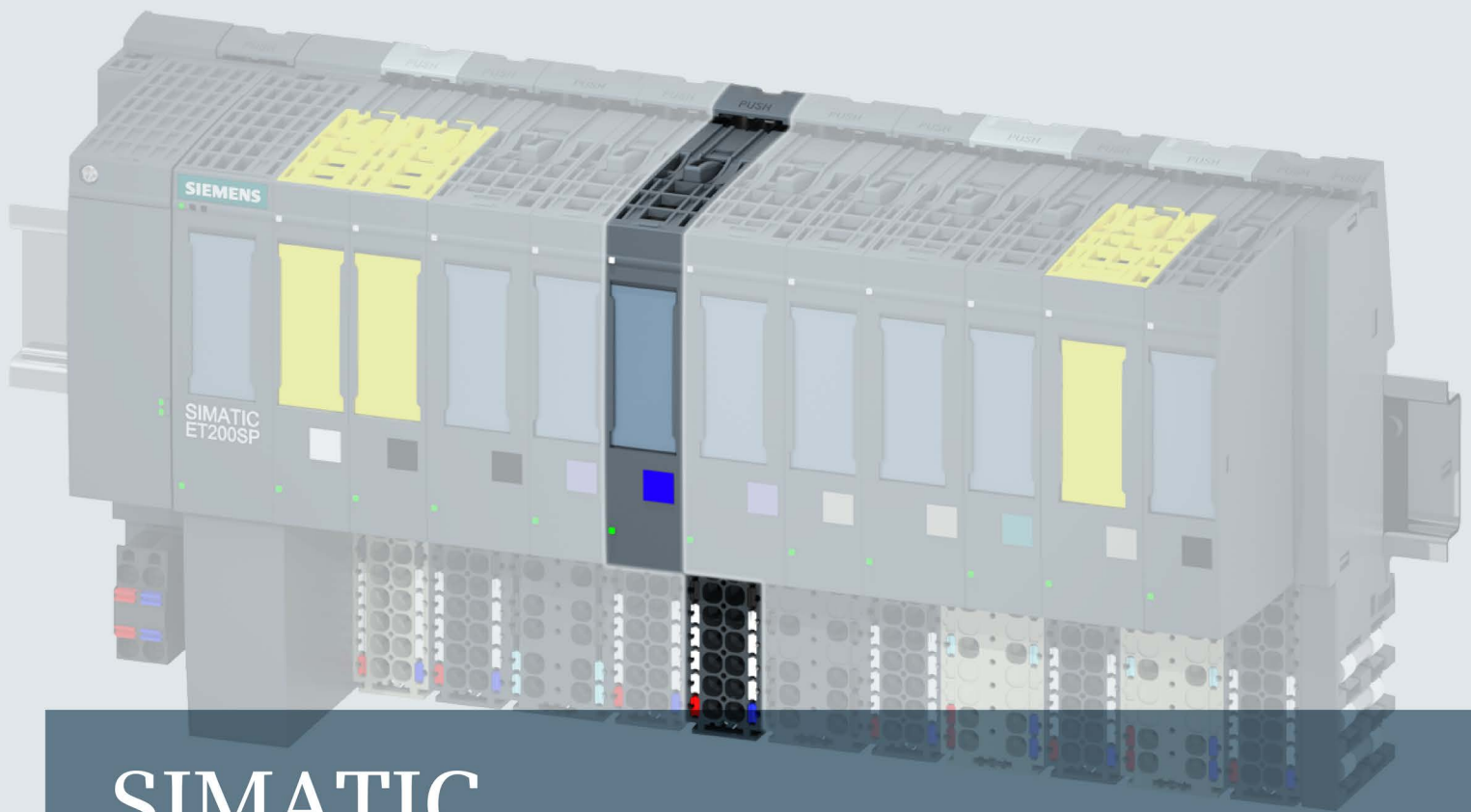


**SIEMENS**



# SIMATIC

ET 200SP

Analog output module AQ 2xU/I HS (6ES7135-6HB00-0DA1)

Manual

Edition

09/2016

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# SIEMENS

## SIMATIC

### ET 200SP

### Analog output module AQ 2xU/I HS (6ES7135-6HB00-0DA1)

#### Manual

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## Legal information

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 <b>WARNING</b>
indicates that death or severe personal injury <b>may</b> result if proper precautions are not taken.
 <b>CAUTION</b>
indicates that minor personal injury can result if proper precautions are not taken.
<b>NOTICE</b>
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# 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:

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### 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.

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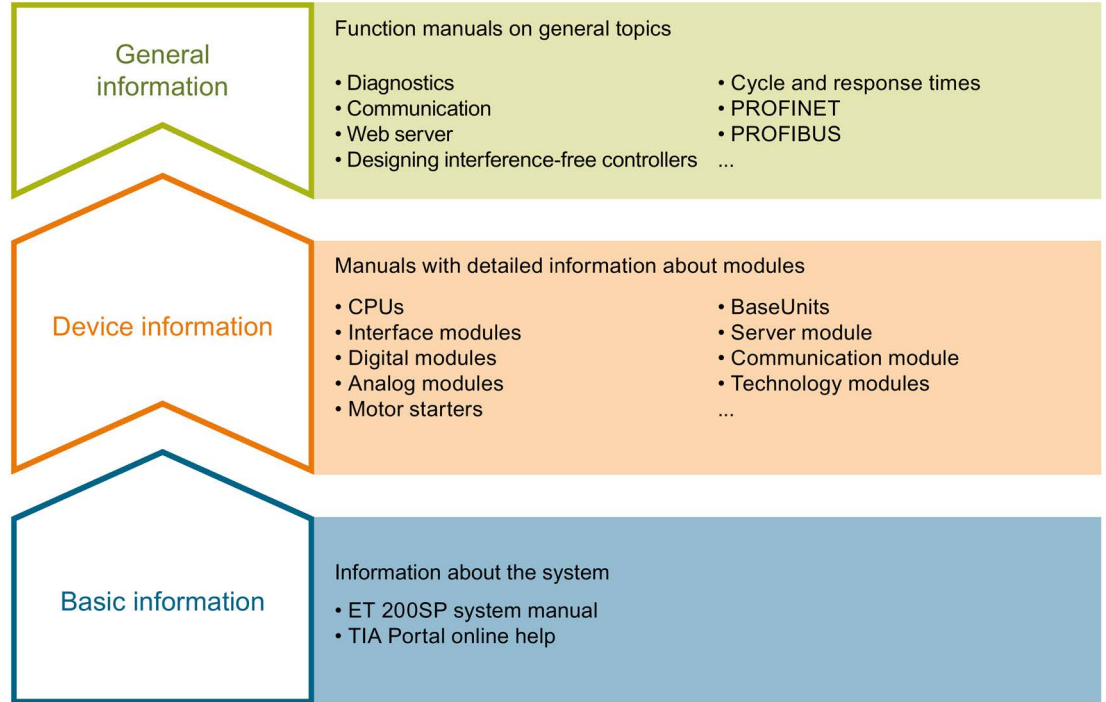
To stay informed about product updates, subscribe to the Siemens Industrial Security RSS Feed under (<http://www.siemens.com/industrialsecurity>).

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The documentation for the SIMATIC ET 200SP distributed I/O system is arranged into three areas.

This arrangement enables you to access the specific content you require.



## Basic information

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

## Device information

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

### General information

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

You can download the documentation free of charge from the Internet (<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"

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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>).

## SIMATIC Automation Tool

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

The SIMATIC Automation Tool provides a multitude of functions:

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

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

## PRONETA

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

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

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

## Product overview

### 2.1 Properties

#### Article number

6ES7135-6HB00-0DA1

#### View of the module

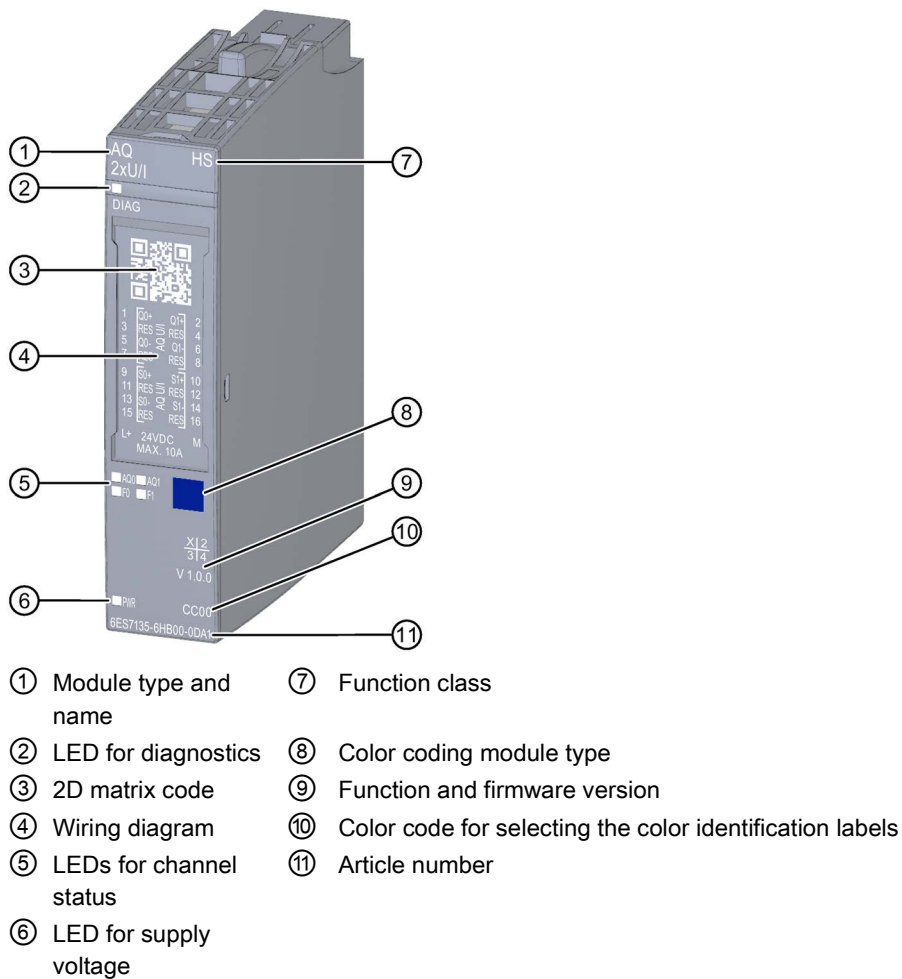


Figure 2-1 View of the AQ 2xU/I HS module

**Properties**

The module has the following technical properties:

- Analog output module with 2 outputs
  - For current output and
  - Voltage output
- Output ranges for current output:
  - $\pm 20$  mA, resolution 16 bit including sign
  - 0 to 20 mA, resolution 15 bit
  - 4 to 20 mA, resolution 14 bit
- Output ranges for voltage output:
  - $\pm 10$  V, resolution 16 bit including sign
  - $\pm 5$  V, resolution 15 bit incl. sign
  - 0 to 10 V, resolution 15 bit
  - 1 to 5 V, resolution 13 bit
- Electrically isolated from supply voltage L+
- Configurable diagnostics (per channel)

The module supports the following functions:

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

Table 2- 1 Version dependencies of other module functions

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

## **Accessories**

The following accessories must be ordered separately:

- Labeling strips
- Reference identification label
- Shield connector

## **See also**

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

# Connecting

## 3.1 Wiring and block diagram

This section includes the block diagram of the module with the AQ 2xU/I HS pin assignments for a 2-wire, 3-wire and 4-wire connection for voltage output.

The 3-wire and 4-wire connection are used for the compensation of the voltage drop on the connection cables.

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.

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**Note**

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

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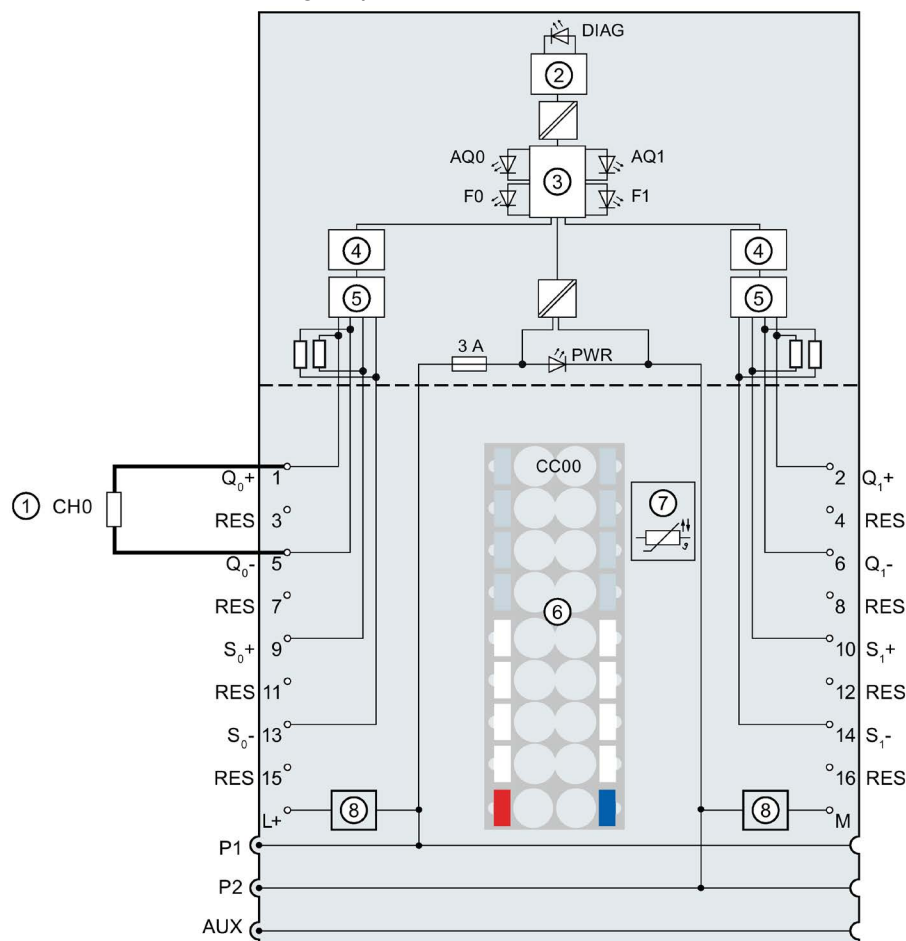
**Note**

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

---

### Connection: Current output 2-wire connection

The figure below shows the block diagram and an example of the terminal assignment of the analog output module AQ 2xU/I HS on the BaseUnit BU type A0/A1.

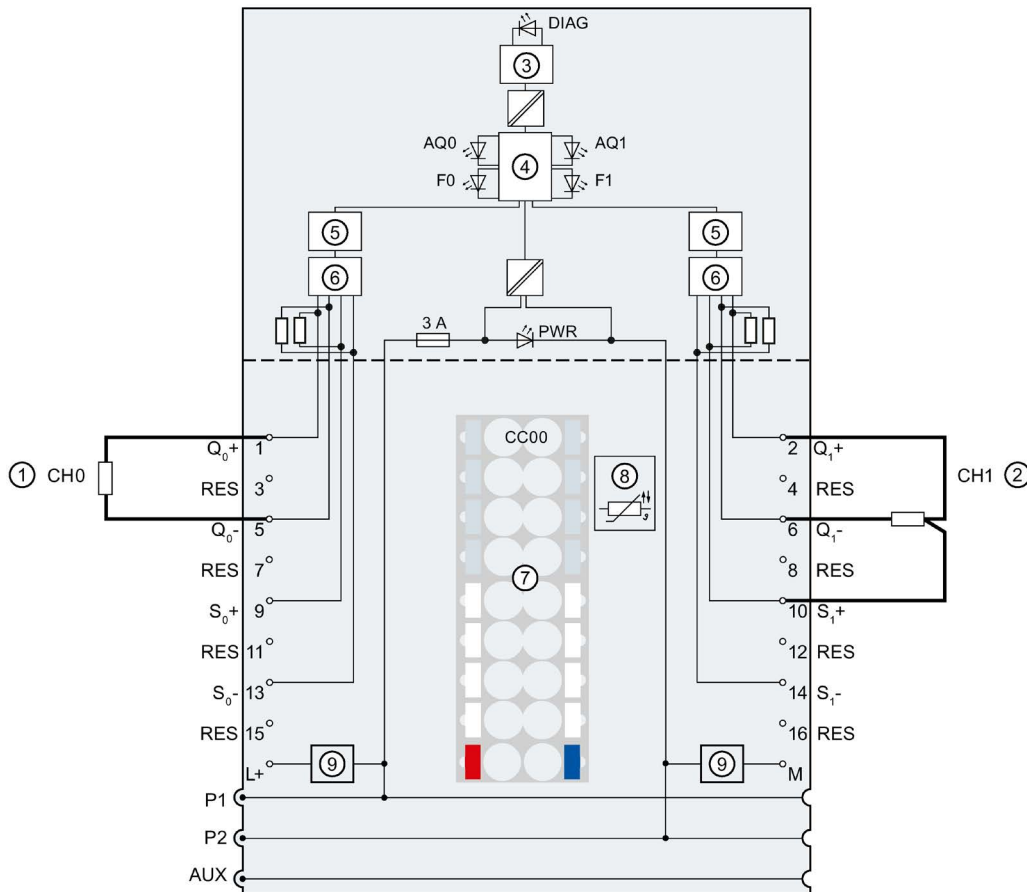


①	2-wire connection for current output	$S_n+$	Sensor cable positive, channel n
②	Backplane bus interface	$S_n-$	Sensor cable negative, channel n
③	Microcontroller	RES	Reserve, must remain unused for future function extensions
④	Digital-to-analog converter (DAC)	L+	24 V DC (infeed only with light-colored BaseUnit)
⑤	Output conditioner	M	Ground
⑥	Color identification label CCxx (optional)	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	Filter connection supply voltage (only when light-colored BaseUnit is present)	AQ0, AQ1	Channel status LED (green)
$Q_n+$	Analog output voltage/current positive, channel n	F0, F1	Channel fault LED (red)
$Q_n-$	Analog output voltage/current negative, channel n	PWR	Power LED (green)

Figure 3-1 Wiring and block diagram for current output 2-wire connection

**Connection: Voltage output 2-wire and 3-wire connection**

The following figure shows the block diagram and an example of the terminal assignment of the analog output module AQ 2xU/I HS on the BaseUnit BU type A0/A1.



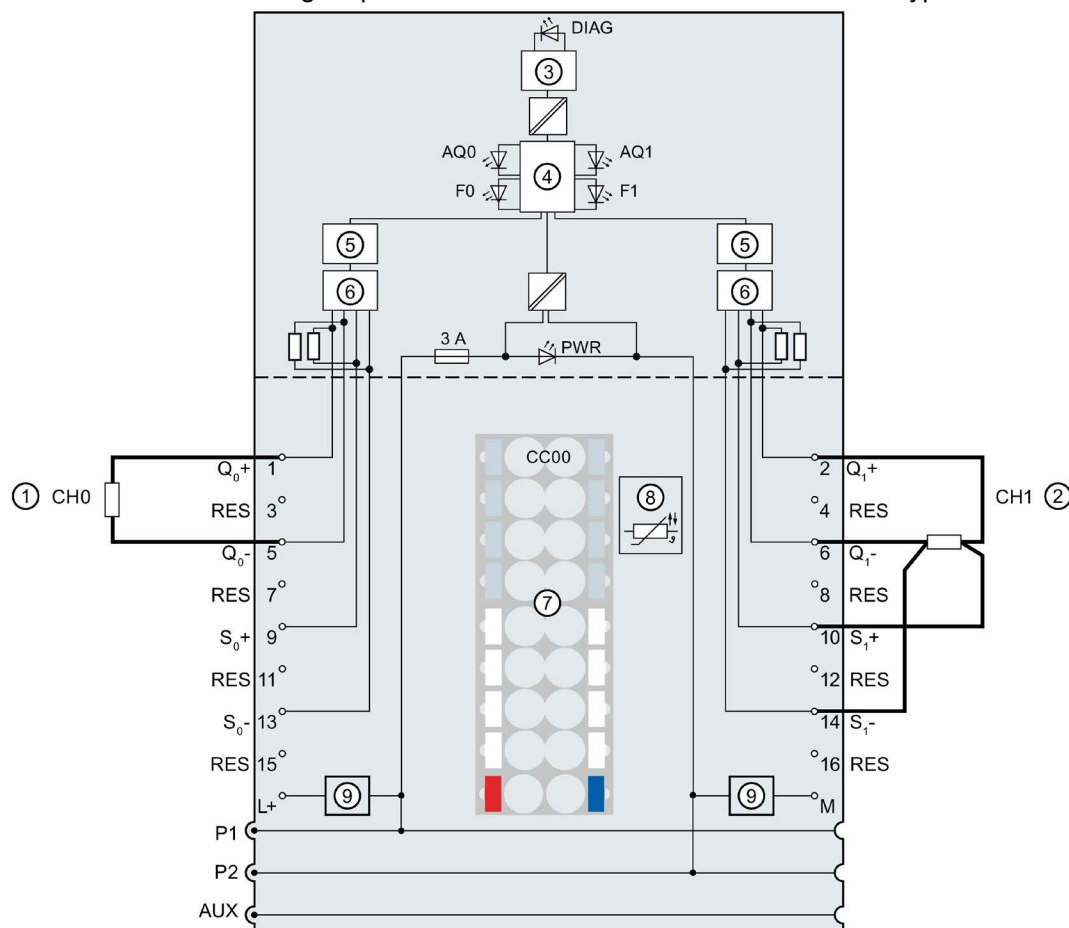
- |                  |   |                  |   |
|------------------|---|------------------|---|
| ①                | 2-wire connection for voltage output  | S <sub>n</sub> + | Sensor cable positive, channel n  |
| ②                | 3-wire connection for voltage output  | S <sub>n</sub> - | Sensor cable negative, channel n  |
| ③                | Output conditioner  | RES              | Reserve, must remain unused for future function extensions  |
| ④                | Digital-to-analog converter (DAC)   | L+               | 24 V DC (infeed only with light-colored BaseUnit)   |
| ⑤                | Microcontroller   | M                | Ground  |
| ⑥                | Backplane bus interface   | P1, P2, AUX      | Internal self-assembling voltage buses<br>Connection to left (dark-colored BaseUnit)<br>Connection to left interrupted (light-colored BaseUnit) |
| ⑦                | Color identification label CCxx (optional)  | DIAG             | Diagnostics LED (green, red)  |
| ⑧                | Temperature recording for BU type A1 only (function cannot be used for this module) | AQ0, AQ1         | Channel status LED (green)  |
| ⑨                | Filter connection supply voltage (only when light-colored BaseUnit is present)      | F0, F1           | Channel fault LED (red)   |
| Q <sub>n</sub> + | Analog output voltage/current positive, channel n                                   | PWR              | Power LED (green)   |
| Q <sub>n</sub> - | Analog output voltage/current negative, channel n                                   |                  |   |

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



### Connection: Voltage output 2-wire and 4-wire connection

The figure below shows the block diagram and an example of the terminal assignment of the analog output module AQ 2xU/I HS on the BaseUnit BU type A0/A1.



- |                 |   |                 |   |
|-----------------|---|-----------------|---|
| ①               | 2-wire connection for voltage output  | S <sub>n+</sub> | Sensor cable positive, channel n  |
| ②               | 4-wire connection for voltage output  | S <sub>n-</sub> | Sensor cable negative, channel n  |
| ③               | Output conditioner  | RES             | Reserve, must remain unused for future function extensions  |
| ④               | Digital-to-analog converter (DAC)   | L+              | 24 V DC (infeed only with light-colored BaseUnit)   |
| ⑤               | Microcontroller   | M               | Ground  |
| ⑥               | Backplane bus interface   | P1, P2, AUX     | Internal self-assembling voltage buses<br>Connection to left (dark-colored BaseUnit)<br>Connection to left interrupted (light-colored BaseUnit) |
| ⑦               | Color identification label CCxx (optional)  | DIAG            | Diagnostics LED (green, red)  |
| ⑧               | Temperature recording for BU type A1 only (function cannot be used for this module) | AQ0, AQ1        | Channel status LED (green)  |
| ⑨               | Filter connection supply voltage (only when light-colored BaseUnit is present)      | F0, F1          | Channel fault LED (red)   |
| Q <sub>n+</sub> | Analog output voltage/current positive, channel n                                   | PWR             | Power LED (green)   |
| Q <sub>n-</sub> | Analog output voltage/current negative, channel n                                   |                 |   |

Figure 3-3 Wiring and block diagram for voltage output 2-wire and 4-wire connection

## Parameters/address space

### 4.1 Output types and output ranges

The analog output module AQ 2xU/I HS has the following output ranges:

Table 4- 1 Output ranges

Output type	Output range	Resolution
Current	±20 mA	16 bit incl. sign
	0 to 20 mA	15 bit
	4 to 20 mA	14 bit
Voltage	± 10 V	16 bit incl. sign
	± 5 V	15 bit incl. sign
	0 to 10 V	15 bit
	1 to 5 V	13 bit

You will find the tables of output ranges and overflow, overrange, etc. in the section Representation of analog values (Page 43) and the "Analog value processing" function manual.

## 4.2 Parameters

### Parameters of the AQ 2×U/I HS

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

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

In addition to assigning parameters with the configuration software, you can also set the parameters in RUN mode (dynamically) using the user program. When assigning parameters in the user program, use the "WRREC" instruction to transfer the parameters to the module by means of data records; see section Parameter assignment and structure of parameter data record (Page 38).

The following parameter settings are possible:

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

Parameter	Value range	Default	Reconfiguration in RUN	Effective range with configuration software, e.g. STEP 7 (TIA Portal)	
				GSD file PROFINET IO	GSD file PROFIBUS DP
Sampling rate	1 value/cycle	1 value/cycle	No	Module	Module
Diagnostics: No supply voltage L+	<ul style="list-style-type: none"> <li>• Disable</li> <li>• Enable</li> </ul>	Disable	Yes	Channel	Channel
Diagnostics: Short-circuit to ground <sup>1</sup>	<ul style="list-style-type: none"> <li>• Disable</li> <li>• Enable</li> </ul>	Disable	Yes	Channel	Channel
Diagnostics: Overflow	<ul style="list-style-type: none"> <li>• Disable</li> <li>• Enable</li> </ul>	Disable	Yes	Channel	Channel <sup>3</sup>
Diagnostics: Underflow	<ul style="list-style-type: none"> <li>• Disable</li> <li>• Enable</li> </ul>	Disable	Yes	Channel	
Diagnostics: Wire break <sup>2</sup>	<ul style="list-style-type: none"> <li>• Disable</li> <li>• Enable</li> </ul>	Disable	Yes	Channel	Channel
Output type/range	<ul style="list-style-type: none"> <li>• Deactivated</li> <li>• Voltage +/- 10 V</li> <li>• Voltage +/- 5 V</li> <li>• Voltage 0 to 10 V</li> <li>• Voltage 1 to 5 V</li> <li>• Current +/- 20 mA</li> <li>• Current 0 to 20 mA</li> <li>• Current 4 to 20 mA</li> </ul>	Current 4 to 20 mA	Yes	Channel	Channel

## 4.2 Parameters

Parameter	Value range	Default	Reconfiguration in RUN	Effective range with configuration software, e.g. STEP 7 (TIA Portal)	
				GSD file PROFINET IO	GSD file PROFIBUS DP
Reaction to CPU STOP	<ul style="list-style-type: none"> <li>Shut down</li> <li>Keep last value</li> <li>Output substitute value</li> </ul>	Shut down	Yes	Channel	Module <sup>3</sup>
Substitute value	For permissible substitute values for the various output ranges, see Parameter assignment and structure of the parameter data record (Page 38) appendix, Substitute values → Codes for substitute values table	0	Yes	Channel	Channel
Potential group	<ul style="list-style-type: none"> <li>Use potential group of the left module (dark-colored BaseUnit)</li> <li>Enable new potential group (light-colored BaseUnit)</li> </ul>	Use potential group of the left module	No	Module	Module

<sup>1</sup> No diagnostics detection between -0.5 V and +0.5 V (no short-circuit detection)

<sup>2</sup> No diagnostics detection between -3 mA and +3 mA (no wire break detection)

<sup>3</sup> Due to the limited number of parameters of a maximum of 244 bytes per ET 200SP station with a PROFIBUS GSD configuration, the parameter assignment options are restricted. If required, you can still assign these parameters using the data record 128 as described in the column "GSD file PROFINET IO" (see table above). The parameter length of the I/O module is 7 bytes.

---

**Note**
**Unused channels**

A deactivated channel always returns the value "no current or voltage".

---

## 4.3 Description of parameters

### **Diagnostics: No supply voltage L+**

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

### **Diagnostics: Short-circuit to ground**

Enabling of the diagnostics when a short-circuit of the actuator supply occurs.

### **Diagnostics: Overflow**

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

### **Diagnostics: Underflow**

Enabling of the diagnostics when the output value falls below the underrange or reaches the minimum output value or underflow.

### **Diagnostics: Wire break**

Enabling of the diagnostics if the line to the actuator is broken.

### **Output type/output range**

See the section Output types and output ranges (Page 18).

### **Reaction to CPU STOP**

Determines the behavior of the module at CPU STOP.

### **Substitute value**

The substitute values are values issued by the outputs (the output) in the event of a CPU STOP.

### **Potential group**

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

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

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

**See also**

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

## 4.4 Oversampling

**Function**

Oversampling is the output of data in constant bus cycle segments (sub-cycles), whereby n sub-cycles correspond to one PROFINET bus cycle. A data packet is transmitted from the controller to the module, which outputs the packet in n constant bus sub-cycles.

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

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

- Each sub-cycle returns an output value.
- The minimum PROFINET bus cycle for oversampling is 250 µs.
- You can configure oversampling for:
  - Channel 0 (1-channel operation)
  - Channel 0/1 (2-channel operation)
- The number of sub-cycles can be set as follows:
  - From 2 to 16 for one channel
  - From 2 to 8 for two channels

**Requirement**

Oversampling is only possible when isochronous mode is set.

**Configuration**

You configure oversampling with the following parameter:

- Sampling rate

---

**Note**

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

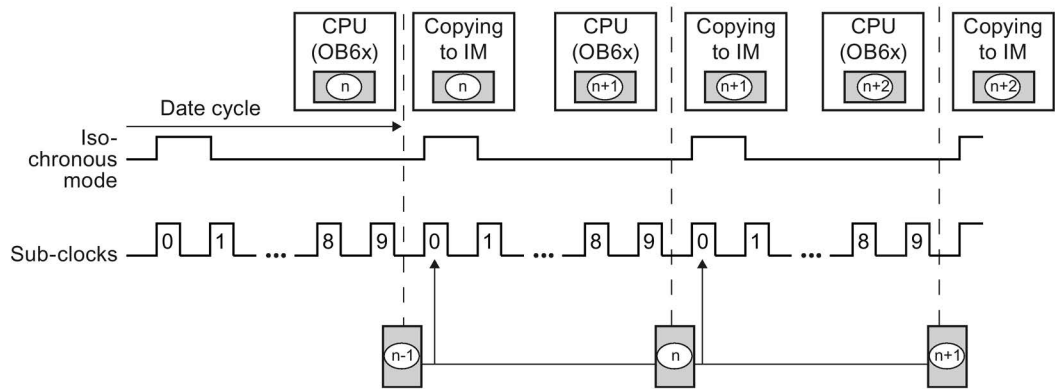
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## Overview of the operating modes

Function	Normal operation	Oversampling in normal operation	
		1-channel operation	2-channel operation
Isochronous mode	Yes, optional	Yes, required	
• Shortest send clock	125 $\mu$ s	250 $\mu$ s	
Oversampling	No	Yes	Yes
• Number of over-sampling levels (output rate)	-	2 to 16	2 to 8
• Shortest sub-cycle (= shortest sampling time)	-	35 $\mu$ s	45 $\mu$ s
$\pm 10$ V	x	x	
0 to 10 V	x	x	
$\pm 5$ V	x	x	
1 to 5 V	x	x	
$\pm 20$ mA	x	x	
0 to 20 mA	x	x	
4 to 20 mA	x	x	
Overflow	x	x	
Underflow	x	x	
Wire break for current	x	x	
Short-circuit for voltage	x	x	
Load voltage diagnostics	x	x	
Value status (QI)	x	-	
Reaction to CPU STOP	x	x	
Data length	4 bytes	32 bytes	

### Chronological sequence

The figure shows the chronological sequence for oversampling. The output data present in the CPU is output in the data cycle after the next one, distributed across the sub-cycles which are generated on the actual module.



① n = output values from bus cycle n

Figure 4-1 Oversampling

## 4.5 Address space

### Configuration options

The following configurations are possible:

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

### Evaluating the value status

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

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

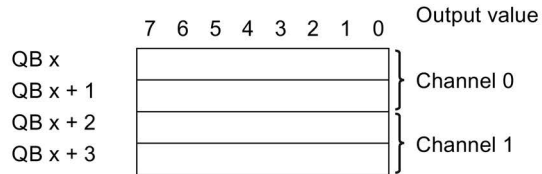
Bit =0: The wiring, the value created on the channel, or similar is incorrect.



## Address space

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

Assignment in the process image output (PIQ)



Assignment in the process image input (PII)

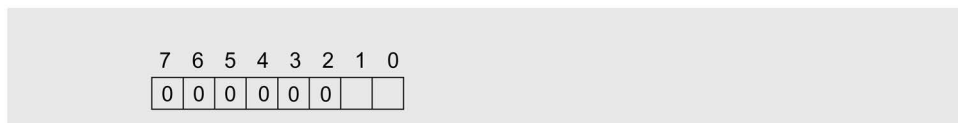


Figure 4-2 Address space of the AQ 2xU/I HS with value status

## Address space of the AQ 2xU/I HS for oversampling with one channel

The following figure shows the assignment of the address space for oversampling with one channel. Writing always starts from QB x. Only a maximum of 16 sub-cycles are possible.

Assignment in the process image output with oversampling

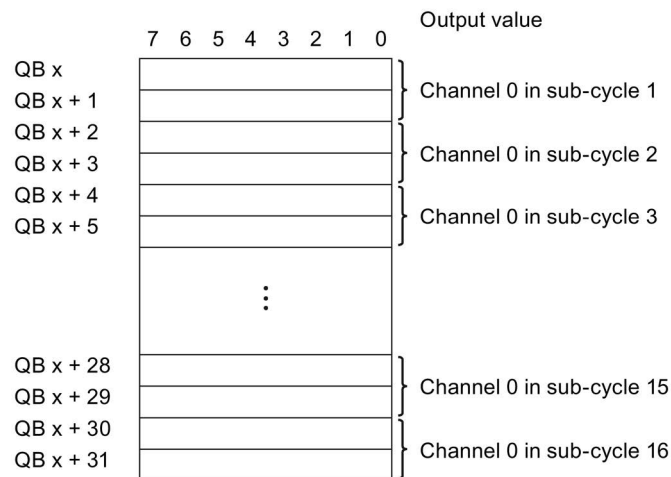


Figure 4-3 Address space of the AQ 2xU/I HS for oversampling with one channel

**Address space of the AQ 2xU/I HS for oversampling with two channels**

The following figure shows the assignment of the address space for oversampling with two channels. Writing always starts from QB x. Only a maximum of 8 sub-cycles are possible.

Assignment in the process image input (PII)

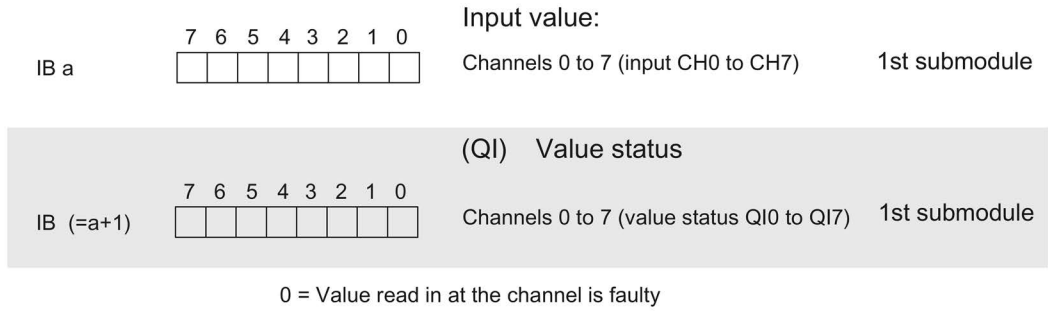


Figure 4-4 Address space of the AQ 2xU/I HS for oversampling with two channels

## Interrupts/diagnostics alarms

### 5.1 Status and error displays

#### LED display

The figure below shows the LED displays of the AQ 2×U/I HS.

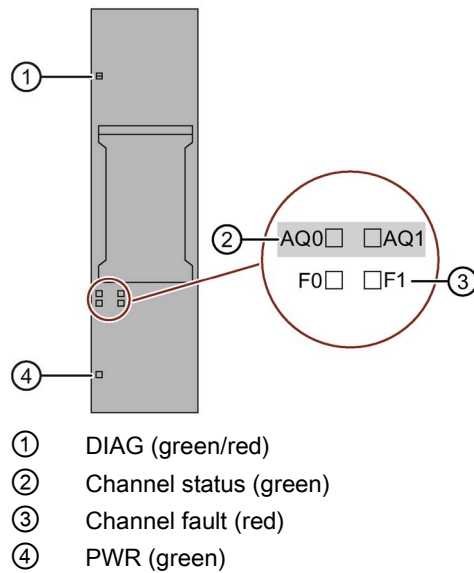






Figure 5-1 LED displays

### Meaning of the LEDs

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









#### DIAG LED

Table 5- 1 Error display of the DIAG LED

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



#### Channel status/channel fault LED

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

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

#### PWR LED

Table 5- 3 Status display of the PWR LED

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

## 5.2 Interrupts

The analog output module AQ 2xU/I HS supports diagnostics interrupts.

### Diagnostics interrupt

The module generates a diagnostics interrupt at the following events:

- Short-circuit
- Overtemperature
- Wire break
- High limit violated
- Low limit violated
- Error
- Parameter assignment error
- No load voltage
- Channel temporarily unavailable

### 5.3 Diagnostics alarms

A diagnostics alarm is output for each diagnostics event and the DIAG LED flashes on the module. The diagnostics alarms can, for example, be read from the diagnostics buffer of the CPU. You can evaluate the error codes with the user program

Table 5- 4 Error types

Diagnostics alarm	Error code	Meaning	Solution
Short-circuit (current)	1H	Short-circuit of the actuator supply	Correct the process wiring
Overtemperature	4H	Thermal overload of the I/O module	Reduce the ambient temperature, pay attention to derating
Wire break (current)	6H	Impedance of actuator circuit too high	Use a different actuator type or modify the wiring, for example, using cables with larger cross-section
		Wire break between the module and actuator	Connect the cable
		Channel not connected (open)	<ul style="list-style-type: none"> <li>Deactivate the channel ("Output type" parameter)</li> <li>Deactivate diagnostics</li> <li>Connect the channel</li> </ul>
High limit violated	7H	The output value defined by the user program is above the overrange.	Correct the output value
Low limit violated	8H	The output value defined by the user program is below the underrange.	Correct the output value
Error	9H	Internal module error occurred	Replace the module
Parameter assignment error	10H	<ul style="list-style-type: none"> <li>The module cannot evaluate parameters for the channel.</li> <li>Incorrect parameter assignment.</li> </ul>	Correct the parameter assignment
No load voltage	11H	No or insufficient supply voltage L+	<ul style="list-style-type: none"> <li>Check supply voltage L+ on the BaseUnit</li> <li>Check BaseUnit type</li> </ul>
Channel temporarily unavailable	1FH	Firmware update is currently in progress or has been canceled. The module does not output any process or substitute values in this state.	<ul style="list-style-type: none"> <li>Wait for firmware update</li> <li>Restart the firmware update</li> </ul>

## Technical specifications

### 6.1 Technical specifications

#### Technical specifications of the AQ 2xU/I HS

	6ES7135-6HB00-0DA1
Product type designation	ET 200SP, AQ 2xU/I High Speed
<b>General information</b>	
Firmware version	V2.0.1
Usable BaseUnits	BU type A0, A1
Color code for module-specific color identification label	CC00
<b>Product function</b>	
I&M data	Yes; I&M0 to I&M3
<b>Engineering with</b>	
STEP 7 TIA Portal can be configured/integrated as of version	V13 SP1
STEP 7 can be configured/integrated as of version	V5.5 SP3 / -
PROFIBUS as of GSD version/GSD revision	GSD revision 5
PROFINET as of GSD version/GSD revision	GSDML V2.3
<b>Operating mode</b>	
Oversampling	Yes; 2 channels per module
<b>CiR Configuration in RUN</b>	
Reconfiguration in RUN possible	Yes
Calibration in RUN possible	Yes
<b>Supply voltage</b>	
Rated value (DC)	24 V
Valid range, low limit (DC)	19.2 V
Valid range, high limit (DC)	28.8 V
<b>Input current</b>	
Current consumption (rated value)	45 mA; no load
<b>Power loss</b>	
Power loss, typ.	0.9 W
<b>Address area</b>	
<b>Address space per module</b>	
Address space per module, max.	4 byte; + 1 byte for QI information (32 bytes in oversampling mode)

	6ES7135-6HB00-0DA1
<b>Analog outputs</b>	
Number of analog outputs	2
Voltage output, short-circuit protection	Yes
Voltage output, short-circuit current, max.	45 mA
Cycle time (all channels), min.	125 µs
Analog output with oversampling	Yes
<ul style="list-style-type: none"> <li>• Values per cycle, max.</li> </ul>	16
<ul style="list-style-type: none"> <li>• Resolution, min.</li> </ul>	45 µs; (2 channels), 35 µs (1 channel)
<b>Output ranges, voltage</b>	
0 to 10 V	Yes; 15 bit
1 V to 5 V	Yes; 13 bit
-5 V to +5 V	Yes; 15 bit incl. sign
-10 V to +10 V	Yes; 16 bit incl. sign
<b>Output ranges, current</b>	
0 to 20 mA	Yes; 15 bit
-20 mA to +20 mA	Yes; 16 bit incl. sign
4 mA to 20 mA	Yes; 14 bit
<b>Wiring the actuators</b>	
for voltage output two-wire connection	Yes
for voltage output four-wire connection	Yes
for current output two-wire connection	Yes
<b>Load resistance (in rated range of the output)</b>	
For voltage outputs, min.	2 kΩ
For voltage outputs, capacitive load, max.	1 µF
For current outputs, max.	500 Ω
For current outputs, inductive load, max.	1 mH
<b>Destruction limit for externally applied voltages and currents</b>	
Voltages at the outputs	30 V
<b>Cable length</b>	
Shielded, max.	1000 m; 200 m for voltage output
<b>Formation of analog values for the outputs</b>	
<b>Settling time</b>	
For resistive load	0.05 ms
For capacitive load	0.05 ms; max. 47 nF and 20 m cable length
For inductive load	0.05 ms



	6ES7135-6HB00-0DA1
<b>Errors/accuracies</b>	
Output ripple (in relation to output range, bandwidth 0 kHz to 50 kHz), (+/-)	0.02%
Linearity error (in relation to output range), (+/-)	0.03%
Temperature error (in relation to output range), (+/-)	0.003%/K
Crosstalk between outputs, max.	-50 dB
Repeat accuracy in settled state at 25 °C (in relation to output range), (+/-)	0.03%
<b>Operational limit in the entire temperature range</b>	
Voltage in relation to output range, (+/-)	0.2%
Current in relation to output range, (+/-)	0.2%
<b>Basic error limit (operational limit at 25 °C)</b>	
Voltage in relation to output range, (+/-)	0.1%
Current in relation to output range, (+/-)	0.1%
<b>Isochronous mode</b>	
Isochronous mode (application synchronized up to terminal)	Yes
Execution and activation time (TCO), min.	70 µs
Bus cycle time (TDP), min.	125 µs
<b>Interrupts/diagnostics/status information</b>	
Substitute values can be applied	Yes
<b>Interrupts</b>	
Diagnostics interrupt	Yes
<b>Diagnostics alarms</b>	
Diagnostics	Yes
Monitoring of supply voltage	Yes
Wire break	Yes; channel-based, only for output type current
Short-circuit	Yes; channel-based, only for output type voltage
Overflow/underflow	Yes
<b>Diagnostics display LED</b>	
Monitoring of 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
<b>Electrical isolation</b>	
<b>Electrical isolation of channels</b>	
Between the channels	No
Between the channels and the backplane bus	Yes
Between the channels and the supply voltage of the electronics	Yes
<b>Insulation</b>	
Insulation tested with	707 V DC (type test)

*Technical specifications*

*6.1 Technical specifications*

	<b>6ES7135-6HB00-0DA1</b>
<b>Ambient conditions</b>	
<b>Ambient temperature during operation</b>	
Horizontal installation, min.	0 °C
Horizontal installation, max.	60 °C
Vertical installation, min.	0 °C
Vertical installation, max.	50 °C
<b>Dimensions</b>	
Width	15 mm
<b>Weights</b>	
Weight, approx.	31 g

Derating trends with horizontal installation:

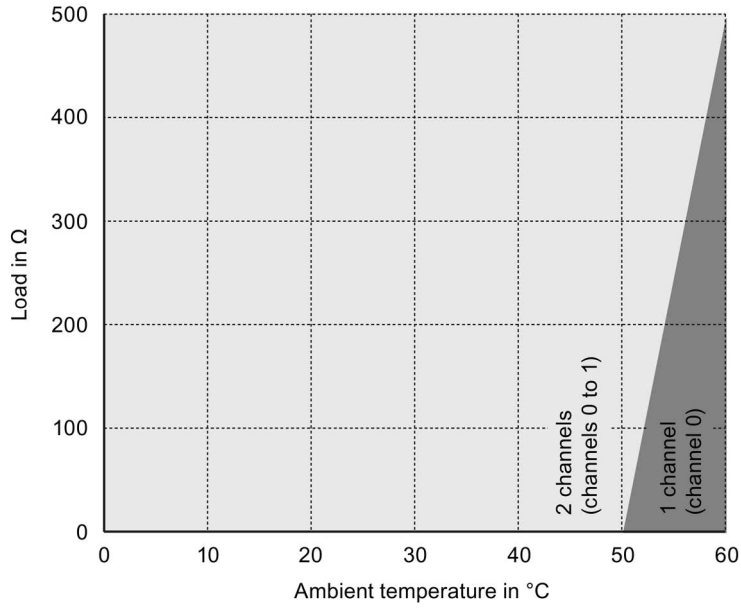


Figure 6-1 Derating trend current output (horizontal)

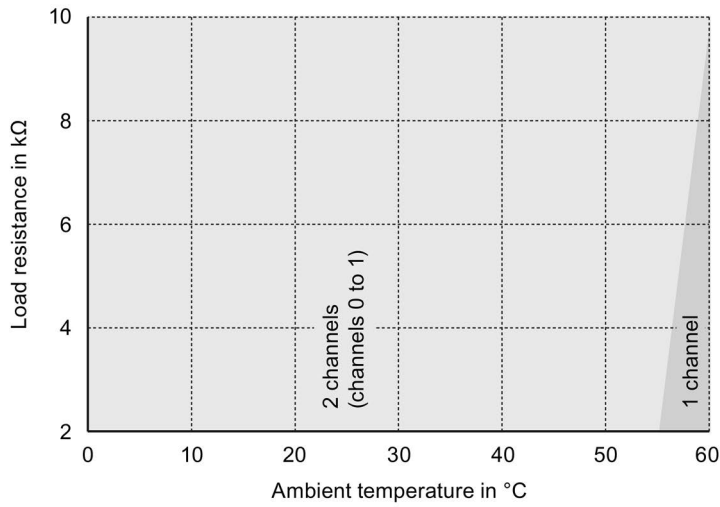


Figure 6-2 Derating trend voltage output (horizontal)

Derating trends with vertical installation:

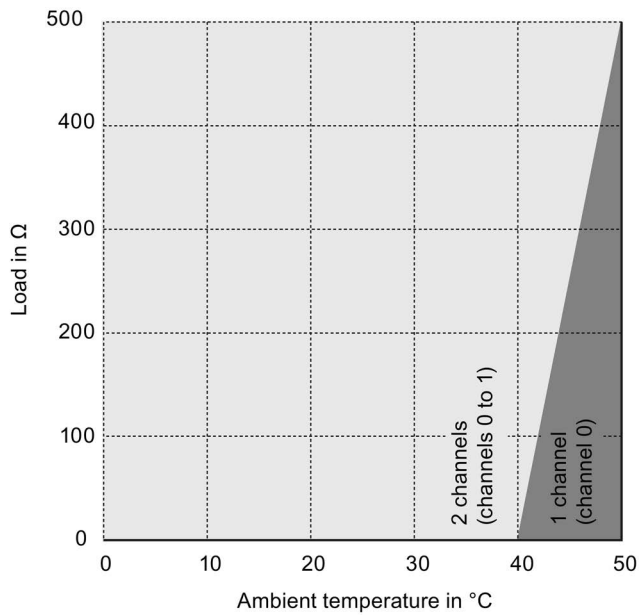


Figure 6-3 Derating trend current output (vertical)

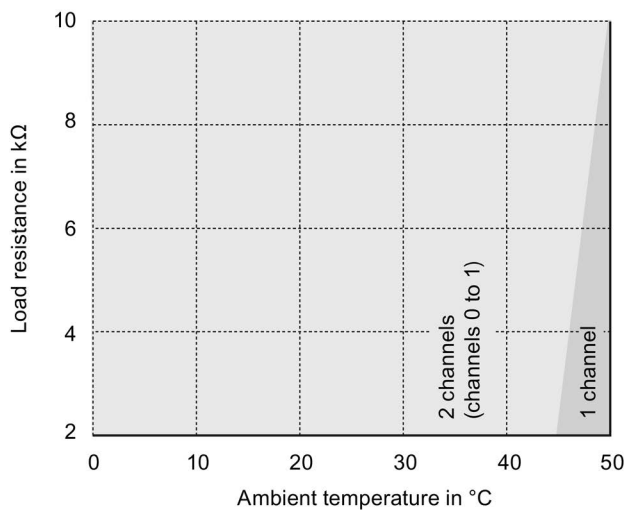


Figure 6-4 Derating trend voltage trend (vertical)

Dimension drawing

See manual ET 200SP BaseUnits

<http://support.automation.siemens.com/WW/view/en/59753521>

## Parameter data record

### 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.

Output type	Output range	Diagnostics					Reaction to CPU STOP	Substitute value
		No supply voltage L+	Short-circuit to ground	Overflow	Underflow	Wire break		
Deactivated		*	*	*	*	*	*	*
Voltage	±5 V	x	x	x	x	-	x	x
	±10 V	x	x	x	x	-	x	x
	1 to 5 V	x	x	x	x	-	x	x
	0 to 10 V	x	x	x	x	-	x	x
Current	±20 mA	x	-	x	x	x	x	x
	0 to 20 mA	x	-	x	x	x	x	x
	4 to 20 mA	x	-	x	x	x	x	x

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

#### Configuring with a PROFIBUS GSD file

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

Output type	Output range	Diagnostics				Reaction to CPU STOP	Substitute value
		No supply voltage L+	Short-circuit to ground	Overflow/ Underflow	Wire break		
Deactivated		*	*	*	*	*	*
Voltage	±5 V	x	x	x	-	x	x
	±10 V	x	x	x	-	x	x
	1 to 5 V	x	x	x	-	x	x
	0 to 10 V	x	x	x	-	x	x
Current	±20 mA	x	-	x	x	x	x
	0 to 20 mA	x	-	x	x	x	x
	4 to 20 mA	x	-	x	x	x	x

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

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

### Parameter assignment in the user program

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

---

#### Note

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

---

### Changing parameters in RUN

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

---

#### Note

#### Changing parameters in RUN

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

---

### STATUS output parameter

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

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

### Structure of data record 128 for entire module

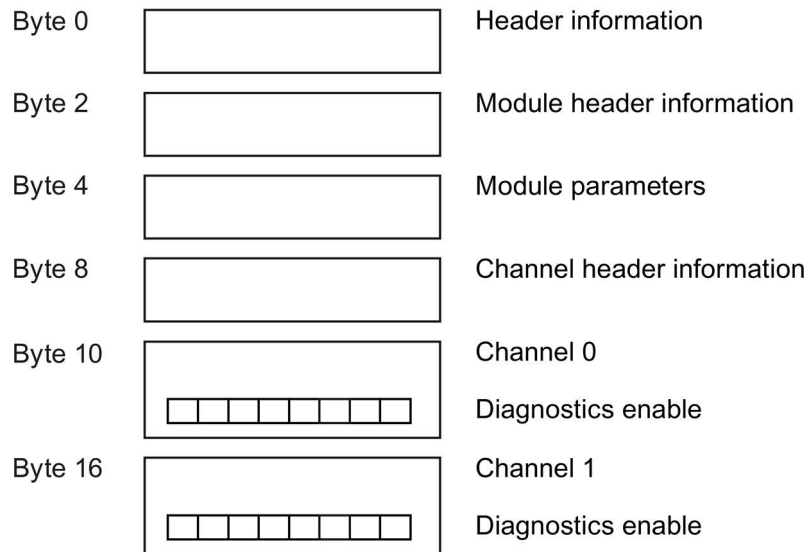


Figure A-1 Structure of data record 128 for entire module

### Header information

The figure below shows the structure of the header information.

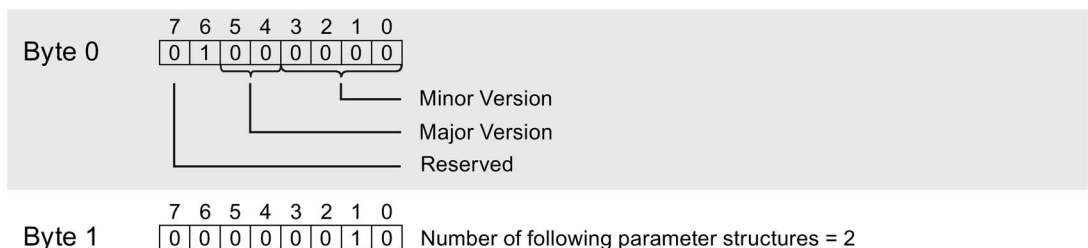


Figure A-2 Header information

### Module header information

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

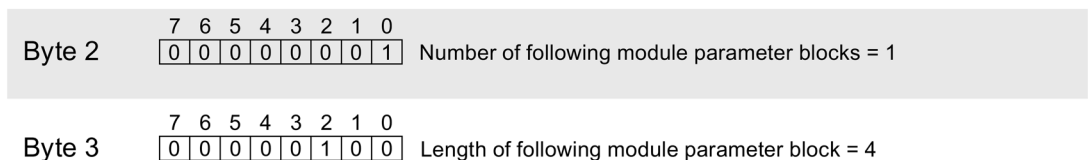


Figure A-3 Module header information

### Module parameter block

The figure below shows the structure of the module parameter block for channels 0 and 1. Enable a parameter by setting the corresponding bit to "1".

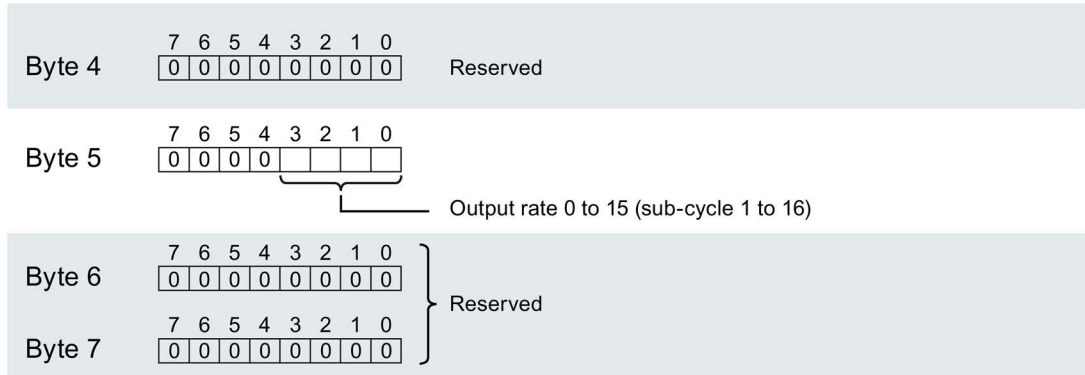


Figure A-4 Module parameter block

### Channel header information

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

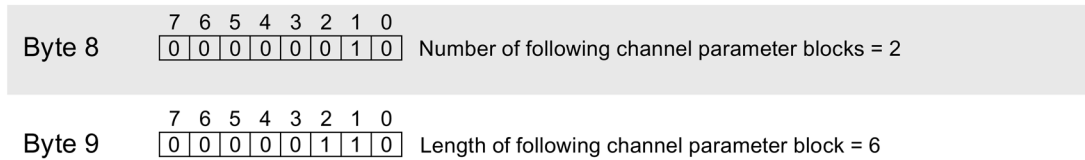


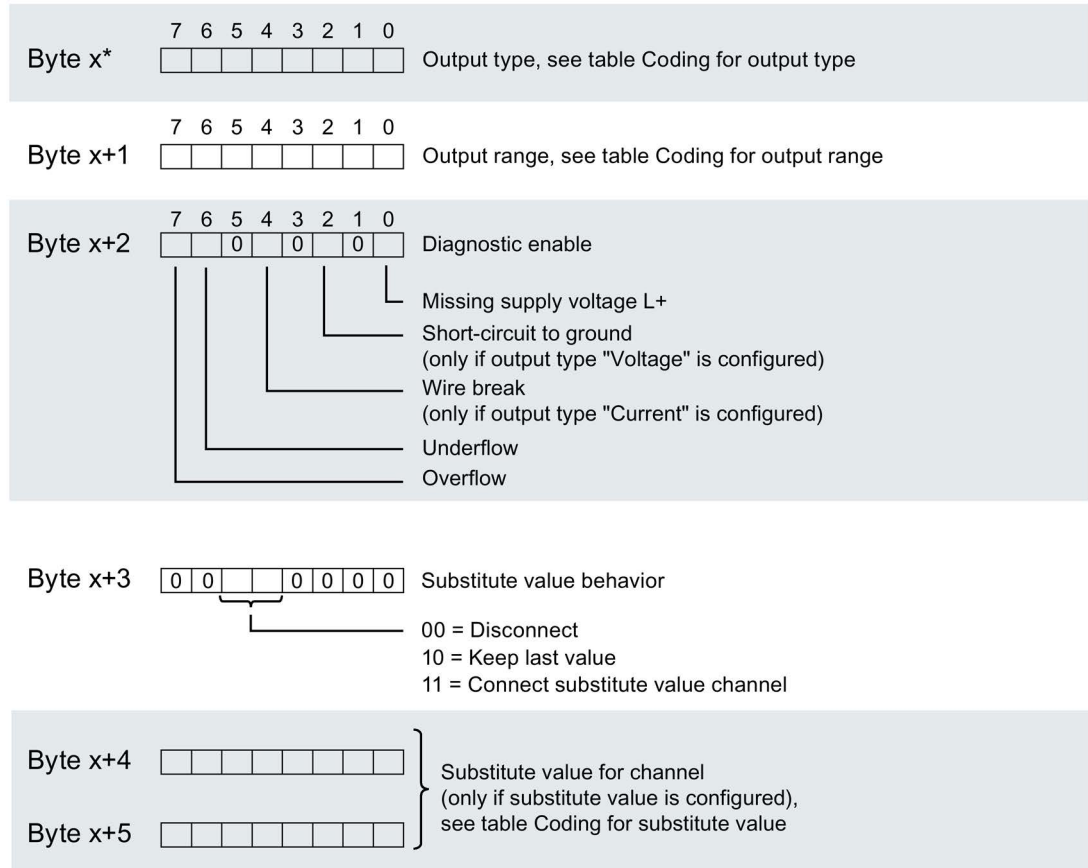
Figure A-5 Channel header information



## Channel parameter block

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

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



\*  $x = 10 + (\text{channel number} \times 6)$ ; channel number = 0 to 1

Figure A-6 Structure of byte x to x+5 for channels 0 and 1

## Codes for output types

The table below contains the codes for the output types of the analog output module. You must enter these codes in bytes x of the channel parameter block of data record 128 (see previous figure).

Table A- 1 Codes for output types

Output type	Code
Deactivated	0000 0000
Voltage	0000 0001
Current	0000 0011

### Codes for output ranges

The table below contains the codes for the output ranges of the analog output module. You must enter these codes in bytes x+1 of the channel parameter block of data record 128 (see previous figure).

Table A- 2 Codes for output ranges

Output range	Code
<b>Voltage</b>	
±10 V	0000 0000
±5 V	0000 0001
0 to 10 V	0000 0010
1 to 5 V	0000 0011
<b>Current</b>	
±20 mA	0000 0000
0 to 20 mA	0000 0001
4 to 20 mA	0000 0010

### Codes for substitute values

The table below contains the codes for the substitute values. You must enter these codes in bytes x+4 and x+5 (see previous figure).

Table A- 3 Codes for substitute values

Output range for	Permitted substitute value
<b>Voltage</b>	
±10 V	-32512 ... +32511
±5 V	-32512 ... +32511
0 to 10 V	0 ... +32511
1 to 5 V	-6912 ... +32511
<b>Current</b>	
±20 mA	-29031 ... +29030
0 to 20 mA	0 ... +29030
4 to 20 mA	-692 ... +29030

## Representation of analog values

This appendix describes the analog values for all output ranges supported by the AQ 2xU/I HS analog output module.

### 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 following table shows the representation of the binary analog values and the associated decimal and hexadecimal units of the analog values.

The resolutions 13, 14, 15, and 16 bit 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 Possible resolutions of the analog values

Resolution in bit	Values		Analog value	
	Decimal	Hexadecimal	High byte	Low byte
13	8	8H	Sign 0 0 0 0 0 0 0	0 0 0 0 1 x x x
14	4	4H	Sign 0 0 0 0 0 0 0	0 0 0 0 0 1 x x
15	2	2H	Sign 0 0 0 0 0 0 0	0 0 0 0 0 0 1 x
16	1	1H	Sign 0 0 0 0 0 0 0	0 0 0 0 0 0 0 1

## B.1 Representation of output ranges

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

Table B-2 Bipolar output ranges

Dec. value	Output value in %	Data word																Range
		2 <sup>15</sup>	2 <sup>14</sup>	2 <sup>13</sup>	2 <sup>12</sup>	2 <sup>11</sup>	2 <sup>10</sup>	2 <sup>9</sup>	2 <sup>8</sup>	2 <sup>7</sup>	2 <sup>6</sup>	2 <sup>5</sup>	2 <sup>4</sup>	2 <sup>3</sup>	2 <sup>2</sup>	2 <sup>1</sup>	2 <sup>0</sup>	
≥32512	117.589	0	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	Maximum output value
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	Underrange
-27649	100.004	1	0	0	1	0	0	1	1	1	1	1	1	1	1	1	1	
-32512	-117.593	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	
≤ -32513	-117.593	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	Minimum output value

Table B-3 Unipolar output ranges

Dec. value	Output value in %	Data word																Range
		2 <sup>15</sup>	2 <sup>14</sup>	2 <sup>13</sup>	2 <sup>12</sup>	2 <sup>11</sup>	2 <sup>10</sup>	2 <sup>9</sup>	2 <sup>8</sup>	2 <sup>7</sup>	2 <sup>6</sup>	2 <sup>5</sup>	2 <sup>4</sup>	2 <sup>3</sup>	2 <sup>2</sup>	2 <sup>1</sup>	2 <sup>0</sup>	
≥32512	117.589	0	1	1	1	1	1	1	1	x	x	x	x	x	x	x	x	Maximum output value
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	
≤ 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Minimum output value

## B.2 Representation of analog values in the voltage output ranges

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

Table B- 4 Voltage output ranges  $\pm 10$  V and  $\pm 5$  V

Values			Voltage output range		Range
	Dec.	Hex.	$\pm 10$ V	$\pm 5$ V	
118.515%	32767	7FFF	11.76 V	5.88 V	Overflow*
	32512	7F00			
117.589%	32511	7EFF	11.76 V	5.88 V	Overrange
	27649	6C01			
100%	27648	6C00	10 V	5 V	Nominal range
75%	20736	5100	7.5 V	3.75 V	
0.003617%	1	1	361.7 $\mu$ V	180.8 $\mu$ V	
0%	0	0	0 V	0 V	
	-1	FFFF	-361.7 $\mu$ V	-180.8 $\mu$ V	
-75%	-20736	AF00	-7.5 V	-3.75 V	
-100%	-27648	9400	-10 V	-5 V	
	-27649	93FF			Underrange
-117.593%	-32512	8100	-11.76 V	-5.88 V	Underflow*
	-32513	80FF	-11.76	-5.88 V	
-118.519%	-32768	8000			

\* Outputs positive maximum value or negative minimum value

Table B- 5 Voltage output range 0 V to 10 V

Values			Voltage output range		Range
	Dec.	Hex.	0 to 10 V		
118.515%	32767	7FFF	11.76 V		Overflow*
	32512	7F00			
117.589%	32511	7EFF	11.76 V		Overrange
	27649	6C01			
100%	27648	6C00	10 V		Nominal range
75%	20736	5100	7.5 V		
0.003617%	1	1	361.7 $\mu$ V		
0%	0	0	0 V		
	-1	FFFF	0 V		
-118.519%	-32768	8000			Underflow*

\* Outputs positive maximum value or negative minimum value

Table B- 6 Voltage output range 1 V to 5 V

Values			Voltage output range	Range
	Dec.	Hex.	1 to 5 V	
118.515%	32767	7FFF	5.70 V	Overflow*
	32512	7F00		
117.589%	32511	7EFF	5.70 V	Overrange
	27649	6C01		
100%	27648	6C00	5 V	Nominal range
75%	20736	5100	4 V	
0.003617%	1	1	1 V + 144.7 μV	
0%	0	0	1 V	
	-1	FFFF	1 V - 144.7 μV	Underrange
-25%	-6912	E500	0 V	
	-6913	E4FF	0 V	Underflow*
-118.519%	-32768	8000		

\* Outputs positive maximum value or negative minimum value

## B.3 Representation of analog values in the current output ranges

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

Table B- 7 Current output range  $\pm 20$  mA

Values			Current output range	Range
	Dec.	Hex.	$\pm 20$ mA	
118.515%	32767	7FFF	21 mA	Overflow*
	29031	7167		
105%	29030	7166	21 mA	Overrange
	27649	6C01	20 mA + 723.4 nA	
100%	27648	6C00	20 mA	Nominal range
75%	20736	5100	15 mA	
0.003617%	1	1	723.4 nA	
0%	0	0	0 mA	
	-1	FFFF	-723.4 nA	
-75%	-20736	AF00	-15 mA	
-100%	-27648	9400	-20 mA	Underrange
	-27649	93FF	-20 mA - 723.4nA	
-105%	-29031	8E99	-21 mA	
	-29032	8E98	-21 mA	Underflow*
-118.519%	-32768	8000		

\* Outputs positive maximum value or negative minimum value

Table B- 8 Current output range 0 to 20 mA

Values			Current output range	Range
	Dec.	Hex.	0 to 20 mA	
118.515%	32767	7FFF	21 mA	Overflow*
	29031	7167		
105%	29030	7166	21 mA	Overrange
	27649	6C01	20 mA + 723.4 nA	
100%	27648	6C00	20 mA	Nominal range
75%	20736	5100	15 mA	
0.003617%	1	1	723.4 nA	
0%	0	0	0 mA	
	-1	FFFF	0 mA	
-118.519%	-32768	8000		

\* Outputs positive maximum value or negative minimum value

Table B- 9 Current output ranges 4 to 20 mA

Values			Current output range	Range
	Dec.	Hex.	4 to 20 mA	
118.515%	32767	7FFF	21 mA	Overflow*
	29377	72C1		
106.25%	29376	72C0	21 mA	Overrange
	27649	6C01	20 mA + 578.7 nA	
100%	27648	6C00	20 mA	Nominal range
75%	19008	4A40	16 mA	
0.003617%	1	1	4 mA + 578.7 nA	
0%	0	0	4 mA	
	-1	FFFF	3.9995 mA	
-2.5%	-692	FD4C	3.6 mA	Underrange
	-693	FD4B	3.6 mA	
-118.519%	-32768	8000		

\* Outputs positive maximum value or negative minimum value