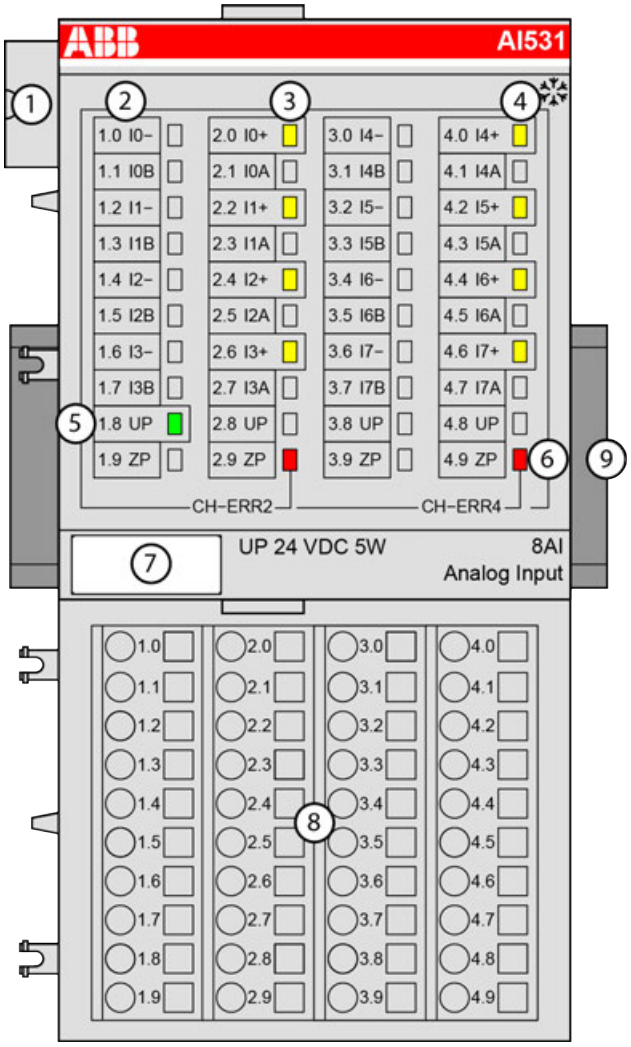
*) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.

1.6.2.2.3 AI531 - Analog input module

- 8 configurable analog inputs
  Resolution 16 bits including sign
- Module-wise galvanically isolated
- XC version available for use in extreme environmental conditions



1 I/O bus
2 Allocation between terminal number and signal names
3 4 yellow LEDs to display the states at the inputs I0 ... I3
4 4 yellow LEDs to display the states at the inputs I4 ... I7
5 1 green LED to display the process supply voltage UP
6 2 red LEDs to display errors (CH-ERR2 and CH-ERR4)
7 Label
8 Terminal unit
9 DIN rail
❄ Sign for XC version

Intended use

The module can be used both on an AC500 processor module and on a communication interface module.

Unless expressly intended for this purpose, the following applications are prohibited:

- Use in explosion-proof areas
- Use in environments with harmful oils, acids, gases, vapors, dusts and radiation
- Operation under water
- Not to be used as a safety module.

Connections



For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.

The modules are plugged on an I/O terminal unit.

↳ *TU515, TU516*

Properly position the modules and press until they lock in place. The terminal units are mounted on a DIN rail or with 2 screws plus the additional accessory for wall mounting.

↳ *Chapter 1.9.3.5 “TA526 - Wall mounting accessory” on page 1145*

The connection of the I/O channels is carried out using the 40 terminals of the I/O terminal unit. I/O modules can be replaced without re-wiring the terminal units.

The internal logic of the module is supplied by the I/O bus.

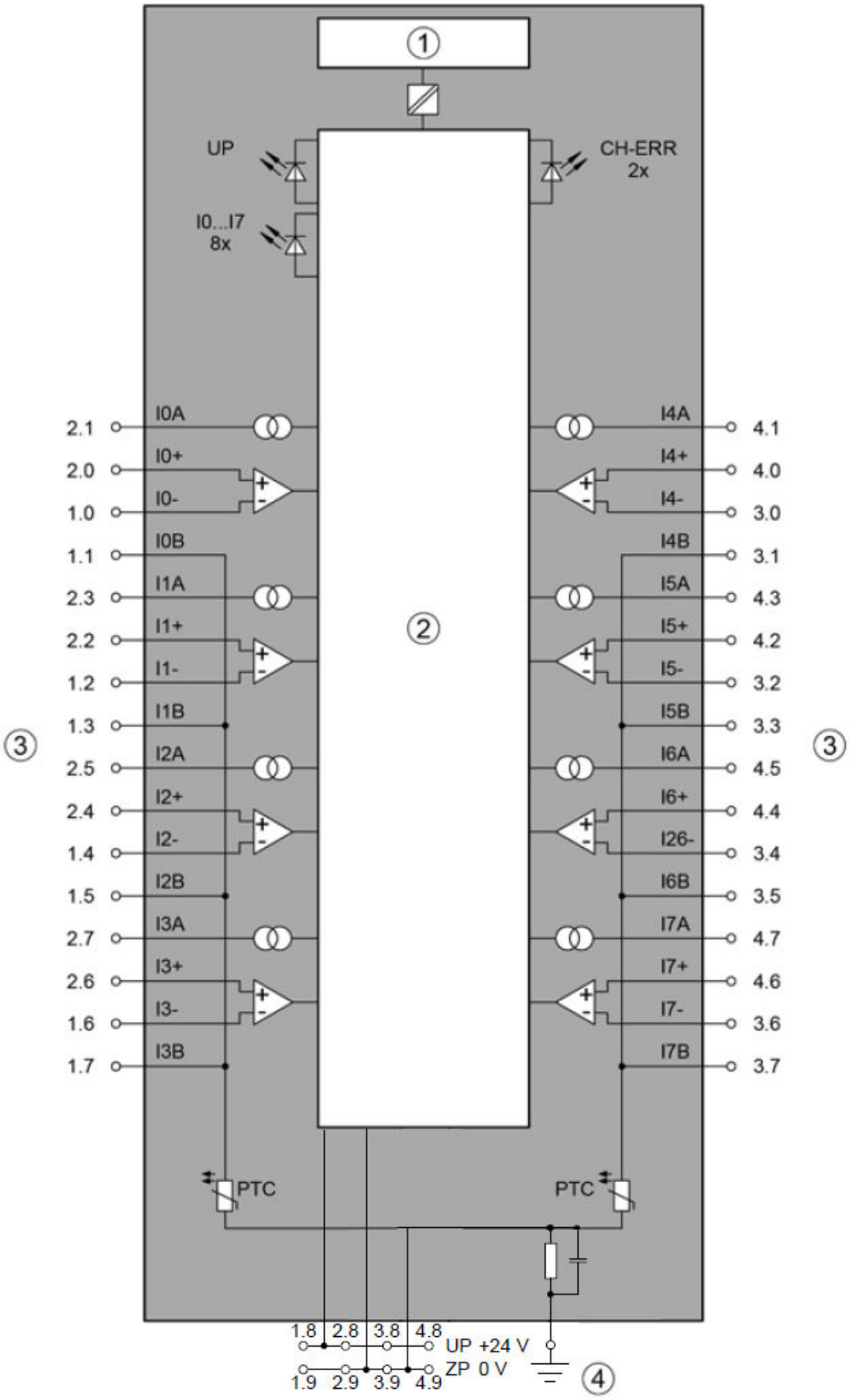
The input/output circuits are powered by the process voltage:

Process voltage UP = +24 V DC. Terminals 1.8 ... 4.8 are internally connected in the terminal unit.

Process voltage ZP = 0 V DC. Terminals 1.9 ... 4.9 are internally connected in the terminal unit.



The maximum current load capability of the terminals must be taken into account.



1 I/O bus interface to the CPU or communication interface module
2 Internal logic and I/O circuits of the module
3 Analog outputs
4 Functional earth connection between terminal unit and DIN rail

WARNING!

Removal/Insertion under power

Removal or insertion under power is permissible only if all conditions for hot swapping are fullfilled.

Conditions for hot swap

“Conditions for hot swap” on page 1152

The devices are not designed for removal or insertion under power when the conditions for hot swap do not apply. Because of unforeseeable consequences, it is not allowed to plug in or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before doing any of the following actions:

– Connect or disconnect any signal or terminal block.
– Remove, mount or replace a module.

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

Prior to proceeding, make sure that power is disconnected and that the area has been thoroughly checked to ensure that flammable materials or ignitable concentrations are not present.

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

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).

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.

NOTICE!

Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

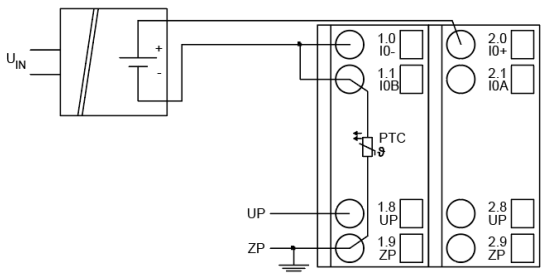
– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

Generally, analog signals must be laid in shielded cables. The cable shields must be grounded at both sides of the cables. In order to avoid unacceptable potential differences between different parts of the installation, low resistance equipotential bonding conductors must be laid.

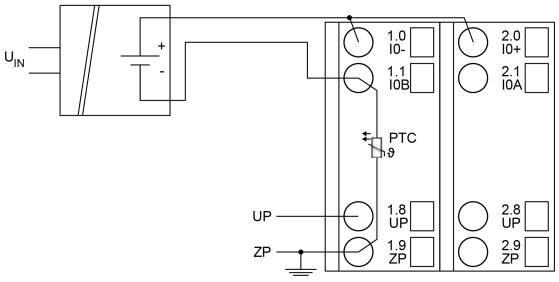
The negative poles of the analog inputs Ix- may accept a potential difference up to ±20 V DC with regard to the common reference potential IxB (AGND, ZP). Observing this maximum voltage difference, analog current inputs of one module can be switched in series to each other and also with current inputs of other modules.

For the open-circuit detection (wire break), each positive analog input channel Ix+ is pulled up to "plus" by a high-resistance resistor and each negative analog input channel Ix- is pulled down to "minus" by a resistor. If wire break occurs, a maximum voltage (overflow or underflow) will be read in then.

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



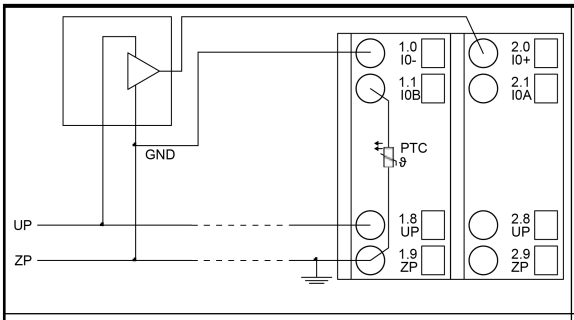
Standard ranges



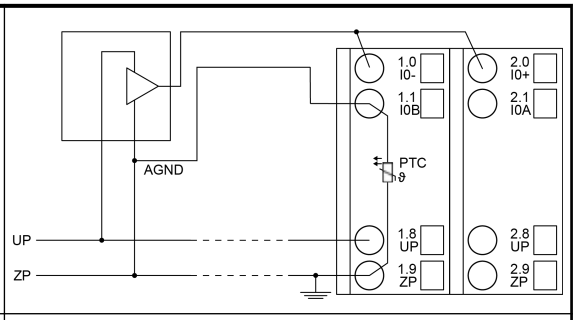
Common mode range (+/-20 V)

In order to avoid error messages or long processing times, it is useful to configure unused analog input channels as "unused".

Connection of active-type analog sensors (Voltage) with no galvanically isolated power supply



Standard ranges

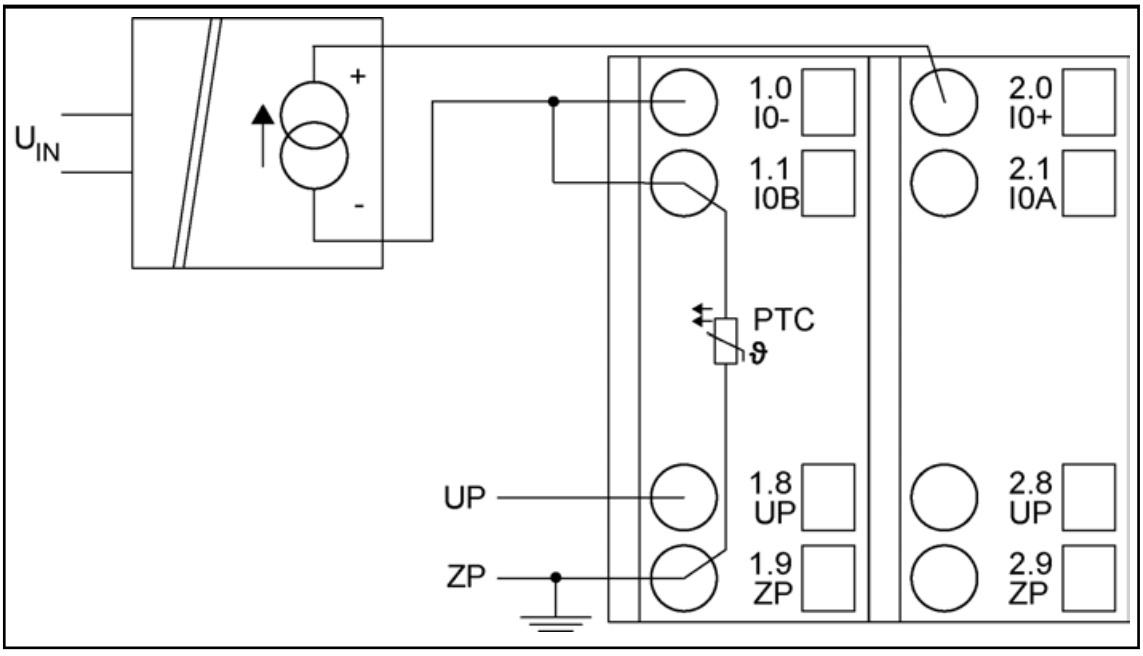


Common mode range (+/-20 V)

CAUTION!
If GND is not directly connected to ZP at the sensor, the supply current flows via the GND line to ZP. Measuring errors can only occur caused by voltage differences higher than ± 20 V DC between GND and ZP.

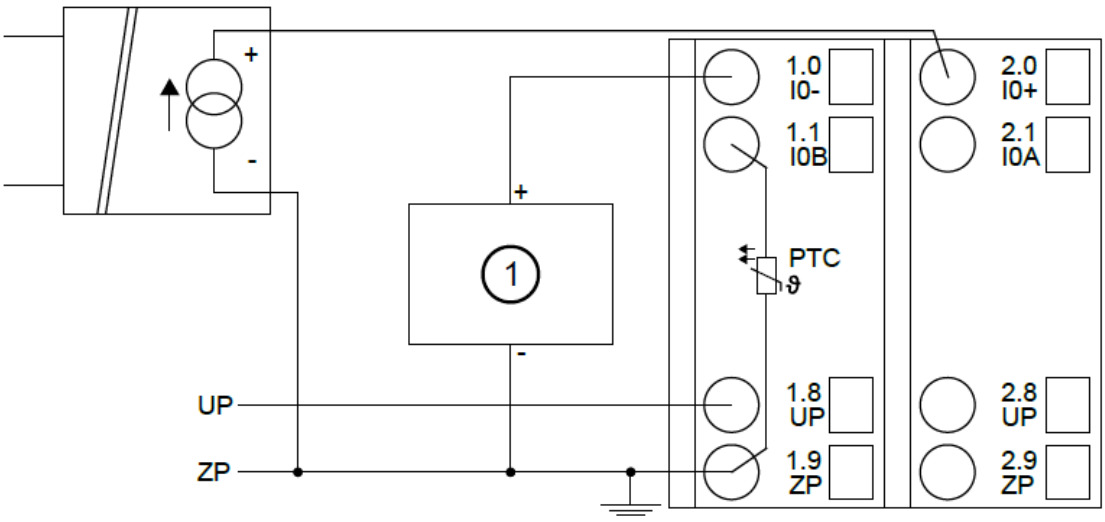
In order to avoid error messages or long processing times, it is useful to configure unused analog input channels as "unused".

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



Unused input channels can be left open, because they are of low resistance.

Connection of active-type analog sensors (Current) with galvanically isolated power supply and series-connection of an additional input



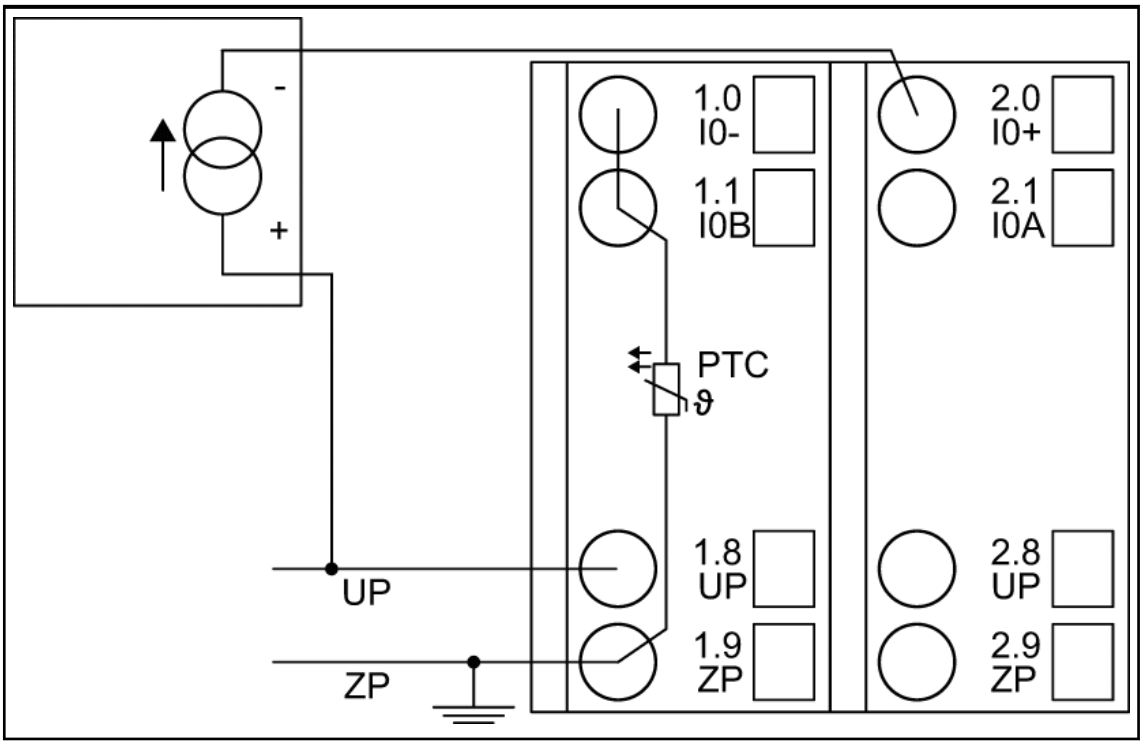
1 - Analog input of the second device

If series-connection of an additional input is used, the input resistance of the module (ca. 330 Ω) must be added to the input resistance of the second device. Make sure that the maximum permitted load resistance of the analog sensor is not exceeded (see the data sheet of the analog sensor).

The input of the module is not related to ZP. If the input of the second device is related to ZP, the order of sequence in the series-connection must be observed by all means (from the sensor to the module and then to the input of the second device).

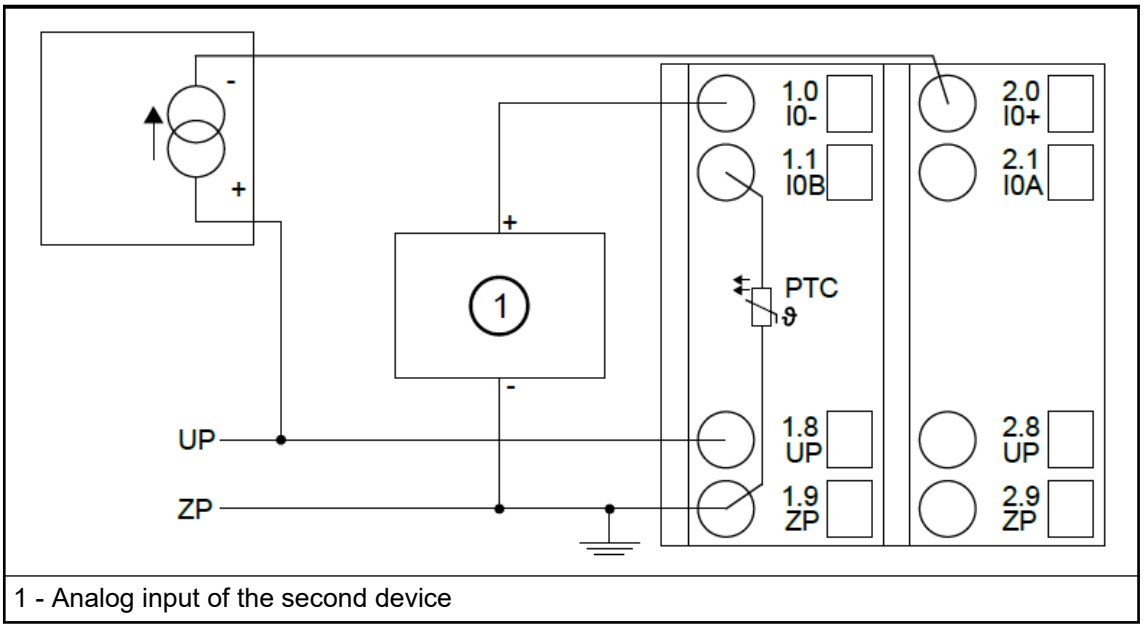
Unused input channels can be left open, because they are of low resistance.

Connection of passive-type analog sensors (Current)



Unused input channels can be left open, because they are of low resistance.

Connection of passive-type analog sensors (Current) and series-connection of an additional analog sensor



1 - Analog input of the second device

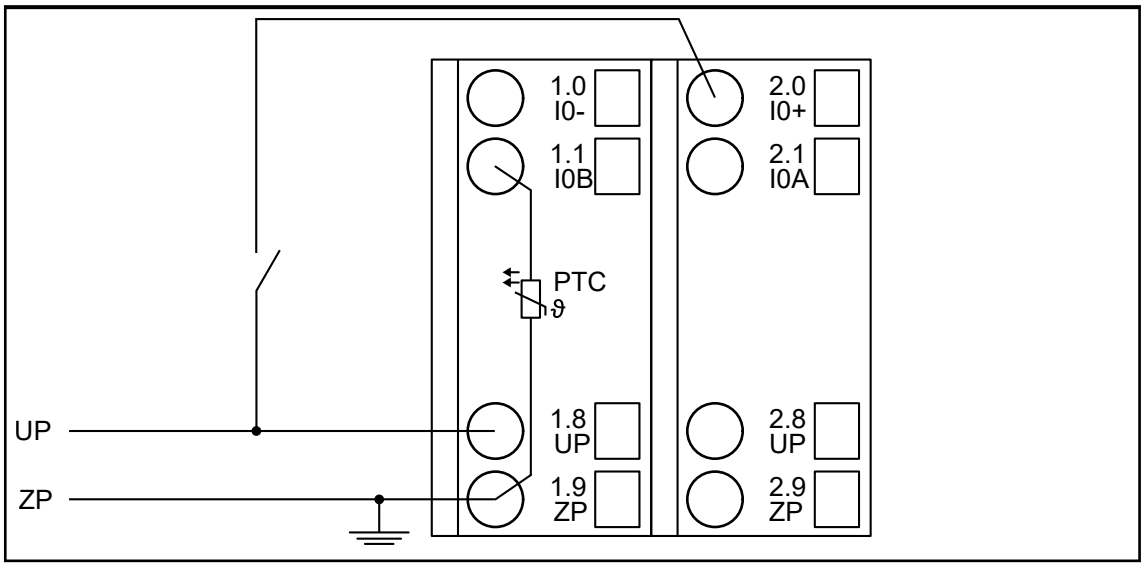
If series-connection of an additional input is used, the input resistance of the module (ca. 330 Ω) must be added to the input resistance of the second device. Make sure that the maximum permitted load resistance of the analog sensor is not exceeded (see the data sheet of the analog sensor).

The input of the module is not related to ZP. If the input of the second device is related to ZP, the order of sequence in the series-connection must be observed by all means (from the sensor to the module and then to the input of the second device).

Unused input channels can be left open, because they are of low resistance.

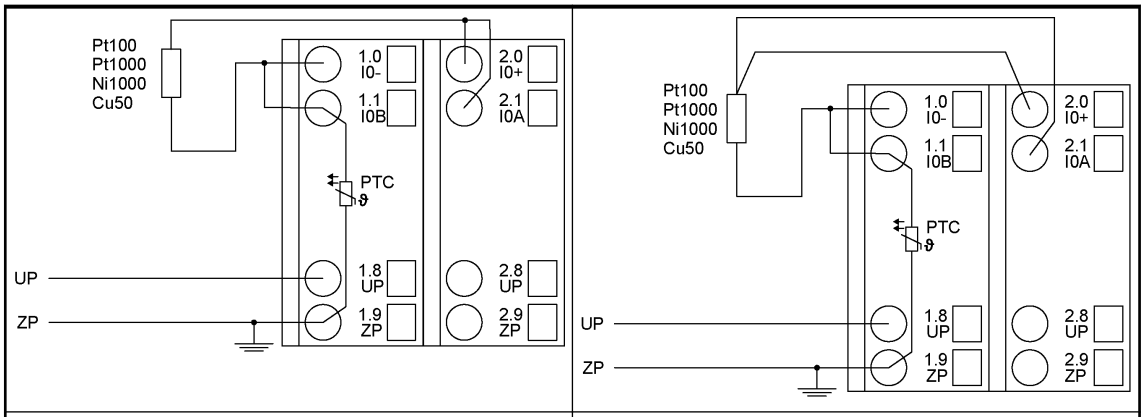
Connection of digital signal sources at analog inputs

Several (or all) analog inputs can be configured as digital inputs. The inputs are not galvanically isolated against the other analog channels.

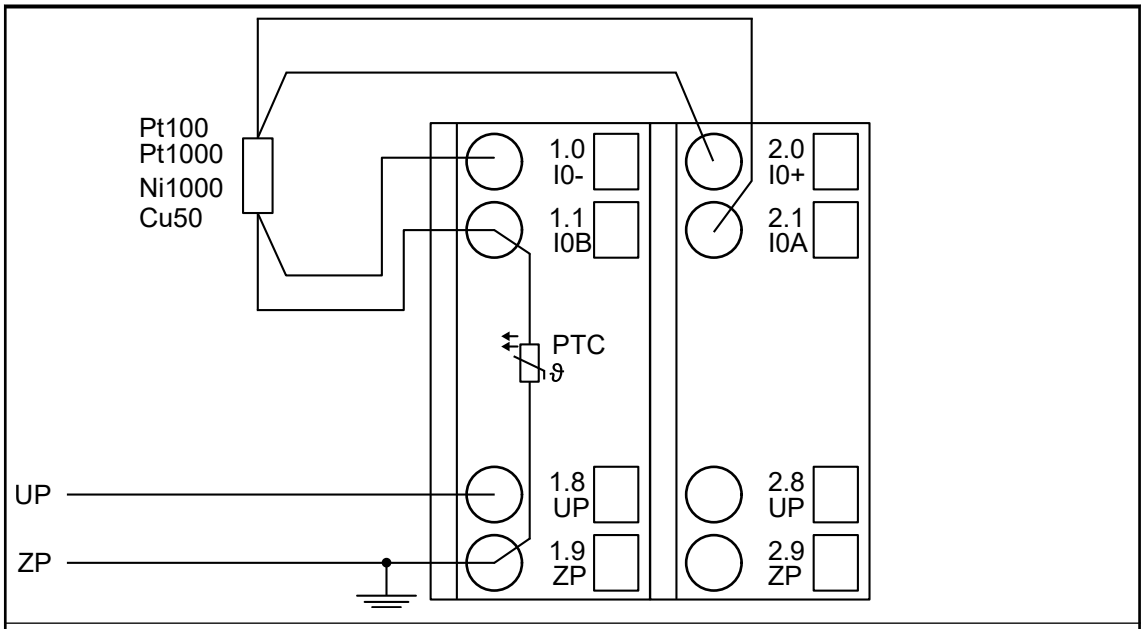


Connection of resistance thermometers

When resistance thermometers (Pt100, Pt1000, Ni1000, Cu50) are used, a constant current must flow through them to build the necessary voltage drop for the evaluation. For this, the module AI531 provides a constant current source which is multiplexed over the 4 analog channels.



2-wire configuration	3-wire configuration



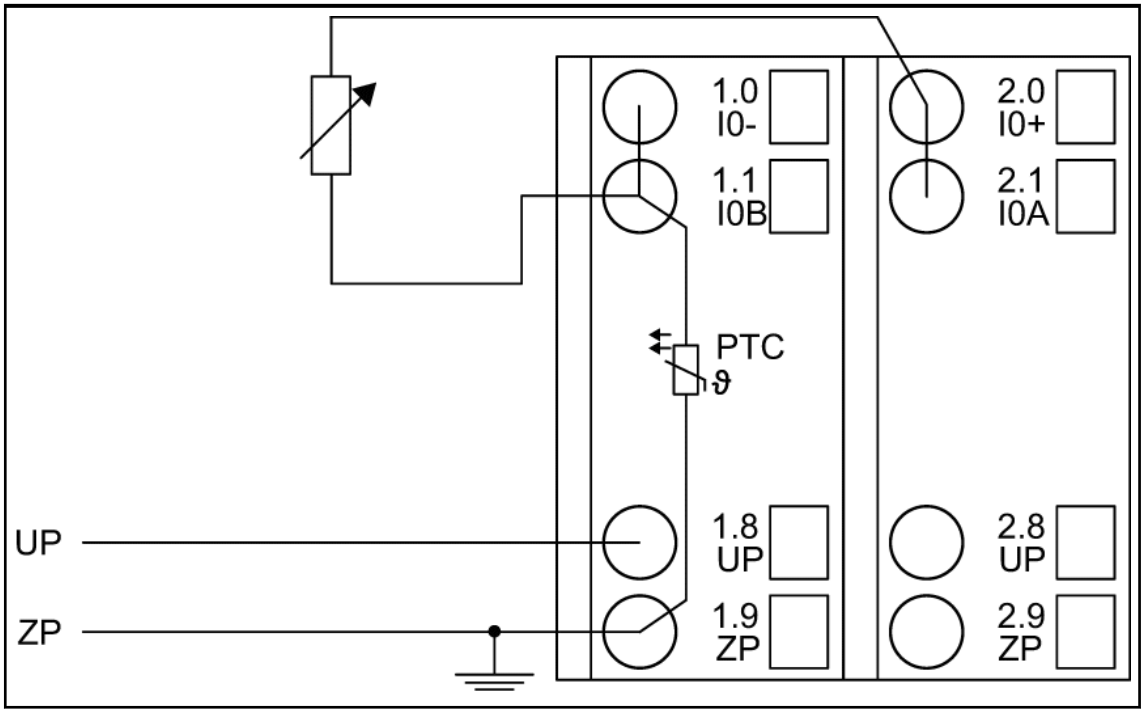
4-wire configuration

The module linearizes the resistance thermometer characteristics. In order to keep measuring errors as small as possible, it is necessary by all means to have all the involved conductors in the same cable. All the conductors must have the same cross section.

In order to avoid error messages from unused analog input channels, it is useful to configure them as "unused".

Connection of resistors in 2-wire configuration

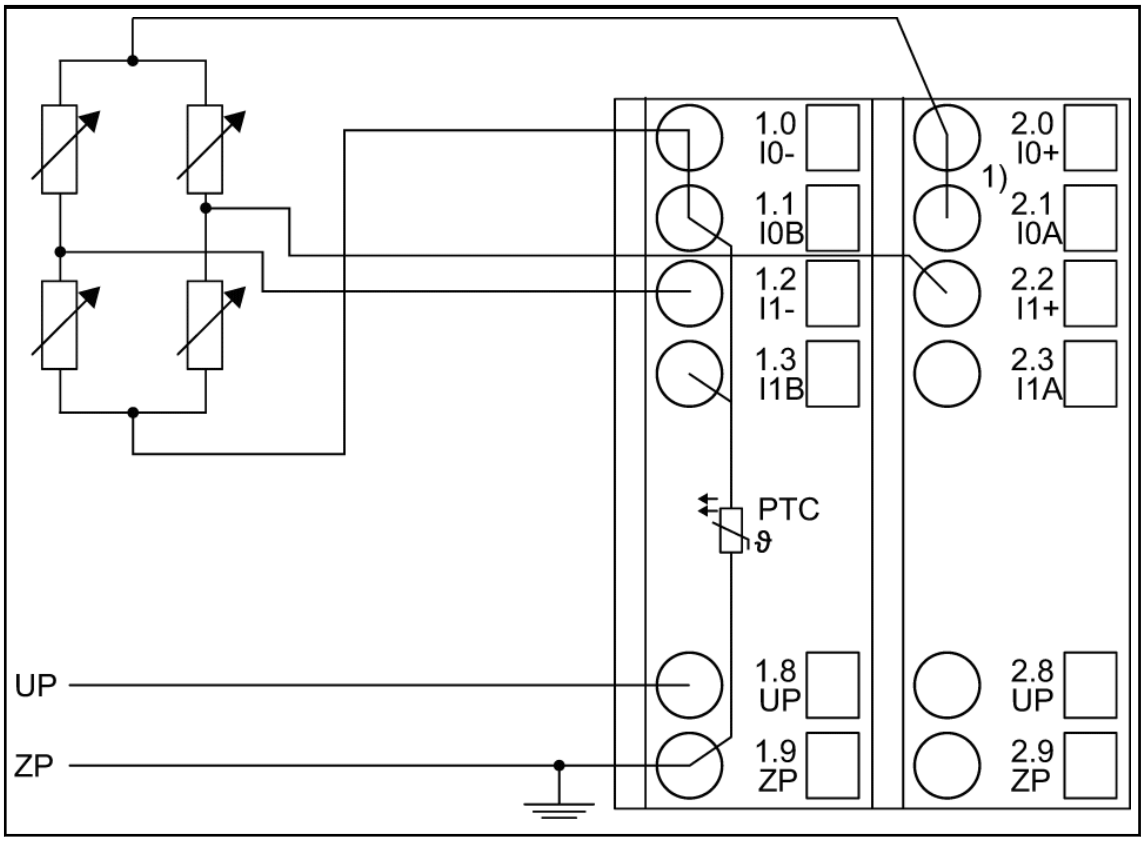
For evaluating resistors, a constant current must flow through them to build the necessary voltage drop. For this, the module AI531 provides a constant current source which is multiplexed over the 4 analog channels.



In order to avoid error messages from unused analog input channels, it is useful to configure them as "unused".

Connection of a resistance measuring bridge with internal supply

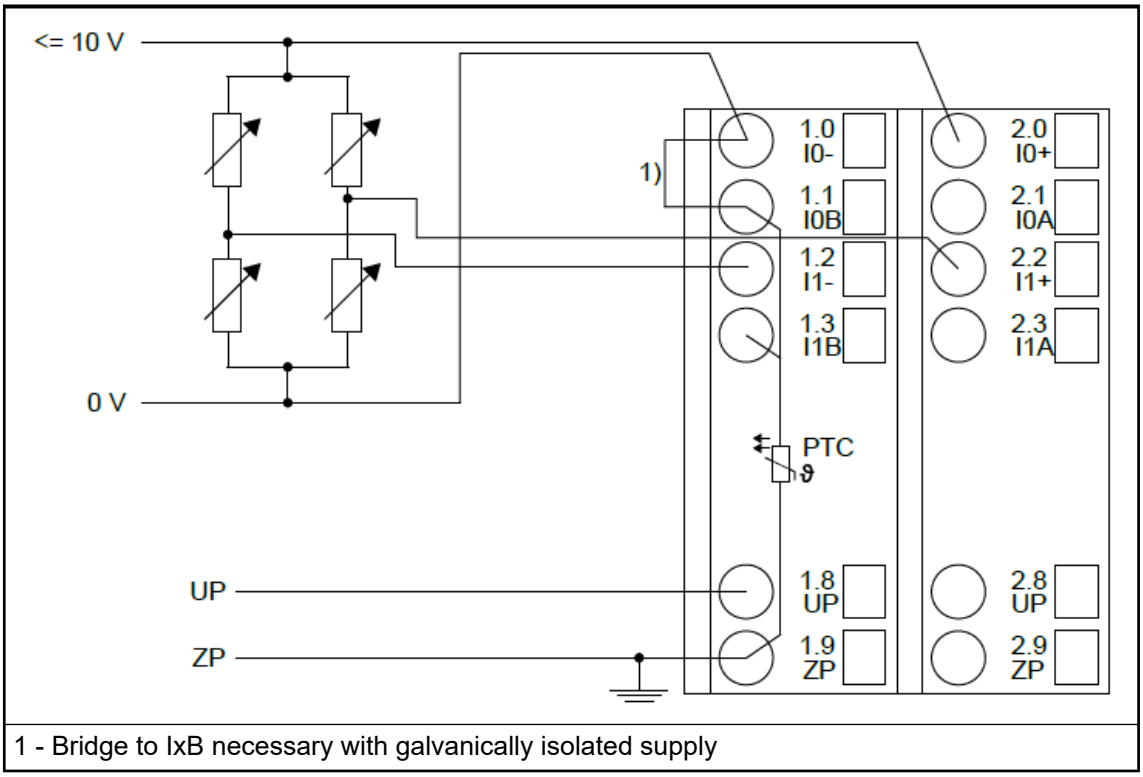
When resistance measuring bridges are connected, the short-circuit-proof voltage output (internal supply) at pin I0A (or I2A, I4A, I6A) must be used. This supply voltage is activated as soon as "Voltage Measurement" is configured for the relevant channel.



The calculation of the resistor deviation must be performed via the bridge voltage by the PLC user program.

Connection of a resistance measuring bridge with external supply

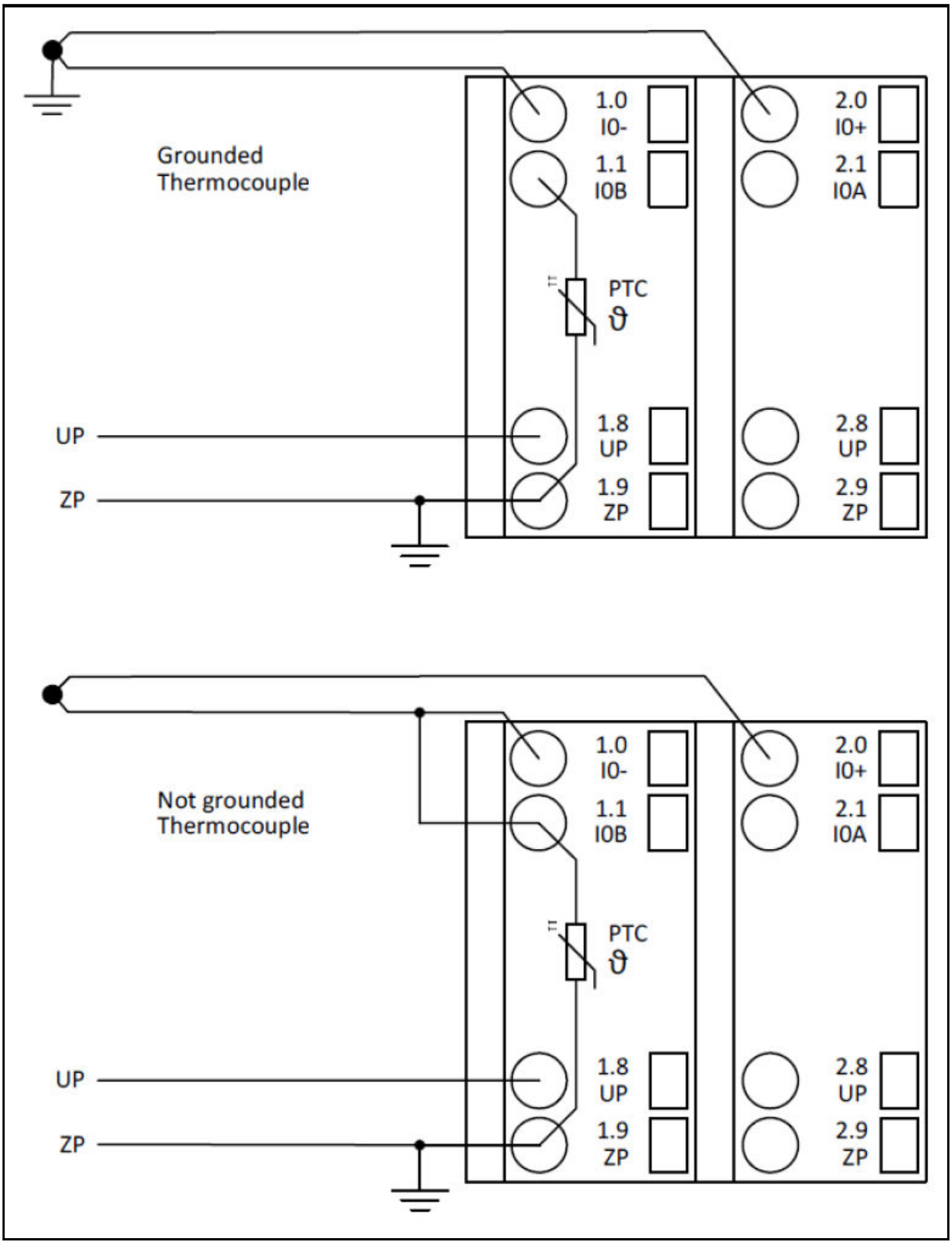
With the connection of a resistance measuring bridge with external supply, the supply voltage is provided separately.



1 - Bridge to IxB necessary with galvanically isolated supply

The calculation of the resistor deviation must be performed via the bridge voltage by the PLC user program.

Connection of thermocouples



The module linearizes the thermocouple characteristics. It supports the following possibilities of temperature compensation and handling with cold junctions:

Internal compensation

An internal temperature sensor which is located next to the terminal unit is used to detect the temperature of the cold junction. So the compensating cables must be connected directly to the terminal unit, where the cold junction is located.

The setting *“Internal compensation (default)”* for the parameter *“Compensation channel”* should be selected.

To get more precise temperature measurements, the use of an external compensation method is recommended.

External compensation with temperature input

The temperature for the cold junction can be determinated externally.

A measured or known temperature value (e.g. ambient temperature in the cabinet) is transferred to the module via the output data word to all required channels. The possible temperature range is -25 °C ... +60 °C and is monitored by the AI531.

The setting *“External with temperature value”* for the parameter *“Compensation channel”* should be selected.

External compensation with compensation box

A compensation box balances the temperature difference between the cold junction and the reference temperature by generating a bridge voltage. The reference temperature is transferred via the output data word.

The compensation box must fit to the type of thermocouple and is located at the end of the compensating cables, where the cold junction is located. The cabling to the AI531 can be carried out with normal cables. The operating manual of the compensation box also has to be considered.

The setting *“External with temperature value”* for the parameter *“Compensation channel”* should be selected.

External compensation with flanking channel

A flanking channel of the same input group can be used for compensation, e. g. for channel 3, the channels 0, 1 and 2 can be selected as reference channels. The type of sensor for the reference channel can be selected in the parameters for the flanking channel. For example, a RTD sensor which is located next to the thermocouple terminal can be used as reference point for other channels.

The setting *“Channel x”* for the parameter *“Compensation channel”* should be selected.

In order to avoid error messages from unused analog input channels, it is useful to configure them as "unused".

Internal data exchange

Digital inputs (bytes)	0
Digital outputs (bytes)	0
Analog inputs (words)	8
Analog outputs (words)	1

Parameterization

The module itself does not store configuration data. It receives its parameterization data from the master device of the I/O bus (CPU or communication interface module) during power-up of the system.

Hence, replacing I/O modules is possible without any re-parameterization via software.



If the external power supply voltage via UP/ZP terminals fails, the I/O module loses its configuration data. The whole station has to be switched off and on again to re-configure the module.

Firmware version	Configuration
Firmware version > V2.0.0	The arrangement of the parameter data is performed by Control Builder Plus/ Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Module: Module slot address: Y = 1 ... 10

Module parameters

Table 84: Module parameters

No.	Name	Default value	Internal value	Values in menu
2	Ignore module	Yes	0	Yes
			1	No
4	Check supply	On	0	On
			1	Off

Channel parameters

Table 85: Channel configuration

No.	Name	Default value	Internal value	Operating modes of the analog inputs, individually configurable
1	Channel configuration	Unused	0	Unused (default)
			1	Analog input 0 V ... 10 V
			2	Digital input
			3	Analog input 0 mA ... 20 mA
			4	Analog input 4 mA ... 20 mA
			5	Analog input -10 V ... +10 V
			8	Analog input Pt100, -50 °C ... +400 °C (2-wire)
			9	Analog input Pt100, -50 °C ... +400 °C (3-wire), requires 2 channels *)
			10	Analog input 0 ... 10 V via differential inputs, requires 2 channels *)
			11	Analog input -10 V ... +10 V via differential inputs, requires 2 channels *)
			14	Analog input Pt100, -50 °C ... +70 °C (2-wire)

No.	Name	Default value	Internal value	Operating modes of the analog inputs, individually configurable
			15	Analog input Pt100, -50 °C ... +70 °C (3-wire), requires 2 channels *)
			16	Analog input Pt1000, -50 °C ... +400 °C (2-wire)
			17	Analog input Pt1000, -50 °C ... +400 °C (3-wire), requires 2 channels *)
			18	Analog input Ni1000, -50 °C ... +150 °C (2-wire)
			19	Analog input Ni1000, -50 °C ... +150 °C (3-wire), requires 2 channels *)
2	Channel monitoring	Diagnosis	0	Diagnosis (Plausib, Cut wire, Short circuit)
			3	Not used
*) In the operating modes with 3-wire configuration or with differential inputs, two adjacent analog inputs belong together (e.g. the channels 0 and 1). In these cases, both channels are configured in the desired operating mode. The lower address must be the even address (channel 0). The next higher address must be the odd address (channel 1). The converted analog value is available at the higher address (channel 1).				

Diagnosis

Table 86: Possible diagnosis of I/O channels

Output range	Condition	
	Output value in the PLC underflow	Output value in the PLC overflow
0 mA ... 20 mA	Error identifier = 7	Error identifier = 4
4 mA ... 20 mA		
-10 V ... +10 V		

Table 87: Error severity E3: Warnings

Error severity	Location	Error code	d1	d2	d3	d4	Description	Remedy
								
E3	iob (I/O bus)	3	14	1 ... 10	31	31	Timeout in the I/O module	Replace I/O module
E3	iob (I/O bus)	9	14	1 ... 10	31	31	Overflow diagnosis buffer	New start
E3	iob (I/O bus)	11	14	1 ... 10	31	31	Process voltage too low	Check process voltage
E3	iob (I/O bus)	19	14	1 ... 10	31	31	Checksum error in the I/O module	Replace I/O module
E3	iob (I/O bus)	26	14	1 ... 10	31	31	Parameter error	Check master
E3	iob (I/O bus)	36	14	1 ... 10	31	31	Internal data exchange failure	Replace I/O module

Error severity	Location	Error code	d1	d2	d3	d4	Description	Remedy
								
E3	iob (I/O bus)	40	14	1 ... 10	31	31	Different hard-/firmware versions in the module	Replace I/O module
E3	iob (I/O bus)	43	14	1 ... 10	31	31	Internal error in the module	Replace I/O module

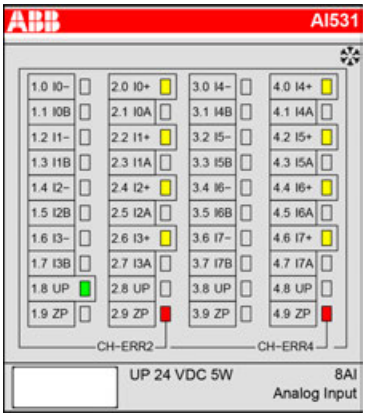
Table 88: Error severity E4: Warnings

Error severity	Location	Error code	d1	d2	d3	d4	Description	Remedy
								
E4	iob (I/O bus)	1	14	1 ... 10	1	0 ... 7	Possibly wrong measured value caused by inadmissible temperature of the compensation channel	Check the temperature compensation channel
E4	iob (I/O bus)	2	14	1 ... 10	1	31	Invalid measured value of the channel caused by overly high voltage difference	Check voltage difference; install equalizing conductors if necessary
E4	iob (I/O bus)	7	14	1 ... 10	1	0 ... 7	Analog value underflow at an analog input	Check input value
E4	iob (I/O bus)	11	14	1 ... 10	1	0 ... 7	Output voltage 10 V faulty	Check output load
E4	iob (I/O bus)	47	14	1 ... 10	1	0 ... 7	Short circuit at an analog input	Check input value
E4	iob (I/O bus)	48	14	1 ... 10	1	0 ... 7	Analog value overflow or broken wire at an analog input	Check input value or terminal

State LEDs

During the power ON procedure, the module initializes automatically. All LEDs (except the channel LEDs) are ON during this time.

States of the LEDs (see also section diagnosis LEDs in the S500 system data):

LED		State	Color	LED = OFF	LED = ON	LED flashes
	Inputs I0 ... I3 and I4 ... I7	Analog input	Yellow	Input is OFF	Input is ON (brightness depends on the value of the analog signal)	--
	UP	Process voltage 24 V DC via terminal	Green	Process voltage is missing	Process voltage OK	--
	CH-ERR2	Channel error, messages in groups (analog inputs combined into the groups 2 and 4)	Red	No error, or process voltage is missing	Severe error within the corresponding group	Error on one channel of the group
	CH-ERR4		Red			
	CH-ERR *)	Module error	Red	--	Internal error	--
	*) Both LEDs CH-ERR2 and CH-ERR4 light up together					

Measuring ranges

Voltage input ranges

Bipolar voltage input range, measuring bridge

The represented resolution corresponds to 16 bits.

Range	-50 mV ... +50 mV	-500 mV ... +500 mV	-1 V ... +1 V	-5 V ... +5 V	-10 V ... +10 V	Common Mode Voltage	Digital value	
							Decimal	Hex.
Overflow	> 58.7945	> 587.9449	> 1.17589	> 5.8794	> 11.7589	> 20.0000	32767	7FFF
Measured value too high	58.7945 : 50.0018	587.9449 : 500.0181	1.17589 : 1.00004	5.8794 : 5.0002	11.7589 : 10.0004		32511 : 27649	7EFF : 6C01
Normal range	50.0000 : 0.0018	500.0000 : 0.0181	1.00000 : 0.00004	5.0000 : 0.0002	10.0000 : 0.0004	20.0000 : 0.0008	27648 : 1	6C00 : 0001
	0.0000	0.0000	0.0000	0.00000	0.0000	0.0000	0	0000

Range	-50 mV ... +50 mV	-500 mV ... +500 mV	-1 V ... +1 V	-5 V ... +5 V	-10 V ... +10 V	Common Mode Voltage	Digital value	
							Decimal	Hex.
Normal range or Measured value too low	-0.0018 : -50.0000	-0.0181 : -500.0000	-0.00004 : -1.00000	-0.0002 : -5.0000	-0.004 : -10.0000	-0.0008 : -20.0000	-1 : -27648	FFFF : 9400
Measured value too low	-50.0018 : -58.7945	-500.0181 : -587.9449	-1.00004 : -1.17589	-5.0002 : -5.8794	-10.0004 : -11.7589		-27649 : -32512	93FF : 8100
Underflow	< -58.7945	< -587.9449	< -1.17589	< -5.8794	< -11.7589	< -20.0000	-32768	8000

Unipolar voltage input range, measuring bridge, digital input

Range		0 V ... +5 V	0 V ... +10 V	Digital input	Digital value	
					Decimal	Hex.
Measured value too high		5.8794 : 5.0002	11.7589 : 10.0004		32511 : 27649	7EFF : 6C01
Normal range		5.0000 : 0.0002	10.0000 : 0.0004	ON	27648 : 1	6C00 : 0001
		0.0000	0.0000	OFF	0	0000
Measured value too low		-0.0002 : -0.8794	-0.0004 : -1.1759		-1 : -4864	FFFF : ED00
Underflow		< -0.8794	< -1.1759		-32768	8000

Current input ranges

Range	-20 mA ... +20 mA	0 mA ... +20 mA	4 mA ... 20 mA	Digital value	
				Decimal	Hex.
Overflow	> 23.5178	> 23.5178	> 22.8142	32767	7FFF
Measured value too high	23.5178 : 20.0007	23.5178 : 20.0007	22.8142 : 20.0006	32511 : 27649	7EFF : 6C01

Range	-20 mA ... +20 mA	0 mA ... +20 mA	4 mA ... 20 mA	Digital value	
				Decimal	Hex.
Normal range	20.0000 : 0.0007	20.0000 : 0.0007	20.0000 : 4.0006	27648 : 1	6C00 : 0001
	0.0000	0.0000	4.0000	0	0000
	-0.0007 : -20.0000			-1 : -27648	FFFF : 9400
Measured value too low		-0.0007 : -3.5178	3.9994 : 1.1852	-1 : -4864	FFFF : ED00
	-20.0007 : -23.5178			-27649 : -32512	93FF : 8100
Underflow	< -23.5178	< -3.5178	< 1.1852	-32768	8000

Resistance thermometer input ranges

The represented resolution corresponds to 16 bits.

Range	Pt100 -50 °C ... +70 °C [1)]	Pt100 / Pt1000 -50 °C ... +400 °C	Pt100 -200 °C ... +850 °C	Ni1000 -50 °C ... +150 °C	Cu50 -200 °C ... +200 °C	Digital value	
						Decimal	Hex.
Overflow	> +80.0 °C	> +450.0 °C	> +850 °C	> +160.0 °C	> +200 °C	32767	7FFF
Measured value too high		+450.0 °C : +400.1 °C				4500 : 4001	1194 : 0FA1
				+160.0 °C : +150.1 °C		1600 : 1501	0640 : 05DD
	+80.0 °C : +70.1 °C					800 : 701	0320 : 02BD

Range	Pt100 -50 °C ... +70 °C [1])	Pt100 / Pt1000 -50 °C ... +400 °C	Pt100 -200 °C ... +850 °C	Ni1000 -50 °C ... +150 °C	Cu50 -200 °C ... +200 °C	Digital value	
						Decimal	Hex.
Normal range	: : : : +70.0 °C : +0.1 °C	: +400.0 °C : : : : + 0.1 °C	+850.0 °C : : : : +0.1 °C	: : : +150.0 °C : : +0.1 °C	: : +200.0 °C : : : +0.1 °C	8500 4000 2000 1500 700 : 1	2134 0FA0 07D0 05DC 02BC : 1
	0.0 °C	0.0 °C	0.0 °C	0.0 °C		0	0000
	-0.1 °C : -50.0 °C	-0.1 °C : -50.0 °C	-0.1 °C : : -200 °C	-0.1 °C : -50.0 °C	-0.1 °C : -50.0 °C [2]) -200.0 °C [2])	-1 : -500 -2000	FFFF : FE0C F830
Measured value too low	-50.1 °C : -60.0 °C	-50.1 °C : -60.0 °C		-50.1 °C : -60.0 °C		-501 : -600	FE0B : FDA8
Under-flow	< -60.0 °C	< -60.0 °C	< -200 °C	< -60.0 °C	< -200 °C [2])	-32768	8000

[1]) also possible with resolution 0.01 K

[2]) if Cu50 with 1.426, -50 °C is valid; if Cu50 with 1.428, -200.0 °C is valid

Resistor input range

The represented resolution corresponds to 16 bits.

Range	Resistor [Ω]	Digital value	
		Decimal	Hex.
Overflow	> 55000	32767	7FFF
Measured value too high	55000 : 50001	30413 : 27649	76CD : 6C01
Normal range	50000 : 2 1 0	27648 : 1 1 0	6C00 : 0001 0001 0000

Thermocouple input ranges

The represented resolution corresponds to 16 bits.

Range	Typ J -210 °C ... +1200 °C	Typ K -270 °C ... +1372 °C	Typ N -270 °C ... +1300 °C	Typ S -50 °C ... +1768 °C	Typ T -270 °C ... +400 °C	Digital value	
						Decimal	Hex.
Overflow	> +1200.0 °C	> +1372.0 °C	> +1300.0 °C	> +1768.0 °C	> +400.0 °C	32767	7FFF
Normal range				+1768.0 °C		17680	4510
		+1372.0 °C		:		13720	3598
		:	+1300.0 °C	:		13000	32C8
	+1200.0 °C	:	:	:		12000	2EE0
	:	:	:	:	+400.0 °C	4000	0FA0
	:	:	:	:	:	:	:
	+0.1 °C	+0.1 °C	+0.1 °C	+0.1 °C	+0.1 °C	1	1
	0.0 °C	0.0 °C	0.0 °C	0.0 °C		0	0000
	-0.1 °C	-0.1 °C	-0.1 °C	-0.1 °C	-0.1 °C	-1	FFFF
	:	:	:	:	:	:	:
	:	:	:	-50.0 °C	:	-500	FE0C
	-210.0 °C	:	:	:	:	-2100	F7CC
		-270.0 °C	-270.0 °C		-270.0 °C	-2700	F574
Under-flow	< -210.0 °C	< -270.0 °C	< -270.0 °C	< -50.0 °C	< -270.0 °C	-32768	8000

Temperature-internal reference point ranges

Range	Value	Digital value	
		Decimal	Hex.
Overflow	> +85 °C	32767	7FFF
Normal range	+85 °C	850	0352
	0 °C	0	0000
	-40 °C	-400	FE70
Underflow	< -40 °C	-32768	8000

Technical data

Technical data of the module

The AC500 and S500 system data is applicable to the standard version.

↳ *Chapter 2.6.1 “System data AC500” on page 1194*

The AC500-XC system data is applicable to the XC version.

↳ *Chapter 2.7.1 “System data AC500-XC” on page 1263*

Only deviating specifications are therefore described here.

The technical data is also applicable to the XC version.

Parameter		Value
Process voltage		
	Rated value	24 V DC
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	Rated protection fuse on UP	10 A fast
	Galvanic isolation	Yes, per module
Current consumption		
	From 24 V DC power supply at the terminals UP/L+ and ZP/M of the CPU/communication interface module	Ca. 2 mA
	Current consumption from UP in normal operation	130 mA
	Inrush current from UP (at power up)	0.056 A^2s
Max. length of analog cables, conductor cross section > 0.14 mm^2 *)		100 m
Weight		130 g
Mounting position		• Horizontal mounting or • Vertical mounting with derating (max. temperature 40 °C)
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.
Temperature		+0.1 °C (0,01°C at Pt100 -50 °C ... +70 °C)
Internal power supply		Through the I/O bus interface (I/O bus)
External power supply		Via terminals (process voltage UP = 24 V DC)
*) The additional current of approx. 3µA flows out of the input for the wire break detection. Depending on the internal resistance of the signal source and the wire, this can lead to a higher measured value due to the voltage drop.		

NOTICE!

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

Technical data of the analog inputs

Parameter	Value
Number of channels per module	8
Distribution of channels into groups	1 group of 8 channels

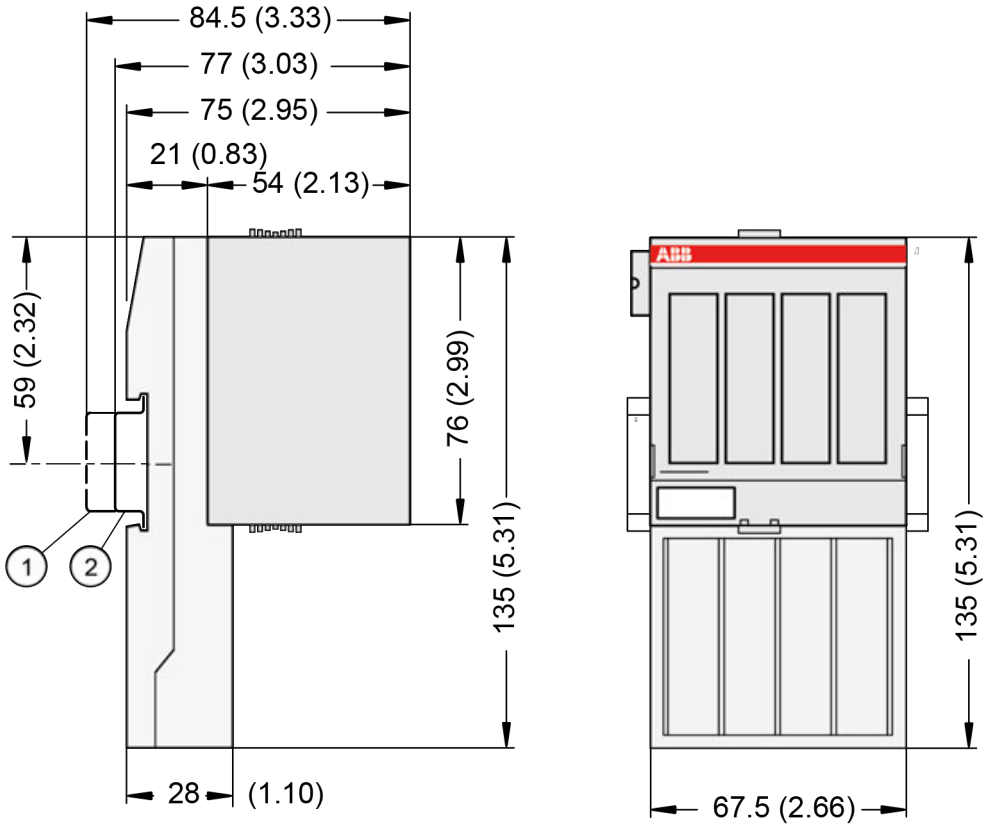
Parameter		Value	
Input type		Bipolar (not with current or Pt100/ Pt1000/ Ni1000/ Cu50/ resistor)	
Galvanic isolation			
	Between the channels	No	
	Between the channels and I/O bus	Yes	
	Between the channels and process supply voltage (UP, ZP)	No	
Common mode input range		± 20 V DC plus signal voltage	
Configurability		Digital input, -50 mV ... +50 mV, -500mV ... +500 mV, -1 V ... +1 V, -5 V ... +5 V, -10 V ... +10 V, 0 V ... +5 V, 0 V ... +10 V, -20 mA ... +20 mA, 0 mA ... 20 mA, 4 mA ... 20 mA, Pt100, Pt1000, Ni1000, Cu50, resistor, thermocouple types J, K, N, S, T (each input can be configured individually)	
Channel input resistance		Voltage: > 100 kΩ, current: ca. 330 Ω	
Input filter		● Line-frequency suppression 50 Hz ● Line-frequency suppression 60 Hz ● No line-frequency suppression	
Indication of the input signals		1 yellow LED per channel, the brightness depends on the value of the analog signal	
Conversion time		● 1 ms (if line-frequency suppression is not activated), ● 100 ms (50 Hz / 60 Hz if line-frequency suppression is activated) per channel	
Resolution		16 bits including sign	
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range		Typ.	± 0.1 % (voltage) ± 0.3 % (current, resistor) at 25 °C
		Max.	± 0.7 % (voltage) ± 0.9 % (current, resistor) ± 0.5 % (thermocouple type J, N, S, T; thermocouple type K > -220 °C) 1.0 K (resistance temperature detectors) at 0 °C ... 60 °C or EMC disturbance
Maximum permanent allowed overload (no damage)			
	Current input	When the input current exceeds the overflow value of the measurement range, the input impedance is switched to high impedance for protection. The maximum allowed overload is then 30 V. The digital value corresponds to the overflow value. Periodically, the input impedance is switched to the normal value and the input current is measured. If the input current is within the measurement range, the input impedance remains at the normal level and the digital value corresponds to the measured current.	

Parameter	Value
Voltage input	30 V
Digital input	24 V
Effect of incorrect input terminal connection	Wrong or no signal detected, no damage up to 35 V
Unused voltage inputs	Are configured as "unused"
Unused current inputs	Have a low resistance, can be left open-circuited
Overvoltage protection	Yes

Technical data of the analog inputs if used as digital inputs

Parameter	Value
Number of channels per module	Max. 8
Distribution of channels into groups	1 group of 8 channels
Input delay	Typ. 2 ms
Indication of the input signals	1 LED per channel
Input signal voltage	24 V DC
Signal 0	-30 V ... +5 V
Undefined signal	+5 V ... +13 V
Signal 1	+13 V ... +30 V
Input current per channel	
Input voltage +24 V	Typ. 5 mA
Input voltage +5 V	Typ. 1 mA
Input voltage +15 V	Typ. 3.1 mA
Input voltage +30 V	< 7 mA
Input resistance	Ca. 4.8 kΩ

Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 250 600 R0001	AI531, analog input module, 8 AI, U/I/Pt100, TC, 16 bits including sign, 4-wires	Active
1SAP 450 600 R0001	AI531-XC, analog input module, 8 AI, U/I/Pt100, TC, 16 bits including sign, 4-wires, XC version	Active

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