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SIMATIC

ET 200S distributed I/O 2AI I 2WIRE HS analog electronic module (6ES7134-4GB52-0AB0)

Manual

01/2008
A5E01001734-02

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.

If more than one degree of danger is present, the warning notice representing the highest degree of danger will be used. A notice warning of injury to persons with a safety alert symbol may also include a warning relating to property damage.

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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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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.
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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

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1.1 2AI I 2WIRE HS analog electronic module (6ES7134-4GB52-0AB0)

Properties

- 2 inputs for current measurement
- Current-limited sensor supply
- Input ranges:

  4 mA to 20 mA, resolution 15 bits

  0 to 20 mA, resolution 15 bits
- Supports isochrone mode
  - Minimum possible time for the isochronous DP cycle (T_{DPmin}): 250 µs
  - Minimum conversion time of the input modules (T_{WE}): 100 µs
- Firmware update of electronic module is possible.

Note

Inputs must not be connected in series for the current measurement.

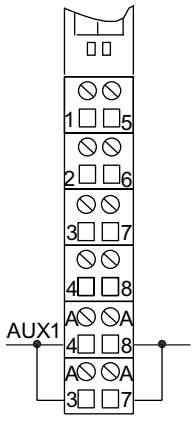
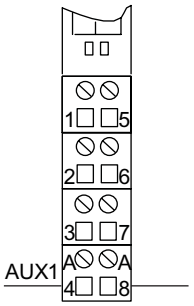
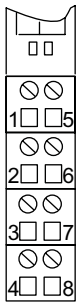
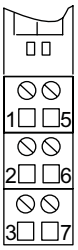
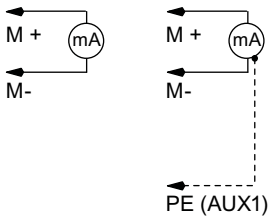
General terminal assignment

Note

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

Terminal assignment for 2AI I 2WIRE HS (6ES7134-4GB52-0AB0)				
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 power module) • n.c.: Not connected (max. 30 VDC can be connected) • AUX1: Protective-conductor terminal or voltage 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 I 2WIRE HS (6ES7134-4GB52-0AB0)				
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
				Wiring examples  2-wire transducer is supplied by means of the measuring circuits.

Block diagram

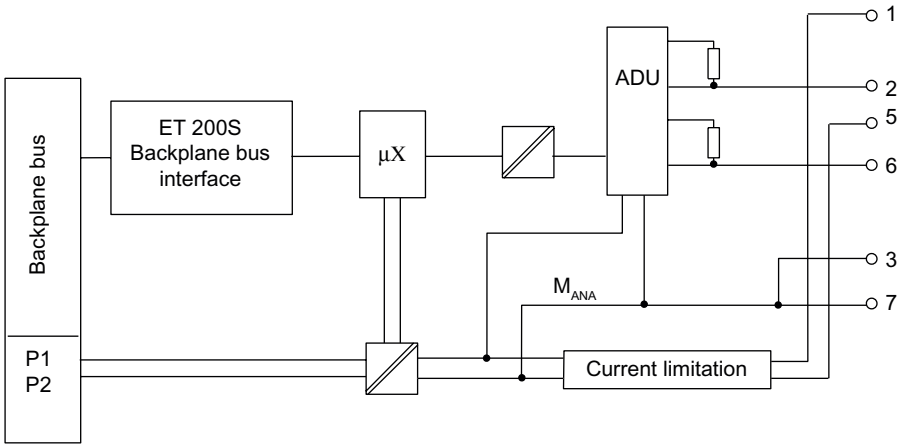


Figure 1-1 Block diagram of the 2AI I 2WIRE HS

Technical specifications for 2AI I 2WIRE HS (6ES7134-4GB52-0AB0)

Dimensions and weight	
Width (mm)	15
Weight	Approx. 45 g
Module-specific data	
Supports isochrone mode	Yes
Number of inputs	2
Cable length	
• Shielded	Max. 200 m
Parameter length	12 bytes
Address space	4 bytes
Voltages, currents, potentials	
Rated load voltage L+ (from the power module)	24 VDC
• Reverse polarity protection	Yes
• Short-circuit protection	Yes (destruction limit 30 mA per channel)
Galvanic isolation	
• Between channels and backplane bus	Yes
• Between channels and load voltage L+	Yes
• Between channels	No
Permissible potential difference	
• Between M_{ANA} and $M_{internal}$ (U_{ISO})	75 VDC, 60 VAC
Insulation test voltage	500 VDC
Current consumption	
• Supply and load voltage L+	Max. 225 mA[1]
Power loss of the module	Typically 2.5 W
Status, interrupts, diagnostics	
Interrupts	
• Hardware interrupt	Can be assigned[2]
Diagnostics function	
• Group error display	Red "SF" LED
• Diagnostics functions readable	Possible[3]

Analog value generation		
Measuring principle	SAR (**S**uccessive **A**pproximation **R**egister)	
Cycle time/resolution:		
• Conversion time in µs (per channel)	15 µs	
• Cycle time in ms (per module)	0.25 ms	
• Resolution (including overrange)	4 to 20 mA/15 bits 0 to 20 mA/15 bits	
Interference suppression, error limits		
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)	± 0,03 %	
Repeatability (in steady state at 25°C with reference to input range)	± 0,1 %	
Sensor supply outputs		
Number of outputs Output voltage • With load	2 24 V (+5%/ -10%)	
Output current • Rated value • Permitted range	 45 mA (per channel) 0 mA to 45 mA	
Short-circuit protection	Yes, electronic	
Sensor selection data		
Input range (rated value/input resistance)		
• Current	4 to 20 mA/106 Ω 0 to 20 mA/106 Ω	
Connection of the sensors		
• For current measurement as 2-wire transducer	Supported	
Load of the 2-wire transducer	max. 670 Ω	
Permitted input current (destruction limit)	30 mA	
Smoothing of the measured values	Yes, can be assigned in 4 steps by means of digital filtering	
	Step None Weak Medium Strong	**Time constant** 1 x cycle time 4 x cycle time 16 x cycle time 32 x cycle time
[1] With sensor supply voltage [2] For interface modules with process interrupt capability only [3] Parameter assignment error Violation of low limit Violation of high limit Open circuit (only with 4 to 20 mA) Process interrupt lost		

Firmware update (as of revision level 03)

To add functions and for troubleshooting, it is possible to load firmware updates to the operating system memory of the electronic module using STEP 7 HW Config.

Note

When you launch the firmware update, the old firmware is deleted. If the firmware update is interrupted or canceled, the electronic module will no longer be capable of functioning. Restart the firmware update and wait until it has completed successfully.

Note

If the ET 200S is operated in conjunction with an S7-300 CPU with PROFIBUS DP interface or an ET 200S Interface Module IM151-3 PN HIGH SPEED, a station failure of the ET 200S can occur during the firmware update.

I&M functions and firmware update

The interface modules identified in the table below (as of order number) can be used to read and write I&M data from the module and for the firmware update.

Interface module	as of order number
IM151-1 HIGH FEATURE	6ES7151-1BA02-0AB0
IM151-3 PN	6ES7151-3AA22-0AB0
IM151-3 PN HIGH FEATURE	6ES7151-3BA22-0AB0
IM151-3 PN FO	6ES7151-3BB22-0AB0
IM151-7 CPU	6ES7151-7AA20-0AB0

1.2 Compatibility with the predecessor module

Compatible with 2AI 2WIRE HS analog electronic module (6ES7132-4GB51-0AB0)

If you configure the 2AI 2WIRE HS (6ES7132-4GB52-0AB0) as the predecessor module (6ES7132-4GB51-0AB0), it behaves compatibly.

The following technical specifications of the 2AI 2WIRE HS (6ES7132-4GB52-0AB0) are set according to the predecessor module (6ES7132-4GB51-0AB0):

Technical specifications for 2AI 2WIRE HS 6ES7132-4GB52-0AB0		**configured as 6ES7132-4GB51-0AB0**
Galvanic isolation		
Between channels and load voltage L+	Yes	Yes
Analog value generation		
Cycle time in ms (per module)	0.25 ms	1 ms
Resolution (including overrange)	4 to 20 mA/15 bit	4 to 20 mA/13 bit
	0 to 20 mA/15 bit	0 to 20 mA/13 bit
Sensor selection data		
Smoothing of the measured values	**Time constant**	**Time constant**
	1 x cycle time	1 x cycle time
	4 x cycle time	64 x cycle time
	16 x cycle time	128 x cycle time
	32 x cycle time	512 x cycle time

Current consumption and power loss

Note the change in the current consumption and power loss of the 2AI 2WIRE HS (6ES7132-4GB52-0AB0) compared to the predecessor module (6ES7132-4GB51-0AB0).

See also

2AI I 2WIRE HS analog electronic module (6ES7134-4GB52-0AB0) (Page 7)

Parameters

2

2.1 Parameters

Parameters for the 2AI I 2WIRE HS analog electronic module

Table 2-1 Parameters for the 2AI I 2WIRE HS analog electronic module

Parameters	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
Hardware interrupt enable	• Disable • Enable	Disable	Module
Type/range of measurement	• Deactivated • 4 to 20 mA • 0 to 20 mA	4 to 20 mA	Channel
High limit	• Low to high limit of the overrange	Depending on the measuring range	Channel
Low limit	• Low to high limit of the overrange	Depending on the measuring range	Channel
* Only in the measuring range 4 to 20 mA			

Note

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

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 by the 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 module cycles.

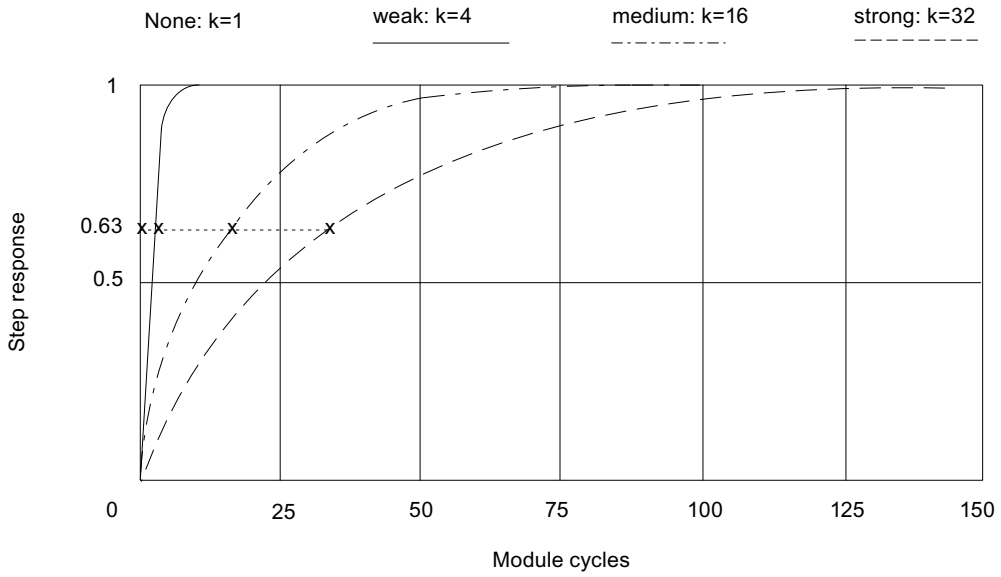


Figure 2-1 Smoothing for 2AI I 2WIRE HS (as of 6ES7134-4GB52-0AB0)

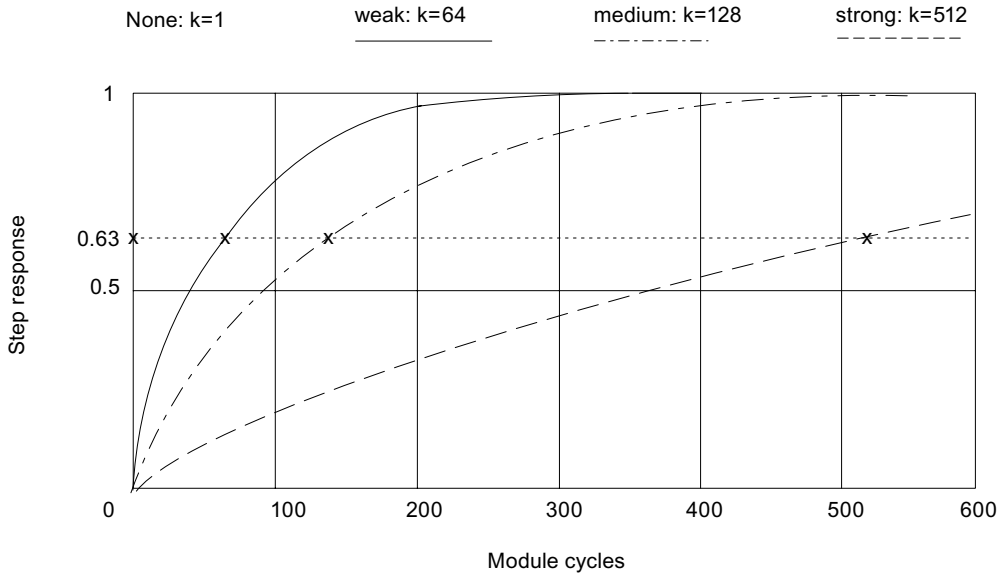


Figure 2-2 Smoothing for 2AI I 2WIRE HS (6ES7134-4GB51-0AB0)

Diagnostics

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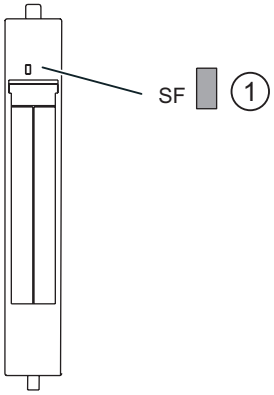
3.1 LED displays on analog electronic modules

Analog electronic modules

LED displays on analog electronic modules:



① Batch error (red)

Status and error displays by means of LEDs on analog electronic modules

The table below shows the status and error displays on the analog electronic modules.

Event (LED)	Cause	Remedy
SF		
values	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 Channel-related diagnostics - error types

Analog input module error types

Table 3-1 Error types

Error type		Meaning	Remedy
31_D	11111: Channel temporarily unavailable	The firmware is being updated. Channel 0 applies to the entire module. The module does not perform any measurements during this time.	--
22_D	10110: Hardware interrupt lost	A hardware interrupt was not recognized.	Correction or coordination of the program, process, module
16_D	10000: Parameter assignment error	Module cannot utilize the parameters for the channel: Inserted module does not match the configuration. Incorrect parameter assignment.	Correct the configuration (align actual and preset configuration). Correct the parameter assignment (wire break diagnostics assigned only for the allowed measuring ranges).
9_D	01001: Error	Internal module error (diagnostic message at channel 0 applies to the entire module)	Replace the module.
8_D	01000: Low limit exceeded	Value is below the underrange.	Correct the module/actuator tuning.
7_D	00111: High limit exceeded	Value is above the overrange.	Correct the module/actuator tuning.
6_D	00110: Open circuit	Line to the encoder is interrupted.	Correct the process wiring.

3.3 Interrupts

Hardware interrupt of analog input modules

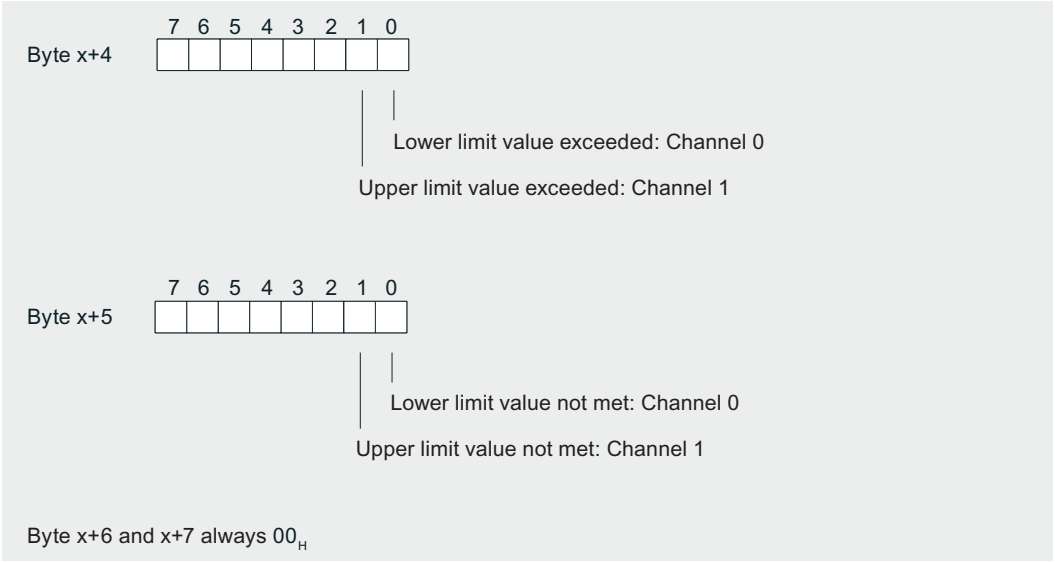


Figure 3-1 Structure as of Byte x+4 and Byte x+5 for hardware interrupt (analog input)

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

Measuring ranges for current: 0 to 20 mA, 4 to 20 mA

Table 4-3 SIMATIC S7 format: Measuring ranges 0 to 20 mA, 4 to 20 mA

Measuring range 0 to 20 mA	Measuring range 4 to 20 mA	Units		Range
		Decimal	Hexadecimal	
> 23.5178	> 22.8142	32767	$7FFF_H$	Overflow
23.5178 : 20.0007	22.8142 : 20.0005	32511 : 27649	$7EFF_H$: $6C01_H$	Overrange
20.0000 15.0000 : 0.0000	20.0000 16.0000 : 4.0000	27648 20736 : 0	$6C00_H$ 5100_H : 0_H	Nominal range
Negative values are not supported	3.9995 . 1.1852	-1 : -4864	$FFFF_H$: $ED00_H$	Underrange
	< 1.1852	-32768	8000_H	Underflow

Measured values in the event of a wire break (as a function of diagnostic enables)

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

Table 4-4 Measured values in the event of a wire break (as a function of diagnostic enables)

Format	Parameter assignment[1]	Measured values		Explanation
		Decimal	Hexadecimal	
S7	• "Wire break" diagnostics enabled	32767	$7FFF_H$	• Diagnostics message "Wire break"
	• "Wire break" diagnostics disabled • "Overflow/underflow" diagnostics enabled	-32767	8000_H	• Measured value after leaving the underrange • Diagnostics message "Low limit exceeded"
	• "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 Influence 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/sensors 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)		Supply voltage L+ on ET 200S (power module)	Input value of the electronics module with analog inputs (evaluation possible in 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 Influence of the value range for the analog input 2AI I 2WIRE HS

The response of the electronic 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 Behavior 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
Nominal 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
Prior to parameter assignment, or incorrect parameter assignment	$7FFF_H$	$7FFF_H$

Connecting

5

5.1 Connecting measuring sensors

Introduction

You can connect a current sensor in the form of a 2-wire transducer to the 2AI I 2WIRE 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. If there are differences in potential between the line ends, an equipotential bonding current that may interfere with the analog signals will flow across the shield. In this 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 channels and backplane bus
- Between load voltage and the channels

Connection of measuring sensors to analog inputs

Between the measuring circuits 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 section.

Generally speaking, however, when connecting 2-wire transducers for current measurement, you should not make a connection from M- to M_{ANA}, from M+ to M_{ANA}, or from M+ to M-. This also applies to inputs that have been assigned accordingly but are not used.

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	Chassis terminal
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}.

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

Connection of isolated measuring sensors to a floating analog input module:

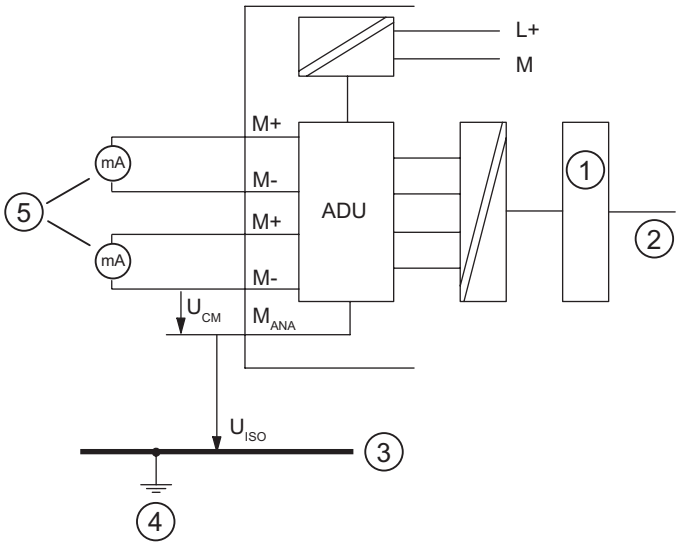


Figure 5-1 Connection of isolated measuring sensors

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

Rules

Pay attention to the following instructions when wiring unused channels:

- "Disable" unused input channels in the parameter assignment.
- A disabled channel always returns the value $7FFF_H$.
- The cycle time remains unchanged at 250 µs.

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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