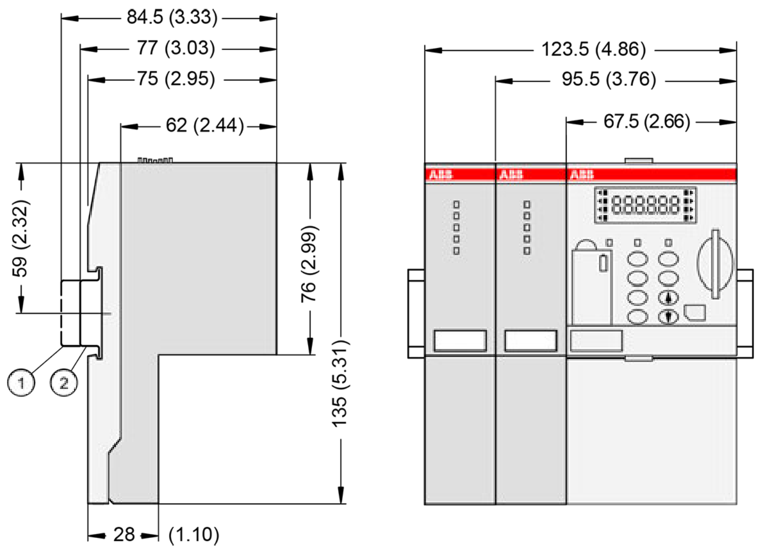
The technical data are also applicable to the XC version.

Parameter	Value
Protocol	PROFINET IO RT
Bus connection	2 RJ45 (PNIO1 and PNIO2), with integrated 2-port switch
Switch	Integrated
Technology	Hilscher NETX 100
Transfer rate	100 Mbit/s (full-duplex)
Transfer method	According to Ethernet II, IEEE 802.3
Ethernet	100 base-TX, internal switch, 2x RJ45 socket
Bus length (segment length max.)	100 m
Indicators	5 LEDs
Usable terminal bases	All TB5xx *Chapter 1.2.1 “TB51x-TB54x” on page 4*
Supported alarm types	Process alarm, diagnostic alarm, return of SubModule, plug alarm, pull alarm
Current consumption from 24 V DC power supply at the terminal base of the CPU	Typ. 85 mA
Internal supply	Via the communication module interface of the terminal base
Setting of the I/O device identifier	With 2 rotary switches at the front side of the module
Weight	Ca. 170 g
Supported protocols	RTC - real-time cyclic protocol, class 1 RTA - real-time acyclic protocol DCP - discovery and configuration protocol *) CL-RPC - connectionless remote procedure call LLDP - link layer discovery protocol SNMP - simply network management protocol MRP - MRP Client

Parameter	Value
Acyclic services	PNIO read / write CM589-PNIO < FW 1.4.0: max. 1024 bytes CM589-PNIO ≥ FW 1.4.0: max. 8096 bytes CM589-PNIO-4: max. 8096 bytes
Total quantity of input and output data	CM589-PNIO < FW 1.4.0 (respectively for input and output): max. 1024 byte CM589-PNIO ≥ FW 1.4.0 (respectively for input and output): max. 1440 byte CM589-PNIO-4 (respectively for input and output): max. 1440 byte
Min. bus cycle	1 ms
Conformance class	CC B

*) Setting NameOfStation via service "DCP SET NameOfStation" is enabled only if rotary switches are adjusted to position "00".

1.4.9.2.7 Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

1.4.9.2.8 Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 172 900 R0011	CM589-PNIO, PROFINET communication module	Active
1SAP 372 900 R0011	CM589-PNIO-XC, PROFINET communication module, XC version	Active

Part no.	Description	Product life cycle phase *)
1SAP 172 900 R0111	CM589-PNIO-4, PROFINET communication module	Active
1SAP 372 900 R0111	CM589-PNIO-4-XC, PROFINET communication module, XC version	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

1.5 Terminal units (AC500 standard)

Hot swap

System requirements for hot swapping of I/O modules:

- *Types of terminal units that support hot swapping of I/O modules have the appendix TU5xx**-H**.*
- *I/O modules as of index F0.*

The following I/O bus masters support hot swapping of attached I/O modules:

- *Communication interface modules CI5xx as of index F0.*
- *Processor module PM585-ETH with firmware version as of V2.8.1.*

NOTICE!

Risk of damage to I/O modules!

Hot swapping is only allowed for I/O modules.

Processor modules and communication interface modules must not be removed or inserted during operation.

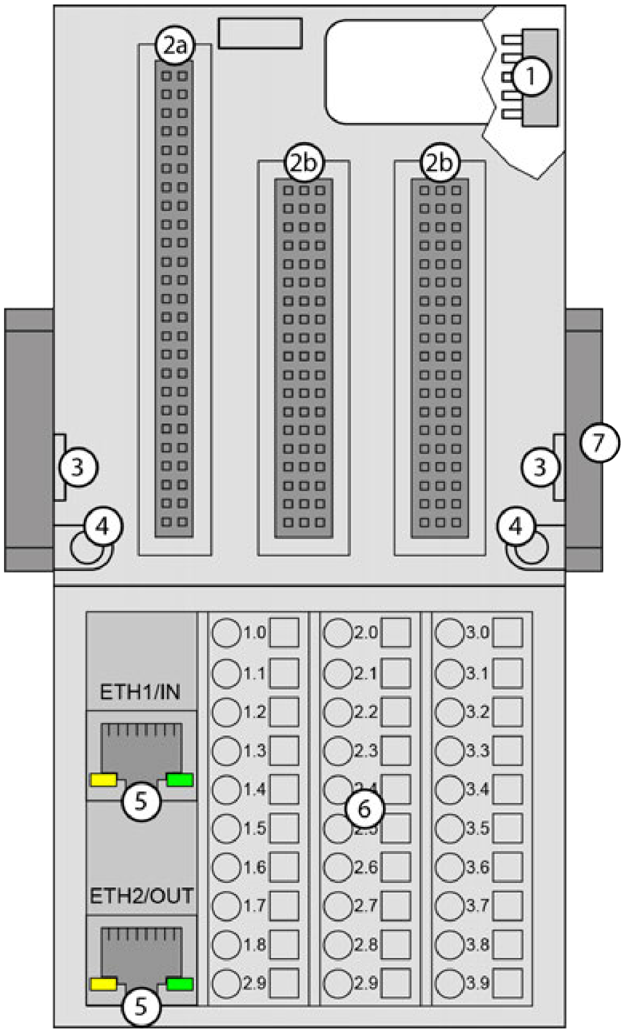
Conditions for hot swapping

- *Digital outputs are not under load.*
- *Input/output voltages above safety extra low voltage/ protective extra low voltages (SELV/PELV) are switched off.*
- *Modules are completely plugged on the terminal unit with both snap fit engaged before switching on loads or input/output voltage.*

1.5.1 TU507-ETH and TU508-ETH for Ethernet communication interface modules

1.5.1.1 Features

- TU507-ETH, Ethernet terminal unit, 24 V DC, screw terminals
- TU508-ETH, Ethernet terminal unit, 24 V DC, spring terminals
- TU508-ETH-XC, Ethernet terminal unit, 24 V DC, spring terminals, XC version



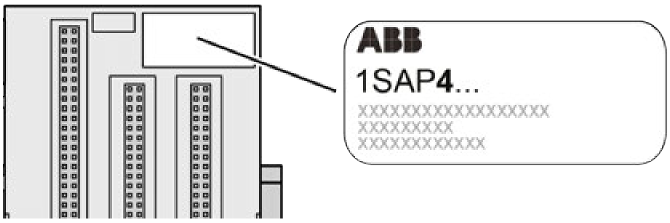
1 I/O bus (10 pins, female) to connect the first terminal unit
2a Plug (2x 25 pins) to connect the inserted Ethernet communication interface module
2b Plug (3x 19 pins) to connect the inserted Ethernet communication interface module
3 With a screwdriver, inserted in this place, the terminal unit and the adjacent terminal unit can be shoved from each other
4 2 holes for wall mounting
5 2 RJ45 interfaces with indication LEDs for connection with the Ethernet network
6 30 terminals for signals and process supply voltages (UP and UP3)
7 DIN rail

The Ethernet communication interface modules plug into the Ethernet terminal unit. When properly seated, they are secured with two mechanical locks. All the connections are made through the Ethernet terminal unit, which allows removal and replacement of the Ethernet communication interface modules without disturbing the wiring at the Ethernet terminal unit.

The Ethernet terminal units TU507-ETH and TU508-ETH are specifically designed for use with AC500/S500 Ethernet communication interface modules (e. g. CI501-PNIO).

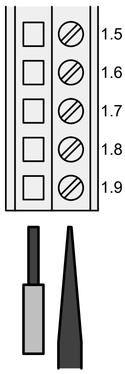
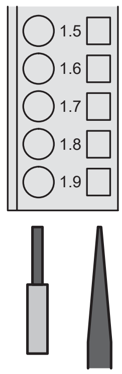
XC version

XC = e**X**treme **C**onditions



> ***Extreme conditions***
>
> *Terminal units for use in extreme ambient conditions have no ❄ sign for XC version.*
>
> *The figure **4** in the Part no. 1SAP**4**... (label) identifies the XC version.*

Terminals

Screw terminals			**Spring terminals**		
Conductor		Screwdriver	Conductor		Screwdriver (opens terminal)

> – *For information about wiring specifications see the description of the terminal units ➥ Chapter 2.6.4.4 “Terminals at the terminal unit” on page 1432.*
>
> – *For a detailed description of the mounting, disassembly and connection of the module, please refer to the System Assembly, Construction and Connection chapter ➥ Chapter 2.6 “AC500 (Standard)” on page 1408.*
>
> – *For information about mechanical dimensions, please refer to the Mechanical dimensions S500 chapter ➥ Chapter 2.6.2.3 “Mechanical dimensions S500” on page 1417*

The terminals 1.8 and 2.8 as well as 1.9, 2.9 and 3.9 are electrically interconnected within the terminal unit and have always the same assignment, independent of the inserted module:

Terminals 1.8 and 2.8: Process supply voltage UP = +24 V DC

Terminal 3.8: Process supply voltage UP3 = +24 V DC

Terminals 1.9, 2.9 and 3.9: Process supply voltage ZP = 0 V

The assignment of the other terminals is dependent on the inserted communication interface module.

> **NOTICE!**
> **Risk of corrosion!**
> Unused connectors and slots may corrode if XC devices are used in salt-mist environments.
>
> Protect unused connectors and slots with TA535 protective caps for XC devices
> *Chapter 1.9.3.6 “TA535 - Protective caps for XC devices” on page 1362*.

1.5.1.2 Technical data

The system data of AC500 and S500 are applicable to the standard version *Chapter 2.6.1 “System data AC500” on page 1408*.

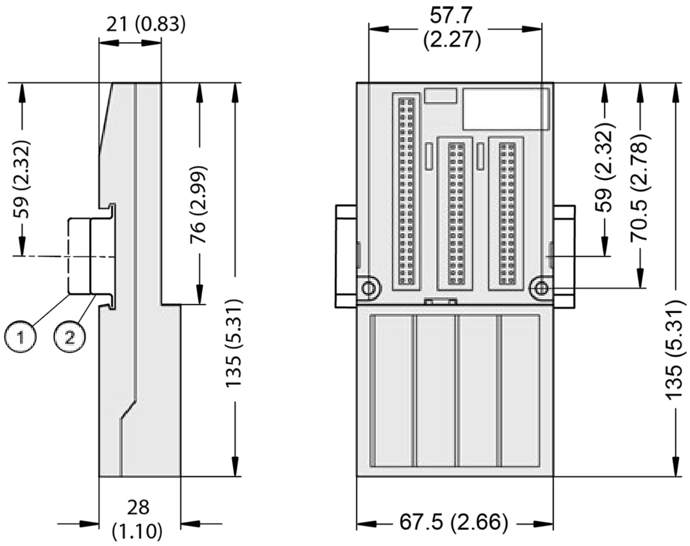
The system data of AC500-XC are applicable to the XC version *Chapter 2.7.1 “System data AC500-XC” on page 1475*.

Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

Parameter	Value
Number of I/O channels per module	Max. 24 (depending on the inserted communication interface module)
Distribution of the channels into groups	3 groups of max. 8 channels each (1.0 ... 1.7, 2.0 ... 2.7, 3.0 ... 3.7), the allocation of the channels is given by the inserted Ethernet bus module
Network interface connector	2 RJ45, 8-pole
Rated voltage	24 V DC
Max. permitted total current	10 A via the supply terminals (UP, UP3 and ZP)
Ethernet	10/100 base-TX or 100 base-TX (depending on CI5xx module plugged in), 2 RJ45 socket
Grounding	Direct connection to the grounded DIN rail or via the screws with wall mounting
Screw terminals	Front terminal, conductor connection vertically with respect to the printed circuit board
Spring-type terminals	Front terminal, conductor connection vertically with respect to the printed circuit board
Weight	200 g
Mounting position	Horizontal or vertical

1.5.1.3 Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

> *The dimensions are in mm and in brackets in inch.*

1.5.1.4 Ordering data

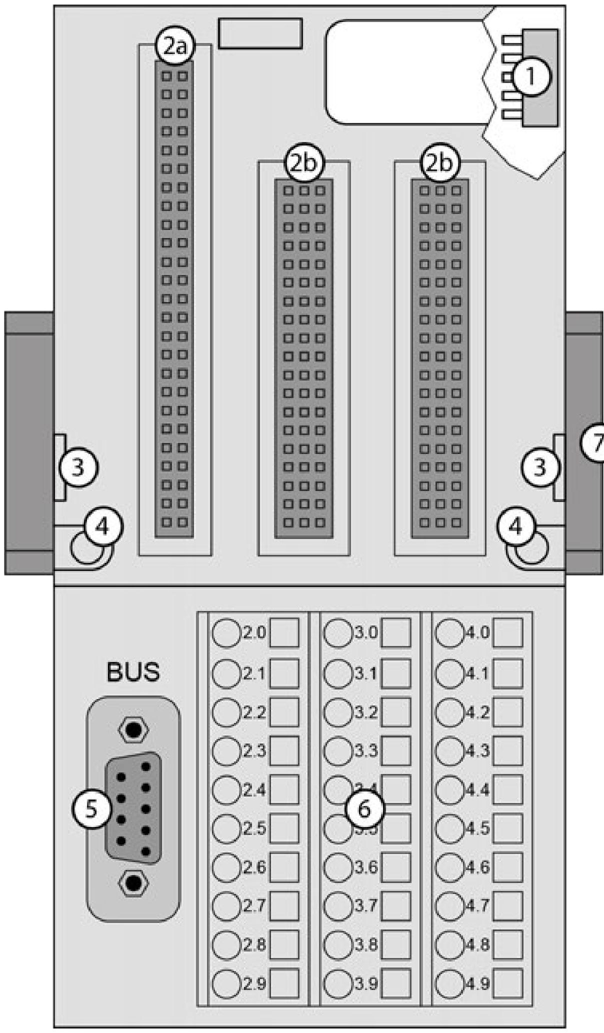
Part no.	Description	Product life cycle phase *)
1SAP 214 200 R0001	TU507-ETH, Ethernet terminal unit, 24 V DC, screw terminals	Active
1SAP 214 000 R0001	TU508-ETH, Ethernet terminal unit, 24 V DC, spring terminals	Active
1SAP 414 000 R0001	TU508-ETH-XC, Ethernet terminal unit, 24 V DC, spring terminals, XC version	Active

> **) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

1.5.2 TU509 and TU510 for communication interface modules

1.5.2.1 Features

- TU509, terminal unit, 24 V DC, screw terminals
- TU510, terminal unit, 24 V DC, spring terminals
- TU510-XC, terminal unit, 24 V DC, spring terminals, XC version



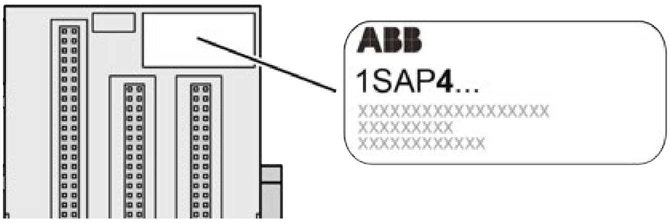
1 I/O bus (10 pins, female) to connect the first terminal unit
2a Plug (2 25 pins) to connect the inserted communication interface module
2b Plug (3 19 pins) to connect the inserted communication interface module
3 With a screwdriver, inserted in this place, the terminal unit and the adjacent terminal unit can be shoved from each other
4 2 holes for wall mounting
5 D-sub 9 (female) for connection with the PROFIBUS network
6 30 terminals for signals and process supply voltages (UP and UP3)
7 DIN rail

The communication interface modules plug into the terminal unit. When properly plugged-in, they are secured with two mechanical locks. All the connections are established via the terminal unit, which allows removal and replacement of the communication interface modules without disturbing the wiring at the terminal unit.

The terminal units TU509 and TU510 are specifically designed for use with AC500/S500 communication interface modules (e. g. CI451-DP).

XC version

XC = e**X**treme **C**onditions

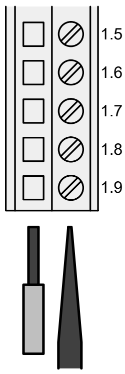
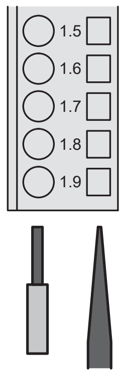


Extreme conditions

Terminal units for use in extreme ambient conditions have no sign for XC version.

*The figure **4** in the Part no. 1SAP**4**... (label) identifies the XC version.*

Terminals

Screw terminals			**Spring terminals**		
Conductor		Screwdriver	Conductor		Screwdriver (opens terminal)

- *For information about wiring specifications see the description of the terminal units* *Chapter 2.6.4.4 “Terminals at the terminal unit” on page 1432.*
- *For a detailed description of the mounting, disassembly and connection of the module, please refer to the System Assembly, Construction and Connection chapter* *Chapter 2.6 “AC500 (Standard)” on page 1408.*
- *For information about mechanical dimensions, please refer to the Mechanical dimensions S500 chapter* *Chapter 2.6.2.3 “Mechanical dimensions S500” on page 1417*

The terminals 2.8, 3.8, 2.9, 3.9 and 4.9 are electrically interconnected within the terminal unit and always have the same assignment, irrespective of the inserted module:

Terminals 2.8 and 3.8: process supply voltage UP = +24 V DC

Terminal 4.8: process supply voltage UP3 = +24 V DC

Terminals 2.9, 3.9 and 4.9: process supply voltage ZP = 0 V

The assignment of the other terminals depends on the inserted communication interface module (see communication interface modules for CANopen and PROFIBUS).

NOTICE!
Risk of corrosion!
Unused connectors and slots may corrode if XC devices are used in salt-mist environments.

Protect unused connectors and slots with TA535 protective caps for XC devices
Chapter 1.9.3.6 "TA535 - Protective caps for XC devices" on page 1362.

1.5.2.2 Technical data

The system data of AC500 and S500 are applicable to the standard version *Chapter 2.6.1 "System data AC500" on page 1408*.

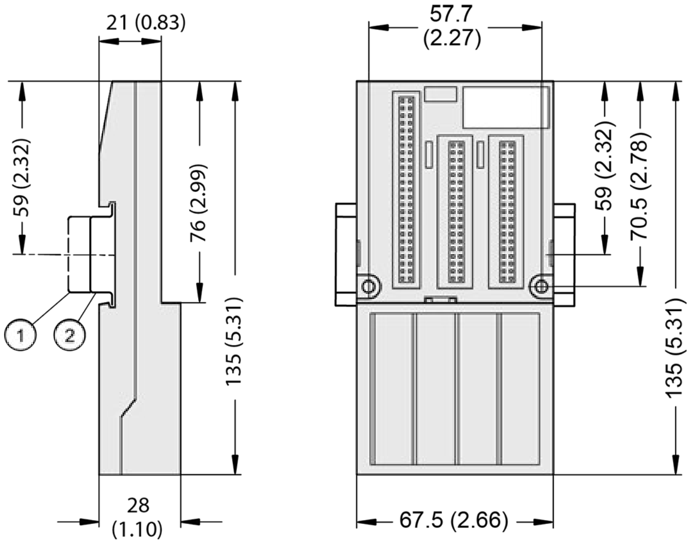
The system data of AC500-XC are applicable to the XC version *Chapter 2.7.1 "System data AC500-XC" on page 1475*.

Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

Parameter	Value
Number of I/O channels per module	Max. 24 (depending on the inserted communication interface module)
Distribution of the channels into groups	3 groups of max. 8 channels each (2.0 ... 2.7, 3.0 ... 3.7, 4.0 ... 4.7), the allocation of the channels is given by the inserted communication interface module
Network interface connector	9-pin D-sub connector, female
Rated voltage	24 V DC
Max. permitted total current	10 A via the supply terminals (UP, UP3 and ZP)
Grounding	Direct connection to the grounded DIN rail or via the screws with wall mounting
Screw terminals	Front terminal, conductor connection vertically with respect to the printed circuit board
Spring terminals	Front terminal, conductor connection vertically with respect to the printed circuit board
Weight	200 g
Mounting position	Horizontal or vertical

1.5.2.3 Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

1.5.2.4 Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 211 000 R0001	TU509, terminal unit, 24 V DC, screw terminals	Active
1SAP 210 800 R0001	TU510, terminal unit, 24 V DC, spring terminals	Active
1SAP 410 800 R0001	TU510-XC, terminal unit, 24 V DC, spring terminals, XC version	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

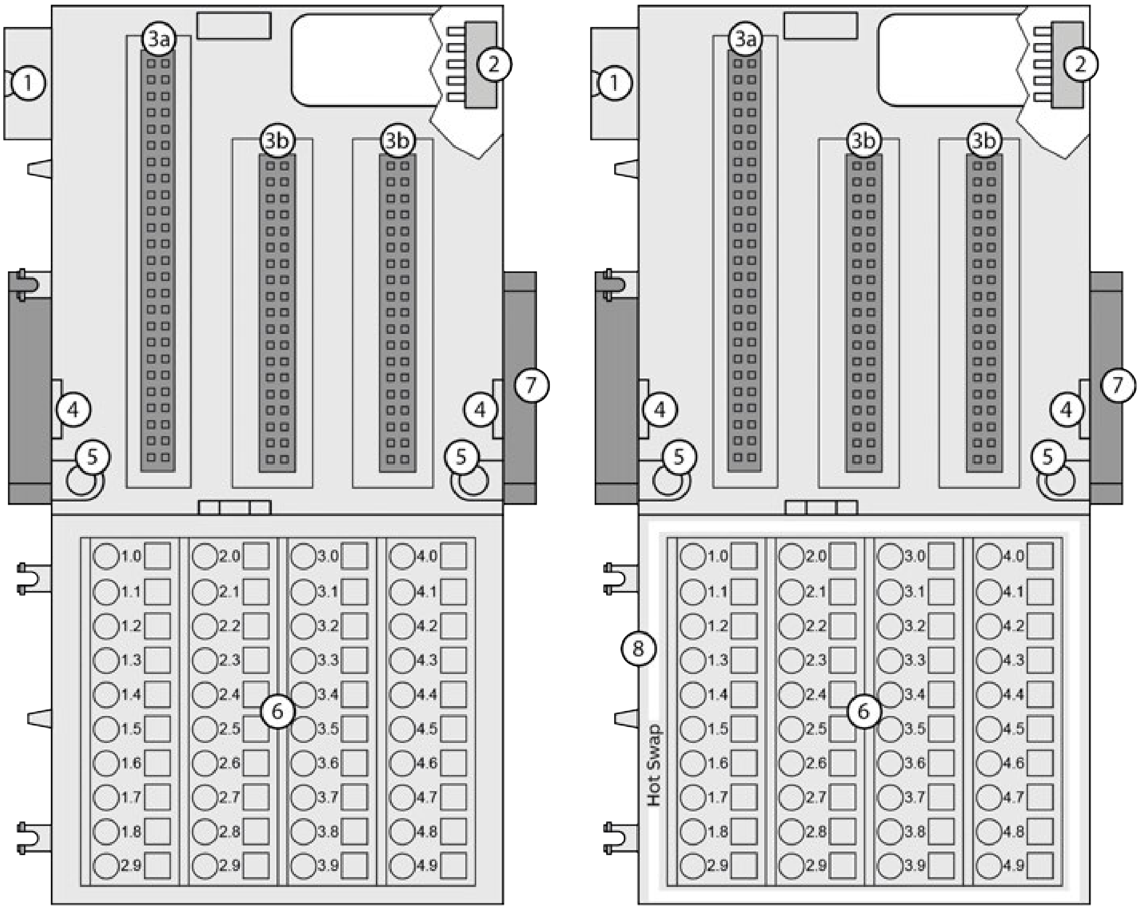
1.5.3 TU515, TU516, TU541 and TU542 for I/O modules

1.5.3.1 Features

- TU515, I/O terminal unit, 24 V DC, screw terminals
- TU516, I/O terminal unit, 24 V DC, spring terminals
- TU516-XC, I/O terminal unit, 24 V DC, spring terminals, XC version
- TU516-H, I/O terminal unit, hot swap, 24 V DC, spring terminals
- TU516-H-XC, I/O terminal unit, hot swap, 24 V DC, spring terminals, XC version
- TU541, I/O terminal unit, 24 V DC, screw terminals
- TU542, I/O terminal unit, 24 V DC, spring terminals
- TU542-XC, I/O terminal unit, 24 V DC, spring terminals, XC version

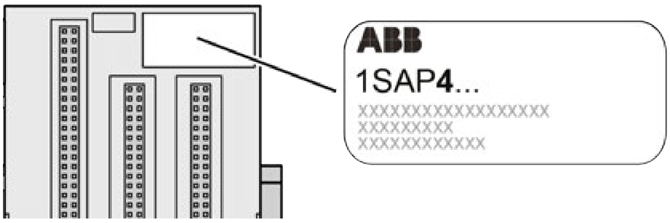
- TU542-H, I/O terminal unit, hot swap, 24 V DC, spring terminals
- TU542-H-XC, I/O terminal unit, hot swap, 24 V DC, spring terminals, XC version

The input/output modules plug into the I/O terminal unit. When properly seated, they are secured with two mechanical locks. All the connections are established via the terminal unit, which allows removal and replacement of the I/O modules without disturbing the wiring at the terminal unit.



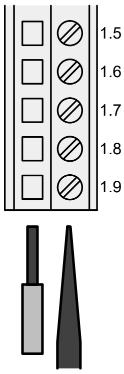
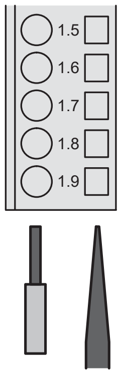
1 I/O bus (10 pins, male) to connect the previous terminal unit, the CPU terminal base or the communication interface module to the terminal unit
2 I/O bus (10 pins, female) to connect other terminal units
3a Plug (2 x 25 pins) to connect the inserted I/O modules
3b Plug (2 x 19 pins) to connect the inserted I/O modules
4 With a screwdriver inserted in this place, the terminal unit and the adjacent terminal unit can be shoved from each other
5 Holes for screw mounting
6 40 terminals for signals and process supply voltage
7 DIN rail
8 White border signifies hot swap capability of the terminal unit

XC version **XC** = e**X**treme **C**onditions



> *Extreme conditions*
>
> *Terminal units for use in extreme ambient conditions have no ❄ sign for XC version.*
>
> *The figure **4** in the Part no. 1SAP**4**... (lable) identifies the XC version.*

Terminals

Screw terminals			**Spring terminals**		
Conductor		Screwdriver	Conductor		Screwdriver (opens terminal)

> – *For information about wiring specifications see the description of the terminal units* *↳ Chapter 2.6.4.4 “Terminals at the terminal unit” on page 1432.*
> – *For a detailed description of the mounting, disassembly and connection of the module, please refer to the System Assembly, Construction and Connection chapter* *↳ Chapter 2.6 “AC500 (Standard)” on page 1408.*
> – *For information about mechanical dimensions, please refer to the Mechanical dimensions S500 chapter* *↳ Chapter 2.6.2.3 “Mechanical dimensions S500” on page 1417*

The following terminals are used for connection of the process supply voltage.

	Terminals							
Type	1.8	2.8	3.8	4.8	1.9	2.9	3.9	4.9
TU515, TU516 and TU516-H	These terminals are internally connected with assignment: process supply voltage UP = +24 V DC				These terminals are internally connected with assignment: process supply voltage ZP = 0 V			
TU541, TU542 and TU542-H	These terminals are internally connected with assignment: process voltage UP = +24 V DC		Separate process supply voltage UP3 = +24 V DC	Separate process supply voltage UP4 = +24 V DC	These terminals are internally connected with assignment: process supply voltage ZP = 0 V		Separate process supply voltage ZP = 0 V	Separate process supply voltage ZP = 0 V

The assignment of the other terminals depends on the inserted communication interface module (see the description of the respective module used).

1.5.3.2 Technical data

The system data of AC500 and S500 are applicable to the standard version ↳ *Chapter 2.6.1 "System data AC500" on page 1408*.

The system data of AC500-XC are applicable to the XC version ↳ *Chapter 2.7.1 "System data AC500-XC" on page 1475*.

Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

Parameter	Value
Number of channels per module	Max. 32
Distribution of the channels into groups	4 groups of 8 channels each (1.0 ... 1.7, 2.0 ... 2.7, 3.0 ... 3.7, 4.0 ... 4.7), the allocation of the channels is given by the inserted I/O module
Rated voltage	24 V DC
Max. permitted total current	10 A, per separated process voltage terminal or for internal connection of process voltages
Grounding	Direct connection to the grounded DIN rail or via the screws with wall mounting
Screw terminals	Front terminal, conductor connection vertically with respect to the printed circuit board
Spring terminals	Front terminal, conductor connection vertically with respect to the printed circuit board
Weight	200 g
Mounting position	Horizontal or vertical

1.5.3.3 Hot swap

Hot swap

WARNING!
Risk of explosion or fire in hazardous environments during hot swapping!
Hot swap must not be performed in flammable environments to avoid life-threatening injury and property damage resulting from fire or explosion.

WARNING!
Electric shock due to negligent behavior during hot swapping!
To avoid electric shock

- make sure the following conditions apply:
  - Digital outputs are not under load.
  - Input/output voltages above safety extra low voltage/ protective extra low voltage (SELV/PELV) are switched off.
  - Modules are fully interlocked with the terminal unit with both snap-fits engaged before switching on loads or input/output voltage.
- Never touch exposed contacts (dangerous voltages).
- Stay away from electrical contacts to avoid arc discharge.
- Do not operate a mechanical installation improperly.

NOTICE!
Risk of damage to I/O modules!
Hot swapping is only allowed for I/O modules.

Processor modules and communication interface modules must not be removed or inserted during operation.

H = **H**ot swap

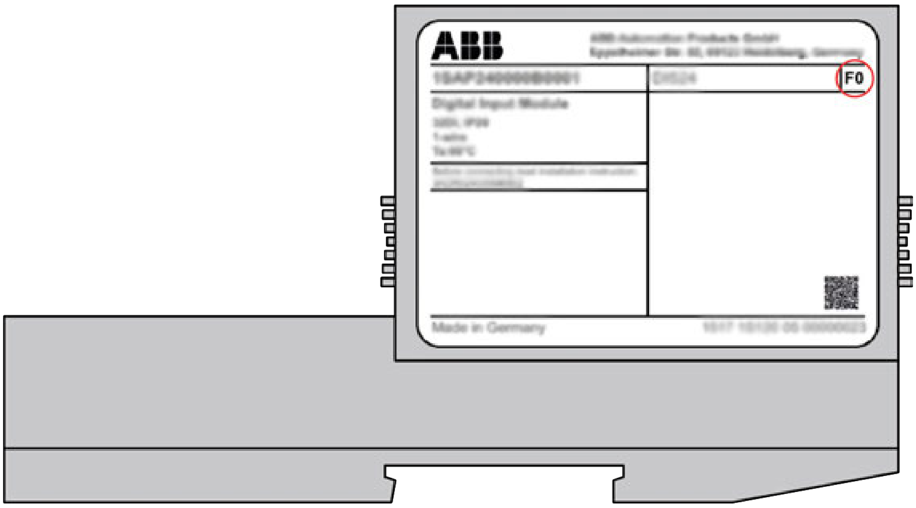
Hot swap
System requirements for hot swapping of I/O modules:

- *Types of terminal units that support hot swapping of I/O modules have the appendix TU5xx-**H**.*
- *I/O modules as of index F0.*

The following I/O bus masters support hot swapping of attached I/O modules:

- *Communication interface modules CI5xx as of index F0.*
- *Processor module PM585-ETH with firmware version as of V2.8.1.*

Hot swap is not supported by AC500-eCo V3 CPU!



The index of the module is in the right corner of the label.

NOTICE!
Risk of damage to I/O modules!
Modules with index below F0 can be damaged when inserted or removed from the terminal unit in a powered system.

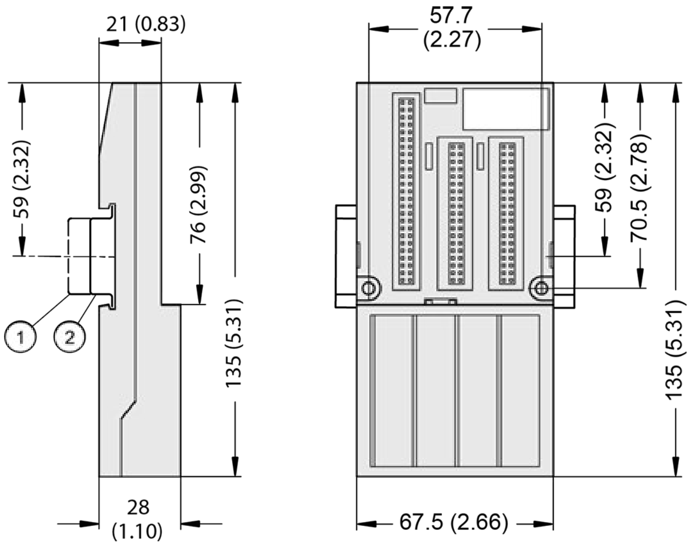
NOTICE!
Risk of damage to I/O modules!
Do not perform hot swapping if any I/O module with firmware version lower than 3.0.14 is part of the I/O configuration.

For min. required device index see table below.

Device	Min. required device index for I/O module as of FW Version 3.0.14
AC522(-XC)	F0
AI523 (-XC)	D2
AI531	D4
AI531-XC	D2
AI561	B2
AI562	B2
AI563	B3
AO523 (-XC)	D2
AO561	B2
AX521 (-XC)	D2
AX522 (-XC)	D2
AX561	B2
CD522 (-XC)	D1

Device	Min. required device index for I/O module as of FW Version 3.0.14
DA501 (-XC)	D2
DA502 (-XC)	F0
DC522 (-XC)	D2
DC523 (-XC)	D2
DC532 (-XC)	D2
DC562	A2
DI524 (-XC)	D2
DI561	B2
DI562	B2
DI571	B2
DI572	A1
DO524 (-XC)	A3
DO526	A2
DO526-XC	A0
DO561	B2
DO562	A2
DO571	B3
DO572	B2
DO573	A1
DX522 (-XC)	D2
DX531	D2
DX561	B2
DX571	B3
FM562	A1

1.5.3.4 Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

1.5.3.5 Ordering data

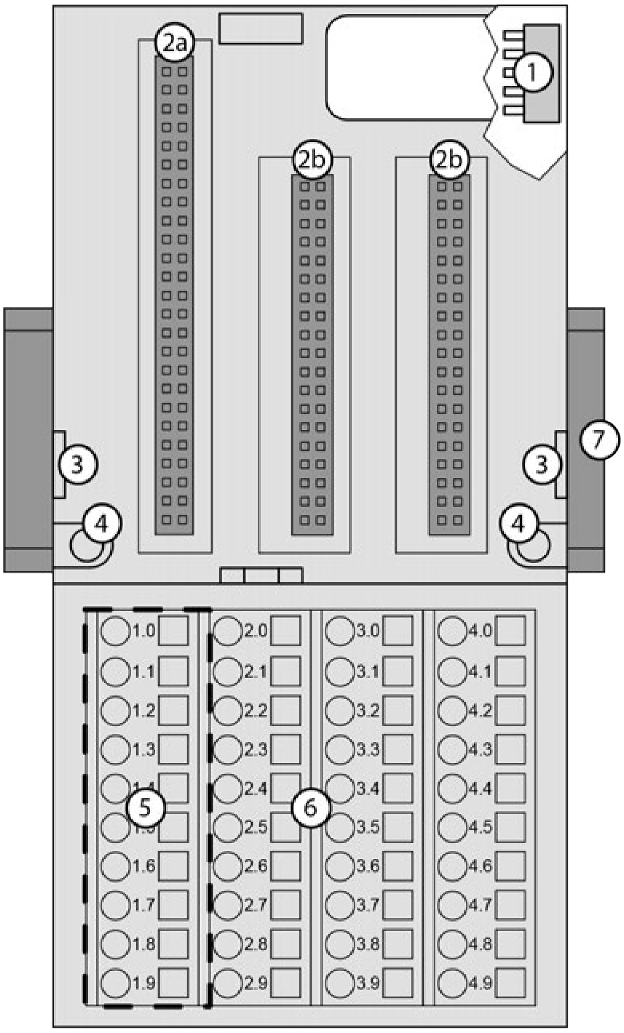
Part no.	Description	Product life cycle phase *)
1SAP 212 200 R0001	TU515, I/O terminal unit, 24 V DC, screw terminals	Active
1SAP 212 000 R0001	TU516, I/O terminal unit, 24 V DC, spring terminals	Active
1SAP 412 000 R0001	TU516-XC, I/O terminal unit, 24 V DC, spring terminals, XC version	Active
1SAP 215 000 R0001	TU516-H, I/O terminal unit, hot swap, 24 V DC, spring terminals, XC version	Active
1SAP 415 000 R0001	TU516-H-XC, I/O terminal unit, hot swap, 24 V DC, spring terminals	Active
1SAP 213 000 R0001	TU541, I/O terminal unit, 24 V DC, screw terminals	Active
1SAP 213 200 R0001	TU542, I/O terminal unit, 24 V DC, spring terminals	Active
1SAP 413 200 R0001	TU542-XC, I/O terminal unit, 24 V DC, spring terminals, XC version	Active
1SAP 215 200 R0001	TU542-H, I/O terminal unit, hot swap, 24 V DC, spring terminals	Active
1SAP 415 200 R0001	TU542-H-XC, I/O terminal unit, hot swap, 24 V DC, spring terminals, XC version	Active

> **) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

1.5.4 TU517 and TU518 for communication interface modules

1.5.4.1 Features

- TU517, terminal unit, 24 V DC, screw terminals
- TU518, terminal unit, 24 V DC, spring terminals
- TU518-XC, terminal unit, 24 V DC, spring terminals, XC version



1 I/O bus (10 pins, female) to connect the first terminal unit
2a Plug (2 25 pins) to connect the inserted communication interface module
2b Plug (2 19 pins) to connect the inserted communication interface module
3 With a screwdriver, inserted in this place, the terminal unit and the adjacent I/O terminal unit can be shoved from each other
4 2 holes for wall mounting
5 10 terminals for connection with the bus system
6 30 terminals for signals and process supply voltages (UP and UP3)
7 DIN rail

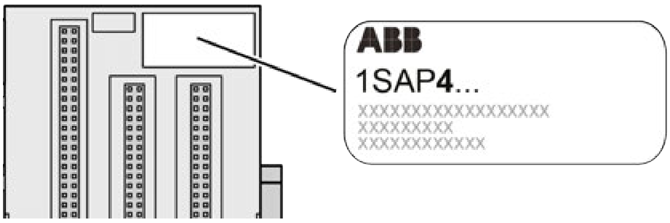
The communication interface modules plug into the terminal unit. When properly plugged-in, they are secured with two mechanical locks. All the connections are established via the terminal unit, which allows removal and replacement of the communication interface modules without disturbing the wiring at the terminal unit.

The terminal units TU517 and TU518 are specifically designed for use with AC500/S500 communication interface modules (e. g. CI581-CN, CI541-DP):

- CANopen communication interface modules
- DeviceNet modules
- PROFIBUS DP communication interface modules

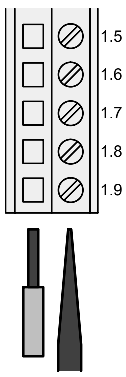
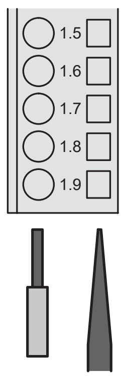
XC version

XC = e**X**treme **C**onditions



> ***Extreme conditions***
>
> *Terminal units for use in extreme ambient conditions have no sign for XC version.*
>
> *The figure **4** in the Part no. 1SAP**4**... (label) identifies the XC version.*

Terminals

Screw terminals			**Spring terminals**		
Conductor		Screwdriver	Conductor		Screwdriver (opens terminal)

> – *For information about wiring specifications see the description of the terminal units* *Chapter 2.6.4.4 "Terminals at the terminal unit" on page 1432.*
>
> – *For a detailed description of the mounting, disassembly and connection of the module, please refer to the System Assembly, Construction and Connection chapter* *Chapter 2.6 "AC500 (Standard)" on page 1408.*
>
> – *For information about mechanical dimensions, please refer to the Mechanical dimensions S500 chapter* *Chapter 2.6.2.3 "Mechanical dimensions S500" on page 1417*

The terminals 2.8, 3.8, 2.9, 3.9 and 4.9 are electrically interconnected within the terminal unit and always have the same assignment, irrespective of the inserted communication interface module:

- Terminals 2.8 and 3.8: process supply voltage UP = +24 V DC
- Terminal 4.8: process supply voltage UP3 = +24 V DC
- Terminals 2.9, 3.9 and 4.9: process supply voltage ZP = 0 V

The assignment of the other terminals depends on the inserted communication interface module (see communication interface modules for CANopen and PROFIBUS).

1.5.4.2 Technical data

The system data of AC500 and S500 are applicable to the standard version *Chapter 2.6.1 “System data AC500” on page 1408*.

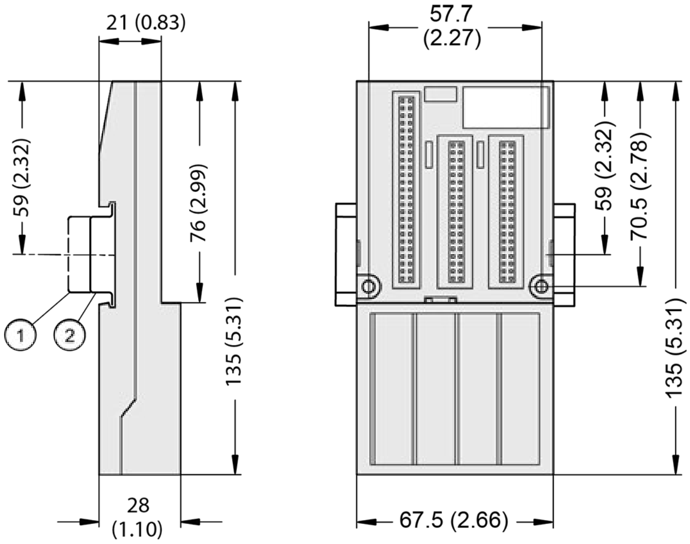
The system data of AC500-XC are applicable to the XC version *Chapter 2.7.1 “System data AC500-XC” on page 1475*.

Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

Parameter	Value
Number of I/O channels per module	Max. 24 (depending on the inserted communication interface module)
Distribution of the channels into groups	3 groups of max. 8 channels each (2.0 ... 2.7, 3.0 ... 3.7, 4.0 ... 4.7), the allocation of the channels is given by the inserted communication interface module
Network interface connector	10 screw or spring terminals (1.0 ... 1.9)
Rated voltage	24 V DC
Max. permitted total current	10 A via the supply terminals (UP, UP3 and ZP)
Grounding	Direct connection to the grounded DIN rail or via the screws with wall mounting
Screw terminals	Front terminal, conductor connection vertically with respect to the printed circuit board
Spring terminals	Front terminal, conductor connection vertically with respect to the printed circuit board
Weight	200 g
Mounting position	Horizontal or vertical

1.5.4.3 Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

1.5.4.4 Ordering data

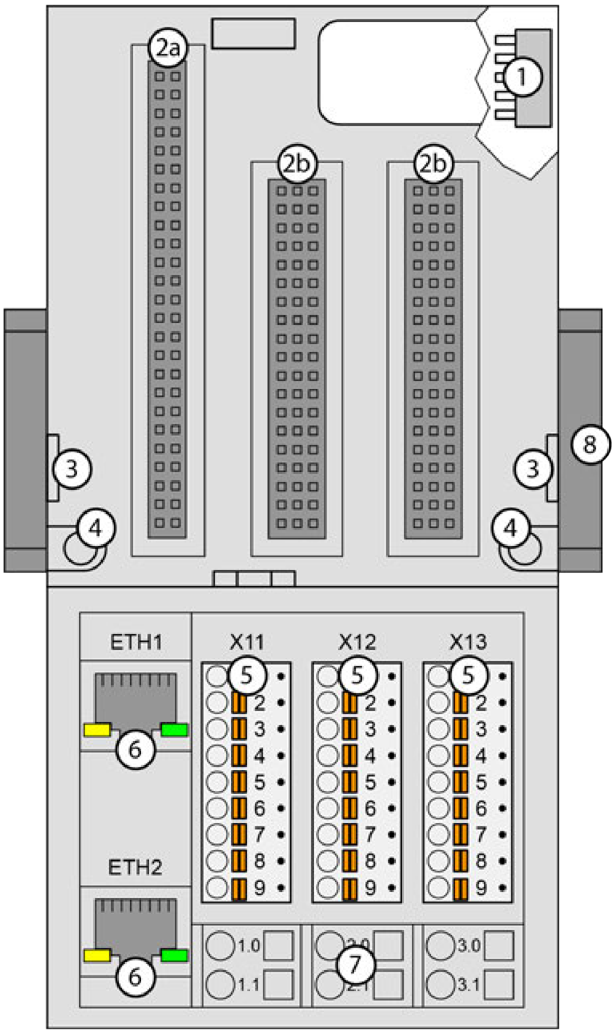
Part no.	Description	Product life cycle phase *)
1SAP 211 400 R0001	TU517, terminal unit, 24 V DC, screw terminals	Active
1SAP 211 200 R0001	TU518, terminal unit, 24 V DC, spring terminals	Active
1SAP 411 200 R0001	TU518-XC, terminal unit, 24 V DC, spring terminals, XC version	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

1.5.5 TU520-ETH for PROFINET communication interface modules

1.5.5.1 Features

- TU520-ETH, 2 RJ45 interfaces for connection to PROFIBUS network, 3 removable connectors for bus systems
- TU520-ETH-XC, 2 RJ45 interfaces for connection to PROFIBUS network, 3 removable connectors for bus systems, XC version

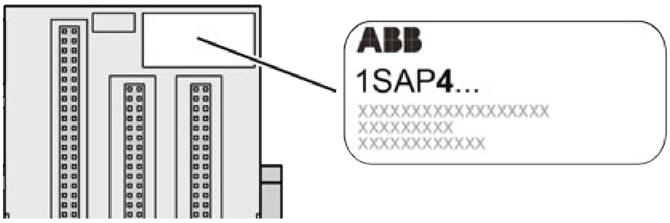


1 I/O bus (10 pins, female) to connect the first terminal unit
2a Plug (2 25 pins) to connect the inserted PROFINET communication interface module
2b Plug (3 19 pins) to connect the inserted PROFINET communication interface module
3 With a screwdriver, inserted in this place, the PROFINET I/O terminal unit and the adjacent I/O terminal unit can be shoved from each other
4 2 holes for wall mounting
5 3 removable connectors to connect the subordinated bus systems
6 2 RJ45 interfaces with indication LEDs for connection with the PROFINET network
7 6 spring terminals for process supply voltage (UP)
8 DIN rail

The PROFINET communication interface modules plug into the PROFINET IO terminal unit. When properly plugged-in, they are secured with two mechanical locks. All the connections are established via the PROFINET IO terminal unit, which allows removal and replacement of the communication interface modules without disturbing the wiring at the PROFINET IO terminal unit.

The PROFINET IO terminal unit TU520-ETH are specifically designed for use with AC500/S500 PROFINET communication interface modules (e. g. CI504-PNIO, CI506-PNIO).

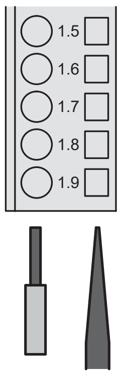
XC version **XC** = e**X**treme **C**onditions



> ***Extreme conditions***
>
> *Terminal units for use in extreme ambient conditions have no ❄ sign for XC version.*
>
> *The figure **4** in the Part no. 1SAP**4**... (label) identifies the XC version.*

> **NOTICE!**
> **Risk of corrosion!**
> Unused connectors and slots may corrode if XC devices are used in salt-mist environments.
>
> Protect unused connectors and slots with TA535 protective caps for XC devices ➜ *Chapter 1.9.3.6 “TA535 - Protective caps for XC devices” on page 1362*.

Spring terminals

Conductor		Screwdriver (opens terminal)

> *For information about wiring specifications see the description for the terminal unit ➜ Chapter 2.6.4.4 “Terminals at the terminal unit” on page 1432.*

> *For a detailed description of the mounting, disassembly and connection of the terminal units and the I/O modules, please refer to the "System Assembly, Construction and Connection" chapter ➜ Chapter 2.6.3 “Mounting and demounting” on page 1419.*

The terminals 1.0, 2.0, 3.0, 1.1, 2.1 and 3.1 are electrically interconnected within the PROFINET IO terminal unit and always have the same assignment, irrespective of the inserted PROFINET communication interface module:

- Terminals 1.0, 2.0 and 3.0: process supply voltage UP = +24 V DC
- Terminals 1.1, 2.1 and 3.1: process supply voltage ZP = 0 V

The assignment of the bus system terminals depends on the inserted PROFINET communication interface module (see Ethernet communication interface modules overview).

1.5.5.2 Technical data

The system data of AC500 and S500 are applicable to the standard version *Chapter 2.6.1 “System data AC500” on page 1408*.

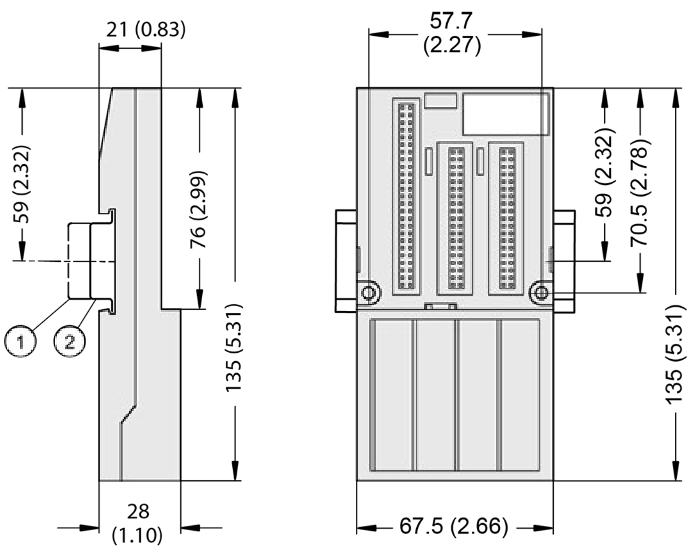
The system data of AC500-XC are applicable to the XC version *Chapter 2.7.1 “System data AC500-XC” on page 1475*.

Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

Parameter	Value
Ethernet	10/100 base-TX or 100 base-TX (depending on the plugged CI5xx module), 2 RJ45 socket
Number of bus system connectors	3 (the type of bus system depends on the PROFINET IO communication interface module)
Rated voltage	24 V DC
Max. permitted total current	10 A via the supply terminals (UP and ZP)
Grounding	Direct connection to the grounded DIN rail or via the screws with wall mounting
Spring terminals	Front terminal, conductor connection vertically with respect to the printed circuit board
Weight	200 g
Mounting position	Horizontal or vertical

1.5.5.3 Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

1.5.5.4 Ordering data

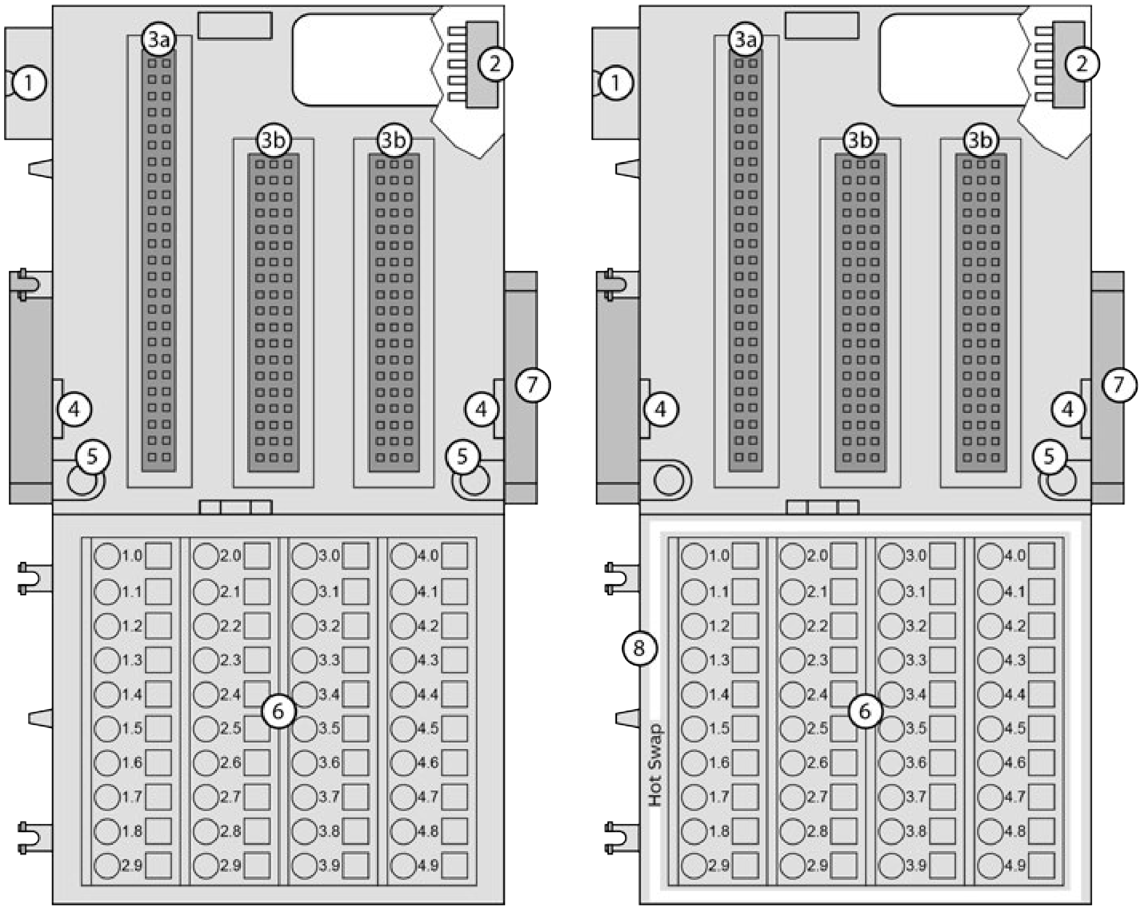
Part no.	Description	Product life cycle phase *)
1SAP 214 400 R0001	TU520-ETH, PROFINET I/O terminal unit, 24 V DC, spring terminals	Active
1SAP 414 400 R0001	TU520-ETH-XC, PROFINET I/O terminal unit, 24 V DC, spring terminals, XC version	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

1.5.6 TU531 and TU532 for I/O modules

1.5.6.1 Features

- TU531, I/O terminal unit, 120/230 V AC, screw terminals
- TU532, I/O terminal unit, 120/230 V AC, spring terminals
- TU532-XC, I/O terminal unit, 120/230 V AC, spring terminals, XC version
- TU532-H, I/O terminal unit, hot swap, 120/230 V AC, spring terminals
- TU532-H-XC, I/O terminal unit, hot swap, 120/230 V AC, spring terminals, XC version

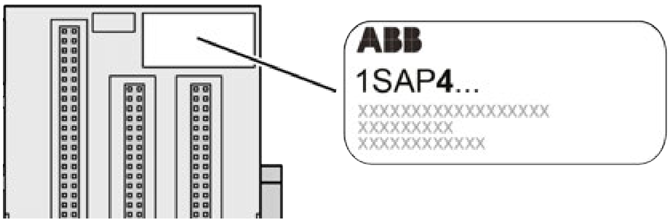


1 I/O bus (10 pins, male) to connect the previous terminal unit, the CPU terminal base or the communication interface module to the terminal unit
2 I/O bus (10 pins, female) to connect other terminal units
3a Plug (2 x 25 pins) to connect the inserted I/O modules
3b Plug (3 x 19 pins) to connect the inserted I/O modules
4 With a screwdriver inserted in this place, the terminal unit and the adjacent I/O terminal unit can be shoved from each other
5 Holes for screw mounting
6 40 terminals for signals and process supply voltage
7 DIN rail
8 White border signifies hot swap capability of the terminal unit

The input/output modules (I/O modules) plug into the I/O terminal unit. When properly plugged-in, they are secured with two mechanical locks. All the connections are established via the terminal unit, which allows removal and replacement of the I/O modules without disturbing the wiring at the terminal unit.

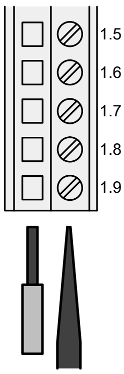
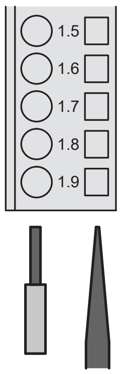
The terminal units TU531 and TU532 are specifically designed for use with AC500/S500 I/O modules that incorporate 115 V AC ... 230 V AC inputs and/or 120/230 V AC relay outputs.

XC version **XC** = e**X**treme **C**onditions



> ***Extreme conditions***
>
> *Terminal units for use in extreme ambient conditions have no ❄ sign for XC version.*
>
> *The figure **4** in the Part no. 1SAP**4**... (label) identifies the XC version.*

Terminals

Screw terminals			Spring terminals		
Conductor		Screwdriver	Conductor		Screwdriver (opens terminal)

> – *For information about wiring specifications see the description of the terminal units ➪ Chapter 2.6.4.4 "Terminals at the terminal unit" on page 1432.*
> – *For a detailed description of the mounting, disassembly and connection of the module, please refer to the System Assembly, Construction and Connection chapter ➪ Chapter 2.6 "AC500 (Standard)" on page 1408.*
> – *For information about mechanical dimensions, please refer to the Mechanical dimensions S500 chapter ➪ Chapter 2.6.2.3 "Mechanical dimensions S500" on page 1417*

The terminals 1.8 ... 4.8 and 1.9 ... 4.9 are electrically interconnected within the terminal unit and always have the same assignment, independent of the inserted module:

- Terminals 1.8 ... 4.8: process supply voltage UP = +24 V DC
- Terminals 1.9 ... 4.9: process supply voltage ZP = 0 V

The assignment of the other terminals depends on the inserted communication interface module (see the description of the respective module used).

The supply voltage of 24 V DC for the module's circuitry comes from the I/O expansion bus (I/O bus).

1.5.6.2 Technical data

The system data of AC500 and S500 are applicable to the standard version ➪ *Chapter 2.6.1 "System data AC500" on page 1408*.

The system data of AC500-XC are applicable to the XC version *Chapter 2.7.1 “System data AC500-XC” on page 1475*.

Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

Parameter	Value
Number of channels per module	32
Distribution of the channels into groups	4 groups of 8 channels each (1.0 ... 1.7, 2.0 ... 2.7, 3.0 ... 3.7, 4.0 ... 4.7), the allocation of the channels is given by the inserted I/O module
Terminals 1.8 ... 4.8 and 1.9 ... 4.9	
Max. voltage	30 V DC
Max. permitted total current	10 A
Terminals 1.0 ... 1.7, 2.0 ... 2.7, 3.0 ... 3.7, 4.0 ... 4.7	
Max. voltage	300 V AC [1])
Max. permitted current	3 A [2])
Grounding	Direct connection to the grounded DIN rail or via the screws with wall mounting
Screw terminals	Front terminal, conductor connection vertically with respect to the printed circuit board
Spring terminals	Front terminal, conductor connection vertically with respect to the printed circuit board
Weight	200 g
Mounting position	Horizontal or vertical

[1]) Only when the voltage is not limited by the specification of the I/O channel or the supply input which is internally connected to the terminal.

[2]) The terminals are connected to the electronic module via internal connectors (X22 (or 3b), X23 (or 3b), X32, X33 and X34). The current per terminal is limited by the permitted current of these connectors.

1.5.6.3 Hot swap

Hot swap

WARNING!

Risk of explosion or fire in hazardous environments during hot swapping!

Hot swap must not be performed in flammable environments to avoid life-threatening injury and property damage resulting from fire or explosion.

WARNING!
Electric shock due to negligent behavior during hot swapping!
To avoid electric shock

- make sure the following conditions apply:
  - Digital outputs are not under load.
  - Input/output voltages above safety extra low voltage/ protective extra low voltage (SELV/PELV) are switched off.
  - Modules are fully interlocked with the terminal unit with both snap-fits engaged before switching on loads or input/output voltage.
- Never touch exposed contacts (dangerous voltages).
- Stay away from electrical contacts to avoid arc discharge.
- Do not operate a mechanical installation improperly.

NOTICE!
Risk of damage to I/O modules!
Hot swapping is only allowed for I/O modules.

Processor modules and communication interface modules must not be removed or inserted during operation.

H = **H**ot swap

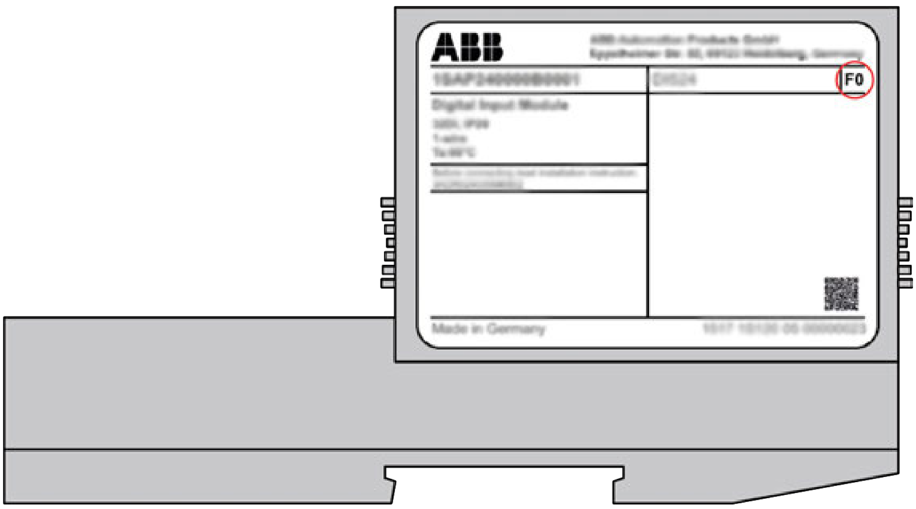
Hot swap
System requirements for hot swapping of I/O modules:

- *Types of terminal units that support hot swapping of I/O modules have the appendix TU5xx-**H**.*
- *I/O modules as of index F0.*

The following I/O bus masters support hot swapping of attached I/O modules:

- *Communication interface modules CI5xx as of index F0.*
- *Processor module PM585-ETH with firmware version as of V2.8.1.*

Hot swap is not supported by AC500-eCo V3 CPU!



The index of the module is in the right corner of the label.

NOTICE!
Risk of damage to I/O modules!
Modules with index below F0 can be damaged when inserted or removed from the terminal unit in a powered system.

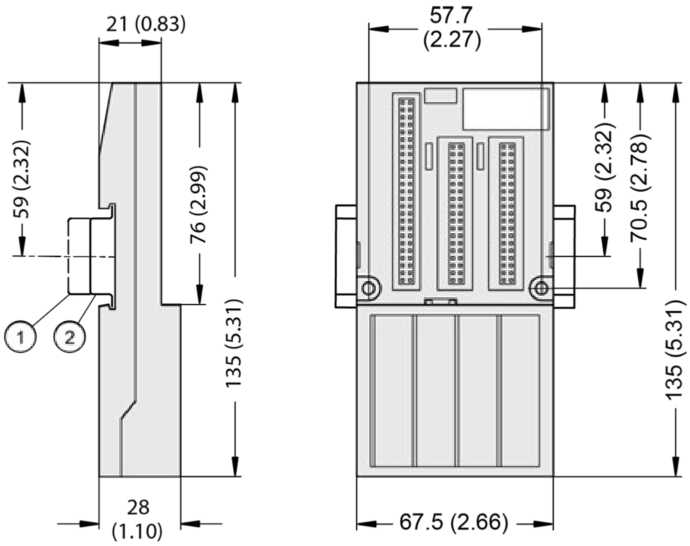
NOTICE!
Risk of damage to I/O modules!
Do not perform hot swapping if any I/O module with firmware version lower than 3.0.14 is part of the I/O configuration.

For min. required device index see table below.

Device	Min. required device index for I/O module as of FW Version 3.0.14
AC522(-XC)	F0
AI523 (-XC)	D2
AI531	D4
AI531-XC	D2
AI561	B2
AI562	B2
AI563	B3
AO523 (-XC)	D2
AO561	B2
AX521 (-XC)	D2
AX522 (-XC)	D2
AX561	B2
CD522 (-XC)	D1
DA501 (-XC)	D2
DA502 (-XC)	F0
DC522 (-XC)	D2
DC523 (-XC)	D2
DC532 (-XC)	D2
DC562	A2
DI524 (-XC)	D2
DI561	B2
DI562	B2
DI571	B2
DI572	A1

Device	Min. required device index for I/O module as of FW Version 3.0.14
DO524 (-XC)	A3
DO526	A2
DO526-XC	A0
DO561	B2
DO562	A2
DO571	B3
DO572	B2
DO573	A1
DX522 (-XC)	D2
DX531	D2
DX561	B2
DX571	B3
FM562	A1

1.5.6.4 Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

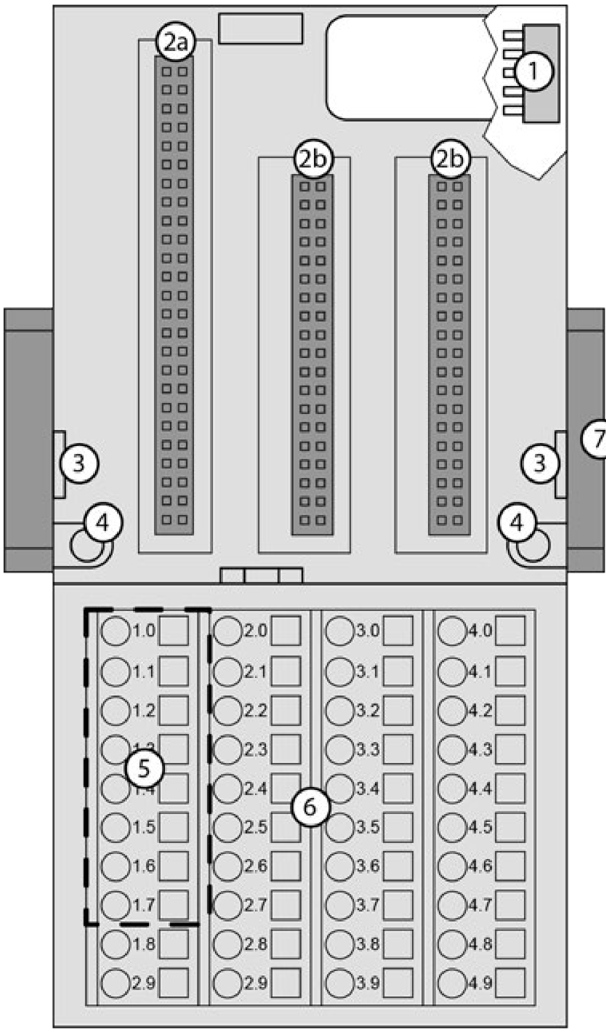
1.5.6.5 Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 217 200 R0001	TU531, terminal unit, 120/230 V AC, relays, screw terminals	Active
1SAP 217 000 R0001	TU532, terminal unit, 120/230 V AC, relays, spring terminals	Active
1SAP 417 000 R0001	TU532-XC, terminal unit, 120/230 V AC, relays, spring terminals, XC version	Active
1SAP 215 100 R0001	TU532-H, terminal unit, hot swap, 120/230 V AC, relays, spring terminals	Active
1SAP 415 100 R0001	TU532-H-XC, terminal unit, hot swap, 120/230 V AC, relays, spring terminals, XC version	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

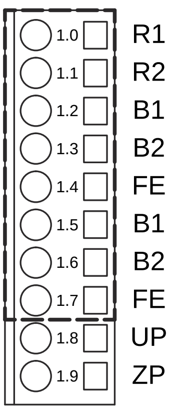
1.5.7 TU551-CS31 and TU552-CS31 for CS31 communication interface modules

- TU551-CS31, CS31 bus terminal unit, 24 V DC, screw terminals
- TU552-CS31, CS31 bus terminal unit, 24 V DC, spring terminals
- TU552-CS31-XC, CS31 bus terminal unit, 24 V DC, spring terminals, XC version



1 I/O bus (10 pins, female) to connect other terminal units
2a Plug (2 25 pins) to connect the inserted I/O modules
2b Plug (2 19 pins) to connect the inserted I/O modules
3 With a screwdriver inserted in this place, the terminal unit and the adjacent terminal unit can be shoved from each other
4 2 holes for wall mounting
5 CS31 bus interface
6 30 terminals for signals and process supply voltage
7 DIN rail

PIN assignment for bus interface



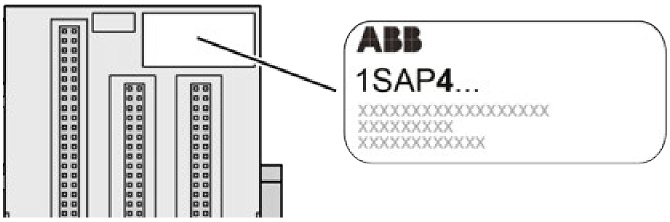
R1	Resistor + (end-of-line)
R2	Resistor - (end-of-line)
B1	CS31 bus +
B2	CS31 bus -
FE	Functional earth
B1	CS31 bus +
B2	CS31 bus -
FE	Functional earth
UP	24 V DC process voltage
ZP	0 V process voltage

The CS31 communication interface modules plug into the terminal unit. When properly plugged-in, they are secured with two mechanical locks. All the connections are established via the terminal unit, which allows removal and replacement of the CS31 communication interface modules without disturbing the wiring at the terminal unit.

The terminal units TU551-CS31 and TU552-CS31 are specifically designed for use with S500 CS31 communication interface modules that incorporate only 24 V DC inputs/outputs or interface signals.

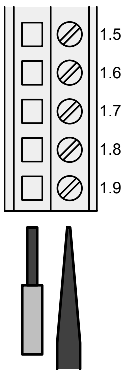
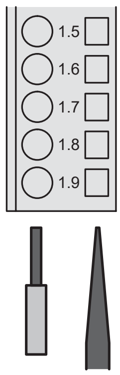
XC version

XC = e**X**treme **C**onditions



> ***Extreme conditions***
>
> *Terminal units for use in extreme ambient conditions have no ❄ sign for XC version.*
>
> *The figure **4** in the Part no. 1SAP**4**... (label) identifies the XC version.*

Terminals

Screw terminals			**Spring terminals**		
Conductor		Screwdriver	Conductor		Screwdriver (opens terminal)

> – *For information about wiring specifications see the description of the terminal units ➔ Chapter 2.6.4.4 “Terminals at the terminal unit” on page 1432.*
> – *For a detailed description of the mounting, disassembly and connection of the module, please refer to the System Assembly, Construction and Connection chapter ➔ Chapter 2.6 “AC500 (Standard)” on page 1408.*
> – *For information about mechanical dimensions, please refer to the Mechanical dimensions S500 chapter ➔ Chapter 2.6.2.3 “Mechanical dimensions S500” on page 1417*

The terminals 1.8 ... 4.8 and 1.9 ... 4.9 are electrically interconnected within the terminal unit and always have the same assignment, irrespective of the inserted module:

- Terminals 1.8 ... 4.8: process voltage UP = +24 V DC
- Terminals 1.9 ... 4.9: process voltage ZP = 0 V

The assignment of the other terminals depends on the inserted CS31 bus module.

The supply voltage of 24 V DC for the module's circuitry comes from ZP and UP.

1.5.7.1 Technical data

The system data of AC500 and S500 are applicable to the standard version ⇘ *Chapter 2.6.1 “System data AC500” on page 1408*.

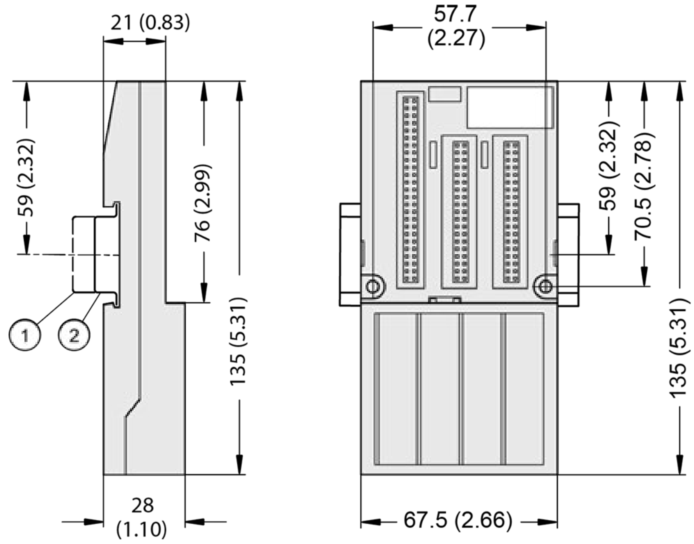
The system data of AC500-XC are applicable to the XC version ⇘ *Chapter 2.7.1 “System data AC500-XC” on page 1475*.

Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

Parameter	Value
Number of channels per module	24
Distribution of the channels into groups	3 groups of 8 channels each (2.0...2.7, 3.0...3.7, 4.0...4.7), the allocation of the channels is given by the inserted CS31 communication interface module
CS31 field bus connector	Terminals 1.0 to 1.7
Rated voltage	24 V DC
Max. permitted total current	10 A (between the terminals 1.8...4.8 and 1.9...4.9)
Grounding	Direct connection to the grounded DIN rail or via the screws with wall mounting
Screw terminals	Front terminal, conductor connection vertically with respect to the printed circuit board
Spring terminals	Front terminal, conductor connection vertically with respect to the printed circuit board
Weight	200 g
Mounting position	Horizontal or vertical

1.5.7.2 Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

1.5.7.3 Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 210 600 R0001	TU551-CS31, CS31 bus terminal unit, 24 V DC, screw terminals	Active
1SAP 210 400 R0001	TU552-CS31, CS31 bus terminal unit, 24 V DC, spring terminals	Active
1SAP 410 400 R0001	TU552-CS31-XC, CS31 bus terminal unit, 24 V DC, spring terminals, XC version	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

1.6 I/O modules

Hot swap

System requirements for hot swapping of I/O modules:

- *Types of terminal units that support hot swapping of I/O modules have the appendix TU5xx**-H**.*
- *I/O modules as of index F0.*

The following I/O bus masters support hot swapping of attached I/O modules:

- *Communication interface modules CI5xx as of index F0.*
- *Processor module PM585-ETH with firmware version as of V2.8.1.*

NOTICE!

Risk of damage to I/O modules!

Hot swapping is only allowed for I/O modules.

Processor modules and communication interface modules must not be removed or inserted during operation.

Conditions for hot swapping

- *Digital outputs are not under load.*
- *Input/output voltages above safety extra low voltage/ protective extra low voltages (SELV/PELV) are switched off.*
- *Modules are completely plugged on the terminal unit with both snap fit engaged before switching on loads or input/output voltage.*

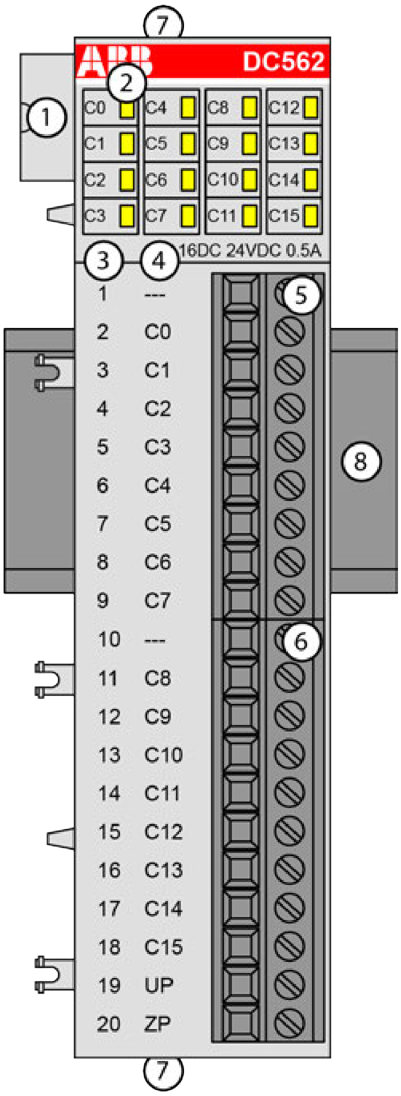
1.6.1 Digital I/O modules

1.6.1.1 S500-eCo

1.6.1.1.1 DC562 - Digital input/output module

Features

- 16 configurable digital inputs/outputs in 1 group, 24 V DC
- Module-wise galvanically isolated



1 I/O bus
2 16 yellow LEDs to display the states of the inputs/outputs C0 ... C15
3 Terminal number
4 Allocation of signal name
5 Terminal block for input and output signals (9-pin)
6 Terminal block for input and output signals (11-pin)
7 2 holes for wall-mounting with screws
8 DIN rail

Intended purpose

The device can be used as a decentralized I/O extension module for S500 communication interface modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs.

The inputs/outputs are group-wise galvanically isolated from each other.

All other circuitry of the module is galvanically isolated from the inputs/outputs.

The I/O module must not be used as a decentralized I/O module with CI590-CS31-HA communication interface modules.

Functionality

Parameter	Value
LED displays	For signal states
Internal power supply	Via I/O bus
External power supply	Via the terminals ZP and UP (process voltage 24 V DC)

Connections

For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.

The connection is carried out by using a removable 9-pin and 11-pin terminal block. These terminal blocks differ in their connection system (spring terminals or screw terminals, cable mounting from the front or from the side). The terminal blocks are not included in the module's scope of delivery and must be ordered separately.

Chapter 1.9.2.1 “TA563-TA565 - Terminal blocks” on page 1352

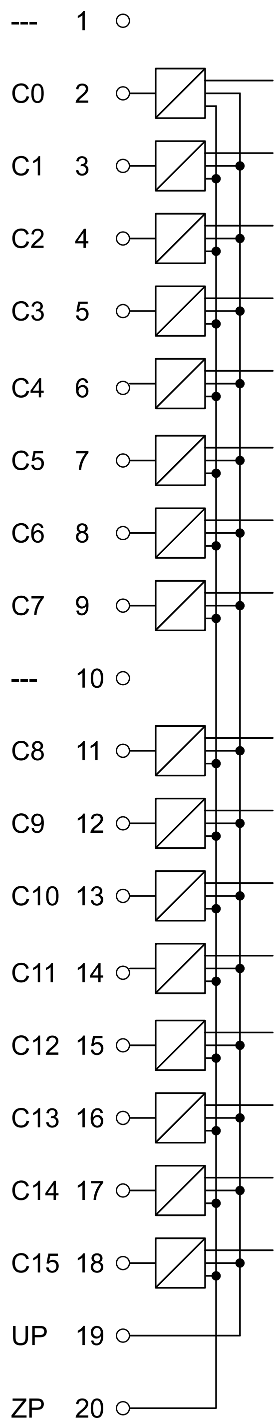


Fig. 91: Internal construction of the digital inputs and outputs

Table 139: Assignment of the terminals:

Terminal	Signal	Description
1	---	Reserved
2	C0	Input/output signal C0
3	C1	Input/output signal C1
4	C2	Input/output signal C2
5	C3	Input/output signal C3
6	C4	Input/output signal C4

Terminal	Signal	Description
7	C5	Input/output signal C5
8	C6	Input/output signal C6
9	C7	Input/output signal C7
10	---	Reserved
11	C8	Input/output signal C8
12	C9	Input/output signal C9
13	C10	Input/output signal C10
14	C11	Input/output signal C11
15	C12	Input/output signal C12
16	C13	Input/output signal C13
17	C14	Input/output signal C14
18	C15	Input/output signal C15
19	UP	Process voltage UP +24 V DC
20	ZP	Process voltage ZP 0 V DC

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a communication interface module or a CPU). Thus, the current consumption from 24 V DC power supply at the terminals L+/UP and M/ZP of the CPU/communication interface module increases by 10 mA per DC562.

The external power supply connection is carried out via the UP (+24 V DC) and ZP (0 V DC) terminals.

WARNING!
Removal/Insertion under power
The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!
Risk of damaging the PLC modules!
Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

Process supply voltage must be connected to UP/ZP of the module. The inputs and UP/ZP must use the same power supply.

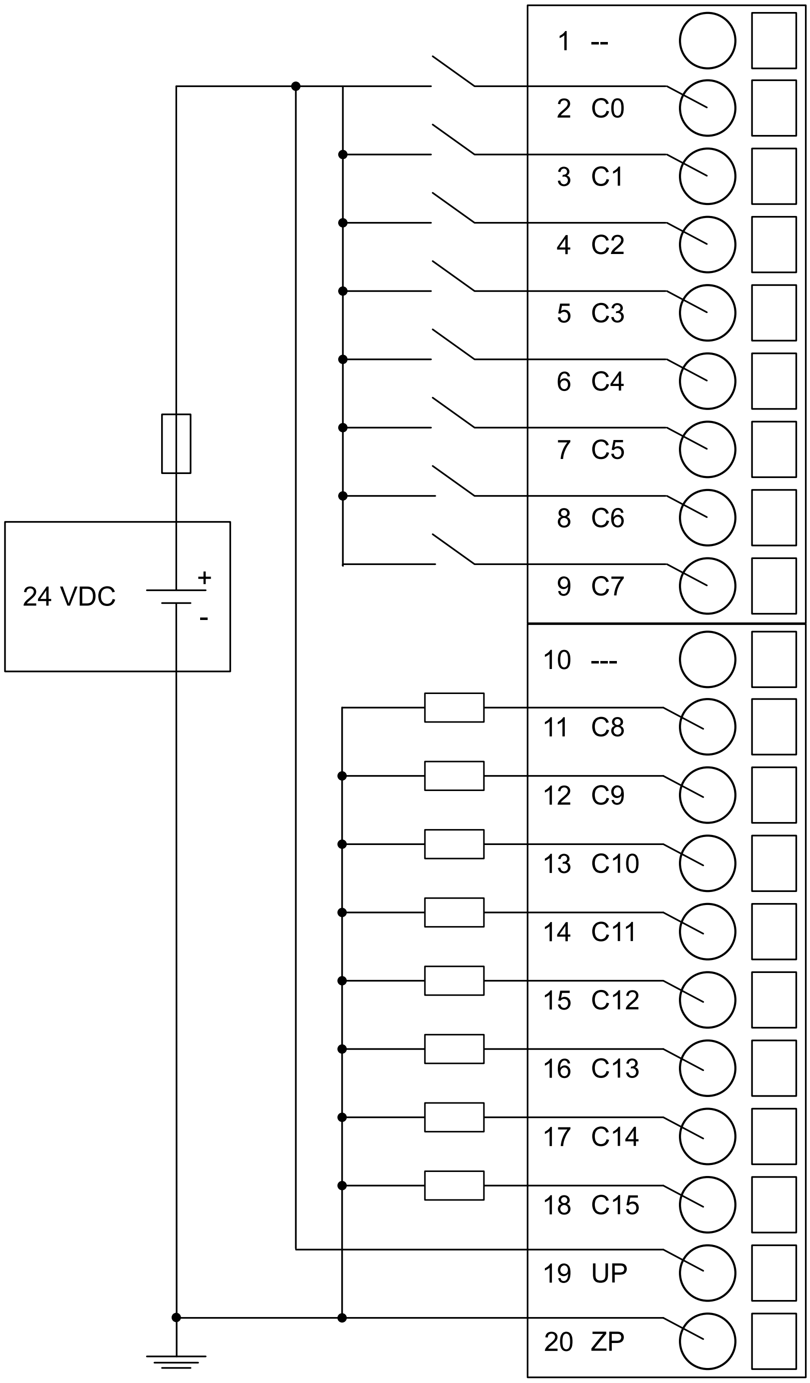


Fig. 92: Connection of the digital input/output module DC562

In this connection example, the inputs/outputs C0 ... C7 are connected as inputs and the inputs/ outputs C8 ... C15 are connected as outputs.

The module provides several diagnosis functions *Chapter 1.6.1.1.1.7 “Diagnosis” on page 316*.

The meaning of the LEDs is described in the section State LEDs *Chapter 1.6.1.1.1.8 “State LEDs” on page 316*.

I/O configuration

The module itself does not store configuration data. It receives its parameterization data from the master device of the I/O bus (CPU or communication interface module) during power-up of the system.

Hence, replacing I/O modules is possible without any re-parameterization via software.

> *If the external power supply voltage via UP/ZP terminals fails, the I/O module loses its configuration data. The whole station has to be switched off and on again to re-configure the module.*

Parameterization

The arrangement of the parameter data is performed with Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Name	Value	Internal Value	Internal Value, Type	Default	Min.	Max.	EDS Slot Index
Module ID	Internal	6155 [1])	WORD	6155 0x180B	0	65535	xx01
Ignore module	No Yes	0 1	BYTE	No (0x00)			
Parameter length [2])	Internal	1 - CPU	BYTE	0	0	255	xx02 [3])

[1]) with CS31 and addresses less than 70, the value is increased by 1

[2]) the module has no additional user-configurable parameters

[3]) Value is hexadecimal: HighByte is slot (xx: 0 ... 7), LowByte is index (1 ... n)

GSD file:

Ext_User_Prm_Data_Len =	0x06
Ext_User_Prm_Data_Const(0) =	0x18, 0x0C, 0x00, 0x02, 0x00, 0x00;

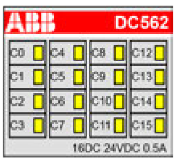
Diagnosis

E1 ... E4	d1	d2	d3	d4	Identifier 000 ... 063	AC500-Display	<- Display in
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 6 Bit 6 ... 7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0 ... 5**	**PNIO diagnosis block**	
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error-Identifier**	**Error message**	**Remedy**
	1)	2)	3)	4)			
Module error DC562							
3	14	1 ... 10	31	31	19	Checksum error in the I/O module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	43	Internal error in the module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	9	Overflow diagnosis buffer	Restart
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	26	Parameter error	Check master
	11 / 12	ADR	1 ... 10				

Remarks:

1)	In AC500 the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31-Bus), 12 = COM2. The PNIO diagnosis block does not contain this identifier.
2)	With "Device" the following allocation applies: 31 = Module itself, 1...10 = expansion module 1 ... 10, ADR = hardware address (e. g. of the DC551-CS31)
3)	With "Module" the following allocation applies depending on the master: Module error: I/O bus or PNIO: 31 = module itself; COM1/COM2: 1 ... 10 = expansion 1 ... 10 Channel error: I/O bus or PNIO = module type (4 = DC); COM1/COM2: 1 ... 10 = expansion 1 ... 10
4)	In case of module errors, with channel "31 = Module itself" is output.

State LEDs

LED		State	Color	LED = OFF	LED = ON
	Inputs/outputs C0 ... C15	Digital input or digital output	Yellow	Input/output is OFF	Input/output is ON (the LEDs are only operating if the module's circuitry is supplied via the I/O bus)

Technical data

Technical data of the module

The system data of AC500-eCo apply.

Chapter 2.5.1 “System data AC500-eCo” on page 1379

Only additional details are therefore documented below.

Parameter		Value
Process voltage UP		
	Connections	Terminal 19 for UP (+24 V DC) and terminal 20 for ZP (0 V)
	Rated value	24 V DC
	Current consumption via UP terminal	90 mA + 0.5 A per output (max.)
	Max. ripple	5 %
	Inrush current	0.000001 A^2s
	Protection against reversed voltage	Yes
Current consumption from 24 V DC power supply at the L+/UP and M/ZP terminals of the CPU/communication interface module		Ca. 10 mA
Galvanic isolation		Yes, between the input/output group and the rest of the module
	Isolated groups	1 group for 16 channels
Surge voltage (max.)		35 V DC for 0.5 s
Max. power dissipation within the module		4.8 W
Input data length		2 bytes
Output data length		2 bytes
Weight		Ca. 125 g
Mounting position		Horizontal or vertical
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

No effects of multiple overloads

No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an external fuse.

Technical data of the digital inputs/outputs if used as inputs

Parameter	Value
Number of channels per module	16 configurable inputs (24 V DC)
Distribution of the channels into groups	1 (16 channels per group)
Connections of the channels C0 to C15	Terminals 1 to 16
Reference potential for the channels C0 to C15	Terminal 20 (negative pole of the process voltage, name ZP)
Indication of the input signals	1 yellow LED per channel; the LED is ON when the input signal is high (signal 1). The module is powered through the I/O bus.

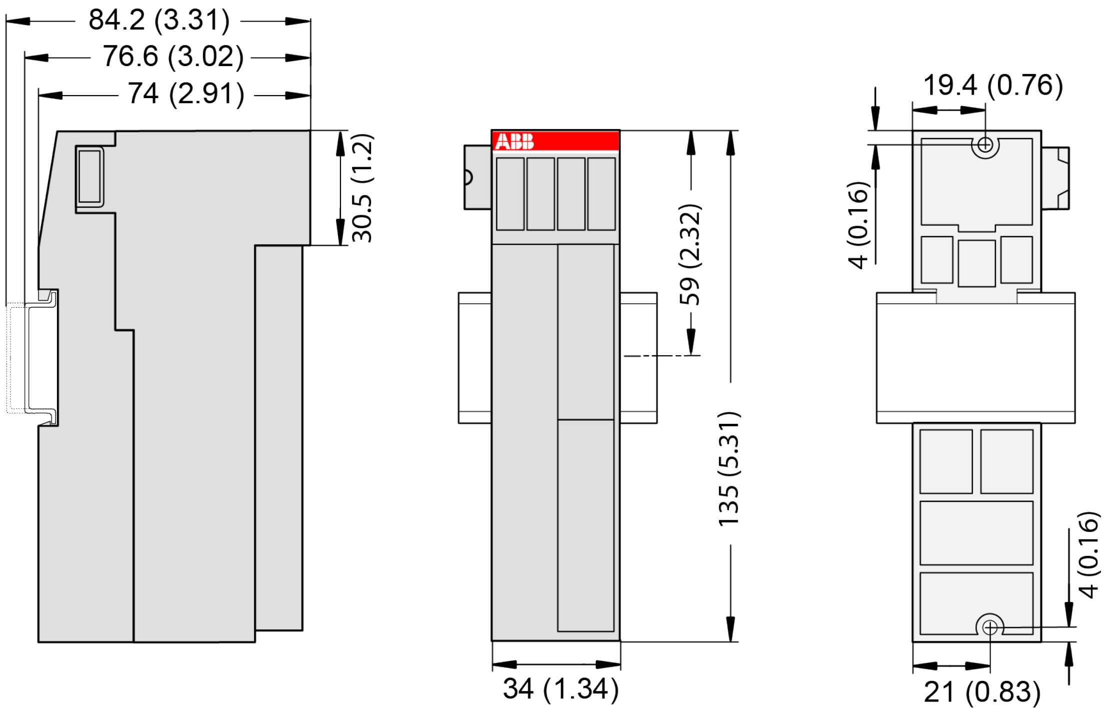
Parameter		Value
Input type according to EN 61131-2		Type 1 sink
Input signal range		+24 V DC
	Signal 0	-3 V ... +5 V
	Undefined signal	+5 V ... +15 V
	Signal 1	+15 V ... +30 V
Ripple with signal 0		-3 V ... +5 V
Ripple with signal 1		+15 V ... +30 V
Input current per channel		
	Input voltage +24 V	Typ. 5 mA
	Input voltage +5 V	Typ. 1 mA
	Input voltage +15 V	> 2.5 mA
	Input voltage +30 V	< 8 mA
Max. permissible leakage current (at 2-wire proximity switches)		1 mA
Input delay (0->1 or 1->0)		Typ. 8 ms
Max. cable length		
	Shielded	500 m
	Unshielded	300 m

Technical data of the digital inputs/outputs if used as outputs

Parameter		Value
Number of channels per module		16 configurable transistor outputs
Distribution of the channels into groups		1 (16 channels per group)
Connections of the channels C0 to C15		Terminals 1 to 16
Reference potential for the channels C0 to C15		Terminal 20 (negative pole of the process voltage, signal name ZP)
Common power supply voltage		Terminal 19 (positive pole of the process voltage, signal name UP)
Indication of the input signals		1 yellow LED per channel; the LED is ON when the input signal is high (signal 1). The module is powered through the I/O bus.
Way of operation		Non-latching type
Output voltage at signal 1		UP -0.3 V at max. current
Output delay (max. at rated load)		
	0 to 1	50 µs
	1 to 0	200 µs
Output current		
	Rated current per channel (max.)	0.5 A at UP 24 V DC
	Rated current per group (max.)	8 A
	Rated current (all channels together, max.)	8 A

Parameter		Value
	Lamp load (max.)	5 W
	Max. leakage current with signal 0	< 0.5 mA
Output type		Non-protected
Protection type		External fuse on each channel
Rated protection fuse (for each channel)		3 A fast
Demagnetization when inductive loads are switched off		Must be performed externally according to driven load specification
Switching frequency		
	With inductive loads	Max. 0.5 Hz
	With lamp loads	Max. 11 Hz at max. 5 W
Short-circuit-proof / Overload-proof		No
	Overload message	No
	Output current limitation	No
	Resistance to feedback against 24 V DC signals	Yes
Connection of 2 outputs in parallel		Not possible
Max. cable length		
	Shielded	500 m
	Unshielded	150 m

Dimensions



The dimensions are in mm and in brackets in inch.

Ordering data

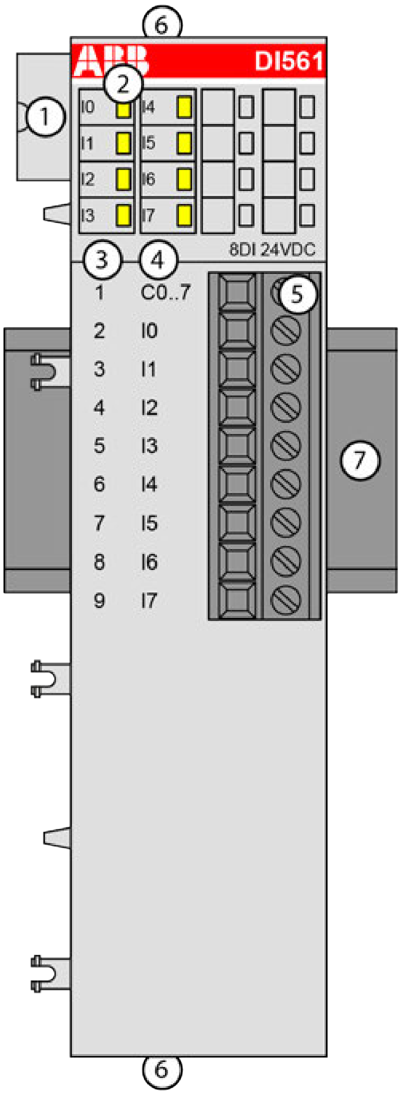
Part no.	Description	Product life cycle phase *)
1SAP 231 900 R0000	DC562, digital input/output module, 16 configurable inputs/outputs, transistor output	Active
1TNE 968 901 R3101	Terminal block TA563-9, 9 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3102	Terminal block TA563-11, 11 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3103	Terminal block TA564-9, 9 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3104	Terminal block TA564-11, 11 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3105	Terminal block TA565-9, 9 pins, spring front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3106	Terminal block TA565-11, 11 pins, spring front, cable front, 6 pieces per unit	Active

*) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.

1.6.1.1.2 DI561 - Digital input module

Features

- 8 digital inputs 24 V DC / 24 V AC (I0 ... I7) in 1 group
- Module-wise galvanically isolated



1 I/O bus
2 8 yellow LEDs to display the signal states of the inputs I0 to I7
3 Terminal number
4 Allocation of signal name
5 Terminal block for input signals (9-pin)
6 2 holes for wall-mounting with screws
7 DIN rail

Intended purpose

The device can be used as a decentralized I/O extension module for S500 communication interface modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs.

The inputs are group-wise galvanically isolated from each other.

All other circuitry of the module is galvanically isolated from the inputs.

The I/O module must not be used as a decentralized I/O module with CI590-CS31-HA communication interface modules.

Functionality

Parameter	Value
LED displays	For signal states
Internal power supply	Via I/O bus
External power supply	Not necessary

Connections

For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.

The connection is carried out by using a removable 9-pin terminal block. These terminal blocks differ in their connection system (spring terminals or screw terminals, cable mounting from the front or from the side). The terminal blocks are not included in the module's scope of delivery and must be ordered separately.

Chapter 1.9.2.1 “TA563-TA565 - Terminal blocks” on page 1352

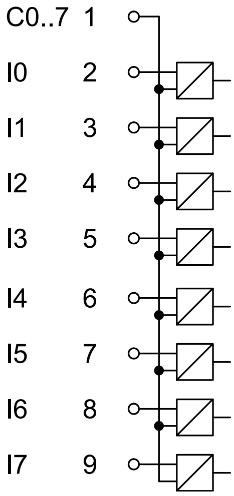


Fig. 93: Internal construction of the digital inputs

Table 140: Assignment of the terminals:

Terminal	Signal	Description
1	C0 ... 7	Input common for signals I0 to I7
2	I0	Input signal I0
3	I1	Input signal I1
4	I2	Input signal I2
5	I3	Input signal I3
6	I4	Input signal I4
7	I5	Input signal I5
8	I6	Input signal I6
9	I7	Input signal I7

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a communication interface module or a CPU). Thus, the current consumption from 24 V DC power supply at the terminals L+/UP and M/ZP of the CPU/communication interface module increases by 10 mA per DI561.

An external power supply connection is not needed.

WARNING!
Removal/Insertion under power

The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

- connect or disconnect any signal or terminal block
- remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!
Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

- Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
- Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

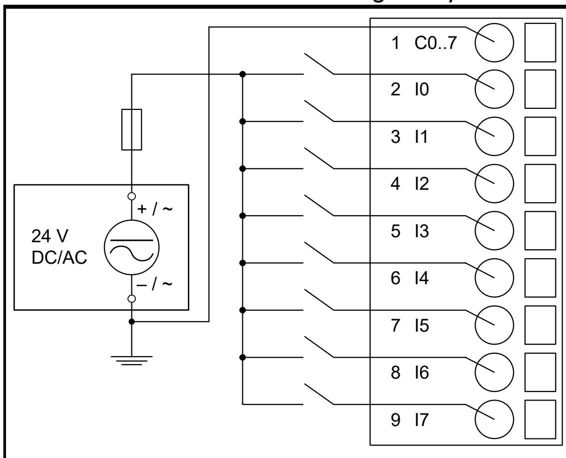
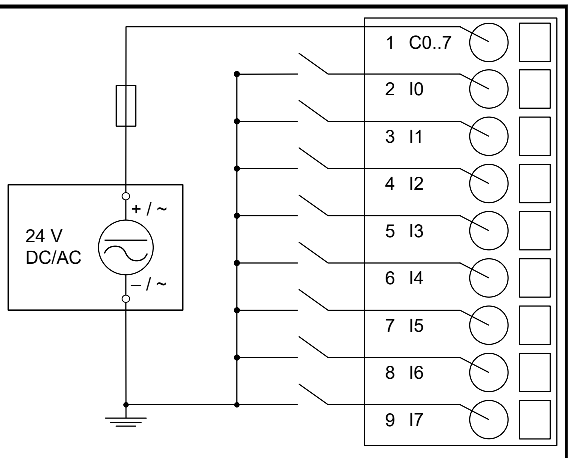
The digital inputs can be used as source inputs or as sink inputs.

NOTICE!
Risk of malfunctions in the plant!

A ground fault, e. g. caused by a damaged cable insulation, can bridge switches accidentally.

Use sink inputs when possible or make sure that, in case of error, there will be no risks to persons or plant.

Table 141: Connection of the digital input module DI561

<table>
<tr>
<td>
</td>
<td>
</td>
</tr>
<tr>
<td>Connection of DI561 - sink inputs</td>
<td>Connection of DI561 - source inputs</td>
</tr>
</table>

The module provides several diagnosis functions *Chapter 1.6.1.1.2.7 “Diagnosis” on page 326*.

The meaning of the LEDs is described in the section State LEDs *Chapter 1.6.1.1.2.8 “State LEDs” on page 326*.

I/O Configuration

The module itself does not store configuration data. It receives its parameterization data from the master device of the I/O bus (CPU or communication interface module) during power-up of the system.

Hence, replacing I/O modules is possible without any re-parameterization via software.

> *If the external power supply voltage via UP/ZP terminals fails, the I/O module loses its configuration data. The whole station has to be switched off and on again to re-configure the module.*

Parameterization

The arrangement of the parameter data is performed with Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Name	Value	Internal Value	Internal Value, Type	Default	Min.	Max.	EDS Slot Index
Module ID	Internal	6105 [1])	WORD	6105 0x17D9	0	65535	xx01
Ignore module	No Yes	0 1	BYTE	No (0x00)			
Parameter length [2])	Internal	1 - CPU	BYTE	0	0	255	xx02 [3])

[1]) with CS31 and addresses smaller than 70, the value is increased by 1

[2]) the module has no additional user-configurable parameters

[3]) Value is hexadecimal: HighByte is slot (xx: 0 ... 7), LowByte is index (1 ... n)

GSD file:

Ext_User_Prm_Data_Len =	0x03
Ext_User_Prm_Data_Const(0) =	0xDA, 0x17, 0x00;

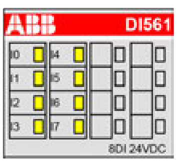
Diagnosis

E1 ... E4	d1	d2	d3	d4	Identifier 000 ... 063	AC500-Display	<– Display in
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 6 Bit 6 ... 7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0 ... 5**	**PNIO diagnosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error Identifier**	**Error message**	**Remedy**
	[1])	**[2])**	**[3])**	**[4])**			
Module error							
3	14	1 ... 10	31	31	19	Checksum error in the I/O module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	43	Internal error in the module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	9	Overflow diagnosis buffer	Restart
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	26	Parameter error	Check master
	11 / 12	ADR	1 ... 10				

Remarks:

[1])	In AC500 the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The PNIO diagnosis block does not contain this identifier.
[2])	With "Device" the following allocation applies: 31 = module itself, 1 ... 10 = decentralized communication interface module 1 ... 10, ADR = hardware address (e. g. of the DC551-CS31)
[3])	With "Module" the following allocation applies depending on the master: Module error: I/O bus or PNIO: 31 = module itself; COM1/COM2: 1 ... 10 = expansion 1 ... 10
[4])	In case of module errors, with channel "31 = module itself" is output.

State LEDs

LED		State	Color	LED = OFF	LED = ON
	Inputs I0...I7	Digital input	Yellow	Input is OFF	Input is ON

> *In the undefined signal range, the state LED for the inputs can be ON although the input state detected by the module is OFF.*

Technical data

Technical data of the module

The system data of AC500-eCo apply.

Chapter 2.5.1 “System data AC500-eCo” on page 1379

Only additional details are therefore documented below.

Parameter	Value
Galvanic isolation	Yes, between the input group and the rest of the module
Isolated groups	1 (8 channels per group)
Current consumption from 24 V DC power supply at the L+/UP and M/ZP terminals of the CPU/communication interface module	Ca. 10 mA
Max. power dissipation within the module	1.6 W
Weight	Ca. 110 g
Mounting position	Horizontal or vertical
Cooling	The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

Technical data of the digital inputs

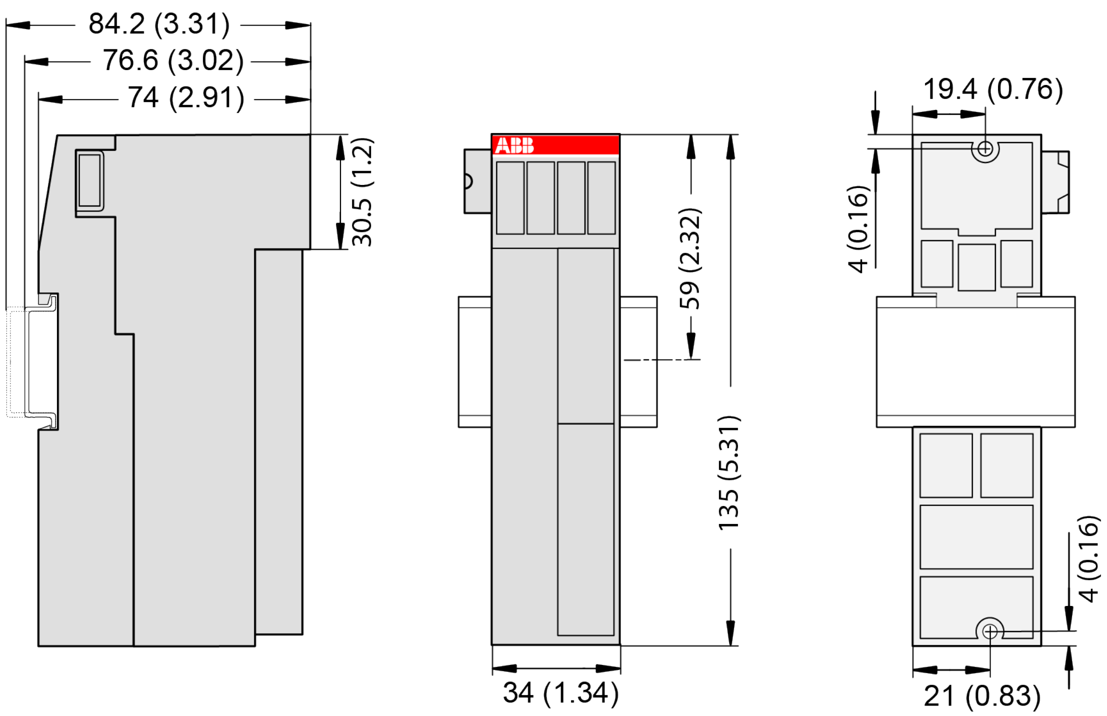
Parameter	Value		
Number of channels per module	8 inputs (24 V DC / 24 V AC)		
Distribution of the channels into groups	1 (8 channels per group)		
Connections of the channels I0 to I7	Terminals 2 ... 9		
Reference potential for the channels I0 to I7	Terminal 1 (plus or negative pole of the process supply voltage, signal name C0 .. 7)		
Indication of the input signals	1 yellow LED per channel; the LED is ON when the input signal is high (signal 1). The module is powered through the I/O bus.		
Monitoring point of input indicator	LED is part of the input circuitry		
Input type according to EN 61131-2	Type 1 source	Type 1 sink	Type 1 AC [1])
Input signal range	-24 V DC	+24 V DC	24 V AC 50/60 Hz
Signal 0	-5 V ... +3 V	-3 V ... +5 V	0 V AC ... 5 V AC
Undefined signal	-15 V ... -5 V	+5 V ... +15 V	5 V AC ... 14 V AC
Signal 1	-30 V ... -15 V	+15 V ... +30 V	14 V AC ... 27 V AC

Parameter	Value	
Input current per channel		
Input voltage 24 V	Typ. 5 mA	Typ. 5 mA r.m.s.
Input voltage 5 V	Typ. 1 mA	Typ. 1 mA r.m.s.
Input voltage 14 V		Typ. 2.7 mA r.m.s.
Input voltage 15 V	> 2.5 mA	
Input voltage 27 V		Typ. 5.5 mA r.m.s.
Input voltage 30 V	< 8 mA	
Max. permissible leakage current (at 2-wire proximity switches)	1 mA	Typ. 1 mA r.m.s.
Input delay (0->1 or 1->0)	Typ. 8 ms	
Input data length	1 byte	
Max. cable length		
Shielded	500 m	
Unshielded	300 m	

[1]) When inputs are used with 24 V AC, external surge limiting filters are required.

Refer to 'System data AC500-eCo' for details *Chapter 2.5.1 “System data AC500-eCo” on page 1379*.

Dimensions



The dimensions are in mm and in brackets in inch.

Ordering data

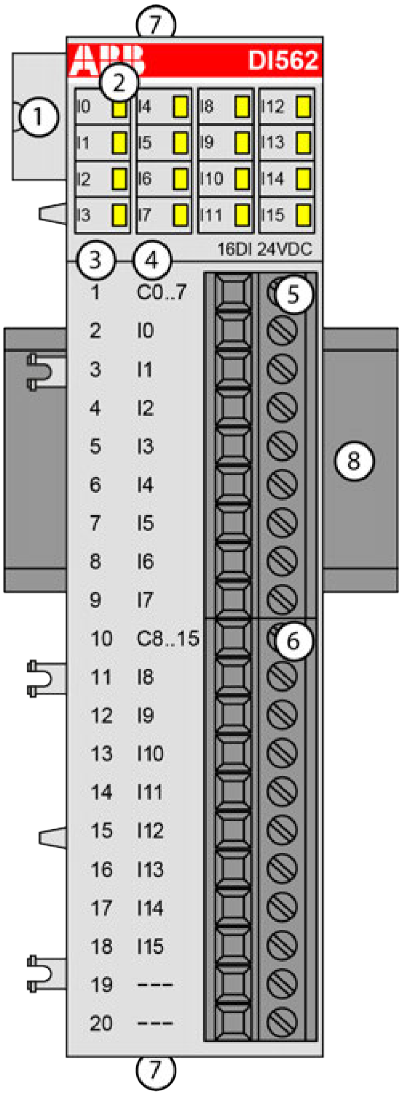
Part no.	Description	Product life cycle phase *)
1TNE 968 902 R2101	DI561, digital input module, 8 DI, 24 V DC / 24 V AC	Active
1TNE 968 901 R3101	Terminal block TA563-9, 9 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3103	Terminal block TA564-9, 9 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3105	Terminal block TA565-9, 9 pins, spring front, cable front, 6 pieces per unit	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

1.6.1.1.3 DI562 - Digital input module

Features

- 16 digital inputs 24 V DC / 24 V AC (I0 ... I15) in 2 groups
- Group-wise galvanically isolated



1 I/O bus
2 16 yellow LEDs to display the signal states of the inputs I0 ... I15
3 Terminal number
4 Allocation of signal name
5 Terminal block for input signals (9-pin)
6 Terminal block for input signals (11-pin)
7 2 holes for wall-mounting with screws
8 DIN rail

Intended purpose

The device can be used as a decentralized I/O extension module for S500 communication interface modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs.

The inputs are group-wise galvanically isolated from each other.

The other electronic circuitry of the module is galvanically isolated from the inputs.

> *The I/O module must not be used as a decentralized I/O module with CI590-CS31-HA communication interface modules.*

Functionality

Parameter	Value
LED displays	For signal states
Internal power supply	Via I/O bus
External power supply	Not necessary

Connections

For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.

The connection is carried out by using removable 9-pin and 11-pin terminal blocks. These terminal blocks differ in their connection system (spring terminals or screw-type terminals, cable mounting from the front or from the side). The terminal blocks are not included in the module's scope of delivery and must be ordered separately.

Chapter 1.9.2.1 “TA563-TA565 - Terminal blocks” on page 1352

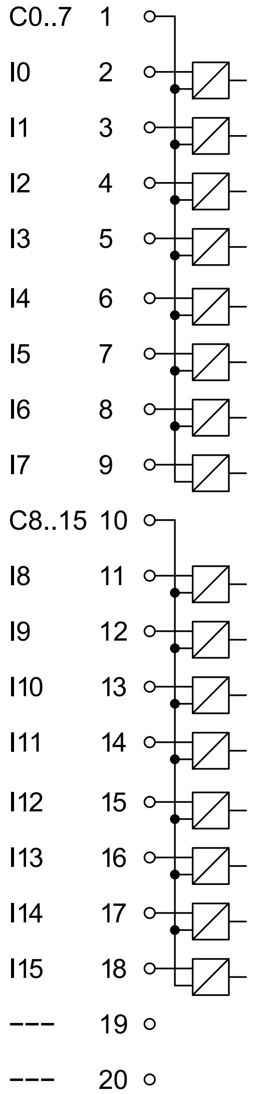


Fig. 94: Internal construction of the digital inputs

Table 142: Assignments of the terminal

Terminal	Signal	Description
1	C0 ... C7	Input common for signals I0 to I7
2	I0	Input signal I0
3	I1	Input signal I1
4	I2	Input signal I2
5	I3	Input signal I3
6	I4	Input signal I4
7	I5	Input signal I5
8	I6	Input signal I6
9	I7	Input signal I7
10	C8 ... C15	Input common for signals I8 ... I15
11	I8	Input signal I8
12	I9	Input signal I9
13	I10	Input signal I10
14	I11	Input signal I11
15	I12	Input signal I12
16	I13	Input signal I13
17	I14	Input signal I14
18	I15	Input signal I15
19	---	Reserved
20	---	Reserved

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a communication interface module or a CPU). Thus, the current consumption from 24 V DC power supply at the terminals L+/UP and M/ZP of the CPU/communication interface module increases by 10 mA per DI562.

An external power supply connection is not needed.

WARNING!

Removal/Insertion under power

The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

- connect or disconnect any signal or terminal block
- remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

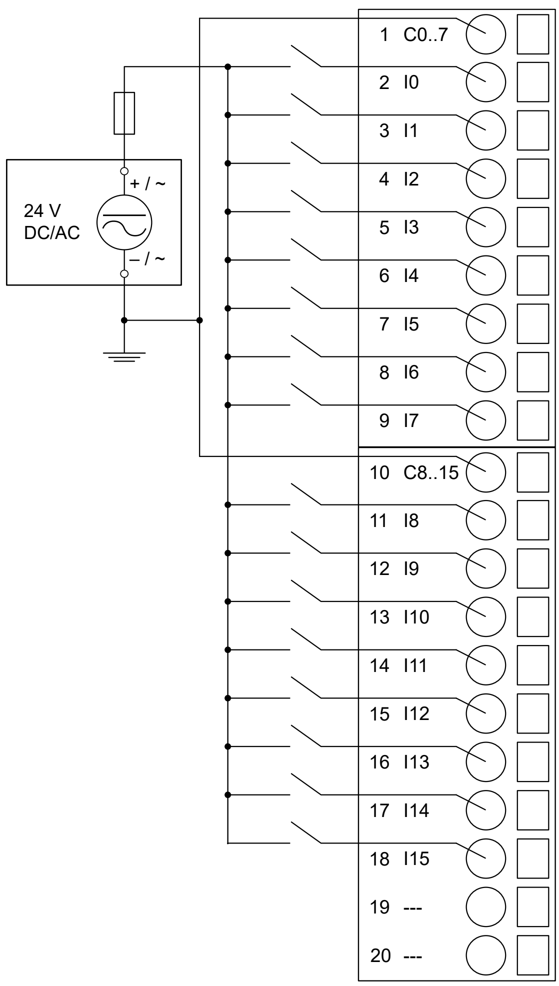
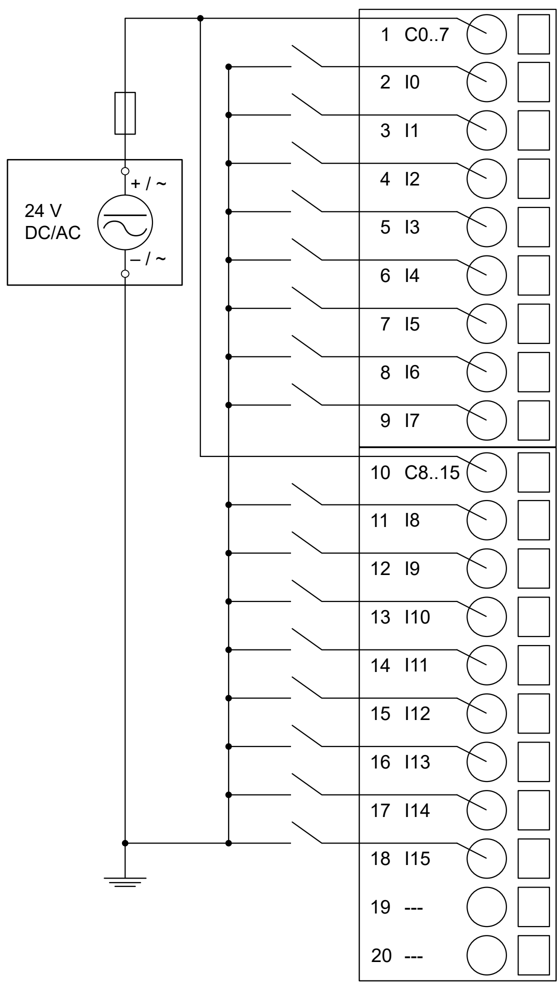
> **NOTICE!**
> **Risk of damaging the PLC modules!**
> Overvoltages and short circuits might damage the PLC modules.
> – Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
> – Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

The module provides several diagnosis functions ↯ *Chapter 1.6.1.1.3.7 “Diagnosis” on page 335*.

The digital inputs can be used as source inputs or as sink inputs.

> **NOTICE!**
> **Risk of malfunctions in the plant!**
> A ground fault, e. g. caused by a damaged cable insulation, can bridge switches accidentally.
>
> Use sink inputs when possible or make sure that, in case of error, there will be no risks to persons or plant.

Table 143: Connection of the digital input module DI562

	
Connection of DI562 - sink inputs	Connection of DI562 - source inputs

The meaning of the LEDs is described in section State LEDs *Chapter 1.6.1.1.3.8 "State LEDs" on page 335*.

I/O configuration

The module itself does not store configuration data. It receives its parameterization data from the master device of the I/O bus (CPU or communication interface module) during power-up of the system.

Hence, replacing I/O modules is possible without any re-parameterization via software.

> *If the external power supply voltage via UP/ZP terminals fails, the I/O module loses its configuration data. The whole station has to be switched off and on again to re-configure the module.*

Parameterization

The arrangement of the parameter data is performed with Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Name	Value	Internal Value	Internal Value, Type	Default	Min.	Max.	EDS Slot Index
Module ID	Internal	6110 [1])	WORD	6110 0x17DE	0	65535	xx01
Ignore module	No Yes	0 1	BYTE	No (0x00)			
Parameter length [2])	Internal	1 - CPU	BYTE	0	0	255	xx02 [3])

Remarks:

[1])	With CS31 and addresses less than 70, the value is increased by 1
[2])	The module has no additional user-configurable parameters
[3])	Value is hexadecimal: HighByte is slot (xx: 0 ... 7), LowByte is index (1 ... n)

GSD file:

Ext_User_Prm_Data_Len =	0x03
Ext_User_Prm_Data_Const(0) =	0xDF, 0x17, 0x00;

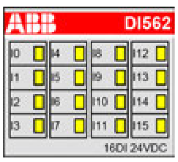
Diagnosis

E1 ... E4	d1	d2	d3	d4	Identifier 000 ... 063	AC500-Display	<- Display in
Class	Comp	Dev	Mod	Ch	Err	PS501 PLC Browser	
Byte 6 Bit 6 ... 7	-	Byte 3	Byte 4	Byte 5	Byte 6 Bit 0 ... 5	PNIO diagnosis block	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error Identifier**	**Error message**	**Remedy**
	[1])	[2])	[3])	[4])			
Module error DI562							
3	14	1 ... 10	31	31	19	Checksum error in the I/O module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	43	Internal error in the module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	9	Overflow diagnosis buffer	Restart
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	26	Parameter error	Check master
	11 / 12	ADR	1 ... 10				

Remarks:

[1])	In AC500 the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The PNIO diagnosis block does not contain this identifier.
[2])	With "Device" the following allocation applies: 31 = module itself, 1 ... 10 = decentralized communication interface module 1 ... 10, ADR = hardware address (e. g. of the DC551-CS31)
[3])	With "Module" the following allocation applies depending on the master: Module error: I/O bus or PNIO: 31 = module itself; COM1/COM2: 1 ... 10 = expansion 1 ... 10
[4])	In case of module errors, with channel "31 = module itself" is output.

State LEDs

LED		State	Color	LED = OFF	LED = ON
	Inputs I0 ... I15	Digital input	Yellow	Input is OFF	Input is ON

In the undefined signal range, the state LED for the inputs can be ON although the input state detected by the module is OFF.

Technical data

Technical data of the module

The system data of AC500-eCo apply.

Chapter 2.5.1 “System data AC500-eCo” on page 1379

Only additional details are therefore documented below.

Parameter	Value
Galvanic isolation	Yes, between the input groups and the rest of the module
Isolated groups	2 (8 channels per group)
Current consumption from 24 V DC power supply at the L+/UP and M/ZP terminals of the CPU/communication interface module	Ca. 10 mA
Max. power dissipation within the module	3.2 W
Weight	Ca. 115 g
Mounting position	Horizontal or vertical
Cooling	The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

Technical data of the digital inputs

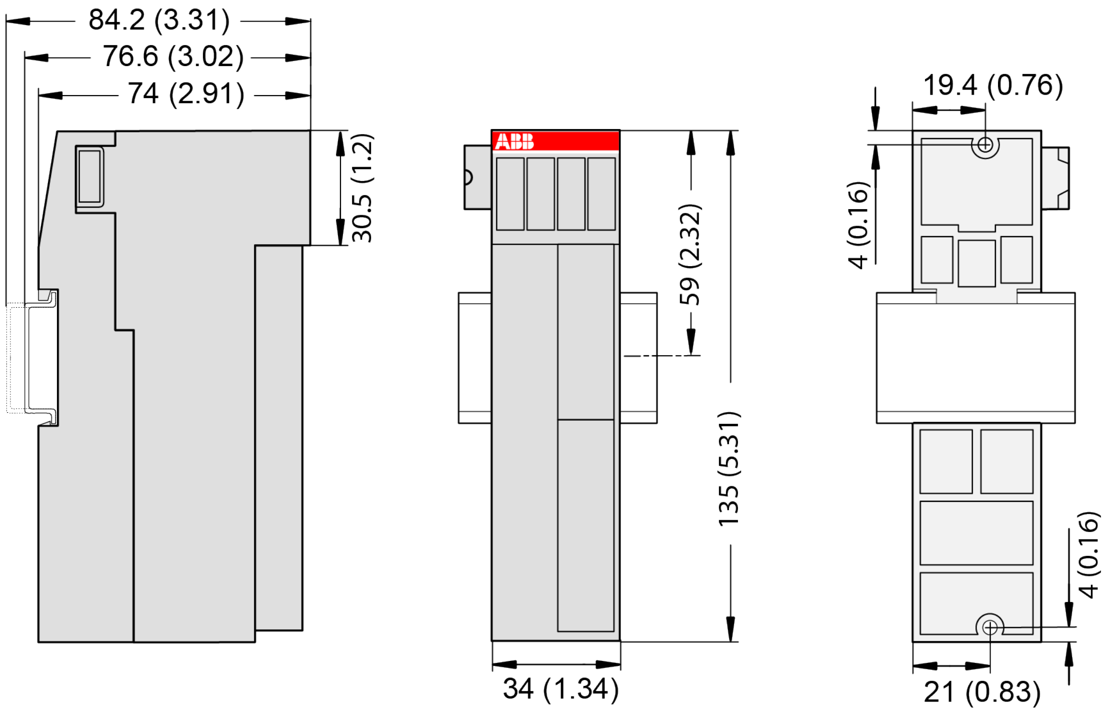
Parameter	Value		
Number of channels per module	16 inputs (24 V DC / 24 V AC)		
Distribution of the channels into groups	2 (8 channels per group)		
Connections of the channels I0 to I7	Terminals 2 ... 9		
Connections of the channels I8 to I15	Terminals 11 ... 18		
Reference potential for the channels I0 to I7	Terminal 1 (positive or negative pole of the process supply voltage, signal name I0 ... I7)		
Reference potential for the channels I8 to I15	Terminal 10 (positive or negative pole of the process supply voltage, signal name I8 ... I15)		
Indication of the input signals	1 yellow LED per channel; the LED is ON when the input signal is high (signal 1). The module is powered through the I/O bus.		
Monitoring point of input indicator	LED is part of the input circuitry		
Input type according to EN 61131-2	Type 1 source	Type 1 sink	Type 1 AC 1)
Input signal range	-24 V DC	+24 V DC	24 V AC 50/60 Hz
Signal 0	-5 V ... +3 V	-3 V ... +5 V	0 V AC ... 5 V AC

Parameter		Value		
	Undefined signal	-15 V ... -5 V	+5 V ... +15 V	5 V AC ... 14 V AC
	Signal 1	-30 V ... -15 V	+15 V ... +30 V	14 V AC ... 27 V AC
Input current per channel				
	Input voltage 24 V	Typ. 5 mA		Typ. 5 mA r.m.s.
	Input voltage 5 V	Typ. 1 mA		Typ. 1 mA r.m.s.
	Input voltage 14 V			Typ. 2.7 mA r.m.s.
	Input voltage 15 V	> 2.5 mA		
	Input voltage 27 V			Typ. 5.5 mA r.m.s.
	Input voltage 30 V	< 8 mA		
Max. permissible leakage current (at 2-wire proximity switches)		1 mA		Typ. 1 mA r.m.s.
Input delay (0->1 or 1->0)		Typ. 8 ms		
Input data length		2 bytes		
Max. cable length				
	Shielded	500 m		
	Unshielded	300 m		

[1]) When inputs are used with 24 V AC, external surge limiting filters are required.

Refer to 'System data AC500-eCo' for details ⇘ *Chapter 2.5.1 “System data AC500-eCo” on page 1379*.

Dimensions



The dimensions are in mm and in brackets in inch.

Ordering data

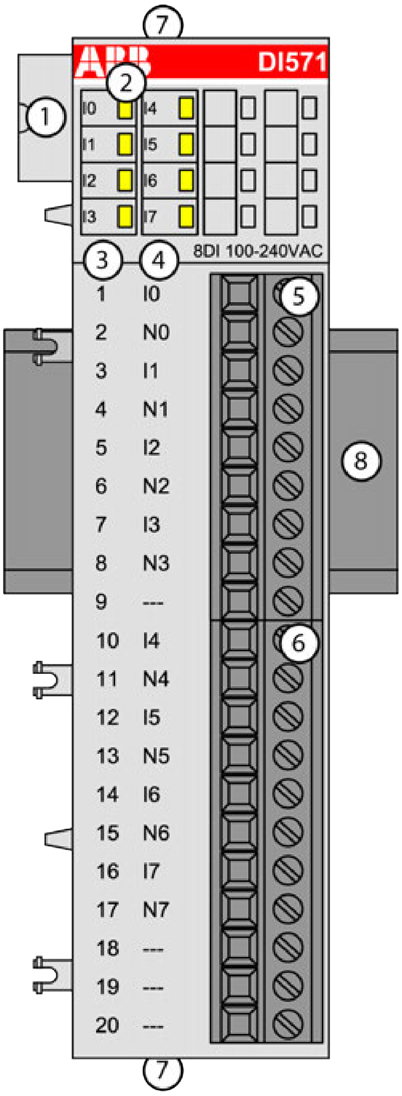
Part no.	Description	Product life cycle phase *)
1TNE 968 902 R2102	DI562, digital input module, 16 DI, 24 V DC / 24 V AC	Active
1TNE 968 901 R3101	Terminal block TA563-9, 9 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3102	Terminal block TA563-11, 11 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3103	Terminal block TA564-9, 9 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3104	Terminal block TA564-11, 11 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3105	Terminal block TA565-9, 9 pins, spring front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3106	Terminal block TA565-11, 11 pins, spring front, cable front, 6 pieces per unit	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

1.6.1.1.4 DI571 - Digital input module

Features

- 8 digital inputs 100 ... 240 V AC (I0 ... I7) in 8 groups
- Module-wise galvanically isolated



1 I/O bus
2 8 yellow LEDs to display the signal states of the inputs I0 ... I7
3 Terminal number
4 Allocation of signal name
5 Terminal block for input signals (9-pin)
6 Terminal block for input signals (11-pin)
7 2 holes for wall-mounting with screws
8 DIN rail

Intended purpose

The device can be used as a decentralized I/O extension module for S500 communication interface modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs.

The inputs are group-wise galvanically isolated from each other.

All other circuitry of the module is galvanically isolated from the inputs.

> *The I/O module must not be used as a decentralized I/O module with CI590-CS31-HA communication interface modules.*

Functionality

Parameter	Value
LED displays	For signal states
Internal power supply	Via I/O bus
External power supply	Not necessary

Connections

> *For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.*

The connection is carried out by using removable 9-pin and 11-pin terminal blocks. These terminal blocks differ in their connection system (spring terminals or screw terminals, cable mounting from the front or from the side). The terminal blocks are not included in the module's scope of delivery and must be ordered separately.

↳ *Chapter 1.9.2.1 “TA563-TA565 - Terminal blocks” on page 1352*

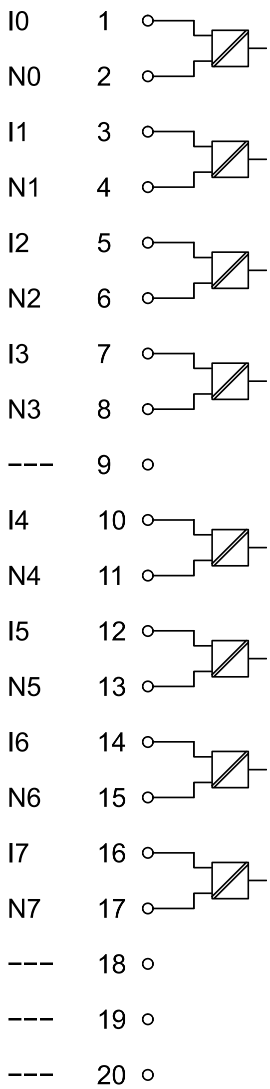


Fig. 95: Internal construction of the digital inputs

Table 144: Assignment of the terminals:

Terminal	Signal	Description
1	I0	Input signal I0
2	N0	Neutral conductor for the input signal I0
3	I1	Input signal I1
4	N1	Neutral conductor for the input signal I1
5	I2	Input signal I2
6	N2	Neutral conductor for the input signal I2
7	I3	Input signal I3
8	N3	Neutral conductor for the input signal I3
9	---	Reserved
10	I4	Input signal I4
11	N4	Neutral conductor for the input signal I4
12	I5	Input signal I5
13	N5	Neutral conductor for the input signal I5

Terminal	Signal	Description
14	I6	Input signal I6
15	N6	Neutral conductor for the input signal I6
16	I7	Input signal I7
17	N7	Neutral conductor for the input signal I7
18	---	Reserved
19	---	Reserved
20	---	Reserved

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a communication interface module or a CPU). Thus, the current consumption from 24 V DC power supply at the terminals L+/UP and M/ZP of the CPU/communication interface module increases by 10 mA per DI571.

An external power supply connection is not needed.

WARNING!
Risk of death by electric shock!
Hazardous voltages can be present at the terminals of the module.

Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.

WARNING!
Removal/Insertion under power
The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

- connect or disconnect any signal or terminal block
- remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!
Risk of damaging the PLC modules!
Overvoltages and short circuits might damage the PLC modules.

- Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
- Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

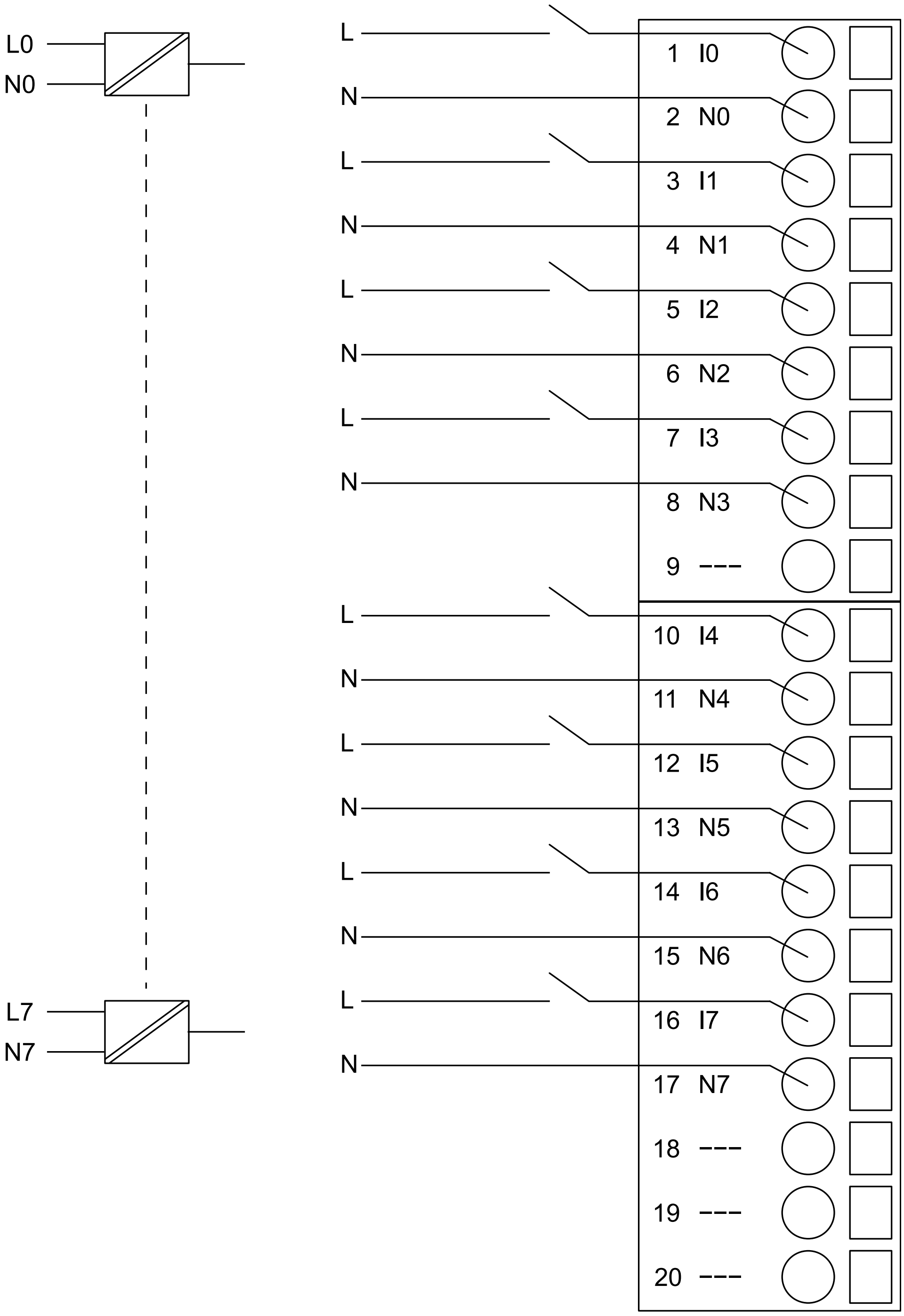


Fig. 96: Connection of the digital input module DI571

NOTICE!
Risk of damaging the PLC modules!
The PLC modules will be irreparably damaged if a voltage > 240 V is connected.

Make sure that all inputs are fed from the same phase. The module must not be connected to a 400 V voltage.

The module provides several diagnosis functions *Chapter 1.6.1.1.4.8 "Diagnosis" on page 345*.

The meaning of the LEDs is described in the section State LEDs *Chapter 1.6.1.1.4.9 "State LEDs" on page 345*.

Internal data exchange

Parameter	Value
Digital inputs (bytes)	1
Digital outputs (bytes)	0

I/O configuration

The module itself does not store configuration data. It receives its parameterization data from the master device of the I/O bus (CPU or communication interface module) during power-up of the system.

Hence, replacing I/O modules is possible without any re-parameterization via software.

If the external power supply voltage via UP/ZP terminals fails, the I/O module loses its configuration data. The whole station has to be switched off and on again to re-configure the module.

Parameterization

The arrangement of the parameter data is performed with Automation Builder software.

The parameter data directly influences the functionality of the modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Name	Value	Internal Value	Internal Value, Type	Default	Min.	Max.	EDS Slot Index
Module ID	Internal	6115 [1])	WORD	6115 0x17E3	0	65535	xx01
Ignore module	No Yes	0 1	BYTE	No (0x00)			
Parameter length [2])	Internal	1 - CPU	BYTE	0	0	255	xx02 [3])

[1]) with CS31 and addresses less than 70, the value is increased by 1

[2]) the module has no additional user-configurable parameters

[3]) Value is hexadecimal: HighByte is slot (xx: 0 ... 7), LowByte is index (1 ... n)

GSD file:

Ext_User_Prm_Data_Len =	0x03
Ext_User_Prm_Data_Const(0) =	0xDF, 0x17, 0x00;

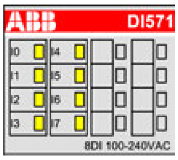
Diagnosis

E1 ... E4	d1	d2	d3	d4	Identifier 000 ... 063	AC500-Display	<- Display in
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 6 Bit 6 ... 7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0 ... 5**	**PNIO diagnosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error Identifier**	**Error message**	**Remedy**
	1)	**2)**	**3)**	**4)**			
Module error							
3	14	1 ... 10	31	31	19	Checksum error in the I/O module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	43	Internal error in the module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	9	Overflow diagnosis buffer	Restart
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	26	Parameter error	Check master
	11 / 12	ADR	1 ... 10				

Remarks:

1)	In AC500 the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The PNIO diagnosis block does not contain this identifier.
2)	With "Device" the following allocation applies: 31 = module itself, 1 ... 10 = decentralized communication interface module 1 ... 10, ADR = hardware address (e. g. of the DC551-CS31)
3)	With "Module" the following allocation applies depending on the master: Module error: I/O bus or PNIO: 31 = module itself; COM1/COM2: 1 ... 10 = expansion 1 ... 10
4)	In case of module errors, with channel "31 = Module itself" is output.

State LEDs

LED		State	Color	LED = OFF	LED = ON
	Inputs I0 ... I7	Digital input	Yellow	Input is OFF	Input is ON (the input voltage is only displayed if the supply voltage of the module is ON)

Technical data

Technical data of the module

The system data of AC500-eCo apply.

Chapter 2.5.1 “System data AC500-eCo” on page 1379

Only additional details are therefore documented below.

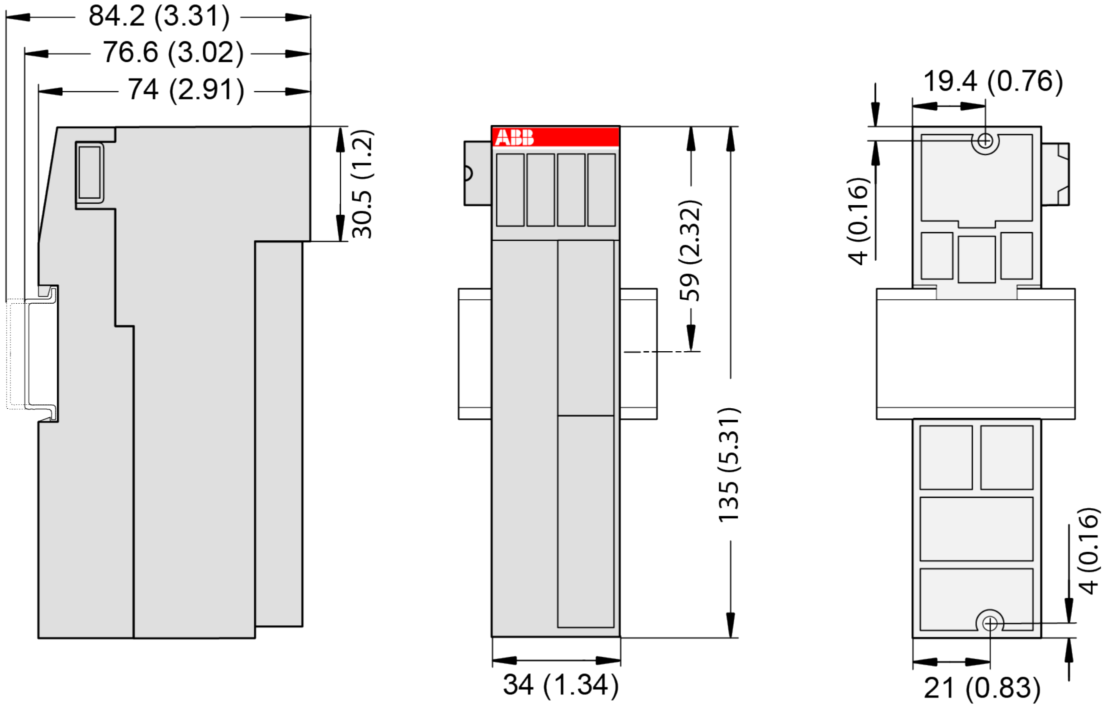
Parameter		Value
Galvanic isolation		Yes, between the channels and the rest of the module
	Isolated groups	8 (1 channel per group)
Current consumption from 24 V DC power supply at the L+/UP and M/ZP terminals of the CPU/communication interface module		Ca. 10 mA
Max. power dissipation within the module		On request
Weight		Ca. 135 g
Mounting position		Horizontal or vertical
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

Technical data of the digital inputs

Parameter		Value
Number of channels per module		8 AC inputs (100-240 V AC)
Distribution of the channels into groups		8 (1 channel per group)
Input voltage range		0 V AC ... 264 V AC (47 Hz ... 63 Hz)
Input current per channel (typically at +25 °C)		<5 mA (at 40 V AC) >6 mA (at 159 V AC, 50 Hz) >7 mA (at 159 V AC, 60 Hz)
Connections of the channels I0 to I7		Terminals 1, 3, 5, 7, 10, 12, 14, 16
Reference potential for the channels I0 to I7		Terminals 2, 4, 6, 8, 11, 13, 15, 17
Indication of the input signals		1 yellow LED per channel; the LED is ON when the input signal is high (signal 1)
Input type according to EN 61131-2		Type 1
Input signal range		
	Signal 0 (max.)	20 V AC
	Undefined signal	20 V AC < U < 79 V AC
	Signal 1 (min.)	79 V AC
Input delay		
	Signal 0 -> 1	Typ. 15 ms
	Signal 1 -> 0	Typ. 30 ms
Input data length		1 byte
Max. permissible leakage current (at 2-wire proximity switches)		1 mA

Parameter		Value
Max. cable length		
	Shielded	500 m
	Unshielded	300 m

Dimensions



The dimensions are in mm and in brackets in inch.

Ordering data

Part no.	Description	Product life cycle phase *)
1TNE 968 902 R2103	DI571, digital input module, 8 DI, 100 V AC ... 240 V AC	Active
1TNE 968 901 R3101	Terminal block TA563-9, 9 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3102	Terminal block TA563-11, 11 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3103	Terminal block TA564-9, 9 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3104	Terminal block TA564-11, 11 pins, screw front, cable front, 6 pieces per unit	Active

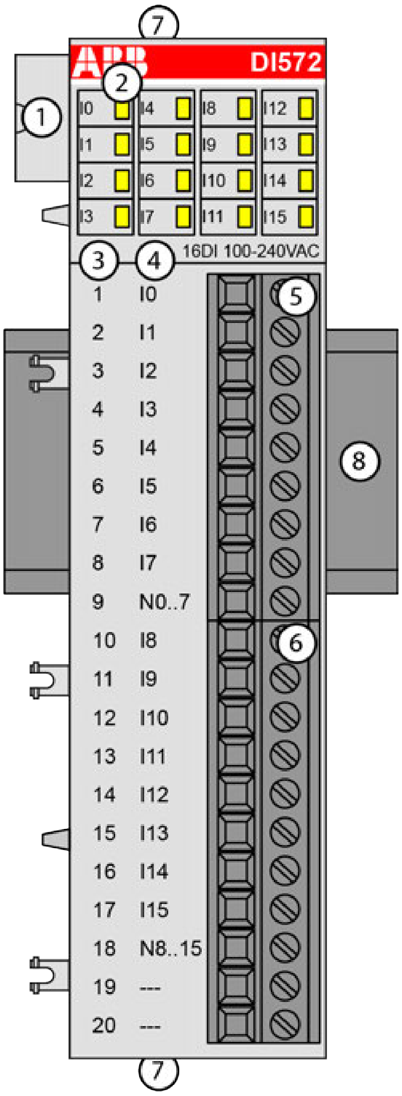
Part no.	Description	Product life cycle phase *)
1TNE 968 901 R3105	Terminal block TA565-9, 9 pins, spring front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3106	Terminal block TA565-11, 11 pins, spring front, cable front, 6 pieces per unit	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

1.6.1.1.5 DI572 - Digital input module

Features

- 16 digital inputs 100 ... 240 V AC (I0 ... I15) in 2 groups
- Module-wise galvanically isolated



1 I/O bus
2 16 yellow LEDs to display the signal states of the inputs I0 ... I15

3 Terminal number
4 Allocation of signal name
5 Terminal block for input signals (9-pin)
6 Terminal block for input signals (11-pin)
7 2 holes for wall-mounting with screws
8 DIN rail

Intended purpose

The device can be used as a decentralized I/O extension module for S500 communication interface modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs.

The inputs are group-wise galvanically isolated from each other.

All other circuitry of the module is galvanically isolated from the inputs.

The I/O module must not be used as a decentralized I/O module with CI590-CS31-HA communication interface modules.

Functionality

Parameter	Value
LED displays	For signal states
Internal power supply	Via I/O bus
External power supply	Not necessary

Connections

For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.

The connection is carried out by using removable 9-pin and 11-pin terminal blocks. These terminal blocks differ in their connection system (spring terminals or screw terminals, cable mounting from the front or from the side). The terminal blocks are not included in the module's scope of delivery and must be ordered separately.

Chapter 1.9.2.1 “TA563-TA565 - Terminal blocks” on page 1352

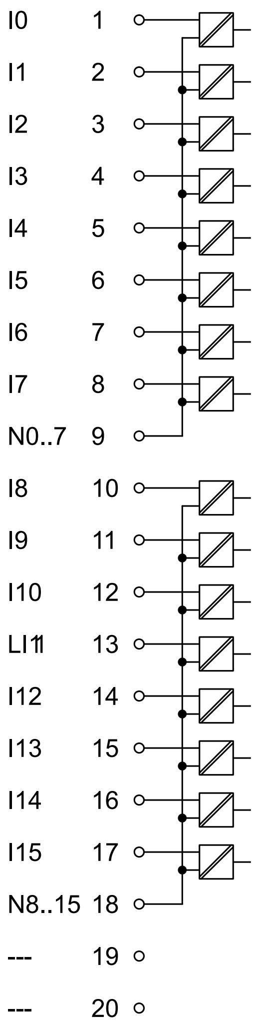


Fig. 97: Block diagram for the internal construction of the digital inputs.

Table 145: Assignment of the terminals

Terminal	Signal	Description
1	I0	Input signal I0
2	I1	Input signal I1
3	I2	Input signal I2
4	I3	Input signal I3
5	I4	Input signal I4
6	I5	Input signal I5
7	I6	Input signal I6
8	I7	Input signal I7
9	N0 ... 7	Neutral conductor for the input signals I0 ... I7
10	I8	Input signal I8
11	I9	Input signal I9
12	I10	Input signal I10
13	I11	Input signal I11
14	I12	Input signal I12
15	I13	Input signal I13

Terminal	Signal	Description
16	I14	Input signal I14
17	I15	Input signal I15
18	N8 ... 15	Neutral conductor for the input signals I8 ... I15
19	---	Reserved
20	---	Reserved

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a communication interface module or a CPU). Thus, the current consumption from 24 V DC power supply at the terminals L+/UP and M/ZP of the CPU/communication interface module increases by 10 mA per DI572.

An external power supply connection is not needed.

WARNING!
Risk of death by electric shock!
Hazardous voltages can be present at the terminals of the module.

Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.

WARNING!
Removal/Insertion under power
The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

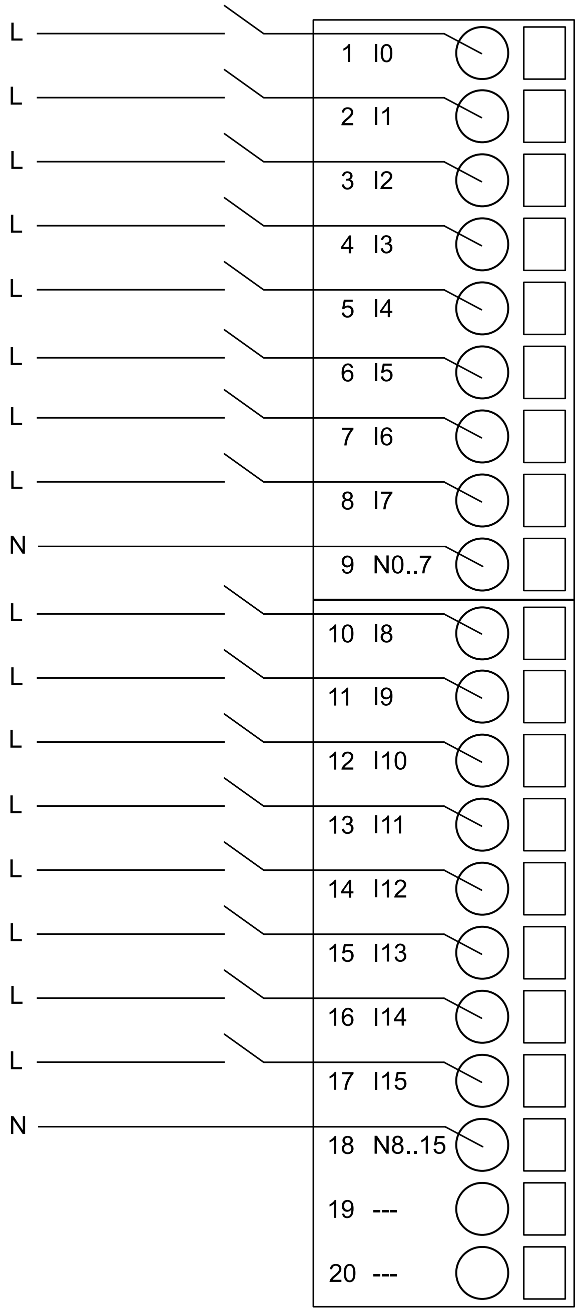
Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!
Risk of damaging the PLC modules!
Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.



NOTICE!

Risk of damaging the PLC modules!

The PLC modules will be irreparably damaged if a voltage > 240 V is connected.

Make sure that all inputs are fed from the same phase. The module must not be connected to a 400 V voltage.

The module provides several diagnosis functions *Chapter 1.6.1.1.5.7 “Diagnosis” on page 354*.

I/O configuration

The module itself does not store configuration data. It receives its parameterization data from the master device of the I/O bus (CPU or communication interface module) during power-up of the system.

Hence, replacing I/O modules is possible without any re-parameterization via software.

If the external power supply voltage via UP/ZP terminals fails, the I/O module loses its configuration data. The whole station has to be switched off and on again to re-configure the module.

Parameterization

The arrangement of the parameter data is performed with Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Parameter name	Value	Internal value	Data type of internal value	Default value	Min.	Max.	EDS Slot Index
Module ID	Internal	6160 [1])	WORD	6160 0x1810	0	65535	xx01 [2])
Ignore module	No	0	BYTE	No 0x00	-	-	-
	Yes	1					
Parameter length	Internal	3	BYTE	3	0	255	xx02 [2])
Input delay	20 ms	0	BYTE	20 ms 0x00	0	1	-
	100 ms	1					

[1]) With CS31 and addresses less than 70, the value is increased by 1.

[2]) Value is hexadecimal: HighByte is slot (xx: 0 ... 7), LowByte is index (1 ... n).

GSD file:

Ext_Module_Prm_Data_Len =	7
Ext_User_Prm_Data_Const(0) =	0x18, 0x11, 0x00, 0x03, 0x00, 0x00, 0x00;

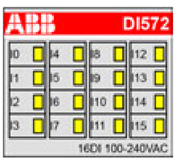
Diagnosis

E1 ... E4	d1	d2	d3	d4	Identifier 000 ... 063	AC500-Display	<– Display in
Class	Comp	Dev	Mod	Ch	Err	PS501 PLC Browser	
Byte 6 Bit 6 ... 7	-	Byte 3	Byte 4	Byte 5	Byte 6 Bit 0 ... 5	PNIO diagnosis block	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error Identifier**	**Error message**	**Remedy**
	1)	2)	3)	4)			
3	14	1 ... 10	31	31	19	Checksum error in the I/O module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	43	Internal error in the module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	9	Overflow diagnosis buffer	Restart
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	26	Parameter error	Check master
	11 / 12	ADR	1 ... 10				

Remarks:

Parameter	Remark
1)	In AC500 the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31-Bus), 12 = COM2. The PNIO diagnosis block does not contain this identifier.
2)	With "Device" the following allocation applies: 31 = module itself, 1 ... 10 = decentralized communication interface module 1 ... 10, ADR = hardware address (e.g. of the DC551-CS31)
3)	With "Module" the following allocation applies depending on the master: module error: I/O bus or PNIO: 31 = module itself; COM1/COM2: 1 ... 10 = expansion 1 ... 10
4)	In case of module errors, with channel "31 = module itself" is output.

State LEDs

LED		State	Color	LED = OFF	LED = ON
	Inputs I0 ... I15	Digital input	Yellow	Input is OFF	Input is ON (the input voltage is only displayed if the supply voltage of the module is ON)

Technical data

Technical data of the module

The system data of AC500-eCo apply.

Chapter 2.5.1 “System data AC500-eCo” on page 1379

Only additional details are therefore documented below.

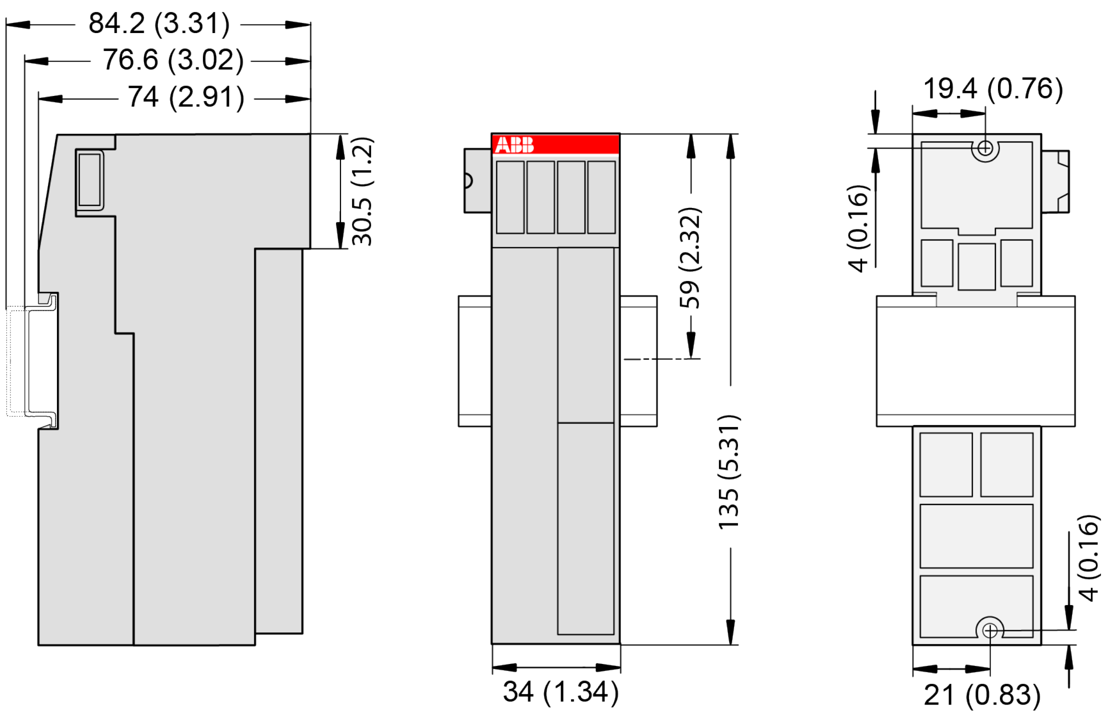
Parameter	Value
Galvanic isolation	Yes, between the input groups and the rest of the module
Isolated groups	2 (8 channels per group)
Current consumption from 24 V DC power supply at the L+/UP and M/ZP terminals of the CPU/communication interface module	Ca. 10 mA
Max. power dissipation within the module	6 W
Weight	Ca. 222 g
Mounting position	Horizontal or vertical
Cooling	The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

Technical data of the digital inputs

Parameter		Value
Number of channels per module		16 AC inputs (100-240 V AC)
Distribution of the channels into groups		2 (8 channels per group)
Input voltage range		0 V AC ... 264 V AC (47 Hz ... 63 Hz)
Input current per channel (typically at +25 °C)		< 3 mA (at 40 V AC) > 6 mA (at 164 V AC) > 8 mA (at 240 V AC)
Connections of the channels I0..I7		Terminals 1... 8
Connections of the channels I8...I15		Terminals 10 ... 17
Reference potential for the channels I0...I7		Terminal 9
Reference potential for the channels I8...I15		Terminal 18
Indication of the input signals		1 yellow LED per channel. The LED is on when the input signal is high (signal 1).
Input type according to EN 61131-2		Type 1
Input signal range		
	Signal 0 (max.)	40 V AC
	Undefined signal	40 V AC < U < 79 V AC
	Signal 1 (min.)	79 V AC
Input delay		
	Signal 0 -> 1	Typ. 24 ms
	Signal 1 -> 0	Typ. 24 ms

Parameter		Value
Input data length		2 bytes
Max. permissible leakage current (at 2-wire proximity switches)		1 mA
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

Dimensions



The dimensions are in mm and in brackets in inch.

Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 230 500 R0000	DI572, digital input module, 16 DI, 100 V AC ... 240 V AC	Active
1TNE 968 901 R3101	Terminal block TA563-9, 9 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3102	Terminal block TA563-11, 11 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3103	Terminal block TA564-9, 9 pins, screw front, cable front, 6 pieces per unit	Active

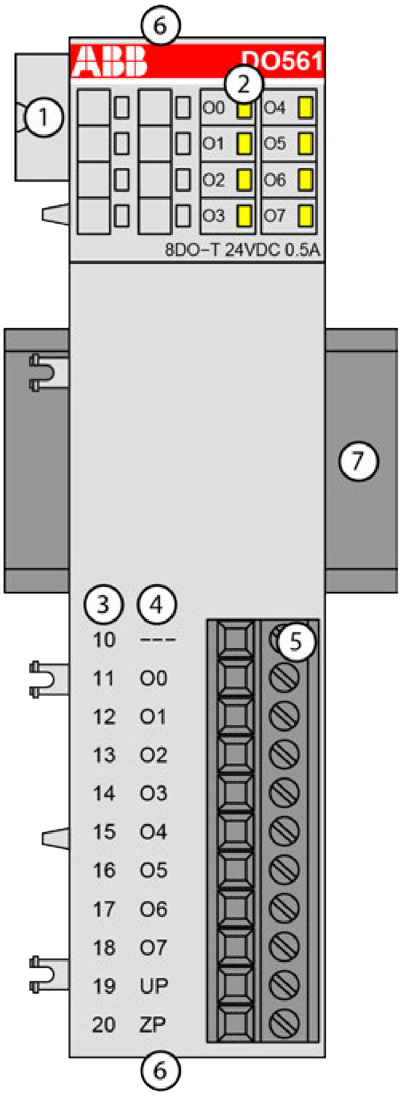
Part no.	Description	Product life cycle phase *)
1TNE 968 901 R3104	Terminal block TA564-11, 11 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3105	Terminal block TA565-9, 9 pins, spring front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3106	Terminal block TA565-11, 11 pins, spring front, cable front, 6 pieces per unit	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

1.6.1.1.6 DO561 - Digital output module

Features

- 8 digital outputs 24 V DC (O0 ... O7) in 1 group
- Module-wise galvanically isolated



1 I/O bus
2 8 yellow LEDs to display the signal states of the outputs O0 ... O7
3 Terminal number
4 Allocation of signal name
5 Terminal block for output signals (11-pin)
6 2 holes for wall-mounting with screws
7 DIN rail

Intended purpose

The device can be used as a decentralized I/O extension module for S500 communication interface modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs.

The outputs are group-wise galvanically isolated from each other.

All other circuitry of the module is galvanically isolated from the outputs.

The I/O module must not be used as a decentralized I/O module with CI590-CS31-HA communication interface modules.

Functionality

Parameter	Value
LED displays	For signal states
Internal power supply	Via I/O bus
External power supply	Via the terminals ZP and UP (process supply voltage 24 V DC)

Connections

For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.

The connection is carried out by using removable 9-pin and 11-pin terminal blocks. These terminal blocks differ in their connection system (spring terminals or screw terminals, cable mounting from the front or from the side). The terminal blocks are not included in the module's scope of delivery and must be ordered separately.

Chapter 1.9.2.1 “TA563-TA565 - Terminal blocks” on page 1352

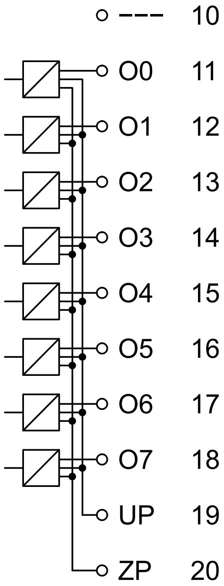


Fig. 98: Internal construction of the digital outputs

Table 146: Assignment of the terminals:

Terminals	Signal	Description
10	---	Reserved
11	O0	Output signal O0
12	O1	Output signal O1
13	O2	Output signal O2
14	O3	Output signal O3

Terminals	Signal	Description
15	O4	Output signal O4
16	O5	Output signal O5
17	O6	Output signal O6
18	O7	Output signal O7
19	UP	Process supply voltage UP +24 V DC
20	ZP	Process supply voltage ZP 0 V

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a communication interface module or a CPU). Thus, the current consumption from 24 V DC power supply at the terminals L+/UP and M/ZP of the CPU/communication interface module increases by 10 mA per DO561.

The external power supply connection is carried out via the UP (+24 V DC) and ZP (0 V DC) terminals.

WARNING!

Removal/Insertion under power

The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!

Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

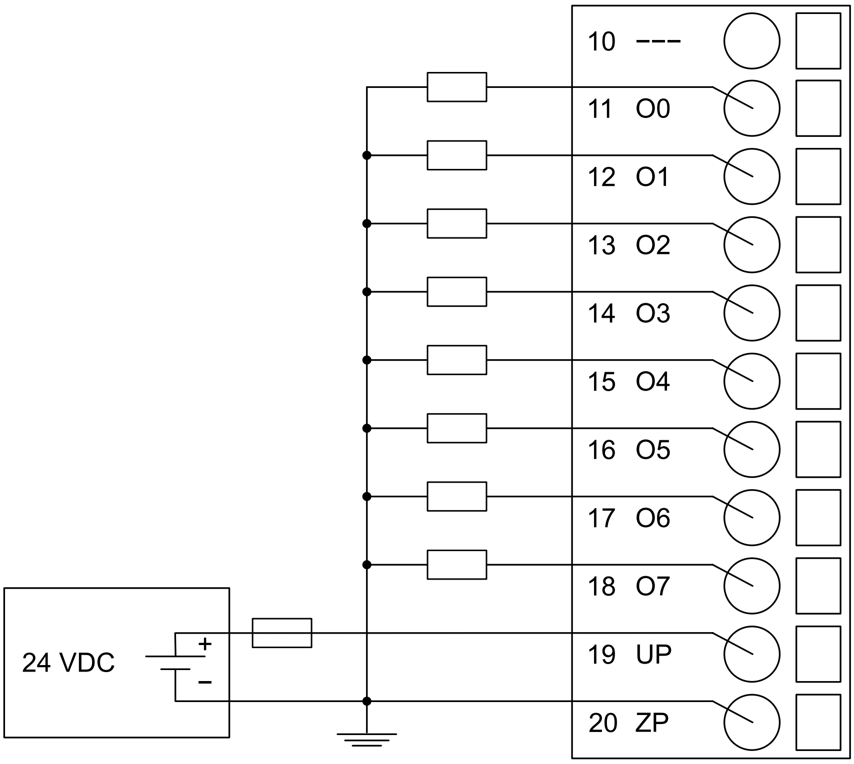


Fig. 99: Connection of the digital output module DO561

> **NOTICE!**
> **Risk of malfunctions in the plant!**
> The outputs may switch on for a period of 10 to 50 µs if the process supply voltage UP/ZP is switched on.
>
> This must be considered in the planning of the application.

> **NOTICE!**
> **Risk of damaging the I/O module!**
> The outputs are not protected against short circuits and overload.
>
> – Never short-circuit or overload the outputs.
> – Never connect the outputs to other voltages.
> – Use an external 3 A fast-protection fuse for the outputs.

The module provides several diagnosis functions *Chapter 1.6.1.1.6.7 "Diagnosis" on page 362*.

The meaning of the LEDs is described in the section State LEDs *Chapter 1.6.1.1.6.8 "State LEDs" on page 363*.

I/O configuration

The module itself does not store configuration data. It receives its parameterization data from the master device of the I/O bus (CPU or communication interface module) during power-up of the system.

Hence, replacing I/O modules is possible without any re-parameterization via software.

If the external power supply voltage via UP/ZP terminals fails, the I/O module loses its configuration data. The whole station has to be switched off and on again to re-configure the module.

Parameterization

The arrangement of the parameter data is performed with Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Name	Value	Internal Value	Internal Value, Type	Default	Min.	Max.	EDS Slot Index
Module ID	Internal	6120 [1])	WORD	6120 0x17E8	0	65535	xx01
Ignore module	No Yes	0 1	BYTE	No (0x00)			
Parameter length	Internal	1	BYTE	0	0	255	xx02 [2])

[1]) with CS31 and addresses smaller than 70, the value is increased by 1

[2]) Value is hexadecimal: HighByte is slot (xx: 0 ... 7), LowByte is index (1 ... n)

GSD file:

Ext_User_Prm_Data_Len =	0x03
Ext_User_Prm_Data_Const(0) =	0xE9, 0x17, 0x00;

Diagnosis

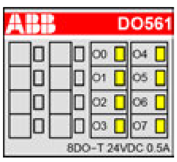
<table>
<tr><th>E1 ... E4</th><th>d1</th><th>d2</th><th>d3</th><th>d4</th><th>Identifier
000 ... 063</th><th>AC500-Display</th><th colspan="2" rowspan="3"><− Display in</th></tr>
<tr><th>Class</th><th>Comp</th><th>Dev</th><th>Mod</th><th>Ch</th><th>Err</th><th>PS501 PLC Browser</th></tr>
<tr><th>Byte 6
Bit 6 ... 7</th><th>-</th><th>Byte 3</th><th>Byte 4</th><th>Byte 5</th><th>Byte 6
Bit 0 ... 5</th><th>PNIO diagnosis block</th></tr>
<tr><th>Class</th><th>Interface</th><th>Device</th><th>Module</th><th>Channel</th><th>Error Identifier</th><th colspan="2">Error message</th><th>Remedy</th></tr>
<tr><td></td><td>1)</td><td>2)</td><td>3)</td><td>4)</td><td></td><td colspan="2"></td><td></td></tr>
<tr><td colspan="9">Module error DO561</td></tr>
<tr><td rowspan="2">3</td><td>14</td><td>1 ... 10</td><td>31</td><td rowspan="2">31</td><td rowspan="2">19</td><td colspan="2" rowspan="2">Checksum error in the I/O module</td><td rowspan="2">Replace I/O module</td></tr>
<tr><td>11 / 12</td><td>ADR</td><td>1 ... 10</td></tr>
</table>

E1 ... E4	d1	d2	d3	d4	Identifier 000 ... 063	AC500-Display	<– Display in
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 6 Bit 6 ... 7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0 ... 5**	**PNIO diagnosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error Identifier**	**Error message**	**Remedy**
	1)	2)	3)	4)			
Module error DO561							
3	14	1 ... 10	31	31	43	Internal error in the module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	9	Overflow diagnosis buffer	Restart
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	26	Parameter error	Check master
	11 / 12	ADR	1 ... 10				

Remarks:

1)	In AC500 the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31-Bus), 12 = COM2. The PNIO diagnosis block does not contain this identifier.
2)	With "Device" the following allocation applies: 31 = module itself, 1 ... 10 = decentralized communication interface module 1 ... 10, ADR = hardware address (e. g. of the DC551-CS31)
3)	With "Module" the following allocation applies depending on the master: Module error: I/O bus or PNIO: 31 = module itself; COM1/COM2: 1 ... 10 = expansion 1 ... 10 Channel error: I/O bus or PNIO = module type (2 = DO); COM1/COM2: 1 ... 10 = expansion 1 ... 10
4)	In case of module errors, with channel "31 = Module itself" is output.

State LEDs

LED		State	Color	LED = OFF	LED = ON
	Outputs O0 ... O7	Digital output	Yellow	Output is OFF	Output is ON (the output voltage is only displayed if the supply voltage of the module is ON)

Technical data

Technical data of the module

The system data of AC500-eCo apply.

Chapter 2.5.1 “System data AC500-eCo” on page 1379

Only additional details are therefore documented below.

Parameter		Value
Process supply voltage UP		
	Connections	Terminal 19 for UP (+24 V DC) and terminal 20 for ZP (0 V DC)
	Rated value	24 V DC
	Current consumption via UP terminal	5 mA + max. 0.5 A per output
	Max. ripple	5 %
	Inrush current	0.000002 A^2s
	Protection against reversed voltage	Yes
	Rated protection fuse for UP	Recommended; the outputs must be protected by an 3 A fast-acting fuse
Current consumption from 24 V DC power supply at the L+/UP and M/ZP terminals of the CPU/communication interface module		Ca. 10 mA
Galvanic isolation		Yes, between the output group and the rest of the module
Isolated groups		1 (8 channels per group)
Surge-voltage (max.)		35 V DC for 0.5 s
Power dissipation within the module (max.)		1.6 W
Weight		Ca. 115 g
Mounting position		Horizontal or vertical
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

No effects of multiple overloads

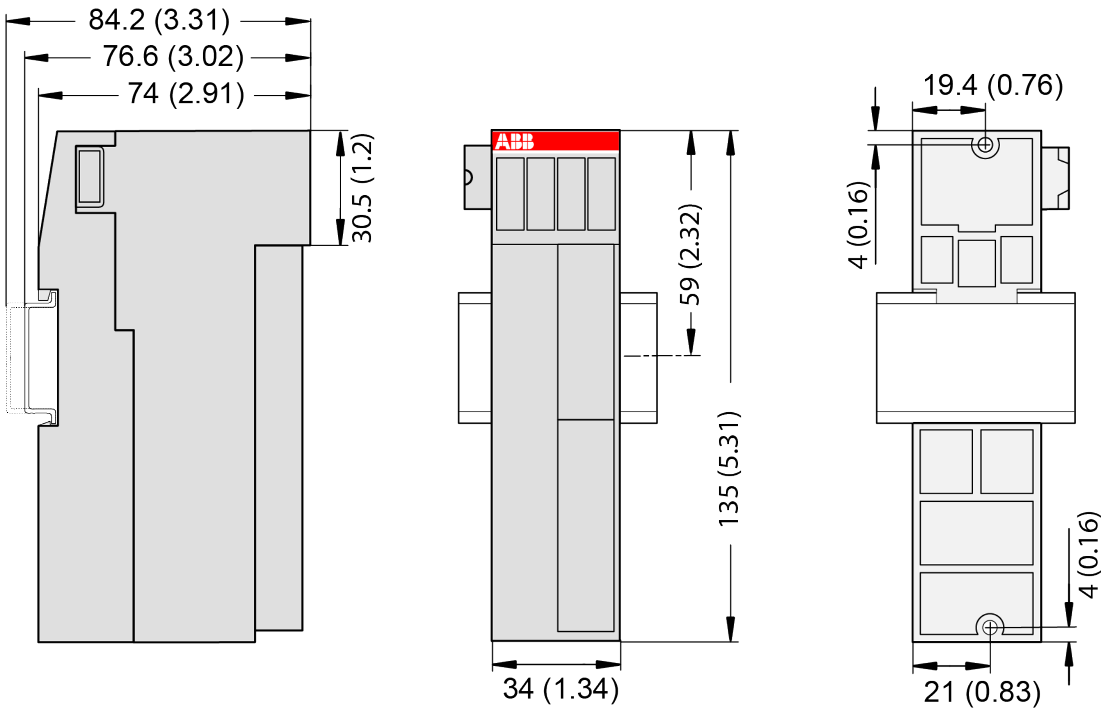
No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an external fuse.

Technical data of the digital outputs

Parameter	Value
Number of channels per module	8 transistor outputs (24 V DC, 0.5 A max.)
Distribution of the channels into groups	1 (8 channels per group)
Connection of the channels O0 to O7	Terminals 11 to 18
Common power supply voltage	Terminal 19 (positive pole of the process voltage, signal name UP)
Reference potential for the channels O0 to O7	Terminal 20 (negative pole of the process voltage, signal name ZP)

Parameter		Value
Indication of the output signals		1 yellow LED per channel; the LED is on when the output signal is high (signal 1) and the module is powered via the I/O bus
Way of operation		Non-latching type
Min. output voltage at signal 1		20 V DC at max. current consumption
Output delay (max. at rated load)		
	0 to 1	50 µs
	1 to 0	200 µs
Output data length		1 byte
Output current		
	Rated current per channel (max.)	0.5 A at UP 24 V DC
	Rated current per group (max.)	4 A
	Lamp load (max.)	5 W
Max. leakage current with signal 0		0.5 mA
Output type		Non-protected
Protection type		External fuse on each channel
Rated protection fuse (for each channel)		3 A fast
Demagnetization when inductive loads are switched off		Must be performed externally according to driven load specification
Switching Frequencies		
	With inductive loads	Max. 0.5 Hz
	With lamp loads	Max. 11 Hz at max. 5 W
Short-circuit-proof / Overload-proof		No
	Overload message	No
	Output current limitation	No
	Resistance to feedback against 24 V DC	No
Connection of 2 outputs in parallel		Not possible
Max. cable length		
	Shielded	500 m
	Unshielded	150 m

Dimensions



The dimensions are in mm and in brackets in inch.

Ordering data

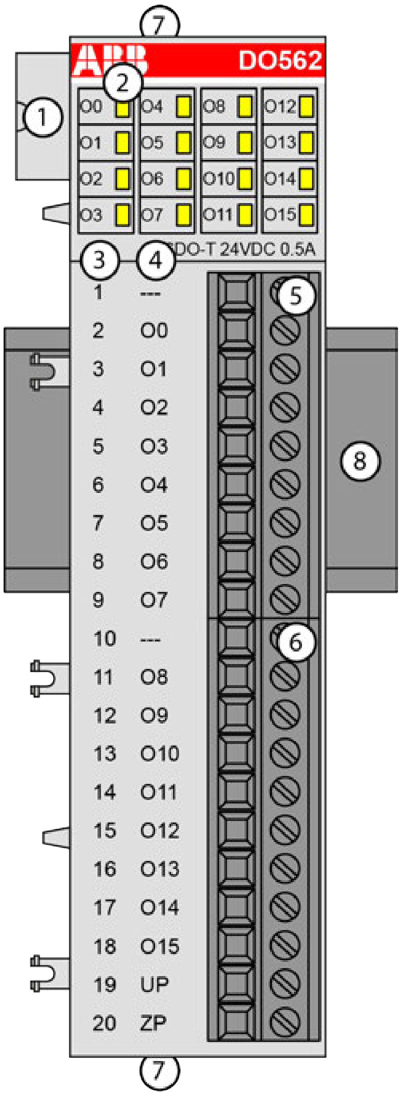
Part no.	Description	Product life cycle phase *)
1TNE 968 902 R2201	DO561, digital output module, 8 DO, transistor output	Active
1TNE 968 901 R3102	Terminal block TA563-11, 11 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3104	Terminal block TA564-11, 11 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3106	Terminal block TA565-11, 11 pins, spring front, cable front, 6 pieces per unit	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

1.6.1.1.7 DO562 - Digital output module

Features

- 16 digital outputs 24 V DC (O0 ... O15) in 1 group
- Module-wise galvanically isolated



1 I/O bus
2 16 yellow LEDs to display the signal states of the outputs O0 ... O15
3 Terminal number
4 Allocation of signal name
5 Terminal block for output signals (9-pin)
6 Terminal block for output signals (11-pin)
7 2 holes for wall-mounting with screws
8 DIN rail

Intended purpose

The device can be used as a decentralized I/O extension module for S500 communication interface modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs.

The outputs are group-wise galvanically isolated from each other.

All other circuitry of the module is galvanically isolated from the outputs.

The I/O module must not be used as a decentralized I/O module with CI590-CS31-HA communication interface modules.

Functionality

Parameter	Value
LED displays	For signal states
Internal power supply	Via I/O bus
External power supply	Via the terminals ZP and UP (process supply voltage 24 V DC)

Connections

For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.

The connection is carried out by using removable 9-pin and 11-pin terminal blocks. These terminal blocks differ in their connection system (spring terminals or screw terminals, cable mounting from the front or from the side). The terminal blocks are not included in the module's scope of delivery and must be ordered separately.

Chapter 1.9.2.1 “TA563-TA565 - Terminal blocks” on page 1352

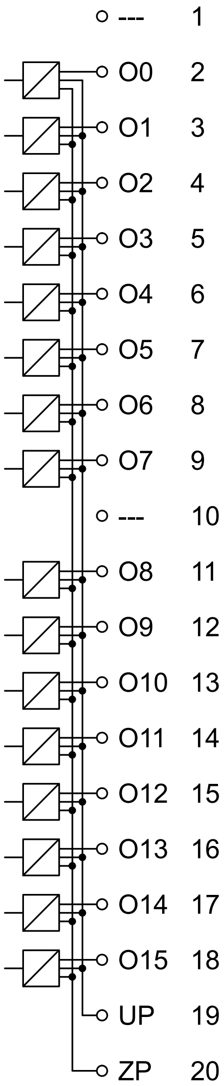


Fig. 100: Internal construction of the digital outputs

Table 147: Assignment of the terminals:

Terminal	Signal	Description
1	---	Reserved
2	O0	Output signal O0
3	O1	Output signal O1
4	O2	Output signal O2
5	O3	Output signal O3
6	O4	Output signal O4
7	O5	Output signal O5
8	O6	Output signal O6
9	O7	Output signal O7
10	---	Reserved
11	O8	Output signal O8
12	O9	Output signal O9
13	O10	Output signal O10

Terminal	Signal	Description
14	O11	Output signal O11
15	O12	Output signal O12
16	O13	Output signal O13
17	O14	Output signal O14
18	O15	Output signal O15
19	UP	Process voltage UP (24 V DC)
20	ZP	Process voltage ZP (0 V DC)

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a communication interface module or a CPU). Thus, the current consumption from 24 V DC power supply at the terminals L+/UP and M/ZP of the CPU/communication interface module increases by 10 mA per DO562.

The external power supply connection is carried out via the UP (+24 V DC) and ZP (0 V DC) terminals.

WARNING!
Removal/Insertion under power
The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!
Risk of damaging the PLC modules!
Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

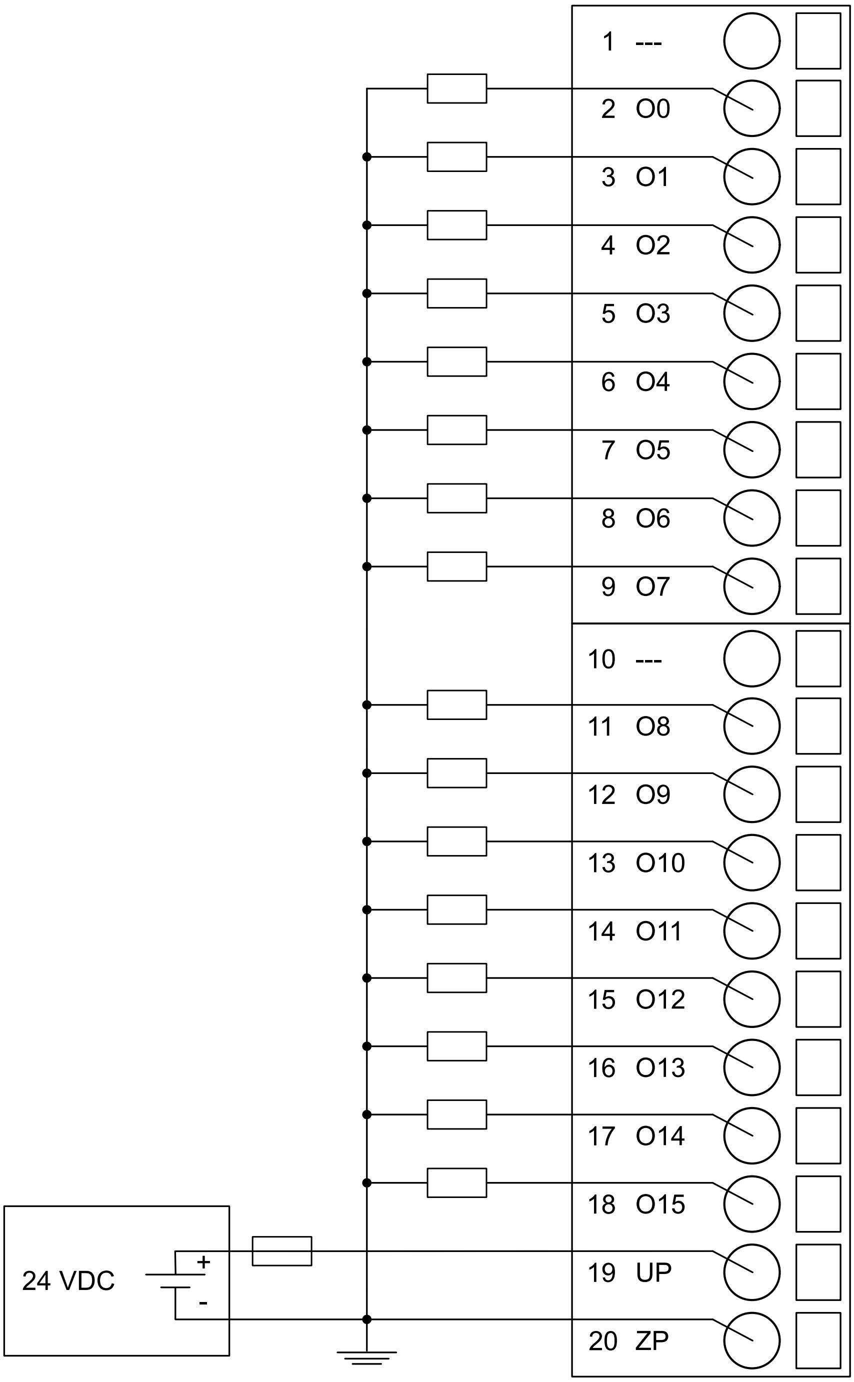


Fig. 101: Connection of the digital output module DO562

> **NOTICE!**
> **Risk of malfunctions in the plant!**
> The outputs may switch on for a period of 10 to 50 µs if the process supply voltage UP/ZP is switched on.
>
> This must be considered in the planning of the application.

NOTICE!
Risk of damaging the I/O module!
The outputs are not protected against short circuits and overload.

– Never short-circuit or overload the outputs.
– Never connect the outputs to other voltages.
– Use an external 3 A fast-protection fuse for the outputs.

The module provides several diagnosis functions *Chapter 1.6.1.1.7.7 “Diagnosis” on page 373*.

The meaning of the LEDs is described in the section Status LEDs *Chapter 1.6.1.1.7.8 “State LEDs” on page 373*.

I/O configuration

The module itself does not store configuration data. It receives its parameterization data from the master device of the I/O bus (CPU or communication interface module) during power-up of the system.

Hence, replacing I/O modules is possible without any re-parameterization via software.

If the external power supply voltage via UP/ZP terminals fails, the I/O module loses its configuration data. The whole station has to be switched off and on again to re-configure the module.

Parameterization

The arrangement of the parameter data is performed with Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Name	Value	Internal Value	Internal Value, Type	Default	Min.	Max.	EDS Slot Index
Module ID	Internal	6145 [1])	WORD	6145 0x1801	0	65535	xx01
Ignore module	No Yes	0 1	BYTE	No (0x00)			
Parameter length	Internal	1	BYTE	0	0	255	xx02 [2])

[1]) with CS31 and addresses less than 70, the value is increased by 1

[2]) Value is hexadecimal: HighByte is slot (xx: 0 ... 7), LowByte is index (1 ... n)

GSD file:

Ext_User_Prm_Data_Len =	0x06
Ext_User_Prm_Data_Const(0) =	0x18, 0x02, 0x00, 0x02, 0x00, 0x00;

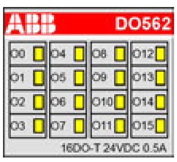
Diagnosis

E1...E4	d1	d2	d3	d4	Identifier 000 ... 063	AC500-Display	<– Display in
Class	Comp	Dev	Mod	Ch	Err	PS501 PLC Browser	
Byte 6 Bit 6 ... 7	-	Byte 3	Byte 4	Byte 5	Byte 6 Bit 0 ... 5	PNIO diagnosis block	
Class	**Inter- face**	**Device**	**Module**	**Channel**	**Error-Identifier**	**Error message**	**Remedy**
	1)	2)	3)	4)			
Module error							
3	14	1 ... 10	31	31	19	Checksum error in the I/O module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	43	Internal error in the module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	9	Overflow diagnosis buffer	Restart
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	26	Parameter error	Check master
	11 / 12	ADR	1 ... 10				

Remarks:

1)	In AC500 the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The PNIO diagnosis block does not contain this identifier.
2)	With "Device" the following allocation applies: 31 = module itself, 1 ... 10 = decentralized communication interface module 1 ... 10, ADR = hardware address (e. g. of the DC551-CS31)
3)	With "Module" the following allocation applies dependent of the master: Module error: I/O bus or PNIO: 31 = Module itself; COM1/COM2: 1 ... 10 = expansion 1 ... 10 Channel error: I/O bus or PNIO = module type (2 = DO); COM1/COM2: 1 ... 10 = expansion 1 ... 10
4)	In case of module errors, with channel "31 = Module itself" is output.

State LEDs



LED		State	Color	LED = OFF	LED = ON
(see image above)	Outputs O0 ... O15	Digital output	Yellow	Output is OFF	Output is ON (the output voltage is only displayed if the supply voltage of the module is ON)

Technical data

Technical data of the module

The system data of AC500-eCo apply.

Chapter 2.5.1 “System data AC500-eCo” on page 1379

Only additional details are therefore documented below.

Parameter		Value
Process supply voltage UP		
	Connections	Terminal 19 for UP (+24 V DC) and terminal 20 for ZP (0 V DC)
	Rated value	24 V DC
	Current consumption via UP terminal	20 mA + max. 0.5 A per output
	Max. ripple	5 %
	Inrush current	0.000002 A^2s
	Protection against reversed voltage	Yes
	Rated protection fuse for UP	Recommended; the outputs must be protected by an 3 A fast-acting fuse
Current consumption from 24 V DC power supply at the L+/UP and M/ZP terminals of the CPU/communication interface module		Ca. 10 mA
Galvanic isolation		Yes, between the output group and the rest of the module
Isolated groups		1 (16 channels per group)
Surge-voltage (max.)		35 V DC for 0.5 s
Max. power dissipation within the module		1.4 W
Weight		Ca. 125 g
Mounting position		Horizontal or vertical
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

No effects of multiple overloads

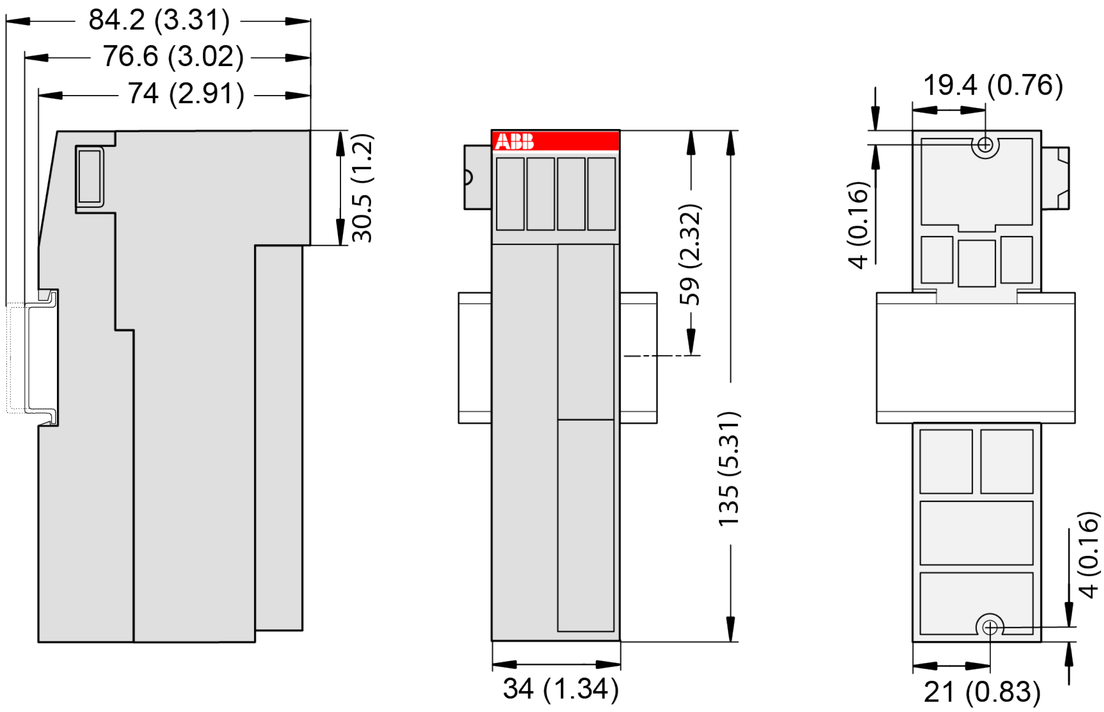
No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an external fuse.

Technical data of the digital outputs

Parameter	Value
Number of channels per module	16 transistor outputs (24 V DC, 0.5 A max.)
Distribution of the channels into groups	1 (16 channels per group)
Connection of the channels O0 ... O7	Terminals 1 ... 9
Connection of the channels O8 ... O15	Terminals 11 ... 18
Common power supply voltage	Terminal 19 (positive pole of the process voltage, signal name UP)
Reference potential for the channels O0 ... O15	Terminal 20 (negative pole of the process voltage, signal name ZP)

Parameter		Value
Indication of the output signals		1 yellow LED per channel; the LED is on when the output signal is high (signal 1) and the module is powered via the I/O bus
Way of operation		Non-latching type
Min. output voltage at signal 1		UP -0.3 V at max. current consumption
Output delay (max. at rated load)		
	0 to 1	50 µs
	1 to 0	200 µs
Output data length		2 bytes
Output current		
	Rated current per channel (max.)	0.5 A at UP 24 V DC
	Rated current per group (max.)	8 A
	Lamp load (max.)	5 W
Max. leakage current with signal 0		0.5 mA
Output type		Non-protected
Protection type		External fuse on each channel
Rated protection fuse (for each channel)		3 A fast
Demagnetization when inductive loads are switched off		Must be performed externally according to driven load specification
Switching Frequencies		
	With inductive loads	Max. 0.5 Hz
	With lamp loads	Max. 11 Hz at max. 5 W
Short-circuit-proof / Overload-proof		No
	Overload message	No
	Output current limitation	No
	Resistance to feedback against 24 V DC	No
Connection of 2 outputs in parallel		Not possible
Max. cable length		
	Shielded	500 m
	Unshielded	150 m

Dimensions



The dimensions are in mm and in brackets in inch.

Ordering data

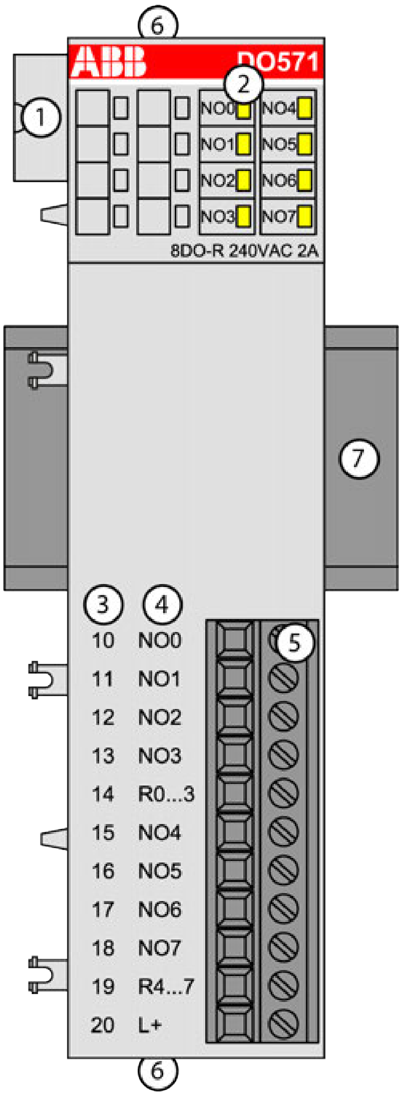
Part no.	Description	Product life cycle phase *)
1SAP 230 900 R0000	DO562, digital output module, 16 DO, transistor output	Active
1TNE 968 901 R3101	Terminal block TA563-9, 9 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3102	Terminal block TA563-11, 11 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3103	Terminal block TA564-9, 9 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3104	Terminal block TA564-11, 11 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3105	Terminal block TA565-9, 9 pins, spring front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3106	Terminal block TA565-11, 11 pins, spring front, cable front, 6 pieces per unit	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

1.6.1.1.8 DO571 - Digital output module

Features

- 8 digital normally open relay outputs 24 V DC / 24 V AC or 100 V AC ... 240 V AC, 2 A max. (NO0 ... NO7) in 2 groups
- Group-wise galvanically isolated



1 I/O bus
2 8 yellow LEDs to display the signal states of the outputs O0 ... O7
3 Terminal number
4 Allocation of signal name
5 Terminal block for output signals (11-pin)
6 2 holes for wall-mounting with screws
7 DIN rail

Intended purpose

The device can be used as a decentralized I/O extension module for S500 communication interface modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs.

The outputs are group-wise galvanically isolated from each other.

All other circuitry of the module is galvanically isolated from the outputs.

> *The I/O module must not be used as a decentralized I/O module with CI590-CS31-HA communication interface modules.*

Functionality

Parameter	Value
LED displays	For signal states
Internal power supply	Via I/O bus
External power supply	Via the terminal L+ (process voltage 24 V DC). The negative pole is provided by the I/O bus.

Connections

> *For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.*

The connection is carried out by using removable 9-pin and 11-pin terminal blocks. These terminal blocks differ in their connection system (spring terminals or screw terminals, cable mounting from the front or from the side). The terminal blocks are not included in the module's scope of delivery and must be ordered separately.

Chapter 1.9.2.1 “TA563-TA565 - Terminal blocks” on page 1352

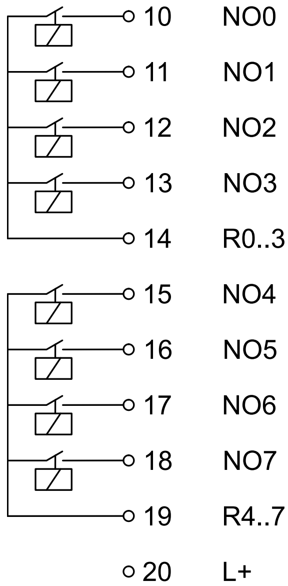


Fig. 102: Internal construction of the digital outputs

Table 148: Assignment of the terminals:

Terminal	Signal	Description
10	NO0	Normally-open contact of the output NO0
11	NO1	Normally-open contact of the output NO1
12	NO2	Normally-open contact of the output NO2
13	NO3	Normally-open contact of the output NO3
14	R0..3	Output common for signals NO0 to NO3
15	NO4	Normally-open contact of the output NO4
16	NO5	Normally-open contact of the output NO5
17	NO6	Normally-open contact of the output NO6
18	NO7	Normally-open contact of the output NO7
19	R4..7	Output common for signals NO4 to NO7
20	L+	Process voltage L+ +24 V DC

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a communication interface module or a CPU). Thus, the current consumption from 24 V DC power supply at the terminals L+/UP and M/ZP of the CPU/communication interface module increases by 5 mA per DO571.

The external power supply connection is carried out via the L+ (+24 V DC) terminal. The negative pole of the external power supply is realized via the I/O bus. Therefore, the CPU/communication interface module and the DO571 must have a common power supply.

WARNING!
Risk of death by electric shock!
Hazardous voltages can be present at the terminals of the module.

Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.

For screw-type terminals only:

WARNING!
For screw terminals only: Danger of death by electric shock!
The IP 20 protection degree is only provided if all terminal screws are tightened.

Tighten all screws of unused load terminals of relay outputs if voltages > 24 V are connected to the relay group.

WARNING!
Removal/Insertion under power
The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!
Risk of damaging the PLC modules!
Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

NOTICE!
Risk of damaging the PLC modules!
The PLC modules can be damaged by overload.

Make sure that the total current of each output common terminal (R0 ... R3 and R4 ... R7) does not exceed 8 A.

Never connect total currents > 8 A per group.

If the group fuse protection is not sufficient, then individual fuse protection of the outputs should be used.

Connection of the module:

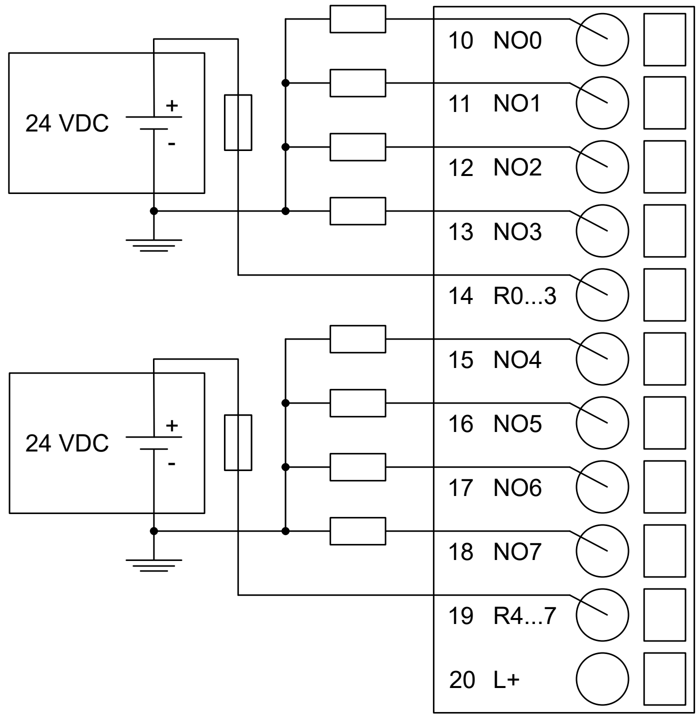


Fig. 103: Connection of 24 V DC actuators

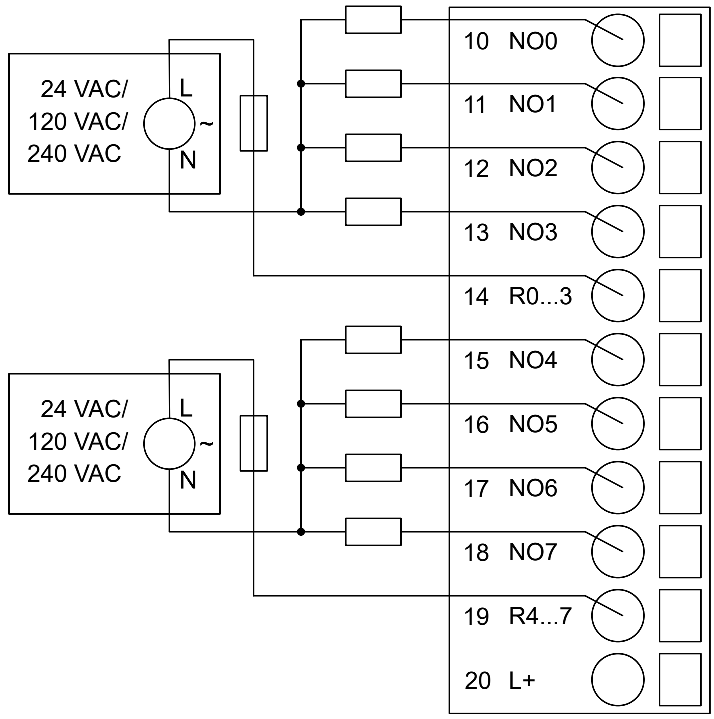


Fig. 104: Connection of 24 V AC or 100 V AC ... 240 V AC actuators

NOTICE!
Risk of damaging the I/O module!
The outputs are not protected against short circuit and overload.

– Never short-circuit or overload the outputs.
– Never connect inductive loads without an external suppression against voltage peaks due to inductive kickback.
– Never connect voltages > 240 V. All outputs must be supplied from the same phase.
– Use an external 5 A fast protection fuse for the outputs.

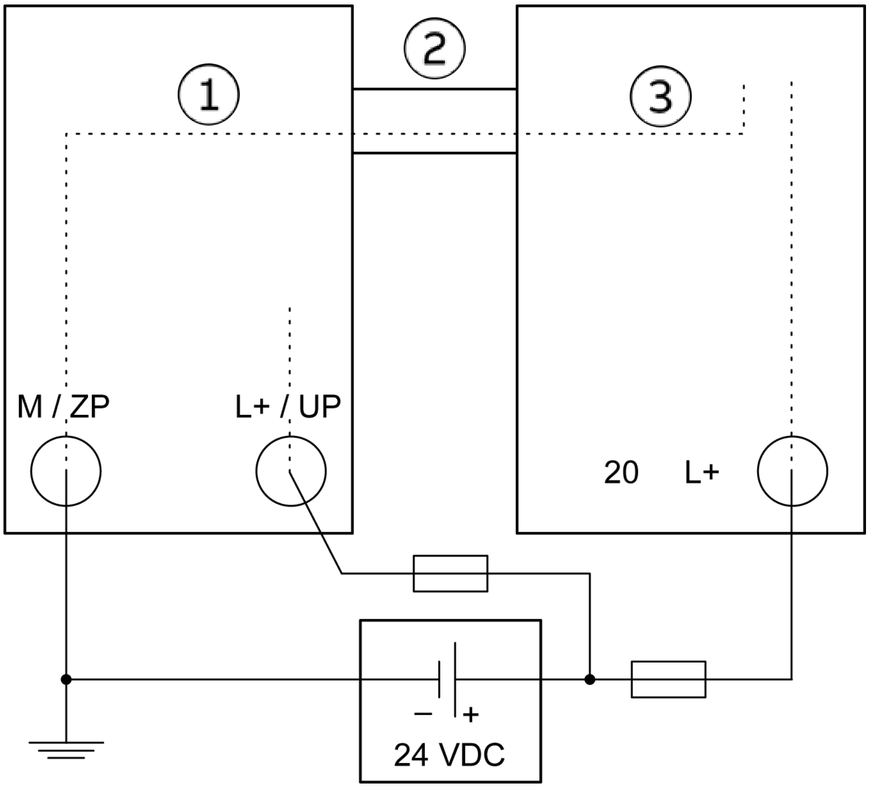


Fig. 105: Power supply - the negative connection is realized via the I/O bus

1 CPU or communication interface module
2 I/O bus
3 DO571

The L+ connection of the DO571 and the 24 V supply of the CPU/communication interface module must be connected to the same 24 V power supply.

The module provides several diagnosis functions *Chapter 1.6.1.1.8.7 “Diagnosis” on page 384*.

The meaning of the LEDs is described in the section Status LEDs *Chapter 1.6.1.1.8.8 “State LEDs” on page 385*.

I/O configuration

The module itself does not store configuration data. It receives its parameterization data from the master device of the I/O bus (CPU or communication interface module) during power-up of the system.

Hence, replacing I/O modules is possible without any re-parameterization via software.

> *If the external power supply voltage via UP/ZP terminals fails, the I/O module loses its configuration data. The whole station has to be switched off and on again to re-configure the module.*

Parameterization

The arrangement of the parameter data is performed with Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Name	Value	Internal Value	Internal Value, Type	Default	Min.	Max.	EDS Slot Index
Module ID	Internal	6125 [1])	WORD	6125 0x17ED	0	65535	xx01
Ignore module	No Yes	0 1	BYTE	No (0x00)			
Parameter length	Internal	1	BYTE	0	0	255	xx02 [2])
Check supply	Off On	0 1	BYTE	On 0x01			

[1]) with CS31 and addresses smaller than 70, the value is increased by 1

[2]) Value is hexadecimal: HighByte is slot (xx: 0 ... 7), LowByte is index (1 ... n)

GSD file:

Ext_User_Prm_Data_Len =	0x04
Ext_User_Prm_Data_Const(0) =	0xEF, 0x17, 0x00,\ 0x01;

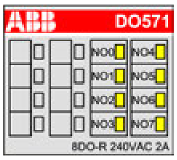
Diagnosis

E1 ... E4	d1	d2	d3	d4	Identi-fier 000 ... 063	AC500-Display	<− Display in
Class	Comp	Dev	Mod	Ch	Err	PS501 PLC Browser	
Byte 6 Bit 6 ... 7	-	Byte 3	Byte 4	Byte 5	Byte 6 Bit 0 ... 5	PNIO diag-nosis block	
Class	Inter-face	Device	Module	Channel	Error Identi-fier	Error message	Remedy
	1)	2)	3)	4)			
Module error							
3	14	1 ... 10	31	31	19	Checksum error in the I/O module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	43	Internal error in the module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	9	Overflow diagnosis buffer	Restart
	11 / 12	ADR	1 ... 10				
4	14	1 ... 10	31	31	26	Parameter error	Check master
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	11	Process voltage too low	Check process voltage
	11 / 12	ADR	1 ... 10				

Remarks:

1)	In AC500 the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The PNIO diagnosis block does not contain this identifier.
2)	With "Device" the following allocation applies: 31 = module itself, 1 ... 10 = decentralized communication interface module 1 ... 10, ADR = Hardware address (e. g. of the DC551-CS31)
3)	With "Module" the following allocation applies depending on the master: Module error: I/O bus or PNIO: 31 = module itself; COM1/COM2: 1 ... 10 = expansion 1 ... 10 Channel error: I/O bus or PNIO = module type (2 = DO); COM1/COM2: 1 ... 10 = expansion 1 ... 10
4)	In case of module errors, with channel "31 = Module itself" is output.

State LEDs

LED		State	Color	LED = OFF	LED = ON
	Outputs O0 ... O7	Digital output	Yellow	Output is OFF	Output is ON (the output voltage is only displayed if the supply voltage of the module is ON)

Technical data

Technical data of the module

The system data of AC500-eCo apply.

Chapter 2.5.1 “System data AC500-eCo” on page 1379

Only additional details are therefore documented below.

Parameter		Value
Process supply voltage L+		
	Connections	Terminal 20 for L+ (+24 V DC). The negative pole is provided by the I/O bus.
	Rated value	24 V DC
	Current consumption via L+	50 mA
	Inrush current (at power-up)	0.0035 A^2s
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	Rated protection fuse for UP	Recommended; the outputs must be protected by a 3 A fast-acting fuse
Current consumption from 24 V DC power supply at the L+/UP and M/ZP terminals of the CPU/communication interface module		Ca. 5 mA
Galvanic isolation		Yes, between the output group and the rest of the module
Isolated groups		2 (4 channels per group)
Surge-voltage (max.)		35 V DC for 0.5 s
Max. power dissipation within the module		2.0 W
Weight		Ca. 150 g
Mounting position		Horizontal or vertical
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

No effects of multiple overloads

No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an external fuse.

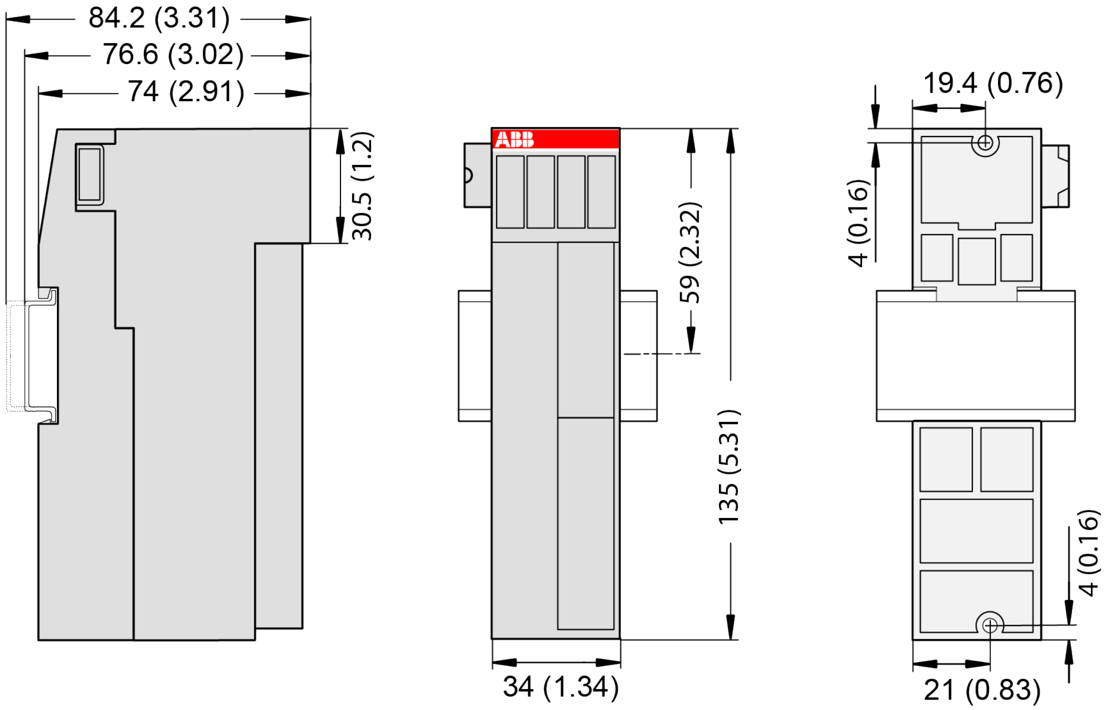
Technical data of the digital outputs

Parameter		Value
Number of channels per module		8 normally-open relay outputs
Distribution of the channels into groups		2 (4 channels per group)
Connection of the channels O0 ... O3		Terminals 10 ... 13
Connection of the channels O4 ... O7		Terminals 15 ... 18
Reference potential for the channels O0 ... O3		Terminal 14 (signal name R0 ... R3)
Reference potential for the channels O4 ... O7		Terminal 19 (signal name R4 ... R7)
Relay coil power supply		Terminal 20 (positive pole of the process supply voltage, signal name L+). The negative pole is provided by the I/O bus.
Indication of the output signals		1 yellow LED per channel; the LED is on when the output signal is high (signal 1) and the module is powered via the I/O bus
Way of operation		Non-latching type
Relay output voltage		
	Rated value	24 V DC / 24 V AC or 120/240 V AC
Output delay		
	Switching 0 to 1 (max.)	Typ. 10 ms
	Switching 1 to 0 (max.)	Typ. 10 ms
Output data length		1 byte
Output current		
	Rated current per channel (max.)	2.0 A (24 V DC / 24 V AC / 48 V AC / 120 V AC / 240 V AC, only resistive loads) 2.0 A (24 V AC / 48 V AC / 120 V AC, only pilot duty) 1.5 A (240 V AC, only pilot duty)
	Rated current per group (max.)	8 A
	Lamp load (max.)	200 W (230 V AC), 30 W (24 V DC)
Spark suppression with inductive AC loads		Must be performed externally according to driven load specification
Switching Frequencies		
	With resistive loads	Max. 1 Hz
	With inductive loads	On Request
	With lamp loads	Max. 1 Hz
Output type		Non-protected
Protection type		External fuse [1])
Rated protection fuse		5 A fast
Short-circuit-proof / Overload-proof		No, should be provided by an external fuse or circuit breaker
	Overload message	No
	Output current limitation	No
Connection of 2 outputs in parallel		Not possible
Lifetime of relay contacts (cycles)		100.000 at rated load

Parameter		Value
Max. cable length		
	Shielded	500 m
	Unshielded	150 m

[1]) Per group in case of group fuse protection. For each channel in case of channel-by-channel fuse protection. The maximum current per group must not be exceeded.

Dimensions



The dimensions are in mm and in brackets in inch.

Ordering data

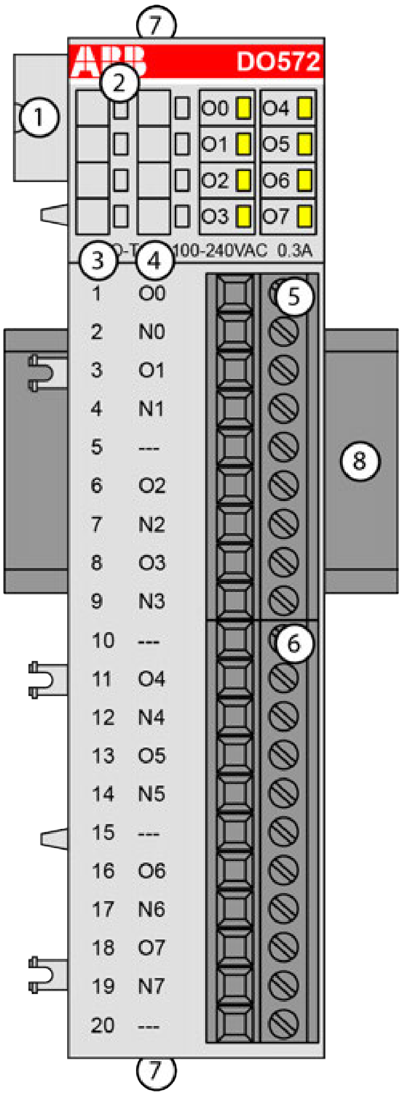
Part no.	Description	Product life cycle phase *)
1TNE 968 902 R2202	DO571, digital output module, 8 DO, relay output	Active
1TNE 968 901 R3102	Terminal block TA563-11, 11 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3104	Terminal block TA564-11, 11 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3106	Terminal block TA565-11, 11 pins, spring front, cable front, 6 pieces per unit	Active

*) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.

1.6.1.1.9 DO572 - Digital output module

Features

- 8 digital triac outputs (O0 ... O7) in 8 groups
- 120/240 V AC
- Module-wise galvanically isolated



1 I/O bus
2 8 yellow LEDs to display the signal states of the outputs O0 ... O7
3 Terminal number
4 Allocation of signal name
5 Terminal block for output signals (9-pin)
6 Terminal block for output signals (11-pin)
7 2 holes for wall-mounting with screws
8 DIN rail

Intended purpose

The device can be used as a decentralized I/O extension module for S500 communication interface modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs.

The outputs are group-wise galvanically isolated from each other.

All other circuitry of the module is galvanically isolated from the outputs.

> *The I/O module must not be used as a decentralized I/O module with CI590-CS31-HA communication interface modules.*

Functionality

Parameter	Value
LED displays	For signal states
Internal power supply	Via I/O bus
External power supply	Not necessary

Connections

> *For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.*

The connection is carried out by using removable 9-pin and 11-pin terminal blocks. These terminal blocks differ in their connection system (spring terminals or screw terminals, cable mounting from the front or from the side). The terminal blocks are not included in the module's scope of delivery and must be ordered separately.

Chapter 1.9.2.1 “TA563-TA565 - Terminal blocks” on page 1352

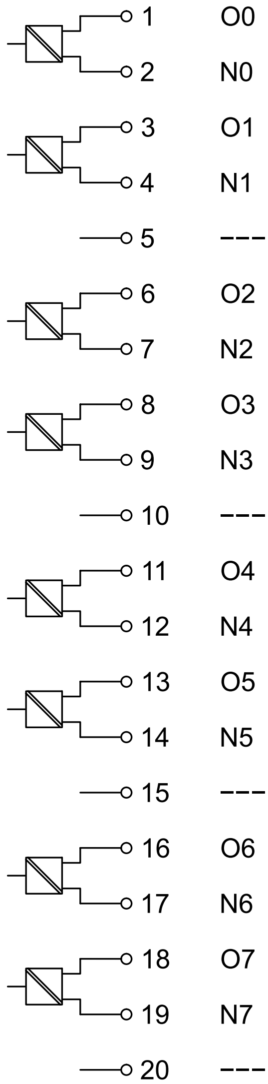


Fig. 106: Internal construction of the digital outputs

Table 149: Assignment of the terminals:

Terminal	Signal	Description
1	O0	Output signal O0
2	N0	Neutral conductor for the output signal O0
3	O1	Output signal O1
4	N1	Neutral conductor for the output signal O1
5	---	Reserved
6	O2	Output signal O2
7	N2	Neutral conductor for the output signal O2
8	O3	Output signal O3
9	N3	Neutral conductor for the output signal O3
10	---	Reserved
11	O4	Output signal O4

Terminal	Signal	Description
12	N4	Neutral conductor for the output signal O4
13	O5	Output signal O5
14	N5	Neutral conductor for the output signal O5
15	---	Reserved
16	O6	Output signal O6
17	N6	Neutral conductor for the output signal O6
18	O7	Output signal O7
19	N7	Neutral conductor for the output signal O7
20	---	Reserved

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a communication interface module or a CPU). Thus, the current consumption from 24 V DC power supply at the terminals L+/UP and M/ZP of the CPU/communication interface module increases by 10 mA per DO572.

An external power supply connection is not needed.

WARNING!
Risk of death by electric shock!
Hazardous voltages can be present at the terminals of the module.

Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.

WARNING!
Removal/Insertion under power
The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!
Risk of damaging the PLC modules!
Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

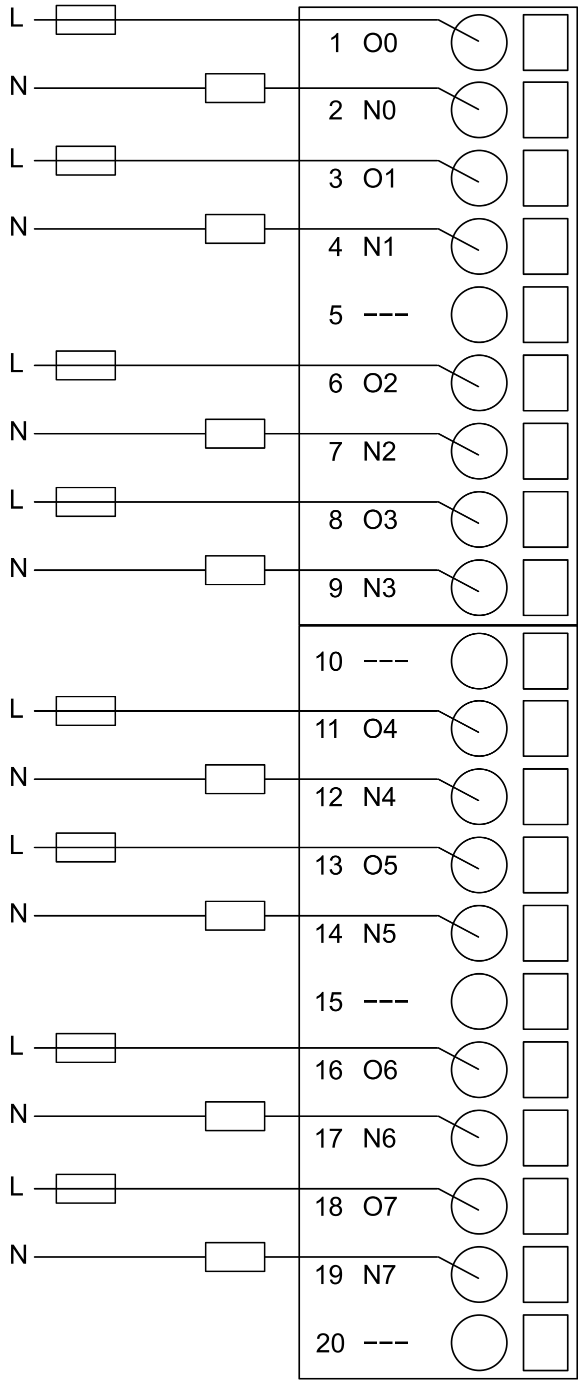


Fig. 107: Connection of the module

> **NOTICE!**
> **Risk of damaging the PLC modules!**
> The PLC modules will be irreparably damaged if a voltage > 240 V is connected.
>
> Make sure that all inputs are fed from the same phase. The module must not be connected to a 400 V voltage.

The module provides several diagnosis functions ↬ *Chapter 1.6.1.1.9.7 “Diagnosis” on page 394*.

The meaning of the LEDs is described in the section State LEDs ↬ *Chapter 1.6.1.1.9.8 “State LEDs” on page 395*.

I/O configuration

The module itself does not store configuration data. It receives its parameterization data from the master device of the I/O bus (CPU or communication interface module) during power-up of the system.

Hence, replacing I/O modules is possible without any re-parameterization via software.

> *If the external power supply voltage via UP/ZP terminals fails, the I/O module loses its configuration data. The whole station has to be switched off and on again to re-configure the module.*

Parameterization

The arrangement of the parameter data is performed with Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Name	Value	Internal Value	Internal Value, Type	Default	Min.	Max.	EDS Slot Index
Module ID	Internal	6130 [1])	WORD	6130 0x17F2	0	65535	xx01
Ignore module	No Yes	0 1	BYTE	No (0x00)			
Parameter length [2])	Internal	1 - CPU	BYTE	0	0	255	xx02 [3])

[1])	With CS31 and addresses smaller than 70, the value is increased by 1
[2])	The module has no additional user-configurable parameters
[3])	Value is hexadecimal: HighByte is slot (xx: 0 ... 7), LowByte is index (1 ... n)

GSD file:

Ext_User_Prm_Data_Len =	0x03
Ext_User_Prm_Data_Const(0) =	0xF3, 0x17, 0x00;

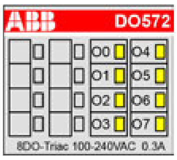
Diagnosis

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identifier 000 ... 063**	**AC500-Display**	**<– Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 6 Bit 6 ... 7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0 ... 5**	**PNIO diagnosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error Identifier**	**Error message**	**Remedy**
	1)	**2)**	**3)**	**4)**			
			Module error				
3	14	1 ... 10	31	31	19	Checksum error in the I/O module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	43	Internal error in the module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	9	Overflow diagnosis buffer	Restart
	11 / 12	ADR	1 ... 10				
4	14	1 ... 10	31	31	26	Parameter error	Check master
	11 / 12	ADR	1 ... 10				

Remarks:

1)	In AC500 the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31-Bus), 12 = COM2. The PNIO diagnosis block does not contain this identifier.
2)	With "Device" the following allocation applies: 31 = module itself, 1 ... 10 = decentralized communication interface module 1 ... 10, ADR = hardware address (e. g. of the DC551-CS31)
3)	With "Module" the following allocation applies depending on the master: Module error: I/O bus or PNIO: 31 = module itself; COM1/COM2: 1 ... 10 = expansion 1 ... 10 Channel error: I/O bus or PNIO = module type (2 = DO); COM1/COM2: 1 ... 10 = expansion 1 ... 10
4)	In case of module errors, with channel "31 = Module itself" is output.

State LEDs

LED		State	Color	LED = OFF	LED = ON
	Outputs O0 ... O7	Digital output	Yellow	Output is OFF	Output is ON

Technical data

Technical data of the module

The system data of AC500-eCo apply.

Chapter 2.5.1 “System data AC500-eCo” on page 1379

Only additional details are therefore documented below.

Parameter	Value
Galvanic isolation	Yes, between the channels and the rest of the module
Isolated groups	8 (1 channel per group)
Current consumption from 24 V DC power supply at the L+/UP and M/ZP terminals of the CPU/communication interface module	Ca. 10 mA
Max. power dissipation within the module	On Request
Weight	ca. 120 g
Mounting position	Horizontal or vertical
Cooling	The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

No effects of multiple overloads

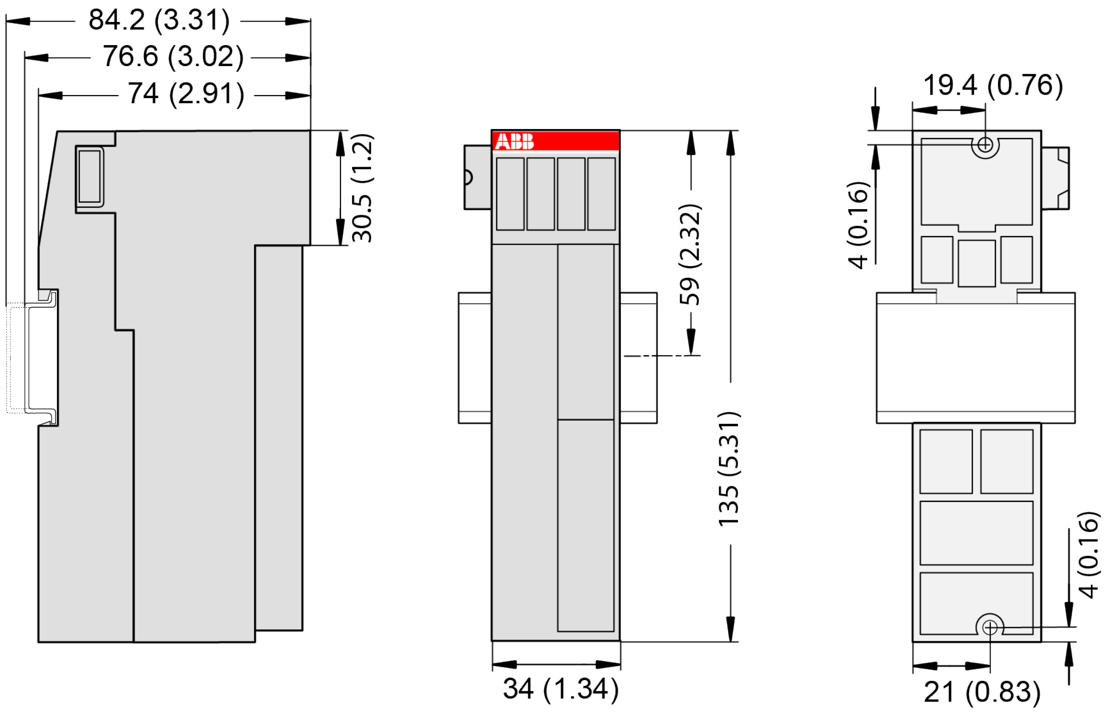
No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an external fuse.

Technical data of the digital outputs

Parameter		Value
Number of channels per module		8 triac outputs
Distribution of the channels into groups		8 groups (1 channel per group)
Connection of the channels O0 to O7		Terminals 1, 3, 5, 7, 10, 12, 14, 16
Reference potential for the channels O0 to O7		Terminals 2, 4, 6, 8, 11, 13, 15, 17
Output voltage for signal 1		On Request
Max. leakage current with signal 0		1.1 mA root mean square at 132 V AC and 1.8 mA root mean square at 264 V AC
Output voltage		
	Rated value	120 V AC or 240 V AC

Parameter		Value
Indication of the output signals		1 yellow LED per channel; the LED is on when the output signal is high (signal 1) and the module is powered via the I/O bus
Way of operation		Non-latching type
Output delay		On Request
Output data length		1 byte
Output current		
	Rated current per channel (max.)	0.3 A
	Rated current per group (max.)	0.3 A
Surge current (max.)		On request
Lamp load (max.)		On request
Spark suppression with inductive AC loads		Must be performed externally according to driven load specification
Switching Frequencies		
	With resistive loads	Max. 10 Hz
	With inductive loads	Not applicable
	With lamp loads	Max. 10 Hz
Output type		Non-protected
Protection type		External fuse on each channel
Rated protection fuse		2 A fast
Short-circuit-proof / Overload-proof		No, should be provided by an external fuse or circuit breaker
	Overload message	No
	Output current limitation	No
Resistance to feedback against 230 V AC		No
Connection of 2 outputs in parallel		Not applicable
Max. cable length		
	Shielded	500 m
	Unshielded	150 m

Dimensions



The dimensions are in mm and in brackets in inch.

Ordering data

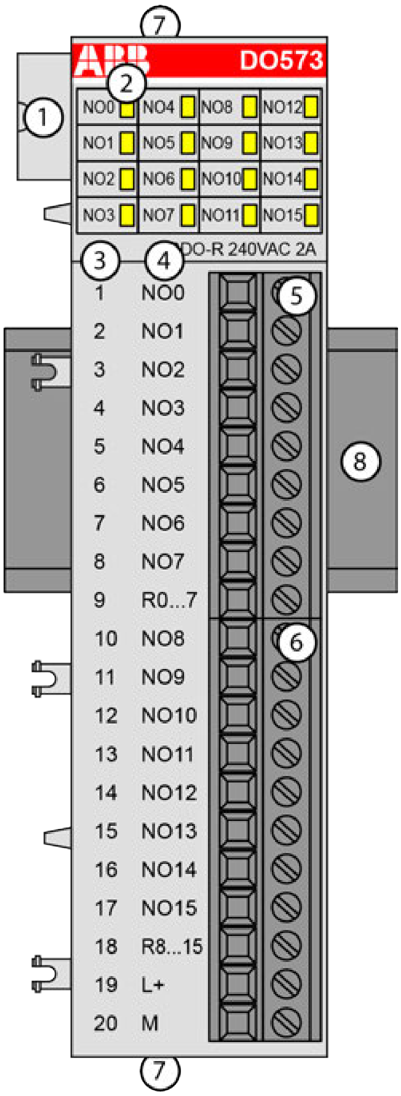
Part no.	Description	Product life cycle phase *)
1TNE 968 902 R2203	DO572, digital output module, 8 DO, triac output	Active
1TNE 968 901 R3101	Terminal block TA563-9, 9 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3102	Terminal block TA563-11, 11 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3103	Terminal block TA564-9, 9 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3104	Terminal block TA564-11, 11 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3105	Terminal block TA565-9, 9 pins, spring front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3106	Terminal block TA565-11, 11 pins, spring front, cable front, 6 pieces per unit	Active

> **) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

1.6.1.1.10 DO573 - Digital output module

Features

- 16 digital normally open relay outputs 24 V DC or 100 V AC ... 240 V AC (NO0 ... NO15) in 2 groups, 2 A max.
- Group-wise galvanically isolated



1 I/O bus
2 16 yellow LEDs to display the signal states of the outputs O0 ... O15
3 Terminal number
4 Allocation of signal name
5 Terminal block for output signals (9-pin)
6 Terminal block for output signals (11-pin)
7 2 holes for wall-mounting with screws
8 DIN rail

Intended purpose

The device can be used as a decentralized I/O extension module for S500 communication interface modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs.

The outputs are group-wise galvanically isolated from each other.

All other circuitry of the module is galvanically isolated from the outputs.

> *The I/O module must not be used as a decentralized I/O module with CI590-CS31-HA communication interface modules.*

Functionality

Parameter	Value
LED displays	For signal states
Internal power supply	Via I/O bus
External power supply	Via the terminals L+ (process voltage 24 V DC) and M (0 V DC); the M terminal is connected to the M terminal of the CPU via the I/O bus

Connections

> *For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.*

The connection is carried out by using removable 9-pin and 11-pin terminal blocks. These terminal blocks differ in their connection system (spring terminals or screw terminals, cable mounting from the front or from the side). The terminal blocks are not included in the module's scope of delivery and must be ordered separately.

Chapter 1.9.2.1 “TA563-TA565 - Terminal blocks” on page 1352

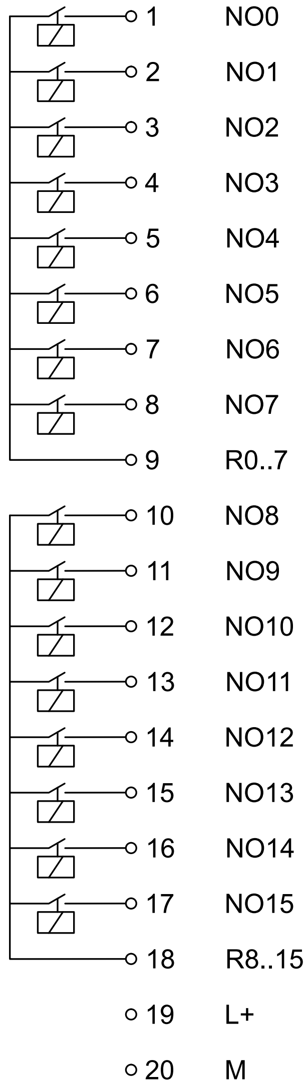


Fig. 108: Internal construction of the digital outputs

Table 150: Assignment of the terminals:

Terminal	Signal	Description
1	NO0	Normally-open contact of the output NO0
2	NO1	Normally-open contact of the output NO1
3	NO2	Normally-open contact of the output NO2
4	NO3	Normally-open contact of the output NO3
5	NO4	Normally-open contact of the output NO4
6	NO5	Normally-open contact of the output NO5
7	NO6	Normally-open contact of the output NO6
8	NO7	Normally-open contact of the output NO7
9	R0..7	Output common for signals NO0 to NO7
10	NO8	Normally-open contact of the output NO8
11	NO9	Normally-open contact of the output NO9
12	NO10	Normally-open contact of the output NO10
13	NO11	Normally-open contact of the output NO11

Terminal	Signal	Description
14	NO12	Normally-open contact of the output NO12
15	NO13	Normally-open contact of the output NO13
16	NO14	Normally-open contact of the output NO14
17	NO15	Normally-open contact of the output NO15
18	R8 ... 15	Output common for signals NO8 to NO15
19	L+	Process voltage L+ (24 V DC)
20	M	Process voltage M (0 V DC)

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a communication interface module or a CPU). Thus, the current consumption from 24 V DC power supply at the terminals L+/UP and M/ZP of the CPU/communication interface module increases by 5 mA per DO573.

The external power supply connection is carried out via the L+ (+24 V DC) and the M (0 V DC) terminals. The M terminal is electrically interconnected to the M/ZP terminal of the CPU/communication interface module.

WARNING!
Risk of death by electric shock!
Hazardous voltages can be present at the terminals of the module.

Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.

For screw-type terminals only:

WARNING!
For screw terminals only: Danger of death by electric shock!
The IP 20 protection degree is only provided if all terminal screws are tightened.

Tighten all screws of unused load terminals of relay outputs if voltages > 24 V are connected to the relay group.

WARNING!
Removal/Insertion under power
The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!

Risk of damaging the I/O module!

The outputs are not protected against short circuit and overload.

– Never short-circuit or overload the outputs.
– Never connect inductive loads without an external suppression against voltage peaks due to inductive kickback.
– Never connect voltages > 240 V. All outputs must be supplied from the same phase.
– Use an external 5 A fast protection fuse for the outputs.

NOTICE!

Risk of damaging the PLC modules!

The PLC modules can be damaged by overload.

Make sure that the total current of each output common terminal (R0..7 and R8..15) does not exceed 10 A.

Never connect total currents > 10 A per group.

If the group fuse protection is not sufficient, then individual fuse protection of the outputs should be used.

The following figure shows the connection of the module:

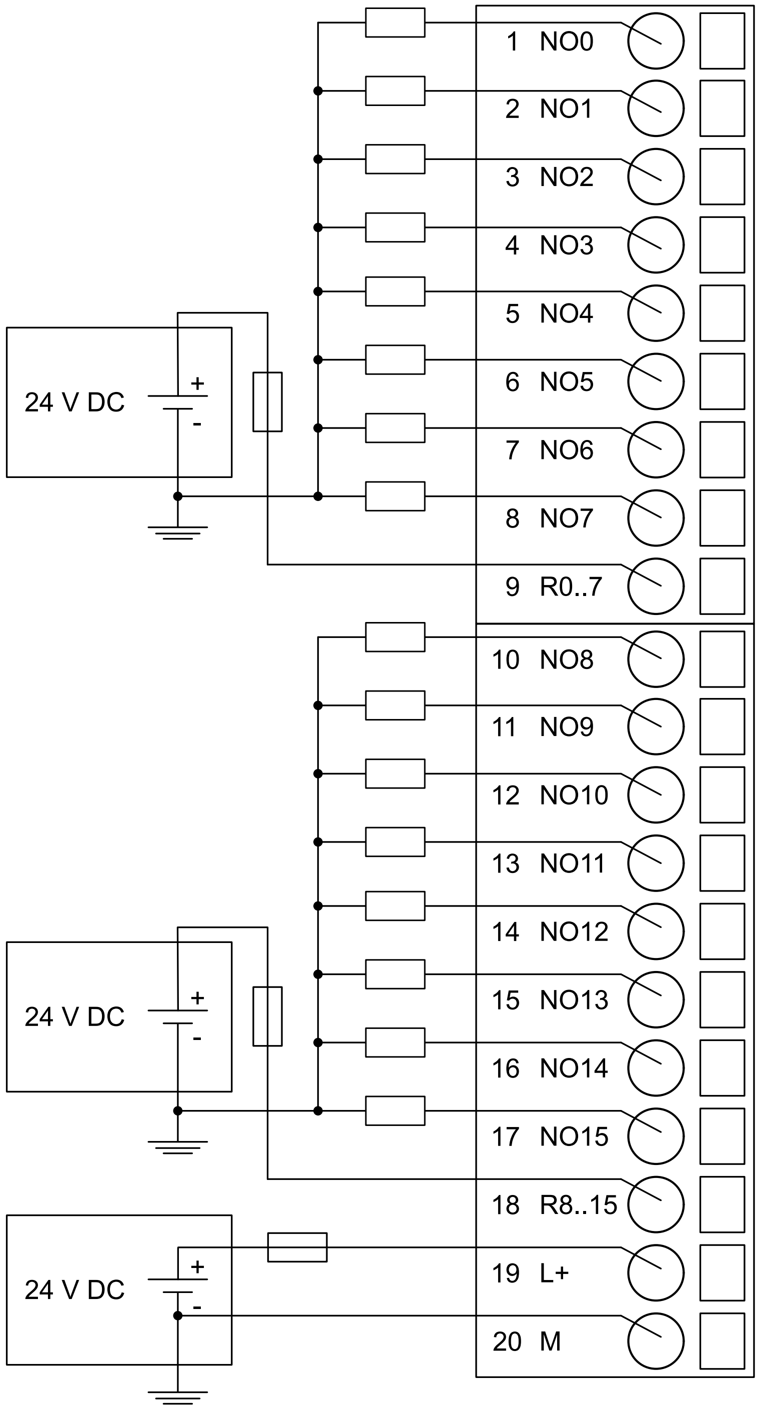


Fig. 109: Connection of 24 V DC actuators

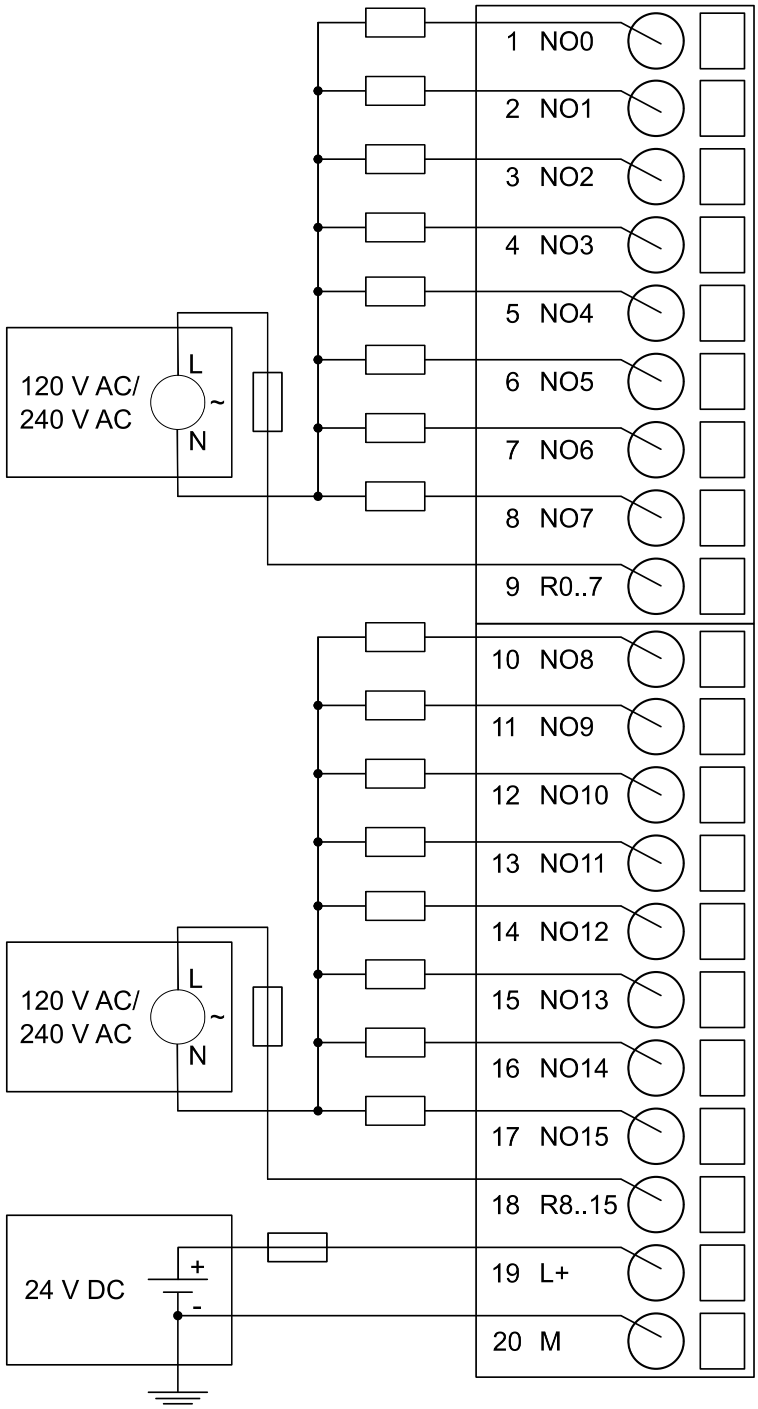


Fig. 110: Connection of 100-240 V AC actuators

The module provides several diagnosis functions.

The meaning of the LEDs is described in the section State LEDs *Chapter 1.6.1.1.9.8 “State LEDs” on page 395*.

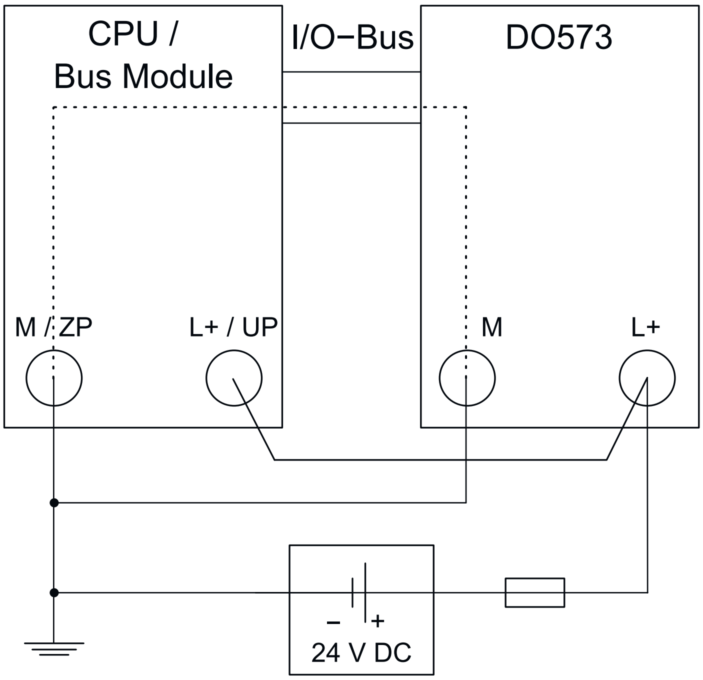


Fig. 111: Power supply - the negative connection is realized via the I/O bus

> *The L+ connection of the DO573 and the 24 V supply of the CPU/communication interface module must be connected to the same 24 V power supply .*

I/O configuration

The module itself does not store configuration data. It receives its parameterization data from the master device of the I/O bus (CPU or communication interface module) during power-up of the system.

Hence, replacing I/O modules is possible without any re-parameterization via software.

> *If the external power supply voltage via UP/ZP terminals fails, the I/O module loses its configuration data. The whole station has to be switched off and on again to re-configure the module.*

Parameterization

The arrangement of the parameter data is performed with Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Name	Value	Internal Value	Internal Value, Type	Default	Min.	Max.	EDS Slot Index
Module ID	Internal	6150 [1])	WORD	6150 0x1806	0	65535	xx01
Ignore module	No Yes	0 1	BYTE	No (0x00)			
Parameter length	Internal	1	BYTE	0	0	255	xx02 [2])
Check supply	Off On	0 1	BYTE	On 0x01			

[1]) with CS31 and addresses less than 70, the value is increased by 1

[2]) Value is hexadecimal: HighByte is slot (xx: 0 ... 7), LowByte is index (1 ... n)

GSD file:

Ext_User_Prm_Data_Len = Ext_User_Prm_Data_Const(0) =	0x07 0x18, 0x07, 0x00, 0x03, 0x01, 0x00, 0x00;

Diagnosis

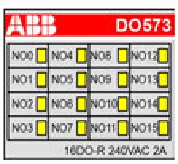
E1 ... E4	d1	d2	d3	d4	Identifier 000 ... 063	AC500-Display	<– Display in
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 6 Bit 6 ... 7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0 ... 5**	**PNIO diagnosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error-Identifier**	**Error message**	**Remedy**
	[1])	**[2])**	**[3])**	**[4])**			
				Module error			
3	14	1 ... 10	31	31	19	Checksum error in the I/O module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	43	Internal error in the module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	9	Overflow diagnosis buffer	Restart
	11 / 12	ADR	1 ... 10				
4	14	1 ... 10	31	31	26	Parameter error	Check master
	11 / 12	ADR	1 ... 10				

<table>
<tr><th>E1 ... E4</th><th>d1</th><th>d2</th><th>d3</th><th>d4</th><th>Identi-fier
000 ... 063</th><th>AC500-Display</th><th colspan="2" rowspan="3"><- Display in</th></tr>
<tr><th>Class</th><th>Comp</th><th>Dev</th><th>Mod</th><th>Ch</th><th>Err</th><th>PS501 PLC Browser</th></tr>
<tr><th>Byte 6
Bit 6 ... 7</th><th>-</th><th>Byte 3</th><th>Byte 4</th><th>Byte 5</th><th>Byte 6
Bit 0 ... 5</th><th>PNIO diag-nosis block</th></tr>
<tr><th>Class</th><th>Inter-face</th><th>Device</th><th>Module</th><th>Channel</th><th>Error-Identi-fier</th><th colspan="2">Error message</th><th>Remedy</th></tr>
<tr><td></td><td>1)</td><td>2)</td><td>3)</td><td>4)</td><td></td><td colspan="2"></td><td></td></tr>
<tr><td colspan="9">Module error</td></tr>
<tr><td rowspan="2">3</td><td>14</td><td>1 ... 10</td><td>31</td><td rowspan="2">31</td><td rowspan="2">11</td><td colspan="2" rowspan="2">Process voltage too low</td><td rowspan="2">Check process voltage</td></tr>
<tr><td>11 / 12</td><td>ADR</td><td>1 ... 10</td></tr>
</table>

Remarks:

1)	In AC500 the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31-Bus), 12 = COM2. The PNIO diagnosis block does not contain this identifier.
2)	With "Device" the following allocation applies: 31 = Module itself, 1 ... 10 = decentralized communication interface module 1 ... 10, ADR = Hardware address (e. g. of the DC551-CS31)
3)	With "Module" the following allocation applies depending on the master: Module error: I/O bus or PNIO: 31 = module itself; COM1/COM2: 1 ... 10 = expan-sion 1 ... 10 Channel error: I/O bus or PNIO = module type (2 = DO); COM1/COM2: 1 ... 10 = expansion 1 ... 10
4)	In case of module errors, with channel "31 = Module itself" is output.

State LEDs

<table>
<tr><th colspan="2">LED</th><th>State</th><th>Color</th><th>LED = OFF</th><th>LED = ON</th></tr>
<tr><td>
</td><td>Outputs NO0 ... NO15</td><td>Digital output</td><td>Yellow</td><td>Output is OFF</td><td>Output is ON
(the output voltage is only displayed if the supply voltage of the module is ON)</td></tr>
</table>

Technical data

Technical data of the module

The system data of AC500-eCo apply.

↳ *Chapter 2.5.1 “System data AC500-eCo” on page 1379*

Only additional details are therefore documented below.

Parameter		**Value**
Process supply voltage L+		
	Connections	Terminals 19 for L+ (+24 V DC) and 20 for M (0 V DC)
	Rated value	24 V DC
	Current consumption via L+	50 mA
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	Rated protection fuse for L+	Recommended; the outputs must be protected by an 5 A fast-acting fuse
Current consumption from 24 V DC power supply at the L+/UP and M/ZP terminals of the CPU/communication interface module		Ca. 5 mA
Galvanic isolation		Yes, between the output groups and the rest of the module
Isolated groups		2 (8 channels per group)
Surge-voltage (max.)		35 V DC for 0.5 s
Max. power dissipation within the module		2.0 W
Weight		Ca. 160 g
Mounting position		Horizontal or vertical
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

No effects of multiple overloads

No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an external fuse.

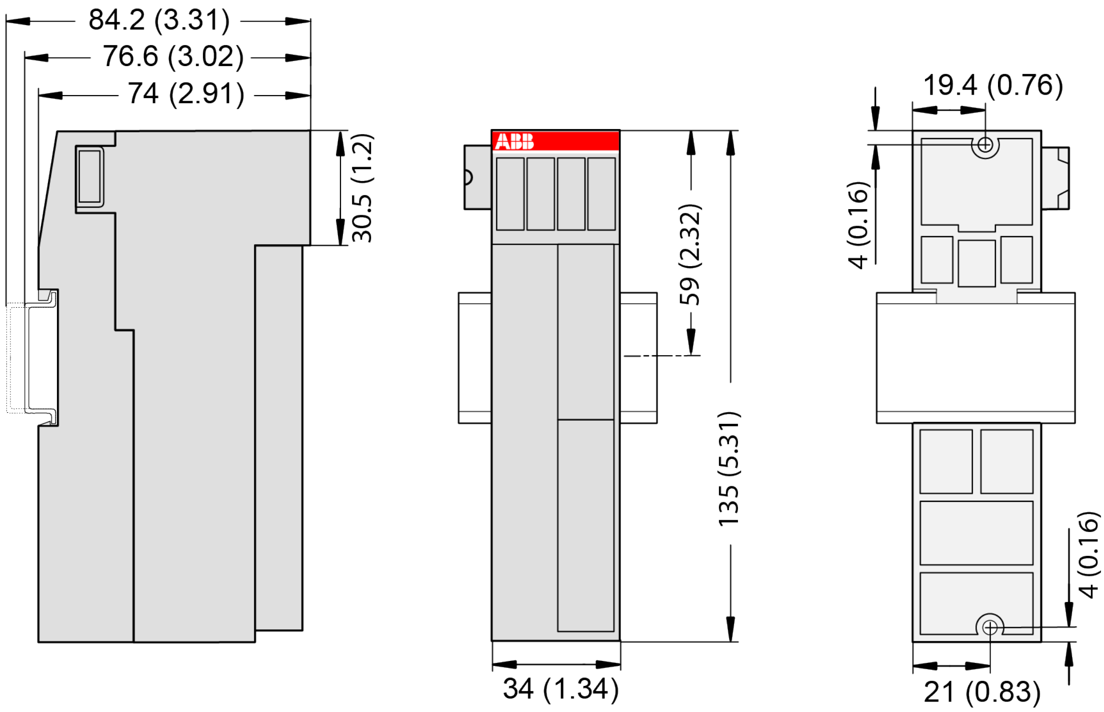
Technical data of the digital outputs

Parameter	**Value**
Number of channels per module	16 normally-open relay outputs
Distribution of the channels into groups	2 (8 channels per group)
Connection of the channels NO0 ... NO7	Terminals 1 ... 8
Connection of the channels NO8 ... NO15	Terminals 10 ... 17
Reference potential for the channels NO0 ... NO7	Terminal 9 (signal name R0 ... 7)
Reference potential for the channels NO8 ... NO15	Terminal 18 (signal name R8 ... 15)
Relay coil power supply	Terminals 19 and 20 (signal names L+ and M)
Indication of the output signals	1 yellow LED per channel; the LED is on when the output signal is high (signal 1) and the module is powered via the I/O bus

Parameter		Value
Way of operation		Non-latching type
Relay output voltage		
	Rated value	24 V DC or 120/240 V AC
Output delay		
	Switching 0 to 1 (max.)	Typ. 10 ms
	Switching 1 to 0 (max.)	Typ. 10 ms
Output data length		2 bytes
Output current		
	Rated current per channel (max.)	2.0 A (24 V DC / 24 V AC / 48 V AC / 120 V AC / 240 V AC, only resistive loads) 2.0 A (24 V AC / 48 V AC / 120 V AC, only pilot duty) 1.5 A (240 V AC, only pilot duty)
	Rated current per group (max.)	10 A
Lamp load (max.)		200 W (230 V AC), 30 W (24 V DC)
Spark suppression with inductive AC loads		Must be performed externally according to driven load specification
Switching Frequencies		
	With resistive loads	Max. 1 Hz
	With inductive loads	On Request
	With lamp loads	Max. 1 Hz
Output type		Non-protected
Protection type		External fuse [1])
Rated protection fuse		5 A fast
Short-circuit-proof / Overload-proof		No, should be provided by an external fuse or circuit breaker
	Overload message	No
	Output current limitation	No
Connection of 2 outputs in parallel		Not possible
Lifetime of relay contacts (cycles)		100.000 at rated load
Max. cable length		
	Shielded	500 m
	Unshielded	150 m

[1]) Per group in case of group fuse protection. For each channel in case of channel-by-channel fuse protection. The maximum current per group must not be exceeded.

Dimensions



The dimensions are in mm and in brackets in inch.

Ordering data

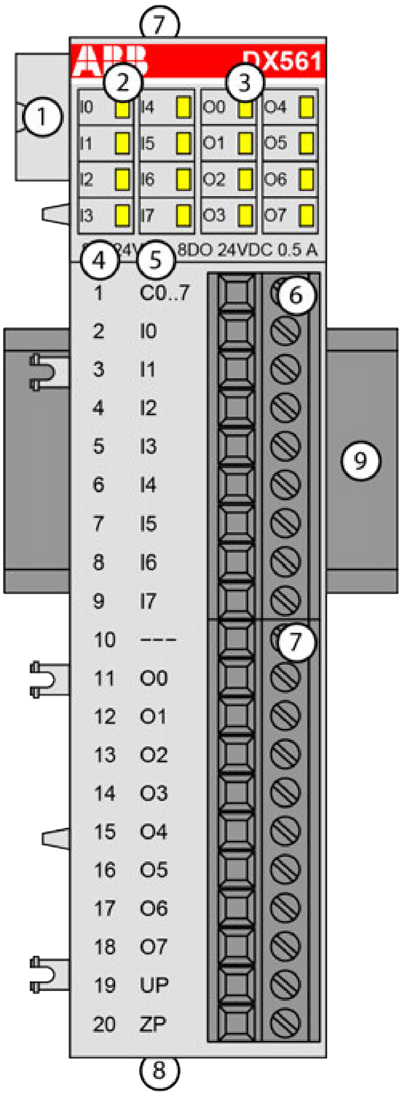
Part no.	Description	Product life cycle phase *)
1SAP 231 300 R0000	DO573, digital output module, 16 DO, relay output	Active
1TNE 968 901 R3101	Terminal block TA563-9, 9 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3102	Terminal block TA563-11, 11 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3103	Terminal block TA564-9, 9 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3104	Terminal block TA564-11, 11 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3105	Terminal block TA565-9, 9 pins, spring front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3106	Terminal block TA565-11, 11 pins, spring front, cable front, 6 pieces per unit	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

1.6.1.1.11 DX561 - Digital input/output module

Features

- 8 digital inputs 24 V DC (I0 ... I7) in 1 group
- 8 digital transistor outputs 24 V DC (O0 ... O7) in 1 group
- Group-wise galvanically isolated



1 I/O bus
2 8 yellow LEDs to display the signal states of the inputs I0 ... I7
3 8 yellow LEDs to display the signal states of the outputs O0 ... O7
4 Terminal number
5 Allocation of signal name
6 Terminal block for input signals (9-pin)
7 Terminal block for output signals (11-pin)
8 2 holes for wall-mounting with screws
9 DIN rail

Intended purpose

The device can be used as a decentralized I/O extension module for S500 communication interface modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs.

The inputs and outputs are group-wise galvanically isolated from each other.

All other circuitry of the module is galvanically isolated from the inputs.

The I/O module must not be used as a decentralized I/O module with CI590-CS31-HA communication interface modules.

Functionality

Parameter	Value
LED displays	For signal states
Internal power supply	Via I/O bus
External power supply	Via the terminals ZP and UP (process voltage 24 V DC)

Connections

For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.

The connection is carried out by using removable 9-pin and 11-pin terminal blocks. These terminal blocks differ in their connection system (spring terminals or screw terminals, cable mounting from the front or from the side). The terminal blocks are not included in the module's scope of delivery and must be ordered separately.

Chapter 1.9.2.1 “TA563-TA565 - Terminal blocks” on page 1352

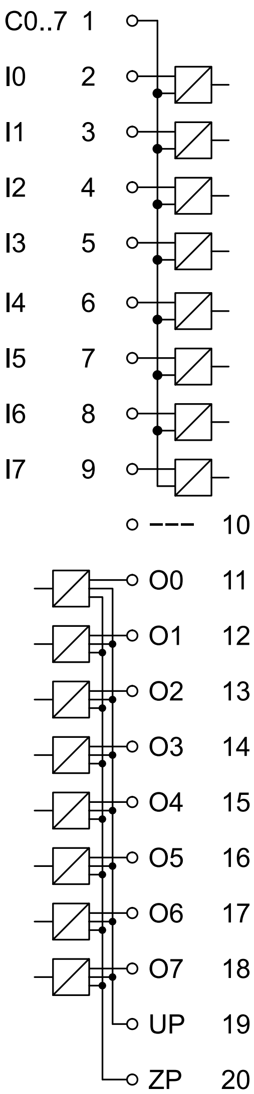


Fig. 112: Internal construction of the digital inputs and outputs

Table 151: Assignment of the terminals:

Terminal	Signal	Description
1	C0 ... 7	Input common for signals I0 ... I7
2	I0	Input signal I0
3	I1	Input signal I1
4	I2	Input signal I2
5	I3	Input signal I3
6	I4	Input signal I4
7	I5	Input signal I5
8	I6	Input signal I6
9	I7	Input signal I7
10	---	Reserved
11	O0	Output signal O0
12	O1	Output signal O1
13	O2	Output signal O2

Terminal	Signal	Description
14	O3	Output signal O3
15	O4	Output signal O4
16	O5	Output signal O5
17	O6	Output signal O6
18	O7	Output signal O7
19	UP	Process voltage UP +24 V DC
20	ZP	Process voltage ZP 0 V DC

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a communication interface module or a CPU). Thus, the current consumption from 24 V DC power supply at the terminals L+/UP and M/ZP of the CPU/communication interface module increases by 10 mA per DX561.

The external power supply connection is carried out via the UP (+24 V DC) and ZP (0 V DC) terminals.

WARNING!
Removal/Insertion under power
The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!
Risk of damaging the PLC modules!
Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

The digital inputs can be used as source inputs or as sink inputs.

NOTICE!
Risk of malfunctions in the plant!
A ground fault, e. g. caused by a damaged cable insulation, can bridge switches accidentally.

Use sink inputs when possible or make sure that, in case of error, there will be no risks to persons or plant.

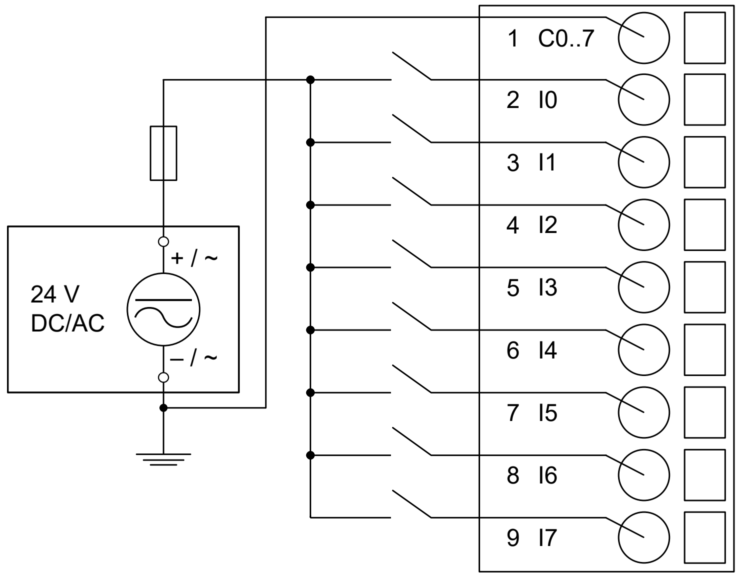


Fig. 113: Connection of inputs to the digital input/output module - sink inputs

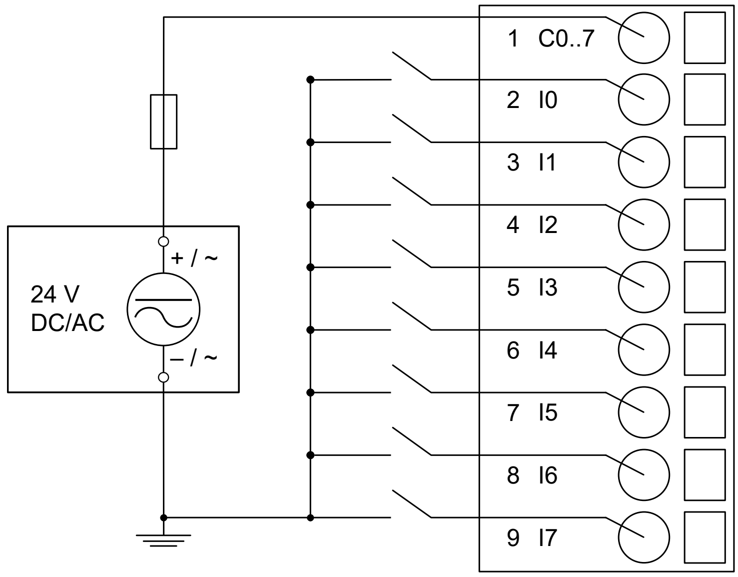


Fig. 114: Connection of inputs to the digital input/output module - source inputs

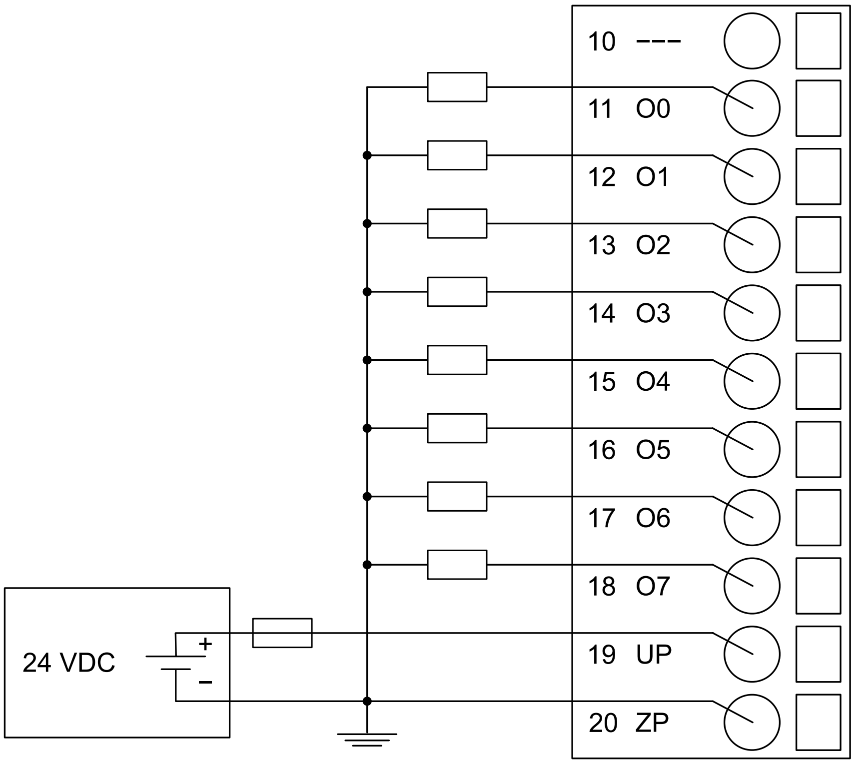


Fig. 115: Connection of the outputs to the module

> **NOTICE!**
> **Risk of malfunctions in the plant!**
> The outputs may switch on for a period of 10 to 50 µs if the process supply voltage UP/ZP is switched on.
>
> This must be considered in the planning of the application.

> **NOTICE!**
> **Risk of damaging the I/O module!**
> The outputs are not protected against short circuits and overload.
>
> – Never short-circuit or overload the outputs.
> – Never connect the outputs to other voltages.
> – Use an external 3 A fast-protection fuse for the outputs.

The module provides several diagnosis functions ➪ *Chapter 1.6.1.1.11.7 “Diagnosis” on page 418*.

The meaning of the LEDs is described in the Displays section ➪ *Chapter 1.6.1.1.11.8 “State LEDs” on page 419* chapter.

I/O configuration

The module itself does not store configuration data. It receives its parameterization data from the master device of the I/O bus (CPU or communication interface module) during power-up of the system.

Hence, replacing I/O modules is possible without any re-parameterization via software.

If the external power supply voltage via UP/ZP terminals fails, the I/O module loses its configuration data. The whole station has to be switched off and on again to re-configure the module.

Parameterization

The arrangement of the parameter data is performed with Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Name	Value	Internal Value	Internal Value, Type	Default	Min.	Max.	EDS Slot Index
Module ID	Internal	6135 [1])	WORD	6135 0x17F7	0	65535	xx01
Ignore module	No Yes	0 1	BYTE	No (0x00)			
Parameter length	Internal	1	BYTE	0	0	255	xx02 [2])

[1]) with CS31 and addresses smaller than 70, the value is increased by 1

[2]) Value is hexadecimal: HighByte is slot (xx: 0 ... 7), LowByte is index (1 ... n)

GSD file:

Ext_User_Prm_Data_Len =	0x03
Ext_User_Prm_Data_Const(0) =	0xF8, 0x17, 0x00,\
(0) =	0x01;

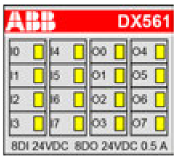
Diagnosis

E1 ... E4	d1	d2	d3	d4	Identifier 000 ... 063	AC500-Display	<− Display in	
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**		
Byte 6 Bit 6 ... 7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0 ... 5**	**PNIO diagnosis block**		
Class	**Interface**	**Device**	**Module**	**Channel**	**Error Identifier**	**Error message**		**Remedy**
	[1])	[2])	[3])	[4])				
Module error								
3	14	1 ... 10	31	31	19	Checksum error in the I/O module		Replace I/O module
	11 / 12	ADR	1 ... 10					
3	14	1 ... 10	31	31	43	Internal error in the module		Replace I/O module
	11 / 12	ADR	1 ... 10					
3	14	1 ... 10	31	31	9	Overflow diagnosis buffer		Restart
	11 / 12	ADR	1 ... 10					
4	14	1 ... 10	31	31	26	Parameter error		Check master
	11 / 12	ADR	1 ... 10					

Remarks:

[1])	In AC500 the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The PNIO diagnosis block does not contain this identifier.
[2])	With "Device" the following allocation applies: 31 = module itself, 1 ... 10 = decentralized communication interface module 1 ... 10, ADR = hardware address (e. g. of the DC551-CS31)
[3])	With "Module" the following allocation applies depending on the master: Module error: I/O bus or PNIO: 31 = module itself; COM1/COM2: 1 ... 10 = expansion 1 ... 10 Channel error: I/O bus or PNIO = module type (2 = DO); COM1/COM2: 1 ... 10 = expansion 1 ... 10
[4])	In case of module errors, with channel "31 = module itself" is output.

State LEDs

LED		State	Color	LED = OFF	LED = ON
	Inputs I0 ... I7	Digital input	Yellow	Input is OFF	Input is ON
	Outputs O0 ... O7	Digital output	Yellow	Output is OFF	Output is ON

Technical data

Technical data of the module

The system data of AC500-eCo apply.

Chapter 2.5.1 “System data AC500-eCo” on page 1379

Only additional details are therefore documented below.

Parameter		Value
Process supply voltage UP		
	Connections	Terminal 19 for UP (+24 V DC) and terminal 20 for ZP (0 V DC)
	Rated value	24 V DC
	Current consumption via UP terminal	5 mA + max. 0.5 A per output
	Max. ripple	5 %
	Inrush current	0.000002 A^2s
	Protection against reversed voltage	Yes
	Rated protection fuse for UP	Recommended; the outputs must be protected by an 3 A fast-acting fuse
Current consumption from 24 V DC power supply at the L+/UP and M/ZP terminals of the CPU/communication interface module		Ca. 10 mA
Galvanic isolation		Yes, between the input group and the output group and the rest of the module
Isolated groups		2 groups (1 group for 8 input channels, 1 group for 8 output channels)
Surge-voltage (max.)		35 V DC for 0.5 s
Max. power dissipation within the module		2.3 W
Weight		ca. 120 g
Mounting position		Horizontal or vertical
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

No effects of multiple overloads

No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an external fuse.

Technical data of the digital inputs

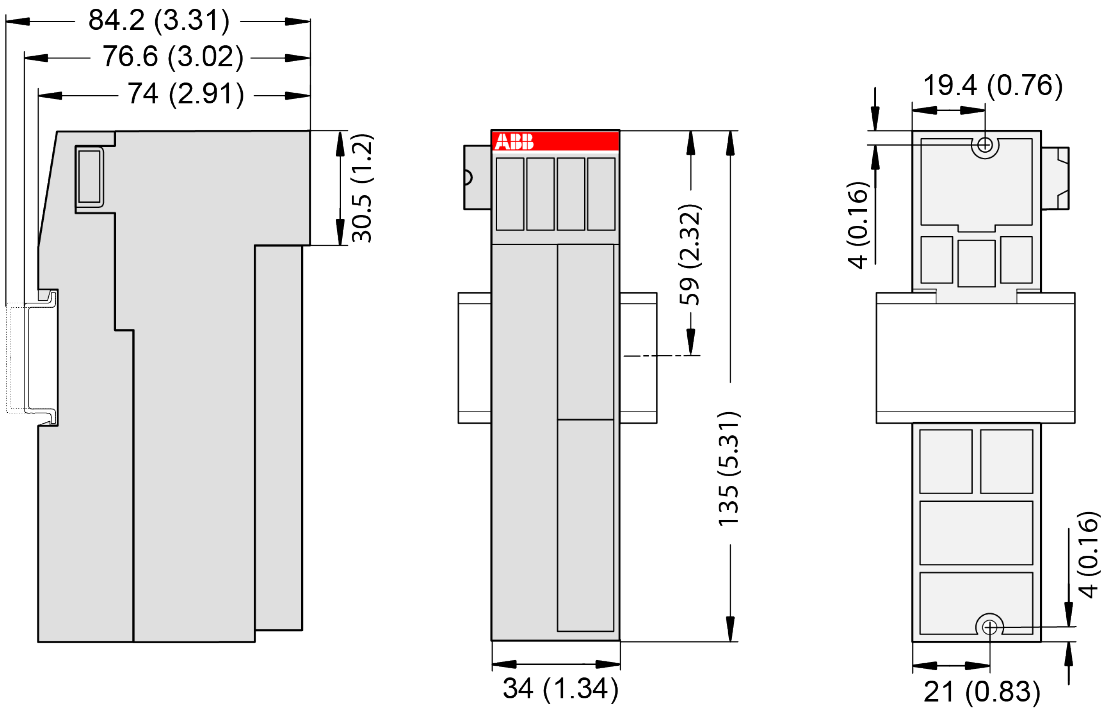
Parameter	Value	
Number of channels per module	8	
Distribution of the channels into groups	1 group for 8 channels	
Connections of the channels I0 ... I7	Terminals 2 ... 9	
Reference potential for the channels I0 ... I7	Terminal 1	
Indication of the input signals	1 yellow LED per channel; the LED is ON when the input signal is high (signal 1)	
Monitoring point of input indicator	LED is part of the input circuitry	
Input type according to EN 61131-2	Type 1 source	Type 1 sink
Input signal range	-24 V DC	+24 V DC
Signal 0	-5 V ... +3 V	-3 V ... +5 V
Undefined signal	-15 V ... + 5 V	+5 V ... +15 V
Signal 1	-30 V ... -15 V	+15 V ... +30 V
Ripple with signal 0	-5 V ... +3 V	-3 V ... +5 V
Ripple with signal 1	-30 V ... -15 V	+15 V ... +30 V
Input current per channel		
Input voltage +24 V	Typ. 5 mA	
Input voltage +5 V	Typ. 1 mA	
Input voltage +15 V	> 2.5 mA	
Input voltage +30 V	< 8 mA	
Max. permissible leakage current (at 2-wire proximity switches)	1 mA	
Input delay (0->1 or 1->0)	Typ. 8 ms	
Input data length	1 byte	
Max. cable length		
Shielded	500 m	
Unshielded	300 m	

Technical data of the digital outputs

Parameter	Value
Number of channels per module	8 transistor outputs (24 V DC, 0.5 A max.)
Distribution of the channels into groups	1 group of 8 channels
Connection of the channels O0 ... O7	Terminals 11 ... 18
Reference potential for the channels O0 ... O7	Terminal 20 (negative pole of the process voltage, name ZP)
Common power supply voltage	Terminal 19 (positive pole of the process voltage, name UP)
Indication of the output signals	1 yellow LED per channel; the LED is on when the output signal is high (signal 1) and the module is powered via the I/O bus
Monitoring point of output indicator	Controlled together with transistor

Parameter		Value
Way of operation		Non-latching type
Max. output voltage at signal 1		20 V DC at max. current consumption
Output delay		
	0 to 1	50 µs
	1 to 0	200 µs
Output data length		1 byte
Output current		
	Rated current per channel (max.)	0.5 A at UP 24 V DC
	Rated current per group (max.)	4 A
	Rated current (all channels together, max.)	4 A
	Lamp load (max.)	5 W
	Max. leakage current with signal 0	0.5 mA
Output type		Non-protected
Protection type		External fuse on each channel
Rated protection fuse (for each channel)		3 A fast
Demagnetization when inductive loads are switched off		Must be performed externally according to driven load specification
Switching Frequencies		
	With inductive loads	Max. 0.5 Hz
	With lamp loads	Max. 11 Hz at max. 5 W
Short-circuit-proof / Overload-proof		No
	Overload message	No
	Output current limitation	No
	Resistance to feedback against 24 V DC	No
Connection of 2 outputs in parallel		Not possible
Max. cable length		
	Shielded	500 m
	Unshielded	150 m

Dimensions



The dimensions are in mm and in brackets in inch.

Ordering data

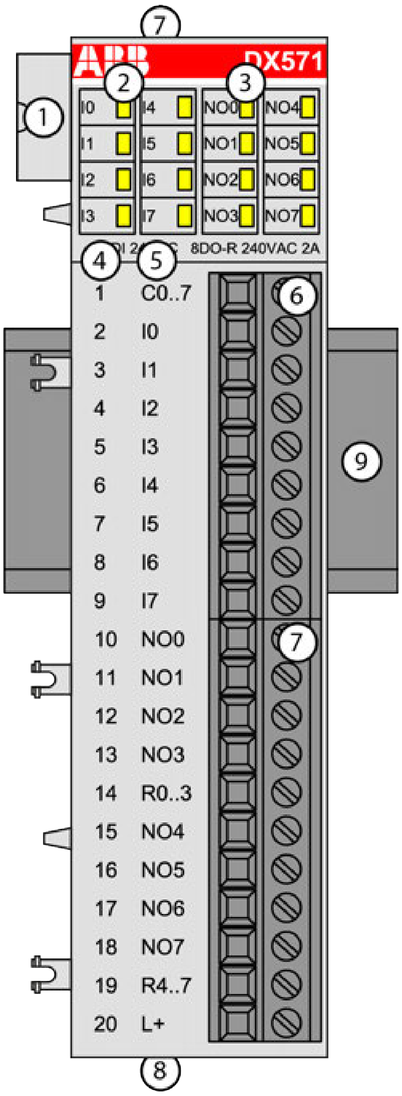
Part no.	Description	Product life cycle phase *)
1TNE 968 902 R2301	DX561, digital input/output module, 8 DI 24 V DC, 8 DO 24 V DC, transistor output	Active
1TNE 968 901 R3101	Terminal block TA563-9, 9 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3102	Terminal block TA563-11, 11 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3103	Terminal block TA564-9, 9 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3104	Terminal block TA564-11, 11 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3105	Terminal block TA565-9, 9 pins, spring front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3106	Terminal block TA565-11, 11 pins, spring front, cable front, 6 pieces per unit	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

1.6.1.1.12 DX571 - Digital input/output module

Features

- 8 digital inputs 24 V DC / 24 V AC (I0 ... I7) in 1 group
- 8 digital normally open relay outputs 24 V DC / 24 V AC or 100 V AC ... 240 V AC, 2 A max. (NO0 ... NO7) in 2 groups
- Group-wise galvanically isolated



1 I/O bus
2 8 yellow LEDs to display the signal states of the inputs I0 ... I7
3 8 yellow LEDs to display the signal states of the outputs NO0 ... NO7
4 Terminal number
5 Allocation of signal name
6 Terminal block for input signals (9-pin)

7 Terminal block for output signals (11-pin)
8 2 holes for wall-mounting with screws
9 DIN rail

Intended purpose

The device can be used as a decentralized I/O extension module for S500 communication interface modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs.

The inputs and outputs are group-wise galvanically isolated from each other.

All other circuitry of the module is galvanically isolated from the inputs.

> *The I/O module must not be used as a decentralized I/O module with CI590-CS31-HA communication interface modules.*

Functionality

Parameter	Value
LED displays	For signal states
Internal power supply	Via I/O bus
External power supply	Via the terminal L+ (process voltage 24 V DC). The negative pole is provided by the I/O bus.

Connections

> *For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.*

The connection is carried out by using removable 9-pin and 11-pin terminal blocks. These terminal blocks differ in their connection system (spring terminals or screw terminals, cable mounting from the front or from the side). The terminal blocks are not included in the module's scope of delivery and must be ordered separately.

Chapter 1.9.2.1 “TA563-TA565 - Terminal blocks” on page 1352

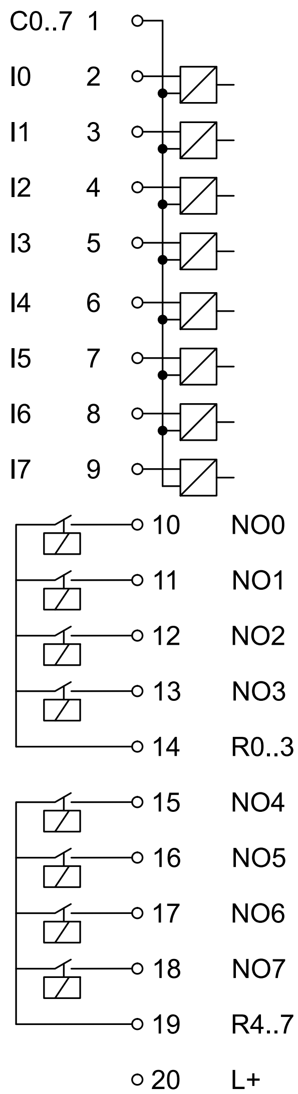


Fig. 116: Internal construction of the digital inputs and outputs

Table 152: Assignment of the terminals:

Terminal	Signal	Description
1	C0 ... 7	Input common for signals I0 ... I7
2	I0	Input signal I0
3	I1	Input signal I1
4	I2	Input signal I2
5	I3	Input signal I3
6	I4	Input signal I4
7	I5	Input signal I5
8	I6	Input signal I6
9	I7	Input signal I7
10	NO0	Normally-open contact of the output 0
11	NO1	Normally-open contact of the output 1

Terminal	Signal	Description
12	NO2	Normally-open contact of the output 2
13	NO3	Normally-open contact of the output 3
14	R0 ... 3	Output common for signals O0 ... O3
15	NO4	Normally-open contact of the output 4
16	NO5	Normally-open contact of the output 5
17	NO6	Normally-open contact of the output 6
18	NO7	Normally-open contact of the output 7
19	R4 ... 7	Output common for signals O4 ... O7
20	L+	Process voltage +24 V DC

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a communication interface module or a CPU). Thus, the current consumption from 24 V DC power supply at the terminals L+/UP and M/ZP of the CPU/communication interface module increases by 5 mA per DX571.

The external power supply connection is carried out via the L+ (+24 V DC) terminal. The negative pole of the external power supply is realized via the I/O bus. Therefore, the CPU/communication interface module and the DX571 must have a common power supply.

WARNING!

Removal/Insertion under power

The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!
Risk of damaging the PLC modules!
Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

NOTICE!
Risk of damaging the PLC modules!
The PLC modules can be damaged by overload.

Make sure that the total current of each output common terminal (R0 ... 3 and R4 ... 7) does not exceed 8 A.

Never connect total currents > 8 A per group.

If the group fuse protection is not sufficient, then individual fuse protection of the outputs should be used.

The module provides several diagnosis functions (see Diagnosis *Chapter 1.6.1.1.12.7 “Diagnosis” on page 431*).

The digital inputs can be used as source inputs or as sink inputs.

NOTICE!
Risk of malfunctions in the plant!
A ground fault, e. g. caused by a damaged cable insulation, can bridge switches accidentally.

Use sink inputs when possible or make sure that, in case of error, there will be no risks to persons or plant.

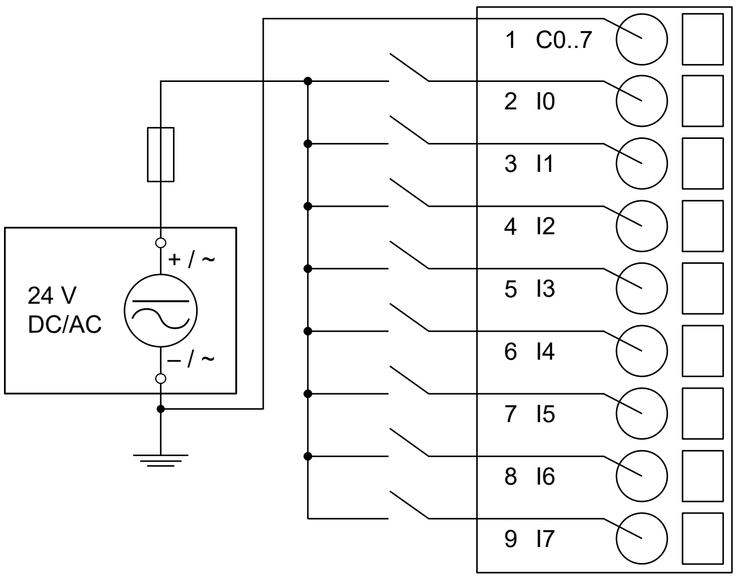


Fig. 117: Connection of inputs to the digital input/output module DX571 - sink inputs

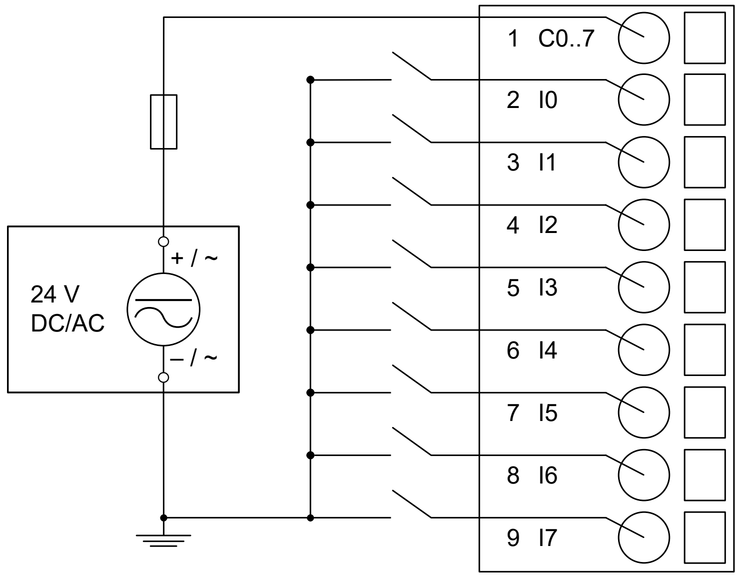


Fig. 118: Connection of inputs to the digital input/output module DX571 - source inputs

The following figures show the connection of the outputs to the module:

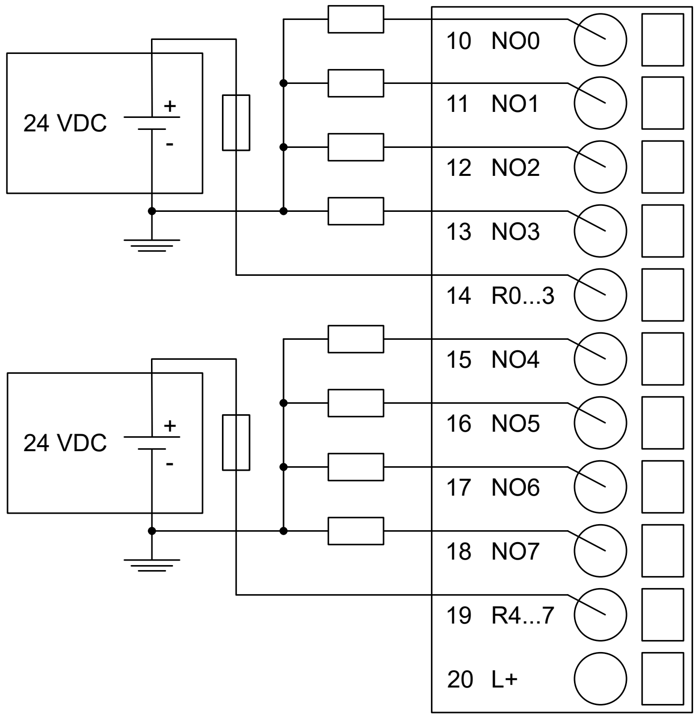


Fig. 119: Connection of 24 V DC actuators

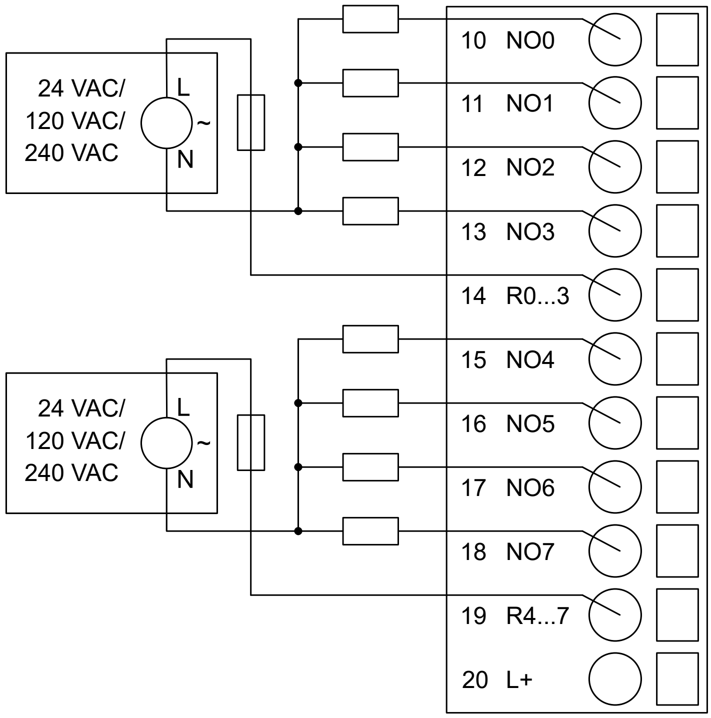


Fig. 120: Connection of 24 V AC or 100 ... 240 V AC actuators

> *The L+ connection of the DX571 and the 24 V supply of the CPU/communication interface module must be connected to the same 24 V power supply.*

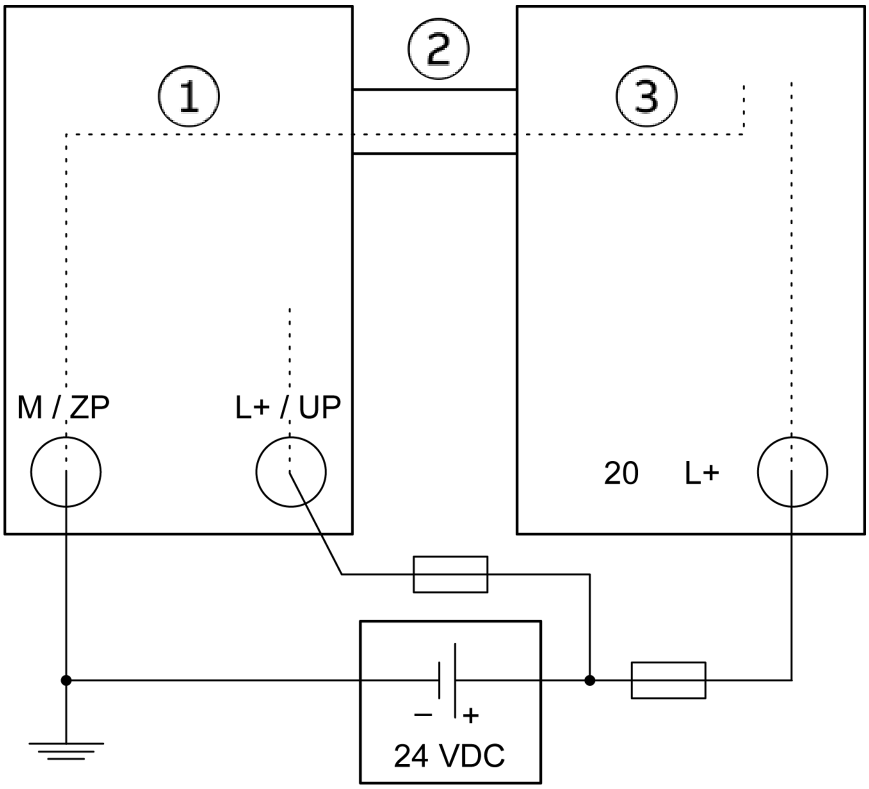


Fig. 121: Power supply - the minus connection is realized via the I/O bus

1 CPU or communication interface module
2 I/O bus
3 DX571

WARNING!
Risk of death by electric shock!
Hazardous voltages can be present at the terminals of the module.

Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.

For screw-type terminals only:

WARNING!
For screw terminals only: Danger of death by electric shock!
The IP 20 protection degree is only provided if all terminal screws are tightened.

Tighten all screws of unused load terminals of relay outputs if voltages > 24 V are connected to the relay group.

NOTICE!
Risk of damaging the I/O module!
The outputs are not protected against short circuit and overload.

– Never short-circuit or overload the outputs.
– Never connect inductive loads without an external suppression against voltage peaks due to inductive kickback.
– Never connect voltages > 240 V. All outputs must be supplied from the same phase.
– Use an external 5 A fast protection fuse for the outputs.

The meaning of the LEDs is described in the Displays section *Chapter 1.6.1.1.12.8 “State LEDs” on page 432*.

I/O configuration

The module itself does not store configuration data. It receives its parameterization data from the master device of the I/O bus (CPU or communication interface module) during power-up of the system.

Hence, replacing I/O modules is possible without any re-parameterization via software.

If the external power supply voltage via UP/ZP terminals fails, the I/O module loses its configuration data. The whole station has to be switched off and on again to re-configure the module.

Parameterization

The arrangement of the parameter data is performed with Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Name	Value	Internal Value	Internal Value, Type	Default	Min.	Max.	EDS Slot Index
Module ID	Internal	6140 1)	WORD	6140 0x17FC	0	65535	xx01
Ignore module	No Yes	0 1	BYTE	No (0x00)			
Parameter length	Internal	1	BYTE	0	0	255	xx02 2)
Check supply	Off On	0 1	BYTE	On 0x01			
1) with CS31 and addresses smaller than 70, the value is increased by 1							
2) Value is hexadecimal: HighByte is slot (xx: 0 ... 7), LowByte is index (1...n)							

GSD file:

Ext_User_Prm_Data_Len =	0x04
Ext_User_Prm_Data_Const(0) =	0xFD, 0x17, 0x00,\
(0) =	0x01;

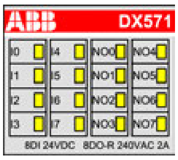
Diagnosis

E1 ... E4	d1	d2	d3	d4	Identifier 000 ... 063	AC500-Display	<– Display in
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 6 Bit 6 ... 7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0 ... 5**	**PNIO diagnosis block**	
Class	**Inter face**	**Device**	**Module**	**Channel**	**Error Identifier**	**Error message**	**Remedy**
	1)	**2)**	**3)**	**4)**			
Module error							
3	14	1 ... 10	31	31	19	Checksum error in the I/O module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	43	Internal error in the module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	9	Overflow diagnosis buffer	Restart
	11 / 12	ADR	1 ... 10				
4	14	1 ... 10	31	31	26	Parameter error	Check master
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	11	Process voltage too low	Check process voltage
	11 / 12	ADR	1 ... 10				

Remarks:

1)	In AC500 the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The PNIO diagnosis block does not contain this identifier.
2)	With "Device" the following allocation applies: 31 = Module itself, 1 ... 10 = decentralized communication interface module 1 ... 10, ADR = hardware address (e. g. of the DC551-CS31)
3)	With "Module" the following allocation applies depending on the master: Module error: I/O bus or PNIO: 31 = Module itself; COM1/COM2: 1 ... 10 = expansion 1 ... 10 Channel error: I/O bus or PNIO = Module type (2 = DO); COM1/COM2: 1 ... 10 = expansion 1 ... 10
4)	In case of module errors, with channel "31 = module itself" is output.

State LEDs

LED		State	Color	LED = OFF	LED = ON
	Inputs I0 ... I7	Digital input	Yellow	Input is OFF	Input is ON
	Outputs NO0 ... NO7	Digital output	Yellow	Output is OFF	Output is ON

In the undefined signal range, the state LED for the inputs can be ON although the input state detected by the module is OFF.

Technical data

Technical data of the module

The system data of AC500-eCo apply.

Chapter 2.5.1 “System data AC500-eCo” on page 1379

Only additional details are therefore documented below.

Parameter		Value
Process supply voltage L+		
	Connections	Terminal 20 for L+ (+24 V DC). The negative pole is provided by the I/O bus.
	Rated value	24 V DC
	Current consumption via L+	50 mA
	Inrush current (at power-up)	0.0035 A^2s

Parameter		Value
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	Rated protection fuse for L+	Recommended; the outputs must be protected by a 3 A fast-acting fuse
Current consumption from 24 V DC power supply at the L+/UP and M/ZP terminals of the CPU/communication interface module		Ca. 5 mA
Galvanic isolation		Yes, between the input group and the output group and the rest of the module
Isolated groups		3 groups (1 group for 8 input channels, 2 groups for 8 output channels)
Surge-voltage (max.)		35 V DC for 0.5 s
Max. power dissipation within the module		2.3 W
Weight		Ca. 150 g
Mounting position		Horizontal or vertical
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

No effects of multiple overloads

No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an external fuse.

Technical data of the digital inputs

Parameter		Value		
Number of channels per module		8		
Distribution of the channels into groups		1 group for 8 channels		
Connections of the channels I0 ... I7		Terminals 2 ... 9		
Reference potential for the channels I0 ... I7		Terminal 1		
Indication of the input signals		1 yellow LED per channel; the LED is ON when the input signal is high (signal 1)		
Monitoring point of input indicator		LED is part of the input circuitry		
Input type according to EN 61131-2		Type 1 source	Type 1 sink	Type 1 AC [1])
Input signal range		-24 V DC	+24 V DC	24 V AC 50/60 Hz
Signal 0		-5 V ... +3 V	-3 V ... +5 V	0 V AC ... 5 V AC
Undefined signal		-15 V ... + 5 V	+5 V ... +15 V	5 V AC ... 14 V AC
Signal 1		-30 V ... -15 V	+15 V ... +30 V	14 V AC ... 27 V AC
Input current per channel				
	Input voltage 24 V	Typ. 5 mA		Typ. 5 mA r.m.s.
	Input voltage 5 V	Typ. 1 mA		Typ. 1 mA r.m.s.
	Input voltage 14 V			Typ. 2.7 mA r.m.s.

Parameter		Value	
	Input voltage 15 V	> 2.5 mA	
	Input voltage 27 V		Typ. 5.5 mA r.m.s.
	Input voltage 30 V	< 8 mA	
Max. permissible leakage current (at 2-wire proximity switches)		1 mA	Typ. 1 mA r.m.s.
Input delay (0->1 or 1->0)		Typ. 8 ms	
Input data length		1 byte	
Max. cable length			
	Shielded	500 m	
	Unshielded	300 m	

[1]) When inputs are used with 24 V AC, external surge limiting filters are required.

Refer to 'System data AC500-eCo' for details ↳ *Chapter 2.5.1 “System data AC500-eCo” on page 1379*.

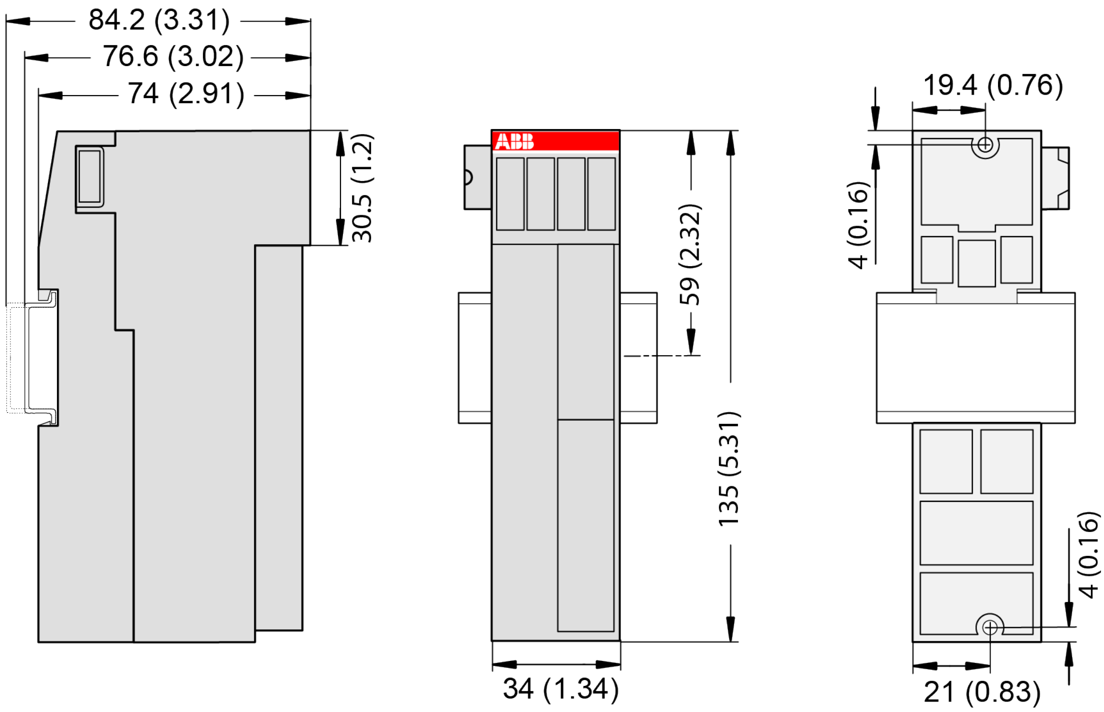
Technical data of the digital outputs

Parameter		Value
Number of channels per module		8 normally-open relay outputs
Distribution of the channels into groups		2 (4 channels per group)
Connection of the channels O0 ... O3		Terminals 10 ... 13
Connection of the channels O4 ... O7		Terminals 15 ... 18
Reference potential for the channels O0 ... O3		Terminal 14 (signal name R0 ... 3)
Reference potential for the channels O4 ... O7		Terminal 19 (signal name R4 ... 7)
Relay coil power supply		Terminal 20 (positive pole of the process supply voltage, signal name L+). The negative pole is provided by the I/O bus.
Indication of the output signals		1 yellow LED per channel; the LED is on when the output signal is high (signal 1) and the module is powered through the I/O bus
Monitoring point of output indicator		Controlled together with relay
Way of operation		Non-latching type
Relay output voltage		
	Rated value	24 V DC / 24 V AC or 120/240 V AC
Output delay		
	Switching 0 to 1 (max.)	Typ. 10 ms
	Switching 1 to 0 (max.)	Typ. 10 ms
Output data length		1 byte
Output current		

Parameter		Value
	Rated current per channel (max.)	2.0 A (24 V DC / 24 V AC / 48 V AC / 120 V AC / 240 V AC, only resistive loads) 2.0 A (24 V AC / 48 V AC / 120 V AC, only pilot duty) 1.5 A (240 V AC, only pilot duty)
	Rated current per group (max.)	8 A
Lamp load (max.)		200 W (230 V AC), 30 W (24 V DC)
Spark suppression with inductive AC loads		Must be performed externally according to driven load specification
Switching Frequencies		
	With resistive loads	Max. 1 Hz
	With inductive loads	On Request
	With lamp loads	Max. 1 Hz
Output type		Non-protected
Protection type		External fuse [1])
Rated protection fuse		5 A fast
Short-circuit-proof / Overload-proof		No, should be provided by an external fuse or circuit breaker
	Overload message	No
	Output current limitation	No
Connection of 2 outputs in parallel		Not possible
Lifetime of relay contacts (cycles)		100.000 at rated load
Max. cable length		
	Shielded	500 m
	Unshielded	150 m

[1]) Per group in case of group fuse protection. For each channel in case of channel-by-channel fuse protection. The maximum current per group must not be exceeded.

Dimensions



The dimensions are in mm and in brackets in inch.

Ordering data

Part no.	Description	Product life cycle phase *)
1TNE 968 902 R2302	DX571, digital input/output module, 8 DI 24 V DC / 24 V AC, 8 DO, relay output	Active
1TNE 968 901 R3101	Terminal block TA563-9, 9 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3102	Terminal block TA563-11, 11 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3103	Terminal block TA564-9, 9 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3104	Terminal block TA564-11, 11 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3105	Terminal block TA565-9, 9 pins, spring front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3106	Terminal block TA565-11, 11 pins, spring front, cable front, 6 pieces per unit	Active

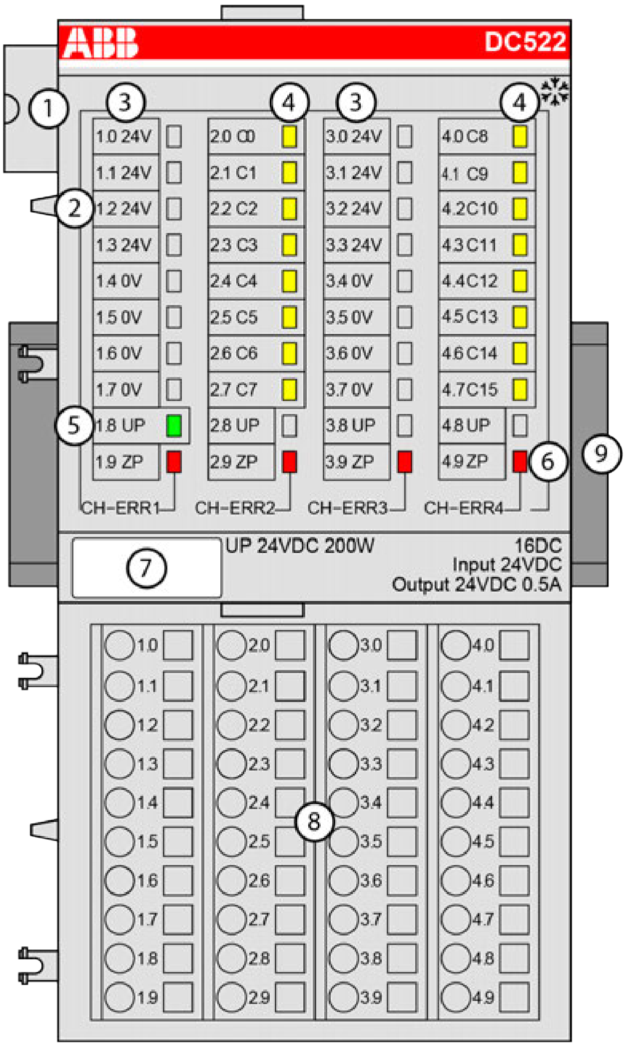
> **) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

1.6.1.2 S500

1.6.1.2.1 DC522 - Digital input/output module

Features

- 16 configurable digital inputs/outputs
- Module-wise galvanically isolated
- Fast counter
- XC version for use in extreme ambient conditions available



1 I/O bus
2 Allocation between terminal number and signal name
3 Sensor power supply 24 V DC / 0.5 A
4 16 yellow LEDs to display the signal states at the digital inputs/outputs (C0 ... C15)
5 1 green LED to display the state of the process supply voltage UP
6 4 red LEDs to display errors
7 Label

8 Terminal unit
9 DIN rail
❄ Sign for XC version

Intended purpose

The device can be used as a decentralized I/O extension module for S500 communication interface modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs.

Digital configurable input/output unit.

- 2 sensor supply voltages 24 V DC, 0.5 A, with short-circuit and overload protection
- 16 digital configurable inputs/outputs 24 V DC (C0 ... C15) in 1 group (2.0 ... 2.7 and 4.0 ... 4.7), each of which can be used
  – as an input,
  – as a transistor output with short-circuit and overload protection, 0.5 A rated current or
  – as a re-readable output (combined input/output) with the technical data of the digital inputs and outputs.
- Optional with fast counter

The configuration is performed by software. The modules are supplied with a process supply voltage of 24 V DC.

All available inputs/outputs are galvanically isolated from all other circuitry of the module. There is no potential separation between the channels within the same group.

For use in extreme ambient conditions (e.g. wider temperature and humidity range), a special XC version of the device is available.

Functionality

Parameter	Value
Fast counter	Integrated, many configurable operating modes (only with AC500)
LED displays	For signal states, errors and supply voltage
Internal power supply	Through the I/O bus interface (I/O bus)
External power supply	Via the terminals ZP and UP (process voltage 24 V DC)
Required terminal unit	TU515 or TU516 ⇨ *Chapter 1.5.3 “TU515, TU516, TU541 and TU542 for I/O modules” on page 282*
Effect of incorrect input terminal connection	Wrong or no signal detected, no damage up to 35 V

The device is plugged on a terminal unit ⇨ *Chapter 1.5.3 “TU515, TU516, TU541 and TU542 for I/O modules” on page 282*. Position the module properly and press until it locks in place. The terminal unit is either mounted on a DIN rail or to the wall using 2 screws plus the additional accessory for wall mounting ⇨ *Chapter 1.9.3.5 “TA526 - Wall mounting accessory” on page 1361*.

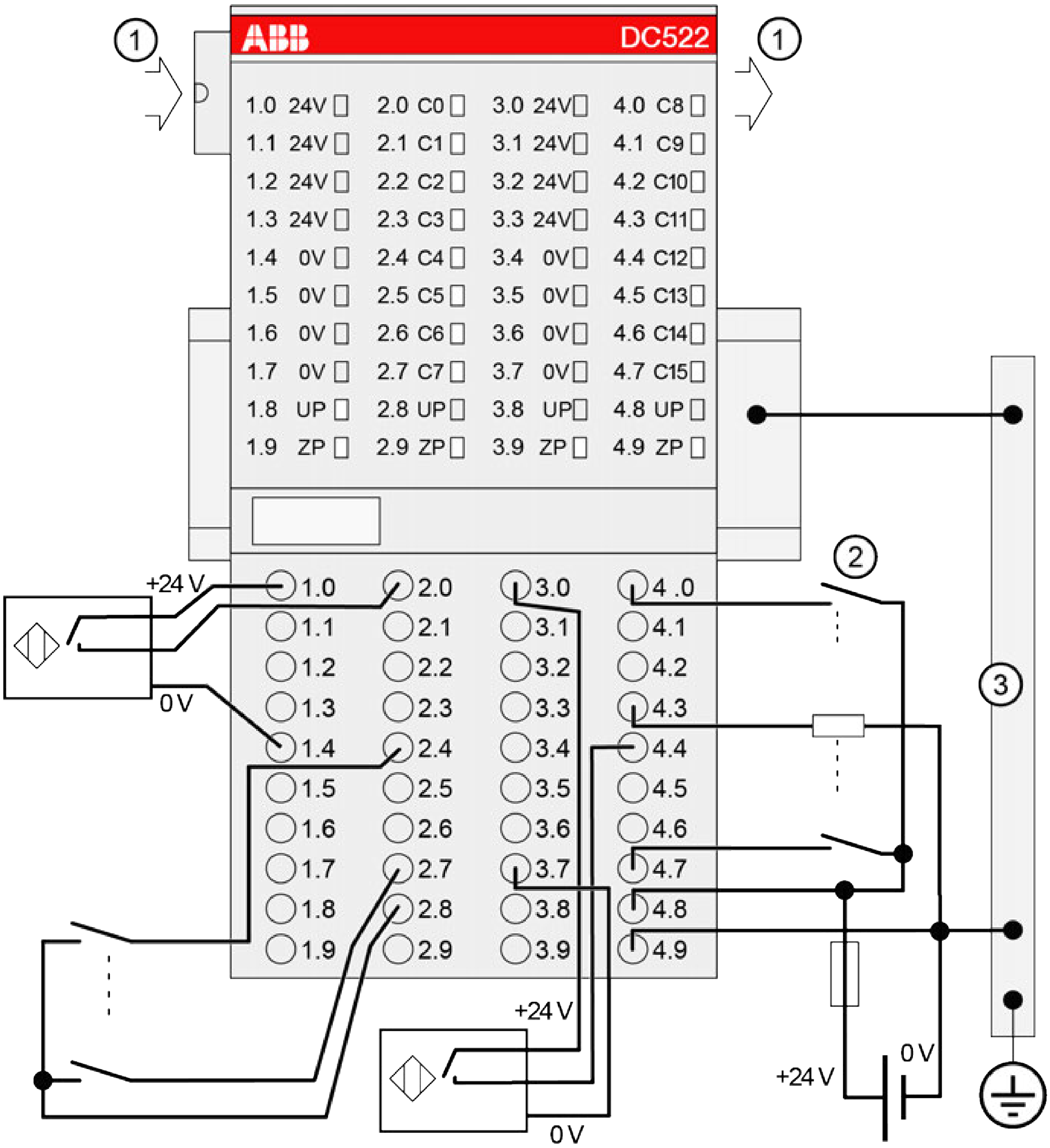
Connections

The connection of the I/O channels is carried out using the 40 terminals of the I/O terminal unit. I/O modules can be replaced without re-wiring the terminal units.

The terminals 1.8... 4.8 and 1.9 ... 4.9 are electrically interconnected within the I/O terminal unit and always have the same assignment, irrespective of the inserted module:

Terminals 1.8 ... 4.8: process voltage UP = +24 V DC

Terminals 1.9 ... 4.9: process voltage ZP = 0 V DC



1 I/O bus
2 4.0 ... 4.7: Connected with UP (switch) -> Input;
Connected with ZP (load) -> Output
3 Control cabinet earth

The assignment of the other terminals:

Terminals	Signal	Description
1.0 ... 1.3	+24 V	4 x sensor power supply sources (loadable with 0.5 A in total)
1.4 ... 1.7	0 V	0 V (reference potential)
2.0 ... 2.7	C0 ... C7	8 digital inputs/outputs
3.0 ... 3.3	+24 V	4 x sensor power supply sources (loadable with 0.5 A in total)
3.4 ... 3.7	0 V	0 V (reference potential)
4.0 ... 4.7	C8 ... C15	8 digital inputs/outputs

CAUTION!
The process supply voltage must be included in the grounding concept (e. g. grounding of the negative terminal).

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a communication interface module or a CPU). Thus, the current consumption from 24 V DC power supply at the terminals L+/UP and M/ZP of the CPU/communication interface module increases by 2 mA per DC522.

The external power supply connection is carried out via the UP (+24 V DC) and the ZP (0 V DC) terminals.

WARNING!
Removal/Insertion under power
Removal or insertion under power is permissible only if all conditions for hot swapping are fullfilled.

Conditions for hot swap

“Conditions for hot swap” on page 1367

The devices are not designed for removal or insertion under power when the conditions for hot swap do not apply. Because of unforeseeable consequences, it is not allowed to plug in or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

Disconnecting any powered devices while they are energized in a hazardous location could result in an electric arc, which could create an ignition source resulting in fire or explosion.

Prior to proceeding, make sure that power is been disconnected and that the area has been thoroughly checked to ensure that flammable materials are not present.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!
Risk of damaging the PLC modules!
Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

NOTICE!
Risk of influences to the connected sensors!
Some sensors may be influenced by the deactivated module outputs of DC522.

Connect a 470 Ω / 1 W resistor in series to inputs C8/C9 if they are used as fast counter inputs to avoid any influences.

The modules provide several diagnosis functions.

Internal data exchange

	Without the fast counter	With the fast counter (only with AC500)
Digital inputs (bytes)	2	4
Digital outputs (bytes)	2	4
Counter input data (words)	0	4
Counter output data (words)	0	8

I/O Configuration

The module itself does not store configuration data. It receives its parameterization data from the master device of the I/O bus (CPU or communication interface module) during power-up of the system.

Hence, replacing I/O modules is possible without any re-parameterization via software.

If the external power supply voltage via UP/ZP terminals fails, the I/O module loses its configuration data. The whole station has to be switched off and on again to re-configure the module.

Parameterization

Firmware version	Configuration
Firmware version > V2.0.0	The arrangement of the parameter data is performed by Control Builder Plus/ Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Module: Module slot address: Y = 1 ... 10

Name	Value	Internal value	Internal value, type	Default	Min.	Max.	EDS Slot/ Index
Module ID	Internal	1220 [1])	Word	1220 0x04C4	0	65535	0x0Y01
Ignore module [2])	No Yes	0 1	Byte	No 0x00			Not for FBP
Parameter length	Internal	7	Byte	7-CPU 6-FBP	0	255	0x0Y02
Check supply	Off On	0 1	Byte	On 0x01	0	1	0x0Y03
Input delay	0.1 ms 1 ms 8 ms 32 ms	0 1 2 3	Byte	8 ms 0x02	0	3	0x0Y04
Fast counter [4])	0 : 10 [3])	0 : 10	Byte	Mode 0 0x00			Not for FBP
Short-circuit detection of output or sensor supply	Off On	0 1	Byte	On 0x01	0	1	0x0Y05
Behaviour of outputs at communication errors	Off Last value Substitute value	0 1+(n*5) 2+(n*5), n ≤ 2	Byte	Off 0x00	0	2	0x0Y06
Substitute value at outputs Bit 15 = Output 15 Bit 0 = Output 0	0 ... 65535	0 ... 0xffff	Word	0 0x0000	0	65535	0x0Y07

Remarks:

[1])	With CS31 and addresses smaller than 70 and FBP, the value is increased by 1
[2])	Not with FBP
[3])	For a description of the counter operating modes, please refer to the 'Fast Counter' section *Chapter 1.6.1.2.10 “Fast counter” on page 545*
[4])	With FBP or CS31 without the parameter Fast Counter

GSD file:

Ext_User_Prm_Data_Len =	9
Ext_User_Prm_Data_Const(0) =	0x04, 0xc5, 0x06, \
	0x01, 0x02, 0x01, 0x00, 0x00, 0x00;

Diagnosis

In case of overload or short-circuit, the outputs switch off automatically and try to switch on again cyclically. Therefore an acknowledgement of the outputs is not necessary. The LED error message, however, is stored.

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identifier 000 ... 063**	**AC500 display**	**<– Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**	
Byte 6 Bit 6 ... 7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0 ... 5**	**FBP diag-nosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error identifier**	**Error message**	**Remedy**
	[1])	[2])	[3])	[4])			
Module error							
3	14	1 ... 10	31	31	19	Checksum error in the I/O module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	3	Timeout in the I/O module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	40	Different hard-/firmware versions in the module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	43	Internal error in the module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	36	Internal data exchange failure	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	9	Overflow diagnosis buffer	New start
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	26	Parameter error	Check master
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	11	Process voltage too low	Check process voltage
	11 / 12	ADR	1 ... 10				
4	14	1 ... 10	31	31	45	Process voltage is switched off (ON −> OFF)	Process voltage ON
	11 / 12	ADR	1 ... 10				
Channel error							

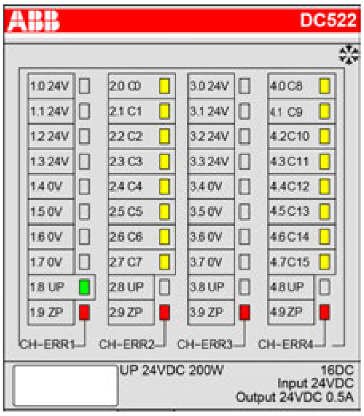
E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identifier** **000 ... 063**	**AC500 display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**	
Byte 6 **Bit 6 ... 7**	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6** **Bit 0 ... 5**	**FBP diag-nosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error identifier**	**Error message**	**Remedy**
	1)	**2)**	**3)**	**4)**			
4	14	1 ... 10	2	0 ... 15	47	Short-circuit at an output	Check connection
	11 / 12	ADR	1 ... 10				

Remarks:

1)	In AC500 the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The FBP diagnosis block does not contain this identifier.
2)	With "Device" the following allocation applies: 31 = module itself, 1 ... 10 = decentralized communication interface module 1 ... 10, ADR = hardware address (e.g. of the DC551)
3)	With "Module" the following allocation applies depending on the master: Module error: I/O bus or FBP: 31 = module itself; COM1/COM2: 1 ... 10 = expansion 1...10 Channel error: I/O bus or FBP = module type (4 = DC); COM1/COM2: 1 ... 10 = expansion 1 ... 10
4)	In case of module errors, with channel "31 = module itself" is output.

State LEDs

During the power ON procedure, the module initializes automatically. All LEDs (except the channel LEDs) are ON during this time.

LED		State	Color	LED = OFF	LED = ON	LED flashes
	Inputs/ outputs C0 ... C15	Digital input or digital output	Yellow	Input/output = OFF	Input/output = ON [1])	--
	UP	Process supply voltage 24 V DC via terminal	Green	Process supply voltage is missing	Process supply voltage OK	--
	CH-ERR1	Channel Error, error messages in groups (digital inputs/ outputs combined into the groups 1, 2, 3, 4)	Red	No error or process supply voltage is missing	Severe error within the corresponding group	Error on one channel of the corresponding group (e.g. short circuit at an output)
	CH-ERR2		Red			
	CH-ERR3		Red			
	CH-ERR4		Red			
	CH-ERR [2])	Module error	Red	--	Internal error	--
	[1]) Indication LED is ON even if an input signal is applied to the channel and the supply voltage is off. In this case the module is not operating and does not generate an input signal.					
	[2]) All of the LEDs CH-ERR1 to CH-ERR4 light up together					

Technical data

Technical data of the module

The system data of AC500 and S500 are applicable to the standard version ✎ *Chapter 2.6.1 “System data AC500” on page 1408*.

The system data of AC500-XC are applicable to the XC version ✎ *Chapter 2.7.1 “System data AC500-XC” on page 1475*.

Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

Parameter		Value
Process supply voltage UP		
	Connections	Terminals 1.8, 2.8, 3.8 and 4.8 for +24 V (UP) as well as 1.9, 2.9, 3.9 and 4.9 for 0 V (ZP)
	Rated value	24 V DC
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	Rated protection fuse on UP	10 A fast
	Galvanic isolation	Yes, per module
Current consumption		
	From 24 V DC power supply at the L+/UP and M/ZP terminals of the CPU/communication interface module	Ca. 2 mA
	From UP at normal operation / with outputs	0.15 A + max. 0.5 A per output

Parameter		Value
	Inrush current from UP (at power up)	0.005 A^2s
Max. power dissipation within the module		6 W (outputs unloaded)
Sensor power supply		
	Connections	Terminals 1.0 ... 1.3 = +24 V, 1.4 ... 1.7 = 0 V Terminals 3.0 ... 3.3 = +24 V, 3.4 ... 3.7 = 0 V
	Voltage	24 V DC with short-circuit and overload protection
	Loadability	Terminals 1.0 ... 1.3, in total max. 0.5 A Terminals 3.0 ... 3.3, in total max. 0.5 A
Weight (without terminal unit)		Ca. 125 g
Mounting position		Horizontal Or vertical with derating (output load reduced to 50 % at +40 °C per group)
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

Multiple overloads
No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an internal smart high-side switch.

NOTICE!
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and temporary overvoltage up to 30 V DC.

Technical data of the configurable digital inputs/outputs

Each of the configurable I/O channels is defined as input or output by the user program. This is done by interrogating or allocating the corresponding channel.

Parameter		Value
Number of channels per module		16 inputs/outputs (with transistors)
Distribution of the channels into groups		1 group of 16 channels
If the channels are used as inputs		
	Channels C0 ... C7	Terminals 2.0 ... 2.7
	Channels C8 ... C15	Terminals 4.0 ... 4.7
If the channels are used as outputs		
	Channels C0 ... C7	Terminals 2.0 ... 2.7
	Channels C8 ... C15	Terminals 4.0 ... 4.7

Parameter	Value
Indication of the input/output signals	1 yellow LED per channel, the LED is ON when the input/output signal is high (signal 1)
Monitoring point of input/output indicator	LED is part of the input circuitry
Galvanic isolation	From the rest of the module

Technical data of the digital inputs/outputs if used as inputs

Parameter		Value
Number of channels per module		Max. 16 digital inputs
Reference potential for all inputs		Terminals 1.9, 2.9, 3.9 and 4.9 (negative pole of the process supply voltage, signal name ZP)
Galvanic isolation		From the rest of the module
Indication of the input signals		1 yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Monitoring point of input/output indicator		LED is part of the input circuitry
Input type acc. to EN 61131-2		Type 1
Input delay (0->1 or 1->0)		Typ. 8 ms, configurable from 0.1 ... 32 ms
Input signal voltage		24 V DC
	Signal 0	-3 V ... +5 V *)
	Undefined signal	> +5 V ... < +15 V
	Signal 1	+15 V ... +30 V
Ripple with signal 0		Within -3 V ... +5 V *)
Ripple with signal 1		Within +15 V ... +30 V
Input current per channel		
	Input voltage +24 V	Typ. 5 mA
	Input voltage +5 V	> 1 mA
	Input voltage +15 V	> 5 mA
	Input voltage +30 V	< 8 mA
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

*) Due to the direct connection to the output, the demagnetizing varistor is also effective at the input (see figure) above. This is why the difference between UPx and the input signal may not exceed the clamp voltage of the varistor. The varistor limits the voltage to approx. 36 V. Consequently, the input voltage must range -12 V ... +30 V when UPx = 24 V and -6 V ... +30 V when UPx = 30 V.

Technical data of the digital inputs/outputs if used as outputs

Parameter		Value
Number of channels per module		Max. 16 transistor outputs
Reference potential for all outputs		Terminals 1.9, 2.9, 3.9 and 4.9 (negative pole of the process supply voltage, signal name ZP)
Common power supply voltage		For all outputs: terminals 1.8, 2.8, 3.8 and 4.8 (positive pole of the process supply voltage, signal name UP)
Output voltage for signal 1		UP (-0.8 V)
Output delay (0->1 or 1->0)		On request
Output current		
	Rated value, per channel	500 mA at UP = 24 V
	Maximum value (all channels together)	8 A
Leakage current with signal 0		< 0.5 mA
Rated protection fuse on UP		10 A fast
Demagnetization when inductive loads are switched off		With varistors integrated in the module (see figure below)
Switching frequency		
	With resistive load	On request
	With inductive loads	Max. 0.5 Hz
	With lamp loads	Max. 11 Hz with max. 5 W
Short-circuit-proof / overload-proof		Yes
Overload message (**I** > 0.7 A)		Yes, after ca. 100 ms
Output current limitation		Yes, automatic reactivation after short circuit/overload
Resistance to feedback against 24 V signals		Yes
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

The following drawing shows the circuitry of a digital input/output with the varistors for demagnetization when inductive loads are switched off.

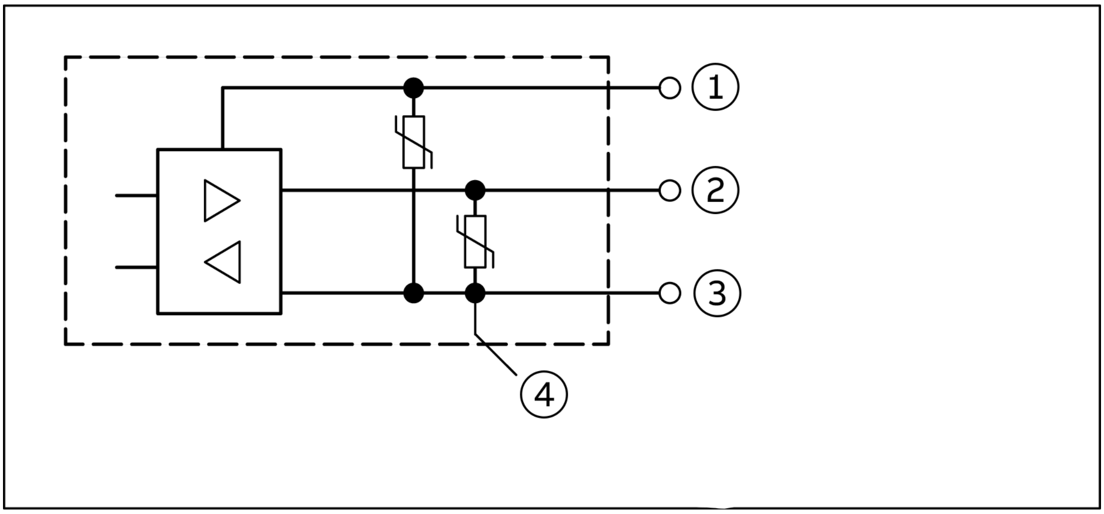


Fig. 122: Digital input/output (circuit diagram)

1 UPx (+ 24 V)
2 Digital input/output
3 ZPx (0 V)
4 For demagnization when inductive loads are switched off

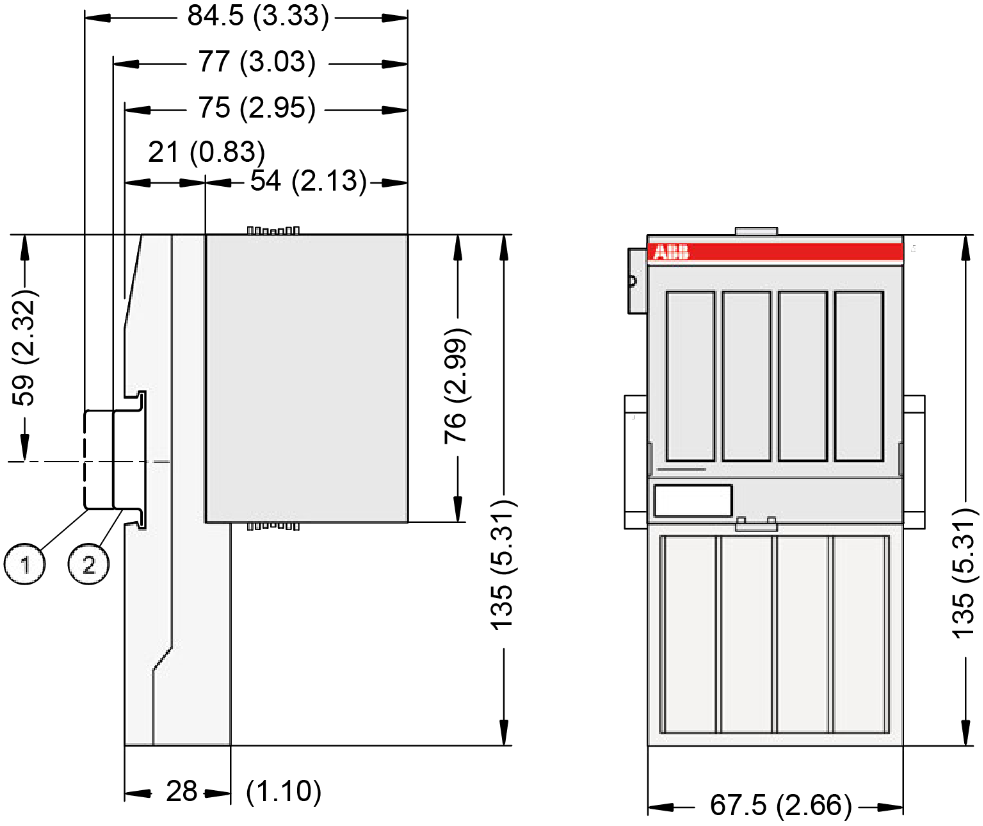
Technical data of the fast counter

The fast counter of the module does not work if the module is connected to a

- *FBP interface module*
- *CS31 bus module*
- *CANopen communication interface module*

Parameter	**Value**
Used inputs	C8 / C9
Used outputs	C10
Counting frequency	Max. 50 kHz

Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

Ordering data

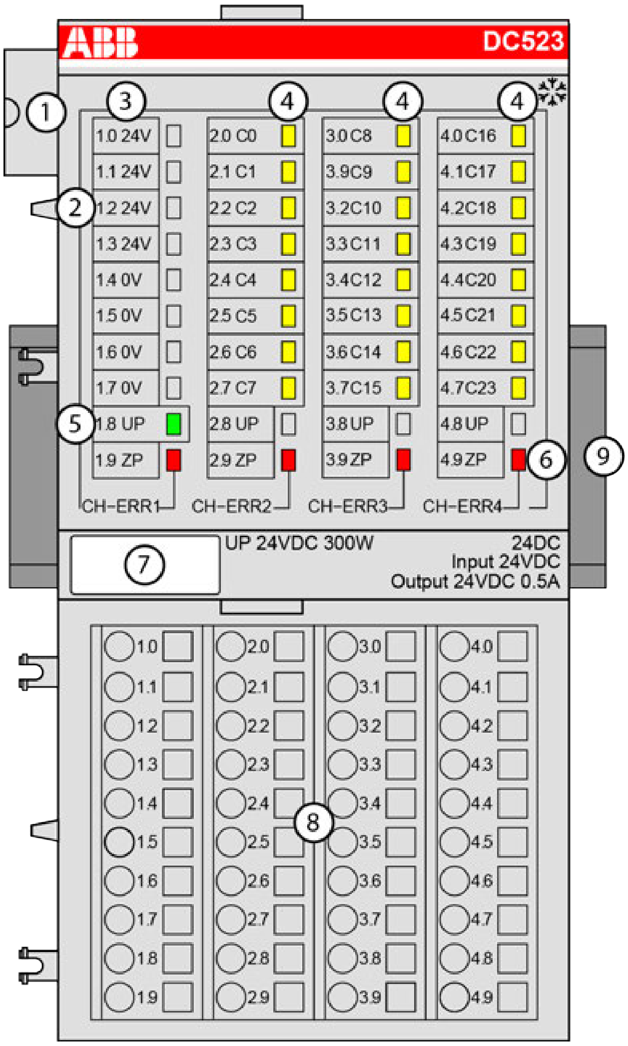
Part no.	Description	Product life cycle phase *)
1SAP 240 600 R0001	DC522, digital input/output module, 16 DC, 24 V DC / 0.5 A, 2-wires	Active
1SAP 440 600 R0001	DC522-XC, digital input/output module, 16 DC, 24 V DC / 0.5 A, 2-wires, XC version	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

1.6.1.2.2 DC523 - Digital input/output module

Features

- 24 configurable digital inputs/outputs
- Module-wise galvanically isolated
- Fast counter
- XC version for use in extreme ambient conditions available



1 I/O bus
2 Allocation between terminal number and signal name
3 Sensor power supply 24 V DC / 0.5 A
4 24 yellow LEDs to display the signal states at the digital inputs/outputs (C0 ... C23)
5 1 green LED to display the status of the process supply voltage UP
6 4 red LEDs to display errors
7 Label
8 Terminal unit
9 DIN rail
Sign for XC version

Intended purpose

The device can be used as a decentralized I/O extension module for S500 communication interface modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs.

Digital configurable input/output unit.

- 1 sensor supply voltage 24 V DC, 0.5 A, with short circuit and overload protection
- 24 digital configurable inputs/outputs 24 V DC (C0 ... C23) in 1 group (2.0 ... 2.7, 3.0 ... 3.7 and 4.0 ... 4.7), of which each can be used
  - as an input,
  - as a transistor output with short circuit and overload protection, 0.5 A rated current or
  - as a re-readable output (combined input/output) with the technical data of the digital inputs and outputs.
- Optional with fast counter

The configuration is performed by software. The modules are supplied with a process supply voltage of 24 V DC.

All available inputs/outputs are galvanically isolated from all other circuitry of the module. There is no potential separation between the channels within the same group.

For use in extreme ambient conditions (e.g. wider temperature and humidity range), a special XC version of the device is available.

Functionality

Parameter	Value
Fast counter	Integrated, many configurable operating modes (only with AC500)
LED displays	For signal states, errors and supply voltage
Internal power supply	Through the I/O bus interface (I/O bus)
External power supply	Via the terminals ZP and UP (process voltage 24 V DC)
Required terminal unit	TU515 or TU516 *Chapter 1.5.3 “TU515, TU516, TU541 and TU542 for I/O modules” on page 282*
Effect of incorrect input terminal connection	Wrong or no signal detected, no damage up to 35 V

> **NOTICE!**
> All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and temporary overvoltage up to 30 V DC.

The device is plugged on a terminal unit *Chapter 1.5.3 “TU515, TU516, TU541 and TU542 for I/O modules” on page 282*. Position the module properly and press until it locks in place. The terminal unit is either mounted on a DIN rail or to the wall using 2 screws plus the additional accessory for wall mounting *Chapter 1.9.3.5 “TA526 - Wall mounting accessory” on page 1361*.

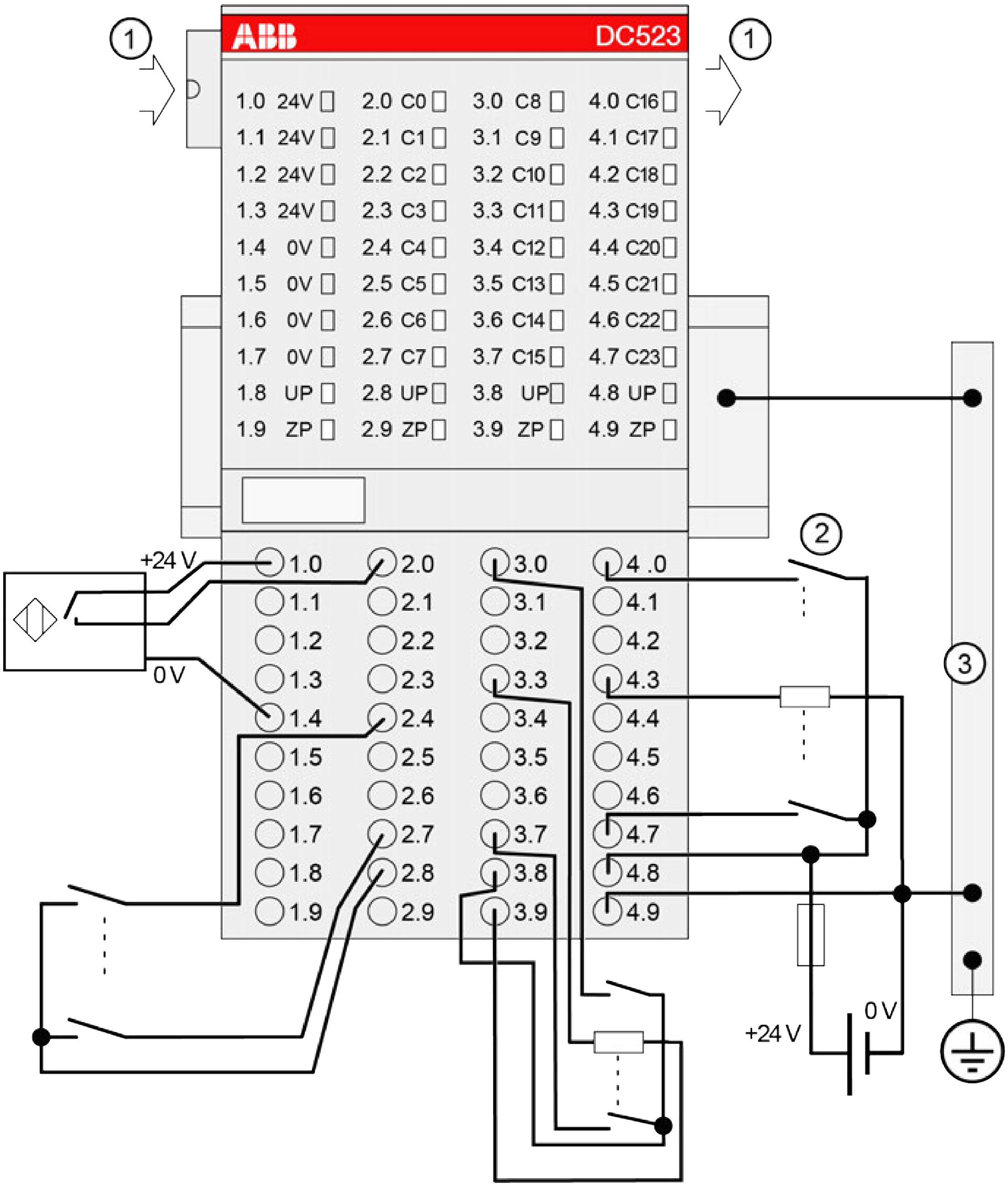
Connections

The connection of the I/O channels is carried out using the 40 terminals of the I/O terminal unit. I/O modules can be replaced without re-wiring the terminal units.

The terminals 1.8 ... 4.8 and 1.9 ... 4.9 are electrically interconnected within the I/O terminal unit and always have the same assignment, irrespective of the inserted module:

Terminals 1.8 ... 4.8: process voltage UP = +24 V DC

Terminals 1.9 ... 4.9: process voltage ZP = 0 V DC



1 I/O bus
2 4.0 ... 4.7: Connected with UP (switch) -> Input;
Connected with ZP (load) -> Output
3 Control cabinet earth

The assignment of the other terminals:

Terminals	Signal	Description
1.0 ... 1.3	+24 V	4 x sensor power supply sources (loadable with 0.5 A in total)
1.4 ... 1.7	0 V	0 V (reference potential)
2.0 ... 2.7	C0 ... C7	8 digital inputs/outputs
3.0 ... 3.7	C8 ... C15	8 digital inputs/outputs
4.0 ... 4.7	C16 ... C23	8 digital inputs/outputs

CAUTION!
The process supply voltage must be included in the grounding concept (e. g. grounding of the negative terminal).

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a communication interface module or a CPU). Thus, the current consumption from 24 V DC power supply at the terminals L+/UP and M/ZP of the CPU/communication interface module increases by 2 mA per DC523.

The external power supply connection is carried out via the UP (+24 V DC) and the ZP (0 V DC) terminals.

WARNING!
Removal/Insertion under power
Removal or insertion under power is permissible only if all conditions for hot swapping are fullfilled.

Conditions for hot swap

"Conditions for hot swap" on page 1367

The devices are not designed for removal or insertion under power when the conditions for hot swap do not apply. Because of unforeseeable consequences, it is not allowed to plug in or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

Disconnecting any powered devices while they are energized in a hazardous location could result in an electric arc, which could create an ignition source resulting in fire or explosion.

Prior to proceeding, make sure that power is been disconnected and that the area has been thoroughly checked to ensure that flammable materials are not present.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!
Risk of damaging the PLC modules!
Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

NOTICE!
Risk of influences to the connected sensors!
Some sensors may be influenced by the deactivated module outputs of DC523.

Connect a 470 Ω / 1 W resistor in series to inputs C16/C17 if they are used as fast counter inputs to avoid any influences.

The modules provide several diagnosis functions.

Internal data exchange

	Without the fast counter	With the fast counter (only with AC500)
Digital inputs (bytes)	3	5
Digital outputs (bytes)	3	5
Counter input data (words)	0	4
Counter output data (words)	0	8

I/O configuration

The module itself does not store configuration data. It receives its parameterization data from the master device of the I/O bus (CPU or communication interface module) during power-up of the system.

Hence, replacing I/O modules is possible without any re-parameterization via software.

If the external power supply voltage via UP/ZP terminals fails, the I/O module loses its configuration data. The whole station has to be switched off and on again to re-configure the module.

Parameterization

Firmware version	Configuration
Firmware version > V2.0.0	The arrangement of the parameter data is performed by Control Builder Plus/ Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Module: Module slot address: Y = 1 ... 10

Name	Value	Internal value	Internal value, type	Default	Min.	Max.	EDS Slot/ Index
Module ID	Internal	1215 [1])	Word	1215 0x04BF	0	65535	0x0Y01
Ignore module [2])	No Yes	0 1	Byte	No 0x00			Not for FBP
Parameter length	Internal	9	Byte	9-CPU 8-FBP	0	255	0x0Y02
Check supply	Off on	0 1	Byte	On 0x01	0	1	0x=Y03

Name	**Value**	**Internal value**	**Internal value, type**	**Default**	**Min.**	**Max.**	**EDS Slot/ Index**
Input delay	0.1 ms 1 ms 8 ms 32 ms	0 1 2 3	Byte	8 ms 0x02	0	3	0x0Y04
Fast counter [4])	0 : 10 [3])	0 : 10	Byte	Mode 0 0x00			Not for FBP
Short circuit detection of output or sensor supply	Off On	0 1	Byte	On 0x01	0	1	0x0Y05
Behaviour of outputs at communication errors	Off Last value Substitute value	0 1+(n*5) 2+(n*5), n ≤ 2	Byte	Off 0x00	0	2	0x0Y06
Substitute value at outputs B23 = Output 23 Bit 0 = Output 0	0 ... 16777215	0 ... 0x00ff-ffff	DWord	0 0x0000 -0000	0	224−1	0x0Y07

Remarks:

[1])	With CS31 and addresses smaller than 70 and FBP, the value is increased by 1
[2])	Not with FBP
[3])	For a description of the counter operating modes, please refer to the 'Fast Counter' section *Chapter 1.6.1.2.10 “Fast counter” on page 545*
[4])	With FBP or CS31 without the parameter Fast Counter

GSD file:

Ext_User_Prm_Data_Len =	11
Ext_User_Prm_Data_Const(0) =	0x04, 0xc0, 0x08, \ 0x01, 0x02, 0x01, 0x00, 0x00, 0x00, 0x00, 0x00;

Diagnosis

In case of overload or short circuit, the outputs switch off automatically and try to switch on again cyclically. Therefore an acknowledgement of the outputs is not necessary. The LED error message, however, is stored.

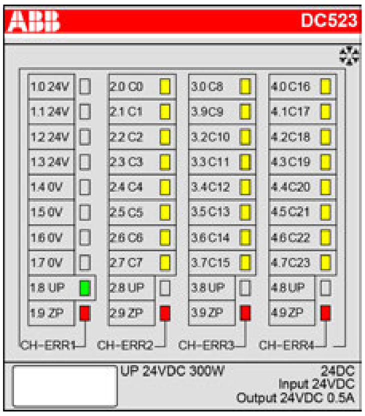
E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identifier 000 ... 063**	**AC500 display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**	
Byte 6 Bit 6 ... 7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0 ... 5**	**FBP diagnosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error identifier**	**Error message**	**Remedy**
	1)	2)	3)	4)			
Module error							
3	14	1 ... 10	31	31	19	Checksum error in the I/O module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	3	Timeout in the I/O module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	40	Different hard-/firmware versions in the module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	43	Internal error in the module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	36	Internal data exchange failure	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	9	Overflow diagnosis buffer	New start
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	26	Parameter error	Check master
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	11	Process voltage too low	Check process voltage
	11 / 12	ADR	1 ... 10				
4	14	1 ... 10	31	31	45	Process voltage is switched off (ON −> OFF)	Process voltage ON
	11 / 12	ADR	1 ... 10				
Channel error							
4	14	1 ... 10	2	0 ... 23	47	Short circuit at an output	Check connection
	11 / 12	ADR	1 ... 10				

Remarks:

1)	In AC500 the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The FBP diagnosis block does not contain this identifier.
2)	With "Device" the following allocation applies: 31 = module itself, 1 ... 10 = decentralized communication interface module 1 ... 10, ADR = Hardware address (e.g. of the DC551)
3)	With "Module" the following allocation applies depending on the master: Module error: I/O bus or FBP: 31 = module itself; COM1/COM2: 1 ... 10 = expansion 1 ... 10 Channel error: I/O bus or FBP = Module type (4 = DC); COM1/COM2: 1 ... 10 = expansion 1 ... 10
4)	In case of module errors, with channel "31 = module itself" is output.

State LEDs

During the power ON procedure, the module initializes automatically. All LEDs (except the channel LEDs) are ON during this time.

LED		State	Color	LED = OFF	LED = ON	LED flashes
	Inputs/ outputs C0 ... C23	Digital input or digital output	Yellow	Input/output = OFF	Input/output = ON 1)	--
	UP	Process supply voltage 24 V DC via terminal	Green	Process supply voltage is missing	Process supply voltage OK	--
	CH-ERR1	Channel error, error messages in groups (digital inputs/ outputs combined into the groups 1, 2, 3, 4)	Red	No error or process supply voltage is missing	Severe error within the corresponding group	Error on one channel of the corresponding group (e.g. short circuit at an output)
	CH-ERR2		Red			
	CH-ERR3		Red			
	CH-ERR4		Red			
	CH-ERR 2)	Module error	Red	--	Internal error	--
	1) Indication LED is ON even if an input signal is applied to the channel and the supply voltage is off. In this case the module is not operating and does not generate an input signal.					
	2) All of the LEDs CH-ERR1 to CH-ERR4 light up together					

Technical data

Technical data of the module

The system data of AC500 and S500 are applicable to the standard version ✎ *Chapter 2.6.1 “System data AC500” on page 1408*.

The system data of AC500-XC are applicable to the XC version ⇨ *Chapter 2.7.1 "System data AC500-XC" on page 1475*.

Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

Parameter		Value
Process supply voltage UP		
	Connections	Terminals 1.8, 2.8, 3.8 and 4.8 for +24 V (UP) as well as 1.9, 2.9, 3.9 and 4.9 for 0 V (ZP)
	Rated value	24 V DC
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	Rated protection fuse on UP	10 A fast
	Galvanic isolation	Yes, per module
Current consumption		
	From 24 V DC power supply at the terminals UP/L+ and ZP/M of the CPU/communication interface module	Ca. 2 mA
	From UP at normal operation / with outputs	0.1 A + max. 0.5 A per output
	Inrush current from UP (at power up)	0.008 A^2s
Max. power dissipation within the module		6 W (outputs unloaded)
Sensor power supply		
	Connections	Terminals 1.0 ... 1.3 = +24 V, 1.4 ... 1.7 = 0 V
	Voltage	24 V DC with short circuit and overload protection
	Loadability	Terminals 1.0 ... 1.3, in total max. 0.5 A
Weight (without terminal unit)		Ca. 125 g
Mounting position		Horizontal Or vertical with derating (output load reduced to 50 % at +40 °C per group)
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

NOTICE!
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and temporary overvoltage up to 30 V DC.

Multiple overloads
No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an internal smart high-side switch.

Technical data of the configurable digital inputs/outputs

Each of the configurable I/O channels is defined as input or output by the user program. This is done by interrogating or allocating the corresponding channel.

Parameter		Value
Number of channels per module		24 inputs/outputs (with transistors)
Distribution of the channels into groups		1 group of 24 channels
If the channels are used as inputs		
	Channels C0 ... C7	Terminals 2.0 ... 2.7
	Channels C8 ... C15	Terminals 3.0 ... 3.7
	Channels C16 ... C23	Terminals 4.0 ... 4.7
If the channels are used as outputs		
	Channels C0 ... C7	Terminals 2.0 ... 2.7
	Channels C8 ... C15	Terminals 3.0 ... 3.7
	Channels C16 ... C23	Terminals 4.0 ... 4.7
Indication of the input/output signals		1 yellow LED per channel, the LED is ON when the input/output signal is high (signal 1)
Monitoring point of input/output indicator		LED is part of the input circuitry
Galvanic isolation		From the rest of the module

Technical data of the digital inputs/outputs if used as inputs

Parameter		Value
Number of channels per module		Max. 24 digital inputs
Reference potential for all inputs		Terminals 1.9, 2.9, 3.9 and 4.9 (negative pole of the process supply voltage, signal name ZP)
Galvanic isolation		From the rest of the module
Indication of the input signals		1 yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Monitoring point of input/output indicator		LED is part of the input circuitry
Input type acc. to EN 61131-2		Type 1
Input delay (0->1 or 1->0)		Typ. 8 ms, configurable from 0.1 to 32 ms
Input signal voltage		24 V DC
	Signal 0	-3 V ... +5 V *)
	Undefined signal	> +5 V ... < +15 V
	Signal 1	+15 V ... +30 V
Ripple with signal 0		Within -3 V ... +5 V *)
Ripple with signal 1		Within +15 V ... +30 V
Input current per channel		
	Input voltage +24 V	Typ. 5 mA
	Input voltage +5 V	> 1 mA
	Input voltage +15 V	> 5 mA

Parameter		Value
	Input voltage +30 V	< 8 mA
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

*) Due to the direct connection to the output, the demagnetizing varistor is also effective at the input (see figure) above. This is why the difference between UPx and the input signal must not exceed the clamp voltage of the varistor. The varistor limits the clamp voltage to approx. 36 V. Consequently, the input voltage must range from -12 V ... +30 V when UPx = 24 V and from -6 V ... +30 V when UPx = 30 V.

Technical data of the digital inputs/outputs if used as outputs

Parameter		Value
Number of channels per module		Max. 24 transistor outputs
Reference potential for all outputs		Terminals 1.9, 2.9, 3.9 and 4.9 (negative pole of the process supply voltage, signal name ZP)
Common power supply voltage		For all outputs: terminals 1.8, 2.8, 3.8 and 4.8 (positive pole of the process supply voltage, signal name UP)
Output voltage for signal 1		UP (-0.8 V)
Output delay (0->1 or 1->0)		On request
Output current		
	Rated value, per channel	500 mA at UP = 24 V
	Maximum value (all channels together)	8 A
Leakage current with signal 0		< 0.5 mA
Rated protection fuse on UP		10 A fast
Demagnetization when inductive loads are switched off		With varistors integrated in the module (see figure below)
Switching frequency		
	With resistive load	On request
	With inductive loads	Max. 0.5 Hz
	With lamp loads	Max. 11 Hz with max. 5 W
Short-circuit-proof / overload-proof		Yes
Overload message (I > 0.7 A)		Yes, after ca. 100 ms
Output current limitation		Yes, automatic reactivation after short circuit/overload
Resistance to feedback against 24 V signals		Yes
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

The following drawing shows the circuitry of a digital input/output with the varistors for demagnetization when inductive loads are switched off.

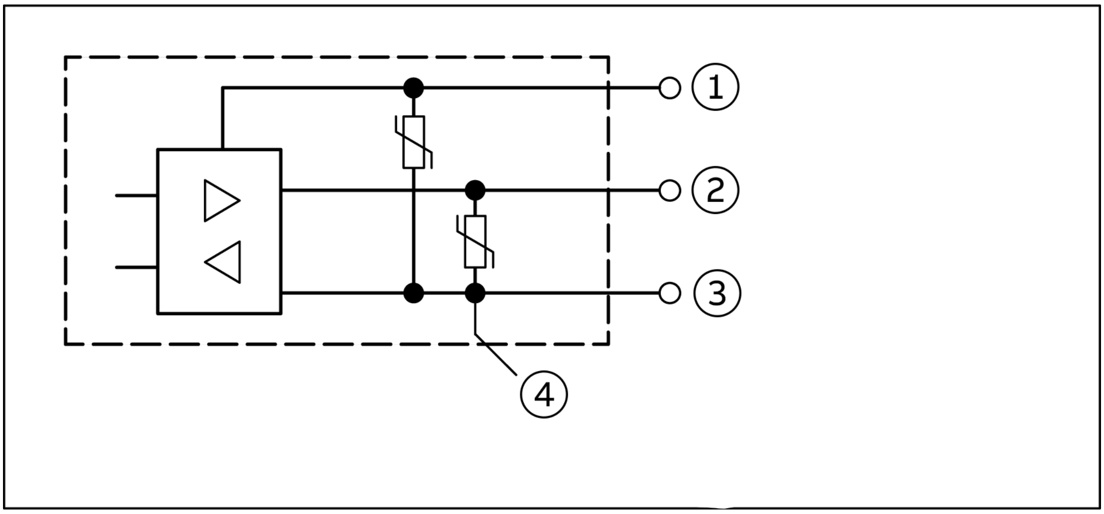


Fig. 123: Digital input/output (circuit diagram)

1 UPx (+ 24 V)
2 Digital input/output
3 ZPx (0 V)
4 For demagnization when inductive loads are switched off

Technical data of the fast counter

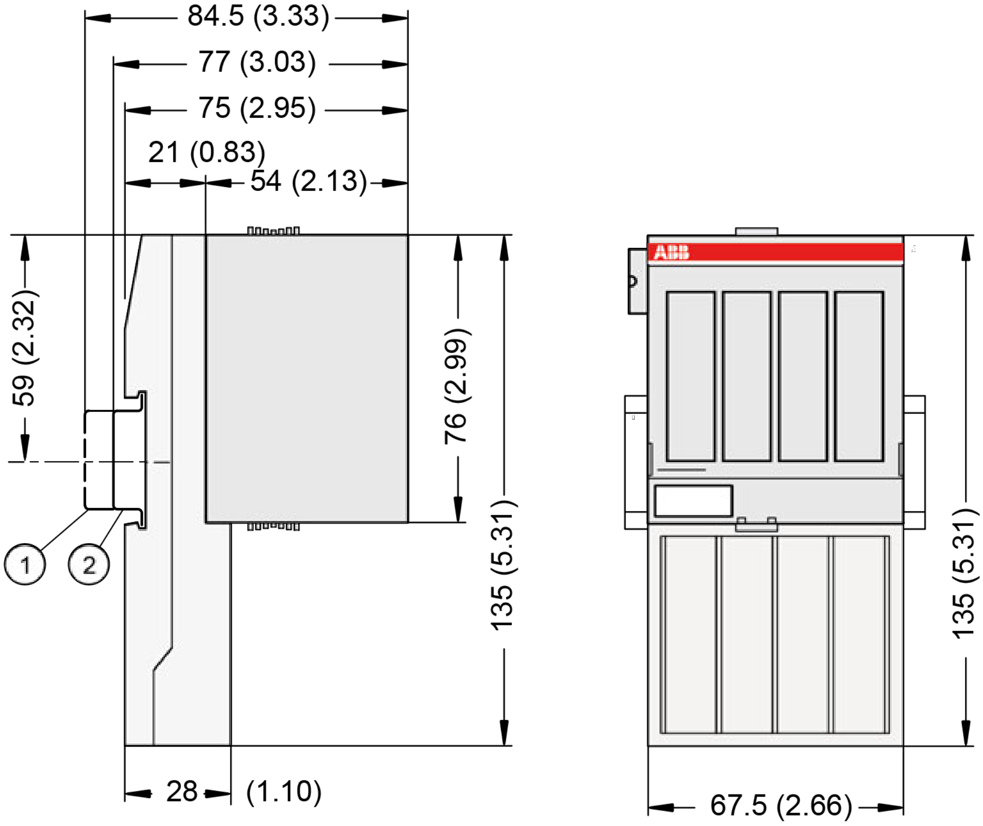
The fast counter of the module does not work if the module is connected to a

- *FBP interface module*
- *CS31 bus module*
- *CANopen communication interface module*

Parameter	Value
Used inputs	C16 / C17
Used outputs	C18
Counting frequency	Max. 50 kHz

How to prepare a device as fast counter and how to connect it to the PLC is described in an *application example*.

Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

> *The dimensions are in mm and in brackets in inch.*

Ordering data

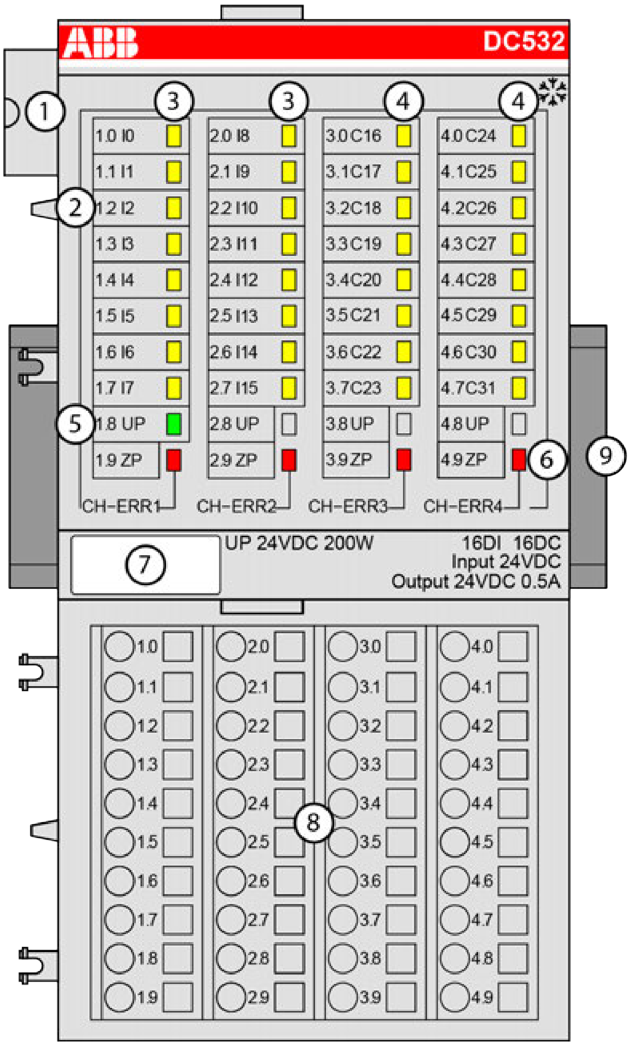
Part no.	Description	Product life cycle phase *)
1SAP 240 500 R0001	DC523, digital input/output module, 24 DC, 24 V DC / 0.5 A, 1-wire	Active
1SAP 440 500 R0001	DC523-XC, digital input/output module, 24 DC, 24 V DC / 0.5 A, 1-wire, XC version	Active

> **) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

1.6.1.2.3 DC532 - Digital input/output module

Features

- 16 digital inputs 24 V DC, 16 configurable digital inputs/outputs
- Module-wise galvanically isolated
- Fast counter
- XC version for use in extreme ambient conditions available



1 I/O bus
2 Allocation between terminal number and signal name
3 16 yellow LEDs to display the signal states at the digital inputs (I0 ... I15)
4 16 yellow LEDs to display the signal states at the digital inputs/outputs (C16 ... C31)
5 1 green LED to display the state of the process supply voltage UP
6 4 red LEDs to display errors
7 Label
8 Terminal unit
9 DIN rail
❄ Sign for XC version

Intended purpose

The device can be used as a decentralized I/O extension module for S500 communication interface modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs.

Digital configurable input / output unit.

- 16 digital inputs 24 V DC in 2 groups (1.0 ... 1.7 and 2.0 ... 2.7)
- 16 digital configurable inputs/outputs 24 V DC (C16 ... C31) in 1 group (3.0 ... 3.7 and 4.0 ... 4.7), of which each can be used
  - as an input,
  - as a transistor output with short circuit and overload protection, 0.5 A rated current or
  - as a re-readable output (combined input/output) with the technical data of the digital inputs and outputs.
- Optional with fast counter

The configuration is performed by software. The modules are supplied with a process supply voltage of 24 V DC.

All available inputs/outputs are galvanically isolated from all other circuitry of the module. There is no potential separation between the channels within the same group.

For use in extreme ambient conditions (e.g. wider temperature and humidity range), a special XC version of the device is available.

Functionality

Parameter	Value
Digital inputs	16 (24 V DC)
Digital inputs/outputs	16 (24 V DC)
Fast counter	Integrated, many configurable operating modes (only with AC500)
LED displays	For signal states, errors and supply voltage
Internal power supply	Through the I/O bus interface (I/O bus)
External power supply	Via the terminals ZP and UP (process voltage 24 V DC)
Required terminal unit	TU515 or TU516 *Chapter 1.5.3 “TU515, TU516, TU541 and TU542 for I/O modules” on page 282*
Effect of incorrect input terminal connection	Wrong or no signal detected, no damage up to 35 V

The device is plugged on a terminal unit *Chapter 1.5.3 “TU515, TU516, TU541 and TU542 for I/O modules” on page 282*. Position the module properly and press until it locks in place. The terminal unit is either mounted on a DIN rail or to the wall using 2 screws plus the additional accessory for wall mounting *Chapter 1.9.3.5 “TA526 - Wall mounting accessory” on page 1361*.

For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.

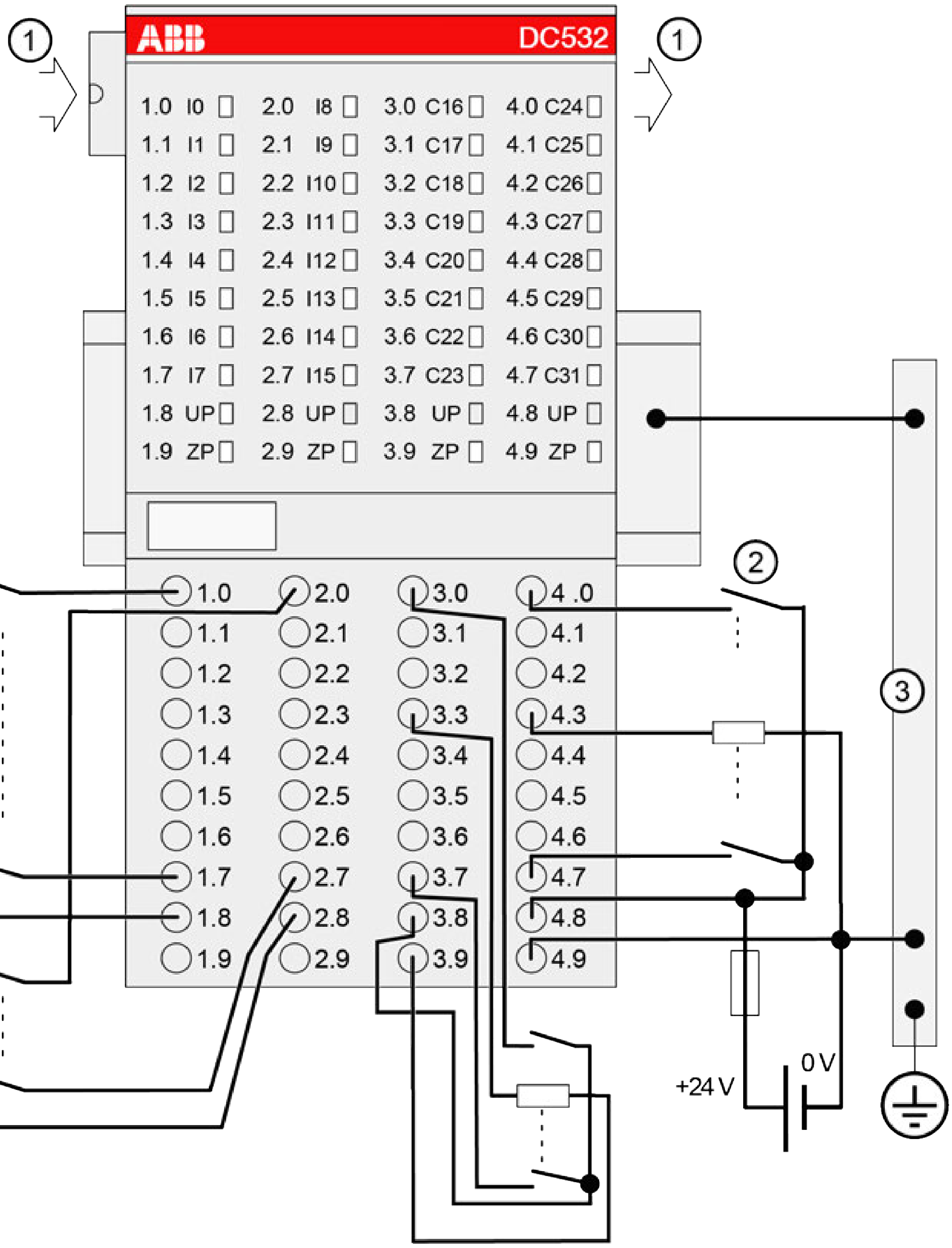
Connections

The connection of the I/O channels is carried out using the 40 terminals of the I/O terminal unit. I/O modules can be replaced without re-wiring the terminal units.

The terminals 1.8 ... 4.8 and 1.9 ... 4.9 are electrically interconnected within the I/O terminal unit and always have the same assignment, irrespective of the inserted module:

Terminals 1.8 ... 4.8: process voltage UP = +24 V DC

Terminals 1.9 ... 4.9: process voltage ZP = 0 V DC



1 I/O bus
2 4.0 ... 4.7: Connected with UP (switch) -> Input;
Connected with ZP (load) -> Output
3 Control cabinet earth

The assignment of the other terminals:

Terminals	Signal	Description
1.0 ... 1.7	I0 ... I7	8 digital inputs
2.0 ... 2.7	I8 ... I15	8 digital inputs
3.0 ... 3.7	C16 ... C23	8 digital inputs/outputs
4.0 ... 4.7	C24 ... C31	8 digital inputs/outputs

CAUTION!
The process supply voltage must be included in the grounding concept (e. g. grounding of the negative terminal).

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a communication interface module or a CPU). Thus, the current consumption from 24 V DC power supply at the terminals L+/UP and M/ZP of the CPU/communication interface module increases by 2 mA per DC532.

The external power supply connection is carried out via the UP (+24 V DC) and the ZP (0 V DC) terminals.

WARNING!
Removal/Insertion under power
Removal or insertion under power is permissible only if all conditions for hot swapping are fullfilled.

Conditions for hot swap

“Conditions for hot swap” on page 1367

The devices are not designed for removal or insertion under power when the conditions for hot swap do not apply. Because of unforeseeable consequences, it is not allowed to plug in or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

Disconnecting any powered devices while they are energized in a hazardous location could result in an electric arc, which could create an ignition source resulting in fire or explosion.

Prior to proceeding, make sure that power is been disconnected and that the area has been thoroughly checked to ensure that flammable materials are not present.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!
Risk of damaging the PLC modules!
Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

NOTICE!
Risk of influences to the connected sensors!
Some sensors may be influenced by the deactivated module outputs of DC532.

Connect a 470 Ω / 1 W resistor in series to inputs C24/C25 if using them as fast counter inputs to avoid any influences.

The module provides several diagnosis functions.

Internal data exchange

	Without the fast counter	With the fast counter (only with AC500)
Digital inputs (bytes)	4	6
Digital outputs (bytes)	2	4
Counter input data (words)	0	4
Counter output data (words)	0	8

I/O configuration

The module itself does not store configuration data. It receives its parameterization data from the master device of the I/O bus (CPU or communication interface module) during power-up of the system.

Hence, replacing I/O modules is possible without any re-parameterization via software.

If the external power supply voltage via UP/ZP terminals fails, the I/O module loses its configuration data. The whole station has to be switched off and on again to re-configure the module.

Parameterization

Firmware version	Configuration
Firmware version > V2.0.0	The arrangement of the parameter data is performed by Control Builder Plus/ Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Module: Module slot address: Y = 1 ... 10

Name	Value	Internal value	Internal value, type	Default	Min.	Max.	
Module ID	Internal	1200 [1])	Word	1200 0x04B0	0	65535	0x0Y01
Ignore module [2])	No Yes	0 1	Byte	No 0x00			Not for FBP
Parameter length	Internal	7	Byte	7-CPU 6-FBP	0	255	0x0Y02
Check supply	Off on	0 1	Byte	On 0x01	0	1	0x0Y03
Input delay	0.1 ms 1 ms 8 ms 32 ms	0 1 2 3	Byte	8 ms 0x02	0	3	0x0Y04
Fast counter [4])	0 : 10 [3])	0 : 10	Byte	Mode 0 0x00			Not for FBP
Output short circuit detection	Off On	0 1	Byte	On 0x01	0	1	0x0Y05
Behaviour of outputs at communication errors	Off Last value Substitute value	0 1+(n*5) 2+(n*5), n ≤ 2	Byte	Off 0x00	0	2	0x0Y06
Substitute value at outputs Bit 15 = Output 15 Bit 0 = Output 0	0 ... 65535	0 ... 0xffff	Word	0 0x0000	0	65535	0x0Y07

Remarks:

[1])	With CS31 and addresses smaller than 70 and FBP, the value is increased by 1
[2])	Not with FBP
[3])	For a description of the counter operating modes, please refer to the 'Fast Counter' section *Chapter 1.6.1.2.10 “Fast counter” on page 545*
[4])	With FBP or CS31 without the parameter Fast Counter

GSD file:

Ext_User_Prm_Data_Len =	9
Ext_User_Prm_Data_Const(0) =	0x04, 0xb1, 0x06, \
	0x01, 0x02, 0x01, 0x00, 0x00, 0x00;

Diagnosis

In case of overload or short circuit, the outputs switch off automatically and try to switch on again cyclically. Therefore, an acknowledgement of the outputs is not necessary. The LED error message, however, is stored.

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identifier 000 ... 063**	**AC500 display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**	
Byte 6 Bit 6 ... 7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0 ... 5**	**FBP diagnosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error Identifier**	**Error message**	**Remedy**
	1)	2)	3)	4)			
Module error							
3	14	1 ... 10	31	31	19	Checksum error in the I/O module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	3	Timeout in the I/O module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	40	Different hard-/firmware versions in the module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	43	Internal error in the module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	36	Internal data exchange failure	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	9	Overflow diagnosis buffer	New start
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	26	Parameter error	Check master
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	11	Process voltage too low	Check process voltage
	11 / 12	ADR	1 ... 10				

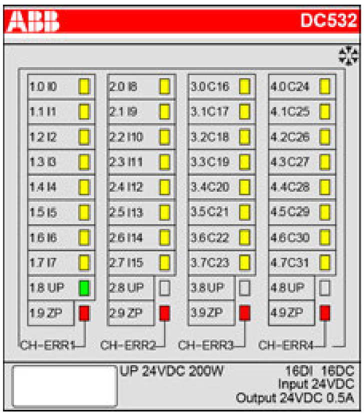
E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier** **000 ... 063**	**AC500 display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**	
Byte 6 **Bit 6 ... 7**	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6** **Bit 0 ... 5**	**FBP diag-nosis block**	
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error Identi-fier**	**Error message**	**Remedy**
	1)	**2)**	**3)**	**4)**			
4	14	1 ... 10	31	31	45	Process voltage is switched off (ON −> OFF)	Process voltage ON
	11 / 12	ADR	1 ... 10				
Channel error DC532							
4	14	1 ... 10	2	16 ... 31	47	Short circuit at a digital output	Check connec-tion
	11 / 12	ADR	1 ... 10				

Remarks:

1)	In AC500 the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The FBP diagnosis block does not contain this identifier.
2)	With "Device" the following allocation applies: 31 = module itself, 1 ... 10 = decentralized communication interface module 1 ... 10, ADR = hardware address (e.g. of the DC551)
3)	With "Module" the following allocation applies depending on the master: Module error: I/O bus or FBP: 31 = module itself; COM1/COM2: 1 ... 10 = expansion 1 ... 10 Channel error: I/O bus or FBP = module type (4 = DC); COM1/COM2: 1 ... 10 = expansion 1 ... 10
4)	In case of module errors, with channel "31 = module itself" is output.

State LEDs

During the power ON procedure, the module initializes automatically. All LEDs (except the channel LEDs) are ON during this time.

LED		State	Color	LED = OFF	LED = ON	LED flashes
	Inputs I0 ... I15	Digital input	Yellow	Input = OFF	Input = ON [1])	--
	Inputs/ outputs C16 ... C31	Digital input/ output	Yellow	Input/output = OFF	Input/output = ON [1])	--
	UP	Process supply voltage 24 V DC via terminal	Green	Process supply voltage is missing	Process supply voltage OK	--
	CH-ERR1	Channel Error, error messages in groups (digital inputs/ outputs combined into the groups 1, 2, 3, 4)	Red	No error or process supply voltage is missing	Severe error within the corresponding group	Error on one channel of the corresponding group (e.g. short circuit at an output)
	CH-ERR2		Red			
	CH-ERR3		Red			
	CH-ERR4		Red			
	CH-ERR [2])	Module Error	Red	--	Internal error	--
	[1]) Indication LED is ON even if an input signal is applied to the channel and the supply voltage is off. In this case the module is not operating and does not generate an input signal.					
	[2]) All of the LEDs CH-ERR1 to CH-ERR4 light up together					

Technical data

Technical data of the module

The system data of AC500 and S500 are applicable to the standard version *Chapter 2.6.1 “System data AC500” on page 1408*.

The system data of AC500-XC are applicable to the XC version *Chapter 2.7.1 “System data AC500-XC” on page 1475*.

Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

Parameter		Value
Process supply voltage UP		
	Connections	Terminals 1.8, 2.8, 3.8 and 4.8 for +24 V (UP) as well as 1.9, 2.9, 3.9 and 4.9 for 0 V (ZP)
	Rated value	24 V DC
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	Rated protection fuse on UP	10 A fast
	Galvanic isolation	Yes, per module
Current consumption		

Parameter		Value
	From 24 V DC power supply at the terminals UP/L+ and ZP/M of the CPU/communication interface module	Ca. 2 mA
	From UP at normal operation / with outputs	0.15 A + max. 0.5 A per output
	Inrush current from UP (at power up)	0.007 A^2s
Max. power dissipation within the module		6 W (outputs unloaded)
Weight (without terminal unit)		ca. 125 g
Mounting position		Horizontal Or vertical with derating (output load reduced to 50 % at +40 °C per group)
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

NOTICE!
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and temporary overvoltage up to 30 V DC.

Multiple overloads
No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an internal smart high-side switch.

Technical data of the digital inputs

Parameter		Value
Number of channels per module		16
Distribution of the channels into groups		1 group of 16 channels
Terminals of the channels I0 ... I7		1.0 ... 1.7
Terminals of the channels I8 ... I15		2.0 ... 2.7
Reference potential for all inputs		Terminals 1.9, 2.8, 3.8 and 4.9 (negative pole of the process supply voltage, signal name ZP)
Galvanic isolation		From the rest of the module (I/O bus)
Indication of the input signals		1 yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Monitoring point of input indicator		LED is part of the input circuitry
Input type acc. to EN 61131-2		Type 1
Input delay (0->1 or 1->0)		Typ. 8 ms, configurable from 0.1 to 32 ms
Input signal voltage		24 V DC
	Signal 0	-3 V ... +5 V
	Undefined signal	> +5 V ... < +15 V Parameter

Parameter		Value
	Signal 1	+15 V ... +30 V
Ripple with signal 0		Within -3 V ... +5 V
Ripple with signal 1		Within +15 V ... +30 V
Input current per channel		
	Input voltage +24 V	Typ. 5 mA
	Input voltage +5 V	> 1 mA
	Input voltage +15 V	> 5 mA
	Input voltage +30 V	< 8 mA
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

Technical data of the configurable digital inputs/outputs

Each of the configurable I/O channels is defined as input or output by the user program. This is done by interrogating or allocating the corresponding channel.

Parameter		Value
Number of channels per module		16 inputs/outputs (with transistors)
Distribution of the channels into groups		1 group of 16 channels
If the channels are used as inputs		
	Channels I16 ... I23	Terminals 3.0 ... 3.7
	Channels I24 ... I31	Terminals 4.0 ... 4.7
If the channels are used as outputs		
	Channels Q16 ... Q23	Terminals 3.0 ... 3.7
	Channels Q24 ... Q31	Terminals 4.0 ... 4.7
Indication of the input/output signals		1 yellow LED per channel, the LED is ON when the input/output signal is high (signal 1)
Monitoring point of input/output indicator		LED is part of the input circuitry
Galvanic isolation		From the rest of the module

Technical data of the digital inputs/outputs if used as inputs

Parameter	Value
Number of channels per module	Max. 16 digital inputs
Reference potential for all inputs	Terminals 1.9, 2.9, 3.9 and 4.9 (negative pole of the process supply voltage, signal name ZP)
Input current, per channel	See 'Technical Data of the Digital Inputs' *Chapter 1.6.1.2.3.10.2 “Technical data of the digital inputs” on page 473*
Input type acc. to EN 61131-2	Type 1
Input delay (0->1 or 1->0)	Typ. 8 ms, configurable from 0.1 to 32 ms

Parameter		Value
Input signal voltage		24 V DC
Signal 0		-3 V ... +5 V *)
undefined signal		> +5 V ... < +15 V
Signal 1		+15 V ... +30 V
Ripple with signal 0		Within -3 V ... +5 V *)
Ripple with signal 1		Within +15 V ... +30 V
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

*) Due to the direct connection to the output, the demagnetizing varistor is also effective at the input (see figure) above. This is why the difference between UPx and the input signal must not exceed the clamp voltage of the varistor. The varistor limits the clamp voltage to approx. 36 V. Consequently, the input voltage must range from -12 V ... +30 V when UPx = 24 V and from -6 V ... +30 V when UPx = 30 V.

Technical data of the digital inputs/outputs if used as outputs

Parameter		Value
Number of channels per module		Max. 16 transistor outputs
Reference potential for all outputs		Terminals 1.9, 2.9, 3.9 and 4.9 (negative pole of the process supply voltage, signal name ZP)
Common power supply voltage		For all outputs: terminals 1.8, 2.8, 3.8 and 4.8 (positive pole of the process supply voltage, signal name UP)
Output voltage for signal 1		UP (-0.8 V)
Output delay (0->1 or 1->0)		On request
Output current		
	Rated value, per channel	500 mA at UP = 24 V
	Maximum value (all channels together)	8 A
Leakage current with signal 0		< 0.5 mA
Rated protection fuse on UP		10 A fast
Demagnetization when inductive loads are switched off		With varistors integrated in the module (see figure below)
Switching frequency		
	With resistive load	On request
	With inductive loads	Max. 0.5 Hz
	With lamp loads	Max. 11 Hz with max. 5 W
Short-circuit-proof / overload-proof		Yes
Overload message (I > 0.7 A)		Yes, after ca. 100 ms
Output current limitation		Yes, automatic reactivation after short circuit/overload
Resistance to feedback against 24 V signals		Yes
Max. cable length		

Parameter		Value
	Shielded	1000 m
	Unshielded	600 m

The following drawing shows the circuitry of a digital input/output with the varistors for demagnetization when inductive loads are switched off.

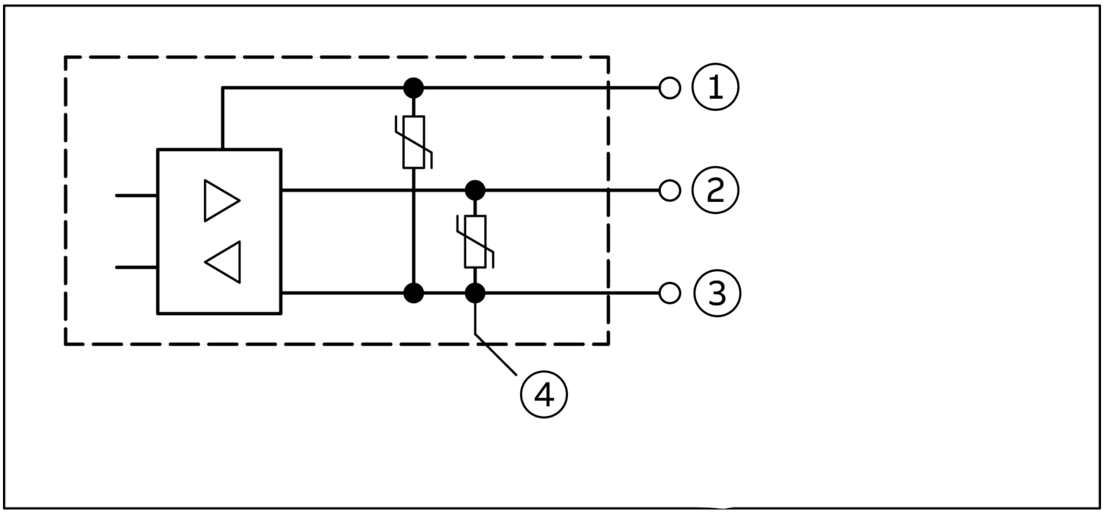


Fig. 124: Digital input/output (circuit diagram)

1 UPx (+ 24 V)
2 Digital input/output
3 ZPx (0 V)
4 For demagnization when inductive loads are switched off

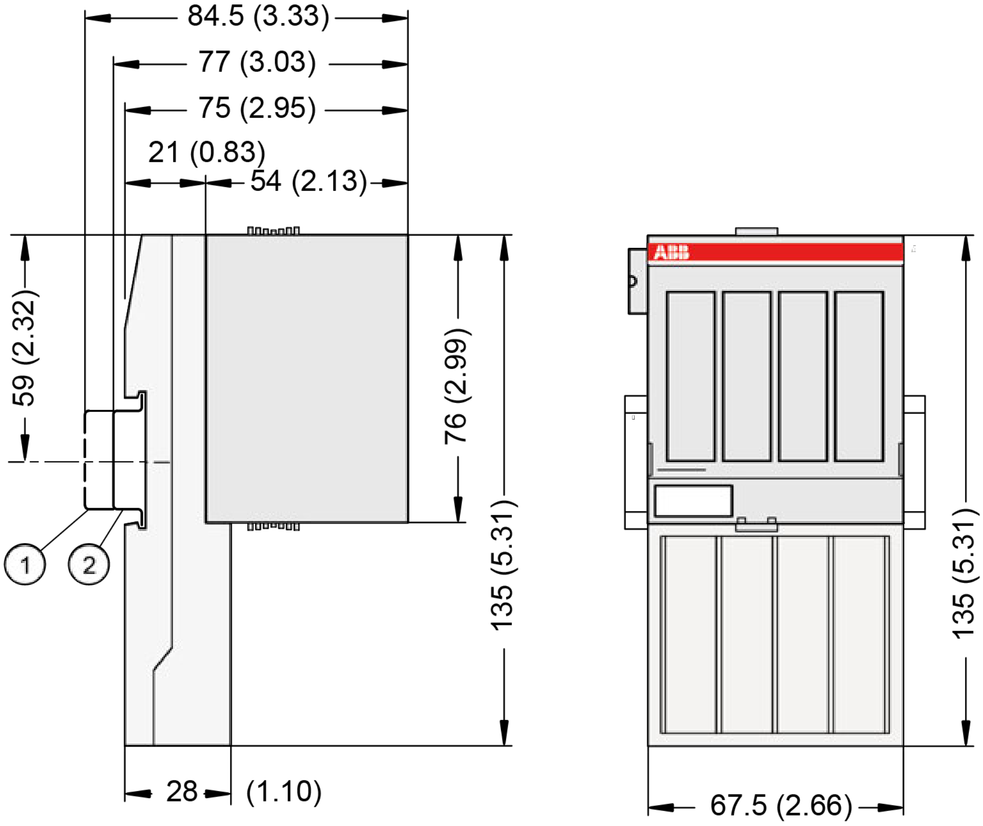
Technical data of the fast counter

The fast counter of the module does not work if the module is connected to a

- *FBP interface module*
- *CS31 bus module*
- *CANopen communication interface module*

Parameter	Value
Used inputs	C24 / C25
Used outputs	C26
Counting frequency	Max. 50 kHz

Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

Ordering data

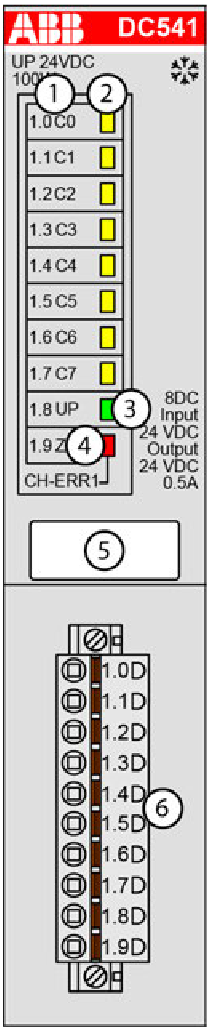
Part no.	Description	Product life cycle phase *)
1SAP 240 100 R0001	DC532, digital input/output module, 16 DI, 16 DC, 24 V DC / 0.5 A, 1-wire	Active
1SAP 440 100 R0001	DC532-XC, digital input/output module, 16 DI, 16 DC, 24 V DC / 0.5 A, 1-wire, XC version	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

1.6.1.2.4 DC541-CM - Digital input/output module

- 8 configurable digital inputs/outputs 24 V DC, in a communication module housing
- Fast counter

- Module-wise galvanically isolated
- XC version for use in extreme ambient conditions available



1 Allocation between terminal number and signal name
2 8 yellow LEDs to display the signal states at the inputs/outputs C0 ... C7
3 1 green LED to display the state of the process supply voltage UP
4 1 red LED to display errors (CH-ERR1)
5 Label
6 Terminal block with 10 terminals for 8 inputs/outputs and process power supply (ZP/UP)
Sign for XC version

Intended purpose

In contrast to other I/O modules, the digital I/O module (multi-function module) DC541-CM is connected to a communication module slot to the left of the AC500 CPU. It contacts the internal communication module bus. This way, the full functionality of the communication module bus is available for the module DC541-CM. Depending on the terminal base TB5x1 used, up to 4 DC541-CM modules can be connected.

The multi-function module DC541-CM can optionally (not at the same time) be configured as an interrupt module or as a fast counter module for 24 V signals (e.g. 24 V incremental encoder).Automation Builder is used for the configuration.

The module contains 8 fast channels (C0 ... C7) with the following features:

- 8 digital inputs/outputs in one group (1.0 ... 1.7), of which each can be used
  – as an input,
  – as a transistor output with short-circuit and overload protection, 0.5 A rated current or
  – as a re-readable output (combined input/output) with the technical data of the digital inputs and outputs.

The states of the inputs/outputs are indicated by yellow LEDs (one per channel). There is no potential separation between the channels.

Functionality

Parameter	Value
Digital inputs/outputs	8 (24 V DC)
Fast counter	Integrated, many configurable operating modes
LED displays	For signal states, errors and supply voltage
Internal power supply	Through the communication module bus
External power supply	Via the terminals ZP and UP (process voltage 24 V DC)
Effect of incorrect input terminal connection	Wrong or no signal detected, no damage up to 35 V

In the operating mode Interrupt I/O module, the channels can be configured as follows:

- Input
- Output
- Interrupt input

In this way, important input information can be evaluated independently of the program cycle and outputs can be set.

In the operating mode Counter, the channels can be configured as follows:

- Input
- Output
- 32-bit bidirectional counter (uses C0 ... C3) as a 32-bit-counter without limit
- 32-bit periodic counter as a 32-bit counter with a limit
- Limiter for a 32-bit counter (limit channel 0)
- 32-bit count up counter (forward counter) with the frequencies 50 kHz, 5 kHz and 2.5 kHz
- Pulse-width modulation (PWM) with a resolution of 10 kHz
- Time and frequency measurement
- Frequency output

Used as a fast counter module, the 8 channels of the multi-function module DC541-CM can be configured and combined individually, easily and versatilely in the PLC configuration. The module is therefore also excellent for universal high-frequency counting tasks up to 50 kHz. In addition, it has measuring functions for rotational speed, time and frequency.

These different channel configurations can now be combined flexibly on-board.

Example 1: 32-bit bidirectional counter incl. zero trace and touch-trigger for max. 50 kHz plus 4 accompanying limiting values (comparison values). When the counter reaches one of the comparison values, the corresponding output can be set in order to trigger control functions at the machine or installation directly.

Example 2: 2 counters for 50 kHz plus frequency measurement with a resolution of 200 µs plus 4 digital I/Os.

Further examples and a detailed description of the fields of application are contained in the chapter "System Technology of AC500'.

Commissioning is carried out via the user program by using the appropriate function blocks.

Connections

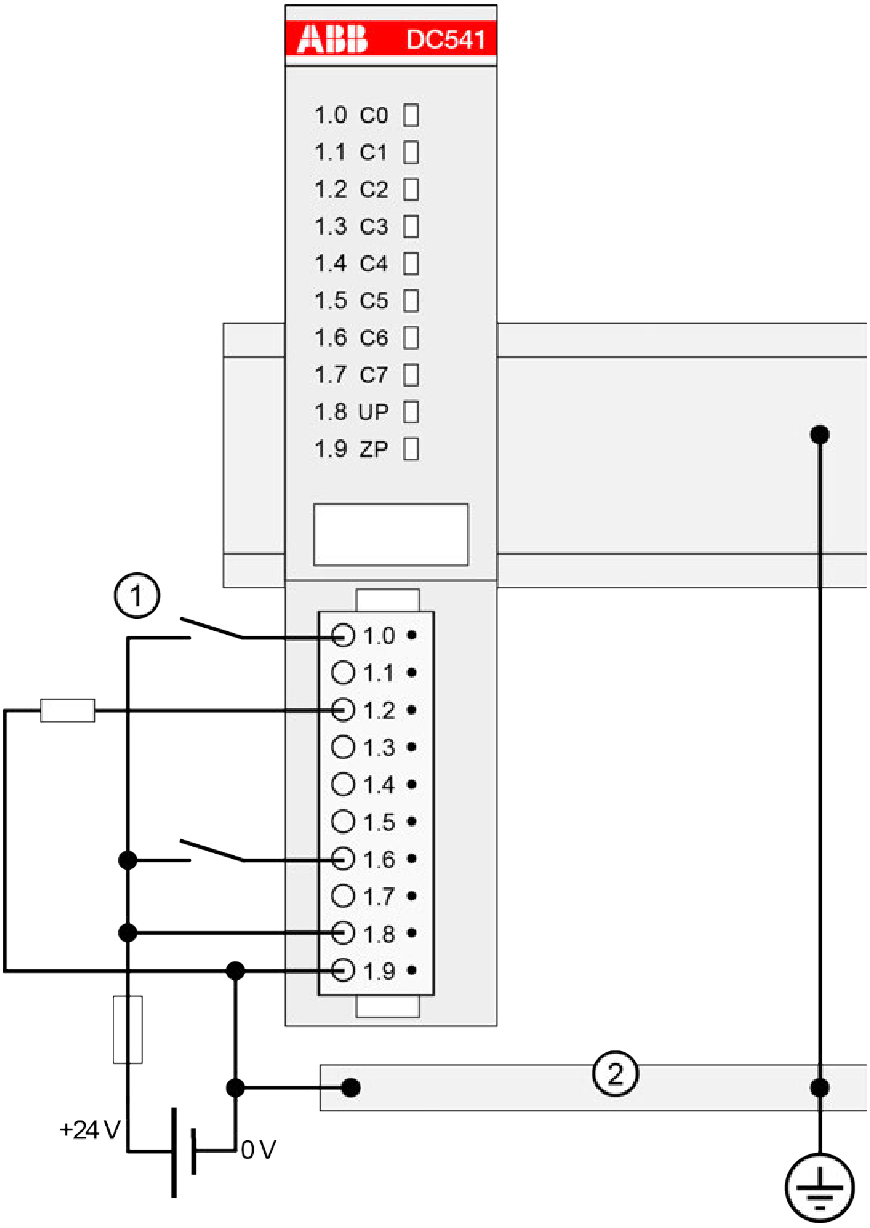
The I/O module DC541-CM is mounted to the left of an AC500 CPU on the same terminal base. The connection to the communication module bus is automatically established while mounting.

The connection of the I/O channels is carried out using the 10 terminals of the removable terminal block. I/O modules can be replaced without re-wiring.

The process voltage is connected in the following way:

Terminal 1.8: process voltage UP = +24 V DC

Terminal 1.9: process voltage ZP = 0 V DC



1 1.0 ... 1.7: Connected with UP (switch) -> Input;
Connected with ZP (load) -> Output
2 Control cabinet earth

The assignment of the other terminals:

Terminals	Signal	Description
1.0 ... 1.7	C0 ... C7	8 digital inputs/outputs

CAUTION!
The process supply voltage must be included in the grounding concept (e. g. grounding of the negative terminal).

The internal supply voltage for the module's circuitry comes from the communication module bus. The process voltage for the inputs/outputs is provided via ZP and UP.

WARNING!
Removal/Insertion under power
The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!
Risk of damaging the PLC modules!
Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

NOTICE!
Risk of influences to the connected sensors!
Some sensors may be influenced by the deactivated module outputs of DC522.

Connect a 470 Ω / 1 W resistor in series to inputs C8/C9 if they are used as fast counter inputs to avoid any influences.

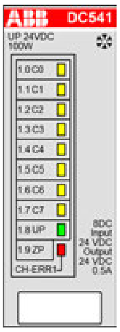
The module provides several diagnostic functions *Chapter 1.6.1.2.4.5 “State LEDs” on page 482*.

I/O configuration and parameterization

The DC541-CM module does not store configuration data itself. Configuration and parameterization are performed with Automation Builder software.

State LEDs

In case of overload or short-circuit, the outputs switch off automatically and try to switch on again cyclically. Therefore, an acknowledgement of the outputs is not necessary.

LED		State	Color	LED = OFF	LED = ON
	Inputs/ out-puts C0 ... C7	Digital input or digital output	Yellow	Input/output = OFF	Input/output = ON
	UP	Process supply voltage 24 V DC via terminal	Green	Process supply voltage is missing	Process supply voltage OK and initialization terminated
	CH-ERR1	Module Error	Red	No error	Error

Technical data

Technical data of the module

The system data of AC500 and S500 are applicable to the standard version *Chapter 2.6.1 “System data AC500” on page 1408*.

The system data of AC500-XC are applicable to the XC version *Chapter 2.7.1 “System data AC500-XC” on page 1475*.

Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

Parameter	Value
Process supply voltage UP	
Connections	Terminals 1.8 for +24 V (UP) and 1.9 for 0 V (ZP)
Rated value	24 V DC
Max. ripple	5 %
Absolute limits at XC version	Above +60 °C: 20 V DC ... 30 V DC
Protection against reversed voltage	Yes
Rated protection fuse on UP	10 A fast
Galvanic isolation	Yes, per module
Current consumption	
From 24 V DC power supply at the Terminal Base of the CPU	10 mA
Current consumption from UP at normal operation / with outputs	10 mA + 5 mA per input
Inrush current from UP (at power up)	0.002 A^2s
Max. power dissipation within the module	6 W (outputs unloaded)
Max. power dissipation within the module	On request

Parameter	Value
Weight (without terminal block)	Ca. 125 g
Mounting position	Horizontal or vertical with derating (output load reduced to 50 % at +40 °C per group)
Cooling	The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.
Altitude	> 2000 m: On request

NOTICE!
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and temporary overvoltage up to 30 V DC.

Multiple overloads
No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an internal smart high-side switch.

Technical data of the configurable digital inputs/outputs

Each of the configurable I/O channels is defined as input or output by the user program. This is done by interrogating or allocating the corresponding channel.

Parameter	Value
Number of channels per module	8 inputs/outputs (with transistors)
Distribution of the channels into groups	1 group of 8 channels
If the channels are used as inputs	
Channels C0...C7	Terminals 1.0 ... 1.7
If the channels are used as outputs	
Channels C0...C7	Terminals 1.0 ... 1.7
Reference potential for all inputs/outputs	Terminal 1.9 (ZP = Negative pole of the process supply voltage)
Indication of the input/output signals	1 yellow LED per channel, the LED is ON when the input/output signal is high (signal 1)
Monitoring point of input/output indicator	LED is part of the input circuitry
Galvanic isolation	From the rest of the module

Technical data of the digital inputs/outputs if used as inputs

Parameter	Value
Number of channels per module	Max. 8 digital inputs
Reference potential for all inputs	Terminal 1.9 (negative pole of the process supply voltage, signal name ZP)

Parameter	Value
Input current per channel	
Input voltage +24 V	Typ. 5 mA
Input voltage +5 V	> 1 mA
Input voltage +15 V	> 5 mA
Input voltage +30 V	< 8 mA
Input type acc. to EN 61131-2	Type 1
Input delay (0 -> 1 or 1 -> 0)	Typ. 2 µs
Input signal voltage	24 V DC
Signal 0	-3 V ... +5 V *)
Undefined signal	> +5 V ... < +15 V
Signal 1	+15 V ... +30 V
Ripple with signal 0	Within -3 V ... +5 V *)
Ripple with signal 1	Within +15 V ... +30 V
Max. cable length	
Shielded	1000 m
Unshielded	600 m

*) Due to the direct connection to the output, the demagnetizing varistor is also effective at the input (see figure) above. This is why the difference between UPx and the input signal must not exceed the clamp voltage of the varistor. The varistor limits the clamp voltage to approx. 36 V. Consequently, the input voltage must range from -12 V ... +30 V when UPx = 24 V and from -6 V ... +30 V when UPx = 30 V.

Technical data of the digital inputs/outputs if used as outputs

Parameter	Value
Number of channels per module	Max. 8 transistor outputs
Common power supply voltage	For all outputs: terminal 1.8 (positive pole of the process supply voltage, signal name UP)
Output voltage for signal 1	UP (-0.8 V)
Output delay (0 -> 1 or 1 -> 0)	Typ. 10 µs
Output current	
Rated value, per channel	500 mA at UP = 24 V
Maximum value (all channels together)	8 A
Leakage current with signal 0	< 0.5 mA
Rated protection fuse for UP	10 A fast
De-magnitization when inductive loads are switched off	With varistors integrated in the module (see figure below)
Switching frequency	
With resistive load	On request
With inductive loads	Max. 0.5 Hz
With lamp loads	Max. 11 Hz with max. 5 W
Short-circuit-proof / overload-proof	Yes

Parameter	Value
Overload message (I > 0.7 A)	Yes, after ca. 100 ms
Output current limitation	Yes, automatic reactivation after short circuit/overload
Resistance to feedback against 24 V signals	Yes
Max. cable length	
Shielded	1000 m
Unshielded	600 m

The following figure shows the circuitry of a digital input/output with the varistors for demagnetization when inductive loads are switched off.

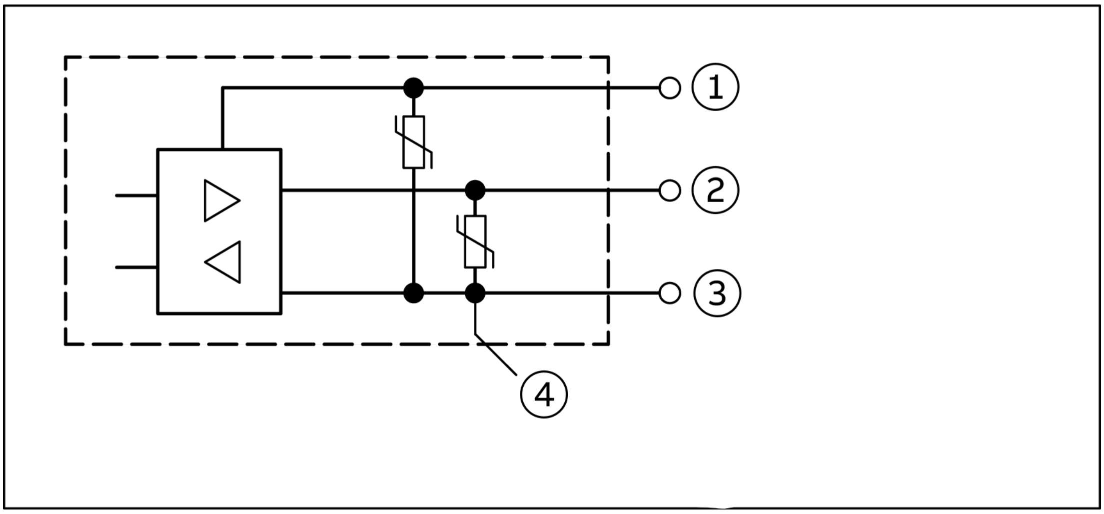


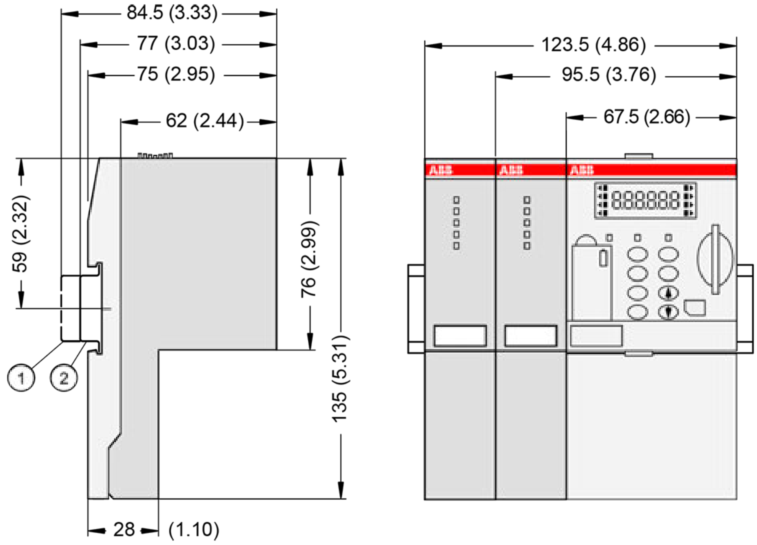
Fig. 125: Digital input/output (circuit diagram)

1 UPx (+ 24 V)
2 Digital input/output
3 ZPx (0 V)
4 For demagnization when inductive loads are switched off

Technical data of the fast counters

Parameter	Value
Used inputs for the traces A and B	C0 / C1
Used input for the zero trace, touch trigger	C2 / C3
Used outputs	C4 ... C7, if needed
Operating modes	*Chapter 1.6.1.2.4.2 “Functionality” on page 479*

Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

> *The dimensions are in mm and in brackets in inch.*

Ordering data

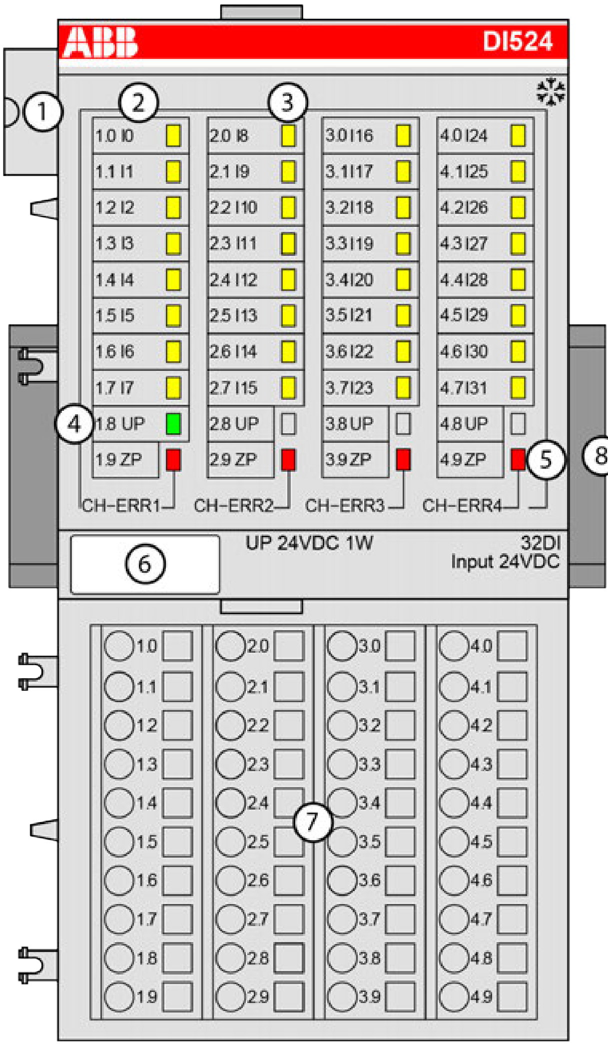
Part no.	Description	Product life cycle phase *)
1SAP 270 000 R0001	DC541-CM, digital input/output module, 8 DC, 24 V DC / 0.5 A, 1-wire	Active
1SAP 470 000 R0001	DC541-CM-XC, digital input/output module, 8 DC, 24 V DC / 0.5 A, 1-wire, XC version	Active

> **) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

1.6.1.2.5 DI524 - Digital input module

Features

- 32 digital inputs 24 V DC in 4 groups (1.0 ... 1.7, 2.0 ... 2.7, 3.0 ... 3.7 and 4.0 ... 4.7)
- Fast counter
- Module-wise galvanically isolated
- XC version for use in extreme ambient conditions available



1 I/O bus
2 Allocation between terminal number and signal name
3 32 yellow LEDs to display the signal states at the digital inputs (I0 ... I31)
4 1 green LED to display the state of the process supply voltage UP
5 4 red LEDs to display errors
6 Label
7 Terminal unit
8 DIN rail
Sign for XC version

Intended purpose

The device can be used as a decentralized I/O extension module for S500 communication interface modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs.

The configuration is performed by software. The modules are supplied with a process supply voltage of 24 V DC.

All available inputs/outputs are galvanically isolated from all other circuitry of the module. There is no potential separation between the channels within the same group.

For use in extreme ambient conditions (e.g. wider temperature and humidity range), a special XC version of the device is available.

Functionality

Parameter	Value
Fast counter	Integrated, many configurable operating modes (only with AC500)
LED displays	For signal states, errors and supply voltage
Internal power supply	Via the I/O bus interface (I/O bus)
External power supply	Via the terminals ZP and UP (process voltage 24 V DC)
Required terminal units	TU515 or TU516 ␥ *Chapter 1.5.3 “TU515, TU516, TU541 and TU542 for I/O modules” on page 282*
Effect of incorrect input terminal connection	Wrong or no signal detected, no damage up to 35 V

The device is plugged on a terminal unit ␥ *Chapter 1.5.3 “TU515, TU516, TU541 and TU542 for I/O modules” on page 282*. Position the module properly and press until it locks in place. The terminal unit is either mounted on a DIN rail or to the wall using 2 screws plus the additional accessory for wall mounting ␥ *Chapter 1.9.3.5 “TA526 - Wall mounting accessory” on page 1361*.

Connections

For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.

The connection of the I/O channels is carried out using the 40 terminals of the I/O terminal unit. I/O modules can be replaced without re-wiring the terminal units.

The terminals 1.8 ... 4.8 and 1.9 ... 4.9 are electrically interconnected within the I/O terminal unit and have always the same assignment, irrespective of the inserted module:

Terminals 1.8 ... 4.8: process voltage UP = +24 V DC

Terminals 1.9 ... 4.9: process voltage ZP = 0 V DC

Table 153: Assignment of the other terminals:

Terminals	Signal	Description
1.0 ... 1.7	I0 ... I7	8 digital inputs
2.0 ... 2.7	I8 ... I15	8 digital inputs
3.0 ... 3.7	I16 ... I23	8 digital inputs
4.0 ... 4.7	I24 ... I31	8 digital inputs

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a communication interface module or a CPU). Thus, the current consumption from 24 V DC power supply at the terminals L+/UP and M/ZP of the CPU/communication interface module increases by 2 mA per DI524.

The external power supply connection is carried out via the UP (+24 V DC) and the ZP (0 V DC) terminals.

WARNING!

Removal/Insertion under power

Removal or insertion under power is permissible only if all conditions for hot swapping are fullfilled.

↳ *Conditions for hot swap*

↳ *“Conditions for hot swap” on page 1367*

The devices are not designed for removal or insertion under power when the conditions for hot swap do not apply. Because of unforeseeable consequences, it is not allowed to plug in or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

Disconnecting any powered devices while they are energized in a hazardous location could result in an electric arc, which could create an ignition source resulting in fire or explosion.

Prior to proceeding, make sure that power is been disconnected and that the area has been thoroughly checked to ensure that flammable materials are not present.

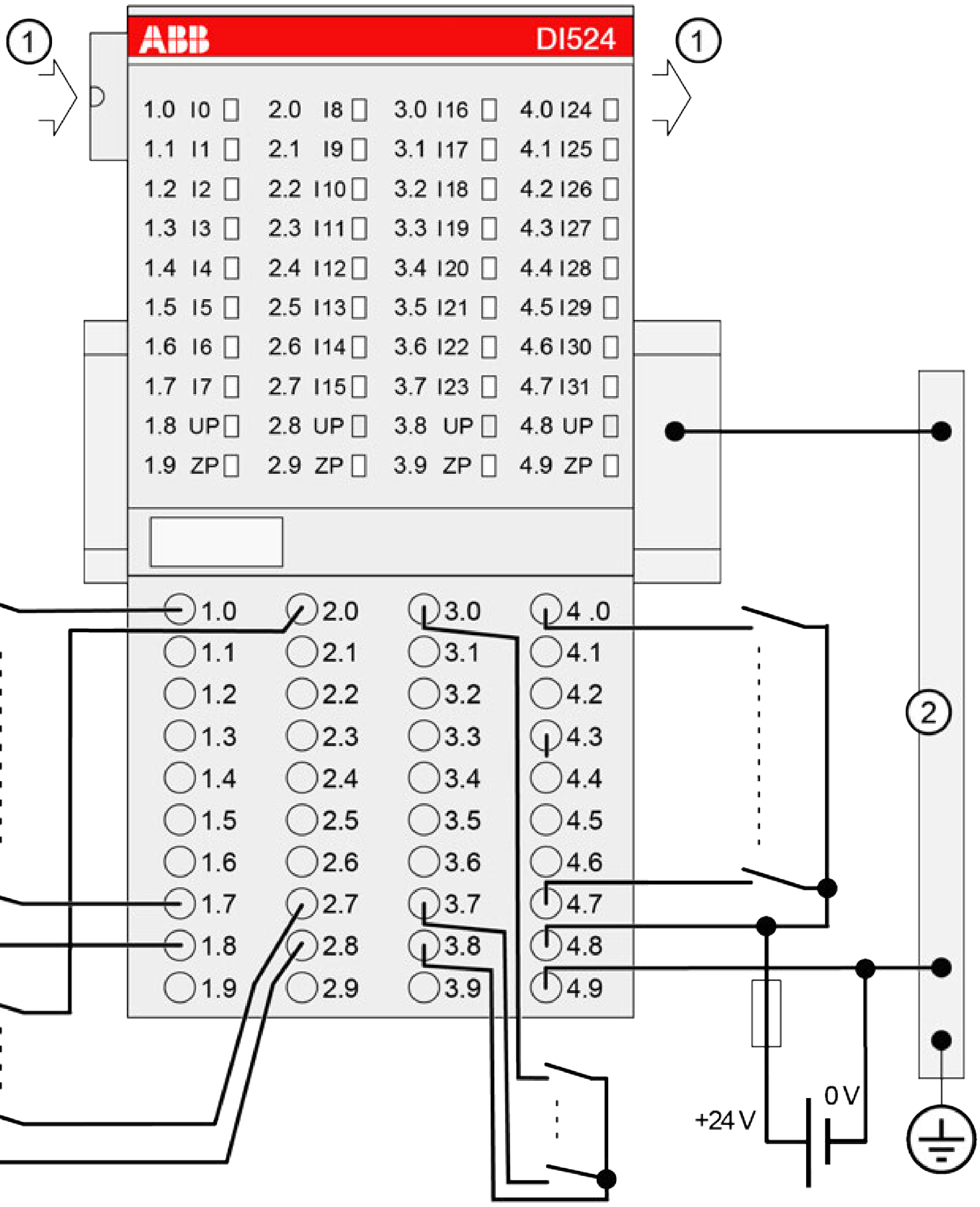
The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!

Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.



1 I/O bus
2 Control cabinet earth

CAUTION!
The process supply voltage must be included in the grounding concept (e. g. grounding of the negative terminal).

The module provides several diagnosis functions.

Internal data exchange

	Without the fast counter	With the fast counter (only with AC500)
Digital inputs (bytes)	4	6
Digital outputs (bytes)	0	2

	Without the fast counter	With the fast counter (only with AC500)
Counter input data (words)	0	4
Counter output data (words)	0	8

I/O configuration

The module itself does not store configuration data. It receives its parameterization data from the master device of the I/O bus (CPU or communication interface module) during power-up of the system.

Hence, replacing I/O modules is possible without any re-parameterization via software.

If the external power supply voltage via UP/ZP terminals fails, the I/O module loses its configuration data. The whole station has to be switched off and on again to re-configure the module.

Parameterization

Firmware version	Configuration
Firmware version > V2.0.0	The arrangement of the parameter data is performed by Control Builder Plus/ Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Module: Module slot address: Y = 1 ... 10

No.	Name	Value	Internal value	Internal value, type	Default	Min.	Max.	EDS Slot/ Index
1	Module ID	Internal	1000 [1])	Word	1000 0x03E8	0	65535	0x0Y01
2	Ignore module [2])	No Yes	0 1	Byte	No 0x00			Not for FBP
3	Parameter length	Internal	3-CPU 2-FBP	Byte	3 2	0	255	0x0Y02
4	Check supply	Off On	0 1	Byte	On 0x01	0	1	0x0Y03

No.	Name	Value	Internal value	Internal value, type	Default	Min.	Max.	EDS Slot/ Index
5	Input delay	0.1 ms 1 ms 8 ms 32 ms	0 1 2 3	Byte	8 ms 0x02	0	3	0x0Y04
6	Fast counter 4)	0 : 10 3)	0 : 10	Byte	Mode 0 0x00			Not for FBP

Remarks:

1)	With CS31 and addresses smaller than 70 and FBP, the value is increased by 1
2)	Not with FBP
3)	For a description of the counter operating modes, please refer to the 'Fast Counter' section *Chapter 1.6.1.2.10 “Fast counter” on page 545*
4)	With FBP or CS31 without the parameter Fast counter

GSD file:

Ext_User_Prm_Data_Len = Ext_User_Prm_Data_Const(0) =	5 0x03, 0xe9, 0x02, \ 0x01, 0x02;

Diagnosis

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identifier** **000 ... 063**	**AC500 display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**	
Byte 6 **Bit 6 ... 7**	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6** **Bit 0 ... 5**	**FBP diag-nosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error identifier**	**Error message**	**Remedy**
	1)	**2)**	**3)**	**4)**			
Module error							
3	14	1 ... 10	31	31	19	Checksum error in the I/O module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	3	Timeout in the I/O module	Replace I/O module
	11 / 12	ADR	1 ... 10				

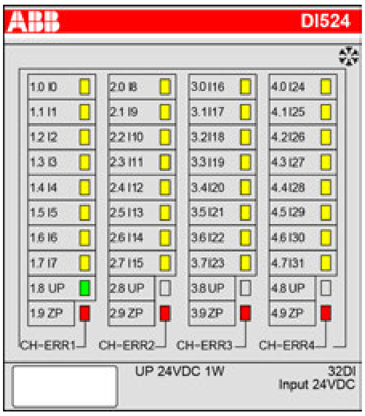
E1 ... E4	d1	d2	d3	d4	Identifier 000 ... 063	AC500 display	<− Display in
Class	Comp	Dev	Mod	Ch	Err	PS501 PLC browser	
Byte 6 Bit 6 ... 7	-	Byte 3	Byte 4	Byte 5	Byte 6 Bit 0 ... 5	FBP diagnosis block	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error identifier**	**Error message**	**Remedy**
	[1])	[2])	[3])	[4])			
3	14	1 ... 10	31	31	40	Different hard-/firmware versions in the module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	43	Internal error in the module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	36	Internal data exchange failure	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	9	Overflow diagnosis buffer	New start
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	26	Parameter error	Check master
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	11	Process voltage too low	Check process voltage
	11 / 12	ADR	1 ... 10				
4	14	1 ... 10	31	31	45	Process voltage is switched off (ON −> OFF)	Process voltage ON
	11 / 12	ADR	1 ... 10				

Remarks:

[1])	In AC500 the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The FBP diagnosis block does not contain this identifier.
[2])	With "Device" the following allocation applies: 31 = module itself, 1 ... 10 = decentralized communication interface module 1 ... 10, ADR = hardware address (e.g. of the DC551)
[3])	With "Module" the following allocation applies depending on the master: Module error: I/O bus or FBP: 31 = module itself; COM1/COM2: 1 ... 10 = expansion 1 ... 10
[4])	In case of module errors, with channel "31 = module itself" is output.

State LEDs

During the power ON procedure, the module initializes automatically. All LEDs (except the channel LEDs) are ON during this time.

LED		State	Color	LED = OFF	LED = ON	LED flashes
	Inputs I0 ... I31	Digital input	Yellow	Input = OFF	Input = ON 1)	--
	UP	Process supply voltage 24 V DC via terminal	Green	Process supply voltage is missing	Process supply voltage OK	--
	CH-ERR1	Channel error, error messages in groups (digital inputs combined into the groups 1, 2, 3, 4)	Red	No error or process supply voltage is missing	Severe error within the corresponding group	Error on one channel of the corresponding group
	CH-ERR2		Red			
	CH-ERR3		Red			
	CH-ERR4		Red			
	CH-ERR 2)	Module error	Red	--	Internal error	--
	1) Indication LED is ON even if an input signal is applied to the channel and the supply voltage is off. In this case the module is not operating and does not generate an input signal.					
	2) All of the LEDs CH-ERR1 to CH-ERR4 light up together					

Technical data

Technical data of the module

The system data of AC500 and S500 are applicable to the standard version *Chapter 2.6.1 “System data AC500” on page 1408*.

The system data of AC500-XC are applicable to the XC version *Chapter 2.7.1 “System data AC500-XC” on page 1475*.

Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

Parameter		Value
Process supply voltage UP		
	Connections	Terminals 1.8, 2.8, 3.8 and 4.8 for +24 V (UP) as well as 1.9, 2.9, 3.9 and 4.9 for 0 V (ZP)
	Rated value	24 V DC
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	Rated protection fuse for UP	10 A fast
	Galvanic isolation	Yes, per module
Current consumption		
	From 24 V DC power supply at the terminals UP/L+ and ZP/M of the CPU/ communication interface module	ca. 2 mA
	From UP at normal operation	0.15 A
	Inrush current from UP (at power up)	0.008 A^2s

Parameter	Value
Weight (without terminal unit)	ca. 105 g
Mounting position	Horizontal or vertical with derating (output load reduced to 50 % at +40 °C per group)
Cooling	The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

NOTICE!
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and temporary overvoltage up to 30 V DC.

Technical data of the digital inputs

Parameter		Value
Number of channels per module		32
Distribution of the channels into groups		1 group of 32 channels
Terminals of the channels I0 ... I7		1.0 ... 1.7
Terminals of the channels I8 ... I15		2.0 ... 2.7
Terminals of the channels I16 ... I23		3.0 ... 3.7
Terminals of the channels I24 ... I31		4.0 ... 4.7
Reference potential for all inputs		Terminals 1.9, 2.9, 3.9 and 4.9 (negative pole of the process supply voltage, signal name ZP)
Galvanic isolation		From the rest of the module (I/O bus)
Indication of the input signals		One yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Monitoring point of input indicator		LED is part of the input circuitry
Input type acc. to EN 61131-2		Type 1
Input delay (0 -> 1 or 1 -> 0)		Typ. 8 ms, configurable from 0.1 ... 32 ms
Input signal voltage		24 V DC
	Signal 0	-3 V ... +5 V
	Undefined signal	> +5 V ... < +15 V
	Signal 1	+15 V ... +30 V
Ripple with signal 0		Within -3 V ... +5 V
Ripple with signal 1		Within +15 V ... +30 V
Input current per channel		
	Input voltage +24 V	Typ. 5 mA
	Input voltage +5 V	> 1 mA
	Input voltage +15 V	> 5 mA
	Input voltage +30 V	< 8 mA
Max. cable length		

Parameter		Value
	Shielded	1000 m
	Unshielded	600 m

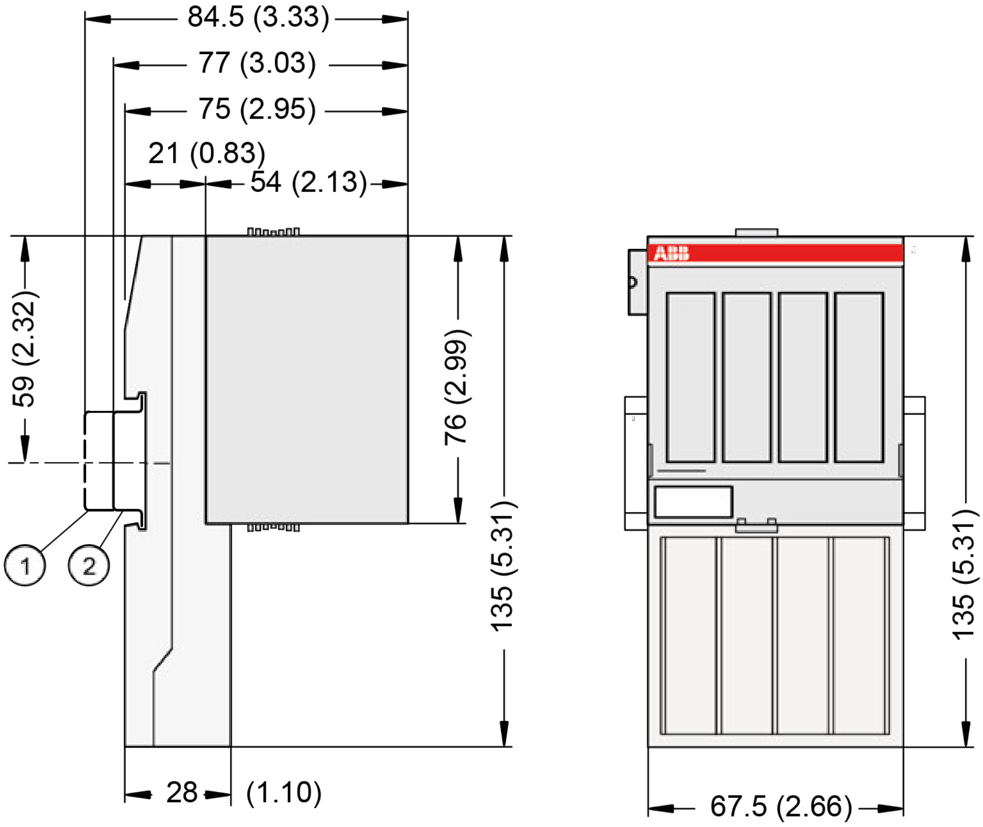
Technical data of the fast counter

The fast counter of the module does not work if the module is connected to a

- *FBP interface module*
- *CS31 bus module*
- *CANopen communication interface module*

Parameter	Value
Used inputs	I24 / I25
Used outputs	None
Counting frequency	Max. 50 kHz

Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

Ordering data

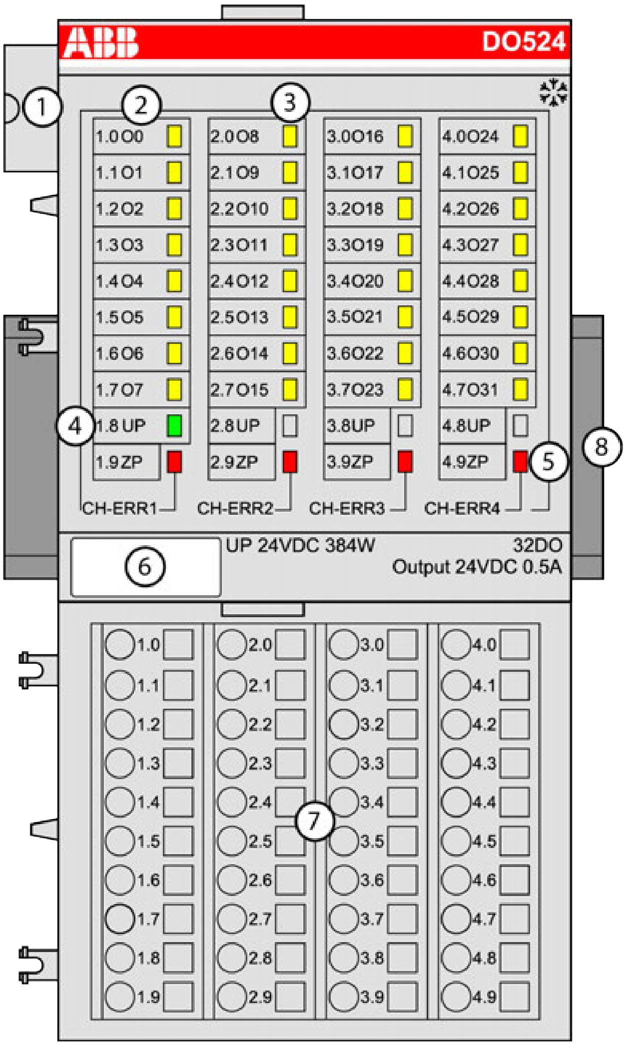
Part no.	Description	Product life cycle phase *)
1SAP 240 000 R0001	DI524, digital input module, 32 DI, 24 V DC, 1-wire	Active
1SAP 440 000 R0001	DI524-XC, digital input module, 32 DI, 24 V DC, 1-wire, XC version	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

1.6.1.2.6 DO524 - Digital output module

Features

- 32 digital outputs 24 V DC / 0.5 A in 4 groups (1.0 ... 4.7) with short circuit and overload protection
- Module-wise galvanically isolated
- XC version for use in extreme ambient conditions available



1 I/O bus
2 Allocation between terminal number and signal name
3 32 yellow LEDs to display the signal states at the digital outputs (O0 ... O31)
4 1 green LED to display the state of the process supply voltage UP
5 4 red LEDs to display errors
6 Label
7 Terminal unit
8 DIN rail
Sign for XC version

Intended purpose

The device can be used as a decentralized I/O extension module for S500 communication interface modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs.

The outputs are galvanically isolated from all other circuitry of the module. There is no potential separation between the channels.

Functionality

Parameter	Value
LED displays	For signal states, errors and supply voltage
Internal power supply	Via the I/O bus interface (I/O bus)
External power supply	Via the terminals ZP and UP (process voltage 24 V DC)
Required terminal unit	TU515 or TU516 ⇘ *Chapter 1.5.3 "TU515, TU516, TU541 and TU542 for I/O modules" on page 282*

The device is plugged on a terminal unit ⇘ *Chapter 1.5.3 "TU515, TU516, TU541 and TU542 for I/O modules" on page 282*. Position the module properly and press until it locks in place. The terminal unit is either mounted on a DIN rail or to the wall using 2 screws plus the additional accessory for wall mounting ⇘ *Chapter 1.9.3.5 "TA526 - Wall mounting accessory" on page 1361*.

> ***Multiple overloads***
> *No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an internal smart high-side switch.*

Connections

> *For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.*

The connection of the I/O channels is carried out using the 40 terminals of the I/O terminal unit. I/O modules can be replaced without re-wiring the terminal units.

The terminals 1.8 ... 4.8 and 1.9 ... 4.9 are electrically interconnected within the I/O terminal unit and have always the same assignment, independent of the inserted module:

Terminals 1.8 ... 4.8: process voltage UP = +24 V DC

Terminals 1.9 ... 4.9: process voltage ZP = 0 V DC

The assignment of the other terminals:

Terminals	Signal	Description
1.0 ... 1.7	O0 ... O7	8 digital outputs
2.0 ... 2.7	O8 ... O15	8 digital outputs
3.0 ... 3.7	O16 ... O23	8 digital outputs
4.0 ... 4.7	O24 ... O31	8 digital outputs

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a communication interface module or a CPU). Thus, the current consumption from 24 V DC power supply at the terminals L+/UP and M/ZP of the CPU/communication interface module increases by 2 mA per DO524.

The external power supply connection is carried out via the UP (+24 V DC) and the ZP (0 V DC) terminals.

WARNING!
Removal/Insertion under power
Removal or insertion under power is permissible only if all conditions for hot swapping are fullfilled.

Conditions for hot swap

"Conditions for hot swap" on page 1367

The devices are not designed for removal or insertion under power when the conditions for hot swap do not apply. Because of unforeseeable consequences, it is not allowed to plug in or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

Disconnecting any powered devices while they are energized in a hazardous location could result in an electric arc, which could create an ignition source resulting in fire or explosion.

Prior to proceeding, make sure that power is been disconnected and that the area has been thoroughly checked to ensure that flammable materials are not present.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!
Risk of damaging the PLC modules!
Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

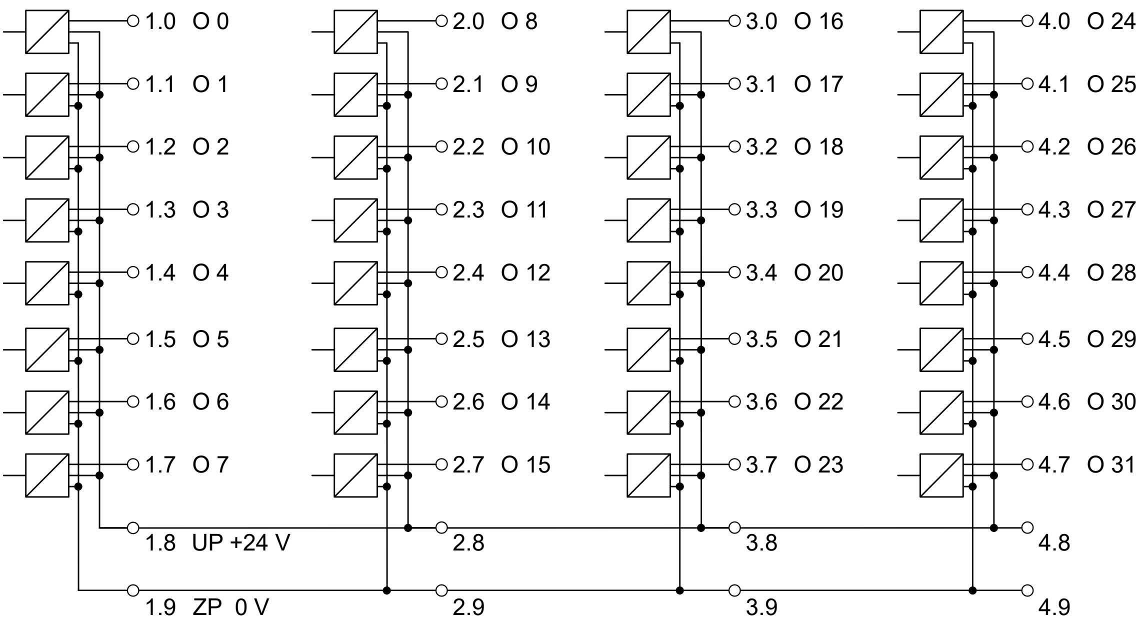


Fig. 126: Internal construction of the digital outputs

The module provides several diagnosis functions.

Internal data exchange

Digital inputs (bytes)	0
Digital outputs (bytes)	4

I/O configuration

The module itself does not store configuration data. It receives its parameterization data from the master device of the I/O bus (CPU or communication interface module) during power-up of the system.

Hence, replacing I/O modules is possible without any re-parameterization via software.

> *If the external power supply voltage via UP/ZP terminals fails, the I/O module loses its configuration data. The whole station has to be switched off and on again to re-configure the module.*

Parameterization

Firmware version	Configuration
Firmware version > V2.0.0	The arrangement of the parameter data is performed by Control Builder Plus/ Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Module: Module slot address: Y = 1 ... 10

Name	Value	Internal value	Internal value, type	Default	Min.	Max.	Max.
Module ID	Internal	1101 1)	WORD	1101 0x044D	0	65535	0x0Y01
Ignore module 2)	No Yes	0 1	BYTE	No 0x00			not for FBP
Parameter length	Internal	7	BYTE	7-CPU 7-FBP	0	255	0x0Y02
Check supply	Off on	0 1	BYTE	On 0x01	0	1	0x0Y03
Output short circuit detection	Off On	0 1	BYTE	On 0x01	0	1	0x0Y04

Name	Value	Internal value	Internal value, type	Default	Min.	Max.	Max.
Behaviour of outputs at communication errors	Off Last value Substitute value	0 1+(n*5) 2+(n*5), n ≤ 2	BYTE	Off 0x00	0	2	0x0Y05
Substitute value at outputs Bit 31 = Output 31 Bit 0 = Output 0	0 ... 4294967295	0 ... 0xffffffff	DWORD	0 0x00000000	0	4294967295	0x0Y06

1) With CS31 and addresses smaller than 70 and FBP, the value is increased by 1

2) Not with FBP

GSD file:

Ext_User_Prm_Data_Len =	10
Ext_User_Prm_Data_Const(0) =	0x04, 0x4d, 0x07, \
	0x01, 0x01, 0x00, 0x00, 0x00, 0x00, 0x00;

Diagnosis

In case of overload or short circuit, the outputs switch off automatically and try to switch on again cyclically. Therefore, an acknowledgement of the outputs is not necessary. The LED error message, however, is stored.

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identifier 000 ... 063**	**AC500 display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**	
Byte 6 Bit 6 ... 7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0 ... 5**	**FBP diagnosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error Identifier**	**Error message**	**Remedy**
	1)	2)	3)	4)			
Module error							
3	14	1 ... 10	31	31	19	Checksum error in the I/O module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	3	Timeout in the I/O module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	40	Different hard-/firmware versions in the module	Replace I/O module

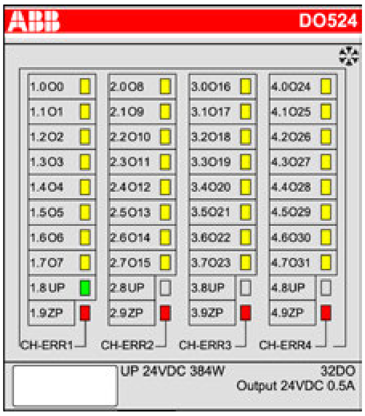
E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identifier** **000 ... 063**	**AC500 display**	**<– Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**	
Byte 6 **Bit 6 ... 7**	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6** **Bit 0 ... 5**	**FBP diag-nosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error Identifier**	**Error message**	**Remedy**
	1)	2)	3)	4)			
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	43	Internal error in the module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	36	Internal data exchange failure	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	9	Overflow diagnosis buffer	New start
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	26	Parameter error	Check master
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	11	Process voltage too low	Check process voltage
	11 / 12	ADR	1 ... 10				
4	14	1 ... 10	31	31	45	Process voltage is switched off (ON –> OFF)	Process voltage ON
	11 / 12	ADR	1 ... 10				
Channel error							
4	14	1 ... 10	2	0...31	47	Short circuit at a digital output	Check connection
	11 / 12	ADR	1 ... 10				

Remarks:

1)	In AC500 the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The FBP diagnosis block does not contain this identifier.
2)	With "Device" the following allocation applies: 31 = module itself, 1 ... 10 = decentralized communication interface module 1 ... 10, ADR = Hardware address (e.g. of the DC551)
3)	With "Module" the following allocation applies dependent of the master: Module error: I/O bus or FBP: 31 = module itself; COM1/COM2: 1 ... 10 = expansion 1 ... 10 Channel error: I/O bus or FBP = module type (4 = DC); COM1/COM2: 1 ... 10 = expansion 1 ... 10
4)	In case of module errors, with channel "31 = Module itself" is output.

State LEDs

During the power ON procedure, the module initializes automatically. All LEDs (except the channel LEDs) are ON during this time.

LED		State	Color	LED = OFF	LED = ON	LED flashes
	Outputs O0 ... O31	Digital output	Yellow	Output = OFF	Output = ON	--
	UP	Process supply voltage 24 V DC via terminal	Green	Process supply voltage is missing	Process supply voltage OK	--
	CH-ERR1	Channel error, error messages in groups (digital outputs combined into the groups 1, 2, 3, 4)	Red	No error or process supply voltage is missing	Severe error within the corresponding group	Error on one channel of the corresponding group (e.g. short circuit at an output)
	CH-ERR2		Red			
	CH-ERR3		Red			
	CH-ERR4		Red			
	CH-ERR *)	Module error	Red	--	Internal error	--
	*) All of the LEDs CH-ERR1 to CH-ERR4 light up together					

Technical data

Technical data of the module

The system data of AC500 and S500 are applicable to the standard version *Chapter 2.6.1 “System data AC500” on page 1408*.

The system data of AC500-XC are applicable to the XC version *Chapter 2.7.1 “System data AC500-XC” on page 1475*.

Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

Parameter		Value
Process supply voltage UP		
	Connections	Terminals 1.8, 2.8, 3.8 and 4.8 for +24 V (UP) as well as 1.9, 2.9, 3.9 and 4.9 for 0 V (ZP)
	Rated value	24 V DC
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	Rated protection fuse on UP	10 A fast
	Galvanic isolation	Yes, per module
Current consumption		
	From 24 V DC power supply at the terminals UP/L+ and ZP/M of the CPU/communication interface module	Ca. 2 mA

Parameter		Value
	From UP at normal operation / with outputs	0.10 A + max. 0.5 A per output
	Inrush current from UP (at power up)	0.005 A^2s
Max. power dissipation within the module		6 W (outputs unloaded)
Weight (without terminal unit)		Ca. 100 g
Mounting position		Horizontal Or vertical with derating (output load reduced to 50 % at +40 °C per group)
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

NOTICE!
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and temporary overvoltage up to 30 V DC.

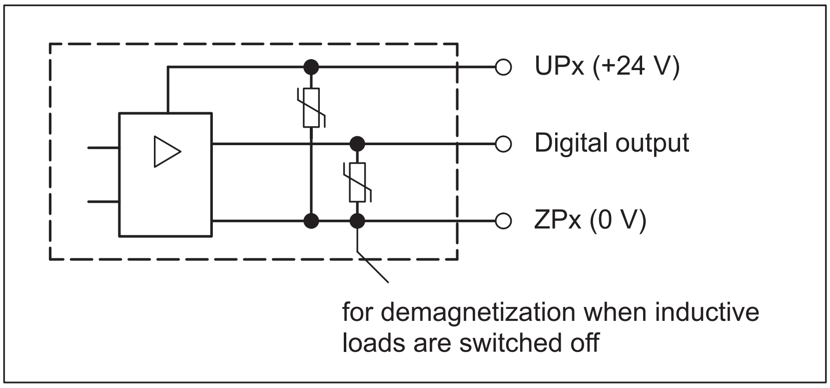
Multiple overloads
No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an internal smart high-side switch.

Technical data of the digital outputs

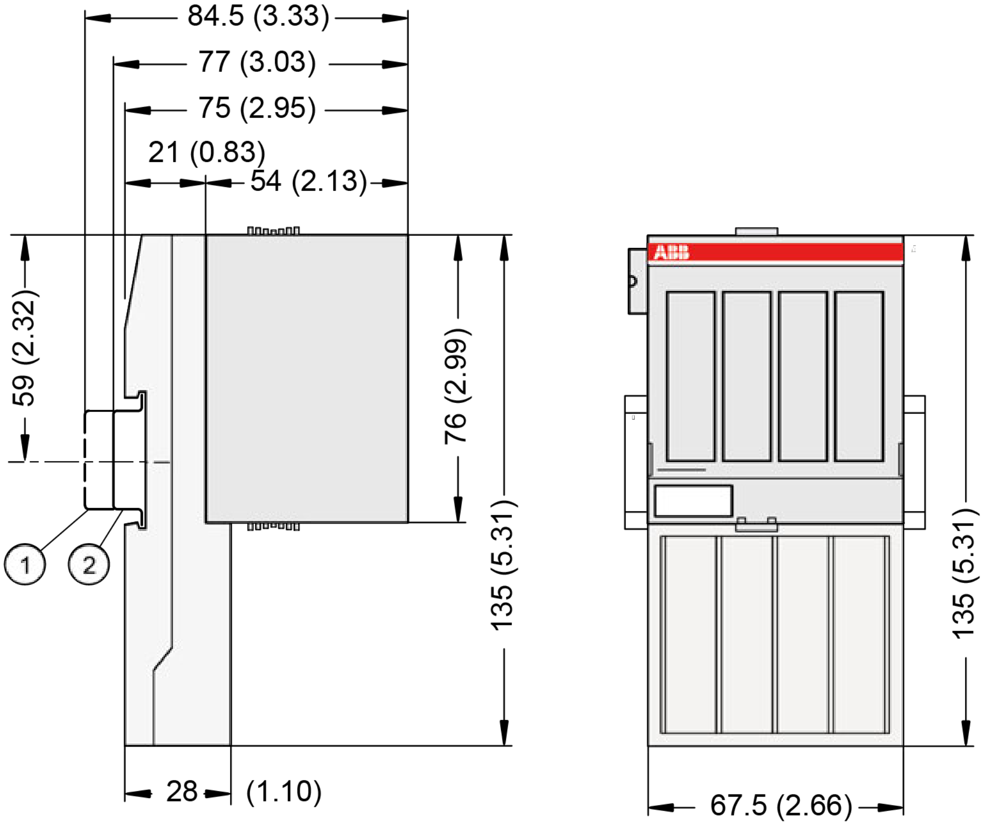
Parameter		Value
Number of channels per module		32 outputs (with transistors)
Distribution of the channels into groups		1 group of 32 channels
Connection of the channels		
	O0 ... O7	Terminals 1.0 ... 1.7
	O8 ... O15	Terminals 2.0 ... 2.7
	O16 ... O23	Terminals 3.0 ... 3.7
	O24 ... O31	Terminals 4.0 ... 4.7
Indication of the output signals		1 yellow LED per channel, the LED is ON if the output signal is high (signal 1)
Reference potential for all outputs		Terminals 1.9, 2.9, 3.9 and 4.9 (negative pole of the process supply voltage, signal name ZP)
Common power supply voltage		For all outputs: terminals 1.8, 2.8, 3.8 and 4.8 (positive pole of the process supply voltage, signal name UP)
Output voltage for signal 1		UP (-0.8 V)
Output delay (0 -> 1 or 1 -> 0)		On request
Output current		
	Rated value, per channel	500 mA at UP = 24 V
	Maximum value (channels O0 ... O15)	4 A

Parameter		Value
	Maximum value (channels O16 ... O31)	4 A
	Maximum value (all channels together)	8 A
Max. leakage current with signal 0		< 0.5 mA
Rated protection fuse on UP		10 A fast
Demagnetization when inductive loads are switched off		With varistors integrated in the module (see figure below)
Switching frequency		
	With resistive load	On request
	With inductive loads	Max. 0.5 Hz
	With lamp loads	Max. 11 Hz with max. 5 W
Short-circuit proof / overload proof		Yes
Overload message (**I** > 0.7 A)		Yes, after ca. 100 ms
Output current limitation		Yes, automatic reactivation after short-circuit/overload
Resistance to feedback against 24 V signals		Yes
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

The following drawing shows the circuitry of a digital output with the varistors for demagnetization when inductive loads are switched off.



Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

Ordering data

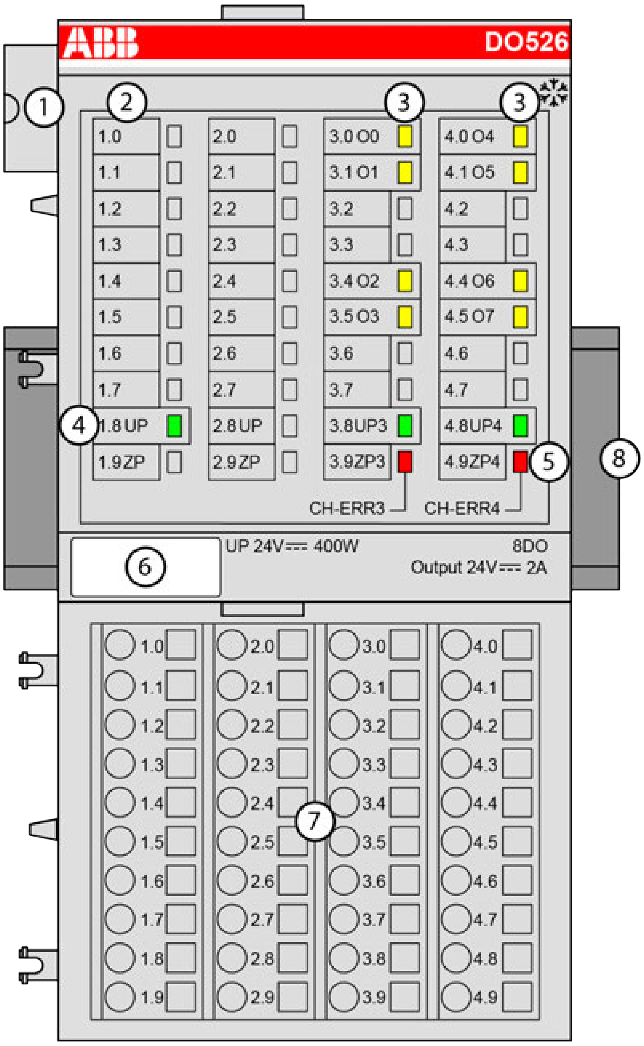
Part no.	Description	Product life cycle phase *)
1SAP 240 700 R0001	DO524, digital output module, 32 DO, 24 V DC / 0.5 A, 1-wire	Active
1SAP 440 700 R0001	DO524-XC, digital output module, 32 DO, 24 V DC / 0.5 A, 1-wire, XC version	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

1.6.1.2.7 DO526 - Digital output module

Features

- 8 digital outputs 24 V DC (O0 ... O7) in 2 groups without short circuit and without overload protection.
- Module and group-wise galvanically isolated
- XC version for use in extreme ambient conditions available



1 I/O bus
2 Allocation between terminal number and signal name
3 8 yellow LEDs to display the signal states of the outputs O0 ... O7
4 3 green LEDs to display the states of the process supply voltage UP, UP3 and UP4
5 2 red LEDs to display errors
6 Label
7 Terminal unit
8 DIN-rail
Sign for XC version

Intended purpose

The device can be used as a decentralized I/O extension module for S500 communication interface modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs.

The outputs are group-wise galvanically isolated from each other.

All other circuitry of the module is galvanically isolated from the outputs.

Potential separation between the channel groups.

Functionality

Parameter	Value
LED displays	For signal states, errors and supply voltages
Internal power supply	Via I/O bus
External power supply	Via the terminals ZP, ZP3, ZP4, UP, UP3 and UP4 (process voltage 24 V DC)
Required terminal unit	TU542 *Chapter 1.5.3 “TU515, TU516, TU541 and TU542 for I/O modules” on page 282*

The output module is plugged on the terminal unit TU542. Properly position the module and press until it locks in place. The terminal unit is mounted on a DIN rail or with 2 screws plus the additional accessory for wall mounting *Chapter 1.9.3.5 “TA526 - Wall mounting accessory” on page 1361*.

Connections

For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.

The connection of the I/O channels is carried out using the 40 terminals of the I/O terminal unit. I/O modules can be replaced without re-wiring the terminal units.

The terminals 1.8 ... 2.8 and 1.9 ... 2.9 are electrically interconnected within the I/O terminal unit and always have the same assignment, irrespective of the inserted module:

Terminals 1.8 ... 2.8:	Process voltage UP = +24 V DC
Terminals 1.9 ... 2.9:	Process voltage ZP = 0 V
Terminal 3.8:	Process voltage UP3 = +24 V DC
Terminal 3.9:	Process voltage ZP3 = 0 V
Terminal 4.8:	Process voltage UP4 = +24 V DC
Terminal 4.9:	Process voltage ZP4 = 0 V

Terminals	Signal	Description
3.0, 3.1, 3.4, 3.5	O0 ... O3	4 digital outputs
4.0, 4.1, 4.4, 4.5	O4 ... O7	4 digital outputs

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a communication interface module or a CPU). Thus, the current consumption from 24 V DC power supply at the terminals L+/UP and M/ZP of the CPU/communication interface module increases by 2 mA per DO526.

The external power supply connection is carried out via the UP, UP3, UP4 (+24 V DC) and the ZP, ZP3, ZP4 (0 V DC) terminals.

NOTICE!

Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

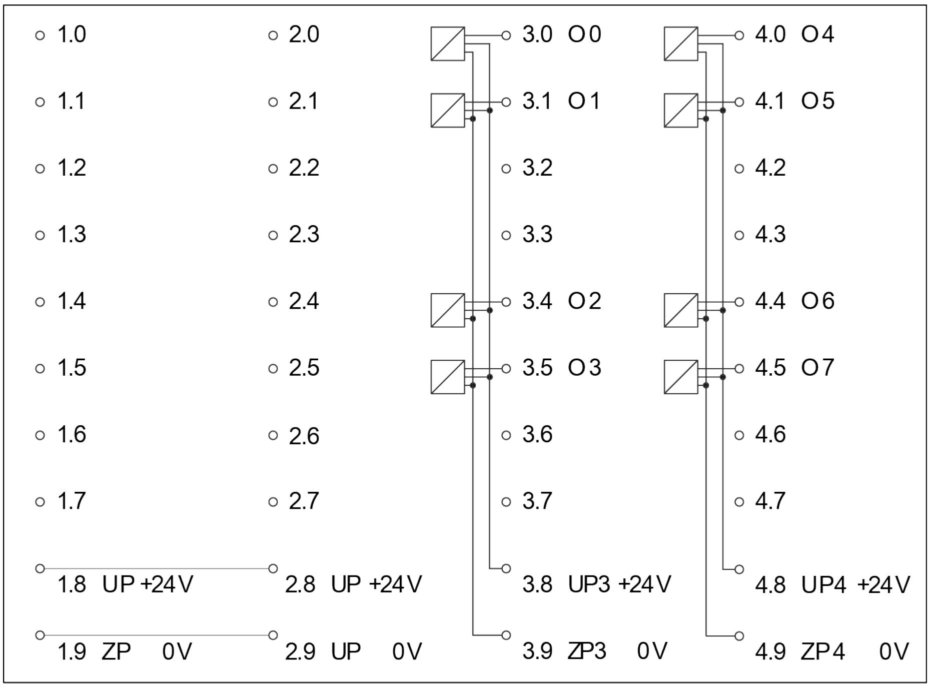
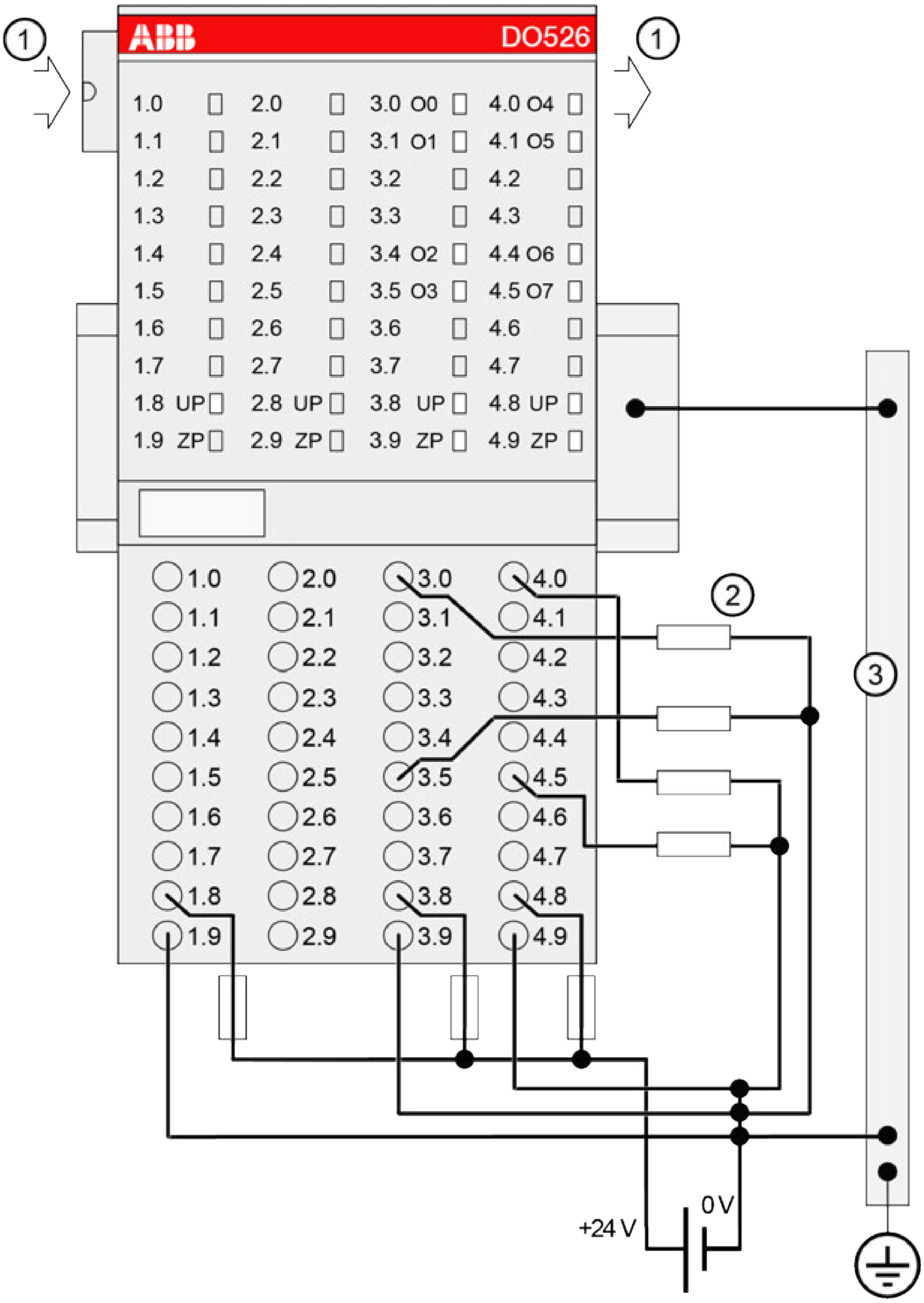


Fig. 127: Internal construction of the digital outputs



1 I/O bus
2 4.0 ... 4.7: Connected with UP (switch) -> Input;
Connected with ZP (load) -> Output
3 Control cabinet earth

> **CAUTION!**
> The process supply voltage must be included in the grounding concept (e. g. grounding of the negative terminal).

The module provides several diagnosis functions.

Internal data exchange

Digital inputs (bytes)	0
Digital outputs (bytes)	1

I/O configuration

The module itself does not store configuration data. It receives its parameterization data from the master device of the I/O bus (CPU or communication interface module) during power-up of the system.

Hence, replacing I/O modules is possible without any re-parameterization via software.

If the external power supply voltage via UP/ZP terminals fails, the I/O module loses its configuration data. The whole station has to be switched off and on again to re-configure the module.

Parameterization

The arrangement of the parameter data is performed with Automation Builder software, versions ≥ 1.2.3.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Module: Module slot address: Y = 1 ... 7

Name	**Value**	**Internal value**	**Internal value, type**	**Default**	**Min.**	**Max.**	**Max.**
Module ID	Internal	1105 [1])	WORD	1105 0x0451	0	65535	0x0Y01
Ignore module [2])	No Yes	0 1	BYTE	No 0x00			not for FBP
Parameter length	Internal	6	BYTE	6-CPU 6-FBP	0	6	0x0Y02
Check supply	Off on	0 1	BYTE	On 0x01	0	1	0x0Y03
Reserve	0 ... 255	0 ... 0xff	BYTE	On 0x01	0	1	0x0Y04
Behaviour of outputs at communication errors	Off Last value Substitute value	0 1+(n*5) 2+(n*5), n ≤ 2	BYTE	Off 0x00	0	2	0x0Y05

Name	Value	Internal value	Internal value, type	Default	Min.	Max.	Max.
Substitute value at outputs Bit 7 = Output 7 Bit 0 = Output 0	0...255	0 ... 0xff	BYTE	0x00	0	255	0x0Y06
Reserve	0 ... 255	0 ... 0xff	BYTE	0x00	0	255	0x0Y07
Reserve	0 ... 255	0 ... 0xff	BYTE	0x00	0	255	0x0Y08
[1]) With CS31 and addresses smaller than 70 and FBP, the value is increased by 1 [2]) Not with FBP							

GSD file:

Ext_User_Prm_Data_Len =	10
Ext_User_Prm_Data_Const(0) =	0x04, 0x51, 0x00, 0x06, 0x01, 0x01, 0x00, 0x00, 0x00, 0x00

Diagnosis

E1 ... E4	d1	d2	d3	d4	Identifier 000 ... 063	AC500 display	<− Display in
Class	Comp	Dev	Mod	Ch	Err	PS501 PLC browser	
Byte 6 Bit 6 ... 7	-	Byte 3	Byte 4	Byte 5	Byte 6 Bit 0 ... 5	FBP diagnosis block	
Class	Interface	Device	Module	Channel	Error Identifier	Error message	Remedy
	[1])	[2])	[3])	[4])			
Module error							
3	14	1 ... 10	31	31	19	Checksum error in the I/O module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	3	Timeout in the I/O module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	40	Different hard-/firmware versions in the module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	43	Internal error in the module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	36	Internal data exchange failure	Replace I/O module
	11 / 12	ADR	1 ... 10				

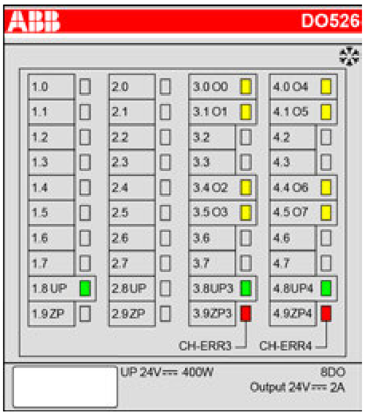
E1 ... E4	d1	d2	d3	d4	Identifier 000 ... 063	AC500 display	<− Display in
Class	Comp	Dev	Mod	Ch	Err	PS501 PLC browser	
Byte 6 Bit 6 ... 7	-	Byte 3	Byte 4	Byte 5	Byte 6 Bit 0 ... 5	FBP diagnosis block	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error Identifier**	**Error message**	**Remedy**
	1)	2)	3)	4)			
3	14	1 ... 10	31	31	9	Overflow diagnosis buffer	New start
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	26	Parameter error	Check master
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	11	Process voltage UP3 and/or UP4 too low	Check process voltage
	11 / 12	ADR	1 ... 10				
4	14	1 ... 10	31	31	45	Process voltage UP is switched off (ON −> OFF)	Process voltage ON
	11 / 12	ADR	1 ... 10				
Channel error							
4	14	1 ... 10	31	0(UP3)	11	Process voltage too low	Check process voltage
	11 / 12	ADR	1 ... 10	4(UP4)			

Remarks:

1)	In AC500 the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31-Bus), 12 = COM2. The FBP diagnosis block does not contain this identifier.
2)	With "Device" the following allocation applies: 31 = module itself, 1 ... 10 = decentralized communication interface module 1 ... 10, ADR = hardware address (e. g. of the DC551-CS31)
3)	With "Module" the following allocation applies depending on the master: Module error: I/O bus or FBP: 31 = module itself; COM1/COM2: 1 ... 10 = expansion 1 ... 10 Channel error: I/O bus or FBP = module type (2 = DO); COM1/COM2: 1 ... 10 = expansion 1 ... 10
4)	In case of module errors, with channel "31 = Module itself" is output.

State LEDs

During the power ON procedure, the module initializes automatically. All LEDs (except the channel LEDs) are ON during this time.

LED		State	Color	LED = OFF	LED = ON	LED flashes
	Outputs O0 ... O7	Digital output	Yellow	Output = OFF	Output = ON [2])	--
	UP	Process supply voltage 24 V DC via terminal	Green	Process supply voltage is missing	Process supply voltage OK	--
	UP3	Process supply voltage out-puts 0 ... 3 24 V DC via terminal	Green	Process supply voltage is missing	Process supply voltage OK	--
	UP4	Process supply voltage out-puts 4 ... 7 24 V DC via terminal	Green	Process supply voltage is missing	Process supply voltage OK	--
	CH-ERR3	Channel Error, error messages in groups (dig-ital outputs combined into the groups 3, 4)	Red	No error or process supply voltage is missing	Severe error within the cor-responding group	Error on in the corresponding group
	CH-ERR4		Red			
	CH-ERR [1])	Module Error	Red	--	Internal error	--

[1]) All of the LEDs CH-ERR3 to CH-ERR4 light up together

[2]) The state of the LEDs corresponds to the logic state of the output. In case of missing or low process supply voltage UP3 or UP4, the signal on the output terminal is off even though the LED is on.

Technical data

Technical data of the module

The system data of AC500 and S500 are applicable to the standard version *Chapter 2.6.1 “System data AC500” on page 1408*.

The system data of AC500-XC are applicable to the XC version *Chapter 2.7.1 “System data AC500-XC” on page 1475*.

Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

Parameter		Value
Process supply voltage UP, UP3 and UP4		
	Connections	Terminals 1.8 and 2.8 for +24 V (UP) as well as 1.9 and 2.9 0 V (ZP) Terminals 3.8 for +24 V (UP3) as well as 3.9 for 0 V (ZP3) Terminals 4.8 for +24 V (UP4) as well as 4.9 for 0 V (ZP4)
	Rated value	24 V DC
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	Rated protection fuse on UP, UP3 and UP4	10 A fast (for each process supply voltage)
	Galvanic isolation	Yes, per module and per output channel groups
Current consumption		
	From 24 V DC power supply at the terminals UP/L+ and ZP/M of the CPU/communication interface module	Ca. 2 mA
	From UP at normal operation / with outputs	Ca. 20 mA + 1.5 mA per output
	From UP3 or UP4 at normal operation / with outputs	Ca. 0.01 A + max. 2 A per output
	Inrush current from UP (at power up)	0.015 A^2s
	Inrush current from UP3 or UP4 (at power up)	0.005 A^2s (without output load)
Max. power dissipation within the module		6 W
Weight (without terminal unit)		Ca. 135 g
Mounting position		Horizontal Or vertical with derating (output load reduced to 50 % at +40 °C per group)
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

!

NOTICE!
Attention:
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply and continuous overvoltage up to 30 V DC.

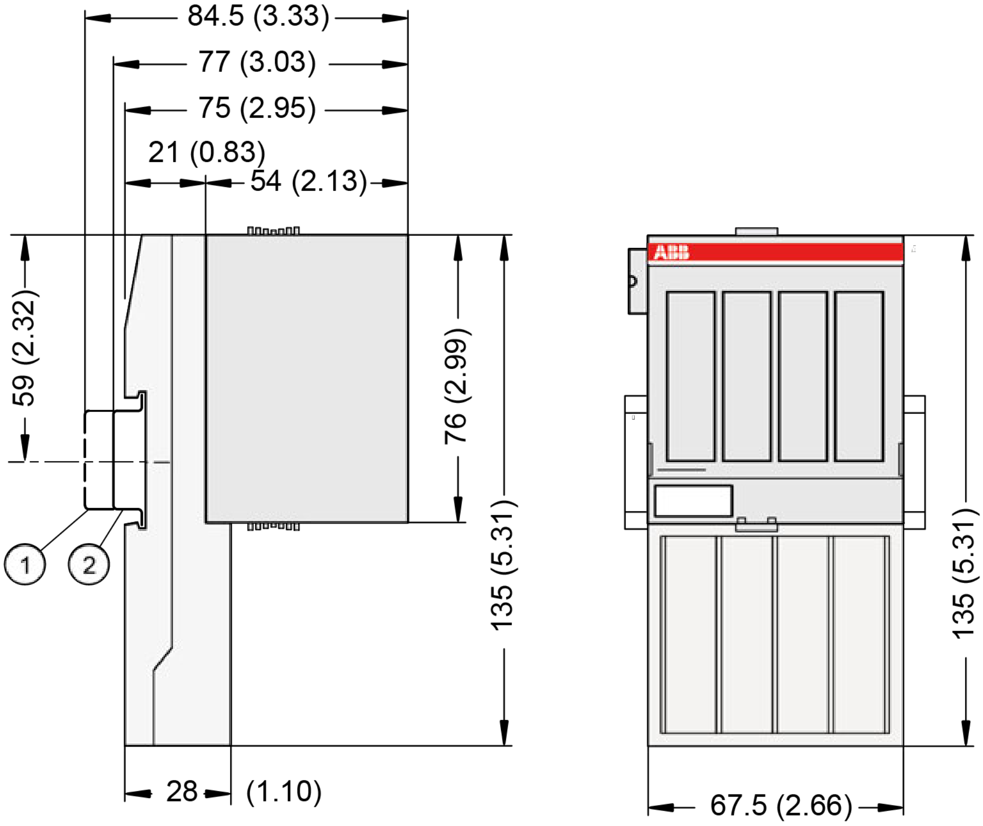
No effects of multiple overloads

No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an external fuse.

Technical data of the digital outputs

Parameter		Value
Number of channels per module		8 outputs (with transistors, non-latching type)
Distribution of the channels into groups		2 groups of 4 channels
Connection of the channels		
	O0 ... O3	Terminals 3.0, 3.1, 3.4, 3.5
	O4 ... O7	Terminals 4.0, 4.1, 4.4, 4.5
Indication of the output signals		1 yellow LED per channel, the LED is ON if the output signal is high (signal 1)
Power supply voltage for the module		Terminals 1.8 and 2.8 (positive pole of the process supply voltage, signal name UP)
Reference potential for module power supply		Terminals 1.9 and 2.9 (negative pole of the process supply voltage, signal name ZP)
Power supply voltage for the outputs O0 to O3		Terminal 3.8 (positive pole of the process supply voltage, signal name UP3)
Reference potential for the outputs O0 to O3		Terminal 3.9 (negative pole of the process supply voltage, signal name ZP3)
Power supply voltage for the outputs O4 to O7		Terminal 4.8 (positive pole of the process supply voltage, signal name UP4)
Reference potential for the outputs O4 to O7		Terminal 4.9 (negative pole of the process supply voltage, signal name ZP4)
Output voltage for signal 1		UP (-0.4 V)
Output delay (0->1 or 1->0)		On request
Output current		
	Rated value, per channel	2 A at UP3 or UP4 = 24 V
	Maximum value (channels O0 ... O3)	8 A
	Maximum value (channels O4 ... O7)	8 A
Leakage current with signal 0		< 0.1 mA
Rated protection fuse on UP		10 A fast
Demagnetization when inductive loads are switched off		With clamp diode in output high side driver
Switching frequency		
	With resistive load	On request
	With inductive loads	Max. 2 Hz
	With lamp loads	Max. 11 Hz with max. 48 W
Short-circuit proof / overload proof		No (should be done externally)
Overload message		No
Output current limitation		No (should be done externally)
Resistance to feedback against 24 V signals		Yes to UP3 or UP4. No to outputs in same group.
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

> *The dimensions are in mm and in brackets in inch.*

Ordering data

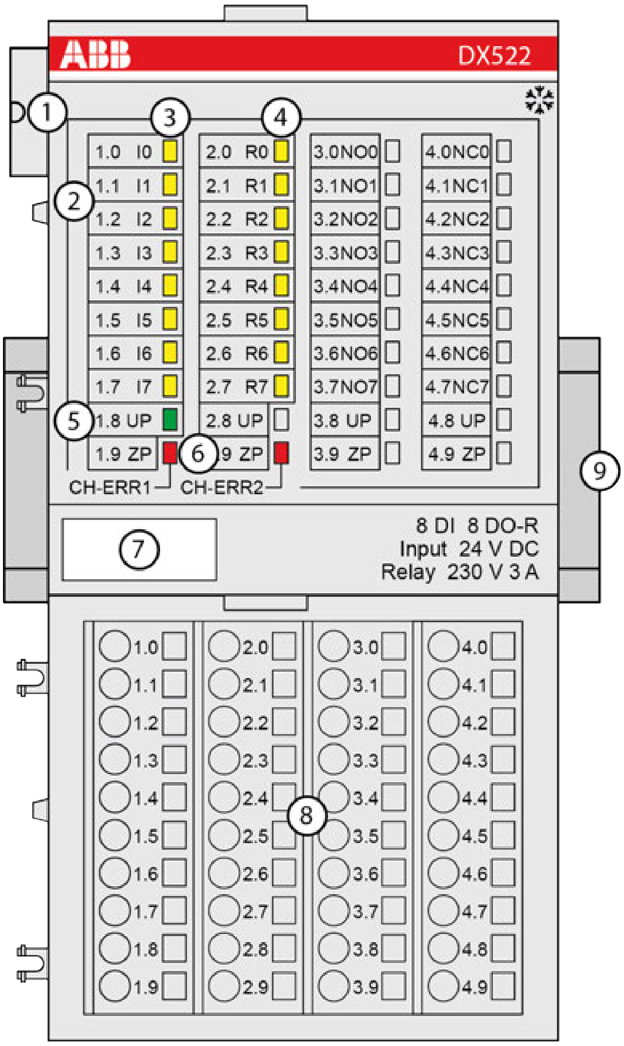
Part no.	Description	Product life cycle phase *)
1SAP 240 800 R0001	DO526, digital output module, 8 DO, 24 V DC / 2 A, 1-wire	Active
1SAP 440 800 R0001	DO526-XC, digital output module, 8 DO, 24 V DC / 2 A, 1-wire, XC version	Active
1SAP 213 200 R0001	TU542, I/O terminal unit, 24 V DC, spring terminals	Active
1SAP 413 200 R0001	TU542-XC, I/O terminal unit, 24 V DC, spring terminals, XC version	Active

1.6.1.2.8 DX522 - Digital input/output module

Features

- 8 digital inputs 24 V DC, module-wise galvanically isolated
- 8 relay outputs

- Fast counter
- XC version for use in extreme ambient conditions available



1 I/O bus
2 Allocation between terminal number and signal name
3 8 yellow LEDs to display the signal states at the digital inputs (I0 ... I7)
4 8 yellow LEDs to display the signal states at the digital relay outputs (R0 ... R7)
5 1 green LED to display the state of the process supply voltage UP
6 2 red LEDs to display errors
7 Label
8 Terminal unit
9 DIN rail
Sign for XC version

Intended purpose

The device can be used as a decentralized I/O extension module for S500 communication interface modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs.

Digital configurable input/output unit.

- 8 digital inputs 24 V DC in 1 group (1.0...1.7)
- 8 digital relay outputs with one change-over contact each (R0...R7). All output channels are galvanically isolated from each other.
- Fast counter

The configuration is performed by software. The modules are supplied with a process supply voltage of 24 V DC.

All available inputs/outputs are galvanically isolated from all other circuitry of the module. There is no potential separation between the channels within the same group.

For use in extreme ambient conditions (e.g. wider temperature and humidity range), a special XC version of the device is available.

Functionality

Parameter	Value
Fast counter	Integrated, many configurable operating modes (only with AC500)
LED displays	For signal states, errors and supply voltage
Internal power supply	Through the I/O bus interface (I/O bus)
External power supply	Via the terminals ZP and UP (process supply voltage 24 V DC)
Required terminal units	TU531 or TU532 *Chapter 1.5.6 “TU531 and TU532 for I/O modules” on page 297*

The device is plugged on a terminal unit *Chapter 1.5.6 “TU531 and TU532 for I/O modules” on page 297*. Position the module properly and press until it locks in place. The terminal unit is either mounted on a DIN rail or to the wall using 2 screws plus the additional accessory for wall mounting *Chapter 1.9.3.5 “TA526 - Wall mounting accessory” on page 1361*.

Connections

WARNING!
Risk of death by electric shock!
Hazardous voltages can be present at the terminals of the module.

Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.

For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.

The connection of the I/O channels is carried out using the 40 terminals of the I/O terminal unit. I/O modules can be replaced without re-wiring the terminal units.

The terminals 1.8 ... 4.8 and 1.9 ... 4.9 are electrically interconnected within the I/O terminal unit and have always the same assignment, irrespective of the inserted module:

- Terminals 1.8 ... 4.8: process supply voltage UP = +24 V DC
- Terminals 1.9 ... 4.9: process supply voltage ZP = 0 V DC

Table 154: Assignment of the other terminals:

Terminals	Signal	Description
1.0 ... 1.7	I0 ... I7	Input signals of the 8 digital inputs
1.8 ... 4.8	UP	Process supply voltage +24 V DC
1.9 ... 4.9	ZP	Reference potential for the 8 digital inputs and the process supply voltage
2.0	R0	Common contact of the first relay output
3.0	NO 0	Normally-open contact of the first relay output
4.0	NC 0	Normally-closed contact of the first relay output
2.1	R1	Common contact of the second relay output
3.1	NO 1	Normally-open contact of the second relay output
4.1	NC 1	Normally-closed contact of the second relay output
:	:	:
2.7	R7	Common contact of the eighth relay output
3.7	NO 7	Normally-open contact of the eighth relay output
4.7	NC 7	Normally-closed contact of the eighth relay output

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a communication interface module or a CPU). Thus, the current consumption from 24 V DC power supply at the terminals L+/UP and M/ZP of the CPU/communication interface module increases by 2 mA per DX522.

The external power supply connection is carried out via the UP (+24 V DC) and the ZP (0 V DC) terminals.

WARNING!
Removal/Insertion under power

Removal or insertion under power is permissible only if all conditions for hot swapping are fullfilled.

Conditions for hot swap

“Conditions for hot swap” on page 1367

The devices are not designed for removal or insertion under power when the conditions for hot swap do not apply. Because of unforeseeable consequences, it is not allowed to plug in or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

Disconnecting any powered devices while they are energized in a hazardous location could result in an electric arc, which could create an ignition source resulting in fire or explosion.

Prior to proceeding, make sure that power is been disconnected and that the area has been thoroughly checked to ensure that flammable materials are not present.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!
Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

The module provides several diagnosis functions.

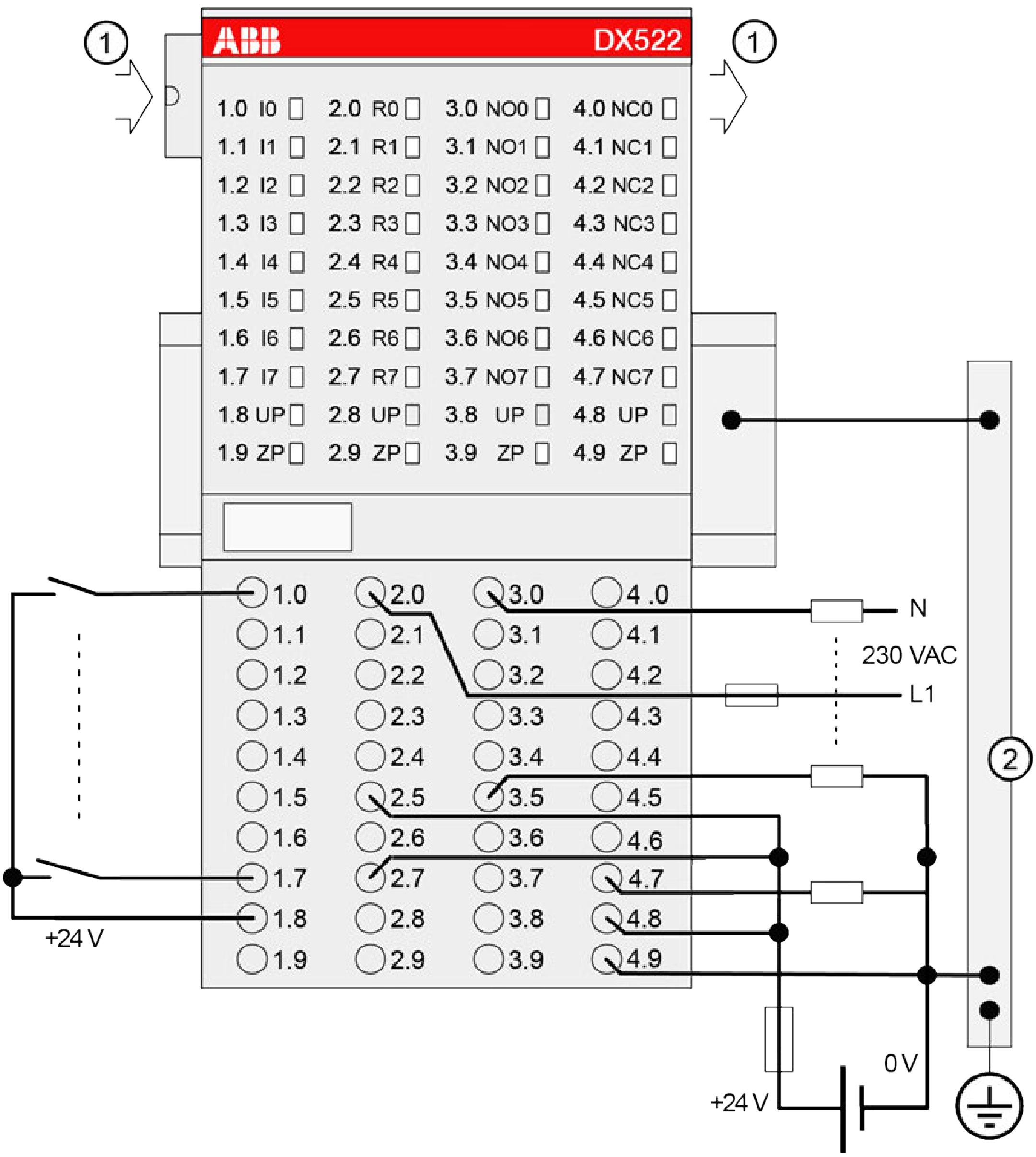


Fig. 128: Connection of the digital input/output module DX522

1 I/O bus
2 Control cabinet earth

NOTICE!

– If the relay outputs have to switch inductive **DC loads**, free-wheeling diodes must be circuited in parallel to these loads.
– If the relay outputs have to switch inductive **AC loads**, spark suppressors are required.

CAUTION!

The process supply voltage must be included in the grounding concept (e. g. grounding of the negative terminal).

NOTICE!

Risk of damaging the PLC module!

The following has to be considered when connecting input and output voltages to the module:

– All 230 V AC feeds must be single-phase from the same supply system.
– Connection of 2 or more relay contacts in series is possible; however, voltages above 230 V AC and 3-phase loads are not allowed.
– The 8 change-over contacts of the relays are galvanically isolated from channel to channel. This allows to connect loads of 24 V DC and 120/230 V AC to relay outputs of the same module. In such cases it is necessary that both supply voltages are grounded to prevent unsafe floating grounds.

NOTICE!

Risk of damaging the PLC module!

There is no internal short-circuit or overload protection for the relay outputs.

Protect the relay contacts by back-up fuses of 6 A max. (characteristic gG/gL). Depending on the application, fuses can be used for single channels or module-wise.

Internal data exchange

	Without the fast counter	**With the fast counter (only with AC500)**
Digital inputs (bytes)	1	3
Digital outputs (bytes)	1	3
Counter input data (words)	0	4
Counter output data (words)	0	8

I/O configuration

The module itself does not store configuration data. It receives its parameterization data from the master device of the I/O bus (CPU or communication interface module) during power-up of the system.

Hence, replacing I/O modules is possible without any re-parameterization via software.

If the external power supply voltage via UP/ZP terminals fails, the I/O module loses its configuration data. The whole station has to be switched off and on again to re-configure the module.

Parameterization

Firmware version	Configuration
Firmware version > V2.0.0	The arrangement of the parameter data is performed by Control Builder Plus/ Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Module: Module slot address: Y = 1 ... 10

Name	Value	Internal value	Internal value, type	Default	Min.	Max.	EDS Slot/ Index
Module ID	Internal	1210 1)	Word	1210 0x04BA	0	65535	0x0Y01
Ignore module 2)	No Yes	0 1	Byte	No 0x00			Not for FBP
Parameter length	Internal	5	Byte	5-CPU 4-FBP	0	255	0x0Y02
Check supply	Off On	0 1	Byte	On 0x01	0	1	0x0Y03
Input delay	0.1 ms 1 ms 8 ms 32 ms	0 1 2 3	Byte	8 ms 0x02	0	3	0x0Y04
Fast Counter 4)	0 : 10 3)	0 : 10	Byte	Mode 0 0x00			Not for FBP
Behaviour of outputs at communication errors	Off Last value Substitute value	0 1+(n*5) 2+(n*5), n ≤ 2	Byte	Off 0x00	0	2	0x0Y05
Substitute value at outputs) Bit 7 = Output 7 Bit 0 = Output 0	0 ... 255	0 ... 0xff	Byte	0 0x00	0	255	0x0Y06

Remarks:

1)	With CS31 and addresses smaller than 70 and FBP, the value is increased by 1
2)	Not with FBP
3)	For a description of the counter operating modes, please refer to the 'Fast Counter' section *Chapter 1.6.1.2.10 “Fast counter” on page 545*
4)	With FBP and without the parameter Fast Counter

GSD file:

Ext_User_Prm_Data_Len =	7
Ext_User_Prm_Data_Const	0x04, 0xbb, 0x04, \
(0) =	0x01, 0x02, 0x00, 0x00;

Diagnosis

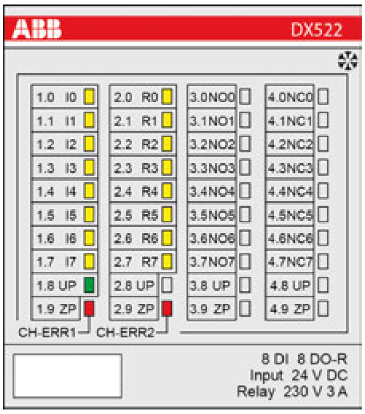
E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identifier 000 ... 063**	**AC500 display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**	
Byte 6 Bit 6 ... 7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0 ... 5**	**FBP diag- nosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error Identifier**	**Error message**	**Remedy**
	[1])	[2])	[3])	[4])			
Module error							
3	14	1 ... 10	31	31	19	Checksum error in the I/O module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	3	Timeout in the I/O module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	40	Different hard-/firmware versions in the module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	43	Internal error in the module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	36	Internal data exchange failure	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	9	Overflow diagnosis buffer	New start
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	26	Parameter error	Check master
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	11	Process supply voltage too low	Check process supply voltage
	11 / 12	ADR	1 ... 10				
4	14	1 ... 10	31	31	45	Process supply voltage is switched off (ON −> OFF)	Process supply voltage ON
	11 / 12	ADR	1 ... 10				

Remarks:

[1])	In AC500 the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The FBP diagnosis block does not contain this identifier.
[2])	With "Device" the following allocation applies: 31 = module itself, 1 ... 10 = decentralized communication interface module 1 ... 10, ADR = hardware address (e.g. of the DC551)
[3])	With "Module" the following allocation applies dependent of the master: Module error: I/O bus or FBP: 31 = module itself; COM1/COM2: 1 ... 10 = expansion 1 ... 10 Channel error: I/O bus or FBP = module type (2 = DO); COM1/COM2: 1 ... 10 = expansion 1 ... 10
[4])	In case of module errors, with channel "31 = module itself" is output.

State LEDs

During the power ON procedure, the module initializes automatically. All LEDs (except the channel LEDs) are ON during this time.

LED		State	Color	LED = OFF	LED = ON	LED flashes
	Inputs I0 ... I7	Digital input	Yellow	Input = OFF	Input = ON [1])	--
	Outputs R0 ... R7 (relays)	Digital output	Yellow	Relay output = OFF	Relay output = ON	--
	UP	Process supply voltage 24 V DC via terminal	Green	Process supply voltage is missing	Process supply voltage OK	--
	CH-ERR1	Channel Error, error messages in groups (digital inputs/ outputs combined into the groups 1 and 2)	Red	No error or process supply voltage is missing	Severe error within the corresponding group	Error on one channel of the corresponding group
	CH-ERR2		Red			
	CH-ERR [2])	Module Error	Red	--	Internal error	--
	[1]) Indication LED is ON even if an input signal is applied to the channel and the supply voltage is off. In this case the module is not operating and does not generate an input signal.					
	[2]) All of the LEDs CH-ERR1 to CH-ERR2 light up together					

Technical data

Technical data of the module

The system data of AC500 and S500 are applicable to the standard version ⇘ *Chapter 2.6.1 “System data AC500” on page 1408*.

The system data of AC500-XC are applicable to the XC version ⇘ *Chapter 2.7.1 “System data AC500-XC” on page 1475*.

Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

Parameter		Value
Process supply voltage UP		
	Connections	Terminals 1.8, 2.8, 3.8 and 4.8 for +24 V (UP) as well as 1.9, 2.9, 3.9 and 4.9 for 0 V (ZP)
	Rated value	24 V DC
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	Rated protection fuse on UP	10 A fast
	Galvanic isolation	Yes, per module
Current consumption		
	From 24 V DC power supply at the terminals UP/L+ and ZP/M of the CPU/ communication interface module	ca. 2 mA
	From UP at normal operation / with outputs	0.05 A + output loads
	Inrush current from UP (at power up)	0.010 A^2s
Max. power dissipation within the module		6 W (outputs OFF)
Weight (without terminal unit)		ca. 300 g
Mounting position		Horizontal or vertical with derating (output load reduced to 50 % at +40 °C per group)
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

NOTICE!
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and temporary overvoltage up to 30 V DC.

No effects of multiple overloads

No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an external fuse.

Technical data of the digital inputs

Parameter	Value
Number of channels per module	8
Distribution of the channels into groups	1 group of 8 channels

Parameter		Value
Terminals of the channels I0 ... I7		1.0 ... 1.7
Reference potential for all inputs		Terminals 1.9, 2.9, 3.9 and 4.9 (negative pole of the process supply voltage, signal name ZP)
Galvanic isolation		From the rest of the module (I/O bus)
Indication of the input signals		One yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Monitoring point of input indicator		LED is part of the input circuitry
Input type acc. to EN 61131-2		Type 1
Input delay (0->1 or 1->0)		Typ. 8 ms, configurable 0.1 ... 32 ms
Input signal voltage		24 V DC
Signal 0		-3 V ... +5 V
Undefined signal		> +5 V ... < +15 V
Signal 1		+15 V ... +30 V
Ripple with signal 0		Within -3 V ... +5 V
Ripple with signal 1		Within +15 V...+30 V
Input current per channel		
	Input voltage +24 V	Typ. 5 mA
	Input voltage +5 V	> 1 mA
	Input voltage +15 V	> 5 mA
	Input voltage +30 V	< 8 mA
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

Technical data of the relay outputs

Parameter	Value
Number of channels per module	8 relay outputs
Distribution of channels into groups	8 groups of 1 channel each
Connection of the channel R0	Terminal 2.0 (common), 3.0 (NO) and 4.0 (NC)
Connection of the channel R1	Terminal 2.1 (common), 3.1 (NO) and 4.1 (NC)
Connection of the channel R6	Terminal 2.6 (common), 3.6 (NO) and 4.6 (NC)
Connection of the channel R7	Terminal 2.7 (common), 3.7 (NO) and 4.7 (NC)
Galvanic isolation	Between the channels and from the rest of the module
Indication of the output signals	One yellow LED per channel, the LED is ON when the relay coil is energized
Monitoring point of output indicator	LED is controlled by process CPU
Way of operation	Non-latching type
Output delay (0->1 or 1->0)	On request
Relay power supply	By UP process supply voltage
Relay outputs	

Parameter		Value
	Output short circuit protection	Should be provided externally with a fuse or circuit breaker
Rated protection fuse		6 A gL/gG per channel
Min. switching current		10 mA
Output switching capacity		
	Resistive load, max.	3 A; 3 A (230 V AC), 2 A (24 V DC)
	Inductive load, max.	1.5 A; 1.5 A (230 V AC), 1.5 A (24 V DC)
	Lamp load	60 W (230 V AC), 10 W (24 V DC)
Output switching capacity (XC version above +60 °C)		On request
Lifetime (cycles)		Mechanical: 300 000; Under load: 300 000 (24 V DC at 2 A), 200 000 (120 V AC at 2 A), 100 000 (230 V AC at 3 A)
Spark suppression with inductive AC load		Must be performed externally according to driven load specifications
Demagnetization with inductive DC load		A free-wheeling diode must be circuited in parallel to the inductive load
Switching frequency		
	With resistive load	Max. 10 Hz
	With inductive load	Max. 2 Hz
	With lamp load	On request
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

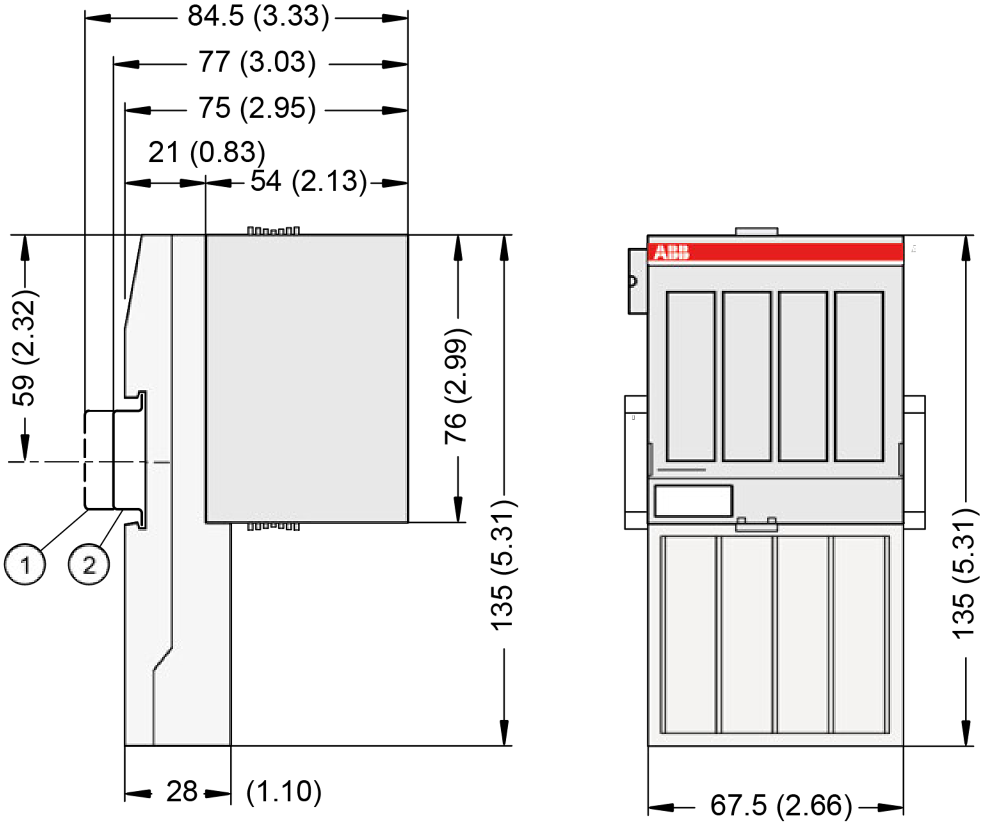
Technical data of the fast counter

The fast counter of the module does not work if the module is connected to a

– *FBP interface module*
– *CS31 bus module*
– *CANopen communication interface module*

Parameter	Value
Used inputs	I0 / I1
Used outputs	None
Counting frequency	50 kHz max.
Operating modes	

Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

Ordering data

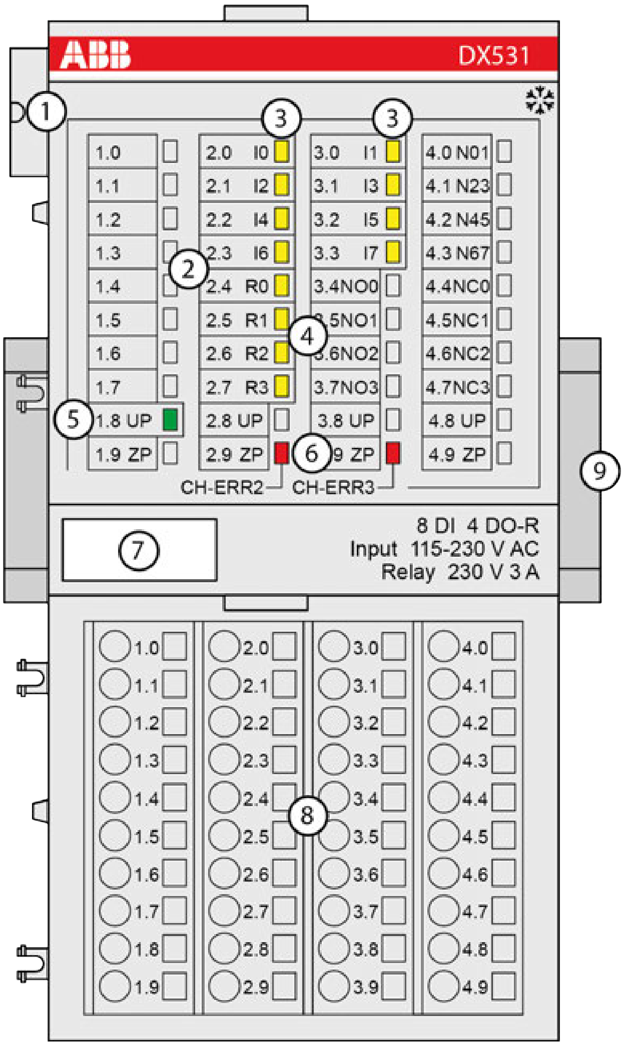
Part no.	Description	Product life cycle phase *)
1SAP 245 200 R0001	DX522, digital input/output module, 8 DI, 24 V DC, 8 DO relays	Active
1SAP 445 200 R0001	DX522-XC, digital input/output module, 8 DI, 24 V DC, 8 DO relays, XC version	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

1.6.1.2.9 DX531 - Digital input/output module

Features

- 8 digital inputs 120/230 V AC
- 4 relay outputs with one change-over contacts each
- Module-wise galvanically isolated



1 I/O bus
2 Allocation between terminal number and signal name
3 8 yellow LEDs to display the signal states at the digital inputs (I0 ... I7)
4 4 yellow LEDs to display the signal states at the digital relay outputs (R0 ... R3)
5 1 green LED to display the state of the process supply voltage UP
6 2 red LEDs to display errors
7 Label
8 Terminal unit
9 DIN rail
✲ Sign for XC version

Intended purpose

The device can be used as a decentralized I/O extension module for S500 communication interface modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs.

Digital configurable input / output unit.

- 8 digital inputs 120/230 V AC in 1 group (2.0 ... 2.3 and 3.0 ... 3.3)
- 4 digital relay outputs with one change-over contact each (R0 ... R3). All output channels are galvanically isolated from each other.

The configuration is performed by software. The modules are supplied with a process supply voltage of 24 V DC.

All available inputs/outputs are galvanically isolated from all other circuitry of the module. There is no potential separation between the channels within the same group.

For use in extreme ambient conditions (e.g. wider temperature and humidity range), a special XC version of the device is available.

Functionality

Parameter	Value
LED displays	For signal states, errors and supply voltage
Internal power supply	Through the I/O bus interface (I/O bus)
External power supply	Via the terminals ZP and UP (process supply voltage 24 V DC)
Required terminal units	TU531 or TU532 ↯ *Chapter 1.5.6 “TU531 and TU532 for I/O modules” on page 297*

The device is plugged on a terminal unit ↯ *Chapter 1.5.6 “TU531 and TU532 for I/O modules” on page 297*. Position the module properly and press until it locks in place. The terminal unit is either mounted on a DIN rail or to the wall using 2 screws plus the additional accessory for wall mounting ↯ *Chapter 1.9.3.5 “TA526 - Wall mounting accessory” on page 1361*.

Connections

WARNING!
Risk of death by electric shock!
Hazardous voltages can be present at the terminals of the module.

Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.

For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.

The connection of the I/O channels is carried out using the 40 terminals of the I/O terminal unit. I/O modules can be replaced without re-wiring the terminal units.

The terminals 1.8 ... 4.8 and 1.9 ... 4.9 are electrically interconnected within the I/O terminal unit and always have the same assignment, irrespective of the inserted module:

- Terminals 1.8 ... 4.8: process supply voltage UP = +24 V DC
- Terminals 1.9 ... 4.9: process supply voltage ZP = 0 V DC

Table 155: Assignment of the other terminals

Terminals	Signal	Description
1.0 ... 1.7	unused	
2.0 and 3.0	I0 and I1	Input signals for the digital inputs I0 and I1
4.0	N01	Neutral conductor for the digital inputs I0 and I1
2.1 and 3.1	I2 and I3	Input signals for the digital inputs I2 and I3
4.1	N23	Neutral conductor for the digital inputs I2 and I3
2.2 and 3.2	I4 and I5	Input signals for the digital inputs I4 and I5
4.2	N45	Neutral conductor for the digital inputs I4 and I5
2.3 and 3.3	I6 and I7	Input signals for the digital inputs I6 and I7
4.3	N67	Neutral conductor for the digital inputs I6 and I7
2.4	R0	Common contact of the first relay output
3.4 and 4.4	NO0 and NC0	NO and NC contacts of the first relay output
2.5	R1	Common contact of the second relay output
3.5 and 4.5	NO1 and NC1	NO and NC contacts of the second relay output
2.6	R2	Common contact of the third relay output
3.6 and 4.6	NO2 and NC2	NO and NC contacts of the third relay output
2.7	R3	Common contact of the fourth relay output
3.7 and 4.7	NO3 and NC3	NO and NC contacts of the fourth relay output

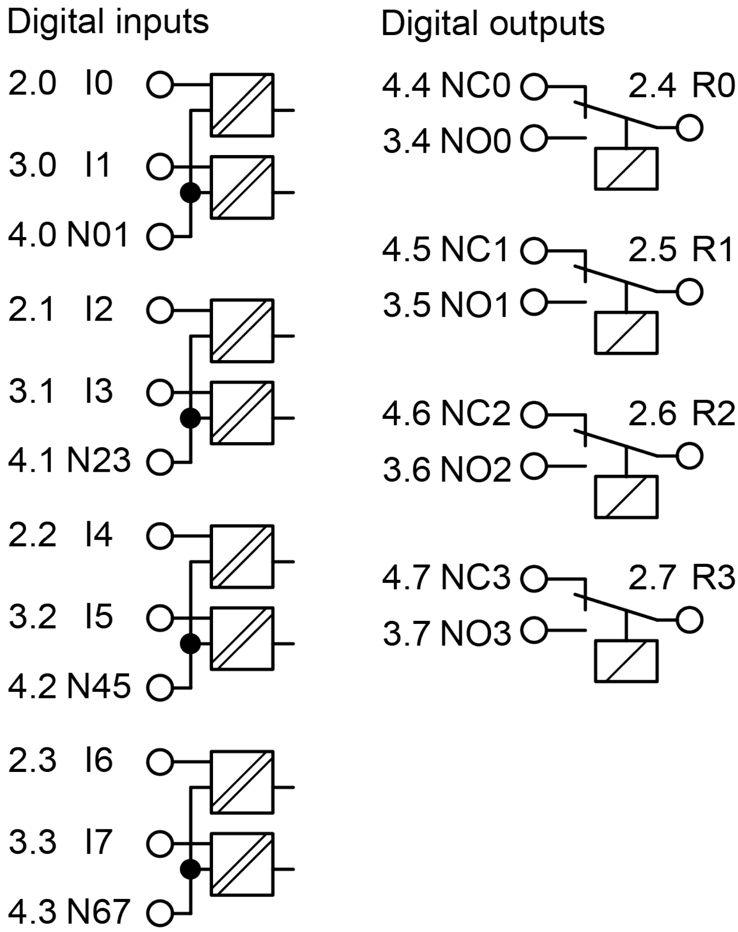


Fig. 129: Internal construction

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a communication interface module or a CPU). Thus, the current consumption from 24 V DC power supply at the terminals L+/UP and M/ZP of the CPU/communication interface module increases by 2 mA per DX531. The external power supply connection is carried out via the UP (+24 V DC) and the ZP (0 V DC) terminals.

WARNING!

Removal/Insertion under power

Removal or insertion under power is permissible only if all conditions for hot swapping are fullfilled.

↳ *Conditions for hot swap*

↳ *"Conditions for hot swap" on page 1367*

The devices are not designed for removal or insertion under power when the conditions for hot swap do not apply. Because of unforeseeable consequences, it is not allowed to plug in or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

- connect or disconnect any signal or terminal block
- remove, mount or replace a module.

Disconnecting any powered devices while they are energized in a hazardous location could result in an electric arc, which could create an ignition source resulting in fire or explosion.

Prior to proceeding, make sure that power is been disconnected and that the area has been thoroughly checked to ensure that flammable materials are not present.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!

Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

- Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
- Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

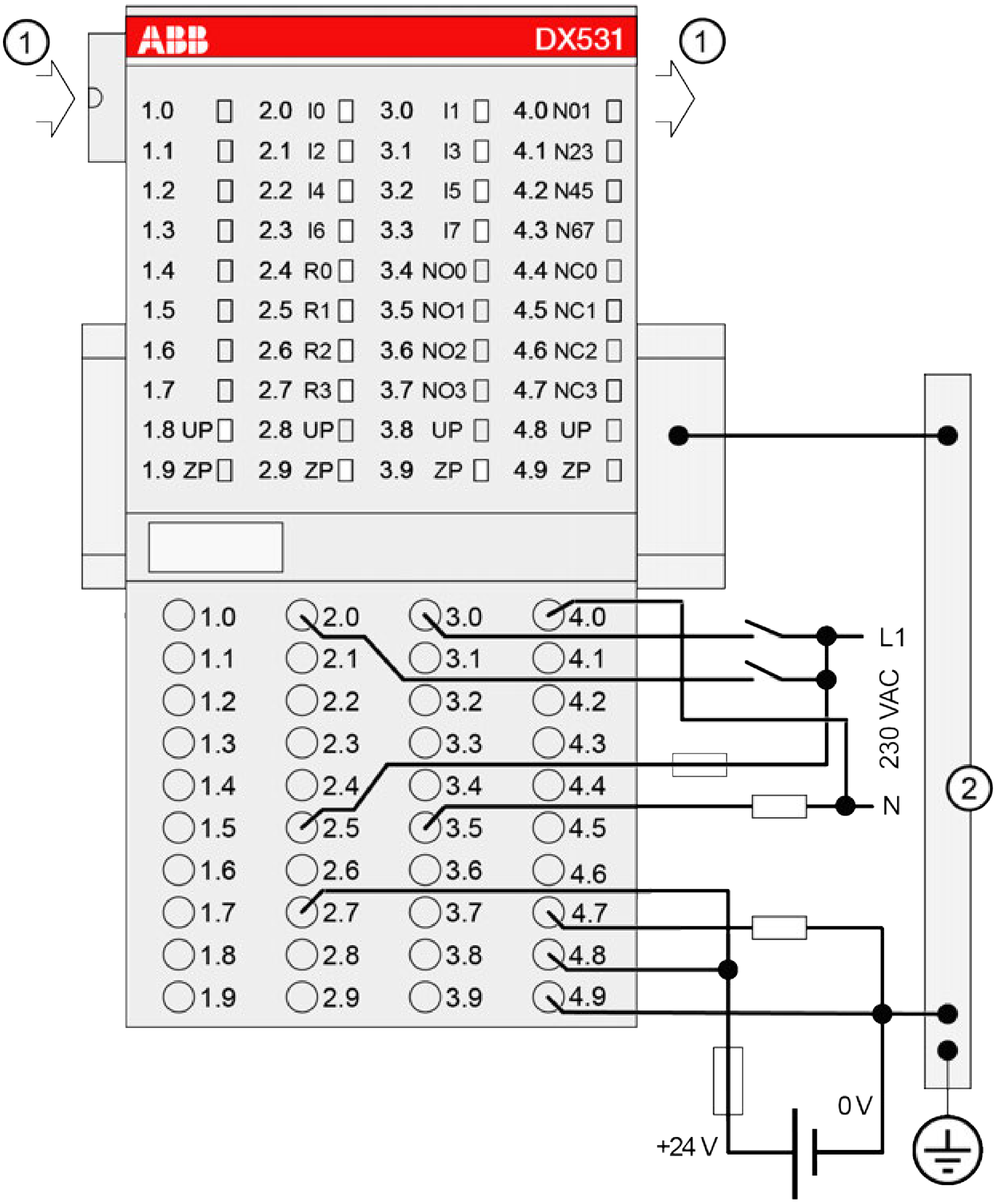


Fig. 130: Connection of the module

1 I/O bus
2 Control cabinet earth

NOTICE!

– If the relay outputs have to switch inductive **DC loads**, free-wheeling diodes must be circuited in parallel to these loads.
– If the relay outputs have to switch inductive **AC loads**, spark suppressors are required.

CAUTION!

The process supply voltage must be included in the grounding concept (e. g. grounding of the negative terminal).

NOTICE!

Risk of damaging the PLC module!

The following has to be considered when connecting input and output voltages to the module:

– All 230 V AC feeds must be single phase from the same supply system.
– Connection of 2 or more relay contacts in series is possible; however, voltages above 230 V AC and 3-phase loads are not allowed.
– The 4 change-over contacts of the relays are galvanically isolated from channel to channel. This allows to connect loads of 24 V DC and 120/230 V AC to relay outputs of the same module. In such cases it is necessary that both supply voltages are grounded to prevent unsafe floating grounds.
– All input signals must come from the same phase of the same supply system (together with the used neutral conductor). The module is designed for 120/230 V AC max., not for 400 V AC, not even between two input terminals.
– All neutral conductor connections must be common to the same supply system, since the terminals 4.0 ... 4.3 are interconnected within the module. Otherwise, accidental energization could occur.

NOTICE!

Risk of damaging the PLC module!

There is no internal short-circuit or overload protection for the relay outputs.

Protect the relay contacts by back-up fuses of 6 A max. (characteristic gG/gL). Depending on the application, fuses can be used for single channels or module-wise.

The module provides several diagnosis functions.

Internal data exchange

Digital inputs (bytes)	1
Digital outputs (bytes)	1
Counter input data (words)	0
Counter output data (words)	0

I/O configuration

The module itself does not store configuration data. It receives its parameterization data from the master device of the I/O bus (CPU or communication interface module) during power-up of the system.

Hence, replacing I/O modules is possible without any re-parameterization via software.

If the external power supply voltage via UP/ZP terminals fails, the I/O module loses its configuration data. The whole station has to be switched off and on again to re-configure the module.

Parameterization

Firmware version	Configuration
Firmware version > V2.0.0	The arrangement of the parameter data is performed by Control Builder Plus/ Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Module: Module slot address: Y = 1 ... 10

Name	Value	Internal value	Internal value, type	Default	Min.	Max.	EDS Slot/ Index
Module ID	Internal	1205 [1])	Word	1205 0x04B5	0	65535	0x0Y01
Ignore module [2])	No Yes	0 1	Byte	No 0x00			not for FBP
Parameter length	Internal	4	Byte	4-CPU 4-FBP	0	255	0x0Y02
Check supply	Off on	0 1	Byte	On 0x01	0	1	0x0Y03
Input delay	20 ms 100 ms	0 1	Byte	20 ms 0x00	0	1	0x0Y04
Behaviour of outputs at communication errors	Off Last value Substitute value	0 1+(n*5) 2+(n*5), n ≤ 2	Byte	Off 0x00	0	2	0x0Y05
Substitute value at outputs Bit 3 = Output 3 Bit 0 = Output 0	0 ... 15	0 ... 0x0f	Byte	0 0x00	0	15	0x0Y06
[1]) With CS31 and addresses smaller than 70 and FBP, the value is increased by 1 [2]) Not with FBP							

GSD file:

Ext_User_Prm_Data_Len =	7
Ext_User_Prm_Data_Const	0x04, 0xb6, 0x04, \
(0) =	0x01, 0x00, 0x00, 0x00;

Diagnosis

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identifier** **000 ... 063**	**AC500 display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**	
Byte 6 **Bit 6 ... 7**	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6** **Bit 0 ... 5**	**FBP diag-nosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error Identifier**	**Error message**	**Remedy**
	1)	2)	3)	4)			
Module error							
3	14	1 ... 10	31	31	19	Checksum error in the I/O module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	3	Timeout in the I/O module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	40	Different hard-/firmware versions in the module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	43	Internal error in the module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	36	Internal data exchange failure	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	9	Overflow diagnosis buffer	New start
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	26	Parameter error	Check master
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	11	Process supply voltage too low	Check process supply voltage
	11 / 12	ADR	1 ... 10				
4	14	1 ... 10	31	31	45	Process supply voltage is switched off (ON −> OFF)	Process supply voltage ON
	11 / 12	ADR	1 ... 10				

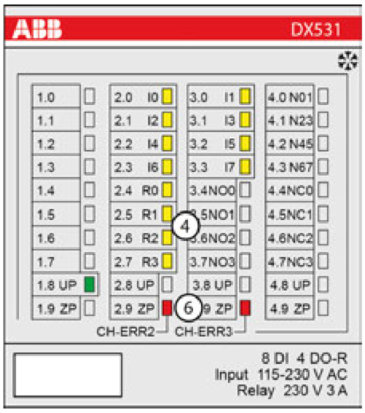
Remarks:

1)	In AC500 the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The FBP diagnosis block does not contain this identifier.
2)	With "Device" the following allocation applies: 31 = module itself, 1 ... 10 = decentralized communication interface module 1 ... 10, ADR = hardware address (e.g. of the DC551)

[3])	With "Module" the following allocation applies depending on the master: Module error: I/O bus or FBP: 31 = module itself; COM1/COM2: 1 ... 10 = expansion 1 ... 10 Channel error: I/O bus or FBP = module type (2 = DO); COM1/COM2: 1 ... 10 = expansion 1 ... 10
[4])	In case of module errors, with channel "31 = module itself" is output.

State LEDs

During the power ON procedure, the module initializes automatically. All LEDs (except the channel LEDs) are ON during this time.

LED		State	Color	LED = OFF	LED = ON	LED flashes
	Inputs I0 ... I7	Digital input	Yellow	Input = OFF	Input = ON	--
	Outputs R0 ... R3 (relays)	Digital output	Yellow	Relay output = OFF	Relay output = ON	--
	UP	Process supply voltage 24 V DC via terminal	Green	Process supply voltage is missing	Process supply voltage OK	--
	CH-ERR2	Channel error, error messages in groups (digital inputs/ outputs combined into the groups 2 and 3)	Red	No error or process supply voltage is missing	Severe error within the corresponding group	Error on one channel of the corresponding group
	CH-ERR3		Red			
	CH-ERR *)	Module Error	Red	--	Internal error	--
	*) All of the LEDs CH-ERR2 to CH-ERR3 light up together					

Technical data

Technical data of the module

The system data of AC500 and S500 are applicable to the standard version *Chapter 2.6.1 “System data AC500” on page 1408*.

The system data of AC500-XC are applicable to the XC version *Chapter 2.7.1 “System data AC500-XC” on page 1475*.

Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

Parameter		Value
Process supply voltage UP		
	Connections	Terminals 1.8, 2.8, 3.8 and 4.8 for +24 V DC (UP) as well as 1.9, 2.9, 3.9 and 4.9 for 0 V DC (ZP)
	Rated value	24 V DC
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	Rated protection fuse on UP	10 A fast
	Galvanic isolation	Yes, per module
Current consumption		
	From 24 V DC power supply at the terminals UP/L+ and ZP/M of the CPU/communication interface module	ca. 2 mA
	From UP at normal operation / with outputs	0.15 A + output loads
Inrush current from UP (at power up)		0.004 A^2s
Max. power dissipation within the module		6 W (outputs OFF)
Weight (without terminal unit)		Ca. 300 g
Mounting position		Horizontal or vertical with derating (output load reduced to 50 % at +40 °C per group)
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

NOTICE!
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and temporary overvoltage up to 30 V DC.

No effects of multiple overloads

No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an external fuse.

Technical data of the digital inputs

Parameter	Value
Number of channels per module	8
Distribution of the channels into groups	4 groups of 2 channels each
Terminals of the channels I0 to I7	*Chapter 1.6.1.2.9.4 “Connections” on page 533*
Galvanic isolation	2500 V AC from the rest of the module (I/O bus)
Indication of the input signals	1 yellow LED per channel The LEDs are only operating if the module is initialized
Monitoring point of input indicator	LED is controlled by process CPU

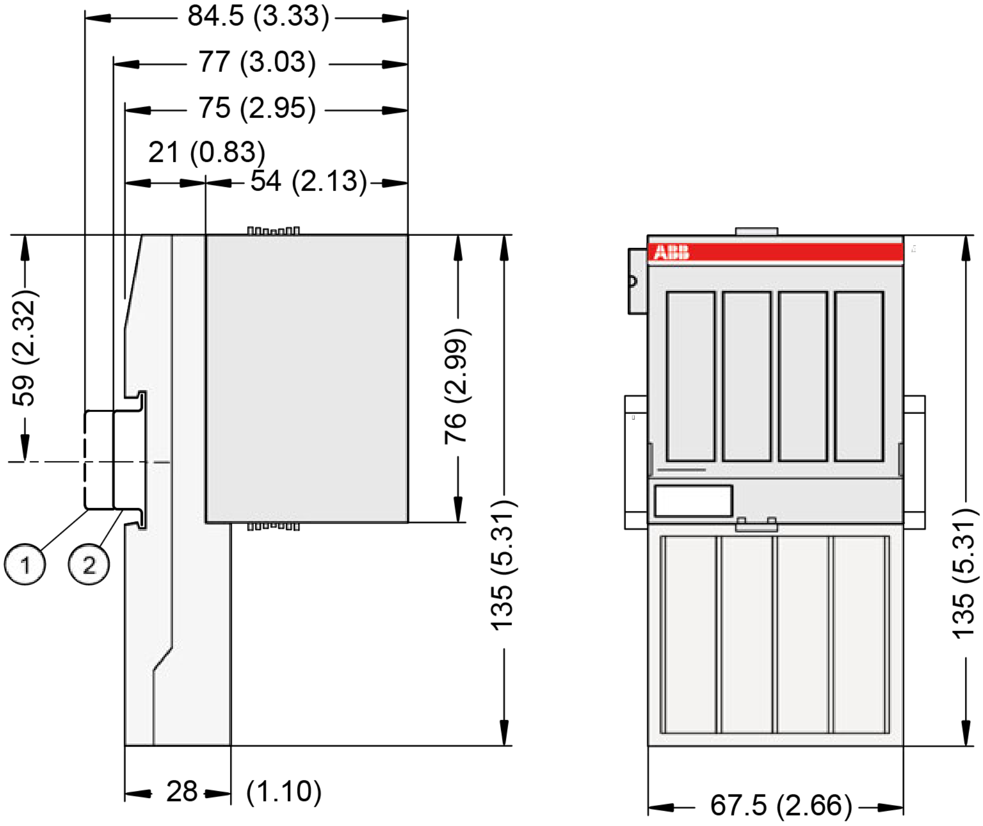
Parameter		Value
Input type acc. to EN 61131-2		Type 2
Input delay (0->1 or 1->0)		Typ. 20 ms
Input signal voltage		230 V AC or 120 V AC
Input signal range		0 V AC ... 265 V AC
Input signal frequency		47 Hz ... 63 Hz
Input characteristic		According EN 61132-2 Type 2
Signal 0		0 V AC ... 40 V AC
Undefined signal		> 40 V AC ... < 74 V AC
Signal 1		74 V AC ... 265 V AC
Input current per channel		
	Input voltage = 159 V AC	> 7 mA
	Input voltage = 40 V AC	< 5 mA
Overvoltage protection		Yes
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

Technical data of the relay outputs

Parameter		Value
Number of channels per module		4 relay outputs
Distribution of channels into groups		4 groups of 1 channel each
Connection of the four relays		*Chapter 1.6.1.2.9.4 “Connections” on page 533*
Galvanic isolation		Between the channels and from the rest of the module
Indication of the output signals		1 yellow LED per channel, the LED is ON when the relay coil is energized
Monitoring point of output indicator		LED is controlled by process CPU
Way of operation		Non-latching type
Output delay (0->1 or 1->0)		On request
Relay power supply		By UP process supply voltage
Relay outputs		
	Output short circuit protection	Must be provided externally with a fuse or circuit breaker
	Rated protection fuse	6 A gL/gG per channel
Output switching capacity		
	Resistive load, max.	3 A; 3 A (230 V AC), 2 A (24 V DC)
	Inductive load, max.	1.5 A; 1.5 A (230 V AC), 1.5 A (24 V DC)
	Lamp load	60 W (230 V AC), 10 W (24 V DC)

Parameter		Value
Lifetime (cycles)		Mechanical: 300 000; Under load: 300 000 (24 V DC at 2 A), 200 000 (120 V AC at 2 A), 100 000 (230 V AC at 3 A)
Spark suppression with inductive AC load		Must be performed externally according to driven load specifications
Demagnetization with inductive DC load		A free-wheeling diode must be circuited in parallel to the inductive load
Switching frequency		
	With resistive load	Max. 10 Hz
	With inductive load	Max. 2 Hz
	With lamp load	On request
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 245 000 R0001	DX531, digital input/output module, 8 DI, 120 / 230 V AC, 4 DO relays, 2-wires	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

1.6.1.2.10 Fast counter

More information can be found in the Automation Builder chapter, *“Fast counters in AC500 devices”*.

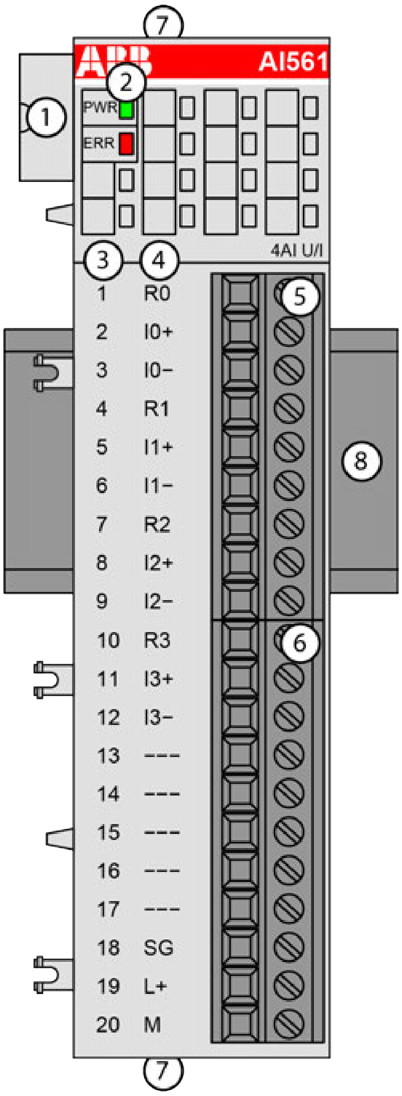
1.6.2 Analog I/O modules

1.6.2.1 S500-eCo

1.6.2.1.1 AI561 - Analog input module

Features

- 4 configurable analog inputs (I0 ... I3) in 1 group
- Resolution: 12 bits including sign



1 I/O bus
2 1 green LED to display power supply, 1 red LED to display error
3 Terminal number
4 Allocation of signal name
5 Terminal block for input signals (9-pin)
6 Terminal block for input signals (11-pin)
7 2 holes for wall-mounting with screws
8 DIN rail

Intended purpose

The device can be used as a decentralized I/O extension module for S500 communication interface modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs.

The inputs are not galvanically isolated from each other.

All other circuitry of the module is not galvanically isolated from the inputs or from the I/O bus.

> *The I/O module must not be used as a decentralized I/O module with CI590-CS31-HA communication interface modules.*

Functionality

4 analog inputs, individually configurable for

- Not used (default setting)
- -2.5 V ... +2.5 V
- -5 V ... +5 V
- 0 V ... +5 V
- 0 V ... +10 V
- 0 mA ... 20 mA
- 4 mA ... 20 mA

Parameter		Value
Resolution of the analog channels		
	Voltage bipolar (-2.5 V ... +2.5 V; -5 V ... +5 V)	12 bits including sign
	Voltage unipolar (0 V ... 5 V; 0 V ... 10 V)	12 bits
	Current (0 mA ... 20 mA; 4 mA ... 20 mA)	12 bits
LED displays		2 LEDs for process voltage and error messages
Internal supply		Via I/O bus
External supply		Via the terminals L+ (process voltage 24 V DC) and M (0 V DC); the M terminal is connected to the M terminal of the CPU via the I/O bus

Connections

For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.

The connection is carried out by using a removable 9-pin and 11-pin terminal block. These terminal blocks differ in their connection system (spring terminals or screw terminals, cable mounting from the front or from the side). The terminal blocks are not included in the module's scope of delivery and must be ordered separately.

Chapter 1.9.2.1 “TA563-TA565 - Terminal blocks” on page 1352

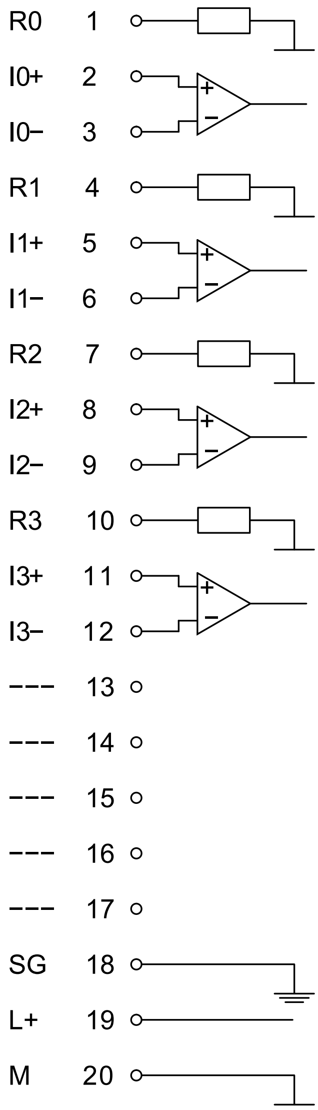


Fig. 131: Internal construction of the analog inputs

The assignment of the terminals:

Terminal	**Signal**	**Description**
1	R0	Burden resistor for input signal 0 for current sensing
2	I0+	Positive pole of input signal 0
3	I0-	Negative pole of input signal 0
4	R1	Burden resistor for input signal 1 for current sensing
5	I1+	Positive pole of input signal 1
6	I1-	Negative pole of input signal 1
7	R2	Burden resistor for input signal 2 for current sensing
8	I2+	Positive pole of input signal 2
9	I2-	Negative pole of input signal 2
10	R3	Burden resistor for input signal 3 for current sensing

Terminal	Signal	Description
11	I3+	Positive pole of input signal 3
12	I3-	Negative pole of input signal 3
13	---	Reserved
14	---	Reserved
15	---	Reserved
16	---	Reserved
17	---	Reserved
18	SG	Shield grounding
19	L+	Process voltage L+ (24 V DC)
20	M	Process voltage M (0 V DC)

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a communication interface module or a CPU). Thus, the current consumption from 24 V DC power supply at the terminals L+/UP and M/ZP of the CPU/communication interface module increases by 10 mA per AI561.

The external power supply connection is carried out via the L+ (+24 V DC) and the M (0 V DC) terminals. The M terminal is interconnected to the M/ZP terminal of the CPU/communication interface module.

NOTICE!
Risk of imprecise and faulty measurements!
Analog signals may be distorted seriously by external electromagnetic influences.

Use shielded wires when wiring analog signal sources. The cable shield must be grounded at both ends of the cable. Provide a potential equalisation of a low resistance to avoid high potential differences between different parts of the plant.

NOTICE!
Risk of damaging the PLC modules!
The PLC modules must not be removed while the plant is connected to a power supply.

Make sure that all voltage sources (supply and process voltage) are switched off before you

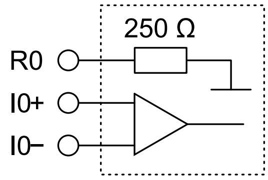
– connect or disconnect any signal or terminal block
– remove or replace a module.

NOTICE!
Risk of damaging the PLC modules!
Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

The module provides several diagnosis functions *Chapter 1.6.2.1.1.7 “Diagnosis” on page 555*.

The following figure is an example of the internal construction of the analog input AI0. The analog inputs AI1 ... AI3 are designed in the same way.



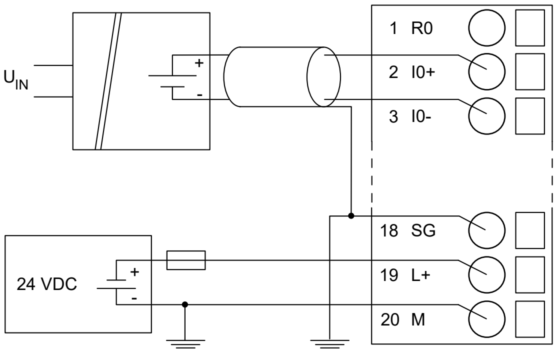
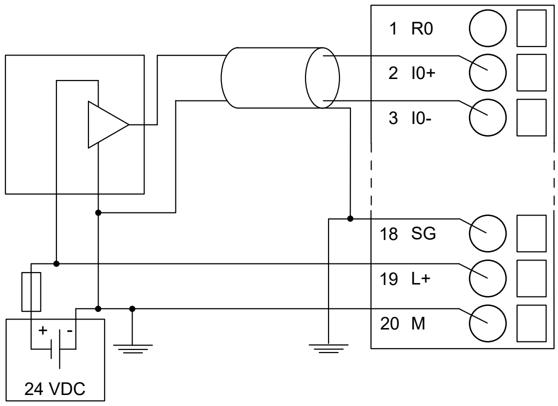
CAUTION!

Risk of damaging the analog input!

The 250 Ω input resistor can be damaged by overcurrent.

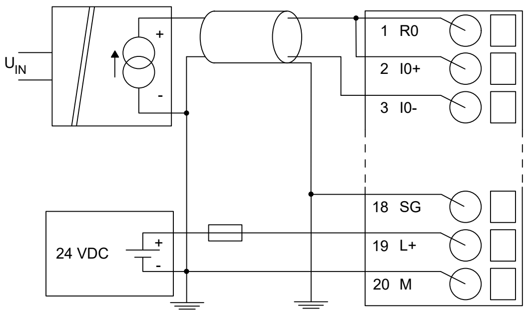
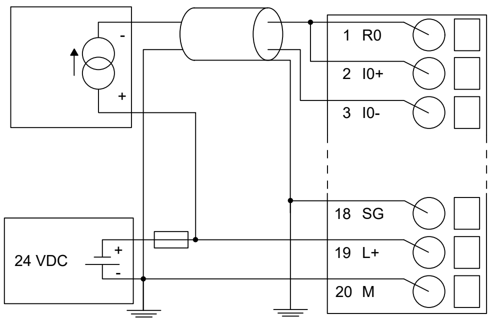
Make sure that the current through the resistor never exceeds 30 mA.

Table 156: Example of the connection of analog sensors (voltage) to the input I0 of the analog input module AI561 (Proceed with the inputs I1 ... I3 in the same way)

	
Connection of active-type analog sensors (voltage)	Connection of passive-type analog sensors (voltage)

Connection of active-type analog sensors (voltage)	Connection of passive-type analog sensors (voltage)
-2.5 V ... 2.5 V	-2.5 V ... 2.5 V
-5 V ... 5 V	-5 V ... 5 V
0 V ... 5 V	0 V ... 5 V
0 V ... 10 V	0 V ... 10 V

Table 157: Example of the connection of analog sensors to the Input I0 of the analog input module AI561 (Proceed with the inputs I1 ... I3 in the same way.)

	
Connection of active-type analog sensors (current)	Connection of passive-type analog sensors (current)

Connection of active-type analog sensors (voltage)	**Connection of passive-type analog sensors (voltage)**
4 mA ... 20 mA	4 mA ... 20 mA
0 mA ... 20 mA	

The meaning of the LEDs is described in the Displays section ↳ *Chapter 1.6.2.1.1.8 “State LEDs” on page 556*.

I/O configuration

The analog input module AI561 does not store configuration data itself.

Parameterization

The arrangement of the parameter data is performed with Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Name	**Value**	**Internal Value**	**Internal value, Type**	**Default**	**Min.**	**Max.**	**EDS Slot Index**
Module ID	Intern	6500 [1])	WORD	0x1964	0	65535	xx01
Ignore module	No Yes	0 1	BYTE	No 0x00			
Parameter length	Internal	6	BYTE	0	0	255	xx02 [2])
Check Supply	Off On	0 1	BYTE	On 0x01			
Analog Data Format	Default	0	BYTE	Default 0x00		255	

[1]) with CS31 and addresses smaller than 70, the value is increased by 1

[2]) Value is hexadecimal: HighByte is slot (xx: 0 ... 7), LowByte is index (1 ... n)

GSD file:	Ext_User_Prm_Data_Len = Ext_User_Prm_Data_Const(0) =	0x09 0x65, 0x19, 0x06, \ 0x01, 0x00, \ 0x00, 0x00, 0x00, 0x00;

Input channel (4x)

Name	Value	Internal value	Internal value, Type	Default	Min.	Max.
Channel configuration	see table 2)	see table 2)	BYTE	0 0x00	0	65535

Table 158: Channel configuration 2)

Internal value	Operating modes for the analog inputs, individually configurable
0	Not used (default)
1	0 V ... 10 V
3	0 mA ... 20 mA
4	4 mA ... 20 mA
6	0 V ... 5 V
7	-5 V ... +5 V
20	-2,5 V ... +2,5 V

Diagnosis

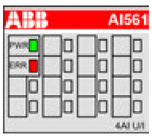
E1 ... E4	d1	d2	d3	d4	Identifier 000 ... 063	AC500 display	<– Display in
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 6 Bit 6 ... 7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0 ... 5**	**PNIO diagnosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error Identifier**	**Error message**	**Remedy**
	1)	**2)**	**3)**	**4)**			
Module error							
3	14	1 ... 10	31	31	19	Checksum error in the I/O module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	9	Overflow diagnosis buffer	Restart
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	26	Parameter error	Check master
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	11	Process voltage too low	Check process voltage
	11 / 12	ADR	1 ... 10				
Channel error							
4	14	1 ... 10	1	0 ... 3	48	Analog value overflow at an analog input	Check input value or terminal
	11 / 12	ADR	1 ... 0				

E1 ... E4	d1	d2	d3	d4	Identifier 000 ... 063	AC500 display	<– Display in
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 6 Bit 6 ... 7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0 ... 5**	**PNIO diagnosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error Identifier**	**Error message**	**Remedy**
	1)	2)	3)	4)			
4	14	1 ... 10	1	0...3	7	Analog value underflow at an analog input	Check input value
	11 / 12	ADR	1 ... 0				

Remarks:

1)	In AC500, the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The PNIO diagnosis block does not contain this identifier.
2)	With "Device" the following allocation applies: 31 = module itself, 1 ... 10 = expansion module 1 ... 10, ADR = hardware address (e. g. of the DC551-CS31)
3)	With "Module" the following allocation applies depending on the master: Module error: I/O bus or PNIO: 31 = module itself; COM1/COM2: 1 ... 10 = expansion 1 ... 10 Channel error: I/O bus or PNIO = module type (1 = AI); COM1/COM2: 1 ... 10 = expansion 1 ... 10
4)	In case of module errors, with channel "31 = Module itself" is output.

State LEDs

LED		State	Color	LED = OFF	LED = ON	LED flashes
	PWR	Process voltage 24 V DC via terminal	Green	CPU module voltage or external 24 V DC supply voltage is missing	3.3 V system voltage (I/O bus) and external 24 V DC supply voltage are present	---
	ERR	Channel or module error	Red	No error or process voltage is missing	Severe error in the module	Error on 1 or more chan-nels of the module

Measuring ranges

> ***Risk of invalid analog input values!***
>
> *The analog input values may be invalid if the measuring range of the inputs is exceeded.*
>
> *Make sure that the analog signal at the connection terminals is always within the signal range.*

Range	-2.5 ... +2.5 V	-5 ... +5 V	0 ... 5 V	0 ... 10 V	0 ... 20 mA	4 ... 20 mA	Digital value	
							Decimal	**Hex.**
Overflow	>2.9397	>5.8795	>5.8795	>11.7589	>23.5178	>22.8142	32767	7FFF
Measured value too high	2.9397 : 2.5014	5.8795 : 5.0029	5.8795 : : : 5.0015	11.7589 : : : 10.0029	23.5178 : : : 20.0058	22.8142 : : 20.0058	32511 : 27664 27658 27656	7EFF : 6C10 6C0A 6C08
Normal range Normal range or measured value too low	2.5000 : 0.0014	5.0000 : 0.0029	5.0000 : : : 0.0015	10.0000 : : : 0.0029	20.0000 : : : 0.0058	20.0000 : : 4.0058	27648 : 16 10 8	6C00 : 0010 000A 0008
	0.0000	0.0000	0.0000	0.0000	0	4	0	0000
	: -0.0014 : : : -2.5000	: -0.0029 : : : -5.0000				3.9942 : : 0	-10 -16 -4864 -6912 : -27648	FFF6 FFF0 ED00 E500 : 9400
Measured value too low	-2.5014 : -2.9398	-5.0029 : -5.8795					-27664 : -32512	93F0 : 8100
Underflow	<-2.9398	<-5.8795	<-0.0300	<-0.0600	<-0.1200	<-0.1200	-32768	8000

The represented resolution corresponds to 12 bits including sign.

Technical data

Technical data of the module

The system data of AC500-eCo apply.

Chapter 2.5.1 “System data AC500-eCo” on page 1379

Only additional details are therefore documented below.

Parameter		Value
Process supply voltage L+		
	Connections	Terminal 19 for L+ (+24 V DC) and terminal 20 for M (0 V)
	Rated value	24 V DC
	Current consumption via L+ terminal	0.1 A
	Inrush current (at power up)	0.05 A^2s
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	Protection fuse for L+	Recommended
Current consumption from 24 V DC power supply at the terminals UP/L+ and ZP/M of the CPU/communication interface module		Ca. 10 mA
Galvanic isolation		No
Surge-voltage (max.)		35 V DC for 0.5 s
Max. power dissipation within the module		2.7 W
Weight		Ca. 120 g
Mounting position		Horizontal or vertical
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

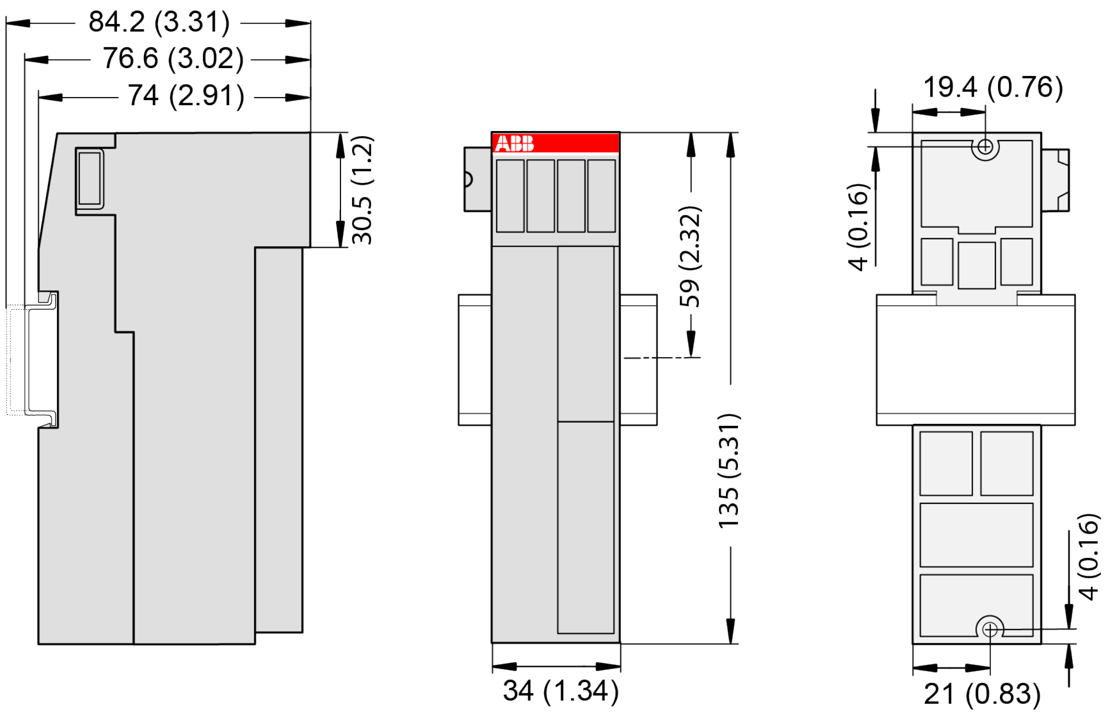
NOTICE!
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and temporary overvoltage up to 30 V DC.

Technical data of the analog inputs

Parameter		Value
Number of channels per module		4 individually configurable voltage or current inputs
Distribution of channels into groups		1 (4 channels per group)
Resolution		
	Unipolar	Voltage: 0 V ... +5 V; 0 V ... +10 V: 12 bits Current 0 mA ... 20 mA; 4 mA ... 20 mA: 12 bits
	Bipolar	Voltage -2.5 V ... +2.5 V; -5 V ... +5 V: 12 bits including sign
Connection of the signals I0- to I3-		Terminals 3, 6, 9, 12
Connection of the signals I0+ to I3+		Terminals 2, 5, 8, 11
Input type		Differential
Galvanic isolation		No galvanic isolation between the inputs and the I/O bus
Common mode input range		Signal voltage plus common mode voltage must be within ± 12 V

Parameter	**Value**	
Indication of the input signals	No	
Channel input resistance	Voltage: > 1 MΩ Current: ca. 250 Ω	
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range	Typ.	± 0.5 % of full scale (voltage) ± 0.5 % of full scale (current 0 mA ... 20 mA) ± 0.7 % of full scale (current 4 mA ... 20 mA) at +25 °C
	Max.	± 2 % of full scale (all ranges) at 0 °C ... +60 °C or EMC disturbance
Time constant of the input filter	Voltage: 300 µs Current: 300 µs	
Relationship between input signal and hex code	*Chapter 1.6.2.1.1.9 “Measuring ranges” on page 557*	
Analog to digital conversion time	Typ. 500 µs per channel	
Unused inputs	Can be left open and should be configured as "unused"	
Input data length	8 bytes	
Overvoltage protection	Yes, up to 30 V DC only for voltage input	
Max. cable length (conductor cross section > 0,14 mm^2)		
Unshielded wire	10 m	
Shielded wire	100 m	

Dimensions



The dimensions are in mm and in brackets in inch.

Ordering data

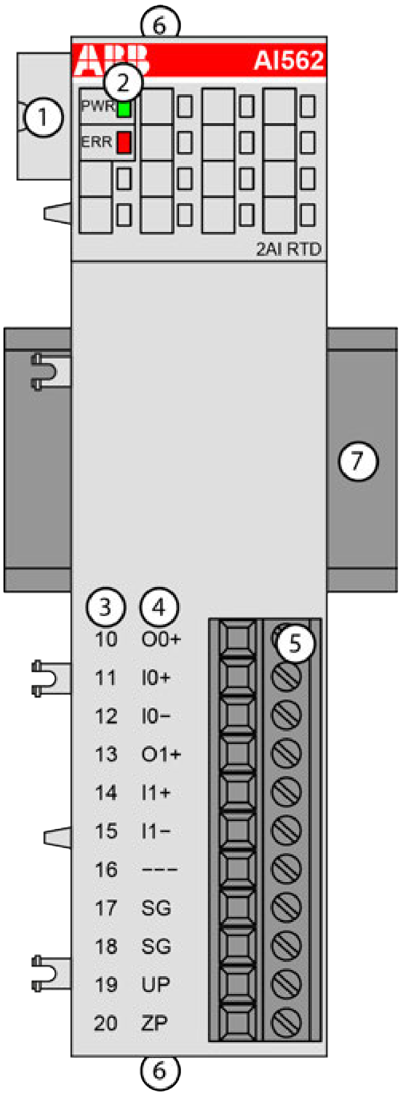
Part no.	Description	Product life cycle phase *)
1TNE 968 902 R1101	AI561, analog input module, 4 AI, U/I	Active
1TNE 968 901 R3101	Terminal block TA563-9, 9 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3102	Terminal block TA563-11, 11 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3103	Terminal block TA564-9, 9 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3104	Terminal block TA564-11, 11 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3105	Terminal block TA565-9, 9 pins, spring front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3106	Terminal block TA565-11, 11 pins, spring front, cable front, 6 pieces per unit	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

1.6.2.1.2 AI562 - Analog input module

Features

- 2 configurable analog resistance temperature detector (RTD) inputs (I0 and I1) in 1 group
- Resolution: 16 bits including sign



1 I/O bus
2 1 green LED to display power supply, 1 red LED to display error
3 Terminal number
4 Allocation of signal name
5 Terminal block for input signals (11-pin)
6 2 holes for wall-mounting with screws
7 DIN rail

Intended purpose

The device can be used as a decentralized I/O extension module for S500 communication interface modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs.

The inputs are not galvanically isolated from each other.

All other circuitry of the module is galvanically isolated from the inputs.

The I/O module must not be used as a decentralized I/O module with CI590-CS31-HA communication interface modules.

Functionality

2 analog RTD-inputs, individually configurable for

- Not used (default)
- Pt100, -50 °C ... +400 °C, 2-wire
- Pt100, -50 °C ... +400 °C, 3-wire
- Pt1000, -50 °C ... +400 °C, 2-wire
- Pt1000, -50 °C ... +400 °C, 3-wire
- Ni1000, -50 °C ... +150 °C, 2-wire
- Ni1000, -50 °C ... +150 °C, 3-wire
- Ni100, -50 °C ... +150 °C, 2-wire
- Ni100, -50 °C ... +150 °C, 3-wire
- Analog input resistance 0 Ω ... 150 Ω
- Analog input resistance 0 Ω ... 300 Ω

Parameter	Value
Resolution of the analog channels	
Temperature	+0.1 °C
LED displays	2 LEDs for process voltage and error messages
Internal supply	Via I/O bus
External supply	Via the terminals UP (process voltage 24 V DC) and ZP (0 V DC)

Connections

For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.

The connection is carried out by using a removable 9-pin and 11-pin terminal block. These terminal blocks differ in their connection system (spring terminals or screw terminals, cable mounting from the front or from the side). The terminal blocks are not included in the module's scope of delivery and must be ordered separately.

Chapter 1.9.2.1 “TA563-TA565 - Terminal blocks” on page 1352

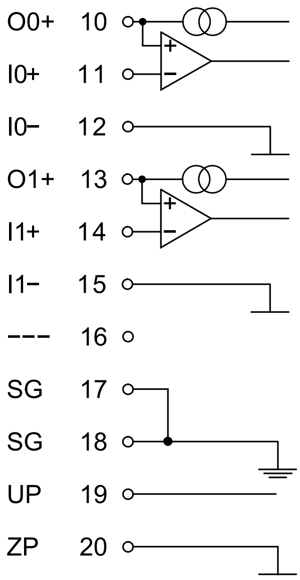


Fig. 132: Internal construction of the analog inputs

The assignment of the terminals:

Terminal	Signal	Description
10	O0+	Current source of channel 0
11	I0+	Sense input of channel 0
12	I0-	Return input of channel 0
13	O1+	Current source of channel 1
14	I1+	Sense input of channel 1
15	I1-	Return input of channel 1
16	---	Reserved
17	SG	Shield grounding
18	SG	Shield grounding
19	UP	Process voltage UP (24 V DC)
20	ZP	Process voltage ZP (0 V DC)

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a communication interface module or a CPU). Thus, the current consumption from 24 V DC power supply at the terminals L+/UP and M/ZP of the CPU/communication interface module increases by 5 mA per AI562.

The external power supply connection is carried out via the UP (+24 V DC) and the ZP (0 V DC) terminals.

NOTICE!
Risk of imprecise and faulty measurements!

Analog signals may be distorted seriously by external electromagnetic influences.

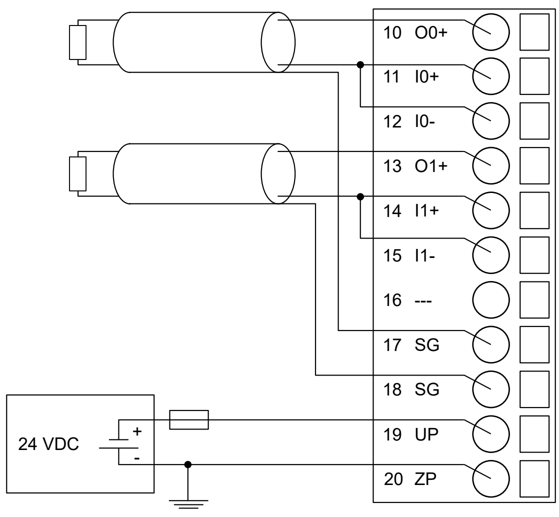
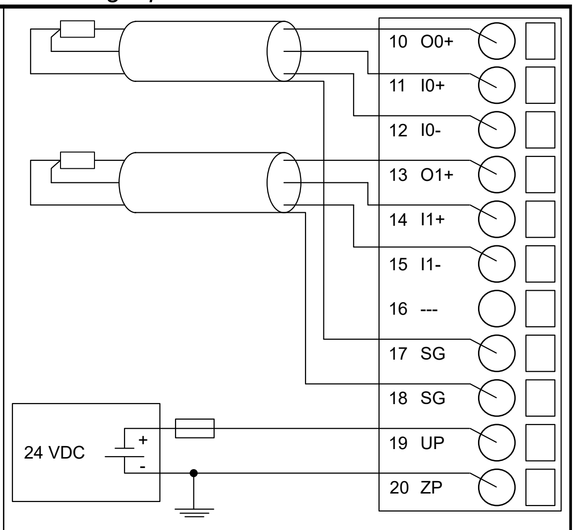
Use shielded wires when wiring analog signal sources. The cable shield must be grounded at both ends of the cable. Provide a potential equalisation of a low resistance to avoid high potential differences between different parts of the plant.

> **NOTICE!**
> **Risk of damaging the PLC modules!**
> The PLC modules must not be removed while the plant is connected to a power supply.
>
> Make sure that all voltage sources (supply and process voltage) are switched off before you
>
> – connect or disconnect any signal or terminal block
> – remove or replace a module.

> **NOTICE!**
> **Risk of damaging the PLC modules!**
> Overvoltages and short circuits might damage the PLC modules.
>
> – Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
> – Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

The module provides several diagnosis functions *Chapter 1.6.2.1.2.7 “Diagnosis” on page 566*.

Table 159: Connection of RTDs to the inputs of the analog input module AI562

	
2-wires input	3-wires input

> *With 2-wires connection, the resistance of the connection wires influences the accuracy of the measured value. Use 3-wires connection to achieve the guaranteed measuring accuracy.*

The meaning of the LEDs is described in the Displays section *Chapter 1.6.2.1.2.8 “State LEDs” on page 567*.

I/O configuration

The analog input module AI562 does not store configuration data itself.

Parameterization

The arrangement of the parameter data is performed with Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Name	Value	Internal value	Internal value, Type	Default	Min.	Max.	EDS Slot Index
Module ID	Intern	6505 [1])	WORD	0x1969	0	65535	xx01
Ignore module	No Yes	0 1	BYTE	No 0x00			
Parameter length	Intern	4	BYTE	0	0	255	xx02 [2])
Check Supply	Off On	0 1	BYTE	On 0x01			
Analog Data Format	Default	0	BYTE	Default 0x00		255	

[1]) with CS31 and addresses less than 70, the value is increased by 1

[2]) Value is hexadecimal: HighByte is slot (xx: 0 ... 7), LowByte is index (1 ... n)

GSD file:

Ext_User_Prm_Data_Len = Ext_User_Prm_Data_Const(0) =	0x07 0x6A, 0x19, 0x04, \ 0x01, 0x00, \ 0x00, 0x00;

Input channel (2x)

Name	Value	Internal value	Internal value, Type	Default	Min.	Max.
Channel configuration	see table [2])	see table [2])	BYTE	0 0x00 see table [3])	0	65535

Table 160: Channel configuration [2])

Internal value	Operating modes for the analog inputs, individually configurable
0	Not used (default) [3])
8	2-wire Pt100 -50 °C ... +400 °C
9	3-wire Pt100 -50 °C ... +400 °C
16	2-wire Pt1000, -50 °C ... +400 °C

Internal value	Operating modes for the analog inputs, individually configurable
17	3-wire Pt1000, -50 °C ... +400 °C
18	2-wire Ni1000 -50 °C ... +150 °C
19	3-wire Ni1000 -50 °C ... +150 °C
22	2-wire Ni100, -50 °C ... +150 °C
23	3-wire Ni100, -50 °C ... +150 °C
32	Analog input resistor 0 Ω ... 150 Ω
33	Analog input resistor 0 Ω ... 300 Ω

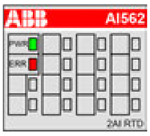
Diagnosis

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identifier** **000 ... 063**	**AC500 display**	**<– Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 6 **Bit 6 ... 7**	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6** **Bit 0 ... 5**	**PNIO diagnosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error Identifier**	**Error message**	**Remedy**
	1)	**2)**	**3)**	**4)**			
Module error							
3	14	1 ... 10	31	31	19	Checksum error in the I/O module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	9	Overflow diagnosis buffer	Restart
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	26	Parameter error	Check master
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	11	Process voltage too low	Check process voltage
	11 / 12	ADR	1 ... 10				
Channel error							
4	14	1 ... 10	1	0...1	48	Analog value overflow at an analog input	Check input value or terminal
	11 / 12	ADR	1 ... 10				
4	14	1 ... 10	1	0...1	7	Analog value underflow at an analog input	Check input value
	11 / 12	ADR	1 ... 10				

Remarks:

[1])	In AC500 the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The PNIO diagnosis block does not contain this identifier.
[2])	With "Device" the following allocation applies: 31 = module itself, 1 ... 10 = expansion module 1 ... 10, ADR = hardware address (e. g. of the DC551-CS31)
[3])	With "Module" the following allocation applies dependent of the master: Module error: I/O bus or PNIO: 31 = module itself; COM1/COM2: 1 ... 10 = expansion 1...10 Channel error: I/O bus or PNIO = module type (1 = AI); COM1/COM2: 1 ... 10 = expansion 1 ... 10
[4])	In case of module errors, with channel "31 = Module itself" is output.

State LEDs

LED		State	Color	LED = OFF	LED = ON	LED flashes
	PWR	Process voltage 24 V DC via terminal	Green	CPU module voltage or external 24 V DC supply voltage is missing	3.3 V system voltage (I/O bus) and external 24 V DC supply voltage are present	---
	ERR	Channel or module error	Red	No error or process voltage is missing	Severe error in the module	Error on 1 or more chan-nels of the module

Measuring ranges

Risk of invalid analog input values!

The analog input values may be invalid if the measuring range of the inputs is exceeded.

Make sure that the analog signal at the connection terminals is always within the signal range.

Resistance temperature detectors

Range	**Pt100 / Pt1000 -50 °C ... +400 °C**	**Ni1000 / Ni100 -50 °C ... +150 °C**	**Digital value**	
			Decimal	**Hex.**
Overflow	> +450.0 °C	> +160.0 °C	32767	7FFF
Measured value too high	+450.0 °C : +400.1 °C		4500 : 4001	1194 : 0FA1

Range	Pt100 / Pt1000 -50 °C ... +400 °C	Ni1000 / Ni100 -50 °C ... +150 °C	Digital value	
			Decimal	**Hex.**
		+160.0 °C : +150.1 °C	1600 : 1501	0640 : 05DD
Normal range	+400.0 °C : : : : + 0.1 °C	 +150.0 °C : : + 0.1 °C	4000 2000 1500 700 : 1	0FA0 07D0 05DC 02BC : 1
	0,0 °C	0.0 °C	0	0000
	-0.1 °C : -50.0 °C	-0.1 °C : -50.0 °C	-1 : -500 -2000	FFFF : FE0C F830
Measured value too low	-50.1 °C : -60.0 °C	-50.1 °C : -60.0 °C	-501 : -600	FE0B : FDA8
Underflow	< -60.0 °C	< -60.0 °C	-32768	8000

Resistances

Range	Resistance 0 Ω ... 150 Ω	Resistance 0 Ω ... 300 Ω	Digital value	
			Decimal	**Hex.**
Overflow	>176.383	>352.767	32767	7FFF
Measured value too high	176.383 150.005	352.767 300.011	32511 27649	7EFF 6C01
Normal range	150.000 : 0.005	300.000 : 0.011	27648 : 1	6C00 : 0001
	0	0	0	0000

Technical data

Technical data of the module

The system data of AC500-eCo apply.

Chapter 2.5.1 “System data AC500-eCo” on page 1379

Only additional details are therefore documented below.

Parameter		Value
Process supply voltage UP		
	Connections	Terminal 19 for UP (+24 V DC) and terminal 20 for ZP (0 V)
	Rated value	24 V DC
	Current consumption	0.04 A
	Inrush current (at power-up)	0.05 A^2s
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	Protection fuse for UP	Recommended
Current consumption from 24 V DC power supply at the terminals UP/L+ and ZP/M of the CPU/communication interface module		Ca. 5 mA
Galvanic isolation		Yes, between the input group and the rest of the module
	Isolated groups	1 (2 channels per group)
Surge-voltage (max.)		35 V DC for 0.5 s
Max. power dissipation within the module		1.1 W
Weight		Ca. 120 g
Mounting position		Horizontal or vertical
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

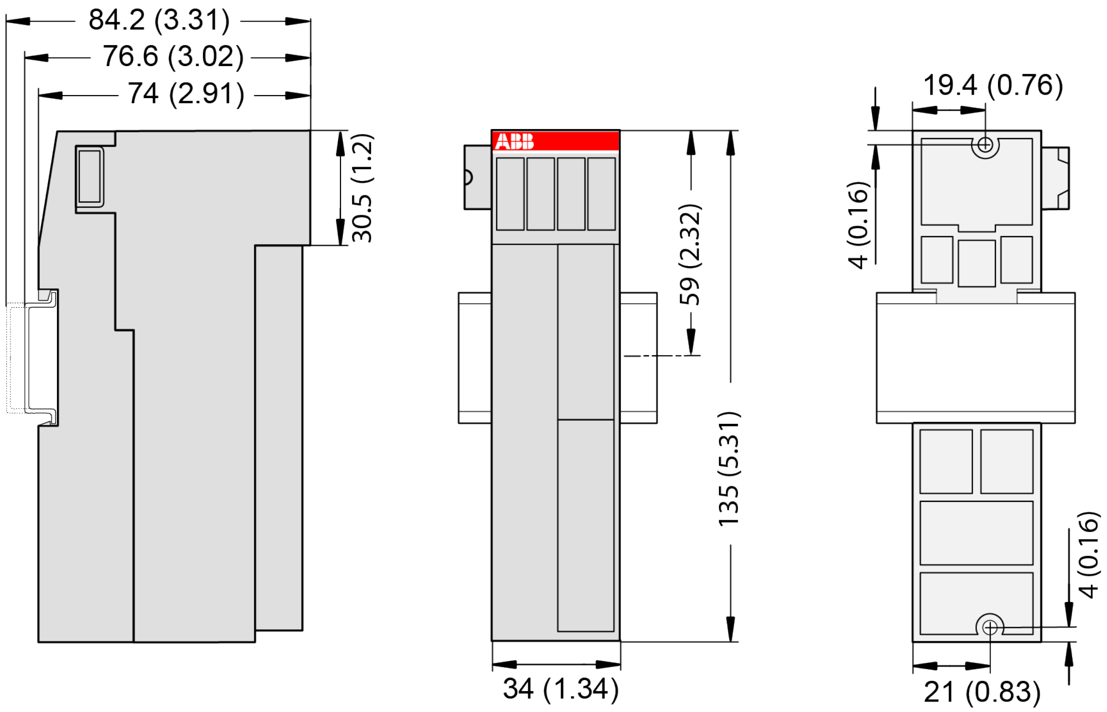
NOTICE!
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and temporary overvoltage up to 30 V DC.

Technical data of the analog inputs

Parameter		Value
Number of channels per module		2 configurable RTD (resistance temperature detector) inputs
Distribution of channels into groups		1 (2 channels per group)
Resolution		
	RTD	+0.1 °C / 0.1 °F
	Resistance	16 bits including sign
Connection of the signals O0+ and O1+		Terminals 10 and 13
Connection of the signals I0- and I1-		Terminals 11 and 14
Connection of the signals I0+ and I1+		Terminals 12 and 15
Input type		Module ground referenced RTD for 2-wire and 3-wire resistance temperature detectors
Galvanic isolation		Against internal power supply and other modules

Parameter		Value	
Input ranges		Pt100, Pt1000, Ni100, Ni1000	
		150 Ω, 300 Ω	
Indication of the input signals		No	
Module update time		All channels: < 1 s	
Channel input resistance		> 100 kΩ	
Input filter attenuation		-3 dB at 3.6 kHz	
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range		Typ.	Depending on RTD max. ±0.6 % of full scale (guaranteed for 3-wires connection only) at +25 °C
		Max.	± 2 % of full scale (guaranteed for 3-wires connection only) at 0 °C ... +60 °C or EMC disturbances
Measuring range		*Chapter 1.6.2.1.2.9 "Measuring ranges" on page 567*	
Analog to digital conversion time		Typ. 140 ms per channel	
Unused inputs		Can be left open and should be configured as "unused"	
Input data length		4 bytes	
Power dissipation inside the sensor (max.)		1 mW	
Suppression of interference		On request	
Maximum input voltage		30 V DC (sense), 5 V DC (source)	
Basic error (resistance)		0.1 % of full-scale	
Repeatability		0.05 % of full-scale	
Overvoltage protection		Yes, up to 30 V DC	
Wire loop resistance		< 20 Ω	
Max. cable length (conductor cross section > 0.14 mm²)			
	Unshielded wire	10 m	
	Shielded wire	100 m	

Dimensions



The dimensions are in mm and in brackets in inch.

Ordering data

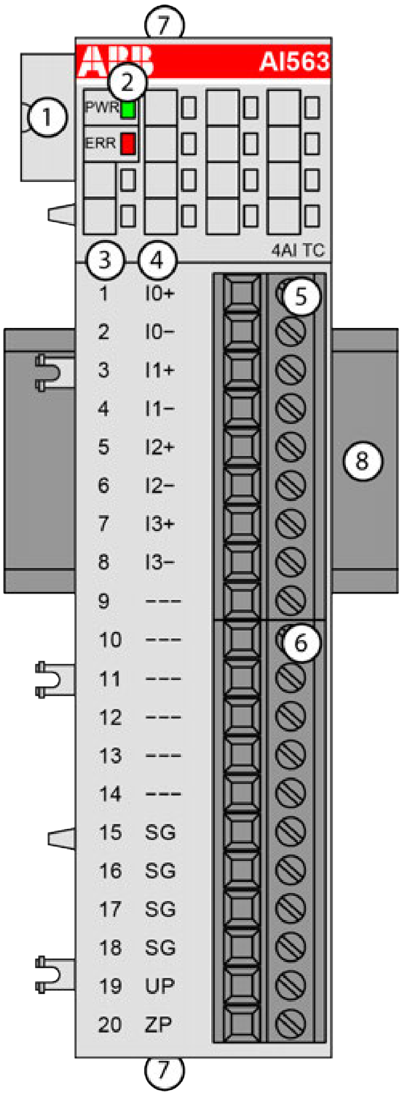
Part no.	Description	Product life cycle phase *)
1TNE 968 902 R1102	AI562, analog input module, 2 AI, RTD	Active
1TNE 968 901 R3102	Terminal block TA563-11, 11 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3104	Terminal block TA564-11, 11 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3106	Terminal block TA565-11, 11 pins, spring front, cable front, 6 pieces per unit	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

1.6.2.1.3 AI563 - Analog input module

Features

- 4 configurable thermocouple (TC) / -80 mV ... +80 mV inputs (I0 ... I3) in 1 group
- Resolution: 16 bits including sign



1 I/O bus
2 1 green LED to display power supply, 1 red LED to display error
3 Terminal number
4 Allocation of signal name
5 Terminal block for input signals (9-pin)
6 Terminal block for input signals (11-pin)
7 2 holes for wall-mounting with screws
8 DIN rail

Intended purpose

The device can be used as a decentralized I/O extension module for S500 communication interface modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs.

The inputs are group-wise galvanically isolated from each other.

The other electronic circuitry of the module is galvanically isolated from the inputs.

The I/O module must not be used as a decentralized I/O module with CI590-CS31-HA communication interface modules.

Functionality

4 analog TC inputs, individually configurable for

- Not used (default)
- Voltage -80 mV ... + 80 mV
- Thermocouple J-type -210 °C ... +1200 °C
- Thermocouple K-type -270 °C ... +1372 °C
- Thermocouple R-type -50 °C ... +1768 °C
- Thermocouple S-type -50 °C ... +1768 °C
- Thermocouple T-type -270 °C ... +400 °C
- Thermocouple E-type -270 °C ... +1000 °C
- Thermocouple N-type -270 °C ... +1300 °C

Parameter	Value
Resolution of the analog channels	
Temperature	+0.1 °C
LED displays	2 LEDs for process voltage and error messages
Internal supply	Via I/O bus
External supply	Via the terminals UP (process voltage 24 V DC) and ZP (0 V DC)

Connections

For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.

After powering up the system, input channels, which are configured will have undefined values /diagnosis message for typically 45 seconds, if the wires of all configured channels are broken.

If the AI563 is connected to a PROFINET communication interface module, the firmware version of PROFINET communication interface module must be 1.2 or above.

The connection is carried out by using a removable 9-pin and 11-pin terminal block. These terminal blocks differ in their connection system (spring terminals or screw terminals, cable mounting from the front or from the side). The terminal blocks are not included in the module's scope of delivery and must be ordered separately.

↳ *Chapter 1.9.2.1 "TA563-TA565 - Terminal blocks" on page 1352*

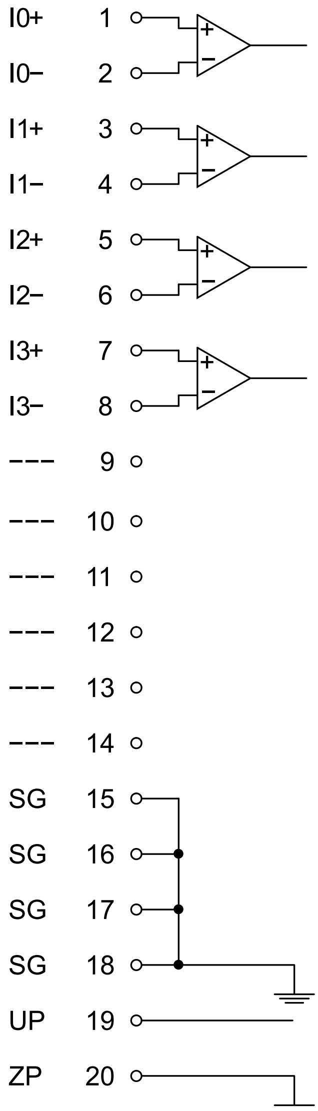


Fig. 133: Internal construction of the analog inputs

Table 161: Assignment of the terminals

Terminal	Signal	Description
1	I0+	Positive pole of channel 0
2	I0-	Negative pole of channel 0
3	I1+	Positive pole of channel 1
4	I1-	Negative pole of channel 1
5	I2+	Positive pole of channel 2
6	I2-	Negative pole of channel 2
7	I3+	Positive pole of channel 3
8	I3-	Negative pole of channel 3
9	---	Reserved
10	---	Reserved
11	---	Reserved
12	---	Reserved

Terminal	Signal	Description
13	---	Reserved
14	---	Reserved
15	SG	Shield grounding
16	SG	Shield grounding
17	SG	Shield grounding
18	SG	Shield grounding
19	UP	Process voltage UP (24 V DC)
20	ZP	Process voltage ZP (0 V DC)

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a communication interface module or a CPU). Thus, the current consumption from 24 V DC power supply at the terminals UP/L+ and ZP/M of the CPU/communication interface module increases by 5 mA per AI563.

The external power supply connection is carried out via the UP (+24 V DC) and the ZP (0 V DC) terminals.

NOTICE!
Risk of imprecise and faulty measurements!
Analog signals may be distorted seriously by external electromagnetic influences.

Use shielded wires when wiring analog signal sources. The cable shield must be grounded at both ends of the cable. Provide a potential equalisation of a low resistance to avoid high potential differences between different parts of the plant.

NOTICE!
Risk of damaging the PLC modules!
The PLC modules must not be removed while the plant is connected to a power supply.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove or replace a module.

NOTICE!
Risk of damaging the PLC modules!
Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

The module provides several diagnosis functions ➪ *Chapter 1.6.2.1.3.7 “Diagnosis” on page 578*.

The following figure shows the connection of thermocouples to the inputs of the module:

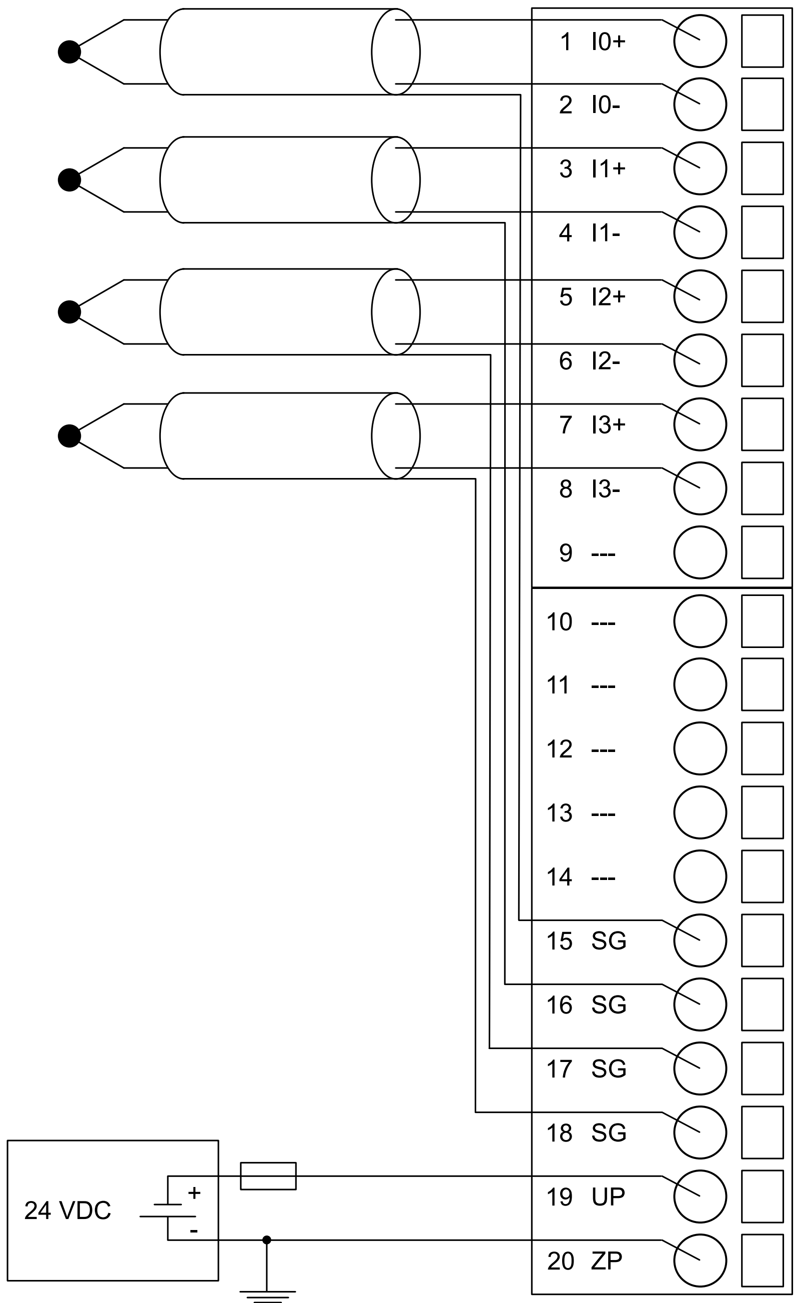


Fig. 134: Connection of thermocouples to the inputs of the module

The meaning of the LEDs is described in Displays chapter *Chapter 1.6.2.1.3.8 "State LEDs" on page 579*.

I/O configuration

The analog input module AI563 does not store configuration data itself.

Parameterization

The arrangement of the parameter data is performed with Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Name	Value	Internal value	Internal value, Type	Default	Min.	Max.	EDS Slot Index
Module ID	Intern	6510 [1])	WORD	0x196E	0	65535	xx01
Ignore module	No Yes	0 1	BYTE	No 0x00			
Parameter length	Intern	6	BYTE	0	0	255	xx02 [2])
Check Supply	Off On	0 1	BYTE	On 0x01			
Analog Data Format	Default	0	BYTE	Default 0x00		255	
[1]) with CS31 and addresses less than 70, the value is increased by 1 [2]) Value is hexadecimal: HighByte is slot (xx: 0 ... 7), LowByte is index (1 ... n)							

GSD file:

Ext_User_Prm_Data_Len = Ext_User_Prm_Data_Const(0) =	0x09 0x6F, 0x19, 0x06, \ 0x01, 0x00, \ 0x00, 0x00, 0x00, 0x00;

Input channel (4x)

Name	Value	Internal value	Internal value, Type	Default	Min.	Max.
Channel configura-tion	see table [2])	see table [2])	BYTE	0 0x00 see table [2])	0	65535

Table 162: Channel configuration [2])

Internal value	Operating modes for the analog inputs, individually configurable
0	Not used (default)
21	Voltage -80 mV ... +80 mV
24	Thermocouple J-type -210 °C ... +1200 °C
25	Thermocouple K-type -270 °C ... +1372 °C
26	Thermocouple R-type -50 °C ... +1768 °C
27	Thermocouple S-type -50 °C ... +1768 °C
28	Thermocouple T-type -270 °C...+400 °C
29	Thermocouple E-type -270 °C ... +1000 °C
30	Thermocouple N-type -270 °C ... +1300 °C

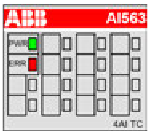
Diagnosis

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identifier** **000 ... 063**	**AC500 display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**	
Byte 6 **Bit 6 ... 7**	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6** **Bit 0 ... 5**	**PNIO diagnosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error Identifier**	**Error message**	**Remedy**
	1)	**2)**	**3)**	**4)**			
Module error							
3	14	1 ... 10	31	31	19	Checksum error in the I/O module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	9	Overflow diagnosis buffer	Restart
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	26	Parameter error	Check master
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	11	Process voltage too low	Check process voltage
	11 / 12	ADR	1 ... 10				
Channel error							
4	14	1 ... 10	1	0 ... 3	48	Analog value overflow or broken wire at an analog input	Check input value or terminal
	11 / 12	ADR	1 ... 10				
4	14	1 ... 10	1	0...3	7	Analog value underflow at an analog input	Check input value
	11 / 12	ADR	1 ... 10				

Remarks:

1)	In AC500 the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The PNIO diagnosis block does not contain this identifier.
2)	With "Device" the following allocation applies: 31 = module itself, 1 ... 10 = expansion module 1...10, ADR = hardware address (e. g. of the DC551-CS31)
3)	With "Module" the following allocation applies dependent of the master: Module error: I/O bus or PNIO: 31 = module itself; COM1/COM2: 1 ... 10 = expansion 1 ... 10 Channel error: I/O bus or PNIO = module type (1 = AI); COM1/COM2: 1 ... 10 = expansion 1 ... 10
4)	In case of module errors, with channel "31 = Module itself" is output.

State LEDs

LED		State	Color	LED = OFF	LED = ON	LED flashes
	PWR	Process voltage 24 V DC via terminal	Green	CPU module voltage or external 24 V DC supply voltage is missing	3.3 V system voltage (I/O bus) and external 24 V DC supply voltage are present	---
	ERR	Channel or module error	Red	No error or process voltage is missing	Severe error in the module	Error on 1 or more chan-nels of the module

Measuring ranges

AI563 needs typ. 6 to 8 seconds for initialization after applying the process supply voltage to clamp UP/ZP. During this time, the accuracy of the measure-ment values is not within specification. After that, valid measurement values are provided by the module. After that, valid measurement values are provided by the module.

After an interruption of the process supply voltage > 10 ms, a re-initialization is performed by AI563.

Risk of invalid analog input values!
The analog input values may be invalid if the measuring range of the inputs is exceeded.

Make sure that the analog signal at the connection terminals is always within the signal range.

When a wire break occurs on a sensor wire, the temperature measurement value of the corresponding channel changes to Overflow (Hexadecimal 7FFF).

Range	Type J -210 °C ... +1200 °C	Type K 270 °C ... +1372 °C	Type N 270 °C ... +1300 °C	Type T -270 °C ... +400 °C	Digital value	
					Decimal	Hex.
Overflow	> +1200.0 °C	> +1372.0 °C	> +1300.0 °C	> +400.0 °C	32767	7FFF
Normal range					17680	4510
		+1372.0 °C			13720	3598
		:	+1300.0 °C		13000	32C8
	+1200.0 °C	:	:		12000	2EE0
	:	:	:	+400.0 °C	4000	0FA0
	:	:	:	:	:	:

Range	Type J -210 °C ... +1200 °C	Type K 270 °C ... +1372 °C	Type N 270 °C ... +1300 °C	Type T -270 °C ... +400 °C	Digital value	
					Decimal	**Hex.**
	+0.1 °C	+0.1 °C	+0.1 °C	+0.1 °C	1	1
	+0.0 °C	+0.0 °C	+0.0 °C		0	0000
	-0.1 °C	-0.1 °C	-0.1 °C	-0.1 °C	-1	FFFF
	:	:	:	:	:	:
	:	:	:	:	-500	FE0C
	-210.0 °C	:	:	:	-2100	F7CC
		-270.0 °C	-270.0 °C	-270.0 °C	-2700	F574
Underflow	< -210.0 °C	< -270.0 °C	< -270.0 °C	< -270.0 °C	-32768	8000

Range	-80 mV ... +80 mV	Type E -270 °C ... +1000 °C	Types R, S -50 °C ... +1768 °C	Digital value	
				Decimal	**Hex.**
Overflow	> +90 mV	> +1000.0 °C	> +1768.0 °C	32767	7FFF
Normal range	+80 mV			27648	6C00
			+1768.0 °C	17680	4510
		+1000.0 °C		10000	2710
				9000	2328
	:	:	:	:	:
	3 µV	+0.1 °C	+0.1 °C	1	1
	0 µV	0.0 °C	0.0 °C	0	0000
	-3 µV	-0.1 °C	-0.1 °C	-1	FFFF
	:	:	:	:	:
	:	:	-50.0 °C	-500	FE0C
	:	-270.0 °C		-2700	F574
	-80 mV			-27648	9400
Underflow	< -90 mV	< -270.0 °C	< -50.0 °C	-32768	8000

Technical data

Technical data of the module

The system data of AC500-eCo apply.

Chapter 2.5.1 “System data AC500-eCo” on page 1379

Only additional details are therefore documented below.

Parameter		Value
Process supply voltage UP		
	Connections	Terminal 19 for UP (+24 V DC) and terminal 20 for ZP (0 V)
	Rated value	24 V DC
	Current consumption	0.10 A
	Inrush current (at power-up)	0.07 A^2s
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	Rated protection fuse for UP	Not necessary
Current consumption from 24 V DC power supply at the terminals UP/L+ and ZP/M of the CPU/communication interface module		Ca. 5 mA
Galvanic isolation		Yes, between the channels and the rest of the module
	Isolated groups	1 (4 channels per group)
Surge-voltage (max.)		35 V DC for 0.5 s
Max. power dissipation within the module		2.6 W
Weight		Ca. 120 g
Mounting position		Horizontal or vertical
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

NOTICE!
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and temporary overvoltage up to 30 V DC.

Technical data of the analog inputs

Parameter		Value
Number of channels per module		4 configurable thermocouple (TC) inputs
Distribution of channels into groups		1 (4 channels per group)
Resolution		
	Temperature	0.1 °C
	Voltage	16 bits including sign
Connection of the signals I0+ to I3+		Terminals 1, 3, 5 and 7
Connection of the signals I0- to I3-		Terminals 2, 4, 6 and 8
Input type		Floating thermocouple
Galvanic isolation		Against internal power supply and other modules
Common mode rejection		> 120 dB at 120 V AC
Indication of the input signals		No
Module update time		All channels: < 1.6 s

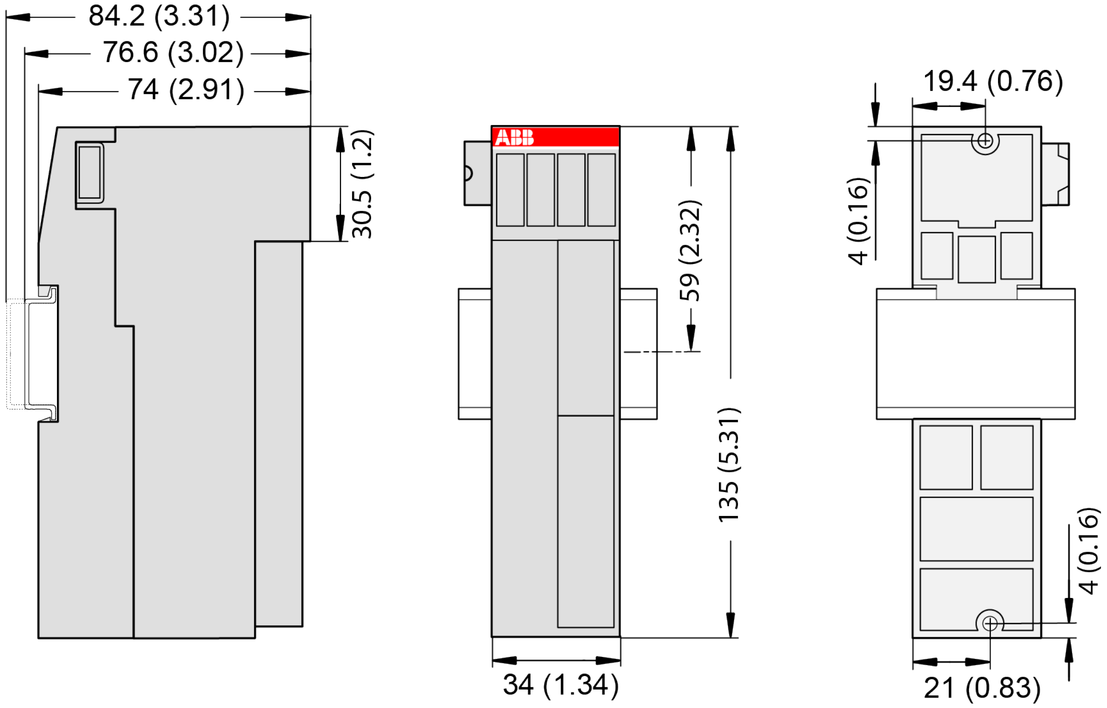
Parameter	Value	
Channel input resistance	On request	
Input filter attenuation	-3 dB at 15 kHz	
Cold junction error	± 1.5 °C	
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range	Typ.	0.1 % of full-scale (voltage) Depending on thermocouple, see table 'Accuracy of thermocouple ranges at +25 °C' *Chapter 1.6.2.1.3.10.2.1 "Accuracy of thermocouple ranges at 25 °C (with cold junction compensation)" on page 582*
	Max.	± 2 % of full scale (T-Type: ± 3 % for -240 °C ... -270 °C) at 0 °C ... +60 °C
Relationship between input signal and hex code	*Chapter 1.6.2.1.3.9 "Measuring ranges" on page 579*	
Analog to digital conversion time	400 ms per channel	
Unused inputs	Can be left open and should be configured as "unused"	
Input data length	8 bytes	
Overvoltage protection	Yes, up to 30 V DC	
Repeatability	On request	
Wire loop resistance	< 100 Ω	
Max. cable length (conductor cross section > 0.14 mm²)		
Unshielded wire	10 m	
Shielded wire	100 m	

Accuracy of thermocouple ranges at 25 °C (with cold junction compensation)

Thermocouple Type	Range	Accuracy
E	-270 °C ... -220 °C	± 2 %
	-220 °C ... +1000 °C	± 0.6 %
J	-210 °C ... +1200 °C	± 0.6 %
K	-270 °C ... -220 °C	± 1.5 %
	-220 °C ... +1372 °C	± 0.6 %
N	-270 °C ... -150 °C	± 2 %
	-150 °C ... +1300 °C	± 0.6 %
R	-50 °C ... +150 °C	± 1.5 %
	+150 °C ... +1768 °C	± 0.6 %
S	-50 °C ... +150 °C	± 1.5 %
	+150 °C ... +1768 °C	± 0.6 %
T	-270 °C ... -240 °C	± 3 %
	-240 °C ... -0 °C	± 2 %
	0 °C ... +400 °C	± 0.6 %

These accuracy values are valid only for stable module temperatures.

Dimensions



The dimensions are in mm and in brackets in inch.

Ordering data

Part no.	Description	Product life cycle phase *)
1TNE 968 902 R1103	AI563, analog input module, 4 AI, thermocouple	Active
1TNE 968 901 R3101	Terminal block TA563-9, 9 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3102	Terminal block TA563-11, 11 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3103	Terminal block TA564-9, 9 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3104	Terminal block TA564-11, 11 pins, screw front, cable front, 6 pieces per unit	Active

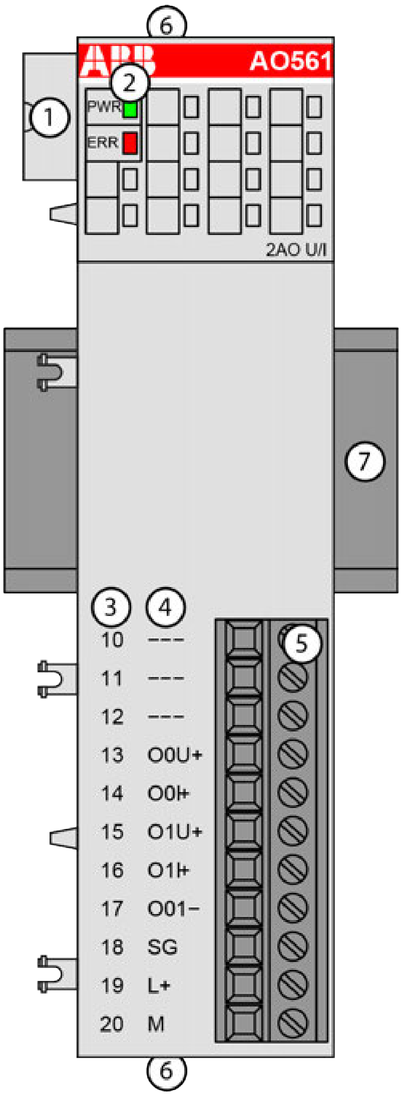
Part no.	Description	Product life cycle phase *)
1TNE 968 901 R3105	Terminal block TA565-9, 9 pins, spring front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3106	Terminal block TA565-11, 11 pins, spring front, cable front, 6 pieces per unit	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

1.6.2.1.4 AO561 - Analog output module

Features

- 2 configurable analog outputs (O0 ... O1) in 1 group
- Resolution: 12 bits including sign



1 I/O bus
2 1 green LED to display power supply, 1 red LED to display error
3 Terminal number
4 Allocation of signal name
5 Terminal block for output signals (11-pin)
6 2 holes for wall-mounting with screws
7 DIN rail

Intended purpose

The device can be used as a decentralized I/O extension module for S500 communication interface modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs.

The outputs are not galvanically isolated from each other.

The other electronic circuitry of the module is not galvanically isolated from the outputs or from the I/O bus.

> *The I/O module must not be used as communication interface module at CI590-CS31-HA bus modules.*

Functionality

2 analog outputs, individually configurable for

- Not used (default setting)
- -10 V ... +10 V
- 0 mA ... 20 mA
- 4 mA ... 20 mA

Parameter		Value
Resolution of the analog channels		
	Voltage bipolar (-10 V ... +10 V)	12 bits including sign
	Current (0 mA ... 20 mA; 4 mA ... 20 mA)	12 bits
LED displays		2 LEDs for process voltage and error messages
Internal supply		Via I/O bus
External supply		Via the terminals L+ (process voltage 24 V DC) and M (0 V DC); the M terminal is connected to the M terminal of the CPU via the I/O bus

Connections

For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.

If the output is configured as not used, the voltage and current output signals are undefined and must not be connected.

The connection is carried out by using a removable 9-pin and 11-pin terminal block. These terminal blocks differ in their connection system (spring terminals or screw terminals, cable mounting from the front or from the side). The terminal blocks are not included in the module's scope of delivery and must be ordered separately.

Chapter 1.9.2.1 “TA563-TA565 - Terminal blocks” on page 1352

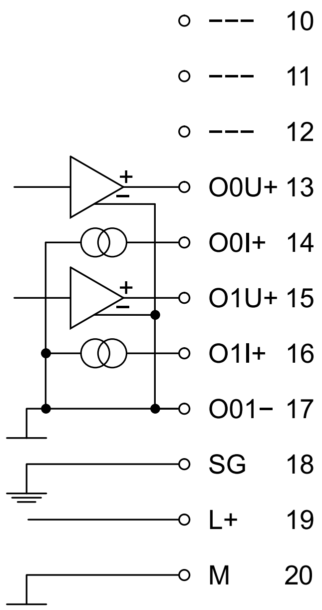


Fig. 135: Internal construction of the analog outputs

The assignment of the terminals:

Terminal	Signal	Description
10	---	Reserved
11	---	Reserved
12	---	Reserved
13	O0U+	Voltage output of channel 0
14	O0I+	Current output of channel 0
15	O1U+	Voltage output of channel 1
16	O1I+	Current output of channel 1
17	O01-	Negative pole of channels O0 and O1
18	SG	Shield grounding
19	L+	Process voltage L+ (24 V DC)
20	M	Process voltage M (0 V DC)

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a communication interface module or a CPU). Thus, the current consumption from 24 V DC power supply at the terminals UP/L+ and ZP/M of the CPU/communication interface module increases by 5 mA per AO561.

The external power supply connection is carried out via the L+ (+24 V DC) and the M (0 V DC) terminals. The M terminal is electrically interconnected to the M/ZP terminal of the CPU/communication interface module.

NOTICE!
Risk of imprecise and faulty measurements!

Analog signals may be distorted seriously by external electromagnetic influences.

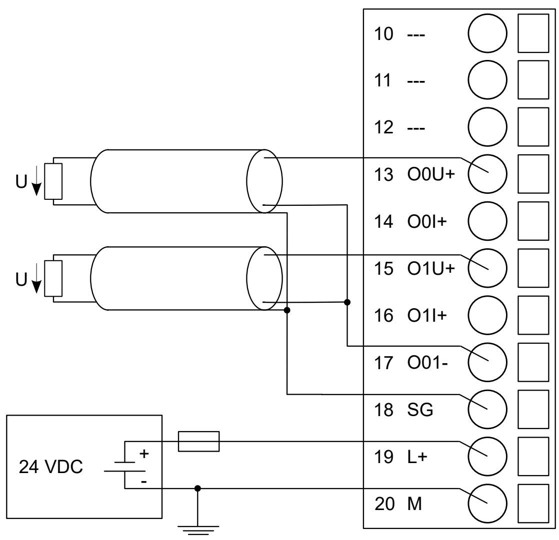
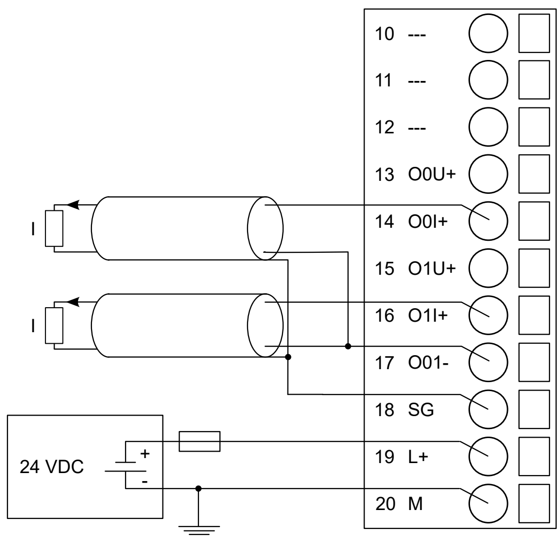
Use shielded wires when wiring analog signal sources. The cable shield must be grounded at both ends of the cable. Provide a potential equalisation of a low resistance to avoid high potential differences between different parts of the plant.

> **NOTICE!**
> **Risk of damaging the PLC modules!**
> The PLC modules must not be removed while the plant is connected to a power supply.
>
> Make sure that all voltage sources (supply and process voltage) are switched off before you
>
> – connect or disconnect any signal or terminal block
> – remove or replace a module.

> **NOTICE!**
> **Risk of damaging the PLC modules!**
> Overvoltages and short circuits might damage the PLC modules.
>
> – Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
> – Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

The module provides several diagnosis functions *Chapter 1.6.2.1.4.7 “Diagnosis” on page 590*.

Table 163: Connection of analog actuators to the analog output module AO561

	
Connection of analog voltage actuators	Connection of analog current actuators

> *The output signal is undefined if the supply voltage at the L+ terminal is below 10 V. This can, for example, occur if the supply voltage has a slow ramp-up / ramp-down behavior and must be foreseen when planning the installation.*

> *If the output is configured in current mode, the voltage output signal is undefined and must not be connected.*
>
> *If the output is configured in voltage mode, the current output signal is undefined and must not be connected.*

I/O configuration

The analog output module AO561 does not store configuration data itself.

Parameterization

The arrangement of the parameter data is performed with Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Name	Value	Internal value	Internal value, Type	Default	Min.	Max.	EDS Slot Index
Module ID	Intern	6515 [1])	WORD	0x1973	0	65535	xx01
Ignore module	No Yes	0 1	BYTE	No 0x00			
Parameter length	Intern	4	BYTE	0	0	255	xx02 [2])
Check Supply	Off On	0 1	BYTE	On 0x01			
Analog Data Format	Default	0	BYTE	Default 0x00		255	
[1]) with CS31 and addresses less than 70, the value is increased by 1 [2]) Value is hexadecimal: HighByte is slot (xx: 0 ... 7), LowByte is index (1 ... n)							

GSD file:

Ext_User_Prm_Data_Len =	0x07
Ext_User_Prm_Data_Const(0) =	0x74, 0x19, 0x04, \ 0x01, 0x00, \ 0x00, 0x00, 0x00, 0x00;

Output channel (2x)

Name	Value	Internal value	Internal value, Type	Default	Min.	Max.
Channel configuration	see table [2])	see table [2])	BYTE	0 0x00 see table [2])	0	65535

Table 164: Channel configuration ²)

Internal value	Operating modes for the analog outputs, individually configurable
0	Not used (default)
128	-10 V ... +10 V
129	0 mA ... 20 mA
130	4 mA ... 20 mA

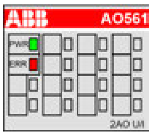
Diagnosis

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identifier 000 ... 063**	**AC500 display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 6 Bit 6 ... 7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0 ... 5**	**PNIO diagnosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error Identifier**	**Error message**	**Remedy**
	1)	**2)**	**3)**	**4)**			
Module error							
3	14	1 ... 10	31	31	19	Checksum error in the I/O module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	9	Overflow diagnosis buffer	Restart
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	26	Parameter error	Check master
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	11	Process voltage too low	Check process voltage
	11 / 12	ADR	1 ... 10				
Channel error							
4	14	1 ... 10	3	0 ... 1	48	Analog value overflow at an analog output	Check output value or terminal
	11 / 12	ADR	1 ... 10				
4	14	1 ... 10	3	0 ... 1	7	Analog value underflow at an analog output	Check output value
	11 / 12	ADR	1 ... 10				

Remarks:

1)	In AC500 the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The PNIO diagnosis block does not contain this identifier.
2)	With "Device" the following allocation applies: 31 = module itself, 1 ... 10 = expansion module 1 ... 10, ADR = hardware address (e. g. of the DC551-CS31)
3)	With "Module" the following allocation applies depending on the master: Module error: I/O bus or PNIO: 31 = module itself; COM1/COM2: 1 ... 10 = expansion 1 ... 10 Channel error: I/O bus or PNIO = module type (3 = AO); COM1/COM2: 1 ... 10 = expansion 1 ... 10
4)	In case of module errors, with channel "31 = Module itself" is output.

State LEDs

LED		State	Color	LED = OFF	LED = ON	LED flashes
	PWR	Process voltage 24 V DC via terminal	Green	CPU module voltage or external 24 V DC supply voltage is missing	3.3 V system voltage (I/O bus) and external 24 V DC supply voltage are present	---
	ERR	Channel or module error	Red	No error or process voltage is missing	Severe error in the module	Error on 1 or more chan-nels of the module

Output ranges

Range	-10 ... +10 V	0 ... 20 mA	4 ... 20 mA	Digital value	
				Decimal	Hex.
Overflow	>11.7589	>23.5178	>22.8142	32767	7FFF
Value too high	11.7589	23.5178	22.8142	32511	7EFF
	:	:	:	:	:
	10.0058	:	:	27664	6C10
	:	:	20.0058	27658	6C0A
	:	20.0058	:	27656	6C08
Normal range	10.0000	20.0000	20.0000	27648	6C00
Normal range or value too low	:	:	:	:	:
	0.0058	:	:	16	0010
	:	:	4.0058	10	000A
	:	0.0058		8	0008
	0.0000	0	4	0	0000

Range	-10 ... +10 V	0 ... 20 mA	4 ... 20 mA	Digital value	
				Decimal	**Hex.**
	:		3.9942	-10	FFF6
	-0.0058		:	-16	FFF0
	:		:	-4864	ED00
	:		0	-6912	E500
	:			:	:
	-10.0000			-27648	9400
Value too low	-10.0058			-27664	93F0
	:			:	:
	-11.7589			-32512	8100
Underflow	<-11.7589		<0.0000	-32768	8000

The represented resolution corresponds to 12 bits including sign.

Technical data

Technical data of the module

The system data of AC500-eCo apply.

Chapter 2.5.1 “System data AC500-eCo” on page 1379

Only additional details are therefore documented below.

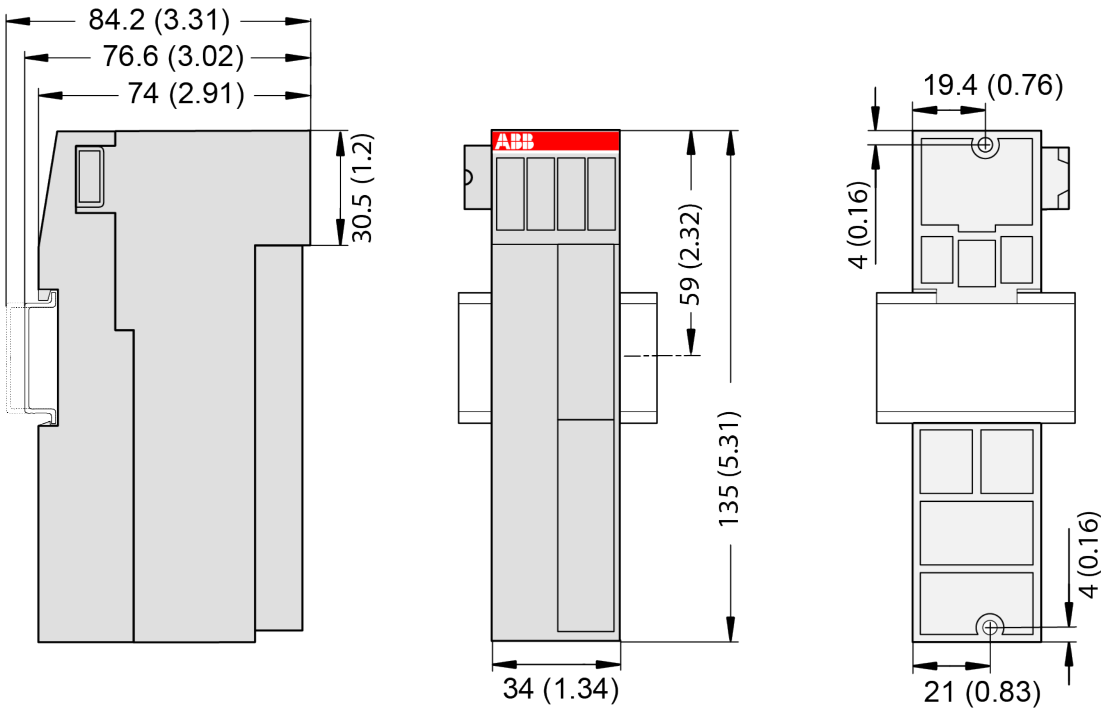
Parameter		Value
Process supply voltage L+		
	Connections	Terminal 19 for L+ (+24 V DC) and terminal 20 for M (0 V)
	Rated value	24 V DC
	Current consumption	0.1 A + output load
	Inrush current (at power-up)	0.05 A^2s
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	Protection fuse for L+	Recommended
Current consumption from 24 V DC power supply at the terminals UP/L+ and ZP/M of the CPU/communication interface module		Ca. 5 mA
Galvanic isolation		No
Surge-voltage (max.)		35 V DC for 0.5 s
Max. power dissipation within the module		3.1 W
Weight		Ca. 120 g
Mounting position		Horizontal or vertical
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

NOTICE!
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and temporary overvoltage up to 30 V DC.

Technical data of the analog outputs

Parameter		Value	
Number of channels per module		2 configurable voltage or current outputs	
Distribution of channels into groups		1 (2 channels per group)	
Connection of the signals O0U- and O1U+		Terminals 13 and 15	
Connection of the signals O0I+ and O1I+		Terminals 14 and 16	
Output type		Bipolar with voltage, unipolar with current	
Resolution		12 bits including sign	
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range		Typ.	± 0.5 % of full scale at +25 °C
		Max.	± 2 % of full scale at 0 °C ... +60 °C or EMC disturbances
Indication of the output signals		No	
Output Resistance (load) as current output		0 Ω ... 500 Ω	
Output load ability as voltage output		± 2 mA max.	
Output data length		4 bytes	
Relationship between output signal and hex code		*Chapter 1.6.2.1.4.9 “Output ranges” on page 591*	
Unused outputs		Must not be connected and must be configured as "unused"	
Overvoltage protection		Yes, up to 30 V DC	
Max. cable length (conductor cross section > 0.14 mm^2)			
	Unshielded wire	10 m	
	Shielded wire	100 m	

Dimensions



The dimensions are in mm and in brackets in inch.

Ordering data

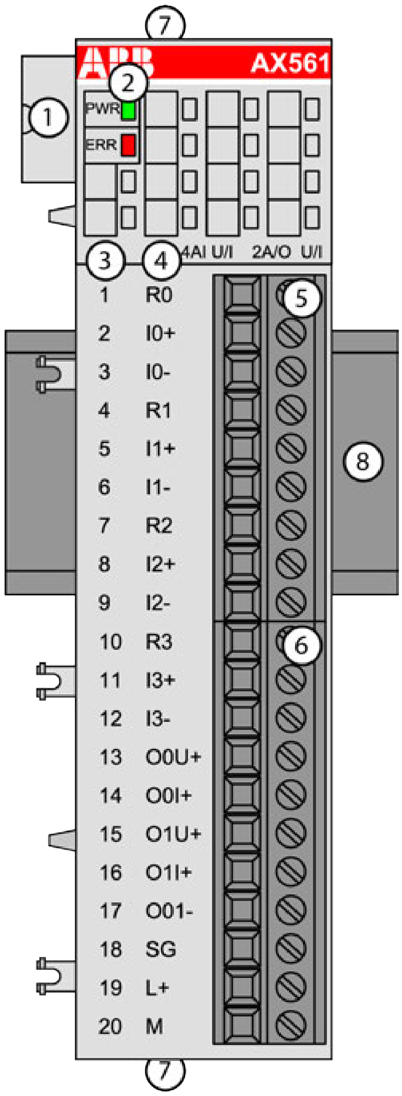
Part no.	Description	Product life cycle phase *)
1TNE 968 902 R1201	AO561, analog output module, 2 AO, U/I	Active
1TNE 968 901 R3102	Terminal block TA563-11, 11 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3104	Terminal block TA564-11, 11 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3106	Terminal block TA565-11, 11 pins, spring front, cable front, 6 pieces per unit	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

1.6.2.1.5 AX561 - Analog input/output module

Features

- 4 configurable analog inputs (I0 ... I3) in 1 group
- 2 configurable analog outputs (O0 and O1) in 1 group
- Resolution: 12 bits including sign



1 I/O bus
2 1 green LED to display power supply, 1 red LED to display error
3 Terminal number
4 Allocation of signal name
5 Terminal block for input signals (9-pin)
6 Terminal block for output signals (11-pin)
7 2 holes for wall-mounting with screws
8 DIN rail

Intended purpose

The device can be used as a decentralized I/O extension module for S500 communication interface modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs.

The inputs are not galvanically isolated from each other.

The outputs are not galvanically isolated from each other.

All other circuitry of the module is not galvanically isolated from the inputs/outputs or from the I/O bus.

The I/O module must not be used as a decentralized I/O module with CI590-CS31-HA communication interface modules.

Functionality

4 analog inputs, individually configurable for

- Not used (default)
- -2.5 V ... +2.5 V
- -5 V ... + 5 V
- 0 V ... +5 V
- 0 V ... +10 V
- 0 mA ... 20 mA
- 4 mA ... 20 mA

2 analog outputs, individually configurable for

- Not used (default)
- -10 V ... +10 V
- 0 mA ... 20 mA
- 4 mA ... 20 mA

Parameter		Value
Resolution of the analog channels		
	Voltage bipolar (-2.5 V ... +2.5 V; -5 V ... +5 V)	12 bits including sign
	Voltage unipolar (0 V ... 5 V; 0 V ... 10 V)	12 bits
	Current (0 mA ... 20 mA; 4 mA ... 20 mA)	12 bits
LED displays		2 LEDs for process voltage and error messages
Internal supply		Via I/O bus
External supply		Via the terminals L+ (process voltage 24 V DC) and M (0 V DC); the M terminal is connected to the M terminal of the CPU via the I/O bus

Connections

For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.

> *If the output is configured as not used, the voltage and current output signals are undefined and must not be connected.*

The connection is carried out by using a removable 9-pin and 11-pin terminal block. These terminal blocks differ in their connection system (spring terminals or screw terminals, cable mounting from the front or from the side). The terminal blocks are not included in the module's scope of delivery and must be ordered separately.

Chapter 1.9.2.1 "TA563-TA565 - Terminal blocks" on page 1352

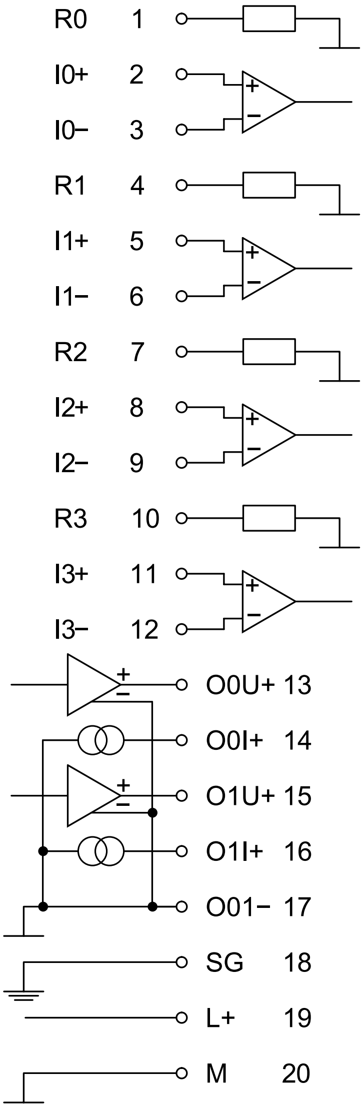


Fig. 136: Internal construction of the analog inputs and outputs

Table 165: Assignment of the terminals

Terminal	Signal	Description
1	R0	Burden resistor for input signal 0 for current sensing
2	I0+	Positive pole of input signal 0
3	I0-	Negative pole of input signal 0
4	R1	Burden resistor for input signal 1 for current sensing
5	I1+	Positive pole of input signal 1

Terminal	Signal	Description
6	I1-	Negative pole of input signal 1
7	R2	Burden resistor for input signal 2 for current sensing
8	I2+	Positive pole of input signal 2
9	I2-	Negative pole of input signal 2
10	R3	Burden resistor for input signal 3 for current sensing
11	I3+	Positive pole of input signal 3
12	I3-	Negative pole of input signal 3
13	O0U+	Voltage output of channel 0
14	O0I+	Current output of channel 0
15	O1U+	Voltage output of channel 1
16	O1I+	Current output of channel 1
17	O01-	Negative pole of channels O0 and O1
18	SG	Shield grounding
19	L+	Process voltage L+ (24 V DC)
20	M	Process voltage M (0 V DC)

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a communication interface module or a CPU). Thus, the current consumption from 24 V DC power supply at the terminals UP/L+ and ZP/M of the CPU/communication interface module increases by 5 mA per AX561.

The external power supply connection is carried out via the L+ (+24 V DC) and the M (0 V DC) terminals. The M terminal is interconnected to the M/ZP terminal of the CPU/communication interface module.

NOTICE!

Risk of imprecise and faulty measurements!

Analog signals may be distorted seriously by external electromagnetic influences.

Use shielded wires when wiring analog signal sources. The cable shield must be grounded at both ends of the cable. Provide a potential equalisation of a low resistance to avoid high potential differences between different parts of the plant.

WARNING!

Removal/Insertion under power

The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!

Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

The module provides several diagnosis functions *Chapter 1.6.2.1.5.7 “Diagnosis” on page 605*.

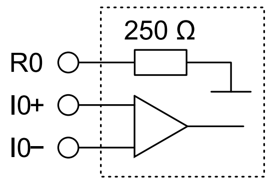


Fig. 137: Example of the internal construction of the analog input AI0 (analog inputs AI1 ... AI3 are designed in the same way)

CAUTION!

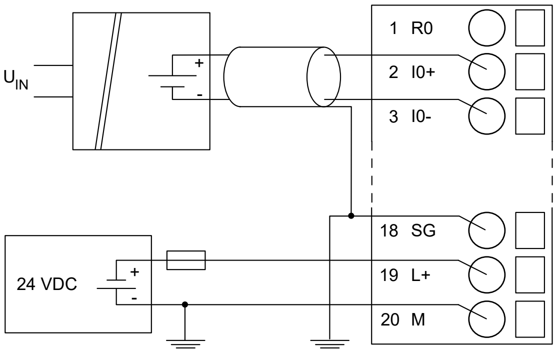
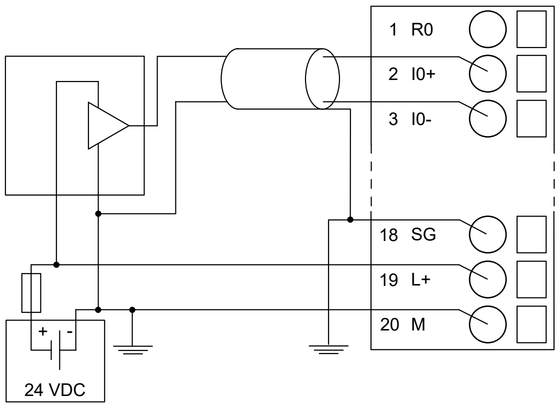
Risk of damaging the analog input!

The 250 Ω input resistor can be damaged by overcurrent.

Make sure that the current through the resistor never exceeds 30 mA.

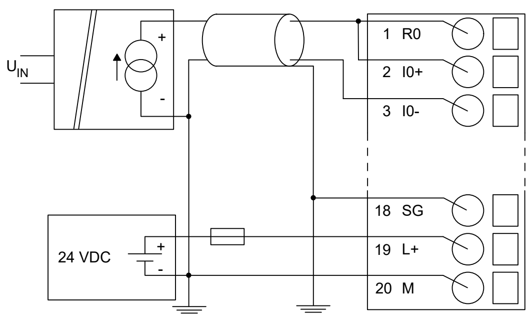
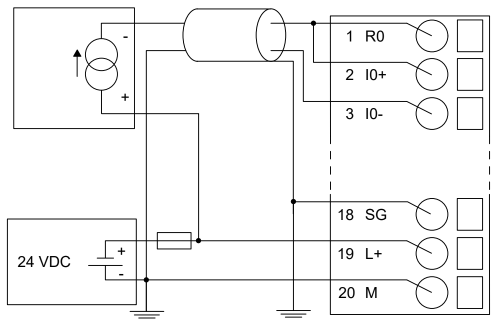
The following figures are an example of the connection of analog sensors (voltage) to the input I0 of the analog input/output module AX561. Proceed with the inputs I1 ... I3 in the same way.

Table 166: Example of the connection of analog sensors (voltage) to the input I0 of the analog input/output module AX561 (Proceed with the inputs I1 to I3 in the same way)

	
Connection of active-type analog sensors (voltage)	Connection of passive-type analog sensors (voltage)

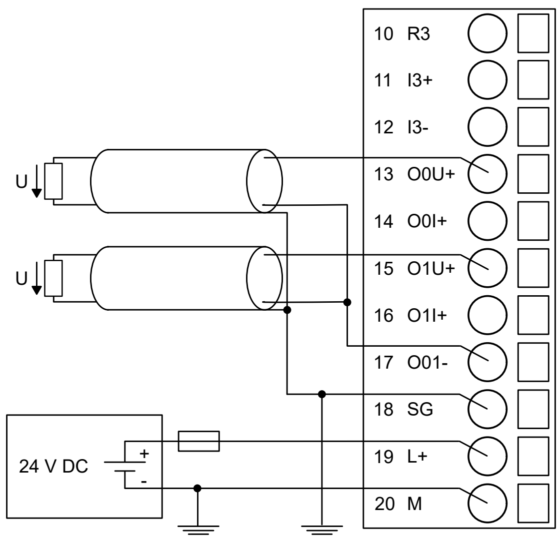
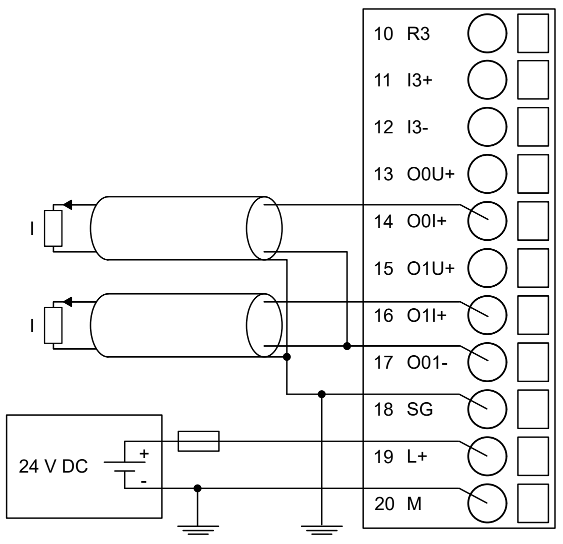
Connection of active-type analog sensors (voltage)	Connection of passive-type analog sensors (voltage)
-2.5 V ... 2.5 V	-2.5 V ... 2.5 V
-5 V ... 5 V	-5 V ... 5 V
0 V ... 5 V	0 V ... 5 V
0 V ... 10 V	0 V ... 10 V

Table 167: Example of the connection of analog sensors (current) to the input I0 of the analog input/output module AX561 (Proceed with the inputs I1 ... I3 in the same way)

	
Connection of active-type analog sensors (current)	Connection of passive-type analog sensors (current)

Connection of active-type analog sensors (voltage)	Connection of passive-type analog sensors (voltage)
4 mA ... 20 mA	4 mA ... 20 mA
0 mA ... 20 mA	

Table 168: Example of the connection of analog actuators to the analog input/output module AX561

	
Connection of analog voltage actuators	Connection of analog current actuators

The output signal is undefined if the supply voltage at the L+ terminal is below 10 V. This can, for example, occur if the supply voltage has a slow ramp-up / ramp-down behavior and must be foreseen when planning the installation.

If the output is configured in current mode, the voltage output signal is undefined and must not be connected.

If the output is configured in voltage mode, the current output signal is undefined and must not be connected.

The meaning of the LEDs is described in the displays chapter ↯ *Chapter 1.6.2.1.5.8 “State LEDs” on page 606*.

I/O configuration

The I/O module does not store configuration data itself.

Parameterization

The arrangement of the parameter data is performed with Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Name	Value	Internal Value	Internal value, Type	Default	Min.	Max.	EDS Slot Index
Module ID	Internal	6520 [1])	WORD	0x1978	0	65535	xx01
Ignore module	No Yes	0 1	BYTE	No 0x00			
Parameter length	Internal	8	BYTE	0	0	255	xx02 [2])
Check Supply	Off On	0 1	BYTE	On 0x01			
Analog Data Format	Default	0	BYTE	Default 0x00			

[1]) With CS31 and addresses less than 70, the value is increased by 1

[2]) Value is hexadecimal: HighByte is slot (xx: 0 ... 7), LowByte is index (1 ... n)

GSD file:

Ext_User_Prm_Data_Len = Ext_User_Prm_Data_Const(0) =	0x0B 0x79, 0x19, 0x08, \ 0x01, 0x00, \ 0x00, 0x00, 0x00, 0x00, \ 0x00, 0x00;

Input channel (4x)

Name	Value	Internal value	Internal value, Type	Default	Min.	Max.
Channel configura-tion	see table [2])	see table [2])	BYTE	0 0x00 see table [2])	0	65535

Table 169: Channel configuration [2])

Internal value	Operating modes for the analog inputs, individually configu-rable
0	Not used (default)
1	0 V ... +10 V
3	0 mA ... 20 mA
4	4 mA ... 20 mA
6	0 V ... +5 V
7	-5 V ... +5 V
20	-2.5 V ... +2.5 V

Output channel (2x)

Name	Value	Internal value	Internal value, Type	Default	Min.	Max.
Channel configura-tion	see see table 2)	see see table 2)	BYTE	0 0x00 see table 2)	0	65535

Table 170: Channel configuration 2)

Internal value	Operating modes for the analog outputs, individually configurable
0	Not used (default)
128	-10 V ... + 10 V
129	0 mA ... 20 mA
130	4 mA ... 20 mA

Diagnosis

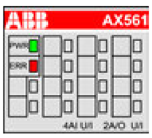
E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identifier** **000 ... 063**	**AC500 display**	**<– Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 6 **Bit 6 ... 7**	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6** **Bit 0 ... 5**	**PNIO diagnosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error Identifier**	**Error message**	**Remedy**
	1)	**2)**	**3)**	**4)**			
Module error							
3	14	1 ... 10	31	31	19	Checksum error in the I/O module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	9	Overflow diagnosis buffer	Restart
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	26	Parameter error	Check master
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	11	Process voltage too low	Check process voltage
	11 / 12	ADR	1 ... 10				
Channel error							
4	14	1 ... 10	1	0 ... 3	48	Analog value overflow at an analog input	Check input value or terminal
	11 / 12	ADR	1 ... 10				
4	14	1 ... 10	1	0 ... 3	7	Analog value underflow at an analog input	Check input value
	11 / 12	ADR	1 ... 10				

E1 ... E4	d1	d2	d3	d4	Identifier 000 ... 063	AC500 display	<- Display in
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 6 Bit 6 ... 7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0 ... 5**	**PNIO diagnosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error Identifier**	**Error message**	**Remedy**
	1)	2)	3)	4)			
4	14	1 ... 10	3	0 ... 1	48	Analog value overflow at an analog output	Check output value or terminal
	11 / 12	ADR	1 ... 10				
4	14	1 ... 10	3	0 ... 1	7	Analog value underflow at an analog output	Check output value
	11 / 12	ADR	1 ... 10				

Remarks:

1)	In AC500 the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The PNIO diagnosis block does not contain this identifier.
2)	With "Device" the following allocation applies: 31 = module itself, 1 ... 10 = expansion module 1 ... 10, ADR = hardware address (e. g. of the DC551-CS31)
3)	With "Module" the following allocation applies dependent of the master: Module error: I/O bus or PNIO: 31 = module itself; COM1/COM2: 1 ... 10 = expansion 1 ... 10 Channel error: I/O bus or PNIO = module type (1 = AI, 3 = AO); COM1/COM2: 1 ... 10 = expansion 1 ... 10
4)	In case of module errors, with channel "31 = Module itself" is output.

State LEDs

LED		State	Color	LED = OFF	LED = ON	LED flashes
	PWR	Process voltage 24 V DC via terminal	Green	CPU module voltage or external 24 V DC supply voltage is missing	3.3 V system voltage (I/O bus) and external 24 V DC supply voltage are present	---
	ERR	Channel or module error	Red	No error or process voltage is missing	Severe error in the module	Error on 1 or more chan-nels of the module

Measuring ranges

> **CAUTION!**
> **Risk of wrong analog input values!**
> The analog input values may be wrong if the measuring range of the inputs are exceeded.
>
> Make sure that the analog signal at the connection terminals is always within the signal range.

Range	-2.5 V ... +2.5 V	-5 V ... +5 V	0 V ... 5 V	0 V ... 10 V	0 mA ... 20 mA	4 mA ... 20 mA	Digital value	
							Decimal	**Hex.**
Overflow	>2.9397	>5.8795	>5.8795	>11.7589	>23.5178	>22.8142	32767	7FFF
Measured value too high	2.9397 : 2.5014	5.8795 : 5.0029	5.8795 : : : 5.0015	11.7589 : : : 10.0029	23.5178 : : : 20.0058	22.8142 : : 20.0058	32511 : 27664 27658 27656	7EFF : 6C10 6C0A 6C08
Normal range Normal range or measured value too low	2.5000 : 0.0014	5.0000 : 0.0029	5.0000 : : : 0.0015	10.0000 : : : 0.0029	20.0000 : : : 0.0058	20.0000 : : 4.0058	27648 : 16 10 8	6C00 : 0010 000A 0008
	0.0000	0.0000	0.0000	0.0000	0	4	0	0000
	: -0.0014 : : : -2.5000	: -0.0029 : : : -5.0000				3.9942 : : 0	-10 -16 -4864 -6912 : -27648	FFF6 FFF0 ED00 E500 : 9400
Measured value too low	-2.5014 : -2.9398	-5.0029 : -5.8795					-27664 : -32512	93F0 : 8100
Underflow	<-2.9398	<-5.8795	<-0.0300	<-0.0600	<-0.1200	<-0.1200	-32768	8000

The represented resolution corresponds to 12 bits including sign.

Output ranges

Range	-10 V ... +10 V	0 mA ... 20 mA	4 mA ... 20 mA	Digital value	
				Decimal	**Hex.**
Overflow	> 11.7589	> 23.5178	> 22.8142	32767	7FFF
Output value too high	11.7589	23.5178	22.8142	32511	7EFF
	:	:	:	:	:
	10.0058	:	:	27664	6C10
	:	:	20.0058	27658	6C0A
	:	20.0058	:	27656	6C08
Normal range	10.0000	20,0000	20.0000	27648	6C00
Normal range or output value too low	:	:	:	:	:
	0.0058	:	:	16	0010
	:	:	4.0058	10	000A
	:	0.0058		8	0008
	0.0000	0	4	0	0000
	:		3.9942	-10	FFF6
	-0.0058		:	-16	FFF0
	:		:	-4864	ED00
	:		0	-6912	E500
	:			:	:
	-10.0000			-27648	9400
Output value too low	-10.0058			-27664	93F0
	:			:	:
	-11.7589			-32512	8100
Underflow	< -11.7589		<0.0000	-32768	8000

The represented resolution corresponds to 12 bits including sign.

Technical data

Technical data of the module

The system data of AC500-eCo apply.

🢂 *Chapter 2.5.1 “System data AC500-eCo” on page 1379*

Only additional details are therefore documented below.

Parameter		Value
Process supply voltage L+		
	Connections	Terminal 19 for L+ (+24 V DC) and terminal 20 for M (0 V)
	Rated value	24 V DC
	Current consumption via L+ terminal	0.14 A + output load
	Inrush current (at power-up)	0.05 A

Parameter		Value
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	Protection fuse for L+	Recommended
Current consumption from 24 V DC power supply at the terminals UP/L+ and ZP/M of the CPU/communication interface module		Ca. 5 mA
Galvanic isolation		No
Surge-voltage (max.)		35 V DC for 0.5 s
Max. power dissipation within the module		4.9 W
Weight		Ca. 120 g
Mounting position		Horizontal or vertical
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

NOTICE!
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and temporary overvoltage up to 30 V DC.

Technical data of the analog inputs

Parameter		Value
Number of channels per module		4 individually configurable voltage or current inputs
Distribution of channels into groups		1 (4 channels per group)
Resolution		
	Unipolar	Voltage: 0 V ... +5 V; 0 V ... +10 V: 12 bits Current 0 mA ... 20 mA; 4 mA ... 20 mA: 12 bits
	Bipolar	Voltage -2.5 V ... +2.5 V; -5 V ... +5 V: 12 bits including sign
Connection of the signals I0- to I3-		Terminals 3, 6, 9, 12
Connection of the signals I0+ to I3+		Terminals 2, 5, 8, 11
Input type		Differential
Galvanic isolation		No galvanic isolation between the inputs and the I/O bus
Common mode input range		Signal voltage plus common mode voltage must be within ± 12 V
Indication of the input signals		No
Channel input resistance		Voltage: >1 MΩ Current: ca. 250 Ω

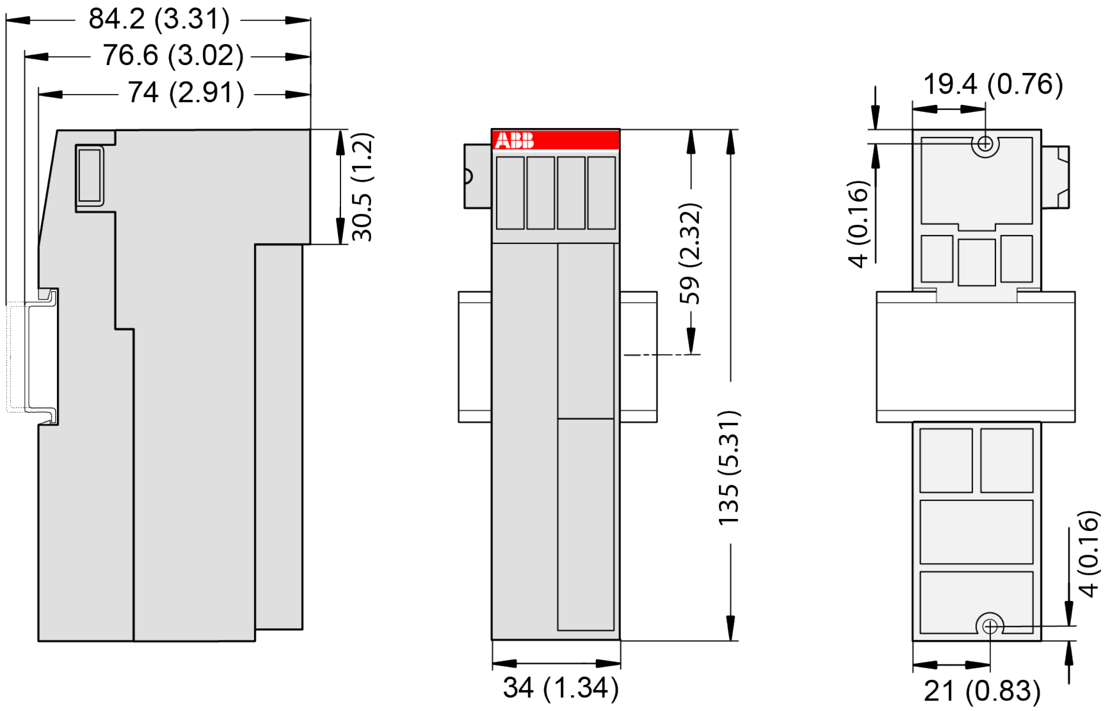
Parameter		Value	
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range		Typ.	± 0.5 % of full scale (voltage) ± 0.5 % of full scale (current 0 mA ... 20 mA) ± 0.7 % of full scale (current 4 mA ... 20 mA) at +25 °C
		Max.	± 2 % of full scale (all ranges) at 0 °C ... +60 °C or EMC disturbance
Time constant of the input filter		Voltage: 300 µs Current: 300 µs	
Relationship between input signal and hex code		*Table on page 607*	
Analog to digital conversion time		Typ. 500 µs per channel	
Unused inputs		Can be left open and should be configured as "unused"	
Input data length		8 bytes	
Overvoltage protection		Yes, up to 30 V DC only for voltage input	
Max. cable length (conductor cross section > 0.14 mm^2)			
	Unshielded wire	10 m	
	Shielded wire	100 m	

Technical data of the analog outputs

Parameter	Value	
Number of channels per module	2 configurable voltage or current outputs	
Distribution of channels into groups	1 (2 channels per group)	
Connection of the signals O0U- and O1U+	Terminals 13 and 15	
Connection of the signals O0I+ and O1I+	Terminals 14 and 16	
Output type	Bipolar with voltage, unipolar with current	
Resolution	12 bits including sign	
Indication of the output signals	No	
Output resistance (load) as current output	0 Ω ... 500 Ω	
Output load ability as voltage output	2 mA max.	
Relationship between input signal and hex code	Table Output Ranges *Table on page 608*	
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range	Typ.	± 0.5 % of full scale (voltage) ± 0.5 % of full scale (current 0 mA ... 20 mA) ± 0.7 % of full scale (current 4 mA ... 20 mA) at +25°C
	Max.	± 2 % of full scale (all ranges) at 0 °C ... +60 °C or EMC disturbance

Parameter		Value
Unused outputs		Can be left open and should be configured as "unused"
Output data length		4 bytes
Overvoltage protection		Yes, up to 30 V DC
Max. cable length (conductor cross section > 0.14 mm²)		
	Unshielded wire	10 m
	Shielded wire	100 m

Dimensions



The dimensions are in mm and in brackets in inch.

Ordering data

Part no.	Description	Product life cycle phase *)
1TNE 968 902 R1301	AX561, analog input/output module, 4 AI, 2 AO, U/I	Active
1TNE 968 901 R3101	Terminal block TA563-9, 9 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3102	Terminal block TA563-11, 11 pins, screw front, cable side, 6 pieces per unit	Active

Part no.	Description	Product life cycle phase *)
1TNE 968 901 R3103	Terminal block TA564-9, 9 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3104	Terminal block TA564-11, 11 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3105	Terminal block TA565-9, 9 pins, spring front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3106	Terminal block TA565-11, 11 pins, spring front, cable front, 6 pieces per unit	Active

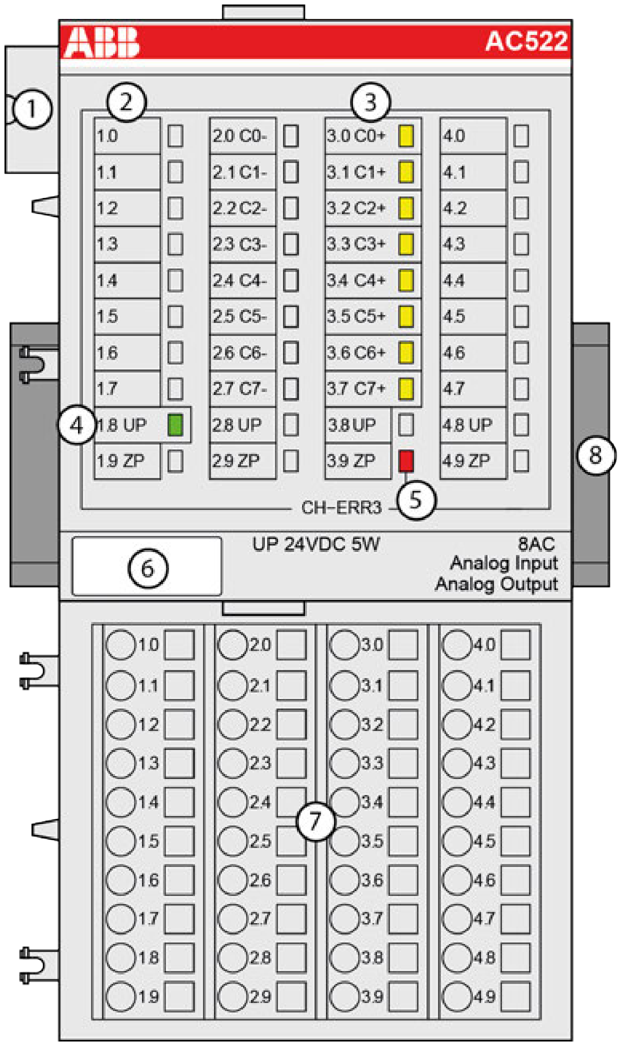
**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

1.6.2.2 S500

1.6.2.2.1 AC522 - Analog input/output module

Features

- 8 channels configurable as analog inputs/outputs in one group (2.0 ... 2.7 and 3.0 ... 3.7)
- Resolution 12 bits including sign
- Module-wise galvanically isolated
- XC version for use in extreme ambient conditions available



1 I/O bus
2 Allocation between terminal number and signal name
3 8 yellow LEDs to display the signal states at the analog inputs/outputs (C0 ... C7)
4 1 green LED to display the state of the process supply voltage UP
5 1 red LED to display errors
6 Label
7 Terminal unit
8 DIN rail
Sign for XC version

Intended purpose

The device can be used as a decentralized I/O extension module for S500 communication interface modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs.

The configuration is performed by software. The modules are supplied with a process voltage of 24 V DC.

The inputs and outputs are galvanically isolated from all other circuitry of the module.

Functionality

8 channels configurable as analog inputs/outputs

If used as inputs, the following signal ranges are individually configurable:

- Unused (default setting)
- 0 V ... 10 V
- -10 V ... +10 V
- 0 mA ... 20 mA
- 4 mA ... 20 mA
- Pt100, -50 °C ... +400 °C (2-wire)
- Pt100, -50 °C ... +400 °C (3-wire), requires 2 channels
- Pt100, -50 °C ... +70 °C (2-wire)
- Pt100, -50 °C ... +70 °C (3-wire), requires 2 channels
- Pt1000, -50 °C ... +400 °C (2-wire)
- Pt1000, -50 °C ... +400 °C (3-wire), requires 2 channels
- Ni1000, -50 °C ... +150 °C (2-wire)
- Ni1000, -50 °C ... +150 °C (3-wire), requires 2 channels
- 0 V ... 10 V with differential inputs, requires 2 channels
- -10 V ... +10 V with differential inputs, requires 2 channels
- Digital signals (digital input)

Parameter		**Value**
Resolution of the analog channels		
	Voltage -10 V ... +10 V	12 bits including sign
	Voltage 0 V ... 10 V	12 bits
	Current 0 mA ... 20 mA, 4 mA ... 20 mA	12 bits
	Temperature	+0.1 °C
LED displays		10 LEDs for signals and error messages
Internal power supply		Via the I/O bus interface (I/O bus)
External power supply		Via the terminals ZP and UP (process voltage 24 V DC)
Required terminal unit		TU515 or TU516 ⇨ *Chapter 1.5.3 “TU515, TU516, TU541 and TU542 for I/O modules” on page 282*

Connections

For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.

The modules are plugged on an I/O terminal unit ⇨ *Chapter 1.5.3 “TU515, TU516, TU541 and TU542 for I/O modules” on page 282*. Properly position the modules and press until they lock in place. The terminal units are mounted on a DIN rail or with 2 screws plus the additional accessory for wall mounting ⇨ *Chapter 1.9.3.5 “TA526 - Wall mounting accessory” on page 1361*.

The connection of the I/O channels is carried out using the 40 terminals of the I/O terminal unit. I/O modules can be replaced without re-wiring the terminal units.

The terminals 1.8, 2.8, 3.8 and 4.8 as well as 1.9, 2.9, 3.9 and 4.9 are electrically interconnected within the I/O terminal units and always have the same assignment, independent of the inserted module:

Terminals 1.8, 2.8, 3.8 and 4.8: process voltage UP = +24 V DC

Terminals 1.9, 2.9, 3.9 and 4.9: process voltage ZP = 0 V DC

The assignment of the other terminals:

Terminals	Signal	Description
1.0 ... 1.7	Unused	Unused
2.0 ... 2.7	C0- ... C7-	Negative poles of the 8 analog inputs/outputs
3.0 ... 3.7	C0+ ... C7+	Positive poles of the analog inputs/outputs
4.0 ... 4.7	Unused	Unused

The negative poles of the analog inputs are connected to each other to form an "Analog Ground" signal for the module.

The negative poles of the analog outputs are connected to each other to form an "Analog Ground" signal for the module.

There is no galvanic isolation between the analog circuitry and ZP/UP. Therefore, the analog sensors must be galvanically isolated in order to avoid loops via the ground potential or the supply voltage.

Because of their common reference potential, analog current inputs cannot be circuited in series, neither within the module nor with channels of other modules.

For the open-circuit detection (wire break), each analog input channel is pulled up to "plus" by a high-resistance resistor. If nothing is connected, the maximum voltage will be read in then.

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a communication interface module or a CPU). Thus, the current consumption from 24 V DC power supply at the terminals L+/UP and M/ZP of the CPU/communication interface module increases by 2 mA per I/O module. The external power supply connection is carried out via the UP (+24 V DC) and the ZP (0 V DC) terminals.

WARNING!

Removal/Insertion under power

Removal or insertion under power is permissible only if all conditions for hot swapping are fullfilled.

Conditions for hot swap

"Conditions for hot swap" on page 1367

The devices are not designed for removal or insertion under power when the conditions for hot swap do not apply. Because of unforeseeable consequences, it is not allowed to plug in or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

Disconnecting any powered devices while they are energized in a hazardous location could result in an electric arc, which could create an ignition source resulting in fire or explosion.

Prior to proceeding, make sure that power is been disconnected and that the area has been thoroughly checked to ensure that flammable materials are not present.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!

Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

Generally, analog signals must be laid in shielded cables. The cable shields must be grounded at both sides of the cables. In order to avoid unacceptable potential differences between different parts of the installation, low resistance equipotential bonding conductors must be laid.

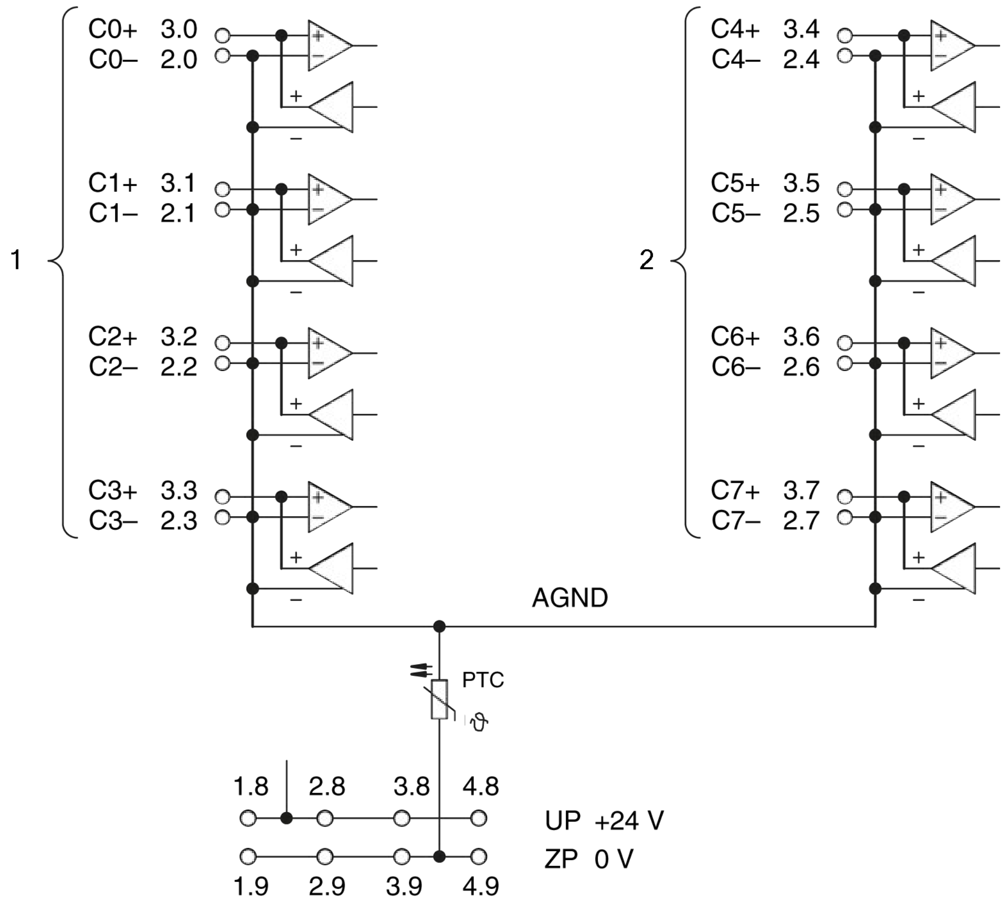


Fig. 138: Connection of the I/O module

1 4 analog I/O channels
as inputs for 0 V ... 10 V, -10 V ... +10 V, 0 mA ... 20 mA, 4 mA ... 20 mA, Pt100/Pt1000/Ni1000 digital signals
as outputs for -10 V ... +10 V, 0 mA ... 20 mA, 4 mA ... 20 mA

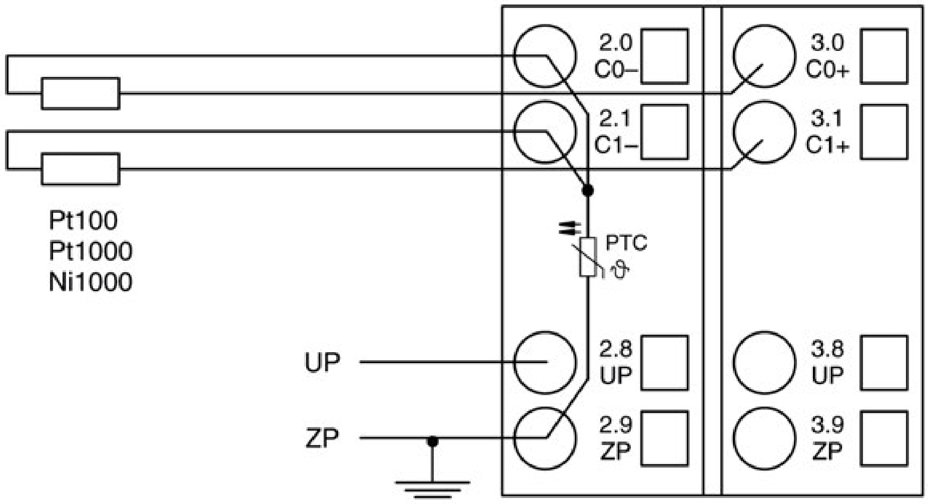
2 4 analog I/O channels
as inputs for 0 V ... 10 V, -10 V ... +10 V, 0 mA ... 20 mA, 4 mA ... 20 mA, Pt100/Pt1000/Ni1000 digital signals
as outputs for -10 V ... +10 V

> *The process voltage must be included in the grounding concept of the control system (e.g. grounding the negative pole).*

> *By installing equipotential bonding conductors between the different parts of the system, it must be made ensured that the potential difference between ZP and AGND never exeeds 1 V.*

Connection of resistance thermometers in 2-wire configuration

When resistance thermometers (Pt100, Pt1000, Ni1000) are used, a constant current must flow through them to build the necessary voltage drop for the evaluation. For this, the I/O module provides a constant current source which is multiplexed over the 8 analog channels.



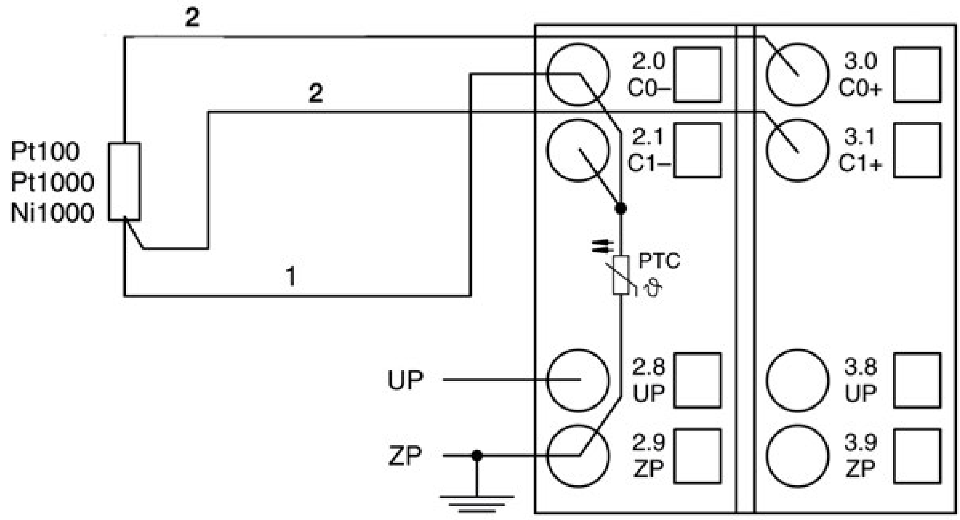
Pt100	-50 °C ... +70 °C	2-wire configuration, one channel used
Pt100	-50 °C ... +400 °C	2-wire configuration, one channel used
Pt1000	-50 °C ... +400 °C	2-wire configuration, one channel used
Ni1000	-50 °C ... +150 °C	2-wire configuration, one channel used

The I/O module performs a linearization of the resistance characteristic.

In order to avoid error messages from unused analog input channels, it is useful to configure them as "unused".

Connection of resistance thermometers in 3-wire configuration

When resistance thermometers (Pt100, Pt1000, Ni1000) are used, a constant current must flow through them to build the necessary voltage drop for the evaluation. For this, the I/O module provides a constant current source which is multiplexed over the max. 8 (depending on the configuration) analog channels.



1 Return line
2 Twisted pair within the cable

If several measuring points are adjacent to each other, only one return line is necessary. This saves wiring costs.

With the 3-wire configuration, two adjacent analog channels belong together (e.g. the channels 0 and 1). In this case, both channels are configured according to the desired operating mode. The lower address must be the even address (channel 0), the next higher address must be the odd address (channel 1).

The constant current of one channel flows through the resistance thermometer. The constant current of the other channel flows through one of the cores. The module calculates the measured value from the two voltage drops and stores it under the input with the higher channel number (e.g. C1).

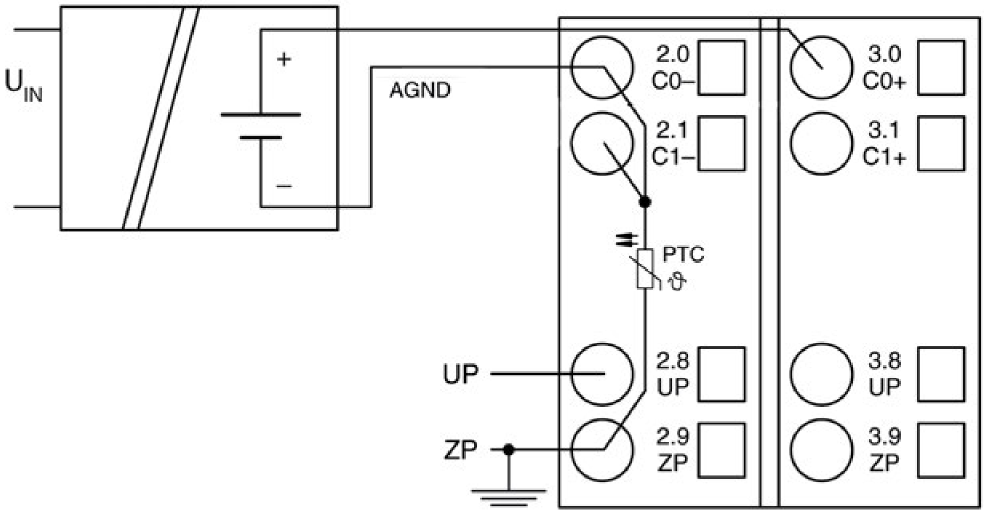
In order to keep measuring errors as small as possible, it is necessary to have all the involved conductors in the same cable. All the conductors must have the same cross section.

Pt100	-50 °C ... +70 °C	3-wire configuration, two channels used
Pt100	-50 °C ... +400 °C	3-wire configuration, two channels used
Pt1000	-50 °C ... +400 °C	3-wire configuration, two channels used
Ni1000	-50 °C ... +150 °C	3-wire configuration, two channels used

The I/O module performs a linearization of the resistance characteristic.

In order to avoid error messages from unused analog input channels, it is useful to configure them as "unused".

Connection of active-type analog sensors (Voltage) with galvanically isolated power supply



By connecting the sensor's negative pole of the output voltage to AGND, the galvanically isolated voltage source of the sensor is referred to ZP.

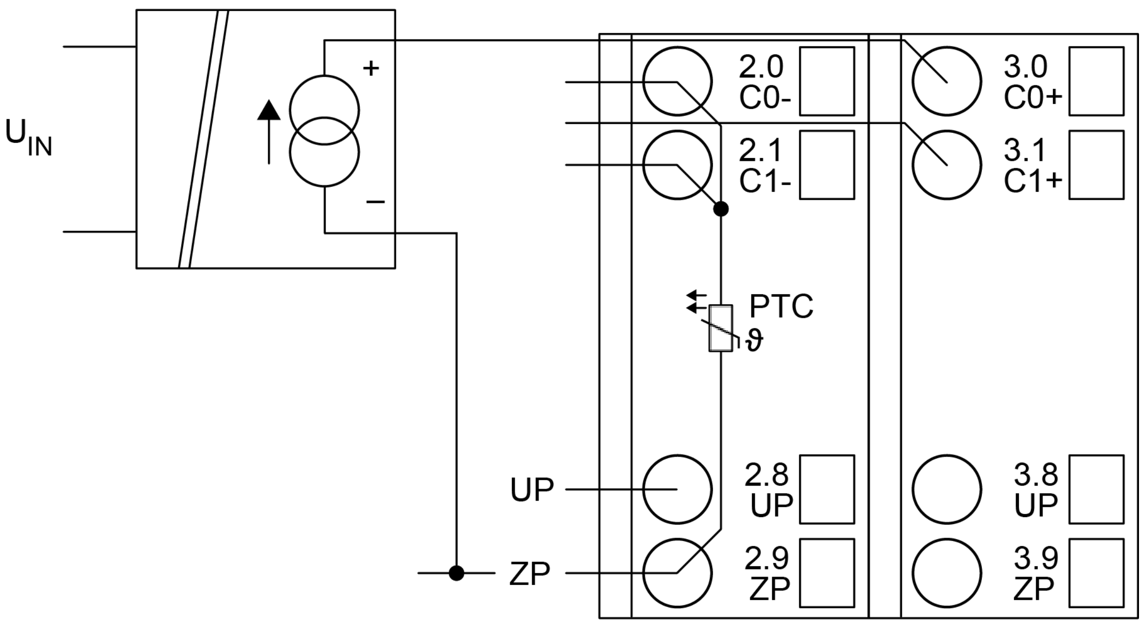
By connecting to AGND the galvanically isolated voltage source of the sensor is referred to ZP.

The following measuring ranges can be configured:

Voltage	0 V ... 10 V	1 channel used
Voltage	-10 V ... +10 V	1 channel used

In order to avoid error messages or long processing times, it is useful to configure unused analog input channels as "unused".

Connection of active-type analog sensors (Current) with galvanically isolated power supply

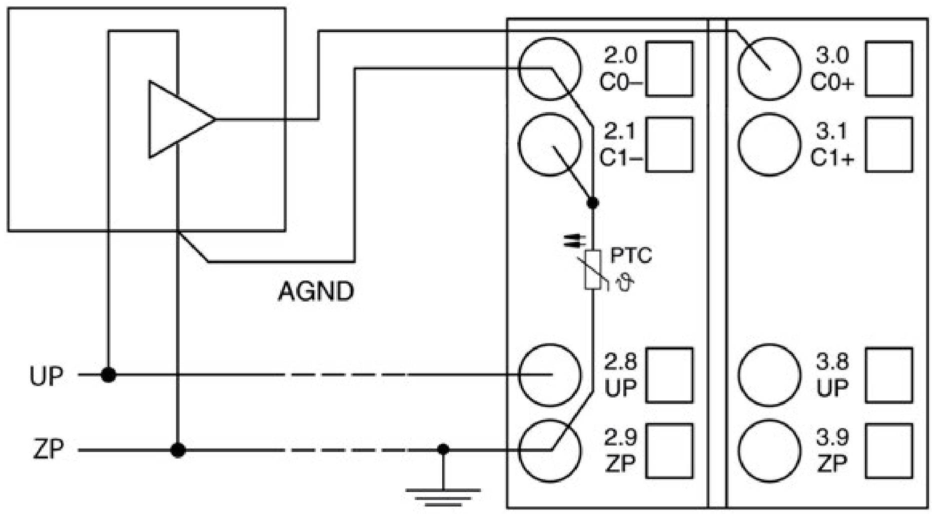


The following measuring ranges can be configured:

Current	0 mA ... 20 mA	1 channel used
Current	4 mA ... 20 mA	1 channel used

Unused input channels can be left open-circuited, because they are of low resistance.

Connection of active-type analog sensors (Voltage) with no galvanically isolated power supply



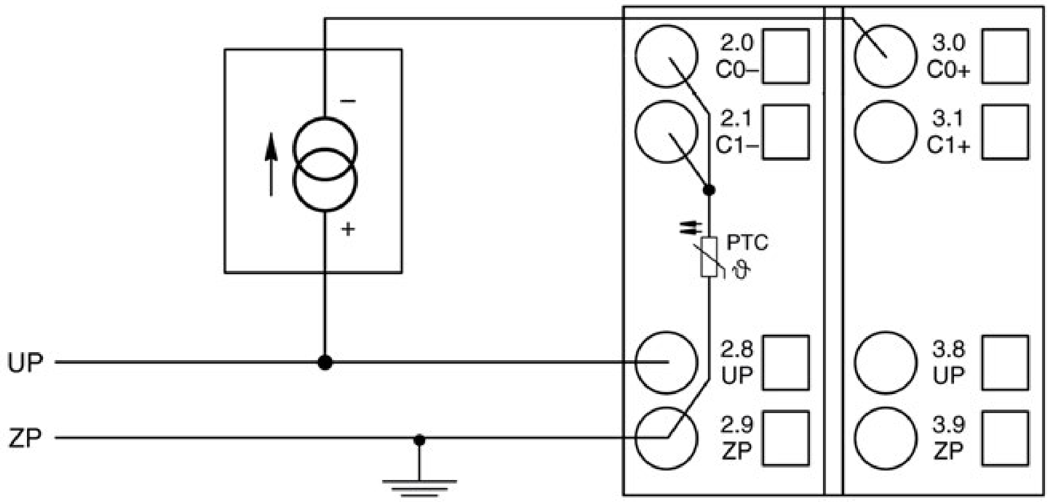
CAUTION!
The potential difference between AGND and ZP at the module must not be greater than 1V, not even in case of long lines (see figure Terminal Assignment).

If AGND does not get connected to ZP, the sensor current flows to ZP via the AGND line. The measuring signal is distorted, as a very small current flows through the voltage line. The total current through the PTC should not exceed 50 mA. This measuring method is therefore only suitable for short lines and small sensor currents. If there are bigger distances, the difference measuring method should be applied.

Voltage	0 V ... 10 V	1 channel used
Voltage	-10 V ... +10 V *)	1 channel used
*) if the sensor can provide this signal range		

In order to avoid error messages or long processing times, it is useful to configure unused analog input channels as "unused".

Connection of passive-type analog sensors (Current)



Current	4 mA ... 20 mA	1 channel used

> **CAUTION!**
> If, during initialization, an analog current sensor supplies more than 25 mA for more than 1 second to an analog input, this input is switched off by the module (input protection). In such cases, it is recommended to protect the analog input by a 10-volt Zener diode (in parallel to I+ and ZP). But, in general, sensors with fast initialization or without current peaks higher than 25 mA are preferrable.

Unused input channels can be left open-circuited because they are of low resistance.

Connection of active-type analog sensors (Voltage) to differential inputs

Differential inputs are very useful if analog sensors are used which are remotely non-isolated (e.g. the minus terminal is remotely grounded).

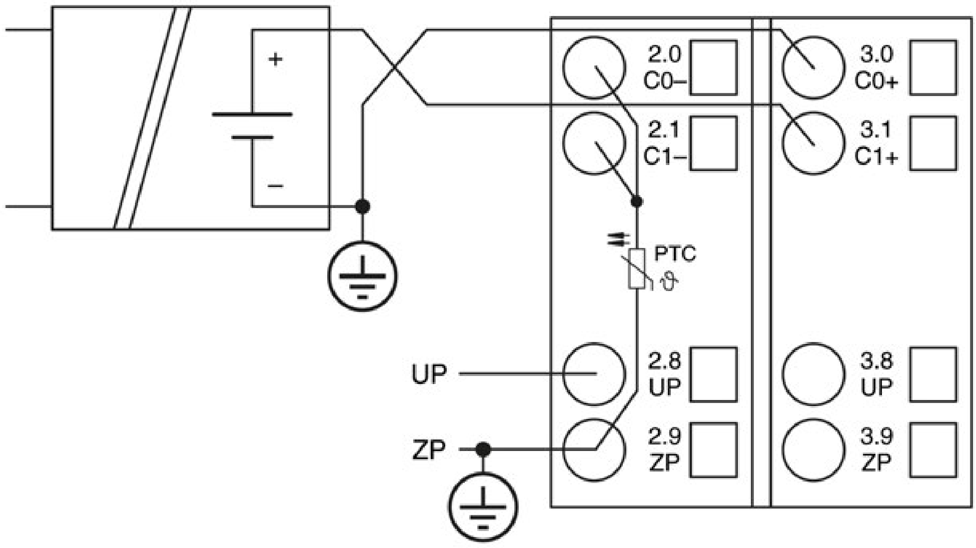
The use of differential inputs helps to considerably increase the measuring accuracy and to avoid ground loops.

With differential input configurations, two adjacent analog channels belong together (e.g. the channels 0 and 1). In this case, both channels are configured according to the desired operating mode. The lower address must be the even address (channel 0), the next higher address must be the odd address (channel 1). The converted analog value is available at the higher address (channel 1).

The analog value is calculated by subtraction of the input value with the higher address from the input value of the lower address.

The converted analog value is available at the odd channel (higher address).

> **CAUTION!**
> The ground potential at the sensors must not have too large a potential difference with respect to ZP (max. ± 1 V within the full signal range). Otherwise, problems may occur concerning the common-mode input voltages of the involved analog inputs.



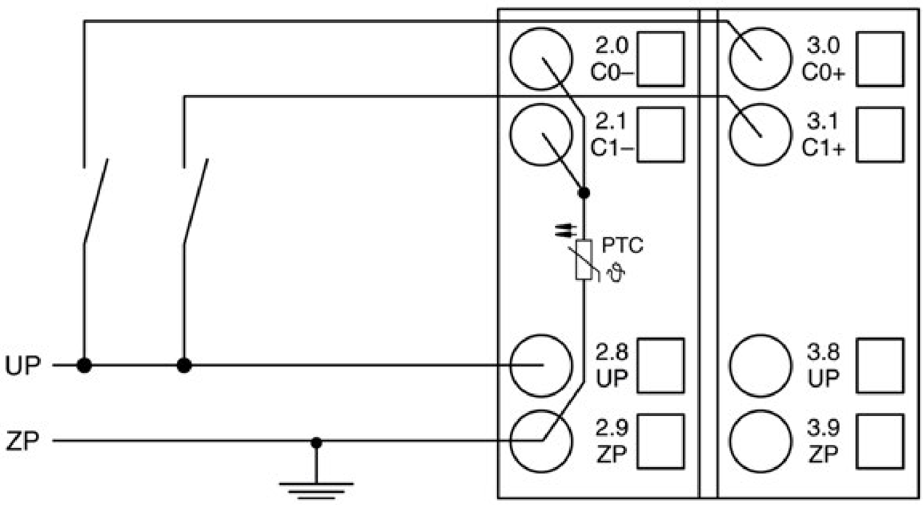
The negative pole of the sensor must be grounded next to the sensor.

Voltage	0 V ... 10 V	with differential inputs, 2 channels used
Voltage	-10 V ... +10 V	with differential inputs, 2 channels used

In order to avoid error messages or long processing times, it is useful to configure unused analog input channels as "unused".

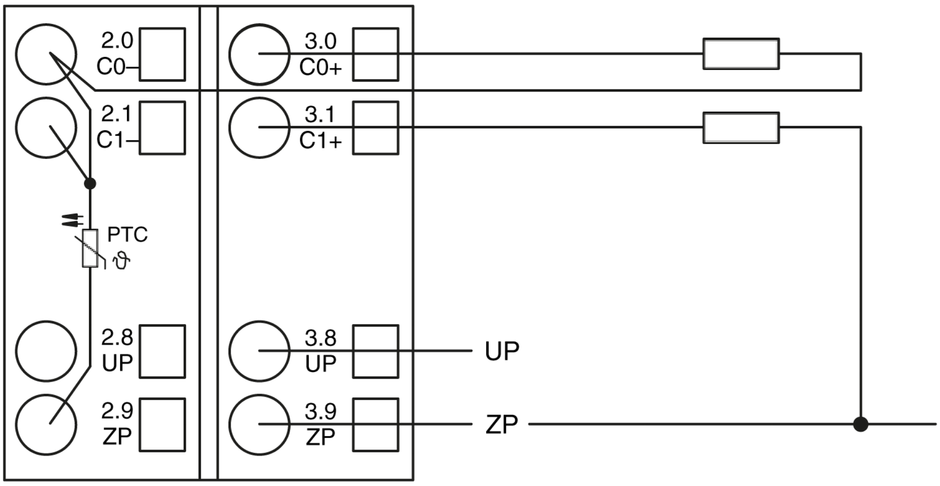
Use of analog inputs as digital inputs

Several (or all) analog inputs can be configured as digital inputs. The inputs are not galvanically isolated against the other analog channels.



Digital input	24 V	1 channel used
Effect of incorrect input terminal connection		Wrong or no signal detected, no damage up to 35 V

Connection of analog output loads (Voltage, current)



Voltage	-10 V ... +10 V	Load max. ± 10 mA	1 channel used
Current	0 mA ... 20 mA	Load 0 Ω ... 500 Ω	1 channel used
Current	4 mA ... 20 mA	Load 0 Ω ... 500 Ω	1 channel used

Only the channels 0 ... 3 can be configured as current output (0 mA ... 20 mA or 4 mA ... 20 mA).

Unused analog outputs can be left open-circuited.

Internal data exchange

Analog inputs (words)	8
Analog outputs (words)	8

I/O configuration

The module does not store configuration data itself. The 8 configurable analog channels are defined as inputs or outputs by the configuration, i.e. each of the configurable channels can used as input or output (or re-readable output in case of voltage input/output).

When a channel is used as input, the corresponding output must be configured unused.

When a channel is used as output, the corresponding input must be configured unused.

Parameterization

Firmware version	Configuration
Firmware version > V2.0.0	The arrangement of the parameter data is performed by Control Builder Plus/ Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Module: Module slot address: Y = 1 ... 10

No.	Name	Value	Internal value	Internal value, type	Default	Min.	Max.	EDS Slot/ Index
1	Module ID	Internal	1520 [1])	Word	1520 0x05f0	0	65535	0x0Y01
2	Ignore module [2])	No Yes	0 1	Byte	No 0x00			not for FBP
3	Parameter length in bytes	Internal	37	Byte	37-CPU 37-FBP	0	255	0x0Y02
4	Check supply	Off On	0 1	Byte	On 0x01	0	1	0x0Y03
5	Analog data format	Default	0	Byte	Default 0x00			0x0Y04
6	Behaviour of outputs at communication errors	Off Last value Substitute value	0 1+(n*5) 2+(n*5), n ≤ 2	Byte	Off 0x00	0	2	0x0Y05
7	Channel configuration Input channel 0	see table Channel configuration		Byte	Default 0x00	0	19	0x0Y06
8	Channel monitoring Input channel 0	see table Channel monitoring		Byte	Default 0x00	0	3	0x0Y07

No.	Name	Value	Internal value	Internal value, type	Default	Min.	Max.	EDS Slot/ Index
9 to 22	Channel configuration and channel monitoring of the input channels 1 to 7	see tables channel configuration and channel monitoring		Byte Byte	Default 0x00 0x00	0 0	19 3	0x0Y08 to 0x0Y15
23	Channel configuration Output channel 0	see table Channel configuration		Byte	Default 0x00	0	130	0x0Y16
24	Channel monitoring Output channel 0	see table Channel monitoring		Byte	Default 0x00	0	3	0x0Y17
25	Substitute value Output channel 0	only valid for output channel 0	0 ... 0xffff	Word	Default 0x0000	0	65535	0x0Y18
26 to 31	Channel configuration and channel monitoring of the output channels 1 to 3	see tables channel configuration and channel monitoring		Byte Byte	Default 0x00 0x00	0 0	130 3	0x0Y19 to 0x0Y1E
32	Channel configuration Output channel 4	see table Channel configuration		Byte	Default 0x00	0	128	0x0Y1F

No.	Name	Value	Internal value	Internal value, type	Default	Min.	Max.	EDS Slot/ Index
33	Channel moni- toring Output channel 4	see table Channel monitoring		Byte	Default 0x00	0	3	0x0Y20
34 to 39	Channel configu- ration and channel moni- toring of the output channels 5 to 7	see tables channel configura- tion and channel monitoring		Byte Byte	Default 0x00 0x00	0 0	128 3	0x0Y21 to 0x0Y26

[1]) With CS31 and addresses less than 70 and FBP, the value is increased by 1

[2]) Not with FBP

GSD file:

Ext_User_Prm_Data_Len = Ext_User_Prm_Data_Const(0) =	40 0x05, 0xf1, 0x25, \ 0x01, 0x00, 0x00, \ 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, \ 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, \ 0x00, 0x00, 0x00, 0x00, \ 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, \ 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00;

Table 171: Input channel (8x)

No.	Name	Internal value, type	Default
1	Channel configuration see table [2])	Byte	0 0x00 see table [2])
2	Channel monitoring see table [3])	Byte	0 0x00 see table [3])

Table 172: Channel configuration 2)

Internal value	Operating modes of the analog inputs, individually configurable
0	Unused (default)
1	Analog input 0 V ... 10 V
2	Digital input
3	Analog input 0 mA ... 20 mA
4	Analog input 4 mA ... 20 mA
5	Analog input -10 V ... +10 V
8	Analog input Pt100, -50 °C ... +400 °C (2-wire)
9	Analog input Pt100, -50 °C ... +400 °C (3-wire), requires 2 channels *)
10	Analog input 0 ... 10 V via differential inputs, requires 2 channels *)
11	Analog input -10 V ... +10 V via differential inputs, requires 2 channels *)
14	Analog input Pt100, -50 °C ... +70 °C (2-wire)
15	Analog input Pt100, -50 °C ... +70 °C (3-wire), requires 2 channels *)
16	Analog input Pt1000, -50 °C ... +400 °C (2-wire)
17	Analog input Pt1000, -50 °C ... +400 °C (3-wire), requires 2 channels *)
18	Analog input Ni1000, -50 °C ... +150 °C (2-wire)
19	Analog input Ni1000, -50 °C ... +150 °C (3-wire), requires 2 channels *)
	*) In the operating modes with 3-wire configuration or with differential inputs, two adjacent analog inputs belong together (e.g. the channels 0 and 1). In these cases, both channels are configured in the desired operating mode. The lower address must be the even address (channel 0). The next higher address must be the odd address (channel 1). The converted analog value is available at the higher address (channel 1).

Table 173: Channel monitoring 3)

Internal value	Monitoring
0	Plausibility, open-circuit (broken wire) and short circuit
1	Open-circuit and short-circuit
2	Plausibility
3	No monitoring

Table 174: Output channel 0 (1 channel)

No.	Name	Value	Internal value	Internal value, type	Default
1	Channel configuration	see table 4)	see table 4)	Byte	see table 4)
2	Channel monitoring	see table 5)	see table 5)	Byte	see table 5)
3	Substitute value see table 6)	0 ... 65535	0 ... 0xffff	Word	0

Table 175: Output channels 1 ... 7 (7x)

No.	Name	Internal value, type	Default
1	Channel configuration see table 4)	Byte	see table 4)
2	Channel monitoring see table 5)	Byte	see table 5)

Table 176: Channel configuration 4)

Internal value	Operating modes of the analog outputs, individually configurable
0	Unused (default)
128	Analog output -10 V ... +10 V
129	Analog output 0 mA ... 20 mA (not with the channels 4 ... 7)
130	Analog output 4 mA ... 20 mA (not with the channels 4 ... 7)

Table 177: Channel monitoring 5)

Internal value	Monitoring
0	Plausibility, open circuit (broken wire) and short circuit (default)
1	Open-circuit (broken wire) and short-circuit
2	Plausibility
3	No monitoring

Table 178: Substitute value 6)

Intended behavior of output channel when the control system stops	Required setting of the module parameter "Behaviour of outputs in case of a communication error"	Required setting of the channel parameter "Substitute value"
Output OFF	Off	0
Last value	Last value	0
Substitute value	Off or last value	1 ... 65535

Diagnosis

Table 179: Possible diagnosis of I/O channels

Output range	Condition	
	Output value in the PLC underflow	Output value in the PLC overflow
0 mA ... 20 mA	Error identifier = 7	Error identifier = 4
4 mA ... 20 mA		
-10 V ... +10 V		

Input range	**Condition**			
	Short circuit	**Wire break**	**Input value under-flow**	**Input value over-flow**
0 mA ... 20 mA	no diagnosis possible	no diagnosis possible	no diagnosis possible	Error identifier = 48
4 mA ... 20 mA	Error identifier = 7	Error identifier = 7	Error identifier = 7	Error identifier = 48
-10 V ... +10 V	no diagnosis possible	Error identifier = 48	Error identifier = 7	Error identifier = 48

Table 180: Content of diagnosis messages

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identifier** **000 ... 063**	**AC500 display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**	
Byte 6 **Bit 6 ... 7**	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6** **Bit 0 ... 5**	**FBP diag-nosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error Identifier**	**Error message**	**Remedy**
	[1])	[2])	[3])	[4])			
Module error							
3	14	1 ... 10	31	31	19	Checksum error in the I/O module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	3	Timeout in the I/O module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	40	Different hard-/firm-ware versions in the module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	43	Internal error in the module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	36	Internal data exchange failure	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	9	Overflow diagnosis buffer	New start
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	26	Parameter error	Check master
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	11	Process voltage too low	Check process voltage
	11 / 12	ADR	1 ... 10				
4	14	1 ... 10	31	31	45	Process voltage is switched off (ON −> OFF)	Process voltage ON
	11 / 12	ADR	1 ... 10				
Channel error							
				AX521 AX522			

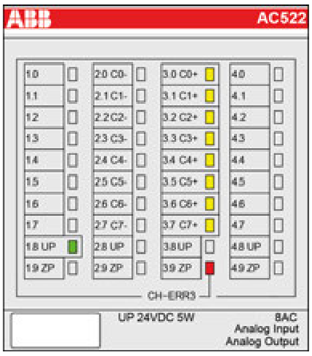
E1 ... E4	**d1**	**d2**	**d3**	**d4**		**Identifier** **000 ... 063**	**AC500 display**	**<– Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**		**Err**	**PS501 PLC browser**	
Byte 6 **Bit 6 ... 7**	**-**	**Byte 3**	**Byte 4**	**Byte 5**		**Byte 6** **Bit 0 ... 5**	**FBP diag-nosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**		**Error Identifier**	**Error message**	**Remedy**
	1)	**2)**	**3)**	**4)**				
4	14	1 ... 10	1	0 ... 3	0 ... 7	48	Analog value overflow or broken wire at an analog input	Check input value or terminal
	11 / 12	ADR	1 ... 10					
4	14	1 ... 10	1	0...3	0 ... 7	7	Analog value underflow at an analog input	Check input value
	11 / 12	ADR	1 ... 10					
4	14	1 ... 10	1	0 ... 3	0 ... 7	47	Short circuit at an analog input	Check terminal
	11 / 12	ADR	1 ... 10					
4	14	1 ... 10	3	4 ... 7	8 ... 15	4	Analog value overflow at an analog output	Check output value
	11 / 12	ADR	1 ... 10					
4	14	1 ... 10	3	4 ... 7	8 ... 15	7	Analog value underflow at an analog output	Check output value
	11 / 12	ADR	1 ... 10					

Remarks:

1)	In AC500, the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The FBP diagnosis block does not contain this identifier.
2)	With "Device" the following allocation applies: 31 = module itself, 1 ... 10 = expansion module 1 ... 10, ADR = hardware address (e.g. of the DC551)
3)	With "Module" the following allocation applies depending on the master: Module error: I/O bus or FBP: 31 = module itself; COM1/COM2: 1 ... 10 = expansion 1 ... 10 Channel error: I/O bus or FBP = module type (1 = AI, 3 = AO); COM1/COM2: 1 ... 10 = expansion 1 ... 10
4)	In case of module errors, with channel "31 = Module itself" is output.

State LEDs

During the power ON procedure, the module initializes automatically. All LEDs (except the channel LEDs) are ON during this time.

LED		State	Color	LED = OFF	LED = ON	LED flashes
	Inputs/ outputs 00...07	Analog input/ output	Yellow	Input/output is OFF	Input/output is ON (brightness depends on the value of the analog signal)	--
	UP	Process voltage 24 V DC via terminal	Green	Process voltage is missing	Process voltage OK	--
	CH-ERR3	Channel error, error messages combined into group 3	Red	No error or process voltage is missing	Severe error within the corresponding group	Error on one channel of the group

Measuring ranges

Input ranges of voltage, current and digital input

The represented resolution corresponds to 16 bits.

Range	0 V ... 10 V	-10 V ... +10 V	0 mA ... 20 mA	4 mA ... 20 mA	Digital input	Digital value	
						Decimal	Hex.
Overflow	>11.7589	>11.7589	>23.5178	>22.8142		32767	7FFF
Measured value too high	11.7589 : 10.0004	11.7589 : 10.0004	23.5178 : 20.0007	22.8142 : 20.0006		32511 : 27649	7EFF : 6C01
Normal range	10.0000 : 0.0004	10.0000 : 0.0004	20.0000 : 0.0007	20.0000 : 4.0006	ON	27648 : 1	6C00 : 0001
Normal range or measured value too low	0.0000	0.0000	0	4	OFF	0	0000
	-0.0004 -1.7593	-0.0004 : : : -10.0000		3.9994 : 0		-1 -4864 -6912 : -27648	FFFF ED00 E500 : 9400
Measured value too low		-10.0004 : -11.7589				-27649 : -32512	93FF : 8100
Underflow	<0.0000	<-11.7589	<0.0000	<0.0000		-32768	8000

Input ranges resistance temperature detector

Range	Pt100 / Pt 1000 -50 °C ... +70 °C	Pt100 / Pt1000 -50 °C ... +400 °C	Ni1000 -50 °C ... +150 °C	Digital value	
				Decimal	**Hex.**
Overflow	> +80.0 °C	> +450.0 °C	> +160.0 °C	32767	7FFF
Measured value too high		+450.0 °C : + 400.1 °C		4500 : 4001	1194 : 0FA1
			+160.0 °C : +150.1 °C	1600 : 1501	0640 : 05DD
	+80.0 °C : +70.1 °C			800 : 701	0320 : 02BD
Normal range	: : +70.0 °C : + 0.1 °C	+400.0 °C : : : +0.1 °C	: +150.0 °C : : + 0.1 °C	4000 1500 700 : 1	0FA0 05DC 02BC : 0001
	0.0 °C	0.0 °C	0.0 °C	0	0000
	-0.1 °C : -50.0 °C	-0.1 °C : -50.0 °C	-0.1 °C : -50.0 °C	-1 : -500	FFFF : FE0C
Measured value too low	-50.1 °C : -60.0 °C	-50.1 °C : -60.0 °C	-50.1 °C : -60.0 °C	-501 : -600	FE0B : FDA8
Underflow	< -60.0 °C	< -60.0 °C	< -60.0 °C	-32768	8000

Output ranges voltage and current

The represented resolution corresponds to 16 bits.

Range	-10 V ... +10 V	0 mA ... 20 mA	4 mA ... 20 mA	Digital value	
				Decimal	**Hex.**
Overflow	0 V	0 mA	0 mA	> 32511	> 7EFF
Value too high	11.7589 V : 10.0004 V	23.5178 mA : 20.0007 mA	22.8142 mA : 20.0006 mA	32511 : 27649	7EFF : 6C01

Range	-10 V ... +10 V	0 mA ... 20 mA	4 mA ... 20 mA	Digital value	
				Decimal	**Hex.**
Normal range	10.0000 V : 0.0004 V	20.0000 mA : 0.0007 mA	20.0000 mA : 4.0006 mA	27648 : 1	6C00 : 0001
	0.0000 V	0.0000 mA	4.0000 mA	0	0000
	-0.0004 V : -10.0000 V	0 mA : 0 mA	3.9994 mA 0 mA 0 mA	-1 -6912 -27648	FFFF E500 9400
Value too low	-10.0004 V : -11.7589 V	0 mA : 0 mA	0 mA : 0 mA	-27649 : -32512	93FF : 8100
Underflow	0 V	0 mA	0 mA	< -32512	< 8100

Technical data

Technical data of the module

The System Data of AC500 and S500 *Chapter 2.6.1 “System data AC500” on page 1408* are applicable to the standard version.

Only additional details are therefore documented below.

Parameter		Value
Process voltage		
	Connections	Terminals 1.8, 2.8, 3.8 and 4.8 for +24 V (UP) as well as 1.9, 2.9, 3.9 and 4.9 for 0 V (ZP)
	Rated value	24 VDC
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	Rated protection fuse on UP	10 A fast
	Galvanic isolation	Yes, per module
Current consumption		
	From 24 VDC power supply at the terminals UP/L+ and ZP/M of the CPU/bus module	Ca. 2 mA
	From UP at normal operation	0.10 A + output loads
Inrush current from UP (at power up)		0.040 A^2s
Max. length of analog cables, conductor cross section > 0.14 mm²		100 m
Weight		300 g

Parameter	Value
Mounting position	Horizontal or vertical with derating (output load reduced to 50 % at +40 °C per group)
Cooling	The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

NOTICE!
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and temporary overvoltage up to 30 V DC.

Technical data of the analog inputs

Parameter	Value	
Number of channels per module	8	
Distribution of channels into groups	1 group of 8 channels	
Connections of the channels C0- ... C7-	Terminals 2.0 ... 2.7	
Connections of the channels C0+ ... C7+	Terminals 3.0 ... 3.7	
Input type	Bipolar (not with current or Pt100/Pt1000/Ni1000)	
Galvanic isolation	Against internal supply and other modules	
Configurability	0 V ... 10 V, -10 V ... +10 V, 0 mA ... 20 mA, 4 mA ... 20 mA, Pt100/1000, Ni1000 (each input can be configured individually)	
Channel input resistance	Voltage: > 100 kΩ Current: ca. 330 Ω	
Time constant of the input filter	Voltage: 100 µs Current: 100 µs	
Indication of the input signals	One LED per channel	
Conversion cycle	2 ms (for 8 inputs + 8 outputs), with Pt/Ni... 1 s	
Resolution	Range 0 V ... 10 V: 12 bits Range -10 V ... +10 V: 12 bits including sign Range 0 mA ... 20 mA: 12 bits Range 4 mA ... 20 mA: 12 bits	
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range	Typ.	± 0.5 % of full scale at +25 °C
	Max.	± 1 % of full scale (all ranges) at 0 °C ... +60 °C or EMC disturbance
Relationship between input signal and hex code	See table ⇨ *Chapter 1.6.2.2.1.10.1 “Input ranges of voltage, current and digital input” on page 632*	
Unused inputs	Must be configured as "unused".	
Overvoltage protection	Yes	

Technical data of the analog inputs, if used as digital inputs

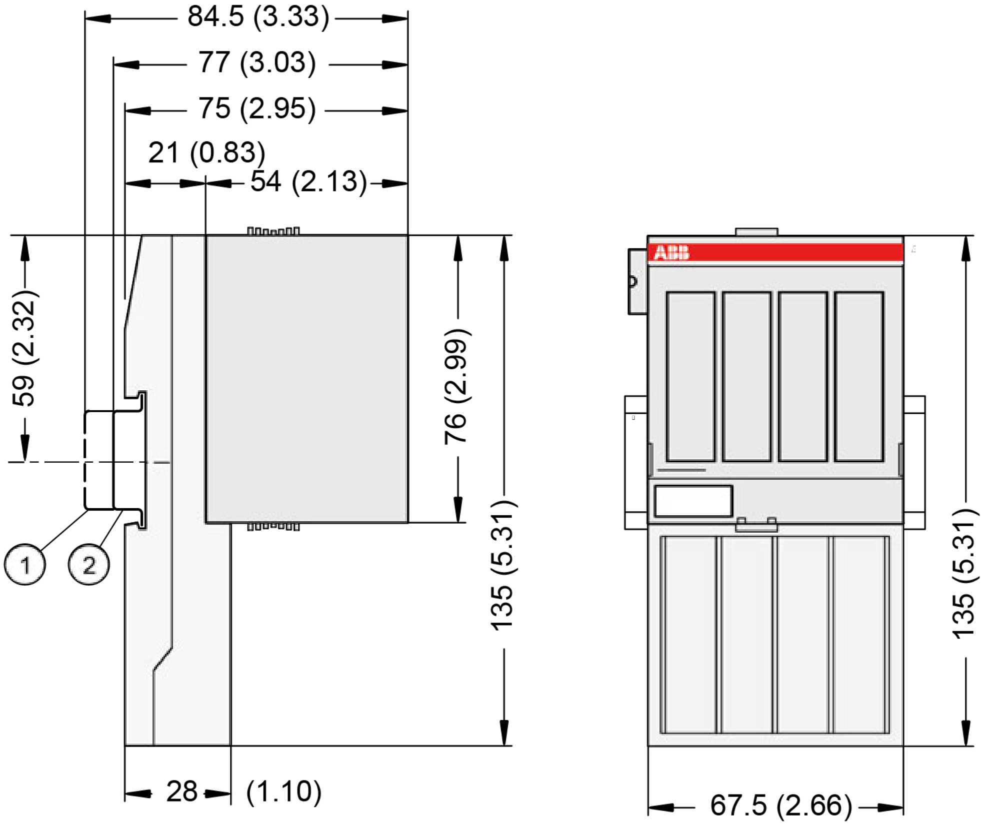
Parameter		Value
Number of channels per module		Max. 8
Distribution of channels into groups		1 group of 8 channels
Connections of the channels C0+ ... C7+		Terminals 3.0 ... 3.7
Reference potential for the inputs		Terminals 1.9 ... 4.9 (ZP)
Input signal delay		Typ. 8 ms, configurable from 0.1 ... 32 ms
Indication of the input signals		1 LED per channel
Input signal voltage		24 VDC
	Signal 0	-30 V ... +5 V
	Undefined signal	+5 V ... +13 V
	Signal 1	+13 V ... +30 V
Input current per channel		
	Input voltage +24 V	Typ. 7 mA
	Input voltage +5 V	Typ. 1.4 mA
	Input voltage +15 V	Typ. 4.3 mA
	Input voltage +30 V	< 9 mA
Input resistance		Ca. 3.5 kΩ

Technical data of the analog outputs

Parameter		Value	
Number of channels per module		8, all channels for voltage, the first 4 channels also for current	
Distribution of channels into groups		1 group of 8 channels	
	Channels C0- ... C7-	Terminals 2.0 ... 2.7	
	Channels C0+ ... C7+	Terminals 3.0 ... 3.7	
Output type		Bipolar with voltage, unipolar with current	
Galvanic isolation		Against internal supply and other modules	
Configurability		-10 V ... +10 V, 0 mA ... 20 mA, 4 mA ... 20 mA (each output can be configured individually), current outputs only channels 0 ... 3	
Output resistance (load), as current output		0 Ω ... 500 Ω	
Output loadability, as voltage output		Max. ± 10 mA	
Indication of the output signals		One LED per channel	
Resolution		12 bits including sign	
Settling time for full range change (resistive load, output signal within specified tolerance)		Typ. 5 ms	
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range		Typ.	± 0.5 % of full scale at +25 °C

Parameter	Value	
	Max.	± 1 % of full scale (all ranges) at 0 °C ... +60 °C or EMC disturbance
Relationship between output signal and hex code	See table 'AC522 - Analog input/output module' ⇘ *Chapter 1.6.2.2.1.10.3 “Output ranges voltage and current” on page 633*	
Unused outputs	Must be configured as "unused".	

Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

Ordering data

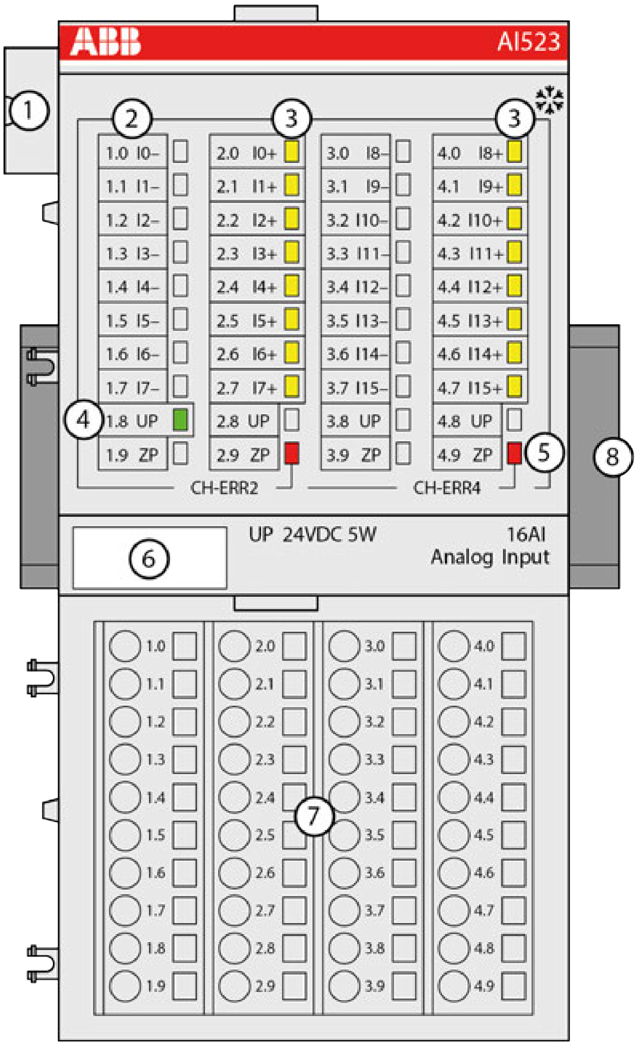
Part no.	Description	Product life cycle phase *)
1SAP 250 500 R0001	AC522, analog input/output module, 8 AC, U/I/RTD, 12 bits including sign, 2-wires	Active
1SAP 450 500 R0001	AC522-XC, analog input/output module, 8 AC, U/I/RTD, 12 bits including sign, 2-wires, XC version	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

1.6.2.2.2 AI523 - Analog input module

Features

- 16 configurable analog inputs (I0 ... I15) in 2 groups (1.0 ... 2.7 and 3.0 ... 4.7) Resolution 12 bits including sign
- Module-wise galvanically isolated
- XC version for use in extreme ambient conditions available



1 I/O bus
2 Allocation between terminal number and signal name
3 16 yellow LEDs to display the signal states at the analog inputs (I0 ... I15)
4 1 green LED to display the state of the process supply voltage UP
5 2 red LEDs to display errors
6 Label
7 Terminal unit
8 DIN rail
❄ Sign for XC version

Intended purpose

The device can be used as a decentralized I/O extension module for S500 communication interface modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs.

Functionality

16 analog inputs, individually configurable for

- Unused (default setting)
- 0 V ... 10 V
- -10 V ... +10 V
- 0 mA ... 20 mA
- 4 mA ... 20 mA

- Pt100, -50 °C ... +400 °C (2-wire)
- Pt100, -50 °C ... +400 °C (3-wire), requires 2 channels
- Pt100, -50 °C ... +70 °C (2-wire)
- Pt100, -50 °C ... +70 °C (3-wire), requires 2 channels
- Pt1000, -50 °C ... +400 °C (2-wire)
- Pt1000, -50 °C ... +400 °C (3-wire), requires 2 channels
- Ni1000, -50 °C ... +150 °C (2-wire)
- Ni1000, -50 °C ... +150 °C (3-wire), requires 2 channels
- 0 V ... 10 V with differential inputs, requires 2 channels
- -10 V ... +10 V with differential inputs, requires 2 channels
- Digital signals (digital input)

Parameter		Value
Resolution of the analog channels		
	Voltage -10 V ... +10 V	12 bits including sign
	Voltage 0 V ... 10 V	12 bits
	Current 0 mA ... 20 mA, 4 mA ... 20 mA	12 bits
	Temperature	0.1 °C
LED displays		19 LEDs for signals and error messages
Internal power supply		Via the I/O bus interface (I/O bus)
External power supply		Via the terminals ZP and UP (process voltage 24 V DC)
Required terminal unit		TU515 or TU516 ➫ *Chapter 1.5.3 “TU515, TU516, TU541 and TU542 for I/O modules” on page 282*

Connections

The modules are plugged on an I/O terminal unit ➫ *Chapter 1.5.3 “TU515, TU516, TU541 and TU542 for I/O modules” on page 282*. Properly position the modules and press until they lock in place. The terminal units are mounted on a DIN rail or with 2 screws plus the additional accessory for wall mounting ➫ *Chapter 1.9.3.5 “TA526 - Wall mounting accessory” on page 1361*.

The connection of the I/O channels is carried out using the 40 terminals of the I/O terminal unit. I/O modules can be replaced without re-wiring the terminal units.

For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.

The terminals 1.8 ... 4.8 and 1.9 ... 4.9 are electrically interconnected within the I/O terminal units and have always the same assignment, independent of the inserted module:

Terminals 1.8 ... 4.8: process voltage UP = +24 V DC

Terminals 1.9 ... 4.9: process voltage ZP = 0 V

The assignment of the other terminals:

Terminals	Signal	Description
1.0 ... 1.7	I0- ... I7-	Negative poles of the first 8 analog inputs
2.0 ... 2.7	I0+ ... I7+	Positive poles of the first 8 analog inputs
3.0 ... 3.7	I8- ... I15-	Negative poles of the fol-lowing 8 analog inputs
4.0 ... 4.7	I8+ ... I15+	Positive poles of the following 8 analog inputs

CAUTION!
The negative poles of the analog inputs are galvanically connected to each other. They form an "Analog Ground" signal for the module. The negative poles of the analog outputs are also galvanically connected to each other to form an "Analog Ground" signal.

CAUTION!
There is no galvanic isolation between the analog circuitry and ZP/UP. There-fore, the analog sensors must be galvanically isolated in order to avoid loops via the ground potential or the supply voltage.

CAUTION!
Because of their common reference potential, analog current inputs cannot be circuited in series, neither within the module nor with channels of other modules.

For the open-circuit detection (wire break), each analog input channel is pulled up to "plus" by a high-resistance resistor. If nothing is connected, the maximum voltage will be read in then.

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a communication interface module or a CPU). Thus, the current consumption from 24 V DC power supply at the terminals L+/UP and M/ZP of the CPU/communication interface module increases by 2 mA per AI523.

The external power supply connection is carried out via the UP (+24 V DC) and the ZP (0 V DC) terminals.

WARNING!

Removal/Insertion under power

Removal or insertion under power is permissible only if all conditions for hot swapping are fullfilled.

Conditions for hot swap

“Conditions for hot swap” on page 1367

The devices are not designed for removal or insertion under power when the conditions for hot swap do not apply. Because of unforeseeable consequences, it is not allowed to plug in or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

Disconnecting any powered devices while they are energized in a hazardous location could result in an electric arc, which could create an ignition source resulting in fire or explosion.

Prior to proceeding, make sure that power is been disconnected and that the area has been thoroughly checked to ensure that flammable materials are not present.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!

Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

Generally, analog signals must be laid in shielded cables. The cable shields must be grounded at both sides of the cables. In order to avoid unacceptable potential differences between different parts of the installation, low resistance equipotential bonding conductors must be laid.

The following figure shows the connection of the module:

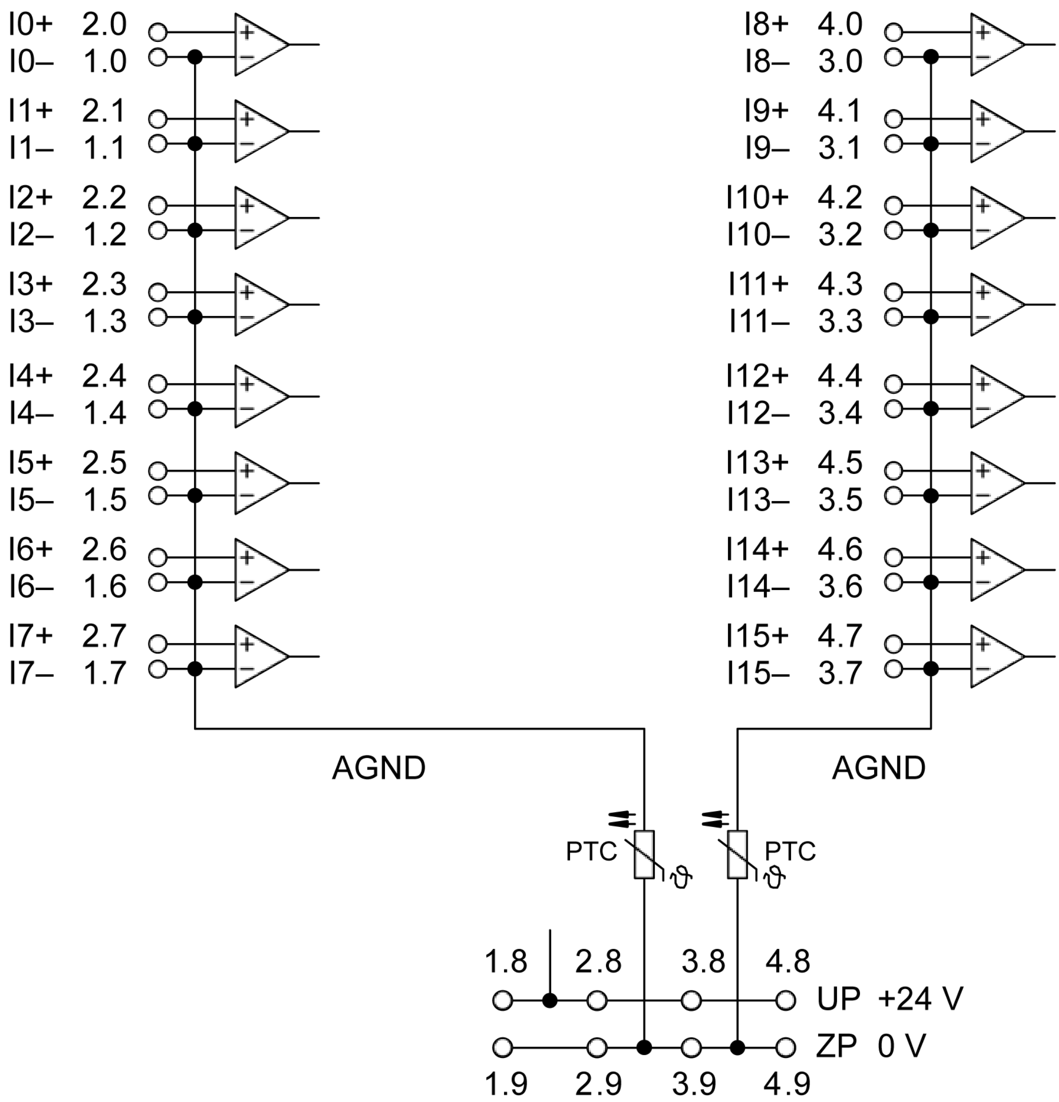


Fig. 139: 16 analog inputs in two groups, individually configurable ✎ Chapter 1.6.2.2.2.3 “Functionality” on page 639

> **CAUTION!**
> By installing equipotential bonding conductors between the different parts of the system, it must be ensured that the potential difference between ZP and AGND never can exceed 1 V.

> **CAUTION!**
> The process supply voltage must be included in the grounding concept (e. g. grounding of the negative terminal).

The modules provide several diagnosis functions ✎ *Chapter 1.6.2.2.2.8 “Diagnosis” on page 657*.

Connection of resistance thermometers in 2-wire configuration

When resistance thermometers (Pt100, Pt1000, Ni1000) are used, a constant current must flow through them to build the necessary voltage drop for the evaluation. For this, the module AI523 provides a constant current source which is multiplexed over the 8 analog channels.

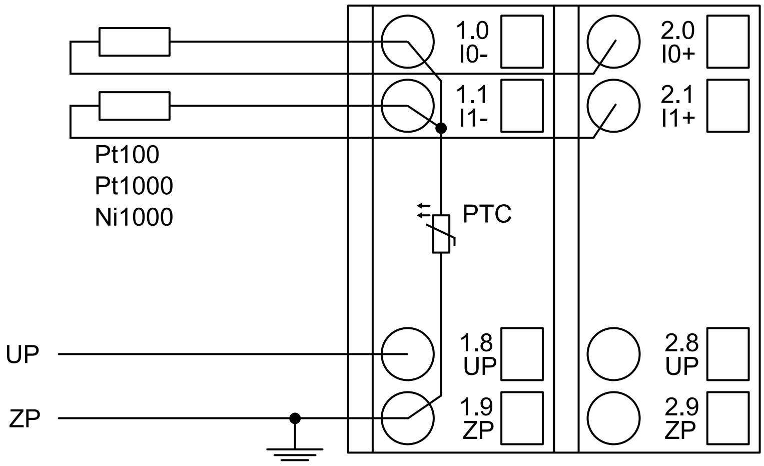


Fig. 140: Connection example

The following measuring ranges can be configured *Chapter 1.6.2.2.2.7 “Parameterization” on page 654*.

Pt100	-50 °C ... +70 °C	2-wire configuration, one channel used
Pt100	-50 °C ... +400 °C	2-wire configuration, one channel used
Pt1000	-50 °C ... +400 °C	2-wire configuration, one channel used
Ni1000	-50 °C ... +150 °C	2-wire configuration, one channel used

The function of the LEDs is described under Displays *Chapter 1.6.2.2.2.8 “Diagnosis” on page 657*.

The module AI523 performs a linearization of the resistance characteristic.

In order to avoid error messages from unused analog input channels, it is useful to configure them as "unused".

Connection of resistance thermometers in 3-wire configuration

When resistance thermometers (Pt100, Pt1000, Ni1000) are used, a constant current must flow through them to build the necessary voltage drop for the evaluation. For this, the module AI523 provides a constant current source which is multiplexed over the max. 8 (depending on the configuration) analog channels.

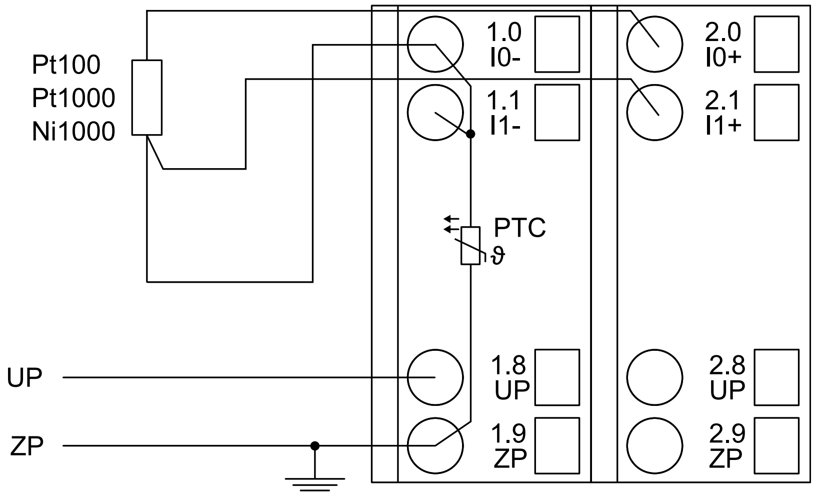


Fig. 141: Connection example

> *If several measuring points are adjacent to each other, the return line is necessary only once. This saves wiring costs.*

With 3-wire configuration, two adjacent analog channels belong together (e.g. the channels 0 and 1). In this case, both channels are configured according to the desired operating mode. The lower address must be the even address (channel 0), the next higher address must be the odd address (channel 1).

The constant current of one channel flows through the resistance thermometer. The constant current of the other channel flows through one of the cores. The module calculates the measured value from the two voltage drops and stores it under the input with the higher channel number (e.g. I1).

In order to keep measuring errors as small as possible, it is necessary to have all the involved conductors in the same cable. All the conductors must have the same cross section.

The following measuring ranges can be configured *Chapter 1.6.2.2.2.7 “Parameterization” on page 654*

Pt100	-50 °C ... +70 °C	3-wire configuration, two channels used
Pt100	-50 °C ... +400 °C	3-wire configuration, two channels used
Pt1000	-50 °C ... +400 °C	3-wire configuration, two channels used
Ni1000	-50 °C ... +150 °C	3-wire configuration, two channels used

The function of the LEDs is described under Displays *Chapter 1.6.2.2.2.8 “Diagnosis” on page 657*.

The module AI523 performs a linearization of the resistance characteristic.

In order to avoid error messages from unused analog input channels, it is useful to configure them as "unused".

Connection of active-type analog sensors (Voltage) with galvanically isolated power supply

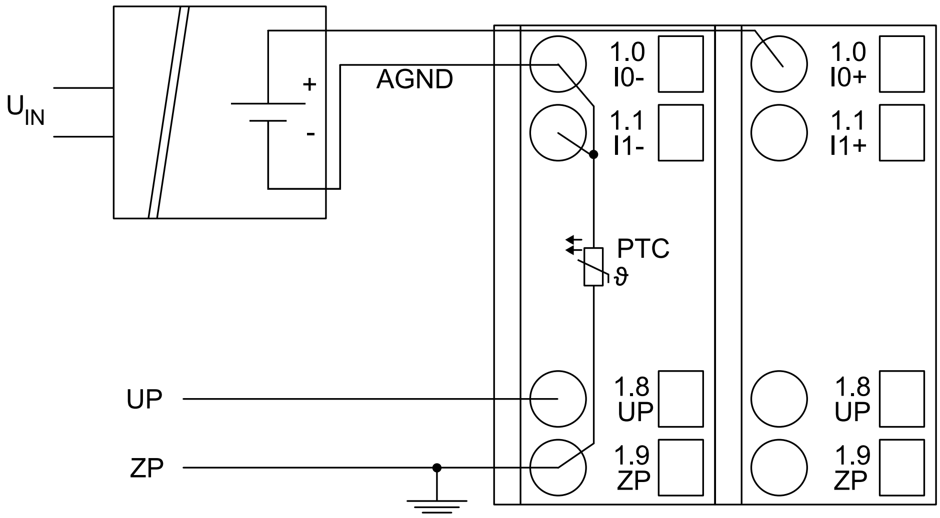


Fig. 142: Connection example

> *By connecting the sensor's negative pole of the output voltage to AGND, the galvanically isolated voltage source of the sensor is referred to ZP.*

The following measuring ranges can be configured ↳ *Chapter 1.6.2.2.2.7 "Parameterization" on page 654* ↳ *Chapter 1.6.2.2.2.10 "Measuring ranges" on page 659*

Voltage	0 V ... 10 V	1 channel used
Voltage	-10 V ... +10 V	1 channel used

The function of the LEDs is described under Displays ↳ *Chapter 1.6.2.2.2.8 "Diagnosis" on page 657*.

In order to avoid error messages or long processing times, it is useful to configure unused analog input channels as "unused".

Connection of active-type analog sensors (Current) with galvanically isolated power supply

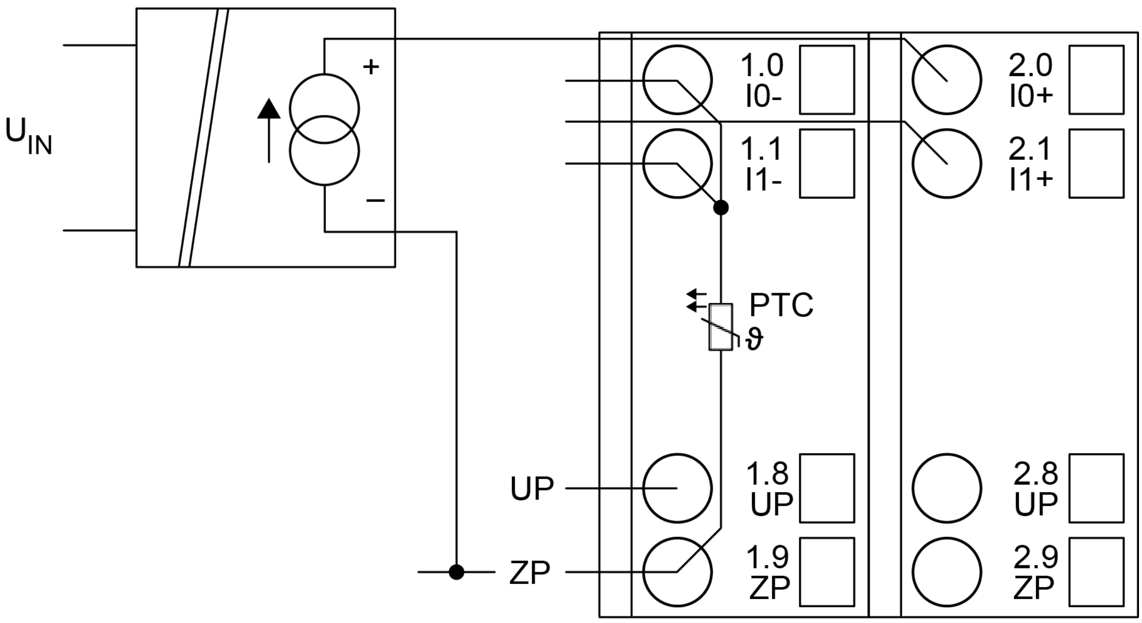


Fig. 143: Connection example

The following measuring ranges can be configured ↳ *Chapter 1.6.2.2.2.7 "Parameterization" on page 654* ↳ *Chapter 1.6.2.2.2.10 "Measuring ranges" on page 659*

Current	0 mA ... 20 mA	1 channel used
Current	4 mA ... 20 mA	1 channel used

The function of the LEDs is described under Displays ↳ *Chapter 1.6.2.2.2.8 "Diagnosis" on page 657*.

Unused input channels can be left open-circuited, because they are of low resistance.

Connection of active-type analog sensors (Voltage) with no galvanically isolated power supply

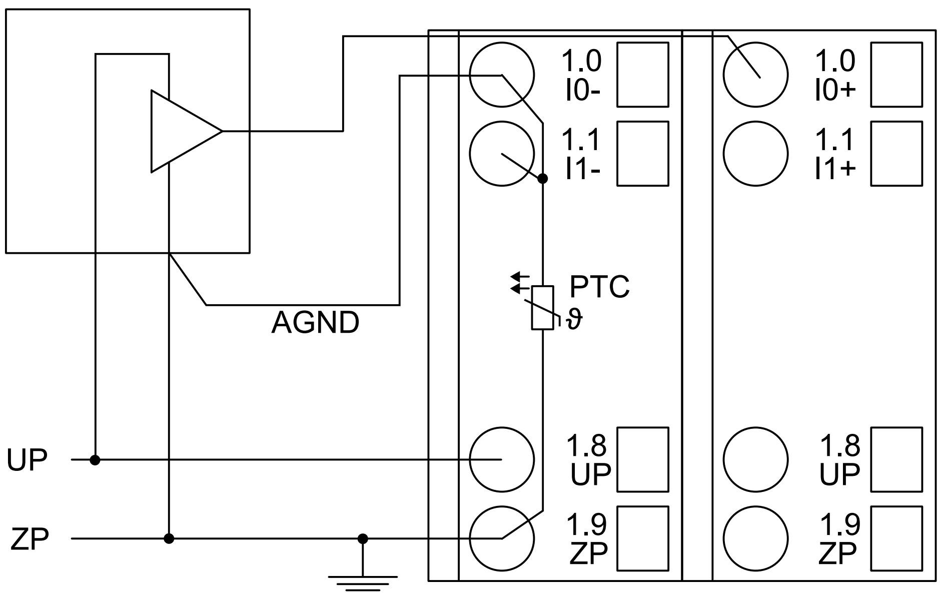


Fig. 144: Connection example

CAUTION!
The potential difference between AGND and ZP at the module must not be greater than 1 V, not even in case of long lines ✎ *Chapter 1.6.2.2.2 “AI523 - Analog input module” on page 638*.

If AGND does not get connected to ZP, the sensor current flows to ZP via the AGND line. The measuring signal is distorted, as a very low current flows over the voltage line. The total current through the PTC should not exceed 50 mA. This measuring method is therefore only suitable for short lines and small sensor currents. If there are bigger distances, the difference measuring method has to be preferred.

The following measuring ranges can be configured ✎ *Chapter 1.6.2.2.2.10 “Measuring ranges” on page 659*

Voltage	0 V ... 10 V	1 channel used
Voltage	-10 V ... +10 V *)	1 channel used
*) if the sensor can provide this signal range		

The function of the LEDs is described under Displays ✎ *Chapter 1.6.2.2.2.8 “Diagnosis” on page 657*.

In order to avoid error messages or long processing times, it is useful to configure unused analog input channels as "unused".

Connection of passive-type analog sensors (Current)

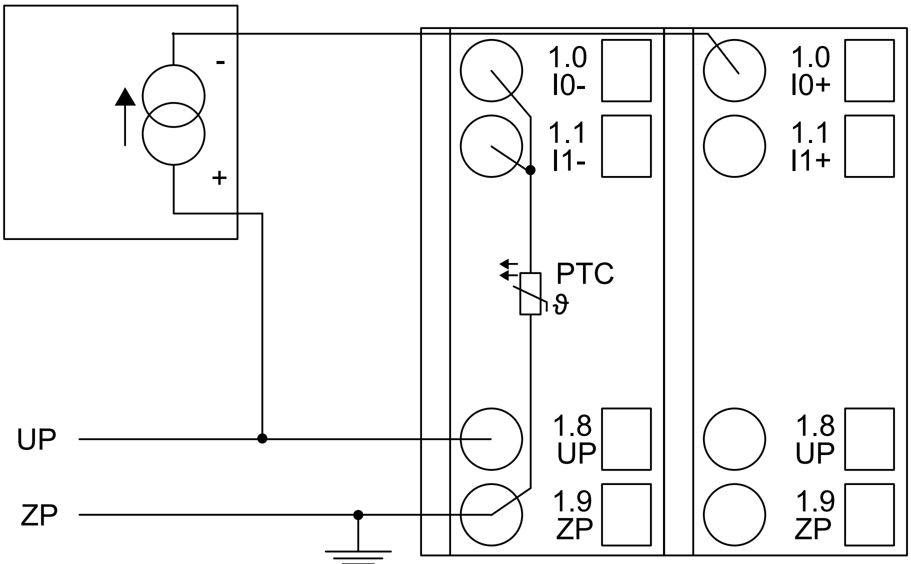


Fig. 145: Connection example

The following measuring ranges can be configured ␦ *Chapter 1.6.2.2.2.7 “Parameterization” on page 654* ␦ *Chapter 1.6.2.2.2.10 “Measuring ranges” on page 659*

Current	4 mA ... 20 mA	1 channel used

The function of the LEDs is described under Displays *Chapter 1.6.2.2.2.8 “Diagnosis” on page 657*.

CAUTION!
If, during initialization, an analog current sensor supplies more than 25 mA for more than 1 second into an analog input, this input is switched off by the module (input protection). In such cases, it is recommended to protect the analog input by a 10-volt Zener diode (in parallel to I+ and ZP). But, in general, it is a better solution to use sensors with fast initialization or without current peaks higher than 25 mA.

Unused input channels can be left open-circuited, because they are of low resistance.

Connection of active-type analog sensors (Voltage) to differential inputs

Differential inputs are very useful if analog sensors which are remotely non-isolated (e.g. the negative terminal is remotely grounded) are used.

The evaluation using differential inputs helps to considerably increase the measuring accuracy and to avoid ground loops.

With differential input configurations, two adjacent analog channels belong together (e.g. the channels 0 and 1). In this case, both channels are configured according to the desired operating mode. The lower address must be the even address (channel 0), the next higher address must be the odd address (channel 1). The converted analog value is available at the higher address (channel 1).

The analog value is calculated by subtraction of the input value with the higher address from the input value of the lower address.

The converted analog value is available at the odd channel (higher address).

CAUTION!
The ground potential at the sensors must not have too big a potential difference with respect to ZP (max. ±1 V within the full signal range). Otherwise problems can occur concerning the common-mode input voltages of the involved analog inputs.

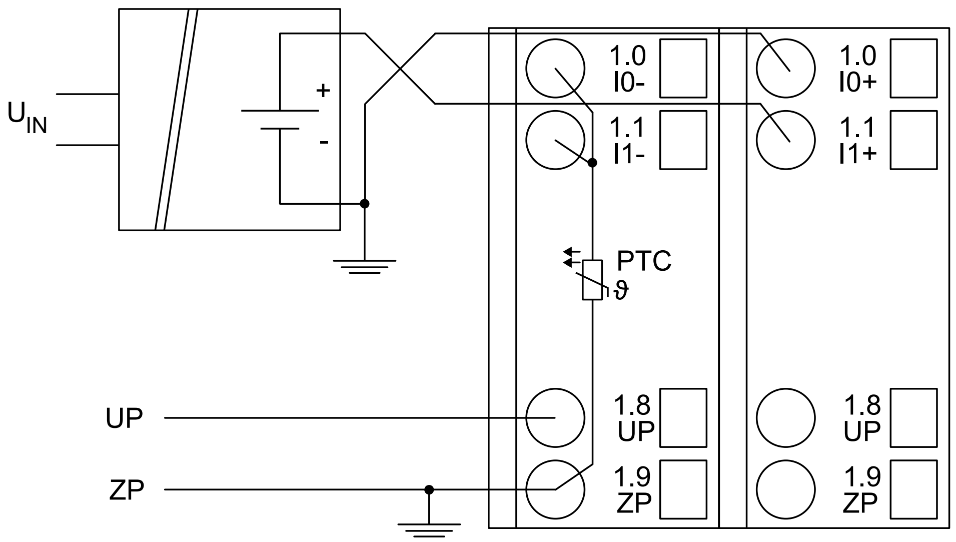


Fig. 146: Connection example

> *The negative pole of the sensor must be grounded next to the sensor.*

The following measuring ranges can be configured ↳ *Chapter 1.6.2.2.2.7 "Parameterization" on page 654* ↳ *Chapter 1.6.2.2.2.10 "Measuring ranges" on page 659*:

Voltage	0 V ... 10 V	with differential inputs, 2 channels used
Voltage	-10 V ... +10 V	with differential inputs, 2 channels used

The function of the LEDs is described under Displays ↳ *Chapter 1.6.2.2.2.8 "Diagnosis" on page 657*.

In order to avoid error messages or long processing times, it is useful to configure unused analog input channels as "unused".

Use of analog inputs as digital inputs

Several (or all) analog inputs can be configured as digital inputs. The inputs are not galvanically isolated against the other analog channels.

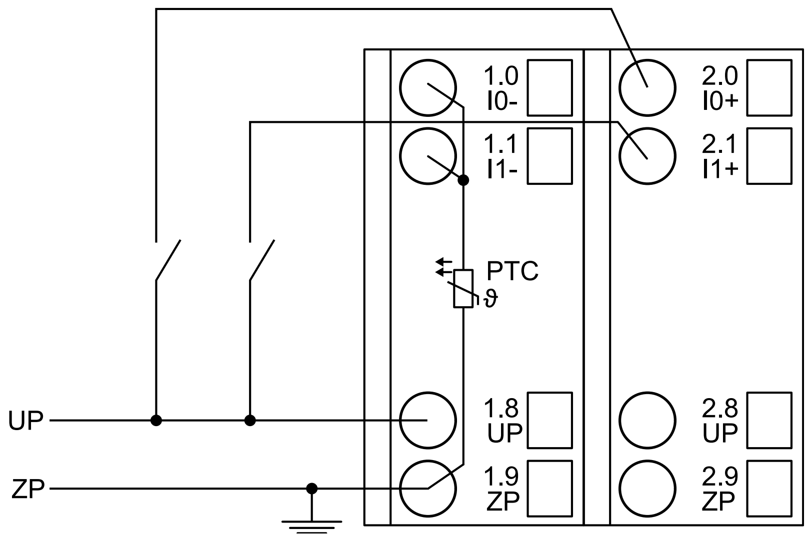


Fig. 147: Connection example

The following operating mode can be configured ↳ *Chapter 1.6.2.2.2.7 "Parameterization" on page 654* ↳ *Chapter 1.6.2.2.2.10 "Measuring ranges" on page 659*

Digital input	24 V	1 channel used
Effect of incorrect input terminal connection		Wrong or no signal detected, no damage up to 35 V

The function of the LEDs is described under Displays.

Internal data exchange

Digital inputs (bytes)	0
Digital outputs (bytes)	0
Counter input data (words)	16
Counter output data (words)	0

I/O configuration

The module does not store configuration data itself. It gets its parameterization data from the master device of the I/O bus (CPU or communication interface module) during power-up of the system.

That means replacing I/O modules is possible without any re-parameterization via software.

If the external power supply voltage via UP/ZP terminals fails, the I/O module loses its configuration data. The whole station has to be switched off and on again to re-configure the module.

Parameterization

Firmware version	Configuration
Firmware version > V2.0.0	The arrangement of the parameter data is performed by Control Builder Plus/ Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Module: Module slot address: Y = 1 ... 10

No.	Name	Value	Internal value	Internal value, type	Default	Min.	Max.	EDS Slot/ Index
1	Module ID	Internal	1515 [1])	Word	1515 0x05eb	0	65535	0x0Y01
2	Ignore module [2])	No Yes	0 1	Byte	No 0x00			not for FBP
3	Parameter length in bytes	Internal	34	Byte	34-CPU 34-FBP	0	255	0x0Y02
4	Check supply	Off On	0 1	Byte	On 0x01	0	1	0x0Y03
5	Analog data format	Default	0	Byte	Default 0x00			0x0Y04

No.	Name	Value	Internal value	Internal value, type	Default	Min.	Max.	EDS Slot/ Index
6	Channel configu-ration Input channel 0	See table 'Channel configuration' *Table 181 “Channel configuration [2])” on page 656*		Byte	Default 0x00	0	19	0x0Y05
7	Channel moni-toring Input channel 0	See table 'Channel monitoring' *Table 182 “Channel monitoring [4])” on page 657*		Byte	Default 0x00	0	3	0x0Y06
8 to 35	Channel configu-ration and channel moni-toring of the input channels 1 ... 14	See table 'Channel con-figuration' *Table 181 “Channel configuration [2])” on page 656* and table 'Channel monitoring' *Table 182 “Channel monitoring [4])” on page 657*		Byte Byte	Default 0x00 0x00	0 0	19 3	0x0Y07 to 0x0Y22
36	Channel configu-ration Input channel 15	See table 'Channel con-figuration' *Table 181 “Channel configuration [2])” on page 656*		Byte	Default 0x00	0	19	0x0Y23
37	Channel moni-toring Input channel 15	See table 'Channel monitorings' *Table 182 “Channel monitoring [4])” on page 657*		Byte	Default 0x00	0	3	0x0Y24
[1]) With CS31 and addresses less than 70 and FBP, the value is increased by 1 [2]) Not with FBP								

GSD file:

Ext_User_Prm_Data_Len =	37
Ext_User_Prm_Data_Const(0) =	0x05, 0xec, 0x22, \
	0x01, 0x00, \
	0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, \
	0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, \
	0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, \
	0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00;

Input channel (16 x with AI523)

No.	Name	Value	Internal value	Internal value, type	Default
1	Channel configuration	see table [2])	see table [2])	Byte	0 0x00 see [3])
2	Channel monitoring	see table [4])	see table [4])	Byte	0 0x00 see [5])

Table 181: Channel configuration [2])

Internal value	Operating modes of the analog inputs, individually configurable
0	Unused (default) [3])
1	Analog input 0 V ... 10 V
2	Digital input
3	Analog input 0 mA ... 20 mA
4	Analog input 4 mA ... 20 mA
5	Analog input -10 V ... +10 V
8	Analog input Pt100, -50 °C ... +400 °C (2-wire)
9	Analog input Pt100, -50 °C ... +400 °C (3-wire), requires 2 channels *)
10	Analog input 0 ... 10 V via differential inputs, requires 2 channels *)
11	Analog input -10 V ... +10 V via differential inputs, requires 2 channels *)
14	Analog input Pt100, -50 °C ... +70 °C (2-wire)
15	Analog input Pt100, -50 °C ... +70 °C (3-wire), requires 2 channels *)
16	Analog input Pt1000, -50 °C ... +400 °C (2-wire)
17	Analog input Pt1000, -50 °C ... +400 °C (3-wire), requires 2 channels *)
18	Analog input Ni1000, -50 °C ... +150 °C (2-wire)

Internal value	Operating modes of the analog inputs, individually configurable
19	Analog input Ni1000, -50 °C ... +150 °C (3-wire), requires 2 channels *)
	*) In the operating modes with 3-wire configuration or with differential inputs, two adjacent analog inputs belong together (e.g. the channels 0 and 1). In these cases, both channels are configured in the desired operating mode. The lower address must be the even address (channel 0). The next higher address must be the odd address (channel 1). The converted analog value is available at the higher address (channel 1).

Table 182: Channel monitoring 4)

Internal value	Monitoring
0	Plausibility, open-circuit (broken wire) and short circuit 5)
1	Open-circuit and short circuit
2	Plausibility
3	No monitoring

Diagnosis

Table 183: Possible diagnosis of I/O channels

Input range	Condition			
	Short circuit	**Wire break**	**Input value under-flow**	**Input value over-flow**
0 mA ... 20 mA	no diagnosis possible	no diagnosis possible	no diagnosis possible	Error identifier = 48
4 mA ... 20 mA	Error identifier = 7	Error identifier = 7	Error identifier = 7	Error identifier = 48
-10 V ... +10 V	no diagnosis possible	Error identifier = 48	Error identifier = 7	Error identifier = 48

E1 ... E4	d1	d2	d3	d4	Identifier 000 ... 063	AC500 display	<– Display in
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**	
Byte 6 Bit 6 ... 7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0 ... 5**	**FBP diag-nosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error identifier**	**Error message**	**Remedy**
	1)	2)	3)	4)			
Module error							
3	14	1 ... 10	31	31	19	Checksum error in the I/O module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	3	Timeout in the I/O module	Replace I/O module
	11 / 12	ADR	1 ... 10				

E1 ... E4	d1	d2	d3	d4	Identifier 000 ... 063	AC500 display	<– Display in
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**	
Byte 6 Bit 6 ... 7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0 ... 5**	**FBP diag-nosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error identifier**	**Error message**	**Remedy**
	1)	2)	3)	4)			
3	14	1 ... 10	31	31	40	Different hard-/firmware versions in the module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	43	Internal error in the module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	36	Internal data exchange failure	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	9	Overflow diagnosis buffer	New start
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	26	Parameter error	Check master
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	11	Process voltage too low	Check process voltage
	11 / 12	ADR	1 ... 10				
4	14	1 ... 10	31	31	45	Process voltage is switched off (ON -> OFF)	Process voltage ON
	11 / 12	ADR	1 ... 10				
Channel error							
4	14	1 ... 10	1	0 ... 15	48	Analog value overflow or broken wire at an analog input	Check input value or terminal
	11 / 12	ADR	1 ... 10				
4	14	1 ... 10	1	0 ... 15	7	Analog value underflow at an analog input	Check input value
	11 / 12	ADR	1 ... 10				
4	14	1 ... 10	1	0 ... 15	47	Short circuit at an analog input	Check ter-minal
	11 / 12	ADR	1 ... 10				

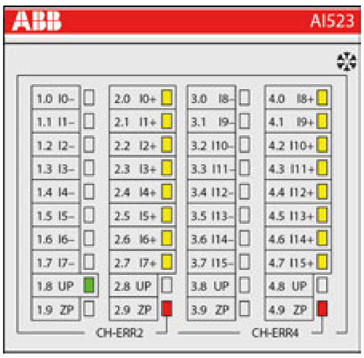
Remarks:

1)	In AC500, the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The FBP diagnosis block does not contain this identifier.
2)	With "Device" the following allocation applies: 31 = module itself, 1 ... 10 = expansion module 1 ... 10, ADR = hardware address (e.g. of the DC551)

[3])	With "Module" the following allocation applies depending on the master: Module error: I/O bus or FBP: 31 = module itself; COM1/COM2: 1 ... 10 = expansion 1 ... 10 Channel error: I/O bus or FBP = module type (1 = AI); COM1/COM2: 1 ... 10 = expansion 1 ... 10
[4])	In case of module errors, with channel "31 = Module itself" is output.

State LEDs

During the power ON procedure, the module initializes automatically. All LEDs (except the channel LEDs) are ON during this time.

LED		State	Color	LED = OFF	LED = ON	LED flashes
	Inputs I0 ... I7 and I8 ... I15	Analog input	Yellow	Input is OFF	Input is ON (brightness depends on the value of the analog signal)	--
	UP	Process voltage 24 V DC via terminal	Green	Process voltage is missing	Process voltage OK	--
	CH-ERR2	Channel error, error messages in groups (analog inputs or outputs combined into the groups 2 and 4)	Red	No error or process voltage is missing	Severe error within the corresponding group	Error on one channel of the group
	CH-ERR4		Red			
	CH-ERR *)	Module error	Red	--	Internal error	--
	*) Both LEDs (CH-ERR2 and CH-ERR4) light up together					

Measuring ranges

Input ranges of voltage, current and digital input

The represented resolution corresponds to 16 bits.

Range	**0 V ... 10 V**	**-10 V ... +10 V**	**0 mA ... 20 mA**	**4 mA ... 20 mA**	**Digital input**	**Digital value**	
						Decimal	**Hex.**
Overflow	>11.7589	>11.7589	>23.5178	>22.8142		32767	7FFF
Measured value too high	11.7589 . . 10.0004	11.7589 : 10.0004	23.5178 : 20.0007	22.8142 : 20.0006		32511 : 27649	7EFF : 6C01
Normal range	10.0000 : 0.0004	10.0000 : 0.0004	20.0000 : 0.0007	20.0000 : 4.0006	: : ON	27648 : 1	6C00 : 0001
Normal range or measured value too low	0.0000	0.0000	0	4	OFF	0	0000
	-0.0004 -1.7593	-0.0004 : : -10.0000		3.9994 1.1858		-1 -4864 : -27648	FFFF ED00 : 9400
Measured value too low		-10.0004 : -11.7589				-27649 : -32512	93FF : 8100
Underflow	<-1.7593	<-11.7589	<0.0000	<1.1858		-32768	8000

Input ranges resistance temperature detector

The resolution corresponds to 16 bits.

Range	**Pt100 / Pt 1000** **-50 °C ... +70 °C**	**Pt100 / Pt1000** **-50 °C ... +400 °C**	**Ni1000** **-50 °C ... +150 °C**	**Digital value**	
				Decimal	**Hex.**
Overflow	> +80.0 °C	> +450.0 °C	> +160.0 °C	32767	7FFF
Measured value too high		+450.0 °C : + 400.1 °C		4500 : 4001	1194 : 0FA1
			+160.0 °C : +150.1 °C	1600 : 1501	0640 : 05DD
	+80.0 °C : +70.1 °C			800 : 701	0320 : 02BD

Range	Pt100 / Pt 1000 -50 °C ... +70 °C	Pt100 / Pt1000 -50 °C ... +400 °C	Ni1000 -50 °C ... +150 °C	Digital value	
				Decimal	**Hex.**
Normal range	: : +70.0 °C : + 0.1 °C	+400.0 °C : : : +0.1 °C	: +150.0 °C : : + 0.1 °C	4000 1500 700 : 1	0FA0 05DC 02BC : 0001
	0.0 °C	0.0 °C	0.0 °C	0	0000
	-0.1 °C : -50.0 °C	-0.1 °C : -50.0 °C	-0.1 °C : -50.0 °C	-1 : -500	FFFF : FE0C
Measured value too low	-50.1 °C : -60.0 °C	-50.1 °C : -60.0 °C	-50.1 °C : -60.0 °C	-501 : -600	FE0B : FDA8
Underflow	< -60.0 °C	< -60.0 °C	< -60.0 °C	-32768	8000

Technical data

Technical data of the module

The system data of AC500 and S500 are applicable to the standard version *Chapter 2.6.1 “System data AC500” on page 1408*.

The system data of AC500-XC are applicable to the XC version *Chapter 2.7.1 “System data AC500-XC” on page 1475*.

Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

Parameter		Value
Process voltage		
	Connections	Terminals 1.8, 2.8, 3.8 and 4.8 for +24 V (UP) as well as 1.9, 2.9, 3.9 and 4.9 for 0 V (ZP)
	Rated value	24 V DC
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	Rated protection fuse on UP	10 A fast
	Galvanic isolation	Yes, per module
Current consumption		
	From 24 V DC power supply at the terminals UP/L+ and ZP/M of the CPU/communication interface module	Ca. 2 mA
	From UP at normal operation / with outputs	0.15 A + output loads

Parameter	Value
Inrush current from UP (at power up)	0.050 A^2s
Max. length of analog cables, conductor cross section > 0.14 mm^2	100 m
Weight	300 g
Mounting position	Horizontal or vertical with derating (output load reduced to 50 % at +40 °C per group)
Cooling	The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

> **NOTICE!**
> All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and temporary overvoltage up to 30 V DC.

Technical data of the analog inputs

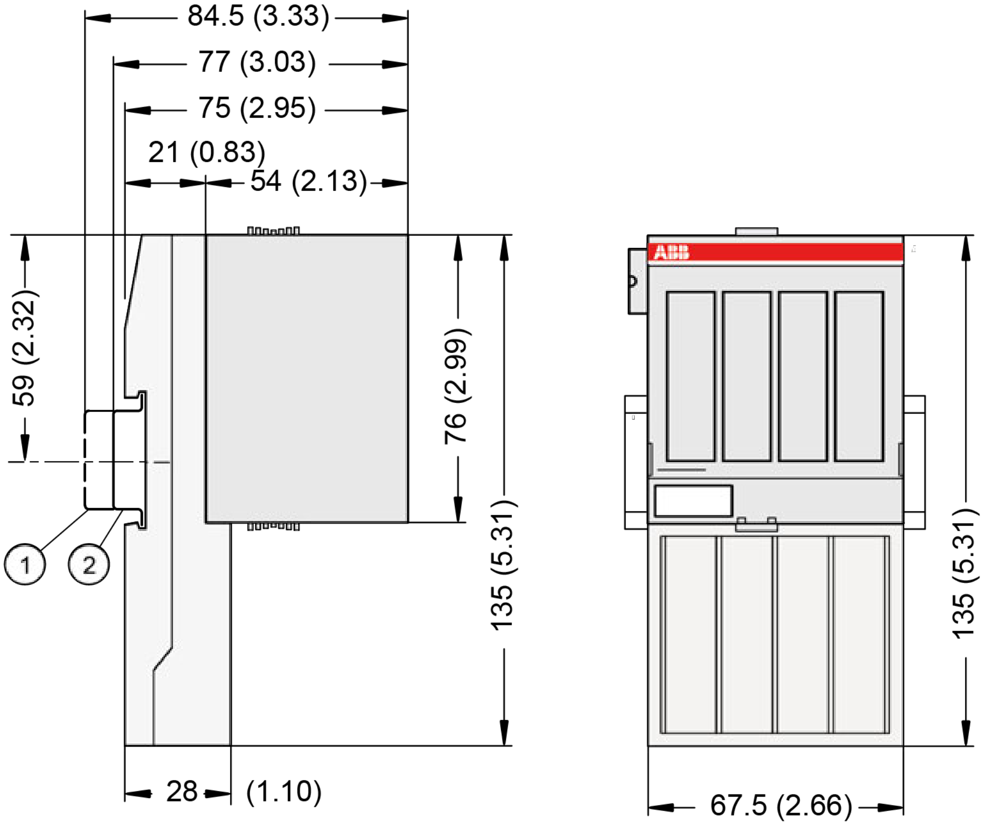
Parameter	Value	
Number of channels per module	16	
Distribution of channels into groups	2 groups of 8 channels each	
Connections of the channels I0- ... I7- Connections of the channels I0+ ... I7+	Terminals 1.0 ... 1.7 Terminals 2.0 ... 2.7	
Connections of the channels I8- ... I15- Connections of the channels I8+ ... I15+	Terminals 3.0 ... 3.7 Terminals 4.0 ... 4.7	
Input type	Bipolar (not with current or Pt100/ Pt1000/ Ni1000)	
Galvanic isolation	Against internal supply and other modules	
Configurability	0 V ... 10 V, -10 V ... +10 V, 0/4 mA ... 20 mA, Pt100/1000, Ni1000 (each input can be configured individually)	
Channel input resistance	Voltage: > 100 kΩ Current: ca. 330 Ω	
Time constant of the input filter	Voltage: 100 µs Current: 100 µs	
Indication of the input signals	1 LED per channel	
Conversion cycle	2 ms (for 16 inputs), with Pt/Ni... 1 s	
Resolution	Range 0 V ... 10 V: 12 bits	
	Range -10 V ... +10 V: 12 bits including sign	
	Range 0 mA ... 20 mA: 12 bits	
	Range 4 mA ... 20 mA: 12 bits	
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range	Typ.	±0.5 % of full scale at +25 °C

Parameter	Value	
	Max.	±1 % of full scale (all ranges) at 0 °C ... +60 °C or EMC disturbance
Relationship between input signal and hex code	*Chapter 1.6.2.2.2.10.2 “Input ranges resistance temperature detector” on page 660*	
Unused voltage inputs	Are configured as "unused"	
Unused current inputs	Have a low resistance, can be left open-circuited	
Overvoltage protection	Yes	

Technical data of the analog inputs, if used as digital inputs

Parameter		Value
Number of channels per module		Max. 16
Distribution of channels into groups		2 groups of 8 channels each
Connections of the channels I0+ ... I7+ Connections of the channels I8+ ... I15+		Terminals 2.0 ... 2.7 Terminals 4.0 ... 4.7
Reference potential for the inputs		Terminals 1.9, 2.9, 3.9 and 4.9 (ZP)
Input signal delay		Typ. 8 ms, configurable from 0.1 ... 32 ms
Indication of the input signals		1 LED per channel
Input signal voltage		24 V DC
	Signal 0	-30 V ... +5 V
	Undefined signal	+5 V ... +13 V
	Signal 1	+13 V ... +30 V
Input current per channel		
	Input voltage +24 V	Typ. 7 mA
	Input voltage +5 V	Typ. 1.4 mA
	Input voltage +15 V	Typ. 4.3 mA
	Input voltage +30 V	< 9 mA
Input resistance		Ca. 3.5 kΩ

Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

Ordering data

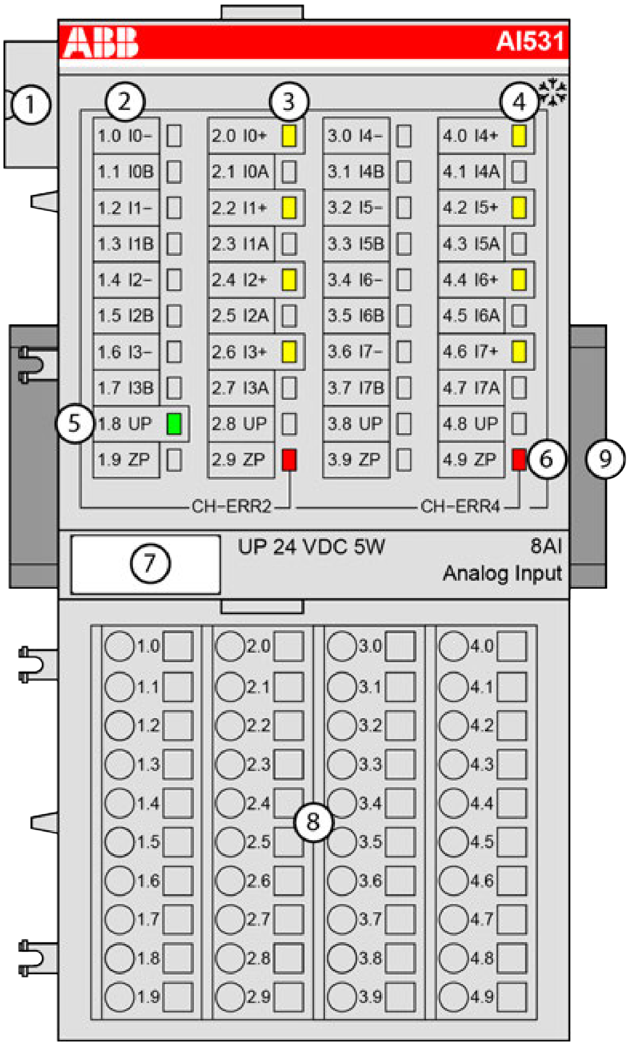
Part no.	Description	Product life cycle phase *)
1SAP 250 300 R0001	AI523, analog input module, 16 AI, U/I/Pt100, 12 bits including sign, 2-wires	Active
1SAP 450 300 R0001	AI523-XC, analog input module, 16 AI, U/I/Pt100, 12 bits including sign, 2-wires, XC version	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

1.6.2.2.3 AI531 - Analog input module

Features

- 8 configurable analog inputs (I0 ... I7) in 2 groups (1.0 ... 1.7 and 2.0 ... 2.7 as well as 3.0 ... 3.7 and 4.0 ... 4.7)
  Resolution 16 bits including sign
- Module-wise galvanically isolated
- XC version for use in extreme ambient conditions available



1 I/O bus
2 Allocation between terminal number and signal names
3 4 yellow LEDs to display the states at the inputs I0 ... I3
4 4 yellow LEDs to display the states at the inputs I4 ... I7
5 1 green LED to display the process supply voltage UP
6 2 red LEDs to display errors (CH-ERR2 and CH-ERR4)
7 Label
8 Terminal unit
9 DIN rail
Sign for XC version

Intended purpose

The device can be used as a decentralized I/O extension module for S500 communication interface modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs.

Functionality

8 analog inputs, individually configurable for

- Unused (default setting)
- 0 V ... 5 V, 0 V ... 10 V
- -50 mV ... +50 mV, -500 mV ... +500 mV
- -1 V ... +1 V, -5 V ... +5 V, -10 V ... +10 V
- 0 mA ... 20 mA
- 4 mA ... 20 mA
- -20 mA ... 20 mA
- Pt100, -50 °C ... +70 °C or +400 °C (2-, 3- and 4-wire)
- Pt100, -200 °C ... +850 °C (2-, 3- and 4-wire)
- Pt1000, -50 °C ... +400 °C (2-, 3- and 4-wire)
- Ni1000, -50 °C ... +150 °C (2-, 3- and 4-wire)
- Cu50 (1.426): -50 °C ... +200 °C (2-, 3- and 4-wire)
- Cu50 (1.428): -200 °C ... +200 °C (2-, 3- and 4-wire)
- 0 Ω ... 50 kΩ
- Thermocouples of types J, K, T, N, S
- Resistance measuring bridge
- Digital signals (digital input)

Parameter		Value
Resolution of the analog channels		
	Voltage and current	16 bits including sign
	Temperature	+0.1 °C (0,01°C at Pt100 -50 °C ... +70 °C)
LED displays		11 LEDs for signals and error messages
Internal power supply		through the I/O bus interface (I/O bus)
External power supply		via terminals (process voltage UP = 24 V DC)
Required terminal unit		TU515 or TU516 *Chapter 1.5.3 “TU515, TU516, TU541 and TU542 for I/O modules” on page 282*

Connections

For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.

The modules are plugged on an I/O terminal unit *Chapter 1.5.3 “TU515, TU516, TU541 and TU542 for I/O modules” on page 282*. Properly position the modules and press until they lock in place. The terminal units are mounted on a DIN rail or with 2 screws plus the additional accessory for wall mounting *Chapter 1.9.3.5 “TA526 - Wall mounting accessory” on page 1361*.

The connection of the I/O channels is carried out using the 40 terminals of the I/O terminal unit. I/O modules can be replaced without re-wiring the terminal units.

The terminals 1.8, 2.8, 3.8, 4.8, 1.9, 2.9, 3.9 and 4.9 are electrically interconnected within the I/O terminal units and always have the same assignment, independent of the inserted module:

Terminals 1.8, 2.8, 3.8 and 4.8: process voltage UP = +24 V DC

Terminals 1.9, 2.9, 3.9 and 4.9: process voltage ZP = 0 V

The assignment of the other terminals:

Terminals	Signal	Description
2.0, 2.2, 2.4, 2.6	I0+ ... I3+	Positive poles of the first 4 analog inputs
1.0, 1.2, 1.4, 1.6	I0- ... I3-	Negative poles of the first 4 analog inputs
2.1, 2.3, 2.5, 2.7	I0A ... I3A	Connections A (supply) of the first 4 analog inputs
1.1, 1.3, 1.5, 1.7	I0B ... I3B	Connections B (analog ground) of the first 4 analog inputs
4.0, 4.2, 4.4, 4.6	I4+ ... I7+	Positive poles of the following 4 analog inputs
3.0, 3.2, 3.4, 3.6	I4- ... I7-	Negative poles of the following 4 analog inputs
4.1, 4.3, 4.5, 4.7	I4A ... I7A	Connections A (supply) of the following 4 analog inputs
3.1, 3.3, 3.5, 3.7	I4B ... I7B	Connections B (analog ground) of the following 4 analog inputs

CAUTION!
Analog sensors must be galvanically isolated against the ground. In order to avoid inaccuracy with the measuring results, the analog sensors should also be isolated against the power supply.

The "IxB" clamps (x=0 ... 7) of the analog inputs are galvanically connected to each other. They form an "Analog Ground Signal" (AGND) for the module.

The negative poles of the analog inputs Ix- may accept a potential difference up to ±20 V DC with regard to the common reference potential IxB (AGND, ZP). Observing this maximum voltage difference, analog current inputs of one module can be switched in series to each other and also with current inputs of other modules.

For the open-circuit detection (wire break), each positive analog input channel Ix+ is pulled up to "plus" by a high-resistance resistor and each negative analog input channel Ix- is pulled down to "minus" by a resistor. If wire break occurs, a maximum voltage (overflow or underflow) will be read in then.

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a communication interface module or a CPU). Thus, the current consumption from 24 V DC power supply at the terminals L+/UP and M/ZP of the CPU/communication interface module increases by 2 mA per AI531.

The external power supply connection is carried out via the UP (+24 V DC) and the ZP (0 V DC) terminals.

WARNING!
Removal/Insertion under power

Removal or insertion under power is permissible only if all conditions for hot swapping are fullfilled.

Conditions for hot swap

"Conditions for hot swap" on page 1367

The devices are not designed for removal or insertion under power when the conditions for hot swap do not apply. Because of unforeseeable consequences, it is not allowed to plug in or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

Disconnecting any powered devices while they are energized in a hazardous location could result in an electric arc, which could create an ignition source resulting in fire or explosion.

Prior to proceeding, make sure that power is been disconnected and that the area has been thoroughly checked to ensure that flammable materials are not present.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!
Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

Generally, analog signals must be laid in shielded cables. The cable shields must be grounded at both sides of the cables. In order to avoid unacceptable potential differences between different parts of the installation, low resistance equipotential bonding conductors must be laid.

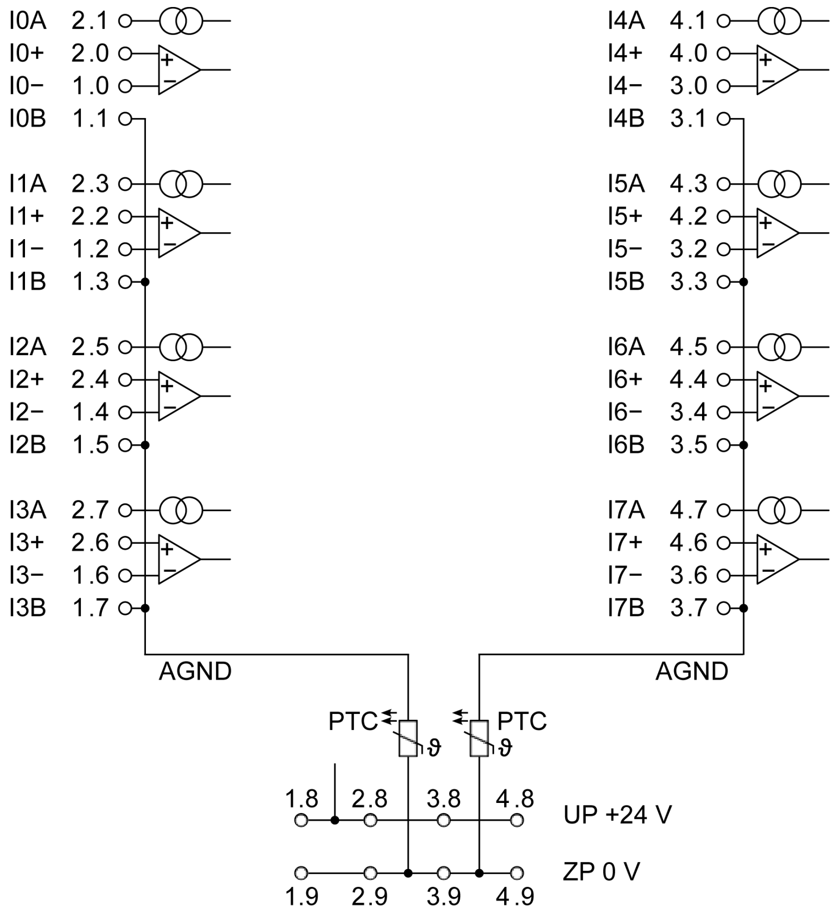


Fig. 148: 8 analog inputs in two groups, individually configurable ⇘ Chapter 1.6.2.2.3.3 “Functionality” on page 666

> **CAUTION!**
> By installing equipotential bonding conductors between the different parts of the system, it must be ensured that the potential difference between ZP and AGND never can exceed 1 V.

> **CAUTION!**
> The process supply voltage must be included in the grounding concept (e. g. grounding of the negative terminal).

The module provides several diagnosis functions ⇘ *Chapter 1.6.2.2.3.8 “Diagnosis” on page 693.*

Connection of active-type analog sensors (Voltage) with galvanically isolated power supply

Standard ranges

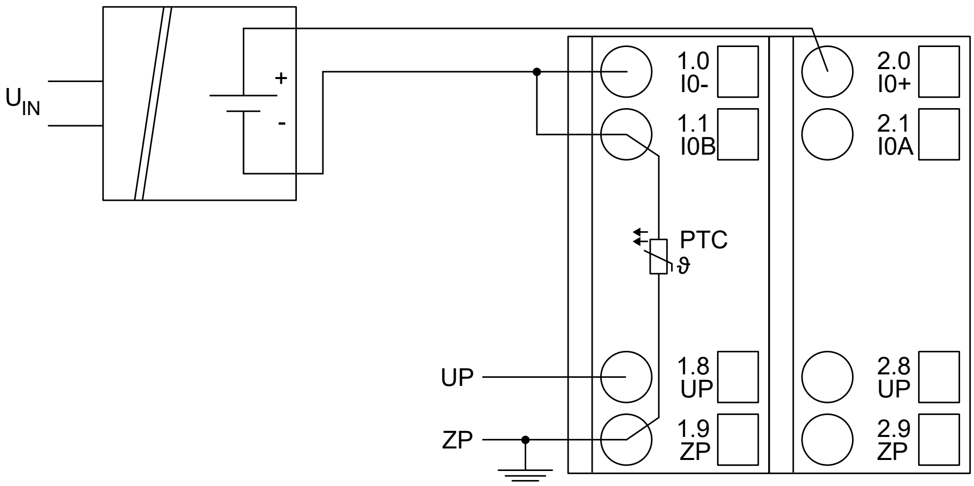


Fig. 149: Connection example

The measuring ranges can be configured ✎ *Chapter 1.6.2.2.3.7 “Parameterization” on page 689*:

Voltage	-50 mV ... +50 mV	1 channel used
Voltage	-500 mV ... +500 mV	1 channel used
Voltage	-1 V ... +1 V	1 channel used
Voltage	-5 V ... +5 V	1 channel used
Voltage	-10 V ... +10 V	1 channel used
Voltage	0 V ... +5 V	1 channel used
Voltage	0 V ... +10 V	1 channel used

Common mode range (+/-20 V)

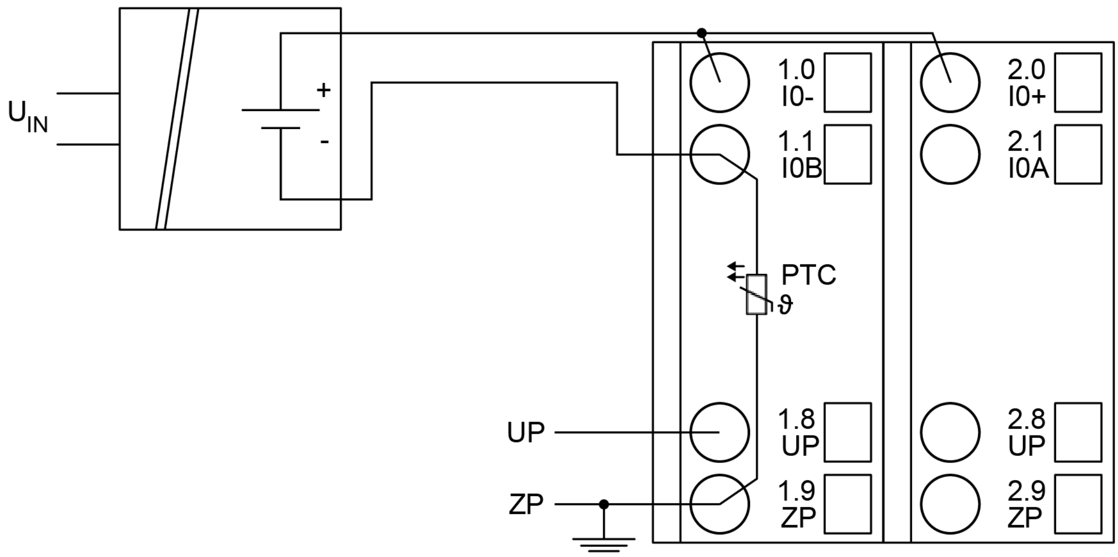


Fig. 150: Connection example

The measuring range can be configured ➪ *Chapter 1.6.2.2.3.7 “Parameterization” on page 689*:

Voltage	Common mode voltage	1 channel used

The function of the LEDs is described under diagnosis and displays/displays ➪ *Chapter 1.6.2.2.3.8 “Diagnosis” on page 693*.

In order to avoid error messages or long processing times, it is useful to configure unused analog input channels as "unused".

Connection of active-type analog sensors (Voltage) with no galvanically isolated power supply

Standard ranges

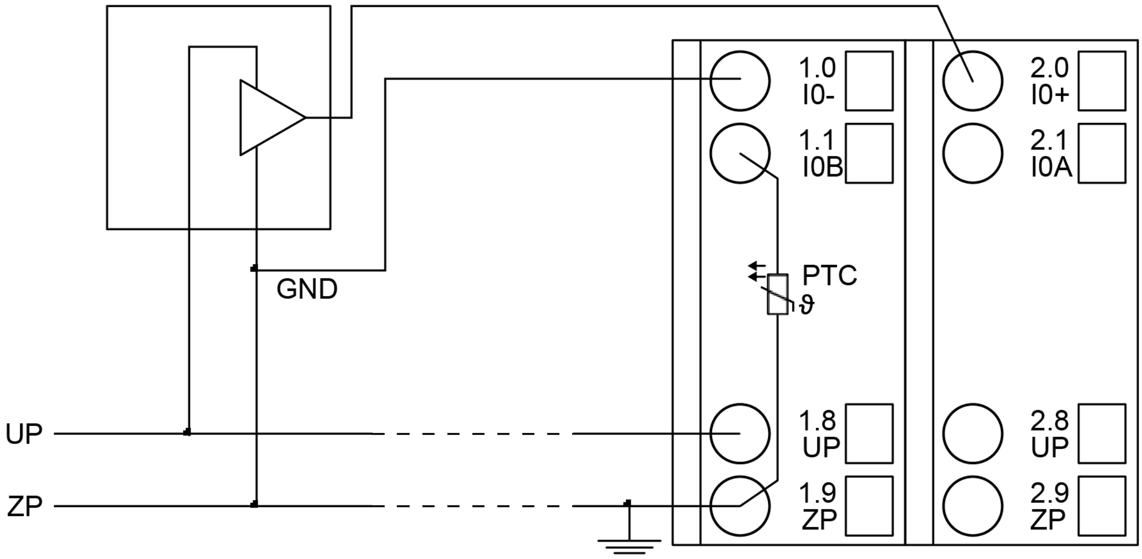


Fig. 151: Connection example

> **CAUTION!**
> If GND is not directly connected to ZP at the sensor, the supply current flows via the GND line to ZP. Measuring errors can only occur caused by voltage differences higher than ± 20 V DC between GND and ZP.

The measuring ranges can be configured *Chapter 1.6.2.2.3.7 “Parameterization” on page 689* :

Voltage	-50 mV ... +50 mV	1 channel used
Voltage	-500 mV ... +500 mV	1 channel used
Voltage	-1 V ... +1 V	1 channel used
Voltage	-5 V ... +5 V	1 channel used
Voltage	-10 V ... +10 V	1 channel used
Voltage	0 V ... +5 V	1 channel used
Voltage	0 V ... +10 V	1 channel used

Common mode range (+/-20 V)

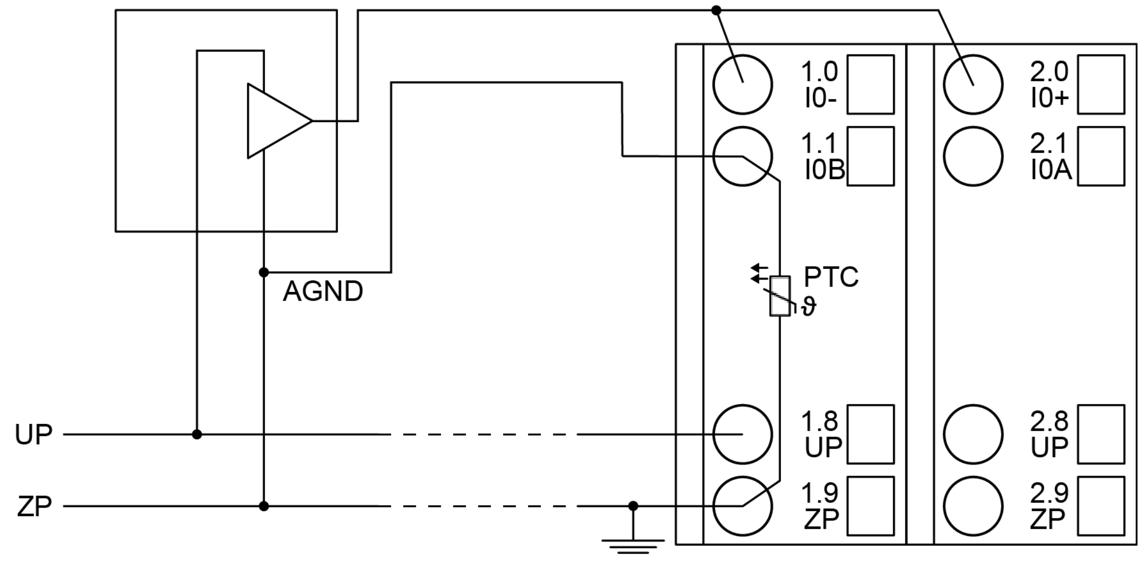


Fig. 152: Connection example

> **CAUTION!**
> If GND is not directly connected to ZP at the sensor, the supply current flows via the GND line to ZP. Measuring errors can only occur caused by voltage differences higher than ±20 V DC between GND and ZP.

The measuring range can be configured *Chapter 1.6.2.2.3.7 “Parameterization” on page 689*:

Voltage	Common mode voltage	1 channel used

The function of the LEDs is described under diagnosis and displays/displays *Chapter 1.6.2.2.3.8 “Diagnosis” on page 693*.

In order to avoid error messages or long processing times, it is useful to configure unused analog input channels as "unused".

Connection of active-type analog sensors (Current) with galvanically isolated power supply

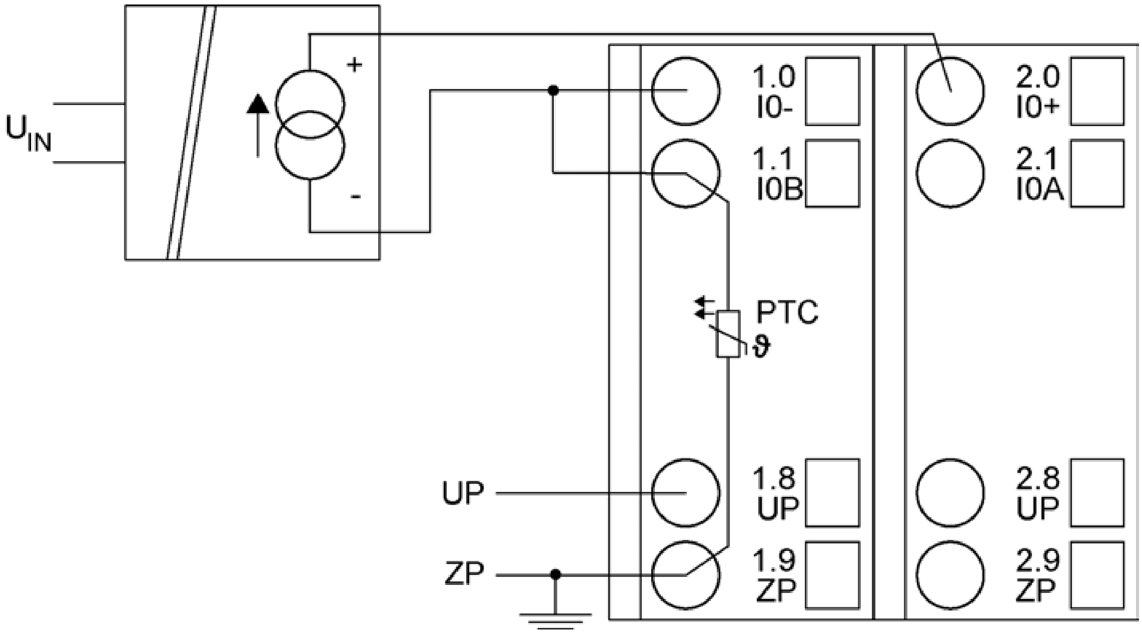


Fig. 153: Connection example

The following measuring ranges can be configured ␥ *Chapter 1.6.2.2.3.7 “Parameterization” on page 689*:

Current	-20 mA ... 20 mA	1 channel used
Current	0 mA ... 20 mA	1 channel used
Current	4 mA ... 20 mA	1 channel used

The function of the LEDs is described under diagnosis and displays/displays ␥ *Chapter 1.6.2.2.3.8 “Diagnosis” on page 693*.

Unused input channels can be left open, because they are of low resistance.

Connection of active-type analog sensors (Current) with galvanically isolated power supply and series-connection of an additional input

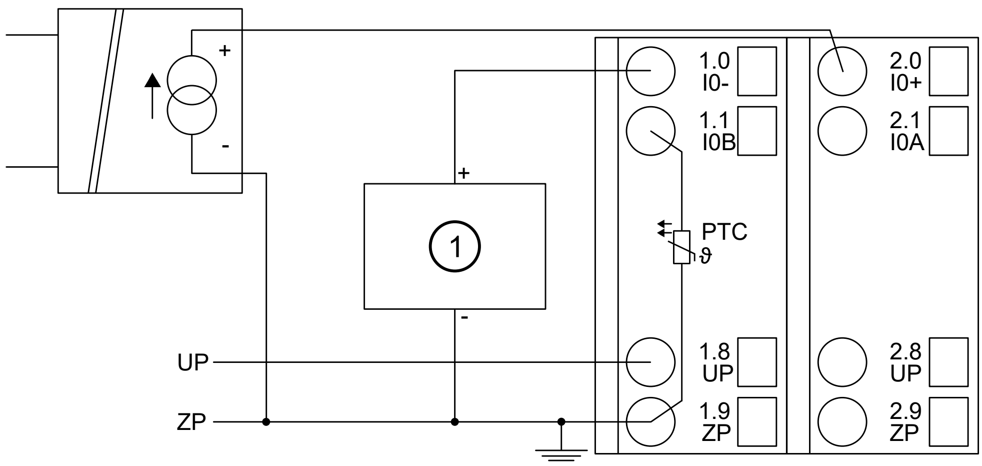


Fig. 154: Connection example

1 Analog input of the second device

If series-connection of an additional input is used, the input resistance of the module (ca. 330 Ω) must be added to the input resistance of the second device. Make sure that the maximum permitted load resistance of the analog sensor is not exceeded (see the data sheet of the analog sensor).

The input of the module is not related to ZP. If the input of the second device is related to ZP, the order of sequence in the series-connection must be observed by all means (from the sensor to the module and then to the input of the second device).

The following measuring ranges can be configured *Chapter 1.6.2.2.3.7 “Parameterization” on page 689*:

Current	-20 mA ... 20 mA	1 channel used
Current	0 mA ... 20 mA	1 channel used
Current	4 mA ... 20 mA	1 channel used

For a description of the functions of the LEDs, please refer to diagnosis and displays/displays *Chapter 1.6.2.2.3.8 “Diagnosis” on page 693*.

Unused input channels can be left open, because they are of low resistance.

Connection of passive-type analog sensors (Current)

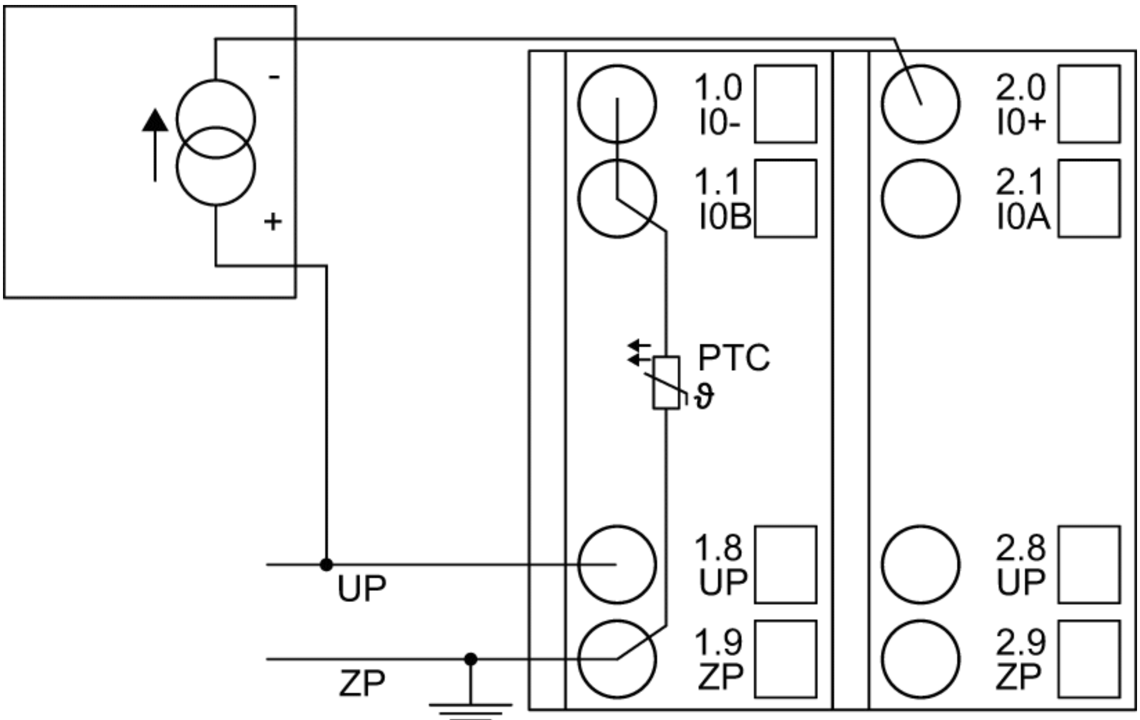


Fig. 155: Connection example

The following measuring ranges can be configured *Chapter 1.6.2.2.3.7 “Parameterization” on page 689*:

Current	-20 mA ... 20 mA *)	1 channel used
Current	0 mA ... 20 mA *)	1 channel used
Current	4 mA ... 20 mA	1 channel used
*) This setting is not applicable with passive-type analog sensors (current).		

The function of the LEDs is described under diagnosis and displays/displays ↬ *Chapter 1.6.2.2.3.8 “Diagnosis” on page 693*.

Unused input channels can be left open, because they are of low resistance.

Connection of passive-type analog sensors (Current) and series-connection of an additional analog sensor

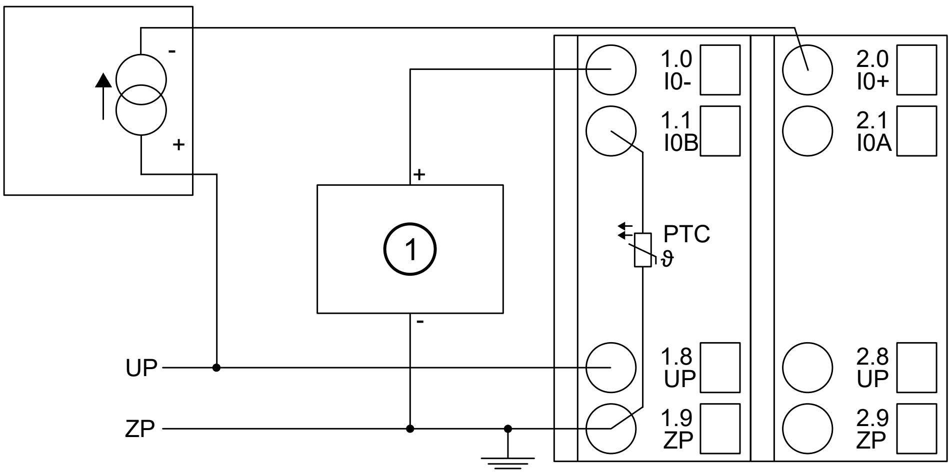


Fig. 156: Connection example

1 Analog input of the second device

If series-connection of an additional input is used, the input resistance of the module (ca. 330 Ω) must be added to the input resistance of the second device. Make sure that the maximum permitted load resistance of the analog sensor is not exceeded (see the data sheet of the analog sensor).

The input of the module is not related to ZP. If the input of the second device is related to ZP, the order of sequence in the series-connection must be observed by all means (from the sensor to the module and then to the input of the second device).

The following measuring ranges can be configured *Chapter 1.6.2.2.3.7 “Parameterization” on page 689*:

Current	-20 mA ... 20 mA *)	1 channel used
Current	0 mA ... 20 mA *)	1 channel used
Current	4 mA ... 20 mA	1 channel used
*) This setting is not applicable with passive-type analog sensors (current).		

The function of the LEDs is described under diagnosis and displays/displays *Chapter 1.6.2.2.3.8 “Diagnosis” on page 693*.

Unused input channels can be left open, because they are of low resistance.

Connection of digital signal sources at analog inputs

Several (or all) analog inputs can be configured as digital inputs. The inputs are not galvanically isolated against the other analog channels.

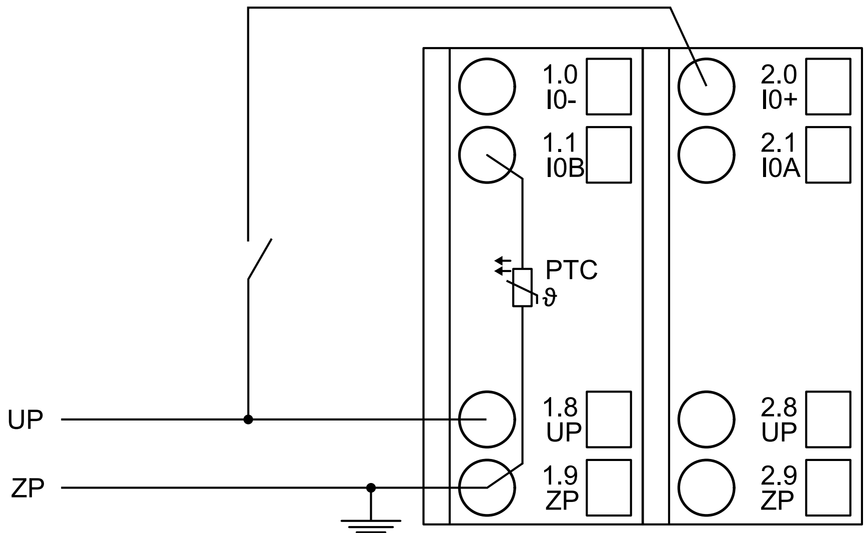


Fig. 157: Connection example

The following operating mode can be configured *Chapter 1.6.2.2.3.7 “Parameterization” on page 689* :

Digital input	24 V	1 channel used
Effect of incorrect input terminal connection		Wrong or no signal detected, no damage up to 35 V

For a description of the function of the LEDs, please refer to diagnosis and displays/displays ⇨ *Chapter 1.6.2.2.3.8 “Diagnosis” on page 693*.

Connection of resistance thermometers in 2-wire configuration

When resistance thermometers (Pt100, Pt1000, Ni1000, Cu50) are used, a constant current must flow through them to build the necessary voltage drop for the evaluation. For this, the module AI531 provides a constant current source which is multiplexed over the 4 analog channels.

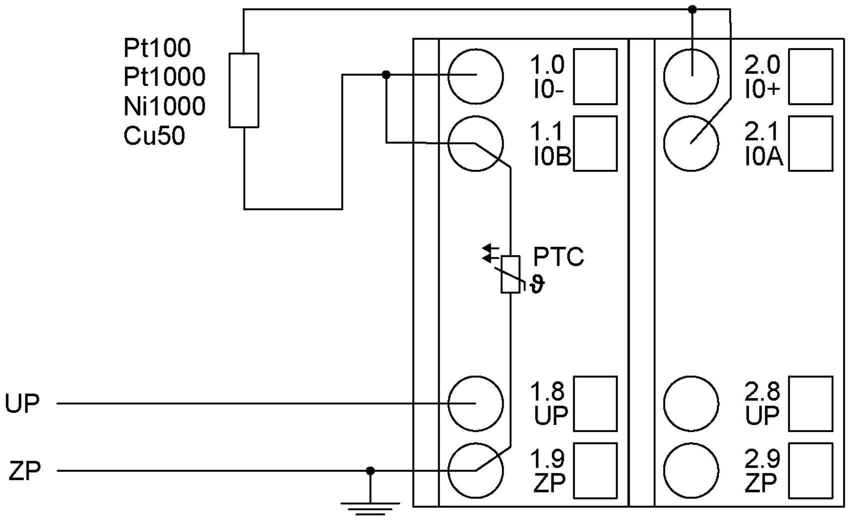


Fig. 158: Connection example

The following measuring ranges can be configured ⇨ *Chapter 1.6.2.2.3.7 “Parameterization” on page 689*:

Pt100	-50 °C ... +70 °C / +400 °C; -200 °C ... +850 °C	1 channel used
Pt1000	-50 °C ... +400 °C	1 channel used
Ni1000	-50 °C ... +150 °C	1 channel used
Cu50	-50 °C ... +200 °C (1.426); -200 °C ... +200 °C (1.428)	1 channel used

For a description of the function of the LEDs, please refer to Diagnosis and displays / displays ⇨ *Chapter 1.6.2.2.3.8 “Diagnosis” on page 693*.

The module linearizes the resistance thermometer characteristics.

In order to avoid error messages from unused analog input channels, it is useful to configure them as "unused".

Connection of resistance thermometers in 3-wire configuration

When resistance thermometers (Pt100, Pt1000, Ni1000, Cu50) are used, a constant current must flow through them to build the necessary voltage drop for the evaluation. For this, the module AI531 provides a constant current source which is multiplexed over the 4 analog channels.

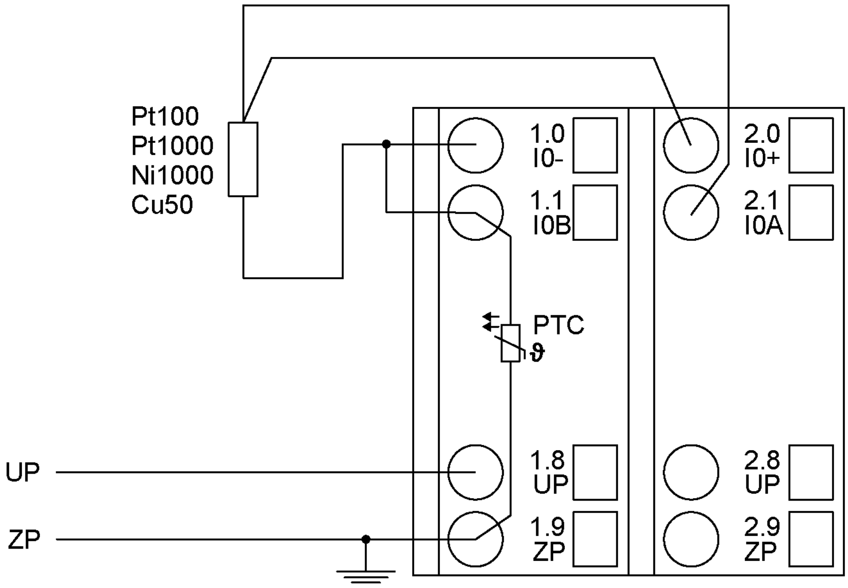


Fig. 159: Connection example

The following measuring ranges can be configured *Chapter 1.6.2.2.3.7 “Parameterization” on page 689*:

Pt100	-50 °C ... +70 °C/+400 °C; -200 °C ... +850 °C	1 channel used
Pt1000	-50 °C ... +400 °C	1 channel used
Ni1000	-50 °C ... +150 °C	1 channel used
Cu50	-50 °C ... +200 °C (1.426); -200 °C ... +200 °C (1.428)	1 channel used

For a description of the function of the LEDs, please refer to diagnosis and displays/displays *Chapter 1.6.2.2.3.8 “Diagnosis” on page 693*.

The module linearizes the resistance thermometer characteristics. In order to keep measuring errors as small as possible, it is necessary by all means to have all the involved conductors in the same cable. All the conductors must have the same cross section.

In order to avoid error messages from unused analog input channels, it is useful to configure them as "unused".

Connection of resistance thermometers in 4-wire configuration

When resistance thermometers (Pt100, Pt1000, Ni1000, Cu50) are used, a constant current must flow through them to build the necessary voltage drop for the evaluation. For this, the module AI531 provides a constant current source which is multiplexed over the 4 analog channels.

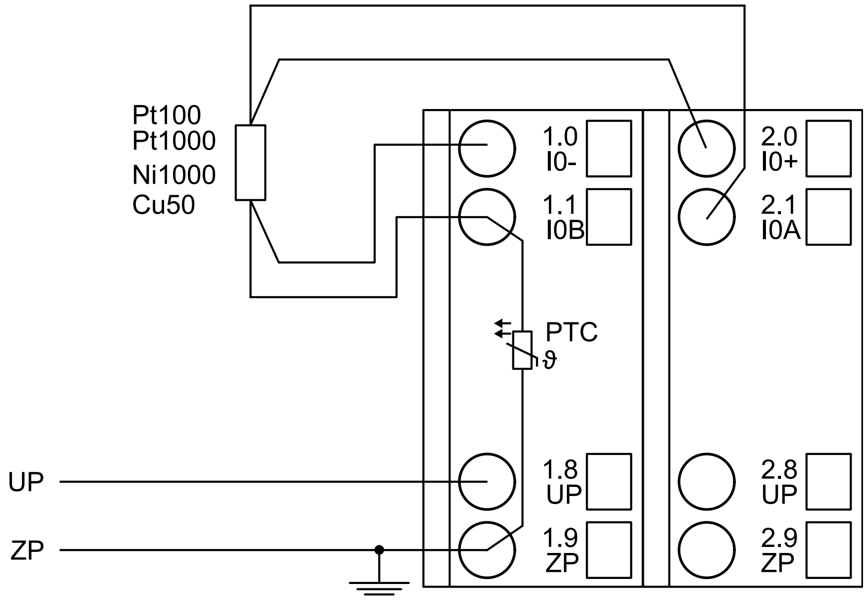


Fig. 160: Connection example

The following measuring ranges can be configured *Chapter 1.6.2.2.3.7 “Parameterization” on page 689*:

Pt100	-50 °C ... +70 °C/+400 °C; -200 °C ... +850 °C	1 channel used
Pt1000	-50 °C ... +400 °C	1 channel used
Ni1000	-50 °C ... +150 °C	1 channel used
Cu50	-50 °C ... +200 °C (1.426); -200 °C ... +200 °C (1.428)	1 channel used

For a description of the function of the LEDs, please refer to diagnosis and displays/displays *Chapter 1.6.2.2.3.8 “Diagnosis” on page 693*.

The module linearizes the resistance thermometer characteristics. In order to keep measuring errors as small as possible, it is necessary by all means, to have all the involved conductors in the same cable.

In order to avoid error messages from unused analog input channels, it is useful to configure them as "unused".

Connection of resistors in 2-wire configuration

For evaluating resistors, a constant current must flow through them to build the necessary voltage drop. For this, the module AI531 provides a constant current source which is multiplexed over the 4 analog channels.

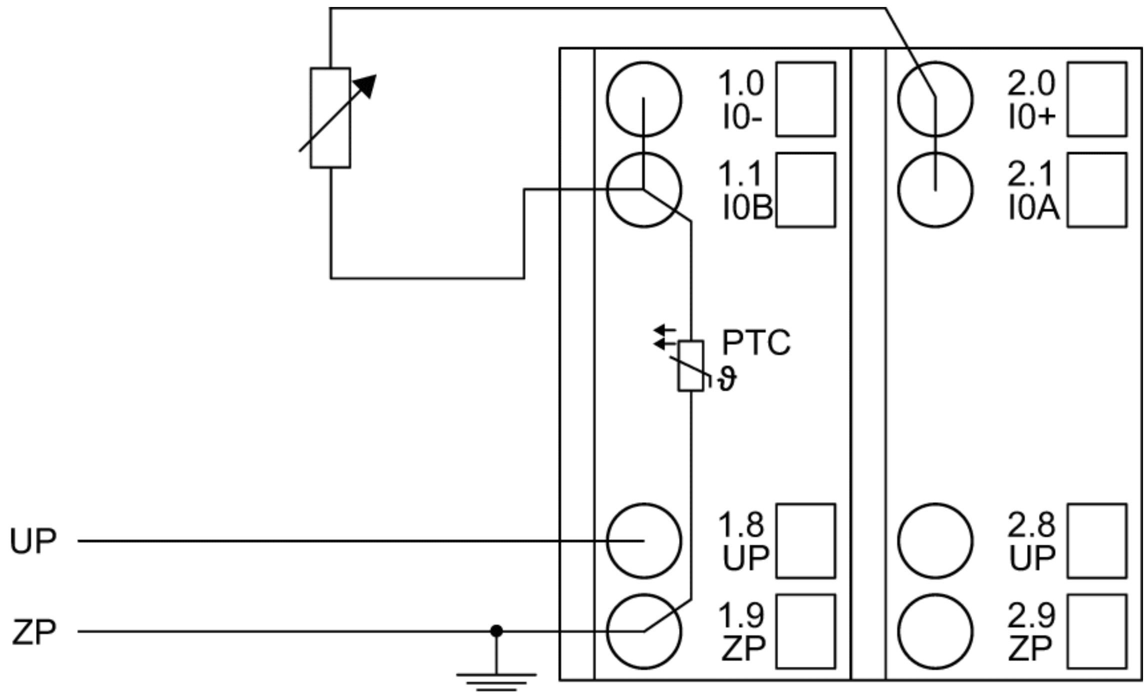


Fig. 161: Connection example

The following measuring ranges can be configured ➪ *Chapter 1.6.2.2.3.7 “Parameterization” on page 689* :

Resistor	50 kΩ	1 channel used

For a description of the function of the LEDs, please refer to diagnosis and displays/displays ➪ *Chapter 1.6.2.2.3.8 “Diagnosis” on page 693*.

In order to avoid error messages from unused analog input channels, it is useful to configure them as "unused".

Connection of a resistance measuring bridge with internal supply

When resistance measuring bridges are connected, the short-circuit-proof voltage output (internal supply) at pin I0A (or I2A, I4A, I6A) must be used. This supply voltage is activated as soon as "Voltage Measurement" is configured for the relevant channel.

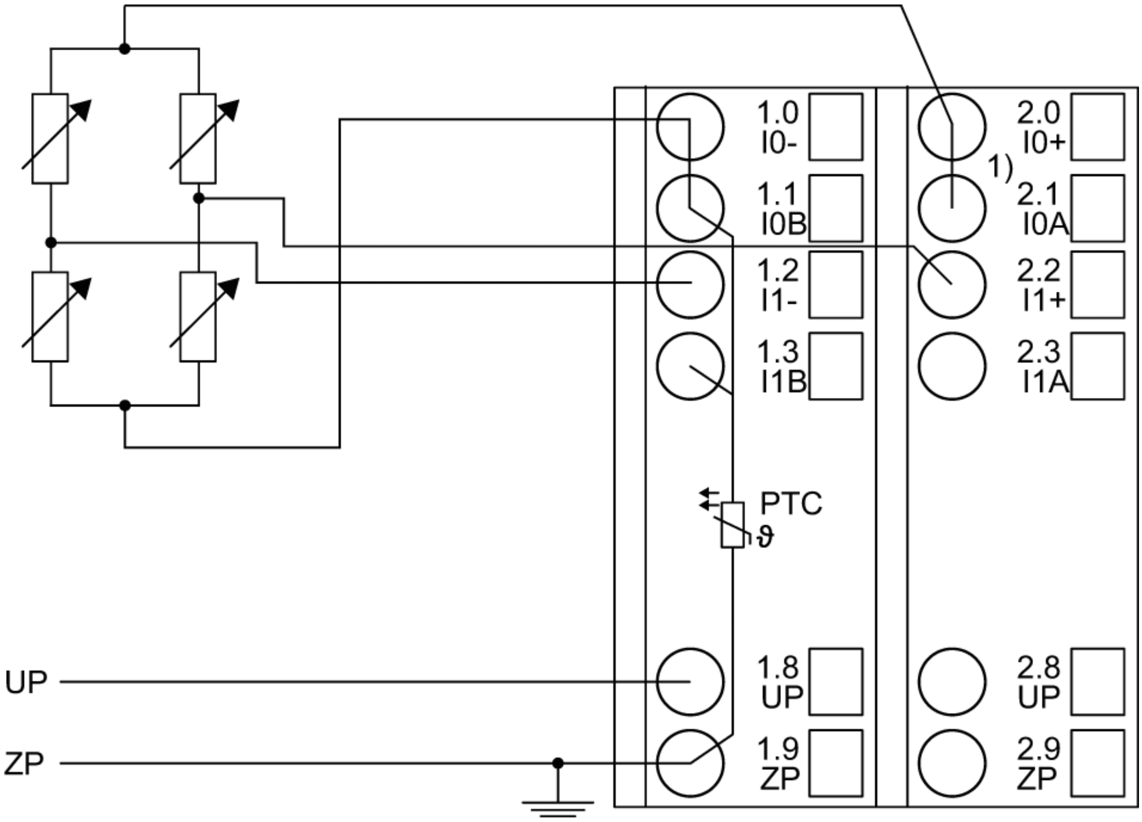


Fig. 162: Connection example

1 Internal supply

All voltage measuring ranges can be configured ↳ *Chapter 1.6.2.2.3.7 “Parameterization” on page 689*.

Voltage	-50 mV ... +50 mV	1 channel used
Voltage	-500 mV ... +500 mV	1 channel used
Voltage	-1 V ... +1 V	1 channel used
Voltage	-5 V ... +5 V	1 channel used
Voltage	-10 V ... +10 V	1 channel used
Voltage	0 V ... +5 V	1 channel used
Voltage	0 V ... +10 V	1 channel used

The calculation of the resistor deviation must be performed via the bridge voltage by the PLC user program.

Connection of a resistance measuring bridge with external supply

With the connection of a resistance measuring bridge with external supply, the supply voltage is provided separately.

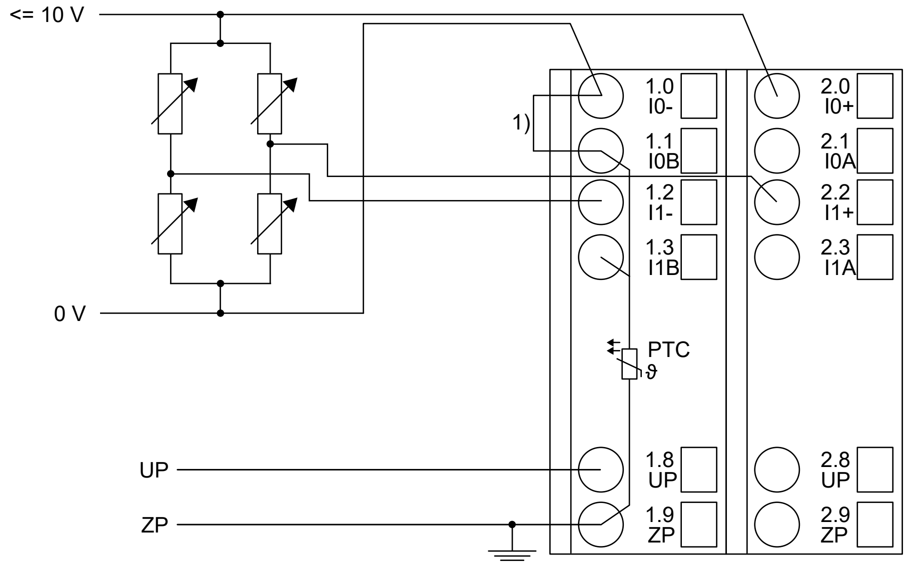


Fig. 163: Connection example

1 Bridge to IxB necessary with galvanically isolated supply

All voltage measuring ranges can be configured *Chapter 1.6.2.2.3.7 "Parameterization" on page 689* .

Voltage	-50 mV ... +50 mV	1 channel used
Voltage	-500 mV ... +500 mV	1 channel used
Voltage	-1 V ... +1 V	1 channel used
Voltage	-5 V ... +5 V	1 channel used
Voltage	-10 V ... +10 V	1 channel used
Voltage	0 V ... +5 V	1 channel used
Voltage	0 V ... +10 V	1 channel used

The calculation of the resistor deviation must be performed via the bridge voltage by the PLC user program.

Connection of thermocouples

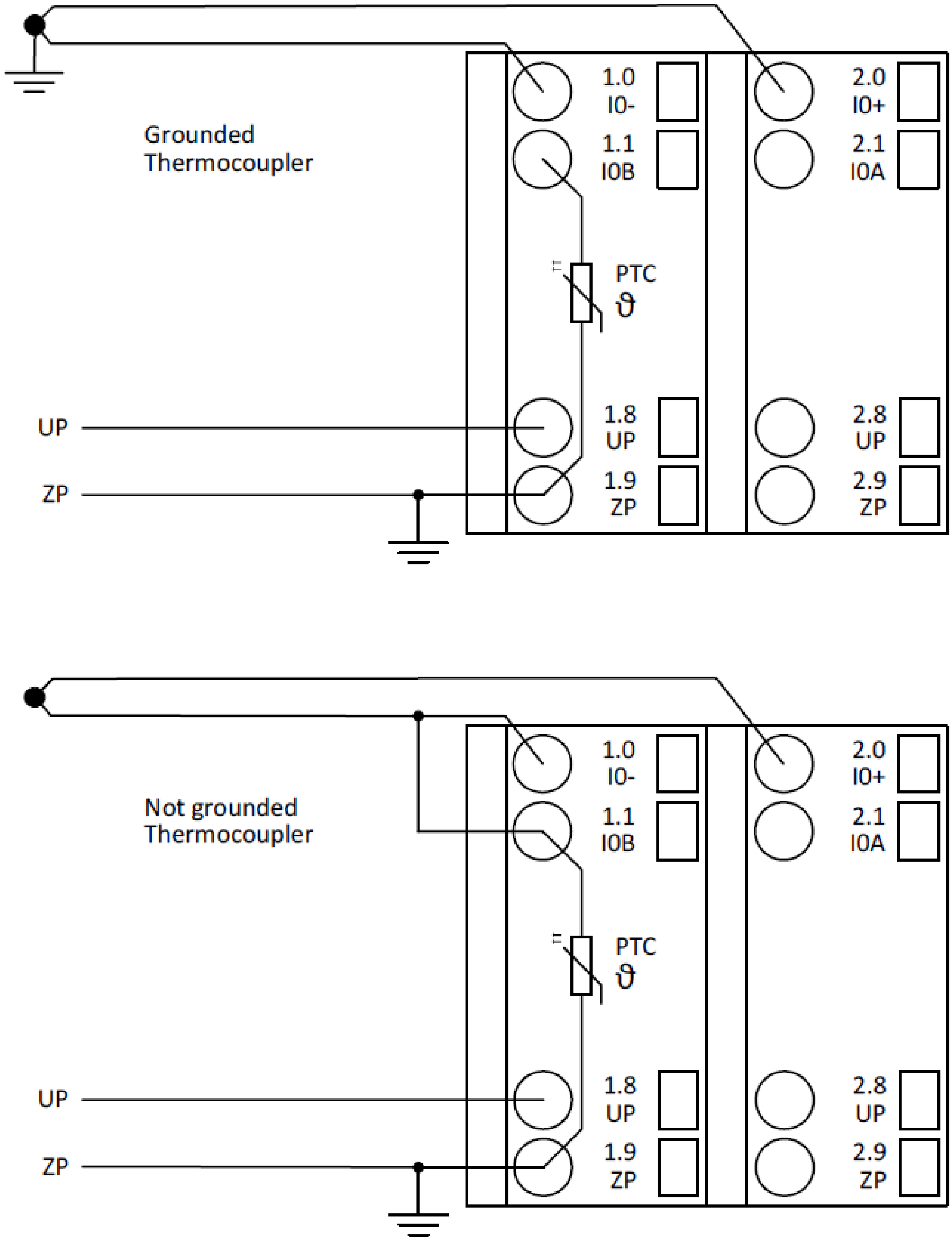


Fig. 164: Connection example

The following measuring ranges can be configured *Chapter 1.6.2.2.3.7 “Parameterization” on page 689* :

J type	-210 °C ... +1200 °C	Fe-CuNi	1 channel used
K type	-270 °C ... +1372 °C	Ni-CrNi	1 channel used
N type	-270 °C ... +1300 °C	NiCrSi-NiSi	1 channel used
S type	-50 °C ... +1768 °C	Pt10Rh-Pt	1 channel used
T type	-270 °C ... +400 °C	Cu-CuNi	1 channel used

For a description of the function of the LEDs, please refer to diagnosis and displays/displays ⇨ *Chapter 1.6.2.2.3.8 “Diagnosis” on page 693*.

The module linearizes the thermocouple characteristics. It supports the following possibilities of temperature compensation and handling with cold junctions:

Internal compensation

An internal temperature sensor which is located next to the terminal unit is used to detect the temperature of the cold junction. So the compensating cables must be connected directly to the terminal unit, where the cold junction is located.

The setting *“Internal compensation (default)”* for the parameter *“Compensation channel”* should be selected.

> *To get more precise temperature measurements, the use of an external compensation method is recommended.*

External compensation with temperature input

The temperature for the cold junction can be determinated externally.

A measured or known temperature value (e.g. ambient temperature in the cabinet) is transferred to the module via the output data word to all required channels. The possible temperature range is -25 °C ... +60 °C and is monitored by the AI531.

The setting *“External with temperature value”* for the parameter *“Compensation channel”* should be selected.

External compensation with compensation box

A compensation box balances the temperature difference between the cold junction and the reference temperature by generating a bridge voltage. The reference temperature is transferred via the output data word.

The compensation box must fit to the type of thermocouple and is located at the end of the compensating cables, where the cold junction is located. The cabling to the AI531 can be carried out with normal cables. The operating manual of the compensation box also has to be considered.

The setting *“External with temperature value”* for the parameter *“Compensation channel”* should be selected.

External compensation with flanking channel

A flanking channel of the same input group can be used for compensation, e. g. for channel 3, the channels 0, 1 and 2 can be selected as reference channels. The type of sensor for the reference channel can be selected in the parameters for the flanking channel. For example, a RTD sensor which is located next to the thermocouple terminal can be used as reference point for other channels.

The setting *“Channel x”* for the parameter *“Compensation channel”* should be selected.
Refer to 'Channel configuration' for possible settings ⇨ *Chapter 1.6.2.2.3.7 “Parameterization” on page 689*.

In order to avoid error messages from unused analog input channels, it is useful to configure them as "unused".

Internal data exchange

Digital inputs (bytes)	0
Digital outputs (bytes)	0
Analog inputs (words)	8
Analog outputs (words)	1

I/O configuration

The module does not store configuration data itself. It gets its parameterization data from the master device of the I/O bus (CPU or communication interface module) during power-up of the system.

This means that replacing I/O modules is possible without any re-parameterization via software.

If the external power supply voltage via UP/ZP terminals fails, the I/O module loses its configuration data. The whole station has to be switched off and on again to re-configure the module.

Parameterization

Firmware version	Configuration
Firmware version > V2.0.0	The arrangement of the parameter data is performed by Control Builder Plus/ Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Module: Module slot address: Y = 1 ... 10

Name	Value	Internal value	Internal value, Type	Default	Min.	Max.	EDS Slot/ Index
Module ID	Internal	1535 [1])	Word	1535 0x05ff	0	65535	0x0Y01
Ignore module [2])	No Yes	0 1	Byte	No 0x00			Not for FBP
Parameter length in bytes	Internal	36	Byte	36	0	255	0x0Y02
Check supply	Off On	0 1	Byte	On 0x01			0x0Y03
Analog data format	Default	0	Byte	Default 0x00			0x0Y04

[1]) With CS31 and addresses smaller than 70 and FBP, the value is increased by 1

[2]) Not with FBP

GSD file:

Ext_User_Prm_Data_Len =	39
Ext_User_Prm_Data_Const(0) =	0x05, 0xff, 0x24, \
	0x01, 0x00, 0x00, 0x00 \
	0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, \
	0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, \
	0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, \
	0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00;

Input channel (8x)

No.	Name	Value	Internal value	Internal value, Type	Default	EDS Slot Index
1	Channel configuration	see table 'Channel configuration' *Table 184 "Channel configuration" on page 691*	see 'Channel configuration' *Table 184 "Channel configuration" on page 691*	Byte	0 0x00	0x0Y07
2	Channel monitoring	see table 'Channel monitoring' *Table 185 "Channel monitoring" on page 692*	see 'Channel monitoring' *Table 185 "Channel monitoring" on page 692*	Byte	0 0x03	
3	Line frequency suppression	see table 'Line frequency suppression' *Further information on page 692*	see 'Line frequency suppression' *Further information on page 692*	Byte	0 0x00	
4	Compensation channel	see table 'Compensation channel' *Further information on page 692*	see table 'Compensation channel' *Further information on page 692*	Byte	0 0x00	

Table 184: Channel configuration

Internal value	Operating modes for the analog inputs, individually configurable
0	Unused (default)
2	Digital input
34	Analog input -50 mV ... +50 mV
35	Analog input -500 mV ... +500 mV
36	Analog input -1 V ... +1 V
7	Analog input -5 V ... +5 V
5	Analog input -10 V ... +10 V
6	Analog input 0 V ... +5 V
1	Analog input 0 V ... +10 V
37	Analog input -20 mA ... +20 mA
3	Analog input 0 mA ... 20 mA
4	Analog input 4 mA ... 20 mA
14	Analog input Pt100 (2-wire), -50 °C ... +70 °C
15	Analog input Pt100 (3-wire), -50 °C ... +70 °C
48	Analog input Pt100 (4-wire), -50 °C ... +70 °C
57	Analog input Pt100 (2-wire), -50 °C ... +70 °C (resolution: 0,01 K)
58	Analog input Pt100 (3-wire), -50 °C ... +70 °C (resolution: 0,01 K)
59	Analog input Pt100 (4-wire), -50 °C ... +70 °C (resolution: 0,01 K)
8	Analog input Pt100 (2-wire), -50 °C ... +400 °C
9	Analog input Pt100 (3-wire), -50 °C ... +400 °C
49	Analog input Pt100 (4-wire), -50 °C ... +400 °C
45	Analog input Pt100 (2-wire), -200 °C ... +850 °C
46	Analog input Pt100 (3-wire), -200 °C ... +850 °C
47	Analog input Pt100 (4-wire), -200 °C ... +850 °C
16	Analog input Pt1000 (2-wire), -50 °C ... +400 °C
17	Analog input Pt1000 (3-wire), -50 °C ... +400 °C
50	Analog input Pt1000 (4-wire), -50 °C ... +400 °C
18	Analog input Ni1000 (2-wire), -50 °C ... +150 °C
19	Analog input Ni1000 (3-wire), -50 °C ... +150 °C
51	Analog input Ni1000 (4-wire), -50 °C ... +150 °C
39	Analog input Cu50 1.426 (2-wire) -50 °C ... +200 °C
40	Analog input Cu50 1.426 (3-wire) -50 °C ... +200 °C
41	Analog input Cu50 1.426 (4-wire) -50 °C ... +200 °C
42	Analog input Cu50 1.428 (2-wire) -200 °C ... +200 °C
43	Analog input Cu50 1.428 (3-wire) -200 °C ... +200 °C
44	Analog input Cu50 1.428 (4-wire) -200 °C ... +200 °C
24	Analog input J-type thermocouple -210 °C ... +1200 °C
25	Analog input K-type thermocouple -270 °C ... +1372 °C
30	Analog input N-type thermocouple -270 °C ... +1300 °C

Internal value	Operating modes for the analog inputs, individually configurable
27	Analog input S-type thermocouple -50 °C ... +1768 °C
28	Analog input T-type thermocouple -270 °C ... +400 °C
38	Analog input resistor 50 kΩ
52	Temperature-internal reference point
53	Common mode voltage

Table 185: Channel monitoring

Internal value	Monitoring
0	Plausibility, open-circuit (wire break) and short circuit (default)
3	No monitoring

Table 186: Line frequency suppression

Internal value	Line frequency suppression
0	50 Hz
1	60 Hz
2	No line frequency suppression

Table 187: Compensation channel

Internal value	Compensation channel
0	Internal compensation (default)
1	Channel 0 (possible with channels 1, 2, 3)
2	Channel 1 (possible with channels 0, 2, 3)
3	Channel 2 (possible with channels 0, 1, 3)
4	Channel 3 (possible with channels 0, 1, 2)
5	Channel 4 (possible with channels 5, 6, 7)
6	Channel 5 (possible with channels 4, 6, 7)
7	Channel 6 (possible with channels 4, 5, 7)
8	Channel 7 (possible with channels 4, 5, 6)
9	External with temperature value

Diagnosis

E1 ... E4	d1	d2	d3	d4	Identifier 000 ... 063	AC500 display	<− Display in
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**	
Byte 6 Bit 6 ... 7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0 ... 5**	**FBP diag-nosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error identifier**	**Error message**	**Remedy**
	1)	2)	3)	4)			
Module error							
3	14	1 ... 10	31	31	19	Checksum error in the I/O module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	3	Timeout in the I/O module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	40	Different hard-/firmware versions in the module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	43	Internal error in the module, e.g. internal analog voltage is not correct	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	36	Internal data exchange failure	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	9	Overflow diagnosis buffer	Restart
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	26	Parameter error	Check master
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	11	Process voltage too low	Check process voltage
	11 / 12	ADR	1 ... 10				
4	14	1 ... 10	31	31	45	Process voltage is switched OFF (ON −> OFF)	Process voltage ON
	11 / 12	ADR	1 ... 10				
Channel error							
4	14	1 ... 10	1	0 ... 7	48	Analog value overflow or broken wire at an analog input	Check input value or terminal
	11 / 12	ADR	1 ... 10				
4	14	1 ... 10	1	0 ... 7	7	Analog value underflow at an analog input	Check input value
	11 / 12	ADR	1 ... 10				
4	14	1 ... 10	1	0 ... 7	47	Short circuit at an analog input	Check ter-minal
	11 / 12	ADR	1 ... 10				
4	14	1 ... 10	1	0 ... 7	1	Possibly wrong meas-ured value caused by inadmissible temper-ature of the compensa-tion channel	Check the tempera-ture com-pensation channel
	11 / 12	ADR	1 ... 10				

E1 ... E4	d1	d2	d3	d4	Identifier 000 ... 063	AC500 display	<− Display in
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**	
Byte 6 Bit 6 ... 7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0 ... 5**	**FBP diagnosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error identifier**	**Error message**	**Remedy**
	1)	2)	3)	4)			
4	14	1 ... 10	1	0 ... 7	2	Invalid measured value of the channel caused by overly high voltage difference	Check voltage difference; install equalizing conductors if necessary
	11 / 12	ADR	1 ... 10				
4	14	1 ... 10	1	0 ... 7	11	Output voltage 10 V faulty	Check output load
	11 / 12	ADR	1 ... 10				

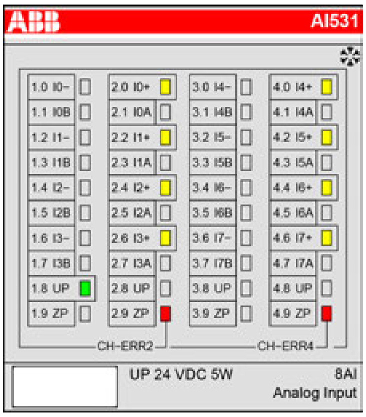
Remarks:

1)	In AC500, the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The FBP diagnosis block does not contain this identifier.
2)	With "Device" the following allocation applies: 31 = module itself, 1 ... 10 expansion module 1 ... 10, ADR = hardware address (e.g. of the DC551)
3)	With "Module" the following allocation applies dependent of the master: Module error: I/O bus or FBP: 31 = module itself; COM1/COM2: 1 ... 10 = expansion 1 ... 10 Channel error: I/O bus or FBP = module type (1 = AI); COM1/COM2: 1 ... 10 = expansion 1 ... 10
4)	In case of module errors, with channel "31 = Module itself" is output.

State LEDs

During the power ON procedure, the module initializes automatically. All LEDs (except the channel LEDs) are ON during this time.

States of the LEDs (see also section diagnosis LEDs in the S500 system data):

LED		State	Color	LED = OFF	LED = ON	LED flashes
	Inputs I0 ... I3 and I4 ... I7	Analog input	Yellow	Input is OFF	Input is ON (brightness depends on the value of the analog signal)	--
	UP	Process voltage 24 V DC via terminal	Green	Process voltage is missing	Process voltage OK	--
	CH-ERR2	Channel error, messages in groups (analog inputs combined into the groups 2 and 4)	Red	No error, or process voltage is missing	Severe error within the corresponding group	Error on one channel of the group
	CH-ERR4		Red			
	CH-ERR *)	Module error	Red	--	Internal error	--
	*) Both LEDs CH-ERR2 and CH-ERR4 light up together					

Measuring ranges

Voltage input ranges

Bipolar voltage input range, measuring bridge

The represented resolution corresponds to 16 bits.

Range	-50 mV ... +50 mV	-500 mV ... +500 mV	-1 V ... +1 V	-5 V ... +5 V	-10 V ... +10 V	Common Mode Voltage	Digital value	
							Decimal	Hex.
Overflow	> 58.7945	> 587.9449	> 1.17589	> 5.8794	> 11.7589	> 20.0000	32767	7FFF
Measured value too high	58.7945 : 50.0018	587.9449 : 500.0181	1.17589 : 1.00004	5.8794 : 5.0002	11.7589 : 10.0004		32511 : 27649	7EFF : 6C01
Normal range	50.0000 : 0.0018	500.0000 : 0.0181	1.00000 : 0.00004	5.0000 : 0.0002	10.0000 : 0.0004	20.0000 : 0.0008	27648 : 1	6C00 : 0001
	0.0000	0.0000	0.0000	0.00000	0.0000	0.0000	0	0000

Range	-50 mV ... +50 mV	-500 mV ... +500 mV	-1 V ... +1 V	-5 V ... +5 V	-10 V ... +10 V	Common Mode Voltage	Digital value	
							Decimal	Hex.
Normal range or Meas-ured value too low	-0.0018 : -50.0000	-0.0181 : -500.0000	-0.00004 : -1.00000	-0.0002 : -5.0000	-0.004 : -10.0000	-0.0008 : -20.0000	-1 : -27648	FFFF : 9400
Meas-ured value too low	-50.0018 : -58.7945	-500.0181 : -587.9449	-1.00004 : -1.17589	-5.0002 : -5.8794	-10.0004 : -11.7589		-27649 : -32512	93FF : 8100
Under-flow	< -58.7945	< -587.9449	< -1.17589	< -5.8794	< -11.7589	< -20.0000	-32768	8000

Unipolar voltage input range, measuring bridge, digital input

Range		0 V ... +5 V	0 V ... +10 V	Digital input	Digital value	
					Decimal	Hex.
Measured value too high		5.8794 : 5.0002	11.7589 : 10.0004		32511 : 27649	7EFF : 6C01
Normal range		5.0000 : 0.0002	10.0000 : 0.0004	ON	27648 : 1	6C00 : 0001
		0.0000	0.0000	OFF	0	0000
Measured value too low		-0.0002 : -0.8794	-0.0004 : -1.1759		-1 : -4864	FFFF : ED00
Underflow		< -0.8794	< -1.1759		-32768	8000

Current input ranges

Range	-20 mA ... +20 mA	0 mA ... +20 mA	4 mA ... 20 mA	Digital value	
				Decimal	Hex.
Overflow	> 23.5178	> 23.5178	> 22.8142	32767	7FFF
Measured value too high	23.5178 : 20.0007	23.5178 : 20.0007	22.8142 : 20.0006	32511 : 27649	7EFF : 6C01

Range	-20 mA ... +20 mA	0 mA ... +20 mA	4 mA ... 20 mA	Digital value	
				Decimal	Hex.
Normal range	20.0000 : 0.0007	20.0000 : 0.0007	20.0000 : 4.0006	27648 : 1	6C00 : 0001
	0.0000	0.0000	4.0000	0	0000
	-0.0007 : -20.0000			-1 : -27648	FFFF : 9400
Measured value too low		-0.0007 : -3.5178	3.9994 : 1.1852	-1 : -4864	FFFF : ED00
	-20.0007 : -23.5178			-27649 : -32512	93FF : 8100
Underflow	< -23.5178	< -3.5178	< 1.1852	-32768	8000

Resistance thermometer input ranges

The represented resolution corresponds to 16 bits.

Range	Pt100 -50 °C ... +70 °C [1])	Pt100 / Pt1000 -50 °C ... +400 °C	Pt100 -200 °C ... +850 °C	Ni1000 -50 °C ... +150 °C	Cu50 -200 °C ... +200 °C	Digital value	
						Decimal	Hex.
Overflow	> +80.0 °C	> +450.0 °C	> +850 °C	> +160.0 °C	> +200 °C	32767	7FFF
Measured value too high		+450.0 °C : +400.1 °C				4500 : 4001	1194 : 0FA1
				+160.0 °C : +150.1 °C		1600 : 1501	0640 : 05DD
	+80.0 °C : +70.1 °C					800 : 701	0320 : 02BD

Range	Pt100 -50 °C ... +70 °C [1])	Pt100 / Pt1000 -50 °C ... +400 °C	Pt100 -200 °C ... +850 °C	Ni1000 -50 °C ... +150 °C	Cu50 -200 °C ... +200 °C	Digital value Decimal	 Hex.
Normal range	: : : : +70.0 °C : +0.1 °C	: +400.0 °C : : : : + 0.1 °C	+850.0 °C : : : : : +0.1 °C	: : : +150.0 °C : : +0.1 °C	: : +200.0 °C : : : +0.1 °C	8500 4000 2000 1500 700 : 1	2134 0FA0 07D0 05DC 02BC : 1
	0.0 °C	0.0 °C	0.0 °C	0.0 °C		0	0000
	-0.1 °C : -50.0 °C	-0.1 °C : -50.0 °C	-0.1 °C : : -200 °C	-0.1 °C : -50.0 °C	-0.1 °C : -50.0 °C [2]) -200.0 °C [2])	-1 : -500 -2000	FFFF : FE0C F830
Measured value too low	-50.1 °C : -60.0 °C	-50.1 °C : -60.0 °C		-50.1 °C : -60.0 °C		-501 : -600	FE0B : FDA8
Under-flow	< -60.0 °C	< -60.0 °C	< -200 °C	< -60.0 °C	< -200 °C [2])	-32768	8000

[1]) also possible with resolution 0.01 K

[2]) if Cu50 with 1.426, -50 °C is valid; if Cu50 with 1.428, -200.0 °C is valid

Resistor input range

The represented resolution corresponds to 16 bits.

Range	Resistor [Ω]	Digital value	
		Decimal	Hex.
Overflow	> 55000	32767	7FFF
Measured value too high	55000 : 50001	30413 : 27649	76CD : 6C01
Normal range	50000 : 2 1 0	27648 : 1 1 0	6C00 : 0001 0001 0000

Thermocouple input ranges

The represented resolution corresponds to 16 bits.

Range	Typ J -210 °C ... +1200 °C	Typ K -270 °C ... +1372 °C	Typ N -270 °C ... +1300 °C	Typ S -50 °C ... +1768 °C	Typ T -270 °C ... +400 °C	Digital value Decimal	 Hex.
Overflow	> +1200.0 °C	> +1372.0 °C	> +1300.0 °C	> +1768.0 °C	> +400.0 °C	32767	7FFF
Normal range				+1768.0 °C		17680	4510
		+1372.0 °C		:		13720	3598
		:	+1300.0 °C	:		13000	32C8
	+1200.0 °C	:	:	:		12000	2EE0
	:	:	:	:	+400.0 °C	4000	0FA0
	:	:	:	:	:	:	:
	+0.1 °C	+0.1 °C	+0.1 °C	+0.1 °C	+0.1 °C	1	1
	0.0 °C	0.0 °C	0.0 °C	0.0 °C		0	0000
	-0.1 °C	-0.1 °C	-0.1 °C	-0.1 °C	-0.1 °C	-1	FFFF
	:	:	:	:	:	:	:
	:	:	:	-50.0 °C	:	-500	FE0C
	-210.0 °C	:	:	:	:	-2100	F7CC
		-270.0 °C	-270.0 °C		-270.0 °C	-2700	F574
Under-flow	< -210.0 °C	< -270.0 °C	< -270.0 °C	< -50.0 °C	< -270.0 °C	-32768	8000

Temperature-internal reference point ranges

Range	Value	Digital value	
		Decimal	Hex.
Overflow	> +85 °C	32767	7FFF
Normal range	+85 °C	850	0352
	0 °C	0	0000
	-40 °C	-400	FE70
Underflow	< -40 °C	-32768	8000

Technical data

Technical data of the module

The system data of AC500 and S500 are applicable to the standard version ↬ *Chapter 2.6.1 "System data AC500" on page 1408*.

The system data of AC500-XC are applicable to the XC version ↬ *Chapter 2.7.1 "System data AC500-XC" on page 1475*.

Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

Parameter		Value
Process voltage		
	Connections	Terminals 1.8, 2.8, 3.8 and 4.8 for +24 V (UP) as well as 1.9, 2.9, 3.9 and 4.9 for 0 V (ZP)
	Rated value	24 V DC
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	Rated protection fuse on UP	10 A fast
	Galvanic isolation	Yes, per module
Current consumption		
	From 24 V DC power supply at the terminals UP/L+ and ZP/M of the CPU/communication interface module	Ca. 2 mA
	Current consumption from UP in normal operation	130 mA
	Inrush current from UP (at power up)	0.056 A^2s
Max. length of analog cables, conductor cross section > 0.14 mm^2 *)		100 m
Weight		130 g
Mounting position		Horizontal or vertical with derating (max. temperature 40 °C)
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.
*) Please note that an additional current of approx. 3µA flows out of the input for the wire break detection. Depending on the internal resistance of the signal source and the wire, this can lead to a higher measured value due to the voltage drop.		

> **NOTICE!**
> All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and temporary overvoltage up to 30 V DC.

Technical data of the analog inputs

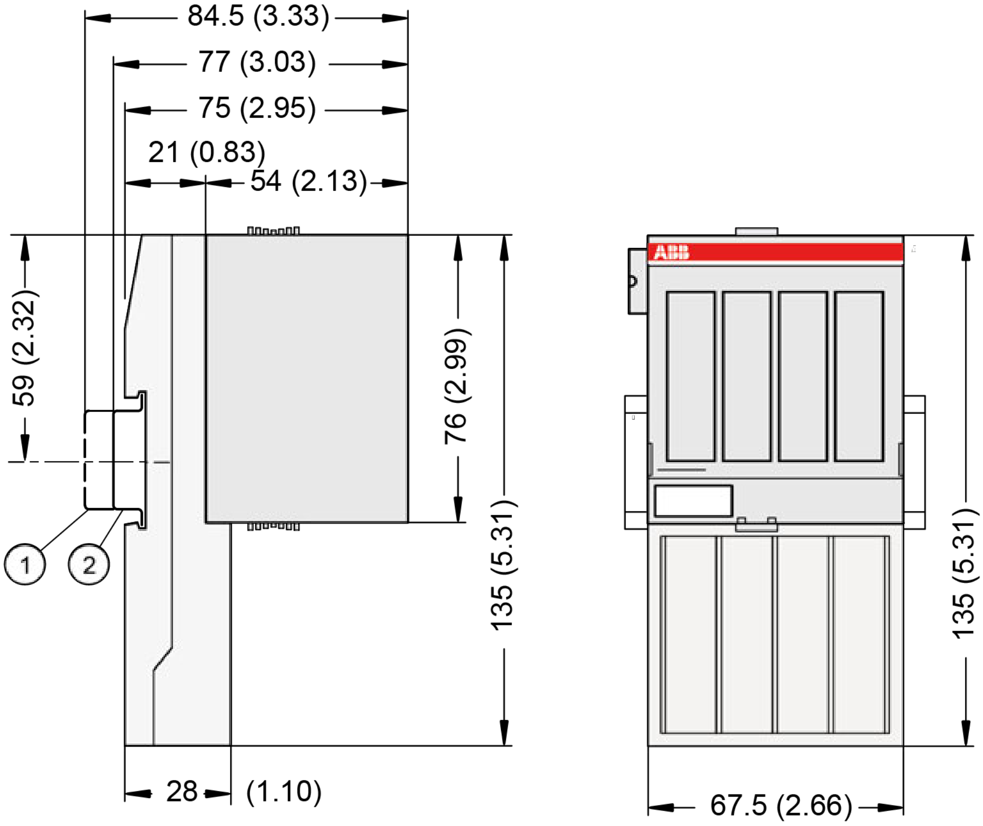
Parameter	Value	
Number of channels per module	8	
Distribution of channels into groups	2 groups of 4 channels each	
Connections of the channels I0 ... I3	Terminals 1.0 ... 1.7 and terminals 2.0 ... 2.7	
Connections of the channels I4 ... I7	Terminals 3.0 ... 3.7 and terminals 4.0 ... 4.7	
Input type	Bipolar (not with current or Pt100/ Pt1000/ Ni1000/ Cu50/ resistor)	
Galvanic isolation	Against internal supply and other modules	
Common mode input range	± 20 V DC plus signal voltage	
Configurability	Digital input, -50 mV ... +50 mV, -500mV ... +500 mV, -1 V ... +1 V, -5 V ... +5 V, -10 V ... +10 V, 0 V ... +5 V, 0 V ... +10 V, -20 mA ... +20 mA, 0 mA ... 20 mA, 4 mA ... 20 mA, Pt100, Pt1000, Ni1000, Cu50, resistor, thermocouple types J, K, N, S, T (each input can be configured individually)	
Channel input resistance	Voltage: > 100 kΩ, current: ca. 330 Ω	
Time constant of the input filter	Line-frequency suppression 50 Hz, 60 Hz, none	
Indication of the input signals	1 yellow LED per channel, the brightness depends on the value of the analog signal	
Conversion time	1 ms (none), 100 ms (50 Hz / 60 Hz) per channel	
Resolution	16 bits including sign	
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range	Typ.	± 0.1 % (voltage) ± 0.3 % (current, resistor) at 25 °C
	Max.	± 0.7 % (voltage) ± 0.9 % (current, resistor) ± 0.5 % (thermocouple type J, N, S, T; thermocouple type K > -220 °C) 1.0 K (resistance temperature detectors) at 0 °C ... 60 °C or EMC disturbance
Maximum permanent allowed overload (no damage)		

Parameter		Value
	Current input	When the input current exceeds the overflow value of the measurement range, the input impedance is switched to high impedance for protection. The maximum allowed overload is then 30 V. The digital value corresponds to the overflow value. Periodically, the input impedance is switched to the normal value and the input current is measured. If the input current is within the measurement range, the input impedance remains at the normal level and the digital value corresponds to the measured current.
	Voltage input	30 V
Relationship between input signal and hex code		*Table 185 “Channel monitoring” on page 692*
Unused voltage inputs		Are configured as "unused"
Unused current inputs		Have a low resistance, can be left open-circuited
Overvoltage protection		Yes

Technical data of the analog inputs if used as digital inputs

Parameter		Value
Number of channels per module		Max. 8
Distribution of channels into groups		2 groups of 4 channels each
Connections of the channels I0+ to I3+ Connections of the channels I4+ to I7+		Terminals 2.0, 2.2, 2.4, 2.6 Terminals 4.0, 4.2, 4.4, 4.6
Reference potential for the inputs		Terminals 1.9, 2.9, 3.9 and 4.9 (ZP)
Input delay		Typ. 2 ms
Indication of the input signals		1 LED per channel
Input signal voltage		24 V DC
	Signal 0	-30 V ... +5 V
	Undefined signal	+5 V ... +13 V
	Signal 1	+13 V ... +30 V
Input current per channel		
	Input voltage +24 V	Typ. 5 mA
	Input voltage +5 V	Typ. 1 mA
	Input voltage +15 V	Typ. 3.1 mA
	Input voltage +30 V	< 7 mA
Input resistance		Ca. 4.8 kΩ

Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

Ordering data

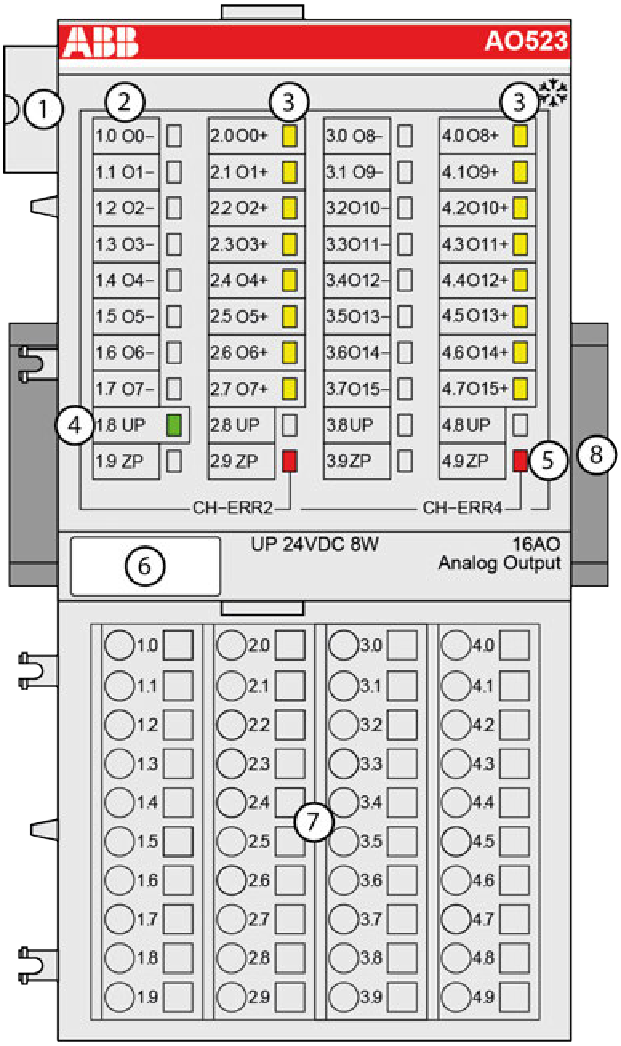
Part no.	Description	Product life cycle phase *)
1SAP 250 600 R0001	AI531, analog input module, 8 AI, U/I/Pt100, TC, 16 bits including sign, 4-wires	Active
1SAP 450 600 R0001	AI531-XC, analog input module, 8 AI, U/I/Pt100, TC, 16 bits including sign, 4-wires, XC version	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

1.6.2.2.4 AO523 - Analog output module

Features

- Module-wise galvanically isolated
- XC version for use in extreme ambient conditions available



1 I/O bus
2 Allocation between terminal number and signal name
3 16 yellow LEDs to display the signal states at the analog outputs (O0 ... O15)
4 1 green LED to display the state of the process supply voltage UP
5 2 red LEDs to display errors
6 Label
7 Terminal unit
8 DIN rail
Sign for XC version

Intended purpose

The device can be used as a decentralized I/O extension module for S500 communication interface modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs.

Functionality

- 16 analog outputs in two groups:
  - 8 channels configurable for voltage or currrent output (O0...O3 / O8...O11)
  - 8 channels for voltage output (O4...O7 / O12...O15)

  Resolution 12 bits including sign

Parameter		Value
Resolution of the analog channels		
	Voltage -10 V ... +10 V	12 bits including sign
	Current 0 mA ... 20 mA, 4 mA ... 20 mA	12 bits
LED displays		19 LEDs for signals and error messages
Internal power supply		Through the I/O bus interface (I/O bus)
External power supply		Via the terminals ZP and UP (process voltage 24 V DC)
Required terminal unit		TU515 or TU516 ⇘ *Chapter 1.5.3 “TU515, TU516, TU541 and TU542 for I/O modules” on page 282*

Connections

For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.

The modules are plugged on an I/O terminal unit ⇘ *Chapter 1.5.3 “TU515, TU516, TU541 and TU542 for I/O modules” on page 282*. Properly position the modules and press until they lock in place. The terminal units are mounted on a DIN rail or with 2 screws plus the additional accessory for wall mounting ⇘ *Chapter 1.9.3.5 “TA526 - Wall mounting accessory” on page 1361*.

The connection of the I/O channels is carried out using the 40 terminals of the I/O terminal unit. I/O modules can be replaced without re-wiring the terminal units.

The terminals 1.8 ... 4.8 and 1.9 ... 4.9 are electrically interconnected within the I/O terminal units and have always the same assignment, independent of the inserted module:

Terminals 1.8 ... 4.8: process voltage UP = +24 V DC

Terminals 1.9 ... 4.9: process voltage ZP = 0 V DC

The assignment of the other terminals:

Terminals	Signal	Description
1.0 ... 1.7	O0- ... O7-	Negative poles of the first 8 analog outputs
2.0 ... 2.7	O0+ ... O7+	Positive poles of the first 8 analog outputs

Terminals	Signal	Description
3.0 ... 3.7	O8- ... O15-	Negative poles of the following 8 analog outputs
4.0 ... 4.7	O8+ ... O15+	Positive poles of the following 8 analog outputs

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a communication interface module or a CPU). Thus, the current consumption from 24 V DC power supply at the terminals L+/UP and M/ZP of the CPU/communication interface module increases by 2 mA per AO523.

The external power supply connection is carried out via the UP (+24 V DC) and the ZP (0 V DC) terminals.

WARNING!
Removal/Insertion under power
Removal or insertion under power is permissible only if all conditions for hot swapping are fullfilled.

Conditions for hot swap

“Conditions for hot swap” on page 1367

The devices are not designed for removal or insertion under power when the conditions for hot swap do not apply. Because of unforeseeable consequences, it is not allowed to plug in or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

Disconnecting any powered devices while they are energized in a hazardous location could result in an electric arc, which could create an ignition source resulting in fire or explosion.

Prior to proceeding, make sure that power is been disconnected and that the area has been thoroughly checked to ensure that flammable materials are not present.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!
Risk of damaging the PLC modules!
Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

Generally, analog signals must be laid in shielded cables. The cable shields must be grounded at both sides of the cables. In order to avoid unacceptable potential differences between different parts of the installation, low resistance equipotential bonding conductors must be laid.

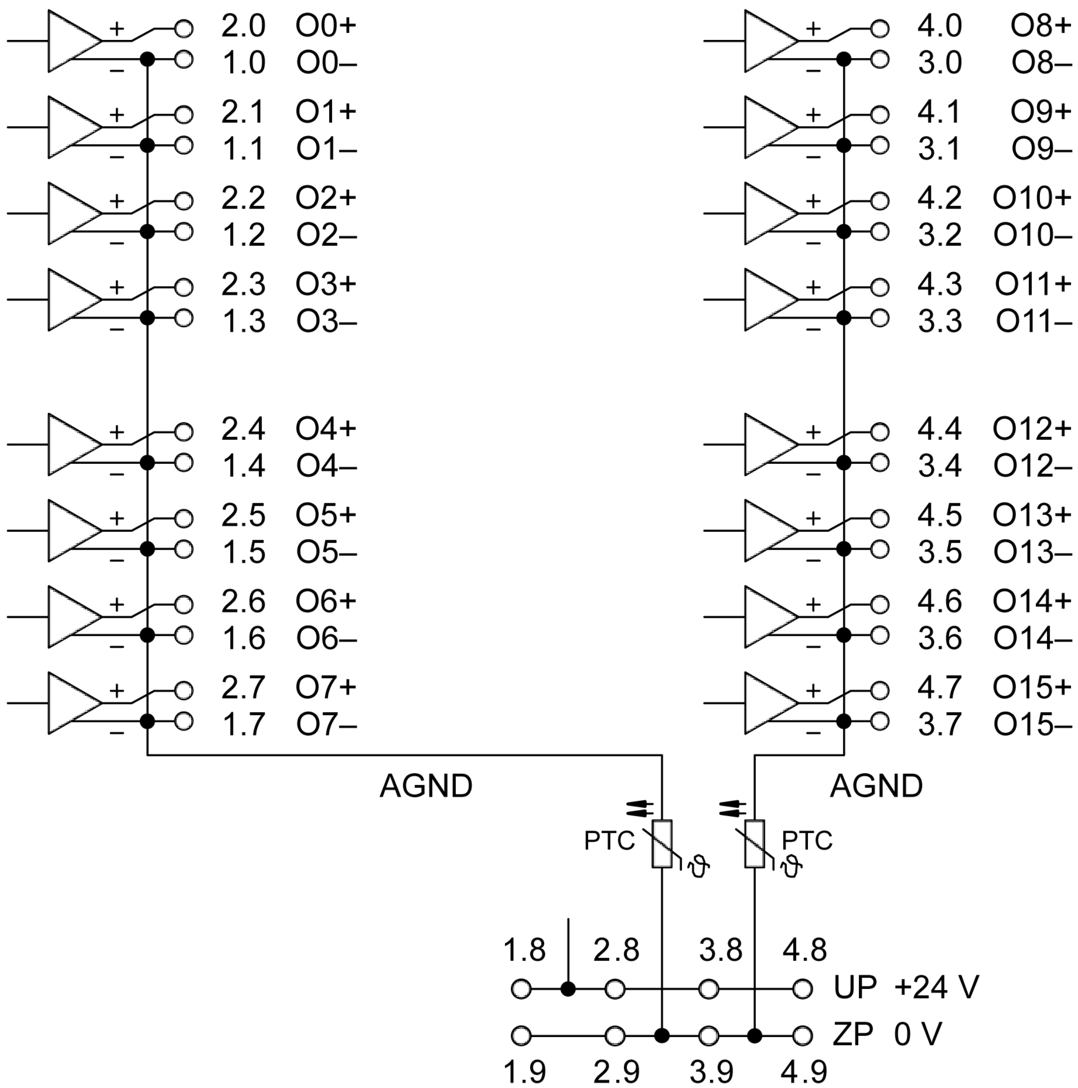


Fig. 165: Connection of the module: 16 analog outputs in two groups *Chapter 1.6.2.2.4.3 "Functionality" on page 705*

CAUTION!
By installing equipotential bonding conductors between the different parts of the system, it must be ensured that the potential difference between ZP and AGND never can exceed 1 V.

CAUTION!
The process supply voltage must be included in the grounding concept (e. g. grounding of the negative terminal).

The modules provide several diagnosis functions *Chapter 1.6.2.2.4.8 "Diagnosis" on page 714*.

Connection of analog output loads (Voltage, current)

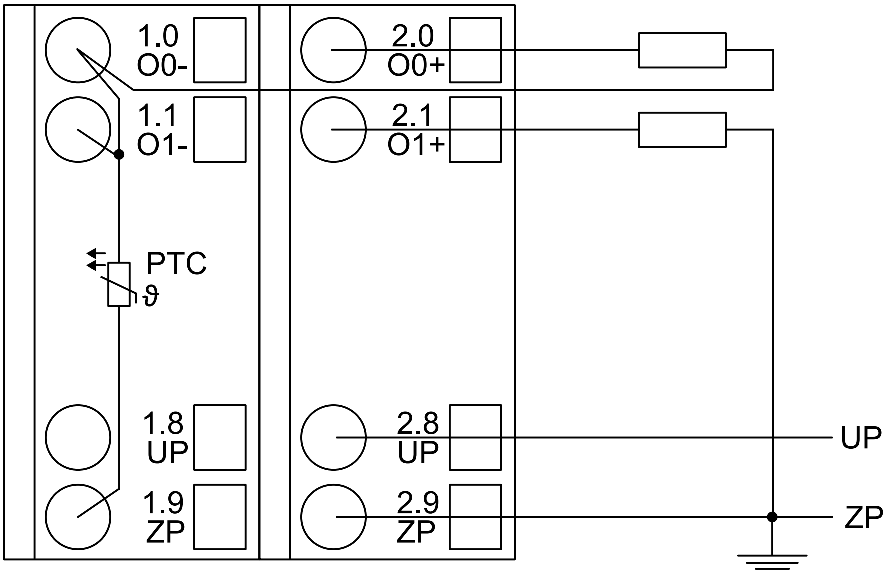


Fig. 166: Connection example

The following measuring ranges can be configured ➪ *Chapter 1.6.2.2.4.7 “Parameterization” on page 709*:

Voltage	-10 V ... +10 V	Load max. ± 10 mA	1 channel used
Current	0 mA ... 20 mA	Load 0 Ω ... 500 Ω	1 channel used
Current	4 ... 20 mA	Load 0 Ω ... 500 Ω	1 channel used

Only the channels 0 ... 3 and 8 ... 11 can be configured as current output (0 mA ... 20 mA or 4 mA ... 20 mA).

The function of the LEDs is described under Displays.

Unused analog outputs can be left open-circuited.

Internal data exchange

Digital inputs (bytes)	0
Digital outputs (bytes)	0
Analog inputs (words)	0
Analog outputs (words)	16

I/O configuration

The module does not store configuration data itself. It gets its parameterization data from the master device of the I/O bus (CPU or communication interface module) during power-up of the system.

That means replacing I/O modules is possible without any re-parameterization via software.

> *If the external power supply voltage via UP/ZP terminals fails, the I/O module loses its configuration data. The whole station has to be switched off and on again to re-configure the module.*

Parameterization

Firmware version	**Configuration**
Firmware version > V2.0.0	The arrangement of the parameter data is performed by Control Builder Plus/ Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Module: Module slot address: Y = 1 ... 10

No.	Name	Value	Internal value	Internal value, type	Default	Min.	Max.	EDS Slot/ Index
1	Module ID	Internal	1510 [1])	Word	1510 0x05e6	0	65535	0x0Y01
2	Ignore module [2])	No Yes	0 1	Byte	No 0x00			Not for FBP
3	Param-eter length in bytes	Internal	39	Byte	39-CPU 39-FBP	0	255	0x0Y02
4	Check supply	Off On	0 1	Byte	On 0x01	0	1	0x0Y03
5	Analog data format	Default	0	Byte	Default 0x00			0x0Y04
6	Behav-iour of outputs at com-munica-tion errors	Off Last value Substi-tute value	0 1+(n*5) 2+(n*5), n ≤ 2	Byte	Off 0x00	0	2	0x0Y05
7	Channel con-figura tion Output channel 0	See table 'Channel configuration' ➪ *Table 188 “Chan nel configuration [3])” on page 713*		Byte	Default 0x00	0	130	0x0Y06
8	Channel moni-toring Output channel 0	See table 'Channel monitoring' ➪ *Table 189 “Chan nel monitoring [4])” on page 713*		Byte	Default 0x00	0	3	0x0Y07
9	Substi-tute value Output channel 0	Output channel 0!	0 ... 0xffff	Word	Default 0x0000	0	65535	0x0Y08

No.	Name	Value	Internal value	Internal value, type	Default	Min.	Max.	EDS Slot/ Index
10 ... 15	Channel configu-ration and channel moni-toring of the output channels 1 to 3	See table 'Channel con-figuration' ➥ *Table 188 “Chan nel configuration [3])” on page 713* and table 'Channel monitoring' ➥ *Table 189 “Chan nel monitoring [4])” on page 713*		Byte Byte	Default 0x00 0x00	0 0	130 3	0x0Y09 to 0x0Y0E
16 ... 23	Channel configu-ration and channel moni-toring of the output channels 4 to 7	See table 'Channel con-figuration' ➥ *Table 188 “Chan nel configuration [3])” on page 713* and table 'Channel monitoring' ➥ *Table 189 “Chan nel monitoring [4])” on page 713*		Byte Byte	Default 0x00 0x00	0 0	128 3	0x0Y0F to 0x0Y16
24	Channel con-figura tion Output channel 8	See table 'Channel configuration' ➥ *Table 188 “Chan nel configuration [3])” on page 713*		Byte	Default 0x00	0	130	0x0Y17
25	Channel moni-toring Output channel 8	See table 'Channel monitoring' ➥ *Table 189 “Chan nel monitoring [4])” on page 713*		Byte	Default 0x00	0	3	0x0Y18
26	Substi-tute value Output channel 8	Output channel 8!	0 ... 0xffff	Word	Default 0x0000	0	65535	0x0Y19

No.	Name	Value	Internal value	Internal value, type	Default	Min.	Max.	EDS Slot/ Index
27 ... 32	Channel configuration and channel monitoring of the output channels 9 to 11	See table 'Channel configuration' *Table 188 "Channel configuration [3])" on page 713* and table 'Channel moitoring' *Table 189 "Channel monitoring [4])" on page 713*		Byte Byte	Default 0x00 0x00	0 0	130 3	0x0Y1A to 0x0Y1F
33 ... 40	Channel configuration and channel monitoring of the output channels 12 to 15	See table 'Channel configuration' *Table 188 "Channel configuration [3])" on page 713* and table 'Channel monitoring' *Table 189 "Channel monitoring [4])" on page 713*		Byte Byte	Default 0x00 0x00	0 0	128 3	0x0Y20 to 0x0Y27
[1]) With CS31 and addresses less than 70 and FBP, the value is increased by 1 [2]) Not with FBP								

GSD file:

Ext_User_Prm_Data_Len =	42
Ext_User_Prm_Data_Const(0) =	0x05, 0xe7, 0x27, \
	0x01, 0x00, 0x00, \
	0x00, 0x00, 0x00, 0x00, \
	0x00, 0x00, 0x00, 0x00, 0x00, 0x00, \
	0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, \
	0x00, 0x00, 0x00, 0x00, \
	0x00, 0x00, 0x00, 0x00, 0x00, 0x00, \
	0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00;

Output channels 0 and 8 (2 channels, AO523)

No.	Name	Value	Internal value	Internal value, type	Default
1	Channel configuration	see below table 'Channel configuration' *Table 188 " Channel configuration 3)" on page 713*	see below table 'Channel configuration' *Table 188 " Channel configuration 3)" on page 713*	Byte	see below table 'Channel configuration' *Table 188 " Channel configuration 3)" on page 713*
2	Channel monitoring	see below table 'Channel monitoring' *Table 189 " Channel monitoring 4)" on page 713*	see below table 'Channel monitoring' *Table 189 " Channel monitoring 4)" on page 713* *8)	Byte	see below table 'Channel monitoring' *Table 189 " Channel monitoring 4)" on page 713*
3	Substitute value *Table 190 " Substitute value" on page 714*	0 ... 65535	0 ... 0xffff	Word	0

Output channels 1 ... 7 and 9 ... 15 (14 channels, AO523)

No.	Name	Internal value, type
1	Channel configuration see table 3)	Byte
2	Channel monitoring see table 4)	Byte

Table 188: Channel configuration 3)

Internal value	Operating modes of the analog outputs, individually configurable
0	Unused (default)
128	Analog output -10 V ... +10 V
129	Analog output 0 mA ... 20 mA (not with the channels 4 ... 7 and 12 ... 15)
130	Analog output 4 mA ... 20 mA (not with the channels 4 ... 7 and 12 ... 15)

Table 189: Channel monitoring 4)

Internal value	Monitoring
0	Plausibility, open-circuit (broken wire) and short circuit (default)
1	Open-circuit (broken wire) and short circuit
2	Plausibility
3	No monitoring

Table 190: Substitute value

Intended behavior of channel 0 when the control system stops	Required setting of the module parameter "Behaviour of outputs in case of a communication error"	Required setting of the channel parameter "Substitute value"
Output OFF	OFF	0
Last value	Last value	0
Substitute value	OFF or Last value	1 ... 65535

Diagnosis

Table 191: Possible diagnosis of I/O channels

Output range	Condition	
	Output value in the PLC underflow	Output value in the PLC overflow
0 mA ... 20 mA	Error identifier = 7	Error identifier = 4
4 mA ... 20 mA		
-10 V ... +10 V		

E1 ... E4	d1	d2	d3	d4	Identifier 000 ... 063	AC500 display	<– Display in
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**	
Byte 6 Bit 6 ... 7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0 ... 5**	**FBP diagnosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error Identifier**	**Error message**	**Remedy**
	1)	2)	3)	4)			
Module error							
3	14	1 ... 10	31	31	19	Checksum error in the I/O module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	3	Timeout in the I/O module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	40	Different hard-/firmware versions in the module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	43	Internal error in the module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	36	Internal data exchange failure	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	9	Overflow diagnosis buffer	New start
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	26	Parameter error	Check master

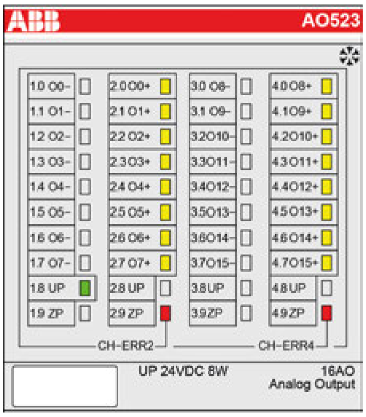
E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identifier** **000 ... 063**	**AC500 display**	**<– Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**	
Byte 6 **Bit 6 ... 7**	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6** **Bit 0 ... 5**	**FBP diag-nosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error Identifier**	**Error message**	**Remedy**
	1)	**2)**	**3)**	**4)**			
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	11	Process voltage too low	Check process voltage
	11 / 12	ADR	1 ... 10				
4	14	1 ... 10	31	31	45	Process voltage is switched off (ON -> OFF)	Process voltage ON
	11 / 12	ADR	1 ... 10				
Channel error							
4	14	1 ... 10	3	0 ... 15	48	Analog value overflow at an analog output	Check output value
	11 / 12	ADR	1 ... 10				
4	14	1 ... 10	3	0 ... 15	7	Analog value underflow at an analog output	Check output value
	11 / 12	ADR	1 ... 10				

Remarks:

1)	In AC500, the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The FBP diagnosis block does not contain this identifier.
2)	With "Device" the following allocation applies: 31 = module itself, 1 ... 10 = expansion module 1 ... 10, ADR = hardware address (e.g. of the DC551)
3)	With "Module" the following allocation applies dependent of the master: Module error: I/O bus or FBP: 31 = module itself; COM1/COM2: 1 ... 10 = expansion 1 ... 10 Channel error: I/O bus or FBP = module type (3 = AO); COM1/COM2: 1 ... 10 = expansion 1 ... 10
4)	In case of module errors, with channel "31 = Module itself" is output.

State LEDs

During the power ON procedure, the module initializes automatically. All LEDs (except the channel LEDs) are ON during this time.

LED		State	Color	LED = OFF	LED = ON	LED flashes
	Outputs O0 ... O7 and O8 ... O15	Analog output	Yellow	Output is OFF	Output is ON (brightness depends on the value of the analog signal)	--
	UP	Process voltage 24 V DC via terminal	Green	Process voltage is missing	Process voltage OK	--
	CH-ERR2	Channel error, error messages in groups (analog inputs or outputs combined into the groups 2 and 4)	Red	No error or process voltage is missing	Severe error within the cor-responding group	Error on one channel of the group
	CH-ERR4		Red			
	CH-ERR *)	Module error	Red	--	Internal error	--
	*) Both LEDs (CH-ERR2 and CH-ERR4) light up together					

Output ranges

Output ranges voltage and current

The represented resolution corresponds to 16 bits.

Range	-10 V ... +10 V	0 mA ... 20 mA	4 mA ... 20 mA	Digital value	
				Decimal	Hex.
Overflow	> 11.7589 V	> 23.5178 mA	> 22.8142 mA	> 32511	> 7EFF
Value too high	11.7589 V : 10.0004 V	23.5178 mA : 20.0007 mA	22.8142 mA : 20.0006 mA	32511 : 27649	7EFF : 6C01
Normal range	10.0000 V : 0.0004 V	20.0000 mA : 0.0007 mA	20.0000 mA : 4.0006 mA	27648 : 1	6C00 : 0001
	0.0000 V	0.0000 mA	4.0000 mA	0	0000
	-0.0004 V : -10.0000 V	0 mA : 0 mA	3.9994 mA 0 mA 0 mA	-1 -6912 -27648	FFFF E500 9400

Range	-10 V ... +10 V	0 mA ... 20 mA	4 mA ... 20 mA	Digital value	
				Decimal	Hex.
Value too low	-10.0004 V : -11.7589 V	0 mA : 0 mA	0 mA : 0 mA	-27649 : -32512	93FF : 8100
Underflow	0 V	0 mA	0 mA	< -32512	< 8100

Technical data

Technical data of the module

The system data of AC500 and S500 are applicable to the standard version ➪ *Chapter 2.6.1 “System data AC500” on page 1408*.

The system data of AC500-XC are applicable to the XC version ➪ *Chapter 2.7.1 “System data AC500-XC” on page 1475*.

Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

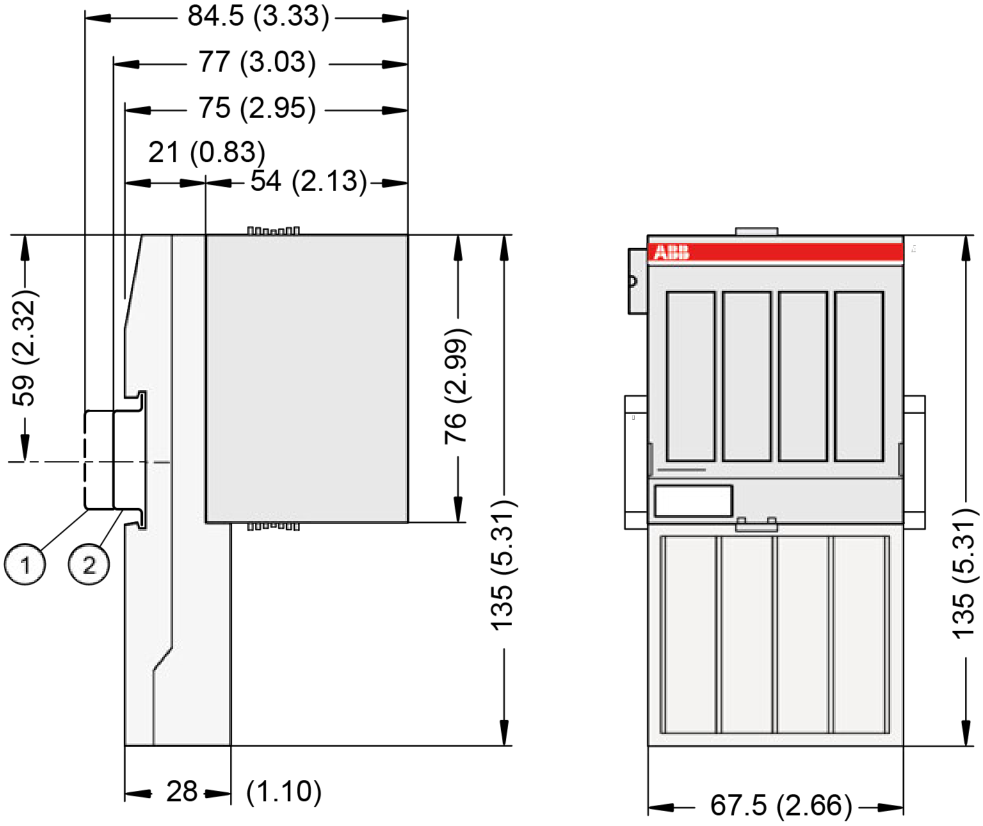
Parameter		Value
Process voltage		
	Connections	Terminals 1.8, 2.8, 3.8 and 4.8 for +24 V (UP) as well as 1.9, 2.9, 3.9 and 4.9 for 0 V (ZP)
	Rated value	24 V DC
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	Rated protection fuse on UP	10 A fast
	Galvanic isolation	Yes, per module
Current consumption		
	From 24 V DC power supply at the terminals UP/L+ and ZP/M of the CPU/communication interface module	Ca. 2 mA
	Current consumption from UP at normal operation	0.15 A + output loads
	Inrush current from UP (at power up)	0.040 A^2s
Max. length of analog cables, conductor cross section > 0.14 mm^2		100 m
Weight		300 g
Mounting position		Horizontal or vertical with derating (output load reduced to 50 % at +40 °C per group)
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

> **NOTICE!**
> All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and temporary overvoltage up to 30 V DC.

Technical data of the analog outputs

Parameter	Value
Number of channels per module	16, of which channnels O0 ... O3 and O8 ... O11 for voltage and current, and channels O4 ... 7 and O12 ... 15 only for voltage
Distribution of channels into groups	1 group
Channels O0- ... O7-	Terminals 1.0 ... 1.7
Channels O0+ ... O7+	Terminals 2.0 ... 2.7
Channels O8- ... O15-	Terminals 3.0 ... 3.7
Channels O8+ ... O15+	Terminals 4.0 ... 4.7
Output type	Bipolar with voltage, unipolar with current
Galvanic isolation	Against internal supply and other modules
Configurability	-10 V ... +10 V, 0 mA ... 20 mA, 4 mA ... 20 mA (each output can be configured individually), current outputs only channels 0 ... 3 and 8 ... 11
Output resistance (load), as current output	0 Ω ... 500 Ω
Output loadability, as voltage output	Max. ± 10 mA
Indication of the output signals	One LED per channel
Resolution	12 bits including sign
Settling time for full range change (resistive load, output signal within specified tolerance)	Typ. 5 ms
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range	Typ.: ± 0.5 % of full scale at +25 °C Max.: ± 1 % of full scale (all ranges) at 0 °C ... +60 °C or EMC disturbance
Relationship between output signal and hex code	*Chapter 1.6.2.2.4.10 “Output ranges” on page 716*
Unused outputs	Can be left open-circuited

Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

Ordering data

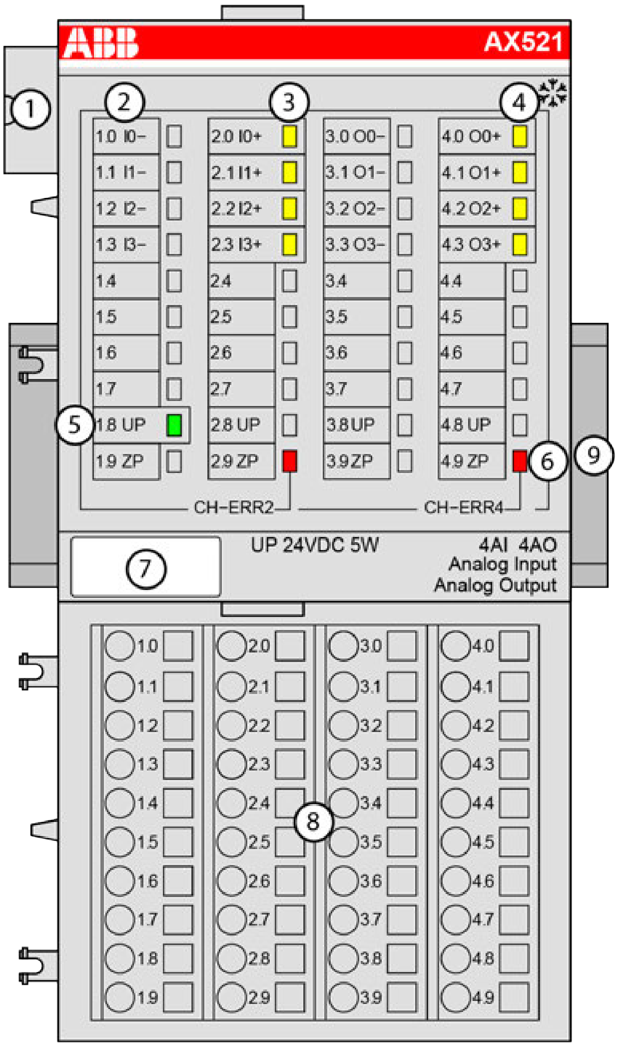
Part no.	Description	Product life cycle phase *)
1SAP 250 200 R0001	AO523, analog output module, 16 AO, U/I, 12 bits including sign, 2-wires	Active
1SAP 450 200 R0001	AO523-XC, analog output module, 16 AO, U/I, 12 bits including sign, 2-wires, XC version	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

1.6.2.2.5 AX521 - Analog input/output module

Features

- 4 configurable analog inputs (I0 ... I3) in 1 group (1.0 ... 2.3)
  Resolution 12 bits including sign
- 4 configurable analog outputs (O0 ... O3) in 1 group (3.0 ... 4.3)
  Resolution 12 bits including sign
- Module-wise galvanically isolated
- XC version for use in extreme ambient conditions available



1 I/O bus
2 Allocation between terminal number and signal name
3 4 yellow LEDs to display the signal states at the analog inputs (I0 ... I3)
4 4 yellow LEDs to display the signal states at the analog outputs (O0 ... O3)
5 1 green LED to display the state of the process supply voltage UP
6 2 red LEDs to display errors
7 Label
8 Terminal unit
9 DIN rail
Sign for XC version

Intended purpose

The device can be used as a decentralized I/O extension module for S500 communication interface modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs.

Functionality

AX521

4 analog inputs (channel 0... channel 3), individually configurable for

- Unused (default setting)
- 0 V ... 10 V
- -10 V ... +10 V
- 0 mA ... 20 mA
- 4 mA ... 20 mA
- Pt100, -50 °C ... +400 °C (2-wire)
- Pt100, -50 °C ... +400 °C (3-wire), requires 2 channels
- Pt100, -50 °C ... +70 °C (2-wire)
- Pt100, -50 °C ... +70 °C (3-wire), requires 2 channels
- Pt1000, -50 °C ... +400 °C (2-wire)
- Pt1000, -50 °C ... +400 °C (3-wire), requires 2 channels
- Ni1000, -50 °C ... +150 °C (2-wire)
- Ni1000, -50 °C ... +150 °C (3-wire), requires 2 channels
- 0 V ... 10 V with differential inputs, requires 2 channels
- -10 V ... +10 V with differential inputs, requires 2 channels
- Digital signals (digital input)

4 analog outputs (channel 0 ... channel 3), individually configurable for

- Unused (default setting)
- -10 V ... +10 V
- 0 mA ... 20 mA
- 4 mA ... 20 mA

Parameter		Value
Resolution of the analog channels		
	Voltage -10 V ... +10 V	12 bits including sign
	Voltage 0 V ... 10 V	12 bits
	Current 0 mA ... 20 mA, 4 mA ... 20 mA	12 bits
	Temperature	+0.1 °C
LED displays		11 LEDs for signals and error messages
Internal power supply		Via the I/O bus interface (I/O bus)
External power supply		Via the terminals ZP and UP (process voltage 24 V DC)
Required terminal unit		TU515 or TU516 *Chapter 1.5.3 “TU515, TU516, TU541 and TU542 for I/O modules” on page 282*

Connections

> *For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.*

The modules are plugged on an I/O terminal unit *Chapter 1.5.3 “TU515, TU516, TU541 and TU542 for I/O modules” on page 282*. Properly position the modules and press until they lock in place. The terminal units are mounted on a DIN rail or with 2 screws plus the additional accessory for wall mounting *Chapter 1.9.3.5 “TA526 - Wall mounting accessory” on page 1361*.

The connection of the I/O channels is carried out using the 40 terminals of the I/O terminal unit. I/O modules can be replaced without re-wiring the terminal units.

The terminals 1.8, 2.8, 3.8 and 4.8 as well as 1.9, 2.9, 3.9 and 4.9 are electrically interconnected within the I/O terminal units and have always the same assignment, irrespective of the inserted module:

Terminals 1.8, 2.8, 3.8 and 4.8: process voltage UP = +24 V DC

Terminals 1.9, 2.9, 3.9 and 4.9: process voltage ZP = 0 V DC

Table 192: Assignment of the other terminals

Terminals	Signal	Description
1.0 ... 1.3	I0- ... I3-	Negative poles of the 4 analog inputs
2.0 ... 2.3	I0+ ... I3+	Positive poles of the 4 analog inputs
3.0 ... 3.3	O0- ... O3-	Negative poles of the 4 analog outputs
4.0 ... 4.3	O0+ ... O3+	Positive poles of the 4 analog outputs

> *The negative poles of the analog inputs are connected to each other to form an "Analog Ground" signal for the module.*

> *The negative poles of the analog outputs are connected to each other to form an "Analog Ground" signal for the module.*

> *There is no galvanic isolation between the analog circuitry and ZP/UP. Therefore, the analog sensors must be galvanically isolated in order to avoid loops via the ground potential or the supply voltage.*

Because of their common reference potential, analog current inputs cannot be circuited in series, neither within the module nor with channels of other modules.

For the open-circuit detection (wire break), each analog input channel is pulled up to "plus" by a high-resistance resistor. If nothing is connected, the maximum voltage will be read in then.

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a communication interface module or a CPU). Thus, the current consumption from 24 V DC power supply at the terminals L+/UP and M/ZP of the CPU/communication interface module increases by 2 mA per I/O module.

The external power supply connection is carried out via the UP (+24 V DC) and the ZP (0 V DC) terminals.

WARNING!
Removal/Insertion under power
Removal or insertion under power is permissible only if all conditions for hot swapping are fullfilled.

↯ *Conditions for hot swap*

↯ *“Conditions for hot swap” on page 1367*

The devices are not designed for removal or insertion under power when the conditions for hot swap do not apply. Because of unforeseeable consequences, it is not allowed to plug in or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

Disconnecting any powered devices while they are energized in a hazardous location could result in an electric arc, which could create an ignition source resulting in fire or explosion.

Prior to proceeding, make sure that power is been disconnected and that the area has been thoroughly checked to ensure that flammable materials are not present.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!
Risk of damaging the PLC modules!
Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

Generally, analog signals must be laid in shielded cables. The cable shields must be grounded at both sides of the cables. In order to avoid unacceptable potential differences between different parts of the installation, low resistance equipotential bonding conductors must be laid.

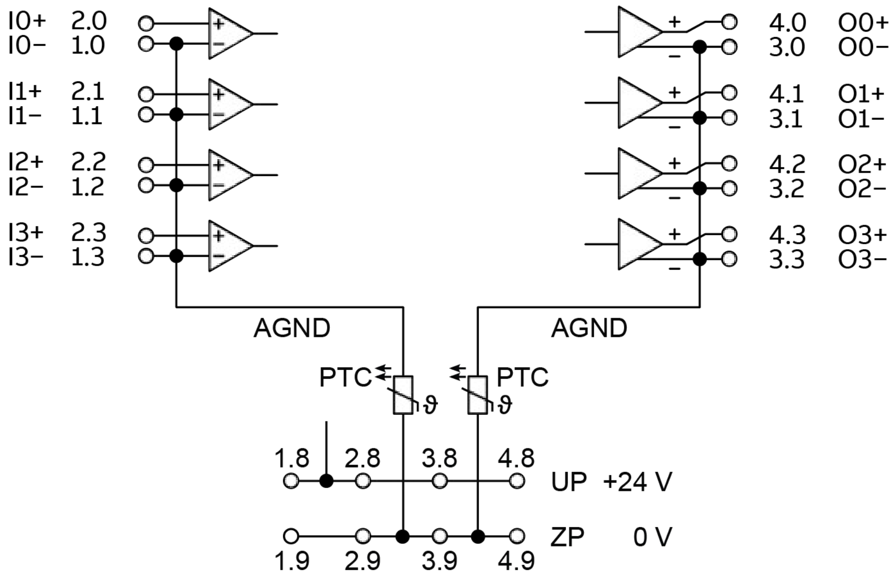


Fig. 167: Connection of the I/O module: 4 analog inputs and 4 analog outputs, individually configurable *↳ Chapter 1.6.2.2.5.3 “Functionality” on page 721*

CAUTION!
By installing equipotential bonding conductors between the different parts of the system, it must be ensured that the potential difference between ZP and AGND never can exceed 1 V.

CAUTION!
The process supply voltage must be included in the grounding concept (e. g. grounding of the negative terminal).

Connection of resistance thermometers in 2-wire configuration

When resistance thermometers (Pt100, Pt1000, Ni1000) are used, a constant current must flow through them to build the necessary voltage drop for the evaluation. For this, the I/O module provides a constant current source which is multiplexed over the 8 analog channels.

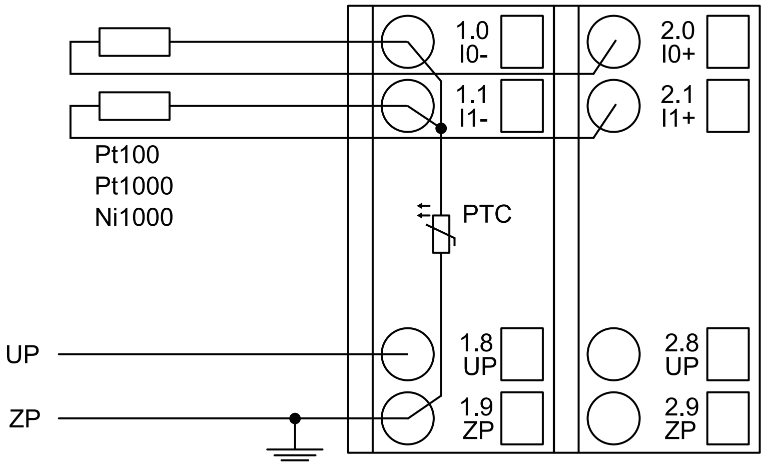


Fig. 168: Connection example

Pt100	-50 °C ... +70 °C	2-wire configuration, one channel used
Pt100	-50 °C ... +400 °C	2-wire configuration, one channel used
Pt1000	-50 °C ... +400 °C	2-wire configuration, one channel used
Ni1000	-50 °C ... +150 °C	2-wire configuration, one channel used

The I/O module performs a linearization of the resistance characteristic.

In order to avoid error messages from unused analog input channels, it is useful to configure them as "unused".

Connection of resistance thermometers in 3-wire configuration

When resistance thermometers (Pt100, Pt1000, Ni1000) are used, a constant current must flow through them to build the necessary voltage drop for the evaluation. For this, the I/O module provides a constant current source which is multiplexed over the max. 8 (depending on the configuration) analog channels.

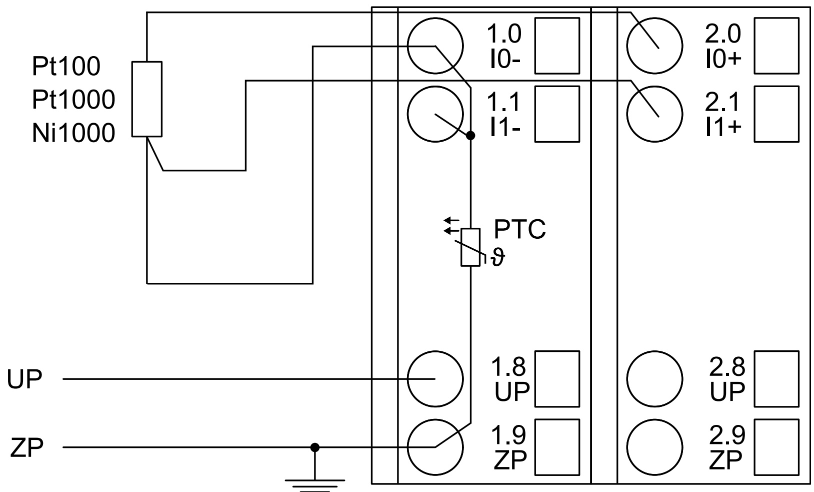


Fig. 169: Connection example

If several measuring points are adjacent to each other, only one return line is necessary. This saves wiring costs.

With the 3-wire configuration, two adjacent analog channels belong together (e.g. the channels 0 and 1). In this case, both channels are configured according to the desired operating mode. The lower address must be the even address (channel 0), the next higher address must be the odd address (channel 1).

The constant current of one channel flows through the resistance thermometer. The constant current of the other channel flows through one of the cores. The module calculates the measured value from the two voltage drops and stores it under the input with the higher channel number (e.g. I1).

In order to keep measuring errors as small as possible, it is necessary to have all the involved conductors in the same cable. All the conductors must have the same cross section.

Pt100	-50 °C ... +70 °C	3-wire configuration, two channels used
Pt100	-50 °C ... +400 °C	3-wire configuration, two channels used
Pt1000	-50 °C ... +400 °C	3-wire configuration, two channels used
Ni1000	-50 °C ... +150 °C	3-wire configuration, two channels used

The I/O module performs a linearization of the resistance characteristic.

In order to avoid error messages from unused analog input channels, it is useful to configure them as "unused".

Connection of active-type analog sensors (Voltage) with galvanically isolated power supply

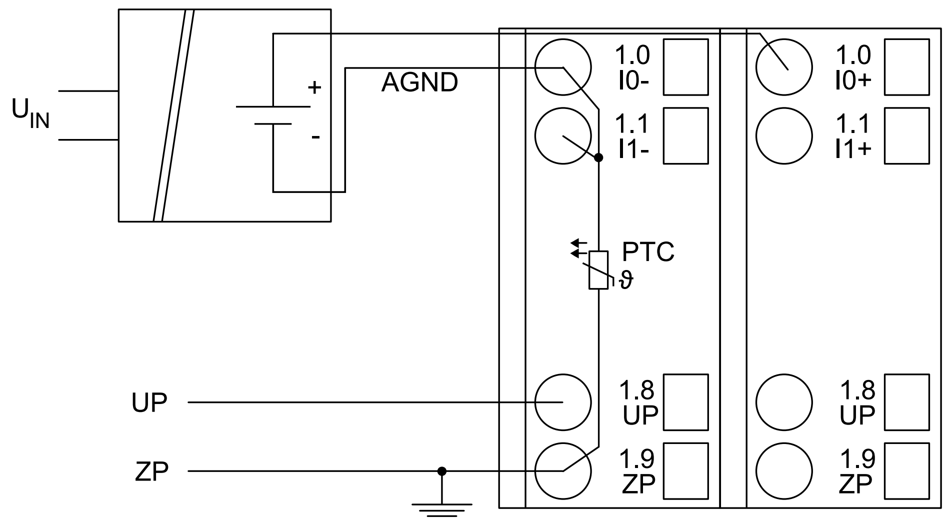


Fig. 170: Connection example

By connecting the sensor's negative pole of the output voltage to AGND, the galvanically isolated voltage source of the sensor is referred to ZP.

The following measuring ranges can be configured for AX521 *Chapter 1.6.2.2.5.7 “Parameterization” on page 736* and for AX522 *Chapter 1.6.2.2.6.7 “Parameterization” on page 766*:

Voltage	0 V ... 10 V	1 channel used
Voltage	-10 V ... +10 V	1 channel used

In order to avoid error messages or long processing times, it is useful to configure unused analog input channels as "unused".

Connection of active-type analog sensors (Current) with galvanically isolated power supply

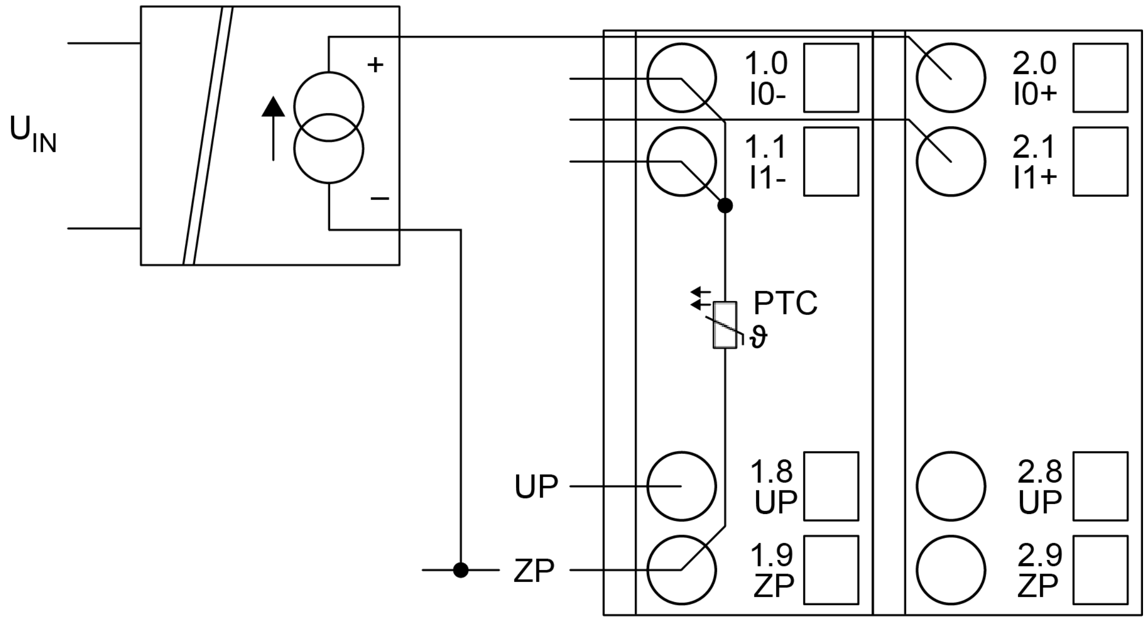


Fig. 171: Connection example

Current	0 mA ... 20 mA	1 channel used
Current	4 mA ... 20 mA	1 channel used

Unused input channels can be left open-circuited, because they are of low resistance.

Connection of active-type analog sensors (Voltage) with no galvanically isolated power supply

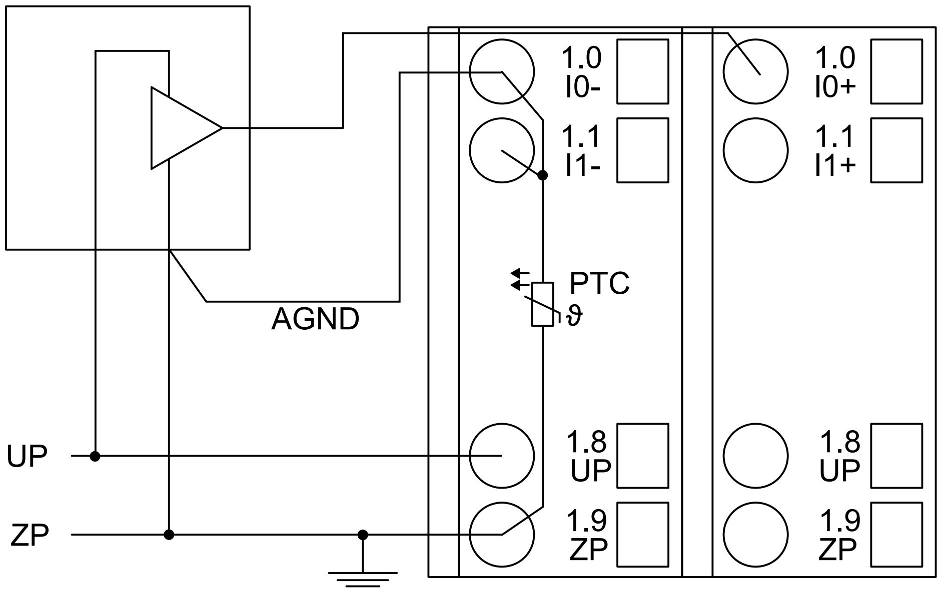


Fig. 172: Connection example

CAUTION!
The potential difference between AGND and ZP at the module must not be greater than 1V, not even in case of long lines (see figure Terminal Assignment).

If AGND does not get connected to ZP, the sensor current flows to ZP via the AGND line. The measuring signal is distorted, as a very small current flows through the voltage line. The total current through the PTC should not exceed 50 mA. This measuring method is therefore only suitable for short lines and small sensor currents. If there are bigger distances, the difference measuring method should be applied.

Voltage	0 V ... 10 V	1 channel used
Voltage	-10 V ... +10 V *)	1 channel used

*) if the sensor can provide this signal range

In order to avoid error messages or long processing times, it is useful to configure unused analog input channels as "unused".

Connection of passive-type analog sensors (Current)

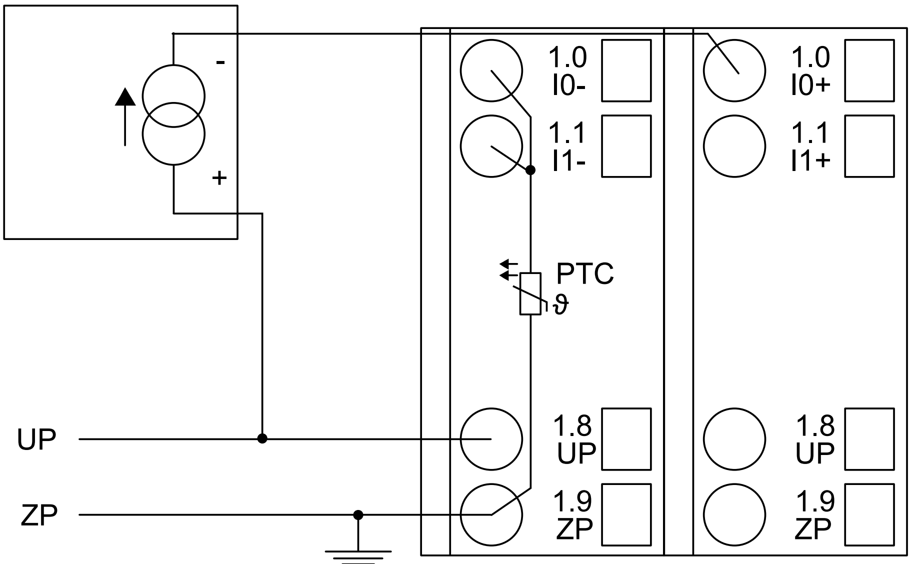


Fig. 173: Connection example

Current	4 mA ... 20 mA	1 channel used

CAUTION!
If, during initialization, an analog current sensor supplies more than 25 mA for more than 1 second to an analog input, this input is switched off by the module (input protection). In such cases, it is recommended to protect the analog input by a 10-volt Zener diode (in parallel to I+ and ZP). But, in general, sensors with fast initialization or without current peaks higher than 25 mA are preferrable.

Unused input channels can be left open-circuited because they are of low resistance.

Connection of active-type analog sensors (Voltage) to differential inputs

Differential inputs are very useful if analog sensors are used which are remotely non-isolated (e.g. the minus terminal is remotely grounded).

The use of differential inputs helps to considerably increase the measuring accuracy and to avoid ground loops.

With differential input configurations, two adjacent analog channels belong together (e.g. the channels 0 and 1). In this case, both channels are configured according to the desired operating mode. The lower address must be the even address (channel 0), the next higher address must be the odd address (channel 1). The converted analog value is available at the higher address (channel 1).

The analog value is calculated by subtraction of the input value with the higher address from the input value of the lower address.

The converted analog value is available at the odd channel (higher address).

CAUTION!
The ground potential at the sensors must not have too large a potential difference with respect to ZP (max. ±1 V within the full signal range). Otherwise, problems may occur concerning the common-mode input voltages of the involved analog inputs.

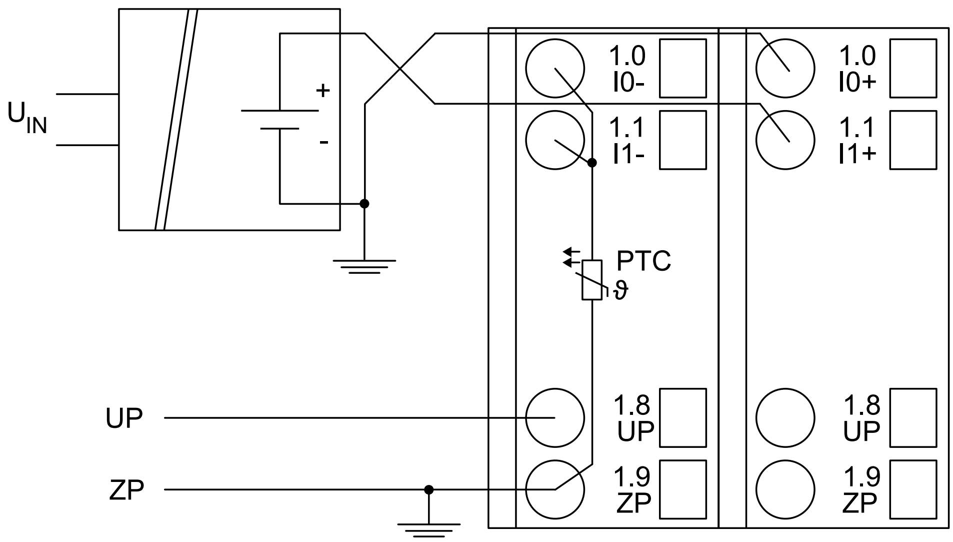


Fig. 174: Connection example

The negative pole of the sensor must be grounded next to the sensor.

Voltage	0 V ... 10 V	with differential inputs, 2 channels used
Voltage	-10 V ... +10 V	with differential inputs, 2 channels used

In order to avoid error messages or long processing times, it is useful to configure unused analog input channels as "unused".

Use of analog inputs as digital inputs

Several (or all) analog inputs can be configured as digital inputs. The inputs are not galvanically isolated against the other analog channels.

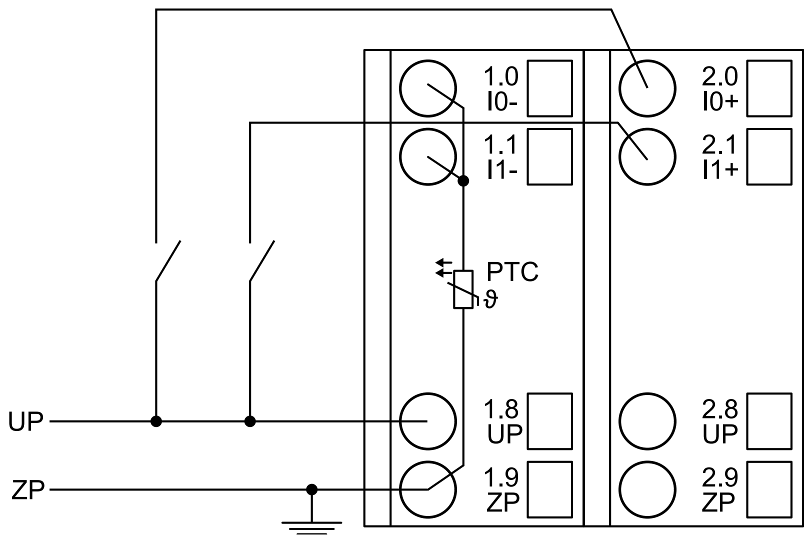


Fig. 175: Connection example

Digital input	24 V	1 channel used
Effect of incorrect input terminal connection		Wrong or no signal detected, no damage up to 35 V

Connection of analog output loads (Voltage, current)

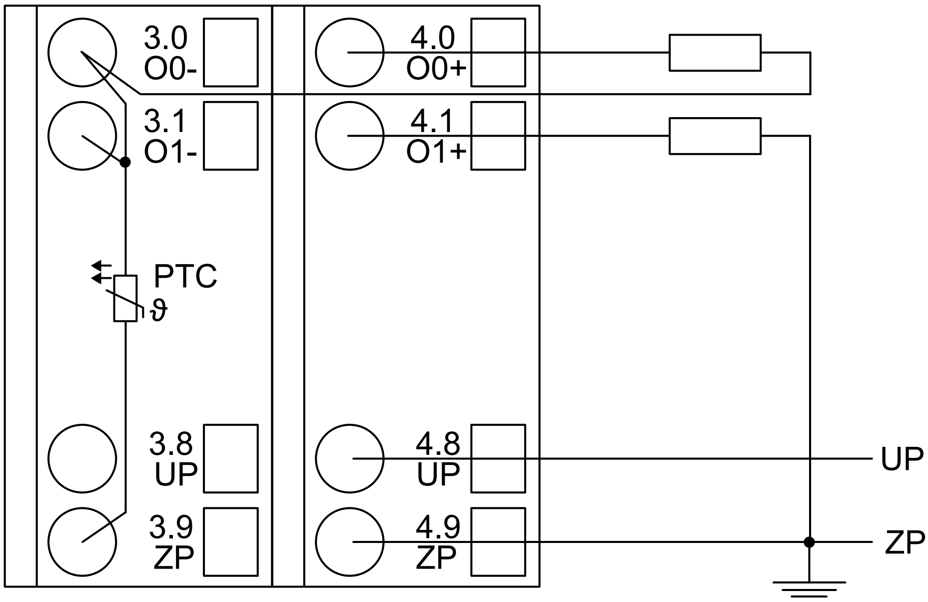


Fig. 176: Connection example

Voltage	-10 V ... +10 V	Load max. ± 10 mA	1 channel used
Current	0 mA ... 20 mA	Load 0 Ω ... 500 Ω	1 channel used
Current	4 mA ... 20 mA	Load 0 Ω ... 500 Ω	1 channel used

Only the channels 0 ... 3 can be configured as current output (0 mA ... 20 mA or 4 mA ... 20 mA).

Unused analog outputs can be left open-circuited.

Internal data exchange

Digital inputs (bytes)	0
Digital outputs (bytes)	0
Counter input data (words)	4
Counter output data (words)	4

I/O configuration

The module does not store configuration data itself. It gets its parameterization data from the master device of the I/O bus (CPU or communication interface module) during power-up of the system.

Hence, replacing I/O modules is possible without any re-parameterization via software.

Parameterization

Firmware version	Configuration
Firmware version > V2.0.0	The arrangement of the parameter data is performed by Control Builder Plus/ Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Module: Module slot address: Y = 1 ... 10

No.	Name	Value	Internal value	Internal value, type	Default	Min.	Max.	EDS Slot/ Index
1	Module ID	Internal	1505 [1])	Word	1505 0x05E1	0	65535	0x0Y01
2	Ignore module [2])	No Yes	0 1	Byte	No 0x00			Not for FBP
3	Parameter length in bytes	Internal	21	Byte	21-CPU 21-FBP	0	255	0x0Y02

No.	Name	Value	Internal value	Internal value, type	Default	Min.	Max.	EDS Slot/ Index
4	Check supply	Off On	0 1	Byte	On 0x01	0	1	0x0Y03
5	Analog data format	Default	0	Byte	Default 0x00			0x0Y04
6	Behaviour of outputs at communication errors	Off Last value Substitute value	0 1+(n*5) 2+(n*5), n ≤ 2	Byte	Off 0x00	0	2	0x0Y05
7	Channel configuration Input channel 0	See table 'Channel configuration' *Table 194 “Channel configuration ²)” on page 739*		Byte	Default 0x00	0	19	0x0Y06
8	Channel monitoring Input channel 0	See table 'Channel monitoring' *Table 195 “Channel monitoring ³)” on page 739*		Byte	Default 0x00	0	3	0x0Y07
9 to 14	Channel configuration and channel monitoring of the input channels 1 to 3	See tables 'Channel configuration' *Table 194 “Channel configuration ²)” on page 739* and 'Channel monitoring' *Table 195 “Channel monitoring ³)” on page 739*		Byte Byte	Default 0x00 0x00	0 0	19 3	0x0Y08 to 0x0Y0D
15	Channel configuration Output channel 0	See table 'Channel configuration' *Table 194 “Channel configuration ²)” on page 739*		Byte	Default 0x00	0	130	0x0Y0E
16	Channel monitoring Output channel 0	See table 'Channel monitoring' *Table 195 “Channel monitoring ³)” on page 739*		Byte	Default 0x00	0	3	0x0Y0F

No.	Name	Value	Internal value	Internal value, type	Default	Min.	Max.	EDS Slot/ Index
17	Substitute value Output channel 0	only valid for output channel 0	0 ... 0xffff	Word	Default 0x0000	0	65535	0x0Y10
18 to 21	Channel configuration and channel monitoring of the output channels 1 to 2	See tables 'Channel configuration' *Table 194 “Channel configuration [2])” on page 739* and 'Channel monitoring' *Table 195 “Channel monitoring [3])” on page 739*		Byte Byte	Default 0x00 0x00	0 0	130 3	0x0Y11 to 0x0Y14
22	Channel configuration Output channel 3	See table 'Channel monitoring' *Table 194 “Channel configuration [2])” on page 739*		Byte	Default 0x00	0	130	0x0Y15
23	Channel monitoring Output channel 3	See table 'Channel monitoring' *Table 195 “Channel monitoring [3])” on page 739*		Byte	Default 0x00	0	3	0x0Y16

[1]) With CS31 and addresses less than 70 and FBP, the value is increased by 1

[2]) Not with FBP

GSD file:

Ext_User_Prm_Data_Len =	24
Ext_User_Prm_Data_Const(0) =	0x05, 0xe2, 0x15, \
	0x01, 0x00, 0x00 \
	0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, \
	0x00, 0x00, 0x00, 0x00, \
	0x00, 0x00, 0x00, 0x00, 0x00, 0x00;

Table 193: Input channel (4x)

No.	Name	Internal value, type	Default
1	Channel configuration see table [2])	Byte	0 0x00 see table [2])
2	Channel monitoring see table [3])	Byte	0 0x00 see table [3])

Table 194: Channel configuration [2])

Internal value	Operating modes of the analog inputs, individually configurable
0	Unused (default)
1	Analog input 0 V ... 10 V
2	Digital input
3	Analog input 0 mA ... 20 mA
4	Analog input 4 mA ... 20 mA
5	Analog input -10 V ... +10 V
8	Analog input Pt100, -50 °C ... +400 °C (2-wire)
9	Analog input Pt100, -50 °C ... +400 °C (3-wire), requires 2 channels *)
10	Analog input 0 ... 10 V via differential inputs, requires 2 channels *)
11	Analog input -10 V ... +10 V via differential inputs, requires 2 channels *)
14	Analog input Pt100, -50 °C ... +70 °C (2-wire)
15	Analog input Pt100, -50 °C ... +70 °C (3-wire), requires 2 channels *)
16	Analog input Pt1000, -50 °C ... +400 °C (2-wire)
17	Analog input Pt1000, -50 °C ... +400 °C (3-wire), requires 2 channels *)
18	Analog input Ni1000, -50 °C ... +150 °C (2-wire)
19	Analog input Ni1000, -50 °C ... +150 °C (3-wire), requires 2 channels *)
	*) In the operating modes with 3-wire configuration or with differential inputs, two adjacent analog inputs belong together (e.g. the channels 0 and 1). In these cases, both channels are configured in the desired operating mode. The lower address must be the even address (channel 0). The next higher address must be the odd address (channel 1). The converted analog value is available at the higher address (channel 1).

Table 195: Channel monitoring [3])

Internal value	Monitoring
0	Plausibility, open-circuit (broken wire) and short circuit
3	No monitoring

Table 196: Output channel 0 (1 channel)

No.	Name	Value	Internal value	Internal value, type	Default
1	Channel configuration	see table [4])	see table [4])	Byte	see table [4])
2	Channel monitoring	see table [5])	see table [5])	Byte	see table [5])
3	Substitute value see table [6])	0 ... 65535	0 ... 0xffff	Word	0

Table 197: Output channels 1 ... 3 (3x)

No.	Name	Internal value, type
1	Channel configuration see table [4])	Byte
2	Channel monitoring see table [6])	Byte

Table 198: Channel configuration [4])

Internal value	Operating modes of the analog outputs, individually configurable
0	Unused (default)
128	Analog output -10 V ... +10 V
129	Analog output 0 mA ... 20 mA (not with the channels 4 ... 7 and 12 ... 15)
130	Analog output 4 mA ... 20 mA (not with the channels 4 ... 7 and 12 ... 15)

Table 199: Channel monitoring [5])

Internal value	Monitoring
0	Plausibility, open circuit (broken wire) and short circuit (default)
3	No monitoring

Table 200: Substitute value [6])

Intended behaviour of output channel when the control system stops	Required setting of the module parameter "Behaviour of outputs in case of a communication error"	Required setting of the channel parameter "Substitute value"
Output OFF	Off	0
Last value infinite	Last value	0
Last value for 5 s and then turn off	Last value 5 sec	0
Last value for 10 s and then turn off	Last value 10 sec	0
Substitute value infinite	Substitute value	Depending on configuration

Intended behaviour of output channel when the control system stops	Required setting of the module parameter "Behaviour of outputs in case of a communication error"	Required setting of the channel parameter "Substitute value"
Substitute value for 5 s and then turn off	Substitute value 5 sec	Depending on configuration
Substitute value for 10 s and then turn off	Substitute value 10 sec	Depending on configuration

Diagnosis

Table 201: Possible diagnosis of I/O channels

Output range	**Condition**	
	Output value in the PLC underflow	**Output value in the PLC overflow**
0 mA ... 20 mA	Error identifier = 7	Error identifier = 4
4 mA ... 20 mA		
-10 V ... +10 V		

Input range	**Condition**			
	Short circuit	**Wire break**	**Input value underflow**	**Input value overflow**
0 mA ... 20 mA	no diagnosis possible	no diagnosis possible	no diagnosis possible	Error identifier = 48
4 mA ... 20 mA	Error identifier = 7	Error identifier = 7	Error identifier = 7	Error identifier = 48
-10 V ... +10 V	no diagnosis possible	Error identifier = 48	Error identifier = 7	Error identifier = 48

Table 202: Content of diagnosis messages

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identifier 000 ... 063**	**AC500 display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**	
Byte 6 Bit 6 ... 7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0 ... 5**	**FBP diagnosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error Identifier**	**Error message**	**Remedy**
	1)	2)	3)	4)			
Module error							
3	14	1 ... 10	31	31	19	Checksum error in the I/O module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	3	Timeout in the I/O module	Replace I/O module
	11 / 12	ADR	1 ... 10				

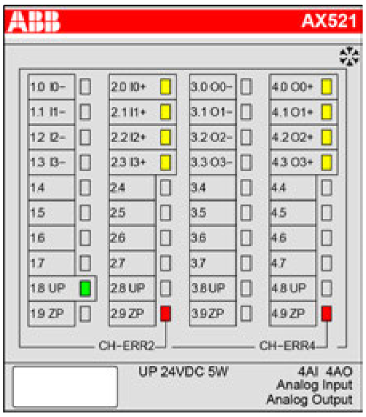
E1 ... E4	d1	d2	d3	d4		Identifier 000 ... 063	AC500 display	<– Display in
Class	**Comp**	**Dev**	**Mod**	**Ch**		**Err**	**PS501 PLC browser**	
Byte 6 Bit 6 ... 7	**-**	**Byte 3**	**Byte 4**	**Byte 5**		**Byte 6 Bit 0 ... 5**	**FBP diag-nosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**		**Error Identifier**	**Error message**	**Remedy**
	[1])	[2])	[3])	[4])				
3	14	1 ... 10	31	31		40	Different hard-/firm-ware versions in the module	Replace I/O module
	11 / 12	ADR	1 ... 10					
3	14	1 ... 10	31	31		43	Internal error in the module	Replace I/O module
	11 / 12	ADR	1 ... 10					
3	14	1 ... 10	31	31		36	Internal data exchange failure	Replace I/O module
	11 / 12	ADR	1 ... 10					
3	14	1 ... 10	31	31		9	Overflow diagnosis buffer	New start
	11 / 12	ADR	1 ... 10					
3	14	1 ... 10	31	31		26	Parameter error	Check master
	11 / 12	ADR	1 ... 10					
3	14	1 ... 10	31	31		11	Process voltage too low	Check process voltage
	11 / 12	ADR	1 ... 10					
4	14	1 ... 10	31	31		45	Process voltage is switched off (ON –> OFF)	Process voltage ON
	11 / 12	ADR	1 ... 10					
Channel error								
				AX521	AX522			
4	14	1 ... 10	1	0 ... 3	0 ... 7	48	Analog value over-flow or broken wire at an analog input	Check input value or terminal
	11 / 12	ADR	1 ... 10					
4	14	1 ... 10	1	0...3	0 ... 7	7	Analog value under-flow at an analog input	Check input value
	11 / 12	ADR	1 ... 10					
4	14	1 ... 10	1	0 ... 3	0 ... 7	47	Short circuit at an analog input	Check terminal
	11 / 12	ADR	1 ... 10					
4	14	1 ... 10	3	4 ... 7	8 ... 15	4	Analog value over-flow at an analog output	Check output value
	11 / 12	ADR	1 ... 10					
4	14	1 ... 10	3	4 ... 7	8 ... 15	7	Analog value under-flow at an analog output	Check output value
	11 / 12	ADR	1 ... 10					

Remarks:

[1])	In AC500, the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The FBP diagnosis block does not contain this identifier.
[2])	With "Device" the following allocation applies: 31 = module itself, 1 ... 10 = expansion module 1 ... 10, ADR = hardware address (e.g. of the DC551)
[3])	With "Module" the following allocation applies depending on the master: Module error: I/O bus or FBP: 31 = module itself; COM1/COM2: 1 ... 10 = expansion 1 ... 10 Channel error: I/O bus or FBP = module type (1 = AI, 3 = AO); COM1/COM2: 1 ... 10 = expansion 1 ... 10
[4])	In case of module errors, with channel "31 = Module itself" is output.

State LEDs

During the power ON procedure, the module initializes automatically. All LEDs (except the channel LEDs) are ON during this time.

LED		State	Color	LED = OFF	LED = ON	LED flashes
	Inputs I0 ... I3	Analog input	Yellow	Input is OFF	Input is ON (brightness depends on the value of the analog signal)	--
	Outputs O0 ... O3	Analog output	Yellow	Output is OFF	Output is ON (brightness depends on the value of the analog signal)	--
	UP	Process voltage 24 V DC via terminal	Green	Process voltage is missing	Process voltage OK	--
	CH-ERR2	Channel error, error messages in groups (analog inputs or outputs combined into the groups 2 and 4)	Red	No error or process voltage is missing	Severe error within the corresponding group	Error on one channel of the group
	CH-ERR4		Red			
	CH-ERR *)	Module error	Red	--	Internal error	--
	*) Both LEDs (CH-ERR2 and CH-ERR4) light up together					

Measuring ranges

Input ranges of voltage, current and digital input

The represented resolution corresponds to 16 bits.

Range	0 V ... 10 V	-10 V ... +10 V	0 mA ... 20 mA	4 mA ... 20 mA	Digital input	Digital value	
						Decimal	Hex.
Overflow	>11.7589	>11.7589	>23.5178	>22.8142		32767	7FFF
Measured value too high	11.7589 . . 10.0004	11.7589 : 10.0004	23.5178 : 20.0007	22.8142 : 20.0006		32511 : 27649	7EFF : 6C01
Normal range	10.0000 : 0.0004	10.0000 : 0.0004	20.0000 : 0.0007	20.0000 : 4.0006	: : ON	27648 : 1	6C00 : 0001
Normal range or measured value too low	0.0000	0.0000	0	4	OFF	0	0000
	-0.0004 -1.7593	-0.0004 : : -10.0000		3.9994 1.1858		-1 -4864 : -27648	FFFF ED00 : 9400
Measured value too low		-10.0004 : -11.7589				-27649 : -32512	93FF : 8100
Underflow	<-1.7593	<-11.7589	<0.0000	<1.1858		-32768	8000

Input ranges resistance temperature detector

Range	Pt100 / Pt 1000 -50 °C ... +70 °C	Pt100 / Pt1000 -50 °C ... +400 °C	Ni1000 -50 °C ... +150 °C	Digital value	
				Decimal	Hex.
Overflow	> +80.0 °C	> +450.0 °C	> +160.0 °C	32767	7FFF
Measured value too high		+450.0 °C : + 400.1 °C		4500 : 4001	1194 : 0FA1
			+160.0 °C : +150.1 °C	1600 : 1501	0640 : 05DD
	+80.0 °C : +70.1 °C			800 : 701	0320 : 02BD

Range	Pt100 / Pt 1000 -50 °C ... +70 °C	Pt100 / Pt1000 -50 °C ... +400 °C	Ni1000 -50 °C ... +150 °C	Digital value	
				Decimal	Hex.
Normal range	: : +70.0 °C : +0.1 °C	+400.0 °C : : : + 0.1 °C	: +150.0 °C : : + 0.1 °C	4000 1500 700 : 1	0FA0 05DC 02BC : 0001
	0.0 °C	0.0 °C	0.0 °C	0	0000
	-0.1 °C : -50.0 °C	-0.1 °C : -50.0 °C	-0.1 °C : -50.0 °C	-1 : -500	FFFF : FE0C
Measured value too low	-50.1 °C : -60.0 °C	-50.1 °C : -60.0 °C	-50.1 °C : -60.0 °C	-501 : -600	FE0B : FDA8
Underflow	< -60.0 °C	< -60.0 °C	< -60.0 °C	-32768	8000

Output ranges voltage and current

The represented resolution corresponds to 16 bits.

Range	-10 V ...+10 V	0 mA ... 20 mA	4 mA ... 20 mA	Digital value	
				Decimal	Hex.
Overflow	0 V	0 mA	0 mA	> 32511	> 7EFF
Value too high	11.7589 V : 10.0004 V	23.5178 mA : 20.0007 mA	22.8142 mA : 20.0006 mA	32511 : 27649	7EFF : 6C01
Normal range	10.0000 V : 0.0004 V	20.0000 mA : 0.0007 mA	20.0000 mA : 4.0006 mA	27648 : 1	6C00 : 0001
	0.0000 V	0.0000 mA	4.0000 mA	0	0000
	-0.0004 V : -10.0000 V	0 mA : 0 mA	3.9994 mA 0 mA 0 mA	-1 -6912 -27648	FFFF E500 9400
Value too low	-10.0004 V : -11.7589 V	0 mA : 0 mA	0 mA : 0 mA	-27649 : -32512	93FF : 8100
Underflow	0 V	0 mA	0 mA	< -32512	< 8100

Technical data

Technical data of the module

The system data of AC500 and S500 are applicable to the standard version *Chapter 2.6.1 “System data AC500” on page 1408*.

The system data of AC500-XC are applicable to the XC version *Chapter 2.7.1 “System data AC500-XC” on page 1475*.

Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

Parameter		Value
Process voltage		
	Connections	Terminals 1.8, 2.8, 3.8 and 4.8 for +24 V (UP) as well as 1.9, 2.9, 3.9 and 4.9 for 0 V (ZP)
	Rated value	24 V DC
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	Rated protection fuse on UP	10 A fast
	Galvanic isolation	Yes, per module
Current consumption		
	From 24 V DC power supply at the terminals UP/L+ and ZP/M of the CPU/communication interface module	Ca. 2 mA
	From UP at normal operation	0.15 A + output loads
Inrush current from UP (at power up)		0.020 A^2s
Max. length of analog cables, conductor cross section > 0.14 mm²		100 m
Weight		300 g
Mounting position		Horizontal or vertical with derating (output load reduced to 50 % at 40 °C per group)
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

NOTICE!
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and temporary overvoltage up to 30 V DC.

Technical data of the analog inputs

Parameter	Value
Number of channels per module	4
Distribution of channels into groups	1 group of 4 channels
Connections of the channels I0- ... I3-	Terminals 1.0 ... 1.3

Parameter	Value	
Connections of the channels I0+ ... I3+	Terminals 2.0 ... 2.3	
Input type	Bipolar (not with current or Pt100/Pt1000/Ni1000)	
Galvanic isolation	Against internal supply and other modules	
Configurability	0 V ... 10 V, -10 V ... +10 V, 0 mA ... 20 mA, 4 mA ... 20 mA, Pt100/1000, Ni1000 (each input can be configured individually)	
Channel input resistance	Voltage: > 100 kΩ Current: ca. 330 Ω	
Time constant of the input filter	Voltage: 100 µs Current: 100 µs	
Indication of the input signals	One LED per channel	
Conversion cycle	2 ms (for 8 inputs + 8 outputs), with Pt/Ni... 1 s	
Resolution	Range 0 V ... 10 V: 12 bits Range -10 V ... +10 V: 12 bits including sign Range 0 mA ... 20 mA: 12 bits Range 4 mA ... 20 mA: 12 bits	
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range	Typ.	± 0.5 % of full scale at 25 °C
	Max.	± 1 % of full scale (all ranges) at 0 °C ... 60 °C or EMC disturbance
Relationship between input signal and hex code	*Chapter 1.6.2.2.5.10.2 “Input ranges resistance temperature detector” on page 744*	
Unused voltage inputs	Are configured as "unused"	
Unused current inputs	Have a low resistance, can be left open-circuited	
Overvoltage protection	Yes	

Technical data of the analog inputs, if used as digital inputs

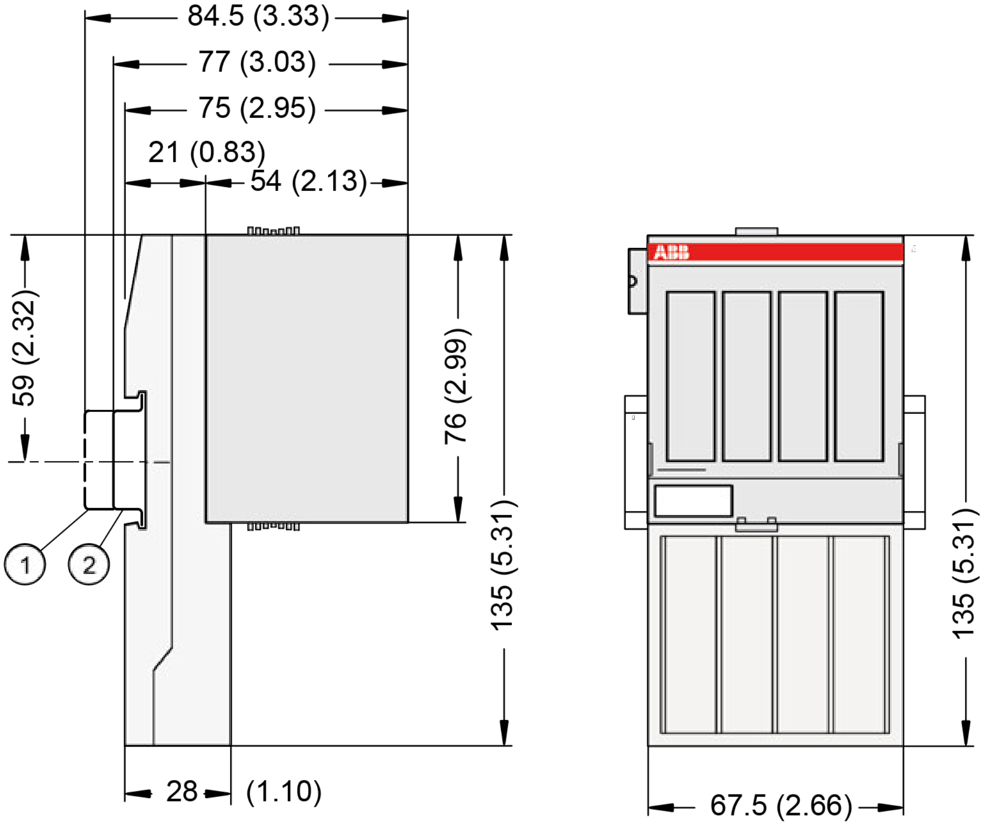
Parameter		Value
Number of channels per module		Max. 4
Distribution of channels into groups		1 group of 4 channels
Connections of the channels I0+ to I3+		Terminals 2.0 to 2.3
Reference potential for the inputs		Terminals 1.9, 2.9, 3.9 and 4.9 (ZP)
Input signal delay		Typ. 8 ms, configurable from 0.1 to 32 ms
Indication of the input signals		1 LED per channel
Input signal voltage		24 V DC
	Signal 0	-30 V ... +5 V
	Undefined signal	+5 V ... +13 V
	Signal 1	+13 V ... +30 V
Input current per channel		
	Input voltage +24 V	Typ. 7 mA

Parameter		Value
	Input voltage +5 V	Typ. 1.4 mA
	Input voltage +15 V	Typ. 4.3 mA
	Input voltage +30 V	< 9 mA
Input resistance		ca. 3.5 kΩ

Technical data of the analog outputs

Parameter		Value	
Number of channels per module		4, all channels for voltage and current	
Distribution of channels into groups		1 group of 4 channels	
	Channels O0- ... O3-	Terminals 3.0 ... 3.3	
	Channels O0+ ... O3+	Terminals 4.0 ... 4.3	
Output type		Bipolar with voltage, unipolar with current	
Galvanic isolation		Against internal supply and other modules	
Configurability		-10 V ... +10 V, 0 mA ... 20 mA, 4 mA ... 20 mA (each output can be configured individually), current outputs only channels 0 ... 3	
Output resistance (load), as current output		0 Ω ... 500 Ω	
Output loadability, as voltage output		Max. ± 10 mA	
Indication of the output signals		One LED per channel	
Resolution		12 bits including sign	
Settling time for full range change (resistive load, output signal within specified tolerance)		Typ. 5 ms	
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range		Typ.	± 0.5 % of full scale at 25 °C
		Max.	± 1 % of full scale (all ranges) at 0 °C ... 60 °C or EMC disturbance
Relationship between output signal and hex code			
Unused outputs		Can be left open-circuited	

Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

Ordering Data

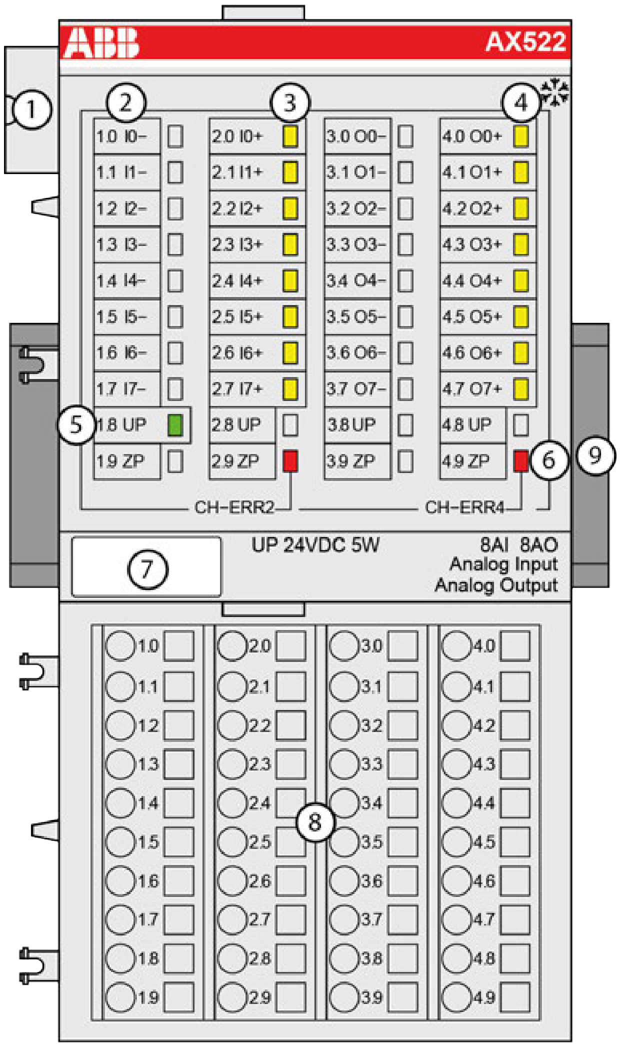
Part no.	Description	Product life cycle phase *)
1SAP 250 100 R0001	AX521, analog input/output module, 4 AI, 4 AO, U/I/Pt100, 12 bits including sign, 2-wires	Active
1SAP 450 100 R0001	AX521-XC, analog input/output module, 4 AI, 4 AO, U/I/Pt100, 12 bits including sign, 2-wires, XC version	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

1.6.2.2.6 AX522 - Analog input/output module

Features

- 8 configurable analog inputs (I0 ... I7) in 1 group (1.0 ... 2.7)
  Resolution 12 bits including sign
- 8 configurable analog outputs (O0 ... O7) in 1 group (3.0 ... 4.7)
  Resolution 12 bits including sign
- Module-wise galvanically isolated
- XC version for use in extreme ambient conditions available



1 I/O bus
2 Allocation between terminal number and signal name
3 8 yellow LEDs to display the signal states at the analog inputs (I0 ... I7)
4 8 yellow LEDs to display the signal states at the analog outputs (O0 ... O7)
5 1 green LED to display the state of the process supply voltage UP
6 2 red LEDs to display errors
7 Label
8 Terminal unit
9 DIN rail
Sign for XC version

Intended purpose

The device can be used as a decentralized I/O extension module for S500 communication interface modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs.

Functionality

8 analog inputs (channel 0 ... channel 7), individually configurable

- Unused (default setting)
- 0 V ... 10 V
- -10 V ... +10 V
- 0 mA ... 20 mA
- 4 mA ... 20 mA
- Pt100, -50 °C ... +400 °C (2-wire)
- Pt100, -50 °C ... +400 °C (3-wire), requires 2 channels
- Pt100, -50 °C ... +70 °C (2-wire)
- Pt100, -50 °C ... +70 °C (3-wire), requires 2 channels
- Pt1000, -50 °C ... +400 °C (2-wire)
- Pt1000, -50 °C ... +400 °C (3-wire), requires 2 channels
- Ni1000, -50 °C ... +150 °C (2-wire)
- Ni1000, -50 °C ... +150 °C (3-wire), requires 2 channels
- 0 V ... 10 V with differential inputs, requires 2 channels
- -10 V ... +10 V with differential inputs, requires 2 channels
- Digital signals (digital input)

Parameter		Value
Resolution of the analog channels		
	Voltage -10 V ... +10 V	12 bits including sign
	Voltage 0 V ... 10 V	12 bits
	Current 0 mA ... 20 mA, 4 mA ... 20 mA	12 bits
	Temperature	0.1 °C
LED displays		19 LEDs for signals and error messages
Internal power supply		Via the I/O bus interface (I/O bus)
External power supply		Via the terminals ZP and UP (process voltage 24 V DC)
Required terminal unit		TU515 or TU516 *Chapter 1.5.3 “TU515, TU516, TU541 and TU542 for I/O modules” on page 282*

Connections

For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.

The modules are plugged on an I/O terminal unit *Chapter 1.5.3 “TU515, TU516, TU541 and TU542 for I/O modules” on page 282*. Properly position the modules and press until they lock in place. The terminal units are mounted on a DIN rail or with 2 screws plus the additional accessory for wall mounting *Chapter 1.9.3.5 “TA526 - Wall mounting accessory” on page 1361*.

The connection of the I/O channels is carried out using the 40 terminals of the I/O terminal unit. I/O modules can be replaced without re-wiring the terminal units.

The terminals 1.8, 2.8, 3.8 and 4.8 as well as 1.9, 2.9,3.9 and 4.9 are electrically interconnected within the I/O terminal units and always have the same assignment, independent of the inserted module:

Terminals 1.8, 2.8, 3.8 and 4.8: process voltage UP = +24 V DC

Terminals 1.9, 2.9, 3.9 and 4.9: process voltage ZP = 0 V DC

The assignment of the other terminals:

Terminals	Signal	Description
1.0 ... 1.7	I0- ... I7-	Negative poles of the 8 analog inputs
2.0 ... 2.7	I0+ ... I7+	Positive poles of the 8 analog inputs
3.0 ... 3.7	O0- ... O7-	Negative poles of the 8 analog outputs
4.0 ... 4.7	O0+ ... O7+	Positive poles of the 8 analog outputs

The negative poles of the analog inputs are connected to each other to form an "Analog Ground" signal for the module.

The negative poles of the analog outputs are connected to each other to form an "Analog Ground" signal for the module.

There is no galvanic isolation between the analog circuitry and ZP/UP. Therefore, the analog sensors must be galvanically isolated in order to avoid loops via the ground potential or the supply voltage.

Because of their common reference potential, analog current inputs cannot be circuited in series, neither within the module nor with channels of other modules.

For the open-circuit detection (wire break), each analog input channel is pulled up to "plus" by a high-resistance resistor. If nothing is connected, the maximum voltage will be read in then.

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a communication interface module or a CPU). Thus, the current consumption from 24 V DC power supply at the terminals L+/UP and M/ZP of the CPU/communication interface module increases by 2 mA per I/O module.

The external power supply connection is carried out via the UP (+24 V DC) and the ZP (0 V DC) terminals.

WARNING!

Removal/Insertion under power

Removal or insertion under power is permissible only if all conditions for hot swapping are fullfilled.

Conditions for hot swap

“Conditions for hot swap” on page 1367

The devices are not designed for removal or insertion under power when the conditions for hot swap do not apply. Because of unforeseeable consequences, it is not allowed to plug in or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

Disconnecting any powered devices while they are energized in a hazardous location could result in an electric arc, which could create an ignition source resulting in fire or explosion.

Prior to proceeding, make sure that power is been disconnected and that the area has been thoroughly checked to ensure that flammable materials are not present.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!

Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

Generally, analog signals must be laid in shielded cables. The cable shields must be grounded at both sides of the cables. In order to avoid unacceptable potential differences between different parts of the installation, low resistance equipotential bonding conductors must be laid.

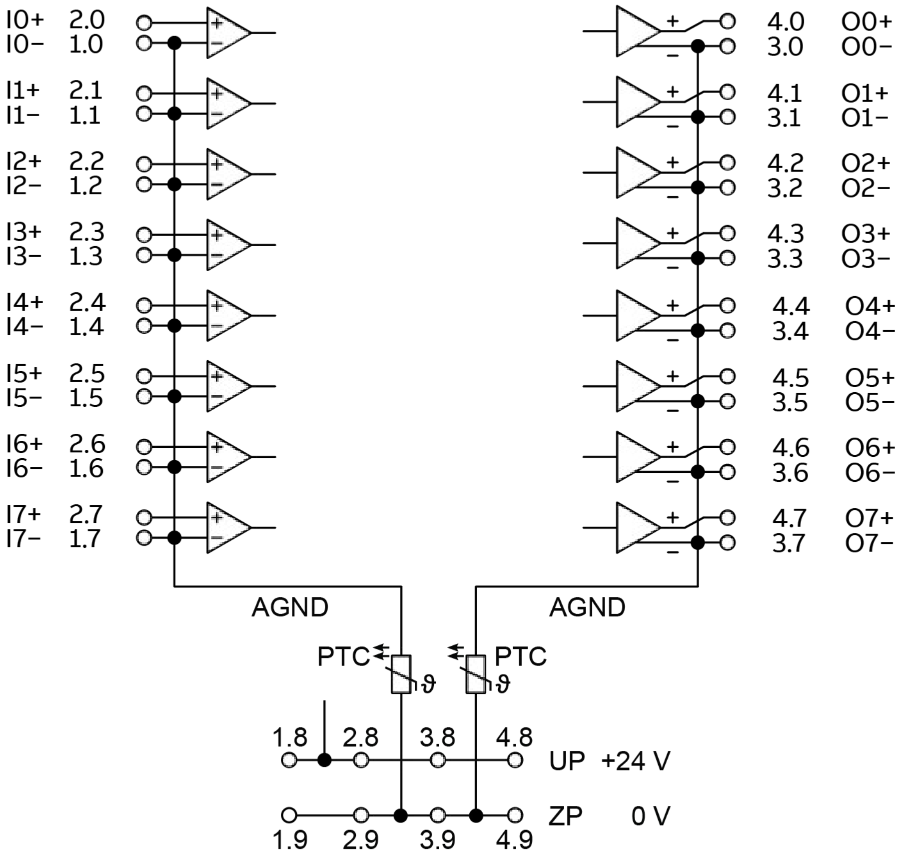


Fig. 177: Connection of the I/O module: 8 analog inputs and 8 analog outputs, individually configurable *Chapter 1.6.2.2.6.3 “Functionality” on page 751*

> **CAUTION!**
> By installing equipotential bonding conductors between the different parts of the system, it must be ensured that the potential difference between ZP and AGND never can exceed 1 V.

> **CAUTION!**
> The process supply voltage must be included in the grounding concept (e. g. grounding of the negative terminal).

Connection of resistance thermometers in 2-wire configuration

When resistance thermometers (Pt100, Pt1000, Ni1000) are used, a constant current must flow through them to build the necessary voltage drop for the evaluation. For this, the I/O module provides a constant current source which is multiplexed over the 8 analog channels.

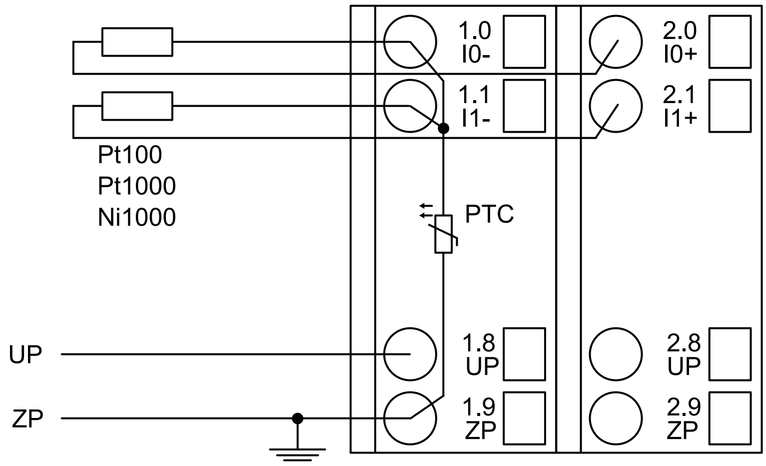


Fig. 178: Connection example

Pt100	-50 °C ... +70 °C	2-wire configuration, one channel used
Pt100	-50 °C ... +400 °C	2-wire configuration, one channel used
Pt1000	-50 °C ... +400 °C	2-wire configuration, one channel used
Ni1000	-50 °C ... +150 °C	2-wire configuration, one channel used

The I/O module performs a linearization of the resistance characteristic.

In order to avoid error messages from unused analog input channels, it is useful to configure them as "unused".

Connection of resistance thermometers in 3-wire configuration

When resistance thermometers (Pt100, Pt1000, Ni1000) are used, a constant current must flow through them to build the necessary voltage drop for the evaluation. For this, the I/O module provides a constant current source which is multiplexed over the max. 8 (depending on the configuration) analog channels.

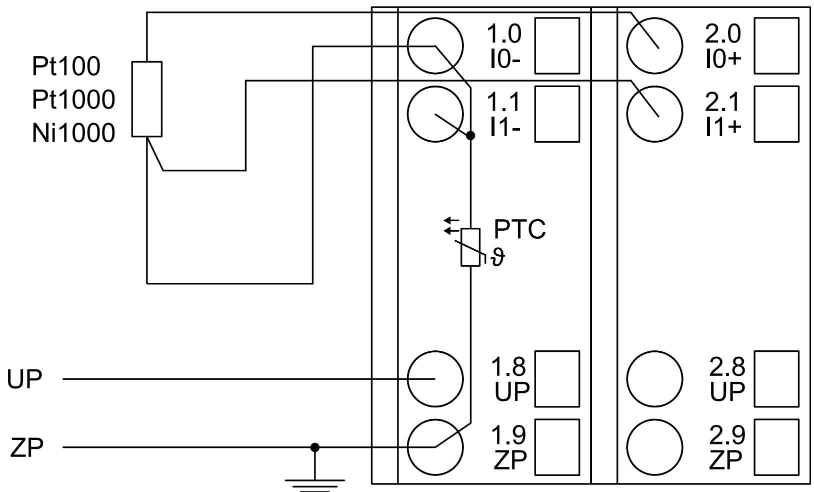


Fig. 179: Connection example

If several measuring points are adjacent to each other, only one return line is necessary. This saves wiring costs.

With the 3-wire configuration, two adjacent analog channels belong together (e.g. the channels 0 and 1). In this case, both channels are configured according to the desired operating mode. The lower address must be the even address (channel 0), the next higher address must be the odd address (channel 1).

The constant current of one channel flows through the resistance thermometer. The constant current of the other channel flows through one of the cores. The module calculates the measured value from the two voltage drops and stores it under the input with the higher channel number (e.g. I1).

In order to keep measuring errors as small as possible, it is necessary to have all the involved conductors in the same cable. All the conductors must have the same cross section.

Pt100	-50 °C ... +70 °C	3-wire configuration, two channels used
Pt100	-50 °C ... +400 °C	3-wire configuration, two channels used
Pt1000	-50 °C ... +400 °C	3-wire configuration, two channels used
Ni1000	-50 °C ... +150 °C	3-wire configuration, two channels used

The I/O module performs a linearization of the resistance characteristic.

In order to avoid error messages from unused analog input channels, it is useful to configure them as "unused".

Connection of active-type analog sensors (Voltage) with galvanically isolated power supply

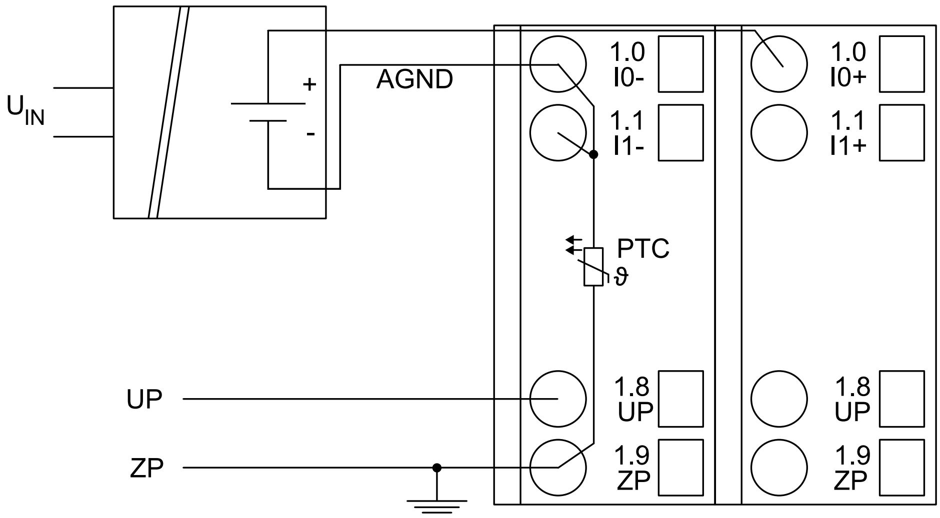


Fig. 180: Connection example

By connecting the sensor's negative pole of the output voltage to AGND, the galvanically isolated voltage source of the sensor is referred to ZP.

The following measuring ranges can be configured for AX521 *Chapter 1.6.2.2.5.7 “Parameterization” on page 736* and for AX522 *Chapter 1.6.2.2.6.7 “Parameterization” on page 766*:

Voltage	0 V ... 10 V	1 channel used
Voltage	-10 V ... +10 V	1 channel used

In order to avoid error messages or long processing times, it is useful to configure unused analog input channels as "unused".

Connection of active-type analog sensors (Current) with galvanically isolated power supply

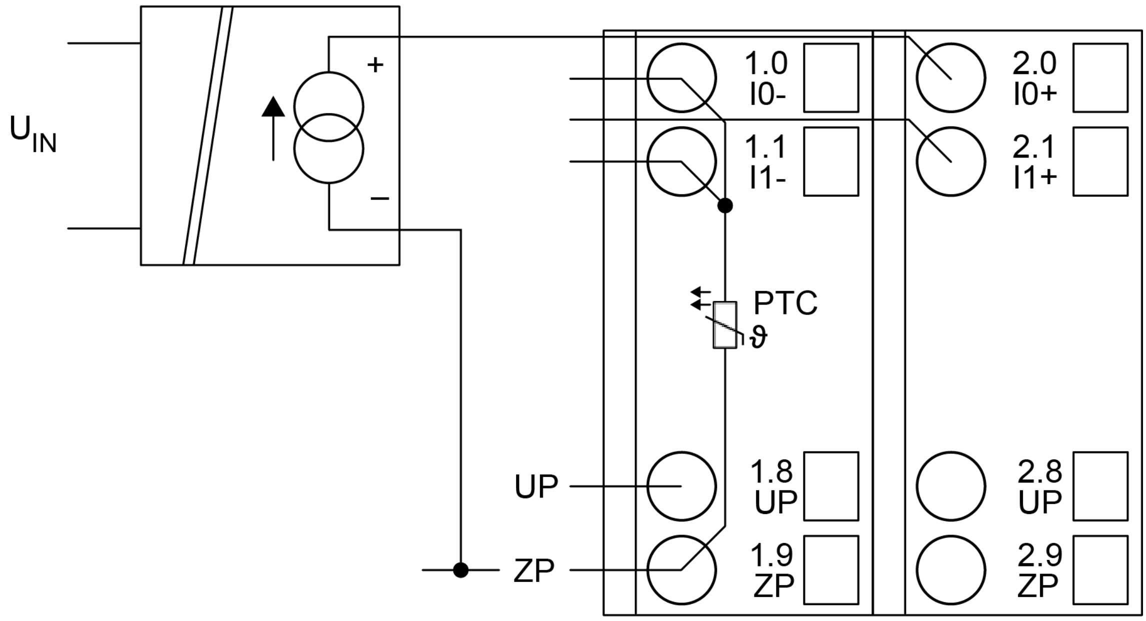


Fig. 181: Connection example

Current	0 mA ... 20 mA	1 channel used
Current	4 mA ... 20 mA	1 channel used

Unused input channels can be left open-circuited, because they are of low resistance.

Connection of active-type analog sensors (Voltage) with no galvanically isolated power supply

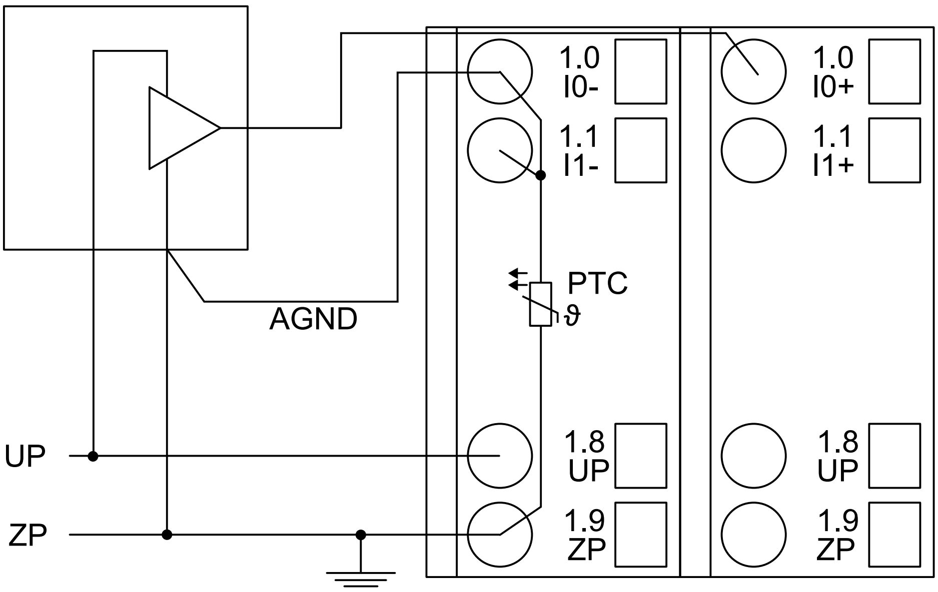


Fig. 182: Connection example

CAUTION!
The potential difference between AGND and ZP at the module must not be greater than 1V, not even in case of long lines (see figure Terminal Assignment).

If AGND does not get connected to ZP, the sensor current flows to ZP via the AGND line. The measuring signal is distorted, as a very small current flows through the voltage line. The total current through the PTC should not exceed 50 mA. This measuring method is therefore only suitable for short lines and small sensor currents. If there are bigger distances, the difference measuring method should be applied.

Voltage	0 V ... 10 V	1 channel used
Voltage	-10 V ... +10 V *)	1 channel used

*) if the sensor can provide this signal range

In order to avoid error messages or long processing times, it is useful to configure unused analog input channels as "unused".

Connection of passive-type analog sensors (Current)

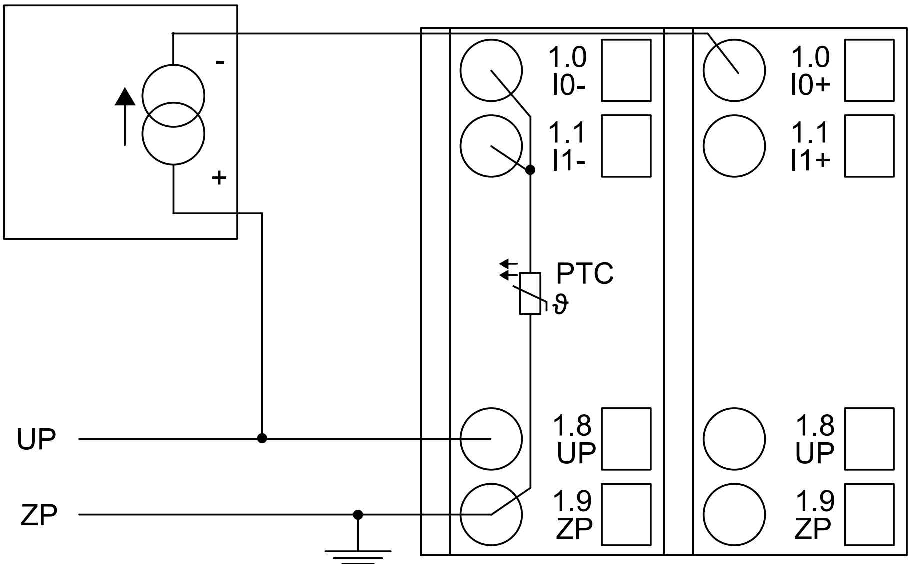


Fig. 183: Connection example

Current	4 mA ... 20 mA	1 channel used

CAUTION!
If, during initialization, an analog current sensor supplies more than 25 mA for more than 1 second to an analog input, this input is switched off by the module (input protection). In such cases, it is recommended to protect the analog input by a 10-volt Zener diode (in parallel to I+ and ZP). But, in general, sensors with fast initialization or without current peaks higher than 25 mA are preferrable.

Unused input channels can be left open-circuited because they are of low resistance.

Connection of active-type analog sensors (Voltage) to differential inputs

Differential inputs are very useful if analog sensors are used which are remotely non-isolated (e.g. the minus terminal is remotely grounded).

The use of differential inputs helps to considerably increase the measuring accuracy and to avoid ground loops.

With differential input configurations, two adjacent analog channels belong together (e.g. the channels 0 and 1). In this case, both channels are configured according to the desired operating mode. The lower address must be the even address (channel 0), the next higher address must be the odd address (channel 1). The converted analog value is available at the higher address (channel 1).

The analog value is calculated by subtraction of the input value with the higher address from the input value of the lower address.

The converted analog value is available at the odd channel (higher address).

CAUTION!
The ground potential at the sensors must not have too large a potential difference with respect to ZP (max. ±1 V within the full signal range). Otherwise, problems may occur concerning the common-mode input voltages of the involved analog inputs.

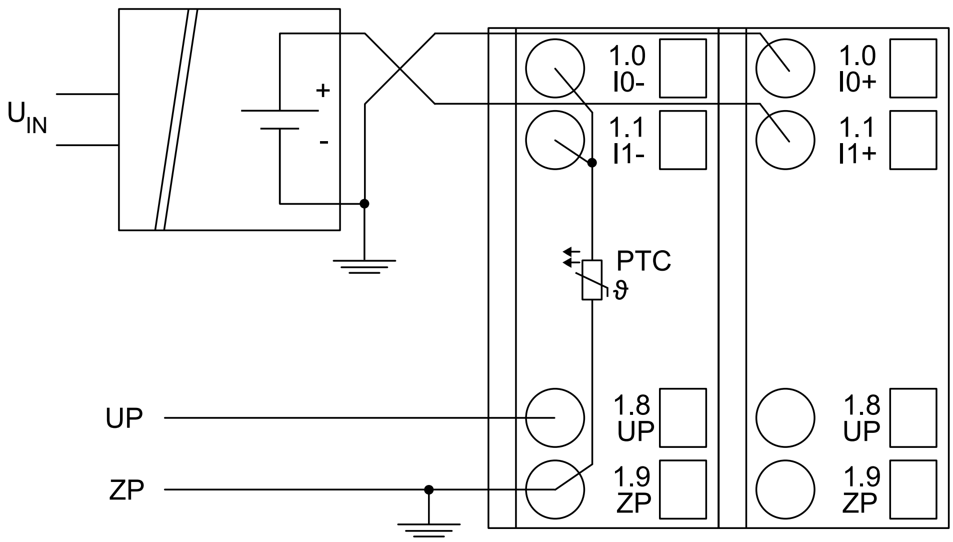


Fig. 184: Connection example

The negative pole of the sensor must be grounded next to the sensor.

Voltage	0 V ... 10 V	with differential inputs, 2 channels used
Voltage	-10 V ... +10 V	with differential inputs, 2 channels used

In order to avoid error messages or long processing times, it is useful to configure unused analog input channels as "unused".

Use of analog inputs as digital inputs

Several (or all) analog inputs can be configured as digital inputs. The inputs are not galvanically isolated against the other analog channels.

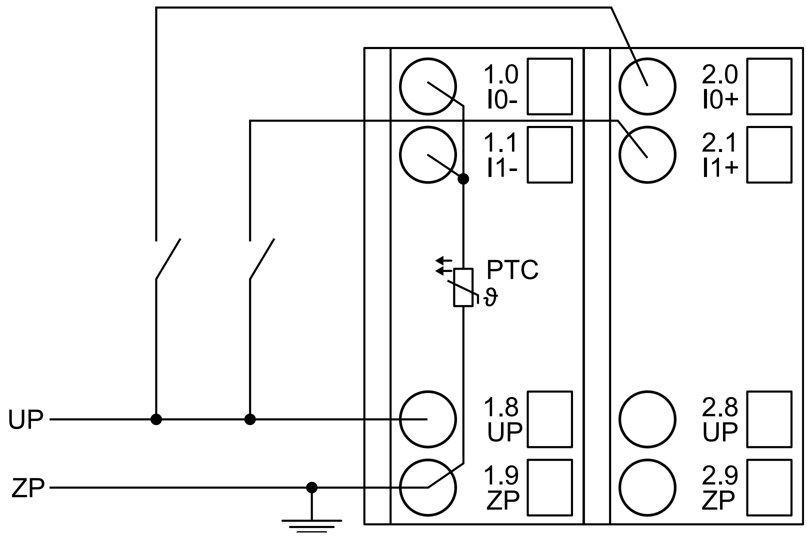


Fig. 185: Connection example

Digital input	24 V	1 channel used
Effect of incorrect input terminal connection		Wrong or no signal detected, no damage up to 35 V

Connection of analog output loads (Voltage, current)

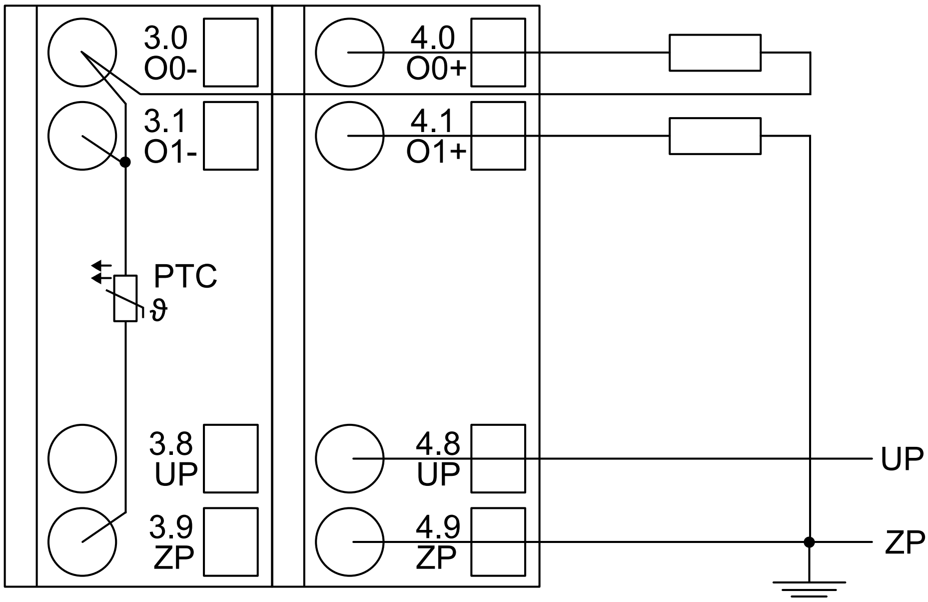


Fig. 186: Connection example

Voltage	-10 V ... +10 V	Load max. ± 10 mA	1 channel used
Current	0 mA ... 20 mA	Load 0 Ω ... 500 Ω	1 channel used
Current	4 mA ... 20 mA	Load 0 Ω ... 500 Ω	1 channel used

Only the channels 0 ... 3 can be configured as current output (0 mA ... 20 mA or 4 mA ... 20 mA).

Unused analog outputs can be left open-circuited.

Internal data exchange

Digital inputs (bytes)	0
Digital outputs (bytes)	0
Counter input data (words)	8
Counter output data (words)	8

I/O configuration

The module does not store configuration data itself. It gets its parameterization data from the master device of the I/O bus (CPU or communication interface module) during power-up of the system.

Hence, replacing I/O modules is possible without any re-parameterization via software.

Parameterization

Firmware version	Configuration
Firmware version > V2.0.0	The arrangement of the parameter data is performed by Control Builder Plus/ Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Module: Module slot address: Y = 1 ... 10

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Module slot address: Y = 1 ... 7

No.	Name	Value	Internal value	Internal value, type	Default	Min.	Max.	EDS Slot/ Index
1	Module ID	Internal	1500 [1])	Word	1500 0x05dc	0	65535	0x0Y01
2	Ignore module [2])	No Yes	0 1	Byte	No 0x00			not for FBP

No.	Name	Value	Internal value	Internal value, type	Default	Min.	Max.	EDS Slot/ Index
3	Parameter length in bytes	Internal	37	Byte	37-CPU 37-FBP	0	255	0x0Y02
4	Check supply	Off On	0 1	Byte	On 0x01	0	1	0x0Y03
5	Analog data format	Default	0	Byte	Default 0x00			0x0Y04
6	Behaviour of outputs at communication errors	Off Last value Substitute value	0 1+(n*5) 2+(n*5), n ≤ 2	Byte	Off 0x00	0	2	0x0Y05
7	Channel configuration Input channel 0	See table 'Channel configuration' *Table 204 “Channel configuration 2)” on page 769*		Byte	Default 0x00	0	19	0x0Y06
8	Channel monitoring Input channel 0	See table 'Channel monitoring' *Table 205 “Channel monitoring 3)” on page 770*		Byte	Default 0x00	0	3	0x0Y07
9 to 22	Channel configuration and channel monitoring of the input channels 1 ... 7	See table 'Channel configuration' *Table 204 “Channel configuration 2)” on page 769* and table 'Channel monitoring' *Table 205 “Channel monitoring 3)” on page 770*		Byte Byte	Default 0x00 0x00	0 0	19 3	0x0Y08 to 0x0Y15
23	Channel configuration Output channel 0	See table 'Channel configuration' *Table 204 “Channel configuration 2)” on page 769*		Byte	Default 0x00	0	130	0x0Y16

No.	Name	Value	Internal value	Internal value, type	Default	Min.	Max.	EDS Slot/ Index
24	Channel moni-toring Output channel 0	See table 'Channel monitoring' *Table 205 “Chan nel monitoring 3)” on page 770*		Byte	Default 0x00	0	3	0x0Y17
25	Substi-tute value Output channel 0	only valid for output channel 0	0 ... 0xffff	Word	Default 0x0000	0	65535	0x0Y18
26 to 31	Channel configu-ration and channel moni-toring of the output channels 1 ... 3	See table 'Channel con-figuration' *Table 204 “Chan nel configuration 2)” on page 769* and table 'Channel monitoring' *Table 205 “Chan nel monitoring 3)” on page 770*		Byte Byte	Default 0x00 0x00	0 0	130 3	0x0Y19 to 0x0Y1E
32	Channel configu-ration Output channel 4	See table 'Channel configuration' *Table 204 “Chan nel configuration 2)” on page 769*		Byte	Default 0x00	0	128	0x0Y1F
33	Channel moni-toring Output channel 4	See table 'Channel monitoring' *Table 205 “Chan nel monitoring 3)” on page 770*		Byte	Default 0x00	0	3	0x0Y20
34 to 39	Channel configu-ration and channel moni-toring of the output channels 5 ... 7	See table 'Channel con-figuration' *Table 204 “Chan nel configuration 2)” on page 769* and table 'Channel monitoring' *Table 205 “Chan nel monitoring 3)” on page 770*		Byte Byte	Default 0x00 0x00	0 0	128 3	0x0Y21 to 0x0Y26

1) With CS31 and addresses less than 70 and FBP, the value is increased by 1

2) Not with FBP

GSD file:

Ext_User_Prm_Data_Len =	24
Ext_User_Prm_Data_Const(0) =	0x05, 0xe2, 0x15, \
	0x01, 0x00, 0x00 \
	0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, \
	0x00, 0x00, 0x00, 0x00, \
	0x00, 0x00, 0x00, 0x00, 0x00, 0x00;

Table 203: Input channel (4x)

No.	Name	Internal value, type	Default
1	Channel configuration see table [2])	Byte	0 0x00 see table [2])
2	Channel monitoring see table [3])	Byte	0 0x00 see table [3])

Table 204: Channel configuration [2])

Internal value	Operating modes of the analog inputs, individually configurable
0	Unused (default)
1	Analog input 0 V ... 10 V
2	Digital input
3	Analog input 0 mA ... 20 mA
4	Analog input 4 mA ... 20 mA
5	Analog input -10 V ... +10 V
8	Analog input Pt100, -50 °C ... +400 °C (2-wire)
9	Analog input Pt100, -50 °C ... +400 °C (3-wire), requires 2 channels *)
10	Analog input 0 ... 10 V via differential inputs, requires 2 channels *)
11	Analog input -10 V ... +10 V via differential inputs, requires 2 channels *)
14	Analog input Pt100, -50 °C ... +70 °C (2-wire)
15	Analog input Pt100, -50 °C ... +70 °C (3-wire), requires 2 channels *)
16	Analog input Pt1000, -50 °C ... +400 °C (2-wire)
17	Analog input Pt1000, -50 °C ... +400 °C (3-wire), requires 2 channels *)
18	Analog input Ni1000, -50 °C ... +150 °C (2-wire)
19	Analog input Ni1000, -50 °C ... +150 °C (3-wire), requires 2 channels *)
	*) In the operating modes with 3-wire configuration or with differential inputs, two adjacent analog inputs belong together (e.g. the channels 0 and 1). In these cases, both channels are configured in the desired operating mode. The lower address must be the even address (channel 0). The next higher address must be the odd address (channel 1). The converted analog value is available at the higher address (channel 1).

Table 205: Channel monitoring [3])

Internal value	Monitoring
0	Plausibility, open-circuit (broken wire) and short circuit
3	No monitoring

Table 206: Output channel 0 (1 channel)

No.	Name	Value	Internal value	Internal value, type	Default
1	Channel configuration	see table [4])	see table [4])	Byte	see table [4])
2	Channel monitoring	see table [5])	see table [5])	Byte	see table [5])
3	Substitute value see table [6])	0 ... 65535	0 ... 0xffff	Word	0

Table 207: Output channels 1 ... 3 (3x)

No.	Name	Internal value, type
1	Channel configuration see table [4])	Byte
2	Channel monitoring see table [6])	Byte

Table 208: Channel configuration [4])

Internal value	Operating modes of the analog outputs, individually configurable
0	Unused (default)
128	Analog output -10 V ... +10 V
129	Analog output 0 mA ... 20 mA (not with the channels 4 ... 7 and 12 ... 15)
130	Analog output 4 mA ... 20 mA (not with the channels 4 ... 7 and 12 ... 15)

Table 209: Channel monitoring [5])

Internal value	Monitoring
0	Plausibility, open circuit (broken wire) and short circuit (default)
3	No monitoring

Table 210: Substitute value [6])

Intended behaviour of output channel when the control system stops	Required setting of the module parameter "Behaviour of outputs in case of a communication error"	Required setting of the channel parameter "Substitute value"
Output OFF	Off	0
Last value infinite	Last value	0

Intended behaviour of output channel when the control system stops	Required setting of the module parameter "Behaviour of outputs in case of a communication error"	Required setting of the channel parameter "Substitute value"
Last value for 5 s and then turn off	Last value 5 sec	0
Last value for 10 s and then turn off	Last value 10 sec	0
Substitute value infinite	Substitute value	Depending on configuration
Substitute value for 5 s and then turn off	Substitute value 5 sec	Depending on configuration
Substitute value for 10 s and then turn off	Substitute value 10 sec	Depending on configuration

Diagnosis

Table 211: Possible diagnosis of I/O channels

Output range	Condition	
	Output value in the PLC underflow	Output value in the PLC overflow
0 mA ... 20 mA	Error identifier = 7	Error identifier = 4
4 mA ... 20 mA		
-10 V ... +10 V		

Input range	Condition			
	Short circuit	Wire break	Input value underflow	Input value overflow
0 mA ... 20 mA	no diagnosis possible	no diagnosis possible	no diagnosis possible	Error identifier = 48
4 mA ... 20 mA	Error identifier = 7	Error identifier = 7	Error identifier = 7	Error identifier = 48
-10 V ... +10 V	no diagnosis possible	Error identifier = 48	Error identifier = 7	Error identifier = 48

Table 212: Content of diagnosis messages

E1 ... E4	**d1**	**d2**	**d3**	**d4**		**Identifier** **000 ... 063**	**AC500 display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**		**Err**	**PS501 PLC browser**	
Byte 6 **Bit 6 ... 7**	**-**	**Byte 3**	**Byte 4**	**Byte 5**		**Byte 6** **Bit 0 ... 5**	**FBP diag-nosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**		**Error Identifier**	**Error message**	**Remedy**
	1)	2)	3)	4)				
Module error								
3	14	1 ... 10	31	31		19	Checksum error in the I/O module	Replace I/O module
	11 / 12	ADR	1 ... 10					
3	14	1 ... 10	31	31		3	Timeout in the I/O module	Replace I/O module
	11 / 12	ADR	1 ... 10					
3	14	1 ... 10	31	31		40	Different hard-/firm-ware versions in the module	Replace I/O module
	11 / 12	ADR	1 ... 10					
3	14	1 ... 10	31	31		43	Internal error in the module	Replace I/O module
	11 / 12	ADR	1 ... 10					
3	14	1 ... 10	31	31		36	Internal data exchange failure	Replace I/O module
	11 / 12	ADR	1 ... 10					
3	14	1 ... 10	31	31		9	Overflow diagnosis buffer	New start
	11 / 12	ADR	1 ... 10					
3	14	1 ... 10	31	31		26	Parameter error	Check master
	11 / 12	ADR	1 ... 10					
3	14	1 ... 10	31	31		11	Process voltage too low	Check process voltage
	11 / 12	ADR	1 ... 10					
4	14	1 ... 10	31	31		45	Process voltage is switched off (ON −> OFF)	Process voltage ON
	11 / 12	ADR	1 ... 10					
Channel error								
				AX521	AX522			
4	14	1 ... 10	1	0 ... 3	0 ... 7	48	Analog value over-flow or broken wire at an analog input	Check input value or terminal
	11 / 12	ADR	1 ... 10					
4	14	1 ... 10	1	0...3	0 ... 7	7	Analog value under-flow at an analog input	Check input value
	11 / 12	ADR	1 ... 10					
4	14	1 ... 10	1	0 ... 3	0 ... 7	47	Short circuit at an analog input	Check terminal
	11 / 12	ADR	1 ... 10					

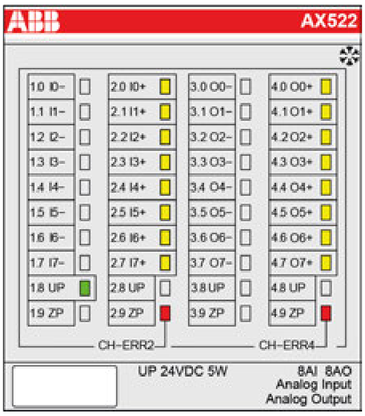
E1 ... E4	**d1**	**d2**	**d3**	**d4**		**Identifier 000 ... 063**	**AC500 display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**		**Err**	**PS501 PLC browser**	
Byte 6 Bit 6 ... 7	**-**	**Byte 3**	**Byte 4**	**Byte 5**		**Byte 6 Bit 0 ... 5**	**FBP diag-nosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**		**Error Identifier**	**Error message**	**Remedy**
	1)	**2)**	**3)**	**4)**				
4	14	1 ... 10	3	4 ... 7	8 ... 15	4	Analog value overflow at an analog output	Check output value
	11 / 12	ADR	1 ... 10					
4	14	1 ... 10	3	4 ... 7	8 ... 15	7	Analog value underflow at an analog output	Check output value
	11 / 12	ADR	1 ... 10					

Remarks:

1)	In AC500, the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The FBP diagnosis block does not contain this identifier.
2)	With "Device" the following allocation applies: 31 = module itself, 1 ... 10 = expansion module 1 ... 10, ADR = hardware address (e.g. of the DC551)
3)	With "Module" the following allocation applies depending on the master: Module error: I/O bus or FBP: 31 = module itself; COM1/COM2: 1 ... 10 = expansion 1 ... 10 Channel error: I/O bus or FBP = module type (1 = AI, 3 = AO); COM1/COM2: 1 ... 10 = expansion 1 ... 10
4)	In case of module errors, with channel "31 = Module itself" is output.

State LEDs

During the power ON procedure, the module initializes automatically. All LEDs (except the channel LEDs) are ON during this time.

<table>
<tr><th colspan="2">LED</th><th>State</th><th>Color</th><th>LED = OFF</th><th>LED = ON</th><th>LED flashes</th></tr>
<tr><td rowspan="6">
</td><td>Inputs I0 ... I7</td><td>Analog input</td><td>Yellow</td><td>Input is OFF</td><td>Input is ON (brightness depends on the value of the analog signal)</td><td>--</td></tr>
<tr><td>Outputs
O0 ... O7</td><td>Analog output</td><td>Yellow</td><td>Output is OFF</td><td>Output is ON (brightness depends on the value of the analog signal)</td><td>--</td></tr>
<tr><td>UP</td><td>Process voltage 24 V DC via terminal</td><td>Green</td><td>Process voltage is missing</td><td>Process voltage OK</td><td>--</td></tr>
<tr><td>CH-ERR2</td><td rowspan="2">Channel error, error messages in groups (analog inputs or outputs combined into the groups 2 and 4)
Module error</td><td>Red</td><td rowspan="2">No error or process voltage is missing</td><td rowspan="2">Severe error within the corresponding group</td><td rowspan="2">Error on one channel of the group</td></tr>
<tr><td>CH-ERR4</td><td>Red</td></tr>
<tr><td>CH-ERR *)</td><td></td><td>Red</td><td>--</td><td>Internal error</td><td>--</td></tr>
<tr><td></td><td colspan="6">*) Both LEDs (CH-ERR2 and CH-ERR4) light up together</td></tr>
</table>

Measuring ranges

Input ranges of voltage, current and digital input

The represented resolution corresponds to 16 bits.

<table>
<tr><th rowspan="2">Range</th><th rowspan="2">0 V ... 10 V</th><th rowspan="2">-10 V ... +10 V</th><th rowspan="2">0 mA ... 20 mA</th><th rowspan="2">4 mA ... 20 mA</th><th rowspan="2">Digital input</th><th colspan="2">Digital value</th></tr>
<tr><th>Decimal</th><th>Hex.</th></tr>
<tr><td>Overflow</td><td>>11.7589</td><td>>11.7589</td><td>>23.5178</td><td>>22.8142</td><td></td><td>32767</td><td>7FFF</td></tr>
<tr><td>Measured value too high</td><td>11.7589
.
.
10.0004</td><td>11.7589
:
10.0004</td><td>23.5178
:
20.0007</td><td>22.8142
:
20.0006</td><td></td><td>32511
:
27649</td><td>7EFF
:
6C01</td></tr>
<tr><td rowspan="2">Normal range</td><td>10.0000
:
0.0004</td><td>10.0000
:
0.0004</td><td>20.0000
:
0.0007</td><td>20.0000
:
4.0006</td><td>:
:
ON</td><td>27648
:
1</td><td>6C00
:
0001</td></tr>
<tr><td>0.0000</td><td>0.0000</td><td>0</td><td>4</td><td>OFF</td><td>0</td><td>0000</td></tr>
</table>

Range	0 V ... 10 V	-10 V ... +10 V	0 mA ... 20 mA	4 mA ... 20 mA	Digital input	Digital value	
						Decimal	Hex.
Normal range or measured value too low	-0.0004 -1.7593	-0.0004 : : -10.0000		3.9994 1.1858		-1 -4864 : -27648	FFFF ED00 : 9400
Measured value too low		-10.0004 : -11.7589				-27649 : -32512	93FF : 8100
Underflow	<-1.7593	<-11.7589	<0.0000	<1.1858		-32768	8000

Input ranges resistance temperature detector

Range	Pt100 / Pt 1000 -50 °C ... +70 °C	Pt100 / Pt1000 -50 °C ... +400 °C	Ni1000 -50 °C ... +150 °C	Digital value	
				Decimal	Hex.
Overflow	> +80.0 °C	> +450.0 °C	> +160.0 °C	32767	7FFF
Measured value too high		+450.0 °C : + 400.1 °C		4500 : 4001	1194 : 0FA1
			+160.0 °C : +150.1 °C	1600 : 1501	0640 : 05DD
	+80.0 °C : +70.1 °C			800 : 701	0320 : 02BD
Normal range	: : +70.0 °C : +0.1 °C	+400.0 °C : : : + 0.1 °C	: +150.0 °C : : + 0.1 °C	4000 1500 700 : 1	0FA0 05DC 02BC : 0001
	0.0 °C	0.0 °C	0.0 °C	0	0000
	-0.1 °C : -50.0 °C	-0.1 °C : -50.0 °C	-0.1 °C : -50.0 °C	-1 : -500	FFFF : FE0C
Measured value too low	-50.1 °C : -60.0 °C	-50.1 °C : -60.0 °C	-50.1 °C : -60.0 °C	-501 : -600	FE0B : FDA8
Underflow	< -60.0 °C	< -60.0 °C	< -60.0 °C	-32768	8000

Output ranges voltage and current

The represented resolution corresponds to 16 bits.

Range	-10 V ...+10 V	0 mA ... 20 mA	4 mA ... 20 mA	Digital value	
				Decimal	Hex.
Overflow	0 V	0 mA	0 mA	> 32511	> 7EFF
Value too high	11.7589 V : 10.0004 V	23.5178 mA : 20.0007 mA	22.8142 mA : 20.0006 mA	32511 : 27649	7EFF : 6C01
Normal range	10.0000 V : 0.0004 V	20.0000 mA : 0.0007 mA	20.0000 mA : 4.0006 mA	27648 : 1	6C00 : 0001
	0.0000 V	0.0000 mA	4.0000 mA	0	0000
	-0.0004 V : -10.0000 V	0 mA : 0 mA	3.9994 mA 0 mA 0 mA	-1 -6912 -27648	FFFF E500 9400
Value too low	-10.0004 V : -11.7589 V	0 mA : 0 mA	0 mA : 0 mA	-27649 : -32512	93FF : 8100
Underflow	0 V	0 mA	0 mA	< -32512	< 8100

Technical data

Technical data of the module

The system data of AC500 and S500 are applicable to the standard version ➪ *Chapter 2.6.1 “System data AC500” on page 1408*.

The system data of AC500-XC are applicable to the XC version ➪ *Chapter 2.7.1 “System data AC500-XC” on page 1475*.

Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

Parameter		Value
Process voltage		
	Connections	Terminals 1.8, 2.8, 3.8 and 4.8 for +24 V (UP) as well as 1.9, 2.9, 3.9 and 4.9 for 0 V (ZP)
	Rated value	24 V DC
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	Rated protection fuse on UP	10 A fast
	Galvanic isolation	Yes, per module
Current consumption		

Parameter		Value
	From 24 V DC power supply at the terminals UP/L+ and ZP/M of the CPU/communication interface module	Ca. 2 mA
	From UP at normal operation	0.15 A + output loads
Inrush current from UP (at power up)		0.020 A^2s
Max. length of analog cables, conductor cross section > 0.14 mm²		100 m
Weight		300 g
Mounting position		Horizontal or vertical with derating (output load reduced to 50 % at 40 °C per group)
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

NOTICE!
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and temporary overvoltage up to 30 V DC.

Technical data of the analog inputs

Parameter	Value	
Number of channels per module	8	
Distribution of channels into groups	1 group of 8 channels	
Connections of the channels I0- ...I7-	Terminals 1.0 ... 1.7	
Connections of the channels I0+ ... I7+	Terminals 2.0 ... 2.3	
Input type	Bipolar (not with current or Pt100/Pt1000/Ni1000)	
Galvanic isolation	Against internal supply and other modules	
Configurability	0 V ... 10 V, -10 V ... +10 V, 0 mA ... 20 mA, 4 mA ... 20 mA, Pt100/1000, Ni1000 (each input can be configured individually)	
Channel input resistance	Voltage: > 100 kΩ Current: ca. 330 Ω	
Time constant of the input filter	Voltage: 100 µs current: 100 µs	
Indication of the input signals	One LED per channel	
Conversion cycle	2 ms (for 8 inputs + 8 outputs), with Pt/Ni... 1 s	
Resolution	Range 0 V ... 10 V: 12 bits Range -10 V ... +10 V: 12 bits including sign Range 0 mA ... 20 mA: 12 bits Range 4 mA ... 20 mA: 12 bits	
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range	Typ.	± 0.5 % of full scale at 25 °C

Parameter	Value	
	Max.	± 1 % of full scale (all ranges) at 0 °C ... 60 °C or EMC disturbance
Unused voltage inputs	Are configured as "unused"	
Unused current inputs	Have a low resistance, can be left open-circuited	
Overvoltage protection	Yes	

Technical data of the analog inputs, if used as digital Inputs

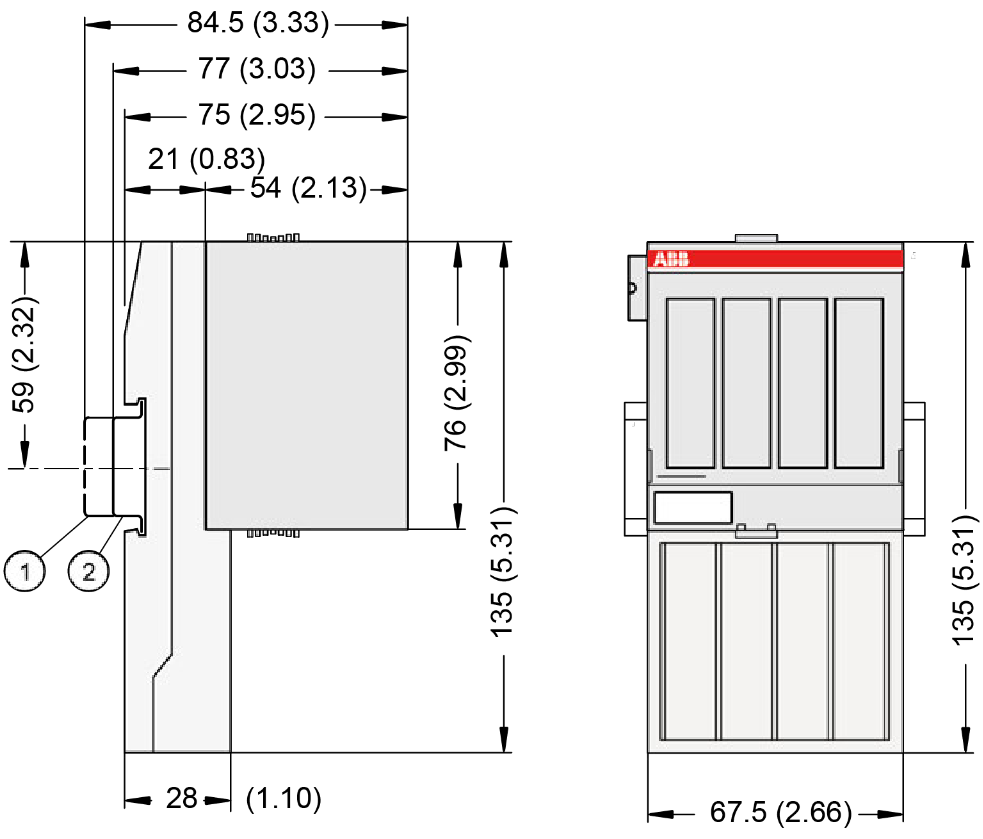
Parameter		Value
Number of channels per module		Max. 8
Distribution of channels into groups		1 group of 8 channels
Connections of the channels I0+ ... I7+		Terminals 2.0 ... 2.7
Reference potential for the inputs		Terminals 1.9, 2.9, 3.9 and 4.9 (ZP)
Input signal delay		Typ. 8 ms, configurable from 0.1 ms ... 32 ms
Indication of the input signals		1 LED per channel
Input signal voltage		24 V DC
	Signal 0	-30 V ... +5 V
	Undefined signal	+5 V ... +13 V
	Signal 1	+13 V ... +30 V
Input current per channel		
	Input voltage +24 V	Typ. 7 mA
	Input voltage +5 V	Typ. 1.4 mA
	Input voltage +15 V	Typ. 4.3 mA
	Input voltage +30 V	< 9 mA
Input resistance		Ca. 3.5 kΩ

Technical data of the analog outputs

Parameter		Value
Number of channels per module		8, all channels for voltage, the first 4 channels also for current
Distribution of channels into groups		1 group of 8 channels
	Channels O0- ... O7-	Terminals 3.0 ... 3.7
	Channels O0+ ... O7+	Terminals 4.0 ... 4.7
Output type		Bipolar with voltage, unipolar with current
Galvanic isolation		Against internal supply and other modules
Configurability		-10 V ... +10 V, 0 mA ... 20 mA, 4 mA ... 20 mA (each output can be configured individually), current outputs only channels 0 ... 3
Output resistance (load), as current output		0 Ω ... 500 Ω

Parameter	Value	
Output loadability, as voltage output	Max. ± 10 mA	
Indication of the output signals	One LED per channel	
Resolution	12 bits including sign	
Settling time for full range change (resistive load, output signal within specified tolerance)	Typ. 5 ms	
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range	Typ.	± 0.5 % of full scale at 25 °C
	Max.	± 1 % of full scale (all ranges) at 0 °C ... 60 °C or EMC disturbance
Relationship between output signal and hex code		
Unused outputs	Can be left open-circuited	

Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 250 000 R0001	AX522, analog input/output module, 8 AI, 8 AO, U/I/Pt100, 12 bits including sign, 2-wires	Active
1SAP 450 000 R0001	AX522-XC, analog input/output module, 8 AI, 8 AO, U/I/Pt100, 12 bits including sign, 2-wires, XC version	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

1.6.3 Digital/Analog I/O modules

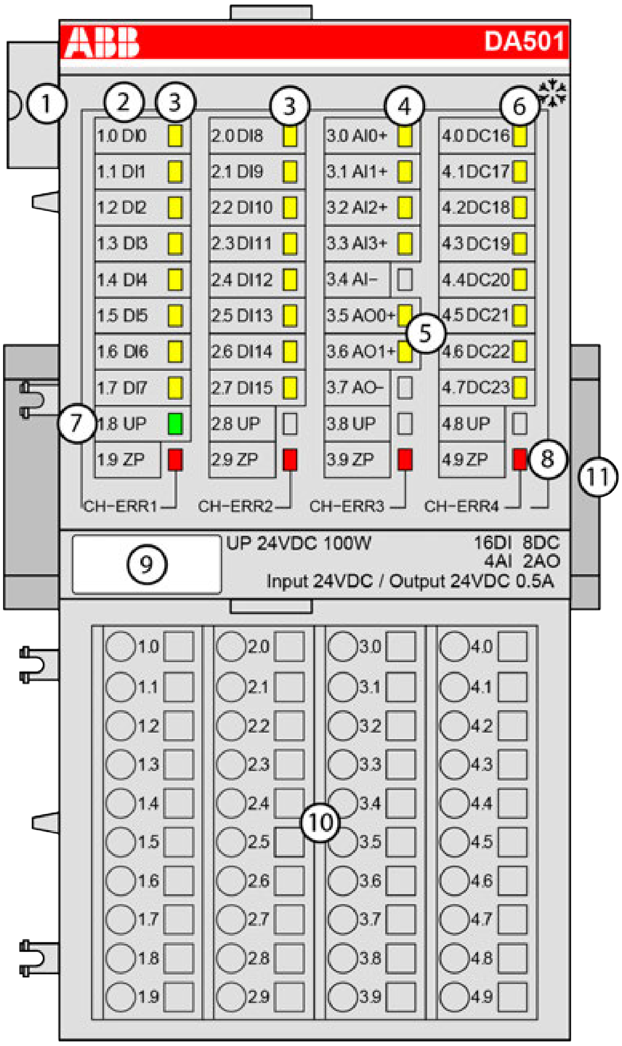
1.6.3.1 S500

1.6.3.1.1 DA501 - Digital/Analog input/output module

Features

- 16 digital inputs 24 V DC
- 8 configurable digital inputs/outputs 24 V DC, 0.5 A max.
- 4 analog inputs, voltage, current and RTD.
  Resolution 12 bits including sign
- 2 analog outputs, voltage and current
  Resolution 12 bits including sign
- Fast counter

- Module-wise galvanically isolated
- XC version for use in extreme ambient conditions available



1 I/O bus
2 Allocation between terminal number and signal name
3 16 yellow LEDs to display the signal states of the digital inputs DI0 ... DI15
4 4 yellow LEDs to display the signal states of the analog inputs AI0 ... AI3
5 2 yellow LEDs to display the signal states of the analog outputs AO0 ... AO1
6 8 yellow LEDs to display the signal state of the configurable digital inputs/outputs DC16 ... DC23
7 1 green LED to display the state of the process supply voltage UP
8 4 red LEDs to display errors
9 Label
10 Terminal unit
11 DIN rail
Sign for XC version

Intended purpose

The device can be used as a decentralized I/O extension module for S500 communication interface modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs.

Functionality

- 16 digital inputs 24 V DC
- 8 configurable digital inputs/outputs 24 V DC, 0.5 A max.

- 4 analog inputs, voltage, current and RTD.
  Resolution 12 bits including sign
- 2 analog outputs, voltage and current
  Resolution 12 bits including sign
- Fast counter

Parameter	Value
Fast Counter	Integrated, many configurable operating modes
Power supply	From the process supply voltage UP
LED displays	For system displays, signal states, errors and power supply
Internal supply voltage	Via the I/O bus interface (I/O bus)
External supply voltage	Via terminals UP and ZP (process supply voltage 24 V DC)
Effect of incorrect input terminal connection	Wrong or no signal detected, no damage up to 35 V
Required terminal unit	TU515 or TU516 *Chapter 1.5.3 “TU515, TU516, TU541 and TU542 for I/O modules” on page 282*

Connections

For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.

The connection is carried out by using the 40 terminals of the terminal unit TU515/TU516 *Chapter 1.5.3 “TU515, TU516, TU541 and TU542 for I/O modules” on page 282*.

The assignment of the terminals:

Terminal	Signal	Description
1.0	DI0	Signal of the digital input DI0
1.1	DI1	Signal of the digital input DI1
1.2	DI2	Signal of the digital input DI2
1.3	DI3	Signal of the digital input DI3
1.4	DI4	Signal of the digital input DI4
1.5	DI5	Signal of the digital input DI5
1.6	DI6	Signal of the digital input DI6
1.7	DI7	Signal of the digital input DI7
1.8	UP	Process voltage UP (24 V DC)
1.9	ZP	Process voltage ZP (0 V DC)
2.0	DI8	Signal of the digital input DI8
2.1	DI9	Signal of the digital input DI9
2.2	DI10	Signal of the digital input DI10

Terminal	Signal	Description
2.3	DI11	Signal of the digital input DI11
2.4	DI12	Signal of the digital input DI12
2.5	DI13	Signal of the digital input DI13
2.6	DI14	Signal of the digital input DI14
2.7	DI15	Signal of the digital input DI15
2.8	UP	Process voltage UP (24 V DC)
2.9	ZP	Process voltage ZP (0 V DC)
3.0	AI0+	Positive pole of analog input signal 0
3.1	AI1+	Positive pole of analog input signal 1
3.2	AI2+	Positive pole of analog input signal 2
3.3	AI3+	Positive pole of analog input signal 3
3.4	AI-	Negative pole of analog input signals 0 to 3
3.5	AO0+	Positive pole of analog output signal 0
3.6	AO1+	Positive pole of analog output signal 1
3.7	AO-	Negative pole of analog output signals 0 and 1
3.8	UP	Process voltage UP (24 V DC)
3.9	ZP	Process voltage ZP (0 V DC)
4.0	C16	Signal of the configurable digital input/ output C16
4.1	C17	Signal of the configurable digital input/ output C17
4.2	C18	Signal of the configurable digital input/ output C18
4.3	C19	Signal of the configurable digital input/ output C19
4.4	C20	Signal of the configurable digital input/ output C20
4.5	C21	Signal of the configurable digital input/ output C21
4.6	C22	Signal of the configurable digital input/ output C22
4.7	C23	Signal of the configurable digital input/ output C23
4.8	UP	Process voltage UP (24 V DC)
4.9	ZP	Process voltage ZP (0 V DC)

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a communication interface module or a CPU). Thus, the current consumption from 24 V DC power supply at the terminals L+/UP and M/ZP of the CPU/communication interface module increases by 2 mA per DA501.

The external power supply connection is carried out via the UP (+24 V DC) and the ZP (0 V DC) terminals.

WARNING!
Removal/Insertion under power
Removal or insertion under power is permissible only if all conditions for hot swapping are fullfilled.

↳ *Conditions for hot swap*

↳ *“Conditions for hot swap” on page 1367*

The devices are not designed for removal or insertion under power when the conditions for hot swap do not apply. Because of unforeseeable consequences, it is not allowed to plug in or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

Disconnecting any powered devices while they are energized in a hazardous location could result in an electric arc, which could create an ignition source resulting in fire or explosion.

Prior to proceeding, make sure that power is been disconnected and that the area has been thoroughly checked to ensure that flammable materials are not present.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!
Risk of damaging the PLC modules!
Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

NOTICE!
Risk of damaging the PLC modules!
The PLC modules must not be removed while the plant is connected to a power supply.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove or replace a module.

CAUTION!
Risk of imprecise and faulty measurements!
Analog signals may be distorted seriously by external electromagnetic influences.

Use shielded wires when wiring analog signal sources. The cable shield must be grounded at both ends of the cable. Provide a potential equalization of a low resistance to avoid high potential differences between different parts of the plant.

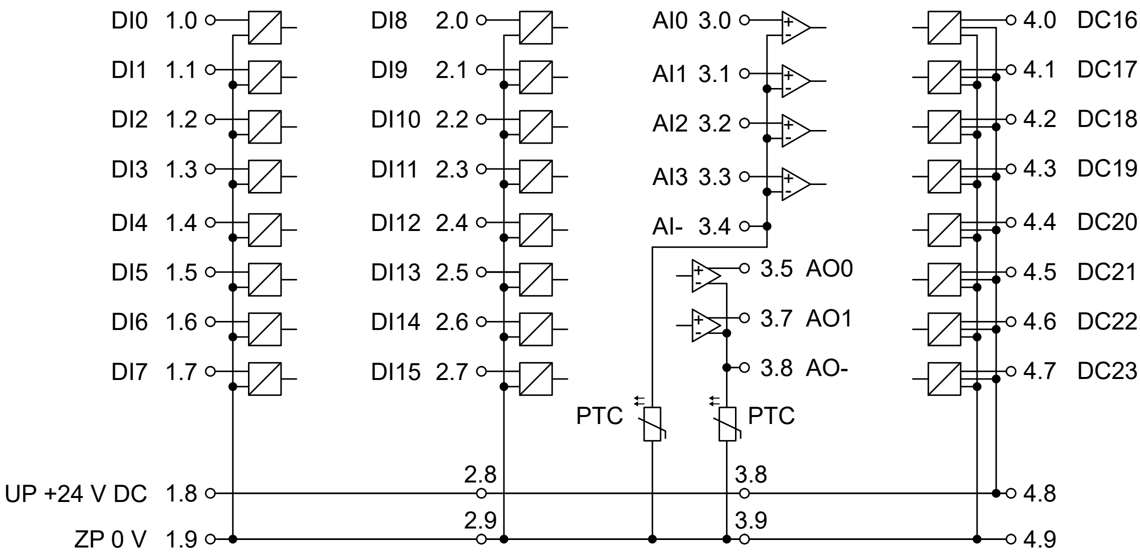


Fig. 187: Terminal assignment of the module

The module provides several diagnosis functions *Chapter 1.6.3.1.1.8 “Diagnosis” on page 801*.

Connection of the digital inputs

The following figure shows the connection of the digital input DI0. Proceed with the digital inputs DI1 ... DI15 in the same way.

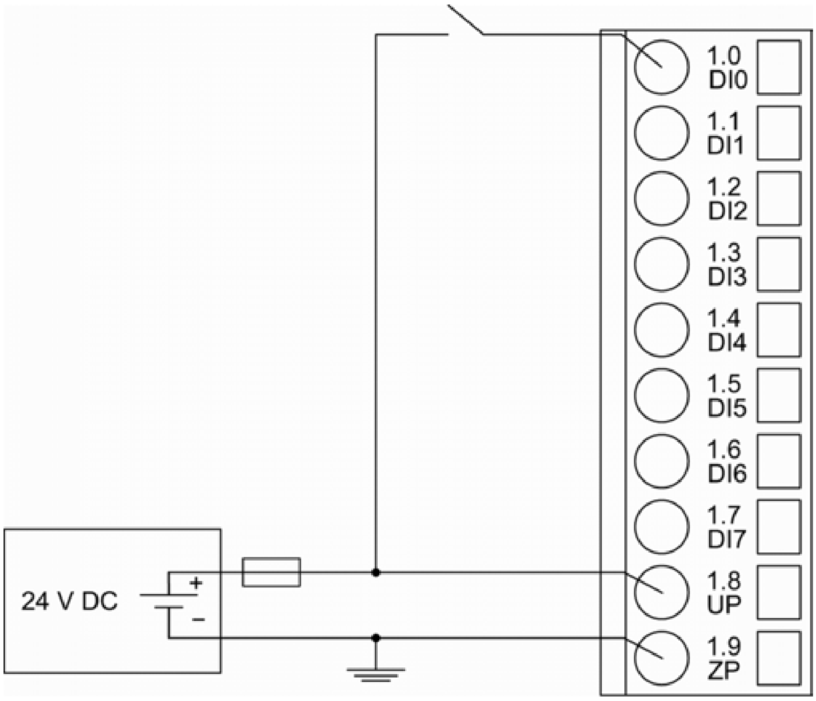


Fig. 188: Connection of the module

The meaning of the LEDs is described in the Displays chapter *Chapter 1.6.3.1.1.9 “State LEDs” on page 803*.

Connection of the configurable digital inputs/outputs

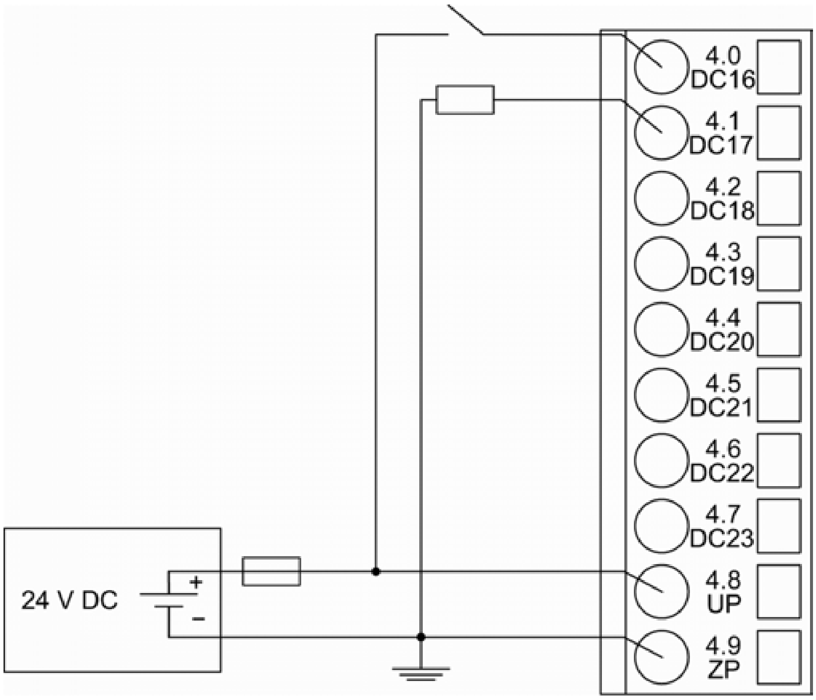


Fig. 189: Connection of configurable digital inputs/outputs to the module (DC16 ... DC23) (DC16 as an input, DC17 as an output)

> **CAUTION!**
> **Risk of influences to the connected sensors!**
> Some sensors may be influenced by the deactivated module outputs of DA501.
>
> If the inputs are used as fast counter inputs, connect a 470 Ω / 1 W resistor in series to inputs DC16/DC17.

Connection of resistance thermometers in 2-wire configuration to the analog inputs

When resistance thermometers (Pt100, Pt1000, Ni1000) are used, a constant current must flow through them to build the necessary voltage drop for the evaluation. For this, the module DA501 provides a constant current source which is multiplexed over the max. 4 analog input channels.

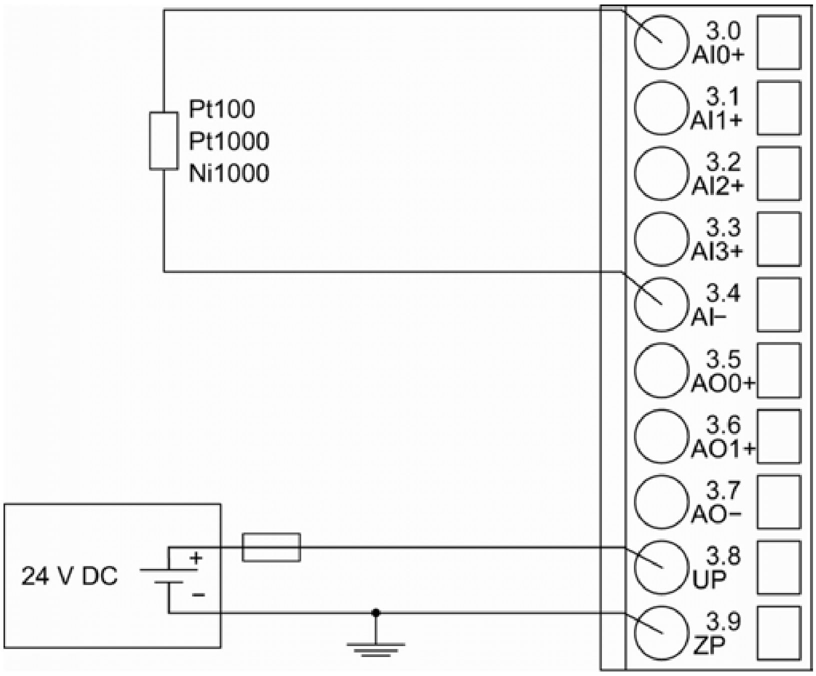


Fig. 190: Connection of resistance thermometers in 2-wire configuration to the analog inputs (AI0 to AI3)

The following measuring ranges can be configured *Chapter 1.6.3.1.1.7 "Parameterization" on page 796*:

Pt100	-50 °C ... +400 °C	2-wire configuration, 1 channel used
Pt1000	-50 °C ... +400 °C	2-wire configuration, 1 channel used
Ni1000	-50 °C ... +150 °C	2-wire configuration, 1 channel used

The function of the LEDs is described under Diagnosis and displays / Displays *Chapter 1.6.3.1.1.9 "State LEDs" on page 803*.

The module DA501 performs a linearization of the resistance characteristic.

To avoid error messages from unused analog input channels, configure them as "unused".

Connection of resistance thermometers in 3-wire configuration to the analog inputs

When resistance thermometers (Pt100, Pt1000, Ni1000) are used, a constant current must flow through them to build the necessary voltage drop for the evaluation. For this, the module DA501 provides a constant current source which is multiplexed over the max. 4 analog input channels.

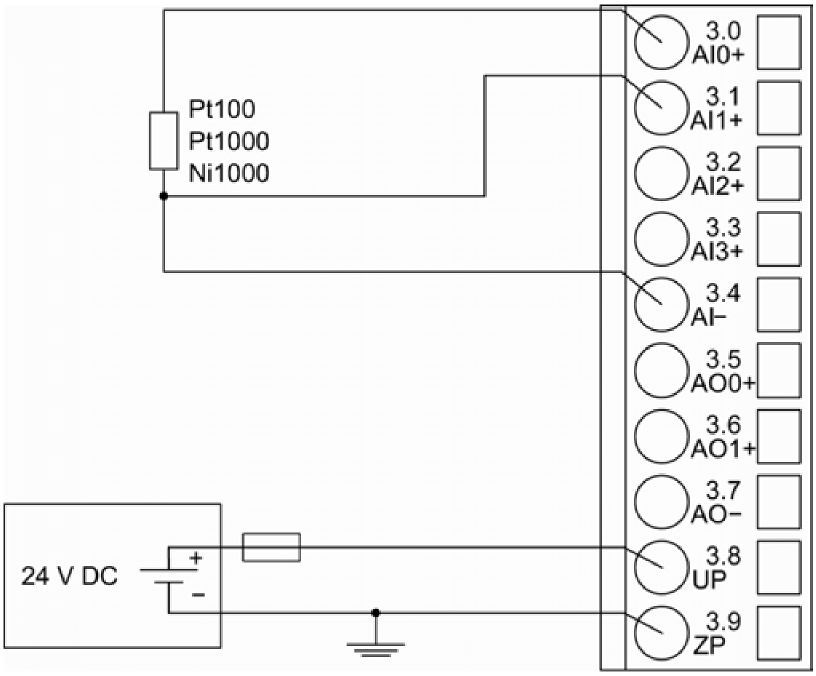


Fig. 191: Connection of resistance thermometers in 3-wire configuration to the analog inputs (AI0 ... AI3)

With 3-wire configuration, 2 adjacent analog channels belong together (e. g. the channels 0 and 1). In this case, both channels are configured according to the desired operating mode. The lower address must be the even address (channel 0), the next higher address must be the odd address (channel 1).

The constant current of one channel flows through the resistance thermometer. The constant current of the other channel flows through one of the cores. The module calculates the measured value from the two voltage drops and stores it under the input with the higher channel number (e. g. I1).

In order to keep measuring errors as small as possible, it is necessary to have all the involved conductors in the same cable. All the conductors must have the same cross section.

The following measuring ranges can be configured ⇘ *Chapter 1.6.3.1.1.7 “Parameterization” on page 796*:

Pt100	-50 °C ... +400 °C	3-wire configuration, 2 channels used
Pt1000	-50 °C ... +400 °C	3-wire configuration, 2 channels used
Ni1000	-50 °C ... +150 °C	3-wire configuration, 2 channels used

The function of the LEDs is described under Diagnosis and displays / Displays ⇘ *Chapter 1.6.3.1.1.8 “Diagnosis” on page 801*.

0

The module DA501 performs a linearization of the resistance characteristic.

To avoid error messages from unused analog input channels, configure them as "unused".

Connection of active-type analog sensors (Voltage) with galvanically isolated power supply to the analog inputs

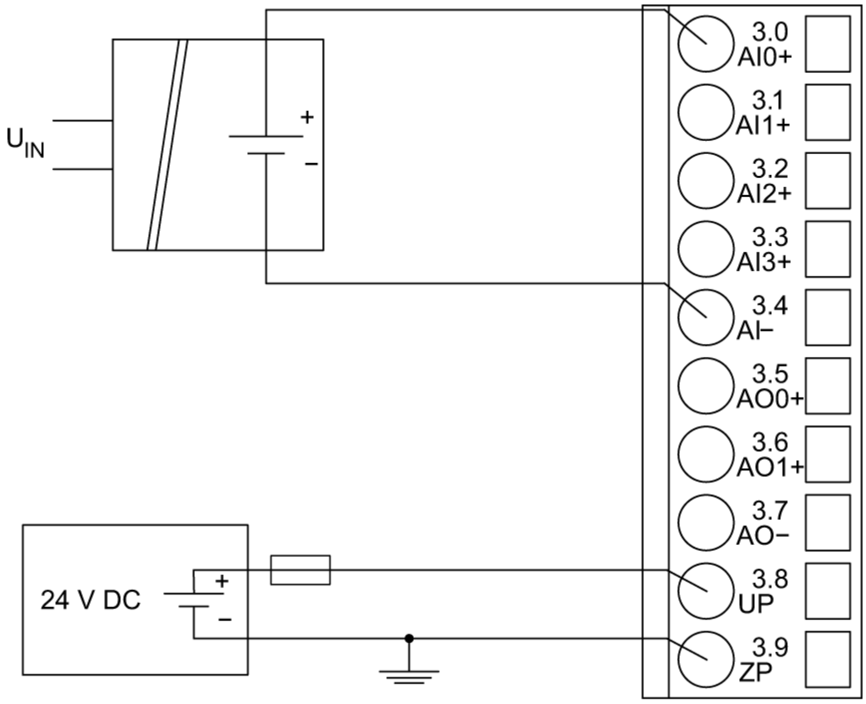


Fig. 192: Connection of active-type analog sensors (voltage) with galvanically isolated power supply to the analog inputs (AI0 ... AI3)

The following measuring ranges can be configured ⇘ *Chapter 1.6.3.1.1.7 “Parameterization” on page 796*:

Voltage	0 V ... 10 V	1 channel used
Voltage	-10 V ... +10 V	1 channel used

The function of the LEDs is described under Diagnosis and displays / Displays ⇘ *Chapter 1.6.3.1.1.9 “State LEDs” on page 803*.

To avoid error messages from unused analog input channels, configure them as "unused".

Connection of active-type analog sensors (Current) with galvanically isolated power supply to the analog inputs

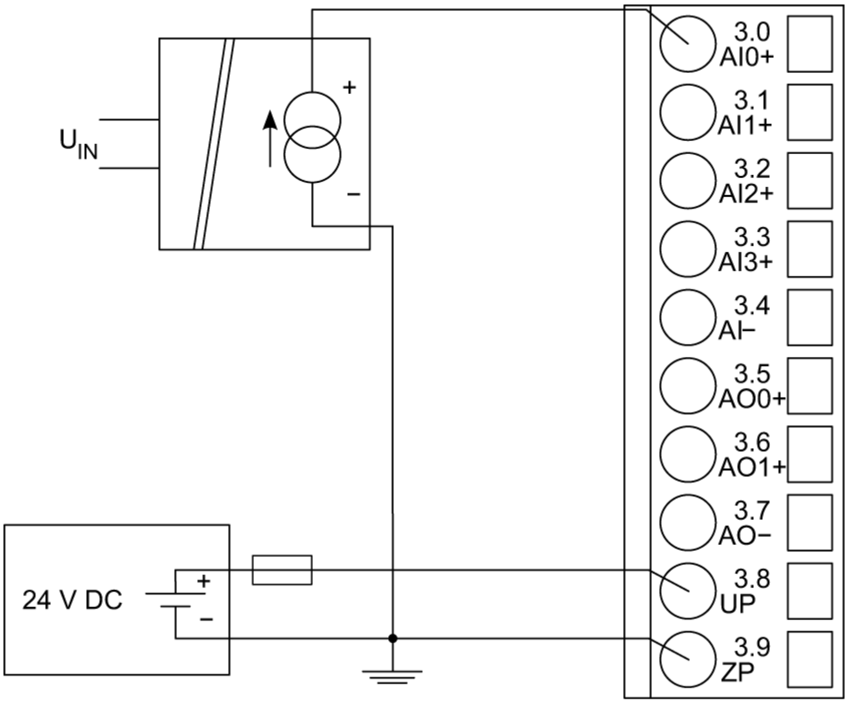


Fig. 193: Connection of active-type analog sensors (current) with galvanically isolated power supply to the analog inputs (AI0 ... AI3)

The following measuring ranges can be configured ⇘ *Chapter 1.6.3.1.1.7 “Parameterization” on page 796*:

Current	0 mA ... 20 mA	1 channel used
Current	4 mA ... 20 mA	1 channel used

The function of the LEDs is described under Diagnosis and displays / Displays ⇘ *Chapter 1.6.3.1.1.9 “State LEDs” on page 803*.

Unused input channels can be left open-circuited, because they are of low resistance.

Connection of active-type analog sensors (Voltage) with no galvanically isolated power supply to the analog inputs

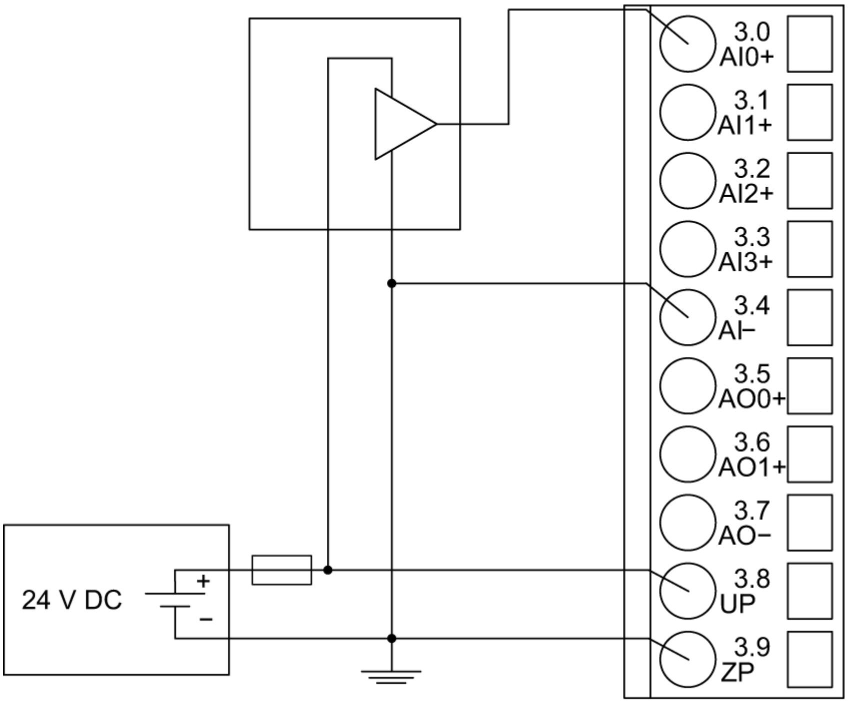


Fig. 194: Connection of active-type sensors (voltage) with no galvanically isolated power supply to the analog inputs (AI0 ... AI3)

CAUTION!
Risk of faulty measurements!
The negative pole at the sensors must not have too big a potential difference with respect to ZP (max. ± 1 V within the full signal range).

Make sure that the potential difference never exceeds ± 1 V.

The following measuring ranges can be configured ➪ *Chapter 1.6.3.1.1.7 “Parameterization” on page 796*:

Voltage	0 V ... 10 V	1 channel used
Voltage	-10 V ... +10 V	1 channel used

For a description of the function of the LEDs, please refer to the Diagnosis and displays / Displays chapter ➪ *Chapter 1.6.3.1.1.9 “State LEDs” on page 803*.

To avoid error messages from unused analog input channels, configure them as "unused".

Connection of passive-type analog sensors (Current) to the analog inputs

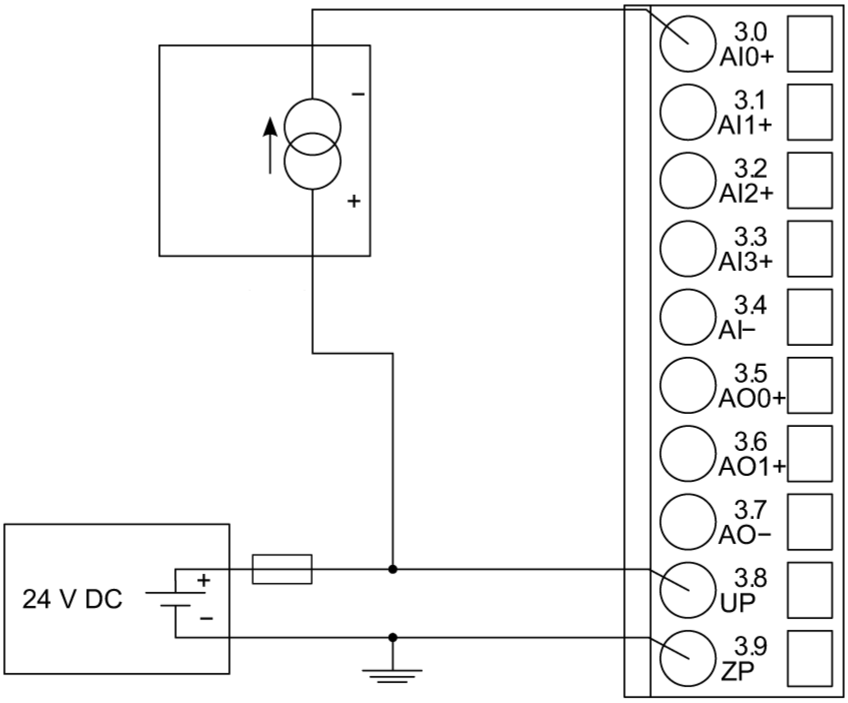


Fig. 195: Connection of passive-type analog sensors (current) to the analog inputs (AI0 to AI3)

The following measuring ranges can be configured ↳ *Chapter 1.6.3.1.1.7 "Parameterization" on page 796*:

Current	4 mA ... 20 mA	1 channel used

For a description of function of the LEDs, please refer to the Diagnosis and displays / Displays chapter ↳ *Chapter 1.6.3.1.1.9 "State LEDs" on page 803*.

CAUTION!
Risk of overloading the analog input!
If an analog current sensor supplies more than 25 mA for more than 1 second during initialization, this input is switched off by the module (input protection).

Only use sensors with fast initialization or without current peaks higher than 25 mA. If not possible, connect a 10-volt Zener diode in parallel to I+ and ZP.

Unused input channels can be left open-circuited, because they are of low resistance.

Connection of active-type analog sensors (Voltage) to differential analog inputs

Differential inputs are very useful if analog sensors which are remotely non-isolated (e.g. the negative terminal is remotely grounded) are used.

Using differential inputs helps to considerably increase the measuring accuracy and to avoid ground loops.

With differential input configurations, two adjacent analog channels belong together (e.g. the channels 0 and 1). In this case, both channels are configured according to the desired operating mode. The lower address must be the even address (channel 0), the next higher address must be the odd address (channel 1). The converted analog value is available at the higher address (channel 1).

The analog value is calculated by subtraction of the input value with the higher address from the input value of the lower address.

The converted analog value is available at the odd channel (higher address).

> **CAUTION!**
> **Risk of faulty measurements!**
> The negative pole at the sensors must not have too large a potential difference with respect to ZP (max. ± 1 V within the full signal range).
>
> Make sure that the potential difference never exceeds ± 1 V.

The following figure shows the connection of active-type analog sensors (voltage) to differential analog inputs AI0 and AI1. Proceed with AI2 and AI3 in the same way.

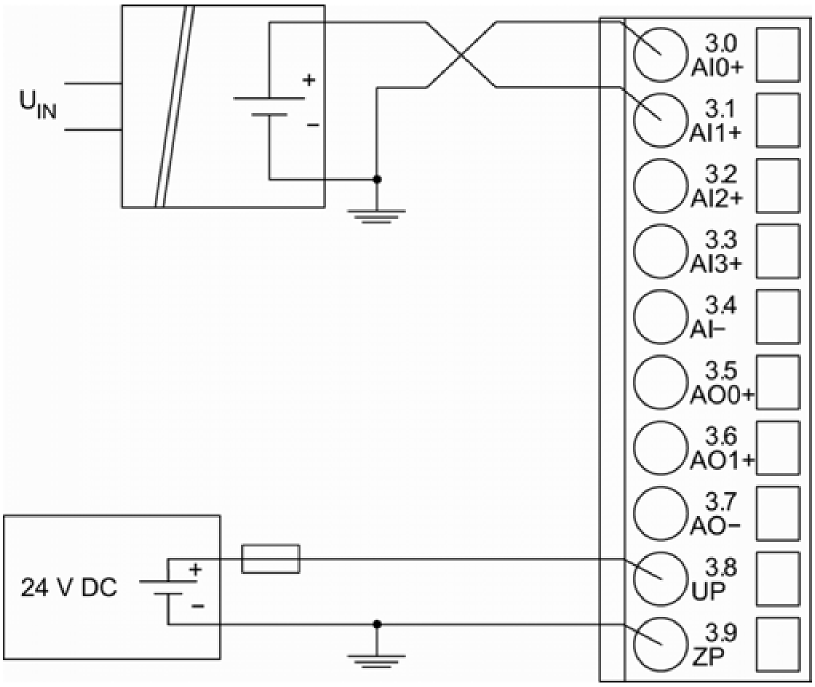


Fig. 196: Connection of active-type analog sensors (voltage) to differential analog inputs (AI0 ... AI3)

The following measuring ranges can be configured ✎ *Chapter 1.6.3.1.1.7 "Parameterization" on page 796*:

Voltage	0 V ... 10 V	with differential inputs, 2 channels used
Voltage	-10 V ... +10 V	with differential inputs, 2 channels used

For a description of the function of the LEDs, please refer to the Diagnosis and displays / Displays chapter ✎ *Chapter 1.6.3.1.1.9 "State LEDs" on page 803.*

To avoid error messages from unused analog input channels, configure them as "unused".

Use of analog inputs as digital inputs

Several (or all) analog inputs can be configured as digital inputs. The inputs are not galvanically isolated against the other analog channels.

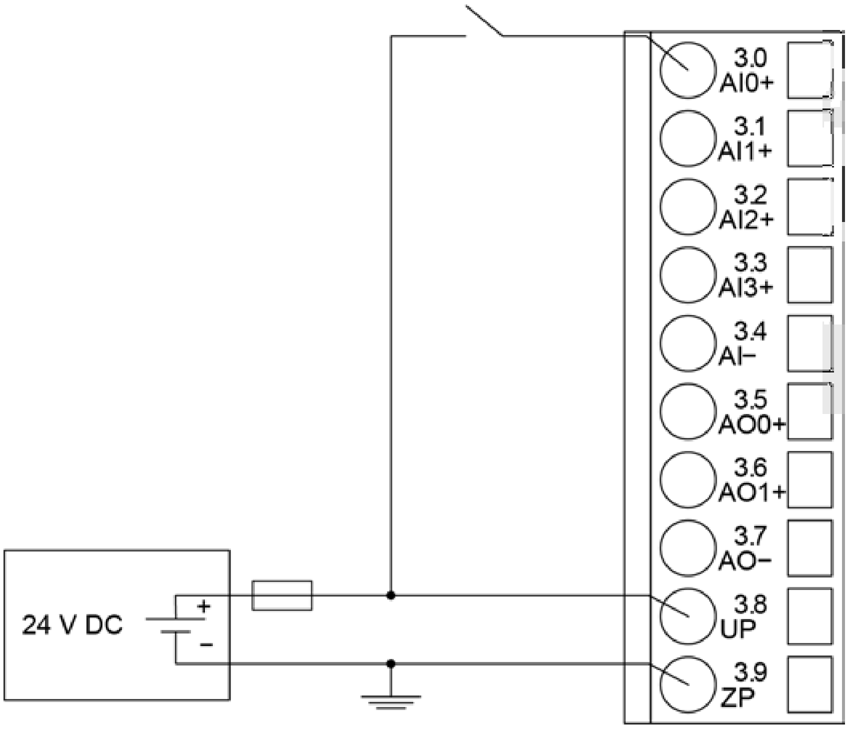


Fig. 197: connection of digital sensors to the analog inputs (AI0 ... AI3)

The following measuring ranges can be configured ✎ *Chapter 1.6.3.1.1.7 “Parameterization” on page 796*:

Digital input	24 V	1 channel used

For a description of the function of the LEDs, please refer to the Diagnosis and displays / Displays chapter ✎ *Chapter 1.6.3.1.1.9 “State LEDs” on page 803*.

Connection of analog output loads (Voltage)

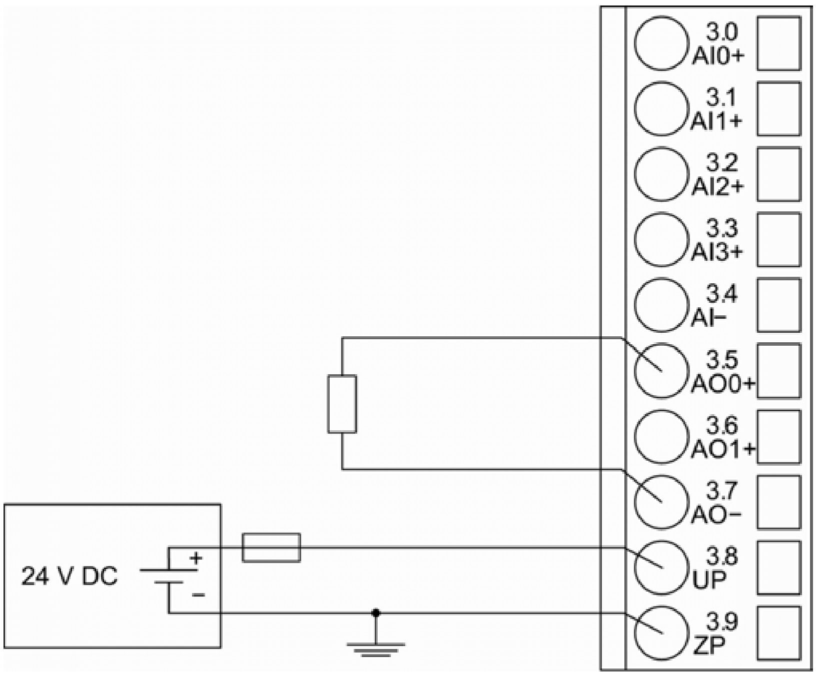


Fig. 198: Connection of analog output loads (voltage) to the analog outputs (AO0 and AO1)

The following measuring ranges can be configured ✎ *Chapter 1.6.3.1.1.7 “Parameterization” on page 796* :

Voltage	-10 V ... +10 V	Load ± 10 mA max.	1 channel used

For a description of the function of the LEDs, please refer to the Diagnosis and displays / Displays chapter ✎ *Chapter 1.6.3.1.1.9 “State LEDs” on page 803*.

Unused analog outputs can be left open-circuited.

Connection of analog output loads (Current)

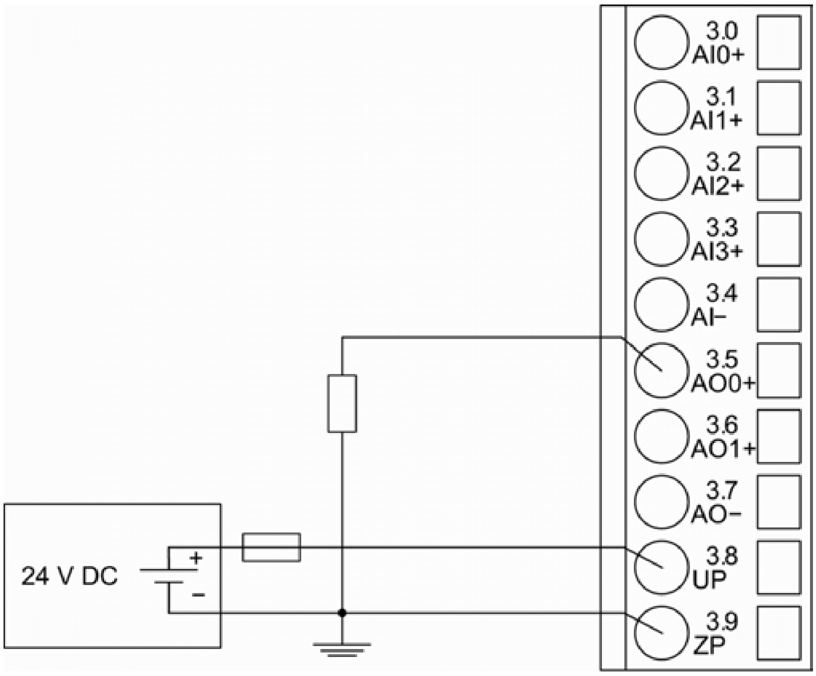


Fig. 199: Connection of analog output loads (current) to the analog outputs (AO0 and AO1)

The following measuring ranges can be configured ✎ *Chapter 1.6.3.1.1.7 “Parameterization” on page 796*:

0

Current	0 mA ... 20 mA	Load 0 Ω ... 500 Ω	1 channel used
Current	4 mA ... 20 mA	Load 0 Ω ... 500 Ω	1 channel used

For a description of the function of the LEDs, please refer to the Diagnosis and displays / Displays chapter ✎ *Chapter 1.6.3.1.1.9 “State LEDs” on page 803*.

Unused analog outputs can be left open-circuited.

Internal data exchange

	Without the fast counter	**With the fast counter (only with AC500)**
Digital inputs (bytes)	3	5
Digital outputs (bytes)	1	3
Analog inputs (words)	4	4

	Without the fast counter	With the fast counter (only with AC500)
Digital outputs (words)	2	2
Counter input data (words)	0	4
Counter output data (words)	0	8

I/O configuration

The module does not store configuration data itself. It gets its parameterization data from the master device of the I/O bus (CPU or communication interface module) during power-up of the system.

Hence, replacing I/O modules is possible without any re-parameterization via software.

Parameterization

Firmware version	Configuration
Firmware version > V2.0.0	The arrangement of the parameter data is performed by Control Builder Plus/ Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Module: Module slot address: Y = 1 ... 10

Name	Value	Internal value	Internal value, type	Default	EDS Slot / Index
Module ID [1])	Internal	1810	WORD	1810	0x0Y01
Ignore module see table [2])	Internal	Yes No	BYTE	No	not for FBP
Parameter length	Internal	8	BYTE	8	0xY02
Check supply	off	0	BYTE	1	0xY03
	on	1			

Name	Value	Internal value	Internal value, type	Default	EDS Slot / Index
Fast counter 3)	0 : 10 4)	0 : 10	BYTE	0	not for FBP
Behavior outputs at comm. error 5)	Off Last value Last value 5 sec Last value 10 sec Substitute value Substitute value 5 sec Substitute value 10 sec	0 1 6 11 2 7 12	BYTE	Off 0x00	0x0Y07

2)	Setting	Description
	On	Error LED lights up at errors of all error classes, Failsafe mode off
	Off by E4	Error LED lights up at errors of error classes E1, E2 and E3, Failsafe mode off
	Off by E3	Error LED lights up at errors of error classes E1 and E2, Failsafe mode off
	On +Failsafe	Error LED lights up at errors of all error classes, Failsafe mode on *)
	Off by E4 + Failsafe	Error LED lights up at errors of error classes E1, E2 and E3, Failsafe mode on *)
	Off by E3 + Failsafe	Error LED lights up at errors of error classes E1 and E2, Failsafe mode on *)

Remarks:

1) With a faulty ID, the Modules reports a "parameter error" and does not perform cyclic process data transmission

2) Not for FBP

3) With FBP or CS31 without the parameter "Fast Counter"

The fast counter of the module does not work if the module is connected to an FBP interface module or CS31 bus module.

4) For counter operating modes, please refer to the description of the fast counter *Chapter 1.6.1.2.10 “Fast counter” on page 545*

5) The parameter Behavior outputs at comm. error is only analyzed if the Failsafe-mode is ON.

Group parameters for the digital part

Name	Value	Internal value	Internal value, type	Default	EDS Slot / Index
Input delay	0.1 ms 1 ms 8 ms 32 ms	0 1 2 3	BYTE	0.1 ms 0x00	0x0Y05
Detect short circuit at outputs	Off On	0 1	BYTE	On 0x01	0x0Y06
Substitute value at output	0 ... 255	00h ... FFh	BYTE	0 0x0000	0x0Y08

*) The parameters Behavior DO at comm. error is only analyzed if the Failsafe mode is ON.

Group parameters for the analog part

Name	Value	Internal value	Internal value, type	Default	EDS Slot / Index
Analog data format	Standard Reserved	0 255	BYTE	0	0x0Y04

*) The parameter Behavior AO at comm. error is only analyzed if the Failsafe mode is ON.

Channel parameters for the analog inputs (4x)

Name	Value	Internal value	Internal value, type	Default	EDS Slot / Index
Input 0, Channel configuration	see table 'Channel configuration' *Table 213 "Channel configuration" on page 799*	see table 'Channel configuration' *Table 213 "Channel configuration" on page 799*	BYTE	0	0x0Y09
Input 0, Check channel	see table 'Channel monitoring' *Table 214 "Channel monitoring" on page 799*	see table 'Channel monitoring' *Table 214 "Channel monitoring" on page 799*	BYTE	0	0x0Y0A
:	:	:	:	:	
:	:	:	:	:	

Name	Value	Internal value	Internal value, type	Default	EDS Slot / Index
Input 3, Channel configuration	see table 'Channel configuration' *Table 213 " Channel configuration" on page 799*	see table 'Channel configuration' *Table 213 " Channel configuration" on page 799*	BYTE	0	0x0Y0F
Input 3, Check channel	see table 'Channel monitoring' *Table 214 " Channel monitoring" on page 799*	see table 'Channel monitoring' *Table 214 " Channel monitoring" on page 799*	BYTE	0	0x0Y10

Table 213: Channel configuration

Internal value	Operating modes of the analog inputs, individually configurable
0 (default)	Not used
1	0 V ... 10 V
2	Digital input
3	0 mA ... 20 mA
4	4 mA ... 20 mA
5	-10 V ... +10 V
8	2-wire Pt100 -50 °C ... +400 °C
9	3-wire Pt100 -50 °C ... +400 °C *)
10	0 V ... 10 V (voltage diff.) *)
11	-10 V ... +10 V (voltage diff.) *)
14	2-wire Pt100 -50 °C ... +70 °C
15	3-wire Pt100 -50 °C ... +70 °C *)
16	2-wire Pt1000 -50 °C ... +400 °C
17	3-wire Pt1000 -50 °C ... +400 °C *)
18	2-wire Ni1000 -50 °C ... +150 °C
19	3-wire Ni1000 -50 °C ... +150 °C *)
	*) In the operating modes with 3-wire configuration or with differential inputs, two adjacent analog inputs belong together (e.g. the channels 0 and 1). In these cases, both channels are configured in the desired operating mode. The lower address must be the even address (channel 0). The next higher address must be the odd address (channel 1). The converted analog value is available at the higher address (channel 1).

Table 214: Channel monitoring

Internal Value	Check Channel
0 (default)	Plausibility, wire break, short circuit
3	Not used

Channel parameters for the analog outputs (2x)

Name	Value	Internal value	Internal value, type	Default	EDS Slot / Index
0 Output 0, Channel configuration	see table 'Channel configuration' *Table 215 "Channel configuration" on page 800*	see table 'Channel configuration' *Table 215 "Channel configuration" on page 800*	BYTE	0	0x0Y11
Output 0, Check channel	see table 'Channel monitoring' *Table 216 "Channel monitoring" on page 801*	see table 'Channel monitoring' *Table 216 "Channel monitoring" on page 801*	BYTE	0	0x0Y12
Output 0, Substitute value	see table 'Substitute value' *Table 217 "Substitute value" on page 801*	see table 'Substitute value' *Table 217 "Substitute value" on page 801*	WORD	0	0x0Y13
Output 1, Channel configuration	see table 'Channel configuration' *Table 215 "Channel configuration" on page 800*	see table 'Channel configuration' *Table 215 "Channel configuration" on page 800*	BYTE	0	0x0Y14
Output 1, Check channel	see table 'Channel monitoring' *Table 216 "Channel monitoring" on page 801*	see table 'Channel monitoring' *Table 216 "Channel monitoring" on page 801*	BYTE	0	0x0Y15
Output 1, Substitute value	see table 'Substitute value' *Table 217 "Substitute value" on page 801*	see table 'Substitute value' *Table 217 "Substitute value" on page 801*	WORD	0	0x0Y16

Table 215: Channel configuration

Internal value	Operating modes of the analog outputs, individually configurable
0 (default)	Not used
128	-10 V ... +10 V
129	0 mA ... 20 mA
130	4 mA ... 20 mA

Table 216: Channel monitoring

Internal value	Check channel
0	Plausibility, wire break, short circuit
3	None

Table 217: Substitute value

Intended behavior of output channel when the control system stops	Required setting of the module parameter "Behavior of outputs in case of a communication error"	Required setting of the channel parameter "Substitute value"
Output OFF	Off	0
Last value infinite	Last value	0
Last value for 5 s and then turn off	Last value 5 sec	0
Last value for 10 s and then turn off	Last value 10 sec	0
Substitute value infinite	Substitute value	Depending on configuration
Substitute value for 5 s and then turn off	Substitute value 5 sec	Depending on configuration
Substitute value for 10 s and then turn off	Substitute value 10 sec	Depending on configuration

Diagnosis

In cases of short circuit or overload, the digital outputs are turned off. The module performs reactivation automatically. Thus an acknowledgement of the errors is not necessary. The error message is stored via the LED.

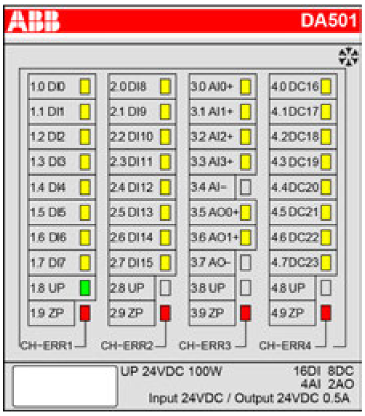
E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identifier 000 ... 063**	**AC500 display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**	
Byte 6 Bit 6 ... 7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0 ... 5**	**FBP diagnosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error Identifier**	**Error message**	**Remedy**
	1)	2)	3)	4)			
Module error							
0	14	1 ... 10	31	31	19	Checksum error in the I/O module	Replace I/O module
3	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	3	Timeout in the I/O module	
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	40	Different hard-/firmware versions in the module	
	11 / 12	ADR	1 ... 10				

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identifier 000 ... 063**	**AC500 display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**	
Byte 6 Bit 6 ... 7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0 ... 5**	**FBP diagnosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error Identifier**	**Error message**	**Remedy**
	1)	2)	3)	4)			
3	14	1 ... 10	31	31	43	Internal error in the module	
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	36	Internal data exchange failure	
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	9	Overflow diagnosis buffer	New start
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	26	Parameter error	Check master
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	11	Process voltage too low	Check process voltage
	11 / 12	ADR	1 ... 10				
4	14	1 ... 10	31	31	45	Process voltage is switched off (ON −> OFF)	Process voltage ON
	11 / 12	ADR	1 ... 10				
Channel error DA501							
4	14	1 ... 10	2	22 ... 29 5)	47	Short circuit at a digital output	Check connection
	11 / 12	ADR	1 ... 10				
Channel error DA501							
4	14	1 ... 10	1	16 ... 19 6)	48	Analog value overflow or broken wire at an analog input	Check input value or terminal
	11 / 12	ADR	1 ... 10				
4	14	1 ... 10	1	16 ... 19 6)	7	Analog value underflow at an analog input	Check input value
	11 / 12	ADR	1 ... 10				
4	14	1 ... 10	1	16 ... 19 6)	47	Short circuit at an analog input	Check terminal
	11 / 12	ADR	1 ... 10				
4	14	1 ... 10	3	20 ... 21 7)	4	Analog value overflow at an analog output	Check output value
	11 / 12	ADR	1 ... 10				
4	14	1 ... 10	3	20 ... 21 7)	7	Analog value underflow at an analog output	Check output value
	11 / 12	ADR	1 ... 10				

Remarks:

[1])	In AC500, the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The FBP diagnosis block does not contain this identifier.
[2])	With "Device" the following allocation applies: 31 = module itself, 1 ... 10 = communication interface module 1 ... 10, ADR = hardware address (e.g. of the DC551)
[3])	With "Module" the following allocation applies depending on the master: Module error: I/O bus or FBP: 31 = module itself; COM1/COM2: 1 ... 10 = expansion 1 ... 10 Channel error: I/O bus or FBP = module type (1 = AI, 3 = AO, 4 = DC); COM1/COM2: 1 ... 10 = expansion 1 ... 10
[4])	In case of module errors, with channel "31 = module itself" is output.
[5])	Ch = 22 ... 29 indicates the digital inputs/outputs DC16 ... DC23
[6])	Ch = 16 ... 19 indicates the analog inputs AI0 ... AI3
[7])	Ch = 20 ... 21 indicates the analog outputs AO0 ... AO1

State LEDs

LED		State	Color	LED = OFF	LED = ON	LED flashes
	DI0 ... DI15	Digital input	Yellow	Input is OFF	Input is ON [1])	--
	DC16 ... DC23	Digital input/output	Yellow	Input/output is OFF	Input/output is ON [1])	--
	AI0 ... AI3	Analog input	Yellow	Input is OFF	Input is ON [2])	--
	AO0 ... AO1	Analog output	Yellow	Output is OFF	Output is ON [2])	--
	UP	Process supply voltage 24 V DC via terminal	Green	Process supply voltage is missing	Process supply voltage OK	--
	CH-ERR1	Channel error, error messages in groups (digital inputs/outputs combined into the groups 1, 2, 3, 4)	Red	No error or process supply voltage is missing	Severe error within the corresponding group	Severe error within the corresponding group (e.g. short circuit at an output)
	CH-ERR2		Red			
	CH-ERR3		Red			
	CH-ERR4		Red			
	CH-ERR [3])	Module error	Red	--	Internal error	--
	[1]) Indication LED is ON even if an input signal is applied to the channel and the supply voltage is off. In this case the module is not operating and does not generate an input signal.					
	[2]) Brightness depends on the value of the analog signal					
	[3]) All of the LEDs CH-ERR1 to CH-ERR4 light up together					

Measuring ranges

Input ranges voltage, current and digital input

Range	0 V ... +10 V	-10 V ... +10 V	0 mA ... 20 mA	4 mA ... 20 mA	Digital input	Digital value	
						Decimal	**Hex.**
Overflow	> 11.7589	> 11.7589	> 23.5178	> 22.8142		32767	7FFF
Measured value too high	11.7589 : 10.0004	11.7589 : 10.0004	23.5178 : 20.0007	22.8142 : 20.0006		32511 : 27649	7EFF : 6C01
Normal range	10.0000 : 0.0004	10.0000 : 0.0004	20.0000 : 0.0007	20.0000 : 4.0006	: : On	27648 : 1	6C00 : 0001
Normal range or measured value too low	0.0000	0.0000	0	4	Off	0	0000
	-0.0004 -1.7593	-0.0004 : : -10,0000		3.9994 1.1858		-1 -4864 : -27648	FFFF ED00 : 9400
Measured value too low		-10.0004 : -11.7589				-27649 : -32512	93FF : 8100
Underflow	< 1.7593	< -11.7589	< 0.0000	< 1.1858		-32768	8000

The represented resolution corresponds to 16 bits.

Input ranges resistance temperature detector

Range	Pt100 / Pt1000 -50 °C ... +70 °C	Pt100 / Pt1000 -50 °C ... +400 °C	Ni1000 -50 °C ... +150 °C
Overflow	> +80.0 °C	> +450.0 °C	> +160.0 °C
Measured value too high		+450.0 °C : + 400.1 °C	
			+160.0 °C : + 150.1 °C
	+80.0 °C : + 70.1 °C		
Normal range	: : +70.0 °C : + 0.1 °C	+400.0 °C : : : + 0.1 °C	+150.0 °C : : + 0.1 °C

Range	Pt100 / Pt1000 -50 °C ... +70 °C	Pt100 / Pt1000 -50 °C ... +400 °C	Ni1000 -50 °C ... +150 °C
	0.0 °C	0.0 °C	0.0 °C
	-0.1 °C : -50.0 °C	-0.1 °C : -50.0 °C	-0.1 °C : -50.0 °C
Measured value too low	-50.1 °C : -60.0 °C	-50.1 °C : -60.0 °C	-50.1 °C : -60.0 °C
Underflow	< -60.0 °C	< -60.0 °C	< -60.0 °C

Range	Digital value	
	Decimal	Hex.
Overflow	32767	7FFF
Measured value too high	4500 : 4001	1194 : 0FA1
	1600 : 1501	0640 : 05DD
	800 : 701	0320 : 02BD
Normal range	4000 1500 700 : 1	0FA0 05DC 02BC : 0001
	0	0000
	-1 : -500	FFFF : FE0C
Measured value too low	-501 : -600	FE0B : FDA8
Underflow	-32768	8000

Output ranges voltage and current

Range	-10 V ... +10 V	0 mA ... 20 mA	4 mA ... 20 mA
Overflow	>11.7589 V	>23.5178 mA	>22.8142 mA
Value too high	11.7589 V : 10.0004 V	23.5178 mA : 20.0007 mA	22.8142 mA : 20.0006 mA
Normal range	10.0000 V : 0.0004 V	20.0000 mA : 0.0007 mA	20.0000 mA : 4.0006 mA
	0.0000 V	0.0000 mA	4.0000 mA
	-0.0004 V : -10.0000 V	0 mA : 0 mA	3.9994 mA 0 mA 0 mA
Value too low	-10.0004 V : -11.7589 V	0 mA : 0 mA	0 mA : 0 mA
Underflow	0 V	0 mA	0 mA

Range	Digital value	
	Decimal	**Hex.**
Overflow	> 32511	> 7EFF
Value too high	32511 : 27649	7EFF : 6C01
Normal range	27648 : 1	6C00 : 0001
	0	0000
	-1 -6912 -27648	FFFF E500 9400
Value too low	-27649 : -32512	93FF : 8100
Underflow	< -32512	< 8100

The represented resolution corresponds to 16 bits.

Technical data

Technical data of the module

The system data of AC500 and S500 are applicable to the standard version ⮊ *Chapter 2.6.1 “System data AC500” on page 1408*.

The system data of AC500-XC are applicable to the XC version ↳ *Chapter 2.7.1 “System data AC500-XC” on page 1475*.

Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

Parameter		Value
Process supply voltage		
	Connections	Terminals 1.8, 2.8, 3.8 and 4.8 for UP (+24 V DC) and 1.9, 2.9, 3.9 and 4.9 for ZP (0 V DC)
	Protection against reverse voltage	yes
	Rated protection fuse at UP	10 A fast
	Rated value	24 V DC
	Max. ripple	5 %
Current consumption		
	From UP	0.07 A + max. 0.5 A per output
	From 24 V DC power supply at the terminals UP/L+ and ZP/M of the CPU/communication interface module	ca. 2 mA
	Inrush current from UP (at power-up)	0.04 A^2s
Galvanic isolation		Yes, per module
Max. power dissipation within the module		6 W (outputs unloaded)
Weight (without terminal unit)		ca. 125 g
Mounting position		Horizontal mounting or vertical with derating (output load reduced to 50 % at +40 °C)
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

NOTICE!
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and temporary overvoltage up to 30 V DC.

Multiple overloads
No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an internal smart high-side switch.

Technical data of the digital inputs

Parameter	Value
Number of channels per module	16
Distribution of the channels into groups	2 groups of 8 channels

Parameter	Value
Terminals of the channels DI0 ... DI7	Terminals 1.0 ... 1.7
Terminals of the channels DI8 ... DI15	Terminals 2.0 ... 2.7
Reference potential for all inputs	Terminals 1.9 ... 3.9 (negative pole of the supply voltage, signal name ZP)
Indication of the input signals	1 yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Monitoring point of input indicator	LED is part of the input circuitry
Input type (according EN 61131-2)	Type 1
Input delay (0->1 or 1->0)	Typ. 0.1 ms, configurable from 0.1...32 ms
Input signal voltage	24 V DC
0-Signal	-3 V ... +5 V
Undefined Signal	> +5 V ... < +15 V
1-Signal	+15 V ... +30 V
Ripple with signal 0	Within -3 V ... +5 V
Ripple with signal 1	Within +15 V ... +30 V
Input current per channel	
Input voltage +24 V	Typ. 5 mA
Input voltage +5 V	> 1 mA
Input voltage +15 V	> 2 mA
Input voltage +30 V	< 8 mA
Max. cable length	
Shielded	1000 m
Unshielded	600 m

Technical data of the configurable digital inputs/outputs

Each of the configurable digital I/O channels can be defined as input or output by the user program. This is done by interrogating or allocating the corresponding channel.

Parameter	Value
Number of channels per module	8 inputs/outputs (with transistors)
Distribution of the channels into groups	1 group for 8 channels
If the channels are used as inputs	
Channels DC16 ... DC23	Terminals 4.0 ... 4.7
If the channels are used as outputs	
Channels DC16 ... DC23	Terminals 4.0 ... 4.7
Indication of the input/output signals	1 yellow LED per channel, the LED is ON when the input/output signal is high (signal 1)
Monitoring point of input/output indicator	LED is part of the input circuitry
Galvanic isolation	Yes, per module

Technical data of the digital inputs/outputs if used as inputs

Parameter		Value
Number of channels per module		8
Distribution of the channels into groups		1 group of 8 channels
Terminals of the channels DC16 ... DC23		Terminals 4.0 ... 4.7
Reference potential for all inputs		Terminals 1.9 ... 4.9 (negative pole of the supply voltage, signal name ZP)
Indication of the input signals		1 yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Monitoring point of input/output indicator		LED is part of the input circuitry
Input type (according EN 61131-2)		Type 1
Input delay (0->1 or 1->0)		Typ. 0.1 ms, configurable 0.1 ... 32 ms
Input signal voltage		24 V DC
	0-Signal	-3 V ... +5 V
	Undefined Signal	> +5 V ... < +15 V
	1-Signal	+15 V ... +30 V
Ripple with signal 0		Within -3 V ... +5 V
Ripple with signal 1		Within +15 V ... +30 V
Input current per channel		
	Input voltage +24 V	Typ. 5 mA
	Input voltage +5 V	> 1 mA
	Input voltage +15 V	> 2 mA
	Input voltage +30 V	< 8 mA
Max. cable length		
	shielded	1000 m
	unshielded	600 m

* Due to the direct connection to the output, the demagnetizing varistor is also effective at the input (see figure) above. This is why the difference between UPx and the input signal must not exceed the clamp voltage of the varistor. The varistor limits the clamp voltage to approx. 36 V. Consequently, the input voltage must range from -12 V ... +30 V when UPx = 24 V and from -6 V ... +30 V when UPx = 30 V.

Technical data of the digital inputs/outputs if used as outputs

Parameter	Value
Number of channels per module	8
Distribution of the channels into groups	1 group of 8 channels
Terminals of the channels DC16 ...DC23	Terminals 4.0 ... 4.7
Reference potential for all outputs	Terminals 1.9 ... 4.9 (negative pole of the supply voltage, signal name ZP)
Common power supply voltage	For all outputs terminals 1.8, 2.8, 3.8 and 4.8 (positive pole of the supply voltage, signal name UP)
Output voltage for signal 1	UP (-0.8 V)

Parameter		Value
Output delay (0->1 or 1->0)		On request
Output current		
	rated value per channel	500 mA at UP = 24 V
	max. value (all channels together)	4 A
Leakage current with signal 0		< 0.5 mA
Fuse for UP		10 A fast
Demagnetization with inductive DC load		Via internal varistors (see figure below this table)
Output switching frequency		
	With resistive load	On request
	With inductive loads	Max. 0.5 Hz
	With lamp loads	11 Hz max. at 5 W max.
Short-circuit-proof / overload-proof		Yes
Overload message (I > 0.7 A)		Yes, after ca. 100 ms
Output current limitation		Yes, automatic reactivation after short circuit/overload
Resistance to feedback against 24 V signals		Yes (software-controlled supervision)
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

The following drawing shows the circuitry of a digital input/output with the varistors for demagnetization when inductive loads are switched off.

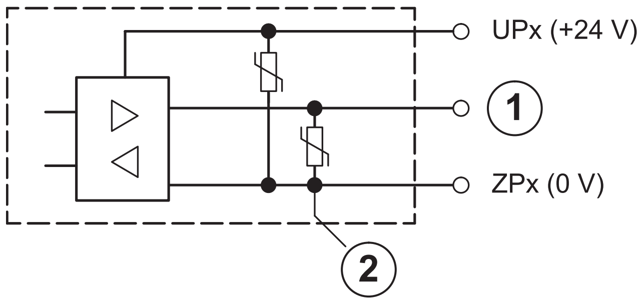


Fig. 200: Digital input/output (circuit diagram)

1 Digital input/output
2 For demagnetization when inductive loads are turned off

Technical data of the fast counter

> *The fast counter of the module does not work if the module is connected to an FBP interface module or CS31 bus module.*

Parameter	Value
Used inputs	DC16 / DC17
Used outputs	DC18
Counting frequency	Max. 50 kHz

Technical data of the analog inputs

Parameter		Value
Number of channels per module		4
Distribution of channels into groups		1 group with 4 channels
Connection if channels AI0+ ... AI3+		Terminals 3.0 ... 3.3
Reference potential for AI0+ ... AI3+		Terminal 3.4 (AI-) for voltage and RTD measurement Terminal 1.9, 2.9, 3.9 and 4.9 for current measurement
Input type		
	Unipolar	Voltage 0 V ... 10 V, current or Pt100/ Pt1000/Ni1000
	Bipolar	Voltage -10 V ... +10 V
Configurability		0 V ... 10 V, -10 V ... +10 V, 0 mA ... 20 mA, 4 mA ... 20 mA, Pt100/1000, Ni1000 (each input can be configured individually)
Channel input resistance		Voltage: > 100 kΩ Current: ca. 330 Ω
Time constant of the input filter		Voltage: 100 µs Current: 100 µs
Indication of the input signals		1 LED per channel (brightness depends on the value of the analog signal)
Conversion cycle		1 ms (for 4 inputs + 2 outputs); with RTDs Pt/Ni... 1 s
Resolution		Range 0 V ... 10 V: 12 bits Range -10 V ... +10 V: 12 bits including sign Range 0 mA ... 20 mA: 12 bits Range 4 mA ... 20 mA: 12 bits Range RTD (Pt100, PT1000, Ni1000): 0.1 °C
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range		Typ. 0.5 %, max. 1 % For XC version below 0 °C and above +60 °C: on request
Relationship between input signal and hex code		*Chapter 1.6.3.1.1.10.2 “Input ranges resistance temperature detector” on page 804*
Unused inputs		Are configured as "unused" (default value)
Overvoltage protection		Yes

Technical data of the analog inputs, if used as digital inputs

Parameter		Value
Number of channels per module		Max. 4
Distribution of channels into groups		1 group of 4 channels
Connections of the channels AI0+ ... AI3+		Terminals 3.0 ... 3.3
Reference potential for the inputs		Terminals 1.9, 2.9, 3.9 and 4.9 (ZP)
Indication of the input signals		1 LED per channel
Input signal voltage		24 V DC
	Signal 0	-30 V ... +5 V
	Undefined signal	+5 V ... +13 V
	Signal 1	+13 V ... +30 V
Input current per channel		
	Input voltage +24 V	Typ. 7 mA
	Input voltage +5 V	Typ. 1.4 mA
	Input voltage +15 V	Typ. 3.7 mA
	Input voltage +30 V	< 9 mA
Input resistance		ca. 3.5 kΩ

Technical data of the analog outputs

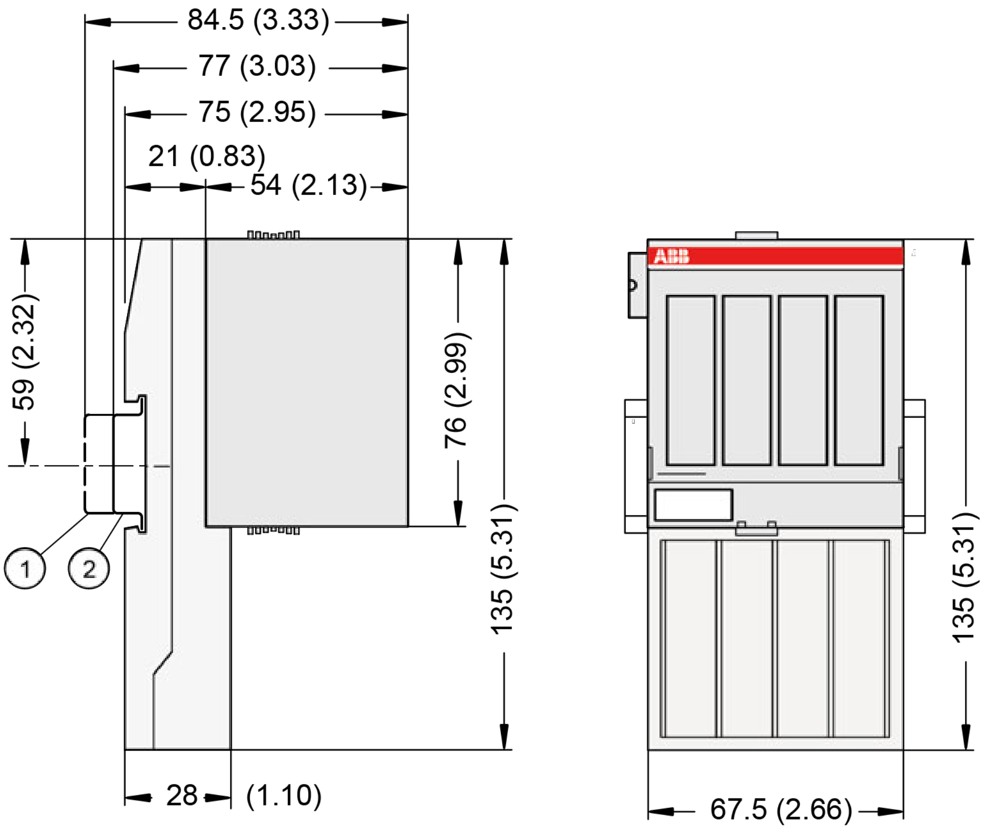
Parameter		Value
Number of channels per module		2
Distribution of channels into groups		1 group for 2 channels
Connection of the channels AO0+ ... AO1+		Terminals 3.5 and 3.6
Reference potential for AO0+ ... AO1+		Terminal 3.7 (AO-) for voltage output Terminals 1.9, 2.9, 3.9 and 4.9 for current output
Output type		
	Unipolar	Current
	Bipolar	Voltage
Galvanic isolation		Against internal supply and other modules
Configurability		-10 V ... +10 V, 0 mA ... 20 mA, 4 mA ... 20 mA (each output can be configured individually)
Output resistance (load) as current output		0 Ω ... 500 Ω
Output loadability as voltage output		± 10 mA max.
Indication of the output signals		1 LED per channel (brightness depends on the value of the analog signal)
Resolution		12 bits including sign
Settling time for full range change (resistive load, output signal within specified tolerance)		Typ. 5 ms
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range		Typ. 0.5 %, max. 1 %

Parameter	Value
Relationship between input signal and hex code	*Chapter 1.6.3.1.1.10.3 “Output ranges voltage and current” on page 806*
Unused outputs	Are configured as "unused" (default value) and can be left open-circuited

Internal data exchange

	Without the fast counter	With the fast counter (only with AC500)
Digital inputs (bytes)	3	5
Digital outputs (bytes)	1	3
Analog inputs (words)	4	4
Analog outputs (words)	2	2
Counter input data (words)	0	4
Counter output data (words)	0	8

Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

Ordering data

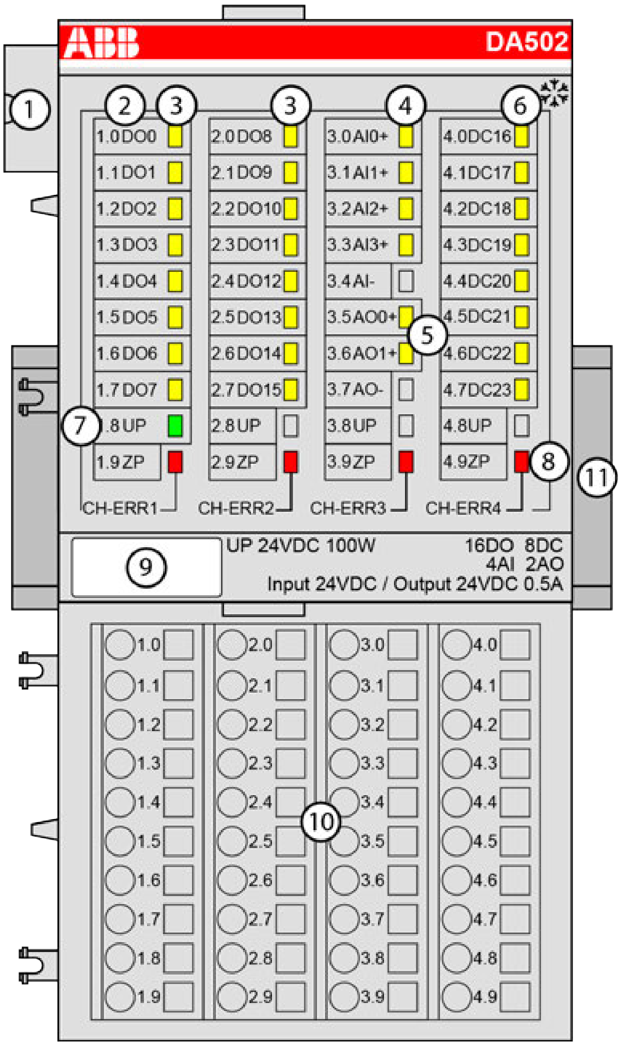
Part no.	Description	Product life cycle phase *)
1SAP 250 700 R0001	DA501, digital/analog input/output module, 16 DI, 8 DC, 4 AI, 2 AO	Active
1SAP 450 700 R0001	DA501-XC, digital/analog input/output module, 16 DI, 8 DC, 4 AI, 2 AO, XC version	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

1.6.3.1.2 DA502 - Digital/Analog input/output module

Features

- 16 digital outputs, 24 V DC, 0.5 A max.
- 8 configurable digital inputs/outputs 24 V DC, 0.5 A max.
- 4 analog inputs, voltage, current and RTD, resolution 12 bits including sign
- 2 analog outputs, voltage and current, resolution 12 bits including sign
- Fast counter
- Module-wise galvanically isolated
- XC version for use in extreme ambient conditions available



1 I/O bus
2 Allocation between terminal number and signal name
3 16 yellow LEDs to display the signal states of the digital outputs DO0 ... DO15
4 4 yellow LEDs to display the signal states of the analog inputs AI0 ... AI3
5 2 yellow LEDs to display the signal states of the analog outputs AO0 ... AO1
6 8 yellow LEDs to display the signal states of the configurable digital inputs/outputs DC16 ... DC23
7 1 green LED to display the state of the process supply voltage UP
8 4 red LEDs to display errors
9 Label
10 Terminal unit
11 DIN rail
Sign for XC version

Intended purpose

The device can be used as a decentralized I/O extension module for S500 communication interface modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs.

Functionality

Parameter	Value
Fast counter	Integrated, many configurable operating modes
Power supply	From the process supply voltage UP
LED displays	For system displays, signal states, errors and power supply
Internal supply voltage	Via the I/O bus interface (I/O bus)
External supply voltage	Via terminals UP and ZP (process supply voltage 24 V DC)
Effect of incorrect input terminal connection	Wrong or no signal detected, no damage up to 35 V
Required terminal unit	TU515 or TU516 *Chapter 1.5.3 "TU515, TU516, TU541 and TU542 for I/O modules" on page 282*

Connections

For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.

The connection is carried out by using the 40 terminals of the terminal unit TU515/TU516 *Chapter 1.5.3 "TU515, TU516, TU541 and TU542 for I/O modules" on page 282*.

The assignment of the terminals:

Terminal	Signal	Description
1.0	DO0	Signal of the digital output DO0
1.1	DO1	Signal of the digital output DO1
1.2	DO2	Signal of the digital output DO2
1.3	DO3	Signal of the digital output DO3
1.4	DO4	Signal of the digital output DO4
1.5	DO5	Signal of the digital output DO5
1.6	DO6	Signal of the digital output DO6
1.7	DO7	Signal of the digital output DO7
1.8	UP	Process voltage UP (24 V DC)
1.9	ZP	Process voltage ZP (0 V DC)
2.0	DO8	Signal of the digital output DO8
2.1	DO9	Signal of the digital output DO9
2.2	DO10	Signal of the digital output DO10
2.3	DO11	Signal of the digital output DO11
2.4	DO12	Signal of the digital output DO12
2.5	DO13	Signal of the digital output DO13
2.6	DO14	Signal of the digital output DO14

Terminal	Signal	Description
2.7	DO15	Signal of the digital output DO15
2.8	UP	Process voltage UP (24 V DC)
2.9	ZP	Process voltage ZP (0 V DC)
3.0	AI0+	Positive pole of analog input signal 0
3.1	AI1+	Positive pole of analog input signal 1
3.2	AI2+	Positive pole of analog input signal 2
3.3	AI3+	Positive pole of analog input signal 3
3.4	AI-	Negative pole of analog input signals 0 ... 3
3.5	AO0+	Positive pole of analog output signal 0
3.6	AO1+	Positive pole of analog output signal 1
3.7	AO-	Negative pole of analog output signals 0 and 1
3.8	UP	Process voltage UP (24 V DC)
3.9	ZP	Process voltage ZP (0 V DC)
4.0	DC16	Signal of the configurable digital input/output DC16
4.1	DC17	Signal of the configurable digital input/output DC17
4.2	DC18	Signal of the configurable digital input/output DC18
4.3	DC19	Signal of the configurable digital input/output DC19
4.4	DC20	Signal of the configurable digital input/output DC20
4.5	DC21	Signal of the configurable digital input/output DC21
4.6	DC22	Signal of the configurable digital input/output DC22
4.7	DC23	Signal of the configurable digital input/output DC23
4.8	UP	Process voltage UP (24 V DC)
4.9	ZP	Process voltage ZP (0 V DC)

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a communication interface module or a CPU). Thus, the current consumption from 24 V DC power supply at the terminals L+/UP and M/ZP of the CPU/communication interface module increases by 2 mA per DA502.

The external power supply connection is carried out via the UP (+24 V DC) and the ZP (0 V DC) terminals.

WARNING!
Removal/Insertion under power

Removal or insertion under power is permissible only if all conditions for hot swapping are fullfilled.

Conditions for hot swap

“Conditions for hot swap” on page 1367

The devices are not designed for removal or insertion under power when the conditions for hot swap do not apply. Because of unforeseeable consequences, it is not allowed to plug in or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

Disconnecting any powered devices while they are energized in a hazardous location could result in an electric arc, which could create an ignition source resulting in fire or explosion.

Prior to proceeding, make sure that power is been disconnected and that the area has been thoroughly checked to ensure that flammable materials are not present.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!
Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

NOTICE!
Risk of damaging the PLC modules!

The PLC modules must not be removed while the plant is connected to a power supply.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove or replace a module.

CAUTION!
Risk of imprecise and faulty measurements!

Analog signals may be distorted seriously by external electromagnetic influences.

Use shielded wires when wiring analog signal sources. The cable shield must be grounded at both ends of the cable. Provide a potential equalization of a low resistance to avoid high potential differences between different parts of the plant.

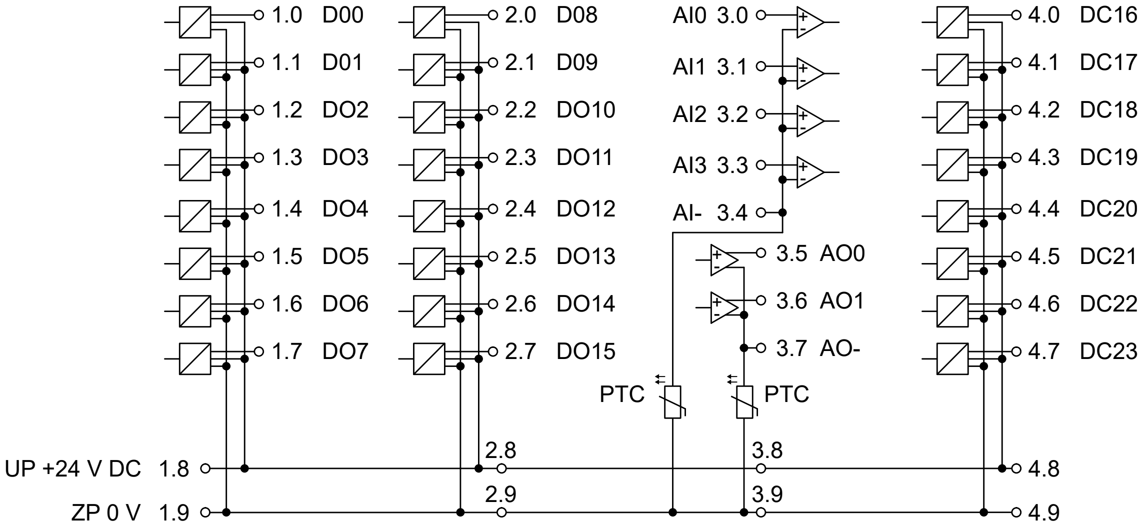


Fig. 201: Terminal assignment of the module

The module provides several diagnosis functions ↯ *Chapter 1.6.3.1.2.8 “Diagnosis” on page 835*.

Connection of the digital outputs

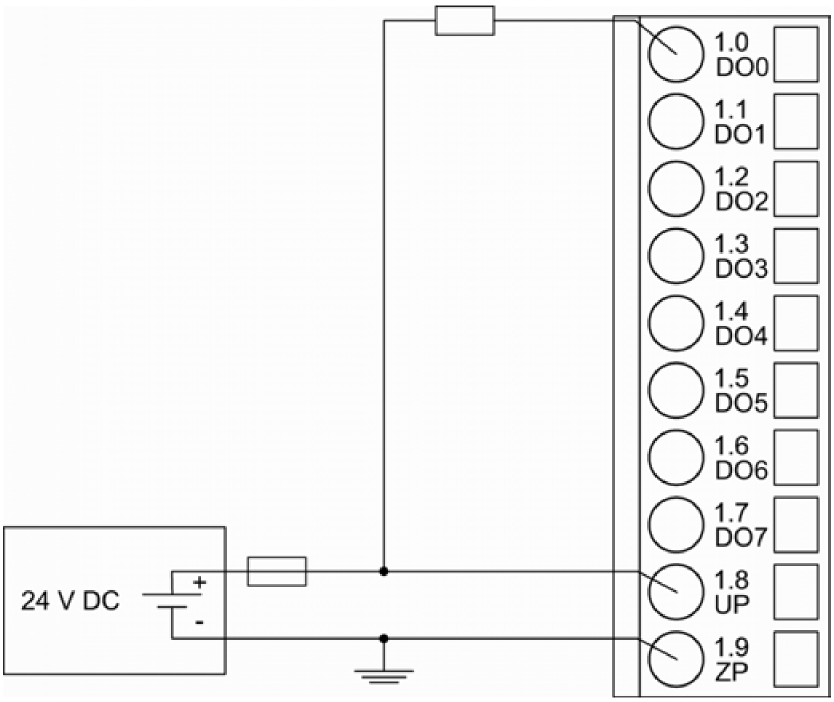


Fig. 202: Connection of the digital outputs (DO0 ... DO15)

For a description of the meaning of the LEDs, please refer to the Displays chapter ↯ *Chapter 1.6.3.1.2.9 “State LEDs” on page 837*.

Connection of the configurable digital inputs/outputs

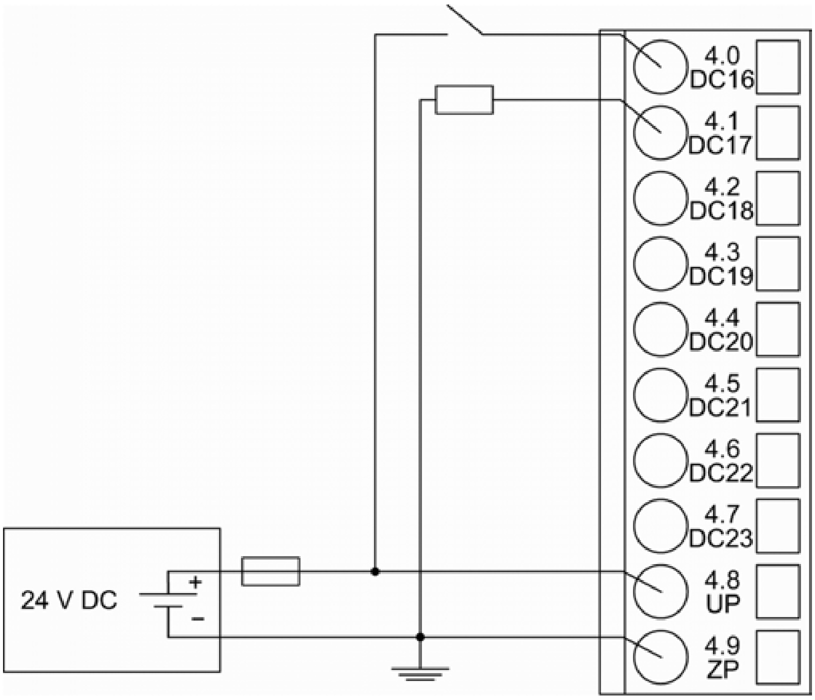


Fig. 203: Connection of the configurable digital input/outputs (DC16 ... DC23) (DC16 as an input, DC17 as an output)

> **NOTICE!**
> **Risk of influences to the connected sensors!**
> Some sensors may be influenced by the deactivated module outputs of DA502.
>
> Connect a 470 Ω / 1 W resistor in series to inputs DC16/DC17 if they are used as fast counter inputs to avoid any influences.

For a description of tthe meaning of the LEDs, please refer to the Displays *Chapter 1.6.3.1.2.9 “State LEDs” on page 837* chapter.

Connection of resistance thermometers in 2-wire configuration to the analog inputs

When resistance thermometers (Pt100, Pt1000, Ni1000) are used, a constant current must flow through them to build the necessary voltage drop for the evaluation. For this, the module DA502 provides a constant current source which is multiplexed over max. 4 analog input channels.

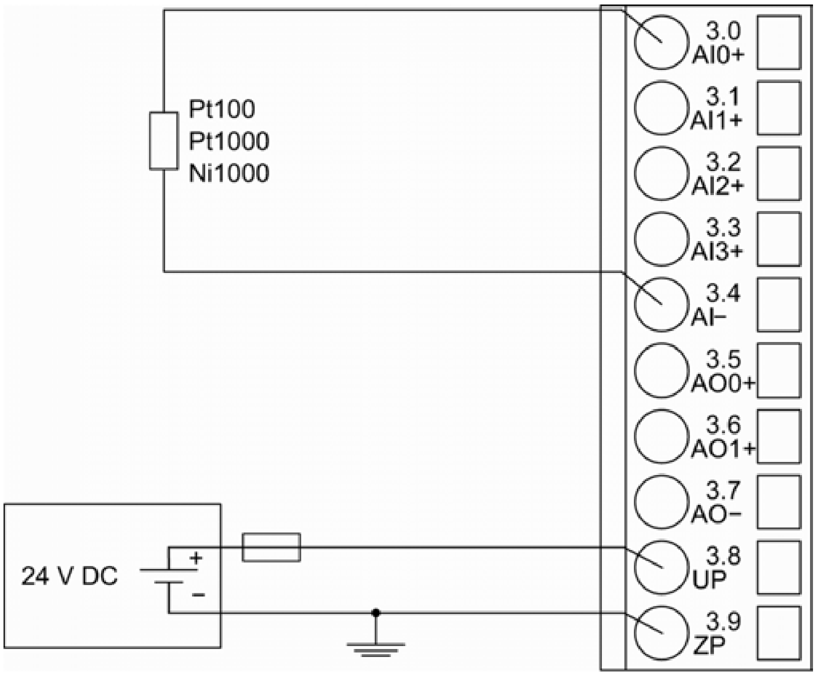


Fig. 204: Connection of resistance thermometers in 2-wire configuration to the analog inputs (AI0 ... AI3)

The following measuring ranges can be configured ➪ *Chapter 1.6.3.1.2.7 "Parameterization" on page 830* ➪ *Chapter 1.6.3.1.2.10 "Measuring ranges" on page 838*:

Pt100	-50 °C ... +400 °C	2-wire configuration, 1 channel used
Pt1000	-50 °C ... +400 °C	2-wire configuration, 1 channel used
Ni1000	-50 °C ... +150 °C	2-wire configuration, 1 channel used

For a description of the function of the LEDs, please refer to Diagnosis and displays / Displays ➪ *Chapter 1.6.3.1.2.9 "State LEDs" on page 837*.

The module DA502 performs a linearization of the resistance characteristic.

To avoid error messages from unused analog input channels, configure them as "unused".

Connection of resistance thermometers in 3-wire configuration to the analog inputs

When resistance thermometers (Pt100, Pt1000, Ni1000) are used, a constant current must flow through them to build the necessary voltage drop for the evaluation. For this, the module DA502 provides a constant current source which is multiplexed over max. 4 analog input channels.

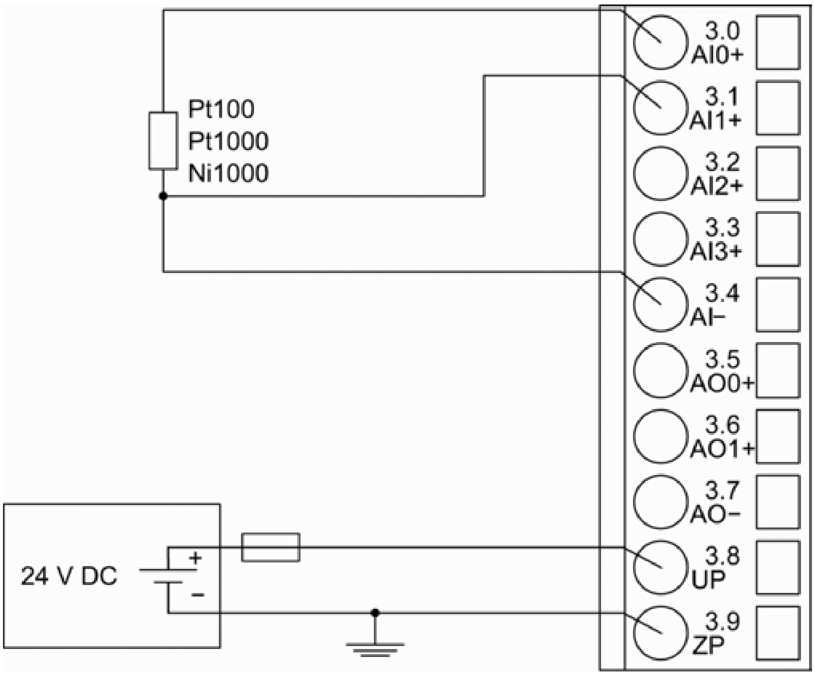


Fig. 205: Connection of resistance thermometers in 3-wire configuration to the analog inputs (AI0 ... AI3)

With 3-wire configuration, 2 adjacent analog channels belong together (e. g. the channels 0 and 1). In this case, both channels are configured according to the desired operating mode. The lower address must be the even address (channel 0), the next higher address must be the odd address (channel 1).

The constant current of one channel flows through the resistance thermometer. The constant current of the other channel flows through one of the cores. The module calculates the measured value from the two voltage drops and stores it under the input with the higher channel number (e. g. I1).

In order to keep measuring errors as small as possible, it is necessary to have all the involved conductors in the same cable. All the conductors must have the same cross section.

The following measuring ranges can be configured *Chapter 1.6.3.1.2.7 “Parameterization” on page 830* *Chapter 1.6.3.1.2.10 “Measuring ranges” on page 838*:

Pt100	-50 °C ... +400 °C	3-wire configuration, 2 channels used
Pt1000	-50 °C ... +400 °C	3-wire configuration, 2 channels used
Ni1000	-50 °C ... +150 °C	3-wire configuration, 2 channels used

For a description of the function of the LEDs, please refer to Diagnosis and displays / Displays *Chapter 1.6.3.1.2.9 “State LEDs” on page 837*.

The module DA502 performs a linearization of the resistance characteristic.

To avoid error messages from unused analog input channels, configure them as "unused".

Connection of active-type analog sensors (Voltage) with galvanically isolated power supply to the analog inputs

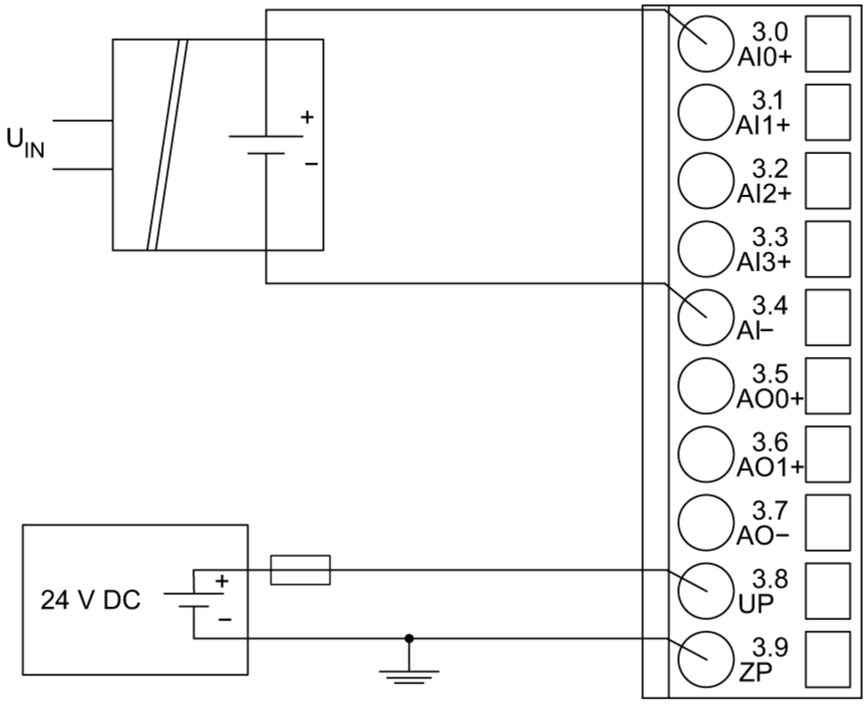


Fig. 206: Connection of active-type analog sensors (voltage) with galvanically isolated power supply to the analog inputs (AI0 ... AI3)

The following measuring ranges can be configured *Chapter 1.6.3.1.2.7 “Parameterization” on page 830* *Chapter 1.6.3.1.2.10 “Measuring ranges” on page 838*:

Voltage	0 V ... 10 V	1 channel used
Voltage	-10 V ... +10 V	1 channel used

For a description of the function of the LEDs, please refer to Diagnosis and displays / Displays *Chapter 1.6.3.1.2.9 “State LEDs” on page 837*.

To avoid error messages from unused analog input channels, configure them as "unused".

Connection of active-type analog sensors (Current) with galvanically isolated power supply to the analog inputs

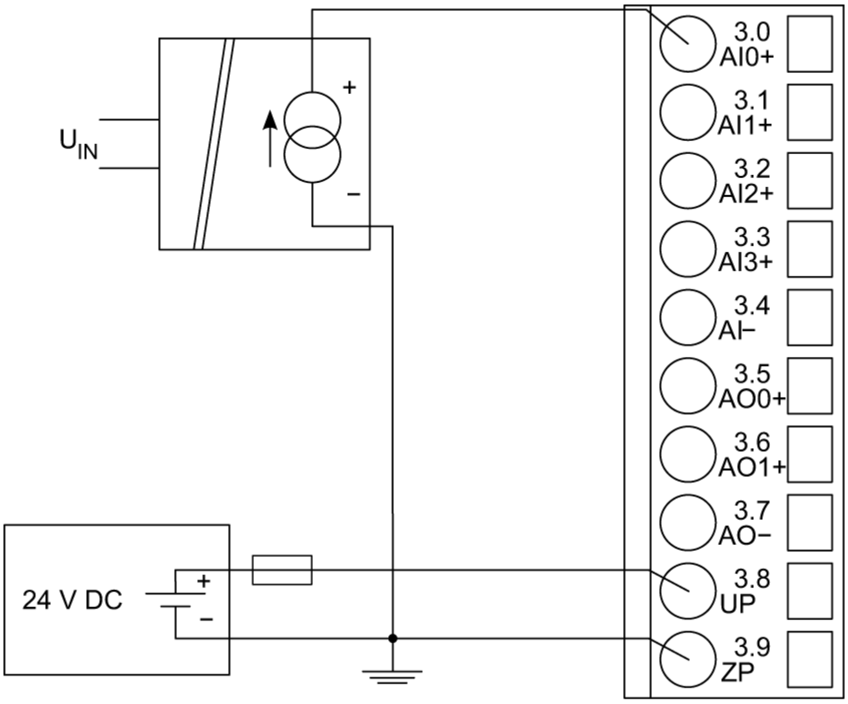


Fig. 207: Connection of active-type analog sensors (current) with galvanically isolated power supply to the analog inputs (AI0 ... AI3)

The following measuring ranges can be configured ➪ *Chapter 1.6.3.1.2.7 “Parameterization” on page 830* ➪ *Chapter 1.6.3.1.2.10 “Measuring ranges” on page 838*:

Current	0 mA ... 20 mA	1 channel used
Current	4 mA ... 20 mA	1 channel used

For a description of the function of the LEDs, please refer to Diagnosis and displays / Displays ➪ *Chapter 1.6.3.1.2.9 “State LEDs” on page 837*.

Unused input channels can be left open-circuited, because they are of low resistance.

Connection of active-type analog sensors (Voltage) with no galvanically isolated power supply to the analog inputs

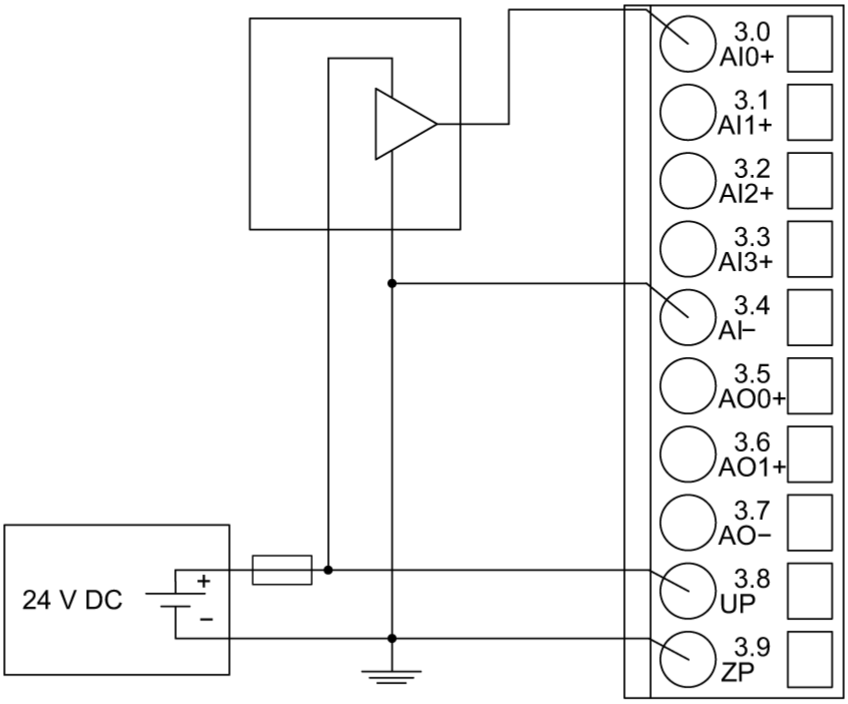


Fig. 208: Connection of active-type sensors (voltage) with no galvanically isolated power supply to the analog inputs (AI0 ... AI3)

> **CAUTION!**
> **Risk of faulty measurements!**
> The negative pole at the sensors must not have too large a potential difference with respect to ZP (max. ±1 V within the full signal range).
>
> Make sure that the potential difference never exceeds ± 1 V.

The following measuring ranges can be configured ♘ *Chapter 1.6.3.1.2.7 “Parameterization” on page 830* ♘ *Chapter 1.6.3.1.2.10 “Measuring ranges” on page 838*:

Voltage	0 V ... 10 V	1 channel used
Voltage	-10 V ... +10 V	1 channel used

For a description of the function of the LEDs, please refer to Diagnosis and displays / Displays ♘ *Chapter 1.6.3.1.2.9 “State LEDs” on page 837*.

To avoid error messages from unused analog input channels, configure them as "unused".

Connection of passive-type analog sensors (Current) to the analog inputs

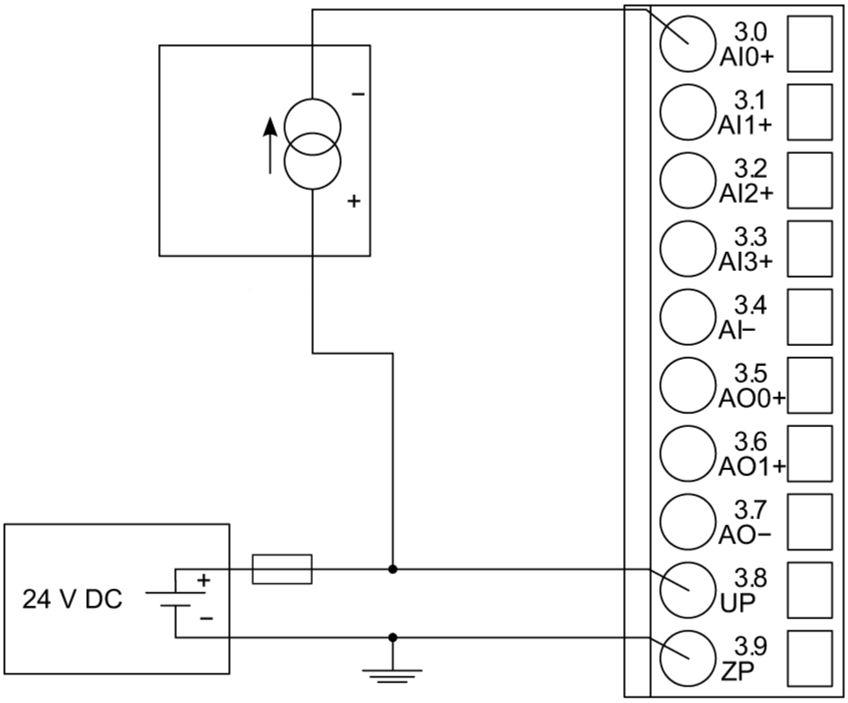


Fig. 209: Connection of passive-type analog sensors (current) to the analog inputs (AI0 ... AI3)

The following measuring ranges can be configured ⇘ *Chapter 1.6.3.1.2.7 “Parameterization” on page 830* ⇘ *Chapter 1.6.3.1.2.10 “Measuring ranges” on page 838*:

Current	4 mA ... 20 mA	1 channel used

For a description of the function of the LEDs, please refer to Diagnosis and displays / Displays ⇘ *Chapter 1.6.3.1.2.9 “State LEDs” on page 837*.

> **!**
> **NOTICE!**
> **Risk of overloading the analog input!**
> If an analog current sensor supplies more than 25 mA for more than 1 second during initialization, this input is switched off by the module (input protection).
>
> Use only sensors with fast initialization or without current peaks higher than 25 mA. If not possible, connect a 10-volt Zener diode in parallel to I+ and ZP.

Unused input channels can be left open-circuited, because they are of low resistance.

Connection of active-type analog sensors (Voltage) to differential analog inputs

Differential inputs are very useful if analog sensors which are remotely non-isolated (e.g. the negative terminal is remotely grounded) are used.

Using differential inputs helps to considerably increase the measuring accuracy and to avoid ground loops.

With differential input configurations, two adjacent analog channels belong together (e.g. the channels 0 and 1). In this case, both channels are configured according to the desired operating mode. The lower address must be the even address (channel 0), the next higher address must be the odd address (channel 1). The converted analog value is available at the higher address (channel 1).

The analog value is calculated by subtraction of the input value with the higher address from the input value of the lower address.

The converted analog value is available at the odd channel (higher address).

CAUTION!
Risk of faulty measurements!
The negative pole at the sensors must not have too large a potential difference with respect to ZP (max. ± 1 V within the full signal range).

Make sure that the potential difference never exceeds ± 1 V.

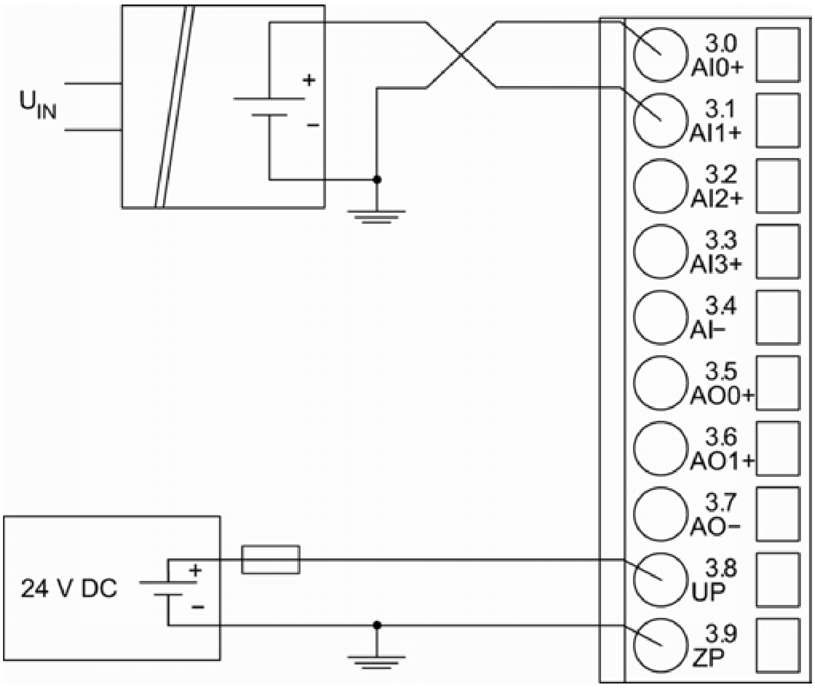


Fig. 210: Connection of active-type analog sensors (voltage) to differential analog inputs (AI0 ... AI3)

The following measuring ranges can be configured *Chapter 1.6.3.1.2.7 “Parameterization” on page 830* *Chapter 1.6.3.1.2.10 “Measuring ranges” on page 838*:

Voltage	0 V ... 10 V	with differential inputs, 2 chan-nels used
Voltage	-10 V ... +10 V	with differential inputs, 2 chan-nels used

For a description of the function of the LEDs, please refer to Diagnosis and displays / Displays *Chapter 1.6.3.1.2.9 “State LEDs” on page 837*.

To avoid error messages from unused analog input channels, configure them as "unused".

Use of analog inputs as digital inputs

Several (or all) analog inputs can be configured as digital inputs. The inputs are not galvanically isolated against the other analog channels.

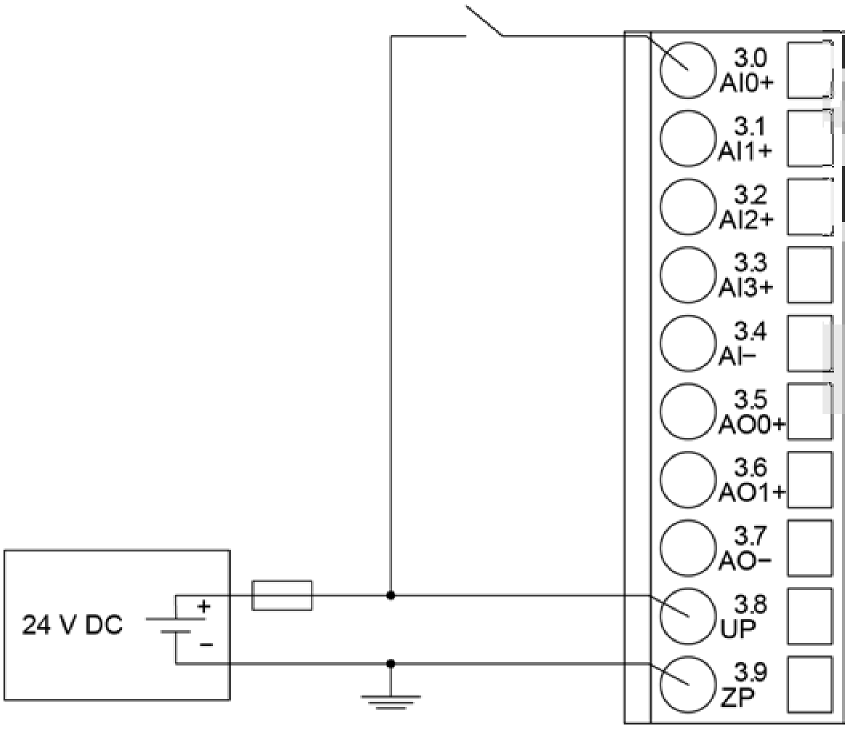


Fig. 211: connection of digital sensors to the analog input (AI0 ... AI3)

The following measuring ranges can be configured *Chapter 1.6.3.1.2.7 “Parameterization” on page 830* *Chapter 1.6.3.1.2.10 “Measuring ranges” on page 838* :

Digital input	24 V	1 channel used

For a description of the function of the LEDs, please refer to Diagnosis and displays / Displays *Chapter 1.6.3.1.2.9 “State LEDs” on page 837*.

Connection of analog output loads (Voltage)

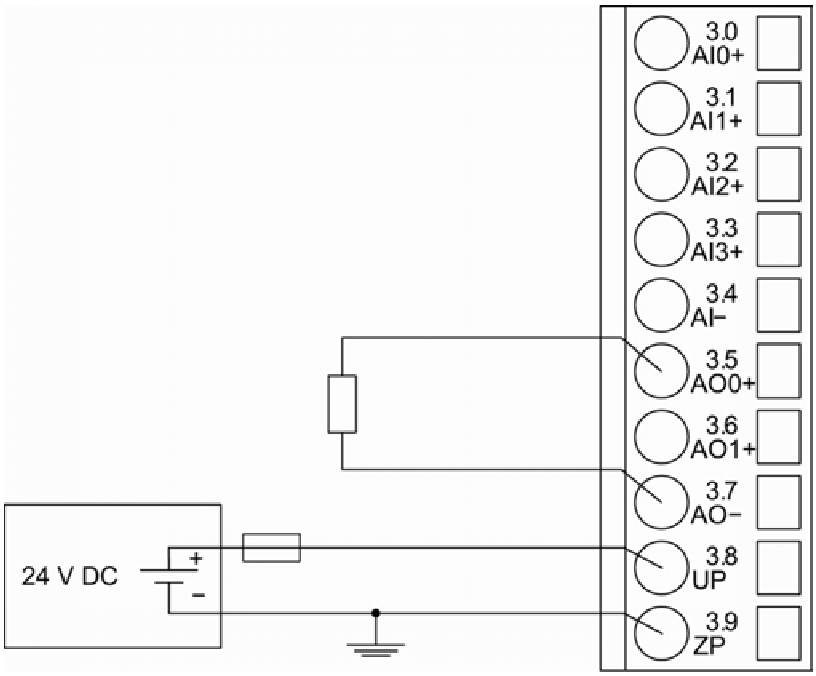


Fig. 212: Connection of analog output loads (voltage) to the analog outputs (AO0 ... AO1)

The following measuring ranges can be configured ➪ *Chapter 1.6.3.1.2.7 “Parameterization” on page 830* ➪ *Chapter 1.6.3.1.2.10 “Measuring ranges” on page 838*:

Voltage	-10 V ... +10 V	Load ± 10 mA max.	1 channel used

For a description of the function of the LEDs, please refer to Diagnosis and displays / Displays ➪ *Chapter 1.6.3.1.2.9 “State LEDs” on page 837*.

Unused analog outputs can be left open-circuited.

Connection of analog output loads (Current)

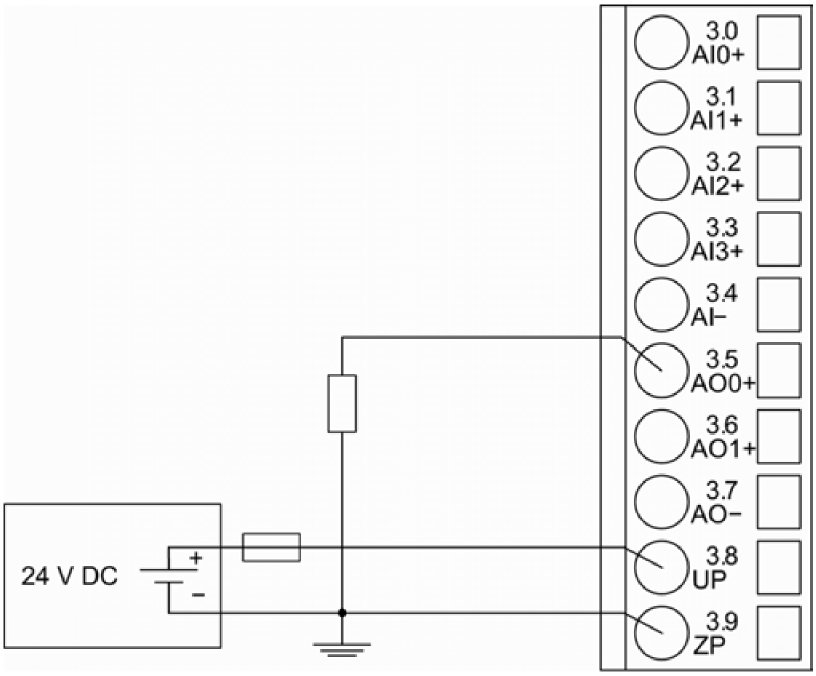


Fig. 213: Connection of analog output loads (current) to the analog outputs (AO0 ... AO1)

The following measuring ranges can be configured ➪ *Chapter 1.6.3.1.2.7 “Parameterization” on page 830* ➪ *Chapter 1.6.3.1.2.10 “Measuring ranges” on page 838*:

Current	0 mA ... 20 mA	Load 0 Ω ... 500 Ω	1 channel used
Current	4 mA ... 20 mA	Load 0 Ω ... 500 Ω	1 channel used

For a description of the function of the LEDs, please refer to Diagnosis and displays / Displays ➪ *Chapter 1.6.3.1.2.9 “State LEDs” on page 837*.

Unused analog outputs can be left open-circuited.

Internal data exchange

	Without the fast counter	With the fast counter (only with AC500)
Digital inputs (bytes)	1	1
Digital outputs (bytes)	3	3
Analog inputs (words)	4	4
Analog outputs (words)	2	2

	Without the fast counter	**With the fast counter (only with AC500)**
Counter input data (words)	0	5
Counter output data (words)	0	9

I/O configuration

The module itself does not store configuration data. It draws its parameterization data from the master device of the I/O bus (CPU or communication interface module) during power-up of the system.

Hence, replacing I/O modules is possible without any re-parameterization via software.

> *If the external power supply voltage via UP/ZP terminals fails, the I/O module loses its configuration data. The whole station has to be switched off and on again to re-configure the module.*

Parameterization

Firmware version	Configuration
Firmware version > V2.0.0	The arrangement of the parameter data is performed by Control Builder Plus/ Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Module: Module slot address: Y = 1 ... 10

Name	Value	Internal value	Internal value, type	Default	EDS Slot / Index
Module ID [1])	Internal	1815	WORD	1815	0x0Y01
Ignore module	Internal	Yes No	BYTE	No	
Parameter length	Internal	8	BYTE	8	0xY02
Check supply	off	0	BYTE	1	0xY03
	on	1			

Name	Value	Internal value	Internal value, type	Default	EDS Slot / Index
Fast counter 3)	0 : 10 2)	0 : 10	BYTE	0	Not for FBP
Behavior outputs at comm. error 5)	Off Last value Last value 5 s Last value 10 s Substitute value Substitute value 5 s Substitute value 10 s	0 1 6 11 2 7 12	BYTE	Off 0x00	0x0Y07

2)	Setting	Description
	On	Error LED lights up at errors of all error classes, Failsafe mode off
	Off by E4	Error LED lights up at errors of error classes E1, E2 and E3, Failsafe mode off
	Off by E3	Error LED lights up at errors of error classes E1 and E2, Failsafe mode off
	On +Failsafe	Error LED lights up at errors of all error classes, Failsafe mode on *)
	Off by E4 + Failsafe	Error LED lights up at errors of error classes E1, E2 and E3, Failsafe mode on *)
	Off by E3 + Failsafe	Error LED lights up at errors of error classes E1 and E2, Failsafe mode on *)

1) With a faulty ID, the module reports a "parameter error" and does not perform cyclic process data transmission

2) For a description of the counter operating modes, please refer to the 'Fast Counter' section *Chapter 1.6.1.2.10 “Fast counter” on page 545*

3) With CS31 without the parameter "Fast Counter"

The fast counter of the module does not work if the module is connected to a CS31 bus module.

5) The parameter Behavior outputs at comm. error is only analyzed if the Failsafe mode is ON.

Group parameters for the digital part

Name	Value	Internal value	Internal value, type	Default	EDS Slot / Index
Input delay	0.1 ms 1 ms 8 ms 32 ms	0 1 2 3	BYTE	0.1 ms 0x00	0x0Y05
Detect short circuit at outputs	Off On	0 1	BYTE	On 0x01	0x0Y06
Substitute value at output	0 ... 255	00h ... FFh	BYTE	0 0x0000	0x0Y08

*) The parameters Behavior DO at comm. error is only analyzed if the Failsafe mode is ON.

Group parameters for the analog part

Name	Value	Internal value	Internal value, type	Default	EDS Slot / Index
Analog data format	Standard Reserved	0 255	BYTE	0	0x0Y04

*) The parameter Behaviour AO at comm. error is only analyzed if the Failsafe mode is ON.

Channel parameters for the analog inputs (4x)

Name	Value	Internal value	Internal value, type	Default	EDS Slot / Index
Input 0, Channel configuration	see table 'Channel configuration' *Table 218 “ Channel configuration” on page 833*	see table 'Channel configuration' *Table 218 “ Channel configuration” on page 833*	BYTE	0	0x0Y09
Input 0, Check channel	see table 'Channel monitoring' *Table 219 “ Channel monitoring” on page 833*	see table 'Channel monitoring' *Table 219 “ Channel monitoring” on page 833*	BYTE	0	0x0Y0A
:	:	:	:	:	
:	:	:	:	:	

Name	Value	Internal value	Internal value, type	Default	EDS Slot / Index
Input 3, Channel configuration	see table 'Channel configuration' *Table 218 " Channel configuration" on page 833*	see table 'Channel configuration' *Table 218 " Channel configuration" on page 833*	BYTE	0	0x0Y0F
Input 3, Check channel	see table 'Channel monitoring' *Table 219 " Channel monitoring" on page 833*	see table 'Channel monitoring' *Table 219 " Channel monitoring" on page 833*	BYTE	0	0x0Y10

Table 218: Channel configuration

Internal value	Operating modes of the analog inputs, individually configurable
0 (default)	Not used
1	0 V ... 10 V
2	Digital input
3	0 mA ... 20 mA
4	4 mA ... 20 mA
5	-10 V ... +10 V
8	2-wire Pt100 -50 °C ... +400 °C
9	3-wire Pt100 -50 °C ... +400 °C *)
10	0 V ... 10 V (voltage diff.) *)
11	-10 V ... +10 V (voltage diff.) *)
14	2-wire Pt100 -50 °C ... +70 °C
15	3-wire Pt100 -50 °C ... +70 °C *)
16	2-wire Pt1000 -50 °C ... +400 °C
17	3-wire Pt1000 -50 °C ... +400 °C *)
18	2-wire Ni1000 -50 °C ... +150 °C
19	3-wire Ni1000 -50 °C ... +150 °C *)
	*) In the operating modes with 3-wire configuration or with differential inputs, two adjacent analog inputs belong together (e.g. the channels 0 and 1). In these cases, both channels are configured in the desired operating mode. The lower address must be the even address (channel 0). The next higher address must be the odd address (channel 1). The converted analog value is available at the higher address (channel 1).

Table 219: Channel monitoring

Internal Value	Check Channel
0 (default)	Plausibility, wire break, short circuit
3	Not used

Channel parameters for the analog outputs (2x)

Name	Value	Internal value	Internal value, type	Default	EDS Slot / Index
0 Output 0, Channel configuration	see table 'Channel configuration' *Table 220 " Channel configuration" on page 834*	see table 'Channel configuration' *Table 220 " Channel configuration" on page 834*	BYTE	0	0x0Y11
Output 0, Check channel	see table 'Channel monitoring' *Table 221 " Channel monitoring" on page 835*	see table 'Channel monitoring' *Table 221 " Channel monitoring" on page 835*	BYTE	0	0x0Y12
Output 0, Substitute value	see table 'Substitute values' *Table 222 " Substitute value" on page 835*	see table 'Substitute values' *Table 222 " Substitute value" on page 835*	WORD	0	0x0Y13
Output 1, Channel configuration	see table 'Channel configuration' *Table 220 " Channel configuration" on page 834*	see table 'Channel configuration' *Table 220 " Channel configuration" on page 834*	BYTE	0	0x0Y14
Output 1, Check channel	see table 'Channel monitoring' *Table 221 " Channel monitoring" on page 835*	see table 'Channel monitoring' *Table 221 " Channel monitoring" on page 835*	BYTE	0	0x0Y15
Output 1, Substitute value	see table 'Substitute values' *Table 222 " Substitute value" on page 835*	see table 'Substitute values' *Table 222 " Substitute value" on page 835*	WORD	0	0x0Y16

Table 220: Channel configuration

Internal value	Operating modes of the analog outputs, individually configurable
0 (default)	Not used
128	-10 V ... +10 V
129	0 mA ... 20 mA
130	4 mA ... 20 mA

Table 221: Channel monitoring

Internal value	Check channel
0	Plausibility, wire break, short circuit
3	None

Table 222: Substitute value

Intended behavior of output channel when the control system stops	Required setting of the module parameter "Behavior of outputs in case of a communication error"	Required setting of the channel parameter "Substitute value"
Output OFF	Off	0
Last value infinite	Last value	0
Last value for 5 s and then turn off	Last value 5 s	0
Last value for 10 s and then turn off	Last value 10 s	0
Substitute value infinite	Substitute value	Depending on configuration
Substitute value for 5 s and then turn off	Substitute value 5 s	Depending on configuration
Substitute value for 10 s and then turn off	Substitute value 10 s	Depending on configuration

Diagnosis

In cases of short circuit or overload, the digital outputs are turned off. The module performs reactivation automatically. Thus, an acknowledgement of the errors is not necessary. The error message is stored via the LED.

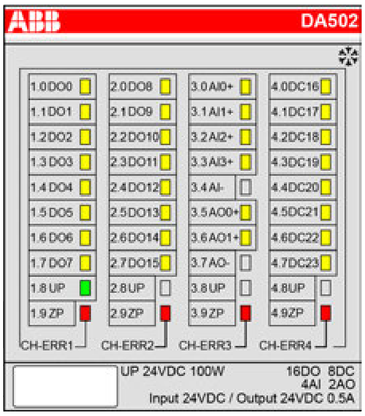
<table>
<tr><th>E1 ... E4</th><th>d1</th><th>d2</th><th>d3</th><th>d4</th><th>Identifier
000 ... 063</th><th>AC500 display</th><th rowspan="3"><– Display in</th></tr>
<tr><th>Class</th><th>Comp</th><th>Dev</th><th>Mod</th><th>Ch</th><th>Err</th><th>PS501 PLC browser</th></tr>
<tr><th>Byte 6
Bit 6 ... 7</th><th>-</th><th>Byte 3</th><th>Byte 4</th><th>Byte 5</th><th>Byte 6
Bit 0 ... 5</th><th>FBP diagnosis block</th></tr>
<tr><th>Class</th><th>Interface</th><th>Device</th><th>Module</th><th>Channel</th><th>Error Identifier</th><th>Error message</th><th>Remedy</th></tr>
<tr><td></td><td>1)</td><td>2)</td><td>3)</td><td>4)</td><td></td><td></td><td></td></tr>
<tr><td colspan="8">Module error</td></tr>
<tr><td rowspan="2">3</td><td>14</td><td>1 ... 10</td><td>31</td><td rowspan="2">31</td><td rowspan="2">19</td><td rowspan="2">Checksum error in the I/O module</td><td rowspan="6">Replace I/O module</td></tr>
<tr><td>11 / 12</td><td>ADR</td><td>1 ... 10</td></tr>
<tr><td rowspan="2">3</td><td>14</td><td>1 ... 10</td><td>31</td><td rowspan="2">31</td><td rowspan="2">3</td><td rowspan="2">Timeout in the I/O module</td></tr>
<tr><td>11 / 12</td><td>ADR</td><td>1 ... 10</td></tr>
<tr><td rowspan="2">3</td><td>14</td><td>1 ... 10</td><td>31</td><td rowspan="2">31</td><td rowspan="2">40</td><td rowspan="2">Different hard-/firmware versions in the module</td></tr>
<tr><td>11 / 12</td><td>ADR</td><td>1 ... 10</td></tr>
</table>

E1 ... E4	d1	d2	d3	d4	Identifier 000 ... 063	AC500 display	<− Display in
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**	
Byte 6 Bit 6 ... 7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0 ... 5**	**FBP diagnosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error Identifier**	**Error message**	**Remedy**
	1)	2)	3)	4)			
3	14	1 ... 10	31	31	43	Internal error in the module	
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	36	Internal data exchange failure	
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	9	Overflow diagnosis buffer	New start
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	26	Parameter error	Check master
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	11	Process voltage too low	Check process voltage
	11 / 12	ADR	1 ... 10				
4	14	1 ... 10	31	31	45	Process voltage is switched off (ON −> OFF)	Process voltage ON
	11 / 12	ADR	1 ... 10				
Channel error DA502							
4	14	1 ... 10	2	0 ... 15	47	Short-circuit at a digital output	Check connection
	11 / 12	ADR	1 ... 10	22 ... 29 5)			
Channel error DA502							
4	14	1 ... 10	1	16 ... 19 6)	48	Analog value overflow or broken wire at an analog input	Check input value or terminal
	11 / 12	ADR	1...10				
4	14	1 ... 10	1	16 ... 19 6)	7	Analog value underflow at an analog input	Check input value
	11 / 12	ADR	1 ... 10				
4	14	1 ... 10	1	16 ... 19 6)	47	Short circuit at an analog input	Check terminal
	11 / 12	ADR	1 ... 10				
4	14	1 ... 10	3	20 ... 21 7)	4	Analog value overflow at an analog output	Check output value
	11 / 12	ADR	1 ... 10				
4	14	1 ... 10	3	20 ... 21 7)	7	Analog value underflow at an analog output	Check output value
	11 / 12	ADR	1 ... 10				

Remarks:

[1])	In AC500, the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2.
[2])	With "Device" the following allocation applies: 31 = module itself, 1 ... 10 = communication interface module 1 ... 10, ADR = hardware address (e.g. of the DC551)
[3])	With "Module" the following allocation applies depending on the master: Module error: I/O bus: 31 = Module itself; COM1/COM2: 1 ... 10 = expansion 1 ... 10 Channel error: I/O bus = module type (1 = AI, 3 = AO, 4 = DC); COM1/COM2: 1 ... 10 = expansion 1 ... 10
[4])	In case of module errors, with channel "31 = module itself" is output.
[5])	Ch = 22 ... 29 indicate the digital inputs/outputs DC16 ... DC23
[6])	Ch = 16 ... 19 indicates the analog inputs AI0 ... AI3
[7])	Ch = 20 ... 21 indicates the analog outputs AO0 ... AO1

State LEDs

LED		State	Color	LED = OFF	LED = ON	LED flashes
	DO0 ... DO15	Digital output	Yellow	Output is OFF	Output is ON	--
	DC16 ...DC23	Digital input/ output	Yellow	Input/output is OFF	Input/output is ON [1])	--
	AI0 ... AI3	Analog input	Yellow	Input is OFF	Input is ON [2])	--
	AO0 ... AO1	Analog output	Yellow	Output is OFF	Output is ON [2])	--
	UP	Process supply voltage 24 V DC via terminal	Green	Process supply voltage is missing	Process supply voltage OK	--
	CH-ERR1	Channel error, error messages in groups (digital inputs/ outputs combined into the groups 1, 2, 3, 4)	Red	No error or process supply voltage is missing	Severe error within the corresponding group	Severe error within the corresponding group (e.g. short circuit at an output)
	CH-ERR2		Red			
	CH-ERR3		Red			
	CH-ERR4		Red			
	CH-ERR [3])	Module error	Red	--	Internal error	--

[1]) Indication LED is ON even if an input signal is applied to the channel and the supply voltage is off. In this case the module is not operating and does not generate an input signal.

[2]) Brightness depends on the value of the analog signal

[3]) All of the LEDs CH-ERR1 to CH-ERR4 light up together

Measuring ranges

Input ranges voltage, current and digital input

Range	**0 V ... +10 V**	**-10 V ... +10 V**	**0 mA ... 20 mA**	**4 mA ... 20 mA**	**Digital input**	**Digital value**	
						Decimal	**Hex.**
Overflow	> 11.7589	> 11.7589	> 23.5178	> 22.8142		32767	7FFF
Measured value too high	11.7589 : 10.0004	11.7589 : 10.0004	23.5178 : 20.0007	22.8142 : 20.0006		32511 : 27649	7EFF : 6C01
Normal range	10.0000 : 0.0004	10.0000 : 0.0004	20.0000 : 0.0007	20.0000 : 4.0006	: : On	27648 : 1	6C00 : 0001
Normal range or measured value too low	0.0000	0.0000	0	4	Off	0	0000
	-0.0004 -1.7593	-0.0004 : : -10,0000		3.9994 1.1858		-1 -4864 : -27648	FFFF ED00 : 9400
Measured value too low		-10.0004 : -11.7589				-27649 : -32512	93FF : 8100
Underflow	< 1.7593	< -11.7589	< 0.0000	< 1.1858		-32768	8000

The represented resolution corresponds to 16 bits.

Input ranges resistance temperature detector

Range	**Pt100 / Pt1000** **-50°C ... +70 °C**	**Pt100 / Pt1000** **-50 °C ... +400 °C**	**Ni1000** **-50 °C ... +150 °C**	**Digital value**	
				Decimal	**Hex.**
Overflow	> +80.0 °C	> +450.0 °C	> +160.0 °C	32767	7FFF
Measured value too high		+450.0 °C : + 400.1 °C		4500 : 4001	1194 : 0FA1
			+160.0 °C : + 150.1 °C	1600 : 1501	0640 : 05DD
	+80.0 °C : +70.1 °C			800 : 701	0320 : 02BD

Range	Pt100 / Pt1000 -50°C ... +70 °C	Pt100 / Pt1000 -50 °C ... +400 °C	Ni1000 -50 °C ... +150 °C	Digital value	
				Decimal	**Hex.**
Normal range	: : +70.0 °C : +0.1 °C	+400.0 °C : : : + 0.1 °C	+150.0 °C : : +0.1 °C	4000 1500 700 : 1	0FA0 05DC 02BC : 0001
	0.0 °C	0.0 °C	0.0 °C	0	0000
	-0.1 °C : -50.0 °C	-0.1 °C : -50.0 °C	-0.1 °C : -50,0 °C	-1 : -500	FFFF : FE0C
Measured value too low	-50.1 °C : -60.0 °C	-50.1 °C : -60.0 °C	-50.1 °C : -60.0 °C	-501 : -600	FE0B : FDA8
Underflow	< -60.0 °C	< -60.0 °C	< -60.0 °C	-32768	8000

Output ranges voltage and current

Range	-10 V ... +10 V	0 mA ... 20 mA	4 mA ... 20 mA	Digital value	
				Decimal	**Hex.**
Overflow	0 V	0 mA	0 mA	> 32511	> 7EFF
Value too high	11.7589 V : 10.0004 V	23.5178 mA : 20.0007 mA	22.8142 mA : 20.0006 mA	32511 : 27649	7EFF : 6C01
Normal range	10.0000 V : 0.0004 V	20.0000 mA : 0.0007 mA	20.0000 mA : 4.0006 mA	27648 : 1	6C00 : 0001
	0.0000 V	0.0000 mA	4.0000 mA	0	0000
	-0.0004 V : -10.0000 V	0 mA : 0 mA	3.9994 mA 0 mA 0 mA	-1 -6912 -27648	FFFF E500 9400
Value too low	-10.0004 V : -11.7589 V	0 mA : 0 mA	0 mA : 0 mA	-27649 : -32512	93FF : 8100
Underflow	0 V	0 mA	0 mA	< -32512	< 8100

The represented resolution corresponds to 16 bits.

Technical data

Technical data of the module

The system data of AC500 and S500 are applicable to the standard version ⇘ *Chapter 2.6.1 “System data AC500” on page 1408*.

The system data of AC500-XC are applicable to the XC version ⇘ *Chapter 2.7.1 “System data AC500-XC” on page 1475*.

Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

Parameter		Value
Process supply voltage		
	Connections	Terminals 1.8, 2.8, 3.8 and 4.8 for UP (+24 V DC) and 1.9, 2.9, 3.9 and 4.9 for ZP (0 V)
	Protection against reverse voltage	yes
	Rated protection fuse at UP	10 A fast
	Rated value	24 V DC
	Max. ripple	5 %
Current consumption		
	From UP	0.07 A + max. 0.5 A per output
	From 24 V DC power supply at the terminals UP/L+ and ZP/M of the CPU/communication interface module	ca. 2 mA
	Inrush current from UP (at power-up)	0.04 A^2s
Galvanic isolation		Yes, per module
Max. power dissipation within the module		6 W (outputs unloaded)
Weight (without terminal unit)		ca. 125 g
Mounting position		Horizontal mounting or vertical with derating (output load reduced to 50% at +40 °C)
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

NOTICE!
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and temporary overvoltage up to 30 V DC.

Multiple overloads
No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an internal smart high-side switch.

Technical data of the digital outputs

Parameter		Value
Number of channels per module		16 outputs (with transistors)
Distribution of the channels into groups		1 group of 16 channels
Connection of the channels		
	DO0 ... DO7	Terminals 1.0 ... 1.7
	DO8 ... DO15	Terminals 2.0 ... 2.7
Indication of the output signals		1 yellow LED per channel, the LED is ON if the output signal is high (signal 1)
Monitoring point of output indicator		LED is controlled by process CPU
Reference potential for all outputs		Terminals 1.9, 2.9, 3.9 and 4.9 (negative pole of the process supply voltage, signal name ZP)
Common power supply voltage		For all outputs: terminals 1.8, 2.8, 3.8 and 4.8 (positive pole of the process supply voltage, signal name UP)
Output voltage for signal 1		UP (-0.8 V)
Output delay (0->1 or 1->0)		On request
Output current		
	Rated value, per channel	500 mA at UP = 24 V
	Maximum value (channels O0 to O15)	4 A
Leakage current with signal 0		< 0.5 mA
Rated protection fuse on UP		10 A fast
Demagnetization when inductive loads are switched off		With varistors integrated in the module (see figure below)
Switching frequency		
	With resistive load	On request
	With inductive loads	Max. 0.5 Hz
	With lamp loads	Max. 11 Hz with max. 5 W
Short-circuit-proof / overload-proof		Yes
Overload message (I > 0.7 A)		Yes, after ca. 100 ms
Output current limitation		Yes, automatic reactivation after short circuit/overload
Resistance to feedback against 24 V signals		Yes
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

Technical data of the configurable digital inputs/outputs

Each of the configurable digital I/O channels can be defined as input or output by the user program. This is done by interrogating or allocating the corresponding channel.

Parameter		Value
Number of channels per module		8 inputs/outputs (with transistors)
Distribution of the channels into groups		1 group for 8 channels
If the channels are used as inputs		
	Channels DC16 ... DC23	Terminals 4.0 ... 4.7
If the channels are used as outputs		
	Channels DC16 ... DC23	Terminals 4.0 ... 4.7
Indication of the input/output signals		1 yellow LED per channel, the LED is ON when the input/output signal is high (signal 1)
Monitoring point of input/output indicator		LED is part of the input circuitry
Galvanic isolation		Yes, per module

Technical data of the digital inputs/outputs if used as inputs

Parameter		Value
Number of channels per module		8
Distribution of the channels into groups		1 group of 8 channels
Terminals of the channels DC16 ... DC23		Terminals 4.0 ... 4.7
Reference potential for all inputs		Terminals 1.9 ... 4.9 (Negative pole of the supply voltage, signal name ZP)
Indication of the input signals		1 yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Monitoring point of input/output indicator		LED is part of the input circuitry
Input type (according EN 61131-2)		Type 1
Input delay (0->1 or 1->0)		Typ. 0.1 ms, configurable from 0.1 ms ... 32 ms
Input signal voltage		24 V DC
	0-Signal	-3 V ... +5 V
	Undefined Signal	> +5 V ... < +15 V
	1-Signal	+15 V ... +30 V
Ripple with signal 0		Within -3 V ... +5 V
Ripple with signal 1		Within +15 V ... +30 V
Input current per channel		
	Input voltage +24 V	Typ. 5 mA
	Input voltage +5 V	> 1 mA
	Input voltage +15 V	> 2 mA
	Input voltage +30 V	< 8 mA
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

* Due to the direct connection to the output, the demagnetizing varistor is also effective at the input (see figure) above. This is why the difference between UPx and the input signal must not exceed the clamp voltage of the varistor. The varistor limits the clamp voltage to approx. 36 V. Consequently, the input voltage must range from -12 V ... +30 V when UPx = 24 V and from -6 V ... +30 V when UPx = 30 V.

Technical data of the digital inputs/outputs if used as outputs

Parameter		Value
Number of channels per module		8
Distribution of the channels into groups		1 group of 8 channels
Terminals of the channels DC16 ... DC23		Terminals 4.0 ... 4.7
Reference potential for all outputs		Terminals 1.9 ... 4.9 (negative pole of the supply voltage, signal name ZP)
Common power supply voltage		For all outputs terminals 1.8, 2.8, 3.8 and 4.8 (positive pole of the supply voltage, signal name UP)
Output voltage for signal 1		UP (-0.8 V)
Output delay (0->1 or 1->0)		On request
Output current		
	rated value per channel	500 mA at UP = 24 V
	max. value (all channels together)	4 A
Leakage current with signal 0		< 0.5 mA
Fuse for UP		10 A fast
Demagnetization with inductive DC load		Via internal varistors (see figure below this table)
Output switching frequency		
	With resistive load	On request
	With inductive loads	Max. 0.5 Hz
	With lamp loads	11 Hz max. at 5 W max.
Short-circuit-proof / overload-proof		Yes
Overload message (I > 0.7 A)		Yes, after ca. 100 ms
Output current limitation		Yes, automatic reactivation after short circuit/overload
Resistance to feedback against 24 V signals		Yes (software-controlled supervision)
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

The following drawing shows the circuitry of a digital input/output with the varistors for demagnetization when inductive loads are switched off.

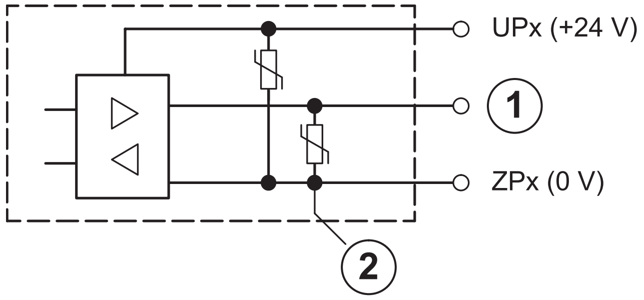


Fig. 214: Digital input/output (circuit diagram)

1 Digital input/output
2 For demagnetization when inductive loads are turned off

Technical data of the fast counter

The fast counter of the module does not work if the module is connected to a CS31 bus module.

Parameter	Value
Counting frequency	Max. 50 kHz

Technical data of the analog inputs

Parameter	Value
Number of channels per module	4
Distribution of channels into groups	1 group with 4 channels
Connection if channels AI0+ ... AI3+	Terminals 3.0 ... 3.3
Reference potential for AI0+ ... AI3+	Terminal 3.4 (AI-) for voltage and RTD measurement Terminal 1.9, 2.9, 3.9 and 4.9 for current measurement
Input type	
Unipolar	Voltage 0 V ... 10 V, current or Pt100/Pt1000/Ni1000
Bipolar	Voltage -10 V ... +10 V
Configurability	0 V ... 10 V, -10 V ... +10 V, 0 mA ... 20 mA, 4 mA ... 20 mA, Pt100/1000, Ni1000 (each input can be configured individually)
Channel input resistance	Voltage: > 100 kΩ Current: ca. 330 Ω
Time constant of the input filter	Voltage: 100 µs Current: 100 µs
Indication of the input signals	1 LED per channel (brightness depends on the value of the analog signal)
Conversion cycle	1 ms (for 4 inputs + 2 outputs); with RTDs Pt/Ni... 1 s
Resolution	Range 0 V ... 10 V: 12 bits Range -10 V ... +10 V: 12 bits including sign Range 0 mA ... 20 mA: 12 bits Range 4 mA ... 20 mA: 12 bits Range RTD (Pt100, PT1000, Ni1000): +0.1 °C
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range	Typ. 0.5 %, max. 1 % For XC version below 0 °C and above +60 °C: on request

Parameter	Value
Relationship between input signal and hex code	*Chapter 1.6.3.1.2.10.2 "Input ranges resistance temperature detector" on page 838*
Unused inputs	Are configured as "unused" (default value)
Overvoltage protection	Yes

Technical data of the analog inputs, if used as digital inputs

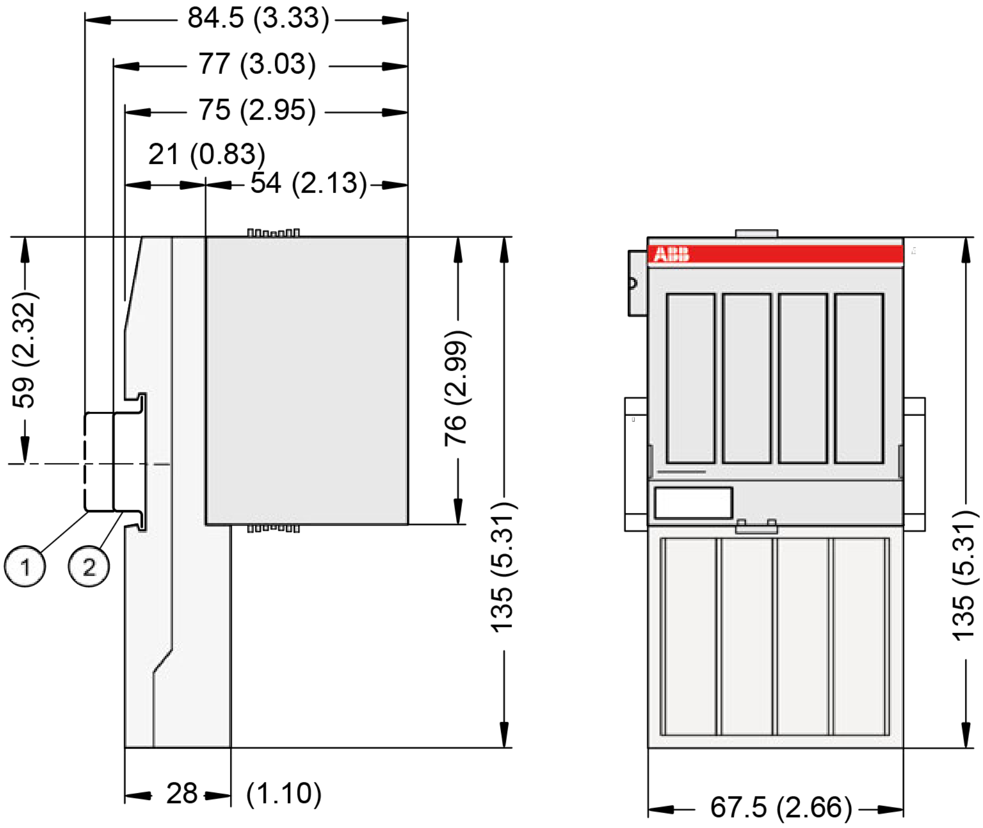
Parameter		Value
Number of channels per module		Max. 4
Distribution of channels into groups		1 group of 4 channels
Connections of the channels AI0+ ... AI3+		Terminals 3.0... 3.3
Reference potential for the inputs		Terminals 1.9, 2.9, 3.9 and 4.9 (ZP)
Indication of the input signals		1 LED per channel
Input signal voltage		24 V DC
	Signal 0	-30 V ... +5 V
	Undefined signal	+5 V ... +13 V
	Signal 1	+13 V ... +30 V
Input current per channel		
	Input voltage +24 V	Typ. 7 mA
	Input voltage +5 V	Typ. 1.4 mA
	Input voltage +15 V	Typ. 3.7 mA
	Input voltage +30 V	< 9 mA
Input resistance		ca. 3.5 kΩ

Technical data of the analog outputs

Parameter		Value
Number of channels per module		2
Distribution of channels into groups		1 group for 2 channels
Connection of the channels AO0+ ... AO1+		Terminals 3.5 and 3.6
Reference potential for AO0+ ... AO1+		Terminal 3.7 (AO-) for voltage output Terminals 1.9, 2.9, 3.9 and 4.9 for current output
Output type		
	Unipolar	Current
	Bipolar	Voltage
Galvanic isolation		Against internal supply and other modules
Configurability		-10 V ... +10 V, 0 mA ... 20 mA, 4 mA ... 20 mA (each output can be configured individually)

Parameter	Value
Output resistance (load), as current output	0 Ω ... 500 Ω
Output loadability, as voltage output	± 10 mA max.
Indication of the output signals	1 LED per channel (brightness depends on the value of the analog signal)
Resolution	12 bits including sign
Settling time for full range change (resistive load, output signal within specified tolerance)	Typ. 5 ms
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range	Typ. 0.5 %, max. 1 %
Relationship between input signal and hex code	*Chapter 1.6.3.1.2.10.3 “Output ranges voltage and current” on page 839*
Unused outputs	Are configured as "unused" (default value) and can be left open-circuited

Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

> *The dimensions are in mm and in brackets in inch.*

Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 250 800 R0001	DA502, digital/analog input/output module, 16 DO, 8 DC, 4 AI, 2 AO	Active
1SAP 450 800 R0001	DA502-XC, digital/analog input/output module, 16 DO, 8 DC, 4 AI, 2 AO, XC version	Active

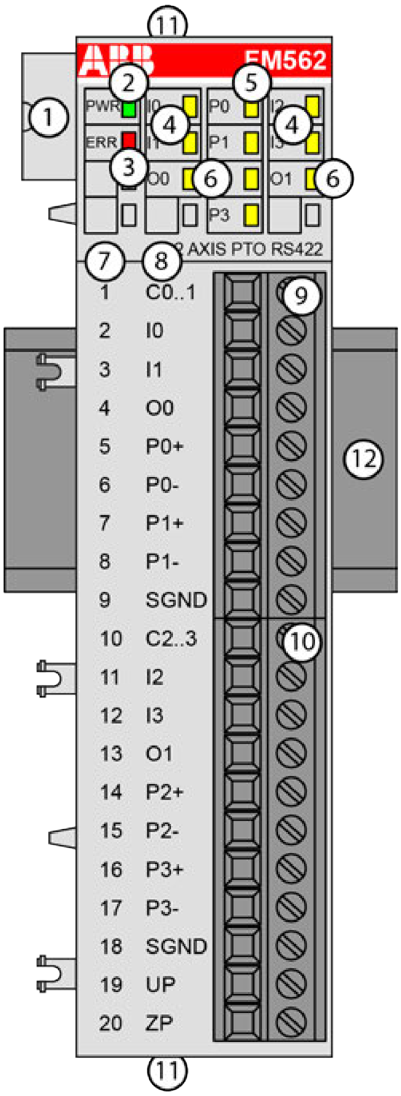
**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

1.7 Function modules

1.7.1 S500-eCo

1.7.1.1 FM562 for pulse train output

- 2 axes motion control
- 2 pulse train outputs per axis, RS-422
- 2 configurable digital inputs per axis, 24 V DC
- 32 bits registers for current position, registered position and speed value
- Group-wise galvanically isolated



1 I/O bus
2 1 green LED to display power supply
3 1 red LED to display error
4 4 yellow LEDs to display the signal states of the inputs I0 to I3
5 4 yellow LEDs to display the signal states of the pulse train outputs P0 ... P3
6 2 yellow LEDs to display the signal states of O0 ... O1 (reserved)
7 Terminal number
8 Allocation of signal name
9 Terminal block for axis signals (9-pin)
10 Terminal block for axis signals and process supply voltage (11-pin)
11 2 holes for wall-mounting with screws
12 DIN rail

1.7.1.1.1 Intended purpose

The function module FM562 for pulse train output (PTO) is used for simple positioning tasks with servo drives or stepper drives. FM562 provides 2 axes with 2 inputs and 2 pulse-train outputs each.

It can be used at the following devices:

- Communication interface modules (e. g. CI501-PNIO, CI541-DP)
- Processor modules

It contains the following features:

- 2 axes control
- 2 configurable discrete digital inputs per axis for enable and limit switches signal inputs
- PTO output type: RS-422 differential output (P0, P1, P2 and P3)
- PTO frequency: 10 Hz to 250kHz
- Configurable PTO output mode: CW/CCW (clockwise/counterclockwise), pulse/direction
- Position and speed control with built in motion profile generators. Integration in the application program by PLCopen motion control function blocks (PS552-MC-E motion control library is required for programming)

The pulse outputs of the 2 axes are not galvanically isolated from each other.

The other circuitry of the module is galvanically isolated from the inputs/outputs.

1.7.1.1.2 Connections

The pulse-train output module FM562 can be connected to the following devices via the I/O bus connector:

- S500 PROFIBUS and PROFINET communication interface module (e. g. CI501-PNIO, CI541-DP)
- AC500 CPUs
- Other AC500 I/O modules

> *The I/O module must not be used as a decentralized I/O module with CI590-CS31-HA communication interface modules.*

> *The module must not be used as a communication interface module at CI58x-CN or CI59x-CS31.*

The connection is carried out by using removable 9-pin and 11-pin terminal blocks. These terminal blocks differ in their connection system (spring terminals or screw terminals, cable mounting from the front or from the side). For more information, please refer to the chapter terminal blocks for S500-eCo I/O modules *Chapter 1.9.2.1 “TA563-TA565 - Terminal blocks” on page 1352*. The terminal blocks are not included in the module's scope of delivery and must be ordered separately.

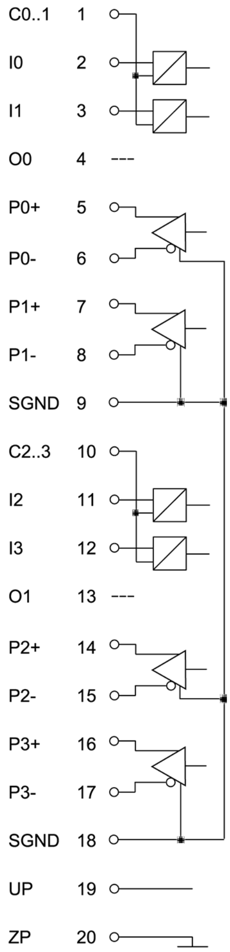


Fig. 215: Internal construction of the digital inputs and outputs

The 2 SGND signals are internally interconnected.

Table 223: Assignment of the terminals

Terminal	Signal	Description
1	C0 ... C1	Input common for signals I0 and I1
2	I0	Input signal I0 (axis enable and limit switch)
3	I1	Input signal I1 (stop)
4	O0	Reserved - do not connect
5	P0+	Pulse output P0+ (positive line)
6	P0-	Pulse output P0- (negative line)
7	P1+	Pulse or direction output P1+ (positive line)
8	P1-	Pulse or direction output P1- (negative line)
9	SGND	Signal ground for pulse output
10	C2 ... C3	Input common for signals I2 and I3

Terminal	Signal	Description
11	I2	Input signal I2 (axis enable and limit switch)
12	I3	Input signal I3 (stop)
13	O1	Reserved - do not connect
14	P2+	Pulse output P2+ (positive line)
15	P2-	Pulse output P2- (negative line)
16	P3+	Pulse or direction output P3+ (positive line)
17	P3-	Pulse or direction output P3- (negative line)
18	SGND	Signal ground for pulse output
19	UP	Process voltage UP +24 V DC
20	ZP	Process voltage ZP 0 V DC

When wiring, the motor phase line and power line should be separated in order to avoid signal disturbances between each other.

For cable length ≤ 30 m, unshielded cable can be used with Baldor and BSD servo drives normally.

For cable length > 30 m, shielded cable must be used for surge purpose.

The grounding of the shield should take place at the control cabinet *⇘ Chapter 2.6.1 “System data AC500” on page 1408.*

The cable shields must be grounded at both ends of the cables. In order to avoid unacceptable potential differences between different parts of the installation, low resistance equipotential bonding conductors must be laid.

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a communication interface module or a CPU). Thus, the current consumption from 24 V DC power supply at the terminals L+/UP and M/ZP of the CPU/communication interface module increases by 5 mA per FM562.

The external power supply connection is carried out via the UP (+24 V DC) and ZP (0 V DC) terminals.

WARNING!
Removal/Insertion under power
The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!
Risk of damaging the PLC modules!
Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

NOTICE!
Risk of damaging the PLC modules!
Never connect any voltages or signals to reserved terminals (marked with --- or O0 / O1). Reserved terminals may carry internal voltages.

Be sure to connect the pulse output signals in the right order. Otherwise, the pulse number may be wrongly calculated and malfunctions may appear.

The module provides several diagnosis functions *Chapter 1.7.1.1.6 “Diagnosis” on page 860*.

The digital inputs can be used as source inputs or as sink inputs.

NOTICE!
Risk of malfunctions in the plant!
A ground fault, e. g. caused by a damaged cable insulation, can bridge switches accidentally.

Use sink inputs when possible or make sure that, in case of error, there will be no risks to persons or plant.

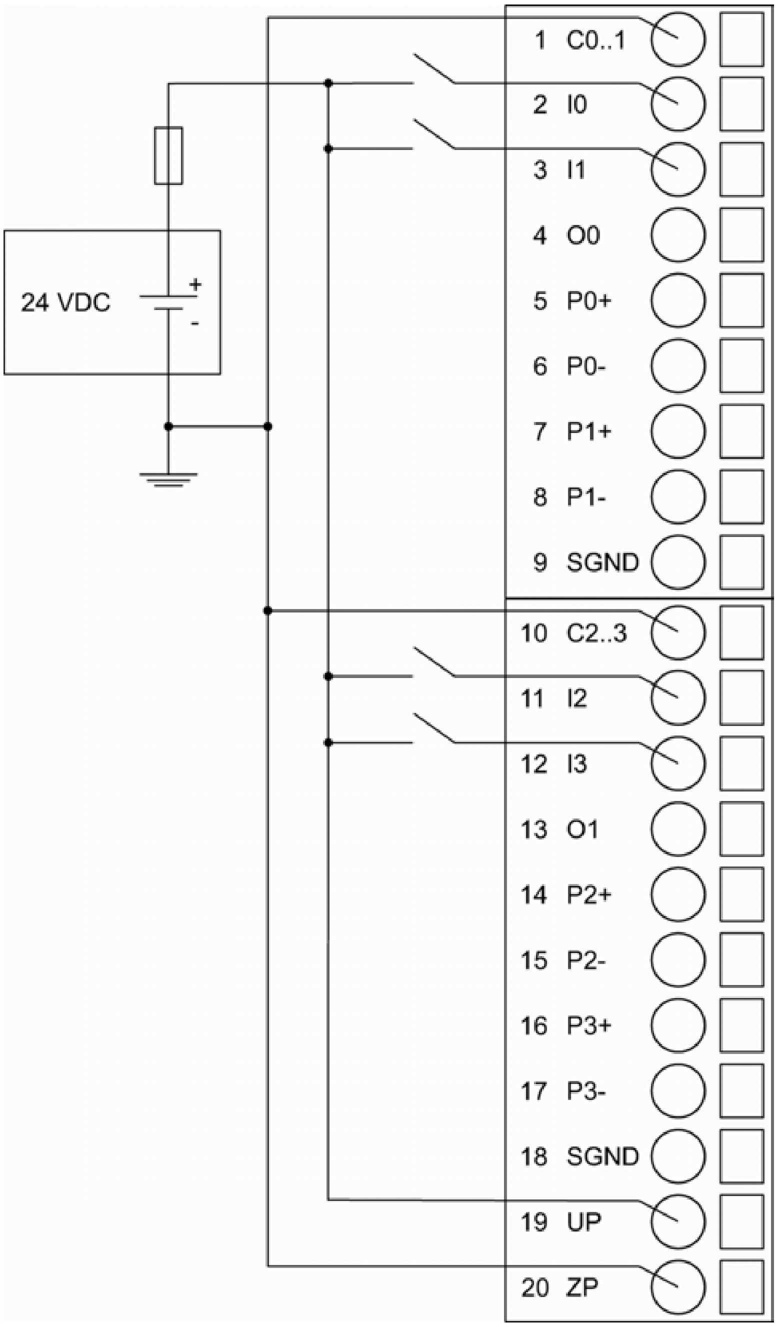


Fig. 216: Connection of inputs to the FM562 - sink inputs

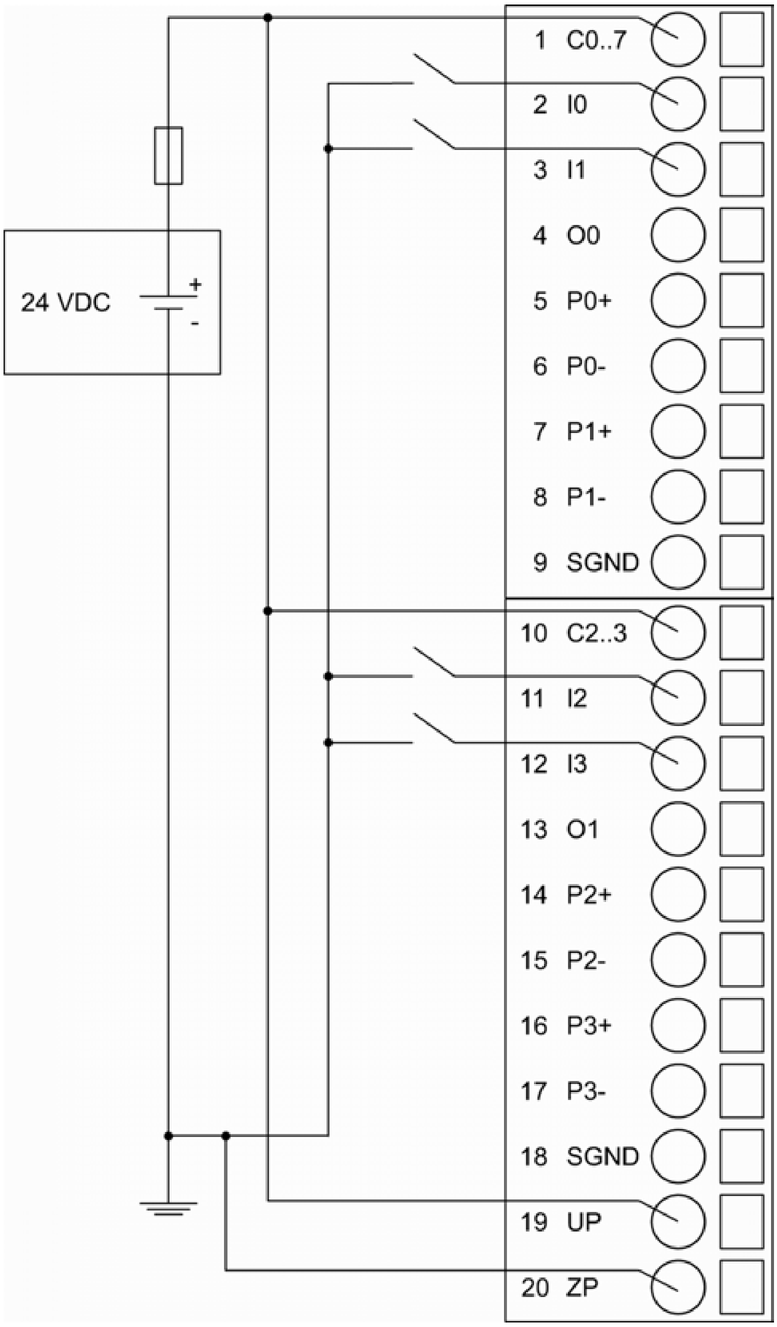


Fig. 217: Connection of inputs to the FM562 - source inputs

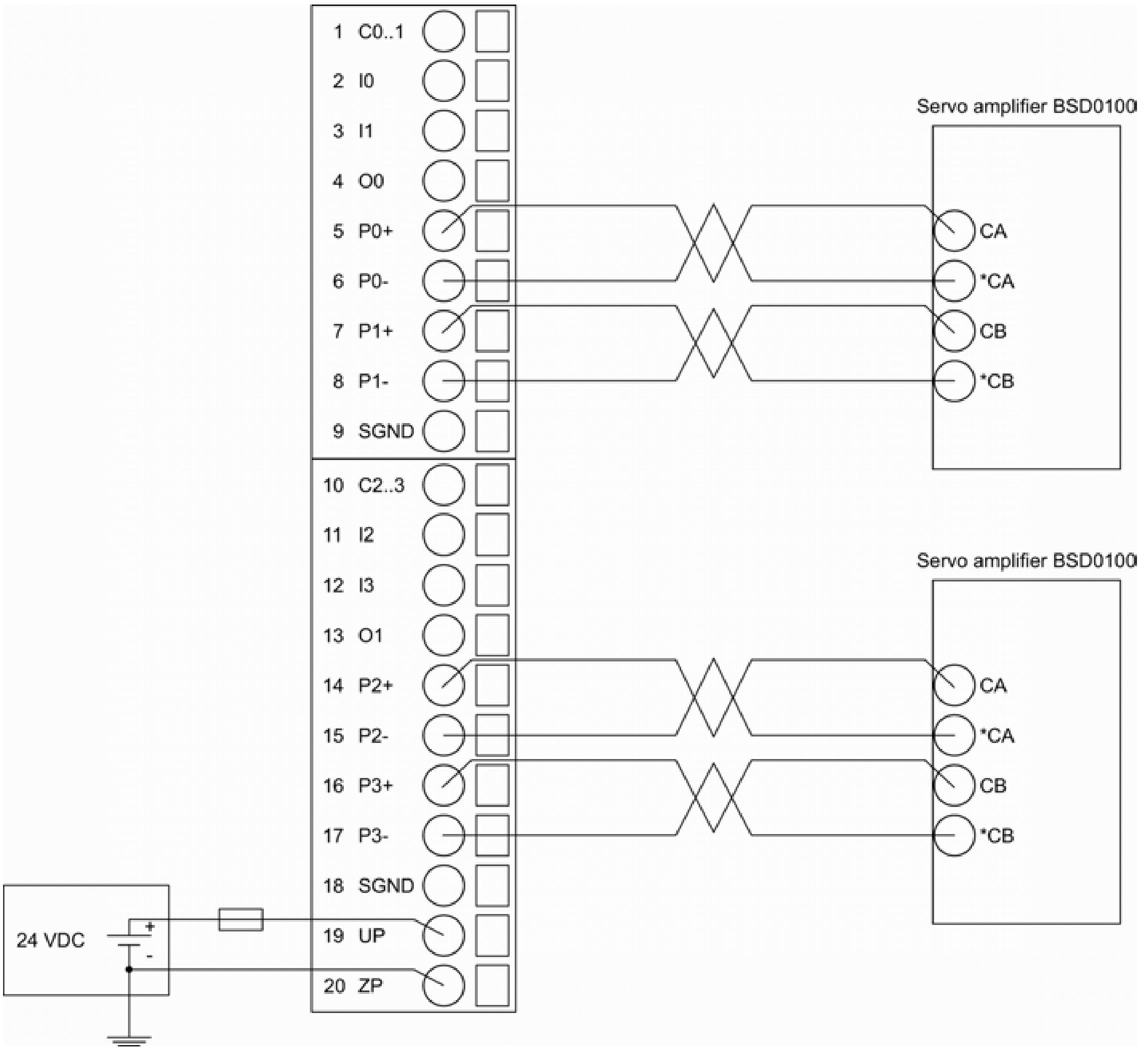


Fig. 218: Connection (differential) of pulse train output to a servo amplifier

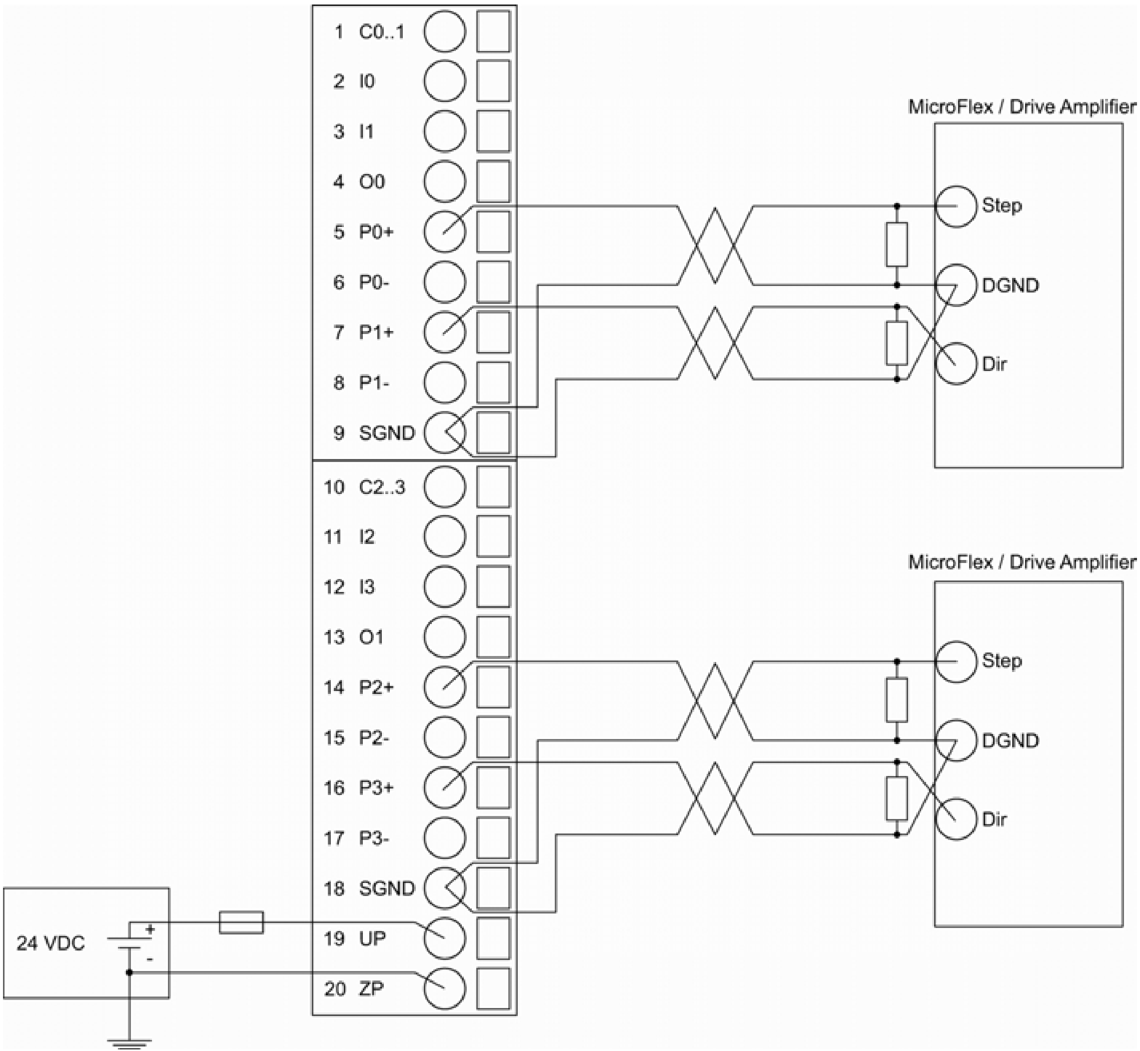


Fig. 219: Connection (single-ended) of pulse train output to a servo amplifier

> *For drives/amplifiers with high-impedance pulse input interface like MicroFlex, the cable ends must be equipped with 100 Ω terminating resistors to eliminate signal reflections. Normally, the resistors are integrated in the interface connectors.*

1.7.1.1.3 Internal data exchange

Parameter	Value
Axes input data (words)	16
Axes output data (words)	16

1.7.1.1.4 I/O configuration

The pulse-train output module FM562 does not store configuration data itself.

1.7.1.1.5 Parameterization

The arrangement of the parameter data is performed with Automation Builder.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

> *For programming, the library package PS552-MC-E is required. This library package is not part of Automation Builder and has to be purchased separately.*

Module parameters

Name	Value	Internal Value	Internal Value, Type	Default	Min.	Max.
Module ID	Internal	1830	WORD	0x0726	0	65535
Ignore module	No Yes	0 1	BYTE	No 0x00		
Parameter length	Internal	19	BYTE	19	0	255
Check Supply	Off On	0 1	BYTE	On 0x01	0	255

Input channels for axis 1

Name	Value	Internal Value	Internal Value, Type	Default	Min.	Max.
Input 0, channel configuration	No function Axis enable / limit switch	0 1	BYTE	No function 0x00	0	1
Input 0, input delay	0.1 ms 1 ms 8 ms 32 ms	0 1 2 3	BYTE	0.1 ms 0x00	0	3
Input 1, channel configuration	No function Stop Registration *)	0 1 2	BYTE	No function 0x00	0	2
Input 1, input delay	0.1 ms 1 ms 8 ms 32 ms	0 1 2 3	BYTE	0.1 ms 0x00	0	3

*) Reserved - do not use

Output channel for axis 1

Name	Value	Internal Value	Internal Value, Type	Default	Min.	Max.
Output 0, channel configura-tion	No function	0	BYTE	No function 0x00	0	2

Slot parameters for axis 1

Name	Value	Internal Value	Internal Value, Type	Default	Min.	Max.
Output mode	CW/CCW Pulse/Direc-tion	0 1	BYTE	CW/CCW 0x00	0	1
Start fre-quency *)	0 ... 65535	0 ... 65535	WORD	0 0x00	0	65535

*) Unit is Hz

Input channels for axis 2

Name	Value	Internal Value	Internal Value, Type	Default	Min.	Max.
Input 2, channel configura-tion	No function Axis enable / limit switch	0 1	BYTE	No function 0x00	0	1
Input 2, input delay	0.1 ms 1 ms 8 ms 32 ms	0 1 2 3	BYTE	0.1ms 0x00	0	3
Input 3, channel configura-tion	No function Stop Registration *)	0 1 2	BYTE	No function 0x00	0	2
Input 3, input delay	0.1 ms 1 ms 8 ms 32 ms	0 1 2 3	BYTE	0.1 ms 0x00	0	3

*) Reserved - do not use

Output channel for axis 2

Name	Value	Internal Value	Internal Value, Type	Default	Min.	Max.
Output 1, channel configuration	No function	0	BYTE	No function 0x00	0	2

Slot parameters for axis 2

Name	Value	Internal Value	Internal Value, Type	Default	Min.	Max.
Output mode	CW/CCW Pulse/Direction	0 1	BYTE	CW/CCW 0x00	0	1
Start frequency *)	0 ... 65535	0 ... 65535	WORD	0 0x00	0	65535

*) Unit is Hz

GSD file:

Ext_User_Prm_Data_Len =	0x17
Ext_User_Prm_Data_Const(0) =	0x07, 0x27, 0x00, 0x13, 0x01\ 0x00, 0x00, 0x00, 0x00, 0x00\ 0x00, 0x00, 0x00, 0x00, 0x00\ 0x00, 0x00, 0x00, 0x00, 0x00\ 0x00, 0x00, 0x00;

1.7.1.1.6 Diagnosis

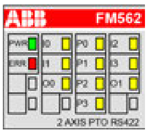
E1...E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier** **000 ... 063**	**AC500 display**	**<– Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 6 **Bit 6...7**	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6** **Bit 0 ... 5**	**PNIO diag-nosis block**	
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error identi-fier**	**Error message**	**Remedy**
	1)	2)	3)	4)			
			Module error FM562				
3	14	1...10	31	31	19	Checksum error in the I/O module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	43	Internal error in the module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	3	Timeout inside the I/O module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	9	Overflow diagnosis buffer	Restart
	11 / 12	ADR	1...10				
3	14	1...10	31	31	26	Parameter error	Check master
	11 / 12	ADR	1...10				
4	14	1...10	31	31	45	Process voltage is switched off (ON => OFF)	Process voltage ON
	11 / 12	ADR	1...10				

Remarks:

1)	In AC500, the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The PNIO diagnosis block does not contain this identifier.
2)	With "Device" the following allocation applies: 31 = module itself, 1..10 = decentralized communication interface module 1..10, ADR = hardware address (e. g. of the DC551-CS31)

3)	With "Module" the following allocation applies depending on the master: Module error: I/O bus or PNIO: 31 = module itself; COM1/COM2: 1..10 = expansion 1..10 Channel error: I/O bus or PNIO = module type (2 = DO); COM1/COM2: 1..10 = expansion 1..10
4)	In case of module errors, with channel "31 = Module itself" is output.

1.7.1.1.7 State LEDs

LED		State	Color	LED = OFF	LED = ON	LED flashes
	PWR	Process voltage 24 V DC via terminal and process voltage via I/O bus	Green	CPU module voltage or external 24 V DC supply voltage is missing	I/O bus voltage and external 24 V DC supply voltage are present (LED is on after startup of the module (approx. 1 s))	---
	ERR	Channel or module error	Red	No error or process voltage is missing	Severe error in the module	Axis related error
	P0 ... P3	Pulse output	Yellow	Output = OFF	Output = ON	LED follows the state of the outputs, depending on frequency
	I0 ... I3	Digital Input	Yellow	Input = OFF	Input = ON	---
	O0 ... O1	Reserved	Yellow	---	---	---

1.7.1.1.8 Technical data

Technical data of the module

The system data of AC500-eCo apply.

Chapter 2.5.1 “System data AC500-eCo” on page 1379

Only additional details are therefore documented below.

Parameter	Value
Digital inputs	4 inputs (2 per axis) 24 V DC, can be used as source inputs or as sink inputs
Input channels 0 and 2	Input signal used for axis enable and limit switch
Input channels 1 and 3	Stop, configurable
Input data length	32 bytes

Parameter	Value
Pulse outputs	Pulse specification ● 2 outputs for each axis, configurable ● Type: RS-422 differential signal ● Mode: CW & CCW or Pulse & Direction ● Frequency: 10 Hz to 250 kHz ● Pulse number: -2147483648 to 2147483647 (32 bits) ● Motion profiles generator
Output data lenth	32 bytes
LED displays	For power supply, errors and signal states
Internal power supply	Via I/O bus
External power supply	Via the terminals ZP and UP (process voltage 24 V DC)

Process supply voltage UP	Value
Connections	Terminal 19 for UP (+24 V DC) and terminal 20 for ZP (0 V)
Rated value	24 V DC
Current consumption via UP terminal	42 mA
Max. ripple	5 %
Inrush current from UP (at power up)	0.067 A^2s
Protection against reversed voltage	Yes
Rated protection fuse for UP	Not necessary
Current consumption from 24 V DC power supply at the L+/UP and M/ZP terminals of the CPU/communication interface module	Ca. 5 mA
Galvanic isolation	Yes, between input groups and the output group and the rest of the module
Isolated groups	5 groups (2 groups for 4 input channels, 1 group for 4 pulse train output channels, 1 group for process supply voltage, 1 group for the rest of the module)
Surge-voltage (max.)	35 V DC for 0.5 s
Max. power dissipation within the module	1.2 W
Weight	Ca. 125 g
Mounting position	Horizontal or vertical
Cooling	The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

No effects of multiple overloads

No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an external fuse.

Technical data of the digital inputs

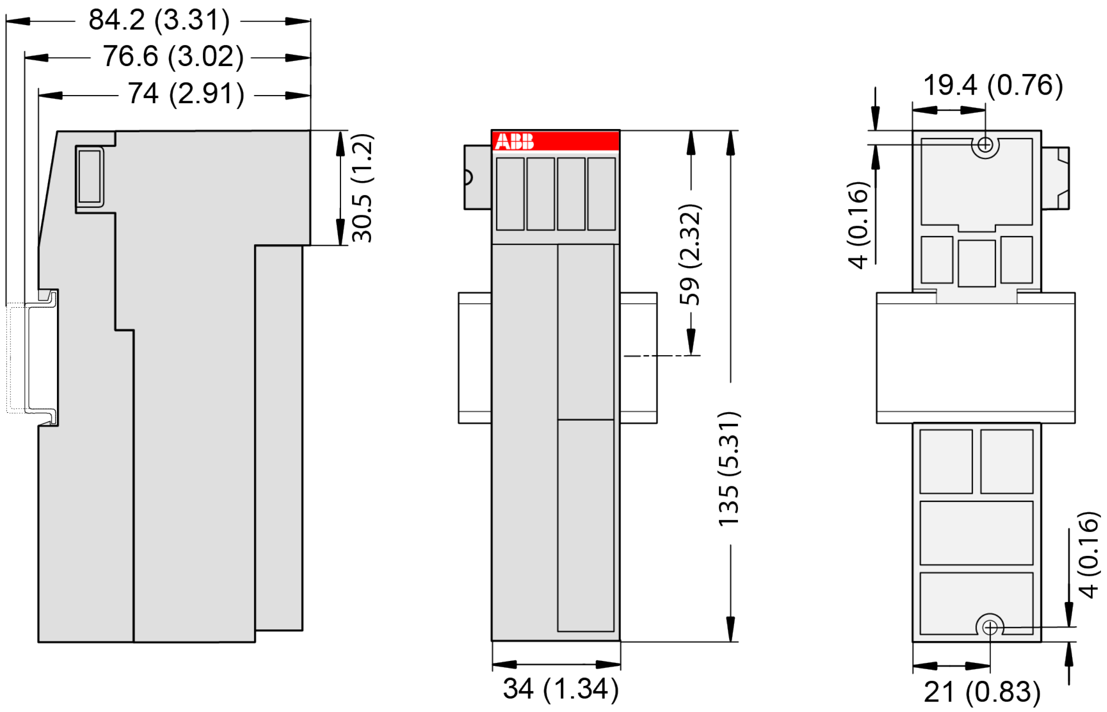
Parameter		Value	
Number of channels per module		4	
Distribution of the channels into axes		1 group of 2 channels for each axis	
	Axis 1	Inputs I0 ... I1	
	Axis 2	Inputs I2 ... I3	
Connections of the channels I0 ... I1		Terminals 2 ... 3	
Connections of the channels I1 ... I3		Terminals 11 ... 12	
Reference potential for the channels I0 ... I1		Terminal 1 (Signal name C0 ... C1)	
Reference potential for the channels I2 to I3		Terminal 10 (Signal name C2 ... C3)	
Galvanic isolation		Yes, per axis	
Indication of the input signals		1 yellow LED per channel; the LED is ON when the input signal is high (signal 1)	
Input type according to EN 61131-2		Type 1 source	Type 1 sink
Input signal range		-24 V DC	+24 V DC
	Signal 0	-5 V ... +3 V	-3 V ... +5 V
	Undefined signal	-15 V ... + 5 V	+5 V ... +15 V
	Signal 1	-30 V ... -15 V	+15 V ... +30 V
Ripple with signal 0		-5 V ... +3 V	-3 V ... +5 V
Ripple with signal 1		-30 V ... -15 V	+15 V ... +30 V
Input current per channel			
	Input voltage +24 V	Typ. 5 mA	
	Input voltage +5 V	Typ. 1 mA	
	Input voltage +15 V	> 2.5 mA	
	Input voltage +30 V	< 8 mA	
Max. permissible leakage current (at 2-wire proximity switches)		1 mA	
Input delay (0->1 or 1->0)		Typ. 0.1 ms ... 32 ms (configurable via software), default: 0.1 ms	
Max. cable length			
	Shielded	500 m	
	Unshielded	300 m	

Technical data of the pulse outputs

Parameter	Value
Number of channels	2 per axis, 4 per module
Output type	RS-422
Output mode	Clockwise and counter-clockwise or pulse and direction
Output frequency	10 Hz to 250 kHz

Parameter		Value
Frequency accuracy		
	From 10 Hz to 500 Hz	± 2 %
	From 501 Hz to 250 kHz	± 1 %
Differential output voltage (at terminal block)		2.8 V at 140 Ω differential load 2.56 V at 100 Ω differential load
Output voltage of positive output (P0+, P1+) referenced to SGND if used for single ended application		Max. 3.3 V without any load Typ. 2.5 V at 100 Ω load
Max. short circuit current		40 mA
Max. cable length		
	Shielded	300 m (at max. frequency, criterion: V ≥ 2 V, tested with 100 Ω termination)
	Unshielded	30 m

1.7.1.1.9 Dimensions



The dimensions are in mm and in brackets in inch.

1.7.1.1.10 Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 233 100 R0001	FM562, pulse-train output module, 2 axes, RS-422, 4 DI, 24 V DC	Classic
1TNE 968 901 R3101	Terminal block TA563-9, 9 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3102	Terminal block TA563-11, 11 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3103	Terminal block TA564-9, 9 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3104	Terminal block TA564-11, 11 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3105	Terminal block TA565-9, 9 pins, spring front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3106	Terminal block TA565-11, 11 pins, spring front, cable front, 6 pieces per unit	Active

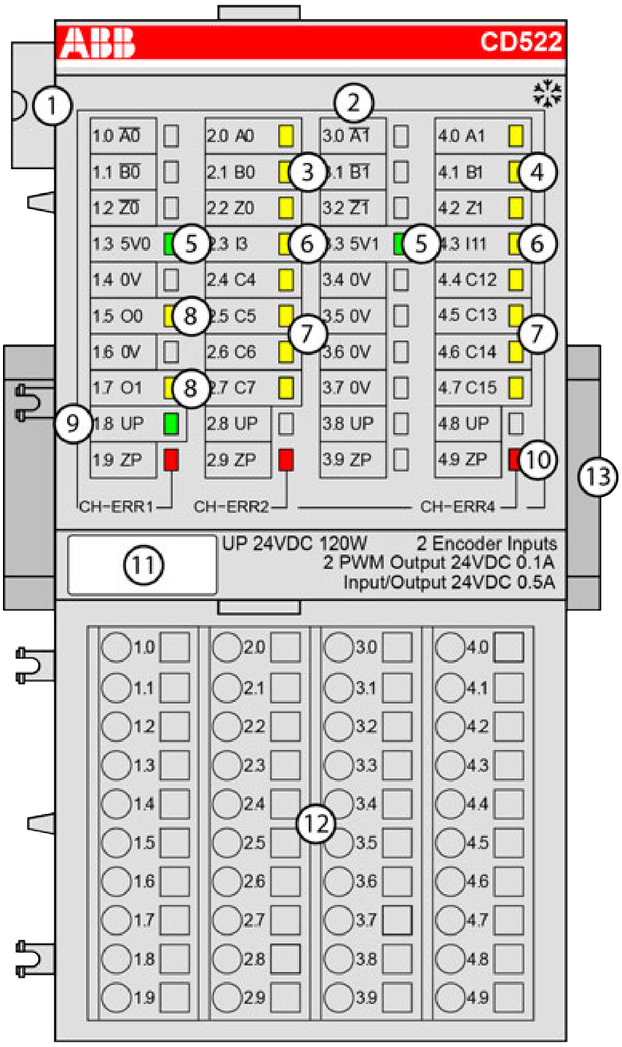
**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

1.7.2 S500

1.7.2.1 CD522 - Encoder, counter and PWM module

1.7.2.1.1 Features

- 2 encoder inputs with 2 integrated 5-V-power-supplies for the encoders
- 2 PWM outputs - 2 digital inputs 24 V DC
- 8 configurable digital inputs/outputs 24 V DC
- Fast counter
- Module-wise galvanically isolated
- XC version for use in extreme ambient conditions available



1 I/O bus
2 Allocation of terminal No. and signal name
3 3 yellow LEDs to display the signal states of the encoder 0 input
4 3 yellow LEDs to display the signal states of the encoder 1 input
5 2 green LEDs to display the 5-V-power-supply states
6 2 yellow LEDs to display the signal state of the digital input I3 and I11
7 8 yellow LEDs to display the input/output signal states
8 2 yellow LEDs to display the signal states of the PWM/pulse outputs
9 1 green LED to display the process voltage UP
10 3 red LEDs to display errors
11 Label
12 Terminal unit
13 DIN rail
❄ Sign for XC version

1.7.2.1.2 Intended purpose

The encoder and PWM module CD522 can be used at the following devices:

- Communication interface modules (e. g. CI501-PNIO, CI541-DP)
- Processor modules

Features:

- 2 independent counting functions with up to 12 configurable modes (including incremental position encoder and frequency input up to 300 kHz)
- 2 independent PWM (pulse-width modulator) or pulse outputs with push-pull driver

- Dedicated inputs/outputs for specific counting functions (e.g. touch, set, reset)
- All unused inputs/outputs can be used with the specifications of standard inputs/outputs range

For use in extreme ambient conditions (e.g. wider temperature and humidity range), a special XC version of the device is available.

Depending on the configuration used, some inputs and outputs are dedicated to specific counting functions (touch, set, reset…). All unused inputs and outputs can be used with the specification of standard inputs/outputs range.

1.7.2.1.3 Functionality

Digital inputs/outputs	24 V DC, dedicated inputs/outputs can be used for specific counting functions: - Catch/touch operation, counter value stored in separate variable on external event (rising or falling edge) - Set input to preset counter register with predefined value - Set input to reset counter register - End value output; the output is set when predefined value is reached - Reference point initialization (RPI) input for incremental encoder initialization All unused inputs/outputs can be used with the specification of standard input/output range. Effect of incorrect input terminal connection: Wrong or no signal detected, no damage up to 35 V.
Fast counter/encoder	integrated, 2 counters (hardware interface with +24 V DC, +5 V DC, differential and 1 Vpp sinus input) with up to 12 configurable operation modes: - 32 bits one counter mode - 16 bits two counter mode - Incremental position encoder - Absolute SSI encoder - Time frequency meter - Frequency input up to 300 kHz

PWM/pulse outputs	2 pulse-width-modulators or pulse outputs Output specification - Push-pull output: 24 V DC, 100 mA max. - Current limitation (thermal and over current) PWM specification - Frequency from 1 Hz to 100 kHz - Value from 0 to 100 % Pulse specification - Frequency from 1 Hz to 15 kHz - Pulse emission from 1 to 65535 pulses - Number of pulses emitted indicator (0 to 100 %) Frequency specification - Frequency output = 100 kHz when duty cycle set to 50 %
Power supply for encoders	2 5V power supplies, max. 100 mA
LED displays	For signal states, errors and supply voltage
Internal power supply	Via I/O bus
External power supply	Via the terminals UP (process voltage 24 V DC) and ZP (0 V DC)
Required terminal unit	TU515 or TU516 *Chapter 1.5.3 “TU515, TU516, TU541 and TU542 for I/O modules” on page 282*

How to prepare a device as fast counter and how to connect it to the PLC is described in an *application example*.

1.7.2.1.4 Connections

The function module CD522 can be connected to the following devices via the I/O bus connector:

- CS31 bus module DC551-CS31
- AC500 CPU
- OtherAC500 I/O devices.

The connection is carried out by using the 40 terminals of the terminal unit TU515/TU516 *Chapter 1.5.3 “TU515, TU516, TU541 and TU542 for I/O modules” on page 282*.

Table 224: Assignment of the terminals

Terminal	Signal	Description
1.0	/A0	Inverted input signal A of encoder 0
1.1	/B0	Inverted input signal B of encoder 0
1.2	/Z0	Inverted input signal Z of encoder 0
1.3	5V0	+5 V DC power supply output 0 for sensors
1.4	0V	0 V reference input
1.5	O0	Output signal of the fast output O0
1.6	0V	0 V reference input
1.7	O1	Output signal of the fast output O1

Terminal	Signal	Description
1.8	UP	Process voltage UP (24 V DC)
1.9	ZP	Process voltage ZP (0 V DC)
2.0	A0	Input signal A of encoder 0
2.1	B0	Input signal B of encoder 0
2.2	Z0	Input signal Z of encoder 0
2.3	I3	Input signal I3 (standard input)
2.4 ... 2.7	C4 ... C7	Signal of the configurable digital input/output C4 ... C7
2.8	UP	Process voltage UP (24 V DC)
2.9	ZP	Process voltage ZP (0 V DC)
3.0	/A1	Inverted input signal A of encoder 1
3.1	/B1	Inverted input signal B of encoder 1
3.2	/Z1	Inverted input signal Z of encoder 1
3.3	5V1	+5 V DC power supply output 1 for sensors
3.4...3.7	0V	0 V reference input
3.8	UP	Process voltage UP (24 V DC)
3.9	ZP	Process voltage ZP (0 V DC)
4.0	A1	Input signal A of encoder 1
4.1	B1	Input signal B of encoder 1
4.2	Z1	Input signal Z of encoder 1
4.3	I11	Input signal I11 (standard input)
4.4 ... 4.7	C12 ... C15	Signal of the configurable digital input/output C12 ... C15
4.8	UP	Process voltage UP (24 V DC)
4.9	ZP	Process voltage ZP (0 V DC)

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a communication interface module or a processor module). Thus, the current consumption from 24 V DC power supply at the terminals L+/UP and M/ZP of the CPU/communication interface module increases by 2 mA per CD522.

The external power supply connection is carried out via the UP (+24 V DC) and the ZP (0 V DC) terminals.

WARNING!

Removal/Insertion under power

The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!

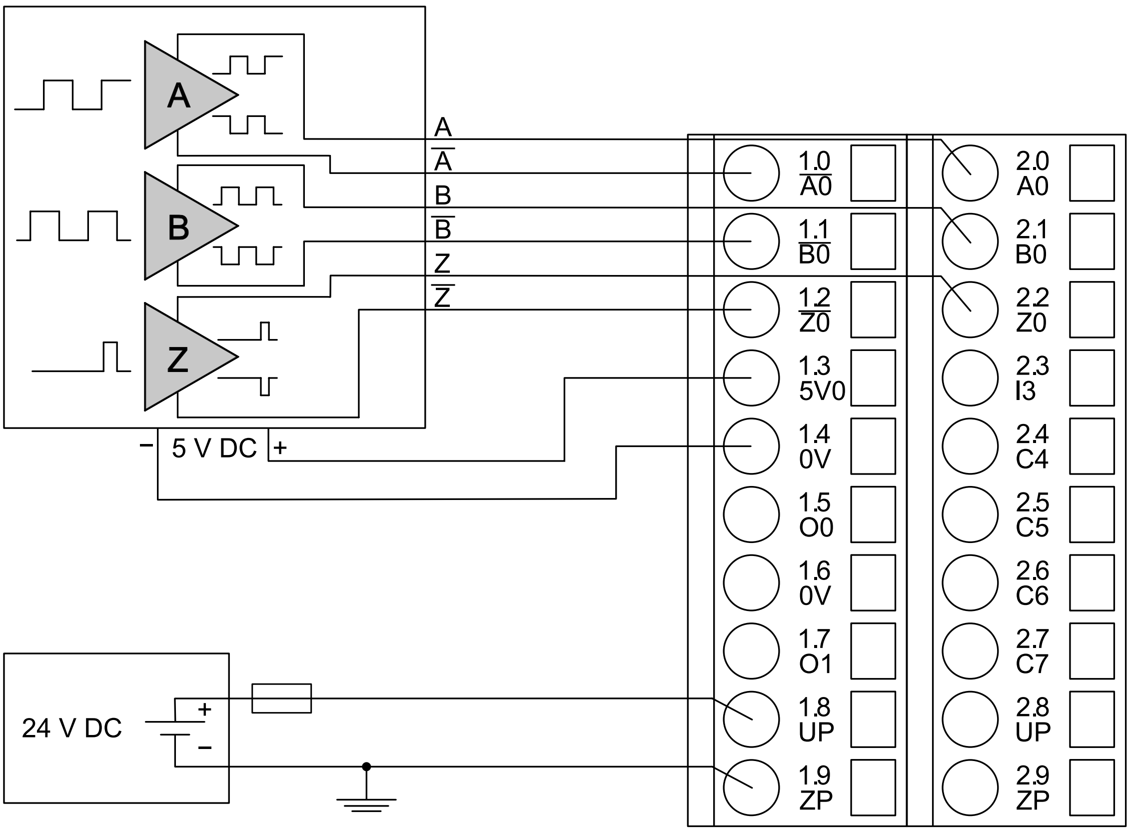
Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

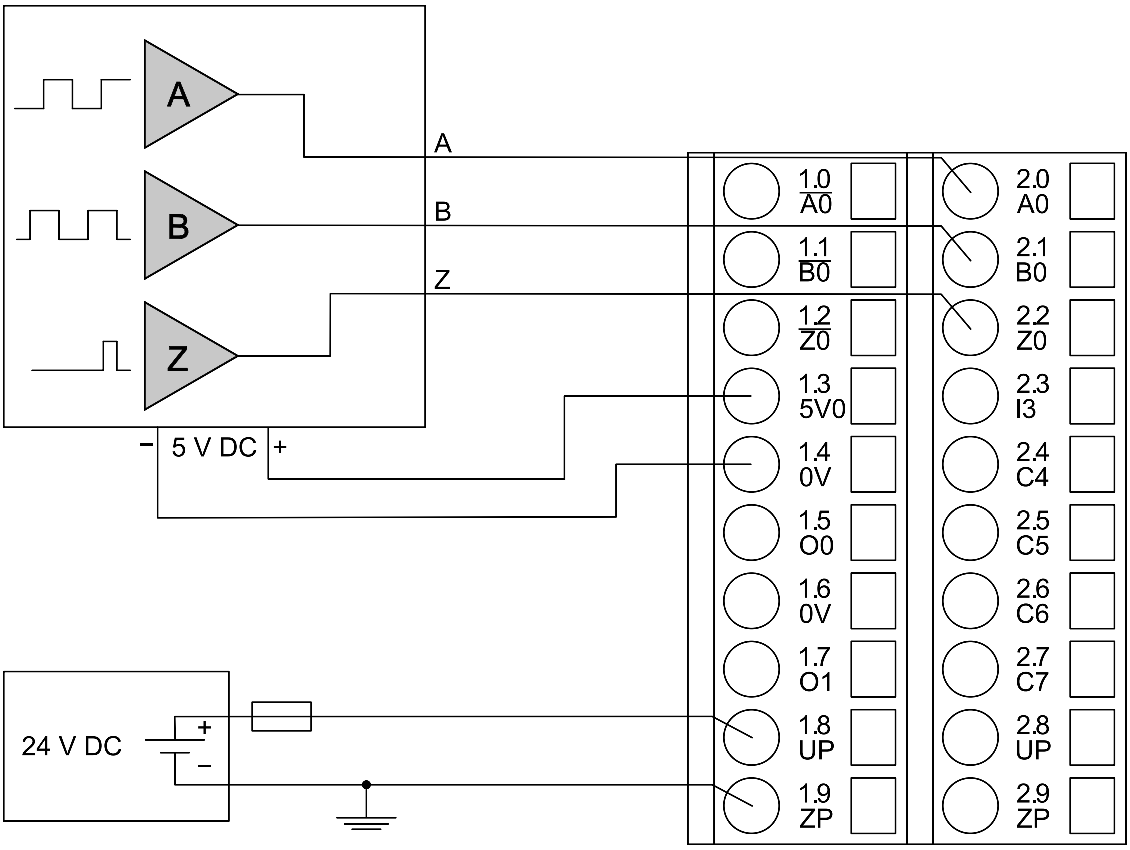
Connection of encoders with differential RS-422 signal

The encoder is powered by the 5 V power supply which is integrated in CD522.

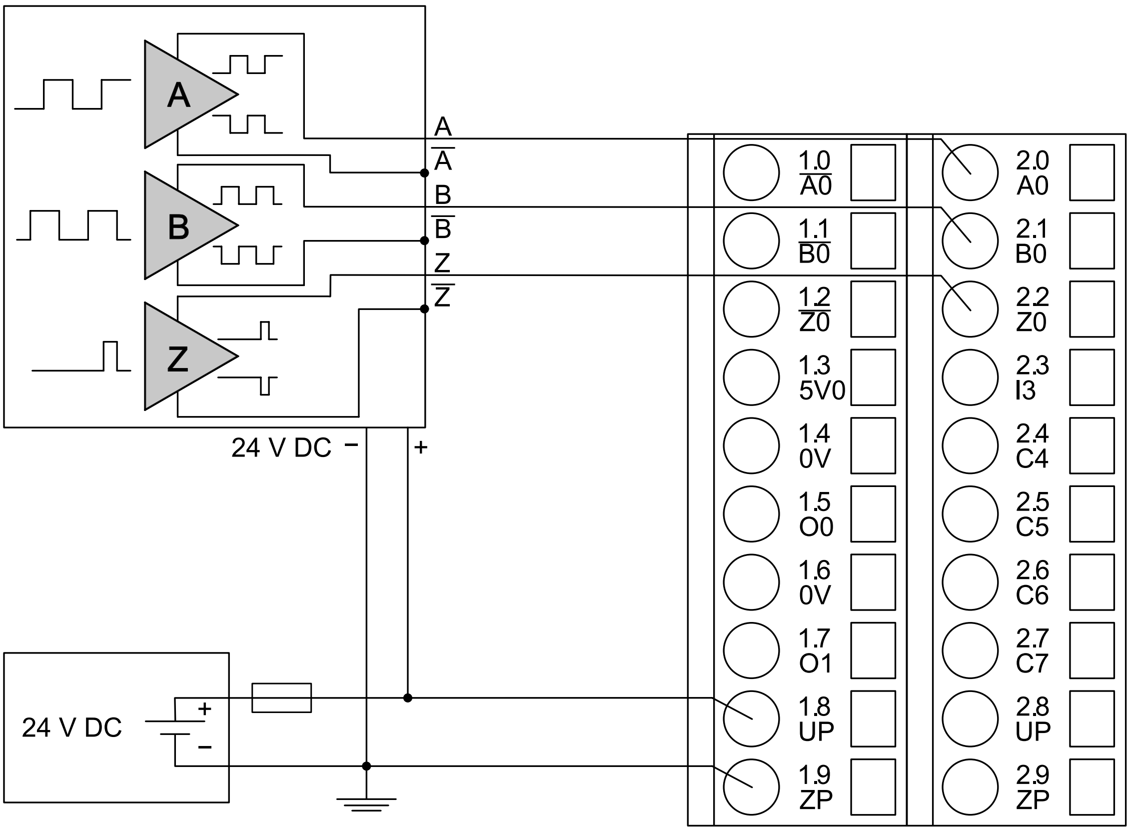


Connection of encoders with 5 V TTL signal

The encoder is powered by the 5 V power supply which is integrated in the CD522.



Connection of encoders with 24 V totem pole signal

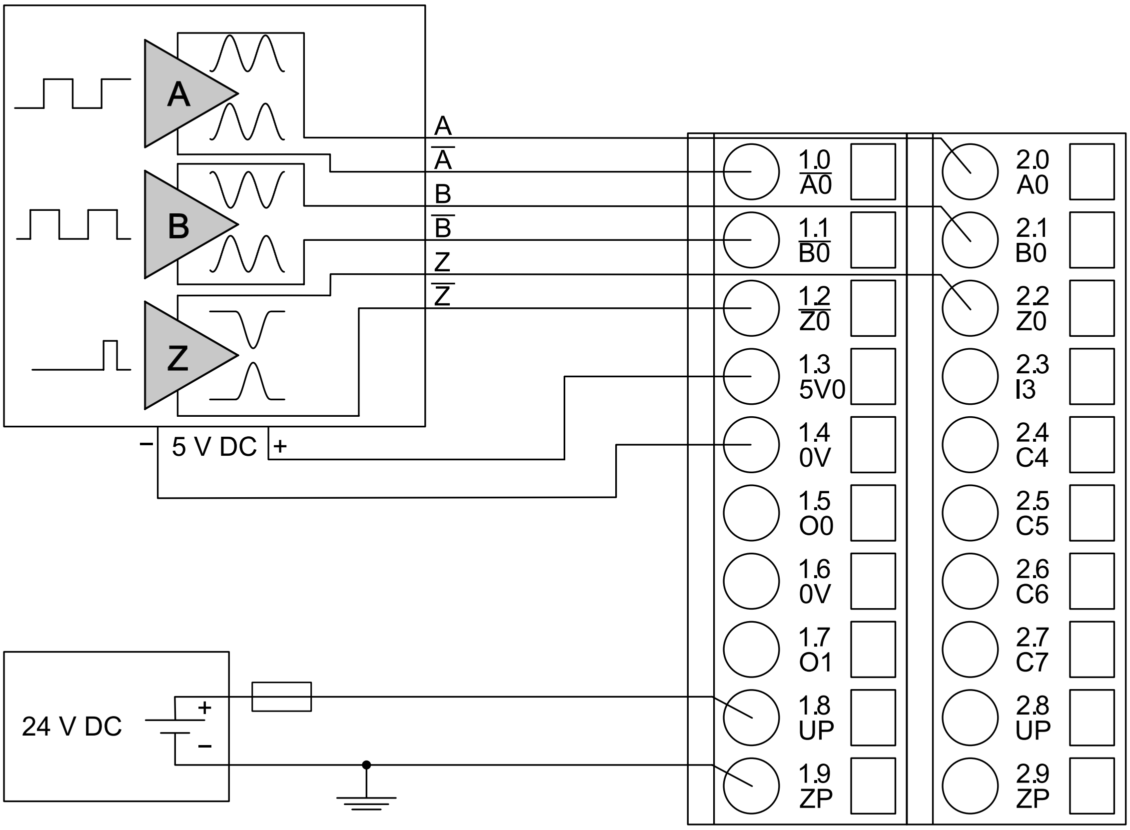


The wires A, B and Z need not to be connected to the module. They are left open.

When using different power supplies for the encoder device and the CD522, make sure that the reference potentials of both power supplies are interconnected.

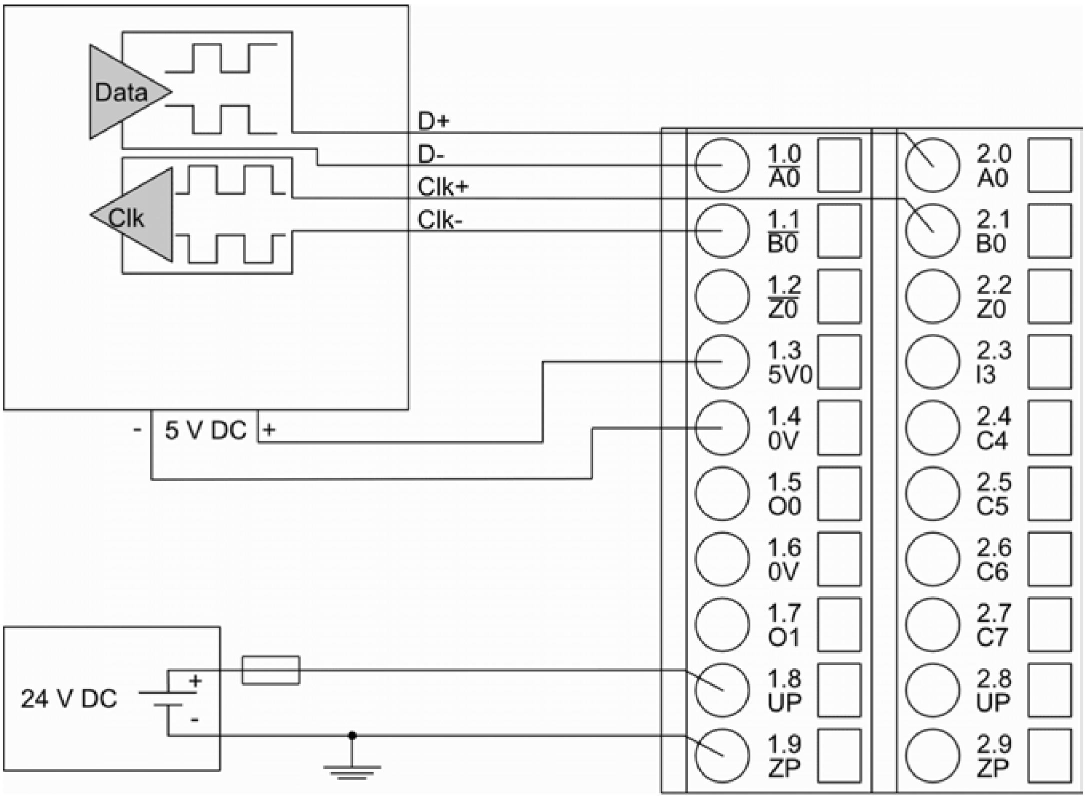
Connection of encoders with 1 Vpp sine signal

The encoder is powered through the 5 V power supply which is integrated in the CD522.



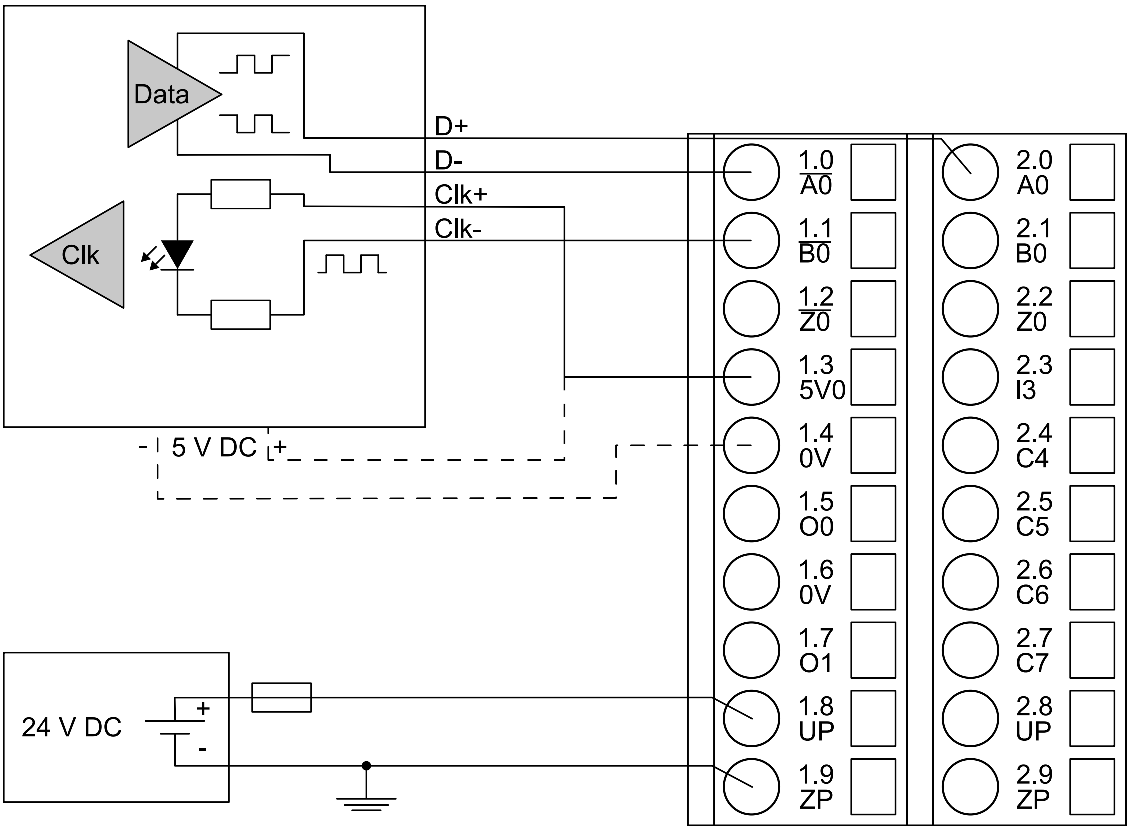
Connection of absolute encoders with SSI interface and differential RS-422 signal

The encoder is powered by the 5 V power supply which is integrated in the CD522.

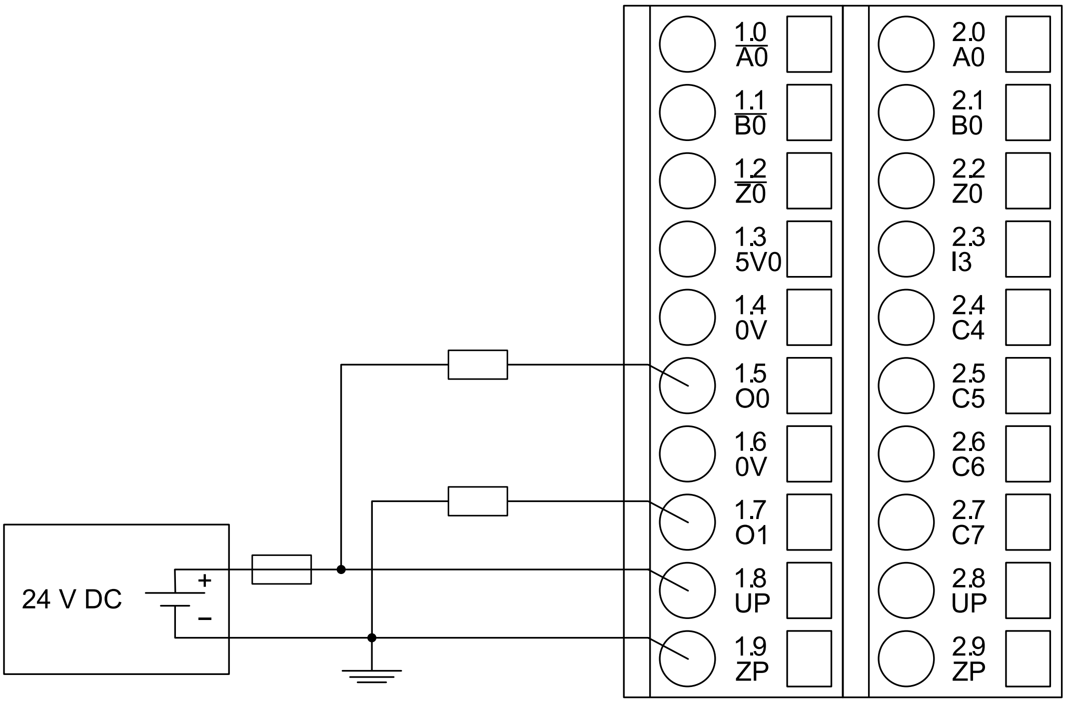


Connection of absolute encoders with an SSI interface and an optocoupler interface at CLK input

The encoder can optionally be powered by the 5 V power supply which is integrated in the CD522.



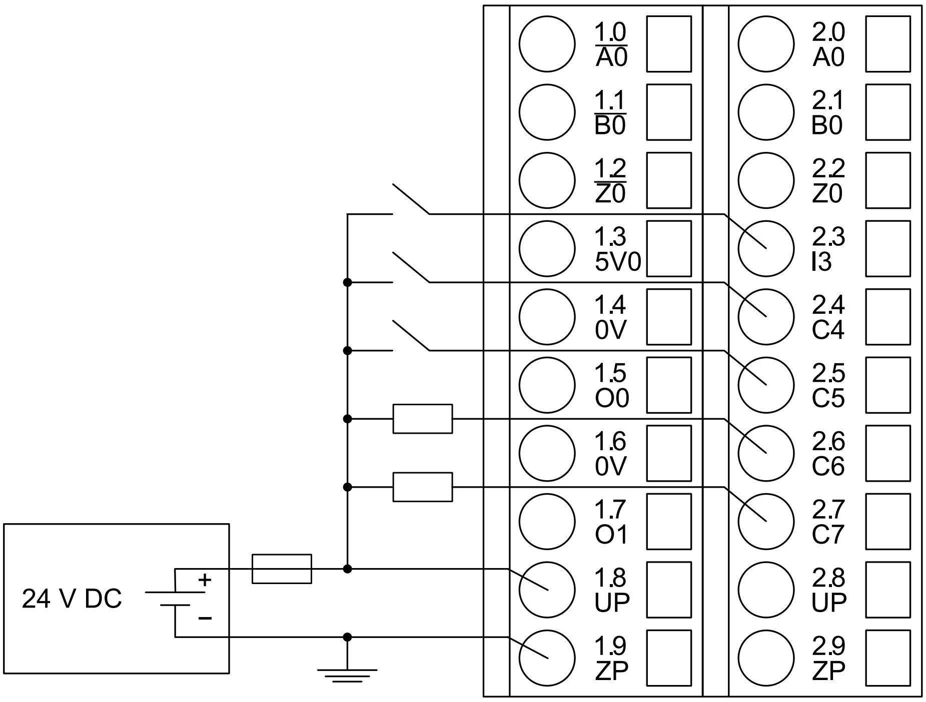
Connection of output loads to the PWM/Pulse putputs



> **NOTICE!**
> **Risk of damaging the module**
> The PWM outputs have no protection against reverse polarity.

Connection of standard inputs/ outputs

Proceed with the inputs/outputs I11 and C12 ... C15 in the same way.



Connection of sensors with frequency out-puts

Proceed with the A0, B0, A1, B1 and Z1 in the same way.

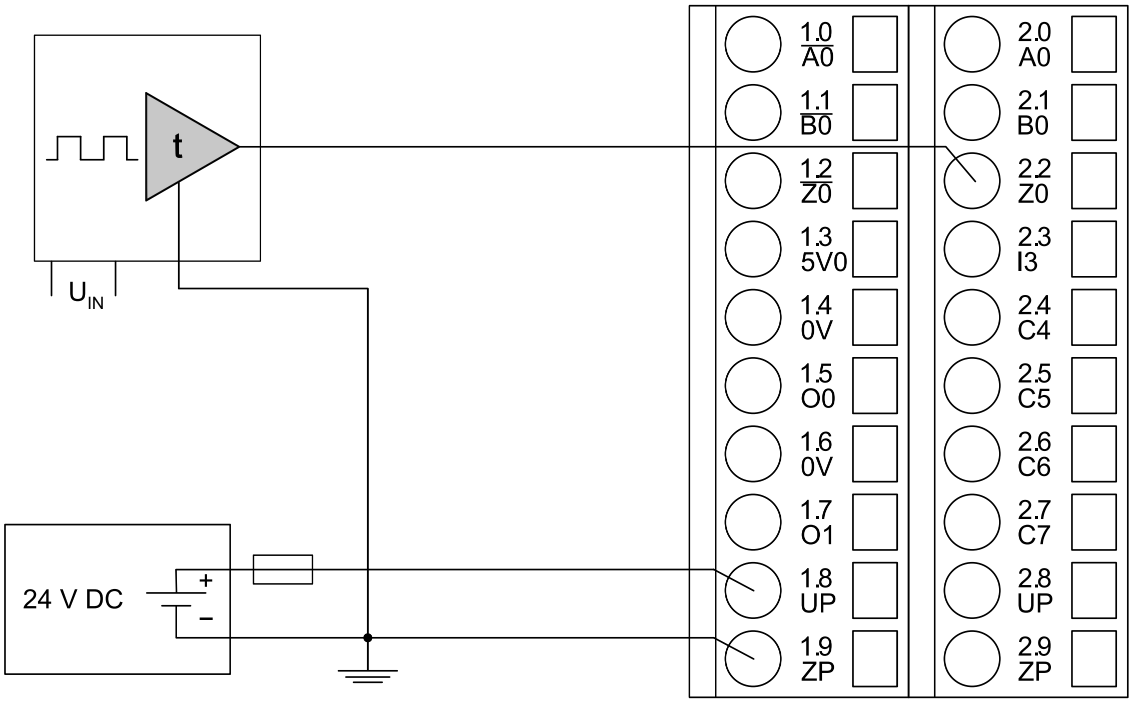


Fig. 220: Example of the connection of sensors with frequency outputs to the input Z0 of the CD522

NOTICE!

Risk of malfunctions!

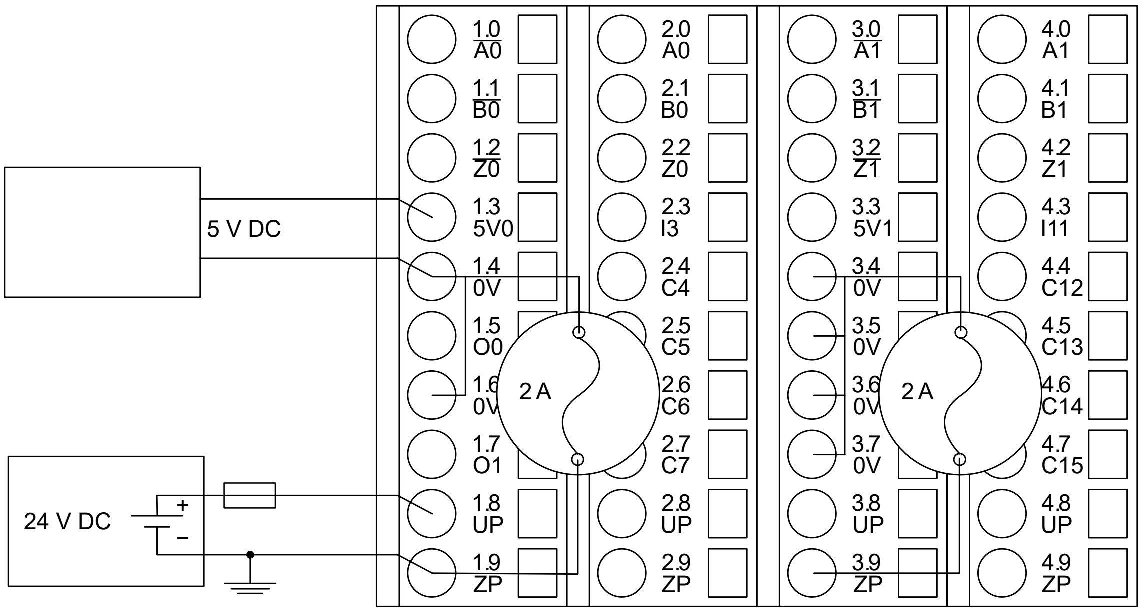
The edges of a signal must be strong enough (0.4 V/µs) to be recognized correctly by the module.

Put a 1 kΩ resistor between 0 V and the Z terminal when using a standard output as time generator.

Connection of sensors to the 5 V power supply

Proceed with the 5 V power supply 1 in the same way.

Each 5-V-power supply provides a current of 100 mA max. It is possible to parallel both integrated power supplies. In this case, the max. current is 200 mA.



NOTICE!
Risk of damaging the module
The integrated 2 A fuse cannot be replaced. If it blows, the module must be replaced.

Ensure that the current per 0 V connection does not exceed 0.5 A.

NOTICE!
Risk of damaging the module
The two 5 V outputs have no protection against reverse polarity.

1.7.2.1.5 Internal data exchange

Parameter	Value
Digital inputs (bytes)	0
Digital outputs (bytes)	0
Analog inputs (words)	12
Analog outputs (words)	16

The data will be transferred in 16-bit words and not in bytes. Two bytes are packed into one 16-bit word.

The bit strings are transmitted in big-endian byte order, so the bytes within the word are swapped. If several bytes are considered, the first byte (lowest address) is the largest (High Byte).

If used with AC500 please check the chapter how to configure CD522 within Automation Builder and use the CD522 library.

The types *“structCD522In”* and *“structCD522Out”* can be added in Automation Builder by using the command *“Generate DUT”* via the context menu of the CD522 device.

To use CD522 with CI50x-PNIO or CI54x-DP as unbundled IOs with other PLCs find the meaning of the IO-Data in following tables below:

From CD522 to PLC

<table>
<tr><th colspan="6">TYPE structCD522In</th></tr>
<tr><td colspan="6">STRUCT</td></tr>
<tr><td>StateBy-tePWM0</td><td>High Byte</td><td>0..100</td><td colspan="3">Percentage of pulses already sent on channel 0</td></tr>
<tr><td>StateBy-tePWM1</td><td>Low Byte</td><td>0..100</td><td colspan="3">Percentage of pulses already sent on channel 1</td></tr>
<tr><td>State-ByteC0</td><td>High Byte</td><td></td><td colspan="3">*)</td></tr>
<tr><td rowspan="9">InputC0</td><td rowspan="9">Low Byte</td><td rowspan="9"></td><td>Name</td><td>Bitposition</td><td>Description</td></tr>
<tr><td>Input A</td><td>0</td><td>Digital Input A</td></tr>
<tr><td>Input B</td><td>1</td><td>Digital Input B</td></tr>
<tr><td>Input Z</td><td>2</td><td>Digital Input C</td></tr>
<tr><td>Input I3</td><td>3</td><td>Digital Input I3</td></tr>
<tr><td>Input I4</td><td>4</td><td>Digital Input I4</td></tr>
<tr><td>Input I5</td><td>5</td><td>Digital Input I5</td></tr>
<tr><td>Input I6</td><td>6</td><td>Digital Input I6</td></tr>
<tr><td>Input I7</td><td>7</td><td>Digital Input I7</td></tr>
<tr><td>Touch-Coun-terHiC0</td><td>WORD</td><td></td><td colspan="3"></td></tr>
<tr><td>Touch-Coun-terLoC0</td><td>WORD</td><td></td><td colspan="3"></td></tr>
<tr><td>Coun-terHiC0</td><td>WORD</td><td></td><td colspan="3"></td></tr>
<tr><td>Coun-terLoC0</td><td>WORD</td><td></td><td colspan="3"></td></tr>
<tr><td>Coun-terHiC1</td><td>WORD</td><td></td><td colspan="3"></td></tr>
<tr><td>Coun-terLoC1</td><td>WORD</td><td></td><td colspan="3"></td></tr>
<tr><td>Reser-vedWC1</td><td>WORD</td><td></td><td colspan="3"></td></tr>
<tr><td>State-ByteC1</td><td>High Byte</td><td></td><td colspan="3">*)</td></tr>
<tr><td rowspan="7">InputC1</td><td rowspan="7">Low Byte</td><td rowspan="7"></td><td>Name</td><td>Bitposition</td><td>Description</td></tr>
<tr><td>Input A</td><td>0</td><td>Digital Input A</td></tr>
<tr><td>Input B</td><td>1</td><td>Digital Input B</td></tr>
<tr><td>Input Z</td><td>2</td><td>Digital Input C</td></tr>
<tr><td>Input I3</td><td>3</td><td>Digital Input I3</td></tr>
<tr><td>Input I4</td><td>4</td><td>Digital Input I4</td></tr>
<tr><td>Input I5</td><td>5</td><td>Digital Input I5</td></tr>
</table>

TYPE structCD522In					
			Input I6	6	Digital Input I6
			Input I7	7	Digital Input I7
Touch-Coun-terHiC1	WORD				
Touch-Coun-terLoC1	WORD				
END_STRUCT					
END_TYPE					

*Table 225: *) Status Byte C0/C1*

Bit	One Counter Modes (1,2,5,6,11,12,13,14)	Two Counter Modes (3,4)
0	CF0 1=End value 0 reached	not used
1	not used	not used
2	NCATCH 1=New catch available	not used
3	OVRFLW0 1=Counter 0 overflow (see Note 3 below)	OVRFLW0 1=Counter 0 overflow (0x0000 ←→ 0xFFFF)
4	SET0_INPUT Logical OR on all inputs configured as set0 input	OVRFLW1 1=Counter 1 overflow (0x0000 ←→ 0xFFFF)
5	RESET0_INPUT Logical OR on all inputs configured as reset0 input	RESET0_INPUT Logical OR on all inputs con-figured as reset0 input
6	not used	not used
7	not used	RESET1_INPUT Logical OR on all inputs con-figured as reset1 input

Bit	16-bit One Counter Mode (8)	Time frequency meter mode (15)
0	CF0 1=Zero crossover detected	not used
1	not used	not used
2	NCATCH 1=New catch available	not used
3	not used	not used
4	SET0_INPUT Logical OR on all inputs configured as set0 input	not used

Bit	16-bit One Counter Mode (8)	Time frequency meter mode (15)
5	RESET0_INPUT Logical OR on all inputs configured as reset0 input	not used
6	not used	NEW 1=New timing value available
7	not used	not used

From PLC to CD522

TYPE structCD522Out			
STRUCT			
FreqPWM0	WORD	0…65535	PWM frequency of channel 0 Unit: Hz or 10Hz (depending on control byte in slot 3) Limit: 100kHz
DutyPul-sePWM0	WORD	0…1000	PWM mode: PWM duty cycle of channel 0 in 1/10 percentage
		0…65535	Pulse mode: Number of pulses to sent on channel 0
ControlPWM0	High Byte	Bit	Description
		0	FREQU_X10 FREQU_X10 1 = Frequency multiplier x10 enabled
		1	not used
		2	not used
		3	PULSE_START Rising edge = Start pulse emission channel 0
		4	not used
		5	not used
		6	not used
		7	1 = Enable Pulse/PWM channel 0
Reser-vedBPWM0	Low Byte		
Reser-vedWPWM0	WORD		
FreqPWM1	WORD	0…65535	PWM frequency of channel 1 Unit: Hz or 10Hz (depending on control byte in slot 3) Limit: 100kHz
DutyPul-sePWM1	WORD	0…1000	PWM mode: PWM duty cycle of channel 1 in 1/10 percentage
		0…65535	Pulse mode: Number of pulses to sent on channel 1
ControlPWM1	High Byte	**Bit**	**Description**

TYPE structCD522Out			
		0	FREQU_X10 1 = Frequency multiplier x10 enabled
		1	not used
		2	not used
		3	PULSE_START Rising edge = Start pulse emission channel 1
		4	not used
		5	not used
		6	not used
		7	1 = Enable Pulse/PWM channel 1
Out-putPW0PWM1	Low Byte	Bit 0 = Digital output value of channel 0 BIT 4 = Digital output value of channel 1	
Reser-vedWPWM1	WORD		
Counter-SetHiC0	WORD		
Counter-SetLoC0	WORD		
CtrlByteC0	High Byte		**)
OutputC0	Low Byte		
ReservedWC0	WORD		
Counter-SetHiC1	WORD		
Counter-SetLoC1	WORD		
CtrlByteC1	High Byte		**)
OutputC1	Low Byte		
ReservedWC1	WORD		
END_STRUCT			
END_TYPE			

*Table 226: **) Counter Control Byte C0/C1*

Bit	One Counter Modes (1,2,5,6,8)	Two Counter Modes (3,4)
0	EN 0=counter disabled 1=counter enabled	EN 0=counter disabled 1=counter enabled
1	SET_0 1=set counter 0	not used

Bit	One Counter Modes (1,2,5,6,8)	Two Counter Modes (3,4)
2	RESET_0 1=reset counter 0	RESET_0 1=reset counter 0
3	not used	UP_DWN0 0=up counter 0 1=down counter 0
4	not used	RESET_1 1=reset counter 1
5	UPDWN 0=up counter 1=down counter	UP_DWN1 0=up counter 1 1=down counter 1
6	NCATCH 0=no catch operation 1=enable next catch operation	NCATCH 0=no catch operation 1=enable next catch operation
7	EDGECATCH 0=catch on falling edge 1=catch on rising edge	EDGECATCH 0=catch on falling edge 1=catch on rising edge

Bit	Relative encoder modes (Modes 11,12,13)	Time frequency meter (Mode 15)
0	EN 0=counter disabled 1=counter enabled	EN 0=counter disabled 1=counter enabled
1	SET_0 1=set counter 0	EN_1_0 1=enable time capture on falling edge
2	RESET_0 1=reset counter 0	EN_0_1 1=enable time capture on rising edge
3	not used	FREQ_0 0=time measure mode 1=frequency and RPM measure mode
4	RPI, Reference Point Indicator	RESET_NEW 1=time/frequency/RPM measure-ment is in reset. NEW flag is cleared.
5	not used	not used
6	NCATCH 0=no catch operation 1=enable next catch operation	not used
7	EDGECATCH 0=catch on falling edge 1=catch on rising edge	not used

Bit	**SSI, absolute encoder (Mode 14)**
0	EN 0=counter disabled 1=counter enabled
1	not used
2	not used
3	not used
4	not used
5	not used
6	NCATCH 0=no catch operation 1=enable next catch operation
7	EDGECATCH 0=catch on falling edge 1=catch on rising edge

1.7.2.1.6 I/O configuration

The module itself does not store configuration data. It receives its parameterization data from the master device of the I/O bus (CPU or communication interface module) during power-up of the system.

Hence, replacing I/O modules is possible without any re-parameterization via software.

If the external power supply voltage via UP/ZP terminals fails, the I/O module loses its configuration data. The whole station has to be switched off and on again to re-configure the module.

1.7.2.1.7 Parameterization

Firmware version	Configuration
Firmware version > V2.0.0	The arrangement of the parameter data is performed by Control Builder Plus/ Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Module: Module slot address: Y = 1 ... 10

Name	Value	Internal value	Internal value, Type	Default	Min.	Max.	EDS Slot Index
Module ID	Intern	1805 [1])	WORD	0x070D	0	65535	0x0Y01
Ignore module [2])	No Yes	0 1	BYTE	No 0x00			Not for FBP

Name	Value	Internal value	Internal value, Type	Default	Min.	Max.	EDS Slot Index
Parameter length	Internal	42	BYTE	0	0	255	xx02 [3])
Check supply	Off On	0 1	BYTE	On 0x01			0x0Y03
Input delay	0.1 ms 1 ms 8 ms 32 ms	0 1 2 3	BYTE	8 ms 0x02	0	3	0x0Y04
Mode Counter 0	see table below	0	BYTE	0x00	0	15	0x0Y05
Counter 0 frequency limit	No filter 50 Hz 500 Hz 5 kHz 20 kHz	0 1 2 3 4	BYTE	No filter 0x00	0	4	0x0Y06
Counter 0 input level	0-24 V DC 0-5 V DC Differen-tial 1 Vpp sinus	0 1 2 3	BYTE	0-24 V DC 0x00	0	3	0X0Y07
SSI 0 fre-quency	200 kHz 500 kHz 1 MHz	2 3 4	BYTE	200 kHz 0x02	0	4	0x0Y08
SSI 0 res-olution (in bit)	8 to 32 bit		BYTE	16 bit 16	8	32	0x0Y09
SSI 0 code type	Binary	0	BYTE	Binary 0	0	0	0x0Y0A
SSI 0 polling time	10 ms		BYTE	10	1	255	0x0Y0B
5 V sensor 0 supply	Off On	0	BYTE	Off 0x00	0	1	0x0Y0C
Mode Counter 1	see table below	0	BYTE	0x00	0	15	0x0Y0D
Counter 1 frequency limit	No filter 50 Hz 500 Hz 5 kHz 20 kHz	0 1 2 3 4	BYTE	No filter 0x00	0	4	0x0Y0E

Name	Value	Internal value	Internal value, Type	Default	Min.	Max.	EDS Slot Index
Counter 1 input level	0-24 V DC 0-5 V DC Differen-tial 1 Vpp sinus	0 1 2 3	BYTE	0-24 V DC 0x00	0	3	0X0Y0F
SSI 1 fre-quency	200 kHz 500 kHz 1 MHz	2 3 4	BYTE	200 kHz 0x02	2	4	0x0Y10
SSI 1 res-olution (in bit)	8 to 32 bit		BYTE	16 bit 16	8	32	0x0Y11
SSI 1 code type	Binary	0	BYTE	Binary 0	0	0	0x0Y12
SSI 1 polling time	10 ms		BYTE	10	1	255	0x0Y13
5 V sensor 1 supply	Off On	0	BYTE	Off 0x00	0	1	0x0Y14
Detection SC on sensors	Off On	0	BYTE	Off 0x00	0	1	0x0Y15
Output behaviour com fault	Off Last value Substitute Last value 5s Substitute 5s Last value 10s Sub-stitute 10s	0 1 2 3 4 5 6	BYTE	Off 0x00	0	1	0x0Y16
Substitute value	0	0	WORD	Default 0x0000	0	65536	0x0Y17

[1]) With CS31 and addresses smaller than 70 and FBP, the value is increased by 1

[2]) Not with FBP

[3]) Value is hexadecimal: HighByte is slot (xx: 1 ... 10), LowByte is index (1 ... n)

Table 227: Operating modes for counters 0 and 1, configuration table

Internal value	Operating modes of counter
0	No counter / No PWM (default value)
1	1-1 UpDown counter (A)
2	2-1 UpDown with release input

Internal value	Operating modes of counter
3	3-2 UpDown counters (A, B)
4	4-2 UpDown (A, B on falling edges)
5	5-1 UpDown dynamic set (B) / rising edge
6	6-1 UpDown dynamic set (B) / falling edge
7	Not used
8	8-1 UpDown with release (B), 0 cross detection
9 - 19	Not used
20	11-1 Incremental encoder
21	12-2 Incremental encoder X2
22	13-1 Incremental encoder X4
30	14-1 SSI, absolute encoder
40	15-1 Time frequency meter

Table 228: GSD file

Ext_User_Prm_Data_Len =	25
Ext_User_Prm_Data_Const(0) =	0x07, 0x0E, 0x17, \
	0x01, 0x02, \
	0x00, 0x00, 0x00, 0x02, 0x10, 0x00, 0x0A, 0x00, \
	0x00, 0x00, 0x00, 0x02, 0x10, 0x00, 0x0A, 0x00, \
	0x00, 0x00, 0x00, 0x00;

1.7.2.1.8 Diagnosis

E1...E4	d1	d2	d3	d4	Identifier 000 ... 063	AC500 display	<− Display in
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**	
Byte 6 Bit 6 ... 7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0 ... 5**	**FBP diagnosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error identifier**	**Error message**	**Remedy**
	1)	2)	3)	4)			
3	14	1...10	31	31	19	Checksum error in the I/O module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	9	Overflow diagnosis buffer	New start
	11 / 12	ADR	1...10				
3	14	1...10	31	31	26	Parameter error	Check master

E1...E4	d1	d2	d3	d4	Identi-fier 000 ... 063	AC500 dis-play	<− Display in
Class	Comp	Dev	Mod	Ch	Err	PS501 PLC browser	
Byte 6 Bit 6 ... 7	-	Byte 3	Byte 4	Byte 5	Byte 6 Bit 0 ... 5	FBP diag-nosis block	
Class	Inter-face	Device	Module	Channel	Error identi-fier	Error message	Remedy
	1)	2)	3)	4)			
	11 / 12	ADR	1...10				
3	14	1...10	31	31	11	Process voltage too low	Check process voltage
	11 / 12	ADR	1...10				

Table 229: Channel error CD522

E1...E4	d1	d2	d3	d4	Identi-fier 000 ... 063	AC500dis-play	<− Display in
Class	Comp	Dev	Mod	Ch	Err	PS501 PLC browser	
Byte 6 Bit 6 ... 7	-	Byte 3	Byte 4	Byte 5	Byte 6 Bit 0 ... 5	FBP diag-nosis block	
Class	Inter-face	Device	Module	Channel	Error identi-fier	Error message	Remedy
	1)	2)	3)	4)			
Channel error							
4	14	1...10	1	0...15	47	Output short cir-cuit	Check output con-nection or terminal
	11 / 12	ADR	1..10				
4	14	1...10	1	0, 1, 8, 9	10	Input frequency too high	Check fre-quency filter parameter or sensor
	11 / 12	ADR	1...10				
4	14	1...10	1	0, 1	2	PWM frequency too high	Clamp min/max value in pro-gram
	11 / 12	ADR	1...10				
4	14	1...10	1	0, 1	10	PWM duty cycle out of range (0-1000)	Clamp min value to 0 in program
	11 / 12	ADR	1...10				
4	14	1...10	1	0, 1	11	5 V sensor supply too low	Check wiring & sensor power
	11 / 12	ADR	1...10				

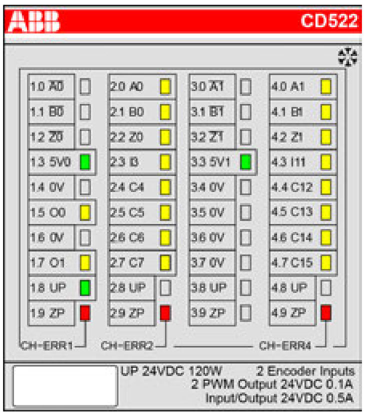
E1...E4	d1	d2	d3	d4	Identifier 000 ... 063	AC500display	<− Display in
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**	
Byte 6 **Bit 6 ... 7**	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6** **Bit 0 ... 5**	**FBP diagnosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error identifier**	**Error message**	**Remedy**
	1)	**2)**	**3)**	**4)**			
4	14	1...10	1	0, 1	18	Internal fuse on 0 V has blown, 0 V not connected to GND	Check wiring, replace module
	11 / 12	ADR	1...10				

Remarks:

1)	In AC500, the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The FBP diagnosis block does not contain this identifier.
2)	With "Device" the following allocation applies: 31 = module itself, 1...10 = decentralized communication interface module 1...10, ADR = hardware address (e.g. of the DC551)
3)	With "Module" the following allocation applies depending on the master: Module error: I/O bus or FBP: 31 = module itself; COM1/COM2: 1...10 = expansion 1...10 Channel error: I/O bus or FBP = module type (2 = DO); COM1/COM2: 1...10 = expansion 1...10
4)	In case of module errors, with channel "31 = Module itself" is output.

1.7.2.1.9 State LEDs

During the power-on procedure, the module initializes automatically. All LEDs (except the LEDs for the signal states) are on during the initialization.

LED		State	Color	LED = OFF	LED = ON	LED flashes
	A0, B0, Z0	Encoder 0 inputs	Yellow	Input ON	Input OFF	LED follows the state of the inputs, depending on frequency
	A1, B1, Z1	Encoder 1 inputs	Yellow	Input ON	Input OFF	LED follows the state of the inputs, depending on frequency
	I3 and I11	Digital inputs	Yellow	Input = ON (the input voltage is even displayed if the supply voltage is OFF).	Input = OFF	---
	C4 ... C7 and C12 ... C15	Configurable digital inputs/ outputs	Yellow	Input/output = ON (the input voltage is even displayed if the supply voltage is OFF).	Input/output = OFF	---
	O0 and O1	Digital PWM outputs	Yellow	Output = ON	Output = OFF	LED follows the state of the outputs, depending on frequency and operation mode
	5V0 and 5V1	Power supply for encoders	Green	Configuration ON and power 5-V-power ready	Configuration OFF or power failure	Power supply outputs are short-circuited
	UP	Process supply voltage	Green	Process voltage OK	Process voltage is missing	---
	CH-ERR1, CH-ERR2, CH-ERR4		Red	Severe error within the corresponding group	No error or process voltage is missing	Error on one channel of the corresponding group (e.g. short circuit at an output)
	CH-ERR *)	Error indication	Red	Internal error or configuration is not loaded	--	---
	*) All LEDs CH-ERR1, CH-ERR2 and CH-ERR4 light up simultaneously					

1.7.2.1.10 Technical data

The system data of AC500 and S500 are applicable to the standard version *Chapter 2.6.1 "System data AC500" on page 1408*.

The system data of AC500-XC are applicable to the XC version *Chapter 2.7.1 “System data AC500-XC” on page 1475*.

Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

Parameter		Value
Process supply voltage		
	Connections	Terminals 1.8, 2.8, 3.8 and 4.8 for UP (+24 V DC) and 1.9, 2.9, 3.9 and 4.9 for ZP (0 V)
	Protection against reverse voltage	Yes
	Rated protection fuse at UP	10 A fast
	Rated value	24 V DC
	Max. ripple	5 %
Current consumption		
	From UP	0.07 A + max. 0.008 A per input + max. 0.5 A per output + 0.01 A for A, B and Z inputs
	Via I/O bus	Ca. 5 mA
	Inrush current from UP (at power-up)	0.04 A^2s
Galvanic isolation		Yes, per module
Max. power dissipation within the module		6 W (outputs unloaded)
Weight (without terminal unit)		Ca. 125 g
Mounting position		Horizontal mounting or vertical with derating (output load reduced to 50 % at +40 °C)
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

NOTICE!
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and temporary overvoltage up to 30 V DC.

Multiple overloads
No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an internal smart high-side switch.

Technical data of the digital inputs/outputs if used as standard inputs

Parameter	Value
Number of channels	2 + 8 configurable digital inputs/outputs
Reference potential for all inputs	Terminals 1.9...4.9 (negative pole of the process supply voltage, signal name ZP)
Galvanic isolation	From the rest of the module

Parameter		Value
Indication of the input signals		1 yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Input type acc. to EN 61131-2		Type 1
Input delay (0->1 or 1->0)		Typ. 8 ms, configurable from 0.1 to 32 ms
Input data length		24 bytes
Input signal voltage		24 V DC
	Signal 0	-3 V ... +5 V *
	Undefined signal	> +5 V ... < +15 V
	Signal 1	+15 V ... +30 V
Ripple with signal 0		Within -3 V ... +5 V *
Ripple with signal 1		Within +15 V ... +30 V
Input current per channel		
	Input voltage +24 V	Typ. 5 mA
	Input voltage +5 V	> 1 mA
	Input voltage +15 V	> 5 mA
	Input voltage +30 V	< 8 mA
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

* Due to the direct connection to the output, the demagnetizing varistor is also effective at the input (see figure) above. This is why the difference between UPx and the input signal must not exceed the clamp voltage of the varistor. The varistor limits the clamp voltage to approx. 36 V. Consequently, the input voltage must range from -12 V ... +30 V when UPx = 24 V and from -6 V ... +30 V when UPx = 30 V.

Technical data of the digital inputs/outputs if used as standard outputs

Parameter		Value
Number of channels		8 configurable digital inputs/outputs
Reference potential for all outputs		Terminals 1.9 ... 4.9 (negative pole of the process supply voltage, signal name ZP)
Common power supply voltage		For all outputs: terminals 1.8 ... 4.8 (positive pole of the process supply voltage, signal name UP)
Output voltage for signal 1		UP (-0.8 V)
Output delay (0->1 or 1->0)		Typ. 10 µs
Output data length		32 bytes
Output current		
	Rated value, per channel	500 mA at UP = 24 V
	Maximum value (all channels together, PWM included)	8 A
Leakage current with signal 0		< 0.5 mA
Rated protection fuse on UP		10 A fast
Demagnetization when inductive loads are switched off		With varistors integrated in the module (see figure below)
Switching frequency		

Parameter		Value
	With resistive load	On request
	With inductive loads	Max. 0.5 Hz
	With lamp loads	Max. 11 Hz with max. 5 W
Short-circuit-proof / overload-proof		Yes
Overload message (I > 0.7 A)		Yes, after ca. 100 ms
Output current limitation		Yes, automatic reactivation after short circuit/overload
Resistance to feedback against 24 V signals		Yes
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

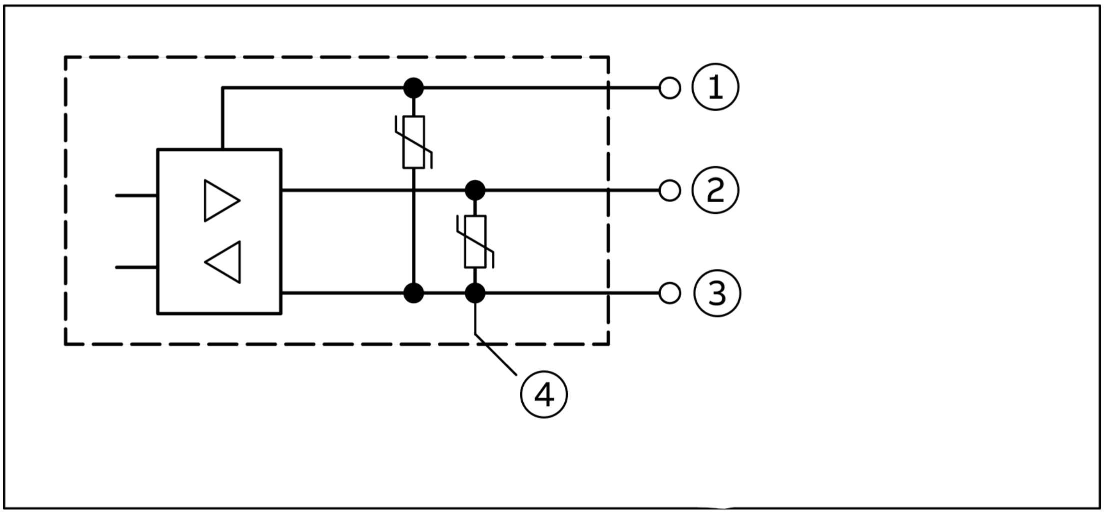


Fig. 221: Digital input/output (circuit diagram)

1 UPx (+ 24 V)
2 Digital input/output
3 ZPx (0 V)
4 For demagnization when inductive loads are switched off

Technical data of the high-speed inputs (A0, B0, Z0; A1, B1, Z1)

Parameter		Value	
Number of channels per module		6	
Reference potential for all inputs		Terminal 1.9, 2.9, 3.9 and 4.9 (negative pole of the process voltage, signal name ZP)	
Input Type		24 V DC	5 V DC / Differential Sinus 1 Vpp
Input current per channel			
	Input voltage +24 V	Typ. 14 mA	
	Input voltage +5 V	> 4.8 mA	
	Input voltage +15 V	> 12 mA	
	Input voltage +30 V	< 15 mA	
Input type acc. to EN 61131-2		Type 1	
Input frequency max. (fast counter)		300 kHz	300 kHz

Parameter	Value	
Input frequency max. (frequency measurement)	5 kHz	5 kHz
Input signal voltage	24 V DC	5 V DC
Signal 0	-3 V ... +5 V	-3 V ... +0,5 V
Undefined signal	> +5 V ... < +15 V	--
Signal 1	+15 V ... +30 V	+0,5 V ... +30 V
Ripple with signal 0	Within -3 V ... +5 V	Within -3 V ... +0.5 V
Ripple with signal 1	Within +15 V ... +30 V	Within +0,5 V ... +30 V
Max. cable length		
Shielded	1000 m	
Unshielded	600 m	

Technical data of the fast outputs O0 and O1

Parameter	Value
Number of channels	2
Reference potential for all outputs	Terminals 1.9 ... 4.9 (negative pole of the process supply voltage, signal name ZP)
Common power supply voltage	For all outputs: terminals 1.8 ... 4.8 (positive pole of the process supply voltage, signal name UP)
Indication of the output signals	Brightness of the LED depends on the number of pulses emitted (0 % to 100 %) (pulse output mode only)
Output voltage for signal 1	UP (-0.1 V)
Output voltage for signal 0	ZP (+0.3 V)
Output delay (0->1 or 1->0)	Typ. 1 µs
Output current	
Rated value, per channel	100 mA at UP = 24 V
Maximum value (all channels together, configurable outputs included))	8 A
Leakage current with signal 0	< 0.5 mA
Rated protection fuse on UP	10 A fast
De-magnetization when inductive loads are switched off	With varistors integrated in the module (see figure above)
Switching frequency	PWM: up to 100 kHz (min. step for PWM value: 2 µs) Pulse: up to 15 kHz
Short-circuit-proof / overload-proof	Yes
Overload message (I > 0.1x A)	Yes, after ca. 100 ms
Output current limitation	Yes, automatic reactivation after short-circuit/overload
Resistance to feedback against 24 V signals	Yes
Resistance to feedback against reverse polarity	No
Max. cable length	

Parameter		Value
	Shielded	1000 m
	Unshielded	600 m

Technical data of the fast outputs (SSI CLK output B0, B1 for optical interface)

Parameter	Value
Number of channels	2
Reference potential for all outputs	Terminals 1.9...4.9 (negative pole of the process supply voltage, signal name ZP)
Common power supply voltage	For all outputs: terminals 1.8 ... 4.8 (positive pole of the process supply voltage, signal name UP)
Output voltage for signal 0	≤ 1.5 V at 10 mA
Output delay (0->1 or 1->0)	Typ. 0.3 µs
Output current	≤ 10 mA
Switching frequency	< 1 MHz (depending on firmware)
Short-circuit-proof / overload-proof	Yes
Output current limitation	Yes, automatic reactivation after short circuit/overload
Resistance to feedback against 24 V signals	Yes
Resistance to feedback against reverse polarity	No
Max. cable length (shielded)	Typ. 12.5 m at 500 kHz (depending on sensor)

Technical data of the fast outputs (SSI CLK Output Differential)

Parameter	Value
Number of channels	2
Reference potential for all outputs	Terminals 1.9 ... 4.9 (negative pole of the process supply voltage, signal name ZP)
Common power supply voltage	For all outputs: terminals 1.8 ... 4.8 (positive pole of the process supply voltage, signal name UP)
Output voltage for signal 1	≥ 2.9 V at 10 mA
Output voltage for signal 0	≤ 1.3 V at 10 mA
Output delay (0->1 or 1->0)	Typ. 0.3 µs
Output current	≤ 10 mA
Switching frequency	< 1 MHz (depending on firmware)
Short-circuit-proof / overload-proof	Yes
Overload message (I > 0.1x A)	Yes, after ca. 100 ms
Output current limitation	Yes, automatic reactivation after short-circuit/overload
Resistance to feedback against 24V signals	Yes
Resistance to feedback against reverse polarity	No
Max. cable length (shielded)	100 m

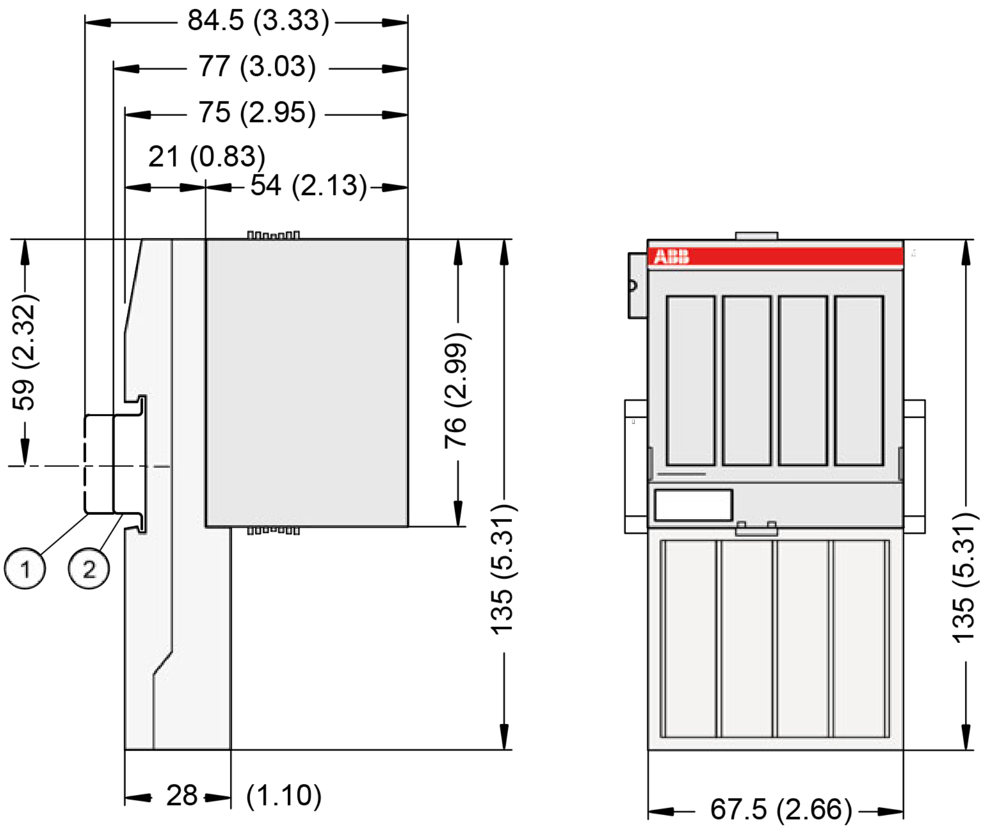
Technical data of the 5 V sensor supply

Parameter	Value
Number of supplies	2, independently configuration
Voltage supply (outputs unloaded)	5 V DC +/- 5%
Resistance to feedback against reverse polarity	No
Output current	100 mA max. (independently) 200 mA max. (parallel use)
Output diagnosis	Yes, with diagnosis LED and error message

Technical data of the 0 V reference input

Parameter		Value
Number of reference inputs (internally connected to ZP through internal fuse)		6
Max. current per connection		0.5 A
Internal fuse protection		
	Terminals 1.4 and 1.6	2 A
	Terminals 3.4 ... 3.7	2 A

1.7.2.1.11 Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

1.7.2.1.12 Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 260 300 R0001	CD522, encoder & PWM module, 2 encoder inputs, 2 PWM outputs, 2 digital inputs 24 V DC, 8 digital outputs 24 V DC	Active
1SAP 460 300 R0001	CD522-XC, encoder & PWM module, 2 encoder inputs, 2 PWM outputs, 2 digital inputs 24 V DC, 8 digital outputs 24 V DC, XC version	Active

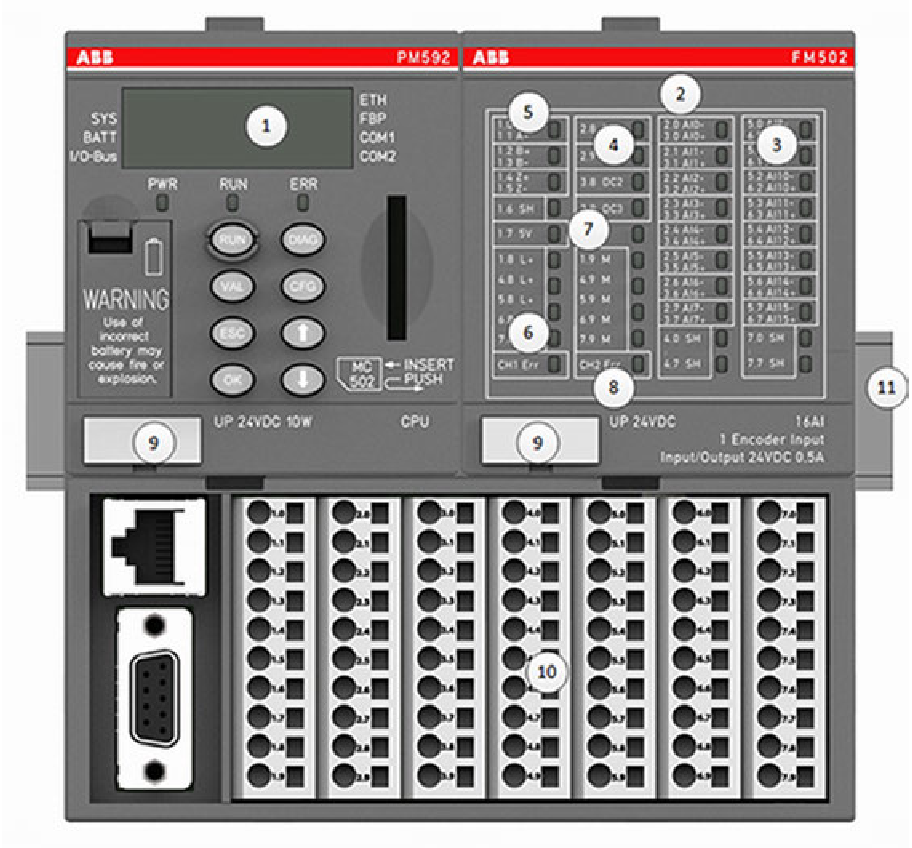
**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

1.7.2.2 FM502-CMS - Analog measurements

- 16 fast analog inputs, up to 50k samples/s.
- Counting functions with different configurable modes, including incremental position encoder and frequency input.
- 4 dedicated inputs/outputs for specific counting measurement functions, e.g. touch, set, reset, start measurement.
- All unused inputs/outputs can be used with the specifications of standard inputs/outputs range.
- Synchronous sampling between all analog channels and the counting input.

FM502-CMS is used for condition monitoring via fast analog signals. For direct connection to processor module PM592-ETH and wiring, the function module terminal bases TF501-CMS or TF521-CMS are available, enabling AC500 communication modules and AC500 I/O modules *➫ Chapter 1.3.2.1 “PM57x (-y), PM58x (-y) and PM59x (-y)” on page 23➫ Chapter 1.2.2 “TF501-CMS and TF521-CMS - Function module terminal bases ” on page 14*.

For usage in extreme ambient conditions a XC version is available.



1 Processor module PM592-ETH
2 Allocation between terminal no. and signal name
3 16 green/red LEDs to display the signal states at the analog inputs A0 ... A15
4 4 yellow LEDs to display digital inputs DI0, DI1 and digital inputs/outputs DC2,DC3
5 3 yellow LEDs display encoder/counter inputs
6 1 green LED to display the state of the process supply voltage L+
7 1 green LED to display the state of 5 V supply voltage for encoder
8 2 red LEDs to display errors
9 Label
10 Function module terminal base
11 DIN rail
Sign for XC version

1.7.2.2.1 Connections

FM502-CMS is plugged on the TF5x1-CMS together with PM592-ETH. The connection is established using the terminals of the TF5x1-CMS. The FM502-CMS can be replaced without re-wiring the TF5x1-CMS *Chapter 1.2.2 “TF501-CMS and TF521-CMS - Function module terminal bases ” on page 14*.

WARNING!

Removal/Insertion under power

The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!

Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

Effect of incorrect input terminal connection	Wrong or no signal detected, no damage up to 35 V

Connection of IEPE sensors

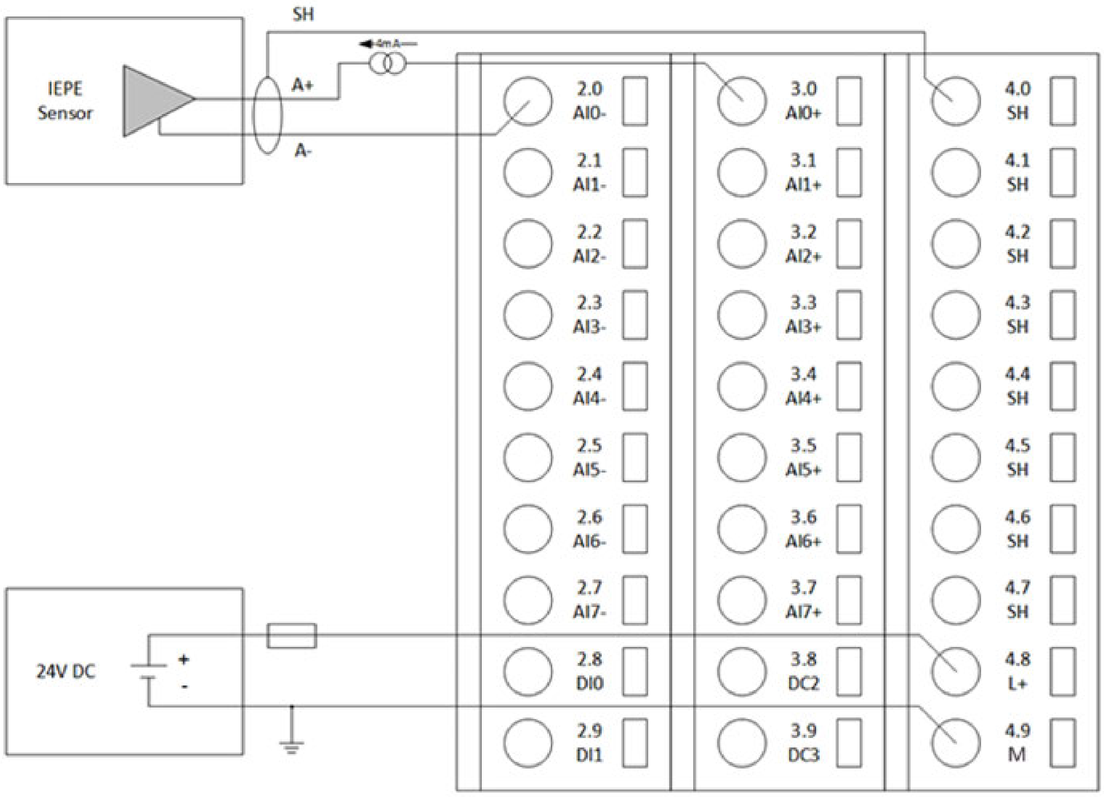
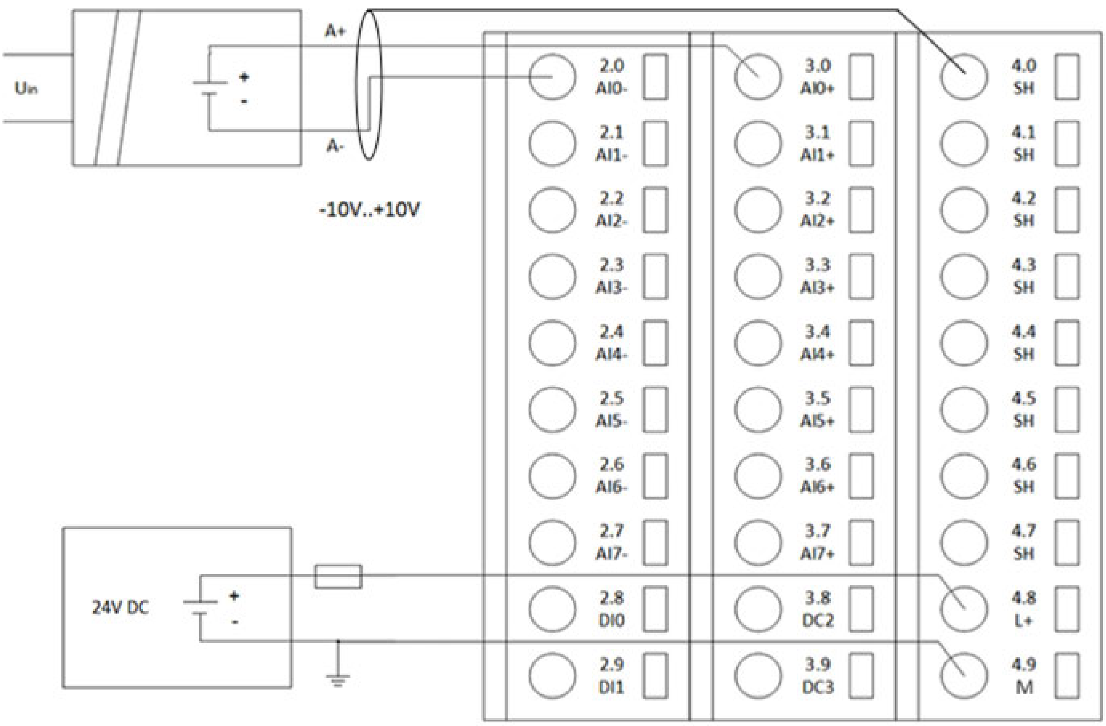


Fig. 222: Connection of IEPE sensor to the FM502-CMS

In order to avoid error messages or long processing times, we recommend to configure unused analog input channels as "unused".

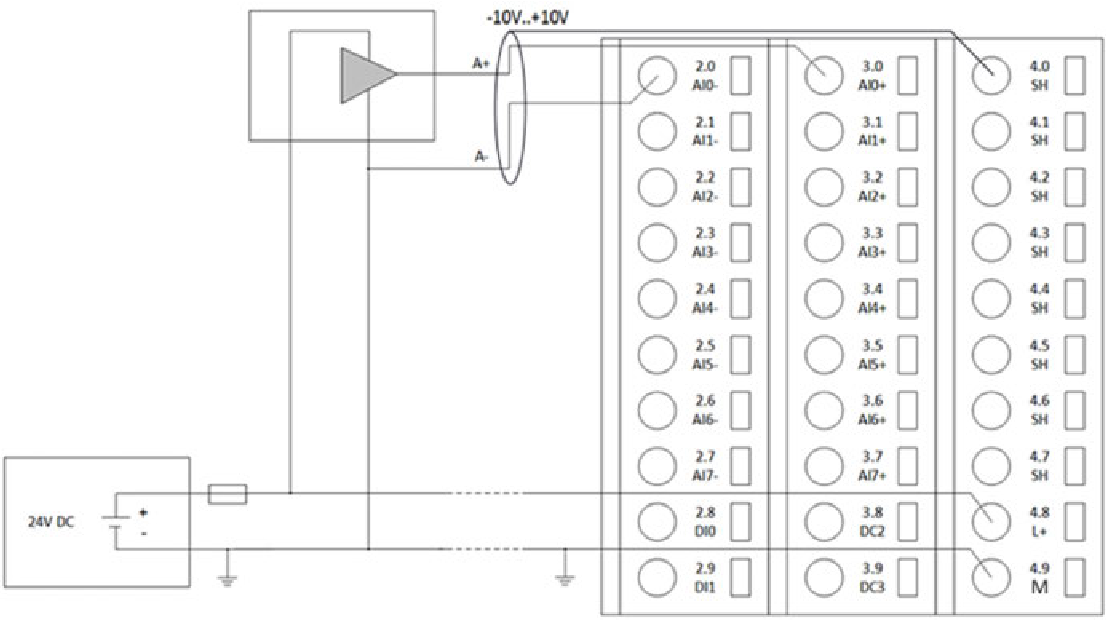
For the open-circuit detection (cut wire) in IEPE mode, each channel is pulled up to the positive supply rail by a high impedance. If nothing is connected, the maximum value will be read *➪ Chapter 1.7.2.2.5 “Measuring ranges” on page 912.*

Connection of active-type analog sensors (Voltage) with galvanically isolated power supply



Every negative analog input is internally connected to M (0 V) via an individual low impedance (PTC) return current path for the sensor supply current in IEPE mode. This is important for applications where a high input impedance on the negative analog input is required. Example: Stain gauges, bridge network.

Connection of active-type analog sensors (Voltage) with no galvanically isolated power supply



NOTICE!
Analog sensors should be galvanically isolated against earth. In order to avoid inaccuracy with the measuring results, the analog sensors should also be isolated against the power supply.

> **NOTICE!**
> If A- is not connected directly to M at the sensor, the supply current flows via A- to M. Measuring errors can occur caused by voltage differences between M and A-.

> **NOTICE!**
> At system start up, the 4 mA current source on each analog input is active for < 10 s. During this limited time, a positive analog input will drift to < 21 V and no current is flowing, when a high impedance sensor is connected. When a low impedance sensor is connected to the analog input, the current is limited to 4 mA. For analog sensors other than standard IEPE, please make sure that the connected sensor will not be damaged under these conditions.

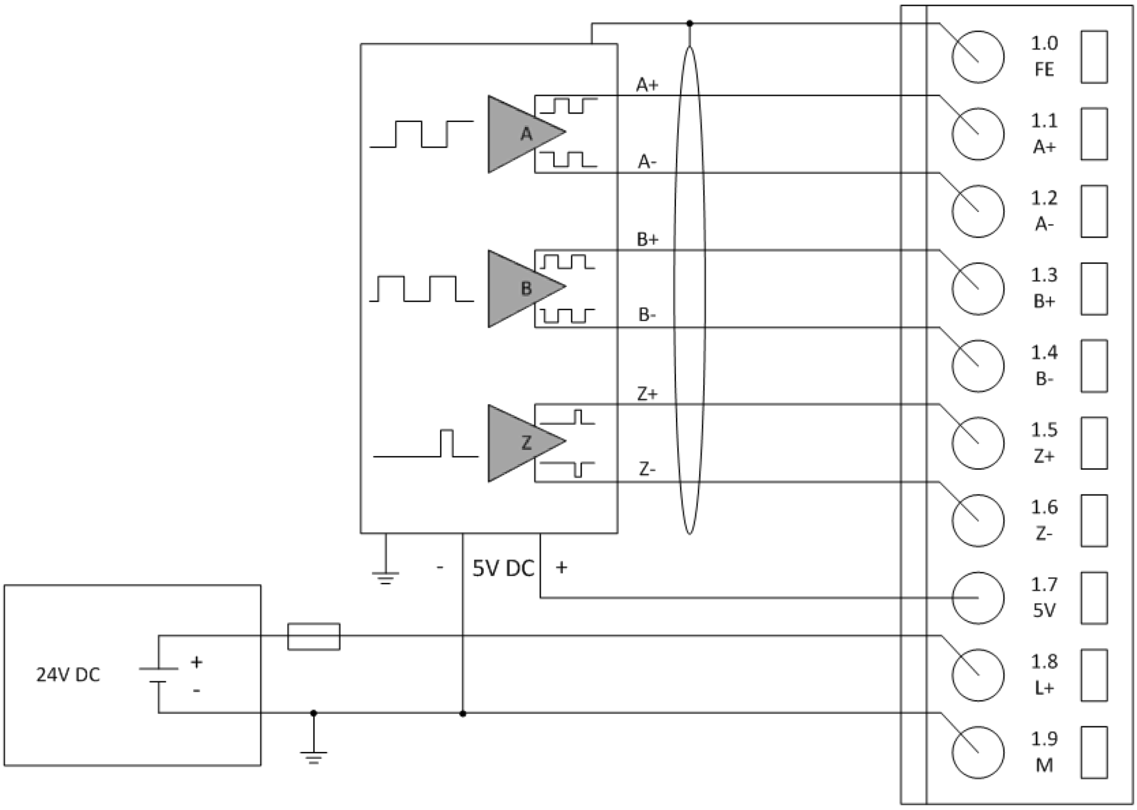
Analog signals must be laid in shielded cables. The analog cable shield must only be connected on the module side (SH terminals) to avoid isothermal relaxation currents influencing the measuring results, and for optimal robustness against external noise. The shield connection must be as short as possible (< 3 cm). The analog shield is capacitive coupled internally with functional earth (FE). Generally to avoid unacceptable potential differences between different parts of the installation, low-resistance equipotential bonding conductors must be laid.

In order to avoid error messages or long processing times, it is recommended to configure unused analog input channels as "unused".

In order to avoid inaccuracy in the analog measurement, the FM502-CMS should be in thermal balance > 15 minutes after power up and start of the PLC application, before measurements are started.

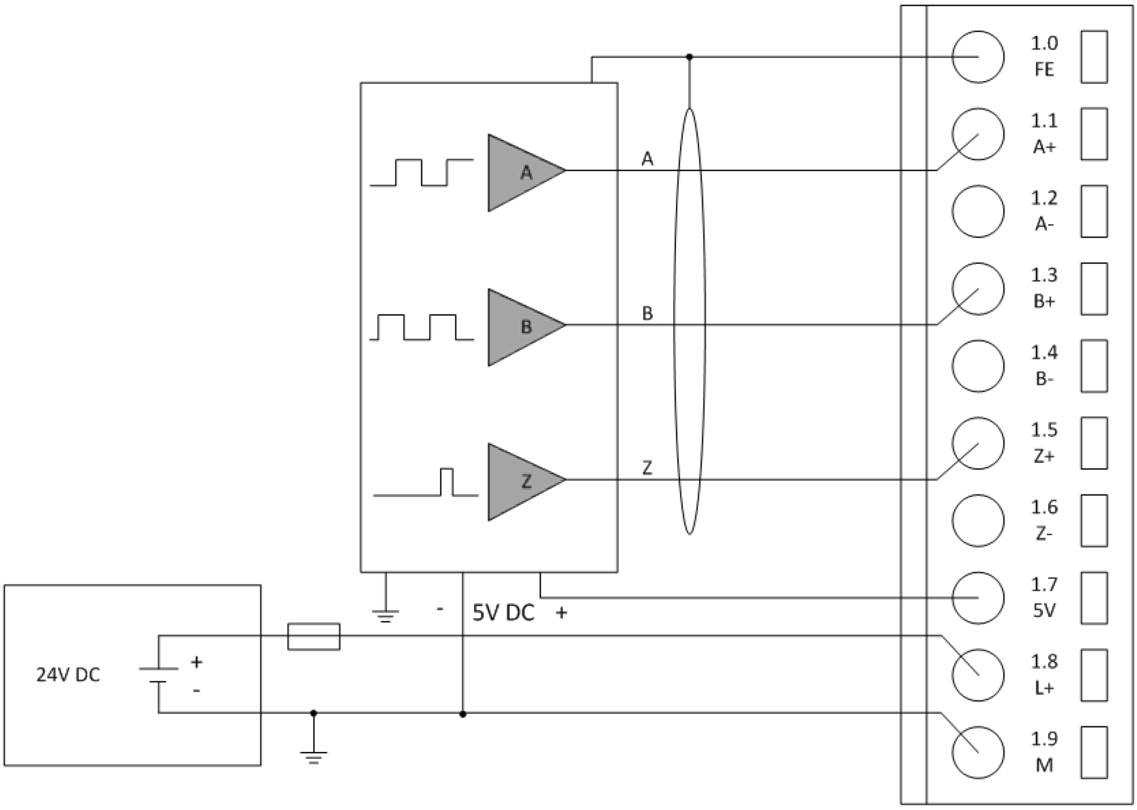
Connection of encoders with differential RS-422 signal

The encoder is powered by the 5 V power supply which is integrated in the FM502-CMS.

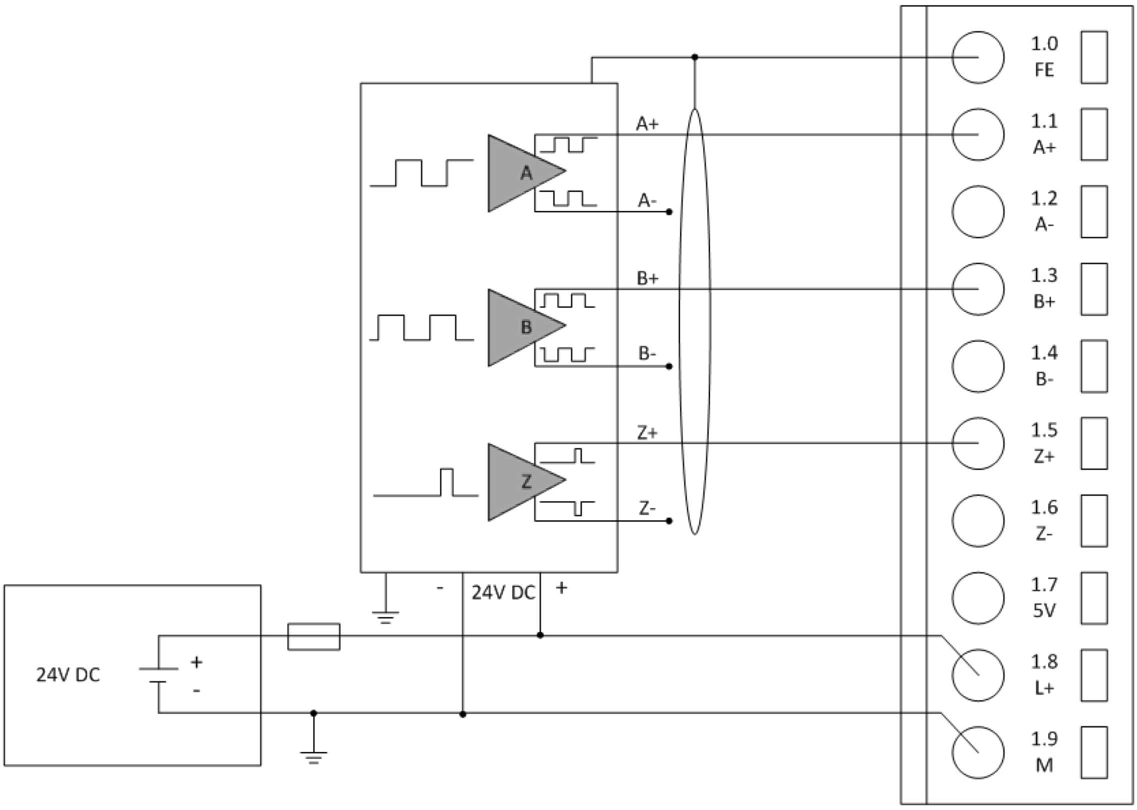


Connection of encoders with 5 V TTL signal

The encoder is powered through the 5 V power supply which is integrated in the FM502-CMS.



Connection of encoders with 24 V totem pole signal

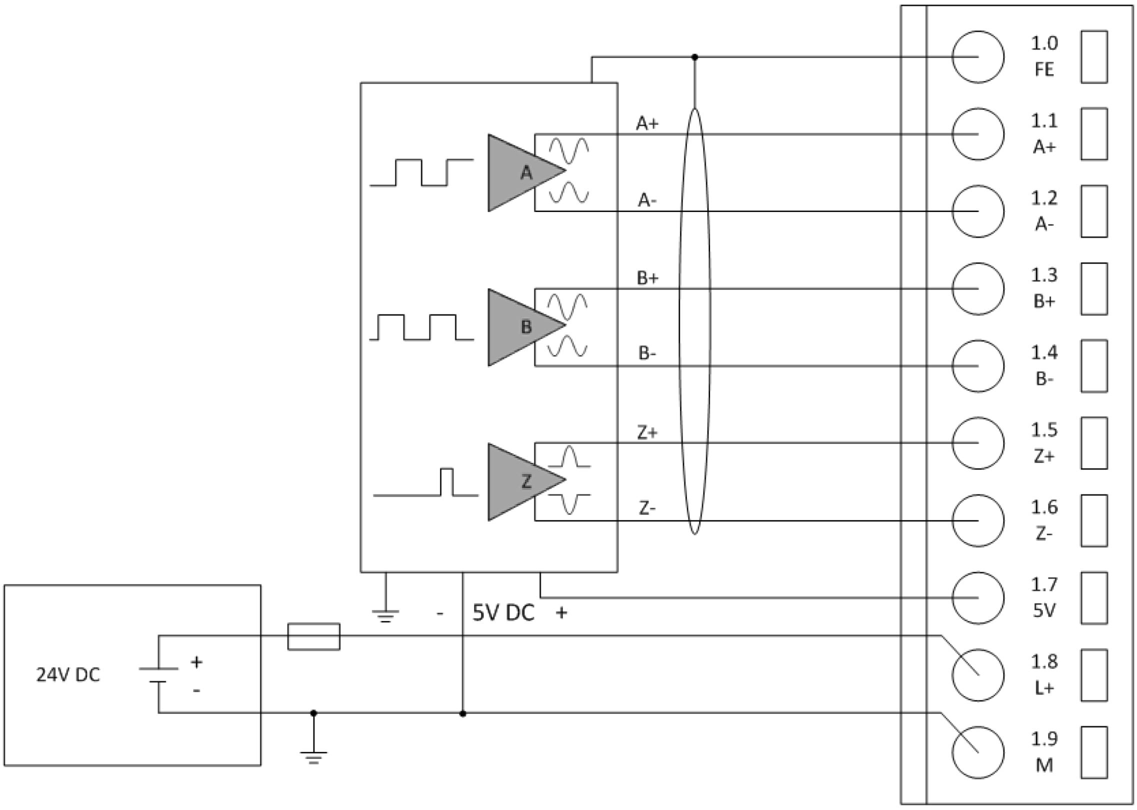


The wires A-, B- and Z- must not be connected to the module for single-ended operation. They are left open.

When using different power supplies for the encoder device and the FM502-CMS, make sure that the reference potentials of both power supplies are interconnected.

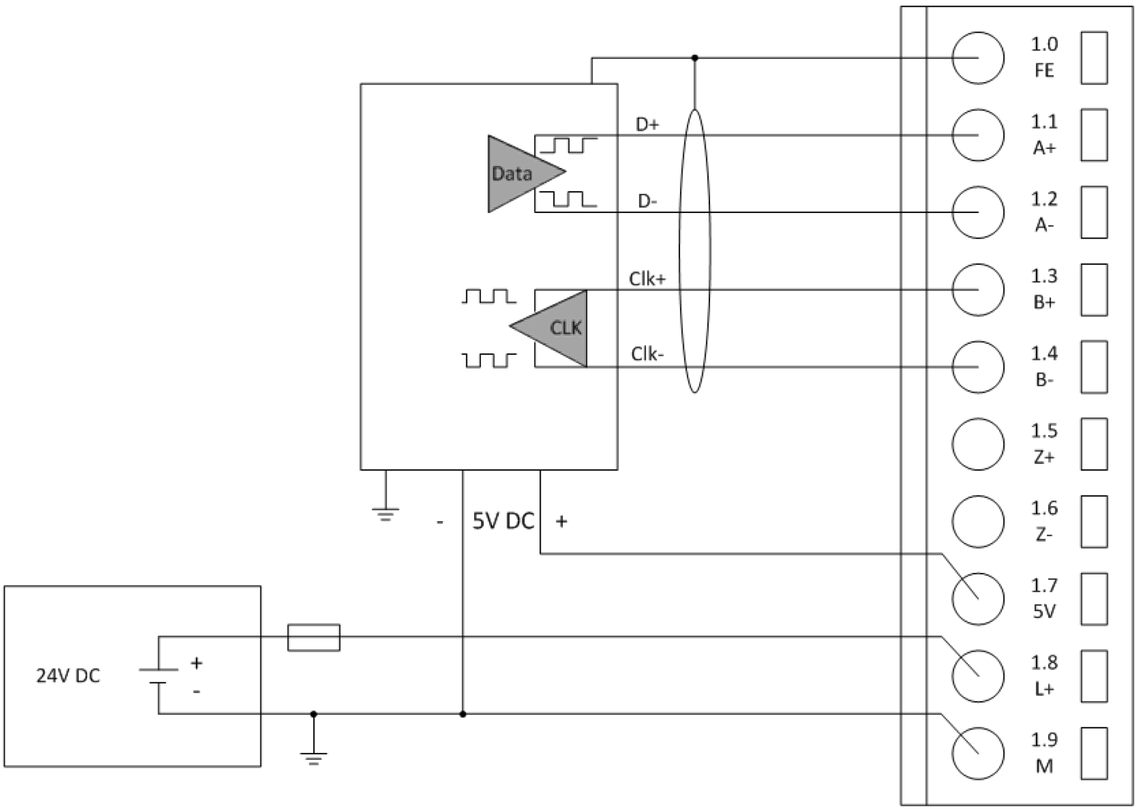
Connection of encoders with 1 Vpp sine signal

The encoder is powered by the 5 V power supply which is integrated in the FM502-CMS.



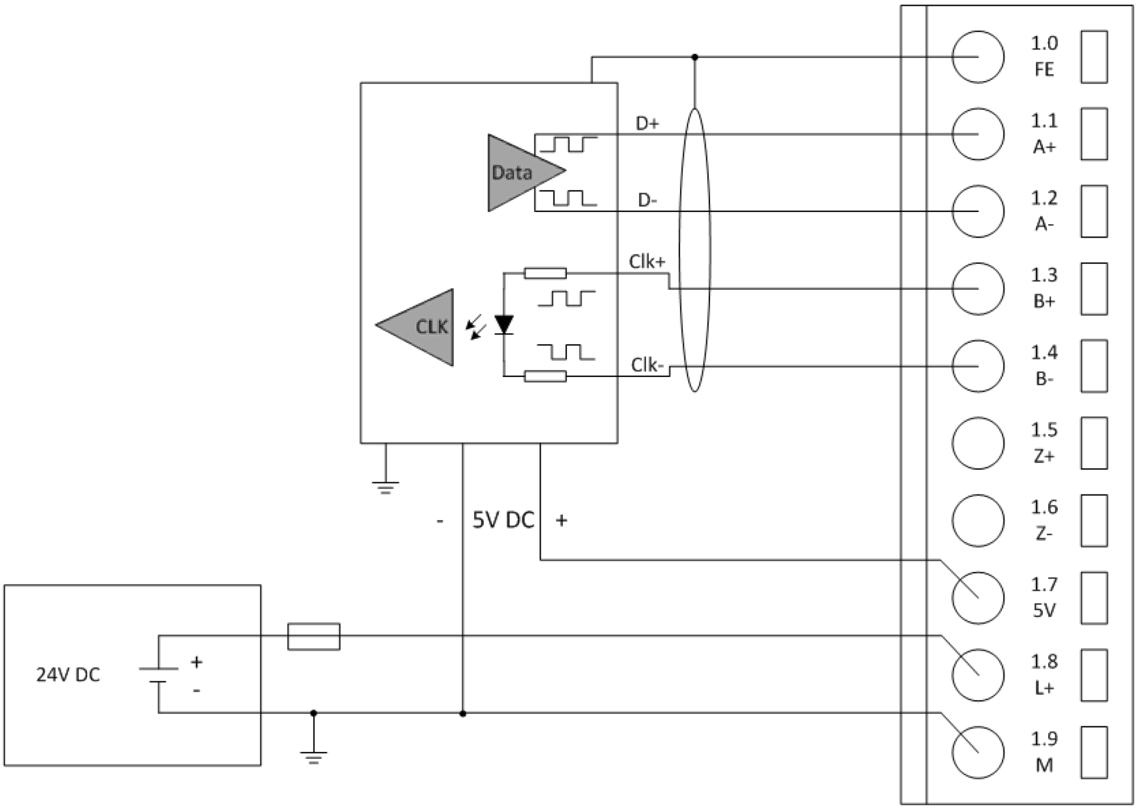
Connection of absolute encoders with RS-422 differential SSI interface

The encoder is powered by the 5 V power supply which is integrated in the FM502-CMS.



Connection of absolute encoders with optical SSI interface (optocoupler at CLK input)

The encoder can optionally be powered by the 5-V-power-supply which is integrated in the FM502-CMS.

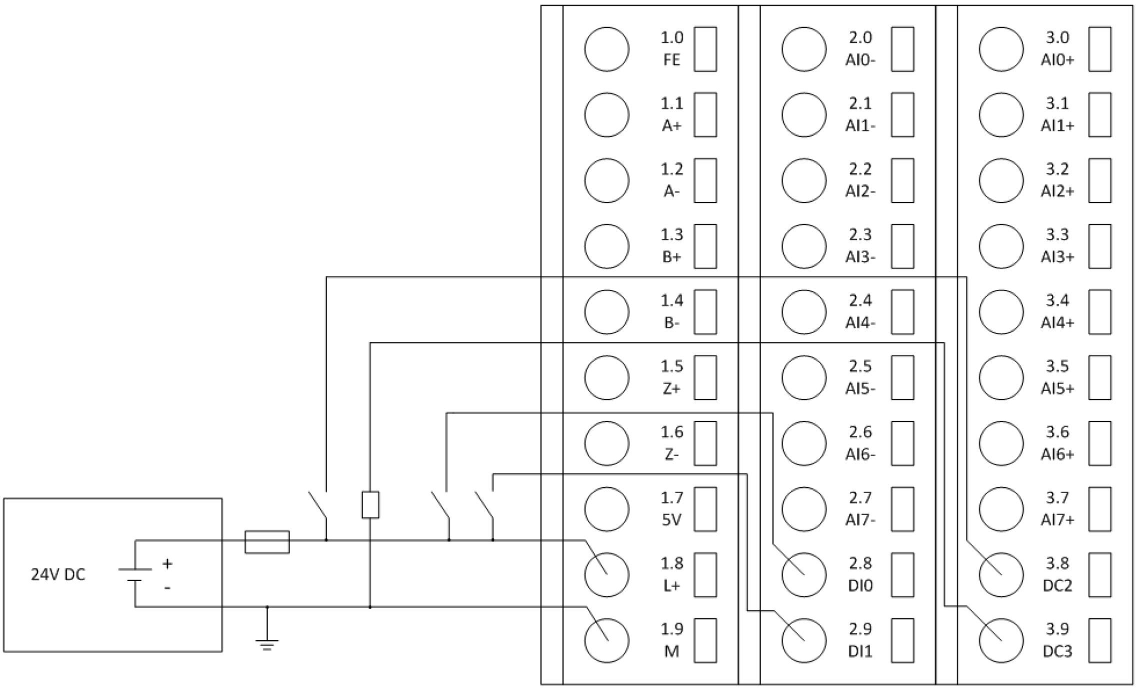


Encoder/counter signals must be laid in shielded cables. The cable shield must be grounded at both sides of the cable. In order to avoid unacceptable potential differences between different parts of the installation, low-resistance equipotential bonding conductors must be laid. Only for applications with low disturbance and/or cables length < 30 m the shield might be omitted.

The 5 V output provides a current of 100 mA max.

NOTICE!
Risk of damaging the FM502-CMS!
The 5 V output has no protection against reverse polarity.

Connection of standard inputs/outputs



Connection of sensors with frequency outputs

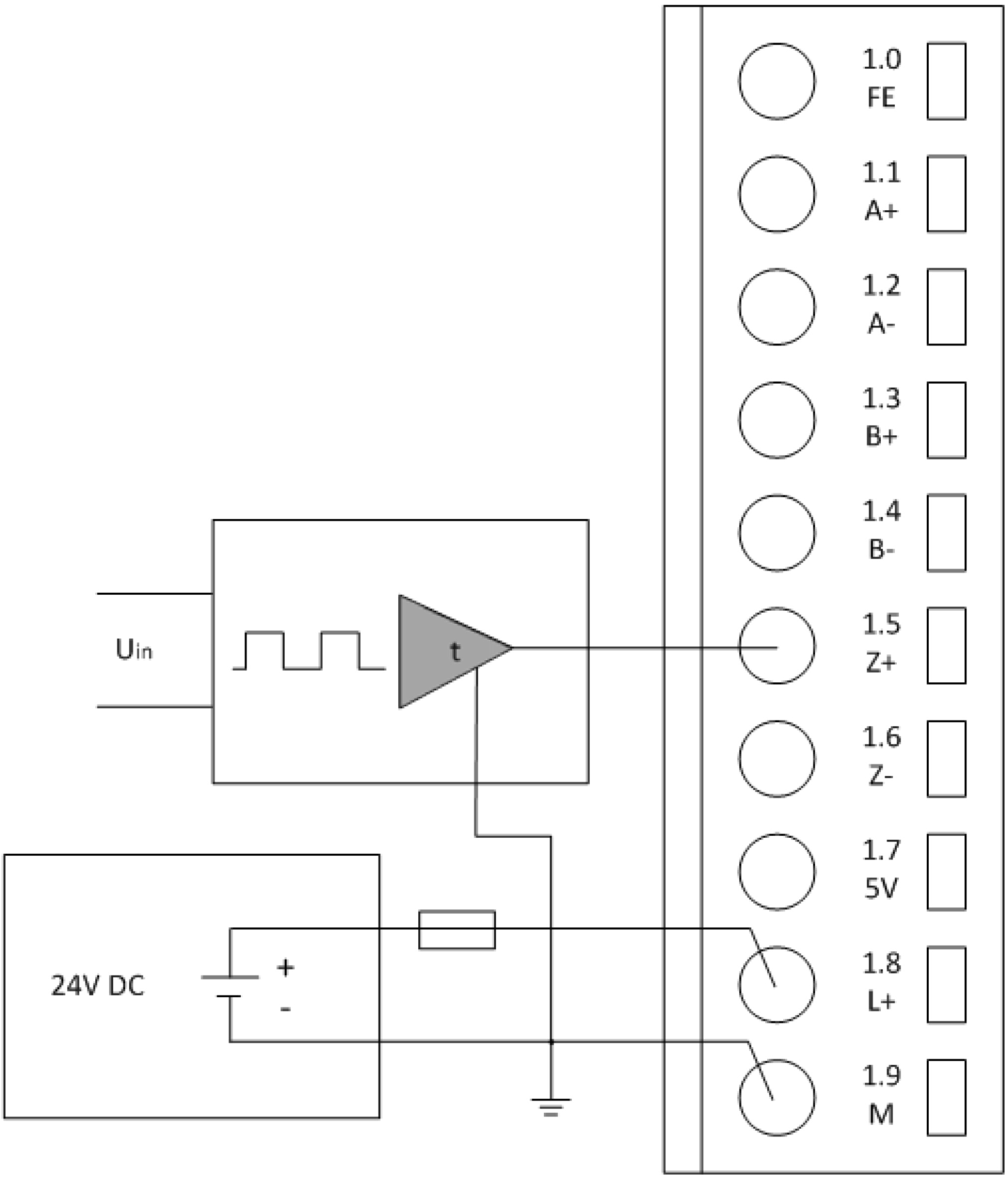


Fig. 223: Example for connection of sensors with frequency outputs to the input Z+

1.7.2.2.2 Internal data exchange

Parameter	Value
Digital inputs (bytes)	4
Digital outputs (bytes)	8
Counter inputs (words)	4
Counter outputs (words)	2
Analog inputs (words)	16
Analog outputs (words)	0

1.7.2.2.3 Diagnosis

Table 230: Module error FM502-CMS

E1...E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier 000 ... 063**	**AC500 display**	**<-- Display in**	
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**		
Byte 6 Bit 6 ... 7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0 ... 5**	**FBP diag-nosis block**		
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error identi-fier**	**Error mes-sage**	**Online number**	**Remedy**
	1)	2)	3)	4)				
3	5	255	29	31	3	Timeout in the I/O module	184545219	Replace I/O module
3	5	255	29	31	11	Process voltage too low	184545227	Replace I/O module
4	5	255	29	31	13	FW update failed	184545229	Retry FW update
3	5	255	29	31	18	5 V sensor supply too low	184545234	Check wiring & sensor power, Replace I/O module
3	5	255	29	31	19	Checksum error in the I/O module	184545235	Replace I/O module
3	5	255	29	31	36	Internal data exchange failure	184545252	Replace I/O module
3	5	255	29	31	43	Internal error in the module	184545259	Replace I/O module
4	5	255	29	31	52	Production data missing	184545268	Call support

Table 231: Channel error FM502-CMS

E1...E4	d1	d2	d3	d4	Identi-fier 000 ... 063	AC500 display	<-- Display in	
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**		
Byte 6 Bit 6 ... 7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0 ... 5**	**FBP diag-nosis block**		
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error identi-fier**	**Error mes-sage**	**Online number**	**Remedy**
	1)	2)	3)	4)				
4	5	255	29	0..15	5	Analog value overflow at an analog input	184543237, 184543301, 184543365, 184543429, 184543493, 184543557, 184543621, 184543685, 184543749, 184543813, 184543877, 184543941, 184544005, 184544069, 184544133, 184544197	Check input value
4	5	255	29	0..15	7	Analog value under-flow at an analog input	184543239, 184543303, 184543367, 184543431, 184543495, 184543559, 184543623,	Check input value

E1...E4	d1	d2	d3	d4	Identi-fier 000 ... 063	AC500 display	<-- Display in	
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**		
Byte 6 Bit 6 ... 7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0 ... 5**	**FBP diag-nosis block**		
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error identi-fier**	**Error mes-sage**	**Online number**	**Remedy**
	[1])	[2])	[3])	[4])				
							184543687, 184543751, 184543815, 184543879, 184543943, 184544007, 184544071, 184544135, 184544199	
4	5	255	29	0..1	10	Encounter/counter input fre-quency too high	184543242, 184543306	Check fre-quency filter param-eter or sensor

E1...E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier 000 ... 063**	**AC500 display**	**<-- Display in**	
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**		
Byte 6 Bit 6 ... 7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0 ... 5**	**FBP diag-nosis block**		
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error identi-fier**	**Error mes-sage**	**Online number**	**Remedy**
	1)	2)	3)	4)				
4	5	255	29	0..15	45	Cut wire at an analog input (only in IEPE mode)	184543277, 184543341, 184543405, 184543469, 184543533, 184543597, 184543661, 184543725, 184543789, 184543853, 184543917, 184543981, 184544045, 184544109, 184544173, 184544237	Check terminal

E1...E4	d1	d2	d3	d4	Identi-fier 000 ... 063	AC500 display	<-- Display in	
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**		
Byte 6 Bit 6 ... 7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0 ... 5**	**FBP diag-nosis block**		
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error identi-fier**	**Error mes-sage**	**Online number**	**Remedy**
	[1])	[2])	[3])	[4])				
4	5	255	29	0..15	46	Short cir-cuit at an analog input (only in IEPE mode)	184543278, 184543342, 184543406, 184543470, 184543534, 184543598, 184543662, 184543726, 184543790, 184543854, 184543918, 184543982, 184544046, 184544110, 184544174, 184544238	Check terminal
4	5	255	29	2..3	47	Short cir-cuit at an digital output	184543407, 184543471	Check terminal or output connec-tion

Remarks:

[1])	In AC500, the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The FBP diagnosis block does not contain this identifier.
[2])	With "Device" the following allocation applies: 31 = module itself, 1..10 = commu-nication interface module 1..10, ADR = hardware address (e.g. of the DC551)

[3])	With "Module" the following allocation applies depending on the master: Module error: I/O bus or FBP: 31 = module itself; COM1/COM2: 1..10 = expansion 1..10 channel error: I/O bus or FBP = module type (1 = AI); COM1/COM2: 1..10 = expansion 1..10
[4])	In case of module errors, with channel "31 = Module itself" is output.

1.7.2.2.4 State LEDs

During the power-on procedure, the module initializes automatically. All LEDs (except the LEDs for the signal states) are on during the initialization.

LED	State	Color	LED = ON	LED = OFF	LED flashing
AI0 - AI15	Analog channel state	Green	Channel acti-vated and OK	Channel deactivated	CMS meas-urement run-ning
		Red	Short circuit (only in IEPE mode) over- / undervoltage (only in +-10V mode)	-	Cable break (only in IEPE mode)
A, B, Z	Encoder 0 inputs	Yellow	Input ON	Input OFF	LED follows the state of the inputs, depending on frequency
DI0, DI1, DC2, DC3	Digital inputs	Yellow	Input = ON (the input voltage is even dis-played if the supply voltage is OFF).	Input = OFF	-
DC2, DC3	Digital outputs	Yellow	Output = ON	Output OFF	-
5 V	Power supply for encoders	Green	Configuration ON and power 5-V-power ready	Configuration OFF or power failure	Power supply outputs are short-circuited
L+	Process supply voltage	Green	Process voltage OK Initialization finished	Process voltage OFF	Firmware update
CH-ERR1, CH-ERR2		Red	Serious error within the cor-responding group	No error or process voltage is missing	Error on one channel of the corresponding group (e.g. short circuit at an output)

1.7.2.2.5 Measuring ranges

Table 232: Voltage input ranges

Range	IEPE	Digital value		-10 V ... +10 V	Digital value	
		Decimal	Hex.		Decimal	Hex.
Open loop overflow	≥ 7.5	3145728	300000	≥ 12.0000	5033164	4CCCCC
Measured value too high	7.499997616... 6.00000238	3145727... 2516583	2FFFFF... 266667	11.99999762... 10.00000238	5033163... 4194305	4CCCCB... 400001
Normal range	6.00000... 0.00000238	2516582... 1	266666... 1	10.0000... 0,00000238	4194304... 1	400000... 1
	0.0000	0	0	0.0000	0	0
	-0.00000238... -6.00000	-1... -2516582	-1... -266666	-0.00000238... -10.0000	-1... -4194304	-1... -400000
Measured value too low	-6.00000238... -7.499997616	-2516583... -3145727	-266667... -2FFFFF	-10.00000238... -11.99999762	-4194305... -5033163	-400001... -4CCCCB
Short circuit / underflow	≤ -7.5	-3145728	-300000	≤ -12.0000	-5033164	-4CCCCC

1.7.2.2.6 Technical data

The system data of AC500 and S500 are applicable to the standard version *Chapter 2.6.1 “System data AC500” on page 1408*.

The system data of AC500-XC are applicable to the XC version *Chapter 2.7.1 “System data AC500-XC” on page 1475*.

Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

Table 233: Technical data of process supply voltage

Parameter	Value
Connections of terminals	The terminals 1.8, 4.8 ... 7.8, 1.9, 4.9 ... 7.9, 4.0 ... 4.7, 7.0 ... 7.7 are electrically interconnected within the TF5x1-CMS. Terminals 1.8, 4.8 ... 7.8: process voltage L+ = +24 V DC Terminals 1.9, 4.9 ... 7.9: process voltage M = 0 V Terminals 4.0 ... 4.7, 7.0 ... 7.7: analog shield clamps SH Terminal 1.0: FE shield clamp of encoder
Protection against reverse voltage	Yes
Rated protection fuse at UP	10 A fast
Rated value	24 V DC
Max. ripple	5 %

Parameter	Value
Current consumption from L+ (FM502-CMS and PM592-ETH, no communication module)	Max. 0.43 A + max. 0.5 A per output
Inrush current from L+ (at power up, FM502-CMS and PM592-ETH, no communica-tion module)	1.2 A^2s
Galvanic isolation	Yes, PM592-ETH and FM502-CMS to other I/O bus modules
Max. power dissipation within the FM502-CMS	6.5 W (outputs unloaded)

NOTICE!
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and temporary overvoltage up to 30 V DC.

Multiple overloads
No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an internal smart high-side switch.

For maritime applications a metal cabinet is required

Table 234: Technical data of the device

Parameter	Value
Weight FM502-CMS	215 g
Weight FM502-CMS-XC	220 g
Mounting position	Horizontal Vertical with derating: max. temperature +40 °C
Cooling	The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.
Deratings for operation of FM502-CMS-XC between +60 °C and +70 °C	No use of 24 V encoder mode. Analog inputs: maximum number of config-ured input channels limited to 75 % per group AI0 ... AI7 and AI8 ... AI15.
Required Terminal Base	TF501 or TF521 *Chapter 1.2.2 “TF501-CMS and TF521-CMS - Function module ter-minal bases ” on page 14*

Table 235: Technical data of the 5 V encoder supply

Parameter	Value
Number of supplies	1
Connections	Terminal 1.7

Parameter	Value
Rated value	5 V DC (+/- 5%)
Resistance to feedback against reverse polarity	No
Resistance to feedback against 24 V signals	Yes
Output current	100 mA max.
Output diagnosis	Yes, with diagnosis LED and error message

Table 236: Technical data of the digital inputs

Parameter		Value
Number of channels		2 + 2 configurable inputs/outputs
Connections		Terminals 2.8, 2.9, 3.8, 3.9
Reference potential		Terminals 1.9, 4.9, 5.9, 6.9, 7.9 for M (0 V)
Indication of the input signals		One yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Input type acc. to EN 61131-2		Type 1
Input delay (0->1 or 1->0)		Typ. 8 ms, configurable from 0.1 ms ... 32 ms
Input signal voltage		24 V DC
	Signal 0	-3 V ... +5 V Due to the direct connection to the output, the demagnetizing varistor is also effective at the input. This is why the difference between L+ and the input signal must not exceed the clamp voltage of the varistor. The varistor limits the clamp voltage to approx. 36 V. The input voltage must range from -12 V ... +30 V when L+ = 24 V and from -6 V ... +30 V when L+ = 30 V.
	Undefined signal	> +5 V ... < +15 V
	Signal 1	+15 V ... +30 V
Ripple with signal 0		Within -3 V ... +5 V
Ripple with signal 1		Within +15 V ... +30 V
Input current per channel		
	Input voltage +24 V	Typ. 5 mA
	Input voltage +5 V	> 1 mA
	Input voltage +15 V	> 5 mA
	Input voltage +30 V	< 8 mA
Max. cable length		
Shielded		1000 m
Unshielded		600 m

Table 237: Technical data of digital outputs

Parameter	Value
Number of channels per module	2 configurable inputs/outputs
Connection	Terminal 3.8, 3.9
Reference potential	Terminals 1.9, 4.9, 5.9, 6.9, 7.9 for M (0 V)

Parameter		Value
Indication of the output signal		One LED per channel
Power supply voltage		Terminals 1.8, 4.8, 5.8, 6.8, 7.8 for L+ (+24 V)
Output voltage for signal 1		L+ (-0.8 V)
Output delay (0->1 or 1->0)		On request
Output current		
	Rated value, per channel: 500 mA at UP = 24 V	500 mA at L+ = 24 V
	Maximum value: 1 A	1 A
Leakage current with signal 0		< 0.5 mA
Demagnetization when inductive loads are switched off		With varistors integrated in the module
Switching frequency		
	With resistive load	On request
	With inductive loads	Max. 0.5 Hz
	With lamp loads	Max. 11 Hz with max. 5 W
Short-circuit proof / overload proof		Yes
Overload message (I > 0.7 A)		Yes, after ca. 100 ms
Output current limitation		Yes, automatic reactivation after short circuit/overload
Resistance to feedback against 24 V signals		Yes
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

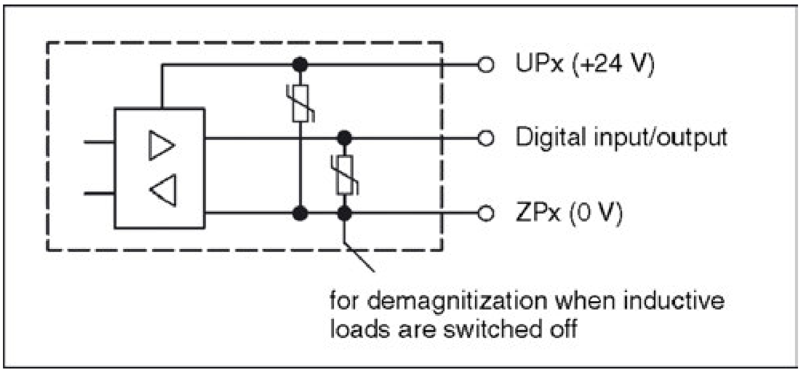


Fig. 224: Circuitry of a digital input/output with the varistors for demagnetization when inductive loads are switched off.

Table 238: Technical data of high speed input (Encoder, A/B/Z)

Parameter	Value
Number of channels per module	3 (sampled synchronously with IEPE inputs)
Connection	Terminals 1.1, 1.2, 1.3, 1.4, 1.5, 1.6
Reference potential	Terminals 1.9, 4.9, 5.9, 6.9, 7.9 for M (0 V)
Indication of the input signals	One LED per channel

Parameter	Value		
Resolution	32 bits		
Input type	24 V DC	5 V DC	Differential RS-422 and 1 Vpp sine
Input current per channel			
Input voltage + 24 V	Typ. 6 mA		
Input voltage + 5 V	> 1 mA		
Input voltage + 15 V	> 5 mA		
Input voltage + 30 V	< 8 mA		
Input type acc. to EN61131-2	Type 1		
Input frequency max. (frequency measurement)	100 kHz (accuracy -0 %/+3 %)		
Input signal voltage	24 V DC	5 V DC	Differential
Input frequence max.	300 kHz	1 MHz	1 MHz
Signal 0	-30 V ... +5 V	-30 V ... +0.8 V	≤ 200 mV
Undefined signal	> +5 V ... < +15 V	> +0.8 V ... < +2.0 V	-
Signal 1	+15 V ... +30 V	+2.0 V ... +30 V	≥ +200 mV
Ripple with signal 0	Within -30 V ... +5 V	Within -30 V ... +0.8 V	-
Ripple with signal 1	Within +15 V ... +30 V	Within +2.0 V ... +30 V	-
Max. cable length, shielded (depending on sensor)	300 m	100 m	

Table 239: Technical data of the fast outputs (SI CLK output B for optical interface)

Parameter	Value
Number of channels	1
Connection	Terminals 1.3, 1.4
Reference potential	Terminals 1.9, 4.9, 5.9, 6.9, 7.9 for M (0 V)
Indication of output signal	One LED per channel, the LED is ON when SSI CLK output B is active
Differential output voltage for signal 1	> 2.4 V at 10 mA
Differential output voltage for signal 0	≤ -2.4 V at 10 mA
Output delay (0->1 or 1->0)	Max. 0.35 µs
Output current	≤ 10 mA
Switching frequency (selectable)	200 kHz, 500 kHz and 1 MHz
Short-circuit-proof/overload-proof	Yes
Output current limitation	Yes, automatic reactivation after short circuit/overload
Resistance to feedback against 24 V signals	Yes
Resistance to feedback against reverse polarity	Yes
Max. cable length, shielded (depending on sensor)	Typ. 12.5 m at 1MHz

Table 240: Technical data of the fast outputs (SSI CLK output B, RS-422 differential)

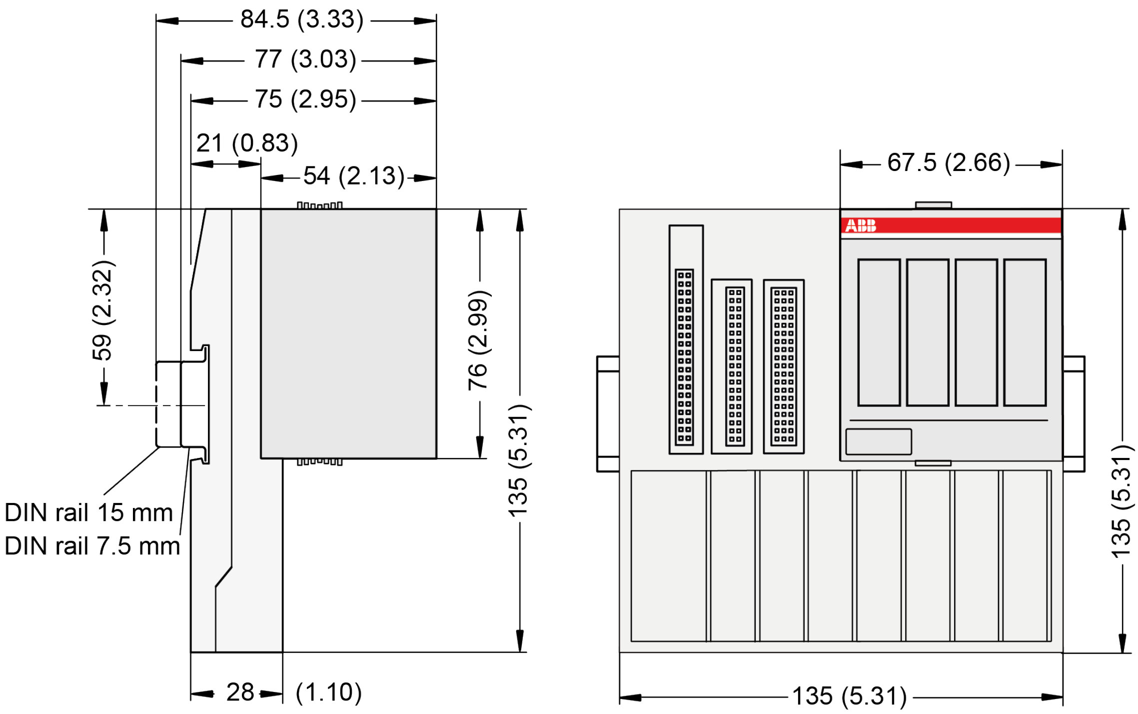
Parameter	**Value**
Number of channels	1
Connection	Terminals 1.3, 1.4
Reference potential	Terminals 1.9, 4.9, 5.9, 6.9, 7.9 for M (0 V)
Differential output voltage	≥ 2.4 V at 10 mA
Output delay (0->1 or 1->0)	Max. 0.35 µs
Switching frequency (selectable)	200 kHz, 500 kHz, 1 MHz
Short-circuit-proof/overload-proof	Yes
Output current limitation	Yes, automatic reactivation after short-circuit/overload
Resistance to feedback against 24 V signals	Yes
Resistance to feedback against reverse polarity	Yes
Max. cable length, shielded (depending on sensor)	100 m

Table 241: Technical data of analog inputs

Parameter	**Value**	
Number of channels per module	16 (synchronous sampled)	
Connection	Terminals 2.0 ... 2.7, 5.0 ... 5.1 for AI-, 3.0 ... 3.7, 6.0 ... 6.7 for AI+	
Indication of the input signal	One bicolor LED per channel for signal and error messages.	
Measurement resolution	≥ 23 Bit	
Resolution	32 bits external use	
Accurracy at +25 °C	≤+/-0.1 %	
Accurracy over operating temperature and vibration	≤+/-0.5 %	
Sample rate/bandwidth high (0 dB)	50 kHz/20 kHz (min. -121 dB/22.5 kHz) 25 kHz/10 kHz (min. -116 dB/11.25kHz) 12.5 kHz/5 kHz (min. -116 dB/5.63 kHz) 6.25 kHz/2.5 kHz (min. -116 dB/2.81 kHz) 3.13 kHz/1.25 kHz (min. -116 dB/1.41 kHz) 1.56 kHz/0.625 kHz (min. -116 dB/0.70 kHz) 0.78 kHz/0.312 kHz (min. -120 dB/0.36 kHz) 0.39 kHz/0.156 kHz (min. -121 dB/0.18 kHz) 0.20 kHz/0.080 kHz (min. -121 dB/0.09 kHz) 0.10 kHz/0.040 kHz (min. -130 dB/0.05 kHz) selectable per channel	
Data storage	128 MB	
Measurement time	Selectable per channel	
Input type default setting	unused	
Input type (selectable per input)	IEPE	-10 V...+10 V

Parameter	Value	
Bandwidth low	min. 3 dB/< 0.1 Hz	min. 3 dB/< 0.1 Hz or DC (selectable)
Dynamic range (SFDR)	> 100 dB	
SINAD (300 Hz/1 kHz sine, 50 k SPS)		
0 dB from full scale	< -90 dB	< -95 dB
-20 dB from full scale	< -75 dB	< -80 dB
-40 dB from full scale	< -55 dB	< -60 dB
Input range	+2 V ... +18 V	-10 V ... +10 V
Measurement range	+/-6 V (DC coupled)	-10 V ... +10 V
Input DC bias range, common mode range	+8 V ... +12 V	+/-1 V
Current source per channel	Typ. 4.2 mA (+/- 7 % over temperature)	-
Input resistance AI- to M	Typ. 27 Ohm (PTC)	
Channel input impedance (AI+/AI-)		
< 1 kHz	> 1 MOhm	> 2 MOhm
5 kHz	> 100 kOhm	> 40 kOhm
10 kHz	> 60 kOhm	> 25 kOhm
20 kHz	> 40 kOhm	> 8 kOhm
Error detection	Short circuit, open wire	-
Max. cable length, shielded (depending on sensor)	100 m	

1.7.2.2.7 Dimensions



The dimensions are in mm and in brackets in inch.

1.7.2.2.8 Ordering data

Part no.	Description	Product life cycle phase *)
1SAP260400R0001	Function module FM502-CMS	Active
1SAP460400R0001	Function module FM502-CMS-XC, XC version	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

1.8 Communication interface modules (S500)

Hot swap

System requirements for hot swapping of I/O modules:

- *Types of terminal units that support hot swapping of I/O modules have the appendix TU5xx**-H**.*
- *I/O modules as of index F0.*

The following I/O bus masters support hot swapping of attached I/O modules:

- *Communication interface modules CI5xx as of index F0.*
- *Processor module PM585-ETH with firmware version as of V2.8.1.*

NOTICE!

Risk of damage to I/O modules!

Hot swapping is only allowed for I/O modules.

Processor modules and communication interface modules must not be removed or inserted during operation.

Conditions for hot swapping

- *Digital outputs are not under load.*
- *Input/output voltages above safety extra low voltage/ protective extra low voltages (SELV/PELV) are switched off.*
- *Modules are completely plugged on the terminal unit with both snap fit engaged before switching on loads or input/output voltage.*

1.8.1 Compatibility of communication modules and communication interface modules

Table 242: Modbus TCP

Communication module	Communication interface module	I/O expansion module S500	I/O expansion module S500-eCo	I/O expansion module S500-S	Applications
Onboard Ethernet interface	CI521-MODTCP CI522-MODTCP	x	x	--	high availability, remote I/O
Onboard Ethernet interface	CI521-MODTCP CI522-MODTCP	x	--	--	hot-swap I/O
CM597-ETH	CI521-MODTCP CI522-MODTCP	x	x	--	high availability, remote I/O
CM597-ETH	CI521-MODTCP CI522-MODTCP	x	--	--	hot-swap I/O

Table 243: PROFIBUS DP

Communication module	Communication interface module	I/O expansion module S500	I/O expansion module S500-eCo	I/O expansion module S500-S	Applications
CM592-DP master	CI541-DP CI542-DP	x	x	--	remote I/O
CM592-DP master	CI541-DP CI542-DP	x	--	--	hot-swap I/O

Table 244: PROFINET IO RT

Communication module	Communication interface module	I/O expansion module S500	I/O expansion module S500-eCo	I/O expansion module S500-S	Applications
CM579-PNIO controller	CI501-PNIO CI502-PNIO	x	x	x	remote I/O, safety I/O
CM579-PNIO controller	CI501-PNIO CI502-PNIO	x	--	--	hot-swap I/O
CM579-PNIO controller	CI504-PNIO CI506-PNIO	x	x	x	remote I/O, safety I/O
CM579-PNIO controller	CI504-PNIO CI506-PNIO	x	--	--	hot-swap I/O

Table 245: CANopen

Communication module	Communication interface module	I/O expansion module S500	I/O expansion module S500-eCo	I/O expansion module S500-S	Applications
CM598-CN master	CI581-CN CI582-CN	x	x	--	remote I/O

Table 246: EtherCAT

Communication module	Communication interface module	I/O expansion module S500	I/O expansion module S500-eCo	I/O expansion module S500-S	Applications
CM579-ETHCAT master	CI511-ETHCAT CI512-ETHCAT	x	x	--	remote I/O

Table 247: CS31 bus

Communication module	Communication interface module	I/O expansion module S500	I/O expansion module S500-eCo	I/O expansion module S500-S	Applications
Onboard COM1 interface	DC551-CS31 CI592-CS31	x	x	--	remote I/O
Onboard COM1 interface	CI590-CS31-HA	x	--	--	high availability
CM574-RS	DC551-CS31 CI592-CS31	x	x	--	remote I/O
CM574-RS	CI590-CS31-HA	x	--	--	high availability

1.8.2 CANopen

1.8.2.1 Comparison CI581 and CI582

The devices differ in their input and output characteristics.

CI581-CN: Input/ Output characteristics

Parameter	Value
Inputs and outputs	8 digital inputs (24 V DC; delay time configurable via software) 8 digital transistor outputs (24 V DC, 0.5 A max.) 4 analog inputs, configurable as: ● -10 V ... +10 V ● 0 V ... +10 V ● -10 V ... +10 V (differential voltage) ● 0 mA ... 20 mA ● 4 mA ... 20 mA ● Pt100 , Pt1000, Ni1000 (for each 2-wire and 3-wire) ● 24 V digital input function 2 analog outputs, configurable as: ● -10 V ... +10 V ● 0 mA ... 20 mA ● 4 mA ... 20 mA
Resolution of the analog channels	12 bits
Fast counter	Integrated, configurable operating modes

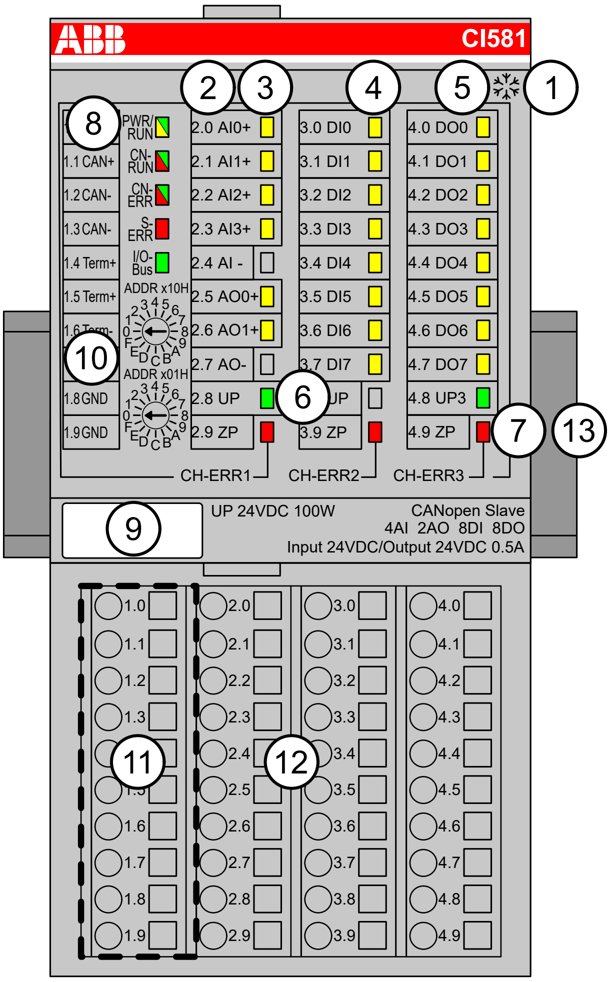
CI582-CN: Input/ Output characteristics

Parameter	Value
Inputs and outputs	8 digital inputs (24 V DC) 8 digital transistor outputs (24 V DC, 0.5 A max.) 8 configurable digital inputs/outputs (24 V DC, 0.5 A max.)

1.8.2.2 CI581-CN

1.8.2.2.1 Features

- 4 analog inputs (resolution 12 bits including sign)
- 2 analog outputs (resolution 12 bits including sign)
- 8 digital inputs 24 V DC
- 8 digital outputs 24 V DC, 0.5 A max
- Module-wise galvanically isolated
- Fast counter
- XC version for use in extreme ambient conditions available



1 I/O bus
2 Allocation between terminal No. and signal name
3 6 yellow LEDs to display the signal states of the analog inputs/outputs (AI0 ... AI3, AO0 ... AO1)
4 8 yellow LEDs to display the signal states of the digital inputs (DI0 ... DI7)
5 8 yellow LEDs to display the signal states of the digital outputs (DO0 ... DO7)

6 2 green LEDs to display the supply voltage UP and UP3
7 3 red LEDs to display errors (CH-ERR1, CH-ERR2, CH-ERR3)
8 5 System LEDs: PWR/RUN, CN-RUN, CN-ERR, S-ERR, I/O-Bus
9 Label
10 2 rotary switches for setting the CANopen Node ID
11 10 terminals to connect the CANopen bus signals
12 Terminal unit
13 DIN rail
❄ Sign for XC version

1.8.2.2.2 Intended purpose

The CANopen communication interface module CI581-CN is used as decentralized I/O module in CANopen networks. Depending on the used terminal unit the network connection is performed either via 9-pin female D-sub or via 10 terminals (screw or spring terminals) which are integrated in the terminal unit. The communication interface module contains 22 I/O channels with the following properties:

- 4 analog inputs (2.0 ... 2.3)
- 2 analog outputs (2.5 ... 2.6)
- 8 digital inputs 24 V DC in 1 group (3.0 ... 3.7)
- 8 digital outputs 24 V DC in 1 group (4.0 ... 4.7)

The inputs/outputs are galvanically isolated from the CANopen network. There is no potential separation between the channels. The configuration of the analog inputs/outputs is performed by software.

For use in extreme ambient conditions (e.g. wider temperature and humidity range), a special XC version of the device is available.

1.8.2.2.3 Functionality

Parameter	Value
Interface	CAN
Protocol	CANopen
Power supply	From the process supply voltage UP
Supply of the electronic circuitry of the I/O modules attached	Through the I/O bus interface (I/O bus)
Rotary switches	For setting the CANopen Node ID for configuration purposes (00h to FFh)
LED displays	For system displays, signal states, errors and power supply
External supply voltage	Via terminals ZP, UP and UP3 (process supply voltage 24 V DC)
Transmission rates	10 / 20 / 50 / 125 / 250 / 500 / 800 kbit/s 1 Mbit/s Auto transmission rate detection is supported
Bus connection	Depending on used terminal unit TU510: 9-pin D-sub connector TU518: 10-pin terminal block
Processor	Hilscher NETX 100
Expandability	Max. 10 S500 I/O modules
State display	Module state: PWR/RUN, CN-RUN, CN-ERR, E-ERR, I/O bus

Parameter		Value
Adjusting elements		2 rotary switches for generation of the node address
Ambient temperature		System data AC500 ⇨ *Chapter 2.6.1 "System data AC500" on page 1408* System data AC500 XC ⇨ *Chapter 2.7.1 "System data AC500-XC" on page 1475*
Current consumption		UP: 0.2 A UP3: 0.06 A + 0.5 A max. per output
Weight (without terminal unit)		Ca. 125 g
Process supply voltages UP/UP3		
	Rated value	24 V DC (for inputs and outputs)
	Max. load for the terminals	10 A
	Protection against reversed voltage	Yes
	Rated protection fuse on UP/UP3	10 A fast
	Galvanic isolation	CANopen interface against the rest of the module
	Inrush current from UP (at power up)	On request
	Current consumption via UP (normal operation)	0.2 A
	Current consumption via UP3	0.06 A + 0.5 A max. per output
	Connections	Terminals 2.8 and 3.8 for +24 V (UP) Terminal 4.8 for +24 V (UP3) Terminals 2.9, 3.9 and 4.9 for 0 V (ZP)
Max. power dissipation within the module		6 W
Reference potential for all digital inputs and outputs		Negative pole of the supply voltage, signal name ZP
Setting of the CANopen Node ID identifier		With 2 rotary switches at the front side of the module
Mounting position		Horizontal Or vertical with derating (output load reduced to 50 % at +40 °C per group)
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.
Effect of incorrect input terminal connection		Wrong or no signal detected, no damage up to 35 V
Required terminal unit		TU509, TU510, TU517 or TU518 ⇨ *Chapter 1.5.2 "TU509 and TU510 for communication interface modules" on page 278* ⇨ *Chapter 1.5.4 "TU517 and TU518 for communication interface modules" on page 290*

All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and continuous overvoltage up to 30 V DC.

CI581-CN: Input/ Output characteristics

Parameter	Value
Inputs and outputs	8 digital inputs (24 V DC; delay time configurable via software) 8 digital transistor outputs (24 V DC, 0.5 A max.) 4 analog inputs, configurable as: ● -10 V ... +10 V ● 0 V ... +10 V ● -10 V ... +10 V (differential voltage) ● 0 mA ... 20 mA ● 4 mA ... 20 mA ● Pt100 , Pt1000, Ni1000 (for each 2-wire and 3-wire) ● 24 V digital input function 2 analog outputs, configurable as: ● -10 V ... +10 V ● 0 mA ... 20 mA ● 4 mA ... 20 mA
Resolution of the analog channels	12 bits
Fast counter	Integrated, configurable operating modes

1.8.2.2.4 Connections

General

The CANopen communication interface module is plugged on the I/O terminal units TU517 *Chapter 1.5.4 “TU517 and TU518 for communication interface modules” on page 290* or TU518 *Chapter 1.5.4 “TU517 and TU518 for communication interface modules” on page 290* and accordingly TU509 *Chapter 1.5.2 “TU509 and TU510 for communication interface modules” on page 278* or TU510 *Chapter 1.5.2 “TU509 and TU510 for communication interface modules” on page 278*. Properly position the module and press until it locks in place.

The connection of the I/O channels is established using the 30 terminals of the I/O terminal unit. I/O modules can be replaced without re-wiring the terminal units.

The terminals 2.8, 3.8, 2.9, 3.9 and 4.9 are electrically interconnected within the terminal unit and always have the same assignment, irrespective of the inserted module:

Terminals 2.8 and 3.8: process supply voltage UP = +24 V DC

Terminal 4.8: process supply voltage UP3 = +24 V DC

Terminals 2.9, 3.9 and 4.9: process supply voltage ZP = 0 V

For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.

With a separate UP3 power supply, the digital outputs can be switched off externally. This way, an emergency-off functionality can be realized.

Do not connect any voltages externally to the digital outputs!

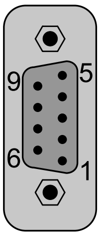
Reason: External voltages at an output or several outputs may cause other outputs to be supplied via that voltage instead of voltage UP3 (reverse voltage). This ist not the intended use.

CAUTION!
Risk of malfunctions by unintended use!
If the function cut-off of the digital outputs is to be used by deactivation of the supply voltage UP3, be sure that no external voltage is connected at the outputs DO0 ... DO7 and DC0 ... DC7.

Possibilities of connection

Mounting on terminal units TU509 or TU510

The assignment of the 9-pin female D-sub for the CANopen signals

	1	---	Reserved
	2	CAN-	Inverted signal of the CAN bus
	3	CAN_GND	Ground potential of the CAN bus
	4	---	Reserved
	5	---	Reserved
	6	---	Reserved
	7	CAN+	Non-inverted signal of the CAN bus
	8	---	Reserved
	9	---	Reserved
	Shield	Cable shield	Functional earth

Bus terminating resistors

The ends of the data lines have to be terminated with a 120 Ω bus terminating resistor. The bus terminating resistor is usually installed directly at the bus connector.

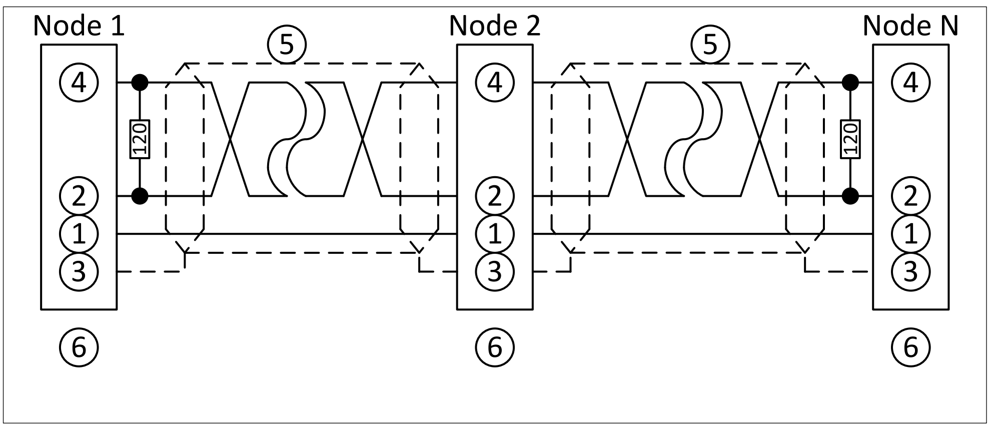


Fig. 225: CANopen interface, bus terminating resistors connected to the line ends

1	CAN_GND
2	CAN_L
3	Shield
4	CAN_H
5	Data line, shielded twisted pair
6	COMBICON connection, CANopen interface

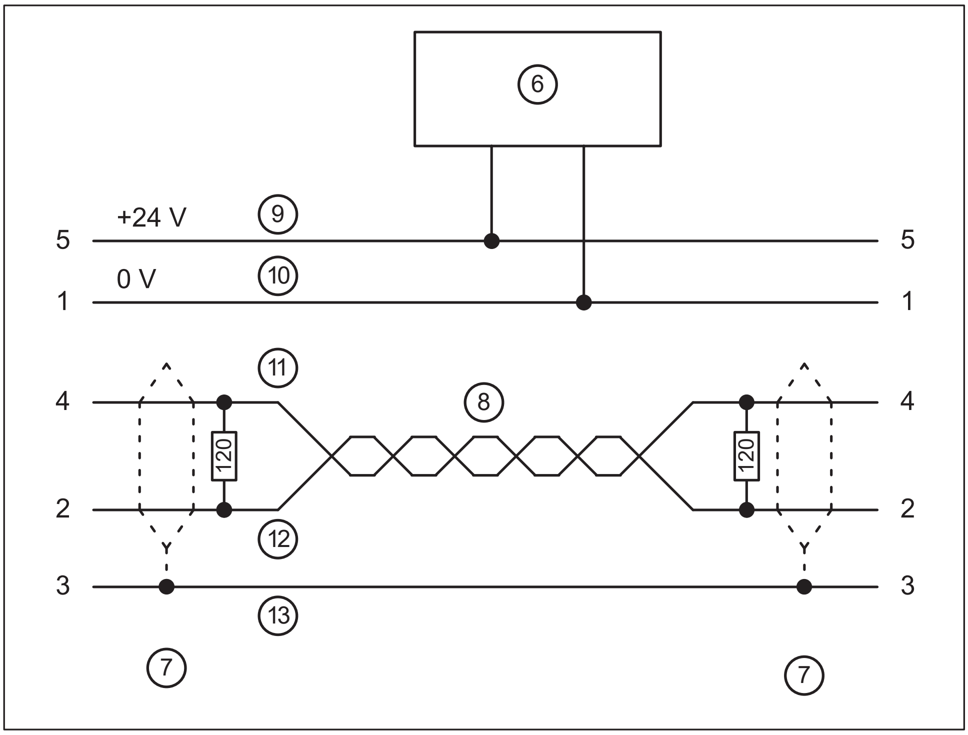


Fig. 226: DeviceNet interface, bus terminating resistors connected to the line ends

6	DeviceNet power supply
7	COMBICON connection, DeviceNet interface
8	Data lines, twisted pair cables
9	red
10	black
11	white
12	blue
13	bare

The grounding of the shield should take place at the switchgear *Chapter 2.6.1 "System data AC500" on page 1408.*

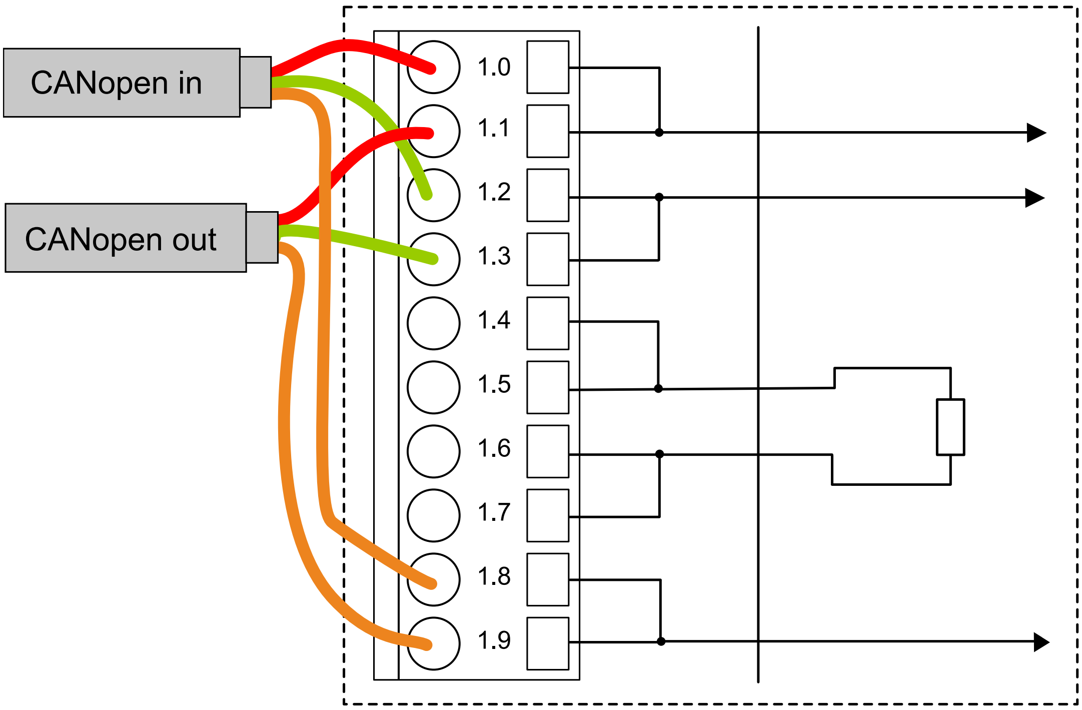
Mounting on terminal units TU517 or TU518

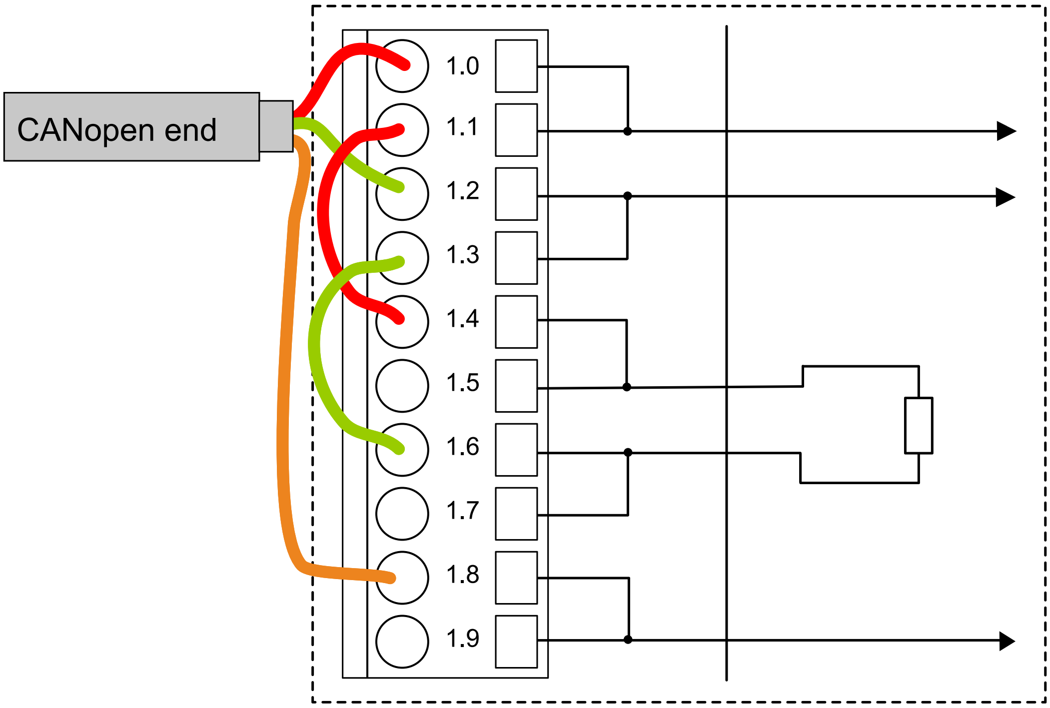
Table 248: Assignment of the terminals

Terminal	Signal	Description
1.0	CAN+	Non-inverted signal of the CAN bus
1.1	CAN+	Non-inverted signal of the CAN bus
1.2	CAN-	Inverted signal of the CAN bus
1.3	CAN-	Inverted signal of the CAN bus
1.4	Term+	CAN bus termination for CAN+ (for bus termination, Term+ must be connected with CAN+)
1.5	Term+	CAN bus termination for CAN+ (connecting alternative for terminal 1.4)
1.6	Term-	CAN bus termination for CAN- (for bus termination, Term- must be connected with CAN-)
1.7	Term-	CAN bus termination for CAN- (connecting alternative for terminal 1.6)
1.8	CAN-GND	Ground potential of the CAN bus
1.9	CAN-GND	Ground potential of the CAN bus

At the line ends of a bus segment, terminating resistors must be connected. If TU517 or TU518 is used, the bus terminating resistors can be enabled by connecting the terminals Term+ and Term- to the data lines CAN+ and CAN- (no external terminating resistors are required, see figure below).

The following figures show the different connection options for the CANopen communication interface module:





In the case of TU517/TU518, the terminating resistors are not located inside the TU but inside the communication interface module CI581-CN. Hence, when removing the device from the TU, the bus terminating resistors are no longer connected to the bus. The bus itself will not be disconnected if a device is removed.

The grounding of the shield should take place at the control cabinet. Please refer to the AC500 System-Data ↳ Chapter 2.6.1 "System data AC500" on page 1408.

Table 249: Assignment of the other terminals

Terminal	Signal	Description
2.0	AI0+	Positive pole of analog input signal 0
2.1	AI1+	Positive pole of analog input signal 1
2.2	AI2+	Positive pole of analog input signal 2
2.3	AI3+	Positive pole of analog input signal 3
2.4	AI-	Negative pole of analog input signals 0 to 3
2.5	AO0+	Positive pole of analog output signal 0
2.6	AO1+	Positive pole of analog output signal 1
2.7	AI-	Negative pole of analog output signals 0 and 1
2.8	UP	Process voltage UP (24 V DC)
2.9	ZP	Process voltage ZP (0 V DC)
3.0	DI0	Signal of the digital input DI0
3.1	DI1	Signal of the digital input DI1
3.2	DI2	Signal of the digital input DI2
3.3	DI3	Signal of the digital input DI3

Terminal	Signal	Description
3.4	DI4	Signal of the digital input DI4
3.5	DI5	Signal of the digital input DI5
3.6	DI6	Signal of the digital input DI6
3.7	DI7	Signal of the digital input DI7
3.8	UP	Process voltage UP (24 V DC)
3.9	ZP	Process voltage ZP (0 V DC)
4.0	DO0	Signal of the digital output DO0
4.1	DO1	Signal of the digital output DO1
4.2	DO2	Signal of the digital output DO2
4.3	DO3	Signal of the digital output DO3
4.4	DO4	Signal of the digital output DO4
4.5	DO5	Signal of the digital output DO5
4.6	DO6	Signal of the digital output DO6
4.7	DO7	Signal of the digital output DO7
4.8	UP3	Process voltage UP3 (24 V DC)
4.9	ZP	Process voltage ZP (0 V DC)

WARNING!

Removal/Insertion under power

The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!

Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

For the open-circuit detection (wire break), each analog input channel is pulled up to "plus" by a high-resistance resistor. If nothing is connected, the maximum voltage will be read in then.

Generally, analog signals must be laid in shielded cables. The cable shields must be grounded at both sides of the cables. In order to avoid unacceptable potential differences between different parts of the installation, low resistance equipotential bonding conductors must be laid.

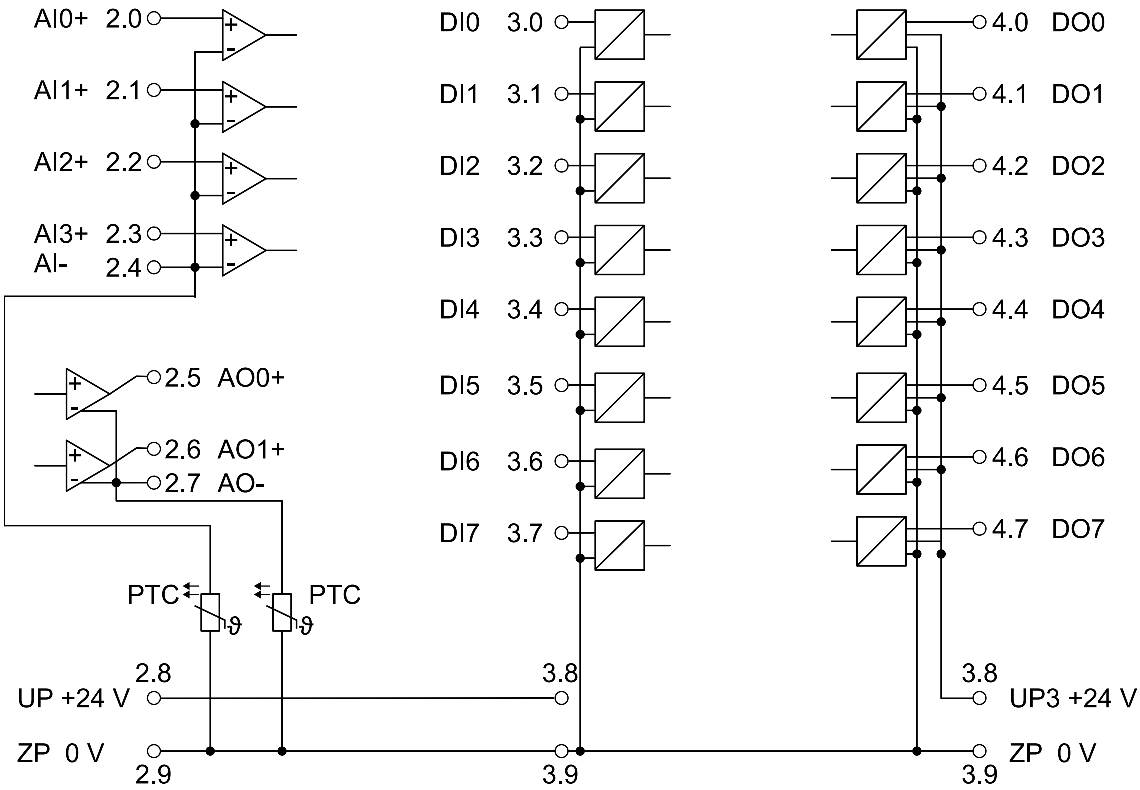


Fig. 227: Connection of the communication interface module CI581-CN

The module provides several diagnosis functions *Chapter 1.8.2.2.9 “Diagnosis” on page 946*.

For the measuring ranges that can be configured, please refer to the sections Measuring Ranges *Chapter 1.8.2.2.11 “Measuring ranges” on page 952* and Parameterization *Chapter 1.8.2.2.8 “Parameterization” on page 942*.

The meaning of the LEDs is described in the section for the state LEDs *Chapter 1.8.2.2.10 “State LEDs” on page 950*.

Bus length

The maximum possible bus length of a CAN network depends on bit rate (transmission rate) and cable type. The sum of all bus segments must not exceed the maximum bus length

Bit Rate (speed)	Bus Length
1 Mbit/s	40 m
800 kbit/s	50 m
500 kbit/s	100 m
250 kbit/s	250 m

Bit Rate (speed)	Bus Length
125 kbit/s	500 m
62.5 kbit/s	1000 m
20 kbit/s	2500 m
10 kbit/s	5000 m

Connection of the digital inputs

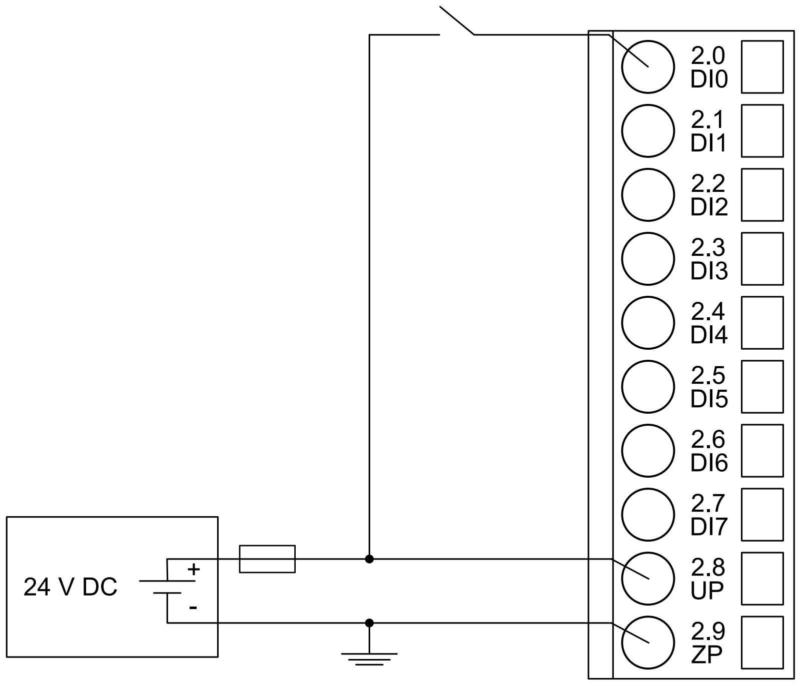


Fig. 228: Connection of the digital inputs to the module CI581-CN

Connection of the digital outputs

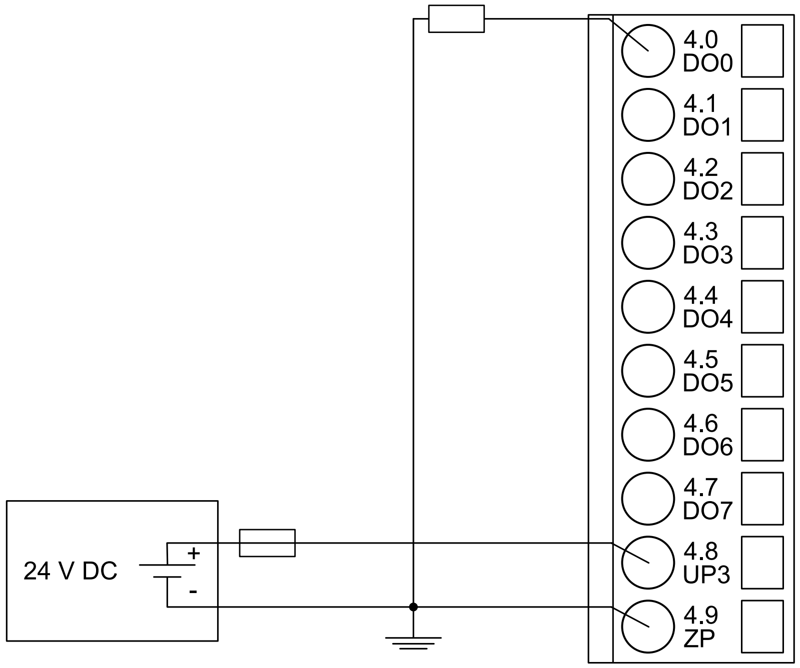


Fig. 229: Connection of configurable digital outputs to the module CI581-CN

Connection of resistance thermometers in 2-wire configuration to the analog inputs

When resistance thermometers (Pt100, Pt1000, Ni1000) are used, a constant current must flow to build the necessary voltage drop for the evaluation. For this, the module CI581-CN provides a constant current source which is multiplexed over the max. 4 analog input channels.

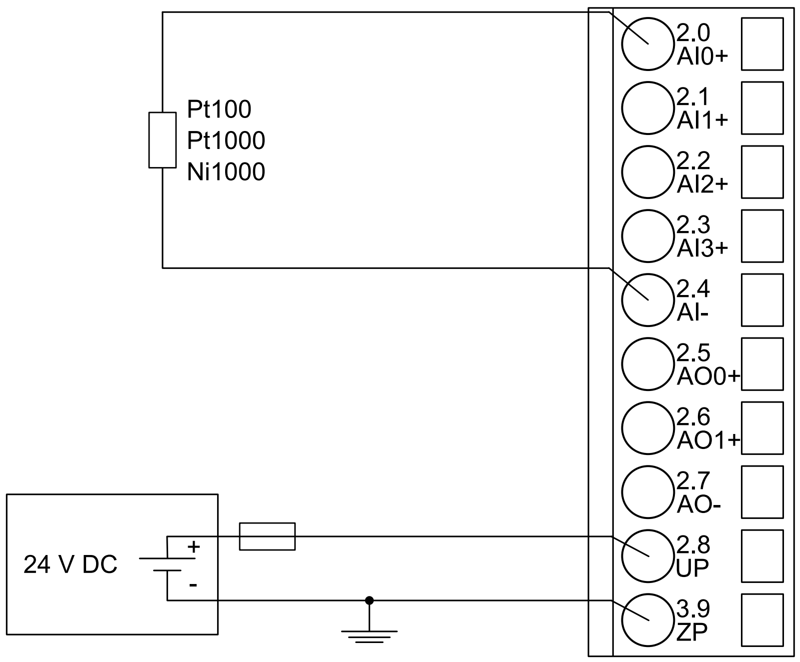


Fig. 230: Connection of resistance thermometers in 2-wire configuration to the analog inputs

Pt100	2-wire configuration, 1 channel used
Pt1000	2-wire configuration, 1 channel used
Ni1000	2-wire configuration, 1 channel used

For the measuring ranges that can be configured, please refer to sections Measuring Ranges *Chapter 1.8.2.2.11 “Measuring ranges” on page 952* and Parameterization *Chapter 1.8.2.2.8 “Parameterization” on page 942*.

The module CI581-CN performs a linearization of the resistance characteristic.

To avoid error messages, configure unused analog input channels as "unused".

Connection of resistance thermometers in 3-wire configuration to the analog inputs

When resistance thermometers (Pt100, Pt1000, Ni1000) are used, a constant current must flow through them to build the necessary voltage drop for the evaluation. For this, the module CI581-CN provides a constant current source which is multiplexed over the max. 4 analog input channels.

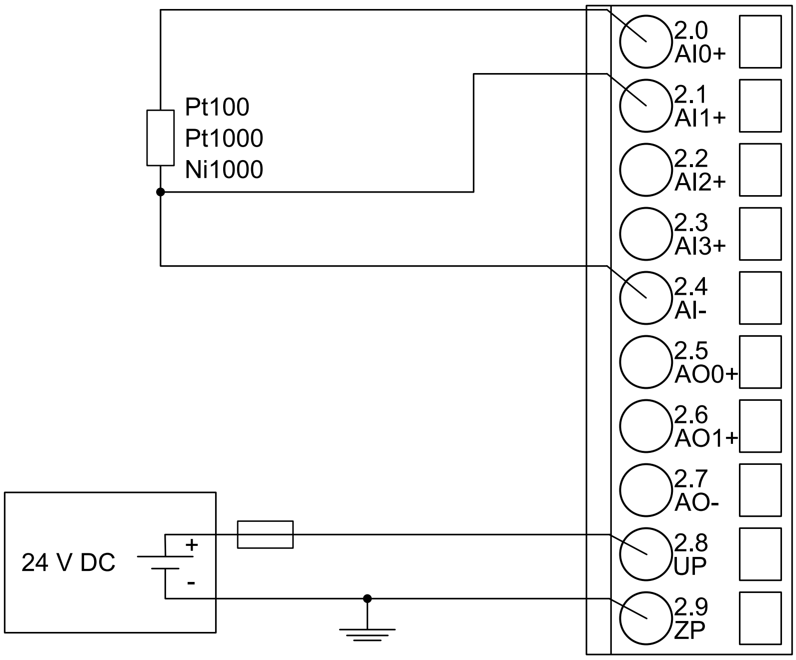


Fig. 231: Connection of resistance thermometers in 3-wire configuration to the analog inputs

With 3-wire configuration, 2 adjacent analog channels belong together (e. g. the channels 0 and 1). In this case, both channels are configured according to the desired operating mode. The lower address must be the even address (channel 0), the next higher address must be the odd address (channel 1).

The constant current of one channel flows through the resistance thermometer. The constant current of the other channel flows through one of the cores. The module calculates the measured value from the two voltage drops and stores it under the input with the higher channel number (e. g. I1).

In order to keep measuring errors as small as possible, it is necessary to have all the involved conductors in the same cable. All the conductors must have the same cross section.

Pt100	3-wire configuration, 2 channels used
Pt1000	3-wire configuration, 2 channels used
Ni1000	3-wire configuration, 2 channels used

For the measuring ranges that can be configured, please refer to the sections Measuring Ranges *Chapter 1.8.2.2.11 “Measuring ranges” on page 952* and Parameterization *Chapter 1.8.2.2.8 “Parameterization” on page 942*.

The module CI581-CN performs a linearization of the resistance characteristic.

To avoid error messages, configure unused analog input channels as "unused".

Connection of active-type analog sensors (Voltage) with galvanically isolated power supply to the analog inputs

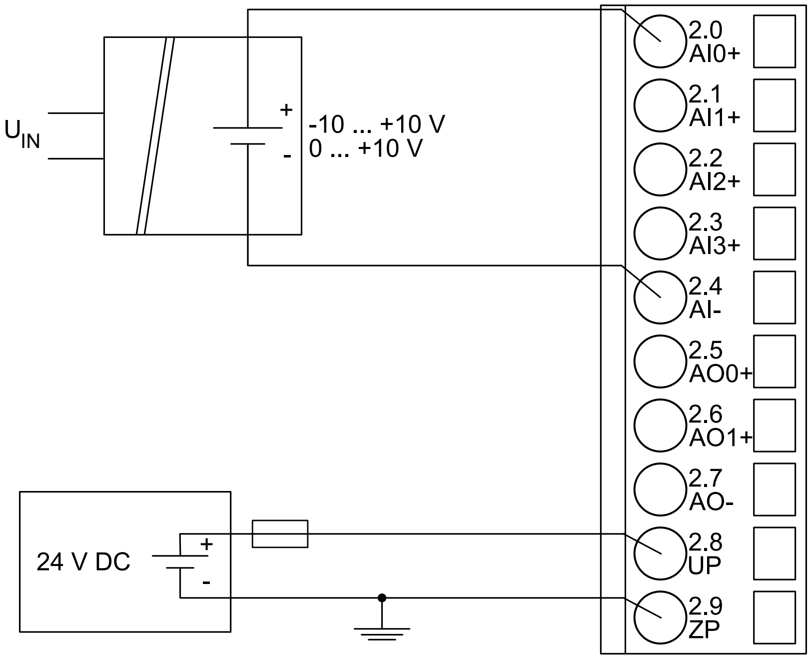


Fig. 232: Connection of active-type analog sensors (voltage) with galvanically isolated power supply to the analog inputs

Voltage	0 ... 10 V	1 channel used
Voltage	-10 V ... +10 V	1 channel used

For the measuring ranges that can be configured, please refer to the sections Measuring Ranges *Chapter 1.8.2.2.11 “Measuring ranges” on page 952* and Parameterization *Chapter 1.8.2.2.8 “Parameterization” on page 942*.

To avoid error messages, configure unused analog input channels as "unused".

Connection of active-type analog sensors (Current) with galvanically isolated power supply to the analog inputs

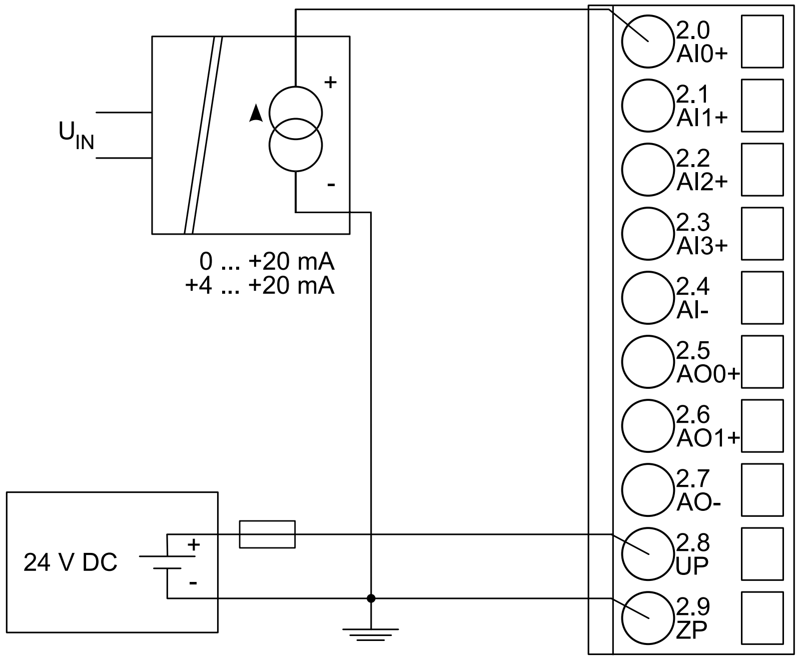


Fig. 233: Connection of active-type analog sensors (current) with galvanically isolated power supply to the analog input AI0 (Proceed with the analog inputs AI1 ... AI3 in the same way)

Current	0 ... 20 mA	1 channel used
Current	4 ... 20 mA	1 channel used

For the measuring ranges that can be configured, please refer to the sections Measuring Ranges ➪ *Chapter 1.8.2.2.11 “Measuring ranges” on page 952* and Parameterization ➪ *Chapter 1.8.2.2.8 “Parameterization” on page 942*.

Unused input channels can be left open-circuited, because they are of low resistance.

Connection of active-type analog sensors (Voltage) with no galvanically isolated power supply to the analog inputs

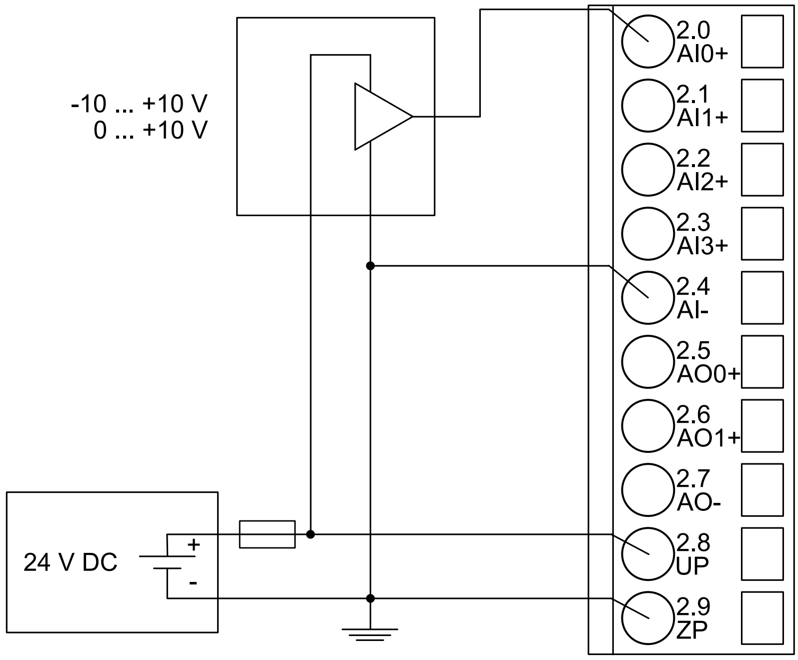


Fig. 234: Connection of active-type sensors (voltage) with no galvanically isolated power supply to the analog inputs (AO ... AI3)

NOTICE!

Risk of faulty measurements!

The negative pole/ground potential at the sensors must not have too large a potential difference with respect to ZP (max. ± 1 V within the full signal range).

Make sure that the potential difference never exceeds ± 1 V.

Voltage	0 ... 10 V	1 channel used
Voltage	-10 V ... +10 V	1 channel used

For the measuring ranges that can be configured, plese refer to the sections Measuring Ranges *Chapter 1.8.2.2.11 “Measuring ranges” on page 952* and Parameterization *Chapter 1.8.2.2.8 “Parameterization” on page 942*.

To avoid error messages, configure unused analog input channels as "unused".

Connection of passive-type analog sensors (Current) to the analog inputs

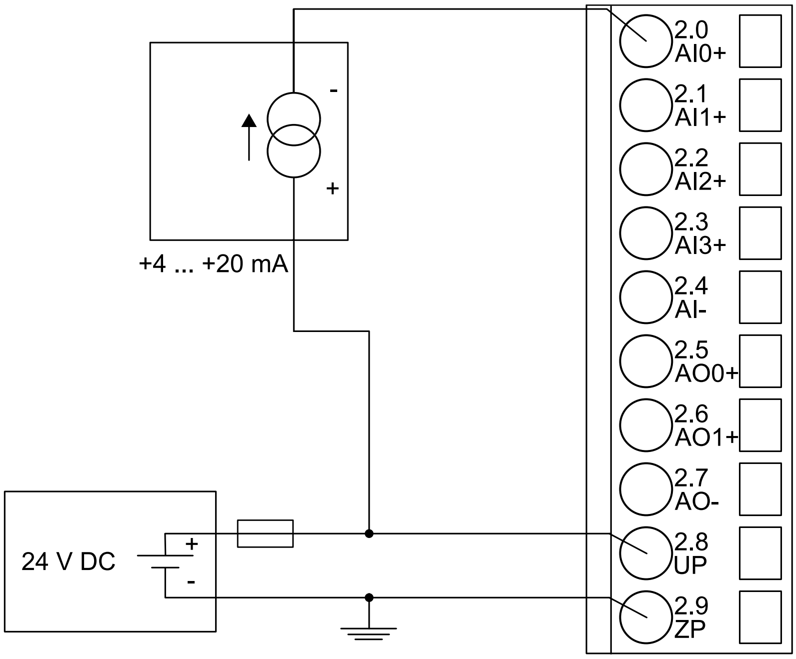


Fig. 235: Connection of passive-type analog sensors (current) to the analog inputs (A0 ... A3)

Current	4 ... 20 mA	1 channel used

CAUTION!
Risk of overloading the analog input!
If an analog current sensor supplies more than 25 mA for more than 1 second during initialization, this input is switched off by the module (input protection).

Only use sensors with fast initialization or without current peaks higher than 25 mA. If not possible, connect a 10-volt Zener diode in parallel to I+ and I-.

Unused input channels can be left open-circuited, because they are of low resistance.

Connection of active-type analog sensors (Voltage) to differential analog inputs

Differential inputs are very useful if analog sensors which are remotely non-isolated (e.g. the negative terminal is remotely grounded) are used.

Using differential inputs helps to considerably increase the measuring accuracy and to avoid ground loops.

With differential input configurations, two adjacent analog channels belong together (e.g. the channels 0 and 1). In this case, both channels are configured according to the desired operating mode. The lower address must be the even address (channel 0), the next higher address must be the odd address (channel 1). The converted analog value is available at the higher address (channel 1).

The analog value is calculated by subtraction of the input value with the higher address from the input value of the lower address.

The converted analog value is available at the odd channel (higher address).

NOTICE!

Risk of faulty measurements!

The negative pole/ground potential at the sensors must not have too large a potential difference with respect to ZP (max. ± 1 V within the full signal range).

Make sure that the potential difference never exceeds ± 1 V.

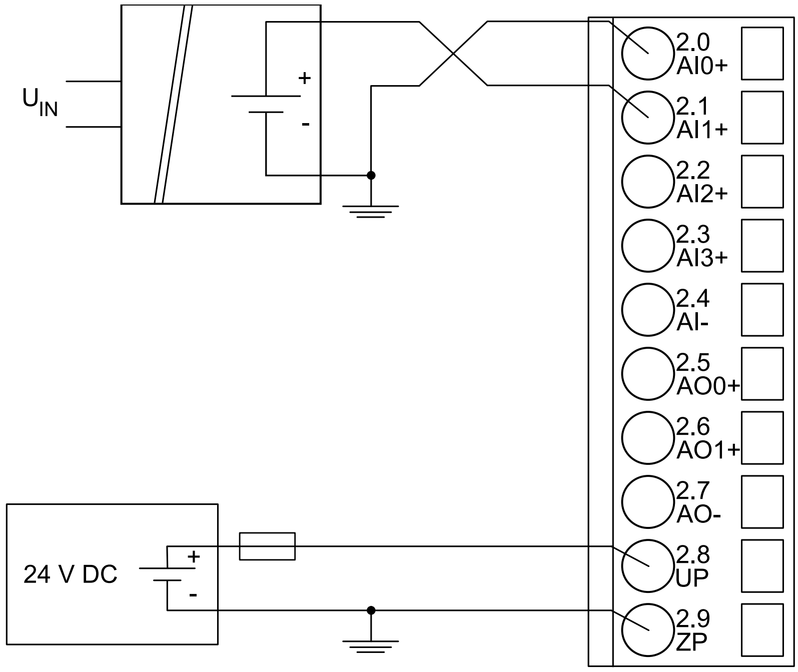


Fig. 236: Connection of active-type analog sensors (voltage) to differential analog inputs (AI0 ... AI3)

Voltage	0 ... 10 V	with differential inputs, 2 channels used
Voltage	-10 V ... +10 V	with differential inputs, 2 channels used

For the measuring ranges that can be configured, please refer to the sections Measuring Ranges *Chapter 1.8.2.2.11 “Measuring ranges” on page 952* and Parameterization *Chapter 1.8.2.2.8 “Parameterization” on page 942*.

To avoid error messages, configure unused analog input channels as "unused".

Use of analog inputs as digital inputs

Several (or all) analog inputs can be configured as digital inputs. The inputs are not galvanically isolated against the other analog channels.

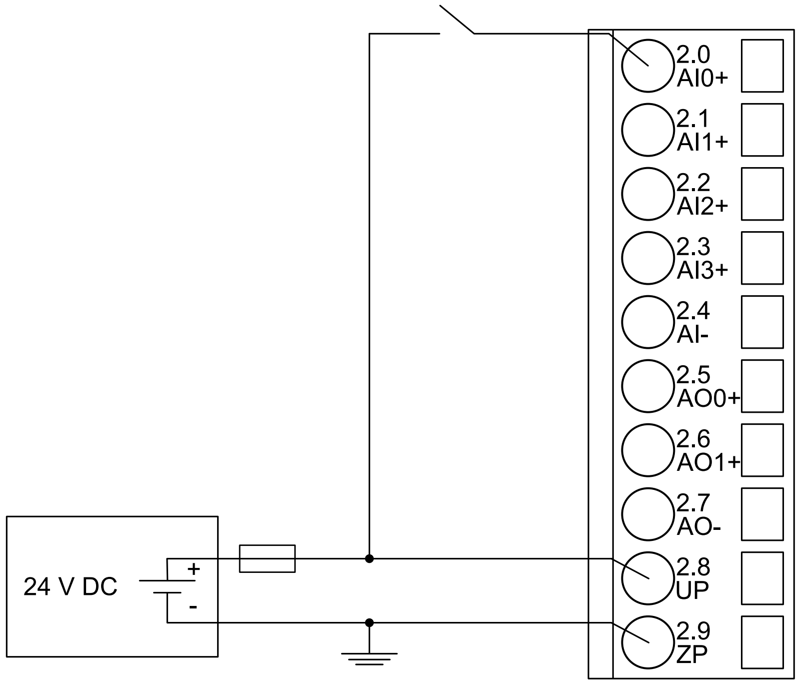


Fig. 237: Connection of digital sensors to the analog input (AI0 ... AI3)

Digital input	24 V	1 channel used

For the measuring ranges that can be configured, please refer to the sections Measuring Ranges *Chapter 1.8.2.2.11 “Measuring ranges” on page 952* and Parameterization *Chapter 1.8.2.2.8 “Parameterization” on page 942*.

Connection of analog output loads (Voltage)

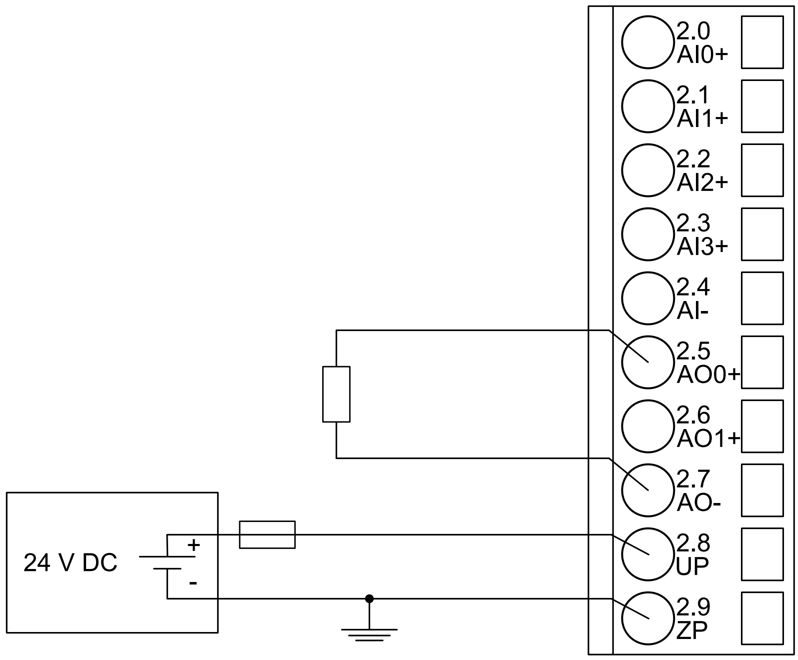


Fig. 238: Connection of analog output loads (voltage) to the analog outputs (AO0 ... AO1)

Voltage	-10 V ... +10 V	Load ± 10 mA max.	1 channel used

For the measuring ranges that can be configured, please refer to the sections Measuring Ranges ⇨ *Chapter 1.8.2.2.11 “Measuring ranges” on page 952* and Parameterization ⇨ *Chapter 1.8.2.2.8 “Parameterization” on page 942*.

Unused analog outputs can be left open-circuited.

Connection of analog output loads (Current)

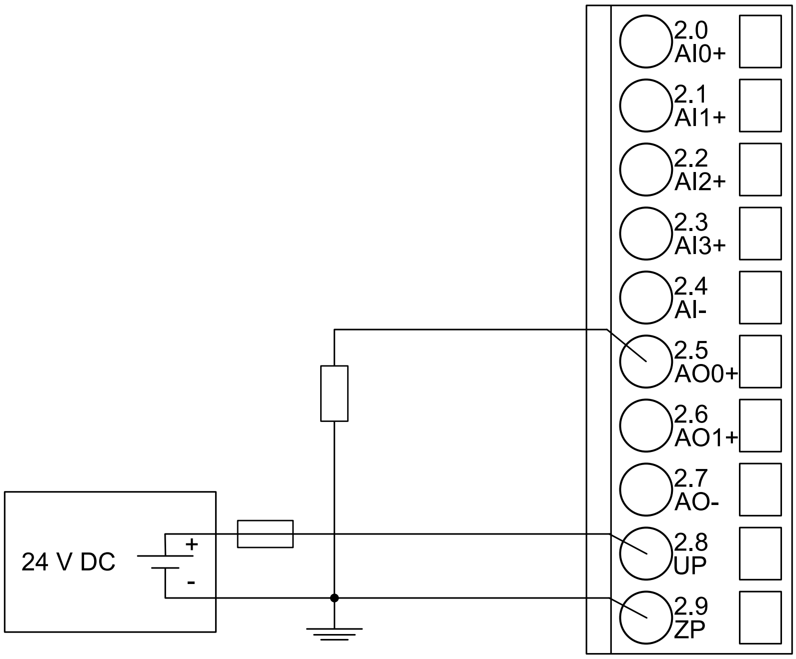


Fig. 239: Connection of analog output loads (current) to the analog outputs (AO0 ... AO1)

Current	0 ... 20 mA	Load 0 ... 500 Ω	1 channel used
Current	4 ... 20 mA	Load 0 ... 500 Ω	1 channel used

For the measuring ranges that can be configured, please refer to the sections Measuring Ranges ⇨ *Chapter 1.8.2.2.11 “Measuring ranges” on page 952* and Parameterization ⇨ *Chapter 1.8.2.2.8 “Parameterization” on page 942*.

Unused analog outputs can be left open-circuited.

1.8.2.2.5 Internal data exchange

Parameter	Value
Digital inputs (bytes)	3
Digital outputs (bytes)	3
Analog inputs (words)	4
Analog outputs (words)	2
Counter input data (words)	4
Counter output data (words)	8

1.8.2.2.6 Addressing

A detailed description concerning addressing can be found in the documentation of ABB Control Builder Plus Software.

> *The CANopen communication interface module reads the position of the rotary switches only during power-up, i. e. changes of the switch position during operation will have no effect until the next module initialization.*
>
> *The range of permitted CANopen slave addresses is 1 to 127. Setting a higher address (> 128) does not lead to an error response, but results in a special mode (DS401). In this special mode, the device creates the node address by subtracting the value 128 from the address switch's value.*

1.8.2.2.7 I/O configuration

The CI582-CN CANopen bus configuration is handled by CANopen master with the exception of the slave node ID (via rotary switches) and the transmision rate (automatic detection).

The digital I/O channels and the fast counter are configured via software.

1.8.2.2.8 Parameterization

Parameters of the module

Name	Value	Internal value	Internal value, type	Default
Module ID [1])	Internal	0x1C84	WORD	0x1C84
Parameter length	Internal	54	BYTE	54
Error LED / Failsafe function (table error LED / Failsafe function ➭ *Further information on page 942*)	On	0	BYTE	0
	Off by E4	1		
	Off by E3	2		
	On + failsafe	16		
	Off by E4 + failsafe	17		
	Off by E3 + failsafe	18		
Reserved	0	0	ARRAY of 24 BYTES	
Check supply (UP and UP3)	On	0	BYTE	
	Off	1		1
Fast counter	0	0	BYTE	0
	:	:		
	10 [2])	10		

[1]) With a faulty ID, the module reports a "parameter error" and does not perform cyclic process data transmission

[2]) For a description of the counter operating modes, please refer to the fast counter section ➭ *Chapter 1.6.1.2.10 “Fast counter” on page 545*.

Table 250: Settings "Error LED / Failsafe function"

Setting	Description
On	Error LED (S-ERR) lights up at errors of all error classes, failsafe mode off
Off by E4	Error LED (S-ERR) lights up at errors of error classes E1, E2 and E3, failsafe mode off
Off by E3	Error LED (S-ERR) lights up at errors of error classes E1 and E2, failsafe mode off
On +Failsafe	Error LED (S-ERR) lights up at errors of all error classes, failsafe mode on *)
Off by E4 + Failsafe	Error LED (S-ERR) lights up at errors of error classes E1, E2 and E3, failsafe mode on *)
Off by E3 + Failsafe	Error LED (S-ERR) lights up at errors of error classes E1 and E2, failsafe mode on *)
*) The parameters Behaviour analog outputs at communication error and Behaviour digital outputs at communication error are only evaluated if the failsafe function is enabled.	

Group parameters for the analog part

Name	Value	Internal value	Internal value, type	Default
Analog data format	Standard Reserved	0 255	BYTE	0
Behavior analog outputs at communication error *)	Off Last value Last value 5 s Last value 10 s Substitute value Substitute value 5 s Substitute value 10 s	0 1 6 11 2 7 12	BYTE	0
*) The parameter Behavior analog outputs at communication error is only analyzed if the failsafe mode is ON.				

Channel parameters for the analog inputs (4x)

Name	Value	Internal value	Internal value, type	Default
Input 0, Channel configuration	Operation modes of analog inputs	Operation modes of analog inputs	BYTE	0
Input 0, Check channel	Settings channel monitoring	Settings channel monitoring	BYTE	0
:	:	:	:	:
:	:	:	:	:

Name	Value	Internal value	Internal value, type	Default
Input 3, Channel configuration	Operation modes of analog inputs	Operation modes of analog inputs	BYTE	0
Input 3, Check channel	Settings channel monitoring	Settings channel monitoring	BYTE	0

Table 251: Channel configuration - Operating modes of the analog inputs

Internal Value	Operating Modes (individually configu-rable)
0 (default)	Not used
1	0 ... 10 V
2	Digital input
3	0 ... 20 mA
4	4 ... 20 mA
5	-10 V ... +10 V
8	2-wire Pt100 -50 °C ... +400 °C
9	3-wire Pt100 -50 ... +400 °C *)
10	0 ... 10 V (voltage diff.) *)
11	-10 V ... +10 V (voltage diff.) *)
14	2-wire Pt100 -50 °C ... +70 °C
15	3-wire Pt100 -50 °C ... +70 °C *)
16	2-wire Pt1000 -50 °C ... +400 °C
17	3-wire Pt1000 -50 °C ... +400 °C *)
18	2-wire Ni1000 -50 °C ...+150 °C
19	3-wire Ni1000 -50 °C ... +150 °C *)
*) In the operating modes with 3-wire configuration or with differential inputs, two adjacent analog inputs belong together (e.g. the channels 0 and 1). In these cases, both channels are configured in the desired operating mode. The lower address must be the even address (channel 0). The next higher address must be the odd address (channel 1). The converted analog value is available at the higher address (channel 1).	

Table 252: Channel monitoring

Internal Value	Check Channel
0 (default)	Plausibility, wire break, short circuit
3	Not used

Channel parameters for the analog outputs (2x)

Name	Value	Internal value	Internal value, type	Default
Output 0, Channel configu-ration	Operation modes of analog outputs	Operation modes of analog outputs	BYTE	0
Output 0, Check channel	Channel moni-toring	Channel moni-toring	BYTE	0
Output 0, Substi-tute value	Substitute value	Substitute value	WORD	0
Output 1, Channel configu-ration	Operation modes of analog outputs	Operation modes of analog outputs	BYTE	0
Output 1, Check channel	Channel moni-toring	Channel moni-toring	BYTE	0
Output 1, Substi-tute value	Substitute value	Substitute value	WORD	0

Table 253: Channel configuration - Operating modes of the analog outputs

Internal value	Operating Modes (individually configu-rable)
0 (default)	Not used
128	-10 V ... +10 V
129	0 mA ... 20 mA
130	4 mA ... 20 mA

Table 254: Channel monitoring

Internal value	Check channel
0	Plausibility, wire break, short circuit
3	None

Table 255: Substitute value

Intended Behavior of Output Channel when the Control System Stops	Required Setting of the Module Parameter "Behavior of Outputs in Case of a Communication Error"	Required Setting of the Channel Parameter "Substi-tute value"
Output OFF	Off	0
Last value infinite	Last value	0
Last value for 5 s and then turn off	Last value 5 sec	0
Last value for 10 s and then turn off	Last value 10 sec	0
Substitute value infinite	Substitute value	Depending on configuration

Intended Behavior of Output Channel when the Control System Stops	Required Setting of the Module Parameter "Behavior of Outputs in Case of a Communication Error"	Required Setting of the Channel Parameter "Substitute value"
Substitute value for 5 s and then turn off	Substitute value 5 sec	Depending on configuration
Substitute value for 10 s and then turn off	Substitute value 10 sec	Depending on configuration

Group parameters for the digital part

Name	Value	Internal value	Internal value, type	Default
Input delay	0.1 ms 1 ms 8 ms 32 ms	0 1 2 3	BYTE	0.1 ms 0x00
Detect short circuit at outputs	Off On	0 1	BYTE	On 0x01
Behavior digital outputs at communcation error [1])	Off Last value Last value 5 sec Last value 10 sec Substitute value Substitute value 5 sec Substitute value 10 sec	0 1 6 11 2 7 12	BYTE	Off 0x00
Substitute value at output	0 ... 255	00h ... FFh	BYTE	0 0x00
Detect voltage overflow at outputs [2])	Off On	0 1	BYTE	Off 0x00

[1]) The parameter Behavior digital outputs at communcation error is only analyzed if the failsafe mode is ON.

[2]) The state "externally voltage detected" appears if the output of a channel DC0 ... DC7 is to be switched on while an external voltage is connected *Chapter 1.8.2.2.4 “Connections” on page 925*. In this case, the start-up is disabled as long as the external voltage is connected. The monitoring of this state and the resulting diagnosis message can be disabled by setting the parameters to "OFF".

1.8.2.2.9 Diagnosis

Structure of the Diagnosis Block via CANOM_NODE_DIAG.

Byte Number	Description	Possible Values
1	Diagnosis byte, slot number	31 = CI581-CN (e. g. error at integrated 8 DI / 8 DO) 1 = 1st connected S500 I/O module ... 10 = 10th connected S500 I/O module
2	Diagnosis byte, module number	According to the I/O bus specification passed on by modules to the fieldbus master
3	Diagnosis byte, channel	According to the I/O bus specification passed on by modules to the fieldbus master
4	Diagnosis byte, error code	According to the I/O bus specification Bit 7 and bit 6, coded error class 0 = E1 1 = E2 2 = E3 3 = E4 Bit 0 to bit 5, coded error description
5	Diagnosis byte, flags	According to the I/O bus specification Bit 7: 1 = coming error Bit 6: 1 = leaving error

In cases of short circuit or overload, the digital outputs are turned off. The module performs reactivation automatically. Thus, an acknowledgement of the errors is not necessary. The error message is stored via the LED.

E1..E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier** **000 .. 063**	**AC500-Display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 4 **Bit 6 ... 7**	**-**	**Byte 1**	**Byte 2**	**Byte 3**	**Byte 4** **Bit 0 ... 5**	**CANopen diag-nosis block**	
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error-** **Identi-fier**	**Error message**	**Remedy**
	1)	2)	3)	4)			
Module errors							
3	-	31	31	31	19	Checksum error in the I/O module	Replace I/O module
3	-	31	31	31	3	Timeout in the I/O module	
3	-	31	31	31	40	Different hard-/firm-ware versions in the module	

E1..E4	d1	d2	d3	d4	Identi-fier 000 .. 063	AC500-Display	<− Display in
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 4 **Bit 6 ... 7**	**-**	**Byte 1**	**Byte 2**	**Byte 3**	**Byte 4** **Bit 0 ... 5**	**CANopen diag-nosis block**	
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error-Identi-fier**	**Error message**	**Remedy**
	1)	2)	3)	4)			
3	-	31	31	31	43	Internal error in the module	
3	-	31	31	31	36	Internal data exchange failure	
3	-	31	31	31	9	Overflow diagnosis buffer	Restart
3	-	31	31	31	26	Parameter error	Check Master
3	-	31	31	31	11	Process voltage UP too low	Check process supply voltage
3	-	31	31	31	45	Process voltage UP gone	Check process supply voltage
3	-	31/1...10	31	31	17	No communication with I/O module	Replace I/O module
3	-	1...10	31	31	32	Wrong I/O module type on socket	Replace I/O module / check configu-ration
4	-	1...10	31	31	31	At least one module does not support failsafe function	Check modules and parame-terization
4	-	31	31	31	46	Voltage feedback on activated digital outputs 4)	Check terminals
4	-	31/1...10	31	31	34	No response during initialization of the I/O module	Replace I/O module
4	-	31	31	31	11	Process voltage UP3 too low	Check process supply voltage

E1..E4	**d1**	**d2**	**d3**	**d4**	**Identi- fier 000 .. 063**	**AC500- Display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 4 Bit 6 ... 7	**-**	**Byte 1**	**Byte 2**	**Byte 3**	**Byte 4 Bit 0 ... 5**	**CANope n diag- nosis block**	
Class	**Inter- face**	**Device**	**Module**	**Channel**	**Error- Identi- fier**	**Error message**	**Remedy**
	1)	2)	3)	4)			
4	-	31	31	31	45	Process voltage UP3 gone	Check process supply voltage
4	-	31	31	31	10	Voltage overflow on outputs (above UP3 level) 5)	Check termi- nals/ check process supply voltage
Channel error digital							
4	-	31	2	0...7	46	Voltage feedback on deactivated dig- ital output 6)	Check terminals
4	-	31	2	0...7	47	Short circuit at dig- ital output 7)	Check terminals
Channel error analog							
4	-	31	1	0..3	48	Analog value over- flow or broken wire at an analog input	Check value or check terminals
4	-	31	1	0..3	7	Analog value underflow at an analog input	Check value
4	-	31	1	0..3	47	Short circuit at an analog input	Check terminals
4	-	31	3	0..1	4	Analog value over- flow at an analog output	Check output value
4	-	31	3	0..1	7	Analog value underflow at an analog output	Check output value

Remarks:

[1])	In AC500, the following interface identifier applies: "-" = Diagnosis via bus-specific function blocks; 0 ... 4 or 10 = position of the communication module;14 = I/O bus; 31 = module itself The identifier is not contained in the CI541-DP diagnosis block.
[2])	With "Device" the following allocation applies: 31 = module itself; 1 ... 10 = decentralized communication interface module
[3])	With "Module" the following allocation applies: 31 = module itself Channel error: module type (1 = AI, 2 = DO, 3 = AO)
[4])	This message appears if external voltages at one or more terminals DO0 ... DO7 cause other digital outputs to be fed by that voltage ↳ *Chapter 1.8.2.2.4 “Connections” on page 925*. All outputs of the digital output groups will be turned off for 5 seconds. The diagnosis message appears for the whole output group.
[5])	The voltage on digital outputs DO0 ... DO7 has overrun the process supply voltage UP3 ↳ *Chapter 1.8.2.2.4 “Connections” on page 925*. Diagnosis message appears for the whole module.
[6])	This message appears if the output of a channel DO0 ... DO7 is to be switched on while an external voltage is connected. In this case, start-up is disabled while the external voltage is connected. Otherwise, this could produce reverse voltage flowing from this output to other digital outputs. This diagnosis message appears for each channel.
[7])	Short circuit: After a short circuit has been detected, the output is deactivated for 100ms seconds. Subsequently, a new start-up will be executed. This diagnosis message appears for each channel.

1.8.2.2.10 State LEDs

The state LEDs are located at the front of module. There are 2 different groups:

- The 5 system LEDs (PWR, CN-RUN, CN-ERR, S-ERR and I/O bus) show the operation states of the module and display possible errors.
- The 27 process LEDs (UP, UP3, inputs, outputs, CH-ERR1 to CH-ERR3) show the process supply voltage and the states of the inputs and outputs and display possible errors.

States of the 5 system LEDs

LED	Color	OFF	ON	Flashing
PWR/RUN	Green	Process supply voltage missing	Internal supply voltage OK, module ready for communication with I/O controller	Start-up / preparing communication
	Yellow	---	---	---
CN-RUN	Green	---	Device configured, CANopen bus in OPERATIONAL state and cyclic data exchange running	Flashing: CANopen bus in PRE-OPERATIONAL state and slave is being configured Single flash: CANopen bus in STOPPED state. Flickering: Autodetect is active

LED	Color	OFF	ON	Flashing
CN-ERR	Red	No system error	CANopen Bus is OFF	Flashing: Configuration error Single flash: error counter overflow due to too many error frames Double flash: A node-guard or a heartbeat event occurred Flickering: Autodetect is active
S-ERR	Red	No error	Internal error	--
I/O bus	Green	No decentralized I/O modules connected or communication error	Decentralized I/O modules connected and operational	---

States of the 27 process LEDs:

LED	Color	OFF	ON	Flashing
AI0 ... AI3	Yellow	Input is OFF	Input is ON (brightness depends on the value of the analog signal)	--
AO0 ... AO1	Yellow	Output is OFF	Output is ON (brightness depends on the value of the analog signal)	--
DI0 ... DI7	Yellow	Input is OFF	Input is ON (the input voltage is even displayed if the supply voltage is OFF)	--
DO0 ... DO7	Yellow	Output is OFF	Output is ON	--
UP	Green	Process supply voltage missing	Process supply voltage OK and initialization finished	--
UP3	Green	Process supply voltage missing	Process supply voltage OK	--
CH-ERR1 to CH-ERR3	Red	No error or process supply voltage missing	Internal error	Error on one channel of the corresponding group

1.8.2.2.11 Measuring ranges

Input ranges voltage, current and digital input

Range	0 V ... +10 V	-10 V ... +10 V	0 mA ... 20 mA	4 mA ... 20 mA	Digital input	Digital value	
						Decimal	**Hex.**
Overflow	> 11.7589	> 11.7589	> 23.5178	> 22.8142		32767	7FFF
Measured value too high	11.7589 : 10.0004	11.7589 : 10.0004	23.5178 : 20.0007	22.8142 : 20.0006		32511 : 27649	7EFF : 6C01
Normal range Normal range or measured value too low	10.0000 : 0.0004	10.0000 : 0.0004	20.0000 : 0.0007	20.0000 : 4.0006	: : On	27648 : 1	6C00 : 0001
	0.0000	0.0000	0	4	Off	0	0000
	-0.0004 -1.7593	-0.0004 : : -10,0000		3.9994 1.1858		-1 -4864 : -27648	FFFF ED00 : 9400
Measured value too low		-10.0004 : -11.7589				-27649 : -32512	93FF : 8100
Underflow	< 1.7593	< -11.7589	< 0.0000	< 1.1858		-32768	8000

The represented resolution corresponds to 16 bits.

Input ranges resistance temperature detector

Range	Pt100 / Pt1000 -50 °C ... +400 °C	Ni1000 -50 °C ... +150 °C	Digital value	
			Decimal	**Hex.**
Overflow	> +450.0 °C	> +160.0 °C	32767	7FFF
Measured value too high	+450.0 °C : + 400.1 °C		4500 : 4001	1194 : 0FA1
		+160.0 °C : +150.1 °C	1600 : 1501	0640 : 05DD
			800 : 701	0320 : 02BD

Range	Pt100 / Pt1000 -50 °C ... +400 °C	Ni1000 -50 °C ... +150 °C	Digital value	
			Decimal	**Hex.**
Normal range	+400.0 °C : : : + 0.1 °C	+150.0 °C : : +0.1 °C	4000 1500 700 : 1	0FA0 05DC 02BC : 0001
	0.0 °C	0.0 °C	0	0000
	-0.1 °C : -50.0 °C	-0.1 °C : -50,0 °C	-1 : -500	FFFF : FE0C
Measured value too low	-50.1 °C : -60.0 °C	-50.1 °C : -60.0 °C	-501 : -600	FE0B : FDA8
Underflow	< -60.0 °C	< -60.0 °C	-32768	8000

Output ranges voltage and current

Range	-10 V ...+10 V	0 mA ... 20 mA	4 mA ... 20 mA	Digital value	
				Decimal	**Hex.**
Overflow	0 V	0 mA	0 mA	> 32511	> 7EFF
Measured value too high	11.7589 V : 10.0004 V	23.5178 mA : 20.0007 mA	22.8142 mA : 20.0006 mA	32511 : 27649	7EFF : 6C01
Normal range	10.0000 V : 0.0004 V	20.0000 mA : 0,0007 mA	20.0000 mA : 4.0006 mA	27648 : 1	6C00 : 0001
	0.0000 V	0.0000 mA	4.0000 mA	0	0000
	-0.0004 V : -10.0000 V	0 mA : 0 mA	3.9994 mA 0 mA 0 mA	-1 -6912 -27648	FFFF E500 9400
Measured value too low	-10.0004 V : -11.7589 V	0 mA : 0 mA	0 mA : 0 mA	-27649 : -32512	93FF : 8100
Underflow	0 V	0 mA	0 mA	< -32512	< 8100

The represented resolution corresponds to 16 bits.

1.8.2.2.12 Technical data

Technical data of the module

The system data of AC500 and S500 are applicable to the standard version ↯ *Chapter 2.6.1 “System data AC500” on page 1408*.

The system data of AC500-XC are applicable to the XC version ↯ *Chapter 2.7.1 “System data AC500-XC” on page 1475*.

Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

> ***Multiple overloads***
> *No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an internal smart high-side switch.*

Parameter		Value
Interface		CAN
Protocol		CANopen
Power supply		From the process supply voltage UP
Supply of the electronic circuitry of the I/O modules attached		Through the I/O bus interface (I/O bus)
Rotary switches		For setting the CANopen Node ID for configuration purposes (00h to FFh)
LED displays		For system displays, signal states, errors and power supply
External supply voltage		Via terminals ZP, UP and UP3 (process supply voltage 24 V DC)
Transmission rates		10 / 20 / 50 / 125 / 250 / 500 / 800 kbit/s 1 Mbit/s Auto transmission rate detection is supported
Bus connection		Depending on used terminal unit TU510: 9-pin D-sub connector TU518: 10-pin terminal block
Processor		Hilscher NETX 100
Expandability		Max. 10 S500 I/O modules
State display		Module state: PWR/RUN, CN-RUN, CN-ERR, E-ERR, I/O bus
Adjusting elements		2 rotary switches for generation of the node address
Ambient temperature		System data AC500 ↯ *Chapter 2.6.1 “System data AC500” on page 1408* System data AC500 XC ↯ *Chapter 2.7.1 “System data AC500-XC” on page 1475*
Current consumption		UP: 0.2 A UP3: 0.06 A + 0.5 A max. per output
Weight (without terminal unit)		Ca. 125 g
Process supply voltages UP/UP3		
	Rated value	24 V DC (for inputs and outputs)
	Max. load for the terminals	10 A

Parameter		Value
	Protection against reversed voltage	Yes
	Rated protection fuse on UP/UP3	10 A fast
	Galvanic isolation	CANopen interface against the rest of the module
	Inrush current from UP (at power up)	On request
	Current consumption via UP (normal operation)	0.2 A
	Current consumption via UP3	0.06 A + 0.5 A max. per output
	Connections	Terminals 2.8 and 3.8 for +24 V (UP) Terminal 4.8 for +24 V (UP3) Terminals 2.9, 3.9 and 4.9 for 0 V (ZP)
Max. power dissipation within the module		6 W
Reference potential for all digital inputs and outputs		Negative pole of the supply voltage, signal name ZP
Setting of the CANopen Node ID identifier		With 2 rotary switches at the front side of the module
Mounting position		Horizontal Or vertical with derating (output load reduced to 50 % at +40 °C per group)
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.
Effect of incorrect input terminal connection		Wrong or no signal detected, no damage up to 35 V
Required terminal unit		TU509, TU510, TU517 or TU518 *Chapter 1.5.2 “TU509 and TU510 for communication interface modules” on page 278* *Chapter 1.5.4 “TU517 and TU518 for communication interface modules” on page 290*

All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and continuous overvoltage up to 30 V DC.

Technical data of the digital inputs

Parameter	Value
Number of channels per module	8
Distribution of the channels into groups	1 group of 8 channels
Terminals of the channels DI0 ... DI7	Terminals 3.0 ... 3.7
Reference potential for all inputs	Terminals 2.9 ... 4.9 (negative pole of the supply voltage, signal name ZP)
Indication of the input signals	1 yellow LED per channel, the LED is ON when the input signal is high (signal 1)

Parameter	Value
Input type (according EN 61131-2)	Type 1
Input delay (0->1 or 1->0)	Typ. 0.1 ms, configurable from 0.1 ms ... 32 ms
Input signal voltage	24 V DC
Signal 0	-3 V ... +5 V
Undefined signal	> +5 V ... < +15 V
Signal 1	+15 V ... +30 V
Ripple with signal 0	Within -3 V ... +5 V
Ripple with signal 1	Within +15 V ... +30 V
Input current per channel	
Input voltage +24 V	Typ. 5 mA
Input voltage +5 V	> 1 mA
Input voltage +15 V	> 2 mA
Input voltage +30 V	< 8 mA
Max. cable length	
Shielded	1000 m
Unshielded	600 m

Technical data of the digital outputs

Parameter	Value
Number of channels per module	8
Distribution of the channels into groups	1 group of 8 channels
Terminals of the channels DO0 to DO7	Terminals 4.0 to 4.7
Reference potential for all outputs	Terminals 2.9 ... 4.9 (negative pole of the supply voltage, signal name ZP)
Common power supply voltage	For all outputs terminal 4.8 (positive pole of the supply voltage, signal name UP3)
Output voltage for signal 1	UP3 (-0.8 V)
Output delay (0->1 or 1->0)	On request
Output current	
Rated value per channel	500 mA at UP3 = 24 V
Max. value (all channels together)	4 A
Leakage current with signal 0	< 0.5 mA
Fuse for UP3	10 A fast
Demagnetization with inductive DC load	Via internal varistors (see figure below this table)
Output switching frequency	
With resistive load	On request
With inductive loads	Max. 0.5 Hz
With lamp loads	11 Hz max. at 5 W max.

Parameter	Value
Short-circuit-proof / overload-proof	Yes
Overload message (I > 0.7 A)	Yes, after ca. 100 ms
Output current limitation	Yes, automatic reactivation after short circuit/overload
Resistance to feedback against 24 V signals	Yes (software-controlled supervision)
Max. cable length	
Shielded	1000 m
Unshielded	600 m

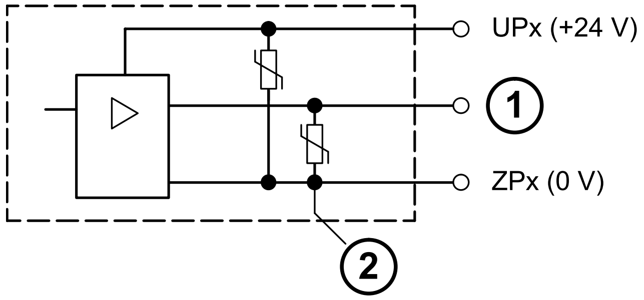


Fig. 240: Circuitry of a digital input/output with the varistors for demagnetization when inductive loads are switched off

1 Digital output
2 Varistors for demagnetization when inductive loads are turned off

Technical data of the analog inputs

Parameter		Value
Number of channels per module		4
Distribution of channels into groups		1 group with 4 channels
Connection if channels AI0+ to AI3+		Terminals 2.0 to2.3
Reference potential for AI0+ to AI3+		Terminal 2.4 (AI-) for voltage and RTD measurement Terminal 2.9, 3.9 and 4.9 for current measurement
Input type		
	Unipolar	Voltage 0...10 V, current or Pt100/Pt1000/ Ni1000
	Bipolar	Voltage -10...+10 V
Galvanic isolation		Against CANopen Bus
Configurability		0...10 V, -10...+10 V, 0/4...20 mA, Pt100/1000, Ni1000 (each input can be configured individually)
Channel input resistance		Voltage: > 100 kΩ Current: ca. 330 Ω
Time constant of the input filter		Voltage: 100 µs Current: 100 µs

Parameter	Value
Indication of the input signals	1 LED per channel (brightness depends on the value of the analog signal)
Conversion cycle	1 ms (for 4 inputs + 2 outputs); with RTDs Pt/ Ni... 1 s
Resolution	Range 0...10 V: 12 bits Range -10...+10 V: 12 bits including sign Range 0...20 mA: 12 bits Range 4...20 mA: 12 bits Range RTD (Pt100, PT1000, Ni1000): +0.1 °C
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range	Typ. 0.5 %, max. 1 %
Relationship between input signal and hex code	*Chapter 1.8.2.2.11.2 “Input ranges resistance temperature detector” on page 952*
Unused inputs	Are configured as "unused" (default value)
Overvoltage protection	Yes

Technical data of the analog inputs if used as digital inputs

Parameter		Value
Number of channels per module		Max. 4
Distribution of channels into groups		1 group of 4 channels
Connections of the channels AI0+ to AI3+		Terminals 2.0 to 2.3
Reference potential for the inputs		Terminals 2.9, 3.9 and 4.9 (ZP)
Indication of the input signals		1 LED per channel
Input signal voltage		24 VDC
	Signal 0	-30 V...+5 V
	Undefined signal	+5 V...+15 V
	Signal 1	+15 V...+30 V
Input current per channel		
	Input voltage +24 V	Typ. 7 mA
	Input voltage +5 V	Typ. 1.4 mA
	Input voltage +15 V	Typ. 3.7 mA
	Input voltage +30 V	< 9 mA
Input resistance		Ca. 3.5 kΩ

Technical data of the analog outputs

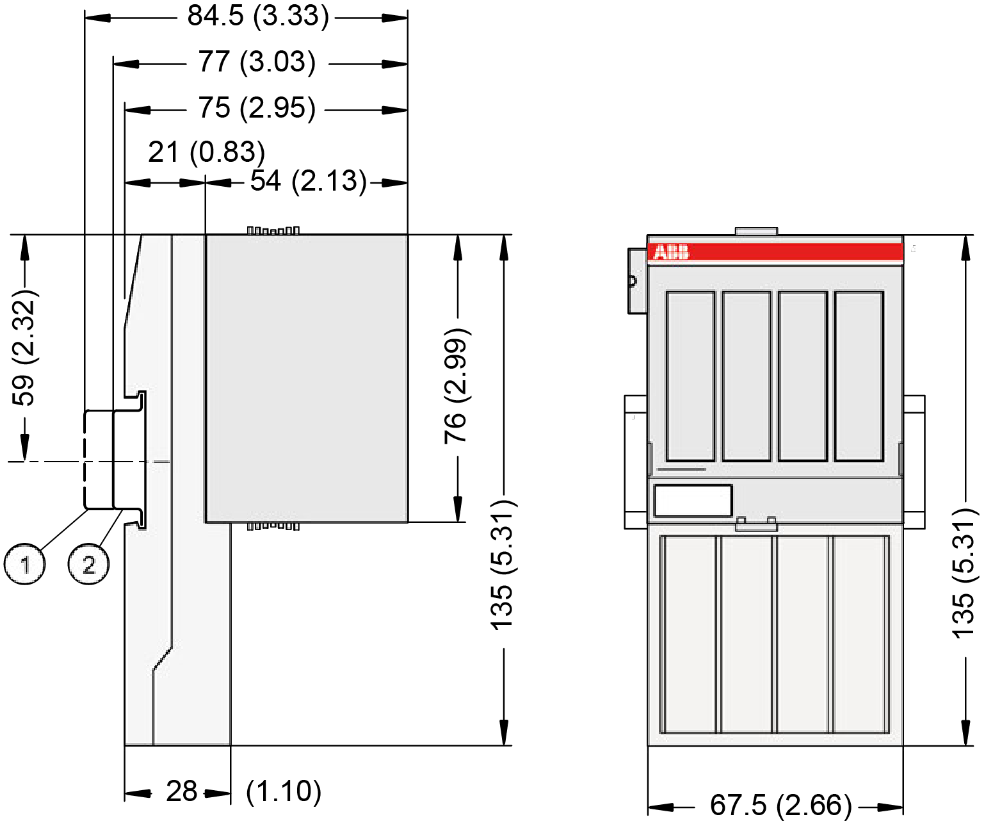
Parameter	Value
Number of channels per module	2
Distribution of channels into groups	1 group for 2 channels

Parameter		Value
Connection of the channels AO0+...AO1+		Terminals 1.5...1.6
Reference potential for AO0+ to AO1+		Terminal 2.7 (AO-) for voltage output Terminal 2.9, 3.9 and 4.9 for current output
Output type		
	Unipolar	Current
	Bipolar	Voltage
Galvanic isolation		Against internal supply and other modules
Configurability		-10...+10 V, 0...20 mA, 4...20 mA (each output can be configured individually)
Output resistance (load), as current output		0...500 Ω
Output loadability, as voltage output		±10 mA max.
Indication of the output signals		1 LED per channel (brightness depends on the value of the analog signal)
Resolution		12 bits including sign
Settling time for full range change (resistive load, output signal within specified tolerance)		Typ. 5 ms
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range		Typ. 0.5 %, max. 1 %
Relationship between input signal and hex code		*Chapter 1.8.2.2.11.3 “Output ranges voltage and current” on page 953*
Unused outputs		Are configured as "unused" (default value) and can be left open-circuited

Technical data of the fast counter

Parameter	Value
Used inputs	Terminal 3.0 (DI0), 3.1 (DI1)
Used outputs	Terminal 4.0 (DO0)
Counting frequency	Depending on operation mode: Mode 1 - 6: max. 200 kHz Mode 7: max. 50 kHz Mode 9: max. 35 kHz Mode 10: max. 20 kHz
Detailed description	Fast Counter *Chapter 1.6.1.2.10 “Fast counter” on page 545*
Operating modes	Operating modes *Chapter 1.6.1.2.10 “Fast counter” on page 545*

1.8.2.2.13 Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

1.8.2.2.14 Ordering data

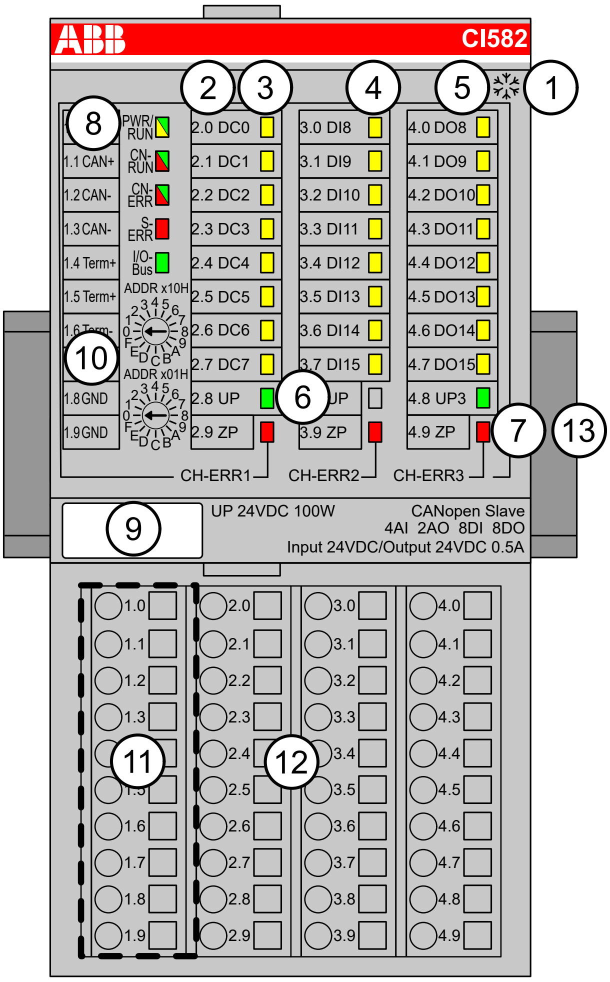
Part no.	Description	Product life cycle phase *)
1SAP 228 100 R0001	CI581-CN, CANopen communication interface module with 8 DI, 8 DO, 4 AI and 2 AO	Active
1SAP 428 100 R0001	CI581-CN-XC, CANopen communication interface module with 8 DI, 8 DO, 4 AI and 2 AO, XC version	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

1.8.2.3 CI582-CN

1.8.2.3.1 Features

- 8 digital inputs 24 V DC
- 8 digital outputs 24 V DC, 0.5 A max.
- 8 configurable digital inputs/outputs 24 V DC, 0.5 A max.
- Module-wise galvanically isolated
- Fast counter
- XC version for use in extreme ambient conditions available



1 I/O bus
2 Allocation between terminal number and signal name
3 8 yellow LEDs to display the signal states of the configurable digital inputs/outputs (DC0 ... DC7)
4 8 yellow LEDs to display the signal states of the digital inputs (DI8 ... DI15)
5 8 yellow LEDs to display the signal states of the digital outputs (DO8 ... DO15)
6 2 green LEDs to display the supply voltage UP and UP3
7 3 red LEDs to display errors (CH-ERR1, CH-ERR2, CH-ERR3)
8 5 System LEDs: PWR/RUN, CN-RUN, CN-ERR, S-ERR, I/O-Bus
9 Label
10 2 rotary switches for setting the CANopen node ID
11 10 terminals to connect the CANopen bus signals
12 Terminal unit
13 DIN rail
Sign for XC version

1.8.2.3.2 Intended purpose

The CANopen communication interface module CI582-CN is used as decentralized I/O module in CANopen networks. Depending on the terminal unit used, the network connection is performed either via a female 9-pin D-sub connector or via 10 terminals (screw or spring terminals) which are integrated in the terminal unit. The communication interface module contains 24 I/O channels with the following properties:

- 8 digital configurable inputs/outputs in 1 group (1.0 ... 1.7)
- 8 digital inputs 24 V DC in 1 group (2.0 ... 2.7)
- 8 digital outputs 24 V DC in 1 group (3.0 ... 3.7)

The inputs/outputs are galvanically isolated from the CANopen network. There is no potential separation between the channels. The configuration of the analog inputs/outputs is performed by software.

For use in extreme ambient conditions (e.g. wider temperature and humidity range), a special XC version of the device is available.

1.8.2.3.3 Functionality

Parameter		Value
Interface		CAN
Protocol		CANopen
Power supply		From the process supply voltage UP
Supply of the electronic circuitry of the I/O modules attached		Through the I/O bus interface (I/O bus)
Rotary switches		For setting the CANopen Node ID for configuration purposes (00h to FFh)
LED displays		For system displays, signal states, errors and power supply
External supply voltage		Via terminals ZP, UP and UP3 (process supply voltage 24 V DC)
Transmission rates		10 / 20 / 50 / 125 / 250 / 500 / 800 kbit/s 1 Mbit/s Auto transmission rate detection is supported
Bus connection		Depending on used terminal unit TU510: 9-pin D-sub connector TU518: 10-pin terminal block
Processor		Hilscher NETX 100
Expandability		Max. 10 S500 I/O modules
State display		Module state: PWR/RUN, CN-RUN, CN-ERR, E-ERR, I/O bus
Adjusting elements		2 rotary switches for generation of the node address
Ambient temperature		System data AC500 *Chapter 2.6.1 "System data AC500" on page 1408* System data AC500 XC *Chapter 2.7.1 "System data AC500-XC" on page 1475*
Current consumption		UP: 0.2 A UP3: 0.06 A + 0.5 A max. per output
Weight (without terminal unit)		Ca. 125 g
Process supply voltages UP/UP3		
	Rated value	24 V DC (for inputs and outputs)

Parameter		Value
	Max. load for the terminals	10 A
	Protection against reversed voltage	Yes
	Rated protection fuse on UP/UP3	10 A fast
	Galvanic isolation	CANopen interface against the rest of the module
	Inrush current from UP (at power up)	On request
	Current consumption via UP (normal operation)	0.2 A
	Current consumption via UP3	0.06 A + 0.5 A max. per output
	Connections	Terminals 2.8 and 3.8 for +24 V (UP) Terminal 4.8 for +24 V (UP3) Terminals 2.9, 3.9 and 4.9 for 0 V (ZP)
Max. power dissipation within the module		6 W
Reference potential for all digital inputs and outputs		Negative pole of the supply voltage, signal name ZP
Setting of the CANopen Node ID identifier		With 2 rotary switches at the front side of the module
Mounting position		Horizontal Or vertical with derating (output load reduced to 50 % at +40 °C per group)
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.
Effect of incorrect input terminal connection		Wrong or no signal detected, no damage up to 35 V
Required terminal unit		TU509, TU510, TU517 or TU518 *Chapter 1.5.2 “TU509 and TU510 for communication interface modules” on page 278* *Chapter 1.5.4 “TU517 and TU518 for communication interface modules” on page 290*

All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and continuous overvoltage up to 30 V DC.

CI582-CN: Input/Output characteristics

Parameter	Value
Inputs and outputs	8 digital inputs (24 V DC) 8 digital transistor outputs (24 V DC, 0.5 A max.) 8 configurable digital inputs/outputs (24 V DC, 0.5 A max.)

1.8.2.3.4 Connections

General

The CANopen communication interface module is plugged on the I/O terminal units TU517 ➥ *Chapter 1.5.4 “TU517 and TU518 for communication interface modules” on page 290* or TU518 ➥ *Chapter 1.5.4 “TU517 and TU518 for communication interface modules” on page 290* and accordingly TU509 ➥ *Chapter 1.5.2 “TU509 and TU510 for communication interface modules” on page 278* or TU510 ➥ *Chapter 1.5.2 “TU509 and TU510 for communication interface modules” on page 278*. Properly position the module and press until it locks in place.

The connection of the I/O channels is established using the 30 terminals of the I/O terminal unit. I/O modules can be replaced without re-wiring the terminal units.

The terminals 2.8, 3.8, 2.9, 3.9 and 4.9 are electrically interconnected within the terminal unit and always have the same assignment, irrespective of the inserted module:

Terminals 2.8 and 3.8: process supply voltage UP = +24 V DC

Terminal 4.8: process supply voltage UP3 = +24 V DC

Terminals 2.9, 3.9 and 4.9: process supply voltage ZP = 0 V

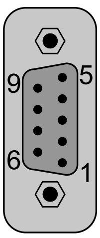
For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.

With a separate UP3 power supply, the digital outputs can be switched off externally. This way, an emergency-off functionality can be realized.

Possibilities of connection

Mounting on terminal units TU509 or TU510

The assignment of the 9-pin female D-sub for the CANopen signals



1	---	Reserved
2	CAN-	Inverted signal of the CAN bus
3	CAN_GND	Ground potential of the CAN bus
4	---	Reserved
5	---	Reserved
6	---	Reserved
7	CAN+	Non-inverted signal of the CAN bus
8	---	Reserved
9	---	Reserved
Shield	Cable shield	Functional earth

Bus terminating resistors

The ends of the data lines have to be terminated with a 120 Ω bus terminating resistor. The bus terminating resistor is usually installed directly at the bus connector.

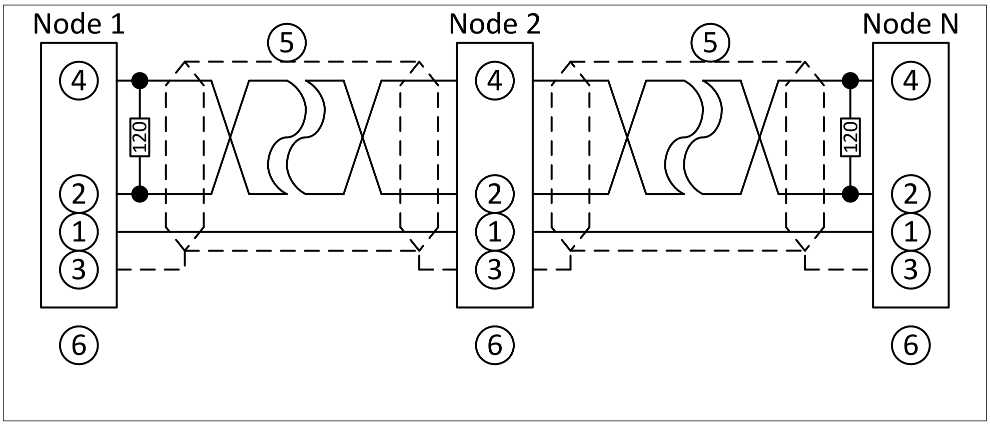


Fig. 241: CANopen interface, bus terminating resistors connected to the line ends

1	CAN_GND
2	CAN_L
3	Shield
4	CAN_H
5	Data line, shielded twisted pair
6	COMBICON connection, CANopen interface

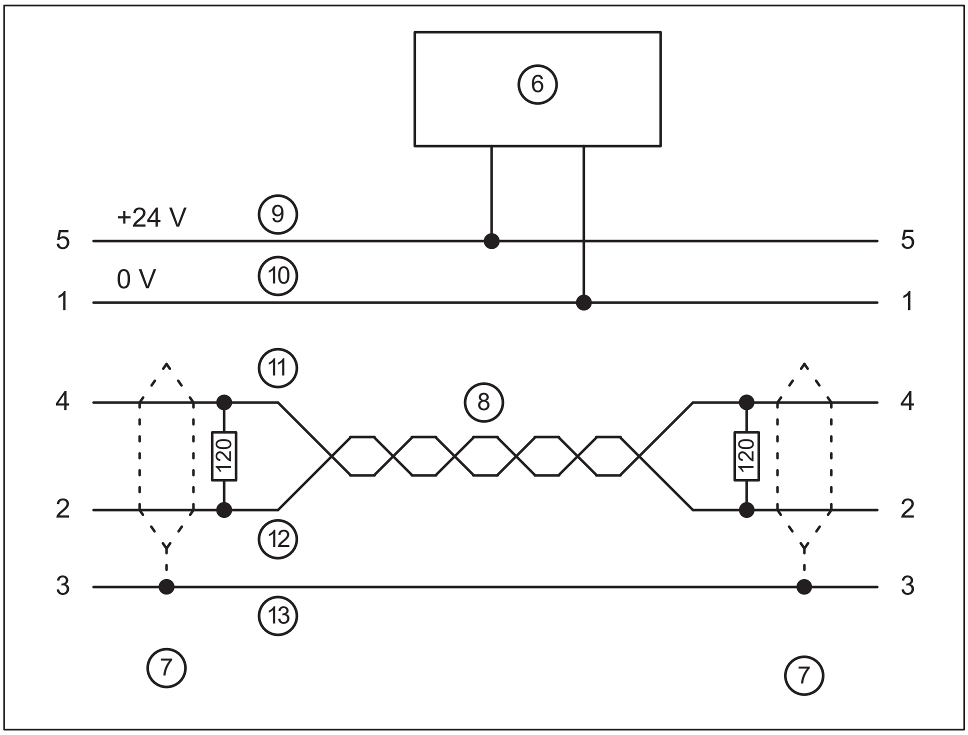


Fig. 242: DeviceNet interface, bus terminating resistors connected to the line ends

6	DeviceNet power supply
7	COMBICON connection, DeviceNet interface
8	Data lines, twisted pair cables
9	red

10	black
11	white
12	blue
13	bare

The grounding of the shield should take place at the switchgear *↯ Chapter 2.6.1 "System data AC500" on page 1408.*

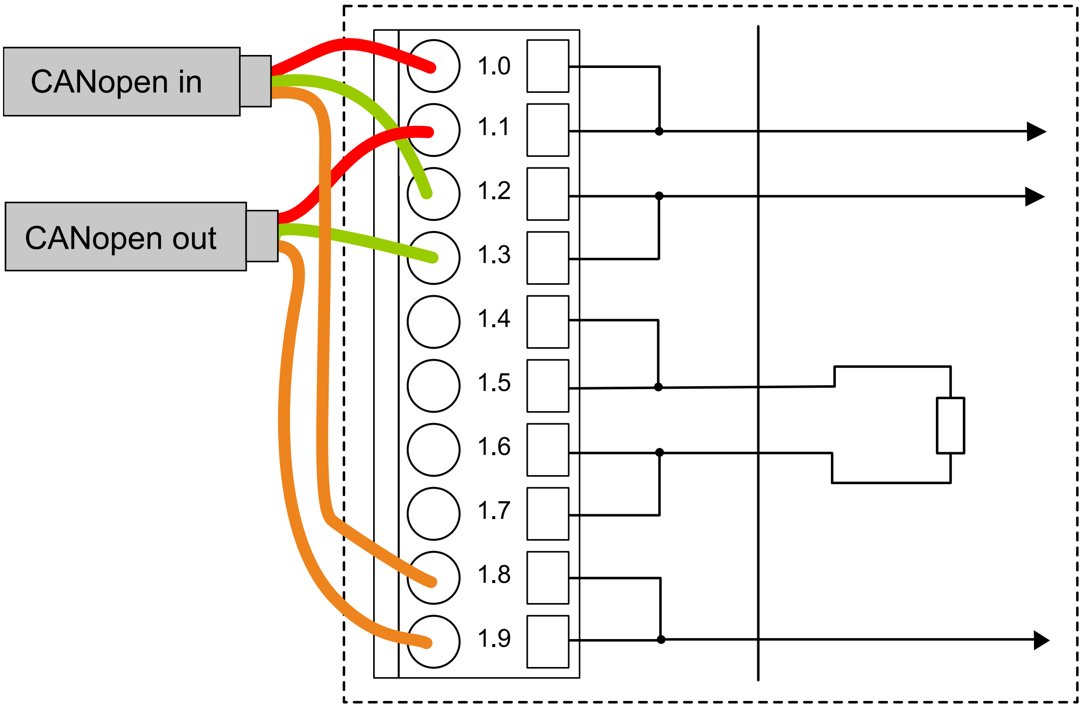
Mounting on terminal units TU517 or TU518

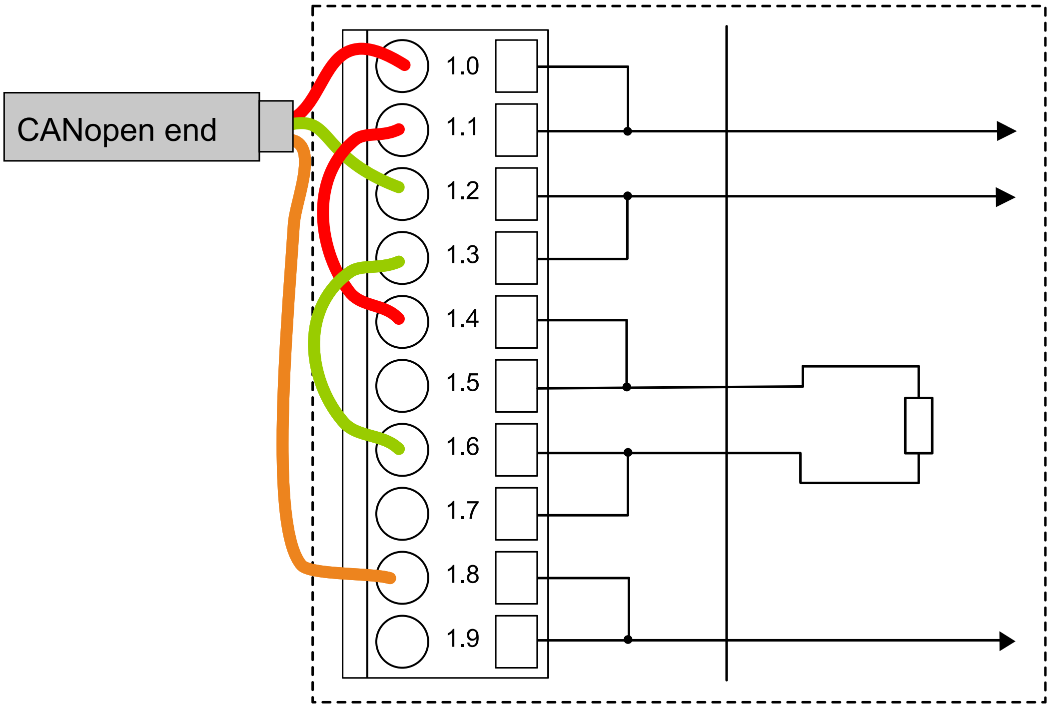
Table 256: Assignment of the terminals

Terminal	Signal	Description
1.0	CAN+	Non-inverted signal of the CAN bus
1.1	CAN+	Non-inverted signal of the CAN bus
1.2	CAN-	Inverted signal of the CAN bus
1.3	CAN-	Inverted signal of the CAN bus
1.4	Term+	CAN bus termination for CAN+ (for bus termination, Term+ must be connected with CAN+)
1.5	Term+	CAN bus termination for CAN+ (connecting alternative for terminal 1.4)
1.6	Term-	CAN bus termination for CAN- (for bus termination, Term- must be connected with CAN-)
1.7	Term-	CAN bus termination for CAN- (connecting alternative for terminal 1.6)
1.8	CAN-GND	Ground potential of the CAN bus
1.9	CAN-GND	Ground potential of the CAN bus

At the line ends of a bus segment, terminating resistors must be connected. If TU517 or TU518 is used, the bus terminating resistors can be enabled by connecting the terminals Term+ and Term- to the data lines CAN+ and CAN- (no external terminating resistors are required, see figure below).

The following figures show the different connection options for the CANopen communication interface module:





In the case of TU517/TU518, the terminating resistors are not located inside the TU but inside the communication interface module CI581-CN. Hence, when removing the device from the TU, the bus terminating resistors are no longer connected to the bus. The bus itself will not be disconnected if a device is removed.

The grounding of the shield should take place at the control cabinet. Please refer to the AC500 System-Data *Chapter 2.6.1 "System data AC500" on page 1408.*

Table 257: Assignment of the other terminals

Terminal	Signal	Description
2.0	DC0	Signal of the configurable digital input/output DC0
2.1	DC1	Signal of the configurable digital input/output DC1
2.2	DC2	Signal of the configurable digital input/output DC2
2.3	DC3	Signal of the configurable digital input/output DC3
2.4	DC4	Signal of the configurable digital input/output DC4
2.5	DC5	Signal of the configurable digital input/output DC5
2.6	DC6	Signal of the configurable digital input/output DC6
2.7	DC7	Signal of the configurable digital input/output DC7
2.8	UP	Process voltage UP (24 V DC)
2.9	ZP	Process voltage ZP (0 V DC)
3.0	DI8	Signal of the digital input DI8
3.1	DI9	Signal of the digital input DI9
3.2	DI10	Signal of the digital input DI10
3.3	DI11	Signal of the digital input DI11
3.4	DI12	Signal of the digital input DI12
3.5	DI13	Signal of the digital input DI13
3.6	DI14	Signal of the digital input DI14
3.7	DI15	Signal of the digital input DI15
3.8	UP	Process voltage UP (24 V DC)
3.9	ZP	Process voltage ZP (0 V DC)
4.0	DO8	Signal of the digital output DO8
4.1	DO9	Signal of the digital output DO9
4.2	DO10	Signal of the digital output DO10
4.3	DO11	Signal of the digital output DO11
4.4	DO12	Signal of the digital output DO12
4.5	DO13	Signal of the digital output DO13
4.6	DO14	Signal of the digital output DO14
4.7	DO15	Signal of the digital output DO15
4.8	UP3	Process voltage UP3 (24 V DC)
4.9	ZP	Process voltage ZP (0 V DC)

WARNING!

Removal/Insertion under power

The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!

Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

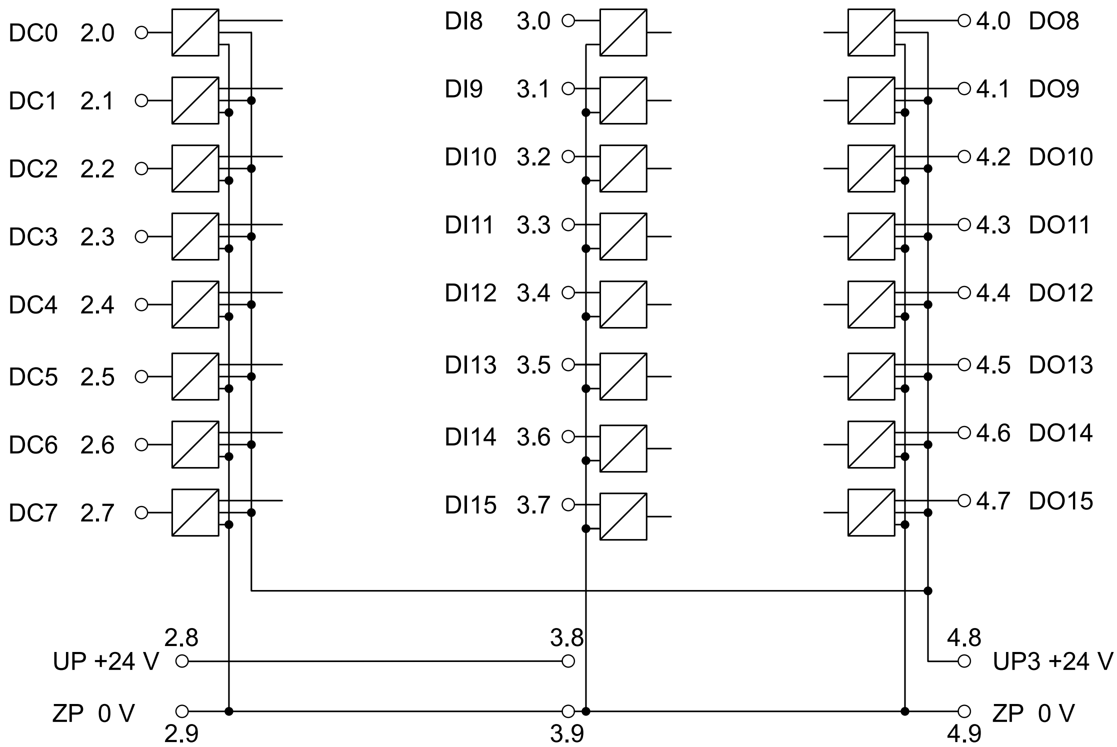


Fig. 243: Connection of the communication interface module CI582-CN

For a description of the meaning of the LEDs, please refer to the section for the state LEDs
Chapter 1.8.2.3.10 “State LEDs” on page 978.

Bus length

The maximum possible bus length of a CAN network depends on bit rate (transmission rate) and cable type. The sum of all bus segments must not exceed the maximum bus length

Bit Rate (speed)	Bus Length
1 Mbit/s	40 m
800 kbit/s	50 m
500 kbit/s	100 m
250 kbit/s	250 m
125 kbit/s	500 m
62.5 kbit/s	1000 m
20 kbit/s	2500 m
10 kbit/s	5000 m

Connection of the digital inputs

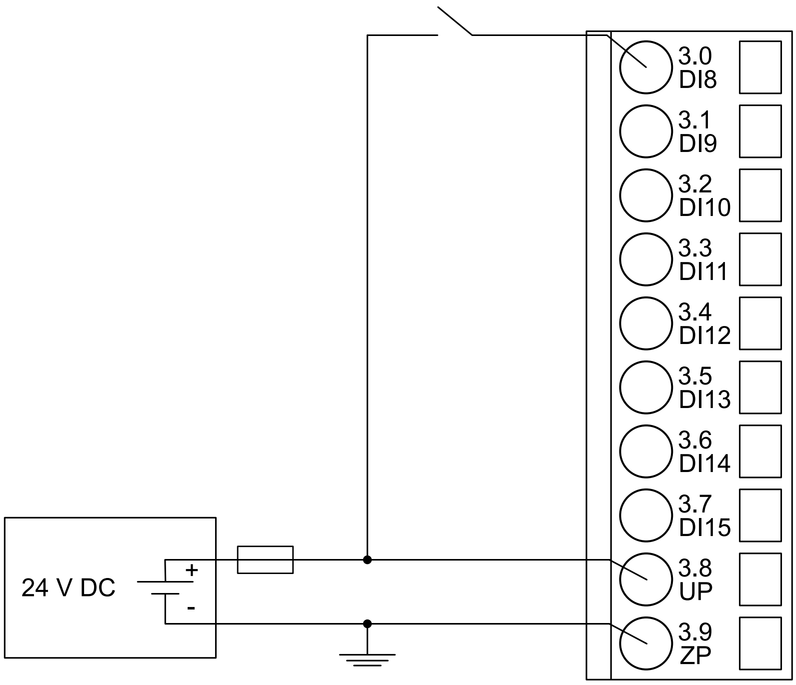


Fig. 244: Connection of the digital inputs (DI8 ... DI15) to the module CI582-CN

Connection of the digital outputs

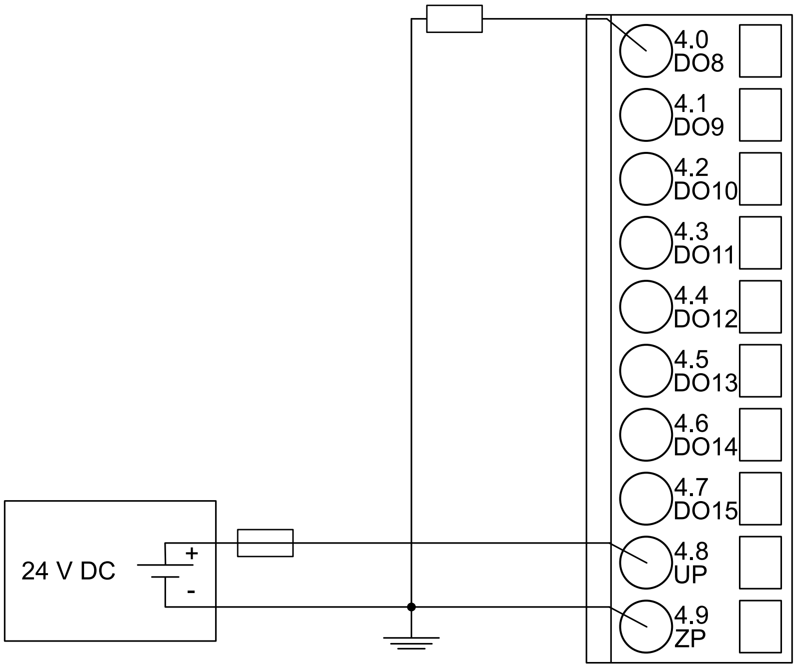


Fig. 245: Connection of configurable digital outputs (DO8 ... DO15) to the module CI582-CN

Connection of the configurable digital inputs/outputs

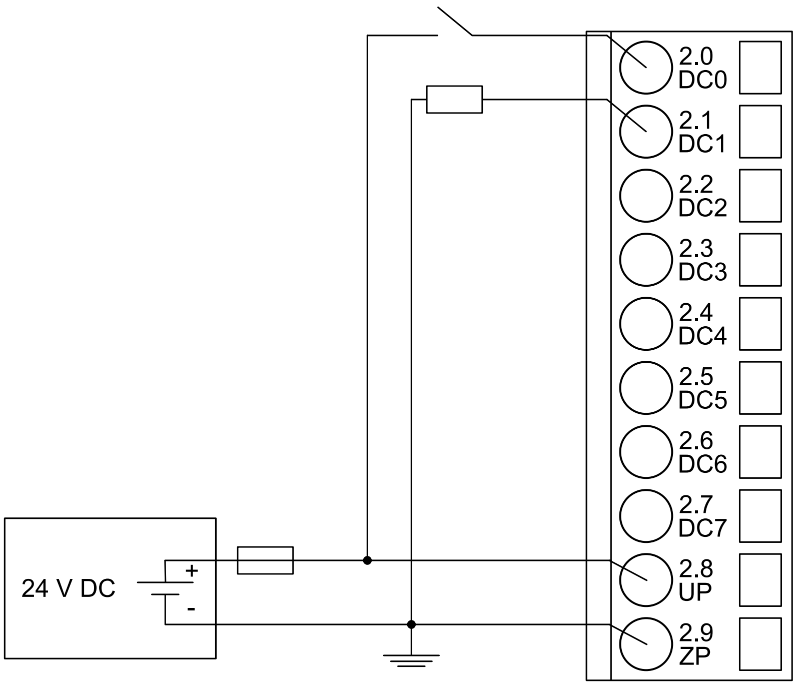


Fig. 246: Connection of configurable digital inputs/outputs (DC0 ... DC7) to the module CI582-CN

1.8.2.3.5 Internal data exchange

Parameter	Value
Digital inputs (bytes)	5
Digital outputs (bytes)	5
Counter input data (words)	4
Counter output data (words)	8

1.8.2.3.6 Addressing

A detailed description concerning addressing can be found in the documentation of ABB Control Builder Plus Software.

> *The CANopen communication interface module reads the position of the rotary switches only during power-up, i. e. changes of the switch position during operation will have no effect until the next module initialization.*
>
> *The range of permitted CANopen slave addresses is 1 to 127. Setting a higher address (> 128) does not lead to an error response, but results in a special mode (DS401). In this special mode, the device creates the node address by subtracting the value 128 from the address switch's value.*

1.8.2.3.7 I/O configuration

The CI582-CN CANopen bus configuration is handled by CANopen master with the exception of the slave node ID (via rotary switches) and the transmision rate (automatic detection).

The digital I/O channels and the fast counter are configured via software.

1.8.2.3.8 Parameterization

Parameters of the module

Name	Value	Internal value	Internal value, type	Default
Module ID [1])	Internal	0x1C89	WORD	0x1C89
Parameter length	Internal	38	BYTE	38
Error LED / fail-safe function table error LED / failsafe function (↳ *Table 258 "Error LED / Failsafe function" on page 973*)	On	0	BYTE	0
	Off by E4	1		
	Off by E3	2		
	On + failsafe	16		
	Off by E4 + fail-safe	17		
	Off by E3 + fail-safe	18		
Reserved	0	0	ARRAY of 24 BYTES	
Check supply	On	0	BYTE	
	Off	1		1

Name	Value	Internal value	Internal value, type	Default
Fast counter	0	0	BYTE	0
	:	:		
	10 [2])	10		

[1]) With a faulty ID, the module reports a "parameter error" and does not perform cyclic process data transmission.

[2]) For a description of the counter operating modes, please refer to the 'Fast Counter' section *Chapter 1.6.1.2.10 “Fast counter” on page 545*.

Table 258: Error LED / Failsafe function

Setting	Description
On	Error LED (S-ERR) lights up at errors of all error classes, failsafe mode off
Off by E4	Error LED (S-ERR) lights up at errors of error classes E1, E2 and E3, failsafe mode off
Off by E3	Error LED (S-ERR) lights up at errors of error classes E1 and E2, failsafe mode off
On + Failsafe	Error LED (S-ERR) lights up at errors of all error classes, failsafe mode on *)
Off by E4 + Failsafe	Error LED (S-ERR) lights up at errors of error classes E1, E2 and E3, failsafe mode on *)
Off by E3 + Failsafe	Error LED (S-ERR) lights up at errors of error classes E1 and E2, failsafe mode on *)
*) The parameter Behavior DO at comm. error is only analyzed if the failsafe mode is ON.	

Group parameters for the digital part

Name	Value	Internal value	Internal value, type	Default
Input delay	0.1 ms 1 ms 8 ms 32 ms	0 1 2 3	BYTE	0.1 ms 0x00
Detect short circuit at outputs	Off On	0 1	BYTE	On 0x01
Behavior DO at comm. error [1])	Off Last value Last value 5 sec Last value 10 sec Substitute value Substitute value 5 sec Substitute value 10 sec	0 1 6 11 2 7 12	BYTE	Off 0x00

Name	Value	Internal value	Internal value, type	Default
Substitute value at output	0 ... 65535	0000h ... FFFFh	WORD	0 0x0000
Preventive voltage feedback monitoring for DC0 ... DC7 [2])	Off On	0 1	BYTE	Off 0x00
Detect voltage overflow at outputs [3])	Off On	0 1	BYTE	Off 0x00

Remarks:

[1])	The parameter Behavior DO at comm. error is applied to DC and DO channels and only analyzed if the failsafe mode is ON.
[2])	The state "externally voltage detected" appears if the output of a channel DC0 ... DC7 is to be switched on while an external voltage is connected. In this case, start-up is disabled while the externally voltage is connected. The monitoring of this state and the resulting diagnosis message can be disabled by setting the parameters to "OFF".
[3])	The error state "voltage overflow at outputs" appears if external voltage at digital outputs DC0 ... DC7 and DO0 ... DO7 has exceeded the process supply voltage UP3 *Chapter 1.8.2.3.4 “Connections” on page 964*. The according diagnosis message "Voltage overflow on outputs " can be disabled by setting the parameters to "OFF". This parameter should only be disabled in exceptional cases as voltage overflow may produce reverse voltage.

1.8.2.3.9 Diagnosis

Structure of the diagnosis block via CANOM_NODE_DIAG.

Byte Number	Description	Possible Values
1	Diagnosis byte, slot number	31 = CI582-CN (e. g. error at integrated 8 DI / 8 DO) 1 = 1st connected S500 I/O module ... 10 = 10th connected S500 I/O module
2	Diagnosis byte, module number	According to the I/O bus specification passed on by modules to the fieldbus master
3	Diagnosis byte, channel	According to the I/O bus specification passed on by modules to the fieldbus master

Byte Number	Description	Possible Values
4	Diagnosis byte, error code	According to the I/O bus specification Bit 7 and bit 6, coded error class 0 = E1 1 = E2 2 = E3 3 = E4 Bit 0 to Bit 5, coded error description
5	Diagnosis byte, flags	According to the I/O bus specification Bit 7: 1 = coming error Bit 6: 1 = leaving error

In cases of short circuit or overload, the digital outputs are turned off. The module performs reactivation automatically. Thus, an acknowledgement of the errors is not necessary. The error message is stored via the LED.

E1..E4	**d1**	**d2**	**d3**	**d4**	**Identifier** **000 .. 063**	**AC500 display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 4 **Bit 6 ... 7**	**-**	**Byte 1**	**Byte 2**	**Byte 3**	**Byte 4** **Bit 0 ... 5**	**CANopen diagnosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error** **identifier**	**Error message**	**Remedy**
	1)	2)	3)	4)			
Module errors							
3	-	31	31	31	19	Checksum error in the I/O module	Replace I/O module
3	-	31	31	31	3	Timeout in the I/O module	
3	-	31	31	31	40	Different hard-/firmware versions in the module	
3	-	31	31	31	43	Internal error in the module	
3	-	31	31	31	36	Internal data exchange failure	
3	-	31	31	31	9	Overflow diagnosis buffer	Restart
3	-	31	31	31	26	Parameter error	Check Master

E1..E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier** **000 .. 063**	**AC500 display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 4 **Bit 6 ... 7**	**-**	**Byte 1**	**Byte 2**	**Byte 3**	**Byte 4** **Bit 0 ... 5**	**CANopen diag-nosis block**	
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error** **identi-fier**	**Error message**	**Remedy**
	[1])	[2])	[3])	[4])			
3	-	31	31	31	11	Process voltage UP too low	Check process supply voltage
3	-	31	31	31	45	Process voltage UP gone	Check process supply voltage
3	-	31/1...10	31	31	17	No communication with I/O module	Replace I/O module
3	-	1...10	31	31	32	Wrong I/O module type on socket	Replace I/O module / check configu-ration
4	-	1...10	31	31	31	At least one module does not support failsafe function	Check modules and parame-terization
4	-	31	31	31	45	Process voltage UP3 too low	Check process voltage
4	-	31	31	31	46	Voltage feedback on activated digital outputs [4])	Check terminals
4	-	31/1...10	31	31	34	No response during initialization of the I/O module	Replace I/O module
4	-	31	31	31	11	Process voltage UP3 too low	Check process supply voltage
4	-	31	31	31	45	Process voltage UP3 gone	Check process supply voltage

E1..E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier** **000 .. 063**	**AC500 display**	**<− Display in**	
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**		
Byte 4 **Bit 6 ... 7**	**-**	**Byte 1**	**Byte 2**	**Byte 3**	**Byte 4** **Bit 0 ... 5**	**CANopen diag-nosis block**		
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error** **identi-fier**	**Error message**		**Remedy**
	1)	**2)**	**3)**	**4)**				
4	-	31	31	31	10	Voltage overflow on outputs (above UP3 level) 5)		Check termi-nals/ check process supply voltage
Channel error digital								
4	-	31	2	8...15	46	Externally voltage detected at digital output DO0 ... DO7 6)		Check terminals
4	-	31	4	0...7	46	Externally voltage detected at digital output DC0 ... DC7 6)		Check terminals
4	-	31	4	0...7	47	Short circuit at digital output DC0 ... DC7 7)		Check terminals
4	-	31	2	8...15	47	Short circuit at digital output DO0 ... DO7 7)		Check terminals

Remarks:

1)	In AC500, the following interface identifier applies: "-" = Diagnosis via bus-specific function blocks; 0 ... 4 or 10 = position of the communication module; 14 = I/O bus; 31 = module itself The identifier is not contained in the CI542-DP diagnosis block.
2)	With "Device" the following allocation applies: 31 = module itself, 1..10 = expansion module
3)	With "Module" the following allocation applies depending on the master: Module error: 31 = module itself Channel error: module type (1 = AI, 2 = DO, 3 = AO)

[4])	This message appears if external voltages at one or more terminals DC0 ... DC7 or DO0 ... DO7 cause other digital outputs to be supplied by that voltage ↬ *Chapter 1.8.2.3.4 “Connections” on page 964*. All outputs of the digital output groups will be turned off for 5 seconds. The diagnosis message appears for the whole output group.
[5])	The voltage at digital outputs DC0 ... DC7 and DO0 ... DO7 has exceeded the process supply voltage UP3 ↬ *Chapter 1.8.2.3.4 “Connections” on page 964*. A diagnosis message appears for the whole module.
[6])	This message appears if the output of a channel DC0 ... DC7 or DO0 ... DO7 should be switched on while an external voltage is connected. In this case the start-up is disabled while the external voltage is connected. Otherwise, this could produce reverse voltage flowing from this output to other digital outputs. This diagnosis message appears for each channel.
[7])	Short circuit: After a short circuit has been detected, the output is deactivated for 100ms. Subsequently, a new start-up will be executed. This diagnosis message appears for each channel.

1.8.2.3.10 State LEDs

The LEDs are located at the front of the module. There are 2 different groups:

- The 5 system LEDs (PWR, CN-RUN, CN-ERR, S-ERR and I/O bus) show the operation states of the module and display possible errors.
- The 29 process LEDs (UP, UP3, inputs, outputs, CH-ERR1 to CH-ERR3) show the process supply voltage and the states of the inputs and outputs and display possible errors.

States of the 5 system LEDs

LED	Color	OFF	ON	Flashing
PWR/RUN	Green	Process supply voltage missing	Internal supply voltage OK, module ready for communication with I/O controller	Start-up / preparing communication
	Yellow	---	---	---
CN-RUN	Green	---	Device configured, CANopen bus in OPERATIONAL state and cyclic data exchange running	Flashing: CANopen bus in PRE-OPERATIONAL state and slave is being configured Single flash: CANopen bus in STOPPED state. Flickering: Autodetect is active

LED	Color	OFF	ON	Flashing
CN-ERR	Red	No system error	CANopen Bus is OFF	Flashing: Configuration error Single flash: error counter overflow due to too many error frames Double flash: A node-guard or a heartbeat event occurred Flickering: Autodetect is active
S-ERR	Red	No error	Internal error	--
I/O bus	Green	No decentralized I/O modules connected or communication error	Decentralized I/O modules connected and operational	---

States of the 29 process LEDs

LED	Color	OFF	ON	Flashing
DC0 ... DC7	Yellow	Input/output is OFF	Input/output is ON	--
DI8 ...DI15	Yellow	Input is OFF	Input is ON (the input voltage is even displayed if the supply voltage is OFF)	--
DO8 ... DO15	Yellow	Output is OFF	Output is ON	--
UP	Green	Process supply voltage missing	Process supply voltage OK and initialization finished	--
UP3	Green	Process supply voltage missing	Process supply voltage OK	--
CH-ERR1 to CH-ERR3	Red	No error or process supply voltage missing	Internal error	Error on one channel of the corresponding group

1.8.2.3.11 Technical data

Technical data of the module

The system data of AC500 and S500 are applicable to the standard version *Chapter 2.6.1 “System data AC500” on page 1408*.

The system data of AC500-XC are applicable to the XC version *Chapter 2.7.1 “System data AC500-XC” on page 1475*.

Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

Multiple overloads
No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an internal smart high-side switch.

Parameter		Value
Interface		CAN
Protocol		CANopen
Power supply		From the process supply voltage UP
Supply of the electronic circuitry of the I/O modules attached		Through the I/O bus interface (I/O bus)
Rotary switches		For setting the CANopen Node ID for configuration purposes (00h to FFh)
LED displays		For system displays, signal states, errors and power supply
External supply voltage		Via terminals ZP, UP and UP3 (process supply voltage 24 V DC)
Transmission rates		10 / 20 / 50 / 125 / 250 / 500 / 800 kbit/s 1 Mbit/s Auto transmission rate detection is supported
Bus connection		Depending on used terminal unit TU510: 9-pin D-sub connector TU518: 10-pin terminal block
Processor		Hilscher NETX 100
Expandability		Max. 10 S500 I/O modules
State display		Module state: PWR/RUN, CN-RUN, CN-ERR, E-ERR, I/O bus
Adjusting elements		2 rotary switches for generation of the node address
Ambient temperature		System data AC500 *Chapter 2.6.1 “System data AC500” on page 1408* System data AC500 XC *Chapter 2.7.1 “System data AC500-XC” on page 1475*
Current consumption		UP: 0.2 A UP3: 0.06 A + 0.5 A max. per output
Weight (without terminal unit)		Ca. 125 g
Process supply voltages UP/UP3		
	Rated value	24 V DC (for inputs and outputs)
	Max. load for the terminals	10 A
	Protection against reversed voltage	Yes
	Rated protection fuse on UP/UP3	10 A fast
	Galvanic isolation	CANopen interface against the rest of the module
	Inrush current from UP (at power up)	On request
	Current consumption via UP (normal operation)	0.2 A
	Current consumption via UP3	0.06 A + 0.5 A max. per output
	Connections	Terminals 2.8 and 3.8 for +24 V (UP) Terminal 4.8 for +24 V (UP3) Terminals 2.9, 3.9 and 4.9 for 0 V (ZP)
Max. power dissipation within the module		6 W
Reference potential for all digital inputs and outputs		Negative pole of the supply voltage, signal name ZP

Parameter	Value
Setting of the CANopen Node ID identifier	With 2 rotary switches at the front side of the module
Mounting position	Horizontal Or vertical with derating (output load reduced to 50 % at +40 °C per group)
Cooling	The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.
Effect of incorrect input terminal connection	Wrong or no signal detected, no damage up to 35 V
Required terminal unit	TU509, TU510, TU517 or TU518 *Chapter 1.5.2 “TU509 and TU510 for communication interface modules” on page 278* *Chapter 1.5.4 “TU517 and TU518 for communication interface modules” on page 290*

All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and continuous overvoltage up to 30 V DC.

Technical data of the digital inputs

Parameter	Value
Number of channels per module	8
Distribution of the channels into groups	1 group of 8 channels
Terminals of the channels DI0 ... DI7	Terminals 3.0 ... 3.7
Reference potential for all inputs	Terminals 2.9 ... 4.9 (negative pole of the supply voltage, signal name ZP)
Indication of the input signals	1 yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Input type (according EN 61131-2)	Type 1
Input delay (0->1 or 1->0)	Typ. 0.1 ms, configurable from 0.1 ms ... 32 ms
Input signal voltage	24 V DC
Signal 0	-3 V ... +5 V
Undefined signal	> +5 V ... < +15 V
Signal 1	+15 V ... +30 V
Ripple with signal 0	Within -3 V ... +5 V
Ripple with signal 1	Within +15 V ... +30 V
Input current per channel	
Input voltage +24 V	Typ. 5 mA
Input voltage +5 V	> 1 mA
Input voltage +15 V	> 2 mA
Input voltage +30 V	< 8 mA

Parameter	Value
Max. cable length	
Shielded	1000 m
Unshielded	600 m

Technical data of the digital outputs

Parameter	Value
Number of channels per module	8
Distribution of the channels into groups	1 group of 8 channels
Terminals of the channels DO0 to DO7	Terminals 4.0 to 4.7
Reference potential for all outputs	Terminals 2.9 ... 4.9 (negative pole of the supply voltage, signal name ZP)
Common power supply voltage	For all outputs terminal 4.8 (positive pole of the supply voltage, signal name UP3)
Output voltage for signal 1	UP3 (-0.8 V)
Output delay (0->1 or 1->0)	On request
Output current	
Rated value per channel	500 mA at UP3 = 24 V
Max. value (all channels together)	4 A
Leakage current with signal 0	< 0.5 mA
Fuse for UP3	10 A fast
Demagnetization with inductive DC load	Via internal varistors (see figure below this table)
Output switching frequency	
With resistive load	On request
With inductive loads	Max. 0.5 Hz
With lamp loads	11 Hz max. at 5 W max.
Short-circuit-proof / overload-proof	Yes
Overload message (I > 0.7 A)	Yes, after ca. 100 ms
Output current limitation	Yes, automatic reactivation after short circuit/overload
Resistance to feedback against 24 V signals	Yes (software-controlled supervision)
Max. cable length	
Shielded	1000 m
Unshielded	600 m

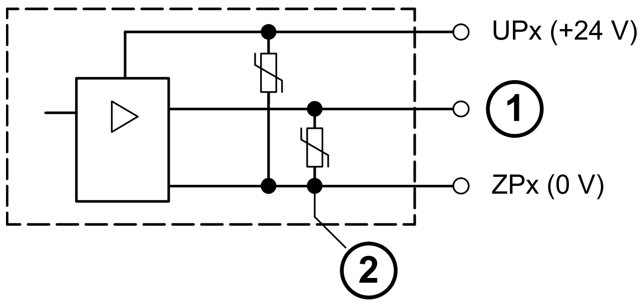


Fig. 247: Circuitry of a digital input/output with the varistors for demagnetization when inductive loads are switched off

1 Digital output
2 Varistors for demagnetization when inductive loads are turned off

Technical data of the configurable digital inputs/outputs

Each of the configurable I/O channels is defined as input or output by the user program. This is done by interrogating or allocating the corresponding channel.

Parameter	Value
Number of channels per module	8 inputs/outputs (with transistors)
Distribution of the channels into groups	1 group for 8 channels
If the channels are used as inputs	
Channels DC0...DC07	Terminals 2.0...2.7
If the channels are used as outputs	
Channels DC0...DC07	Terminals 2.0...2.7
Indication of the input/output signals	1 yellow LED per channel, the LED is ON when the input/output signal is high (signal 1)
Galvanic isolation	From the CANopen network

Technical data of the digital inputs/outputs if used as inputs

Please refer to the Technical Data of the Digital Inputs *Chapter 1.8.2.3.11 “Technical data” on page 979*. Deviation:

Terminals of the channels DC0 to DC7: Terminals 2.0 to 2.7

Due to the direct connection to the output, the demagnetizing varistor is also effective at the input. This is why the difference between UPx and the input signal must not exceed the clamp voltage of the varistor. The varistor limits the clamp voltage to approx. 36 V. Consequently, the input voltage must range from -12 V to +30 V when UPx = 24 V and from -6 V to +30 V when UPx = 30 V.

Technical data of the digital inputs/outputs if used as outputs

Please refer to the Technical Data of the Digital Outputs *Chapter 1.8.2.3.11 “Technical data” on page 979*. Deviation:

Terminals of the channels DC0 to DC7: Terminals 2.0 to 2.7

The following drawing shows the circuitry of a digital input/output with the varistors for demagnetization when inductive loads are switched off.

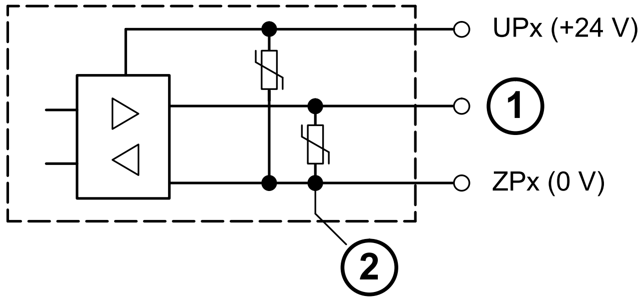


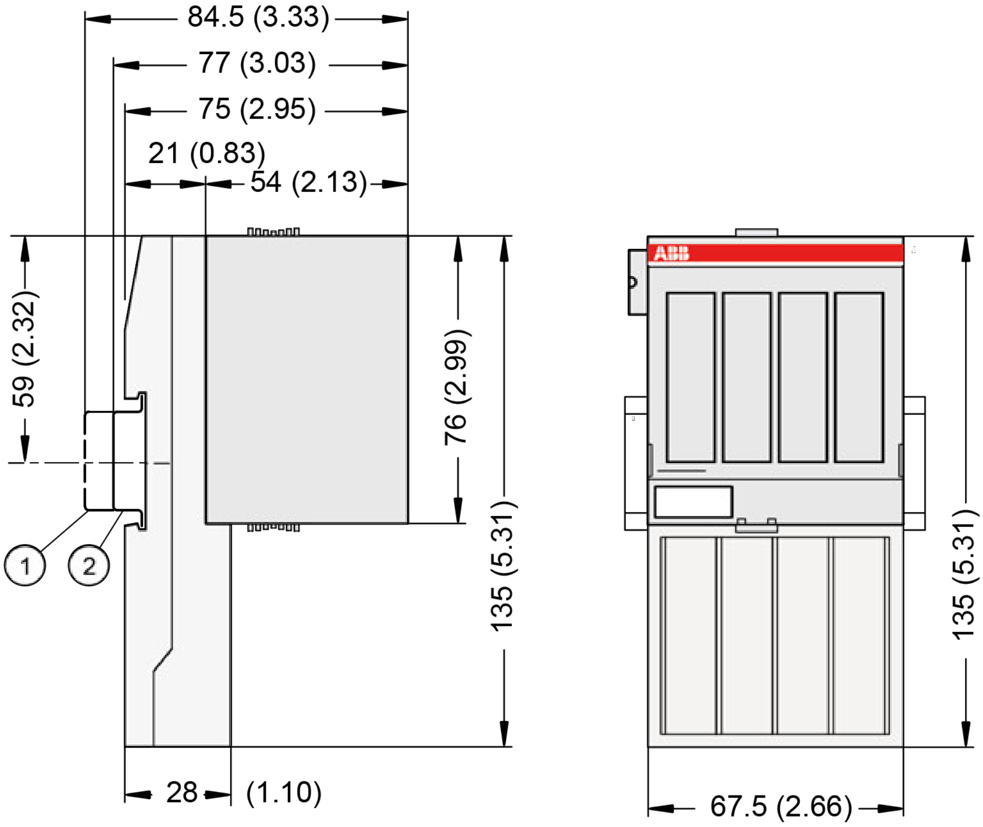
Fig. 248: Digital input/output (circuit diagram)

1	Digital input/output
2	For demagnetization when inductive loads are turned off

Technical data of the fast counter

Parameter	Value
Used inputs	Terminal 3.0 (DI8), 3.1 (DI9)
Used outputs	Terminal 4.0 (DO8)
Counting frequency	Depending on operation mode: Mode 1 - 6: max. 200 kHz Mode 7: max. 50 kHz Mode 9: max. 35 kHz Mode 10: max. 20 kHz
Detailed description	Fast Counter *Chapter 1.6.1.2.10 “Fast counter” on page 545*
Operating modes	Operating modes *Chapter 1.6.1.2.10 “Fast counter” on page 545*

1.8.2.3.12 Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

1.8.2.3.13 Ordering data

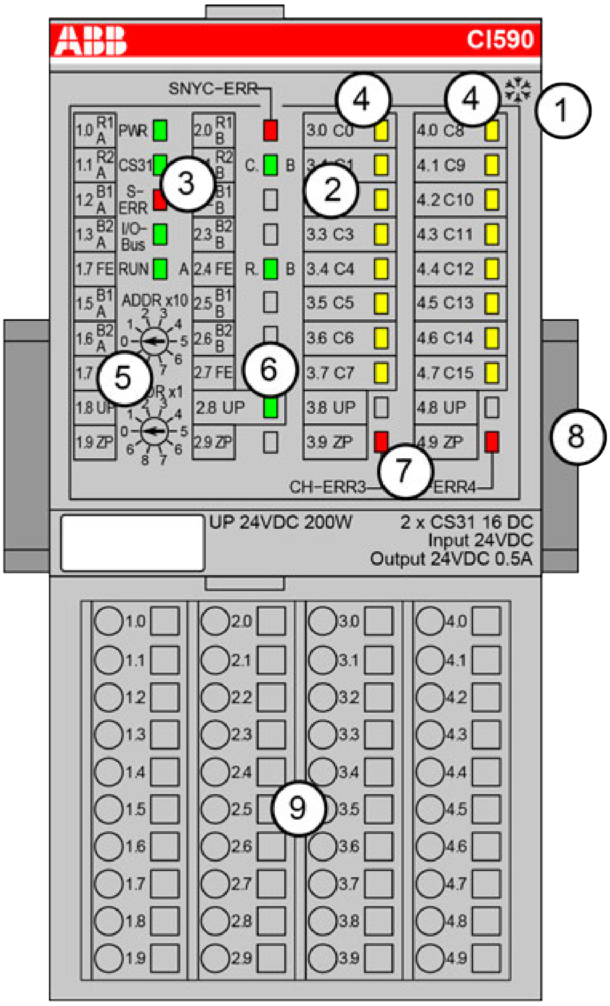
Part no.	Description	Product life cycle phase *)
1SAP 228 200 R0001	CI582-CN, CANopen communication interface module with 8 DI, 8 DO and 8 DC	Active
1SAP 428 200 R0001	CI582-CN-XC, CANopen communication interface module with 8 DI, 8 DO and 8 DC, XC version	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

1.8.3 CS31

1.8.3.1 CI590-CS31-HA

- 16 configurable digital inputs/outputs 24 V DC
- CS31 bus connection
- Module-wise galvanically isolated
- Fast counter
- XC version for usage in extreme ambient conditions available



1 I/O bus
2 Allocation between terminal number and signal name
3 5 system LEDs
4 16 yellow LEDs to display the signal states of the configurable digital inputs/outputs C0 ... C15
5 2 rotary switches to set the module's address (00d ... 99d)
6 1 green LED to display the process voltage UP
7 2 red LEDs to display errors
8 DIN rail
9 Terminal unit
Sign for XC version

1.8.3.1.1 Intended purpose

The High Availability CS31 bus module CI590-CS31-HA is used as a decentralized I/O module on CS31 field buses. The CI590-CS31-HA contains two RS-485 interfaces for connecting the module to two separate CS31 buses to have redundancy/backup or high availability. In addition, the CI590-CS31-HA provides 16 I/O channels with 16 configurable digital inputs/outputs (C0...C15) in one group. This group can be used as follows:

- 24 V DC input
- 24 V DC transistor output, 0.5 A (max.), short-circuit and overload protected
- re-readable output (combined input/output) with identical technical data of the digital inputs and outputs

The inputs and outputs are group-wise galvanically isolated from the CS31 buses and from other modules. Each CS31 bus is galvanically isolated from other terminals.

1.8.3.1.2 Functionality

Parameter	Value
Interface bus A	RS-485, CS31 protocol, galvanically isolated from other electronic.
Interface bus B	RS-485, CS31 protocol, galvanically isolated from other electronic.
Address switches	Two rotary switches for setting the CS31 bus address (00d to 99d).
I/O bus	I/O bus to connect S500 I/O modules (max. 7).
Digital inputs/outputs	16 configurable digital inputs/outputs in one group: 24 V DC, 0.5 A (max.), short-circuit and overload protected.
High-speed counter	Integrated, with many configurable operating modes.
LED displays	For system states, signal states, errors and power supply.
External power supply	Via UP and ZP terminal (process voltage: 24 V DC).
Effect of incorrect input terminal connection	Wrong or no signal detected, no damage up to 35 V
Required terminal unit	TU552-CS31 *Chapter 1.5.7 “TU551-CS31 and TU552-CS31 for CS31 communication interface modules” on page 304*

1.8.3.1.3 Connections

The CS31-HA communication interface module CI590-CS31-HA is plugged on CS31 terminal unit TU551-CS31 or TU552-CS31. Hereby, it clicks in with two mechanical locks. The terminal unit is mounted on a DIN rail or with two screws plus the additional accessory for wall mounting (TA526).

> *Mounting, disassembling and connection for the terminal units and the I/O modules are described in detail in the S500 system data chapters.*

The connection is carried out by using the 40 terminals of the terminal unit TU551-CS31/TU552-CS31. It is possible to replace the CI590-CS31-HA without loosening the wiring.

Table 259: Assignment of the terminals

Terminal	Signal	Description
1.0	R1A	Integrated terminating resistors for CS31 bus A, terminal 1
1.1	R2A	Integrated terminating resistors for CS31 bus A, terminal 2
1.2	B1A	CS31 bus A, bus line 1
1.3	B2A	CS31 bus A, bus line 2
1.4	FE	Functional earth
1.5	B1A	CS31 bus A, bus line 1
1.6	B2A	CS31 bus A, bus line 2
1.7	FE	Functional earth
1.8	UP	Process voltage UP (24 V DC)
1.9	ZP	Process voltage ZP (0 V DC)
2.0	R1B	Integrated terminating resistors for CS31 bus B, terminal 1
2.1	R2B	Integrated terminating resistors for CS31 bus B, terminal 2
2.2	B1B	CS31 bus B, bus line 1
2.3	B2B	CS31 bus B, bus line 2
2.4	FE	Functional earth
2.5	B1B	CS31 bus B, bus line 1
2.6	B2B	CS31 bus B, bus line 2
2.7	FE	Functional earth
2.8	UP	Process voltage UP (24 V DC)
2.9	ZP	Process voltage ZP (0 V DC)
3.0	C0	Signal of the configurable digital input/output C0
3.1	C1	Signal of the configurable digital input/output C1
3.2	C2	Signal of the configurable digital input/output C2
3.3	C3	Signal of the configurable digital input/output C3
3.4	C4	Signal of the configurable digital input/output C4
3.5	C5	Signal of the configurable digital input/output C5
3.6	C6	Signal of the configurable digital input/output C6
3.7	C7	Signal of the configurable digital input/output C7
3.8	UP	Process voltage UP (24 V DC)
3.9	ZP	Process voltage ZP (0 V DC)
4.0	C8	Signal of the configurable digital input/output C8
4.1	C9	Signal of the configurable digital input/output C9
4.2	C10	Signal of the configurable digital input/output C10
4.3	C11	Signal of the configurable digital input/output C11
4.4	C12	Signal of the configurable digital input/output C12
4.5	C13	Signal of the configurable digital input/output C13
4.6	C14	Signal of the configurable digital input/output C14

Terminal	Signal	Description
4.7	C15	Signal of the configurable digital input/output C15
4.8	UP	Process voltage UP (24 V DC)
4.9	ZP	Process voltage ZP (0 V DC)

CAUTION!
Risk of damaging the PLC modules!
The PLC modules must not be removed if the plant is powered on. Make sure that all voltage sources (supply and process voltage) are switched off before removing or replacing a module.

CAUTION!
Risk of damaging the PLC modules!
The PLC modules can be damaged by overvoltages and short circuits. Make sure that all voltage sources (supply and process voltage) are switched off before starting system operation.

The module provides several diagnostic functions *Chapter 1.8.3.1.10 “Diagnosis” on page 997*.

The following figure demonstrates connection of the configurable digital inputs/outputs. The digital input/output C0 is connected as an output and the digital input/output C1 is connected as an input. Connect the digital inputs/outputs C2 ... C15 in the same way.

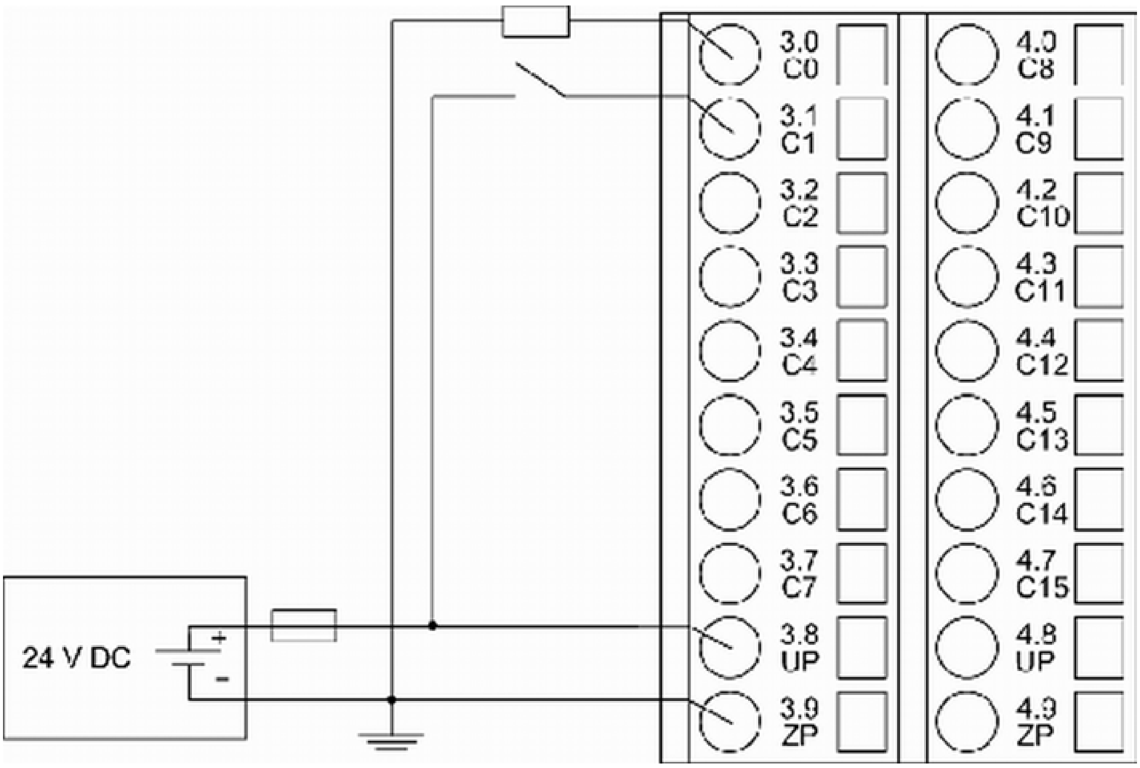


Fig. 249: CI590-02

CAUTION!

Risk of influences to the connected sensors!

Some sensors may be influenced by the deactivated module outputs of CI590-CS31-HA. Connect a 470 Ω / 1 W resistor in series configurable inputs/outputs C8/C9 if using them as fast counter inputs to safely avoid any influences.

The meaning of the LEDs is described in the chapter *Chapter 1.8.3.1.11 "State LEDs" on page 1000*.

1.8.3.1.4 CS31 bus connections

CS31 bus is connected with terminals 1.0 to 1.7 and 2.0 to 2.7 through the terminal unit. The end-of-line resistor can also be activated by using external wire jumpers.

There are different possibilities of connecting CS31 buses to the CI590-CS31-HA:

Option 1

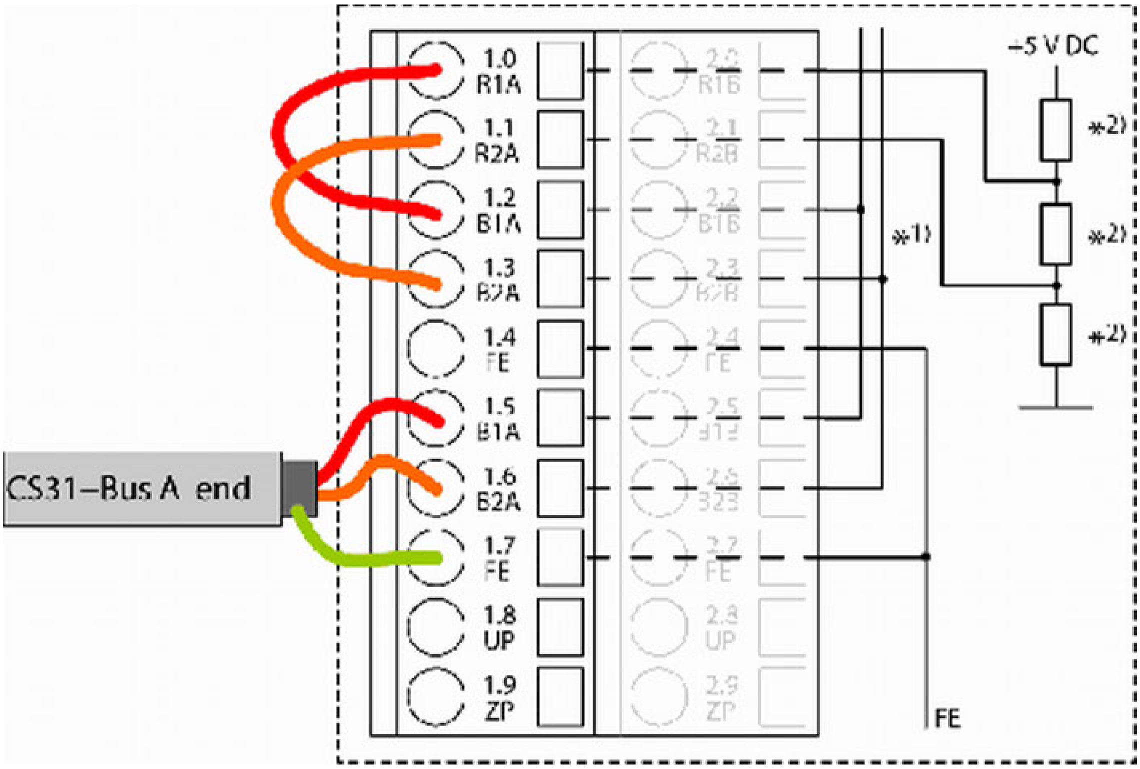


Fig. 250: Connection of CS31 bus A with CI590-CS31-HA located at the bus end

[1]) Connection between the bus lines is located inside the terminal unit.
[2]) Terminating resistors are located in the terminal unit TU551-CS31/TU552-CS31.

Option 2

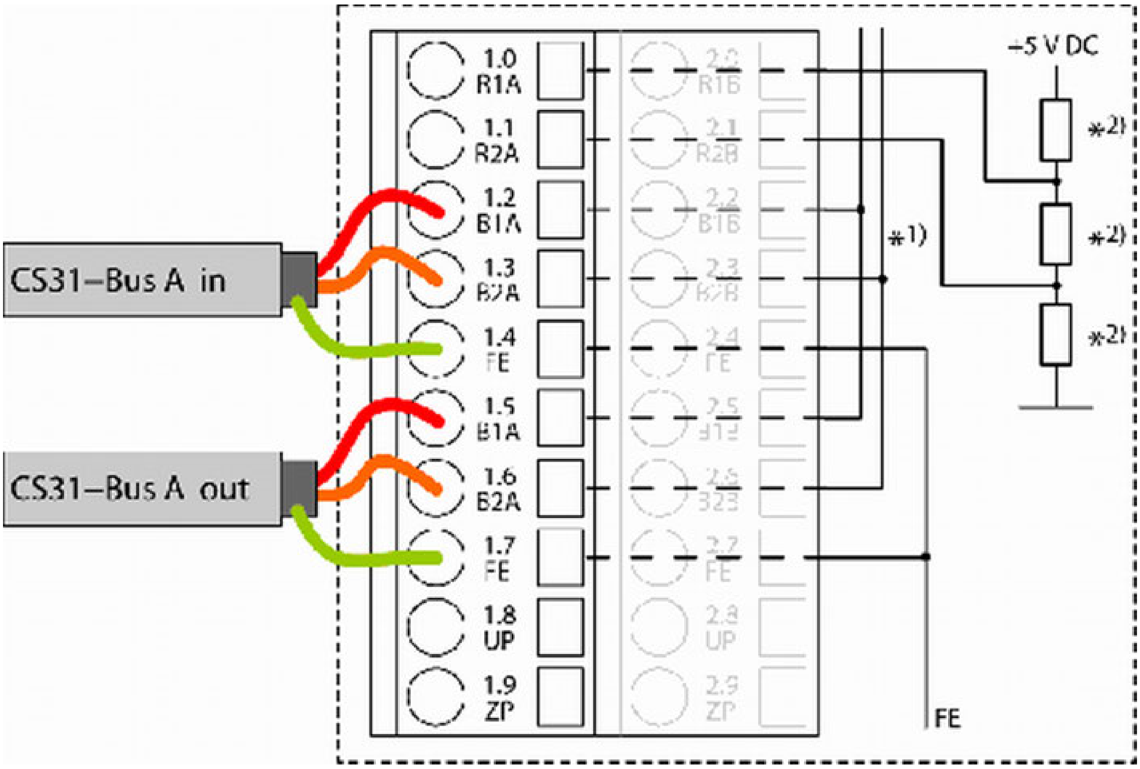


Fig. 251: Connection of CS31 bus A with CI590-CS31-HA located in the middle of the bus

1) Connection between the bus lines is located inside the terminal unit.
2) Terminating resistors are located in the terminal unit TU551-CS31/TU552-CS31.

Option 3

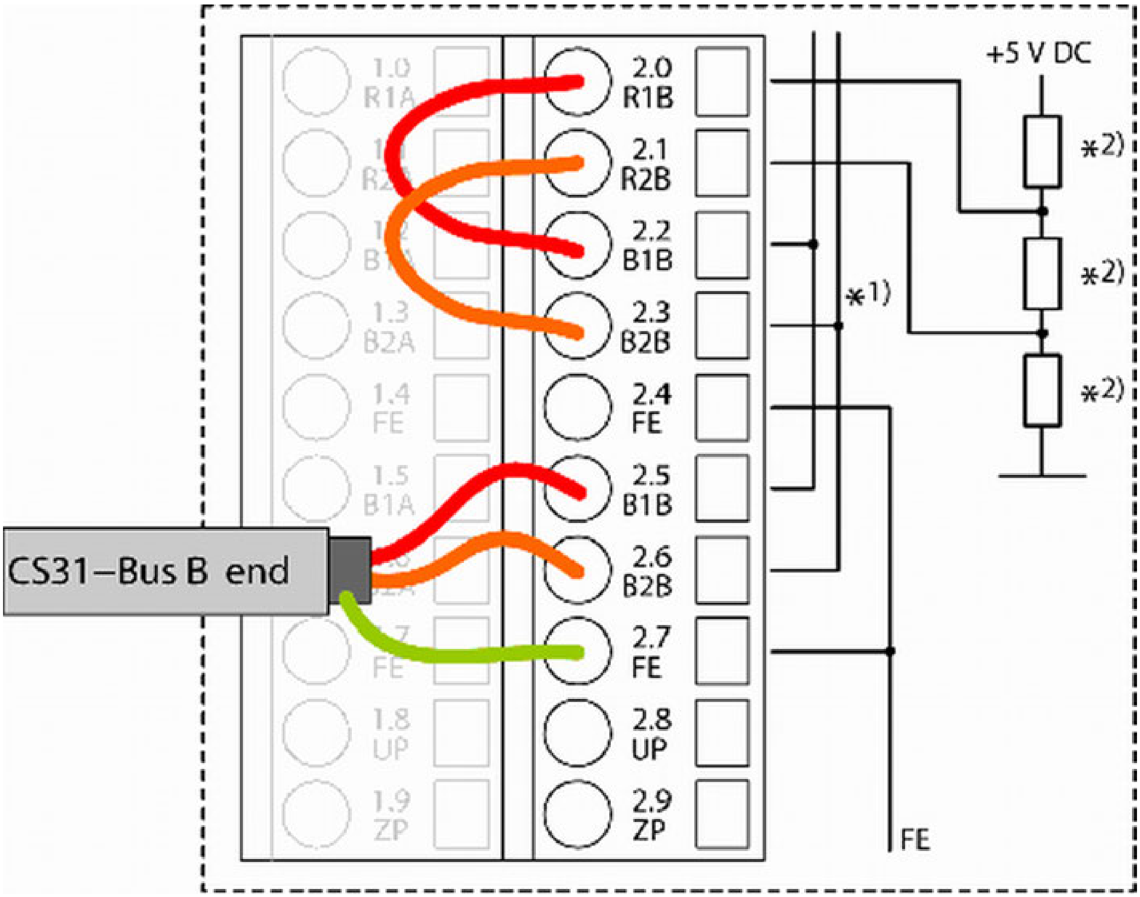


Fig. 252: Connection of CS31 bus B with CI590-CS31-HA located at the bus end

1) Connection between the bus lines is located inside the CI590-CS31-HA module.
2) Terminating resistors are located in the CI590-CS31-HA module.

Option 4

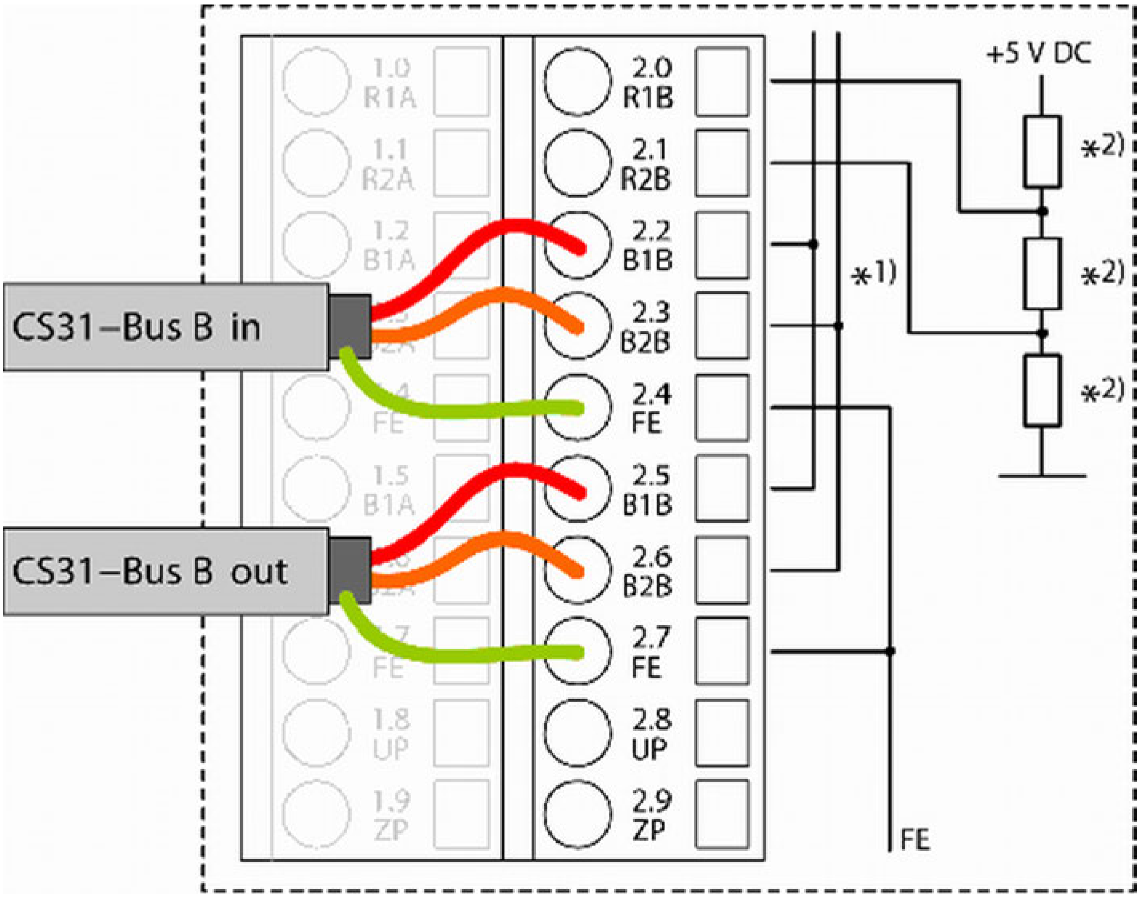


Fig. 253: Connection of CS31 bus B with CI590-CS31-HA located in the middle of the bus

1) Connection between the bus lines is located inside the CI590-CS31-HA module.
2) Terminating resistors are located in the CI590-CS31-HA module.

Details on CS31 wiring is described seperately *Chapter 2.6.4.9 “CS31 bus” on page 1441*.

1.8.3.1.5 Internal data exchange

Parameter	Without fast counter	With fast counter (only with AC500)
Digital inputs (bytes)	2 + expansion modules	5 + expansion modules
Digital outputs (bytes)	2 + expansion modules	5 + expansion modules
Counter input data (words)	0	4 (+4 AI)
Counter output data (words)	0	8 (+8 AO)

1.8.3.1.6 Addressing

An address must be set at every module so that the field bus communication module can access the specific inputs and outputs.

Only one address is used to identify the module on bus A and bus B.

> *CI590-CS31-HA address must be set based on the “number of CS31 modules“ calculated by Automation Builder.*

The address (00d ... 99d) is set with two rotary switches on the front panel of the module.

> *CS31 bus module reads the position of the address switches only during initialization after power on, i.e. changes of the settings during operation remain ineffective.*

1.8.3.1.7 CI590-CS31-HA limitations

The following peculiarities concerning the CS31 bus in the AC500 must be observed when addressing S500 I/O devices at the CS31 bus:

- One CS31 software module can occupy a maximum of 15 bytes of inputs and 15 bytes of outputs in the digital area. This corresponds to 15 x 8 = 120 digital inputs and 120 outputs.
- One CS31 software module can allocate a maximum of eight words of inputs and eight words of outputs in the analog area.
- A maximum of 31 of these CS31 software modules are allowed for connection to the CS31 bus.
- If a device contains more than 15 bytes or eight words of inputs or outputs, it occupies two or more of the 31 CS31 software modules.
- The CI590-CS31 can internally manage two CS31 software modules in the digital area and five CS31 software modules in the analog area. This corresponds to a maximum of:
  - 240 digital inputs (2 x 15 bytes) and
  - 240 digital outputs (2 x 15 bytes) and
  - 40 analog inputs (5 x 8 words) and
  - 40 analog outputs (5 x 8 words).
- Address setting is done at the CI590-CS31 using two rotary switches at the module's front plate.
- To enable the fast counter of the CI590-CS31 the hardware address (HW_ADR) has to be set to the module address + 70. With activated fast counter, the module addresses 0 ... 28 (hardware address setting 70 ... 98) are allowed.

  Then, the CI590-CS31 registers contain two CS31 software modules using the module address (hardware address 70), once in the digital area and once in the analog area.
- CS31 software module 1 in digital area:

  -> registers using the module address.

  CS31 software module 2 in digital area:

  -> registers using module address+7 and bit "Channel ≥ 7" set.

  CS31 software module 1 in analog area:

  -> registers using the module address.

  CS31 software module 2 in analog area:

  -> registers using module address and bit "Channel ≥ 7" set.

  CS31 software module 3 in analog area:

  -> registers using the module address+1.

  CS31 software module 4 in analog area:

  -> registers using module address+1 and bit "Channel ≥ 7" set.
- The CI590-CS31 can manage a maximum of 255 parameters. This does not cause any restrictions in all configurations with the currently available S500 I/O devices.
- The next free address for a CI590-CS31 is derived from the highest address occupied in the digital area or the analog area of the previous CI590-CS31.

- When connecting several S500 expansion modules to a CI590-CS31 via the I/O Bus, their inputs and outputs follow the CI590-CS31s inputs and outputs without gap. Such a cluster can occupy up to six CS31 software modules.
- A maximum of seven S500 expansion modules (extensions) can be connected to a CI590-CS31.

1.8.3.1.8 I/O configuration

The CI590-CS31-HA does not store configuration data itself. The 16 configurable digital inputs/outputs are defined as inputs or outputs by the user program, i.e. each of the configurable channels can be used as input or output (or re-readable output) by interrogation or allocation with the user program.

1.8.3.1.9 Parametrization

Arrangement of parameter data is performed by your master configuration software Automation Builder.

CAUTION!

Risk of configuration errors!

Contradictory parameter settings may cause configuration errors of the CI590-CS31-HA and attached I/O modules. Please make sure, the fast counter mode is not set to value 0 if the module is included with fast counter in PLC configuration.

The parameter data directly influences module functionality.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Name	Value	Internal Value	Internal Value, Type	Default	Min.	Max.
Module address	1	2740 [1])	BYTE	2740 0 x 0AB4	0	61
Ignore module	No Yes	0 1	BYTE	No (0 x 00)	-	-
Parameter length	Internal	8 7 [2])	BYTE	8 7 [2])	0	255
Check supply	Off On	0 1	BYTE	On 0 x 01	-	-

Name	Value	Internal Value	Internal Value, Type	Default	Min.	Max.
Error LED / Failsafe Function	On Off by E4 Off by E3 On + Fail-safe Off by E4 + Fail-safe Off by E3 + Fail-safe	-	-	On	-	-
Stop behavior	Switch over Stop Both stop/ fail-safe	0 1 2	BYTE	0	-	-
Output compare: If outputs of both CI590-CS31-HA are different, the error information will be accessible by extended diagnosis function blocks.	No check Binary Analog ± 256 Analog ± 512 Binary + Analog 256 Binary + Analog 512	0 1 2 3 4 5	BYTE	0	-	-
Input delay	0.1 ms 1 ms 8 ms 32 ms	0 1 2 3	BYTE	8 ms 0 x 02	-	-

Name	Value	Internal Value	Internal Value, Type	Default	Min.	Max.
Fast counter	0 : 10 [3])	0 : 10	BYTE	Mode 0 0 x 00	-	-
Detection short-circuit at outputs	Off On	0 1	BYTE	On 0 x 01	-	-
Behavior outputs at communication fault	Off Last value Substitute value	0 1 2	BYTE	Off 0 x 00	-	-
Substitute value	0 ... 65535	0 ... 0xffff	WORD	0	-	-

[1]) with CS31 and addresses less than 70 and FBP, the value is increased by 1.

[2]) with CS31 and addresses less than 70, without the parameter "Fast Counter".

[3]) Counter operating modes, see description of the fast counter.

1.8.3.1.10 Diagnosis

Structure of CI590-CS31-HA diagnosis block

If a CI590-CS31-HA module is connected via a CS31 bus, then the field bus master receives diagnosis information by an extended diagnosis block. The following table specifies the structure of this information. In case of an error the user can get this information by the diagnosis system *Chapter 1.8.3.1.10.2 “Diagnosis table CI590-CS31-HA” on page 998*.

Byte Number	Description	Possible values
1	Data length (header included)	18
2	Diagnosis byte	0 = Communication with CI590-CS31-HA OK 1 = Communication with CI590-CS31-HA failed
3	CI590-CS31-HA diagnosis byte, module number	0 = CI590-CS31-HA (e.g. error at the integrated 16 DC) 1 = 1st attached S500 I/O module 2 = 2nd attached S500 I/O module ... 7 = 7th attached S500 I/O module
4	CI590-CS31-HA diagnosis byte, slot	According to the I/O bus specification passed on by modules to the fieldbus master
5	CI590-CS31-HA diagnosis byte, channel	According to the I/O bus specification passed on by modules to the fieldbus master

Byte Number	Description	Possible values
6	CI590-CS31-HA diagnosis byte, error code	According to the I/O bus specification Bit 7 and bit 6, coded error class 0 = E1 1 = E2 2 = E3 3 = E4 Bit 0 to bit 5, coded error description passed on by modules to the fieldbus master
7	CI590-CS31-HA diagnosis byte, flags	According to the I/O bus specification Bit 7: 1 = coming error Bit 6: 1 = leaving error Bit 5: 1 = diag reset Bit 2 to bit 4: reserved Bit 1: 1 = explicit acknowledgement Bit 0: 1 = static error passed on by modules to the fieldbus master Value = 0: static message for other systems, which do not have a coming/leaving evaluation
8ff	reserved	

Diagnosis table CI590-CS31-HA

In case of overload or short circuit, the outputs switch off automatically and try to switch on again cyclically. Therefore an acknowledgement of the outputs is not necessary. The LED error message, however, is stored.

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identifier** **000 ... 063**	**AC500 display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**	
Byte 6 **Bit 6 ... 7**	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6** **Bit 0 ... 5**	**FBP diagnosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error identifier**	**Error message**	**Remedy**
	1)	**2)**	**3)**	**4)**			
Module Error							
3	11	ADR	31	31	3	Timeout in the I/O module	Replace I/O module

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier** **000 ... 063**	**AC500 display**	**<– Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**	
Byte 6 **Bit 6 ... 7**	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6** **Bit 0 ... 5**	**FBP diagnosis block**	
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error identi-fier**	**Error message**	**Remedy**
	[1])	[2])	[3])	[4])			
3	11	ADR	31	31	19	Checksum error in the I/O module	
3	11	ADR	31	31	36	Internal data exchange failure	
3	11	ADR	31	31	40	Different hard-/firm-ware versions in the module	
3	11	ADR	31	31	43	Internal error in the module	
3	11	ADR	31	31	9	Overflow diagnosis buffer	Restart
3	11	ADR	31	31	26	Parameter error	Check master
3	11	ADR	31	31	11	Process voltage too low	Check process voltage
3	11	ADR	1...7	31	17	No communication to the I/O module	Replace I/O module
3	11	ADR	31	31 31	28	Configurations from PLC A of PLC B are different	Check PLC CS31 module configuration
3	11	ADR ADR	31	31	36	Wait Com (Only 1 bus or 1 CPU is active/operational)	Check second CPU or other bus connection
4	11	ADR	31	31	45	Process voltage ON/OFF	Process voltage ON
4	11	ADR	31/ 1...7	31	34	Wait ready (No reply during initiali-zation of the I/O module)	Replace I/O module
4	11	ADR	31/ 1...7	31	32	Wrong I/O module in the slot	Replace I/O module or check configuration
4	11	ADR	31	31	54	CPU conflict ● Both CPUs are in STOP mode ● HA cycle time too small ● Mismatch in comparison of analog values	● Check CPU status ● Check HA cycle ● Check wiring between the analog modules and the CPU

E1 ... E4	d1	d2	d3	d4	Identi-fier 000 ... 063	AC500 display	<– Display in
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**	
Byte 6 Bit 6 ... 7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0 ... 5**	**FBP diagnosis block**	
Class	**Inter-face**	**Devic e**	**Module**	**Chann el**	**Error identi-fier**	**Error message**	**Remedy**
	[1])	[2])	[3])	[4])			
Channel Error CI590-CS31-HA							
4	11	ADR	31/ 1 ... 7	8 ... 23	47	Short circuit at a digital output	Check connec-tion

Remarks:

[1])	In AC500 the following interface identifier applies: 11 = COM1 (protocol CS31 bus only possible with COM1)
[2])	With "Device" and CS31 bus master, the hardware address of the CI590-CS31-HA (0 ... 69) is output.
[3])	With "Module" the following allocation applies: 31 = module itself, 1 ... 7 = Expansion 1 ... 7
[4])	In case of module errors, with channel "31 = Module itself" is output.

1.8.3.1.11 State LEDs

Table 260: States of the LEDs:

LED	Status	Color	LED = OFF	LED = ON	LED Flashes
PWR	System voltage	Green	System firm-ware is not running	System firm-ware is run-ning	--
CS31 A	CS31 commu-nication	Green	No communi-cation at CS31 bus A	Communica-tion at CS31 bus A OK	10 Hz: Not bit lifetime man-agement
C. B	CS31 commu-nication	Green	No communi-cation at CS31 bus B	Communica-tion at CS31 bus B OK	10 Hz: Not bit lifetime man-agement
S-ERR	Sum Error	Red	--	Internal error detected	2 Hz: Diag-nostic event happened
I/O-Bus	Communica-tion via the I/O bus	Green	No I/O bus communica-tion	Expansion modules con-nected	2 Hz: Error I/O bus

LED	Status	Color	LED = OFF	LED = ON	LED Flashes
RUN A	CPU active	Green	CPU A is not primary	CPU A is primary	RUN B LED off: CI590-CS31-HA primary self selection. No primary order from both PLC. PLC A has been selected as primary. RUN B LED on: 2 primary orders. PLC B is primary.
R. B	CPU active	Green	CPU B is not primary	CPU B is primary	RUN A LED off: CI590-CS31-HA primary self selection. No primary order from both PLC. PLC B has been selected as primary. RUN A LED on: 2 primary orders. PLC A is primary.
SYNC-ERR	Outputs from CPU A and CPU B	Red	--	Configuration conflict detected	10 Hz: Not parameterized 2 Hz: Switch-over has occured
C0...C15	Digital inputs/ outputs	Yellow	Input/output = OFF	Input/output = ON (the input voltage is even displayed if the supply voltage is OFF)	--
UP	Process supply voltage and initialization	Green	Process voltage is missing	Process voltage OK and initialization completed	Module was not initialized correctly
CH-ERR3		Red	No error	Severe error within the corresponding group	Error on one channel of the corresponding group (e.g. short-circuit at an output)

LED	Status	Color	LED = OFF	LED = ON	LED Flashes
CH-ERR4		Red	No error	Severe error within the corresponding group	Error on one channel of the corresponding group (e.g. short-circuit at an output)
CH-ERR *)	Module error	Red	No error or process voltage is missing	Internal error	--
*) All LEDs CH-ERR2 to CH-ERR4 light up together					

1.8.3.1.12 Technical data

Technical data of the module

The system data of AC500 and S500 are applicable to the standard version *Chapter 2.6.1 “System data AC500” on page 1408*.

The system data of AC500-XC are applicable to the XC version *Chapter 2.7.1 “System data AC500-XC” on page 1475*.

Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

Parameter		Value
Rated supply voltage of the module		24 V DC (UP/ZP)
Current consumption of the module (UP)		50 mA
Process voltage UP:		
	Rated value	24 V DC (for inputs and outputs)
	Max. electric charge for the supply terminals	10 A
	Protection against reversed voltage	Yes
	Rated protection fuse at UP	10 A fast
	Galvanic isolation	CS31 bus A interface from the rest of the module CS31 bus B interface from the rest of the module
	Inrush current from UP (at power-up)	0.040 A^2s
	Current consumption from UP at normal operation / with outputs	0.1 A + max. 0.008 A per input + max. 0.5 A per output
	Connections	Terminals 1.8 ... 4.8 for +24 V (UP) and 1.9 ... 4.9 for 0 V (ZP)
Max. power dissipation within the module		6 W (outputs unloaded)
Number of configurable digital inputs/outputs		16
Reference potential for all digital inputs and outputs		Negative pole of the supply voltage, signal name ZP
Address setting		

Parameter	Value
Diagnosis ✎ *Chapter 1.8.3.1.10 “Diagnosis” on page 997*	With two rotary switches on the front panel
Operating and error displays	27 LEDs altogether
Weight (without terminal unit)	Approx. 125 g
Mounting position	Horizontal or vertical with derating (output load reduced to 50 % at +40 °C per group)
Cooling	The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

NOTICE!
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and temporary overvoltage up to 30 V DC.

Multiple overloads
No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an internal smart high-side switch.

Configurable digital inputs/outputs

Each of the configurable digital inputs/outputs is defined as input or output by the user program. This is done by interrogating or allocating the corresponding channel.

Parameter	Value
Number of channels per module	16 inputs/outputs (with transistors)
Distribution of the channels into groups	1 group of 16 channels
Connection of the channels C0 ... C7	Terminals 3.0 ... 3.7
Connection of the channels C8 ... C15	Terminals 4.0 ... 4.7
Indication of the input/output signals	1 yellow LED per channel, the LED is ON if the input/output signal is high (signal 1)
Galvanic isolation	Yes, between the I/O channels and the rest of the module

Digital inputs/outputs if used as inputs

Parameter		Value
Number of channels per module		16 digital inputs
Reference potential for all inputs		Terminals 1.9, 2.9, 3.9 and 4.9 (negative pole of the process supply voltage, signal name ZP)
Input current per channel:		
	Input voltage +24 V	Typ. 5 mA
	Input voltage +5 V	> 1 mA

Parameter		Value
	Input voltage +15 V	> 2 mA
	Input voltage +30 V	< 8 mA
Input type acc. to EN 61131-2		Type 1
Input delay (0->1 or 1->0)		Typ. 8 ms, configurable from 0.1 to 32 ms
Input signal voltage		24 V DC
Signal 0		-3 V ... +5 V *)
Undefined signal		> +5 V ... <+15 V
Signal 1		+15 V ... +30 V
Ripple with signal 0		Within -3 V ... +5 V *)
Ripple with signal 1		Within +15 V ... +30 V
Max. cable length:		
	Shielded	1000 m
	Unshielded	600 m

*) Due to the direct connection to the output, the demagnetizing varistor is also effective at the input (see figure) above. This is why the difference between UPx and the input signal may not exceed the clamp voltage of the varistor. The varistor limits the voltage to approx. 36 V. Following this, the input voltage must range from -12 V ... +30 V if UPx = 24 V and from -6 V ... +30 V if UPx = 30 V.

Digital inputs/outputs if used as outputs

Parameter		Value
Number of channels per module		Max. 16 transistor outputs
Reference potential for all outputs		Terminals 1.9, 2.9, 3.9 and 4.9 (negative pole of the process supply voltage, signal name ZP)
Common power supply voltage		For all outputs: terminals 1.8, 2.8, 3.8 and 4.8 (positive pole of the process supply voltage, signal name UP)
Output voltage for signal 1		UP (-0.8 V)
Output delay (0->1 or 1->0)		On request
Output current:		
	Rated value, per channel	500 mA at UP = 24 V
	Maximum value (all channels together)	10 A
Leakage current with signal 0		< 0.5 mA
Rated protection fuse on UP		10 A fast
Demagnetization when inductive loads are switched off		With varistors integrated in the module (see figure below)
Switching frequency:		
	With resistive loads	On request
	With inductive loads	Max. 0.5 Hz
	With lamp loads	Max. 11 Hz with max. 5 W
Short-circuit-proof / overload-proof		Yes
Overload message (I > 0.7 A)		Yes, after approx. 100 ms

Parameter		Value
Output current limitation		Yes, automatic reactivation after short circuit/overload
Resistance to feedback against 24 V signals		Yes
Max. cable length:		
	Shielded	1000 m
	Unshielded	600 m

The following drawing shows the circuitry of a digital input/output with the varistors for demagnetization if inductive loads are switched off.

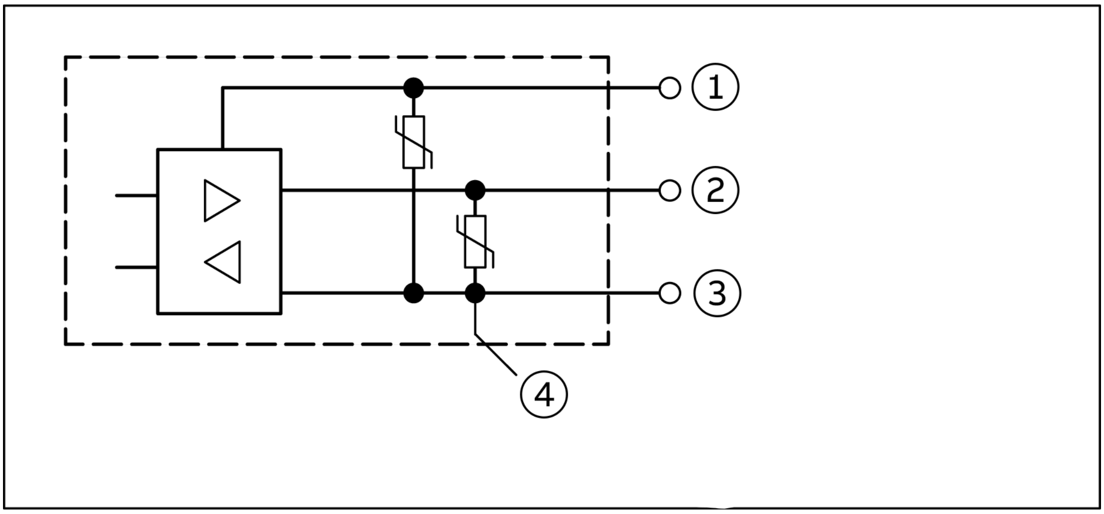


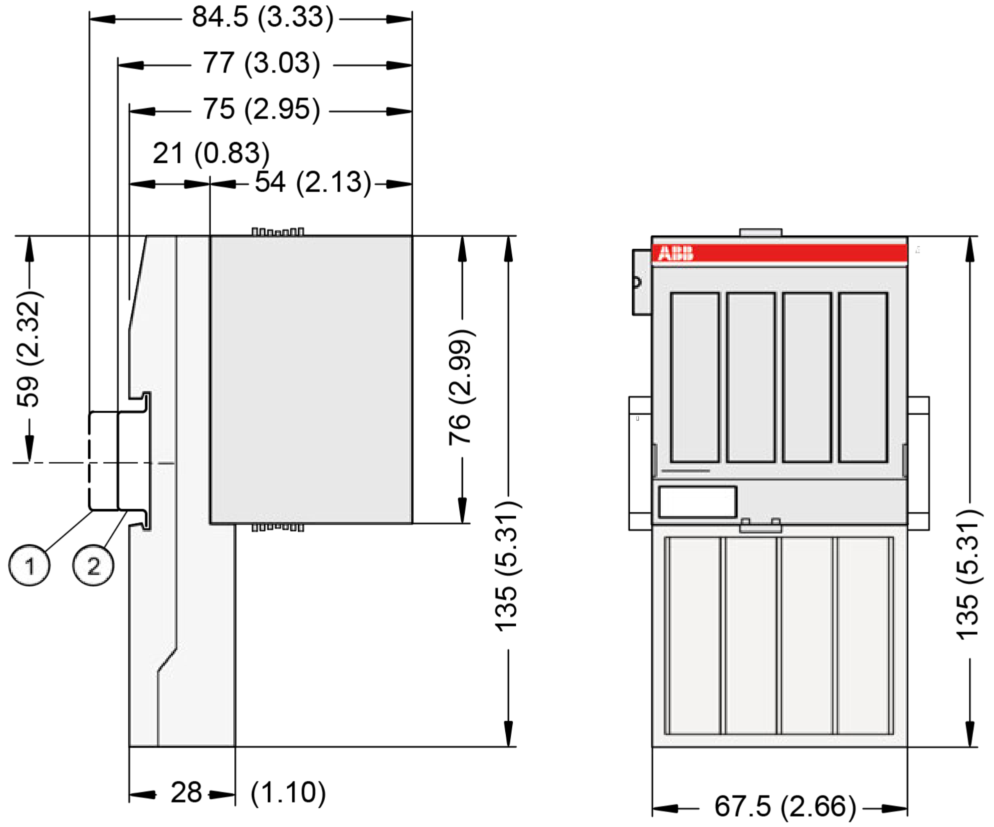
Fig. 254: Digital input/output (circuit diagram)

1 UPx (+ 24 V)
2 Digital input/output
3 ZPx (0 V)
4 For demagnization when inductive loads are switched off

Technical data of the fast counter

Parameter	Value
Used inputs	C8 / C9
Used outputs	C10
Counting frequency	Max. 50 kHz

1.8.3.1.13 Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

1.8.3.1.14 Ordering data

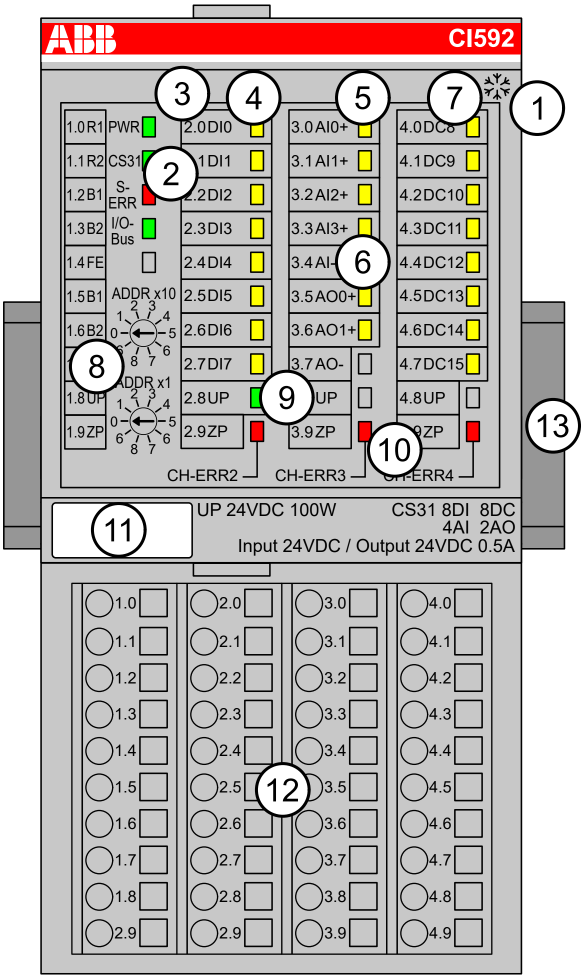
Part no.	Description	Product life cycle phase *)
1SAP 221 100 R0001	CI590-CS31-HA, CS31 redundant communication interface module, 16 DC	Active
1SAP 421 100 R0001	CI590-CS31-HA-XC, CS31 redundant communication interface module, 16 DC, XC version	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

1.8.3.2 CI592-CS31 - Digital and analog inputs and outputs

- 8 digital inputs 24 V DC
- 8 configurable digital inputs/outputs 24 V DC

- 4 analog inputs (resolution 12 bits plus sign)
- 2 analog outputs (resolution 12 bits plus sign)
- CS31 bus connection
- Module-wise galvanically isolated
- Fast counter
- XC version for usage in extreme ambient conditions available



1 I/O bus
2 4 system LEDs
3 Allocation between terminal number and signal name
4 8 yellow LEDs to display the signal states of the digital inputs DI0 ... DI7
5 4 yellow LEDs to display the signal states of the analog inputs AI0 ... AI3
6 2 yellow LEDs to display the signal states of the analog outputs AO0 ... AO1
7 8 yellow LEDs to display the signal states of the configurable digital inputs/outputs DC8 ... DC15
8 2 rotary switches to set the module's address (00d ... 99d)
9 1 green LED to display the process voltage UP
10 3 red LEDs to display errors
11 Label
12 Terminal unit
13 DIN rail
Sign for XC version

1.8.3.2.1 Intended purpose

The CS31 bus module is used as a decentralized I/O module on CS31 field buses. The bus connection is performed on a RS-485 serial interface, which allows the connection of this module to all existing CS31 buses. In addition, the CS31 bus module provides 22 I/O channels with the following properties:

- 8 digital inputs, 24 V DC
- 8 configurable digital inputs/outputs 24 V DC, 0.5 A max.
- 4 analog inputs, voltage, current and RTD, resolution 12 bits plus sign
- 2 analog outputs, voltage and current, resolution 12 bits plus sign

The configuration is performed by software.

For usage in extreme ambient conditions (e.g. wider temperature and humidity range), a special XC version of the device is available.

1.8.3.2.2 Functionality

Interface	RS-485, CS31 protocol
Address switches	For setting the module's address (00d ... 99d)
Digital inputs	8 (24 V DC; delay time configurable via software)
Configurable digital inputs/outputs	8 (24 V DC, 0.5 A max.)
Analog inputs	4 (configurable via software), resolution 12 bits plus sign, voltage, current and RTD input
Analog outputs	2 (configurable via software), resolution 12 bits plus sign, voltage and current output
Fast counter	Integrated, many configurable operating modes
LED displays	For system displays, signal statuses, errors and power supply
External supply voltage	Via terminals UP and ZP (process supply voltage 24 V DC)
Effect of incorrect input terminal connection	Wrong or no signal detected, no damage up to 35 V
Required terminal unit	TU551-CS31 or TU552-CS31 *Chapter 1.5.7 “TU551-CS31 and TU552-CS31 for CS31 communication interface modules” on page 304*

1.8.3.2.3 Connections

The CS31 communication interface module CI592-CS31 is plugged on the CS31 terminal unit TU551-CS31 or TU552-CS31 *Chapter 1.5.7 “TU551-CS31 and TU552-CS31 for CS31 communication interface modules” on page 304*. Hereby, it clicks in with two mechanical locks. The terminal unit is mounted on a DIN rail or with 2 screws plus the additional accessory for wall mounting *Chapter 1.9.3.5 “TA526 - Wall mounting accessory” on page 1361*.

> *For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.*

The connection is carried out by using the 40 terminals of the terminal unit TU551-CS31/TU552-CS31. It is possible to replace the CI592-CS31 without loosening the wiring.

Table 261: Assignment of the terminals

Terminal	Signal	Description
1.0	R1	Integrated terminating resistors for CS31 bus, Terminal 1
1.1	R2	Integrated terminating resistors for CS31 bus, Terminal 2
1.2	B1	CS31 bus, bus line 1
1.3	B2	CS31 bus, bus line 2
1.4	FE	Functional earth
1.5	B1	CS31 bus, bus line 1
1.6	B2	CS31 bus, bus line 2
1.7	FE	Functional earth
1.8	UP	Process voltage UP (24 V DC)
1.9	ZP	Process voltage ZP (0 V DC)
2.0	DI0	Signal of the digital input DI0
2.1	DI1	Signal of the digital input DI1
2.2	DI2	Signal of the digital input DI2
2.3	DI3	Signal of the digital input DI3
2.4	DI4	Signal of the digital input DI4
2.5	DI5	Signal of the digital input DI5
2.6	DI6	Signal of the digital input DI6
2.7	DI7	Signal of the digital input DI7
2.8	UP	Process voltage UP (24 V DC)
2.9	ZP	Process voltage ZP (0 V DC)
3.0	AI0+	Positive pole of analog input signal 0
3.1	AI1+	Positive pole of analog input signal 1
3.2	AI2+	Positive pole of analog input signal 2
3.3	AI3+	Positive pole of analog input signal 3
3.4	AI-	Negative pole of analog input signals 0 ... 3
3.5	AO0+	Positive pole of analog output signal 0
3.6	AO1+	Positive pole of analog output signal 1
3.7	AO-	Negative pole of analog output signals 0 and 1
3.8	UP	Process voltage UP (24 V DC)
3.9	ZP	Process voltage ZP (0 V DC)
4.0	C8	Signal of the configurable digital input/output C8
4.1	C9	Signal of the configurable digital input/output C9
4.2	C10	Signal of the configurable digital input/output C10
4.3	C11	Signal of the configurable digital input/output C11
4.4	C12	Signal of the configurable digital input/output C12

Terminal	Signal	Description
4.5	C13	Signal of the configurable digital input/output C13
4.6	C14	Signal of the configurable digital input/output C14
4.7	C15	Signal of the configurable digital input/output C15
4.8	UP	Process voltage UP (24 V DC)
4.9	ZP	Process voltage ZP (0 V DC)

WARNING!
Removal/Insertion under power
The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!
Risk of damaging the PLC modules!
Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

NOTICE!
Risk of imprecise and faulty measurements!
Analog signals may be distorted seriously by external electromagnetic influences.

Use shielded wires when wiring analog signal sources. The cable shield must be grounded at both ends of the cable. Provide a potential equalisation of a low resistance to avoid high potential differences between different parts of the plant.

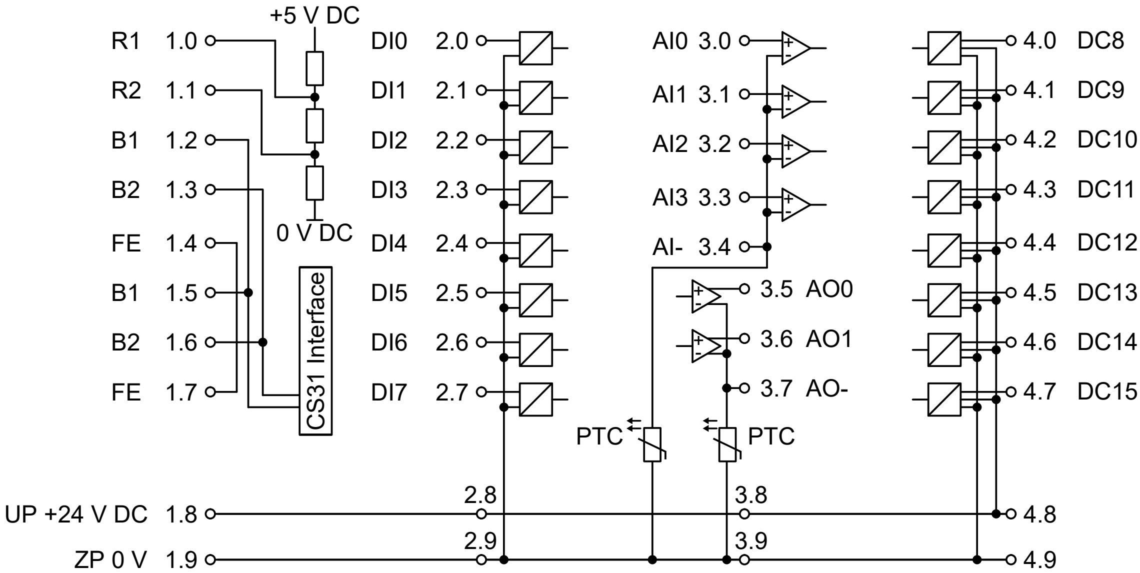


Fig. 255: Terminal assignment of the CS31 communication interface module CI592-CS31

The module provides several diagnosis functions *Chapter 1.8.3.2.9 "Diagnosis" on page 1028*.

The measuring ranges are described in the section Measuring Ranges *Chapter 1.8.3.2.8 "Parameterization" on page 1022* *Chapter 1.8.3.2.11 "Measuring ranges" on page 1031*:

The meaning of the LEDs is described in the section Status LEDs *Chapter 1.8.3.2.10 "State LEDs" on page 1030*.

Connection of the digital inputs

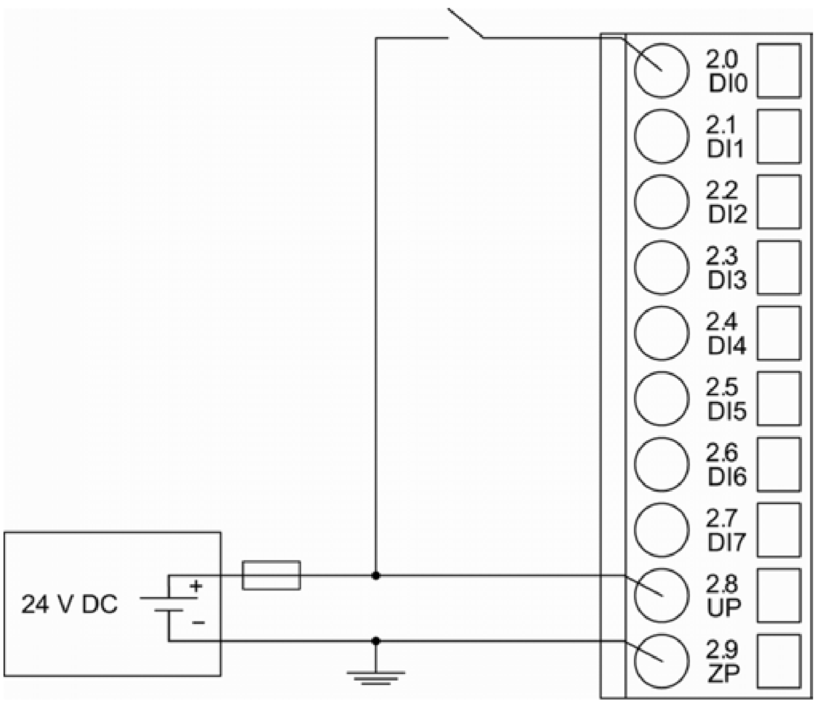


Fig. 256: Connection of the digital inputs (DI0 ... DI7)

Connection of the configurable digital inputs/outputs

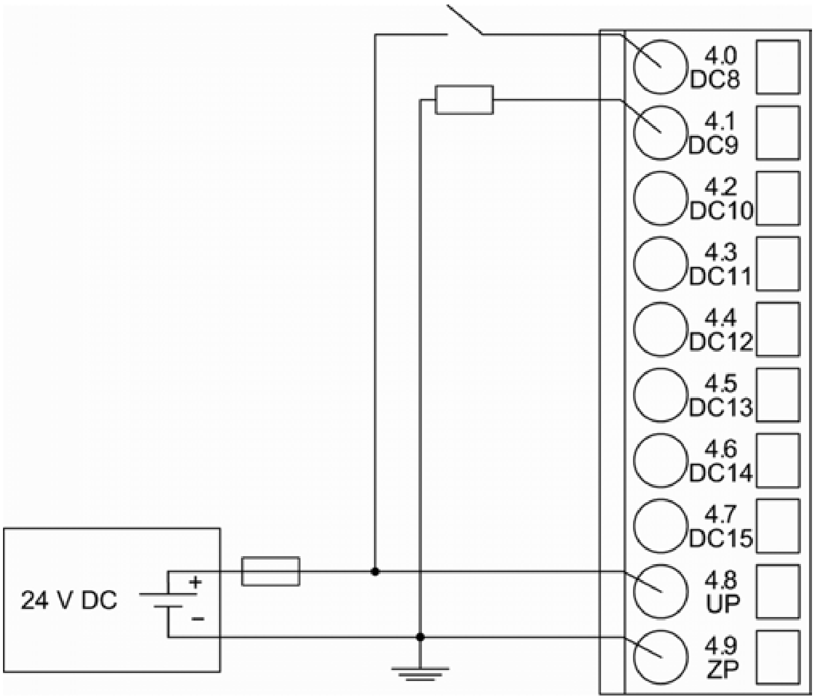


Fig. 257: Connection of configurable digital inputs/outputs (DC8 ... DC15)(DC8 as an input, DC9 as an output)

CAUTION!
Risk of influences to the connected sensors!
Some sensors may be influenced by the deactivated module outputs of CI592-CS31.

If using inputs as fast counter inputs, connect a 470 Ω / 1 W resistor in series to configurable inputs/outputs DC8/DC9.

Connection of resistance thermometers in 2-wire configuration to the analog inputs

When resistance thermometers (Pt100, Pt1000, Ni1000) are used, a constant current must flow to build the necessary voltage drop for the evaluation. For this, the module CI592-CS31 provides a constant current source which is multiplexed over the max. 4 analog input channels.

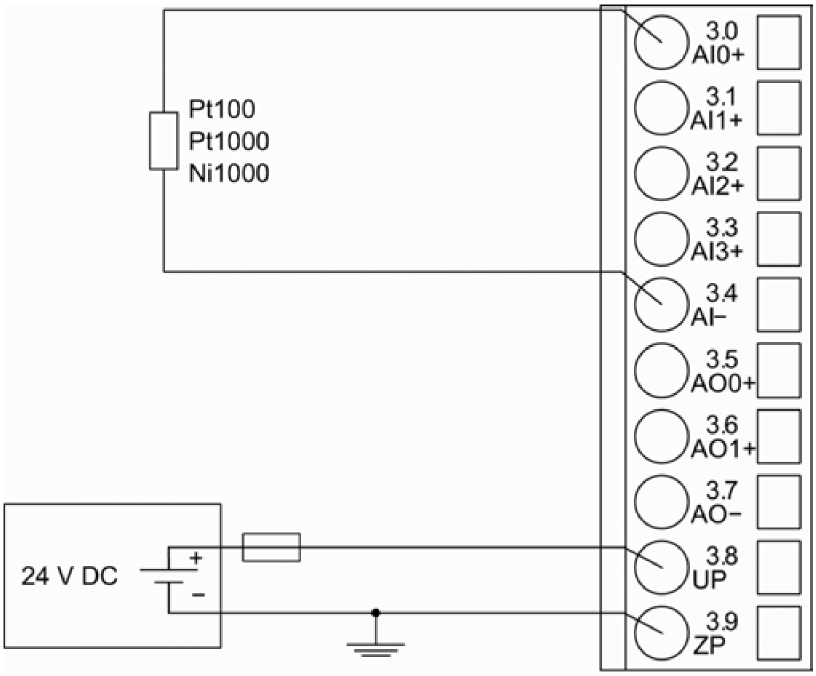


Fig. 258: Connection of resistance thermometers in 2-wire configuration to the analog inputs (AI0 ... AI3)

Pt100	-50 °C ... +400 °C	2-wire configuration, 1 channel used
Pt1000	-50 °C ... +400 °C	2-wire configuration, 1 channel used
Ni1000	-50 °C ... +150 °C	2-wire configuration, 1 channel used

The measuring ranges are described in the section Measuring Ranges *Chapter 1.8.3.2.8 “Parameterization” on page 1022* *Chapter 1.8.3.2.11 “Measuring ranges” on page 1031*:

The module CI592-CS31 performs a linearization of the resistance characteristic.

Configure unused analog input channels as "unused".

Connection of resistance thermometers in 3-wire configuration to the analog inputs

When resistance thermometers (Pt100, Pt1000, Ni1000) are used, a constant current must flow to build the necessary voltage drop for the evaluation. For this, the module CI592-CS31 provides a constant current source which is multiplexed over the max. 4 analog input channels.

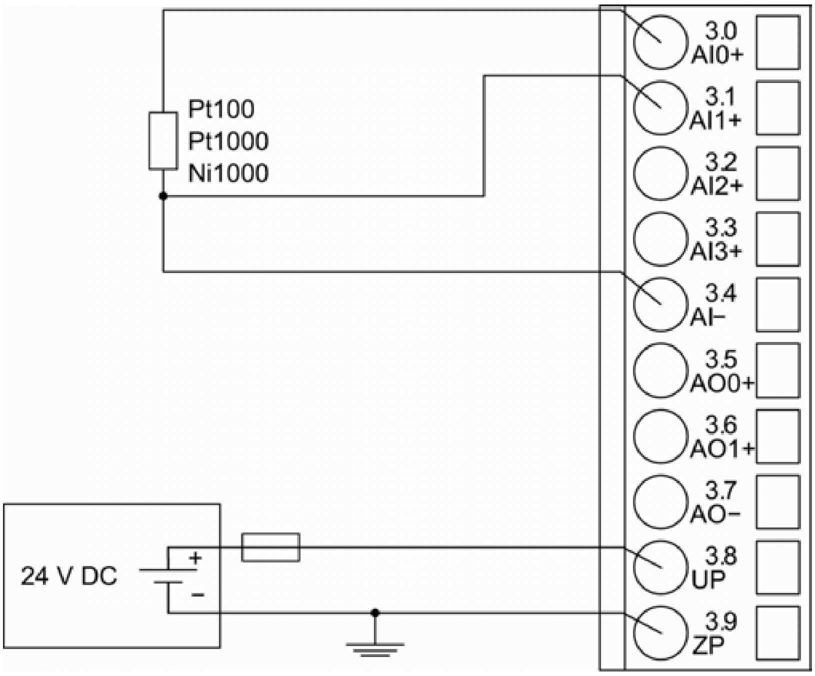


Fig. 259: Connection of resistance thermometers in 3-wire configuration to the analog inputs (AI0 ... AI3)

With 3-wire configuration, 2 adjacent analog channels belong together (e. g. the channels 0 and 1). In this case, both channels are configured according to the desired operating mode. The lower address must be the even address (channel 0), the next higher address must be the odd address (channel 1).

The constant current of one channel flows through the resistance thermometer. The constant current of the other channel flows through one of the cores. The module calculates the measured value from the two voltage drops and stores it under the input with the higher channel number (e. g. I1).

In order to keep measuring errors as small as possible, it is necessary to have all the involved conductors in the same cable. All the conductors must have the same cross section.

Pt100	3-wire configuration, 2 channels used
Pt1000	3-wire configuration, 2 channels used
Ni1000	3-wire configuration, 2 channels used

The measuring ranges are described in the section Measuring Ranges *Chapter 1.8.3.2.8 “Parameterization” on page 1022* *Chapter 1.8.3.2.11 “Measuring ranges” on page 1031*:

The module CI592-CS31 performs a linearization of the resistance characteristic.

To avoid error messages from unused analog input channels, configure them as "unused".

Connection of active-type analog sensors (Voltage) with galvanically power supply to the analog inputs

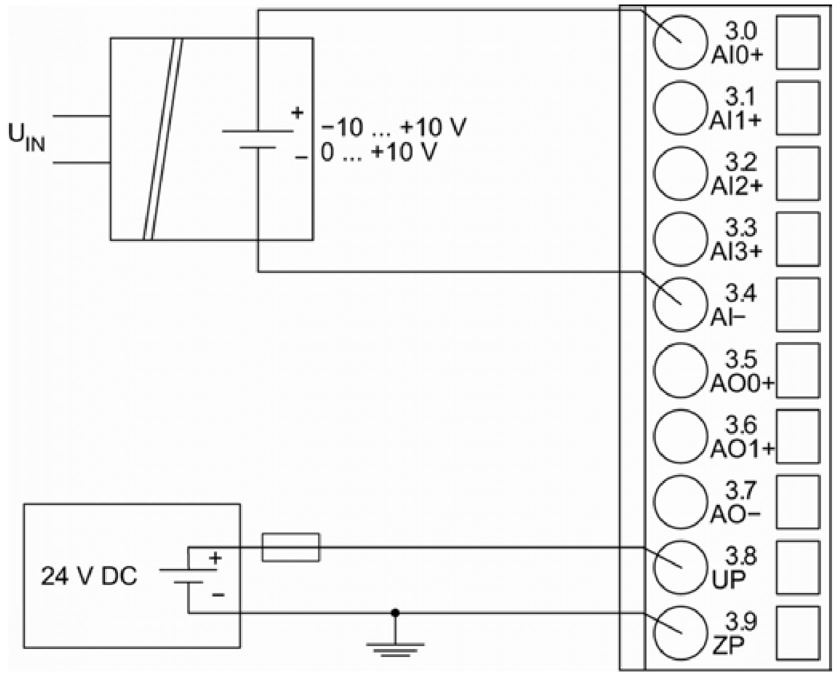


Fig. 260: Connection of active-type analog sensors (voltage) with galvanically power supply to the analog inputs (AI0 ... AI3)

Voltage	0 ... 10 V	1 channel used
Voltage	-10 V ... +10 V	1 channel used

The measuring ranges are described in the section Measuring Ranges *Chapter 1.8.3.2.8 “Parameterization” on page 1022* *Chapter 1.8.3.2.11 “Measuring ranges” on page 1031*:

To avoid error messages from unused analog input channels, configure them as "unused".

Connection of active-type analog sensors (Current) with galvanically isolated power supply to the analog inputs

The following figure shows the connection of active-type analog sensors (current) with galvanically isolated power supply to the analog input AI0. Proceed with the analog inputs AI1 ... AI3 in the same way.

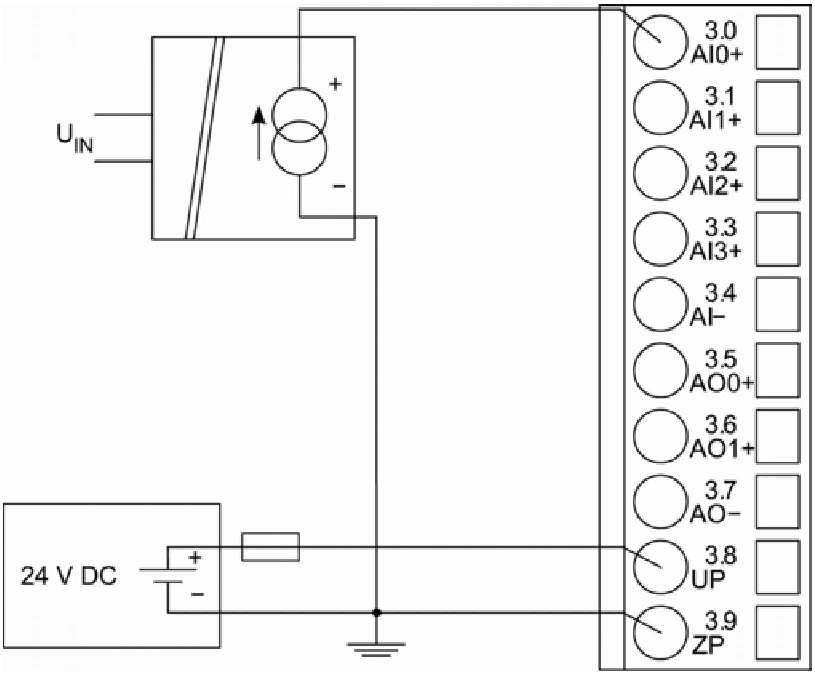


Fig. 261: Connection of active-type analog sensors (current) with galvanically isolated power supply to the analog inputs (AI0 ... AI3)

Current	0 ... 20 mA	1 channel used
Current	4 ... 20 mA	1 channel used

The measuring ranges are described in the section Measuring Ranges ✎ *Chapter 1.8.3.2.8 “Parameterization” on page 1022* ✎ *Chapter 1.8.3.2.11 “Measuring ranges” on page 1031*:

Unused input channels can be left open-circuited, because they are of low resistance.

Connection of active-type analog sensors (Voltage) with no galvanically isolated power supply to the analog inputs

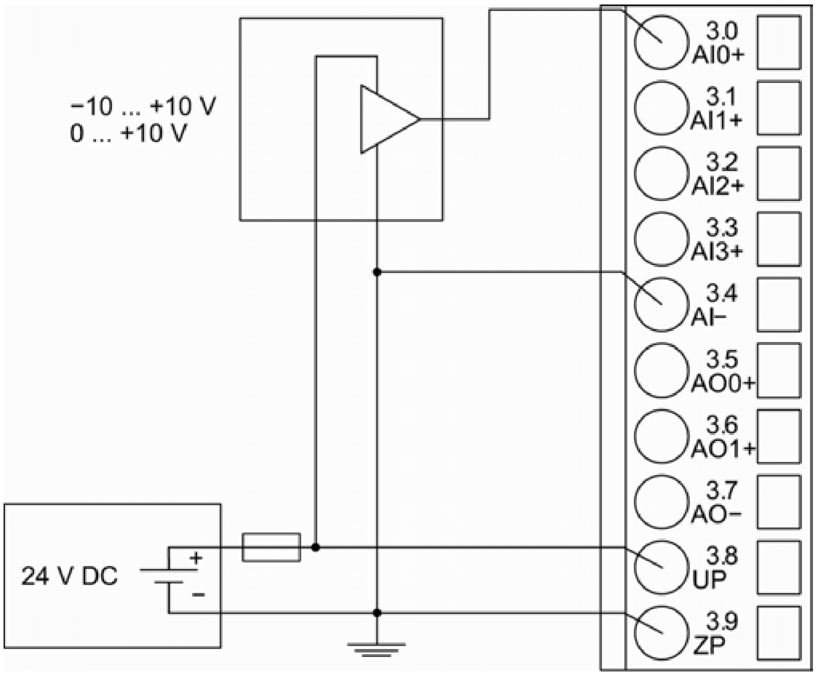


Fig. 262: Connection of active-type sensors (voltage) with no galvanically isolated power supply to the analog inputs (AI0 ... AI3)

NOTICE!
Risk of faulty measurements!
The negative pole/ground potential at the sensors must not have too large a potential difference with respect to ZP (max. ± 1 V within the full signal range).

Make sure that the potential difference never exceeds ± 1 V.

Voltage	0 ... 10 V	1 channel used
Voltage	-10 V ... +10 V	1 channel used

The measuring ranges are described in the section Measuring Ranges ➡ *Chapter 1.8.3.2.8 “Parameterization” on page 1022* ➡ *Chapter 1.8.3.2.11 “Measuring ranges” on page 1031*:

To avoid error messages from unused analog input channels, configure them as "unused".

Connection of passive-type analog sensors (current) to the analog inputs

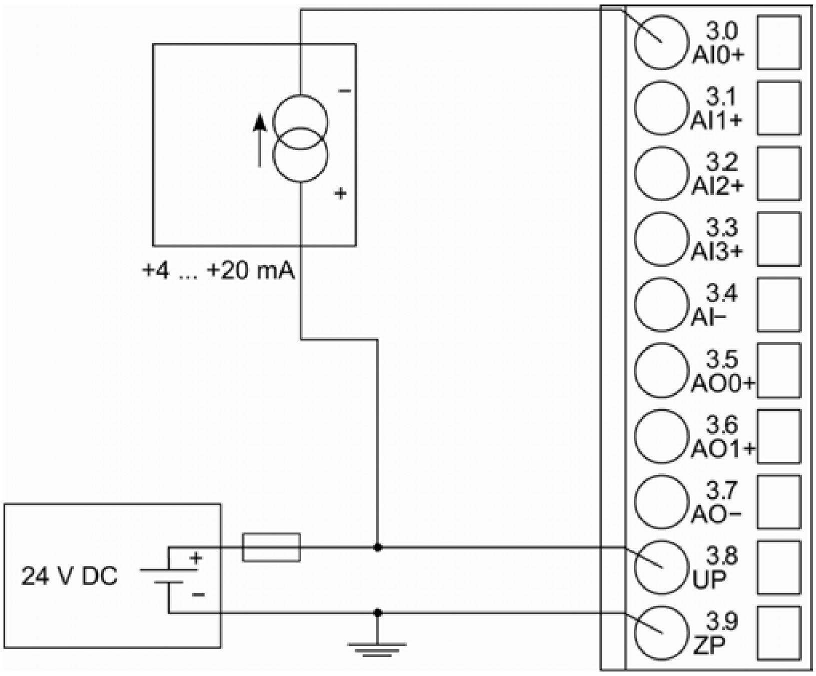


Fig. 263: Connection of passive-type analog sensors (current) to the analog inputs (AI0 ... AI3)

Current	4 ... 20 mA	1 channel used

The measuring ranges are described in the section Measuring Ranges *Chapter 1.8.3.2.8 “Parameterization” on page 1022* *Chapter 1.8.3.2.11 “Measuring ranges” on page 1031*:

CAUTION!
Risk of overloading the analog input!
If an analog current sensor supplies more than 25 mA for more than 1 second during initialization, this input is switched off by the module (input protection).

Use only sensors with fast initialization or without current peaks higher than 25 mA. If not possible, connect a 10-volt zener diode in parallel to I+ and I-.

Unused input channels can be left open-circuited, because they are of low resistance.

Connection of active-type analog sensors (Voltage) to differential analog inputs

Differential inputs are very useful, if analog sensors are used which are remotely non-isolated (e.g. the minus terminal is remotely grounded).

The evaluation using differential inputs helps to considerably increase the measuring accuracy and to avoid ground loops.

With differential input configurations, two adjacent analog channels belong together (e.g. the channels 0 and 1). In this case, both channels are configured according to the desired operating mode. The lower address must be the even address (channel 0), the next higher address must be the odd address (channel 1). The converted analog value is available at the higher address (channel 1).

The analog value is calculated by subtraction of the input value with the higher address from the input value of the lower address.

The converted analog value is available at the odd channel (higher address).

NOTICE!
Risk of faulty measurements!
The negative pole/ground potential at the sensors must not have too large a potential difference with respect to ZP (max. ± 1 V within the full signal range).

Make sure that the potential difference never exceeds ± 1 V.

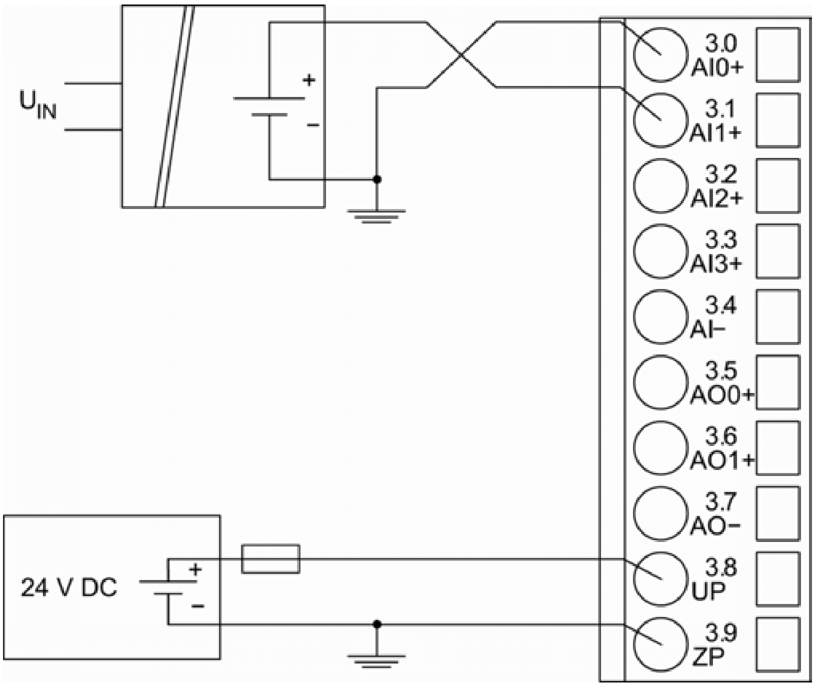


Fig. 264: Connection of active-type analog sensors (voltage) to differential analog inputs (AI0 ... AI3)

Voltage	0 ... 10 V	with differential inputs, 2 channels used
Voltage	-10 V ... +10 V	with differential inputs, 2 channels used

The measuring ranges are described in the section Measuring Ranges *Chapter 1.8.3.2.8 “Parameterization” on page 1022* *Chapter 1.8.3.2.11 “Measuring ranges” on page 1031*:

To avoid error messages from unused analog input channels, configure them as "unused".

Use of analog inputs as digital inputs

Several (or all) analog inputs can be configured as digital inputs. The inputs are not galvanically isolated against the other analog channels.

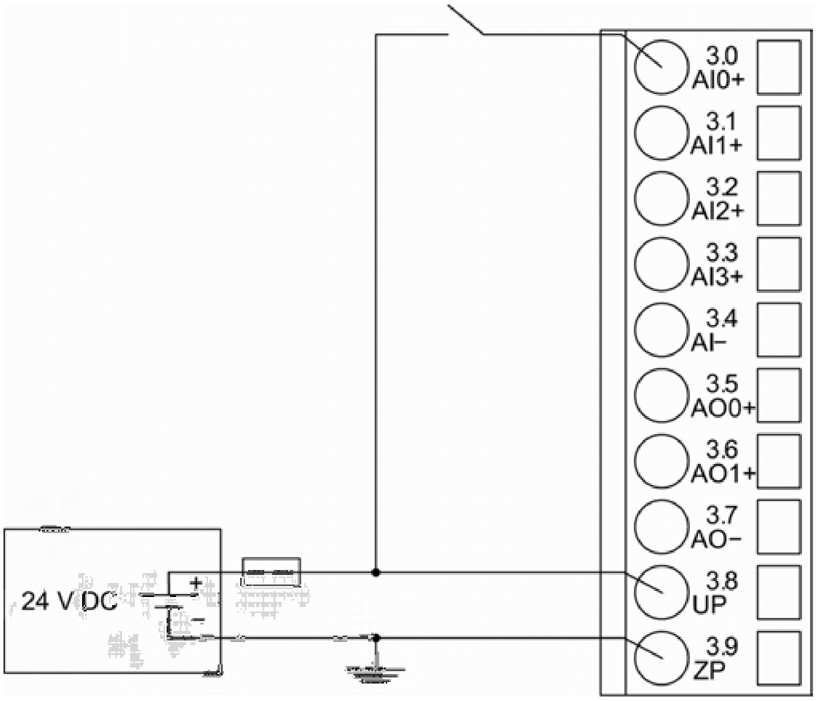


Fig. 265: Connection of digital sensors to the analog inputs (AI0 ... AI3)

Digital input	24 V	1 channel used

The measuring ranges are described in the section Measuring Ranges ␗ *Chapter 1.8.3.2.8 “Parameterization” on page 1022* ␗ *Chapter 1.8.3.2.11 “Measuring ranges” on page 1031*:

Connection of analog output loads (Voltage)

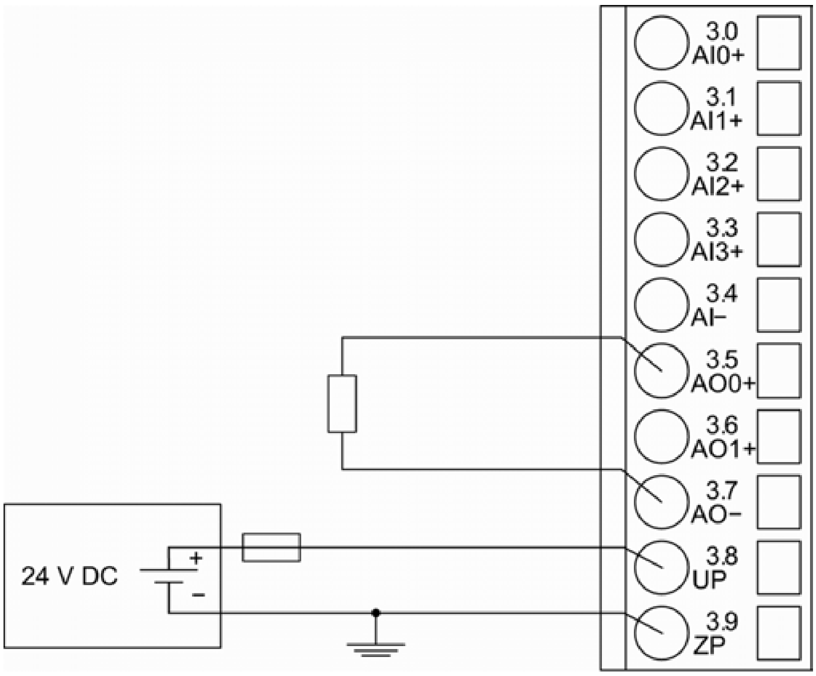


Fig. 266: Connection of analog output loads (voltage) to the analog outputs (AO0 and AO1)

Voltage	-10 V ... +10 V	Load ± 10 mA max.	1 channel used

The measuring ranges are described in the section Measuring Ranges *Chapter 1.8.3.2.8 “Parameterization” on page 1022* *Chapter 1.8.3.2.11 “Measuring ranges” on page 1031*:

Unused analog outputs can be left open-circuited.

Connection of analog output loads (Current)

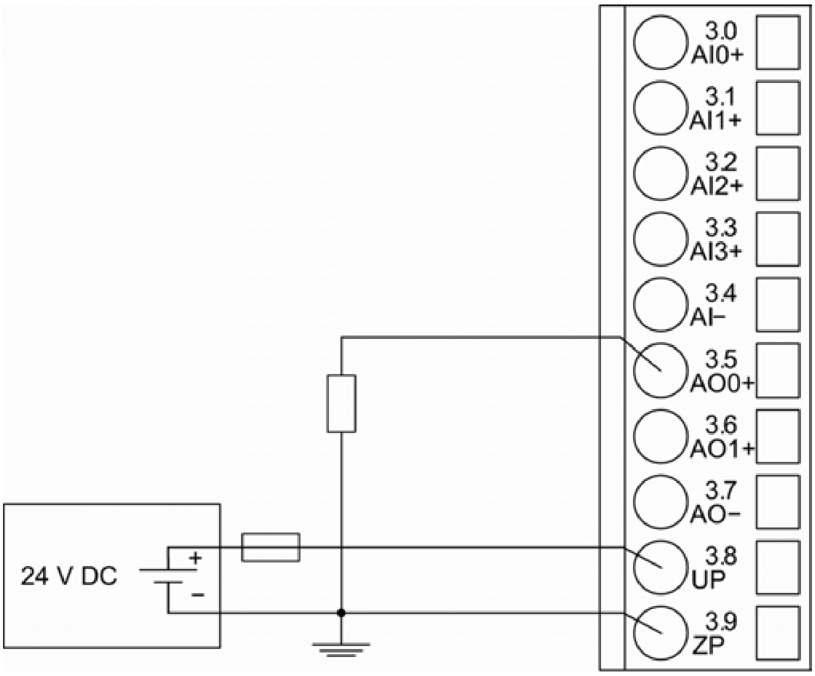


Fig. 267: Connection of analog output loads (current) to the analog outputs (AO0 and AO1)

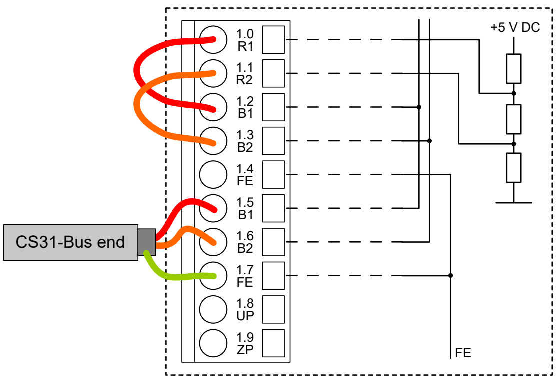
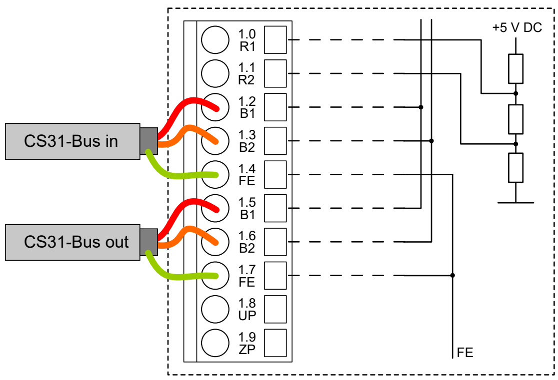
Current	0 ... 20 mA	Load 0 ... 500 Ω	1 channel used
Current	4 ... 20 mA	Load 0 ... 500 Ω	1 channel used

The measuring ranges are described in the section Measuring Ranges *Chapter 1.8.3.2.8 “Parameterization” on page 1022* *Chapter 1.8.3.2.11 “Measuring ranges” on page 1031*:

Unused analog outputs can be left open-circuited.

1.8.3.2.4 CS31 bus connections

Table 262: Different possibilities of connecting the CS31 buses to the CI592-CS31

	
Connection of CS31 bus - the CI592-CS31 is located at the bus end	Connection of CS31 bus - the CI592-CS31 is located at the middle of the bus

Details on CS31 wiring is described seperately ↳ *Chapter 2.6.4.9 “CS31 bus” on page 1441*.

1.8.3.2.5 Internal data exchange

	without the fast counter	with the fast counter (only with AC500)
Digital inputs (bytes)	2 + communication interface modules	4 + communication interface modules
Digital outputs (bytes)	1 + communication interface modules	3 + communication interface modules
Analog inputs (words)	4 + communication interface modules	4 + communication interface modules
Analog outputs (words)	2 + communication interface modules	2 + communication interface modules
Counter input data (words)	0	4
Counter output data (words)	0	8

1.8.3.2.6 I/O configuration

The CI592-CS31 module does not store configuration data itself. The configurable channels are defined as inputs or outputs by the user program, i.e. each of the configurable channels can be used as input or output (or re-readable output) by interrogation or allocation by the user program.

1.8.3.2.7 Addressing

An address must be set at every module so that the field bus communication module can access the specific inputs and outputs.

A detailed description concerning "addressing" can be found in the chapters "Addressing" of the CPUs and communication modules.

The address (00d ... 99d) is set with two rotary switches on the front panel of the module.

> *The CS31 bus module reads the position of the address switches only during the initialization after power ON, i.e. changes of the setting during operation remain ineffective.*

1.8.3.2.8 Parameterization

Parameters of the module - if used with fast counter

Name	Value	Internal value	Internal value, type	Default
Module ID 1)	Internal	2725	WORD	2725
Parameter length	Internal	22	BYTE	22
Error LED / Fail-safe function 2)	On	0	BYTE	0
	Off by E4	1		
	Off by E3	3		

Name	Value	Internal value	Internal value, type	Default
	On + failsafe	16		
	Off by E4 + fail-safe	17		
	Off by E3 + fail-safe	19		
Check supply	off	0	BYTE	
	on	1		1

If the communication interface module is configured as a fast counter module and '0 - no Counter' in Automation Builder is selected the channel ERR LEDs stays on and the module does not start up. The address was adjusted with '71'.

Only the '0- no Counter' mode does not operate. If any other counter is selected e.g. '1-1 Up counter' the module starts up and can be utilized.

Parameters of the module - if used without fast counter

Name	Value	Internal value	Internal value, type	Default
Module ID [1])	Internal	2726	WORD	2726
Parameter length	Internal	23	BYTE	23
Error LED / Fail-safe function [2])	On	0	BYTE	0
	Off by E4	1		
	Off by E3	3		
	On + failsafe	16		
	Off by E4 + fail-safe	17		
	Off by E3 + fail-safe	19		
Check supply	Off	0	BYTE	
	On	1		1

Remarks:

[1]) With a faulty Module ID, the Modules reports a "parameter error" and does not perform cyclic process data transmission

[2]) Error LED/Failsafe function:

Setting	Description
On	Error-LED lights up at errors of all error classes, Failsafe mode off
Off by E4	Error LED lights up at errors of error classes E1, E2 and E3, Failsafe mode off
Off by E3	Error LED lights up at errors of error classes E1 and E2, Failsafe mode off

Setting	Description
On +Failsafe	Error-LED lights up at errors of all error classes, Failsafe mode on *)
Off by E4 + Failsafe	Error LED lights up at errors of error classes E1, E2 and E3, Failsafe mode on *)
Off by E3 + Failsafe	Error LED lights up at errors of error classes E1 and E2, Failsafe mode on *)

*) The parameters behaviourAOatCommunicationFault and behaviourDOatCommunicationFault are only analyzed if the Failsafe mode is ON.

Group parameters for the digital part

Name	Value	Internal value	Internal value, type	Default
Input delay	0.1 ms 1 ms 8 ms 32 ms	0 1 2 3	BYTE	0.1 ms 0x00
Fast counter	No counter 1 Up counter 1 Up counter with release input 2 UpDown counters 2 UpDown (2. On falling edges) 1 Updown dynamic set/ rising edge 1 Updown dynamic set/ falling edge 1 UpDown directional discriminator Reserved 1 UpDown directional discriminator x2 1 UpDown directional discriminator x4	0 1 2 3 4 5 6 7 8 9 10	BYTE	0
Detect short circuit at outputs	Off On	0 1	BYTE	On 0x01

Name	Value	Internal value	Internal value, type	Default
Behaviour DO at comm. error *)	Off Last value Last value 5 sec Last value 10 sec Substitute value Substitute value 5 sec Substitute value 10 sec	0 1 6 11 2 7 12	BYTE	Off 0x00
Substitute value at output	0 ... 255	00h ... FFh	BYTE	0 0x0000

*) The parameter Behaviour DO at comm. error is only analyzed if the Failsafe-mode is ON.

Group parameters for the analog part

Name	Value	Internal value	Internal value, type	Default
Analog data format	Standard Reserved	0 255	BYTE	0
Behaviour AO at comm. error *)	Off Last value Last value 5 s Last value 10 s Substitute value Substitute value 5 s Substitute value 10 s	0 1 6 11 2 7 12	BYTE	0

*) The parameter Behaviour AO at comm. error is only analyzed if the Failsafe-mode is ON.

Channel parameters for the analog inputs (4x)

Name	Value	Internal value	Internal value, type	Default
Input 0, Channel configuration	see table 1)	see table 1)	BYTE	0
Input 0, Check channel	see table 2)	see table 2)	BYTE	0
:	:	:	:	:
:	:	:	:	:

Name	Value	Internal value	Internal value, type	Default
Input 3, Channel configuration	see table [1])	see table [1])	BYTE	0
Input 3, Check channel	see table [2])	see table [2])	BYTE	0

Table 263: Channel configuration [1])

Internal value	Operating modes of the analog inputs, individually configurable
0 (default)	Not used
1	0 V ... 10 V
2	Digital input
3	0 mA ... 20 mA
4	4 mA ... 20 mA
5	-10 V ... +10 V
8	2-wire Pt100 -50 °C ... +400 °C
9	3-wire Pt100 -50 ... +400 °C *)
10	0 ... 10 V (voltage diff.) *)
11	-10 V ... +10 V (voltage diff.) *)
14	2-wire Pt100 -50 °C ... +70 °C
15	3-wire Pt100 -50 °C ... +70 °C *)
16	2-wire Pt1000 -50 °C ... +400 °C
17	3-wire Pt1000 -50 °C ... +400 °C *)
18	2-wire Ni1000 -50 °C ... +150 °C
19	3-wire Ni1000 -50 °C ...+150 °C *)
	*) In the operating modes with 3-wire configuration or with differential inputs, two adjacent analog inputs belong together (e.g. the channels 0 and 1). In these cases, both channels are configured in the desired operating mode. The lower address must be the even address (channel 0). The next higher address must be the odd address (channel 1). The converted analog value is available at the higher address (channel 1).

Table 264: Channel monitoring [2])

Internal Value	Check Channel
0 (default)	Plausib(ility), cut wire, short circuit
3	Not used

Channel parameters for the analog outputs (2x)

Name	Value	Internal value	Internal value, type	Default
Output 0, Channel configuration	see table [3])	see table [3])	BYTE	0
Output 0, Check channel	see table [4])	see table [4])	BYTE	0
Output 0, Substitute value	see table [5])	see table [5])	WORD	0
Output 1, Channel configuration	see table [3])	see table [3])	BYTE	0
Output 1, Check channel	see table [4])	see table [4])	BYTE	0
Output 1, Substitute value	see table [5])	see table [5])	WORD	0

Table 265: Channel configuration [3])

Internal value	Operating modes of the analog outputs, individually configurable
0 (default)	Not used
128	-10 V ... +10 V
129	0 ... 20 mA
130	4 ... 20 mA

Table 266: Channel monitoring [4])

Internal value	Check channel
0	Plausib(ility), cut wire, short circuit
3	None

Table 267: Substitute value [5])

Intended behavior of output channel when the control system stops	Required setting of the module parameter "Behaviour of outputs in case of a communication error"	Required setting of the channel parameter "Substitute value"
Output OFF	Off	0
Last value infinite	Last value	0
Last value for 5 s and then turn off	Last value 5 sec	0
Last value for 10 s and then turn off	Last value 10 sec	0
Substitute value infinite	Substitute value	Depending on configuration
Substitute value for 5 s and then turn off	Substitute value 5 sec	Depending on configuration
Substitute value for 10 s and then turn off	Substitute value 10 sec	Depending on configuration

1.8.3.2.9 Diagnosis

In cases of short circuit or overload, the digital outputs are turned off. The modules performs reactivation automatically. Thus an acknowledgement of the errors is not necessary. The error message is stored via the LED.

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier 000 ... 063**	**AC500-Display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 6 Bit 6 ... 7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0 ... 5**	**PNIO diag-nosis block**	
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error identi-fier**	**Error message**	**Remedy**
	1)	2)	3)	4)			
Module errors CI592-CS31							
3	11	ADR	31	31	19	Checksum error in the I/O module	Replace I/O module
3	11	ADR	31	31	3	Timeout in the I/O module	
3	11	ADR	31	31	40	Different hard-/firm-ware versions in the module	
3	11	ADR	31	31	43	Internal error in the module	
3	11	ADR	31	31	36	Internal data exchange failure	
3	11	ADR	31	31	9	Overflow diagnosis buffer	Restart
3	11	ADR	31	31	26	Parameter error	Check master
3	11	ADR	31	31	11	Process voltage UP too low	Check process supply voltage
3	11	ADR	31/1 ... 7	31	17	No communication with I/O module	Replace I/O module
3	11	ADR	1 ... 7	31	32	Wrong I/O module type on socket	Replace I/O module / Check configu-ration
4	11	ADR	31	31	45	Process voltage UP OFF	Turn process voltage ON

E1 ... E4	d1	d2	d3	d4	Identi-fier 000 ... 063	AC500-Display	<− Display in
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 6 **Bit 6 ... 7**	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6** **Bit 0 ... 5**	**PNIO diag-nosis block**	
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error identi-fier**	**Error message**	**Remedy**
	1)	2)	3)	4)			
4	11	ADR	1 ... 7	31	31	At least one module does not support failsafe function	Check modules and parame-terization
4	11	ADR	31/1 ... 7	31	34	No response during initialization of the I/O module	Replace I/O module
Channel error digital CI592-CS31							
4	11	ADR	31/1 ... 7	14 ... 21 5)	47	Short circuit at dig-ital output	Check terminals
Channel error analog CI592-CS31							
4	11	ADR	31/1 ... 7	8 ... 11 6)	48	Analog value over-flow or broken wire at an analog input	Check value or check terminals
4	11	ADR	31/1 ... 7	8 ... 11 6)	7	Analog value underflow at an analog input	Check value
4	11	ADR	31/1 ... 7	8 ... 11 6)	47	Short-circuit at an analog input	Check terminals
4	11	ADR	31/1 ... 7	12 ... 13 7)	4	Analog value over-flow at an analog output	Check output value
4	11	ADR	31/1 ... 7	12 ... 13 7)	7	Analog value underflow at an analog output	Check output value

Remarks:

1)	In AC500 the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The FBP diagnosis block does not contain this identifier.
2)	With "Device" the following allocation applies: 31 = Module itself, 1 ... 7 = expansion module 1 ... 7, ADR = Hardware address (e.g. of the DC551)

[3])	With "Module" the following allocation applies: 31 = Module itself; 1 ... 7 = expansion 1 ... 7
[4])	In case of module errors, with channel "31 = Module itself" is output.
[5])	Ch = 14 ... 21 indicates the digital inputs/outputs DC8 ... DC15
[6])	Ch = 8 ... 11 indicates the analog inputs AI0 ... AI3
[7])	Ch = 12 ... 13 indicates the analog outputs AO0 ... AO1

1.8.3.2.10 State LEDs

The LEDs are located at the front of module. There are 2 different groups:

- The 4 system LEDs (PWR, CS31, S-ERR and I/O-Bus) show the operation state of the module and display possible errors.
- The 26 process LEDs (UP, inputs, outputs, CH-ERR2 to CH-ERR4) show the process supply voltage and the states of the inputs and outputs and display possible errors.

Table 268: State of the 4 system-LEDs:

LED	State	Color	OFF	ON	Flashing
PWR/RUN	System voltage	Green	Process supply voltage missing	Internal supply voltage OK, module ready for communication with I/O Controller	Start-up / preparing communication
CS31	CS31 communication	Green	No communication at the CS31 bus module	Communication at the CS31 bus OK	Diagnosis mode
S-ERR	Sum Error	Red	No error	Internal error	--
I/O-Bus	Communication via the I/O bus	Green	No communication interface module connected or communication error	Communication interface module connected and operational	---

Table 269: State of the 27 process LEDs:

LED	State	Color	OFF	ON	Flashing
DI0 ... DI7	Digital input	Yellow	Input is OFF	Input is ON (the input voltage is even dis-played if the supply voltage is OFF)	--
DC8 ... DC15	Digital input/ output	Yellow	Input/output is OFF	Input/output is ON (the input voltage is even dis-played if the supply voltage is OFF)	--
AI0 ... AI3	Analog input	Yellow	Input is OFF	Input is ON (brightness depends on the value of the analog signal)	--
AO0 ... AO1	Analog output	Yellow	Output is OFF	Output is ON (brightness depends on the value of the analog signal)	--
UP	Process supply voltage 24 V DC via terminal	Green	Process supply voltage is missing	Process supply voltage OK	--
CH-ERR2	Channel Error, error mes-sages in groups (digital inputs/outputs combined into the groups 1, 2, 3, 4)	Red	No error or process supply voltage is missing	Severe error within the cor-responding group	Severe error within the cor-responding group (e.g. short-circuit at an output)
CH-ERR3		Red			
CH-ERR4		Red			
CH-ERR *)	Module Error	Red	--	Internal error	--
*) All of the LEDs CH-ERR2 to CH-ERR4 light up together					

1.8.3.2.11 Measuring ranges

Input ranges voltage, current and digital input

Range	0 V ... 10 V	-10 V ... +10 V	0 mA ... 20 mA	4 mA ... 20 mA	Digital input	Digital value	
						Decimal	Hex.
Overflow	>11.7589	>11.7589	>23.5178	>22.8142		32767	7FFF
Measured value too high	11.7589 : 10.0004	11.7589 : 10.0004	23.5178 : 20.0007	22.8142 : 20.0006		32511 : 27649	7EFF : 6C01

Range	**0 V ... 10 V**	**-10 V ... +10 V**	**0 mA ... 20 mA**	**4 mA ... 20 mA**	**Digital input**	**Digital value**	
						Decimal	**Hex.**
Normal range	10.0000 : 0.0004	10.0000 : 0.0004	20.0000 : 0.0007	20.0000 : 4.0006	: : On	27648 : 1	6C00 : 0001
Normal range or measured value too low	0.0000	0.0000	0	4	Off	0	0000
	-0.0004 -1.7593	-0.0004 : : : -10,0000		3.9994 : 0		-1 -4864 -6912 : -27648	FFFF ED00 E500 : 9400
Measured value too low		-10.0004 : -11.7589				-27649 : -32512	93FF : 8100
Underflow	<0.0000	<-11.7589	<0.0000	<0.0000		-32768	8000

The represented resolution corresponds to 16 bits.

Input range resistor

Range	**Pt100 / Pt1000** **-50 °C ... +400 °C**	**Ni1000** **-50 °C ... +150 °C**	**Digital value**	
			Decimal	**Hex.**
Overflow	> +450.0 °C	> +160.0 °C	32767	7FFF
Measured value too high	+450.0 °C : +400.1 °C		4500 : 4001	1194 : 0FA1
		+160.0 °C : + 150.1 °C	1600 : 1501	0640 : 05DD
			800 : 701	0320 : 02BD
Normal range	+400.0 °C : : : +0.1 °C	+150.0 °C : : +0.1 °C	4000 1500 700 : 1	0FA0 05DC 02BC : 0001
	0.0 °C	0.0 °C	0	0000
	-0.1 °C : -50.0 °C	-0.1 °C : -50.0 °C	-1 : -500	FFFF : FE0C

Range	Pt100 / Pt1000 -50 °C ... +400 °C	Ni1000 -50 °C ... +150 °C	Digital value	
			Decimal	**Hex.**
Measured value too low	-50.1 °C : -60.0 °C	-50.1 °C : -60.0 °C	-501 : -600	FE0B : FDA8
Underflow	< -60.0 °C	< -60.0 °C	-32768	8000

Output ranges voltage and current

Range	-10 V ... +10 V	0 mA ... 20 mA	4 mA ... 20 mA	Digital value	
				Decimal	**Hex.**
Overflow	0 V	0 mA	0 mA	> 32511	> 7EFF
Measured value too high	11.7589 V : 10.0004 V	23.5178 mA : 20.0007 mA	22.8142 mA : 20.0006 mA	32511 : 27649	7EFF : 6C01
Normal range	10.0000 V : 0.0004 V	20.0000 mA : 0,0007 mA	20.0000 mA : 4.0006 mA	27648 : 1	6C00 : 0001
	0.0000 V	0.0000 mA	4.0000 mA	0	0000
	-0.0004 V : -10.0000 V	0 mA : 0 mA	3.9994 mA 0 mA 0 mA	-1 -6912 -27648	FFFF E500 9400
Measured value too low	-10.0004 V : -11.7589 V	0 mA : 0 mA	0 mA : 0 mA	-27649 : -32512	93FF : 8100
Underflow	0 V	0 mA	0 mA	< -32512	< 8100

The represented resolution corresponds to 16 bits.

1.8.3.2.12 Technical data

Technical data of the module

The system data of AC500 and S500 are applicable to the standard version *Chapter 2.6.1 “System data AC500” on page 1408*.

The system data of AC500-XC are applicable to the XC version *Chapter 2.7.1 “System data AC500-XC” on page 1475*.

Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

Multiple overloads
No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an internal smart high-side switch.

Parameter		Value
Process supply voltage UP:		
	Rated value	24 V DC
	Protection against reverse voltage	Yes
	Rated protection fuse at UP	10 A fast
Current consumption		
	From UP	0.07 A + max. 0.5 A per output
	From 24 V DC power supply at the terminals UP/L+ and ZP/M of the CPU/ communication interface module (depending on system architecture)	5 mA
	Inrush current from UP (power-up)	0.040 A^2s
Interface		RS-485
Protocol		CS31
Galvanic isolation		Yes, CS31 bus from the rest of the module
Max. power dissipation within the module		6 W (outputs unloaded)
Rotary switch		2 rotary switches on the front panel for setting the module's address
Operating and error displays		30 LEDs (totally)
Weight (without terminal unit)		Approx. 125 g

NOTICE!
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and temporary overvoltage up to 30 V DC.

Technical data of the digital inputs

Parameter	Value
Number of channels per module	8
Distribution of the channels into groups	1 group of 8 channels
Terminals of the channels DI0 ... DI7	Terminals 1.0 ... 1.7
Reference potential for all inputs	Terminals 1.9 ... 3.9 (negative pole of the supply voltage, signal name ZP)
Indication of the input signals	1 yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Input type (according EN 61131-2)	Type 1
Input delay (0->1 or 1->0)	Typ. 0.1 ms, configurable from 0.1ms ... 32 ms
Input signal voltage	24 V DC

Parameter		Value
	Signal 0	-3 V ... +5 V
	Undefined Signal	> +5 V ... < +15 V
	Signal 1	+15 V ... +30 V
Ripple with signal 0		Within -3 V ... +5 V
Ripple with signal 1		Within +15 V ... +30 V
Input current per channel		
	Input voltage +24 V	Typ. 5 mA
	Input voltage +5 V	> 1 mA
	Input voltage +15 V	> 2 mA
	Input voltage +30 V	< 8 mA
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

Technical data of the configurable digital inputs/outputs

Each of the configurable digital I/O channels can be defined as input or output by the user program. This is done by interrogating or allocating the corresponding channel.

Parameter		Value
Number of channels per module		8 inputs/outputs (with transistors)
Distribution of the channels into groups		1 group for 8 channels
If the channels are used as inputs		
	Channels DC8 ... DC15	Terminals 4.0 ... 4.7
If the channels are used as outputs		
	Channels DC8 ... DC15	Terminals 4.0 ... 4.7
Indication of the input/output signals		1 yellow LED per channel, the LED is ON when the input/output signal is high (signal 1)
Galvanic isolation		Yes, per module

Technical data of the digital inputs/outputs if used as inputs

Parameter	Value
Number of channels per module	8
Distribution of the channels into groups	1 group of 8 channels
Terminals of the channels DC8 ... DC15	Terminals 4.0 ... 4.7
Reference potential for all inputs	Terminals 1.9 ... 4.9 (negative pole of the supply voltage, signal name ZP)
Indication of the input signals	1 yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Input type (according EN 61131-2)	Type 1

Parameter	Value
Input delay (0->1 or 1->0)	Typ. 0.1 ms, configurable from 0.1...32 ms
Input signal voltage	24 V DC
0-Signal	-3 V ... +5 V *)
Undefined Signal	> +5 V ... < +15 V
1-Signal	+15 V ... +30 V
Ripple with signal 0	Within -3 V ... +5 V *)
Ripple with signal 1	Within +15 V ... +30 V
Input current per channel	
Input voltage +24 V	Typ. 5 mA
Input voltage +5 V	> 1 mA
Input voltage +15 V	> 2 mA
Input voltage +30 V	< 8 mA
Max. cable length	
Shielded	1000 m
Unshielded	600 m

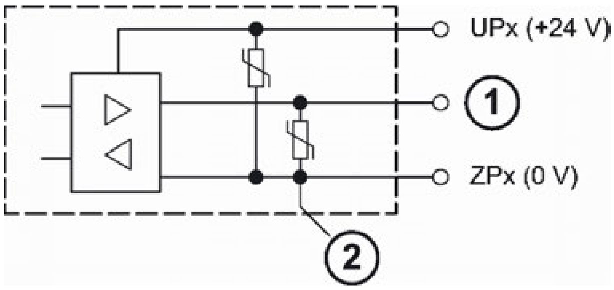
*) Due to the direct connection to the output, the demagnetizing varistor is also effective at the input (see figure) above. This is why the difference between UPx and the input signal may not exceed the clamp voltage of the varistor. The varistor limits the voltage to approx. 36 V. Following this, the input voltage must range from -12 V ... +30 V when UPx = 24 V and from -6 V ... +30 V when UPx = 30 V.

Technical data of the digital inputs/outputs if used as outputs

Parameter	Value
Number of channels per module	8
Distribution of the channels into groups	1 group of 8 channels
Terminals of the channels DC8 ... DC15	Terminals 4.0 ... 4.7
Reference potential for all outputs	Terminals 1.9 ... 4.9 (negative pole of the supply voltage, signal name ZP)
Common power supply voltage	For all outputs terminals 1.8, 2.8, 3.8 and 4.8 (positive pole of the supply voltage, signal name UP)
Output voltage for signal 1	UP (-0.8 V)
Output delay (0->1 or 1->0)	On request
Output current	
Rated value per channel	500 mA at UP = 24 V
Max. value (all channels together)	4 A
Leakage current with signal 0	< 0.5 mA
Fuse for UP	10 A fast
Demagnetization with inductive DC load	Via internal varistors (see figure below this table)
Output switching frequency	
With resistive load	On request

Parameter		Value
	With inductive loads	Max. 0.5 Hz
	With lamp loads	11 Hz max. at 5 W max.
Short-circuit-proof / overload-proof		Yes
Overload message (I > 0.7 A)		Yes, after ca. 100 ms
Output current limitation		Yes, automatic reactivation after short circuit/overload
Resistance to feedback against 24 V signals		Yes (software-controlled supervision)
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

The following drawing shows the circuitry of a digital input/output with the varistors for demagnetization when inductive loads are switched off.



1 Digital input/output
2 For demagnetization when inductive loads are turned off

Technical data of the fast counter

Parameter	Value
Used inputs	DC8 / DC9
Used outputs	DC10
Counting frequency	Max. 50 kHz

Technical data of the analog inputs

Parameter		Value
Number of channels per module		4
Distribution of channels into groups		1 group with 4 channels
Connection if channels AI0+ ... AI3+		Terminals 3.0 ... 3.3
Reference potential for AI0+ ... AI3+		Terminal 3.4 (AI-) for voltage and RTD measurement Terminal 1.9, 2.9, 3.9 and 4.9 for current measurement
Input type		
	Unipolar	Voltage 0 V ... 10 V, current or Pt100/Pt1000/Ni1000

Parameter		Value
	Bipolar	Voltage -10 V ... +10 V
Configurability		0 V ... 10 V, -10 V ... +10 V, 0 mA ... 20 mA, 4 mA ... 20mA, Pt100/1000, Ni1000 (each input can be configured individually)
Channel input resistance		Voltage: > 100 kΩ Current: ca. 330 Ω
Time constant of the input filter		Voltage: 100 µs Current: 100 µs
Indication of the input signals		1 LED per channel (brightness depends on the value of the analog signal)
Conversion cycle		1 ms (for 4 inputs + 2 outputs); with RTDs Pt/Ni... 1 s
Resolution		Range 0 V ... 10 V: 12 bits Range -10 V ... +10 V: 12 bits + sign Range 0 mA ... 20 mA: 12 bits Range 4 mA ... 20 mA: 12 bits Range RTD (Pt100, PT1000, Ni1000): +0.1 °C
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range		Typ. 0.5 %, max. 1 %
Relationship between input signal and hex code		Tables Input Ranges Voltage, Current and Digital Input *Chapter 1.8.3.2.11.1 “Input ranges voltage, current and digital input” on page 1031* and Input Range Resistor *Chapter 1.8.3.2.11.2 “Input range resistor” on page 1032*
Unused inputs		Are configured as "unused" (default value)
Overvoltage protection		Yes

Technical data of the analog inputs, if used as digital inputs

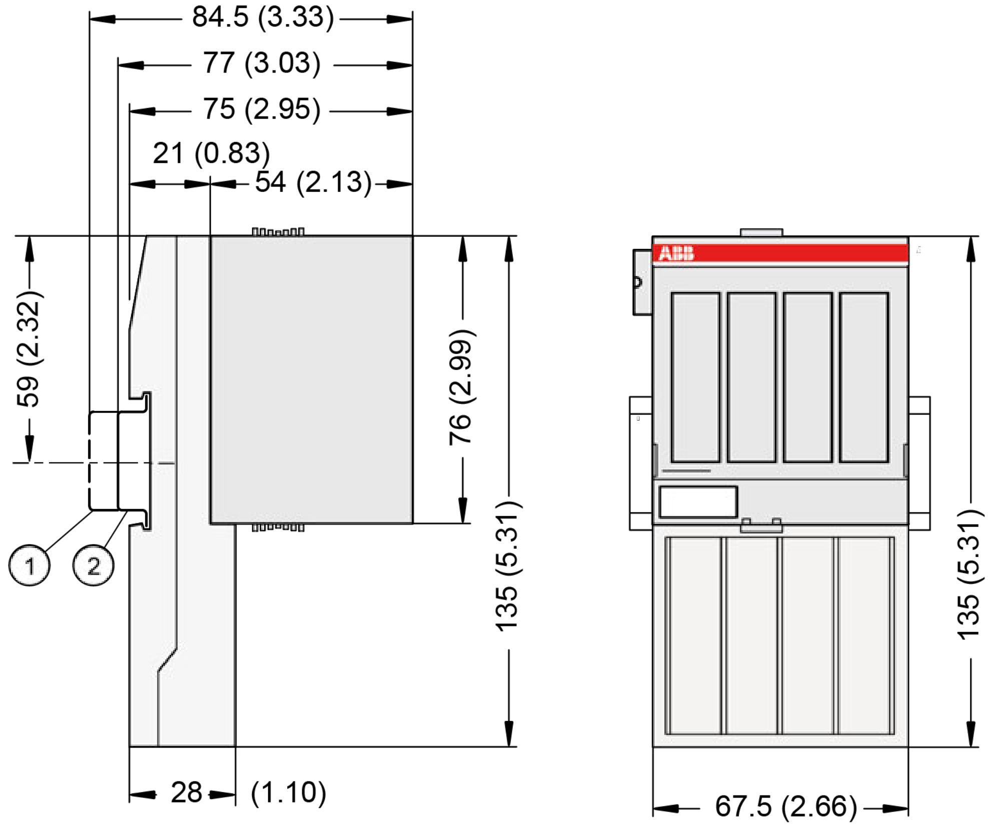
Parameter		Value
Number of channels per module		Max. 4
Distribution of channels into groups		1 group of 4 channels
Connections of the channels AI0+ ... AI3+		Terminals 3.0 ... 3.3
Reference potential for the inputs		Terminals 1.9, 2.9, 3.9 and 4.9 (ZP)
Indication of the input signals		1 LED per channel
Input signal voltage		24 V DC
	Signal 0	-30 V ... +5 V
	Undefined signal	+5 V ... +13 V
	Signal 1	+13 V ... +30 V
Input current per channel		
	Input voltage +24 V	Typ. 7 mA
	Input voltage +5 V	Typ. 1.4 mA

Parameter		Value
	Input voltage +15 V	Typ. 3.7 mA
	Input voltage +30 V	< 9 mA
Input resistance		ca. 3.5 kΩ

Technical data of the analog outputs

Parameter		Value
Number of channels per module		2
Distribution of channels into groups		1 group for 2 channels
Connection of the channels AO0+ ... AO1+		Terminals 3.5 and 3.6
Reference potential for AO0+ ... AO1+		Terminal 3.7 (AO-) for voltage output Terminals 1.9, 2.9, 3.9 and 4.9 for current output
Output type		
	Unipolar	Current
	Bipolar	Voltage
Galvanic isolation		Against internal supply and other modules
Configurability		-10 V ... +10 V, 0 mA ... 20 mA, 4 mA ... 20 mA (each output can be configured individually)
Output resistance (load), as current output		0 Ω ... 500 Ω
Output loadability, as voltage output		± 10 mA max.
Indication of the output signals		1 LED per channel (brightness depends on the value of the analog signal)
Resolution		12 bits (+ sign)
Settling time for full range change (resistive load, output signal within specified tolerance)		Typ. 5 ms
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range		Typ. 0.5 %, max. 1 %
Relationship between input signal and hex code		Table Output Ranges Voltage and Current *Chapter 1.8.3.2.11.3 “Output ranges voltage and current” on page 1033*
Unused outputs		Are configured as "unused" (default value) and can be left open-circuited

1.8.3.2.13 Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

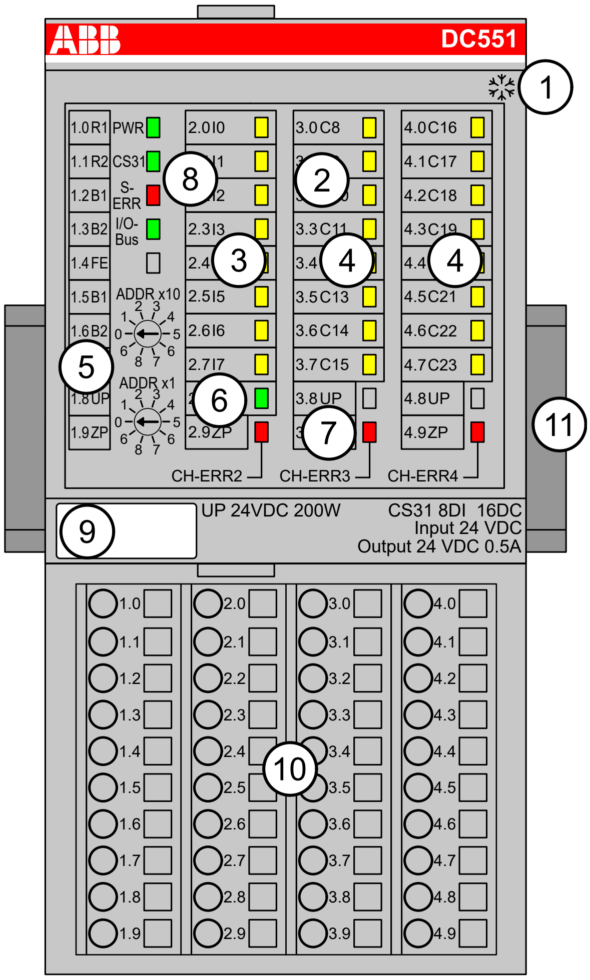
1.8.3.2.14 Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 221 200 R0001	CI592-CS31, CS31 communication interface module with 8 DI, 8 DC, 4 AI, 2 AO	Active
1SAP 421 200 R0001	CI592-CS31-XC, CS31 communication interface module with 8 DI, 8 DC, 4 AI, 2 AO, XC version	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

1.8.3.3 DC551-CS31 - Digital inputs and outputs

- 8 digital inputs 24 V DC, 16 configurable digital inputs/outputs
- Module-wise galvanically isolated
- Fast counter
- XC version for usage in extreme ambient conditions available



1 I/O bus
2 Allocation between terminal number and signal name
3 8 yellow LEDs to display the signal states of the digital inputs I0 ... I7
4 16 yellow LEDs to display the signal states of the digital inputs/outputs C8 ... C23
5 2 rotary switches to set the module's address (00d ... 99d)
6 1 green LED to display the process voltage UP
7 3 red LEDs to display errors
8 4 system LEDs
9 Label
10 Terminal unit
11 DIN rail
❄ Sign for XC version

1.8.3.3.1 Intended purpose

> *The CS31 communication interface module DC551-CS31 can only be used together with the AC500 CPUs and dedicated PS501 control builder.*

The CS31 communication interface module is used as a decentralized I/O module on CS31 field buses. The bus connection is performed on a RS-485 serial interface, which allows the connection of this module to all existing CS31 buses. In addition, the CS31 communication interface module provides 24 I/O channels with the following properties:

- 8 digital inputs 24 V DC in one group (2.0 ... 2.7)
- 16 digital inputs/outputs in one group (3.0 ... 4.7), of which each can be used
- as an input,
- as a transistor output with short circuit and overload protection, 0.5 A rated current or
- as a re-readable output (combined input/output) with the technical data of the digital inputs and outputs.

The inputs and output are galvanically isolated from the other electronic circuitry of the module.

For usage in extreme ambient conditions (e.g. wider temperature and humidity range), a special XC version of the device is available.

1.8.3.3.2 Functionality

Interface	RS-485, CS31 protocol
Supply of the module's electronic circuitry	From UP and ZP (power supply)
Supply of the electronic circuitry of the I/O modules attached	Through the bus interface (I/O bus)
Address switches	For setting the CS31 field bus address (0 ... 99)
Digital inputs	8 (24 V DC)
Digital inputs/outputs	16 (24 V DC)
Fast Counter	Integrated, many configurable operating modes
LED displays	For system displays, signal statuses, errors and power supply
External supply voltage	Via the terminals ZP and UP (process voltage 24 V DC)
Effect of incorrect input terminal connection	Wrong or no signal detected, no damage up to 35 V
Required terminal unit	TU551-CS31 or TU552-CS31 *Chapter 1.5.7 “TU551-CS31 and TU552-CS31 for CS31 communication interface modules” on page 304*

1.8.3.3.3 Connections

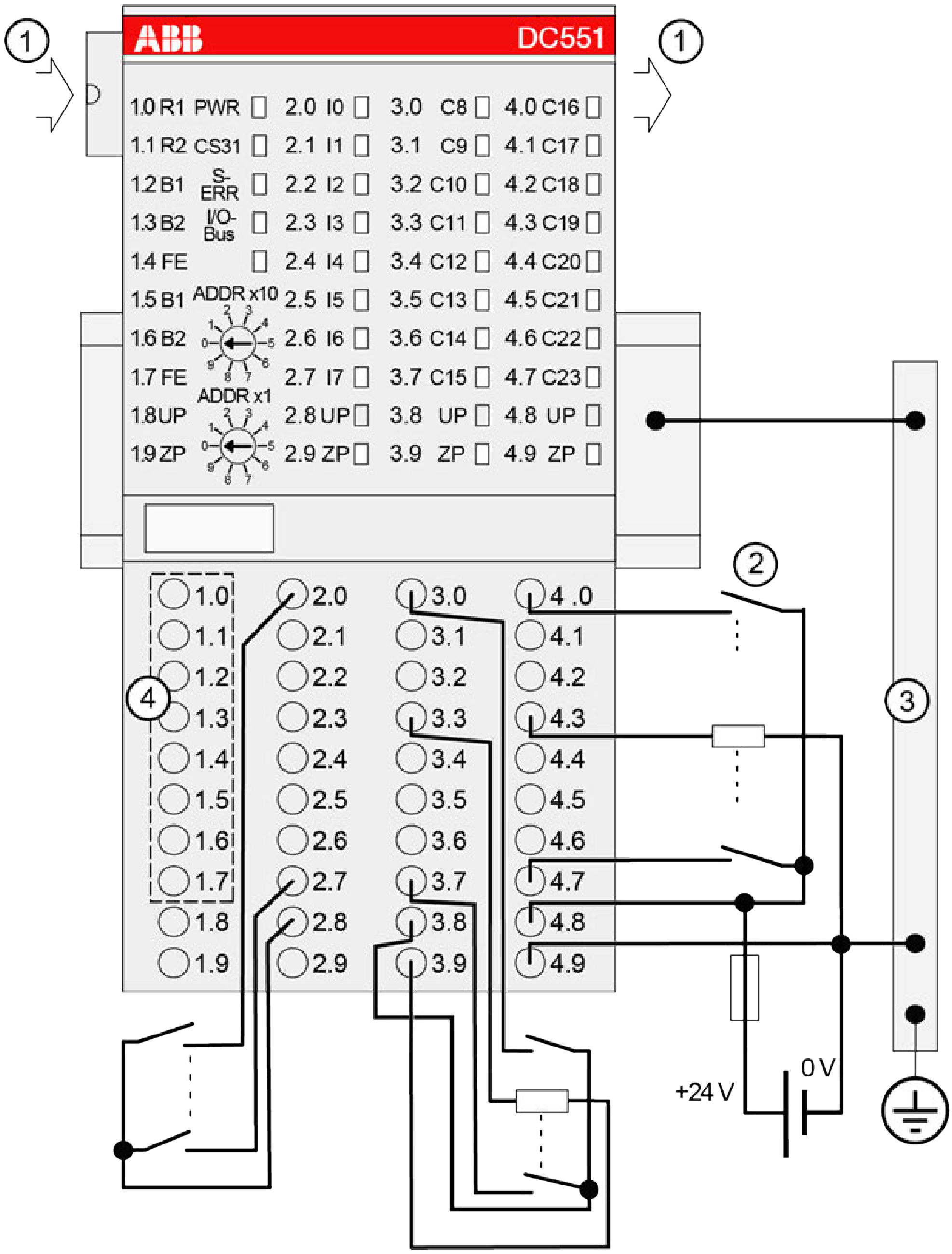
The CS31 communication interface module is plugged on the CS31 terminal unit TU551 or TU552 *Chapter 1.5.7 “TU551-CS31 and TU552-CS31 for CS31 communication interface modules” on page 304*. Hereby, it clicks in with two mechanical locks. The terminal unit is mounted on a DIN rail or with 2 screws plus the additional accessory for wall mounting (TA526 *Chapter 1.9.3.5 “TA526 - Wall mounting accessory” on page 1361*).

The connection of the I/O channels is carried out using the 40 terminals of the CS31 terminal unit. It is possible, to replace CS31 bus modules and I/O modules without loosening the wiring.

The terminals 1.8 ... 4.8 and 1.9 ... 4.9 are electrically interconnected within the terminal unit and always have the same assignment, irrespective of the inserted module:

- Terminals 1.8 ... 4.8: process voltage UP = +24 V DC
- Terminals 1.9 ... 4.9: process voltage ZP = 0 V

The assignment of the other terminals depends on the inserted CS31 bus module.



1 I/O bus
2 4.0 ... 4.7: Connected with UP (switch) -> Input;
Connected with ZP (load) -> Output
3 Control cabinet earth
4 1.0 ... 1.7: *Chapter 1.8.3.3.4 “CS31 bus connections” on page 1044*

Table 270: Assignment of the other terminals

Terminals	Signal	Description
1.0 ... 1.7	RS-485	CS31 bus interface
2.0 ... 2.7	I0 ... I7	8 digital inputs
3.0 ... 4.7	C8 ... C23	16 digital inputs/outputs

CAUTION!
The process supply voltage must be included in the grounding concept (e. g. grounding of the negative terminal).

The supply voltage 24 V DC for the module's electronic circuitry comes from the ZP/UP terminals.

The module provides several diagnosis functions *Chapter 1.8.3.3.11 "Diagnosis" on page 1050*.

WARNING!
Removal/Insertion under power
The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

CAUTION!
Risk of influences to the connected sensors!
Some sensors may be influenced by the deactivated module outputs of DC551-CS31.

Connect a 470 Ω / 1 W resistor in series to inputs C16/C17 if using them as fast counter inputs to safely avoid any influences.

1.8.3.3.4 CS31 bus connections

The CS31 bus is connected through the terminal unit with the terminals 1.0 ... 1.7. The end-of-line resistor can also be activated by using external wire jumpers.

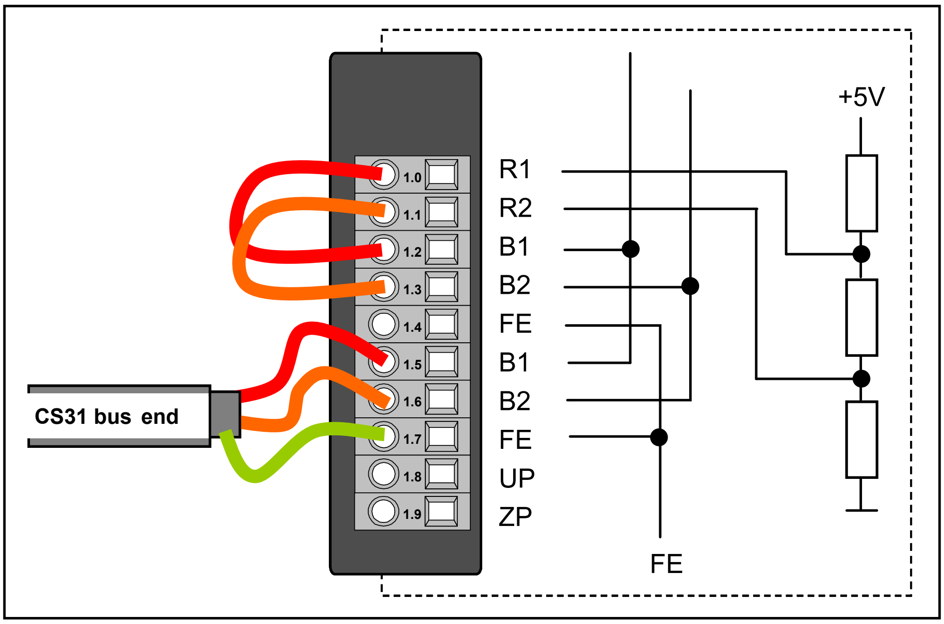


Fig. 268: CS31 communication interface module at the end of the CS31 bus (end-of-line resistor activated)

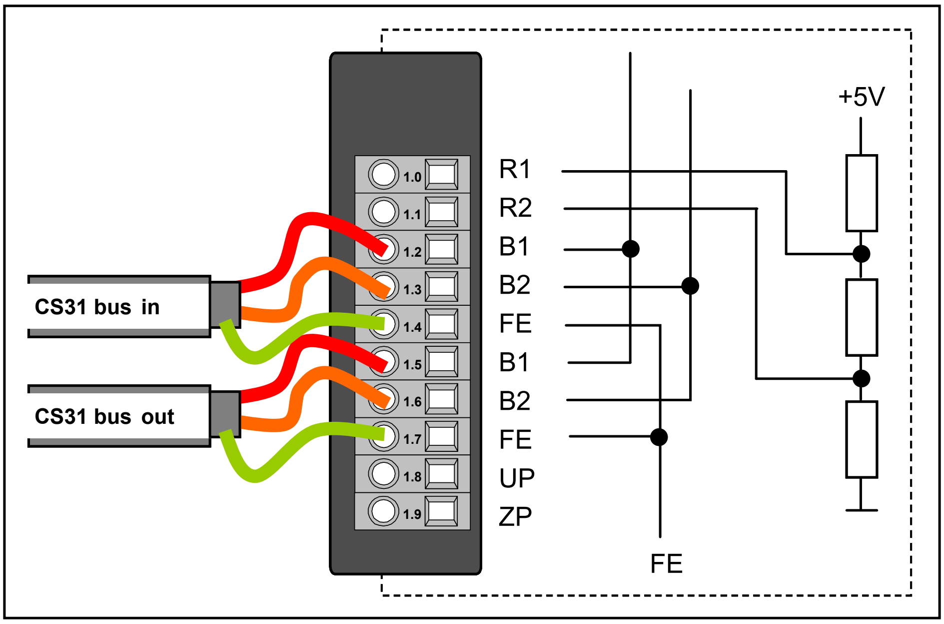


Fig. 269: CS31 communication interface module in the middle of the CS31 bus (end-of-line resistor not activated)

Details on CS31 wiring is described seperately *Chapter 2.6.4.9 "CS31 bus" on page 1441*.

1.8.3.3.5 Internal data exchange

	without the fast counter	**with the fast counter (only with AC500)**
Digital inputs (bytes)	3 + expansion modules (see above)	5 + expansion modules (see above)
Digital outputs (bytes)	2 + expansion modules (see above)	4 + expansion modules (see above)
Counter input data (words)	0	5 (16 DI + 4 AI)
Counter output data (words)	0	9 (16 DO + 8 AO)

1.8.3.3.6 Addressing

An address must be set at every module so that the field bus communication module can access the specific inputs and outputs.

The address (00 ... 99) is set with two rotary switches on the front panel of the module.

CS31 communication interface module reads the position of the address switches only during the initialization after power ON, i.e. changes of the setting during operation remain ineffective.

1.8.3.3.7 DC551-CS31 limitations

Digital I/O

DC551-CS31 is able to manage up to 240 digital I/O channels. It uses 2 digital bus addresses in this case.

The physical address to identify the I/O is	address n (switch address) for the 1st module (120 I/O)
	address n + 7 + bit 8/15 = 1 for the 2nd module

To be compatible with old CPU and EC500 using this physical address, to address I/O in user program: Use only 6 I/O modules with 32 DI.

Analog I/O

Analog limitation to 40 AI/AO with 4 bus addresses used.

Case of DC551-CS31 with fast counter

An additional bus address is used for "double word" values of the fast counter.

Table 271: Maximum configuration

DC551-CS31 8DI + 16 DC + counter	16 AI	16 AI	DC532	DC532	DC532	DC532	DC532

The following configuration uses 7 bus addresses (the fast counter needs 16 DI + 16 DO + 4 AI + 8 AO):

2 bus addresses for digital I/O (24 + 16 + 5x32)DI + (16 + 16 + 5x16)DO = 200 DI (>120) + 112 DO

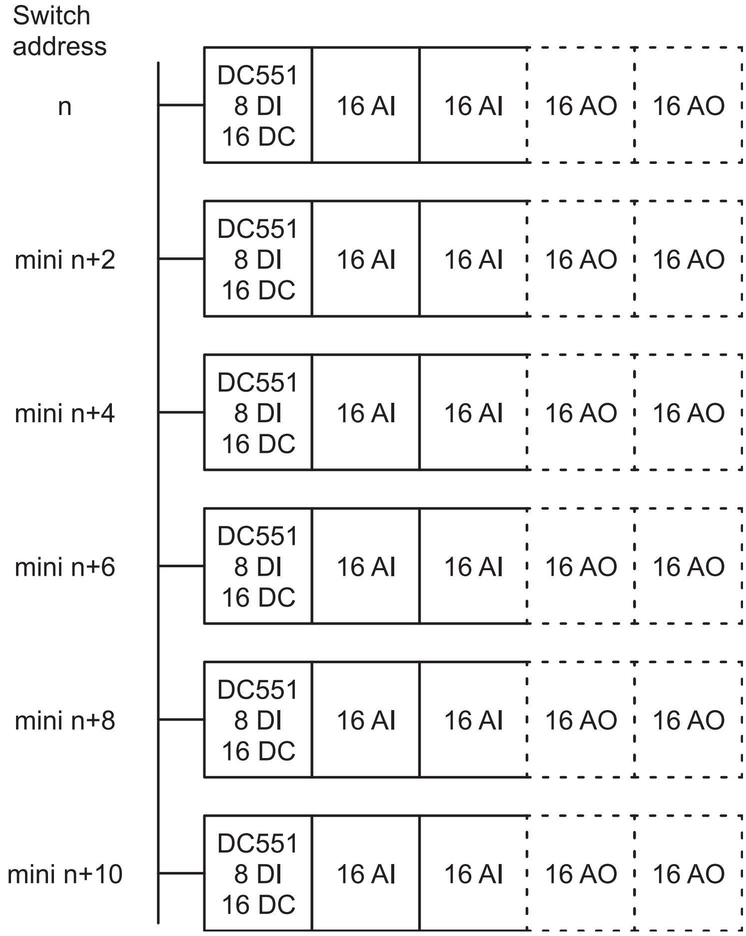
5 bus addresses for analog I/O (4 + 2x16)AI + 8 AO = 36 AI + 8 AO

If the communication interface module is configured as a fast counter module and '0 - no Counter' in Automation Builder is selected the channel ERR LEDs stays on and the module does not start up. The address was adjusted with '71'.

Only the '0- no Counter' mode does not operate. If any other counter is selected e.g. '1-1 Up counter' the module starts up and can be utilized.

Small overview of the addressing possibilities

Configuration example with 32 analog inputs with or without 32 analog outputs (fast counter not used) = 5 bus addresses by the communication interface module



If there are fewer analog outputs than analog inputs, no additional address is necessary. Change the type from "analog in" to "analog I/O".

- 30 bus addresses used, 1 bus address free
- 192 analog inputs (+ 192 analog outputs)
- 48DI / 96DC (144 DI / 96 DO for CS31 and user program)
- Switch address incremented to avoid control overlap.

In CPU table module switch address n will be seen as (idem for AC500 or old CPU):

- Address n, type digital I/O, 8 DI/16 DC
- Address n, type analog I or I/O, 8 AI (+ 8 AO)
- Address n + bit 8/15=1, type analog I or I/O, 8 AI (+ 8 AO)
- Address n+1, type analog I or I/O, 8 AI (+ 8 AO)
- Address n+1 + bit 8/15=1, type analog I or I/O, 8 AI (+ 8 AO)

1.8.3.3.8 I/O configuration

The DC551-CS31 module does not store configuration data itself. The 16 configurable channels are defined as inputs or outputs by the user program, i.e. each of the configurable channels can be used as input or output (or re-readable output) by interrogation or allocation by the user program.

1.8.3.3.9 Parameterization

No.	Name	Value	Internal value	Internal value, type	Default	Min.	Max.
1	Module ID	Internal	2715 [1])	Word	2715 0x0a9b	0	65535
2	Ignore module	No Yes	0 1	Byte	No 0x00		
14	Parameter length	Internal	8 (7 [4])	Byte	8 (7 [4])	0	255
16	Check supply	Off On	0 1	Byte	On 0x01		
17	Input delay	0.1 ms 1 ms 8 ms 32 ms	0 1 2 3	Byte	8 ms 0x02		
18	Fast counter	0 : 10 [3])	0 : 10	Byte	Mode 0 0x00		
Nr.+1	Detection short-circuit at outputs	Off On	0 1	Byte	On 0x01		
Nr.+1	Behaviour outputs at communication errors	Off Last value Substitute value	0 1 2	Byte	Off 0x00		
Nr.+1	Substitute value outputs Bit 15 = Output 15 Bit 0 = Output 0	0...65535	0...0xffff	Word	0		

[1]) With CS31 and addresses less than 70, the value is increased by 1

[3]) Counter operating modes ➪ *Chapter 1.6.1.2.10 “Fast counter” on page 545*, description of the fast counter ➪ *Chapter 1.6.1.2.10 “Fast counter” on page 545*

[4]) With CS31 and addresses less than 70, without the parameter Fast Counter

1.8.3.3.10 Structure of the diagnosis block of the DC551-CS31

If a DC551-CS31 module is connected via a CS31 bus, then the field bus master receives diagnosis information by an extended diagnosis block.

Table 272: Structure of the diagnosis block

Byte number	Description	Possible values
1	Data length (header included)	18
2	Diagnosis byte	0 = Communication with DC551-CS31 OK 1 = Communication with DC551-CS31 failed
3	DC551-CS31 diagnosis byte, module number	0 = DC551 (e.g. error at the integrated 8DI/16DC) 1 = 1st attached S500 I/O module ... 7 = 7th attached S500 I/O module
4	DC551-CS31 diagnosis byte, slot	According to the I/O bus specification passed on by modules to the fieldbus master
5	DC551-CS31 diagnosis byte, channel	According to the I/O bus specification passed on by modules to the fieldbus master
6	DC551-CS31 diagnosis byte, error code	According to the I/O bus specification Bit 7 and bit 6, coded error class 0 = E1 1 = E2 2 = E3 3 = E4 Bit 0 to bit 5, coded error description passed on by modules to the fieldbus master
7	DC551-CS31 diagnosis byte, flags	According to the I/O bus specification Bit 7: 1 = coming error Bit 6: 1 = leaving error Bit 5: 1 = Diag reset Bit 2 to bit 4: reserved Bit 1: 1 = explicit acknowledgement Bit 0: 1 = static error Passed on by modules to the fieldbus master Value = 0: static message for other systems, which do not have a coming/leaving evaluation
8ff	Reserved	

1.8.3.3.11 Diagnosis

In case of overload or short-circuit, the outputs switch off automatically and try to switch on again cyclically. Therefore an acknowledgement of the outputs is not necessary. The LED error message, however, is stored.

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier 000 ... 063**	**AC500 display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**	
Byte 6 Bit 6 ... 7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0 ... 5**	**FBP diag-nosis block**	
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error identi-fier**	**Error message**	**Remedy**
	1)	2)	3)	4)			
Module error							
3	11	ADR	31	31	19	Checksum error in the I/O module	Replace I/O module
3	11	ADR	31	31	3	Timeout in the I/O module	
3	11	ADR	31	31	40	Different hard-/firm-ware versions in the module	
3	11	ADR	31	31	43	Internal error in the module	
3	11	ADR	31	31	36	Internal data exchange failure	
3	11	ADR	31	31	9	Overflow diagnosis buffer	New start
3	11	ADR	31	31	26	Parameter error	Check master
3	11	ADR	31	31	11	Process voltage too low	Check process voltage
3	11	ADR	1...7	31	17	No communication to the I/O module	Replace I/O module
4	11	ADR	31	31	45	Process voltage ON/OFF	Process voltage ON
4	11	ADR	31/1..7	31	34	No reply at initial-ization of the I/O module	Replace I/O module

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier** **000 ... 063**	**AC500 display**	**<− Display in**	
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**		
Byte 6 **Bit 6 ... 7**	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6** **Bit 0 ... 5**	**FBP diag-nosis block**		
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error identi-fier**	**Error message**		**Remedy**
	[1])	[2])	[3])	[4])				
4	11	ADR	31/1.7	31	32	Wrong I/O module in the slot		Replace I/O module or check configu-ration
Channel error DC551-CS31								
4	11	ADR	31/1..7	8..23	47	Short-circuit at a digital output		Check connec-tion

Remarks:

[1])	In AC500 the following interface identifier applies: 11 = COM1 (protocol CS31 bus only possible with COM1)
[2])	With "Device" and CS31 bus master, the hardware address of the DC551-CS31 (0 ... 69) is output.
[3])	With "Module" the following allocation applies: 31 = Module itself, 1 ... 7 = Expansion 1 ... 7
[4])	In case of module errors, with channel "31 = Module itself" is output.

1.8.3.3.12 Status LEDs

The LEDs are on the front panels of the modules. There are two different groups:

- The 4 system LEDs (PWR, S-ERR, CS31 and I/O-Bus) show the operating status of the module and indicate possible errors.
- The 28 process LEDs (UP, inputs, outputs, CH-ERR2 to CH-ERR4) display the supply voltage and signal statuses of the inputs and outputs and indicate possible errors.

All of the S500 modules have LEDs to display operating statuses and errors.

LED	Status	Color	LED = OFF	LED = ON	LED flashes
PWR	System voltage	Green	Missing internal system voltage or field bus supply is missing	Internal system voltage is OK	--
CS31	CS31 communication	Green	No communication at the CS31 bus module	Communication at the CS31 bus OK	Diagnosis mode
S-ERR	Sum Error	Red	No error or system voltage is missing	Internal error (storing can be parameterized)	--
I/O-Bus	Communication via the I/O bus	Green	No I/O modules connected or data error	I/O modules connected	Error I/O bus
Reserved	Not defined	-	-	-	-
I0 ... I7	Digital inputs	Yellow	Input = OFF	Input = ON (the input voltage is even displayed if the supply voltage is OFF)	-
C8 ... C23	Digital inputs/ outputs	Yellow	Input/output = OFF	Input/output = ON (the input voltage is even displayed if the supply voltage is OFF)	-
UP	Process supply voltage and initialization	Green	Process voltage is missing	Process voltage OK	--
CH-ERR2	Channel Error, error messages in groups (digital inputs/outputs combined into the groups 2 to 4)	Red	No error	Severe error within the corresponding group	Error on one channel of the corresponding group (e.g. short-circuit at an output)
CH-ERR3		Red			
CH-ERR4		Red			
CH-ERR *)	Module Error	Red	No error or process voltage is missing	Internal error	--
*) All LEDs CH-ERR2 to CH-ERR4 light up together					

The status of the LEDs concerning the CS31 communication interface module in connection with the I/O modules is described in detail in the S500 system data.

1.8.3.3.13 Technical data

Technical data of the module

The system data of AC500 and S500 are applicable to the standard version ⮫ *Chapter 2.6.1 “System data AC500” on page 1408*.

The system data of AC500-XC are applicable to the XC version ⮫ *Chapter 2.7.1 “System data AC500-XC” on page 1475*.

Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

Parameter		Value
Rated supply voltage of the module		24 V DC (UP/ZP)
Current consumption of the module (UP)		15 mA
Process voltage UP		
	Rated value	24 V DC (for inputs and outputs)
	Max. electric charge for the supply terminals	10 A
	Protection against reversed voltage	Yes
	Rated protection fuse at UP	10 A fast
	Galvanic isolation	CS31 bus interface from the rest of the module
	Inrush current from UP (at power-up)	0.040 A^2s
	Current consumption from UP at normal operation / with outputs	0.1 A + max. 0.008 A per input + max. 0.5 A per output
	Connections	Terminals 1.8 ... 4.8 for +24 V (UP) and 1.9 ... 4.9 for 0 V (ZP)
Max. power dissipation within the module		6 W (outputs unloaded)
Number of digital inputs		8
Number of configurable digital inputs/outputs		16
Reference potential for all digital inputs and outputs		Negative pole of the supply voltage, signal name ZP
Address setting		With 2 rotary switches on the front panel
Diagnosis		Diagnosis and Displays ⮫ *Chapter 1.8.3.3.11 “Diagnosis” on page 1050*
Operating and error displays		32 LEDs altogether
Weight (without terminal unit)		Ca. 125 g
Mounting position		Horizontal Or vertical with derating (output load reduced to 50 % at +40°C per group)
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

> **NOTICE!**
> All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and temporary overvoltage up to 30 V DC.

Multiple overloads
No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an internal smart high-side switch.

Technical data of the digital inputs

Parameter	Value
Number of channels per module	8
Distribution of the channels into groups	1 group of 8 channels
Terminals of the channels I0 ... I7	2.0 ... 2.7
Terminals of the channels C8 ... C23	3.0 ... 4.7
Reference potential for all inputs	Terminals 1.9 ... 4.9 (negative pole of the process supply voltage, signal name ZP)
Galvanic isolation	From the CS31 bus
Indication of the input signals	1 yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Input type acc. to EN 61131-2	Type 1
Input delay (0->1 or 1-> 0)	Typ. 8 ms, configurable 0.1 ms ... 32 ms
Input signal voltage	24 V DC
Signal 0	-3 V ... +5 V
Undefined signal	> +5 V ... < +15 V
Signal 1	+15 V ... +30 V
Ripple with signal 0	Within -3 V ... +5 V
Ripple with signal 1	Within +15 V ... +30 V
Input current per channel	
Input voltage +24 V	Typ. 5 mA
Input voltage +5 V	> 1 mA
Input voltage +15 V	> 2 mA
Input voltage +30 V	< 8 mA
Max. cable length	
Shielded	1000 m
Unshielded	600 m

Technical data of the configurable digital inputs/outputs

Each of the configurable I/O channels is defined as input or output by the user program. This is done by interrogating or allocating the corresponding channel.

Parameter	Value
Number of channels per module	16 inputs/outputs (with transistors)
Distribution of the channels into groups	1 group of 16 channels

Parameter		Value
If the channels are used as inputs		
	Channels I8 ... I23	Terminals 3.0 ... 4.7
If the channels are used as outputs		
	Channels Q8 ... Q23	Terminals 3.0 ... 4.7
Indication of the input/output signals		1 yellow LED per channel, the LED is ON when the input/output signal is high (signal 1)
Galvanic isolation		From the CS31 bus

Technical data of the digital inputs/outputs if used as outputs

Parameter		Value
Number of channels per module		Max. 16 transistor outputs
Reference potential for all outputs		Terminals 1.9 ... 4.9 (negative pole of the process supply voltage, signal name ZP)
Common power supply voltage		For all outputs: terminals 1.8 ... 4.8 (positive pole of the process supply voltage, signal name UP)
Output voltage for signal 1		UP (-0.8 V)
Output delay (0->1 or 1->0)		On request
Output current		
	Rated value, per channel	500 mA at UP = 24 V
	Maximum value (all channels together)	10 A
Leakage current with signal 0		< 0.5 mA
Rated protection fuse on UP		10 A fast
Demagnetization when inductive loads are switched off		With varistors integrated in the module (see figure below)
Switching frequency		
	With resistive loads	On request
	With inductive loads	Max. 0.5 Hz
	With lamp loads	Max. 11 Hz with max. 5 W
Short-circuit-proof / overload-proof		Yes
Overload message (I > 0.7 A)		Yes, after ca. 100 ms
Output current limitation		Yes, automatic reactivation after short circuit/overload
Resistance to feedback against 24 V signals		Yes
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

The following drawing shows the circuitry of a digital input/output with the varistors for demagnetization when inductive loads are switched off.

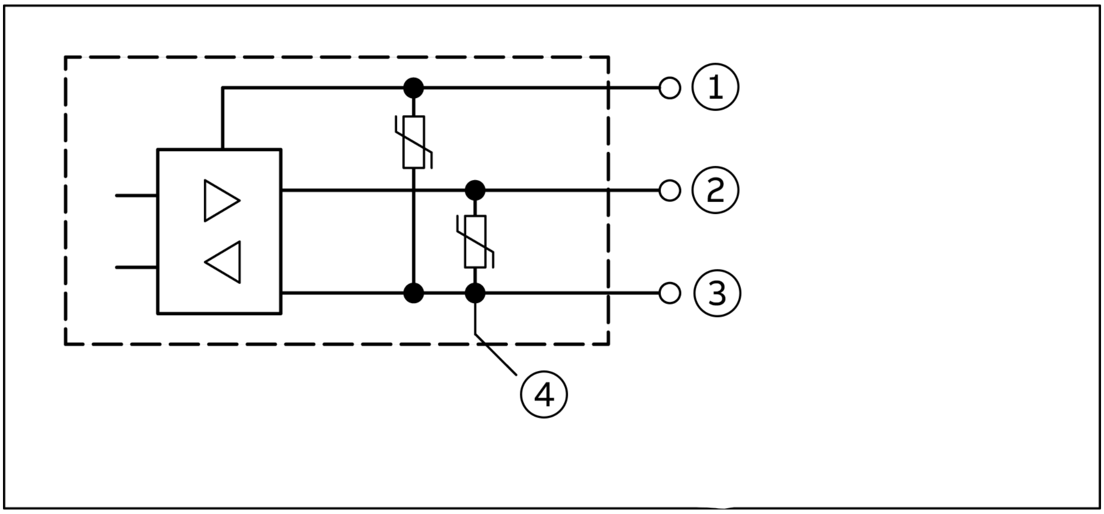


Fig. 270: Digital input/output (circuit diagram)

1 UPx (+ 24 V)
2 Digital input/output
3 ZPx (0 V)
4 For demagnization when inductive loads are switched off

Technical data of the digital inputs/outputs if used as inputs

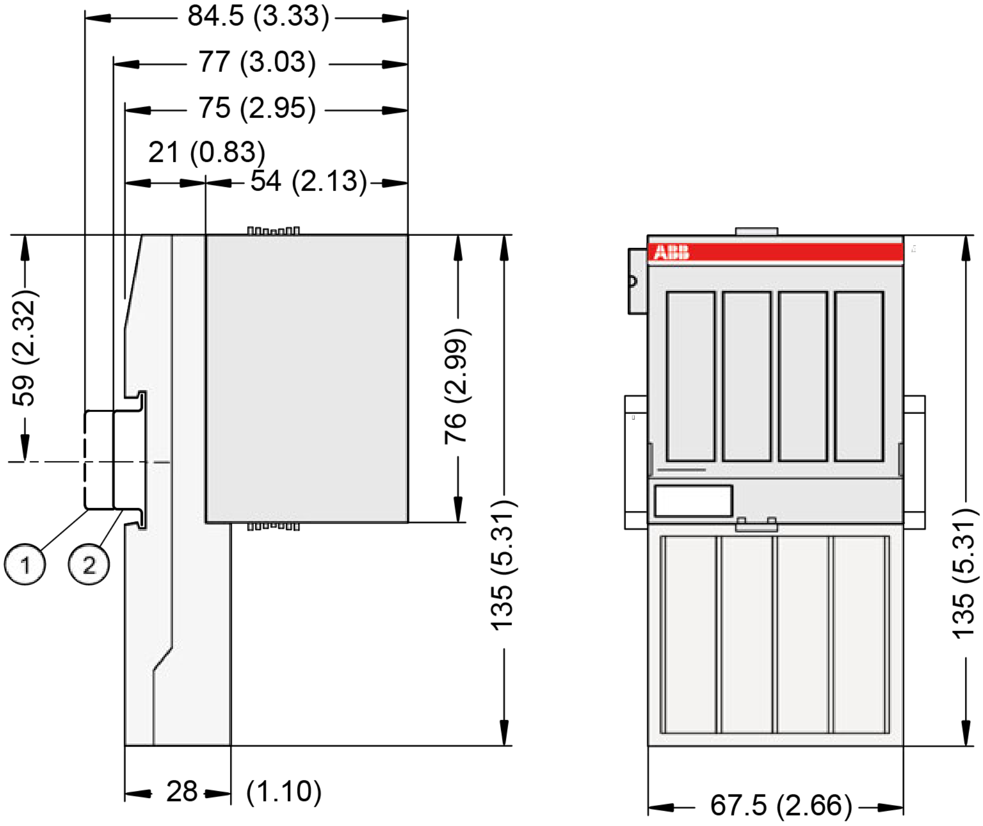
Parameter		Value
Number of channels per module		Max. 16 digital inputs
Reference potential for all inputs		Terminals 1.9 ... 4.9 (negative pole of the process supply voltage, signal name ZP)
Input current, per channel		Technical Data of the Digital Inputs
Input type acc. to EN 61131-2		Type 1
Input delay (0->1 or 1->0)		Typ. 8 ms, configurable 0.1 ms ...32 ms
Input signal voltage		24 V DC
	Signal 0	-3 V ... +5 V *)
	Undefined signal	> +5 V ... < +15 V
	Signal 1	+15 V ... +30 V
Ripple with signal 0		within -3 V ... +5 V *)
Ripple with signal 1		within +15 V ... +30 V
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

*) Due to the direct connection to the output, the demagnetizing varistor is also effective at the input (see figure) above. This is why the difference between UPx and the input signal may not exceed the clamp voltage of the varistor. The varistor limits the voltage to approx. 36 V. Following this, the input voltage must range from -12 V ... +30 V when UPx = 24 V and from -6 V ... +30 V when UPx = 30 V.

Technical data of the fast counter

Parameter	Value
Used inputs	C16 / C17
Used outputs	C18
Counting frequency	Max. 50 kHz

1.8.3.3.14 Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

> *The dimensions are in mm and in brackets in inch.*

1.8.3.3.15 Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 220 500 R0001	DC551-CS31, CS31 communication interface module, 8 DI and 16 DC	Active
1SAP 420 500 R0001	DC551-CS31-XC, CS31 communication interface module, 8 DI and 16 DC, XC version	Active

) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.

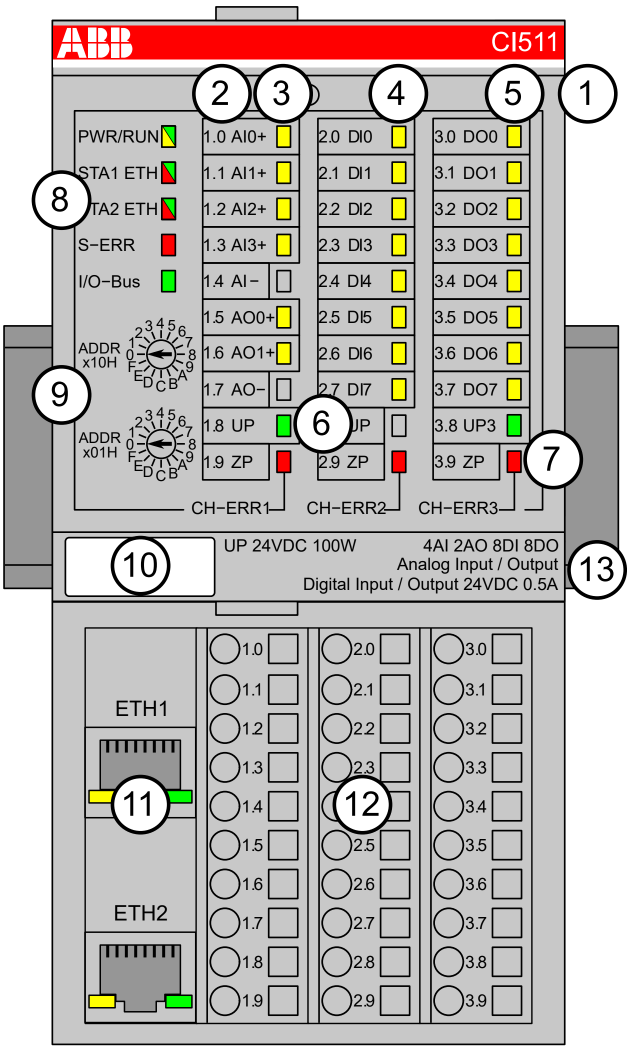
1.8.4 EtherCAT

1.8.4.1 CI511-ETHCAT

1.8.4.1.1 Features

- 4 analog inputs (resolution 12 bits including sign)
- 2 analog outputs (resolution 12 bits including sign)
- 8 digital inputs 24 V DC
- 8 digital outputs 24 V DC, 0.5 A max.
- Cam switch functionality (see also Extended Cam Switch Library)
- Extended Cam switch functionality *) (see also Extended Cam Switch Library)
- Module-wise galvanically isolated - Expandability with up to 10 S500 I/O Modules *)

*) Applicable for device index C0 and above.



1 I/O bus
2 Allocation between terminal number and signal name

3 6 yellow LEDs to display the signal states of the analog inputs/outputs (AI0 ... AI3, AO0 ... AO1)
4 8 yellow LEDs to display the signal states of the digital inputs (DI0 ... DI7)
5 8 yellow LEDs to display the signal states of the digital outputs (DO0 ... DO7)
6 2 green LEDs to display the supply voltage UP and UP3
7 3 red LEDs to display errors (CH-ERR1, CH-ERR2, CH-ERR3)
8 5 system LEDs: PWR/RUN, NET, DC, S-ERR, I/O-Bus
9 2 rotary switches (reserved for future extensions)
10 Label
11 Ethernet interfaces (ETH1, ETH2) on the terminal unit
12 Terminal unit
13 DIN rail

1.8.4.1.2 Intended purpose

The EtherCAT communication interface module CI511-ETHCAT is used as decentralized I/O module in EtherCAT networks. The network connection is performed via 2 RJ45 connectors which are integrated in the terminal unit. The communication interface module contains 22 I/O channels with the following properties:

- 4 analog inputs (1.0 ... 1.3)
- 2 analog outputs (1.5 ... 1.6)
- 8 digital inputs 24 V DC in 1 group (2.0 ... 2.7)
- 8 digital outputs 24 V DC in 1 group (3.0 ... 3.7)
- Cam switch functionality

The inputs/outputs are galvanically isolated from the Ethernet network. There is no potential separation between the channels. The configuration of the analog inputs/outputs is performed by software.

1.8.4.1.3 Functionality

Parameter	Value
Interface	Ethernet
Protocol	EtherCAT
Power supply	From the process supply voltage UP
Supply of the electronic circuitry of the I/O expansion modules attached	Through the I/O bus interface (I/O bus)
Rotary switches	Not used; reserved for future extensions
Analog inputs	4 (configurable via software)
Analog outputs	2 (configurable via software)
Digital inputs	8 (24 V DC; delay time configurable via software)
Digital outputs	8 (24 V DC, 0.5 A max.)
LED displays	For system displays, signal states, errors and power supply
External supply voltage	Via terminals ZP, UP and UP3 (process supply voltage 24 V DC)
Effect of incorrect input terminal connection	Wrong or no signal detected, no damage up to 35 V
Required terminal unit	TU507 or TU508 *Chapter 1.5.1 “TU507-ETH and TU508-ETH for Ethernet communication interface modules” on page 274*

1.8.4.1.4 Connections

General

The Ethernet communication interface module CI511-ETHCAT is plugged on the I/O terminal unit TU507-ETH or TU508-ETH. Properly seat the module and press until it locks in place. The terminal unit is mounted on a DIN rail or with 2 screws plus the additional accessory for wall mounting (TA526).

> *For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.*

The connection of the I/O channels is carried out using the 30 terminals of the I/O terminal unit. I/O modules can be replaced without re-wiring the terminal units.

The terminals 1.8 and 2.8 as well as 1.9, 2.9 and 3.9 are electrically interconnected within the terminal unit and have always the same assignment, independent of the inserted module:

Terminals 1.8 and 2.8: Process supply voltage UP = +24 V DC

Terminal 3.8: Process supply voltage UP3 = +24 V DC

Terminals 1.9, 2.9 and 3.9: Process supply voltage ZP = 0 V

> *With a separate UP3 power supply, the digital outputs can be switched off externally. This way, an emergency-off functionality can be realized.*

The assignment of the other terminals:

Terminal	Signal	Description
1.0 ... 1.3	AI0 ... AI3	Positive pole of the 4 analog inputs
1.4	AI-	Negative pole of the analog inputs
1.5 ... 1.6	AO0 ... AO1	Positive pole of the 2 analog outputs
1.7	AO-	Negative pole of the analog outputs
2.0 ... 2.7	DI0 ... DI7	8 digital inputs
3.0 ... 3.7	DO0 ... DO7	8 digital outputs

WARNING!

Removal/Insertion under power

The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

CAUTION!

There is no galvanic isolation between the analog circuitry and ZP/UP. Therefore, the analog sensors must be galvanically isolated in order to avoid loops via the ground potential or the supply voltage.

CAUTION!

Because of their common reference potential, analog current inputs cannot be circuited in series, neither within the module nor with channels of other modules.

For the open-circuit detection (wire break), each channel is pulled up to "plus" by a high-resistance resistor. If nothing is connected, the maximum voltage will be read in then.

Analog signals are always laid in shielded cables. The cable shields are grounded at both ends of the cables. In order to avoid unacceptable potential differences between different parts of the installation, low resistance equipotential bonding conductors must be laid.

For simple applications (low disturbances, no high requirement on precision), the shielding can also be omitted.

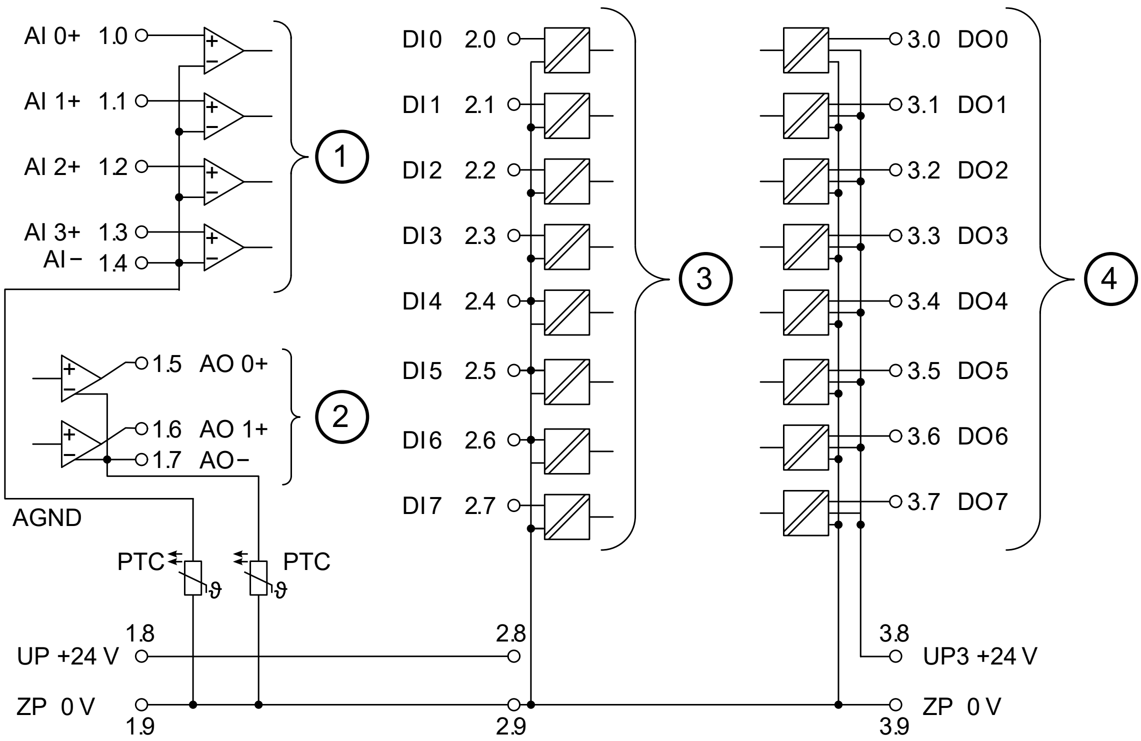


Fig. 271: Connection of the communication interface module CI511-ETHCAT

1 4 analog inputs, configurable for 0 ... 10 V, -10 ... +10 V, 0/4 ... 20 mA, Pt100/Pt1000, Ni1000 and digital signals
2 2 analog outputs, configurable for -10 ... +10 V, 0/4 ... 20 mA
3 8 digital inputs 24 V DC
4 8 digital outputs 24 V DC, 0.5 A max.

In case of voltage feedback, 2 cases are distinguished:

1. The outputs are already active

The output group will be switched off. A diagnosis message will appear. After 5 seconds, the module tries automatic reactivation.

2. The outputs are not active

Only the output with voltage feedback will not be set to active. A diagnosis message will appear.

NOTICE!
Risk of faulty measurements!
The negative pole/ground potential at the sensors must not have too large a potential difference with respect to ZP (max. ± 1 V within the full signal range).

Make sure that the potential difference never exceeds ± 1 V.

CAUTION!
The process supply voltage must be included within the grounding concept of the plant (e. g. grounding of the negative pole).

The module provide several diagnosis functions *Chapter 1.8.4.1.9 “Diagnosis” on page 1079*.

The measuring ranges are described in the section Measuring Ranges *Chapter 1.8.4.1.8 “Parameterization” on page 1073* *Chapter 1.8.4.1.11 “Measuring ranges” on page 1082*.

The function of the LEDs is described in the section State LEDs *Chapter 1.8.4.1.9 “Diagnosis” on page 1079*.

Connection of resistance thermometers in 2-wire configuration

When resistance thermometers (Pt100, Pt1000, Ni1000) are used, a constant current must flow through them to build the necessary voltage drop for the evaluation. For this, the module CI511-ETHCAT provides a constant current source which is multiplexed over the max. 4 analog input channels.

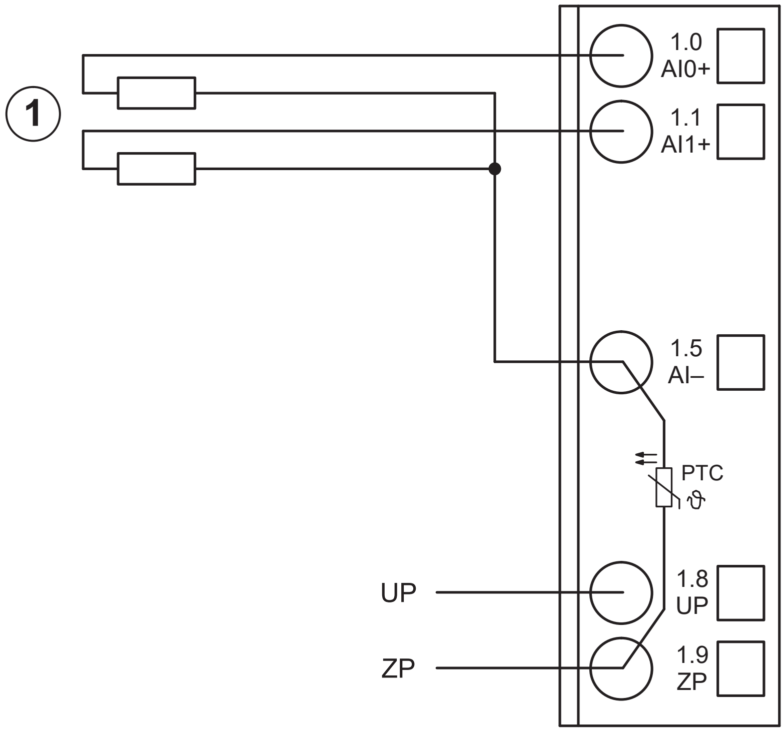


Fig. 272: Connection of resistance thermometers in 2-wire configuration

1 Pt100 (2-wire), Pt1000 (2-wire), Ni1000 (2-wire); 1 analog sensor requires 1 channel

Pt100	-50 °C ... +400 °C	2-wire configuration, 1 channel used
Pt1000	-50 °C ... +400 °C	2-wire configuration, 1 channel used
Ni1000	-50 °C ... +150 °C	2-wire configuration, 1 channel used

The measuring ranges are described in the section Measuring Ranges *Chapter 1.8.4.1.8 “Parameterization” on page 1073* *Chapter 1.8.4.1.11 “Measuring ranges” on page 1082*.

The module CI511-ETHCAT performs a linearization of the resistance characteristic.

In order to avoid error messages from unused analog input channels, it is useful to configure them as "unused".

Connection of resistance thermometers in 3-wire configuration

When resistance thermometers (Pt100, Pt1000, Ni1000) are used, a constant current must flow through them to build the necessary voltage drop for the evaluation. For this, the module CI511-ETHCAT provides a constant current source which is multiplexed over the max. 4 analog input channels.

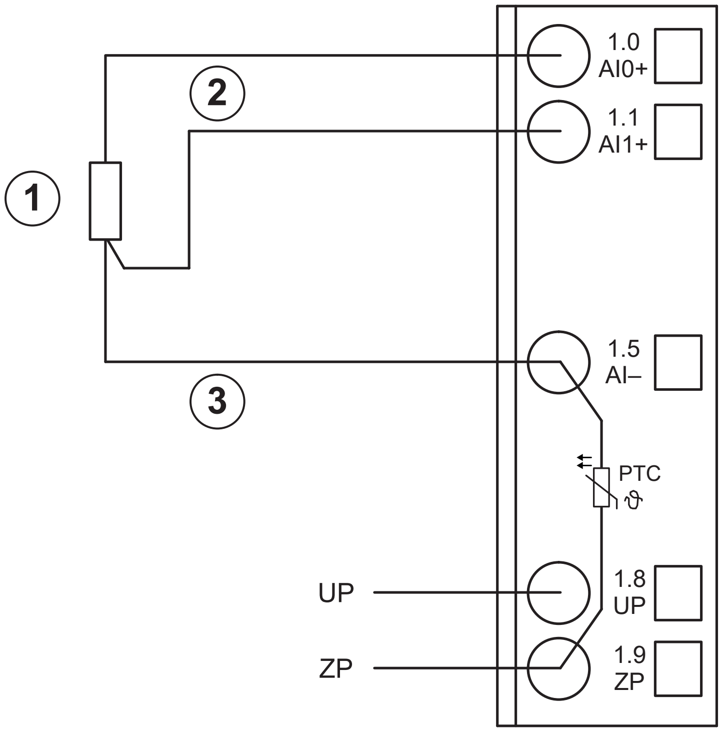


Fig. 273: Connection of resistance thermometers in 3-wire configuration

1 Pt100 (3-wire), Pt1000 (3-wire), Ni1000 (3-wire); 1 analog sensor requires 2 channels
2 Twisted pair within the cable
3 Return line: The return line is only needed once if measuring points are adjacent to each other. This saves wiring costs.

With 3-wire configuration, two adjacent analog channels belong together (e. g. the channels 0 and 1). In this case, both channels are configured according to the desired operating mode. The lower address must be the even address (channel 0), the next higher address must be the odd address (channel 1).

The constant current of one channel flows through the resistance thermometer. The constant current of the other channel flows through one of the cores. The module calculates the measured value from the two voltage drops and stores it under the input with the higher channel number (e. g. I1).

In order to keep measuring errors as small as possible, it is necessary, to have all the involved conductors in the same cable. All the conductors must have the same cross section.

Pt100	-50 °C ... +400 °C	3-wire configuration, 2 channels used
Pt1000	-50 °C ... +400 °C	3-wire configuration, 2 channels used
Ni1000	-50 °C ... +150 °C	3-wire configuration, 2 channels used

The measuring ranges are described in the section Measuring Ranges *Chapter 1.8.4.1.8 “Parameterization” on page 1073* *Chapter 1.8.4.1.11 “Measuring ranges” on page 1082*.

The module CI511-ETHCAT performs a linearization of the resistance characteristic.

In order to avoid error messages from unused analog input channels, it is useful to configure them as "unused".

Connection of active-type analog sensors (Voltage) with galvanically isolated power supply

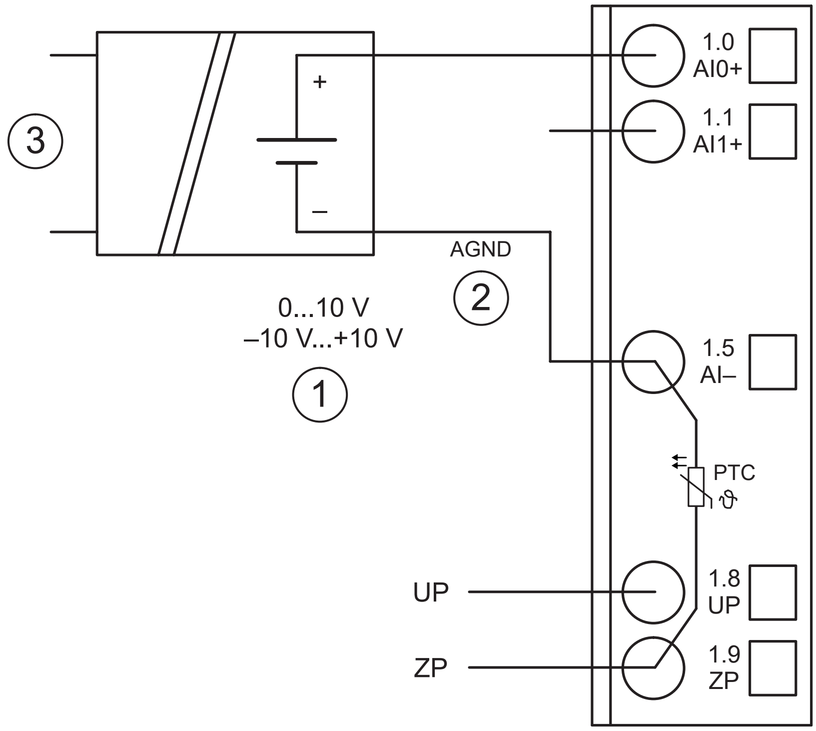


Fig. 274: Connection of active-type analog sensors (voltage) with galvanically isolated power supply

1 1 analog sensor requires 1 channel
2 By connecting to AI-, the galvanically isolated voltage source of the sensor is referred to ZP
3 Galvanically isolated power supply for the analog sensor

Voltage	0 ... 10 V	1 channel used
Voltage	-10 V ... +10 V	1 channel used

The measuring ranges are described in the section Measuring Ranges *Chapter 1.8.4.1.8 “Parameterization” on page 1073* *Chapter 1.8.4.1.11 “Measuring ranges” on page 1082*.

In order to avoid error messages or long processing times, it is useful to configure unused analog input channels as "unused".

Connection of active-type analog sensors (Current) with galvanically isolated power supply

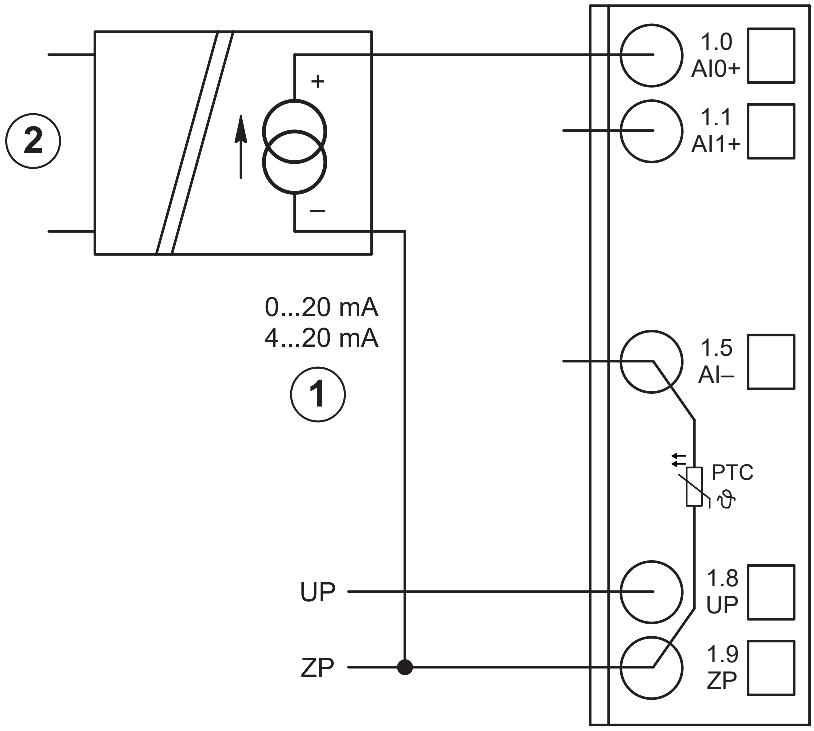


Fig. 275: Connection of active-type analog sensors (current) with galvanically isolated power supply

1 1 analog sensor requires 1 channel
2 Galvanically isolated power supply for the analog sensor

Current	0 ... 20 mA	1 channel used
Current	4 ... 20 mA	1 channel used

The measuring ranges are described in the section Measuring Ranges *Chapter 1.8.4.1.8 “Parameterization” on page 1073* *Chapter 1.8.4.1.11 “Measuring ranges” on page 1082*.

Unused input channels can be left open-circuited, because they are of low resistance.

Connection of active-type analog sensors (Voltage) with no galvanically isolated power supply

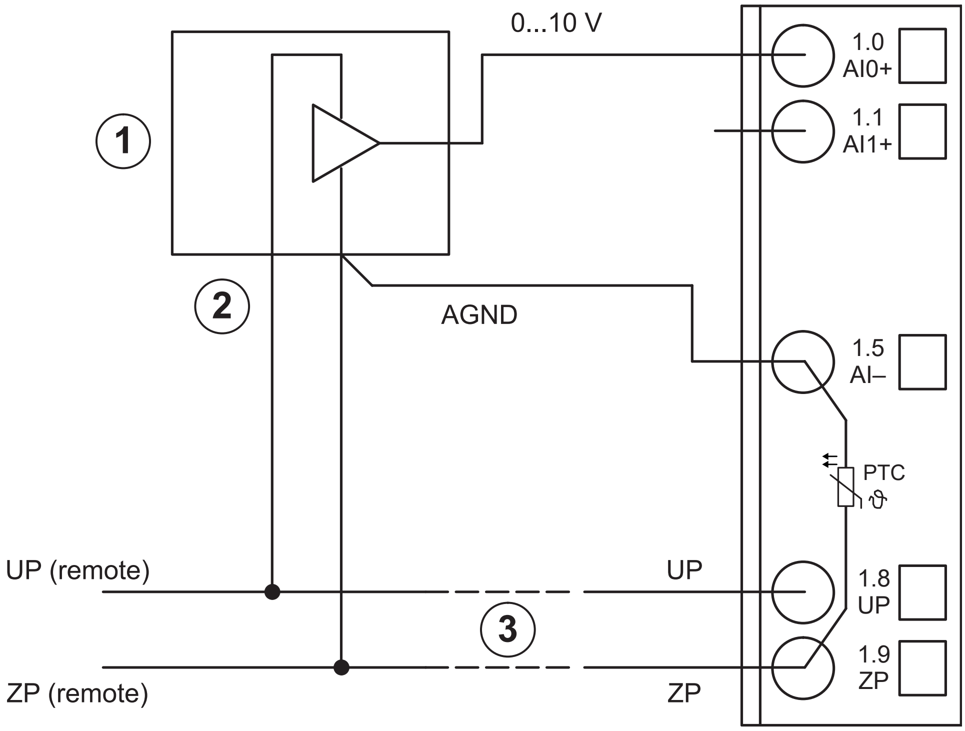


Fig. 276: Connection of active-type sensors (voltage) with no galvanically isolated power supply

1 1 analog sensor requires 1 channel
2 Power supply not galvanically isolated
3 The connection between the negative pole of the sensor and ZP has to be performed
4 Long cable

NOTICE!

Risk of faulty measurements!

The negative pole/ground potential at the sensors must not have too large a potential difference with respect to ZP (max. ± 1 V within the full signal range).

Make sure that the potential difference never exceeds ± 1 V.

Voltage	0 ... 10 V	1 channel used
Voltage	-10 V ... +10 V *)	1 channel used

*) if the sensor can provide this signal range

The measuring ranges are described in the section Measuring Ranges *Chapter 1.8.4.1.8 “Parameterization” on page 1073* *Chapter 1.8.4.1.11 “Measuring ranges” on page 1082*.

In order to avoid error messages or long processing times, it is useful to configure unused analog input channels as "unused".

Connection of passive-type analog sensors (Current)

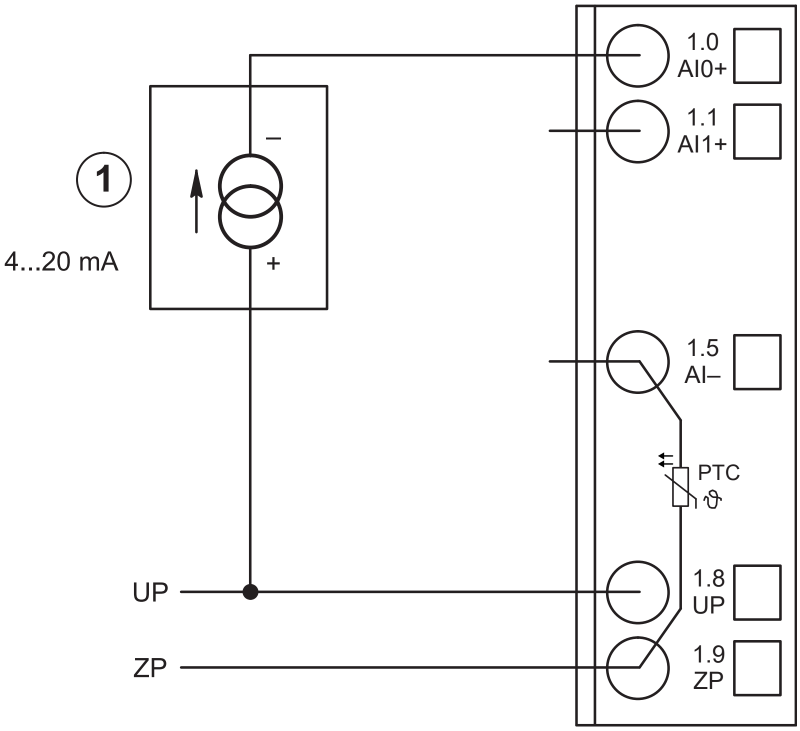


Fig. 277: Connection of passive-type analog sensors (current)

1 1 analog sensor requires 1 channel

Current	4 ... 20 mA	1 channel used

The measuring ranges are described in the section Measuring Ranges *Chapter 1.8.4.1.8 "Parameterization" on page 1073* *Chapter 1.8.4.1.11 "Measuring ranges" on page 1082*.

CAUTION!

If, during initialization, an analog current sensor supplies more than 25 mA for more than 1 second into an analog input, this input is switched off by the module (input protection). In such cases, it is recommended, to protect the analog input by a 10-volt Zener diode (in parallel to I+ and ZP). But, in general, it is a better solution to prefer sensors with fast initialization or without current peaks higher than 25 mA.

Unused input channels can be left open-circuited, because they are of low resistance.

Connection of active-type analog sensors (Voltage) to differential inputs

Differential inputs are very useful, if analog sensors are used which are remotely non-isolated (e.g. the minus terminal is remotely grounded).

The evaluation using differential inputs helps to considerably increase the measuring accuracy and to avoid ground loops.

With differential input configurations, two adjacent analog channels belong together (e.g. the channels 0 and 1). In this case, both channels are configured according to the desired operating mode. The lower address must be the even address (channel 0), the next higher address must be the odd address (channel 1). The converted analog value is available at the higher address (channel 1).

The analog value is calculated by subtraction of the input value with the higher address from the input value of the lower address.

The converted analog value is available at the odd channel (higher address).

Important: The ground potential at the sensors must not have a too big potential difference with respect to ZP (max. ±1 V within the full signal range). Otherwise problems can occur concerning the common-mode input voltages of the involved analog inputs

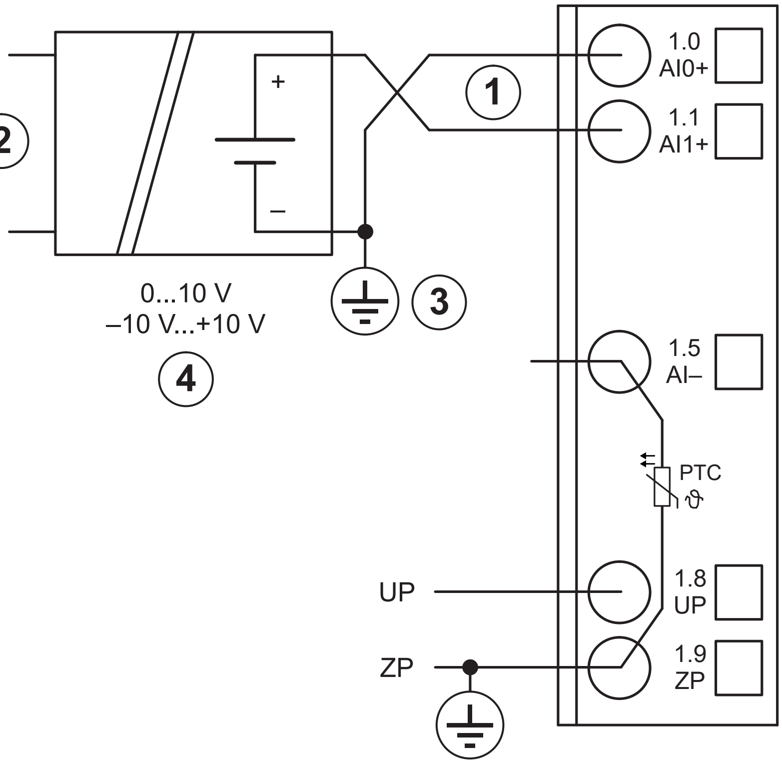


Fig. 278: Connection of active-type analog sensors (voltage) to differential inputs

1 1 analog sensor requires 2 channels
2 Galvanically isolated power supply for the analog sensor
3 Grounding at the sensor
4 0 V ... 10 V / -10 V ... +10 V connected to differential inputs

Voltage	0 V ... 10 V	with differential inputs, 2 channels used
Voltage	-10 V ... +10 V	with differential inputs, 2 channels used

The measuring ranges are described in the section Measuring Ranges *Chapter 1.8.4.1.8 “Parameterization” on page 1073* *Chapter 1.8.4.1.11 “Measuring ranges” on page 1082*.

In order to avoid error messages or long processing times, it is useful to configure unused analog input channels as "unused".

Use of analog inputs as digital inputs

Several (or all) analog inputs can be configured as digital input. The inputs are not galvanically isolated against the other analog channels.

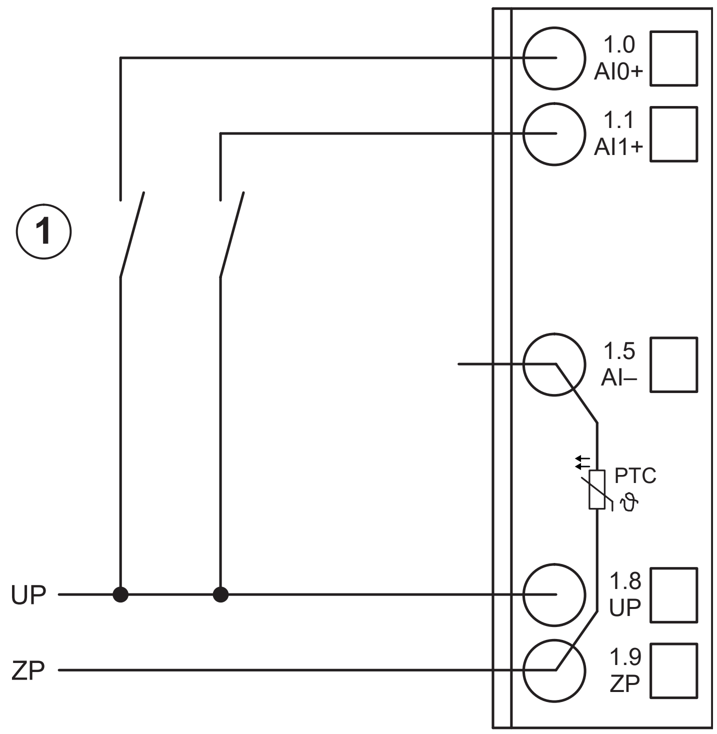


Fig. 279: Use of analog inputs as digital inputs

1 1 digital signal requires 1 channel

Digital input	24 V	1 channel used

The measuring ranges are described in the section Measuring Ranges ⧉ *Chapter 1.8.4.1.8 "Parameterization" on page 1073* ⧉ *Chapter 1.8.4.1.11 "Measuring ranges" on page 1082*.

Connection of analog output loads (Voltage, current)

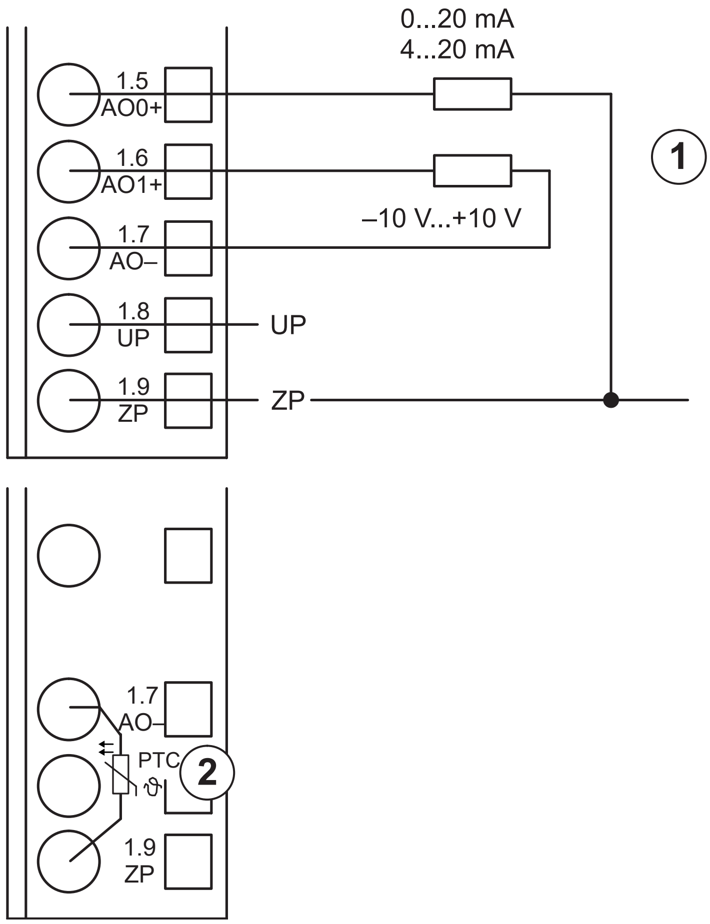


Fig. 280: Connection of analog output loads (voltage, current)

1 1 analog load requires 1 channel

Voltage	-10 V ... +10 V	Load ± 10 mA max.	1 channel used
Current	0 ... 20 mA	Load 0 Ω ... 500 Ω	1 channel used
Current	4 ... 20 mA	Load 0 Ω ... 500 Ω	1 channel used

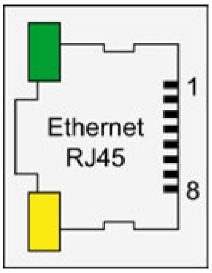
The measuring ranges are described in the section Measuring Ranges *Chapter 1.8.4.1.8 “Parameterization” on page 1073* *Chapter 1.8.4.1.11 “Measuring ranges” on page 1082*.

Unused analog outputs can be left open-circuited.

Assignment of the Ethernet ports

The terminal unit for the communication interface module provides two Ethernet interfaces with the following pin assignment. The pin assignment is used for the EtherCAT master (communication module CM5xy-ETHCAT) as well.

Pin assignment

Interface	Pin	Signal	Description
	1	TxD+	Transmit data +
	2	TxD-	Transmit data -
	3	RxD+	Receive data +
	4	NC	Not connected
	5	NC	Not connected
	6	RxD-	Receive data -
	7	NC	Not connected
	8	NC	Not connected
	Shield	Cable shield	Functional earth

In corrosive environment, please protect unused connectors using the TA535 accessory.

Not supplied with this device.

Further information about wiring and cable types

The EtherCAT network differentiates between input-connectors (IN) and output-connectors (OUT):

At the EtherCAT slaves (communication interface modules), the ETH1-connector is IN and the ETH2-connector is OUT.

At the EtherCAT master (communication module), the ETHCAT1 connector has to be used. The ETHCAT2 connector is reserved for future extensions.

1.8.4.1.5 Internal data exchange

Parameter	Value
Digital inputs (bytes)	1
Digital outputs (bytes)	1
Analog inputs (words)	4
Analog outputs (words)	2

1.8.4.1.6 Addressing

The Ethernet bus module CI511-ETHCAT does not consider the position of the rotary switches at the front side of the module. The function of the rotary switches is reserved for future expansions.

1.8.4.1.7 I/O configuration

> *In order to be able to use the CI51X-ETHCAT with device index C0 or above properly, please download the corresponding device description (.xml-)files from http://www.abb.com/plc and install them to the device repository of your Automation Builder. This will allow you to use up to 10 Expandable S500 I/O modules as well as the Extended Cam Switch Library with your CI51X-ETHCAT device.*

The CI511-ETHCAT does not store configuration data itself.

The analog I/O channels are configured via software.

1.8.4.1.8 Parameterization

Module parameter

Name	Value	Internal value	Internal value, type	Default
Module ID	Internal	48155	WORD	48155
Parameter length	Internal	28	BYTE	28
Error LED / Fail-safe function [1])	On Off by E4 Off by E3 On + failsafe Off by E4 + failsafe Off by E3 + failsafe	0 1 3 16 17 19	BYTE	0
Check Supply	Off On	0 1	BYTE	1

Table 273: Error LED / Failsafe function [1])

Setting	Description
On	Error LED lights up at errors of all error classes, Failsafemode off
Off by E4	Error LED lights up at errors of error classes E1, E2 and E3, Failsafemode off
Off by E3	Error LED lights up at errors of error classes E1 and E2 auf, Failsafemode off
On + failsafe	Error LED lights up at errors of all error classes, Failsafemode on *)
Off by E4 + failsafe	Error LED lights up at errors of error classes E1, E2 and E3, Failsafemode on *)
Off by E3 + failsafe	Error LED lights up at errors of error classes E1 and E2, Failsafe-mode on *)

*) The parameters behaviourAOatCommunicationFault and behaviourDOatCommunicationFault are only analyzed if the Failsafe-mode is ON.

Group parameters of the cam switch

Name	Value	Internal value	Internal value, type	Default
numOfUsed-Cams [1])	0 ... 32 128 ... 160	0 ... 32 218 ... 160	WORD	0
resolution [2])	0 ... 2 -1	0 ... 2 -1	DWORD	36000
zeroShift [3])	0 ... 2 -1	0 ... 2 -1	DWORD	0
EncoderBitReso-lution [4])	8 ... 32	8 ... 32	WORD	18
Reserve	-	-	WORD	-

[1]) The parameter numOfUsedCams defines the interrupt cycle time (Therefore, it takes effect to the accuracy of the track) and the behavior of the module if the DC information is lost.

Parameter setting for numOfUsed-Cams	Number of cams used	Interrupt cycle time	Behavior if DC infor-mation is lost
0	0	50 µs	Module changes to "safe-operational" state; the outputs are activated trough the user program
1...8	1...8	80 µs	
9...16	9...16	100 µs	
17...32	17...32	200 µs	
128	0	50 µs	Module keeps in "operational" state; the outputs are acti-vated trough the user program
129 ... 136	1 ... 8	80 µs	Module keeps in "operational" state; the cam switch out-puts are activated according to an inter-polated timing infor-mation
137 ... 144	9 ... 16	100 µs	
145 ... 170	17 ... 32	200 µs	

[2]) The parameter resolution defines the angle resolution of the track. The value gives the number of increments related to 360°; e. g. the value 36,000 corresponds to an angle resolution of 0.01°.

[3]) The parameter zeroShift defines the zero shift. With it the encoder can be adjusted to the mounting position. The value of zeroShift is set in encoder-increments. It is not assigned to the parameter resolution of the cam switch.

[4]) The parameter EncoderBitResolution defines the resolution of the used encoder (in bits), e. g. with the default setting 18 bits the encoder has 196,608 divisions.

Channel parameters for the cam switch (max. 32x)

Name	Value	Internal value	Internal value, type	Default
camToTrack0 *)	Digital Output 0 ... 7, none	0 ... 7, FF	BYTE	FF
:	:	:	:	:
camToTrack31	Digital Output 0 ...7, none	0 ... 7, FF	BYTE	FF

*) The value of the parameter camToTrack# defines which DO (digital output) is assigned to the track. camToTrack0 = 3 for example means that track 0 is assigned to the digital output 3. If the value FFh is set to a track, no digital output is assigned to it.

Name	Value	Referred FB from extended Cam Switch Library [2])	Internal value	Internal value, type	Default
cam-Type[0] [1]) ...	Common Pulsed Timed Comfort Cam shift Binary shift Multiturn cam Time timed Reference Multiturn timed	MCX_CamSwitchSimple_c MCX_CamSwitchSimple_dc MCX_PulseSwitch_dc MCX_CamSwitchTimed_dc MCX_CamSwitchCom-fort_dc MCX_CamShift_dc MCX_BinaryShift_dc MCX_CamSwitchMulti_dc MCX_SwitchTimeTimed_dc MCX_BinaryReference_dc MCX_CamSwitchMulti-Timed_dc	0 1 2 3 4 5 6 7 8 9	BYTE	0

[1]) camType additionally to camToTrack identifies the type of each cam switch and enables the use of a specific function block from the Extended Cam Switch Library.

[2]) camType parameters and the Extended Camswitch Library are only available for CI511-ETHCAT and CI512-ETHCAT with device index C0 and above.

Group parameters for the analog part

Name	Value	Internal value	Internal value, type	Default
Analog data format	Standard	0	BYTE	0
Behaviour AO at comm. error *)	Off Last value Last value 5 s Last value 10 s Substitute value Substitute value 5 s Substitute value 10 s	0 1 6 11 2 7 12	BYTE	0

*) The parameter Behaviour AO at comm. error is only analyzed if the Failsafe-mode is ON.

Channel parameters for the analog inputs (4x)

Name	Value	Internal value	Internal value, type	Default
Input 0, channel configuration	see [1])	see [1])	BYTE	0
Input 0, check channel	see [2])	see [2])	BYTE	0
:	:	:	:	:
:	:	:	:	:
Input 3, channel configuration	see [1])	see [1])	BYTE	0
Input 3, channel configuration	see [2])	see [2])	BYTE	0

Channel configuration [1])

Internal value	Operating modes of the analog inputs, individually configurable
0 (default)	Not used
1	0 ... 10 V
2	Digital input
3	0 ... 20 mA
4	4 ... 20 mA
5	-10 V ... +10 V
8	2-wire Pt100 -50 °C ... +400 °C
9	3-wire Pt100 -50 °C ...+400 °C *)
10	0 V ... 10 V (voltage diff.) *)
11	-10 V ... +10 V (voltage diff.) *)
14	2-wire Pt100 -50 °C ... +70 °C
15	3-wire Pt100 -50 °C ... +70 °C *)

Internal value	Operating modes of the analog inputs, individually configurable
16	2-wire Pt1000 -50 °C ...+400 °C
17	3-wire Pt1000 -50 °C ...+400 °C *)
18	2-wire Ni1000 -50 °C ...+150 °C
19	3-wire Ni1000 -50 °C ...+150 °C *)
	*) In the operating modes with 3-wire configuration or with differential inputs, two adjacent analog inputs belong together (e.g. the channels 0 and 1). In these cases, both channels are configured in the desired operating mode. The lower address must be the even address (channel 0). The next higher address must be the odd address (channel 1). The converted analog value is available at the higher address (channel 1).

Table 274: Channel monitoring [2])

Internal Value	Check channel
0	Plausibility, wire break, short circuit
3	not used

Channel parameters for the analog outputs (2x)

Name	Value	Internal value	Internal value, type	Default
Output 0, channel configu-ration	see [3])	see [3])	BYTE	0
Output 0, check channel	see [4])	see [4])	BYTE	0
Output 0, substi-tute value	see [5])	see [5])	WORD	0
Output 1, channel configu-ration	see [3])	see [3])	BYTE	0
Output 1, check channel	see [4])	see [4])	BYTE	0
Output 1, substi-tute value	see [5])	see [5])	WORD	0

Table 275: Channel configuration [3])

Internal value	Operating modes of the analog outputs, individually configu-rable
0	Not used (default)
128	-10 V ... +10 V
129	0 ... 20 mA
130	4 ... 20 mA

Table 276: Channel monitoring [4])

Internal value	Check channel
0	Plausibility, wire break, short circuit
3	None

Table 277: Substitute value [5])

Intended behavior of output channel when the control system stops	Required setting of the module parameter "Behaviour of outputs in case of a communication error"	Required setting of the channel parameter "Substitute value"
Output OFF	Off	0
Last value infinite	Last value	0
Last value for 5 s	Last value 5 s	0
Last value for 10 s	Last value 10 s	0
Substitute value infinite	Substitute value	Depending on configura-tion
Substitute value for 5 s	Substitute value 5 s	Depending on configura-tion
Substitute value for 10 s	Substitute value 10 s	Depending on configura-tion

Group parameters for the digital part

Name	Value	Internal value	Internal value, type	Default
Input delay	0.01 ms 1 ms 8 ms 32 ms	0 1 2 3	BYTE	0.01 ms 0x00
Detect short circuits at outputs	Off On	0 1	BYTE	On 0x01
Behaviour DO at comm. error *)	Off Last value Last value 5 sec Last value 10 sec Substitute value Substitute 5 sec Substitute 10 sec	0 1 6 11 2 7 12	BYTE	Off 0x00
Substitute value at output	0 ... 255	00h ... FFh	BYTE	0 0x0000

*) The parameter behaviourDOatCommunicationFault is only analyzed if the Failsafe-mode is ON.

1.8.4.1.9 Diagnosis

In cases of short circuit or overload, the digital outputs are turned off. The modules performs reactivation automatically. Thus an acknowledgement of the errors is not necessary. The error message is stored via the LED.

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identifier 000 ... 063**	**AC500-Display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 6 Bit 6 ... 7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0 ... 5**	**ETHCAT Diagnosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error identifier**	**Error message**	**Remedy**
	1)	2)	3)	4)			
Module error							
3	-	31	31	31	19	Checksum error in the I/O module	Replace I/O module
3	-	31	31	31	3	Timeout in the I/O module	
3	-	31	31	31	40	Different hard-/firmware versions in the module	
3	-	31	31	31	43	Internal error in the module	
3	-	31	31	31	36	Internal data exchange failure	
3	-	31	31	31	20	Slave-to-Slave malfunction	Check configuration
3	-	31	31	31	41	Distributed Clock malfunction	Check configuration
3	-	31	31	31	9	Overflow diagnosis buffer	Restart
3	-	31	31	31	26	Parameter error	Check master
3	-	31	31	31	11	Process voltage UP too low	Check process supply voltage UP
4	-	31	31	31	45	Process voltage UP3 too low	Check process voltage
4	-	31	31	31	34	No response during initialization of the I/O module	Replace I/O module

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier 000 ... 063**	**AC500-Display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 6 Bit 6 ... 7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0 ... 5**	**ETHCAT Diag-nosis block**	
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error identi-fier**	**Error message**	**Remedy**
	1)	**2)**	**3)**	**4)**			
4	-	31	31	31	46	Voltage feedback on activated digital outputs 4)	Check terminals
Channel error digital							
4	-	31	2	0..7	46	Voltage feedback on deactivated dig-ital output 5)	Check terminals
4	-	31	2	0..7	47	Short circuit at dig-ital output	Check terminals
Channel error analog							
4	-	31	1	0..3	48	Analog value over-flow or broken wire at an analog input	Check value or check terminals
4	-	31	1	0..3	7	Analog value underflow at an analog input	Check value
4	-	31	1	0..3	47	Short circuit at an analog input	Check terminals
4	-	31	3	0..1	48	Analog value over-flow at an analog output	Check output value
4	-	31	3	0..1	7	Analog value underflow at an analog output	Check output value

Remarks:

1)	In AC500 the following interface identifier applies: "-" = Diagnosis via bus-specific function blocks; 0 ... 4 or 10 = Position of the Communication Module;14 = I/O bus; 31 = Module itself The identifier is not contained in the CI511-ETHCAT diagnosis block.
2)	With "Device" the following allocation applies: 31 = Module itself or ADR = Hardware address (e. g. of the DC551)

[3])	With "Module" the following allocation applies dependent of the master: 31 = Module itself (Module error) or Module type (1=AI, 2=DO, 3=AO; channel error)
[4])	Diagnosis message appears for the whole output group and not per channel. The message occurs if the output channel is already active.
[5])	Diagnosis message appears per channel. The message occurs if the output channel is not active.

1.8.4.1.10 State LEDs

The LEDs are located at the front of module. There are 2 different groups:

- The 5 system LEDs (PWR, NET, DC, S-ERR and I/O-Bus) show the operation state of the module and display possible errors.
- The 27 process LEDs (UP, UP3, inputs, outputs, CH-ERR1 to CH-ERR3) show the process supply voltage and the states of the inputs and outputs and display possible errors.

Table 278: States of the 5 system LEDs

LED	Color	Off	On	Flashing	1x Flash	2x Flash
PWR/RUN	Green	Error in the internal supply voltage or process voltage missing	Internal supply voltage OK	Module is not configured	--	--
	Yellow	--	--	--	--	--
NET	Green	Init	Operational	Pre-operational	Safe-operational	--
	Red	No error	PDI Watchdog Timeout	Invalid Configuration	Unsolicited State Change	Application time out
DC *)	Green	Distributed Clock not active	Distributed Clock active	--	--	--
	Red	--	--	--	--	--
S-ERR	Red	No error	Internal error	--	--	--
I/O-Bus	Green	No communication interface modules connected or communication error	---	---	--	--
ETH1	Green	No EtherCAT connection	Link OK No data transfer	Link OK Data transfer OK	--	--
	Yellow	--	--	--	--	--

LED	Color	Off	On	Flashing	1x Flash	2x Flash
ETH2	Green	No EtherCAT connection	Link OK No data transfer	Link OK Data transfer OK	--	--
	Yellow	--	--	--	--	--

*) The state of this LED is only significant if the cam switch functionality is enabled

Table 279: States of the 27 process LEDs

LED	Color	OFF	ON	Flashing
AI0 ... AI3	Yellow	Input is OFF	Input is ON (brightness depends on the value of the analog signal)	--
AO0 ... AO1	Yellow	Output is OFF	Output is ON (brightness depends on the value of the analog signal)	--
DI0 ... DI7	Yellow	Input is OFF	Input is ON (the input voltage is even displayed if the supply voltage is OFF)	--
DO0 ... DO7	Yellow	Output is OFF	Output is ON	--
UP	Green	Process supply voltage missing	Process supply voltage OK and initialization fin-ished	--
UP3	Green	Process supply voltage missing	Process supply voltage OK	--
CH-ERR1 to CH-ERR3	Red	No error or process supply voltage missing	Internal error	Error on one channel of the corresponding group

1.8.4.1.11 Measuring ranges

Input ranges voltage, current and digital input

Range	0 V ... +10 V	-10 V ... +10 V	0 mA ... 20 mA	4 mA ... 20 mA	Digital input	Digital value	
						Decimal	**Hex.**
Overflow	> 11.7589	> 11.7589	> 23.5178	> 22.8142		32767	7FFF
Measured value too high	11.7589 : 10.0004	11.7589 : 10.0004	23.5178 : 20.0007	22.8142 : 20.0006		32511 : 27649	7EFF : 6C01
Normal range	10.0000 : 0.0004	10.0000 : 0.0004	20.0000 : 0.0007	20.0000 : 4.0006	: : On	27648 : 1	6C00 : 0001

Range	0 V ... +10 V	-10 V ... +10 V	0 mA ... 20 mA	4 mA ... 20 mA	Digital input	Digital value	
						Decimal	Hex.
Normal range or measured value too low	0.0000	0.0000	0	4	Off	0	0000
	-0.0004 -1.7593	-0.0004 : : -10,0000		3.9994 1.1858		-1 -4864 : -27648	FFFF ED00 : 9400
Measured value too low		-10.0004 : -11.7589				-27649 : -32512	93FF : 8100
Underflow	< 1.7593	< -11.7589	< 0.0000	< 1.1858		-32768	8000

The represented resolution corresponds to 16 bits.

Input ranges resistance temperature detector

Range	Pt100 / Pt1000 -50 °C ... +400 °C	Ni1000 -50 °C ... +150 °C	Digital value	
			Decimal	Hex.
Overflow	> +450.0 °C	> +160.0 °C	32767	7FFF
Measured value too high	+450.0 °C : +400.1 °C		4500 : 4001	1194 : 0FA1
		+160.0 °C : +150.1 °C	1600 : 1501	0640 : 05DD
			800 : 701	0320 : 02BD
Normal range	+400.0 °C : : : +0.1 °C	+150.0 °C : : + 0.1 °C	4000 1500 700 : 1	0FA0 05DC 02BC : 0001
	0.0 °C	0.0 °C	0	0000
	-0.1 °C : -50.0 °C	-0.1 °C : -50,0 °C	-1 : -500	FFFF : FE0C
Measured value too low	-50.1 °C : -60.0 °C	-50.1 °C : -60.0 °C	-501 : -600	FE0B : FDA8
Underflow	< -60.0 °C	< -60.0 °C	-32768	8000

Output ranges voltage and current

Range	-10 V ... +10 V	0 mA ... 20 mA	4 mA ... 20 mA	Digital value	
				Decimal	**Hex.**
Overflow	0 V	0 mA	0 mA	> 32511	> 7EFF
Measured value too high	11.7589 V : 10.0004 V	23.5178 mA : 20.0007 mA	22.8142 mA : 20.0006 mA	32511 : 27649	7EFF : 6C01
Normal range	10.0000 V : 0.0004 V	20.0000 mA : 0,0007 mA	20.0000 mA : 4.0006 mA	27648 : 1	6C00 : 0001
	0.0000 V	0.0000 mA	4.0000 mA	0	0000
	-0.0004 V : -10.0000 V	0 mA : 0 mA	3.9994 mA 0 mA 0 mA	-1 -6912 -27648	FFFF E500 9400
Measured value too low	-10.0004 V : -11.7589 V	0 mA : 0 mA	0 mA : 0 mA	-27649 : -32512	93FF : 8100
Underflow	0 V	0 mA	0 mA	< -32512	< 8100

The represented resolution corresponds to 16 bits.

1.8.4.1.12 Technical data

Technical data of the module

The system data of AC500 and S500 are applicable to the standard version ⇘ *Chapter 2.6.1 “System data AC500” on page 1408*.

The system data of AC500-XC are applicable to the XC version ⇘ *Chapter 2.7.1 “System data AC500-XC” on page 1475*.

Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

Parameter	Value
Bus connection	2 x RJ45
Technology	Hilscher NETX 100
Transfer rate	10/100 Mbit/s (full-duplex)
Transfer method	According to Ethernet II, IEEE 802.3
Ethernet	100 base-TX, internal switch, 2x RJ45 socket
Expandability (S500 I/O modules)	Up to 10 S500 I/O modules (Index C0 and above), not available (Index below C0)
Indicators	5 LEDs for state indication
Adjusting elements	2 rotary switches (used for future topology extensions)

Parameter	Value
Quantity of input/output data	CI512-ETHCAT: 10 bytes input and 14 bytes output CI511-ETHCAT: 18 bytes input and 18 bytes output
Limit of data for input and output	144 byte
Acyclic services	SDO (1500 bytes max.) Emergency ECAT_SLV_DIAG
Protective functions (according to CODESYS)	Protected against: ● short circuit ● reverse supply ● overvoltage ● reverse polarity Galvanic isolation to network

Parameter		Value
Process supply voltage UP/UP3		
	Rated value	24 V DC (for inputs and outputs)
	Max. load for the terminals	10 A
	Protection against reversed voltage	Yes
	Rated protection fuse on UP/UP3	10 A fast
	Galvanic isolation	Ethernet interface against the rest of the module
	Inrush current from UP (at power up)	On request
	Current consumption via UP (normal operation)	0.2 A
	Current consumption via UP3	0.06 A + 0.5 A max. per output
	Connections	Terminals 1.8 and 2.8 for +24 V (UP) Terminal 3.8 for +24 V (UP3) Terminals 1.9, 2.9 and 3.9 for 0 V (ZP)
Max. power dissipation within the module		6 W
Number of digital inputs		8
Number of digital outputs		8
Number of analog inputs		4
Number of analog outputs		2
Reference potential for all digital inputs and outputs		Negative pole of the supply voltage, signal name ZP
Diagnosis		See Diagnosis and Displays *Chapter 1.8.4.1.9 “Diagnosis” on page 1079*
Operation and error displays		32 LEDs (totally)
Weight (without terminal unit)		ca. 125 g

Parameter	Value
Mounting position	Horizontal Or vertical with derating (output load reduced to 50 % at +40 °C per group)
Cooling	The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

NOTICE!
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and temporary overvoltage up to 30 V DC.

Multiple overloads
No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an internal smart high-side switch.

Technical data of the digital inputs

Parameter		Value
Number of channels per module		8
Distribution of the channels into groups		1 group of 8 channels
Terminals of the channels DI0 ... DI7		Terminals 2.0 ... 2.7
Reference potential for all inputs		Terminals 1.9 ... 3.9 (Negative pole of the supply voltage, signal name ZP)
Indication of the input signals		1 yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Input type (according EN 61131-2)		Type 1
Input delay (0->1 or 1->0)		Typ. 0.1 ms, configurable from 0.1 ms ... 32 ms
Input signal voltage		24 V DC
	0-Signal	-3 V ... +5 V
	Undefined Signal	> +5 V ... < +15 V
	1-Signal	+15 V ... +30 V
Ripple with signal 0		Within -3 V ... +5 V
Ripple with signal 1		Within +15 V ... +30 V
Input current per channel		
	Input voltage +24 V	Typ. 5 mA
	Input voltage +5 V	> 1 mA
	Input voltage +15 V	> 2 mA
	Input voltage +30 V	< 8 mA
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

Technical data of the digital outputs

Parameter		Value
Number of channels per module		8
Distribution of the channels into groups		1 group of 8 channels
Terminals of the channels DO0 ... DO7		Terminals 3.0 ... 3.7
Reference potential for all outputs		Terminals 1.9 ... 3.9 (Negative pole of the supply voltage, signal name ZP)
Common power supply voltage		For all outputs terminal 3.8 (positive pole of the supply voltage, signal name UP3)
Output voltage for signal 1		UP3 (-0.8 V)
Output delay (0->1 or 1->0)		On request
Output current		
	Rated value per channel	500 mA at UP3 = 24 V
	Max. value (all channels together)	4 A
Leakage current with signal 0		< 0.5 mA
	Fuse for UP3	10 A fast
Demagnetization with inductive DC load		Via internal varistors (see figure below this table)
Output switching frequency		
	With resistive load	On request
	With inductive loads	Max. 0.5 Hz
	With lamp loads	11 Hz max. at 5 W max.
Short-circuit-proof / overload-proof		Yes
Overload message (I > 0.7 A)		Yes, after ca. 100 ms
Output current limitation		Yes, automatic reactivation after short circuit/overload
Resistance to feedback against 24 V signals		Yes (software-controlled supervision)
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

The following drawing shows the circuitry of a digital input/output with the varistors for demagnetization when inductive loads are switched off.

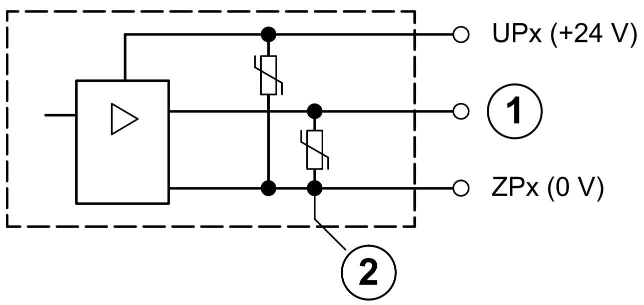


Fig. 281: Digital input/output (circuit diagram)

1 Digital output
2 Varistors for demagnetization when inductive loads are turned off

Technical data of the analog inputs

Parameter		Value
Number of channels per module		4
Distribution of channels into groups		1 group with 4 channels
Connection if channels AI0+ ... AI3+		Terminals 1.0 ... 1.3
Reference potential for AI0+ ... AI3+		Terminal 1.4 (AI-) for voltage and RTD measurement Terminals 1.9, 2.9 and 3.9 for current measurement
Input type		
	Unipolar	Voltage 0 V ... 10 V, current or Pt100/Pt1000/ Ni1000
	Bipolar	Voltage -10 V ... +10 V
Galvanic isolation		Against Ethernet network
Configurability		0 V ... 10 V, -10 V ... +10 V, 0/4 mA ... 20 mA, Pt100/1000, Ni1000 (each input can be configured individually)
Channel input resistance		Voltage: > 100 kΩ Current: ca. 330 Ω
Time constant of the input filter		Voltage: 100 µs Current: 100 µs
Indication of the input signals		1 LED per channel (brightness depends on the value of the analog signal)
Conversion cycle		1 ms (for 4 inputs + 2 outputs); with RTDs Pt/ Ni... 1 s
Resolution		Range 0 ... 10 V: 12 bits Range -10 ... +10 V: 12 bits including sign Range 0 ... 20 mA: 12 bits Range 4 ... 20 mA: 12 bits Range RTD (Pt100, PT1000, Ni1000): +0.1 °C
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range		Typ. 0.5 %, max. 1 %
Relationship between input signal and hex code		*Chapter 1.8.4.1.11.2 “Input ranges resistance temperature detector” on page 1083*
Unused inputs		Are configured as "unused" (default value)
Overvoltage protection		Yes

Technical data of the analog inputs, if used as digital inputs

Parameter	Value
Number of channels per module	Max. 4
Distribution of channels into groups	1 group of 4 channels
Connections of the channels AI0+ ... AI3+	Terminals 1.0 ... 1.3

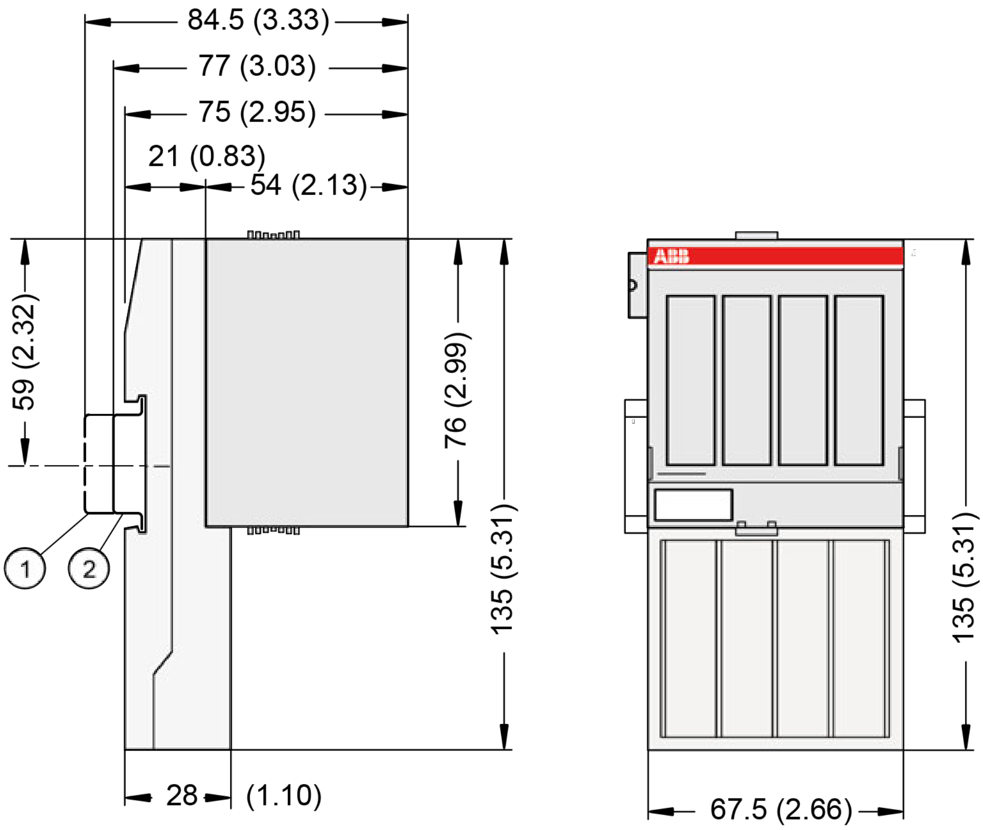
Parameter		Value
Reference potential for the inputs		Terminals 1.9, 2.9 and 3.9 (ZP)
Indication of the input signals		1 LED per channel
Input signal voltage		24 V DC
	Signal 0	-30 V ... +5 V
	Undefined signal	+5 V ... +13 V
	Signal 1	+13 V ... +30 V
Input current per channel		
	Input voltage +24 V	Typ. 7 mA
	Input voltage +5 V	Typ. 1.4 mA
	Input voltage +15 V	Typ. 3.7 mA
	Input voltage +30 V	< 9 mA
Input resistance		Ca. 3.5 kΩ

Technical data of the analog outputs

Parameter		Value
Number of channels per module		2
Distribution of channels into groups		1 group for 2 channels
Connection of the channels AO0+...AO1+		Terminals 1.5 ... 1.6
Reference potential for AO0+ ... AO1+		Terminal 1.7 (AO-) for voltage outputTerminals 1.9, 2.9 and 3.9 (ZP) for current output
Output type		
	Unipolar	Current
	Bipolar	Voltage
Galvanic isolation		Against Ethernet network
Configurability		-10 V ... +10 V, 0 mA ... 20 mA, 4 mA ... 20 mA (each output can be configured individually)
Output resistance (load), as current output		0 Ω ... 500 Ω
Output loadability, as voltage output		± 10 mA max.
Indication of the output signals		1 LED per channel (brightness depends on the value of the analog signal)
Resolution		12 bits including sign
Settling time for full range change (resistive load, output signal within specified tolerance)		Typ. 5 ms
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range		Typ. 0.5 %, max. 1 %

Parameter	Value
Relationship between input signal and hex code	Table Output Ranges Voltage and Current *Chapter 1.8.4.1.11.3 “Output ranges voltage and current” on page 1084*
Unused outputs	Are configured as unused (default value) and can be left open-circuited

1.8.4.1.13 Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

1.8.4.1.14 Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 220 900 R0001	CI511-ETHCAT, EtherCAT communication interface module, 8 DI, 8 DO, 4 AI and 2 AO	Active

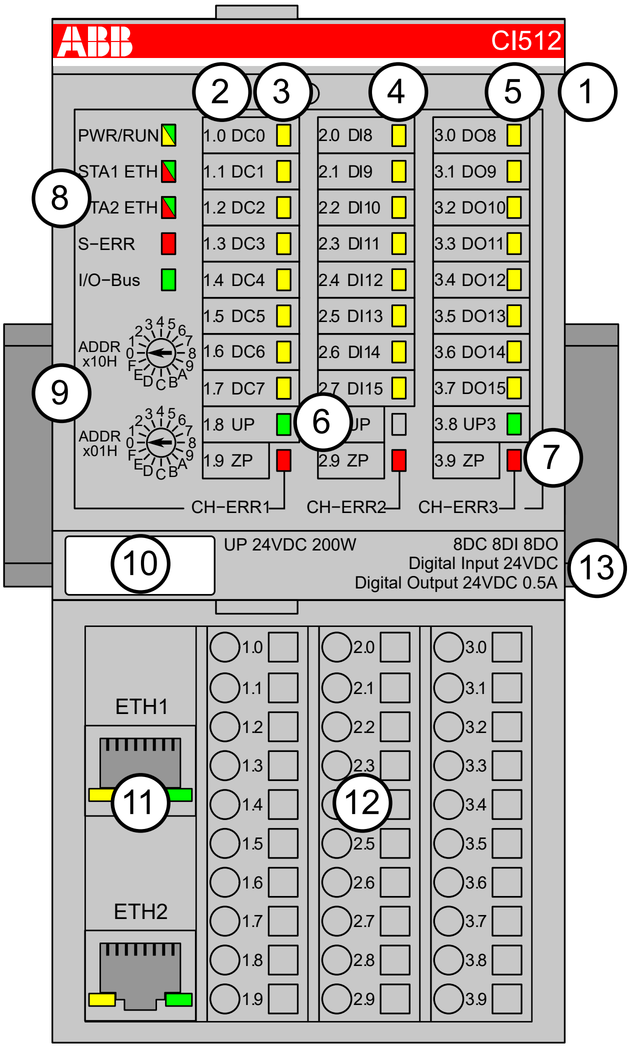
) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.

1.8.4.2 CI512-ETHCAT

1.8.4.2.1 Features

- 8 digital inputs 24 V DC
- 8 digital outputs 24 V DC, 0.5 A max.
- 8 configurable digital inputs/outputs 24 V DC, 0.5 A max.
- Cam switch functionality (see also Extended Cam Switch Library)
- Extended Cam switch functionality *)
  (see also Extended Cam Switch Library)
- Module-wise galvanically isolated
- Expandability with up to 10 S500 I/O modules *)

*) Applicable for device index C0 and above.



1 I/O bus
2 Allocation between terminal number and signal name
3 8 yellow LEDs to display the signal states of the digital configurable inputs/outputs (DC0 ... DC7)

4 8 yellow LEDs to display the signal states of the digital inputs (DI0 ... DI7)
5 8 yellow LEDs to display the signal states of the digital outputs (DO0 ... DO7)
6 2 green LEDs to display the supply voltage UP and UP3
7 3 red LEDs to display errors (CH-ERR1, CH-ERR2, CH-ERR3)
8 5 System LEDs: PWR/RUN, NET, DC, S-ERR, I/O-Bus
9 2 rotary switches (reserved for future extensions)
10 Label
11 Ethernet interfaces (ETH1, ETH2) on the terminal unit
12 Terminal unit
13 DIN rail

1.8.4.2.2 Intended purpose

The EtherCAT communication interface module CI512-ETHCAT is used as decentralized I/O module in EtherCAT networks. The network connection is performed via 2 RJ45 connectors which are integrated in the terminal unit. The communication interface module contains 24 I/O channels with the following properties:

- 8 digital configurable inputs/outputs in 1 group (1.0 ... 1.7)
- 8 digital inputs 24 V DC in 1 group (2.0 ... 2.7)
- 8 digital outputs 24 V DC in 1 group (3.0 ... 3.7)
- Cam switch functionality

The inputs/outputs are galvanically isolated from the Ethernet network. There is no potential separation between the channels. The configuration of the configurable digital inputs/outputs is performed by software.

1.8.4.2.3 Functionality

Parameter	Value
Interface	Ethernet
Protocol	EtherCAT
Power supply	From the process supply voltage UP
Supply of the electronic circuitry of the I/O expansion modules attached	Through the I/O bus interface (I/O bus)
Rotary switches	Not used; reserved for future extensions
Configurable digital inputs/outputs	8 (configurable via software)
Digital inputs	8 (24 V DC; delay time configurable via software)
Digital outputs	8 (24 V DC, 0.5 A max.)
LED displays	For system displays, signal states, errors and power supply
External supply voltage	Via terminals ZP, UP and UP3 (process supply voltage 24 V DC)
Effect of incorrect input terminal connection	Wrong or no signal detected, no damage up to 35 V
Required terminal unit	TU507 or TU508 *Chapter 1.5.1 “TU507-ETH and TU508-ETH for Ethernet communication interface modules” on page 274*

1.8.4.2.4 Connections

The Ethernet communication interface module CI512-ETHCAT is plugged on the I/O terminal unit TU507-ETH or TU508-ETH. Properly seat the module and press until it locks in place. The terminal unit is mounted on a DIN rail or with 2 screws plus the additional accessory for wall mounting (TA526).

The connection of the I/O channels is carried out using the 30 terminals of the I/O terminal unit. I/O modules can be replaced without re-wiring the terminal units.

For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.

The terminals 1.8 and 2.8 as well as 1.9, 2.9 and 3.9 are electrically interconnected within the terminal unit and have always the same assignment, independent of the inserted module:

Terminals 1.8 and 2.8: Process supply voltage UP = +24 V DC

Terminal 3.8: Process supply voltage UP3 = +24 V DC

Terminals 1.9, 2.9 and 3.9: Process supply voltage ZP = 0 V

With a separate UP3 power supply, the digital outputs can be switched off externally. This way, an emergency-off functionality can be realized.

The assignment of the other terminals:

Terminals	Signal	Description
1.0 ... 1.7	DC0 ... DC7	8 digital inputs/outputs (configurable via software)
2.0 ... 2.7	DI0 ... DI7	8 digital inputs (delay time configurable via software)
3.0 ... 3.7	DO0 ... DO7	8 digital outputs

WARNING!

Removal/Insertion under power

The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!
Risk of damaging the PLC modules!
Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

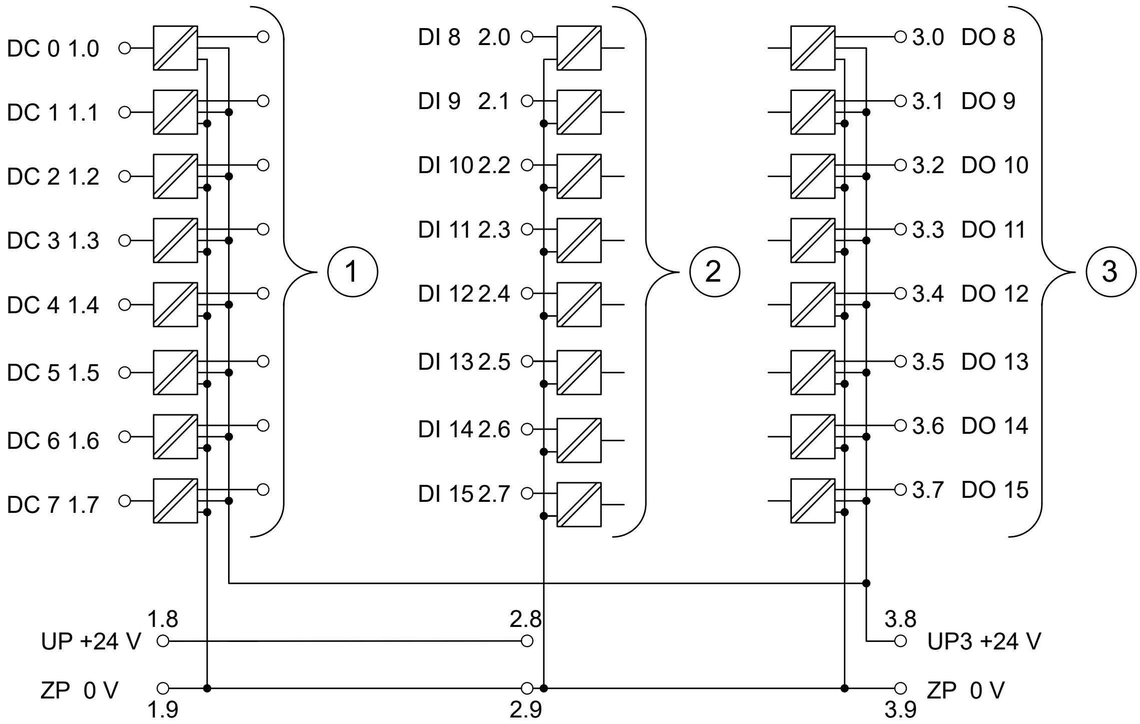


Fig. 282: Connection of the communication interface module CI512-ETHCAT

1 8 digital configurable inputs/outputs 24 V DC
2 8 digital inputs 24 V DC
3 8 digital outputs 24 V DC

In case of voltage feedback, 2 cases are distinguished:

1. The outputs are already active

The output group will be switched off. A diagnosis message will appear. After 5 seconds, the module tries automatic reactivation.

2. The outputs are not active

Only the output with voltage feedback will not be set to active. A diagnosis message will appear.

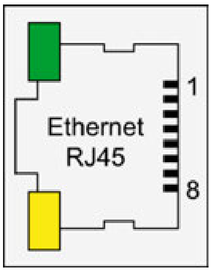
CAUTION!
The process supply voltage must be included within the grounding concept of the plant (e. g. grounding of the negative pole).

The module provides several diagnosis functions *Chapter 1.8.4.2.10 “Diagnosis” on page 1099*.

1.8.4.2.5 Assignment of the Ethernet ports

The terminal unit for the communication interface module provides two Ethernet interfaces with the following pin assignment. The pin assignment is used for the EtherCAT master (communication module CM5xy-ETHCAT) as well.

Pin assignment

Interface	Pin	Signal	Description
	1	TxD+	Transmit data +
	2	TxD-	Transmit data -
	3	RxD+	Receive data +
	4	NC	Not connected
	5	NC	Not connected
	6	RxD-	Receive data -
	7	NC	Not connected
	8	NC	Not connected
	Shield	Cable shield	Functional earth

In corrosive environment, please protect unused connectors using the TA535 accessory.

Not supplied with this device.

↬ *Further information about wiring and cable types*

The EtherCAT network differentiates between input-connectors (IN) and output-connectors (OUT):

At the EtherCAT slaves (communication interface modules), the ETH1-connector is IN and the ETH2-connector is OUT.

At the EtherCAT master (communication module), the ETHCAT1 connector has to be used. The ETHCAT2 connector is reserved for future extensions.

1.8.4.2.6 Internal data exchange

Parameter	Value
Digital inputs (bytes)	1
Digital outputs (bytes)	1
Configurable digital inputs/outputs (bytes)	1 + 1

1.8.4.2.7 Addressing

The Ethernet communication interface module CI512-ETHCAT does not consider the position of the rotary switches at the front side of the module. The function of the rotary switches is reserved for future expansions.

1.8.4.2.8 I/O configuration

> *In order to be able to use the CI51X-ETHCAT with device index C0 or above properly, please download the corresponding device description (.xml-)files from http://www.abb.com/plc and install them to the device repository of your Automation Builder. This will allow you to use up to 10 Expandable S500 I/O modules as well as the Extended Cam Switch Library with your CI51X-ETHCAT device.*

The CI512-ETHCAT does not store configuration data itself.

The analog I/O channels are configured via software.

1.8.4.2.9 Parameterization

Module parameter

Name	Value	Internal value	Internal value, type	Default
Module ID	Internal	49435	WORD	49435
Parameter length	Internal	10	BYTE	10
Error LED / Fail-safe function [1])	On Off by E4 Off by E3 On + failsafe Off by E4 + failsafe Off by E3 + failsafe	0 1 3 16 17 19	BYTE	0
Check Supply	Off On	0 1	BYTE	1

Table 280: Error LED / Failsafe function [1])

Setting	Description
On	Error LED lights up at errors of all error classes, Failsafe mode off
Off by E4	Error LED lights up at errors of error classes E1, E2 and E3, Failsafe mode off
Off by E3	Error LED lights up at errors of error classes E1 and E2 auf, Failsafe mode off
On + failsafe	Error LED lights up at errors of all error classes, Failsafe mode on *)
Off by E4 + failsafe	Error LED lights up at errors of error classes E1, E2 and E3, Failsafe mode on *)
Off by E3 + failsafe	Error LED lights up at errors of error classes E1 and E2, Failsafe mode on *)

*) The parameter behaviourDOatCommunicationFault is only analyzed if the Failsafe-mode is ON.

Group parameters of the cam switch

Name	Value	Internal value	Internal value, type	Default
numOfUsed-Cams [1])	0 ... 32 128 ... 160	0 ... 32 218 ... 160	WORD	0
resolution [2])	0 ... 2 -1	0 ... 2 -1	DWORD	36000
zeroShift [3])	0 ... 2 -1	0 ... 2 -1	DWORD	0
EncoderBitReso-lution [4])	8 ... 32	8 ... 32	WORD	18
Reserve	-	-	WORD	-

Remarks:

[1]) The parameter numOfUsedCams defines the interrupt cycle time (Therefore, it takes effect to the accuracy of the track) and the behavior of the module if the DC information is lost.

Parameter setting for numOfUsed-Cams	Number of cams used	Interrupt cycle time	Behavior if DC infor-mation is lost
0	0	50 µs	Module changes to "safe-operational" state; the outputs are activated trough the user program
1 ... 8	1 ... 8	80 µs	
9 ... 16	9 ... 16	100 µs	
17 ... 32	17 ... 32	200 µs	
128	0	50 µs	Module keeps in "operational" state; the outputs are acti-vated trough the user program
129 ... 136	1 ... 8	80 µs	Module keeps in "operational" state; the cam switch out-puts are activated according to an inter-polated timing infor-mation
137 ... 144	9 ... 16	100 µs	
145 ... 170	17 ... 32	200 µs	

[2]) The parameter resolution defines the angle resolution of the track. The value gives the number of increments related to 360°; e. g. the value 36,000 corresponds to an angle resolution of 0.01°.

[3]) The parameter zeroShift defines the zero shift. With it the encoder can be adjusted to the mounting position. The value of zeroShift is set in encoder-increments. It is not assigned to the parameter resolution of the cam switch.

[4]) The parameter EncoderBitResolution defines the resolution of the used encoder (in bits), e. g. with the default setting 18 bits the encoder has 196,608 divisions.

Channel parameters for the cam switch (max. 32x)

Name	Value	Internal value	Internal value, type	Default
camToTrack0 [1])	Digital Output 0 ... 15, none	0 ... 15, FF	BYTE	FF
:	:	:	:	:
camToTrack31	Digital Output 0 ... 15, none	0 ... 15, FF	BYTE	FF

[1]) The value of the parameter camToTrack# defines which DO (digital output) is assigned to the track. camToTrack0 = 3 for example means that track 0 is assigned to the digital output 3. If the value FFh is set to a track, no digital output is assigned to it.

Name	Value	Referred FB from extended Cam Switch Library [2])	Internal value	Internal value, type	Default
cam-Type[0]	Common	MCX_CamSwitchSimple_c	0	BYTE	0
	Pulsed	MCX_CamSwitchSimple_dc			
[1])	Timed	MCX_PulseSwitch_dc	1		
...	Comfort	MCX_CamSwitchTimed_dc	2		
	Cam shift	MCX_CamSwitchComfort_dc	3		
	Binary shift	MCX_CamShift_dc	4		
	Multiturn cam	MCX_BinaryShift_dc	5		
	Time timed	MCX_CamSwitchMulti_dc	6		
	Reference	MCX_SwitchTimeTimed_dc	7		
	Multiturn timed	MCX_BinaryReference_dc	8		
		MCX_CamSwitchMulti-Timed_dc	9		

[1]) camType additionally to camToTrack identifies the type of each cam switch and enables the use of a specific function block from the Extended Cam Switch Library.

[2]) camType parameters and the Extended Camswitch Library are only available for CI511-ETHCAT and CI512-ETHCAT with device index C0 and above.

Group parameters for the digital part

Name	Value	Internal value	Internal value, type	Default
Input delay	0.01 ms	0	BYTE	0.01 ms
	1 ms	1		0x00
	8 ms	2		
	32 ms	3		
Detect short circuit at outputs	Off	0	BYTE	On
	On	1		0x01

Name	Value	Internal value	Internal value, type	Default
Behaviour DO at comm. error *)	Off Last value Last value 5 sec Last value 10 sec Substitute value Substitute value 5 sec Substitute value 10 sec	0 1 6 11 2 7 12	BYTE	Off 0x00
Substitute values DO	0 ... 65535	0000h ... FFFFh	WORD	0 0x0000
*) The parameter behaviourDOatCommunicationFault is only analyzed if the Failsafe-mode is ON.				

1.8.4.2.10 Diagnosis

In cases of short circuit or overload, the digital outputs are turned off. The modules performs reactivation automatically. Thus an acknowledgement of the errors is not necessary. The error message is stored via the LED.

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identifier** **000 ... 063**	**AC500-Display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 6 **Bit 6 ... 7**	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6** **Bit 0 ... 5**	**ETHCAT Diagnosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error identifier**	**Error message**	**Remedy**
	1)	2)	3)				
Module error							
3	-	31	31	31	43	Internal error in the module	Replace I/O module
3	-	31	31	31	20	Slave-to-Slave malfunction	Check configuration
3	-	31	31	31	41	Distributed Clock malfunction	Check configuration
3	-	31	31	31	26	Parameter error	Check master
3	-	31	31	31	11	Process voltage UP too low	Check process supply voltage

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identifier 000 ... 063**	**AC500-Display**	**<− Display in**	
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**		
Byte 6 Bit 6 ... 7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0 ... 5**	**ETHCAT Diagnosis block**		
Class	**Interface**	**Device**	**Module**	**Channel**	**Error identifier**	**Error message**		**Remedy**
	1)	**2)**	**3)**					
4	-	31	31	31	45	Process voltage UP3 too low		Check process voltage
4	-	31	31	31	34	No response during initialization of the I/O module		Replace I/O module
4	-	31	31	31	46	Voltage feedback on activated digital outputs 4)		Check terminals
Channel error digital								
4	-	31	2	0 ... 15	46	Voltage feedback on deactivated digital output 5)		Check terminals
4	-	31	4	0 ... 7	47	Short circuit at digital output		Check terminals
4	-	31	2	8 ... 15	47	Short circuit at digital output		Check terminals

Remarks:

1)	In AC500 the following interface identifier applies: "-" = Diagnosis via bus-specific function blocks; 0 ... 4 or 10 = Position of the Communication Module; 14 = I/O bus; 31 = Module itself The identifier is not contained in the CI512-ETHCAT diagnosis block.
2)	With "Device" the following allocation applies: 31 = Module itself or ADR = Hardware address (e. g. of the DC551)
3)	With "Module" the following allocation applies dependent of the master: 31 = Module itself (Module error) or Module type (1=AI, 2=DO, 3=AO; channel error)
4)	Diagnosis message appears for the whole output group and not per channel. The message occurs if the output channel is already active.
5	Diagnosis message appears per channel. The message occurs if the output channel is not active.

1.8.4.2.11 State LEDs

The LEDs are located at the front of module. There are 2 different groups:

- The 5 system LEDs (PWR, NET, DC, S-ERR and I/O-Bus) show the operation state of the module and display possible errors.
- The 29 process LEDs (UP, UP3, inputs, outputs, CH-ERR1 to CH-ERR3) show the process supply voltage and the states of the inputs and outputs and display possible errors.

Table 281: States of the 5 system LEDs

LED	Color	Off	On	Flashing	1x flash	2x flash
PWR/RUN	Green	Error in the internal supply voltage or process voltage missing	Internal supply voltage OK	Module is not configured	--	--
	Yellow	--	--	--	--	--
NET	Green	Init	Operational	Pre-operational	Safe-operational	--
	Red	No error	PDI Watchdog Timeout	Invalid Configuration	Unsolicited State Change	Application time out
DC *)	Green	Distributed Clock not active	Distributed Clock active	--	--	--
	Red	--	--	--	--	--
S-ERR	Red	No error	Internal error	--	--	--
I/O-Bus	Green	No communication interface modules connected or communication error	---	---	--	--
ETH1	Green	No EtherCAT connection	Link OK No data transfer	Link OK Data transfer OK	--	--
	Yellow	--	--	--	--	--
ETH2	Green	No EtherCAT connection	Link OK No data transfer	Link OK Data transfer OK	--	--
	Yellow	--	--	--	--	--
*) The state of this LED is only significant if the camswitch functionality is enabled						

Table 282: States of the 29 process LEDs

LED	Color	OFF	ON	Flashing
DC0 ... DC7	Yellow	Input/Output is OFF	Input/Output is ON	--
DI8 ... DI15	Yellow	Input is OFF	Input is ON (the input voltage is even displayed if the supply voltage is OFF)	--
DO8 ... DO15	Yellow	Output is OFF	Output is ON	--
UP	Green	Process supply voltage missing	Process supply voltage OK and initialization fin-ished	--
UP3	Green	Process supply voltage missing	Process supply voltage OK	--
CH-ERR1 to CH-ERR3	Red	No error or process supply voltage missing	Internal error	Error on one channel of the corresponding group

1.8.4.2.12 Technical data

Technical data of the module

The system data of AC500 and S500 are applicable to the standard version *Chapter 2.6.1 “System data AC500” on page 1408*.

The system data of AC500-XC are applicable to the XC version *Chapter 2.7.1 “System data AC500-XC” on page 1475*.

Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

Parameter	Value
Bus connection	2 x RJ45
Technology	Hilscher NETX 100
Transfer rate	10/100 Mbit/s (full-duplex)
Transfer method	According to Ethernet II, IEEE 802.3
Ethernet	100 base-TX, internal switch, 2x RJ45 socket
Expandability (S500 I/O modules)	Up to 10 S500 I/O modules (Index C0 and above), not available (Index below C0)
Indicators	5 LEDs for state indication
Adjusting elements	2 rotary switches (used for future topology extensions)
Quantity of input/output data	CI512-ETHCAT: 10 bytes input and 14 bytes output CI511-ETHCAT: 18 bytes input and 18 bytes output
Limit of data for input and output	144 byte

Parameter	Value
Acyclic services	SDO (1500 bytes max.) Emergency ECAT_SLV_DIAG
Protective functions (according to CODESYS)	Protected against: ● short circuit ● reverse supply ● overvoltage ● reverse polarity Galvanic isolation to network

Parameter		Value
Process supply voltages UP/UP3		
	Rated value	24 V DC (for inputs and outputs)
	Max. load for the terminals	10 A
	Protection against reversed voltage	Yes
	Rated protection fuse on UP/UP3	10 A fast
	Galvanic isolation	Ethernet interface against the rest of the module
	Inrush current from UP (at power up)	On request
	Current consumption via UP (normal operation)	0.15 A
	Current consumption via UP3	0.06 A + 0.5 A max. per output
	Connections	Terminals 1.8 and 2.8 for +24 V (UP) Terminal 3.8 for +24 V (UP3) Terminals 1.9, 2.9 and 3.9 for 0 V (ZP)
Max. power dissipation within the module		6 W
Number of digital inputs		8
Number of digital outputs		8
Number of configurable digital inputs/outputs		8
Reference potential for all digital inputs and outputs		Negative pole of the supply voltage, signal name ZP
Diagnosis		See Diagnosis and Displays *Chapter 1.8.4.2.10 “Diagnosis” on page 1099*
Operation and error displays		34 LEDs (totally)
Weight (without terminal unit)		Ca. 125 g
Mounting position		Horizontal Or vertical with derating (output load reduced to 50 % at +40 °C per group)
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

NOTICE!
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and temporary overvoltage up to 30 V DC.

Multiple overloads
No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an internal smart high-side switch.

Technical data of the digital inputs

Parameter		Value
Number of channels per module		8
Distribution of the channels into groups		1 group of 8 channels
Terminals of the channels DI0 ... DI7		Terminals 2.0 ... 2.7
Reference potential for all inputs		Terminals 1.9 ... 3.9 (negative pole of the supply voltage, signal name ZP)
Indication of the input signals		1 yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Input type (according EN 61131-2)		Type 1
Input delay (0->1 or 1->0)		Typ. 0.1 ms, configurable from 0.1 ms ... 32 ms
Input signal voltage		24 V DC
	0-Signal	-3 V ... +5 V
	undefined Signal	> +5 V ... < +15 V
	1-Signal	+15 V ... +30 V
Ripple with signal 0		Within -3 V ... +5 V
Ripple with signal 1		Within +15 V ... +30 V
Input current per channel		
	Input voltage +24 V	Typ. 5 mA
	Input voltage +5 V	> 1 mA
	Input voltage +15 V	> 2 mA
	Input voltage +30 V	< 8 mA
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

Technical data of the digital outputs

Parameter	Value
Number of channels per module	8
Distribution of the channels into groups	1 group of 8 channels

Parameter		Value
Terminals of the channels DO0 ... DO7		Terminals 3.0 ... 3.7
Reference potential for all outputs		Terminals 1.9 ... 3.9 (negative pole of the supply voltage, signal name ZP)
Common power supply voltage		For all outputs terminal 3.8 (positive pole of the supply voltage, signal name UP3)
Output voltage for signal 1		UP3 (-0.8 V)
Output delay (0->1 or 1->0)		On request
Output current		
	Rated value per channel	500 mA at UP3 = 24 V
	Max. value (all channels together)	4 A
Leakage current with signal 0		< 0.5 mA
	Fuse for UP3	10 A fast
Demagnetization with inductive DC load		Via internal varistors (see figure below this table)
Output switching frequency		
	With resistive load	On request
	With inductive loads	Max. 0.5 Hz
	With lamp loads	11 Hz max. at 5 W max.
Short-circuit-proof / overload-proof		Yes
Overload message (**I** > 0.7 A)		Yes, after ca. 100 ms
Output current limitation		Yes, automatic reactivation after short circuit/overload
Resistance to feedback against 24V signals		Yes (software-controlled supervision)
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

The following drawing shows the circuitry of a digital input/output with the varistors for demagnetization when inductive loads are switched off.

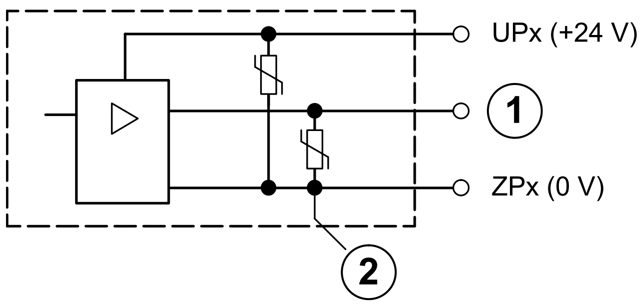


Fig. 283: Digital input/output (circuit diagram)

1 Digital output
2 Varistors for demagnetization when inductive loads are turned off

Figure:

Technical data of the configurable digital inputs/outputs

Each of the configurable I/O channels is defined as input or output by the user program. This is done by interrogating or allocating the corresponding channel.

Parameter		Value
Number of channels per module		8 inputs/outputs (with transistors)
Distribution of the channels into groups		1 group for 8 channels
If the channels are used as inputs		
	Channels DC0 ... DC07	Terminals 1.0 ... 1.7
If the channels are used as outputs		
	Channels DC0 ... DC07	Terminals 1.0 ... 1.7
Indication of the input/output signals		1 yellow LED per channel, the LED is ON when the input/output signal is high (signal 1)
Galvanic isolation		From the Ethernet network

Technical data of the digital inputs/outputs if used as inputs

Parameter		Value
Number of channels per module		8
Distribution of the channels into groups		1 group of 8 channels
Terminals of the channels DC0 ... DC7		Terminals 1.0 ... 1.7
Reference potential for all inputs		Terminals 1.9 ... 3.9 (negative pole of the supply voltage, signal name ZP)
Indication of the input signals		1 yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Input type (according EN 61131-2)		Type 1
Input delay (0->1 or 1->0)		Typ. 0.1 ms, configurable from 0.1 ms ... 32 ms
Input signal voltage		24 V DC
	0-Signal	-3 V ... +5 V *)
	Undefined Signal	> +5 V ... < +15 V
	1-Signal	+15 V ... +30 V
Ripple with signal 0		Within -3 V ... +5 V *)
Ripple with signal 1		Within +15 V ... +30 V
Input current per channel		
	Input voltage +24 V	Typ. 5 mA
	Input voltage +5 V	> 1 mA
	Input voltage +15 V	> 2 mA
	Input voltage +30 V	< 8 mA
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

*) Due to the direct connection to the output, the demagnetizing varistor is also effective at the input (see figure) above. This is why the difference between UPx and the input signal may not exceed the clamp voltage of the varistor. The varistor limits the voltage to approx. 36 V. Following this, the input voltage must range from -12 V ... +30 V when UPx = 24 V and from -6 V ... +30 V when UPx = 30 V.

Technical data of the digital inputs/outputs if used as outputs

Parameter		Value
Number of channels per module		8
Distribution of the channels into groups		1 group of 8 channels
Terminals of the channels DC0 ... DC7		Terminals 1.0 ... 1.7
Reference potential for all outputs		Terminals 1.9 ... 3.9 (negative pole of the supply voltage, signal name ZP)
Common power supply voltage		For all outputs terminal 3.8 (positive pole of the supply voltage, signal name UP3)
Output voltage for signal 1		UP3 (-0.8 V)
Output delay (0->1 or 1->0)		On request
Output current		
	Rated value per channel	500 mA at UP3 = 24 V
	Max. value (all channels together)	4 A
Leakage current with signal 0		< 0.5 mA
	Fuse for UP3	10 A fast
Demagnetization with inductive DC load		Via internal varistors (see figure below this table)
Output switching frequency		
	With resistive load	On request
	With inductive loads	Max. 0.5 Hz
	With lamp loads	11 Hz max. at 5 W max.
Short-circuit-proof / overload-proof		Yes
Overload message (**I** > 0.7 A)		Yes, after ca. 100 ms
Output current limitation		Yes, automatic reactivation after short circuit/overload
Resistance to feedback against 24V signals		Yes (software-controlled supervision)
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

The following drawing shows the circuitry of a digital input/output with the varistors for demagnetization when inductive loads are switched off.

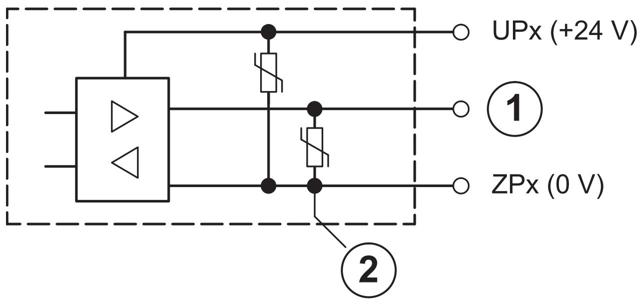
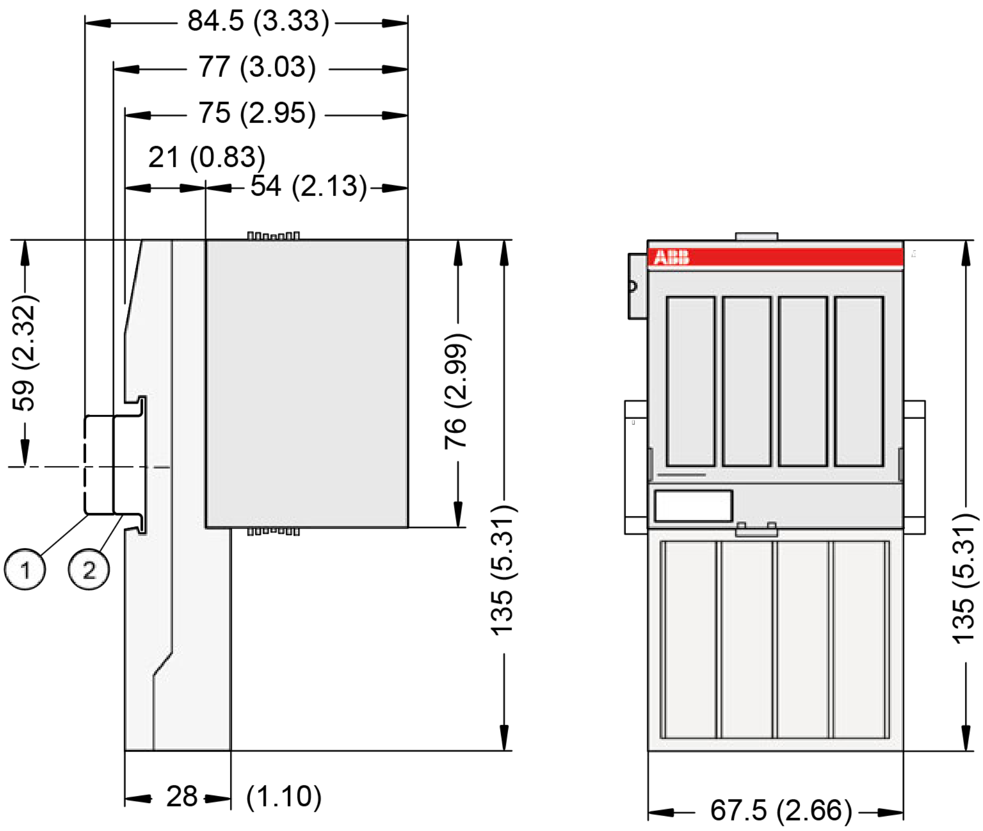


Fig. 284: Digital input/output (circuit diagram)

1 Digital input/output
2 For demagnetization when inductive loads are turned off

1.8.4.2.13 Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

> *The dimensions are in mm and in brackets in inch.*

1.8.4.2.14 Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 221 000 R0001	CI512-ETHCAT, EtherCAT communication interface module, 8 DI, 8 DO and 8 DC	Active

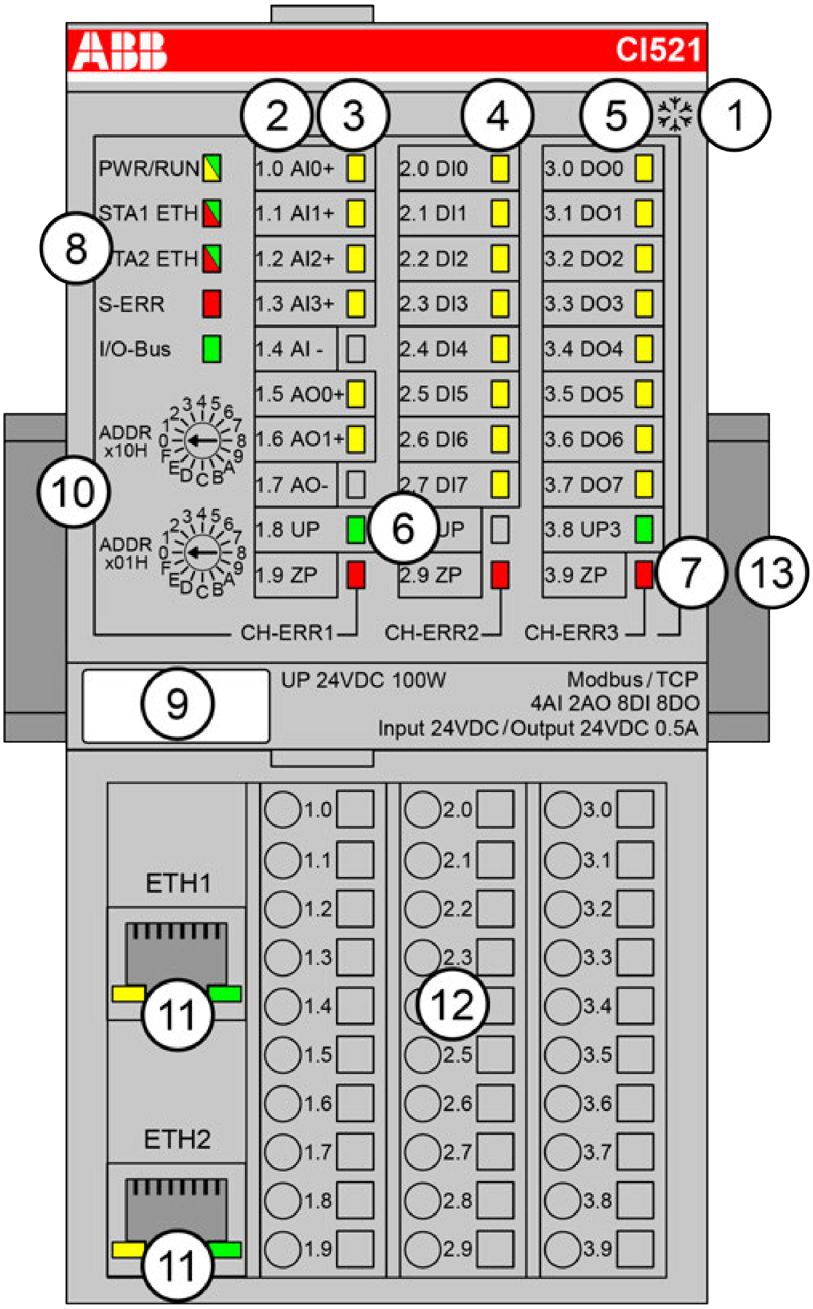
**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

1.8.5 Modbus

1.8.5.1 CI521-MODTCP

1.8.5.1.1 Features

- 4 analog inputs (resolution 12 bits including sign)
- 2 analog outputs (resolution 12 bits including sign)
- 8 digital inputs 24 V DC
- 8 digital outputs 24 V DC, 0.5 A max.
- Module-wise galvanically isolated
- Fast counter
- XC version for usage in extreme ambient conditions available



1 I/O bus
2 Allocation between terminal number and signal name
3 6 yellow LEDs to display the signal states of the analog inputs/outputs (AI0 ... AI3, AO0 ... AO1)
4 8 yellow LEDs to display the signal states of the digital inputs (DI0 ... DI7)
5 8 yellow LEDs to display the signal states of the digital outputs (DO0 ... DO7)
6 2 green LEDs to display the process supply voltage UP and UP3
7 3 red LEDs to display errors (CH-ERR1, CH-ERR2, CH-ERR3)
8 5 system LEDs: PWR/RUN, STA1 ETH, STA2 ETH, S-ERR, I/O-Bus
9 Label
10 2 rotary switches for setting the IP address
11 Ethernet interfaces (ETH1, ETH2) on the terminal unit
12 Terminal unit
13 DIN rail
❄ Sign for XC version

1.8.5.1.2 Intended purpose

The Modbus TCP communication interface module CI521-MODTCP is used as decentralized I/O module in Modbus TCP networks. The network connection is performed via 2 RJ45 connectors which are integrated in the terminal unit. The communication interface module contains 22 I/O channels with the following properties:

- 4 analog inputs (1.0 ... 1.3)
- 2 analog outputs (1.5 ... 1.6)
- 8 digital inputs 24 V DC in 1 group (2.0 ... 2.7)
- 8 digital outputs 24 V DC in 1 group (3.0 ... 3.7)

The inputs/outputs are galvanically isolated from the Ethernet network. There is no potential separation between the channels. The configuration of the analog inputs/outputs is performed by software.

For usage in enhanced ambient conditions (e.g. wider temperature and humidity range), a special XC version of the device is available.

1.8.5.1.3 Functionality

Parameter	Value
Interface	Ethernet
Protocol	Modbus TCP
Power supply	From the process supply voltage UP
Supply of the electronic circuitry of the I/O expansion modules attached	Through the I/O bus interface (I/O bus)
Rotary switches	for setting the last BYTE of the IP (00h to FFh)
Analog inputs	4 (configurable via software)
Analog outputs	2 (configurable via software)
Digital inputs	8 (24 V DC; delay time configurable via software)
Digital outputs	8 (24 V DC, 0.5 A max.)
LED displays	For system displays, signal states, errors and power supply
External supply voltage	Via terminals ZP, UP and UP3 (process supply voltage 24 V DC)
Required terminal unit	TU507 or TU508 ➪ *Chapter 1.5.1 “TU507-ETH and TU508-ETH for Ethernet communication interface modules” on page 274*

1.8.5.1.4 Connections

General

The Ethernet communication interface module CI521-MODTCP is plugged on the I/O terminal unit TU507-ETH or TU508-ETH ➪ *Chapter 1.5.1 “TU507-ETH and TU508-ETH for Ethernet communication interface modules” on page 274*. Properly seat the module and press until it locks in place. The terminal unit is mounted on a DIN rail or with 2 screws plus the additional accessory for wall mounting ➪ *Chapter 1.9.3.5 “TA526 - Wall mounting accessory” on page 1361*.

The connection of the I/O channels is carried out using the 30 terminals of the I/O terminal unit. I/O modules can be replaced without re-wiring the terminal units.

For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.

The terminals 1.8 and 2.8 as well as 1.9, 2.9 and 3.9 are electrically interconnected within the terminal unit and have always the same assignment, independent of the inserted module:

Terminals 1.8 and 2.8: Process supply voltage UP = +24 V DC

Terminal 3.8: Process supply voltage UP3 = +24 V DC

Terminals 1.9, 2.9 and 3.9: Process supply voltage ZP = 0 V

With a separate UP3 power supply, the digital outputs can be switched off externally. This way, an emergency-off functionality can be realized.

Conditions for undisturbed operating with older I/O expansion modules

All I/O expansion modules that are attached to the CI52x-MODTCP must be powered up together with the CI52x-MODTCP if the firmware version of these I/O expansion modules is V1.9 or lower.

The firmware version is related to the index. The index is printed on the module type label on the right side.

Modules as of index listed in the following table can be powered up independently.

S500 I/O module type	First index with firmware version above 1.9
AI523	D0
AI523-XC	D0
AI531	A3
AI531-XC	A0
AO523	D0
AO523-XC	D0
AX521	D0
AX521-XC	D0
AX522	D0
AX522-XC	D0
CD522	A2
CD522-XC	A0
DA501	A2
DA501-XC	A0
DA502	A1
DA502-XC	A1
DC522	D0
DC522-XC	D0
DC523	D0

S500 I/O module type	First index with firmware version above 1.9
DC523-XC	D0
DC532	D0
DC532-XC	D0
DI524	D0
DI524-XC	D0
DO524	A2
DO524-XC	A2
DX522	D0
DX522-XC	D0
DX531	D0
AC522	D0
PD501	D0

Do not connect any voltages externally to digital outputs!

Reason: Externally voltages at an output or several outputs may cause that other outputs are supplied through that voltage instead of voltage UP3 (reverse voltage). This ist not intended usage.

CAUTION!
Risk of malfunction by unintended usage!
If the function cut-off of the digital outputs is to be used by deactivation of the supply voltage UP3, be sure that no external voltage is conncted at the outputs DO0..DO7.

Table 283: Assignment of the other terminals

Terminal	Signal	Description
1.0	AI0+	Positive pole of analog input signal 0
1.1	AI1+	Positive pole of analog input signal 1
1.2	AI2+	Positive pole of analog input signal 2
1.3	AI3+	Positive pole of analog input signal 3
1.4	AI-	Negative pole of analog input signals 0 to 3
1.5	AO0+	Positive pole of analog output signal 0
1.6	AO1+	Positive pole of analog output signal 1
1.7	AI-	Negative pole of analog output signals 0 and 1
1.8	UP	Process voltage UP (24 V DC)
1.9	ZP	Process voltage ZP (0 V DC)
2.0	DI0	Signal of the digital input DI0
2.1	DI1	Signal of the digital input DI1
2.2	DI2	Signal of the digital input DI2
2.3	DI3	Signal of the digital input DI3
2.4	DI4	Signal of the digital input DI4

Terminal	Signal	Description
2.5	DI5	Signal of the digital input DI5
2.6	DI6	Signal of the digital input DI6
2.7	DI7	Signal of the digital input DI7
2.8	UP	Process voltage UP (24 V DC)
2.9	ZP	Process voltage ZP (0 V DC)
3.0	DO0	Signal of the digital output DO0
3.1	DO1	Signal of the digital output DO1
3.2	DO2	Signal of the digital output DO2
3.3	DO3	Signal of the digital output DO3
3.4	DO4	Signal of the digital output DO4
3.5	DO5	Signal of the digital output DO5
3.6	DO6	Signal of the digital output DO6
3.7	DO7	Signal of the digital output DO7
3.8	UP3	Process voltage UP3 (24 V DC)
3.9	ZP	Process voltage ZP (0 V DC)

WARNING!

Removal/Insertion under power

The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!

Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

For the open-circuit detection (wire break), each analog input channel is pulled up to "plus" by a high-resistance resistor. If nothing is connected, the maximum voltage will be read in then.

Generally, analog signals must be laid in shielded cables. The cable shields must be grounded at both sides of the cables. In order to avoid unacceptable potential differences between different parts of the installation, low resistance equipotential bonding conductors must be laid.

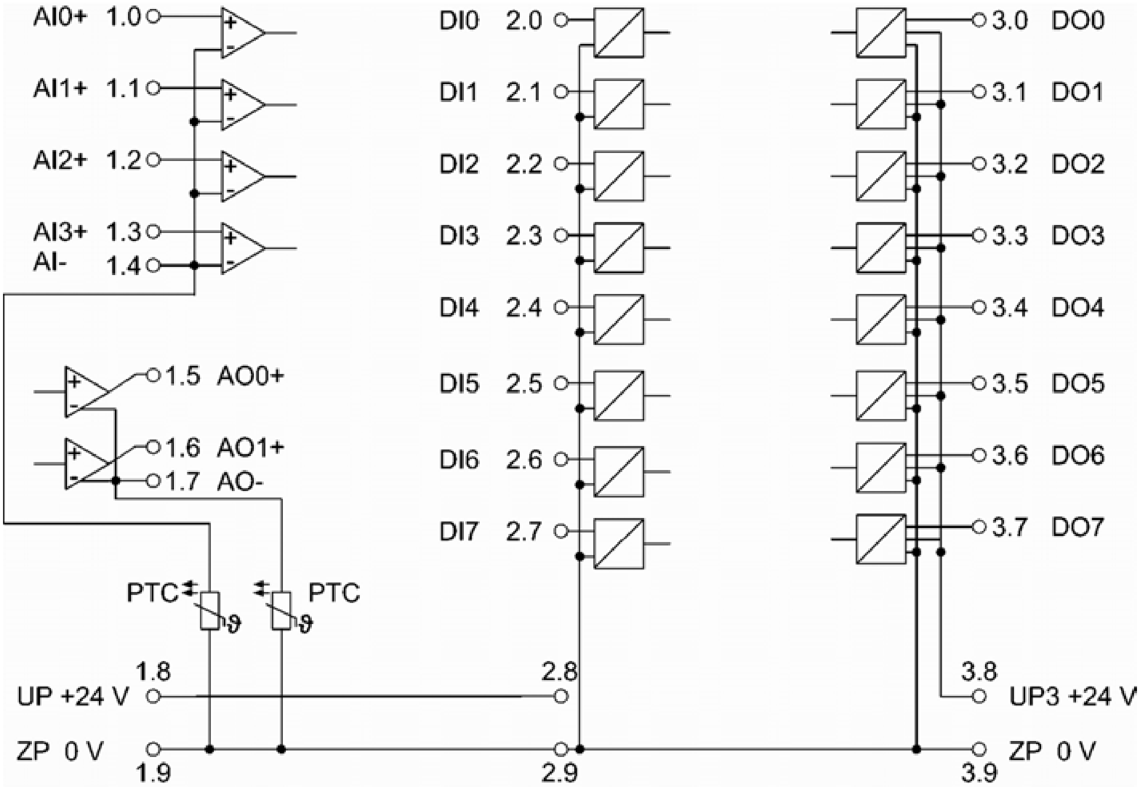


Fig. 285: Connection of the communication interface module CI521-MODTCP

Connection of the digital inputs

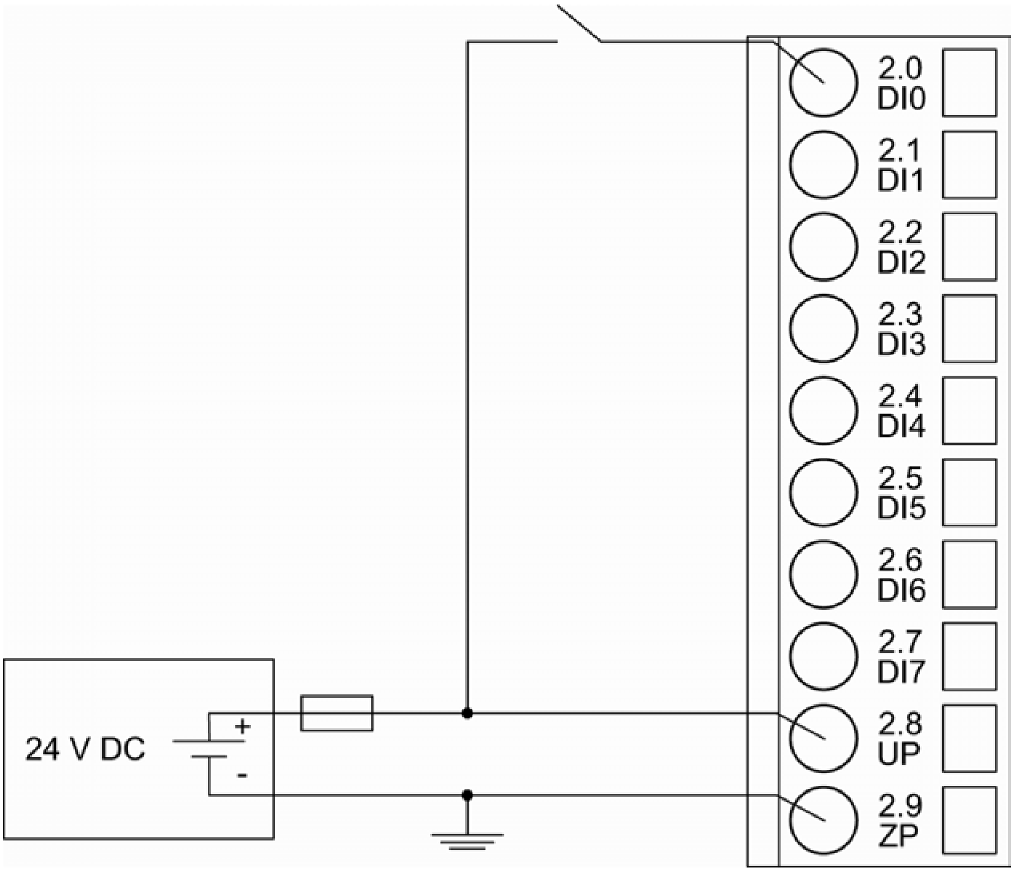


Fig. 286: Connection of the digital inputs (DO0 ... DO7) to the module CI521-MODTCP

The meaning of the LEDs is described in Displays *Chapter 1.8.5.1.10 "State LEDs" on page 1140*.

Connection of the digital outputs

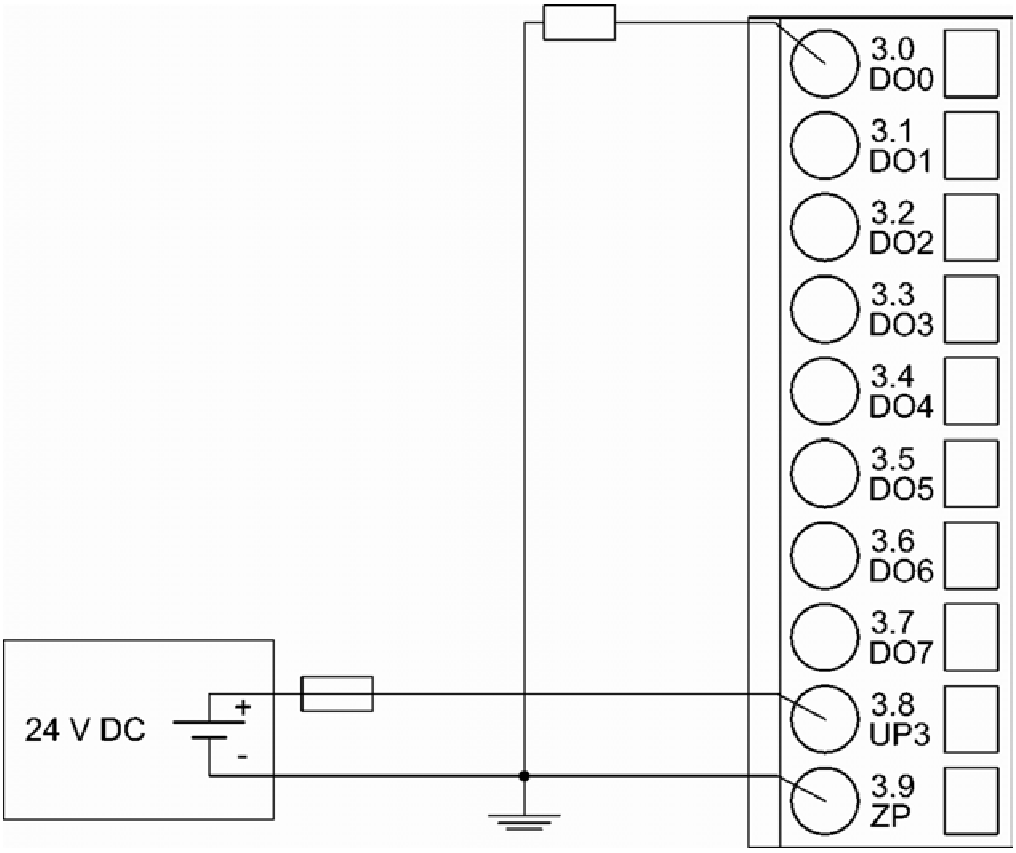


Fig. 287: Connection of configurable digital inputs/outputs (DO0 ... DO7) to the module CI521-MODTCP

The meaning of the LEDs is described in Displays *Chapter 1.8.5.1.10 “State LEDs” on page 1140*.

Connection of resistance thermometers in 2-wire configuration to the analog inputs

When resistance thermometers (Pt100, Pt1000, Ni1000) are used, a constant current must flow through them to build the necessary voltage drop for the evaluation. For this, the module CI521-MODTCP provides a constant current source which is multiplexed over the max. 4 analog input channels.

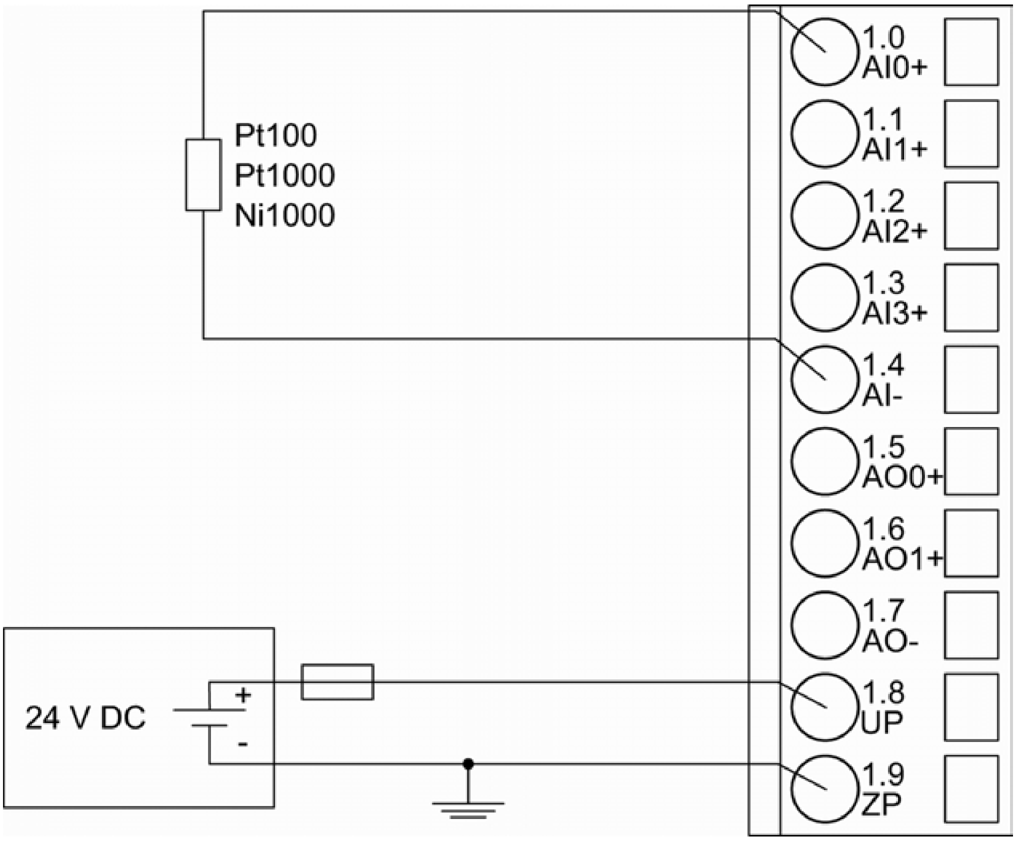


Fig. 288: Connection of resistance thermometers in 2-wire configuration to the analog inputs (AI0 ... AI3)

The following measuring ranges can be configured *Chapter 1.8.5.1.8 “Parameterization” on page 1129* *Chapter 1.8.5.1.11 “Measuring ranges” on page 1141*:

Pt100	-50 °C ... +70 °C	2-wire configuration, 1 channel used
Pt100	-50 °C ... +400 °C	2-wire configuration, 1 channel used
Pt1000	-50 °C ... +400 °C	2-wire configuration, 1 channel used
Ni1000	-50 °C ... +150 °C	2-wire configuration, 1 channel used

The function of the LEDs is described under Diagnosis and displays / Displays *Chapter 1.8.5.1.9 “Diagnosis” on page 1135*.

The module CI521-MODTCP performs a linearization of the resistance characteristic.

To avoid error messages from unused analog input channels, configure them as "unused".

Connection of resistance thermometers in 3-wire configuration to the analog inputs

When resistance thermometers (Pt100, Pt1000, Ni1000) are used, a constant current must flow through them to build the necessary voltage drop for the evaluation. For this, the module CI521-MODTCP provides a constant current source which is multiplexed over the max. 4 analog input channels.

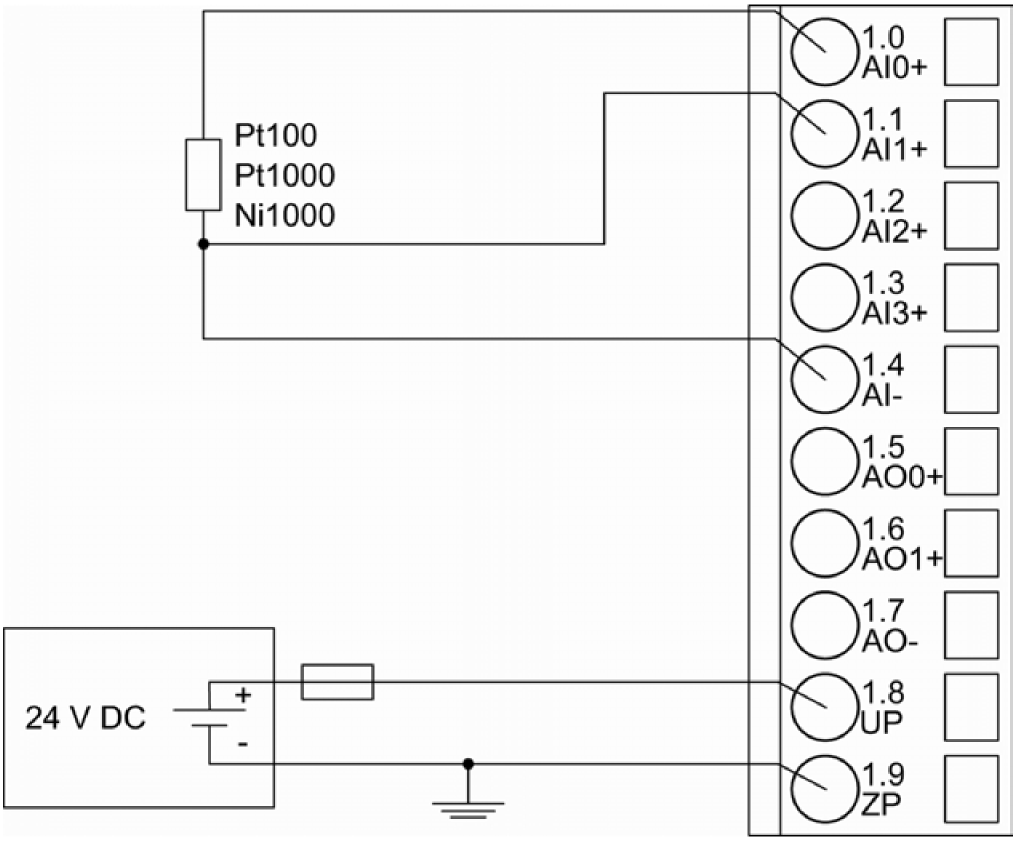


Fig. 289: Connection of resistance thermometers in 3-wire configuration to the analog inputs (AI0 ... AI3)

With 3-wire configuration, 2 adjacent analog channels belong together (e. g. the channels 0 and 1). In this case, both channels are configured according to the desired operating mode. The lower address must be the even address (channel 0), the next higher address must be the odd address (channel 1).

The constant current of one channel flows through the resistance thermometer. The constant current of the other channel flows through one of the cores. The module calculates the measured value from the two voltage drops and stores it under the input with the higher channel number (e. g. I1).

In order to keep measuring errors as small as possible, it is necessary to have all the involved conductors in the same cable. All the conductors must have the same cross section.

The following measuring ranges can be configured *Chapter 1.8.5.1.8 “Parameterization” on page 1129* and *Chapter 1.8.5.1.11 “Measuring ranges” on page 1141*:

Pt100	-50 °C ... +70 °C	3-wire configuration, 2 channels used
Pt100	-50 °C ... +400 °C	3-wire configuration, 2 channels used
Pt1000	-50 °C ... +400 °C	3-wire configuration, 2 channels used
Ni1000	-50 °C ... +150 °C	3-wire configuration, 2 channels used

The function of the LEDs is described under Diagnosis and displays / Displays *Chapter 1.8.5.1.9 “Diagnosis” on page 1135*.

The module CI521-MODTCP performs a linearization of the resistance characteristic.

To avoid error messages from unused analog input channels, configure them as "unused".

Connection of active-type analog sensors (voltage) with galvanically isolated power supply to the analog inputs

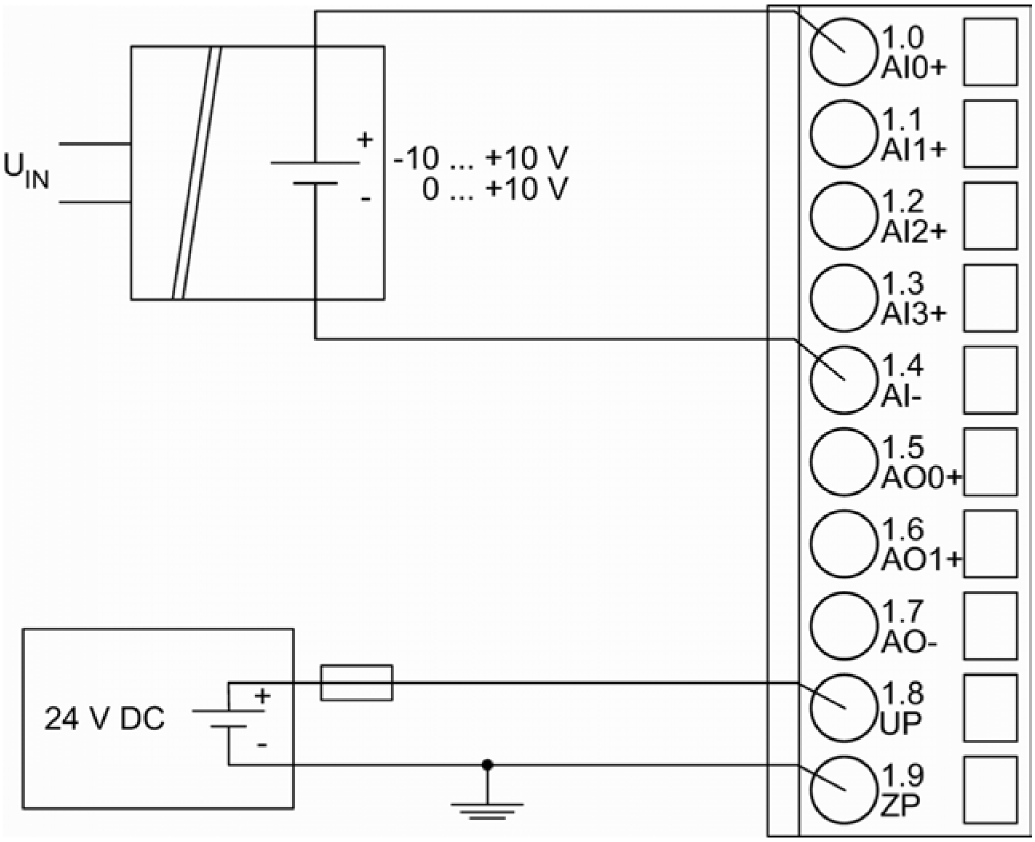


Fig. 290: Connection of active-type analog sensors (voltage) with galvanically isolated power supply to the analog inputs (AI0 ... AI3)

The following measuring ranges can be configured ⇨ *Chapter 1.8.5.1.8 “Parameterization” on page 1129* ⇨ *Chapter 1.8.5.1.11 “Measuring ranges” on page 1141*:

Voltage	0 ... 10 V	1 channel used
Voltage	-10 V ... +10 V	1 channel used

The function of the LEDs is described under Diagnosis and displays / Displays ⇨ *Chapter 1.8.5.1.9 “Diagnosis” on page 1135*.

To avoid error messages from unused analog input channels, configure them as "unused".

Connection of active-type analog sensors (Current) with galvanically isolated power supply to the analog inputs

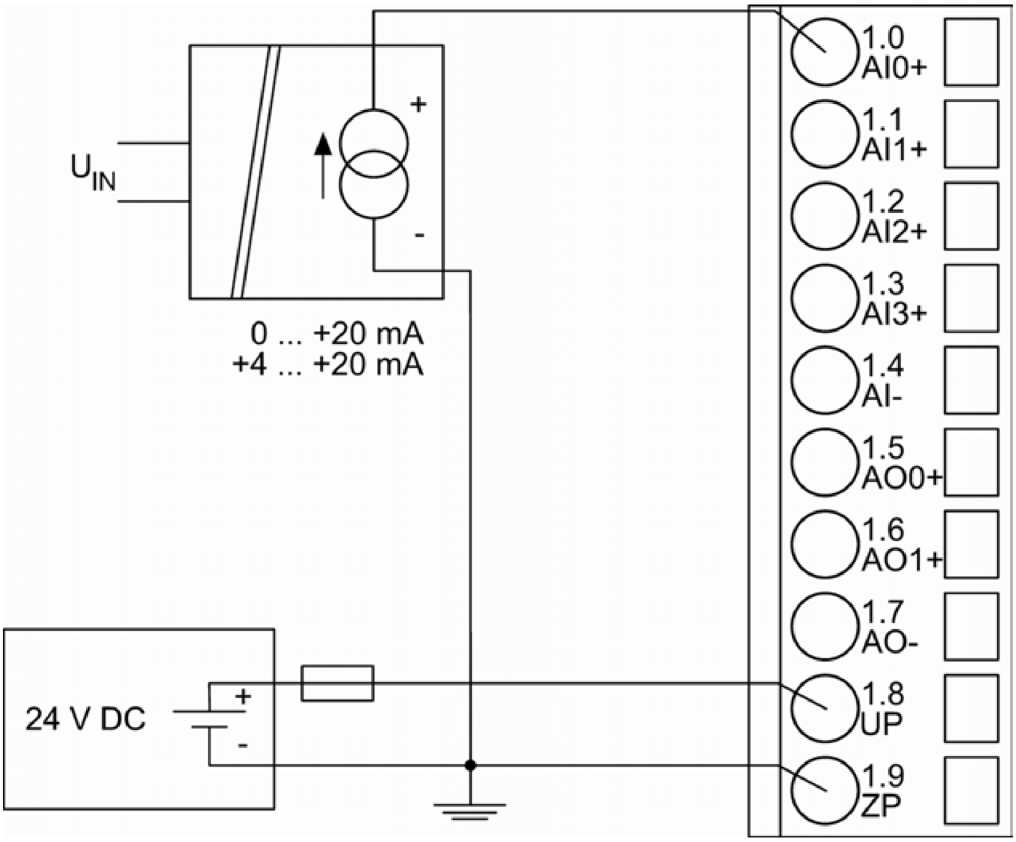


Fig. 291: Connection of active-type analog sensors (current) with galvanically isolated power supply to the analog inputs (AI0 ... AI3)

The following measuring ranges can be configured ➪ *Chapter 1.8.5.1.8 “Parameterization” on page 1129* ➪ *Chapter 1.8.5.1.11 “Measuring ranges” on page 1141*:

Current	0 mA ... 20 mA	1 channel used
Current	4 mA ...20 mA	1 channel used

The function of the LEDs is described under Diagnosis and displays / Displays ➪ *Chapter 1.8.5.1.9 “Diagnosis” on page 1135*.

Unused input channels can be left open-circuited, because they are of low resistance.

To avoid error messages through unused analog input channels in measuring range 4 mA ... 20 mA, these channels should be configured as "Not used".

Connection of active-type analog sensors (Voltage) with no galvanically isolated power supply to the analog inputs

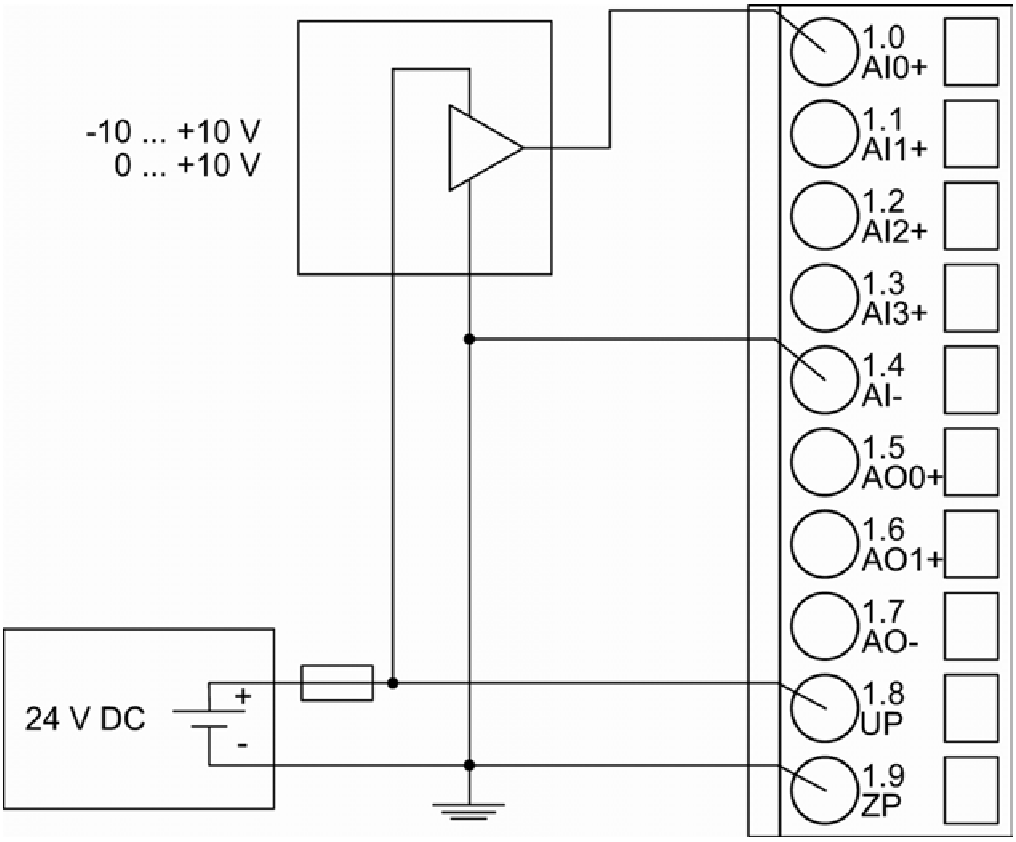


Fig. 292: Connection of active-type sensors (voltage) with no galvanically isolated power supply to the analog inputs (AI0 ... AI3)

CAUTION!

Risk of faulty measurements!

The negative pole at the sensors must not have too big a potential difference with respect to ZP (max. ± 1 V).

Make sure that the potential difference never exceeds ± 1 V (also not with long cable lengths).

The following measuring ranges can be configured *Chapter 1.8.5.1.8 “Parameterization” on page 1129* *Chapter 1.8.5.1.11 “Measuring ranges” on page 1141*.

Voltage	0 ... 10 V	1 channel used
Voltage	-10 V ... +10 V	1 channel used

The function of the LEDs is described under Diagnosis and displays / Displays *Chapter 1.8.5.1.9 “Diagnosis” on page 1135*.

To avoid error messages from unused analog input channels, configure them as "unused".

Connection of passive-type analog sensors (Current) to the analog inputs

The following figure shows the connection of passive-type analog sensors (current) to the analog input AI0. Proceed with the analog inputs AI1 ... AI3 in the same way.

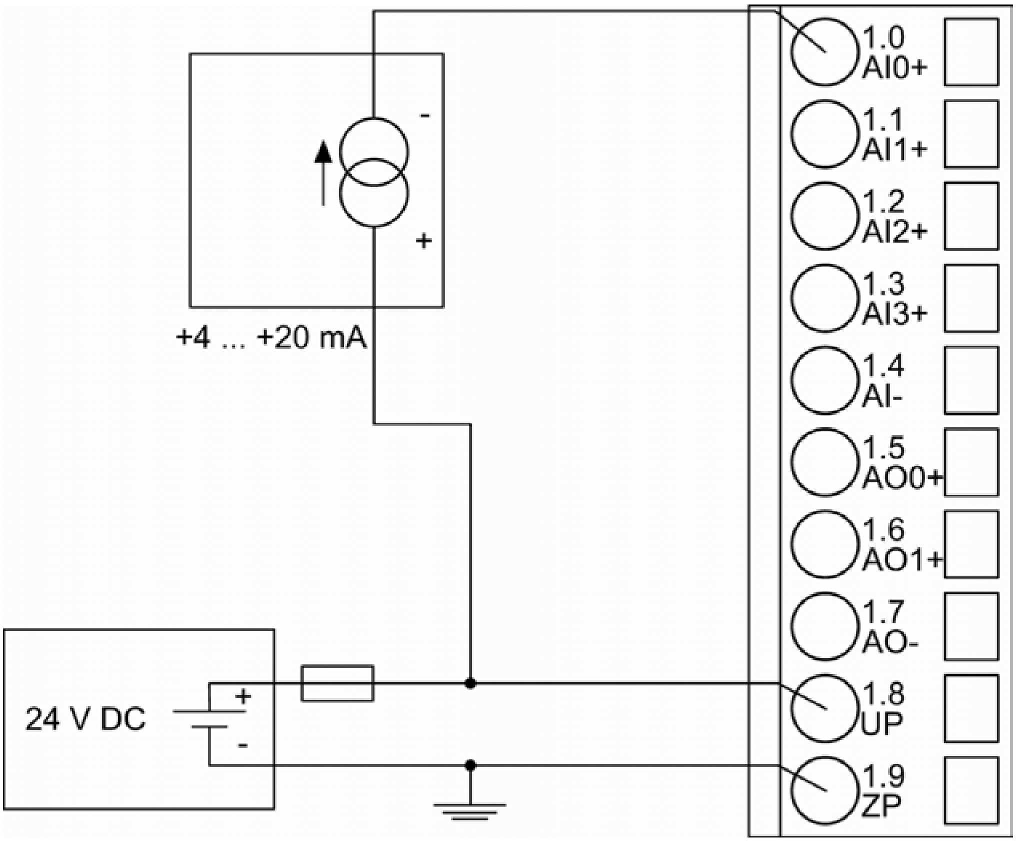


Fig. 293: Connection of passive-type analog sensors (current) to the analog inputs (AI0 ... AI3)

The following measuring ranges can be configured *Chapter 1.8.5.1.8 “Parameterization” on page 1129* *Chapter 1.8.5.1.11 “Measuring ranges” on page 1141*:

Current	4 mA ... 20 mA	1 channel used

The function of the LEDs is described under Diagnosis and displays / Displays *Chapter 1.8.5.1.9 “Diagnosis” on page 1135*.

CAUTION!
Risk of overloading the analog input!
If an analog current sensor supplies more than 25 mA for more than 1 second during initialization, this input is switched off by the module (input protection).

Use only sensors with fast initialization or without current peaks higher than 25 mA. If not possible, connect a 10-volt Zener diode in parallel to AIx+ and ZP.

Unused input channels can be left open-circuited, because they are of low resistance.

To avoid error messages through unused analog input channels in measuring range 4 mA ... 20 mA, these channels should be configured as "Not used".

Connection of active-type analog sensors (Voltage) to differential analog inputs

Differential inputs are very useful, if analog sensors are used which are remotely non-isolated (e.g. the minus terminal is remotely grounded).

The evaluation using differential inputs helps to considerably increase the measuring accuracy and to avoid ground loops.

With differential input configurations, two adjacent analog channels belong together (e.g. the channels 0 and 1). In this case, both channels are configured according to the desired operating mode. The lower address must be the even address (channel 0), the next higher address must be the odd address (channel 1). The converted analog value is available at the higher address (channel 1).

The analog value is calculated by subtraction of the input value with the higher address from the input value of the lower address.

The converted analog value is available at the odd channel (higher address).

CAUTION!

Risk of faulty measurements!

The negative pole at the sensors must not have too big a potential difference with respect to ZP (max. ±1 V).

Make sure that the potential difference never exceeds ±1 V.

The following figure shows the connection of active-type analog sensors (voltage) to differential analog inputs AI0 and AI1. Proceed with AI2 and AI3 in the same way.

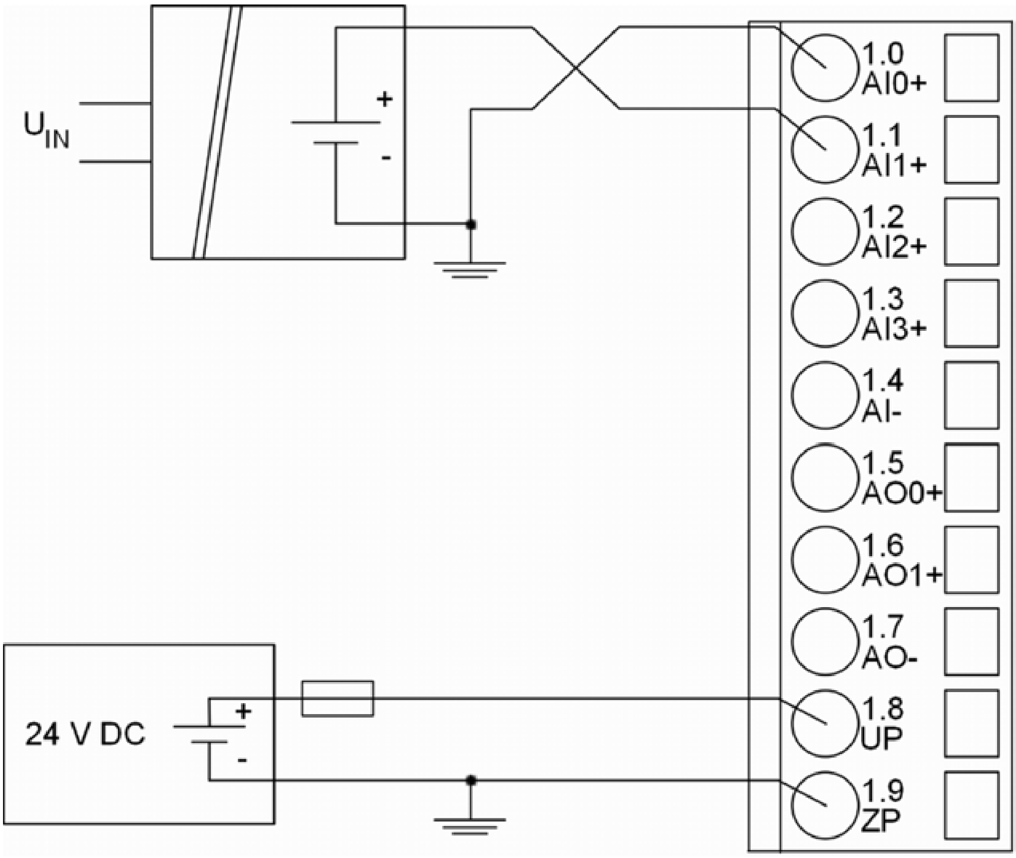


Fig. 294: Connection of active-type analog sensors (voltage) to differential analog inputs (AI0 ... AI3)

The following measuring ranges can be configured *Chapter 1.8.5.1.8 “Parameterization” on page 1129* *Chapter 1.8.5.1.11 “Measuring ranges” on page 1141*:

Voltage	0 V ... 10 V	With differential inputs, 2 channels used
Voltage	-10 V ... +10 V	With differential inputs, 2 channels used

The function of the LEDs is described under Diagnosis and displays / Displays ↻ *Chapter 1.8.5.1.9 “Diagnosis” on page 1135*.

To avoid error messages from unused analog input channels, configure them as "unused".

Use of analog inputs as digital inputs

Several (or all) analog inputs can be configured as digital inputs ↻ *Chapter 1.8.5.1.12.5 “Technical data of the analog inputs if used as digital inputs” on page 1147*. The inputs are not galvanically isolated against the other analog channels.

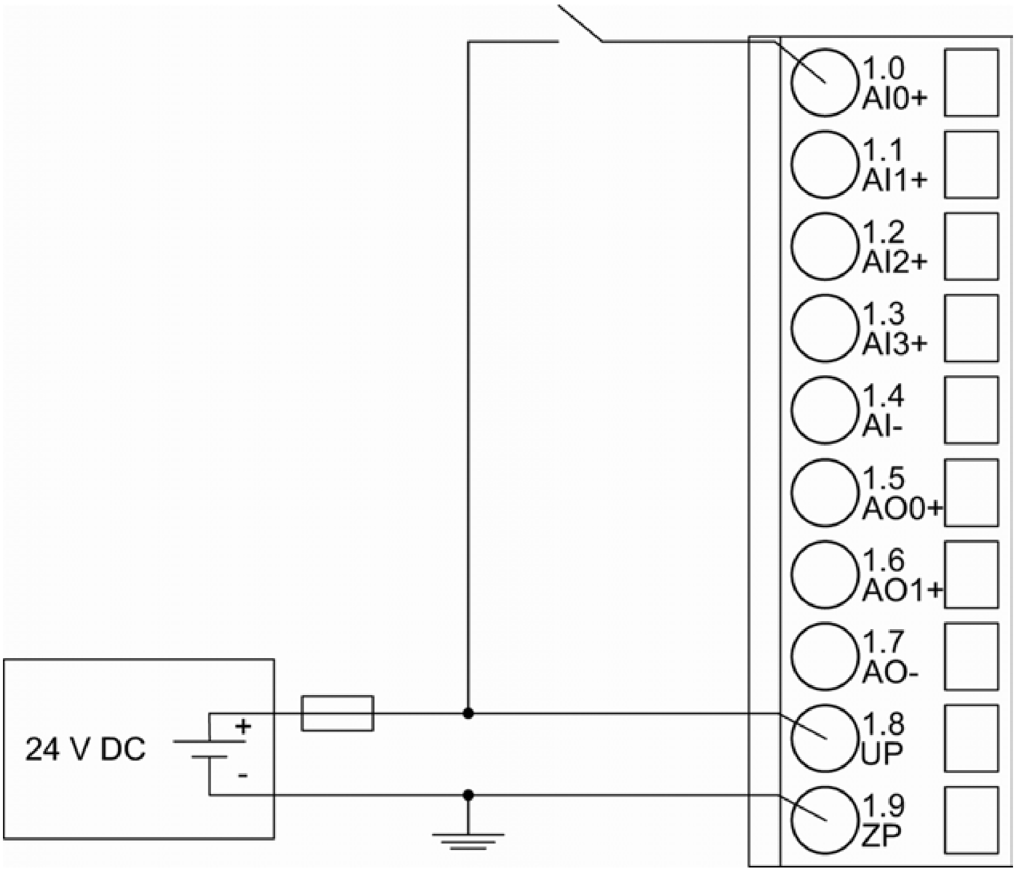


Fig. 295: Connection of digital sensors to the analog inputs (AI0 ... AI3)

The following measuring ranges can be configured ↻ *Chapter 1.8.5.1.8 “Parameterization” on page 1129* and ↻ *Chapter 1.8.5.1.11 “Measuring ranges” on page 1141* :

Digital input	24 V	1 channel used

The function of the LEDs is described under Diagnosis and displays / Displays ↻ *Chapter 1.8.5.1.9 “Diagnosis” on page 1135*.

Connection of analog output loads (Voltage)

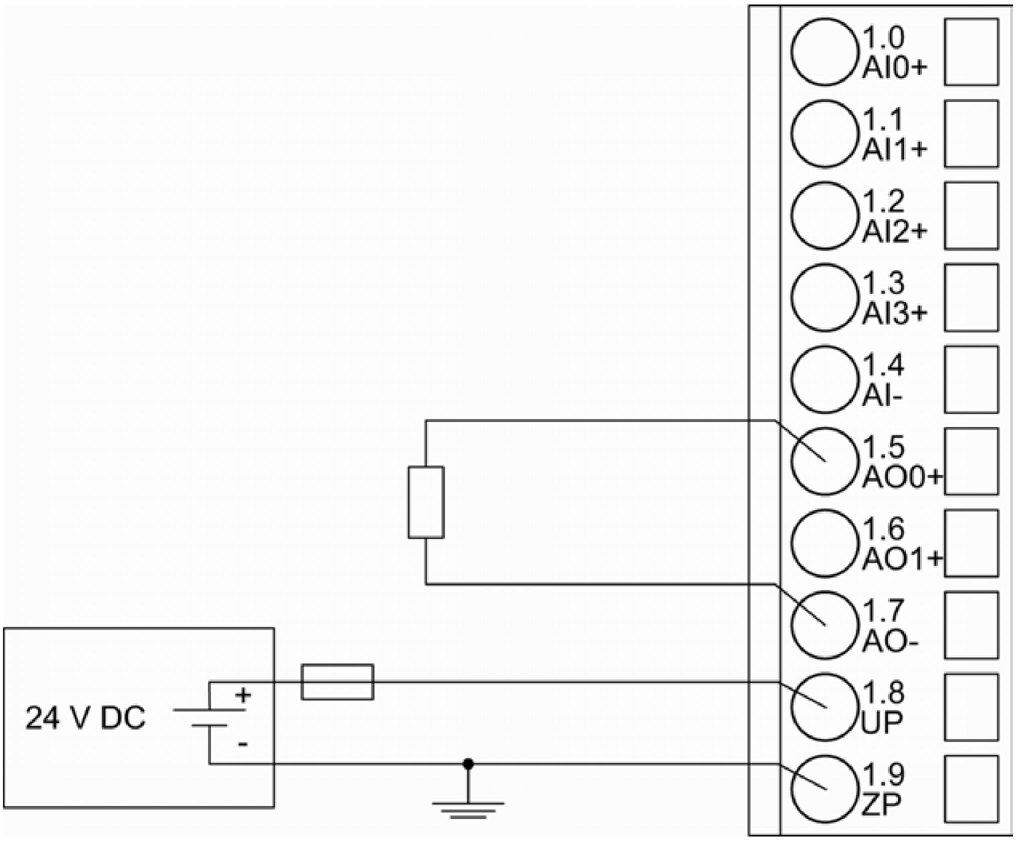


Fig. 296: Connection of analog output loads (voltage) to the analog outputs (AO0 ... AO1)

The following measuring ranges can be configured *Chapter 1.8.5.1.8 “Parameterization” on page 1129* *Chapter 1.8.5.1.11 “Measuring ranges” on page 1141*

Voltage	-10 V ... +10 V	Load ± 10 mA max.	1 channel used

The function of the LEDs is described under Diagnosis and displays / Displays *Chapter 1.8.5.1.9 “Diagnosis” on page 1135*.

Unused analog outputs can be left open-circuited.

Connection of analog output loads (Current)

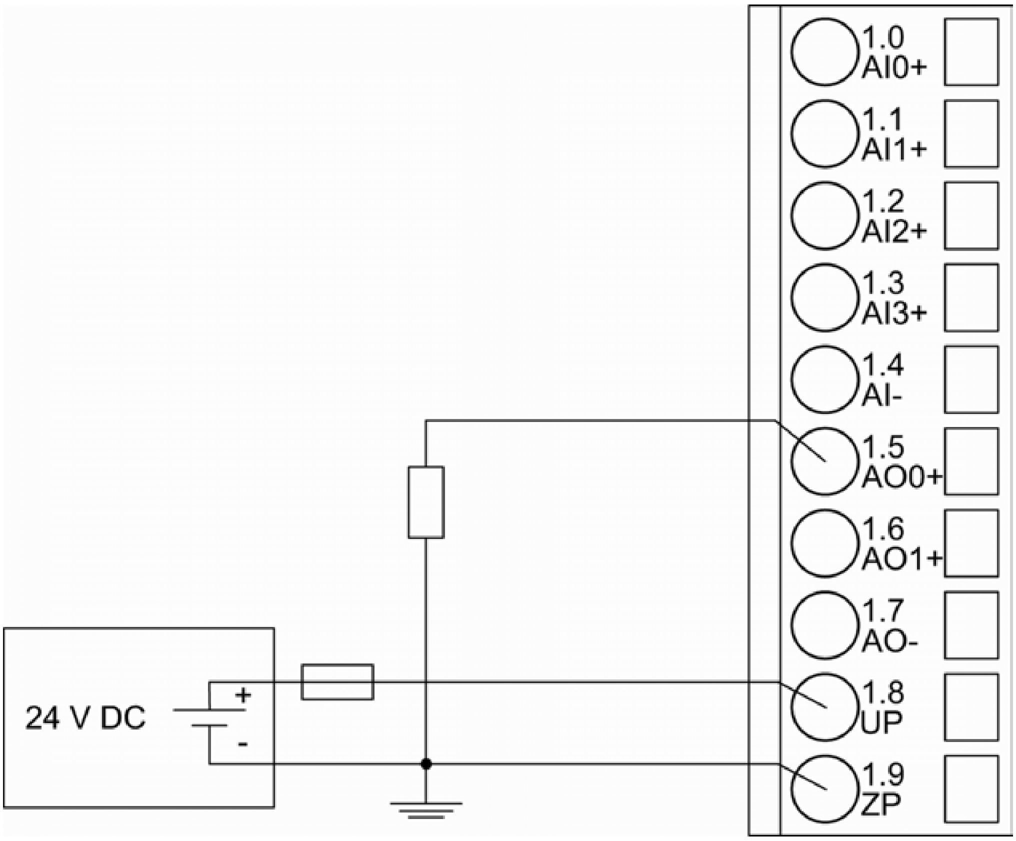


Fig. 297: Connection of analog output loads (current) to the analog outputs (AO0 and AO1)

The following measuring ranges can be configured *Chapter 1.8.5.1.8 "Parameterization" on page 1129* *Chapter 1.8.5.1.11 "Measuring ranges" on page 1141*:

Current	0 mA ... 20 mA	Load 0 ... 500 Ω	1 channel used
Current	4 ... 20 mA	Load 0 ... 500 Ω	1 channel used

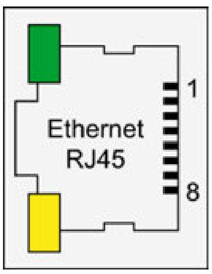
The function of the LEDs is described under Diagnosis and displays / Displays *Chapter 1.8.5.1.9 "Diagnosis" on page 1135*.

Unused analog outputs can be left open-circuited.

Assignment of the Ethernet ports

The terminal unit for the communication interface module provides two Ethernet interfaces with the following pin assignment:

Pin assignment

Interface	Pin	Signal	Description
 Ethernet RJ45 1 8	1	TxD+	Transmit data +
	2	TxD-	Transmit data -
	3	RxD+	Receive data +
	4	NC	Not connected
	5	NC	Not connected
	6	RxD-	Receive data -

Interface	Pin	Signal	Description
	7	NC	Not connected
	8	NC	Not connected
	Shield	Cable shield	Functional earth

In corrosive environment, please protect unused connectors using the TA535 accessory.

Not supplied with this device.

↳ *Further information about wiring and cable types*

1.8.5.1.5 Internal data exchange

Parameter	Value
Digital inputs (bytes)	3
Digital outputs (bytes)	3
Analog inputs (words)	4
Analog outputs (words)	2
Counter input data (words)	4
Counter output data (words)	8

Replacement of a Modbus TCP communication interface module:

The module must be powered off before it is replaced. If the configuration data is stored in the module, then the configuration data must be downloaded into the new module, either by using Modbus communication or by using the Modbus configurator which is contained in the Automation Builder distribution.

1.8.5.1.6 Addressing

The module reads the position of the rotary switches only during power-up, i.e. changes of the switch position during operation will have no effect until the next module initialization.

The IP address of the CI521-MODTCP Module can be set with the "ABB IP Configuration Tool".

If the last byte of the IP is set to 0, the address switch will be used instead.

Address switch position 255 is mapped to fixed IP 192.168.0.254 independent of other stored settings. This is a backup so the module can always get a valid IP address and can be configured by the “ABB IP Configuration Tool”.

Address switch position 0 is mapped to last byte equal 1 and DHCP enabled.

The factory setting for the IP is 192.168.0.x (last byte is address switch).

1.8.5.1.7 I/O configuration

The CI521-MODTCP stores configuration parameters (IP address configuration, module parameters).

The analog/digital I/O channels are configured via software.

Details about configuration are described in Parameterization *Chapter 1.8.5.1.8 “Parameterization” on page 1129*.

1.8.5.1.8 Parameterization

Parameters of the module

Name	Value	Internal value	Internal value, type	Default
Module ID [1])	Internal	7400	WORD	7000
Ignore Module	Internal	0	BYTE	0
Parameter length	Internal	63	BYTE	63
Error LED / Fail-safe function see table Error LED / Failsafe function *Table 284 “Error LED / Failsafe function” on page 1130*	On	0	BYTE	0
	Off by E4	1		
	Off by E3	3		
	On + failsafe	16		
	Off by E4 + fail-safe	17		
	Off by E3 + fail-safe	19		
Master IP for Write restriction [4])	No master IP Master IP	0,0,0,0 W,X,y,z	ARRAY[0..3] OF BYTE	0,0,0,0
Master IP for Write restriction [4])	No master IP Master IP	0,0,0,0 W,X,y,z	ARRAY[0..3] OF BYTE	0,0,0,0
Master IP for Write restriction [4])	No master IP Master IP	0,0,0,0 W,X,y,z	ARRAY[0..3] OF BYTE	0,0,0,0
Master IP for Write restriction [4])	No master IP Master IP	0,0,0,0 W,X,y,z	ARRAY[0..3] OF BYTE	0,0,0,0
Master IP for Write restriction [4])	No master IP Master IP	0,0,0,0 W,X,y,z	ARRAY[0..3] OF BYTE	0,0,0,0
Master IP for Write restriction [4])	No master IP Master IP	0,0,0,0 W,X,y,z	ARRAY[0..3] OF BYTE	0,0,0,0
Master IP for Write restriction [4])	No master IP Master IP	0,0,0,0 W,X,y,z	ARRAY[0..3] OF BYTE	0,0,0,0
Master IP for Write restriction [4])	No master IP Master IP	0,0,0,0 W,X,y,z	ARRAY[0..3] OF BYTE	0,0,0,0

Name	Value	Internal value	Internal value, type	Default
Timeout for Bus supervision	No supervision 10 ms timeout 20 ms timeout	0 1 2	BYTE	No supervision
IO Mapping Structure [3])	Fixed Mapping Dynamic Mapping	0 1	BYTE	0
Reserved	Internal	0	ARRAY[0..2] OF BYTE	0,0,0
Check supply	off on	0 1	BYTE	1
Fast counter	0 : 10 [3])	0 : 10	BYTE	0

[1]) With a faulty ID, the Modules reports a "parameter error" and does not perform cyclic process data transmission.

[2]) Counter operating modes.

[3]) Fixed Mapping means each module has its own Modbus registers for data transfer independent of the IO bus constellation.

Dynamic mapping means the structure of the IO Date is dependent on the I/O bus constellation. Each I/O bus expansion module starts directly after the module before on the next Word address.

[4]) If none of the parameters is set all masters / clients in the network have read and write rights on the CI52x-MODTCP device and its connected expansion modules.

If at least one parameter is set only the configured masters / clients have write rights on the CI52x-MODTCP device, all other masters / clients still have read access to the CI52x-MODTCP device.

Table 284: Error LED / Failsafe function

Setting	Description
On	Error LED (S-ERR) lights up at errors of all error classes, Failsafe-mode off
Off by E4	Error LED (S-ERR) lights up at errors of error classes E1, E2 and E3, Failsafe-mode off
Off by E3	Error LED (S-ERR) lights up at errors of error classes E1 and E2, Failsafe-mode off
On +Failsafe	Error LED (S-ERR) lights up at errors of all error classes, Failsafe-mode on *)
Off by E4 + Failsafe	Error LED (S-ERR) lights up at errors of error classes E1, E2 and E3, Failsafe-mode on *)
Off by E3 + Failsafe	Error LED (S-ERR) lights up at errors of error classes E1 and E2, Failsafe-mode on *)

*) The parameters Behaviour AO at comm. error and Behaviour DO at comm. error are only analyzed if the Failsafe-mode is ON.

Group parameters for the analog part

Name	Value	Internal value	Internal value, type	Default
Analog data format	Standard Reserved	0 255	BYTE	0
Behaviour AO at comm. error *)	Off Last value Last value 5 s Last value 10 s Substitute value Substitute value 5 s Substitute value 10 s	0 1 6 11 2 7 12	BYTE	0
*) The parameter Behaviour AO at comm. error is only analyzed if the Failsafe-mode is ON.				

Channel parameters for the analog inputs (4x)

Name	Value	Internal value	Internal value, type	Default
Input 0, Channel configuration	Table Operating modes of the analog inputs *Table 285 “Channel configuration” on page 1132*	Table Operating modes of the analog inputs *Table 285 “Channel configuration” on page 1132*	BYTE	0
Input 0, Check channel	Table Channel montoring *Table 286 “Channel monitoring” on page 1132*	Table Channel montoring *Table 286 “Channel monitoring” on page 1132*	BYTE	0
:	:	:	:	:
:	:	:	:	:
Input 3, Channel configuration	Table Operating modes of the analog inputs *Table 285 “Channel configuration” on page 1132*	Table Operating modes of the analog inputs *Table 285 “Channel configuration” on page 1132*	BYTE	0
Input 3, Check channel	Table Channel montoring *Table 286 “Channel monitoring” on page 1132*	Table Channel montoring *Table 286 “Channel monitoring” on page 1132*	BYTE	0

Table 285: Channel configuration

Internal value	Operating modes of the analog inputs, individually configurable
0 (default)	Not used
1	0 ... 10 V
2	Digital input
3	0 ... 20 mA
4	4 ... 20 mA
5	-10 V ... +10 V
8	2-wire Pt100 -50 ... +400 °C
9	3-wire Pt100 -50 ... +400 °C *)
10	0 ... 10 V (voltage diff.) *)
11	-10 V ... +10 V (voltage diff.) *)
14	2-wire Pt100 -50 ... +70 °C
15	3-wire Pt100 -50 ... +70 °C *)
16	2-wire Pt1000 -50 ... +400 °C
17	3-wire Pt1000 -50 ... +400 °C *)
18	2-wire Ni1000 -50 ... +150 °C
19	3-wire Ni1000 -50 ... +150 °C *)
*) In the operating modes with 3-wire configuration or with differential inputs, two adjacent analog inputs belong together (e.g. the channels 0 and 1). In these cases, both channels are configured in the desired operating mode. The lower address must be the even address (channel 0). The next higher address must be the odd address (channel 1). The converted analog value is available at the higher address (channel 1).	

Table 286: Channel monitoring

Internal Value	Check Channel
0 (default)	Plausibility, wire break, short circuit
3	Not used

Channel parameters for the analog outputs (2x)

Name	Value	Internal value	Internal value, type	Default
Output 0, Channel configuration	Table Operating modes of the analog outputs *Table 287 “Channel configuration” on page 1133*	Table Operating modes of the analog outputs *Table 287 “Channel configuration” on page 1133*	BYTE	0
Output 0, Check channel	Table Channel monitoring *Table 288 “Channel monitoring” on page 1133*	Table Channel monitoring *Table 288 “Channel monitoring” on page 1133*	BYTE	0

Name	Value	Internal value	Internal value, type	Default
Output 0, Substitute value	Table Substitute value ↳ *Table 289 “Substitute value” on page 1133*	Table Substitute value ↳ *Table 289 “Substitute value” on page 1133*	WORD	0
Output 1, Channel configuration	Table Operating modes of the analog outputs ↳ *Table 287 “Channel configuration” on page 1133*	Table Operating modes of the analog outputs ↳ *Table 287 “Channel configuration” on page 1133*	BYTE	0
Output 1, Check channel	Table Channel monitoring ↳ *Table 288 “Channel monitoring” on page 1133*	Table Channel monitoring ↳ *Table 288 “Channel monitoring” on page 1133*	BYTE	0
Output 1, Substitute value	Table Substitute value ↳ *Table 289 “Substitute value” on page 1133*	Table Substitute value ↳ *Table 289 “Substitute value” on page 1133*	WORD	0

Table 287: Channel configuration

Internal value	Operating modes of the analog outputs, individually configurable
0 (default)	Not used
128	-10 V ... +10 V
129	0 ... 20 mA
130	4 ... 20 mA

Table 288: Channel monitoring

Internal value	Check channel
0	Plausibility, wire break, short circuit
3	None

Table 289: Substitute value

Intended behavior of output channel when the control system stops	Required setting of the module parameter "Behaviour of outputs in case of a communication error"	Required setting of the channel parameter "Substitute value"
Output OFF	Off	0
Last value infinite	Last value	0
Last value for 5 s and then turn off	Last value 5 sec	0
Last value for 10 s and then turn off	Last value 10 sec	0
Substitute value infinite	Substitute value	Depending on configuration

Intended behavior of output channel when the control system stops	Required setting of the module parameter "Behaviour of outputs in case of a communication error"	Required setting of the channel parameter "Substitute value"
Substitute value for 5 s and then turn off	Substitute value 5 sec	Depending on configuration
Substitute value for 10 s and then turn off	Substitute value 10 sec	Depending on configuration

Group parameters for the digital part

Name	Value	Internal value	Internal value, type	Default
Input delay	0.1 ms	0	BYTE	0.1 ms
	1 ms	1		0x00
	8 ms	2		
	32 ms	3		
Detect short circuit at outputs	Off	0	BYTE	On
	On	1		0x01
Behaviour DO at comm. error [1])	Off	0	BYTE	Off
	Last value	1		0x00
	Last value 5 sec	6		
	Last value 10 sec	11		
	Substitute value	2		
	Substitute value 5 sec	7		
	Substitute value 10 sec	12		
Substitute value at output	0 ... 255	00h ... FFh	BYTE	0
				0x0000
Detect voltage overflow at outputs [2])	Off	0	BYTE	On
	On	1		0x01
[1]) The parameters Behaviour DO at comm. error is only analyzed if the Failsafe-mode is ON.				
[2]) The state "externally voltage detected" appears, if the output of a channel DC0 ... DC7 should be switched on while an externally voltage is connected *Chapter 1.8.5.1.4 “Connections” on page 1111*. In this case the start up is disabled, as long as the externally voltage is connected. The monitoring of this state and the resulting diagnosis message can be disabled by setting the parameters to "OFF".				

1.8.5.1.9 Diagnosis

Table 290: Structure of the diagnosis block

Byte Number	Description	Possible Values
1	Diagnosis Byte, slot number	31 = CI521-MODTCP (e. g. error at integrated 8 DI / 8 DO) 1 = 1st connected S500 I/O Module ... 10 = 10th connected S500 I/O Module
2	Diagnosis Byte, module number	According to the I/O bus specification passed on by modules to the fieldbus master
3	Diagnosis Byte, channel	According to the I/O bus specification passed on by modules to the fieldbus master
4	Diagnosis Byte, error code	According to the I/O bus specification Bit 7 and bit 6, coded error class 0 = E1 1 = E2 2 = E3 3 = E4 Bit 0 to bit 5, coded error description
5	Diagnosis Byte, flags	According to the I/O bus specification Bit 7: 1 = coming error Bit 6: 1 = leaving error

In cases of short circuit or overload, the digital outputs are turned off. The modules performs reactivation automatically. Thus an acknowledgement of the errors is not necessary. The error message is stored via the LED.

For diagnosis firmware version ≥ 3.2.6 is required.

E1 ... E4	d1	d2	d3	d4	Identi-fier 000 ... 063	AC500-Display	<− Display in
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 4 Bit 6 ... 7	**-**	**Byte 1**	**Byte 2**	**Byte 3**	**Byte 4 Bit 0 ... 5**	**PNIO diag-nosis block**	
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error-Identi-fier**	**Error message**	**Remedy**
	1)	2)	3)				
Module errors							
3	-	31	31	31	19	Checksum error in the I/O module	Replace I/O module
3	-	31	31	31	3	Timeout in the I/O module	
3	-	31	31	31	40	Different hard-/firm-ware versions in the module	
3	-	31	31	31	43	Internal error in the module	
3	-	31	31	31	36	Internal data exchange failure	
3	-	31	31	31	9	Overflow diagnosis buffer	Restart
3	-	31	31	31	26	Parameter error	Check Master
3	-	31	31	31	11	Process voltage UP too low	Check process supply voltage
3	-	31	31	31	45	No process voltage UP	Check process supply voltage
3	-	31/1...10	31	31	17	No communication with I/O module	Replace I/O module
3	-	1...10	31	31	32	Wrong I/O module type on socket	Replace I/O module / Check configu-ration
4	-	1...10	31	31	31	At least one module does not support failsafe function	Check modules and parame-terization

E1 ... E4	d1	d2	d3	d4	Identi-fier 000 ... 063	AC500-Display	<– Display in
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 4 Bit 6 ... 7	**-**	**Byte 1**	**Byte 2**	**Byte 3**	**Byte 4 Bit 0 ... 5**	**PNIO diag-nosis block**	
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error-Identi-fier**	**Error message**	**Remedy**
	[1])	[2])	[3])				
4	-	1...10	31	5	8	I/O module removed from hot swap terminal unit or defective module on hot swap ter-minal unit [9])	Plug I/O module, replace I/O module
4	-	1...10	31	5	28	Wrong I/O module plugged on hot swap terminal unit [9])	Remove wrong I/O module and plug pro-jected I/O module
4	-	1...10	31	5	42	No communication with I/O module on hot swap terminal unit [9])	Replace I/O module
4	-	1...10	31	5	54	I/O module does not support hot swap [8]) [9])	Power off system and replace I/O module
4	-	1...10	31	6	8	Hot swap terminal unit configured but not found	Replace terminal unit by hot swap terminal unit
4	-	1...10	31	6	42	No communication with hot swap ter-minal unit [9])	Restart, if error persists replace terminal unit
4	-	31	31	31	46	Voltage feedback on activated digital outputs DO0...DO7 on UP3 [4])	Check terminals

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier** **000 ... 063**	**AC500-Display**	**<- Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 4 **Bit 6 ... 7**	**-**	**Byte 1**	**Byte 2**	**Byte 3**	**Byte 4** **Bit 0 ... 5**	**PNIO diag-nosis block**	
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error-** **Identi-fier**	**Error message**	**Remedy**
	[1])	**[2])**	**[3])**				
4	-	31/1...10	31	31	34	No response during initialization of the I/O module	Replace I/O module
4	-	31	31	31	11	Process voltage UP3 too low	Check process supply voltage
4	-	31	31	31	45	No process voltage UP3	Check process supply voltage
4	-	31	31	31	10	Voltage overflow on outputs (above UP3 level) [5])	Check termi-nals/ check process supply voltage
Channel error digital							
4	-	31	2	0...7	46	Externally voltage detected at digital output DO0...DO7 [6])	Check terminals
4	-	31	2	0...7	47	Short circuit at dig-ital output [7])	Check terminals
Channel error analog							
4	-	31	1	0..3	48	Analog value over-flow or broken wire at an analog input	Check value or check terminals
4	-	31	1	0..3	7	Analog value underflow at an analog input	Check value
4	-	31	1	0..3	47	Short circuit at an analog input	Check terminals

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier 000 ... 063**	**AC500-Display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 4 Bit 6 ... 7	**-**	**Byte 1**	**Byte 2**	**Byte 3**	**Byte 4 Bit 0 ... 5**	**PNIO diag-nosis block**	
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error-Identi-fier**	**Error message**	**Remedy**
	1)	**2)**	**3)**				
4	-	31	3	0..1	4	Analog value over-flow at an analog output	Check output value
4	-	31	3	0..1	7	Analog value underflow at an analog output	Check output value

Remarks:

1)	In AC500 the following interface identifier applies: "-" = Diagnosis via bus-specific function blocks; 0 ... 4 or 10 = Position of the Communication Module;14 = I/O bus; 31 = Module itself The identifier is not contained in the CI521-MODTCP diagnosis block.
2)	With "Device" the following allocation applies: 31 = Module itself; 1..10 = Expansion module
3)	With "Module" the following allocation applies: 31 = Module itself Module type (1 = AI, 2 = DO, 3 = AO)
4)	This message appears, if externally voltages at one or more terminals DO0...DO7 cause that other digital outputs are supplied through that voltage *Chapter 1.8.5.1.4 “Connections” on page 1111*. All outputs of the apply digital output groups will be turned off for 5 seconds. The diagnosis message appears for the whole output group.
5)	The voltage on digital outputs DO0...DO7 has overrun the process supply voltage UP3 *Chapter 1.8.5.1.4 “Connections” on page 1111*. Diagnosis message appears for the whole module.
6)	This message appears, if the output of a channel DO0...DO7 should be switched on while an externally voltage is connected. In this case the start up is disabled, as long as the externally voltage is connected. Otherwise this could produce reverse voltage from this output to other digital outputs. This diagnosis message appears per channel.
7)	Short circuit: After a detected short circuit, the output is deactivated for 100ms. Then a new start up will be executed. This diagnosis message appears per channel.

8)	In case of an I/O module doesn't support hot swapping, do not perform any hot swap operations (also not on any other terminal units (slots)) as modules may be damaged or I/O bus communication may be disturbed.
9)	Diagnosis for hot swap available as of version index F0.

1.8.5.1.10 State LEDs

The LEDs are located at the front of module. There are 2 different groups:

- The 5 system LEDs (PWR, STA1 ETH, STA2 ETH, S-ERR and I/O-Bus) show the operation state of the module and display possible errors.
- The 27 process LEDs (UP, UP3, inputs, outputs, CH-ERR1 to CH-ERR3) show the process supply voltage and the states of the inputs and outputs and display possible errors.

Table 291: States of the 5 system LEDs

LED	Color	OFF	ON	Flashing
PWR/RUN	Green	Process supply voltage missing	Internal supply voltage OK, module ready for communication with IO Controller	Start-up / preparing communication
	Yellow	---	---	---
STA1 ETH (System LED "BF")	Green	---	Device configured, cyclic data exchange running	Device configured, acyclic data exchange running
	Red	---	Communication error (timeout) appeared	IP address error
STA2 ETH (System LED "SF")	Green	Device has valid parameters	Device is running parameterization sequenze	Device has no parameters
	Red	---	---	Device has invalid parameters
S-ERR	Red	No error	Internal error	--
I/O-Bus	Green	No expansion modules connected or communication error	Expansion modules connected and operational	---
ETH1	Green	No connection at Ethernet interface	Connected to Ethernet interface	---
	Yellow	---	Device is transmitting telegrams	Device is transmitting telegrams
ETH2	Green	No connection at Ethernet interface	Connected to Ethernet interface	---
	Yellow	---	Device is transmitting telegrams	Device is transmitting telegrams

Table 292: States of the 27 process LEDs

LED	Color	OFF	ON	Flashing
AI0 ... AI3	Yellow	Input is OFF	Input is ON (brightness depends on the value of the analog signal)	--
AO0 ... AO1	Yellow	Output is OFF	Output is ON (brightness depends on the value of the analog signal)	--
DI0 ... DI7	Yellow	Input is OFF	Input is ON (the input voltage is even displayed if the supply voltage is OFF)	--
DO0 ... DO7	Yellow	Output is OFF	Output is ON	--
UP	Green	Process supply voltage missing	Process supply voltage OK and initialization finished	--
UP3	Green	Process supply voltage missing	Process supply voltage OK	--
CH-ERR1 to CH-ERR3	Red	No error or process supply voltage missing	Internal error	Error on one channel of the corresponding group

1.8.5.1.11 Measuring ranges

Input ranges voltage, current and digital input

Range	0 V ... +10 V	-10 V ... +10 V	0 mA ... 20 mA	4 mA ... 20 mA	Digital input	Digital value	
						Decimal	**Hex.**
Overflow	> 11.7589	> 11.7589	> 23.5178	> 22.8142		32767	7FFF
Measured value too high	11.7589 : 10.0004	11.7589 : 10.0004	23.5178 : 20.0007	22.8142 : 20.0006		32511 : 27649	7EFF : 6C01
Normal range	10.0000 : 0.0004	10.0000 : 0.0004	20.0000 : 0.0007	20.0000 : 4.0006	: : On	27648 : 1	6C00 : 0001
Normal range or measured value too low	0.0000	0.0000	0	4	Off	0	0000
	-0.0004 -1.7593	-0.0004 : : -10,0000		3.9994 1.1858		-1 -4864 : -27648	FFFF ED00 : 9400

Range	0 V ... +10 V	-10 V ... +10 V	0 mA ... 20 mA	4 mA ... 20 mA	Digital input	Digital value	
						Decimal	Hex.
Measured value too low		-10.0004 : -11.7589				-27649 : -32512	93FF : 8100
Underflow	< 1.7593	< -11.7589	< 0.0000	< 1.1858		-32768	8000

The represented resolution corresponds to 16 bits.

Input ranges resistance temperature detector

Range	Pt100 / Pt1000 -50 °C ... +70 °C	Pt100 / Pt1000 -50 °C ... +400 °C	Ni1000 -50 °C ... +150 °C	Digital value	
				Decimal	Hex.
Overflow	> +80.0 °C	> +450.0 °C	> +160.0 °C	32767	7FFF
Measured value too high		+450.0 °C : +400.1 °C		4500 : 4001	1194 : 0FA1
			+160.0 °C : +150.1 °C	1600 : 1501	0640 : 05DD
	+80.0 °C : +70.1 °C			800 : 701	0320 : 02BD
Normal range	+70.0 °C : +0.1 °C	+400.0 °C : : : +0.1 °C	+150.0 °C : : + 0.1 °C	4000 1500 700 : 1	0FA0 05DC 02BC : 0001
	0.0 °C	0.0 °C	0.0 °C	0	0000
Normal range	-0.1 °C : -50.0 °C	-0.1 °C : -50.0 °C	-0.1 °C : -50,0 °C	-1 : -500	FFFF : FE0C
Measured value too low	-50.1 °C : -60.0 °C	-50.1 °C : -60.0 °C	-50.1 °C : -60.0 °C	-501 : -600	FE0B : FDA8
Underflow	< -60.0 °C	< -60.0 °C	< -60.0 °C	-32768	8000

Output ranges voltage and current

Range	-10 V ... +10 V	0 mA ... 20 mA	4 mA ... 20 mA	Digital value	
				Decimal	**Hex.**
Overflow	0 V	0 mA	0 mA	> 32511	> 7EFF
Measured value too high	11.7589 V : 10.0004 V	23.5178 mA : 20.0007 mA	22.8142 mA : 20.0006 mA	32511 : 27649	7EFF : 6C01
Normal range	10.0000 V : 0.0004 V	20.0000 mA : 0,0007 mA	20.0000 mA : 4.0006 mA	27648 : 1	6C00 : 0001
	0.0000 V	0.0000 mA	4.0000 mA	0	0000
	-0.0004 V : -10.0000 V	0 mA : 0 mA	3.9994 mA 0 mA 0 mA	-1 -6912 -27648	FFFF E500 9400
Measured value too low	-10.0004 V : -11.7589 V	0 mA : 0 mA	0 mA : 0 mA	-27649 : -32512	93FF : 8100
Underflow	0 V	0 mA	0 mA	< -32512	< 8100

The represented resolution corresponds to 16 bits.

1.8.5.1.12 Technical data

Technical data of the module

The system data of AC500 and S500 are applicable to the standard version *Chapter 2.6.1 “System data AC500” on page 1408*.

The system data of AC500-XC are applicable to the XC version *Chapter 2.7.1 “System data AC500-XC” on page 1475*.

Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

Parameter		Value
Process supply voltages UP/UP3		
	Rated value	24 V DC (for inputs and outputs)
	Max. load for the terminals	10 A
	Protection against reversed voltage	Yes
	Rated protection fuse on UP/UP3	10 A fast
	Galvanic isolation	Ethernet interface against the rest of the module
	Inrush current from UP (at power up)	On request
	Current consumption via UP (normal operation)	0.2 A
	Current consumption via UP3	0.06 A + 0.5 A max. per output

Parameter		Value
	Connections	Terminals 1.8 and 2.8 for +24 V (UP) Terminal 3.8 for +24 V (UP3) Terminals 1.9, 2.9 and 3.9 for 0 V (ZP)
Max. power dissipation within the module		6 W
Number of digital inputs		8
Number of digital outputs		8
Number of analog inputs		4
Number of analog outputs		2
Reference potential for all digital inputs and outputs		Negative pole of the supply voltage, signal name ZP
Ethernet		10/100 base-TX, internal switch, 2 x RJ45 socket
Setting of the IP address		With ABB IP config tool and 2 rotary switches at the front side of the module
Diagnose		See Diagnosis and Displays *Chapter 1.8.5.1.9 "Diagnosis" on page 1135*
Operation and error displays		32 LEDs (totally)
Weight (without terminal unit)		Ca. 125 g
Mounting position		Horizontal or vertical with derating (output load reduced to 50 % at +40 °C per group)
Extended ambient temperature (XC version)		> +60 °C on request
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

NOTICE!
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and temporary overvoltage up to 30 V DC.

Technical data of the digital inputs

Parameter		Value
Number of channels per module		8
Distribution of the channels into groups		1 group of 8 channels
Terminals of the channels DI0 ... DI7		Terminals 2.0 ... 2.7
Reference potential for all inputs		Terminals 1.9 ... 3.9 (negative pole of the supply voltage, signal name ZP)
Indication of the input signals		1 yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Input type (according EN 61131-2)		Type 1
Input delay (0->1 or 1->0)		Typ. 0.1 ms, configurable from 0.1...32 ms
Input signal voltage		24 V DC
	0-Signal	-3 V ... +5 V

Parameter		Value
	Undefined Signal	> +5 V ... < +15 V
	1-Signal	+15 V ... +30 V
Ripple with signal 0		Within -3 V ... +5 V
Ripple with signal 1		Within +15 V ... +30 V
Input current per channel		
	Input voltage +24 V	Typ. 5 mA
	Input voltage +5 V	> 1 mA
	Input voltage +15 V	> 2 mA
	Input voltage +30 V	< 8 mA
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

Technical data of the digital outputs

Parameter		Value
Number of channels per module		8
Distribution of the channels into groups		1 group of 8 channels
Terminals of the channels DO0 ... DO7		Terminals 3.0 ... 3.7
Reference potential for all outputs		Terminals 1.9 ... 3.9 (negative pole of the supply voltage, signal name ZP)
Common power supply voltage		For all outputs terminal 3.8 (positive pole of the supply voltage, signal name UP3)
Output voltage for signal 1		UP3 (-0.8 V)
Output delay (0->1 or 1->0)		On request
Output current		
	Rated value per channel	500 mA at UP3 = 24 V
	Max. value (all channels together)	4 A
Leakage current with signal 0		< 0.5 mA
	Fuse for UP3	10 A fast
Demagnetization with inductive DC load		Via internal varistors (see figure below this table)
Output switching frequency		
	With resistive load	On request
	With inductive loads	Max. 0.5 Hz
	With lamp loads	11 Hz max. at 5 W max.
Short-circuit-proof / overload-proof		Yes
Overload message (I > 0.7 A)		Yes, after ca. 100 ms
Output current limitation		Yes, automatic reactivation after short circuit/overload
Resistance to feedback against 24 V signals		Yes (software-controlled supervision)

Parameter	Value
Max. cable length	
Shielded	1000 m
Unshielded	600 m

The following drawing shows the circuitry of a digital input/output with the varistors for demagnetization when inductive loads are switched off.

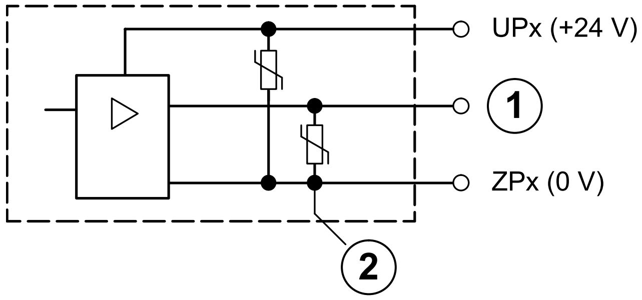


Fig. 298: Digital input/output (circuit diagram)

1 Digital Output
2 Varistors for demagnetization when inductive loads are turned off

Technical data of the analog inputs

Parameter	Value
Number of channels per module	4
Distribution of channels into groups	1 group with 4 channels
Connection if channels AI0+ ... AI3+	Terminals 1.0 ... 1.3
Reference potential for AI0+ ... AI3+	Terminal 1.4 (AI-) for voltage and RTD measurement Terminal 1.9, 2.9 and 3.9 for current measurement
Input type	
Unipolar	Voltage 0 V ... 10 V, current or Pt100/Pt1000/Ni1000
Bipolar	Voltage -10 V ... +10 V
Galvanic isolation	Against Ethernet network
Configurability	0 V ... 10 V, -10 V ... +10 V, 0/4 mA ... 20 mA, Pt100/1000, Ni1000 (each input can be configured individually)
Channel input resistance	Voltage: > 100 kΩ Current: ca. 330 Ω
Time constant of the input filter	Voltage: 100 µs Current: 100 µs
Indication of the input signals	1 LED per channel (brightness depends on the value of the analog signal)
Conversion cycle	1 ms (for 4 inputs + 2 outputs); with RTDs Pt/Ni ... 1 s

Parameter	Value
Resolution	Range 0 V ... 10 V: 12 bits Range -10 V ... +10 V: 12 bits including sign Range 0 mA ... 20 mA: 12 bits Range 4 mA ... 20 mA: 12 bits Range RTD (Pt100, PT1000, Ni1000): +0.1 °C
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range	Typ. 0.5 %, max. 1 %
Relationship between input signal and hex code	↳ *Chapter 1.8.5.1.11.2 “Input ranges resistance temperature detector” on page 1142*
Unused inputs	Are configured as "unused" (default value)
Overvoltage protection	Yes

Technical data of the analog inputs if used as digital inputs

Parameter		Value
Number of channels per module		Max. 4
Distribution of channels into groups		1 group of 4 channels
Connections of the channels AI0+ ... AI3+		Terminals 1.0 ... 1.3
Reference potential for the inputs		Terminals 1.9, 2.9 and 3.9 (ZP)
Indication of the input signals		1 LED per channel
Input signal voltage		24 V DC
	Signal 0	-30 V ... +5 V
	Undefined signal	+5 V ... +13 V
	Signal 1	+13 V ... +30 V
Input current per channel		
	Input voltage +24 V	Typ. 7 mA
	Input voltage +5 V	Typ. 1.4 mA
	Input voltage +15 V	Typ. 3.7 mA
	Input voltage +30 V	< 9 mA
Input resistance		Ca. 3.5 kΩ

Technical data of the analog outputs

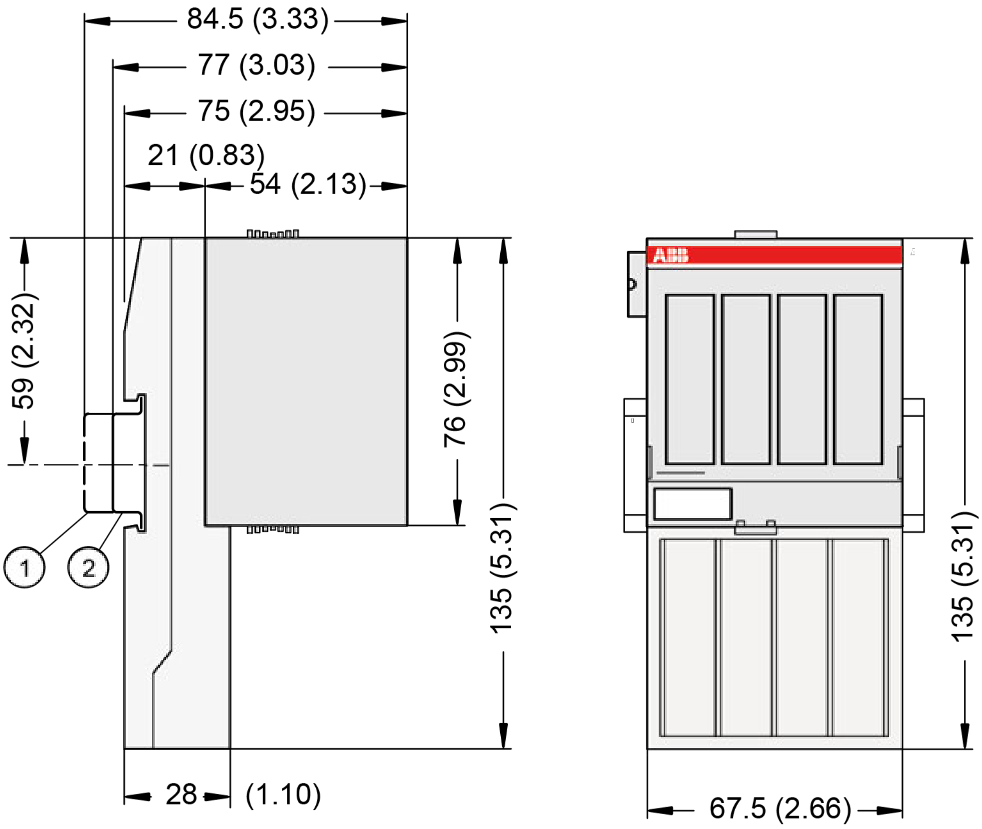
Parameter	Value
Number of channels per module	2
Distribution of channels into groups	1 group for 2 channels
Connection of the channels AO0+ ... AO1+	Terminals 1.5 ... 1.6
Reference potential for AO0+ ... AO1+	Terminal 1.7 (AO-) for voltage outputTerminal 1.9, 2.9 and 3.9 for current output

Parameter		Value
Output type		
	Unipolar	Current
	Bipolar	Voltage
Galvanic isolation		Against internal supply and other modules
Configurability		-10 V ... +10 V, 0 mA ... 20 mA, 4 mA ... 20 mA (each output can be configured individually)
Output resistance (load), as current output		0 Ω ... 500 Ω
Output loadability, as voltage output		± 10 mA max.
Indication of the output signals		1 LED per channel (brightness depends on the value of the analog signal)
Resolution		12 bits including sign
Settling time for full range change (resistive load, output signal within specified tolerance)		Typ. 5 ms
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range		Typ. 0.5 %, max. 1 %
Relationship between input signal and hex code		Table Output ranges voltage and current *Chapter 1.8.5.1.11.3 "Output ranges voltage and current" on page 1143*
Unused outputs		Are configured as "unused" (default value) and can be left open-circuited

Technical data of the fast counter

Parameter	Value
Used inputs	Terminal 2.0 (DI0), 2.1 (DI1)
Used outputs	Terminal 3.0 (DO0)
Counting frequency	Depending on operation mode: Mode 1 - 6: max. 200 kHz Mode 7: max. 50 kHz Mode 9: max. 35 kHz Mode 10: max. 20 kHz
Operating modes	'Operating modes'

1.8.5.1.13 Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

> *The dimensions are in mm and in brackets in inch.*

1.8.5.1.14 Ordering data

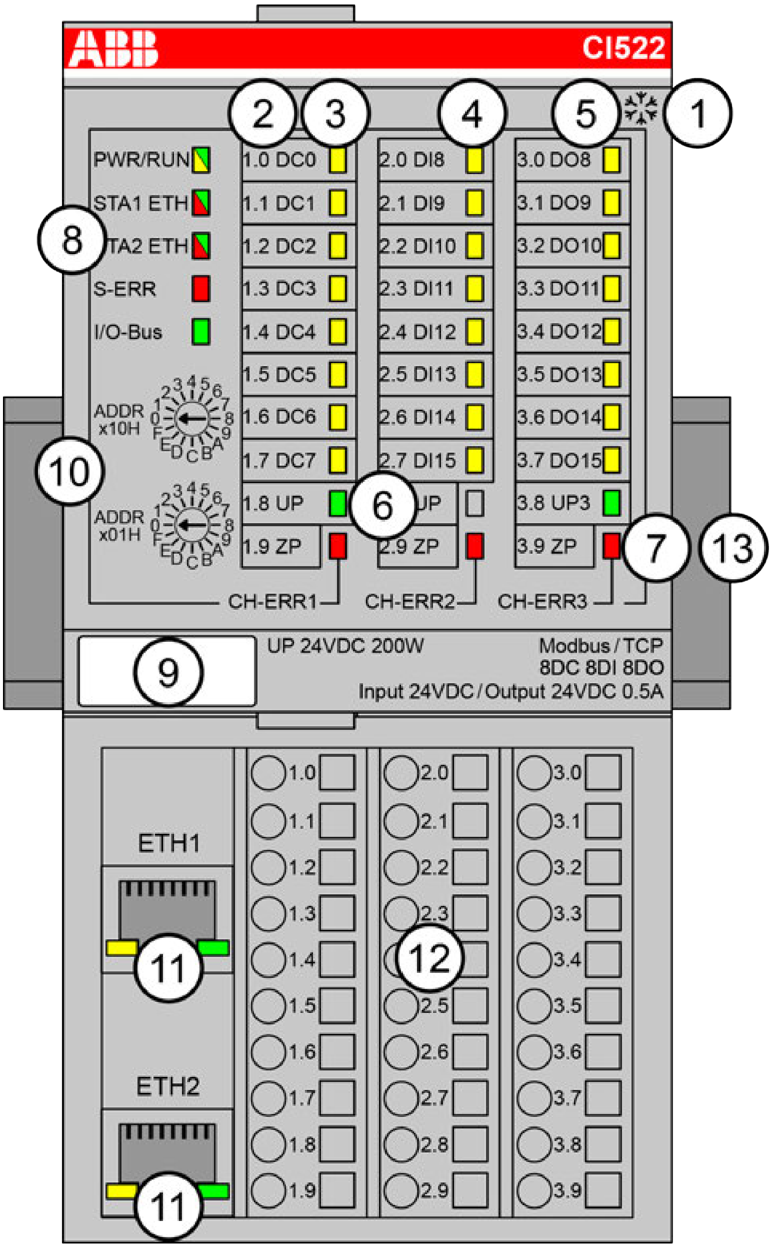
Part no.	Description	Product life cycle phase *)
1SAP 222 100 R0001	CI521-MODTCP, Modbus TCP communication interface module, 4 AI, 2 AO, 8 DI and 8 DO	Active
1SAP 422 100 R0001	CI521-MODTCP-XC, Modbus TCP communication interface module, 4 AI, 2 AO, 8 DI and 8 DO, XC version	Active

> **) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

1.8.5.2 CI522-MODTCP

1.8.5.2.1 Features

- 8 digital inputs 24 V DC
- 8 digital outputs 24 V DC, 0.5 A max.
- 8 configurable digital inputs/outputs 24 V DC, 0.5 A max.
- Module-wise galvanically isolated
- Fast counter
- XC version for usage in extreme ambient conditions available



1 I/O bus
2 Allocation between terminal number and signal name
3 8 yellow LEDs to display the signal states of the digital configurable inputs/outputs (DC0 ... DC7)
4 8 yellow LEDs to display the signal states of the digital inputs (DI8 ... DI15)
5 8 yellow LEDs to display the signal states of the digital outputs (DO8 ... DO15)
6 2 green LEDs to display the process supply voltage UP and UP3
7 3 red LEDs to display errors (CH-ERR1, CH-ERR2, CH-ERR3)
8 5 system LEDs: PWR/RUN, STA1 ETH, STA2 ETH, S-ERR, I/O-Bus
9 Label

10 2 rotary switches for setting the IP address
11 Ethernet interfaces (ETH1, ETH2) on the terminal unit
12 Terminal unit
13 DIN rail
❄ Sign for XC version

1.8.5.2.2 Intended purpose

Modbus TCP communication interface module CI522-MODTCP is used as decentralized I/O module in Modbus TCP networks. The network connection is performed via 2 RJ45 connectors which are integrated in the terminal unit. The communication interface module contains 24 I/O channels with the following properties:

- 8 digital configurable inputs/outputs in 1 group (1.0 ... 1.7)
- 8 digital inputs 24 V DC in 1 group (2.0 ... 2.7)
- 8 digital outputs 24 V DC in 1 group (3.0 ... 3.7)

The inputs/outputs are galvanically isolated from the Ethernet network. There is no potential separation between the channels. The configuration of the configurable digital inputs/outputs is performed by software.

For usage in extreme ambient conditions (e.g. wider temperature and humidity range), a special XC version of the device is available.

1.8.5.2.3 Functionality

Interface	Ethernet
Protocol	Modbus TCP
Power supply	From the process supply voltage UP
Supply of the electronic circuitry of the I/O expansion modules attached	Through the I/O bus interface (I/O bus)
Rotary switches	for setting the last BYTE of the IP ADDRESS (00h ... FFh)
Configurable digital inputs/outputs	8 (configurable via software)
Digital inputs	8 (24 V DC; delay time configurable via software)
Digital outputs	8 (24 V DC, 0.5 A max.)
LED displays	For system displays, signal states, errors and power supply
External supply voltage	Via terminals ZP, UP and UP3 (process supply voltage 24 V DC)
Required terminal unit	TU507 or TU508 *Chapter 1.5.1 “TU507-ETH and TU508-ETH for Ethernet communication interface modules” on page 274*

1.8.5.2.4 Connections

General

The Ethernet communication interface module CI522-MODTCP is plugged on the I/O terminal unit TU507-ETH ⇘ *Chapter 1.5.1 “TU507-ETH and TU508-ETH for Ethernet communication interface modules” on page 274* or TU508-ETH ⇘ *Chapter 1.5.1 “TU507-ETH and TU508-ETH for Ethernet communication interface modules” on page 274*. Properly seat the module and press until it locks in place. The terminal unit is mounted on a DIN rail or with 2 screws plus the additional accessory for wall mounting ⇘ *Chapter 1.9.3.5 “TA526 - Wall mounting accessory” on page 1361*.

The connection of the I/O channels is carried out using the 30 terminals of the I/O terminal unit. I/O modules can be replaced without re-wiring the terminal units.

For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.

The terminals 1.8 and 2.8 as well as 1.9, 2.9 and 3.9 are electrically interconnected within the terminal unit and have always the same assignment, independent of the inserted module:

Terminals 1.8 and 2.8: Process supply voltage UP = +24 V DC

Terminal 3.8: Process supply voltage UP3 = +24 V DC

Terminals 1.9, 2.9 and 3.9: Process supply voltage ZP = 0 V

With a separate UP3 power supply, the digital outputs can be switched off externally. This way, an emergency-off functionality can be realized.

Conditions for undisturbed operating with older I/O expansion modules

All I/O expansion modules that are attached to the CI52x-MODTCP must be powered up together with the CI52x-MODTCP if the firmware version of these I/O expansion modules is V1.9 or lower.

The firmware version is related to the index. The index is printed on the module type label on the right side.

Modules as of index listed in the following table can be powered up independently.

S500 I/O module type	First index with firmware version above 1.9
AI523	D0
AI523-XC	D0
AI531	A3
AI531-XC	A0
AO523	D0
AO523-XC	D0
AX521	D0
AX521-XC	D0
AX522	D0
AX522-XC	D0
CD522	A2

S500 I/O module type	First index with firmware version above 1.9
CD522-XC	A0
DA501	A2
DA501-XC	A0
DA502	A1
DA502-XC	A1
DC522	D0
DC522-XC	D0
DC523	D0
DC523-XC	D0
DC532	D0
DC532-XC	D0
DI524	D0
DI524-XC	D0
DO524	A2
DO524-XC	A2
DX522	D0
DX522-XC	D0
DX531	D0
AC522	D0
PD501	D0

Do not connect any voltages externally to digital outputs!

This ist not intended usage.

Reason: Externally voltages at one or more terminals DC0 ... DC7 or DO8 ... DO15 may cause that other digital outputs are supplied through that voltage instead of voltage UP3 (reverse voltage).

This is also possible, if DC channels are used as inputs. For this, the source for the input signals should be the impressed UP3 of the device.

This limitation does not apply for the input channels DI0 ... DI7.

CAUTION!
Risk of malfunction by unintended usage!
If the function cut-off of the digital outputs is to be used by deactivation of the supply voltage UP3, be sure that no external voltage is conncted at the outputs DO8 ... DO15 and DC0 ... DC7.

The assignment of the other terminals:

Terminal	Signal	Description
1.0	DC0	Signal of the configurable digital input/output DC0
1.1	DC1	Signal of the configurable digital input/output DC1

Terminal	Signal	Description
1.2	DC2	Signal of the configurable digital input/output DC2
1.3	DC3	Signal of the configurable digital input/output DC3
1.4	DC4	Signal of the configurable digital input/output DC4
1.5	DC5	Signal of the configurable digital input/output DC5
1.6	DC6	Signal of the configurable digital input/output DC6
1.7	DC7	Signal of the configurable digital input/output DC7
1.8	UP	Process voltage UP (24 V DC)
1.9	ZP	Process voltage ZP (0 V DC)
2.0	DI8	Signal of the digital input DI8
2.1	DI9	Signal of the digital input DI9
2.2	DI10	Signal of the digital input DI10
2.3	DI11	Signal of the digital input DI11
2.4	DI12	Signal of the digital input DI12
2.5	DI13	Signal of the digital input DI13
2.6	DI14	Signal of the digital input DI14
2.7	DI15	Signal of the digital input DI15
2.8	UP	Process voltage UP (24 V DC)
2.9	ZP	Process voltage ZP (0 V DC)
3.0	DO8	Signal of the digital output DO8
3.1	DO9	Signal of the digital output DO9
3.2	DO10	Signal of the digital output DO10
3.3	DO11	Signal of the digital output DO11
3.4	DO12	Signal of the digital output DO12
3.5	DO13	Signal of the digital output DO13
3.6	DO14	Signal of the digital output DO14
3.7	DO15	Signal of the digital output DO15
3.8	UP3	Process voltage UP3 (24 V DC)
3.9	ZP	Process voltage ZP (0 V DC)

WARNING!
Removal/Insertion under power

The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!
Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

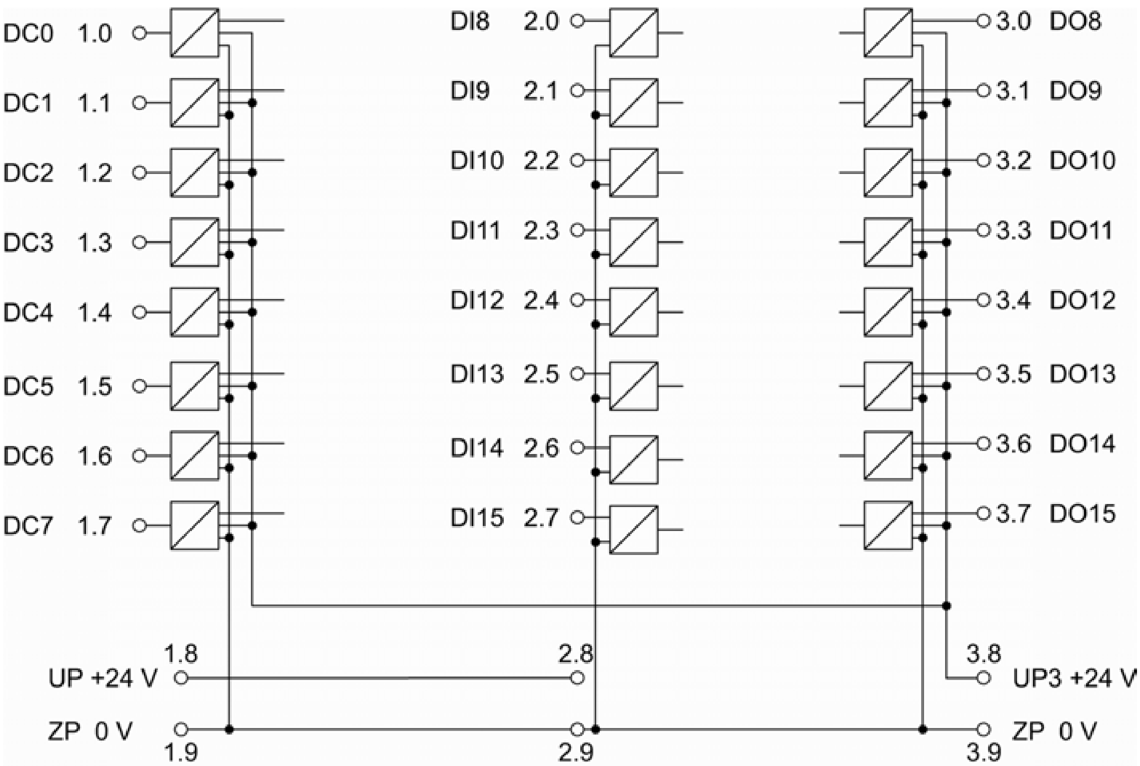


Fig. 299: Connection of the communication interface module CI522-MODTCP

Connection of the digital inputs

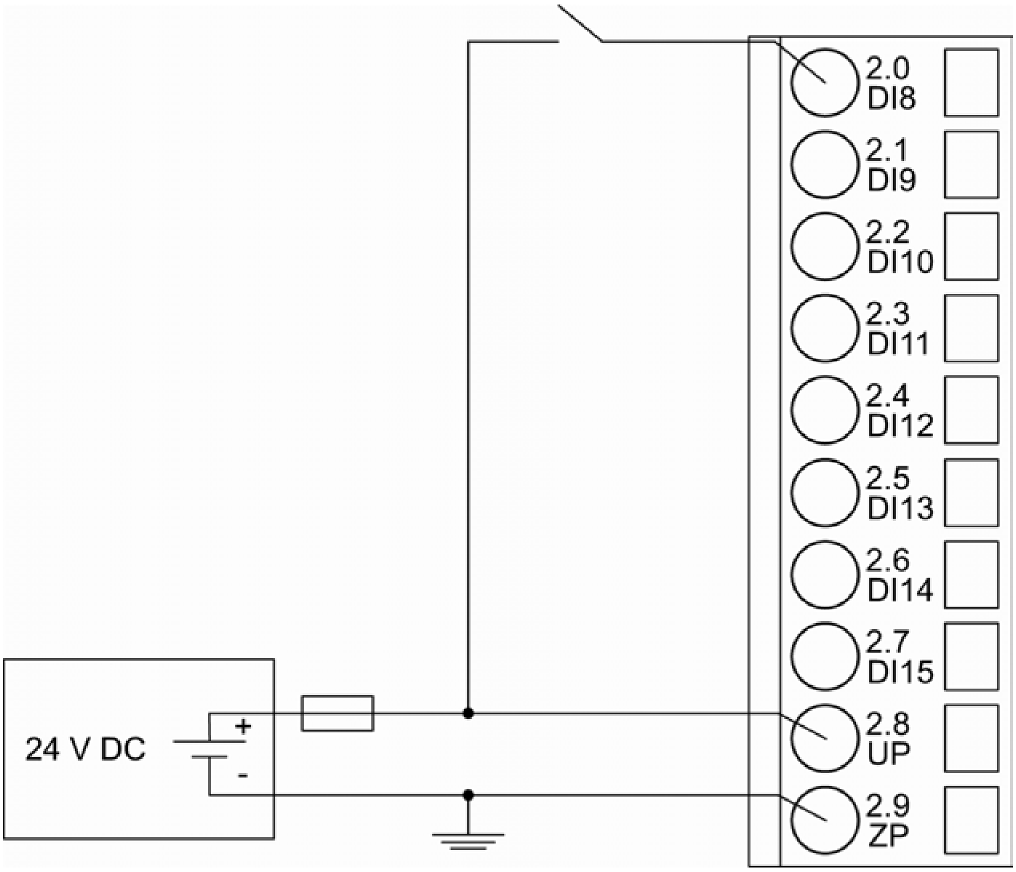


Fig. 300: Connection of the digital inputs (DI8 ... DI15) to the module CI522-MODTCP

The meaning of the LEDs is described in Displays *Chapter 1.8.5.2.10 “State LEDs” on page 1167*.

Connection of the digital outputs

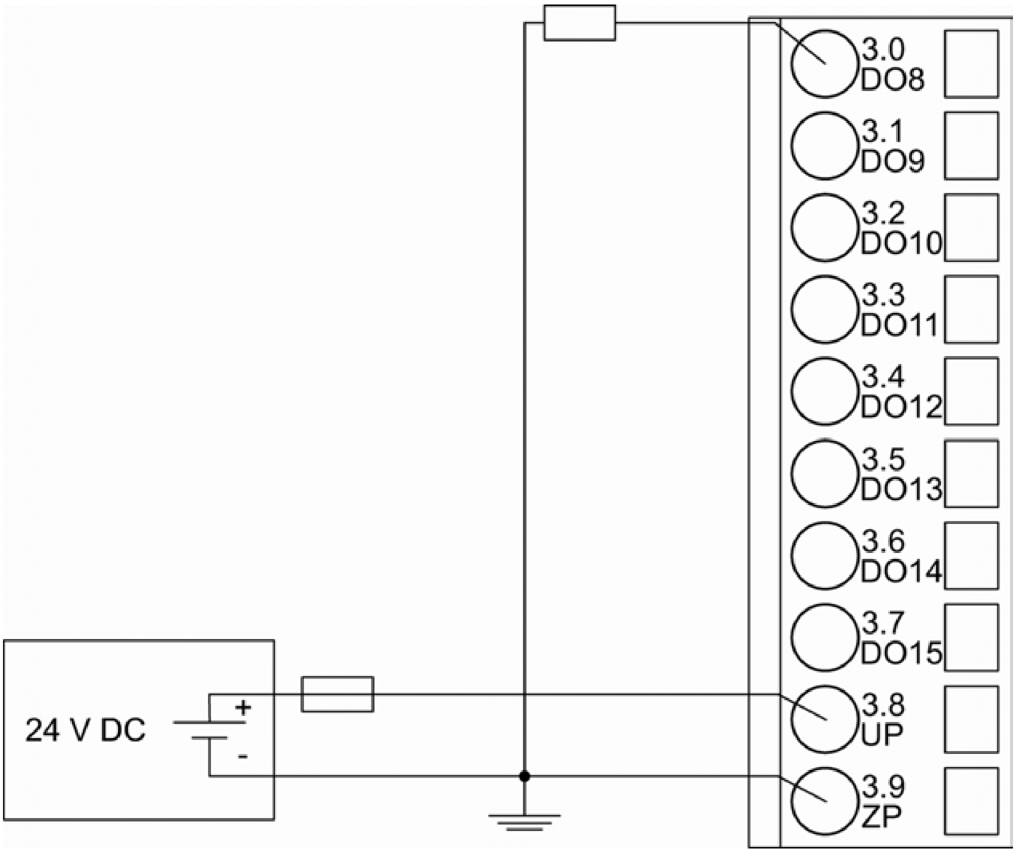


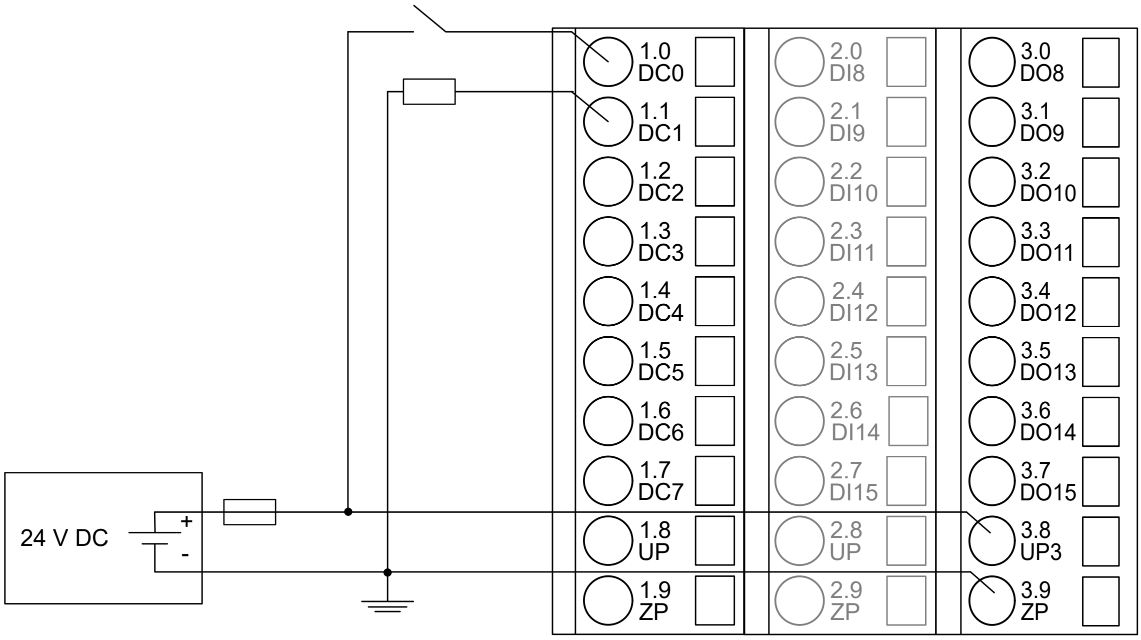
Fig. 301: Connection of the digital output DO8. Proceed with the digital outputs DO9 ... DO15 in the same way

The meaning of the LEDs is described in Displays *Chapter 1.8.5.2.10 “State LEDs” on page 1167*.

Connection of the configurable digital inputs/outputs

The following figure shows the connection of the configurable digital input/output DC0 and DC1. DC0 is connected as an input and DC1 is connected as an output. Proceed with the configurable digital inputs/outputs DC2 ... DC7 in the same way.

> **CAUTION!**
> If a DC channel is used as input, the source for the input signals should be the impressed UP3 of the device *Chapter 1.8.5.2.4 “Connections” on page 1152*.

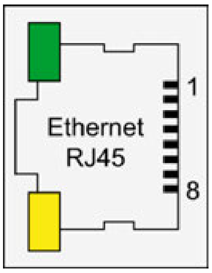


The meaning of the LEDs is described in Displays *Chapter 1.8.5.2.10 “State LEDs” on page 1167*.

Assignment of the Ethernet ports

The terminal unit for the communication interface module provides two Ethernet interfaces with the following pin assignment:

Pin assignment

Interface	Pin	Signal	Description
	1	TxD+	Transmit data +
	2	TxD-	Transmit data -
	3	RxD+	Receive data +
	4	NC	Not connected
	5	NC	Not connected
	6	RxD-	Receive data -
	7	NC	Not connected
	8	NC	Not connected
	Shield	Cable shield	Functional earth

In corrosive environment, please protect unused connectors using the TA535 accessory.

Not supplied with this device.

Further information about wiring and cable types

1.8.5.2.5 Internal data exchange

Digital inputs (bytes)	5
Digital outputs (bytes)	5
Counter input data (words)	4
Counter output data (words)	8

Replacement of a Modbus TCP communication interface module:

The module must be powered off before it is replaced. If the configuration data is stored in the module, then the configuration data must be downloaded into the new module, either by using Modbus communication or by using the Modbus configurator which is contained in the Automation Builder distribution.

1.8.5.2.6 Addressing

The IP address of the CI5221-MODTCP Module can be set with the “ABB IP Configuration Tool” .

If the last byte of the IP is set to 0, the address switch will be used instead.

Address switch position 255 is mapped to fixed IP 192.168.0.254 independent of other stored settings. This is a backup so the module can always get a valid IP address and can be configured by the “ABB IP Configuration Tool”.

Address switch position 0 is mapped to last byte equal 1 and DHCP enabled.

The factory setting for the IP is 192.168.0.x (last byte is address switch).

The module reads the position of the rotary switches only during power-up, i.e. changes of the switch position during operation will have no effect until the next module initialization.

1.8.5.2.7 I/O configuration

The CI522-MODTCP stores configuration parameters (IP address configuration, module parameters).

The digital I/O channels are configured via software.

Details about configuration are described in Parameterization *Chapter 1.8.5.2.8 “Parameterization” on page 1159*.

1.8.5.2.8 Parameterization

Parameters of the module

Name	Value	Internal value	Internal value, type	Default
Module ID [1])	Internal	7405	WORD	7405
Ignore Module	Internal	0	BYTE	0
Parameter length	Internal	47	BYTE	47

Name	Value	Internal value	Internal value, type	Default
Error LED / Fail-safe function (Table Error LED / Failsafe function *Table 293 " Table Error LED / Failsafe function" on page 1161*)	On	0	BYTE	0
	Off by E4	1		
	Off by E3	3		
	On + failsafe	16		
	Off by E4 + fail-safe	17		
	Off by E3 + fail-safe	19		
Master IP for Write restriction 4)	No master IP Master IP	0,0,0,0 W,X,y,z	ARRAY[0..3] OF BYTE	0,0,0,0
Master IP for Write restriction 4)	No master IP Master IP	0,0,0,0 W,X,y,z	ARRAY[0..3] OF BYTE	0,0,0,0
Master IP for Write restriction 4)	No master IP Master IP	0,0,0,0 W,X,y,z	ARRAY[0..3] OF BYTE	0,0,0,0
Master IP for Write restriction 4)	No master IP Master IP	0,0,0,0 W,X,y,z	ARRAY[0..3] OF BYTE	0,0,0,0
Master IP for Write restriction 4)	No master IP Master IP	0,0,0,0 W,X,y,z	ARRAY[0..3] OF BYTE	0,0,0,0
Master IP for Write restriction 4)	No master IP Master IP	0,0,0,0 W,X,y,z	ARRAY[0..3] OF BYTE	0,0,0,0
Master IP for Write restriction 4)	No master IP Master IP	0,0,0,0 W,X,y,z	ARRAY[0..3] OF BYTE	0,0,0,0
Master IP for Write restriction 4)	No master IP Master IP	0,0,0,0 W,X,y,z	ARRAY[0..3] OF BYTE	0,0,0,0
Timeout for Bus supervision	No supervision 10 ms timeout 20 ms timeout	0 1 2	BYTE	No supervision
IO Mapping Structure 3)	Fixed Mapping Dynamic Mapping	0 1	BYTE	0
Reserved	Internal	0	ARRAY[0..2] OF BYTE	0,0,0
Check supply	off on	0 1	BYTE	1
Fast counter	0 : 10 2)	0 : 10	BYTE	0

Remarks:

1)	With a faulty ID, the module reports a "parameter error" and does not perform cyclic process data transmission.
2)	Counter operating modes *Chapter 1.6.1.2.10 "Fast counter" on page 545*
3)	Fixed Mapping means each module has its own Modbus registers for data transfer independent of the I/O bus constellation description. Dynamic mapping means the structure of the IO Date is dependent on the I/O bus constellation. Each I/O bus expansion module starts directly after the module before on the next Word address.
4)	If none of the parameters is set all masters / clients in the network have read and write rights on the CI52x-MODTCP device and its connected expansion modules. If at least one parameter is set only the configured masters / clients have write rights on the CI52x-MODTCP device, all other masters / clients still have read access to the CI52x-MODTCP device.

Table 293: Table Error LED / Failsafe function

Setting	Description
On	Error LED (S-ERR) lights up at errors of all error classes, Failsafe-mode off
Off by E4	Error LED (S-ERR) lights up at errors of error classes E1, E2 and E3, Failsafe-mode off
Off by E3	Error LED (S-ERR) lights up at errors of error classes E1 and E2, Failsafe-mode off
On + Failsafe	Error LED (S-ERR) lights up at errors of all error classes, Failsafe-mode on *)
Off by E4 + Failsafe	Error LED (S-ERR) lights up at errors of error classes E1, E2 and E3, Failsafe-mode on *)
Off by E3 + Failsafe	Error LED (S-ERR) lights up at errors of error classes E1 and E2, Failsafe-mode on *)
*) The parameter Behaviour DO at comm. error is only analyzed if the Failsafe-mode is ON.	

Group parameters for the digital part

Name	Value	Internal value	Internal value, type	Default
Input delay	0.1 ms 1 ms 8 ms 32 ms	0 1 2 3	BYTE	0.1 ms 0x00
Detect short circuit at outputs	Off On	0 1	BYTE	On 0x01

Name	Value	Internal value	Internal value, type	Default
Behaviour DO at comm. error [1])	Off Last value Last value 5 sec Last value 10 sec Substitute value Substitute value 5 sec Substitute value 10 sec	0 1 6 11 2 7 12	BYTE	Off 0x00
Substitute value at output	0 ... 65535	0000h ... FFFFh	WORD	0 0x0000
Preventive voltage feedback monitoring for DC0 ... DC7 [2])	Off On	0 1	BYTE	Off 0x00
Detect voltage overflow at outputs [3])	Off On	0 1	BYTE	Off 0x00

Remarks:

[1])	The parameter Behaviour DO at comm. error is apply to DC and DO channels and only analyzed if the Failsafe-mode is ON.
[2])	The state "externally voltage detected" appears, if the output of a channel DC0 ... DC7 should be switched on while an externally voltage is connected. In this case the start up is disabled, as long as the externally voltage is connected. The monitoring of this state and the resulting diagnosis message can be disabled by setting the parameters to "OFF".
[3])	The error state "voltage overflow at outputs" appears, if externally voltage at digital outputs DC0 ... DC7 and accordingly DO8 ... DO15 has exceeded the process supply voltage UP3 *Chapter 1.8.5.2.4 “Connections” on page 1152*. The according diagnosis message "Voltage overflow on outputs " can be disabled by setting the parameters on "OFF". This parameter should only be disabled in exceptional cases for voltage overflow may produce reverse voltage.

1.8.5.2.9 Diagnosis

Table 294: Structure of the Diagnosis Block

Byte Number	Description	Possible Values
1	Diagnosis Byte, slot number	31 = CI502-PNIO (e. g. error at integrated 8 DI / 8 DO) 1 = 1st connected S500 I/O Module ... 10 = 10th connected S500 I/O Module
2	Diagnosis Byte, module number	According to the I/O bus specification passed on by modules to the fieldbus master

Byte Number	Description	Possible Values
3	Diagnosis Byte, channel	According to the I/O bus specification passed on by modules to the fieldbus master
4	Diagnosis Byte, error code	According to the I/O bus specification Bit 7 and bit 6, coded error class 0 = E1 1 = E2 2 = E3 3 = E4 Bit 0 to bit 5, coded error description
5	Diagnosis Byte, flags	According to the I/O bus specification Bit 7: 1 = coming error Bit 6: 1 = leaving error
6	Reserved	0

In cases of short circuit or overload, the digital outputs are turned off. The modules performs reactivation automatically. Thus an acknowledgement of the errors is not necessary. The error message is stored via the LED.

For diagnosis firmware version ≥ 3.2.6 is required.

E1 ... E4	d1	d2	d3	d4	Identi-fier 000 ... 063	AC500-Display	<− Display in
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 4 **Bit 6 ... 7**	**-**	**Byte 1**	**Byte 2**	**Byte 3**	**Byte 4** **Bit 0 ... 5**	**PNIO diag-nosis block**	
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error-** **Identi-fier**	**Error message**	**Remedy**
	1)	2)	3)				
Module errors							
3	-	31	31	31	19	Checksum error in the I/O module	Replace I/O module
3	-	31	31	31	3	Timeout in the I/O module	
3	-	31	31	31	40	Different hard-/firm-ware versions in the module	
3	-	31	31	31	43	Internal error in the module	

E1 ... E4	d1	d2	d3	d4	Identi-fier 000 ... 063	AC500-Display	<− Display in
Class	Comp	Dev	Mod	Ch	Err	PS501 PLC Browser	
Byte 4 Bit 6 ... 7	-	Byte 1	Byte 2	Byte 3	Byte 4 Bit 0 ... 5	PNIO diag-nosis block	
Class	Inter-face	Device	Module	Channel	Error- Identi-fier	Error message	Remedy
	[1])	[2])	[3])				
3	-	31	31	31	36	Internal data exchange failure	
3	-	31	31	31	9	Overflow diagnosis buffer	Restart
3	-	31	31	31	26	Parameter error	Check Master
3	-	31	31	31	11	Process voltage UP too low	Check process supply voltage
3	-	31	31	31	45	Process voltage UP gone	Check process supply voltage
3	-	31/1...10	31	31	17	No communication with I/O module	Replace I/O module
3	-	1...10	31	31	32	Wrong I/O module type on socket	Replace I/O module / Check configu-ration
4	-	1...10	31	31	31	At least one module does not support failsafe function	Check modules and parame-terization
4	-	1...10	31	5	8	I/O module removed from hot swap terminal unit or defective module on hot swap ter-minal unit [9])	Plug I/O module, replace I/O module

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier** **000 ... 063**	**AC500-Display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 4 **Bit 6 ... 7**	**-**	**Byte 1**	**Byte 2**	**Byte 3**	**Byte 4** **Bit 0 ... 5**	**PNIO diag-nosis block**	
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error-** **Identi-fier**	**Error message**	**Remedy**
	1)	2)	3)				
4	-	1...10	31	5	28	Wrong I/O module plugged on hot swap terminal unit 9)	Remove wrong I/O module and plug pro-jected I/O module
4	-	1...10	31	5	42	No communication with I/O module on hot swap terminal unit 9)	Replace I/O module
4	-	1...10	31	5	54	I/O module does not support hot swap 8) 9)	Power off system and replace I/O module
4	-	1...10	31	6	8	Hot swap terminal unit configured but not found	Replace terminal unit by hot swap terminal unit
4	-	1...10	31	6	42	No communication with hot swap ter-minal unit 9)	Restart, if error persists replace terminal unit
4	1...6	255	2	0	45	The connected Communication Module has no con-nection to the net-work	Check cabeling
4	-	31	31	31	45	Process voltage UP3 too low	Check process voltage

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier** **000 ... 063**	**AC500-Display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 4 **Bit 6 ... 7**	**-**	**Byte 1**	**Byte 2**	**Byte 3**	**Byte 4** **Bit 0 ... 5**	**PNIO diag-nosis block**	
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error-** **Identi-fier**	**Error message**	**Remedy**
	1)	2)	3)				
4	-	31	31	31	46	Reverse voltage from digital out-puts DO8...DO15 to UP3 4)	Check terminals
4	-	31/1...10	31	31	34	No response during initialization of the I/O module	Replace I/O module
4	-	31	31	31	11	Process voltage UP3 too low	Check process supply voltage
4	-	31	31	31	45	Process voltage UP3 gone	Check process supply voltage
4	-	31	31	31	10	Voltage overflow at outputs (above UP3 level) 5)	Check termi-nals/ check process supply voltage
Channel error digital							
4	-	31	2	8..15	46	Externally voltage detected at digital output DO8...DO15 6)	Check terminals
4	-	31	4	0...7	46	Externally voltage detected at digital output DC0...DC7 6)	Check terminals
4	-	31	4	0...7	47	Short circuit at digital output DC0...DC7 7)	Check terminals
4	-	31	2	8...15	47	Short circuit at digital output DO8...DO15 7)	Check terminals

Remarks:

[1])	In AC500 the following interface identifier applies: "-" = Diagnosis via bus-specific function blocks; 0 ... 4 or 10 = Position of the Communication Module; 14 = I/O bus; 31 = Module itself The identifier is not contained in the CI502-PNIO diagnosis block.
[2])	With "Device" the following allocation applies: 31 = Module itself, 1..10 = Expansion module
[3])	With "Module" the following allocation applies dependent of the master: Module error: 31 = Module itself Channel error: Module type (1 = AI, 2 = DO, 3 = AO)
[4])	This message appears, if externally voltages at one or more terminals DC0 ... DC7 oder DO8 ... DO15 cause that other digital outputs are supplied through that voltage (voltage feedback, see description in 'Connections' *Chapter 1.8.5.2.4 “Connections” on page 1152*. All outputs of the apply digital output groups will be turned off for 5 seconds. The diagnosis message appears for the whole output group.
[5])	The voltage at digital outputs DC0 ... DC7 and accordingly DO8 ... DO15 has exceeded the process supply voltage UP3 *Chapter 1.8.5.2.4 “Connections” on page 1152*. Diagnosis message appears for the whole module.
[6])	This message appears, if the output of a channel DC0 ... DC7 or DO8 ... DO15 should be switched on while an externally voltage is connected. In this case the start up is disabled, as long as the externally voltage is connected. Otherwise this could produce reverse voltage from this output to other digital outputs. This diagnosis message appears per channel.
[7])	Short circuit: After a detected short circuit, the output is deactivated for 2000ms. Then a new start up will be executed. This diagnosis message appears per channel.
[8])	In case of an I/O module doesn’t support hot swapping, do not perform any hot swap operations (also not on any other terminal units (slots)) as modules may be damaged or I/O bus communication may be disturbed.
[9])	Diagnosis for hot swap available as of version index F0.

1.8.5.2.10 State LEDs

The LEDs are located at the front of module. There are 2 different groups:

- The 5 system LEDs (PWR, STA1 ETH, STA2 ETH, S-ERR and I/O-Bus) show the operation state of the module and display possible errors.
- The 29 process LEDs (UP, UP3, inputs, outputs, CH-ERR1 to CH-ERR3) show the process supply voltage and the states of the inputs and outputs and display possible errors.

Table 295: States of the 5 system LEDs

LED	Color	OFF	ON	Flashing
PWR/RUN	Green	Process supply voltage missing	Internal supply voltage OK, module ready for communication with I/O Controller	Start-up / preparing communication
	Yellow	---	---	---

LED	Color	OFF	ON	Flashing
STA1 ETH (System LED "BF")	Green	---	Device configured, cyclic data exchange running	Device configured, acyclic data exchange running
	Red	---	Communication error (timeout) appeared	IP address error
STA2 ETH (System LED "SF")	Green	Device has valid parameters	Device is running parameterization sequenze	Device has no parameters
	Red	---	---	Device has invalid parameters
S-ERR	Red	No error	Internal error	--
I/O-Bus	Green	No expansion modules connected or communication error	Expansion modules connected and operational	---
ETH1	Green	No connection at Ethernet interface	Connected to Ethernet interface	---
	Yellow	---	Device is transmitting telegrams	Device is transmitting telegrams
ETH2	Green	No connection at Ethernet interface	Connected to Ethernet interface	---
	Yellow	---	Device is transmitting telegrams	Device is transmitting telegrams

Table 296: States of the 29 process LEDs

LED	Color	OFF	ON	Flashing
DC0 ... DC7	Yellow	Input/Output is OFF	Input/Output is ON	--
DI8 ... DI15	Yellow	Input is OFF	Input is ON (the input voltage is even displayed if the supply voltage is OFF)	--
DO8 ... DO15	Yellow	Output is OFF	Output is ON	--
UP	Green	Process supply voltage missing	Process supply voltage OK and initialization finished	--
UP3	Green	Process supply voltage missing	Process supply voltage OK	--
CH-ERR1 to CH-ERR3	Red	No error or process supply voltage missing	Internal error	Error on one channel of the corresponding group

1.8.5.2.11 Technical data

Technical data of the module

The system data of AC500 and S500 are applicable to the standard version *Chapter 2.6.1 “System data AC500” on page 1408*.

The system data of AC500-XC are applicable to the XC version *Chapter 2.7.1 “System data AC500-XC” on page 1475*.

Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

Parameter		Value
Process supply voltages UP/UP3		
	Rated value	24 V DC (for inputs and outputs)
	Max. load for the terminals	10 A
	Protection against reversed voltage	Yes
	Rated protection fuse on UP/UP3	10 A fast
	Galvanic isolation	Ethernet interface against the rest of the module
	Inrush current from UP (at power up)	On request
	Current consumption via UP (normal operation)	0.15 A
	Current consumption via UP3	0.06 A + 0.5 A max. per output
	Connections	Terminals 1.8 and 2.8 for +24 V (UP) Terminal 3.8 for +24 V (UP3) Terminals 1.9, 2.9 and 3.9 for 0 V (ZP)
Max. power dissipation within the module		6 W
Number of digital inputs		8
Number of digital outputs		8
Number of configurable digital inputs/outputs		8
Reference potential for all digital inputs and outputs		Negative pole of the supply voltage, signal name ZP
Ethernet		10/100 base-TX, internal switch, 2 x RJ45 socket
Setting of the I/O device identifier		With 2 rotary switches at the front side of the module
Diagnosis		See Diagnosis and Displays *Chapter 1.8.5.2.9 “Diagnosis” on page 1162*
Operation and error displays		34 LEDs (totally)
Weight (without terminal unit)		Ca. 125 g
Mounting position		Horizontal or vertical with derating (output load reduced to 50 % at +40°C per group)
Extended ambient temperature (XC version)		> +60 °C on request
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

NOTICE!
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and temporary overvoltage up to 30 V DC.

Multiple overloads
No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an internal smart high-side switch.

Technical data of the digital inputs

Parameter		Value
Number of channels per module		8
Distribution of the channels into groups		1 group of 8 channels
Terminals of the channels DI8 ... DI15		Terminals 2.0 ... 2.7
Reference potential for all inputs		Terminals 1.9 ... 3.9 (negative pole of the supply voltage, signal name ZP)
Indication of the input signals		1 yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Input type (according EN 61131-2)		Type 1
Input delay (0->1 or 1->0)		Typ. 0.1 ms, configurable from 0.1 ms ... 32 ms
Input signal voltage		24 V DC
	Signal 0	-3 V ... +5 V
	Undefined Signal	> +5 V ... < +15 V
	Signal 1	+15 V ... +30 V
Ripple with signal 0		Within -3 V ... +5 V
Ripple with signal 1		Within +15 V ... +30 V
Input current per channel		
	Input voltage +24 V	Typ. 5 mA
	Input voltage +5 V	> 1 mA
	Input voltage +15 V	> 2 mA
	Input voltage +30 V	< 8 mA
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

Technical data of the digital outputs

Parameter	Value
Number of channels per module	8
Distribution of the channels into groups	1 group of 8 channels

Parameter		Value
Terminals of the channels DO8 ... DO15		Terminals 3.0 ... 3.7
Reference potential for all outputs		Terminals 1.9 ... 3.9 (negative pole of the supply voltage, signal name ZP)
Common power supply voltage		For all outputs terminal 3.8 (positive pole of the supply voltage, signal name UP3)
Output voltage for signal 1		UP3 (-0.8 V)
Output delay (0->1 or 1->0)		On request
Output current		
	Rated value per channel	500 mA at UP3 = 24 V
	Max. value (all channels together)	4 A
Leakage current with signal 0		< 0.5 mA
	Fuse for UP3	10 A fast
Demagnetization with inductive DC load		Via internal varistors (see figure below this table)
Output switching frequency		
	With resistive load	On request
	With inductive loads	Max. 0.5 Hz
	With lamp loads	11 Hz max. at 5 W max.
Short-circuit-proof / overload-proof		Yes
Overload message (I > 0.7 A)		Yes, after ca. 100 ms
Output current limitation		Yes, automatic reactivation after short circuit/overload
Resistance to feedback against 24V signals		Yes (software-controlled supervision)
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

The following drawing shows the circuitry of a digital input/output with the varistors for demagnetization when inductive loads are switched off.

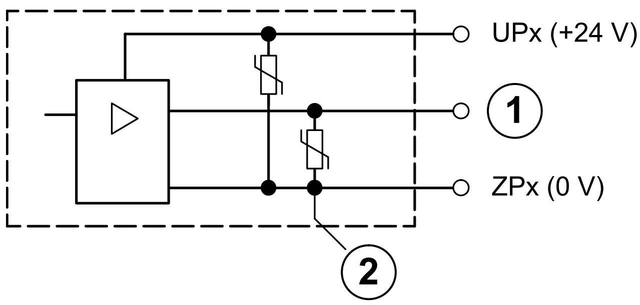


Fig. 302: Digital input/output (circuit diagram)

1 Digital output
2 Varistors for demagnetization when inductive loads are turned off

Technical data of the configurable digital inputs/outputs

Each of the configurable I/O channels is defined as input or output by the user program. This is done by interrogating or allocating the corresponding channel.

Parameter		Value
Number of channels per module		8 inputs/outputs (with transistors)
Distribution of the channels into groups		1 group for 8 channels
If the channels are used as inputs		
	Channels DC0 ... DC7	Terminals 1.0 ... 1.7
If the channels are used as outputs		
	Channels DC0 ... DC7	Terminals 1.0 ... 1.7
Indication of the input/output signals		1 yellow LED per channel, the LED is ON when the input/output signal is high (signal 1)
Galvanic isolation		From the Ethernet network

Technical data of the digital inputs/outputs if used as inputs

Parameter		Value
Number of channels per module		8
Distribution of the channels into groups		1 group of 8 channels
Terminals of the channels DC0 ... DC7		Terminals 1.0 ... 1.7
Reference potential for all inputs		Terminals 1.9 ... 3.9 (negative pole of the supply voltage, signal name ZP)
Indication of the input signals		1 yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Input type (according EN 61131-2)		Type 1
Input delay (0->1 or 1->0)		Typ. 0.1 ms, configurable from 0.1 ms ... 32 ms
Input signal voltage		24 V DC
	Signal 0	-3 V ... +5 V *)
	Undefined Signal	> +5 V ... < +15 V
	Signal 1	+15 V ... +30 V
Ripple with signal 0		Within -3 V ... +5 V *)
Ripple with signal 1		Within +15 V ... +30 V
Input current per channel		
	Input voltage +24 V	Typ. 5 mA
	Input voltage +5 V	> 1 mA
	Input voltage +15 V	> 2 mA
	Input voltage +30 V	< 8 mA
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

*) Due to the direct connection to the output, the demagnetizing varistor is also effective at the input (see figure) above. This is why the difference between UPx and the input signal may not exceed the clamp voltage of the varistor. The varistor limits the voltage to approx. 36 V. Following this, the input voltage must range from -12 V ... +30 V when UPx = 24 V and from -6 V ... +30 V when UPx = 30 V.

Technical data of the digital inputs/outputs if used as outputs

Parameter		Value
Number of channels per module		8
Distribution of the channels into groups		1 group of 8 channels
Terminals of the channels DC0 ... DC7		Terminals 1.0 ... 1.7
Reference potential for all outputs		Terminals 1.9 ... 3.9 (negative pole of the supply voltage, signal name ZP)
Common power supply voltage		For all outputs terminal 3.8 (positive pole of the supply voltage, signal name UP3)
Output voltage for signal 1		UP3 (-0,8 V)
Output delay (0->1 or 1->0)		On request
Output current		
	Rated value per channel	500 mA at UP3 = 24 V
	Max. value (all channels together)	4 A
Leakage current with signal 0		< 0.5 mA
	Fuse for UP3	10 A fast
Demagnetization with inductive DC load		Via internal varistors (see figure below this table)
Output switching frequency		
	With resistive load	On request
	With inductive loads	Max. 0.5 Hz
	With lamp loads	11 Hz max. at 5 W max.
Short-circuit-proof / overload-proof		Yes
Overload message (**I** > 0.7 A)		Yes, after ca. 100 ms
Output current limitation		Yes, automatic reactivation after short circuit/overload
Resistance to feedback against 24V signals		Yes (software-controlled supervision)
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

The following drawing shows the circuitry of a digital input/output with the varistors for demagnetization when inductive loads are switched off.

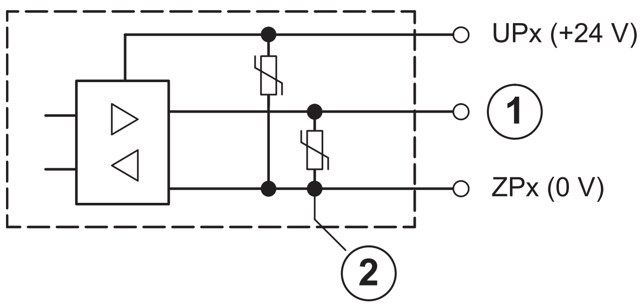


Fig. 303: Digital input/output (circuit diagram)

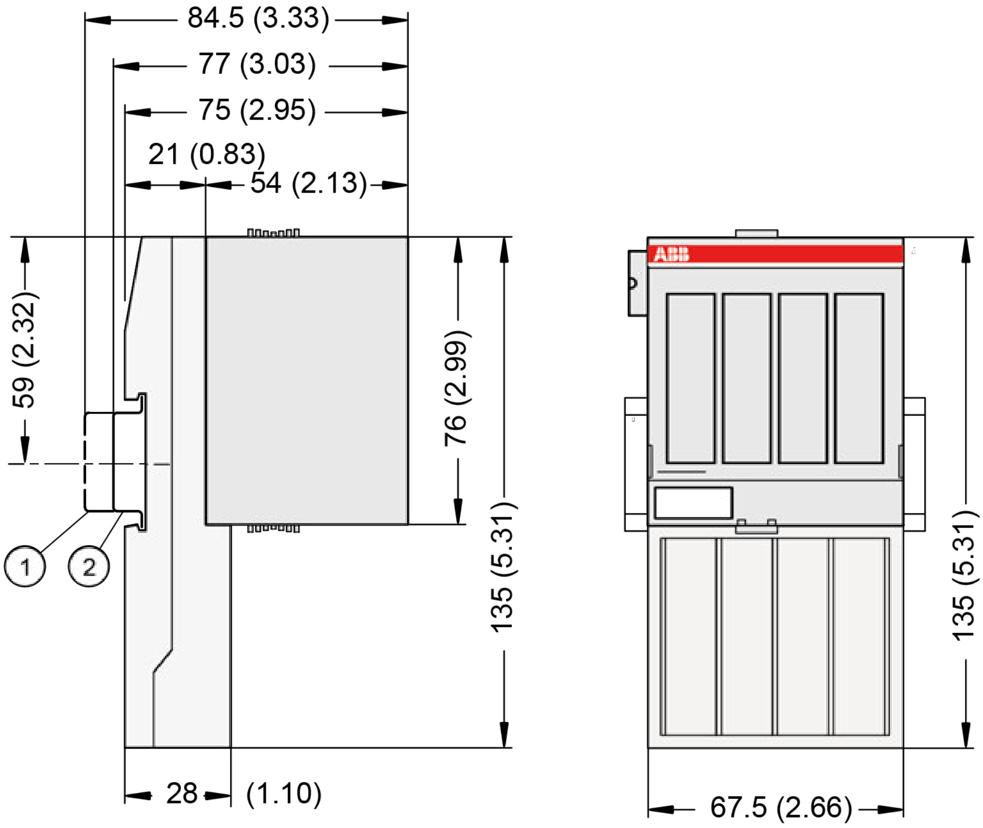
1 Digital input/output
2 For demagnetization when inductive loads are turned off

Technical data of the fast counter

Parameter	Value
Used inputs	Terminal 2.0 (DI8),Terminal 2.1 (DI9)
Used outputs	Terminal 3.0 (DO8)
Counting frequency	Depending on operation mode: Mode 1- 6: max. 200 kHz Mode 7: max. 50 kHz Mode 9: max. 35 kHz Mode 10: max. 20 kHz

How to prepare a device as fast counter and how to connect it to the PLC is described in an *application example*.

1.8.5.2.12 Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

1.8.5.2.13 Ordering data

Ordering No.	Scope of delivery	Product life cycle phase *)
1SAP 222 200 R0001	CI522-MODTCP, Modbus TCP communication interface module, 8 DC, 8 DI and 8 DO	Active
1SAP 422 200 R0001	CI522-MODTCP-XC, Modbus TCP communication interface module, 8 DC, 8 DI and 8 DO, XC version	Active

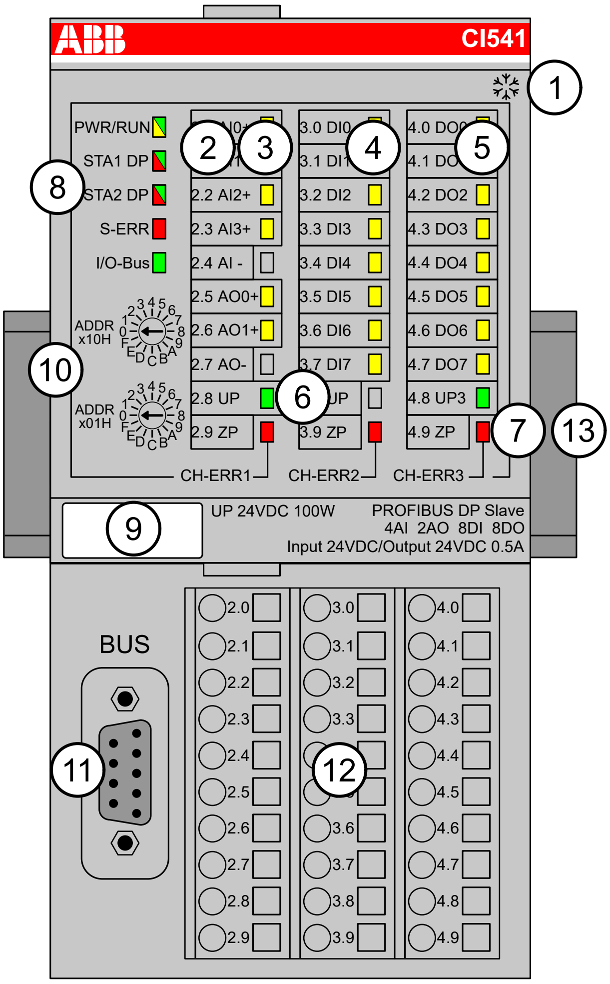
**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

1.8.6 PROFIBUS

1.8.6.1 CI541-DP

1.8.6.1.1 Features

- 4 configurable analog inputs (2-wire/single-ended) or 2 configurable analog inputs (3-wire/differential)
  Resolution 12 bits including sign
- 2 analog outputs
  Resolution 12 bits including sign
- 8 digital inputs 24 V DC in 1 group
- 8 digital outputs 24 V DC in 1 group, 0.5 A max.
- Fast counter
- Module-wise galvanically isolated
- XC version for usage in extreme ambient conditions available



1 I/O bus
2 Allocation between terminal number and signal name
3 6 yellow LEDs to display the signal states of the analog inputs/outputs (AI0 ... AI3, AO0 ... AO1)
4 8 yellow LEDs to display the signal states of the digital inputs (DI0 ... DI7)
5 8 yellow LEDs to display the signal states of the digital outputs (DO0 ... DO7)
6 2 green LEDs to display the process supply voltage UP and UP3
7 3 red LEDs to display errors (CH-ERR1, CH-ERR2, CH-ERR3)
8 5 system LEDs: PWR/RUN, STA1 DP, STA2 DP, S-ERR, I/O-Bus
9 Label
10 2 rotary switches for setting the PROFIBUS ID
11 9-pin D-SUB connector to connect the PROFIBUS DP signals
12 Terminal unit
13 DIN rail
❄ Sign for XC version

1.8.6.1.2 Intended purpose

The PROFIBUS DP communication interface module is used as decentralized I/O module in PROFIBUS DP networks. Depending on the used terminal unit the network connection is performed either via 9-pole female D-sub or via 10 terminals (screw-type or spring terminals) which are integrated in the terminal unit. The communication interface module contains 22 I/O channels.

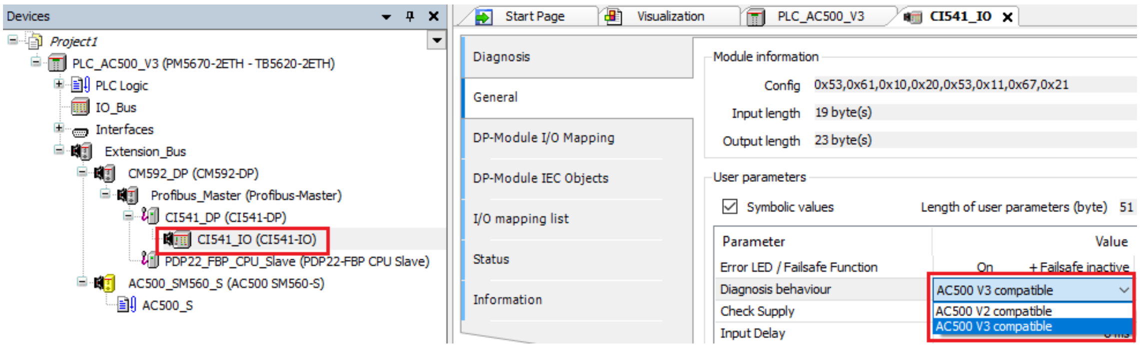
The inputs/outputs are galvanically isolated from the PROFIBUS DP network. There is no potential separation between the channels. The configuration of the analog inputs/outputs is performed by software.

For usage in extreme ambient conditions (e.g. wider temperature and humidity range), a special XC version of the device is available.

- 4 configurable analog inputs (2-wire/single-ended) or 2 configurable analog inputs (3-wire/differential)
  Resolution 12 bits including sign
- 2 analog outputs
  Resolution 12 bits including sign
- 8 digital inputs 24 V DC in 1 group
- 8 digital outputs 24 V DC in 1 group, 0.5 A max.
- Fast counter
- Module-wise galvanically isolated
- XC version for usage in extreme ambient conditions available

1.8.6.1.3 Diagnosis settings

The current CI54x does not run in combination with a V3 PLC if in the *"General"* tab the parameter *"Diagnosis behavior"* is set to *"AC500 V3 compatible"*. How to change the setting in your AB project is described below.



1. Double click in the *"Device"* tree on *"CI541_IO"*.

   ⇨ The tab for the various settings opens.

2. Double click on the *"General"* tab.
3. Double click on the *"Value"* of the parameter *"Diagnosis behavior"*.
4. Click on the small arrow.

   ⇨ A submenu with two values opens.

5. Click on *"AC500 V2 compatible"* as setting.
6. Close the tab.

After changing the parameter to *"AC500 V2 compatible"* the CI54x get in *"RUN"*.

If the CI54x indicates a S500 diagnosis message, following AC500 diagnosis entry (*"655374 CI54x communication interface module is sending not supported diagnosis format - Check configuration and FW revision of communication interface module"*) is shown in the diagnosis editor and history. This diagnosis message does not have impact to cyclic data exchange between the master and the CI54x.

In case of a parameter change from V2 to V3 the parameter at the CI54x of V3 has the same value than at the CI54x below V2 (that means AC500 V2 compatible).

1.8.6.1.4 Functionality

Parameter	Value
Interface	PROFIBUS
Protocol	PROFIBUS DP (DP-V0 and DP-V1)

Parameter	Value
Power supply	From the process supply voltage UP
Supply of the electronic circuitry of the I/O expansion modules attached	Through the I/O bus interface (I/O bus)
Rotary switches	For setting the PROFIBUS ID for configuration purposes (00h to FFh)
Expandability	Max. 10 S500 I/O modules
Fast counter	Integrated, configurable operating modes
LED displays	For system displays, signal states, errors and power supply
External supply voltage	Via terminals ZP, UP and UP3 (process supply voltage 24 V DC)
Effect of incorrect input terminal connection	Wrong or no signal detected, no damage up to 35 V
Required terminal unit	TU509, TU510, TU517 or TU518 *Chapter 1.5.2 "TU509 and TU510 for communication interface modules" on page 278* *Chapter 1.5.4 "TU517 and TU518 for communication interface modules" on page 290*

1.8.6.1.5 Connections

General

For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.

The PROFIBUS DP communication interface module CI541-DP is plugged on the I/O terminal units TU509 *Chapter 1.5.2 "TU509 and TU510 for communication interface modules" on page 278* or TU510 *Chapter 1.5.2 "TU509 and TU510 for communication interface modules" on page 278* and accordingly TU517 *Chapter 1.5.4 "TU517 and TU518 for communication interface modules" on page 290* or TU518 *Chapter 1.5.4 "TU517 and TU518 for communication interface modules" on page 290*. Properly seat the module and press until it locks in place. The terminal unit is mounted on a DIN rail or with 2 screws plus the additional accessory for wall mounting *Chapter 1.9.3.5 "TA526 - Wall mounting accessory" on page 1361*.

The connection of the I/O channels is carried out using the 30 terminals of the I/O terminal unit. I/O modules can be replaced without re-wiring the terminal units.

The terminals 2.8 and 3.8 as well as 2.9, 3.9 and 4.9 are interconnected within the terminal unit and have always the same assignment, independent of the inserted module:

Terminals 2.8 and 3.8: Process supply voltage UP = +24 V DC

Terminal 4.8: Process supply voltage UP3 = +24 V DC

Terminals 2.9, 3.9 and 4.9: Process supply voltage ZP = 0 V

With a separate UP3 power supply, the digital outputs can be switched off externally. This way, an emergency-off functionality can be realized.

Do not connect any voltages externally to digital outputs!

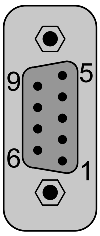
Reason: Externally voltages at an output or several outputs may cause that other outputs are supplied through that voltage instead of voltage UP3 (reverse voltage). This ist not intended usage.

CAUTION!
Risk of malfunction by unintended usage!
If the function cut-off of the digital outputs is to be used by deactivation of the supply voltage UP3, be sure that no external voltage is conncted at the outputs DO0 ... DO7.

Possibilities of connection

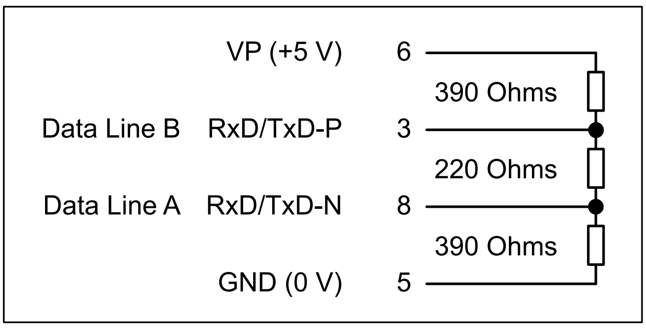
Connection on terminal units TU509 or TU510

The assignment of the 9-pole female D-sub for the PROFIBUS signals:

	1	---	Reserved
	2	---	Reserved
	3	B	Data line B (receive and send line, positive)
	4	---	Reserved
	5	DGND	Reference potential for data transmissions and +5 V
	6	VP (5 V)	+5 V (Power supply voltage for terminating resistors)
	7	---	Reserved
	8	A	Data line A (receive and send line, negative)
	9	---	Reserved
	Shield	Shield	Shield, functional earth

Bus termination

The line ends of the bus segment must be equipped with bus terminating resistors. Normally, these resistors are integrated in the interface connectors.



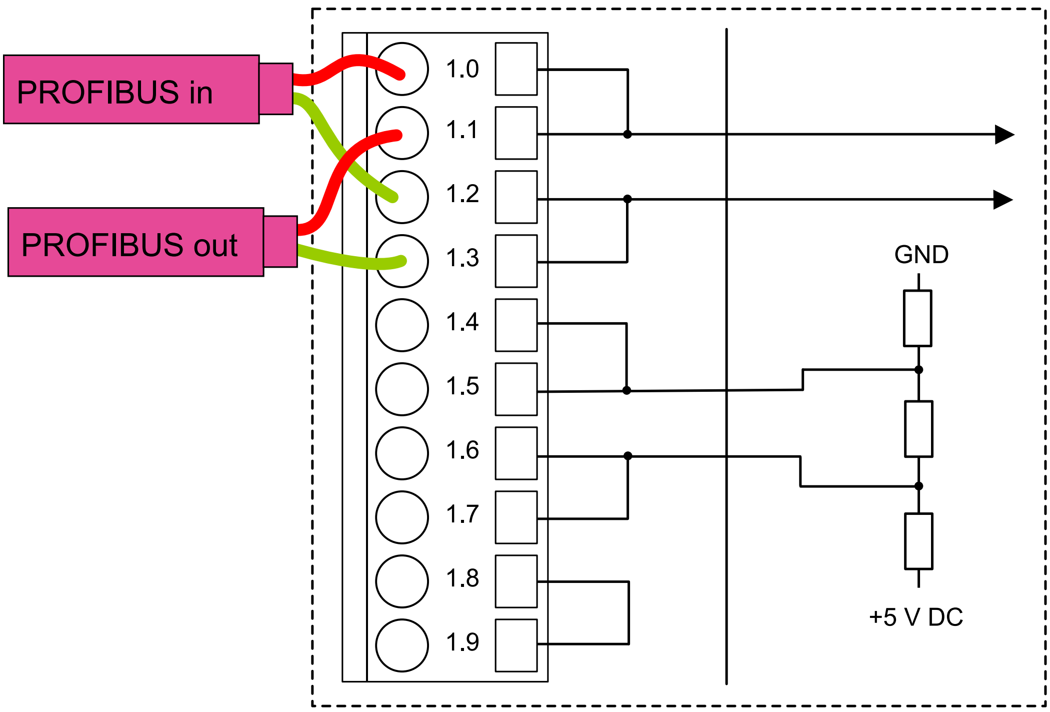
The grounding of the shield should take place at the control cabinet *Chapter 2.6.1 "System data AC500" on page 1408.*

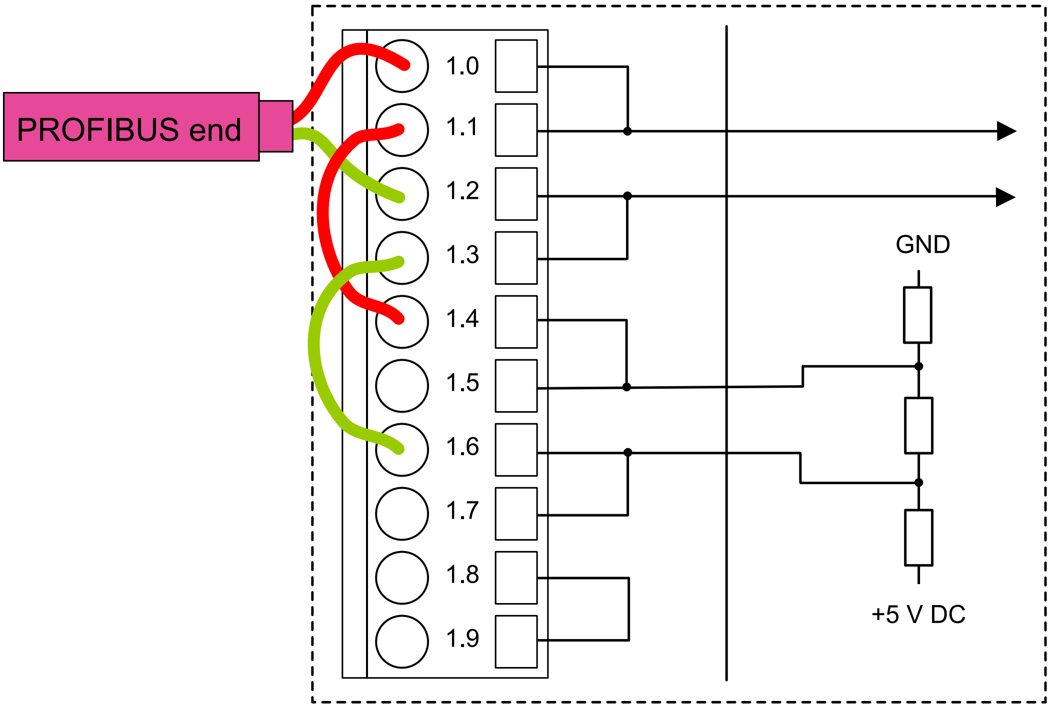
Mounting on terminal units TU517 or TU518

The assignment of the terminals 1.0 ... 1.9:

Terminal	Signal	Description
1.0	B	Data line B (receive and send line, positive)
1.1	B	Data line B (receive and send line, positive)
1.2	A	Data line A (receive and send line, negative)
1.3	A	Data line A (receive and send line, negative)
1.4	TermB	Bus termination data line B
1.5	TermB	Bus termination data line B
1.6	TermA	Bus termination data line A
1.7	TermA	Bus termination data line A
1.8	DGND	Reference potential for data transmission
1.9	DGND	Reference potential for data transmission

At the line ends of a bus segment, terminating resistors must be connected. If using TU517/ TU518, the bus terminating resistors can be enabled by connecting the terminals TermA and TermB to the data lines A and B (no external terminating resistors are required, see figure below).





If using TU517/TU518, note that the terminating resistors are not located inside the TU, but inside the communication interface module CI541-DP. I. e. when removing the device from the TU, the bus terminating resistors are not connected to the bus any more. The bus itself will not be disconnected if a device is removed.

If using TU517/TU518 the max. permitted transmission rate is limited to 1.5 MBaud.

The grounding of the shield should take place at the control cabinet *➪ Chapter 2.6.1 “System data AC500” on page 1408.*

Technical data bus cable

Parameter	Value
Type	Twisted pair (shielded)
Characteristic impedance	135...165 Ω
Cable capacitance	< 30 pF/m
Conductor diameter of the cores	≥ 0.64 mm
Conductor cross section of the cores	≥ 0.34 mm²
Cable resistance per core	≤ 55 Ω/km
Loop resistance (resistance of two cores)	≤ 110 Ω/km

Cable length

The maximum possible cable length of a PROFIBUS subnet within a segment depends on the transmission rate (baud rate).

Transmission rate	Maximum cable length
9.6 kBaud to 93.75 kBaud	1200 m
187.5 kBaud	1000 m
500 kBaud	400 m
1.5 MBaud	200 m
3 MBaud to 12 MBaud	100 m

The assignment of the other terminals:

Terminal	Signal	Description
2.0	AI0+	Positive pole of analog input signal 0
2.1	AI1+	Positive pole of analog input signal 1
2.2	AI2+	Positive pole of analog input signal 2
2.3	AI3+	Positive pole of analog input signal 3
2.4	AI-	Negative pole of analog input signals 0 to 3
2.5	AO0+	Positive pole of analog output signal 0
2.6	AO1+	Positive pole of analog output signal 1
2.7	AI-	Negative pole of analog output signals 0 and 1
2.8	UP	Process voltage UP (24 V DC)
2.9	ZP	Process voltage ZP (0 V DC)
3.0	DI0	Signal of the digital input DI0
3.1	DI1	Signal of the digital input DI1
3.2	DI2	Signal of the digital input DI2
3.3	DI3	Signal of the digital input DI3
3.4	DI4	Signal of the digital input DI4
3.5	DI5	Signal of the digital input DI5
3.6	DI6	Signal of the digital input DI6
3.7	DI7	Signal of the digital input DI7
3.8	UP	Process voltage UP (24 V DC)
3.9	ZP	Process voltage ZP (0 V DC)
4.0	DO0	Signal of the digital output DO0
4.1	DO1	Signal of the digital output DO1
4.2	DO2	Signal of the digital output DO2
4.3	DO3	Signal of the digital output DO3
4.4	DO4	Signal of the digital output DO4
4.5	DO5	Signal of the digital output DO5
4.6	DO6	Signal of the digital output DO6
4.7	DO7	Signal of the digital output DO7
4.8	UP3	Process voltage UP3 (24 V DC)
4.9	ZP	Process voltage ZP (0 V DC)

WARNING!

Removal/Insertion under power

The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!

Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

For the open-circuit detection (cut wire), each channel is pulled up to "plus" by a high-resistance resistor. If nothing is connected, the maximum voltage will be read in then.

Analog signals are always laid in shielded cables. The cable shields are grounded at both ends of the cables. In order to avoid unacceptable potential differences between different parts of the installation, low resistance equipotential bonding conductors must be laid.

For simple applications (low electromagnetic disturbances, no high requirement on precision), the shielding can also be omitted.

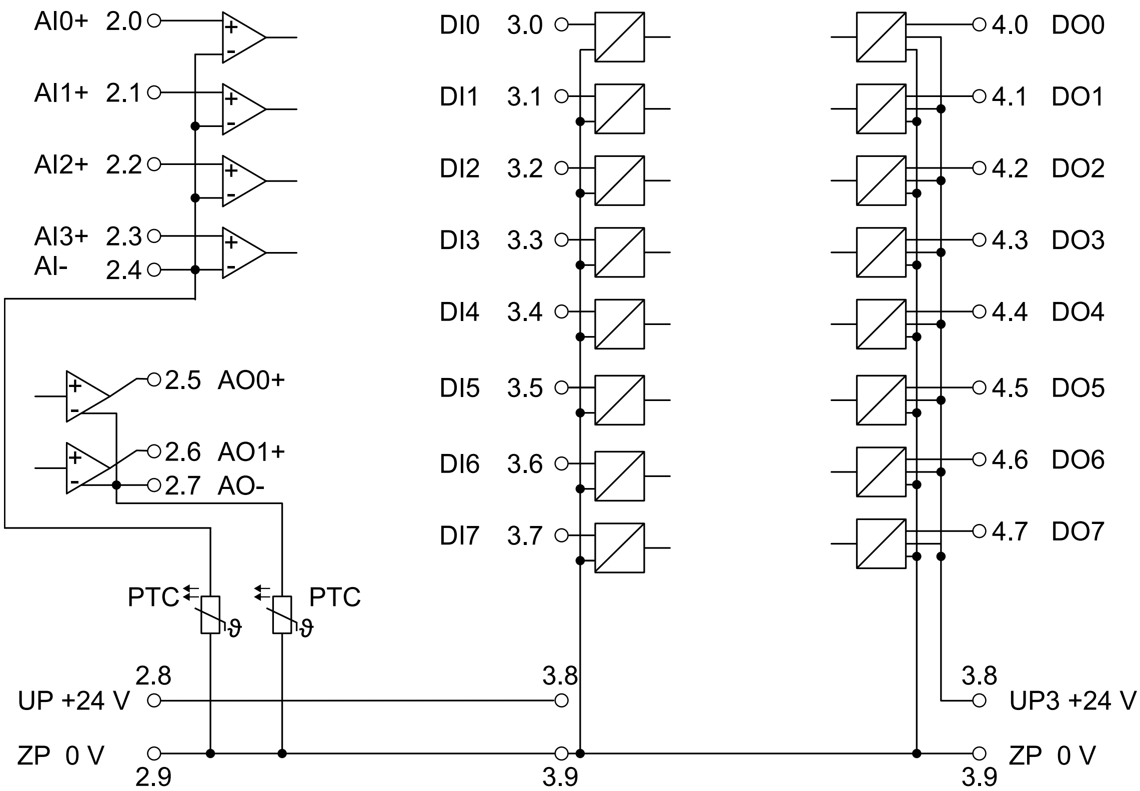


Fig. 304: Connection of the PROFIBUS DP communication interface module CI541-DP

Connection of the digital inputs

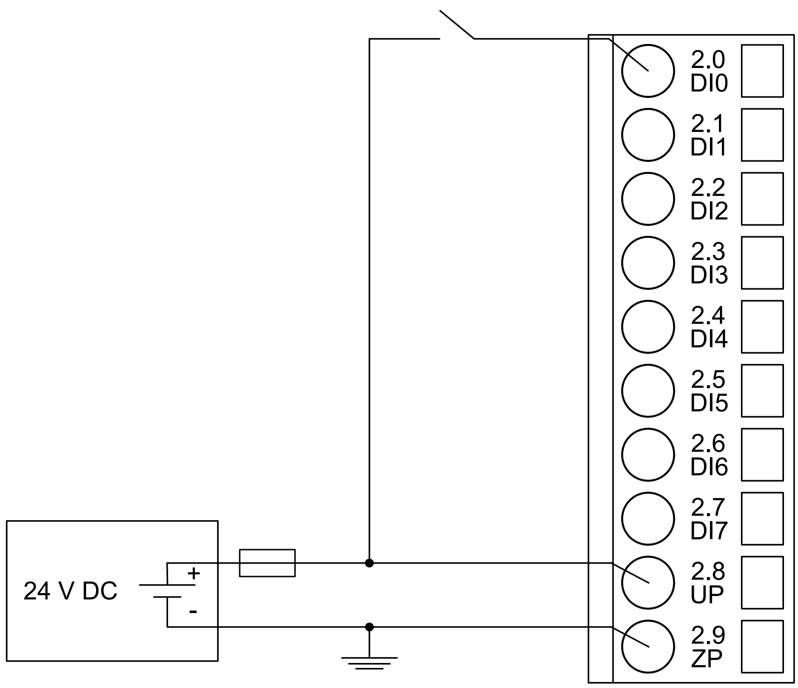


Fig. 305: Connection of the digital input DI0 (Proceed with the digital inputs DI1 ... DI7 in the same way)

The meaning of the LEDs is described in Displays *Chapter 1.8.6.1.11 “State LEDs” on page 1204*.

Connection of the digital outputs

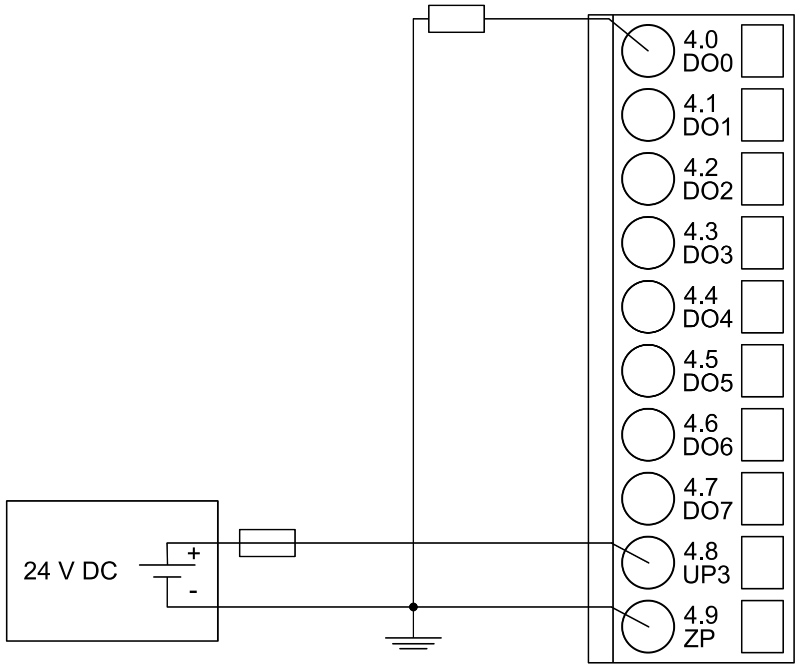


Fig. 306: Connection of the digital output DO0 (Proceed with the digital outputs DO1 ... DO7 in the same way)

The meaning of the LEDs is described in Displays *Chapter 1.8.6.1.11 "State LEDs" on page 1204*.

Connection of resistance thermometers in 2-wire configuration to the analog inputs

When resistance thermometers (Pt100, Pt1000, Ni1000) are used, a constant current must flow through them to build the necessary voltage drop for the evaluation. For this, the module CI541-DP provides a constant current source which is multiplexed over the max. 4 analog input channels.

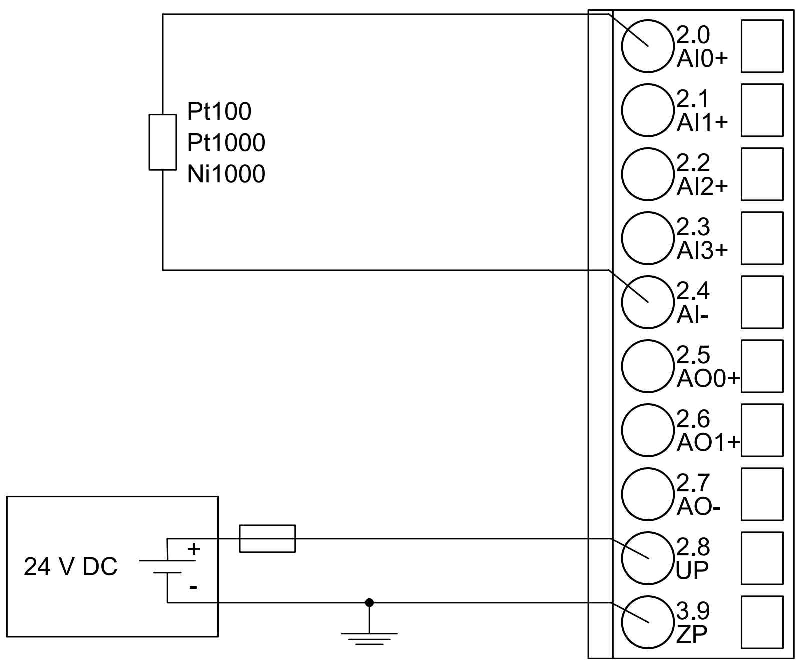


Fig. 307: Connection of resistance thermometers in 2-wire configuration to the analog input AI0 (Proceed with the analog inputs AI1 ... AI3 in the same way)

The following measuring ranges can be configured *Chapter 1.8.6.1.9 “Parameterization” on page 1194* *Chapter 1.8.6.1.12 “Measuring ranges” on page 1205*:

Pt100	-50 °C ... +400 °C	2-wire configuration, 1 channel used
Pt1000	-50 °C ... +400 °C	2-wire configuration, 1 channel used
Ni1000	-50 °C ... +150 °C	2-wire configuration, 1 channel used

The function of the LEDs is described under Diagnosis and displays / Displays *Chapter 1.8.6.1.11 “State LEDs” on page 1204*.

The module CI541-DP performs a linearization of the resistance characteristic.

To avoid error messages from unused analog input channels, configure them as "unused".

Connection of resistance thermometers in 3-wire configuration to the analog inputs

When resistance thermometers (Pt100, Pt1000, Ni1000) are used, a constant current must flow through them to build the necessary voltage drop for the evaluation. For this, the module CI541-DP provides a constant current source which is multiplexed over the max. 4 analog input channels.

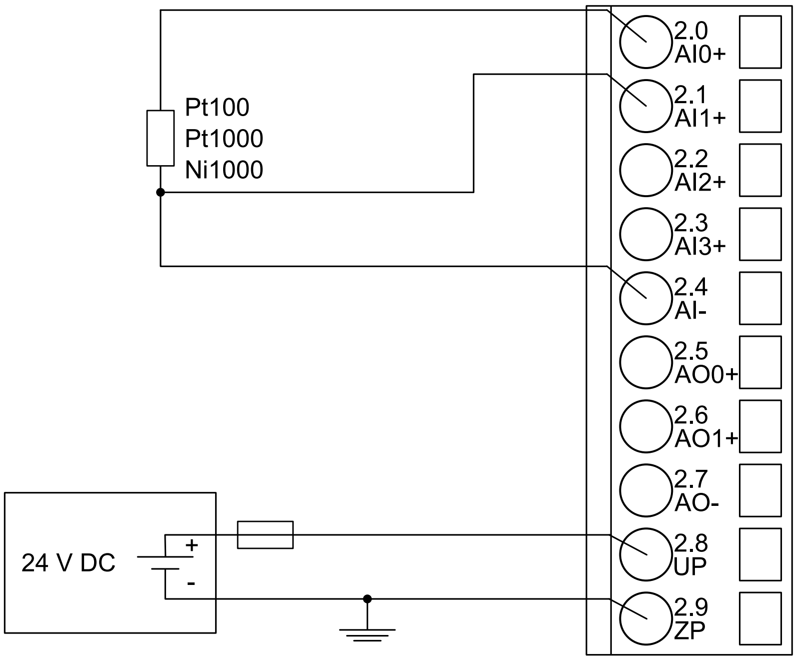


Fig. 308: Connection of resistance thermometers in 3-wire configuration to the analog inputs AI0 and AI1 (Proceed with the analog inputs AI2 and AI3 in the same way)

With 3-wire configuration, 2 adjacent analog channels belong together (e. g. the channels 0 and 1). In this case, both channels are configured according to the desired operating mode. The lower address must be the even address (channel 0), the next higher address must be the odd address (channel 1).

The constant current of one channel flows through the resistance thermometer. The constant current of the other channel flows through one of the cores. The module calculates the measured value from the two voltage drops and stores it under the input with the higher channel number (e. g. I1).

In order to keep measuring errors as small as possible, it is necessary to have all the involved conductors in the same cable. All the conductors must have the same cross section.

The following measuring ranges can be configured ␦ *Chapter 1.8.6.1.9 “Parameterization” on page 1194* ␦ *Chapter 1.8.6.1.12 “Measuring ranges” on page 1205*:

Pt100	-50 °C ... +400 °C	3-wire configuration, 2 channels used
Pt1000	-50 °C ... +400 °C	3-wire configuration, 2 channels used
Ni1000	-50 °C ... +150 °C	3-wire configuration, 2 channels used

The function of the LEDs is described under Diagnosis and displays / Displays ␦ *Chapter 1.8.6.1.11 “State LEDs” on page 1204*.

The module CI541-DP performs a linearization of the resistance characteristic.

To avoid error messages from unused analog input channels, configure them as "unused".

Connection of active-type analog sensors (Voltage) with galvanically isolated power supply to the analog inputs

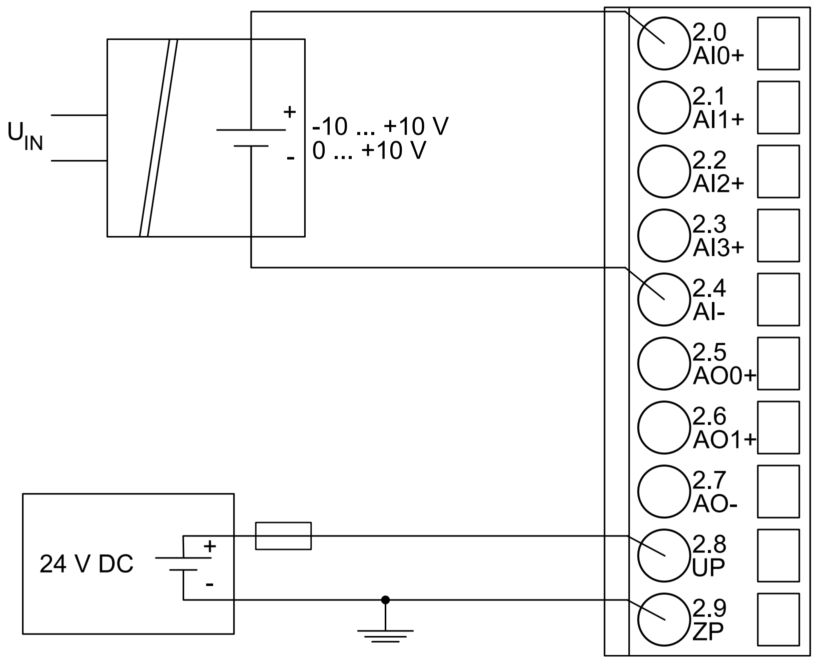


Fig. 309: Connection of active-type analog sensors (voltage) with galvanically isolated power supply to the analog input AI0 (Proceed with the analog inputs AI1 ... AI3 in the same way)

The following measuring ranges can be configured ␦ *Chapter 1.8.6.1.9 “Parameterization” on page 1194* ␦ *Chapter 1.8.6.1.12 “Measuring ranges” on page 1205*:

Voltage	0 V ... 10 V	1 channel used
Voltage	-10 V ... +10 V	1 channel used

The function of the LEDs is described under Diagnosis and displays / Displays ␦ *Chapter 1.8.6.1.11 “State LEDs” on page 1204*.

To avoid error messages from unused analog input channels, configure them as "unused".

Connection of active-type analog sensors (Current) with galvanically isolated power supply to the analog inputs

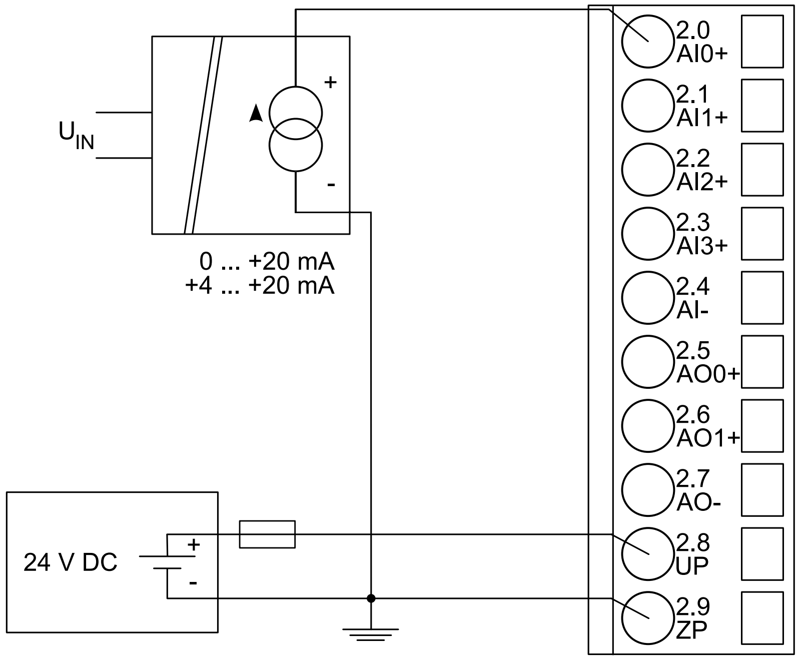


Fig. 310: Connection of active-type analog sensors (current) with galvanically isolated power supply to the analog input AI0 (Proceed with the analog inputs AI1 ... AI3 in the same way)

The following measuring ranges can be configured ⇘ *Chapter 1.8.6.1.9 “Parameterization” on page 1194* ⇘ *Chapter 1.8.6.1.12 “Measuring ranges” on page 1205*:

Current	0 mA ... 20 mA	1 channel used
Current	4 mA ... 20 mA	1 channel used

The function of the LEDs is described under 'State LEDs' ⇘ *Chapter 1.8.6.1.11 “State LEDs” on page 1204*.

Unused input channels can be left open-circuited, because they are of low resistance.

To avoid error messages through unused analog input channels in measuring range 4 ... 20 mA, these channels should be configured as "Not used".

Connection of active-type analog sensors (Voltage) with no galvanically isolated power supply to the analog inputs

The following figure shows the connection of active-type analog sensors (voltage) with no galvanically isolated power supply to the analog input AI0. Proceed with the analog inputs AI1 ... AI3 in the same way.

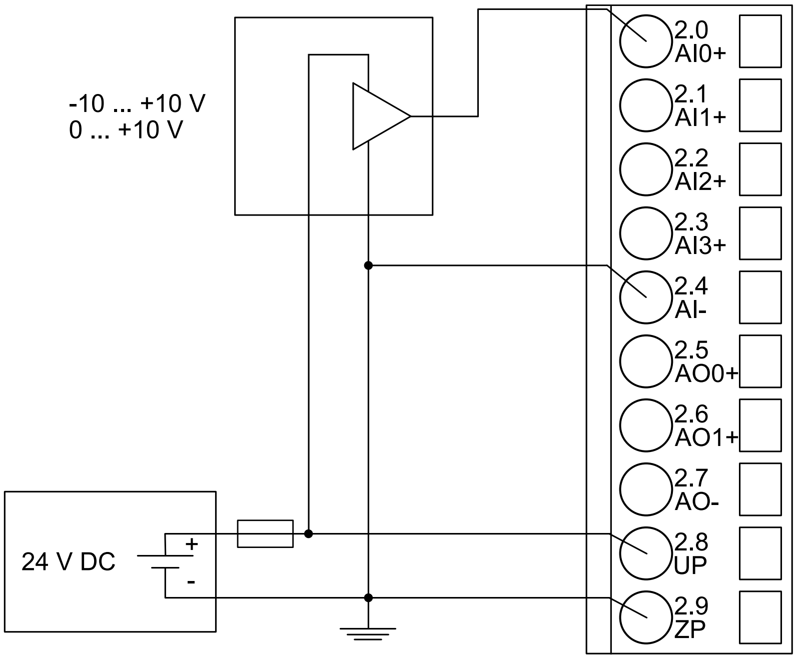


Fig. 311: Connection of active-type analog sensors (voltage) with no galvanically isolated power supply to the analog input AI0 (Proceed with the analog inputs AI1 ... AI3 in the same way)

CAUTION!
Risk of faulty measurements!
The negative pole at the sensors must not have too big a potential difference with respect to ZP (max. ± 1 V).

Make sure that the potential difference never exceeds ± 1 V (also not with long cable lengths).

The following measuring ranges can be configured *Chapter 1.8.6.1.9 "Parameterization" on page 1194* *Chapter 1.8.6.1.12 "Measuring ranges" on page 1205*:

Voltage	0 V ... 10 V	1 channel used
Voltage	-10 V ... +10 V	1 channel used

The function of the LEDs is described under Diagnosis and displays / Displays *Chapter 1.8.6.1.11 "State LEDs" on page 1204*.

To avoid error messages from unused analog input channels, configure them as "unused".

Connection of passive-type analog sensors (Current) to the analog inputs

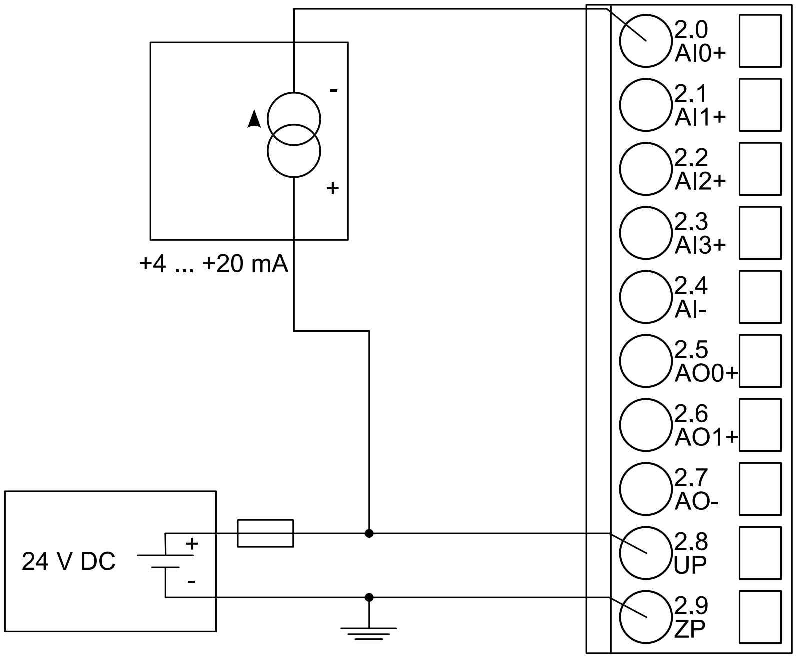


Fig. 312: Connection of passive-type analog sensors (current) to the analog input AI0 (Proceed with the analog inputs AI1 ... AI3 in the same way)

The following measuring ranges can be configured *Chapter 1.8.6.1.9 "Parameterization" on page 1194* *Chapter 1.8.6.1.9 "Parameterization" on page 1194* :

Current	4 mA ... 20 mA	1 channel used

The function of the LEDs is described under Diagnosis and displays / Displays *Chapter 1.8.6.1.11 "State LEDs" on page 1204*.

CAUTION!

Risk of overloading the analog input!

If an analog current sensor supplies more than 25 mA for more than 1 second during initialization, this input is switched off by the module (input protection).

Use only sensors with fast initialization or without current peaks higher than 25 mA. If not possible, connect a 10-volt Zener diode in parallel to AIx+ and ZP.

Unused input channels can be left open-circuited, because they are of low resistance.

To avoid error messages through unused analog input channels in measuring range 4 mA ... 20 mA, these channels should be configured as "Not used".

Connection of active-type analog sensors (Voltage) to differential analog inputs

Differential inputs are very useful, if analog sensors are used which are remotely non-isolated (e.g. the minus terminal is remotely grounded).

The evaluation using differential inputs helps to considerably increase the measuring accuracy and to avoid ground loops.

With differential input configurations, two adjacent analog channels belong together (e.g. the channels 0 and 1). In this case, both channels are configured according to the desired operating mode. The lower address must be the even address (channel 0), the next higher address must be the odd address (channel 1). The converted analog value is available at the higher address (channel 1).

The analog value is calculated by subtraction of the input value with the higher address from the input value of the lower address.

The converted analog value is available at the odd channel (higher address).

CAUTION!
Risk of faulty measurements!
The negative pole at the sensors must not have too big a potential difference with respect to ZP (max. ±1 V).

Make sure that the potential difference never exceeds ±1 V.

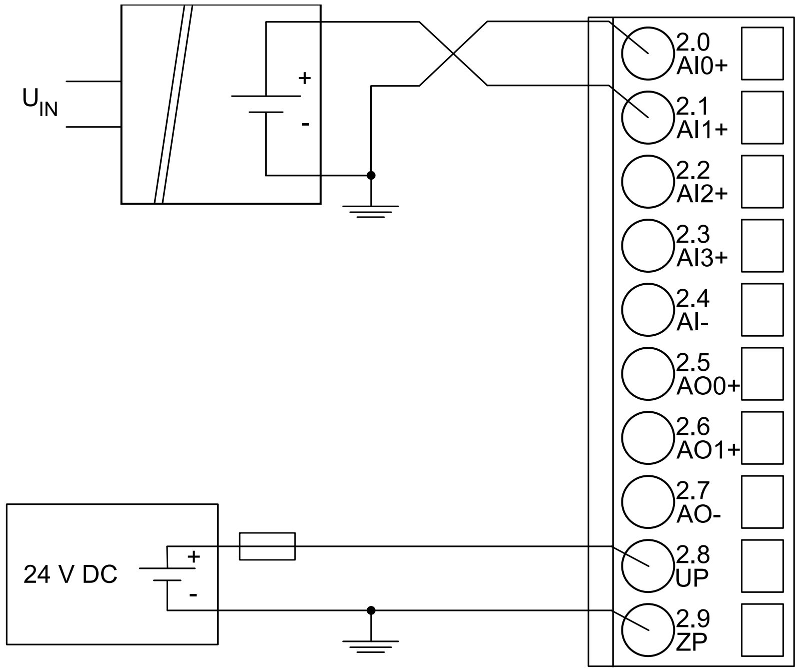


Fig. 313: Connection of active-type analog sensors (voltage) to differential analog inputs AI0 and AI1 (Proceed with AI2 and AI3 in the same way)

The following measuring ranges can be configured ↻ *Chapter 1.8.6.1.9 “Parameterization” on page 1194* ↻ *Chapter 1.8.6.1.12 “Measuring ranges” on page 1205*:

Voltage	0 V ... 10 V	with differential inputs, 2 channels used
Voltage	-10 V ... +10 V	with differential inputs, 2 channels used

The function of the LEDs is described under Diagnosis and displays / Displays ↻ *Chapter 1.8.6.1.11 “State LEDs” on page 1204*.

To avoid error messages from unused analog input channels, configure them as "unused".

Use of analog inputs as digital inputs

Several (or all) analog inputs can be configured as digital inputs. The inputs are not galvanically isolated against the other analog channels.

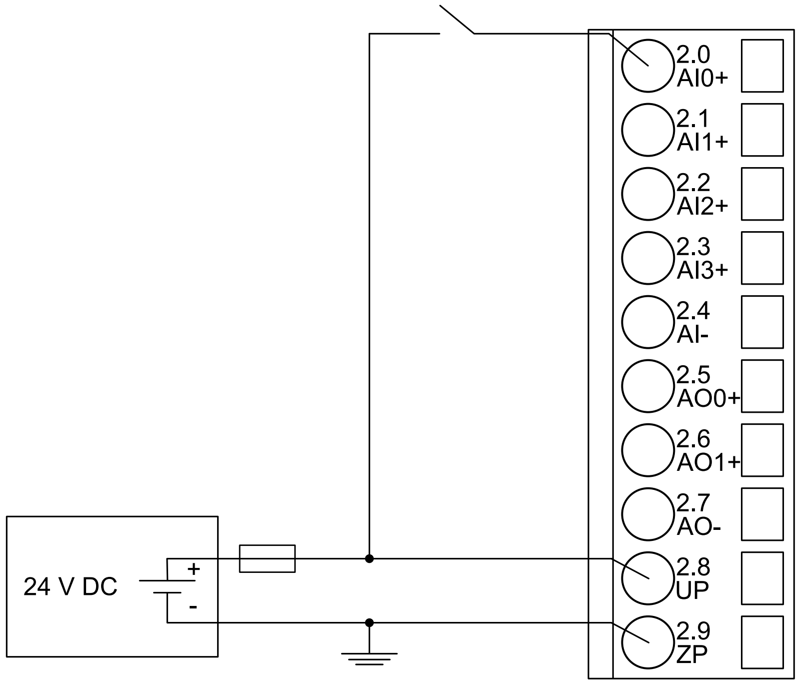


Fig. 314: Connection of digital sensors to the analog input AI0 (Proceed with the analog inputs AI1 ... AI3 in the same way)

The following measuring ranges can be configured ↪ *Chapter 1.8.6.1.9 "Parameterization" on page 1194* ↪ *Chapter 1.8.6.1.12 "Measuring ranges" on page 1205*:

Digital input	24 V	1 channel used

The function of the LEDs is described under Diagnosis and displays / Displays ↪ *Chapter 1.8.6.1.11 "State LEDs" on page 1204*.

Connection of analog output loads (Voltage)

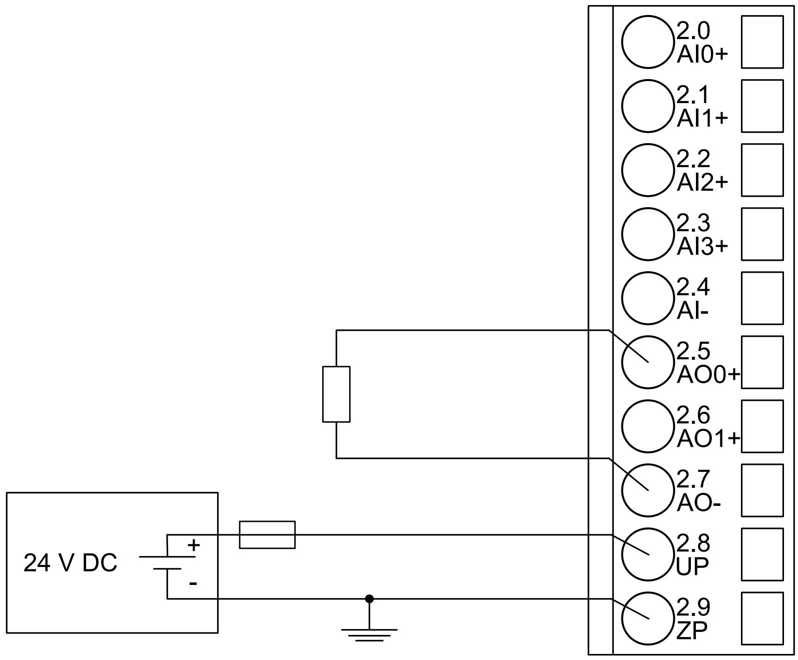


Fig. 315: Connection of analog output loads (voltage) to the analog output AO0 (Proceed with the analog output AO1 in the same way)

The following measuring ranges can be configured ↳ *Chapter 1.8.6.1.9 “Parameterization” on page 1194* ↳ *Chapter 1.8.6.1.12 “Measuring ranges” on page 1205*:

Voltage	-10 V ... +10 V	Load ± 10 mA max.	1 channel used

The function of the LEDs is described under Diagnosis and displays / Displays ↳ *Chapter 1.8.6.1.11 “State LEDs” on page 1204*.

Unused analog outputs can be left open-circuited.

Connection of analog output loads (Current)

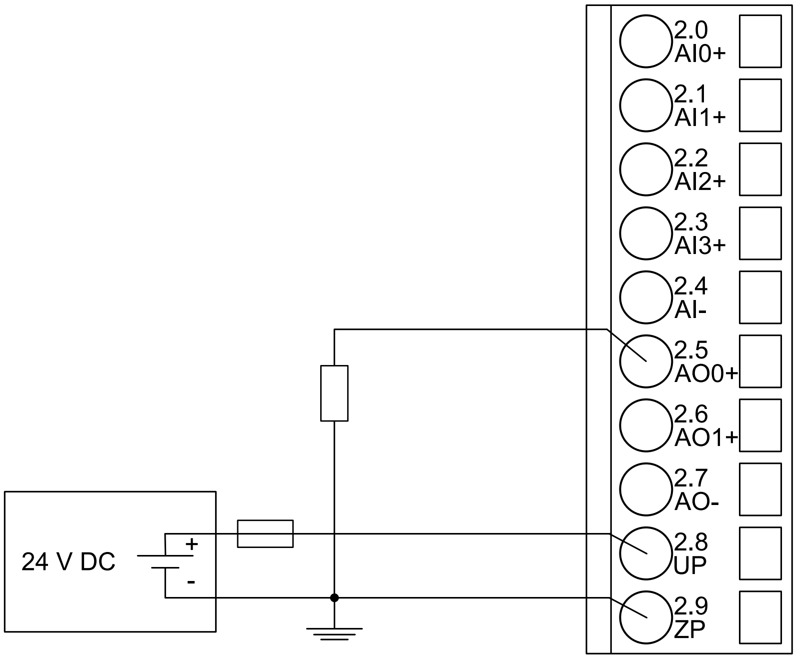


Fig. 316: Connection of analog output loads (current) to the analog output AO0 (Proceed with the analog output AO1 in the same way)

The following measuring ranges can be configured ↳ *Chapter 1.8.6.1.9 “Parameterization” on page 1194* ↳ *Chapter 1.8.6.1.12 “Measuring ranges” on page 1205*:

Current	0 mA ... 20 mA	Load 0 Ω ... 500 Ω	1 channel used
Current	4 mA ... 20 mA	Load 0 Ω ... 500 Ω	1 channel used

The function of the LEDs is described under Diagnosis and displays / Displays ↳ *Chapter 1.8.6.1.10 “Diagnosis” on page 1199*.

Unused analog outputs can be left open-circuited.

1.8.6.1.6 Internal data exchange

Parameter	Value
Digital inputs (bytes)	3
Digital outputs (bytes)	3
Analog inputs (words)	4
Analog outputs (words)	2

Parameter	Value
Counter input data (words)	4
Counter output data (words)	8

1.8.6.1.7 Addressing

> *The module reads the position of the rotary switches only during power-up, i.e. changes of the switch position during operation will have no effect until the next module initialization.*

1.8.6.1.8 I/O configuration

The CI541-DP PROFIBUS DP bus configuration is handled by PROFIBUS DP master with the exception of the slave bus ID (via rotary switches) and the transmission rate (automatic detection).

The analog/digital I/O channels and the fast counter are configured via software.

Details about configuration are described in Parameterization *Chapter 1.8.6.1.9 “Parameterization” on page 1194*.

1.8.6.1.9 Parameterization

Parameters of the module

Table 297: Parameters of the module:

Name	Value	Internal value	Internal value, type	Default
Module ID [1])	Internal	0x1C20	WORD	0x1C20
Parameter length	Internal	47	BYTE	47
Reserved (1 byte)	0	0	BYTE	0
Error LED / Failsafe function (see *Table 298 “Settings "Error LED / Failsafe function"” on page 1195*)	On	0	BYTE	0
	Off by E4	1		
	Off by E3	2		
	On + failsafe	16		
	Off by E4 + failsafe	17		
	Off by E3 + failsafe	18		
Reserved (20 bytes)	0	0	BYTE	0
Check supply (UP and UP3)	On	0	BYTE	
	Off	1		1
Fast counter	0	0	BYTE	0
	:	:		

Name	Value	Internal value	Internal value, type	Default
	10 [2])	10		
[1]) With a faulty ID, the Modules reports a "parameter error" and does not perform cyclic process data transmission [2]) Counter operating modes, see description of the fast counter *Chapter 1.6.1.2.10 "Fast counter" on page 545*.				

Table 298: Settings "Error LED / Failsafe function"

Setting	Description
On	Error LED (S-ERR) lights up at errors of all error classes, Failsafe mode off
Off by E4	Error LED (S-ERR) lights up at errors of error classes E1, E2 and E3, Failsafe mode off
Off by E3	Error LED (S-ERR) lights up at errors of error classes E1 and E2, Failsafe mode off
On +Failsafe	Error LED (S-ERR) lights up at errors of all error classes, Failsafe mode on *)
Off by E4 + Failsafe	Error LED (S-ERR) lights up at errors of error classes E1, E2 and E3, Failsafe mode on *)
Off by E3 + Failsafe	Error LED (S-ERR) lights up at errors of error classes E1 and E2, Failsafe mode on *)
*) The parameters Behaviour analog outputs at communication error and Behaviour digital outputs at communication error are only evaluated if failsafe function is enabled.	

Group parameters for the analog part

Name	Value	Internal value	Internal value, type	Default
Analog data format	Standard Reserved	0 255	BYTE	0
Behaviour analog outputs at communication error *)	Off Last value Last value 5 s Last value 10 s Substitute value Substitute value 5 s Substitute value 10 s	0 1 6 11 2 7 12	BYTE	0
*) The parameter Behaviour analog outputs at communication error is only analyzed if the Failsafe mode is ON.				

Channel parameters for the analog inputs (4x)

General

Name	Value	Internal value	Internal value, type	Default
Input 0, Channel configuration	Operation modes of analog inputs ⇨ *Table 299 “Operation modes of analog inputs:” on page 1196*	Operation modes of analog inputs ⇨ *Table 299 “Operation modes of analog inputs:” on page 1196*	BYTE	0
Input 0, Check channel	Settings channel monitoring ⇨ *Further information on page 1197*	Settings channel monitoring ⇨ *Further information on page 1197*	BYTE	0
:	:	:	:	:
:	:	:	:	:
Input 3, Channel configuration	Operation modes of analog inputs ⇨ *Table 299 “Operation modes of analog inputs:” on page 1196*	Operation modes of analog inputs ⇨ *Table 299 “Operation modes of analog inputs:” on page 1196*	BYTE	0
Input 3, Check channel	Settings channel monitoring ⇨ *Further information on page 1197*	Settings channel monitoring ⇨ *Further information on page 1197*	BYTE	0

Channel configuration

Table 299: Operation modes of analog inputs:

Internal value	Operating modes of the analog inputs, individually configurable
0 (default)	Not used
1	0 ... 10 V
2	Digital input
3	0 mA ... 20 mA
4	4 mA ... 20 mA
5	-10 V ... +10 V
8	2-wire Pt100 -50 °C ... +400 °C
9	3-wire Pt100 -50 °C ... +400 °C *)
10	0 V ... 10 V (voltage diff.) *)
11	-10 V ... +10 V (voltage diff.) *)
14	2-wire Pt100 -50 °C ... +70 °C
15	3-wire Pt100 -50 °C ... +70 °C *)
16	2-wire Pt1000 -50 °C ... +400 °C
17	3-wire Pt1000 -50 °C ... +400 °C *)
18	2-wire Ni1000 -50 °C ... +150 °C

19	3-wire Ni1000 -50 °C ... +150 °C *)
*) In the operating modes with 3-wire configuration or with differential inputs, two adjacent analog inputs belong together (e.g. the channels 0 and 1). In these cases, both channels are configured in the desired operating mode. The lower address must be the even address (channel 0). The next higher address must be the odd address (channel 1). The converted analog value is available at the higher address (channel 1).	

Channel monitoring

Table 300: Table settings channel monitoring:

Internal Value	Check Channel
0 (default)	Plausib(ility), cut wire, short circuit
3	Not used

Channel parameters for the analog outputs (2x)

Name	Value	Internal value	Internal value, type	Default
Output 0, Channel configu-ration	Operation modes of analog outputs *Table 301 "Table operation modes of analog outputs:" on page 1198*	Operation modes of analog outputs *Table 301 "Table operation modes of analog outputs:" on page 1198*	BYTE	0
Output 0, Check channel	Channel moni-toring *Table 302 "Table channel monitoring:" on page 1198*	Channel moni-toring *Table 302 "Table channel monitoring:" on page 1198*	BYTE	0
Output 0, Substi-tute value	Substitute value *Table 303 "Table substitute value:" on page 1198*	Substitute value *Table 303 "Table substitute value:" on page 1198*	WORD	0
Output 1, Channel configu-ration	Operation modes of analog outputs *Table 301 "Table operation modes of analog outputs:" on page 1198*	Operation modes of analog outputs *Table 301 "Table operation modes of analog outputs:" on page 1198*	BYTE	0
Output 1, Check channel	Channel moni-toring *Table 302 "Table channel monitoring:" on page 1198*	Channel moni-toring *Table 302 "Table channel monitoring:" on page 1198*	BYTE	0
Output 1, Substi-tute value	Substitute value *Table 303 "Table substitute value:" on page 1198*	Substitute value *Table 303 "Table substitute value:" on page 1198*	WORD	0

Channel configuration

Table 301: Table operation modes of analog outputs:

Internal value	Operating modes of the analog outputs, individually configurable
0 (default)	Not used
128	-10 V ... +10 V
129	0 mA ... 20 mA
130	4 mA ... 20 mA

Channel monitoring

Table 302: Table channel monitoring:

Internal value	Check channel
0	Plausib(ility), cut wire, short circuit
3	None

Substitute value

Table 303: Table substitute value:

Intended behavior of output channel when the control system stops	Required setting of the module parameter "Behaviour of outputs in case of a communication error"	Required setting of the channel parameter "Substitute value"
Output OFF	Off	0
Last value infinite	Last value	0
Last value for 5 s and then turn off	Last value 5 sec	0
Last value for 10 s and then turn off	Last value 10 sec	0
Substitute value infinite	Substitute value	depending on configuration
Substitute value for 5 s and then turn off	Substitute value 5 sec	depending on configuration
Substitute value for 10 s and then turn off	Substitute value 10 sec	depending on configuration

Group parameters for the digital part

Name	Value	Internal value	Internal value, type	Default
Input delay	0.1 ms 1 ms 8 ms 32 ms	0 1 2 3	BYTE	0.1 ms 0x00
Detect short circuit at outputs	Off On	0 1	BYTE	On 0x01

Name	Value	Internal value	Internal value, type	Default
Behaviour digital outputs at com-muncation error [1])	Off Last value Last value 5 sec Last value 10 sec Substitute value Substitute value 5 sec Substitute value 10 sec	0 1 6 11 2 7 12	BYTE	Off 0x00
Substitute value at output	0 ... 255	00h ... FFh	BYTE	0 0x00
Detect voltage overflow at out-puts [2])	Off On	0 1	BYTE	Off 0x00
[1]) The parameters Behaviour digital outputs at communcation error is only analyzed if the Failsafe-mode is ON. [2]) The state "externally voltage detected" appears, if the output of a channel DC0 ... DC7 should be switched on while an externally voltage is connected *Chapter 1.8.6.1.5 “Connec-tions” on page 1178*. In this case the start up is disabled, as long as the externally voltage is connected. The monitoring of this state and the resulting diagnosis message can be disabled by setting the parameters to "OFF".				

1.8.6.1.10 Diagnosis

Structure of the diagnosis block via DPM_SLV_DIAG function block.

Byte Number	Description	Possible Values
1	Data length (header included)	7
2	PROFIBUS DP V1 coding: Vendor specific	129
3	Diagnosis Byte, slot number	31 = CI541-DP (e. g. error at integrated 8 DI / 8 DO) 1 = 1st connected S500 I/O Module ... 10 = 10th connected S500 I/O Module
4	Diagnosis Byte, module number	According to the I/O bus specification passed on by modules to the fieldbus master
5	Diagnosis Byte, channel	According to the I/O bus specification passed on by modules to the fieldbus master

Byte Number	Description	Possible Values
6	Diagnosis Byte, error code	According to the I/O bus specification Bit 7 and bit 6, coded error class 0 = E1 1 = E2 2 = E3 3 = E4 Bit 0 to bit 5, coded error description
7	Diagnosis Byte, flags	According to the I/O bus specification Bit 7: 1 = coming error Bit 6: 1 = leaving error

In cases of short circuit or overload, the digital outputs are turned off. The modules performs reactivation automatically. Thus an acknowledgement of the errors is not necessary. The error message is stored via the LED.

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier** **000 ... 063**	**AC500-Display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 6 **Bit 6 ... 7**	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6** **Bit 0 ... 5**	**PROFIBUS DP diag-nosis block**	
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error-** **Identi-fier**	**Error message**	**Remedy**
	1)	**2)**	**3)**				
Module errors							
3	-	31	31	31	19	Checksum error in the I/O module	Replace I/O module
3	-	31	31	31	3	Timeout in the I/O module	
3	-	31	31	31	40	Different hard-/firm-ware versions in the module	
3	-	31	31	31	43	Internal error in the module	
3	-	31	31	31	36	Internal data exchange failure	
3	-	31	31	31	9	Overflow diagnosis buffer	Restart
3	-	31	31	31	26	Parameter error	Check master

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier 000 ... 063**	**AC500-Display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 6 Bit 6 ... 7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0 ... 5**	**PROFIBUS DP diag-nosis block**	
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error-Identi-fier**	**Error message**	**Remedy**
	[1])	[2])	[3])				
3	-	31	31	31	11	Process voltage UP too low	Check process supply voltage
3	-	31	31	31	45	Process voltage UP gone	Check process supply voltage
3	-	31/1...10	31	31	17	No communication with I/O device	Replace I/O module
3	-	1...10	31	31	32	Wrong I/O module type on socket	Replace I/O module / Check configu-ration
4	-	1...10	31	31	31	At least one module does not support failsafe function	Check modules and parame-terization
4	-	1...10	31	5	8	I/O module removed from hot swap terminal unit or defective module on hot swap ter-minal unit [9])	Plug I/O module, replace I/O module
4	-	1...10	31	5	28	Wrong I/O module plugged on hot swap terminal unit [9])	Remove wrong I/O module and plug pro-jected I/O module
4	-	1...10	31	5	42	No communication with I/O module on hot swap terminal unit [9])	Replace I/O module

E1 ... E4	d1	d2	d3	d4	Identi-fier 000 ... 063	AC500-Display	<− Display in
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 6 **Bit 6 ... 7**	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6** **Bit 0 ... 5**	**PROFIBUS DP diag-nosis block**	
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error-** **Identi-fier**	**Error message**	**Remedy**
	1)	**2)**	**3)**				
4	-	1...10	31	5	54	I/O module does not support hot swap 8) 9)	Power off system and replace I/O module
4	-	1...10	31	6	8	Hot swap terminal unit configured but not found	Replace terminal unit by hot swap terminal unit
4	-	1...10	31	6	42	No communication with hot swap ter-minal unit 9)	Restart, if error persists replace terminal unit
4	-	31	31	31	46	Reverse voltage from digital outputs DO0...DO7 to UP3 4)	Check connec-tion
4	-	31/1...10	31	31	34	No response during initialization of the I/O module	Replace I/O module
4	-	31	31	31	11	Process voltage UP3 too low	Check process supply voltage
4	-	31	31	31	45	Process voltage UP3 gone	Check process supply voltage
4	-	31	31	31	10	Voltage overflow on outputs (above UP3 level) 5)	Check termi-nals/ check process supply voltage

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier 000 ... 063**	**AC500-Display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 6 Bit 6 ... 7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0 ... 5**	**PROFIBUS DP diag-nosis block**	
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error-Identi-fier**	**Error message**	**Remedy**
	[1])	**[2])**	**[3])**				
Channel error digital							
4	-	31	2	0...7	46	Externally voltage detected on digital output DO0...DO7 [6])	Check terminals
4	-	31	2	0...7	47	Short circuit at digital output [7])	Check terminals
Channel error analog							
4	-	31	1	0...3	48	Analog value overflow or broken wire at an analog input	Check value or check terminals
4	-	31	1	0...3	7	Analog value underflow at an analog input	Check value
4	-	31	1	0...3	47	Short-circuit at an analog input	Check terminals
4	-	31	3	0...1	4	Analog value overflow at an analog output	Check output value
4	-	31	3	0...1	7	Analog value underflow at an analog output	Check output value

Remarks:

[1])	In AC500 the following interface identifier applies: "-" = Diagnosis via bus-specific function blocks; 0...4 or 10 = Position of the Communication Module; 14 = I/O bus; 31 = Module itself The identifier is not contained in the CI541-DP diagnosis block.
[2])	With "Device" the following allocation applies: 31 = Module itself; 1...10 = Expansion module
[3])	With "Module" the following allocation applies: 31 = Module itself Channel error: Module type (1 = AI, 2 = DO, 3 = AO)

4)	This message appears, if externally voltages at one or more terminals DO0...DO7 cause that other digital outputs are supplied through that voltage (voltage feedback, see description in section 'Connection' *Chapter 1.8.6.1.5 “Connections” on page 1178*). All outputs of the apply digital output groups will be turned off for 5 seconds. The diagnosis message appears for the whole output group.
5)	The voltage on digital outputs DO0 ... DO7 has overrun the process supply voltage UP3 (see description in section 'Connection' *Chapter 1.8.6.1.5 “Connections” on page 1178*). Diagnosis message appears for the whole module.
6)	This message appears, if the output of a channel DO0 ... DO7 should be switched on while an externally voltage is connected. In this case the start up is disabled, as long as the externally voltage is connected. Otherwise this could produce reverse voltage from this output to other digital outputs. This diagnosis message appears per channel.
7)	Short circuit: After a detected short circuit, the output is deactivated for 100ms. Then a new start up will be executed. This diagnosis message appears per channel.
8)	In case of an I/O module doesn’t support hot swapping, do not perform any hot swap operations (also not on any other terminal units (slots)) as modules may be damaged or I/O bus communication may be disturbed.
9)	Diagnosis for hot swap available as of version index F0.

1.8.6.1.11 State LEDs

The LEDs are located at the front of module. There are 2 different groups:

- The 5 system LEDs (PWR, STA1-DP, STA2-DP, S-ERR and I/O-Bus) show the operation state of the module and display possible errors.
- The 27 process LEDs (UP, UP3, inputs, outputs, CH-ERR1 to CH-ERR3) show the process supply voltage and the states of the inputs and outputs and display possible errors.

Table 304: States of the 5 system LEDs:

LED	Color	OFF	ON	Flashing
PWR/RUN	Green	Process supply voltage missing	Internal supply voltage OK, module ready for communication with I/O Controller	Start-up / preparing communication
	Yellow	---	---	---
STA1-DP	Green	---	PROFIBUS running	Invalid device parameters
STA2-DP	Red	No error	Bus timeout	No communication to master
S-ERR	Red	No error	Internal error	--
I/O-Bus	Green	No communication interface modules connected or communication error	Communication interface modules connected and operational	---

Table 305: States of the 27 process LEDs:

LED	Color	OFF	ON	Flashing
AI0 to AI3	Yellow	Input is OFF	Input is ON (brightness depends on the value of the analog signal)	--
AO0 to AO1	Yellow	Output is OFF	Output is ON (brightness depends on the value of the analog signal)	--
DI0 to DI7	Yellow	Input is OFF	Input is ON (the input voltage is even displayed if the supply voltage is OFF)	--
DO0 toDO7	Yellow	Output is OFF	Output is ON	--
UP	Green	Process supply voltage missing	Process supply voltage OK and initialization fin-ished	--
UP3	Green	Process supply voltage missing	Process supply voltage OK	--
CH-ERR1 to CH-ERR3	Red	No error or process supply voltage missing	Internal error	Error on one channel of the corresponding group

1.8.6.1.12 Measuring ranges

Input ranges voltage, current and digital input

Range	0 V ... +10 V	-10 V ... +10 V	0 mA ... 20 mA	4 mA ... 20 mA	Digital input	Digital value	
						Decimal	**Hex.**
Overflow	> 11.7589	> 11.7589	> 23.5178	> 22.8142		32767	7FFF
Measured value too high	11.7589 : 10.0004	11.7589 : 10.0004	23.5178 : 20.0007	22.8142 : 20.0006		32511 : 27649	7EFF : 6C01
Normal range	10.0000 : 0.0004	10.0000 : 0.0004	20.0000 : 0.0007	20.0000 : 4.0006	: : On	27648 : 1	6C00 : 0001
Normal range or measured value too low	0.0000	0.0000	0	4	Off	0	0000
	-0.0004 -1.7593	-0.0004 : : -10,0000		3.9994 1.1858		-1 -4864 : -27648	FFFF ED00 : 9400

Range	0 V ... +10 V	-10 V ... +10 V	0 mA ... 20 mA	4 mA ... 20 mA	Digital input	Digital value	
						Decimal	Hex.
Measured value too low		-10.0004 : -11.7589				-27649 : -32512	93FF : 8100
Underflow	< 1.7593	< -11.7589	< 0.0000	< 1.1858		-32768	8000

The represented resolution corresponds to 16 bits.

Input ranges resistance temperature detector

Range	Pt100 / Pt1000 -50 ... +70 °C	Pt100 / Pt1000 -50 ... +400 °C	Ni1000 -50 ... +150 °C
Overflow	> +80.0 °C	> +450.0 °C	> +160.0 °C
Measured value too high		+450.0 °C : + 400.1 °C	
			+160.0 °C : +150.1 °C
Normal range		+400.0 °C : : : + 0.1 °C	+150.0 °C : : +0.1 °C
		0.0 °C	0.0 °C
		-0.1 °C : -50.0 °C	-0.1 °C : -50.0 °C
Measured value too low		-50.1 °C : -60.0 °C	-50.1 °C : -60.0 °C
Underflow	< -60.0 °C	< -60.0 °C	< -60.0 °C

Range	Digital value	
	Decimal	Hex.
Overflow	32767	7FFF
Measured value too high	4500 : 4001	1194 : 0FA1

Range	Digital value	
	Decimal	**Hex.**
	1600 : 1501	0640 : 05DD
	800 : 701	0320 : 02BD
Normal range	4000 1500 700 : 1	0FA0 05DC 02BC : 0001
	0	0000
	-1 : -500	FFFF : FE0C
Measured value too low	-501 : -600	FE0B : FDA8
Underflow	-32768	8000

Output ranges voltage and current

Range	-10...+10 V	0...20 mA	4...20 mA
Overflow	>11.7589 V	>23.5178 mA	>22.8142 mA
Measured value too high	11.7589 V : 10.0004 V	23.5178 mA : 20.0007 mA	22.8142 mA : 20.0006 mA
Normal range	10.0000 V : 0.0004 V	20.0000 mA : 0.0007 mA	20.0000 mA : 4.0006 mA
	0.0000 V	0.0000 mA	4.0000 mA
	-0.0004 V : -10.0000 V	0 mA : 0 mA	3.9994 mA 0 mA 0 mA
Measured value too low	-10.0004 V : -11.7589 V	0 mA : 0 mA	0 mA : 0 mA
Underflow	0 V	0 mA	0 mA

Range	Digital value	
	Decimal	**Hex.**
Overflow	> 32511	> 7EFF
Measured value too high	32511 : 27649	7EFF : 6C01
Normal range	27648 : 1	6C00 : 0001
	0	0000
	-1 -6912 -27648	FFFF E500 9400
Measured value too low	-27649 : -32512	93FF : 8100
Underflow	< -32512	< 8100

The represented resolution corresponds to 16 bits.

1.8.6.1.13 Technical data

Technical data of the module

The system data of AC500 and S500 are applicable to the standard version ➨ *Chapter 2.6.1 “System data AC500” on page 1408*.

The system data of AC500-XC are applicable to the XC version ➨ *Chapter 2.7.1 “System data AC500-XC” on page 1475*.

Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

Parameter		Value
Process supply voltages UP/UP3		
	Rated value	24 V DC (for inputs and outputs)
	Max. load for the terminals	10 A
	Protection against reversed voltage	Yes
	Rated protection fuse on UP/UP3	10 A fast
	Galvanic isolation	PROFIBUS interface against the rest of the module
	Inrush current from UP (at power up)	On request
	Current consumption via UP (normal operation)	0.2 A
	Current consumption via UP3	0.06 A + 0.5 A max. per output

Parameter		Value
	Connections	Terminals 2.8 and 3.8 for +24 V (UP) Terminal 4.8 for +24 V (UP3) Terminals 2.9, 3.9 and 4.9 for 0 V (ZP)
Max. power dissipation within the module		6 W
Configurable digital inputs/outputs		8
Number of digital inputs		8
Number of digital outputs		8
Reference potential for all digital inputs and outputs		Negative pole of the supply voltage, signal name ZP
Setting of the PROFIBUS DP identifier		With 2 rotary switches at the front side of the module
Diagnose		See Diagnosis *Chapter 1.8.6.1.10 “Diagnosis” on page 1199*
Operation and error displays		32 LEDs (totally)
Weight (without terminal unit)		Ca. 125 g
Mounting position		Horizontal Or vertical with derating (output load reduced to 50 % at +40 °C per group)
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

NOTICE!
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and temporary overvoltage up to 30 V DC.

Multiple overloads
No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an internal smart high-side switch.

Technical data of the digital inputs

Parameter	Value
Number of channels per module	8
Distribution of the channels into groups	1 group of 8 channels
Terminals of the channels DI0 ... DI7	Terminals 3.0 ... 3.7
Reference potential for all inputs	Terminals 2.9 ... 4.9 (negative pole of the supply voltage, signal name ZP)
Indication of the input signals	1 yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Input type (according EN 61131-2)	Type 1
Input delay (0->1 or 1->0)	Typ. 0.1 ms, configurable from 0.1 ms ... 32 ms

Parameter		Value
Input signal voltage		24 V DC
	0-Signal	-3 V ... +5 V
	Undefined Signal	> +5 V ... < +15 V
	1-Signal	+15 V ... +30 V
Ripple with signal 0		Within -3 V ... +5 V
Ripple with signal 1		Within +15 V ... +30 V
Input current per channel		
	Input voltage +24 V	Typ. 5 mA
	Input voltage +5 V	> 1 mA
	Input voltage +15 V	> 2 mA
	Input voltage +30 V	< 8 mA
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

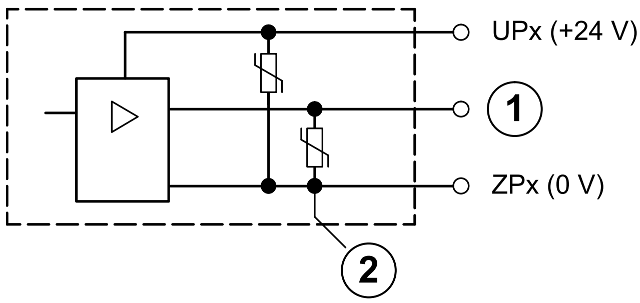
Technical data of the digital outputs

Parameter		Value
Number of channels per module		8
Distribution of the channels into groups		1 group of 8 channels
Terminals of the channels DO0 ... DO7		Terminals 4.0 ... 4.7
Reference potential for all outputs		Terminals 2.9 ... 4.9 (negative pole of the supply voltage, signal name ZP)
Common power supply voltage		For all outputs terminal 4.8 (positive pole of the supply voltage, signal name UP3)
Output voltage for signal 1		UP3 (-0.8 V)
Output delay (0->1 or 1->0)		On request
Output current		
	Rated value per channel	500 mA at UP3 = 24 V
	Max. value (all channels together)	4 A
Leakage current with signal 0		< 0.5 mA
	Fuse for UP3	10 A fast
Demagnetization with inductive DC load		Via internal varistors (see figure below this table)
Output switching frequency		
	With resistive load	On request
	With inductive loads	Max. 0.5 Hz
	With lamp loads	11 Hz max. at 5 W max.
Short-circuit-proof / overload-proof		Yes
Overload message (I > 0.7 A)		Yes, after ca. 100 ms

Parameter		Value
Output current limitation		Yes, automatic reactivation after short circuit/overload
Resistance to feedback against 24 V signals		Yes (software-controlled supervision)
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

The module provides several diagnosis functions ↳ *Chapter 1.8.6.1.10 "Diagnosis" on page 1199*.

The following drawing shows the circuitry of a digital input/output with the varistors for demagnetization when inductive loads are switched off.



1 Digital output
2 Varistors for demagnetization when inductive loads are turned off

Technical data of the analog inputs

Parameter		Value
Number of channels per module		4
Distribution of channels into groups		1 group with 4 channels
Connection if channels AI0+ ... AI3+		Terminals 2.0 ... 2.3
Reference potential for AI0+ ... AI3+		Terminal 2.4 (AI-) for voltage and RTD measurement Terminal 2.9, 3.9 and 4.9 for current measurement
Input type		
	Unipolar	Voltage 0 V ... 10 V, current or Pt100/Pt1000/Ni1000
	Bipolar	Voltage -10 V ... +10 V
Galvanic isolation		Against PROFIBUS
Configurability		0 V ... 10 V, -10 V ... +10 V, 0/4 mA ... 20 mA, Pt100/1000, Ni1000 (each input can be configured individually)
Channel input resistance		Voltage: > 100 kΩ Current: ca. 330 Ω
Time constant of the input filter		Voltage: 100 µs Current: 100 µs
Indication of the input signals		1 LED per channel (brightness depends on the value of the analog signal)

Parameter	Value
Conversion cycle	1 ms (for 4 inputs + 2 outputs); with RTDs Pt/ Ni... 1 s
Resolution	Range 0 V ... 10 V: 12 bits Range -10 V ... +10 V: 12 bits including sign Range 0 mA ... 20 mA: 12 bits Range 4 mA ... 20 mA: 12 bits Range RTD (Pt100, PT1000, Ni1000): +0.1 °C
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range	Typ. 0.5 %, max. 1 %
Relationship between input signal and hex code	Tables Input Ranges Voltage, Current and Digital Input and Input range resistance temperature detector *Chapter 1.8.6.1.12 “Measuring ranges” on page 1205*
Unused inputs	Are configured as "unused" (default value)
Overvoltage protection	Yes

Technical data of the analog inputs if used as digital inputs

Parameter		Value
Number of channels per module		Max. 4
Distribution of channels into groups		1 group of 4 channels
Connections of the channels AI0+ ... AI3+		Terminals 2.0 ... 2.3
Reference potential for the inputs		Terminals 2.9, 3.9 and 4.9 (ZP)
Indication of the input signals		1 LED per channel
Input signal voltage		24 V DC
	Signal 0	-30 V ... +5 V
	Undefined signal	+5 V ... +15 V
	Signal 1	+15 V ... +30 V
Input current per channel		
	Input voltage +24 V	Typ. 7 mA
	Input voltage +5 V	Typ. 1.4 mA
	Input voltage +15 V	Typ. 3.7 mA
	Input voltage +30 V	< 9 mA
Input resistance		Ca. 3.5 kΩ

Technical data of the analog outputs

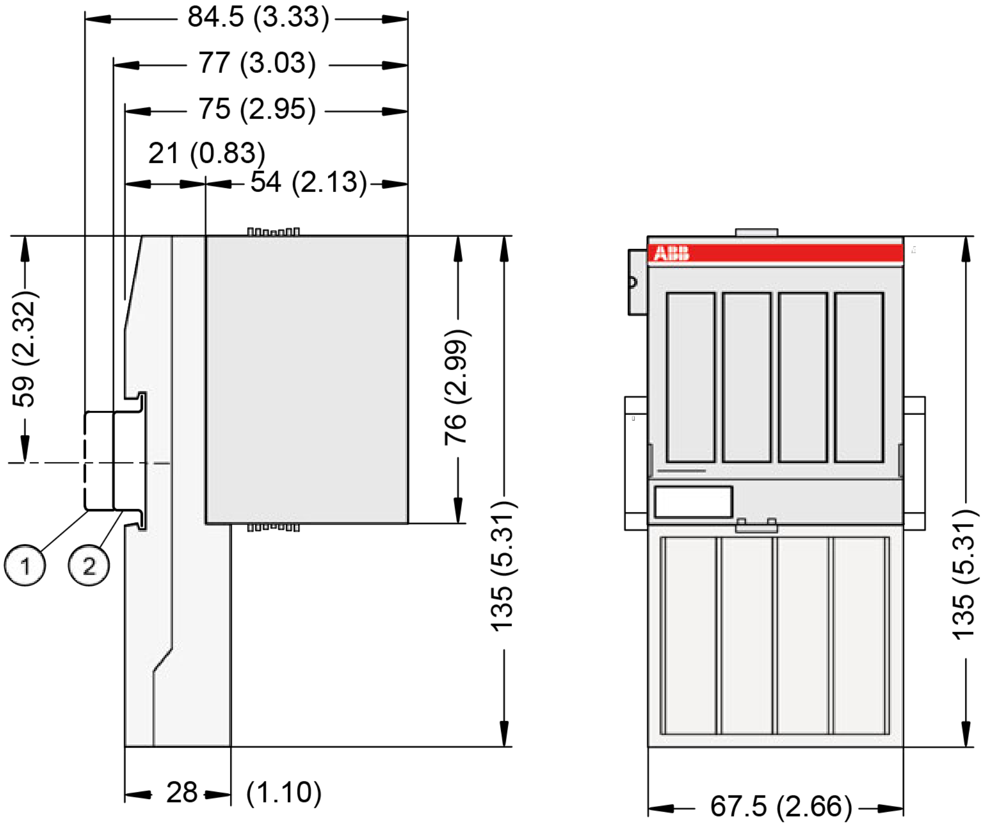
Parameter	Value
Number of channels per module	2
Distribution of channels into groups	1 group for 2 channels

Parameter		Value
Connection of the channels AO0+ ... AO1+		Terminals 2.5 ... 2.6
Reference potential for AO0+ ... AO1+		Terminal 2.7 (AO-) for voltage output Terminal 2.9, 3.9 and 4.9 for current output
Output type		
	Unipolar	Current
	Bipolar	Voltage
Galvanic isolation		Against PROFIBUS
Configurability		-10 V ... +10 V, 0 mA ... 20 mA, 4 mA ... 20 mA (each output can be configured individually)
Output resistance (load), as current output		0 Ω ... 500 Ω
Output loadability, as voltage output		± 10 mA max.
Indication of the output signals		1 LED per channel (brightness depends on the value of the analog signal)
Resolution		12 bits including sign
Settling time for full range change (resistive load, output signal within specified tolerance)		Typ. 5 ms
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range		Typ. 0.5 %, max. 1 %
Relationship between input signal and hex code		Table Output Ranges Voltage and Current ↳ *Chapter 1.8.6.1.12.3 “Output ranges voltage and current” on page 1207*
Unused outputs		Are configured as "unused" (default value) and can be left open-circuited

Technical data of the fast counter

Parameter	Value
Used inputs	Terminal 3.0 (DI0), 3.1 (DI1)
Used outputs	Terminal 4.0 (DO0)
Counting frequency	Depending on operation mode: Mode 1 - 6: max. 200 kHz Mode 7: max. 50 kHz Mode 9: max. 35 kHz Mode 10: max. 20 kHz

1.8.6.1.14 Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

1.8.6.1.15 Ordering data

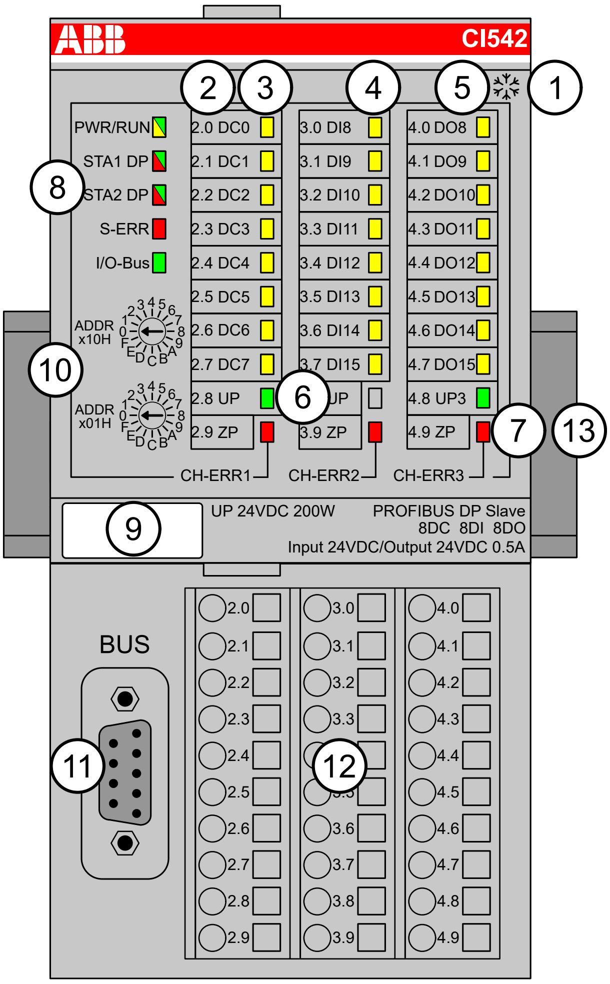
Ordering No.	Scope of delivery	Product life cycle phase *)
1SAP 224 100 R0001	CI541-DP, PROFIBUS DP communication interface module, 8 DI, 8 DO, 4 AI and 2 AO	Active
1SAP 424 100 R0001	CI541-DP-XC, PROFIBUS DP communication interface module, 8 DI, 8 DO, 4 AI and 2 AO, XC version	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

1.8.6.2 CI542-DP

1.8.6.2.1 Features

- 8 digital inputs 24 V DC
- 8 digital outputs 24 V DC, 0.5 A max.
- 8 configurable digital inputs/outputs 24 V DC, 0.5 A max.
- Module-wise galvanically isolated
- Fast counter
- XC version for usage in extreme ambient conditions available



1 I/O bus
2 Allocation between terminal number and signal name
3 8 yellow LEDs to display the signal states of the configurable digital inputs/outputs (DC0 ... DC7)
4 8 yellow LEDs to display the signal states of the digital inputs (DI8 ... DI15)
5 8 yellow LEDs to display the signal states of the digital outputs (DO8 ... DO15)
6 2 green LEDs to display the process supply voltage UP and UP3
7 3 red LEDs to display errors (CH-ERR1, CH-ERR2, CH-ERR3)
8 5 system LEDs: PWR/RUN, STA1 DP, STA2 DP, S-ERR, I/O-Bus
9 Label
10 2 rotary switches for setting the PROFIBUS ID
11 9-pin D-SUB connector to connect the PROFIBUS DP signals
12 Terminal unit
13 DIN rail
Sign for XC version

1.8.6.2.2 Intended purpose

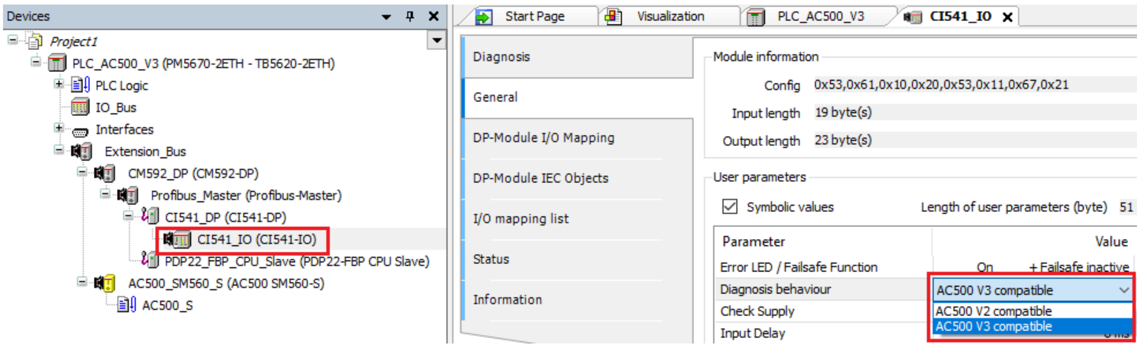
The PROFIBUS DP communication interface module is used as decentralized I/O module in PROFIBUS networks. Depending on the used terminal unit the network connection is performed either via 9-pole female D-sub or via 10 terminals (screw-type or spring terminals) which are integrated in the terminal unit.

The inputs/outputs are galvanically isolated from the PROFIBUS network. There is no potential separation between the channels. The configuration of the configurable digital inputs/outputs is performed by software.

For usage in extreme ambient conditions (e.g. wider temperature and humidity range), a special XC version of the device is available.

1.8.6.2.3 Diagnosis settings

The current CI54x does not run in combination with a V3 PLC if in the *"General"* tab the parameter *"Diagnosis behavior"* is set to *"AC500 V3 compatible"*. How to change the setting in your AB project is described below.



1. Double click in the *"Device"* tree on *"CI541_IO"*.

   ⇨ The tab for the various settings opens.

2. Double click on the *"General"* tab.
3. Double click on the *"Value"* of the parameter *"Diagnosis behavior"*.
4. Click on the small arrow.

   ⇨ A submenu with two values opens.

5. Click on *"AC500 V2 compatible"* as setting.
6. Close the tab.

After changing the parameter to *"AC500 V2 compatible"* the CI54x get in *"RUN"*.

If the CI54x indicates a S500 diagnosis message, following AC500 diagnosis entry (*"655374 CI54x communication interface module is sending not supported diagnosis format - Check configuration and FW revision of communication interface module"*) is shown in the diagnosis editor and history. This diagnosis message does not have impact to cyclic data exchange between the master and the CI54x.

In case of a parameter change from V2 to V3 the parameter at the CI54x of V3 has the same value than at the CI54x below V2 (that means AC500 V2 compatible).

1.8.6.2.4 Connections

General

> *For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.*

The PROFIBUS DP communication interface module CI542-DP is plugged on the I/O terminal units TU509 *Chapter 1.5.2 "TU509 and TU510 for communication interface modules" on page 278* or TU510 *Chapter 1.5.2 "TU509 and TU510 for communication interface modules" on page 278* and accordingly TU517 *Chapter 1.5.4 "TU517 and TU518 for communication interface modules" on page 290* or TU518 *Chapter 1.5.4 "TU517 and TU518 for communication interface modules" on page 290*. Properly seat the module and press until it locks in place. The terminal unit is mounted on a DIN rail or with 2 screws plus the additional accessory for wall mounting *Chapter 1.9.3.5 "TA526 - Wall mounting accessory" on page 1361*.

The connection of the I/O channels is carried out using the 30 terminals of the I/O terminal unit. I/O modules can be replaced without re-wiring the terminal units.

The terminals 2.8 and 3.8 as well as 2.9, 3.9 and 4.9 are electrically interconnected within the terminal unit and have always the same assignment, independent of the inserted module:

Terminals 2.8 and 3.8: Process supply voltage UP = +24 V DC

Terminal 4.8: Process supply voltage UP3 = +24 V DC

Terminals 2.9, 3.9 and 4.9: Process supply voltage ZP = 0 V

> *With a separate UP3 power supply, the digital outputs can be switched off externally. This way, an emergency-off functionality can be realized.*

> *Do not connect any voltages externally to digital outputs!*
>
> *This ist not intended usage.*
>
> *Reason: Externally voltages at one or more terminals DC0...DC7 or DO0...DO7 may cause that other digital outputs are supplied through that voltage instead of voltage UP3 (reverse voltage).*
>
> *This is also possible, if DC channels are used as inputs. For this, the source for the input signals should be the impressed UP3 of the device.*
>
> *This limitation does not apply for the input channels DI0...DI7.*

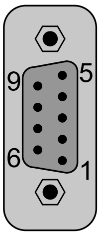
> **CAUTION!**
> **Risk of malfunction by unintended usage!**
> If the function cut-off of the digital outputs is to be used by deactivation of the supply voltage UP3, be sure that no external voltage is conncted at the outputs DO0...DO7 and DC0...DC7.

Possibilities of connection

Assignment

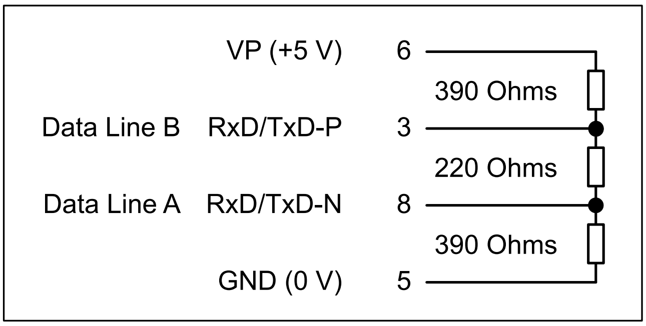
Mounting on terminal units TU509 or TU510:

The assignment of the 9-pole female D-sub for the PROFIBUS DP signals.

Serial Interface	Pin	Signal	Description
	1	---	Reserved
	2	---	Reserved
	3	B	PROFIBUS DP signal B
	4	---	Reserved
	5	DGND	Ground for 5 V power supply
	6	VP (5 V)	5 V power supply
	7	---	Reserved
	8	A	PROFIBUS DP signal A
	9	---	Reserved
	Shield	Cable shield	Functional earth

Bus termination

The line ends of the bus segment must be equipped with bus terminating resistors. Normally, these resistors are integrated in the interface connectors.



The grounding of the shield should take place at the control cabinet, see System-Data AC500 ➪ Chapter 2.6.1 "System data AC500" on page 1408.

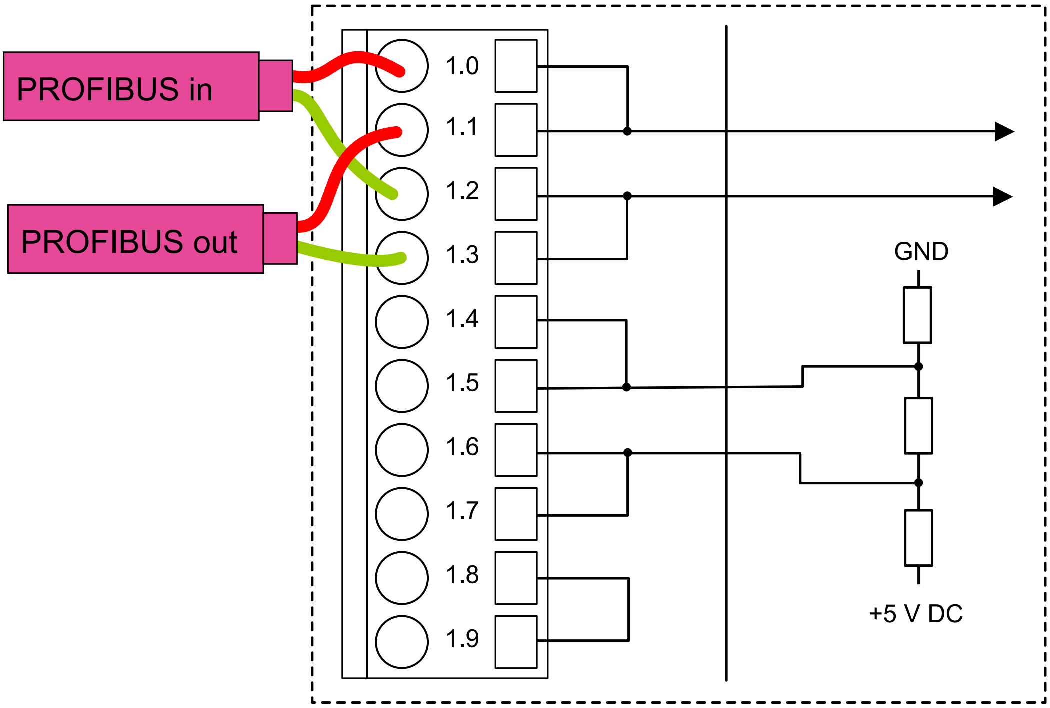
Mounting on terminal units TU517 or TU518:

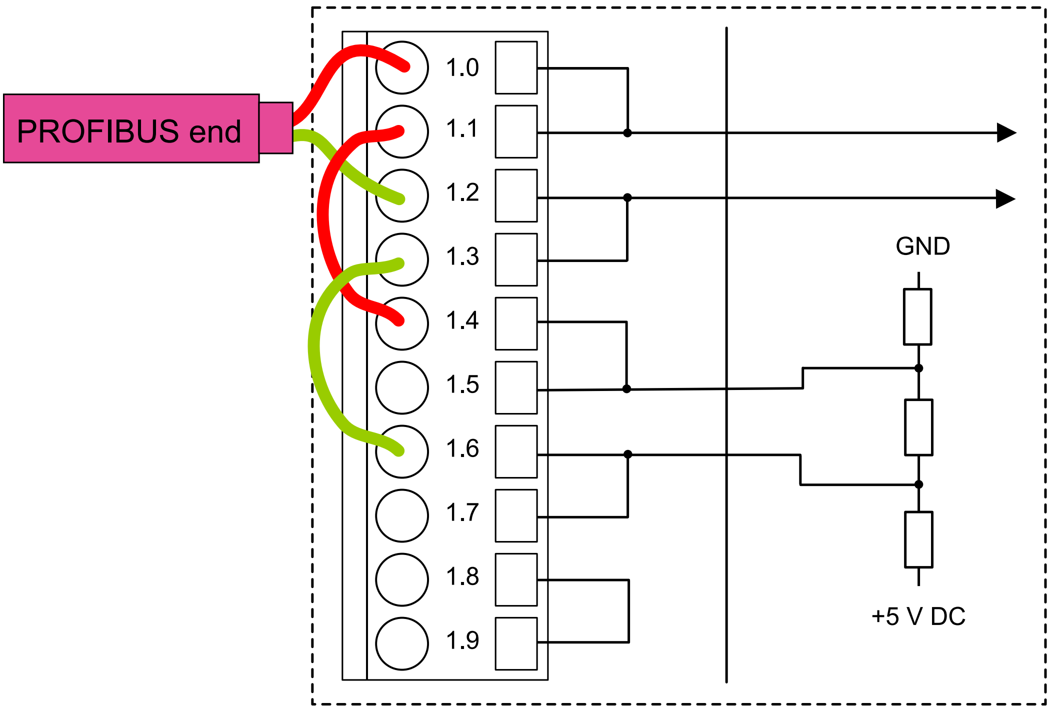
The assignment of the terminals 1.0 - 1.9:

Terminal	Signal	Description
1.0	B	Data line B (receive and send line, positive)
1.1	B	Data line B (receive and send line, positive)
1.2	A	Data line A (receive and send line, negative)
1.3	A	Data line A (receive and send line, negative)
1.4	TermB	Bus termination data line B
1.5	TermB	Bus termination data line B
1.6	TermA	Bus termination data line A

Terminal	Signal	Description
1.7	TermA	Bus termination data line A
1.8	DGND	Reference potential for data transmission
1.9	DGND	Reference potential for data transmission

At the line ends of a bus segment, terminating resistors must be connected. If using TU517/ TU518, the bus terminating resistors can be enabled by connecting the terminals TermA and TermB to the data lines A and B (no external terminating resistors are required, see figure below).





If using TU517/TU518, note that the terminating resistors are not located inside the TU, but inside the communication interface module CI541-DP. I. e. when removing the device from the TU, the bus terminating resistors are not connected to the bus any more. The bus itself will not be disconnected if a device is removed.

If using TU517/TU518 the max. permitted transmission rate is limited to 1.5 MBaud.

Technical data bus cable

Parameter	Value
Type	Twisted pair (shielded)
Characteristic impedance	135 Ω...165 Ω
Cable capacitance	< 30 pF/m
Conductor diameter of the cores	≥ 0.64 mm
Conductor cross section of the cores	≥ 0.34 mm²
Cable resistance per core	≤ 55 Ω/km
Loop resistance (resistance of two cores)	≤ 110 Ω/km

Cable length

The maximum possible cable length of a PROFIBUS subnet within a segment depends on the transmission rate (baud rate).

Transmission rate	Maximum cable length
9.6 kBaud to 93.75 kBaud	1200 m
187.5 kBaud	1000 m
500 kBaud	400 m
1.5 MBaud	200 m
3 MBaud to 12 MBaud	100 m

The assignment of the other terminals:

Terminal	Signal	Description
2.0	DC0	Signal of the configurable digital input/output DC0
2.1	DC1	Signal of the configurable digital input/output DC1
2.2	DC2	Signal of the configurable digital input/output DC2
2.3	DC3	Signal of the configurable digital input/output DC3
2.4	DC4	Signal of the configurable digital input/output DC4
2.5	DC5	Signal of the configurable digital input/output DC5
2.6	DC6	Signal of the configurable digital input/output DC6
2.7	DC7	Signal of the configurable digital input/output DC7

Terminal	Signal	Description
2.8	UP	Process voltage UP (24 V DC)
2.9	ZP	Process voltage ZP (0 V DC)
3.0	DI8	Signal of the digital input DI8
3.1	DI9	Signal of the digital input DI9
3.2	DI10	Signal of the digital input DI10
3.3	DI11	Signal of the digital input DI11
3.4	DI12	Signal of the digital input DI12
3.5	DI13	Signal of the digital input DI13
3.6	DI14	Signal of the digital input DI14
3.7	DI15	Signal of the digital input DI15
3.8	UP	Process voltage UP (24 V DC)
3.9	ZP	Process voltage ZP (0 V DC)
4.0	DO8	Signal of the digital output DO8
4.1	DO9	Signal of the digital output DO9
4.2	DO10	Signal of the digital output DO10
4.3	DO11	Signal of the digital output DO11
4.4	DO12	Signal of the digital output DO12
4.5	DO13	Signal of the digital output DO13
4.6	DO14	Signal of the digital output DO14
4.7	DO15	Signal of the digital output DO15
4.8	UP3	Process voltage UP3 (24 V DC)
4.9	ZP	Process voltage ZP (0 V DC)

WARNING!

Removal/Insertion under power

The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

> **NOTICE!**
> **Risk of damaging the PLC modules!**
> Overvoltages and short circuits might damage the PLC modules.
> – Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
> – Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

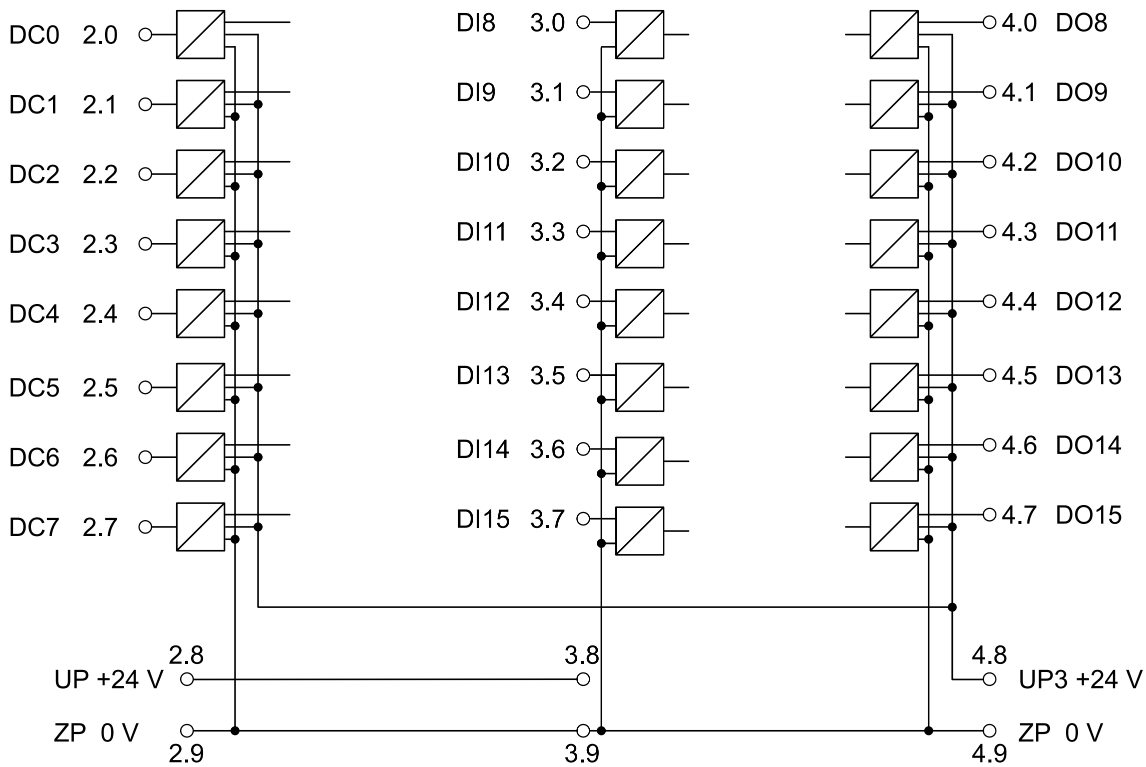


Fig. 317: Connection of the PROFIBUS DP communication interface module CI542-DP

Connection of the digital inputs

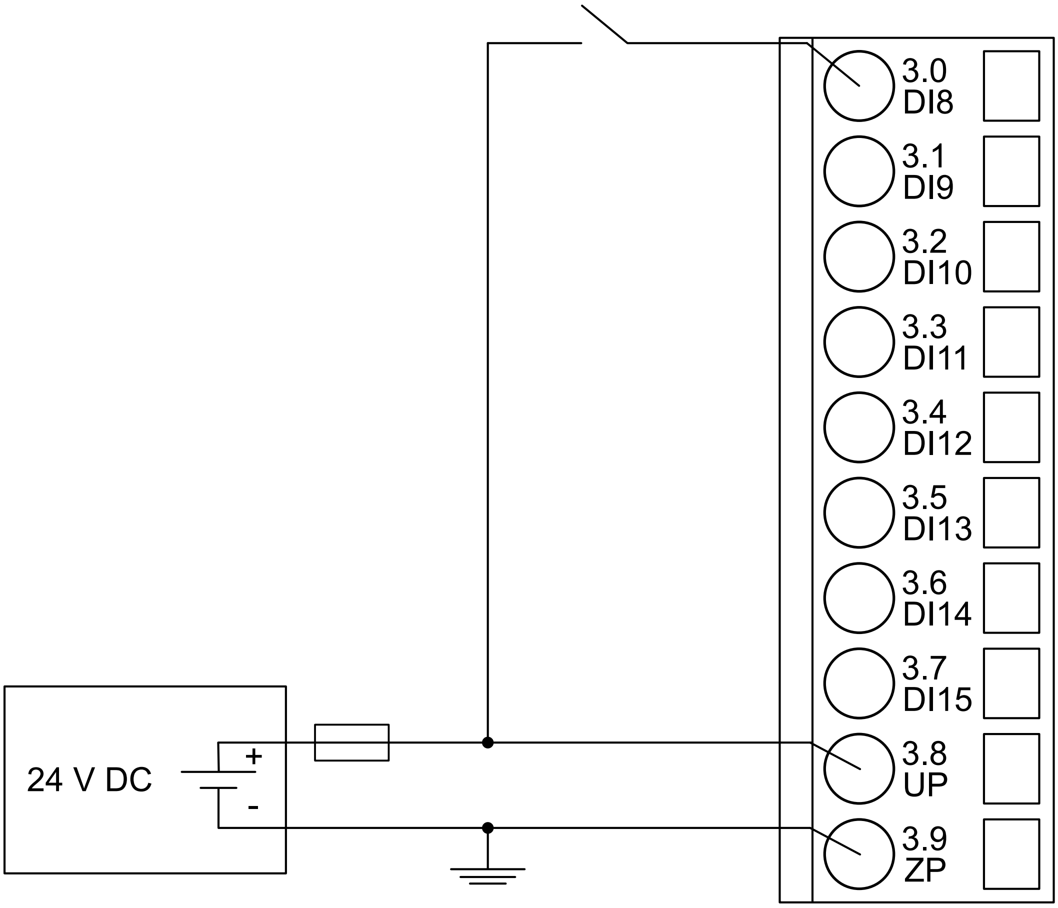


Fig. 318: Connection of the digital input DI8 (Proceed with the digital inputs DI9 to DI15 in the same way)

The meaning of the LEDs is described in Displays *Chapter 1.8.6.2.10 "State LEDs" on page 1232*.

Connection of the digital outputs

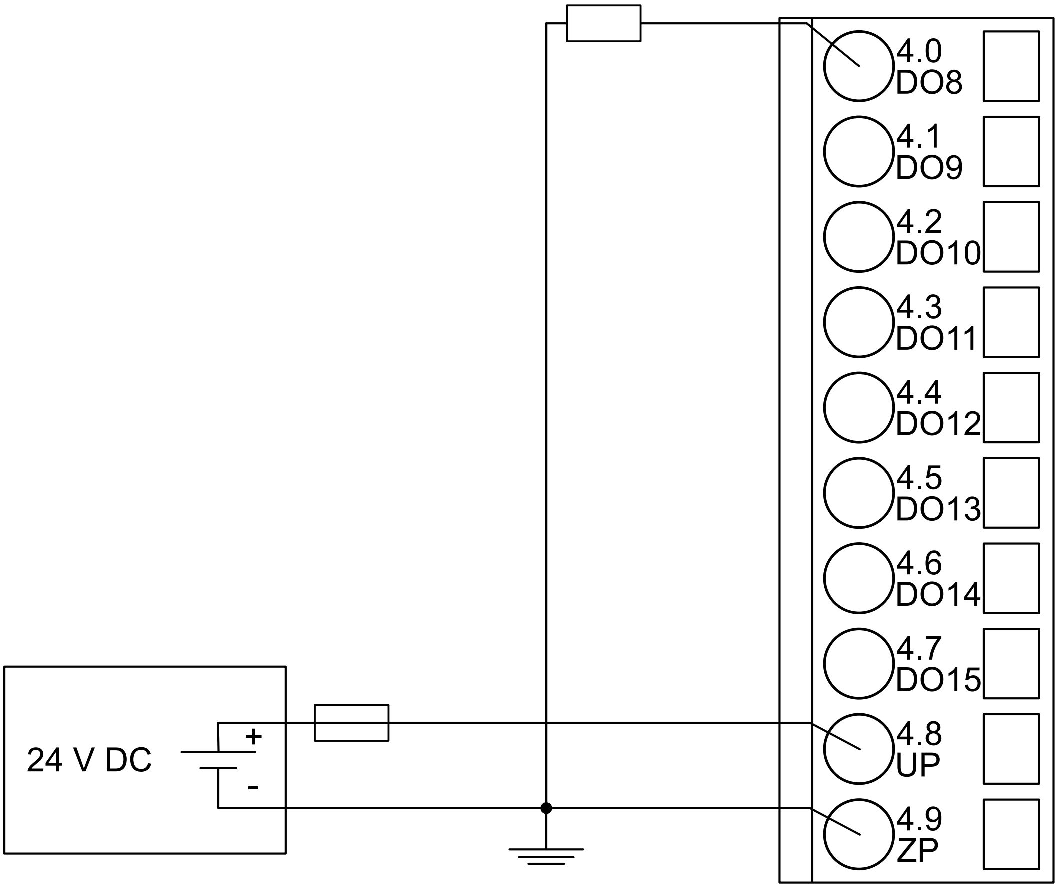


Fig. 319: Connection of the digital output DO8 (Proceed with the digital outputs DO9 - DO15 in the same way)

The meaning of the LEDs is described in Displays *Chapter 1.8.6.2.10 “State LEDs” on page 1232*.

Connection of the configurable digital inputs/outputs

> **CAUTION!**
> If a DC channel is used as input, the source for the input signals should be the impressed UP3 of the device *Chapter 1.8.6.2.4 “Connections” on page 1217*.

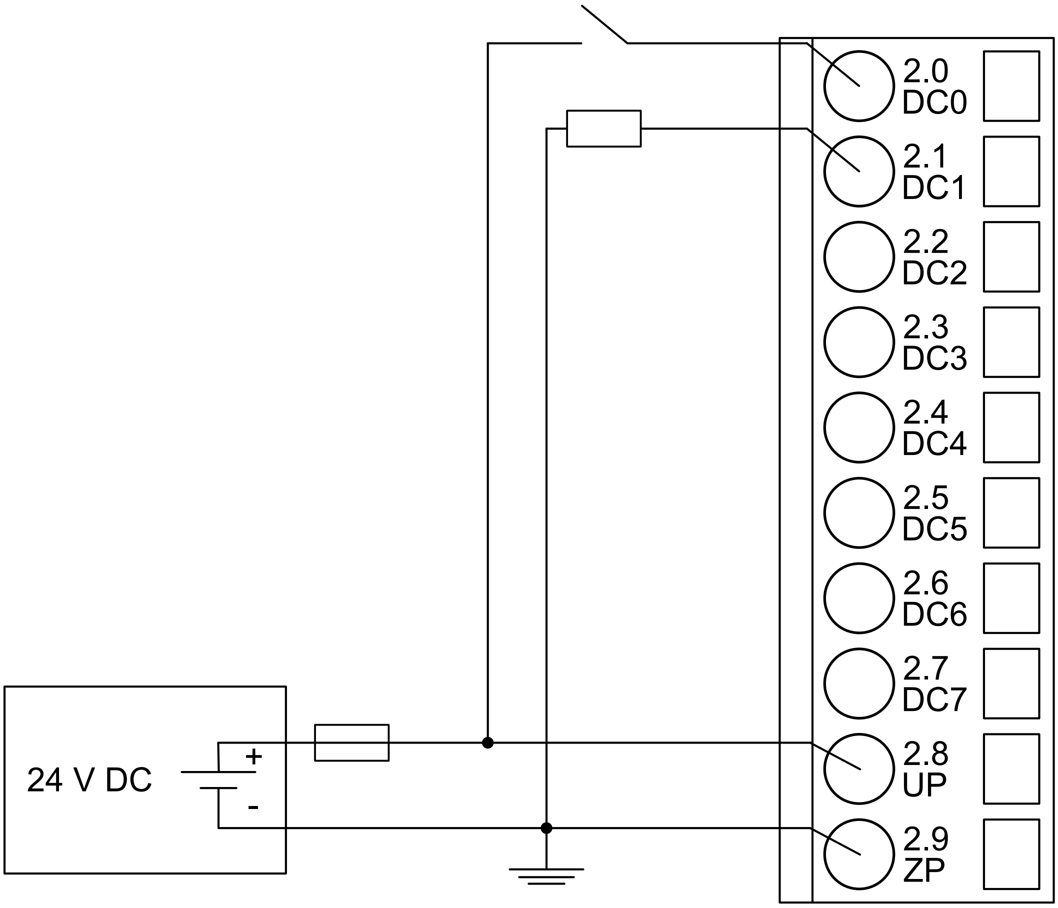


Fig. 320: Connection of the configurable digital input/output DC0 and DC1 (Proceed with the configurable digital inputs/outputs DC2 to DC7 in the same way)

The meaning of the LEDs is described in Displays *Chapter 1.8.6.2.10 “State LEDs” on page 1232*.

1.8.6.2.5 Internal data exchange

Parameter	Value
Digital inputs (bytes)	5
Digital outputs (bytes)	5
Counter input data (words)	4
Counter output data (words)	8

1.8.6.2.6 Addressing

The module reads the position of the rotary switches only during power-up, i.e. changes of the switch position during operation will have no effect until the next module initialization.

1.8.6.2.7 I/O configuration

The CI542-DP PROFIBUS DP bus configuration is handled by PROFIBUS DP master with the exception of the slave bus ID (via rotary switches) and the transmission rate (automatic detection).

The digital I/O channels and the fast counter are configured via software.

Details about configuration are described in Parameterization.

1.8.6.2.8 Parameterization

Parameters of the module

Name	Value	Internal value	Internal value, type	Default
Module ID [1])	Internal	0x1C25	WORD	0x1C25
Parameter length	Internal	31	BYTE	31
Reserved (1 byte)	0	0	BYTE	0
Error LED / Failsafe function ↳ *Table 306 “Settings "Error LED / Failsafe function"” on page 1226* (see table)	On	0	BYTE	0
	Off by E4	1		
	Off by E3	2		
	On + failsafe	16		
	Off by E4 + failsafe	17		
	Off by E3 + failsafe	18		
Reserved (20 bytes)	0	0	BYTE	0
Check supply	On	0	BYTE	
	Off	1		1
Fast counter	0	0	BYTE	0
	:	:		
	10 [2])	10		

[1]) With a faulty ID, the module reports a "parameter error" and does not perform cyclic process data transmission.

[2]) Counter operating modes, see 'Fast Counter' ↳ *Chapter 1.6.1.2.10 “Fast counter” on page 545*.

Table 306: Settings "Error LED / Failsafe function"

Setting	Description
On	Error LED (S-ERR) lights up at errors of all error classes, Failsafe mode off
Off by E4	Error LED (S-ERR) lights up at errors of error classes E1, E2 and E3, Failsafe mode off
Off by E3	Error LED (S-ERR) lights up at errors of error classes E1 and E2, Failsafe mode off
On + Failsafe	Error LED (S-ERR) lights up at errors of all error classes, Failsafe mode on *)

Setting	Description
Off by E4 + Failsafe	Error LED (S-ERR) lights up at errors of error classes E1, E2 and E3, Failsafe mode on *)
Off by E3 + Failsafe	Error LED (S-ERR) lights up at errors of error classes E1 and E2, Failsafe mode on *)
*) The parameter Behaviour DO at comm. error is only analyzed if the Failsafe mode is ON.	

Group parameters for the digital part

Name	Value	Internal value	Internal value, type	Default
Input delay	0.1 ms 1 ms 8 ms 32 ms	0 1 2 3	BYTE	0.1 ms 0x00
Detect short circuit at outputs	Off On	0 1	BYTE	On 0x01
Behaviour DO at comm. error [1])	Off Last value Last value 5 sec Last value 10 sec Substitute value Substitute value 5 sec Substitute value 10 sec	0 1 6 11 2 7 12	BYTE	Off 0x00
Substitute value at output	0 ... 65535	0000h ... FFFFh	WORD	0 0x0000
Preventive voltage feedback monitoring for DC0 ... DC7 [2])	Off On	0 1	BYTE	Off 0x00
Detect voltage overflow at outputs [3])	Off On	0 1	BYTE	Off 0x00

Remarks:

[1])	The parameter Behaviour DO at comm. error is apply to DC and DO channels and only analyzed if the Failsafe-mode is ON.
[2])	The state "externally voltage detected" appears, if the output of a channel DC0 ... DC7 should be switched on while an externally voltage is connected. In this case the start up is disabled, as long as the externally voltage is connected. The monitoring of this state and the resulting diagnosis message can be disabled by setting the parameters to "OFF".
[3])	The error state "voltage overflow at outputs" appears, if externally voltage at digital outputs DC0 ... DC7 and accordingly DO0 ... DO7 has exceeded the process supply voltage UP3 *Chapter 1.8.6.2.4 “Connections” on page 1217*. The according diagnosis message "Voltage overflow on outputs " can be disabled by setting the parameters on "OFF". This parameter should only be disabled in exceptional cases for voltage overflow may produce reverse voltage.

1.8.6.2.9 Diagnosis

Structure of the diagnosis block via DPM_SLV_DIAG function block.

Byte Number	Description	Possible Values
1	Data length (header included)	7
2	PROFIBUS DP V1 coding: Vendor specific	129
3	Diagnosis Byte, slot number	31 = CI542-DP (e. g. error at integrated 8 DI / 8 DO) 1 = 1st connected S500 I/O module ... 10 = 10th connected S500 I/O module
4	Diagnosis Byte, module number	According to the I/O bus specification passed on by modules to the fieldbus master
5	Diagnosis Byte, channel	According to the I/O bus specification passed on by modules to the fieldbus master
6	Diagnosis Byte, error code	According to the I/O bus specification Bit 7 and bit 6, coded error class 0 = E1 1 = E2 2 = E3 3 = E4 Bit 0 to bit 5, coded error description
7	Diagnosis Byte, flags	According to the I/O bus specification Bit 7: 1 = coming error Bit 6: 1 = leaving error

In cases of short circuit or overload, the digital outputs are turned off. The modules performs reactivation automatically. Thus an acknowledgement of the errors is not necessary. The error message is stored via the LED.

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier** **000 ... 063**	**AC500-Display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 6 **Bit 6 ... 7**	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6** **Bit 0 ... 5**	**PROFIBUS DP diag-nosis block**	
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error-** **Identi-fier**	**Error message**	**Remedy**
	[1])	[2])	[3])				
Module errors							
3	-	31	31	31	19	Checksum error in the I/O module	Replace I/O module
3	-	31	31	31	3	Timeout in the I/O module	
3	-	31	31	31	40	Different hard-/firm-ware versions in the module	
3	-	31	31	31	43	Internal error in the module	
3	-	31	31	31	36	Internal data exchange failure	
3	-	31	31	31	9	Overflow diagnosis buffer	Restart
3	-	31	31	31	26	Parameter error	Check master
3	-	31	31	31	11	Process voltage UP too low	Check process supply voltage
3	-	31	31	31	45	Process voltage UP gone	Check process supply voltage
3	-	31/1...10	31	31	17	No communication with I/O module	Replace I/O module
3	-	1...10	31	31	32	Wrong I/O module type on socket	Replace I/O module / Check configu-ration
4	-	1...10	31	31	31	At least one module does not support failsafe function	Check modules and parame-terization

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier** **000 ... 063**	**AC500-Display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 6 **Bit 6 ... 7**	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6** **Bit 0 ... 5**	**PROFIBUS DP diag-nosis block**	
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error-** **Identi-fier**	**Error message**	**Remedy**
	1)	**2)**	**3)**				
4	-	1...10	31	5	8	I/O module removed from hot swap terminal unit or defective module on hot swap ter-minal unit 9)	Plug I/O module, replace I/O module
4	-	1...10	31	5	28	Wrong I/O module plugged on hot swap terminal unit 9)	Remove wrong I/O module and plug pro-jected I/O module
4	-	1...10	31	5	42	No communication with I/O module on hot swap terminal unit 9)	Replace I/O module
4	-	1...10	31	5	54	I/O module does not support hot swap 8) 9)	Power off system and replace I/O module
4	-	1...10	31	6	8	Hot swap terminal unit configured but not found	Replace terminal unit by hot swap terminal unit
4	-	1...10	31	6	42	No communication with hot swap ter-minal unit 9)	Restart, if error persists replace terminal unit
4	-	31	31	31	45	Process voltage UP3 too low	Check process voltage

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier 000 ... 063**	**AC500-Display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 6 Bit 6 ... 7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0 ... 5**	**PROFIBUS DP diag-nosis block**	
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error- Identi-fier**	**Error message**	**Remedy**
	[1])	**[2])**	**[3])**				
4	-	31	31	31	46	Reverse voltage from digital outputs DO0..DO7 to UP3 [4])	Check terminals
4	-	31/1...10	31	31	34	No response during initialization of the I/O module	Replace I/O module
4	-	31	31	31	11	Process voltage UP3 too low	Check process supply voltage
4	-	31	31	31	45	Process voltage UP3 gone	Check process supply voltage
4	-	31	31	31	10	Voltage overflow at outputs (above UP3 level) [5])	Check termi-nals/ check process supply voltage
Channel error digital							
4	-	31	2	8...15	46	Externally voltage detected at digital output DO0 ... DO7 [6])	Check terminals
4	-	31	4	0...7	46	Externally voltage detected at digital output DC0 ... DC7 [6])	Check terminals
4	-	31	4	0...7	47	Short circuit at dig-ital output DC0 ... DC7[7])	Check terminals
4	-	31	2	8...15	47	Short circuit at dig-ital output DO0 ... DO7[7])	Check terminals

Remarks:

[1])	In AC500 the following interface identifier applies: "-" = Diagnosis via bus-specific function blocks; 0 ... 4 or 10 = Position of the Communication Module;14 = I/O bus; 31 = Module itself The identifier is not contained in the CI542-DP diagnosis block.
[2])	With "Device" the following allocation applies: 31 = Module itself, 1..10 = expansion module
[3])	With "Module" the following allocation applies dependent of the master: Module error: 31 = Module itself Channel error: Module type (1 = AI, 2 = DO, 3 = AO)
[4])	This message appears, if externally voltages at one or more terminals DC0 ... DC7 oder DO0 ... DO7 cause that other digital outputs are supplied through that voltage. All outputs of the apply digital output groups will be turned off for 5 seconds. The diagnosis message appears for the whole output group.
[5])	The voltage at digital outputs DC0 .. DC7 and accordingly DO0 ... DO7 has exceeded the process supply voltage UP3 *Chapter 1.8.6.2.4 “Connections” on page 1217*. Diagnosis message appears for the whole module.
[6])	This message appears, if the output of a channel DC0 ... DC7 or DO0 ... DO7 should be switched on while an externally voltage is connected. In this case the start up is disabled, as long as the externally voltage is connected. Otherwise this could produce reverse voltage from this output to other digital outputs. This diagnosis message appears per channel.
[7])	Short circuit: After a detected short circuit, the output is deactivated for 100ms. Then a new start up will be executed. This diagnosis message appears per channel.
[8])	In case of an I/O module doesn’t support hot swapping, do not perform any hot swap operations (also not on any other terminal units (slots)) as modules may be damaged or I/O bus communication may be disturbed.
[9])	Diagnosis for hot swap available as of version index F0.

1.8.6.2.10 State LEDs

The LEDs are located at the front of module. There are 2 different groups:

- The 5 system LEDs (PWR, STA1 DP, STA2 DP, S-ERR and I/O-Bus) show the operation state of the module and display possible errors.
- The 29 process LEDs (UP, UP3, inputs, outputs, CH-ERR1 to CH-ERR3) show the process supply voltage and the states of the inputs and outputs and display possible errors.

Table 307: States of the 5 system LEDs:

LED	Color	OFF	ON	Flashing
PWR/RUN	Green	Process supply voltage missing	Internal supply voltage OK, module ready for communication with I/O Controller	Start-up / preparing communication
	Yellow	---	---	---
STA1-DP	Green	---	PROFIBUS running	Invalid device parameters

LED	Color	OFF	ON	Flashing
STA2-DP	Red	No error	Bus timeout	No communica-tion to master
S-ERR	Red	No error	Internal error	--
I/O-Bus	Green	No communica-tion interface modules con-nected or com-munication error	Communication interface module connected and operational	---

Table 308: States of the 29 process LEDs:

LED	Color	OFF	ON	Flashing
DC0 ... DC7	Yellow	Input/Output is OFF	Input/Output is ON	--
DI8 ... DI15	Yellow	Input is OFF	Input is ON (the input voltage is even displayed if the supply voltage is OFF)	--
DO8 ... DO15	Yellow	Output is OFF	Output is ON	--
UP	Green	Process supply voltage missing	Process supply voltage OK and initialization fin-ished	--
UP3	Green	Process supply voltage missing	Process supply voltage OK	--
CH-ERR1 to CH-ERR3	Red	No error or process supply voltage missing	Internal error	Error on one channel of the corresponding group

1.8.6.2.11 Technical data

Technical data of the module

The system data of AC500 and S500 are applicable to the standard version *Chapter 2.6.1 “System data AC500” on page 1408*.

The system data of AC500-XC are applicable to the XC version *Chapter 2.7.1 “System data AC500-XC” on page 1475*.

Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

Parameter		Value
Process supply voltages UP/UP3		
	Rated value	24 V DC (for inputs and outputs)
	Max. load for the terminals	10 A
	Protection against reversed voltage	Yes
	Rated protection fuse on UP/UP3	10 A fast

Parameter		Value
	Galvanic isolation	PROFIBUS interface against the rest of the module
	Inrush current from UP (at power up)	On request
	Current consumption via UP (normal operation)	0.2 A
	Current consumption via UP3	0.06 A + 0.5 A max. per output
	Connections	Terminals 2.8 and 3.8 for +24 V (UP) Terminal 4.8 for +24 V (UP3) Terminals 2.9, 3.9 and 4.9 for 0 V (ZP)
Max. power dissipation within the module		6 W
Number of digital inputs		8
Number of digital outputs		8
Number of analog inputs		4
Number of analog outputs		2
Reference potential for all digital inputs and outputs		Negative pole of the supply voltage, signal name ZP
Setting of the PROFIBUS DP identifier		With 2 rotary switches at the front side of the module
Diagnose		See Diagnosis *Chapter 1.8.6.2.9 “Diagnosis” on page 1228*
Operation and error displays		34 LEDs (totally)
Weight (without terminal unit)		Ca. 125 g
Mounting position		Horizontal Or vertical with derating (output load reduced to 50 % at +40 °C per group)
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

NOTICE!
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and temporary overvoltage up to 30 V DC.

Multiple overloads
No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an internal smart high-side switch.

Technical data of the digital inputs

Parameter	Value
Number of channels per module	8
Distribution of the channels into groups	1 group of 8 channels

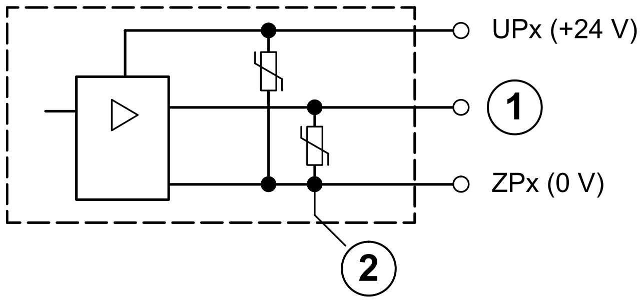
Parameter	Value
Terminals of the channels DI0 ... DI7	Terminals 3.0 ... 3.7
Reference potential for all inputs	Terminals 2.9 ... 4.9 (negative pole of the supply voltage, signal name ZP)
Indication of the input signals	1 yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Input type (according EN 61131-2)	Type 1
Input delay (0->1 or 1->0)	Typ. 0.1 ms, configurable from 0.1 ms ... 32 ms
Input signal voltage	24 V DC
Signal 0	-3 V ... +5 V
Undefined Signal	> +5 V ... < +15 V
Signal 1	+15 V ... +30 V
Ripple with signal 0	Within -3 V ... +5 V
Ripple with signal 1	Within +15 V ... +30 V
Input current per channel	
Input voltage +24 V	Typ. 5 mA
Input voltage +5 V	> 1 mA
Input voltage +15 V	> 2 mA
Input voltage +30 V	< 8 mA
Max. cable length	
Shielded	1000 m
Unshielded	600 m

Technical data of the digital outputs

Parameter	Value
Number of channels per module	8
Distribution of the channels into groups	1 group of 8 channels
Terminals of the channels DO0 ... DO7	Terminals 4.0 ... 4.7
Reference potential for all outputs	Terminals 2.9 ... 4.9 (negative pole of the supply voltage, signal name ZP)
Common power supply voltage	For all outputs terminal 4.8 (positive pole of the supply voltage, signal name UP3)
Output voltage for signal 1	UP3 (-0.8 V)
Output delay (0->1 or 1->0)	On request
Output current	
Rated value per channel	500 mA at UP3 = 24 V
Max. value (all channels together)	4 A
Leakage current with signal 0	< 0.5 mA
Fuse for UP3	10 A fast
Demagnetization with inductive DC load	Via internal varistors (see figure below this table)
Output switching frequency	

Parameter		Value
	With resistive load	On request
	With inductive loads	Max. 0.5 Hz
	With lamp loads	11 Hz max. at 5 W max.
Short-circuit-proof / overload-proof		Yes
Overload message (I > 0.7 A)		Yes, after ca. 100 ms
Output current limitation		Yes, automatic reactivation after short circuit/overload
Resistance to feedback against 24 V signals		Yes (software-controlled supervision)
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

The following drawing shows the circuitry of a digital input/output with the varistors for demagnetization when inductive loads are switched off.



1 Digital output
2 Varistors for demagnetization when inductive loads are turned off

Technical data of the configurable digital inputs/outputs

Each of the configurable I/O channels is defined as input or output by the user program. This is done by interrogating or allocating the corresponding channel.

Parameter		Value
Number of channels per module		8 inputs/outputs (with transistors)
Distribution of the channels into groups		1 group for 8 channels
If the channels are used as inputs		
	Channels DC0 ... DC07	Terminals 2.0 ... 2.7
If the channels are used as outputs		
	Channels DC0 ... DC07	Terminals 2.0 ... 2.7
Indication of the input/output signals		1 yellow LED per channel, the LED is ON when the input/output signal is high (signal 1)
Galvanic isolation		From the PROFIBUS network

Technical data of the digital inputs/outputs if used as inputs

Parameter		Value
Number of channels per module		8
Distribution of the channels into groups		1 group of 8 channels
Terminals of the channels DC0 ... DC7		Terminals 2.0 .... 2.7
Reference potential for all inputs		Terminals 2.9 ... 4.9 (negative pole of the supply voltage, signal name ZP)
Indication of the input signals		1 yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Input type (according EN 61131-2)		Type 1
Input delay (0->1 or 1->0)		Typ. 0.1 ms, configurable from 0.1 ms ... 32 ms
Input signal voltage		24 V DC
	Signal 0	-3 V ... +5 V
	Undefined Signal	> +5 V ... < +15 V
	Signal 1	+15 V ... +30 V
Ripple with signal 0		Within -3 V ... +5 V
Ripple with signal 1		Within +15 V ... +30 V
Input current per channel		
	Input voltage +24 V	Typ. 5 mA
	Input voltage +5 V	> 1 mA
	Input voltage +15 V	> 2 mA
	Input voltage +30 V	< 8 mA
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

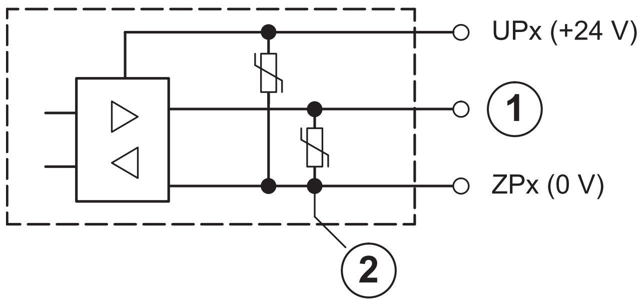
*) Due to the direct connection to the output, the demagnetizing varistor is also effective at the input (see figure) above. This is why the difference between UPx and the input signal may not exceed the clamp voltage of the varistor. The varistor limits the voltage to approx. 36 V. Following this, the input voltage must range from -12 V ... +30 V when UPx = 24 V and from -6 V ... +30 V when UPx = 30 V.

Technical data of the digital inputs/outputs if used as outputs

Parameter	Value
Number of channels per module	8
Distribution of the channels into groups	1 group of 8 channels
Terminals of the channels DC0 ... DC7	Terminals 2.0 .... 2.7
Reference potential for all outputs	Terminals 2.9 ... 4.9 (negative pole of the supply voltage, signal name ZP)
Common power supply voltage	For all outputs terminal 4.8 (positive pole of the supply voltage, signal name UP3)
Output voltage for signal 1	UP3 (-0.8 V)
Output delay (0->1 or 1->0)	On request
Output current	

Parameter	Value
Rated value per channel	500 mA at UP3 = 24 V
Max. value (all channels together)	4 A
Leakage current with signal 0	< 0.5 mA
Fuse for UP3	10 A fast
Demagnetization with inductive DC load	Via internal varistors (see figure below this table)
Output switching frequency	
With resistive load	On request
With inductive loads	Max. 0.5 Hz
With lamp loads	11 Hz max. at 5 W max.
Short-circuit-proof / overload-proof	Yes
Overload message (I > 0.7 A)	Yes, after ca. 100 ms
Output current limitation	Yes, automatic reactivation after short circuit/overload
Resistance to feedback against 24 V signals	Yes (software-controlled supervision)
Max. cable length	
Shielded	1000 m
Unshielded	600 m

The following drawing shows the circuitry of a digital input/output with the varistors for demagnetization when inductive loads are switched off.

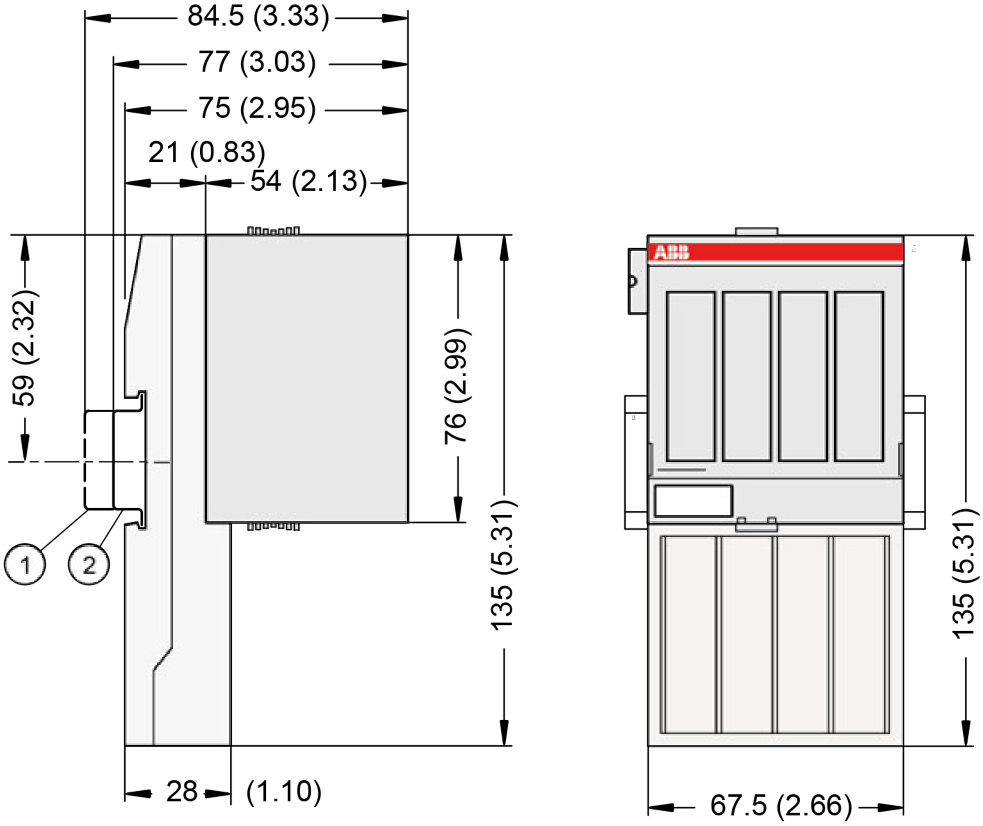


1 Digital input/output
2 For demagnetization when inductive loads are turned off

Technical data of the fast counter

Parameter	Value
Used inputs	Terminal 3.0 (DI0),Terminal 3.1 (DI1)
Used outputs	Terminal 4.0 (DO0)
Counting frequency	Depending on operation mode: Mode 1- 6: max. 200 kHz Mode 7: max. 50 kHz Mode 9: max. 35 kHz Mode 10: max. 20 kHz

1.8.6.2.12 Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

1.8.6.2.13 Ordering Data

Part no.	Description	Product life cycle phase *)
1SAP 224 200 R0001	CI542-DP, PROFIBUS DP communication interface module, 8 DI, 8 DO and 8 DC	Active
1SAP 424 200 R0001	CI542-DP-XC, PROFIBUS DP communication interface module, 8 DI, 8 DO and 8 DC, XC version	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

1.8.7 PROFINET

1.8.7.1 Comparison of the CI5xx-PNIO modules

The PROFINET IO devices combine the advantages of decentralized I/O modules with the reaction time of AC500 mounted central I/O modules. The devices for PROFINET provide the extension -PNIO in the device name.

The communication module CM579-PNIO acts as I/O controller in a PROFINET network. It is connected to the processor module via an internal communication bus. Depending on the terminal base, several communication modules can be used for one processor module.

The communication interface modules CI5xx-PNIO act as I/O devices in a PROFINET network.

Additionally the communication module CM589-PNIO(-4) can be used to setup a AC500 PLC to act as I/O module in a PROFINET network.

The difference of the CI5xx-PNIO devices can be found in their input and output characteristics ↬ *Chapter 1.8.7.1.1 “Characteristics of CI50x-PNIO” on page 1240*.

The characteristics for CM589-PNIO(-4) can be found in the device description for CM589-PNIO ↬ *Further information on page 272*.

1.8.7.1.1 Characteristics of CI50x-PNIO

Parameter	Value
Bus connection	2 x RJ45
Switch	Integrated
Technology	Hilscher NETX 100
Transfer rate	10/100 Mbit/s (full-duplex)
Transfer method	According to Ethernet II, IEEE 802.3
Ethernet	100 base-TX, internal switch, 2x RJ45 socket
Expandability	Max. 10 S500 I/O modules
Adjusting elements	2 rotary switches for generation of an explicit name
Supported protocols	RTC - real time cyclic protocol, class 1 *) RTA - real time acyclic protocol DCP - discovery and configuration protocol CL-RPC - connectionless remote procedure Call LLDP - link layer discovery protocol MRP - MRP Client
Acyclic services	PNIO read / write sequence (max. 1024 bytes per telegram) Process-Alarm service
Supported alarm types	Process Alarm, Diagnostic Alarm, Return of SubModule, Plug Alarm, Pull Alarm
Min. bus cycle	1 ms

Parameter	Value
Conformance class	CC A
Protective functions (according to IEC 61131-3)	Protected against: ● short circuit ● reverse supply ● overvoltage ● reverse polarity Galvanic isolation from the rest of the module

*) Priorization with the aid of VLAN-ID including priority level

1.8.7.1.2 Input/Output characteristics of CI501-PNIO

The PROFINET communication interface module CI501-PNIO is used as decentralized I/O module in PROFINET networks. The network connection is performed via 2 RJ45 connectors which are integrated in the terminal unit. The communication interface module contains 22 I/O channels with the following properties:

- 4 analog inputs (1.0 ... 1.3), configurable as:
  - -10 V ... +10 V
  - 0 V ... +10 V
  - -10 V ... +10 V (differential voltage)
  - 0 mA ... 20 mA
  - 4 mA ... 20 mA
  - Pt100 , Pt1000, Ni1000 (for each 2-wire and 3-wire)
  - 24 V digital input function
- 2 analog outputs (1.5 ... 1.6), configurable as:
  - -10 V ... +10 V
  - 0 mA ... 20 mA
  - 4 mA ... 20 mA
- 8 digital inputs 24 V DC in 1 group (2.0 ... 2.7)
- 8 digital transistor outputs 24 V DC (0.5 A max.) in 1 group (3.0 ... 3.7)
- Resolution of the analog channels: 12 bits

The inputs/outputs are galvanically isolated from the Ethernet network. There is no potential separation between the channels. The configuration of the analog inputs/outputs is performed by software.

For usage in enhanced ambient conditions (e.g. wider temperature and humidity range), a special XC version of the device is available.

1.8.7.1.3 Input/Output characteristics of CI502-PNIO

- 8 digital inputs 24 V DC
- 8 digital transistor outputs 24 V DC, 0.5 A max.
- 8 configurable digital inputs/outputs 24 V DC, 0.5 A max.
- Module-wise galvanically isolated
- XC version for usage in extreme ambient conditions available

1.8.7.1.4 Technical data of the serial interfaces of CI504-PNIO

Parameter	Value
Number of serial interfaces	3
Connectors for serial interfaces	X11 for COM1 X12 for COM2 X13 for COM3
Supported physical layers	RS-232 RS-422 RS-485
Supported protocols	ASCII
Transmission rate	Configurable from 300 bit/s to 115.200 bit/s

1.8.7.1.5 Technical data of the serial interfaces of CI506-PNIO

Parameter	Value
Number of serial interfaces	2
Connectors for serial interfaces	X11 for COM1 X12 for COM2
Supported physical layers	RS-232 RS-422 RS-485
Supported protocols	ASCII
Transmission rate	Configurable from 300 bit/s to 115.200 bit/s

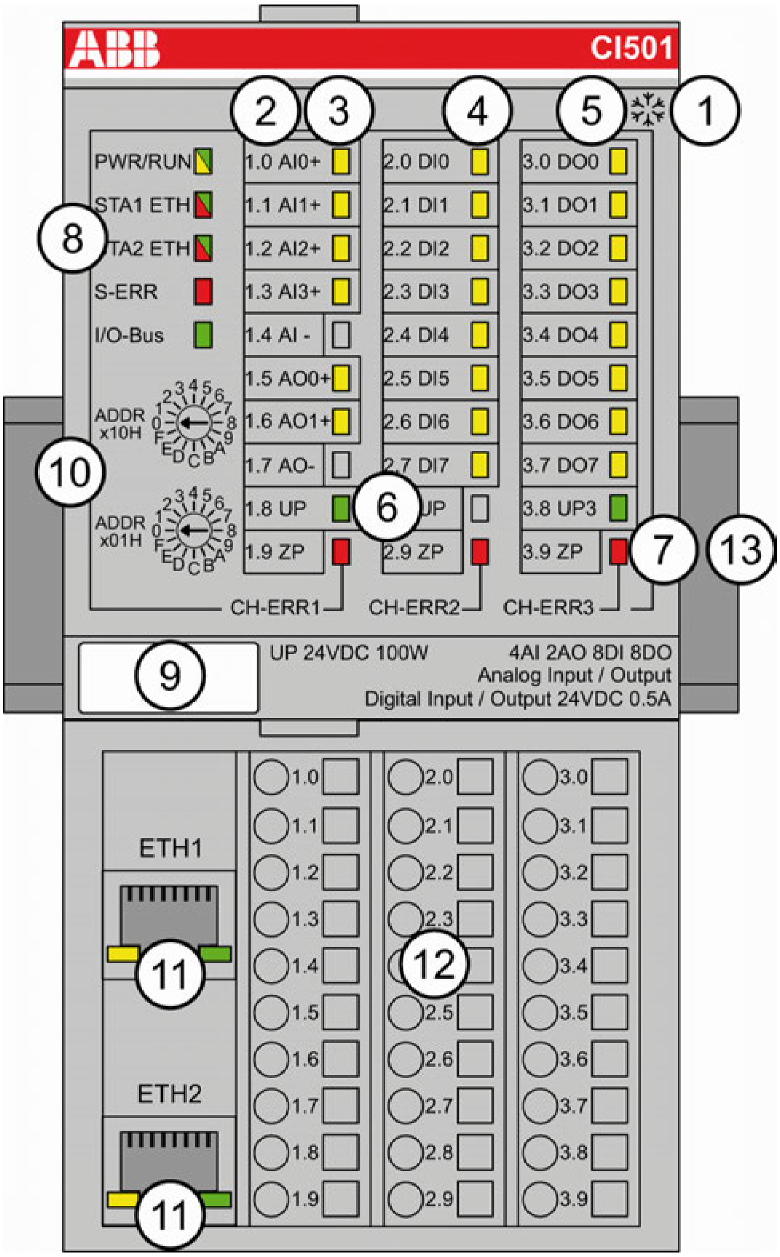
1.8.7.1.6 Technical data of the CANopen interfaces (CI506-PNIO)

Parameter	Value
Number of CANopen interfaces	1
Connector for CANopen Interface	X13
Transmission rate	Up to 1 Mbit/s

1.8.7.2 CI501-PNIO

1.8.7.2.1 Features

- 4 analog inputs, 2 analog outputs, 8 digital inputs, 8 digital outputs
- Resolution 12 bits including sign
- Module-wise galvanically isolated
- Fast counter
- XC version for usage in extreme ambient conditions available



1 I/O bus
2 Allocation between terminal number and signal name
3 6 yellow LEDs to display the signal states of the analog inputs/outputs (AI0 ... AI3, AO0 ... AO1)
4 8 yellow LEDs to display the signal states of the digital inputs (DI0 ... DI7)
5 8 yellow LEDs to display the signal states of the digital outputs (DO0 ... DO7)
6 2 green LEDs to display the process supply voltage UP and UP3
7 3 red LEDs to display errors (CH-ERR1, CH-ERR2, CH-ERR3)
8 5 system LEDs: PWR/RUN, STA1 ETH, STA2 ETH, S-ERR, I/O-Bus
9 Label
10 2 rotary switches for setting the I/O device identifier
11 Ethernet interfaces (ETH1, ETH2) on the terminal unit
12 Terminal unit
13 DIN rail
Sign for XC version

1.8.7.2.2 Intended purpose

The PROFINET communication interface modules CI501-PNIO and CI502-PNIO are used as communication interface modules in PROFINET networks. The network connection is performed by Ethernet cables which are inserted in the RJ45 connectors in the terminal unit. An Ethernet switch in the communication interface module allows daisy chaining of the network.

For usage in enhanced ambient conditions (e.g. wider temperature and humidity range), a special XC version of the device is available.

1.8.7.2.3 Functionality

The communication interface module contains 22 I/O channels with the following properties:

- 4 configurable analog inputs (2-wire / single-ended) or 2 configurable analog inputs (3-wire / differential) (1.0 ... 1.3)
- 2 analog outputs (1.5 ... 1.6)
- 8 digital inputs 24 V DC in 1 group (2.0 ... 2.7)
- 8 digital outputs 24 V DC, 0.5 A max. in 1 group (3.0 ... 3.7)

The inputs/outputs are galvanically isolated from the PROFINET network. There is no potential separation between the channels. The configuration of the analog inputs/outputs is performed by software.

Parameter	Value
Interface	Ethernet
Protocol	PROFINET IO RT
Power supply	From the process supply voltage UP
Supply of the electronic circuitry of the I/O expansion modules attached	Through the I/O bus interface (I/O bus)
Rotary switches	For setting the I/O device identifier for configuration purposes (00h to FFh)
LED displays	For system displays, signal states, errors and power supply
External supply voltage	Via terminals ZP, UP and UP3 (process supply voltage 24 V DC)
Effect of incorrect input terminal connection	Wrong or no signal detected, no damage up to 35 V
Required terminal unit	TU507 or TU508 ⇨ *Chapter 1.5.1 “TU507-ETH and TU508-ETH for Ethernet communication interface modules” on page 274*

1.8.7.2.4 Connections

General

The Ethernet communication interface module CI501-PNIO is plugged on the I/O terminal unit TU507-ETH or TU508-ETH ⇨ *Chapter 1.5.1 “TU507-ETH and TU508-ETH for Ethernet communication interface modules” on page 274*. Properly seat the module and press until it locks in place. The terminal unit is mounted on a DIN rail or with 2 screws plus the additional accessory for wall mounting ⇨ *Chapter 1.9.3.5 “TA526 - Wall mounting accessory” on page 1361*.

The connection of the I/O channels is carried out using the 30 terminals of the I/O terminal unit. I/O modules can be replaced without re-wiring the terminal units.

For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.

The terminals 1.8 and 2.8 as well as 1.9, 2.9 and 3.9 are electrically interconnected within the terminal unit and have always the same assignment, independent of the inserted module:

Terminals 1.8 and 2.8: Process supply voltage UP = +24 V DC

Terminal 3.8: Process supply voltage UP3 = +24 V DC

Terminals 1.9, 2.9 and 3.9: Process supply voltage ZP = 0 V

With a separate UP3 power supply, the digital outputs can be switched off externally. This way, an emergency-off functionality can be realized.

Do not connect any voltages externally to digital outputs!

Reason: External voltages at an output or several outputs may cause that other outputs are supplied through that voltage instead of voltage UP3 (reverse voltage). This is unintended usage.

CAUTION!
Risk of malfunction by unintended usage!
If the function cut-off of the digital outputs is to be used by deactivation of the supply voltage UP3, be sure that no external voltage is connected at the outputs DO0 ... DO7.

Table 309: Assignment of the other terminals

Terminal	Signal	Description
1.0	AI0+	Positive terminal of analog input signal 0
1.1	AI1+	Positive terminal of analog input signal 1
1.2	AI2+	Positive terminal of analog input signal 2
1.3	AI3+	Positive terminal of analog input signal 3
1.4	AI-	Negative terminal of analog input signals 0 to 3
1.5	AO0+	Positive terminal of analog output signal 0
1.6	AO1+	Positive terminal of analog output signal 1
1.7	AI-	Negative terminal of analog output signals 0 and 1
1.8	UP	Process voltage UP (24 V DC)
1.9	ZP	Process voltage ZP (0 V DC)
2.0	DI0	Signal of the digital input DI0
2.1	DI1	Signal of the digital input DI1
2.2	DI2	Signal of the digital input DI2
2.3	DI3	Signal of the digital input DI3
2.4	DI4	Signal of the digital input DI4
2.5	DI5	Signal of the digital input DI5

Terminal	Signal	Description
2.6	DI6	Signal of the digital input DI6
2.7	DI7	Signal of the digital input DI7
2.8	UP	Process voltage UP (24 V DC)
2.9	ZP	Process voltage ZP (0 V DC)
3.0	DO0	Signal of the digital output DO0
3.1	DO1	Signal of the digital output DO1
3.2	DO2	Signal of the digital output DO2
3.3	DO3	Signal of the digital output DO3
3.4	DO4	Signal of the digital output DO4
3.5	DO5	Signal of the digital output DO5
3.6	DO6	Signal of the digital output DO6
3.7	DO7	Signal of the digital output DO7
3.8	UP3	Process voltage UP3 (24 V DC)
3.9	ZP	Process voltage ZP (0 V DC)

WARNING!
Removal/Insertion under power
The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!
Risk of damaging the PLC modules!
Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

For the open-circuit detection (wire break), each analog input channel is pulled up to "plus" by a high-resistance resistor. If nothing is connected, the maximum voltage will be read in then.

Generally, analog signals must be laid in shielded cables. The cable shields must be grounded at both sides of the cables. In order to avoid unacceptable potential differences between different parts of the installation, low resistance equipotential bonding conductors must be laid.

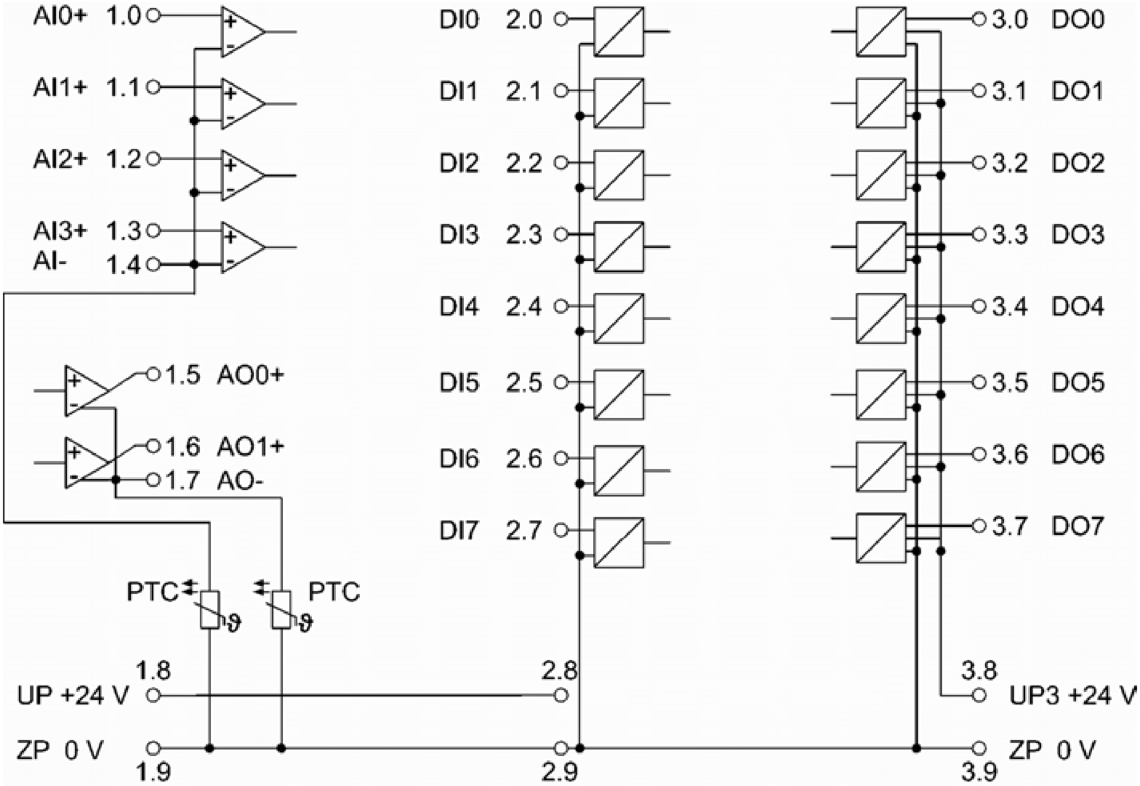


Fig. 321: Connection of the Ethernet bus module CI501-PNIO

Connection of the digital inputs

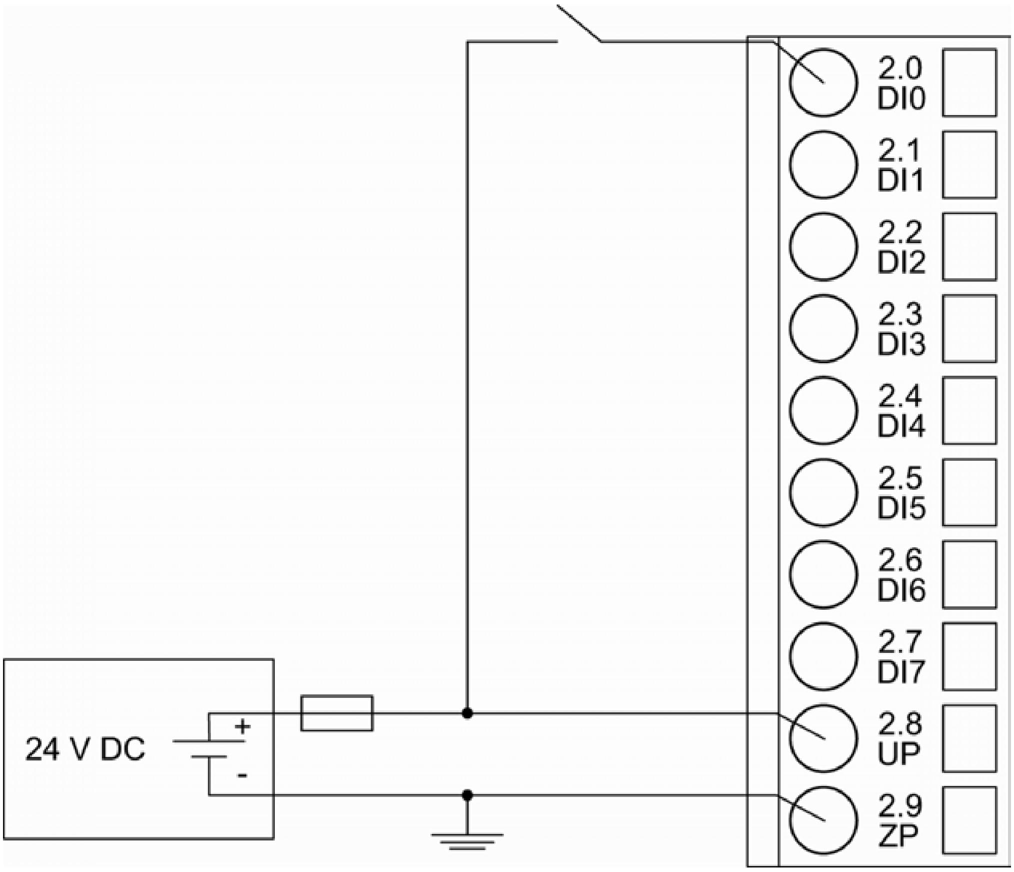


Fig. 322: Connection of the digital inputs (DI0 ... DI7)

Chapter 1.8.7.2.10 “State LEDs” on page 1272

Connection of the digital outputs

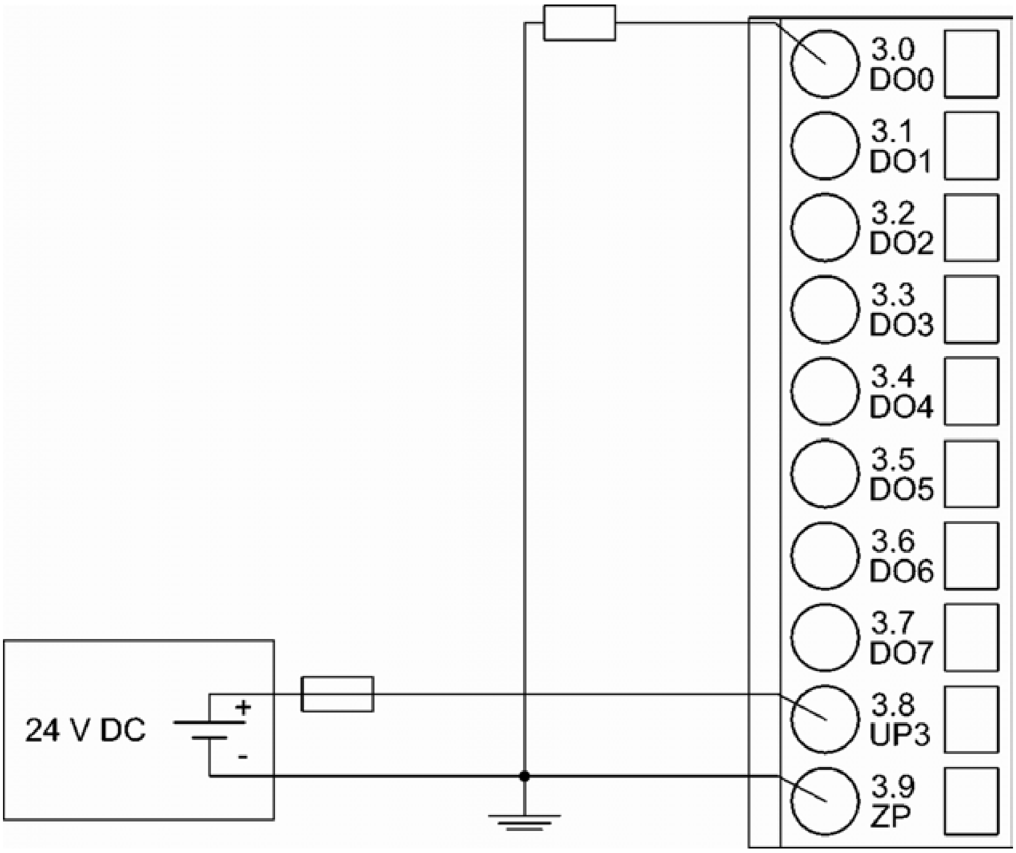


Fig. 323: Connection of the digital output (DO0 ... DO7)

Chapter 1.8.7.2.10 "State LEDs" on page 1272

Connection of resistance thermometers in 2-wire configuration to the analog inputs

When resistance thermometers (Pt100, Pt1000, Ni1000) are used, a constant current must flow through them to build the necessary voltage drop for the evaluation. For this, the module CI501-PNIO provides a constant current source which is multiplexed over the max. 4 analog input channels.

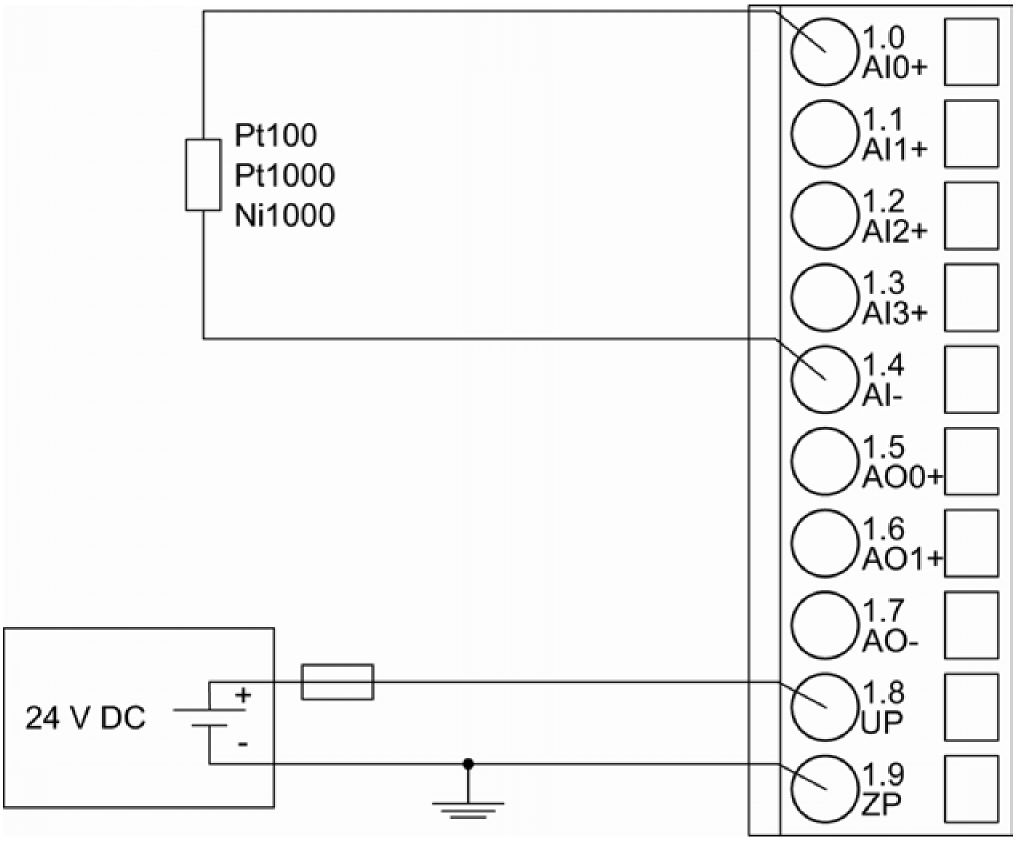


Fig. 324: Connection of resistance thermometers in 2-wire configuration to the analog inputs (AI0 ... AI3)

Table 310: Configurable measuring ranges

Pt100	-50 °C ... +400 °C	2-wire configuration, 1 channel used
Pt1000	-50 °C ... +400 °C	2-wire configuration, 1 channel used
Ni1000	-50 °C ... +150 °C	2-wire configuration, 1 channel used

Chapter 1.8.7.2.8 “Parameterization” on page 1261

Chapter 1.8.7.2.9 “Diagnosis” on page 1267

The module CI501-PNIO performs a linearization of the resistance characteristic.

To avoid error messages from unused analog input channels, configure them as "unused".

Connection of resistance thermometers in 3-wire configuration to the analog inputs

When resistance thermometers (Pt100, Pt1000, Ni1000) are used, a constant current must flow through them to build the necessary voltage drop for the evaluation. For this, the module CI501-PNIO provides a constant current source which is multiplexed over the max. 4 analog input channels.

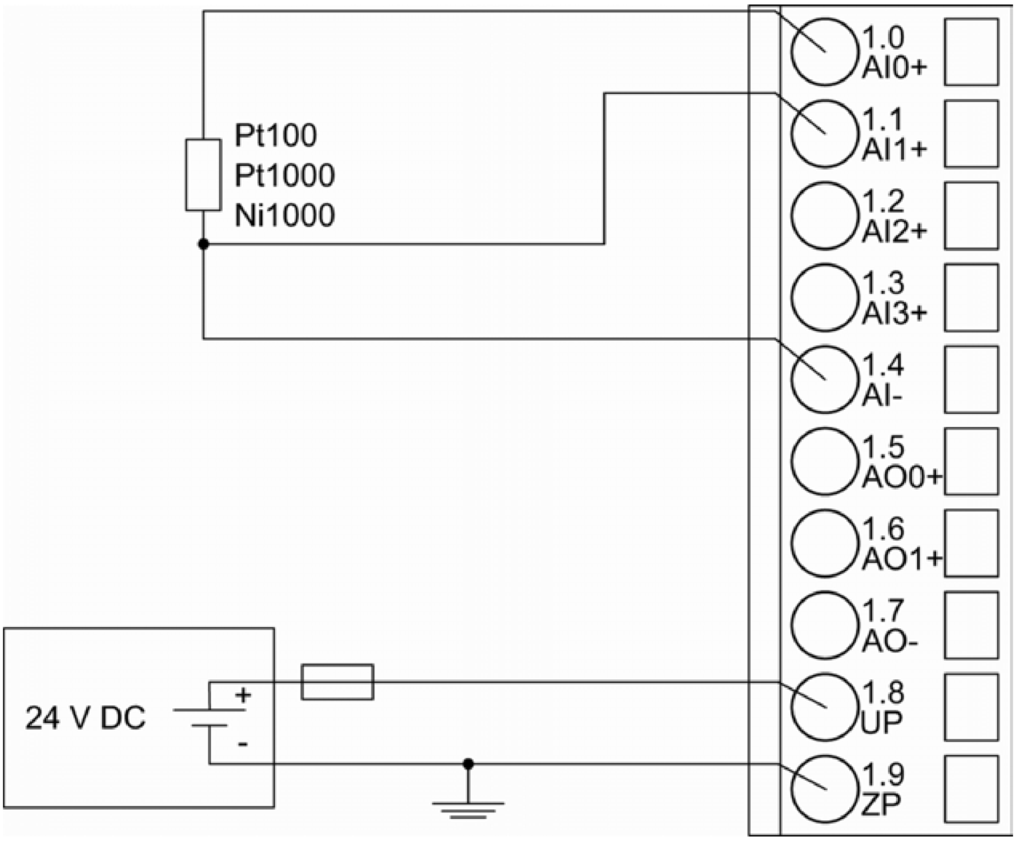


Fig. 325: Connection of resistance thermometers in 3-wire configuration to the analog inputs (AI0 ... AI3)

With 3-wire configuration, 2 adjacent analog channels belong together (e. g. the channels 0 and 1). In this case, both channels are configured according to the desired operating mode. The lower address must be the even address (channel 0), the next higher address must be the odd address (channel 1).

The constant current of one channel flows through the resistance thermometer. The constant current of the other channel flows through one of the cores. The module calculates the measured value from the two voltage drops and stores it under the input with the higher channel number (e. g. I1).

In order to keep measuring errors as small as possible, it is necessary to have all the involved conductors in the same cable. All the conductors must have the same cross section.

Table 311: Configurable measuring ranges

Pt100	-50 °C ... +70 °C	3-wire configuration, 2 channels used
Pt100	-50 °C ... +400 °C	3-wire configuration, 2 channels used
Pt1000	-50 °C ... +400 °C	3-wire configuration, 2 channels used
Ni1000	-50 °C ... +150 °C	3-wire configuration, 2 channels used

Chapter 1.8.7.2.8 “Parameterization” on page 1261

Chapter 1.8.7.2.9 “Diagnosis” on page 1267

The module CI501-PNIO performs a linearization of the resistance characteristic.

To avoid error messages from unused analog input channels, configure them as "unused".

Connection of active-type analog sensors (Voltage) with galvanically isolated power supply to the analog inputs

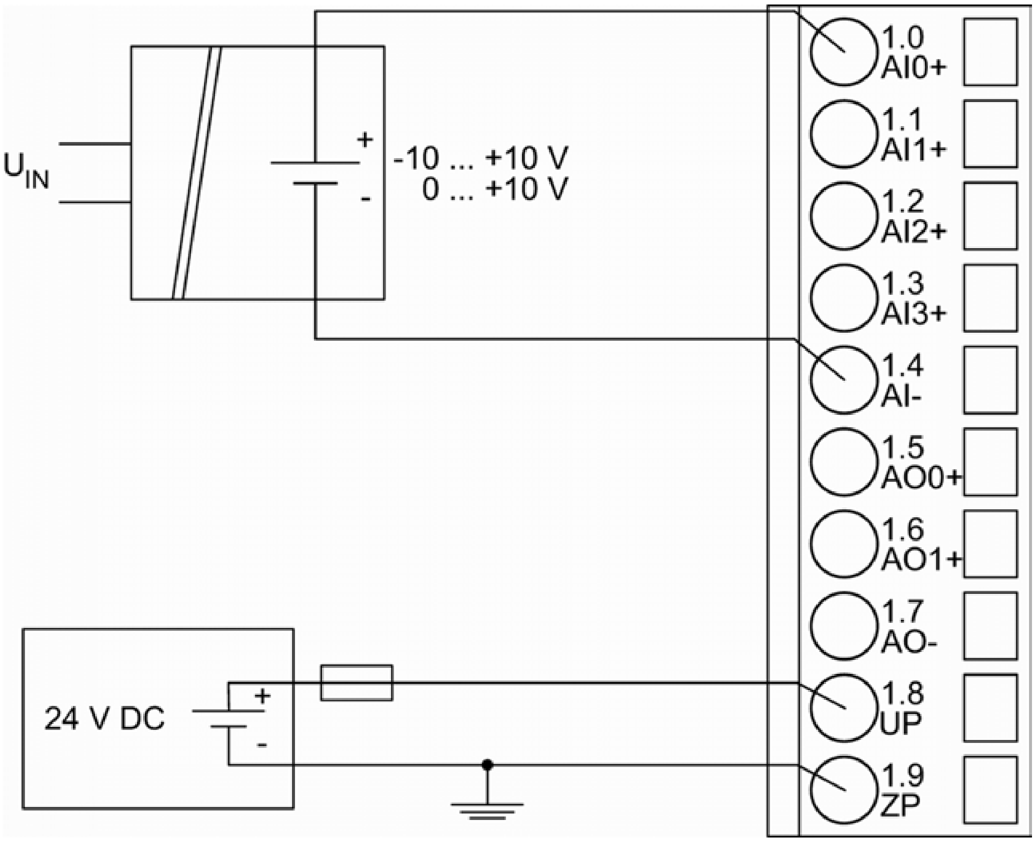


Fig. 326: Connection of active-type analog sensors (voltage) with galvanically isolated power supply to the analog inputs (AI0 ... AI3)

Table 312: Configurable measuring ranges

Voltage	0 V ... 10 V	1 channel used
Voltage	-10 V ... +10 V	1 channel used

Chapter 1.8.7.2.8 “Parameterization” on page 1261

Chapter 1.8.7.2.9 “Diagnosis” on page 1267

To avoid error messages from unused analog input channels, configure them as "unused".

Connection of active-type analog sensors (Current) with galvanically isolated power supply to the analog inputs

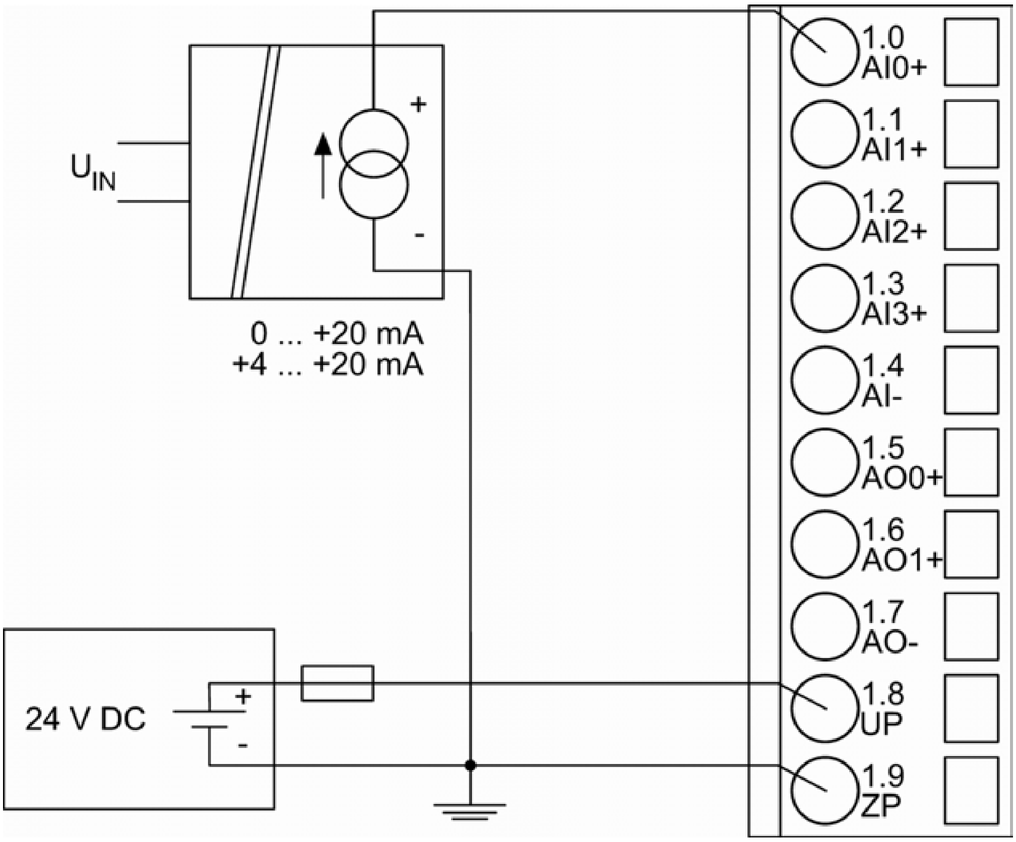


Fig. 327: Connection of active-type analog sensors (current) with galvanically isolated power supply to the analog inputs (AI0 ... AI3)

Table 313: Configurable measuring ranges

Current	0 mA ... 20 mA	1 channel used
Current	4 mA ... 20 mA	1 channel used

Chapter 1.8.7.2.8 “Parameterization” on page 1261

Chapter 1.8.7.2.9 “Diagnosis” on page 1267

Unused input channels can be left open-circuited, because they are of low resistance.

To avoid error messages through unused analog input channels in measuring range 4 mA ... 20 mA, these channels should be configured as "Not used".

Connection of active-type analog sensors (Voltage) with no galvanically isolated power supply to the analog inputs

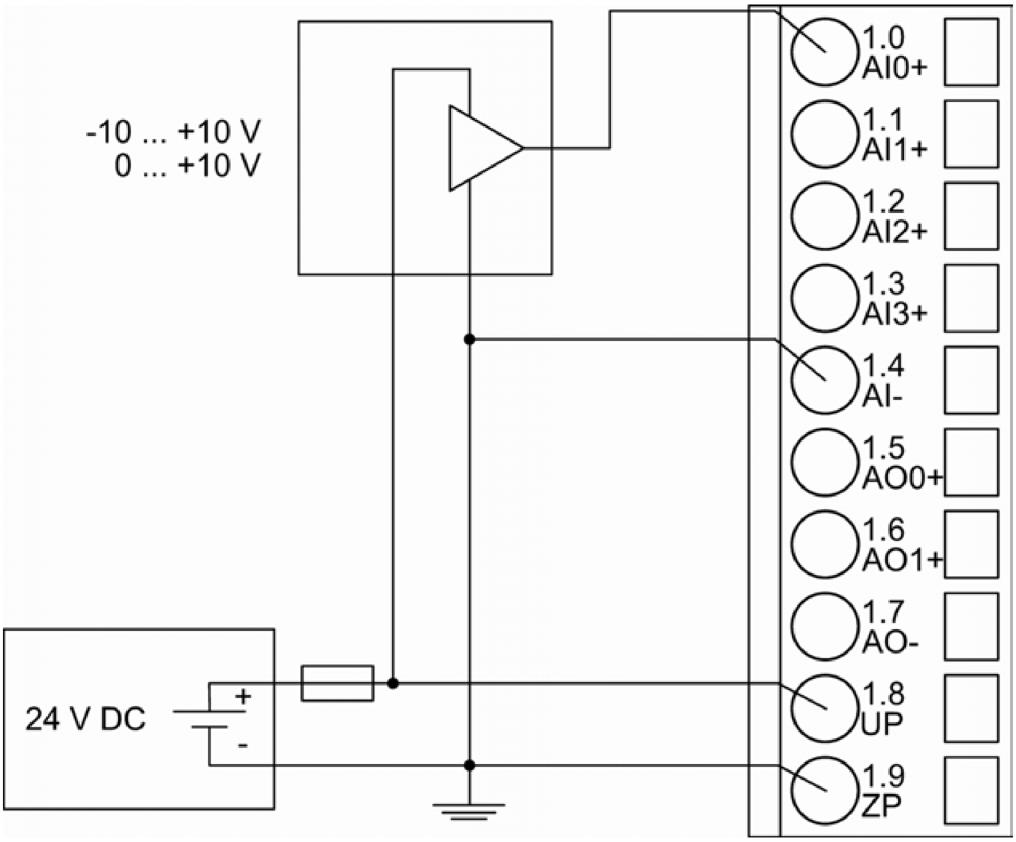


Fig. 328: Connection of active-type analog sensors (voltage) with no galvanically isolated power supply to the analog inputs (AI0 ... AI3)

CAUTION!
Risk of faulty measurements!
The negative pin at the sensors must not have too big a potential difference with respect to ZP (max. ± 1 V).

Make sure that the potential difference never exceeds ± 1 V (also not with long cable lengths).

Table 314: Configurable measuring ranges

Voltage	0 V ... 10 V	1 channel used
Voltage	-10 V ... +10 V	1 channel used

Chapter 1.8.7.2.8 "Parameterization" on page 1261

Chapter 1.8.7.2.8 "Parameterization" on page 1261

Chapter 1.8.7.2.9 "Diagnosis" on page 1267

To avoid error messages from unused analog input channels, configure them as "unused".

Connection of passive-type analog sensors (Current) to the analog inputs

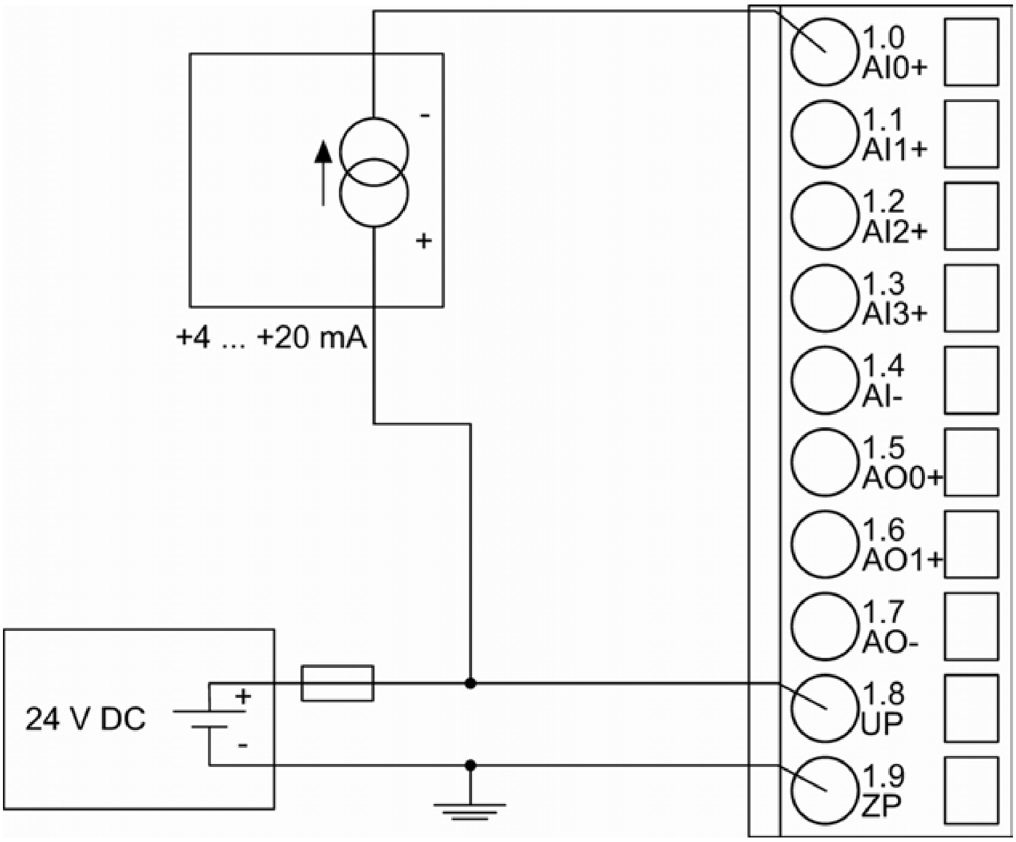


Fig. 329: Connection of passive-type analog sensors (current) to the analog inputs (AI0 ... AI3)

Table 315: Configurable measuring ranges

Current	4 mA ... 20 mA	1 channel used

Chapter 1.8.7.2.8 “Parameterization” on page 1261

Chapter 1.8.7.2.9 “Diagnosis” on page 1267

CAUTION!

Risk of overloading the analog input!

If an analog current sensor supplies more than 25 mA for more than 1 second during initialization, this input is switched off by the module (input protection).

Use only sensors with fast initialization or without current peaks higher than 25 mA. If not possible, connect a 10-volt zener diode in parallel to AIx+ and ZP.

Unused input channels can be left open-circuited, because they are of low resistance.

To avoid error messages through unused analog input channels in measuring range 4 mA ... 20 mA, these channels should be configured as "Not used".

Connection of active-type analog sensors (Voltage) to differential analog inputs

Differential inputs are very useful, if analog sensors are used which are remotely non-isolated (e.g. the minus terminal is remotely grounded).

The evaluation using differential inputs helps to considerably increase the measuring accuracy and to avoid ground loops.

With differential input configurations, two adjacent analog channels belong together (e.g. the channels 0 and 1). In this case, both channels are configured according to the desired operating mode. The lower address must be the even address (channel 0), the next higher address must be the odd address (channel 1). The converted analog value is available at the higher address (channel 1).

The analog value is calculated by subtraction of the input value with the higher address from the input value of the lower address.

The converted analog value is available at the odd channel (higher address).

CAUTION!
Risk of faulty measurements!
The negative pin at the sensors must not have too big a potential difference with respect to ZP (max. ± 1 V).

Make sure that the potential difference never exceeds ± 1 V.

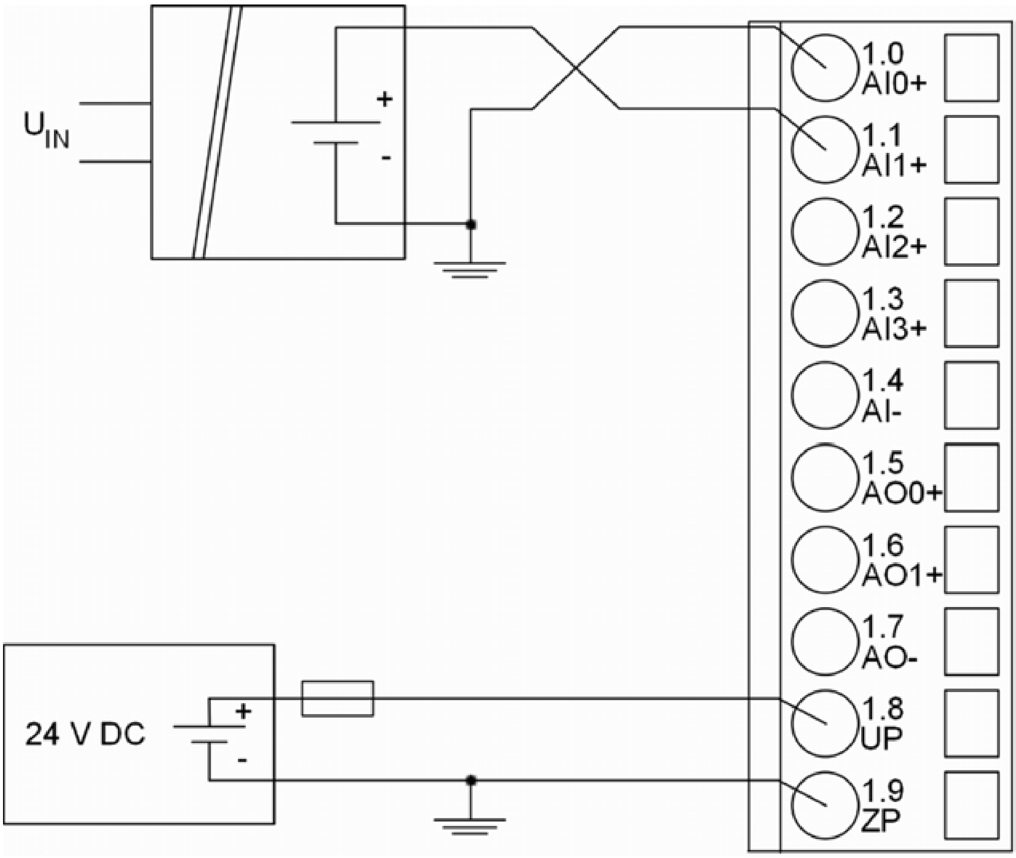


Fig. 330: Connection of active-type analog sensors (voltage) to differential analog inputs (AI0 ... AI3)

Table 316: Configurable measuring ranges

Voltage	0 V ... 10 V	With differential inputs, 2 channels used
Voltage	-10 V ... +10 V	With differential inputs, 2 channels used

Chapter 1.8.7.2.8 “Parameterization” on page 1261

Chapter 1.8.7.2.9 “Diagnosis” on page 1267

To avoid error messages from unused analog input channels, configure them as "unused".

Use of analog inputs as digital inputs

Several (or all) analog inputs can be configured as digital inputs. The inputs are not galvanically isolated against the other analog channels.

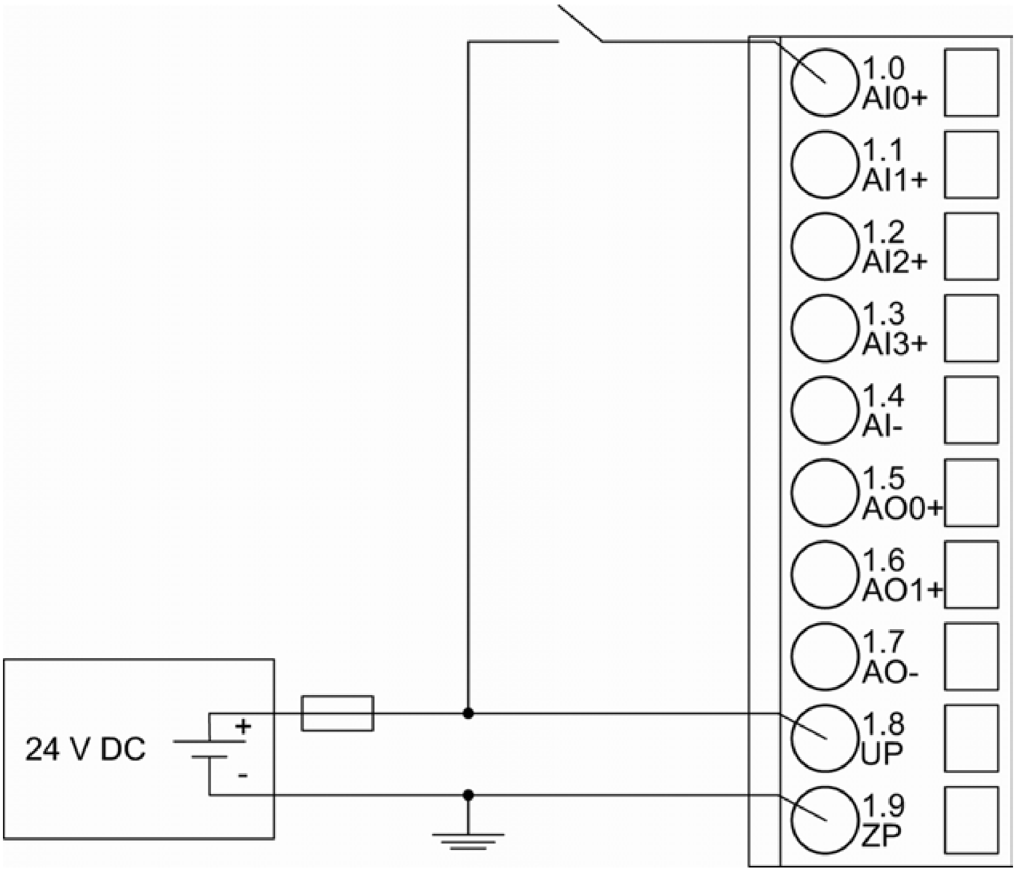


Fig. 331: Connection of digital sensors to the analog inputs (AI0 ... AI3)

Table 317: Configurable measuring ranges

Digital input	24 V	1 channel used
Effect of incorrect input terminal connection		Wrong or no signal detected, no damage up to 35 V

↳ *Chapter 1.8.7.2.8 “Parameterization” on page 1261*

↳ *Chapter 1.8.7.2.9 “Diagnosis” on page 1267*

Connection of analog output loads (Voltage)

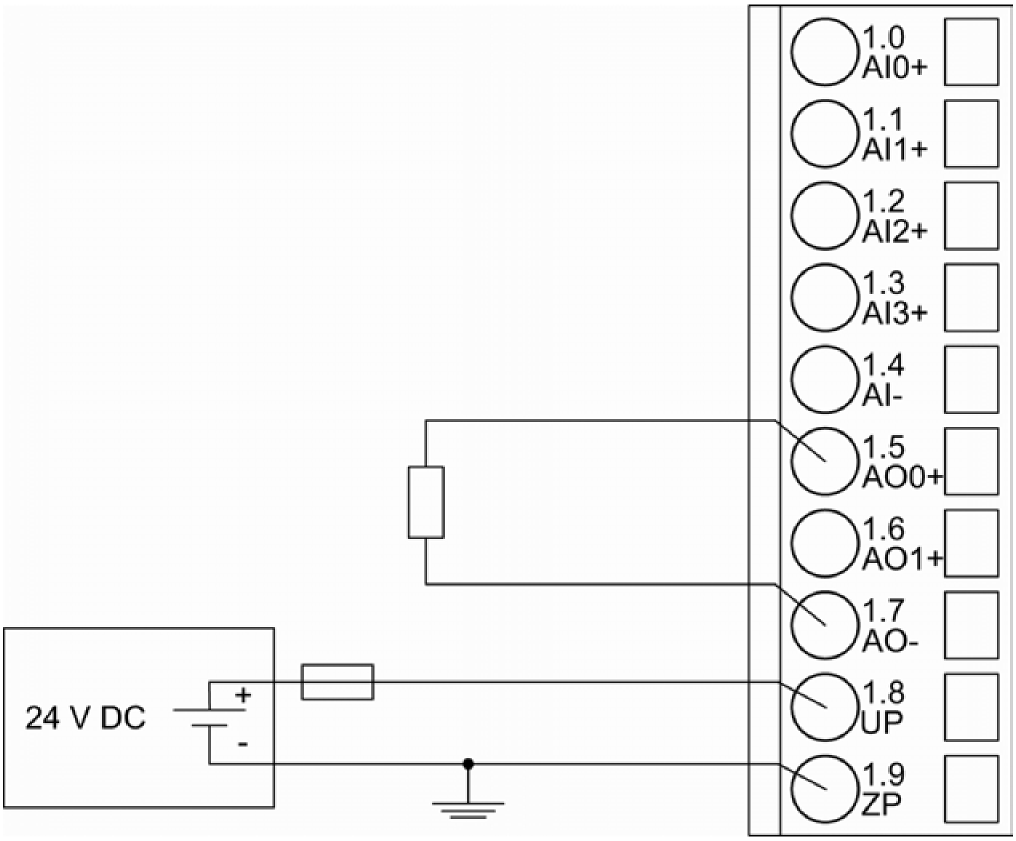


Fig. 332: Connection of analog output loads (voltage) to the analog outputs (AO0 ... AO1)

Table 318: Configurable measuring ranges

Voltage	-10 V ... +10 V	Load ± 10 mA max.	1 channel used

Chapter 1.8.7.2.8 “Parameterization” on page 1261

Chapter 1.8.7.2.9 “Diagnosis” on page 1267

Unused analog outputs can be left open-circuited.

Connection of analog output loads (Current)

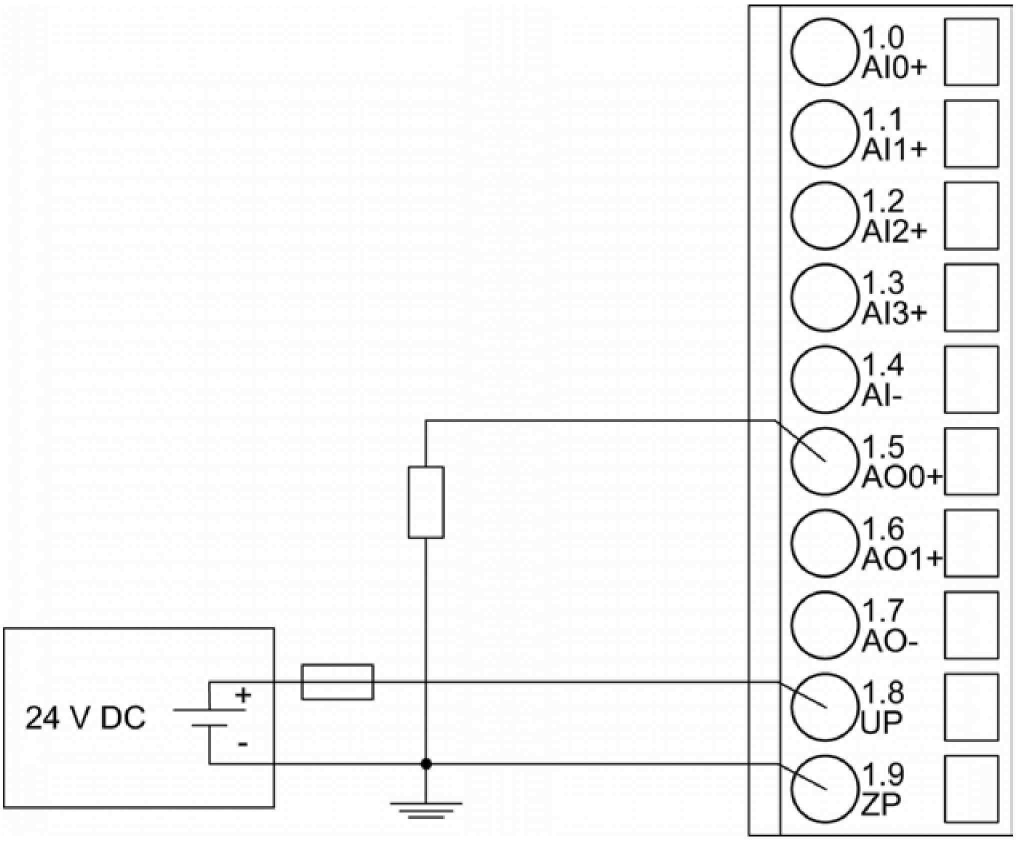


Fig. 333: Connection of analog output loads (current) to the analog otputs (AO0 and AO1)

Table 319: Configurable measuring ranges

Current	0 mA ... 20 mA	Load 0 Ω...500 Ω	1 channel used
Current	4 mA ... 20 mA	Load 0 Ω...500 Ω	1 channel used

Chapter 1.8.7.2.8 “Parameterization” on page 1261

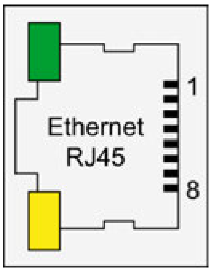
Chapter 1.8.7.2.9 “Diagnosis” on page 1267

Unused analog outputs can be left open-circuited.

Assignment of the Ethernet ports

The terminal unit for the communication interface module provides two Ethernet interfaces with the following pin assignment:

Pin assignment

Interface	Pin	Signal	Description
	1	TxD+	Transmit data +
	2	TxD-	Transmit data -
	3	RxD+	Receive data +
	4	NC	Not connected
	5	NC	Not connected
	6	RxD-	Receive data -
	7	NC	Not connected

Interface	Pin	Signal	Description
	8	NC	Not connected
	Shield	Cable shield	Functional earth

In corrosive environment, please protect unused connectors using the TA535 accessory.

Not supplied with this device.

Further information about wiring and cable types

1.8.7.2.5 Internal data exchange

Parameter	Value
Digital inputs (bytes)	3
Digital outputs (bytes)	3
Analog inputs (words)	4
Analog outputs (words)	2
Counter input data (words)	4
Counter output data (words)	8

1.8.7.2.6 Addressing

The module has 2 rotary switches to set an explicit name to the PROFINET IO device before commissioning. No engineering tool is needed in this case.

The device gets its name (including the fixed part of the device name) with the switch settings (01h...FFh). This name can be used directly within the device configuration: “CI5xx-pn-yy”

"CI5xx-pn-yy” xx is the fixed part of the device name (e.g. CI501) and yy represents the position of the rotary switch (0..FFh). The rotary switch values must be entered in hexadecimal format. For example, to set the name to “CI5xx-pn-08”, set the upper rotary switch to “0” and the lower switch to “8”.

The module reads the position of the rotary switches only during power-up, i.e. changes of the switch position during operation will have no effect until the next module initialization.

1.8.7.2.7 I/O configuration

The CI501-PNIO stores some PROFINET configuration parameters (I/O device identifier, I/O device type and IP address configuration). No more configuration data is stored.

The analog/digital I/O channels are configured via software.

Chapter 1.8.7.2.8 “Parameterization” on page 1261

1.8.7.2.8 Parameterization

Parameters of the module

Name	Value	Internal value	Internal value, type	Default
Module ID [1])	Internal	7000	WORD	7000
Parameter length	Internal	25	BYTE	25
Error LED / Fail-safe function see table Error LED / Failsafe function *Table 320 “Error LED / Failsafe function” on page 1262*	On	0	BYTE	0
	Off by E4	1		
	Off by E3	3		
	On + failsafe	16		
	Off by E4 + fail-safe	17		
	Off by E3 + fail-safe	19		
Process cycle time [2])	1 ms process cycle time	1	BYTE	1 ms
	2 ms process cycle time	2		
	3 ms process cycle time	3		
	4 ms process cycle time	4		
	5 ms process cycle time	5		
	6 ms process cycle time	6		
	7 ms process cycle time	7		
	8 ms process cycle time	8		
	9 ms process cycle time	9		
	10 ms process cycle time	10		
	11 ms process cycle time	11		
	12 ms process cycle time	12		
	13 ms process cycle time	13		
	14 ms process cycle time	14		
	15 ms process cycle time	15		
	16 ms process cycle time	16		
Check supply	off	0	BYTE	1
	on	1		

Name	Value	Internal value	Internal value, type	Default
Input delay	8 ms	8 ms	BYTE	8 ms
Fast counter	0 : 10 [3])	0 : 10	BYTE	0
Detect short circuit at outputs	On	1	BYTE	On
Behavior digital outputs at comm. error	Off	0	BYTE	Off
Substitute value digital outputs	0	0..255	BYTE	0
Overvoltage behavior on output	Off	0	BYTE	Off
Behavior analog outputs atcomm. error	Off	0	BYTE	Off
I/O-Bus reset	Off	0	BYTE	Off
	On	1	BYTE	Off

Remarks:

[1])	With a faulty ID, the modules reports a "parameter error" and does not perform cyclic process data transmission.
[2])	As for device index C0 the parameter is no longer evaluated.
[3])	Counter operating modes, see description of the Fast counter ⇘ *Chapter 1.6.1.2.10 “Fast counter” on page 545*.

Table 320: Error LED / Failsafe function

Setting	Description
On	Error LED (S-ERR) lights up at errors of all error classes, Failsafe-mode off
Off by E4	Error LED (S-ERR) lights up at errors of error classes E1, E2 and E3, Failsafe-mode off
Off by E3	Error LED (S-ERR) lights up at errors of error classes E1 and E2, Failsafe-mode off
On +Failsafe	Error LED (S-ERR) lights up at errors of all error classes, Failsafe-mode on *)
Off by E4 + Failsafe	Error LED (S-ERR) lights up at errors of error classes E1, E2 and E3, Failsafe-mode on *)
Off by E3 + Failsafe	Error LED (S-ERR) lights up at errors of error classes E1 and E2, Failsafe-mode on *)
*) The parameters Behaviour AO at comm. error and Behaviour DO at comm. error are only analyzed if the Failsafe-mode is ON.	

IO-BUS reset after PROFINET reconnection

IO-BUS reset after PROFINET reconnection controls the behavior of PROFINET CI modules in relation to connected I/O modules (both safety and non-safety I/O modules).

- IO-BUS reset after PROFINET reconnection = *"On"* resets and, thus, re-parameterizes all attached I/O modules. All internal I/O modules states are reset, including the related diagnosis information.

  Note that if the parameter is set to *"On"* then:
  - The bumpless re-start of non-safety I/O modules will not be supported. It means, for example, that non-safety output channels will go from fail-safe values to *"0"* values during the re-connection and re-parameterization time and after that go to new output values.
  - Safety I/O modules will be re-parameterized and re-started as newly started modules, which may not require their PROFIsafe reintegration, depending on safety CPU state, in the safety application.
- IO-BUS reset after PROFINET reconnection = *"Off"* will not reset all attached I/O modules. It will re-parameterize I/O modules only if parameter change is detected during the reconnection. All internal I/O modules states are not reset, including the related diagnosis information.

  Note that if the parameter is set to *"Off"* then:
  - The bumpless re-start of non-safety I/O modules is supported (if no parameters are changed). It means, for example, that non-safety output channels will not go from fail-safe values to *"0"* values during the re-connection and re-parameterization time, but directly from fail-safe values to new output values.
  - Safety I/O modules will not be re-parameterized (if no parameters are changed). Thus, they may continue their operation, which may require their PROFIsafe reintegration in the safety application on the safety CPU, e.g., if PROFIsafe watchdog time for this safety I/O module has expired. Any reintegration of such safety I/O modules will be not only application specific but also PROFIsafe specific and depend on the safety I/O handling in the safety application.

Group parameters for the analog part

Name	Value	Internal value	Internal value, type	Default
Analog data format	Standard	0	BYTE	0
	Reserved	255		
Behaviour AO at comm. error *)	Off	0	BYTE	0
	Last value	1		
	Last value 5 s	6		
	Last value 10 s	11		
	Substitute value	2		
	Substitute value 5 s	7		
	Substitute value 10 s	12		
*) The parameter Behaviour AO at comm. error is only analyzed if the Failsafe-mode is ON.				

Channel parameters for the analog inputs (4x)

Name	Value	Internal value	Internal value, type	Default
Input 0, Channel configuration	Table Operating modes of the analog inputs *Table 321 “Channel configuration” on page 1264*	Table Operating modes of the analog inputs *Table 321 “Channel configuration” on page 1264*	BYTE	0
Input 0, Check channel	Table Channel montoring *Table 322 “Channel monitoring” on page 1265*	Table Channel montoring *Table 322 “Channel monitoring” on page 1265*	BYTE	0
:	:	:	:	:
:	:	:	:	:
Input 3, Channel configuration	Table Operating modes of the analog inputs *Table 321 “Channel configuration” on page 1264*	Table Operating modes of the analog inputs *Table 321 “Channel configuration” on page 1264*	BYTE	0
Input 3, Check channel	Table Channel montoring *Table 322 “Channel monitoring” on page 1265*	Table Channel montoring *Table 322 “Channel monitoring” on page 1265*	BYTE	0

Table 321: Channel configuration

Internal value	Operating modes of the analog inputs, individually configurable
0 (default)	Not used
1	0 V ... 10 V
2	Digital input
3	0 mA ... 20 mA
4	4 mA ... 20 mA
5	-10 V ... +10 V
8	2-wire Pt100 -50 °C ... +400 °C
9	3-wire Pt100 -50 °C ... +400 °C *)
10	0 V ... 10 V (voltage diff.) *)
11	-10 V ... +10 V (voltage diff.) *)
14	2-wire Pt100 -50 °C ... +70 °C
15	3-wire Pt100 -50 °C ... +70 °C *)
16	2-wire Pt1000 -50 °C ... +400 °C
17	3-wire Pt1000 -50 °C ... +400 °C *)
18	2-wire Ni1000 -50 °C ... +150 °C

Internal value	Operating modes of the analog inputs, individually configurable
19	3-wire Ni1000 -50 °C ... +150 °C *)
*) In the operating modes with 3-wire configuration or with differential inputs, two adjacent analog inputs belong together (e.g. the channels 0 and 1). In these cases, both channels are configured in the desired operating mode. The lower address must be the even address (channel 0). The next higher address must be the odd address (channel 1). The converted analog value is available at the higher address (channel 1).	

Table 322: Channel monitoring

Internal Value	Check Channel
0 (default)	Plausibility, wire break, short circuit
3	Not used

Channel parameters for the analog outputs (2x)

Name	Value	Internal value	Internal value, type	Default
Output 0, Channel configuration	Table Operating modes of the analog outputs *Further information on page 1266*	Table Operating modes of the analog outputs *Further information on page 1266*	BYTE	0
Output 0, Check channel	Table Channel monitoring *Table 324 “Channel monitoring” on page 1266*	Table Channel monitoring *Table 324 “Channel monitoring” on page 1266*	BYTE	0
Output 0, Substitute value	Table Substitute value *Table 325 “Substitute value” on page 1266*	Table Substitute value *Table 325 “Substitute value” on page 1266*	WORD	0
Output 1, Channel configuration	Table Operating modes of the analog outputs *Further information on page 1266*	Table Operating modes of the analog outputs *Further information on page 1266*	BYTE	0
Output 1, Check channel	Table Channel monitoring *Table 324 “Channel monitoring” on page 1266*	Table Channel monitoring *Table 324 “Channel monitoring” on page 1266*	BYTE	0
Output 1, Substitute value	Table Substitute value *Table 325 “Substitute value” on page 1266*	Table Substitute value *Table 325 “Substitute value” on page 1266*	WORD	0

Table 323: Channel configuration

Internal value	Operating modes of the analog outputs, individually configurable
0 (default)	Not used
128	-10 V ... +10 V
129	0 mA ... 20 mA
130	4 mA ... 20 mA

Table 324: Channel monitoring

Internal value	Check channel
0	Plausibility, wire break, short circuit
3	None

Table 325: Substitute value

Intended behavior of output channel when the control system stops	Required setting of the module parameter "Behaviour of outputs in case of a communication error"	Required setting of the channel parameter "Substitute value"
Output OFF	Off	0
Last value infinite	Last value	0
Last value for 5 s and then turn off	Last value 5 sec	0
Last value for 10 s and then turn off	Last value 10 sec	0
Substitute value infinite	Substitute value	Depending on configuration
Substitute value for 5 s and then turn off	Substitute value 5 sec	Depending on configuration
Substitute value for 10 s and then turn off	Substitute value 10 sec	Depending on configuration

Group parameters for the digital part

Name	Value	Internal value	Internal value, type	Default
Input delay	0.1 ms	0	BYTE	0.1 ms
	1 ms	1		0x00
	8 ms	2		
	32 ms	3		
Detect short circuit at outputs	Off	0	BYTE	On
	On	1		0x01

Name	Value	Internal value	Internal value, type	Default
Behaviour DO at comm. error [1])	Off Last value Last value 5 sec Last value 10 sec Substitute value Substitute value 5 sec Substitute value 10 sec	0 1 6 11 2 7 12	BYTE	Off 0x00
Substitute value at output	0 ... 255	00h ... FFh	BYTE	0 0x0000
Detect voltage overflow at outputs [2])	Off On	0 1	BYTE	On 0x01

[1]) The parameters Behaviour DO at comm. error is only analyzed if the Failsafe-mode is ON.

[2]) The state "externally voltage detected" appears, if the output of a channel DC0 ... DC7 should be switched on while an externally voltage is connected *Chapter 1.8.7.2.4 “Connections” on page 1244*. In this case the start up is disabled, as long as the externally voltage is connected. The monitoring of this state and the resulting diagnosis message can be disabled by setting the parameters to "OFF".

1.8.7.2.9 Diagnosis

Table 326: Structure of the diagnosis block via PNIO_DEV_ALARM function block

Byte Number	Description	Possible Values
1	Diagnosis Byte, slot number	31 = CI501-PNIO (e. g. error at integrated 8 DI / 8 DO) 1 = 1st connected S500 I/O module ... 10 = 10th connected S500 I/O module
2	Diagnosis Byte, module number	According to the I/O bus specification passed on by modules to the fieldbus master
3	Diagnosis Byte, channel	According to the I/O bus specification passed on by modules to the fieldbus master

Byte Number	Description	Possible Values
4	Diagnosis Byte, error code	According to the I/O bus specification Bit 7 and bit 6, coded error class 0 = E1 1 = E2 2 = E3 3 = E4 Bit 0 to bit 5, coded error description
5	Diagnosis Byte, flags	According to the I/O bus specification Bit 7: 1 = coming error Bit 6: 1 = leaving error

In cases of short circuit or overload, the digital outputs are turned off. The modules performs reactivation automatically. Thus an acknowledgement of the errors is not necessary. The error message is stored via the LED.

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier** **000 ... 063**	**AC500-Display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 4 **Bit 6 ... 7**	**-**	**Byte 1**	**Byte 2**	**Byte 3**	**Byte 4** **Bit 0 ... 5**	**PNIO diag-nosis block**	
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error-** **Identi-fier**	**Error message**	**Remedy**
	1)	**2)**	**3)**				
Module errors							
3	-	31	31	31	19	Checksum error in the I/O module	Replace I/O module
3	-	31	31	31	3	Timeout in the I/O module	
3	-	31	31	31	40	Different hard-/firm-ware versions in the module	
3	-	31	31	31	43	Internal error in the module	
3	-	31	31	31	36	Internal data exchange failure	
3	-	31	31	31	9	Overflow diagnosis buffer	Restart
3	-	31	31	31	26	Parameter error	Check master

E1 ... E4	d1	d2	d3	d4	Identi-fier 000 ... 063	AC500-Display	<− Display in
Class	Comp	Dev	Mod	Ch	Err	PS501 PLC Browser	
Byte 4 Bit 6 ... 7	-	Byte 1	Byte 2	Byte 3	Byte 4 Bit 0 ... 5	PNIO diag-nosis block	
Class	Inter-face	Device	Module	Channel	Error- Identi-fier	Error message	Remedy
	[1])	[2])	[3])				
3	-	31	31	31	11	Process voltage UP too low	Check process supply voltage
3	-	31	31	31	45	No process voltage UP	Check process supply voltage
3	-	31/1...10	31	31	17	No communication with I/O module	Replace I/O module
3	-	1...10	31	31	32	Wrong I/O module type on socket	Replace I/O module / Check configu-ration
4	-	1...10	31	31	31	At least one module does not support failsafe function	Check modules and parame-terization
4	-	1...10	31	5	8	I/O module removed from hot swap terminal unit or defective module on hot swap ter-minal unit [9])	Plug I/O module, replace I/O module
4	-	1...10	31	5	28	Wrong I/O module plugged on hot swap terminal unit [9])	Remove wrong I/O module and plug pro-jected I/O module
4	-	1...10	31	5	42	No communication with I/O module on hot swap terminal unit [9])	Replace I/O module

E1 ... E4	d1	d2	d3	d4	Identi-fier 000 ... 063	AC500-Display	<− Display in
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 4 Bit 6 ... 7	**-**	**Byte 1**	**Byte 2**	**Byte 3**	**Byte 4 Bit 0 ... 5**	**PNIO diag-nosis block**	
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error- Identi-fier**	**Error message**	**Remedy**
	[1])	[2])	[3])				
4	-	1...10	31	5	54	I/O module does not support hot swap [8]) [9])	Power off system and replace I/O module
4	-	1...10	31	6	8	Hot swap terminal unit configured but not found	Replace terminal unit by hot swap terminal unit
4	-	1...10	31	6	42	No communication with hot swap ter-minal unit [9])	Restart, if error persists replace terminal unit
4	-	31	31	31	46	Voltage feedback on activated digital outputs DO0...DO7 on UP3 [4])	Check terminals
4	-	31/1...10	31	31	34	No response during initialization of the I/O module	Replace I/O module
4	-	31	31	31	11	Process voltage UP3 too low	Check process supply voltage
4	1...6	255	2	0	45	The connected Communication Module has no con-nection to the net-work	Check cabeling
4	-	31	31	31	45	No process voltage UP3	Check process supply voltage

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier** **000 ... 063**	**AC500-Display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 4 **Bit 6 ... 7**	**-**	**Byte 1**	**Byte 2**	**Byte 3**	**Byte 4** **Bit 0 ... 5**	**PNIO diag-nosis block**	
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error-** **Identi-fier**	**Error message**	**Remedy**
	[1])	[2])	[3])				
4	-	31	31	31	10	Voltage overflow on outputs (above UP3 level) [5])	Check termi-nals/ check process supply voltage
Channel error digital							
4	-	31	2	0...7	46	Externally voltage detected at digital output DO0...DO7 [6])	Check terminals
4	-	31	2	0...7	47	Short circuit at dig-ital output [7])	Check terminals
Channel error analog							
4	-	31	1	0...3	48	Analog value over-flow or broken wire at an analog input	Check value or check terminals
4	-	31	1	0...3	7	Analog value underflow at an analog input	Check value
4	-	31	1	0...3	47	Short circuit at an analog input	Check terminals
4	-	31	3	0...1	4	Analog value over-flow at an analog output	Check output value
4	-	31	3	0...1	7	Analog value underflow at an analog output	Check output value

Remarks:

1)	In AC500 the following interface identifier applies: "-" = Diagnosis via bus-specific function blocks; 0 ... 4 or 10 = Position of the communication module;14 = I/O bus; 31 = Module itself The identifier is not contained in the CI501-PNIO diagnosis block.
2)	With "Device" the following allocation applies: 31 = Module itself; 1 ... 10 = Expansion module
3)	With "Module" the following allocation applies: 31 = Module itself Module type (1 = AI, 2 = DO, 3 = AO)
4)	This message appears, if externally voltages at one or more terminals DO0 ... DO7 cause that other digital outputs are supplied through that voltage *Chapter 1.8.7.2.4 “Connections” on page 1244*. All outputs of the apply digital output groups will be turned off for 5 seconds. The diagnosis message appears for the whole output group.
5)	The voltage on digital outputs DO0 ... DO7 has overrun the process supply voltage UP3 *Chapter 1.8.7.2.4 “Connections” on page 1244*. Diagnosis message appears for the whole module.
6)	This message appears, if the output of a channel DO0 ... DO7 should be switched on while an externally voltage is connected. In this case the start up is disabled, as long as the externally voltage is connected. Otherwise this could produce reverse voltage from this output to other digital outputs. This diagnosis message appears per channel.
7)	Short circuit: After a detected short circuit, the output is deactivated for 100 ms. Then a new start up will be executed. This diagnosis message appears per channel.
8)	In case of an I/O module doesn’t support hot swapping, do not perform any hot swap operations (also not on any other terminal units (slots)) as modules may be damaged or I/O bus communication may be disturbed.
9)	Diagnosis for hot swap available as of version index F0.

1.8.7.2.10 State LEDs

The LEDs are located at the front of module. There are 2 different groups:

- The 5 system LEDs (PWR, STA1 ETH, STA2 ETH, S-ERR and I/O-Bus) show the operation state of the module and display possible errors.
- The 27 process LEDs (UP, UP3, inputs, outputs, CH-ERR1 to CH-ERR3) show the process supply voltage and the states of the inputs and outputs and display possible errors.

Table 327: States of the 5 system LEDs

LED	Color	OFF	ON	Flashing
PWR/RUN	Green	Process supply voltage missing	Internal supply voltage OK, module ready for communication with I/O Controller	Start-up / preparing communication
	Yellow	---	---	---
STA1 ETH (System LED "BF")	Green	---	Device configured, cyclic data exchange running	---

LED	Color	OFF	ON	Flashing
	Red	---	---	Device is not configured
STA2 ETH (System LED "SF")	Green	---	---	Got identification request from I/O controller
	Red	No system error	System error (collective error)	---
S-ERR	Red	No error	Internal error	--
I/O-Bus	Green	No expansion modules con-nected or com-munication error	Expansion modules con-nected and operational	---
ETH1	Green	No connection at Ethernet inter-face	Connected to Ethernet inter-face	---
	Yellow	---	Device is trans-mitting telegrams	Device is trans-mitting telegrams
ETH2	Green	No connection at Ethernet inter-face	Connected to Ethernet inter-face	---
	Yellow	---	Device is trans-mitting telegrams	Device is trans-mitting telegrams

Table 328: States of the 27 process LEDs

LED	Color	OFF	ON	Flashing
AI0 ... AI3	Yellow	Input is OFF	Input is ON (brightness depends on the value of the analog signal)	--
AO0 ... AO1	Yellow	Output is OFF	Output is ON (brightness depends on the value of the analog signal)	--
DI0 ... DI7	Yellow	Input is OFF	Input is ON (the input voltage is even displayed if the supply voltage is OFF)	--
DO0 ... DO7	Yellow	Output is OFF	Output is ON	--
UP	Green	Process supply voltage missing	Process supply voltage OK and initialization fin-ished	--
UP3	Green	Process supply voltage missing	Process supply voltage OK	--
CH-ERR1 to CH-ERR3	Red	No error or process supply voltage missing	Internal error	Error on one channel of the corresponding group

1.8.7.2.11 Measuring ranges

Input ranges voltage, current and digital input

Range	0 V ... +10 V	-10 V ... +10 V	0 mA ... 20 mA	4 mA ... 20 mA	Digital input	Digital value	
						Decimal	Hex.
Overflow	> 11.7589	> 11.7589	> 23.5178	> 22.8142		32767	7FFF
Measured value too high	11.7589 : 10.0004	11.7589 : 10.0004	23.5178 : 20.0007	22.8142 : 20.0006		32511 : 27649	7EFF : 6C01
Normal range	10.0000 : 0.0004	10.0000 : 0.0004	20.0000 : 0.0007	20.0000 : 4.0006	: : On	27648 : 1	6C00 : 0001
Normal range or measured value too low	0.0000	0.0000	0	4	Off	0	0000
	-0.0004 -1.7593	-0.0004 : : -10,0000		3.9994 1.1858		-1 -4864 : -27648	FFFF ED00 : 9400
Measured value too low		-10.0004 : -11.7589				-27649 : -32512	93FF : 8100
Underflow	< 1.7593	< -11.7589	< 0.0000	< 1.1858		-32768	8000

The represented resolution corresponds to 16 bits.

Input ranges resistance temperature detector

Range	Pt100 / Pt1000 -50 ... +70 °C	Pt100 / Pt1000 -50 ... +400 °C	Ni1000 -50 ... +150 °C	Digital value	
				Decimal	Hex.
Overflow	> +80.0 °C	> +450.0 °C	> +160.0 °C	32767	7FFF
Measured value too high	+80.0 °C	+450.0 °C : +400.1 °C		4500 : 4001	1194 : 0FA1
			+160.0 °C : +150.1 °C	1600 : 1501	0640 : 05DD
Normal range		+400.0 °C : : : + 0.1 °C	+150.0 °C : : +0.1 °C	800 : 701	0320 : 02BD

Range	**Pt100 / Pt1000** **-50 ... +70 °C**	**Pt100 / Pt1000** **-50 ... +400 °C**	**Ni1000** **-50 ... +150 °C**	**Digital value**	
				Decimal	**Hex.**
		0.0 °C	0.0 °C	4000 1500 700 : 1	0FA0 05DC 02BC : 0001
		-0.1 °C : -50.0 °C	-0.1 °C : -50.0 °C	0	0000
Measured value too low	< -60.0 °C	-50.1 °C : -60.0 °C	-50.1 °C : -60.0 °C	-1 : -500	FFFF : FE0C
Underflow	< -60.0 °C	< -60.0 °C	< -60.0 °C	-501 : -600	FE0B : FDA8

Output ranges voltage and current

Range	**-10...+10 V**	**0...20 mA**	**4...20 mA**	**Digital value**	
				Decimal	**Hex.**
Overflow	> 11.7589 V	> 23.5178 mA	> 22.8142 mA	> 32511	> 7EFF
Measured value too high	11.7589 V : 10.0004 V	23.5178 mA : 20.0007 mA	22.8142 mA : 20.0006 mA	32511 : 27649	7EFF : 6C01
Normal range	10.0000 V : 0.0004 V	20.0000 mA : 0.0007 mA	20.0000 mA : 4.0006 mA	27648 : 1	6C00 : 0001
	0.0000 V	0.0000 mA	4.0000 mA	0	0000
	-0.0004 V : -10.0000 V	0 mA : 0 mA	3.9994 mA 0 mA 0 mA	-1 -6912 -27648	FFFF E500 9400
Measured value too low	-10.0004 V : -11.7589 V	0 mA : 0 mA	0 mA : 0 mA	-27649 : -32512	93FF : 8100
Underflow	< -11.7589 V	0 mA	0 mA	< -32512	< 8100

The represented resolution corresponds to 16 bits.

1.8.7.2.12 Technical data

Technical data of the module

The system data of AC500 and S500 are applicable to the standard version *Chapter 2.6.1 “System data AC500” on page 1408*.

The system data of AC500-XC are applicable to the XC version *Chapter 2.7.1 “System data AC500-XC” on page 1475*.

Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

Parameter		Value
Process supply voltages UP/UP3		
	Rated value	24 V DC (for inputs and outputs)
	Max. load for the terminals	10 A
	Protection against reversed voltage	Yes
	Rated protection fuse on UP/UP3	10 A fast
	Galvanic isolation	Ethernet interface against the rest of the module
	Inrush current from UP (at power up)	On request
	Current consumption via UP (normal operation)	0.2 A
	Current consumption via UP3	0.06 A + 0.5 A max. per output
	Connections	Terminals 1.8 and 2.8 for +24 V (UP) Terminal 3.8 for +24 V (UP3) Terminals 1.9, 2.9 and 3.9 for 0 V (ZP)
Max. power dissipation within the module		6 W
Number of digital inputs		8
Number of digital outputs		8
Number of analog inputs		4
Number of analog outputs		2
Input data length		19 bytes
Output data length		23 bytes
Reference potential for all digital inputs and outputs		Negative terminal of the supply voltage, signal name ZP
Setting of the I/O device identifier		With 2 rotary switches at the front side of the module
Diagnose		See Diagnosis and Displays *Chapter 1.8.7.2.9 “Diagnosis” on page 1267*
Operation and error displays		32 LEDs (totally)
Weight (without terminal unit)		Ca. 125 g
Mounting position		Horizontal or vertical with derating (output load reduced to 50 % at +40 °C per group)
Extended ambient temperature (XC version)		>+60 °C on request
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

NOTICE!
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and temporary overvoltage up to 30 V DC.

Multiple overloads
No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an internal smart high-side switch.

Parameter	Value
Bus connection	2 x RJ45
Switch	Integrated
Technology	Hilscher NETX 100
Transfer rate	10/100 Mbit/s (full-duplex)
Transfer method	According to Ethernet II, IEEE 802.3
Ethernet	100 base-TX, internal switch, 2x RJ45 socket
Expandability	Max. 10 S500 I/O modules
Adjusting elements	2 rotary switches for generation of an explicit name
Supported protocols	RTC - real time cyclic protocol, class 1 *) RTA - real time acyclic protocol DCP - discovery and configuration protocol CL-RPC - connectionless remote procedure Call LLDP - link layer discovery protocol MRP - MRP Client
Acyclic services	PNIO read / write sequence (max. 1024 bytes per telegram) Process-Alarm service
Supported alarm types	Process Alarm, Diagnostic Alarm, Return of SubModule, Plug Alarm, Pull Alarm
Min. bus cycle	1 ms
Conformance class	CC A
Protective functions (according to IEC 61131-3)	Protected against: ● short circuit ● reverse supply ● overvoltage ● reverse polarity Galvanic isolation from the rest of the module

*) Priorization with the aid of VLAN-ID including priority level

Technical data of the digital inputs

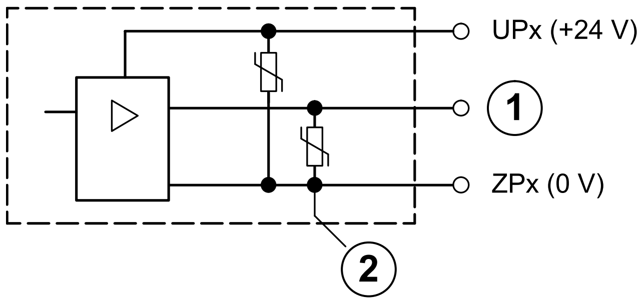
Parameter		Value
Number of channels per module		8
Distribution of the channels into groups		1 group of 8 channels
Terminals of the channels DI0 ... DI7		Terminals 2.0 ... 2.7
Reference potential for all inputs		Terminals 1.9 ... 3.9 (negative terminal of the supply voltage, signal name ZP)
Indication of the input signals		1 yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Input type (according EN 61131-2)		Type 1
Input delay (0->1 or 1->0)		Typ. 0.1 ms, configurable from 0.1 ms ... 32 ms
Input signal voltage		24 V DC
	0-Signal	-3 V ... +5 V
	Undefined Signal	> +5 V ... < +15 V
	1-Signal	+15 V ... +30 V
Ripple with signal 0		Within -3 V ... +5 V
Ripple with signal 1		Within +15 V ... +30 V
Input current per channel		
	Input voltage +24 V	Typ. 5 mA
	Input voltage +5 V	> 1 mA
	Input voltage +15 V	> 2 mA
	Input voltage +30 V	< 8 mA
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

Technical data of the digital outputs

Parameter		Value
Number of channels per module		8
Distribution of the channels into groups		1 group of 8 channels
Terminals of the channels DO0 ... DO7		Terminals 3.0 ... 3.7
Reference potential for all outputs		Terminals 1.9 ... 3.9 (negative terminal of the supply voltage, signal name ZP)
Common power supply voltage		For all outputs terminal 3.8 (positive terminal of the supply voltage, signal name UP3)
Output voltage for signal 1		UP3 (-0.8 V)
Output delay (0->1 or 1->0)		On request
Output current		
	Rated value per channel	500 mA at UP3 = 24 V
	Max. value (all channels together)	4 A
Leakage current with signal 0		< 0.5 mA

Parameter		Value
	Fuse for UP3	10 A fast
Demagnetization with inductive DC load		Via internal varistors (see figure below this table)
Output switching frequency		
	With resistive load	On request
	With inductive loads	Max. 0.5 Hz
	With lamp loads	11 Hz max. at 5 W max.
Short-circuit-proof / overload-proof		Yes
Overload message (I > 0.7 A)		Yes, after ca. 100 ms
Output current limitation		Yes, automatic reactivation after short circuit/overload
Resistance to feedback against 24 V signals		Yes (software-controlled supervision)
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

The following drawing shows the circuitry of a digital input/output with the varistors for demagnetization when inductive loads are switched off.



1 Digital output
2 Varistors for demagnetization when inductive loads are turned off

Technical data of the analog inputs

Parameter		Value
Number of channels per module		4
Distribution of channels into groups		1 group with 4 channels
Connection if channels AI0+ ... AI3+		Terminals 1.0 ... 1.3
Reference potential for AI0+ ... AI3+		Terminal 1.4 (AI-) for voltage and RTD measurement Terminal 1.9, 2.9 and 3.9 for current measurement
Input type		
	Unipolar	Voltage 0 V ... 10 V, current or Pt100/Pt1000/Ni1000
	Bipolar	Voltage -10 V ... +10 V
Galvanic isolation		Against Ethernet network

Parameter	Value
Configurability	0 V ... 10 V, -10 V ... +10 V, 0 mA ... 20 mA, 4 mA ... 20 mA Pt100/1000, Ni1000 (each input can be configured individually)
Channel input resistance	Voltage: > 100 kΩ Current: ca. 330 Ω
Time constant of the input filter	Voltage: 100 µs Current: 100 µs
Indication of the input signals	1 LED per channel (brightness depends on the value of the analog signal)
Conversion cycle	1 ms (for 4 inputs + 2 outputs); with RTDs Pt/ Ni... 1 s
Resolution	Range 0 V ... 10 V: 12 bits Range -10 V ... +10 V: 12 bits including sign Range 0 mA ... 20 mA: 12 bits Range 4 mA ... 20 mA: 12 bits Range RTD (Pt100, PT1000, Ni1000): +0.1 °C
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range	Typ. 0.5 %, max. 1 %
Relationship between input signal and hex code	
Unused inputs	Are configured as "unused" (default value)
Overvoltage protection	Yes

Technical data of the analog inputs, if used as digital inputs

Parameter		Value
Number of channels per module		Max. 4
Distribution of channels into groups		1 group of 4 channels
Connections of the channels AI0+ ... AI3+		Terminals 1.0 ... 1.3
Reference potential for the inputs		Terminals 1.9, 2.9 and 3.9 (ZP)
Indication of the input signals		1 LED per channel
Input signal voltage		24 V DC
	Signal 0	-30 V ... +5 V
	Undefined signal	+5 V ... +13 V
	Signal 1	+13 V ... +30 V
Input current per channel		
	Input voltage +24 V	Typ. 7 mA
	Input voltage +5 V	Typ. 1.4 mA
	Input voltage +15 V	Typ. 3.7 mA
	Input voltage +30 V	< 9 mA
Input resistance		Ca. 3.5 kΩ

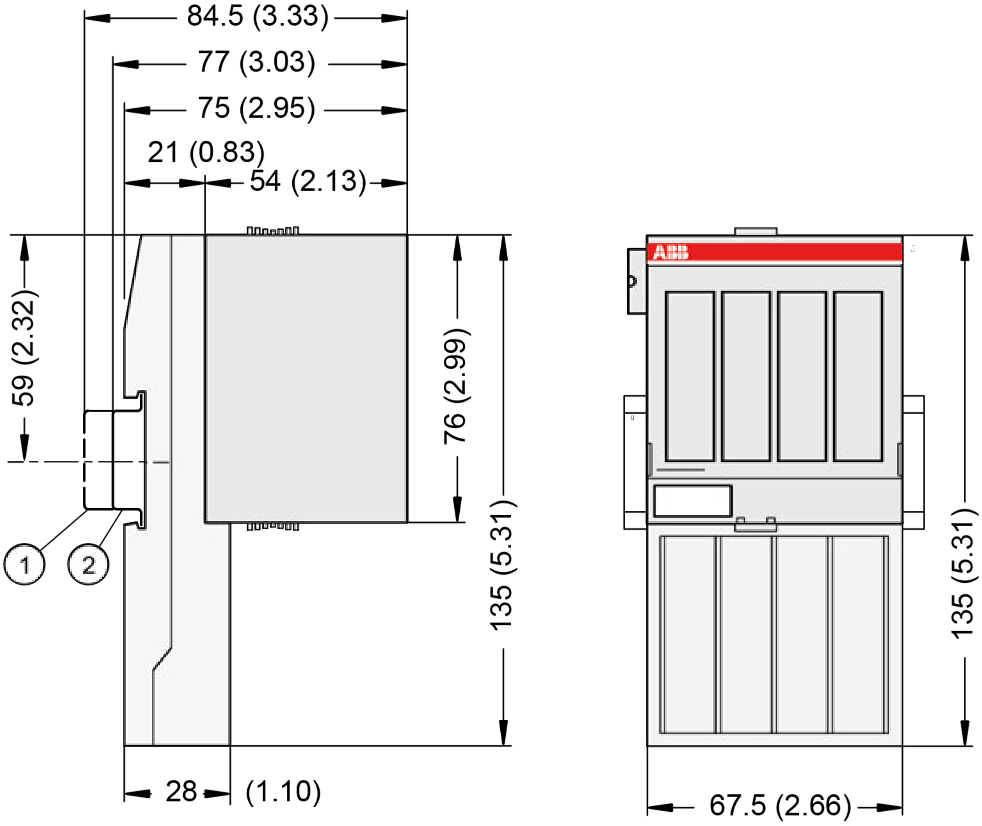
Technical data of the analog outputs

Parameter		Value
Number of channels per module		2
Distribution of channels into groups		1 group for 2 channels
Connection of the channels AO0+ ... AO1+		Terminals 1.5 ... 1.6
Reference potential for AO0+ ... AO1+		Terminal 1.7 (AO-) for voltage output terminal 1.9, 2.9 and 3.9 for current output
Output type		
	Unipolar	Current
	Bipolar	Voltage
Galvanic isolation		Against internal supply and other modules
Configurability		-10 V ... +10 V, 0 mA ... 20 mA, 4 mA ... 20 mA (each output can be configured individually)
Output resistance (load), as current output		0 Ω ... 500 Ω
Output loadability, as voltage output		± 10 mA max.
Indication of the output signals		1 LED per channel (brightness depends on the value of the analog signal)
Resolution		12 bits including sign
Settling time for full range change (resistive load, output signal within specified tolerance)		Typ. 5 ms
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range		Typ. 0.5 %, max. 1 %
Relationship between input signal and hex code		Table Output ranges voltage and current *Chapter 1.8.7.2.11.3 “Output ranges voltage and current” on page 1275*
Unused outputs		Are configured as "unused" (default value) and can be left open-circuited

Technical data of the fast counter

Parameter	Value
Used inputs	Terminal 2.0 (DI0), 2.1 (DI1)
Used outputs	Terminal 3.0 (DO0)
Counting frequency	Depending on operation mode: Mode 1 - 6: max. 200 kHz Mode 7: max. 50 kHz Mode 9: max. 35 kHz Mode 10: max. 20 kHz

1.8.7.2.13 Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

1.8.7.2.14 Ordering data

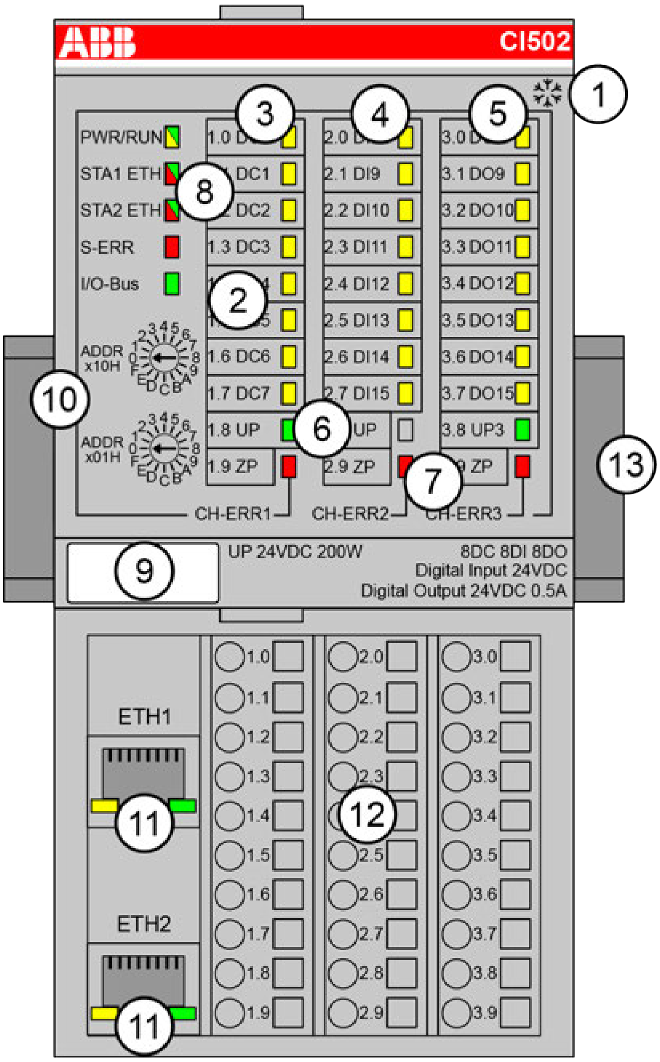
Part no.	Description	Product life cycle phase *)
1SAP 220 600 R0001	CI501-PNIO (V3), PROFINET communication interface module, 8 DI, 8 DO, 4 AI and 2 AO	Active
1SAP 420 600 R0001	CI501-PNIO-XC (V3), PROFINET communication interface module, 8 DI, 8 DO, 4 AI and 2 AO, XC version	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

1.8.7.3 CI502-PNIO

1.8.7.3.1 Features

- 8 digital inputs 24 V DC
- 8 digital outputs 24 V DC, 0.5 A max.
- 8 configurable digital inputs/outputs 24 V DC, 0.5 A max.
- Module-wise galvanically isolated
- Fast counter
- XC version for usage in extreme ambient conditions available



1 I/O bus
2 Allocation between terminal number and signal name
3 8 yellow LEDs to display the signal states of the digital configurable inputs/outputs (DC0 ... DC7)
4 8 yellow LEDs to display the signal states of the digital inputs (DI8 ... DI15)
5 8 yellow LEDs to display the signal states of the digital outputs (DO8 ... DO15)
6 2 green LEDs to display the process supply voltage UP and UP3
7 3 red LEDs to display errors (CH-ERR1, CH-ERR2, CH-ERR3)
8 5 system LEDs: PWR/RUN, STA1 ETH, STA2 ETH, S-ERR, I/O-Bus
9 Label
10 2 rotary switches for setting the I/O device identifier
11 Ethernet interfaces (ETH1, ETH2) on the terminal unit
12 Terminal unit
13 DIN rail
❄ Sign for XC version

1.8.7.3.2 Intended purpose

The PROFINET communication interface module CI502-PNIO is used as communication interface module in PROFINET networks. The network connection is performed via 2 RJ45 connectors which are integrated in the terminal unit.

For usage in extreme ambient conditions (e.g. wider temperature and humidity range), a special XC version of the device is available.

1.8.7.3.3 Functionality

The CI502 communication interface module contains 24 I/O channels with the following properties:

- 8 digital configurable inputs/outputs
- 8 digital inputs: 24 V DC
- 8 digital outputs: 24 V DC, 0.5 A max.

The inputs/outputs are galvanically isolated from the Ethernet network. There is no potential separation between the channels. The configuration of the analog inputs/outputs is performed by software.

Parameter	Value
Interface	Ethernet
Protocol	PROFINET IO RT
Power supply	From the process supply voltage UP
Supply of the electronic circuitry of the I/O expansion modules attached	Through the I/O bus interface (I/O bus)
Rotary switches	For setting the IO device identifier for configuration purposes (00h to FFh)
Configurable digital inputs/outputs	8 (configurable via software)
Digital inputs	8 (24 V DC; delay time configurable via software)
Digital outputs	8 (24 V DC, 0.5 A max.)
LED displays	For system displays, signal states, errors and power supply
External supply voltage	Via terminals ZP, UP and UP3 (process supply voltage 24 V DC)
Effect of incorrect input terminal connection	Wrong or no signal detected, no damage up to 35 V
Required terminal unit	TU507-ETH or TU508-ETH *Chapter 1.5.1 “TU507-ETH and TU508-ETH for Ethernet communication interface modules” on page 274*

1.8.7.3.4 Connections

General

The Ethernet communication interface module CI502-PNIO is plugged on the I/O terminal unit TU507-ETH *Chapter 1.5.1 “TU507-ETH and TU508-ETH for Ethernet communication interface modules” on page 274* or TU508-ETH *Chapter 1.5.1 “TU507-ETH and TU508-ETH for Ethernet communication interface modules” on page 274*. Properly seat the module and press until it locks in place. The terminal unit is mounted on a DIN rail or with 2 screws plus the additional accessory for wall mounting *Chapter 1.9.3.5 “TA526 - Wall mounting accessory” on page 1361*.

The connection of the I/O channels is carried out using the 30 terminals of the I/O terminal unit. I/O modules can be replaced without re-wiring the terminal units.

For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.

The terminals 1.8 and 2.8 as well as 1.9, 2.9 and 3.9 are electrically interconnected within the terminal unit and have always the same assignment, independent of the inserted module:

Terminals 1.8 and 2.8: Process supply voltage UP = +24 V DC

Terminal 3.8: Process supply voltage UP3 = +24 V DC

Terminals 1.9, 2.9 and 3.9: Process supply voltage ZP = 0 V.

The assignment of the other terminals:

With a separate UP3 power supply, the digital outputs can be switched off externally. This way, an emergency-off functionality can be realized.

Do not connect any voltages externally to digital outputs!

This ist not intended usage.

Reason: Externally voltages at one or more terminals DC0 ... DC7 or DO0 ... DO7 may cause that other digital outputs are supplied through that voltage instead of voltage UP3 (reverse voltage).

This is also possible, if DC channels are used as inputs. For this, the source for the input signals should be the impressed UP3 of the device.

This limitation does not apply for the input channels DI0 ... DI7.

CAUTION!
Risk of malfunction by unintended usage!
If the function cut-off of the digital outputs is to be used by deactivation of the supply voltage UP3, be sure that no external voltage is conncted at the outputs DO0 ... DO7 and DC0 ... DC7.

Table 329: Assignment of the other terminals

Terminal	Signal	Description
1.0	DC0	Signal of the configurable digital input/output DC0
1.1	DC1	Signal of the configurable digital input/output DC1
1.2	DC2	Signal of the configurable digital input/output DC2
1.3	DC3	Signal of the configurable digital input/output DC3
1.4	DC4	Signal of the configurable digital input/output DC4
1.5	DC5	Signal of the configurable digital input/output DC5

Terminal	Signal	Description
1.6	DC6	Signal of the configurable digital input/output DC6
1.7	DC7	Signal of the configurable digital input/output DC7
1.8	UP	Process voltage UP (24 V DC)
1.9	ZP	Process voltage ZP (0 V DC)
2.0	DI8	Signal of the digital input DI8
2.1	DI9	Signal of the digital input DI9
2.2	DI10	Signal of the digital input DI10
2.3	DI11	Signal of the digital input DI11
2.4	DI12	Signal of the digital input DI12
2.5	DI13	Signal of the digital input DI13
2.6	DI14	Signal of the digital input DI14
2.7	DI15	Signal of the digital input DI15
2.8	UP	Process voltage UP (24 V DC)
2.9	ZP	Process voltage ZP (0 V DC)
3.0	DO8	Signal of the digital output DO8
3.1	DO9	Signal of the digital output DO9
3.2	DO10	Signal of the digital output DO10
3.3	DO11	Signal of the digital output DO11
3.4	DO12	Signal of the digital output DO12
3.5	DO13	Signal of the digital output DO13
3.6	DO14	Signal of the digital output DO14
3.7	DO15	Signal of the digital output DO15
3.8	UP3	Process voltage UP3 (24 V DC)
3.9	ZP	Process voltage ZP (0 V DC)

WARNING!

Removal/Insertion under power

The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!
Risk of damaging the PLC modules!
Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

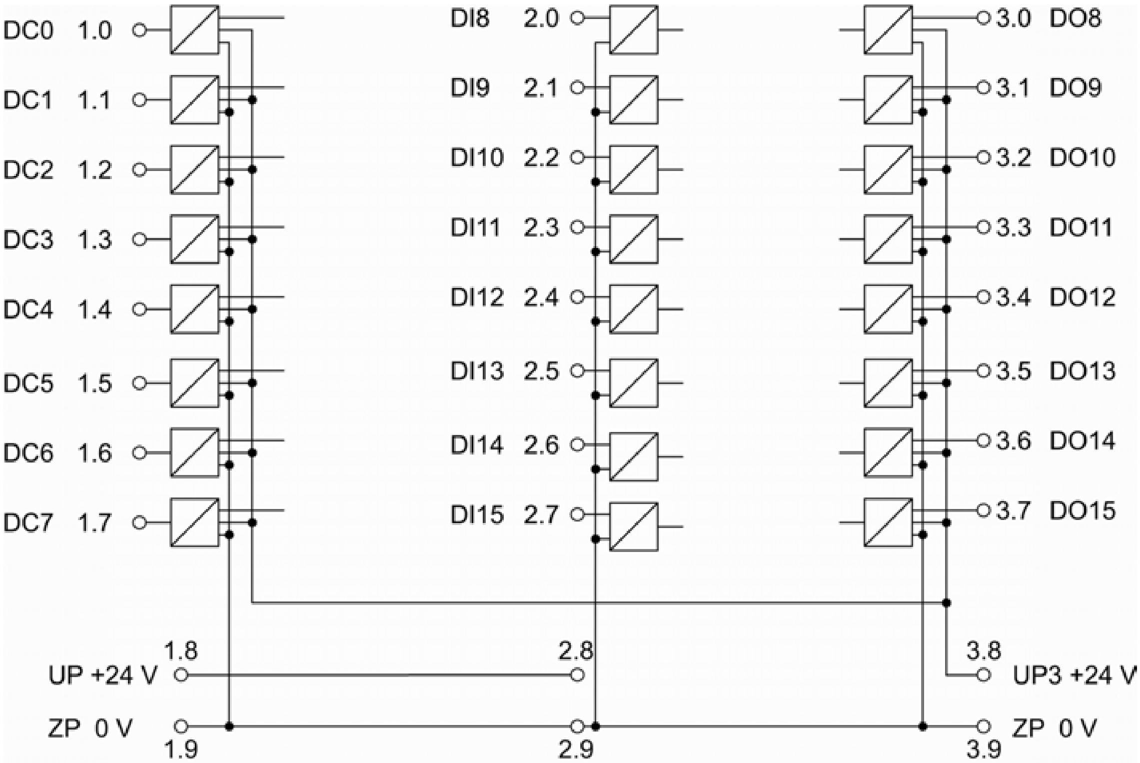


Fig. 334: Connection of the Ethernet communication interface module CI502-PNIO

Connection of the Digital inputs

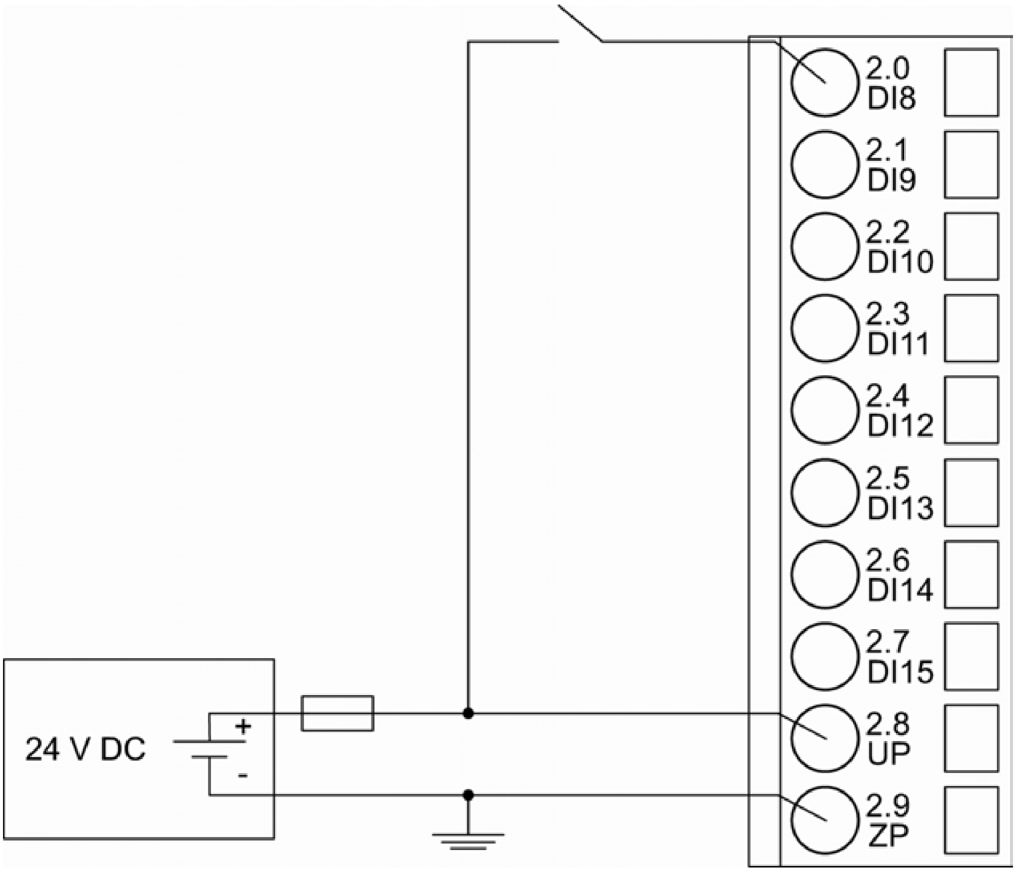


Fig. 335: Connection of the digital inputs (DI8 ... DI15)

The meaning of the LEDs is described in 'Displays' *Chapter 1.8.7.3.10 “State LEDs” on page 1300*.

Connection of the Digital outputs

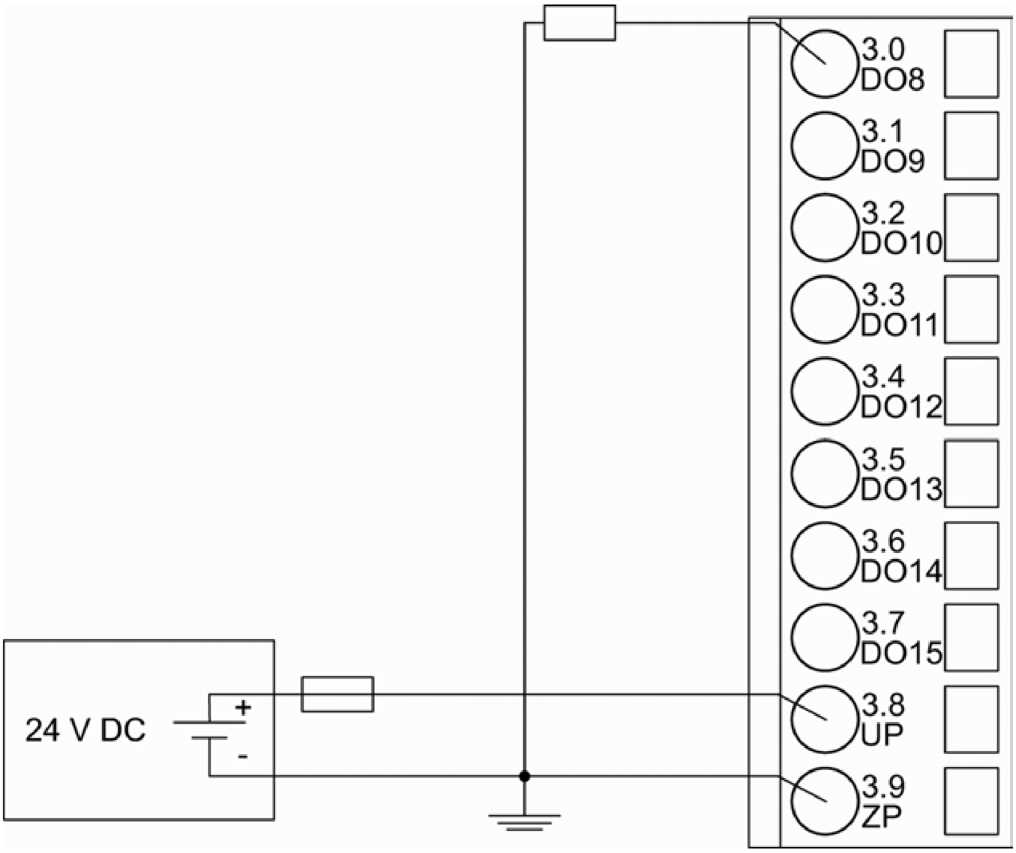


Fig. 336: Connection of the digital outputs (DO8 ... DO15)

The meaning of the LEDs is described in 'Displays' *Chapter 1.8.7.3.10 “State LEDs” on page 1300*.

Connection of the configurable digital inputs/outputs

The following figure shows the connection of the configurable digital input/output DC0 and DC1. DC0 is connected as an input and DC1 is connected as an output. Proceed with the configurable digital inputs/outputs DC2 ... DC7 in the same way.

> **CAUTION!**
> If a DC channel is used as input, the source for the input signals should be the impressed UP3 of the device *Chapter 1.8.7.3.4 “Connections” on page 1284*.

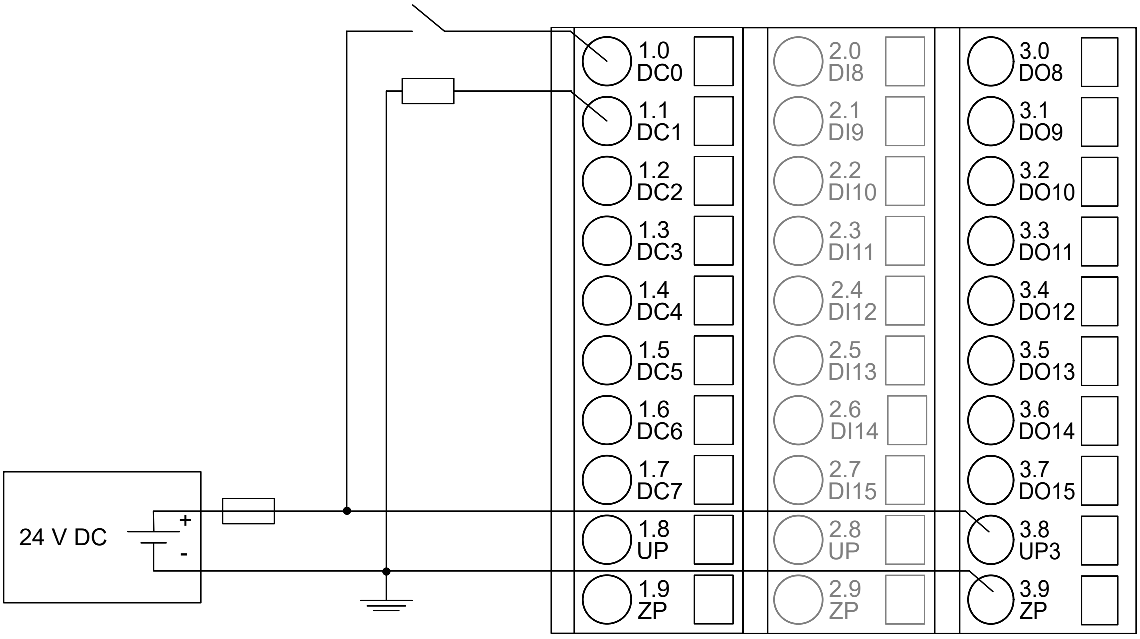


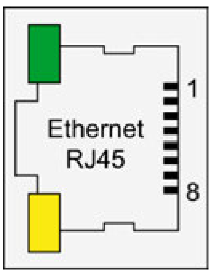
Fig. 337: Connection of the configurable digital inputs/outputs (DC0 ... DC7)(DC0 as input, DC1 as output)

The meaning of the LEDs is described in 'Displays' *Chapter 1.8.7.3.10 “State LEDs” on page 1300*.

Assignment of the Ethernet ports

The terminal unit for the communication interface module provides two Ethernet interfaces with the following pin assignment:

Pin assignment

Interface	Pin	Signal	Description
	1	TxD+	Transmit data +
	2	TxD-	Transmit data -
	3	RxD+	Receive data +
	4	NC	Not connected
	5	NC	Not connected
	6	RxD-	Receive data -
	7	NC	Not connected
	8	NC	Not connected
	Shield	Cable shield	Functional earth

In corrosive environment, please protect unused connectors using the TA535 accessory.

Not supplied with this device.

↪ *Further information about wiring and cable types*

1.8.7.3.5 Internal data exchange

Parameter	Value
Digital inputs (bytes)	5
Digital outputs (bytes)	5
Counter input data (words)	4
Counter output data (words)	8

1.8.7.3.6 Addressing

The module has 2 rotary switches to set an explicit name to the PROFINET IO device before commissioning. No engineering tool is needed in this case.

The device gets its name (including the fixed part of the device name) with the switch settings (01h...FFh). This name can be used directly within the device configuration: “CI5xx-pn-yy”

"CI5xx-pn-yy” xx is the fixed part of the device name (e.g. CI501) and yy represents the position of the rotary switch (0..FFh). The rotary switch values must be entered in hexadecimal format. For example, to set the name to “CI5xx-pn-08”, set the upper rotary switch to “0” and the lower switch to “8”.

The module reads the position of the rotary switches only during power-up, i.e. changes of the switch position during operation will have no effect until the next module initialization.

1.8.7.3.7 I/O configuration

The CI502-PNIO stores some PROFINET configuration parameters (I/O device identifier, I/O device type and IP address configuration). No more configuration data is stored.

The digital I/O channels are configured via software.

Details about configuration are described in 'Parameterization' ↪ *Chapter 1.8.7.3.8 “Parameterization” on page 1292*.

1.8.7.3.8 Parameterization

Parameters of the module

Name	Value	Internal value	Internal value, type	Default
Module ID [1])	Internal	7005	WORD	7005
Parameter length	Internal	8	BYTE	8
Error LED / Fail-safe function (Table Error LED / Failsafe function ↻ *Further information on page 1292*)	On	0	BYTE	0
	Off by E4	1		
	Off by E3	3		
	On + failsafe	16		
	Off by E4 + fail-safe	17		
	Off by E3 + fail-safe	19		
Process cycle time	1 ms process cycle time	1	BYTE	1 ms
	2 ms process cycle time	2		
	3 ms process cycle time	3		
	4 ms process cycle time	4		
	5 ms process cycle time	5		
	6 ms process cycle time	6		
	7 ms process cycle time	7		
	8 ms process cycle time	8		
	9 ms process cycle time	9		
	10 ms process cycle time	10		
	11 ms process cycle time	11		
	12 ms process cycle time	12		
	13 ms process cycle time	13		
	14 ms process cycle time	14		
	15 ms process cycle time	15		
	16 ms process cycle time	16		
Check supply	Off	0	BYTE	1
	On	1		

Name	Value	Internal value	Internal value, type	Default
Fast counter	0 : 10 [2])	0 : 10	BYTE	0
I/O-Bus reset	Off	0	BYTE	Off
	On	1	BYTE	Off
[1]) With a faulty ID, the module reports a "parameter error" and does not perform cyclic process data transmission. [2]) Counter operating modes *Chapter 1.6.1.2.10 “Fast counter” on page 545*				

Table 330: Table Error LED / Failsafe function

Setting	Description
On	Error LED (S-ERR) lights up at errors of all error classes, Failsafe-mode off
Off by E4	Error LED (S-ERR) lights up at errors of error classes E1, E2 and E3, Failsafe-mode off
Off by E3	Error LED (S-ERR) lights up at errors of error classes E1 and E2, Failsafe-mode off
On + Failsafe	Error LED (S-ERR) lights up at errors of all error classes, Failsafe-mode on *)
Off by E4 + Failsafe	Error LED (S-ERR) lights up at errors of error classes E1, E2 and E3, Failsafe-mode on *)
Off by E3 + Failsafe	Error LED (S-ERR) lights up at errors of error classes E1 and E2, Failsafe-mode on *)
*) The parameter Behaviour DO at comm. error is only analyzed if the Failsafe-mode is ON.	

IO-BUS reset after PROFINET reconnection

IO-BUS reset after PROFINET reconnection controls the behavior of PROFINET CI modules in relation to connected I/O modules (both safety and non-safety I/O modules).

- IO-BUS reset after PROFINET reconnection = *“On”* resets and, thus, re-parameterizes all attached I/O modules. All internal I/O modules states are reset, including the related diagnosis information.

  Note that if the parameter is set to *“On”* then:
  – The bumpless re-start of non-safety I/O modules will not be supported. It means, for example, that non-safety output channels will go from fail-safe values to *“0”* values during the re-connection and re-parameterization time and after that go to new output values.
  – Safety I/O modules will be re-parameterized and re-started as newly started modules, which may not require their PROFIsafe reintegration, depending on safety CPU state, in the safety application.
- IO-BUS reset after PROFINET reconnection = *“Off”* will not reset all attached I/O modules. It will re-parameterize I/O modules only if parameter change is detected during the reconnection. All internal I/O modules states are not reset, including the related diagnosis information.

  Note that if the parameter is set to *“Off”* then:
  – The bumpless re-start of non-safety I/O modules is supported (if no parameters are changed). It means, for example, that non-safety output channels will not go from fail-safe values to *“0”* values during the re-connection and re-parameterization time, but directly from fail-safe values to new output values.
  – Safety I/O modules will not be re-parameterized (if no parameters are changed). Thus, they may continue their operation, which may require their PROFIsafe reintegration in the safety application on the safety CPU, e.g., if PROFIsafe watchdog time for this safety I/O module has expired. Any reintegration of such safety I/O modules will be not only application specific but also PROFIsafe specific and depend on the safety I/O handling in the safety application.

Group parameters for the digital part

Name	Value	Internal value	Internal value, type	Default
Input delay	0.1 ms 1 ms 8 ms 32 ms	0 1 2 3	BYTE	0.1 ms 0x00
Detect short circuit at outputs	Off On	0 1	BYTE	On 0x01
Behaviour DO at comm. error [1])	Off Last value Last value 5 sec Last value 10 sec Substitute value Substitute value 5 sec Substitute value 10 sec	0 1 6 11 2 7 12	BYTE	Off 0x00
Substitute value at output	0 ... 65535	0000h ... FFFFh	WORD	0 0x0000

Name	Value	Internal value	Internal value, type	Default
Preventive voltage feedback monitoring for DC0..DC7 [2])	Off On	0 1	BYTE	Off 0x00
Detect voltage overflow at out-puts [3])	Off On	0 1	BYTE	Off 0x00

Remarks:

[1])	The parameter Behaviour DO at comm. error is apply to DC and DO channels and only analyzed if the Failsafe-mode is ON.
[2])	The state "externally voltage detected" appears, if the output of a channel DC0 ... DC7 should be switched on while an externally voltage is connected. In this case the start up is disabled, as long as the externally voltage is connected. The monitoring of this state and the resulting diagnosis message can be disabled by setting the parameters to "OFF".
[3])	The error state "voltage overflow at outputs" appears, if externally voltage at digital outputs DC0 ... DC7 and accordingly DO0 ... DO7 has exceeded the process supply voltage UP3 ⯑ *Chapter 1.8.7.3.4 “Connections” on page 1284* (see description in section). The according diagnosis message "Voltage overflow on outputs " can be disabled by setting the parameters on "OFF". This parameter should only be disabled in exceptional cases for voltage overflow may produce reverse voltage.

1.8.7.3.9 Diagnosis

Structure of the Diagnosis Block via function block PNIO_DEV_ALARM.

Byte Number	Description	Possible Values
1	Diagnosis Byte, slot number	31 = CI502-PNIO (e. g. error at integrated 8 DI / 8 DO) 1 = 1st connected S500 I/O module ... 10 = 10th connected S500 I/O module
2	Diagnosis Byte, module number	According to the I/O bus specification passed on by modules to the fieldbus master
3	Diagnosis Byte, channel	According to the I/O bus specification passed on by modules to the fieldbus master

Byte Number	Description	Possible Values
4	Diagnosis Byte, error code	According to the I/O bus specification Bit 7 and bit 6, coded error class 0 = E1 1 = E2 2 = E3 3 = E4 Bit 0 to bit 5, coded error description
5	Diagnosis Byte, flags	According to the I/O bus specification Bit 7: 1 = coming error Bit 6: 1 = leaving error

In cases of short circuit or overload, the digital outputs are turned off. The modules performs reactivation automatically. Thus an acknowledgement of the errors is not necessary. The error message is stored via the LED.

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier** **000 ... 063**	**AC500-Display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 4 **Bit 6 ... 7**	**-**	**Byte 1**	**Byte 2**	**Byte 3**	**Byte 4** **Bit 0 ... 5**	**PNIO diag-nosis block**	
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error-** **Identi-fier**	**Error message**	**Remedy**
	[1])	[2])	[3])				
Module errors							
3	-	31	31	31	19	Checksum error in the I/O module	Replace I/O module
3	-	31	31	31	3	Timeout in the I/O module	
3	-	31	31	31	40	Different hard-/firm-ware versions in the module	
3	-	31	31	31	43	Internal error in the module	
3	-	31	31	31	36	Internal data exchange failure	
3	-	31	31	31	9	Overflow diagnosis buffer	Restart
3	-	31	31	31	26	Parameter error	Check master

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier 000 ... 063**	**AC500-Display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 4 Bit 6 ... 7	**-**	**Byte 1**	**Byte 2**	**Byte 3**	**Byte 4 Bit 0 ... 5**	**PNIO diag-nosis block**	
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error-Identi-fier**	**Error message**	**Remedy**
	1)	2)	3)				
3	-	31	31	31	11	Process voltage UP too low	Check process supply voltage
3	-	31	31	31	45	Process voltage UP gone	Check process supply voltage
3	-	31/1 ... 10	31	31	17	No communication with I/O device	Replace I/O module
3	-	1 ... 10	31	31	32	Wrong I/O device type on socket	Replace I/O module / Check configu-ration
4	-	1 ... 10	31	31	31	At least one module does not support failsafe function	Check modules and parame-terization
4	-	1 ... 10	31	5	8	I/O module removed from hot swap terminal unit or defective module on hot swap ter-minal unit 9)	Plug I/O module, replace I/O module
4	-	1 ... 10	31	5	28	Wrong I/O module plugged on hot swap terminal unit 9)	Remove wrong I/O module and plug pro-jected I/O module
4	-	1 ... 10	31	5	42	No communication with I/O module on hot swap terminal unit 9)	Replace I/O module

E1 ... E4	d1	d2	d3	d4	Identi-fier 000 ... 063	AC500-Display	<− Display in
Class	Comp	Dev	Mod	Ch	Err	PS501 PLC Browser	
Byte 4 Bit 6 ... 7	-	Byte 1	Byte 2	Byte 3	Byte 4 Bit 0 ... 5	PNIO diag-nosis block	
Class	Inter-face	Device	Module	Channel	Error- Identi-fier	Error message	Remedy
	1)	2)	3)				
4	-	1 ... 10	31	5	54	I/O module does not support hot swap 8) 9)	Power off system and replace I/O module
4	-	1 ... 10	31	6	8	Hot swap terminal unit configured but not found	Replace terminal unit by hot swap terminal unit
4	-	1 ... 10	31	6	42	No communication with hot swap ter-minal unit 9)	Restart, if error persists replace terminal unit
4	1...6	255	2	0	45	The connected Communication Module has no con-nection to the net-work	Check cabeling
4	-	31	31	31	45	Process voltage UP3 too low	Check process voltage
4	-	31	31	31	46	Reverse voltage from digital outputs DO0..DO7 to UP3 4)	Check terminals
4	-	31/1 ... 10	31	31	34	No response during initialization of the I/O module	Replace I/O module
4	-	31	31	31	11	Process voltage UP3 too low	Check process supply voltage
4	-	31	31	31	45	Process voltage UP3 gone	Check process supply voltage

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier** **000 ... 063**	**AC500-Display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 4 **Bit 6 ... 7**	**-**	**Byte 1**	**Byte 2**	**Byte 3**	**Byte 4** **Bit 0 ... 5**	**PNIO diag-nosis block**	
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error-** **Identi-fier**	**Error message**	**Remedy**
	[1])	**[2])**	**[3])**				
4	-	31	31	31	10	Voltage overflow at outputs (above UP3 level) [5])	Check termi-nals/ check process supply voltage
Channel error digital							
4	-	31	2	8 ... 15	46	Externally voltage detected at digital output DO0 ... DO7 [6])	Check terminals
4	-	31	4	0 ... 7	46	Externally voltage detected at digital output DC0 ... DC7 [6])	Check terminals
4	-	31	4	0 ... 7	47	Short circuit at digital output DC0 ... DC7[7])	Check terminals
4	-	31	2	8 ... 15	47	Short circuit at digital output DO0 ... DO7[7])	Check terminals

Remarks:

[1])	In AC500 the following interface identifier applies: "-" = Diagnosis via bus-specific function blocks; 0 ... 4 or 10 = Position of the Communication Module;14 = I/O-Bus; 31 = Module itself The identifier is not contained in the CI502-PNIO diagnosis block.
[2])	With "Device" the following allocation applies: 31 = Module itself, 1 ... 10 = Expansion module
[3])	With "Module" the following allocation applies dependent of the master: Module error: 31 = Module itself Channel error: Module type (1 = AI, 2 = DO, 3 = AO)

[4])	This message appears, if externally voltages at one or more terminals DC0 ... DC7 oder DO0 ... DO7 cause that other digital outputs are supplied through that voltage (voltage feedback, see description in 'Connections' *Chapter 1.8.7.3.4 "Connections" on page 1284*. All outputs of the apply digital output groups will be turned off for 5 seconds. The diagnosis message appears for the whole output group.
[5])	The voltage at digital outputs DC0 ... DC7 and accordingly DO0 ... DO7 has exceeded the process supply voltage UP3 *Chapter 1.8.7.3.4 "Connections" on page 1284*. Diagnosis message appears for the whole module.
[6])	This message appears, if the output of a channel DC0 ... DC7 or DO0 ... DO7 should be switched on while an externally voltage is connected. In this case the start up is disabled, as long as the externally voltage is connected. Otherwise this could produce reverse voltage from this output to other digital outputs. This diagnosis message appears per channel.
[7])	Short circuit: After a detected short circuit, the output is deactivated for 2000 ms. Then a new start up will be executed. This diagnosis message appears per channel.
[8])	In case of an I/O module doesn't support hot swapping, do not perform any hot swap operations (also not on any other terminal units (slots)) as modules may be damaged or I/O bus communication may be disturbed.
[9])	Diagnosis for hot swap available as of version index F0.

1.8.7.3.10 State LEDs

The LEDs are located at the front of module. There are 2 different groups:

- The 5 system LEDs (PWR, STA1 ETH, STA2 ETH, S-ERR and I/O-Bus) show the operation state of the module and display possible errors.
- The 29 process LEDs (UP, UP3, inputs, outputs, CH-ERR1 to CH-ERR3) show the process supply voltage and the states of the inputs and outputs and display possible errors.

Table 331: States of the 5 system LEDs

LED	Color	OFF	ON	Flashing
PWR/RUN	Green	Process supply voltage missing	Internal supply voltage OK, module ready for communication with IO Controller	Start-up / preparing communication
	Yellow	---	---	---
STA1 ETH (System-LED "BF")	Green	---	Device configured, cyclic data exchange running	---
	Red	---	---	Device is not configured
STA2 ETH (System LED "SF")	Green	---	---	Got identification request from I/O controller
	Red	No system error	System error (collective error)	---
S-ERR	Red	No error	Internal error	--

LED	Color	OFF	ON	Flashing
I/O-Bus	Green	No expansion modules connected or communication error	Expansion modules connected and operational	---
ETH1	Green	No connection at Ethernet interface	Connected to Ethernet interface	---
	Yellow	---	Device is transmitting telegrams	Device is transmitting telegrams
ETH2	Green	No connection at Ethernet interface	Connected to Ethernet interface	---
	Yellow	---	Device is transmitting telegrams	Device is transmitting telegrams

Table 332: States of the 29 process LEDs

LED	Color	OFF	ON	Flashing
DC0 ... DC7	Yellow	Input/Output is OFF	Input/Output is ON	--
DI8 ... DI15	Yellow	Input is OFF	Input is ON (the input voltage is even displayed if the supply voltage is OFF)	--
DO8 ... DO15	Yellow	Output is OFF	Output is ON	--
UP	Green	Process supply voltage missing	Process supply voltage OK and initialization finished	--
UP3	Green	Process supply voltage missing	Process supply voltage OK	--
CH-ERR1 to CH-ERR3	Red	No error or process supply voltage missing	Internal error	Error on one channel of the corresponding group

1.8.7.3.11 Technical data

Technical data of the module

The system data of AC500 and S500 are applicable to the standard version *Chapter 2.6.1 “System data AC500” on page 1408*.

The system data of AC500-XC are applicable to the XC version *Chapter 2.7.1 “System data AC500-XC” on page 1475*.

Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

Parameter	Value
Process supply voltages UP/UP3	
Rated value	24 V DC (for inputs and outputs)
Max. load for the terminals	10 A
Protection against reversed voltage	Yes
Rated protection fuse on UP/UP3	10 A fast
Galvanic isolation	Ethernet interface against the rest of the module
Inrush current from UP (at power up)	On request
Current consumption via UP (normal operation)	0.15 A
Current consumption via UP3	0.06 A + 0.5 A max. per output
Connections	Terminals 1.8 and 2.8 for +24 V (UP) Terminal 3.8 for +24 V (UP3) Terminals 1.9, 2.9 and 3.9 for 0 V (ZP)
Max. power dissipation within the module	6 W
Number of digital inputs	8
Number of digital outputs	8
Number of configurable digital inputs/outputs	8
Input data length	12 bytes
Output data length	20 bytes
Reference potential for all digital inputs and outputs	Negative terminal of the supply voltage, signal name ZP
Setting of the I/O device identifier	With 2 rotary switches at the front side of the module
Diagnosis	See Diagnosis and Displays *Chapter 1.8.7.3.9 “Diagnosis” on page 1295*
Operation and error displays	34 LEDs (totally)
Weight (without terminal unit)	Ca. 125 g
Mounting position	Horizontal or vertical with derating (output load reduced to 50 % at +40 °C per group)
Extended ambient temperature (XC version)	> +60 °C on request
Cooling	The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

NOTICE!
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and temporary overvoltage up to 30 V DC.

Multiple overloads
No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an internal smart high-side switch.

Parameter	Value
Bus connection	2 x RJ45
Switch	Integrated
Technology	Hilscher NETX 100
Transfer rate	10/100 Mbit/s (full-duplex)
Transfer method	According to Ethernet II, IEEE 802.3
Ethernet	100 base-TX, internal switch, 2x RJ45 socket
Expandability	Max. 10 S500 I/O modules
Adjusting elements	2 rotary switches for generation of an explicit name
Supported protocols	RTC - real time cyclic protocol, class 1 *) RTA - real time acyclic protocol DCP - discovery and configuration protocol CL-RPC - connectionless remote procedure Call LLDP - link layer discovery protocol MRP - MRP Client
Acyclic services	PNIO read / write sequence (max. 1024 bytes per telegram) Process-Alarm service
Supported alarm types	Process Alarm, Diagnostic Alarm, Return of SubModule, Plug Alarm, Pull Alarm
Min. bus cycle	1 ms
Conformance class	CC A
Protective functions (according to IEC 61131-3)	Protected against: ● short circuit ● reverse supply ● overvoltage ● reverse polarity Galvanic isolation from the rest of the module

*) Priorization with the aid of VLAN-ID including priority level

Technical data of the digital inputs

Parameter	Value
Number of channels per module	8
Distribution of the channels into groups	1 group of 8 channels
Terminals of the channels DI0 ... DI7	Terminals 2.0 ... 2.7
Reference potential for all inputs	Terminals 1.9 ... 3.9 (Negative terminal of the supply voltage, signal name ZP)
Indication of the input signals	1 yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Input type (according EN 61131-2)	Type 1
Input delay (0->1 or 1->0)	Typ. 0.1 ms, configurable from 0.1 ms ... 32 ms

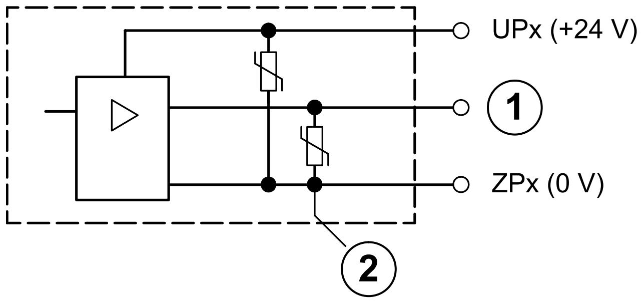
Parameter		Value
Input signal voltage		24 V DC
	Signal 0	-3 V ... +5 V
	Undefined Signal	> +5 V ... < +15 V
	Signal 1	+15 V ... +30 V
Ripple with signal 0		Within -3 V ... +5 V
Ripple with signal 1		Within +15 V ... +30 V
Input current per channel		
	Input voltage +24 V	Typ. 5 mA
	Input voltage +5 V	> 1 mA
	Input voltage +15 V	> 2 mA
	Input voltage +30 V	< 8 mA
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

Technical data of the digital outputs

Parameter		Value
Number of channels per module		8
Distribution of the channels into groups		1 group of 8 channels
Terminals of the channels DO0 ... DO7		Terminals 3.0 ... 3.7
Reference potential for all outputs		Terminals 1.9 ... 3.9 (negative terminal of the supply voltage, signal name ZP)
Common power supply voltage		For all outputs terminal 3.8 (positive terminal of the supply voltage, signal name UP3)
Output voltage for signal 1		UP3 (-0.8 V)
Output delay (0->1 or 1->0)		On request
Output current		
	Rated value per channel	500 mA at UP3 = 24 V
	Max. value (all channels together)	4 A
Leakage current with signal 0		< 0.5 mA
	Fuse for UP3	10 A fast
Demagnetization with inductive DC load		Via internal varistors (see figure below this table)
Output switching frequency		
	With resistive load	On request
	With inductive loads	Max. 0.5 Hz
	With lamp loads	11 Hz max. at 5 W max.
Short-circuit-proof / overload-proof		Yes
Overload message (I > 0.7 A)		Yes, after ca. 100 ms

Parameter		Value
Output current limitation		Yes, automatic reactivation after short circuit/overload
Resistance to feedback against 24 V signals		Yes (software-controlled supervision)
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

The following drawing shows the circuitry of a digital input/output with the varistors for demagnetization when inductive loads are switched off.



1 Digital output
2 Varistors for demagnetization when inductive loads are turned off

Technical data of the configurable digital inputs/outputs

Each of the configurable I/O channels is defined as input or output by the user program. This is done by interrogating or allocating the corresponding channel.

Parameter		Value
Number of channels per module		8 inputs/outputs (with transistors)
Distribution of the channels into groups		1 group for 8 channels
If the channels are used as inputs		
	Channels DC0 ... DC07	Terminals 1.0 ... 1.7
If the channels are used as outputs		
	Channels DC0 ... DC07	Terminals 1.0 ... 1.7
Indication of the input/output signals		1 yellow LED per channel, the LED is ON when the input/output signal is high (signal 1)
Galvanic isolation		From the Ethernet network

Technical data of the digital inputs/outputs if used as inputs

Parameter	Value
Number of channels per module	8
Distribution of the channels into groups	1 group of 8 channels
Terminals of the channels DC0 ... DC7	Terminals 1.0 ... 1.7
Reference potential for all inputs	Terminals 1.9 ... 3.9 (Negative terminal of the supply voltage, signal name ZP)

Parameter		Value
Indication of the input signals		1 yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Input type (according EN 61131-2)		Type 1
Input delay (0->1 or 1->0)		Typ. 0.1 ms, configurable from 0.1 ms ... 32 ms
Input signal voltage		24 V DC
	Signal 0	-3 V ... +5 V
	Undefined Signal	> +5 V ... < +15 V
	Signal 1	+15 V ... +30 V
Ripple with signal 0		Within -3 V ... +5 V
Ripple with signal 1		Within +15 V ... +30 V
Input current per channel		
	Input voltage +24 V	Typ. 5 mA
	Input voltage +5 V	> 1 mA
	Input voltage +15 V	> 2 mA
	Input voltage +30 V	< 8 mA
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

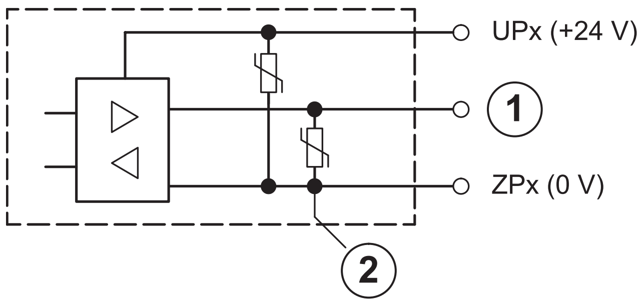
*) Due to the direct connection to the output, the demagnetizing varistor is also effective at the input (see figure) above. This is why the difference between UPx and the input signal may not exceed the clamp voltage of the varistor. The varistor limits the voltage to approx. 36 V. Following this, the input voltage must range from -12 V ... +30 V when UPx = 24 V and from -6 V ... +30 V when UPx = 30 V.

Technical data of the digital inputs/outputs if used as outputs

Parameter		Value
Number of channels per module		8
Distribution of the channels into groups		1 group of 8 channels
Terminals of the channels DC0 ... DC7		Terminals 1.0 ... 1.7
Reference potential for all outputs		Terminals 1.9 ... 3.9 (negative terminal of the supply voltage, signal name ZP)
Common power supply voltage		For all outputs terminal 3.8 (positive terminal of the supply voltage, signal name UP3)
Output voltage for signal 1		UP3 (-0.8 V)
Output delay (0->1 or 1->0)		On request
Output current		
	Rated value per channel	500 mA at UP3 = 24 V
	Max. value (all channels together)	4 A
Leakage current with signal 0		< 0.5 mA
	Fuse for UP3	10 A fast
Demagnetization with inductive DC load		Via internal varistors (see figure below this table)

Parameter		Value
Output switching frequency		
	With resistive load	On request
	With inductive loads	Max. 0.5 Hz
	With lamp loads	11 Hz max. at 5 W max.
Short-circuit-proof / overload proof		Yes
Overload message (I > 0.7 A)		Yes, after ca. 100 ms
Output current limitation		Yes, automatic reactivation after short circuit/overload
Resistance to feedback against 24 V signals		Yes (software-controlled supervision)
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

The following drawing shows the circuitry of a digital input/output with the varistors for demagnetization when inductive loads are switched off.

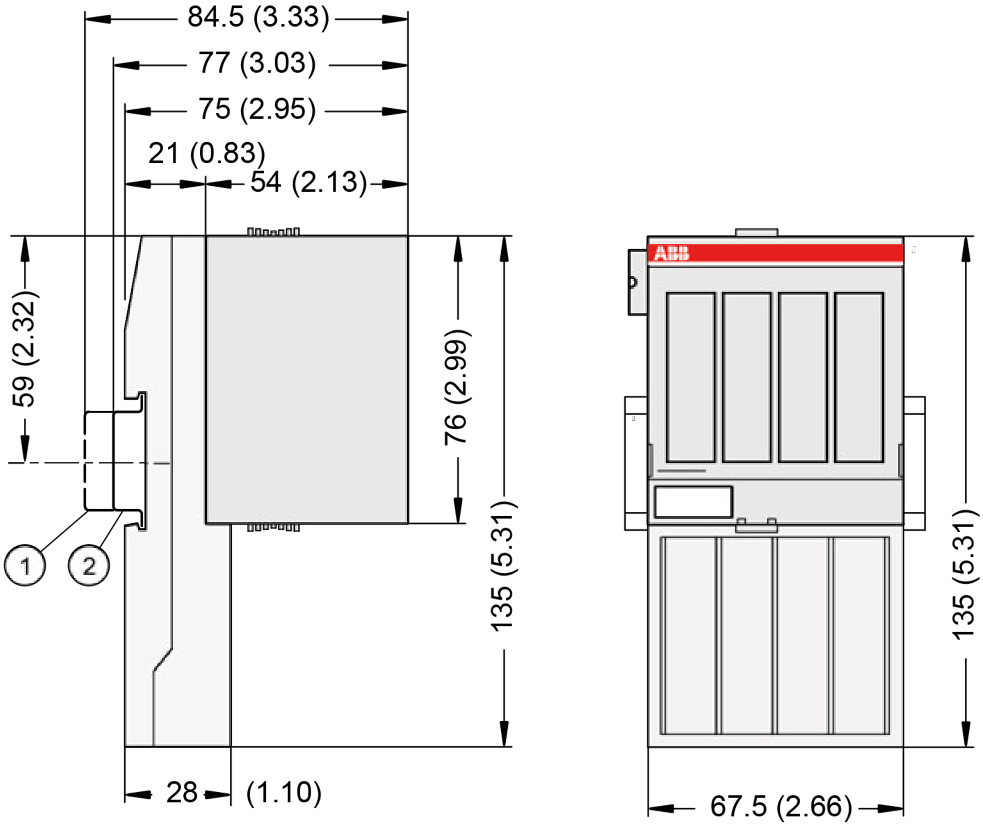


1 Digital input/output
2 For demagnetization when inductive loads are turned off

Technical data of the fast counter

Parameter	Value
Used inputs	Terminal 2.0 (DI8),Terminal 2.1 (DI9)
Used outputs	Terminal 3.0 (DO8)
Counting frequency	Depending on operation mode: Mode 1- 6: max. 200 kHz Mode 7: max. 50 kHz Mode 9: max. 35 kHz Mode 10: max. 20 kHz

1.8.7.3.12 Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

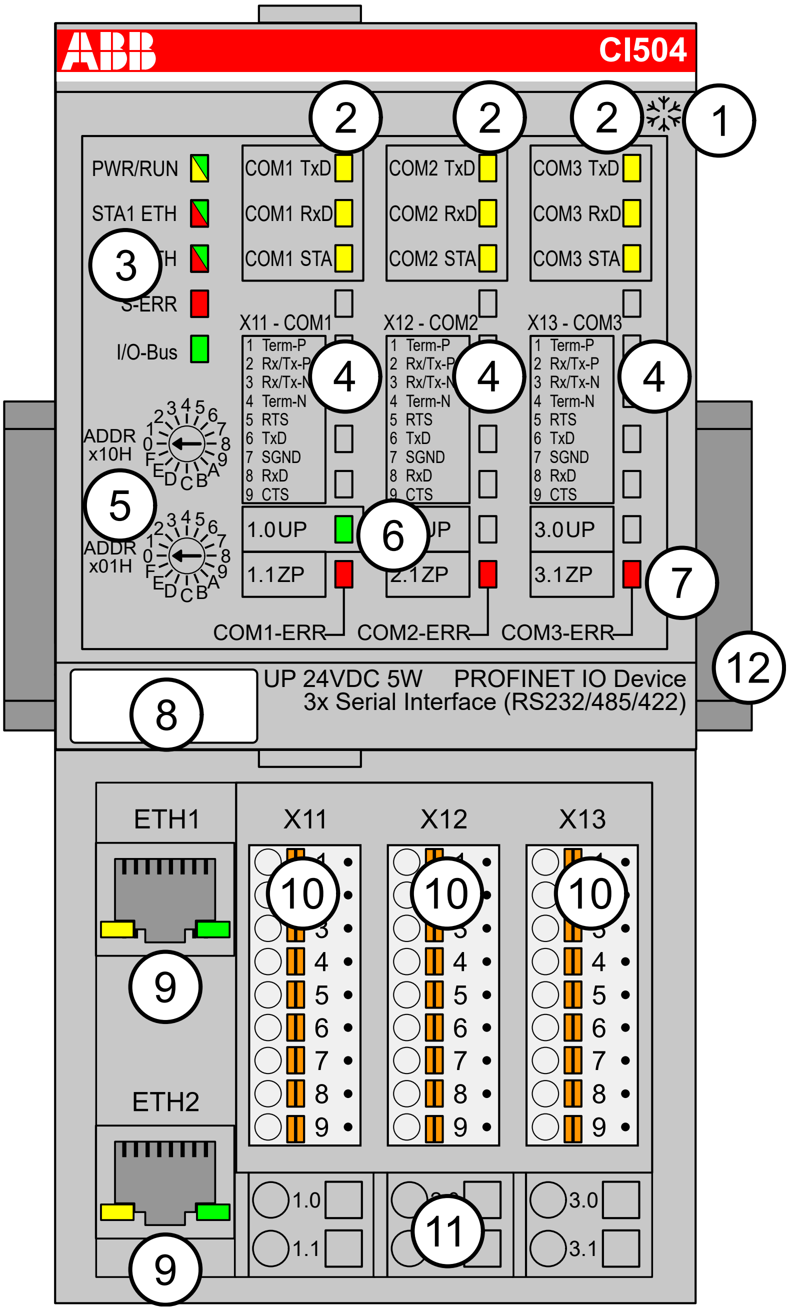
1.8.7.3.13 Ordering data

Active	Active	Product life cycle phase *)
1SAP 220 700 R0001	CI502-PNIO (V3), PROFINET communication interface module, 8 DI, 8 DO and 8 DC	Active
1SAP 420 700 R0001	CI502-PNIO-XC (V3), PROFINET communication interface module, 8 DI, 8 DO and 8 DC, XC version	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

1.8.7.4 CI504-PNIO

- 3 serial UART interfaces (RS-232, RS-422 or RS-485)
- Module-wise galvanically isolated
- XC version for usage in extreme ambient conditions available



1 I/O bus
2 3 x 3 yellow LEDs to display the signal states of the serial interfaces COM1, COM2 and COM3
3 5 system LEDs: PWR/RUN, STA1 ETH, STA2 ETH, S-ERR, I/O-Bus
4 Allocation between terminal number and signal name of the serial interfaces
5 2 rotary switches for setting the I/O device identifier
6 1 green LED to display the process voltage UP
7 3 red LEDs to display errors (COM1-ERR, COM2-ERR, COM3-ERR) of the serial interfaces
8 Label
9 Ethernet Interfaces (ETH1, ETH2) on the terminal unit
10 3 removable connectors to connect the interfaces

11 6 spring terminals for power supply voltage (UP)
12 DIN rail
❄ Sign for XC version

1.8.7.4.1 Intended purpose

The PROFINET communication interface module CI504-PNIO provides 3 onboard serial interfaces. The network connection is performed via 2 RJ45 connectors which are integrated in the terminal unit.

The bus interfaces are galvanically isolated from the Ethernet network.

For usage in extreme ambient conditions (e. g. wider temperature and humidity range), a special XC version of the device is available.

1.8.7.4.2 Functionality

Parameter	Value
Interface	Ethernet
Protocol	PROFINET IO RT
Serial Interfaces	3 Serial UART interfaces RS-232, RS-422 and RS-485 available as physical layer
Serial protocol	ASCII
I/O bus interface	For up to 10 AC500 I/O Modules
Rotary switches	For setting the I/O device identifier for configuration purposes (00h to FFh)
LED displays	For system displays, field bus indication, errors and power supply
Power supply	Via terminals UP and ZP (process supply voltage 24 V DC)
Effect of incorrect input terminal connection	Wrong or no signal detected, no damage up to 35 V
Required terminal unit	TU520 *Chapter 1.5.5 “TU520-ETH for PROFINET communication interface modules” on page 293*

1.8.7.4.3 Connections

The PROFINET communication interface module CI504-PNIO is plugged on the terminal unit TU520-ETH *Chapter 1.5.5 “TU520-ETH for PROFINET communication interface modules” on page 293*. Properly seat the module and press until it locks in place. The terminal unit is mounted on a DIN rail or with 2 screws plus the additional accessory for wall mounting *Chapter 1.9.3.5 “TA526 - Wall mounting accessory” on page 1361*.

The connection of the power supply voltage is carried out using the 6 terminals and the 3 removable connectors of the terminal unit. The CI504-PNIO can be replaced without re-wiring the terminal units.

> *For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.*

The terminals 1.0, 2.0 and 3.0 as well as 1.1, 2.1 and 3.1 are electrically interconnected within the terminal unit and have always the same assignment, independent of the inserted module:

Table 333: Assignment of the terminals

Terminal	Signal	Description
1.0	UP	Process voltage UP (+24 V DC)
1.1	ZP	Process voltage ZP (0 V DC)
2.0	UP	Process voltage UP (+24 V DC)
2.1	ZP	Process voltage ZP (0 V DC)
3.0	UP	Process voltage UP (+24 V DC)
3.1	ZP	Process voltage ZP (0 V DC)

Table 334: Assignment of the terminals of removable connectors X11, X12 and X13 (Serial interfaces)

Terminal	Signal	Description	
1	Term-P	RS-485	Internal line terminating resistor for non-inverted signal (Rx/Tx-P)
		RS-422	Non-inverted receive signal terminal (RxD+)
2	Rx/Tx-P	RS-485	Non-inverted I/O signal terminal for each channel
		RS-422	Non-inverted transmit signal terminal (TxD+)
3	Rx/Tx-N	RS-485	Inverted I/O signal terminal for each channel
		RS-422	Inverted transmit signal terminal (TxD-)
4	Term-N	RS-485	Internal line-terminating resistor for inverted signal (Rx/Tx-N) terminal
		RS-422	Inverted receive signal terminal (RxD-)
5	RTS	RS-232	Request To Send signal terminal for each channel
6	TxD	RS-232	Transmit signal terminal for each channel
7	SGND	RS-232	Signal ground for each channel
8	RxD	RS-232	Receive signal terminal for each channel
9	CTS	RS-232	Clear To Send signal terminal for each channel

The connection of SGND (ground) is optional for RS-485/RS-422.

For RS-422, no external line-terminating resistors have to connected. They are already connected inside the module.

> **WARNING!**
> **Removal/Insertion under power**
> The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.
>
> Make sure that all voltage sources (supply and process voltage) are switched off before you
>
> – connect or disconnect any signal or terminal block
> – remove, mount or replace a module.
>
> Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.
>
> Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.
>
> The devices must not be opened when in operation. The same applies to the network interfaces.

> **NOTICE!**
> **Risk of damaging the PLC modules!**
> Overvoltages and short circuits might damage the PLC modules.
>
> – Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
> – Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

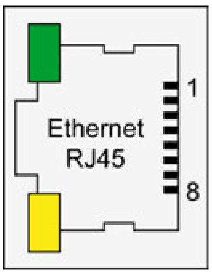
The module provide several diagnosis functions ✎ *Chapter 1.8.7.4.7 “Diagnosis” on page 1317*.

Further information is provided in the System Technology chapter PROFINET.

1.8.7.4.4 Assignment of the Ethernet ports

The terminal unit for the communication interface module provides two Ethernet interfaces with the following pin assignment:

Pin assignment

Interface	Pin	Signal	Description
	1	TxD+	Transmit data +
	2	TxD-	Transmit data -
	3	RxD+	Receive data +
	4	NC	Not connected
	5	NC	Not connected
	6	RxD-	Receive data -
	7	NC	Not connected
	8	NC	Not connected
	Shield	Cable shield	Functional earth

In corrosive environment, please protect unused connectors using the TA535 accessory.

Not supplied with this device.

Further information about wiring and cable types

1.8.7.4.5 Addressing

The module has 2 rotary switches to set an explicit name to the PROFINET IO device before commissioning. No engineering tool is needed in this case.

The device gets its name (including the fixed part of the device name) with the switch settings (01h...FFh). This name can be used directly within the device configuration: “CI5xx-pn-yy”

"CI5xx-pn-yy” xx is the fixed part of the device name (e.g. CI501) and yy represents the position of the rotary switch (0..FFh). The rotary switch values must be entered in hexadecimal format. For example, to set the name to “CI5xx-pn-08”, set the upper rotary switch to “0” and the lower switch to “8”.

The module reads the position of the rotary switches only during power-up, i.e. changes of the switch position during operation will have no effect until the next module initialization.

1.8.7.4.6 Parameterization

Parameters of the module

Name	**Value**	**Internal value**	**Internal value, type**	**Default**
Module ID [1])	Internal	7010	WORD	7010
Parameter length	Internal	33	BYTE	33
Error LED / Fail-safe function see table [2])	On	0	BYTE	0
	Off by E4	1		
	Off by E3	3		
	On + failsafe	16		
	Off by E4 + fail-safe	17		
	Off by E3 + fail-safe	19		
I/O-Bus reset	Off	0	BYTE	Off
	On	1	BYTE	Off

Remarks:

[1]) With a faulty module ID, the module reports a "parameter error" and does not perform cyclic process data transmission

Table 335: Error LED / Failsafe function [2])

Setting	Description
On	Error LED lights up at errors of all error classes, Failsafe-mode off
Off by E4	Error LED lights up at errors of error classes E1, E2 and E3, Failsafe-mode off
Off by E3	Error LED lights up at errors of error classes E1 and E2, Fail-safe-mode off
On + Failsafe	Error LED lights up at errors of all error classes, Failsafe-mode on
Off by E4 + Failsafe	Error LED lights up at errors of error classes E1, E2 and E3, Failsafe-mode on
Off by E3 + Failsafe	Error LED lights up at errors of error classes E1 and E2, Fail-safe-mode on

All values are validated during the parameterization of the CI504-PNIO according to the appended expansion modules. In the case of error, a diagnosis message "parameter errors" is generated and the cyclic process data transfer is terminated.

IO-BUS reset after PROFINET reconnection

IO-BUS reset after PROFINET reconnection controls the behavior of PROFINET CI modules in relation to connected I/O modules (both safety and non-safety I/O modules).

- IO-BUS reset after PROFINET reconnection = *"On"* resets and, thus, re-parameterizes all attached I/O modules. All internal I/O modules states are reset, including the related diagnosis information.

  Note that if the parameter is set to *"On"* then:
  - The bumpless re-start of non-safety I/O modules will not be supported. It means, for example, that non-safety output channels will go from fail-safe values to *"0"* values during the re-connection and re-parameterization time and after that go to new output values.
  - Safety I/O modules will be re-parameterized and re-started as newly started modules, which may not require their PROFIsafe reintegration, depending on safety CPU state, in the safety application.
- IO-BUS reset after PROFINET reconnection = *"Off"* will not reset all attached I/O modules. It will re-parameterize I/O modules only if parameter change is detected during the reconnection. All internal I/O modules states are not reset, including the related diagnosis information.

  Note that if the parameter is set to *"Off"* then:
  - The bumpless re-start of non-safety I/O modules is supported (if no parameters are changed). It means, for example, that non-safety output channels will not go from fail-safe values to *"0"* values during the re-connection and re-parameterization time, but directly from fail-safe values to new output values.
  - Safety I/O modules will not be re-parameterized (if no parameters are changed). Thus, they may continue their operation, which may require their PROFIsafe reintegration in the safety application on the safety CPU, e.g., if PROFIsafe watchdog time for this safety I/O module has expired. Any reintegration of such safety I/O modules will be not only application specific but also PROFIsafe specific and depend on the safety I/O handling in the safety application.

Parameters of the 3 serial channels

Name	Value	Internal value	Internal value, type	Default
Behavior for serial channel communication during PROFINET communication fault	Stop communi-cation and reset FIFO	0	BYTE	0
	Continue serial communication	1		
Number of frames/data blocks in reception FIFO	1 ... 40	1 ... 40	BYTE	1
Number of frames/Data blocks in transmission FIFO	1 ... 40	1 ... 40	BYTE	1
Behavior during reception FIFO overflow	Discard new received frames	1	BYTE	2
	Overwrite oldest frame in FIFO	2		
	Discard new received frames and send PROFINET alarm	3		
	Overwrite oldest frame in FIFO and send PROFINET alarm	4		
Physical layer	RS-232	1	BYTE	1
	RS-485	2		
	RS-422	3		
RTS control	None	0	BYTE	1
	Telegram	1		
	RTS/CTS (DTE <-> DTE)	2		
	RTS/CTS (DTE -> DCE)	3		
	RTS/CTS (DCE <- DTE)	4		
TLS (RTS leading cycle)	0 ms ... 850 ms	0 ... 850	WORD	0
CDLY (RTS trailing cycle)	0 ms ... 850 ms	0 ... 850	WORD	0
Character timeout	0/32 bits	0/32	WORD	0
Telegram ending selection	None	0	BYTE	None
	String (check reception)	1		
	Telegram length	2		
	Character timeout	4		

Name	**Value**	**Internal value**	**Internal value, type**	**Default**
Telegram ending character	0 ... 255	0 ... 255	BYTE	0
Telegram ending value	0 ... 65535	0 ... 65535	WORD	0
Checksum	None	0	BYTE	0
	CRC8	1		
	CRC16	2		
	LRC	3		
	ADD	4		
	CS31	5		
	CRC8-FBP	6		
	XOR	7		
	CRC16 (Intel)	8		
Handshake mode	None	0	BYTE	0
	XON/XOFF	2		
Transmission rate	Channel inactive	0	DWORD	19200
	300 bit/s	300		
	1200 bit/s	1200		
	4800 bit/s	4800		
	9600 bit/s	9600		
	14400 bit/s	14400		
	19200 bit/s	19200		
	38400 bit/s	38400		
	38400 bit/s	57600		
	57600 bit/s	57600		
	115200 bit/s	115200		
Parity	No parity	0	BYTE	No parity
	Odd parity	1		
	Even parity	2		
Data bits	5 bits	0	BYTE	8
	6 bits	1		
	7 bits	2		
	8 bits	3		
Stop bits	1 bit	0	BYTE	1
	2 bits	1		

Configuration with Automation Builder

The physical layers are selectable as submodules in PROFINET configuration (parameter Physical Layer not visible and fixed with the correct value). Certain parameters are not visible if a certain physical layer is selected. This concept of parameterization provides a better usability than configuring via GSDML (see below).

> ***Configuration via GSDML (use by 3rd party PROFINET configuration tool)***
> *All parameters are visible independent of the configured physical layer (via parameter “Physical Layer”). The user must take precautions for each parameter since certain parameter values are invalid for certain physical layers. Nevertheless, the CI5xx-PNIO module performs a parameter check depending on the configured physical layer and generates a diagnosis message (parameter error) in the case of error.*

General precautions

- If parameter telegram ending selection is set to value Character Timeout, the value in the parameter Character Timeout must be set to 0. The parameter End Value must be set to 32 (equivalent to 32-bits character timeout). Only 32-bits character timeout is supported.
- Checksum is only supported if a telegram ending selection is active.
- Please refer to AC500 serial channel documentation for additional precautions.

Precautions for RS-485/RS-422

DTE/DCE is not supported. The parameter RTS Control must be set to value Telegram or to None.

1.8.7.4.7 Diagnosis

Structure of the Diagnosis Block via PNIO_DEV_ALARM function block

Byte Number	Description	Possible Values
1	Diagnosis Byte, slot number	31 = CI504-PNIO (e. g. error at integrated Serial Interface) 1 = 1st connected S500 I/O module ... 10 = 10th connected S500 I/O module
2	Diagnosis Byte, module number	According to the I/O bus specification passed on by modules to the fieldbus master
3	Diagnosis Byte, channel	According to the I/O bus specification passed on by modules to the fieldbus master
4	Diagnosis Byte, error code	According to the I/O bus specification Bit 7 and bit 6, coded error class 0 = E1 1 = E2 2 = E3 3 = E4 Bit 0 to bit 5, coded error description
5	Diagnosis Byte, flags	According to the I/O bus specification Bit 7: 1 = coming error Bit 6: 1 = leaving error

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier** **000 ... 063**	**AC500 display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**	
Byte 4 **Bit 6 ... 7**	**-**	**Byte 1**	**Byte 2**	**Byte 3**	**Byte 4** **Bit 0 ... 5**	**PNIO diag-nosis block**	
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error identi-fier**	**Error message**	**Remedy**
	[1])	[2])	[3])				
Module error							
3	-	31	31	31	43	Internal error in the module	Replace module
3	-	31	31	31	9	Overflow diagnosis buffer	New start
3	-	31	31	31	26	Parameter error	Check master
3	-	31	31	31	11	Process voltage too low	Check process voltage
3	-	31	31	31	45	Process voltage gone	Check process voltage
3	-	1 ... 10	31	31	17	No communication with I/O module	Replace I/O module
4	-	1 ... 10	31	31	31	At least 1 I/O Module does not support failsafe mode	Check I/O modules and parame-terization
4	-	1 ... 10	31	31	32	Wrong I/O Module type on socket	Replace I/O module Check configu-ration
4	-	1 ... 10	31	31	34	No response during initialization of the I/O Module	Replace I/O module
Serial Channel error							

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier** **000 ... 063**	**AC500 display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**	
Byte 4 **Bit 6 ... 7**	**-**	**Byte 1**	**Byte 2**	**Byte 3**	**Byte 4** **Bit 0 ... 5**	**PNIO diag-nosis block**	
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error identi-fier**	**Error message**	**Remedy**
	1)	**2)**	**3)**				
4	-	31	31	1 ... 3	12	Reception SW FIFO overrun	Check modules and parame-terization
4	-	31	31	1 ... 3	26	Parameter error	Check modules and parame-terization

Remarks:

1)	In AC500 the following interface identifier applies: "-" = Diagnosis via bus-specific function blocks; 0 ... 4 or 10 = Position of the Communication Module; 14 = I/O bus; 31 = Module itself The identifier is not contained in the CI504-PNIO diagnosis block.
2)	With "Device" the following allocation applies: 31 = Module itself
3)	With "Module" the following allocation applies dependent of the master: 31 = Module itself or 1 ... 10 expansion module

1.8.7.4.8 State LEDs

The LEDs are located at the front of module. There are 4 different groups:

- 5 system LEDs (PWR, STA1 ETH, STA2 ETH, S-ERR and I/O-Bus) show the operation state of the module and display possible errors.
- 4 Ethernet state LEDs located at the terminal unit TU520-ETH
- 12 state LEDs for the serial interfaces
- 1 LED to display the presence of the process supply voltage UP

Table 336: States of the 5 system LEDs

LED	Color	OFF	ON	Flashing
PWR/RUN	Green	Process supply voltage missing	Internal supply voltage OK, module ready for communication with I/O Controller	Start-up / preparing communication
	Yellow	---	---	---
STA1 ETH (System LED "BF")	Green	---	Device configured, cyclic data exchange running	---
	Red	---	---	Device is not configured
STA2 ETH (System LED "SF")	Green	---	---	Got identification request from I/O controller
	Red	No system error	System error (collective error)	---
S-ERR	Red	No error	Internal error	--
I/O-Bus	Green	No communication interface module connected or communication error	communication interface module connected and operational	---

Table 337: States of the 4 Ethernet state LEDs

LED	Color	OFF	ON	Flashing
ETH1-Link	Green	No connection at Ethernet interface	Connected to Ethernet interface	---
ETH1-Rx Tx	Yellow	---	Device is transmitting telegrams	Device is transmitting telegrams
ETH2-Link	Green	No connection at Ethernet interface	Connected to Ethernet interface	---
Eth2-Rx Tx	Yellow	---	Device is transmitting telegrams	Device is transmitting telegrams

Table 338: States of the 12 state LEDs (4 per channel) of the serial interfaces

LED	Color	OFF	ON	Flashing
COMx TxD	Yellow	No data transmission over serial network	--	Channel is transmitting data via the serial interface (flashing rate depending on the telegram transmission frequency)
COMx RxD	Yellow	No data reception from serial network	--	Channel is receiving data from the serial interface (flashing rate depending on the telegram reception frequency)
COMx STA	Yellow	RS-232: RTS signal not active RS-485: Channel is in reception mode RS-422:Channel is not enabled	RS-232: RTS signal is active RS-485: Channel is transmitting RS-422: Channel is enabled (able to receive and transmit)	--
COMx-ERR	Red	Channel enabled, no error OR Channel deactivated	Channel boot up	Channel error (receive buffer overflow)

Table 339: State of the power supply LED

LED	Color	OFF	ON	Flashing
UP	Green	No process voltage available	Process voltage available	--

1.8.7.4.9 Technical data

Technical data of the module

The system data of AC500 and S500 are applicable to the standard version ↳ *Chapter 2.6.1 “System data AC500” on page 1408*.

The system data of AC500-XC are applicable to the XC version ↳ *Chapter 2.7.1 “System data AC500-XC” on page 1475*.

Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

Parameter		Value
Process supply voltages UP		
	Rated value	24 V DC

Parameter	Value
Max. load for the terminals	10 A
Protection against reversed voltage	Yes
Rated protection fuse on UP	10 A fast
Inrush current from UP (at power up)	On request
Current consumption via UP (normal operation)	0.15 A
Connections	Terminals 1.0, 2.0 and 3.0 for +24 V (UP) Terminals 1.1, 2.1 and 3.1 for 0 V (ZP)
Input data length	0 ... 36 bytes
Output data length	0 ... 36 bytes
Max. power dissipation within the module	5 W
Setting of the I/O module identifier	With 2 rotary switches at the front side of the module
Operation and error displays	18 LEDs (total)
Weight (without terminal unit)	ca. 125 g
Mounting position	Horizontal or vertical
Cooling	The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

Galvanic isolation	Ethernet interface against the rest of the module, each serial port against each other and the rest of the module
Diagnosis	See Diagnosis *Chapter 1.8.7.4.7 “Diagnosis” on page 1317*

NOTICE!
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and temporary overvoltage up to 30 V DC.

Multiple overloads
No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an internal smart high-side switch.

Parameter	Value
Bus connection	2 x RJ45
Switch	Integrated
Technology	Hilscher NETX 100
Transfer rate	10/100 Mbit/s (full-duplex)
Transfer method	According to Ethernet II, IEEE 802.3
Ethernet	100 base-TX, internal switch, 2x RJ45 socket

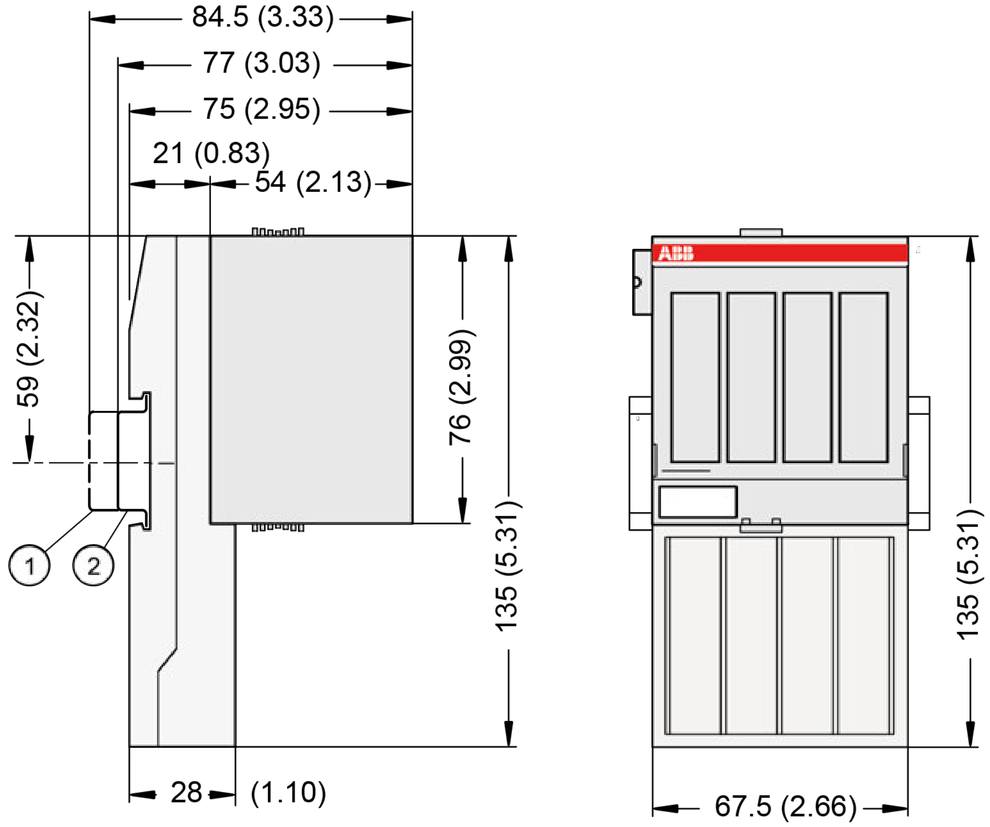
Parameter	Value
Expandability	Max. 10 S500 I/O modules
Adjusting elements	2 rotary switches for generation of an explicit name
Supported protocols	RTC - real time cyclic protocol, class 1 *) RTA - real time acyclic protocol DCP - discovery and configuration protocol CL-RPC - connectionless remote procedure Call LLDP - link layer discovery protocol MRP - MRP Client
Acyclic services	PNIO read / write sequence (max. 1024 bytes per telegram) Process-Alarm service
Supported alarm types	Process Alarm, Diagnostic Alarm, Return of SubModule, Plug Alarm, Pull Alarm
Min. bus cycle	1 ms
Conformance class	CC A
Protective functions (according to IEC 61131-3)	Protected against: ● short circuit ● reverse supply ● overvoltage ● reverse polarity Galvanic isolation from the rest of the module

*) Priorization with the aid of VLAN-ID including priority level

Technical data of the serial interfaces

Parameter	Value
Number of serial interfaces	3
Connectors for serial interfaces	X11 for COM1 X12 for COM2 X13 for COM3
Supported physical layers	RS-232 RS-422 RS-485
Supported protocols	ASCII
Transmission rate	Configurable from 300 bit/s to 115.200 bit/s

1.8.7.4.10 Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

1.8.7.4.11 Ordering data

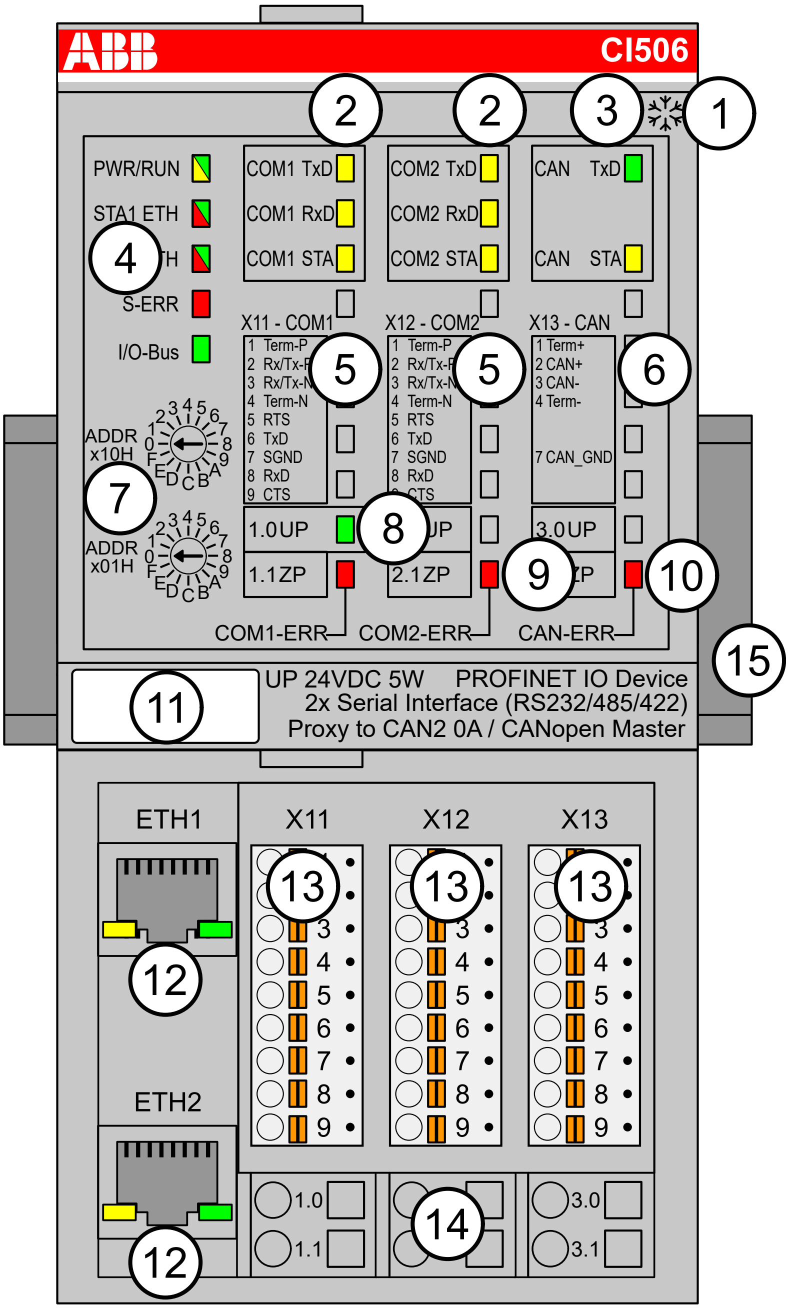
Part no.	Description	Product life cycle phase *)
1SAP 221 300 R0001	CI504-PNIO, PROFINET communication interface module with 3 serial interfaces	Active
1SAP 421 300 R0001	CI504-PNIO-XC, PROFINET communication interface module with 3 serial interfaces, XC version	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

1.8.7.5 CI506-PNIO

- 2 serial UART interfaces (RS-232, RS-422 or RS-485)
- 1 CANopen master interface

- Module-wise galvanically isolated
- XC version for usage in extreme ambient conditions available



1 I/O bus
2 2 x 3 yellow LEDs to display the signal states of the serial interfaces COM1 and COM2
3 1 green and 1 yellow LEDs to display the signal states of the CANopen interface
4 5 system LEDs: PWR/RUN, STA1 ETH, STA2 ETH, S-ERR, I/O-Bus
5 Allocation between terminal number and signal name of the serial interfaces
6 Allocation between terminal number and signal name of the CANopen interface
7 2 rotary switches for setting the I/O device identifier
8 1 green LED to display the process voltage UP
9 2 red LEDs to display errors (COM1-ERR, COM2-ERR) of the serial interfaces
10 1 red LED to display errors (CAN-ERR) of the CANopen interface
11 Label
12 Ethernet Interfaces (ETH1, ETH2) on the terminal unit
13 3 removable connectors to connect the subordinated interfaces

14 6 spring terminals for power supply voltage (UP)
15 DIN rail
❄ Sign for XC version

1.8.7.5.1 Intended purpose

The PROFINET communication interface module CI506-PNIO provides 2 onboard serial interfaces and 1 CANopen master interface. The network connection is performed via 2 RJ45 connectors which are integrated in the terminal unit.

The bus interfaces are galvanically isolated from the Ethernet network.

For usage in extreme ambient conditions (e. g. wider temperature and humidity range), a special XC version of the device is available.

1.8.7.5.2 Functionality

Parameter	Value
Primary interface	Ethernet
Protocol (1st interface)	PROFINET IO RT
Secondary interface	CAN
Protocol (2nd interface)	CANopen
CANopen master	Transmission rate up to 1 Mbit/s Support for up to 126 CANopen slaves
Serial Interfaces	2 Serial UART interfaces RS-232, RS-422 and RS-485 available as physical layer
Serial protocol	ASCII
I/O bus interface	For up to 10 AC500 I/O modules
Supply of the electronic circuitry of the I/O expansion modules attached	Through the I/O bus interface (I/O bus)
Rotary switches	For setting the I/O device identifier for configuration purposes (00h to FFh)
LED displays	For system displays, field bus indication, errors and power supply
Power supply	Via terminals UP and ZP (process supply voltage 24 V DC)
Effect of incorrect input terminal connection	Wrong or no signal detected, no damage up to 35 V
Required terminal unit	TU520 *Chapter 1.5.5 “TU520-ETH for PROFINET communication interface modules” on page 293*

1.8.7.5.3 Connections

The Ethernet Bus Module CI506-PNIO is plugged on the terminal unit TU520-ETH *Chapter 1.5.5 “TU520-ETH for PROFINET communication interface modules” on page 293*. Properly seat the module and press until it locks in place. The terminal unit is mounted on a DIN rail or with 2 screws plus the additional accessory for wall mounting *Chapter 1.9.3.5 “TA526 - Wall mounting accessory” on page 1361*.

The connection of the power supply voltage is carried out using the 6 terminals and the 3 removable connectors of the terminal unit. The CI506-PNIO can be replaced without re-wiring the terminal units.

For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.

The terminals 1.0, 2.0 and 3.0 as well as 1.1, 2.1 and 3.1 are electrically interconnected within the terminal unit and have always the same assignment, independent of the inserted module:

Table 340: Assignment of the terminals

Terminal	Signal	Description
1.0	UP	Process voltage UP (+24 V DC)
1.1	ZP	Process voltage ZP (0 V DC)
2.0	UP	Process voltage UP (+24 V DC)
2.1	ZP	Process voltage ZP (0 V DC)
3.0	UP	Process voltage UP (+24 V DC)
3.1	ZP	Process voltage ZP (0 V DC)

Table 341: Assignment of the terminals of removable connectors X11 and X12 (Serial interfaces)

Terminal	Signal	Description	
1	Term-P	RS-485	Internal line terminating resistor for non-inverted signal (Rx/Tx-P)
		RS-422	Non-inverted receive signal terminal (RxD+)
2	Rx/Tx-P	RS-485	Non-inverted I/O signal terminal for each channel
		RS-422	Non-inverted transmit signal terminal (TxD+)
3	Rx/Tx-N	RS-485	Inverted I/O signal terminal for each channel
		RS-422	Inverted transmit signal terminal (TxD-)
4	Term-N	RS-485	Internal line-terminating resistor for inverted signal (Rx/Tx-N) terminal
		RS-422	Inverted receive signal terminal (RxD-)
5	RTS	RS-232	Request To Send signal terminal for each channel
6	TxD	RS-232	Transmit signal terminal for each channel
7	SGND	RS-232	Signal ground for each channel
8	RxD	RS-232	Receive signal terminal for each channel
9	CTS	RS-232	Clear To Send signal terminal for each channel

The connection of SGND (ground) is optional for RS-485/RS-422.

For RS-422, no external line-terminating resistors have to connected. They are already connected inside the module.

Table 342: Assignment of the terminals of removable connector X13 (CANopen interface)

Terminal	Signal	Description
1	TERM+	Internal line-terminating resistor for CAN bus. Bridging to CAN HIGH terminal if bus termination is required
2	CAN+	Non-inverted CAN data terminal
3	CAN-	Inverted CAN data terminal
4	TERM-	Internal line-terminating resistor for CAN bus. Bridging to CAN LOW terminal if bus termination is required
5	Not used	Not used
6	Not used	Not used
7	CAN_GND	CAN ground terminal
8	Not used	Not used
9	Not used	Not used

WARNING!
Removal/Insertion under power
The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!
Risk of damaging the PLC modules!
Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

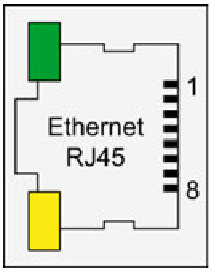
The module provide several diagnosis functions *Chapter 1.8.7.5.8 “Diagnosis” on page 1335*.

Further information is provided in the System Technology chapter PROFINET.

1.8.7.5.4 Assignment of the Ethernet ports

The terminal unit for the communication interface module provides two Ethernet interfaces with the following pin assignment:

Pin assignment

Interface	Pin	Signal	Description
	1	TxD+	Transmit data +
	2	TxD-	Transmit data -
	3	RxD+	Receive data +
	4	NC	Not connected
	5	NC	Not connected
	6	RxD-	Receive data -
	7	NC	Not connected
	8	NC	Not connected
	Shield	Cable shield	Functional earth

In corrosive environment, please protect unused connectors using the TA535 accessory.

Not supplied with this device.

Further information about wiring and cable types

1.8.7.5.5 Addressing

The module has 2 rotary switches to set an explicit name to the PROFINET IO device before commissioning. No engineering tool is needed in this case.

The device gets its name (including the fixed part of the device name) with the switch settings (01h...FFh). This name can be used directly within the device configuration: “CI5xx-pn-yy”

"CI5xx-pn-yy” xx is the fixed part of the device name (e.g. CI501) and yy represents the position of the rotary switch (0..FFh). The rotary switch values must be entered in hexadecimal format. For example, to set the name to “CI5xx-pn-08”, set the upper rotary switch to “0” and the lower switch to “8”.

The module reads the position of the rotary switches only during power-up, i.e. changes of the switch position during operation will have no effect until the next module initialization.

1.8.7.5.6 I/O configuration

The CI506-PNIO stores some PROFINET configuration parameters:

- Slave station name
- Slave station type
- IP address configuration

- MAC address
- Production data

No more configuration data is stored. The serial interfaces and the CANopen interface is configured via software. For details, refer to Parameterization *Chapter 1.8.7.5.7 “Parameterization” on page 1330*.

1.8.7.5.7 Parameterization

Parameters of the module

Name	Value	Internal value	Internal value, type	Default
Module ID [1])	Internal	7015	WORD	7015
Parameter length	Internal	33	BYTE	33
Error LED / Fail-safe function see table [2])	On	0	BYTE	0
	Off by E4	1		
	Off by E3	3		
	On + failsafe	16		
	Off by E4 + fail-safe	17		
	Off by E3 + fail-safe	19		
I/O-Bus reset	Off	0	BYTE	Off
	On	1	BYTE	Off

Remarks:

[1]) With a faulty module ID, the module reports a "parameter error" and does not perform cyclic process data transmission

Table 343: Error LED / Failsafe function [2])

Setting	Description
On	Error LED lights up at errors of all error classes, Failsafe-mode off
Off by E4	Error LED lights up at errors of error classes E1, E2 and E3, Failsafe-mode off
Off by E3	Error LED lights up at errors of error classes E1 and E2, Failsafe-mode off
On + Failsafe	Error LED lights up at errors of all error classes, Failsafe-mode on
Off by E4 + Failsafe	Error LED lights up at errors of error classes E1, E2 and E3, Failsafe-mode on
Off by E3 + Failsafe	Error LED lights up at errors of error classes E1 and E2, Failsafe-mode on

All values are validated during the parameterization of the CI506-PNIO according to the appended communication interface modules. In the case of error, a diagnosis message "parameter error" is generated and the cyclic process data transfer is terminated.

IO-BUS reset after PROFINET reconnection

IO-BUS reset after PROFINET reconnection controls the behavior of PROFINET CI modules in relation to connected I/O modules (both safety and non-safety I/O modules).

- IO-BUS reset after PROFINET reconnection = *"On"* resets and, thus, re-parameterizes all attached I/O modules. All internal I/O modules states are reset, including the related diagnosis information.

  Note that if the parameter is set to *"On"* then:
  - The bumpless re-start of non-safety I/O modules will not be supported. It means, for example, that non-safety output channels will go from fail-safe values to *"0"* values during the re-connection and re-parameterization time and after that go to new output values.
  - Safety I/O modules will be re-parameterized and re-started as newly started modules, which may not require their PROFIsafe reintegration, depending on safety CPU state, in the safety application.
- IO-BUS reset after PROFINET reconnection = *"Off"* will not reset all attached I/O modules. It will re-parameterize I/O modules only if parameter change is detected during the reconnection. All internal I/O modules states are not reset, including the related diagnosis information.

  Note that if the parameter is set to *"Off"* then:
  - The bumpless re-start of non-safety I/O modules is supported (if no parameters are changed). It means, for example, that non-safety output channels will not go from fail-safe values to *"0"* values during the re-connection and re-parameterization time, but directly from fail-safe values to new output values.
  - Safety I/O modules will not be re-parameterized (if no parameters are changed). Thus, they may continue their operation, which may require their PROFIsafe reintegration in the safety application on the safety CPU, e.g., if PROFIsafe watchdog time for this safety I/O module has expired. Any reintegration of such safety I/O modules will be not only application specific but also PROFIsafe specific and depend on the safety I/O handling in the safety application.

Parameters of the 2 serial channels

Name	Value	Internal value	Internal value, type	Default
Behavior for serial channel communication during PROFINET communication fault	Stop communication and reset FIFO	0	BYTE	0
	Continue serial communication	1		
Number of frames/data blocks in reception FIFO	1 ... 40	1 ... 40	BYTE	1
Number of frames/Data blocks in transmission FIFO	1 ... 40	1 ... 40	BYTE	1
Behavior during reception FIFO overflow	Discard new received frames	1	BYTE	2
	Overwrite oldest frame in FIFO	2		
	Discard new received frames and send PROFINET alarm	3		
	Overwrite oldest frame in FIFO and send PROFINET alarm	4		
Physical layer	RS-232	1	BYTE	1

Name	Value	Internal value	Internal value, type	Default
	RS-485	2		
	RS-422	3		
RTS control	None	0	BYTE	1
	Telegram	1		
	RTS/CTS (DTE <-> DTE)	2		
	RTS/CTS (DTE -> DCE)	3		
	RTS/CTS (DCE <- DTE)	4		
TLS (RTS leading cycle)	0 ms ... 850 ms	0 ... 850	WORD	0
CDLY (RTS trailing cycle)	0 ms ... 850 ms	0 ... 850	WORD	0
Character timeout	0/32 bits	0/32	WORD	0
Telegram ending selection	None	0	BYTE	None
	String (check reception)	1		
	Telegram length	2		
	Character timeout	4		
Telegram ending character	0 ... 255	0 ... 255	BYTE	0
Telegram ending value	0 ... 65535	0 ... 65535	WORD	0
Checksum	None	0	BYTE	0
	CRC8	1		
	CRC16	2		
	LRC	3		
	ADD	4		
	CS31	5		
	CRC8-FBP	6		
	XOR	7		
	CRC16 (Intel)	8		
Handshake mode	None	0	BYTE	0
	XON/XOFF	2		
Transmission rate	Channel inactive	0	DWORD	19200
	300 bit/s	300		
	1200 bit/s	1200		
	4800 bit/s	4800		
	9600 bit/s	9600		
	14400 bit/s	14400		
	19200 bit/s	19200		
	38400 bit/s	38400		
	38400 bit/s	57600		
	57600 bit/s	57600		

Name	Value	Internal value	Internal value, type	Default
	115200 bit/s	115200		
Parity	No parity	0	BYTE	No parity
	Odd parity	1		
	Even parity	2		
Data bits	5 bits	0	BYTE	8
	6 bits	1		
	7 bits	2		
	8 bits	3		
Stop bits	1 bit	0	BYTE	1
	2 bits	1		

Configuration with Automation Builder

The physical layers are selectable as submodules in PROFINET configuration (parameter Physical Layer not visible and fixed with the correct value). Certain parameters are not visible if a certain physical layer is selected. This concept of parameterization provides a better usability than configuring via GSDML (see below).

Configuration via GSDML (use by 3rd party PROFINET configuration tool)

All parameters are visible independent of the configured physical layer (via parameter “Physical Layer”). The user must take precautions for each parameter since certain parameter values are invalid for certain physical layers. Nevertheless, the CI5xx-PNIO module performs a parameter check depending on the configured physical layer and generates a diagnosis message (parameter error) in the case of error.

General precautions

- If parameter telegram ending selection is set to value Character Timeout, the value in the parameter Character Timeout must be set to 0. The parameter End Value must be set to 32 (equivalent to 32-bits character timeout). Only 32-bits character timeout is supported.
- Checksum is only supported if a telegram ending selection is active.
- Please refer to AC500 serial channel documentation for additional precautions.

Precautions for RS-485/RS-422

DTE/DCE is not supported. The parameter RTS Control must be set to value Telegram or to None.

Parameters of the CANopen master

Name	Value	Internal value	Internal value, type	Default
CANopen master transmission rate	1000 kbit/s	0	DWORD	0
	800 kbit/s	1		
	500 kbit/s	2		
	250 kbit/s	3		
	125 kbit/s	4		
	100 kbit/s	5		
	50 kbit/s	6		
	20 kbit/s	7		
	10 kbit/s	8		
CANopen master SYNC object ID *)	0x01 to 0x7FFF	1 - 32767	DWORD	0x80
CANopen master SYNC cycle time *)	SYNC OFF	0	DWORD	0
	1 ms ... 65535 ms	1 ... 65535		
CANopen master heartbeat producer time *)	Heartbeat producer OFF	0	DWORD	10
	1 ms ... 65535 ms	1 ... 65535		
*) Parameter becomes irrelevant if the CANopen master function is not selected.				

The CANopen master functionality can only be activated when using ControlBuilderPlus/Automation Builder.

CAN2A / CAN2B parameters

Name	Value	Internal value	Internal value, type	Default
CAN transmission rate	1000 kbit/s	0	DWORD	0
	800 kbit/s	1		
	500 kbit/s	2		
	250 kbit/s	3		
	125 kbit/s	4		
	100 kbit/s	5		
	50 kbit/s	6		
	20 kbit/s	7		
	10 kbit/s	8		

Configuration via GSDML (use by 3rd party PROFINET configuration tool)
The parameter CAN transmission rate must be set twice for each CAN2A and CAN2B interfaces, and they must be set with identical values.

Buffer parameters (to be configured for each used buffer)

Name	Value	Internal value	Internal value, type	Default
Identifier	0 ... 2047 (CAN2A)	0 ... 2047 (CAN2A)	WORD (CAN2A)	0
	0 ... 536870911 (CAN2B)	0 ... 536870911 (CAN2B)	DWORD (CAN2B)	
Receive buffer size (size in numbers of telegrams)	1 ... 32	1 ... 32	BYTE	1
Behaviour on receive buffer overflow *)	Overwrite	0	BYTE	0
	Discard	1		
	Overwrite and send diagnos-tics (PROFINET alarm)	3		
	Discard and send diagnos-tics (PROFINET alarm)	4		
*) The following table describes the values in detail.				

Setting	Description
Overwrite	The oldest buffer entry which is stored in the buffer is over-written with the new incoming telegram.
Discard	The new incoming telegram is discarded.
Overwrite and send diagnostics (PROFINET alarm)	The oldest buffer entry which is stored in the buffer is overwritten with the new incoming telegram. Additionally, a PROFINET alarm (diagnostic) will be sent to inform the user of the overflow occurrence.
Discard and send diagnostics (PROFINET alarm)	The new incoming telegram is discarded. Additionally a PROFINET alarm (diagnostic) will be sent to inform the user of the overflow occurrence.

Up to 64 buffers are allowed to be configured for each CAN2A and CAN2B type, each buffer containing the parameters described above.

1.8.7.5.8 Diagnosis

Structure of the Diagnosis Block via PNIO_DEV_ALARM function block

Byte Number	Description	Possible Values
1	Diagnosis Byte, slot number	31 = CI506-PNIO (e. g. error at integrated serial interface) 1 = 1st connected S500 I/O module ... 10 = 10th connected S500 I/O module
2	Diagnosis Byte, module number	According to the I/O bus specification passed on by modules to the fieldbus master
3	Diagnosis Byte, channel	According to the I/O bus specification passed on by modules to the fieldbus master
4	Diagnosis Byte, error code	According to the I/O bus specification Bit 7 and bit 6, coded error class 0 = E1 1 = E2 2 = E3 3 = E4 Bit 0 to bit 5, coded error description
5	Diagnosis Byte, flags	According to the I/O bus specification Bit 7: 1 = coming error Bit 6: 1 = leaving error

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier** **000 ... 063**	**AC500display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**	
Byte 4 **Bit 6 ... 7**	**-**	**Byte 1**	**Byte 2**	**Byte 3**	**Byte 4** **Bit 0 ... 5**	**PNIO diag-nosis block**	
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error identi-fier**	**Error message**	**Remedy**
	1)	2)	3)				
Module error							
3	-	31	31	31	43	Internal error in the module	Replace module
3	-	31	31	31	9	Overflow diagnosis buffer	New start
3	-	31	31	31	26	Parameter error	Check master
3	-	31	31	31	11	Process voltage too low	Check process voltage

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier** **000 ... 063**	**AC500display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**	
Byte 4 **Bit 6 ... 7**	**-**	**Byte 1**	**Byte 2**	**Byte 3**	**Byte 4** **Bit 0 ... 5**	**PNIO diag-nosis block**	
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error identi-fier**	**Error message**	**Remedy**
	[1])	[2])	[3])				
3	-	1 ... 10	31	31	17	No communication with I/O Module	Replace I/O module
4	-	1 ... 10	31	31	31	At least 1 I/O Module does not support failsafe mode	Check I/O modules and parame-terization
4	-	1 ... 10	31	31	32	Wrong I/O Module type on socket	Replace I/O module Check configu-ration
4	-	1 ... 10	31	31	34	No response during initialization of the I/O Module	Replace I/O Module
Serial Channel error							
4	-	31	31	1 ... 2	12	Reception SW FIFO overrun	Check modules and parame-terization
4	-	31	31	1 ... 2	26	Parameter error	Check modules and parame-terization
CANopen Channel error [4])							
4	-	31	31	12 ... 75	12	Reception SW FIFO (CAN2.0A) overrun (Buffer number 1...64) [5])	Check modules and parame-terization
4	-	31	31	112 ... 175	12	Reception SW FIFO (CAN2.0B) overrun (Buffer number 1...64) [5])	Check modules and parame-terization

Remarks:

[1])	In AC500 the following interface identifier applies: "-" = Diagnosis via bus-specific function blocks; 0 ... 4 or 10 = Position of the Communication Module; 14 = I/O bus; 31 = Module itself The identifier is not contained in the CI506-PNIO diagnosis block.
[2])	With "Device" the following allocation applies: ADR = Hardware address (e.g. of the CI506-PNIO)
[3])	With "Module" the following allocation applies dependent of the master: 31 = Module itself
[4])	All CANopen master and slave diagnostics are not available as PROFINET alarms; instead they can be read via PROFINET acyclic service. In AC500 PLC these are available in form of function blocks.
[5])	CAN2A Buffers 1 ... 64 are mapped to the channel values 12 ... 75, so the correlation value 11 has to be subtracted from the channel value to get the correct buffer number. CAN2B Buffers 1 ... 64 are mapped to the channel values 112 ... 175, so the correlation value 111 has to be subtracted from the channel value to get the correct buffer number

1.8.7.5.9 State LEDs

The LEDs are located at the front of module. There are 4 different groups:

- 5 system LEDs (PWR, STA1 ETH, STA2 ETH, S-ERR and I/O-Bus) show the operation state of the module and display possible errors.
- 4 Ethernet state LEDs located at the terminal unit TU520-ETH
- 11 state LEDs for the serial interfaces an the CANopen Interface
- 1 LED to display the presence of the process supply voltage UP

Table 344: States of the 5 system LEDs

LED	Color	OFF	ON	Flashing
PWR/RUN	Green	Process supply voltage missing	Internal supply voltage OK, module ready for communication with I/O Controller	Start-up / preparing communication
	Yellow	---	---	---
STA1 ETH (System-LED "BF")	Green	---	Device configured, cyclic data exchange running	---
	Red	---	---	Device is not configured
STA2 ETH (System-LED "SF")	Green	---	---	Got identification request from I/O controller
	Red	No system error	System error (collective error)	---

LED	Color	OFF	ON	Flashing
S-ERR	Red	No error	Internal error	--
I/O-Bus	Green	No communication interface modules connected or communication error	Communication interface module connected and operational	---

Table 345: States of the 4 Ethernet state LEDs

LED	Color	OFF	ON	Flashing
ETH1-Link	Green	No connection at Ethernet interface	Connected to Ethernet interface	---
ETH1-Rx Tx	Yellow	---	Device is transmitting telegrams	Device is transmitting telegrams
ETH2-Link	Green	No connection at Ethernet interface	Connected to Ethernet interface	---
Eth2-Rx Tx	Yellow	---	Device is transmitting telegrams	Device is transmitting telegrams

Table 346: States of the 8 state LEDs (4 per channel) of the serial interfaces

LED	Color	OFF	ON	Flashing
COMx TxD	Yellow	No data transmission over serial network	--	Channel is transmitting data via the serial interface (flashing rate depending on the telegram transmission frequency)
COMx RxD	Yellow	No data reception from serial network	--	Channel is receiving data from the serial interface (flashing rate depending on the telegram reception frequency)
COMx STA	Yellow	RS-232: RTS signal not active RS-485: Channel is in reception mode RS-422:Channel is not enabled	RS-232: RTS signal is active RS-485: Channel is transmitting RS-422: Channel is enabled (able to receive and transmit)	--
COMx-ERR	Red	Channel enabled, no error or Channel deactivated	Channel boot up	Channel error (receive buffer overflow)

Table 347: States of the 3 state LEDs of the CANopen interfaces

LED	Color	OFF	ON	Flashing
CAN-RUN	Yellow	--	Device configured, CANopen Bus in OPERATIONAL state and cyclic data exchange running	Flashing cyclically: CANopen Bus in Pre-operational state and slave is being configured Single flash: CANopen Bus in Stopped state.
CAN-STA	Yellow	No data transmission	Channel is transmitting data	--
CAN-ERR	Red	No error	CANopen bus is OFF	Flashing cyclically: Configuration error Single flash: Error counter overflow due to too many error frames Double flash: A Node-Guard or a Heartbeat event occurred

Table 348: State of the power supply LED

LED	Color	OFF	ON	Flashing
UP	Green	No process voltage available	Process voltage available	--

1.8.7.5.10 Technical data

Technical data of the module

The system data of AC500 and S500 are applicable to the standard version *Chapter 2.6.1 “System data AC500” on page 1408*.

The system data of AC500-XC are applicable to the XC version *Chapter 2.7.1 “System data AC500-XC” on page 1475*.

Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

Parameter		Value
Process supply voltages UP		
	Rated value	24 V DC
	Max. load for the terminals	10 A
	Protection against reversed voltage	Yes

Parameter		Value
	Rated protection fuse on UP	10 A fast
	Inrush current from UP (at power up)	On request
	Current consumption via UP (normal operation)	0.15 A
	Connections	Terminals 1.0, 2.0 and 3.0 for +24 V (UP) Terminals 1.1, 2.1 and 3.1 for 0 V (ZP)
Input data length		0 ... 36 bytes
Output data length		0 ... 36 bytes
Max. power dissipation within the module		5 W
Setting of the I/O module identifier		With 2 rotary switches at the front side of the module
Operation and error displays		18 LEDs (total)
Weight (without terminal unit)		ca. 125 g
Mounting position		Horizontal or vertical
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

Galvanic isolation	Ethernet interface against the rest of the module, each serial and CAN port against each other and the rest of the module
Diagnosis	See Diagnosis *Chapter 1.8.7.5.8 “Diagnosis” on page 1335*

NOTICE!
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and temporary overvoltage up to 30 V DC.

Multiple overloads
No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an internal smart high-side switch.

Parameter	Value
Bus connection	2 x RJ45
Switch	Integrated
Technology	Hilscher NETX 100
Transfer rate	10/100 Mbit/s (full-duplex)
Transfer method	According to Ethernet II, IEEE 802.3
Ethernet	100 base-TX, internal switch, 2x RJ45 socket
Expandability	Max. 10 S500 I/O modules

Parameter	Value
Adjusting elements	2 rotary switches for generation of an explicit name
Supported protocols	RTC - real time cyclic protocol, class 1 *) RTA - real time acyclic protocol DCP - discovery and configuration protocol CL-RPC - connectionless remote procedure Call LLDP - link layer discovery protocol MRP - MRP Client
Acyclic services	PNIO read / write sequence (max. 1024 bytes per telegram) Process-Alarm service
Supported alarm types	Process Alarm, Diagnostic Alarm, Return of SubModule, Plug Alarm, Pull Alarm
Min. bus cycle	1 ms
Conformance class	CC A
Protective functions (according to IEC 61131-3)	Protected against: ● short circuit ● reverse supply ● overvoltage ● reverse polarity Galvanic isolation from the rest of the module

*) Priorization with the aid of VLAN-ID including priority level

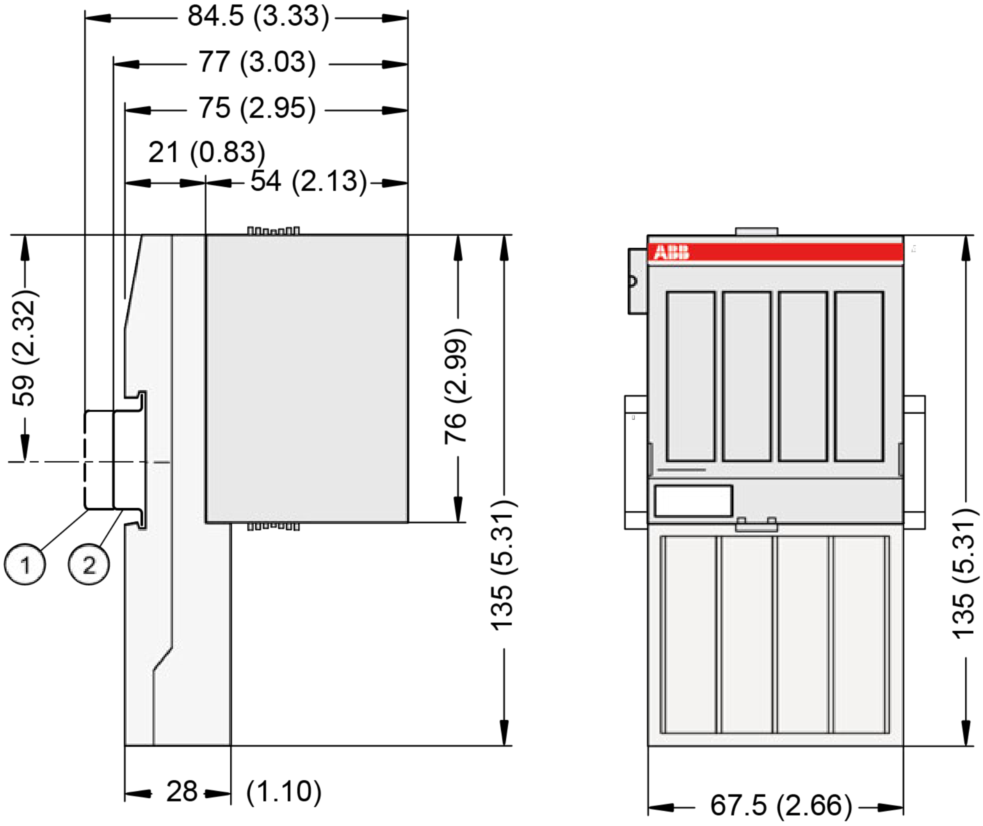
Technical data of the serial interfaces

Parameter	Value
Number of serial interfaces	2
Connectors for serial interfaces	X11 for COM1 X12 for COM2
Supported physical layers	RS-232 RS-422 RS-485
Supported protocols	ASCII
Transmission rate	Configurable from 300 bit/s to 115.200 bit/s

Technical data of the CANopen interface

Parameter	Value
Number of CANopen interfaces	1
Connector for CANopen Interface	X13
Transmission rate	Up to 1 Mbit/s

1.8.7.5.11 Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

1.8.7.5.12 Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 221 500 R0001	CI506-PNIO, PROFINET communication interface module with 2 serial interfaces and 1 CANopen master interface	Active
1SAP 421 500 R0001	CI506-PNIO-XC, PROFINET communication interface module with 2 serial interfaces and 1 CANopen master interface, XC version	Active

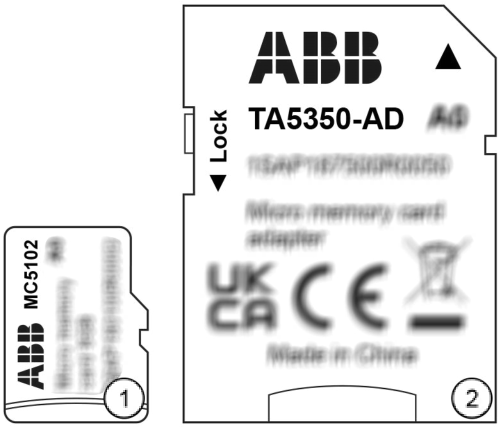
**)* *Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

1.9 Accessories

1.9.1 AC500-eCo

1.9.1.1 MC5102 - Micro memory card with adapter

- Solid state flash memory storage



1 Micro memory card
2 TA5350-AD micro memory card adapter, necessary for use in AC500 processor modules

> *The MC5102 micro memory card has no write protect switch.*
>
> *The TA5350-AD micro memory card adapter has a write protect switch.*
>
> *In the position "LOCK", the inserted micro memory card can only be read.*

Memory card type	AC500 V2	AC500-XC V2	AC500 V3	AC500-XC V3	AC500-eCo V3
MC5141	x	x	x	x	-
MC5102 **with** TA5350-AD micro memory card adapter	x [1])	x [1]) [2])	x	x [2])	-
MC5102 **without** TA5350-AD micro memory card adapter	-	-	-	-	x

[1]) As of firmware 2.5.x

[2]) Temporary use of MC5102 is possible under normal environmental conditions, but MC5141 should be preferred.

> *The use of other micro memory cards is prohibited. ABB is not responsible nor liable for consequences resulting from use of unapproved memory cards.*

Purpose

> *Processor modules can be operated with and without (micro) memory card.*
>
> *Processor modules are supplied without (micro) memory card. It must be ordered separately.*

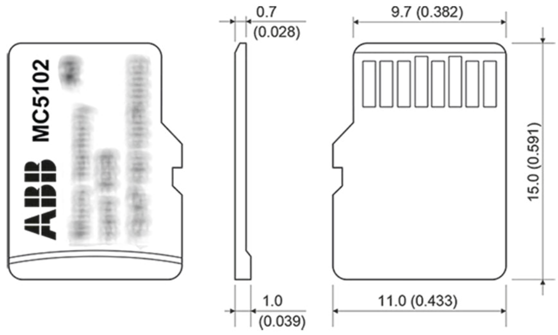
The micro memory card is used to store or backup application data and/or application programs or project source codes as well as to update the internal CPU firmware.

The micro memory card can only be used temporarily in standard and XC applications.

The memory card can be read/written on a PC with a SDHC compatible memory card reader when using TA5350-AD micro memory card adapter.

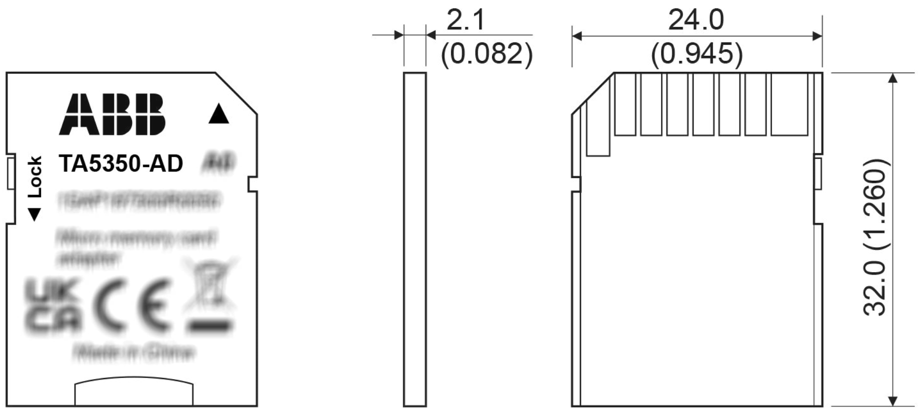
Dimensions

Micro memory card



The dimensions are in mm and in brackets in inch.

Micro memory card adapter



The dimensions are in mm and in brackets in inch.

Insert the micro memory card

AC500 V2 and AC500-eCo V2

1. Unpack the micro memory card and insert it into the supplied micro memory card adapter.
2. Insert the micro memory card adapter with integrated micro memory card into the memory card slot of the processor module until locked.

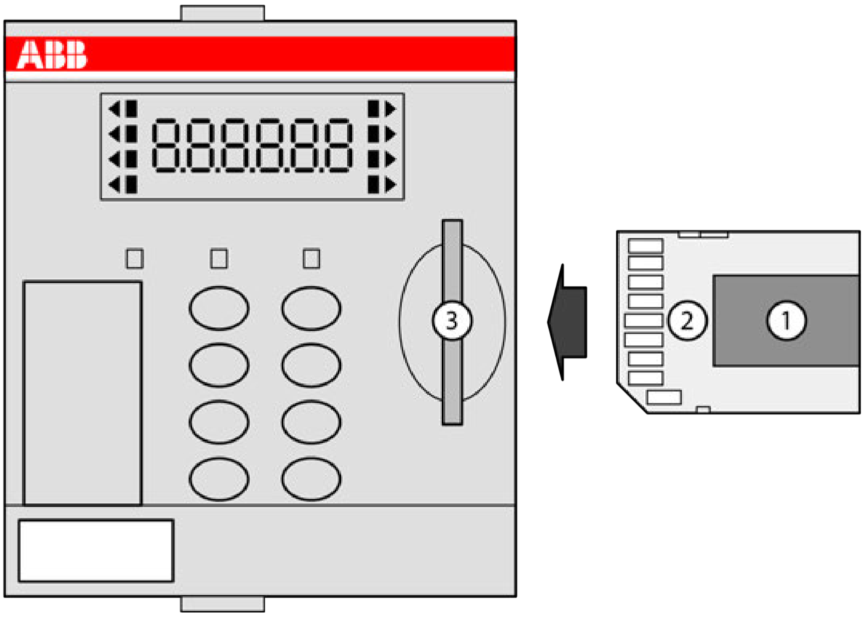


Fig. 338: Insert micro memory card into PM57x, PM58x and PM59x

1 Micro memory card
2 Micro memory card adapter
3 Memory card slot

Remove the micro memory card

AC500 V2 and AC500-eCo V2

> **NOTICE!**
> **Removal of the micro memory card**
> Do not remove the micro memory card when it is working!
>
> Remove the micro memory card with micro memory card adapter only when the RUN LED is not blinking.
>
> Otherwise the micro memory card and/or files on it might get corrupted and/or normal PLC operation might be disturbed.

1. To remove the micro memory card adapter with the integrated micro memory card, push on the micro memory card adapter until it moves forward.
2. By this, the micro memory card adapter is unlocked and can be removed.

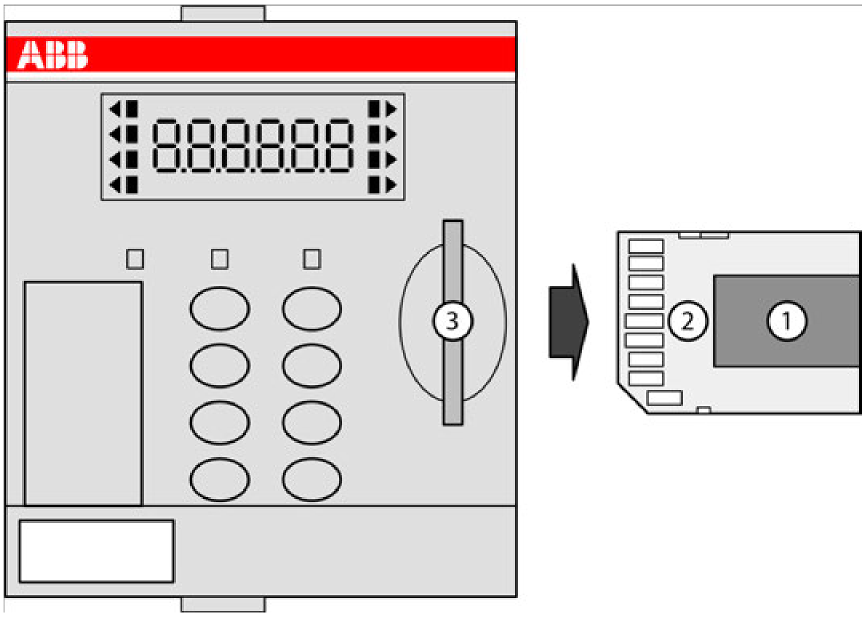


Fig. 339: Remove micro memory card from PM57x, PM58x and PM59x

1 Micro memory card
2 Micro memory card adapter
3 Memory card slot

Technical data

Parameter		Value
Memory capacity		8 GB
Total bytes written (TBW)		On request
Data retention		
	at beginning	10 years at +40 °C
	when number of write processes has been 90 % of lifetime of each cell	1 year at +40 °C
Write protect switch		
	Micro memory card	No
	Micro memory card adapter	Yes
Weight		0.25 g
Dimensions		15 mm x 11 mm x 0.7 mm

It is not possible to use 100 % of a device's memory space. About 10 % of the total available space must remain unused at any time to maintain normal device operation.

Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 180 100 R0002	MC5102, micro memory card with TA5350-AD micro memory card adapter	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

1.9.1.2 MC5141 - Memory card

- Solid state flash memory storage

1 MC5141 memory card

The memory card has a write protect switch.

In the position "LOCK", the memory card can only be read.

Memory card type	**AC500 V2**	**AC500-XC V2**	**AC500 V3**	**AC500-XC V3**	**AC500-eCo V3**
MC5141	x	x	x	x	-
MC5102 **with** TA5350-AD micro memory card adapter	x [1])	x [1]) [2])	x	x [2])	-
MC5102 **without** TA5350-AD micro memory card adapter	-	-	-	-	x

[1]) As of firmware 2.5.x

[2]) Temporary use of MC5102 is possible under normal environmental conditions, but MC5141 should be preferred.

The use of other memory cards is prohibited. ABB is not responsible nor liable for consequences resulting from use of unapproved memory cards.

Purpose

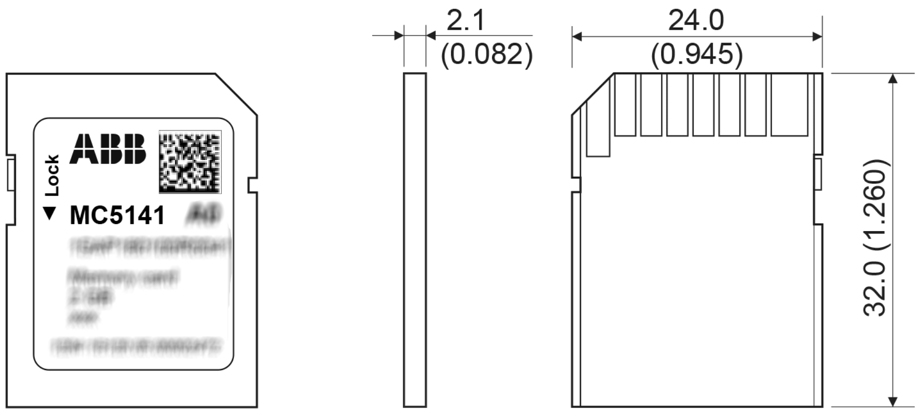
> *Processor modules can be operated with and without (micro) memory card.*
>
> *Processor modules are supplied without (micro) memory card. It must be ordered separately.*

The memory card is used to store or backup application data and/or application programs or project source codes as well as to update the internal CPU firmware.

The memory card is intended for long-term use in standard and XC application.

The memory card can be read/written on a PC with a SDHC compatible memory card reader.

Dimensions



> *The dimensions are in mm and in brackets in inch.*

Insert the memory card

AC500 V2 and AC500-eCo V2

1. Unpack the memory card.
2. Insert the memory card into the memory card slot of the processor module until locked.

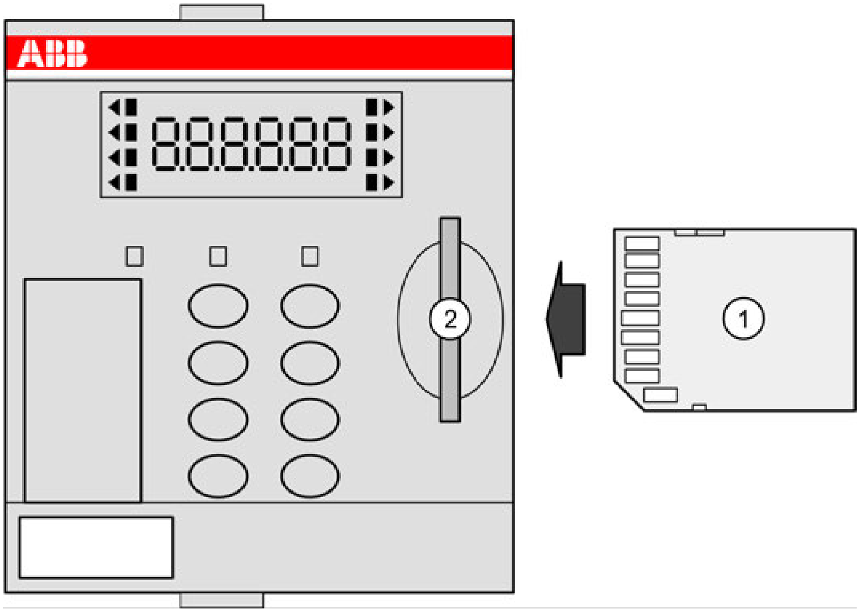


Fig. 340: Insert memory card into PM57x, PM58x and PM59x

1 Memory card
2 Memory card slot

Remove the memory card

AC500 V2 and AC500-eCo V2

> **NOTICE!**
> **Disturbed PLC operation**
> Do not remove the memory card when it is working!
>
> Otherwise the memory card and/or files on it might get corrupted and/or normal PLC operation might be disturbed.
>
> –

1. To remove the memory card, push on the memory card until it moves forward.
2. By this, the memory card is unlocked and can be removed.

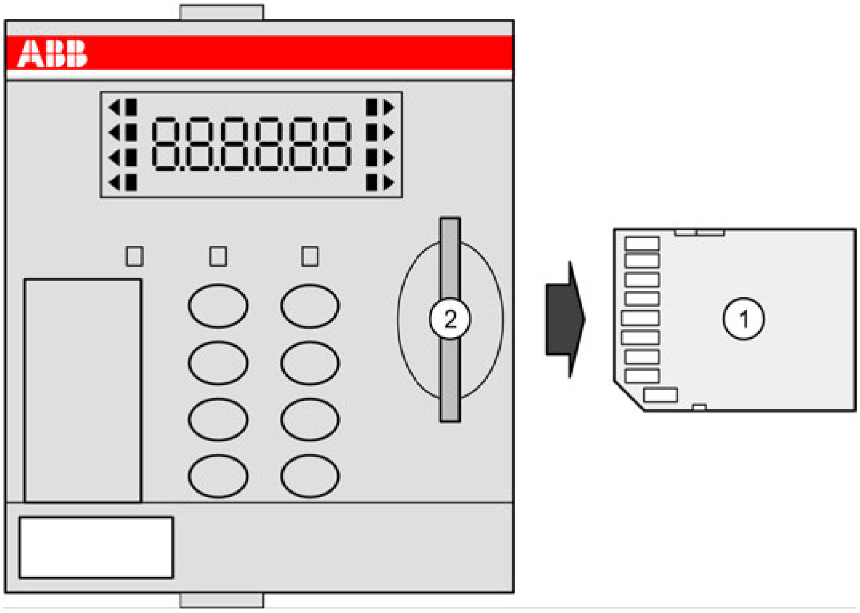


Fig. 341: Remove memory card from PM57x, PM58x and PM59x

1 Memory card
2 Memory card slot

Technical data

Parameter		Value
Memory capacity		2 GB
Total bytes written (TBW)		On request
Data retention		
	at beginning	10 years at +40 °C
	when number of write processes has been 90 % of lifetime of each cell	1 year at +40 °C
Write protect switch		Yes, at the edge of the memory card
Weight		2 g
Dimensions		24 mm x 32 mm x 2.1 mm

It is not possible to use 100 % of a device's memory space. About 10 % of the total available space must remain unused at any time to maintain normal device operation.

Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 180 100 R0041	MC5141, memory card	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

1.9.2 S500-eCo

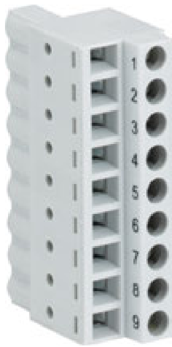
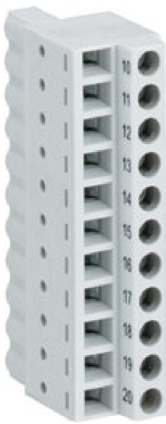
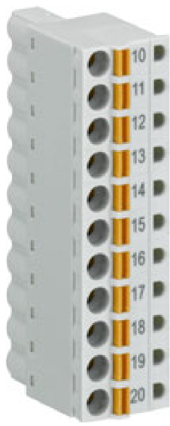
1.9.2.1 TA563-TA565 - Terminal blocks

CAUTION!
Risk of injury and damaging the module when using unapproved terminal blocks!
Only use terminal blocks approved by ABB to avoid injury and damage to the module.

These terminal blocks must only be used with AC500-eCo I/O modules and AC500-eCo processor modules.

Intended purpose

The TA563-TA565 terminal blocks are used to connect process signals and process voltages to AC500-eCo I/O modules and AC500-eCo processor modules (with -P extension inside their type designator only).

Screw terminals with cable insertion on the side	Screw terminals with cable insertion on the front	Spring terminals with cable insertion on the front
TA563-9 	TA564-9 	TA565-9 
TA563-11 	TA564-11 	TA565-11 

WARNING!

For screw terminals only: Danger of death by electric shock!

The IP 20 protection degree is only provided if all terminal screws are tightened.

Tighten all screws of unused load terminals of relay outputs if voltages > 24 V are connected to the relay group.

Technical data

Table 349: Screw-type terminals (TA563/TA564)

Parameter		Value
Type		Front terminal or side terminal (depending on model)
Conductor cross section		
	Solid	0.5 mm^2 ... 2.5 mm^2
	Flexible	0.5 mm^2 ... 2.5 mm^2
Stripped conductor end		
	TA563	8 mm
	TA564	10 mm
Width of the screwdriver		3.5 mm
Fastening torque		0.4 Nm ... 0.5 Nm
Degree of protection		IP 20 (if all terminal screws are tightened)
Conductor cross section flexible, with ferrule with/without plastic sleeve		Min. 0.25 mm^2 Max. 1.5 mm^2

Table 350: Spring terminals (TA565)

Parameter		Value
Type		Front terminal
Conductor cross section		
	Solid	0.5 mm^2 ... 2.5 mm^2
	Flexible	0.5 mm^2 ... 2.5 mm^2
Stripped conductor end		10 mm
Degree of protection		IP 20
Conductor cross section flexible, with ferrule with/without plastic sleeve		Min. 0.25 mm^2 Max. 1.5 mm^2

Ordering data

Part no.	Description	Product life cycle phase *)
1TNE 968 901 R3101	Terminal Block TA563-9, 9-pin, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3102	Terminal Block TA563-11, 11-pin, screw front, cable side, 6 pieces per unit	Active

Part no.	Description	Product life cycle phase *)
1TNE 968 901 R3103	Terminal Block TA564-9, 9-pin, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3104	Terminal Block TA564-11, 11-pin, screw front, cable front, 6 pieces per unit	Active

Part no.	Description	Product life cycle phase *)
1TNE 968 901 R3105	Terminal Block TA565-9, 9-pin spring front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3106	Terminal Block TA565-11, 11-pin, spring front, cable front, 6 pieces per unit	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

1.9.3 S500

1.9.3.1 CP-E - Economic range

The power supplies feature series and parallel connection as well as a true redundant setup via a redundancy module.

- Wide-range input voltage
- Mounting on DIN rail
- High efficiency of up to 90 %
- Low power dissipation and low heating
- Wide ambient temperature range from -40 °C ... +70 °C
- No-load-proof, overload-proof, continuous short-circuit-proof
- Power factor correction (depending on the type)
- Approved in accordance with all relevant international standards

Table 351: Ordering data

Order No.	Type	Input	Output	Overload capacity	Module width [mm]
1SVR427030R0000	CP-E 24/0.75	100-240 V AC or 120-370 V DC	24 V DC, 0.75 A	-	22.5
1SVR427031R0000	CP-E 24/1.25	100 V AC ... 240 V AC or 90V DC ... 375 V DC	24 V DC, 1.25 A	-	40.5
1SVR427032R0000	CP-E 24/2.5	100 V AC ... 240 V AC or 90 V DC ... 375 V DC	24 V DC, 2.5 A	-	40.5
1SVR427034R0000	CP-E 24/5.0	115/230 V AC auto select or 210 V DC ... 370 V DC	24 V DC, 5 A	-	63.2
1SVR427035R0000	CP-E 24/10.0	115/230 V AC auto select or 210 V DC ... 370 V DC	24 V DC, 10 A	-	83
1SVR427036R0000	CP-E 24/20.0	115 V AC ... 230 V AC or 120 V DC ... 370 V DC	24 V DC, 20 A	-	175

1.9.3.2 CP-C.1 - High performance range

The power supplies feature series and parallel connection as well as a true redundant setup via a redundancy module.

The CP-C.1 power supplies are ABB’s high performance and most advanced range. With excellent efficiency, high reliability and innovative functionality it is prepared for the most demanding industrial applications. These power supplies have a 50 % integrated power reserve and operate at an efficiency of up to 94 %. They are equipped with overheat protection and active power factor correction. Combinded with a broad AC and DC input range and extensive worldwide approvals the CP-C.1 power supplies are the preferred choice for professional DC applications.

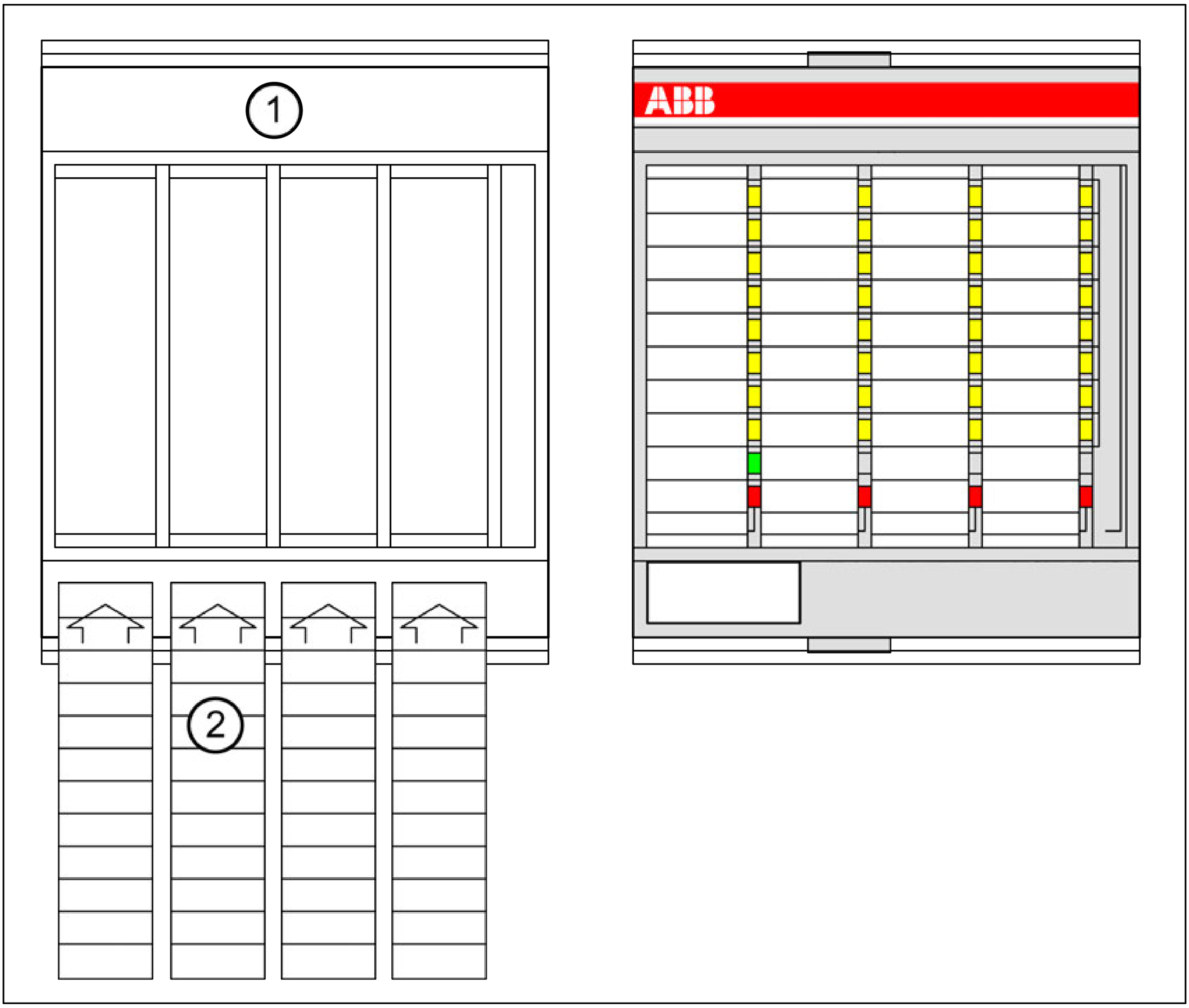
- Typical efficiency of up to 94 %
- Power reserve design delivers up to 150 % of the nominal output current
- Signaling outputs for DC OK and power reserve mode
- High power density leads to very compact and small devices
- No-load-proof, overload-proof, continuous short-circuit-proof
- Active power factor correction (PFC)

Table 352: Ordering data

Order No.	Type	Input	Output	Overload capacity	Module width [mm]
1SVR360563R1001	CP-C.1 24/5.0	110 V AC ... 240 V AC or 90 V DC ... 300 V DC	24 V DC, 5 A	+50 %	40
1SVR360663R1001	CP-C.1 24/10.0	110 V AC ... 240 V AC or 90 V DC ... 300 V DC	24 V DC, 10 A	+50 %	60
1SVR360763R1001	CP-C.1 24/20.0	110 V AC ... 240 V AC or 90 V DC ... 300 V DC	24 V DC, 20 A	+30 %	82

1.9.3.3 TA523 - Pluggable label mounting

For labelling the channels of S500 I/O modules.



1 Pluggable label mounting TA523
2 Plastic labels to be inserted into the holder

Purpose

The pluggable label mounting is used to hold 4 plastic labels, on which the meaning of the I/O channels of I/O modules can be written down. The holder is transparent so that after snapping it onto the module the LEDs shine through.

Handling instructions

The plastic labels can be printed out from *TA523.doc*.

Technical data

Parameter	Value
Use	For labelling channels of I/O modules
Mounting	Snap-on to the module
Weight	20 g
Dimensions	82 mm x 67 mm x 13 mm

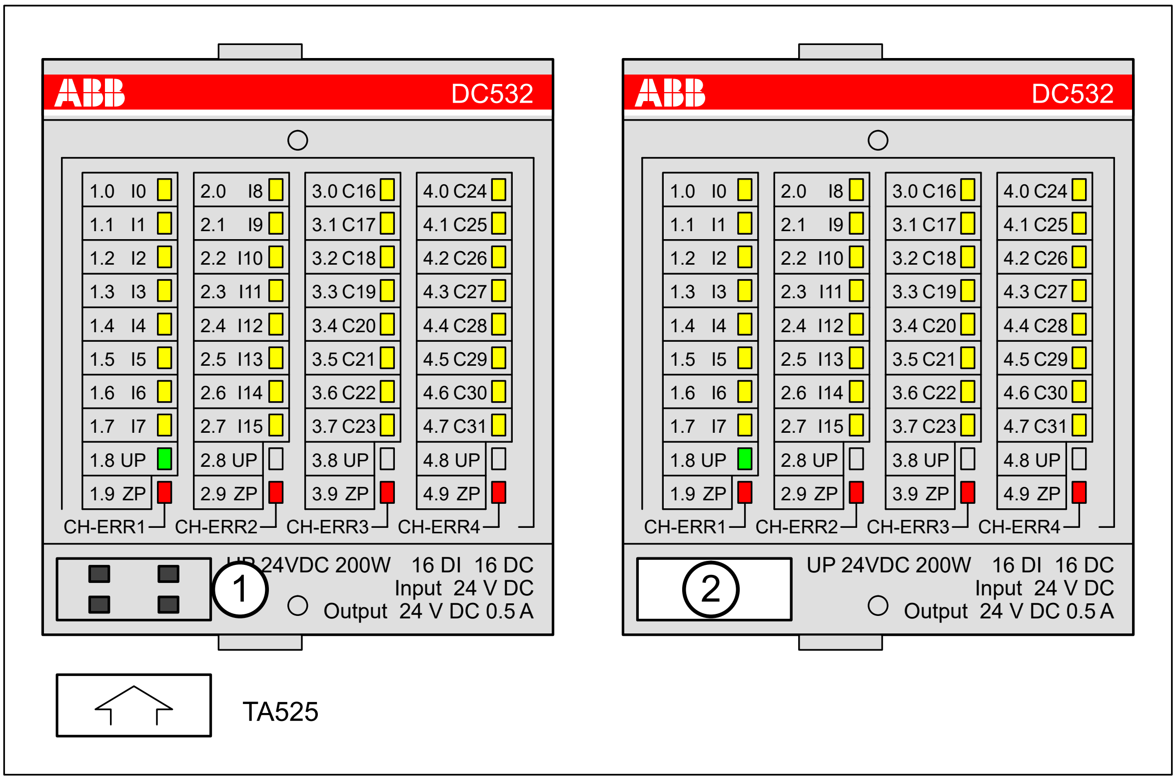
Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 180 500 R0001	TA523, pluggable label mounting (10 pieces)	Active

) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.

1.9.3.4 TA525 - Plastic labels

Accessory to label AC500 and S500 modules.



1 Module without plastic label TA525
2 Module with plastic label TA525

Purpose

The plastic labels are suitable for labelling AC500 and S500 modules (CPUs, communication modules and I/O modules). The small plastic parts can be written on with a standard waterproof pen.

Handling instructions

The plastic labels are inserted under a slight pressure. For disassembly, a small screwdriver is inserted at the lower edge of the module.

Technical data

Parameter	Value
Use	For labelling AC500 and S500 modules
Mounting	Insertion under a slight pressure

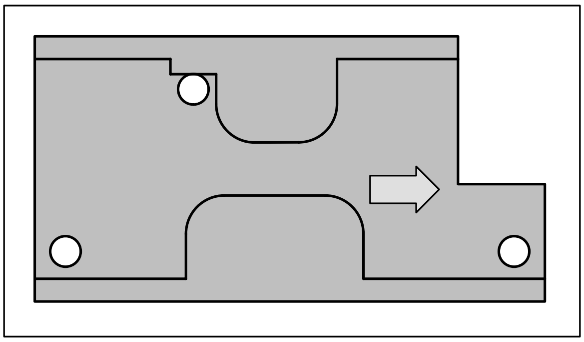
Parameter	Value
Disassembly	With a small screwdriver
Scope of delivery	10 pieces
Weight	1 g per piece
Dimensions	8 mm x 20 mm x 5 mm

Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 180 700 R0001	TA525, Set of 10 white plastic labels	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

1.9.3.5 TA526 - Wall mounting accessory



Purpose

If a terminal base or a terminal unit should be mounted with screws, the wall mounting accessories TA526 must be inserted at the rear side first. This plastic parts prevent bending of terminal bases and terminal units while screwing up.

Handling of the wall mounting accessory with terminal units

Handling of the wall mounting accessory with terminal bases

Technical data

Parameter	Value
Weight	5 g
Dimensions	67 mm x 35 mm x 5,5 mm

Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 180 800 R0001	TA526, wall mounting accessory	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

1.9.3.6 TA535 - Protective caps for XC devices

Purpose

Accessory to cover unused connectors of XC devices in salt mist environments.

One TA535 package includes different cap types for the following connectors:

- RJ45 connectors
- 9-pole D-sub connector
- FieldBusPlug connector

Protection should be done for all unused slots of -XC devices.

Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 182 300 R0001	TA535, Protective Caps for XC devices	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

2 System assembly, construction and connection

2.1 Introduction

This chapter provides information on assembly, construction and connection of control systems of the product family AC500.

The AC500 product family consists of the sub-families:

- AC500 (standard): standard PLC that offers a wide range of performance levels and scalability.
- AC500-eCo: cost-effective PLC that offers total inter-operability with the core AC500 range.
- AC500-S: PLC for special safety requirements in all functional safety applications.

AC500 (standard) and AC500-S provide devices with -XC extension as a product variant. Those devices operate mainly identical to the appropriate AC500 product family, however, can be operated under extreme conditions *Chapter 2.7.1 “System data AC500-XC” on page 1475*.

AC500 product family is characterized by functional modularity, i.e. the devices of all AC500 sub-families can be combined flexible.

As assembly, construction and connection for the devices of the AC500 product family is similar, information that is valid for all sub-families is provided within an overall section. Details that are only valid for a specific AC500 sub-family are described in separate sections.

As assembly, construction and connection for the devices of the AC500 product family is similar, information that is valid for all sub-families is provided within an overall section *Chapter 2.4 “Overall information (valid for complete AC500 product family)” on page 1368*. Details that are only valid for a specific AC500 sub-family are described in separate sections.

> ***Consider the safety instructions***
> *In the description, special attention must be paid to designs using galvanic isolation, grounding and EMC measures for the reasons stated. Consider the safety instructions for AC500 product family.*

2.2 Regulations

Planning and installation of the electrical system

The planning and installation of the electrical system must be carried out in compliance with the applicable regulations and standards. Hazards due to malfunctions must be prevented by taking appropriate measures.

The suitability of the products for the respective application is proven by declarations of conformity and certificates.

The PLC Automation catalog contains an *overview of the available declarations of conformity and certificates*.

Qualified personnel

Both the AC500 control system and other components in the vicinity are operated with dangerous touch voltages. Touching live components can lead to serious health implications or even death.

To avoid such risks and the occurrence of property damage, persons involved in the installation, commissioning and maintenance must have relevant knowledge about:

- Automation technology
- Handling of hazardous voltages
- Application of relevant standards and regulations, accident prevention regulations and regulations on special environmental conditions (e.g., hazardous areas due to explosive substances, heavy soiling or corrosive influences).

2.3 Safety instructions

Relevant standards and regulations, accident prevention regulations and regulations on special environmental conditions must be observed (e.g., hazardous areas due to explosive substances, heavy soiling or corrosive influences).

The devices must be handled and operated within the specified technical data and system data.

The devices contain no serviceable parts and must not be opened.

Removable covers must be closed during operation unless otherwise specified.

Any liability for the consequences of incorrect use or unauthorized repairs is rejected.

Qualified personnel

Both the AC500 control system and other components in the vicinity are operated with dangerous touch voltages. Touching live components can lead to serious health implications or even death.

To avoid such risks and the occurrence of property damage, persons involved in the installation, commissioning and maintenance must have relevant knowledge about:

- Automation technology
- Handling of hazardous voltages
- Application of relevant standards and regulations, accident prevention regulations and regulations on special environmental conditions (e.g., hazardous areas due to explosive substances, heavy soiling or corrosive influences).

Functional safety

The *AC500-S safety user manual* must be read and understood before using the safety configuration and programming tools of Automation Builder/PS501 Control Builder Plus. Only qualified personnel are permitted to work with AC500-S safety PLCs.

General information

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variants and requirements associated with any particular installation, ABB cannot assume responsibility or liability for actual use based on the examples and diagrams.

The PLC was developed according to the relevant standards. Any module-specific measures are described in the individual descriptions of the modules.

PLC-specific safety notices

The product family AC500 control system is designed according to the EN 61131-2 and IEC 61131-2 standards. Any data that differs from IEC 61131-2, is due to the higher requirements of Maritime Services. Other differences are described in the technical data description of the devices.

NOTICE!

Avoidance of electrostatic charging

PLC devices and equipment are sensitive to electrostatic discharge, which can cause internal damage and affect normal operation. Observe the following rules when handling the system:

– Touch a grounded object to discharge potential static.
– Wear an approved grounding wrist strap.
– Do not touch connectors or pins on component boards.
– Do not touch circuit components inside the equipment.
– If available, use a static-safe workstation.
– When not in use, store the equipment in appropriate static-safe packaging.

NOTICE!

Use of suitable enclosure

The devices must be mounted in a control cabinet that ensures compliance with the specified environmental conditions.

Cleaning instructions

Do not use cleaning agent for cleaning the device.

Use a damp cloth instead.

Connection plans and a user program must be created so that no dangerous situations can occur during normal operation or failure.

The application must be tested to ensure that no dangerous situations can occur during operation.

Do not operate devices outside of the specified, technical data!

Trouble-free functioning cannot be ensured outside of the specified data.

NOTICE!

PLC damage due to missing grounding

– Make sure to ground the devices.
– The grounding (switch cabinet grounding) is supplied both by the mains connection (or 24 V supply voltage) and via the DIN rail. The DIN rail must be connected to ground before power is supplied to the device. The grounding may be removed only if it is certain that no more power is being supplied to the control system.
– In case of screw mounting, use metal screws for grounding.

CAUTION!

Do not obstruct the ventilation for cooling!

The ventilation slots on the upper and lower sides of the devices must not be covered.

CAUTION!
Run signal and power wiring separately!
Signal and supply lines (power cables) must be laid out so that no malfunctions due to capacitive and inductive interference can occur (EMC).

WARNING!
Warning sign on the module!
This indicates that dangerous voltages may be present or that surfaces may have dangerous temperatures.

WARNING!
Splaying of strands can cause hazards!
Avoid splayed strands when wiring terminals with stranded conductors.

– Ferrules can be used to prevent splaying.

WARNING!
Removal/Insertion under power
Removal or insertion under power is permissible only if all conditions for hot swapping are fullfilled.

↬ *Conditions for hot swap*

↬ *“Conditions for hot swap” on page 1367*

The devices are not designed for removal or insertion under power when the conditions for hot swap do not apply. Because of unforeseeable consequences, it is not allowed to plug in or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

Disconnecting any powered devices while they are energized in a hazardous location could result in an electric arc, which could create an ignition source resulting in fire or explosion.

Prior to proceeding, make sure that power is been disconnected and that the area has been thoroughly checked to ensure that flammable materials are not present.

The devices must not be opened when in operation. The same applies to the network interfaces.

Conditions for hot swap

Hot swap

System requirements for hot swapping of I/O modules:

- *Types of terminal units that support hot swapping of I/O modules have the appendix TU5xx-**H**.*
- *I/O modules as of index F0.*

The following I/O bus masters support hot swapping of attached I/O modules:

- *Communication interface modules CI5xx as of index F0.*
- *Processor module PM585-ETH with firmware version as of V2.8.1.*

NOTICE!
Risk of damage to I/O modules!
Hot swapping is only allowed for I/O modules.

Processor modules and communication interface modules must not be removed or inserted during operation.

Conditions for hot swapping

- *Digital outputs are not under load.*
- *Input/output voltages above safety extra low voltage/ protective extra low voltages (SELV/PELV) are switched off.*
- *Modules are completely plugged on the terminal unit with both snap fit engaged before switching on loads or input/output voltage.*

Information on batteries

CAUTION!
Use only ABB approved lithium battery modules!
At the end of the battery's lifetime, always replace it only with a genuine battery module.

CAUTION!
Risk of explosion!
Do not open, re-charge or disassemble lithium batteries. Attempting to charge lithium batteries will lead to overheating and can cause explosions.

Protect them from heat and fire and store them in a dry place.

Never short-circuit or operate lithium batteries with the polarities reversed. The batteries are likely to overheat and explode. Avoid unintentional short circuiting do not store batteries in metal containers and do not place them on metallic surfaces. Escaping lithium is a health hazard.

Environment considerations

Recycle exhausted batteries. Dispose of batteries in an environmentally conscious manner in accordance with regulations issued by the local authorities.

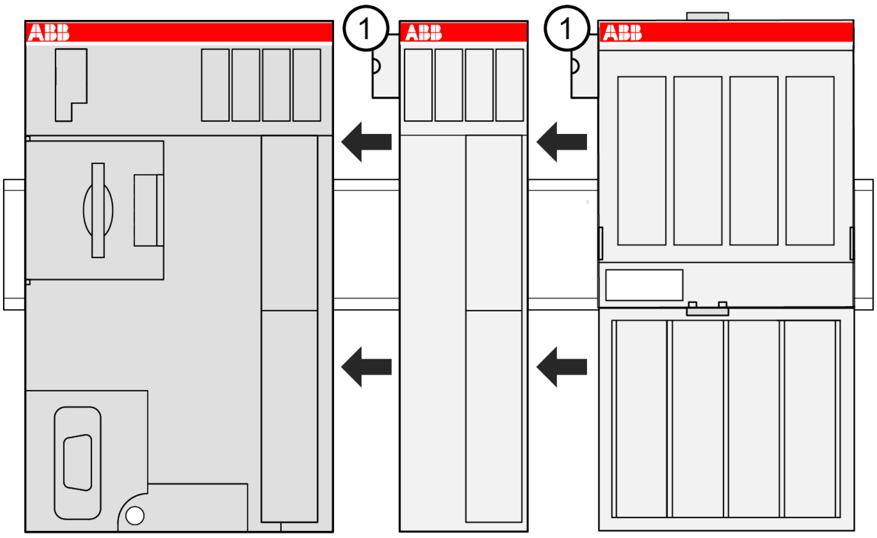
2.4 Overall information (valid for complete AC500 product family)

2.4.1 I/O bus

The synchronized I/O bus is the I/O data bus for the I/O modules connected with the processor modules or communication interface modules. Through this bus, I/O and diagnosis data are transferred.

With its fast data transmission, the I/O bus obtains very low reaction times.

Up to 10 I/O terminal units (for one I/O module each) can be added to one terminal base or to one AC500-eCo processor module. The I/O terminal units and the AC500-eCo I/O modules, have a bus input at the left side and a bus output at the right side. Thus the length of the I/O bus increases with the number of attached I/O modules *Table 353 “Maximum number of I/O devices which can be connected to the I/O bus” on page 1369*.



1 I/O bus connection

The connection of the I/O bus is performed automatically by telescoping the modules on the DIN rail. The I/O bus provides the following signals:

- Supply voltage of 3.3 V DC for feeding the electronic interface components
- 3 data lines for the synchronized serial data exchange
- several control signals

> **NOTICE!**
> Except when using hot swap terminal units, the I/O bus is not designed for pulling and plugging modules during operation. If a module is pulled or plugged on a terminal unit that is **not** hot swap capable while the bus is running, the following consequences are possible
>
> – reset of the station or of the processor module
> – system lockup
> – damage of the module

WARNING!

Removal/Insertion under power

Removal or insertion under power is permissible only if all conditions for hot swapping are fullfilled.

↳ *Conditions for hot swap*

↳ *"Conditions for hot swap" on page 1367*

The devices are not designed for removal or insertion under power when the conditions for hot swap do not apply. Because of unforeseeable consequences, it is not allowed to plug in or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

Disconnecting any powered devices while they are energized in a hazardous location could result in an electric arc, which could create an ignition source resulting in fire or explosion.

Prior to proceeding, make sure that power is been disconnected and that the area has been thoroughly checked to ensure that flammable materials are not present.

The devices must not be opened when in operation. The same applies to the network interfaces.

Profibus (master and slave) and CM589-PNIO are available since version 2.5.0 of the Automation Builder.

Table 353: Maximum number of I/O devices which can be connected to the I/O bus

Device	**Version Automation Builder**	**Version firmware**	**Max. number of I/O devices**
CS31 bus modules DC551-CS31 and CI592-CS31-HA	All	All	7
CANopen bus modules CI581-CN and CI582-CN	As of V2.1.0	All	10
PROFIBUS bus modules CI541-DP and CI542-DP	As of V2.1.0	all	10
PROFINET bus modules CI504-PNIO and CI506-PNIO	As of V2.1.0	all	10
EtherCAT communication interface module CI511-ETHCAT and CI512-ETHCAT	As of V1.1	As of V2.0.x	10
Modbus communication interface module CI521 and CI522	Independent from Automation Builder version	all	10

Profibus (master and slave) and CM589-PNIO are available since version 2.5.0 of the Automation Builder.

Table 354: General data of the I/O bus

Parameter	Value
Supply voltage, signal level	3.3 V DC ± 10 %
Max. supply current	On request
Type of the data interface	Synchronized serial data exchange
Bus data transmission speed	1.8 Mb/s
Minimum bus cycle time	500 µs This value is valid for all module combinations (from 1 to 10 I/O modules)
Galvanic isolation	I/O bus is galvanic connected to CPU and communication interface logic ciruits. Galvanic isolation of I/O bus is I/O module specific. See each module specification for details.
Protection against electrostatic discharge (ESD)	TB5xx, TB56xx: with protection diodes, no ESD discharge allowed on the port.

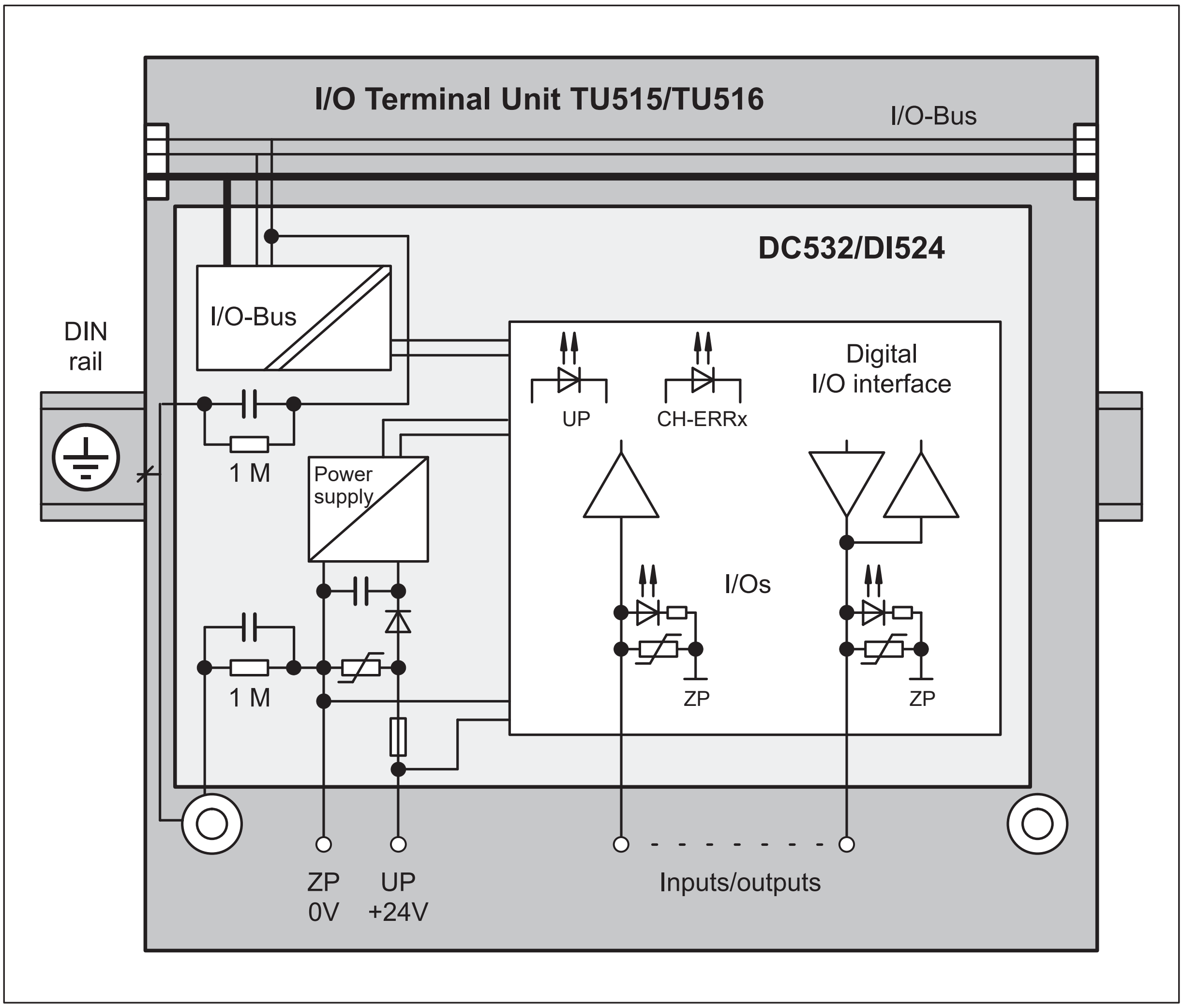
Table 355: Wiring (bus connection)

Parameter	Value
Bus connection	Left-side and right-side connection from module to module via a 10-pole HE plug (male at the left side, female at the right side)
Mechanical connection	Established by the terminal units
Max. bus length	1 m

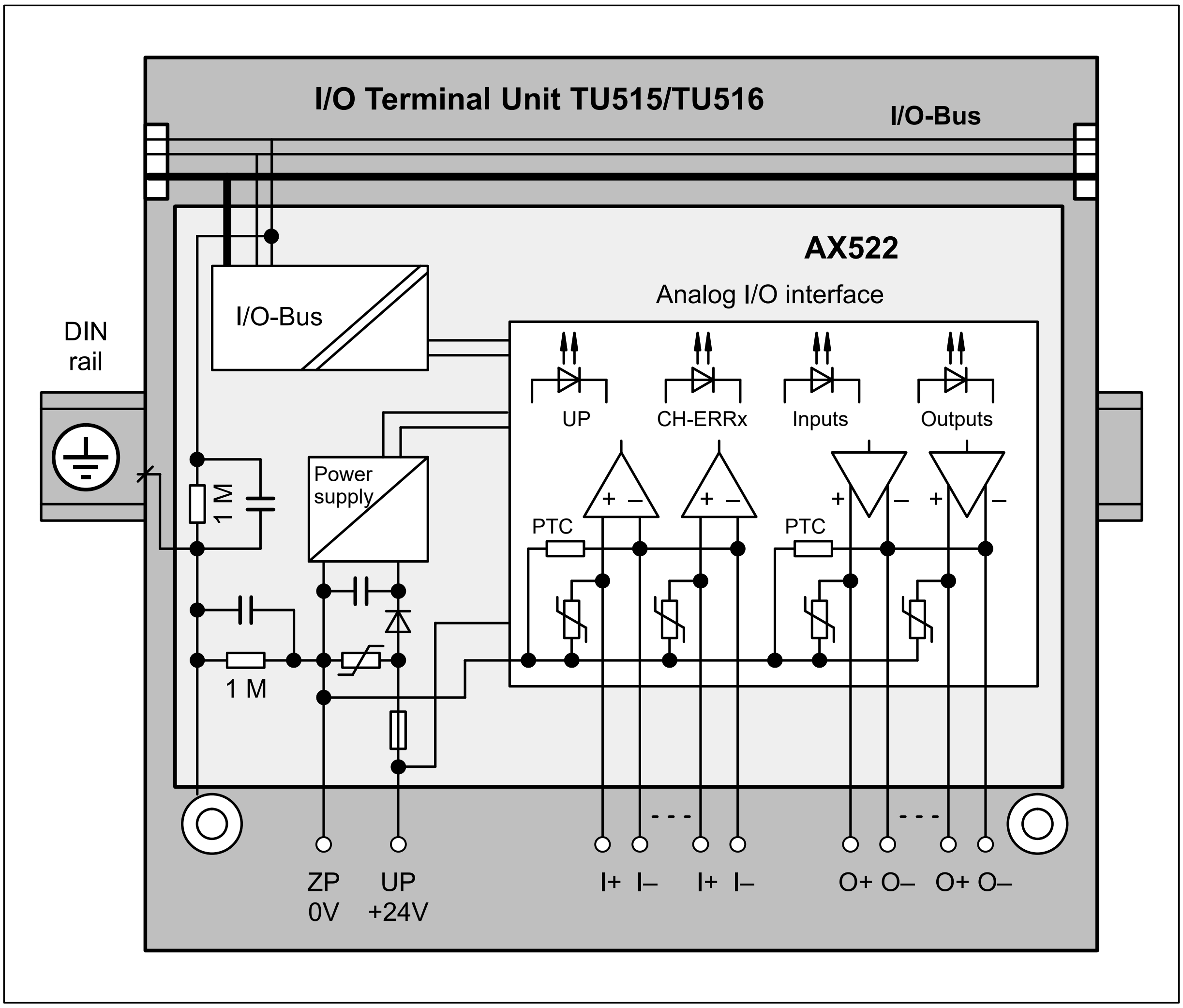
2.4.2 Grounding concept

NOTICE!
PLC damage due to missing grounding
- Make sure to ground the devices.
- The grounding (switch cabinet grounding) is supplied both by the mains connection (or 24 V supply voltage) and via the DIN rail. The DIN rail must be connected to ground before power is supplied to the device. The grounding may be removed only if it is certain that no more power is being supplied to the control system.
- In case of screw mounting, use metal screws for grounding.

Block diagram: Digital I/O modules



Block diagram: Analog I/O modules



2.4.3 EMC-conforming assembly and construction

2.4.3.1 General principles

> *AC500 and AC500-eCo PLC devices are Class II/Class III devices and do not require a Protective Earth (PE) connection.*
>
> *For proper EMC performance, all metal parts, DIN rails, mounting screws, and cable shield connection terminals are connected to a common ground and provide Functional Earth (FE). This is typically connected to a common reference potential, such as equipotential bonding rails.*
>
> *Signal Grounds (SGND or GND) are used for signal reference and must not be connected to cable shields, FE or other signals unless otherwise specified in the specific device description.*

General considerations

Electric and electronical devices have to work correctly on site. This is also valid when electro-magnetic influences affect them in defined and/or expected strength. The devices themselves must not emit electro-magnetic noises.

Advant controller components have a very high noise immunity.

When the wiring and grounding instructions are met, an error-free operation is given.

High electro-magnetic noises of nearby mounted applications must be taken in consideration during the planning phase.

An EMC compatible earthing concept will also guarantee an error-free operation here.

In order to prevent operating malfunctions, it is recommended, that the operating personnel discharge themselves prior to touching communication connectors or perform other suitable measures to reduce effects of electrostatic discharges.

There are three important principles to be especially considered:

- *Keep all connections as short as possible (in particular the grounding conductors)*
- *Use large conductor cross sections (in particular for the grounding conductors)*
- *Create low-impedance, i.e. good and large-sized contacts (in particular for the grounding conductors)*

Pay attention to the following:

- *Use vibration-resistant connections*
- *Clean metallic contact areas*
- *Use solid plug and screw-type connections*
- *Use earth cable shields with clips on a well-grounded metallic surface*
- *Do not use aluminium parts*
- *Do not use sheath wires*
- *Do not use toothed lock washers under screw connections*

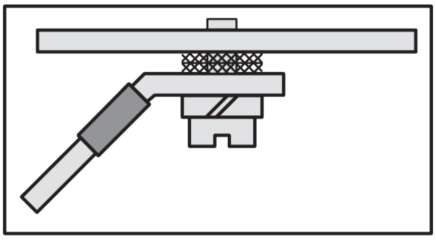


Fig. 342: Assembly: wrong

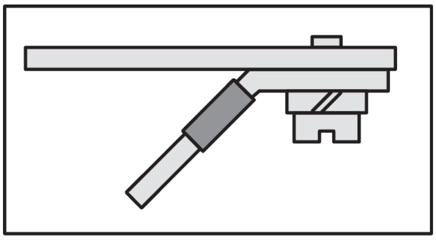


Fig. 343: Assembly: correct

Make a connection between the DIN rails and PE (Protective Earth). For this, use an grounding wire with a minimum conductor cross section of 10 mm².

The wire is connected to the DIN rail with an M6 screw.

A large-area contact of the DIN rail with the metallic mounting plate improves the EMC behavior significantly, as the disturbances can be discharged more effective.

2.4.3.2 Cable routing

- Route cables meeting the standards.
- Sort the cables into cable groups:
  - Power current cables
  - Power supply cables
  - Signal cables
  - Data cables
- Route signal cables and data cables separately from the power cables.
  - Separate cable ducts or cable bundles.
  - The distance should be 20 cm or greater.
- Lay signal and data cables close to earthed surfaces.

2.4.3.3 Cable shields

- Use only shielded data cables. The shield should be grounded at both ends.
  A cable shield only grounded at one end can only protect from capacitively coupled interference and low-frequency disturbances (50 Hz hum).
- Avoid parasitic currents flowing through the cable shields.
  This can be done by installing current-carrying equipotential bondings.
- Use only cables with braided shields.
  Foil shields are not robust enough, cannot be contacted well and have poor HF properties.
- Use only metallic or [metal]-plated plugs for shielded data cables.
- Use only shielded cables for analog signals.
  For small signals ground the shield only at one end.
- Ground the cable shield directly with a clip when entering the control cabinet.
  Do not cut the shield until the cable reaches the module connected.

> *The connection between the PE bar and the shield bar must have a low impedance.*

2.4.3.4 Control cabinet

> *Installation of configurations in shielded cabinet can be required in shipping applications. Follow specific instructions in the applicable type approval certificate.*

Available certificates can be found in the internet

1. Open landing page of the product e.g. DO526
2. In the middle of the page, click on *[Downloads]*.
   ⇨ A two-column window opens on the page with all available documents.
3. In the left column of the downloads page click on *[Certificate]*.
   ⇨ All available certificates are listed in the right column.

In the list of certificates, the maritime certificates can be identified by the title. The title consists of the abbreviation of the maritime classification society followed by the words: Type Approval Certificate. E.g. "DNV Type Approval Certificate: ...".

Connections

The connections between the control cabinet, the mounting plates, the PE bar and the shield bar must have a low impedance.

Grounding

Ground the control cabinet doors with short and highly flexible conductors.

Control cabinet lighting

Only use lighting with interference suppression.

For supplying the PC

Use the mains socket which is located inside the control cabinet.

↳ *Chapter 2.5.2.1 "Control cabinet assembly for AC500 (indoor use)" on page 1383*

2.4.3.5 Reference potential

- Provide a uniform reference potential in the entire installation and ground all electrical appliances if possible.
- Route your grounding conductors in a star configuration so that no ground loops can occur.

2.4.3.6 Equipotential bonding

The Installation of equipotential bondings are necessary if there are present or expected potential differences between parts of your application.

- *The impedance of equipotential bonding must be equal or lower than 10 % of the shield impedance of the shielded signal cables between the same points.*
- *The conductor cross section of a equipotential bonding must be 16 mm² to withstand the maximum possible compensating current.*
- *Equipotential bondings and shielded signal cables should be laid close to each other.*
- *Equipotential bondings must be connected to PE with low impedance.*

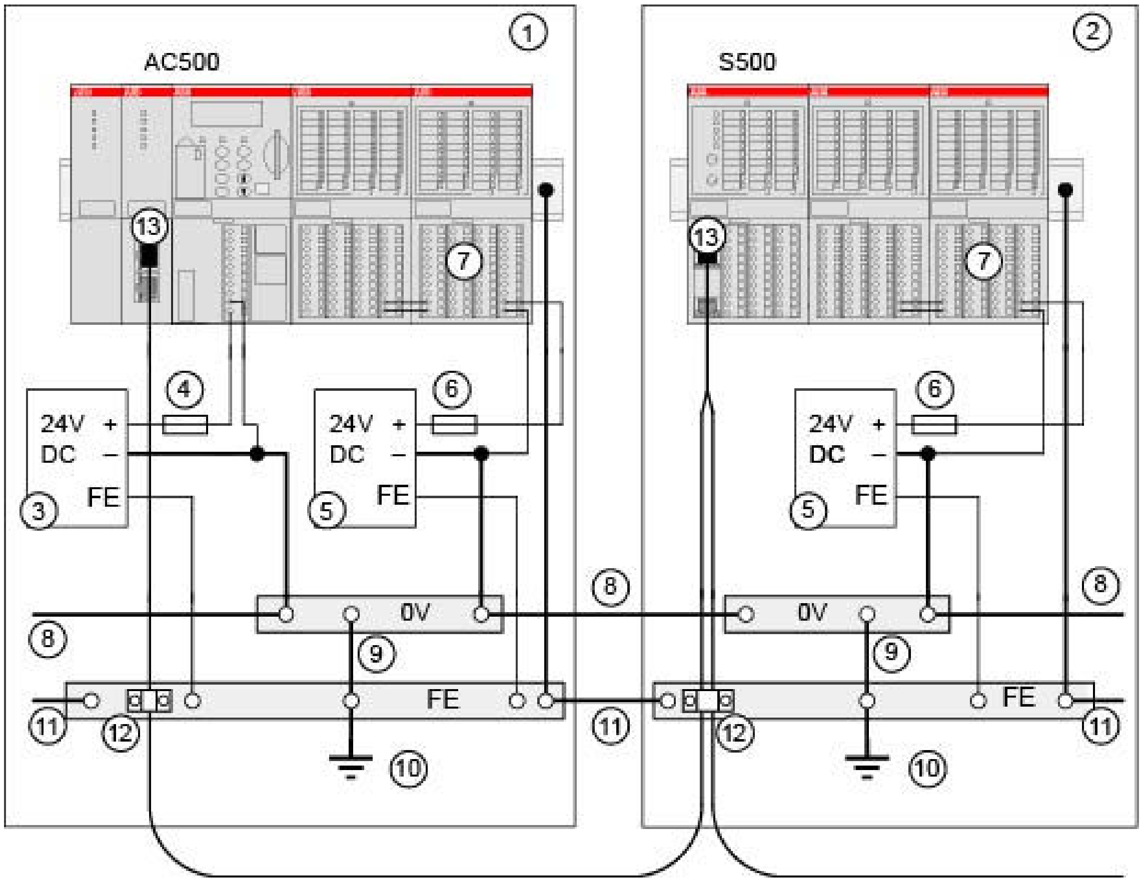


Fig. 344: AC500, equipotential bonding

1 Cabinet 1
2 Cabinet 2
3 Power supply for the CPU
4 Fuse for the CPU power
5 Power supply for the I/Os
6 Fuse for the I/O power
7 For fuses for the contacts of the relay outputs
8 0V rail
9 Grounding of the 0V rail
10 Cabinet grounding
11 Equipotential bonding between the cabinets min. 16 mm^2
12 Cable shields grounding
13 Fieldbus connection (e.g. Ethernet)

2.4.4 Power supply dimensioning

2.4.4.1 General

The power consumption of a complete station consists of the sum of all individual consumptions.

The two supply voltages with 24 V DC are distinguished in the AC500 platform:

- Supply of the internal logic via terminals L+ and M on the CPU module, or an the AC500 terminal base for: CPU, communication mudule(s) and I/O bus.
- Supply of the process-side input/output circuits for analog signals and 24 V DC digital signals via the ZP and UP terminals of the S500 terminal units.

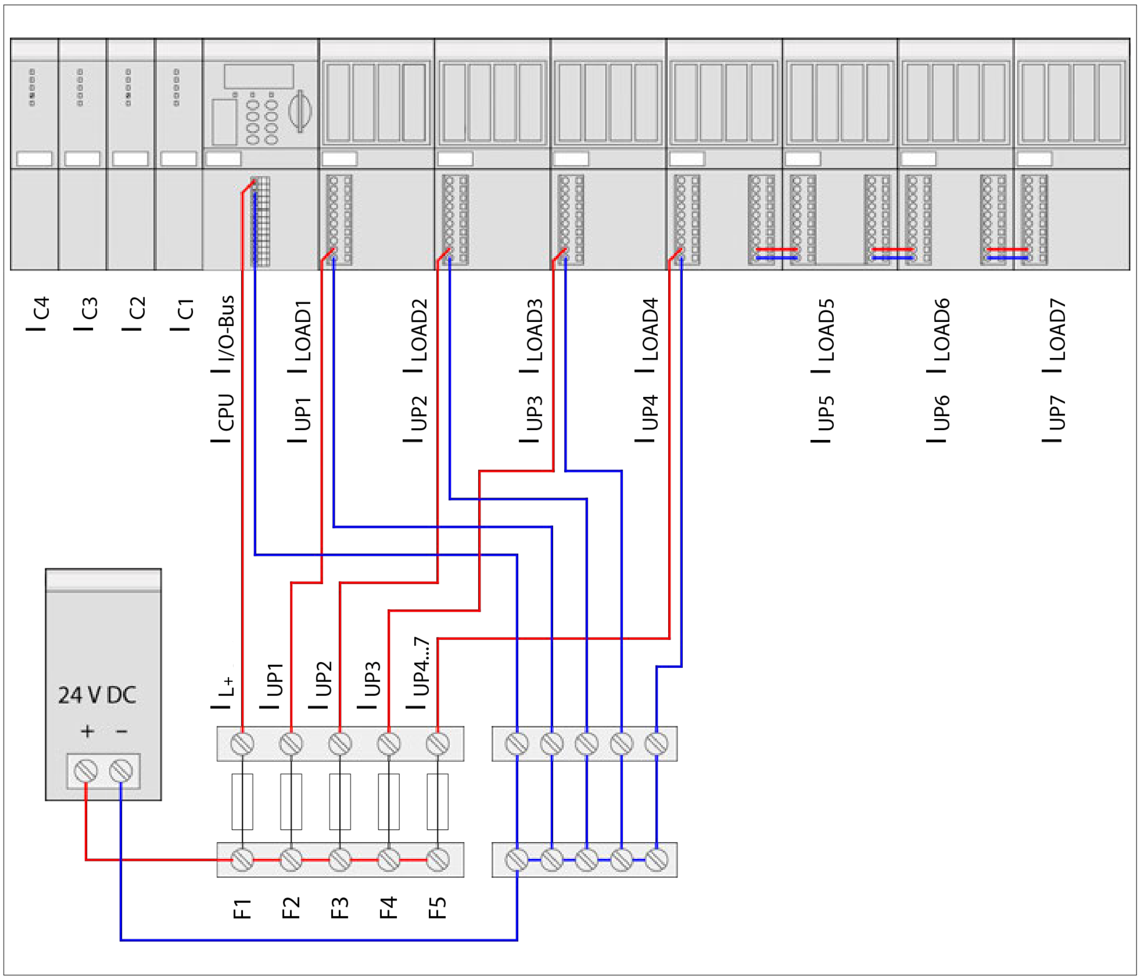
The two supply voltages can be provided by the same power supply unit. The CPU and the I/O modules should, however, be fused separately. Of course also separate power supplies are possible.

2.4.4.2 Calculation of the total current consumption

Example

In the example, the AC500 control system consists of the following devices:

- AC500 CPU with Ethernet interface
- 4 communication modules
- 7 I/O modules (digital and analog)
- As well as the required terminal bases and terminal units



> *Because of the high total current consumption of the digital I/O modules (from UP = 24 V DC), the supply is divided up into several electric circuits fused separately.*
>
> *The maximum permitted total current over the supply terminals of the I/O terminal units is 8 A.*

The total current can be calculated as follows:

$I_{Total} = I_{L+} + I_{UP}$

with the assumptions

$I_{L+} = I_{CPU} + I_{I/O\ bus} + I_{C1} + I_{C2} + I_{C3} + I_{C4}$ (CPU + communication modules + I/O bus)

$I_{I/O\ bus}$ = Number of expansion modules × Current consumption through the I/O bus per module

and

$I_{UP} = I_{UP1} + I_{LOAD1} + I_{UP2} + I_{LOAD2} + I_{UP3} + I_{LOAD3} + I_{UP4} + I_{LOAD4} + I_{UP5} + I_{LOAD5} + I_{UP6} + I_{LOAD6} + I_{UP7} + I_{LOAD7}$

If one assumes that all outputs are switched on and are operated with their maximum permitted load currents (under compliance with the maximum permitted currents at the supply terminals), then the following values are the result for an example shown above:

	I_{CPU} *)	I_{Cx} *)	$I_{I/O\ bus}$ *)	I_{UPx} *)	I_{LOADx} *)
CPU/communication module part					
CPU	0.110 A	-	-	-	-
C1	-	0.050 A	-	-	-
C2	-	0.085 A	-	-	-
C3	-	0.050 A	-	-	-
C4	-	0.050 A	-	-	-
I/O module part					
Analog1	-	-	0.002 A	0.150 A	-
Analog2	-	-	0.002 A	0.150 A	0.160 A
Analog3	-	-	0.002 A	0.100 A	0.080 A
Analog4	-	-	0.002 A	0.100 A	0.080 A
Digital1	-	-	0.002 A	0.050 A	8.000 A
Digital2	-	-	0.002 A	0.050 A	8.000 A
Digital3	-	-	0.002 A	0.050 A	8.000 A
Σ columns	0.110 A	0.235 A	0.014 A	0.650 A	24.320 A
	$\Sigma I_{L+} \approx 0.4$ A			$\Sigma I_{UP} \approx 25$ A	
	$I_{Total} \approx 25.4$ A				
*) All values in this column are exemplary values					

2.4.4.3 Dimensioning of the fuses

To be able to select the fuses for the station correctly, both the current consumption and the inrush currents (melting integral for the series-connected fuse) must be taken into consideration.

Fuse	for	Σ of the melting integrals in A²s	$I_{L+\ A}$	$I_{UPx\ A}$	Recommended fuse	
					Type	Value
F1	CPU logic	1.000	≈ 0.4	-	Quick	10 A
F2	Module Digital1	0.005	-	8.050	Quick	10 A
F3	Module Digital2	0.008	-	8.050	Quick	10 A
F4	Module Digital3	0.007	-	8.050	Quick	10 A
F5	Modules Analog1 + Analog2 + Analog3 + Analog4	0.130	-	0.820	Quick	10 A

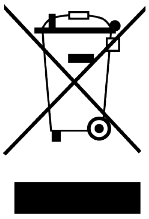
2.4.5 Decommissioning

1. Delete applications.
2. Delete applications from memory card, if available.
3. If available, remove memory card and battery from CPU.
4. Demount and dispose the hardware modules.

Chapter 2.4.6 “Recycling” on page 1379

> *If you can not access the data stored in the CPU, e.g., because the CPU is not functional any more, then physically destroy the device.*
>
> *This ensures that the credentials that are stored in the device, can not be misused.*

2.4.6 Recycling



> ***Disposal and recycling information***
>
> *This symbol on the product (and on its packaging) is in accordance with the European Union's Waste Electrical and Electronic Equipment (WEEE) Directive.*
>
> *The symbol indicates that this product must be recycled/disposed of separately from other household waste.*
>
> *It is the end user’s responsibility to dispose of this product by taking it to a designated WEEE collection facility for the proper collection and recycling of the waste equipment.*
>
> *The separate collection and recycling of waste equipment will help to conserve natural resources and protect human health and the environment.*
>
> *For more information about recycling, please contact your local environmental office, an electrical/electronic waste disposal company or the store where you purchased the product.*

2.5 AC500-eCo

2.5.1 System data AC500-eCo

2.5.1.1 Environmental conditions

Table 356: Process and supply voltages

Parameter		Value
24 V DC		
	Voltage	24 V (-15 %, +20 %)
	Protection against reverse polarity	Yes
24 V AC		
	Voltage	24 V (-15 %, +10 %)
	Frequency	50/60 Hz (-6 %, +4 %)
100 V AC ... 240 V AC wide-range supply		
	Voltage	100 V ... 240 V (-15 %, +10 %)

Parameter		Value
	Frequency	50/60 Hz (-6 %, +4 %)
Allowed interruptions of power supply, according to EN 61131-2		
	DC supply	Interruption < 10 ms, time between 2 interruptions > 1 s, PS2
	AC supply	Interruption < 0.5 periods, time between 2 interruptions > 1 s

NOTICE!
Risk of damaging the PLC due to improper voltage levels!

– Never exceed the maximum tolerance values for process and supply voltages.
– Never fall below the minimum tolerance values for process and supply voltages.
  Observe the **system data** and the **technical data** of the used module.
  Chapter 2.5.1 “System data AC500-eCo” on page 1379

NOTICE!
Improper voltage level or frequency range which cause damage of AC inputs:

– AC voltage above 264 V
– Frenquency below 47 Hz or above 62.4 Hz

NOTICE!
Improper connection leads cause overtemperature on terminals.

PLC modules may be destroyed by using wrong cable type, wire size and cable temperature classification.

Parameter		Value
Temperature		
	Operating	0 °C ... +60 °C (horizontal mounting of modules) 0 °C ... +40 °C (vertical mounting of modules and output load reduced to 50 % per group)
	Storage	-40 °C ... +70 °C
	Transport	-40 °C ... +70 °C
Humidity		Max. 95 %, without condensation
Air pressure		
	Operating	> 800 hPa / < 2000 m
	Storage	> 660 hPa / < 3500 m

2.5.1.2 Creepage distances and clearances

The creepage distances and clearances meet the requirements of the overvoltage category II, pollution degree 2.

2.5.1.3 Power supply units

> *AC500 and AC500-eCo PLC devices are Class II/Class III devices and do not require a Protective Earth (PE) connection.*
>
> *For proper EMC performance, all metal parts, DIN rails, mounting screws, and cable shield connection terminals are connected to a common ground and provide Functional Earth (FE). This is typically connected to a common reference potential, such as equipotential bonding rails.*
>
> *Signal Grounds (SGND or GND) are used for signal reference and must not be connected to cable shields, FE or other signals unless otherwise specified in the specific device description.*

For the supply of the modules, power supply units according to SELV or PELV specifications must be used.

> ***Safety Extra Low Voltage (SELV) and Protective Extra Low Voltage (PELV)***
> *To ensure electrical safety of AC500/AC500-eCo extra low voltage circuits, 24 V DC supply, communication interfaces, I/O circuits, and all connected devices must be powered from sources meeting requirements of SELV, PELV, class 2, limited voltage or limited power according to applicable standards.*

> **WARNING!**
> **Improper installation can lead to death by touching hazardous voltages!**
> To avoid personal injury, safe separation, double or reinforced insulation and separation of the primary and secondary circuit must be observed and implemented during installation.
>
> – Only use power converters for safety extra-low voltages (SELV) with safe galvanic separation of the primary and secondary circuit.
> – Safe separation means that the primary circuit of mains transformers must be separated from the secondary circuit by double or reinforced insulation. The protective extra-low voltage (PELV) offers protection against electric shock.

2.5.1.4 Electromagnetic compatibility

Table 357: Range of use

Application
Device suitable only as *Control Equipment for Industrial Applications*.

Table 358: Electromagnetic compatibility

Parameter	Value
Device suitable only as *Control Equipment for Industrial Applications*, including marine applications. IEC 61131-2, zone B *Chapter 2.5.1.6 “Approvals and certifications” on page 1383*	
Radiated emission according to IEC 61000-6-4 CISPR11, class A	Yes
Conducted emission according to IEC 61000-6-4 CISPR11, class A	Yes
Electrostatic discharge (ESD) according to IEC 61000-4-2, criterion B	Air discharge: 8 kV Contact discharge: 6 kV
Fast transient interference voltages (burst) according to IEC 61000-4-4, criterion B	Power supply (DC): 2 kV Digital inputs/outputs (24 V DC): 1 kV Digital inputs/outputs (240 V AC): 2 kV Analog inputs/outputs: 1 kV Communication lines shielded: 1 kV
High energy transient interference voltages (surge) according to IEC 61000-4-5, criterion B	Power supply (DC): - Line to ground: 1 kV - Line to line: 0,5 kV Digital inputs/outputs/relay: (24 V DC): - Line to ground: 1 kV (AC): - Line to ground: 2 kV - Line to line: 1 kV Analog inputs/outputs: - Line to ground: 1 kV Communication lines: - Line to ground: 1 kV
Influence of radiated disturbances IEC 61000-4-3, criterion A	Test field strength: 10 V/m
Influence of line-conducted interferences IEC 61000-4-6, criterion A	Test voltage: 10 V
Power frequency magnetic fields IEC 61000-4-8, criterion A	30 A/m 50 Hz 30 A/m 60 Hz

2.5.1.5 Mechanical data

Parameter	Value
Mounting	Horizontal/Vertical
Wiring method	Spring/screw terminals

Parameter	Value
Degree of protection	PLC system: IP 20 ● with all modules or option boards plugged in ● with all terminals plugged in ● with all covers closed
Housing	Classification V-2 according to UL 94
Vibration resistance (sinusoidal) acc. to IEC 60068-2-6	All three axes 2 Hz ... 8.4 Hz, 3.5 mm peak, 8.4 Hz ... 150 Hz, 1 g
Shock test acc. to IEC 60068-2-27	All three axes 15 g, 11 ms, half-sinusoidal
Mounting of the modules:	
Mounting Rail Top Hat according to IEC 60715	35 mm, depth 7.5 mm or 15 mm
Mounting with screws	M4
Fastening torque	1.2 Nm

2.5.1.6 Approvals and certifications

The PLC Automation catalog contains an *overview of the available approvals and certifications*.

2.5.2 Mechanical dimensions

2.5.2.1 Control cabinet assembly for AC500 (indoor use)

↳ *Information on EMC-conforming assembly and construction*

PLC enclosure

> **NOTICE!**
> **PLC damage due to incorrect housing**
> Due to their construction (degree of protection IP 20 according to EN 60529) and their connection technology, the devices are only suitable for operation in closed control cabinets.

To protect PLCs against:

- unauthorized access,
- dusting and pollution,
- moisture and wetness and
- mechanical damage,

control cabinet IP54 for common dry factory floor environment is suitable.

Maintain spacing from:

- enclosure walls
- wireways
- adjacent equipment

Allow a minimum of 20 mm clearance on all sides. This provides ventilation and galvanic isolation.

It is recommended to mount the modules on an grounded mounting plate, or an grounded DIN rail, independent of the mounting location.

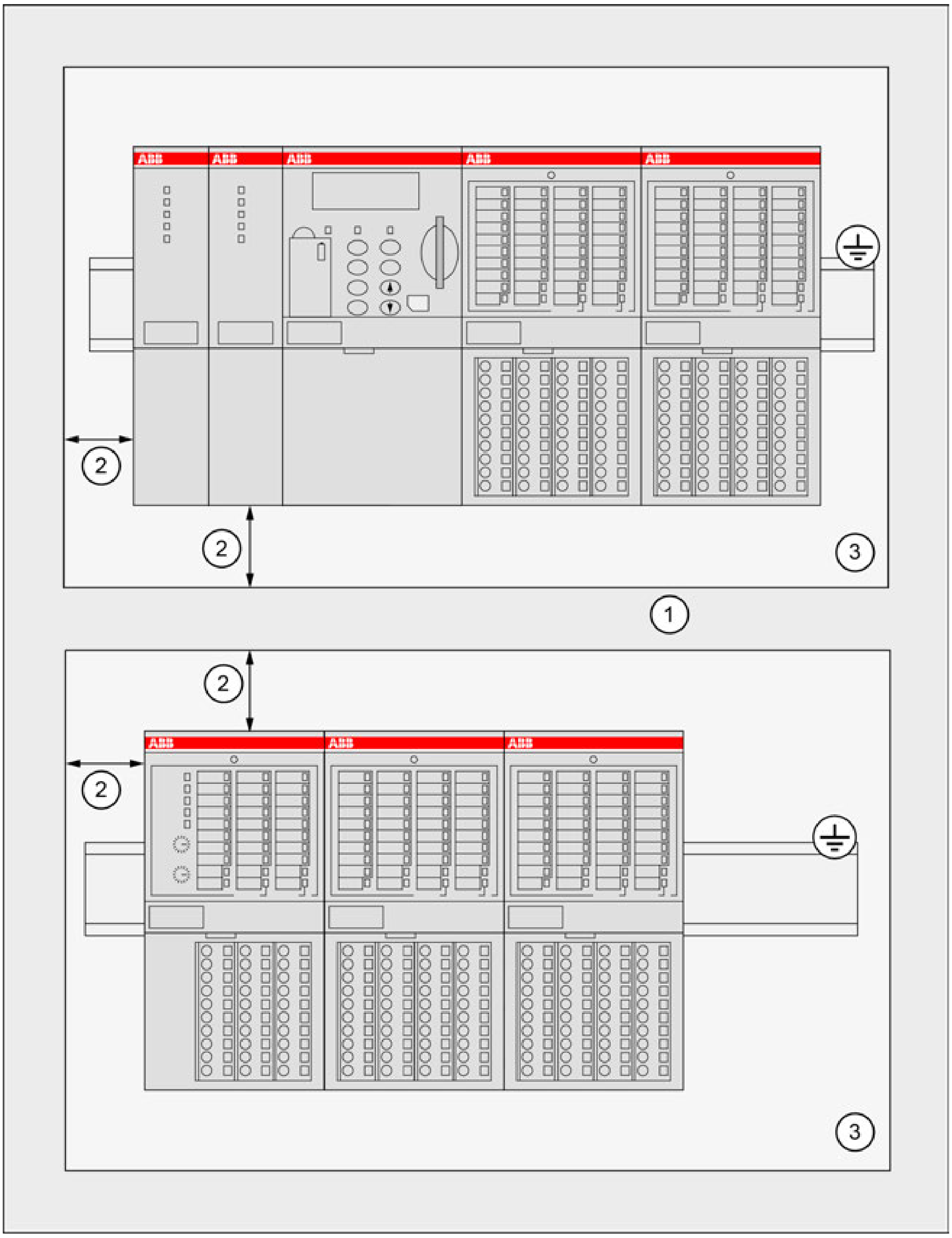


Fig. 345: Installation of AC500/S500 modules in a control cabinet

1 Cable duct
2 Distance from cable duct ≥20 mm
3 Mounting plate, grounded

NOTICE!

Horizontal mounting is highly recommended.

Vertical mounting is possible, however, derating consideration should be made to avoid problems with poor air circulation and overheating *Chapter 2.6.1.1 “Environmental conditions” on page 1408*.

When horizontal mounted, end-stop clamps are recommended to secure the modules in case of shock or vibration.

When vertically mounted, always place an end-stop clamps on the bottom and on the top of the modules to properly secure the modules.

2.5.2.2 Mechanical dimensions AC500-eCo

All mechanical dimensions are given in millimeters and inches. The value in brackets is the inch-value.

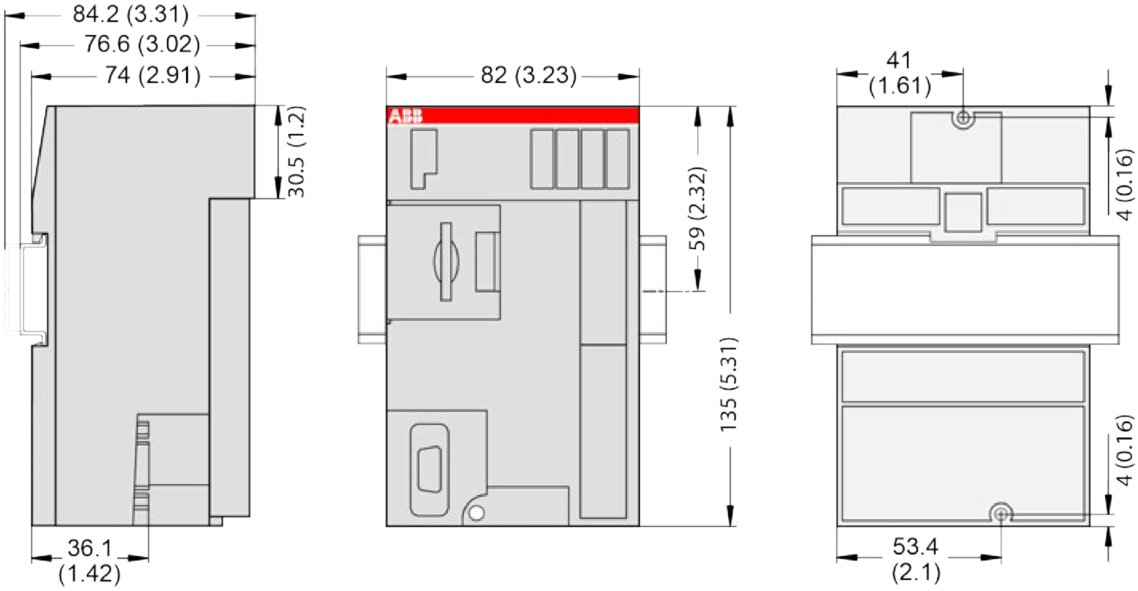


Fig. 346: Side, front and back view

2.5.2.3 Mechanical dimensions S500-eCo

All mechanical dimensions are given in millimeters and inches. The value in brackets is the inch-value.

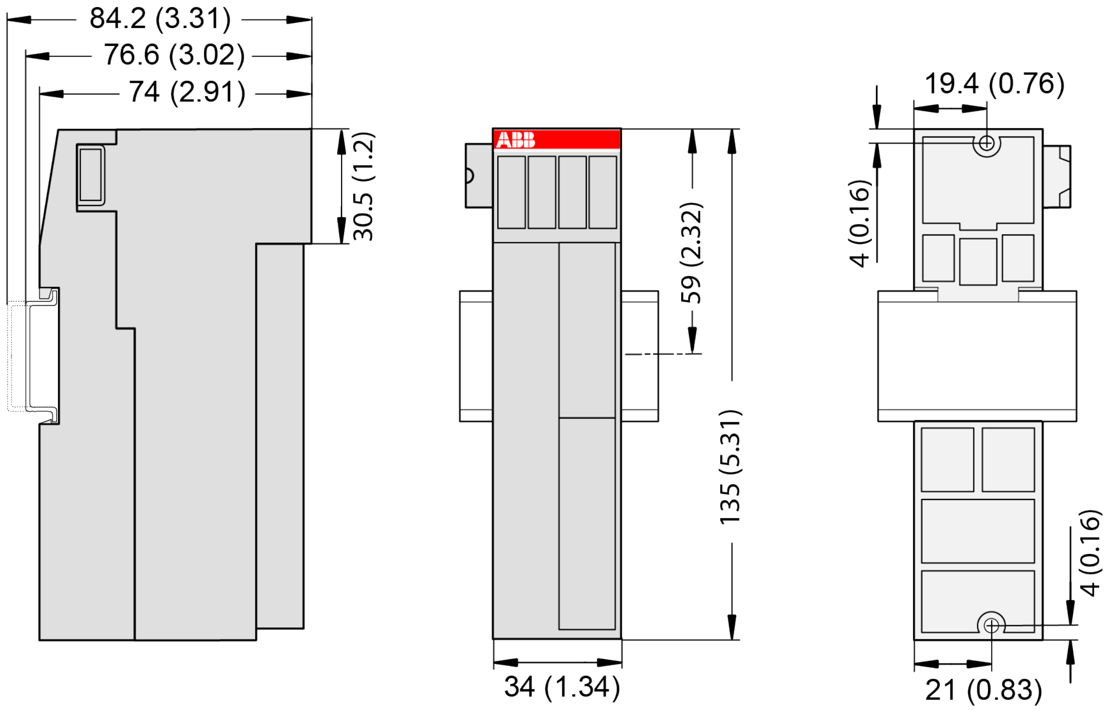


Fig. 347: Side, front and back view

2.5.3 Mounting and demounting

The control system is designed to be mounted to a well-grounded mounting surface such as a metal panel. Additional grounding connections from the mounting tabs or DIN rail (if used), are not required unless the mounting surface cannot be grounded.

During panel or DIN rail mounting of all devices, be sure that all debris (metal chips, wire strands, etc.) is kept from falling into the controller. Debris that falls into the controller could cause damage while the controller is energized.

All devices are grounded through the DIN rail to chassis ground. Use zinc plated yellow-chromate steel DIN rail to assure proper grounding. The use of other DIN rail materials (e.g. aluminium, plastic, etc.) that can corrode, oxidize, or are poor conductors, can result in improper or intermittent grounding.

Consider the safety instructions

In the description, special attention must be paid to designs using galvanic isolation, grounding and EMC measures for the reasons stated. Consider the safety instructions for AC500 product family.

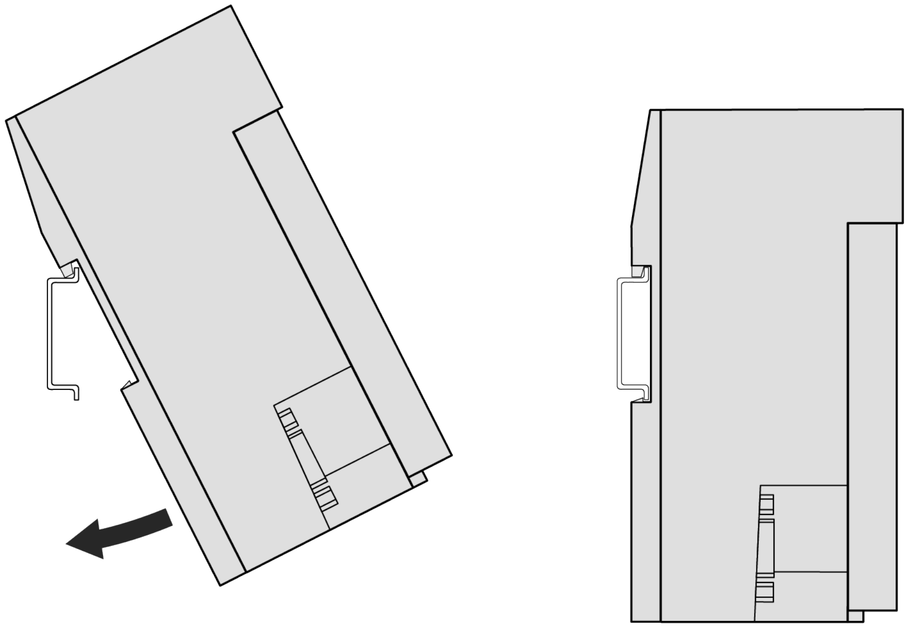
2.5.3.1 Mounting and demounting of the AC500-eCo CPUs

Mounting a processor module on a DIN rail

NOTICE!
Risk of function faults!
The processor module is grounded via DIN rail.

The DIN rail must be included into the grounding conception of the plant.

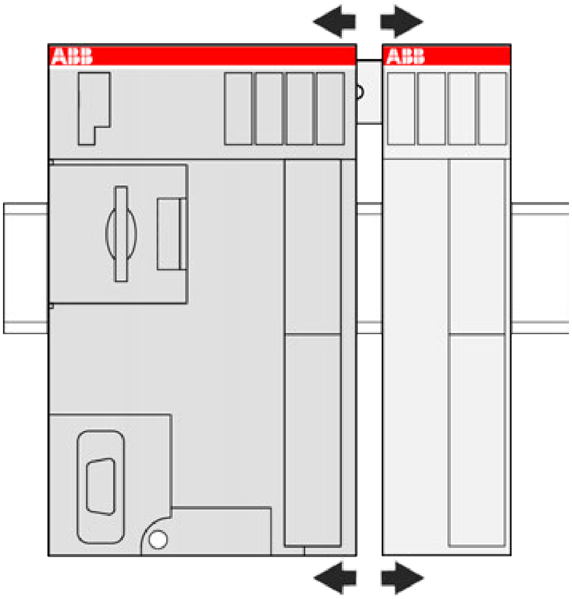
Use only metal screws for grounding.



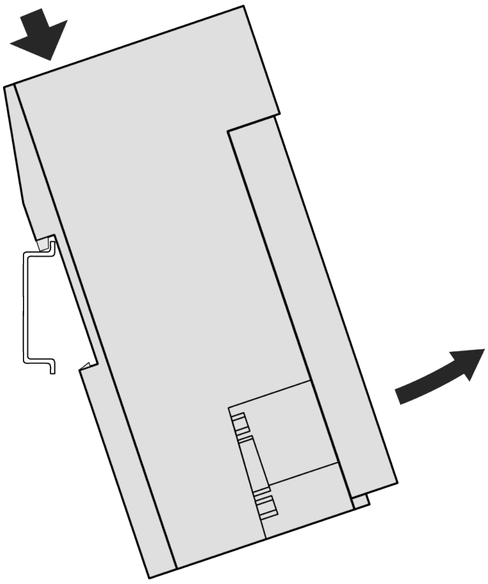
Mount the processor module at the top of the DIN rail, then snap it in below.

Demounting a processor module mounted on a DIN rail

1. Remove I/O modules if connected.



2. While pressing down processor module pull it away from DIN rail.



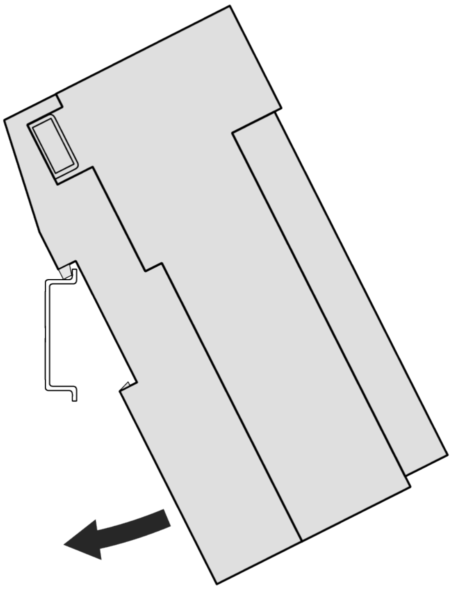
2.5.3.2 Mounting and demounting of S500-eCo I/O modules

S500-eCo I/O modules can be mounted on a DIN rail

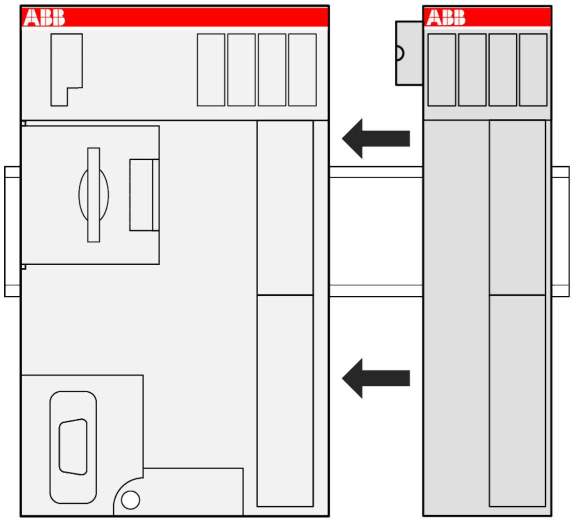
Mounting I/O modules on a DIN rail

> **NOTICE!**
> **Risk of function faults!**
> The S500-eCo I/O modules are grounded via the DIN rail.
>
> The DIN rail must be included into the grounding concept of the plant.
>
> Use only metal screws.

1. Mount I/O module at the top of the DIN rail, then snap it in below.

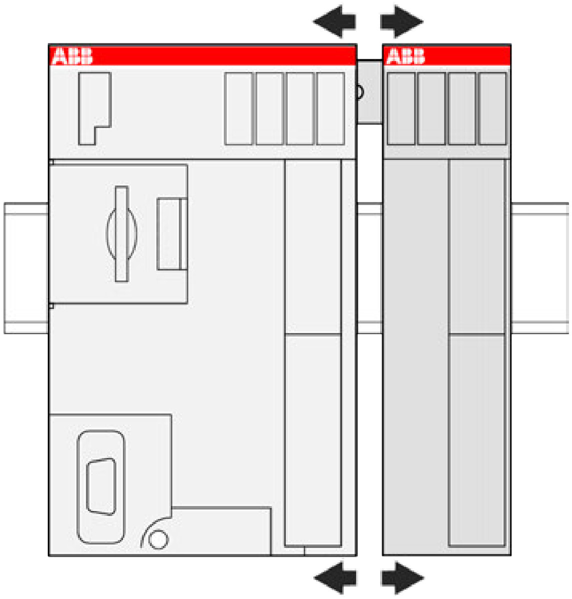


2. Attach I/O module by hand to an other module. The I/O bus is connected automatically.

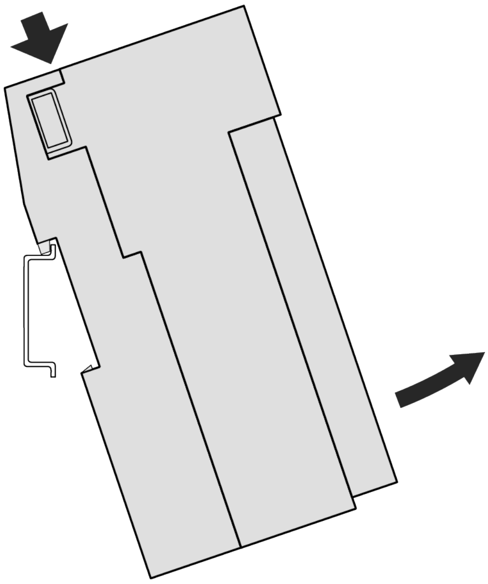


Demounting I/O modules mounted on a DIN rail

1. Remove I/O module by hand if connected.



2. While pressing down I/O module pull it away from DIN rail.



2.5.3.3 Mounting/Demounting the accessories

Additional components such as batteries, cables, etc. are required for commissioning the PLC system. Information on assembly, replacement or basic use of the orderable components can be found in the description of the respective accessory.

Chapter 2.6.5 “Handling of accessories” on page 1453

Hardware details can be found in the device specifications of the accessory.

Chapter 1.9 “Accessories” on page 1344

2.5.4 Connection and wiring

For detailed information such as technical data of your mounted devices (AC500 product family) refer to the hardware device specification of the appropriate device.

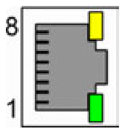
> **NOTICE!**
> All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and temporary overvoltage up to 30 V DC.

2.5.4.1 Ethernet

> *Ethernet is also used for PROFINET, EtherCAT and Modbus TCP connection.*

2.5.4.1.1 Ethernet interface

The Ethernet interface is carried out via a RJ45 jack. The pin assignment of the Ethernet interface:

Interface	Pin	Description	
	1	Tx+	Transmit Data +
	2	Tx-	Transmit Data -
	3	Rx+	Receive data +
	4	NC	Not connected
	5	NC	Not connected
	6	Rx-	Receive data -
	7	NC	Not connected
	8	NC	Not connected
	Shield	Cable shield	Functional earth

The supported protocols and used Ethernet ports can be found in a separate chapter 'Ethernet protocols and ports for AC500'.

Communication via Modbus TCP/IP is described in detail in a separate chapter 'Communication with Modbus RTU'.

2.5.4.1.2 Wiring

Cable length restrictions

For the maximum possible cable lengths within an Ethernet network, various factors have to be taken into account. Twisted pair cables (TP cables) are used as transmission medium for 10 Mbit/s Ethernet (10Base-T) as well as for 100 Mbit/s (Fast) Ethernet (100Base-TX). For a transmission rate of 10 Mbit/s, cables of at least category 3 (IEA/TIA 568-A-5 Cat3) or class C (according to European standards) are allowed. For fast Ethernet with a transmission rate of 100 Mbit/s, cables of category 5 (Cat5) or class D or higher have to be used. The maximum length of a segment, which is the maximum distance between two network components, is restricted to 100 m due to the electric properties of the cable.

Furthermore, the length restriction for one collision domain has to be observed. A collision domain is the area within a network which can be affected by a possibly occurring collision (i.e. the area the collision can propagate over). This, however, only applies if the components operate in half-duplex mode since the CSMA/CD access method is only used in this mode. If the components operate in full-duplex mode, no collisions can occur. Reliable operation of the collision detection method is important, which means that it has to be able to detect possible collisions even for the smallest possible frame size of 64 bytes (512 bits). But this is only guaranteed if the first bit of the frame arrives at the most distant subscriber within the collision domain before the last bit has left the transmitting station. Furthermore, the collision must be able to propagate to both directions at the same time. Therefore, the maximum distance between two ends must not be longer than the distance corresponding to the half signal propagation time of 512 bits. Thus, the resulting maximum possible length of the collision domain is 2000 m for a transmission rate of 10 Mbit/s and 200 m for 100 Mbit/s. In addition, the bit delay times caused by the passed network components also have to be considered.

Table 359: Specified cable properties of the respective cable types per 100 m:

Parameter	10Base-T [10 MHz]	100Base-TX [100 MHz]
Attenuation [dB/100m]	10.7	23.2
NEXT [dB/100m]	23	24
ACR [dB/100m]	N/A	4
Return loss [dB/100m]	18	10
Wave impedance [Ohms]	100	100
Category	3 or higher	5
Class	C or higher	D or higher

TP cable

The TP cable has eight wires arranged in four pairs of twisted wires. Different color codes exist for the coding of the wires, the coding according to EIA/TIA 568, version 1, being the one most commonly used. In this code, the individual pairs are coded with blue, orange, green and brown color. One wire of a pair is unicolored and the corresponding second wire is striped, the respective color alternating with white. For shielded cables, a distinction is made between cables that have one single shield around all pairs of wires and cables that have an additional individual shield for each pair of wires. The following table shows the different color coding systems for TP cables:

Table 360: Color coding of TP cables:

Pairs	EIA/TIA 568 Version 1		EIA/TIA 568 Version 2		DIN 47100		IEC 189.2	
Pair 1	white/ blue	blue	green	red	white	brown	white	blue
Pair 2	white/ orange	orange	black	yellow	green	yellow	white	orange
Pair 3	white/ green	green	blue	orange	grey	pink	white	green
Pair 4	white/ brown	brown	brown	slate	blue	red	white	brown

Two general variants are distinguished for the pin assignment of the normally used RJ45 connectors: EIA/TIA 568 version A and version B. The wiring according to EIA/TIA 568 version B is the one most commonly used.

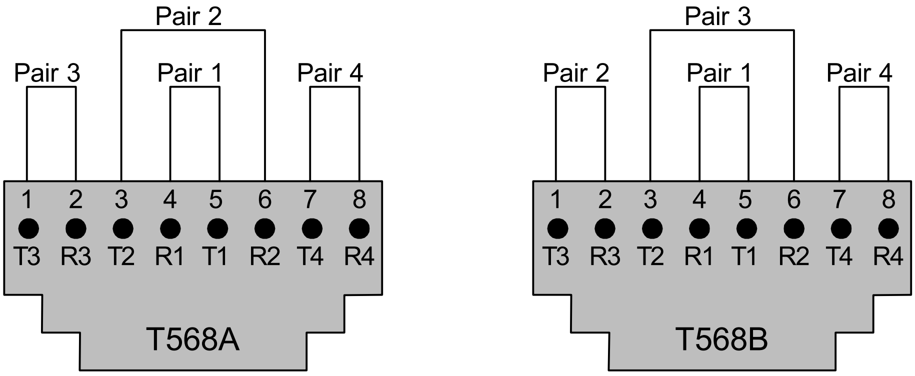


Fig. 348: Pin assignment of RJ45 sockets

2.5.4.1.3 Cable types

Straight-through cable For networks with more than two subscribers, hubs or switches have to be used additionally for distribution. These active devices already have the crossover functionality implemented which allows a direct connection of the terminal devices using straight-through cables.

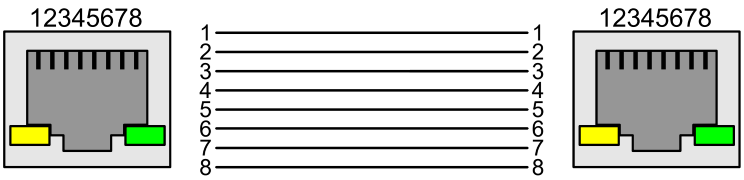


Fig. 349: Wiring of a straight-through cable

> **CAUTION!**
> **Risk of communication faults!**
> When using inappropriate cables, malfunctions in communication may occur.
>
> Only use network cables of the categories 5 (Cat 5, Cat 5e, Cat 6 or Cat 7) or higher within PROFINET networks.

2.5.4.2 Modbus RTU connection details

The Modbus RTU protocol is implemented in the AC500 processor modules.

Modbus is a master-slave (client-server) protocol. The client sends a request to the server(s) and receives the response(s).

Available serial interfaces can work as Modbus interfaces simultaneously.

The Modbus client operating mode of an interface is set with the function block COM_MOD_MAST.

Technical data

Table 361: Description of the Modbus protocol

Parameter	Value
Supported standard	PM57x, PM58x and PM59x: EIA RS-232 / RS-485
Number of connection points	1 client Max. 1 server with RS-232 interface Max. 31 servers with RS-485
Protocol	Modbus
Operating mode	Client/server
Address	Server only
Data transmission control	CRC16
Data transmission speed	From 300 bits/s to 187,500 bits/s
Encoding	1 start bit 8 data bits 1 parity bit, (optional) even, odd, mark or space 1 or 2 stop bits

Table 362: Max. cable length

Parameter			Value
Max. cable length for RS-485 on COM1 / COM2 for AC500 CPU			1.200 m at 19.200 baud
Max. cable length for RS-485 on COM1 / COM2 for AC500-eCo CPU			
	COM1:		
		Non-isolated:	Max. 50 m (with shielded cable)
	COM2:		

If a processor module provides more than one serial interface, both interfaces (COM1/COM2) can be operated simultaneously as Modbus interfaces and can operate as Modbus server as well as Modbus client.

Bus topology Point-to-point with RS-232 or bus topology with RS-485. Modbus is a master-slave protocol.

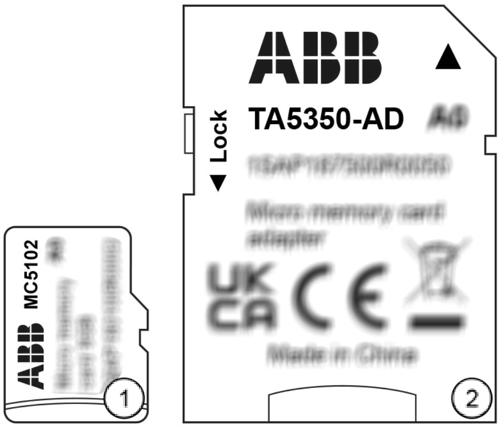
2.5.5 Handling of accessories

This section only describes accessories that are frequently used for system assembly, connection and construction.

↳ *All additional accessories that can be used to supplement the AC500 system*

2.5.5.1 MC5102 - Micro memory card with adapter

- Solid state flash memory storage



1 Micro memory card
2 TA5350-AD micro memory card adapter, necessary for use in AC500 processor modules

> *The MC5102 micro memory card has no write protect switch.*
>
> *The TA5350-AD micro memory card adapter has a write protect switch.*
>
> *In the position "LOCK", the inserted micro memory card can only be read.*

Memory card type	**AC500 V2**	**AC500-XC V2**	**AC500 V3**	**AC500-XC V3**	**AC500-eCo V3**
MC5141	x	x	x	x	-
MC5102 **with** TA5350-AD micro memory card adapter	x [1])	x [1]) [2])	x	x [2])	-
MC5102 **without** TA5350-AD micro memory card adapter	-	-	-	-	x

[1]) As of firmware 2.5.x

[2]) Temporary use of MC5102 is possible under normal environmental conditions, but MC5141 should be preferred.

> *The use of other micro memory cards is prohibited. ABB is not responsible nor liable for consequences resulting from use of unapproved memory cards.*

Purpose

> *Processor modules can be operated with and without (micro) memory card.*
>
> *Processor modules are supplied without (micro) memory card. It must be ordered separately.*

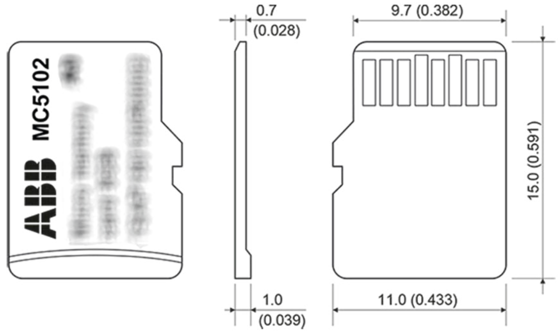
The micro memory card is used to store or backup application data and/or application programs or project source codes as well as to update the internal CPU firmware.

The micro memory card can only be used temporarily in standard and XC applications.

The memory card can be read/written on a PC with a SDHC compatible memory card reader when using TA5350-AD micro memory card adapter.

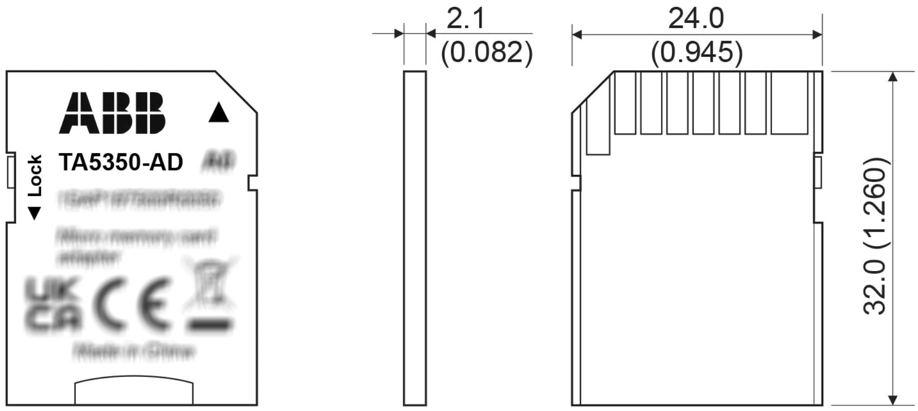
Dimensions

Micro memory card



The dimensions are in mm and in brackets in inch.

Micro memory card adapter



The dimensions are in mm and in brackets in inch.

Insert the micro memory card

AC500 V2 and AC500-eCo V2

1. Unpack the micro memory card and insert it into the supplied micro memory card adapter.
2. Insert the micro memory card adapter with integrated micro memory card into the memory card slot of the processor module until locked.

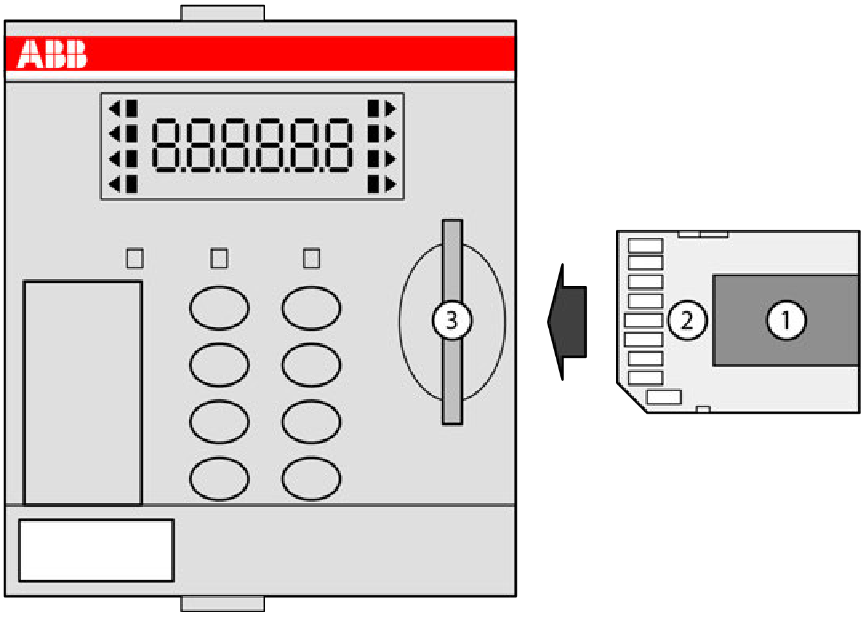


Fig. 350: Insert micro memory card into PM57x, PM58x and PM59x

1 Micro memory card
2 Micro memory card adapter
3 Memory card slot

Remove the micro memory card

AC500 V2 and AC500-eCo V2

> **NOTICE!**
>
> **Removal of the micro memory card**
>
> Do not remove the micro memory card when it is working!
>
> Remove the micro memory card with micro memory card adapter only when the RUN LED is not blinking.
>
> Otherwise the micro memory card and/or files on it might get corrupted and/or normal PLC operation might be disturbed.

1. To remove the micro memory card adapter with the integrated micro memory card, push on the micro memory card adapter until it moves forward.
2. By this, the micro memory card adapter is unlocked and can be removed.

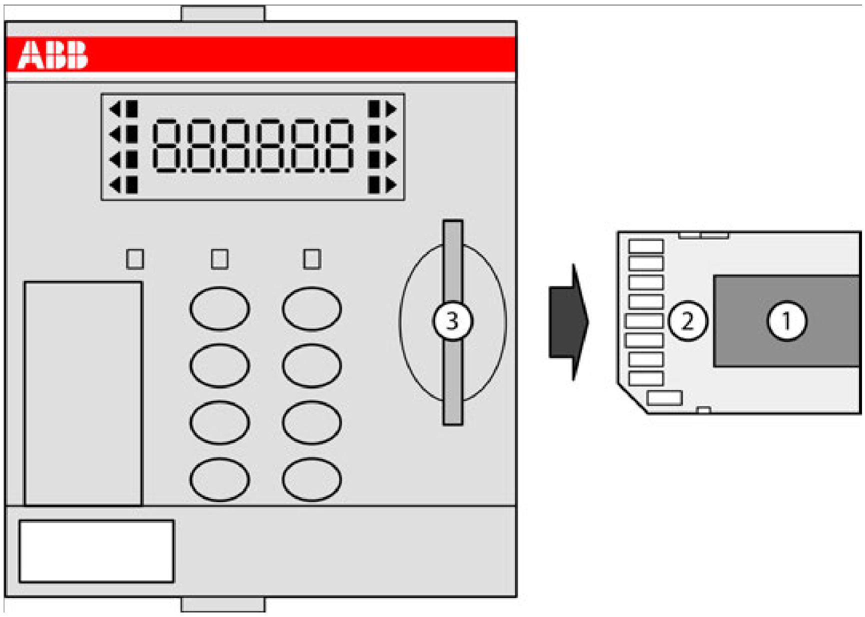


Fig. 351: Remove micro memory card from PM57x, PM58x and PM59x

1 Micro memory card
2 Micro memory card adapter
3 Memory card slot

Technical data

Parameter		Value
Memory capacity		8 GB
Total bytes written (TBW)		On request
Data retention		
	at beginning	10 years at +40 °C
	when number of write processes has been 90 % of lifetime of each cell	1 year at +40 °C
Write protect switch		
	Micro memory card	No
	Micro memory card adapter	Yes
Weight		0.25 g
Dimensions		15 mm x 11 mm x 0.7 mm

It is not possible to use 100 % of a device's memory space. About 10 % of the total available space must remain unused at any time to maintain normal device operation.

Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 180 100 R0002	MC5102, micro memory card with TA5350-AD micro memory card adapter	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

2.5.5.2 MC5141 - Memory card

- Solid state flash memory storage

1 MC5141 memory card

The memory card has a write protect switch.

In the position "LOCK", the memory card can only be read.

Memory card type	AC500 V2	AC500-XC V2	AC500 V3	AC500-XC V3	AC500-eCo V3
MC5141	x	x	x	x	-
MC5102 **with** TA5350-AD micro memory card adapter	x [1])	x [1]) [2])	x	x [2])	-
MC5102 **without** TA5350-AD micro memory card adapter	-	-	-	-	x

[1]) As of firmware 2.5.x

[2]) Temporary use of MC5102 is possible under normal environmental conditions, but MC5141 should be preferred.

The use of other memory cards is prohibited. ABB is not responsible nor liable for consequences resulting from use of unapproved memory cards.

Purpose

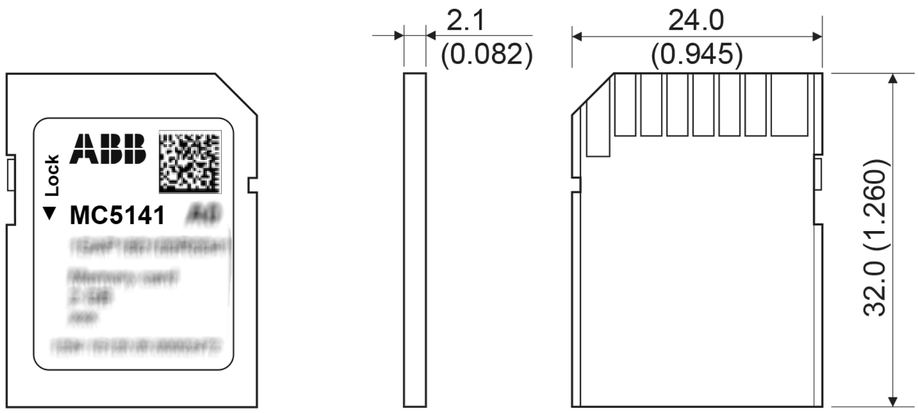
> *Processor modules can be operated with and without (micro) memory card.*
>
> *Processor modules are supplied without (micro) memory card. It must be ordered separately.*

The memory card is used to store or backup application data and/or application programs or project source codes as well as to update the internal CPU firmware.

The memory card is intended for long-term use in standard and XC application.

The memory card can be read/written on a PC with a SDHC compatible memory card reader.

Dimensions



> *The dimensions are in mm and in brackets in inch.*

Insert the memory card

AC500 V2 and AC500-eCo V2

1. Unpack the memory card.
2. Insert the memory card into the memory card slot of the processor module until locked.

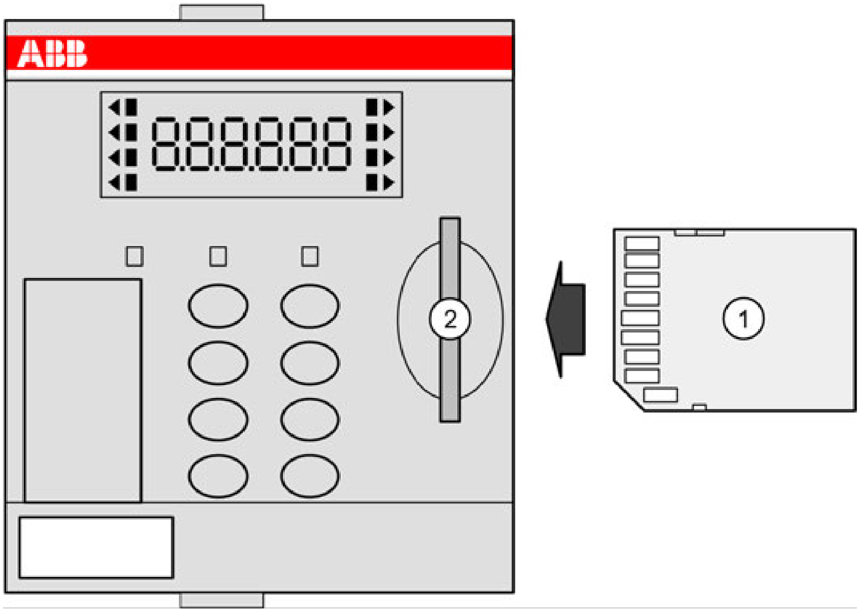


Fig. 352: Insert memory card into PM57x, PM58x and PM59x

1 Memory card
2 Memory card slot

Remove the memory card

AC500 V2 and AC500-eCo V2

> **NOTICE!**
> **Disturbed PLC operation**
> Do not remove the memory card when it is working!
>
> Otherwise the memory card and/or files on it might get corrupted and/or normal PLC operation might be disturbed.
>
> –

1. To remove the memory card, push on the memory card until it moves forward.
2. By this, the memory card is unlocked and can be removed.

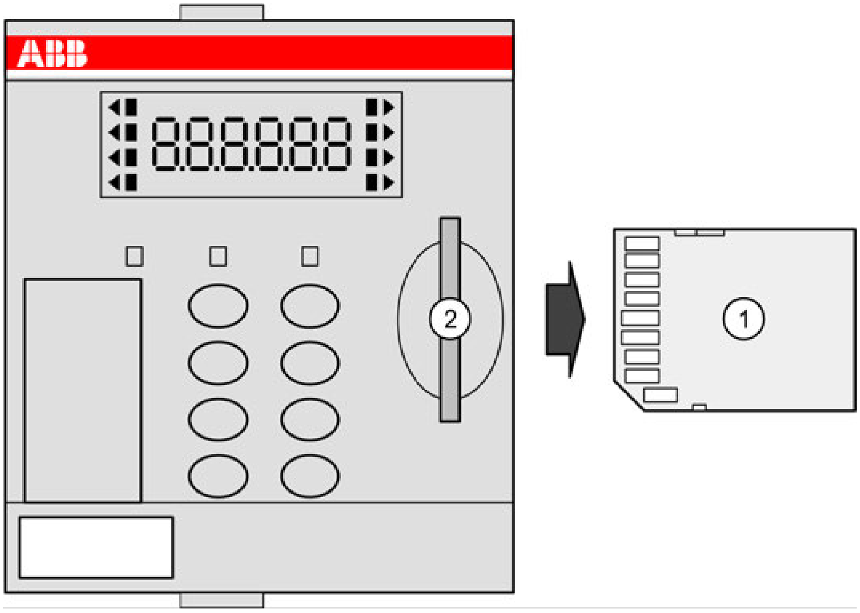


Fig. 353: Remove memory card from PM57x, PM58x and PM59x

1 Memory card
2 Memory card slot

Technical data

Parameter		Value
Memory capacity		2 GB
Total bytes written (TBW)		On request
Data retention		
	at beginning	10 years at +40 °C
	when number of write processes has been 90 % of lifetime of each cell	1 year at +40 °C
Write protect switch		Yes, at the edge of the memory card
Weight		2 g
Dimensions		24 mm x 32 mm x 2.1 mm

It is not possible to use 100 % of a device's memory space. About 10 % of the total available space must remain unused at any time to maintain normal device operation.

Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 180 100 R0041	MC5141, memory card	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

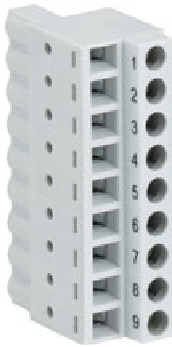
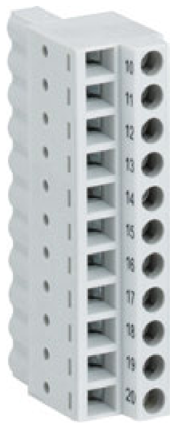
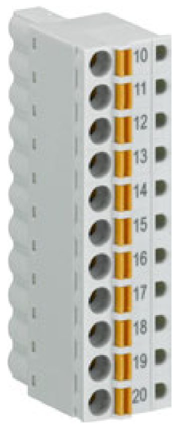
2.5.5.3 TA563-TA565 - Terminal blocks

CAUTION!
Risk of injury and damaging the module when using unapproved terminal blocks!
Only use terminal blocks approved by ABB to avoid injury and damage to the module.

These terminal blocks must only be used with AC500-eCo I/O modules and AC500-eCo processor modules.

Intended purpose

The TA563-TA565 terminal blocks are used to connect process signals and process voltages to AC500-eCo I/O modules and AC500-eCo processor modules (with -P extension inside their type designator only).

Screw terminals with cable insertion on the side	Screw terminals with cable insertion on the front	Spring terminals with cable insertion on the front
TA563-9 	TA564-9 	TA565-9 
TA563-11 	TA564-11 	TA565-11 

WARNING!
For screw terminals only: Danger of death by electric shock!
The IP 20 protection degree is only provided if all terminal screws are tightened.

Tighten all screws of unused load terminals of relay outputs if voltages > 24 V are connected to the relay group.

Technical data

Table 363: Screw-type terminals (TA563/TA564)

Parameter		Value
Type		Front terminal or side terminal (depending on model)
Conductor cross section		
	Solid	0.5 mm^2 ... 2.5 mm^2
	Flexible	0.5 mm^2 ... 2.5 mm^2
Stripped conductor end		
	TA563	8 mm
	TA564	10 mm
Width of the screwdriver		3.5 mm
Fastening torque		0.4 Nm ... 0.5 Nm
Degree of protection		IP 20 (if all terminal screws are tightened)
Conductor cross section flexible, with ferrule with/without plastic sleeve		Min. 0.25 mm^2 Max. 1.5 mm^2

Table 364: Spring terminals (TA565)

Parameter		Value
Type		Front terminal
Conductor cross section		
	Solid	0.5 mm^2 ... 2.5 mm^2
	Flexible	0.5 mm^2 ... 2.5 mm^2
Stripped conductor end		10 mm
Degree of protection		IP 20
Conductor cross section flexible, with ferrule with/without plastic sleeve		Min. 0.25 mm^2 Max. 1.5 mm^2

Ordering data

Part no.	Description	Product life cycle phase *)
1TNE 968 901 R3101	Terminal Block TA563-9, 9-pin, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3102	Terminal Block TA563-11, 11-pin, screw front, cable side, 6 pieces per unit	Active

Part no.	Description	Product life cycle phase *)
1TNE 968 901 R3103	Terminal Block TA564-9, 9-pin, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3104	Terminal Block TA564-11, 11-pin, screw front, cable front, 6 pieces per unit	Active

Part no.	Description	Product life cycle phase *)
1TNE 968 901 R3105	Terminal Block TA565-9, 9-pin spring front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3106	Terminal Block TA565-11, 11-pin, spring front, cable front, 6 pieces per unit	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

2.5.5.4 CP-E - Economic range

The power supplies feature series and parallel connection as well as a true redundant setup via a redundancy module.

- Wide-range input voltage
- Mounting on DIN rail
- High efficiency of up to 90 %
- Low power dissipation and low heating
- Wide ambient temperature range from -40 °C ... +70 °C
- No-load-proof, overload-proof, continuous short-circuit-proof
- Power factor correction (depending on the type)
- Approved in accordance with all relevant international standards

Table 365: Ordering data

Order No.	Type	Input	Output	Overload capacity	Module width [mm]
1SVR427030R0000	CP-E 24/0.75	100-240 V AC or 120-370 V DC	24 V DC, 0.75 A	-	22.5
1SVR427031R0000	CP-E 24/1.25	100 V AC ... 240 V AC or 90V DC ... 375 V DC	24 V DC, 1.25 A	-	40.5

Order No.	Type	Input	Output	Overload capacity	Module width [mm]
1SVR427032R0000	CP-E 24/2.5	100 V AC ... 240 V AC or 90 V DC ... 375 V DC	24 V DC, 2.5 A	-	40.5
1SVR427034R0000	CP-E 24/5.0	115/230 V AC auto select or 210 V DC ... 370 V DC	24 V DC, 5 A	-	63.2
1SVR427035R0000	CP-E 24/10.0	115/230 V AC auto select or 210 V DC ... 370 V DC	24 V DC, 10 A	-	83
1SVR427036R0000	CP-E 24/20.0	115 V AC ... 230 V AC or 120 V DC ... 370 V DC	24 V DC, 20 A	-	175

2.5.5.5 CP-C.1 - High performance range

The power supplies feature series and parallel connection as well as a true redundant setup via a redundancy module.

The CP-C.1 power supplies are ABB’s high performance and most advanced range. With excellent efficiency, high reliability and innovative functionality it is prepared for the most demanding industrial applications. These power supplies have a 50 % integrated power reserve and operate at an efficiency of up to 94 %. They are equipped with overheat protection and active power factor correction. Combinded with a broad AC and DC input range and extensive worldwide approvals the CP-C.1 power supplies are the preferred choice for professional DC applications.

- Typical efficiency of up to 94 %
- Power reserve design delivers up to 150 % of the nominal output current
- Signaling outputs for DC OK and power reserve mode
- High power density leads to very compact and small devices
- No-load-proof, overload-proof, continuous short-circuit-proof
- Active power factor correction (PFC)

Table 366: Ordering data

Order No.	Type	Input	Output	Overload capacity	Module width [mm]
1SVR360563R1001	CP-C.1 24/5.0	110 V AC ... 240 V AC or 90 V DC ... 300 V DC	24 V DC, 5 A	+50 %	40
1SVR360663R1001	CP-C.1 24/10.0	110 V AC ... 240 V AC or 90 V DC ... 300 V DC	24 V DC, 10 A	+50 %	60
1SVR360763R1001	CP-C.1 24/20.0	110 V AC ... 240 V AC or 90 V DC ... 300 V DC	24 V DC, 20 A	+30 %	82

2.6 AC500 (Standard)

2.6.1 System data AC500

2.6.1.1 Environmental conditions

Table 367: Process and supply voltages

Parameter		Value
24 V DC		
	Voltage	24 V (-15 %, +20 %)
	Protection against reverse polarity	Yes
100 V AC...240 V AC wide-range supply		
	Voltage	100 V ... 240 V (-15 %, +10 %)
	Frequency	50/60 Hz (-6 %, +4 %)
Allowed interruptions of power supply, according to EN 61131-2		
	DC supply	Interruption < 10 ms, time between 2 interruptions > 1 s, PS2
	AC supply	Interruption < 0.5 periods, time between 2 interruptions > 1 s

NOTICE!
Risk of damaging the PLC due to improper voltage levels!

– Never exceed the maximum tolerance values for process and supply voltages.
– Never fall below the minimum tolerance values for process and supply voltages.
  Observe the **system data** *Chapter 2.6.1 “System data AC500” on page 1408* and the **technical data** of the module used.

NOTICE!
Improper voltage level or frequency range which cause damage of AC inputs:

– AC voltage above 264 V
– Frenquency below 47 Hz or above 62.4 Hz

NOTICE!
Improper connection leads cause overtemperature on terminals.

PLC modules may be destroyed by using wrong cable type, wire size and cable temperature classification.

Parameter		Value
Temperature		
	Operating	0 °C ... +60 °C: Horizontal mounting of modules. 0 °C ... +40 °C: Vertical mounting of modules. Output load reduced to 50 % per group.
	Storage	-40 °C ... +70 °C
	Transport	-40 °C ... +70 °C
Humidity		Max. 95 %, without condensation
Air pressure		
	Operating	> 800 hPa / < 2000 m
	Storage	> 660 hPa / < 3500 m

2.6.1.2 Creepage distances and clearances

The creepage distances and clearances meet the requirements of the overvoltage category II, pollution degree 2.

2.6.1.3 Power supply units

AC500 and AC500-eCo PLC devices are Class II/Class III devices and do not require a Protective Earth (PE) connection.

For proper EMC performance, all metal parts, DIN rails, mounting screws, and cable shield connection terminals are connected to a common ground and provide Functional Earth (FE). This is typically connected to a common reference potential, such as equipotential bonding rails.

Signal Grounds (SGND or GND) are used for signal reference and must not be connected to cable shields, FE or other signals unless otherwise specified in the specific device description.

For the supply of the modules, power supply units according to SELV or PELV specifications must be used.

Safety Extra Low Voltage (SELV) and Protective Extra Low Voltage (PELV)
To ensure electrical safety of AC500/AC500-eCo extra low voltage circuits, 24 V DC supply, communication interfaces, I/O circuits, and all connected devices must be powered from sources meeting requirements of SELV, PELV, class 2, limited voltage or limited power according to applicable standards.

WARNING!
Improper installation can lead to death by touching hazardous voltages!
To avoid personal injury, safe separation, double or reinforced insulation and separation of the primary and secondary circuit must be observed and implemented during installation.

– Only use power converters for safety extra-low voltages (SELV) with safe galvanic separation of the primary and secondary circuit.
– Safe separation means that the primary circuit of mains transformers must be separated from the secondary circuit by double or reinforced insulation. The protective extra-low voltage (PELV) offers protection against electric shock.

2.6.1.4 Electromagnetic compatibility

Table 368: Electromagnetic compatibility

Parameter	Value
Device suitable only as *Control Equipment for Industrial Applications*, including marine applications. IEC 61131-2, zone B *Chapter 2.6.1.6 “Approvals and certifications” on page 1412*	
Radiated emission according to IEC 61000-6-4 CISPR11, class A	Yes
Conducted emission according to IEC 61000-6-4 CISPR11, class A	Yes

Parameter	Value
Electrostatic discharge (ESD) according to IEC 61000-4-2, criterion B	Air discharge: 8 kV Contact discharge: 6 kV
Fast transient interference voltages (burst) according to IEC 61000-4-4, criterion B	Power supply (DC): 2 kV Digital inputs/outputs (24 V DC): 1 kV Digital inputs/outputs (240 V AC): 2 kV Analog inputs/outputs: 1 kV Communication lines shielded: 1 kV
High energy transient interference voltages (surge) according to IEC 61000-4-5, criterion B	Power supply (DC): - Line to ground: 1 kV - Line to line: 0,5 kV Digital inputs/outputs/relay: (24 V DC): - Line to ground: 1 kV (AC): - Line to ground: 2 kV - Line to line: 1 kV Analog inputs/outputs: - Line to ground: 1 kV Communication lines: - Line to ground: 1 kV
Influence of radiated disturbances IEC 61000-4-3, criterion A	Test field strength: 10 V/m
Influence of line-conducted interferences IEC 61000-4-6, criterion A	Test voltage: 10 V
Power frequency magnetic fields IEC 61000-4-8, criterion A	30 A/m 50 Hz 30 A/m 60 Hz

2.6.1.5 Mechanical data

Parameter	Value
Mounting	Horizontal/Vertical
Wiring method	Spring/screw terminals
Degree of protection	PLC system: IP 20 ● with all modules or option boards plugged in ● with all terminals plugged in ● with all covers closed
Housing	Classification V-2 according to UL 94
Vibration resistance (sinusoidal) acc. to IEC 60068-2-6	All three axes 2 Hz ... 8.4 Hz, 3.5 mm peak, 8.4 Hz ... 150 Hz, 1 g

Parameter	Value
Shock test acc. to IEC 60068-2-27	All three axes 15 g, 11 ms, half-sinusoidal
Mounting of the modules:	
Mounting Rail Top Hat according to IEC 60715	35 mm, depth 7.5 mm or 15 mm
Mounting with screws	M4
Fastening torque	1.2 Nm

2.6.1.6 Approvals and certifications

The PLC Automation catalog contains an *overview of the available approvals and certifications*.

2.6.2 Mechanical dimensions

2.6.2.1 Control cabinet assembly for AC500 (indoor use)

Information on EMC-conforming assembly and construction

PLC enclosure

> **NOTICE!**
> **PLC damage due to incorrect housing**
> Due to their construction (degree of protection IP 20 according to EN 60529) and their connection technology, the devices are only suitable for operation in closed control cabinets.

To protect PLCs against:

- unauthorized access,
- dusting and pollution,
- moisture and wetness and
- mechanical damage,

control cabinet IP54 for common dry factory floor environment is suitable.

Maintain spacing from:

- enclosure walls
- wireways
- adjacent equipment

Allow a minimum of 20 mm clearance on all sides. This provides ventilation and galvanic isolation.

It is recommended to mount the modules on an grounded mounting plate, or an grounded DIN rail, independent of the mounting location.

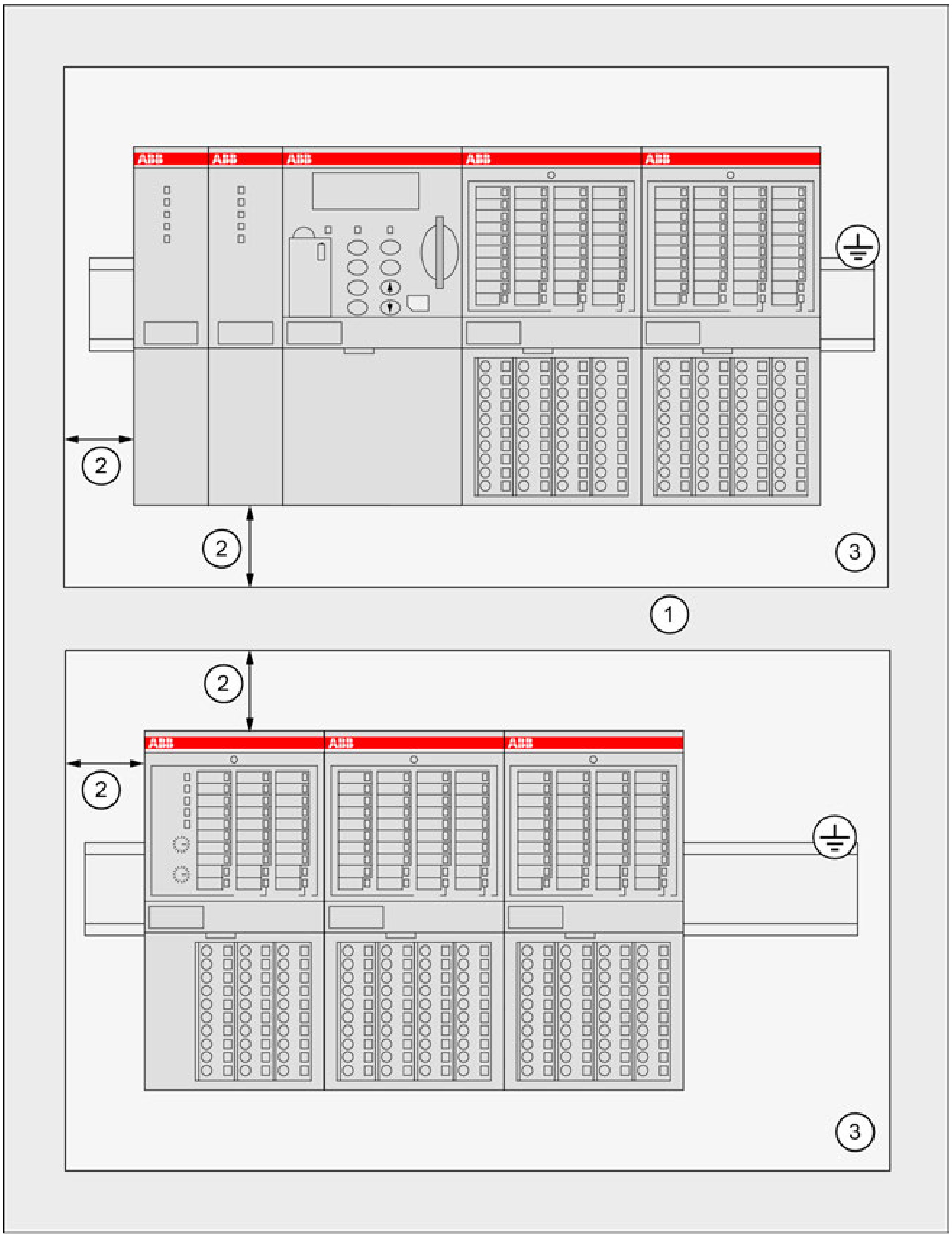


Fig. 354: Installation of AC500/S500 modules in a control cabinet

1 Cable duct
2 Distance from cable duct ≥20 mm
3 Mounting plate, grounded

> **NOTICE!**
> Horizontal mounting is highly recommended.
>
> Vertical mounting is possible, however, derating consideration should be made to avoid problems with poor air circulation and overheating *Chapter 2.6.1.1 "Environmental conditions" on page 1408*.

> *When horizontal mounted, end-stop clamps are recommended to secure the modules in case of shock or vibration.*
>
> *When vertically mounted, always place an end-stop clamps on the bottom and on the top of the modules to properly secure the modules.*

2.6.2.2 Mechanical dimensions AC500

Dimensions: terminal bases

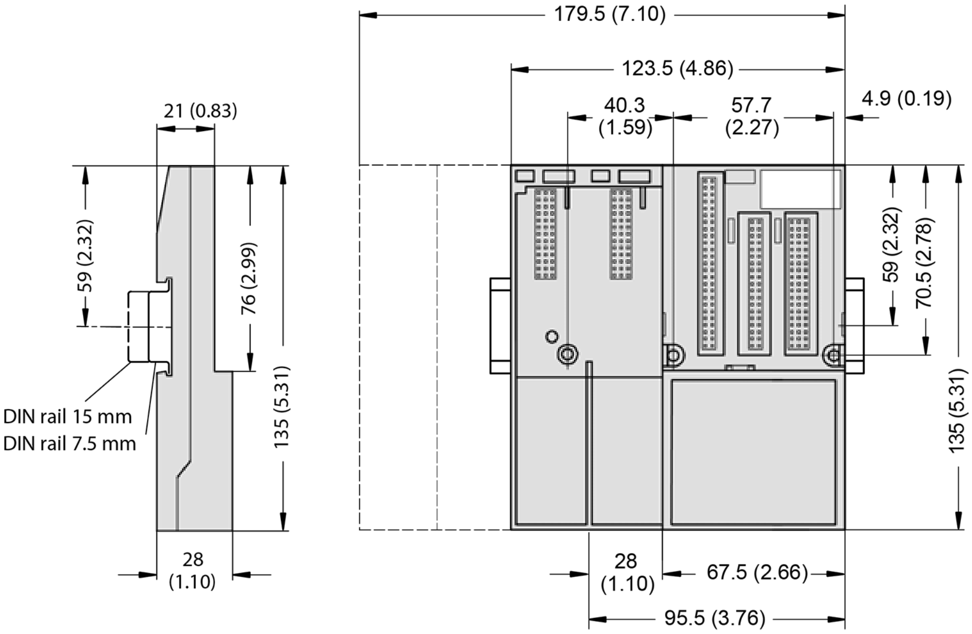


Fig. 355: Terminal bases, side view and front view

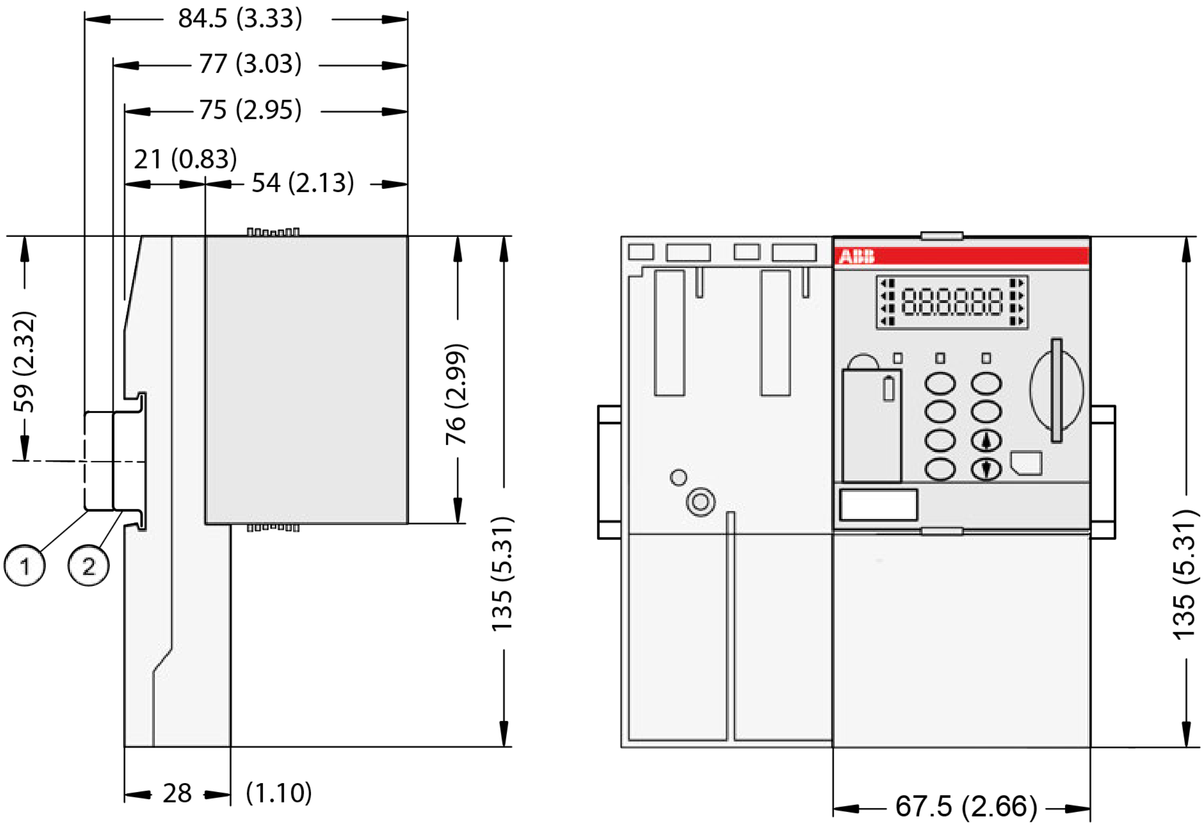


Fig. 356: Terminal bases with processor modules, side view and front view

Dimensions: function module terminal bases

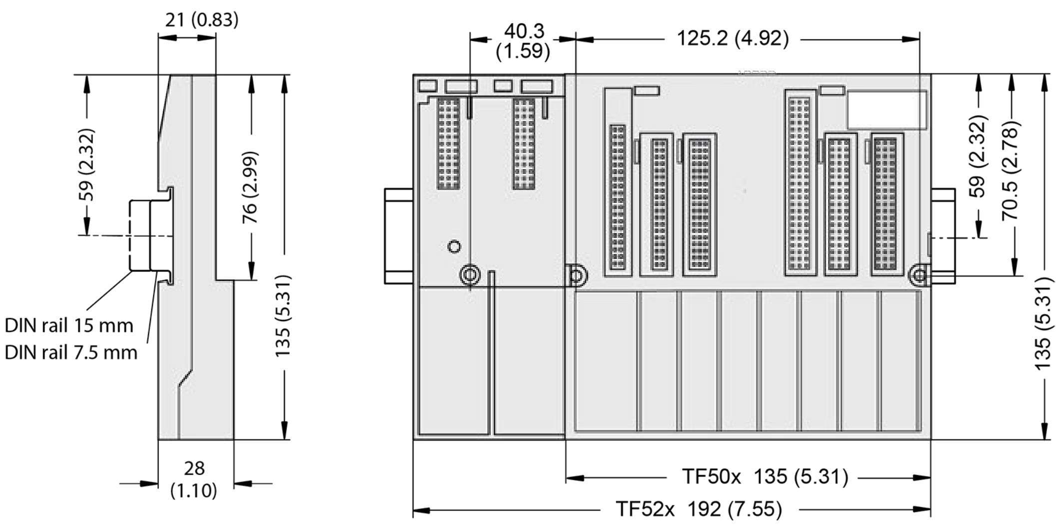


Fig. 357: Function module terminal bases, side view and front view

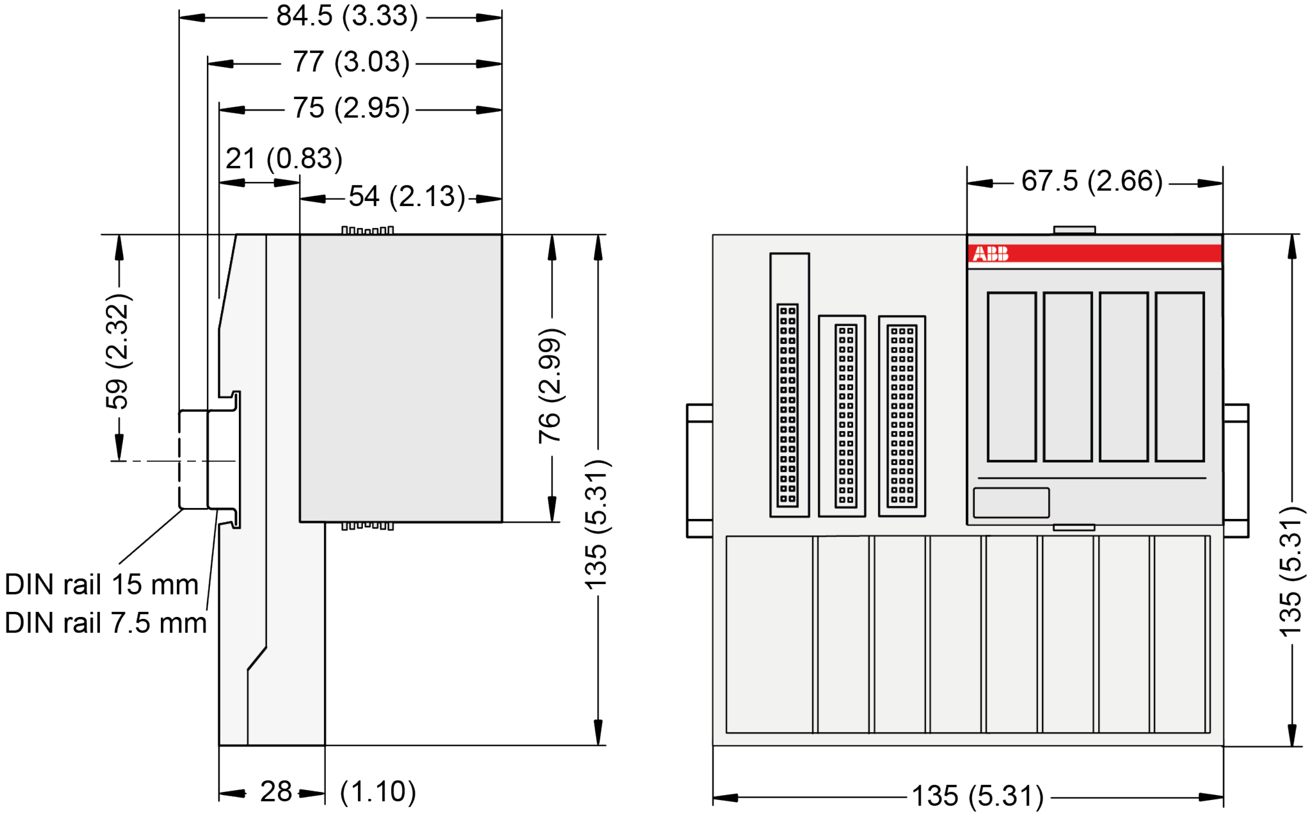


Fig. 358: Function module terminal bases with function modules for CMS, side view and front view

Dimensions:
PM595

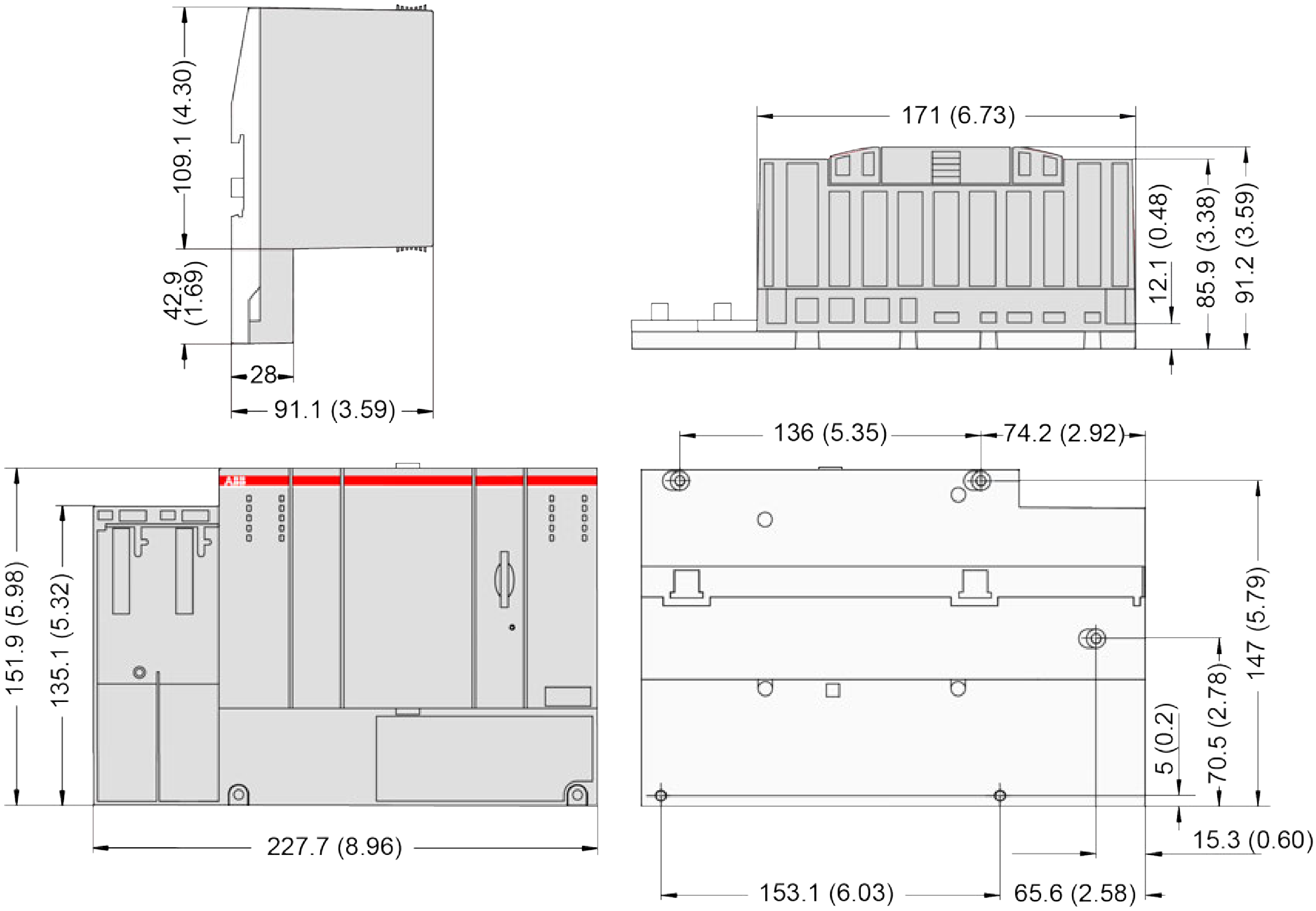


Fig. 359: Processor podule PM595, side view, top view, front view, back view

2.6.2.3 Mechanical dimensions S500

Dimensions:
Terminal units

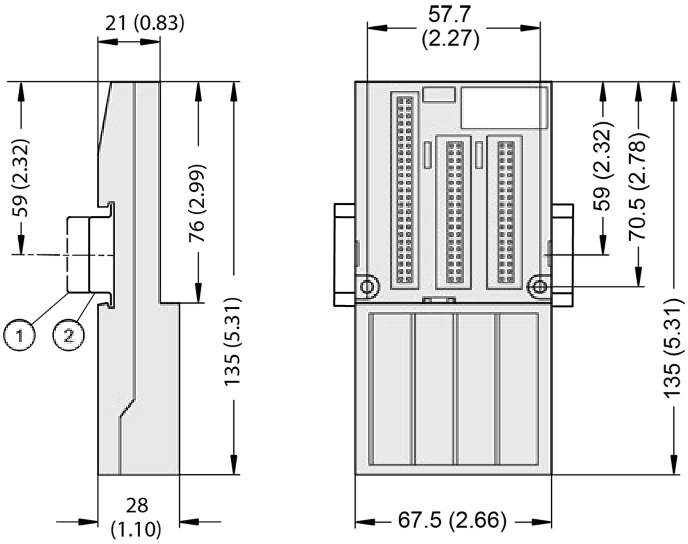


Fig. 360: Terminal units, side view and front view

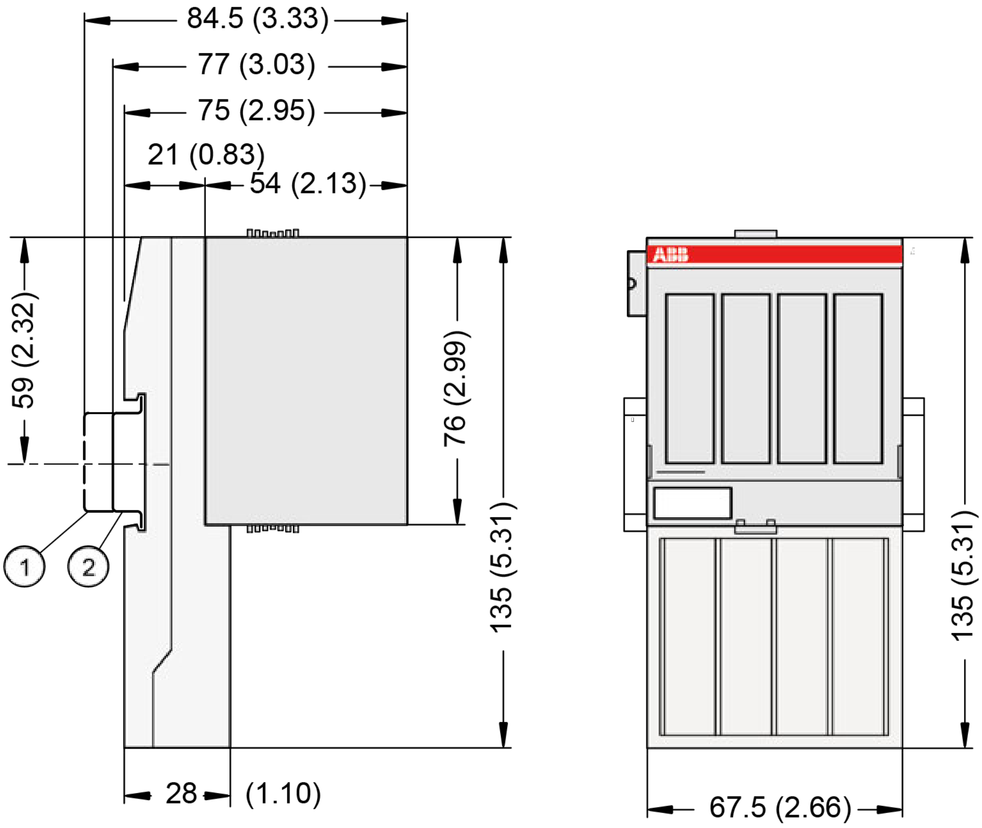


Fig. 361: Terminal units and S500 modules, side view and front view

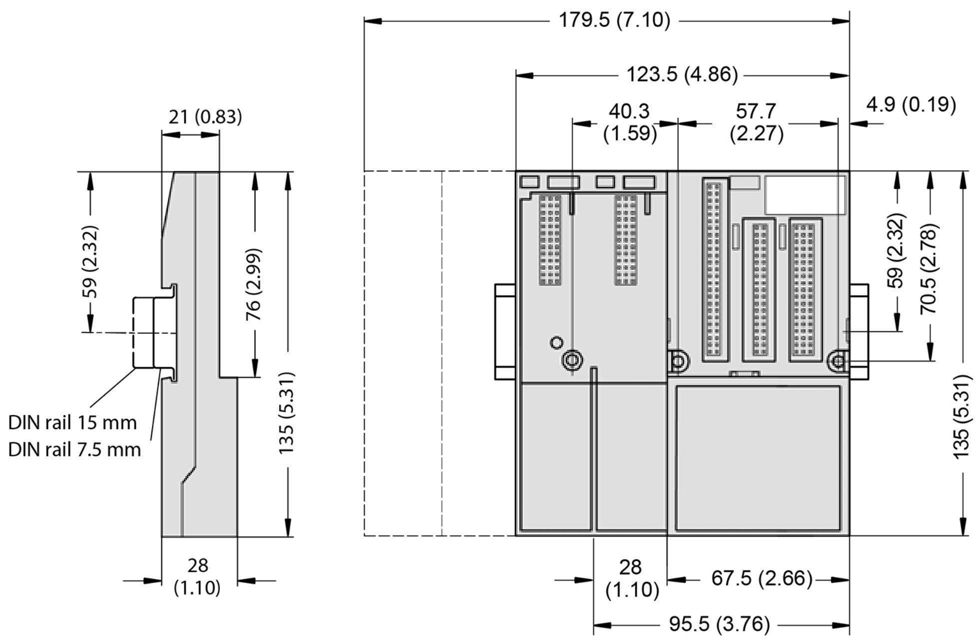


Fig. 362: Terminal base (for comparison)

> *All dimensions are in mm (in.). Hole spacing tolerance: ±0.4 mm (0.016 in.)*

Dimensions:
FM502-CMS

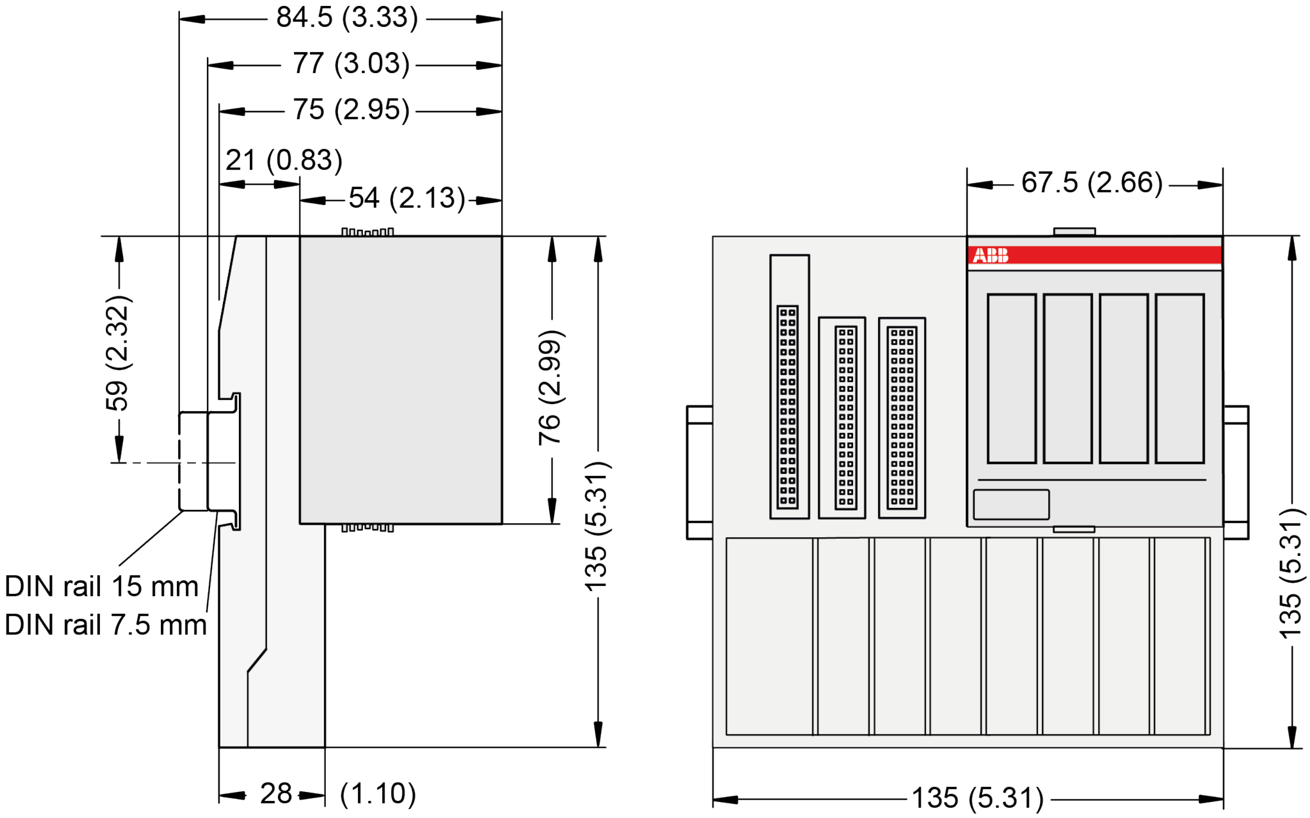


Fig. 363: Function module terminal bases and function modules for CMS, side view and front view

2.6.3 Mounting and demounting

The control system is designed to be mounted to a well-grounded mounting surface such as a metal panel. Additional grounding connections from the mounting tabs or DIN rail (if used), are not required unless the mounting surface cannot be grounded.

During panel or DIN rail mounting of all devices, be sure that all debris (metal chips, wire strands, etc.) is kept from falling into the controller. Debris that falls into the controller could cause damage while the controller is energized.

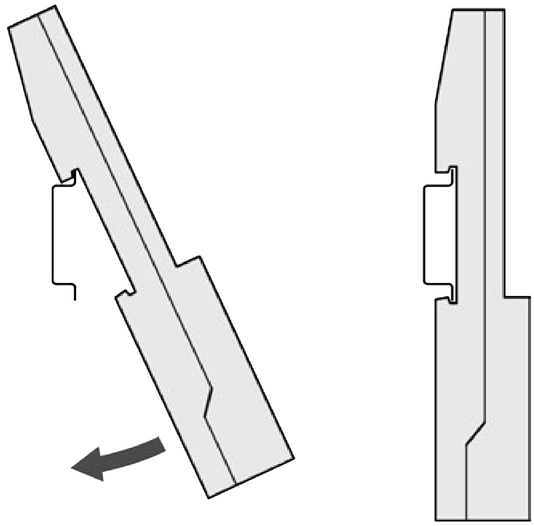
All devices are grounded through the DIN rail to chassis ground. Use zinc plated yellow-chromate steel DIN rail to assure proper grounding. The use of other DIN rail materials (e.g. aluminium, plastic, etc.) that can corrode, oxidize, or are poor conductors, can result in improper or intermittent grounding.

Consider the safety instructions
In the description, special attention must be paid to designs using galvanic isolation, grounding and EMC measures for the reasons stated. Consider the safety instructions for AC500 product family.

2.6.3.1 Mounting and demounting the terminal base

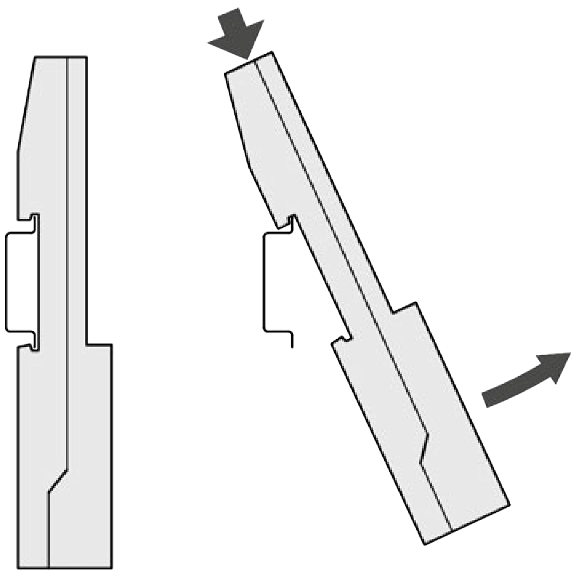
Mounting and demounting on DIN rail

1. Mount DIN rail 7.5 mm or 15 mm.
2. Mount the terminal base/function module terminal base:



⇨ The terminal base is put on the DIN rail above and then snapped-in below.

3. The demounting is carried out in a reversed order.



Mounting with screws

If the Terminal Base should be mounted with screws, wall mounting accessories TA526 must be inserted at the rear side first *Chapter 2.6.5.4 “TA526 - Wall mounting accessory” on page 1464*. These plastic parts prevent bending of the terminal base while screwing on. TB51x needs one TA526, TB52x and TB54x need two TA526.

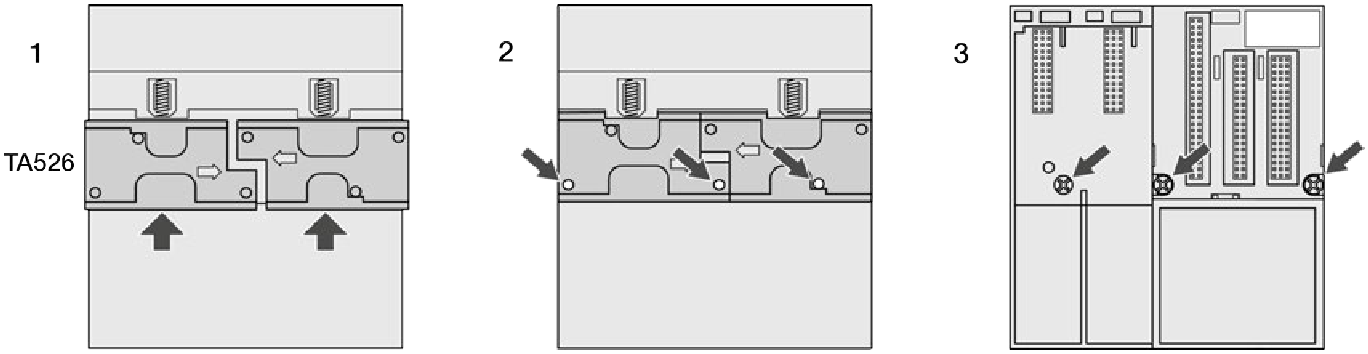


Fig. 364: Terminal bases, Fastening with screws

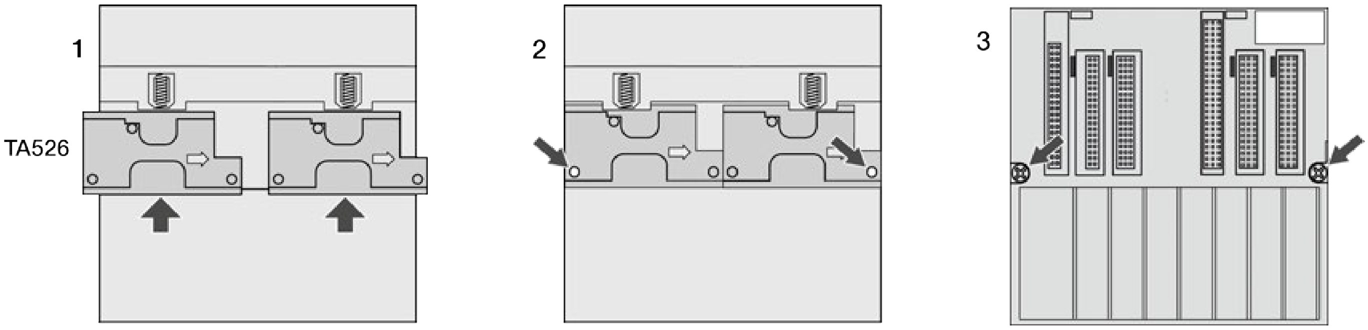


Fig. 365: Function module terminal bases, Fastening with screws

By wall mounting, the terminal base is grounded through the screws. It is necessary that

– *the screws have a conductive surface (e.g. steel zinc-plated or brass nickel-plated)*
– *the mounting plate is grounded*
– *the screws have a good electrical contact to the mounting plate*

Practical tip

The following procedure allows you to use the mounted modules as a template for drilling holes in the panel. Due to module mounting hole tolerance, it is important to follow these procedures:

1. On a clean work surface, mount no more than 3 modules (e.g. one terminal base and two terminal units).
2. Using the mounted modules as a template, carefully mark the center of all module-mounting holes on the panel.
3. Return the mounted modules to the clean work surface, including any previously mounted modules.
4. Drill and tap the mounting holes for the screws (M4 or #8 recommended).
5. Place the modules back on the panel and check for proper hole alignment.
6. Attach the modules to the panel using the mounting screws.

If mounting more modules, mount only the last one of this group and put the others aside. This reduces remounting time during drilling and tapping of the next group.

7. Repeat the steps for all remaining modules.

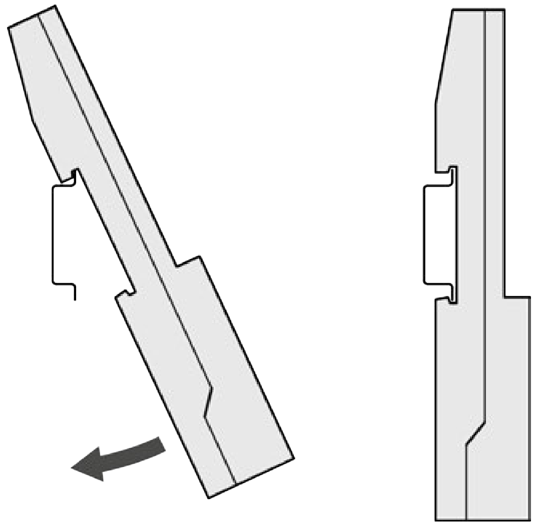
2.6.3.2 Mounting and demounting the terminal unit

Mounting on DIN rail

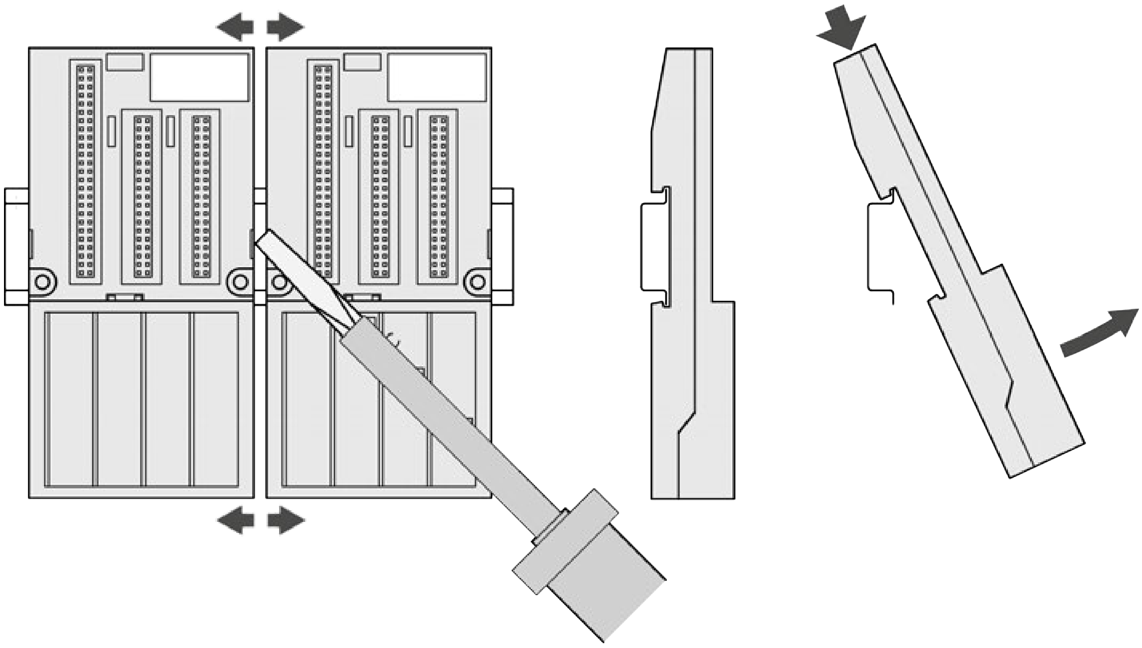
1. Mount DIN rail 7.5 mm or 15 mm.
2. Mount the terminal unit.

   The terminal unit is snapped into the DIN rail in the same way as the Terminal Base. Once secured to the DIN rail, slide the terminal unit to the left until it fully locks into place creating a solid mechanical and connection.

   > *When attaching the devices, make sure the bus connectors are securely locked together to ensure proper connection. Max. 10 terminal units can be attached.*



3. Demounting: A screwdriver is inserted in the indicated place to separate the terminal units.



Mounting with screws

If the terminal unit should be mounted with screws, wall mounting accessories TA526 must be inserted at the rear side first *Chapter 2.6.5.4 “TA526 - Wall mounting accessory” on page 1464*. These plastic parts prevent bending of the Terminal Base while screwing on.

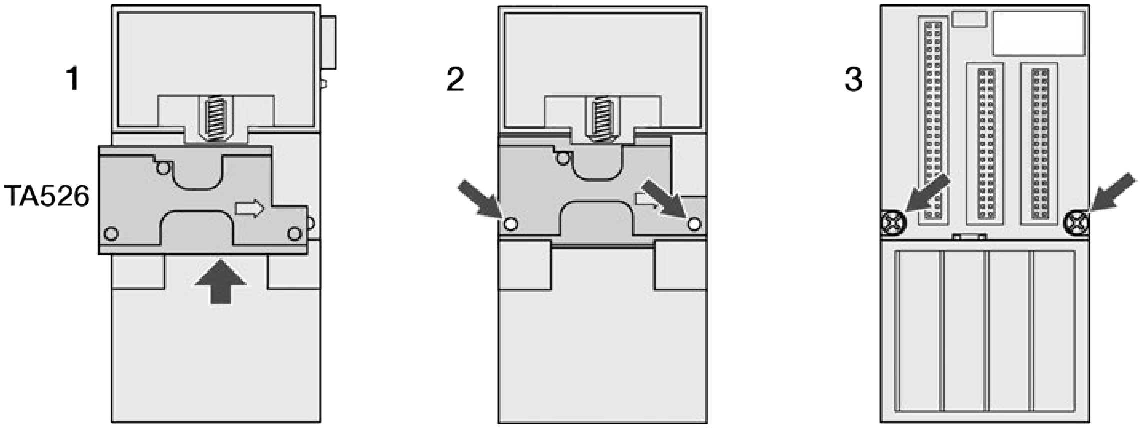


Fig. 366: Fastening with screws

By wall mounting, the terminal unit is grounded through the screws. It is necessary that

- *the screws have a conductive surface (e.g. steel zinc-plated or brass nickel-plated)*
- *the mounting plate is grounded*
- *the screws have a good electrical contact to the mounting plate*

Practical tip

The following procedure allows you to use the mounted modules as a template for drilling holes in the panel. Due to module mounting hole tolerance, it is important to follow these procedures:

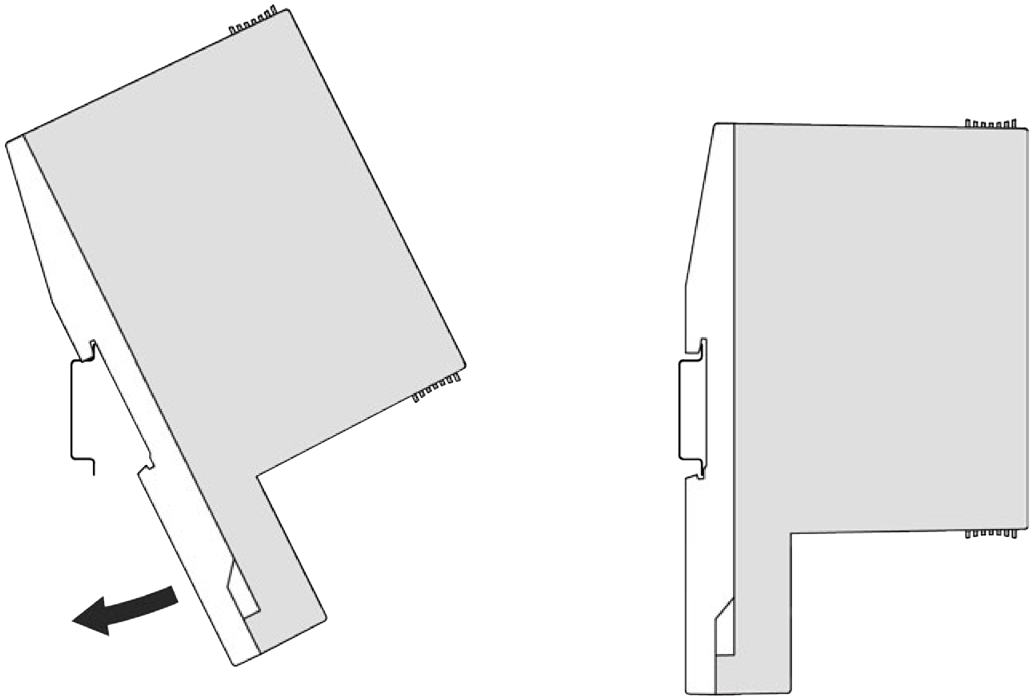
1. On a clean work surface, mount no more than 3 modules (e.g. one terminal base and two terminal units).
2. Using the mounted modules as a template, carefully mark the center of all module-mounting holes on the panel.
3. Return the mounted modules to the clean work surface, including any previously mounted modules.
4. Drill and tap the mounting holes for the screws (M4 or #8 recommended).
5. Place the modules back on the panel and check for proper hole alignment.
6. Attach the modules to the panel using the mounting screws.

   If mounting more modules, mount only the last one of this group and put the others aside. This reduces remounting time during drilling and tapping of the next group.

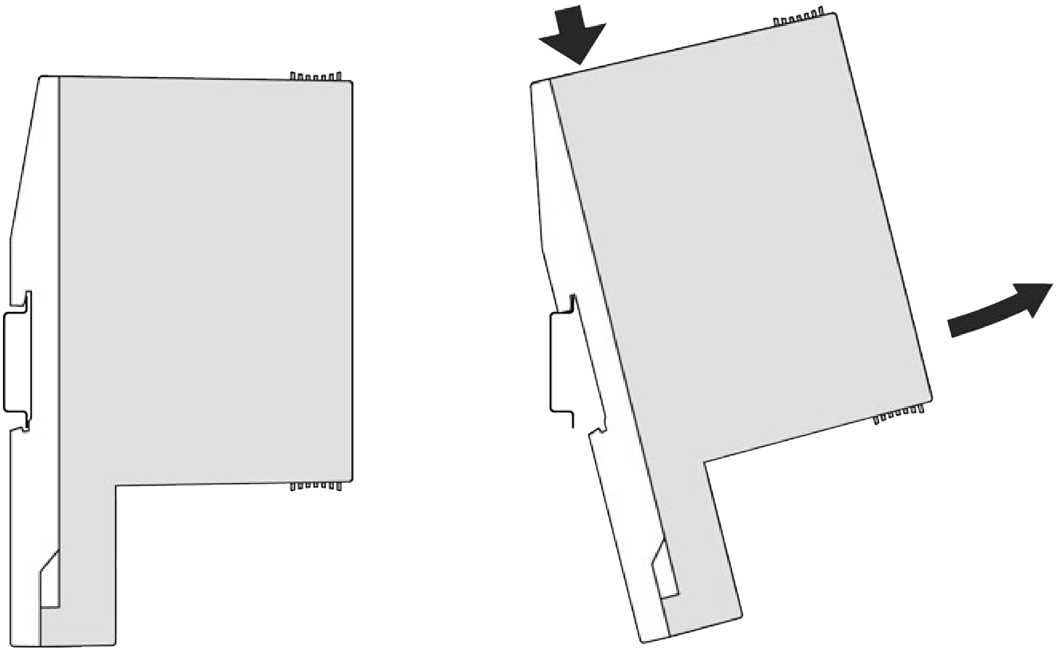
7. Repeat the steps for all remaining modules.

2.6.3.3 Mounting and demounting the processor module PM595

Mounting on DIN rail



▷ Put the processor module on the DIN rail above and then snapped-in below. The demounting is carried out in a reversed order.



1. Pull down the processor module.
2. Remove it.

NOTICE!

Risk of malfunctions!

Unused slots for communication modules are not protected against accidental physical contact.

- Unused slots for communication modules must be covered with dummy communication modules to achieve IP20 rating *Chapter 2.6.5.6 “TA524 - Dummy communication module” on page 1469*.
- I/O bus connectors must not be touched during operation.

NOTICE!

Only use TA543 accessory when the PLC is to be screw mounted. With DIN rail mounting the PLC could not be removed from the rail without the risk of damaging the housing.

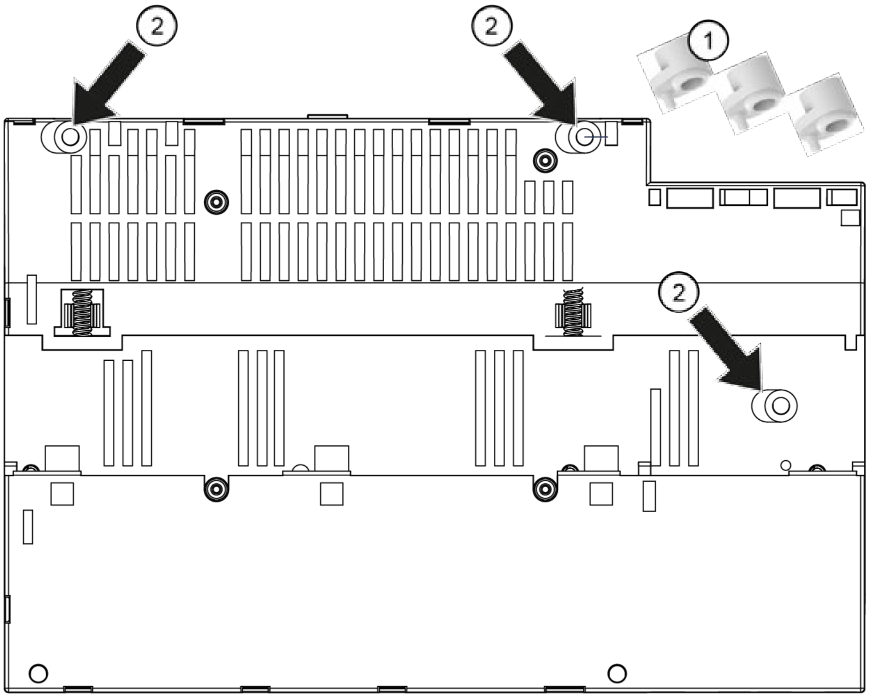
Mounting with screws

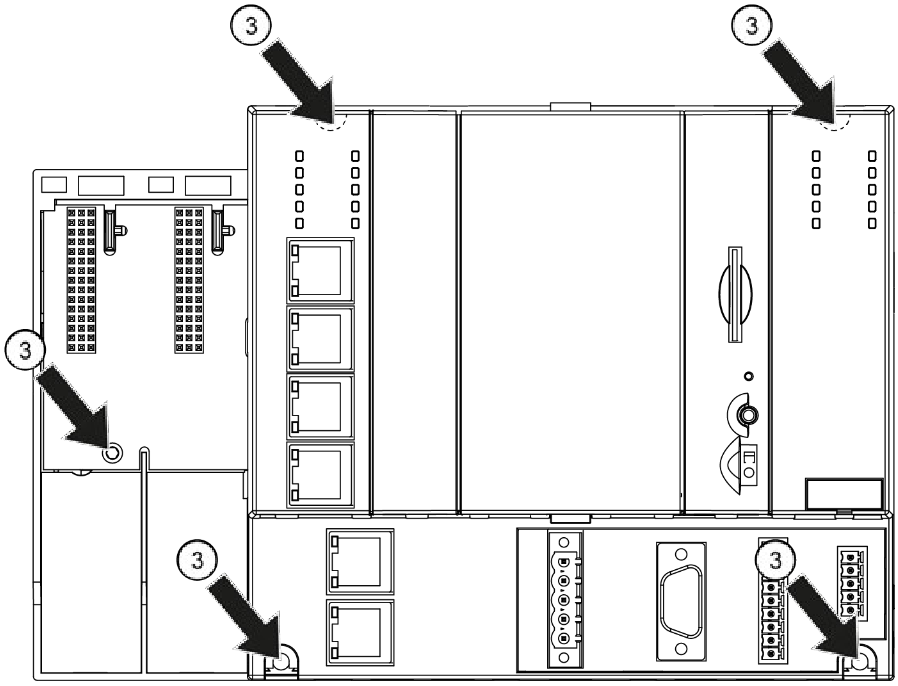
NOTICE!

Use screw mounting accessory to avoid damage!

For screw mounting, the use of the TA543 screw mounting accessory (1SAP182800R0001) is mandatory to prevent bending and damage to the module.

A dimension drawing for the position of screw's holes can be found in mechanical dimensions AC500 *Chapter 2.6.2.2 “Mechanical dimensions AC500” on page 1414.*





1 3 parts of screw mounting accessory TA543
2 3 slots for screw mounting accessory TA543
3 5 holes for screw mounting

1. Insert 3 parts of screw mounting accessory TA543 into the slots on the backside of the processor module PM595.

⇨

> **NOTICE!**
>
> **Use screw mounting accessory to avoid damage!**
>
> For screw mounting, the use of the TA543 screw mounting accessory (1SAP182800R0001) is mandatory to prevent bending and damage to the module.

2. Fasten the processor module PM595 with 5 screws (M4, max 1.2 Nm) from the front side.

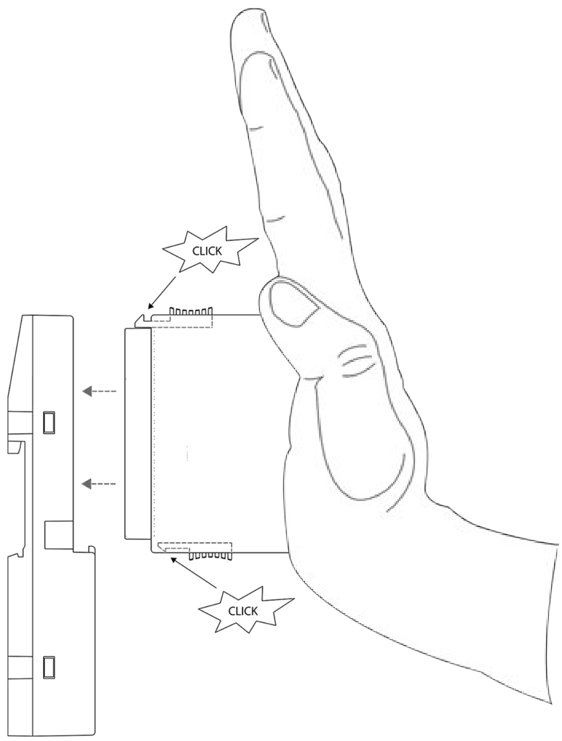
⇨

> *By screw mounting, the processor module PM595 is grounded through the screws. It is necessary that*
>
> – *the screws have a conductive surface (e.g. steel zinc-plated or brass nickel-plated)*
> – *the mounting plate is grounded*
> – *the screws have a good electrical contact to the mounting plate*

> *Thread lock washer is highly recommended to prevent the screw from loosening after long time use.*

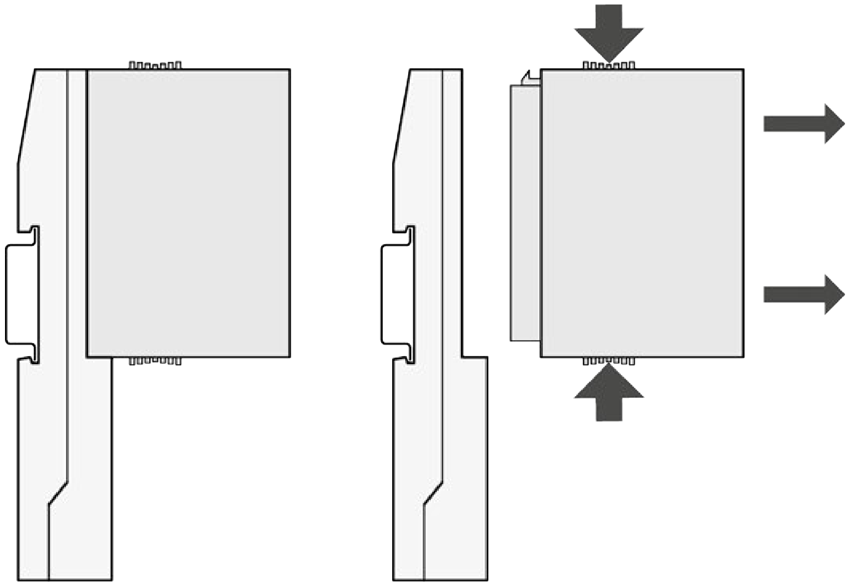
2.6.3.4 Mounting and demounting the AC500 processor module

1. After mounting the terminal base on the DIN rail, mount the processor module.



2. Press the processor module into the terminal base until it locks in place.

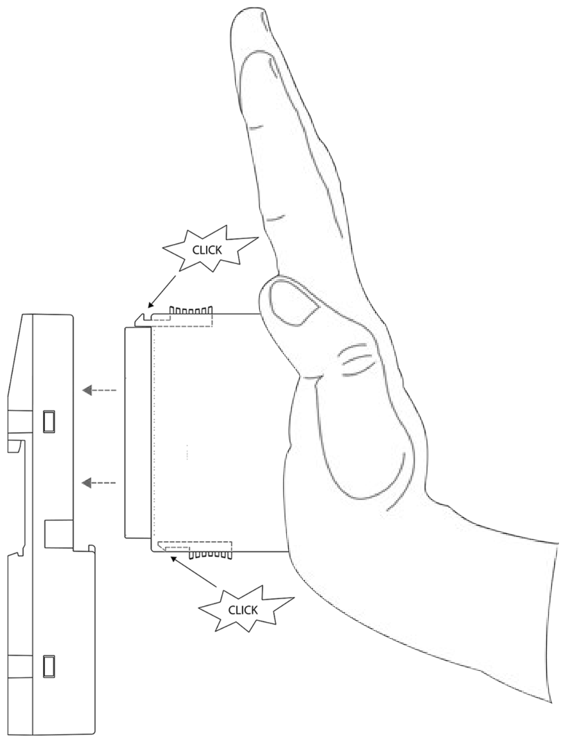
3. The demounting is carried out in a reversed order. Press above and below, then remove the processor module.



2.6.3.5 Mounting and demounting the I/O module

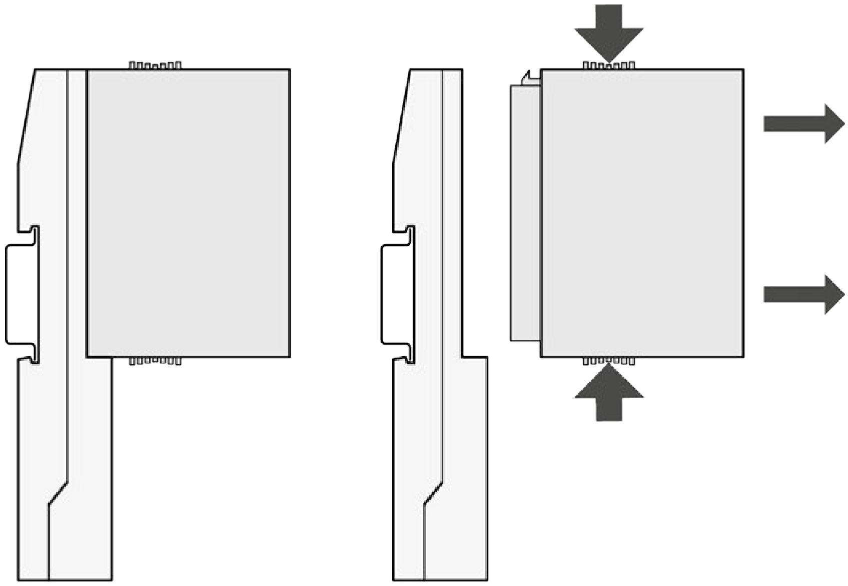
After mounting the terminal unit, mount the I/O modules.

1. Press the I/O module into the terminal unit until it locks in place.



2. The demounting is carried out in a reversed order.

   Press above and below, then remove the module.



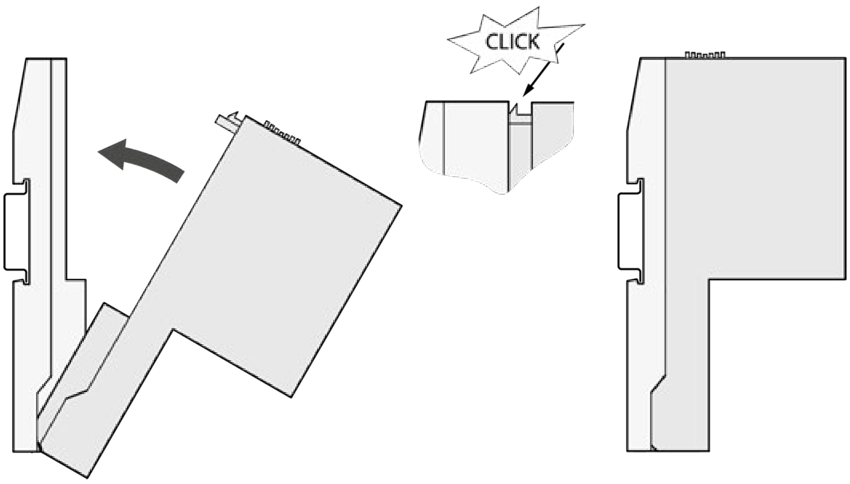
2.6.3.6 Mounting and demounting the communication module

Communication modules are mounted on the left side of the processor module on the same terminal base. The connection is established automatically when mounting the communication module.

> **NOTICE!**
> **Risk of damaging the PLC modules!**
> Overvoltages and short circuits might damage the PLC modules.
> – Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
> – Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

After mounting the terminal base, mount the communication modules.

1. First insert the bottom nose of the communication module into the dedicated holes of the terminal base. Then, rotate the communication module on the dedicated terminal base slot until it is locked in place.

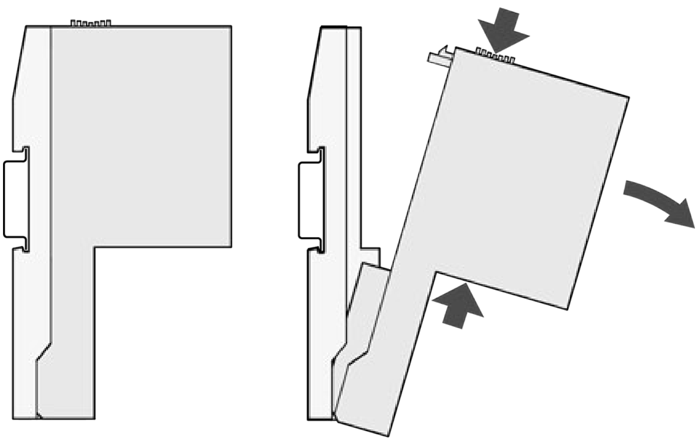


⇨

> **NOTICE!**
> **Risk of malfunctions!**
> Unused slots for communication modules are not protected against accidental physical contact.
> – Unused slots for communication modules must be covered with dummy communication modules to achieve IP20 rating ⇘ *Chapter 2.6.5.6 "TA524 - Dummy communication module" on page 1469*.
> – I/O bus connectors must not be touched during operation.

2. The demounting is carried out in a reversed order.

   Press above and below, then rotate the communication module and remove it.



2.6.3.7 Mounting/Demounting the accessories

Additional components such as batteries, cables, etc. are required for commissioning the PLC system. Information on assembly, replacement or basic use of the orderable components can be found in the description of the respective accessory.

⇘ *Chapter 2.6.5 "Handling of accessories" on page 1453*

Hardware details can be found in the device specifications of the accessory.

⇘ *Chapter 1.9 "Accessories" on page 1344*

2.6.4 Connection and wiring

For detailed information such as technical data of your mounted devices (AC500 product family) refer to the hardware device description of the appropriate device.

NOTICE!

Attention:

The devices should be installed by experts who are trained in wiring electronic devices. In case of bad wiring, the following problems could occur:

– On the terminal base, the terminals L+ and M are doubled. If the power supply is badly connected, a short circuit could happen and lead to a destruction of the power supply or its fuse. If no suitable fuse exists, the terminal base itself might be destroyed.
– The terminal bases and all electronic modules and terminal units are protected against reverse polarity.
– All necessary measures should be carried out to avoid damages to modules and wiring. Notice the wiring plans and connection examples.

NOTICE!

All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and temporary overvoltage up to 30 V DC.

NOTICE!

Attention:

Due to possible loss of communcation, the communication cables should be fixed with cable duct or bracket or clamp during application.

2.6.4.1 Power supply for AC500 system

The system is powered by two different power circuits:

- The power supply for the processor module is provided through the terminals L+/M.
- The power supply for the I/O modules is provided through the terminals UP/ZP.

The power supply for the processor module is galvanic isolated from the power supply for the I/O modules.

As soon as the power supply for the processor module is present, the processor module starts. The power supply of the processor module and the I/O modules should be powered on the same time, otherwise the processor module will not switch to run mode after startup.

When during operation the power supply falls below the minimum process and supply voltage for more than 10 ms, the processor module switches to safe mode. A restart of the processor module only occurs by switching the power supply off and on again.

If an I/O module is disconnected during operation from the power supply while the processor module is still powered, the processor module will continue its normal operation on all other powered peripherals (other I/O modules, communication modules and communication interfaces), but freezes the input image. After recovery of the power supply of the affected I/O module it will continue normal operation and inputs and outputs will be updated.

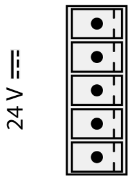
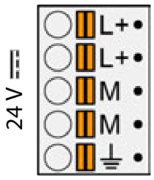
Chapter 2.6.1.1 “Environmental conditions” on page 1408

As power supply for the AC500 system, the ABB power supplies series CP can be used *Chapter 2.5.5.4 “CP-E - Economic range” on page 1406* *Chapter 2.5.5.5 “CP-C.1 - High performance range” on page 1407*.

2.6.4.2 Power supply for processor modules

The supply voltage of 24 V DC is connected to a removable 5-pin terminal block. L+/M exist twice. It is therefore possible to feed e.g. external sensors (up to 8 A max. with 1.5 mm² conductor) via these terminals.

Pin assignment

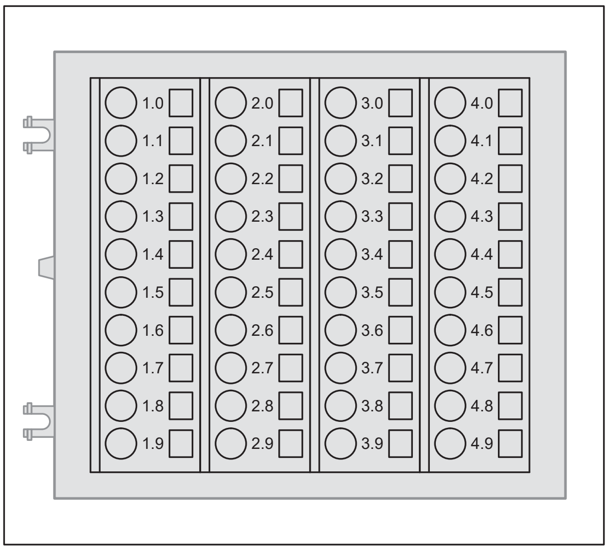
Pin Assignment		Label	Function	Description
 Terminal block removed	 Terminal block inserted	L+	+24 V DC	Positive pin of the power supply voltage
		L+	+24 V DC	Positive pin of the power supply voltage
		M	0 V	Negative pin of the power supply voltage
		M	0 V	Negative pin of the power supply voltage
		⏚	FE	Functional earth

2.6.4.3 Terminals for power supply and the COM1 interface

Terminal type: Spring terminal

Number of cores per terminal	Conductor type	Cross section
1	Solid	0.08 mm² ... 1.5 mm²
1	Flexible	0.08 mm² ... 1.5 mm²
1 with wire-end ferrule (without plastic sleeve)	Flexible	0.25 mm² ... 1.5 mm²
1 with wire-end ferrule (with plastic sleeve)	Flexible	0.25 mm² ... 0.5 mm²
1 (TWIN wire end ferrule)	Flexible	0.5 mm²

2.6.4.4 Terminals at the terminal unit



Terminal type: Screw-type terminal

Front terminal, conductor connection vertically with respect to the printed circuit board.

Parameter	Value
Type	Front terminal
Degree of protection	IP 20
Stripped conductor end	9 mm, min. 8 mm
Fastening torque	0.6 Nm
Needed tool	Slotted screwdriver
Dimensions	Blade diameter 3.5 mm

Terminal units with product index < C0 e. g. 1SAP 212 200 R0001 B0

Number of cores per terminal	Conductor type	Cross section
1	Solid	0.08 mm² ... 2.5 mm²
1	Flexible	0.08 mm² ... 2.5 mm²
1 with wire-end ferrule	Flexible	0.25 mm² ... 1.5 mm²
2	Solid	Not intended
2	Flexible	Not intended
2 with TWIN wire end ferrule (length 10 mm) with plastic sleeve	Flexible	2 x 0.25 mm² or 2 x 0.5 mm² or 2 x 0.75 mm², with square cross-section of the wire-end ferrule also 2 x 1.0 mm²

Terminal units with product index ≥ C0 e. g. 1SAP 212 200 R0001 C0

Number of cores per terminal	Conductor type	Cross section
1	Solid	0.08 mm² ... 2.5 mm²
1	Flexible	0.08 mm² ... 2.5 mm²
1 with wire-end ferrule without plastic sleeve	Flexible	0.08 mm² ... 2.5 mm²
1 with wire-end ferrule with plastic sleeve	Flexible	0.14 mm² ... 1.5 mm²
2	Solid	0.08 mm² ... 1.5 mm²
2	Flexible	0.08 mm² ... 1.5 mm²
2 with TWIN wire end ferrule (length 10 mm) with plastic sleeve	Flexible	2 x 0.5 mm² ... 2 x 1.0 mm²
2 with separate wire-end ferrule without plastic sleeve	Flexible	0.08 mm² ... 0.75 mm²

Terminal type: Spring terminal

Front terminal, conductor connection vertically with respect to the printed circuit board.

Parameter	Value
Type	Front terminal
Degree of protection	IP 20
Stripped conductor end	9 mm, min. 8 mm
Needed tool	Slotted screwdriver
Dimensions	2.5 x 0.4 to 3.5 x 0.5 mm, screwdriver must be at least 15 mm free of insulation at the tip

Number of cores per terminal	Conductor type	Cross section
1	Solid	0.08 mm² ... 2.5 mm²
1	Flexible	0.08 mm² ... 2.5 mm²
1 with wire-end ferrule	Flexible	0.25 mm² ... 1.5 mm²
2	Solid	Not intended
2	Flexible	Not intended
2 with TWIN wire end ferrule (length 10 mm) with plastic sleeve	Flexible	2 x 0.25 mm² or 2 x 0.5 mm² or 2 x 0.75 mm², with square cross-section of the wire-end ferrule also 2 x 1.0 mm²

2.6.4.5 Connection of wires at the spring terminals

Connection

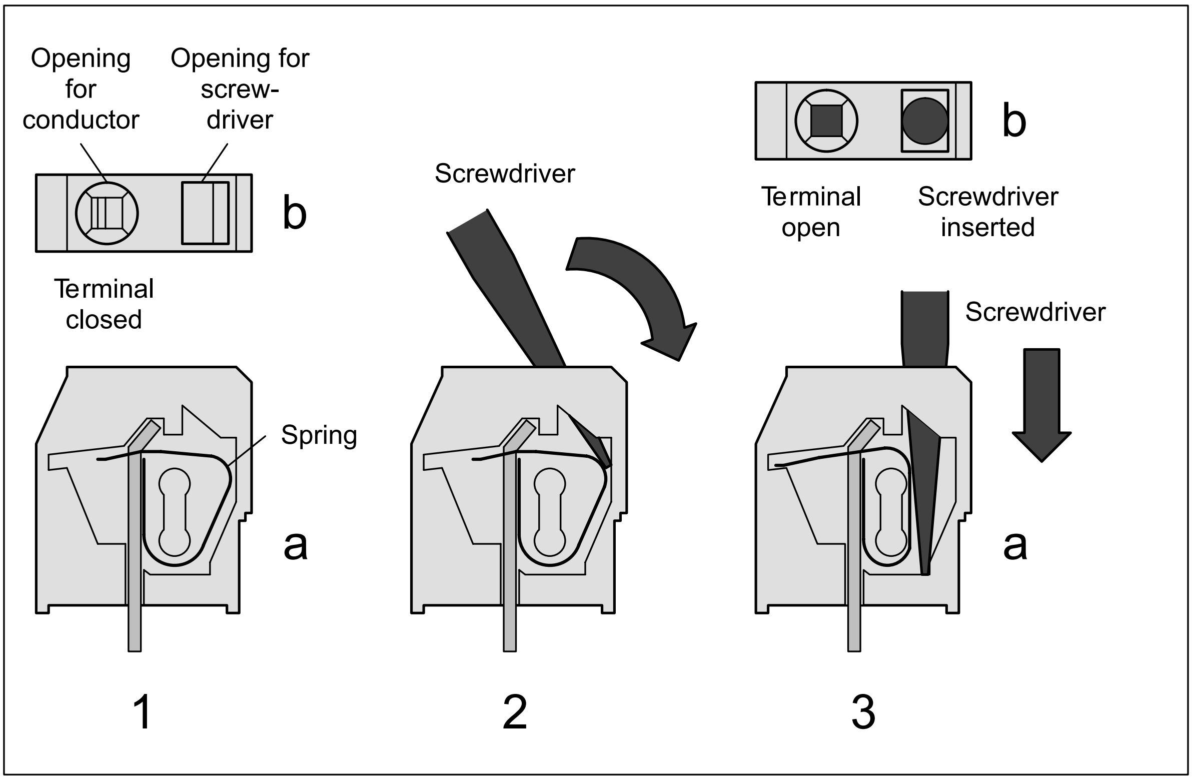


Fig. 367: Connect the wire to the spring terminal (steps 1 ... 3)

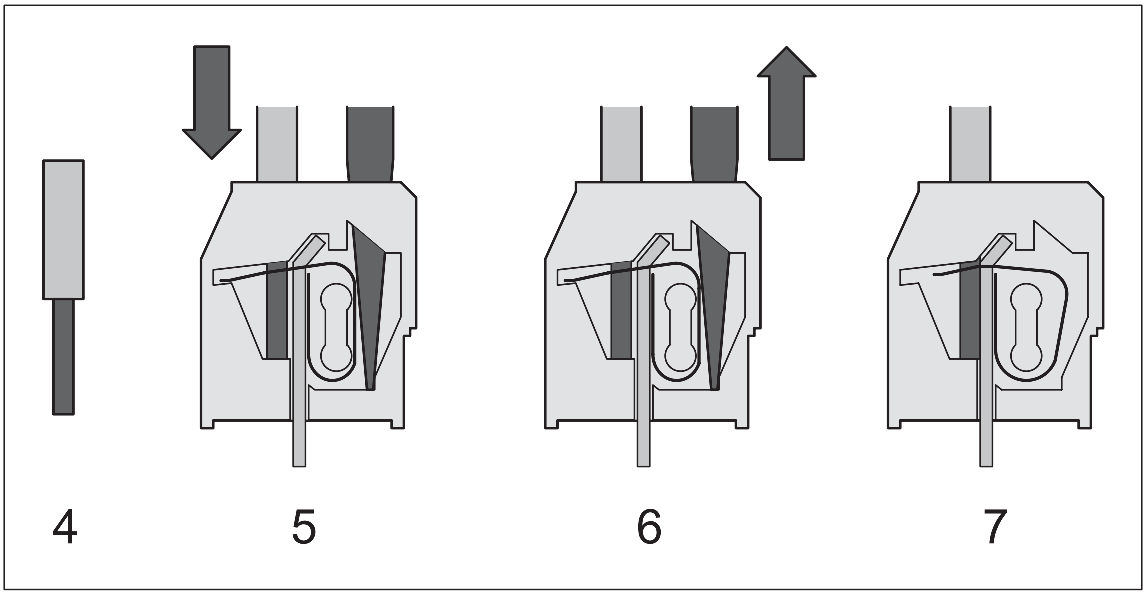


Fig. 368: Connect the wire to the spring terminal (steps 4 ... 7)

1. Side view (open terminal drawn for illustration)
2. The top view shows the openings for wire and screwdriver
3. Insert screwdriver (2.5 x 0.4 to 3.5 x 0.5 mm) at an angle, screwdriver must be at least 15 mm free of insulation at the tip
4. While erecting the screwdriver, insert it until the stop (requires a little strength)
5. Screwdriver inserted - terminal open
6. Strip the wire for 7 mm (and put on wire-end ferrule)
7. Insert wire into the open terminal
8. Done

Disconnection

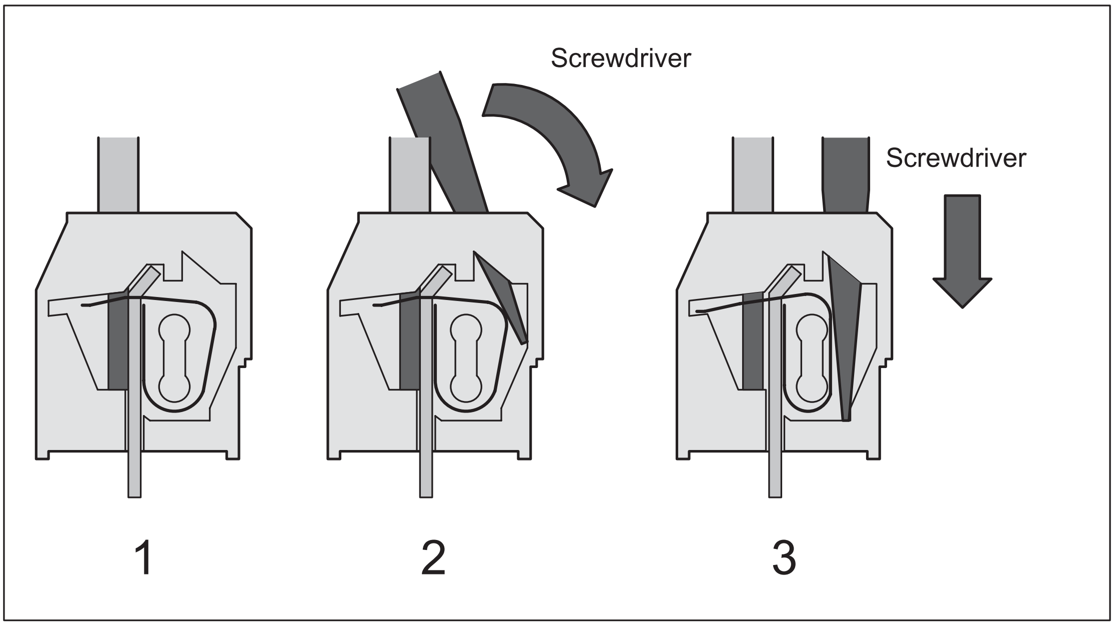


Fig. 369: Disconnect wire from the spring terminal (steps 1 ... 3)

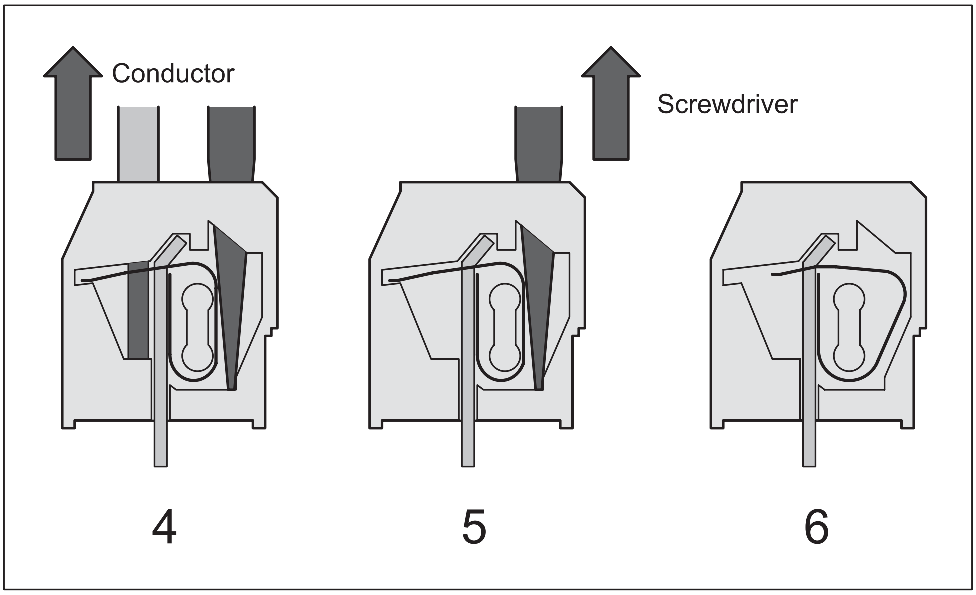


Fig. 370: Disconnect wire from the spring terminal (steps 4 ... 6)

1. Terminal with wire connected
2. Insert screwdriver (2.5 x 0.4 ... 3.5 x 0.5 mm) at an angle, screwdriver must be at least 15 mm free of insulation at the tip
3. While erecting the screwdriver, insert it until the stop (requires a little strength) - terminal is now open
4. Remove wire from the open terminal
5. Done

2.6.4.6 [ERROR: Missing definition for variable "title_terminals_for_cms"!]

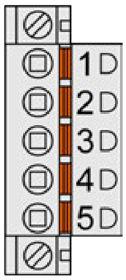


Fig. 371: Combicon, 5-pole, female, removable plug with spring terminals

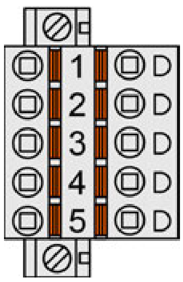


Fig. 372: Combicon, 5-pole, female, removable plug with spring terminals

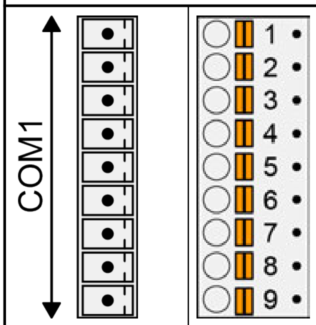
Terminal type: Spring terminal

Number of cores per terminal	Conductor type	Cross section	Stripped conductor end
1	solid	0.2 mm² ... 2.5 mm²	10 mm
1	flexible	0.2 mm² ... 2.5 mm²	10 mm
1 with wire-end ferrule (without plastic sleeve)	flexible	0.25 mm² ... 2.5 mm²	10 mm
1 with wire-end ferrule (with plastic sleeve)	flexible	0.25 mm² ... 2.5 mm²	10 mm

2.6.4.7 Serial interface COM1 of the terminal bases

The serial interface COM1 is connected via a removable 9-pin terminal block. It is configurable for RS-232 or RS-485 and can be used for:

- Online access,
- A free protocol,
- Modbus RTU, client and server,
- CS31 bus, as master only *Chapter 2.6.4.9 “CS31 bus” on page 1441*.



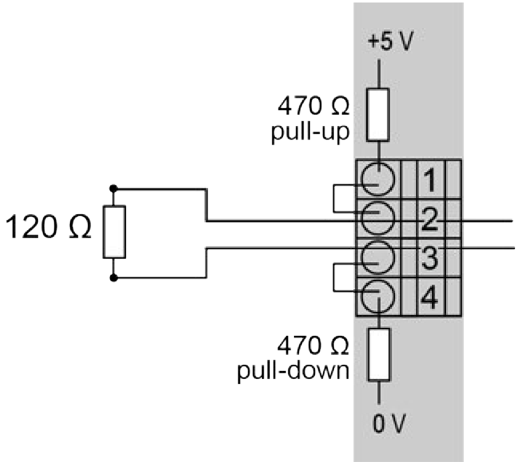
		Pin	Signal	Interface	Description
Terminal block removed	Terminal block inserted	1	Terminator P	RS-485	Terminator P
		2	RxD/TxD-P	RS-485	Receive/Transmit, positive
		3	RxD/TxD-N	RS-485	Receive/Transmit, negative
		4	Terminator N	RS-485	Terminator N
		5	RTS	RS-232	Request to send (output)
		6	TxD	RS-232	Transmit data (output)
		7	SGND	Signal Ground	
		8	RxD	RS-232	Receive data (input)
		9	CTS	RS-232	Clear to send (input)

RS-485 bus

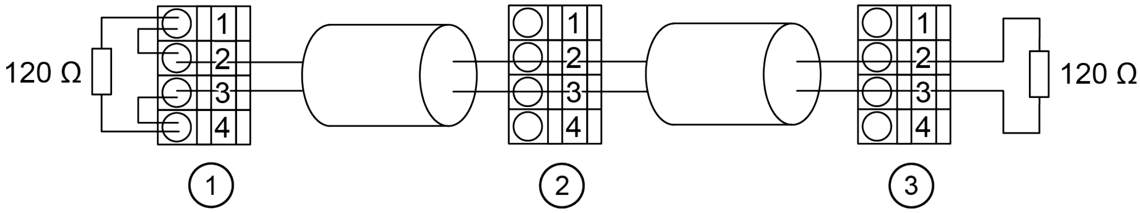
If the RS-485 bus is used, each interconnected bus line (each bus segment) must be electrically terminated. The following is necessary:

- 2 resistors of 120 Ω each at both line ends (to avoid signal reflections)
- Pull-up resistor at RxD/TxD-P and a pull-down resistor at RxD/TxD-N. These 2 resistors care for a defined high level on the bus, while there is no data exchange.
- *Further information on page 1452*

It is useful, to activate both the pull-up and the pull-down resistors, which only are necessary once on every bus line, at the bus master. For this reason, these two resistors are already integrated within the COM1 interface of the AC500 terminal bases. They can be activated by connecting the terminals 1-2 and 3-4 of COM1.

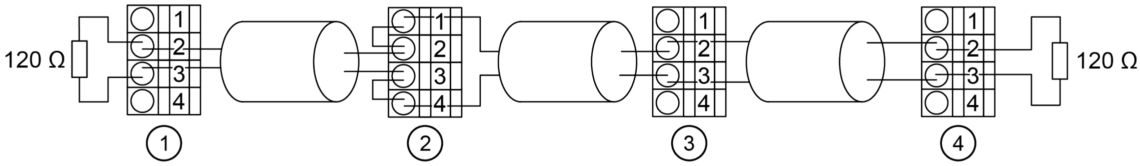


The following drawing shows an RS-485 bus with the bus master at the line end.



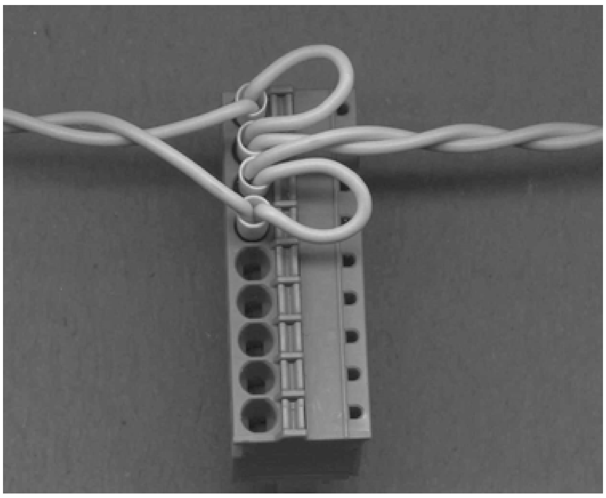
1 Master at the bus line end, pull-up and pull-down activated, bus termination with 120 Ω resistors
2 Slave within the bus line
3 Slave at the bus line end, bus termination with 120 Ω resistors

If the master is located within the bus line, it does not need a terminating resistor. The pull-up and the pull-down resistors, however, must be activated (see the following drawing).



1 Slave at the bus line end, bus termination with 120 Ω resistors
2 Master within the bus line, pull-up and pull-down activated
3 Slave within the bus line
4 Slave at the bus line end, bus termination with 120 Ω resistors

The following photo shows a wiring example "master within the bus line", wired at the COM1 bus connector of the terminal base:



> *If the bus is operated with several masters, the pull-up and pull-down resistors may only be activated at one master.*

The grounding of the cable shields of the bus lines are described in the CS31 bus (PM57x, PM58x and PM59x) *Chapter 2.6.4.9 "CS31 bus" on page 1441*.

Table 369: Max. cable length

Parameter			Value
Max. cable length for RS-485 on COM1 / COM2 for AC500 CPU			1.200 m at 19.200 baud
Max. cable length for RS-485 on COM1 / COM2 for AC500-eCo CPU			
	COM1:		
		Non-isolated:	Max. 50 m (with shielded cable)
	COM2:		

2.6.4.8 Serial interface COM2 of the terminal bases

> *The serial interface COM2 is not available at:*
>
> – *Processor modules with type designator -2ETH (e. g. PM591-2ETH)*
> – *Processor modules PM56xx*

The serial interface COM2 is connected via a 9-pole D-sub connector. It is not intended to use COM2 to establish a CS31 system bus. It is configurable for RS-232 or RS-485 and can be used for

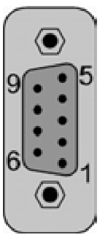
- online access
- a free protocol
- Modbus RTU, master and slave

If the RS-485 bus is used, each interconnected bus line (each bus segment) must be electrically terminated. The following is necessary:

- 2 resistors of 120 Ω each at both line ends (to avoid signal reflections)
- a pull-up resistor at RxD/TxD-P and a pull-down resistor at RxD/TxD-N. These 2 resistors care for a defined high level on the bus, while there is no data exchange.
- *Further information on page 1452*

It is useful, to activate both the pull-up and the pull-down resistors, which only are necessary once on every bus line, at the bus master.

Pin assignment

Serial Interface	Pin	Signal	Interface	Description	
	1	FE	-	Functional earth	
	2	TxD	RS-232	Transmit data	Output
	3	RxD/TxD-P	RS-485	Receive/Transmit	Positive
	4	RTS	RS-232	Request to send	Output
	5	SGND	Signal ground	0 V supply out	

Serial Interface	Pin	Signal	Interface	Description	
	6	+5 V	-	5 V supply out	
	7	RxD	RS-232	Receive data	Input
	8	RxD/TxD-N	RS-485	Receive/Transmit	Negative
	9	CTS	RS-232	Clear to send	Input
	Shield	FE	-	Functional earth	

NOTICE!

Risk of corrosion!

Unused connectors and slots may corrode if XC devices are used in salt-mist environments.

Protect unused connectors and slots with TA535 protective caps for XC devices *Chapter 1.9.3.6 "TA535 - Protective caps for XC devices" on page 1362*.

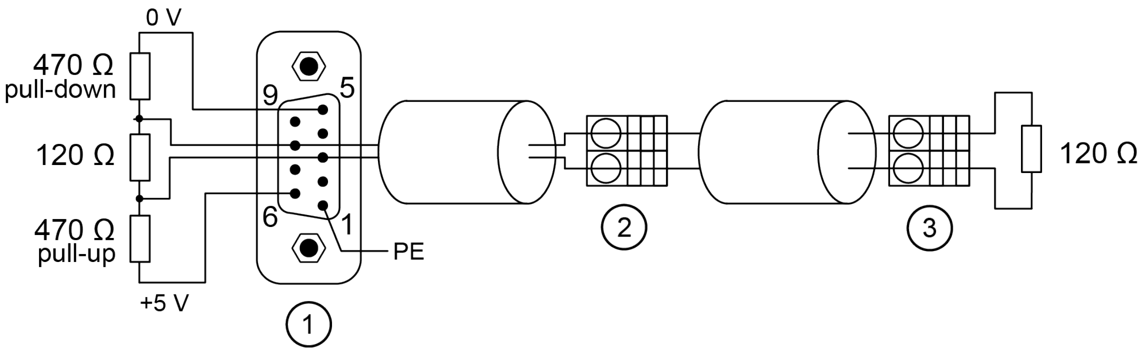
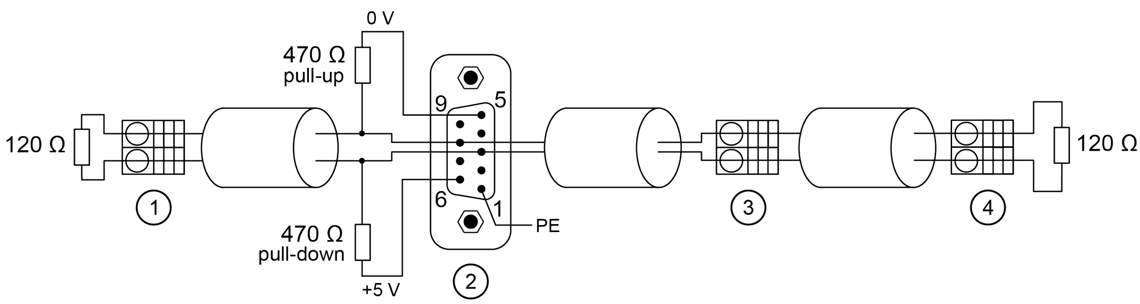


Fig. 373: RS-485 bus with the bus master at the line end

1 Master at the bus line end, pull-up and pull-down activated, bus termination with 120 Ω resistors
2 Slave within the bus line
3 Slave at the bus line end, bus termination with 120 Ω resistors

If the master is located within the bus line, it does not need a terminating resistor. The pull-up and the pull-down resistors, however, are necessary:



1 Slave at the bus line end, bus termination with 120 Ω resistors
2 Master within the bus line, pull-up and pull-down activated
3 Slave within the bus line
4 Slave at the bus line end, bus termination with 120 Ω resistors

NOTICE!

If the bus is operated with several masters, the pull-up and pull-down resistors may only be installed at one master.

The cable shields must be grounded.

Table 370: Max. cable length

Parameter			Value
Max. cable length for RS-485 on COM1 / COM2 for AC500 CPU			1.200 m at 19.200 baud
Max. cable length for RS-485 on COM1 / COM2 for AC500-eCo CPU			
	COM1:		
		Non-isolated:	Max. 50 m (with shielded cable)
	COM2:		

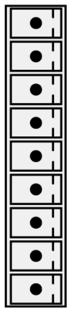
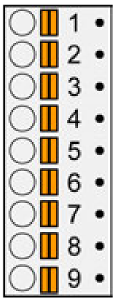
2.6.4.9 CS31 bus

2.6.4.9.1 Connection of the processor module to the CS31 bus

> *The PM56xx processor module does **not** support the CS31 bus.*

COM1 of the terminal base The processor module can be used as a CS31 bus master. The connection is performed via the serial interface COM1 used as a CS31 bus.

Pin assignment (RS-485 / RS-232)

		Pin	Signal	Interface	Description
COM1  Terminal block removed	COM1  Terminal block inserted	1	Terminator P	RS-485	Terminator P
		2	RxD/TxD-P	RS-485	Receive/Transmit, positive
		3	RxD/TxD-N	RS-485	Receive/Transmit, negative
		4	Terminator N	RS-485	Terminator N
		5	RTS	RS-232	Request to send (output)
		6	TxD	RS-232	Transmit data (output)
		7	SGND	Signal Ground	Signal Ground
		8	RxD	RS-232	Receive data (input)
		9	CTS	RS-232	Clear to send (input)

> **NOTICE!**
> **Unused connector!**
> Make sure that the terminal block is always connected to the terminal base or communication module, even if you do not use the interface.

With connecting the terminals 1 ... 2 and 3 ... 4, a pull-up and a pull-down resistor can be activated *Chapter 2.6.4.7 “Serial interface COM1 of the terminal bases” on page 1437*.

2.6.4.9.2 Wiring

Wiring

Bus line	
Construction	2 cores, twisted, with common shield
Conductor cross section	> 0.22 mm² (24 AWG)
Recommendation	0.5 mm² corresponds to 0.8 mm
Twisting rate	> 10 per meter (symmetrically twisted)
Resistance per core	< 100 Ω/km
Characteristic impedance	ca. 120 Ω (100 Ω ... 150 Ω)
Capacitance between the cores	< 55 nF/km (if higher, the max. bus length must be reduced)
Terminating resistors	120 Ω ¼ W at both line ends

2.6.4.9.3 Bus topology

A CS31 bus always contains only one bus master (CPU or communication module) which controls all actions on the bus. Up to 31 slaves can be connected to the bus, e.g. remote modules or slave-configured CPUs. Besides the wiring instructions shown below, the wiring and grounding instructions provided with the descriptions of the modules are valid additionally.

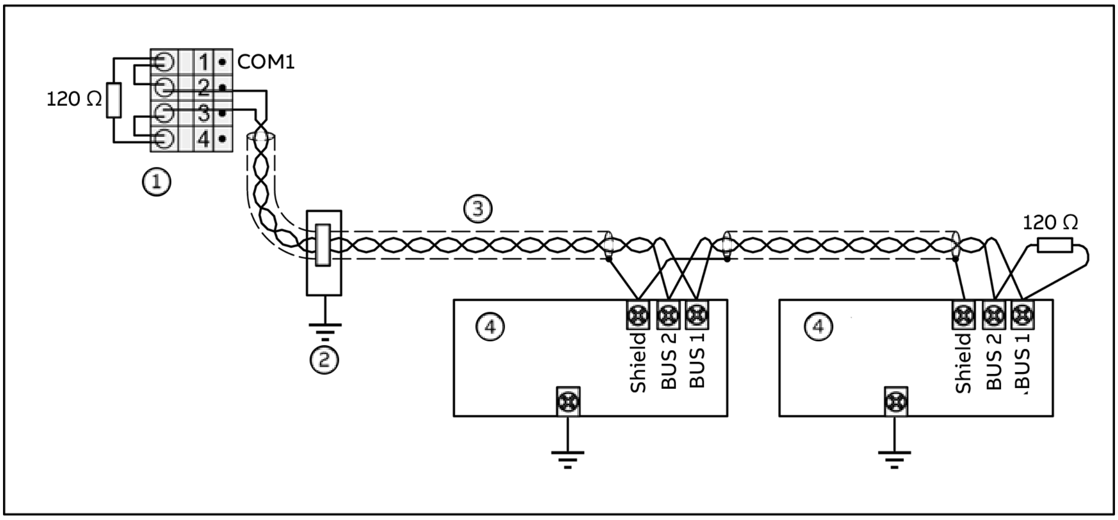


Fig. 374: Bus topology for a CS31 bus at COM1 (bus master at one end of the bus line)

1 CS31 bus master (e.g. PM581, master at the bus line end, pull-up and pull-down activated, bus termination 120 Ω)
2 Direct grounding with clip on cabinet steel plate
3 CS31 bus
4 CS31 slave

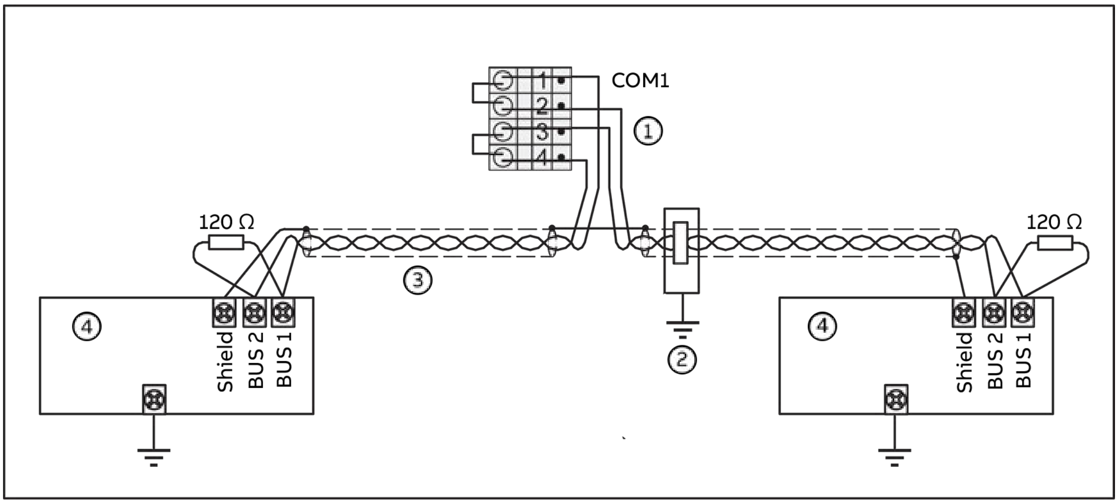


Fig. 375: Bus topology for a CS31 bus at COM1 (bus master within the bus line)

1 CS31 bus master (e.g. PM581, master at the bus line end, pull-up and pull-down activated, bus termination 120 Ω)
2 Direct grounding with clip
3 CS31 bus
4 CS31 slave

NOTICE!
Risk of malfunctions!
Spur lines are not allowed within the CS31 bus.

Loop the bus line from module to module.

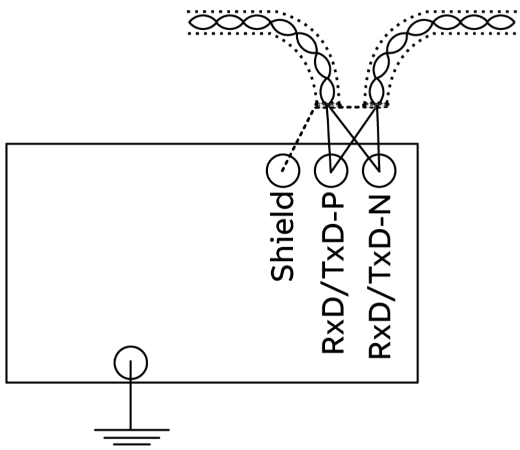


Fig. 376: CS31 slave - Bus line: Correct

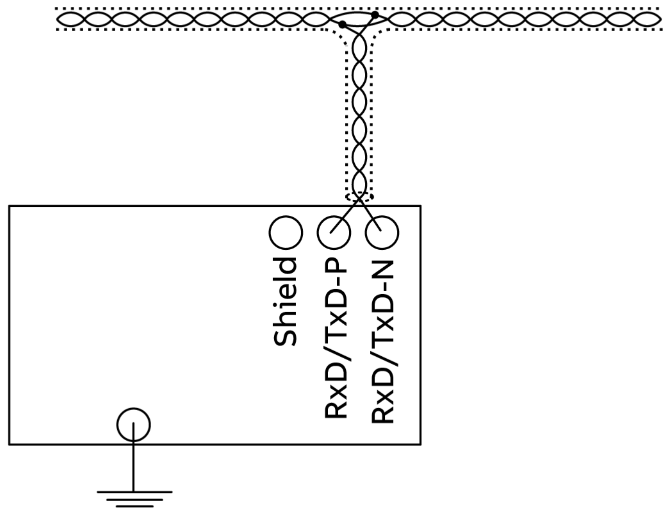


Fig. 377: CS31 slave - Bus line: Wrong

2.6.4.9.4 Grounding

In order to avoid disturbance, the cable shields must be grounded directly.

Case a:

Multiple control cabinets: If it can be guaranteed that no potential differences can occur between the control cabinets by means of current-carrying metal connections (grounding bars, steel constructions etc.), the direct grounding is chosen.

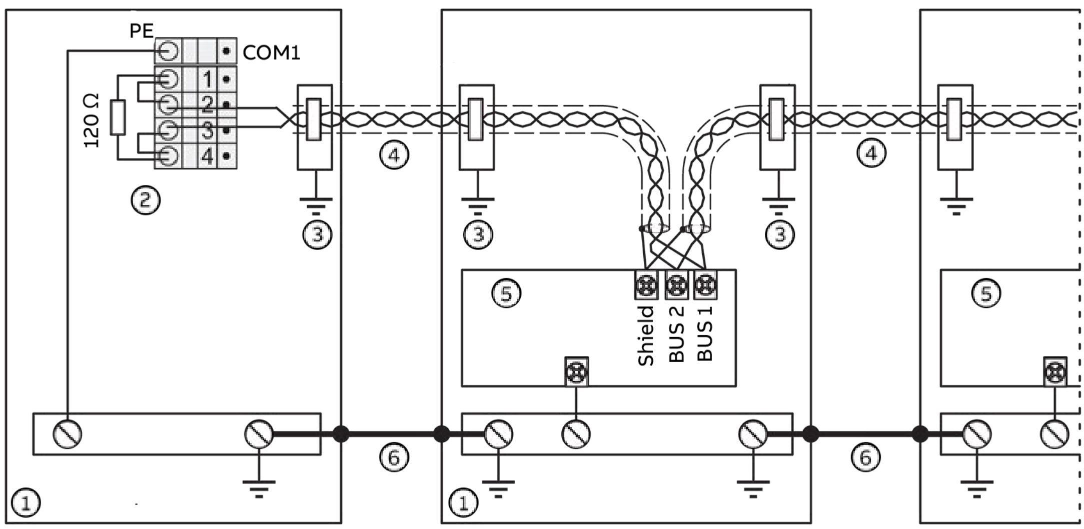


Fig. 378: Direct grounding

1 Cabinet
2 CS31 bus master (e.g. PM581)
3 Direct grounding of shields when entering the cabinet
4 CS31 bus system
5 CS31 slave
6 Current-carrying connection

Case b:

Multiple control cabinets: If potential differences can occur between the control cabinets, the capacitive grounding method is chosen in order to avoid circulating currents on the cable shields.

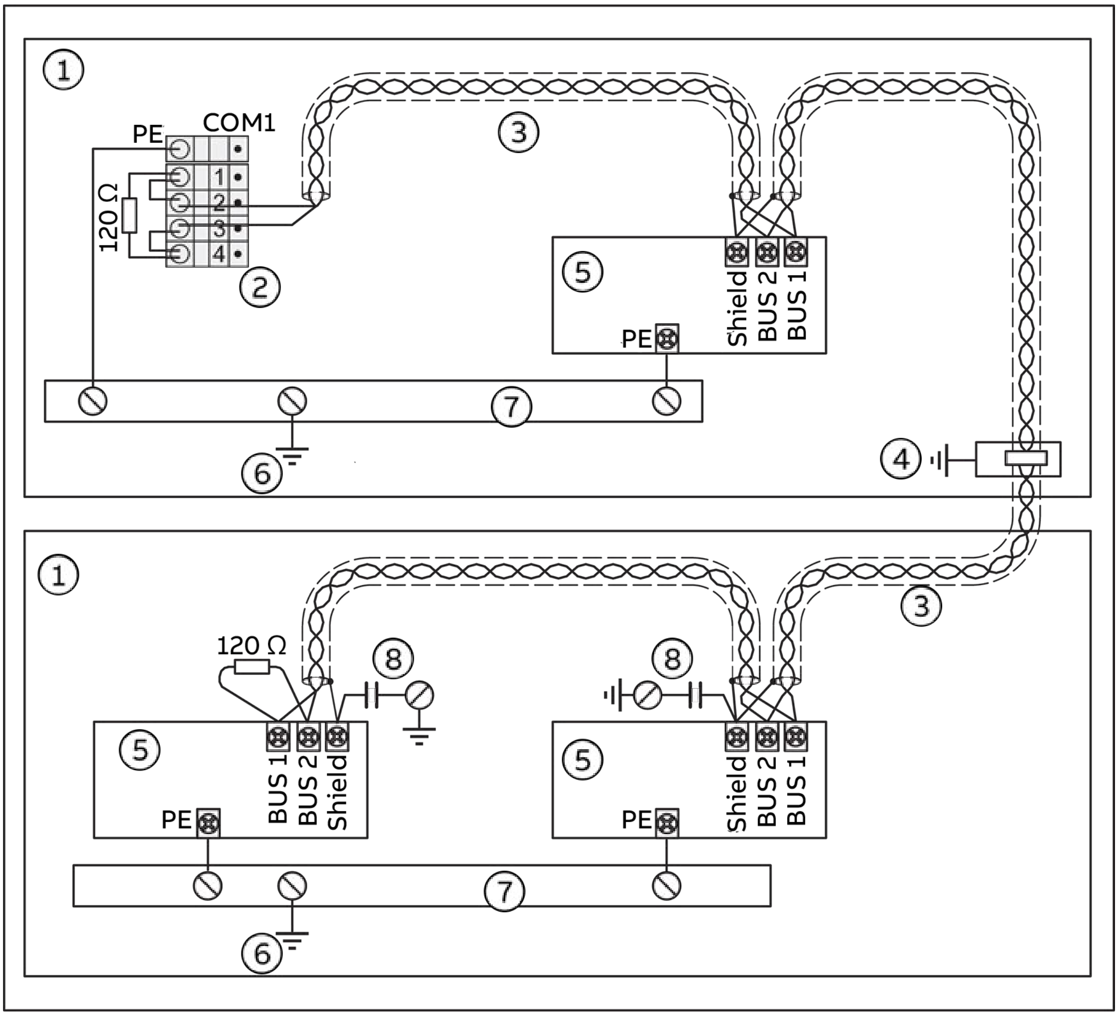


Fig. 379: Grounding concept with several control cabinets: direct grounding of cable shields when cables enter the first control cabinet (containing the master), and capacitive grounding at the modules

1 Cabinet
2 CS31 bus master e.g. PM581
3 CS31 bus system
4 Direct grounding of shields when entering the cabinet
5 CS31 slave
6 Cabinet grounding
7 Grounding bar
8 Capacitive grounding 0.1 uF X-type capacitor directly on on the cabinet's steel plate

Everywhere is valid: The total length of the grounding connections between the shield of the terminal base and the grounding bar must be as short as possible (max. 25 cm). The conductor cross section must be at least 2.5 mm^2.

> *VDE 0160 requires, that the shield must be grounded directly at least once per system.*

2.6.4.10 CANopen field bus

Types of bus cables

For CANopen, only bus cables with characteristics as recommended in ISO 11898 are to be used. The requirements for the bus cables depend on the length of the bus segment. Regarding this, the following recommendations are given by ISO 11898:

Length of segment [m]	Bus cable (shielded, twisted pair)			Max. transmission rate [kbit/s]
	Conductor cross section [mm²]	Line resistance [Ω/km]	Wave impedance [Ω]	
0...40	0.25 ... 0.34 / AWG23, AWG22	70	120	1000 at 40 m
40...300	0.34 ... 0.60 / AWG22, AWG20	< 60	120	< 500 at 100 m
300...600	0.50 ... 0.60 / AWG20	< 40	120	< 100 at 500 m
600...1000	0.75 ... 0.80 / AWG18	< 26	120	< 50 at 1000 m

NOTICE!
Risk of telegram and data errors!
The use of wrong cable type and quality could lead to limitations in cable length, causing telegram and data errors.

NOTICE!
Risk of damaging the terminating resistor!
A bus-line short-circuit to the 24 V DC power supply can cause damage by exceeding the power rating of the terminating resistor.

NOTICE!
Risk of telegram and data errors!
Miss- or unterminated data lines can cause reflections on the bus, leading to telegram and data errors. For maximum cable length and transmission rate, the bus must always be terminated on both ends with the characteristic impedance of the cable type.

NOTICE!
Verification of termination (Make sure the power supply on all CAN nodes is turned off)!
To verify the termination, the DC resistance between CAN_H and CAN_L can be measured. The value should be between 50 Ω and 70 Ω.

Check for correct resistor values, short circuits and correct number of terminating resistors, if the measurement is showing deviations.

Installation hint

Ensure that the termination and FE connection will not be removed when removing CAN modules from the bus.

Branches are not allowed in a CAN network. Stubs should be avoided or kept as short as possible (< 0.3 m).

When connecting the cable take care to use one dedicated twisted pair for the CAN signals (CAN_L and CAN_H) and another free wire for CAN_GND. CAN_GND must be connected as reference, to avoid common mode problems causing telegram errors.

Keep the CAN bus wiring away from electrical disturbance and close to earth potential to minimize interference.

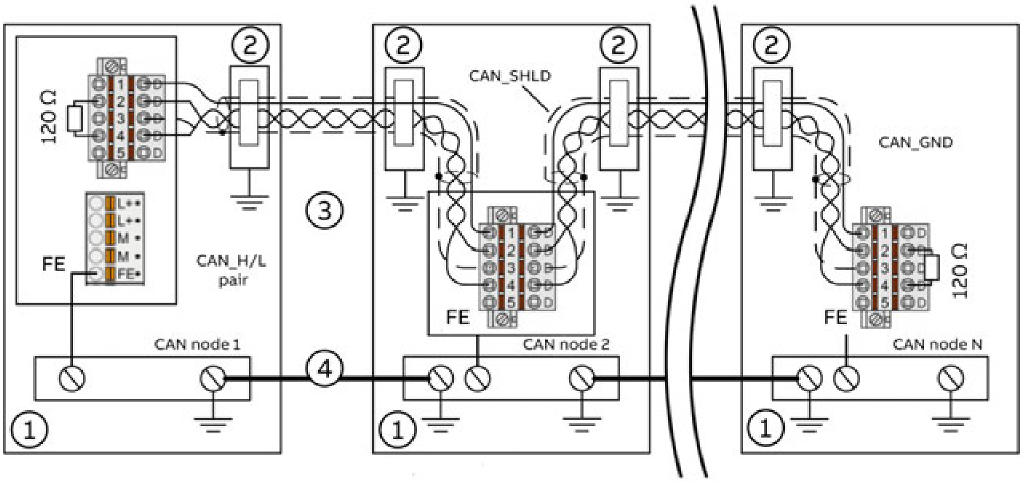


Fig. 380: CAN bus, connection and wiring

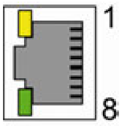
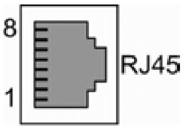
1 Cabinet
2 Direct grounding of shields when entering the cabinet
3 CAN bus segment
4 Current-carrying connection

2.6.4.11 Ethernet connection details

2.6.4.11.1 Ethernet interface

Ethernet is also used for PROFINET, EtherCAT and Modbus TCP connection.

Pin assignment

Interface	Pin	Signal	Description
 or 	1	TxD+	Transmit data +
	2	TxD-	Transmit data -
	3	RxD+	Receive data +
	4	NU	Not used
	5	NU	Not used
	6	RxD-	Receive data -
	7	NU	Not used
	8	NU	Not used
	Shield	Cable shield	Functional earth

2.6.4.11.2 Wiring

Cable length restrictions

For the maximum possible cable lengths within an Ethernet network, various factors have to be taken into account. Twisted pair cables (TP cables) are used as transmission medium for 10 Mbit/s Ethernet (10Base-T) as well as for 100 Mbit/s (Fast) Ethernet (100Base-TX). For a transmission rate of 10 Mbit/s, cables of at least category 3 (IEA/TIA 568-A-5 Cat3) or class C (according to European standards) are allowed. For fast Ethernet with a transmission rate of 100 Mbit/s, cables of category 5 (Cat5) or class D or higher have to be used. The maximum length of a segment, which is the maximum distance between two network components, is restricted to 100 m due to the electric properties of the cable.

Furthermore, the length restriction for one collision domain has to be observed. A collision domain is the area within a network which can be affected by a possibly occurring collision (i.e. the area the collision can propagate over). This, however, only applies if the components operate in half-duplex mode since the CSMA/CD access method is only used in this mode. If the components operate in full-duplex mode, no collisions can occur. Reliable operation of the collision detection method is important, which means that it has to be able to detect possible collisions even for the smallest possible frame size of 64 bytes (512 bits). But this is only guaranteed if the first bit of the frame arrives at the most distant subscriber within the collision domain before the last bit has left the transmitting station. Furthermore, the collision must be able to propagate to both directions at the same time. Therefore, the maximum distance between two ends must not be longer than the distance corresponding to the half signal propagation time of 512 bits. Thus, the resulting maximum possible length of the collision domain is 2000 m for a transmission rate of 10 Mbit/s and 200 m for 100 Mbit/s. In addition, the bit delay times caused by the passed network components also have to be considered.

Table 371: Specified cable properties of the respective cable types per 100 m:

Parameter	10Base-T [10 MHz]	100Base-TX [100 MHz]
Attenuation [dB/100m]	10.7	23.2
NEXT [dB/100m]	23	24
ACR [dB/100m]	N/A	4
Return loss [dB/100m]	18	10
Wave impedance [Ohms]	100	100
Category	3 or higher	5
Class	C or higher	D or higher

TP cable

The TP cable has eight wires arranged in four pairs of twisted wires. Different color codes exist for the coding of the wires, the coding according to EIA/TIA 568, version 1, being the one most commonly used. In this code, the individual pairs are coded with blue, orange, green and brown color. One wire of a pair is unicolored and the corresponding second wire is striped, the respective color alternating with white. For shielded cables, a distinction is made between cables that have one single shield around all pairs of wires and cables that have an additional individual shield for each pair of wires. The following table shows the different color coding systems for TP cables:

Table 372: Color coding of TP cables:

Pairs	EIA/TIA 568 Version 1		EIA/TIA 568 Version 2		DIN 47100		IEC 189.2	
Pair 1	white/ blue	blue	green	red	white	brown	white	blue
Pair 2	white/ orange	orange	black	yellow	green	yellow	white	orange
Pair 3	white/ green	green	blue	orange	grey	pink	white	green
Pair 4	white/ brown	brown	brown	slate	blue	red	white	brown

Two general variants are distinguished for the pin assignment of the normally used RJ45 connectors: EIA/TIA 568 version A and version B. The wiring according to EIA/TIA 568 version B is the one most commonly used.

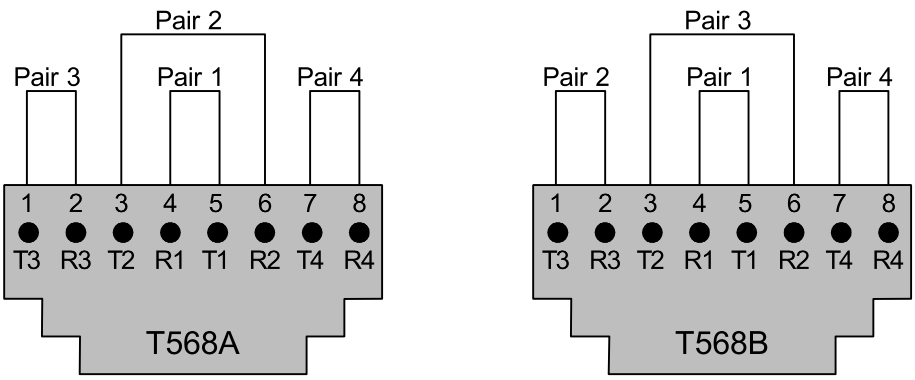


Fig. 381: Pin assignment of RJ45 sockets

2.6.4.11.3 Cable types

Crossover cable

> ***Particular use***
> *Crossover cables are needed only for a direct Ethernet connection without crossover functionality. In particular for AC500 modules in product life cycle phase "Classic".*

Crossover cables are for a direct Ethernet connection of two terminal devices as the simplest variant of a network. From transmission lines of the first station to the reception lines of the second station.

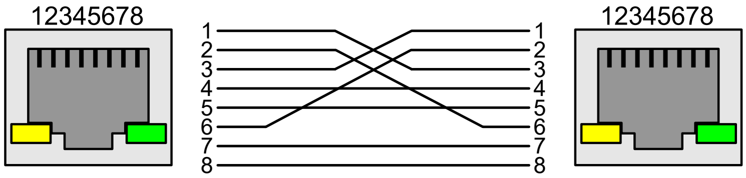


Fig. 382: Wiring of a crossover cable

Straight-through cable

For networks with more than two subscribers, hubs or switches have to be used additionally for distribution. These active devices already have the crossover functionality implemented which allows a direct connection of the terminal devices using straight-through cables.

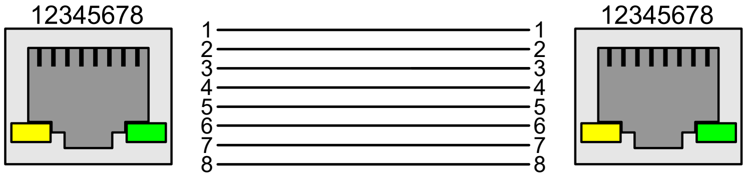


Fig. 383: Wiring of a straight-through cable

CAUTION!
Risk of communication faults!
When using inappropriate cables, malfunctions in communication may occur.

Only use network cables of the categories 5 (Cat 5, Cat 5e, Cat 6 or Cat 7) or higher within PROFINET networks.

2.6.4.12 PROFIBUS connection details

Attachment plug for the bus cable

9-pin D-sub connector, male

Parameter	Value
Fastening torque	0.4 Nm

Assignment

Pin	Signal	Description
1	Shield	Shielding, protective ground
2	not used	-
3	RxD/TxD-P	Reception / transmission line, positive
4	CBTR-P	Control signal for repeater, positive (optional)
5	DGND	Reference potential for data lines and +5 V
6	VP	+5 V, supply voltage for bus terminating resistors
7	not used	-

Pin	Signal	Description
8	RxD/TxD-N	Reception / transmission line, negative
9	CNTR-N	Control signal for repeater, negative (optional)

Bus cable

Parameter	Value
Type	Twisted pair (shielded)
Characteristic impedance	135 Ω ... 165 Ω
Cable capacitance	< 30 pF/m
Conductor diameter of the cores	≥ 0.64 mm
Conductor cross section of the cores	≥ 0.34 mm²
Cable resistance per core	≤ 55 Ω/km
Loop resistance (resistance of two cores)	≤ 110 Ω/km

Cable lengths

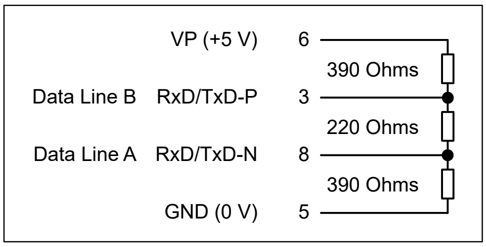
The maximum possible cable length of a PROFIBUS subnet within a segment depends on the tranmission rate (baud rate).

Transmission Rate	Maximum Cable Length
9.6 / 19.2 / 93.75 kBaud	1200 m
187.5 kBaud	1000 m
500 kBaud	400 m
1.5 MBaud	200 m
3 MBaud to 12 MBaud	100 m

Branch lines are generally permissible for transmission rates of up to 1500 kbit/s. But in fact they should be avoided for transmission rates higher than 500 kbit/s.

Bus terminating resistors

The line ends (of the bus segments) have to be terminated using bus terminating resistors according to the drawing below. The bus terminating resistors are usually placed inside the bus connector.



Repeaters

One bus segment can have up to 32 subscribers. Using repeaters a system can be expanded to up to 126 subscribers. Repeaters are also required for longer transfer lines. Please note that a repeater's load to the bus segment is the same as the load of a normal bus subscriber. The sum of normal bus subscribers and repeaters in one bus segment must not exceed 32.

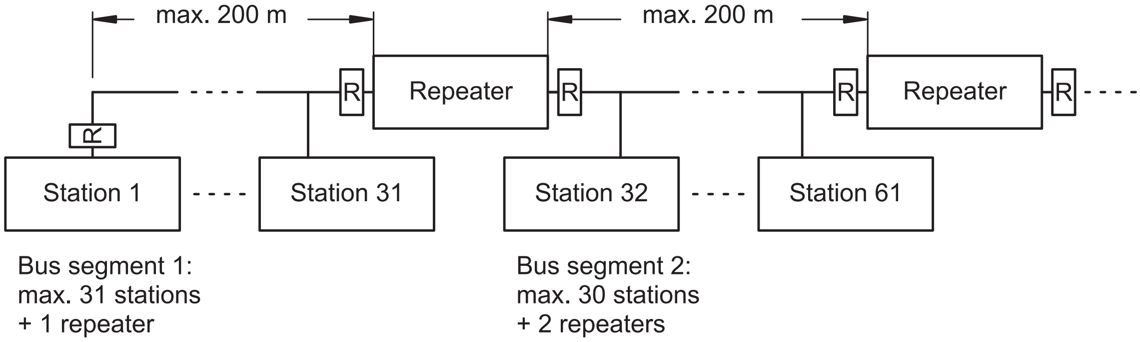


Fig. 384: Principle example for a PROFIBUS-DP system with repeaters (1500 kbit/s baud rate)

2.6.4.13 Modbus RTU connection details

The Modbus RTU protocol is implemented in the AC500 processor modules.

Modbus is a master-slave (client-server) protocol. The client sends a request to the server(s) and receives the response(s).

Available serial interfaces can work as Modbus interfaces simultaneously.

The Modbus client operating mode of an interface is set with the function block COM_MOD_MAST.

Technical data

Table 373: Description of the Modbus protocol

Parameter	Value
Supported standard	PM57x, PM58x and PM59x: EIA RS-232 / RS-485
Number of connection points	1 client Max. 1 server with RS-232 interface Max. 31 servers with RS-485
Protocol	Modbus
Operating mode	Client/server
Address	Server only
Data transmission control	CRC16
Data transmission speed	From 300 bits/s to 187,500 bits/s
Encoding	1 start bit 8 data bits 1 parity bit, (optional) even, odd, mark or space 1 or 2 stop bits

Table 374: Max. cable length

Parameter			Value
Max. cable length for RS-485 on COM1 / COM2 for AC500 CPU			1.200 m at 19.200 baud
Max. cable length for RS-485 on COM1 / COM2 for AC500-eCo CPU			
	COM1:		
		Non-isolated:	Max. 50 m (with shielded cable)
	COM2:		

If a processor module provides more than one serial interface, both interfaces (COM1/COM2) can be operated simultaneously as Modbus interfaces and can operate as Modbus server as well as Modbus client.

Bus topology Point-to-point with RS-232 or bus topology with RS-485. Modbus is a master-slave protocol.

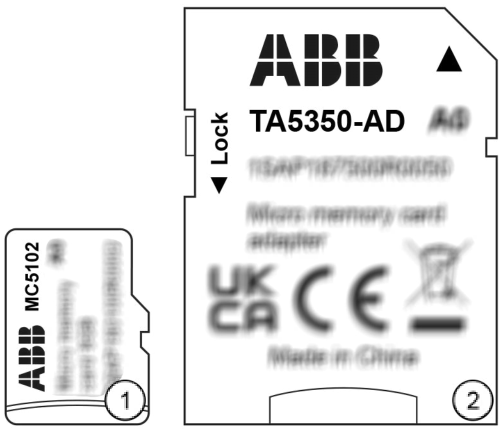
2.6.5 Handling of accessories

This section only describes accessories that are frequently used for system assembly, connection and construction.

All additional accessories that can be used to supplement the AC500 system

2.6.5.1 MC5102 - Micro memory card with adapter

- Solid state flash memory storage



1 Micro memory card
2 TA5350-AD micro memory card adapter, necessary for use in AC500 processor modules

> *The MC5102 micro memory card has no write protect switch.*
> *The TA5350-AD micro memory card adapter has a write protect switch.*
> *In the position "LOCK", the inserted micro memory card can only be read.*

Memory card type	AC500 V2	AC500-XC V2	AC500 V3	AC500-XC V3	AC500-eCo V3
MC5141	x	x	x	x	-
MC5102 **with** TA5350-AD micro memory card adapter	x 1)	x 1) 2)	x	x 2)	-
MC5102 **without** TA5350-AD micro memory card adapter	-	-	-	-	x

1) As of firmware 2.5.x

2) Temporary use of MC5102 is possible under normal environmental conditions, but MC5141 should be preferred.

The use of other micro memory cards is prohibited. ABB is not responsible nor liable for consequences resulting from use of unapproved memory cards.

Purpose

Processor modules can be operated with and without (micro) memory card.

Processor modules are supplied without (micro) memory card. It must be ordered separately.

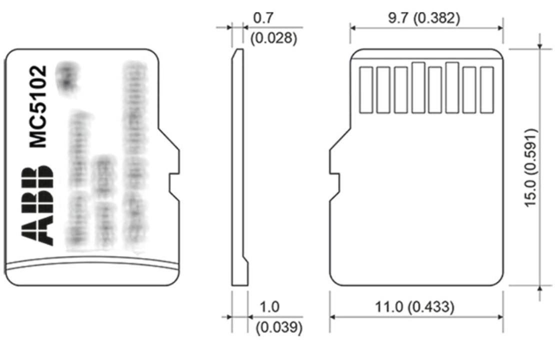
The micro memory card is used to store or backup application data and/or application programs or project source codes as well as to update the internal CPU firmware.

The micro memory card can only be used temporarily in standard and XC applications.

The memory card can be read/written on a PC with a SDHC compatible memory card reader when using TA5350-AD micro memory card adapter.

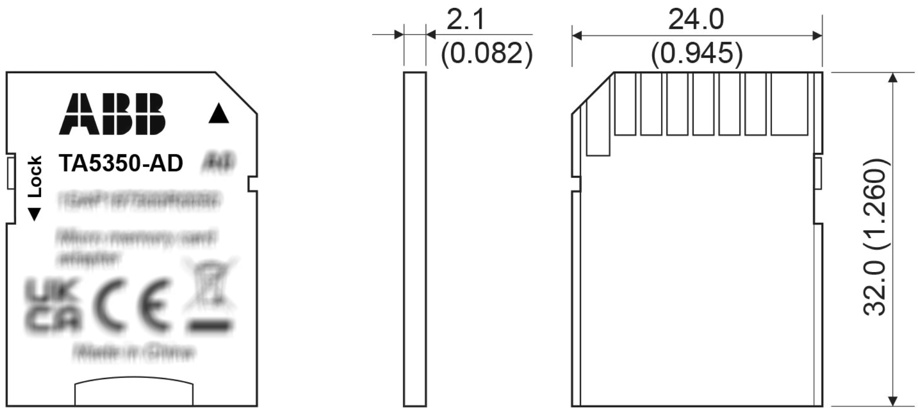
Dimensions

Micro memory card



The dimensions are in mm and in brackets in inch.

Micro memory card adapter



The dimensions are in mm and in brackets in inch.

Insert the micro memory card

AC500 V2 and AC500-eCo V2

1. Unpack the micro memory card and insert it into the supplied micro memory card adapter.
2. Insert the micro memory card adapter with integrated micro memory card into the memory card slot of the processor module until locked.

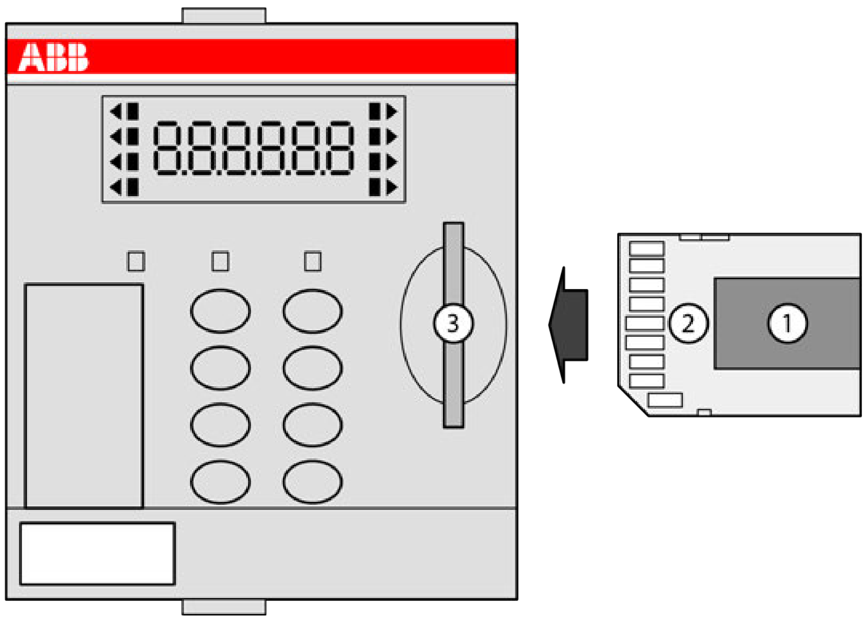


Fig. 385: Insert micro memory card into PM57x, PM58x and PM59x

1 Micro memory card
2 Micro memory card adapter
3 Memory card slot

Remove the micro memory card

AC500 V2 and AC500-eCo V2

> **NOTICE!**
> **Removal of the micro memory card**
> Do not remove the micro memory card when it is working!
>
> Remove the micro memory card with micro memory card adapter only when the RUN LED is not blinking.
>
> Otherwise the micro memory card and/or files on it might get corrupted and/or normal PLC operation might be disturbed.

1. To remove the micro memory card adapter with the integrated micro memory card, push on the micro memory card adapter until it moves forward.
2. By this, the micro memory card adapter is unlocked and can be removed.

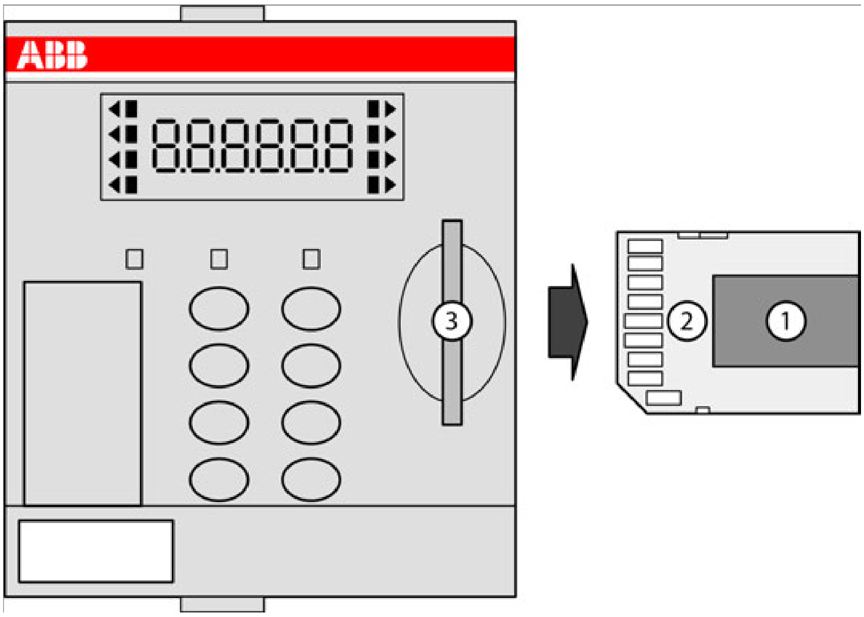


Fig. 386: Remove micro memory card from PM57x, PM58x and PM59x

1 Micro memory card
2 Micro memory card adapter
3 Memory card slot

Technical data

Parameter		Value
Memory capacity		8 GB
Total bytes written (TBW)		On request
Data retention		
	at beginning	10 years at +40 °C
	when number of write processes has been 90 % of lifetime of each cell	1 year at +40 °C
Write protect switch		
	Micro memory card	No

Parameter	Value
Micro memory card adapter	Yes
Weight	0.25 g
Dimensions	15 mm x 11 mm x 0.7 mm

It is not possible to use 100 % of a device's memory space. About 10 % of the total available space must remain unused at any time to maintain normal device operation.

Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 180 100 R0002	MC5102, micro memory card with TA5350-AD micro memory card adapter	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

2.6.5.2 MC5141 - Memory card

- Solid state flash memory storage

1 MC5141 memory card

The memory card has a write protect switch.

In the position "LOCK", the memory card can only be read.

Memory card type	AC500 V2	AC500-XC V2	AC500 V3	AC500-XC V3	AC500-eCo V3
MC5141	x	x	x	x	-
MC5102 **with** TA5350-AD micro memory card adapter	x [1])	x [1]) [2])	x	x [2])	-
MC5102 **without** TA5350-AD micro memory card adapter	-	-	-	-	x

[1]) As of firmware 2.5.x

[2]) Temporary use of MC5102 is possible under normal environmental conditions, but MC5141 should be preferred.

The use of other memory cards is prohibited. ABB is not responsible nor liable for consequences resulting from use of unapproved memory cards.

Purpose

Processor modules can be operated with and without (micro) memory card.

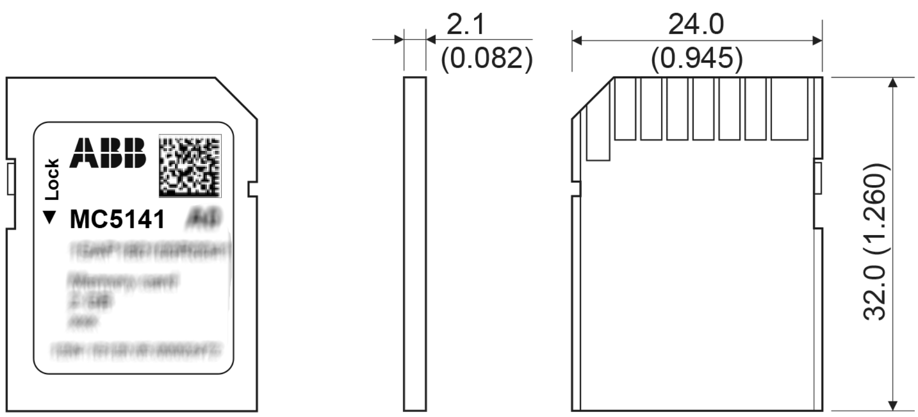
Processor modules are supplied without (micro) memory card. It must be ordered separately.

The memory card is used to store or backup application data and/or application programs or project source codes as well as to update the internal CPU firmware.

The memory card is intended for long-term use in standard and XC application.

The memory card can be read/written on a PC with a SDHC compatible memory card reader.

Dimensions



The dimensions are in mm and in brackets in inch.

Insert the memory card

AC500 V2 and AC500-eCo V2

1. Unpack the memory card.
2. Insert the memory card into the memory card slot of the processor module until locked.

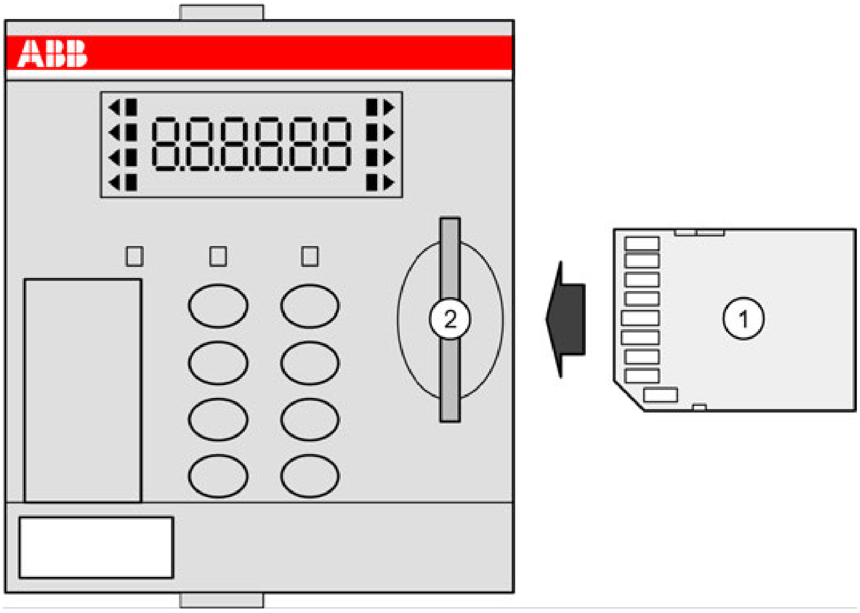


Fig. 387: Insert memory card into PM57x, PM58x and PM59x

1 Memory card
2 Memory card slot

Remove the memory card

AC500 V2 and AC500-eCo V2

> **NOTICE!**
> **Disturbed PLC operation**
> Do not remove the memory card when it is working!
>
> Otherwise the memory card and/or files on it might get corrupted and/or normal PLC operation might be disturbed.
>
> –

1. To remove the memory card, push on the memory card until it moves forward.
2. By this, the memory card is unlocked and can be removed.

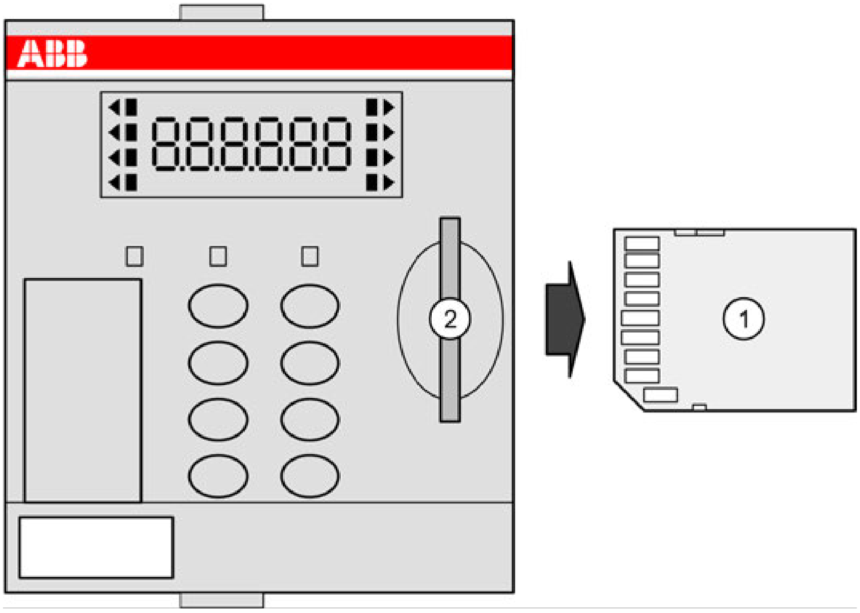


Fig. 388: Remove memory card from PM57x, PM58x and PM59x

1 Memory card
2 Memory card slot

Technical data

Parameter		Value
Memory capacity		2 GB
Total bytes written (TBW)		On request
Data retention		
	at beginning	10 years at +40 °C
	when number of write processes has been 90 % of lifetime of each cell	1 year at +40 °C
Write protect switch		Yes, at the edge of the memory card
Weight		2 g
Dimensions		24 mm x 32 mm x 2.1 mm

It is not possible to use 100 % of a device's memory space. About 10 % of the total available space must remain unused at any time to maintain normal device operation.

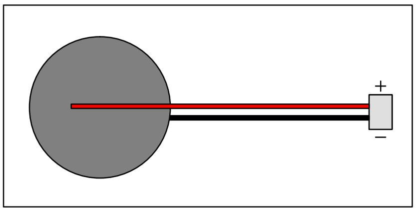
Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 180 100 R0041	MC5141, memory card	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

2.6.5.3 TA521 - Battery

- Manganese dioxide lithium battery, 3 V, 560 mAh
- Non-rechargeable



Purpose

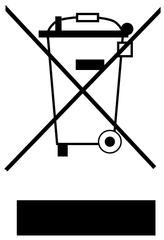
The TA521 battery is the only applicable battery for the AC500 processor modules *Chapter 1.3.2.1 “PM57x (-y), PM58x (-y) and PM59x (-y)” on page 23*. It cannot be recharged.

The processor modules are supplied without lithium battery. It must be ordered separately. The TA521 lithium battery is used for data (SRAM) and RTC buffering while the processor module is not powered.

The CPU monitors the discharge degree of the battery. A warning is issued before the battery condition becomes critical (about 2 weeks before). Once the warning message appears, the battery should be replaced as soon as possible.

Handling instructions

- Do not short-circuit or re-charge the battery! It can cause excessive heating and explosion.
- Do not disassemble the battery!
- Do not heat up the battery and not put into fire! Risk of explosion.
- Store the battery in a dry place.
- Replace the battery with supply voltage ON in order not to risk data being lost.
- Recycle exhausted batteries meeting the environmental standards.



Battery lifetime

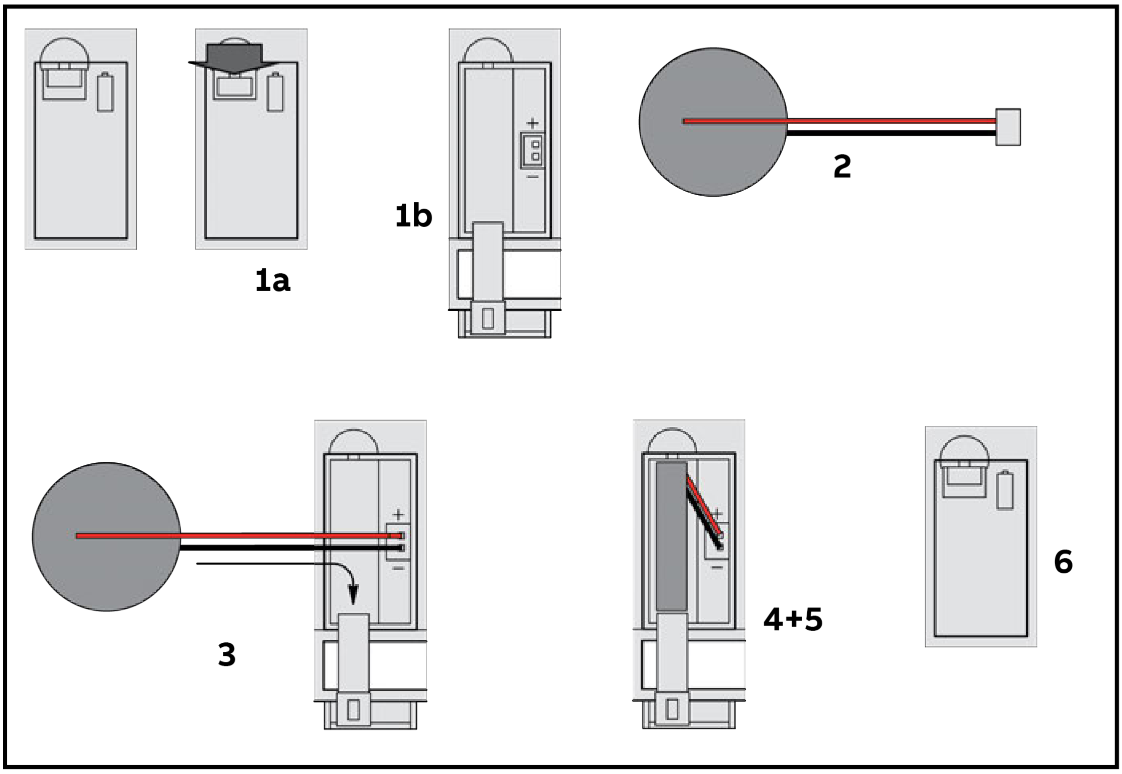
The battery lifetime is the time, the battery can store data while the processor module is not powered. As long as the processor module is powered, the battery will only be discharged by its own leakage current.

To avoid a short battery discharge, the battery should always be inserted or replaced while the process module is under power, then the battery is correctly recognized and will not shortly discharged.

Insertion

To ensure propper operation and to prevent data loss, the battery insertion or replacement must be always done with the system under power. Without battery and power supply there is no data buffering possible.

WARNING!
Risk of fire or explosion!
Use of incorrect Battery may cause fire or explosion.



1. Open the battery compartment with the small locking mechanism, press it down and slip down the door. The door is attached to the front face of the processor module and cannot be removed.
2. Remove the TA521 battery from its package and hold it by the small cable. Remove then the small connector from the socket, do this best by lifting it out with a screwdriver.
3. Insert the battery connector into the small connector port of the compartment. The connector is keyed to find the correct polarity (red = positive pole = above).
4. Insert first the cable and then the battery into the compartment, push it until it reaches the bottom of the compartment.
5. Arrange the cable in order not to inhibit the door to close.
6. Pull-up the door and press until the locking mechanism snaps.

In order to prevent data losses or problems, the battery should be replaced after 3 years of utilisation or at least as soon as possible after receiving the "low battery warning" indication.

Do not use a battery older than 3 years for replacement, do not keep batteries too long in stock.

Replacement of the battery

To ensure propper operation and to prevent data loss, the battery insertion or replacement must be always done with the system under power. Without battery and power supply there is no data buffering possible.

1. Open the battery compartment with the small locking mechanism, press it down and slip down the door. The door is attached to the front view of the processor module and cannot be removed.
2. Remove the old TA521 battery from the battery compartment by pulling it by the small cable. Remove then the small connector from the socket, do this best by lifting it out with a screwdriver.

3. Follow the previous instructions to insert a new battery.

CAUTION!
Risk of explosion!
Do not open, re-charge or disassemble lithium batteries. Attempting to charge lithium batteries will lead to overheating and can cause explosions.

Protect them from heat and fire and store them in a dry place.

Never short-circuit or operate lithium batteries with the polarities reversed. The batteries are likely to overheat and explode. Avoid unintentional short circuiting do not store batteries in metal containers and do not place them on metallic surfaces. Escaping lithium is a health hazard.

In order to prevent data losses or problems, the battery should be replaced after 3 years of utilisation or at least as soon as possible after receiving the "low battery warning" indication.

Do not use a battery older than 3 years for replacement, do not keep batteries too long in stock.

Technical data

Parameter	Value
Nominal voltage	3 V
Nominal capacity	560 mAh
Temperature range (index below C0)	Operating: 0 °C ... +60 °C Storage: -20 °C ... +60 °C Transport: -20 °C ... +60 °C

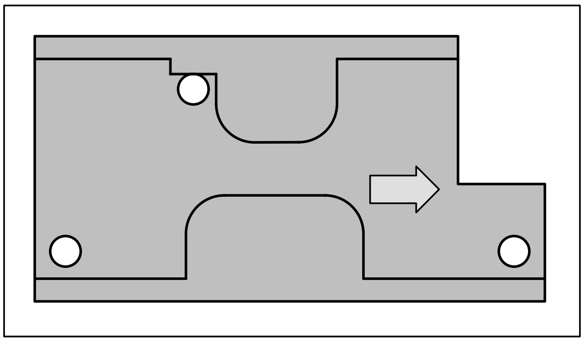
Parameter	Value
Temperature range (index C0 and above)	Operating: -40 °C ... +70 °C Storage: -40 °C ... +85 °C Transport: -40 °C ... +85 °C
Battery lifetime	Typ. 3 years at +25 °C
Self-discharge	2 % per year at +25 °C 5 % per year at +40 °C 20 % per year at +60 °C
Protection against reverse polarity	Yes, by mechanical coding of the plug.
Insulation	The battery is completely insulated.
Connection	Red = positive pole = above at plug, black = negative pole,
Weight	7 g
Dimensions	Diameter of the button cell: 24.5 mm Thickness of the button cell: 5 mm

Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 180 300 R0001	TA521, lithium battery	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

2.6.5.4 TA526 - Wall mounting accessory



Purpose

If a terminal base or a terminal unit should be mounted with screws, the wall mounting accessories TA526 must be inserted at the rear side first. This plastic parts prevent bending of terminal bases and terminal units while screwing up.

⇘ *Handling of the wall mounting accessory with terminal units*

⇘ *Handling of the wall mounting accessory with terminal bases*

Technical data

Parameter	Value
Weight	5 g
Dimensions	67 mm x 35 mm x 5,5 mm

Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 180 800 R0001	TA526, wall mounting accessory	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

2.6.5.5 TA541 - Battery

- Manganese dioxide lithium battery, 3 V
- Non-rechargeable

Purpose

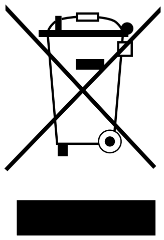
The TA541 lithium battery is the only applicable battery for PM595 *Chapter 1.3.2.2 "PM595-4ETH" on page 37*. It is used to save RAM content of the processor module (PM595-4ETH-F only) and to back-up the real-time clock (all PM595 variants). It cannot be recharged.

The processor modules are supplied without a lithium battery. It therefore must be ordered separately. The lithium battery is used to save RAM contents of AC500 processor modules and back-up the real-time clock. Although the processor modules can work without a battery, its use is still recommended in order to avoid process data being lost.

The CPU monitors the discharge degree of the battery. A warning is output, before the battery condition becomes critical (about 2 weeks before). After the warning message has appeared, the battery should be replaced as soon as possible.

Handling instructions

- Do not short-circuit or re-charge the battery! It can cause excessive heating and explosion.
- Do not disassemble the battery!
- Do not heat up the battery and not put into fire! Risk of explosion.
- Store the battery in a dry place.
- Replace the battery with supply voltage ON in order not to risk data being lost.
- Recycle exhausted batteries meeting the environmental standards.

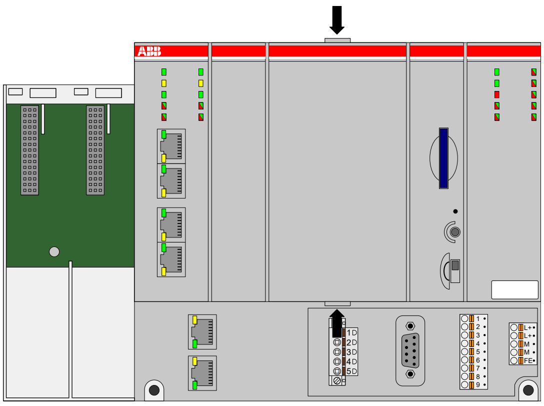


Battery lifetime The battery lifetime is the time the battery can store data while the CPU is not powered. As long as the CPU is powered, the battery will only be discharged by its own leakage current.

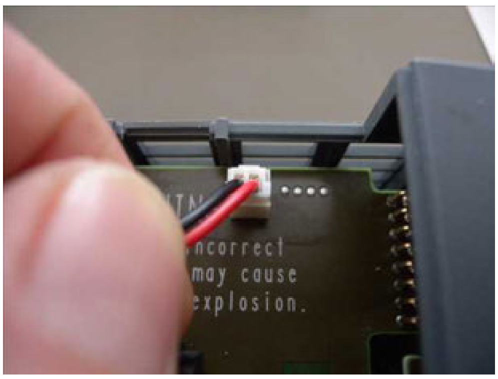
Insertion

> *The TA541 lithium battery is the only applicable battery for processor modules PM595.*

1. Remove the front cover / display by pressing the marked areas with your fingers and pull it to the front.

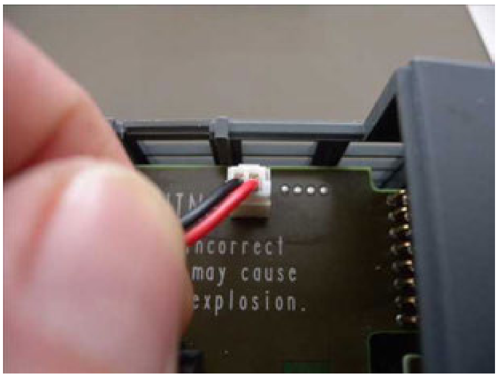


2. Remove the old battery from the battery compartment by pulling it by the small cable. Remove then the small connector from the socket.



3. Remove the battery from its package and hold it by the small cable.

4. Insert the battery connector into the connector port of the PCB. The connector is keyed to find the correct polarity (red = positive pole = right side).



5. Insert the battery into the battery compartment on the left side as shown in the figure.

6. Re-assemble the front cover / display by pressing it straight from the front until it snaps in.

> *In order to prevent data losses or problems, the battery should be replaced after 3 years of utilisation or at least as soon as possible after receiving the "low battery warning" indication.*
>
> *Do not use a battery older than 3 years for replacement, do not keep batteries too long in stock.*

Replacement of the battery

For PM595-4ETH-F only: battery replacement should be done with the system under power. Without battery and power supply there is no data buffering possible.

For PM595-4ETH-M-XC only: battery only back-ups the real-time clock.

1. Remove the front cover / display by pressing the marked areas and pull it to the front.
2. Remove the old battery from the battery compartment by pulling it by the small cable. Remove then the small connector from the socket, do this best by lifting it out with a screwdriver.

   Follow the previous instructions to insert a new battery.

CAUTION!
Risk of explosion!
Do not open, re-charge or disassemble lithium batteries. Attempting to charge lithium batteries will lead to overheating and can cause explosions.

Protect them from heat and fire and store them in a dry place.

Never short-circuit or operate lithium batteries with the polarities reversed. The batteries are likely to overheat and explode. Avoid unintentional short circuiting do not store batteries in metal containers and do not place them on metallic surfaces. Escaping lithium is a health hazard.

Technical data

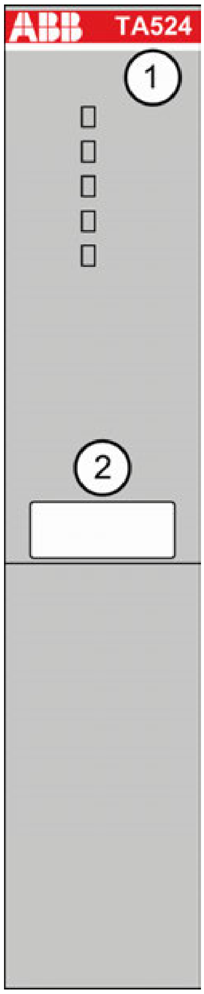
Parameter	Value
Nominal voltage	3 V
Nominal capacity	1800 mAh
Temperature range	Operating: -40 °C ... +70 °C Storage: -40 °C ... +85 °C Transport: -40 °C ... +85 °C
Battery lifetime	Typ. 3 years at +25 °C
Self-discharge	1 % per year at +25 °C 5 % per year at +40 °C 20 % per year at +60 °C
Protection against reverse polarity	Yes, by mechanical coding of the plug
Insulation	The battery is completely insulated.
Connection	Red = positive pole = above at plug Black = negative pole
Weight	17 g
Dimensions	Diameter of the battery: ca. 18 mm Height of the battery: ca. 35 mm

Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 182 700 R0001	TA541, lithium battery	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

2.6.5.6 TA524 - Dummy communication module



1 Type
2 Label

Purpose

TA524 is used to cover an unused communication module slot of a terminal base. It protects the terminal base from dust and inadvertent touch.

Chapter 1.2.1 "TB51x-TB54x" on page 4

Handling instructions

TA524 is mounted in the same way as a common communication module.

Chapter 2.6.3.6 "Mounting and demounting the communication module" on page 1429

Technical data

Parameter	Value
Weight	50 g
Dimensions	135 mm x 28 mm x 62 mm

Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 180 600 R0001	TA524, dummy communication module	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

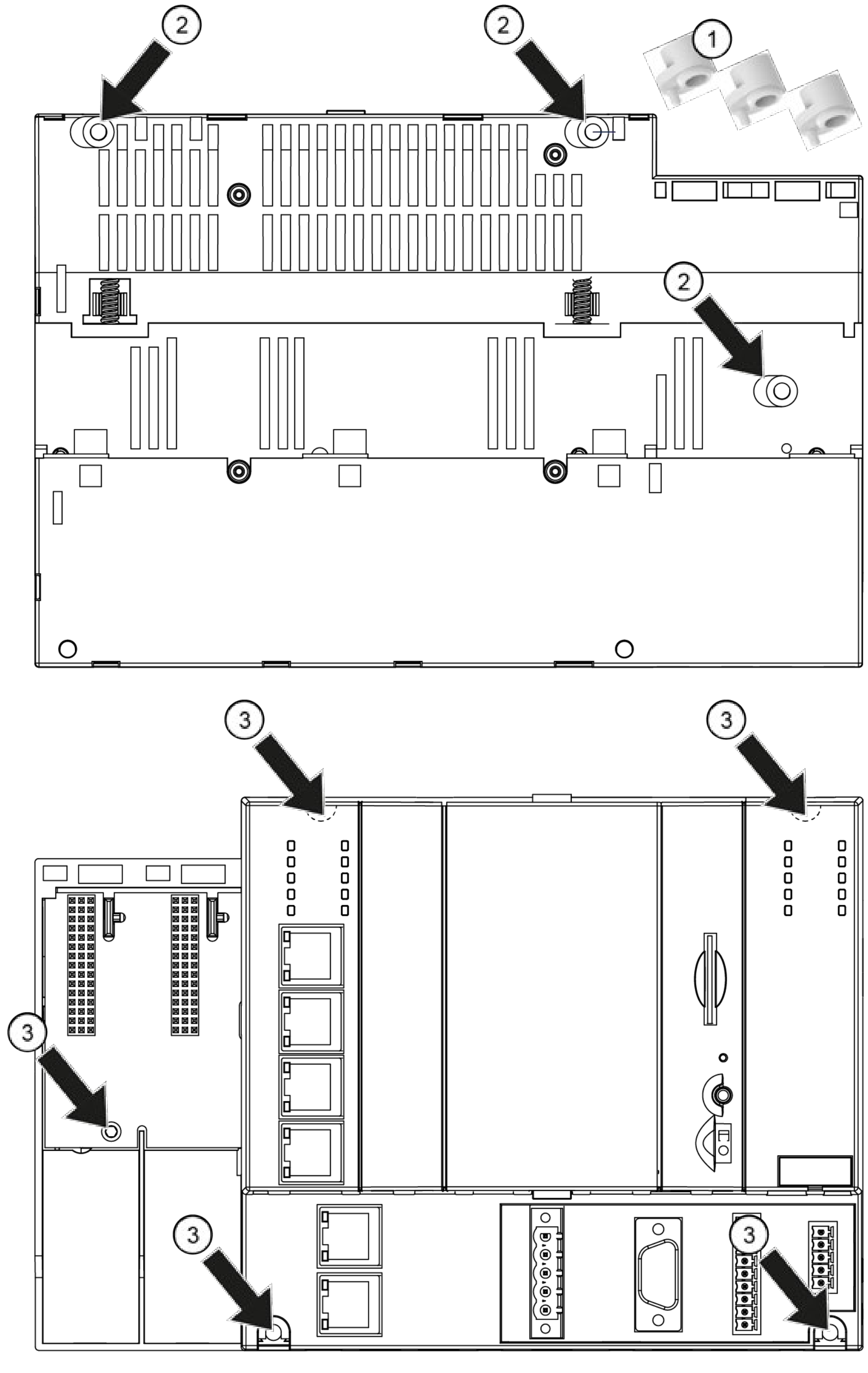
2.6.5.7 TA543 - Screw mounting accessory

Intended purpose

The TA543 screw mounting accessory is used for mounting the processor module PM595 without DIN rail.

Handling instruction

3 TA543 must be snapped on the backside of PM595 *Chapter 2.6.3.3 “Mounting and demounting the processor module PM595” on page 1424*.



1 3 parts of screw mounting accessory TA543
2 3 slots for screw mounting accessory TA543
3 5 holes for screw mounting

Technical data

Parameter	Value
Weight	5 g
Dimensions	12 mm x 8.5 mm x 10 mm

Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 182 800 R0001	TA543, screw mounting accessory for PM595	Active

> **) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

2.6.5.8 CP-E - Economic range

The power supplies feature series and parallel connection as well as a true redundant setup via a redundancy module.

- Wide-range input voltage
- Mounting on DIN rail
- High efficiency of up to 90 %
- Low power dissipation and low heating
- Wide ambient temperature range from -40 °C ... +70 °C
- No-load-proof, overload-proof, continuous short-circuit-proof
- Power factor correction (depending on the type)
- Approved in accordance with all relevant international standards

Table 375: Ordering data

Order No.	Type	Input	Output	Overload capacity	Module width [mm]
1SVR427030R0000	CP-E 24/0.75	100-240 V AC or 120-370 V DC	24 V DC, 0.75 A	-	22.5
1SVR427031R0000	CP-E 24/1.25	100 V AC ... 240 V AC or 90V DC ... 375 V DC	24 V DC, 1.25 A	-	40.5
1SVR427032R0000	CP-E 24/2.5	100 V AC ... 240 V AC or 90 V DC ... 375 V DC	24 V DC, 2.5 A	-	40.5
1SVR427034R0000	CP-E 24/5.0	115/230 V AC auto select or 210 V DC ... 370 V DC	24 V DC, 5 A	-	63.2
1SVR427035R0000	CP-E 24/10.0	115/230 V AC auto select or 210 V DC ... 370 V DC	24 V DC, 10 A	-	83
1SVR427036R0000	CP-E 24/20.0	115 V AC ... 230 V AC or 120 V DC ... 370 V DC	24 V DC, 20 A	-	175

2.6.5.9 CP-C.1 - High performance range

The power supplies feature series and parallel connection as well as a true redundant setup via a redundancy module.

The CP-C.1 power supplies are ABB’s high performance and most advanced range. With excellent efficiency, high reliability and innovative functionality it is prepared for the most demanding industrial applications. These power supplies have a 50 % integrated power reserve and operate at an efficiency of up to 94 %. They are equipped with overheat protection and active power factor correction. Combinded with a broad AC and DC input range and extensive worldwide approvals the CP-C.1 power supplies are the preferred choice for professional DC applications.

- Typical efficiency of up to 94 %
- Power reserve design delivers up to 150 % of the nominal output current
- Signaling outputs for DC OK and power reserve mode
- High power density leads to very compact and small devices
- No-load-proof, overload-proof, continuous short-circuit-proof
- Active power factor correction (PFC)

Table 376: Ordering data

Order No.	Type	Input	Output	Overload capacity	Module width [mm]
1SVR360563R1001	CP-C.1 24/5.0	110 V AC ... 240 V AC or 90 V DC ... 300 V DC	24 V DC, 5 A	+50 %	40
1SVR360663R1001	CP-C.1 24/10.0	110 V AC ... 240 V AC or 90 V DC ... 300 V DC	24 V DC, 10 A	+50 %	60
1SVR360763R1001	CP-C.1 24/20.0	110 V AC ... 240 V AC or 90 V DC ... 300 V DC	24 V DC, 20 A	+30 %	82

2.7 AC500-XC

2.7.1 System data AC500-XC

2.7.1.1 Environmental conditions

Table 377: Process and supply voltages

Parameter		Value
24 V DC		
	Voltage	24 V (-15 %, +20 %)
	Protection against reverse polarity	Yes
100 V AC...240 V AC wide-range supply		
	Voltage	100 V ... 240 V (-15 %, +10 %)
	Frequency	50/60 Hz (-6 %, +4 %)
Allowed interruptions of power supply, according to EN 61131-2		
	DC supply	Interruption < 10 ms, time between 2 interruptions > 1 s, PS2
	AC supply	Interruption < 0.5 periods, time between 2 interruptions > 1 s

> **NOTICE!**
> **Risk of damaging the PLC due to improper voltage levels!**
>
> – Never exceed the maximum tolerance values for process and supply voltages.
> – Never fall below the minimum tolerance values for process and supply voltages.
> Observe the **system data** *Chapter 2.6.1 “System data AC500” on page 1408* and the **technical data** of the module used.

> **NOTICE!**
> Improper voltage level or frequency range which cause damage of AC inputs:
>
> – AC voltage above 264 V
> – Frenquency below 47 Hz or above 62.4 Hz

> **NOTICE!**
> Improper connection leads cause overtemperature on terminals.
>
> PLC modules may be destroyed by using wrong cable type, wire size and cable temperature classification.

Parameter		Value
Temperature		
	Operating	-40 °C ... +70 °C -40 °C ... 0 °C: Due to the LCD technology, the display might respond very slowly. -40 °C ... +40 °C: Vertical mounting of modules possible, output load limited to 50 % per group +60 °C ... +70 °C with the following deratings: ● System is limited to max. 2 communication modules per terminal base ● Applications certified for cULus up to +60 °C ● Digital inputs: maximum number of simultaneously switched on input channels limited to 75 % per group (e.g. 8 channels => 6 channels) ● Digital outputs: output current maximum value (all channels together) limited to 75 % per group (e.g. 8 A => 6 A) ● Analog outputs only if configured as voltage output: maximum total output current per group is limited to 75 % (e.g. 40 mA => 30 mA) ● Analog outputs only if configured as current output: maximum number of simultaneously used output channels limited to 75 % per group (e.g. 4 channels => 3 channels)
	Storage / Transport	-40 °C ... +85 °C
Humidity		Operating / Storage: 100 % r. H. with condensation
Air pressure		Operating: -1000 m .... 5000 m (1080 hPa ... 620 hPa) > 2000 m (< 795 hPa): ● Max. operating temperature must be reducted by 10 K for each 1000 m exceeding 2000 m ● I/O module relay contacts must be operated with 24 V nominal only

Parameter	Value
Immunity to corrosive gases	Yes, according to: ISA S71.04.1985 Harsh group A, G3/GX IEC60068-2-60 Method 4 with following concentrations: ● H2S 100 ± 10ppb ● NO2 1250 ± 20ppb ● CL2 100 ± 10ppb ● SO2 300 ± 20ppb
Immunity to salt mist	Yes, horizontal mounting only, according to IEC 60068-2-52 severity level: 1

NOTICE!
Risk of corrosion!
Unused connectors and slots may corrode if XC devices are used in salt-mist environments.

Protect unused connectors and slots with TA535 protective caps for XC devices *Chapter 1.9.3.6 “TA535 - Protective caps for XC devices” on page 1362*.

NOTICE!
Risk of malfunctions!
Unused slots for communication modules are not protected against accidental physical contact.

– Unused slots for communication modules must be covered with dummy communication modules to achieve IP20 rating *Chapter 2.6.5.6 “TA524 - Dummy communication module” on page 1469*.
– I/O bus connectors must not be touched during operation.

2.7.1.2 Creepage distances and clearances

The creepage distances and clearances meet the requirements of the overvoltage category II, pollution degree 2.

2.7.1.3 Power supply units

AC500 and AC500-eCo PLC devices are Class II/Class III devices and do not require a Protective Earth (PE) connection.

For proper EMC performance, all metal parts, DIN rails, mounting screws, and cable shield connection terminals are connected to a common ground and provide Functional Earth (FE). This is typically connected to a common reference potential, such as equipotential bonding rails.

Signal Grounds (SGND or GND) are used for signal reference and must not be connected to cable shields, FE or other signals unless otherwise specified in the specific device description.

> ***Safety Extra Low Voltage (SELV) and Protective Extra Low Voltage (PELV)***
> *To ensure electrical safety of AC500/AC500-eCo extra low voltage circuits, 24 V DC supply, communication interfaces, I/O circuits, and all connected devices must be powered from sources meeting requirements of SELV, PELV, class 2, limited voltage or limited power according to applicable standards.*

> **WARNING!**
> **Improper installation can lead to death by touching hazardous voltages!**
> To avoid personal injury, safe separation, double or reinforced insulation and separation of the primary and secondary circuit must be observed and implemented during installation.
>
> – Only use power converters for safety extra-low voltages (SELV) with safe galvanic separation of the primary and secondary circuit.
> – Safe separation means that the primary circuit of mains transformers must be separated from the secondary circuit by double or reinforced insulation. The protective extra-low voltage (PELV) offers protection against electric shock.

2.7.1.4 Electromagnetic compatibility

Table 378: Electromagnetic compatibility

Parameter	Value
Device suitable only as *Control Equipment for Industrial Applications*, including marine applications. IEC 61131-2, zone B *Chapter 2.7.1.6 “Approvals and certifications” on page 1480*	
Radiated emission according to IEC 61000-6-4 CISPR11, class A	Yes
Conducted emission according to IEC 61000-6-4 CISPR11, class A	Yes
Electrostatic discharge (ESD) according to IEC 61000-4-2, criterion B	Air discharge: 8 kV Contact discharge: 6 kV
Fast transient interference voltages (burst) according to IEC 61000-4-4, criterion B	Power supply (DC): 4 kV Digital inputs/outputs (24 V DC): 2 kV Digital inputs/outputs (240 V AC): 4 kV Analog inputs/outputs: 2 kV Communication lines shielded: 2 kV

Parameter	Value
High energy transient interference voltages (surge) according to IEC 61000-4-5, criterion B	Power supply (DC): - Line to ground: 1 kV - Line to line: 0,5 kV Digital inputs/outputs/relay: (24 V DC): - Line to ground: 1 kV (AC): - Line to ground: 2 kV - Line to line: 1 kV Analog inputs/outputs: - Line to ground: 1 kV Communication lines: - Line to ground: 1 kV
Influence of radiated disturbances IEC 61000-4-3, criterion A	Test field strength: 10 V/m
Influence of line-conducted interferences IEC 61000-4-6, criterion A	Test voltage: 10 V
Power frequency magnetic fields IEC 61000-4-8, criterion A	30 A/m 50 Hz 30 A/m 60 Hz

2.7.1.5 Mechanical data

Parameter	Value
Mounting	Horizontal/vertical (no application in salt mist environment)
Wiring method	Spring terminals
Degree of protection	PLC system: IP 20 ● with all modules or option boards plugged in ● with all terminals plugged in ● with all covers closed
Housing	Classification V-2 according to UL 94
Vibration resistance (sinusoidal) acc. to IEC 60068-2-6	2 Hz ... 8.4 Hz, 3.5 mm peak, 8.4 Hz ... 500 Hz, 2 g
Vibration resistance (broadband random) acc. to IEC 60068-2-64	5 Hz ... 500 Hz, 1,9 g rms (operational) 5 Hz ... 500 Hz, 4 g rms (non operational)
Shock resistance	All three axes 15 g, 11 ms, half-sinusoidal
Mounting of the modules:	
Mounting Rail Top Hat according to IEC 60715	35 mm, depth 7.5 mm or 15 mm

Parameter	Value
Mounting with screws	M4
Fastening torque	1.2 Nm

2.7.1.6 Approvals and certifications

The PLC Automation catalog contains an *overview of the available approvals and certifications*.

2.8 AC500-S

Functional safety

The *AC500-S safety user manual* must be read and understood before using the safety configuration and programming tools of Automation Builder/PS501 Control Builder Plus. Only qualified personnel are permitted to work with AC500-S safety PLCs.

The AC500-S safety PLC includes the following safety-relevant hardware components.

- SM560-S/SM560-S-FD-1/SM560-S-FD-4
- DI581-S
- DX581-S
- AI581-S
- TU582-S

—
new.abb.com/plc

3ADR010121, 22, en_US