
AC500-eCo V3 - Analog Option Boards

Preliminary Manual for Automation Builder 2.6.0

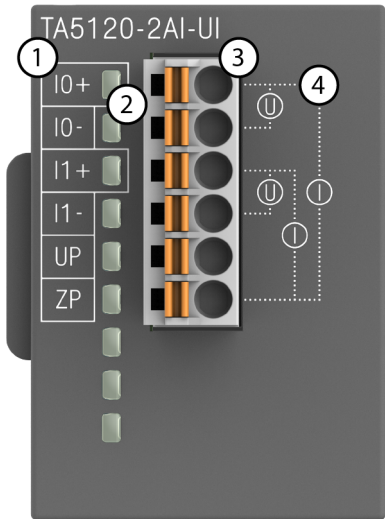
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1 TA5120-2AI-UI - Analog input option board

- 2 configurable analog inputs (I0 and I1) in 1 group
Resolution 12 bits
- Option board is galvanically isolated



- 1 Allocation of terminal and signal name
- 2 2 yellow LEDs to display the signal states at the analog inputs I0 and I1
- 3 6-pin terminal block for analog input signals and power supply (UP, ZP)
- 4 Input connection diagram for U and I

1.1 Intended purpose

The option board is used as analog input extension module for AC500-eCo V3 CPUs (PM50xx).



The analog option boards TA5120-2AI-UI, TA5123-2AI-RTD and TA5126-2AO-UI can only be used from AB 2.5.2, SystemFW 3.5.0_HF-7, BootFW 3.5.1 and higher.

Using the option boards with lower versions will create a configuration error and the CPU will not start.

1.2 Functionality

2 analog inputs, individually configurable for

- Not used (default setting)
- 0 V ... 10 V
- 0 mA ... 20 mA
- 4 mA ... 20 mA

Parameter	Value
Resolution of the analog channels	
Voltage 0 V ... 10 V	12 bits

Parameter		Value
	Current 0 mA ... 20 mA,	12 bits
	Current 4 mA ... 20 mA	12 bits
LED displays		2 LEDs for signals I0 and I1
Internal power supply		Via the CPU PM50xx
External power supply		Via the terminals UP and ZP (process voltage 24 V DC)
Required CPU		PM50xx

1.3 Connections



WARNING!

Removal/Insertion under power

The option boards are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug option boards 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 an option board.

Disconnecting any powered option board 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 option board TA5120-2AI-UI for analog input extension is plugged into an AC500-eCo V3 CPU PM50xx.

Insert the module and press it into the slot until it clicks into place.



*A detailed description of the assembly and disassembly of the option board can be found in the chapter **Mounting and demounting option boards**.*

The electrical connection is made via a removable 6-pin terminal block. For more information, please refer to the chapter **TA52xx(-x) - Terminal block sets**.

The terminal block is included in the scope of delivery of the option board. Further terminal blocks can be ordered separately as spare parts ↗ *Chapter 1.10 "Ordering data" on page 16.*

Table 1: Assignment of the terminals:

Terminal	Signal	Description
1	I0+	Positive analog input I0
2	I0-	Negative analog input I0
3	I1+	Positive analog input I1
4	I1-	Negative analog input I1

Terminal	Signal	Description
5	UP	Process voltage UP = +24 V DC
6	ZP	Process voltage ZP = 0 V DC



CAUTION!

The negative terminal of the analog inputs (voltage 0 V...10 V) are connected internally and form an internal analog ground (AGND). This analog ground is connected to ZP via a PTC resistor. There is no galvanic isolation between the analog circuitry and ZP/UP. Hence, analog inputs can not be connected in series.

The internal power supply of the circuits of the module takes place via the connection to the CPU. Thus, the current consumption from 24 V DC power supply at the terminals L+ and M of the CPU module increases by << 1 mA per TA5120-2AI-UI.

The external power supply is connected via the terminals UP (+24 V DC) and ZP (0 V DC).



NOTICE!

Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.



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:

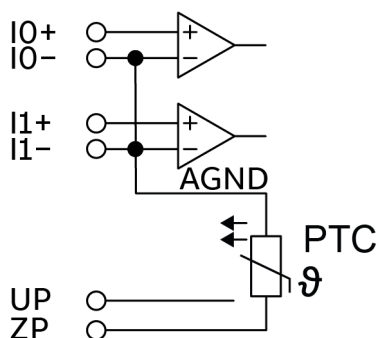


Fig. 1: Internal construction of the analog inputs



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.



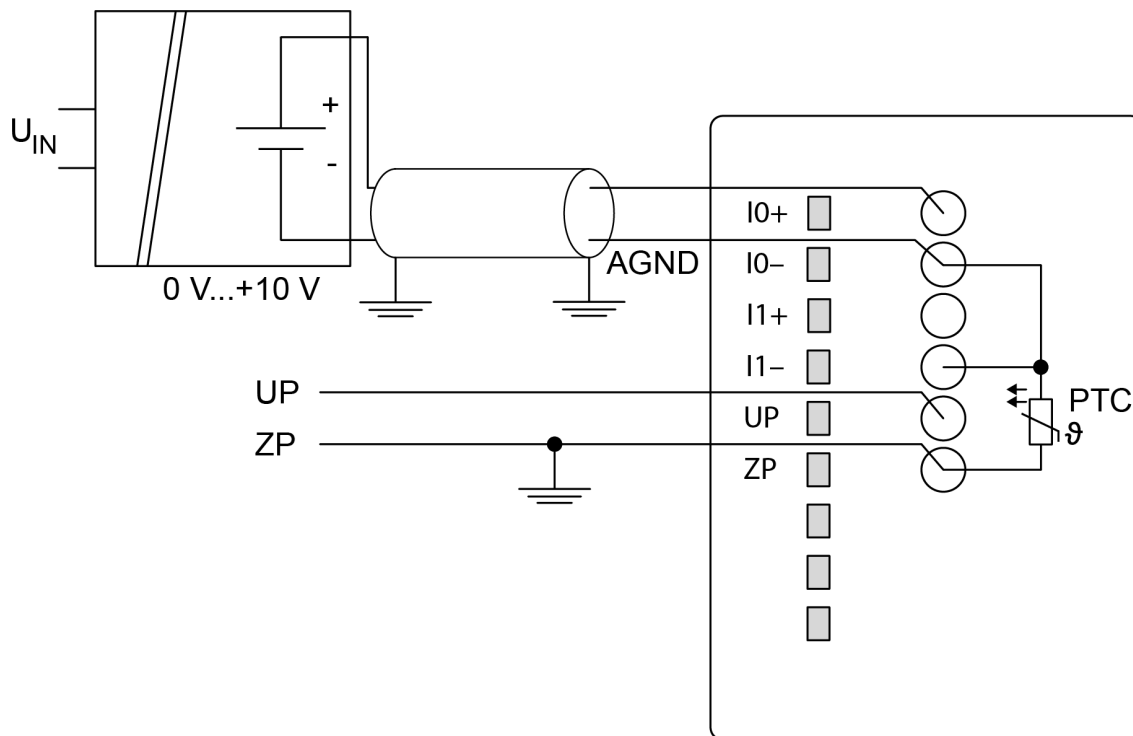
CAUTION!

The process supply voltage must be included in the grounding concept (e. g. grounding of the negative terminal).

The option board provides several diagnosis functions, see Diagnosis ↗ *Chapter 1.6 “Diagnosis” on page 11.*

The meaning of the LEDs is described in the section State LEDs ↗ *Chapter 1.7 “State LEDs” on page 13.*

1.3.1 Connection of active-type analog sensors (Voltage) with galvanically isolated power supply



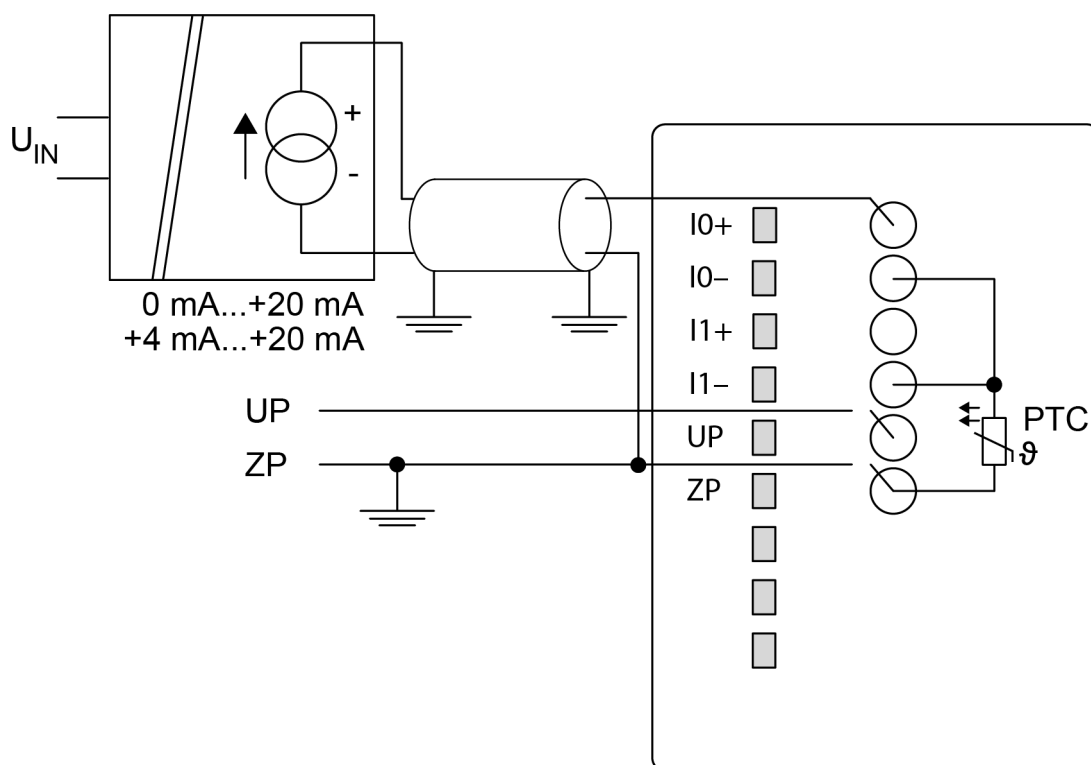
By connecting the sensor's negative terminal of the output voltage to AGND, the galvanically isolated voltage source of the sensor is referred to ZP.

The following measuring ranges can be configured for TA5120-2AI-UI ↗ *Chapter 1.5 “Parameterization” on page 11:*

Parameter	Value
Channel configuration	0 V...+10 V

In order to avoid error messages or long processing times, it is useful to configure unused analog input channels as "not used".

1.3.2 Connection of active-type analog sensors (Current) with galvanically isolated power supply

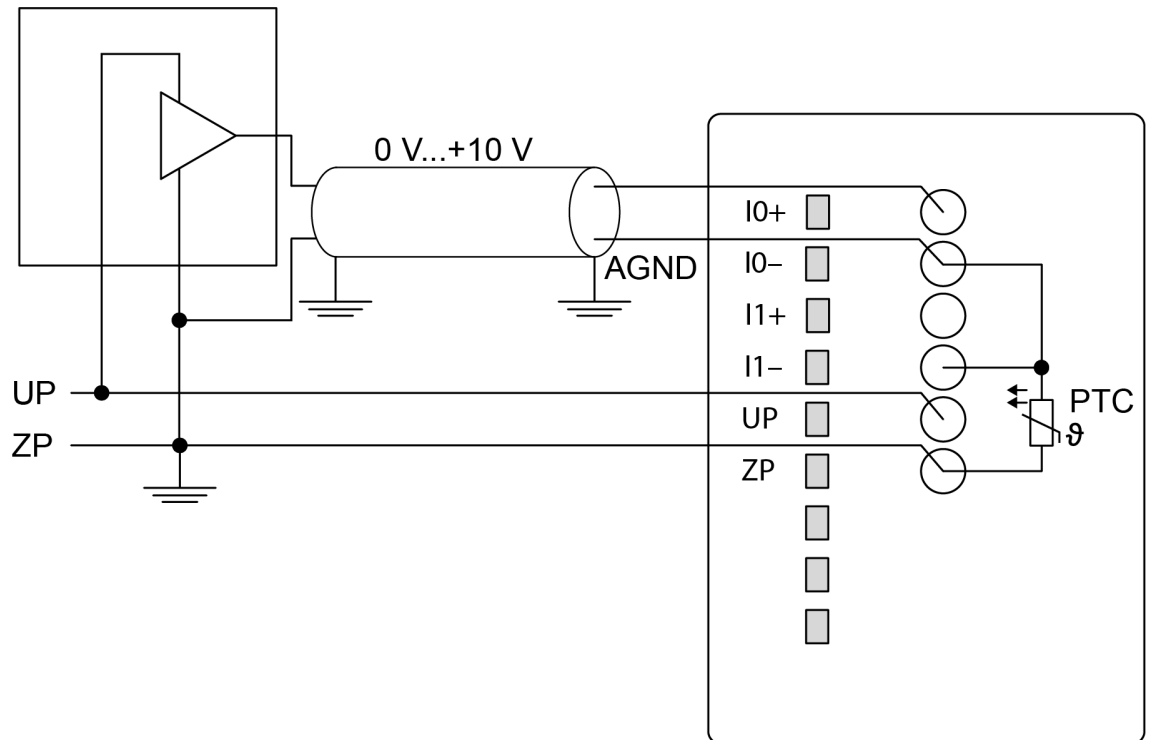


Parameter	Value
Channel configuration	0 mA...+20 mA or +4 mA...+20 mA

Unused current input channels can be left open when configured to 0 mA...20 mA because of low input impedance.

In order to avoid error messages or long processing times, it is useful to configure unused analog input channels as "not used".

1.3.3 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.

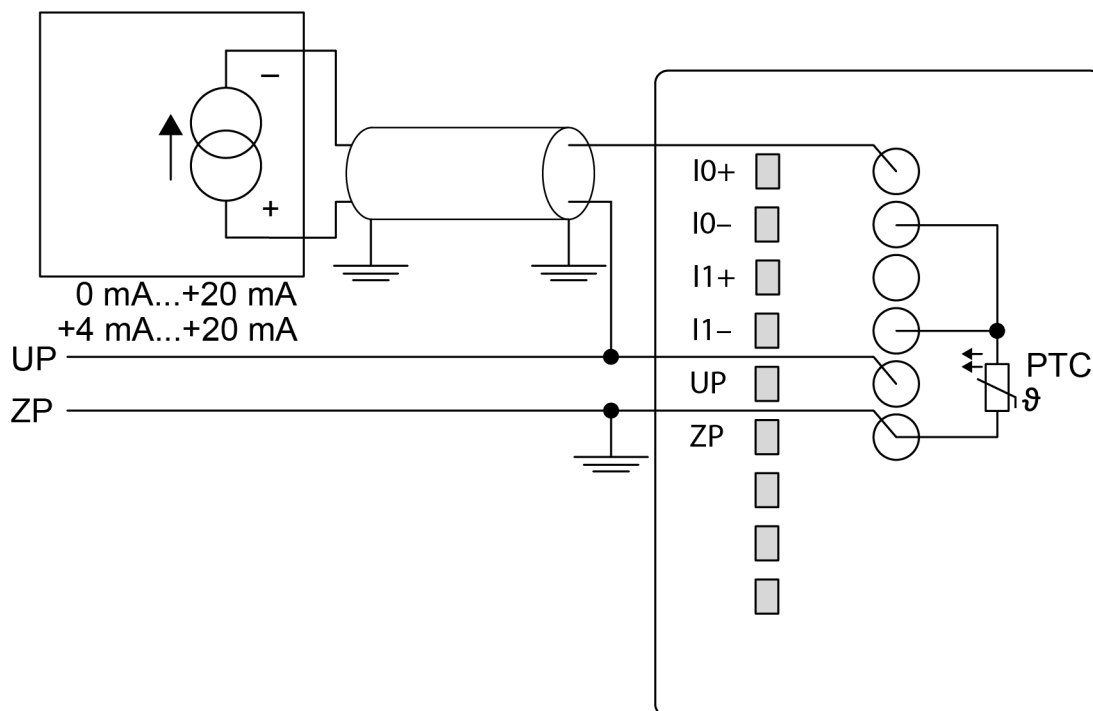


If AGND does not get connected to ZP, the sensor supply current flows to ZP via the AGND line. This current will distort the measuring signal, as a very small current flows through the AGND line. ZP connection should be close to the sensor. The total current through the PTC should not exceed 50 mA. This measuring method is therefore only suitable for short lines and small compensation currents via the AGND line.

Parameter	Value
Channel configuration	0 V...+10 V

In order to avoid error messages or long processing times, it is useful to configure unused analog input channels as "not used".

1.3.4 Connection of passive-type analog sensors (Current)



Parameter	Value
Channel configuration	0 mA...+20 mA or +4 mA...+20 mA

Unused current input channels can be left open when configured to 0 mA...20 mA because of low input impedance.

In order to avoid error messages or long processing times, it is useful to configure unused analog input channels as "not 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 I-). But, in general, sensors with fast initialization or without current peaks higher than 25 mA are preferable.

1.4 I/O configuration

The option board itself does not store configuration data. It receives its parameterization from the CPU module during power-up of the system.

Hence, replacing optional modules is possible without any re-parameterization via software.

Parameter	Value
Configurability	0 V...10 V 0 mA...20 mA 4 mA...20 mA (each input can be configured individually)
Unused voltage inputs	Must be configured as "not used"
Unused current inputs	Must be configured as "not used"

1.5 Parameterization

The arrangement of the parameter data is performed with Automation Builder software.

1. In the device tree, double-click the desired option board.
2. Select the “TA5120-2AI-UI Parameters” tab to edit the parameterization of the desired option board.

Parameter	Type	Value	Default Value	Unit	Description
Run on config fault	Enumeration of BYTE	No	No		Start PLC program even on configuration fault
Check supply	Enumeration of BYTE	On	On		Check supply
Input 0, channel configuration	Enumeration of BYTE	Not used	Not used		Analog input 0 - Configuration of analog input channel
Input 0, check channel	Enumeration of BYTE	Plausib, Cut wire, Short circuit	Plausib, Cut wire, Short circuit		Analog input 0 - Check channel
Input 1, channel configuration	Enumeration of BYTE	Not used	Not used		Analog input 1 - Configuration of analog input channel
Input 1, check channel	Enumeration of BYTE	Plausib, Cut wire, Short circuit	Plausib, Cut wire, Short circuit		Analog input 1 - Check channel

1.6 Diagnosis

Type	Device	Timestamp	Severity	Error Code	Description	Additional Data
Start refresh Stop refresh Acknowledge Selected Alarms						

1. In the device tree, double-click the desired option board.
2. Select the “Diagnosis” tab to view the diagnosis messages of the desired option board.

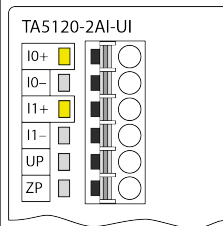
Bus pos.	Type	Channel	Class	Error	Description	Remedy
Module error (Channel 255)						
0..2	31	255	3	3	Timeout Communication timeout to CPU	If the process voltage is connected properly, replace the option board.
0..2	31	255	3	51	Invalid slot Wrong or missing option board in the appropriate slot	Check the configuration and the hardware setup.

Bus pos.	Type	Channel	Class	Error	Description	Remedy
0..2	31	255	4	11	Process voltage is too low	Check the process voltage.
0..2	31	255	4	34	Data not ready Data synchronization warning	Check PLC program and synchronize. ¹⁾
0..2	31	255	3	40	SW-mismatch Hardware does not match the firmware version	Replace the option board.
0..2	31	255	3	53	Download failed Power loss during firm-ware update	Replace the option board. ²⁾
0..2	31	255	3	9	DIAG_BUF_OVERFLOW Overflow in Diagnosis buffer	Diagnosis overflow usually means too many repeated warnings or errors. Please check all diagnosis in detail and take the appropriate action. A restart will clear the diagnosis.
0..2	31	255	3	43	DIAG_INTERNAL_ERR Internal error in the option board	Replace the option board.
0..2	31	255	3	26	DIAG_CFG_PRM_ERR Parameterization error	Check the CPU parameterization.
0..2	31	255	3	19	DIAG_CRC_ERR Checksum error in option board	Replace the option board.
Channel warning						
0..2	1	0..1	4	3	Highest level Voltage measurement overflow	Check the input value.
0..2	1	0..1	4	51	Lowest level Measurement underflow, or broken wire in current range 4 mA...20 mA	Check the input value and the wiring.
0..2	1	0..1	4	11	Overload wire break Broken wire in voltage mode, overflow in current mode	Check the input value and the wiring.

Remarks:

¹⁾	If no other error occurs, the programs are not identical and the parameter is set to report an error in this case.
²⁾	Do not remove the power supply from the option board during the firmware update.

1.7 State LEDs

	LED	State	Color	LED = OFF	LED = ON	LED flashes
	Inputs I0 ... I1	Analog input	Yellow	Input is OFF or input value is too low	Input is ON (brightness depends on the value of the analog signal)	--

1.8 Measuring ranges

1.8.1 Input ranges of voltage and current

The represented resolution corresponds to 12 bits.

Table 2: Measuring range: 0 V ... 10 V

Range	Input [V]	Digital value	
		Decimal	Hex.
Wire break	> 13.1784	32767	7FFF
Overflow	> 11.7564	32767	7FFF
Input voltage too high	11.7564	32504	7EF8
	:	:	:
	10.0029	27656	6C08
Normal range	10.0000	27648	6C00
	:	:	:
	0.0029	8	0008
	0.0000	0	0
Input voltage too low	-0.0029	-8	FFF8
	:	:	:
	-1.7593	-4864	ED00
Underflow	< -1.7593	-32768	8000

Table 3: Measuring range: 0 mA ... 20 mA

Range	Input [mA]	Digital value	
		Decimal	Hex.
Overflow	> 23.5127	32767	7FFF
Input current too high	23.5127	32504	7EF8
	:	:	:
	20.0058	27656	6C08
Normal range	20.0000	27648	6C00
	:	:	:
	0.0058	8	0008

Range	Input [mA]	Digital value	
		Decimal	Hex.
	0.0000	0	0
Input current too low	-0.0058	-8	FFF8
	:	:	:
	-3.5185	-4864	ED00
Underflow	< -3.5185	-32768	8000
Negative overrange	< -23.5185	-32768	8000

Table 4: Measuring range: 4 mA ... 20 mA

Range	Input [mA]	Digital value	
		Decimal	Hex.
Overflow	> 22.8102	32767	7FFF
Input current too high	22.8102	32504	7EF8
	:	:	:
	20.0046	27656	6C08
Normal range	20.0000	27648	6C00
	:	:	:
	4.0046	8	0008
	4.0000	0	0
Input current too low	3.9954	-8	FFF8
	:	:	:
	1.1898	-4856	ED08
	1.1852	-4864	ED00
Underflow	< 1.1852	-32768	8000
Negative overrange	< -14.8148	-32768	8000

1.9 Technical data

The system data of AC500-eCo V3 apply

Only additional details are therefore documented below.

Parameter		Value
Process voltage		
	Connections	Terminal 5 for +24 V (UP) as well as terminal 6 for 0 V (ZP)
	Rated value	24 V DC
	Protection against reversed voltage	Yes
	Rated protection fuse on UP	1 A slow
	Galvanic isolation	Yes, per module (no isolation between channels)
Current consumption		

Parameter		Value
	From 24 V DC power supply at the terminals UP/L+ and ZP/M of the CPU PM50xx	< 1 mA
	From UP at normal operation	max. 20 mA
Inrush current from UP (at power up)		0.005 A ² s
Max. length of analog cables, conductor cross section > 0.14 mm ²		On request
Weight		20 g
Mounting position		Horizontal or vertical with derating
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

1.9.1 Technical data of the analog inputs



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.

Parameter		Value
Number of channels per module		2
Distribution of channels into groups		1 group of 2 channels
Connections of the channel 0		
Voltage mode		
	Terminal I0+ and I0-	Terminals 1 and 2
Current mode		
	Terminal I0+ and ZP	Terminal 1 and 6
Connections of the channel 1		
Voltage mode		
	Terminal I1+ and I1-	Terminals 3 and 4
Current mode		
	Terminal I1+ and ZP	Terminals 3 and 6
Input type		Unipolar
Galvanic isolation		Yes, per option board (no isolation between channels)
Configurability		0 V...10 V 0 mA...20 mA 4 mA...20 mA (each input can be configured individually)

Parameter		Value	
Channel input resistance		Voltage: > 100 kΩ Current: ca. 330 Ω Not used: > 100 kΩ	
Time constant of the input filter		Voltage: 10 μs Current: 10 μs	
Indication of the input signals		1 LED per channel	
Conversion cycle *)			
	1 activated channel	1 ms	
	2 activated channel	2 ms	
Resolution for all configurations		12 bits	
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range		Max.	±0.3 % at 25 °C
		Max.	±0.5 % over full temperature range
Temperature coefficient (is related to the max error at 25°C and max error in the full range)		±0.005 %/K	
Temporary deviation during EMC disturbance		Max.	±1 %
Mapping between input signal and digital value		Input ranges of voltage and current ↪ Chapter 1.8.1 “Input ranges of voltage and current” on page 13	
Unused voltage inputs		Must be configured as "not used"	
Unused current inputs		Must be configured as "not used"	
Overvoltage protection		Yes	

*) The value is the sampling time on the option board. the complete conversion cycle time is also related to the CPU cycle time.

1.10 Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 187 100 R0001	TA5120-2AI-UI: AC500-eCo V3, analog input option board, 2AI U/I, 12 bits, spring/cable front terminal 3.50 mm pitch	Active
1SAP 187 100 R0201	TA5120-2AI-UIW: AC500-eCo V3, analog input option board, 2AI U/I, 12 bits, spring/cable front terminal 3.50 mm pitch, wide temperature range	In preparation
Spare parts		
1SAP 187 400 R0013 (**)	TA5220-SPF6: spring terminal block, removable, 6-pin, spring front, cable front, 6 pieces per packing unit	Active



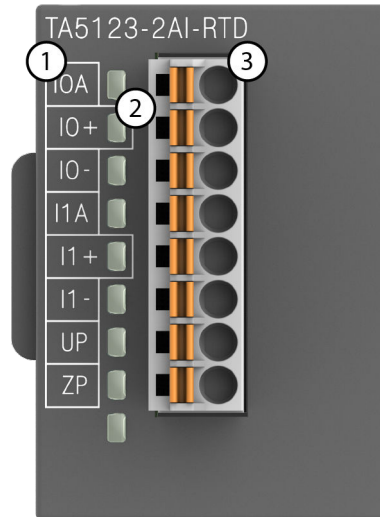
*) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.



****)** *The needed spring terminal block is always delivered with the option board.
The terminal block listed in the table is for spare part only if needed.*

2 TA5123-2AI-RTD - Analog input option board

- 2 configurable analog inputs (I0 and I1) in 1 group
Resolution 15 bits plus sign
- Module-wise galvanically isolated



- 1 Allocation of signal name
- 2 2 yellow LEDs to display the signal states at the analog inputs I0 and I1
- 3 8-pin terminal block for analog input signals and power supply (UP, ZP)

2.1 Intended purpose

The option board is used as analog input extension module for AC500-eCo V3 CPUs (PM50xx).



The analog option boards TA5120-2AI-UI, TA5123-2AI-RTD and TA5126-2AO-UI can only be used from AB 2.5.2, SystemFW 3.5.0_HF-7, BootFW 3.5.1 and higher.

Using the option boards with lower versions will create a configuration error and the CPU will not start.

2.2 Functionality

2 analog inputs, individually configurable for

- Not used (default setting)
- Pt100, -50 °C...+400 °C (2-wire)
- Pt100, -50 °C...+400 °C (3-wire)
- Pt100, -50 °C...+130 °C (2-wire)
- Pt100, -50 °C...+130 °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)
- NTC (2-wire)

Parameter	Value
Resolution of the analog channels	
Temperature	0.1 °C
LED displays	2 LEDs for signals I0 and I1
Internal power supply	Via the CPU PM50xx
External power supply	Via the terminals UP and ZP (process voltage 24 V DC)
Required CPU	PM50xx

2.3 Connections



WARNING!

Removal/Insertion under power

The option boards are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug option boards 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 an option board.

Disconnecting any powered option board 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 option board TA5123-2AI-RTD for analog input extension is plugged into an AC500-eCo V3 CPU PM50x2. Insert the module and press it until it locks into place.



*A detailed description of the assembly and disassembly of the module can be found in the chapter **Mounting and demounting option boards**.*

The electrical connection is made via a removable 8-pin terminal block. For more information, please refer to the chapter **TA52xx(-x) - Terminal block sets**.

The terminal block is included in the module's scope of delivery and additional terminal blocks as spare parts can be ordered separately.

Table 5: Assignment of the terminals:

Terminal	Signal	Description
1	I0A	Connection A (supply) of the analog input I0
2	I0+	Positive analog input I0
3	I0-	Negative analog input I0
4	I1A	Connection A (supply) of the analog input I1
5	I1+	Positive analog input I1
6	I1-	Negative analog input I1

Terminal	Signal	Description
7	UP	Process voltage UP = +24 VDC
8	ZP	Process voltage ZP = 0 V



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.



CAUTION!

The negative terminals of the analog inputs are electrically connected to each other. They form an "Analog Ground" signal for the module.



CAUTION!

There is no galvanic isolation between the analog circuitry and ZP/UP. Therefore, the analog sensors must be electrically isolated in order to avoid loops via the earth potential or the supply voltage.

The internal power supply of the circuits of the module takes place via the connection to the CPU. Thus, the current consumption from 24 VDC power supply at the terminals L+ and M of the CPU module increases by << 1 mA per TA5123-2AI-RTD.

The external power supply is connected via the UP (+24 VDC) and the ZP (0 VDC) terminals.



NOTICE!

Risk of damaging the PLC modules!

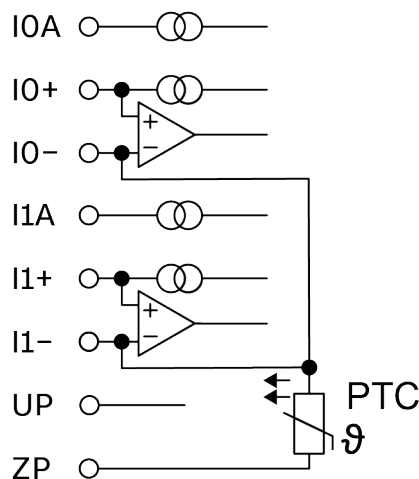
Overvoltages and short circuits might damage the PLC modules.

Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.



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 block diagram shows the internal construction of the analog inputs:



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, see Diagnosis ↗ *Chapter 2.6 "Diagnosis"* on page 24.

The meaning of the LEDs is described in the section State LEDs ↗ *Chapter 2.7 "State LEDs"* on page 24.

2.3.1 Connection of resistance thermometers in 2-wire configuration

When resistance thermometers (Pt100, Pt1000, Ni1000, NTC) are used, a current must flow through them to build the necessary voltage drop for the evaluation. For this, the module TA5123-2AI-RTD provides a current source which is multiplexed over the 2 analog channels.

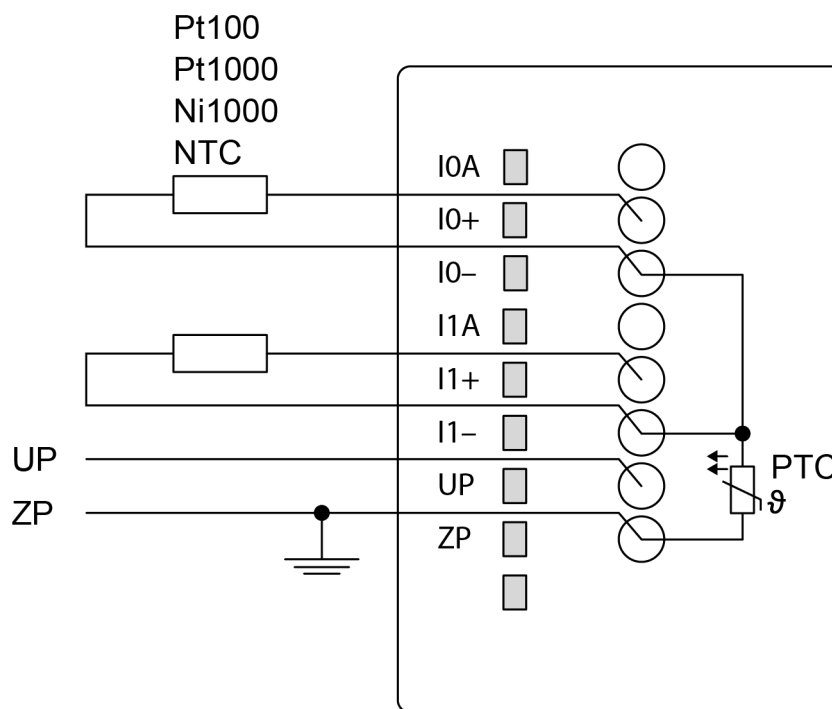


Fig. 2: Connection example

The following measuring ranges can be configured:

Pt100	-50 °C...+400 °C	1 channel used
	-50 °C...+130 °C	1 channel used
Pt1000	-50 °C...+400 °C	1 channel used
Ni1000	-50 °C...+150 °C	1 channel used
NTC	-	1 channel used

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 "not used".

2.3.2 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 AI531 provides a constant current source which is multiplexed over the 2 analog channels.

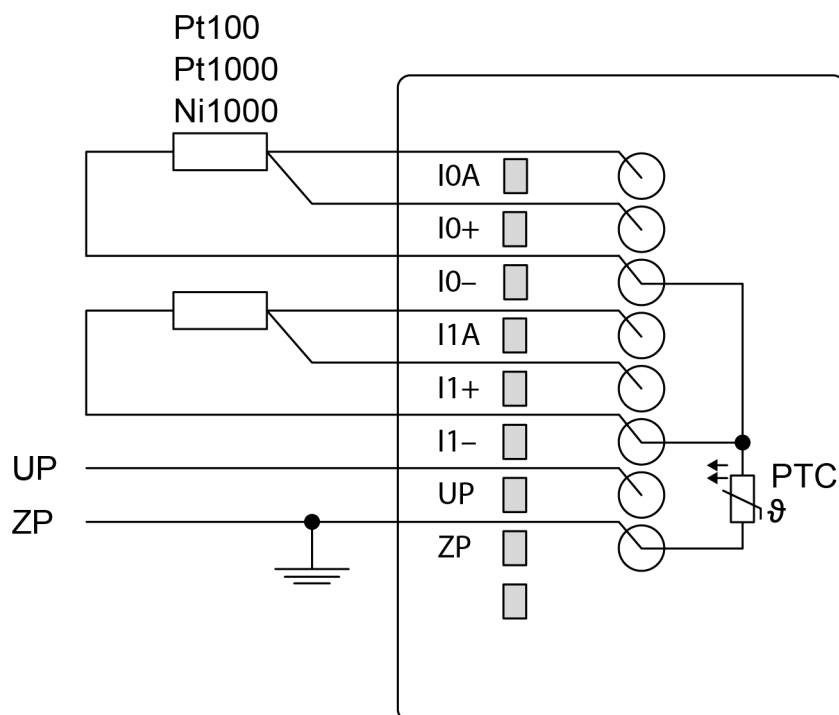


Fig. 3: Connection example

Pt100	-50 °C...+400 °C	1 channel used
	-50 °C...+130 °C	1 channel used
Pt1000	-50 °C...+400 °C	1 channel used
Ni1000	-50 °C...+150 °C	1 channel used
NTC	-	1 channel used

For a description of the function of the LEDs, please refer to Diagnosis and displays / displays.

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 "not used".

2.4 I/O configuration

The module itself does not store configuration data. It receives its parameterization data from the CPU module during power-up of the system.

Hence, replacing optional modules is possible without any re-parameterization via software.

2.5 Parameterization

The arrangement of the parameter data is performed with Automation Builder software.

1. In the device tree, double-click the desired option board.
2. Select the "TA5123-2AI-RTD Parameters" tab to edit the parameterization of the desired option board.

TA5123_2AI-RTD X						
TA5123-2AI-RTD Parameters	Parameter	Type	Value	Default Value	Unit	Description
TA5123-2AI-RTD I/O Mapping	Run on config fault	Enumeration of BYTE	No	No		Start PLC program even on configuration fault
	Check supply	Enumeration of BYTE	On	On		Check supply
I/O mapping list	Input 0, channel configuration	Enumeration of BYTE	Not used	Not used		Analog input 0 - Configuration of analog input channel
TA5123-2AI-RTD IEC Objects	R, T, B configuration - when NTC (2-wire) is configured		Not used			
	R - Resistance at temperature T	DIWORD(100...200000)	P1100 (3-wire) -50...+400 °C	10000	Ohm	Resistance at temperature T
	T - Temperature at resistance R	DIWORD(1...1000)	P1100 (3-wire) -50...+400 °C	25	°C	Temperature at resistance R
Diagnosis	B - Shape of the curve	DIWORD(1000...8000)	P1100 (3-wire) -50...+130 °C	3435	K	The shape of the curve, represents the relationship between the resistance and the temperature of a particular thermistor
Information	Input 0, check channel	Enumeration of BYTE	P11000 (5-wire) -50...+400 °C	Plausib, Cut wire, Short circuit		Analog input 0 - Check channel
	Input 0, noise rejection	Enumeration of BYTE	N10000 (2-wire) -50...+150 °C	50 Hz		Analog input 0 - Noise rejection
	Input 1, channel configuration	Enumeration of BYTE	NTC (2-wire)	Not used		Analog input 1 - Configuration of analog input channel
	R, T, B configuration - when NTC (2-wire) is configured					
	R - Resistance at temperature T	DIWORD(100...200000)	10000	10000	Ohm	Resistance at temperature T
	T - Temperature at resistance R	DIWORD(1...1000)	25	25	°C	Temperature at resistance R
	B - Shape of the curve	DIWORD(1000...8000)	3435	3435	K	The shape of the curve, represents the relationship between the resistance and the temperature of a particular thermistor
	Input 1, check channel	Enumeration of BYTE	Plausib, Cut wire, Short circuit	Plausib, Cut wire, Short circuit		Analog input 1 - Check channel
	Input 1, noise rejection	Enumeration of BYTE	50 Hz	50 Hz		Analog input 1 - Noise rejection

2.6 Diagnosis

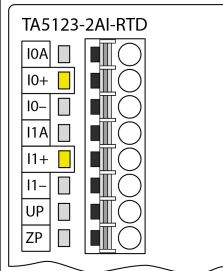
TA5123_2AI-RTD X						
TA5123-2AI-RTD Parameters	Start refresh Stop refresh Acknowledge Selected Alarms					
TA5123-2AI-RTD I/O Mapping	Type	Device	Timestamp	Severity	Error Code	Description
I/O mapping list						
TA5123-2AI-RTD IEC Objects						
Diagnosis						
Information						

1. In the device tree, double-click the desired option board.
2. Select the "Diagnosis" tab to view the diagnosis messages of the desired option board.

The following table shows the diagnosis messages.

Device	Severity	Error code	Description	
			Error Message	Remedy
TA5123--2AI-RTD	11	1	Wrong or no board plugged	Replace with correct functional board
TA5123--2AI-RTD	11	2	Board defective	Replace with correct functional board
TA5123--2AI-RTD	11	3	Failed to set direction	Replace with correct functional board
TA5123--2AI-RTD	11	4	Parameter wrong	Verify setting of parameter "Run on config fault"

2.7 State LEDs

	LED	State	Color	LED = OFF	LED = ON	LED flashes
	Inputs IO...I1	Analog input	Yellow	Input is OFF	Input is ON (brightness depends on the value of the analog signal)	--

2.8 Measuring ranges

2.8.1 Input ranges resistance temperature detector

Range	Pt100 -50...+130 °C	Pt100 / Pt1000 -50...+400 °C	Ni1000 -50...150 °C	Digital value	
				Decimal	Hex.
Overflow	> 140.0 °C	> 450.0 °C	> 160.0 °C	32767	7FFF
Measured value too high		450.0 °C		4500	1194
		:		:	:
		400.1 °C		4001	0FA1
			160.0 °C	1600	0640
			:	:	:
			150.1 °C	1501	05DD
Normal range	140.0 °C			1400	0578
	:			:	:
	130.1 °C			1301	0515
	:	400.0 °C	:	4000	0FA0
	:	:	150.0 °C	1500	05DC
	130.0 °C	:	:	1300	0514
	:	:	:	:	:
	0.1 °C	0.1 °C	0.1 °C	1	0001
	0.0 °C	0.0 °C	0.0 °C	0	0000
	-0.1 °C	-0.1 °C	-0.1 °C	-1	FFFF
	:	:	:	:	:
	-50.0 °C	-50.0 °C	-50.0 °C	-500	FE0C
Measured value too low	-50.1 °C	-50.1 °C	-50.1 °C	-501	FE0B
	:	:	:	:	:
	-60.0 °C	-60.0 °C	-60.0 °C	-600	FDA8
Underflow	< -60.0 °C	< -60.0 °C	< -60.0 °C	-32768	8000

2.9 Technical data

The system data of AC500-eCo V3 apply

Only additional details are therefore documented below.

Parameter		Value
Process voltage		
	Connections	Terminals 7 for +24 V (UP) and 8 for 0 V (ZP)
	Rated value	24 V DC
	Protection against reversed voltage	Yes
	Rated protection fuse on UP	1 A slow

Parameter		Value
	Galvanic isolation	Yes, per module (no isolation between channels)
Current consumption		
	From 24 V DC power supply at the terminals UP/L+ and ZP/M of the CPU PM50x2	<< 1 mA
	From UP at normal operation	max. 20 mA
Inrush current from UP (at power up)		0.005 A ² s
Max. length of analog cables, conductor cross section > 0.14 mm ²		On request
Weight		20 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.

2.9.1 Technical data of the analog inputs



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.

Parameter	Value
Number of channels per module	2
Distribution of channels into groups	1 group of 2 channels
Connections of the channels I0A and I1A	Terminals 1 and 4
Connections of the channels I0+ and I1+	Terminals 2 and 5
Connections of the channels I0- and I1-	Terminals 3 and 6
Input type	Unipolar with Pt100, Pt1000, Ni1000 and NTC
Galvanic isolation	Yes, per module (no isolation between channels)

Parameter		Value
Configurability		Pt100 (2-wire) -50 °C...+400 °C Pt100 (3-wire) -50 °C...+400 °C Pt100 (2-wire) -50 °C...+130 °C Pt100 (3-wire) -50 °C...+130 °C Pt1000 (2-wire) -50 °C...+400 °C Pt1000 (3-wire) -50 °C...+400 °C Ni1000 (2-wire) -50 °C...+150 °C Ni1000 (3-wire) -50 °C...+150 °C NTC (2-wire) (each input can be configured individually)
Indication of the input signals		1 LED per channel
Conversion cycle		
RTD, 2-wire measurement		
	1 activated channel	500 ms
	2 activated channels	1000 ms
NTC measurement		
	1 activated channel	500 ms
	2 activated channels	1000 ms
RTD, 3-wire measurement		
	1 activated channel	1000 ms
	2 activated channels	2000 ms
Resolution		Range 15 bits plus sign
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range		Typ. On request
		Max. On request
Overvoltage protection		Yes

2.10 Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 187 100 R0002	TA5123-2AI-RTD: AC500-eCo V3, analog input option board, 2AI RTD, 15 bits plus sign, spring/cable front terminal 3.50 mm pitch	Active
1SAP 187 100 R0202	TA5123-2AI-RTW: AC500-eCo V3, analog input option board, 2AI RTD, 15 bits plus sign, spring/cable front terminal 3.50 mm pitch, wide temperature range	In preparation
Spare parts		
1SAP 187 400 R0015 **)	TA5220-SPF8: spring terminal block, removable, 8-pin, spring front, cable front, 6 pieces per packing unit	Active



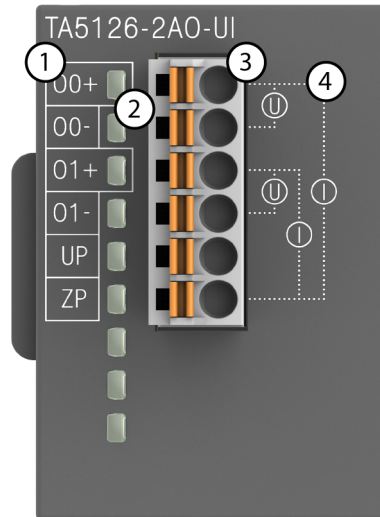
**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*



****) The needed spring terminal block is always delivered with the option board. The terminal block listed in the table is for spare part only if needed.*

3 TA5126-2AO-UI - Analog output option board

- 2 configurable analog outputs (O0 and O1) in 1 group
Resolution 12 bits
- Option board is galvanically isolated



- 1 Allocation of signal name
- 2 2 yellow LEDs to display the signal states at the analog outputs O0 and O1
- 3 6-pin terminal block for analog output signals and power supply (UP, ZP)
- 4 Output connection diagram for U and I

3.1 Intended purpose

The option board is used as analog output extension module for AC500-eCo V3 CPUs (PM50xx).



The analog option boards TA5120-2AI-UI, TA5123-2AI-RTD and TA5126-2AO-UI can only be used from AB 2.5.2, SystemFW 3.5.0_HF-7, BootFW 3.5.1 and higher.

Using the option boards with lower versions will create a configuration error and the CPU will not start.

3.2 Functionality

2 analog outputs, individually configurable for

- Not used (default setting)
- 0 V...10 V
- 0 mA...20 mA
- 4 mA...20 mA

Parameter	Value
Resolution of the analog channels	
Voltage 0 V...10 V	12 bits

Parameter		Value
	Current 0 mA...20 mA,	12 bits
	Current 4 mA...20 mA	12 bits
LED displays		2 LEDs for signals O0 and O1
Internal power supply		Via the CPU PM50xx
External power supply		Via the terminals UP and ZP (process voltage 24 V DC)
Required CPU		PM50xx

3.3 Connections



WARNING!

Removal/Insertion under power

The option boards are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug option boards 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 an option board.

Disconnecting any powered option board 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 option board TA5126-2AO-UI for analog output extension is plugged into an AC500-eCo V3 CPU PM50xx.

Insert the module and press it into the slot until it clicks into place.



*A detailed description of the assembly and disassembly of the option board can be found in the chapter **Mounting and demounting option boards**.*

The electrical connection is carried out by using a removable 6-pin terminal block. For more information, please refer to the chapter **TA52xx(-x) - Terminal block sets**.

The terminal block is included in the scope of delivery of the option board. Further terminal blocks can be ordered separately as spare parts ↗ *Chapter 3.10 "Ordering data" on page 38.*

Table 6: Assignment of the terminals:

Terminal	Signal	Description
1	O0+	Positive analog output O0
2	O0-	Negative analog output O0
3	O1+	Positive analog output O1
4	O1-	Negative analog output O1

Terminal	Signal	Description
5	UP	Process voltage UP = +24 V DC
6	ZP	Process voltage ZP = 0 V DC



CAUTION!

The negative terminal of the analog outputs (voltage 0 V...10 V) are connected internally and form an internal analog ground (AGND). This analog ground is connected to ZP via a PTC resistor. There is no galvanic isolation between the analog circuitry and ZP/UP.

The internal power supply voltage for the module's circuitry is carried out via the connection to CPU. Thus, the current consumption from 24 V DC power supply at the terminals L+ and M of the CPU module increases by << 1 mA per TA5126-2AO-UI.

The external power supply connection is carried out via the terminals UP (+24 V DC) and ZP (0 V DC).



NOTICE!

Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.



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:

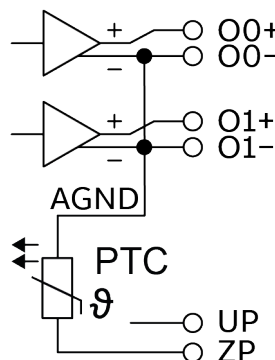


Fig. 4: Internal construction of the analog outputs



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.



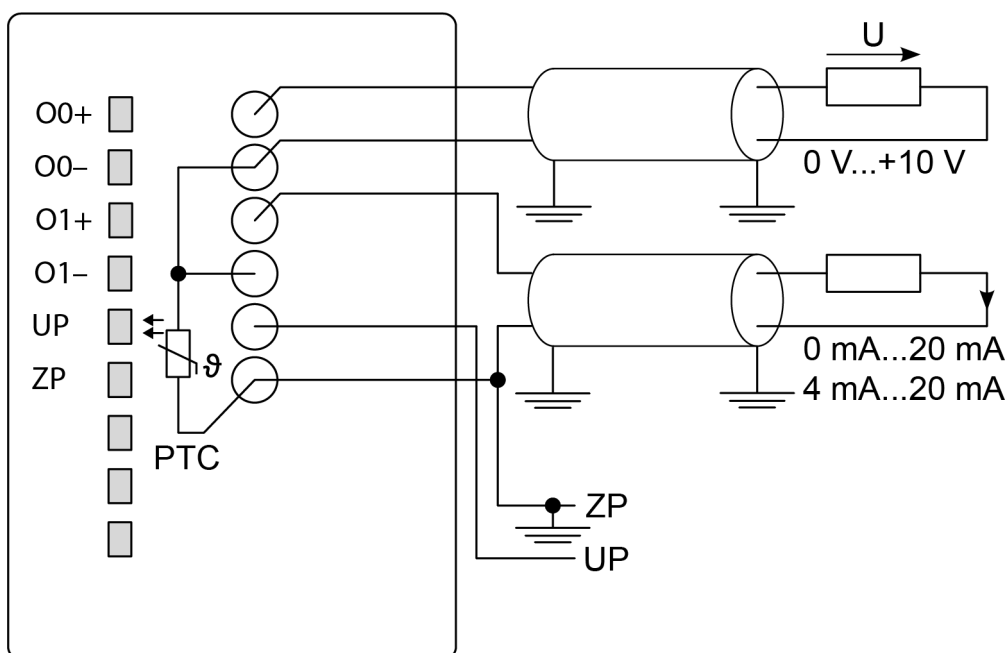
CAUTION!

The process supply voltage must be included in the grounding concept (e. g. grounding of the negative terminal).

The module provides several diagnosis functions, see Diagnosis ↗ *Chapter 3.6 "Diagnosis" on page 33.*

The meaning of the LEDs is described in the section State LEDs ↗ *Chapter 3.7 "State LEDs" on page 35.*

3.3.1 Connection of analog output loads (Voltage, current)



Parameter	Value
Channel configuration	0 V...+10 V
	0 mA...20 mA
	4 mA...20 mA

Not used voltage outputs must be left open. Not used current outputs can be left open.

In order to avoid error messages or long processing times, it is useful to configure unused analog output channels as "not used".

3.4 I/O configuration

The option board itself does not store configuration data. It receives its parameterization from the CPU module during power-up of the system.

Hence, replacing optional modules is possible without any re-parameterization via software.

Parameter	Value
Configurability	0 V...10 V 0 mA...20 mA 4 mA...20 mA (each input can be configured individually)
Unused voltage outputs	Must be configured as "not used"
Unused current outputs	Must be configured as "not used"

3.5 Parameterization

The arrangement of the parameter data is performed with Automation Builder software.

1. In the device tree, double-click the desired option board.
2. Select the “TA5126-2AO-UI Parameters” tab to edit the parameterization of the desired option board.

Parameter	Type	Value	Default Value	Unit	Description
Run on config fault	Enumeration of BYTE	No	No		Start PLC program even on configuration fault
Check supply	Enumeration of BYTE	On	On		Check supply
Behaviour outputs at comm. error	Enumeration of BYTE	Off	Off		Output value by communication error
Output 0, channel configuration	Enumeration of BYTE	Not used	Not used		Analog output 0 - Configuration of analog output channel
Output 0, check channel	Enumeration of BYTE	Plausib, Cut wire, Short circuit	Plausib, Cut wire, Short circuit		Analog output 0 - Check channel
Output substitute value for channel 0 and 1	WORD(0...65535)	0	0		Set the substitute value for channel 0 and 1
Output 1, channel configuration	Enumeration of BYTE	Not used	Not used		Analog output 1 - Configuration of analog output channel
Output 1, check channel	Enumeration of BYTE	Plausib, Cut wire, Short circuit	Plausib, Cut wire, Short circuit		Analog output 1 - Check channel

3.6 Diagnosis

Type	Device	Timestamp	Severity	Error Code	Description	Additional Data
<div>Start refresh Stop refresh Acknowledge Selected Alarms</div>						

1. In the device tree, double-click the desired option board.
2. Select the “Diagnosis” tab to view the diagnosis messages of the desired option board.

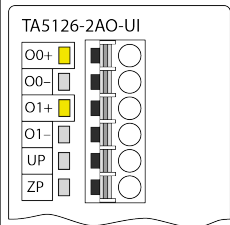
Bus pos.	Type	Channel	Class	Error	Description	Remedy
Module error (Channel 255)						
0..2	31	255	3	3	Timeout Communication timeout to CPU	If the process voltage is connected properly, replace the option board.
0..2	31	255	3	51	Invalid slot Wrong or missing option board in the appropriate slot	Check the configuration and the hardware setup.

Bus pos.	Type	Channel	Class	Error	Description	Remedy
0..2	31	255	4	11	Process voltage is too low	Check the process voltage.
0..2	31	255	4	34	Data not ready Data synchronization warning	Check PLC program and synchronize. ¹⁾
0..2	31	255	3	40	SW-mismatch Hardware does not match the firmware version	Replace the option board.
0..2	31	255	3	53	Download failed Power loss during firm-ware update	Replace the option board. ²⁾
0..2	31	255	3	9	DIAG_BUF_OVERFLOW Overflow in Diagnosis buffer	Diagnosis overflow usually means too many repeated warnings or errors. Please check all diagnosis in detail and take the appropriate action. A restart will clear the diagnosis.
0..2	31	255	3	43	DIAG_INTERNAL_ERR Internal error in the option board	Replace the option board.
0..2	31	255	3	26	DIAG_CFG_PRM_ERR Parameterization error	Check the CPU parameterization.
0..2	31	255	3	19	DIAG_CRC_ERR Checksum error in option board	Replace the option board.
Channel warning						
0..2	1	0..1	4	4	Highest level Output value is greater than the highest level	Check the output value.
0..2	1	0..1	4	7	Lowest level Output value is lower than the lowest level	Check the output value.
0..2	1	0..1	4	46	DIAG_EXT_VOLTAGE_F EEDED Output is short circuited to another voltage	Check the wiring. ³⁾
0..2	1	0..1	4	48	Overload wire break Output value is overflow or broken wire in current mode, or output value overflow in voltage mode	Check the output value and the wiring. ⁴⁾

Remarks:

1)	If no other error occurs, the programs are not identical and the parameter is set to report an error in this case.
2)	Do not remove the power supply from the option board during the firmware update.
3)	In this case, output will be switched ON /OFF with a 10 sec cycle
4)	in this case, if the output is configured as voltage output , the output will be switched ON /OFF with a 10 sec cycle

3.7 State LEDs

	LED	State	Color	LED = OFF	LED = ON	LED flashes
	Outputs O0...O1	Analog output	Yellow	Output is OFF or output value is too low	Output is ON (brightness depends on the value of the analog signal)	--

3.8 Measuring ranges

3.8.1 Output ranges of voltage and current

The represented resolution corresponds to 12 bits.

Table 7: Measuring range: 0 V ... 10 V

Range	Output [V]	Digital value	
		Decimal	Hex.
Overflow	0 V	> 32504	> 7EF8
Output value too high	11.7564	32504	7EF8
	:	:	:
	10.0029	27656	6C08
Normal range	10.0000	27648	6C00
	:	:	:
	0.0029	8	0008
	0.0000	0	0
Output value too low	-0.0029	-8	FFF8
	:	:	:
	-1.7593	-4864	ED00
Underflow	0	< -4864	< ED00

Table 8: Measuring range: 0 mA ... 20 mA

Range	Output [mA]	Digital value	
		Decimal	Hex.
Overflow	0.0000	> 32504	> 7EF8
Output value too high	23.5127	32504	7EF8
	:	:	:
	20.0058	27656	6C08
Normal range	20.0000	27648	6C00
	:	:	:
	0.0058	8	0008
	0.0000	0	0
Underflow	0	< 0	< 0

Table 9: Measuring range: 4 mA ... 20 mA

Range	Output [mA]	Digital value	
		Decimal	Hex.
Overflow	0.0000	> 32504	> 7EF8
Output value too high	22.8102	32504	7EF8
	:	:	:
	20.0046	27656	6C08
Normal range	20.0000	27648	6C00
	:	:	:
	4.0046	8	0008
	4.0000	0	0
Output value too low	3.995	-8	FFF8
	:	:	:
	0.0046	-6904	E508
	0.0000	-6912	E500
Underflow	0	< -6912	< E500

3.9 Technical data

The system data of AC500-eCo V3 apply

Only additional details are therefore documented below.

Parameter		Value
Process voltage		
	Connections	Terminal 5 for +24 V (UP) as well as terminal 6 for 0 V (ZP)
	Rated value	24 V DC
	Protection against reversed voltage	Yes
	Rated protection fuse on UP	1 A slow

Parameter		Value
	Galvanic isolation	Yes, per module (no isolation between channels)
Current consumption		
	From 24 V DC power supply at the terminals UP/L+ and ZP/M of the CPU PM50xx	<< 1 mA
	From UP at normal operation	max. 70 mA
Inrush current from UP (at power up)		0.005 A ² s
Max. length of analog cables, conductor cross section > 0.14 mm ²		On request
Weight		20 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.

3.9.1 Technical data of the analog outputs



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.

Parameter		Value
Number of channels per module		2
Distribution of channels into groups		1 group of 2 channels
Connections of the channel 0		
	Voltage mode	
	Terminal O0+ and O0-	Terminals 1 and 2
	Current mode	
	Terminal O0+ and ZP	Terminal 1 and 6
Connections of the channel 1		
	Voltage mode	
	Terminal O1+ and O1-	Terminals 3 and 4
	Current mode	
	Terminal O1+ and ZP	Terminals 3 and 6
Output type		Unipolar
Galvanic isolation		Yes, per option board (no isolation between channels)

Parameter		Value
Configurability		0 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		Max. ± 10 mA
Indication of the output signals		One LED per channel
Conversion cycle		
	1 activated channel	250 μ s
	2 activated channel	500 μ s
Resolution for all configurations		12 bits
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	Max.	± 0.4 % at 25 °C
	Max.	± 0.5 % over full temperature range
Temperature coefficient (is related to the max error at 25°C and max error in the full range)		± 0.003 %/K
Temporary deviation during EMC disturbance		Max. ± 3 %
Mapping between output signal and digital value		Output ranges of voltage and current ↪ <i>Chapter 3.8.1 "Output ranges of voltage and current" on page 35</i>
Unused voltage outputs		Must be configured as "not used"
Unused current outputs		Must be configured as "not used"

3.10 Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 187 100 R0003	TA5126-2AO-UI: AC500-eCo V3, analog output option board, 2AO U/I, 12 bits, spring/cable front terminal 3.50 mm pitch	Active
1SAP 187 100 R0203	TA5126-2AO-UIW: AC500-eCo V3, analog output option board, 2AO U/I, 12 bits, spring/cable front terminal 3.50 mm pitch, wide range temperature	In preparation
Spare parts		
1SAP 187 400 R0013 **)	TA5220-SPF6: spring terminal block, removable, 6-pin, spring front, cable front, 6 pieces per packing unit	Active



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



***) The needed spring terminal block is always delivered with the option board.
The terminal block listed in the table is for spare part only if needed.*

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