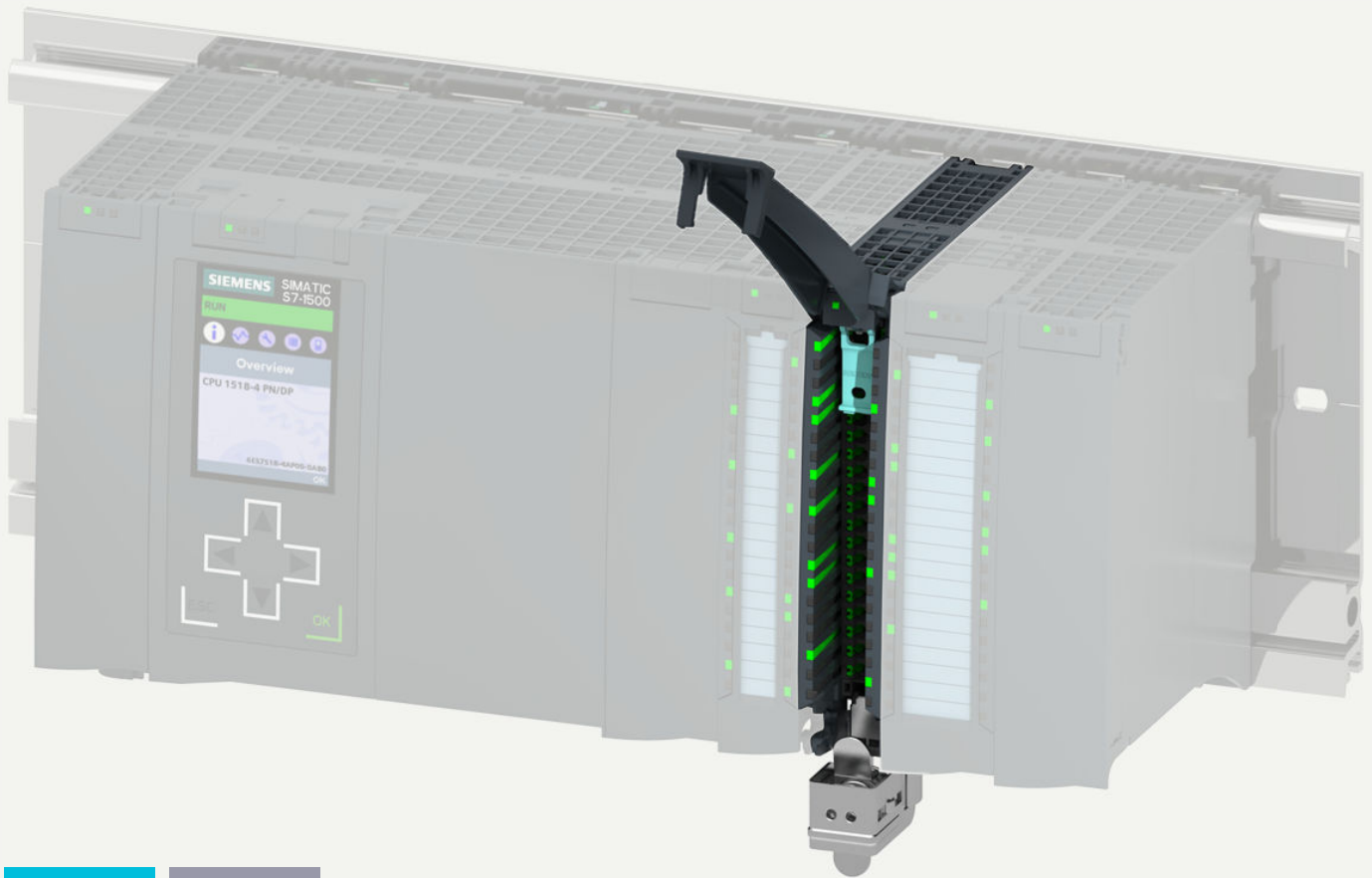




Edition

05/2024

EQUIPMENT MANUAL

# SIMATIC

## S7-1500 / ET 200MP

Analog input module AI 24xCVM HF  
6ES7531-7LK00-0AB0

[support.industry.siemens.com](https://support.industry.siemens.com)

## SIMATIC

### S7-1500/ET 200MP Analog input module AI 24xCVM HF (6ES7531-7LK00-0AB0)

#### Equipment Manual

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## Legal information

### Warning notice system

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

#### **DANGER**

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

#### **WARNING**

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

#### **CAUTION**

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

#### **NOTICE**

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

If more than one degree of danger is present, the warning notice representing the highest degree of danger will be used. A notice warning of injury to persons with a safety alert symbol may also include a warning relating to property damage.

### Qualified Personnel

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

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### Disclaimer of Liability

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

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# Introduction

## Purpose of the documentation

This Equipment Manual supplements the System Manual System Manual S7-1500/ET 200MP (<https://support.industry.siemens.com/cs/de/en/view/59191792>).

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

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

## 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.

---

## 1.1 S7-1500/ET 200MP documentation guide

### 1.1.1 Information classes S7-1500/ET 200MP



The documentation for the SIMATIC S7-1500 automation system and the ET 200MP distributed I/O system is arranged into three areas.

This arrangement enables you to access the specific content you require. Changes and supplements to the manuals are documented in a Product Information.

You can download the documentation free of charge from the Internet

(<https://support.industry.siemens.com/cs/ww/en/view/109742691>).

## 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.

The STEP 7 online help supports you in the configuration and programming.

Examples:

- Getting Started S7-1500
- S7-1500/ET 200MP System Manual
- Online help TIA Portal

## Device information



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

Examples:

- Equipment Manuals CPUs
- Equipment Manuals Interface Modules
- Equipment Manuals Digital Modules
- Equipment Manuals Analog Modules
- Equipment Manuals Communications Modules
- Equipment Manuals Technology Modules
- Equipment Manuals Power Supply Modules

## General information



The function manuals contain detailed descriptions on general topics relating to the SIMATIC S7-1500 and ET 200MP systems.

Examples:

- Function Manual Diagnostics
- Function Manual Communication
- Function Manual Motion Control
- Function Manual Web Server
- Function Manual Cycle and Response Times
- PROFINET Function Manual
- PROFIBUS Function Manual

## Product Information

Changes and supplements to the manuals are documented in a Product Information. The Product Information takes precedence over the device and system manuals.

You can find the latest Product Information on the S7-1500 and ET 200MP systems on the Internet (<https://support.industry.siemens.com/cs/de/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>)

## Manual Collection fail-safe modules

The Manual Collection contains the complete documentation on the fail-safe SIMATIC modules, gathered together in one file.

You can find the Manual Collection on the Internet.

(<https://support.industry.siemens.com/cs/de/en/view/109806400>)

## 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>).

### 1.1.2 Basic tools

#### Tools

The tools described below support you in all steps: from planning, over commissioning, all the way to analysis of your system.

#### TIA Selection Tool

The TIA Selection Tool tool supports you in the selection, configuration, and ordering of devices for Totally Integrated Automation (TIA).

As successor of the SIMATIC Selection Tools, the TIA Selection Tool assembles the already known configurators for automation technology into a single tool.

With the TIA Selection Tool, you can generate a complete order list from your product selection or product configuration.

You can find the TIA Selection Tool on the Internet.

(<https://support.industry.siemens.com/cs/ww/en/view/109767888>)

#### SIMATIC Automation Tool

You can use the SIMATIC Automation Tool to perform commissioning and maintenance activities on various SIMATIC S7 stations as bulk operations independent of TIA Portal.

The SIMATIC Automation Tool offers a wide range of functions:

- Scanning of a PROFINET/Ethernet system network and identification of all connected CPUs
- Assignment of addresses (IP, subnet, Gateway) and device 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
- RUN/STOP mode switchover
- CPU localization through LED flashing
- Reading out of CPU error information
- Reading the CPU diagnostic buffer
- Reset to factory settings
- Firmware update 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

SIEMENS PRONETA (PROFINET network analysis) is a commissioning and diagnostic tool for PROFINET networks. PRONETA Basic has two core functions:

- In the network analysis, you get an overview of the PROFINET topology. Compare a real configuration with a reference installation or make simple parameter changes, e.g. to the names and IP addresses of the devices.
- The "IO test" is a simple and rapid test of the wiring and the module configuration of a plant, including documentation of the test results.

You can find SIEMENS PRONETA Basic on the Internet:

(<https://support.industry.siemens.com/cs/ww/en/view/67460624>)

SIEMENS PRONETA Professional is a licensed product that offers you additional functions. It offers you simple asset management in PROFINET networks and supports operators of automation systems in automatic data collection/acquisition of the components used through various functions:

- The user interface (API) offers an access point to the automation cell to automate the scan functions using MQTT or a command line.
- With PROFlenergy diagnostics, you can quickly detect the current pause mode or the readiness for operation of devices that support PROFlenergy and change these as needed.
- The data record wizard supports PROFINET developers in reading and writing acyclic PROFINET data records quickly and easily without PLC and engineering.

You can find SIEMENS PRONETA Professional on the Internet.

(<https://www.siemens.com/proneta-professional>)

## SINETPLAN

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

The advantages at a glance

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

You can find SINETPLAN on the Internet

(<https://new.siemens.com/global/en/products/automation/industrial-communication/profinet/sinetplan.html>).

### 1.1.3 SIMATIC Technical Documentation

Additional SIMATIC documents will complete your information. You can find these documents and their use at the following links and QR codes.

The Industry Online Support gives you the option to get information on all topics. Application examples support you in solving your automation tasks.

#### Overview of the SIMATIC Technical Documentation

Here you will find an overview of the SIMATIC documentation available in Siemens Industry Online Support:



Industry Online Support International

<https://support.industry.siemens.com/cs/ww/en/view/109742705>

Watch this short video to find out where you can find the overview directly in Siemens Industry Online Support and how to use Siemens Industry Online Support on your mobile device:



Quick introduction to the technical documentation of automation products per video <https://support.industry.siemens.com/cs/us/en/view/109780491>



YouTube video: Siemens Automation Products - Technical Documentation at a Glance <https://youtu.be/TwLSxxRQsA>

#### Retention of the documentation

Retain the documentation for later use.

For documentation provided in digital form:

1. Download the associated documentation after receiving your product and before initial installation/commissioning. Use the following download options:
  - Industry Online Support International: <https://support.industry.siemens.com>  
The article number is used to assign the documentation to the product. The article number is specified on the product and on the packaging label. Products with new, non-compatible functions are provided with a new article number and documentation.
  - ID link:  
Your product may have an ID link. The ID link is a QR code with a frame and a black frame corner at the bottom right. The ID link takes you to the digital nameplate of your product. Scan the QR code on the product or on the packaging label with a smartphone camera, barcode scanner, or reader app. Call up the ID link.
2. Retain this version of the documentation.

## Updating the documentation

The documentation of the product is updated in digital form. In particular in the case of function extensions, the new performance features are provided in an updated version.

1. Download the current version as described above via the Industry Online Support or the ID link.
2. Also retain this version of the documentation.

## mySupport

With "mySupport" you can get the most out of your Industry Online Support.

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                             |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Registration</b>             | You must register once to use the full functionality of "mySupport". After registration, you can create filters, favorites and tabs in your personal workspace.                                                                                                                                                                                                                                             |
| <b>Support requests</b>         | Your data is already filled out in support requests, and you can get an overview of your current requests at any time.                                                                                                                                                                                                                                                                                      |
| <b>Documentation</b>            | In the Documentation area you can build your personal library.                                                                                                                                                                                                                                                                                                                                              |
| <b>Favorites</b>                | You can use the "Add to mySupport favorites" to flag especially interesting or frequently needed content. Under "Favorites", you will find a list of your flagged entries.                                                                                                                                                                                                                                  |
| <b>Recently viewed articles</b> | The most recently viewed pages in mySupport are available under "Recently viewed articles".                                                                                                                                                                                                                                                                                                                 |
| <b>CAX data</b>                 | The CAX data area gives you access to the latest product data for your CAX or CAe system. You configure your own download package with a few clicks: <ul style="list-style-type: none"> <li>• Product images, 2D dimension drawings, 3D models, internal circuit diagrams, EPLAN macro files</li> <li>• Manuals, characteristics, operating manuals, certificates</li> <li>• Product master data</li> </ul> |

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

## 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 can find the application examples on the Internet.  
(<https://support.industry.siemens.com/cs/ww/en/ps/ae>)

# Industrial cybersecurity

Due to the digitalization and increasing networking of machines and industrial plants, the risk of cyber attacks is also growing. Appropriate protective measures are therefore mandatory, particularly in the case of critical infrastructure facilities.

Refer to the System Manual (<https://support.industry.siemens.com/cs/de/en/view/59191792>) for general information and measures regarding industrial cybersecurity.

This section provides an overview of security-related information pertaining to your SIMATIC device.

## 2.1 Cybersecurity information

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

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

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

For additional information on industrial cybersecurity measures that may be implemented, please visit

<https://www.siemens.com/cybersecurity-industry>.

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

To stay informed about product updates, subscribe to the Siemens Industrial Cybersecurity RSS Feed under

<https://new.siemens.com/cert>.

## 2.2 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/109805059>).

## Product overview

### 3.1 Properties

#### Article number

6ES7531-7LK00-0AB0

#### View of the module

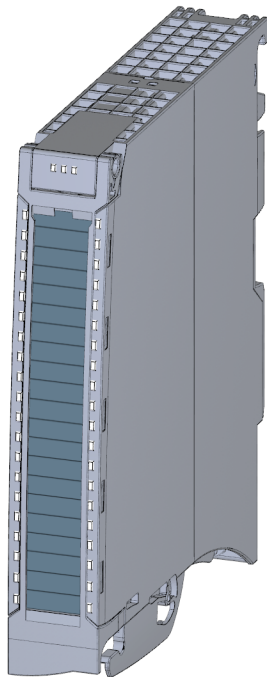


Figure 3-1 View of the AI 24xCVM HF module

## Properties

The module has the following technical properties:

- 2 potential groups for 12 channels
- Measurement type voltage, adjustable  $\pm 5$  V
  - Connection of maximum 24 channels,  $\pm 3.5$  V each
  - Connection of maximum 16 channels,  $\pm 5$  V each
- Interference frequency suppression: 10/50/60/400 Hz
- Electrical isolation
  - from backplane bus
  - in groups of 12 channels
- Resolution 16 bits or 24 bits including sign
- Operational limit (0 - 60 °C): 0.1%
- Configurable diagnostics (per channel)
- Hardware interrupt on limit violation can be set per channel (two low and two high limits per channel)

The module supports the following functions:

Table 3-1 Version dependencies of the module functions

| Function                           | Firmware version of the module | Configuration software                 |                                                    |
|------------------------------------|--------------------------------|----------------------------------------|----------------------------------------------------|
|                                    |                                | STEP 7 (TIA Portal) as of V19 HSP 0452 | GSD file in STEP 7 (TIA Portal) as of V19 HSP 0452 |
| Firmware update                    | V1.0.0 or higher               | X                                      | X<br>(PROFINET IO only)                            |
| Identification data I&M0 to I&M3   | V1.0.0 or higher               | X                                      | X<br>(PROFINET IO only)                            |
| Configuration in RUN               | V1.0.0 or higher               | X                                      | X<br>(PROFINET IO only)                            |
| Value status                       | V1.0.0 or higher               | X                                      | X<br>(PROFINET IO only)                            |
| Module internal Shared Input (MSI) | V1.0.0 or higher               | X<br>(PROFINET IO only)                | X<br>(PROFINET IO only)                            |

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

## Accessories

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

- Front connector (push-in terminals) including cable tie
- Shield bracket
- Shield clamp
- Power supply element (push-in terminals)
- Labeling strips
- U connector
- Universal front cover

## Other components

The following component can be ordered separately:

You can find more information on accessories in the S7-1500/ET 200MP

(<https://support.industry.siemens.com/cs/de/de/view/59191792/en>) system manual.

## Connecting

### 4.1 Wiring and block diagrams

In this section you will find the schematic circuit diagram of the module and various connection options.

You can find information on wiring the front connector, establishing the cable shield, etc., in the S7-1500/ET 200MP (<https://support.industry.siemens.com/cs/de/en/view/59191792>) System Manual, section "Wiring".

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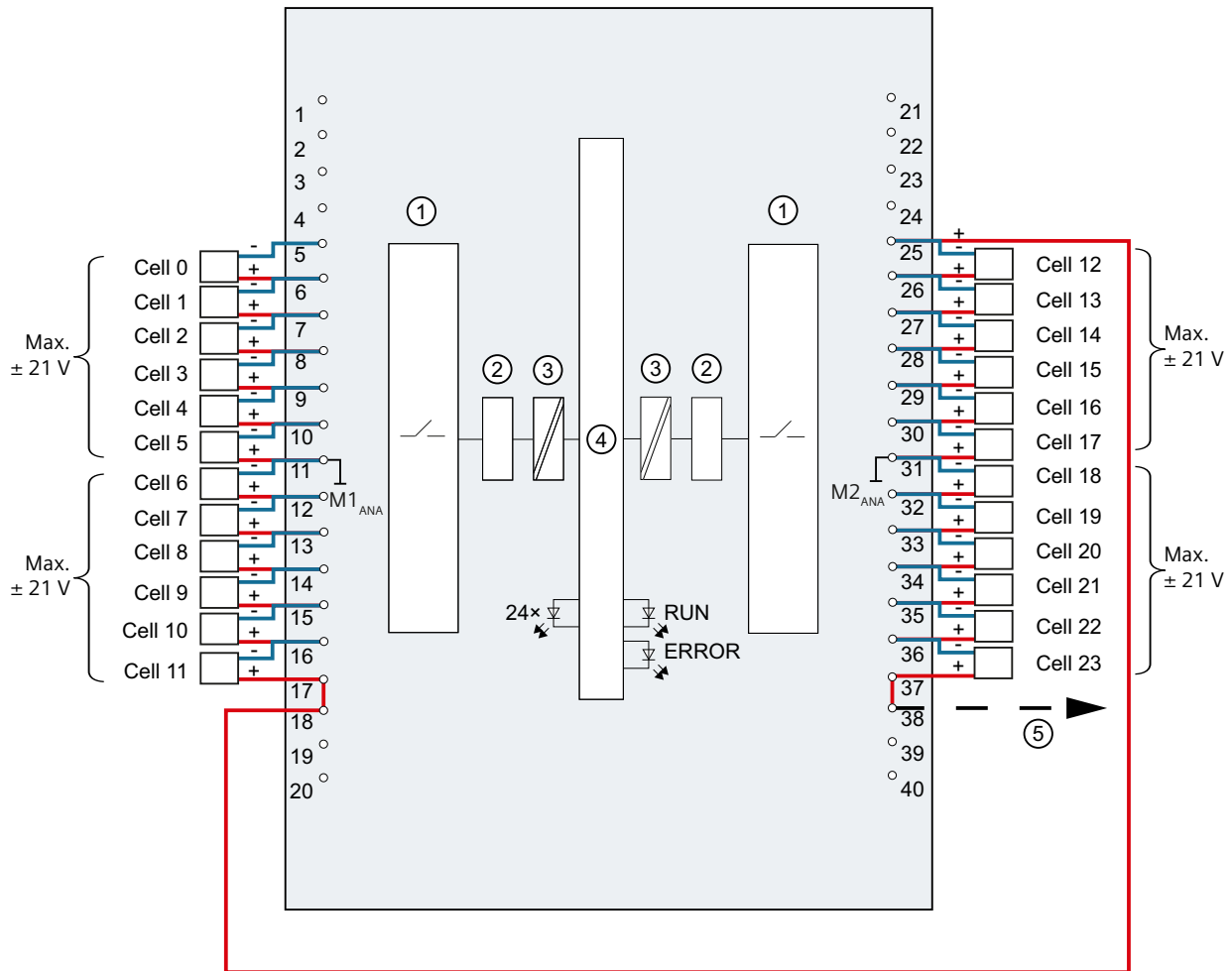
#### NOTE

- You may use and combine the different wiring options for all channels.
  - Use cables with insulation of a suitable proof voltage.
-



### Schematic circuit diagram and connector pin assignment for cell voltage measurement

The example in the following diagram shows the connector pin assignment for the cell voltage measurement with 24 channels:



- |   |                                   |                  |                                                  |
|---|-----------------------------------|------------------|--------------------------------------------------|
| ① | Multiplexer (MUX)                 | CHx              | 24 x channel and 24 x channel status (green/red) |
| ② | Analog-to-Digital Converter (ADC) | RUN              | Status display LED (green)                       |
| ③ | Electrical isolation              | ERROR            | Error display LED (red)                          |
| ④ | Backplane bus interface           | M <sub>ANA</sub> | Reference potential of the analog circuit        |
| ⑤ | Optional cable to another module  |                  |                                                  |

Figure 4-1 Schematic circuit diagram and connector pin assignment for cell voltage measurement 24 channels

The example in the following diagram shows the connector pin assignment for the cell voltage measurement with 16 channels:

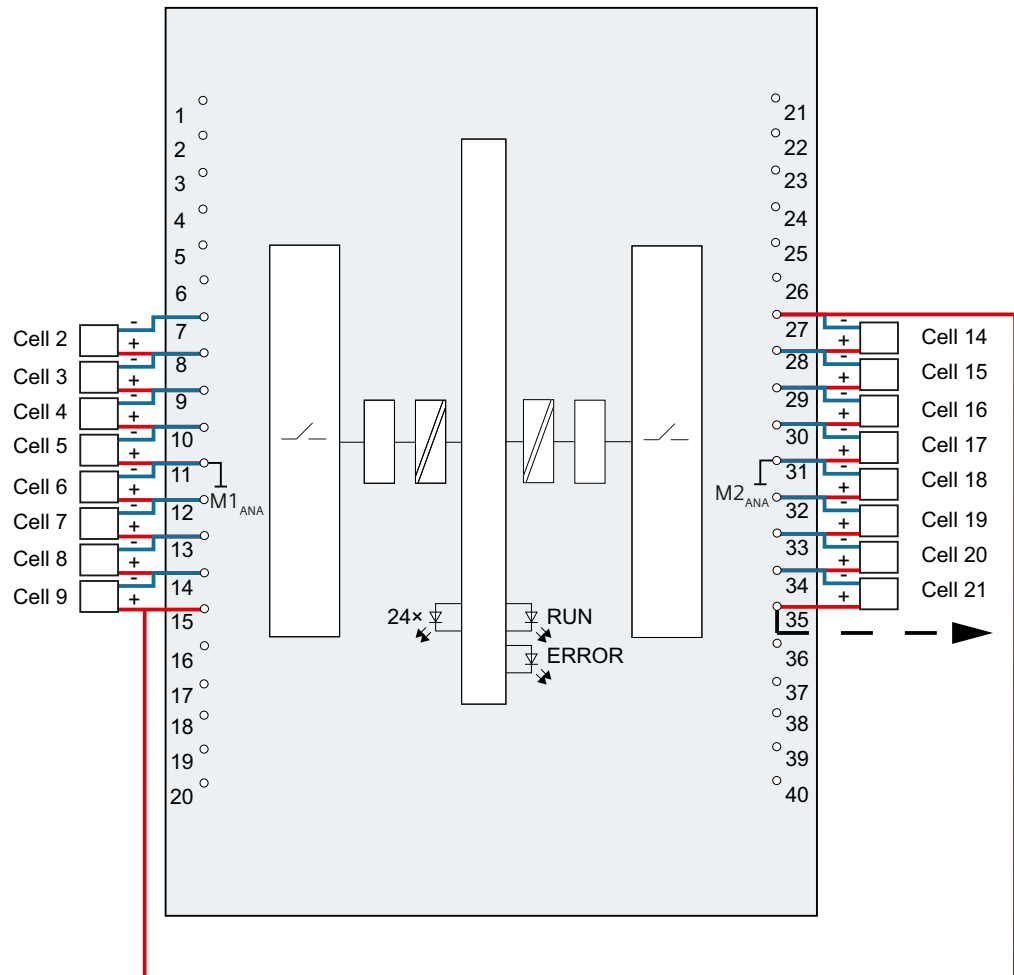


Figure 4-2 Schematic circuit diagram and connector pin assignment for cell voltage measurement 16 channels

#### NOTE

##### Calibration per side (potential groups) only necessary for one channel

To calibrate the channels, you only have to calibrate one channel per side.

Channel 6 (terminal 11 and 12) is displayed for the left side. Connect terminal 11 to ground.

Channel 18 (terminal 31 and 32) is displayed for the right side. Connect terminal 31 to ground.

## Protective circuit of the inputs and possible voltages

The module is used for cell voltage measurement. The connection of two cells is routed with a line to the module. The last channel on each potential group is routed to 2 terminals. You can connect one terminal with the cells, the other terminal is used for connection to the next analog input.

The maximum measurable voltage at a channel corresponds to the measuring range (see "Analog value representation (Page 48)"). The maximum voltage at each analog input (pin 5-10; 12-18 and 25-30; 32-38) is  $\pm 21$  V against  $M_{ANA}$  (pin 11 or pin 31). If a voltage lies outside the permissible range, the module responds as in the case of a wire break.

## Dependencies of the channels

You can reduce the number of active channels, or bridge the unused channels. In doing so, you must activate the neighboring channels with channel 5 and 17. If you activate wire-break diagnostics, deactivated channels must not be connected. The following table shows the dependencies of the channels:

| Channel 0...11          | Channel 12...23          |
|-------------------------|--------------------------|
| All channels activated  | All channels activated   |
| Channels 0-10 activated | Channels 12-22 activated |
| Channels 1-10 activated | Channels 13-22 activated |
| Channels 1-9 activated  | Channels 13-21 activated |
| Channels 2-9 activated  | Channels 14-21 activated |
| Channels 2-8 activated  | Channels 14-20 activated |
| Channels 3-8 activated  | Channels 15-20 activated |
| Channels 3-7 activated  | Channels 15-19 activated |
| Channels 4-7 activated  | Channels 16-19 activated |
| Channels 4-6 activated  | Channels 16-18 activated |
| Channels 5-6 activated  | Channels 17-18 activated |
| Channel 5 activated     | Channel 17 activated     |

## Parameters/address space

### 5.1 Measurement type and measuring range

#### Introduction

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

| Measurement type | Measuring range | Analog value representation                                                         |
|------------------|-----------------|-------------------------------------------------------------------------------------|
| Voltage          | $\pm 5$ V       | See Appendix Representation of analog values in voltage measuring ranges (Page 49). |
| Deactivated      | -               |                                                                                     |

The tables of the input ranges, overflow, undershoot range, etc. are available in appendix Analog value representation (Page 48).

### 5.2 Parameters

#### Parameters of the AI 24xCVM HF

The AI 24xCVM HF is available for STEP 7 (TIA Portal) V19 with HSP 0452. In this case, STEP 7 (TIA Portal) checks the configured properties for plausibility during configuration.

You can also assign the module parameters using a GSD file and the configuration software of any provider. The module checks the validity of the configured properties only after the configuration has been downloaded.

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

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

The following parameter settings for the channels are possible:

Table 5-1 Configurable parameters and their defaults

| Parameter                            | Range of values                                            | Default setting | Configuration in RUN | Scope with configuration software, e.g., STEP 7 (TIA Portal)                                                     |
|--------------------------------------|------------------------------------------------------------|-----------------|----------------------|------------------------------------------------------------------------------------------------------------------|
|                                      |                                                            |                 |                      | Integrated in the hardware catalog of STEP 7 (TIA Portal) as of V20 and V19 HSP 0452 or the PROFINET IO GSD file |
| Diagnostics                          |                                                            |                 |                      |                                                                                                                  |
| • Overflow                           | Yes/No                                                     | No              | Yes                  | Channel                                                                                                          |
| • Underflow                          | Yes/No                                                     | No              | Yes                  | Channel                                                                                                          |
| • Wire break                         | Yes/No                                                     | No              | Yes                  | Channel                                                                                                          |
| Measuring                            |                                                            |                 |                      |                                                                                                                  |
| • Measurement type                   | See section Measurement type and measuring range (Page 20) | Voltage         | Yes                  | Channel                                                                                                          |
| • Measuring range                    |                                                            | ±5 V            | Yes                  | Channel                                                                                                          |
| • Interference frequency suppression | 400 Hz<br>60 Hz<br>50 Hz<br>10 Hz                          | 50 Hz           | Yes                  | Channel                                                                                                          |
| • Smoothing                          | None/low/medium/high                                       | None            | Yes                  | Channel                                                                                                          |
| Hardware interrupt                   |                                                            |                 |                      |                                                                                                                  |
| • Hardware interrupt high limit 1    | Yes/No                                                     | No              | Yes                  | Channel                                                                                                          |
| • Hardware interrupt low limit 1     | Yes/No                                                     | No              | Yes                  | Channel                                                                                                          |
| • Hardware interrupt high limit 2    | Yes/No                                                     | No              | Yes                  | Channel                                                                                                          |
| • Hardware interrupt low limit 2     | Yes/No                                                     | No              | Yes                  | Channel                                                                                                          |

## 5.3 Declaration of parameters

### Overflow

Enabling of the diagnostics if the measured value violates the high limit.

### Underflow

Enabling of the diagnostics if the measured value violates the low limit.

### Wire break

All analog inputs (without  $M_{ANA}$ ) are connected with the internal supply with 1 mOhm. If an active channel has a wire break or a voltage above  $\pm 21.3$  V to  $M_{ANA}$ , a wire break is reported. If you activate a wire-break check at a channel, all active channels of the channel group are tested for a wire break. A diagnostics message burst is avoided in this way.

### Interference frequency suppression

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

With this parameter, the user specifies the line frequency that is predominant in the plant.

## Smoothing

The individual measured values are smoothed using filtering. The smoothing can be set in 4 levels.

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

The following figure shows after how many module cycles the smoothed analog value is almost 100%, depending on the set smoothing. Is valid for each signal change at the analog input.

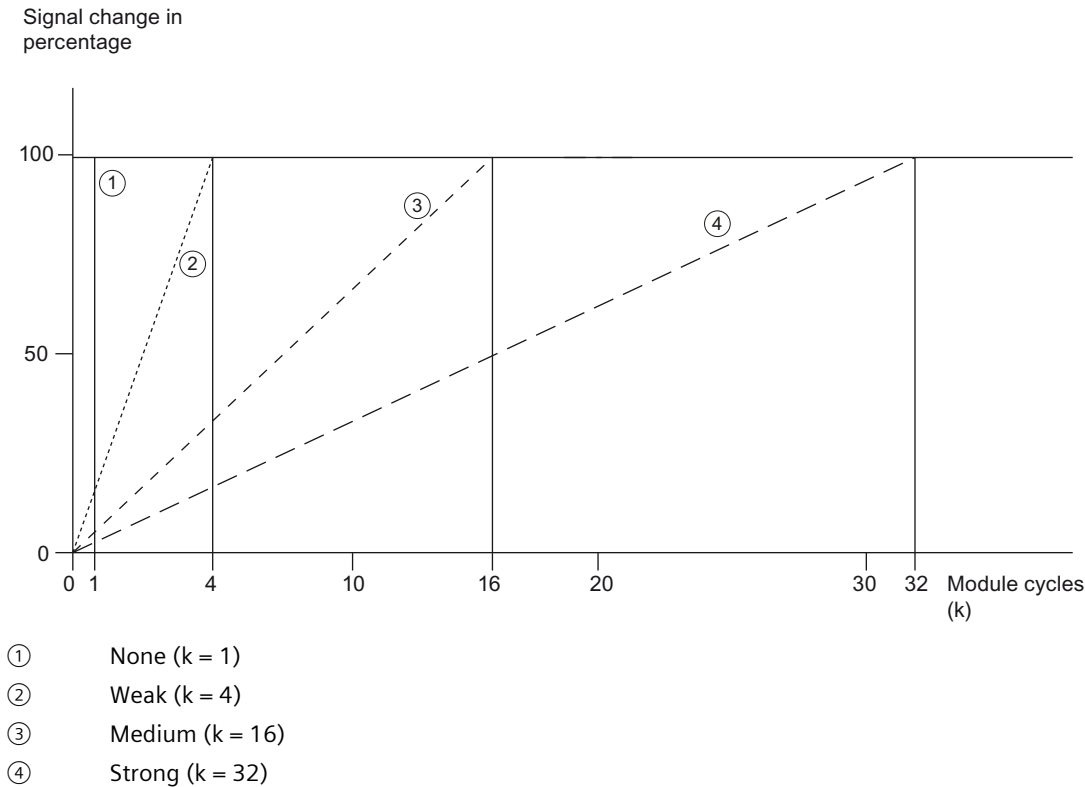


Figure 5-1 Smoothing in the case of AI 24xCVM HF

## Hardware interrupt 1 or 2

Enable a hardware interrupt at violation of high limit 1 or 2 or low limit 1 or 2.

## Low limit 1 or 2

Specifies the low limit threshold that triggers hardware interrupt 1 or 2.

## High limit 1 or 2

Specifies the high limit threshold that triggers hardware interrupt 1 or 2.

## 5.4 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 inputs.

### Configuration options of the AI 24xCVM HF

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 5-2 Configuration options

| Configuration                                                                                                              | Short designation/<br>module name in the<br>GSD file | Configuration software, e.g., with STEP 7 (TIA Portal)                               |                                                                                                    |
|----------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------|--------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|
|                                                                                                                            |                                                      | Integrated in the hardware<br>catalog STEP 7 (TIA Portal)<br>as of V20, V19 HSP 0452 | GSD file in<br>STEP 7 (TIA Portal)<br>V19 HSP 0452 or high-<br>er, or STEP 7 V5.5 SP3<br>or higher |
| 1 x 24-channel without value status                                                                                        | AI 24xCVM HF                                         | X                                                                                    | X                                                                                                  |
| 1 x 24-channel with value status                                                                                           | AI 24xCVM HF, QI                                     | X                                                                                    | X                                                                                                  |
| 1 x 24-channel with value status for module-<br>internal shared input (MSI) with up to 4 sub-<br>modules                   | AI 24xCVM HF, MSI                                    | X                                                                                    | X                                                                                                  |
| 1 x 24-channel with REAL representation and<br>value status                                                                | AI 24xCVM HF, REAL,<br>QI                            | X                                                                                    | X                                                                                                  |
| 1 x 24-channel with REAL representation,<br>value status for module-internal shared input<br>(MSI) with up to 4 submodules | AI 24xCVM HF, REAL,<br>MSI                           | X                                                                                    | X                                                                                                  |

### Value status (Quality Information, QI)

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

- AI 24xCVM HF, QI
- AI 24xCVM HF, MSI
- AI 24xCVM HF, REAL, QI
- AI 24xCVM HF, REAL, MSI

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



### 5.4.1 Address space 1x24-channel with and without value status

#### Address space for configuration as 1 x 24-channel AI 24xCVM HF and AI 24xCVM HF QI

The figure below shows the population of the address space for the configuration as a 1 x 24-channel module. You can freely assign the start address for the module. The addresses of the channels are derived from the start address.

"IB x" stands, for example, for the module start address input byte x.

Assignment in the process image of the inputs (PII)

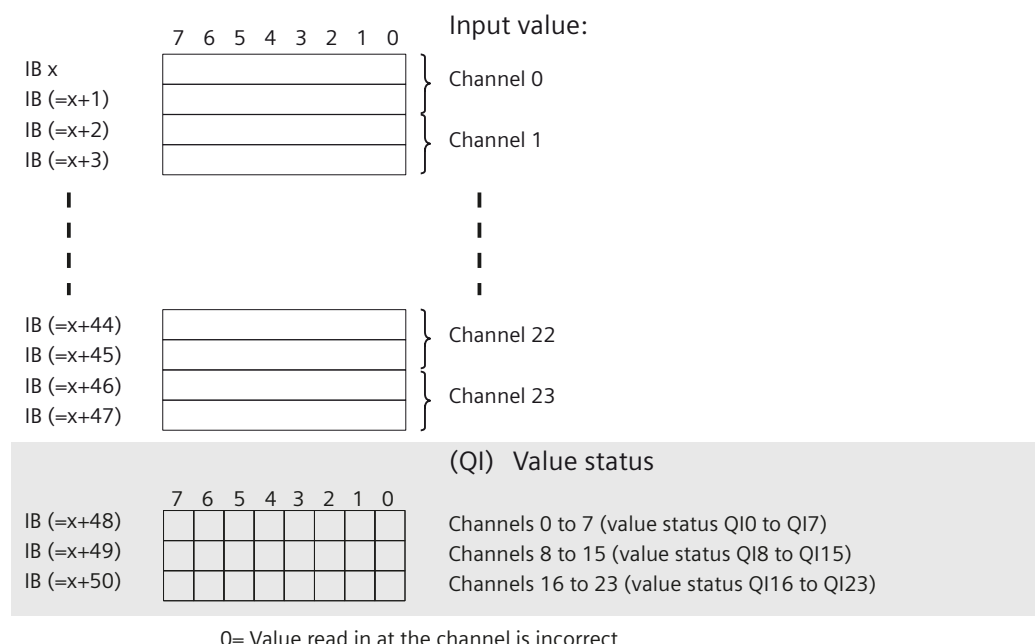


Figure 5-2 Address space for configuration as 1 x 24-channel AI 24xCVM HF with value status

### 5.4.2 Address space 1 x 24-channel with value status for MSI

#### Address space for configuration as 1 x 24-channel AI 24xCVM HF MSI

When configured as 1 x 24-channel module (module-internal shared input, MSI), channels 0 to 23 of the module are copied 4 times to up to 4 submodules. Channels 0 to 23 are then present with identical input values in different submodules. These submodules can be assigned to up to four IO controllers when the module is used in a shared device. Each IO controller has read access to the same channels.

The number of 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 first submodule (=basic submodule), the value status 0 indicates that the value is incorrect.

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

5.4 Address space

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

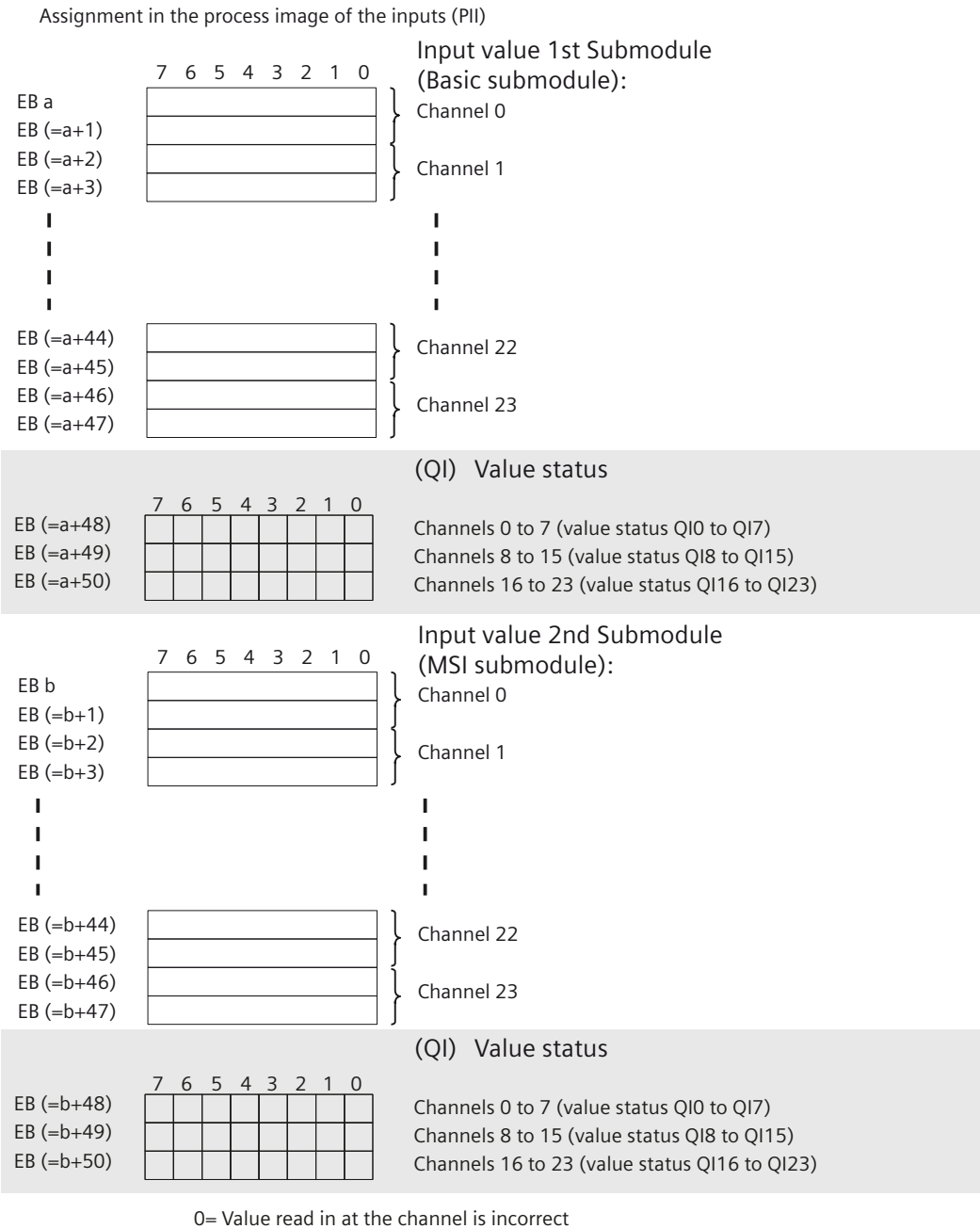


Figure 5-3 Address space for configuration as 1 x 24-channel AI 24xCVM HF MSI with value status

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

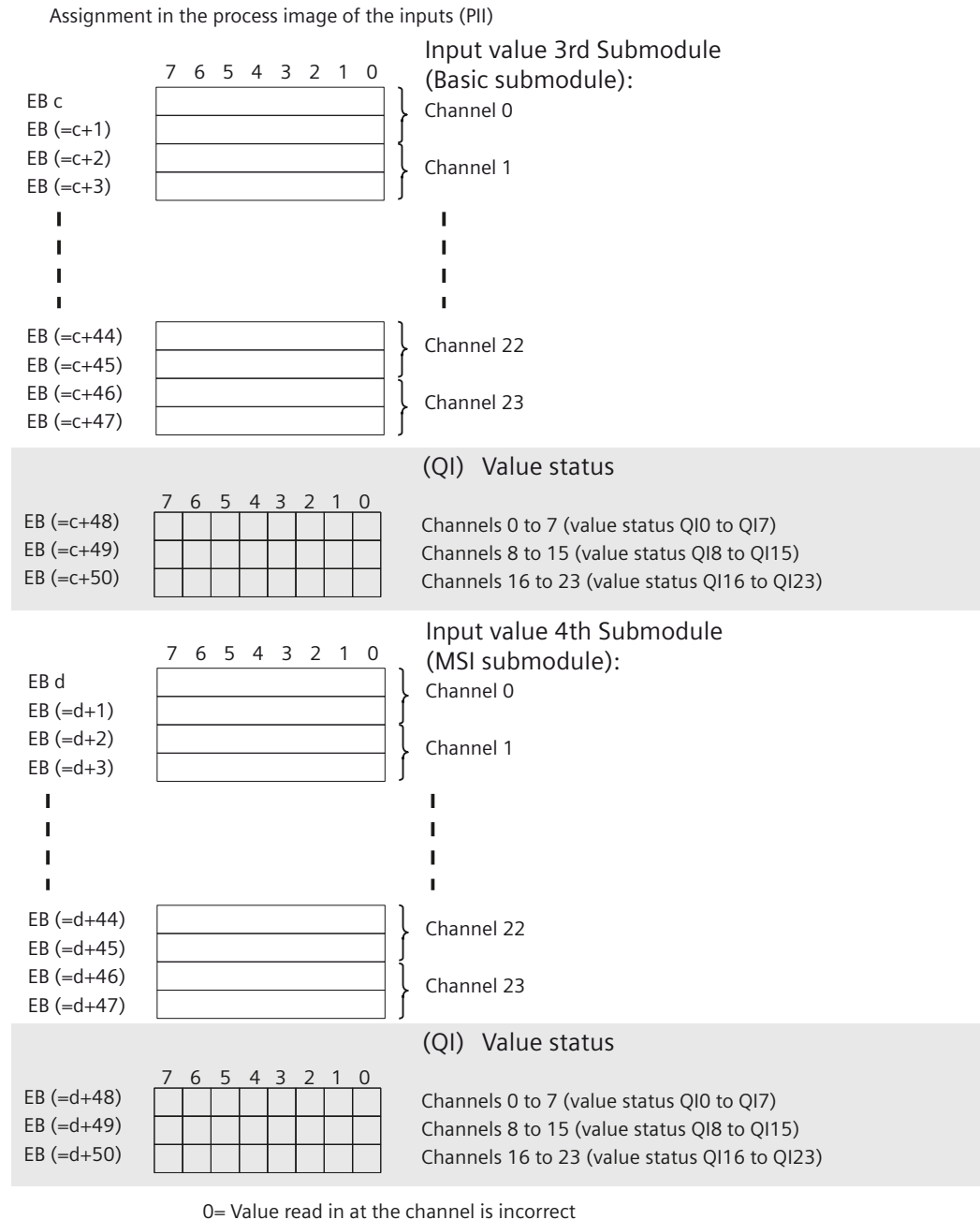


Figure 5-4 Address space for configuration as 1 x 24-channel AI 24xCVM HF MSI with value status

## Reference

You can find information on the Shared Input/Output (MSI/MSO) functionality in the section "Module-internal shared input/shared output (MSI/MSO)" of the PROFINET with STEP 7 (<https://support.industry.siemens.com/cs/de/en/view/49948856/en>) Function Manual.

5.4.3 Address space 1 x 24-channel with REAL representation and value status

Address space for configuration as 1 x 24-channel AI 24xCVM HF and AI 24xCVM HF QI

The figure below shows the population of the address space for the configuration as a 1 x 24-channel module. You can freely assign the start address for the module. The addresses of the channels are derived from the start address.

"IB x" stands, for example, for the module start address input byte x.

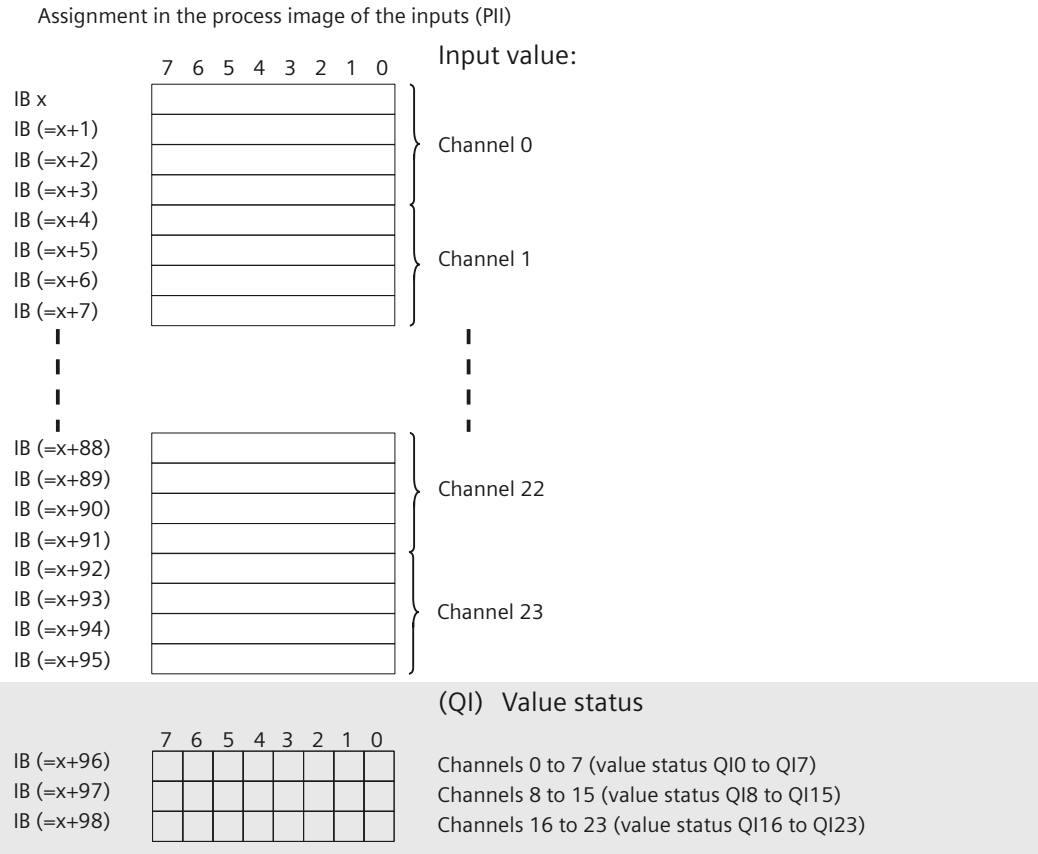


Figure 5-5 Address space for configuration as 1 x 24-channel AI 24xCVM HF with value status REAL representation

#### 5.4.4 Address space 1 x 24-channel with REAL representation, value status for MSI

##### Address space for configuration as 1 x 24-channel AI 24xCVM HF MSI

When configured as 1 x 24-channel module (module-internal shared input, MSI), channels 0 to 23 of the module are copied 4 times to up to 4 submodules. Channels 0 to 23 are then present with identical input values in different submodules. These submodules can be assigned to up to four IO controllers when the module is used in a shared device. Each IO controller has read access to the same channels.

The number of 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 first submodule (=basic submodule), the value status 0 indicates that the value is incorrect.

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

5.4 Address space

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

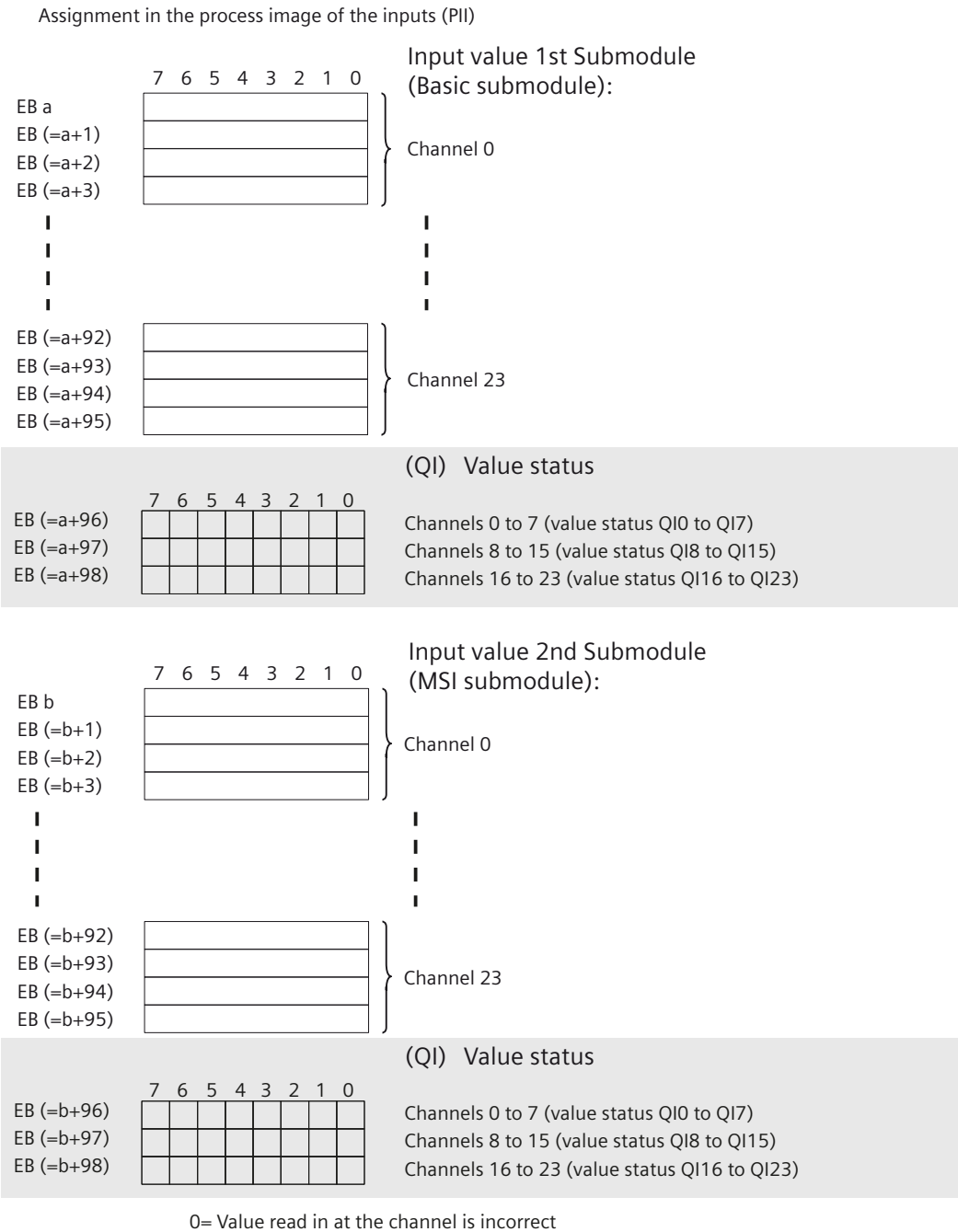


Figure 5-6 Address space for configuration as 1 x 24-channel AI 24xCVM HF MSI with value status REAL representation

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

Assignment in the process image of the inputs (PII)

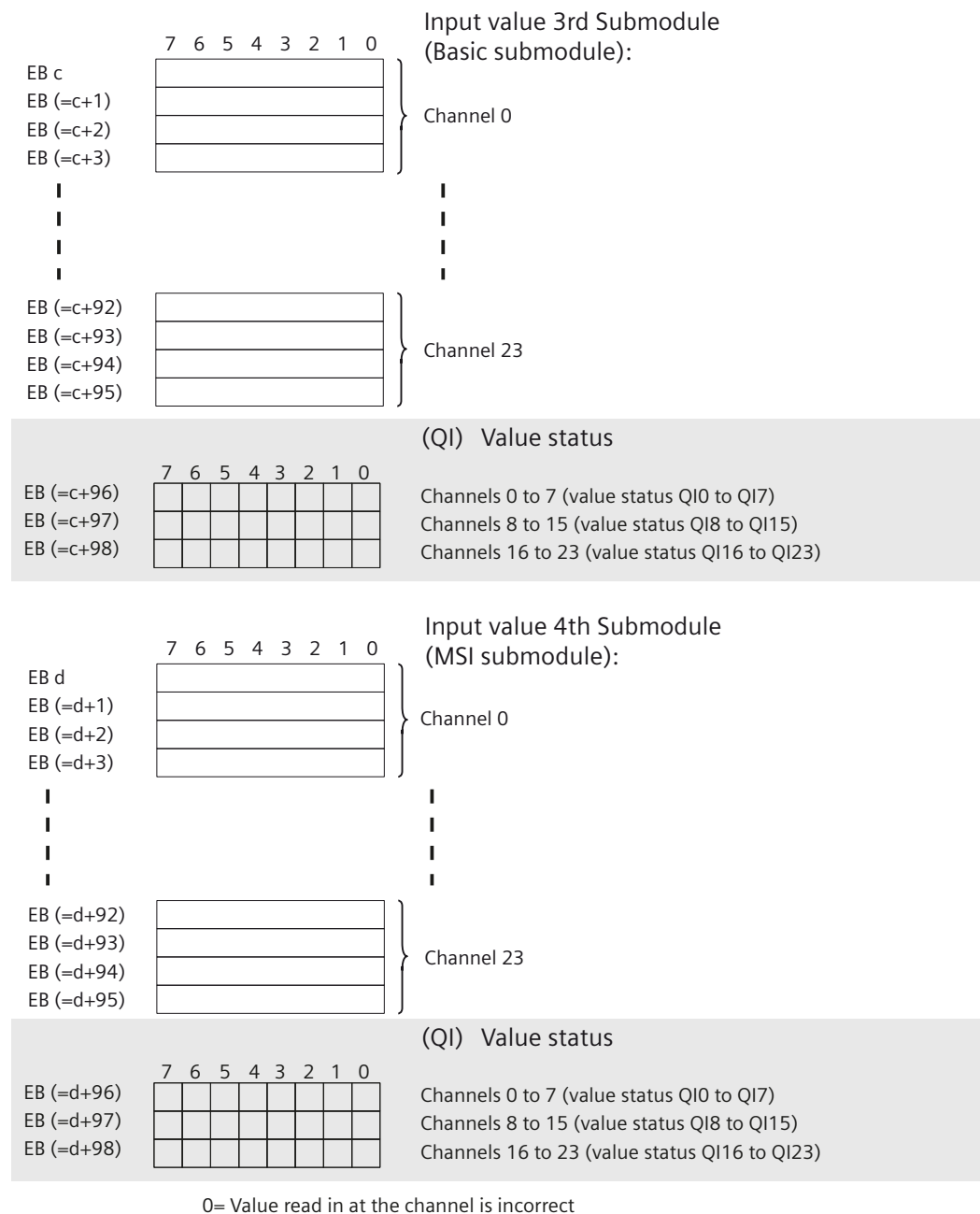


Figure 5-7 Address space for configuration as 1 x 24-channel AI 24xCVM HF MSI with value status REAL representation

## Reference

You can find information on the Shared Input/Output (MSI/MSO) functionality in the section "Module-internal shared input/shared output (MSI/MSO)" of the PROFINET with STEP 7 (<https://support.industry.siemens.com/cs/de/en/view/49948856/en>) Function Manual.

## Interrupts/diagnostic alarms

### 6.1 Status and error displays

#### LED displays

The figure below shows the LED displays (status and error displays) of the AI 24xCVM HF.

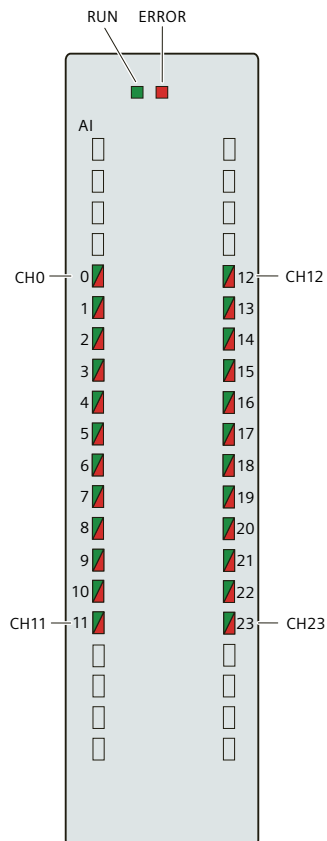


Figure 6-1 LED displays of the AI 24xCVM HF module

#### 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 [\(Page 35\)](#).



## RUN and ERROR LED

Table 6-1 Status and error displays RUN and ERROR

| LED                                                                                          |                                                                                              | Meaning                                                                        | Remedy                                                                                                                                                                                                                |
|----------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| RUN                                                                                          | ERROR                                                                                        |                                                                                |                                                                                                                                                                                                                       |
| <br>Off     | <br>Off     | Voltage missing or too low at backplane bus.                                   | <ul style="list-style-type: none"> <li>Switch on the CPU and/or the system power supply modules.</li> <li>Verify that the U connectors are inserted.</li> <li>Check whether too many modules are inserted.</li> </ul> |
| <br>Flashes | <br>Off     | The module starts and flashes until the valid parameter assignment is set.     | ---                                                                                                                                                                                                                   |
| <br>On      | <br>Off     | Module is configured.                                                          |                                                                                                                                                                                                                       |
| <br>On      | <br>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).                                                                                                                                             |
| <br>Flashes | <br>Flashes | Hardware defective.                                                            | Replace the module.                                                                                                                                                                                                   |

## CHx LED

Table 6-2 Status display of the CHx LED

| Channel status LED                                                                         | Meaning                                                |
|--------------------------------------------------------------------------------------------|--------------------------------------------------------|
| <br>Off | Channel deactivated or module switched off             |
| <br>On  | Channel activated and no channel diagnostics available |
| <br>On  | Channel activated and channel diagnostics available    |

## 6.2 Interrupts

The AI 24xCVM HF analog input module supports diagnostic alarms and hardware 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:

- Wire break
- Overflow
- Underflow
- Parameter assignment error

## Hardware interrupt

The module generates a hardware interrupt at the following events:

- Low limit violated 1
- High limit violated 1
- Low limit violated 2
- Violation of high limit 2

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

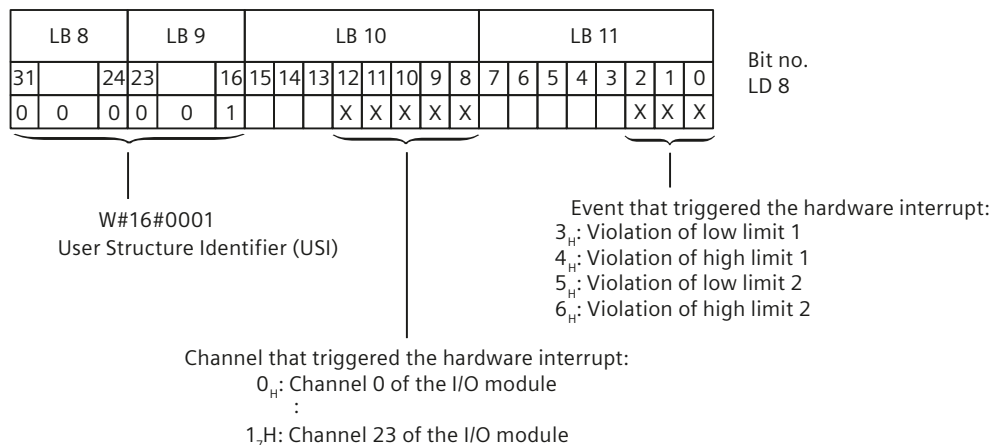


Figure 6-2 OB start information

## Reaction when reaching limits 1 and 2 at the same time

If the two high limits 1 and 2 are reached at the same time, the module always signals the hardware interrupt for high limit 1 first. The configured value for high limit 2 is irrelevant. After processing the hardware interrupt for high limit 1, the module triggers the hardware interrupt for high limit 2.

The module has the same reaction when the low limits are reached at the same time. If the two low limits 1 and 2 are reached at the same time, the module always signals the hardware interrupt for low limit 1 first. After processing the hardware interrupt for low limit 1, the module triggers the hardware interrupt for low limit 2.

## Structure of the additional interrupt information

Table 6-3 Structure of USI = W#16#0001

| Data block name                                                   | Contents          | Remark                                                                    | Bytes |
|-------------------------------------------------------------------|-------------------|---------------------------------------------------------------------------|-------|
| USI<br>(User Structure Identifier)                                | W#16#0001         | Additional interrupt info for hardware interrupts of the I/O module       | 2     |
| The channel that triggered the hardware interrupt follows.        |                   |                                                                           |       |
| Channel                                                           | B#16#00 to B#16#n | Number of the event-triggering channel (n = number of module channels -1) | 1     |
| It follows the error event that triggered the hardware interrupt. |                   |                                                                           |       |

| Data block name |       | Contents | Remark                    | Bytes |
|-----------------|-------|----------|---------------------------|-------|
|                 | Event | B#16#03  | Low limit violated 1      | 1     |
|                 |       | B#16#04  | High limit violated 1     |       |
|                 |       | B#16#05  | Low limit violated 2      |       |
|                 |       | B#16#06  | Violation of high limit 2 |       |

## 6.3 Diagnostics alarms

A diagnostics alarm is generated and the ERROR LED flashes for each diagnostics event on the module. 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.

Table 6-4 Diagnostics alarms, their meaning and corrective measures

| Diagnostics alarm          | Error code      | Meaning                                                                                                                                              | Remedy                                                                                                                                                                     |
|----------------------------|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Wire break                 | 6 <sub>H</sub>  | Wire break between the module and cell                                                                                                               | Connect the cable                                                                                                                                                          |
|                            |                 | Channel not connected (open)                                                                                                                         | <ul style="list-style-type: none"> <li>• Disable diagnostics</li> <li>• Connect the channel</li> <li>• bridge the unused channels</li> <li>• Deactivate channel</li> </ul> |
|                            |                 | Impermissible input voltage                                                                                                                          | Check the input voltage                                                                                                                                                    |
| Overflow                   | 7 <sub>H</sub>  | Measuring range violated                                                                                                                             | Check the measuring range                                                                                                                                                  |
| Underflow                  | 8 <sub>H</sub>  | Measuring range violated                                                                                                                             | Check the measuring range                                                                                                                                                  |
| Parameter assignment error | 10 <sub>H</sub> | <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                                                                                                                                           |

### Diagnostics alarms with value status (QI)

If you configure the module with value status (QI), the module always checks all errors even if the respective diagnostics is not enabled. But the module cancels the inspection as soon as it detects the first error, regardless if the respective diagnostics has been enabled or not. The result may be that enabled diagnostics may not be displayed.

**Example:** You have enabled "Underflow" diagnostics, but the module detects the previous "Wire break" diagnostics and aborts after this error message. The "Underflow" diagnostics is not detected.

**Recommendation:** To ensure that all errors are subjected to the diagnostics, select all check boxes under "Diagnostics".

## Technical specifications

### 7.1 Technical specifications

#### Technical specifications of the AI 24xCVM HF

|                                                                                   |                                                              |
|-----------------------------------------------------------------------------------|--------------------------------------------------------------|
| <b>Article number</b>                                                             | <b>6ES7531-7LK00-0AB0</b>                                    |
| <b>General information</b>                                                        |                                                              |
| Product type designation                                                          | AI 24xCVM HF                                                 |
| HW functional status                                                              | From FS01                                                    |
| Firmware version                                                                  | V1.0.0                                                       |
| <ul style="list-style-type: none"> <li>FW update possible</li> </ul>              | Yes                                                          |
| <b>Product function</b>                                                           |                                                              |
| <ul style="list-style-type: none"> <li>I&amp;M data</li> </ul>                    | Yes; I&M0 to I&M3                                            |
| <b>Operating mode</b>                                                             |                                                              |
| <ul style="list-style-type: none"> <li>Oversampling</li> </ul>                    | No                                                           |
| <ul style="list-style-type: none"> <li>MSI</li> </ul>                             | Yes                                                          |
| <b>CiR - Configuration in RUN</b>                                                 |                                                              |
| Reparameterization possible in RUN                                                | Yes                                                          |
| Calibration possible in RUN                                                       | Yes                                                          |
| <b>Power</b>                                                                      |                                                              |
| Power available from the backplane bus                                            | 2.8 W                                                        |
| <b>Power loss</b>                                                                 |                                                              |
| Power loss, typ.                                                                  | 2.1 W                                                        |
| <b>Analog inputs</b>                                                              |                                                              |
| Number of analog inputs                                                           | 24                                                           |
| <ul style="list-style-type: none"> <li>For voltage measurement</li> </ul>         | 24; at $\pm 3.5$ V; 16 channels at $\pm 5$ V                 |
| permissible input voltage for voltage input (destruction limit), max.             | 160 V                                                        |
| <b>Input ranges (rated values), voltages</b>                                      |                                                              |
| <ul style="list-style-type: none"> <li>-5 V to +5 V</li> </ul>                    | Yes                                                          |
| <ul style="list-style-type: none"> <li>Input resistance (-5 V to +5 V)</li> </ul> | 1 M $\Omega$ ; connected to +27 V for open-circuit detection |
| <b>Cable length</b>                                                               |                                                              |
| <ul style="list-style-type: none"> <li>shielded, max.</li> </ul>                  | 200 m                                                        |

|                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                            |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Article number</b>                                                                                                                                                                                              | <b>6ES7531-7LK00-0AB0</b>                                                                                                                                                                                                                                                  |
| <b>Analog value generation for the inputs</b>                                                                                                                                                                      |                                                                                                                                                                                                                                                                            |
| <b>Integration and conversion time/resolution per channel</b>                                                                                                                                                      |                                                                                                                                                                                                                                                                            |
| <ul style="list-style-type: none"> <li>Resolution with overrange (bit including sign), max.</li> </ul>                                                                                                             | 16 bit; 24 bits in floating-point format                                                                                                                                                                                                                                   |
| <ul style="list-style-type: none"> <li>Integration time, parameterizable</li> </ul>                                                                                                                                | Yes                                                                                                                                                                                                                                                                        |
| <ul style="list-style-type: none"> <li>Integration time (ms)</li> </ul>                                                                                                                                            | 2,5 / 16,67 / 20 / 100 ms                                                                                                                                                                                                                                                  |
| <ul style="list-style-type: none"> <li>Basic conversion time, including integration time (ms) <ul style="list-style-type: none"> <li>— additional conversion time for wire-break monitoring</li> </ul> </li> </ul> | 10 / 24 / 28 / 109 ms<br><br>35 ms; once per module cycle                                                                                                                                                                                                                  |
| <ul style="list-style-type: none"> <li>Basic execution time of the module (all channels released)</li> </ul>                                                                                                       | Channel 0 and 12, 1 and 13, etc. measure in pairs simultaneously. The slower channel of each pair determines the basic execution time of the channel pair. The basic execution time of the module is calculated by adding the basic conversion times of the channel pairs. |
| <b>Smoothing of measured values</b>                                                                                                                                                                                |                                                                                                                                                                                                                                                                            |
| <ul style="list-style-type: none"> <li>Number of smoothing levels</li> </ul>                                                                                                                                       | 4                                                                                                                                                                                                                                                                          |
| <ul style="list-style-type: none"> <li>parameterizable</li> </ul>                                                                                                                                                  | Yes                                                                                                                                                                                                                                                                        |
| <ul style="list-style-type: none"> <li>Step: None</li> </ul>                                                                                                                                                       | Yes                                                                                                                                                                                                                                                                        |
| <ul style="list-style-type: none"> <li>Step: low</li> </ul>                                                                                                                                                        | Yes                                                                                                                                                                                                                                                                        |
| <ul style="list-style-type: none"> <li>Step: Medium</li> </ul>                                                                                                                                                     | Yes                                                                                                                                                                                                                                                                        |
| <ul style="list-style-type: none"> <li>Step: High</li> </ul>                                                                                                                                                       | Yes                                                                                                                                                                                                                                                                        |
| <b>Encoder</b>                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                            |
| <b>Connection of signal encoders</b>                                                                                                                                                                               |                                                                                                                                                                                                                                                                            |
| <ul style="list-style-type: none"> <li>for voltage measurement</li> </ul>                                                                                                                                          | Yes                                                                                                                                                                                                                                                                        |
| <b>Errors/accuracies</b>                                                                                                                                                                                           |                                                                                                                                                                                                                                                                            |
| Linearity error (relative to input range), (+/-)                                                                                                                                                                   | 0.02 %                                                                                                                                                                                                                                                                     |
| Temperature error (relative to input range), (+/-)                                                                                                                                                                 | 0.005 %/K                                                                                                                                                                                                                                                                  |
| Crosstalk between the inputs, max.                                                                                                                                                                                 | -80 dB                                                                                                                                                                                                                                                                     |
| Repeat accuracy in steady state at 25 °C (relative to input range), (+/-)                                                                                                                                          | 0.02 %                                                                                                                                                                                                                                                                     |
| note regarding accuracy                                                                                                                                                                                            | at temperatures below 0 °C, the figures for operating error and temperature error are doubled                                                                                                                                                                              |
| <b>Operational error limit in overall temperature range</b>                                                                                                                                                        |                                                                                                                                                                                                                                                                            |
| <ul style="list-style-type: none"> <li>Voltage, relative to input range, (+/-)</li> </ul>                                                                                                                          | 0.1 %                                                                                                                                                                                                                                                                      |
| <b>Basic error limit (operational limit at 25 °C)</b>                                                                                                                                                              |                                                                                                                                                                                                                                                                            |
| <ul style="list-style-type: none"> <li>Voltage, relative to input range, (+/-)</li> </ul>                                                                                                                          | 0.05 %                                                                                                                                                                                                                                                                     |

|                                                                                                                                               |                                                                                                       |
|-----------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|
| <b>Article number</b>                                                                                                                         | <b>6ES7531-7LK00-0AB0</b>                                                                             |
| <b>Interference voltage suppression for <math>f = n \times (f_1 \pm 1 \%)</math>, <math>f_1</math> = interference frequency</b>               |                                                                                                       |
| <ul style="list-style-type: none"> <li>Series mode interference (peak value of interference &lt; rated value of input range), min.</li> </ul> | 36 dB                                                                                                 |
| <ul style="list-style-type: none"> <li>Common mode interference, min.</li> </ul>                                                              | 70 dB                                                                                                 |
| <b>Interrupts/diagnostics/status information</b>                                                                                              |                                                                                                       |
| Diagnostics function                                                                                                                          | Yes                                                                                                   |
| <b>Alarms</b>                                                                                                                                 |                                                                                                       |
| <ul style="list-style-type: none"> <li>Diagnostic alarm</li> </ul>                                                                            | Yes                                                                                                   |
| <ul style="list-style-type: none"> <li>Limit value alarm</li> </ul>                                                                           | Yes; two upper and two lower limit values in each case                                                |
| <b>Diagnoses</b>                                                                                                                              |                                                                                                       |
| <ul style="list-style-type: none"> <li>Monitoring the supply voltage</li> </ul>                                                               | Yes                                                                                                   |
| <ul style="list-style-type: none"> <li>Wire-break</li> </ul>                                                                                  | Yes                                                                                                   |
| <ul style="list-style-type: none"> <li>Overflow/underflow</li> </ul>                                                                          | Yes                                                                                                   |
| <b>Diagnostics indication LED</b>                                                                                                             |                                                                                                       |
| <ul style="list-style-type: none"> <li>RUN LED</li> </ul>                                                                                     | Yes; green LED                                                                                        |
| <ul style="list-style-type: none"> <li>ERROR LED</li> </ul>                                                                                   | Yes; red LED                                                                                          |
| <ul style="list-style-type: none"> <li>Monitoring of the supply voltage (PWR-LED)</li> </ul>                                                  | No                                                                                                    |
| <ul style="list-style-type: none"> <li>Channel status display</li> </ul>                                                                      | Yes; green LED                                                                                        |
| <ul style="list-style-type: none"> <li>for channel diagnostics</li> </ul>                                                                     | Yes; red LED                                                                                          |
| <ul style="list-style-type: none"> <li>for module diagnostics</li> </ul>                                                                      | Yes; red LED                                                                                          |
| <b>Potential separation</b>                                                                                                                   |                                                                                                       |
| <b>Potential separation channels</b>                                                                                                          |                                                                                                       |
| <ul style="list-style-type: none"> <li>between the channels</li> </ul>                                                                        | No                                                                                                    |
| <ul style="list-style-type: none"> <li>between the channels, in groups of</li> </ul>                                                          | 12                                                                                                    |
| <ul style="list-style-type: none"> <li>between the channels and backplane bus</li> </ul>                                                      | Yes                                                                                                   |
| <b>Permissible potential difference</b>                                                                                                       |                                                                                                       |
| Between the inputs and MANA (UCM)                                                                                                             | 21 V DC                                                                                               |
| between M internally and the inputs                                                                                                           | 600 V DC; insulation rated for 1000 V DC basic insulation: between the channels and the backplane bus |
| <b>Isolation</b>                                                                                                                              |                                                                                                       |
| Isolation tested with                                                                                                                         | 4700 V DC between channels and backplane bus                                                          |
| <b>Standards, approvals, certificates</b>                                                                                                     |                                                                                                       |
| Suitable for applications according to AMS 2750                                                                                               | No                                                                                                    |
| Suitable for applications according to CQI-9                                                                                                  | No                                                                                                    |
| <b>product functions / security / header</b>                                                                                                  |                                                                                                       |
| signed firmware update                                                                                                                        | Yes                                                                                                   |
| data integrity                                                                                                                                | No                                                                                                    |

|                                                        |                                                                                     |
|--------------------------------------------------------|-------------------------------------------------------------------------------------|
| <b>Article number</b>                                  | <b>6ES7531-7LK00-0AB0</b>                                                           |
| <b>Ambient conditions</b>                              |                                                                                     |
| <b>Ambient temperature during operation</b>            |                                                                                     |
| • horizontal installation, min.                        | -30 °C                                                                              |
| • horizontal installation, max.                        | 60 °C                                                                               |
| • vertical installation, min.                          | -30 °C                                                                              |
| • vertical installation, max.                          | 40 °C                                                                               |
| <b>Altitude during operation relating to sea level</b> |                                                                                     |
| • Installation altitude above sea level, max.          | 4 000 m; Restrictions for installation altitudes > 2 000 m, see entry ID: 109763260 |
| <b>Dimensions</b>                                      |                                                                                     |
| Width                                                  | 25 mm                                                                               |
| Height                                                 | 147 mm                                                                              |
| Depth                                                  | 129 mm                                                                              |
| <b>Weights</b>                                         |                                                                                     |
| Weight, approx.                                        | 240 g                                                                               |

## Dimension drawing

### A.1 Dimensional drawing

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

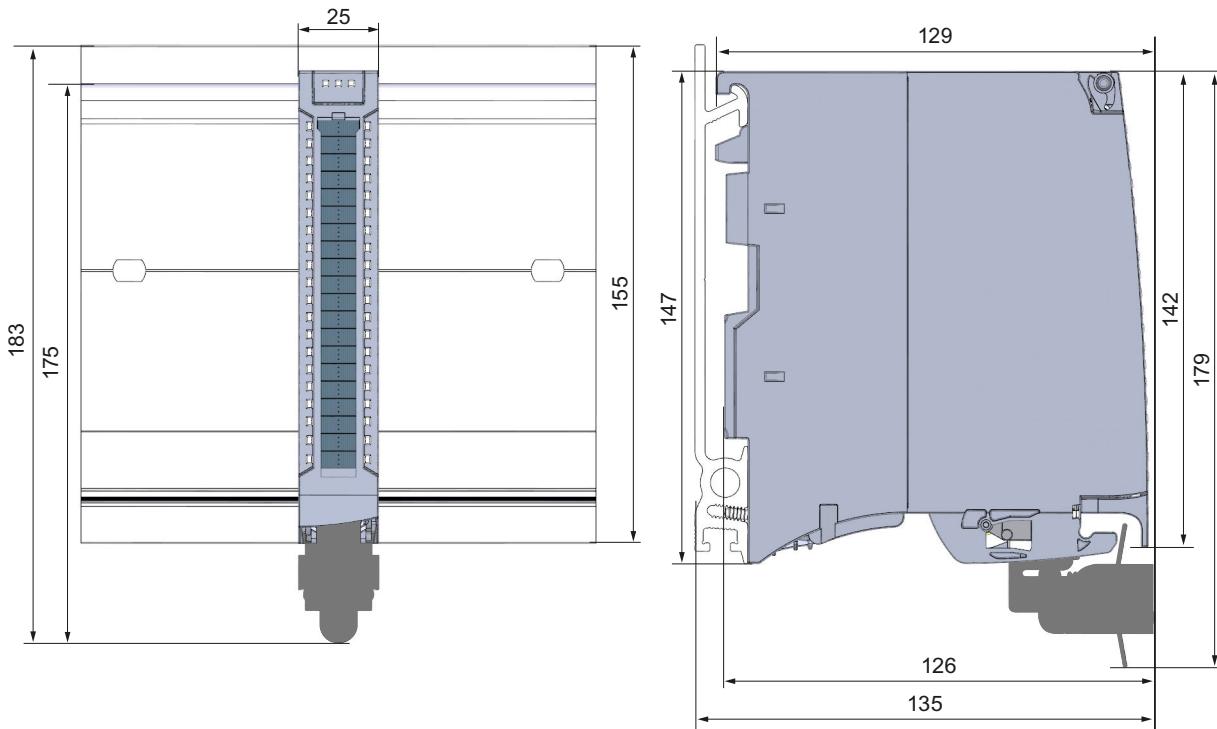


Figure A-1 Dimension drawing of the AI 24xCVM HF module



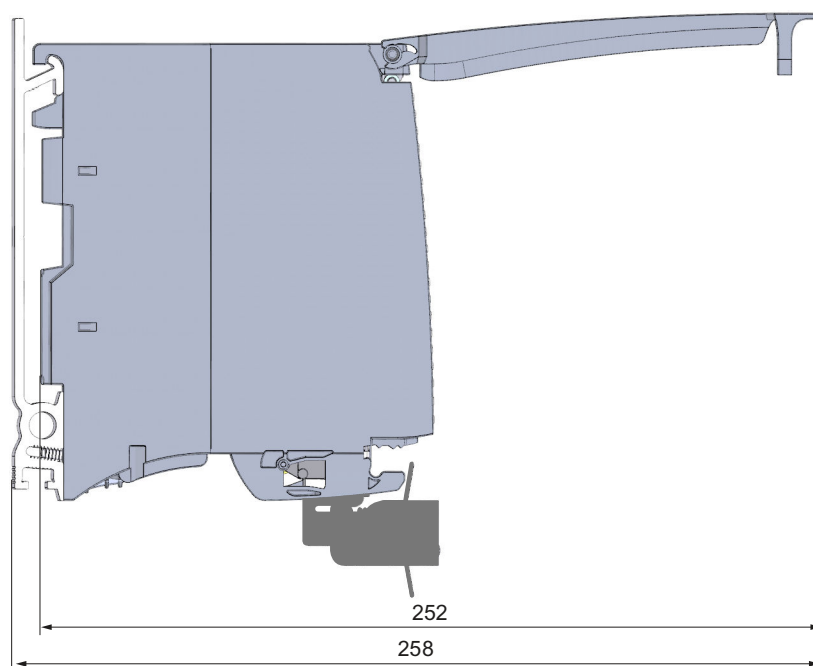


Figure A-2 Dimension drawing of the AI 24xCVM HF module, side view with open front flap

## Parameter data records

### B.1 Parameter assignment

#### Parameter assignment in the user program

You can change the parameters of the module in RUN mode, for example, deactivate channel.

#### Parameter assignment in RUN

The WRREC instruction is used to transfer the parameters to the module using data records 0 to 23. 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.

#### Assignment of data record and channel

For configuration with 1 x 24-channel, the parameters are located in data records 0 to 23 and are assigned as follows:

- Data record 0 for channel 0
- Data record 1 for channel 1
- ...
- Data record 22 for channel 22
- Data record 23 for channel 23

## B.2 Structure of the parameter data records

The figure below shows the structure of data record 0 for channel 0 as an example. The structure is identical for channels 1 to 23. 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".

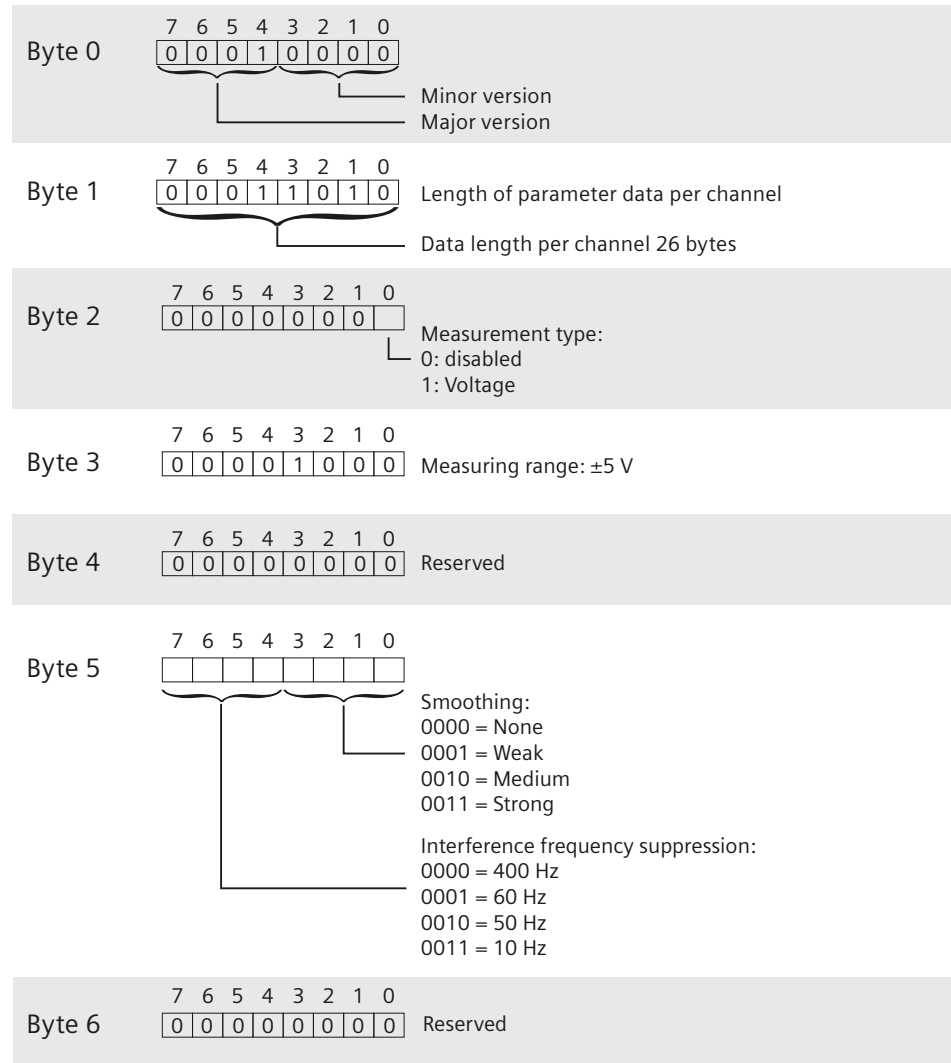
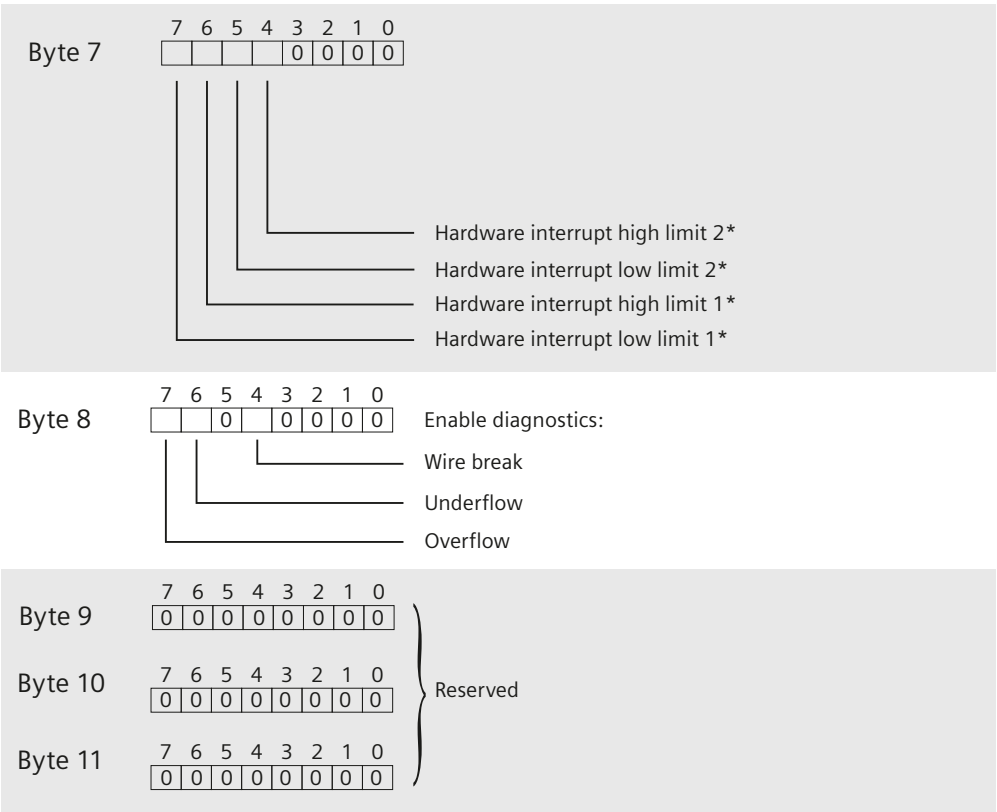


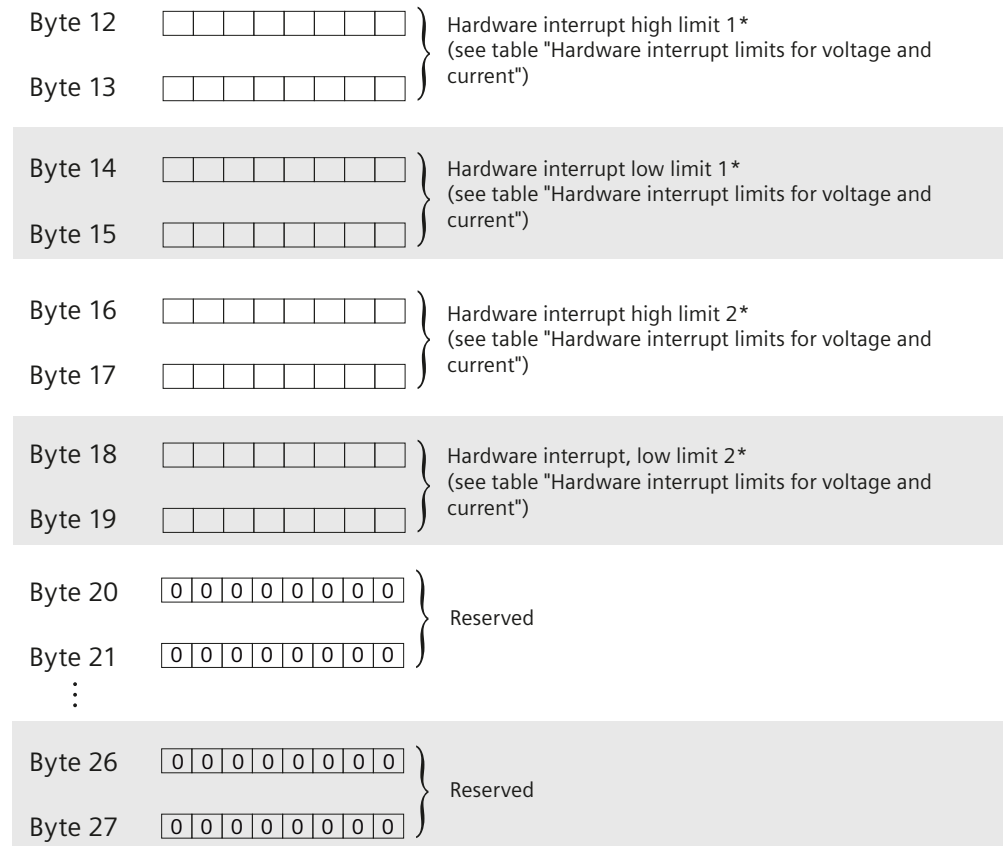
Figure B-1 Structure of data record 0: Bytes 0 to 6

B.2 Structure of the parameter data records



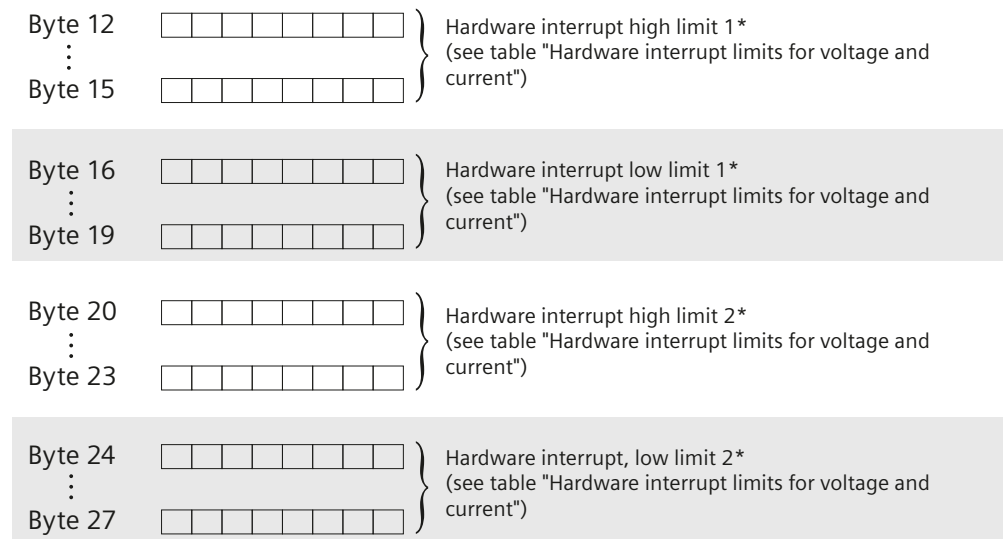
\* Activation of hardware interrupts via a data record is only possible if the channel has been assigned a hardware interrupt OB in STEP 7

Figure B-2 Structure of data record 0: Bytes 7 to 11

**Structure of hardware interrupt limits in S7 value representation bytes 12 to 19**

\* high limit must be greater than low limit

Figure B-3 Structure of data record 0: Bytes 12 to 19

**Structure of hardware interrupt limits in Real value representation bytes 12 to 27**

\* high limit must be greater than low limit

Figure B-4 Structure of data record 0: Bytes 12 to 27

## B.3 Coding of limits for hardware interrupts

### Hardware interrupt limits

The following tables list the valid hardware interrupt limits. The limit values depend on the selected measuring type and range. The values that you can set for hardware interrupts (high/low limit) must not exceed the respective nominal measuring range.

### Limit values in S7 value display

You enter the limits in S7 value display in bytes 12 to 19 of the corresponding data record.

Table B-1 Limits for hardware interrupts for voltage  $\pm 5$  V

|        |            |
|--------|------------|
| 32510  | High limit |
| -32511 | Low limit  |

### Limit values in Real value display

You enter the limits in Real value display in bytes 12 to 27 of the corresponding data record.

Table B-2 Limits for hardware interrupts for voltage  $\pm 5$  V

|        |            |
|--------|------------|
| 5.879  | High limit |
| -5.879 | Low limit  |

## B.4 Error when transferring the data record

### Error when transferring the data record

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

The WRREC instruction for writing data records returns corresponding error codes when errors occur in the STATUS parameter, see also the description of the "STATUS" parameter in the STEP 7 online help).

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

| Error code in STATUS parameter (hexadecimal) |        |        |        | Meaning                                  | Remedy                                       |
|----------------------------------------------|--------|--------|--------|------------------------------------------|----------------------------------------------|
| Byte 0                                       | Byte 1 | Byte 2 | Byte 3 |                                          |                                              |
| DF                                           | 80     | E0     | 01     | Unspecified error.                       | -                                            |
| DF                                           | 80     | E0     | 02     | Wrong version in the header information. | Correct the version of the parameter blocks. |
| DF                                           | 80     | E0     | 03     | Wrong length in the header information   | Correct the length of the parameter blocks.  |
| DF                                           | 80     | E1     | 00     | Unspecified error.                       | -                                            |

*B.4 Error when transferring the data record*

| Error code in STATUS parameter<br>(hexadecimal) |        |        |        | Meaning                                                                                 | Remedy                              |
|-------------------------------------------------|--------|--------|--------|-----------------------------------------------------------------------------------------|-------------------------------------|
| Byte 0                                          | Byte 1 | Byte 2 | Byte 3 |                                                                                         |                                     |
| DF                                              | 80     | E1     | 01     | Reserved bit set                                                                        | Check the parameters of the module. |
| DF                                              | 80     | E1     | 02     | Invalid diagnostics enable bit set for operating mode.                                  | Check the parameters of the module. |
| DF                                              | 80     | E1     | 04     | Invalid value for hardware interrupt limit.                                             | Check the parameters of the module. |
| DF                                              | 80     | E1     | 05     | Invalid coding set for measuring range / measurement type / output range / output type. | Check the parameters of the module. |
| DF                                              | 80     | E1     | 08     | Invalid coding set for interference frequency suppression.                              | Check the parameters of the module. |
| DF                                              | 80     | E1     | 09     | Invalid coding for smoothing.                                                           | Check the parameters of the module. |
| DF                                              | 80     | E1     | 16     | Invalid measurement type / output type.                                                 | Check the parameters of the module. |
| DF                                              | 80     | E1     | 17     | Invalid measuring range / output range                                                  | Check the parameters of the module. |

# Analog value representation

## C.1 Representation of analog values

### Introduction

The analog values for all measuring ranges that you can use with the AI 24xCVM HF analog module are shown in this appendix.

### 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       |               |
|-----------------------------------|---------|----------------|--------------------|---------------|
|                                   | Decimal | Hexadecimal    | High byte          | Low byte      |
| 16                                | 1       | 1 <sub>H</sub> | Sign 0 0 0 0 0 0 0 | 0 0 0 0 0 0 1 |

## C.2 Representation of input ranges

The tables below set out the digitized representation of the input ranges separately for bipolar and unipolar input ranges. The resolution is 16 bits.

Table C-2 Bipolar input ranges

| Units  | Measured 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> |                  |
| 32767  | >117.589            | 0               | 1               | 1               | 1               | 1               | 1               | 1              | 1              | 1              | 1              | 1              | 1              | 1              | 1              | 1              | 1              | Overflow         |
| 32511  | 117.589             | 0               | 1               | 1               | 1               | 1               | 1               | 1              | 0              | 1              | 1              | 1              | 1              | 1              | 1              | 1              | 1              | 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              | Undershoot range |
| -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              | Underflow        |
| -32768 | <-117.593           | 1               | 0               | 0               | 0               | 0               | 0               | 0              | 0              | 0              | 0              | 0              | 0              | 0              | 0              | 0              | 0              |                  |



## C.3 Representation of analog values in voltage measuring ranges

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

Table C-3 Voltage measuring range in S7 format

| Values |      | Voltage measuring range | Range            |
|--------|------|-------------------------|------------------|
| dec    | hex  | $\pm 5$ V               |                  |
| 32767  | 7FFF | $>5.879$ V              | Overflow         |
| 32511  | 7EFF | $5.879$ V               | Overshoot range  |
| 27649  | 6C01 |                         |                  |
| 27648  | 6C00 | $5$ V                   | Nominal range    |
| 20736  | 5100 | $3.75$ V                |                  |
| 1      | 1    | $180.8$ $\mu$ V         |                  |
| 0      | 0    | $0$ V                   |                  |
| -1     | FFFF |                         |                  |
| -20736 | AF00 | $-3.75$ V               |                  |
| -27648 | 9400 | $-5$ V                  |                  |
| -27649 | 93FF |                         | Undershoot range |
| -32512 | 8100 | $-5.879$ V              |                  |
| -32768 | 8000 | $< -5.879$ V            | Underflow        |

Table C-4 Voltage measuring range in Real format

| Values    | Voltage measuring range | Range            |
|-----------|-------------------------|------------------|
| Hex       | $\pm 5$ V               |                  |
| 7F80 0000 | $>5.879$ V              | Overflow         |
| 40BC 20C5 | $5.879$ V               | Overshoot range  |
| 40A0 0001 |                         |                  |
| 40A0 0000 | $5$ V                   | Nominal range    |
| 4070 0000 | $3.75$ V                |                  |
| 393D 9521 | $180.8$ $\mu$ V         |                  |
| 0000 0000 | $0$ V                   |                  |
| FFFF      |                         |                  |
| C070 0000 | $-3.75$ V               |                  |
| C0A0 0000 | $-5$ V                  |                  |
| C09F FFFF |                         | Undershoot range |
| C0BC 20C5 | $-5.879$ V              |                  |
| FF80 0000 | $< -5.879$ V            | Underflow        |

## C.4 Measured values for wire break diagnostic

### Measured values on diagnostic event "wire break", dependent on diagnostics enables

Error events initiate a diagnostics entry and trigger a diagnostics interrupt if configured accordingly.

Table C-5 Measured values if there is a wire break diagnosis, S7 format

| Parameter assignment                                                                                                                                                                                                             | Measured values |                   | Explanation                                                                                                                                  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|-------------------|----------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>"Wire break" diagnostics enabled</li> <li>"Overflow/Underflow" diagnostics enabled or disabled</li> </ul> ("Wire break" diagnostics takes priority over "Overflow/Underflow" diagnostics) | 32767           | 7FFF <sub>H</sub> | "Wire break" or "Cable break" diagnostics alarm                                                                                              |
| <ul style="list-style-type: none"> <li>"Wire break" diagnostics disabled</li> <li>"Overflow/Underflow" diagnostics enabled</li> </ul>                                                                                            | -32768          | 8000 <sub>H</sub> | <ul style="list-style-type: none"> <li>Measured value after leaving the underrange</li> <li>Diagnostic alarm "Low limit violated"</li> </ul> |
| <ul style="list-style-type: none"> <li>"Wire break" diagnostics disabled</li> <li>"Overflow/Underflow" diagnostics disabled</li> </ul>                                                                                           | -32768          | 8000 <sub>H</sub> | Measured value after leaving the underrange                                                                                                  |

Table C-6 Measured values for wire break diagnostics, Real format

| Parameter assignment                                                                                                                                                                                                             | Measured values       |                       | Explanation                                                                                                                                  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>"Wire break" diagnostics enabled</li> <li>"Overflow/Underflow" diagnostics enabled or disabled</li> </ul> ("Wire break" diagnostics takes priority over "Overflow/Underflow" diagnostics) | $3.4 \times 10^{38}$  | 7F800000 <sub>H</sub> | "Wire break" or "Cable break" diagnostics alarm                                                                                              |
| <ul style="list-style-type: none"> <li>"Wire break" diagnostics disabled</li> <li>"Overflow/Underflow" diagnostics enabled</li> </ul>                                                                                            | $-3.4 \times 10^{38}$ | FF800000 <sub>H</sub> | <ul style="list-style-type: none"> <li>Measured value after leaving the underrange</li> <li>Diagnostic alarm "Low limit violated"</li> </ul> |
| <ul style="list-style-type: none"> <li>"Wire break" diagnostics disabled</li> <li>"Overflow/Underflow" diagnostics disabled</li> </ul>                                                                                           | $-3.4 \times 10^{38}$ | FF800000 <sub>H</sub> | Measured value after leaving the underrange                                                                                                  |