SIEMENS

SIMATIC

ET 200S distributed I/O 2AI RTD HF analog electronic module (6ES7134-4NB51-0AB0)

Manual

05/2007
A5E01076876-02

Safety Guidelines

This manual contains notices you have to observe in order to ensure your personal safety, as well as to prevent damage to property. The notices referring to your personal safety are highlighted in the manual by a safety alert symbol, notices referring only to property damage have no safety alert symbol. These notices shown below are graded according to the degree of danger.

⚠DANGER

indicates that death or severe personal injury **will** result if proper precautions are not taken.

⚠WARNING

indicates that death or severe personal injury **may** result if proper precautions are not taken.

⚠CAUTION

with a safety alert symbol, indicates that minor personal injury can result if proper precautions are not taken.

CAUTION

without a safety alert symbol, indicates that property damage can result if proper precautions are not taken.

NOTICE

indicates that an unintended result or situation can occur if the corresponding information is not taken into account.

If more than one degree of danger is present, the warning notice representing the highest degree of danger will be used. A notice warning of injury to persons with a safety alert symbol may also include a warning relating to property damage.

Qualified Personnel

The device/system may only be set up and used in conjunction with this documentation. Commissioning and operation of a device/system may only be performed by **qualified personnel**. Within the context of the safety notes in this documentation qualified persons are defined as persons who are authorized to commission, ground and label devices, systems and circuits in accordance with established safety practices and standards.

Prescribed Usage

Note the following:

⚠WARNING

This device may only be used for the applications described in the catalog or the technical description and only in connection with devices or components from other manufacturers which have been approved or recommended by Siemens. Correct, reliable operation of the product requires proper transport, storage, positioning and assembly as well as careful operation and maintenance.

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Ordernumber: A5E01076876-02
℗ 09/2007

Preface

Purpose of the manual

This manual supplements the *ET 200S Distributed I/O System* Operating Instructions. General functions for the ET 200S are described in the *ET 200S Distributed I/O System* Operating Instructions.

The information in this document along with the operating instructions enables you to commission the ET 200S.

Basic knowledge requirements

To understand these operating instructions you should have general knowledge of automation engineering.

Scope of the manual

This manual applies to this ET 200S module. It describes the components that are valid at the time of publication.

Recycling and disposal

Thanks to the fact that it is low in contaminants, this ET 200S module is recyclable. For environmentally compliant recycling and disposal of your electronic waste, please contact a company certified for the disposal of electronic waste.

Additional support

If you have any questions relating to the products described in these operating instructions, and do not find the answers in this document, please contact your local Siemens representative.

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- Your local contact for Automation & Drives in our contact database.
- Information about on-site services, repairs, spare parts. Lots more can be found on our "Services" pages.

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Properties

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1.1 2AI RTD HF analog electronic module (6ES7134-4NB51-0AB0)

Properties

- 2 inputs for resistance thermometer or resistance measurement
- Input ranges
  - Resistance thermometers: Pt100; Ni100; Ni120; Pt200; Ni200; Pt500; Ni500; Pt1000; Ni1000; Cu10; resolution max. 15 bits + sign
  - Resistance measurement: 150 Ω; 300 Ω; 600 Ω; 3000 Ω; PTC; resolution max. 15 bits
- Automatic compensation of line resistances in the case of a three-wire connection
- Temperature coefficient can be assigned parameters for resistance-type sensors
- High accuracy
- Isolated from the load voltage
- Linearization of the sensor characteristic curves
- Permitted common-mode voltage 5 Vss AC
- Recording of reference junction temperature (together with the Electronic Module 2AI TC ST)
- Compatible with the 2AI RTD ST (6ES7134-4JB50-0AB50)

Note

The EM 2AI RTD HF can replace a 2AI RTD ST in an existing system.

- The wiring does not have to be changed. The additional bridges on the terminal module of the 2AI RTD ST do not have to be removed.
- The configuration (in HW Config or the GSD file) does not have to be changed. Only the new functions of the 2AI RTD HF cannot be assigned parameters in this instance.

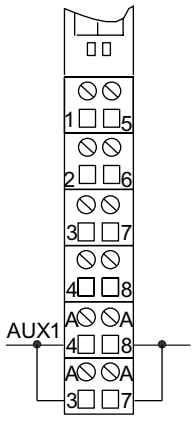
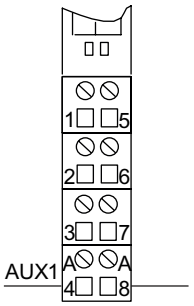
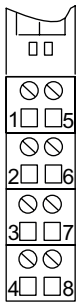
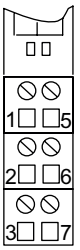
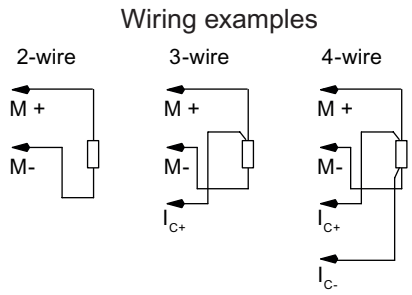
General terminal assignment

Note

Terminals 4, 8, A4, A8, A3 and A7 are only available at specified terminal modules.

Terminal assignment for 2AI RTD HF (6ES7134-4NB51-0AB0)				
Terminal	**Assignment**	**Terminal**	**Assignment**	**Notes**
1	M_{0+}	**5**	M_{1+}	• M_{n+}: Measuring line positive, Channel n • M_{n-}: Measuring line negative, Channel n • I_{C0+}: Constant current line positive, Channel n • I_{C0-}: Measuring line negative, Channel n • AUX1: Protective-conductor terminal or potential bus (freely usable up to 230 VAC)
2	M_{0-}	**6**	M_{1-}	
3	I_{C0+}	**7**	I_{C1+}	
4	I_{C0-}	**8**	I_{C1-}	
A4	AUX1	**A8**	AUX1	
A3	AUX1	**A7**	AUX1	

Usable terminal modules

Usable terminal modules for 2AI RTD HF (6ES7134-4NB51-0AB0)				
TM-E15C26-A1 (6ES7193-4CA50-0AA0)	TM-E15C24-A1 (6ES7193-4CA30-0AA0)	TM-E15C24-01 (6ES7193-4CB30-0AA0)	TM-E15C23-01 (6ES7193-4CB10-0AA0)	← Spring terminal
TM-E15S26-A1 (6ES7193-4CA40-0AA0)	TM-E15S24-A1 (6ES7193-4CA20-0AA0)	TM-E15S24-01 (6ES7193-4CB20-0AA0)	TM-E15S23-01 (6ES7193-4CB00-0AA0)	← Screw-type terminal
TM-E15N26-A1 (6ES7193-4CA80-0AA0)	TM-E15N24-A1 (6ES7193-4CA70-0AA0)	TM-E15N24-01 (6ES7193-4CB70-0AA0)	TM-E15N23-01 (6ES7193-4CB60-0AA0)	← Fast Connect
				

Block diagram

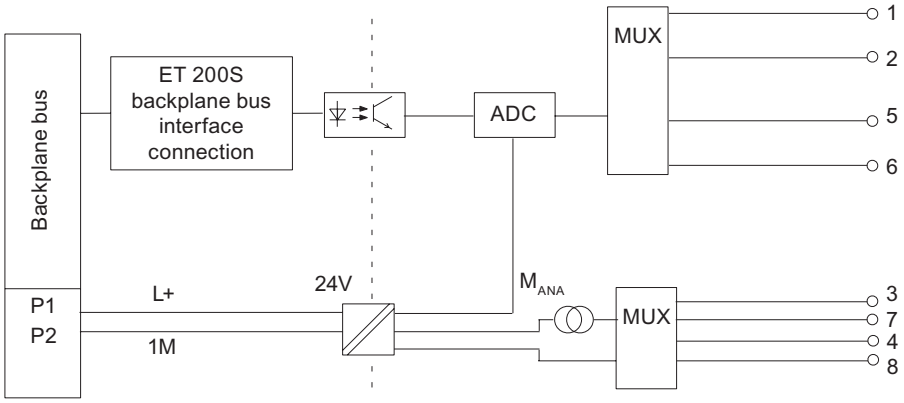


Figure 1-1 Block diagram of the 2AI RTD HF

Technical specifications for the 2AI RTD HF (6ES7134-4NB51-0AB0)

Dimensions and weight	
Width (mm)	15
Weight	Approx. 40 g
Module-specific data	
Supports isochronous operation	No
Number of inputs	2
Cable length	
• Shielded	Max. 200 m
Parameter length	7 bytes (4 bytes when used as 2AI RTD ST)
Address space	4 byte
Voltages, currents, potentials	
Rated load voltage L+ (from the power module)	24 VDC
• Reverse polarity protection	Yes
Power supply of the transducers	Yes
• Constant-current supply for resistance-type sensors	Approx. 1.25 mA
• Short-circuit protection	Yes
Electrical isolation	
• Between the channels and backplane bus	Yes
• Between the channels and load voltage L+	Yes
• Between the channels	No
Permissible potential difference	
• Between M_{ANA} and the central grounding point (U_{ISO})	75 VDC / 60 VAC
Insulation tested	500 VDC

Current consumption		
• From load voltage L+	Max. 30 mA	
Power dissipation of the module	Typically 0.6 W	
Status, interrupts, diagnostics		
Diagnostics function		
• Group error	Red LED "SF"	
• Diagnostic functions readable	Yes	
Analog value generation		
Measuring principle	Integrating (sigma-delta)	
Integration and cycle time/resolution per channel:		
• Integration time can be assigned parameters	Yes	
• Interference frequency suppression in Hz	60	50
• Integration time in ms	16,7	20
• Basic conversion time incl. integration time in ms	50	60
• Additional conversion time for wire break check diagnosis in ms	5	5
• Additional conversion time in ms for line compensation in three-wire connections	50	60
• Cycle time in ms	Number of active channels per module x conversion time	
• Resolution (including overshoot range)	Pt 100; Ni 100; Ni120; Pt 200; Ni 200; Pt 500; Ni 500; Pt 1000; Ni 1000; Cu 10 / 15 bits + sign 150 Ω; 300 Ω; 600 Ω; 3000 Ω; / 15 bits PTC[1] / 1 bit	
Suppression of interference, limits of error		
Noise suppression for f = n x (f1 ± 1%), (f1 = interference frequency)		
• Common-mode interference (U_{SS}) • Series-mode interference (peak interference value < rated value of input range)	Min. 90 dB min. 70 dB	
Crosstalk between the inputs	Min. -50 dB	
Operational limit (in the entire temperature range, with reference to the input range)		
• Resistance-type sensor	± 0,1 %	
• Pt100, Pt200, Pt500, Pt1000 Standard	± 1.0 K	
• Pt100, Pt200, Pt500, Pt1000 Climatic	± 0.25 K	
• Ni100, Ni120, Ni200, Ni500, Ni 1000 Standard and Climatic	± 0.4 K	
• Cu10	± 1.5 K	

Basic error limit for resistance-type sensors (operational limit at 25°C with reference to input range)		
• Resistance-type sensor	± 0,05 %	
• Pt100, Pt200, Pt500, Pt1000 Standard	± 0.6 K	
• Pt100, Pt200, Pt500, Pt1000 Climatic	± 0.13 K	
• Ni100, Ni120, Ni200, Ni500, Ni 1000 Standard and Climatic	± 0.2 K	
• Cu10	± 1.0 K	
Temperature error (with reference to the input range)	± 0.0009 %/K	
Linearity error (with reference to the input range)	± 0,01 %	
Repeatability (in transient state at 25°C, in relation to input range)	± 0,05 %	
Data for selecting a sensor		
Input range (rated value)/input resistance		
• Resistance-type sensor	150 Ω/min. 10 MΩ 300 Ω/min. 10 MΩ 600 Ω/min. 10 MΩ 3000 Ω/min. 10 MΩ PTC min 10 MΩ	
• Resistance thermometer	Pt100/min. 10 MΩ Ni100/min. 10 MΩ Ni120/min. 10 MΩ Pt200/min. 10 MΩ Ni200/min. 10 MΩ Pt500/min. 10 MΩ Ni500/min. 10 MΩ Pt1000/min. 10 MΩ Ni1000/min. 10 MΩ Cu10/min. 10 MΩ	
Permitted input voltage (destruction limit)	Max. 9 V	
Connection of the sensors • For measuring resistance – Two-wire connection – Three-wire connection – Four-wire connection	 Yes, Yes, internal compensation of line resistances Yes	
Characteristic curve linearization	Yes, can be assigned parameters for Ptxxx, Nixxx	
Smoothing of the measured values	Yes, parameters can be assigned in 4 steps by means of digital filtering	
	Step	**Time constant**
	None	1 x cycle time
	Weak	4 x cycle time
	Medium	32 x cycle time
	Strong	64 x cycle time
[1]In accordance with VDE 0660 Part 302/303, Type A, no diagnostics for overrun/underrun		

Use of Cu10 sensors

- Select "Three-wire thermal resistor" and "Cu10" at parameter assignment.
- Wire the Cu10 sensor in accordance with the three-wire connection method.
- Automatic, internal compensation of line resistance for the missing measuring line occurs during operation.

Note

Please note the following to ensure optimum line compensation in the case of Cu10:

- The sum of the cable resistance and measurement resistance must not exceed 31 Ω.
- The cable must have a resistance of no more than 8 Ω if you want to use the temperature range up to and above 312 °C.
  Example: A 200 m Cu cable with a 0.5 mm^2 conductor cross-section has approximately 7 Ω. A smaller cross-section shortens the permissible cable length accordingly.

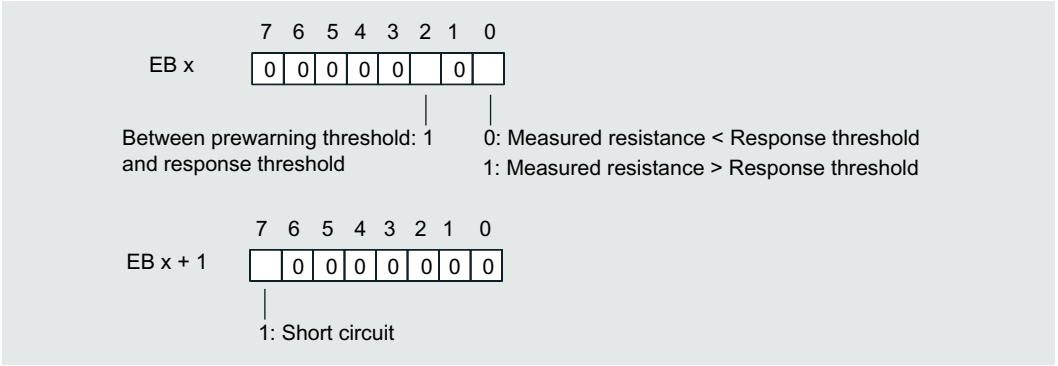
Using PTC resistors

PTCs are suitable for temperature monitoring and as thermal protective devices for complex drives and transformer windings.

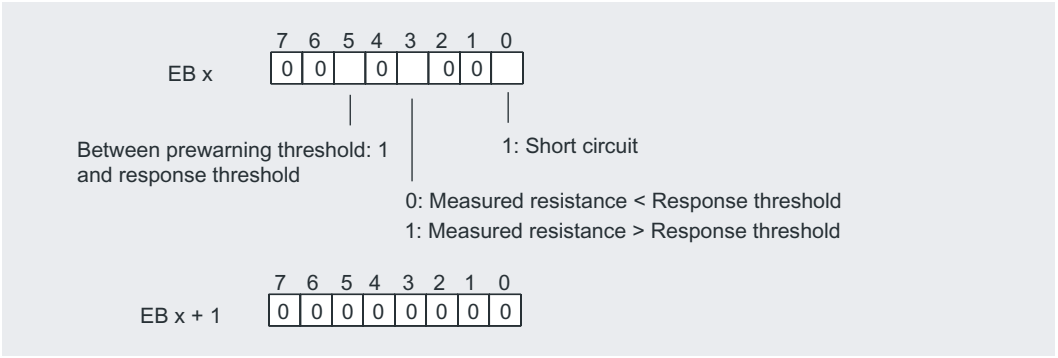
- Select "Two-wire resistor" and "PTC" at parameter assignment:
- Connect the PTC in accordance with the two-wire connection method.
- Apply PTC resistors of Type A (PTC thermistors) in accordance with DIN / VDE 0660, Part 302.
- If the diagnosis "Overrun/underrun" is enabled, a diagnosis "Lower limit exceeded" indicating a short-circuit is indicated at resistance values < 18 Ω.
- Sensor data for the PTC resistor:

Properties	Technical specifications	Remarks
Switching points	**Behavior with rising temperature**	
	< 550 Ω	**Normal range:** • SIMATIC S7: Bit 0 = "0", Bit 2 = "0" (in the PII) • SIMATIC S5: Bit 3 = "0", Bit 5 = "0" (in the PII)
	550 Ω to 1650 Ω	**Prewarning range:** • SIMATIC S7: Bit 0 = "0", Bit 2 = "1" (in the PII) • SIMATIC S5: Bit 3 = "0", Bit 5 = "1" (in the PII)
	> 1650 Ω	**Addressable range:** • SIMATIC S7: Bit 0 = "1", Bit 2 = "0" (in the PII) • SIMATIC S5: Bit 3 = "1", Bit 5 = "0" (in the PII)
	Behavior with falling temperature	
	> 750 Ω	**Addressable range:** • SIMATIC S7: Bit 0 = "1", Bit 2 = "0" (in the PII) • SIMATIC S5: Bit 3 = "1", Bit 5 = "0" (in the PII)
	750 Ω to 540 Ω	**Prewarning range:** • SIMATIC S7: Bit 0 = "0", Bit 2 = "1" (in the PII) • SIMATIC S5: Bit 3 = "0", Bit 5 = "1" (in the PII)
	< 540 Ω	**Normal range:** • SIMATIC S7: Bit 0 = "0", Bit 2 = "0" (in the PII) • SIMATIC S5: Bit 3 = "0", Bit 5 = "0" (in the PII)
(TNF-5) °C (TNF+5) °C (TNF+15) °C Measuring voltage Voltage on the PTC	Max. 550 Ω Min. 1330 kΩ Min. 4000 kΩ Max. 7.5 V	TNF= rated operating temperature

- Assignment in the process input image (PII) in the case of SIMATIC S7



- Assignment in the process input image (PII) in the case of SIMATIC S5

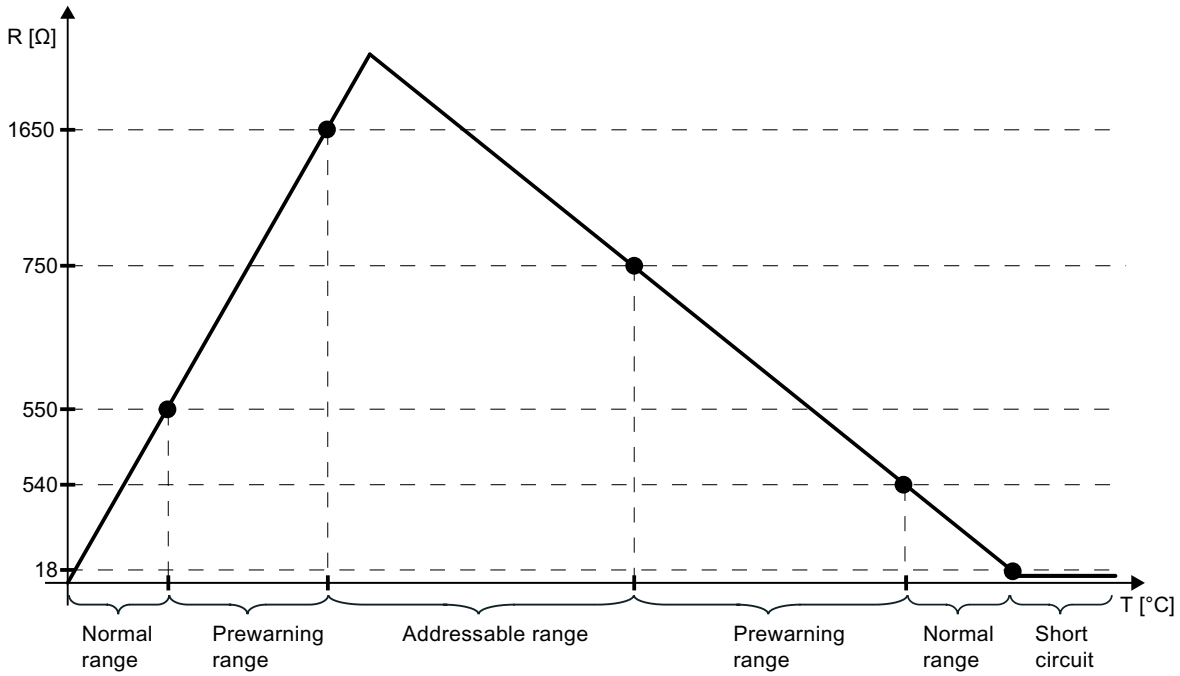


- Notes on programming

NOTICE
Only the bits 0+2 or 3+5 are relevant for the purposes of evaluation in the process input image. You can use bits 0+2 or 3+5 to monitor the temperature of a motor, for example. Bits 0+2 or 3+5 in the process input image does not have a retentive function. Make sure at parameter assignment that motor start-up is controlled (by means of an acknowledgment), for example. Bits 0+2 or 3+5 cannot be set at the same time, but set one after the other. For safety reasons, always evaluate the diagnostic inputs of the 2AI RTD HF because measurement is not possible when the EM is removed, when the power supply to the EM has failed, or in the event of a wire break or short-circuit of the measuring lines.

Example

The diagram below shows the temperature pattern and the switching points belonging to it.



Parameters

2

2.1 Parameters

Table 2-1 Parameters for Analog Input Module 2AI RTD HF

Parameters	Range of values	Default setting	Applicability
Group diagnostics	• Disable • Enable	Disable	Module
Diagnostics: overflow/underflow	• Disable • Enable	Disable	Module
Diagnostics: Wire break	• Disable[1] • Enable	Disable	Channel
Smoothing	• None • Weak • Medium • Strong	None	Channel
Temperature unit	• Celsius • Fahrenheit	Celsius	Module
Type of measurement	• De-activated • Four-wire resistor • Three-wire resistor • Two-wire resistor • Four-wire thermal resistor • Three-wire thermal resistor • Two-wire thermal resistor	Four-wire thermal resistor	Channel
Temperature coefficient	• Pt 0.003850 • Pt 0.003916 • Pt 0.003902 • Pt 0.003920 • Pt 0.003851 • Ni 0.006180 • Ni 0.006720 • Ni 0.005000 • Cu 0.00427	Pt 0.003851	Channel

Parameters	Range of values	Default setting	Applicability
Measuring range	• 150 Ω • 300 Ω • 600 Ω • 3000 Ω • PTC • Pt100 Climatic • Ni100 Climatic Range • Pt100 Standard • Ni100 Standard • Pt500 standard range • Pt1000 standard range • Ni1000 standard range • Pt200 climatic range • Pt500 climatic range • Pt1000 climatic range • Ni1000 climatic range • Pt200 standard range • Ni120 standard range • Ni120 climatic range • Cu10 climatic range • Cu10 standard range • Ni200 standard range • Ni200 climatic range • Ni500 standard range • Ni500 climatic range	Pt100 Standard	Channel
[1] Wire break diagnostic is disabled if - Type of measurement = "deactivated" or Measuring Range = "PTC" was assigned.			

Type of measurement

The following table lists the temperature coefficients and measuring ranges you can set for each measurement type:

Type of measurement	Temperature coefficient	Measuring range
De-activated	–	–
Four-wire resistor Three-wire resistor	–	150 Ω / 300 Ω / 600 Ω / 3000 Ω
Two-wire resistor	–	150 Ω / 300 Ω / 600 Ω / 3000 Ω / PTC
Three-wire thermal resistor	Pt 0.003850/ Pt 0.003916 / Pt 0.003902 / Pt 0.003920 / Pt 0.003851[1]	Pt100 climatic range / Pt100 standard range / Pt200 climatic range / Pt200 standard range / Pt500 climatic range / Pt500 standard range / Pt1000 climatic range / Pt1000 standard range
	Ni 0.006180[1] / Ni 0.006720	Ni100 climatic range / NI100 standard range / Ni120 climatic range / Ni120 standard range / Ni200 climatic range / Ni200 standard range / Ni500 climatic range / Ni500 standard range / Ni1000 climatic range / Ni1000 standard range
	Ni 0.005000	Ni 1000 climatic range[2] Ni 1000 standard range[2]
	Cu 0.00427[1]	Cu10 climatic range / Cu10 standard range
Two-wire thermal resistor Four-wire thermal resistor	Pt 0.003850 / Pt 0.003916 / Pt 0.003902 / Pt 0.003920 / Pt 0.003851	Pt100 climatic range / Pt100 standard range / Pt200 climatic range / Pt200 standard range / Pt500 climatic range / Pt500 standard range / Pt1000 climatic range / Pt1000 standard range
	Ni 0,006180 / Ni 0,006720	Ni100 climatic range / Ni100 standard range / Ni120 climatic range / Ni120 standard range / Ni200 climatic range / Ni200 standard range / Ni500 climatic range / Ni500 standard range / Ni1000 climatic range / Ni1000 standard range
	Ni 0.005000	Ni 1000 climatic range[2] Ni 1000 standard range[2]
[1] The default settings for the temperature coefficients are valid for Europe. [2] For LG-Ni 1000 sensors from Siemens Building Ltd (Landis & Stäfa)		

Temperature coefficient

The correction factor for the temperature coefficient (α-value) specifies how much the resistance of a certain material changes when the temperature is raised by 1° C.

The temperature coefficient depends on the chemical composition of the material. Only one value is used in Europe for each type of sensor (default value).

Additional values enable you to make a sensor-specific setting for the temperature coefficient, therefore ensuring more accuracy.

2.2 Parameter description

Smoothing

The individual measured values are smoothed by digital filtering. The smoothing can be adjusted in four steps, in which the smoothing factor k multiplied with cycle time of the electronic module equals the time constant of the smoothing filter. The higher the smoothing the greater the time constant of the filter.

The following diagrams show the step response with the various smoothing factors depending on the number of subassembly cycles.

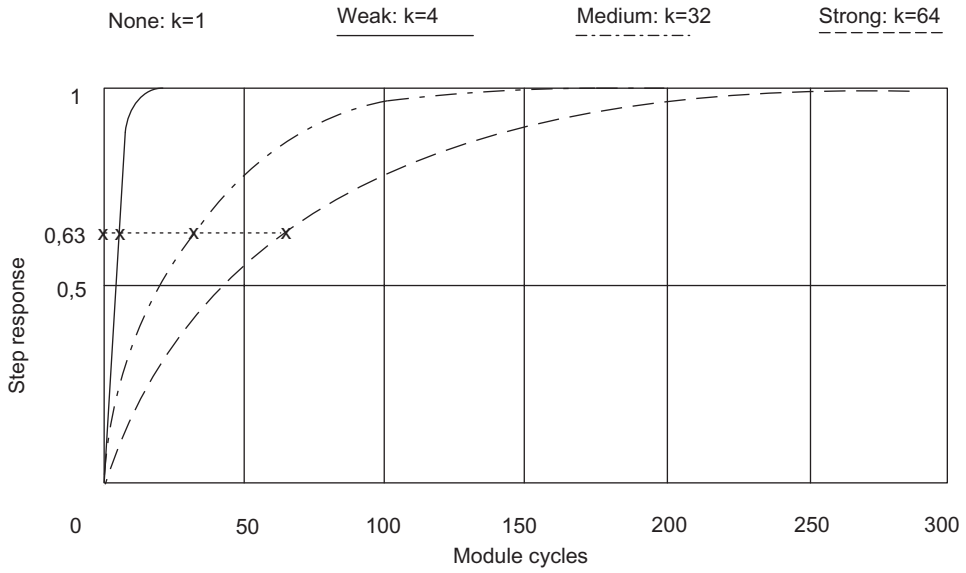


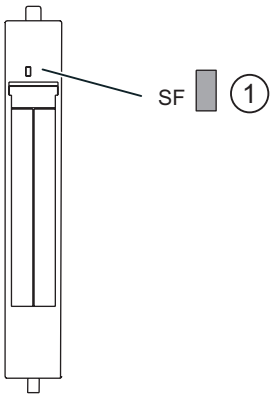
Figure 2-1 Smoothing with 2AI RTD HF

Diagnostics

3

3.1 Diagnostics using LED display

LED display



① Batch error (red)

Status and error displays

Event (LED)	Cause	Remedy
SF		
On	No configuration or incorrect module plugged in. No load voltage.present There is a diagnostic message.	Check the parameter assignment. Check the load voltage. Evaluate the diagnostics.

3.2 Error types

Analog input module error types

Table 3-1 Error types

Fault type		Meaning	Remedy
16_D	10000: Parameter assignment error	Module cannot use the parameter for the channel: Inserted module does not match the one configured. Faulty parameter assignment.	Correct the configuration (align actual and preset configuration). Correct the parameter assignment (diagnostics wire break only for the allowed measuring range parameterized).
9_D	01001: Errors	Internal module error (diagnostics message at channel 0 applies to the entire module)	Replace the module.
7_D	00111: Violation of higher limit	Value is above the overshoot range.	Correct the module/actuator tuning.
8_D	01000: Lower value limit fallen below	Value is below the underrange. Short-circuit at module 2AI RDT HF with configuration of the PTC channel.	Correct the module/actuator tuning.
6_D	00110: Wire break*	Line to the sensor interrupted.	Correct the process wiring.
* Wire break for the measured-current and constant-current cable of the sensor is signaled.			

Analog value representation

4

4.1 Introduction

Electronic modules with analog outputs

With the electronic module with analog inputs, continuously variable signals, such as those occurring in temperature measurement and resistance measurement, can be acquired, evaluated, and converted to digital values for further processing.

4.2 Analog value representation for measuring range with SIMATIC S7

Analog value representation

With the same nominal range, the digitized analog value is the same for input and output values. Analog values are represented in two's complement.

The following table shows the analog value representation of the analog electronic modules.

Table 4-1 Analog value representation (SIMATIC S7 format)

Resolution	Analog value															
Bit number	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Significance of the bits	S	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^{9}	2^{8}	2^{7}	2^{6}	2^{5}	2^{4}	2^{3}	2^{2}	2^{1}	2^{0}

Sign

The sign (S) of the analog value is always in bit number 15:

- "0" → +
- "1" → –

Measured value resolution

The following table shows the representation of the binary analog values and the corresponding decimal and hexadecimal representation of the units of the analog values.

The table shows the resolutions 11, 12, 13, and 15 bit + sign. Each analog value is entered left aligned in the ACCU. The bits marked with "x" are set to "0".

Table 4-2 Measured value resolution of the analog values (SIMATIC S7 format)

Resolution in bits	Units		Analog value	
	Decimal	Hexadecimal	High byte	Low byte
11+S	16	10_H	S 0 0 0 0 0 0 0	0 0 1 x x x x
12+S	8	8_H	S 0 0 0 0 0 0 0	0 0 0 1 x x x
13+S	4	4_H	S 0 0 0 0 0 0 0	0 0 0 0 1 x x
15 + sign	1	1_H	S 0 0 0 0 0 0 0	0 0 0 0 0 0 1

Note

This resolution does not apply to temperature values. The converted temperature values are the result of a conversion in the analog electronic module.

Note

The following applies with temperature measurements: When leaving the linearized nominal range, the existing gradient of the characteristic curve is retained in the overflow and underflow range.

4.3 Measuring ranges

4.3.1 Measuring ranges for thermoresistor

Introduction

The following tables contain the digitized analog values for the measuring ranges of the analog input modules.

Since the binary representation of the analog values is always the same, these tables contain only a comparison of the measuring ranges with the units.

Measured values in the event of wire break dependent on enabled diagnostics for resistance measurement

The following extensions exist for the measuring ranges Temperature sensor Pt xxx Standard and Climatic, Ni xx Standard and Climatic, Cu 10 Standard and Climatic:

Table 4-3 Measured values in the event of wire break dependent on enabled diagnostics

Format	Parameter assignment	Measured values		Notes
		Decimal	Hexadecimal	
S7	• "Wire break" diagnostics enabled	32767	$7FFF_H$	• Diagnostics message "wire break"
	• "Wire break" diagnostics disabled • "Overflow/underflow" diagnosis enabled	-32767	8000_H	• Measured value after leaving the undershoot range • "Value under low limit" diagnostic message
	• "Wire break" diagnostics disabled • "Overflow/underflow" diagnosis disabled	-32767	8000_H	• Measured value after leaving the undershoot range

Measuring ranges for resistance thermometer Pt x00 Standard

Table 4-4 SIMATIC S7 format: Measuring ranges Pt 100, 200, 500, 1000 Standard in °C and °F

Pt x00 Standard in °C (1 digit = 0.1 °C)	Units		Pt x00 Standard in °F (1 digit = 0.1 °F)	Units		Range
	Decimal	Hexadecimal		Decimal	Hexadecimal	
> 1000,0	32767	$7FFF_H$	> 1832,0	32767	$7FFF_H$	Overflow
1000,0 : 850,1	10000 : 8501	2710_H : 2135_H	1832,0 : 1562,1	18320 : 15621	4790_H : $3D05_H$	Overshoot range
850,0 : -200,0	8500 : -2000	2134_H : $F830_H$	1562,0 : -328,0	15620 : -3280	$3D04_H$: $F330_H$	Nominal range
-200,1 : -243,0	-2001 : -2430	$F82F_H$: $F682_H$	-328,1 : -405,4	-3281 : -4054	$F32F_H$: $F02A_H$	Undershoot range
< -243,0	-32768	8000_H	< -405,4	-32768	8000_H	Underflow

Measuring ranges for resistance thermometer Pt x00 Climatic

Table 4-5 SIMATIC S7 format: Measuring ranges Pt 100, 200, 500, 1000 Climatic in °C and °F

Pt x00 Climatic in °C (1 digit = 0.01 °C)	Units		Pt x00 Climatic in °F (1 digit = 0.01 °F)	Units		Range
	Decimal	Hexadecimal		Decimal	Hexadecimal	
> 155,00	32767	$7FFF_H$	> 311,00	32767	$7FFF_H$	Overflow
155,00 : 130,01	15500 : 13001	$3C8C_H$: $32C9_H$	311,00 : 266,01	31100 : 26601	$797C_H$: $E9_H$	Overshoot range
130,00 : -120,00	13000 : -12000	$32C8_H$: $D120_H$	266,00 : -184,00	26600 : -18400	$E8_H$: $B820_H$	Nominal range
-120,01 : -145,00	-12001 : -14500	$D11F_H$: $C75C_H$	-184,01 : -229,00	-18401 : -22900	$B81F_H$: $A68C_H$	Undershoot range
< -145,00	-32768	8000_H	< -229,00	-32768	8000_H	Underflow

Measuring ranges for resistance thermometer Ni x00 Standard

Table 4-6 SIMATIC S7 format: Measuring ranges Ni 100, 120, 200, 500, 1000 Standard in °C and °F

Ni x00 Standard in °C (1 digit = 0.1 °C)	Units		Ni x00 Standard in °F (1 digit = 0.1 °F)	Units		Range
	Decimal	Hexadecimal		Decimal	Hexadecimal	
> 295,0	32767	$7FFF_H$	> 563,0	32767	$7FFF_H$	Overflow
295,0 : 250,1	2950 : 2501	$B86_H$: $9C5_H$	563,0 : 482,1	5630 : 4821	$15FE_H$: $12D5_H$	Overshoot range
250,0 : -60,0	2500 : -600	$9C4_H$: $FDA8_H$	482,0 : -76,0	4820 : -760	$12D4_H$: $FD08_H$	Nominal range
-60,1 : -105,0	-601 : -1050	$FDA7_H$: $FBE6_H$	-76,1 : -157,0	-761 : -1570	$FD07_H$: $F9DE_H$	Undershoot range
< -105,0	-32768	8000_H	< -157,0	-32768	8000_H	Underflow

Measuring ranges for resistance thermometer Ni x00 Climatic

Table 4-7 SIMATIC S7 format: Measuring ranges Ni 100, 120, 200, 500, 1000 Climatic in °C and °F

Ni x00 Climatic in °C (1 digit = 0.01 °C)	Units		Ni x00 Climatic in °F (1 digit = 0.01 °F)	Units		Range
	Decimal	Hexadecimal		Decimal	Hexadecimal	
> 295,00	32767	$7FFF_H$	> 325,11	32767	$7FFF_H$	Overflow
295,00 : 250,01	29500 : 25001	$733C_H$: $61A9_H$	327,66 : 280,01	32766 : 28001	$7FFE_H$: $6D61_H$	Overshoot range
250,00 : -60,00	25000 : -6000	$61A8_H$: $E890_H$	280,00 : -76,00	28000 : -7600	$6D60_H$: $E250_H$	Nominal range
-60,01 : -105,00	-6001 : -10500	$E88F_H$: $D6FC_H$	-76,01 : -157,00	-7601 : -15700	$E24F_H$: $C2AC_H$	Undershoot range
< -105,00	-32768	8000_H	< -157,00	-32768	8000_H	Underflow

Measuring ranges for resistance thermometer Cu 10 Standard

Table 4-8 SIMATIC S7 format: Measuring ranges Cu 10 Standard in °C and °F

Cu 10 Standard in °C (1 digit = 0.1 °C)	Units		Cu 10 Standard in °F (1 digit = 0.1 °F)	Units		Range
	Decimal	Hexadecimal		Decimal	Hexadecimal	
> 312,0	32767	$7FFF_H$	> 593,6	32767	$7FFF_H$	Overflow
312,0 : 260,1	3120 : 2601	$C30_H$: $A29_H$	593,6 : 500,1	5936 : 5001	1730_H : $12D5_H$	Overshoot range
260,0 : -200,0	2600 : -2000	$A28_H$: $F830_H$	500,0 : -328,0	5000 : -3280	1389_H : $F330_H$	Nominal range
-200,1 : -240,0	-2001 : -2400	$F82F_H$: $F6A0_H$	-328,1 : -400,0	-3281 : -4000	$F32F_H$: $F060_H$	Undershoot range
< -240,0	-32768	8000_H	< -400,0	-32768	8000_H	Underflow

Measuring ranges for resistance thermometer Cu 10 Climatic

Table 4-9 SIMATIC S7 format: Measuring ranges Cu 10 Climatic in °C and °F

Cu 10 Climatic in °C (1 digit = 0.01 °C)	Units		Cu 10 Climatic in °F (1 digit = 0.01° F)	Units		Range
	Decimal	Hexadecimal		Decimal	Hexadecimal	
> 180,00	32767	$7FFF_H$	> 325,11	32767	$7FFF_H$	Overflow
180,00 : 150,01	18000 : 15001	$_H$: $3A99_H$	327,66 : 280,01	32766 : 28001	$7FFE_H$: $6D61A_H$	Overshoot range
150,00 : -50,00	15000 : -5000	$3A98_H$: $EC78_H$	280,00 : -58,00	28000 : -5800	$6D60_H$: $E958_H$	Nominal range
-50,01 : -60,00	-5001 : -6000	$EC77_H$: $E890_H$	-58,01 : -76,00	-5801 : -7600	$E957_H$: $E250_H$	Undershoot range
< -60,00	-32768	8000_H	< -76,00	-32768	8000_H	Underflow

4.3.2 Resistance measurement ranges

Measuring ranges for resistive sensors: 150 Ω, 300 Ω, 600 Ω, 3000 Ω

Table 4-10 SIMATIC S7 format: Measuring ranges 150 Ω, 300 Ω, 600 Ω, 3000 Ω

Measuring range 150 Ω	Measuring range 300 Ω	Measuring range 600 Ω	Measuring range 3000 Ω	Units		Range
				Decimal	Hexadecimal	
> 176.38	> 352,77	> 705,53	> 3527,67	32767	$7FFF_H$	Overflow
176,38 : 150,005	352,77 : 300,01	705,53 : 600,02	3527,67 : 3000,11	32511 : 27649	$7EFF_H$: $6C01_H$	Overshoot range
150,00 112,50 : 0,00	300,00 225,00 : 0,00	600,00 450,00 : 0,00	3000,00 2250,00 : 0,00	27648 20736 : 0	$6C00_H$ 5100_H : 0_H	Nominal range
(negative values are not physically possible)				-1 : -4864	$FFFF_H$: $ED00_H$	Undershoot range[1]
				-32768	8000_H	Underflow[1]
[1] With faulty connection of resistors						

4.4 Effect on analog value representation

4.4.1 Influence of the supply voltage and the operating state on analog input values

The input values of the analog modules are dependent on the supply voltage for electronics/sensors and on the operating state of the PLC (CPU of the DP master). The table below shows this dependency.

Table 4-11 Dependence of the analog input values on the operating state of the PLC (CPU of the DP master) and the supply voltage L+

Operating state of the PLC (CPU of the DP master)		Power supply L+ on ET 200S (power module)	Input value of the electronic module with analog inputs (evaluation possible on the CPU of the DP master)
POWER ON	RUN	L+ present	Process values
			$7FFF_H$ until first conversion after startup, or after assignment of parameters for the module is completed.
		L+ missing	$7FFF_H$
POWER ON	STOP	L+ present	Process value
		L+ missing	$7FFF_H$
POWER OFF	-	L+ present	-
		L+ missing	-

4.4.2 Influence of the value range on the Analog Input 2AI RTD HF

The way electronic modules respond to analog inputs depends on where the input values fall within the value range. This is illustrated by the table below.

Table 4-12 Response of the analog modules, depending on where the analog input value falls within the range of values

Measured value within ...	Input value in SIMATIC S7 format	Input value in SIMATIC S5 format
Nominal range	Measured value	Measured value
Over-/Undershoot range	Measured value	Measured value
Overflow	$7FFF_H$	End of the overshoot range +1 plus overflow bit
Underflow	8000_H	End of the underrange -1 plus overflow bit
Prior to parameter assignment, or incorrect parameter assignment	$7FFF_H$	$7FFF_H$

Connecting

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5.1 Connecting measuring sensors

Introduction

You can connect resistances as measuring sensors to the analog input module.

In this chapter you will find out how to connect the measuring sensors and what to watch for when doing so.

Lines for analog signals

You should use shielded and twisted-pair lines for the analog signals. This reduces the effect of interference. You should ground the shield of the analog lines at both ends of the line. If there are differences in potential between the ends of the line, a compensating current flows via the shield that can interfere with the analog signals. If this is the case, you should only ground the shield at one end of the line.

Analog input modules

In the case of the analog input modules there is electrical isolation:

- Between logic and backplane bus.
- Between load voltage and the channels
  - Isolation: No link between M_{ANA} and the central grounding point (U_{ISO})

  Note

  Ensure that this potential difference U_{ISO} does not exceed the permitted value.

Abbreviations used

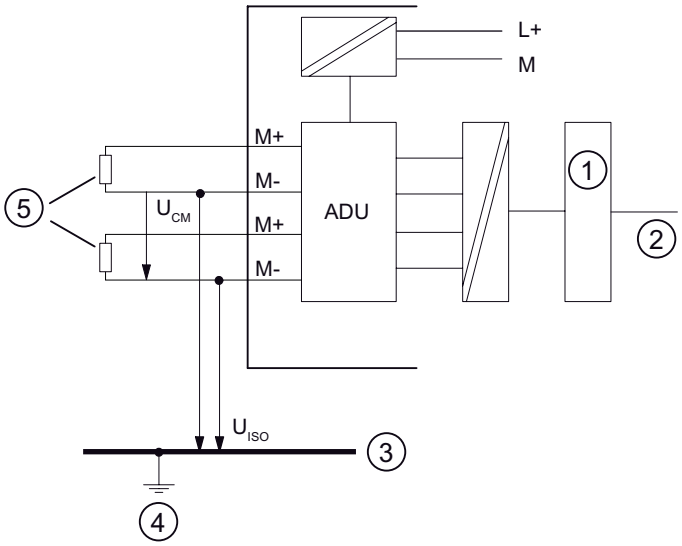
The meanings of the abbreviations in the figures below are as follows:

M +	Measuring line (positive)
M -	Measuring line (negative)
I_C+	Constant current cable (positive)
I_C-	Constant current cable (negative)
U_{CM}	Potential difference between inputs
U_{ISO}	Potential difference between M- and central grounding point

Connection of isolated measuring sensors to analog inputs

The isolated measuring sensors are not connected to the local ground potential. They can be floating.

The following figure illustrates the connection of isolated measuring sensors to a floating analog input module:



① Logic
② Backplane bus
③ Ground bus
④ Central grounding point
⑤ Isolated measuring sensors

5.2 Wiring unused channels of the analog input modules

Rules

Pay attention to the following instructions when wiring unused channels:

- "Disable" unused input channels when setting parameters.
- A disabled channel always returns the value $7FFF_H$.
- The module cycle time is halved with the 2AI RTD HF standard module.
- To adhere to the permissible potential differences, you must wire jumpers on the terminal module for the unused channels.

Analog input module	TM connection terminal							
	Channel 0				Channel 1			
	1	2	3	4	5	6	7	8
2AI RTD HF	● — ●				● — ●			

5.3 Using the shield connection

Rules

To prevent interference we recommend the following with the analog electronic modules:

- Use shielded wires to the sensors and actuators.
- Lay out the wire shields on the shield connection.
- Connect the shield connection with low impedance to the ground bus.

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