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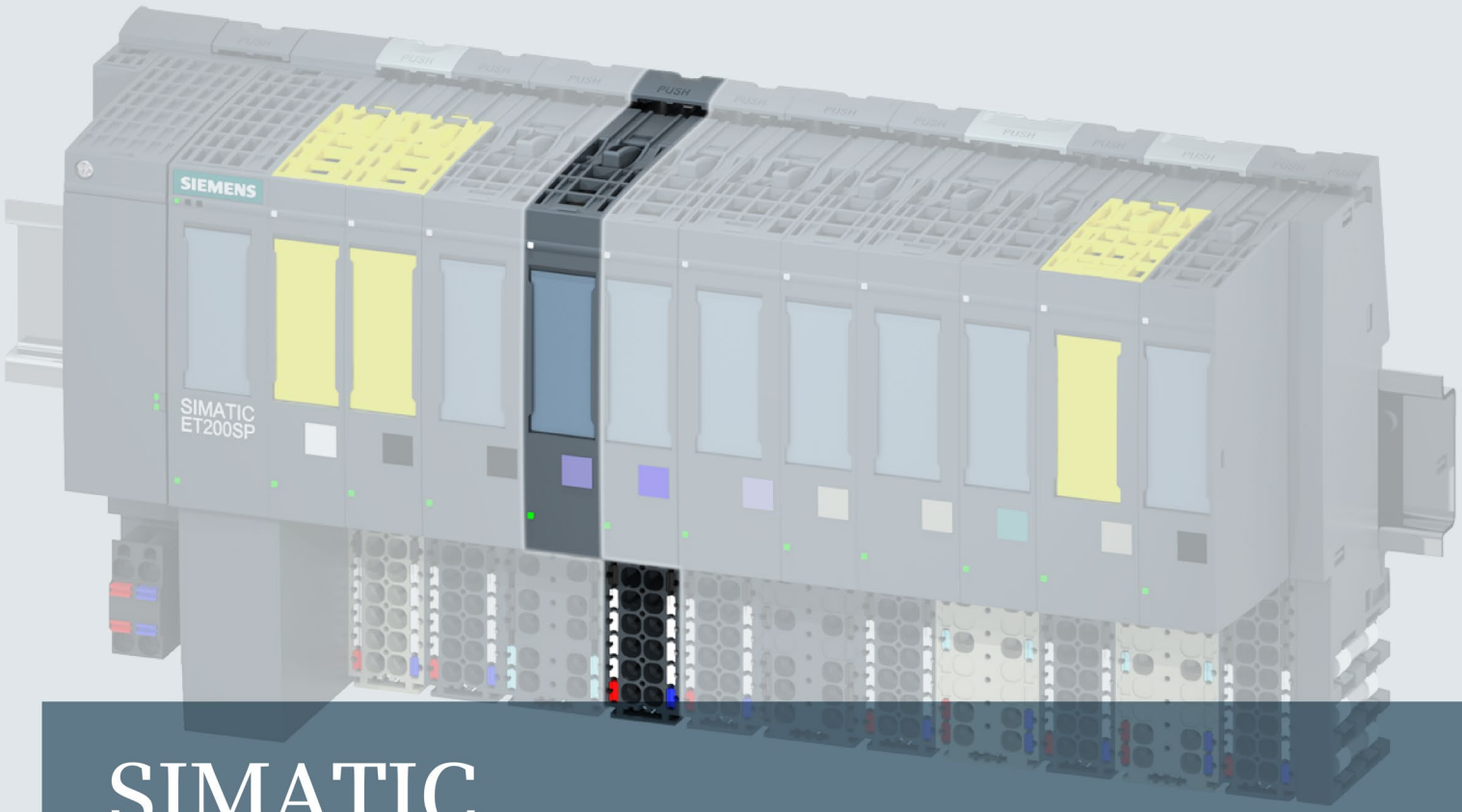

SIMATIC

ET 200SP

Analog input module AI 2xU/I 2-/4-wire HF (6ES7134-6HB00-0CA1)

Manual

Edition 12/2015

Answers for industry.

SIEMENS

SIMATIC

ET 200SP
Analog input module
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Manual

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A5E33062495-AB

Legal information

Warning notice system

This manual contains notices you have to observe in order to ensure your personal safety, as well as to prevent damage to property. The notices referring to your personal safety are highlighted in the manual by a safety alert symbol, notices referring only to property damage have no safety alert symbol. These notices shown below are graded according to the degree of danger.

⚠ 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

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.

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.

Qualified Personnel

The product/system described in this documentation may be operated only by **personnel qualified** for the specific task in accordance with the relevant documentation, in particular its warning notices and safety instructions. Qualified personnel are those who, based on their training and experience, are capable of identifying risks and avoiding potential hazards when working with these products/systems.

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We have reviewed the contents of this publication to ensure consistency with the hardware and software described. Since variance cannot be precluded entirely, we cannot guarantee full consistency. However, the information in this publication is reviewed regularly and any necessary corrections are included in subsequent editions.

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℗ 12/2015 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.

Conventions

CPU: When the term "CPU" is used in this manual, 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.

Security information

Siemens provides products and solutions with industrial security functions that support the secure operation of plants, solutions, machines, equipment and/or networks. They are important components in a holistic industrial security concept. With this in mind, Siemens' products and solutions undergo continuous development. Siemens recommends strongly that you regularly check for product updates.

For the secure operation of Siemens products and solutions, it is necessary to take suitable preventive action (e.g. cell protection concept) and integrate each component into a holistic, state-of-the-art industrial security concept. Third-party products that may be in use should also be considered. You can find more information about industrial security on the Internet (http://www.siemens.com/industrialsecurity).

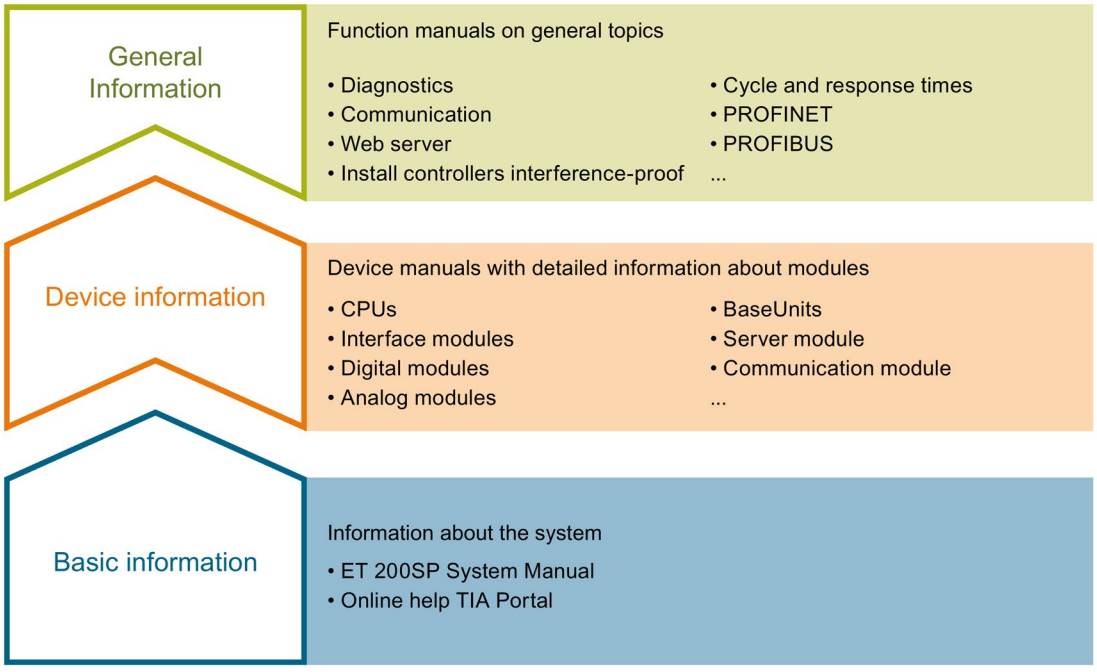
To stay informed about product updates as they occur, sign up for a product-specific newsletter. You can find more information on the Internet (http://support.automation.siemens.com).

Table of contents

Guide to documentation

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, terminal 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, designing interference-free controllers.

You can download the documentation free of charge from the Internet (http://w3.siemens.com/mcms/industrial-automation-systems-simatic/en/manual-overview/tech-doc-et200/Pages/Default.aspx).

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 (http://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.

You need to register once to use the full functionality of "mySupport".

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

"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 (http://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 (http://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 (http://w3.siemens.com/mcms/topics/en/simatic/tia-selection-tool).

Product overview

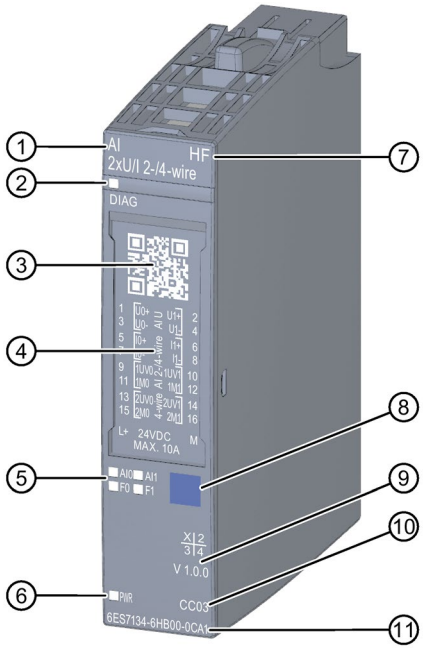
2

2.1 Properties

Article number

6ES7134-6HB00-0CA1

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

Image 2-1 View of the module AI 2×U/I 2-/4-wire HF

Properties

The module has the following technical properties:

- Analog input module with 2 inputs
- Resolution: Up to 16 bits including sign
- Single channel electrical isolation
- Voltage measurement type can be set per channel
- Current measuring type can be set per channel (for 2-wire or 4-wire transducer)
- Configurable diagnostics (per channel)

The module supports the following functions:

- Firmware update
- I&M identification data
- Configuration in RUN
- PROFIenergy
- Calibration in runtime
- Isochronous mode (PROFINET IO only)
- Value status (PROFINET IO only)

Table 2- 1 Version dependencies of other module functions

Function	Product version of the module as of	Firmware version of the module as of
Measuring range adjustment	1	V2.0.0
Scaling of measured values	1	V2.0.0
Module-internal shared input (MSI)	1	V2.0.0

You can configure the module with STEP 7 (TIA Portal) and with a GSD file [1].

[1] Version required for STEP 7: V5.5 SP4 HF7

Accessories

The following accessories must be ordered separately:

- Labeling strips
- Color identification labels
- Reference identification label
- Shield connector

See also

You can find additional information on the accessories in the ET 200SP distributed I/O system system manual.

Wiring

3

3.1 Wiring and block diagram

This section includes the block diagram of the AI 2xU/I 2-/4-wire HF module with the various terminal assignments for a 2- und 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

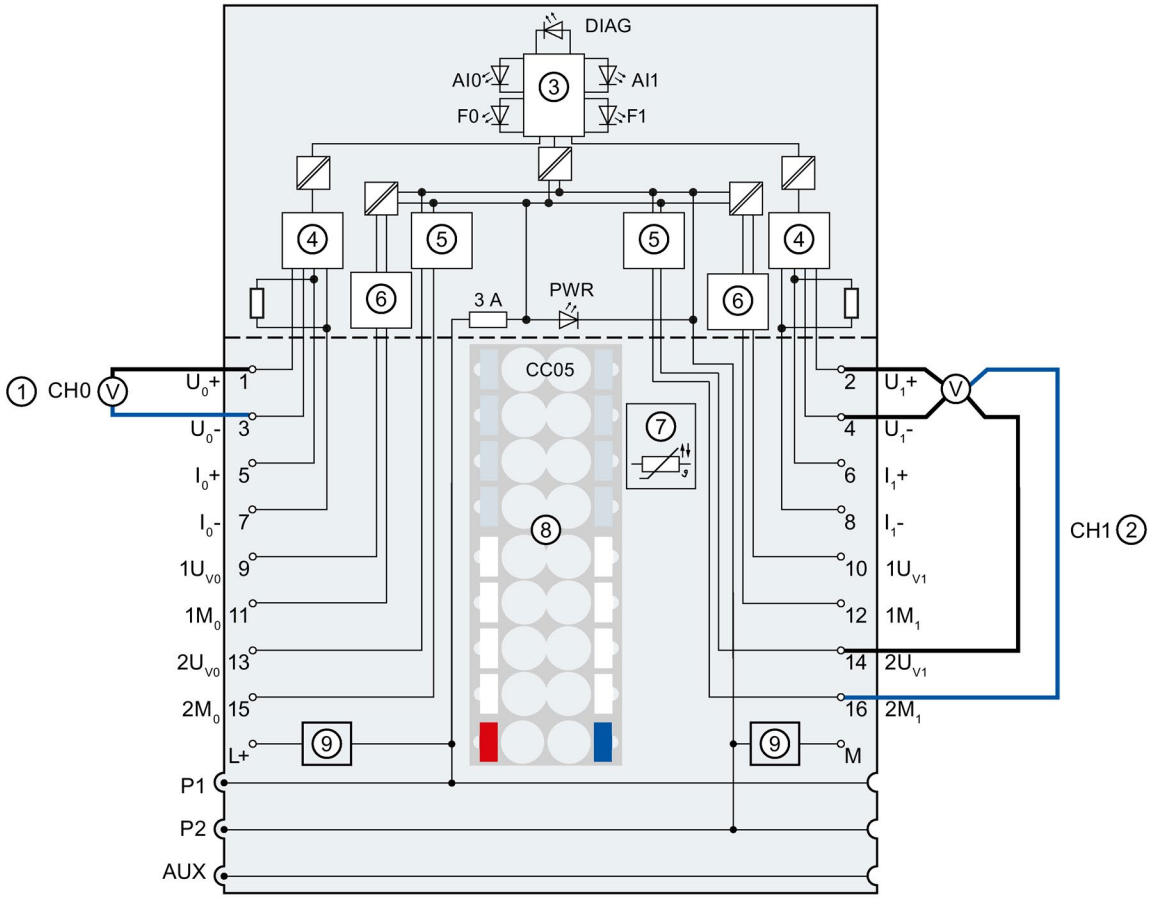
You can use and combine the different wiring options for all channels.

Note

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

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

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

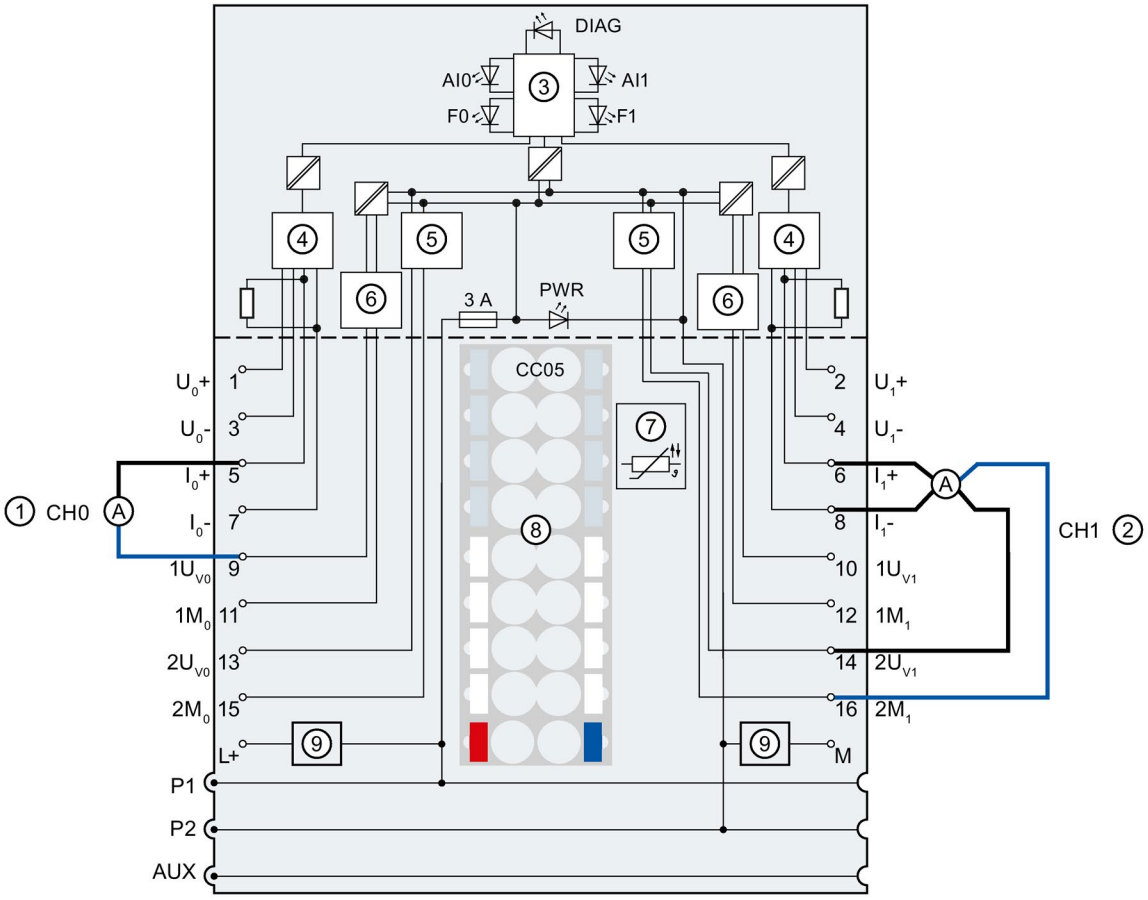


①	2-wire connection for voltage measurement	I_n+	Current input positive, channel n
②	4-wire connection for voltage measurement	I_n-	Current input negative, channel n
③	Backplane bus interface	U_{Vn}	Supply voltage, channel n
④	Analog-to-digital converter (ADC)	M_n	Reference ground to U_{Vn}, channel n
⑤	Current limitation (4-wire)	L+	24 V DC (infeed only with light-colored BaseUnit)
⑥	Current limitation (2-wire)	P1, P2, AUX	Internal self-assembling voltage buses Connection to left (dark-colored BaseUnit) Connection to left interrupted (light-colored BaseUnit)
⑦	Temperature recording for BU type A1 only (function cannot be used for this module)	DIAG	Diagnostics LED (green, red)
⑧	Color-coded label with color code CC05 (optional)	AI0, AI1	Channel status LED (green)
⑨	Filter connection supply voltage (only when light-colored BaseUnit is present)	F0, F1	Channel fault LED (red)
U_n+	Voltage input positive, channel n	PWR	Power LED (green)
Un-	Voltage input negative, channel n		

Image 3-1 Wiring and block diagram for voltage measurement 2-wire and 4-wire connection

Wiring: Current measurement 2-wire and 4-wire connection (2-wire and 4-wire transducer)

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



①	2-wire connection for current measurement (2-wire transducer)	U_n+	Voltage input positive, channel n
②	4-wire connection for current measurement (4-wire transducer)	U_n-	Voltage input negative, channel n
③	Backplane bus interface	U_{Vn}	Supply voltage, channel n
④	Analog-to-digital converter (ADC)	M_n	Reference ground to U_{Vn}, channel n
⑤	Current limitation (4-wire)	L+	24 V DC (infeed only with light-colored BaseUnit)
⑥	Current limitation (2-wire)	P1, P2, AUX	Internal self-assembling voltage buses Connection to left (dark-colored BaseUnit) Connection to left interrupted (light-colored BaseUnit)
⑦	Temperature recording for BU type A1 only (function cannot be used for this module)	DIAG	Diagnostics LED (green, red)
⑧	Color-coded label with color code CC05 (optional)	AI0, AI1	Channel status LED (green)
⑨	Filter connection supply voltage (only when light-colored BaseUnit is present)	F0, F1	Channel fault LED (red)
I_n+	Current input positive, channel n	PWR	Power LED (green)
I_n-	Current input negative, channel n		

Image 3-2 Wiring and block diagram for current measurement 2-wire and 4-wire connection (2-wire and 4-wire transducer)

Parameters/address space

4

4.1 Measurement types and measuring ranges

The following table shows the measurement types and the respective measuring range.

Table 4- 1 Measurement types and measuring ranges

Measurement type	Measuring range	Resolution
Voltage	± 5 V	16 bits incl. sign
	± 10 V	16 bits incl. sign
	1 to 5 V	15 bits
	0 to 10 V	15 bits
Current	0 to 20 mA (2-wire and 4-wire transducer)	15 bits
	4 to 20 mA (2-wire and 4-wire transducer)	15 bits
	± 20 mA (only with 4-wire transducer)	16 bit including sign

You can find the tables of measuring ranges and overflow, overrange, etc. in the appendix Representation of analog values (Page 52) and the "Analog value processing" function manual.

Measuring range adjustment

See Measuring range adjustment (Page 21).

Scaling of measured values

See Scaling of measured values (Page 24).

4.2 Parameters

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

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

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

When assigning parameters in the user program, use the WRREC instruction to transfer the parameters to the module by means of data records; refer to the section Parameter assignment and structure of parameter data record (Page 42).

The following parameter settings are possible:

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

Parameter	Range of values	Default	Configuration in RUN	Scope with configuration software, e.g. STEP 7 (TIA Portal)	
				GSD file PROFINET IO	GSD file PROFIBUS DP
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
Diagnostics: Underflow	• Disable • Enable	Disable	Yes	Channel	Channel
Diagnostics: Wire break	• Disable • Enable	Disable	Yes	Channel	Channel

Parameter	Range of values	Default	Configuration in RUN	Scope with configuration software, e.g. STEP 7 (TIA Portal)	
				GSD file PROFINET IO	GSD file PROFIBUS DP
Measurement type/measuring range	• Deactivated • Voltage – ±5 V – ±10 V – 1 V to 5 V – 0 V to 10 V • Current (4-wire transducer) – 0 to 20 mA – 4 to 20 mA – ±20 mA • Current (2-wire transducer) – 0 to 20 mA – 4 to 20 mA	Current (4-wire transducer) 4..20 mA	Yes	Channel	Channel
Smoothing	• None • 2 times • 4 times • 8 times • 16 times • 32 times	None	Yes	Channel	Channel
Interference frequency suppression [2]	• 16.6 Hz (67.5 ms) • 50 Hz (22.5 ms) • 60 Hz (18.75 ms) • 300 Hz (10 ms) • 600 Hz (5 ms) • 1.2 kHz (2.5 ms) • 2.4 kHz (1.25 ms) • 4.8 kHz (0.625 ms)	50 Hz (22.5 ms)	Yes	Channel	Channel
Measuring range adjustment [1]	• Disable • Enable	Disable	Yes	Channel	-
Measuring range adjustment high limit [1]	Value within the nominal range of the measuring range in mV or µA	0	Yes	Channel	-
Measuring range adjustment low limit [1]	Value within the nominal range of the measuring range in mV or µA	0	Yes	Channel	-
Scaled high nominal range limit [3]	REAL	20.0	Yes	Channel	-
Scaled low nominal range limit [3]	REAL	4.0	Yes	Channel	-

Parameter	Range of values	Default	Configuration in RUN	Scope with configuration software, e.g. STEP 7 (TIA Portal)	
				GSD file PROFINET IO	GSD file PROFIBUS DP
Hardware interrupt high limit 1 [1]	• Disable • Enable	Disable	Yes	Channel	-
Hardware interrupt low limit 1 [1]	• Disable • Enable	Disable	Yes	Channel	-
Hardware interrupt high limit 2 [1]	• Disable • Enable	Disable	Yes	Channel	-
Hardware interrupt low limit 2 [1]	• Disable • Enable	Disable	Yes	Channel	-
Hardware interrupt high limit 1 [1]	• Value (INT) • Value (REAL) [3]	• 27648 • 0.0 [3]	Yes	Channel	-
Hardware interrupt low limit 1 [1]	• Value (INT) • Value (REAL) [3]	• 0 • 0.0 [3]	Yes	Channel	-
Hardware interrupt high limit 2 [1]	• Value (INT) • Value (REAL) [3]	• 27648 • 0.0 [3]	Yes	Channel	-
Hardware interrupt low limit 2 [1]	• Value (INT) • Value (REAL) [3]	• 0 • 0.0 [3]	Yes	Channel	-
Potential group	• Use potential group of the left module (module plugged into a dark-colored BaseUnit) • Enable new potential group (module plugged into light-colored BaseUnit)	Use potential group of the left module	No	Module	Module

1 Due to the limited number of parameters at a maximum of 244 bytes per ET 200SP station with a PROFIBUS GSD configuration, the configuration options are restricted. If required, you can assign these parameters using data record 128 as described in the "GSD file PROFINET IO" column (see table above). The parameter length of the I/O module is 7 bytes.

2 In normal operation, different interference frequency suppression settings can be configured for both channels. These cause different integration times for the analog-to-digital conversion. The module-internal time for updating the user data is now based on the longer integration time for both channels.
In isochronous mode, both channels must be configured with the same interference frequency suppression of 4.8 kHz.

3 Only for configuration SCALE.

Note

Unused channels

Deactivate the unused inputs in the parameter assignment.

A deactivated input always returns the value $7FFF_H$ or $7F800000_H$ with measured value scaling.

Property of the module in isochronous mode

The permitted interference frequency suppression of both channels for isochronous mode of the modules is 4.8 kHz (0.625 ms).

Note that no instantaneous value for the time Ti is returned in isochronous mode. The analog module AI 2xU/I 2-/4-wire HF returns a mean value for the range of 0.625 ms starting at Ti.

4.3 Explanation of parameters

Diagnostics: No supply voltage L+

Enabling of the diagnostics for no or insufficient supply voltage L+.

Diagnostics: Short-circuit to ground

Enabling of the diagnostics if a short-circuit of the actuator supply to ground occurs. 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

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

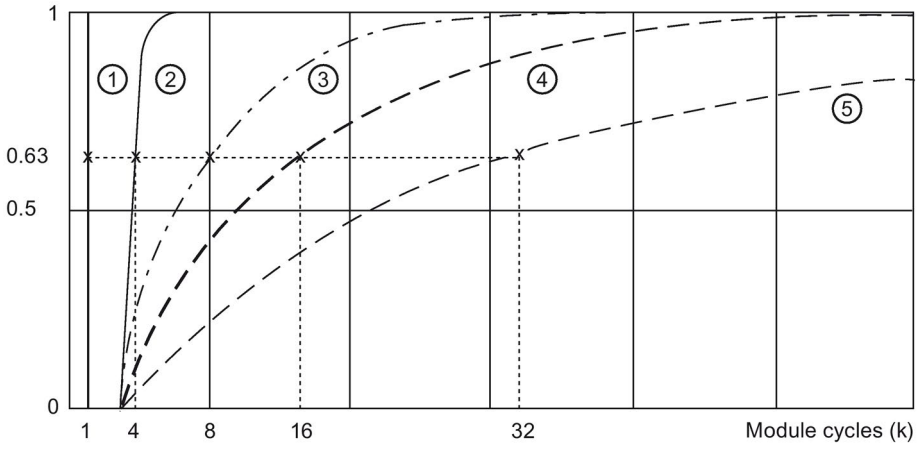
The wire break and underflow diagnostics can be activated simultaneously. If both diagnostics events occur simultaneously, the wire break diagnostics is output.

Smoothing

The individual measured values are smoothed by filtering. The smoothing can be set in 5 levels.

Smoothing time = number of module cycles (k) x 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 applies to every signal change at the analog input.



① No smoothing (k = 1)
② Weak (k = 4)
③ Medium (k = 8)
④ Strong (k = 16)
⑤ Very strong (k = 32)

Image 4-1 Smoothing AI 2×U/I 2-/4-wire HF

Interference frequency suppression

Suppresses the interference affecting analog input modules that is caused by the frequency of the AC voltage network used.

The frequency of the AC voltage network can negatively affect the measured value, in particular when measuring in the low voltage range and with thermocouples. With this parameter, the user specifies the line frequency that is predominant in the plant.

Measuring range adjustment

The measuring range adjustment is a limited section of a measuring range supported by the analog input module. It is available for current and voltage measurements.

A limited measuring range in S7 format is shown, which is defined by the high and low limits of the measuring range adjustment.

Scaling of measured values

With measured value scaling, the user data of an analog input module is displayed as REAL (32-bit floating point) instead of S7 format.

The representation of the measuring range is defined by the scaled high and low limits of nominal range limit (as REAL).

The measured value scaling can be combined with the measuring range adjustment. In this case, the measuring range is adjusted first and then the representation of the measuring range is scaled.

BaseUnit with incoming supply voltage

Specifies that a light-colored BaseUnit with incoming supply voltage is located on this slot (see ET 200SP distributed I/O system (http://support.automation.siemens.com/WW/view/en/58649293) system manual).

Potential group

A potential group consists of a group of directly adjacent I/O modules within an ET 200SP station, which are supplied via a common supply voltage.

A potential group begins with a light-colored BaseUnit through which the required voltage is supplied for all modules of the potential group. The light-colored BaseUnit interrupts the three self-assembling voltage buses P1, P2 and AUX to the left neighbor.

All additional I/O modules of this potential group are plugged into dark-colored BaseUnits. You take the potential of the self-assembling voltage buses P1, P2 and AUX from the left neighbor.

A potential group ends with the dark-colored BaseUnit, which follows a light-colored BaseUnit or server module in the station configuration.

See also

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

4.4 Measuring range adjustment

Introduction

The measuring range adjustment is available for current and voltage measuring ranges.

The measuring range adjustment (base measuring range) is valid for the following ranges:

- Nominal range
- Underrange (of the measuring range adjustment)
- Overrange (of the measuring range adjustment)

Note

Live zero measuring ranges are not supported.

Function

The measuring range adjustment is a limited section of a measuring range supported by the module.

It allows you to increase the resolution for a configurable part of the measuring range in S7 format.

- The function is enabled with the "Measuring range adjustment" parameter
- The "Measuring range adjustment high limit" parameter sets the high limit of the measuring range in mV or µA.
- The "Measuring range adjustment low limit" parameter sets the low limit of the measuring range in mV or µA.

Note

The "Measuring range adjustment" function can be used in combination with the "Measured value scaling" function. See also Scaling of measured values (Page 24).

Note

When the "Measuring range adjustment high limit" and "Measuring range adjustment low limit" parameters are too close together, resolution may be lost, which means it may no longer be possible to show every value.

Rules

- The limits of the measuring range adjustment must be selected within the nominal range of the base measuring range. They are specified in integers.
- The measuring range adjustment is resolved depending on the base measuring range from 0_H to $6C00_H$ or 9400_H to $6C00_H$.
- Underranges/overranges apply in accordance with the S7 format and the base measuring range.
  Special consideration: Negative values are not possible for "Current (2-wire transducer) 0..20 mA". With a measuring range adjustment, an underrange is offered when possible and cut off at 0 mA. If the underrange limit ($ED00_H$) is > 0 mA, QI = 0 and the analog value 8000_H are output when it is violated.

Example

The following values result, for example:

Table 4- 3 Example of measuring range adjustment

Measuring range adjustment	Measuring range resolution	
	Bipolar	Unipolar
Base measuring range	±10 V	0 V to 10 V
Adjusted measuring range	+2 V to +5 V	+2 V to +5 V
Measuring range adjustment high limit	5000 mV (S7: +27648)	5000 mV (S7: +27648)
Measuring range adjustment low limit	2000 mV (S7: -27648)	2000 mV (S7: 0)

The following example illustrates the effect of a measuring range adjustment:

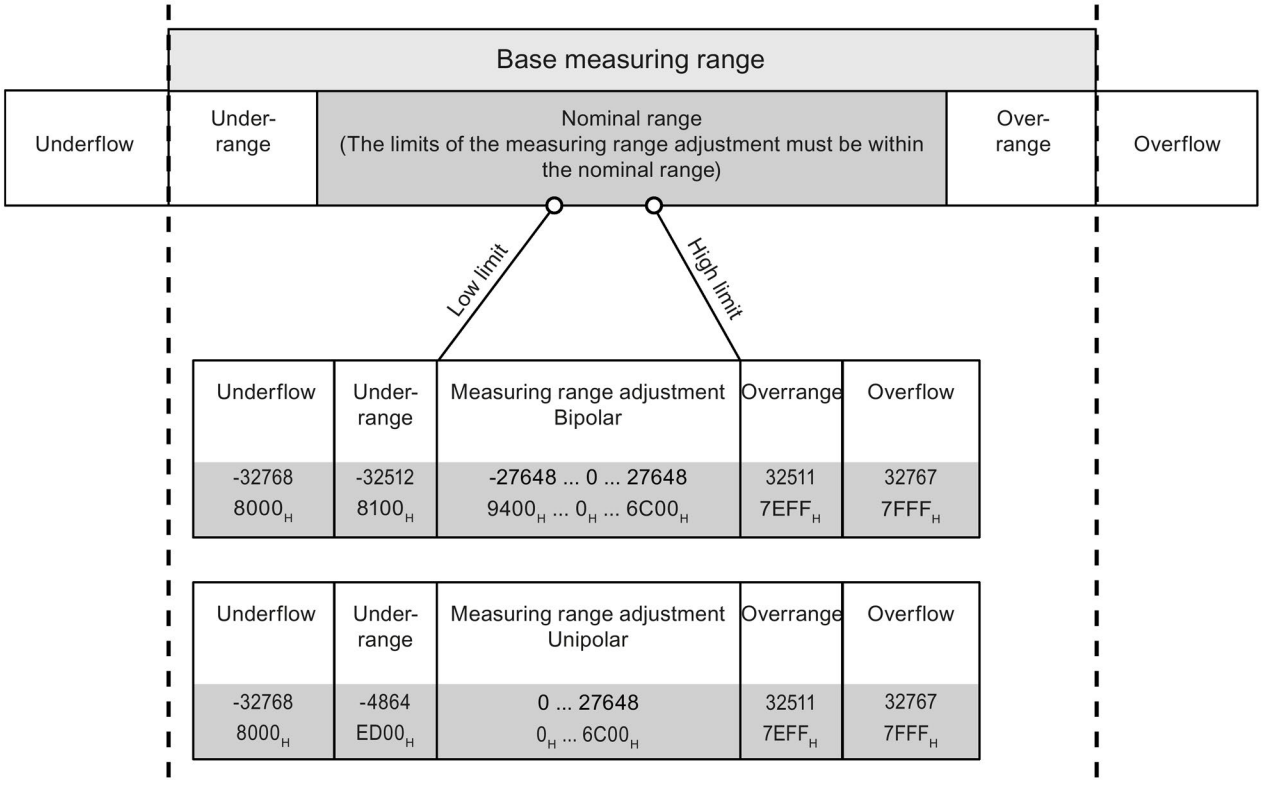


Image 4-2 Example of a measuring range adjustment

Configuration

The following figure shows an example of a configuration:

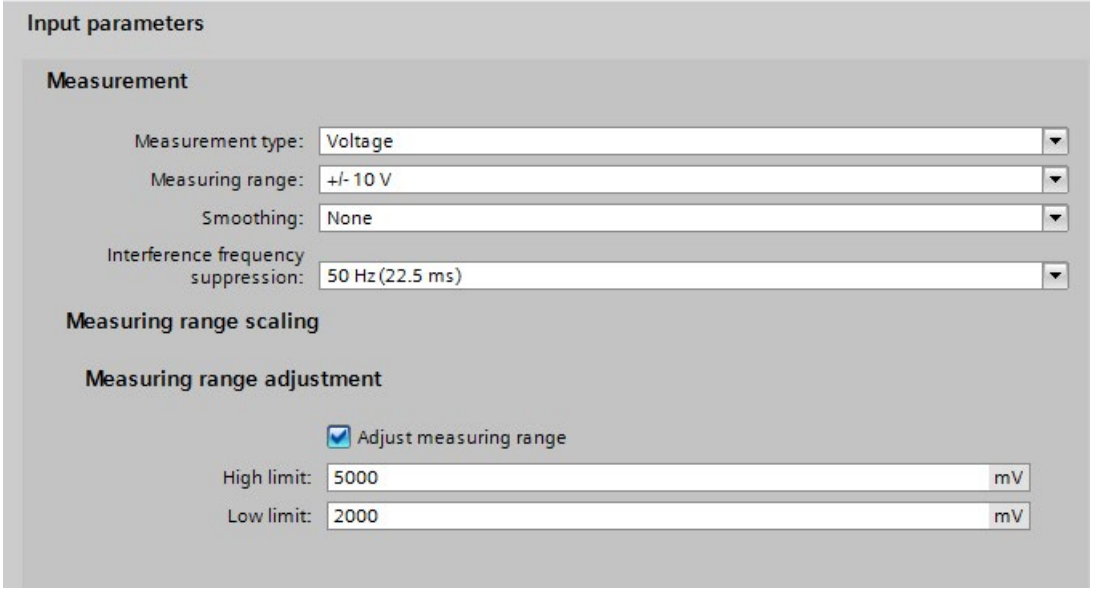


Image 4-3 Example of a configuration

In the configuration example, a measuring range adjustment of 2000 mV to 5000 mV is displayed.

4.5 Scaling of measured values

Introduction

The measured value scaling can be combined with the measuring range adjustment. In this case, the measuring range is adjusted first and then the representation of the measuring range is scaled.

Function

With measured value scaling, the user data of an AI 2xU/I 2-/4-wire HF module is displayed as REAL (32-bit floating point) instead of S7 format.

The representation of the measuring range is defined by the following parameters:

- The "Scaled high nominal range limit" parameter sets the desired display value (in REAL) for the high nominal range limit of the measuring range.
- The "Scaled low nominal range limit" parameter sets the desired display value (in REAL) for the low nominal range limit of the measuring range.

Note

With measured value scaling, the substitute value is minus infinity for underflow (FF800000H) and plus infinity for overflow (7F800000H).

Note

Effects of inversion

It is possible to set the "Scaled high nominal range limit" parameter lower than the "Scaled low nominal range limit" parameter, whereby the representation of the measuring range will be inverted compared to the terminal value (V, mA).

Overflow/underflow and hardware interrupts are always based on representation in REAL. A terminal value of > 11.76 V triggered an underflow for an inverted measured value scaling. Hardware interrupts react similarly.

Note

When the Parameter "Scaled high nominal range limit" and "Scaled low nominal range limit" parameters are too close together, resolution may be lost, which means it may no longer be possible to show every value.

Example

The following values result, for example:

Table 4- 4 Example of measured value scaling

	Low nominal range limit	High nominal range limit
Base measuring range	-10 V	+10 V
S7 format	-27648	+27648
Scaling of measured values	1.00	7.00

As shown in the table, -10 V corresponds to 1.00 and +10 V corresponds to 7.00.

Combination with measuring range adjustment

If the measuring range adjustment is enabled in addition to measured value scaling, first the measuring range is scaled and then the representation of the measuring range. The table below shows an example of the combination of measured value scaling and measuring range adjustment.

Table 4- 5 Example for a combination of measured value scaling and measuring range adjustment

	Low nominal range limit	High nominal range limit
Measuring range adjustment	-4000 mV	8000 mV
S7 format	-27648	+27648
Scaling of measured values	1.00	7.00

As shown in the table, -4 V corresponds to 1.00 and +8 V corresponds to 7.00.

Configuration

The following figures show examples of a configuration in STEP 7:

Configuration of measured value scaling

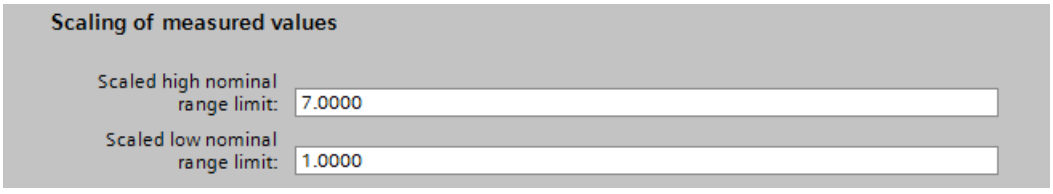


Image 4-4 Configuration of measured value scaling

Configuration with measuring range adjustment and measured value scaling

In the configuration example, a measuring range adjustment of -4000 mV to 8000 mV is displayed and additionally converted to a scaled high and low nominal range limit of 1.00 to 7.00.

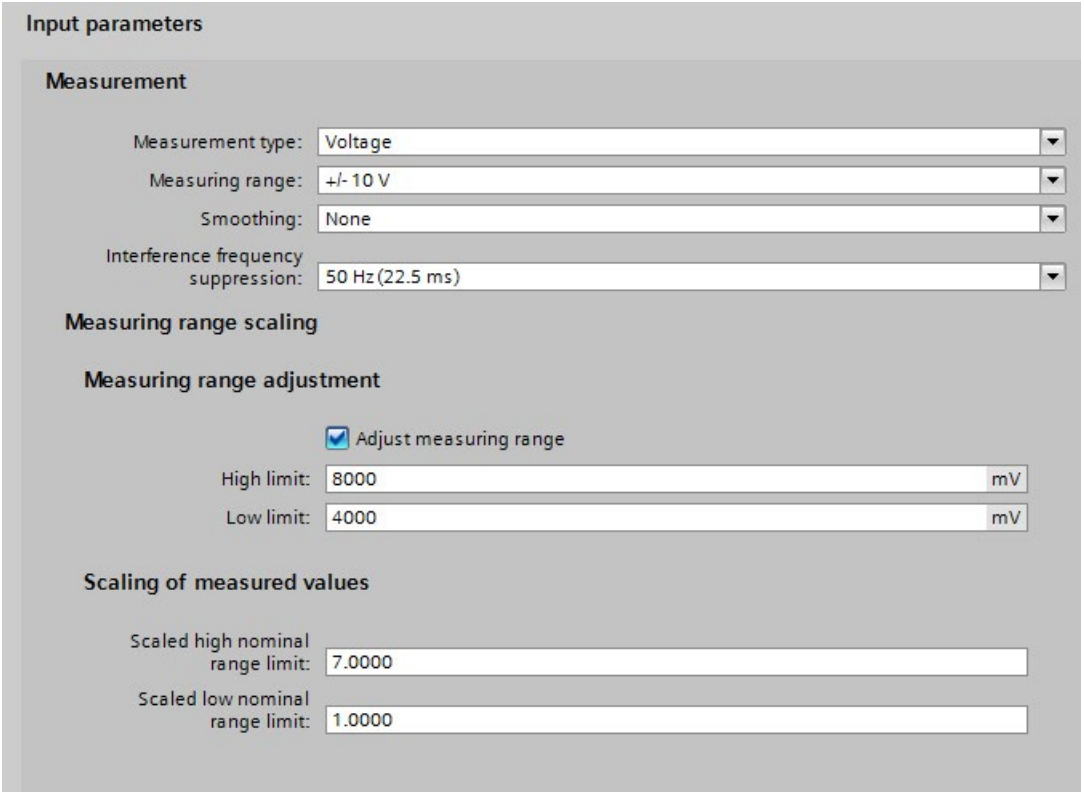


Image 4-5 Configuration with measuring range adjustment and measured value scaling

4.6 Address space

The module can be configured differently in STEP 7; see following table. Depending on the configuration, additional/different addresses are assigned in the process image of the inputs.

Configuration options of AI 2xU/I 2-/4-wire HF

You can configure the module with STEP 7 (TIA Portal) or with a GSD file. If you configure the module by means of a GSD file, the configurations are available under various short designations/module names; see the table below. The following configurations are possible:

Table 4- 6 Configuration options with GSD file

Configuration	Short designation/module name in the GSD file	Configuration software, e.g. with STEP 7 (TIA Portal)		
		Integrated in the hardware catalog STEP 7, as of V13, SP1	GSD file PROFINET IO	GSD file PROFIBUS DP
1 x 2-channel without value status	AI 2xU/I 2-, 4-wire HF V1.0	X	X	X
1 x 2-channel with value status	AI 2xU/I 2-, 4-wire HF V1.0, QI	X	X	---
1 x 2-channel without value status	AI 2xU/I 2-, 4-wire HF V2.0	---	X	X
1 x 2-channel with value status	AI 2xU/I 2-, 4-wire HF V2.0, QI	---	X	---
1 x 2-channel with value status for module-internal Shared Input with up to 4 submodules	AI 2xU/I 2-, 4-wire HF V2.0, MSI	---	X	---
1 x 2-channel with value status and measured value scaling	AI 2xU/I 2-, 4-wire HF V2.0, SCALE	---	X	---

Value status (Quality Information, QI)

The value status is always activated for the following module names:

- AI 2xU/I 2-, 4-wire HF, QI,
- AI 2xU/I 2-, 4-wire HF, MSI
- AI 2xU/I 2-, 4-wire HF, SCALE

An additional bit is assigned to each channel for the value status. The value status bit indicates whether the read in analog value is valid. (0 = value is incorrect).

Evaluating the value status

If you enable the value status for the analog module, an additional byte is occupied in the input address space. Bits 1 and 0 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, etc. is incorrect.

Address space for configuration as 1 x 2-channel AI 2×U/I 2-/4-wire HF, QI

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

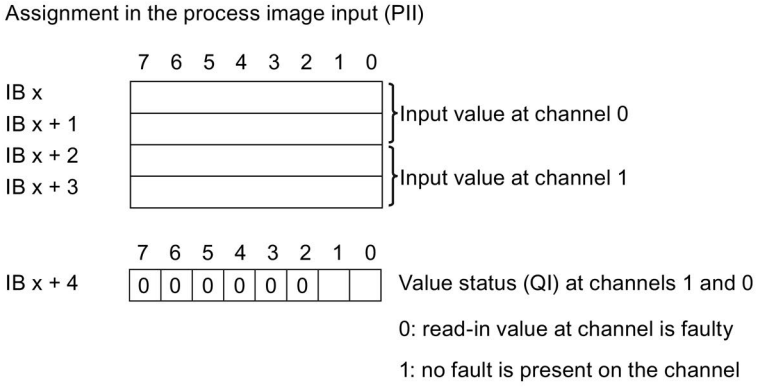


Image 4-6 Address space of the analog input module AI 2xU/I 2-/4-wire HF, QI with value status

Address space for configuration as 1 x 2-channel AI 2×U/I 2-/4-wire HF MSI

For the configuration as a 1 x 2-channel module (module-internal shared input, MSI), channels 0 and 1 of module are copied to up to four submodules. Channels 0 and 1 are then available with identical input values in various submodules. These submodules can be assigned to up to four IO controllers when the module is used in a shared device. Each IO controller has read access to the same channels.

The number of usable submodules is dependent on the interface module used. Please observe the information in the manual for the particular interface module.

Value status (Quality Information, QI)

The meaning of the value status depends on the submodule on which it occurs.

For the 1st submodule (=basic submodule), the value status 0 indicates that the value is incorrect.

For the 2nd to 4th submodule (=MSI submodule), the value status 0 indicates that the value is incorrect or the basic submodule has not yet been configured (not ready).

The following figure shows the assignment of the address space with submodules 1 and 2.

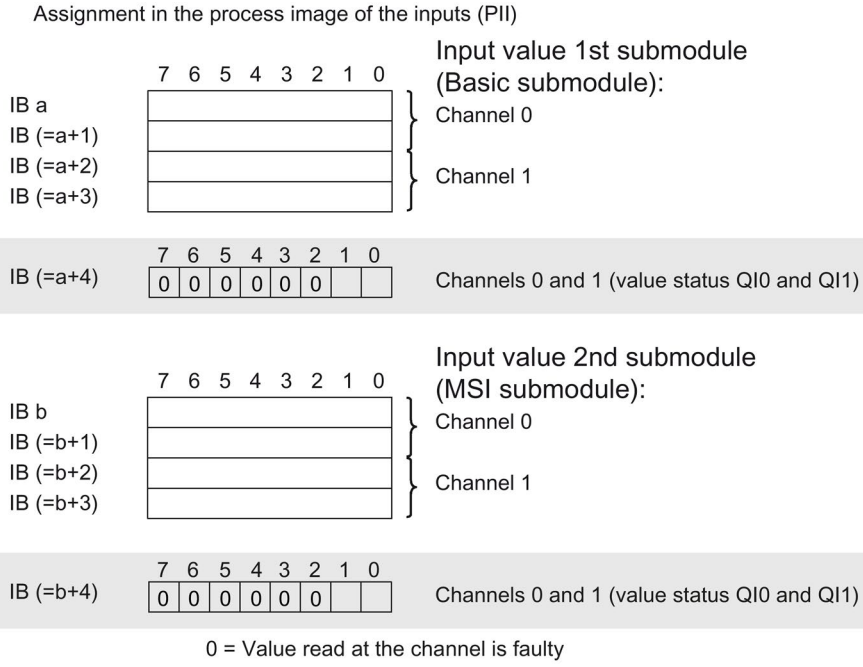


Image 4-7 Address space for configuration as 1x 2-channel AI 2×U/I 2-/4-wire HF MSI with value status

The figure below shows the assignment of the address space with submodules 3 and 4.

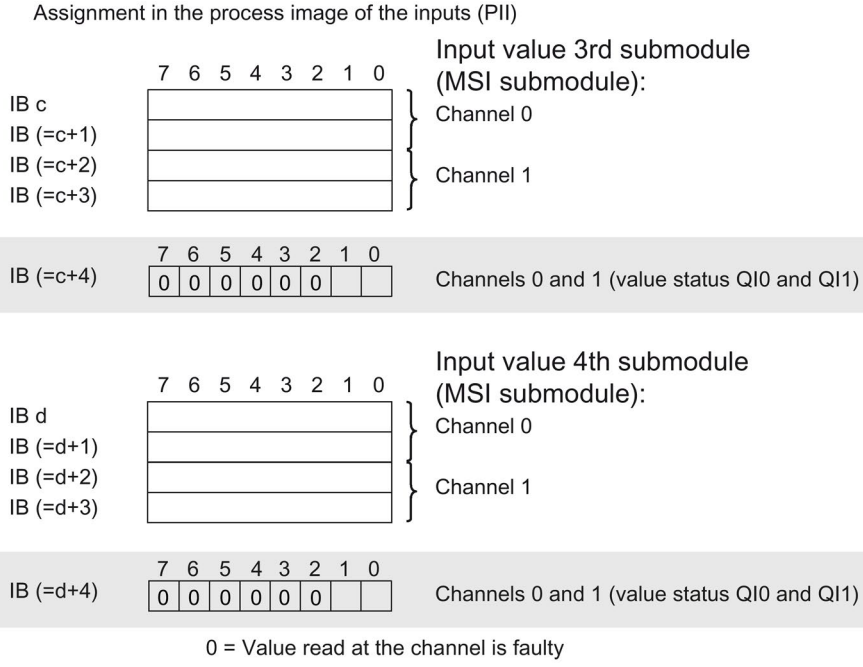


Image 4-8 Address space for configuration as 1x 2-channel AI 2×U/I 2-/4-wire HF MSI with value status

Address space for configuration as 1 x 2-channel AI 2×U/I 2-/4-wire HF SCALE

The following figure shows the assignment of the address space for the AI 2xU/I 2-/4-wire HF, SCALE with value status (Quality Information (QI)). The value status cannot be deselected for this configuration.

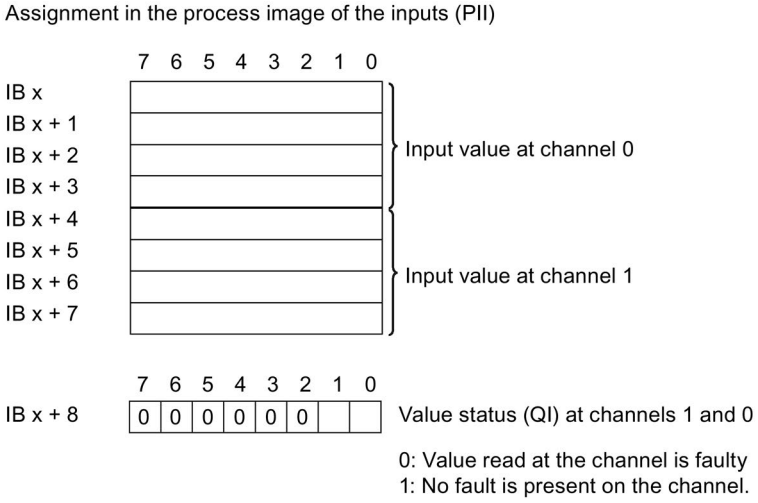


Image 4-9 Address space for configuration as 1 x 2-channel AI 2×U/I 2-/4-wire HF, SCALE with value status

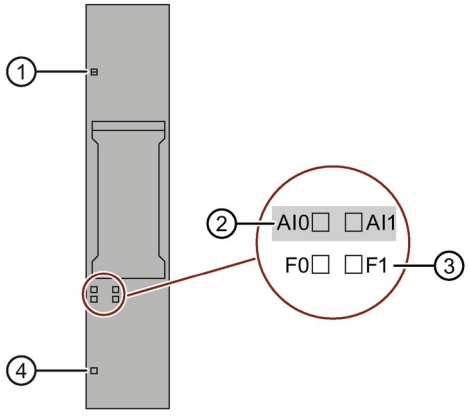
Interrupts/diagnostics alarms

5

5.1 Status and error displays

LED displays

The following figure shows you the LED display of the AI 2xU/I 2-/4-wire HF.



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

Image 5-1 LED display

Meaning of the LED displays

The following tables contain the meaning of the status and error displays. Remedies for diagnostics alarms can be found in section Diagnostics alarms (Page 35).

Table 5- 1 Error display DIAG LED

DIAG LED	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

Table 5- 2 Status and error display LED channel status / channel error

LEDs		Meaning
Channel status	Channel error	
Off	Off	Channel deactivated or load voltage missing
On	Off	Channel activated and no channel diagnostics
Off	On	Channel activated and channel diagnostics
On	On	Not permitted (error)

Table 5- 3 PWR LED status display

PWR LED	Meaning
Off	Load voltage missing
On	Load voltage present

5.2 Interrupts

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

Diagnostics interrupts

The module generates a diagnostic interrupt at the following events:

- Short-circuit (current: sensor supply; voltage: 1 to 5 V, encoder supply)
- Wire break (current: 4 to 20 mA)
- High limit violated
- Low limit violated
- Error
- Parameter assignment error
- Hardware interrupt lost
- Supply voltage missing
- Channel temporarily unavailable

Hardware interrupts

The module generates a hardware interrupt at the following events:

- Violation of low limit 1
- Violation of high limit 1
- Violation of low limit 2
- Violation of high limit 2

S7-1500

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

The block interface is represented 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 "RALARM" (read additional interrupt information) instruction and in the STEP 7 online help.

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

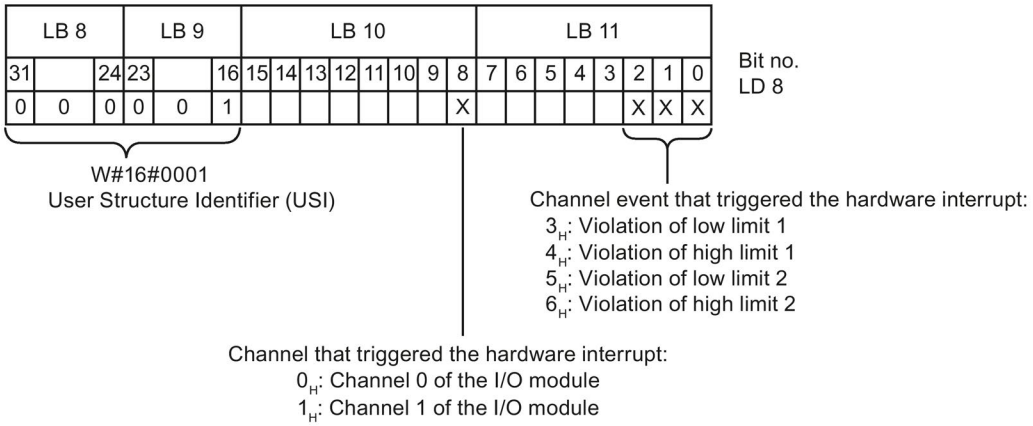


Image 5-2 OB start information

Structure of the additional interrupt information

Table 5- 4 Structure of the additional interrupt information

Data block name		Content	Comment	Bytes
USI (User Structure Identifier)		W#16#0001	Additional interrupt information for hardware interrupts of the I/O module	2
Channel that triggered the hardware interrupt.				
	Channel	B#16#00 to B#16#01	Channel 0 and 1 of the I/O module	1
Event that triggered the hardware interrupt.				
	Error event	B#16#03	Violation of low limit 1	1
		B#16#04	Violation of high limit 1	
		B#16#05	Violation of low limit 2	
		B#16#06	Violation of high limit 2	

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 meaning and corrective measures

Diagnostics alarm	Error code	Meaning	Solution
Short-circuit (encoder supply)	1_H	Short-circuit encoder supply to ground	Correct interplay between module and encoder
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 4 to 20 mA)	6_H	Impedance of encoder circuit too high	Use a different encoder type or modify the wiring, e.g. use cables with larger cross-section
		Wire break between the module and sensor	Connect the cable
		Channel not connected (open)	• Disable diagnostics • Connect the encoder contacts
High limit violated	7_H	Value is above the overrange.	Correct interplay between module and encoder
Low limit violated	8_H	Value is below the underrange.	Correct interplay between module and encoder
Error	9_H	Internal module error has occurred (diagnostics alarm on channel 0 applies for the entire module).	Replace 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).
Supply voltage missing	11_H	Missing or insufficient supply voltage L+	• Check supply voltage L+ on the BaseUnit • Check BaseUnit type
Hardware interrupt lost	16_H	Error is reported when a hardware interrupt (high/low limit) could not be reported.	• Limits might be assigned twice. • If necessary, reduce the bus cycle. • If necessary, use higher SFU.
Channel temporarily unavailable	$1F_H$	Firmware update is currently in progress or has been canceled. The module does not read process values in this state.	• Wait for firmware update • Restart the firmware update
		Switch to user calibration	

Technical specifications

6

Technical specifications of the AI 2×U/I 2-/4-wire HF

	6ES7134-6HB00-0CA1
General information	
Product type designation	ET 200SP, AI 2xU/I 2/4-wire High Feature, PU 1
Firmware version	V2.0
• FW update possible	Yes
Usable BaseUnits	BU type A0, A1
Color code for module-specific color identification label	CC03
Product function	
I&M data	Yes; I&M0 to I&M3
Scalable measuring range	No
Engineering with	
STEP 7 TIA Portal can be configured/integrated as of version	V13
STEP 7 can be configured/integrated as of version	V5.5 / -
PCS 7 can be configured/integrated as of version	V8.1 SP1
PROFIBUS as of GSD version/GSD revision	GSD revision 5
PROFINET as of GSD version/GSD revision	GSDML V2.3
Operating mode	
Oversampling	No
MSI	Yes
CiR Configuration in RUN	
Configuration in RUN possible	Yes
Calibration in RUN possible	Yes
Supply voltage	
Rated value (DC)	24 V
Valid range, low limit (DC)	19.2 V
Valid range, high limit (DC)	28.8 V
Polarity reversal protection	Yes
Input current	
Current consumption (rated value)	39 mA; without sensor supply

	6ES7134-6HB00-0CA1
Encoder supply	
24 V encoder supply	
24 V	Yes
Short-circuit protection	Yes
Output current, max.	20 mA; max. 50 mA per channel for a duration < 10 s (two-wire)
Additional 24 V encoder supply	
Short-circuit protection	Yes; channel-based
Output current, max.	100 mA; max. 150 mA per channel for a duration < 10 s (four-wire)
Power loss	
Power loss, typ.	0.95 W; without sensor supply
Address area	
Address space per module	
Address space per module, max.	4 bytes; + 1 byte for QI information
Analog inputs	
Number of analog inputs	2; Differential inputs
Maximum permissible input voltage for voltage input (destruction limit)	30 V
Permissible input current for current input (destruction limit), max.	50 mA
Input ranges (rated values), voltages	
0 to +10 V	Yes; 15 bits
Input resistance (0 to 10 V)	75 kΩ
1 V to 5 V	Yes; 15 bits
Input resistance (1 V to 5 V)	75 kΩ
-10 V to +10 V	Yes; 16 bits incl. sign
Input resistance (-10 V to +10 V)	75 kΩ
-5 V to +5 V	Yes; 16 bits incl. sign
Input resistance (-5 V to +5 V)	75 kΩ
Input ranges (rated values), currents	
0 mA to 20 mA	Yes; 15 bits
Input resistance (0 to 20 mA)	130 Ω
-20 mA to +20 mA	Yes; 16 bits incl. sign
Input resistance (-20 mA to +20 mA)	130 Ω
4 mA to 20 mA	Yes; 15 bits
Input resistance (4 mA to 20 mA)	130 Ω
Cable length	
Shielded, max.	1000 m; 200 m for voltage measurement

	6ES7134-6HB00-0CA1
Formation of analog values for the inputs	
Measuring principle	Sigma Delta
Integration and conversion time/resolution per channel	
Resolution with overrange (bit including sign), max.	16 bits
Integration time configurable	Yes
Interference voltage suppression for interference frequency f1 in Hz	16.6 / 50 / 60 / 300 / 600 / 1 200 / 2 400 / 4 800
Basic execution time of the module (all channels enabled)	1 ms
Measured value smoothing	
Number of levels	6; none; 2/4/8/16/32 times
Configurable	Yes
Encoders	
Connection of the signal transmitters	
For voltage measurement	Yes
For current measurement as 2-wire transducer	Yes
• Load of 2-wire transducer, max.	650 Ω
For current measurement as 4-wire transducer	Yes
Errors/accuracies	
Linearity error (in relation to input range), (+/-)	0.01%
Temperature error (in relation to input range), (+/-)	0.003%/K
Crosstalk between inputs, min.	-50 dB
Repeat accuracy in settled state at 25 °C (in relation to input range), (+/-)	0.01%
Operational limit in the entire temperature range	
Voltage in relation to input range, (+/-)	0.1%
Current in relation to input range, (+/-)	0.1%
Basic error limit (operational limit at 25 °C)	
Voltage in relation to input range, (+/-)	± 0.05%; 0.1% with SFU 4.8 kHz
Current in relation to input range, (+/-)	± 0.05%; 0.1% with SFU 4.8 kHz
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 mode (application synchronized up to terminal)	Yes
Filtering and processing time (TCI), min.	800 µs
Bus cycle time (TDP), min.	1 ms
Jitter, max.	5 µs

	6ES7134-6HB00-0CA1
Interrupts/diagnostics/status information	
Interrupts	
Diagnostics interrupt	Yes
Limit interrupt	Yes; two high limits and two low limits each
Diagnostics alarms	
Diagnostics	Yes
Monitoring of the supply voltage	Yes
Wire break	Yes, measuring range 4 to 20 mA only
Short-circuit	Yes; for 1 to 5 V, and for current measuring ranges for short-circuit in sensor supply
Group error	Yes
Overflow/underflow	Yes
Diagnostics indicator 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
Electrical isolation	
Electrical isolation of channels	
Between the channels	Yes
Between the channels and backplane bus	Yes
Between the channels and voltage supply of the electronics	Yes
Permitted potential difference	
Between different circuits	75 V DC / 60 V AC (basic isolation)
Between the inputs (UCM)	75 V DC/60 V AC
Isolation	
Isolation tested with	707 V DC (type test)
Dimensions	
Width	15 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
		Underflow	Overflow	Wire break	Short-circuit to ground	Missing supply voltage L+	
Deactivated	*	*	*	*	*	*	*
Voltage	±5 V	x	x	–	x [1]	x	x
	±10 V	x	x	–	x [1]	x	x
	1 V to 5 V	x	x	–	x	x	x
	0 V to 10 V	x	x	–	x [1]	x	x
Current (4-wire transducer)	0 mA to 20 mA	x	x	–	x	x	x
	4 mA to 20 mA	x	x	x	x	x	x
	±20 mA	x	x	-	x	x	x
Current (2-wire transducer)	0 mA to 20 mA	x [1 2]	x	–	x	x	x
	4 mA to 20 mA	x	x	x	x	x	x

x = property is allowed, – = property is **not allowed**, * = property is not relevant

1 only possible as of firmware V2.0

2 The diagnostics Underflow can always be enabled for "Current (2-wire transducer) 0..20 mA", but it is only reported when a complete underflow range is created by the measuring range adjustment.

Configuring with a PROFIBUS GSD file

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

Table A- 1 Dependencies of the measurement type and measuring range PB

Measurement type	Measuring range	Diagnostics						Hardware interrupts
		Underflow	Overflow	Wire break	Load voltage L+	Short-circuit to ground	Smoothing / interference frequency suppression	
Deactivated	*	*	*	*	*	*	*	*
Voltage	±5 V	x	x	–	x	x [1]	x	–
	±10 V	x	x	–	x	x [1]	x	–
	1 V to 5 V	x	x	–	x	x	x	–
	0 V to 10 V	x	x	–	x	x [1]	x	–
Current (4-wire transducer)	0 mA to 20 mA	x	x	–	x	x	x	–
	4 mA to 20 mA	x	x	x	x	x	x	–
	±20 mA	x	x	-	x	x	x	–
Current (2-wire transducer)	0 mA to 20 mA	–	x	–	x	x	x	–
	4 mA to 20 mA	x	x	x	x	x	x	–

x = property is allowed, – = property is **not allowed**, * = property is not relevant

[1] only possible as of firmware V2.0

A.2 Parameter assignment and structure of parameter data record

The data records of the module have an identical structure, regardless of whether you configure the module with PROFIBUS DP or PROFINET IO.

Parameter assignment in the user program

You can reassign the module parameters in RUN. For example, the measuring range of selected channels can be changed in RUN without having an effect on the other channels.

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 that the parameters set in STEP 7 will be 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.

Note

Changing parameter settings in runtime can cause the process values to freeze for the duration of the parameter assignment for the module.

Output parameter STATUS

If errors occur when transferring parameters with the "WRREC" instruction, the module continues operation with the previous parameter assignment. However, the STATUS output parameter contains a corresponding error code.

You will find a description of the "WRREC" instruction and the error codes in the STEP 7 online help.

Structure of data record 128

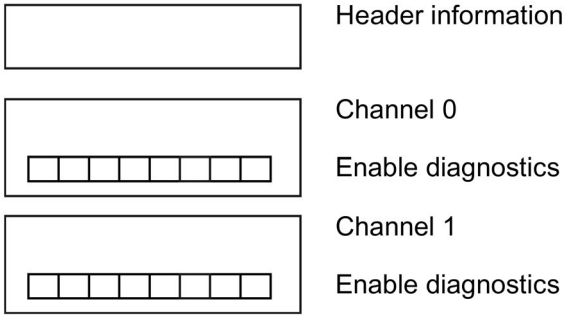


Image A-1 Structure of data record 128

Header information (V1.0)

The figure below shows the structure of the header information (V1.0).

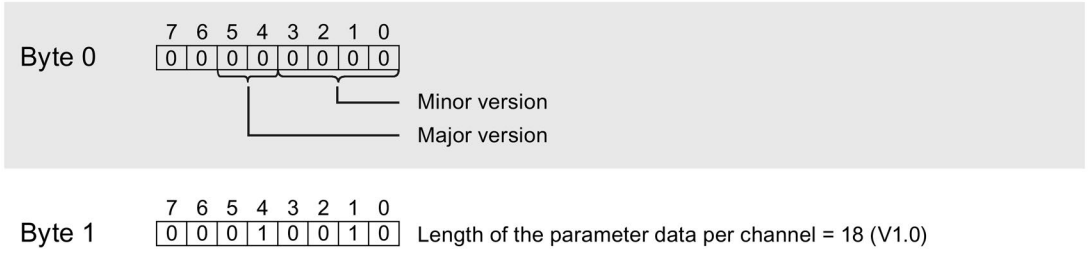


Image A-2 Header information (V1.0)

Header information (V2.0)

The figure below shows the structure of the header information (V2.0).

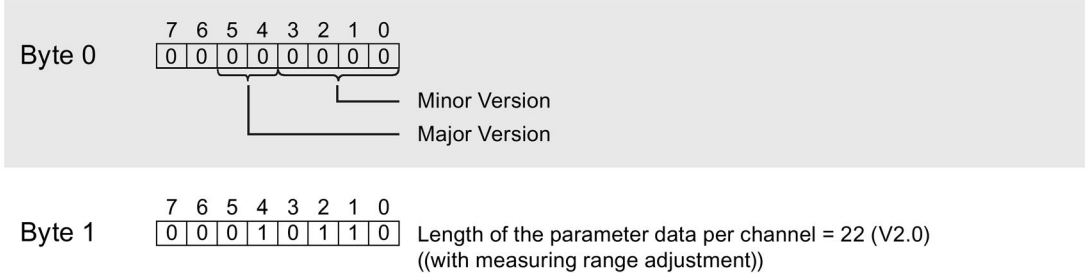


Image A-3 Header information (V2.0)

Header information (V2.0 SCALE)

The figure below shows the structure of the header information.

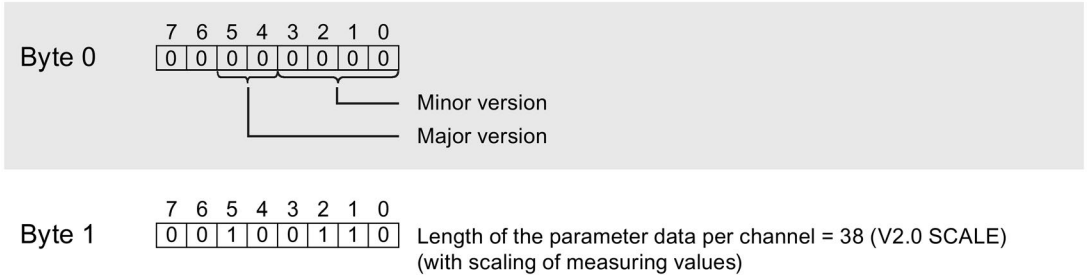


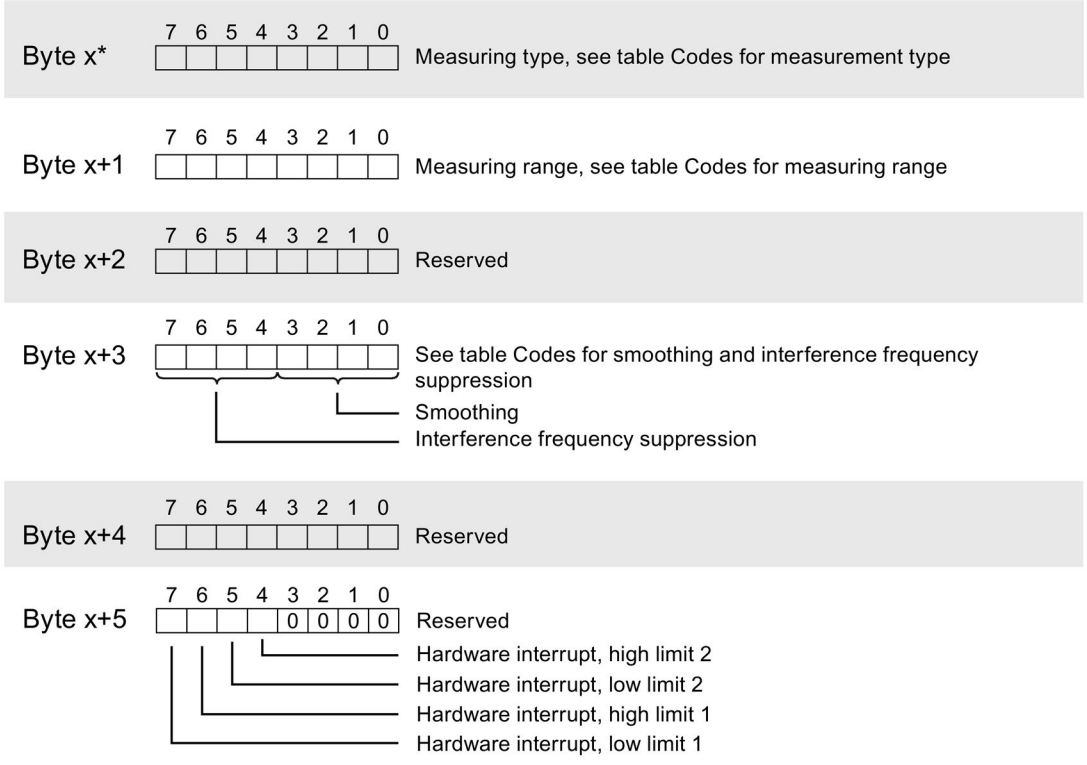
Image A-4 Header information (V2.0 SCALE)

Parameter (V1.0)

The following figure shows the structure of the parameters for channels 0 and 1.

You enable a parameter by setting the corresponding bit to "1".

* x = 2 + (channel number x 18); channel number is 0 or 1



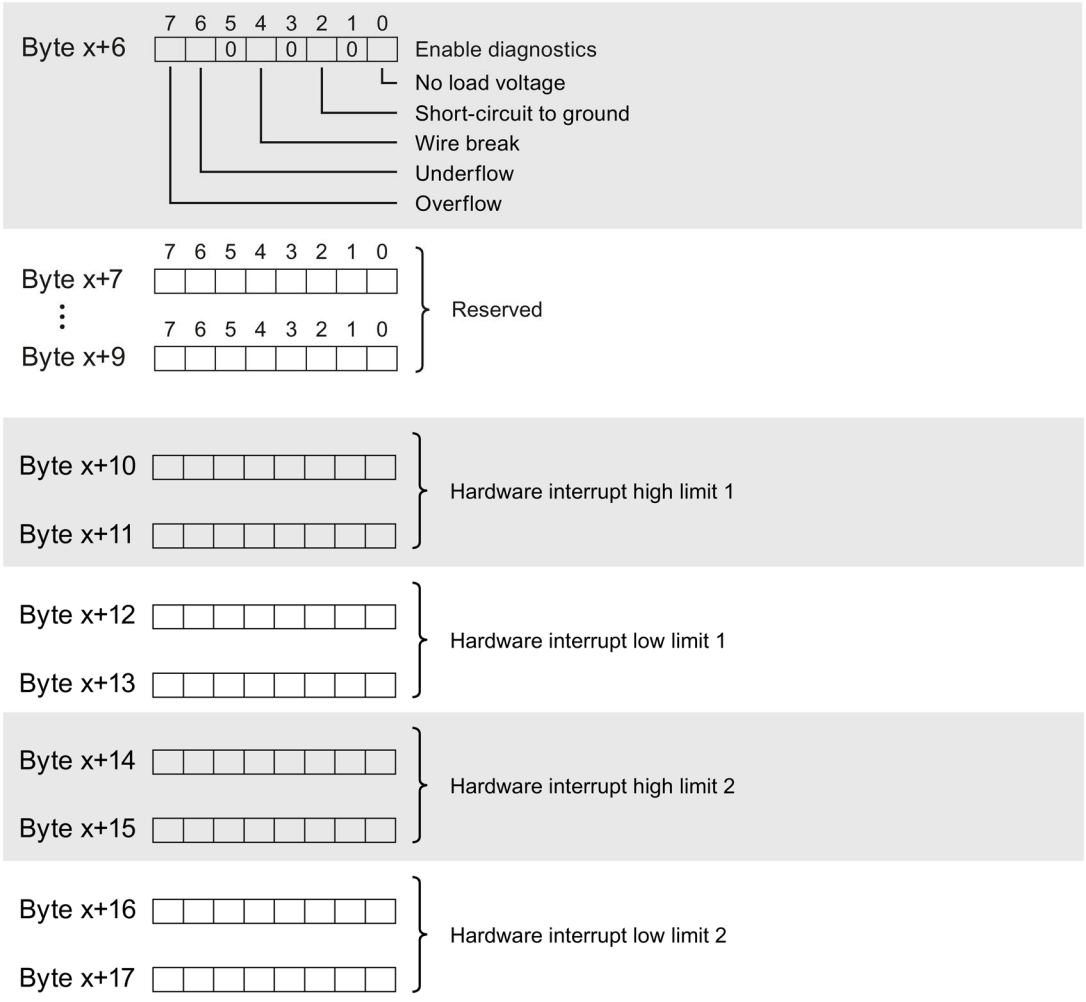


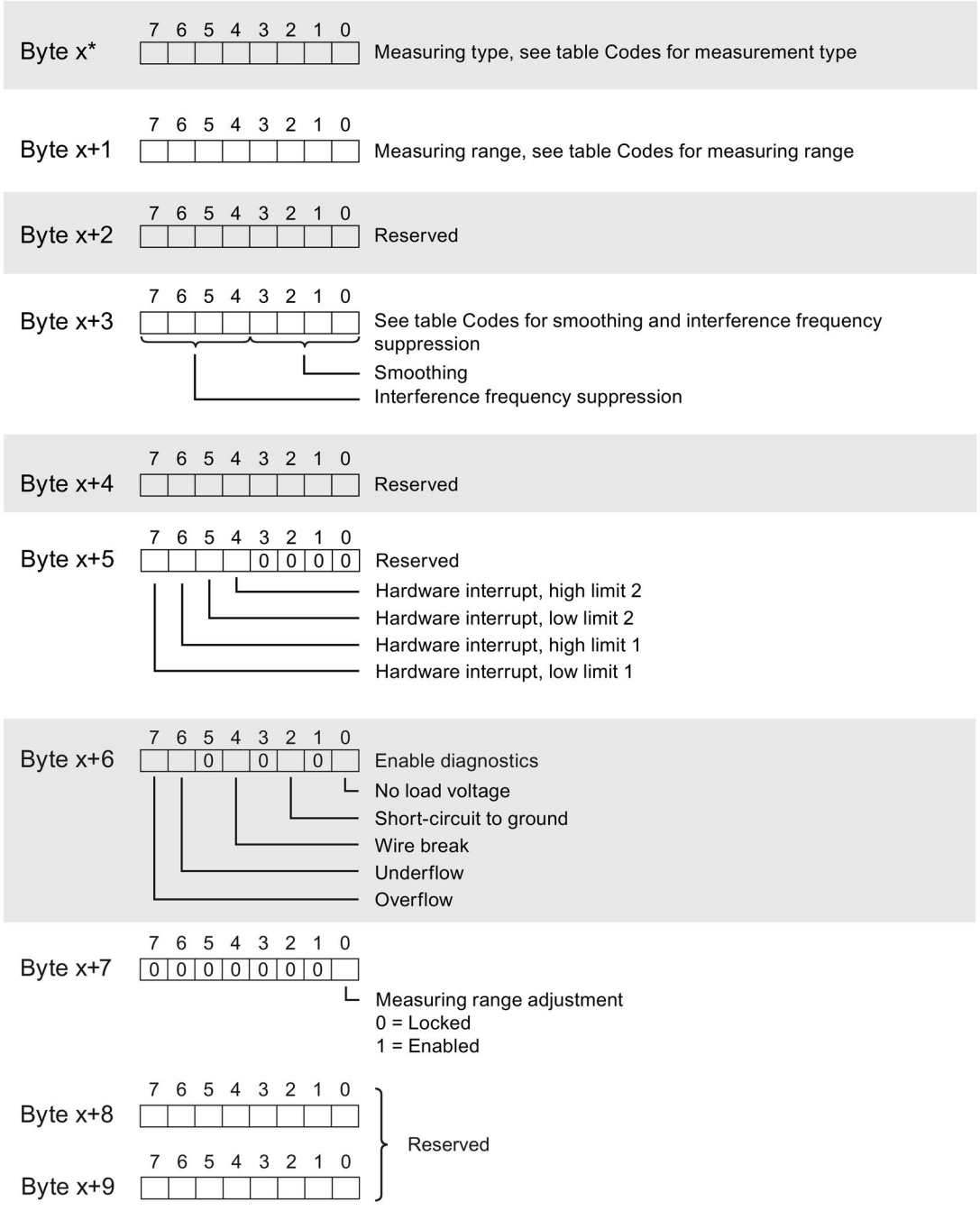
Image A-5 Structure of byte x to x+17 for channel 0 and 1

Parameter (V2.0)

The following figure shows the structure of the parameters for channels 0 and 1.

You enable a parameter by setting the corresponding bit to "1".

* x = 2 + (channel number x 22); channel number is 0 or 1



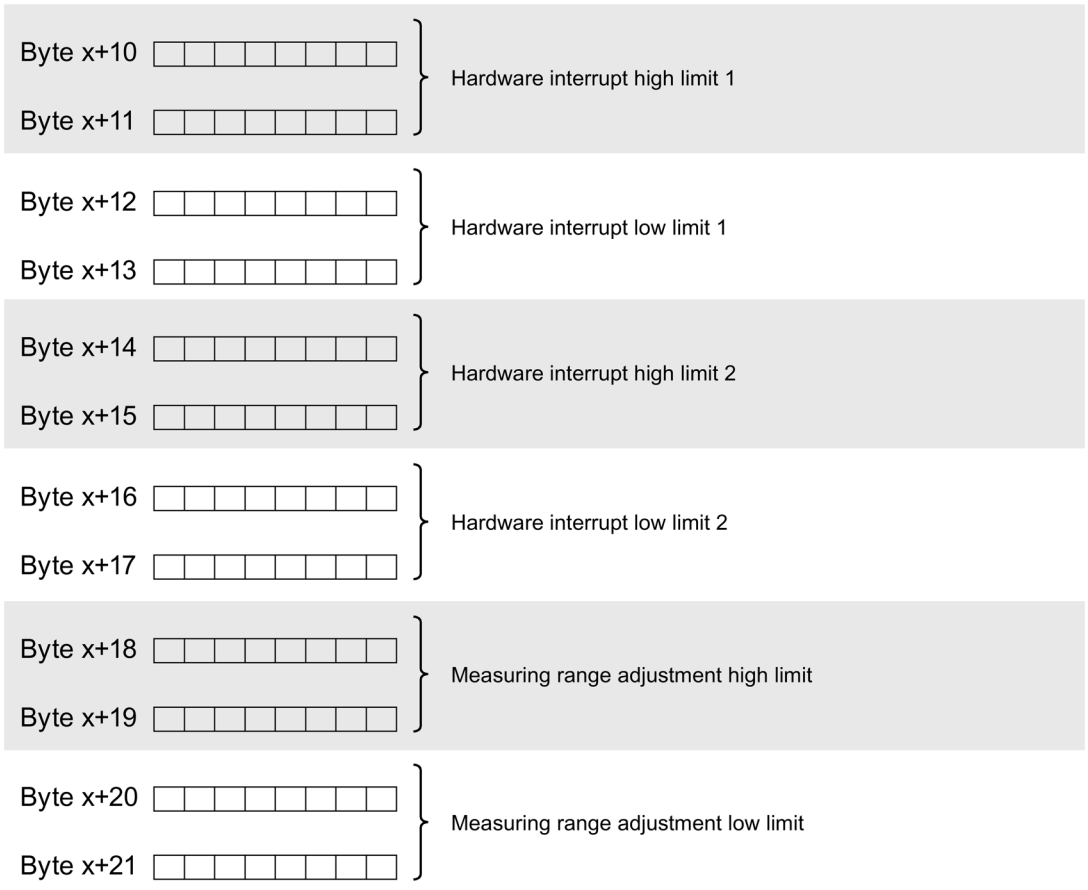


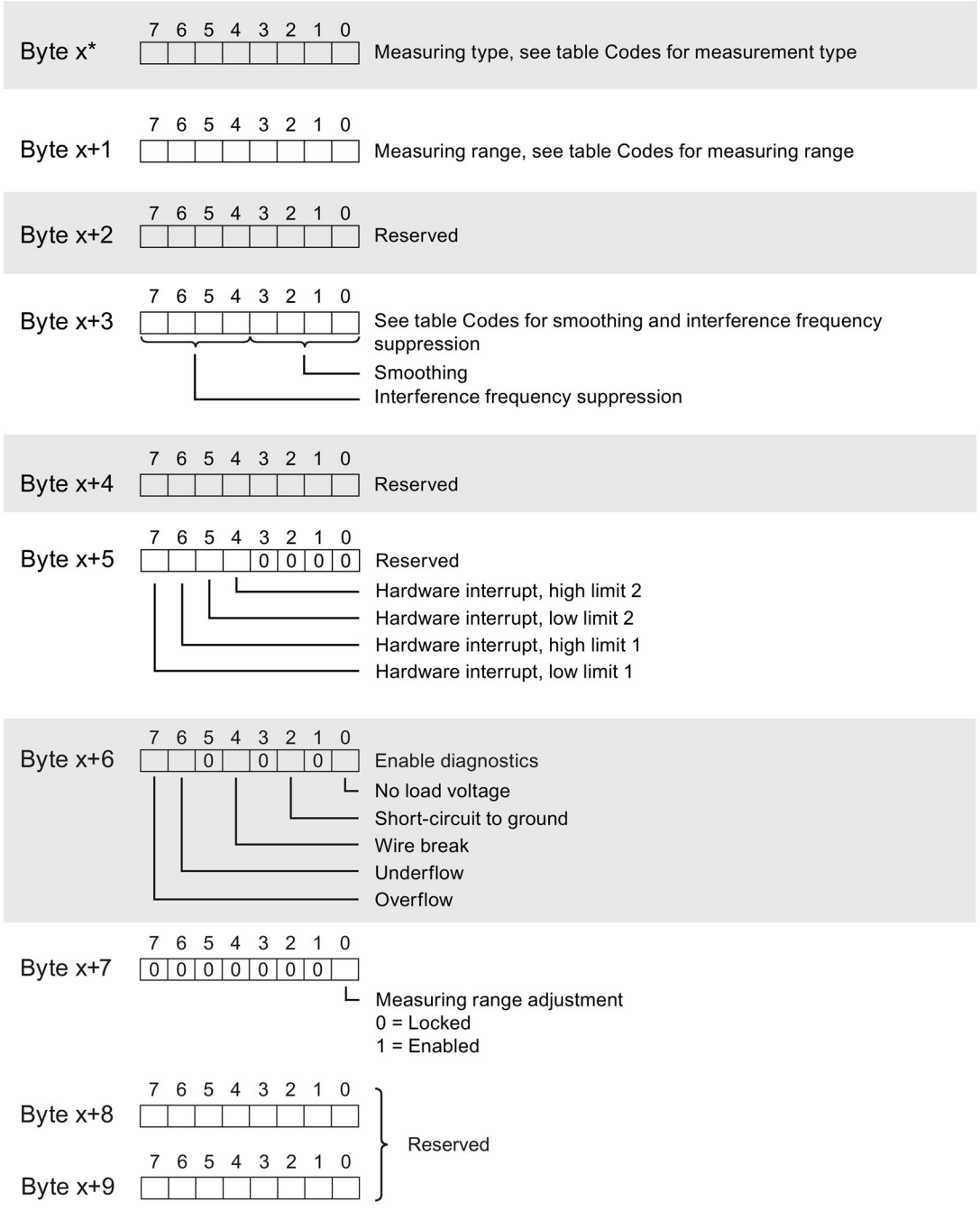
Image A-6 Structure of bytes x to x+21 for channels 0 and 1

Parameter (V2.0 SCALE)

The following figure shows the structure of the parameters for channels 0 and 1.

You enable a parameter by setting the corresponding bit to "1".

* x = 2 + (channel number x 38); channel number is 0 or 1



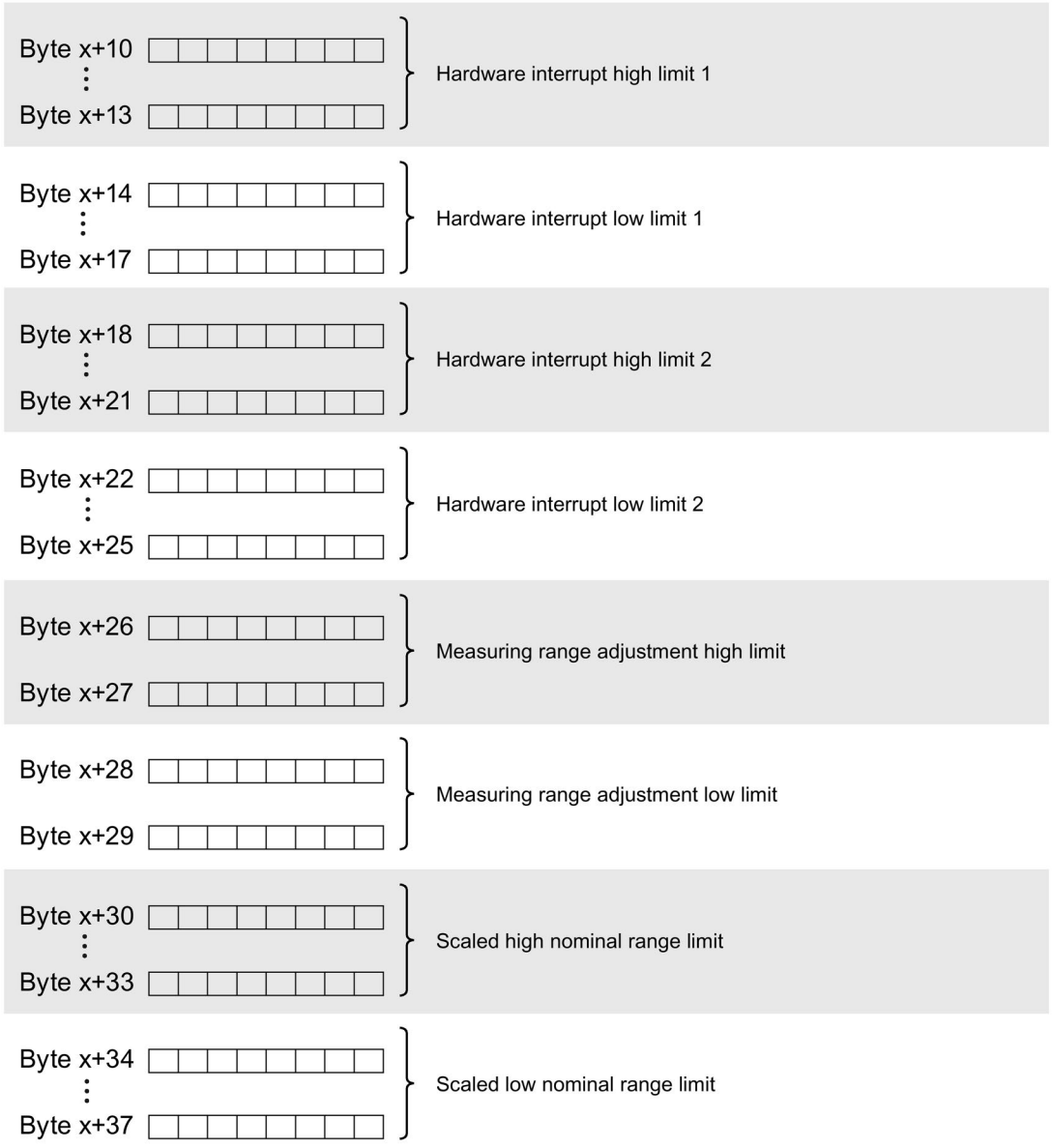


Image A-7 Structure of bytes x to x+37 for channels 0 and 1

Codes for measurement types

The following table contains all the measurement types of the analog input module with its codes. You must enter these codes at byte x (see previous figure).

Table A- 2 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 all codes for the measuring ranges of the analog input module. You must enter these codes at byte x+1 (see previous figure).

Table A- 3 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	
0 mA to 20 mA	0000 0010
4 mA to 20 mA	0000 0011
±20 mA	0000 0100

Codes for smoothing and interference frequency suppression

The following table contains all coding for smoothing and interference frequency suppression. You must enter these codes at byte x (see previous figure).

Table A- 4 Codes for smoothing

Smoothing	Code
None	0000
2 times	0100
4 times	0001
8 times	0101
16 times	0010
32 times	0011

Table A- 5 Codes for interference frequency suppression

Interference frequency suppression	Code
16.6 Hz (67.5 ms)	0100
50 Hz (22.5 ms)	0010
60 Hz (18.75 ms)	0001
300 Hz (10 ms)	0101
600 Hz (5 ms)	0110
1.2 kHz (2.5 ms)	0111
2.4 kHz (1.25 ms)	1000
4.8 kHz (0.625 ms)	1001

Error transmitting the data record

The module always checks all values of the transmitted data record. The module applies the values from the data record only when all values have been transmitted without errors.

The WRREC instruction for writing data records returns the appropriate error codes if there are errors in the STATUS parameter.

The following table shows the module-specific error codes and their meaning for parameter data record 128.

Error code in the STATUS parameter (hexadecimal)				Meaning	Solution
Byte 0	Byte 1	Byte 2	Byte 3		
DF	80	B0	xx	Number of the data record unknown	Enter valid number for data record.
DF	80	B1	xx	Length of the data record incorrect	Enter valid value for data record length.
DF	80	B2	xx	Slot invalid or unavailable	• Check the station to determine if the module is plugged in or pulled. • Check assigned values for the parameters of the WREC instruction.
DF	80	I0	xx	Incorrect version or error in the header information	Correct the version, length and number of parameter blocks.
DF	80	I1	xx	Parameter error	Check the parameters of the module.

Representation of analog values

B

This section shows the analog values for all measuring ranges supported by the analog input module AI 2xU/I 2-/4wire HF.

Measured value resolution

The digitized analog value is the same for input and output values at the same nominal range. The analog values are represented as a fixed point number in the two's complement.

The resolutions 15 and 16 bits including sign are displayed. Each analog value is entered in the ACCU left-justified. The bits marked with "x" are set to "0".

Table B- 1 Resolution of the analog values

Resolution in bits	Values		Analog value	
	Decimal	Hexadecimal	High byte	Low byte
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

The tables below set out the digitized representation of the input ranges by 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.