



Edition

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EQUIPMENT MANUAL

# SIMATIC

S7-1500 / ET 200MP

Digital input module DI 16x24...125VUC HF  
6ES7521-7EH00-0AB0

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

## SIMATIC

### S7-1500/ET 200MP Digital input module DI 16x24...125VUC HF (6ES7521-7EH00-0AB0)

#### 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.

### Proper use of Siemens products

Note the following:

#### **WARNING**

Siemens products may only be used for the applications described in the catalog and in the relevant technical documentation. If products and components from other manufacturers are used, these must be recommended or approved by Siemens. Proper transport, storage, installation, assembly, commissioning, operation and maintenance are required to ensure that the products operate safely and without any problems. The permissible ambient conditions must be complied with. The information in the relevant documentation must be observed.

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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:

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### NOTE

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

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## 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

Part number:

6ES7521-7EH00-0AB0

View of the module

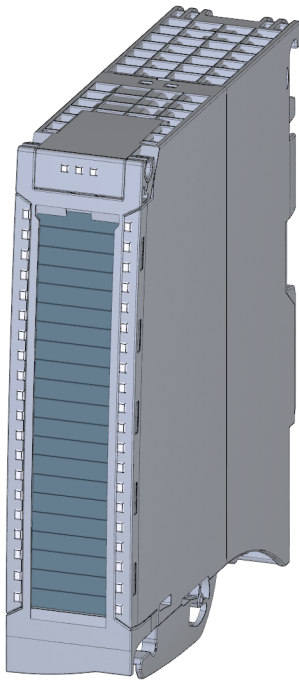


Figure 3-1 View of the module DI 16x24...125VUC HF

#### Properties

The module has the following technical properties:

- 16 digital inputs; electrically isolated in groups of 1 of which channels 0 and 1 optionally with counter function
- Rated input voltage 24 V UC to 125 V UC
- Configurable diagnostics (per channel)
- Configurable hardware interrupt (per channel)
- Programmable input delay (only with DC)
- Suitable for switches and 2-/3-/4-wire proximity switches

### 3.1 Properties

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)                                 | GSD file in STEP 7 (TIA Portal)                                    |
| Firmware update                                        | V1.0.0 or higher               | V13, SP1 or higher with HSP 0142                    | V12 or higher, or STEP 7 V5.5 SP3 or higher                        |
| Identification data I&M0 to I&M3                       | V1.0.0 or higher               | V13, SP1 or higher with HSP 0142                    | V12 or higher, or STEP 7 V5.5 SP3 or higher                        |
| Parameter assignment in RUN                            | V1.0.0 or higher               | V13, SP1 or higher with HSP 0142                    | V12 or higher, or STEP 7 V5.5 SP3 or higher                        |
| Module internal shared input (MSI)                     | V1.0.0 or higher               | V13, SP1 or higher with HSP 0142 (PROFINET IO only) | V12 or higher, or STEP 7 V5.5 SP3 or higher (PROFINET IO only)     |
| Configurable submodules / submodules for Shared Device | V1.0.0 or higher               | V13, SP1 or higher with HSP 0142 (PROFINET IO only) | V12 or higher, or STEP 7 V5.5 SP3 or higher (PROFINET IO only)     |
| Channel 0 and 1 optionally with counter function*      | V1.1.0 or higher               | As of V18 with HSP 0382                             | V15 SP1 or higher, or STEP 7 V5.5 SP4 or higher (PROFINET IO only) |

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

### Compatibility

The following table shows the compatibility of the modules and the dependencies between hardware functional status (FS) and firmware version (FW) used:

| Hardware functional status | Firmware version | Note                                                                 |
|----------------------------|------------------|----------------------------------------------------------------------|
| FS01                       | V1.0.0           | Upgrade and downgrade not possible between V1.0.0 and higher         |
| FS02                       | V1.0.0           | Upgrade and downgrade not possible between V1.0.0 and higher         |
| FS03                       | V1.0.0           | Upgrade and downgrade not possible between V1.0.0 and higher         |
| FS04                       | V1.1.0           | Upgrade and downgrade not possible between V1.1.0 and other versions |

### Accessories

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

- Labeling strips
- U connector
- Universal front cover

## Other components

The following component must be ordered separately:

Front connectors, including potential jumpers and cable ties

You can find additional information on accessories in the system manual S7-1500/ET 200MP

(<http://support.automation.siemens.com/WW/view/en/59191792>).

## 3.2 Functions

### 3.2.1 Count

#### Introduction

As of firmware version V1.1.0 of the module you have the option of using channels 0 and 1 in the "Count" mode. The other channels can be used as standard inputs (DI mode).

If do not use channels 0 and 1 in the "Count" mode, these channels can also be used as digital inputs. The two channels 0 and 1 can only be used as counter inputs together.

When counting, the edges of the digital input are acquired and evaluated accordingly e.g.:

- For counting single items up to a maximum limit
- For applications with repeating counting procedures

#### Reference

You will find the basics and additional information on the counting function in the function manual Counting, measuring and position detection

(<http://support.automation.siemens.com/WW/view/en/59709820>).

#### Counting with channel 0 and channel 1

You control the counting function via the IO addresses of the module. These IO addresses are also known as the control interface (output addresses) and feedback interface (input addresses), see section Address space Counting mode (Page 30).

If you set the parameters of channels 0 and 1 for counting, you then have the following options:

- You influence the behavior if one of the counting limits is exceeded using
  - Stop counting.
  - Continue counting.
- The bit STS\_DQ (bit in the feedback interface) signals that the counted value is in one of the following ranges depending on the parameter assignment:
  - Between a comparison value and the high counting limit.
  - Between a comparison value and the low counting limit.
- You can set a parameter for a hardware interrupt if a comparison event occurs for DQ.
- You can define counting limits and comparison values for counting from 0 ... 4294967295 ( $2^{32}-1$ ).
- You can set start values or have the user program set load values for counting.

The count direction is only up.

## Reference

You will find examples of counting with channels 0 and 1 in the section Examples of counting  
(Page 33)

# Wiring

## 4.1 Wiring and block diagram

This section contains the block diagram of the module and outlines various wiring options. You can find information on wiring the front connector, establishing a cable shield, etc. in the system manual S7-1500/ET 200MP (<http://support.automation.siemens.com/WW/view/en/59191792>).

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**NOTE**

Do not insert the potential jumpers included with the front connector!

---

## Wiring and block diagram

The figure below shows you how to wire the module and the assignment of the channels to the addresses (input byte a to input byte b).

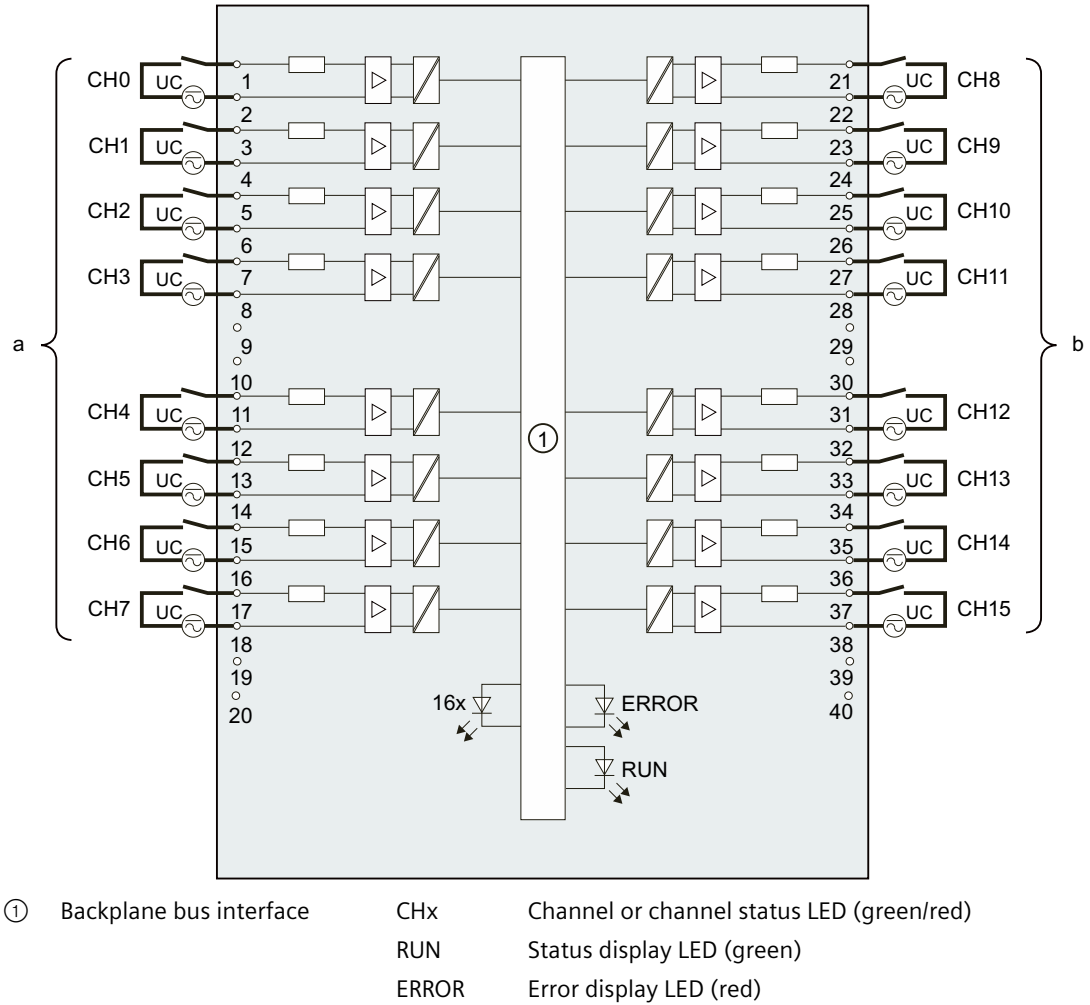
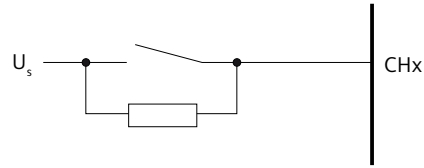


Figure 4-1 Block diagram and terminal assignment

### Resistor circuitry of the encoders

To detect a wire break, it is necessary that enough quiescent current is flowing even when the encoder contacts are open. Connect a resistor to the encoder contacts for this reason, see figure below.



Rated input voltage:

24 V AC/DC

48 V AC/DC

125 V AC/DC

Resistance:

16 k $\Omega$  ... 21 k $\Omega$  with 1.0 W

37 k $\Omega$  ... 53 k $\Omega$  with 0.5 W

101 k $\Omega$  ... 156 k $\Omega$  with 0.25 W

Figure 4-2 Resistor circuitry of the encoders

## Parameters/address space

### 5.1 Parameters

#### 5.1.1 Parameters

##### DI 16x24...125VUC HF parameters

When you assign the module parameters with STEP 7, you use various parameters to specify the module properties. The parameters that can be set depend on whether you use the module in standard mode or in counter mode. You will find the parameters in section DI mode parameters (Page 20) or section Counter mode parameters (Page 22). The effective range of the configurable parameters depends on the type of configuration. The following configurations are possible:

- Central operation with a S7-1500 CPU
- Distributed operation on PROFINET IO in an ET 200MP system
- Distributed operation on PROFIBUS DP in an ET 200MP system

For parameter assignment in the user program, the parameters are transferred to the module using the WRREC instruction (parameter reassignment in RUN) via data records; see chapter Parameter assignment and structure of the parameter data records (Page 48).

#### 5.1.2 Parameters DI mode

##### Parameters of the DI 16x24...125VUC HF in DI mode

You can find the parameters in the DI mode in the table below. These parameters apply to channels 0 to 15.

Table 5-1 Configurable parameters and their defaults

| Parameter          | Range of values                                         | Default setting                                                                         | Parameter reassignment in RUN | Range of effectiveness with configuration software, e.g. STEP 7                  |                                         |
|--------------------|---------------------------------------------------------|-----------------------------------------------------------------------------------------|-------------------------------|----------------------------------------------------------------------------------|-----------------------------------------|
|                    |                                                         |                                                                                         |                               | Integrated in the hardware catalog as of STEP 7, V13 SP1 or GSD file PROFINET IO | GSD file PROFIBUS DP                    |
| <b>Diagnostics</b> |                                                         |                                                                                         |                               |                                                                                  |                                         |
| • Wire break       | Yes/No                                                  | No                                                                                      | Yes                           | Channel                                                                          | Channel group (CH0 to CH7, CH8 to CH15) |
| <b>Input delay</b> | 0.05 ms, 0.1 ms, 0.4 ms, 1.6 ms, 3.2 ms, 12.8 ms, 20 ms | <ul style="list-style-type: none"> <li>• 20 ms</li> <li>• Fixed 20 ms for AC</li> </ul> | Yes                           | Channel                                                                          | Channel group (CH0 to CH7, CH8 to CH15) |

| Parameter                 | Range of values | Default setting | Parameter reassignment in RUN | Range of effectiveness with configuration software, e.g. STEP 7                  |                      |
|---------------------------|-----------------|-----------------|-------------------------------|----------------------------------------------------------------------------------|----------------------|
|                           |                 |                 |                               | Integrated in the hardware catalog as of STEP 7, V13 SP1 or GSD file PROFINET IO | GSD file PROFIBUS DP |
| <b>Hardware interrupt</b> |                 |                 |                               |                                                                                  |                      |
| • Rising edge             | Yes/No          | No              | Yes                           | Channel                                                                          | Channel              |
| • Falling edge            | Yes/No          | No              | Yes                           | Channel                                                                          | Channel              |
| • Rising and falling edge | Yes/No          | No              | Yes                           | Channel                                                                          | Channel              |

**NOTE****Input delay for AS input voltages**

If you are operating channels of the module with an AC input voltage, you must set the input delay for these channels at 20 ms.

If you set a different input delay, the input signal might be incorrectly altered and the wrong value read.

### 5.1.3 Explanation of the parameters of DI mode

#### Wire break

Enabling diagnostics if the line to the encoder is interrupted.

#### Input delay

This parameter can be used to suppress signal disruptions. Changes to the signal are only detected if they are constantly pending longer than the set input delay time.

#### Hardware interrupt

Specifies whether or not a hardware interrupt is disabled or with which of the following events a hardware interrupt is generated.

- Rising edge
- Falling edge
- Rising and falling edge

### 5.1.4 Parameters of the Counting mode

#### Parameters of the DI 16x24...125VUC HF in the Counting mode

If you want to use the module for counting, you need to set the module parameters as DI 16x24...125VUC HF. For channels 0 and channel 1, the following parameter settings are then possible. For channels 2 to 15, the parameter settings apply as with the DI 16x24...125VUC HF, , see section Parameters DI mode (Page 20).

Table 5-2 Settable parameters and their defaults in the Counting mode

| Parameter                 | Range of values                                                                                                                                                         | Default setting                                          | Parameter reassignment in RUN | Range of effectiveness with configuration software, e.g. STEP 7                                |                      |
|---------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------|-------------------------------|------------------------------------------------------------------------------------------------|----------------------|
|                           |                                                                                                                                                                         |                                                          |                               | Integrated in the hardware catalog as of STEP 7, V13 SP1 with HSP 0118 or GSD file PROFINET IO | GSD file PROFIBUS DP |
| <b>Diagnostics</b>        |                                                                                                                                                                         |                                                          |                               |                                                                                                |                      |
| • No supply voltage L+    | Yes/No                                                                                                                                                                  | No                                                       | Yes                           | Channel*                                                                                       | ---                  |
| • Wire break              | Yes/No                                                                                                                                                                  | No                                                       | Yes                           | Channel                                                                                        | ---                  |
| <b>Input delay</b>        | 0.05 ms, 0.1 ms, 0.4 ms, 1.6 ms, 3.2 ms, 12.8 ms, 20 ms                                                                                                                 | 3.2 ms; for isochronous mode 0.05 ms (cannot be changed) | Yes                           | Channel                                                                                        | ---                  |
| <b>Hardware interrupt</b> | <ul style="list-style-type: none"> <li>Disable</li> <li>Comparison event occurred for DQ</li> </ul>                                                                     | Disable                                                  | Yes                           | Channel                                                                                        | ---                  |
| <b>Set output DQ</b>      | <ul style="list-style-type: none"> <li>Between a comparison value and the high counting limit</li> <li>Between a comparison value and the low counting limit</li> </ul> | Between a comparison value and the high counting limit   | Yes                           | Channel                                                                                        | ---                  |
| <b>Edge selection</b>     | <ul style="list-style-type: none"> <li>On rising edge</li> <li>On falling edge</li> <li>On rising and falling edge</li> </ul>                                           | On rising edge                                           | Yes                           | Channel                                                                                        | ---                  |

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

You can prevent this alarm surge by enabling diagnostics for one channel only.

\*\* Comparison value or start value must be less than or equal to the value for the high counting limit.

| Parameter                                  | Range of values                                                                            | Default setting | Parameter reassignment in RUN | Range of effectiveness with configuration software, e.g. STEP 7                                |                      |
|--------------------------------------------|--------------------------------------------------------------------------------------------|-----------------|-------------------------------|------------------------------------------------------------------------------------------------|----------------------|
|                                            |                                                                                            |                 |                               | Integrated in the hardware catalog as of STEP 7, V13 SP1 with HSP 0118 or GSD file PROFINET IO | GSD file PROFIBUS DP |
| High counting limit                        | 0 ... 4294967295                                                                           | 4294967295      | Yes                           | Channel                                                                                        | ---                  |
| Comparison value                           | 0 ... 4294967295**                                                                         | 1               | Yes                           | Channel                                                                                        | ---                  |
| Start value                                | 0 ... 4294967295**                                                                         | 0               | Yes                           | Channel                                                                                        | ---                  |
| Behavior when a counting limit is exceeded | <ul style="list-style-type: none"> <li>Stop counting</li> <li>Continue counting</li> </ul> | Stop counter    | Yes                           | Channel                                                                                        | ---                  |

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

You can prevent this alarm surge by enabling diagnostics for one channel only.

\*\* Comparison value or start value must be less than or equal to the value for the high counting limit.

### 5.1.5 Explanation of the parameters of the Counting mode

#### Missing supply voltage L+

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

#### Wire break

Enabling diagnostics if the line to the encoder is interrupted.

#### Input delay

This parameter can be used to suppress signal disruptions. Changes to the signal are only detected if they are constantly pending longer than the set input delay time.

#### Hardware interrupt

Specifies whether or not a hardware interrupt is generated by the event "Comparison event occurred for DQ" (rising edge at STS\_DQ).

## Set output DQ

With this parameter, you specify the behavior of the STS\_DQ bit in the feedback interface. You can assign this bit in the user program, for example, with a hardware output, see Address space Counting mode [\(Page 30\)](#).

| Behavior                                               | Meaning                                                                                                                  |
|--------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|
| Between a comparison value and the high counting limit | STS_DQ bit is set if the following condition is met:<br>Comparison value $\leq$ counted value $\leq$ high counting limit |
| Between a comparison value and the low counting limit  | STS_DQ bit is set if the following condition is met:<br>Low counting limit $\leq$ counted value $\leq$ comparison value  |

## Edge selection

With this parameter you specify which edge is used to count.

You can select the following options:

- On rising edge
- On falling edge
- On rising and falling edge

## High counting limit

With this parameter you limit the counting range. You can enter a value up to 4294967295 ( $2^{32} - 1$ ).

## Comparison value

With this parameter you specify the count value at which the digital output DQ (STS\_DQ bit of the feedback interface) switches due to the selected comparison event.

## Start value

With this parameter, you specify the value at which counting begins and is continued if defined events occur. The following condition must be met:

Low counting limit  $\leq$  start value  $\leq$  high counting limit.

## Behavior when a counting limit is exceeded

With this parameter, you specify the behavior if a counting limit is exceeded.

| Behavior          | Meaning                                                                                                                                                                                                              |
|-------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Stop counting     | After a counting limit is exceeded, the counting procedure is aborted and the STS_GATE bit (internal gate) is reset. To restart the counting, the SW_GATE bit must be reset via the control interface and set again. |
| Continue counting | After a counting limit is exceeded, the counted value is set to the other counting limit and counting is continued.                                                                                                  |

## 5.2 Address space

### 5.2.1 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. The letters "a" and "b" are printed on the module. "IB a" for example, stands for module start address input byte a.

### Configuration options of DI 16x24...125VUC 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 5-3 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 hard-<br>ware catalog as of<br>STEP 7 (TIA Portal) V13<br>SP1 with HSP 0142 | GSD file in<br>STEP 7 (TIA Portal) V12 or<br>higher or STEP 7 V5.5 SP3 or<br>higher |
| 1 x 16-channel without value status                                                                                 | DI 16x24...125VUC HF                                 | X                                                                                             | X                                                                                   |
| 1 x 16-channel with value status                                                                                    | DI 16x24...125VUC HF QI                              | X                                                                                             | X                                                                                   |
| 2 x 8-channel without value status                                                                                  | DI 16x24...125VUC HF S                               | X<br>(PROFINET IO only)                                                                       | X<br>(PROFINET IO only)                                                             |
| 2 x 8-channel with value status                                                                                     | DI 16x24...125VUC HF S QI                            | X<br>(PROFINET IO only)                                                                       | X<br>(PROFINET IO only)                                                             |
| 1 x 16-channel with value status for<br>module-internal shared input with up<br>to 4 submodules                     | DI 16x24...125VUC HF MSI                             | X<br>(PROFINET IO only)                                                                       | X<br>(PROFINET IO only)                                                             |
| 1 x 16-channel with value status<br>(channel 0 and channel 1 for count-<br>ing, channels 2 to 15 as digital inputs) | DI 16x24...125VUC HF<br>Count                        | V19 or higher                                                                                 | X<br>(PROFINET IO only)                                                             |

Value status (Quality Information, QI)

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

- DI 16x24...125VUC HF QI,
- DI 16x24...125VUC HF S QI
- DI 16x24...125VUC HF MSI
- DI 16x24...125VUC HF Count

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).

Address space for configuration as 16-channel DI 16x24...125VUC HF QI

The figure below shows the assignment of the address space for the configuration as a 16-channel module with value status. You can freely assign the start address for the module. The addresses of the channels are derived from the start address.

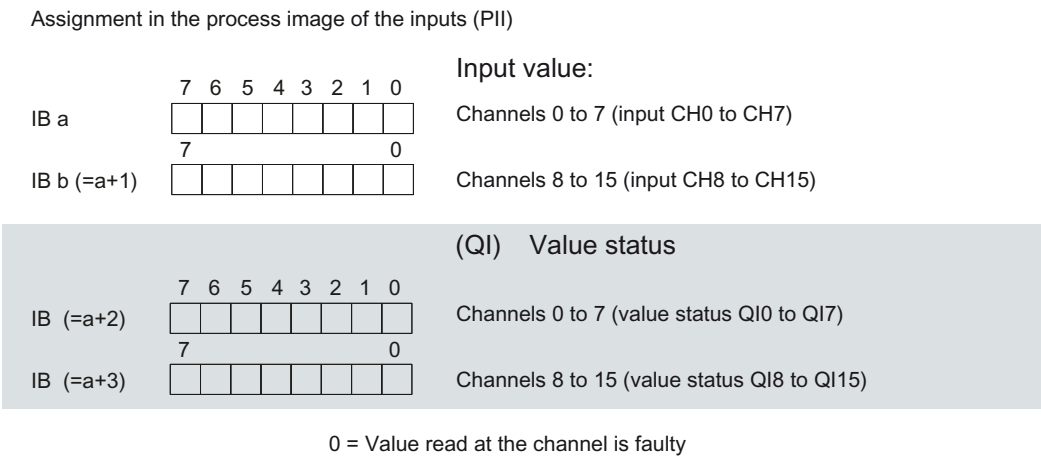


Figure 5-1 Address space for configuration as 16-channel DI 16x24...125VUC HF QI with value status

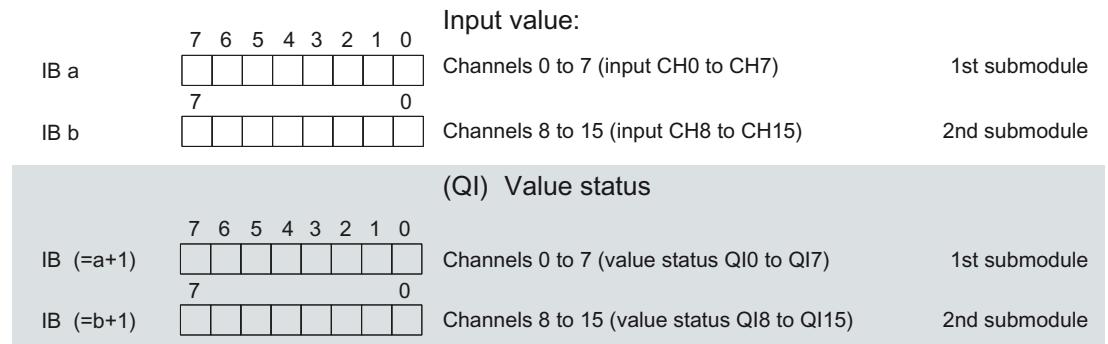
### Address space for configuration as 2 x 8-channel DI 16x24...125VUC HF S QI

For the configuration as a 2 x 8-channel module, the channels of the module are divided into multiple submodules. The submodules can be assigned to different IO controllers when the module is used in a shared device.

The number of usable IO controllers depends on the interface module used. Please observe the information in the manual for the particular interface module.

Contrary to the 1 x 16-channel module configuration, each of the two submodules has a freely assignable start address.

Assignment in the process image of the inputs (PII)



0 = Value read at the channel is faulty

Figure 5-2 Address space for configuration as 2 x 8-channel DI 16x24...125VUC HF QI

### Address space for configuration as 1 x 16-channel DI 16x24...125VUC HF MSI

The channels 0 to 15 of the module are copied in up to four submodules with configuration 1 x 16-channel module (Module-internal shared input, MSI). Channels 0 to 15 are then available 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 being 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 involved.

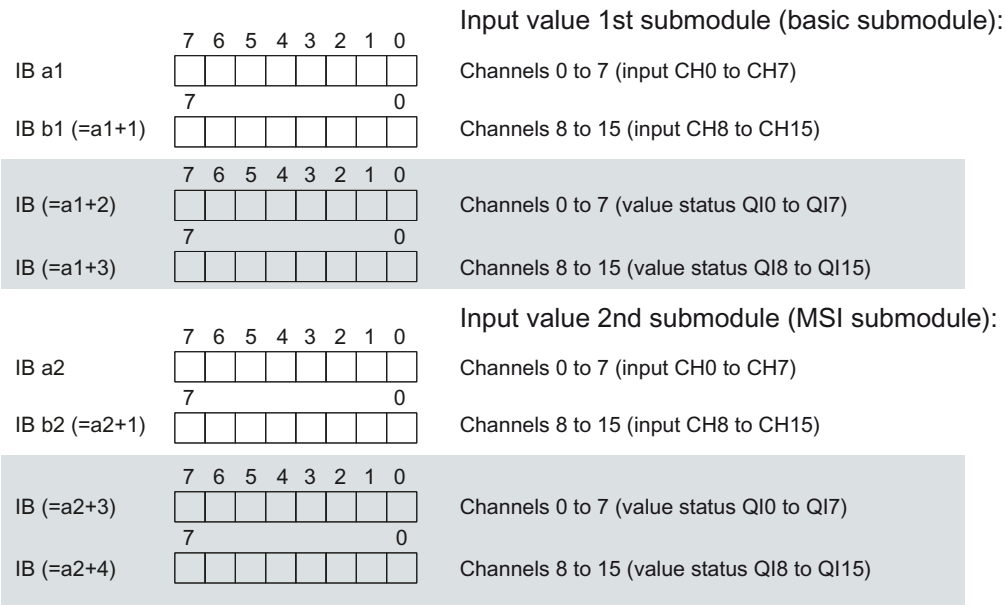
For the first submodule (=basic submodule), the value status 0 indicates that the value is incorrect.

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).

5.2 Address space

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

Assignment in the process image of the inputs (PII) for 1st and 2nd submodule



0 = Value read at the channel is faulty

Figure 5-3 Address space for configuration as 1 x 16-channel DI 16x24...125VUC HF MSI

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

Assignment in the process image of the inputs (PII) for 3rd and 4th submodule

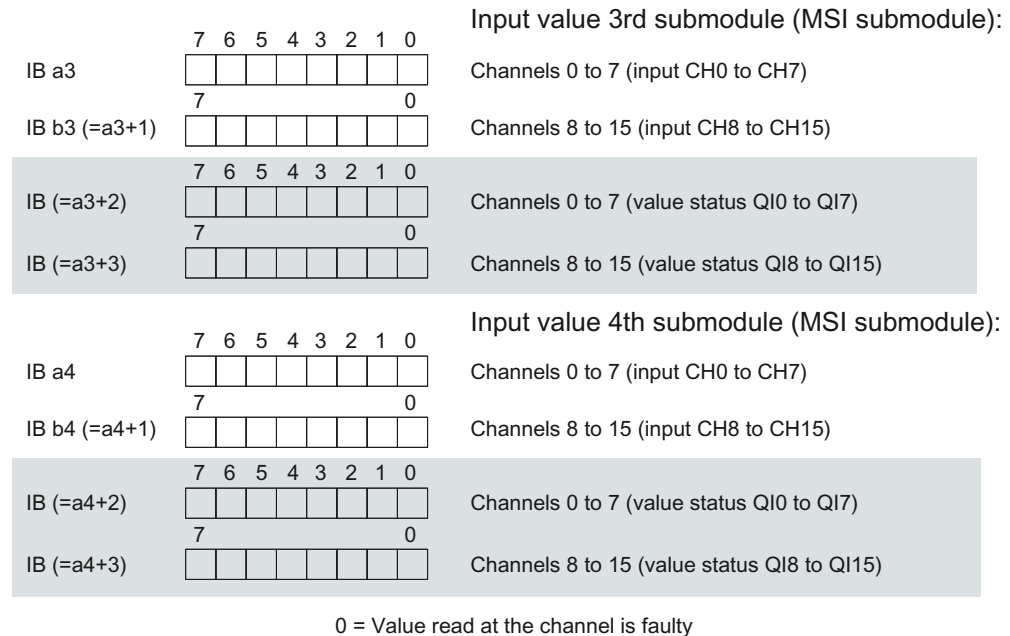


Figure 5-4 Address space for configuration as 1 x 16-channel DI 16x24...125VUC HF MSI

## Reference

You can find information on the module-internal shared input/shared output (MSI/MSO) function in the section Module-internal shared input/shared output (MSI/MSO) of the function manual PROFINET with STEP 7 V13

(<https://support.industry.siemens.com/cs/ww/en/view/49948856>).

### 5.2.2 Address space Counting mode

#### Address space for configuration as 1 x 16-channel DI 16x24...125VUC HF Count

The address space of channel 0 and channel 1 used for counting consists of the control and feedback interface. The Count function is controlled directly via the two interfaces. With suitable parameter assignment, a hardware interrupt is triggered.

If you use the module in the "Counting mode" (channels 0 and 1), the module occupies the following address areas:

- 16 bytes in the process image output (control interface).
- 20 bytes in the process image input (feedback interface).

#### Control interface

The figure below shows the address assignment of the module in the process image output. You use the control interface, for example, to start the counter or to set the counter value. With the "SW gate" control bit you open and close the software gate of the corresponding channel.

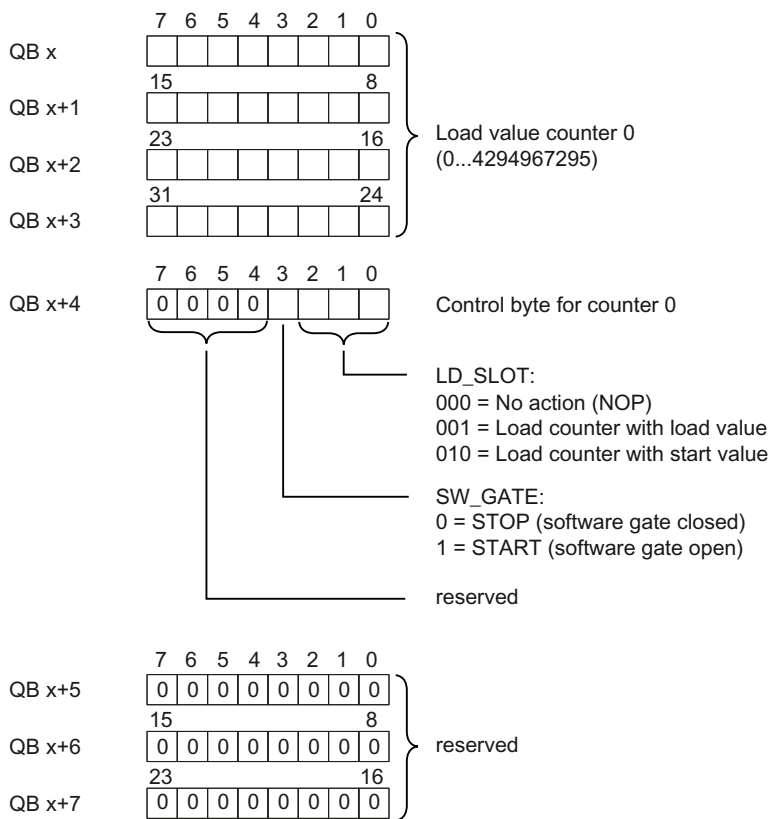


Figure 5-5 Assignment of the address space of the control interface of the DI 16x24...125VUC Count (bytes 0 to 7)

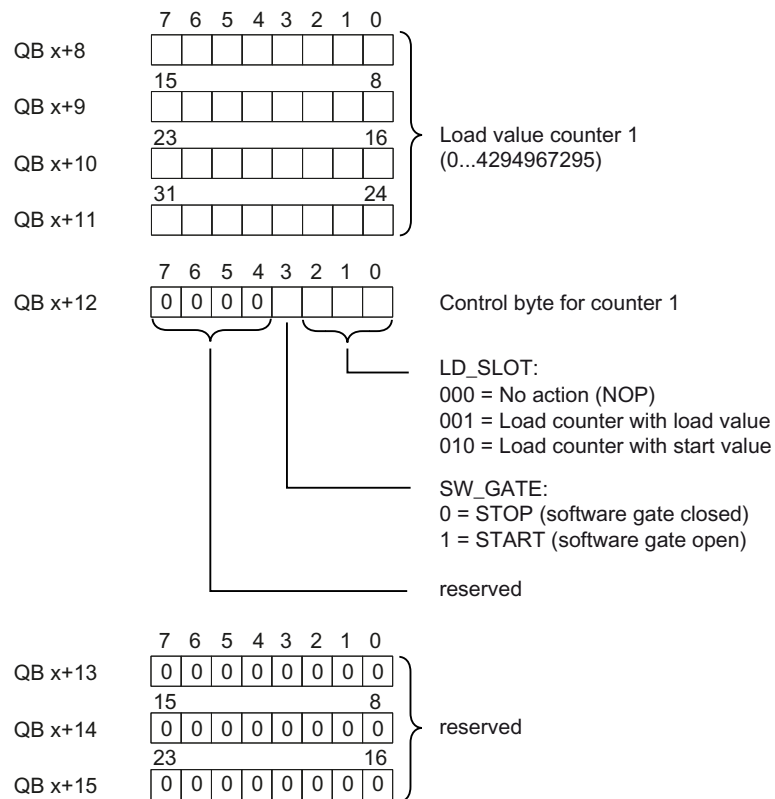
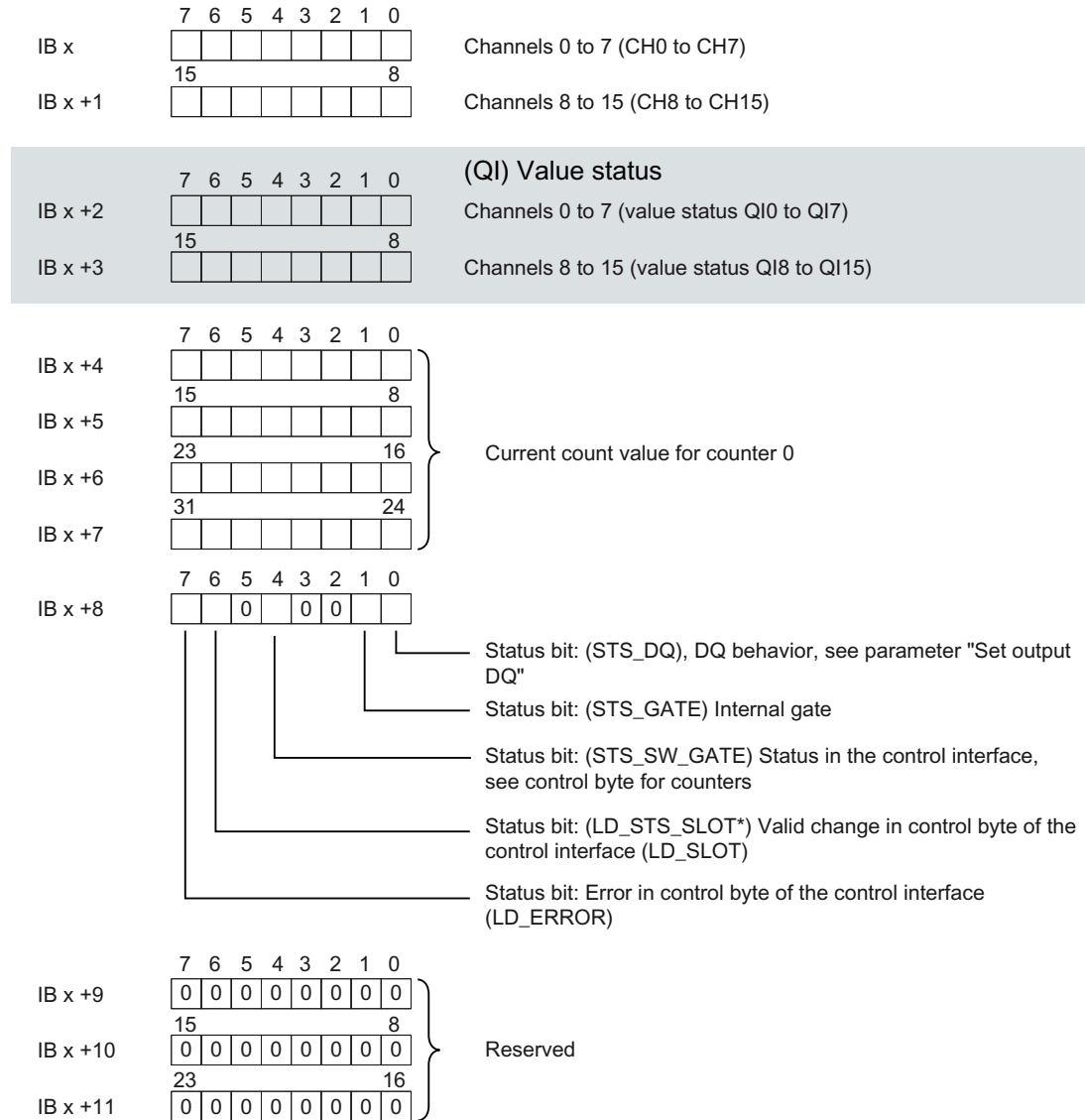


Figure 5-6 Assignment of the address space of the control interface of the DI 16x24...125VUC Count (bytes 8 to 15)

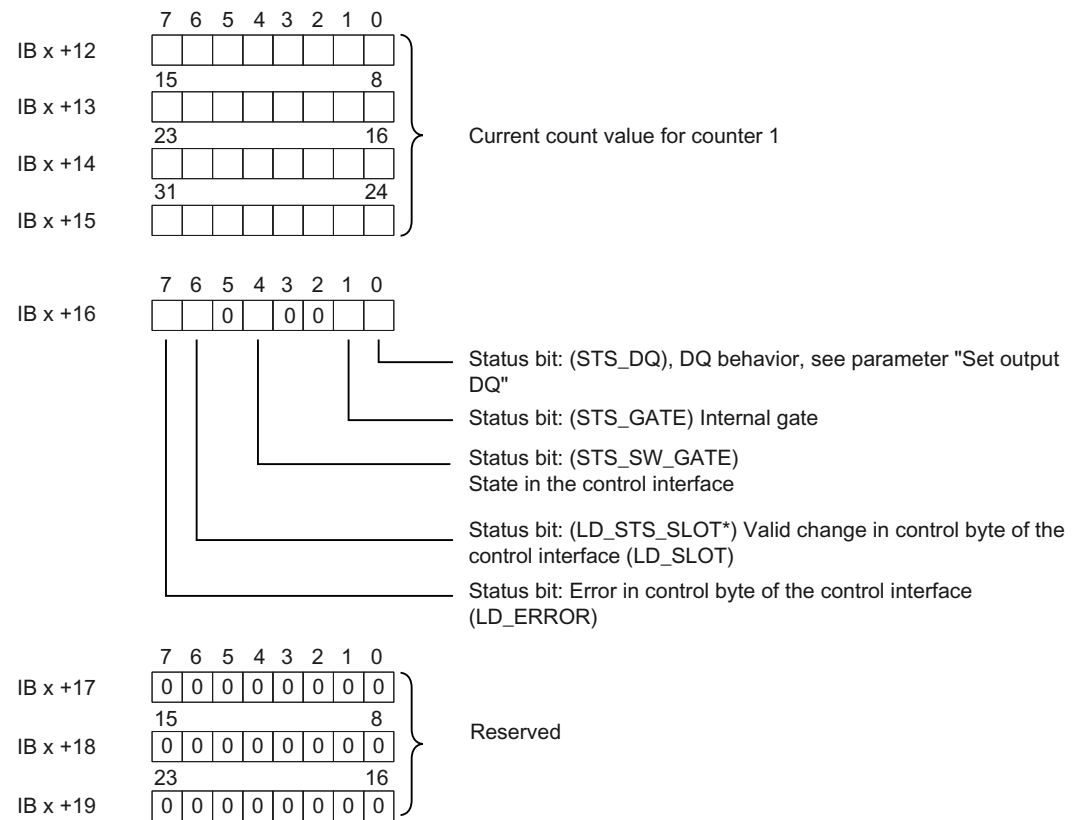
## Feedback interface

The figure below shows the address assignment of the module in the process image input. The feedback interface for the counters (channels 0 and 1) begins at input byte x+4. Via the feedback interface, the user program receives current counted values and status information from the module.



\* "Acknowledgment bit" for bits 0 to 2 in the control interface (LD\_SLOT). This bit changes its state when a new command is specified in LD\_SLOT.

Figure 5-7 Assignment of the address space of the feedback interface of the DI 16x24...125VUC Count (bytes 0 to 11)



\* "Acknowledgment bit" for bits 0 to 2 in the control interface (LD\_SLOT). This bit changes its state when a new command is specified in LD\_SLOT.

Figure 5-8 Assignment of the address space of the feedback interface of the DI 16x24...125VUC Count (bytes 12 to 19)

### 5.2.3 Examples of counting

In this section, you will find examples of the behavior of the counter and how you can specify this behavior. You specify the properties of the counter in the parameter assignment.

#### Behavior when a counting limit is exceeded - Stop counting

The following section describes the effects of the parameter "Behavior when a counting limit is exceeded = Stop counting". To control the counter, the bits of the control byte of the control interface are used, see section Address space Counting mode (Page 30)

Counting begins at the current counted value (the SW\_GATE is set in the control byte). Bit sequence in the control byte of the control interface 0000 1000.

After the high counting limit is violated, counting is aborted (counting stops) and the counted value jumps to the low counting limit = 0. The STS\_GATE bit is reset.

To restart the counting, the SW\_GATE bit must be reset via the control interface and set again.

Whether or not counting is started again with the current counter value or with the start value depends on the command byte in the control interface.

Bit sequence in control byte of the control interface:

- bit 0 to 2 = "000" Start with current counter value
- bit 0 to 2 = "010" Start with start value

If the SW\_GATE bit is reset in the control byte of the control interface before reaching the high counting limit, counting is stopped.

The following figure shows an example of the principle of stopping counting when a counting limit is exceeded.

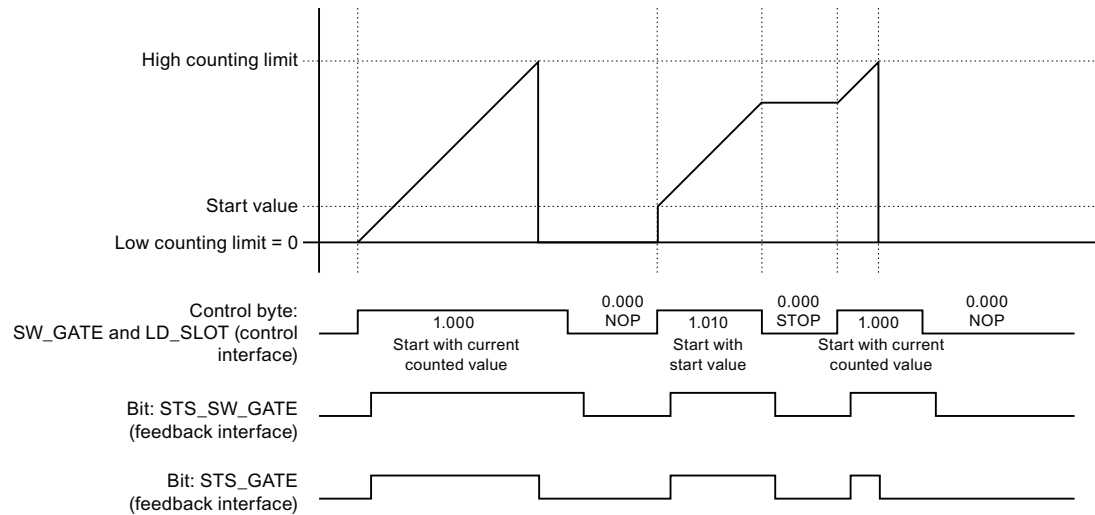


Figure 5-9 Principle: Stop counting

### Behavior when a counting limit is exceeded - Continue counting

The following section describes the effects of the parameter "Behavior when a counting limit is exceeded = Continue counting". To control the counter, the bits of the control byte of the control interface are used, see section Address space Counting mode (Page 30), subsection Control interface.

Counting begins at the current counted value (the SW-GATE is set in the control byte). Bit sequence in the control byte of the control interface 0000 1000.

After the high counting limit is exceeded, the counted value jumps to the low counting limit = 0 and counting is continued.

If the SW\_GATE bit is reset in the control byte of the control interface before reaching the high counting limit, counting is stopped.

The following figure shows an example of the principle of continuing counting when a counting limit is exceeded.

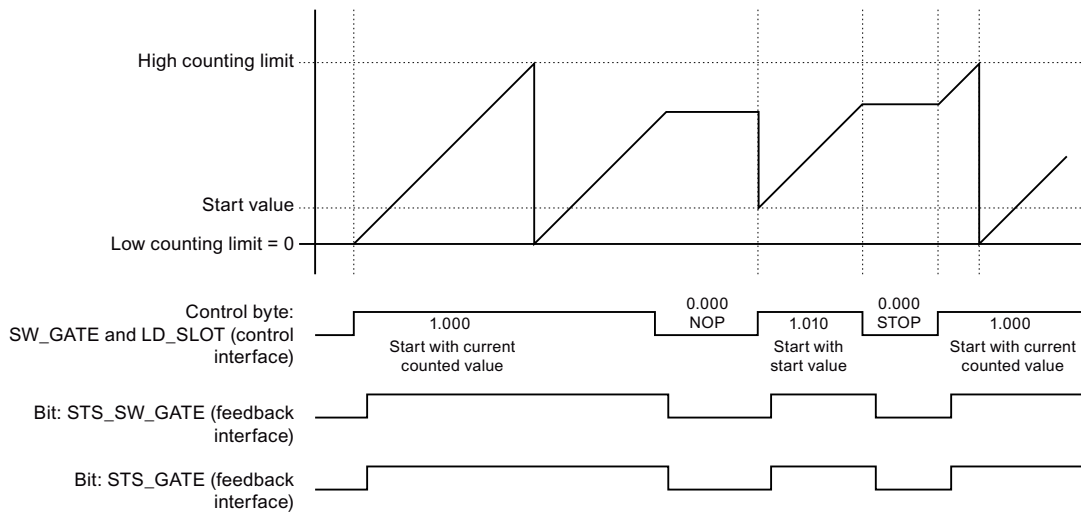


Figure 5-10 Principle: Continue counting

### Set output DQ - behavior of the STS\_DQ bit

The following section shows the behavior of the STS\_DQ bit with the parameter assignment "Set output DQ = between comparison value and high counting limit".

The STS\_DQ bit is set to 1

when the comparison value  $\leq$  counted value  $\leq$  high counting limit is reached.

As an option, a hardware interrupt can be enabled in the parameter assignment. This is generated with the parameter rising edge of the STS\_DQ bit.

The following figure shows an example of the behavior of the STS\_DQ bit between the comparison value and high counting limit.

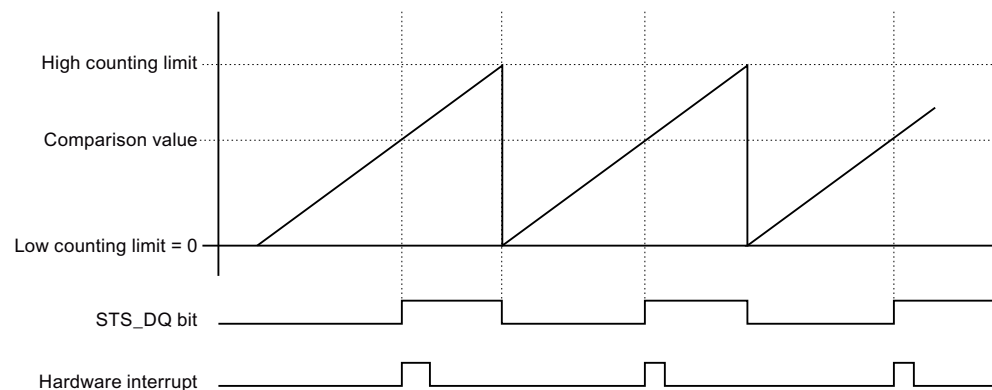


Figure 5-11 Behavior of the STS\_DQ bit and hardware interrupt

The following section shows the behavior of the STS\_DQ bit with the parameter assignment "Set output DQ = between low counting limit and comparison value".

The STS\_DQ bit is set to 1

when the low counting limit  $\leq$  counted value  $\leq$  comparison value is reached.

As an option, a hardware interrupt can be enabled in the parameter assignment. This is generated with the parameter rising edge of the STS\_DQ bit.

The following figure shows an example of the behavior of the STS\_DQ bit between the low counting limit and comparison value.

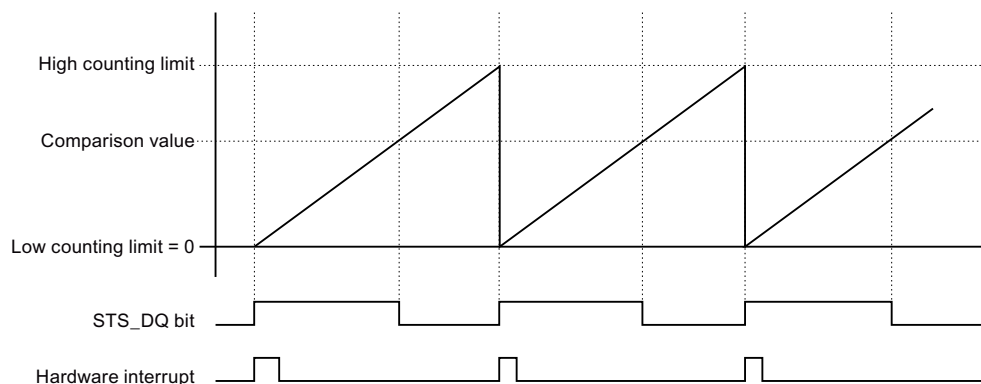


Figure 5-12 Behavior of the STS\_DQ bit and hardware interrupt

## Counting limits

The counting limits define the range of values of the counted value used. The counting limits can be set in the parameters and can be changed with the user program during runtime.

Configurable high counting limit:  $4294967295 (2^{32} - 1)$ .

Low counting limit (not settable): 0

You can continue or terminate (automatic gate stop) counting if a counting limit is exceeded, see the parameter "Behavior when a counting limit is exceeded".

## Start value/load value

The start value is specified in the parameter assignment with STEP 7 (TIA Portal). The load value can be changed by the user program. Both values must be between the low counting limit and high counting limit.

## Comparison values

You specify a comparison value per channel that can control the feedback bit STS\_DQ regardless of the user program. When the current counted value corresponds to the comparison condition set in the parameters, the feedback bit STS\_DQ is set. You can use the feedback bit STS\_DQ to control a digital output of a digital output module.

The comparison values can be set in the parameters and can be changed during runtime via the user program with parameter data record 0/1.

## Gate control

The opening and closing of the software gate (SW-GATE) defines the time window in which the count signals are acquired. The software gate is controlled by the user program.

## Reference

You can find additional information on the counting functionality in the function manual S7-1500, ET 200MP, ET 200SP counting, measuring and position detection (<http://support.automation.siemens.com/WW/view/en/59709820>).

## Interrupts/diagnostic alarms

### 6.1 Status and error displays

#### LED displays

The following figure shows the LED displays (status and error displays) of module.

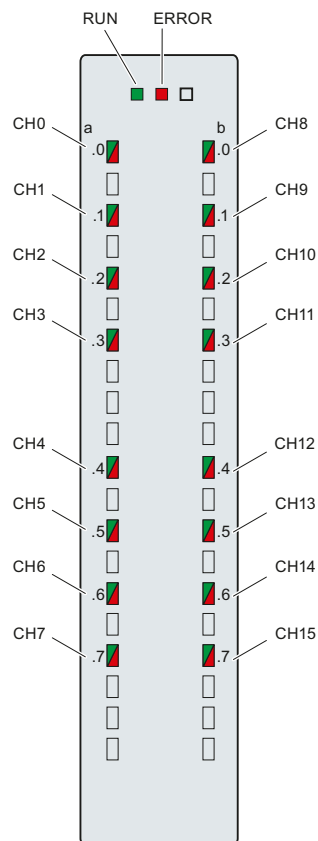


Figure 6-1 LED displays of the module DI 16x24...125VUC HF

#### Meaning of the LED displays

The tables below explain the meaning of the status and error displays.

**LED RUN/ERROR**

Table 6-1 RUN/ERROR status and error displays

| 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 to see if 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 ready.                                                               |                                                                                                                                                                                                                         |
| <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.                                                                                                                                                                                                     |

**LED CHx**

Table 6-2 CHx status display

| LED CHx                                                                                    | Meaning                                            | Remedy                                                                                                           |
|--------------------------------------------------------------------------------------------|----------------------------------------------------|------------------------------------------------------------------------------------------------------------------|
| <br>Off | 0 = Status of the input signal.                    | ---                                                                                                              |
| <br>On  | 1 = Status of the input signal.                    | ---                                                                                                              |
| <br>On  | Diagnostics: Wire break or hardware interrupt lost | Check the wiring. When using simple switches, disable diagnostics or connect a resistor to the encoder contacts. |

6.2 Interrupts

Digital input module DI 16x24...125VUC HF supports diagnostic and hardware interrupts. You can find detailed information on the error event in the error organization block with the "RALRM" instruction (read additional interrupt info) and in the STEP 7 online help.

Diagnostics interrupt

The module generates a diagnostic interrupt at the following events:

- Wire break
- Parameter assignment error
- Hardware interrupt lost

Hardware interrupt

The module generates a hardware interrupt at the following events:

- Rising edge
- Falling edge
- Rising and falling edge

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

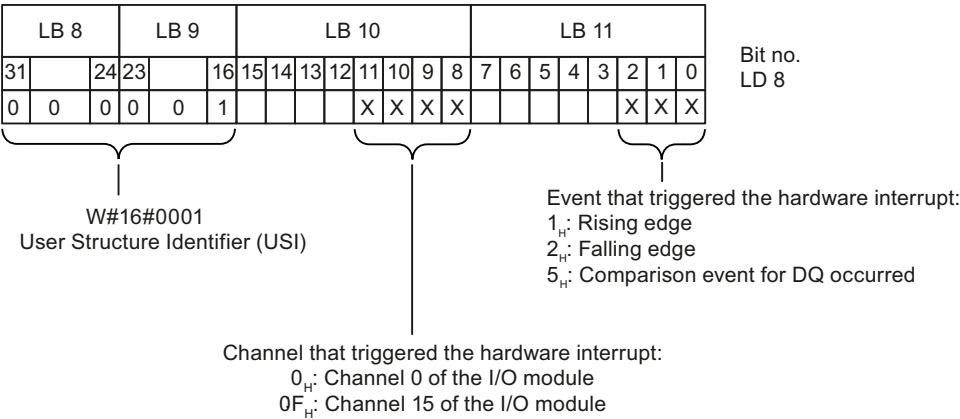


Figure 6-2 Start information of the organization block

## Structure of the additional interrupt information

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

| Data block name                                                   | Contents           | Comment                                                                        | Bytes |
|-------------------------------------------------------------------|--------------------|--------------------------------------------------------------------------------|-------|
| <b>USI</b><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.        |                    |                                                                                |       |
| <b>Channel</b>                                                    | B#16#00 to B#16#0F | Number of the event-triggering channel (channel 0 to channel 15 of the module) | 1     |
| It follows the error event that triggered the hardware interrupt. |                    |                                                                                |       |
| <b>Event</b>                                                      | B#16#01            | Rising edge                                                                    | 1     |
|                                                                   | B#16#02            | Falling edge                                                                   |       |
|                                                                   | B#16#05            | Comparison event for DQ occurred (only in "Counter mode")                      |       |

## 6.3 Diagnostics alarms

### 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.

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

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

| Diagnostics alarm          | Error code      | Meaning                                                                                                                                         | Corrective measures                                                                                                                                                                                                                                                                                                        |
|----------------------------|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Wire break                 | 6 <sub>H</sub>  | Impedance of encoder circuit too high                                                                                                           | Use a different encoder type or modify the wiring, for example, using cables with larger cross-section                                                                                                                                                                                                                     |
|                            |                 | Wire break between the module and sensor                                                                                                        | Connect the cable                                                                                                                                                                                                                                                                                                          |
|                            |                 | Channel not connected (open)                                                                                                                    | <ul style="list-style-type: none"> <li>Disable diagnostics</li> <li>Connect encoder contacts with resistor: <ul style="list-style-type: none"> <li>16 kΩ ... 21 kΩ with 1.0 W at 24 V AC/DC</li> <li>37 kΩ ... 53 kΩ with 0.5 W at 48 V AC/DC</li> <li>101 kΩ ... 156 kΩ with 0.25 W at 125 V AC/DC</li> </ul> </li> </ul> |
| 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                                                                                                                                                                                                                                                                                           |
| Hardware interrupt lost    | 16 <sub>H</sub> | The module cannot trigger an interrupt because the previous interrupt was not acknowledged; possibly a configuration error                      | Change interrupt processing in the CPU and edit the module parameters if necessary (the error persists until the module is assigned new parameters).                                                                                                                                                                       |

## Technical specifications

### Technical specifications of the DI 16x24...125VUC HF

|                                                                                                          |                                      |
|----------------------------------------------------------------------------------------------------------|--------------------------------------|
| <b>Article number</b>                                                                                    | <b>6ES7521-7EH00-0AB0</b>            |
| <b>General information</b>                                                                               |                                      |
| Product type designation                                                                                 | DI 16x24 ... 125 V UC HF             |
| HW functional status                                                                                     | From FS01                            |
| Firmware version                                                                                         | from 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                    |
| <ul style="list-style-type: none"> <li>Isochronous mode</li> </ul>                                       | No                                   |
| <ul style="list-style-type: none"> <li>Prioritized startup</li> </ul>                                    | Yes                                  |
| <b>Engineering with</b>                                                                                  |                                      |
| <ul style="list-style-type: none"> <li>STEP 7 TIA Portal configurable/integrated from version</li> </ul> | V14 / -                              |
| <ul style="list-style-type: none"> <li>STEP 7 configurable/integrated from version</li> </ul>            | V5.5 SP3 / -                         |
| <ul style="list-style-type: none"> <li>PROFIBUS from GSD version/GSD revision</li> </ul>                 | V1.0 / V5.1                          |
| <ul style="list-style-type: none"> <li>PROFINET from GSD version/GSD revision</li> </ul>                 | V2.3 / -                             |
| <b>Operating mode</b>                                                                                    |                                      |
| <ul style="list-style-type: none"> <li>DI</li> </ul>                                                     | Yes                                  |
| <ul style="list-style-type: none"> <li>Counter</li> </ul>                                                | Yes; V1.1.0 or higher                |
| <ul style="list-style-type: none"> <li>Oversampling</li> </ul>                                           | No                                   |
| <ul style="list-style-type: none"> <li>MSI</li> </ul>                                                    | Yes                                  |
| <b>Power</b>                                                                                             |                                      |
| Power available from the backplane bus                                                                   | 1.2 W                                |
| <b>Power loss</b>                                                                                        |                                      |
| Power loss, typ.                                                                                         | 2.2 W; At 24 V DC; 6.0 W at 125 V AC |
| <b>Digital inputs</b>                                                                                    |                                      |
| Number of digital inputs                                                                                 | 16                                   |
| Digital inputs, parameterizable                                                                          | Yes                                  |
| Source/sink input                                                                                        | Yes                                  |
| Input characteristic curve in accordance with IEC 61131, type 3                                          | Yes; At 24 V DC                      |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                    |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Article number</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                        | <b>6ES7521-7EH00-0AB0</b>                                                                                                                          |
| <b>Digital input functions, parameterizable</b> <ul style="list-style-type: none"> <li>Counter <ul style="list-style-type: none"> <li>Number, max.</li> <li>Counting frequency, max.</li> <li>Counting width</li> </ul> </li> </ul>                                                                                                                                                                                                                                          | Yes; from FS04<br>2; Channel 0 and 1<br>6 kHz<br>32 bit                                                                                            |
| <b>Input voltage</b> <ul style="list-style-type: none"> <li>Rated value (DC)</li> <li>Rated value (AC)</li> <li>for signal "0"</li> <li>for signal "1"</li> </ul>                                                                                                                                                                                                                                                                                                            | 24 V; 48 V, 125 V<br>24 V; 48 V, 125 V (50 - 60 Hz)<br>-5 ... +5 V<br>+11 ... +146 V                                                               |
| <b>Input current</b> <ul style="list-style-type: none"> <li>for signal "1", typ.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                  | 3 mA; At 24 V DC                                                                                                                                   |
| <b>Input delay (for rated value of input voltage)</b><br><b>for standard inputs</b> <ul style="list-style-type: none"> <li>parameterizable</li> <li>at "0" to "1", min.</li> <li>at "0" to "1", max.</li> <li>at "1" to "0", min.</li> <li>at "1" to "0", max.</li> </ul> <b>for interrupt inputs</b> <ul style="list-style-type: none"> <li>parameterizable</li> </ul> <b>for technological functions</b> <ul style="list-style-type: none"> <li>parameterizable</li> </ul> | Yes; 0.05 / 0.1 / 0.4 / 1.6 / 3.2 / 12.8 / 20 ms parameterizable with DC, 20 ms fixed with AC<br>0.05 ms<br>20 ms<br>0.05 ms<br>20 ms<br>Yes<br>No |
| <b>Cable length</b> <ul style="list-style-type: none"> <li>shielded, max.</li> <li>unshielded, max.</li> </ul>                                                                                                                                                                                                                                                                                                                                                               | 1 000 m<br>600 m                                                                                                                                   |
| <b>Encoder</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                    |
| <b>Connectable encoders</b> <ul style="list-style-type: none"> <li>2-wire sensor <ul style="list-style-type: none"> <li>permissible quiescent current (2-wire sensor), max.</li> </ul> </li> </ul>                                                                                                                                                                                                                                                                           | Yes<br>1.5 mA                                                                                                                                      |
| <b>Interrupts/diagnostics/status information</b>                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                    |
| Diagnostics function                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Yes                                                                                                                                                |
| <b>Alarms</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                    |
| <ul style="list-style-type: none"> <li>Diagnostic alarm</li> <li>Hardware interrupt</li> </ul>                                                                                                                                                                                                                                                                                                                                                                               | Yes<br>Yes                                                                                                                                         |

|                                              |                           |
|----------------------------------------------|---------------------------|
| <b>Article number</b>                        | <b>6ES7521-7EH00-0AB0</b> |
| <b>Diagnoses</b>                             |                           |
| • Monitoring the supply voltage              | No                        |
| • Wire-break                                 | Yes; To I < 550 µA        |
| • Short-circuit                              | No                        |
| <b>Diagnostics indication LED</b>            |                           |
| • RUN LED                                    | Yes; green LED            |
| • ERROR LED                                  | Yes; red LED              |
| • Monitoring of the supply voltage (PWR-LED) | No                        |
| • Channel status display                     | Yes; green LED            |
| • for channel diagnostics                    | Yes; red LED              |
| • for module diagnostics                     | Yes; red LED              |
| <b>Potential separation</b>                  |                           |
| <b>Potential separation channels</b>         |                           |
| • between the channels                       | Yes                       |
| • between the channels, in groups of         | 1                         |
| • between the channels and backplane bus     | Yes                       |
| <b>Permissible potential difference</b>      |                           |
| between different circuits                   | 146 V DC/132 V AC         |
| <b>Isolation</b>                             |                           |
| Isolation tested with                        | 2 000 V DC                |
| <b>Standards, approvals, certificates</b>    |                           |
| Suitable for safety functions                | No                        |
| <b>product functions / security / header</b> |                           |
| signed firmware update                       | Yes                       |
| data integrity                               | No                        |
| <b>Ambient conditions</b>                    |                           |
| <b>Ambient temperature during operation</b>  |                           |
| • horizontal installation, min.              | -30 °C; from FS04         |
| • horizontal installation, max.              | 60 °C                     |
| • vertical installation, min.                | -30 °C; from FS04         |
| • vertical installation, max.                | 40 °C                     |
| <b>Dimensions</b>                            |                           |
| Width                                        | 35 mm                     |
| Height                                       | 147 mm                    |
| Depth                                        | 129 mm                    |
| <b>Weights</b>                               |                           |
| Weight, approx.                              | 240 g                     |

## Power reduction (derating) in relation to the mounting position and ambient temperature (per module)

The following graphs show the number of channels (CHx) that can be used simultaneously in relation to the mounting position of the S7-1500/ET 200MP automation system and the ambient temperature.

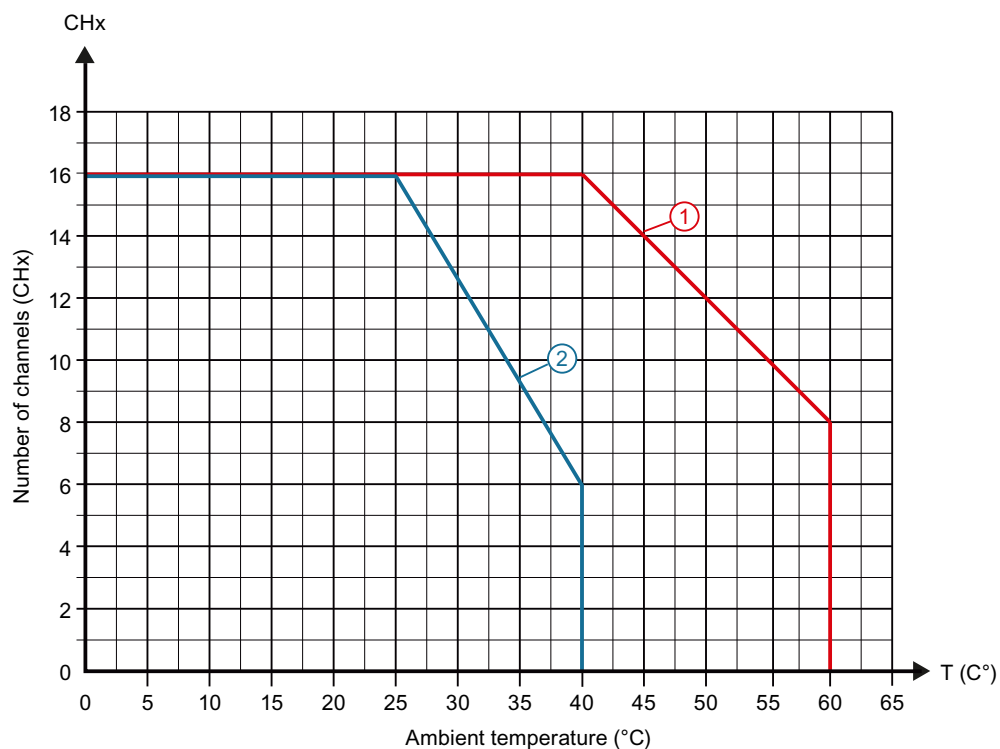


Figure 7-1 Information on channels used simultaneously (per module):

## Dimensional drawing

### A.1 Dimensional drawing

The dimensional drawing of the module on the mounting rail, as well as a dimensional drawing with open front cover, are provided in this appendix. Always observe the specified dimensions for installations in cabinets, control rooms, etc.

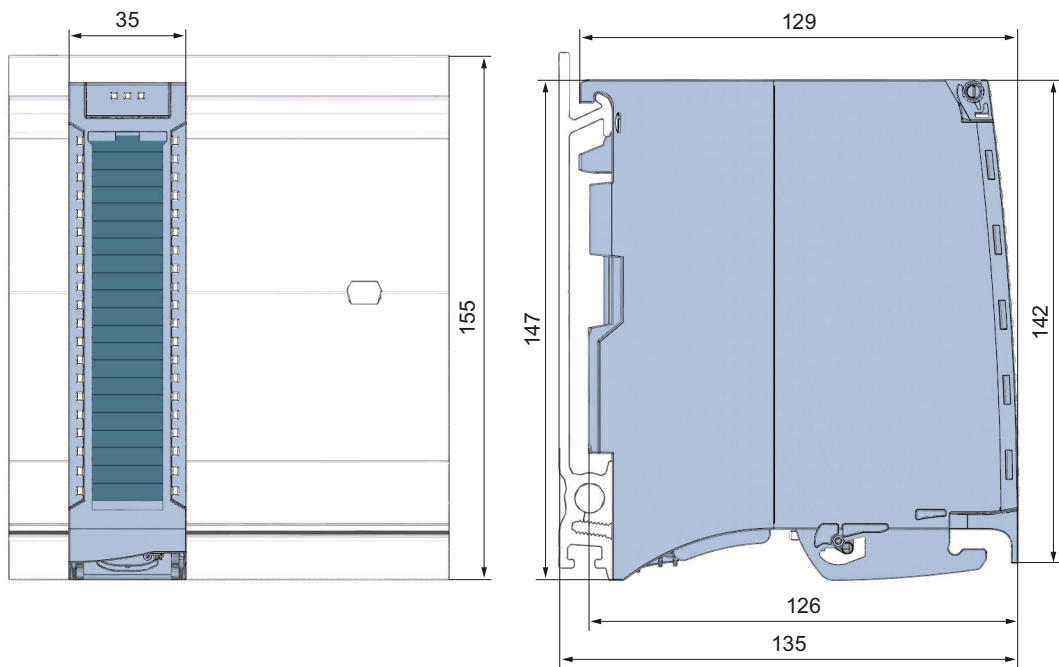


Figure A-1 Dimension drawing of the DI 16x24...125VUC HF module

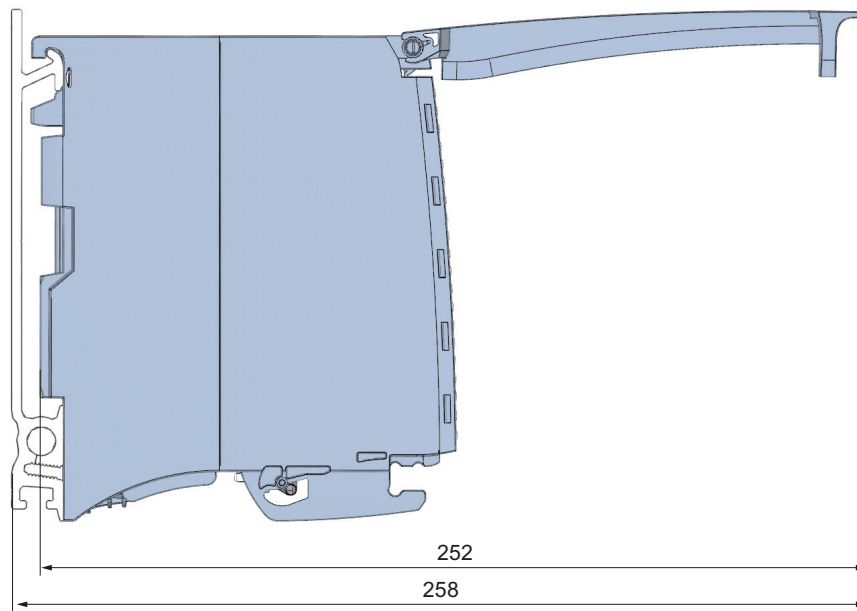


Figure A-2 Dimension drawing of the DI 16x24...125VUC HF module, side view with open front cover

## Parameter data records

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

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

#### Dependencies for configuration with GSD file

When a GSD file is used to configure a module, dependencies can arise when "assigning the parameters".

There are no dependencies for this module. You can assign the individual parameters in any combination.

#### Parameter assignment in the user program

You have the option to reconfigure the module in RUN (e.g. the input delay values of selected channels can be edited without having an effect on the other channels).

#### Parameter assignment in RUN

The "WRREC" instruction is used to transfer the parameters to the module using data records 0 to 15. 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.

#### Output parameter STATUS

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

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

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

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

## B.2 Structure of the parameter data records DI

### Assignment of data record and channel

For the configuration with 1 x 16-channel, the parameters are located in data records 0 to 15 and are assigned as follows:

- Data record 0 for channel 0
- Data record 1 for channel 1
- ...
- Data record 14 for channel 14
- Data record 15 for channel 15

For the configuration as a 4 x 8-channel module, the module has 4 submodules with eight channels each. The parameters for the channels are located in data records 0 to 7 and are assigned as follows:

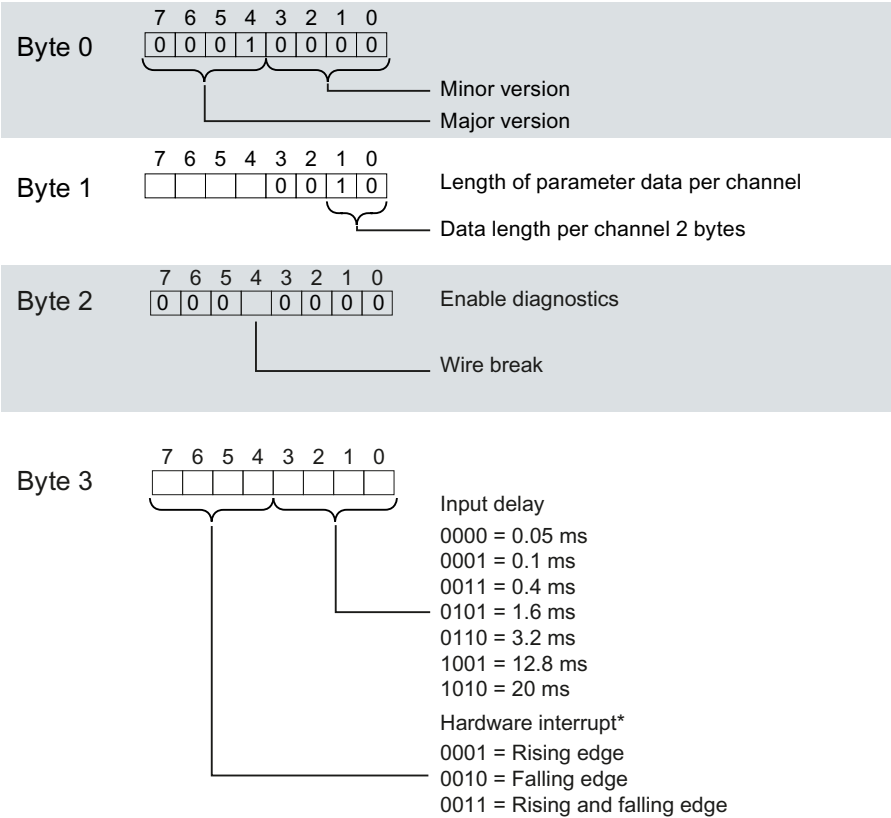
- Data records 0 to 7 for channels 0 to 7 (submodule 1)
- Data records 0 to 7 for channels 8 to 15 (submodule 2)

Address the respective submodule for data record transfer.

Data record structure

The figure below shows the structure of data record 0 for channel 0 as an example. The structure is identical for channels 1 to 15. 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".



\* Enabling the hardware interrupts via a data record is only possible if the channel is assigned to a hardware interrupt OB in STEP 7

Figure B-1 Structure of data record 0: Bytes 0 to 3

## B.3 Structure of the parameter data records Counting mode

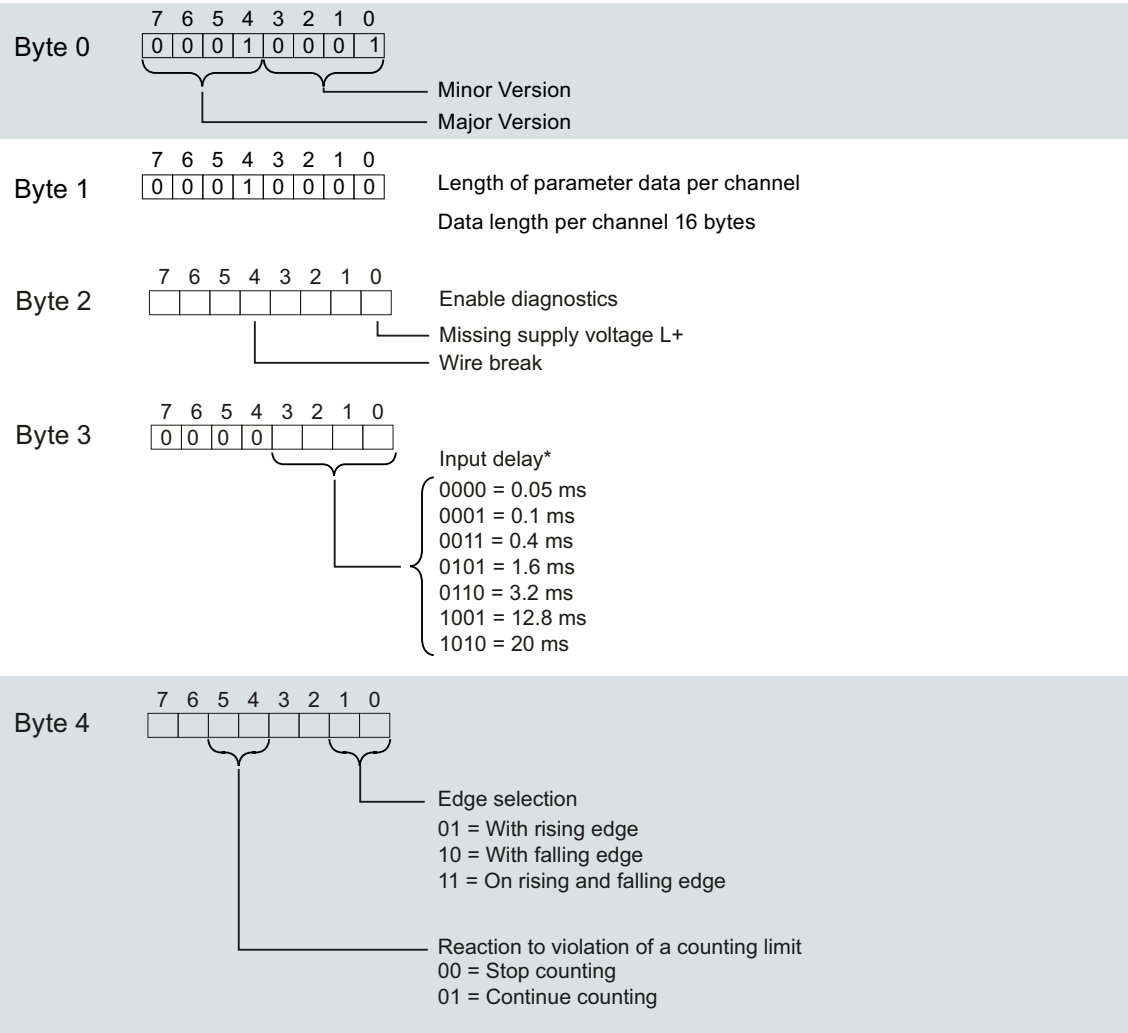
### Assignment of data record and channel

For the configuration with 1 x 16 channels, the parameters are located in data records 0 to 15 and are assigned as follows:

- Data record 0 for channel 0 with counting function
- Data record 1 for channel 1 with counting function
- Data record 2 for channel 2 (structure as in DI mode)
- ...
- Data record 14 for channel 14 (structure as in DI mode)
- Data record 15 for channel 15 (structure as in DI mode)

Structure of data record 0 of the Counting mode

The example in the figure below shows the structure of data record 0 for channel 0. The structure of channel 1 is identical, the values are located in data record 1. 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".



\* In isochronous mode 0.05 ms (cannot be changed)

Figure B-2 Structure of data record 0: Bytes 0 to 4

## B.3 Structure of the parameter data records Counting mode

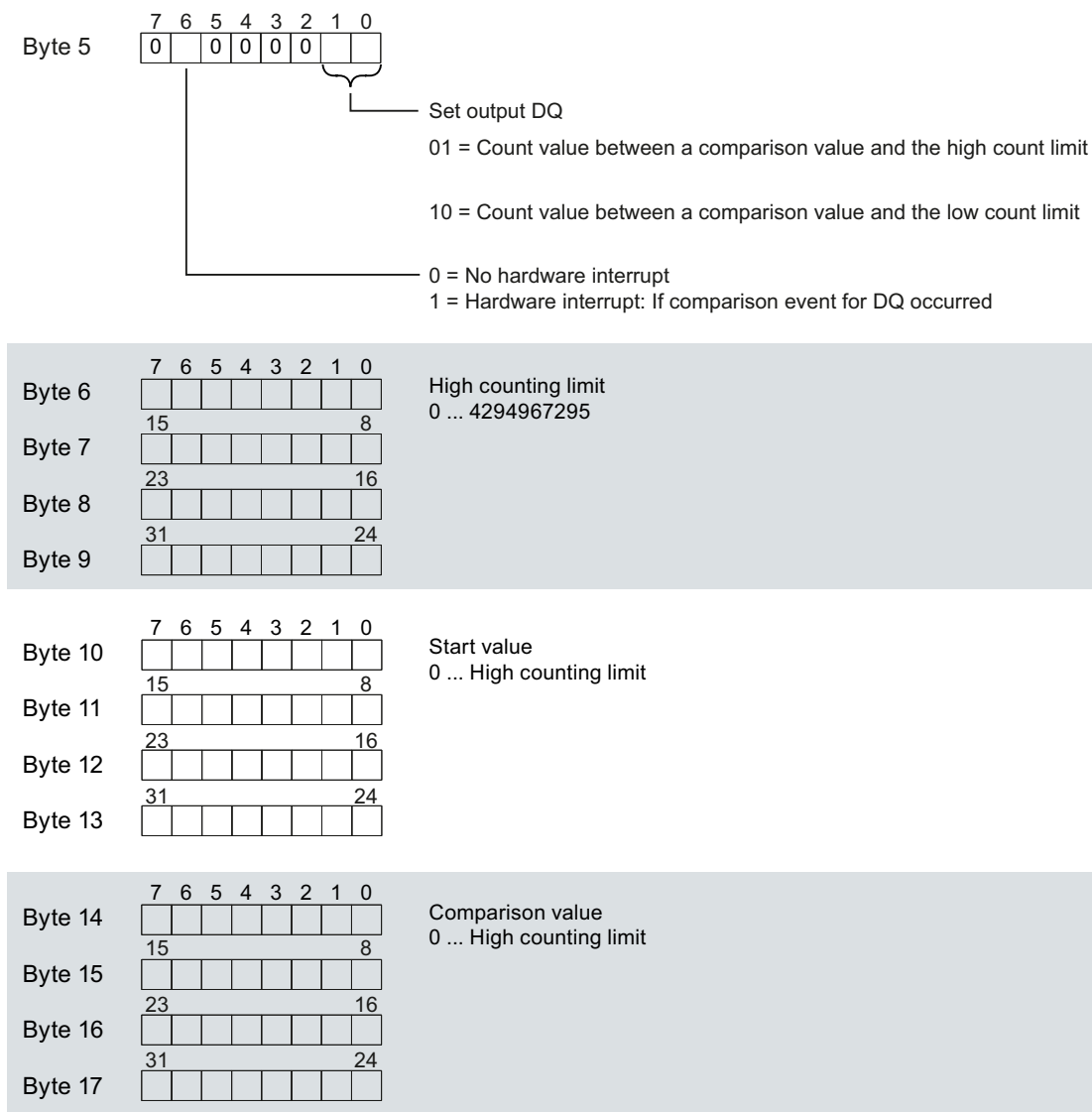


Figure B-3 Structure of data record 0: Bytes 5 to 17

Keep in mind that the counter is stopped and reset to the start value when you change count parameters.

Changing the parameters "Diagnostics" and "Hardware interrupts" does not have an effect on the counter.

### Structure of data records 2 to 15

The structure of data records 2 to 15 for channels 2 to 15 is identical to the structure in the DI mode, see section Structure of the parameter data records DI (Page 49), figure Structure of data record 0: Bytes 0 to 3.