AMIKON TECHNICAL DOCUMENTATION

Installation Instructions

Siemens 6ES7134-6TD00-0CA1

ET 200SP HART Input Module

INPUTS	RANGE	HART	BASEUNIT
4 current	**4-20 mA**	**Revisions 5-7**	**A0 / A1**

For qualified personnel only. Isolate the equipment and follow the complete manufacturer and site safety procedures. This reference does not replace the approved project design or the full installation manual.

01 PREPARATION AND WIRING CHECKS

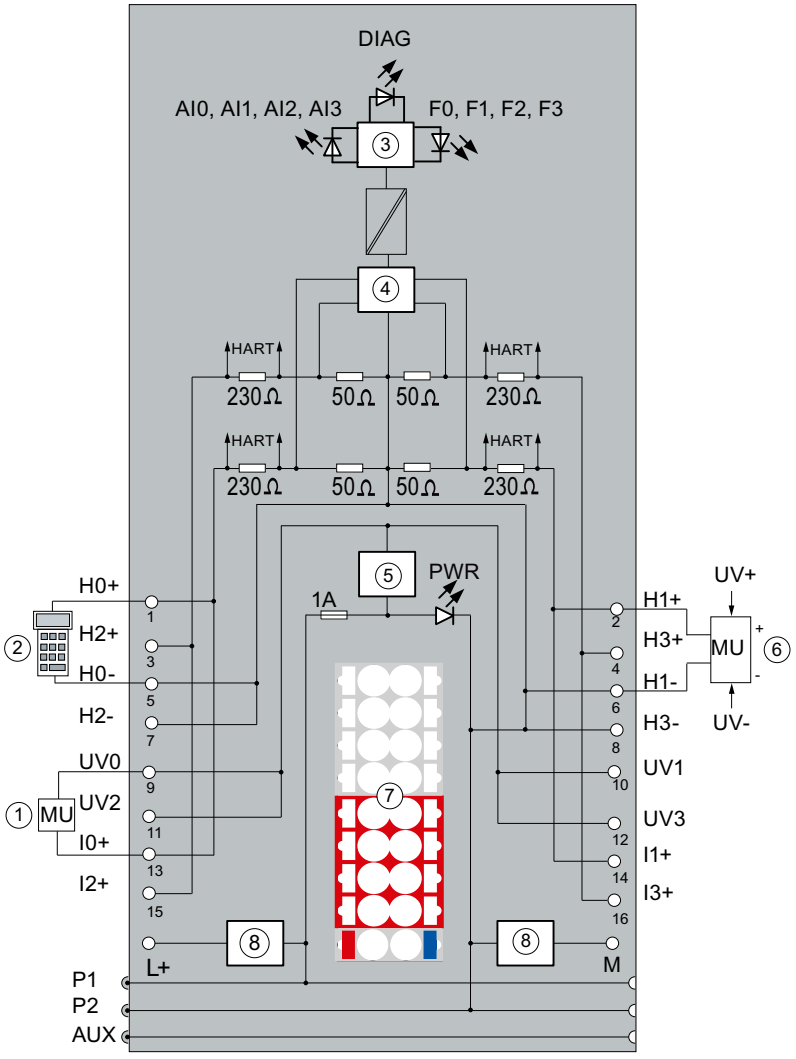
- Match A0/A1 BaseUnit, potential-group supply and the CC03 terminal assignment.
- Follow the exact transmitter and HART test-terminal drawing; do not assume channel isolation.
- Check interface and controller restrictions before choosing QI or HART-variable configuration.
- Set the correct 4-20 mA mode, wire-break threshold and HART mapping for each loop.
- Verify loop current, QI, HART quality and device status before handing the measurement back to control logic.

02 ORIGINAL WIRING REFERENCE

Original source PDF pages 14, 2, 3, 9, 13, 22, 23, 24, 25, 27, 28, 29, 30, 31, 32, 33, 34, 35, 37, 38, 39, 40, 41. The following pages retain the original Siemens drawings and printed page numbers.

Siemens original documentation and product reference

General terminal assignment



Block diagram AI 4xI 2-wire 4...20mA HART

①	Connection of a 2-wire transducer, at channel 0 in this case
②	Optional connection of an external hand-held (secondary master) to the HART test connection terminal (at channel 0 in this case)
③	Backplane bus connection
④	Analog-digital converter (ADC)
⑤	Current limitation
⑥	Non-isolated 4-wire connection to the HART test connection terminal (at channel 1 in this case)
⑦	Color-coded label CC03 (optional)
⑧	Filter circuit supply voltage (only available on light-colored BaseUnit)
Hn+	HART signal "+", channel n
Hn-	HART signal "-", channel n
UVn	Supply voltage channel n
In+	Input signal "+" channel n
L+	24 V DC (infeed only with light-colored BaseUnit)
M	Ground
P1,P2, AUX	Internal self-assembling voltage buses Connection to the left (dark-colored BaseUnit) Connection to the right interrupted (light-colored BaseUnit)
DIAG	Diagnostics LED (green, red)
AI0 to AI3	Channel status LED (green)
F0 to F3	Channel fault LED (red)
PWR	Power LED (green)

Supply voltage L+/M

Connect supply voltage (24V DC) to terminals L+ and M. An internal protective circuit protects the analog module from reverse polarity. The analog module monitors the connection of the supply voltage.

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.

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indicates that death or severe personal injury **will** result if proper precautions are not taken.

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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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Preface

Validity of the documentation

This manual describes the analog input module AI 4xI 2-wire 4...20mA HART, article number 6ES7134-6TD00-0CA1.

It supplements the system manual ET 200SP distributed I/O system (http://support.automation.siemens.com/WW/view/en/58649293). Functions that generally relate to the system are described in this manual.

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

Conventions

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 and 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, systems, machines and networks.

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Documentation guide

1

Introduction

The documentation of the SIMATIC products has a modular structure and covers diverse topics relating to your automation system.

The complete documentation for the ET 200SP system consists of the system manual, function manuals, and manuals for the individual devices.

The STEP 7 information system (online help) also supports you in configuring and programming your automation system.

Overview of documentation for analog input module AI 4xI 2-wire 4...20mA HART

The following table lists further documentation that you will need when using analog input module AI 4xI 2-wire 4...20mA HART.

Table 1-1 Documentation

Topic	Documentation	Most important contents
System description	System Manual ET 200SP distributed I/O system (http://support.automation.siemens.com/WW/view/en/58649293)	• Application planning • Installation • Connecting • Commissioning
Analog value processing	Function Manual Analog value processing (http://support.automation.siemens.com/WW/view/en/67989094)	• Basics of analog technology (wiring, processing, assembly system) • Description/explanation of meaning, e.g., conversion and cycle times, basic error limits, operational limits
System diagnostics	Function manual Diagnostics (http://support.automation.siemens.com/WW/view/en/59192926)	• Overview • Hardware/software diagnostic evaluation
BaseUnits	Manual ET 200SP BaseUnits (http://support.automation.siemens.com/WW/view/en/59753521)	Technical specifications

SIMATIC manuals

The latest manuals for SIMATIC products are available for download free of charge from the Internet (http://www.siemens.com/simatic-tech-doku-portal).

Wiring up

3

3.1 Connection and block diagram

The AI 4xI 2-wire 4...20mA HART analog module can be used with all A0 or A1-type BaseUnits.

You connect the transducers to the BaseUnit of the analog module. The infeed of the supply voltage at the light BaseUnit of the associated potential group supplies the module and the transducers connected to the encoder supply voltages.

A new potential group always begins with a light BaseUnit.

BaseUnit

The BaseUnit is not included in the product package of the module and must be ordered separately.

An overview of the BaseUnits that you can use with the analog module can be found in Product information for documentation of the ET 200SP Distributed I/O System (http://support.automation.siemens.com/WW/view/en/73021864)

Information regarding selection of the suitable BaseUnit can be found in system manual ET 200SP distributed I/O system (http://support.automation.siemens.com/WW/view/en/58649293) and in the manual ET 200SP BaseUnits (http://support.automation.siemens.com/WW/view/en/59753521).

Information regarding wiring of the BaseUnit, creating the cable shield, etc., can be found in system manual ET 200SP distributed I/O system (http://support.automation.siemens.com/WW/view/en/58649293) in the section "Connecting".

Note

The first BaseUnit of a station must be a light BaseUnit. Also keep this in mind during the configuration.

4.3 HART communication interface

Data records

The HART commands are sent as so-called external HART requests from the client (e.g., PDM or the STEP 7 user program) to the connected field device via data records. The response of the field device is made available again in the system via data records.

HART communication may only be handled by one client (e.g., PDM) per channel. If a channel is handled by several clients, the response made available by the module cannot be allocated to one client with certainty. The AI 4xI 2-wire 4...20mA HART analog module does not support client management.

Each client/channel is allocated fixed data records:

Table 4-5 Structure of the data records

Channel	Data record number	
	Request to the field device	Response from the field device
0	80	81
1	82	83
2	84	85
3	86	87

The corresponding data records are transferred to the module with the "WRREC" instruction and read by the module with the "RDREC" instruction.

Errors during the transfer are indicated at output parameter STATUS.

Errors during interpretation of the request data record are signaled in the corresponding response data record. The faulty request can be read back again using the request data record.

Rules

- After having written a request data record, a client must read the response data record before it may write another request data record.
- The client can evaluate the "processing status" in the response data record: If the "processing status" indicates "successful" or "error," the response data record contains current response data or error displays.
- The response data record must always be read completely because the analog module may modify the data record after the initial reading with "successful" or "error" status.
  If the processing status in the response data record indicates "successful" or "error", the data record contains current response data or error displays.
- The client may only write a request data record to the module again when it has read the response to the previously written request data record via the corresponding response data record. Otherwise, the response from the module is overwritten.
- The STATUS component in the response frame (HART device status in the response data) provides information on whether errors have occurred and, if so, which errors.

Each request is stored on a channel-specific basis, and the corresponding request data record is disabled. Another writing of the same request data record is thus not possible and is

acknowledged with BUSY.
The disable of the request data record is reset after the termination or completion of the requested HART command.

SHC sequence

If a HART command is sent to the module with a set SHC bit, then this channel is reserved for HART commands for 2 seconds. This means that no more internal HART commands are sent to the field device with this channel.

Each time a HART command with a set SHC bit is sent, the module reserves this channel again for another 2 seconds for HART commands. If a HART command without a set SHC bit is detected for this channel, or if no further command occurs for this channel within 2 seconds after the previous HART command, then command 3 or 9 for reading the HART variables is cyclically sent to the field device for this channel.

4.4 HART variables

Introduction

Numerous HART field devices make available additional measured quantities (e.g. sensor temperature).

A maximum of four HART variables supported by the connected field device can be cyclically read per channel with activated HART functionality. The HART variables are read automatically with HART command 3 (for field devices with HART rev. 5 and 6) or with command 9 (for field devices with HART rev. 7 or later).

These four HART variables per channel are always stored in HART variable data record 121 and can be read at any time. See section HART variable data record (Page 59).

In addition, a maximum of 4 HART variables can be configured directly in the input address space of the AI 4xI 2-wire 4…20mA HART analog module. The HART variables are assigned to a channel in the properties dialog of the module. The parameter assignment uses parameter data record 140, see section AUTOHOTSPOT. This makes it easy for you to process measured values directly from the field device as input data in the automation device.

Address assignment

Provided you map HART variables in the input address space of the module by means of the configuration tool or selection of the appropriate configuration, 20 bytes are always additionally allocated for the HART variables.

Configuration of HART variables

You can configure up to 4 HART variables for each channel

- PV (Primary Variable)
- SV (Secondary Variable)

- TV (Tertiary Variable)
- QV (Quaternary)

When HART mode is enabled, the AI 4xI 2-wire 4...20mA HART analog module autonomously and cyclically reads the variables supplied by the connected field devices and makes them available in the input address space according to the configuration.

Each HART variable consists of a 4-byte value and a quality code byte.

Quality code

The quality code describes the process status of the corresponding HART variable.

Basic structure of the quality code

Bit	7....6	5....2	1...0
	Quality 0 0: Bad 0 1: Uncertain 1 0: Good 1 1: Good	Sub-status Coded according to "PROFIBUS PA Profile for Process Control Devices"	Limits 0 0: OK 0 1: Low limit 1 0: High limit 1 1: Constant

The quality codes generated by the AI 4xI 2-wire 4...20mA HART analog module are based on the HART Revision of the utilized field device.

Field devices with HART Revision 5 and 6

The quality code is formed exclusively from the 1st and 2nd Status byte (HART device status) of the response frames (HART command 3).

Quality code	Meaning (process status)	
80_H	Value is okay	Applies even when the following bits are set in the 2nd status byte of the HART response frame: • Configuration changed • Startup (cold start) • Fixed analog output current setting
78_H	Value is uncertain	Applies even when the following bits are set in the 2nd status byte of the HART response frame: • Additional status information available • Analog output current saturated • Secondary variable outside the limits • Primary variable outside the range
84_H	Response code RC8: Update error	
24_H	Response code RC16: Access restricted	Request from field device refused

Quality code	Meaning (process status)	
23_H	Communication error or HART variable not present in the field device	
37_H	Initialization value from analog module	After module startup
00_H	Initialization value from S7 system	

Field devices with HART Revision 7 or higher

The quality code is formed from the 1st status byte (HART device status) and the "Device variable status" (DVS) of the response frames (HART command 9).

Quality code	Meaning (process status)	
80_H	Value is okay	
89_H	"Good" with "Low limit"	Process status, formed from the "Device variable status" (DVS) of the response frames with corresponding limits (see above).
$8A_H$	"Good" with "High limit"	
$28_{H...}2B_H$	"Bad"	
$68_{H...}6B_H$	"Poor accuracy"	
$78_{H...}7B_H$	"Manual" or "Fixed" (manually controlled or fixed value)	
$88_{H...}8B_H$	"More device variable state available" (additional status information available)	
84_H	Response code RC8: Update error	
24_H	Response code RC16: Access restricted	Request from field device refused
23_H	Communication error or HART variable not present in the field device	
37_H	Initialization value from analog module	After module startup
40_H	Read alternatively via command 3	
00_H	Initialization value from S7 system	

Parameters

5

5.1 Parameters of the AI 4xI 2-wire 4...20mA HART

You specify how the AI 4xI 2-wire 4...20mA HART analog module operates using parameters.

The parameters are subdivided into:

- Channel or technology parameters (data record 128)
  With PROFIBUS DP GSD configuration, there is a reduced configuration via the startup configuration (Prm frame).
- Parameters that define the display of HART variables in the address space of the module; HART mapping parameters (data record 140)

With configuration in the user program, the parameters are transferred to the modules via data records with the "WRREC" instruction; see section Parameter assignment and structure of the channel/technology parameters (Page 53).

5.1.1 Channel/technology parameters

Parameters of the AI 4xI 2-/4-wire ST

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

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

Table 5-1 Configurable channel/technology parameters and their default settings

Parameter	Value range	Default	Configuration in RUN	Effective range 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	Module [2]
Diagnostics encoder supply	• Disable • Enable	Disable	Yes	Channel	Module [2]
Diagnostics overflow	• Disable • Enable	Disable	Yes	Channel	Module [2]
Diagnostics underflow	• Disable • Enable	Disable	Yes	Channel	Module [2]

Parameter	Value range	Default	Configuration in RUN	Effective range with configuration software, e.g. STEP 7 (TIA Portal)	
				GSD file PROFINET IO	GSD file PROFIBUS DP
Diagnostics wire break	• Disable • Enable	Disable	Yes	Channel	Module [2]
Diagnostics HART	• Disable • Enable	Disable	Yes	Channel	Module [2]
Measuring type/range	• Disabled • Current (2-wire transducer) 4..20 mA • Current (2-wire transducer) 4..20 mA HART	Current (2-wire transducer) 4..20 mA HART	Yes	Channel	Channel
Smoothing	• none • 4-fold (weak) • 16-fold (medium) • 32-fold (strong)	none	Yes	Channel	Channel
Interference frequency suppression	• 60 Hz (integration time 16.6 ms) • 50 Hz [1] (integration time 20 ms) • 10 Hz (integration time 100 ms)	50 Hz	Yes	Channel	Module [2]
Current limit for wire break diagnostics	• 1.185 mA • 3.6 mA	1.185 mA	Yes	Channel	Cannot be changed [2]
Number of HART preamble bytes	5...20	5	Yes	Channel	Cannot be changed [2]
Number of HART repetitions	0...255	5	Yes	Channel	Cannot be changed [2]
Potential group	• Use potential group of the left module • Allow new potential group	Use potential group of the left module	No	Module	Module

[1] Interference frequency suppression: Noise at 400 Hz is automatically included in the filtering at 50 Hz.

[2] Because the PROFIBUS GSD configuration limits the number of parameters to a maximum of 244 bytes per ET 200SP station, the options for parameter assignment are limited. In this case, the parameter assignment uses data record 245. If required, you can assign this parameter using data record 128 as described in the "GSD File PROFINET IO" column (see table above).

Note

Unused channels

"Disable" unused channels in the parameter assignment to improve the cycle time of the module.

A disabled channel always supplies the analog value $7FFF_H$.

See also

Parameter assignment and structure of the channel/technology parameters (Page 53)

5.1.2 Explanation of the channel/technology parameters

Diagnostics no supply voltage L+

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

Diagnostics encoder supply

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.

The short-circuit and underflow diagnostics can be enabled simultaneously. If both diagnostic events occur simultaneously, the short-circuit diagnostics information 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 when the module has no current flow at the input or the current flow at the input is below the configured wire break limit.

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

Diagnostics HART

Enabling of the diagnostics of the HART frame-specific monitoring and the status information supplied by the connected field device in the HART frame (HART device status).

Current limit for wire break diagnostics

You use this to specify the current limit for detecting wire breaks. If the current falls below the configured wire break limit, the measured value is declared invalid and, if wire break diagnostics is enabled, corresponding diagnostics information is generated. When value status is configured, the analog value is marked as invalid.

With a wire break limit of 3.6 mA, the measured value becomes invalid when the current falls below 3.6 mA and is marked as valid again when it rises above 3.8 mA.

There is no hysteresis for a wire break limit of 1.185 mA.

Measuring type/range

The AI 4xI 2-wire 4...20mA HART analog input module has the following measuring ranges:

Table 5-2 Measuring ranges

Measuring type	Measuring range	Resolution
Disabled	-	-
Current (2-wire transducer)	4 to 20 mA	15 bits + sign
Current (2-wire transducer)	4 to 20 mA HART	15 bits + sign

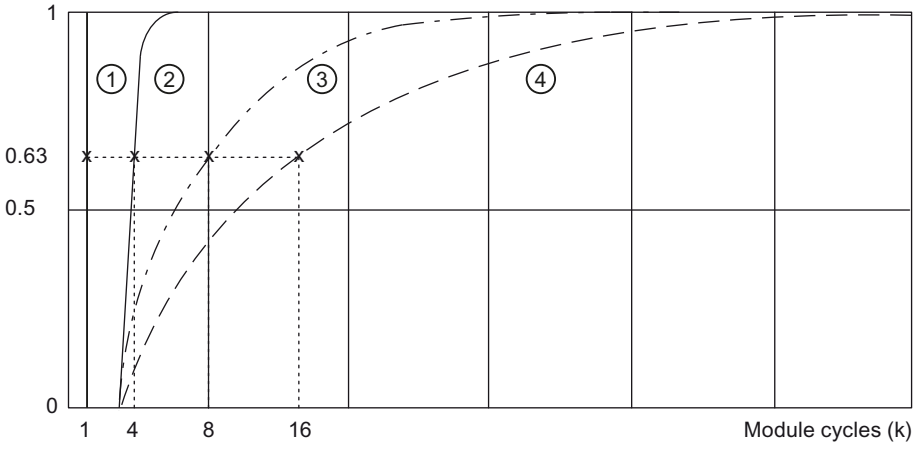
An overview of the measuring range as well as overflow, overrange, etc., can be found in the section Analog value representation (Page 67) and in Analog Value Processing function manual.

Smoothing

The individual measured values are smoothed by filtering. Smoothing can be set in 4 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)

Figure 5-1 Smoothing of the analog value

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 supply system may interfere with the measured value, in particular in low voltage ranges. .

Number of HART preamble bytes

Specifies the number of preamble bytes that the module prefixes to each HART frame to be sent (FF_H). These bytes are used for synchronizing the frames.

Number of HART repetitions

Specifies the number of HART frame repetitions. If the analog module receives no response or receives a response with error to a HART frame sent to the field device, the frame is accordingly repeated, i.e., resent to the field device.

Because HART communication of the individual channels uses multiplex operation, faulty HART frames affect the other channels when the number of HART repetitions is high. In other words, the other channels are processed less frequently.

Potential group

Specifies that a BaseUnit with supply voltage infeed is located in this slot (see system manual ET 200SP Distributed I/O System (http://support.automation.siemens.com/WW/view/en/58649293)).

See also

Parameters of the AI 4xI 2-wire 4...20mA HART (Page 27)

5.1.3 HART mapping parameters

The HART mapping parameters allow a maximum of 4 HART variables to be configured (mapped) in the address space of the module.

Each HART variable occupies 5 bytes of input data. As soon as you configure (map) at least one HART variable in the input address space, the addresses for all four variables are occupied (20 bytes).

With PROFIBUS DP GSD configuration with HART variables, the HART variables cannot be directly configured. The four secondary variables are supplied in ascending channel order in the address space of the module.
When required, this can be changed using data record 140; see section AUTOHOTSPOT.

Parameters

Table 5-3 Configurable HART mapping parameters

Parameter		Value range	Default	Configuration in RUN	With GSD file PROFIBUS DP
Variable 0	Channel	0...3	0	Yes	0
	Type	• Non / Cir • Primary • Secondary • Tertiary • Quartenary	Non / Cir	Yes	Secondary
Variable 1	Channel	0...3	0	Yes	1
	Type	• Non / Cir • Primary • Secondary • Tertiary • Quartenary	Non / Cir	Yes	Secondary
Variable 2	Channel	0...3	0	Yes	2
	Type	• Non / Cir • Primary • Secondary • Tertiary • Quartenary	Non / Cir	Yes	Secondary
Variable 3	Channel	0...3	0	Yes	3
	Type	• Non / Cir • Primary • Secondary • Tertiary • Quartenary	Non / Cir	Yes	Secondary

Configuring/address space

6

6.1 Configuring

You configure the analog module AI 4xI 2-wire 4...20mA HART

- In the TIA Portal V13.0.1 or higher
- With STEP 7 V5.5 + SP4 or higher (HSP0263)
- Using GSD/GSDML

The GSD files for the ET 200SP Distributed I/O System can be downloaded from the Internet:

- GSDML (http://support.automation.siemens.com/WW/view/en/57138621)
- GSD (http://support.automation.siemens.com/WW/view/en/ 73016883)

Configuration options

The following configurations are possible:

- Without value status and without HART variables ("AI 4xI 2-wire 4...20 mA HART")
- Without value status, with HART variables ("AI 4xI 2-wire 4...20 mA HART, 4 variables")
- With value status and without HART variables ("AI 4xI 2-wire 4...20 mA HART, QI")
- With value status, with HART variables ("AI 4xI 2-wire 4...20 mA HART, 4 variables, QI")

With GSD/GSDML configuration, you must select one of the possible configurations directly.

The configuration for STEP 7 (TIA Portal or HW Config) is made indirectly via the parameters.

Restrictions

- Value status is not available for a PROFIBUS DP station.
- Downstream of a Standard IM (V1.1), the module can be operated only in the "Without value status and without HART variables" configuration.
- TIA Portal:
  - The module behind a standard IM (V1.1) is not available.
  - TIA Portal as of V14.0.1
    The module can be centrally configured on the following CPU:
    - CPU 1510SP-1 (as of V2.1)
    - CPU 1512SP-1 PN (as of V2.1)
  - TIA Portal as of V15.0.0
    The module can be configured as an open controller.
  - The module cannot be used behind fail-safe controllers.

6.2 Address space

The following figure shows the allocation of the address space of the AI 4xI 2-wire 4...20mA HART module for a configuration with value status (Quality Information, QI) and with HART variables.

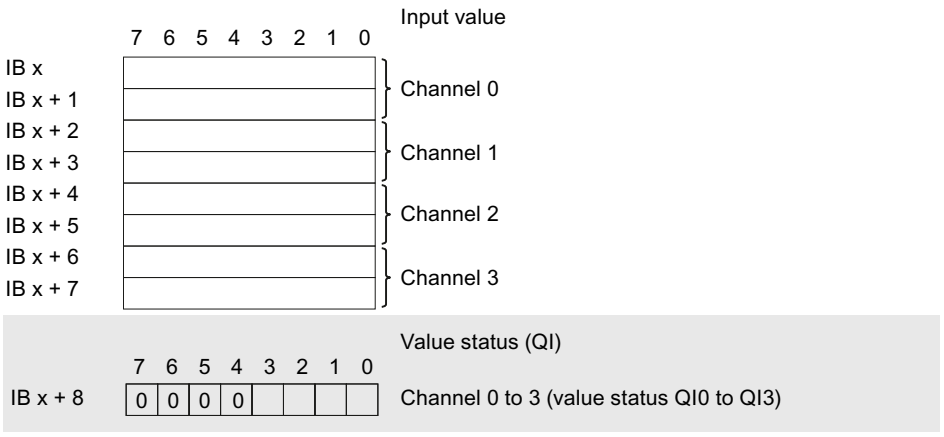
The addresses for the value status are only available if the value status has been enabled or the corresponding configuration has been configured from the GSDML.

The addresses for the HART variables are only available if configuration/parameter assignment of the HART variables has been carried out or the corresponding configuration has been configured from the GSD/GSDML.

If the HART variables are configured and there is no value status configuration or parameter assignment, the HART variables begin directly after the analog values, thus starting from IB x + 8.

Table 6-1 Address space of analog input module AI 4xI 2-wire 4...20mA HART

Assignment in the process image input (PII)



IB x+9 .... IB x+12	Value	Configured HART variable 0
IB x+13	Quality code	
IB x+14 .... IB x+17	Value	Configured HART variable 1
IB x+18	Quality code	
IB x+19 .... IB x+22	Value	Configured HART variable 2
IB x+23	Quality code	
IB x+24 .... IB x+27	Value	Configured HART variable 3
IB x+28	Quality code	

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 0 to 3 in this byte are assigned to the corresponding channel. The provide information about the validity of the analog value, namely irrespective of the diagnostics enables.

Bit = 1: There is no error in the analog value or the analog value acquisition of the channel.

Bit = 0: The analog value of the channel cannot be correctly acquired.
The channel is disabled; there is a fault in the wiring or module.

Evaluating HART variables

If you have configured (mapped) HART variables for the analog module, four HART variables with 5 bytes each are stored in the input address space.

Each HART variable consists of a 4-byte real value and a quality code byte. The quality code describes the validity of the value; see section HART variables (Page 23) .

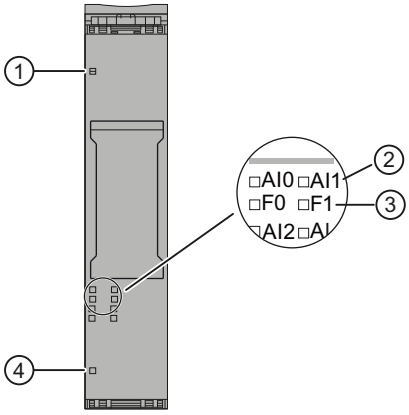
Interrupts/diagnostics alarms

7

7.1 Status and error displays

LED displays

The figure below shows the status and error displays of the AI 4xI 2-wire 4...20mA HART analog input module.



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

Figure 7-1 LED displays

Meaning of the LED displays

The following tables show the meaning of the status and error displays. Measures for dealing with diagnostic alarms can be found in the section Diagnostics alarms (Page 39).

Table 7-1 Status display of the channel status/channel fault LEDs

LEDs		Meaning
Channel status	**Channel fault**	
□ Off	□ Off	Channel disabled or module switched off
■ On	□ Off	Channel enabled and no channel diagnostics present

LEDs		Meaning
Channel status	**Channel fault**	
□ Off	■ On	Channel enabled and channel diagnostics present
■ On	■ On	Channel enabled and **only** HART channel diagnostics present

Table 7-2 DIAG LED error display

DIAG LED	Meaning
□ Off	Backplane bus supply of the ET 200SP is not OK or switched off
☼ Flashes	Module parameters not assigned
■ On	Module parameters assigned and no module diagnostics
☼ Flashes	Module parameters assigned and module diagnostics, at least one error is currently present

Table 7-3 Status display of the PWR LED

PWR LED	Meaning
□ Off	No supply voltage L+
■ On	Supply voltage L+ present

7.2 Interrupts

The AI 4xI 2-wire 4...20mA HART analog input module supports diagnostic interrupts.

Diagnostic interrupt

The module generates a diagnostic interrupt for the following events:

- Channel/component temporarily unavailable
- Short-circuit / Overload of encoder voltage
- Wire break
- Low limit violated

- High limit violated
- Error
- No supply voltage L+
- HART communication error or HART field device error

7.3 Diagnostics alarms

A diagnostic alarm is generated for each detected diagnostic event. The DIAG LED flashes on the module.

There is additionally a channel-specific display of the diagnostics through the corresponding channel fault/channel status LEDs.

The diagnostic alarms can, for example, be read from the diagnostic buffer of the CPU or be displayed in STEP 7 using the Online and Diagnostics view. You can evaluate the error codes with the user program.

Table 7-4 Diagnostic alarms, their meaning and how to deal with them

Diagnostic alarm	Error code	Meaning	Remedy
Channel/component temporarily unavailable	$1F_H$	• Update of the firmware is being performed or has been canceled. The module does not perform any measurements during this time.	
Short-circuit/overload at external encoder supply *	$10E_H$	• Short-circuit of the encoder supply to M • Short-circuit of the input to the encoder supply • Overload of the encoder supply	• Correct the module/encoder tuning
Wire break	6_H	• Impedance of encoder circuit too high. • Wire break between the module and sensor • Channel not connected (open)	• Use a different encoder type or modify the wiring, for example, using cables with a larger cross-section • Connect the cable • Disable diagnostics • Connect the sensor contacts
High limit violated	7_H	• The analog value is above the overrange.	• Correct the module/encoder tuning
Low limit violated	8_H	• The analog value is below the underrange.	• Correct the module/encoder tuning
Error	9_H	• Internal module error occurred.	• Replace module
No supply voltage	11_H	• No or insufficient supply voltage L+	• Check wiring of the supply voltage L + on the BaseUnit • Check BaseUnit type

Diagnostic alarm	Error code	Meaning	Remedy
HART communication error	141_H	• HART field device is not responding • Timing error • HART field device has not understood the sent command (1st status byte)	• Check the process wiring • Correct the parameter assignment • Set output current of ≥4 mA • Increase the number of assigned repetitions
HART primary variable outside range	142_H	• Incorrect parameters in the HART field device • HART field device is at "Primary variable outside the limits" in simulation mode • Incorrect measuring point • Primary variable assigned outside the limits	• Check the parameter assignment of the HART device • Correct the simulation • Check whether the correct transducer is connected
HART output current of the field device saturated	143_H	The output current of the HART field device is saturated: • Incorrect parameters in the HART field device • HART field device is set to a measured value that is too high in simulation mode • Incorrect measuring point	
HART output current of the field device specified	144_H	The output current of the HART field device is set to a fixed value: • Incorrect parameters in the HART field device • HART field device is set to a measured value that is too high in simulation mode • Incorrect measuring point	
HART secondary variable outside the limits	149_H	• Incorrect parameters in the HART field device • HART field device is at "Non-primary variable outside the limits" in simulation mode • Incorrect measuring point • Non-primary variable assigned outside the limits	
HART - more status available	145_H	• The identifier for "Additional status information available" of the HART field device was set in the HART device status (in the 2nd status byte).	• Read status using HART command 48 and eliminate error/cause, if necessary

Diagnostic alarm	Error code	Meaning	Remedy
HART configuration changed (reset again automatically by the module after approximately 1 minute)	146_H	• The identifier for "Parameter reassignment" of the HART field device was set in the HART device status (in the 2nd status byte).	• If you do not want a diagnostic interrupt to be triggered for parameter reassignment, the diagnostic interrupt must not be enabled.
HART malfunction in field device	147_H	• The field device signals a malfunction in the HART device status (in the 2nd status byte)	• Read status using HART command 48 and eliminate error/cause, if necessary • Replace the field device

* Short-circuit of the encoder supply to ground and/or of the input signal to the encoder supply of a channel can have a temporary effect on other channels (duration < 0.5 s). This means the short-circuit diagnostic information can also be signaled on unaffected channels and/or the measured value can be affected temporarily.