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ET 200S distributed I/O 2AI U HF analog electronic module (6ES7134-4LB02-0AB0)

Manual

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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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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.

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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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- Information about on-site services, repairs, spare parts. Lots more can be found on our "Services" pages.

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Properties

1.1 2AI U HF analog electronic module (6ES7134-4LB02-0AB0)

Properties

- 2 inputs for measuring voltage
- Input ranges:
 - ± 5 V, resolution 15 bits + sign
 - ± 10 V, resolution 15 bits + sign
 - 1 V to 5 V, resolution 15 bits
- Isolated from the load voltage L+
- Permitted common-mode voltage between the channels 100 VAC
- Supports isochronous operation
 - Minimum time for the isochronous DP cycle (T_{DPmin}): 0.7 ms
 - Minimum conversion time of the input modules (T_{WEmin}): 0.5 ms
- Supports I&M functions

General terminal assignment

Note

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

Terminal assignment for 2AI U HF (6ES7134-4LB02-0AB0)				
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	

Usable terminal modules

Usable terminal modules for 2AI U HF (6ES7134-4LB02-0AB0)				
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>Wiring examples</p>

Block diagram

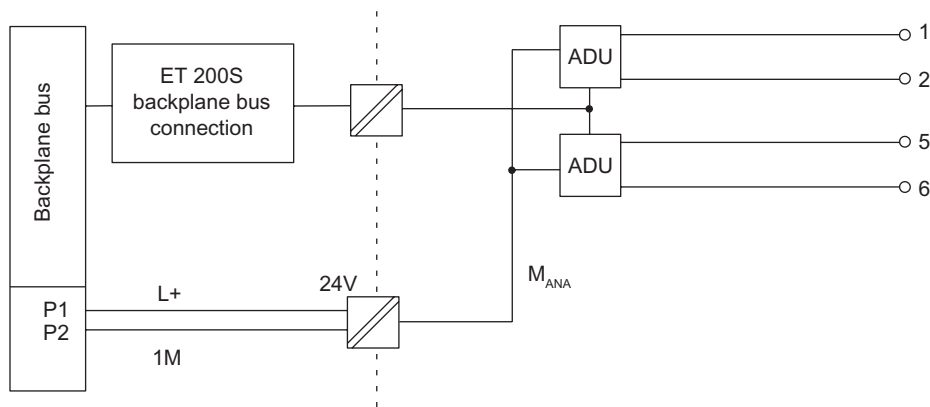


Figure 1-1 Block diagram of the 2AI U HF

2AI U HF technical data (6ES7134-4LB02-0AB0)

Dimensions and weight	
Width (mm)	15
Weight	Approx. 45 g
Module-specific data	
Supports isochronous operation ¹	Yes
Supports I&M functions	Yes
Number of inputs	2
Cable length	
• Shielded	Max. 200 m
Parameter length	12 bytes
Address space	4 bytes
Analog value representation	S5 and S7 format
¹ Supported if no interference frequency suppression or smoothing is configured.	
Voltages, currents, potentials	
Rated load voltage L+ (from the power module)	24 VDC
• Reverse polarity protection	Yes
• Supply of the transmitters	No
Electrical isolation	
• Between the channels and backplane bus	Yes
• Between the channels and load voltage L+	Yes
• Between the channels	No
Permissible potential difference	
• Between channels (U_{CM})	140 VDC / 100 VAC
• Between M_{ANA} and the central grounding point (U_{iso})	75 V DC, 60 V AC
Insulation tested	500 VDC
Current consumption	
• From load voltage L+	Max. 55 mA
Power dissipation of the module	Typically 0.85 W
Status, interrupts, diagnostics	
Diagnostics function	
• Group error	Red "SF" LED
• Diagnostic functions readable	Yes
• Hardware interrupts ²	Configurable, violation of upper and lower limits
² Hardware interrupts are only sent if the process interrupt mechanism is not overloaded.	

Properties

1.1 2AI U HF analog electronic module (6ES7134-4LB02-0AB0)

Analog value generation			
Measuring principle	Sigma-Delta		
Conversion and cycle time			
• Integration time can be assigned parameters	Yes		
• Interference frequency suppression in Hz	60	50	No
• Conversion time in ms (per channel)	17	20	0,04
• Cycle time in ms (per module)	18	21	0,5
• Resolution (including overshoot range)	± 10 V/15 bits + sign ± 5 V/15 bits + sign 1 to 5 V/15 bits		
Suppression of interference, limits of error			
Interference voltage suppression for $f = n \times (f_1 \pm 0.5 \%)$, ($f_1 =$ interference frequency)			
• Common-mode interference (U_{SS})	Min. 100 dB		
• Series-mode interference (peak interference value < rated value of input range)	min. 90 dB		
• Crosstalk between the inputs	min. -100 dB		
Operational limit (entire temperature range with reference to input range; calibration enabled ¹)	$\pm 0.1\%$ with interference frequency suppression $\pm 0.2\%$ without interference frequency suppression		
Operational limit (operational limit at 25°C)	$\pm 0.05\%$ with interference frequency suppression $\pm 0.1\%$ without interference frequency suppression		
Temperature error (with reference to the input range)	$\pm 0.003 \%$ /K		
Linearity error (with reference to the input range)	$\pm 0,01 \%$		
Repeatability (in steady state at 25°C with reference to input range)	$\pm 0,01 \%$		
Data for selecting a sensor			
Input range (rated value)/input resistance			
• Voltage	± 10 V/min. 0.8 M Ω ± 5 V/min. 0.8 M Ω 1 to 5 V/min. 0.8 M Ω		
Permitted input voltage (destruction limit)	35 V continuous 75 V for 1 ms max., pulse-duty factor 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	16 x cycle time	
	Strong	32 x cycle time	

I&M functions

The I&M data can be read from the module using interface modules with the following order numbers or firmware/product versions (or higher):

Interface module	Order Number	Firmware version	Product version
IM151-1 HIGH FEATURE	6ES7151-1BA01-0AB0	V2.0	02
IM151-3 PN	6ES7151-3AA20-0AB0	V4.0	01
IM151-3 PN HIGH FEATURE	6ES7151-3AA20-0AB0	V4.0	01
IM151-3 PN FO	6ES7151-3BB21-0AB0	V4.0	01

Parameters

2.1 Parameters

Table 2-1 Parameters for analog input module

2AI U HF	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
Smoothing ¹	<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
Interference frequency suppression ¹	<ul style="list-style-type: none"> • Disable • Enable 	Disable	Module
Diagnostics: Wire break ²	<ul style="list-style-type: none"> • Disable • Enable 	Disable	Channel
¹ Not with isochronous mode ² Only in the measuring range 1 V 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.

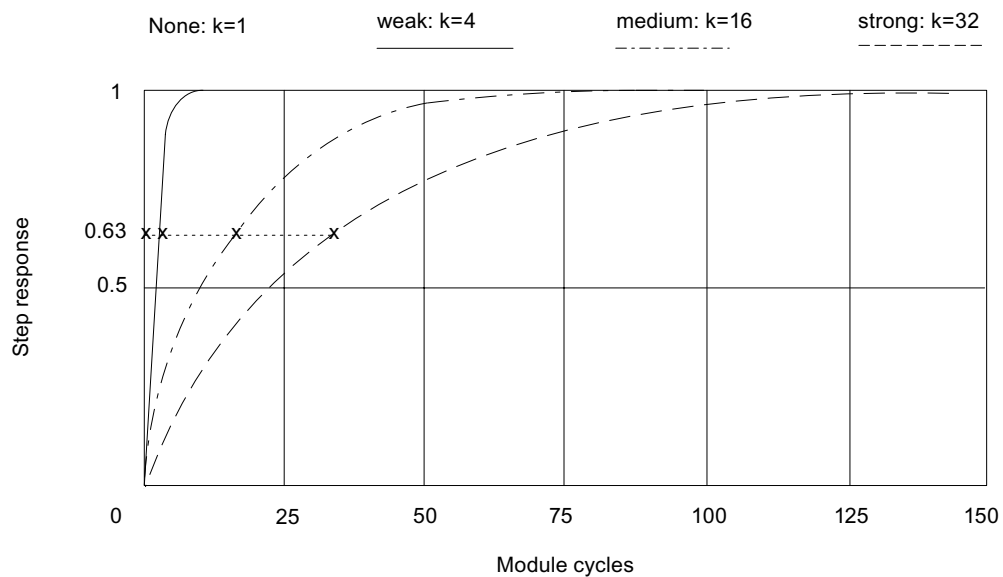


Figure 2-1 Smoothing with the 2AI U HF

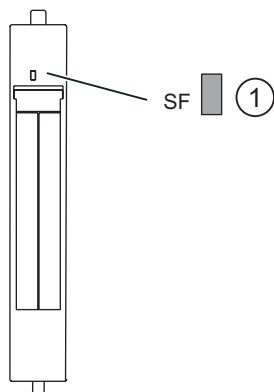
Interference frequency suppression

The 2AI U HF analog input module supports the setting of interference frequency suppression (50 Hz or 60 Hz) on the interface module. This analog input module (HIGH FEATURE) also enables the interference frequency suppression to be disabled; i.e., this setting will be ignored on the interface module. Disabling interference suppression reduces the conversion and cycle times in this module.

Diagnostics

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

4.1 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

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: ±5 V , ±10 V

Table 4-3 SIMATIC S7 format: Measuring ranges ±5 V and ±10 V

Measuring range ±5 V	Measuring range ±10 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

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	32511	7EFF _H	Overshoot range
:	:	:	
5,000145	27649	6C01 _H	
5,000	27648	6C00 _H	Nominal range
4,000	20736	5100 _H	
:	:	:	
1,000	0	0 _H	
0,999855	-1	FFFF _H	Underrange
:	:	:	
0,296	-4864	ED00 _H	
< 0,296	-32768	8000 _H	Underflow

4.3 Effect on analog value representation

4.3.1 Effect of the supply voltage and the operating state on analog input values

The input and output values of the analog modules are dependent on the power supply for electronics/sensors and on the operating state of the PLC (CPU of the DP master). This is illustrated by the table below.

Table 4-5 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	-

4.3.2 Effect of the value range on the 2AI U HF 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 4-6 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 incorrect parameter assignment	7FFF _H	7FFF _H

Connecting

5.1 Connecting measuring sensors

Introduction

You can connect voltage encoders to the 2AI U HF 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.

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.
 - Electrical isolation: No link between M_{ANA} and the central grounding point (U_{ISO})

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 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:

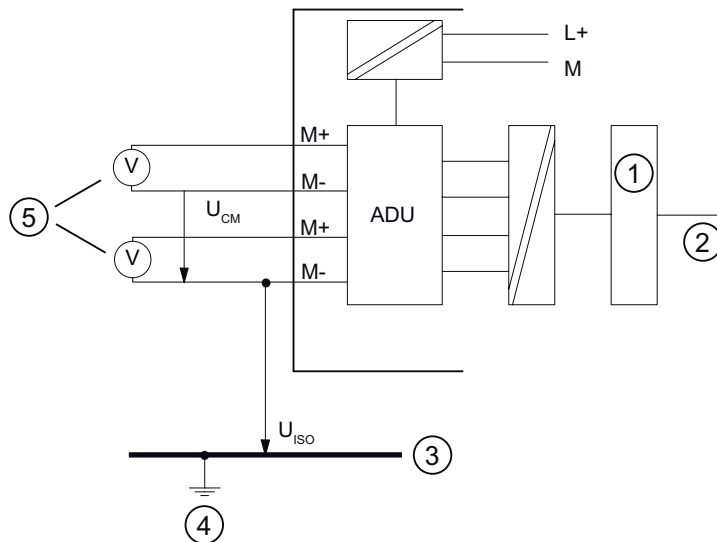
- M+: Measuring line (positive)
- M-: Measuring line (negative)
- M_{ANA}: Reference potential of the analog measuring circuit
- M: Ground connection
- L+: Rated load voltage 24 V DC
- U_{CM}: Potential difference between inputs and reference potential of the measuring circuit M_{ANA}
- U_{ISO}: Potential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

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

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



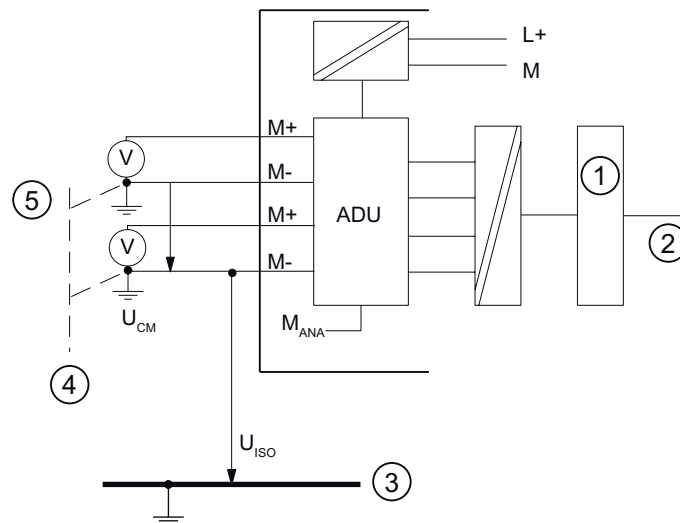
- ① Logic
- ② Backplane bus
- ③ Ground bus
- ④ Central grounding point
- ⑤ Isolated measuring encoders

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.



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

5.2 Wiring unused channels on 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.

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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