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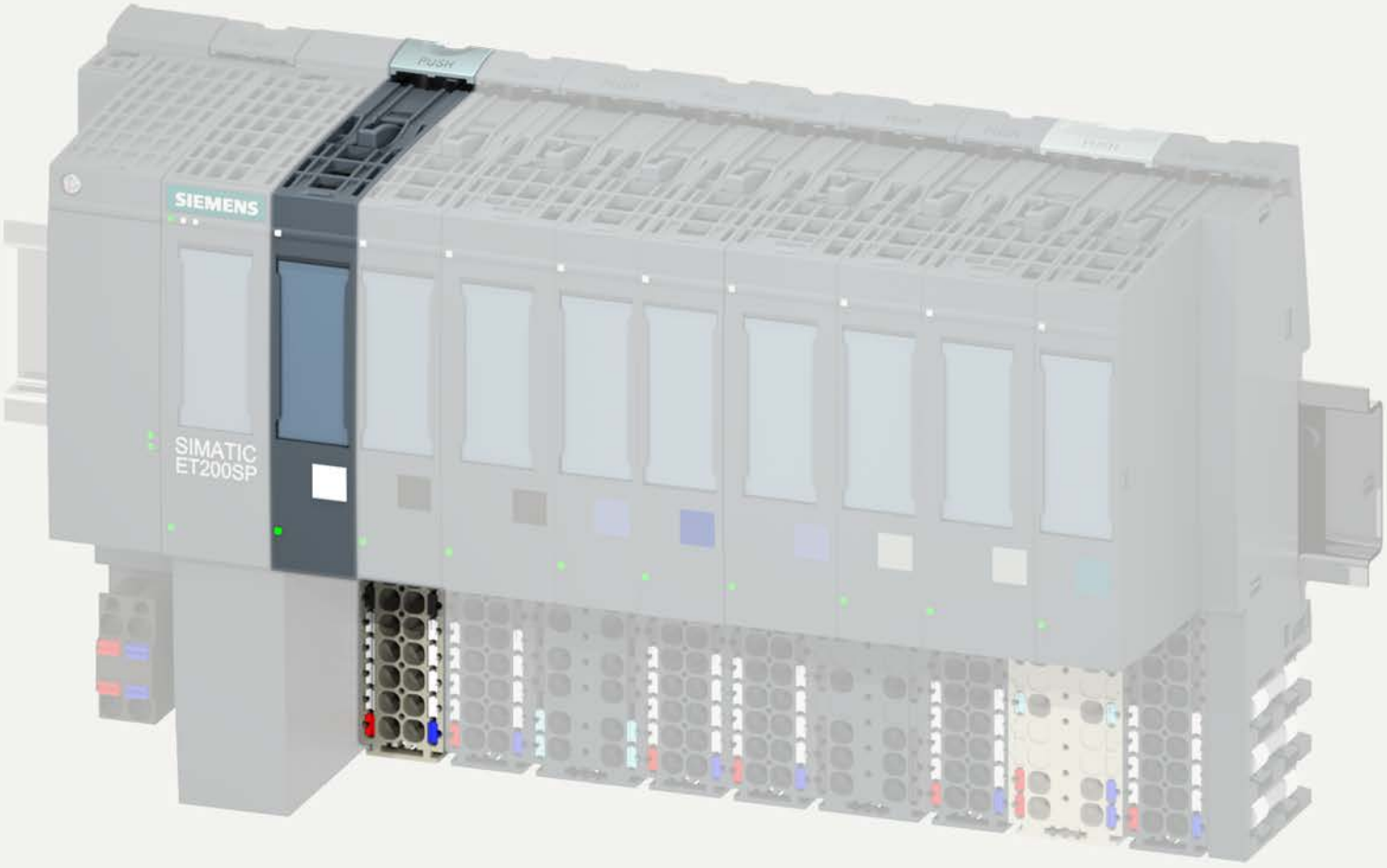

Edition 03/2024

EQUIPMENT MANUAL

SIMATIC

ET 200SP

Digital input module DI 8xNAMUR HF
6ES7131-6TF00-0CA0

support.industry.siemens.com

SIEMENS

SIMATIC

ET 200SP
DI 8xNAMUR HF
digital input module
(6ES7131-6TF00-0CA0)

Equipment Manual

03/2024

A5E03894478-AB

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.

Trademarks

All names identified by ® are registered trademarks of Siemens Aktiengesellschaft. The remaining trademarks in this publication may be trademarks whose use by third parties for their own purposes could violate the rights of the owner.

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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A5E03894478-AB
Ⓟ 05/2024 Subject to change

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Introduction

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Purpose of the documentation

This equipment manual supplements the ET 200SP Distributed I/O System (https://support.industry.siemens.com/cs/ww/en/view/58649293) system manual.

Functions that generally relate to the system are described in this manual.

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

Changes compared to previous version

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

- Wiring and block diagrams have been revised.
- The technical specifications have been updated.

Conventions

CPU: When the term "CPU" is used in the following, it applies to the CPUs of the S7-1500 automation system as well as to the CPUs/interface modules of the ET 200SP distributed I/O system.

STEP 7: In this documentation, "STEP 7" is used as a synonym for all versions of the configuration and programming software "STEP 7 (TIA Portal)".

Please also observe notes marked as follows:

Note

A note contains important information on the product described in the documentation, on the handling of the product or on the section of the documentation to which particular attention should be paid.

Recycling and disposal

For environmentally friendly recycling and disposal of your old equipment, contact a certified electronic waste disposal company and dispose of the equipment according to the applicable regulations in your country.

1.1 ET 200SP Documentation Guide

1.1.1 Information classes ET 200SP

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

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

You can download the documentation free of charge from the Internet (https://support.industry.siemens.com/cs/ww/en/view/109742709).

Basic information

The System Manual describes in detail the configuration, installation, wiring and commissioning of the SIMATIC ET 200SP distributed I/O system.

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

Examples:

- ET 200SP System Manual
- System Manual ET 200SP HA/ET 200SP modules for devices used in a hazardous area
- 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 Motor Starter
- BaseUnits Equipment Manuals
- Equipment Manual Server Module
- Equipment Manuals Communications Modules
- Equipment Manuals Technology Modules

General information

The function manuals contain detailed descriptions on general topics relating to the SIMATIC ET 200SP distributed I/O system.

Examples:

- Function Manual ET 200AL/ET 200SP Mixed Configuration
- Function Manual Diagnostics
- Function Manual Communication
- PROFINET Function Manual
- PROFIBUS Function Manual
- Function Manual Designing Interference-free Controllers
- MultiFieldbus 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 ET 200SP distributed I/O system on the Internet. (https://support.industry.siemens.com/cs/de/en/view/73021864)

Manual Collection ET 200SP

The Manual Collection contains the complete documentation on the SIMATIC ET 200SP distributed I/O system gathered together in one file.

You can find the Manual Collection on the Internet.
(https://support.industry.siemens.com/cs/cn/en/view/84133942)

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/ww/en/view/109806400)

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 PROFIenergy diagnostics, you can quickly detect the current pause mode or the readiness for operation of devices that support PROFIenergy 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 MultiFieldbus Configuration Tool (MFCT)

MultiFieldbus Configuration Tool

MultiFieldbus Configuration Tool (MFCT) is a PC-based software and supports the configuration of MultiFieldbus- and DALI-devices. In addition, the MFCT offers convenient options for mass firmware updates of ET 200 devices with MultiFieldbus- support and reading service data for many other Siemens devices.

Functional scope of the MFCT

- MultiFieldbus configuration:
  Engineering, configuration and diagnostics of MultiFieldbus-devices, provision of the required project files (project, UDT-, CSV- and EDS-file), transfer/export of the files to device and/or data memory.
- DALI configuration:
  Device selection and online configuration of DALI devices.
- TM FAST:
  Generation and download of FPGA-UPD- and FPGA-DB-files.
- Maintenance:
  Topology scan of a Ethernet network, reading of service data, parameter assignment and firmware update.
- Settings:
  Language switching German / English, network scanner speed, setting of the network adapter, installation of GSDML-and EDS-files.

System/installation requirements for MFCT

The MFCT runs under Microsoft Windows and does not require installation or administrator rights.

For MFCT you must also install the following software:

- Microsoft .NET Framework 4.8 (You can find an Offline Installer on the Internet. (https://support.microsoft.com/en-us/topic/microsoft-net-framework-4-8-offline-installer-for-windows-9d23f658-3b97-68ab-d013-aa3c3e7495e0))
- NPcap from directory "Misc"
- PG/PC interface from directory "Misc"
- Microsoft C++ Redistributable for x86-systems (you can find the installation data for download on the Internet. (https://aka.ms/vs/15/release/vc_redist.x86.exe))

The download of the tool and further information as well as documentation on the individual functions of the MFCT can be found on the Internet.
(https://support.industry.siemens.com/cs/de/en/view/109773881)

1.1.4 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/TwLSxxRQQsA)

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.

Registration	You must register once to use the full functionality of "mySupport". After registration, you can create filters, favorites and tabs in your personal workspace.
Support requests	Your data is already filled out in support requests, and you can get an overview of your current requests at any time.
Documentation	In the Documentation area you can build your personal library.
Favorites	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.
Recently viewed articles	The most recently viewed pages in mySupport are available under "Recently viewed articles".
CAx data	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: • Product images, 2D dimension drawings, 3D models, internal circuit diagrams, EPLAN macro files • Manuals, characteristics, operating manuals, certificates • Product master data

You can find "mySupport" 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 2

2.1 Introduction to 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.

You can find more general information and measures on the subject of industrial cybersecurity in the ET 200SP Distributed I/O system (https://support.industry.siemens.com/cs/ww/en/view/58649293) System Manual.

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

2.2 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 more information on protective industrial cybersecurity measures for implementation, please visit (https://www.siemens.com/global/en/products/automation/topic-areas/industrial-cybersecurity.html).

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 customers' exposure to cyber threats.

To stay informed about product updates at all times, subscribe to the Siemens Industrial Cybersecurity RSS Feed under (https://new.siemens.com/global/en/products/services/cert.html).

2.3 Cybersecurity-relevant information

Observe all cybersecurity-relevant information.

Topics with relevant cybersecurity information	Reference
Operational application environment and security assumptions	
Requirements for the operational application environment of the system and security assumptions	You can find this section in the System Manual (https://support.industry.siemens.com/cs/ww/en/view/58649293).
Security properties of the product	
Access protection	Also note the information on access protection in the Protection chapter of the System Manual (https://support.industry.siemens.com/cs/ww/en/view/58649293).
Data integrity	The topic of data integrity is described in the Industrial cybersecurity section of the System Manual (https://support.industry.siemens.com/cs/ww/en/view/58649293).
Signed firmware update	The topic of signed firmware updates is described in the Industrial cybersecurity section of the System Manual (https://support.industry.siemens.com/cs/ww/en/view/58649293).
PROFINET Security Class 1 • The device supports PROFINET Security Class 1. • With the introduction of PROFINET Security Class 1, additional security settings have been integrated into the PROFINET communication.	You can find detailed information about PROFINET Security Class 1 and additional security settings in the PROFINET with STEP 7 Function Manual (https://support.automation.siemens.com/WW/view/en/49948856).
Supported Ethernet services	You can find information on supported services in the Technical specifications section. You can find detailed information about supported Ethernet services in the Communication Function Manual (https://support.industry.siemens.com/cs/ww/en/view/59192925).
Interfaces, ports, protocols and services	
Information on the following is security related: • Communications layer and communication role • Default states • Enabling/disabling of ports and services	You can find detailed information on these topics in the Communication Function Manual (https://support.industry.siemens.com/cs/ww/en/view/59192925).
Secure operation	
Recommendations for safe operation	You can find cross-system information on the safe operation of interface modules in the System Manual (https://support.industry.siemens.com/cs/ww/en/view/58649293).
Corrective measures for known risks	Corrective measures for known risks are announced on the Siemens ProductCERT and Siemens CERT (https://siemens.com/productcert) web page. For more information on SIEMENS ProductCERT, refer to the System Manual (https://support.industry.siemens.com/cs/ww/en/view/58649293).

Topics with relevant cybersecurity information	Reference
Security checks	You can find descriptions of specific security measures, such as cyclic checks of the configuration via checksums, in the Industrial cybersecurity section of the System Manual (https://support.industry.siemens.com/cs/ww/en/view/58649293).
Secure decommissioning Products that contain security-relevant data must be safely decommissioned before disposal or resale.	You can find information on safe decommissioning in the Safe operation of the system section of the System Manual (https://support.industry.siemens.com/cs/ww/en/view/58649293).

Product overview

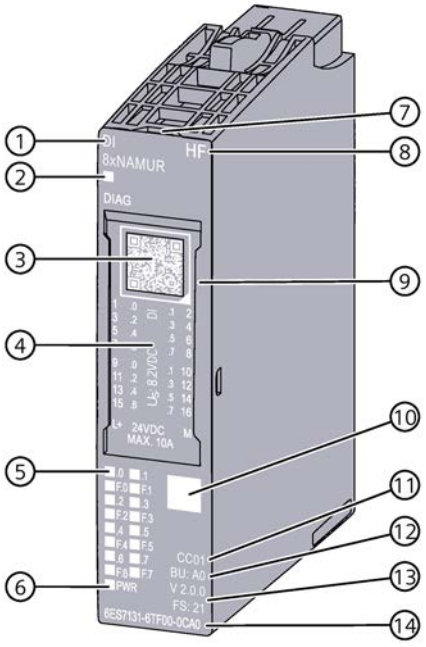
3

3.1 Properties

Article number

6ES7131-6TF00-0CA0

View of the module



① Module type and name
② LED for diagnostics
③ QR code for identification link
④ Wiring diagram
⑤ LEDs for channel status and channel fault
⑥ LED for supply voltage
⑦ Slot for optional equipment labeling plate
⑧ Function class
⑨ Insertion option for optional labeling strip
⑩ Color coding module type
⑪ Color code for selecting the color-coded labels
⑫ BU type
⑬ Firmware and functional version
⑭ Article number

Figure 3-1 DI 8xNAMUR HF view of the module

Properties

The module has the following technical properties:

- Digital input module with 8 inputs
- Value status (quality information) (per channel)
- Sensor supply 8.2 V DC (PROFIenergy) that can be switched off individually (per channel)
- Supply voltage L+
- Selectable diagnostics (per channel)
- Suitable for connecting NAMUR sensors and connected and unconnected mechanical contacts

Note

The module can be used as an encoder module for the digital output module DQ 4x24VDC/2A HS.

Table 3- 1 Operating modes of DI 8xNAMUR HF

Property		**Operating mode DI**	**Counter mode**			
		DI	CNT1	CNT2	CNT3	CNT4
Number of channels		8xDI	1xCNT 1XDI or control channel 6xDI	2xCNT 2xDI or control channel 4xDI	3xCNT 3xDI or control channel 2xDI	4xCNT 4xDI or control channel
Isochronous mode		No				
Counter width, max. counting frequency		-	32 bits, 5 kHz max.*			
Configurable input delay		100 µs - 20 ms	100 µs - 20 ms			
Configurable hardware interrupts; rising edge and/or falling edge (per channel)		x	For DI inputs or control channels only.			
Data length	Inputs	2 bytes	12 bytes	22 bytes	32 bytes	42 bytes
	Outputs	0 bytes	5 bytes	10 bytes	15 bytes	20 bytes

*If the gate/dir functionality is used with a frequency of more than 2 kHz:

- The minimum pulse length is 500 µs
- Response time is 500 µs

The module supports the following functions:

Table 3- 2 Version dependencies of the functions

Function	HW version	FW version	STEP 7		GSD file	
			TIA Portal	V5.x	PROFINET IO	PROFIBUS DP
Firmware update	As of FS01	As of V1.0.0	Integrated as of V13	• As of V5.5 SP3 with HSP 0229 V3.0 • Integrated as of V5.5 SP4	X	X
Identification data I&M0 to I&M3	As of FS01	As of V1.0.0	Integrated as of V13	• As of V5.5 SP3 with HSP 0229 V3.0 • Integrated as of V5.5 SP4	X	X
Reconfiguration in RUN	As of FS01	As of V1.0.0	Integrated as of V13	• As of V5.5 SP3 with HSP 0229 V3.0 • Integrated as of V5.5 SP4	X	X
Hardware interrupts	As of FS01	As of V1.0.0	Integrated as of V13	• As of V5.5 SP3 with HSP 0229 V3.0 • Integrated as of V5.5 SP4	X	X
Diagnostics alarms	As of FS01	As of V1.0.0	Integrated as of V13	• As of V5.5 SP3 with HSP 0229 V3.0 • Integrated as of V5.5 SP4	X	X
Power failure detection	As of FS01	As of V1.0.0	Integrated as of V13	• As of V5.5 SP3 with HSP 0229 V3.0 • Integrated as of V5.5 SP4	X	X
Pulse stretching	As of FS01	As of V1.0.0	Integrated as of V13	• As of V5.5 SP3 with HSP 0229 V3.0 • Integrated as of V5.5 SP4	X	X
PROFIenergy	As of FS01	As of V1.0.0	Integrated as of V13	• As of V5.5 SP3 with HSP 0229 V3.0 • Integrated as of V5.5 SP4	X	X
Pulse stretching	As of FS01	As of V1.0.0	Integrated as of V13	• As of V5.5 SP3 with HSP 0229 V3.0 • Integrated as of V5.5 SP4	X	X

	HW	FW ver-	STEP 7		GSD file	
Chatter monitoring	As of FS01	As of V1.0.0	Integrated as of V13	• As of V5.5 SP3 with HSP 0229 V3.0 • Integrated as of V5.5 SP4	X	X
Diagnostics for changeover contact sensor type	As of FS01	As of V1.0.0	Integrated as of V13	• As of V5.5 SP3 with HSP 0229 V3.0 • Integrated as of V5.5 SP4	X	X
Counter functionality	As of FS21	As of V2.0.0	• V18 Update 3 with HSP0400 • Integrated as of V19	• As of V5.5 SP3 with HSP 0229 V9.0 • Integrated as of V5.7 SP3	X	X[1]
Input delay	As of FS21	As of V2.0.0	• V18 Update 3 with HSP0400 • Integrated as of V19	• As of V5.5 SP3 with HSP 0229 V9.0 • Integrated as of V5.7 SP3	X	X

[1] Measuring functions and counters with scaling of measured values are not supported for PROFIBUS DP.

You can configure the module with STEP 7 (TIA Portal) and with a GSD file. The configurations for the operating modes can be found under various codes / module names:

Table 3- 3 Codes / module names for the configuration options

Operating mode (all with QI)	Configuration software			
	HSP0400 for STEP 7 (TIA Portal)	HSP0229 V9.0 for STEP 7	GSD file PROFINET IO	GSD file PROFIBUS DP
DI NAMUR	DI 8xNAMUR HF *FW version: V1.0*	DI 8xNAMUR HF	DI 8xNAMUR HF V1.0, QI	DI 8xNAMUR HF V1.0, QI
DI NAMUR	DI 8xNAMUR HF *FW version: V2.0*	DI 8xNAMUR HF	DI 8xNAMUR HF V2.0, QI	DI 8xNAMUR HF V2.0, QI
4-channel pulse counter	DI 8xNAMUR HF *FW version: V2.0*	DI 8xNAMUR HF	DI 8xNAMUR HF V2.0, QI, CNT 4	-
3-channel pulse counter	DI 8xNAMUR HF *FW version: V2.0*	DI 8xNAMUR HF	DI 8xNAMUR HF V2.0, QI, CNT 3	DI 8xNAMUR HF V2.0, QI, CNT3
2-channel pulse counter	DI 8xNAMUR HF *FW version: V2.0*	DI 8xNAMUR HF	DI 8xNAMUR HF V2.0, QI, CNT 2	-
1-channel pulse counter	DI 8xNAMUR HF *FW version: V2.0*	DI 8xNAMUR HF	DI 8xNAMUR HF V2.0, QI, CNT 1	DI 8xNAMUR HF V2.0, QI, CNT1
4-channel pulse counter, scaling of measured values	DI 8xNAMUR HF *FW version: V2.0*	DI 8xNAMUR HF	DI 8xNAMUR HF V2.0, QI, CNT 4, SCALE	-
3-channel pulse counter, scaling of measured values	DI 8xNAMUR HF *FW version: V2.0*	DI 8xNAMUR HF	DI 8xNAMUR HF V2.0, QI, CNT 3, SCALE	-

Operating mode (all	**Configuration software**			
2-channel pulse counter, scaling of measured values	DI 8xNAMUR HF *FW version: V2.0*	DI 8xNAMUR HF	DI 8xNAMUR HF V2.0, QI, CNT 2, SCALE	-
1-channel pulse counter, scaling of measured values	DI 8xNAMUR HF *FW version: V2.0*	DI 8xNAMUR HF	DI 8xNAMUR HF V2.0, QI, CNT 1, SCALE	-

The following table shows the configuration options for ET 200SP DI NAMUR:

Table 3- 4 Engineering with

STEP 7 TIA Portal, configurable/integrated as of version	V18 Update 3 with HSP0400 / V19
STEP 7, configurable/integrated as of version	HSP0229 V9.0 as of STEP 7 V5.5 SP3 / STEP 7 V5.7.3
PROFIBUS as of GSD version/GSD revision	GSD revision 5
PROFINET as of GSD version/GSD revision	GSDML V2.42

Accessories

The following accessories can be ordered separately:

- Labeling strips
- Color identification labels
- Reference identification label
- Shield connection

You can find more information on accessories in the System Manual ET 200SP Distributed I/O System (https://support.automation.siemens.com/WW/view/en/58649293).

See also

ET 200SP Product information
(https://support.industry.siemens.com/cs/ww/en/view/73021864)

Operating mode DI

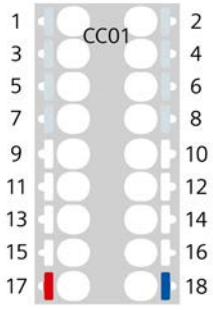
4

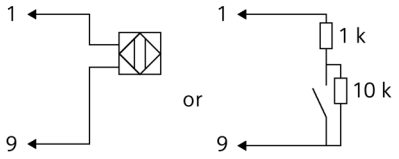
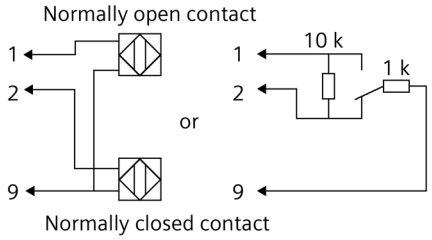
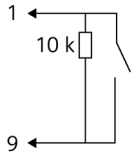
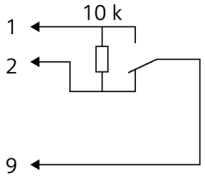
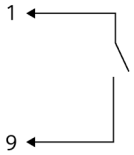
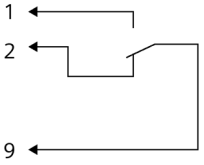
4.1 Wiring

4.1.1 Pin assignment

General pin assignment

Table 4- 1 Pin assignment for DI 8×NAMUR HF (6ES7131-6TF00-0CA0)

Description	Signal	Terminal	BaseUnit BU type A0	Terminal	Signal	Description
Digital input, channel 0	DI_0	1		2	DI_1	Digital input, channel 1
Digital input, channel 2	DI_2	3		4	DI_3	Digital input, channel 3
Digital input, channel 4	DI_4	5		6	DI_5	Digital input, channel 5
Digital input, channel 6	DI_6	7		8	DI_7	Digital input, channel 7
Sensor supply, channel 0	Us_0	9		10	Us_1	Sensor supply, channel 1
Sensor supply, channel 2	Us_2	11		12	Us_3	Sensor supply, channel 3
Sensor supply, channel 4	Us_4	13		14	Us_5	Sensor supply, channel 5
Sensor supply, channel 6	Us_6	15		16	Us_7	Sensor supply, channel 7
24 V DC supply voltage	L+	17		18	M	Ground

<table>
<tr><td colspan="3">The figures below show the connections for input signal DI0 for all sensor types.</td></tr>
<tr><td>NAMUR sensors / IEC 60947-5-6 sensors
 
</td><td>NAMUR changeover contacts /
IEC 60947-5-6 changeover contacts
 
</td><td>Single contact connected with 10 kΩ (mechanical normally open contact)
 
</td></tr>
<tr><td>Changeover contact connected with 10 kΩ (mechanical changeover contact)
 
</td><td>Single contact, unconnected (mechanical normally open contact with single contact)
 
</td><td>Changeover contact, unconnected (mechanical changeover contact)
 
</td></tr>
</table>

[1] Usable BaseUnit types, can be identified by the last two digits of the order number. See also system manual ET 200SP Distributed I/O System.

Note

The load group of the module must begin with a light BaseUnit. Also keep this in mind during configuration.

Firmware update

When updating the firmware, the L+ supply voltage must be applied to the module at the start and during the firmware update.

4.1.2 Block diagram

This section contains the schematic circuit diagram of the module.

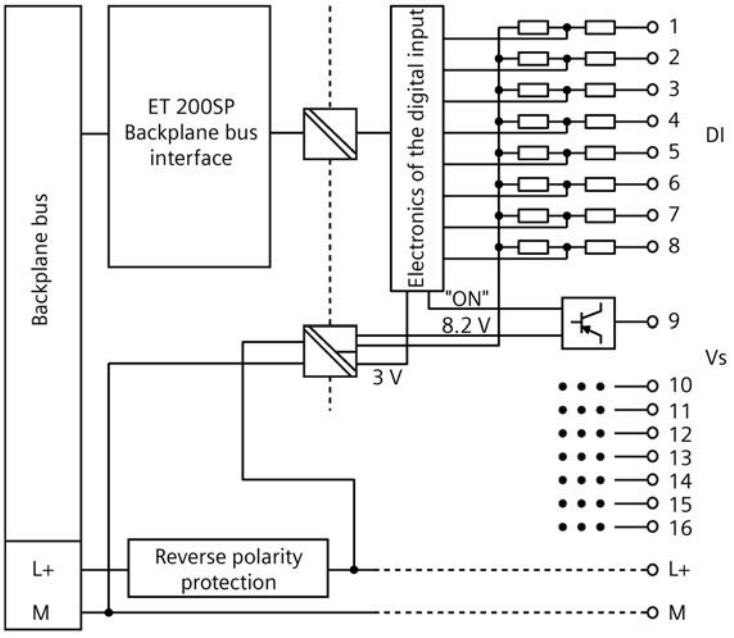


Figure 4-1 Block diagram DI 8×NAMUR HF

4.2 Parameters/address space

4.2.1 Parameters

DI 8xNAMUR HF parameters

You can specify the module properties with various parameters in the course of your STEP 7 configuration. The following table lists the configurable parameters. The effective range of the configurable parameters depends on the type of configuration.

The following configurations are possible:

- Central operation on an ET 200SP-CPU or on an ET 200SP Open Controller
- Distributed operation on PROFINET IO in an ET 200SP system
- Distributed operation with PROFIBUS DP in an ET 200SP system
- Distributed operation on EtherNet/IP in an ET 200SP system
- Distributed operation on Modbus TCP in an ET 200SP system

In addition to parameter assignment via the configuration software, you can also configure parameters in RUN mode (dynamic) via the user program. When assigning parameters in the user program, use the "WRREC" instruction to transfer the parameters to the module by means of data records (see chapter Parameter assignment and structure of the parameter data record for operating mode DI (Page 84)).

The following parameter settings are possible:

Table 4- 2 Settable parameters and their defaults in the DI mode (GSD file)

Parameters	Value range	Default	Reconfiguration in RUN	Effective range with configuration software, e.g. STEP 7 (TIA Portal)	
				GSD file PROFINET IO	GSD file PROFIBUS DP
Diagnostics: No supply voltage L+	• Disable • Enable	Disable	Yes	Channel	Channel
Diagnostics: Short circuit to ground	• Disable • Enable	Disable	Yes	Channel	Channel
Diagnostics: Wire break	• Disable • Enable	Disable	Yes	Channel	Channel
Diagnostics: Chatter error	• Disable • Enable	Disable	Yes	Channel	-
Diagnostics: Changeover error	• Disable • Enable	Disable	Yes	Channel	Channel[1]
Sensor type	• Deactivated • NAMUR sensor • Single contact, unconnected • Single contact with 10 kΩ • NAMUR changeover contact[1] • Changeover contact, unconnected[1] • Changeover contact with 10 kΩ[1]	NAMUR sensor	Yes	Channel	Channel
Pulse stretching	• None • 0.5 s • 1 s • 2 s	None	Yes	Channel	-
Digital input	• Normal • Inverted	Normal	Yes	Channel	Channel
Chatter monitoring	• Deactivated • 2 ... 32 signal changes	Deactivated	Yes	Channel	-
Monitoring window	• 0.5 s • 1 s ... 100 s	0.5 s	Yes	Channel	-

Parameters	Value range	Default	Reconfiguration in RUN	Effective range with configuration software, e.g. STEP 7 (TIA Portal)	
Input delay[4]	• None • 0.1 ms • 0.2 ms • 0.4 ms • 0.8 ms • 1.6 ms • 3.2 ms • 6.4 ms • 10 ms • 12.8 ms • 20 ms	0.1 ms	Yes	Channel	Channel[2]
Hardware interrupt rising edge	• Disable • Enable	Disable	Yes	Channel	- [3]
Hardware interrupt falling edge	• Disable • Enable	Disable	Yes	Channel	- [3]
Potential group	• Use the potential group of the left module (module plugged into a dark BaseUnit) • Enable new potential group (module plugged into a light BaseUnit)	Use potential group of the left module	No	Module	Module

1 Can only be parameterized for even channels

2 "Input delay" for channels 0-3 and 4-7 can only be set identically.

3 Due to the limited number of parameters of a maximum of 244 bytes per ET 200SP station with a PROFIBUS GSD configuration, the parameter assignment options are restricted. The parameter length of the I/O module is 10 bytes with a PROFIBUS GSD configuration. If necessary, you can set this parameter, however, with data records 0 to 7 or data record 128, see Appendix "Parameter data record".

4 As of firmware version V2.0.0

Technology functions

All technology functions, such as

- Pulse stretching
- Chatter monitoring
- Changeover errors
- Hardware interrupts

are executed only when there is an fault-free signal (QI = 1). This means that there is no diagnostics information on the channel (see also chapter Address space (Page 35)).

Changing parameter settings and effects on the technology functions

Reconfiguring a technology function starts its processing again. Reconfiguring one technology function has no effect on other technology functions. Exception: Signal inversion and chatter monitoring, because an additional edge change is generated when signal inversion is disabled/enabled.

4.2.2 Explanation of parameters

Diagnostics: No supply voltage L+

The diagnostics alarm is enabled for missing or insufficient supply voltage L+.

This diagnostic message is also set if another problem occurs with the supply voltage of the sensor (e.g. if a fault occurs in the supply voltage of the module for the sensors). Another example is when both problems occur together: L+ problems (usually external reasons) and problems with the sensor supply (internal reasons).

Tip: To avoid a diagnostics overload, you should only enable "Diagnostics: Missing supply voltage" for an active channel.

Diagnostics: Short-circuit to ground

The diagnostics alarm is enabled if there is a short-circuit of the sensor supply to ground.

"Short-circuit to ground" diagnostics is available with the following sensor setting:

- NAMUR sensor
- NAMUR changeover contact

Diagnostics: Wire break

The diagnostics alarm is enabled if the line to the sensor is interrupted.

"Wire break" diagnostics is available with the following sensor setting:

- NAMUR sensor
- Single contact with 10 kΩ
- NAMUR changeover contact
- Changeover contact with 10 kΩ

Diagnostics: Chatter error

The diagnostic message is enabled when a chatter error occurs.

Chatter monitoring is a process control function for digital input signals. It detects and reports signal changes that are unexpected in process engineering, for example when an input signal fluctuates too often between "0" and "1". If signal characteristics like these occur, it is a sign that the sensors are faulty or that there are instabilities from a process engineering viewpoint.

Diagnostics: Changeover error

The diagnostics alarm is enabled when a changeover error occurs.

"Changeover error" diagnostics is available with the following sensor setting:

- NAMUR changeover contact
- Changeover contact, unconnected
- Changeover contact with 10 kΩ

Sensor type

Specifies which sensor type is connected (see Pin assignment (Page 21) chapter for DI NAMUR HF).

For the sensor types

- NAMUR changeover contact
- Changeover contact, unconnected
- Changeover contact with 10 kΩ

the following applies: The normally open contact channel must be set according to the sensor type. The normally closed contact channel must be deactivated.

If "Channel deactivated" is shown, this means that the channel is not activated.

Pulse stretching

Sets whether and for how long pulse stretching is to take place.

Pulse stretching is a function for changing a digital input signal. A pulse at a digital input is extended to at least the configured length. If the input pulse is already longer than the configured length, then the pulse will not be changed.

Digital input

Specifies whether or not the input signal is to be inverted. You can use the parameter for the following encoder types:

- NAMUR sensor
- Single contact, unconnected
- Single contact with 10 kΩ

Chatter monitoring

Chatter monitoring: Setting of the signal change

Settings for the tolerated number of signal changes during chatter monitoring within the monitoring window.

Number of signal changes = 0 deactivates the chatter monitoring function.

Monitoring window

Chatter monitoring: Setting of the monitoring window

Each input channel has a configurable monitoring window. The monitoring window is started the first time the input signal changes. If the input signal changes within the monitoring window more often than the configured number of signal changes, this is recognized as a chatter error. If no chatter error is detected within the monitoring window, the window is restarted at the next signal change.

Input delay

This parameter can be used to suppress signal interference. Changes to the signal are only detected if they are present consistently for longer than the set input delay time.

For input channels with longer input delays, the read-in time is moved accordingly. This means individual channels can be assigned input delays, if necessary, without having a retroactive negative impact on the possible cycle time.

Hardware interrupt rising edge

Specifies whether a hardware interrupt is generated for a rising edge.

Hardware interrupt falling edge

Specifies whether a hardware interrupt is generated for a falling edge.

Potential group

A potential group consists of a group of directly adjacent I/O modules within an ET 200SP station, which are supplied via a common supply voltage.

A potential group begins with a light BaseUnit through which the required voltage is supplied for all modules of the potential group. The light BaseUnit interrupts the three self-assembling voltage buses P1, P2, and AUX to the left neighbor.

Specify on which slot a light BaseUnit with supply voltage feed or a dark BaseUnit is located (see ET 200SP Distributed I/O System (https://support.industry.siemens.com/cs/ww/en/view/58649293) System Manual).

All additional I/O modules of this potential group are plugged into dark BaseUnits. You take the potential of the self-assembling voltage buses P1, P2 and AUX from the left neighbor.

The station configuration must be completed with a server module.

4.2.3 Pulse stretching

Description

Pulse stretching is a function for changing a digital input signal. A pulse at a digital input is extended to at least the configured length. If the input pulse is already longer than the configured length, then the pulse will not be changed.

A pulse-stretched signal is the input signal for the hardware interrupts.

Principle of pulse stretching

The following figure uses examples to show if and how input pulses are changed.

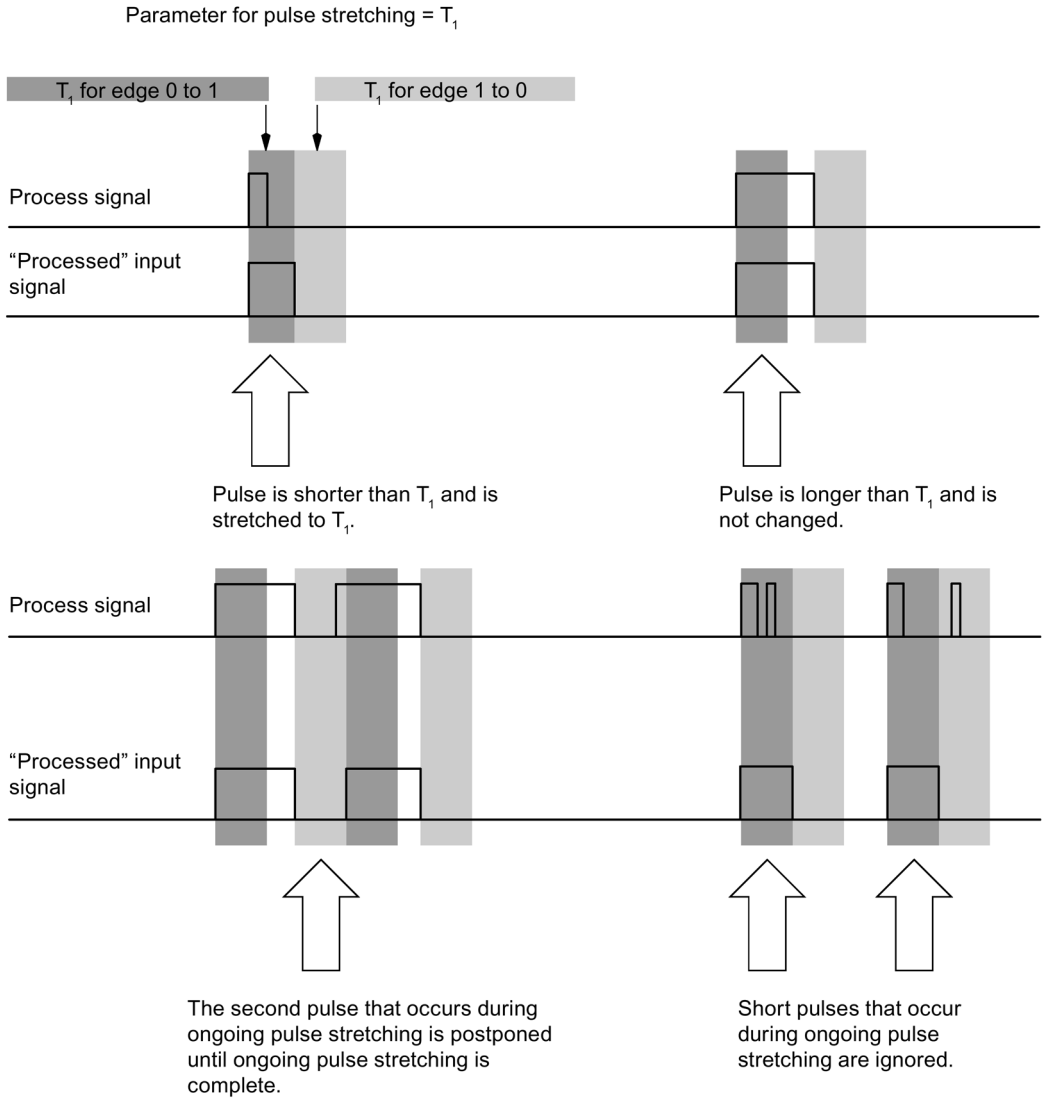


Figure 4-2 Principle of pulse stretching

Note

If you set pulse stretching for an input channel, this will also affect the chatter monitoring that is enabled for this channel. The "pulse-stretched" signal is the input signal for the chatter monitoring. You should therefore match the parameter settings for pulse stretching and chatter monitoring to one another. By selecting the appropriate values for the parameters you can adjust the functions optimally to your process.

Note

Pulse stretching in progress is reset in the event of an error in the value status (QI = 0, e.g. wire break).

4.2.4 Chatter monitoring

Description

Chatter monitoring is a process control function for digital input signals. It detects and reports signal changes that are unexpected in process engineering, for example when an input signal fluctuates too often between the states "0" and "1". This period is known as the "monitoring window". If signal characteristics like these occur, it is a sign that the sensors are faulty or that there are instabilities from a process engineering viewpoint.

Activating chatter monitoring

You activate chatter monitoring by specifying a permitted number of input signal changes between the states "0" and "1" within the monitoring window. The number 0 disables the chatter monitoring function.

A chatter error detected by the chatter monitoring has a direct effect on the value status (QI).

Detecting a chatter error

Each input channel has a monitoring window specified by parameters. The monitoring window is started the first time the input signal changes. If the input signal changes within the monitoring window more often than the configured number of signal changes, this is recognized as a chatter error. If no chatter error is detected within the monitoring window, the window is restarted at the next signal change.

Reporting a chatter error

If a chatter error occurs, the current signal status is entered in the process image and the value status of the signal is set to "invalid" (QI = 0). If "Chatter error" diagnostics is enabled, "Chatter error" is also entered as diagnostic information, triggering an incoming diagnostics interrupt.

You can evaluate and process the value status (QI) and the diagnostics information in the user program.

Resetting a chatter error

If no further chattering of the input signal is detected within three monitoring windows, an outgoing diagnostics interrupt is triggered. The status of the value of the current signal in the process image is set to "valid".

Note

Active chatter monitoring is reset if there is an error in the input signal (value status QI = 0).

Principle

The following figure gives you another graphic illustration of the principle of chatter monitoring.

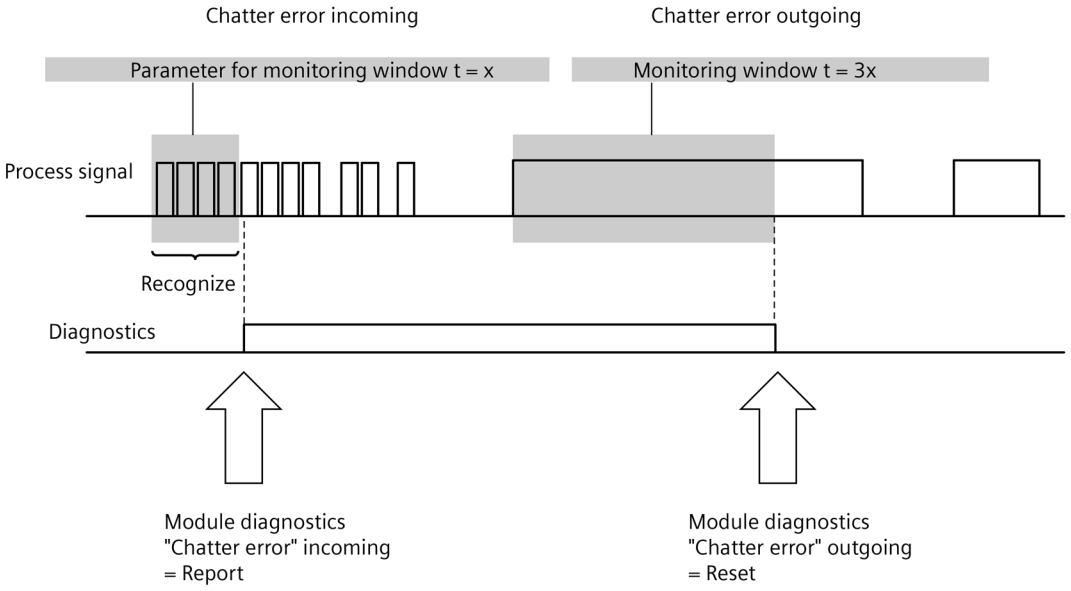


Figure 4-3 The principle of chatter monitoring

4.2.5 Address space

Configuration options of the DI 8×NAMUR HF

Configuration with value status:

- DI 8×NAMUR HF QI

Evaluating the value status

As a result of configuration with value status (QI), an additional byte is allocated in the input address space. Each bit in this byte is assigned to a channel and returns information about the validity of the digital value.

Deactivated channels or channels that are not operating correctly return a value status of QI = 0.

With changeover contacts, the value status of a normally closed channel is always QI = 0. The validity of the signal must be checked on the normally open channel.

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

Address space of the digital input module DI 8×NAMUR HF

The following figure shows the assignment of address space for the DI 8×NAMUR HF with value status (Quality Information (QI)).

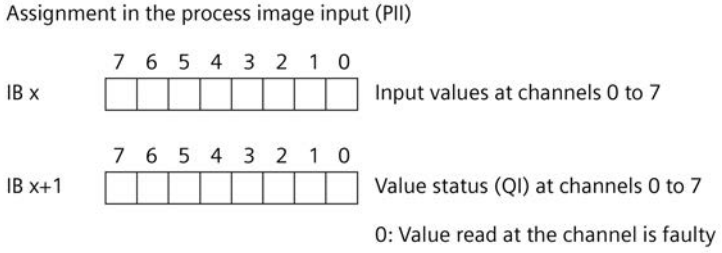


Figure 4-4 Address space of the DI 8×NAMUR HF digital input module with value status

Technology functions

All technology functions, such as

- Pulse stretching
- Chatter monitoring
- Changeover error
- Hardware interrupt

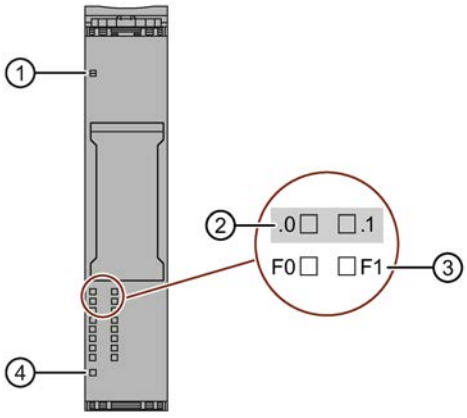
require a valid input signal that returns QI = 1 (no diagnostics detected). Otherwise, they will not run.

4.3 Interrupts/diagnostics alarms

4.3.1 Status and fault displays

LED displays

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



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

Figure 4-5 LED display

Meaning of the LEDs

The following tables describe the meaning of the status and error displays. Corrective measures for diagnostics alarms can be found in the chapter Diagnostics alarms (Page 41).

LED DIAG

Table 4- 3 LED DIAG fault display

LED DIAG	Meaning
Off	Backplane bus supply of the system is interrupted or switched off.
Flashing	Module parameters not assigned
On	Module parameters assigned and no module/channel diagnostics available
Flashing	Module parameters assigned and module/channel diagnostics available

LED channel status/channel fault

The channel status LED shows the signal status of the user data of an input. If inversion is enabled, the channel status LED shows the inverted status of the signal applied to the terminal.

If there is a diagnostics event on the channel, the channel status LED is always off if diagnostics is enabled and therefore does not indicate the signal status of the user data of the input.

Table 4- 4 Channel status/channel fault LED status and fault display

LED		Meaning
Channel status	Channel fault	
Off	Off	Input returns "0" signal and no channel diagnostics available or channel deactivated
On	Off	Input returns "1" signal and no channel diagnostics available
Off	On	Channel activated and channel diagnostics available
On	On	Not permitted (fault)

LED PWR

Table 4- 5 LED PWR status display

LED PWR	Meaning
□ Off	Supply voltage L+ is missing, is too low or polarity reversed
■ On	Supply voltage L+ present

4.3.2 Interrupts

Digital input module DI 8×NAMUR HF supports diagnostics and hardware interrupts.

Diagnostics interrupt

The module generates a diagnostics interrupt at the following events:

- Short-circuit to ground
- Wire break
- Supply voltage missing
- Changeover error
- Chatter error
- Parameterization error
- Hardware interrupt lost
- Channel/component temporarily unavailable

Detailed information on the event is available in the STEP 7 online help.

Evaluating hardware interrupts with IO controller

The module generates a hardware interrupt at the following events:

- At rising edge (signal change from "0" to "1")
- At falling edge (signal change from "1" to "0")

In the event of an interrupt, interrupt OBs run automatically in the CPU of the IO controller.

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

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 the local data double word 8.

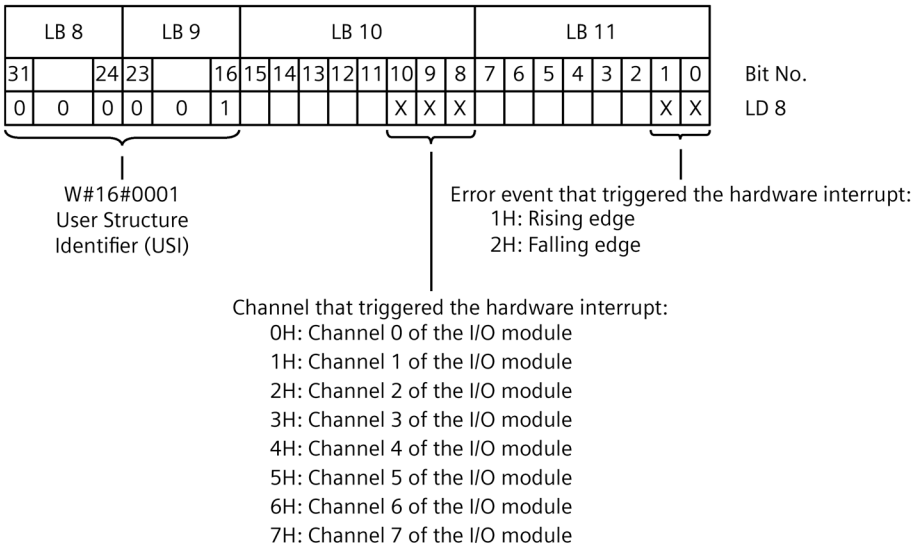


Figure 4-6 Organization block start information

If a hardware interrupt could not be signaled because there are too many hardware interrupts pending, the module generates the diagnostic interrupt "Hardware interrupt lost". You can find more information in the chapter Diagnostics of the inputs (Page 41).

The order of events on the individual channels within the 500-microsecond interval is not maintained. The events are reported to the PLC in groups in the order of the channels.

Structure of the additional interrupt information

Table 4- 6 Structure of USI = W#16#0001

Data block name		Contents	Comment	Bytes
USI (User Structure Identifier)		W#16#0001	Additional interrupt information for hardware interrupts of the I/O module	2
The channel that triggered the hardware interrupt follows.				
	Channel	B#16#00 to B#16#07	Channel 0 to 7 of the I/O module	1
The error event that triggered the hardware interrupt follows.				
	Error event	B#16#01	Rising edge	1
		B#16#02	Falling edge	

4.3.3 Diagnostics alarms

Diagnostics alarms

A diagnostic message is generated and the DIAG-LED flashes red on the module for each diagnostics event. You can read out the diagnostics alarms, for example, in the diagnostic buffer of the CPU. You can evaluate the fault codes with the user program.

Table 4- 7 Diagnostics alarms, meaning and corrective measures

Diagnostics alarm	Fault code	Meaning	Remedy
Short-circuit (NAMUR changeover contact and NAMUR sensor only) Tip: Check the normally open and normally closed contact channels of the NAMUR changeover contact.	1H	Short-circuit in the signal line to the sensor	Correct the process wiring
		Sensor defective	Replace the sensor
		Wrong sensor type configured	Correct the parameter assignment
		Load impedance too low	Use a sensor with a higher impedance
Wire break (only NAMUR changeover contact, NAMUR sensor, sensor connected with 10 kΩ and single contact connected with 10 kΩ) Tip: Check the normally open and normally closed contact channels of the NAMUR changeover contact	6H	Signal line to a sensor interrupted	Correct the process wiring
		Sensor defective	Replace the sensor
		Wrong sensor type configured	Correct the parameter assignment
		Load impedance too high	Use a different sensor type or modify the wiring, for example, using cables with a larger cross-section
		Channel not connected (open)	Disable diagnostics, connect sensor contacts
Error	9H	Sensor supply defective	Replace the module
		Hardware failure	
		This fault cannot be deactivated by parameter assignment, it is always active.	
Parameterization error	10H	• The module cannot evaluate parameters for the channel. • Incorrect parameter assignment.	Correct parameter assignment
Supply voltage missing	11H	Supply voltage L+ missing or too low	Check the supply voltage L+ on the BaseUnit Check BaseUnit type
		Is reported in the event of a power failure (24 V or 8.2 V power supply). This fault replaces all other faults (i.e. if there is a power failure, only this fault is reported, regardless of other faults currently present).	
Hardware interrupt lost	16H	• Module cannot trigger an interrupt because a preceding interrupt was not processed completely • Possible cause: Too many hardware interrupts in too short a time	Change interrupt processing in the CPU and reparameterize the module accordingly

Diagnostics alarm	Fault code	Meaning	Remedy
External fault (changeover sensors only)	1A$_H$	Changeover error: Validity check between normally closed and normally open contact channel negative	Check process wiring, change sensor
Error1 in actuator/encoder = Signal flutters	1D$_H$	Chatter error: Signal chatters: too many signal changes within the monitoring window If no further chattering of the input signal is detected within three monitoring windows, an outgoing diagnostics alarm is triggered. The status of the value of the current signal in the process image is set to "valid".	Verify the chatter monitoring parameters Check process wiring, if necessary change sensor
Channel/component temporarily unavailable	1F$_H$	Firmware update is currently in progress or has been canceled while running. The module does not read in process values in this state.	• Connecting the supply voltage • Wait for firmware update • Restart the firmware update

The diagnostics events occur at an interval of 2 kHz (every 500 µs), but the actual time of reporting to the CPU depends on several factors (the actual system load, duration of the ET 200SP backplane cycle, etc.).

4.3.4 Diagnostics for changeover contact sensor type

Diagnostics for changeover contact sensor type

With the changeover error diagnostics, the switchover between two input channels is checked. If there is a signal change in a changeover contact channel and there is no signal change at the other contact changeover channel after the tolerated switchover time, the diagnostics module returns a changeover error.

The tolerated switchover time between the two channels is set to the fixed value of 300 ms.

Changeover sensors are always assigned to two adjacent channels: The normally open contact channel should be set in accordance with the sensor type to channel 0, 2, 4, 6, and the respective corresponding normally closed contact channel 1, 3, 5, 7 deactivated.

Principle of changeover contact diagnostics

If the digital inputs of a channel group are configured as "changeover contacts", the module for this channel group carries out diagnostics for the changeover contact sensor type.

The digital input signal and the value status are only updated for the normally open contact channel (channels 0, 2, 4, 6). The digital input signal is "0" and the value status is "invalid" (QI = 0) for the normally closed contact channel (channels 1, 3, 5, 7). This channel is only used for a validity check of the sensor.

If the validity check is negative, the following applies:

- The module identifies the value status of the normally open contact channel as "invalid" (QI = 0)
- The module creates a diagnostics entry for the normally open contact channel and
- A diagnostics interrupt is triggered if changeover error diagnostics is enabled.

Please note the following special features for changeover contact diagnostics:

- If the normally open and normally closed contact signals are not plausible after 300 ms, (e.g. if there is no L/H or H/L combination of the channel pairs), a changeover error is output as diagnostics information.
- A time interval of 300 ms from the last change on each of the two channels is measured (change from/to L, H or a fault state). If another change occurs during the 300 ms time interval, the check is restarted for another 300 ms.

- If a fault has already occurred (QI = 0, e.g. a wire break), the module no longer performs diagnostics for changeover errors.
- Depending on the type of changeover contact, the are different diagnostic options (Dependencies for configuration with GSD files (Page 83)). Depending on the sensor type, a changeover error can have different causes.
  - In the case of connected changeover contacts, a changeover error may also be the result of a short-circuit (sensor is not defective; there is a short-circuit).
  - In the case of unconnected changeover contacts, a changeover error may also be the result of a wire break.
  - If a wire break or short-circuit can be detected with the particular sensor type but its diagnostics is not enabled, instead of the wire break or short-circuit diagnostics information, the changeover error diagnostics information is displayed if this is enabled.
  - During the time interval of 300 ms determined for the check (with possible repeated extension), the changeover contact channel reports a diagnostics that was valid before the first change. As soon as the 300 ms time interval passes without further changes, this diagnostics is updated.

Example:

- The changeover contact is configured on the first channel (index 0).
- Index 1 is automatically configured as its "odd" partner.
- Channel 0 measures the L state and channel 1 measures the wire break state.
- For channel 0, both diagnostic bits 6 and 26 are set (there is a wire break at the odd input).
- Nothing is reported for channel 1 (odd channel is automatically configured and reports DI = 0, QI = 0 to the CPU).

Tip: Data records 0 to 7 and changeover sensor

Using the data records 1, 3, 5 and 7, you can configure a changeover sensor on an even channel (normally closed contact channel).

The corresponding normally open contact channel can be configured with the data records 0, 2, 4 and 6.

An even changeover contact channel must be followed by an odd, deactivated channel. Otherwise:

- you receive a parameter assignment error or
- the parameter assignment is rejected and the current parameter assignment retained.

Remedy: First, send data records 1, 3, 5 and 7 with "deactivated", and then send data records 0, 2, 4 and 6 with changeover contact sensor.

Counter mode (CNT) 5

5.1 Counter

Numerator frequency

The maximum counting frequency is 5 kHz. This means that the counter is able to count all edges correctly if the signal on the counting channel does not change faster than 5 kHz.

5.1.1 Counters and changeover contacts

Counters and changeover contacts

Changeover contacts are not supported in the counter mode.

PROFIBUS restrictions

If PROFIBUS is used with the GSD configuration, only the CNT1 and CNT3 pulse counter configurations are available. The reason for this is that the size of the input data of CNT4 is more than 32 bytes, which makes its use with PROFIBUS impossible.

Counter and DI functionality

The counter function can be deactivated for a specific counting channel by setting it to digital input mode. In this mode the counting channel works as a DI channel.

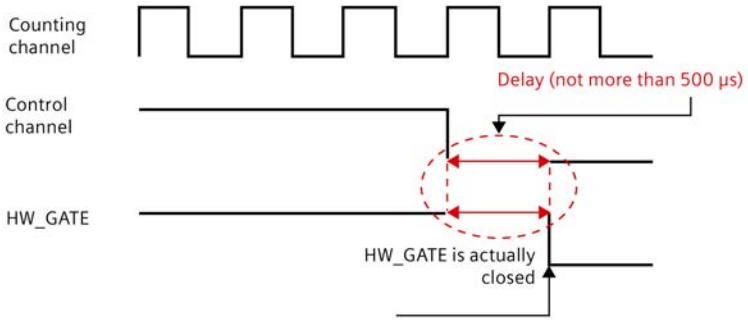
The control channel has 3 possible states - DI, gate control, direction control. In the DI operating mode, the control channel behaves as a DI channel, i.e. its control function is deactivated. If the control channel is configured in either gate or direction control operating mode, beyond the control function of that channel, its entire DI function will still be available.

5.1.2 Restrictions of the control channel

Delay in setting the control channel

The signals are processed with a frequency of 2 kHz by the control channel. This means that there can be a delay of up to 500 µs in setting the control channel.

Delay in setting the control channel



The figure shows the delay when the HW_GATE is turned off by switching the control channel from HIGH to LOW. The actual HW_GATE value is only changed after a certain delay.

5.2 Wiring

5.2.1 Pin assignment

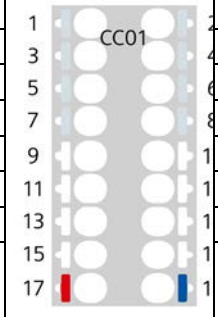
This chapter includes the block diagram of the DI 8xNAMUR HF module with the terminal assignments for a 1-wire, 2-wire and 3-wire connection in the counter mode. You may use and combine the different wiring options for all channels.

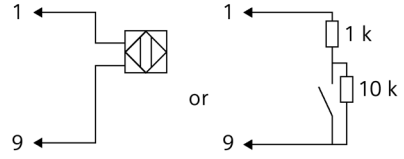
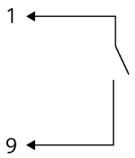
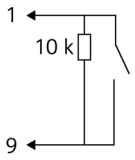
You can find information on wiring the BaseUnit in the System Manual Distributed I/O system ET 200SP (https://support.industry.siemens.com/cs/ww/en/view/58649293).

Note

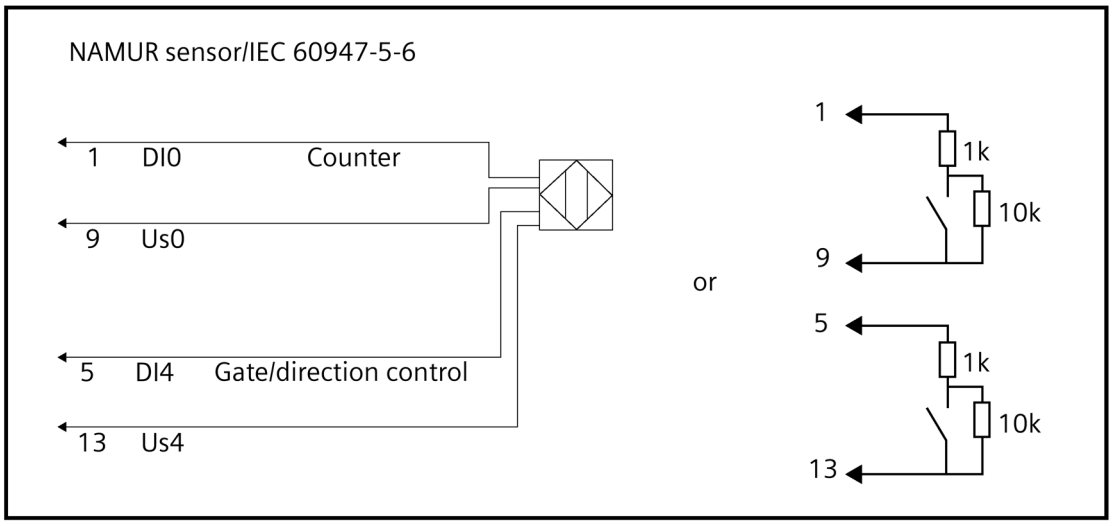
The load group of the module must begin with a light-colored BaseUnit. Keep this in mind also during the configuration.

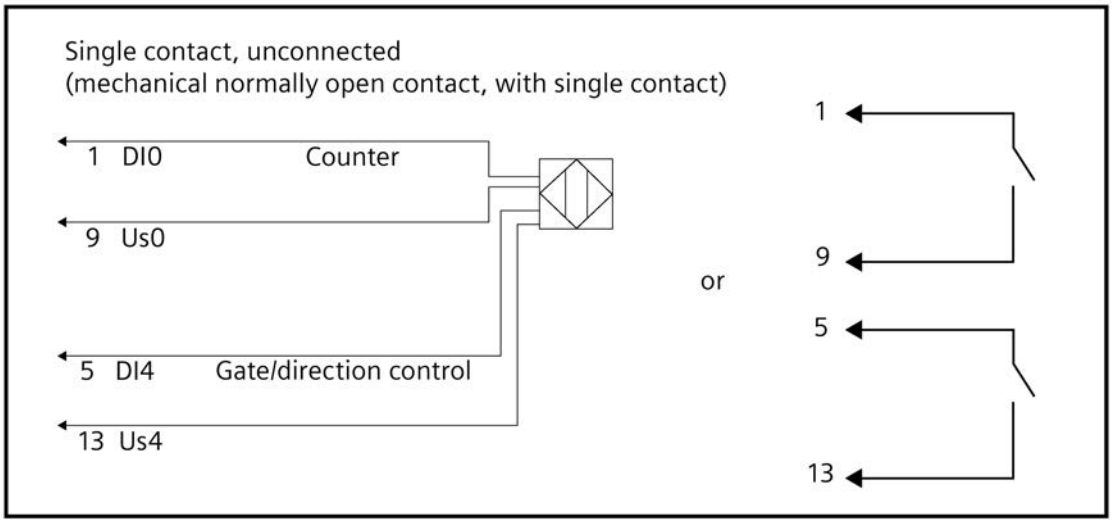
Pin assignment

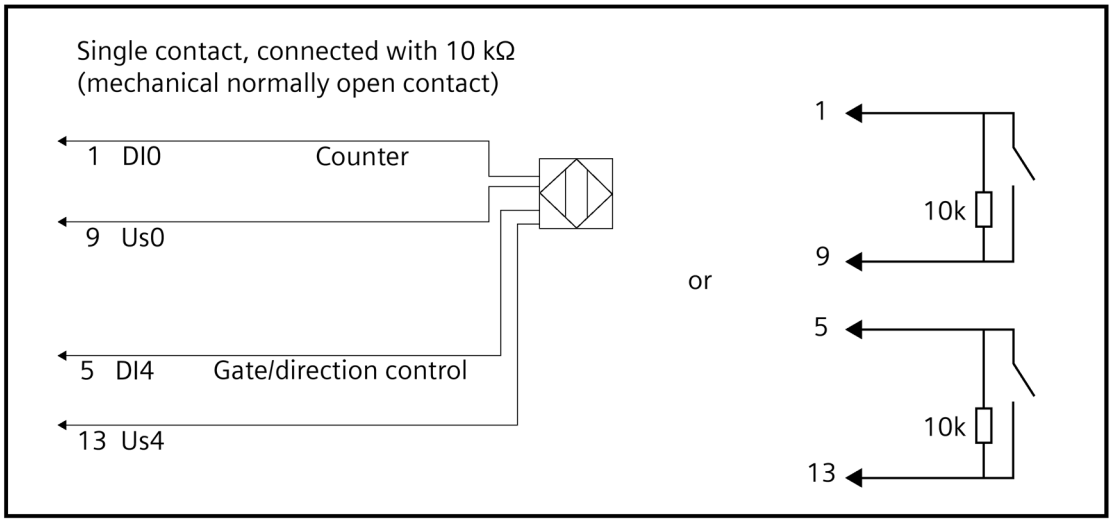
Description	Signal	Terminal	BaseUnit BU type A0	Terminal	Signal	Description
Digital input, channel 0	DI_0	1		2	DI_1	Digital input, channel 1
Digital input, channel 2	DI_2	3		4	DI_3	Digital input, channel 3
Digital input, channel 4	DI_4	5		6	DI_5	Digital input, channel 5
Digital input, channel 6	DI_6	7		8	DI_7	Digital input, channel 7
Sensor supply, channel 0	US_0	9		10	US_1	Sensor supply, channel 1
Sensor supply, channel 2	US_2	11		12	US_3	Sensor supply, channel 3
Sensor supply, channel 4	US_4	13		14	US_5	Sensor supply, channel 5
Sensor supply, channel 6	US_6	15		16	US_7	Sensor supply, channel 7
24 V DC supply voltage	L+	17		18	M	Ground

The figures below show the connections for input signal DI0 for all sensor types.		
NAMUR sensors / IEC 60947-5-6 sensors	Single contact, unconnected (mechanical normally open contact with single contact)	Single contact connected with 10 kΩ (mechanical normally open contact)
		

[1] Usable BaseUnit types, can be identified by the last two digits of the order number. See also system manual ET 200SP Distributed I/O System.


NAMUR sensor/IEC 60947-5-6
1 DI0 Counter
9 Us0
5 DI4 Gate/direction control
13 Us4
or
1
1k
10k
9
5
1k
10k
13


Single contact, unconnected
(mechanical normally open contact, with single contact)
1 DI0 Counter
9 Us0
5 DI4 Gate/direction control
13 Us4
or
1
9
5
13


Single contact, connected with 10 kΩ
(mechanical normally open contact)
1 DI0 Counter
9 Us0
5 DI4 Gate/direction control
13 Us4
or
1
10k
9
5
10k
13

5.2.2 Schematic circuit diagram

This section contains the schematic circuit diagram of the module.

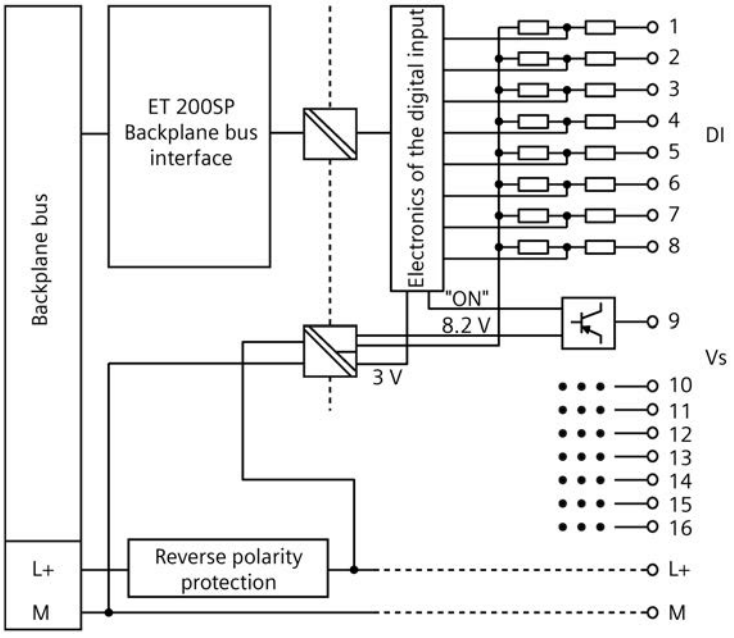


Figure 5-1 Block diagram DI 8xNAMUR HF

5.3 Parameters/address space

5.3.1 Counting

Function

Counting refers to the detection and summation of events. The respective counters of the module detect encoder signals and pulses and evaluate them accordingly, for example:

- For counting general piece goods up to a maximum limit
- For applications with recurring counting processes

You can count with DI_0 through DI_3. You can specify each counter's characteristics using the functions described below.

Counter limits

The counting limits define the counter value range used. The counter limits are configurable and can be modified during runtime using the user program.

The maximum possible counting limit is 2147483647 (2^{31}–1). The minimum possible counting limit is –2147483648 ($–2^{31}$).

You can continue or stop counting upon violation of a counting limit (automatic gate stop) Upon high and low limit violations of the counter value, an event bit is set in the feedback interface (Page 72) in each case.

Start value

You can configure a start value within the counter limits. The start value can be modified during runtime with the user program.

Gate control

Opening and closing the hardware gate and software gate defines the period of time during which the counting signals are recordd.

The control of the hardware gate takes place externally via the digital inputs DI_4 through DI_7. The software gate is controlled via the user program. Use of the hardware gate can be enabled through parameter assignment.

Count direction

The counting direction is specified either via suitable external pulse signals at the each counter's control input or via the configuration.

Comparison values

You define two comparison values that can control the STS_DQ feedback bit, independent of the user program. If the current counter value meets the configured comparison condition, the STS_DQ reset bit is set. You can use the STS_DQ reset bit in order to control a digital output module's digital output.

The comparison values are configurable and can be modified during runtime with the user program. When a comparison event occurs, in each case an event bit is set in the feedback interface (Page 72).

5.3.2 Scaling

The property of the scaling is similar to the scaling of the measured values in the Analog input module AI 2xU/I 2-/4-wire HF (https://support.industry.siemens.com/cs/de/en/view/89116945).

Function

Note

Effects of inversion

It is possible to set the "Scaled high nominal range limit" parameter lower than the "Scaled low nominal range limit" parameter, whereby the representation of the measuring range will be inverted compared to the terminal value.

Note

When the Parameter "Scaled high nominal range limit" and "Scaled low nominal range limit" parameters are too close together, resolution may be lost, which means it may no longer be possible to show every value.

Process image (I/0 data structure)

The output data has the same format as the counters, only SLOT is in FLOAT32 format here.

Table 5- 1 Address space in the configuration digital operation with "Count" operating mode without QI

Byte offset	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Data type
QB x	*SLOT (load value)*								*Float32*
QB x + 1									
QB x + 2									
QB x + 3									
QB x + 4	RESET_ EVENT_ CMP1	RESET_ EVENT_ CMP0	RESET_ EVENT_ OFLW	RESET_ EVENT_ UFLW	SW_GATE	LD_SLOT (meaning of the load value)			Unsigned8 (bit granular)

Notes:

"QB" stands for output byte

x = channel number × 5

The input data has the same format as the counters, but now instead of the "Count value", (formerly INTEGER32), a new scaled "Count value" in FLOAT32 format is reported to the CPU.

Table 5- 2 Address space in the configuration digital operation with "Count" operating mode without QI

Byte offset	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Data type
IB x + 2	COUNT_VALUE								*Float32*
IB x + 3									
IB x + 4									
IB x + 5									
IB x + 6	**MEASURED_VALUE**								Float32
IB x + 7									
IB x + 8									
IB x + 9									
IB x + 10	LD_ERROR	LD_STS_SLOT	0	0	**STS_M_INTERVAL**	QI	STS_GATE	STS_DQ	Unsigned8 (bit granular)
IB x + 11	RESET_EVENT_CMP1_ACK	RESET_EVENT_CMP0_ACK	RESET_EVENT_UFLW_ACK	RESET_EVENT_OFLW_ACK	EVENT_CMP1	EVENT_CMP0	EVENT_OFLW	EVENT_UFLW	Unsigned8 (bit granular)

Notes:

"IB" stands for input byte

x = channel number × 10

The data marked in italics represent the changes presented for SCLx submodules compared to CNTx submodules.

The data marked in bold means that the parameter is used for measuring.

Parameter data record DS129

The representation of the measuring range is defined by the following parameters:

- The "Scaled high nominal range limit" parameter sets the desired display value (in REAL) for the high nominal range limit of the measuring range.
- The "Scaled low nominal range limit" parameter sets the desired display value (in REAL) for the low nominal range limit of the measuring range.

The "Start value", "Comparison value 0" and "Comparison value 1" are now in the FLOAT32 format. The reason for this is that these values are represented in the scaling mode in the range [*low_scaling_limit, high_scaling_limit*] instead of [low_cnt_limit, high_cnt_limit] as with the usual counters.

Changing the scaling configuration during operation

The scaling parameters

- "Scaled high nominal range limit" and
- "Scaled low nominal range limit"

can be changed to any valid values during the operation.

Commands (LD_SLOT)

In the chapter Process image (I/0 data structure) it has already been described that LD_SLOT is in FLOAT32 format. It applies to the scaled range [*low_scaling_limit, high_scaling_limit*]. The table below shows the commands and their meaning.

Command (in binary 3-bit format)	Meaning	Response
000	NOP (no action)	No action
001	Load the scaled counter value (Float32)	The Integer32 count value is calculated and set.
011	Load the scaled start value (Float32)	The Integer32 start value is calculated and set.
100	Load the scaled comparison value 0 (Float32)	The Float32 comparison value 0 is set.
101	Load the scaled comparison value 1 (Float32)	The Float32 comparison value 1 is set.
110	Load the scaled low nominal range limit (Float32)	The Float32-scaled low nominal range limit is set. The Integer32 lower count limit is calculated and set.
111	Load the scaled high nominal range limit (Float32)	The Float32-scaled high nominal range limit is set. The Integer32 higher count limit is calculated and set.

Use of commands "110" and "111"

To properly use the commands "110" and "111" in scaling mode, take the gain into account.

Gain

If, for example, count limits are set to [0; 100] and scaled nominal range limits are set to [0.0; 1.0], this means that one pulse (one count) represents the value 1.0 / 100 = 0.01 in the scaled nominal range. This value is known as gain. If, for example, 100 counts corresponds to a distance of 1.0 m, this ratio is represented by the gain 0.01 m/number of counts.

The gain is calculated only once during parameter assignment of the module (e.g. during initial configuration from TIA Portal or by writing DS 129). The gain is viewed as physically significant (e.g. property of a sensor) and its value must therefore be retained. The gain must not be changed after processing of the commands "110" (set low scaled limit) and "111" (set high scaled limit).

Note

If you use commands "110" and "111" in scaling mode, the resulting length of the new scaled nominal range must equal the gain multiplied by the integer number.

Example

"Low nominal range limit" is 3, "High nominal range limit" is 113, "Scaled low nominal range limit" is 6.5 and "Scaled high nominal range limit" is 17.5.

Gain = (17.5 - 6.5) / (113 - 3) = 0.1

The new value for the high scaled limit (command "111") can only be 6.5 + n * 0.1. For example, the values 9.501, 13.75 and 17.193 are rejected (LD_ERROR bit is defined in the input data), but the values 9.5, 13.7 and 17.2 are accepted as the scaled high nominal range limit.

Additional examples

- If the scaled range is to be doubled (increased by 100%), the "Scaled high nominal range limit" can be calculated with 17.5 + (17.5 - 6.5) * 1 = 28.5.
- An increase of 20% can be achieved by changing the scaled high nominal range limit to 17.5 + (17.5 - 6.5) * 0.2 = 19.7.

For rounding tolerance, values that are close enough to the permissible values (within approximately 5%) are also accepted and adapted in the module.

5.3.3 Parameters

You can specify the module properties with various parameters in the course of your STEP 7 configuration. The following table lists the configurable parameters. The effective range of the configurable parameters depends on the type of configuration.

The following configurations are possible:

- Central operation on an ET 200SP CPU or on an ET 200SP Open Controller
- Distributed operation on PROFINET IO in an ET 200SP system
- Distributed operation on PROFIBUS DP in an ET 200SP system
- Distributed operation on EtherNet/IP in an ET 200SP system
- Distributed operation on Modbus TCP in an ET 200SP system

In addition to configuration via the configuration software, you can also configure parameters in RUN mode (dynamic) via the user program. When assigning parameters in the user program, use the "WRREC" instruction to transfer the parameters to the module by means of data records, see chapter Parameter assignment and structure of parameter data record for counter mode (Page 89).

The following parameter settings are possible for each operating mode:

Table 5- 3 Settable parameters and their defaults in the Counting mode (GSD file)

Parameters	Value range	Default	Reconfiguration in RUN	Effective range with configuration software	
				HSP0400 for STEP 7 (TIA Portal); HSP0229 for STEP 7; PROFINET IO GSD file	GSD file PROFIBUS DP
Diagnostics No supply voltage L+	• Disable • Enable	Disable	Yes	Channel	Channel
Diagnostics: Short-circuit to ground	• Disable • Enable	Disable	Yes	Channel	Channel
Diagnostics Wire break	• Disable • Enable	Disable	Yes	Channel	Channel
Diagnostics: Chatter error	• Disable • Enable	Disable	Yes	Channel	-

Parameters	Value range	Default	Reconfiguration	Effective range with configuration software	
Sensor type	• Channel deactivated • NAMUR sensor • Single contact unconnected • Single contact, connected with 10 kΩ • NAMUR changeover contact • Changeover contact, unconnected • Changeover contact, connected with 10 kΩ	NAMUR sensor	Yes	Channel	Channel
Pulse stretching	• None • 0.5 s • 1 s • 2 s	None	Yes	Channel	-
Digital input	• Normal • Inverted	Normal	Yes	Channel	Channel
Chatter monitoring	• Deactivated • 2 to 32 signal changes	Deactivated	Yes	Channel	-
Monitoring window	• 0.5 s • 1 s ... 100 s	0.5 s	Yes	Channel	-
Input delay	• None • 0.1 ms • 0.2 ms • 0.4 ms • 0.8 ms • 1.6 ms • 3.2 ms • 6.4 ms • 10 ms • 12.8 ms • 20 ms	0.1 ms	Yes	Channel	Channel[1]
Hardware interrupt rising edge	• Disable • Enable	Disable	Yes	Channel	Channel
Hardware interrupt falling edge	• Disable • Enable	Disable	Yes	Channel	Channel

Parameters	Value range	Default	Reconfiguration	Effective range with configuration software	
Potential group	• Use the potential group of the left module (module plugged into a dark BaseUnit) • Enable new potential group (module plugged into a light BaseUnit)	Use potential group of the left module	No	Module	Module
Edge selection	• At rising edge • At falling edge	At rising edge	Yes	Channel	Channel
Reaction to violation of a counting limit	• Stop counting • Continue counting	Stop counting	Yes	Channel	Channel
Set function of DI	• Digital input • Gate start/stop • Count direction	Digital input	Yes	Channel	Channel
Count direction	• Up • Down	Up	Yes	Channel	Channel
Set output DQ	• Off (DQ = 0) • Off (DQ = 1) • Between comparison value 0 and 1 • Not between comparison value 0 and 1	Off (DQ = 0)	Yes	Channel	Channel
Comparison value 1	-2147483647 ... 2147483647	10	Yes	Channel	Channel
Comparison value 0	-2147483648 ... 2147483646	0	Yes	Channel	— [2]
Start value	-2147483648 ... 2147483647	0	Yes	Channel	— [2]
Counter high limit	-2147483647 ... 2147483647	2147483647	Yes	Channel	Channel
Counter low limit	-2147483648 ... 2147483646	0	Yes	Channel	— [2]
Update time [µs]	0 ... 25000000 µs	10000	Yes	Channel	Channel
Increments per unit	1 ... 65535	1	Yes	Channel	Channel

Parameters	Value range	Default	Reconfiguration	Effective range with configuration software	
Measured value	• No measurement • Frequency • Period duration • Velocity	No measurement	Yes	Channel	Channel
Time base for velocity measurement	• 1 ms • 10 ms • 100 ms • 1 s • 1 min	1 min	Yes	Channel	Channel

1 "Input delay" for channels 0-3 and 4-7 can only be set identically. If your PROFIBUS Master supports the "Read / write data record" function, you can set this parameter for each channel via data record 128.

2 Because the number of parameters is limited to 244 bytes per ET 200SP station in a PROFIBUS GSD configuration, the parameter assignment options are limited. The parameter length of the I/O module is up to 37 bytes with a PROFIBUS GSD configuration. If your PROFIBUS Master supports the "Read/write data record" function, you can set these parameters via data records 128 and 129.

5.3.4 Explanation of parameters

Diagnostics: No supply voltage L+

The diagnostics alarm is enabled for missing or insufficient supply voltage L+.

This diagnostic message is also set if another problem occurs with the supply voltage of the sensor (e.g. if a fault occurs in the supply voltage of the module for the sensors). Another example is when both problems occur together: L+ problems (usually external reasons) and problems with the sensor supply (internal reasons).

Tip: To avoid a diagnostics overload, you should only enable "Diagnostics: Missing supply voltage" for an active channel.

Diagnostics: Short-circuit to ground

The diagnostics alarm is enabled if there is a short-circuit of the sensor supply to ground.

"Short-circuit to ground" diagnostics is available with the following sensor setting:

- NAMUR sensor
- NAMUR changeover contact

Diagnostics: Wire break

The diagnostics alarm is enabled if the line to the sensor is interrupted.

"Wire break" diagnostics is available with the following sensor setting:

- NAMUR sensor
- Single contact with 10 kΩ
- NAMUR changeover contact
- Changeover contact with 10 kΩ

Diagnostics: Chatter error

The diagnostic message is enabled when a chatter error occurs.

Chatter monitoring is a process control function for digital input signals. It detects and reports signal changes that are unexpected in process engineering, for example when an input signal fluctuates too often between "0" and "1". If signal characteristics like these occur, it is a sign that the sensors are faulty or that there are instabilities from a process engineering viewpoint.

Sensor type

Specifies which sensor type is connected (see section Pin assignment (Page 47) for DI NAMUR HF).

For the sensor types

- NAMUR changeover contact
- Changeover contact, unconnected
- Changeover contact with 10 kΩ

the following applies: The normally open contact channel must be set according to the sensor type. The normally closed contact channel must be deactivated.

If "Channel deactivated" is shown, this means that the channel is not activated.

Pulse stretching

Sets whether and for how long pulse stretching is to take place.

Pulse stretching is a function for changing a digital input signal. A pulse at a digital input is extended to at least the configured length. If the input pulse is already longer than the configured length, then the pulse will not be changed.

Digital input

Specifies whether or not the input signal is to be inverted. You can use the parameter for the following encoder types:

- NAMUR sensor
- Single contact, unconnected
- Single contact with 10 kΩ

Chatter monitoring

Chatter monitoring: Setting of the signal change

Settings for the tolerated number of signal changes during chatter monitoring within the monitoring window.

Number of signal changes = 0 deactivates the chatter monitoring function.

Monitoring window

Chatter monitoring: Setting of the monitoring window

Each input channel has a configurable monitoring window. The monitoring window is started the first time the input signal changes. If the input signal changes within the monitoring window more often than the configured number of signal changes, this is recognized as a chatter error. If no chatter error is detected within the monitoring window, the window is restarted at the next signal change.

Input delay

This parameter can be used to suppress signal interference. Changes to the signal are only detected if they are present consistently for longer than the set input delay time.

For input channels with longer input delays, the read-in time is moved accordingly. This means individual channels can be assigned input delays, if necessary, without having a retroactive negative impact on the possible cycle time.

Hardware interrupt rising edge

Specifies whether a hardware interrupt is generated for a rising edge.

Hardware interrupt falling edge

Specifies whether a hardware interrupt is generated for a falling edge.

Potential group

Specifies whether a light-colored BaseUnit with infeed of the supply voltage is located in this slot (see the System Manual SIMATIC ET 200SP Distributed I/O System (https://support.industry.siemens.com/cs/ww/en/view/58649293)).

Edge selection

Selects the edge that is counted:

- At rising edge:
  The respective counter counts all rising edges at the digital input.
- At falling edge:
  The respective counter counts all falling edges at the digital input.

Note

If the "Reverse direction" option is selected in "Set function of DI" and the counting direction in the process changes, the counting edge is automatically adjusted (opposite edges).

Reaction to violation of a counting limit

Selection of the reaction to violation of the counter high limit in the upward direction or the counter low limit in the downward direction:

- Stop counting:
  After a counting limit is violated, the internal gate is closed. This stops the counting process. The counter value is set to the opposite counting limit. To restart counting, you must close and reopen the software/hardware gate.
- Continue counting:
  After a counting limit is violated, the counter value is set to the opposite counting limit and counting continues.

Set function of DI

Selects the function of DI_{n+4}, which controls the assigned counter input DI_n:

- Digital input:
  No function is assigned to DI_{n+4}. The signal status of DI_{n+4} is read by the CPU using the feedback interface (Page 66).
- Gate start/stop:
  Setting DI_{n+4} opens the hardware gate for DI_n. Resetting DI_{n+4} closes the hardware gate for DI_n.
- Count direction:
  DI_{n+4} reverses the counting direction at DI_n, in order to adjust it to the process. If DI_{n+4} is not set, DI_n counts up. If DI_{n+4} is set, DI_n counts down.

In "Count direction" mode, the edge is changed when the counting direction is changed. For this reason, the "Count direction" parameter is ignored in this mode. In this case, the actual type of the counting edges depends on the value of the "Edge selection" parameter. The table below shows a summary of the counter behavior.

Edge selection/count direction	Up	Down
At rising edge	Counting of rising edges	Counting of falling edges
At falling edge	Counting of falling edges	Counting of rising edges

Count direction

Count direction selection:

- Up:
  The respective counter counts up.
- Down:
  The respective counter counts down.

Note

This parameter has no effect if the "Reverse direction" option is selected in "Set function of DI".

If, for example, the "Edge selection" via DS129 was initially set to "At rising edge", then the rising edges are counted upward by setting the control channel to 0 (up). The falling edges, on the other hand, are counted downwards by setting the control channel to 1 (down).

Set output DQ

Selects the function that controls the response of the STS_DQ feedback bit (Page 67): You use the feedback bit STS_DQ to control a digital output of a digital output module.

- Off (DQ = 0):
  STS_DQ is independent of the counter value and permanently not set.
- Off (DQ = 1):
  STS_DQ is independent of the counter value and permanently set.
- Between comparison value 0 and 1:
  STS_DQ is set if counter value ≥ comparison value 0 and counter value ≤ comparison value 1.
- Not between comparison value 0 and 1:
  STS_DQ is set if counter value < comparison value 0 or counter value > comparison value 1.

Comparison value 1

Sets the second comparison value.

The following applies:

- Comparison value 1 > comparison value 0
- Comparison value 1 ≤ counter high limit

Comparison value 0

Sets the first comparison value.

The following applies:

- Comparison value 0 < comparison value 1
- Comparison value 0 ≥ counter low limit

Start value

Sets the start value.

The following applies:

- Start value ≥ counter low limit
- Start value ≤ counter high limit

Counter high limit

Sets counter high limit.

The following applies:

- Counter high limit > counter low limit
- Counter high limit ≤ 2147483647 (2^{31} - 1)

Counter low limit

Sets the counter low limit.

The following applies:

- Counter low limit < counter high limit
- Counter low limit ≥ -2147483648 (-2^{31})

Update time [µs]

By configuring the update time in microseconds, you define the interval between two measured value updates.

Increments per unit

With this parameter, you define the number of count pulses per relevant unit that the incremental or pulse encoder supplies for the velocity measurement.

Measured value

Used to select the measurement type, i.e. frequency, period and velocity measurement.

Time base for velocity measurement

With this parameter, you specify the time base with which the velocity should be provided.

You can select from the following options:

- 1 ms
- 10 ms
- 100 ms
- 1 s
- 1 min

The default setting is "1 min".

5.3.5 Address space

5.3.5.1 Assignment of the control interface

Control interface

The user program uses the control interface to influence the behavior of the module's counter.

The table below shows the structure of the control interface for individual channels.

Byte offset	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Data type
QB x	SLOT (load value)								Integer32/Float32[1]
QB x + 1									
QB x + 2									
QB x + 3									
QB x + 4	RESET_ EVENT_ CMP1	RESET_ EVENT_ CMP0	RESET_ EVENT_ OFLW	RESET_ EVENT_ UFLW	SW_GATE	LD_SLOT (meaning of the load value)			Unsigned8 (bit granular)

Notes:

"QB" stands for output byte

x = channel number × 5

[1] The data type depends on the mode used. The Integer32 data type is supported in count mode and the Float32 data type in scaling mode.

5.3.5.2 Notes on the control interface

Notes on the control bits

Control bit	Notes
SLOT	With this value you specify the load value for the respective channel. Use the LD_SLOT load request to evaluate the loaded value.
LD_SLOT	With this load request you specify the meaning of the value in SLOT (load value) for the respective channel. The user program performs the respective action, as soon as LD_SLOT changes. When the loading request LD_SLOT = 011_B is entered and the software gate is opened, each counting operation begins with the start value. If another load request is entered and the software gate is opened, counting continues with the current count at each start of the counting operation. These two situations are also in effect when the hardware gate is configured and the software gate is closed.
SW_GATE	With this bit, you open and close the software gate of the respective channel. Together, the software gate and the hardware gate form the internal gate. The module only carries out the counting process when the internal gate is open. 0 means: Software gate closed 1 means: Software gate open
RES_EVENT_UFLW	Use this bit to initiate the resetting of the saved event in the EVENT_UFLW feedback bit for the respective channel.
RES_EVENT_OFLW	Use this bit to initiate the resetting of the saved event in the EVENT_OFLW feedback bit for the respective channel.
RES_EVENT_CMP0	Use this bit to initiate the resetting of the saved event in the EVENT_CMP0 feedback bit for the respective channel.
RES_EVENT_CMP1	Use this bit to initiate the resetting of the saved event in the EVENT_CMP1 feedback bit for the respective channel.

Table 5- 4 Detailed display of SW_GATE and LD_SLOT

Control interface SW_GATE.LD_SLOT	Conversion to LD_SLOT command	Action (LD_SLOT)	Load value (SLOT)	Response to GATE start
x.000 (NOP)	1.xxx 0.000	Deactivate counter	-	-
	0.xxx 1.000	Activate counter	-	Counting from the current value
	1.xxx 1.000	The counter remains activated	-	Maintaining the previous behavior
	0.xxx 0.000	The counter remains deactivated	-	-
x.001 (CNT = LW)	1.xxx 0.001	Deactivate counter	In the counter value	-
	0.xxx 1.001	Activate counter	In the counter value	Counting from the current value
	1.xxx 1.001	The counter remains activated	In the counter value	Maintaining the previous behavior
	0.xxx 0.001	The counter remains deactivated	In the counter value	-
x.010 (reserved)	1.xxx 0.010	Deactivate counter	-	-
	0.010 1.010	Activate counter (only the SW_GATE change)	-	Counting from the current value
	0.xxx 1.010 xxx ≠ 010	(LD_ERROR=1) reserved	-	Maintaining the previous behavior
	1.xxx 1.010 0.xxx 0.010	(LD_ERROR =1) counter remains activated or deactivated	-	Maintaining the previous behavior
x.011 (SW = LW / CNT = SW)	1.xxx 0.011	Deactivate counter	In start value	-
	0.xxx 1.011	Activate counter	-	Counting from the start value
	1.xxx 1.011	The counter remains activated	In start value	Maintaining the previous behavior
	0.xxx 0.011	The counter remains deactivated	In start value	-
x.100 (V0 = LW)	1.xxx 0.100	Deactivate counter	In V0	-
	0.xxx 1.100	Activate counter	In V0	Counting from the current value
	1.xxx 1.100	The counter remains activated	In V0	Maintaining the previous behavior
	0.xxx 0.100	The counter remains deactivated	In V0	-
x.101 (V1 = LW)	1.xxx 0.101	Deactivate counter	In V1	-
	0.xxx 1.101	Activate counter	In V1	Counting from the current value
	1.xxx 1.101	The counter remains activated	In V1	Maintaining the previous behavior
	0.xxx 0.101	The counter remains deactivated	In V1	-

Control interface SW_GATE.LD_SLOT	Conversion to LD_SLOT command	Action (LD_SLOT)	Load value (SLOT)	Response to GATE start
x.110 (UZG = LW)	1.xxx 0.110	Deactivate counter	In the UZG	-
	0.xxx 1.110	Activate counter	In the UZG	Counting from the current value
	1.xxx 1.110	The counter remains activated	In the UZG	Maintaining the previous behavior
	0.xxx 0.110	The counter remains deactivated	In the UZG	-
x.111 (OZG = LW)	1.xxx 0.111	Deactivate counter	In the OZG	-
	0.xxx 1.111	Activate counter	In the OZG	Counting from the current value
	1.xxx 1.111	The counter remains activated	In the OZG	Maintaining the previous behavior
	0.xxx 0.111	The counter remains deactivated	In the OZG	-

HW GATE is configured as follows:

No command is executed after the edge change 0 → 1 of the HW gate. Instead, the counter reacts to the last setting "Behavior at GATE start", provided that SW_GATE = 1 has remained stable.

Abbreviations:

NOP = No operation

CNT = Count value

V0 = Comparison limit 0

UZG = Lower count limit

LW = Load value (SLOT)

V1 = Comparison limit 1

OZG = Higher count limit

SW = Start value

5.3.5.3 Assignment of the feedback interface

Feedback interface

The user program receives current values and status information from the module via the feedback interface. The figure below shows the address space allocation for the feedback interface in the process image of the inputs.

The first two bytes represent the DI and QI information for all channels.

Byte offset	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Data type
IB 0	DI7	DI6	DI5	DI4	DI3	DI2	DI1	DI0	Unsigned8 (bit granular)
IB 1	QI7	QI6	QI5	QI4	QI3	QI2	QI1	QI0	Unsigned8 (bit granular)

Below you can find the meaning of the values:

Name	Meaning
DI<n> [n=0..7]	Digital input for channel <n>, i.e. DI0 is the digital input for channel 0, DI1 is the digital input for channel 1, etc.
QI<n> [n=0..7]	Quality information for the channel <n>.

The following structure is used for every channel. It consists of 10 bytes. For example, for 4 counter channels, this information uses 10 * 4 = 40 bytes. The fields used only for the measurements are marked in bold.

Byte offset	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Data type
IB x + 2	COUNT_VALUE								Integer32/Float32[1]
IB x + 3									
IB x + 4									
IB x + 5									
IB x + 6	**MEASURED_VALUE**								Float32
IB x + 7									
IB x + 8									
IB x + 9									
IB x + 10	LD_ERROR	LD_STS_SLOT	0	0	**STS_M_INTERVAL**	QI	STS_GATE	STS_DQ	Unsigned8 (bit granular)
IB x + 11	RESET_EVENT_CMP1_ACK	RESET_EVENT_CMP0_ACK	RESET_EVENT_UFLW_ACK	RESET_EVENT_OFLW_ACK	EVENT_CMP1	EVENT_CMP0	EVENT_OFLW	EVENT_UFLW	Unsigned8 (bit granular)

Notes:

"IB" stands for input byte

x = channel number × 10

[1] The data type depends on the mode used. The Integer32 data type is supported in count mode and the Float32 data type in scaling mode.

5.3.5.4 Notes on the feedback interface

Notes on the feedback bits

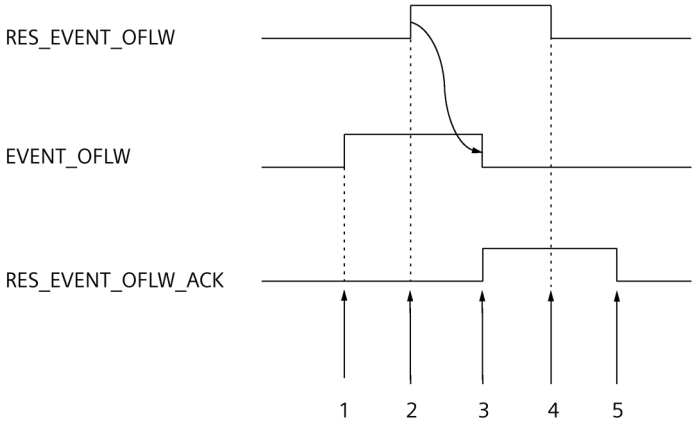
Feedback bit	Notes
COUNT_VALUE	This value returns the current counter value for the respective channel.
MEASURED_VALUE	**If measurements are activated, frequency, velocity and current velocity are included in the value in Float32 format. Otherwise, this field contains 0 if measurements are disabled.** This value shows the current measured value with REAL data type: • Frequency: Based on the time sequence of the count pulses or position value changes, the average frequency within a measuring interval is calculated and returned as a floating-point number in units of hertz. • Period duration: Based on the time sequence of the count pulses or position value changes, the average period within a measuring interval is calculated and returned as a floating-point number in units of seconds. • Velocity: Based on the time sequence of the count pulses or position value changes and additional parameters, the average velocity within a measuring interval is calculated and returned in the configured unit. The measured values are returned as signed values. The sign indicates whether the counter value increased or decreased during the relevant time interval. The update time is asynchronous to the opening of the internal gate, which means that the update time is not started when the gate is opened. After the internal gate is closed, the last measured value calculated is still returned.
STS_DQ	This bit depends on the "Set output" parameter of the respective channel. You can use STS_DQ in each case, in order to control a digital output module's digital output.
STS_GATE	Together, the software gate and the hardware gate form the internal gate. This bit indicates the status of the internal gate for the respective channel. The module only counts if the internal gate is open. 0 means: Gate closed 1 means: Gate open Note: If you change a channel parameter in RUN via data record 128 or 129, all values of the changed channel are transferred to the module again. In doing so, the internal gate of the respective channel is closed and the counter value is set to the start value. To restart counting, you need to close and reopen the software gate in each case.
QI	Quality information for the counter channel.
STS_M_INTERVAL	**This bit is used only for the additional "Measurement" property and not for the counter functionality itself. You can find more information in the function manual Counting, measurement and position detection.**
LD_STS_SLOT	This bit indicates for the respective channel, by mean of a status change (toggling), that the load request for SLOT (LD_SLOT) has been detected and executed.

Feedback bit	Notes
LD_ERROR	This bit indicates for the respective channel that an error occurred (latching) during loading via the control interface. The loaded value was not applied. One of the following conditions has not been met: • Count low limit ≤ count value (If this condition is not met, the start value is loaded as the current count value.) • Counter low limit ≤ start value • Counter low limit ≤ comparison value 0/1 • Count high limit ≥ count value (If this condition is not met, the start value is loaded as the current count value.) • Counter high limit ≥ start value • Counter high limit ≥ comparison value 0/1 • Counter low limit < counter high limit • Comparison value 0 < comparison value 1 • Do not write a reserved load request in LD_SLOT
EVENT_UFLW	For the respective channel, this bit indicates the saved state which shows that there was a counter value underflow (a violation of the counter low limit). You reset the status by acknowledgment with RES_EVENT_UFLW.
EVENT_OFLW	For the respective channel, this bit indicates the saved state which shows that there was a counter value overflow (a violation of the counter high limit). You reset the status by acknowledgment with RES_EVENT_OFLW.
EVENT_CMP0	For the respective channel, this bit indicates the saved status which shows that a comparison event with comparison value 0 has occurred. You reset the status by acknowledgment with RES_EVENT_CMP0. The EVENT_CMP0 bit is not set when you set the counter value to the start value.
EVENT_CMP1	For the respective channel, this bit indicates the saved status which shows that a comparison event with comparison value 1 has occurred. You reset the status by acknowledgment with RES_EVENT_CMP1. The EVENT_CMP1 bit is not set when you set the counter value to the start value.
RES_EVENT_UFLW_ACK	This bit indicates for the respective channel that the reset of event bit EVENT_UFLW is active.
RES_EVENT_OFLW_ACK	This bit indicates for the respective channel that the reset of event bit EVENT_OFLW is active.
RES_EVENT_CMP0_ACK	This bit indicates for the respective channel that the reset of event bit EVENT_CMP0 is active.
RES_EVENT_CMP1_ACK	This bit indicates for the respective channel that the reset of event bit EVENT_CMP1 is active.

Complete acknowledgment principle

Saving bits are acknowledged according to the complete acknowledgment principle.

The figure below shows an example of the sequence of the complete acknowledgment principle in the event of an overflow:



① The EVENT_OFLW feedback bit is set as a saving event upon overflow.
② You set the RES_EVENT_OFLW control bit to trigger EVENT_OFLW reset.
③ The RES_EVENT_OFLW_ACK feedback bit is set when reset of EVENT_OFLW is detected.
④ You then rest the control bit RES_EVENT_OFLW .
⑤ The RES_EVENT_OFLW_ACK feedback bit is reset.

Figure 5-2 Acknowledgment principle

Note

If you have initiated the reset of an event bit, you must wait for the respective feedback bit. Then you can initiate another reset.

Note

Opening the software gate or hardware gate (0-1 transition) resets all event bits.

See also

Counting, measuring and position detection
(https://support.industry.siemens.com/cs/ww/en/view/59709820)

5.4 Interrupts/diagnostic messages

5.4.1 Status and fault displays

LED display

For detailed information on the LED displays, refer to the chapter Status and fault displays (Page 36) of the operating mode DI.

5.4.2 Interrupts

Digital input module DI 8×NAMUR HF supports diagnostics and hardware interrupts.

Diagnostics and hardware interrupts

In general, all diagnostic and hardware interrupts are supported and reported in the same way in the counter mode as in the operating mode DI.

The counter channels do not offer some properties of the operating mode DI, therefore 0x1A (external fault) and 0x1D (actuator fault) are not available. 0x1A is used for the changeover errors and 0x1D for the chatter errors.

You can find more information on the diagnostic and hardware interrupts in the section Diagnostic messages (Page 41).

5.5 Measurement

The measuring functions are largely described in the Function Manual Counting, measuring and position detection (https://support.industry.siemens.com/cs/ww/en/view/59709820), especially in chapter 2.2.9.1 "Overview of measuring functions", (only the declared accuracy up to 100 ppm is not relevant), as well as 2.2.9.2 "Measured value determination with incremental or pulse encoder" (only the chapters "Measuring principle", "Frequency measurement", "Period measurement" and "Velocity measurement" are relevant).

Measuring ranges

The measuring functions have the following measuring range limits:

Measurement type	Low measuring range limit	High measuring range limit
Frequency measurement	0.04 Hz	5 kHz
Period measurement	200 µs	25 s
Velocity measurement	Depending on the configured number of "Increments per unit" and the "Time base for velocity measurement"	

All measured values are returned as signed values. The sign indicates whether the counter value increased or decreased during the relevant time interval.

Parameter data record DS129

There are 4 values in DS129 that are used to perform measurements.

- **Measured value**

  Used to select the measurement type, i.e. frequency, period and velocity measurement.

- **Update time**

  You will find the description of this value in the Function Manual Counting, measuring and position detection (https://support.industry.siemens.com/cs/ww/en/view/59709820), chapter 2.2.9.1 "Overview of measuring functions".

- **Time base for velocity measurement and Increments per unit**

  The description of these two values can be found in the above Function Manual, chapter 2.2.9.2 "Measured value determination with incremental or pulse encoder", "Velocity measurement" chapter.

Changing the measurement parameters during the run

All 4 parameters described above in "Parameter data record DS129" can be changed to any valid values during the run.

Process image (I/O data structure)

A measured value (frequency, period duration or velocity) is supplied via MEASURED_VALUE in the feedback interface.

The feedback bit STS_M_INTERVAL shows whether a counting pulse occurred in the previous measuring interval. This enables a distinction to be made between an assumed and an actual counting pulse.

More information can be found in the Function Manual Counting, measuring and position detection (https://support.industry.siemens.com/cs/ww/en/view/59709820) as well as in the Process image (I/O data structure) chapter for the counter mode.

Technical specifications

6

6.1 Technical specifications

DI 8×NAMUR HF technical specifications

The following table shows the technical specifications as of 03/2024. You can find a data sheet including daily updated technical specifications on the Internet (https://support.industry.siemens.com/cs/ww/en/pv/6ES7131-6TF00-0CA0/td?dl=en).

Article number	6ES7131-6TF00-0CA0
General information	
Product type designation	DI 8xNAMUR HF
HW functional status	from FS21
Firmware version	V2.0 or higher
• FW update possible	Yes
usable BaseUnits	BU type A0
Color code for module-specific color identification plate	CC01
Product function	
• I&M data	Yes; I&M0 to I&M3
• Isochronous mode	No
• suitable for operation on PROFINET R1 IMs	Yes
Engineering with	
• STEP 7 TIA Portal configurable/integrated from version	V19
• STEP 7 configurable/integrated from version	V5.5 SP3 / -
• PROFIBUS from GSD version/GSD revision	GSD Revision 5
• PROFINET from GSD version/GSD revision	GSDML V2.42
Operating mode	
• DI	Yes
• Counter	Yes
• Oversampling	No
• MSI	No
Supply voltage	
Rated value (DC)	24 V
permissible range, lower limit (DC)	19.2 V
permissible range, upper limit (DC)	28.8 V
Reverse polarity protection	Yes
Input current	
Current consumption, max.	70 mA

Article number	6ES7131-6TF00-0CA0
Encoder supply	
Number of outputs	8
Short-circuit protection	Yes
24 V encoder supply	
• 24 V	No
• Short-circuit protection	No
NAMUR encoder supply	
• 8.2 V	Yes
• Short-circuit protection	Yes
• Output current per channel, max.	8 mA
• Output current per module, max.	64 mA
Power loss	
Power loss, typ.	1.5 W
Address area	
Address space per module	
• Address space per module, max.	1 byte
• Inputs	42 byte; 1 byte + 1 byte for QI information in DI mode; 42 bytes in Counter mode
• Outputs	20 byte; 0 in DI mode; 20 bytes in Counter mode
Hardware configuration	
Automatic encoding	Yes
• Mechanical coding element	Yes
• Type of mechanical coding element	Type A
Submodules	
• Number of configurable submodules, max.	1
Selection of BaseUnit for connection variants	
• 2-wire connection	BU type A0
• 3-wire connection	BU type A0
Digital inputs	
Number of digital inputs	8; NAMUR
Digital inputs, parameterizable	Yes
Pulse extension	Yes; 0.5 s, 1 s, 2 s
Edge evaluation	Yes; rising edge, falling edge, edge change
Signal change flutter	Yes; 2 to 32 signal changes
Flutter observation window	Yes; 0.5 s, 1 s to 100 s in 1-s steps
Digital input functions, parameterizable	
• Gate start/stop	Yes
• Freely usable digital input	Yes
• Counter	Yes
– Number, max.	4; See manual for details

Article number	**6ES7131-6TF00-0CA0**
– Counting frequency, max.	5 kHz
– Counting width	32 bit
– Counting direction up/down	Yes
Input voltage	
• Rated value (DC)	8.2 V
Input current	
for 10 k switched contact	
– for signal "0", min.	0.35 mA
– for signal "0", max.	1.2 mA
– for signal "1", min.	2.1 mA
– for signal "1", max.	7 mA
for unswitched contact	
– for signal "0", max. (permissible quiescent current)	0.5 mA
– for signal "1", typ.	8 mA
for NAMUR encoders	
– for signal "0", min.	0.35 mA
– for signal "0", max.	1.2 mA
– for signal "1", min.	2.1 mA
– for signal "1", max.	7 mA
Input delay (for rated value of input voltage)	
• tolerated changeover time for changeover contacts	300 ms
for standard inputs	
– parameterizable	No
for NAMUR inputs	
– at "0" to "1", max.	20 ms; See manual for details
– at "1" to "0", max.	20 ms; See manual for details
Cable length	
• shielded, max.	200 m; 50 m for Counter mode
Encoder	
Connectable encoders	
• NAMUR encoder/changeover contact according to EN 60947	Yes
• Single contact / changeover contact unconnected	Yes
• Single contact / changeover contact connected with 10 kΩ	Yes
Interrupts/diagnostics/status information	
Diagnostics function	Yes
Alarms	
• Diagnostic alarm	Yes; channel by channel
• Hardware interrupt	Yes; Parameterizable, channels 0 to 7

Article number	6ES7131-6TF00-0CA0
Diagnoses	
• Diagnostic information readable	Yes
• Monitoring the supply voltage	Yes
– parameterizable	Yes
• Monitoring of encoder power supply	No
• Wire-break	Yes; channel by channel
• Short-circuit	Yes; channel by channel
Diagnostics indication LED	
• Monitoring of the supply voltage (PWR-LED)	Yes; green PWR LED
• Channel status display	Yes; green LED
• for channel diagnostics	Yes; red LED
• for module diagnostics	Yes; green/red DIAG LED
Potential separation	
Potential separation channels	
• between the channels	No
• between the channels and backplane bus	Yes
• Between the channels and load voltage L+	Yes
Isolation	
Isolation tested with	707 V DC (type test)
Standards, approvals, certificates	
Suitable for safety functions	No
Ambient conditions	
Ambient temperature during operation	
• horizontal installation, min.	-30 °C
• horizontal installation, max.	60 °C
• vertical installation, min.	-30 °C
• vertical installation, max.	50 °C
Altitude during operation relating to sea level	
• Installation altitude above sea level, max.	5 000 m; Restrictions for installation altitudes > 2 000 m, see manual
Dimensions	
Width	15 mm
Height	73 mm
Depth	58 mm
Weights	
Weight, approx.	32 g

NAMUR sensors and connected contacts

Monitoring for short-circuit and wire break only for NAMUR changeover contacts. The response ranges of the diagnostics correspond to IEC 60947-5-6.

Dimension drawing

See manual BaseUnits (https://support.industry.siemens.com/cs/ww/en/view/59753521)

Parameter data record

A

A.1 Dependencies when configuring with GSD files

When configuring the module with a GSD file, remember that the settings of some parameters are dependent on each other, see the tables below.

Configuring with a PROFINET GSD file

The table lists the diagnostics information and its dependencies on the sensor types for PROFINET.

Sensor type	Diagnostics information					
	Missing supply voltage L+	Short-circuit to ground	Wire break	Chatter error	Changeo-ver error	Inversion
NAMUR sensor	×	×	×	×	-	×
Single contact, unconnected	×	-	-	×	-	×
Single contact, connected with 10 kΩ	×	-	×	×	-	×
NAMUR changeover contact	×	×	×	×	×	-
Changeover contact, unconnected	×	-	-	×	×	-
Changeover contact, connected with 10 kΩ	×	-	×	×	×	-

Configuring with a PROFIBUS GSD file

The table lists the diagnostics information and its dependencies on the sensor types for PROFIBUS.

Sensor type	Diagnostics information				
	Missing supply voltage L+	Short-circuit to ground	Wire break	Changeover error	Inversion
NAMUR sensor	×	×	×	-	×
Single contact, unconnected	×	-	-	-	×
Single contact, connected with 10 kΩ	×	-	×	-	×
NAMUR changeover contact	×	×	×	×	-
Changeover contact, unconnected	×	-	-	×	-
Changeover contact, connected with 10 kΩ	×	-	×	×	-

A.2 Parameter assignment and structure of the parameter data record 128 for operating mode DI

Data record 128 of the module has an identical structure, regardless of whether you configure the module with PROFIBUS DP or PROFINET IO. With data record 128, you can change the parameter assignment of the module in your user program regardless of its configuration. This means that you can use all the functions of the module even if you configured it using PROFIBUS GSD.

With data records 0 to 7, you can configure the individual channels.

When the interface module IM 155-6 DP HF (PROFIBUS DP) is used and data records 0 and 1 are read, the module returns the diagnostics data records and not the parameter data records of the DI 8xNAMUR HF.

Parameter assignment in the user program

You can change the parameters of the module in RUN (e.g. "Switch diagnostics on" can be changed in RUN).

Changing parameters in RUN

The "WRREC" instruction is used to transfer the parameters to the module using data record 128 or data records 0 to 7. The parameters set with STEP 7 are not changed on the CPU, which means that the parameters set in STEP 7 are valid again after a restart.

If you reconfigure a module and diagnostics are pending prior to the reconfiguration, these diagnostics are not signaled as "outgoing".

Output parameter STATUS

If errors occur when transferring parameters with the "WRREC" instruction, the module continues operation with the previous parameter assignment. However, a corresponding error code is written to the STATUS output parameter.

You will find a description of the "WRREC" instruction and the error codes in the STEP 7 online help.

Structure of data record 128 and data records 0 to 7

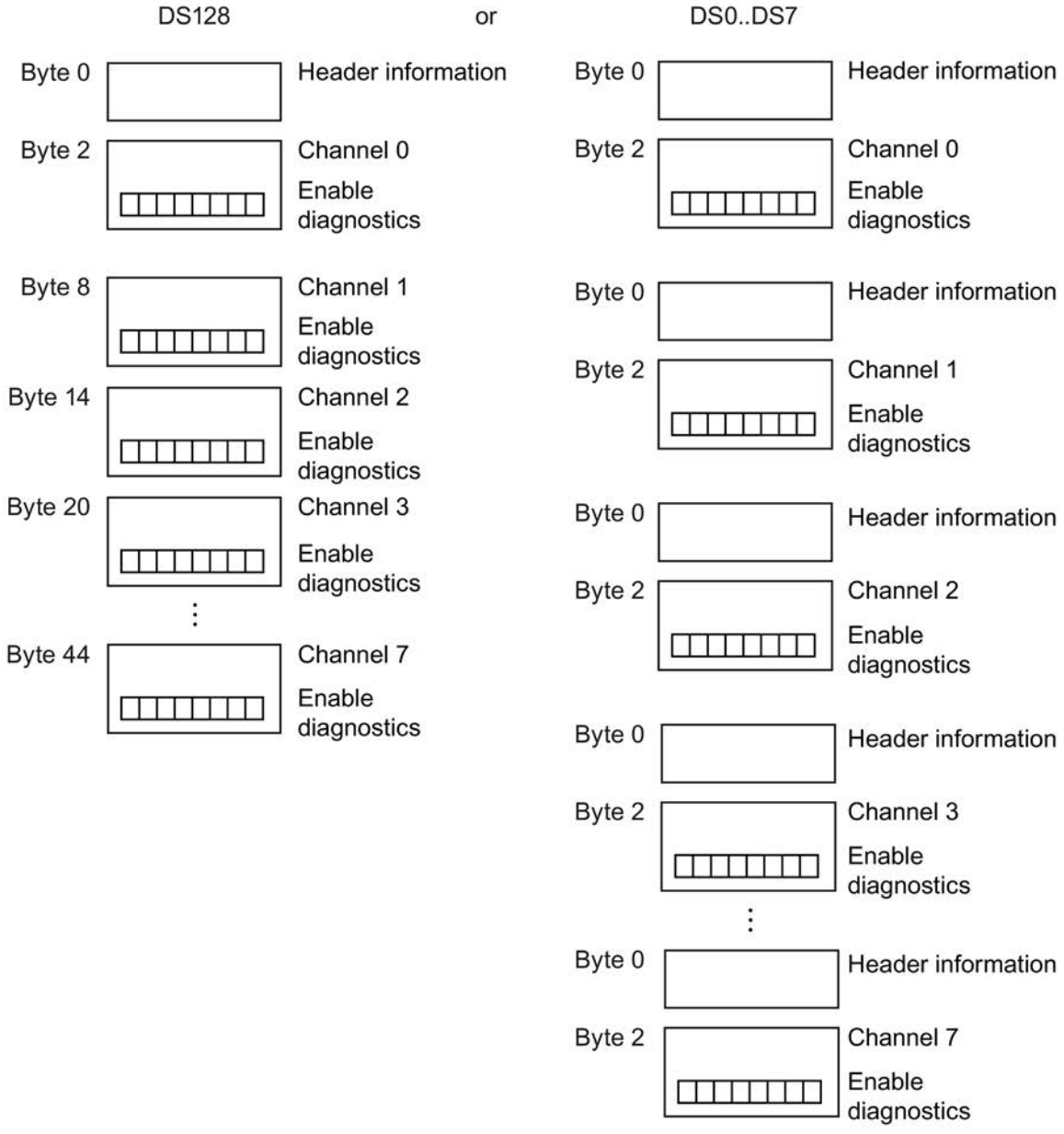


Figure A-1 Structure of data record 128 and data records 0 to 7

Header information

The figure below shows the structure of the header information (NAMUR V1.0).

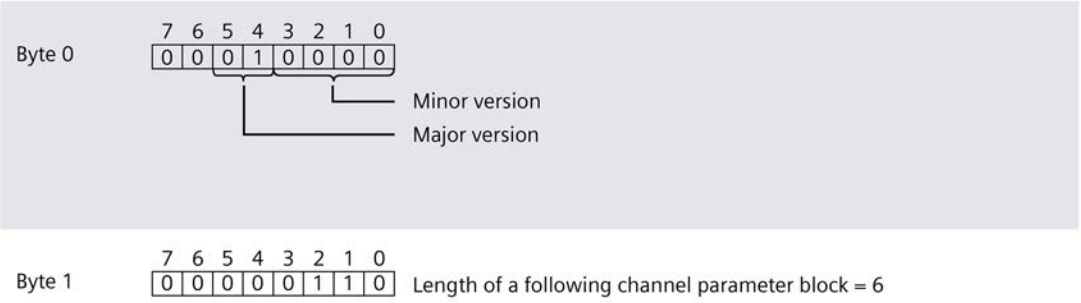


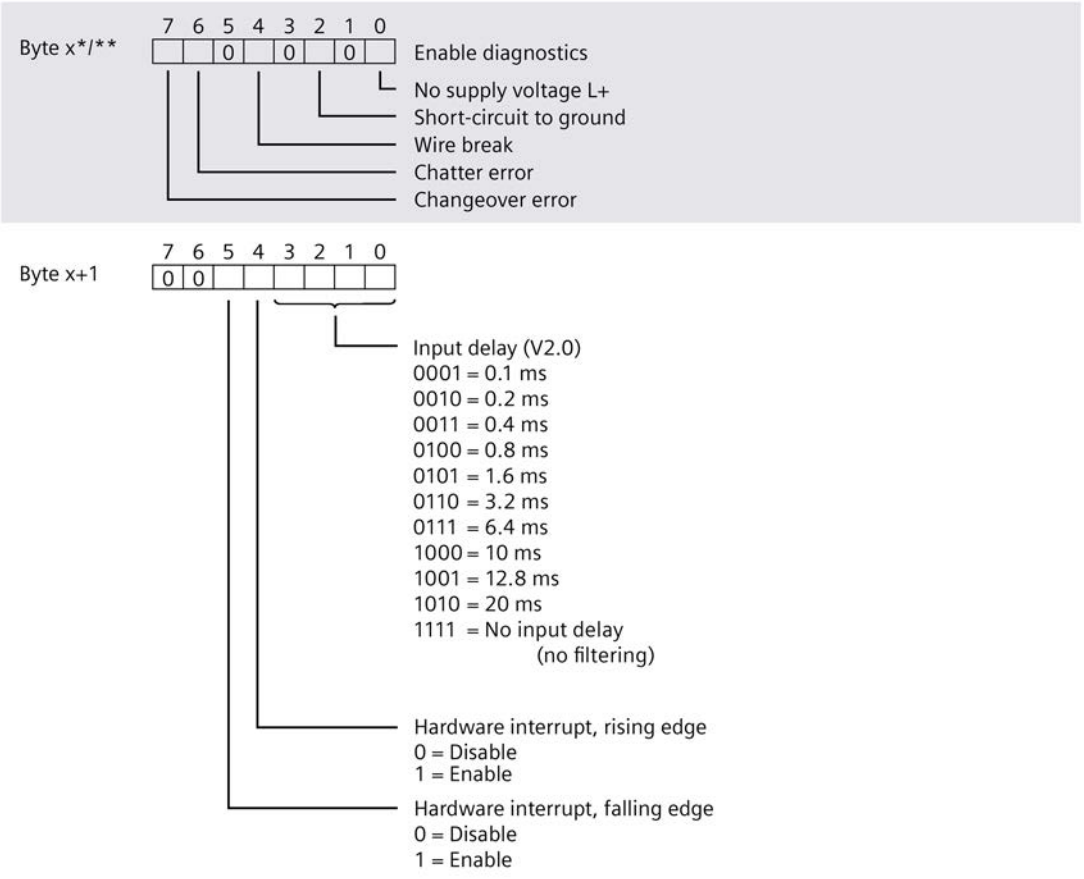
Figure A-2 DS 128 or DS 0 to 7: Bytes 0 and 1; header information (structure version 1.0)

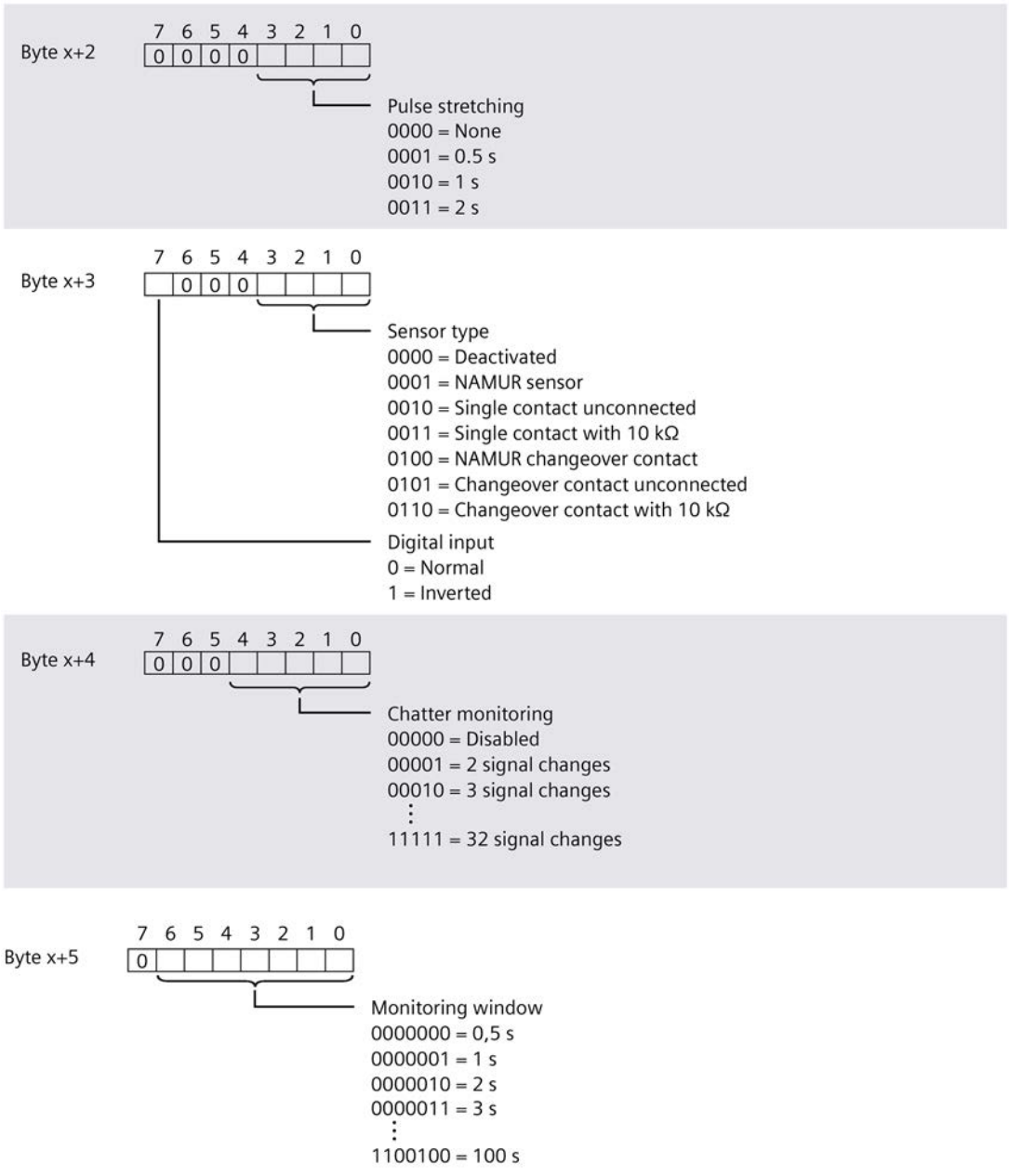
The figure below shows the structure of the header information (NAMUR V2.0).

Figure A-3 DS 128 or DS 0 to 7: Bytes 0 and 1; header information (structure version 1.1)

Parameters

The figure below shows the structure of the parameters for channels 0 to 7. You enable a parameter by setting the corresponding bit to "1".





* x = 2 + (channel number × 6); channel number = 0 to 7 for DS 128
** x = 2 for DS 0 to DS 7

Figure A-4 DS 128 or DS 0 to 7: Byte x to x+5: Structure for channels 0 to 7

When the DI NAMUR V1.0 is configured, the parameter Input delay 0000 = reserved.

A.3 Assignment and structure of parameter data record 128 for counting operating mode

Data record 128 of the module has an identical structure, regardless of whether you configure the module with PROFIBUS DP or PROFINET IO. With data record 128, you can change the parameter assignment of the module in your user program regardless of its configuration. This means that you can use all the functions of the module even if you configured it using PROFIBUS GSD.

With data records 0 to 7, you can configure the individual channels.

When the interface module IM 155-6 DP HF (PROFIBUS DP) is used and data records 0 and 1 are read, the module returns the diagnostics data records and not the parameter data records of the DI 8xNAMUR HF.

Parameter assignment in the user program

You can change the parameters of the module in RUN (e.g. "Switch diagnostics on" can be changed in RUN).

Changing parameters in RUN

The "WRREC" instruction is used to transfer the parameters to the module using data record 128 or data records 0 to 7. The parameters set with STEP 7 are not changed on the CPU, which means that the parameters set in STEP 7 are valid again after a restart.

If you reconfigure a module and diagnostics are pending prior to the reconfiguration, these diagnostics are not signaled as "outgoing".

STATUS output parameter

If errors occur when transferring parameters with the "WRREC" instruction, the module continues operation with the previous parameter assignment. However, a corresponding error code is written to the STATUS output parameter.

You will find a description of the "WRREC" instruction and the error codes in the STEP 7 online help.

Structure of data record 128 and data records 0 to 7

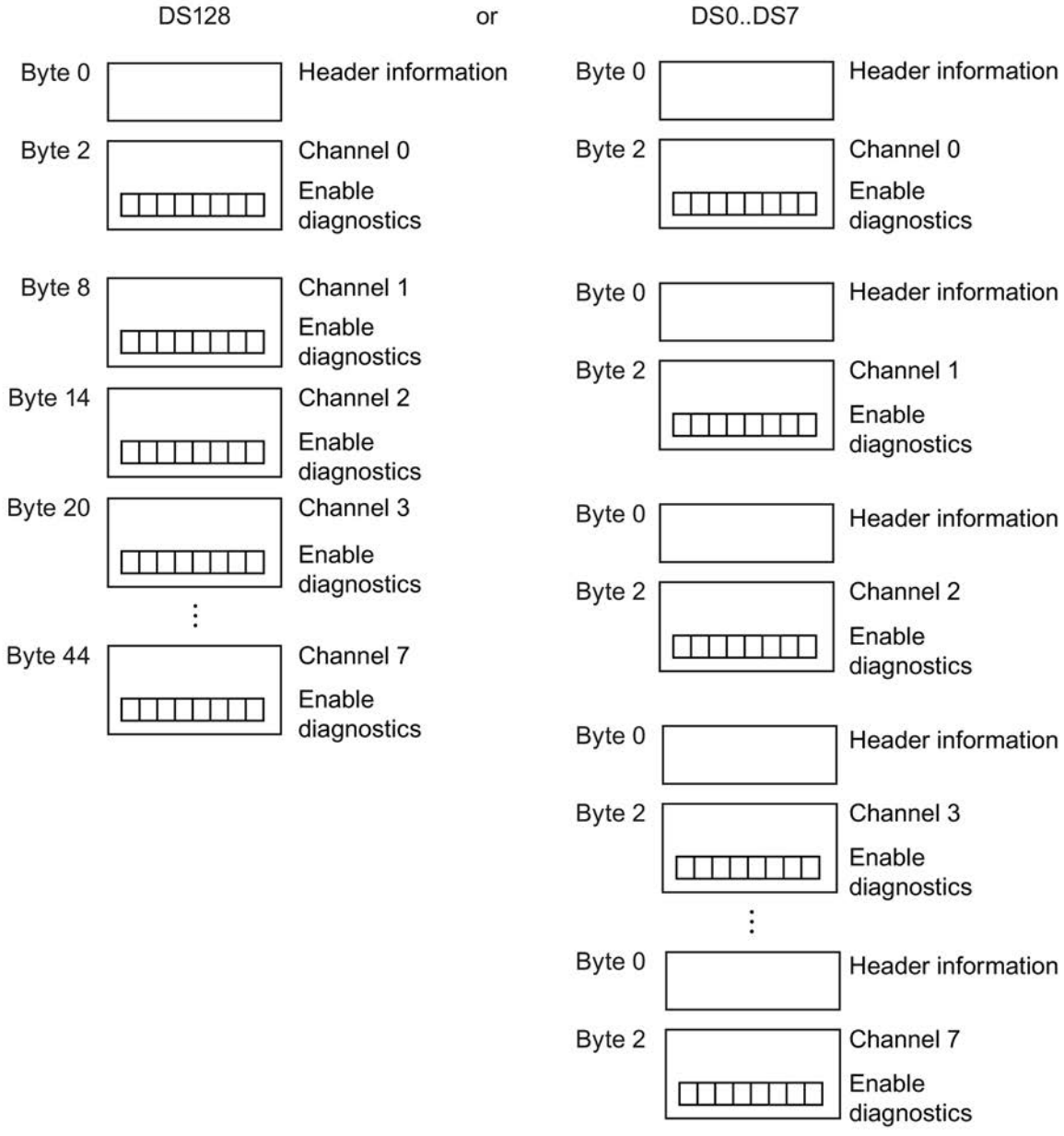


Figure A-5 Structure of data record 128 and data records 0 to 7

Header information

The figure below shows the structure of the header information.

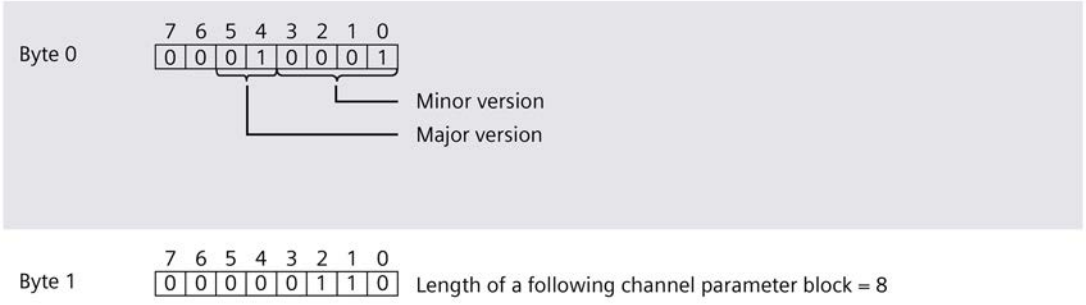
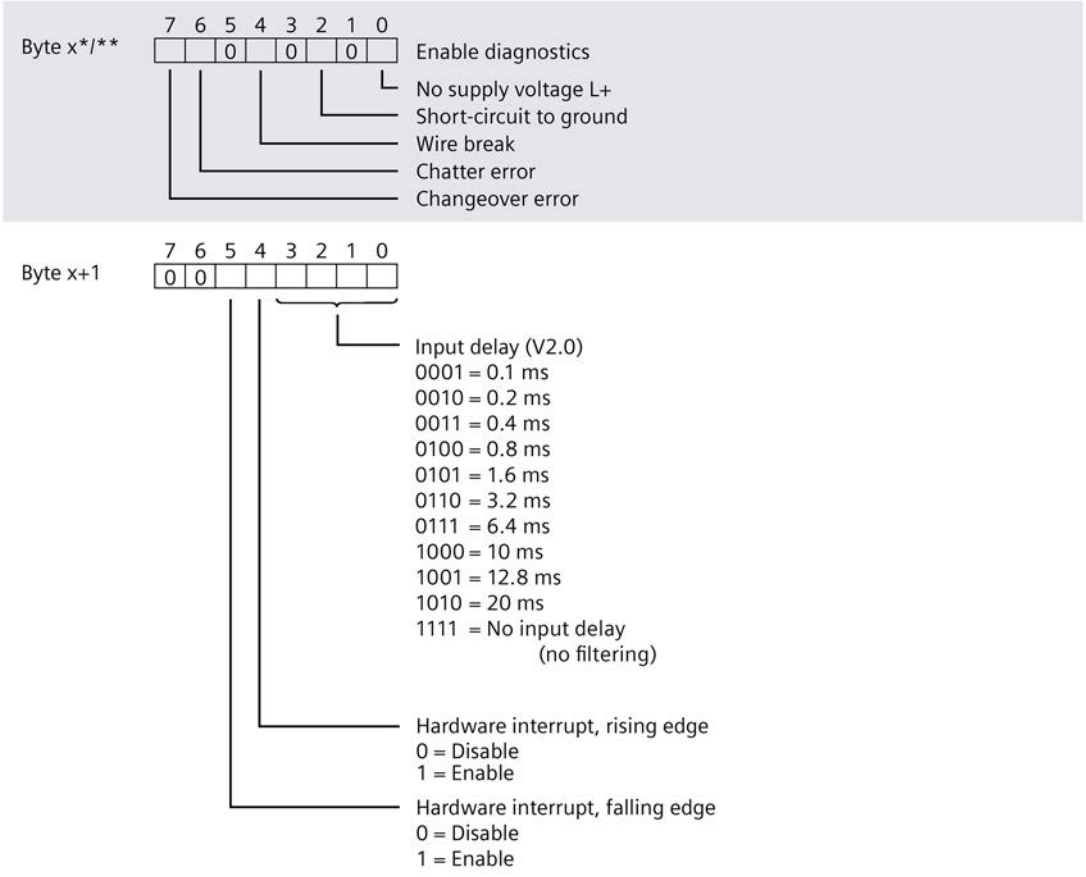
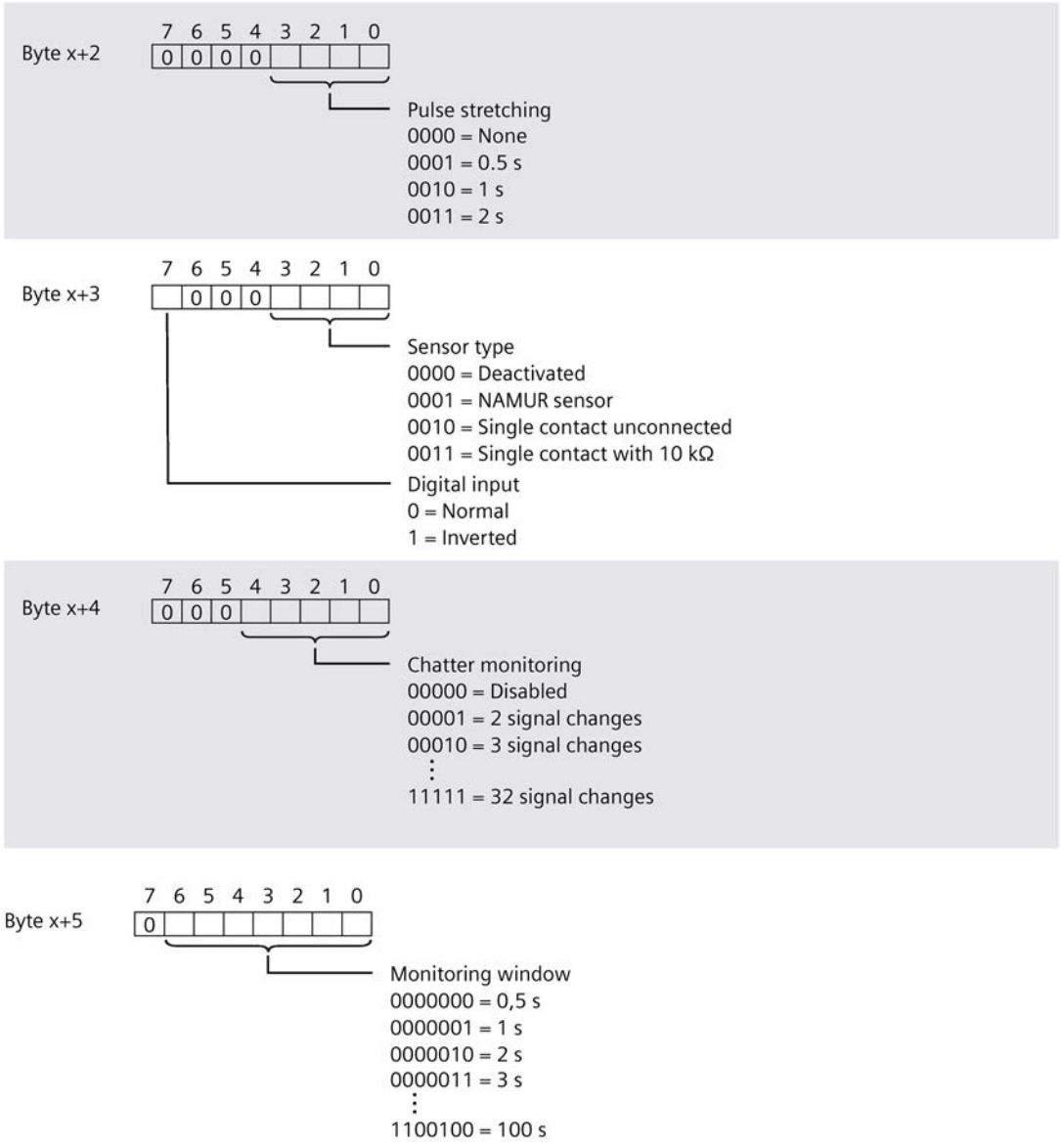


Figure A-6 DS 128 or DS 0 to 7: Bytes 0 and 1; header information

Parameters

The figure below shows the structure of the parameters for channels 0 to 7. You enable a parameter by setting the corresponding bit to "1".





* x = 2 + (channel number × 6); channel number = 0 to 7 for DS 128
** x = 2 for DS 0 to DS 7

Figure A-7 DR 128 or DR 0 to 7: Byte x to x+5: Structure for channels 0 to 7

A.4 Assignment and structure of parameter data record 129 for Counting operating mode

You can configure the counting channels via data record 129. The meaning of some parameters, such as "Scaled high counting limit" and "Scaled low counting limit" depends on whether scaling is enabled. Data record 129 has a variable length depending on how many counting channels were selected, but the length and structure of the parameter block per channel is fixed and the same regardless of the selected submodule.

Parameter assignment in the user program

You can change the parameters of the module in RUN.

Changing parameters in RUN

The "WRREC" instruction is used to transfer the parameters to the module using data record 129. The parameters set with STEP 7 are not changed in the CPU, which means that the parameters set with STEP 7 are valid again after a restart.

Note

A parameter data record that has content different from the startup parameter assignment can result in a brief exit from clocked mode and renewed synchronization with the fieldbus cycle.

Output parameter STATUS

If errors occur when transferring parameters with the "WRREC" instruction, the module continues operation with the previous parameter assignment. The STATUS output parameter contains a corresponding error code.

You can find a description of the "WRREC" instruction and the error codes in the STEP 7 online help.

Structure of data record 129 for the submodule with 4 counting channels (CNT4)

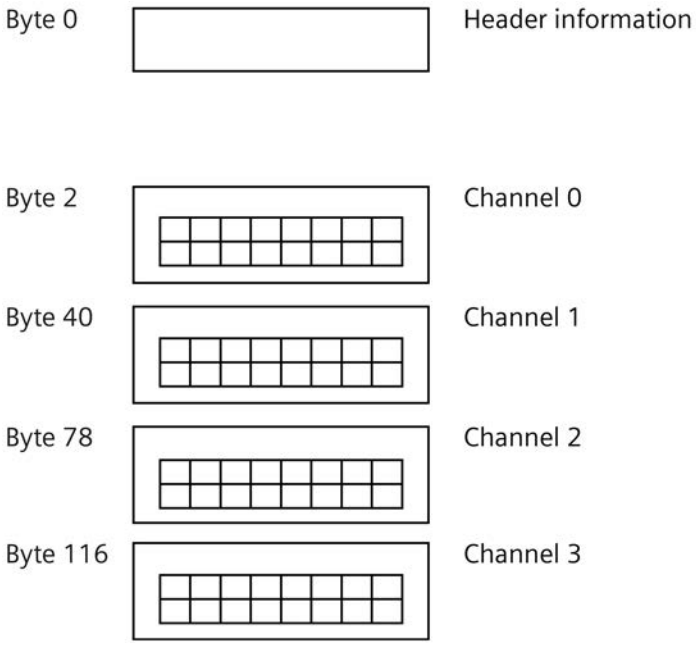


Figure A-8 Structure of data record 129 for the submodule CNT4

Note

The length of data record 129 depends on the number of counting channels. The figure shows an example for 4 counting channels. If there are fewer counting channels (1, 2 or 3), only the corresponding number of blocks per channel are used.

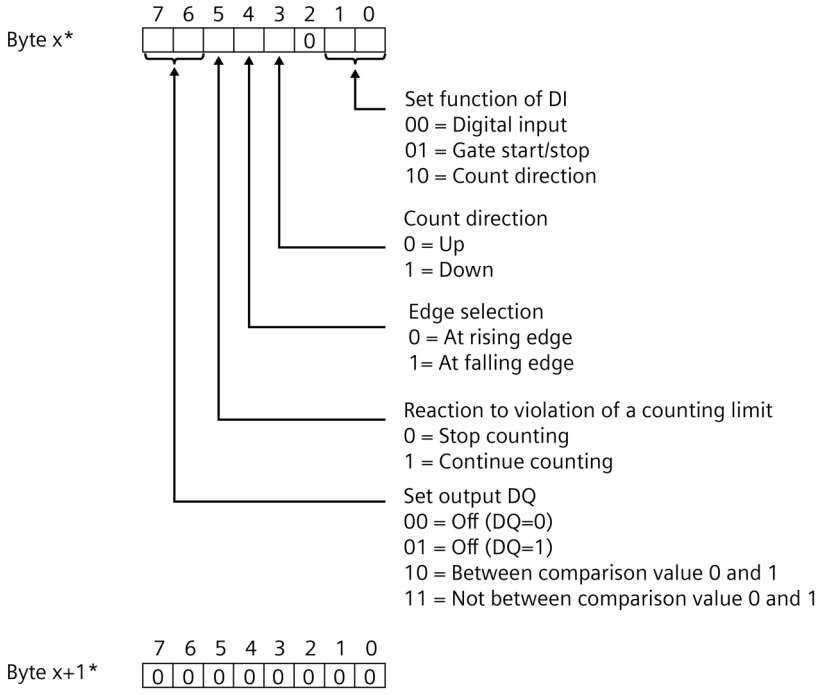
Header information

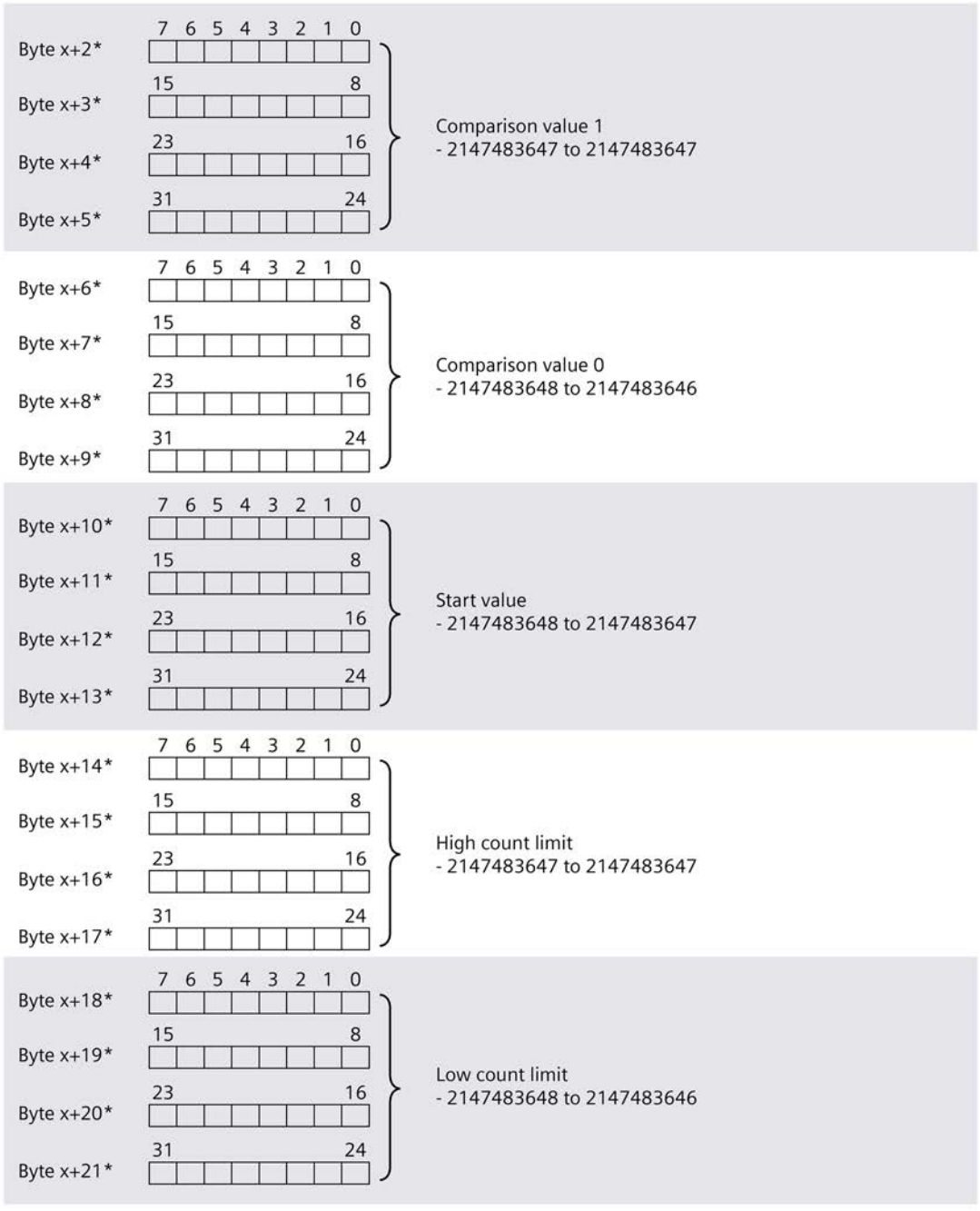
The figure below shows the structure of the header information.

Figure A-9 Header information

Parameters

The figure below shows the structure of the parameters for channels 0 to 3. You enable a parameter by setting the corresponding bit to "1".




7 6 5 4 3 2 1 0
Byte x+2*
15 8
Byte x+3*
23 16
Byte x+4*
31 24
Byte x+5*
Comparison value 1
- 2147483647 to 2147483647
7 6 5 4 3 2 1 0
Byte x+6*
15 8
Byte x+7*
23 16
Byte x+8*
31 24
Byte x+9*
Comparison value 0
- 2147483648 to 2147483646
7 6 5 4 3 2 1 0
Byte x+10*
15 8
Byte x+11*
23 16
Byte x+12*
31 24
Byte x+13*
Start value
- 2147483648 to 2147483647
7 6 5 4 3 2 1 0
Byte x+14*
15 8
Byte x+15*
23 16
Byte x+16*
31 24
Byte x+17*
High count limit
- 2147483647 to 2147483647
7 6 5 4 3 2 1 0
Byte x+18*
15 8
Byte x+19*
23 16
Byte x+20*
31 24
Byte x+21*
Low count limit
- 2147483648 to 2147483646

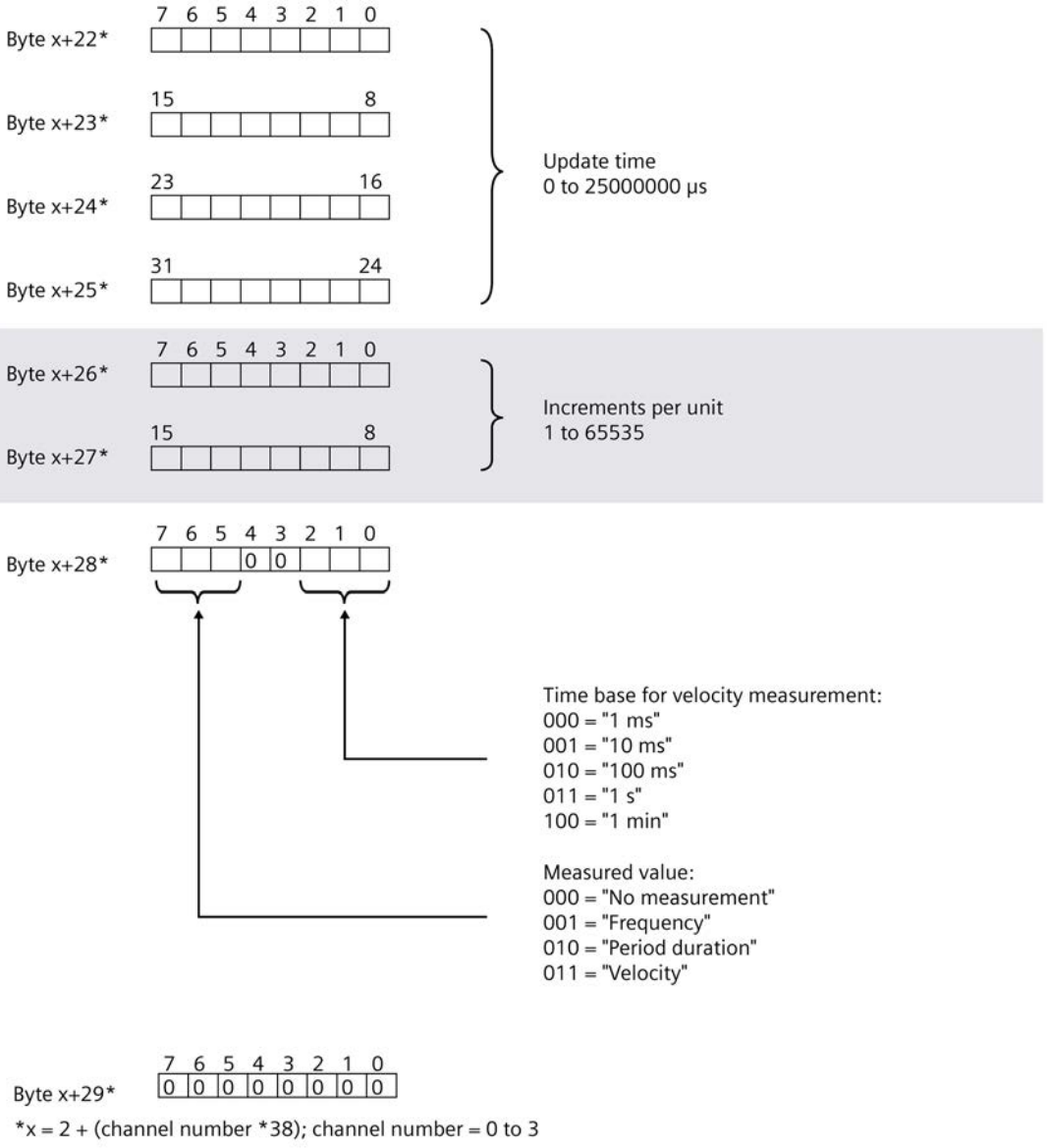
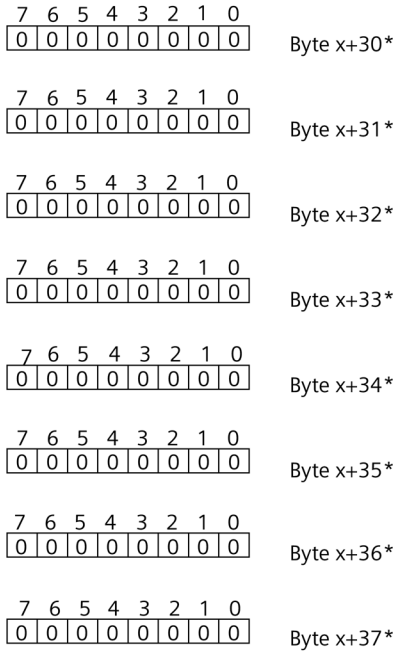


Figure A-10 Structure byte x to x+29 for channels 0 to 3

The meaning of the next bytes x+30* - x+37* depends on whether a configuration with "SCALE" is used.

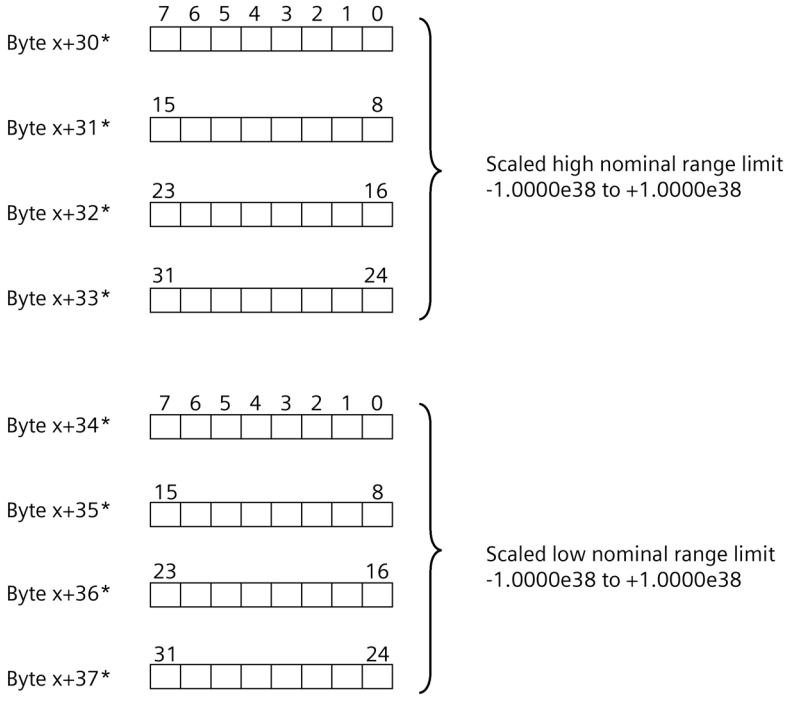
Bytes x+30* - x+37* for counter submodules WITHOUT scaling



*x = 2 + (channel number *38); channel number = 0 to 3

Figure A-11 Structure byte x+30 to x+37, without scaling

Bytes x+30* - x+37* for counter submodules WITH scaling



*x = 2 + (channel number *38); channel number = 0 to 3

Figure A-12 Structure byte x+30 to x+37, with scaling

A.5 Error codes

Error when transferring the data record

The module always checks all values of the transferred data record. Only if all the values were transferred without errors does the module apply the values from the data record.

The WRREC instruction for writing data records returns corresponding error codes when errors occur in the STATUS parameter.

The following table shows the module-specific error codes and their meaning for the parameter data records 128 and 129

Table A- 1 Error messages, their meaning and remedial measures

Error code in STATUS parameter (hexadecimal)				**Meaning**	**Remedy**
Byte 0	Byte 1	Byte 2	Byte 3		
DFH	80H	B0H	00H	Number of the data record unknown	Enter a valid number for the data record.
DFH	80H	B1H	01H	Length of the data record incorrect	Enter a valid value for the data record length.
DFH	80H	B2H	00H	Module not accessible	• Check station. • Plug the module in correctly. • Check parameters of the WRREC block.
DFH	80H	E0H	01H	Header error (version or specified bits incorrect).	Correct version number or fixed bits, see Figure A-2 DS 128 or DS 0 to 7: Bytes 0 and 1; header information (structure version 1.0) (Page 86).
DFH	80H	E0H	02H	Header error (number or length of parameter structures or parameter blocks incorrect)	Correct the number and length of the parameter structures or parameter blocks, see Figure A-2 DS 128 or DS 0 to 7: Bytes 0 and 1; header information (structure version 1.0) (Page 86).
DFH	80H	E1H	01H	Reserved bit set	Write 0 to all reserved bits.
DFH	80H	E1H	02H	Invalid diagnostics enable bit set for operating mode	Correct the diagnostics enables to correspond to the operating mode.
DFH	80H	E1H	20H	Number of changes for chatter monitoring not correct	Use valid coding for parameter "Chatter monitoring".
DFH	80H	E1H	21H	Changeover contact sensor type cannot be set for this channel	User changeover contact sensor type only for even-numbered channel indexes (0, 2, 4, 6).
DFH	80H	E1H	22H	Channel with changeover contact must not be inverted	Do not use inversion on channels with changeover contact.
DFH	80H	E1H	23H	Channel next to the changeover contact (odd-numbered channel index) must be deactivated.	When using a changeover contact, set the sensor type to an even-numbered channel index (0, 2, 4, 6) and deactivate the channel on the corresponding odd-numbered index (1, 3, 5, 7).
DFH	80H	E1H	24H	Wrong sensor type (unknown)	Use correct sensor type.

Error code in STATUS parameter (hexadecimal)				Meaning	Remedy
Byte 0	Byte 1	Byte 2	Byte 3		
DF$_H$	80$_H$	E1$_H$	25$_H$	Invalid coding for pulse stretching	Use valid coding for parameter "Pulse stretching", see Parameter assignment and structure of the parameter data record 128 for operating mode DI (Page 84).
DF$_H$	80$_H$	E1$_H$	26$_H$	Version of the data record (DS) is not correct	Use the correct version number in the data record header, corresponding to the current operating mode.
DF$_H$	80$_H$	E1$_H$	27$_H$	Length of data record (DS) is not correct	Use the correct data record length, corresponding to the operating mode, data record number and its version.
DF$_H$	80$_H$	E1$_H$	28$_H$	Invalid coding for input delay.	Use valid coding for parameter "Input delay", see Parameter assignment and structure of the parameter data record 128 for operating mode DI (Page 84).
DF$_H$	80$_H$	E1$_H$	2A$_H$	DI mode is not correct	Use only the permissible mode (DI/GATE/DIR) for the DI channel that is assigned to the CNT channel.
DF$_H$	80$_H$	E1$_H$	2C$_H$	Control input cannot be deactivated	Put the channel into non-counting mode before deactivating.
DF$_H$	80$_H$	E1$_H$	2E$_H$	Invalid coding for parameter "Measured value"	Use valid coding for parameter "Measured value", see Figure A-10 Structure byte x to x+29 for channels 0 to 3 (Page 97).
DF$_H$	80$_H$	E1$_H$	2F$_H$	Use a valid coding for the time base of the speed measurement	Use valid coding for parameter "Time base for velocity measurement"; see Figure A-10 Structure byte x to x+29 for channels 0 to 3 (Page 97).
DF$_H$	80$_H$	E1$_H$	30$_H$	Comparison values are not correct	Ensure that the comparison values lie within the limits and are in the right order.
DF$_H$	80$_H$	E1$_H$	31$_H$	Count limits are not correct	Use valid count values for scaled values.
DF$_H$	80$_H$	E1$_H$	32$_H$	Update time for the measurement is not correct	Use update time ≤ 25 s.
DF$_H$	80$_H$	E1$_H$	33$_H$	The value of "Increments per unit" is not correct	Use an increment value not equal to zero.

See also

Assignment and structure of parameter data record 129 for Counting operating mode (Page 93)

Compatibility

B

Principle of operation

This mode provides basic properties with technological functions, emulating the behavior of the previous module.

- The input data consists of two bytes, 8 bits for the status of the digital input and 8 bits for the value status.
- Hardware interrupts and diagnostics are captured using samples taken at 3 ms sampling intervals.
- Technological functions are processed in intervals of 3 ms.
- The input data for the CPU is set every 500 µs.

Input filtering

There are two basic modes of input filtering operation:

1. Compatible filtering (with the mode compatible with FS lower than 21)
2. Filtering based on input delay (with the mode compatible with FS higher than 21)

Compatible input filtering

With compatible input filtering (when the module is configured in the compatible mode), all fault states (wire break, short-circuit) must persist for at least the time of 3 samples in order to be confirmed. In the worst case, a fault state that lasts slightly longer than 2 sampling intervals (i.e. 6+ ms) is confirmed (results in a diagnostics event).

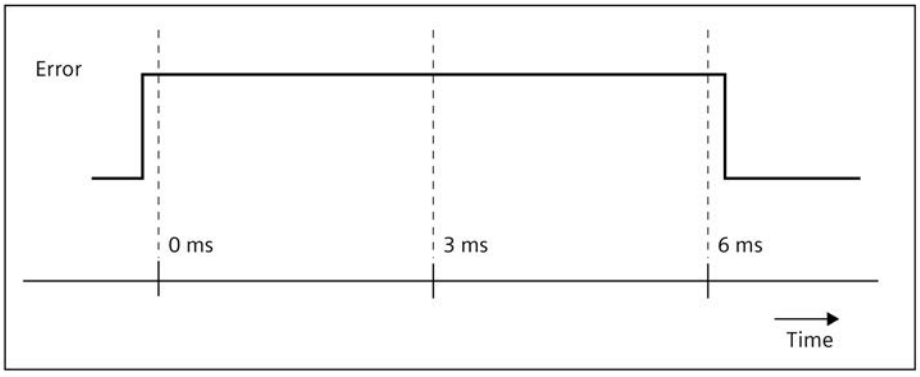


Figure B-1 Duration of the input event = 6+ ms

The fault-free states (L and H) are considered as a common logical "fault-free state". A fault-free state must take 6+ ms to be confirmed. As soon as this state is confirmed, there is no filtering between the L and H states (i.e. even a short L/H pulse - e.g. an EMI event - can be sent to the PLC).

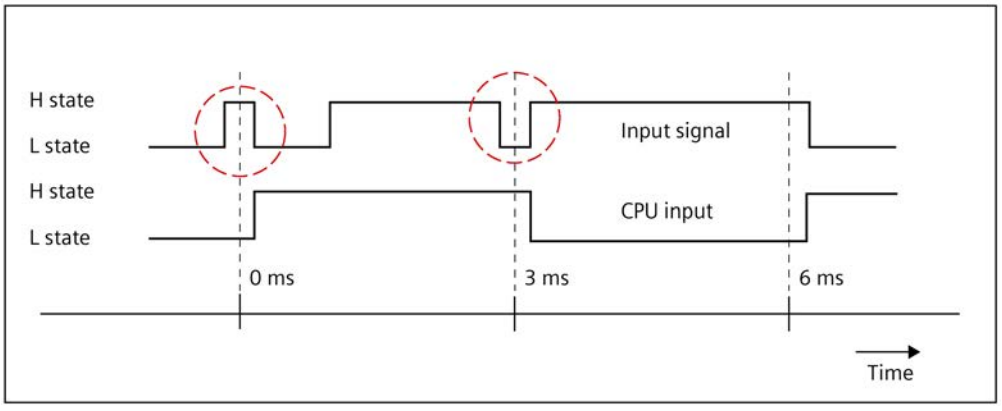


Figure B-2 Short non-filtered L and H states

The events marked in the dashed circles are considered to be valid samples and are sent to the CPU. Even a very short pulse can be sampled and evaluated as a 3 ms pulse in the CPU.

Functions of the operating mode DI

C

Function of the filtering dependent on the input delay

The filter algorithm works with two input states:

1. The "currently valid state" and
2. The "new state" waiting for confirmation.

The filter samples the input signal. If the logic input state changes, this is only output by the filter when it has completed a specific number of samples without the value changing. Even with a short pulse that is sampled at least once, the algorithm is reset and sampling of the changed input signal begins again.

The following figure shows an example of the input and output square waveforms of a signal filtered depending on the input delay. The two states are designated L (LOW) and H (HIGH), the input delay of which is set to five samples. The filter does not output the change in signal after pulse ① because the input state changes again within the input delay time (after three samplings). The same applies to pulse ② (change after three samples) and to pulse ③ (change after four samples).

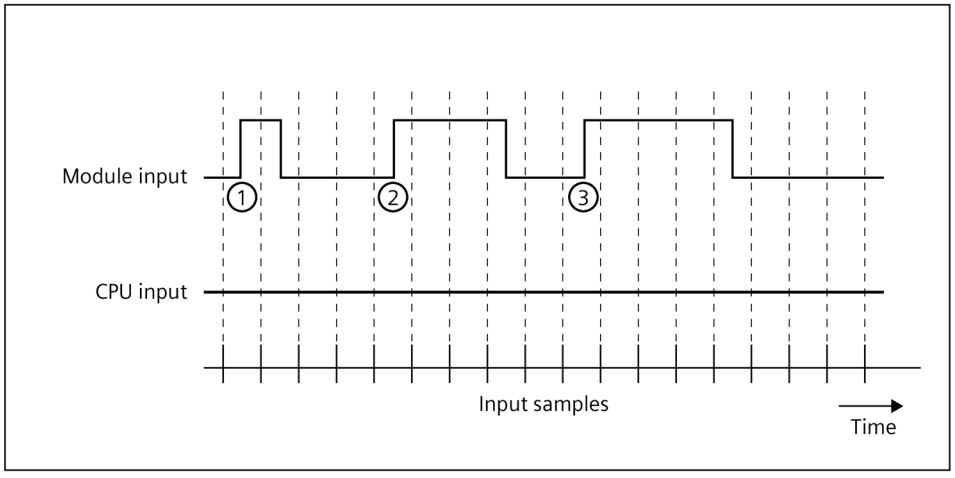


Figure C-1 A short input pulse will not pass the filter (input delay set to 5 samples)

The next example shows that a pulse that lasts long enough passes the filter and the input signal is thus accepted. By contrast, a pulse that is too short is filtered out. In this scenario, the input delay is 3 samples.

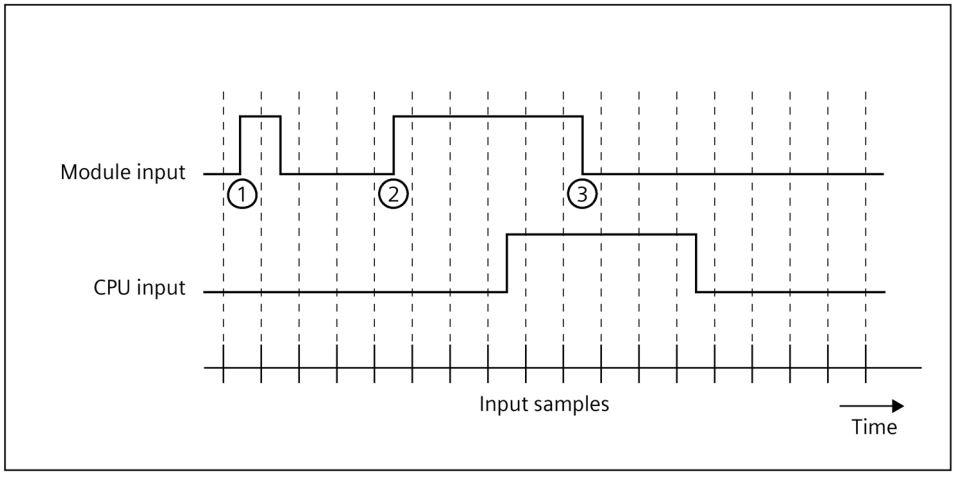


Figure C-2 A sufficiently long pulse will pass the filter (input delay set to 3 samples)

The pulse ① is filtered out. The rising edge ② passes the filter with a delay of 3 samples, the same applies to the falling edge ③. The long pulse is copied to the output in each case and delayed by the input delay.

The last example shows how the input switches between several states. For sake of simplicity, the input delay is set to the same value (three sample cycles) for all states.

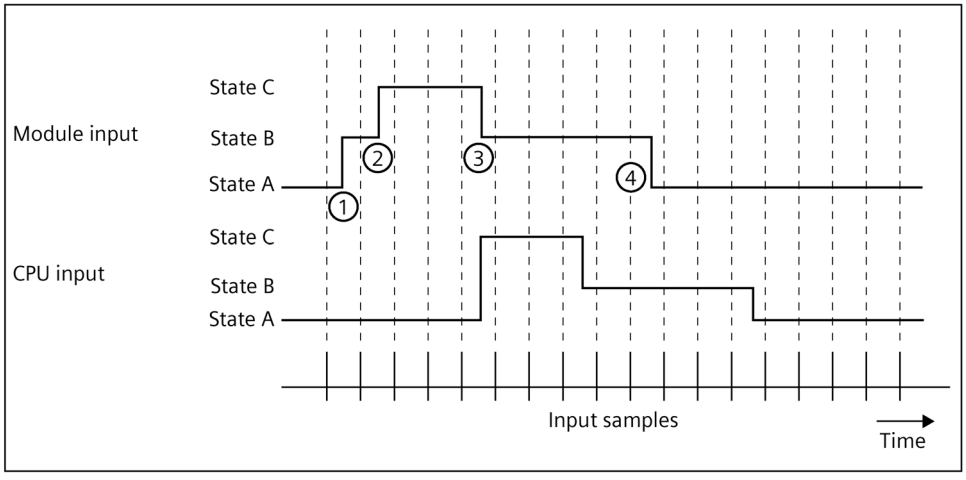


Figure C-3 Switching between several states (input delay set to 3 samples)

The first pulse ① is filtered out because the state B (log. L) is sampled only once. The change to state C (log. H) ② passes the filter after 3 samples and is transferred to the CPU. The change back to state B ③ passes the filter after another 3 samples. The last change to state A (wire break) ④ is also output after three sample values.

Input delay and samples

The module inputs are sampled at 32 kHz, which corresponds to a period of 31.25 µs. The input delay constants can be expressed as multiples of 100 µs. This means that the input delay achieved differs slightly from the set delay.

For each possible input delay setting, a specific number of samples is selected for confirmation. The number is chosen to minimize the difference between the required and the achieved input delay. For shorter input delays, the difference is larger, in the worst case it is 6.25%.

In addition, the input signal passes a low-pass EMC filter that slightly changes the curve in the time domain. The step response of the input signal is symmetrical for the H to L and L to H transitions, but the threshold between H and L is not symmetrical. The result is that more H states are sampled for a signal with a 50% duty cycle. For this reason, the number of samples of the H states is one larger than that of the L states.

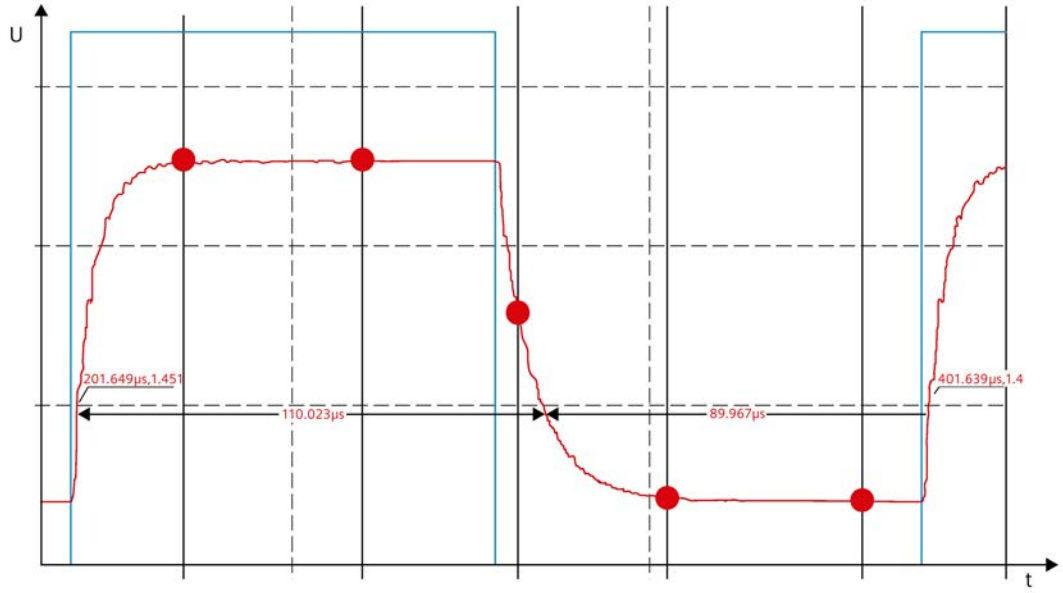


Figure C-4 Filtered step response (red) of the input signal (blue): At a duty cycle of 50%, more H samples are measured.

Example:

With an input delay of 100 µs, the selected number of samples is 3 (because 3 x 31.25 µs = 93.75 µs), which yields a difference of 6.25%. The number of samples to confirm the H state is 3, and the number of samples to confirm the L state is only 2.

Table C- 1 Settings for the individual input delays

Setting the input delay	Exact number of samples	Number of samples H state	Number of samples L state	Difference for the H state
100 µs	3.2	3	2	-6.25%
200 µs	6.4	6	5	-6.25%
400 µs	12.8	13	12	+1.56%
800 µs	25.6	26	25	+1.56%
1.6 ms	51.2	51	50	-0.39%
3.2 ms	102.4	102	101	-0.39%
6.4 ms	204.8	205	204	+0.10%
10 ms	320	320	319	0%
12.8 ms	409.6	410	409	+0.10%
20 ms	640	640	639	0%