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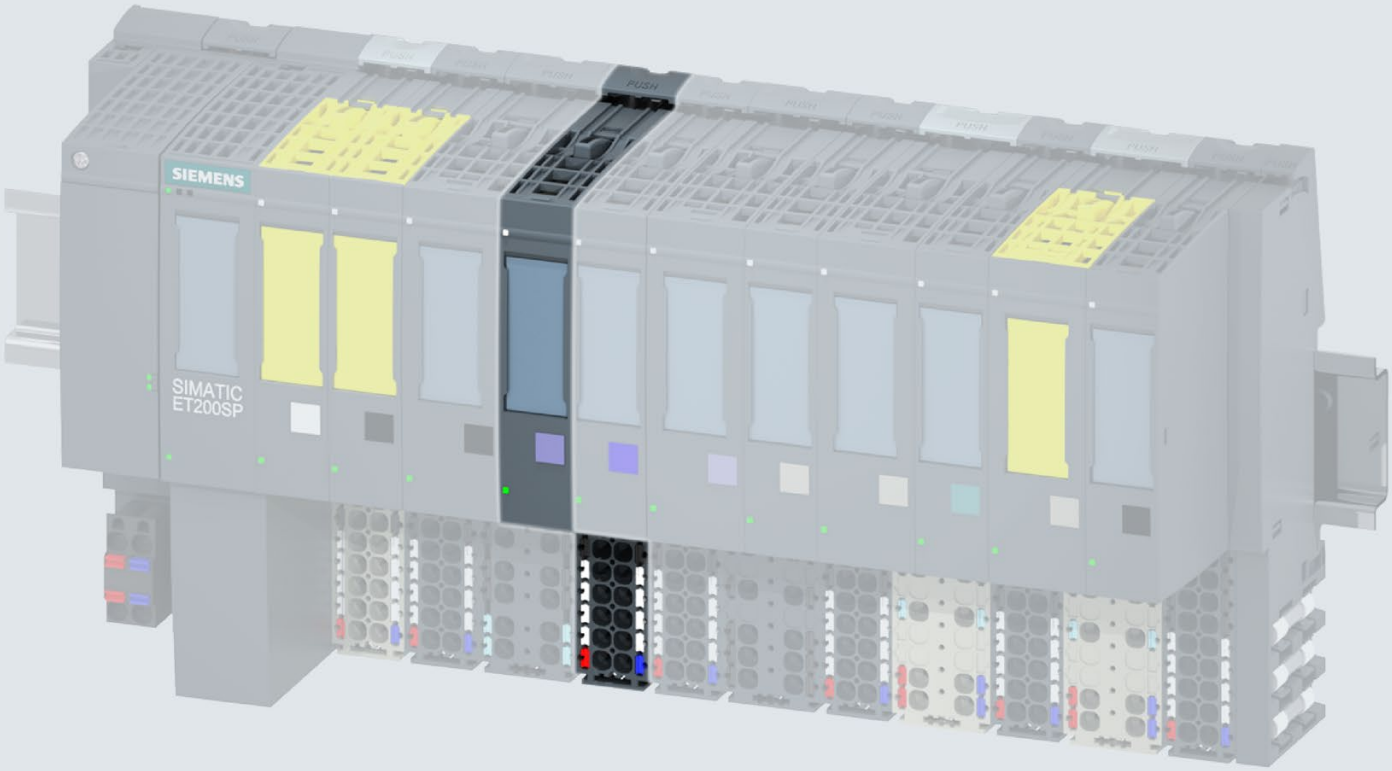

Manual

SIMATIC

ET 200SP

Analog input module
AI 2xU/I 2-/4-wire HS (6ES7134-6HB00-0DA1)

Edition 09/2018

support.industry.siemens.com

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ET 200SP
Analog input module
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(6ES7134-6HB00-0DA1)

Manual

09/2018

A5E03576060-AF

Legal information

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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

indicates that minor personal injury can result if proper precautions are not taken.

NOTICE

indicates that property damage can result if proper precautions are not taken.

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A5E03576060-AF
℗ 10/2018 Subject to change

Preface

Purpose of the documentation

This manual supplements the ET 200SP distributed I/O system (http://support.automation.siemens.com/WW/view/en/58649293) system manual.

Functions that generally relate to the system are described in this system manual.

The information provided in this manual and in the system/function manuals supports you in commissioning the system.

Changes compared to previous version

Compared to the previous version, this manual contains the following change:

Wiring and block diagram for current measurement 2-wire and 4-wire connection has been changed.

Conventions

CPU: When the term "CPU" is used in the following, it applies to the CPUs of the S7-1500 automation system as well as to the CPUs/interface modules of the ET 200SP distributed I/O system.

STEP 7: In this documentation, "STEP 7" is used as a synonym for all versions of the configuration and programming software "STEP 7 (TIA Portal)".

Please also observe notes marked as follows:

Note

A note contains important information on the product described in the documentation, on the handling of the product or on the section of the documentation to which particular attention should be paid.

Recycling and disposal

For environmentally friendly recycling and disposal of your old equipment, contact a certified electronic waste disposal company and dispose of the equipment according to the applicable regulations in your country.

Security information

Siemens provides products and solutions with industrial security functions that support the secure operation of plants, systems, machines and networks.

In order to protect plants, systems, machines and networks against cyber threats, it is necessary to implement – and continuously maintain – a holistic, state-of-the-art industrial security concept. Siemens' products and solutions constitute one element of such a concept.

Customers are responsible for preventing unauthorized access to their plants, systems, machines and networks. Such systems, machines and components should only be connected to an enterprise network or the internet if and to the extent such a connection is necessary and only when appropriate security measures (e.g. firewalls and/or network segmentation) are in place.

For additional information on industrial security measures that may be implemented, please visit (https://www.siemens.com/industrialsecurity).

Siemens' products and solutions undergo continuous development to make them more secure. Siemens strongly recommends that product updates are applied as soon as they are available and that the latest product versions are used. Use of product versions that are no longer supported, and failure to apply the latest updates may increase customers' exposure to cyber threats.

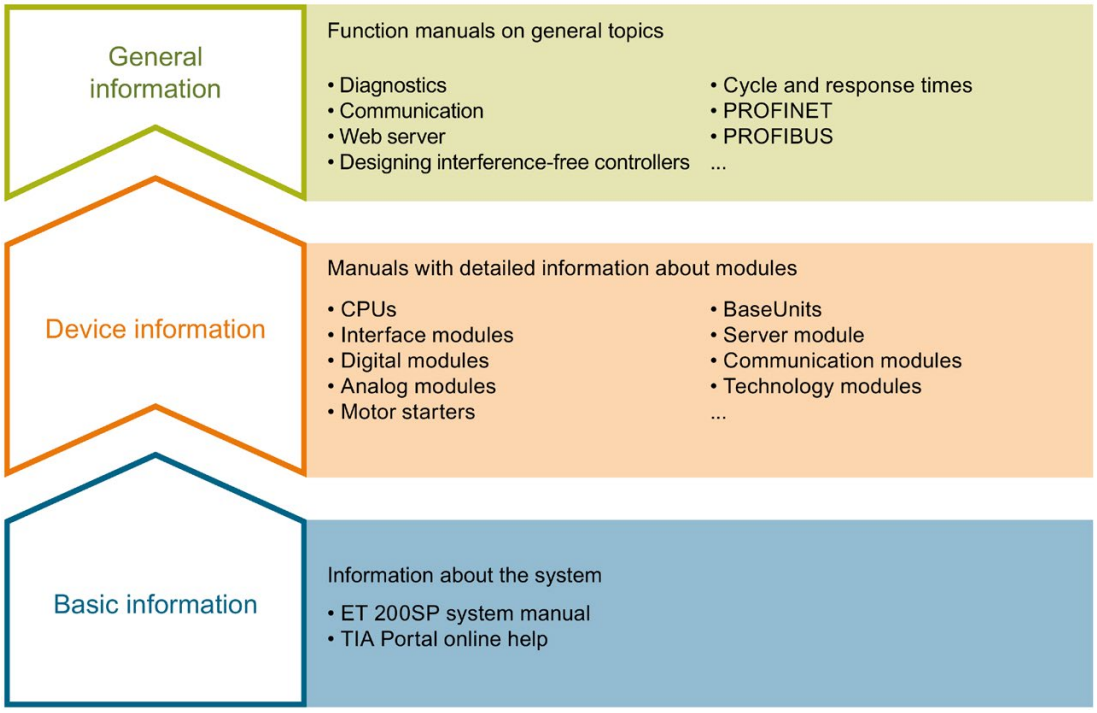
To stay informed about product updates, subscribe to the Siemens Industrial Security RSS Feed under (https://www.siemens.com/industrialsecurity).

Table of contents

Documentation Guide

1

The documentation for the SIMATIC ET 200SP distributed I/O system is arranged into three areas.
This arrangement enables you to access the specific content you require.



Basic information

The system manual describes in detail the configuration, installation, wiring and commissioning of the SIMATIC ET 200SP. distributed I/O system. The STEP 7 online help supports you in the configuration and programming.

Device information

Product manuals contain a compact description of the module-specific information, such as properties, wiring diagrams, characteristics and technical specifications.

General information

The function manuals contain detailed descriptions on general topics regarding the SIMATIC ET 200SP distributed I/O system, e.g. diagnostics, communication, Web server, motion control and OPC UA.

You can download the documentation free of charge from the Internet (https://support.industry.siemens.com/cs/ww/en/view/109742709).

Changes and supplements to the manuals are documented in a Product Information.

You can download the product information free of charge from the Internet (https://support.industry.siemens.com/cs/us/en/view/73021864).

Manual Collection ET 200SP

The Manual Collection contains the complete documentation on the SIMATIC ET 200SP distributed I/O system gathered together in one file.

You can find the Manual Collection on the Internet (https://support.automation.siemens.com/WW/view/en/84133942).

"mySupport"

With "mySupport", your personal workspace, you make the most of your Industry Online Support.

In "mySupport" you can store filters, favorites and tags, request CAx data and put together your personal library in the Documentation area. Furthermore, your data is automatically filled into support requests and you always have an overview of your current requests.

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"mySupport" - Documentation

In the Documentation area of "mySupport", you have the possibility to combine complete manuals or parts of them to make your own manual.
You can export the manual in PDF format or in an editable format.

You can find "mySupport" - Documentation in the Internet (https://support.industry.siemens.com/My/ww/en/documentation).

"mySupport" - CAx Data

In the CAx Data area of "mySupport", you can have access the latest product data for your CAx or CAe system.

You configure your own download package with a few clicks.

In doing so you can select:

- Product images, 2D dimension drawings, 3D models, internal circuit diagrams, EPLAN macro files
- Manuals, characteristics, operating manuals, certificates
- Product master data

You can find "mySupport" - CAx Data in the Internet (https://support.industry.siemens.com/my/ww/en/CAxOnline).

Application examples

The application examples support you with various tools and examples for solving your automation tasks. Solutions are shown in interplay with multiple components in the system - separated from the focus in individual products.

You can find the application examples on the Internet (https://support.industry.siemens.com/sc/ww/en/sc/2054).

TIA Selection Tool

With the TIA Selection Tool, you can select, configure and order devices for Totally Integrated Automation (TIA).
This tool is the successor of the SIMATIC Selection Tool and combines the known configurators for automation technology into one tool.
With the TIA Selection Tool, you can generate a complete order list from your product selection or product configuration.

You can find the TIA Selection Tool on the Internet (https://w3.siemens.com/mcms/topics/en/simatic/tia-selection-tool).

SIMATIC Automation Tool

You can use the SIMATIC Automation Tool to run commissioning and maintenance activities simultaneously on various SIMATIC S7 stations as a bulk operation independently of the TIA Portal.

The SIMATIC Automation Tool provides a multitude of functions:

- Scanning of a PROFINET/Ethernet network and identification of all connected CPUs
- Address assignment (IP, subnet, gateway) and station name (PROFINET device) to a CPU
- Transfer of the data and the programming device/PC time converted to UTC time to the module
- Program download to CPU
- Operating mode switchover RUN/STOP
- Localization of the CPU by means of LED flashing
- Reading out CPU error information
- Reading the CPU diagnostic buffer
- Reset to factory settings
- Updating the firmware of the CPU and connected modules

You can find the SIMATIC Automation Tool on the Internet (https://support.industry.siemens.com/cs/ww/en/view/98161300).

PRONETA

With SIEMENS PRONETA (PROFINET network analysis), you analyze the plant network during commissioning. PRONETA features two core functions:

- The topology overview independently scans PROFINET and all connected components.
- The IO check is a fast test of the wiring and the module configuration of a system.

You can find SIEMENS PRONETA on the Internet (https://support.industry.siemens.com/cs/ww/en/view/67460624).

SINETPLAN

SINETPLAN, the Siemens Network Planner, supports you in planning automation systems and networks based on PROFINET. The tool facilitates professional and predictive dimensioning of your PROFINET installation as early as in the planning stage. In addition, SINETPLAN supports you during network optimization and helps you to exploit network resources optimally and to plan reserves. This helps to prevent problems in commissioning or failures during productive operation even in advance of a planned operation. This increases the availability of the production plant and helps improve operational safety.

The advantages at a glance

- Network optimization thanks to port-specific calculation of the network load
- Increased production availability thanks to online scan and verification of existing systems
- Transparency before commissioning through importing and simulation of existing STEP 7 projects
- Efficiency through securing existing investments in the long term and optimal exploitation of resources

You can find SINETPLAN on the Internet (https://www.siemens.com/sinetplan).

Product overview

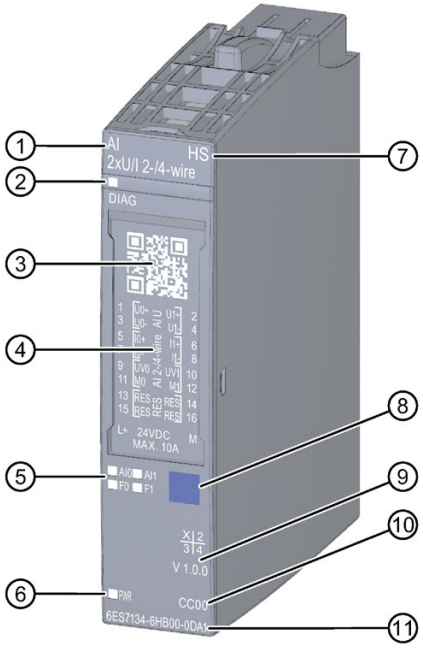
2

2.1 Properties

Article number

6ES7134-6HB00-0DA1

View of the module



① Module type and name
② LED for diagnostics
③ 2D matrix code
④ Wiring diagram
⑤ LEDs for channel status
⑥ LED for supply voltage
⑦ Function class
⑧ Color coding module type
⑨ Function and firmware version
⑩ Color code for selecting the color identification labels
⑪ Article number

Figure 2-1 View of the AI 2×U/I 2-/4-wire HS module

Properties

The module has the following technical properties:

- Analog input module with 2 inputs
- Measurement types voltage and current for 2-/4-wire transducers
- Input ranges for voltage measurement:
  - ±10 V, resolution 16 bit including sign
  - ±5 V, resolution 15 bit incl. sign
  - 1 to 5 V, resolution 13 bit
  - 0 to 10 V, resolution 15 bit
- Input ranges for current measurement:
  - ±20 mA, resolution 16 bit incl. sign
  - 4 to 20 mA, resolution 14 bit
  - 0 to 20 mA, resolution 15 bit
- Electrically isolated between the channels
- Electrically isolated from supply voltage L+
- Permitted common mode voltage: 100 V_{pp}/35 V_{rms}
- Configurable diagnostics (per channel)
- Hardware interrupt on limit violation can be set per channel (two high and two low limits per channel)

The module supports the following functions:

- Firmware update
- I&M identification data
- Reconfiguration in RUN
- PROFIenergy

Table 2- 1 Version dependencies of other module functions

Function	Product version of the module as of	Firmware version of the module as of
Basic version	1	V1.0.0
Isochronous mode with send clock up to 250 µs	2	V1.1.0
Value status	2	V1.1.0
Oversampling channel 0	2	V1.1.0
Oversampling channel 0 and 1	2	V2.0.0
Isochronous mode with send clock up to 125 µs	2	V2.0.1

Accessories

The following accessories must be ordered separately:

- Labeling strips
- Reference identification label
- Shield connector

See also

You can find more information on accessories in the ET 200SP distributed I/O system (https://support.industry.siemens.com/cs/ww/en/view/58649293) system manual.

Connecting 3

3.1 Wiring and block diagram

This section contains the block diagram of the AI 2xU/I 2-/4-wire HS module with the various terminal assignments for a 2-wire and 4-wire connection.

You can find information on wiring the BaseUnit in the ET 200SP distributed I/O system (http://support.automation.siemens.com/WW/view/en/58649293) system manual.

Note

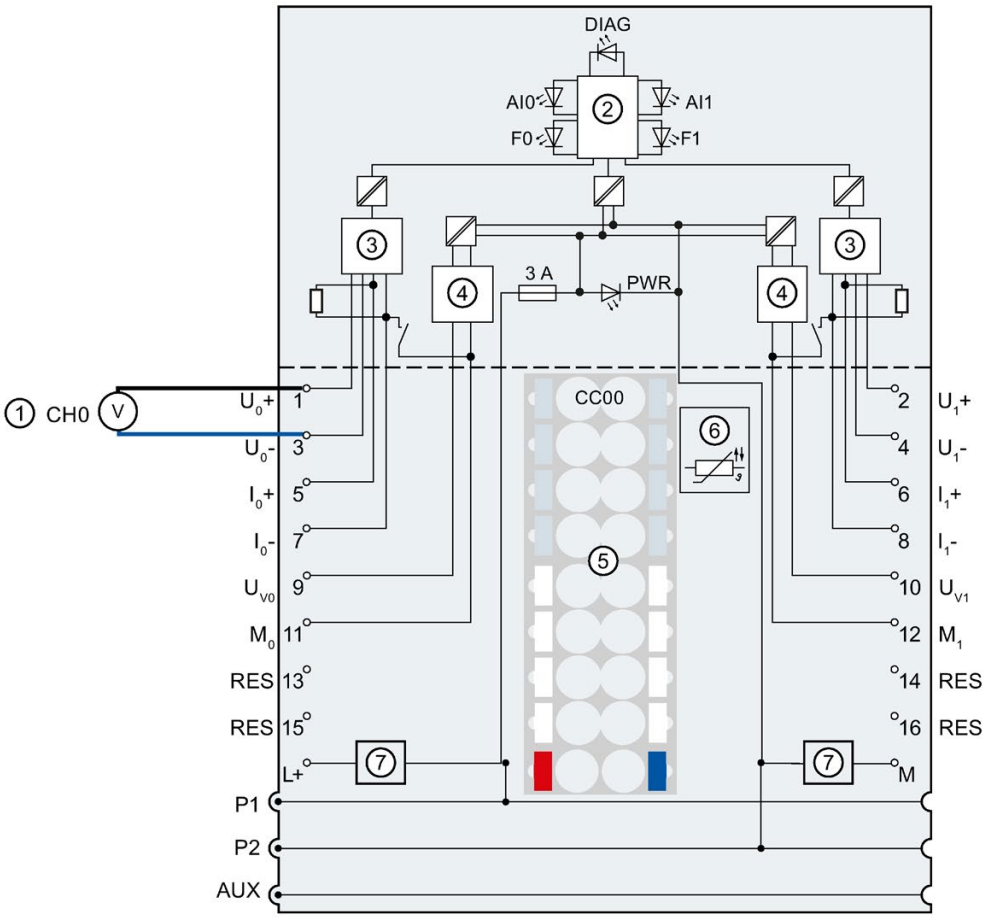
You can use and combine the different wiring options for all channels.

Note

The load group of the module must begin with a light BaseUnit. Keep this in mind also during the configuration.

Wiring: Voltage measurement 2-wire connection

The following figure shows the block diagram and an example for the terminal assignment of the analog input module AI 2xU/I 2-/4-wire HS on the BaseUnit BU type A0/A1.

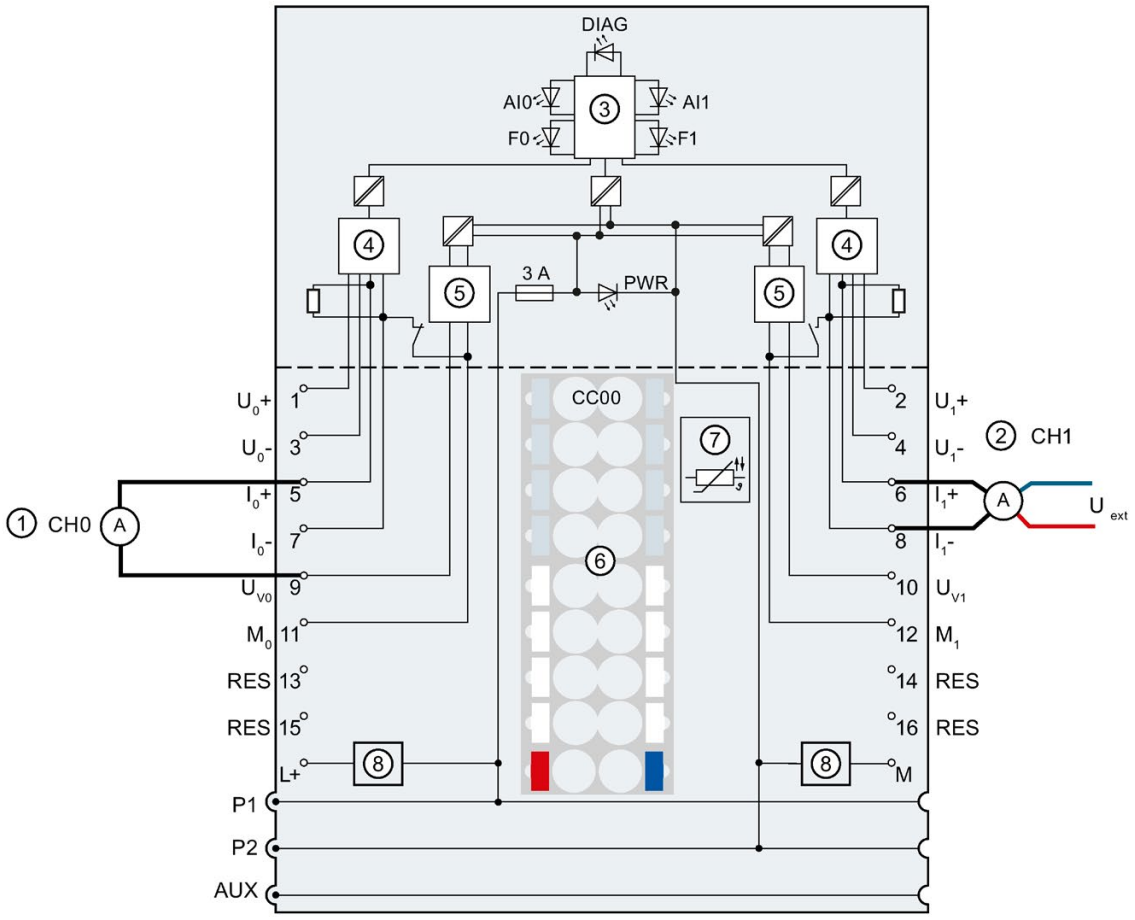


①	2-wire connection for voltage measurement	U_{Vn}	Supply voltage, channel n
②	Backplane bus interface	RES	Reserve, must remain unused for future function extensions
③	Analog-to-digital converter (ADC)	M_n	Reference ground to U_{Vn}, channel n
④	Current limitation	L+	24 V DC (infeed only with light BaseUnit)
⑤	Color identification label CCxx (optional)	M	Ground
⑥	Temperature recording for BU type A1 only (function cannot be used for this module)	P1, P2, AUX	Internal self-assembling voltage buses Connection to left (dark BaseUnit) Connection to left interrupted (light BaseUnit)
⑦	Supply voltage filter circuit (only when light BaseUnit is present)	DIAG	Diagnostics LED (green, red)
U_n+	Voltage input positive, channel n	AI0, AI1	Channel status LED (green)
U_n-	Voltage input negative, channel n	F0, F1	Channel fault LED (red)
I_n+	Current input positive, channel n	PWR	Power LED (green)
I_n-	Current input negative, channel n		

Figure 3-1 Wiring and block diagram for voltage measurement 2-wire connection

Wiring: Current measurement 2-wire and 4-wire connection

The following figure shows the block diagram and an example for the terminal assignment of the analog input module AI 2xU/I 2-/4-wire HS on the BaseUnit BU type A0/A1.



①	2-wire connection for current measurement	U_n+	Voltage input positive, channel n
②	4-wire connection for current measurement	U_n-	Voltage input negative, channel n
③	Backplane bus interface	U_{Vn}	Supply voltage, channel n
④	Analog-to-digital converter (ADC)	RES	Reserve, must remain unused for future function extensions
⑤	Current limitation	M_n	Reference ground to U_{Vn}, channel n
⑥	Color identification label CCxx (optional)	L+	24 V DC (infeed only with light BaseUnit)
⑦	Temperature recording for BU type A1 only (function cannot be used for this module)	P1, P2, AUX	Internal self-assembling voltage buses Connection to left (dark BaseUnit) Connection to left interrupted (light BaseUnit)
⑧	Supply voltage filter circuit (only when light BaseUnit is present)	DIAG	Diagnostics LED (green, red)
U_{ext}	Encoder supply external	AI0, AI1	Channel status LED (green)
I_n+	Current input positive, channel n	F0, F1	Channel fault LED (red)
I_n-	Current input negative, channel n	PWR	Power LED (green)

Figure 3-2 Wiring and block diagram for current measurement 2-wire and 4-wire connection

Parameters/address space

4

4.1 Measurement types and measuring ranges

The analog input module AI 2×U/I 2/4-wire HSF has the following measuring ranges:

Table 4- 1 Measuring ranges

Measurement type	Measuring range	Resolution
Voltage	±10 V	16 bit incl. sign
	±5 V	15 bit incl. sign
	0 to 10 V	15 bit
	1 to 5 V	13 bit
Current (2-/4-wire transducers)	±20 mA [1]	16 bit incl. sign
	0 to 20 mA	15 bit
	4 to 20 mA	14 bit

You can find the tables of measuring ranges and overflow, overrange, etc. in the section Representation of analog values (Page 45) and the "Analog Value Processing" function manual.

[1] Measuring range "+/-20 mA" is only possible with the measurement type "Current (4-wire transducer)".

4.2 Parameters

Parameters of the AI 2xU/I 2/4-wire HS

The effective range of the parameters depends on the type of configuration. The following configurations are possible:

- Central operation on an ET 200SP CPU or on an ET 200SP Open Controller
- Distributed operation on PROFINET IO in an ET 200SP system
- Distributed operation on PROFIBUS DP in an ET 200SP system

In addition to assigning parameters with the configuration software, you can also set the parameters in RUN mode (dynamically) using the user program. When assigning parameters in the user program, use the "WRREC" instruction to transfer the parameters to the module by means of data records; see section Parameter assignment and structure of parameter data record (Page 39).

The following parameter settings are possible:

Table 4- 2 Configurable parameters and their defaults (GSD file)

Parameter	Value range	Default	Reconfiguration in RUN	Effective range with configuration software, e.g. STEP 7 (TIA Portal)	
				GSD file PROFINET IO	GSD file PROFIBUS DP
Sampling rate	1 value/cycle	1 value/cycle	No	Module	Module
Diagnostics: No supply voltage L+	• Disable • Enable	Disable	Yes	Channel	Channel
Diagnostics: Short-circuit to ground	• Disable • Enable	Disable	Yes	Channel	Channel
Diagnostics: Overflow	• Disable • Enable	Disable	Yes	Channel	Channel [1]
Diagnostics: Underflow	• Disable • Enable	Disable	Yes	Channel	
Diagnostics: Wire break	• Disable • Enable	Disable	Yes	Channel	Channel
Type/range of measurement	• Deactivated • Voltage 1 to 5 V • Voltage +/- 5 V • Voltage +/- 10 V • Voltage 0 to 10 V • Current (4-wire transducer) 0 to 20 mA • Current (4-wire transducer) +/- 20 mA • Current (4-wire transducer) 4 to 20 mA • Current (2-wire transducer) 0 to 20 mA • Current (2-wire transducer) 4 to 20 mA	Current (4-wire transducer) 4 to 20 mA	Yes	Channel	Channel
Smoothing	• None • 2 times • 4 times • 8 times • 16 times • 32 times • 64 times	None	Yes	Channel	Channel

Parameter	Value range	Default	Reconfiguration in RUN	Effective range with configuration software, e.g. STEP 7 (TIA Portal)	
				GSD file PROFINET IO	GSD file PROFIBUS DP
Hardware interrupt high limit 1	• Disable • Enable	Disable	Yes	Channel	- [1]
Hardware interrupt low limit 1	• Disable • Enable	Disable	Yes	Channel	
Hardware interrupt high limit 2	• Disable • Enable	Disable	Yes	Channel	
Hardware interrupt low limit 2	• Disable • Enable	Disable	Yes	Channel	
High limit 1	• Value	27648	Yes	Channel	Channel [1]
Low limit 1	• Value	0	Yes	Channel	
High limit 2	• Value	27648	Yes	Channel	
Low limit 2	• Value	0	Yes	Channel	
Potential group	• Use potential group of the left module (dark-colored BaseUnit) • Enable new potential group (light-colored BaseUnit)	Use potential group of the left module	No	Module	Module

[1] Due to the limited number of parameters of a maximum of 244 bytes per ET 200SP station with a PROFIBUS GSD configuration, the parameter assignment options are restricted. If required, you can still assign these parameters using the data record 128 as described in the column "GSD file PROFINET IO" (see table above). The parameter length of the I/O module is 4 bytes.

Note

Unused channels

"Deactivate" the unused channels in the parameter assignment.

A deactivated channel always returns the value $7FFF_H$.

4.3 Description of parameters

Diagnostics: No supply voltage L+

Enabling of the diagnostics alarm for missing or insufficient supply voltage L+.

Diagnostics: Short-circuit to ground

Enabling of the diagnostics in the event of a short-circuit of the encoder supply to ground or of an input to the encoder supply. A short-circuit is also detected in the range of 1 to 5 V if the input signal is short-circuited or the input is not connected.

The short-circuit and underflow diagnostics can be activated simultaneously. If both diagnostics events occur simultaneously, the short-circuit diagnostics is output.

Diagnostics: Overflow

Enabling of the diagnostics when the measured value exceeds the overrange.

Diagnostics: Underflow

Enabling of the diagnostics when the measured value falls below the underrange.

Diagnostics: Wire break

Enabling of the diagnostics if the module has no current flow or has too little current for the measurement in the range of 4 mA to 20 mA.

The wire break and underflow diagnostics can be activated simultaneously. If both diagnostics events occur simultaneously, the wire break diagnostics is output.

Measurement type/measuring range

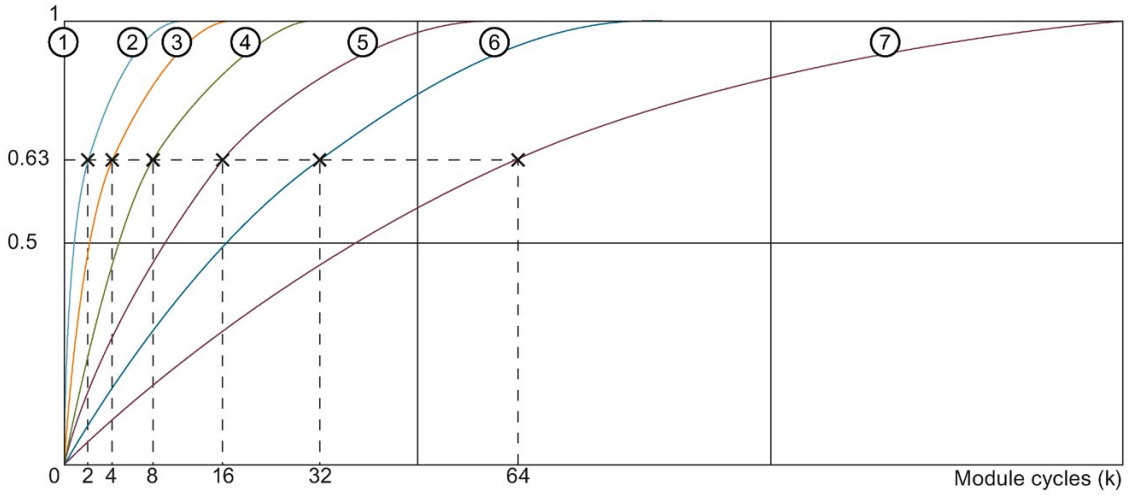
See the section Measurement types and measuring ranges (Page 16).

Smoothing

The individual measured values are smoothed by filtering. The smoothing can be set in 7 levels.

Smoothing time = number of module cycles (k) × cycle time of the module.

The following figure shows how many module cycles it takes for the smoothed analog value to approach 100%, depending on the configured smoothing. This is valid for all signal changes at the analog input.



① No smoothing
② 2x smoothing
③ 4x smoothing
④ 8x smoothing
⑤ 16x smoothing
⑥ 32x smoothing
⑦ 64x smoothing

Figure 4-1 Smoothing with AI 2×U/I 2-/4-wire HS

Potential group

You can use the "Potential group" parameter to specify whether the module is inserted in a light-colored or dark-colored BaseUnit.

A potential group always starts with an I/O module that is inserted on a light-colored BaseUnit. All modules inserted to the right of this on dark-colored BaseUnits belong to the same potential group, because the dark-colored BaseUnits are supplied via the light-colored BaseUnits.

The potential group ends with a new light-colored BaseUnit or the end of the station.

See also

ET 200SP Distributed I/O System
(http://support.automation.siemens.com/WW/view/en/58649293)

4.4 Oversampling

Function

Oversampling is the acquisition of data in constant bus cycle segments (sub-cycles). The configured number n of sub-cycles corresponds to one PROFINET bus cycle.

Oversampling is useful whenever you require acquisition of data with high time resolution but without using an extremely short PROFINET bus cycle and thus fast CPU cycles.

With oversampling, a PROFINET bus cycle is divided into constant bus sub-cycles:

- One measured value is acquired in each sub-cycle.
- The minimum PROFINET bus cycle is 250 µs. Only a subset of functions is available for shorter sub-cycles.
- The shortest possible sub-cycle is 50 µs.
- You can configure oversampling:
  - For channel 0 (1-channel operation)
  - For channel 0/1 (2-channel operation)
- The number of sub-cycles can be set as follows:
  - From 2 to 16 for one channel
  - From 2 to 8 for two channels

Requirement

Oversampling is only possible when isochronous mode is set.

Configuration

You configure oversampling with the following parameter:

- Sampling rate

Note

Do not use a reduction ratio for blocks in the case of configuration with oversampling in the runtime groups of your user program. This will ensure that the data processing in the user program of the CPU is synchronized with the acquisition on the module.

Overview of the operating modes

Function	Normal operation	Oversampling in normal operation		Oversampling in high-speed	
		1-channel operation	2-channel operation	1-channel operation	2-channel operation
Isochronous mode	Yes, optional	Yes, required		Yes, required	
• Shortest send clock	125 µs	500 µs		250 µs	
Oversampling	No	Yes		Yes	
• Number of oversampling levels (sampling rate)	-	2 to 16	2 to 8	2 to 16	2 to 8
• Shortest sub-cycle (= shortest sampling time)	-	250 µs		50 µs	
Hardware interrupt	x	-		-	
Smoothing	x	x		-	
±10 V	x	x		x	
0 to 10 V	x	x		-	
±5 V	x	x		-	
1 to 5 V	x	x		-	
±20 mA	x	x		x	
0 to 20 mA	x	x		-	
4 to 20 mA	x	x		-	
Overflow/underflow	x	x		x[1)]	
Wire break 4 to 20 mA	x	x		-	
Short-circuit (1 to 5 V)	x	x		-	
Short-circuit encoder supply with current measuring ranges	x	x		x	
Load voltage diagnostics	x	x		x	
Value status (QI)	x	-		-	
Address space	4 bytes	32 bytes		32 bytes	

1 For product version 1, the result must be present for at least one fieldbus cycle + 250 µs for a reliable detection of the diagnostics (overflow/underflow) as of firmware version 1.x.

Sampling interval

The duration of a subcycle is the sampling interval. The cycle time T (send clock) for isochronous mode is specified in the configuration software. This time, divided by the configured sampling rate n_{Sample}, yields the sampling interval t_{Sample} of the module.

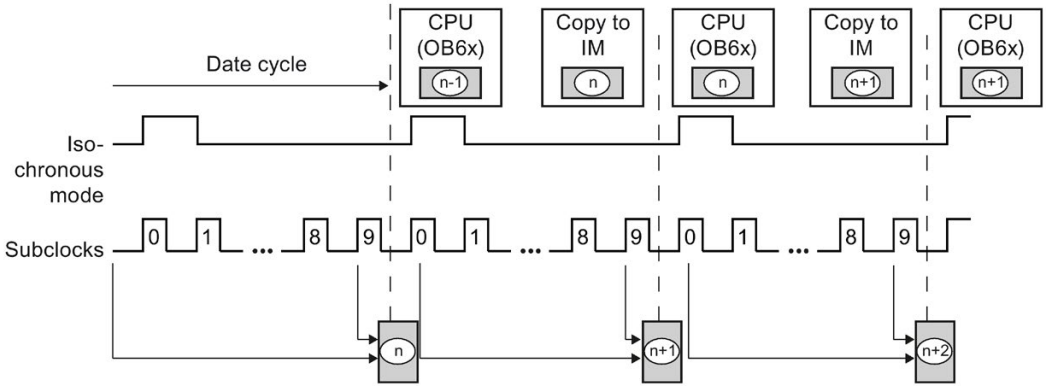
Example calculation:

$$t_{Sample} = \frac{T}{n_{Sample}} = \frac{1\ ms}{16} = 62{,}5\ \mu s$$

Figure 4-2 Example of calculating the sampling interval

Chronological sequence

The figure shows the chronological sequence for oversampling. The acquired measured vales of a data cycle with oversampling are only copied to the interface module in the subsequent bus cycle and are then available to the processing CPU one bus cycle later.



① n = measured values from bus cycle n

Figure 4-3 Oversampling

4.5 Address space

Configuration options

The following configurations are possible:

- Configuration 1: Without value status
- Configuration 2: With value status

Evaluating the value status

An additional byte is occupied in the input address space if you enable the value status for the analog module. Bits 0 to 1 in this byte are assigned to a channel. They provide information about the validity of the analog value.

Bit =1: No fault is present on the channel.

Bit =0: The wiring, the value created on the channel, or similar is incorrect.

Address space

The following figure shows the assignment of the address space for the AI 2xU/I 2-/4-wire HS with value status (Quality Information (QI)). The addresses for the value status are only available if the value status is enabled.

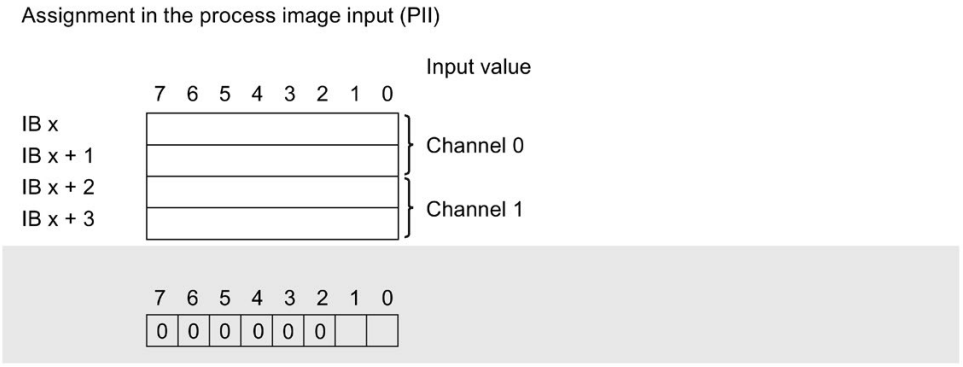


Figure 4-4 Address space of the AI 2xU/I 2-/4-wire HS with value status

Address space of the AI 2×U/I 2-/4-wire HS for oversampling with one channel

The following figure shows the assignment of the address space for oversampling with one channel. Writing always starts from IB x. If fewer than 16 sub-cycles are set, the addresses that are then unused are filled with $7FFF_H$.

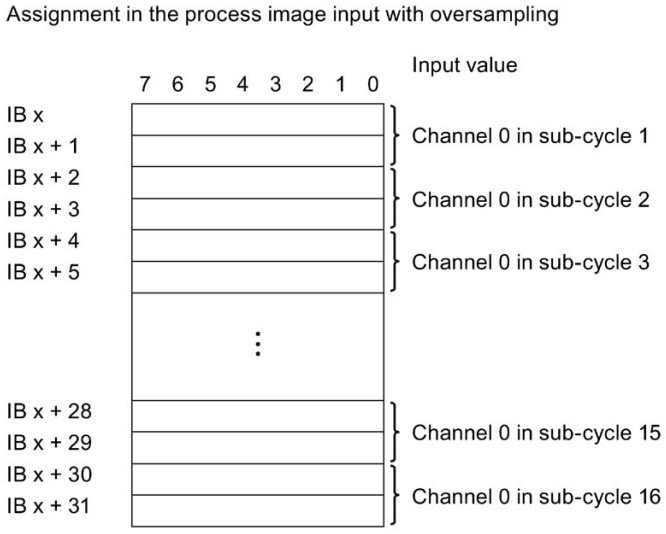


Figure 4-5 Address space of AI 2xU/I 2-/4-wire HS for oversampling with one channel

Address space of the AI 2×U/I 2-/4-wire HS for oversampling with two channels

The following figure shows the assignment of the address space for oversampling with two channels. Writing always starts from IB x. Only a maximum of 8 sub-cycles are possible. If fewer than 8 sub-cycles are set, the addresses that are then unused are filled with $7FFF_H$.

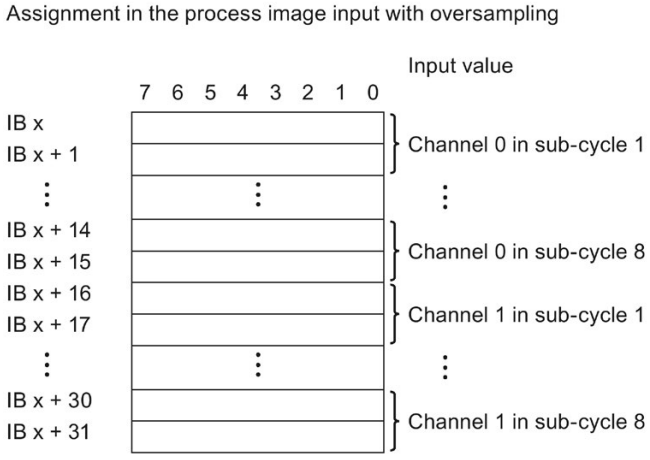


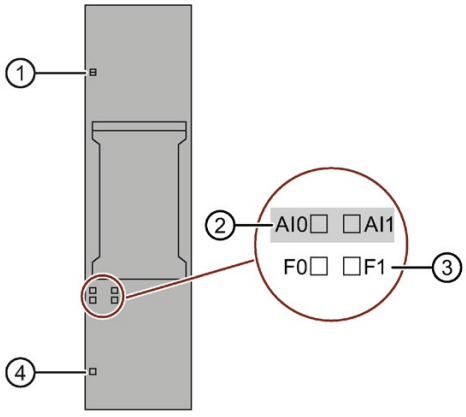
Figure 4-6 Address space of AI 2xU/I 2-/4-wire HS for oversampling with two channels

5 Interrupts/diagnostics interrupts

5.1 Status and error displays

LED displays

The figure below shows the LED displays of the AI 2×U/I 2-/4-wire HS.



① DIAG (green/red)
② Channel status (green)
③ Channel fault (red)
④ PWR (green)

Figure 5-1 LED displays

Meaning of the LEDs

The following tables contain the meaning of the status and error displays. Corrective measures for diagnostics alarms can be found in section Diagnostics alarms (Page 30).

DIAG LED

Table 5- 1 Error display of the DIAG LED

DIAG	Meaning
Off	Backplane bus supply of the ET 200SP not OK
Flashes	Module parameters not assigned
On	Module parameters assigned and no module diagnostics
Flashes	Module parameters assigned and module diagnostics

Channel status/channel fault LED

Table 5- 2 Status/error display of the channel status/channel fault LED

Channel status	Channel fault	Meaning
Off	Off	Channel deactivated or no load voltage L+
On	Off	Channel activated and no channel diagnostics
Off	On	Channel activated and channel diagnostics
On	On	Not permitted (error)

PWR LED

Table 5- 3 Status display of the PWR LED

PWR	Meaning
Off	No supply voltage L+
On	Supply voltage L+ present

5.2 Interrupts

The analog input module AI 2×U/I 2-/4-wire HS supports hardware and diagnostic interrupts.

Evaluating hardware interrupts with IO controller

The module generates a hardware interrupt at the following events:

- Low limit 1 violated
- High limit 1 violated
- Low limit 2 violated
- High limit 2 violated

If an interrupt occurs, a corresponding interrupt OB is called in the CPU of the IO controller.

S7-1500

Detailed information on the event is available in the STEP 7 online help.

The block interface is shown here with optimized block access, which is set in the TIA Portal by default.

Name	Data type	Comment
LADDR	HW_IO	Hardware identifier of the module triggering the interrupt
USI	WORD	USI (High/Low)
IChannel	USInt	Channel that triggered the hardware interrupt
EventType	Byte	Error event

S7-300/400 or a different CPU

You can obtain detailed information on the event in the hardware interrupt organization block with the instruction "RALARM" (read additional interrupt info) and in the STEP 7 online help.

The channel of the module that triggered the hardware interrupt is entered in the start information of OB4x in the OB4x_POINT_ADDR tag. The following figure shows the assignment to the bits of double word 8 in local data.

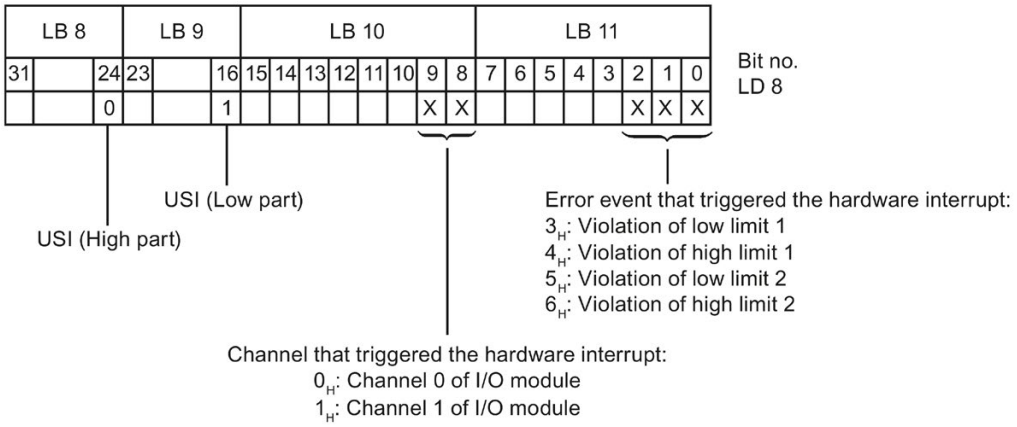


Figure 5-2 OB4x_POINT_ADDR tag

Structure of the additional interrupt information

Table 5- 4 Structure of USI = W#16#0001

Data block name		Content	Comment	Bytes
USI		W#16#0001	User Structure Identifier: Additional interrupt info for hardware interrupts of the I/O module	2
The channel that triggered the hardware interrupt follows.				
	Channel	B#16#00 to B#16#01	Channel 0 and 1 of the I/O module	1
The error event that triggered the hardware interrupt follows.				
	Error event	B#16#03	Low limit 1 violated	1
		B#16#04	High limit 1 violated	
		B#16#05	Low limit 2 violated	
		B#16#06	High limit 2 violated	

Diagnostics interrupt

The module generates a diagnostics interrupt at the following events:

- Short-circuit (current and voltage 1 to 5 V)
- Wire break (current)
- High limit violated
- Low limit violated
- Error
- Parameter assignment error
- No load voltage
- Channel temporarily unavailable

5.3 Diagnostics alarms

A diagnostics alarm is generated and the DIAG-LED flashes on the module for each diagnostics event. You can read out the diagnostics alarms, for example, in the diagnostics buffer of the CPU. You can evaluate the error codes with the user program.

Table 5- 5 Diagnostics alarms, their meanings and corrective measures

Diagnostics alarm	Error code	Meaning	Solution
Short-circuit (current)	1_H	Encoder supply to ground	Correct interplay between module and encoder
		Input after encoder supply	
Short-circuit (1 to 5 V)	1_H	Short circuit of input signal	Correct interplay between module and encoder
		Open input	Connect input
Wire break (current)	6_H	Impedance of encoder circuit too high	Use a different encoder type or modify the wiring, for example, using cables with larger cross-section
		Wire break between the module and sensor	Connect the cable
		Channel not connected (open)	• Deactivate diagnostics • Connect the encoder contacts
High limit violated	7_H	Value is above overrange.	Correct the output value
Low limit violated	8_H	Value is below underrange.	Correct the output value
Error	9_H	Internal module error has occurred (diagnostics alarm on channel 0 applies for the entire module).	Replace the module
Parameter assignment error	10_H	• The module cannot evaluate parameters for the channel. • Incorrect parameter assignment.	Correct the parameter assignment (wire break diagnostics set only with the permitted measuring ranges).

Diagnostics alarm	Error code	Meaning	Solution
No load voltage	11_H	No or insufficient supply voltage L+	• Check supply voltage L+ on the BaseUnit • Check BaseUnit type
Channel temporarily unavailable	$1F_H$	Firmware update in progress or update has been canceled. The module does not read any process values in this state.	• Wait for firmware update • Restart the firmware update

Technical specifications

6

6.1 Technical specifications

Technical specifications of AI 2xU/I 2-/4-wire HS

The following table shows the technical specifications as of 09/2018. You will find a data sheet including daily updated technical specifications on the Internet (https://support.industry.siemens.com/cs/ww/en/pv/6ES7134-6HB00-0DA1/td?dl=en).

Article number	6ES7134-6HB00-0DA1
General information	
Product type designation	AI 2xU/I 2-/4-wire HS
Firmware version	V2.0.1
• FW update possible	Yes
usable BaseUnits	BU type A0, A1
Color code for module-specific color identification plate	CC00
Product function	
• I&M data	Yes; I&M0 to I&M3
• Measuring range scalable	No
• Scalable measured values	No
• Adjustment of measuring range	No
Engineering with	
• STEP 7 TIA Portal configurable/integrated as of version	V13 SP1
• STEP 7 configurable/integrated as of version	V5.5 SP3 / -
• PROFIBUS as of GSD version/GSD revision	GSD Revision 5
• PROFINET as of GSD version/GSD revision	GSDML V2.3
Operating mode	
• Oversampling	Yes; 2 channels per module
• MSI	No
CiR – Configuration in RUN	
Reparameterization possible in RUN	Yes
Calibration possible in RUN	No

Article number	6ES7134-6HB00-0DA1
Supply voltage	
Rated value (DC)	24 V
permissible range, lower limit (DC)	19.2 V
permissible range, upper limit (DC)	28.8 V
Reverse polarity protection	Yes
Input current	
Current consumption (rated value)	39 mA; without sensor supply
24 V encoder supply	
• 24 V	Yes; For current measurement
• Short-circuit protection	Yes
• Output current, max.	20 mA; max. 50 mA per channel for a duration < 10 s
Power loss	
Power loss, typ.	0.95 W; without sensor supply
Address area	
Address space per module	
• Address space per module, max.	4 byte; + 1 byte for QI information (32 bytes in the oversampling operating mode)
Hardware configuration	
Selection of BaseUnit for connection variants	
• 2-wire connection	BU type A0, A1
• 4-wire connection	BU type A0, A1
Analog inputs	
Number of analog inputs	2; Differential inputs
• For current measurement	2
• For voltage measurement	2
permissible input voltage for voltage input (destruction limit), max.	30 V
permissible input current for current input (destruction limit), max.	50 mA
Cycle time (all channels), min.	125 µs
Analog input with oversampling	Yes
• Values per cycle, max.	16
• Resolution, min.	50 µs

Article number	6ES7134-6HB00-0DA1
Input ranges (rated values), voltages	
• 0 to +10 V	Yes; 15 bit
• Input resistance (0 to 10 V)	75 kΩ
• 1 V to 5 V	Yes; 13 bit
• Input resistance (1 V to 5 V)	75 kΩ
• -10 V to +10 V	Yes; 16 bit incl. sign
• Input resistance (-10 V to +10 V)	75 kΩ
• -5 V to +5 V	Yes; 15 bit incl. sign
• Input resistance (-5 V to +5 V)	75 kΩ
Input ranges (rated values), currents	
• 0 to 20 mA	Yes; 15 bit
• Input resistance (0 to 20 mA)	130 Ω
• -20 mA to +20 mA	Yes; 16 bit incl. sign
• Input resistance (-20 mA to +20 mA)	130 Ω
• 4 mA to 20 mA	Yes; 14 bit
• Input resistance (4 mA to 20 mA)	130 Ω
Cable length	
• shielded, max.	1 000 m; 200 m for voltage measurement
Analog value generation for the inputs	
Measurement principle	Actual value encryption (successive approximation)
Integration and conversion time/resolution per channel	
• Resolution with overrange (bit including sign), max.	16 bit
• Interference voltage suppression for interference frequency f1 in Hz	No
• Conversion time (per channel)	10 µs
Smoothing of measured values	
• Number of smoothing levels	7; none; 2-/4-/8-/16-/32-/64-fold
• parameterizable	Yes

Article number	6ES7134-6HB00-0DA1
Encoder	
Connection of signal encoders	
• for voltage measurement	Yes
• for current measurement as 2-wire transducer	Yes
– Burden of 2-wire transmitter, max.	650 Ω
• for current measurement as 4-wire transducer	Yes
Errors/accuracies	
Linearity error (relative to input range), (+/-)	0.03 %
Temperature error (relative to input range), (+/-)	0.01 %/K
Crosstalk between the inputs, min.	-50 dB
Repeat accuracy in steady state at 25 °C (relative to input range), (+/-)	0.1 %
Operational error limit in overall temperature range	
• Voltage, relative to input range, (+/-)	0.3 %
• Current, relative to input range, (+/-)	0.3 %
Basic error limit (operational limit at 25 °C)	
• Voltage, relative to input range, (+/-)	0.2 %
• Current, relative to input range, (+/-)	0.2 %
Interference voltage suppression for f = n x (f1 +/- 1 %), f1 = interference frequency	
• Common mode voltage, max.	35 V
• Common mode interference, min.	90 dB
Isochronous mode	
Isochronous operation (application synchronized up to terminal)	Yes
Filtering and processing time (TCI), min.	80 µs
Bus cycle time (TDP), min.	125 µs; Starting from firmware Version V2.0.1
Interrupts/diagnostics/status information	
Alarms	
• Diagnostic alarm	Yes
• Limit value alarm	Yes; two upper and two lower limit values in each case

Article number	6ES7134-6HB00-0DA1
Diagnostic messages	
• Wire-break	Yes; channel-by-channel, at 4 to 20 mA only
• Short-circuit	Yes; channel-by-channel, at 1 to 5 V or for current measuring ranges short-circuit in encoder supply
• Group error	Yes
• Overflow/underflow	Yes
Diagnostics indication LED	
• Monitoring of the supply voltage (PWR-LED)	Yes; green PWR LED
• Channel status display	Yes; Green LED
• for channel diagnostics	Yes; Red LED
• for module diagnostics	Yes; green/red DIAG LED
Potential separation	
Potential separation channels	
• between the channels	Yes
• between the channels and backplane bus	Yes
• between the channels and the power supply of the electronics	Yes
Permissible potential difference	
between the inputs (UCM)	75 V DC/60 V AC
Isolation	
Isolation tested with	707 V DC (type test)
Dimensions	
Width	15 mm
Height	73 mm
Depth	58 mm
Weights	
Weight, approx.	32 g

Dimension drawing

See manual ET 200SP BaseUnits
(http://support.automation.siemens.com/WW/view/en/59753521)

Parameter data record

A

A.1 Dependencies when configuring with GSD file

When configuring the module with a GSD file, remember that the settings of some parameters are dependent on each other.

Configuring with a PROFINET GSD file

The table lists the properties and their dependencies on the measurement type and measuring range for PROFINET.

Measurement type	Measuring range	Diagnostics					Hardware interrupts
		No supply voltage L+	Short-circuit to ground	Overflow	Underflow	Wire break	
Deactivated		*	*	*	*	*	*
Voltage	1 to 5 V	x	x	x	x	-	x
	±5 V	x	-	x	x	-	x
	±10 V	x	-	x	x	-	x
	0 to 10 V	x	-	x	x	-	x
Current (4-wire transducer)	0 to 20 mA	x	x	x	x	-	x
	±20 mA	x	x	x	x	-	x
	4 to 20 mA	x	x	x	x	x	x
Current (2-wire transducer)	0 to 20 mA	x	x	x	-	-	x
	4 to 20 mA	x	x	x	x	x	x

x = Property is allowed, - = Property is **not allowed**, * = Property is not relevant

Configuring with a PROFIBUS GSD file

The table lists the properties and their dependencies on the measurement type and measuring range for PROFIBUS.

Measurement type	Measuring range	Diagnostics				Hardware interrupts
		No supply voltage L+	Short-circuit to ground	Overflow/underflow	Wire break	
Deactivated		*	*	*	*	*
Voltage	1 to 5 V	x	x	x	-	-
	+/- 5 V	x	-	x	-	-
	+/- 10 V	x	-	x	-	-
	0 to 10 V	x	-	x	-	-
Current (4-wire transducer)	0 to 20 mA	x	x	x	-	-
	+/- 20 mA	x	x	x	-	-
	4 to 20 mA	x	x	x	x	-
Current (2-wire transducer)	0 to 20 mA	x	x	x	-	-
	4 to 20 mA	x	x	x	x	-

x = Property is allowed, - = Property is **not allowed**, * = Property is not relevant

A.2 Parameter assignment and structure of the parameter data record

Parameter assignment in the user program

The module can be re-configured in RUN (for example, the voltage or current values of selected channels can be changed in RUN without having an effect on the other channels).

Note

Following a firmware update, you need to re-configure the I/O module before you can use the new functions.

Changing parameters in RUN

The "WRREC" instruction is used to transfer the parameters to the module using data record 128. The parameters set in STEP 7 are not changed in the CPU, which means the parameters set in STEP 7 are valid again after a restart.

Note

Changing parameters in RUN

A parameter data record that has content different from the startup parameter assignment results in a brief exit from clocked measuring mode and renewed synchronization with the fieldbus cycle. The slowest channel provides the "internal" measuring cycle.

STATUS output parameter

The module ignores errors that occur during the transfer of parameters with the "WRREC" instruction and continues operation with the previous parameter assignment. The STATUS output parameter contains a corresponding error code.

The description of the "WRREC" instruction and the error codes is available in the STEP 7 online help.

Structure of data record 128 for entire module

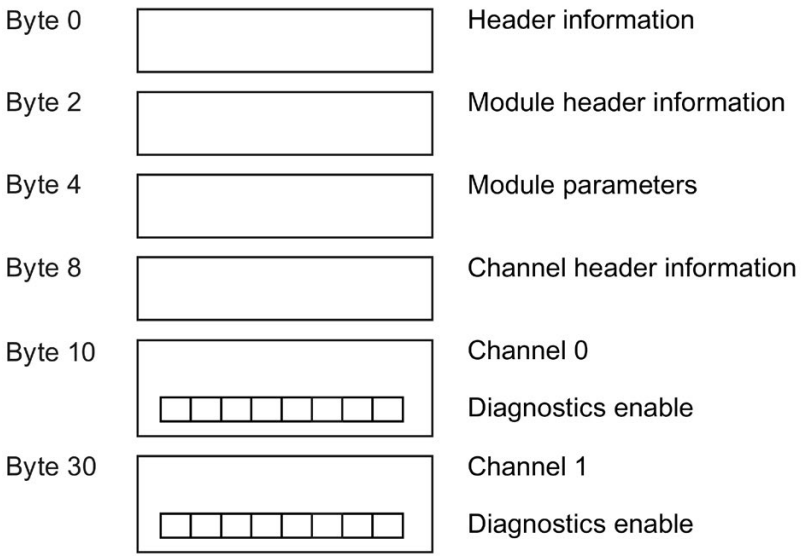


Figure A-1 Structure of data record 128 for entire module

Header information

The figure below shows the structure of the header information.

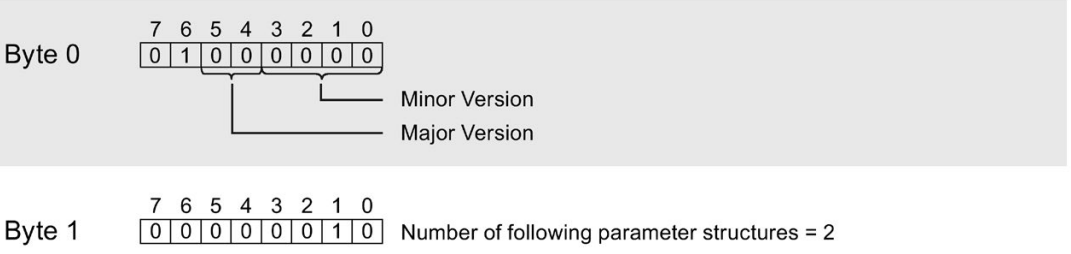


Figure A-2 Header information

Module header information

The figure below shows the structure of the module header information.

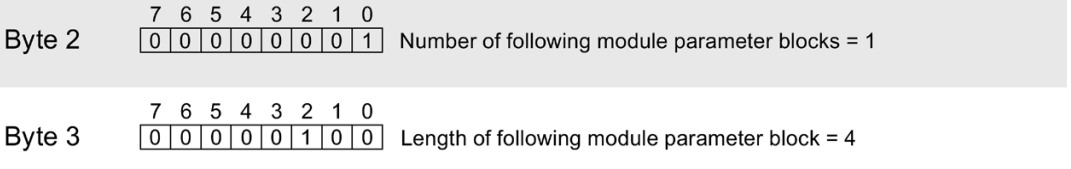


Figure A-3 Module header information

Module parameter block

The figure below shows the structure of the module parameter block.

Enable a parameter by setting the corresponding bit to "1".

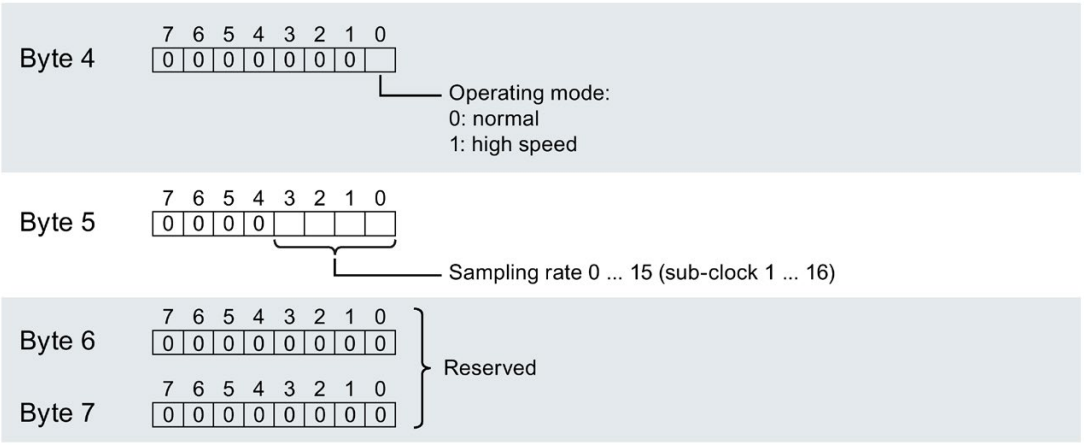


Figure A-4 Module parameter block

Channel header information

The figure below shows the structure of the channel header information.

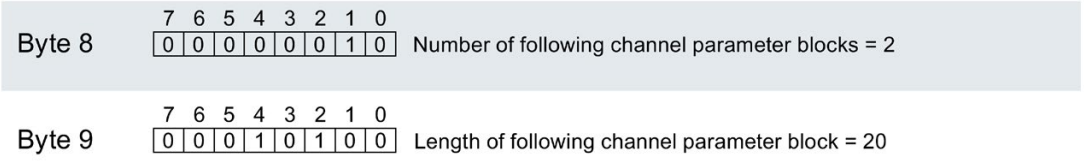
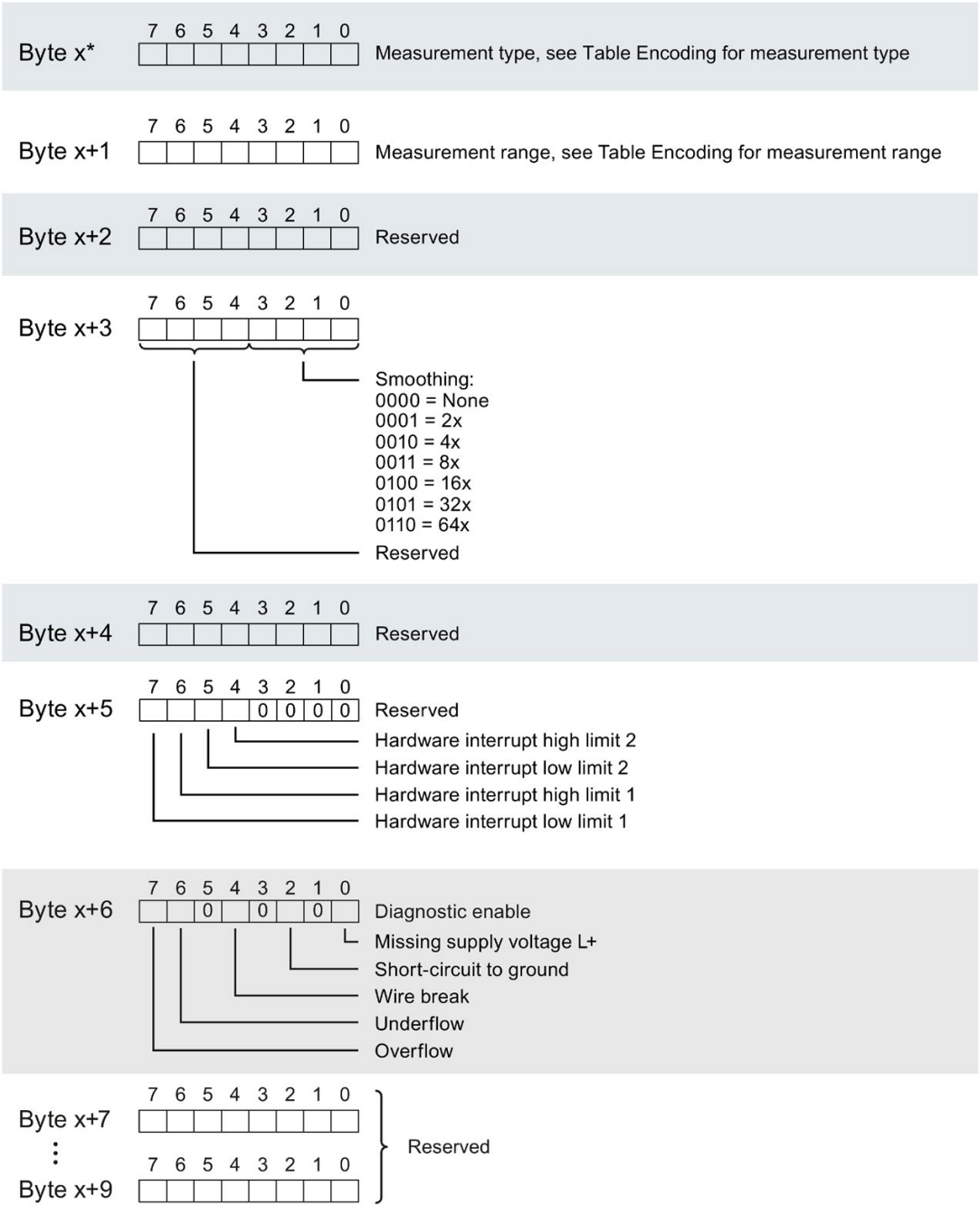


Figure A-5 Channel header information

Channel parameter block

The figure below shows the structure of the channel parameter block.

Enable a parameter by setting the corresponding bit to "1".



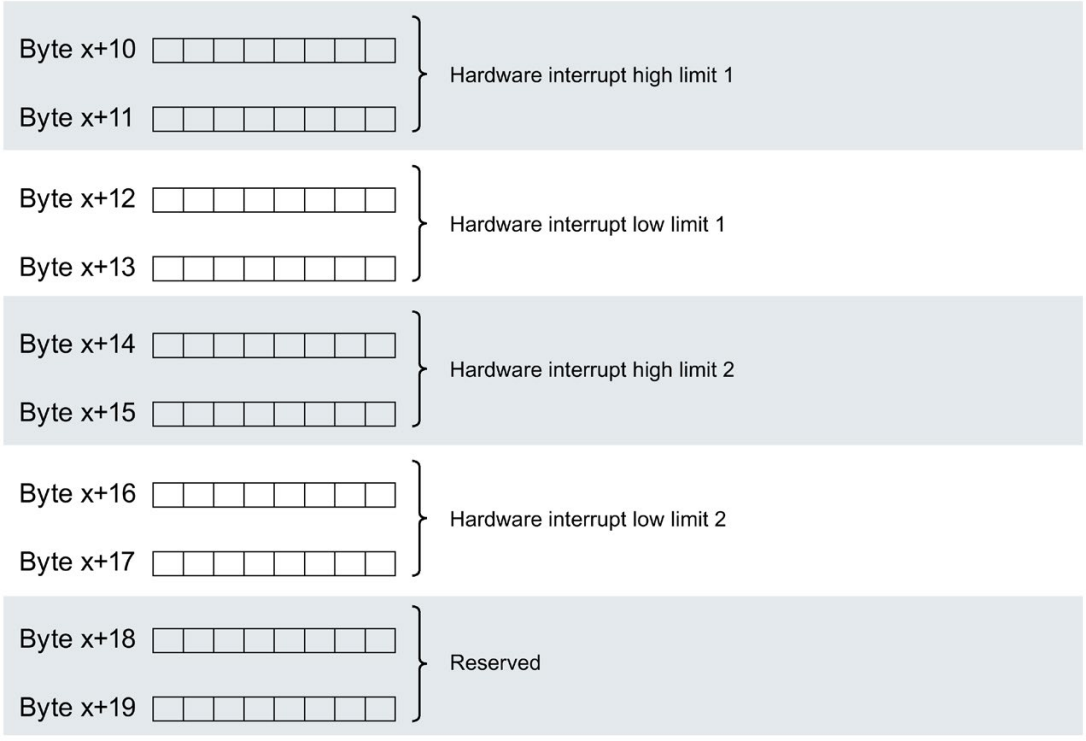


Figure A-6 Structure of byte x to x+19 for channels 0 and 1

Codes for measurement types

The following table contains the codes for the measurement types of the analog input module. You must enter these codes in byte x (see channel parameter block figure).

Table A- 1 Codes for measurement types

Measurement type	Code
Deactivated	0000 0000
Voltage	0000 0001
Current, 4-wire transducer	0000 0010
Current, 2-wire transducer	0000 0011

Codes for measuring ranges

The following table contains the codes for the measuring ranges of the analog input module. You must enter these codes in byte x+1 (see channel parameter block figure).

Table A- 2 Codes for measuring ranges

Measuring range	Code
Voltage	
±5 V	0000 1000
±10 V	0000 1001
1 to 5 V	0000 1010
0 to 10 V	0000 1011
Current	
±20 mA	0000 0100
0 to 20 mA	0000 0010
4 to 20 mA	0000 0011

Representation of analog values

B

This appendix shows the analog values for all measuring ranges that you can use with the analog module.

Measured value resolution

The resolution of the analog values differs depending on the analog module and its parameter assignment.

The table below shows the representation of binary analog values and of the associated decimal and hexadecimal units of the analog values.

Each analog value is written left aligned to the tags. The bits marked with "x" are set to "0".

Table B- 1 Resolution of the analog values

Resolution in bits including sign	Values		Analog value	
	Decimal	Hexadecimal	High byte	Low byte
13	8	8_H	Sign 0 0 0 0 0 0 0	0 0 0 0 1 x x x
14	4	4_H	Sign 0 0 0 0 0 0 0	0 0 0 0 0 1 x x
15	2	2_H	Sign 0 0 0 0 0 0 0	0 0 0 0 0 0 1 x
16	1	1_H	Sign 0 0 0 0 0 0 0	0 0 0 0 0 0 0 1

B.1 Representation of input ranges

In the following tables, you can find the digitized representation of the bipolar and unipolar input ranges. The resolution is 16 bits.

Table B- 2 Bipolar input ranges

Dec. value	Measured value in %	Data word																Range
		2^{15}	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}	
32767	>117.589	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	Overflow
32511	117.589	0	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	Overrange
27649	100.004	0	1	1	0	1	1	0	0	0	0	0	0	0	0	0	1	
27648	100.000	0	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	Nominal range
1	0.003617	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	
0	0.000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
-1	-0.003617	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
-27648	-100.000	1	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	
-27649	-100.004	1	0	0	1	0	0	1	1	1	1	1	1	1	1	1	1	Underrange
-32512	-117.593	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	
-32768	<-117.593	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Underflow

Table B- 3 Unipolar input ranges

Dec. value	Measured value in %	Data word																Range
		2^{15}	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}	
32767	>117.589	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	Overflow
32511	117.589	0	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	Overrange
27649	100.004	0	1	1	0	1	1	0	0	0	0	0	0	0	0	0	1	
27648	100.000	0	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	Nominal range
1	0.003617	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	
0	0.000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
-1	-0.003617	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	Underrange
-4864	-17.593	1	1	1	0	1	1	0	1	0	0	0	0	0	0	0	0	
-32768	<-17.593	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Underflow

B.2 Representation of analog values in voltage measuring ranges

The following tables list the decimal and hexadecimal values (codes) of the possible voltage measuring ranges.

Table B- 4 Voltage measuring range ±10 V and ±5 V

Values		Voltage measuring range		Range
Dec.	Hex.	±10 V	±5 V	
32767	7FFF	> 11.759 V	> 5.879 V	Overflow
32511	7EFF	11.759 V	5.879 V	Overrange
27649	6C01			
27648	6C00	10 V	5 V	Nominal range
20736	5100	7.5 V	3.75 V	
1	1	361.7 µV	180.8 µV	
0	0	0 V	0 V	
-1	FFFF			
-20736	AF00	-7.5 V	-3.75 V	
-27648	9400	-10 V	-5 V	
-27649	93FF			Underrange
-32512	8100	-11.759 V	-5.879 V	
-32768	8000	< -11.759 V	< -5.879 V	Underflow

Table B- 5 Voltage measuring range 1 V to 5 V and 0 V to 10 V

Values		Voltage measuring range		Range
Dec.	Hex.	1 to 5 V	0 to 10 V	
32767	7FFF	> 5.704 V	> 11.759 V	Overflow
32511	7EFF	5.704 V	11.759 V	Overrange
27649	6C01			
27648	6C00	5 V	10 V	Nominal range
20736	5100	4 V	7.5 V	
1	1	1 V + 144.7 µV	361.7 µV	
0	0	1 V	0 V	
-1	FFFF			Underrange
-4864	ED00	0.296 V	-1.759 V	
-32768	8000	< 0.296 V	< -1.759 V	Underflow

B.3 Representation of analog values in the current measuring ranges

The following tables list the decimal and hexadecimal values (codes) of the possible current measuring ranges.

Table B- 6 Current measuring range ±20 mA

Values		Current measuring range	Range
Dec.	Hex.	±20 mA	
32767	7FFF	> 23.52 mA	Overflow
32511	7EFF	23.52 mA	Overrange
27649	6C01		
27648	6C00	20 mA	Nominal range
20736	5100	15 mA	
1	1	723.4 nA	
0	0	0 mA	
-1	FFFF		
-20736	AF00	-15 mA	
-27648	9400	-20 mA	
-27649	93FF		Underrange
-32512	8100	-23.52 mA	
-32768	8000	< -23.52 mA	Underflow

Table B- 7 Current measuring ranges 0 to 20 mA and 4 to 20 mA

Values		Current measuring range		Range
Dec.	Hex.	0 to 20 mA*	4 to 20 mA	
32767	7FFF	> 23.52 mA**	> 22.81 mA**	Overflow
32511	7EFF	23.52 mA	22.81 mA	Overrange
27649	6C01			
27648	6C00	20 mA	20 mA	Nominal range
20736	5100	15 mA	16 mA	
1	1	723.4 nA	4 mA + 578.7 nA	
0	0	0 mA	4 mA	
-1	FFFF			Underrange
-4864	ED00	-3.52 mA	1.185 mA	
-32768	8000	< -3.52 mA	< 1.185 mA	Underflow

* For measurement type "2-wire transducer", negative values are not possible for the range "0 to 20 mA". Therefore, no underrange or underflow exists here.

** For measurement type "2-wire transducer", the behavior described here is supported for overflow up to max. 35 mA.