

10.4 Analog input modules

Diagnostic message	Configurable	Possible cause of error	Corrective measure
Parameter assignment error	No	One parameter, or the combination of parameters, is not plausible	Reassign the module parameters
		The wire jumper (terminals 10 and 11) does not match the parameter assignment of the measurement type.	Check wire jumper
Wire break	Yes	The connection of the transducer is interrupted	Check the wiring
		Resistance of sensor protection circuit too high	Use a different type of sensor or modify the wiring, for example, use cables with larger cross-section
		Channel not connected (open)	Disable the channel group ("Measurement type" parameter) or connect the channel
Low limit violation of measuring range / under-range	Yes (Group diagnostics)	Analog value below the under-range	Check the measuring range selection
		In the case of measuring range 4 mA to 20 mA, sensor may be connected with reverse polarity.	Check terminals
High limit violation of measuring range / over-range	Yes (Group diagnostics)	Analog value above the over-range	Assign a different measuring range

10.4.5 Analog input module AI 8 x TC/4 x RTD

Article numbers

Standard module: 6ES7 650-8AR60-0AA0

Module with conformal coating: 6ES7 650-8AR60-1AA0

Properties

The analog input module AI 8 x TC/4 x RTD is characterized by the following properties:

- 8 inputs in 4 channel groups
- Measured value resolution, can be set for each channel group (depending on the set interference frequency suppression)
 - 9 bits + sign (integration time 2.5 ms) $\triangleq$ 400 Hz
 - 12 bits + sign (integration time 16.67 / 20 ms) $\triangleq$ 60/50 Hz
 - 15 bits + sign (integration time 100 ms) $\triangleq$ 10 Hz

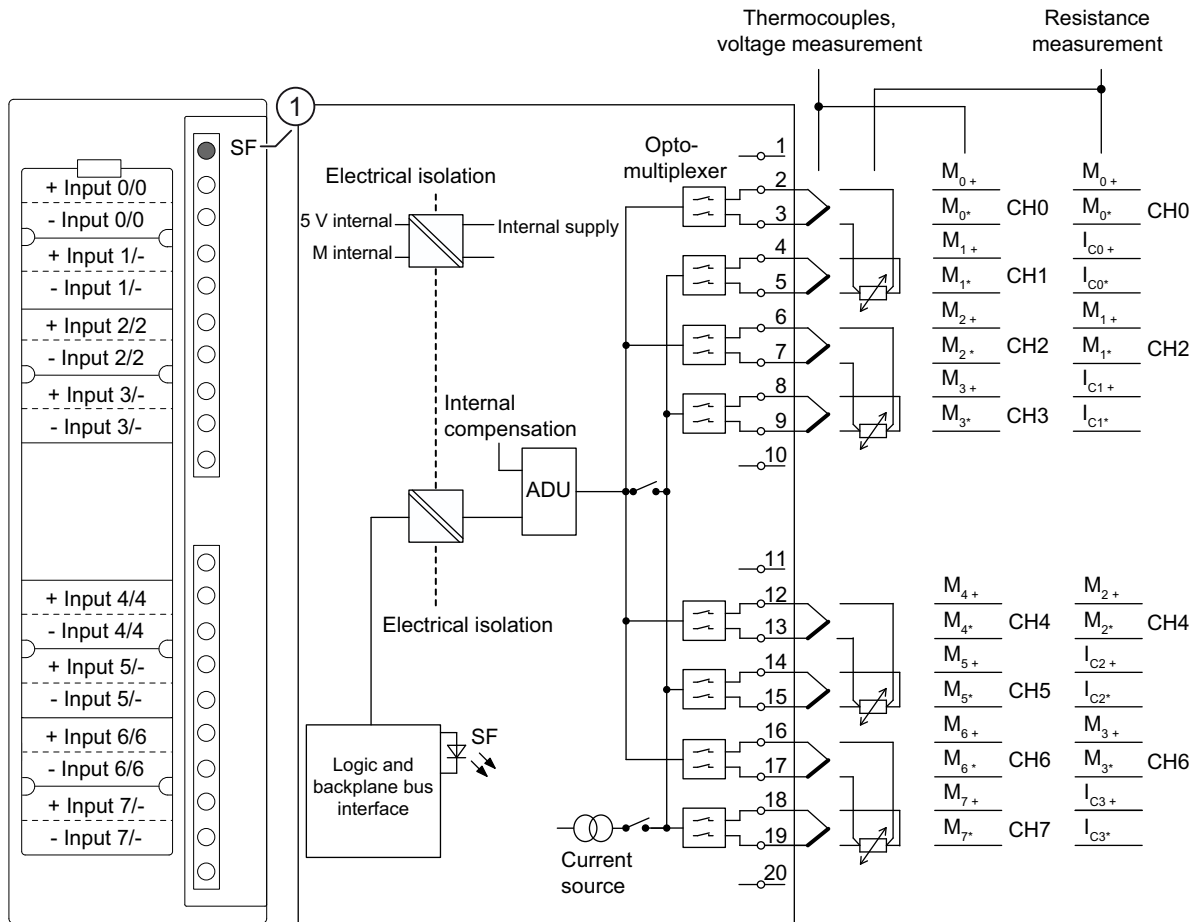
- Measurement type can be selected for each channel group:
 - Voltage
 - Resistance (in non-redundant use)
 - Temperature
- Any measuring range selection for each channel group
- Configurable diagnostics
- Configurable diagnostic interrupt
- Electrically isolated from the CPU
- Common mode < 60 V between the channels
- Configuration in Run (CiR) supported

Resolution

The resolution of the measured value is directly dependent on the integration time selected, i.e. the longer the integration time for an analog input channel is, the more accurate the resolution of the measured value will be.

Wiring and block diagrams of the AI 8 x TC/4 x RTD

Module view and wiring diagram of AI 8 x TC/4 x RTD.



① Group error display - red (SF LED)

Figure 10-18 Module view and block diagram of the AI 8 x TC/4 x RTD

Notes on the module

No external supply voltage L+ (24 V) is necessary for the analog input module AI 8 x TC/4 x RTD.

If thermal resistors (e.g. Pt100) are used for external compensation, connect them to channels 6 and 7.

If a compensation box is used for external compensation, connect it to channel 7.

Notes on the front connector

If you use the front connector 6ES7392-1AJ20-0AA0, you attain a higher accuracy of temperature measurements with thermocouples in the "Internal compensation" measurement type. The accuracy of the internal reference junction temperature is ± 1.5 K when this front connector is used at ambient temperatures from 0 to 60 °C.

You can connect cables of 0.25 mm² to 1 mm².

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Note**Measurement of temperatures with thermocouples**

Observe the following when measuring temperatures by means of thermocouples and assigned redundancy:

The value specified on the "Redundancy" tab under "Tolerance window" is always based on 2764.8 °C. Thus, for example, based on the input of "1" a tolerance of 27 degrees is checked. When "5" is entered, a tolerance of 138 degrees is checked.

Technical specifications of the AI 8 x TC/4 x RTD

Technical specifications				
Dimensions and weight				
Dimensions W x H x D (mm)		40 x 125 x 120		
Weight		Approx. 210 g		
Module-specific data				
Number of inputs		8		
• With resistance transducers		4		
Cable length, shielded		Max. 200 m Max. 50 m for voltage ranges ≤ 80 mV and thermocouples		
Voltages, currents, potentials				
Bus power supply		5 V DC		
Current consumption from backplane bus		Max. 120 mA		
Power loss of the module		Typ. 0.6 W		
Electrical isolation				
• Between the channels and backplane bus		Yes		
• Between channels		No Permitted common-mode voltage: 75 V DC or 60 V AC		
Isolation, designed for basic isolation				
• Between the channels and backplane bus (U _{iso})		75 V DC or 60 V AC		
Isolation tested with		500 V AC or 707 V DC, type test		
Analog value formation				
Measuring principle		SIGMA-DELTA		
Integration/conversion time/resolution (per channel)				
• Configurable		Yes	Yes	Yes
• Integration time in ms		2.5	16.67	100
• Basic conversion time =		7.5	50	60
• 3 x integration time +		+	+	+
• Transient recovery time of optomultiplexer in ms		2.5	2.5	2.5
• Additional conversion time for wire break detection in ms		2.5	2.5	2.5

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Sensor selection data		
Input ranges (rated values) / input resistance	± 25 mV	/10 MΩ
• Voltage	± 50 mV	/10 MΩ
	± 80 mV	/10 MΩ
	± 250 mV	/10 MΩ
	± 500 mV	/10 MΩ
	± 1 V	/10 MΩ
• Resistance	150 Ω	/10 MΩ
	300 Ω	/10 MΩ
	600 Ω	/10 MΩ
• Thermocouples	Type: T, U, E, J, L, K, N, R, S, B	/10 MΩ
• Resistance thermometer	Pt100, Pt200, Ni100	/10 MΩ
Measuring current for thermal resistors and wire-break check	Approx. 0.5 mA	
Permissible input voltage for voltage input (destruction limit)	Max. 35 V permanent; 75 V for max. 1 s (pulse duty factor 1:10)	
Connecting the signal transmitter		
• For voltage measurement	Supported	
• For resistance measurement with 4-wire connection, with 3-wire connection ¹ with 2-wire connection ¹	Supported	
Characteristics linearization	Configurable	
• For thermocouples	• Type : T, U, E, J, L, K, N, R, S, B	
• For thermal resistors	• Pt100, Pt200, Ni 100 (standard and climatic range)	
Temperature compensation	Configurable	
• Internal temperature compensation	Supported	
• External temperature compensation with compensation box	Supported	
• External temperature compensation with thermal resistors (e.g. Pt100)	Supported	
• Compensation for 0 °C reference junction temperature	Supported	
• Compensation for 50° C reference junction temperature	Supported	
¹ Without cable resistance correction		

10.4.5.1 Parameters of the AI 8 x TC/4 x RTD

Parameter assignment

The parameters are assigned using the parameter assignment dialog of HW Config

Parameters of the AI 8 x TC/4 x RTD

The table below provides an overview of the assignable parameters and their default settings for the AI 8 x TC/4 x RTD.

The default settings apply when you have not assigned parameters in HW Config or you have not changed any parameters.

Table 10-19 Parameters of the AI 8 x TC/4 x RTD

Parameter	Value range	Default setting	Scope
Diagnostic interrupt enable	Yes / No	Yes	Module
Diagnostics			
• Group diagnostics	Yes / No	Yes	Channel
• Wire break check	Yes / No	Yes	Channel
Measurement type	Disabled U: Voltage R-4L: Resistance (4-wire connection) RT: Resistance (thermal resistance) TC-L00C: Thermocouple (Ref.Temp 0°C) TC-L50C: Thermocouple (Ref.Temp 50°C) TC-IL: Thermocouple (comp. internal) TC-EL: Thermocouple (comp. external)	U	Channel group
Measuring range	Corresponds to the set measurement type see below	+/- 1 V	Channel group
Interference frequency suppression / integration time	400 Hz (2.5 ms) 60 Hz (16.6 ms) 50 Hz (20 ms) 10 Hz (100 ms)	50 Hz (20 ms)	Channel group

Channel groups

In the analog input module AI 8 x TC/4 x RTD, 2 channels are combined to form one channel group. Parameters can always only be assigned to one channel group, i.e. parameters that are assigned for a channel group always apply to both channels of this channel group.

Table 10-20 Assignment of analog input channels of the AI 8 x TC/4 x RTD to channel groups

Channel	Assigned channel group
Channel 0	Channel group 0
Channel 1	
Channel 2	Channel group 1
Channel 3	
Channel 4	Channel group 2
Channel 5	
Channel 6	Channel group 3
Channel 7	

Group diagnostics

The diagnostics parameter "Group diagnostics" enables the signaling of channel-specific errors to be switched off, with the exception of parameter assignment errors.

Wire break check

The analog input module AI 8 x TC/4 x RTD carries out a wire-break check for all ranges if it is enabled via parameter assignment. In the case of the thermal resistance measurement (RT), all 4 connection wires are monitored for wire break.

Possible measuring ranges

The possible measuring ranges as a function of the measurement type setting can be found in the following tables.

Measuring ranges for voltage measurements

Selected measurement type	Explanation	Measuring range
U	Voltage	$\pm 25 \text{ mV}$ $\pm 50 \text{ mV}$ $\pm 80 \text{ mV}$ $\pm 250 \text{ mV}$ $\pm 500 \text{ mV}$ $\pm 1 \text{ V}$

Measuring ranges for resistance measurement

Selected measurement type	Explanation	Measuring range
R-4L	Resistance 4-wire connection	150 ohms 300 ohms 600 ohms

Connectable thermocouples and their measuring ranges

The linearization of the thermocouple characteristic curves occurs for thermocouples in accordance with IEC 584.

Diagnostic messages and possible corrective measures

Table 10-22 Diagnostic messages of AI 8 x TC/4 x RTD and possible remedial measures

Diagnostic message	Configurable	Possible cause of error	Corrective measure
Module parameters not assigned	No	Startup error	Reassign the module parameters
Incorrect parameters	No	One parameter, or the combination of parameters, is not plausible	Reassign the module parameters
Time monitoring tripped	No	Intermittently high electromagnetic interference	Eliminate the interference
EPROM error	No	Module defective	Replace the module
RAM error	No	Module defective	Replace the module
Parameter assignment error	No	One parameter, or the combination of parameters, is not plausible	Reassign the module parameters
Wire break	Yes	The connection of the transducer is interrupted	Check the wiring
		Resistance of sensor protection circuit too high	Use a different type of sensor or modify the wiring, for example, use cables with larger cross-section
		Channel not connected (open)	Disable the channel group ("Measurement type" parameter) or connect the channel
Low limit violation of measuring range / under-range	Yes (group diagnostics)	Analog value below the under-range	Check the measuring range selection
		In the case of measuring range 4 mA to 20 mA, sensor may be connected with reverse polarity.	Check terminals
High limit violation of measuring range / over-range	Yes (group diagnostics)	Analog value above the over-range	Assign a different measuring range

10.5 Analog output modules

Overview of properties

The table below presents the ET 200PA SMART analog output module based on its most important properties.

Properties	Module	
	AO 8 x 12 Bit	AO 8 x 12 Bit HART
	6ES7 650-8BK60-xAA0	6ES7 650-8BT60-xAA0