TECHNICAL DOCUMENTATION

CI502-PNIO (-XC) Description

Read this manual prior to performing any task!

ABB Automation Products GmbH
Eppelheimer Straße 82
69123 Heidelberg, Germany
Telephone: +49 62 21 701 1444
Fax: +49 62 21 701 1382
E-mail: plc.support@de.abb.com
Internet: www.abb.com/PLC

3ADR024127K0201, 1, en_US

Table of contents

1 CI502-PNIO (-XC)

- 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 electrically isolated
- Fast Counter
- XC version for usage in extreme ambient conditions available

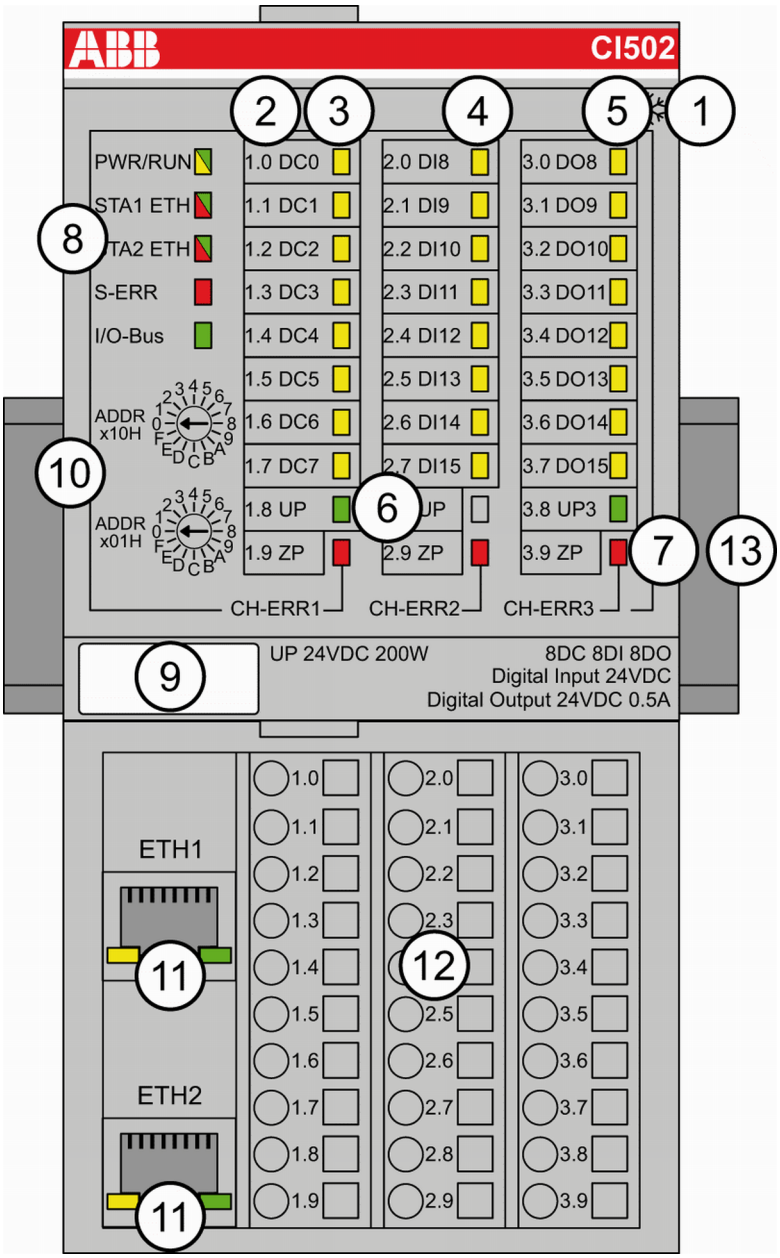


Fig. 1: PROFINET® IO Bus Module CI502-PNIO

Elements of the module	
1	I/O-Bus
2	Allocation between terminal No. and signal name
3	8 yellow LEDs to display the signal statuses of the digital configurable inputs/outputs (DC0 - DC7)
4	8 yellow LEDs to display the signal statuses of the digital inputs (DI8 - DI15)
5	8 yellow LEDs to display the signal statuses 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 STA1 ETH STA2 ETH S-ERR I/O-Bus
9	Label
10	2 rotary switches for setting the IO Device identifier
11	Ethernet interfaces (ETH1, ETH2) on the Terminal Unit
12	I/O Terminal Unit (TU507-ETH or TU508-ETH) with 30 terminals (screw-type or spring terminals)
13	DIN rail
❄	Sign for XC version

1.1 Intended Purpose

The PROFINET® Bus Module CI502-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 Bus 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 electrically 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.

1.2 Functionality

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 expansion 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 statuses, 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 35V

1.3 Electrical Connection

The Ethernet Bus Module CI502-PNIO 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 electrical 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 electrical connection of the module, please refer to the System Assembly, Construction and Connection chapter.

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 VThe 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 not intended usage!

If the function cut off of the digital outputs should 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.

The assignment of the other terminals:

Terminal	Signal	Meaning
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
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

Terminal	Signal	Meaning
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 and process voltage) are switched off before you begin with operations at the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

The following figure shows the electrical connection of the Ethernet Bus Module CI502-PNIO.

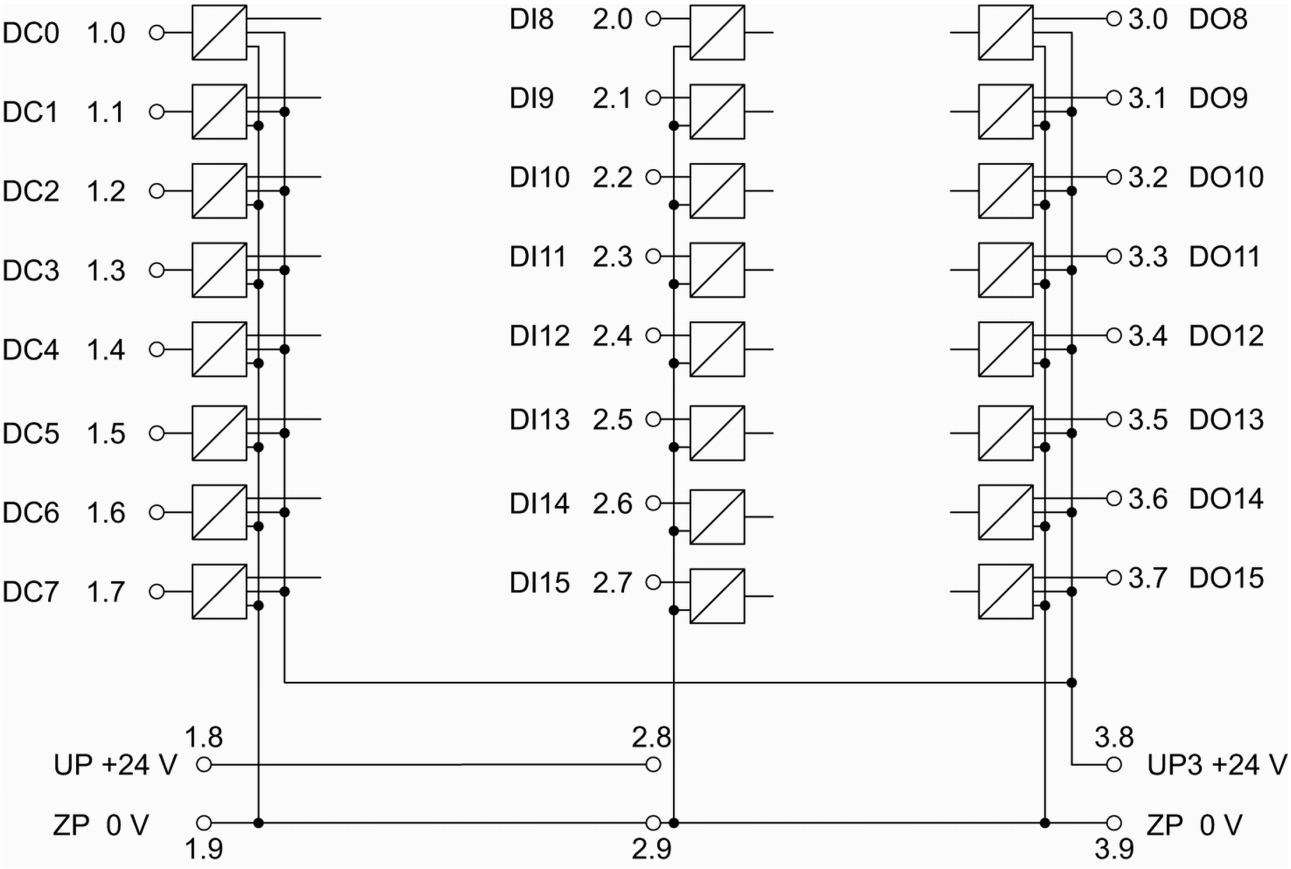


Fig. 2: Connection of the Bus Module CI502-PNIO

Further information is provided in the System Technology chapter *PROFINET*.

1.3.1 Connection of the digital inputs

The following figure shows the electrical connection of the digital input DI8. Proceed with the digital inputs DI9 to DI15 in the same way.

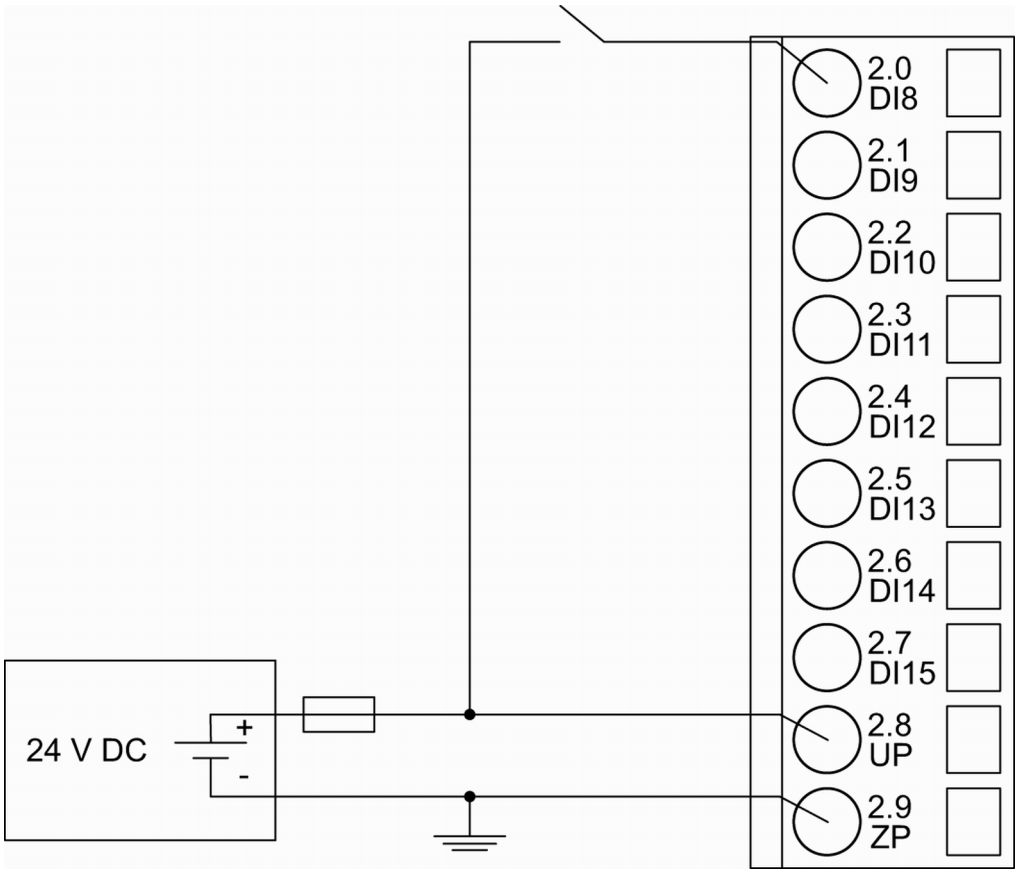


Fig. 3: Connection of the digital inputs to the module CI502-PNIO

The meaning of the LEDs is described in Displays *Chapter 1.8.1 “Status LEDs” on page 20*.

1.3.2 Connection of the digital outputs

The following figure shows the electrical connection of the digital output DO8. Proceed with the digital outputs DO9 - DO15 in the same way.

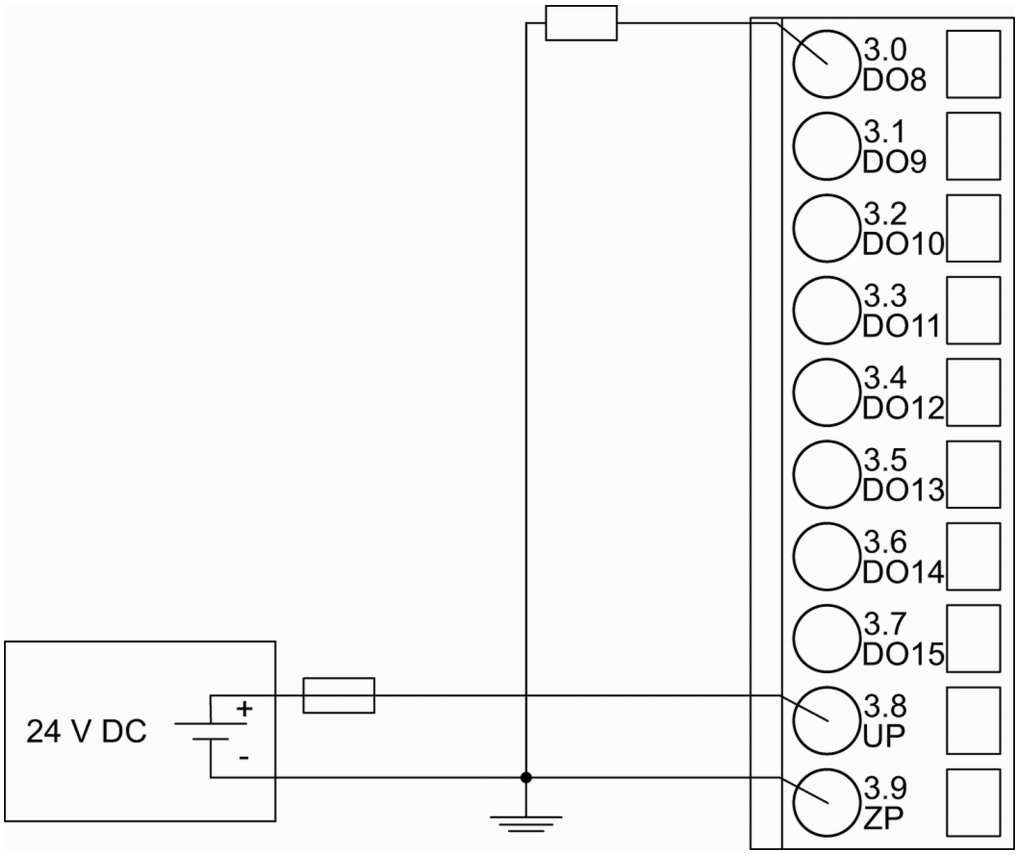


Fig. 4: Connection of configurable digital inputs/outputs to the module CI502-PNIO

The meaning of the LEDs is described in Displays *Chapter 1.8.1 “Status LEDs” on page 20*.

1.3.3 Connection of the configurable digital inputs/outputs

The following figure shows the electrical 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 to 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 1.3 “Electrical Connection” on page 6*.

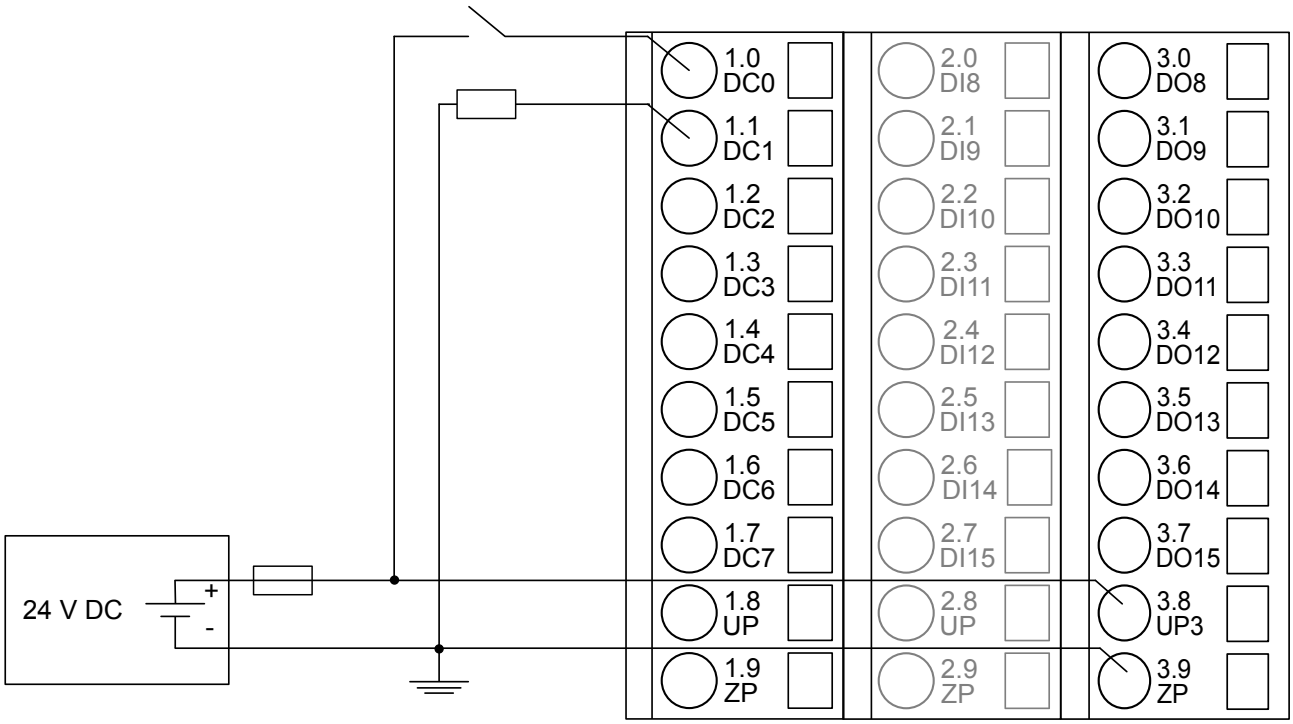


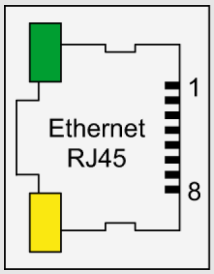
Fig. 5: Connection of configurable digital inputs/outputs to the module CI502-PNIO

The meaning of the LEDs is described in Displays *Chapter 1.8.1 "Status LEDs" on page 20*.

1.3.4 Assignment of the Ethernet Ports

The Terminal Unit for the Communication Interface Module provides two Ethernet interfaces with the following pin assignment:

Table 1: Pin assignment RJ45 jack:



1	TxD+	Transmit data +
2	TxD-	Transmit data -
3	RxD+	Receive data +
4	NC	not used
5	NC	not used
6	RxD-	Receive data -
7	NC	not used
8	NC	not used
Shield	Cable shield	Functional earth

1.4 Internal Data Exchange

Digital inputs (bytes)	5
Digital outputs (bytes)	5
Counter input data (words)	4
Counter output data (words)	8

1.5 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.

1.6 I/O Configuration

The CI502-PNIO stores some PROFINET® configuration parameters (IO Device identifier, IO 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 1.7 “Parameterization” on page 13*.

1.7 Parameterization

1.7.1 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 / Failsafe function (Table Error LED / Failsafe function *Further information on page 13*)	On	0	BYTE	0
	Off by E4	1		
	Off by E3	3		
	On + failsafe	16		
	Off by E4 + failsafe	17		
	Off by E3 + failsafe	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		

Name	Value	Internal value	Internal value, type	Default
	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 on	0 1	BYTE	1
Fast counter	0 : 10 2*)	0 : 10	BYTE	0

*1) With a faulty ID, the module reports a "parameter error" and does not perform cyclic process data transmission.

*2) Counter operating modes

Table 2: Table Error LED / Failsafe function

Setting	Meaning
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.	

1.7.2 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 *)	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 **)	Off On	0 1	BYTE	Off 0x00

Name	Value	Internal value	Internal value, type	Default
Detect voltage overflow at outputs ***)	Off On	0 1	BYTE	Off 0x00

*) The parameter Behaviour DO at comm. error is apply to DC and DO channels and only analyzed if the Failsafe-mode is ON.

**) The status "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".

***) The error status "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 1.3 “Electrical Connection” on page 6* (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 Diagnosis

Structure of the Diagnosis Block via *PNIO_DEV_ALARM* Function 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
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.

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**	**PNIO diag-nosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error-Identifier**	**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 device	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 4 Bit 6..7	-	Byte 1	Byte 2	Byte 3	Byte 4 Bit 0..5	PNIO diag-nosis block	

Class	Interface	Device	Module	Channel	Error-Identifier	Error message	Remedy
	*1)	*2)	*3)				
3	-	1...10	31	31	32	Wrong I/O device type on socket	Replace I/O module / Check configura-tion
4	-	1...10	31	31	31	At least one module does not support fail-safe function	Check modules and parame-terization
4	1...6	255	2	0	45	The connected Com-munication Module has no connection to the network	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	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	PNIO diag-nosis block	

Class	Interface	Device	Module	Channel	Error-Identifier	Error message	Remedy
	*1)	*2)	*3)				
4	-	31	31	31	10	Voltage overflow at outputs (above UP3 level) *5)	Check terminals/ 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	2	0...7	47	Short circuit at digital output *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 Electrical Connection ↳ *Chapter 1.3 "Electrical Connection" on page 6*. 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 1.3 “Electrical Connection” on page 6*. 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 2000ms. Then a new start up will be executed. This diagnosis message appears per channel.

1.8.1 Status 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 status 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 statuses of the inputs and outputs and display possible errors.

Table 3: Status 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 IO Controller
	Red	No system error	System error (collective error)	---
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

LED	Color	OFF	ON	Flashing
ETH2	Green	No connection at Ethernet interface	Connected to Ethernet interface	---
	Yellow	---	Device is transmitting telegrams	Device is transmitting telegrams

Table 4: Status of the 29 process LEDs

LED	Color	OFF	ON	Flashing
DC0 to DC7	Yellow	Input/Output is OFF	Input/Output is ON	--
DI8 to DI15	Yellow	Input is OFF	Input is ON (the input voltage is even displayed if the supply voltage is OFF)	--
DO8 to 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

1.9 Technical Data

The System Data of AC500 and S500 are valid for standard version.

The System Data of AC500-XC are valid for the XC version.

Only additional details are therefore documented below.

1.9.1 Technical Data of the Module

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
Electrical 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		Minus pole of the supply voltage, signal name ZP
Setting of the IO Device identifier		With 2 rotary switches at the front side of the module
Diagnosis		See Diagnosis and Displays *Chapter 1.8 “Diagnosis” on page 16*
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 switch-gear cabinet.

NOTICE!

Attention:

All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and continuous overvoltage up to 30 V DC.

Effects of multiple overloads on isolated multi-channel modules

No effect, as every channel is protected individually by an internal smart high-side switch.

Bus connection	2 x RJ45
Switch	Integrated
Technology	Hilscher netX100
Transfer rate	10/100 MBit/s (full-duplex)
Transfer method	According to Ethernet II, IEE802.3
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
Acyclic services	PNIO read / write sequence (max. 1024 bytes per telegram) Process-Alarm service
Supported alarm types	Process Alarm, Diagnostic Alarm, Return of Sub-Module, Plug Alarm, Pull Alarm
Min. bus cycle	1 ms
Conformance Class	CC A
Protective functions (according to IEC61131-3)	Protected against: - short circuit - reverse supply - overvoltage - reverse polarity Electrical isolation from the rest of the module

* Priorization with the aid of VLAN-ID including priority level

1.9.2 Technical Data of the Digital Inputs

Number of channels per module		8
Distribution of the channels into groups		1 group of 8 channels
Terminals of the channels DI0 to DI7		Terminals 2.0 to 2.7
Reference potential for all inputs		Terminals 1.9...3.9 (Minus 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
	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

1.9.3 Technical Data of the Digital Outputs

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 3.0 to 3.7
Reference potential for all outputs	Terminals 1.9...3.9 (minus pole of the supply voltage, signal name ZP)
Common power supply voltage	For all outputs terminal 3.8 (plus 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.

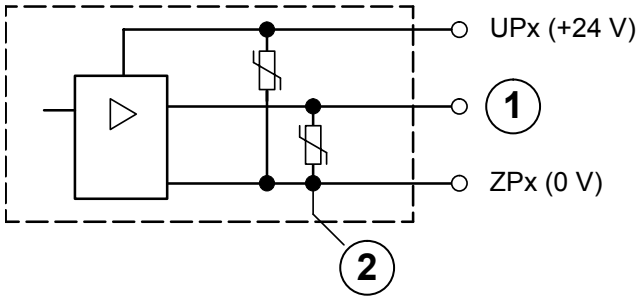


Fig. 6: Digital input/output (circuit diagram)

1 Digital Output
2 Varistors for demagnetization when inductive loads are turned off

1.9.4 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.

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)
Electrical isolation	From the Ethernet network

1.9.4.1 Technical Data of the Digital Inputs/Outputs if used as Inputs

Number of channels per module	8
Distribution of the channels into groups	1 group of 8 channels
Terminals of the channels DC0 to DC7	Terminals 1.0 to 1.7
Reference potential for all inputs	Terminals 1.9...3.9 (Minus 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
	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 to + 30 V when UPx = 24 V and from - 6 V to + 30 V when UPx = 30 V.

1.9.4.2 Technical Data of the Digital Inputs/Outputs if used as Outputs

Number of channels per module	8
Distribution of the channels into groups	1 group of 8 channels
Terminals of the channels DC0 to DC7	Terminals 1.0 to 1.7
Reference potential for all outputs	Terminals 1.9...3.9 (minus pole of the supply voltage, signal name ZP)
Common power supply voltage	For all outputs terminal 3.8 (plus 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.

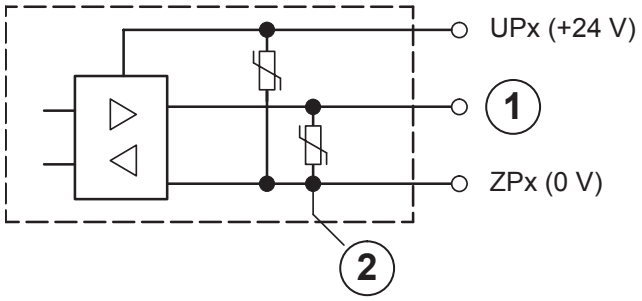


Fig. 7: Digital input/output (circuit diagram)

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

Figure:

1.9.5 Technical Data of the Fast Counter

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
Detailed description	See Fast Counter
Operating modes	See Operating modes

1.10 Ordering Data

Ordering No.	Scope of delivery
1SAP 220 700 R0001	CI502-PNIO (V3), PROFINET® Bus Module with 8 DI, 8 DO and 8 DC
1SAP 420 700 R0001	CI502-PNIO-(V3)-XC, PROFINET® Bus Module with 8 DI, 8 DO and 8 DC, XC version
1SAP 214 200 R0001	TU507-ETH, ETH Terminal Unit, screw-type terminals
1SAP 214 000 R0001	TU508-ETH, ETH Terminal Unit, spring terminals
1SAP 414 000 R0001	TU508-ETH-XC, ETH Terminal Unit, spring terminals, XC version

2 System Information

2.1 PROFINET® Modules

2.1.1 Communication Modules and Communication Interface Modules

The Communication Module *CM5xy-PNIO* is used as IO Controllers in a PROFINET® network. It is connected to the Processor Module via an internal communication bus .

The Communication Interface Modules CI50x-PNIO are the IO devices for PROFINET® RT. The difference of those devices can be found in their input and output characteristics *Comparison*.

2.1.2 Device Model of PROFINET® IO Devices

PROFINET® standard defines modules and sub-modules to give structure to IO devices data. These items are used in hierarchical order wherein a module may include one or more sub-modules. The input and output data of an IO device are located inside these sub-modules. The modules and sub-modules can be identified via ident-numbers (module ident-number and sub module ident-number) and can be assigned to slots and sub slots. Basically 32767 slot indexes and also 32767 sub slot indexes are available to design the device structure.

PROFINET® standard defines the following sub-module types which have special meaning and provide standard device functionality. In AC500 PROFINET IO devices the protocol stack defines how these special sub-modules have to be placed. The sub-modules have to be assigned to module slot 0:

Sub-module type	Assigned sub-slot
DAP	1
Interface	32768
Port 1	32769
Port 2	32770

Automation Builder configuration assigns DAP, interface, port 1 and port 2 to desired slot/sub-slots. These modules are inserted automatically in hidden style so they are not visible to the user. It is only required to assign manually the modules/sub-modules needed for providing IO data.

AC500 PROFINET IO devices use module types which support one single sub-module only. This single sub-module is inserted automatically in hidden style so it is not visible to the user. Different types of modules provide different structures of IO data, e.g. single bytes, multiple bytes, words etc. Combining a selection of module types defines a specific structure of IO channels at the device.

The different types of modules are:

Module type	Ident number	Description
4 Byte input	36864	4 byte input data, to be mapped to IEC output
4 Byte Output	36868	4 byte output data, to be mapped to IEC input
16 Byte Input	36865	16 byte input data, to be mapped to IEC output
16 Byte Output	36869	16 byte output data, to be mapped to IEC input

Module type	Ident number	Description
16 Byte Input Output	36872	16 byte input and 16 byte output data
4 Word Input	36866	4 word input data, to be mapped to IEC output
4 Word Output	36870	4 word output data, to be mapped to IEC input
16 Word Input	36867	16 word input data, to be mapped to IEC output
16 Word Output	36871	16 word output data, to be mapped to IEC input
16 Word Input Output	36873	16 word input and 16 word output data
16 Byte 16 Word Input Output	36874	16 byte and word input and output data

Sub-module ident-numbers are the same as the module ident-numbers. Basically PROFINET® standard defines the property API to define standard behavior to IO devices. AC500 PROFINET IO devices support API 0 only. Corresponding API setting for protocol stack configuration is set automatically .

2.1.3 Allocation of the Device Name

General Information

There are 2 possibilities for the allocation of the device name of the modules CI50x-PNIO or CM589-PNIO:

- Allocation of the device name via DCP (Engineering Tool needed)
- Allocation of the device name via address switches (without Engineering Tool)

For the start-up of PROFINET®, the address information "MAC address" and an unique "device name" is sufficient. The allocation of the IP address is performed via the IO Controller automatically during start-up of the bus communication.

CAUTION!

Malfunctions due to wrong device name settings!

Each device name can only be used once in a network to be explicit.

Make sure that each device has an unique device name.

A maximum of 256 CI5x1-PNIO devices can be used within the same network. The ABB CM579-PNIO PROFINET® Controller can handle up to 128 PROFINET® IO Devices.

Allocation of the Device Name via DCP

The allocation of the device name via DCP is standard for PROFINET® networks. For this possibility of allocation, it is absolutely necessary to set both address switches must to "00".

A device name set via DCP will be also present after a restart of the device (is stored permanently).

If the address switches are not set to "00", the device name via DCP is also stored permanently. But after a restart, the stored device name is not used.

Allocation of the Device Name via Address Switches

The AC500 PROFINET® IO RT Devices (CI50x-PNIO) are equipped with 2 rotary switches to set an explicit name to the IO Devices before commissioning. No engineering tool is needed.

The device gets its name (including the fixed part of the device name) directly from the setting of the switches (01h...FFh). This name can be used directly within the device configuration.

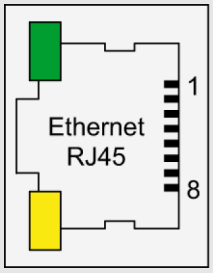
This name is for example:

ci501-pn-xx

"ci501-pn is the fixed part of the device name and xx represents the position of the rotary switch (0..255d or 0..FFh).

2.2 Pin Assignment

Table 5: Pin assignment RJ45 jack:



1	TxD+	Transmit data +
2	TxD-	Transmit data -
3	RxD+	Receive data +
4	NC	not used
5	NC	not used
6	RxD-	Receive data -
7	NC	not used
8	NC	not used
Shield	Cable shield	Functional earth

For the supported protocols and used Ethernet ports, please refer to the description of AC500 Ethernet Protocols and Ports *Ethernet Protocols and Ports*.

For a detailed description of the communication via Modbus TCP/IP, please refer to Communication with Modbus RTU and Modbus TCP/IP *Modbus Communication*.

2.3 Wiring

2.3.1 Cable Types

A direct connection of two terminal devices is the simplest variant of an Ethernet network. In this case, a crossover cable (also called crossconnect or crosslink cable) has to be used to connect the transmission lines of the first station to the reception lines of the second station. The following figure shows the wiring of a crossover cable.

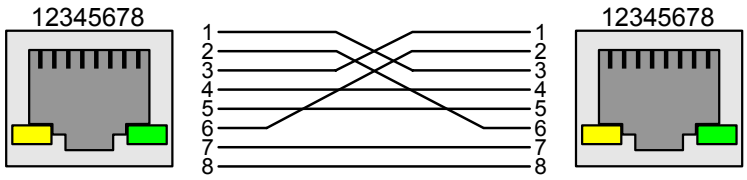


Fig. 8: Wiring of a crossover cable

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.

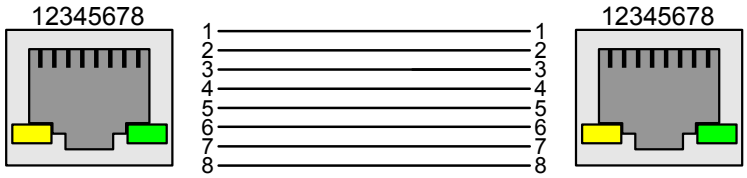


Fig. 9: Wiring of a straight-through cable

CAUTION!

Risk of communication faults!

When uning 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.

2.3.2 Cable Length Restrictions

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.

The following table shows the specified properties of the respective cable types per 100 m.

Table 6: Specified cable properties:

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

2.4 PROFINET® Implementation

2.4.1 System Start-up Behaviour

Initial Operation

The PROFINET® protocol is handled automatically by the PROFINET® Communication Module and the PLC operation system. When the Communication Module is initialized in the proper way and the user application is running, the Communication Module and the bus become active.

No function blocks are needed for the cyclic process data exchange. The access to the send and receive data to the according operands range can be performed in the direct way. The access takes place either via operands or symbolic variables. Special PROFINET® functions are realised by function blocks of the PROFINET® Library.

IP assignment

After switching on the power supply of the PLC, the Communication Module assigns the IP-addresses (by means of DCP) to the IO devices. The IO device identification is done by the adjusted position of the switches for setting the device identifier.

Initialization

When the user application changes into the run mode, the configured IO devices are initialized. At this time, the IO devices get their configuration (and the configuration of possibly connected I/O modules) by the IO controller.

Then the configured devices are compared with the available IO devices and I/O modules of the real assembly. If the result of the compare is conformed, the IO devices get their configuration. Otherwise the available devices get their configuration and the failure is displayed with the error LEDs of the bus module. The error can also be displayed by using the diagnosis function blocks.

The Communication Module and the IO devices change into the cyclic process data exchange when the configuration transfer is completed.

If the configuration is not successful or the cyclic process data exchange between IO controller and IO device is broken (e. g. removing of the plug), both participant

- close their communication
- change their status into the initial condition
- try to build up a new connection.

This procedure has no influence on devices where the configuration was successful.

Because of that a replacement of a faulty IO device can be done without restarting the PLC. But you have to consider that the new device must have the same position of the switches for setting the device identifier like the replaced one and switch off the power supply of the device you want to replace.