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SIMATIC

ET 200S distributed I/O 2AI I 4WIRE ST analog electronic module (6ES7134-4GB11-0AB0)

Manual

04/2007
A5E01076100-01

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.

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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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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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The portal to our technical documentation for the various SIMATIC products and systems is available at:

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The online catalog and ordering system are available at:
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Training center

We offer courses to help you get started with the ET 200S and the SIMATIC S7 automation system. Please contact your regional training center or the central training center in D - 90327, Nuremberg, Germany.
Phone: +49 (911) 895-3200.

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- The bulletin board, a worldwide knowledge exchange for users and experts.
- 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 I 4WIRE ST analog electronic module (6ES7134-4GB11-0AB0)

Properties

- 2 inputs for measuring current
- Input ranges:
  - ± 20 mA, resolution 13 bits + sign
  - 4 to 20 mA, resolution 13 bits
- Permissible common mode voltage 2 VAC_{SS}
- Extended temperature range from 0 to 50°C with vertical installation

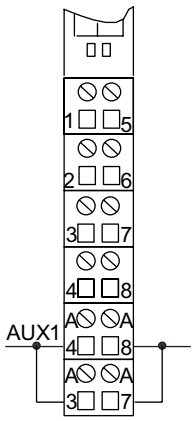
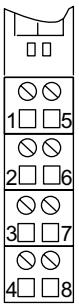
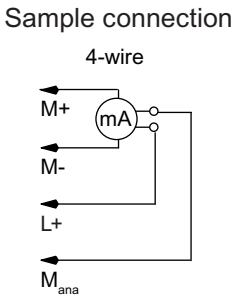
General terminal assignment

Note

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

Terminal assignment for 2AI I 4WIRE ST (6ES7134-4GB11-0AB0)				
Terminal	**Assignment**	**Terminal**	**Assignment**	**Notes**
1	M_{0+}	**5**	M_{1+}	• M_{n+}: Input signal "+", Channel n • M_{n-}: Input signal "-", Channel n • L+: Power supply for four-wire measuring transducer • M_{ana}: Ground (of power module) • AUX1: Protective-conductor terminal or potential bus (freely usable up to 230 VAC)
2	M_{0-}	**6**	M_{1-}	
3	L+	**7**	L+	
4	M_{ana}	**8**	M_{ana}	
A4	AUX1	**A8**	AUX1	
A3	AUX1	**A7**	AUX1	

Usable terminal modules

Usable terminal modules for 2AI I 4WIRE ST (6ES7134-4GB11-0AB0)		
TM-E15C26-A1 (6ES7193-4CA50-0AA0)	TM-E15C24-01 (6ES7193-4CB30-0AA0)	← Spring terminal
TM-E15S26-A1 (6ES7193-4CA40-0AA0)	TM-E15S24-01 (6ES7193-4CB20-0AA0)	← Screw-type terminal
TM-E15N26-A1 (6ES7193-4CA80-0AA0)	TM-E15N24-01 (6ES7193-4CB70-0AA0)	← Fast Connect
		

Block diagram

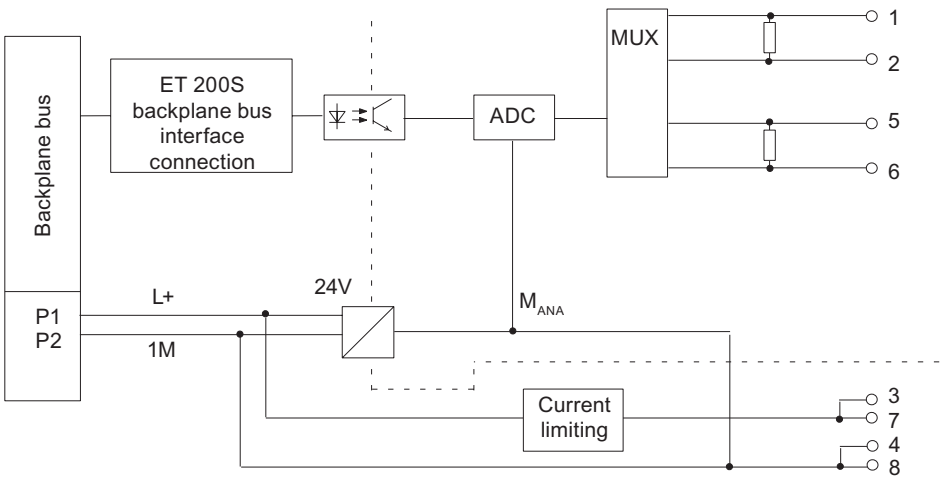


Figure 1-1 Block diagram of the 2AI I 4WIRE ST

2AI I 4WIRE ST technical specifications (6ES7134-4GB11-0AB0)

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	4 bytes	
Address space	4 bytes	
Voltages, currents, potentials		
Rated load voltage L+ (from the power module)	24 VDC	
• Reverse polarity protection	Yes	
Power supply of the transducers	Yes	
• Short-circuit protection	Yes, 60 mA (for both channels)	
Electrical isolation		
• Between the channels and backplane bus	Yes	
• Between the channels and load voltage L+	No	
• Between the channels	No	
Permissible potential difference		
• Between M_{ANA} and the backplane bus (U_{iso})	75 V DC, 60 V AC	
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 "SF" LED	
• Diagnostic functions readable	Yes	
Analog value generation		
Measuring principle	Integrative	
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
• Conversion time in ms	55	65
• Cycle time in ms	Number of active channels per module x conversion time	
• Resolution (including overshoot range)	± 20 mA/13 bits + sign 4 to 20 mA/13 bits	

Suppression of interference, limits of error		
Noise suppression for f = n x (f1 ± 1%), (f1 = interference frequency)		
• Common mode interference (peak value of interference < rated value of input range)	Min. 70 dB	
Crosstalk between the inputs	Min. - 50 dB	
Operational limit (in the entire temperature range, with reference to the input range)	± 0,6 %	
Basic error limit (operational limit at 25°C with reference to input range)	± 0,4 %	
Temperature error (with reference to the input range)	± 0.005 %/K	
Linearity error (with reference to the input range)	± 0,01 %	
Repeatability (in steady state at 25°C with reference to input range)	± 0,05 %	
Data for selecting a sensor		
Input range (rated value)/input resistance		
• Current	± 20 mA/50 Ω	
	4 to 20 mA/50 Ω	
Permitted input current (destruction limit)	40 mA	
Smoothing of the measured values	Yes, can be assigned parameters 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

Parameters

2

2.1 Parameters

Table 2-1 Parameters for analog input module

2 AI I 4WIRE ST	Range of values	Default setting	Applicability
Group diagnostics (parameter assignment error, internal error)	• Disable • Enable	Disable	Module
Diagnostics: Overflow/underflow	• Disable • Enable	Disable	Module
Diagnostics: Wire break*	• Disable • Enable	Disable	Channel
Smoothing	• None • Weak • Medium • Strong	None	Channel
Type/range of measurement	• Deactivated • 4WIRE: 4 to 20 mA • 4WIRE: ± 20 mA	4WIRE: 4 to 20 mA	Channel
* Only in the measuring range 4 to 20 mA			

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 greater the smoothing, the greater the time constant of the filter.

The following diagrams show the step response with the various smoothing factors in relation to the number of module cycles.

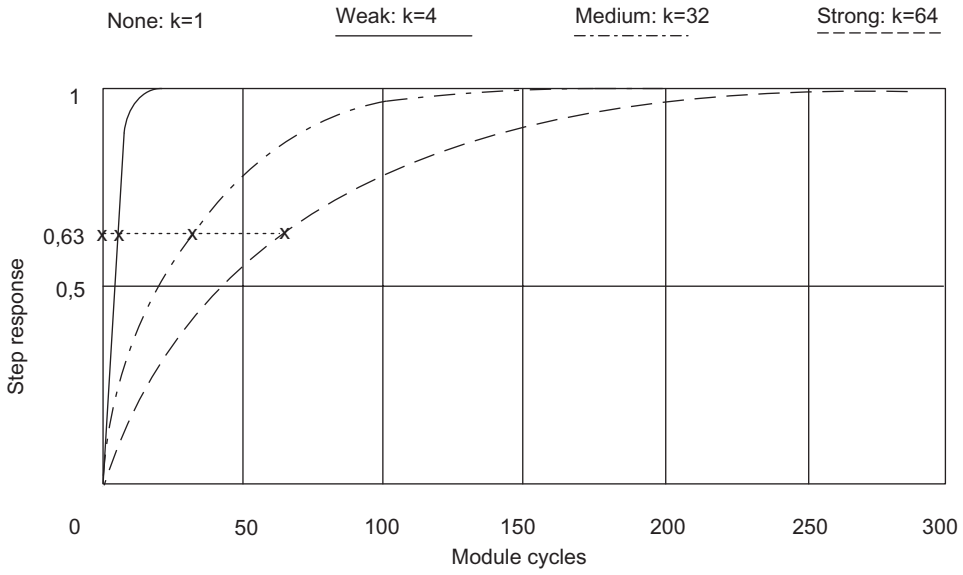


Figure 2-1 Smoothing with the 2 AI I 4WIRE ST

Diagnostics

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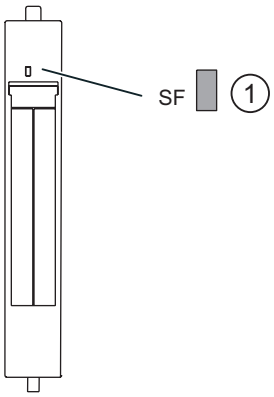
3.1 Diagnostics using LED display

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

Error 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. Incorrect parameter assignment.	Correct the configuration (align actual and set configuration). Correct the parameter assignment (wire break diagnostics only parameterized for the permitted measuring ranges).
9_D	01001: Error	Internal module error (diagnostic message at channel 0 applies to the entire module)	Replace the module.
7_D	00111: Upper limit exceeded	Value is above the overshoot range.	Correct the module/final controlling element tuning.
8_D	01000: Lower limit value undershot	Value is below the underrange.	Correct the module/final controlling element tuning.
6_D	00110: Open circuit	Line to the encoder interrupted.	Correct the process wiring.

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" → –

Output value

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 below 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 Output 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

4.3 Measuring ranges

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 only compare the measuring ranges with the units.

Measuring ranges for current: 4 to 20 mA

Table 4-3 SIMATIC S7 format: Measuring range 4 to 20 mA

Measuring range 4 to 20 mA	Units		Range
	Decimal	Hexadecimal	
> 22,8142	32767	$7FFF_H$	Overflow
22,8142 : 20,0005	32511 : 27649	$7EFF_H$: $6C01_H$	Overshoot range
20,0000 16,0000 : 4,0000	27648 20736 : 0	$6C00_H$ 5100_H : 0_H	Nominal range
3,9995 . 1,1852	-1 : -4864	$FFFF_H$: $ED00_H$	Underrange
< 1,1852	-32768	8000_H	Underflow

Current measuring range: ± 20 mA

Table 4-4 SIMATIC S7 format: Measuring range ± 20 mA

Measuring range ± 20 mA	Units		Range
	Decimal	Hexadecimal	
> 23,5150	32767	$7FFF_H$	Overflow
23,5150 : 20,0007	32511 : 27649	$7EFF_H$: $6C01_H$	Overshoot range
20,0000 14,9980 : -14,9980 -20,0000	27648 20736 : -20736 -27648	$6C00_H$ 5100_H : $AF00_H$ 9400_H	Nominal range
-20,0007 : -23,5160	-27649 : -32512	$93FF_H$: 8100_H	Underrange
< -23,5160	-32768	8000_H	Underflow

Measured values in the event of a wire break in relation to enabled diagnostics

The following additional information applies to the current measuring range 4 to 20 mA:

Table 4-5 Measured values in the event of a wire break in relation to enabled diagnostics

Format	Parameter assignment[1]	Measured values		Description
		Decimal	Hexadecimal	
S7	• "Wire break" diagnostics enabled	32767	$7FFF_H$	• "Open circuit" diagnostic message
	• "Wire break" diagnostics disabled • "Overflow/underflow" diagnostics enabled	-32767	8000_H	• Measured value after leaving the underrange • "Lower limit value undershot" diagnostic message
	• "Wire break" diagnostics disabled • "Overflow/underflow" diagnostics disabled	-32767	8000_H	• Measured value after leaving the underrange
[1] Measuring range limits for wire break and underflow detection: At 1.185 mA				

4.4 Effect on analog value representation

4.4.1 Effect 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/encoders and on the operating state of the PLC (CPU of the DP master). This is illustrated by the table below.

Table 4-6 Relationship between the analog input values for 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)		Supply voltage 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+ present	$7FFF_H$
POWER ON	STOP	L+ missing	Process value
		L+ present	$7FFF_H$
POWER OFF	-	L+ missing	-
		L+ present	-

4.4.2 Effect of the value range on the 2 AI I 4WIRE ST analog input

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 4-7 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-/underrange	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 with incorrect parameter assignment*	$7FFF_H$	$7FFF_H$
* With product version 1 of the 2 AI I 4WIRE ST, the following applies: If the parameter setting error diagnostic message is triggered because the parameters have been assigned incorrectly (e.g., wire break in measuring range ±20 mA), the SF LED on the module lights up and the diagnostics can be evaluated. With this status, the correct input values are sent to the DP master.		

Connecting

5

5.1 Connecting measuring sensors

Introduction You can connect current transmitters to the 2 AI I 4WIRE analog input module to act as:

- Connecting 4-wire transmitters.

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

Cables for analog signals

You should use shielded and twisted-pair cables for the analog signals. This reduces the effect of interference. You should ground the shield of the analog cables at both ends. If there are differences in potential between the cable ends, an equipotential bonding current that may interfere with the analog signals will flow across the shield. If this is the case, you should only ground the shield at one end of the cable.

Analog input modules

The analog input modules are electrically isolated:

- Between the logic and backplane bus
- No isolation: Link between M_{ANA} and central grounding point

Note

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

Connecting measuring encoders to analog inputs

There can be only a limited potential difference U_{CM} (common mode) 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 is not exceeded, you must take different steps depending on the whether the encoders are isolated or non-isolated. The steps you have to take are described in this chapter.

Abbreviations used

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

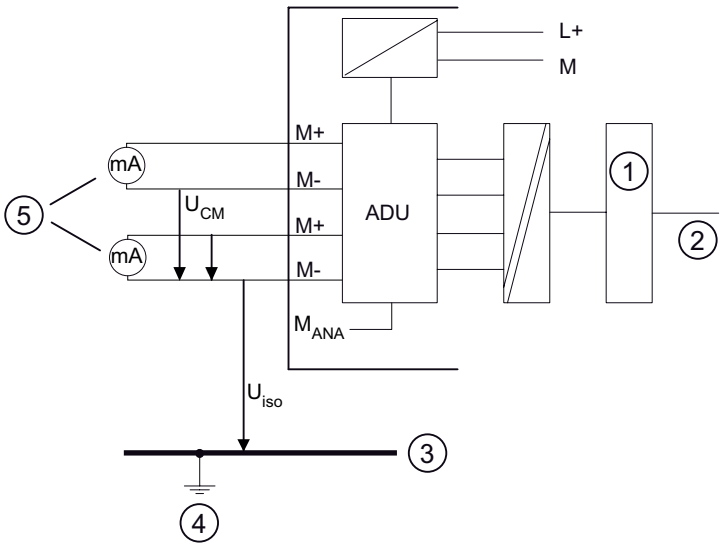
M+:	Measuring line (positive)
M-	Measuring line (negative)
M_{ANA}	Analog measuring circuit reference potential
M	Ground connection
L+	Rated load voltage 24 V DC
U_{CM}	Potential difference between inputs and reference potential of the measuring circuit M_{ANA}
U_{ISO}	Potential difference between M_{ANA}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

Isolated measuring encoders

The isolated measuring encoders are not connected to the local ground potential. These can be potential-free. 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}.

In environments with a high level of EMC interference, it is advisable to connect M- to M_{ANA} in order to prevent the permissible U_{CM} value from being exceeded.

The following schematic representation illustrates the connection of isolated measuring encoders to the analog input modules.



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

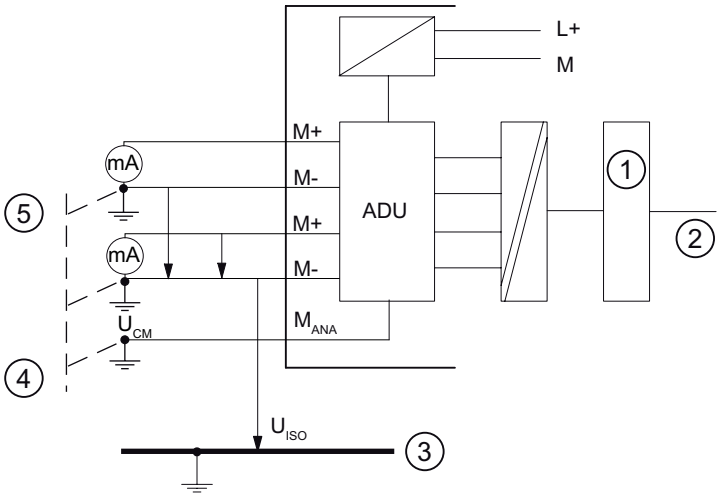
Non-isolated measuring encoders

The non-isolated measuring encoders 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 equipotential bonding conductors between the measuring points.

The following schematic representation illustrates the connection of non-isolated measuring encoders to an optically isolated analog input module.

Connection of non-isolated measuring encoders to an optically isolated analog input module:



① Logic
② Backplane bus
③ Ground bus
④ Equipotential bonding conductor
⑤ Non-isolated measuring encoders

Operating four-wire transmitters on an external voltage supply

If there is electrical isolation between the output and the transmitter supply, you can connect the transmitter to the 2 AI I 4WIRE ST without the need for additional connections.

If there is no electrical isolation between the output and the transmitter supply, you can only connect the transmitter to the 2 AI I 4WIRE ST if the reference potential of the supply voltages (24 V DC) is the same.

If there is an increase in interference radiation, it is recommended that you connect M- to M_{ANA} on the terminal module of the 2 AI I 4WIRE ST.

5.2 Wiring unused channels of the analog input modules

Rules

Pay attention to the following instructions when wiring unused channels:

- "Deactivate" unused input channels when assigning parameters.
- A deactivated channel always returns the value $7FFF_H$.
- The module cycle time is halved with the 2 AI I 4WIRE ST modules.

5.3 Using the shield connection

Rules

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

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

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