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ET 200S distributed I/O 2AI U ST analog electronic module (6ES7134-4FB01-0AB0)

Manual

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Legal information

Warning notice system

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.

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CAUTION
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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 (<http://support.automation.siemens.com/WW/view/en/1144348>).

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 this manual and do not find the answers in this document, please contact your local Siemens representative (<http://www.siemens.com/automation/partners>).

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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, and lots more.

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Properties

1.1 2AI U ST analog electronic module (6ES7134-4FB01-0AB0)

Properties

- 2 inputs for measuring voltage
- Input ranges:
 - ± 10 V, resolution 13 bits + sign
 - ± 5 V, resolution 13 bits + sign
 - 1 V to 5 V, resolution 13 bits
- Isolated from the load voltage L+
- Permitted common mode voltage 5 VAC_{SS}
- Extended temperature range from 0 to 50°C with vertical installation

General terminal assignment

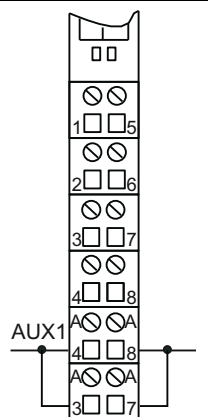
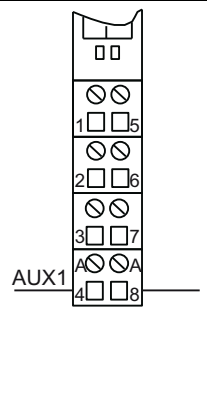
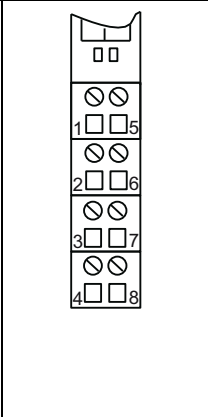
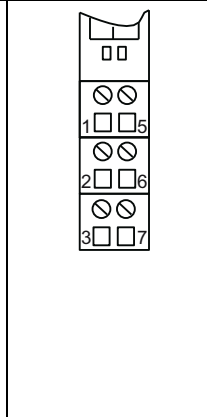
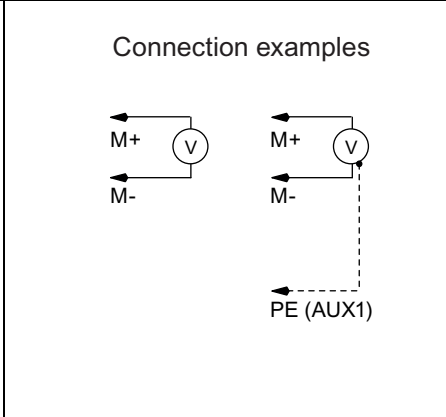
Note

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

Terminal assignment for 2AI U ST (6ES7134-4FB01-0AB0)				
Terminal	Assignment	Terminal	Assignment	Notes
1	M ₀₊	5	M ₁₊	<ul style="list-style-type: none"> • M_{n+}: Input signal "+", channel n • M_{n-}: Input signal "-", channel n • n.c.: Not connected (max. 30 V DC can be connected) • AUX1: Protective-conductor terminal or potential bus (freely usable up to 230 VAC)
2	M ₀₋	6	M ₁₋	
3	n.c.*	7	n.c.*	
4	n.c.	8	n.c.	
A4	AUX1	A8	AUX1	
A3	AUX1	A7	AUX1	

* Product version 003 and higher

Usable terminal modules

Usable terminal modules for 2AI U ST (6ES7134-4FB01-0AB0)				
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
				<p>Connection examples</p> 

Block diagram

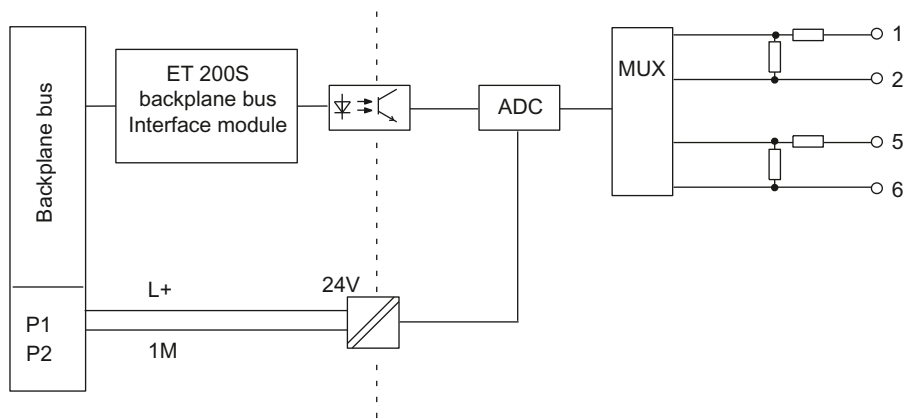


Figure 1-1 Block diagram of the 2AI U ST

2AI U ST technical specifications (6ES7134-4FB01-0AB0)

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
Electrical isolation	
• Between the channels and backplane bus	Yes
• Between the channels and load voltage L+	Yes
• Between the channels	No
Permitted potential difference	
• Between the inputs and the central grounding point (U_{iso})	75 VDC / 60 VAC
• between the inputs	5 VAC _{SS}
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)	± 10 V/13 bits + sign ± 5 V/13 bits + sign 1 V to 5 V/13 bits

Properties

1.1 2AI U ST analog electronic module (6ES7134-4FB01-0AB0)

Suppression of interference, limits of error	
Interference voltage suppression for $f = n \times (f1 \pm 1 \%)$, ($f1 =$ interference frequency)	
• Common-mode interference (U_{ss})	Min. 90 dB
• Series-mode interference	min. 70 dB
(peak interference value < rated value of input range)	
• Crosstalk between the inputs	min. -50 dB
Operational limit (in the entire temperature range, with reference to the input range)	$\pm 0.6 \%$
Basic error limit (operational limit at 25°C with reference to input range)	$\pm 0.4 \%$
Temperature error (with reference to the input range)	$\pm 0.01 \%/K$
Linearity error (with reference to the input range)	$\pm 0.01 \%$
Repeatability (in steady state at 25°C with reference to input range)	$\pm 0.05 \%$
Data for selecting a sensor	
Input range (rated value)/input resistance	
• Voltage	$\pm 5 V/\text{min. } 100 \text{ k}\Omega$ 1 V to 5 V/min. 100 k Ω $\pm 10 V/\text{min. } 100 \text{ k}\Omega$
Permitted input voltage (destruction limit)	35 V continuous, 75 V at max. duration of 1 ms (sampling ratio 1:20)
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

2.1 Parameters

Table 2- 1 Parameters for analog input module

2 AI U ST	Range of values	Default setting	Applicability
Group diagnostics (parameter assignment error, internal error)	<ul style="list-style-type: none"> • Disable • Enable 	Disable	Module
Diagnostics: Overflow/underflow	<ul style="list-style-type: none"> • Disable • Enable 	Disable	Module
Diagnostics: Wire break*	<ul style="list-style-type: none"> • Disable • Enable 	Disable	Channel
Smoothing	<ul style="list-style-type: none"> • None • Weak • Medium • Strong 	None	Channel
Type/range of measurement	<ul style="list-style-type: none"> • Deactivated • ± 5 V • ± 10 V • 1 to 5 V 	± 10 V	Channel
* Only in the measuring range of 1 to 5 V			

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 figure below shows the step response with the various smoothing factors in relation to the number of subassembly cycles.

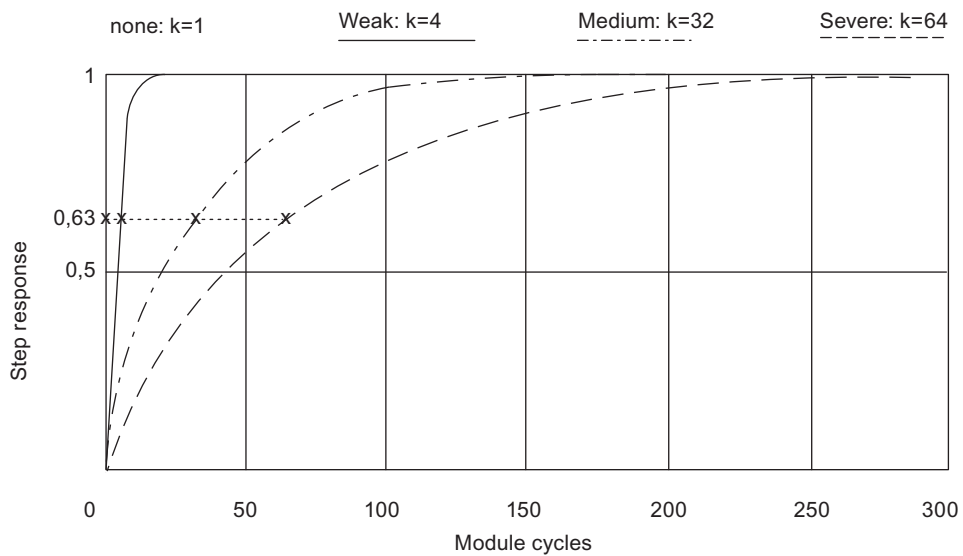
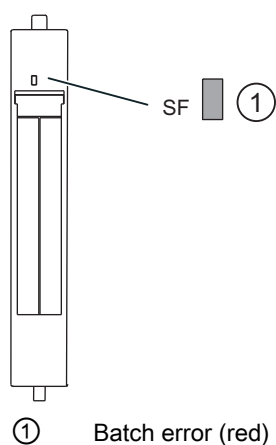


Figure 2-1 Smoothing with the 2AI U ST

Diagnostics

3.1 Diagnostics using LED display

LED display



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

4.1 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 for 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" → –

Analog values

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 11, 12, 13, 14, and 15 bit resolutions + sign. Each analog value is entered left aligned in the ACCU. The bits marked with "x" are set to "0".

Table 4-2 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 0 1 x x x x
12+S	8	8 _H	S 0 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 0 1 x x
14+S	2	4 _H	S 0 0 0 0 0 0 0	0 0 0 0 0 0 1 x
15 + sign	1	1 _H	S 0 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.

Voltage measuring ranges: $\pm 5\text{ V}$, $\pm 10\text{ V}$

Table 4- 3 SIMATIC S7 format: Measuring ranges $\pm 5\text{ V}$ and $\pm 10\text{ V}$

Measuring range $\pm 5\text{ V}$	Measuring range $\pm 10\text{ V}$	Units		Range
		Decimal	Hexadecimal	
> 5,8794	> 11,7589	32767	7FFF _H	Overflow
5,8794	11,7589	32511	7EFF _H	Overshoot range
:	:	:	:	
5,0002	10,0004	27649	6C01 _H	
5,00	10,00	27648	6C00 _H	Nominal range
3,75	7,50	20736	5100 _H	
:	:	:	:	
-3,75	-7,50	-20736	AF00 _H	
-5,00	-10,00	-27648	9400 _H	
-5,0002	-10,0004	-27649	93FF _H	Underrange
:	:	:	:	
-5,8796	-11,759	-32512	8100 _H	
< -5,8796	< -11,759	-32768	8000 _H	Underflow

4.3 Measuring ranges

Voltage measuring ranges: 1 to 5 V

Table 4- 4 SIMATIC S7 format: Measuring range 1 to 5 V

Measuring range 1 to 5 V	Units		Range
	Decimal	Hexadecimal	
> 5,704	32767	7FFF _H	Overflow
5,704 : 5,000145	32511 : 27649	7EFF _H : 6C01 _H	Overshoot range
5,000 4,000 : 1,000	27648 20736 : 0	6C00 _H 5100 _H : 0 _H	Nominal range
0,999855 : 0,296	-1 : -4864	FFFF _H : ED00 _H	Underrange
< 0,296	-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 voltage measuring range 1 to 5 V:

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 0.296 V

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+ missing	7FFF _H
POWER ON	STOP	L+ present	Process value
		L+ missing	7FFF _H
POWER OFF	-	L+ present	-
		L+ missing	-

4.4.2 Effect of the value range on the 2 AI U Standard 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 U 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.

5.1 Connecting measuring sensors

Introduction

You can connect encoders with voltage signals to the 2AI U ST analog input module.

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

Note

Note the following connection notes regarding terminals 3 and 7 when using the analog input module 2AI U ST as of product version 003.

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
- Between the load voltage and the channels.

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, make a connection between terminal M and the central grounding point.

Connecting measuring encoders to analog inputs

There can only be a limited potential difference U_{CM} (common mode) between the measuring lines M- of the input channels. To ensure that the permitted value is not exceeded, you must take different steps depending on 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:

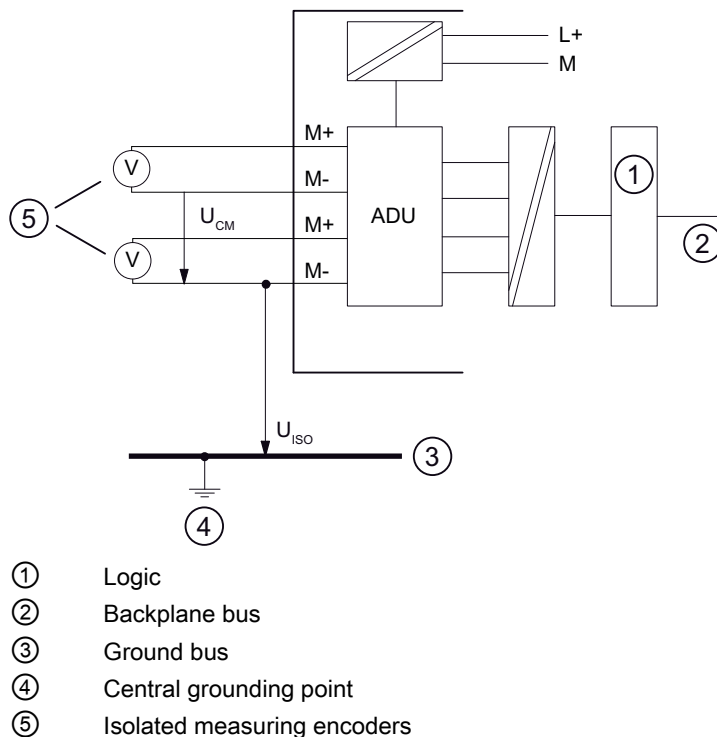
- M+: Measuring line (positive)
- M-: Measuring line (negative)
- M: Ground connection
- L+: Rated load voltage 24 V DC
- U_{CM} : Potential difference between the inputs
- U_{ISO} : Potential difference between inputs and central grounding point

Isolated measuring encoders

The isolated measuring encoders are not connected to the local ground potential. These can be potential-free. Owing to local conditions or interference, differences in potential U_{CM} (static or dynamic) may occur between the M- measuring cables of the input channels and the central grounding point.

The permitted value for U_{CM} must not be exceeded, even in environments with strong EMC interference.

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

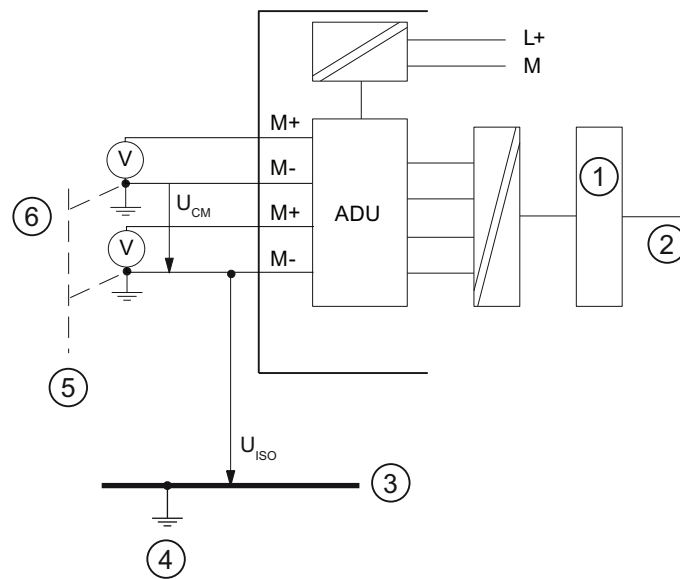


Non-isolated measuring encoders

The non-isolated measuring encoders are connected to the local ground potential. You must connect M - to the potential to ground. 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 illustrates the connection of non-isolated measuring encoders to the optically isolated analog input modules.



- ① Logic
- ② Backplane bus
- ③ Ground bus
- ④ Central grounding point
- ⑤ Equipotential bonding conductor
- ⑥ Non-isolated measuring encoders

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 U ST module.
- To adhere to the permissible potential differences (U_{CM}), you must wire jumpers on the terminal module for the unused channels.

Analog input module	TM connecting terminal							
	Channel 0				Channel 1			
	1	2	3	4	5	6	7	8
2 AI U ST	● — ● — ●				● — ● — ●			

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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