SIEMENS


# SIMATIC

## S7-1500 / ET 200MP

Analog output module AQ 8xU/I HS (6ES7532-5HF00-0AB0)

Manual

Edition 09/2016

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# Analog output module AQ 8xU/I HS
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Manual




09/2016

A5E03484776-AD

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# Preface

## Purpose of the documentation

This manual supplements the system manual: S7-1500/ET 200MP (https://support.industry.siemens.com/cs/ww/en/view/59191792) automation system.

Functions that relate in general to the systems are described in these manuals.

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

## Changes compared to previous version

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

- As of firmware version V2.1.0, the module supports the oversampling function.
- Original texts of the license conditions and copyright notes for open-source software are available on the Internet as of 09/2016.

## Conventions

The term "CPU" is used in this manual both for the CPUs of the S7-1500 automation system, as well as for interface modules of the ET 200MP distributed I/O system.

Please also observe notes marked as follows:

**Note**

A note contains important information regarding the product described in the documentation or its handling, or draws special attention to a section of the documentation.

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## Open Source Software

Open-source software is used in the firmware of the I/O modules. Open Source Software is provided free of charge. We are liable for the product described, including the open-source software contained in it, pursuant to the conditions applicable to the product. Siemens accepts no liability for the use of the open source software over and above the intended program sequence, or for any faults caused by modifications to the software.

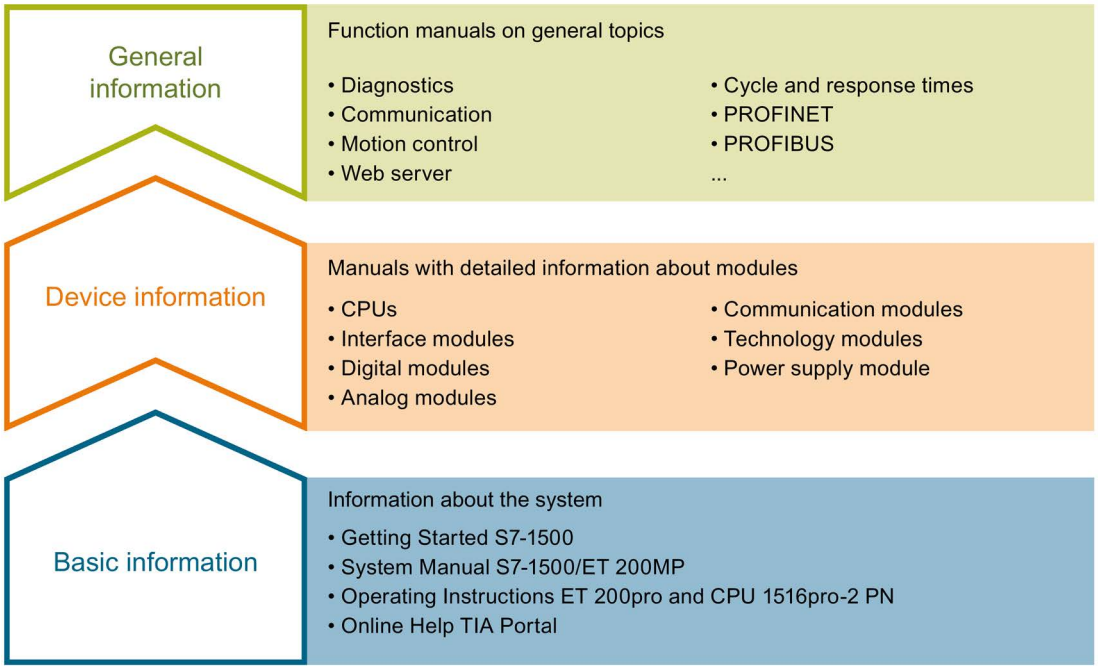
For legal reasons, we are obliged to publish the original text of the license conditions and copyright notices. Please read the information relating to this on the Internet (https://support.industry.siemens.com/cs/ww/en/view/109739516).

# Table of contents

# Documentation guide

# 1

The documentation for the SIMATIC S7-1500 automation system, the CPU 1516pro-2 PN based on SIMATIC S7-1500 and the SIMATIC ET 200MP 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 and Getting Started describe in detail the configuration, installation, wiring and commissioning of the SIMATIC S7-1500 and ET 200MP systems. For CPU 1516pro-2 PN you use the corresponding operating instructions. 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 S7-1500 and ET 200MP systems, e.g. diagnostics, communication, motion control, Web server, 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/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/68052815).

### Manual Collection S7-1500/ET 200MP

The Manual Collection contains the complete documentation on the SIMATIC S7-1500 automation system and the ET 200MP distributed I/O system gathered together in one file.

You can find the Manual Collection on the Internet (https://support.industry.siemens.com/cs/ww/en/view/86140384).

### SIMATIC S7-1500 comparison list for programming languages

The comparison list contains an overview of which instructions and functions you can use for which controller families.

You can find the comparison list on the Internet (https://support.industry.siemens.com/cs/ww/en/view/86630375).

### "mySupport"

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

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

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You can export the manual as PDF file or in a format that can be edited later.

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## "mySupport" - CAx data

In the CAx data area in "mySupport", you can access the current 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 on 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 on individual products.

You will 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 date 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 PROFINET 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

## 2.1 Properties

### Article number

6ES7532-5HF00-0AB0

### View of the module

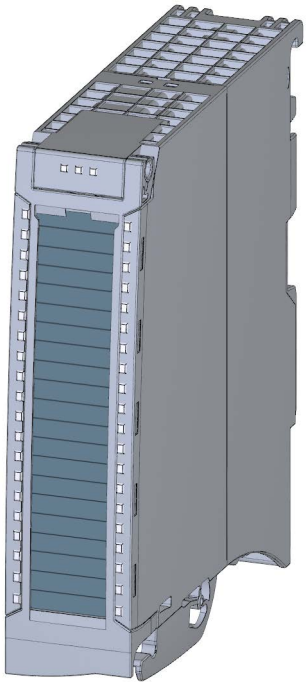


Figure 2-1 View of the AQ 8xU/I HS module

## Properties

The module has the following technical properties:

- Channel-based selection of 8 analog outputs
- Selection of channels for current output
- Selection of channels for voltage output
- Resolution: 16 bits including sign
- Configurable diagnostics (per channel)
- Fast updating of the output values

The module supports the following functions:

Table 2- 1 Version dependencies of the module functions

| Function | Firmware version of the module | Configuration software | |
|---|---|---|---|
| | | STEP 7 (TIA Portal) | GSD file in STEP 7 (TIA Portal) V12 or higher, or STEP 7 V5.5 SP3 or higher |
| Firmware update | V1.0.0 or higher | V12 or higher | X |
| Identification data I&M0 to I&M3 | V1.0.0 or higher | V12 or higher | X |
| Parameter assignment in RUN | V1.0.0 or higher | V12 or higher | X |
| Isochronous mode | V1.0.0 or higher | V12 or higher | --- |
| Calibration in runtime | V1.0.0 or higher | V12 or higher | X |
| Module-internal Shared Output (MSO) | V2.0.0 or higher | V13 Update 3 or higher (PROFINET IO only) | X (PROFINET IO only) |
| Configurable submodules / submodules for Shared Device | V2.0.0 or higher | V13 Update 3 or higher (PROFINET IO only) | X (PROFINET IO only) |
| Oversampling | V2.1.0 or higher | V14 or higher and HSP 0186 (PROFINET IO only) | --- |

You can configure the module with STEP 7 (TIA Portal) and with a GSD file. The oversampling function requires isochronous mode and can therefore only be configured with STEP 7 (TIA Portal).

### Accessories

The following accessories are supplied with the module and can also be ordered separately as spare parts:

- Shield bracket
- Shield terminal
- Power supply element
- Labeling strips
- U connector
- Universal front door

### Other components

The following component can be ordered separately:

Front connectors, including potential jumpers and cable ties

You can find additional information on accessories in the S7-1500/ET 200MP (http://support.automation.siemens.com/WW/view/en/59191792) system manual.

## 2.2 Functions

### 2.2.1 Oversampling for outputs

### Function

Oversampling is defined as the transfer 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 outputs a 16-bit value per channel.
- The shortest possible sub-cycle is 125 µs.
- Sub-cycles are possible in increments of 2 to 16. The following applies here: Isochronous data cycle / number of sub-cycles ≥ permitted sub-cycle duration (125 µs).

## Typical area of application

Controlling of a feed valve because output data can be controlled exactly at the current position of the machine.

## Requirements

- Firmware version V2.1.0 or higher of the module.
- Isochronous mode has to be set.

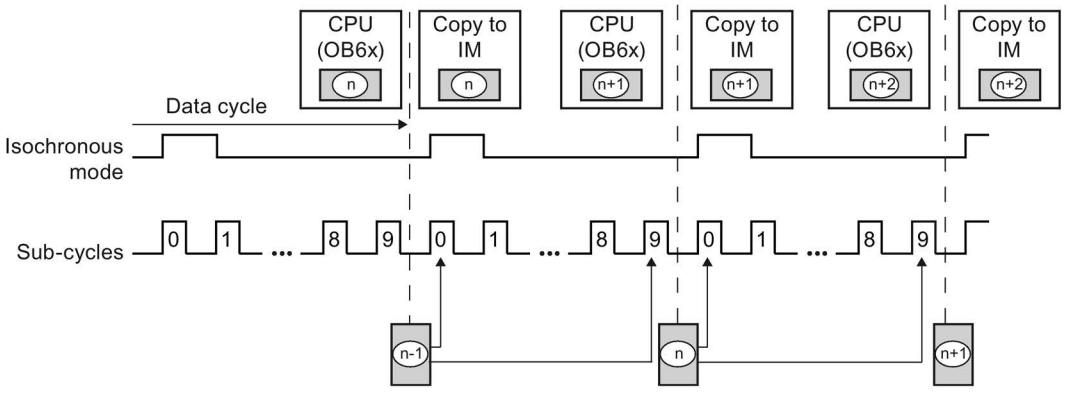
## Configuration

You configure the oversampling function by means of the output rate parameter.

## Chronological sequence

The existing output data of a data cycle (send clock) is copied into the interface module in the next data cycle and is available for the module in the data cycle after that.

The figure below shows the chronological sequence for oversampling with 10 sub-cycles.




n Output value from cycle n

Figure 2-2 Chronological sequence with oversampling

## Output interval

The duration of a sub-cycle corresponds to the output interval. The bus cycle time $T_{DP}$ (send clock for isochronous mode) is specified in the configuration software. The actual output interval of the module results from this time divided by the set sampling rate (2-16).

$$\text{Output interval} = \frac{T_{DP}}{n_{Sample}} = \frac{2\ \text{ms}}{16} = 125\ \mu\text{s}$$

Figure 2-3 Example for the calculation of the output interval

# Wiring

# 3

This section contains the block diagram of the module and outlines various connection options.

You can find information on wiring the front connector, establishing a cable shield, etc in the Wiring section of the S7-1500/ET 200MP (http://support.automation.siemens.com/WW/view/en/59191792) system manual.

**Note**

- You may use and combine the different wiring options for all channels.
- Do not insert the potential jumpers included with the front connector!

## Abbreviations used

Meaning of the abbreviations used in the figures below:

| | |
|---|---|
| $QV_n$ | Voltage output channel |
| $QI_n$ | Current output channel |
| Sn+/Sn- | Sense line channel |
| L+ | Supply voltage connection |
| M | Ground connection |
| $M_{ANA}$ | Reference potential of the analog circuit |
| CHx | Channel or display of the channel status |
| PWR | Display for the supply voltage |

## Pin assignment for the power supply element

The power supply element is plugged onto the front connector for powering the analog module. Wire the supply voltage to terminals 41 (L+) and 44 (M). Use terminals 42 (L+) and 43 (M) to loop the potential to the next module.

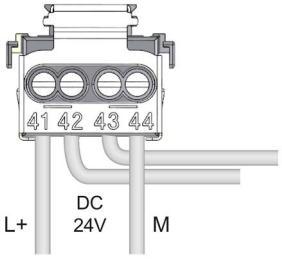
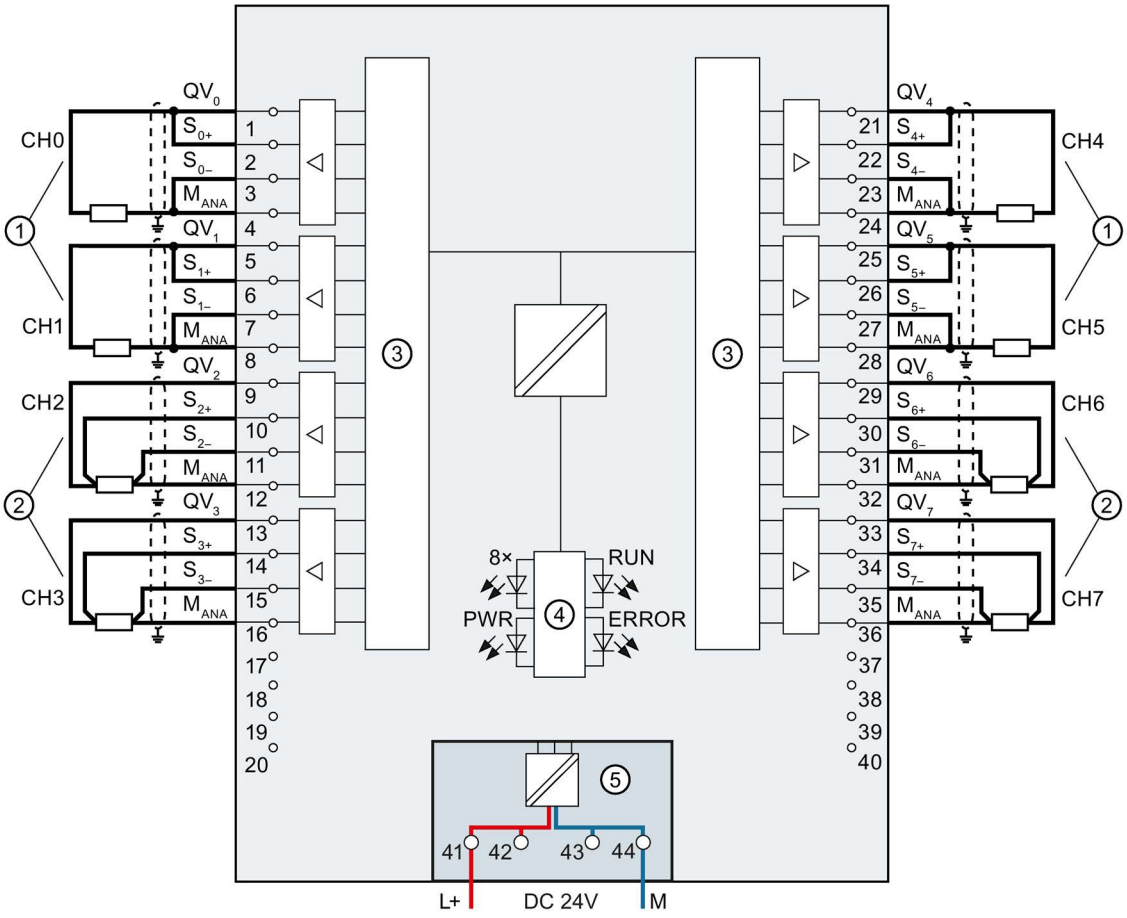



Figure 3-1 Power supply element wiring

## Block diagram and terminal assignment for the voltage output

The example in the figure below shows the pin assignment for a voltage measurement.

- 2-wire connection, no compensation for line impedance.
- 4-wire connection with compensation for line impedance is displayed.

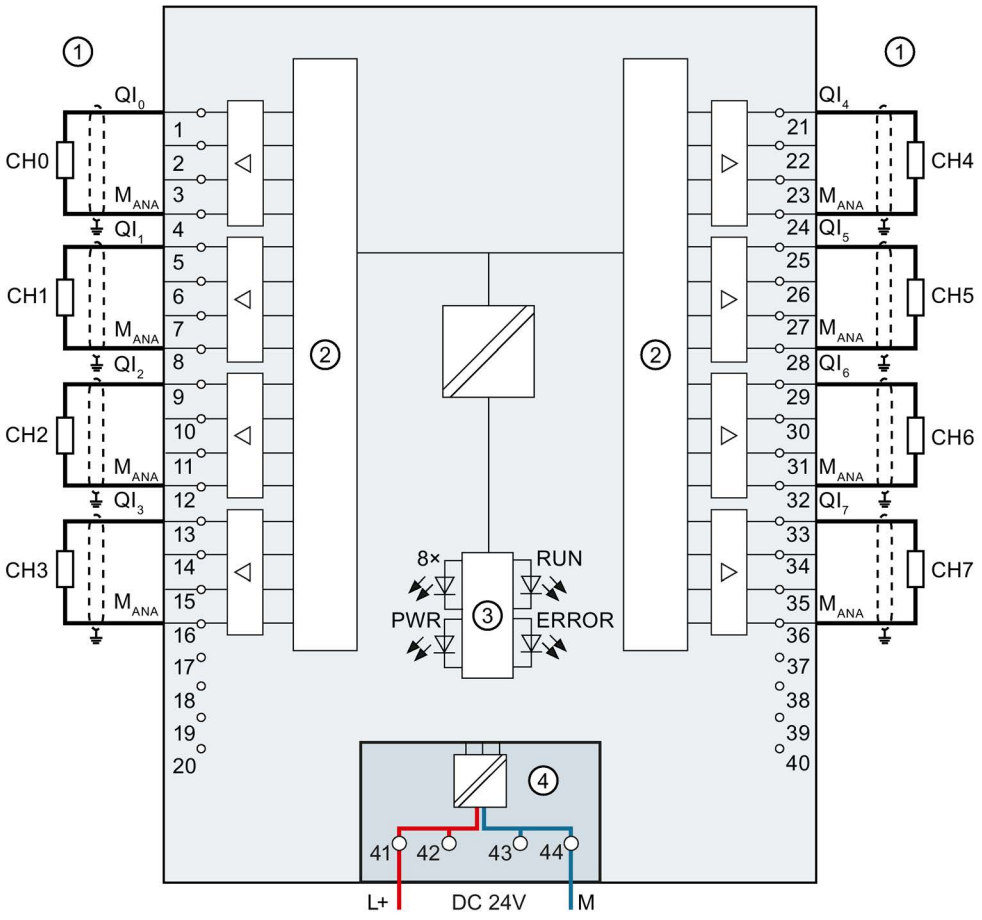



| | | | |
|---|---|---|---|
| ① | 2-wire connection (jumper at the front connector) | CHx | Channel or 8 x channel status (green/red) |
| ② | 4-wire connection | RUN | Status display LED (green) |
| ③ | Digital Analog Converter (DAC) | ERROR | Error display LED (red) |
| ④ | Backplane bus interface | PWR | LED for power supply (green) |
| ⑤ | Supply voltage via power supply element | | |

Figure 3-2 Block diagram and terminal assignment for the voltage output

## Block diagram and terminal assignment for a current output

The following figure shows an example of the terminal assignment for current output circuitry.




| | | | |
|---|---|---|---|
| ① | Load on current outputs | CHx | Channel or 8 x channel status (green/red) |
| ② | Digital Analog Converter (DAC) | RUN | Status display LED (green) |
| ③ | Backplane bus interface | ERROR | Error display LED (red) |
| ④ | Supply voltage via power supply element | PWR | LED for power supply (green) |

Figure 3-3 Block diagram and terminal assignment for a current output

# Parameters/address space

# 4

## 4.1 Output ranges

The module is set to voltage output type by default with output range ±10 V. You need to edit the module parameters with STEP 7 if you want to use a different output range or output type.

### Output type and output ranges

| Output type | Output range | Representation of analog values |
|---|---|---|
| Voltage | 1 V to 5 V<br>0 V to 10 V<br>±10 V | See Appendix Representation of analog values in the voltage output ranges (Page 48). |
| Current | 0 mA to 20 mA<br>4 mA to 20 mA<br>±20 mA | See Appendix Representation of analog values in the current output ranges (Page 49). |
| Deactivated | - | |

The tables of the output ranges, overflow, overrange, etc. are available in the Appendix Representation of analog values (Page 46).

# 4.2 Parameters

## Parameters of AQ 8xU/I HS

The AQ 8xU/I HS is usually already integrated in the hardware catalog of STEP 7 (TIA Portal). In this case, STEP 7 (TIA Portal) checks the configured properties for plausibility during configuration.

However, you can also assign parameters to the module by means of a GSD file and the configuration software of any provider. The module does not check the validity of the configured properties until after the configuration has been loaded.

When you assign the module parameters in STEP 7, you use various parameters to specify the module properties. 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 a S7-1500 CPU
- Distributed operation on PROFINET IO in an ET 200MP system
- Distributed operation on PROFIBUS DP in an ET 200MP 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 chapter Parameter assignment and structure of the parameter data records (Page 42).

Table 4- 1 Configurable parameters and their defaults

| Parameters | Range of values | Default setting | Parameter assignment in RUN | Scope with configuration software, e.g., STEP 7 (TIA Portal) | |
|---|---|---|---|---|---|
| | | | | Integrated in the hardware catalog STEP 7 (TIA Portal) as of V12 or GSD file PROFINET IO | GSD file PROFIBUS DP |
| **AQ configuration** | | | | | |
| Output rate<br>(for the oversampling function) | 1...16 values/cycle | 1 | No | Module<br>(not GSD file) | --- |
| **Diagnostics** | | | | | |
| • Missing supply voltage L+ | Yes/No | No | No | Channel [1] | Module [2] |
| • Wire break | Yes/No | No | No | Channel | Module [2] |
| • Short circuit to ground | Yes/No | No | No | Channel | Module [2] |
| • Overflow | Yes/No | No | No | Channel | Module [2] |
| • Underflow | Yes/No | No | No | Channel | Module [2] |

| Parameters | Range of values | Default setting | Parameter assignment in RUN | Scope with configuration software, e.g., STEP 7 (TIA Portal) | |
|---|---|---|---|---|---|
| | | | | Integrated in the hardware catalog STEP 7 (TIA Portal) as of V12 or GSD file PROFINET IO | GSD file PROFIBUS DP |
| **Output** | | | | | |
| • Output type | Voltage/current | Voltage | Yes | Channel | Channel |
| • Output range | See chapter output ranges (Page 18) | ±10 V | Yes | Channel | Channel |
| • Reaction to CPU STOP | • Turn off<br>• Keep last value<br>• Output substitute value [4] | Turn off | Yes | Channel | Channel [3]<br>• Turn off<br>• Keep last value |
| • Substitute value | See Parameter assignment and structure of the parameter data records (Page 42) | 0 | Yes | Channel | --- [3] |

[1] If you enable diagnostics for multiple channels, you will receive an alarm surge on failure of the supply voltage because each enabled channel will detect this fault.

You can prevent this message burst by assigning the diagnostics function to one channel only.

[2] You can set the effective range of the diagnostics for each channel in the user program with data records 64 to 71.

[3] You can configure the setting "Output substitute value" and the substitute value in the user program by means of data records 64 to 71.

## Short-circuit detection

The diagnostics for short circuit to ground can be configured for the voltage output type. A short-circuit detection is not possible for small output values; the output voltages must therefore be below -0.5 V or above +0.5 V.

## Open-circuit detection

The diagnostics for open circuit can be configured for the current output type. An open-circuit detection is not possible for small output values; the output voltages must therefore be below -3 mA or above +3 mA.

## 4.3 Declaration of parameters

### Output rate

Specifies the number of sub-cycles per isochronous data cycle for the for the oversampling function.

### Missing supply voltage L+

Enabling of the diagnostics, with missing or too little supply voltage L+.

### Wire break

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

### Short circuit to ground

Enabling of the diagnostics if a short-circuit of the output to $M_{ANA}$ occurs.

### Overflow

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

### Underflow

Enabling of the diagnostics when the output value violates the underrange.

### Reaction to CPU STOP

Determines the reaction of the output to the CPU going into STOP state.

### Substitute value

The substitute value is the value that the module outputs in case of a CPU STOP.

# 4.4 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 outputs/inputs.

## Configuration options of AQ 8xU/I HS

You can configure the module with STEP 7 (TIA Portal) or with a GSD file.

When you configure the module by means of the GSD file, the configurations are available under different abbreviations/module names.

The following configurations are possible:

Table 4- 2 Configuration options

| Configuration | Abbreviation/module name in the GSD file | Configuration software, e.g., with STEP 7 (TIA Portal) | |
|---|---|---|---|
| | | Integrated in hardware catalog STEP 7 (TIA Portal) | GSD file in STEP 7 (TIA Portal) V12 or higher or STEP 7 V5.5 SP3 or higher |
| 1 x 8-channel without value status | AQ 8xU/I HS | V12 or higher | X |
| 1 x 8-channel with value status | AQ 8xU/I HS QI | V12 or higher | X |
| 8 x 1-channel without value status | AQ 8xU/I HS S | V13 Update 3 or higher (PROFINET IO only) | X (PROFINET IO only) |
| 8 x 1-channel with value status | AQ 8xU/I HS S QI | V13 Update 3 or higher (PROFINET IO only) | X (PROFINET IO only) |
| 1 x 8-channel with value status for module-internal Shared Output with up to 4 submodules | AQ 8xU/I HS MSO | V13 Update 3 or higher (PROFINET IO only) | X (PROFINET IO only) |
| 1 x 8-channel without value status for oversampling | --- | V14 or higher with HSP 0186 (PROFINET IO only) | --- |

## Value status (Quality Information, QI)

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

- AQ 8xU/I HS QI
- AQ 8xU/I HS S QI
- AQ 8xU/I HS MSO

An additional bit is assigned to each channel for the value status. The bit for the value status indicates if the output value specified by the user program is actually pending at the module terminal (0 = value is incorrect).

## Address space of the AQ 8xU/I HS and AQ 8xU/I HS QI

The following figure shows the address space allocation for the configuration as 8-channel module. You can freely assign the start address for the module. The addresses of the channels are derived from the start address.

"QB x" stands, for example, for the module start address output byte x.

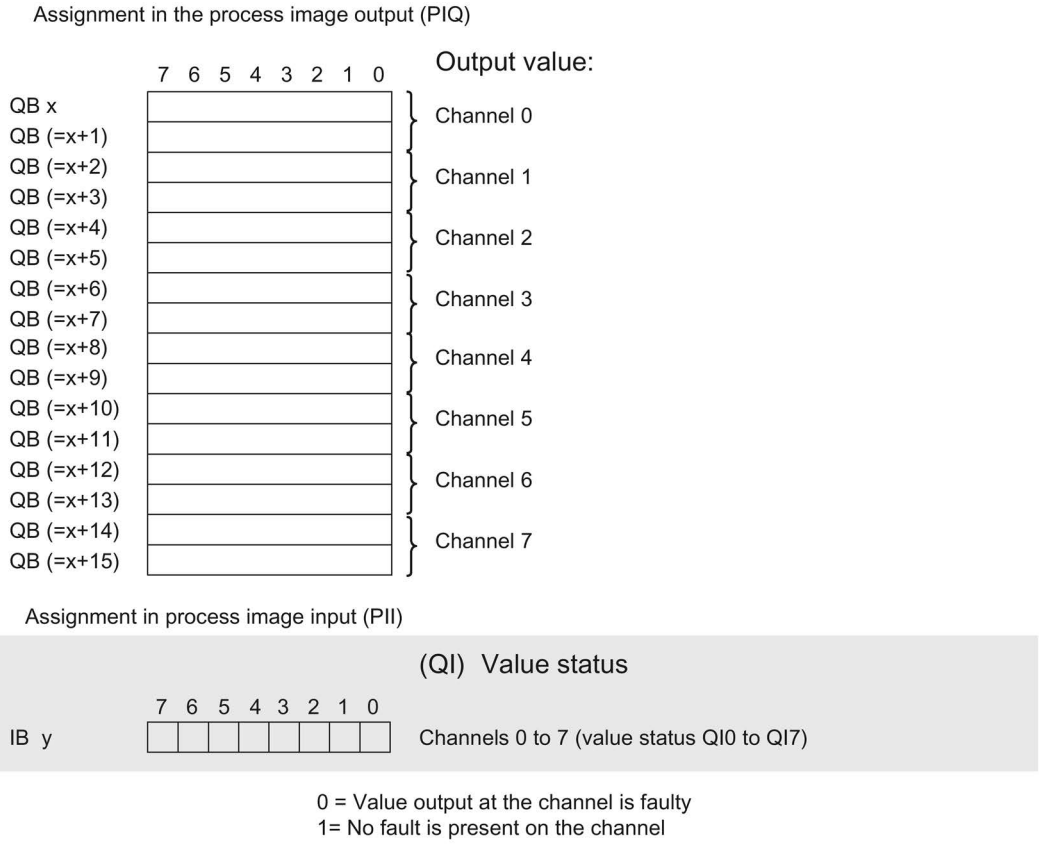



Figure 4-1 Address space for configuration as 1 x 8-channel AQ 8xU/I HS with value status

## Address space for configuration as 8 x 1-channel AQ 8xU/I HS QI and AQ 8xU/I HS S QI

For the configuration as a 8 x 1-channel module, the channels of the module are divided into multiple submodules. The submodules can be assigned to different IO controllers when the module is used in a shared device.

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

Contrary to the 1 x 8-channel module configuration, each of the eight submodules has a freely assignable start address.

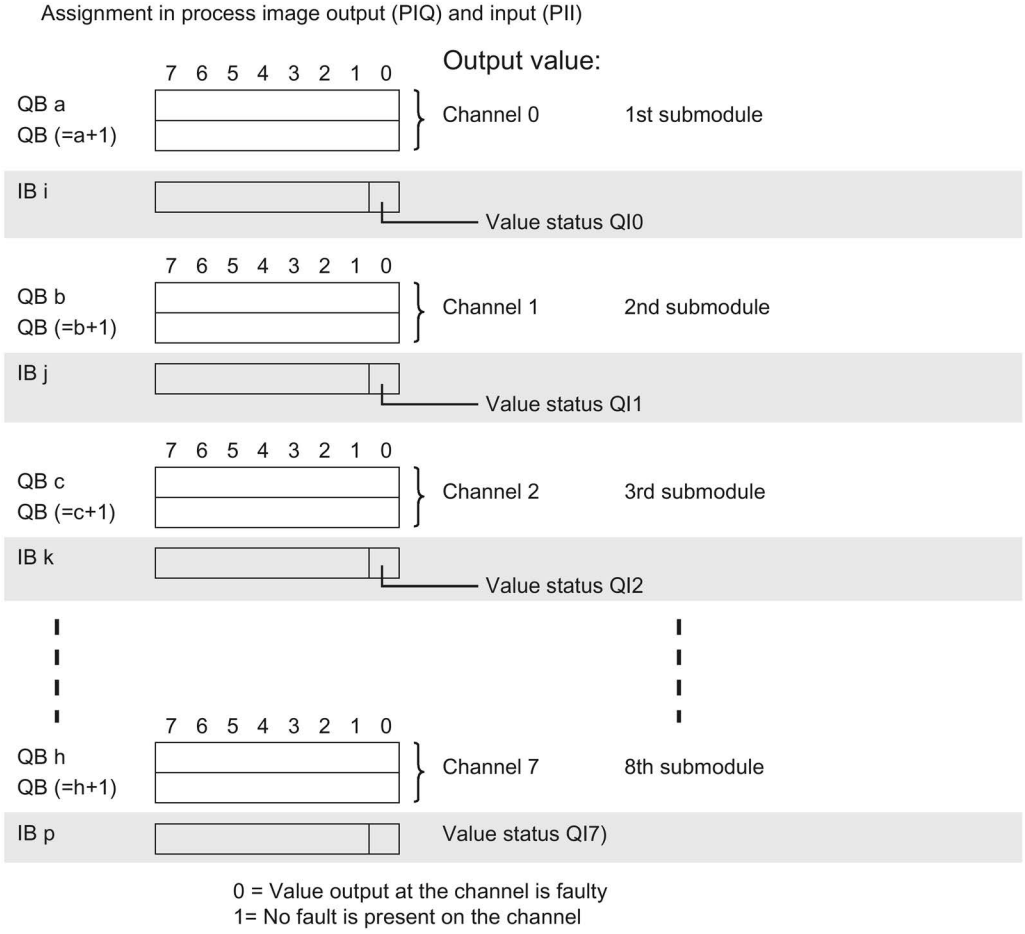



Figure 4-2 Address space for configuration as 8 x 1-channel AQ 8xU/I HS S QI with value status

## Address space for configuration as 1 x 8-channel AQ 8xU/I HS MSO

For the configuration as a 1 x 8-channel module (module-internal Shared Output, MSO), channels 0 to 7 of the module are copied to multiple submodules. Channels 0 to 7 are then available with identical values in various submodules. These submodules can be assigned to up to four IO controllers when the module is used in a shared device.

- The IO controller to which submodule 1 is assigned has write access to outputs 0 to 7.
- The IO controllers to which submodule 2, 3, or 4 is assigned have read access to outputs 0 to 7.

The number of usable IO controllers depends 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 or that the IO controller of the basic submodule is in STOP state.

For the 2nd to 4th submodule (=MSO submodule), the value status 0 indicates that the value is incorrect or one of the following errors has occurred:

- The basic submodule is not yet configured (not ready).
- The connection between the IO controller and the basic submodule has been interrupted.
- The IO controller of the basic submodule is in STOP or POWER OFF state.

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

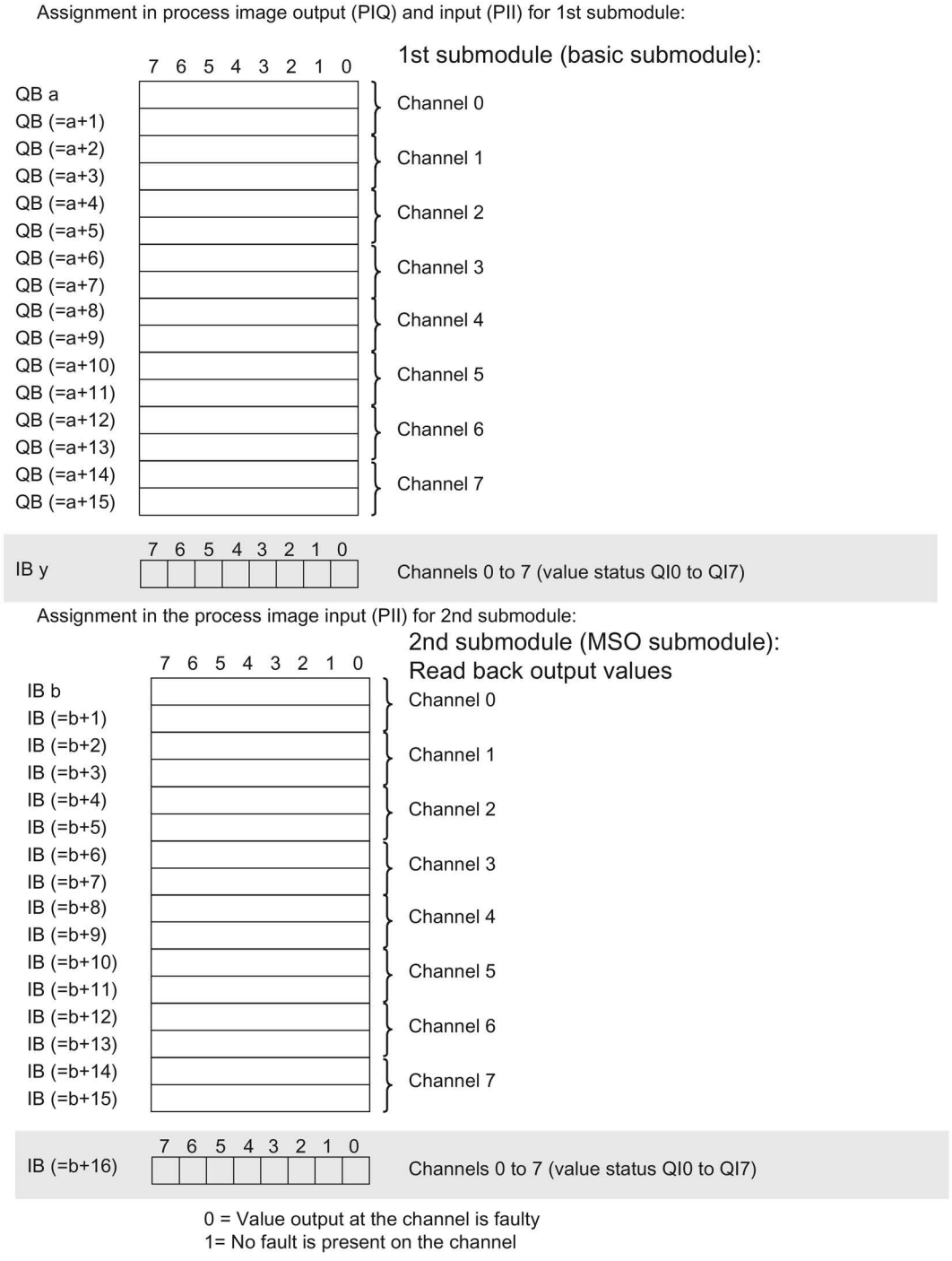



Figure 4-3 Address space for configuration as 1 x 8-channel AQ 8xU/I HS MSO with value status

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

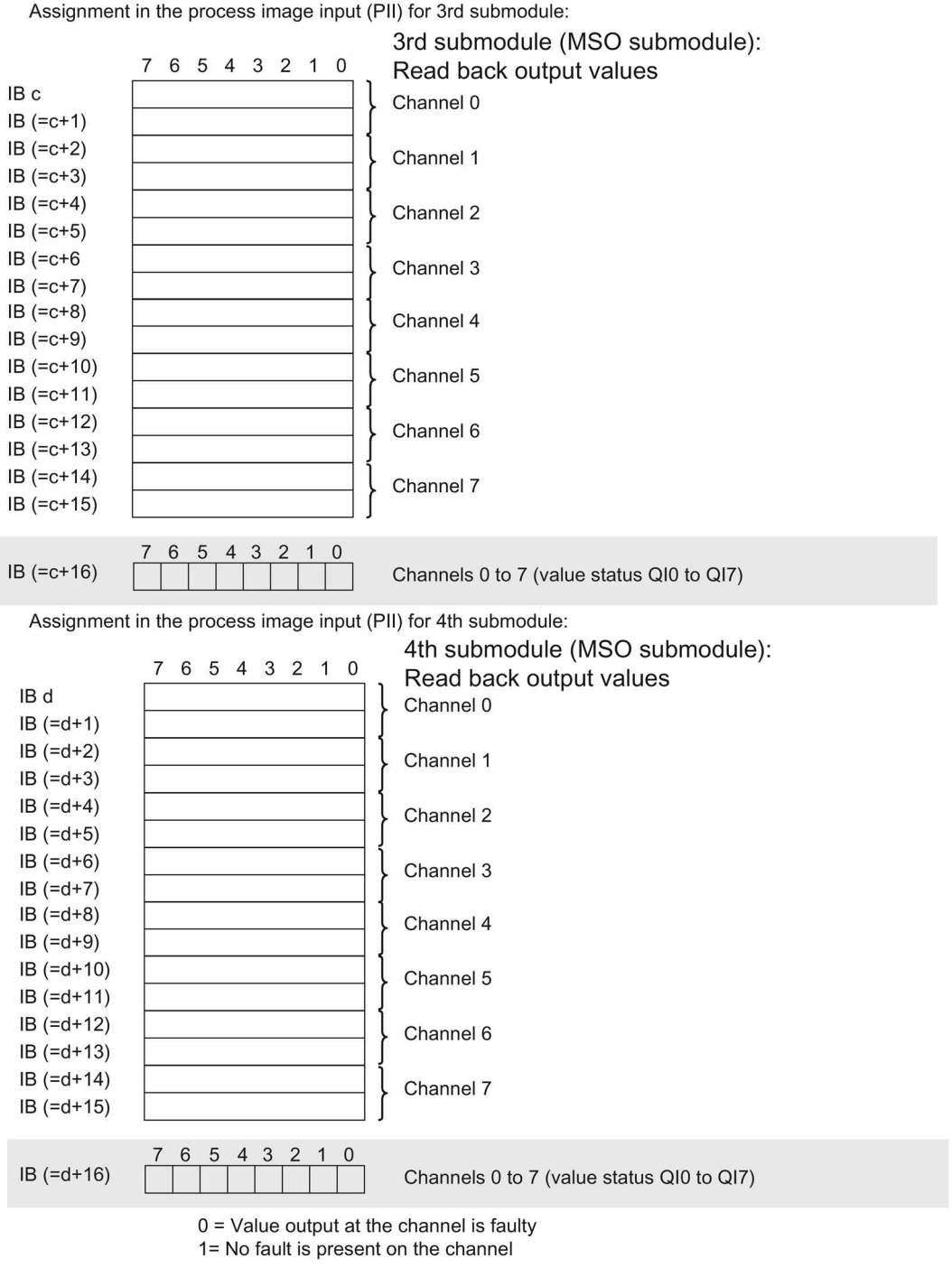



Figure 4-4 Address space for configuration as 1 x 8-channel AQ 8xU/I HS MSO with value status

### Reference

You can find information on the Shared Input/Output (MSI/MSO) function in the section Module-Internal Shared Input/Output (MSI/MSO) of the PROFINET with STEP 7 V13 (https://support.industry.siemens.com/cs/ww/en/view/49948856) function manual.

### Address space for configuration as 1 x 8-channel AQ 8xU/I HS for oversampling

The following figure shows the address space assignment with the configuration as 8-channel module for the oversampling function. You can freely assign the start address for the module. The addresses of the channels are derived from the start address.

Writing always starts from QB x. If fewer than 16 sub-cycles are set, the addresses that are then unused are ignored.

"QB x" stands, for example, for the module start address output byte x.

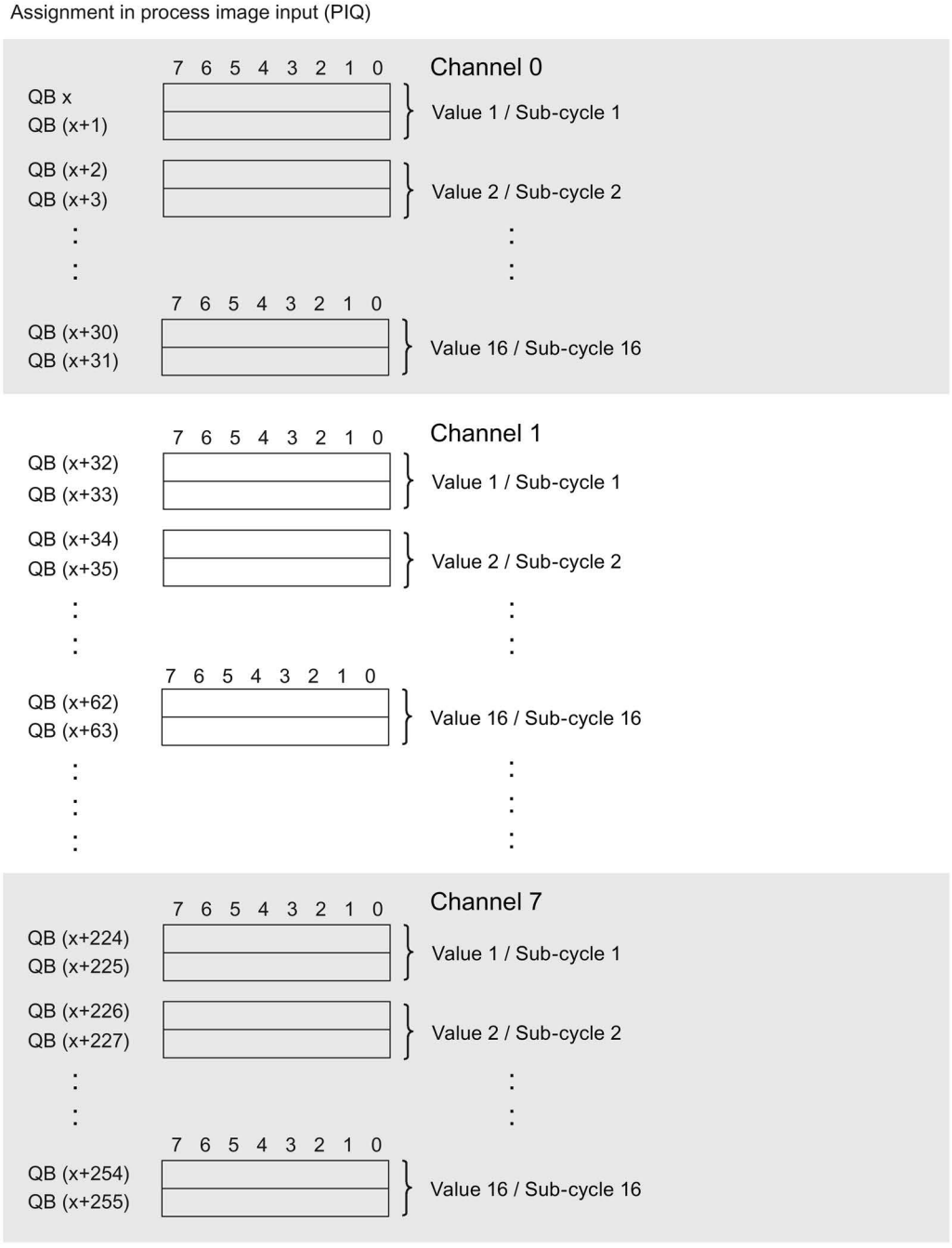



Figure 4-5 Address space for configuration as 1 x 8-channel AI 8xU/I HS for oversampling

# Interrupts/diagnostics alarms

# 5

## 5.1 Status and error displays

### LED displays

The figure below shows the LED displays (status and error displays) of the AQ 8xU/I HS.

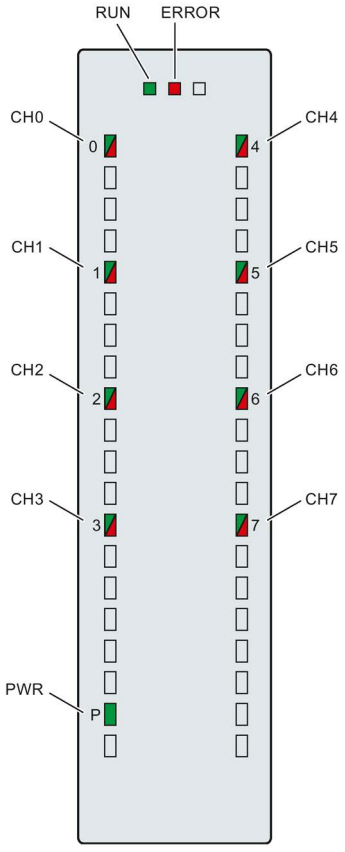



Figure 5-1 LED displays of the AQ 8xU/I HS module

## Meaning of the LED displays

The following tables explain the meaning of the status and error displays. Remedial measures for diagnostic alarms can be found in section Diagnostic alarms.

## RUN and ERROR LED

Table 5- 1 Status and error displays RUN and ERROR

| LED | | Meaning | Remedy |
|---|---|---|---|
| RUN | ERROR | | |
| ☐ Off | ☐ Off | Voltage missing or too low at backplane bus | • Switch on the CPU and/or the system power supply modules.<br>• Verify that the U connectors are inserted.<br>• Check to see if too many modules are inserted. |
| ☼ Flashes | ☐ Off | The module starts and flashes until the valid parameter assignment is set. | --- |
| ■ On | ☐ Off | Module is configured | |
| ■ On | ☼ Flashes | Indicates module errors (at least one error at one channel, e.g., wire break). | Evaluate the diagnostics data and eliminate the error (e.g., wire break). |
| ☼ Flashes | ☼ Flashes | Hardware defective | Replace the module. |

## PWR LED

Table 5- 2 PWR status display

| LED PWR | Meaning | Remedy |
|---|---|---|
| ☐ Off | Supply voltage L+ too low or missing | Check the L+ supply voltage. |
| ■ On | Supply voltage L+ is present and OK | --- |

## CHx LED

Table 5- 3 CHx status display

| LED CHx | Meaning | Remedy |
|---|---|---|
| ☐ Off | Channel deactivated | --- |
| ■ On | Channel configured and OK | --- |
| ■ On | Diagnostic alarm: e.g., wire break, overflow, underflow | Check the wiring.<br>Disable diagnostics. |

### See also

Diagnostics alarms (Page 33)

## 5.2 Interrupts

The analog output module AQ 8xU/I HS supports diagnostic interrupts.

You can find detailed information on the event in the error organization block with the RALRM instruction (read additional interrupt info) and in the STEP 7 online help.

### Diagnostic interrupt

The module generates a diagnostic interrupt at the following events:

- Missing supply voltage L+
- Short circuit to ground
- Wire break
- Overflow
- Underflow
- Parameter assignment error

## 5.3 Diagnostics alarms

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

If the module is operated distributed with PROFIBUS DP in an ET 200MP system, you have the option to read out diagnostics data with the instruction RDREC or RD_REC using data record 0 and 1. The structure of the data records is available on the Internet in the "Manual for interface module IM 155-5 DP ST (6ES7155-5BA00-0AB0)".

Table 5- 4 Diagnostics alarms, their meaning and corrective measures

| Diagnostics alarm | Error code | Meaning | Remedy |
|---|---|---|---|
| Short circuit to ground | $1_H$ | Overload at output | Eliminate overload |
| | | Short-circuit of output $Q_V$ to $M_{ANA}$ | Eliminate the short-circuit |
| Wire break | $6_H$ | Encoder circuit impedance too high | Use a different actuator type or modify the wiring, for example, use cables with larger cross-section |
| | | Wirebreak between the module and actuator | Connect the cable |
| | | Channel not connected (open) | • Disable the channel ("output type" parameter)<br>• Connect the channel |
| Overflow | $7_H$ | The output value set by the user program exceeds the valid rated range/overshoot range. | Correct the output value |
| Underflow | $8_H$ | The output value set by the user program undershoots the valid rated range/undershoot range. | Correct the output value |
| Parameter assignment error | $10_H$ | • The module cannot evaluate parameters for the channel<br>• Incorrect parameter assignment. | Correct the parameter assignment |
| Load voltage missing | $11_H$ | Supply voltage L+ of the module is missing | Connect supply voltage L+ to module |

# Technical specifications

# 6

## Technical specifications of the AQ 8xU/I HS

| | 6ES7532-5HF00-0AB0 |
|---|---|
| **General information** | |
| Product type designation | AQ 8xU/I HS |
| Hardware functional status | FS01 |
| Firmware version | V2.1.0 |
| • FW update possible | Yes |
| **Product function** | |
| I&M data | Yes; I&M0 to I&M3 |
| Scalable output range | No |
| **Engineering with** | |
| STEP 7 TIA Portal can be configured/integrated as of version | V14 / - |
| STEP 7 can be configured/integrated as of version | V5.5 SP3 / - |
| PROFIBUS as of GSD version/GSD revision | V1.0 / V5.1 |
| PROFINET as of GSD version/GSD revision | V2.3 / - |
| **Operating mode** | |
| Oversampling | Yes |
| MSO | 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) | 20.4 V |
| Valid range, high limit (DC) | 28.8 V |
| Reverse polarity protection | Yes |
| **Input current** | |
| Current consumption, max. | 260 mA; with 24 V DC supply |
| **Power** | |
| Power consumption from the backplane bus | 1.15 W |
| **Power loss** | |
| Power loss, typ. | 7 W |

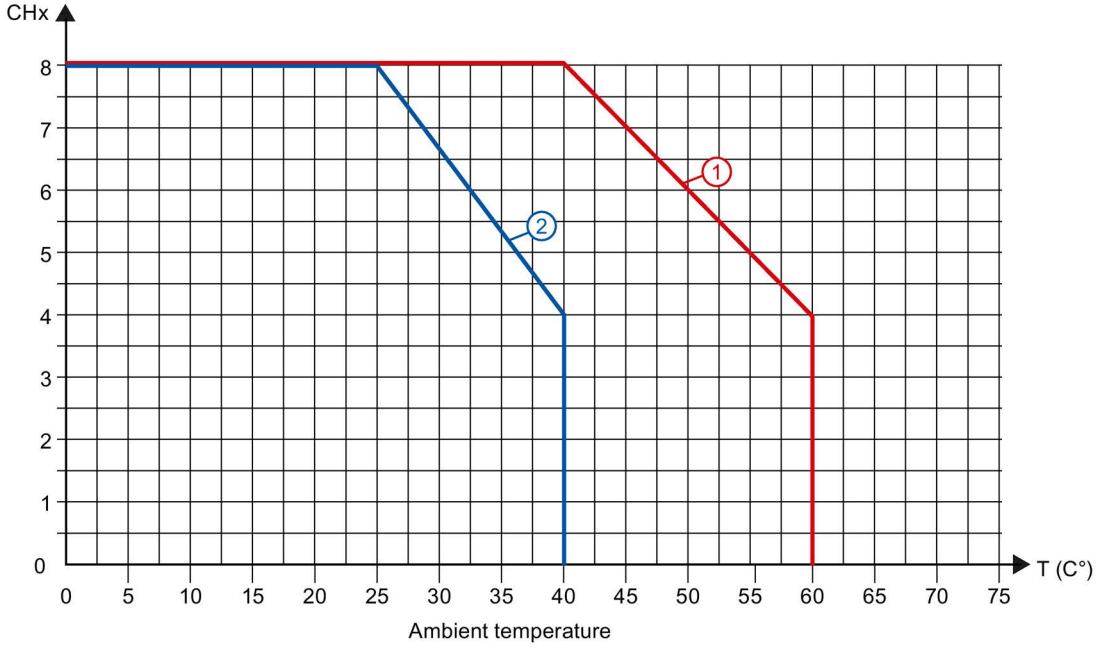
| | 6ES7532-5HF00-0AB0 |
|---|---|
| **Analog outputs** | |
| Number of analog outputs | 8 |
| Voltage output, short-circuit protection | Yes |
| Voltage output, short-circuit current, max. | 45 mA |
| Current output, open-circuit voltage, max. | 20 V |
| Cycle time (all channels), min. | 125 µs; regardless of the number of activated channels |
| **Output ranges, voltage** | |
| 0 V to 10 V | Yes |
| 1 V to 5 V | Yes |
| -10 V to +10 V | Yes |
| **Output ranges, current** | |
| 0 mA to 20 mA | Yes |
| -20 mA to +20 mA | Yes |
| 4 mA to 20 mA | Yes |
| **Connection of actuators** | |
| for voltage output two-wire connection | Yes |
| for voltage output four-wire connection | Yes |
| for current output two-wire connection | Yes |
| **Load resistance (in the rated output range)** | |
| for voltage outputs, min. | 1 kΩ |
| for voltage outputs, capacitive load, max. | 100 nF |
| for current outputs, max. | 500 Ω |
| for current outputs, inductive load, max. | 1 mH |
| **Cable length** | |
| shielded, max. | 200 m |
| **Analog value generation for the outputs** | |
| **Integration and conversion time/resolution per channel** | |
| Resolution with overrange (bit including sign), max. | 16 bit |
| Conversion time (per channel) | 50 µs; regardless of the number of activated channels |
| **Settling time** | |
| for resistive load | 30 µs; see additional description in the manual |
| for capacitive load | 100 µs; see additional description in the manual |
| for inductive load | 100 µs; see additional description in the manual |

| | 6ES7532-5HF00-0AB0 |
|---|---|
| **Errors/accuracies** | |
| Output ripple (relative to output range, bandwidth 0 to 50 kHz), (+/-) | 0.02% |
| Linearity error (relative to output range), (+/-) | 0.15% |
| Temperature error (in relation to output range), (+/-) | 0.002%/K |
| Crosstalk between outputs, max. | -100 dB |
| Repeat accuracy in settled state at 25 °C (in relation to output range), (+/-) | 0.05% |
| **Operational limit in overall temperature range** | |
| Voltage in relation to output range, (+/-) | 0.3% |
| Current in relation to output range, (+/-) | 0.3% |
| **Basic error limit (operational limit at 25 °C)** | |
| Voltage in relation to output range, (+/-) | 0.2% |
| Current in relation to output range, (+/-) | 0.2% |
| **Isochronous mode** | |
| Isochronous mode (application synchronized up to terminal) | Yes |
| Execution and activation time (TCO), min. | 100 µs |
| Bus cycle time (TDP), min. | 250 µs |
| **Interrupts/diagnostics/status information** | |
| Diagnostics function | Yes |
| Substitute values can be applied | Yes |
| **Interrupts** | |
| Diagnostic interrupt | Yes |
| **Diagnostics alarms** | |
| Monitoring of supply voltage | Yes |
| Wire break | Yes; only for output type current |
| Short-circuit | Yes; only for output type voltage |
| Overflow/underflow | Yes |
| **Diagnostics indicator LED** | |
| RUN LED | Yes; green LED |
| ERROR LED | Yes; red LED |
| Monitoring of supply voltage (PWR LED) | Yes; green LED |
| Channel status display | Yes; green LED |
| For channel diagnostics | Yes; red LED |
| For module diagnostics | Yes; red LED |
| **Electrical isolation** | |
| **Electrical isolation of channels** | |
| Between the channels | No |
| Between the channels, in groups of | 8 |
| Between the channels and backplane bus | Yes |
| Between the channels and load voltage L+ | Yes |

| | 6ES7532-5HF00-0AB0 |
|---|---|
| **Permitted potential difference** | |
| between S- and MANA (UCM) | 8 V DC |
| **Isolation** | |
| Isolation tested with | 707 V DC (type test) |
| **Distributed mode** | |
| Prioritized startup | No |
| **Dimensions** | |
| Width | 35 mm |
| Height | 147 mm |
| Depth | 129 mm |
| **Weights** | |
| Weight, approx. | 325 g |

## Derating depending on overall length, ambient temperature and output type (per module)

The following trends show the number of channels (CHx) that can be used simultaneously in horizontal and vertical installation of the S7-1500 automation system/ET 200MP distributed I/O system depending on the ambient temperature.




① Horizontal mounting of the system

② Vertical mounting of the system

Figure 6-1 Information on channels used simultaneously (per module) for output type: Current and voltage

**Note**

All eight channels can be used in the case of voltage outputs with load resistances > 5 kΩ and ambient temperatures up to 40° (vertical installation) or up to 60° (horizontal installation).

## Settling times for voltage outputs

The settling time for voltage outputs is influenced mainly by the capacitive load.

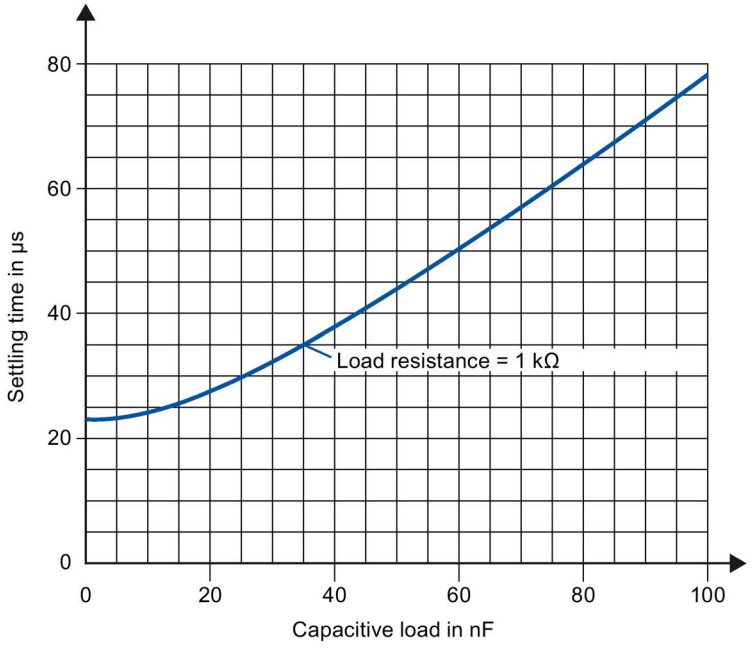



Figure 6-2 Typical settling times for voltage outputs

## Settling times for current outputs

The settling time for current outputs increases when the load impedance rises.

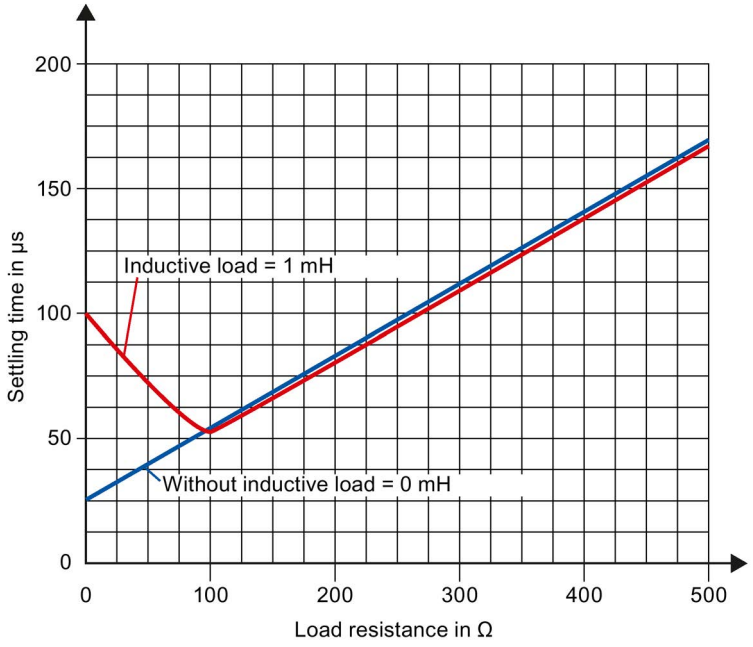



Figure 6-3 Typical settling times for current outputs

## See also

Parameters (Page 19)

# Dimensional drawing

# A

This appendix contains the dimensional drawing of the module installed on a mounting rail and with a shield bracket. Always observe the specified dimensions for installation in cabinets, control rooms, etc.

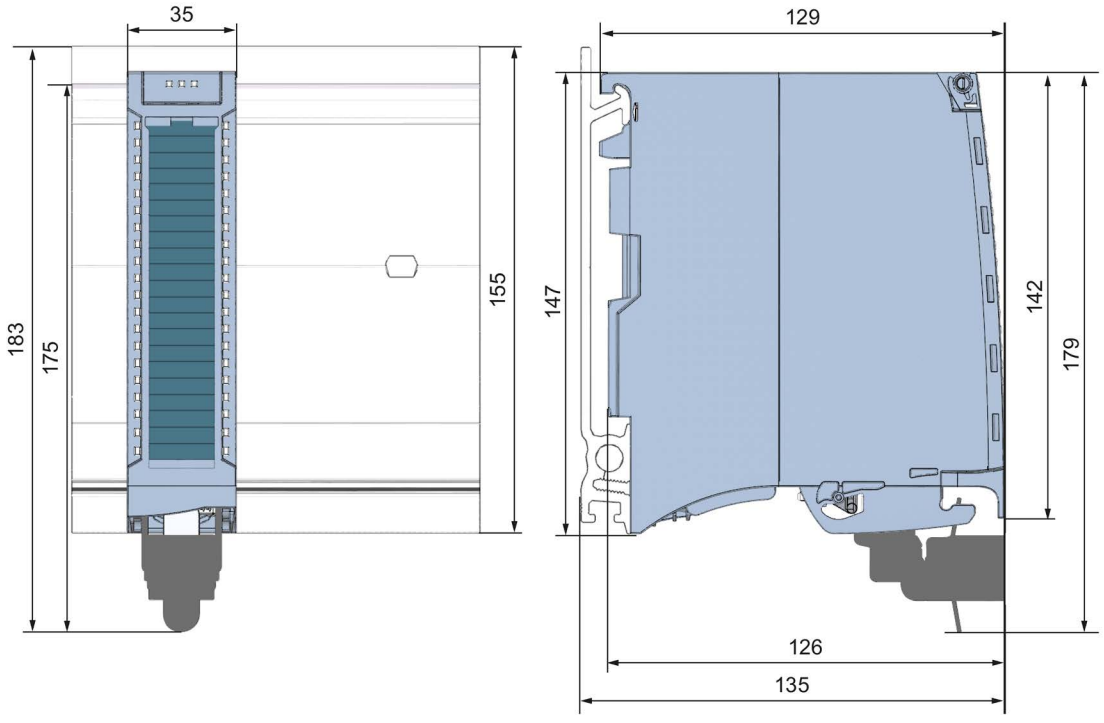



Figure A-1 Dimensional drawing of the AQ 8xU/I HS module


Figure A-2 Dimensional drawing of the AQ 8xU/I HS module, side view with open front panel

# Parameter data records

# B

## B.1 Parameter assignment and structure of the parameter data records

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

### Dependencies for configuration with GSD file

When configuring the module with a GSD file, remember that the settings of some parameters are dependent on each other. The parameters are only checked for plausibility by the module after the transfer to the module.

The following table lists the parameters that depend on one another.

Table B- 1 Dependencies of parameters for configuration with GSD file

| Device-specific parameters (GSD file) | Dependent parameters |
|---|---|
| Short circuit to ground | With **output type** voltage only |
| Wire break | With **output type** current only |
| Substitute value | Only if **Reaction to CPU STOP** -> **Output substitute value** is configured |

### Parameter assignment in the user program

You have the option to assign module parameters in RUN (e.g., the voltage or current values of selected channels can be edited in RUN without having an effect on the other channels).

### Parameter assignment in RUN

The WRREC instruction is used to transfer the parameters to the module using data records 64 to 71. The parameters set in STEP 7 do not change in the CPU, which means the parameters set in STEP 7 are still valid after a restart.

The parameters are only checked for plausibility by the module after the transfer to the module.

### Output parameter STATUS

The module ignores errors that occurred during the transfer of parameters with the WRREC instruction and continues operation with the previous parameter assignment. However, a corresponding error code is written to the STATUS output parameter.

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

### Operation of the module behind a PROFIBUS DP interface module

If the module is operated behind a PROFIBUS DP interface module, the parameter data records 0 and 1 are not read back. You obtain the diagnostics data records 0 and 1 with the read back parameter data records 0 and 1. You can find additional information in the Interrupts section of the manual for the PROFIBUS DP interface module on the Internet (http://support.automation.siemens.com/WW/view/en/78324181).

### Assignment of data record and channel

The channel parameters in data records 64 to 71 are available for 1x 8-channel configuration and are assigned as follows:

- Data record 64 for channel 0
- Data record 65 for channel 1
- ...
- Data record 70 for channel 6
- Data record 71 for channel 7

For configuration 8 x 1-channel, the module has 8 submodules with one channel each. The parameters for the channel are available in data record 64 and are assigned as follows:

- Data record 64 for channel 0 (submodule 1)
- Data record 64 for channel 1 (submodule 2)
- ...
- Data record 64 for channel 5 (submodule 6)
- Data record 64 for channel 6 (submodule 7)
- Data record 64 for channel 7 (submodule 8)

Address the respective submodule for data record transfer.

## Data record structure

The figure below shows the structure of data record 64 for channel 0 as an example. The structure is identical for channels 1 to 7. The values in byte 0 and byte 1 are fixed and may not be changed.

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

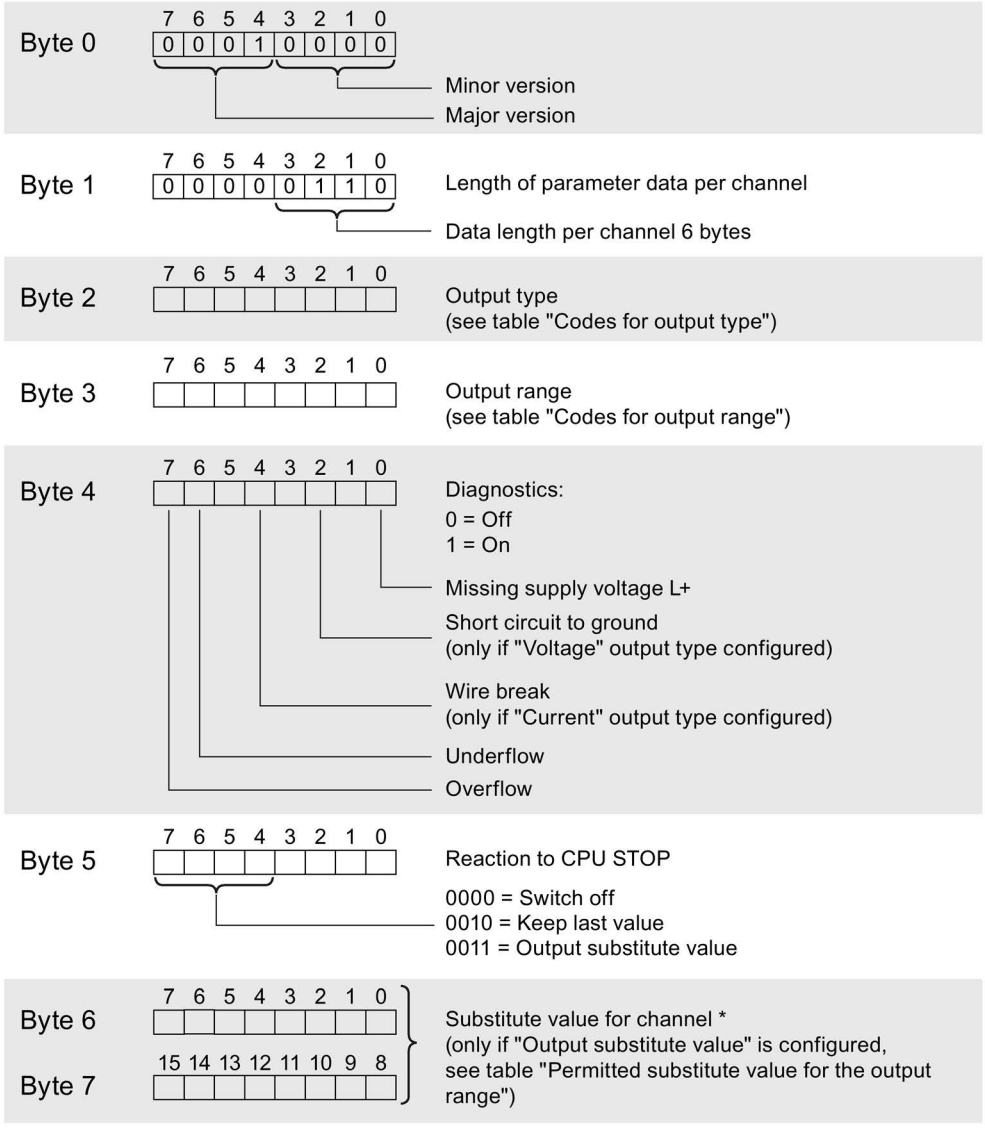



Figure B-1 Data record structure: Bytes 0 to 7

### Note

You can only configure the oversampling function with STEP 7 (TIA Portal) via the output rate parameter.

## Output type codes

The following table lists all output types of the analog output module along with their codes. Enter these codes at byte 2 of the data record for the corresponding channel (see the previous figure).

Table B- 2 Code for the output type

| Output type | Code |
|---|---|
| Deactivated | 0000 0000 |
| Voltage | 0000 0001 |
| Current | 0000 0010 |

## Codes for the output ranges

The table below contains all output ranges of the analog output module with their codes. Enter these codes at byte 3 of the data record for the corresponding channel (see the previous figure).

Table B- 3 Output range code

| Output range for voltage | Code |
|---|---|
| 1 V to 5 V | 0000 0011 |
| 0 V to 10 V | 0000 0010 |
| ±10 V | 0000 0000 |
| **Output range for current** | **Code** |
| 0 mA to 20 mA | 0000 0001 |
| 4 mA to 20 mA | 0000 0010 |
| ±20 mA | 0000 0000 |

## Valid substitute values

The following table lists all output ranges for the valid substitute values. Enter these substitute values at bytes 6 and 7 of the data record for the corresponding channel (see the previous figure). You can find the binary representation of the output ranges in section Representation of analog values (Page 46).

Table B- 4 Valid substitute value for the output range

| Output range | Valid substitute value |
|---|---|
| ±10 V | -32512 ... +32511 |
| 1 V to 5 V | -6912 ... +32511 |
| 0 V to 10 V | 0 ... +32511 |
| ±20 mA | -32512 ... +32511 |
| 4 mA to 20 mA | -6912 ... +32511 |
| 0 mA to 20 mA | 0 ... +32511 |

# Representation of analog values

# C

## Introduction

This appendix describes the analog values for all output ranges supported by the AQ 8xU/I HS analog module.

## Measured value resolution

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

Table C- 1 Resolution of the analog values

| Resolution in bits including sign | Values | | Analog value | |
|---|---|---|---|---|
| | dec | hex | high byte | low byte |
| 16 | 1 | $1_H$ | Sign 0 0 0 0 0 0 0 | 0 0 0 0 0 0 0 1 |

# C.1 Representation of output ranges

The tables below set out the digitalized representation of the output ranges by bipolar and unipolar range. The resolution is 16 bits.

Table C- 2 Bipolar output ranges

| Value dec. | Output value in % | Data word | | | | | | | | | | | | | | | | Range |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | $2^{15}$ | $2^{14}$ | $2^{13}$ | $2^{12}$ | $2^{11}$ | $2^{10}$ | $2^{9}$ | $2^{8}$ | $2^{7}$ | $2^{6}$ | $2^{5}$ | $2^{4}$ | $2^{3}$ | $2^{2}$ | $2^{1}$ | $2^{0}$ | |
| 32511 | 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 | Overshoot range |
| 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 | Rated 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 | Undershoot range |
| -32512 | -117,593 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| -32512 | -117,593 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Minimum output value** |

* When values > 32511 are specified, the output value is limited to 117.589%.

** When values < -32512 are specified, the output value is limited to -117.593%.

Table C- 3 Unipolar output ranges

| Value dec. | Output value in % | Data word | | | | | | | | | | | | | | | | Range |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | $2^{15}$ | $2^{14}$ | $2^{13}$ | $2^{12}$ | $2^{11}$ | $2^{10}$ | $2^{9}$ | $2^{8}$ | $2^{7}$ | $2^{6}$ | $2^{5}$ | $2^{4}$ | $2^{3}$ | $2^{2}$ | $2^{1}$ | $2^{0}$ | |
| 32511 | 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 | Overshoot range |
| 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 | Rated 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** |

* When values > 32511 are specified, the output value is limited to 117.589%.

** When values < 0 are specified, the output value is limited to 0%.

# C.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 C- 4 Voltage output range ±10 V

| Values | | | Voltage output range | Range |
|---|---|---|---|---|
| | dec | hex | ±10 V | |
| >117.589 % | >32511 | >7EFF | 11.76 V | Maximum output value |
| 117.589 % | 32511 | 7EFF | 11.76 V | Overshoot range |
| | 27649 | 6C01 | | |
| 100 % | 27648 | 6C00 | 10 V | Rated range |
| 75 % | 20736 | 5100 | 7.5 V | |
| 0.003617 % | 1 | 1 | 361.7 µV | |
| 0 % | 0 | 0 | 0 V | |
| | -1 | FFFF | -361.7 µV | |
| -75 % | -20736 | AF00 | -7.5 V | |
| -100 % | -27648 | 9400 | -10 V | |
| | -27649 | 93FF | | Undershoot range |
| -117.593 % | -32512 | 8100 | -11.76 V | |
| <-117.593 % | <-32512 | <8100 | -11.76 V | Minimum output value |

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

| Values | | | Voltage output range | Range |
|---|---|---|---|---|
| | dec | hex | 0 V to 10 V | |
| >117.589 % | >32511 | >7EFF | 11.76 V | Maximum output value |
| 117.589 % | 32511 | 7EFF | 11.76 V | Overshoot range |
| | 27649 | 6C01 | | |
| 100 % | 27648 | 6C00 | 10 V | Rated range |
| 75 % | 20736 | 5100 | 7.5 V | |
| 0.003617 % | 1 | 1 | 361.7 µV | |
| 0 % | 0 | 0 | 0 V | |
| <0 % | <0 | <0 | 0 V | Minimum output value |

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

| Values | | | Voltage output range | Range |
|---|---|---|---|---|
| | dec | hex | 1 V to 5 V | |
| >117.589 % | >32511 | >7EFF | 5.70 V | Maximum output value |
| 117.589 % | 32511 | 7EFF | 5.70 V | Overshoot range |
| | 27649 | 6C01 | | |
| 100 % | 27648 | 6C00 | 5 V | Rated 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 | Undershoot range |
| -25 % | -6912 | E500 | 0 V | |
| <-25 % | <-6912 | <E500 | 0 V | Minimum output value |

## C.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 C- 7 Current output range ±20 mA

| Values | | | Current output range | Range |
|---|---|---|---|---|
| | dec | hex | ±20 mA | |
| >117.589 % | >32511 | >7EFF | 23.52 mA | Maximum output value |
| 117.589 % | 32511 | 7EFF | 23.52 mA | Overshoot range |
| | 27649 | 6C01 | | |
| 100 % | 27648 | 6C00 | 20 mA | Rated 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 | |
| | -27649 | 93FF | | Undershoot range |
| -117.593 % | -32512 | 8100 | -23.52 mA | |
| <-117.593 % | <-32512 | <8100 | -23.52 mA | Minimum output value |

Table C- 8 Current output range 0 to 20 mA

| Values | | | Current output range | Range |
|---|---|---|---|---|
| | dec | hex | 0 mA to 20 mA | |
| >117.589 % | >32511 | >7EFF | 23.52 mA | Maximum output value |
| 117.589 % | 32511 | 7EFF | 23.52 mA | Overshoot range |
| | 27649 | 6C01 | | |
| 100 % | 27648 | 6C00 | 20 mA | Rated range |
| 75 % | 20736 | 5100 | 15 mA | |
| 0.003617 % | 1 | 1 | 723.4 nA | |
| 0 % | 0 | 0 | 0 mA | |
| <0 % | <0 | <0 | 0 mA | Minimum output value |

Table C- 9 Current output range 4 to 20 mA

| Values | | | Current output range | Range |
|---|---|---|---|---|
| | dec | hex | 4 mA to 20 mA | |
| >117.589 % | >32511 | >7EFF | 22.81 mA | Maximum output value |
| 117.589 % | 32511 | 7EFF | 22.81 mA | Overshoot range |
| | 27649 | 6C01 | | |
| 100 % | 27648 | 6C00 | 20 mA | Rated range |
| 75 % | 20736 | 5100 | 16 mA | |
| 0.003617 % | 1 | 1 | 4 mA | |
| 0 % | 0 | 0 | 4 mA | |
| | -1 | FFFF | | Undershoot range |
| -25 % | -6912 | E500 | 0 mA | |
| <-25 % | <-6912 | <E500 | 0 mA | Minimum output value |