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ET 200S distributed I/O
2AI U HS analog electronic module
(6ES7134-4FB51-0AB0)

Manual

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04/2007
A5E01076015-01

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.

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Preface

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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Properties

1

1.1 2AI U HS analog electronic module (6ES7134-4FB51-0AB0)

Properties

- 2 inputs for measuring voltage
- Input ranges:

  ± 10 V, resolution 13 bits + sign

  ± 5 V, resolution 13 bits + sign

  ± 2.5 V, resolution 13 bits + sign

  1 V to 5 V, resolution 13 bits
- Isolated from the load voltage L+
- Permissible common mode voltage 100 VAC_{SS}
- Supports isochronous operation
  - Minimum time for the synchronous DP cycle (T_{DPmin}): 2.5 ms
  - Minimum conversion time of the input modules (T_{WEmin}): 1.1 ms

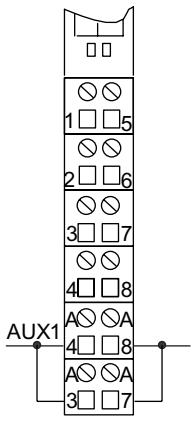
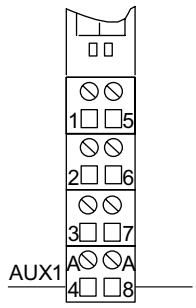
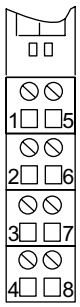
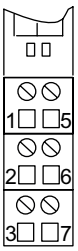
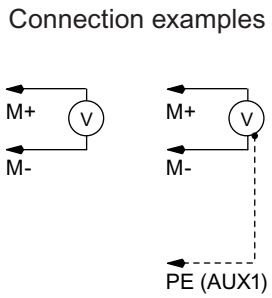
General terminal assignment

Note

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

Terminal assignment for 2AI U HS (6ES7134-4FB51-0AB0)				
Terminal	**Assignment**	**Terminal**	**Assignment**	**Notes**
1	M_{0+}	**5**	M_{1+}	• M_{n+}: Input signal "+", Channel n • M_{n-}: Input signal "-", Channel n • M_{ana}: Ground of the module • n.c.: Not connected (max. DC 30 V can be connected) • AUX1: Protective-conductor terminal or potential bus (freely usable up to 230 VAC)
2	M_{0-}	**6**	M_{1-}	
3	M_{ana}	**7**	M_{ana}	
4	n.c.	**8**	n.c.	
A4	AUX1	**A8**	AUX1	
A3	AUX1	**A7**	AUX1	

Usable terminal modules

Usable terminal modules for 2AI U HS (6ES7134-4FB51-0AB0)				
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

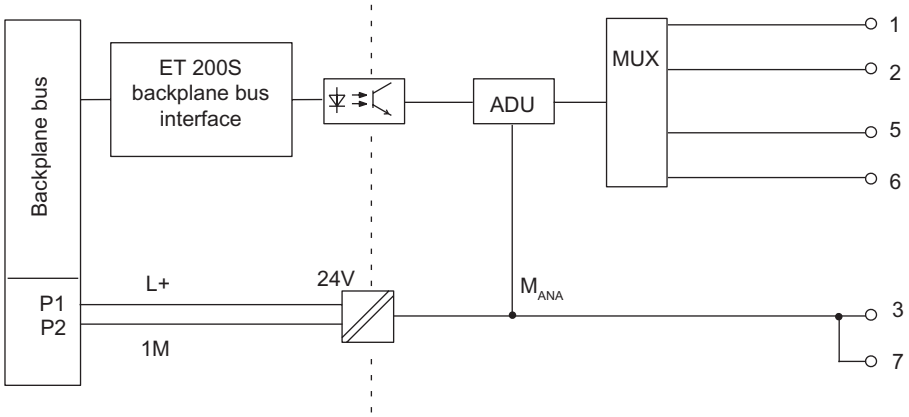


Figure 1-1 Block diagram of the 2AI U HS

2AI U HS technical specifications (6ES7134-4FB51-0AB0)

Dimensions and weight	
Width (mm)	15
Weight	Approx. 40 g
Module-specific data	
Supports isochronous operation	Yes
Number of inputs	2
Cable length	
• Shielded	Max. 200 m
Parameter length	12 bytes (4 bytes when used as 6ES7134 4FB50-0AB0)
Address space	4 bytes
Voltages, currents, potentials	
Rated load voltage L+ (from the power module)	24 VDC
• Reverse polarity protection	Yes
Galvanic isolation	
• Between the channels and backplane bus	Yes
• Between the channels and load voltage L+	Yes
• Between the channels	No
Permissible potential difference	
• Between the inputs and M_{ANA} (U_{CM})	100 VAC_{SS}
• Between M_{ANA} and the central grounding point (U_{ISO})	75 VDC / 60 VAC
Insulation tested	500 VDC
Current consumption	
• Power supply and load voltage L+ (no load)	Max. 35 mA
Power dissipation of the module	Typically 0.8 W
Status, interrupts, diagnostics	
Interrupts	
• Hardware interrupt	Can be assigned parameters[1]
Diagnostics function	
• Group error display	Red "SF" LED
• Diagnostic information can be displayed	Possible[2]
Analog value generation	
Measuring principle	Instantaneous value encoding
Cycle time/resolution:	
• Conversion time in ms (per channel)	0,1
• Cycle time in ms (per module)	1
• Resolution (including overrange)	± 10 V/13 bits + sign ± 5 V/13 bits + sign ± 2.5 V/13 bits + sign 1 V to 5 V/13 bits

Suppression of interference, limits of error		
• Common mode interference (U_{cm}) < 100 VSS)	> 70 dB	
Crosstalk between the inputs	> 50 dB	
Operational limit (in the entire temperature range, with reference to the input range)	± 0,3 %	
Basic error limit (operational limit at 25°C with reference to input range)	± 0,2 %	
Temperature error (with reference to the input range)	±0,01 %/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 ranges (rated value)/input resistance		
• Voltage	± 10 V/min. 100 kΩ ± 5 V/min. 100 kΩ ± 2.5 V/min. 100 kΩ 1 V - 5 V/min. 100 kΩ	
Maximum input voltage for voltage input (destruction limit)	50 V continuous, 100 V at max. duration of 1 ms (sampling ratio 1:20)	
Connection of the sensors		
• For measuring voltage	Supported	
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	64 x cycle time
	Medium	128 x cycle time
	Strong	512 x cycle time

[1] DPV1 only

[2] Parameter assignment error
Violation of lower limit value
Violation of upper limit value
Open circuit (only with 1 V to 5 V)
Process interrupt lost

Parameters

2

2.1 Parameters

Table 2-1 Parameters for analog input module

2AI U HS	Range of values	Default setting	Applicability
Group diagnosis (parameter assignment error, internal error)	• Disable • Enable	Disable	Module
Diagnostics: Overflow/underflow	• Disable • Enable	Disable	Module
Smoothing	• None • Weak • Medium • Strong	None	Channel
Enable hardware interrupt	• Disable • Enable	Disable	Module
Type/range of measurement	• De-activated • ± 2,5 V • ± 5 V • ± 10 V • 1 mA to 5 V	± 10 V	Channel
High limit	• low to high limit of the overrange	27648	Channel
Low limit	• low to high limit of the overrange	0	Channel

Note

If you deactivate a HS module channel, you do not gain any advantages in terms of speed, due to the measuring procedure used.

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.

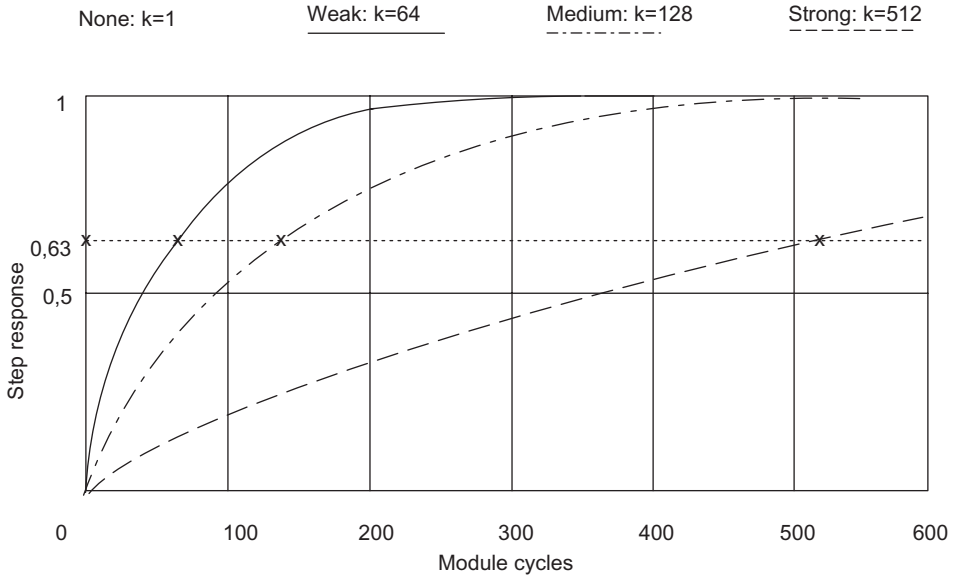


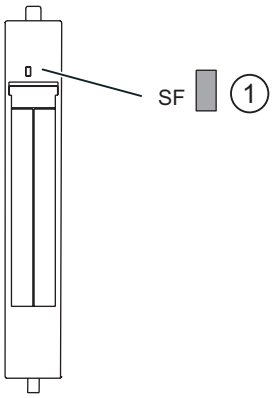
Figure 2-1 Smoothing for 2AI U HS (6ES7134-4FB51-0AB0/ 6ES7134-4FB50-0AB0)

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

Analog input modules	Fault type		Meaning	Remedy
2AI U HS	16_D	10000: Configuration 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 overrange.	Correct the module/actuator tuning.
	8_D	01000: Lower value limit fallen below	Value is below the underrange.	Correct the module/actuator tuning.

3.3 Interrupts

Hardware interrupt of analog input modules

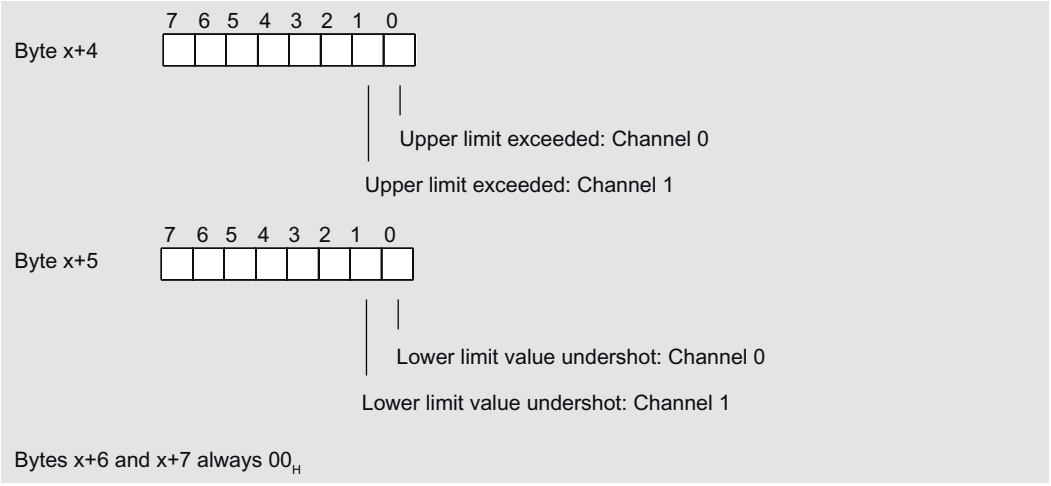


Figure 3-1 Structure as of Byte x+4 and Byte x+5 for hardware interrupt (analog input)

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 contain only a comparison of the measuring ranges with the units.

measuring ranges for voltage ± 2.5 V, ± 5 V and ± 10 V

Table 4-3 SIMATIC S7 format: measuring ranges ± 2.5 V, ± 5 V and ± 10 V

Measuring range ± 2.5 V	Measuring range ± 5 V	Measuring range ± 10 V	Units		Range
			Decimal	Hexadecimal	
> 2,9397	> 5,8794	> 11,7589	32767	$7FFF_H$	Overflow
2,9397	5,8794	11,7589	32511	$7EFF_H$	Overshoot range
:	:	:	:	:	
2,5001	5,0002	10,0004	27649	$6C01_H$	
2,5	5,00	10,00	27648	$6C00_H$	Rated range
1,86	3,75	7,50	20736	5100_H	
:	:	:	:	:	
-1,86	-3,75	-7,50	-20736	$AF00_H$	
-2,50	-5,00	-10,00	-27648	9400_H	
-2,5001	-5,0002	-10,0004	-27649	$93FF_H$	Undershoot range
:	:	:	:	:	
-2,9397	-5,8796	-11,759	-32512	8100_H	
< -2,9397	< -5,8796	< -11,759	-32768	8000_H	Underflow

Voltage measuring ranges: 1 mA to 5 V

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

Measuring range 1 V to 5 V	Units		Range
	Decimal	Hexadecimal	
> 5,704	32767	$7FFF_H$	Overflow
5,704 : 5,000145	32511 : 27649	$7EFF_H$: $6C01_H$	Overrange
5,000 4,000 : 1,000	27648 20736 : 0	$6C00_H$ 5100_H : 0_H	Rated range
0,999855 : 0,296	-1 : -4864	$FFFF_H$: $ED00_H$	Undershoot range
< 0,296	-32768	8000_H	Underflow

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). The table below shows this dependency..

Table 4-5 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 electronics 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 2AI U HS analog input

The response of the electronics modules with analog inputs depends on the part of the value range in which the input values are located. The table below shows this dependency..

Table 4-6 Response of the analog modules, depending on the location of the analog input value in the range of values

Measured value within ...	Input value in SIMATIC S7 format	Input value in SIMATIC S5 format
Rated 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 undershoot range -1 plus overflow bit
Prior to parameter assignment, or incorrect parameter assignment	$7FFF_H$	$7FFF_H$

Connecting

5

5.1 Connecting measuring sensors

Introduction

You can connect encoders with voltage signals to the 2AI U HS 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 The following are used:
  - 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. If there is a possibility of exceeding the permitted value, make a connection between terminal M_{ANA} and the central grounding point.

Connection of 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 the whether the sensors 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	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 central grounding point

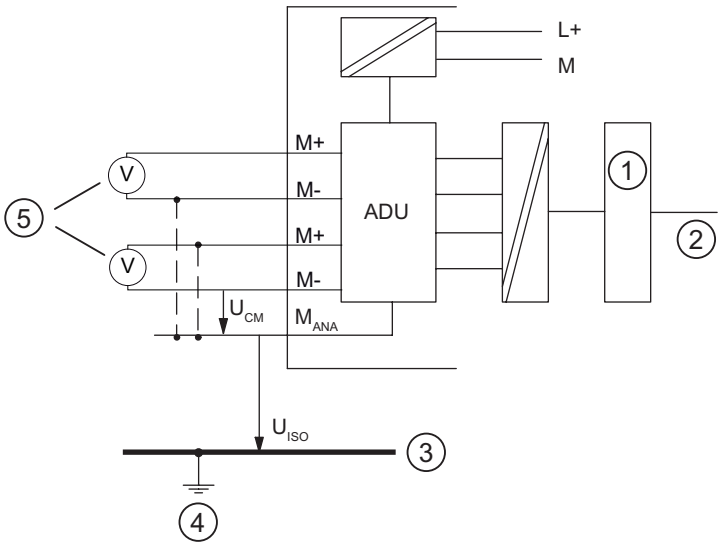
Isolated measuring sensors

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:

- For the 2 AI U analog input module: Connect M- with M_{ANA}!

The following figure illustrates the connection of isolated measuring sensors to the floating analog input modules.



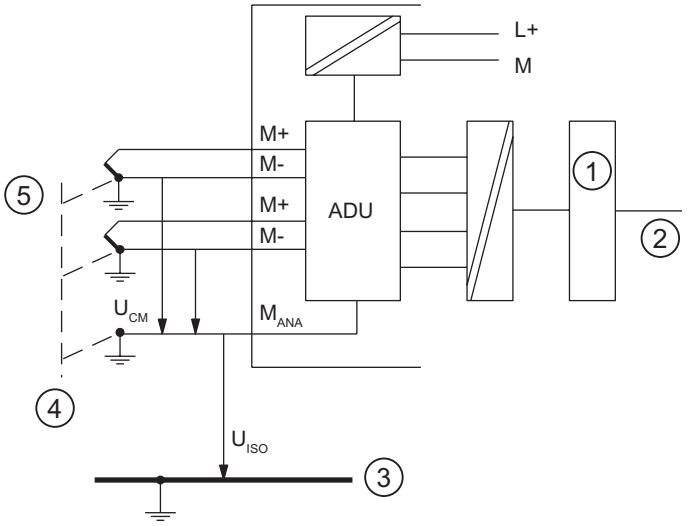
① Logic
② Backplane bus
③ Ground bus
④ Central grounding point
⑤ Isolated measuring sensors

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 equipotential bonding conductors between the measuring points.

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



① Logic
② Backplane bus
③ Ground bus
④ Equipotential bonding cable
⑤ Non-isolated measuring sensors

Sensor selection

Note the following factors when selecting the sensors:

- Length, impedance, and capacitance of the cable
- Reaction speed of the utilized sensors

Note

When a sensor is connected or a wire break is repaired during a measuring operation, false measurements and false diagnostics can occur on both inputs if the permissible input current is exceeded.

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 cycle time of the 2AI U HS module is always 250 ms.
- 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 connection terminal							
	Channel 0				Channel 1			
	1	2	3	4	5	6	7	8
2AI U HS								

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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