

MANUFACTURER DOCUMENT PACKAGE

Manufacturer's Manual

Selected official pages for procurement and maintenance review

PRODUCT BRAND

Siemens

PRODUCT MODEL

6ES7134-4JB00-0AB0

Standard Thermocouple Input Module. Relevant section pages: 128, 129, 130, 131, 132, 402, 403, 404, 405, 406, 407, 408, 409, 413, 414, 415, 419, 420, 425, 472, 473, 474, 475, 476. Adjacent model text on shared pages is outside this product reference.

OFFICIAL SOURCE

SIMATIC ET 200S Distributed I/O System; 07/2003, EWA-4NEB780602402-09

Original Siemens documentation (third-party-hosted copy)

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SIEMENS

SIMATIC

ET 200S Distributed I/O System

Manual



The following supplement is part of this documentation:

No.	Designation	Drawing number	Edition
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This manual is part of the documentation
package with the order number
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EWA-4NEB780602402-09

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Safety Guidelines

This manual contains notices intended to ensure personal safety, as well as to protect the products and connected equipment against damage. These notices are highlighted by the symbols shown below and graded according to severity by the following texts:



Danger

indicates that death, severe personal injury or substantial property damage will result if proper precautions are not taken.



Warning

indicates that death, severe personal injury or substantial property damage can result if proper precautions are not taken.



Caution

indicates that minor personal injury can result if proper precautions are not taken.

Caution

indicates that property damage can result if proper precautions are not taken.

Notice

draws your attention to particularly important information on the product, handling the product, or to a particular part of the documentation.

Qualified Personnel

Only **qualified personnel** should be allowed to install and work on this equipment. Qualified persons are defined as persons who are authorized to commission, to ground and to tag circuits, equipment, and systems in accordance with established safety practices and standards.

Correct Usage

Note the following:



Warning

This device and its components 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.

This product can only function correctly and safely if it is transported, stored, set up, and installed correctly, and operated and maintained as recommended.

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We have checked the contents of this manual for agreement with the hardware and software described. Since deviations cannot be precluded entirely, we cannot guarantee full agreement. However, the data in this manual are reviewed regularly and any necessary corrections included in subsequent editions. Suggestions for improvement are welcomed.

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EWA-4NEB780602402-09

Preface

Purpose of the manual

The information in this manual enables you to run the ET 200S distributed I/O system on PROFIBUS-DP as a DP slave.

Required level of knowledge

Knowledge of the field of automation engineering is required to understand the manual.

Scope of the manual

This manual is valid for the components of the ET 200S distributed I/O system specified in Appendix A.

This manual contains a description of the components that were valid at the time the manual was published. We reserve the right to enclose a Product Information bulletin containing up-to-date information about new components and new versions of components.

Changes since the previous version

The following changes/additions have been made since the previous version of the manual:

- New function: option handling
- New ET 200S Power Supply module
- New PM-E 24–48 VDC power module
- New 4 DI NAMUR electronic module
- Changes to the IM151-1 STANDARD and IM151-1 FO STANDARD interface modules



Caution

Do not look directly into the opening of the transmission diodes.
The light beam that comes out could damage your eyes.

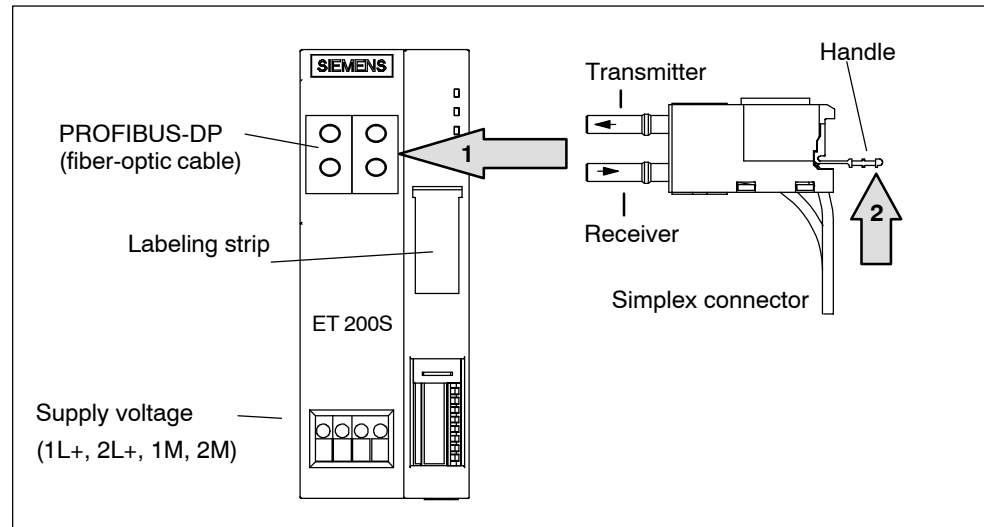


Figure 5-13 Wiring the IM151-1 FO STANDARD

5.5 Inserting and identifying the electronic modules

Features

- The electronic modules are inserted in the terminal modules.
- A labeling strip allows you to identify the electronic modules.
- Electronic modules are:
 - Self-coding
 - Type-coded

The first time you insert an electronic module, a code element engages on the terminal module. This mechanically prevents the wrong electronic module from being inserted.

Requirements

Adhere to the rules below for inserting electronic modules. See Section 3.5 (The electronic modules you can use on the various terminal modules).

Inserting and identifying the electronic modules

1. Insert the electronic module in the terminal module until you hear it snap into place.
2. Pull the labeling strip up out of the electronic module in order to identify it.
3. Then put the labeling strip back into the electronic module.

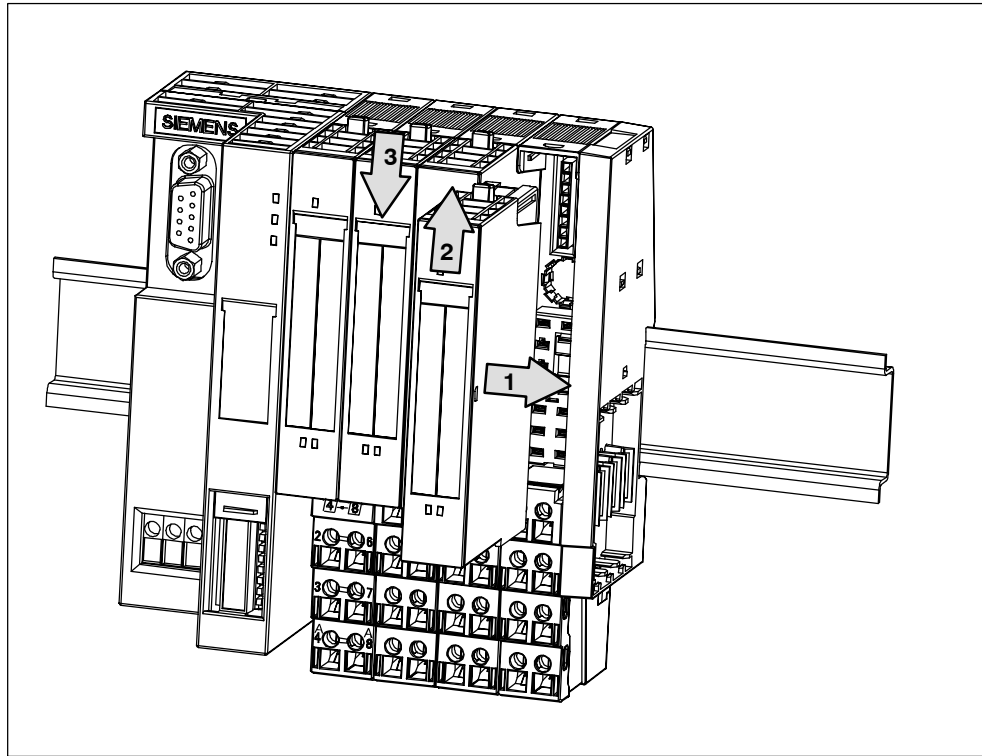


Figure 5-14 Inserting and identifying electronic modules

Removing electronic modules

1. Simultaneously press the two release buttons on the top and bottom of the electronic module.
2. Pull the electronic module out from the terminal module at the front.

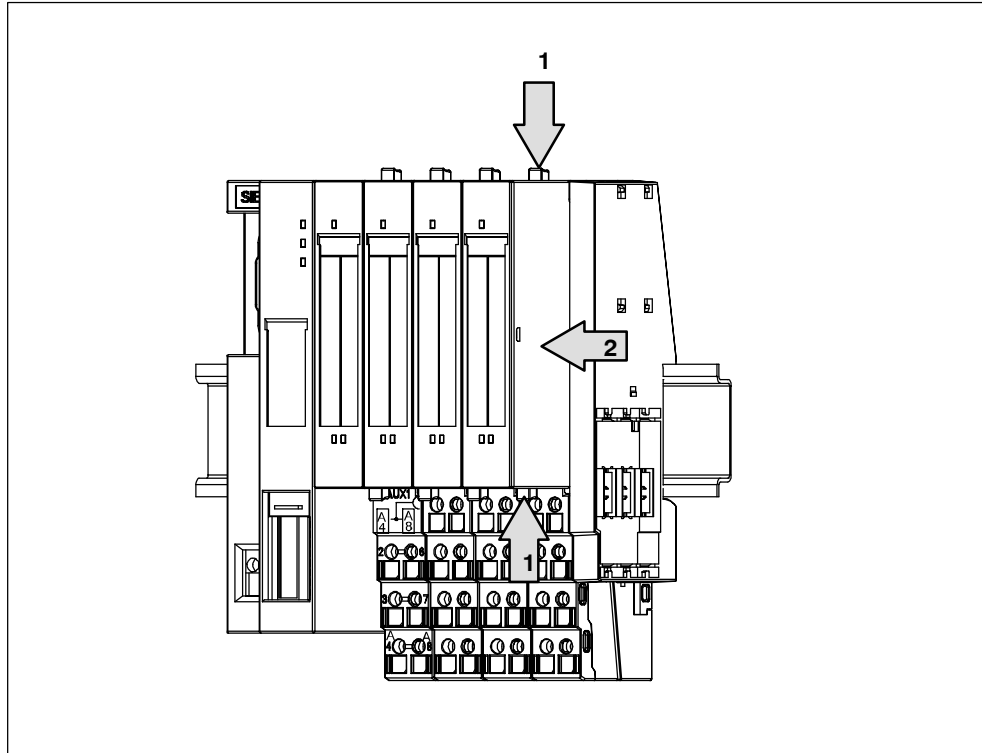


Figure 5-15 Removing electronic modules

Changing the type of an electronic module

You have already removed the electronic module:

1. Use a screwdriver to push the code element out of the terminal module.
2. Put the code element on the used electronic module again.
3. Insert the new electronic module (different type) in the terminal module until you hear it snap into place.
4. Identify the new electronic module.

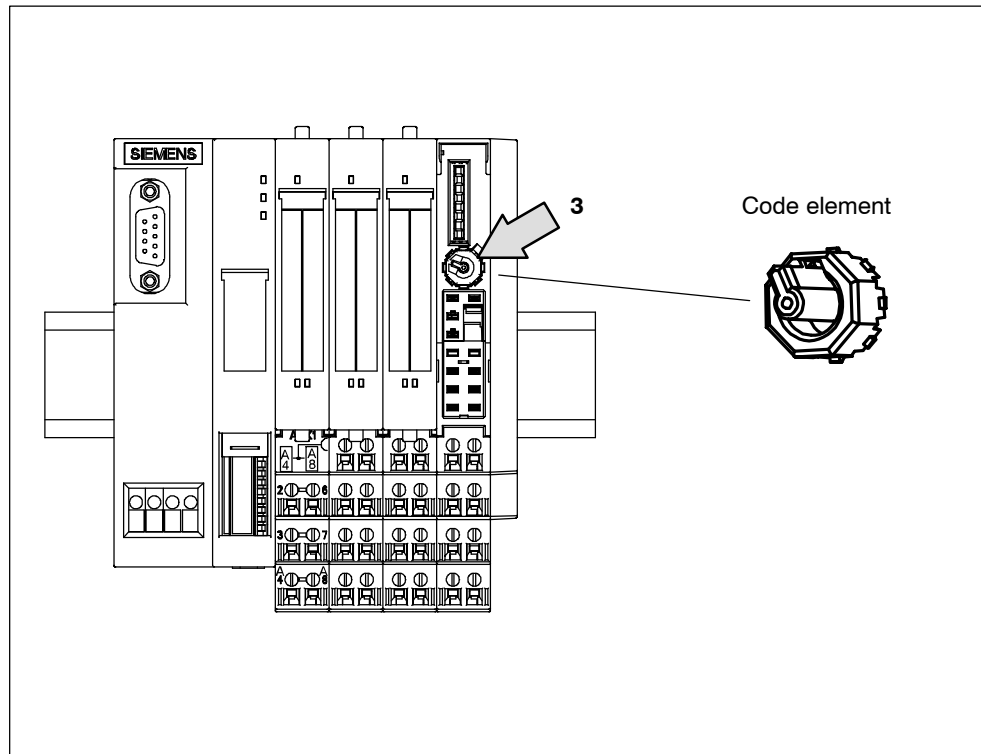


Figure 5-16 Removing the code element



Warning

When you make changes to the code, it can lead to dangerous states in your system.

Replacing a defective electronic module

You have already removed the electronic module:

1. Remove the code element from bottom of the new electronic module.
2. Insert the new electronic module (same type) in the terminal module until you hear it snap into place.
3. Identify the new electronic module.

Removing and inserting electronic modules during operation

ET 200S supports the removal and insertion of modules during operation (during the RUN operating mode). The ET 200S remains in RUN mode when an electronic module is removed. The protective conductor connections of the ET 200S are not interrupted.

Note

- You cannot remove and insert modules during operation unless the corresponding parameters have been assigned. See Section 9.1.
- You can remove and insert modules during operation as of the IM151-1 BASIC, IM151-1 STANDARD (6ES7 151-1AA01-0AB0), IM151-1 FO STANDARD, and IM151-1 HIGH FEATURE.
- If **one** module is missing (gap) and the ET 200S is switched on, the station will not start up (see Section 6.6.10).
- The removal and insertion of modules affects the clocking (equidistance).

If you replace more than one module, only one gap can result.

The following table indicates which modules you can remove and insert under which conditions:

Table 5-1 Removing and inserting electronic modules

Modules	Removing and inserting	Conditions
Interface module	No	—
Power modules	Yes	The load voltage must be switched off.
Digital electronic modules (input)	Yes	—
Digital electronic modules (output)	Yes	The load voltage must be switched off by means of an external switch/fuse.
Analog electronic modules	Yes	—
4 IQ-SENSE	Yes	The sensors can also be replaced during operation. These are then parameterized automatically by the electronic module.

13.2 Fundamentals of analog value processing

13.2.1 Connecting measuring sensors

Introduction

You can connect different measuring sensors to the analog input modules, depending on the type of module involved:

- Voltage sensor
- Current sensors as:
 - Two-wire measuring transducer
 - Four-wire measuring transducer
- Resistance-type sensor

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 the logic circuitry and backplane bus
- Between the load voltage and the channels. The following differences exist:
 - No isolation: Connection between M_{ANA} and the central grounding point
 - Isolation: No connection between M_{ANA} and the central grounding point (U_{ISO})

Analog output modules

In the case of the analog output modules there is generally electrical isolation:

- Between the logic circuitry and backplane bus
- Between the load voltage and M_{ANA} .

Note

Ensure that this potential difference (U_{ISO}) does not exceed the permitted value. If there is a possibility of exceeding the permitted value, make a connection between terminal M_{ANA} and the central grounding point.

Connecting measuring sensors to analog inputs

Between the measuring lines $M-$ of the input channels and the reference point of the measuring circuit M_{ANA} there can be only a limited potential difference U_{CM} (common-mode voltage). To ensure that the permitted value is not exceeded, you must take different steps depending on whether the sensors are isolated or non-isolated. The steps you have to take are described in this chapter.

Generally speaking, however, when connecting two-wire measuring transducers for current measurement and when connecting resistance-type sensors, you should not make a connection from $M-$ to M_{ANA} . This also applies to correspondingly parameterized but unused inputs.

Note

For the analog input modules 2AI U, 2AI RTD, and 2AI TC, you must short-circuit unused analog inputs.

Abbreviations used

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

$M +:$	Measuring line (positive)
$M -:$	Measuring line (negative)
$M_{ANA}:$	Reference potential of the analog measuring circuit
$M:$	Frame connection
$L +:$	Rated load voltage 24 VDC
$U_{CM}:$	Potential difference between inputs and reference potential of the measuring circuit M_{ANA}
$U_{ISO}:$	Potential difference between M_{ANA} and the central grounding point

Isolated measuring sensors

The isolated measuring sensors are not connected to the local ground potential. They can be floating. Depending on local conditions or interference, potential differences U_{CM} (static or dynamic) can occur between the measuring lines $M-$ of the input channels and the reference point of the measuring circuit M_{ANA} .

To ensure that the permitted value for U_{CM} is not exceeded in environments with strong EMC interference, the following applies:

- In the case of the analog input modules 2AI U, 2AI I 4WIRE, and 2AI TC:
Connect $M-$ to M_{ANA} .
- When connecting two-wire measuring transducers for current measurement and when connecting resistance-type sensors, you must not connect $M-$ to M_{ANA} .

Isolated measuring sensors (continued)

Figure 13-1 illustrates the connection of isolated measuring sensors to the floating analog input modules.

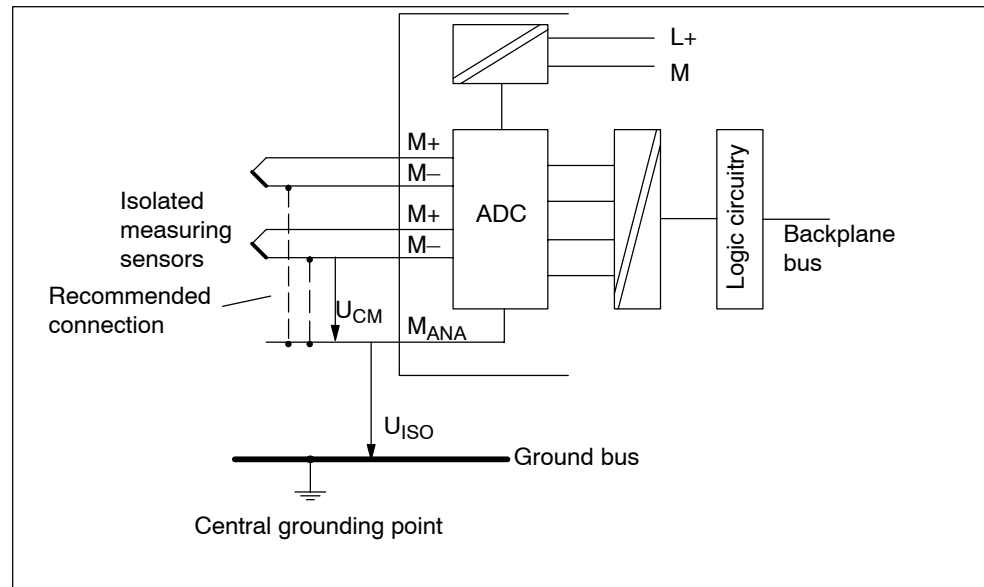


Figure 13-1 Connection of isolated measuring sensors to a floating analog input module

Non-isolated measuring sensors

The non-isolated measuring sensors are connected to the local ground potential. You must connect M_{ANA} to the ground potential. Depending on local conditions or interference, potential differences U_{CM} (static or dynamic) can occur between the locally distributed measuring points.

If the permitted value for U_{CM} is exceeded, there must be equalizing lines between the measuring points.

Figure 13-2 illustrates the connection of non-isolated measuring sensors to a floating analog input module.

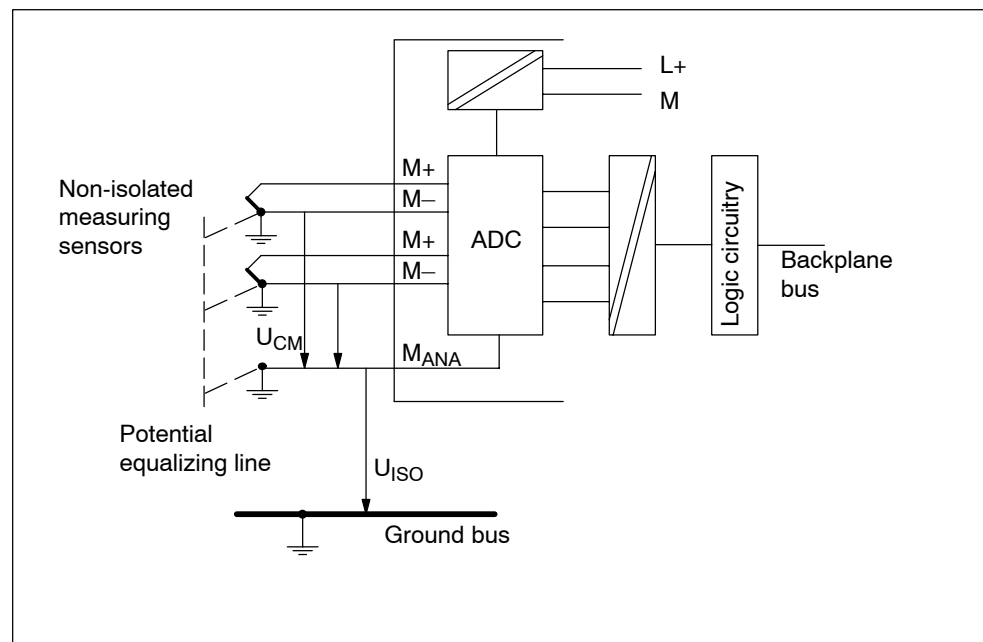


Figure 13-2 Connection of non-isolated measuring sensors to a floating analog input module

Operating four-wire measuring transducers on an external voltage supply

If there is isolation between the output and the supply of the measuring transducer, you can connect it to the 2AI I 4WIRE without additional connections.

If there is no isolation between the output and the supply of the measuring transducer, you can connect it to the 2AI I 4WIRE only if the reference potential of the power supply voltages (24 VDC) is the same.

If there is an increase in interference radiation, a connection between $M-$ and M_{ana} on the terminal module of the 2AI I 4WIRE is recommended.

13.2.2 Connecting thermocouples

Introduction

This section contains additional information on connecting thermocouples.

Compensation of the reference junction temperature

There are various ways of obtaining the reference junction temperature in order to get an absolute temperature value from the temperature difference between the reference junction and the measuring point.

Table 13-25 Compensation of the reference junction temperature

Option	Description	Reference junction parameters
No compensation	You record not only the temperature of the measurement point. The temperature of the reference junction (transition from Cu line to thermocouple line) also affects the thermo-electromotive force. The measured value is thus errored.	None
Use of a compensating box on the incoming lines of a single thermocouple	You compensate using a compensating box. The compensating box is the transition point from the Cu line to the thermocouple line. No further processing is necessary through the 2AI TC Standard.	None

Table 13-25 Compensation of the reference junction temperature

Option	Description	Reference junction parameters
Use of a Pt100 Climatic Range resistance thermometer to record the reference junction temperature (best method)	You can record the reference junction temperature using a resistance thermometer (Pt100 Climatic Range). Given appropriate parameter assignment, this temperature value in the ET 200S is distributed to the 2AI TC Standard modules and calculated in the modules together with the temperature value obtained for the measurement point. Number of reference junctions: 1	The parameter assignment of the IM151-1 and the 2AI TC must be coordinated: • 2AI RTD Standard parameterized to the Pt100 climatic range at the correct slot; • 2AI TC Standard: reference junction: RTD; select reference junction number 1 • IM: Assignment of the reference junction to a slot with the 2AI RTD Standard; selection of a channel;
Internal compensation in the case of the 2AI TC High Feature	There is a temperature sensor in the TM-E15S24-AT and TM-E15C24-AT terminal modules. The temperature sensor reports the temperature of the terminals to the 2AI TC High Feature. This value is then calculated together with the measured value from the channel of the electronic module.	• 2AI TC High Feature: Reference junction: yes

Extension to a reference junction

The thermocouples can be extended from their connection point by means of equalizing lines to the reference junction (transition to Cu line) or the compensating box. The reference junction can also be an ET 200S terminal module.

The equalization lines are made of the same material as the wires of the thermocouple. The incoming lines are made of copper. Ensure correct polarity when connecting.

Use of a compensating box

The influence of the temperature on the reference junction of a thermocouple (for example, terminal boxes) can be adjusted with a compensating box.

The compensating box contains a bridge circuit that is adjusted for a certain reference junction temperature (compensating temperature). You connect the thermocouples or their adjustment lines to the compensating box. The compensating box then forms the reference junction.

If the actual reference temperature differs from the compensating temperature, the temperature-dependent bridge resistance changes. A positive or negative compensation voltage occurs that is added to the thermo-electromotive force.

Compensating boxes with a **reference junction temperature of 0 °C** must be used for the compensation of the analog input modules.

Please note:

- The compensating box must be supplied on an isolated basis.
- The power supply unit must have adequate interference filtering (by means of a grounded shielding winding, for example).

Compensation by means of a resistance thermometer at the 2AI RTD

If thermocouples that are connected to the inputs of the 2AI TC have the same reference junction, compensate by means of a 2AI RTD.

For both channels of the 2AI TC module, you can select “RTD” or “None” as the reference junction. If you select “RTD,” the same reference junction (RTD channel) is always used for both channels.

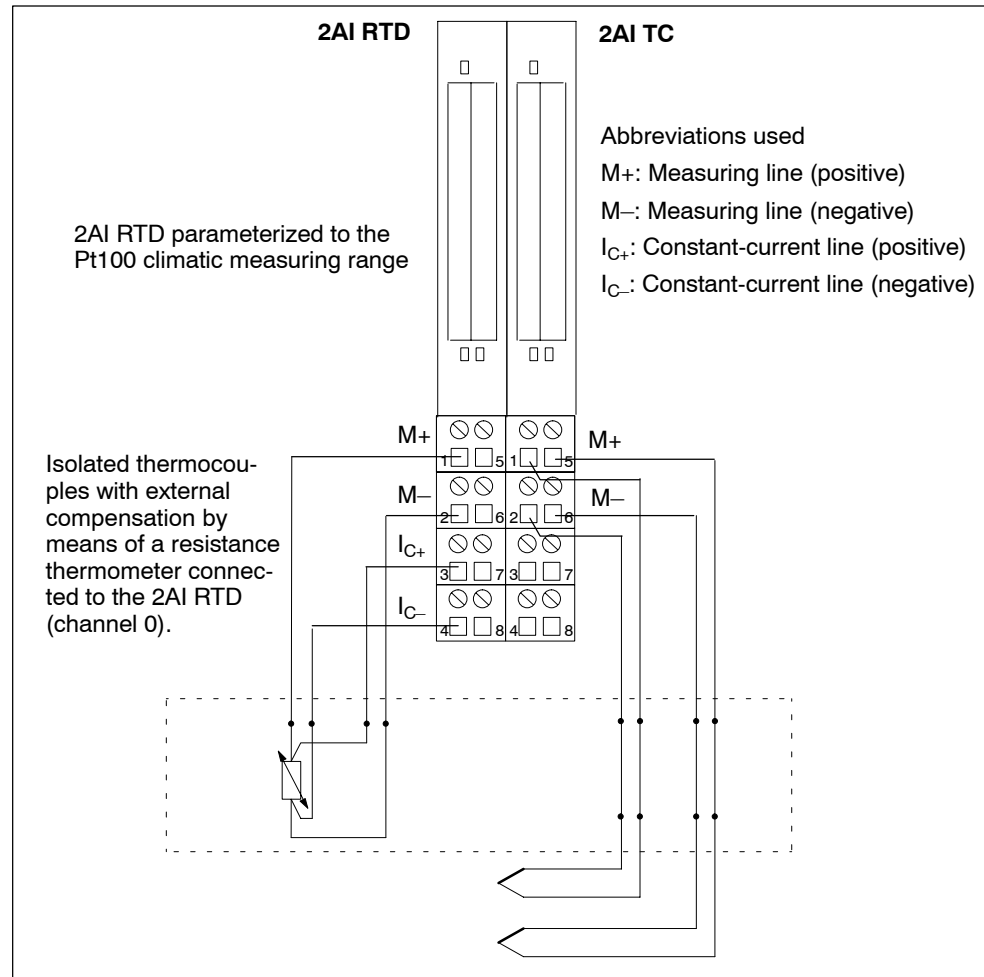


Figure 13-3 Compensation by means of the 2AI RTD

13.2.3 Notes on and circuits of unused channels of the analog input modules

- Deactivate unused input channels during parameter assignment.
- A deactivated channel always returns a value of 7FFF_H.
- In the case of the standard modules 2AI U, 2AI I 2WIRE, 2AI I 4WIRE, 2AI RTD Standard, 2AI RTD High Feature, 2AI TC Standard, and 2AI TC High Feature, the cycle time of the module is halved.
- In the case of the high-speed modules 2AI U, 2AI I 2WIRE, and 2AI I 4WIRE, the cycle time remains unchanged at 1 ms.
- To adhere to the permissible potential differences (U_{CM}), you must wire jumpers on the terminal module for the unused channels. This is necessary in the case of the following modules:

Analog input module	TM terminal							
	Channel 0				Channel 1			
	1	2	3	4	5	6	7	8
2AI U Standard	●	●	●		●	●	●	
2AI RTD Standard, 2AI RTD High Feature, 2AI TC High Feature	●	●			●	●		
2AI TC Standard	●	●	●		●	●	●	
2AI U High Speed	●	●	●		●	●	●	

13.3 Behavior of the analog modules during operation and in the event of problems

This section deals with the following topics:

- The dependence of the analog input and output values on the supply voltage of the electronic module and on the operating modes of the PLC
- The behavior of the analog electronic modules depending on the position of the analog values in the respective value range
- The effect of errors on the analog inputs/outputs
- Use of the shield contact

Effect of the supply voltage and the operating mode

The input and output values of the analog modules are dependent on the supply voltage for electronic components/sensors and on the operating mode of the PLC (CPU of the DP master).

Table 13-27 How the analog input/output values depend on the operating mode of the PLC (CPU of the DP master) and the supply voltage L +

Operating mode of the PLC (CPU of the DP master)		Supply voltage L + to ET 200S (power module)	Input value of the electronic module with analog inputs (evaluation possible in the CPU of the DP master)	Output value of the electronic module with analog outputs
Power on	RUN	L + applied	Process values 7FFF _H until the first conversion after switching on or after parameterization of the module	PLC values Until the first value output: • After switching on, a signal of 0 mA or 0 V is output • Dependent on the "Behavior at CPU-Master-STOP" parameter
		L + not applied	7FFF _H	—
Power on	STOP	L + applied	Process value	Dependent on the "Behavior at CPU-Master-STOP" parameter
		L + not applied	7FFF _H	—
Power off	—	L + applied	—	Dependent on the "Behavior at CPU-Master-STOP" parameter
		L + not applied	—	—

Effect of the value range for the analog input

The behavior of the electronic modules with analog inputs depends on where the input values are in the value range. The following table 13-28 illustrates this dependency.

Table 13-28 Behavior of the analog modules depending on the position of the analog input value in the value range

Measured value in	Input value in SIMATIC S7 format	Input value in SIMATIC S5 format
Rated range	Measured value	Measured value
Overrange/underrange	Measured value	Measured value
Overflow	7FFF _H	End of the overrange +1 plus overflow bit
Underflow	8000 _H	End of the underrange -1 plus overflow bit
Before assigning parameters or in the case of incorrect parameter assignment ¹⁾	7FFF _H	7FFF _H

¹⁾ The following applies to 2AI U Standard, 2AI I 2WIRE Standard, 2AI I 4WIRE Standard, 2AI RTD Standard, and 2AI TC Standard with product version 1: If you assign a parameter incorrectly and trigger the diagnostic message for a parameterization error (for example, wire break for measuring range ± 20 mA), the SF LED lights up on the module and you can evaluate the diagnosis. In this state, correct input values are delivered to the DP master.

Effect of the value range for the analog output

The behavior of the electronic modules with analog outputs depends on where the output values are in the value range. The following table indicates this:

Table 13-29 Behavior of the analog modules depending on the position of the analog output value in the value range

Output value in	Output value in SIMATIC S5/S7 format
Rated range	Value from DP master
Overrange/underrange	Value from DP master
Overflow	0 signal
Underflow	0 signal
Before assigning parameters or in the case of incorrect parameter assignment ¹⁾	0 signal

¹⁾ The following applies to 2AO U Standard, 2AO I Standard with product version 1: If the substitute value that was assigned as parameter is outside the nominal range, a diagnostic message for parameter error is entered and the SF LED lights up. In this state, the output values transmitted by the DP master are output at the analog output modules.

Parameters for

- 2AI RTD Standard analog electronic module
- 2AI TC Standard analog electronic module
- 2AI TC High Feature analog electronic module

Table 13-33 Parameters for analog input modules RTD, TC

2AI RTD Standard	2AI TC Standard	2AI TC High Feature	Value range	Default	Applicability
Group diagnosis (parameter assignment error, internal error)			• Disable • Enable	Disable	Module
Diagnostics: Overflow/underflow			• Disable • Enable	Disable	Module
Diagnostics: Wire break ²⁾	Diagnostics: Wire break check ¹⁾		• Disable • Enable	Disable	Channel
Smoothing			• None • Weak • Medium • Strong	None	Channel
		Temperature unit	• Celsius • Fahrenheit	Celsius	Module
—	Reference junction	—	• None • RTD	None	Channel
—		Reference junction	• None • Yes (i.e. internal)	None	Channel
—	Reference junction number	—	• None • 1 to 8 (in the case of the IM151-1 STANDARD, IM151-1 FO STANDARD) • 1 (in the case of the IM151-1 BASIC, IM151-1 HIGH FEATURE)	None	Module
Type/ range of measure- ment	—		• Deactivated • 150 ohms • 300 ohms • 600 ohms • Pt100 Climatic • Ni100 Climatic Range • Pt100 Standard • Ni100 Standard	Pt100 Standard	Channel

Table 13-33 Parameters for analog input modules RTD, TC, continued

2AI RTD Standard	2AI TC Standard	2AI TC High Feature	Value range	Default	Applica-bility
—	Type/range of measurement	—	- Deactivated - Voltage ± 80 mV - TC-EL type T (Cu-CuNi) - TC-EL type K (NiCr-Ni) - TC-EL type B (PtRh-PtRh) - TC-EL type N (NiCrSi-NiSi) - TC-EL type E (NiCr-CuNi) - TC-EL type R (PtRh-Pt) - TC-EL type S (PtRh-Pt) - TC-EL type J (Fe-Cu-Ni) - TC-EL type L (Fe-Cu-Ni)	TC-EL type K (NiCr-Ni)	Channel
		Type/range of measurement	- Deactivated - Voltage ± 80 mV - TC-EL type T (Cu-CuNi) - TC-EL type K (NiCr-Ni) - TC-EL type B (PtRh-PtRh) - TC-EL type C (WRe-WRe) - TC-EL type N (NiCrSi-NiSi) - TC-EL type E (NiCr-CuNi) - TC-EL type R (PtRh-Pt) - TC-EL type S (PtRh-Pt) - TC-EL type J (Fe-Cu-Ni) - TC-EL type L (Fe-Cu-Ni)	TC-EL type K (NiCr-Ni)	Channel

- 1) Only with thermocouples. A parameter assignment error occurs when the wire break diagnosis is enabled in the voltage measuring range. The module does not start up.
- 2) The wire break is only detected with constant-current lines.

Smoothing

The individual measured values are smoothed by means of digital filtering. The smoothing can be adjusted in 4 steps, where the smoothing factor k multiplied by the cycle time of the electronic module corresponds to the time constant of the smoothing filter. The greater the smoothing, the greater the time constant of the filter.

The figures below show the step response for the different smoothing factors depending on the number of module cycles.

- Smoothing in the case of the 2AI U Standard, 2AI U High Feature, 2AI I 2WIRE Standard, 2AI I 4WIRE Standard, 2AI I 2/4WIRE High Feature, 2AI RTD Standard, 2AI RTD High Feature, 2AI TC Standard, 2AI TC High Feature

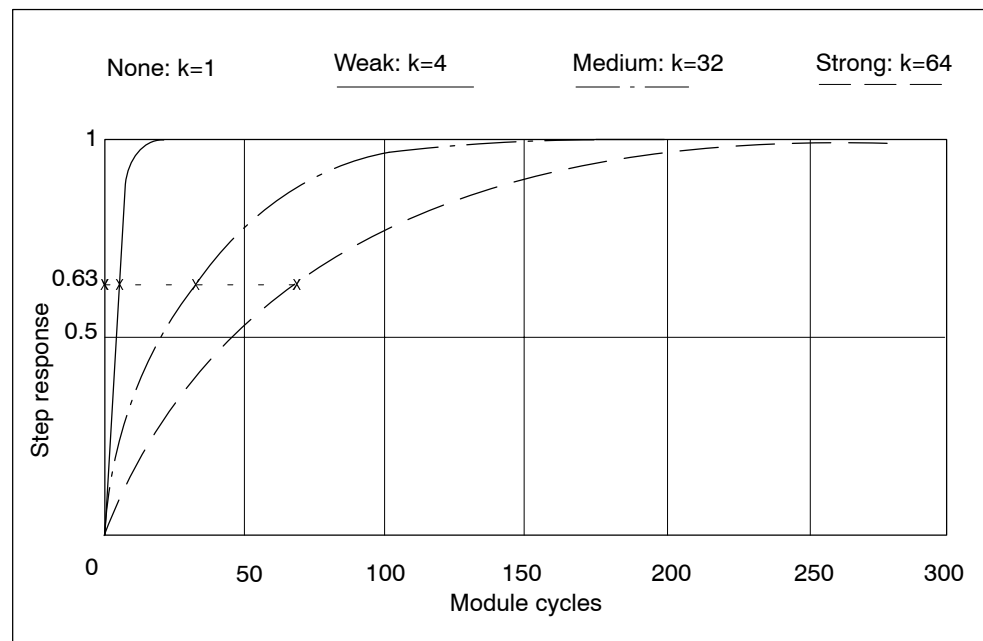


Figure 13-5 Smoothing in the case of the 2AI U Standard, 2AI U High Feature, 2AI I 2WIRE Standard, 2AI I 4WIRE Standard, 2AI I 2/4WIRE High Feature, 2AI RTD Standard, 2AI RTD High Feature, 2AI TC Standard, 2AI TC High Feature

**13.15 2AI TC Standard analog electronic module
(6ES7134-4JB00-0AB0)**

Order number

6ES7134-4JB00-0AB0

Features

- 2 inputs for thermocouple or voltage measurement
- Input ranges:
 - Voltage measurement: ± 80 mV, resolution 15 bits + sign
 - Thermocouples: type E, N, J, K, L, S, R, B, T, resolution 15 bits + sign
- Isolated from the load voltage L+
- Linearization of the sensor characteristic curves
- Permitted common-mode voltage 2 VAC_{pp}

Terminal assignment

The following table indicates the terminal assignment of the 2AI TC Standard for the different terminal modules:

Voltage measurement as for 2Al U Standard (see Section 13.5).

Table 13-46 Terminal assignment of the 2AI TC Standard

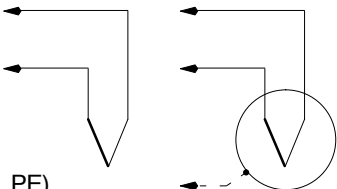
View	Terminal assignment	Remarks
 TM-E15S24-A1 and 2AI TC Standard CH0 M_{0+} 1 □ 5 M_{0-} 2 □ 6 M_{ana} 3 □ 7 AUX1 (e.g. PE) 4 □ 8	CH1 M_{1+} M_{1-} M_{ana} AUX1 (e.g. PE)  AUX1 must be applied to PE.	Channel 0: Terminals 1 to A4 Channel 1: Terminals 5 to A8 M_{+}: Measuring line (positive) M_{-}: Measuring line (negative) M_{ana}: Ground of the module

Table 13-46 Terminal assignment of the 2AI TC Standard, continued

View	Terminal assignment	Remarks
CH0 M₀₊ M_{0−} M_{ana} n. c. 1 5 2 6 3 7 4 8 CH1 M₁₊ M_{1−} M_{ana} n. c. <		

Block diagram

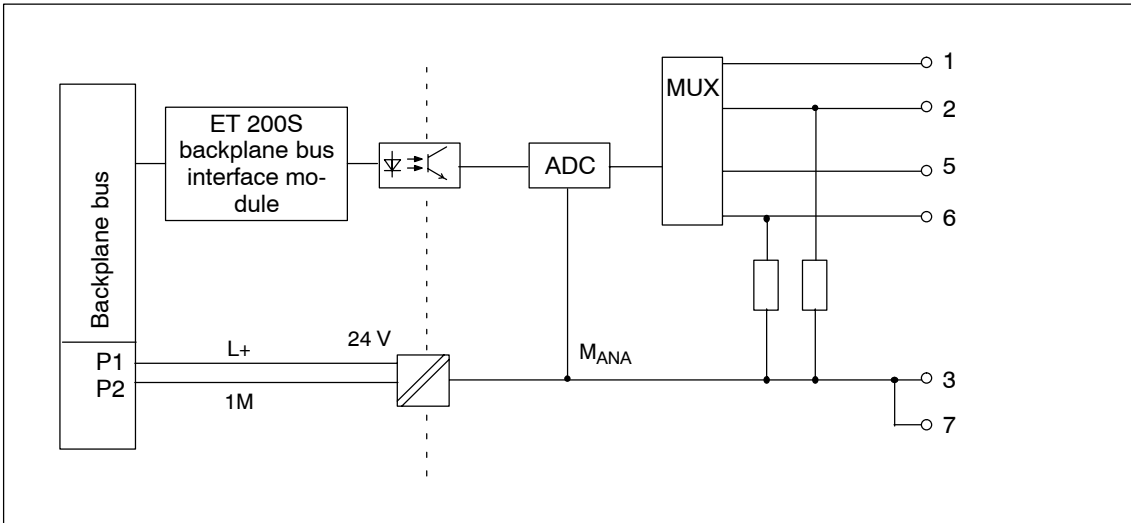


Figure 13-17 Block diagram of the 2AI TC Standard

Technical specifications

Dimensions and weight		- Between M_{ANA} and the central grounding point (U_{ISO}) 75 VDC/60 VAC - Between inputs and M_{ANA} (U_{CM}) 2 VAC_{pp} Insulation tested 500 VDC Current consumption - From load voltage L+ Max. 30 mA Power dissipation of the module Typ. 0.6 W
Dimensions		
W × H × D (mm)	15 × 81 × 52	
Weight	Approx. 40 g	
Data for specific modules		Status, interrupts, diagnostics
Supports clocked operation	No	
Number of inputs	2	Diagnostic functions - Group error Red "SF" LED - Diagnostic functions readable Yes
Length of cable		
Shielded	Max. 50 m	
Voltages, currents, potentials		
Rated load voltage L+ (from the power module)	24 VDC	
Reverse polarity protection	Yes	
Isolation		
Between the channels and backplane bus	Yes	
Between the channels and load voltage L+	Yes	
Between the channels	No	
Between the channels and 24 V supply voltage	Yes	
Permissible potential difference		

Analog value generation			Linearity error (with reference to the input range)	± 0.01%
Measuring principle	Integrative		Repeatability (in steady state at 25 °C with reference to input range)	± 0.05%
Integration time/conversion time/resolution per channel:			Data for selecting a sensor	
• Integration time parameterizable	Yes		Input range (rated value)/input resistance	
• Interference frequency suppression in Hz	60	50	• Voltage	± 80 mV/min. 1 MΩ
• Integration time in milliseconds	16.7	20	• Thermocouple	Type E, N, J, K, L, S, R, B, T/min. 1 MΩ
• Basic conversion time including Integration time in milliseconds	55	65	Permitted input voltage (destruction limit)	± 10 V, continuous
• Additional conversion time for wire break check diagnosis in ms	20	20	Connection of the sensors	
• Cycle time in ms	Number of active channels per module × conversion time		• For measuring voltage	Possible
• Resolution (including overrange)	15 bits plus sign		Characteristic curve linearization	Yes, parameterizable for type E, N, J, K, L, S, R, B, T to IEC 584
Suppression of interference, limits of error			Temperature compensation	
Interference voltage suppression for $f = n \times (f_1 \pm 1\%)$, (f_1 = interference frequency)			• Internal temperature compensation	Not possible
• Common-mode interference (U_{pp})	Min. 90 dB		• External temperature compensation by looping a compensating box into the measuring circuit	Possible, one external compensating box per channel
• Series-mode interference (peak interference value < rated value of input range)	Min. 70 dB		• External compensation by means of temperature value obtained at an analog module of the same ET 200S station	Yes
Crosstalk between the inputs	Min. -50 dB		Smoothing of the measured values	Yes, parameterizable in 4 steps by means of digital filtering
Operational limit (in the entire temperature range, with reference to the input range) ¹⁾	± 0.6%			Step Time constant
Basic error limit (operational limit at 25 °C with reference to input range) ¹⁾	± 0.4%			None 1 x cycle time
Temperature error (with reference to the input range)	± 0.005%/K			Weak 4 x cycle time
				Medium 32 x cycle time
				Strong 64 x cycle time

¹⁾ For type N: as of -150 °C, type B: as of 200 °C, type T: as of -230 °C

Compensation of thermocouples with a compensating box

As well as the error limits of the 2AI TC Standard electronic module (see Table “Technical specifications” in this chapter) you must also take the accuracy of the compensating box into account.

Compensation of thermocouples with a Pt100 on the 2AI RTD Standard

Factors affecting the accuracy of the temperature measurement	
Wiring rules	Ensure there is good thermal contact between the reference junction and the Pt100 used for compensation.
	We recommend that you wire the Pt100 with a four-conductor connection.
Additional technical specifications on the error limits of the 2AI TC	The accuracy of the thermal resistor (Pt100) used for compensation must be taken into account.*
	The error of the measurement input (2AI RTD Standard) used for compensation must be taken into account.*

- * In the case of thermocouples with a characteristic curve with a very shallow gradient, these errors can lead to a major measurement discrepancy.
 For the following thermocouples, this leads to a restriction of the input range of the thermocouples in which the accuracy specifications of the manual apply:
 Type N: –100 °C
 Type K: –230 °C
 Type E: –230 °C