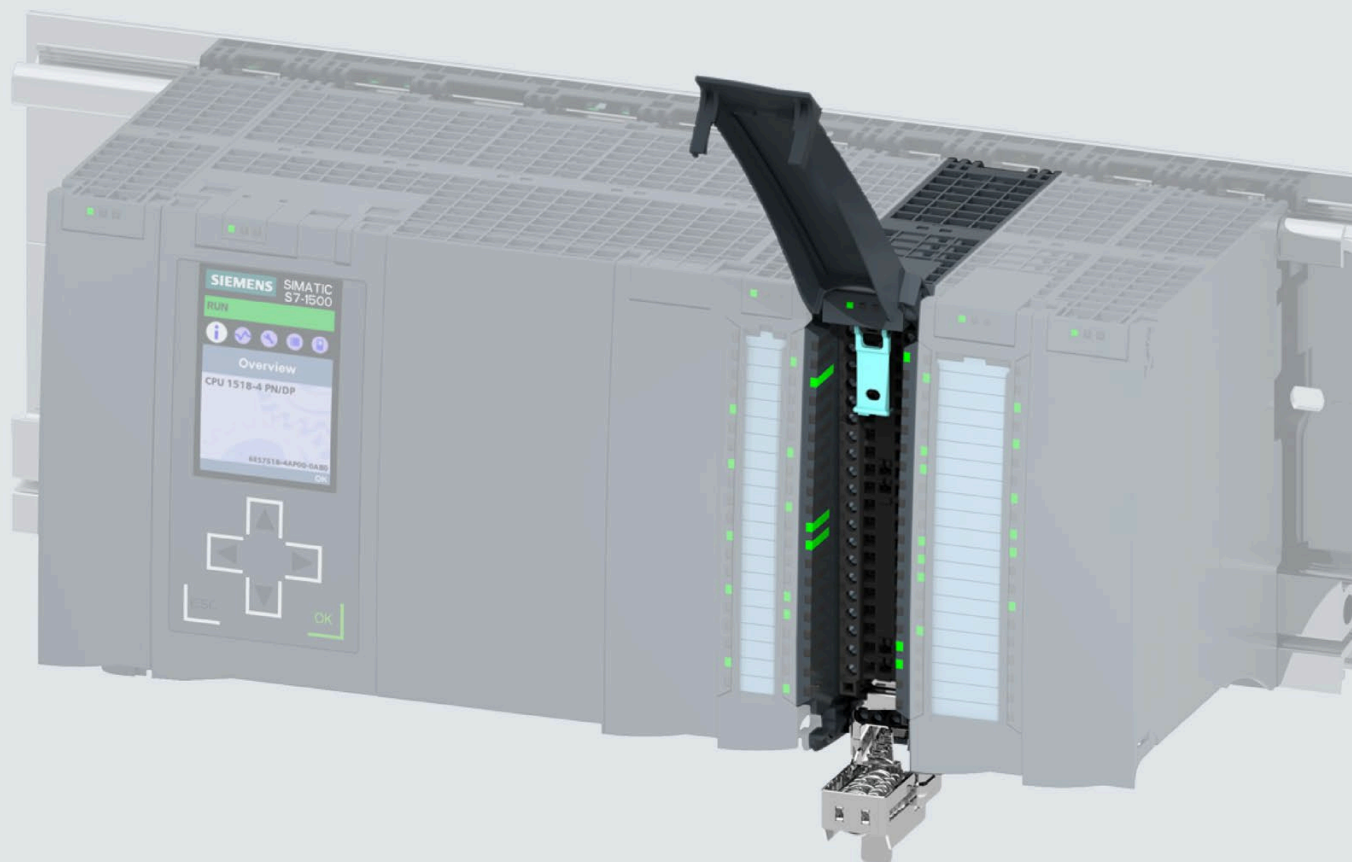


SIEMENS



Manual

SIMATIC

S7-1500 / ET 200MP

Digital input module
DI 16xNAMUR HF
(6ES7521-7TH00-0AB0)

Edition

07/2021

support.industry.siemens.com

SIMATIC

S7-1500/ET 200MP Digital Input Module DI 16xNAMUR HF (6ES7521-7TH00-0AB0)

Equipment Manual

Preface

Documentation guide

1

Product overview

2

Connecting

3

Parameters/address space

4

Interrupts/diagnostics alarms

5

Technical specifications

6

Dimension drawing

A

Parameter data record

B

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 AG. 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.

Preface

Purpose of the documentation

This equipment manual supplements the S7-1500/ET 200MP (<https://support.industry.siemens.com/cs/ww/en/view/59191792>) system manual and the function manuals. This equipment manual contains a description of the module-specific information. The system-related functions are described in the system manual. All system-spanning functions are described in the function manuals.

The information of the present equipment manual and the system manual enables you to commissioning of the DI 16xNAMUR HF module.

Conventions

If the term "CPU" is used in the following, it applies both to central processing units of the S7-1500 automation system as well as the interface modules of the ET 200MP distributed I/O system.

Also read the 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.

Security information

Siemens provides products and solutions with industrial security 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 security concept. Siemens' products and solutions constitute one element of such a concept.

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

For additional information on industrial security measures that may be implemented, please visit (<https://www.siemens.com/industrialsecurity>).

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, subscribe to the Siemens Industrial Security RSS Feed visit (<https://www.siemens.com/industrialsecurity>).

Siemens Industry Online Support

You can find current information on the following topics quickly and easily here:

- **Product support**

All the information and extensive know-how on your product, technical specifications, FAQs, certificates, downloads, and manuals.

- **Application examples**

Tools and examples to solve your automation tasks – as well as function blocks, performance information and videos.

- **Services**

Information about Industry Services, Field Services, Technical Support, spare parts and training offers.

- **Forums**

For answers and solutions concerning automation technology.

- **mySupport**

Your personal working area in Industry Online Support for messages, support queries, and configurable documents.

This information is provided by the Siemens Industry Online Support in the Internet (<https://support.industry.siemens.com>).

Industry Mall

The Industry Mall is the catalog and order system of Siemens AG for automation and drive solutions on the basis of Totally Integrated Automation (TIA) and Totally Integrated Power (TIP).

You can find catalogs for all automation and drive products on the Internet (<https://mall.industry.siemens.com>).

Open-source software

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

For legal reasons, we are obliged to publish the original text of the license conditions and copyright notices. Please read the information relating to this on the Internet.

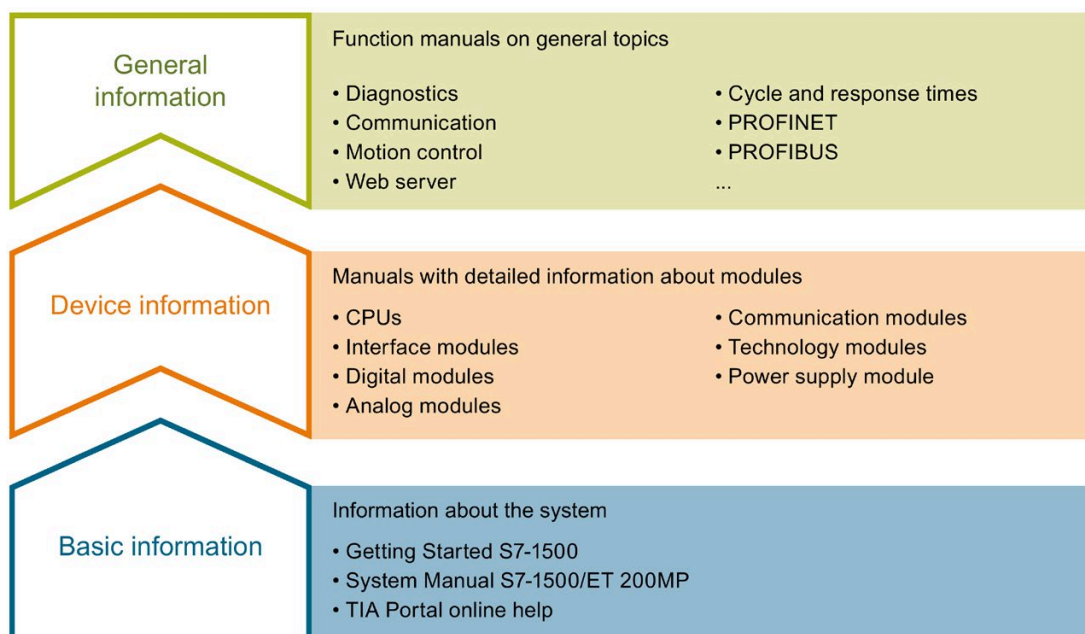
Table of contents

	Preface	3
1	Documentation guide	8
2	Product overview	10
2.1	Properties	10
2.2	Counting function	12
3	Connecting	14
3.1	Pin assignment	14
3.2	Wiring and block diagram	16
4	Parameters/address space	19
4.1	Parameters	19
4.2	Parameters DI mode	20
4.3	Explanation of the parameters of DI mode.....	21
4.4	Parameters of the Counting mode.....	23
4.5	Explanation of the parameters of the Counting mode.....	25
4.6	Pulse stretching	28
4.7	Chatter monitoring	30
4.8	Address space.....	32
4.8.1	Address space.....	32
4.8.2	Address space DI mode	33
4.8.3	Address space Counting mode	36
4.9	Examples of counting	39
4.9.1	Reaction to violation of a counting limit - Stop counting	39
4.9.2	Reaction to violation of a counting limit - Continue counting	41
4.9.3	Set output DQ - behavior of the STS_DQ bit	42
4.9.4	Counting once with direction setting via digital input	44
4.9.5	Counting once with hardware gate	45
4.9.6	Parameters	46
5	Interrupts/diagnostics alarms	47
5.1	Status and error displays	47
5.2	Interrupts	49
5.3	Diagnostics alarms.....	51
6	Technical specifications	52
6.1	Technical specifications	52

A	Dimension drawing	57
A.1	Dimensional drawing	57
B	Parameter data record	59
B.1	Parameter assignment and structure of the parameter data records.....	59
B.2	Structure of the parameter data records DI mode	60
B.3	Structure of the parameter data records Counting mode	63

Documentation guide

The documentation for the SIMATIC S7-1500 automation system and the SIMATIC ET 200MP distributed I/O system is arranged into three areas. This arrangement enables you to access the specific content you require.



Basic information

The System Manual and Getting Started describe in detail the configuration, installation, wiring and commissioning of the SIMATIC S7-1500 and ET 200MP systems. The STEP 7 online help supports you in the configuration and programming.

Device information

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

General information

The function manuals contain detailed descriptions on general topics regarding the SIMATIC S7-1500 and ET 200MP systems, e.g. diagnostics, communication, motion control, Web server, OPC UA.

You can download the documentation free of charge from the Internet (<https://support.industry.siemens.com/cs/ww/en/view/109742691>).

Changes and supplements to the manuals are documented in a Product Information.

You can download the product information free of charge from the Internet (<https://support.industry.siemens.com/cs/us/en/view/68052815>).

Manual Collection S7-1500/ET 200MP

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

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

SIMATIC S7-1500 comparison list for programming languages

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

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

"mySupport"

With "mySupport", your personal workspace, you make the best out of your Industry Online Support.

In "mySupport", you can save filters, favorites and tags, request CAx data and compile your personal library in the Documentation area. In addition, your data is already filled out in support requests and you can get an overview of your current requests at any time.

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

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

Application examples

The application examples support you with various tools and examples for solving your automation tasks. Solutions are shown in interplay with multiple components in the system - separated from the focus on individual products.

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

Product overview

2.1 Properties

Part number:

6ES7521-7TH00-0AB0

View of the module

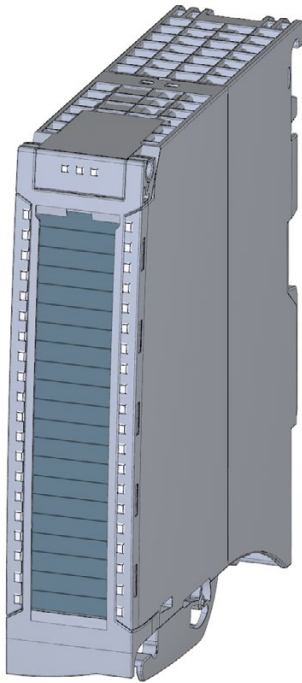


Figure 2-1 View of the module DI 16xNAMUR HF

Properties

The module has the following technical properties:

- 16 digital inputs; electrically isolated in groups of 8
 - Channel 0 to 3 in them have an optional counting function
- Nominal input voltage 8.2V DC (NAMUR)
- Configurable diagnostics (per channel)
- Configurable hardware interrupt (per channel)
- Pulse stretching
- Chatter monitoring

The module supports the following functions:

Table 2- 1 Version dependencies of the module functions

Function	Firmware version of the module	Configuration software	
		STEP 7 (TIA Portal) as of V17 with HSP 347	GSD file in STEP 7 (TIA Portal) as of V17 or STEP 7 as of V5.5 SP3 ???
Firmware update	As of V1.0.0	X	--- / X
Identification data I&M0 to I&M3	As of V1.0.0	X	X
Parameter assignment in RUN	As of V1.0.0	X	X
Isochronous mode	As of V1.0.0	X	X
Module internal Shared Input (MSI)	As of V1.0.0	X (PROFINET IO only)	X (PROFINET IO only)
Configurable submodules / submodules for Shared Device	As of V1.0.0	X (PROFINET IO only)	X (PROFINET IO only)
Counting function for 4 channels	As of V1.0.0	X	X

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

Accessories

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

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

Other components

The following component must be ordered separately:

- Front connectors, including potential jumpers and cable ties

You can find additional information on accessories in the system manual S7-1500/ET 200MP (<https://support.industry.siemens.com/cs/ww/en/view/59191792>).

2.2 Counting function

Introduction

You can use the channels 0 to 3 in "counting" mode. The other channels can be used as standard inputs (DI mode).

If do not use channels 0 and 3 in "Count" mode, these channels can also be used as digital inputs. Channels 0 to 3 can only be used together as counting inputs.

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

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

Reference

You will find the basics and additional information on the counting function in the function manual Counting, measuring and position detection (<https://support.industry.siemens.com/cs/ww/en/view/59709820>).

Counting with channel 0 to channel 3

You control the counting function via the IO addresses of the module. These IO addresses are also known as the control interface (output addresses) and feedback interface (input addresses), see section Address space Counting mode (Page 36).

If you configure channels 0 to 3 for counting, you have the following options:

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

The count direction is

- Up
- Down
- Optionally controllable via a digital input

Reference

Examples for counting with channel 0 to 3 can be found in the section Examples of counting (Page 39).

Connecting

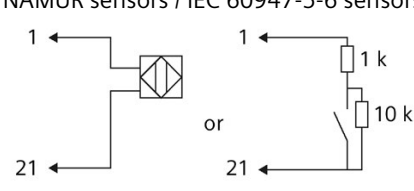
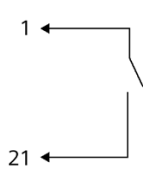
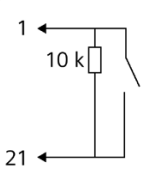
3.1 Pin assignment

General pin assignment

Table 3- 1 Pin assignment for DI 16×NAMUR HF

Digital input designation		Counter designation		Pin	View	Pin	Sensor supply designation	
NAMUR input group 1	DI ₀	Counter 0 to 3	Cn 0	1		21	1Us	8.2V sensor supply group 1
	DI ₁		Cn 1	2		22	1Us	
	DI ₂		Cn 2	3		23	1Us	
	DI ₃		Cn 3	4		24	1Us	
	DI ₄	HW gates 0 to 3	HW gate 0	5		25	1Us	
	DI ₅		HW gate 1	6		26	1Us	
	DI ₆		HW gate 2	7		27	1Us	
	DI ₇		HW gate 3	8		28	1Us	
	-		-	9		29	1Ms	Ground sensor supply group 1
	-		-	10		30	2Ms	Ground sensor supply group 2
NAMUR input group 2	DI ₈	Count direction channel 0 to 3	Dir 0	11		31	2Us	8.2V sensor supply group 2
	DI ₉		Dir 1	12		32	2Us	
	DI ₁₀		Dir 2	13		33	2Us	
	DI ₁₁		Dir 3	14		34	2Us	
	DI ₁₂	-	-	15		35	2Us	
	DI ₁₃	-	-	16		36	2Us	
	DI ₁₄	-	-	17		37	2Us	
	DI ₁₅	-	-	18		38	2Us	
	-		-	19		39	24 V D C	24 V module supply
	-		-	20		40	M	Ground module supply

Table 3- 2 Connections across all sensor types for DI 16×NAMUR HF

Connections for DI 16×NAMUR HF (6ES7521-7TH00-00)		
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 with 10 kΩ ±10% wired with 250 mW (mechanical normally open contact) 

Firmware update

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

3.2 Wiring and block diagram

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

You can find information on wiring the front connector, establishing a cable shield, etc. in the system manual S7-1500/ET 200MP

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

Wiring and block diagram for digital inputs

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

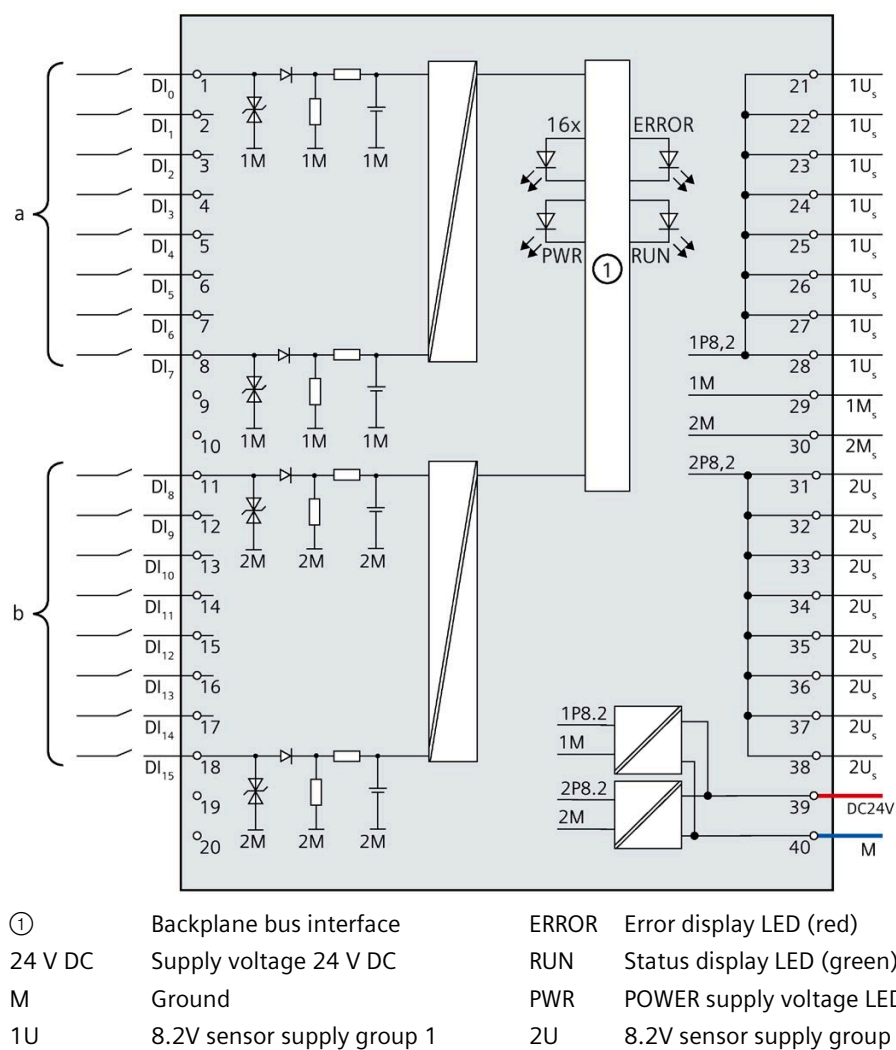


Figure 3-1 Block diagram and pin assignment

Wiring and block diagram for counting inputs

The figure below shows you how to connect the module and map the channels to the addresses for the counting inputs (input byte a to input byte b).

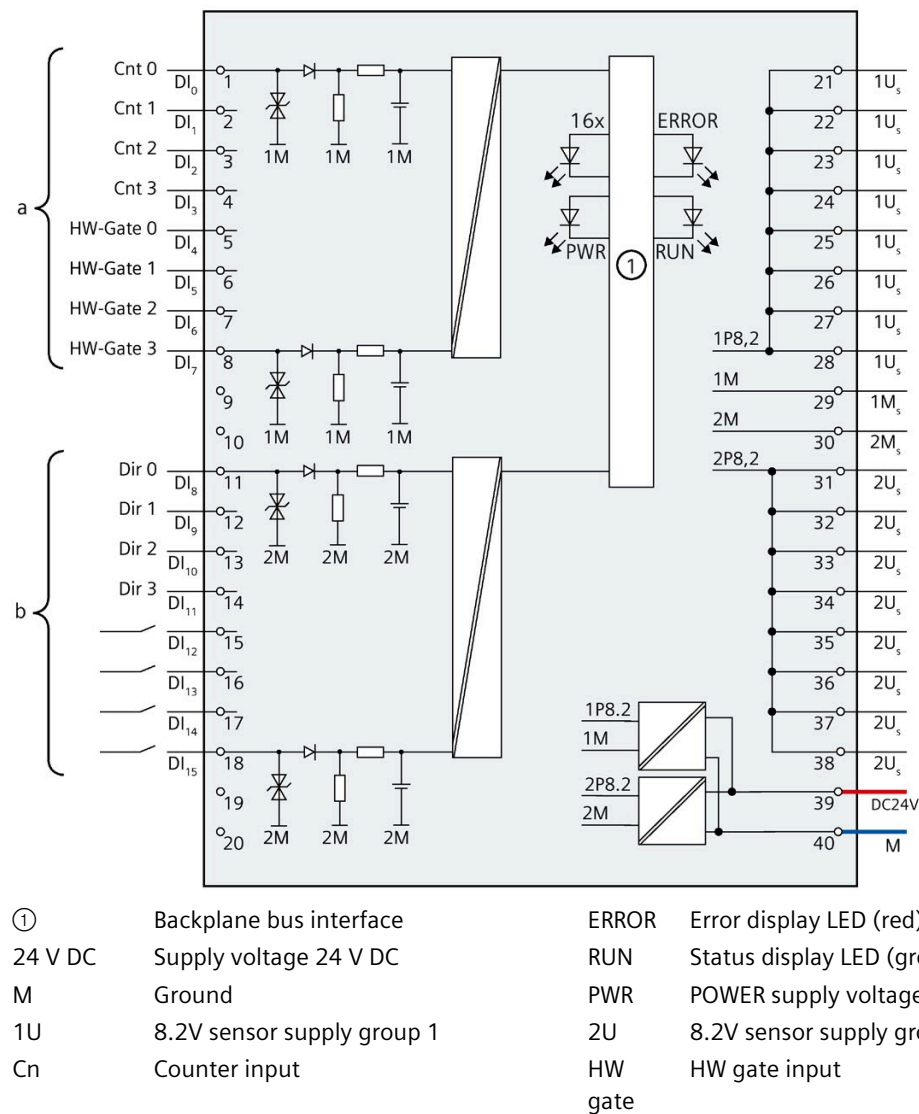


Figure 3-2 Block diagram and pin assignment

Supply element, shielding bracket and shielding terminal

The supply element, shielding bracket and shielding terminal are supplied as part of the 16xNAMUR HF. You must connect your cable shield over the shielding terminal.

Tip: Using the potential jumpers

Use the potential jumpers supplied with the front connector if you want to loop-through the 24 V DC supply voltage to a neighboring module. This helps you to avoid having to terminate two wires to one terminal.

Proceed as follows:

1. Connect the 24 V DC supply voltage to terminals 39 and 40.
2. Insert the potential jumpers between terminals 19 and 39 (24 V DC) and 20 and 40 (M).
3. Use the terminals 19 (24 V DC) and 20 (M) to loop the potential on to the next module.

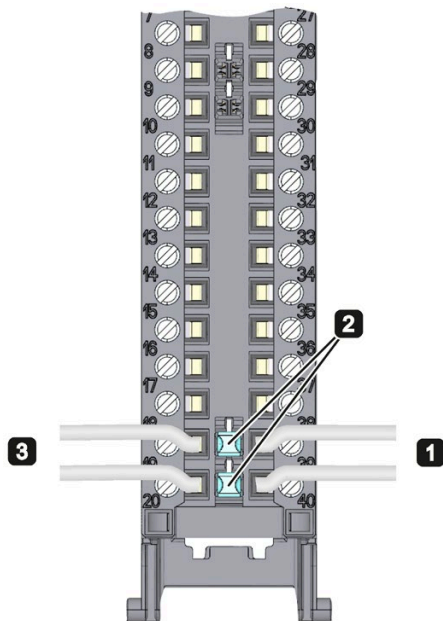


Figure 3-3 Potential jumpers

Note**Potential jumper**

The maximum current carrying capacity per potential jumper must not exceed 8 A.

Note**Potential jumpers**

Do not plug the potential jumpers supplied with the front connector between terminals 9 and 29 as well as 10 and 30.

Parameters/address space

4.1 Parameters

Parameters of the DI 16xNAMUR HF

Specify the module properties with the various parameters in the course of the parameter assignment of the module with STEP 7. The adjustable parameters depend on the functions of the module you use. You will find the parameters in section Parameters DI mode (Page 20) or section Parameters of the Counting mode (Page 23). The effective range of the configurable parameters depends on the type of configuration. The following configurations are possible:

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

When assigning parameters in the user program, transfer the parameters to the module with the WRREC instruction (Configuration in RUN) via data records, see the section Parameter assignment and structure of the parameter data records (Page 59).

4.2 Parameters DI mode

Parameters of the DI 16xNAMUR HF in the DI operating mode

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

Table 4- 1 Settable parameters and their defaults in the DI mode

Parameter	Range of values	Default setting	Parameter assignment in RUN	Effective range with configuration software, e.g. STEP 7	
				Integrated in the hardware catalog as of STEP 7, V13 SP1 or GSD file PROFINET IO	GSD file PROFIBUS DP
Diagnostics					
• No supply voltage L+	Yes/No	No	Yes	Channel*	Module**
• Short circuit "Sensor supply to M"	Yes/No	No	Yes	Channel*	Channel group**
• Wire break	Yes/No	No	Yes	Channel*	Channel group**
• Chatter error	Yes/No	No	Yes	Channel*	Channel group**
Input delay	0.05 ms, 0.1 ms, 0.4 ms, 1.6 ms, 3.2 ms, 12.8 ms, 20 ms	3.2 ms; for isochronous mode 0.05 ms (cannot be changed)	Yes	Channel	Channel group**
Hardware interrupt					
• Rising edge	Yes/No	No	Yes	Channel	Channel
• Falling edge	Yes/No	No	Yes	Channel	Channel
Pulse stretching*	None, 0.5 s, 1 s, 2 s, 0.05 s, 0.1 s, 0.2 s	None	Yes	Channel	Channel group **
Digital input	• Normal • Inverted	Normal	Yes	Channel	Channel group **

Parameter	Range of values	Default setting	Parameter assignment	Effective range with configuration software, e.g. STEP 7	
Chatter monitoring - number of signal changes **	- Disabled 2 ... 32	Disabled	Yes	Channel	Channel group **
Chatter monitoring - Monitoring window**	0.5 s 1 s ... 100 s	0.5 s	Yes	Channel	Channel group **

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

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

** The scope can be assigned for each channel during parameter assignment in RUN.

4.3 Explanation of the parameters of DI mode

No supply voltage L+

Enabling of the diagnostics for no or insufficient supply voltage L+.

Wire break

Enabling diagnostics if the line to the sensor is interrupted.

Input delay

You can suppress signal interference with this parameter. Changes to the signal are only detected if they are constantly pending for longer than the set input delay time.

Hardware interrupt

Defines whether a hardware interrupt is disabled or for which of the following events the module generates a hardware interrupt:

- Rising edge
- Falling edge

Diagnostics: Chatter error

Enabling of the diagnostics alarm when a chatter error occurs.

Chatter monitoring detects and reports unusual process-related signal curves, such as excessive fluctuation of the input signal between "0" and "1". The occurrence of such signal changes is an indication of faulty sensors or process instabilities.

4.3 Explanation of the parameters of DI mode

Chatter monitoring: Monitoring window

Chatter monitoring: Setting of the monitoring window

Each input channel has a configurable monitoring window. The first signal change of the input signal starts the monitoring window. If the monitoring window detects a chatter error, then the monitoring time is extended to three times the time. If the monitoring window does not detect a chatter error within this time, the monitoring time is reduced to the single time again.

Chatter monitoring: Number of signal changes

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.

Pulse stretching

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

Pulse stretching is a function used to change a digital input signal. A pulse at a digital input is stretched at least to the configured length. If the input pulse is already longer than the configured length, then the pulse is not stretched.

Inverted

NAMUR sensors supply an inverted signal. So that you can use the same logic for 24 VDC signals in the user program, parameter assignment via this function is recommended.

Specifies whether or not the input signal is to be inverted.

Inversion is only possible with the following sensor types:

- NAMUR sensor
- Single contact unwired
- Single contact with 10 k Ω

4.4 Parameters of the Counting mode

Parameters of DI 16xNAMUR HF Count in the counting mode

If you want to use the module for counting, configure the module as DI 16xNAMUR HF Count. The following parameter settings are then possible for channels 0 to 3. For channels 4 to 15, the parameter settings apply as for the DI 16xNAMUR HF, see section Parameters DI mode (Page 20).

Note

When using the counting function, the limit is 20 000 edges per second.

The maximum counting frequency is 20 kHz with the "Count at positive edge" and "Count at negative edge" parameter assignment.

If you use the parameter assignment "Count at positive and negative edge", the maximum counting frequency is 10 kHz.

Note that counting pulses are lost when the limits are exceeded. You then receive the diagnostics alarm "Hardware interrupts lost".

Table 4- 2 Settable parameters and their defaults in the Counting mode

Parameter	Range of values	Default setting	Parameter assignment in RUN	Effective range with configuration software, e.g. STEP 7	
				Integrated in hardware catalog from STEP 7, V17 with HSP 347 or GSD file PROFINET IO	GSD file PROFIBUS DP
Diagnostics					
• No supply voltage L+	Yes/No	No	Yes	Channel*	Module
• Wire break	Yes/No	No	Yes	Channel	Channel group
• Short circuit "Sensor supply to ground"	Yes/No	No	Yes	Channel	Channel group
Input delay	0.05 ms, 0.1 ms, 0.4 ms, 1.6 ms, 3.2 ms, 12.8 ms, 20 ms	3.2 ms; for isochronous mode 0.05 ms (cannot be changed)	Yes	Channel	0.05 ms ***

4.4 Parameters of the Counting mode

Parameter	Range of values	Default setting	Parameter assignment	Effective range with configuration software, e.g. STEP 7	
Hardware interrupt	- Disable - Comparison event occurred for DQ	Disable	Yes	Channel	---
Set output DQ	- Between comparison value and high counting limit - Between comparison value and low counting limit	Between comparison value and high counting limit	Yes	Channel	---
Edge selection	- On rising edge - On falling edge - On rising and falling edge	On rising edge	Yes	Channel	On rising edge ***
High counting limit	0 ... 4294967295	4294967295	Yes	Channel	4294967295 ***
Comparison value	0 ... 4294967295**	1	Yes	Channel	1 ***
Start value	0 ... 4294967295**	0	Yes	Channel	0 ***
Behavior when a counting limit is exceeded	- Stop counting - Continue counting	Continue running the counter	Yes	Channel	Continue running the counter ***
Count direction	- Up - Down - Controlled by digital input	Up	Yes	Channel	Up ***
Hardware gate	- Disabled - Enabled	Disabled	Yes	Channel	Disabled ***

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

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

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

*** Parameter selection is not possible

4.5 Explanation of the parameters of the Counting mode

No supply voltage L+

Enabling of the diagnostics for no or insufficient supply voltage L+.

Wire break

Enabling diagnostics if the line to the sensor is interrupted.

Input delay

You can suppress signal interference with this parameter. Changes to the signal are only detected if they are constantly pending for longer than the set input delay time.

Hardware interrupt

Defines whether or not the module generates a hardware interrupt at the "Comparison event for DQ" (positive edge at STS_DQ).

Set output DQ

With this parameter, you specify the behavior of the STS_DQ bit in the feedback interface. You can assign this bit in the user program, for example, with a hardware output, see Address space Counting mode (Page 36).

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

4.5 Explanation of the parameters of the Counting mode

Edge selection

You use this parameter to define the edge by which the module counts.

You can select the following options:

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

Note

When using the counting function, the limit is 20 000 edges per second.

The maximum counting frequency is 20 kHz with the "Count at positive edge" and "Count at negative edge" parameter assignment.

If you use the parameter assignment "Count at positive and negative edge", the maximum counting frequency is 10 kHz.

Note that counting pulses are lost when the limits are exceeded. You then receive the diagnostics alarm "Hardware interrupts lost".

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).

High counting limit

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

Comparison value

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

Start value

You use this parameter to define the value at which the counting starts and continues counting at defined events. The following condition must be met:

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

Behavior when a counting limit is exceeded

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

Behavior	Meaning
Stop counting	After a count limit is violated, the counting procedure is aborted and the STS_GATE bit (internal gate) is reset. To restart the counting process, you need to reset the SW_GATE bit via the control interface and set the counter value to the start value.
Continue counting	After a count limit is violated, the module sets the counted value to the other count limit and continues the count process.

Count direction

You use this parameter to define in which direction counting is performed.

Hardware gate

You use this parameter to define the one-time counting.

With the hardware gate, as with the software gate, you can start and stop the counting process with an external signal. If you use the hardware gate, the software gate must be enabled ("1").

The counting process stops when the high counting limit is violated. The counted value jumps to the low counting limit (=0).

Inverted

NAMUR sensors supply an inverted signal. So that you can use the same logic for 24 VDC signals in the user program, parameter assignment via this function is recommended.

Specifies whether or not the input signal is to be inverted.

Inversion is only possible with the following sensor types:

- NAMUR sensor
- Single contact unwired
- Single contact with 10 k Ω

Pulse stretching (only adjustable at channels 4 to 15)

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

Pulse stretching is a function used to change a digital input signal. A pulse at a digital input is stretched at least to the configured length. If the input pulse is already longer than the configured length, then the pulse is not stretched.

4.6 Pulse stretching

Diagnostics: Chatter error (only adjustable at channels 4 to 15)

Enabling of the diagnostics alarm when a chatter error occurs.

Chatter monitoring detects and reports unusual process-related signal curves, such as excessive fluctuation of the input signal 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.

Chatter monitoring: Monitoring window (only adjustable at channels 4 to 15)

Chatter monitoring: Setting of the monitoring window

Each input channel has a configurable monitoring window. The first signal change of the input signal starts the monitoring window. If the monitoring window detects a chatter error, then the monitoring time is extended to three times the time. If the monitoring window does not detect a chatter error within this time, the monitoring time is reduced to the single time again.

Chatter monitoring: Number of signal changes (only adjustable at channels 4 to 15)

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.

4.6 Pulse stretching

Description

"Pulse stretching" is a function used to change a digital input signal. The function stretches a pulse at a digital input to at least the configured length. If the input pulse is already longer than the configured length, the function does not change the pulse.

The pulse-stretched signal is the input signal for the hardware interrupt.

Principle of pulse stretching

The following figure shows examples of whether and how the function changes input pulses.

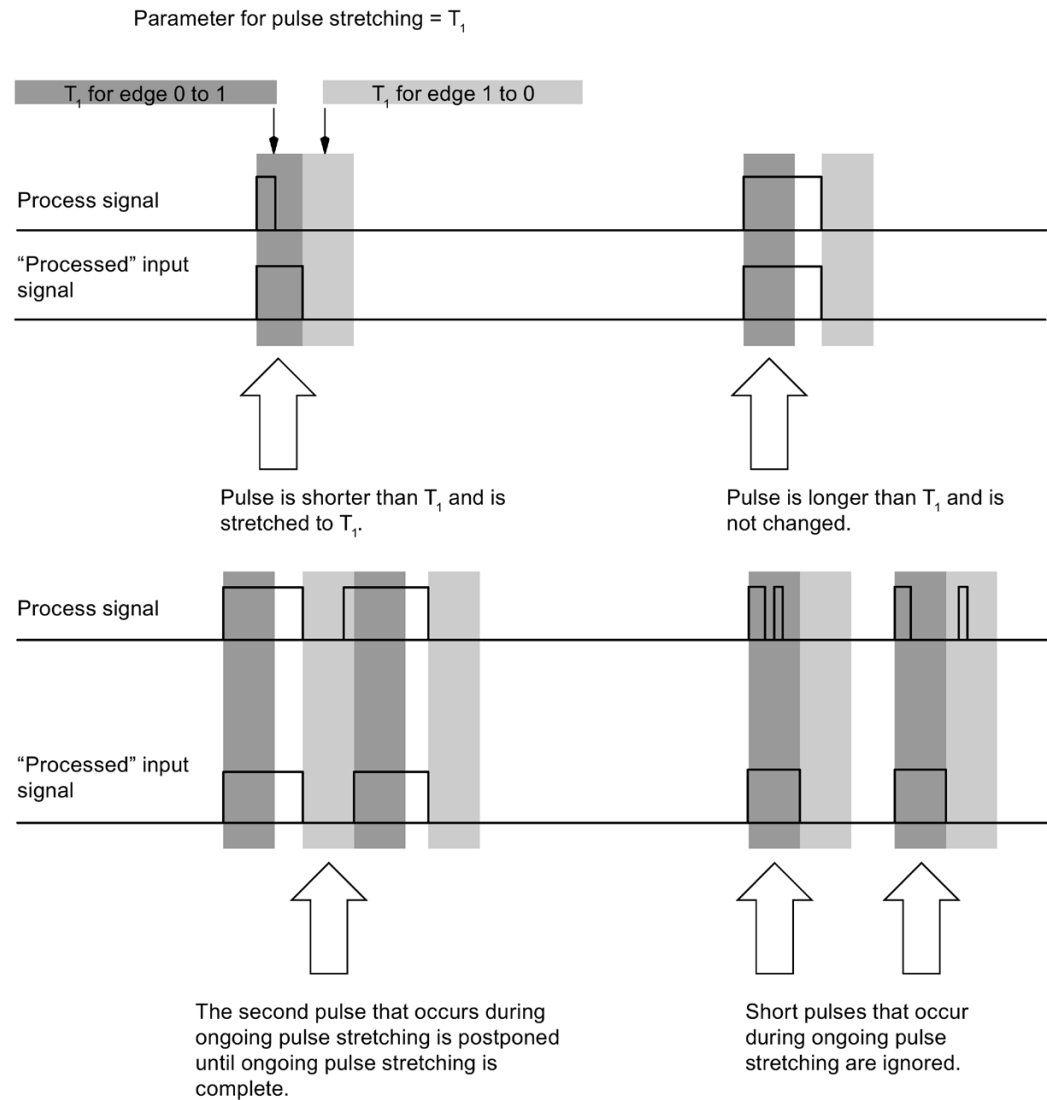


Figure 4-1 Principle of pulse stretching

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.

4.7 Chatter monitoring

Note

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

4.7 Chatter monitoring

Description

The "Chatter monitoring" function detects and reports signal changes that are unexpected in process engineering, for example when an input signal fluctuates too often between "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 "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).

Note

Chatter monitoring can only be used at digital inputs

The chatter monitoring can only be used at the digital inputs. Chatter monitoring cannot be enabled at the counter inputs.

Detecting a chatter error

Each input channel has a monitoring window that has been assigned parameters. The first signal change of the input signal starts the monitoring window. If the input signal within the monitoring window changes more often than the configured number of signal changes, the function detects a chatter error. In the event of a chatter error, the time is extended to three times the time. If the function does not detect a chatter error within the monitoring window, the monitoring window starts again at the next signal change.

Reporting a chatter error

If a chatter error occurs, the current signal state 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 more chatter of the input signal is detected within triple the monitoring window, the function triggers an outgoing diagnostics interrupt. 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.

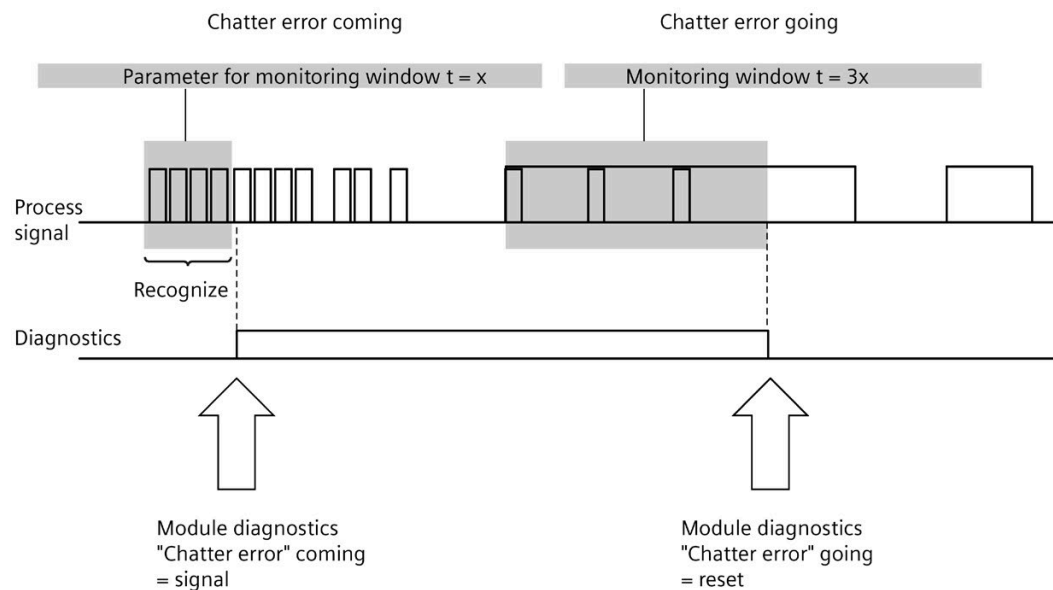


Figure 4-2 The principle of chatter monitoring

Chatter monitoring and "settling time" if a chatter error occurs

The signal changes...	Result
Once more than set in "Number of signal changes".	The monitoring time restarts.
Less often than set in "Number of signal changes".	The monitoring time does not restart. Instead it runs once from the start of the original chatter error detection. Even a change just before the time is up is tolerated.

4.8 Address space

4.8.1 Address space

You can configure the module differently in STEP 7, see the following table. Depending on the configuration, additional/different addresses are assigned in the process image of the inputs.

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

Configuration options of the DI 16xNAMUR HF

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

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

The following configurations are possible:

Table 4- 3 Configuration options

Configuration	Short designation/ module name in the GSD file	Configuration software, e.g., with STEP 7 (TIA Portal)	
		Integrated in the hardware catalog of STEP 7 (TIA Portal)	GSD file in STEP 7 (TIA Portal) as of V17 or STEP 7 as of V5.5 SP3 ????
1 x 16-channel without value status	DI 16xNAMUR HF	As of V17	X
1 x 16-channel with value status	DI 16xNAMUR HF QI	As of V17	X
2 x 8-channel without value status	DI 16xNAMUR HF S	As of V17 (PROFINET IO only)	X (PROFINET IO only)
2 x 8-channel with value status	DI 16xNAMUR HF S QI	As of V17 (PROFINET IO only)	X (PROFINET IO only)
1 x 16-channel with value status for module-internal shared input with up to 4 submodules	DI 16xNAMUR HF MSI	As of V17 (PROFINET IO only)	X (PROFINET IO only)
1x16-channel with value status (channels 0 to 3 for counting; channels 4 to 15 as digital inputs)	DI 16xNAMUR HF Count	As of V17	X (PROFINET IO only)

Value status (Quality Information, QI)

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

- DI 16xNAMUR HF QI,
- DI 16xNAMUR HF S QI
- DI 16xNAMUR HF MSI
- DI 16xNAMUR HF Count

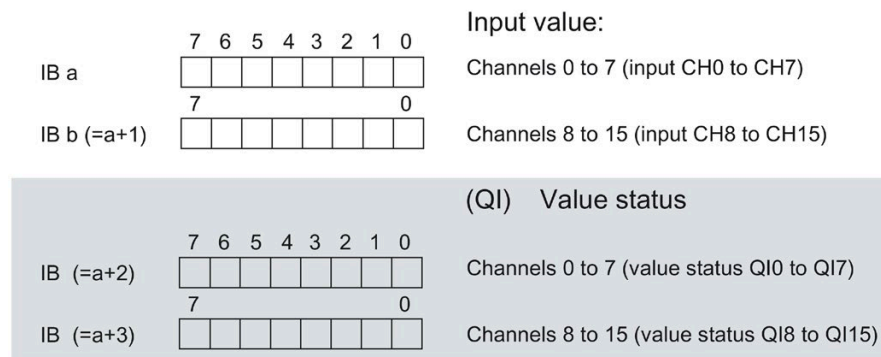
An additional bit is assigned to each channel for the value status. The value status bit indicates if the read in digital value is valid. (0 = Value is incorrect).

4.8.2 Address space DI mode

Address space when configured as 16-channel DI 16xNAMUR HF QI

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

Assignment in the process image of the inputs (PII)



0 = Value read at the channel is faulty

Figure 4-3 Address space when configured as 16-channel DI 16xNAMUR HF QI with value status

Address space when configured as 2 x 8-channel DI 16xNAMUR HF S QI

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

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

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

Assignment in the process image of the inputs (PII)

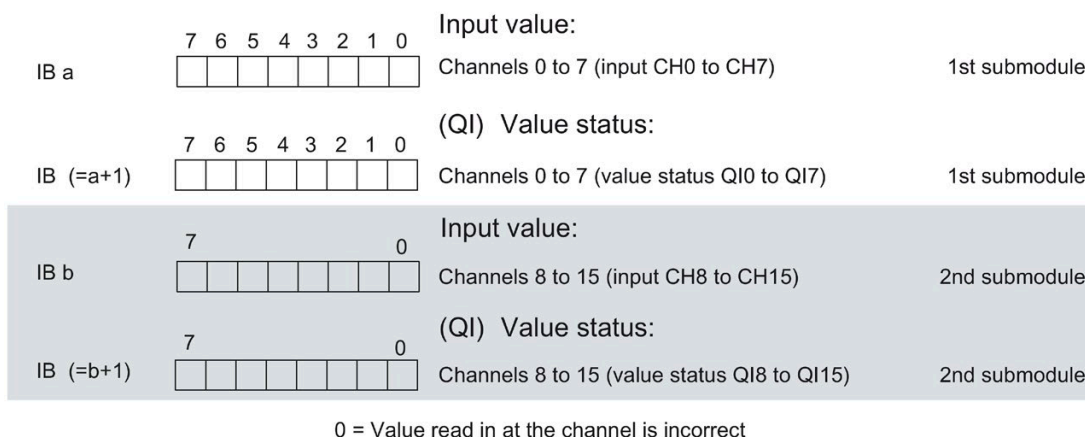


Figure 4-4 Address space when configured as 2 x 8-channel DI 16xNAMUR HF S QI

Address space when configured as 1 x 16-channel DI 16xNAMUR HF MSI

The channels 0 to 15 of the module are copied in up to four submodules with configuration 1 x 16-channel module (Module-internal shared input, MSI). Channels 0 to 15 are then available with identical input values in different submodules. These submodules can be assigned to up to four IO controllers when using the module in a shared device. Each IO controller has read access to the same channels.

The number of IO controllers depends on the interface module being used. Read the information in the equipment manual for the particular interface module.

Value status (Quality Information, QI)

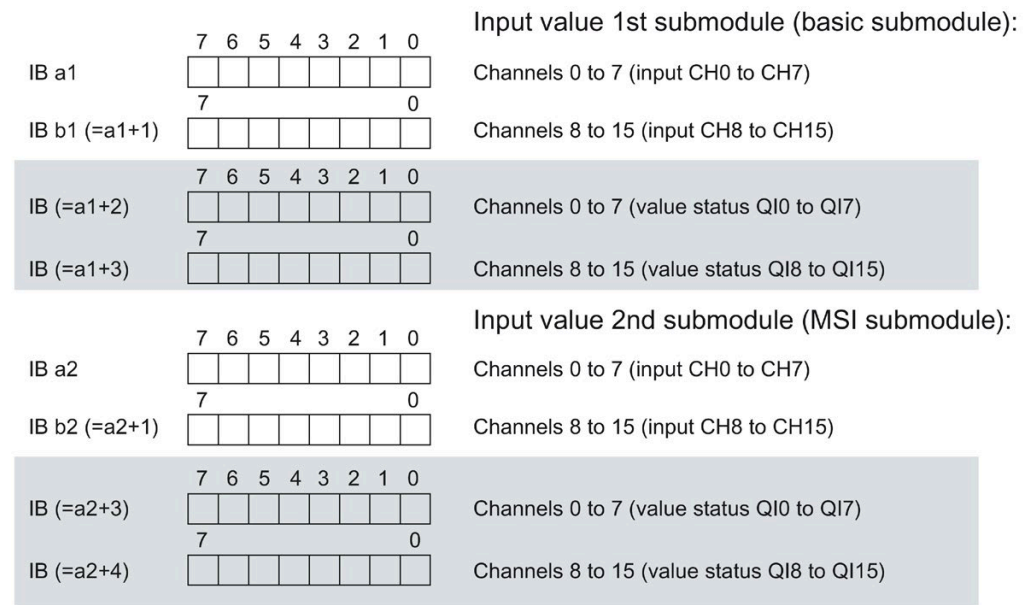
The meaning of the value status depends on the submodule involved.

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

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

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

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



0 = Value read at the channel is faulty

Figure 4-5 Address space when configured as 1 x 16-channel DI 16xNAMUR HF MSI

4.8 Address space

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

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

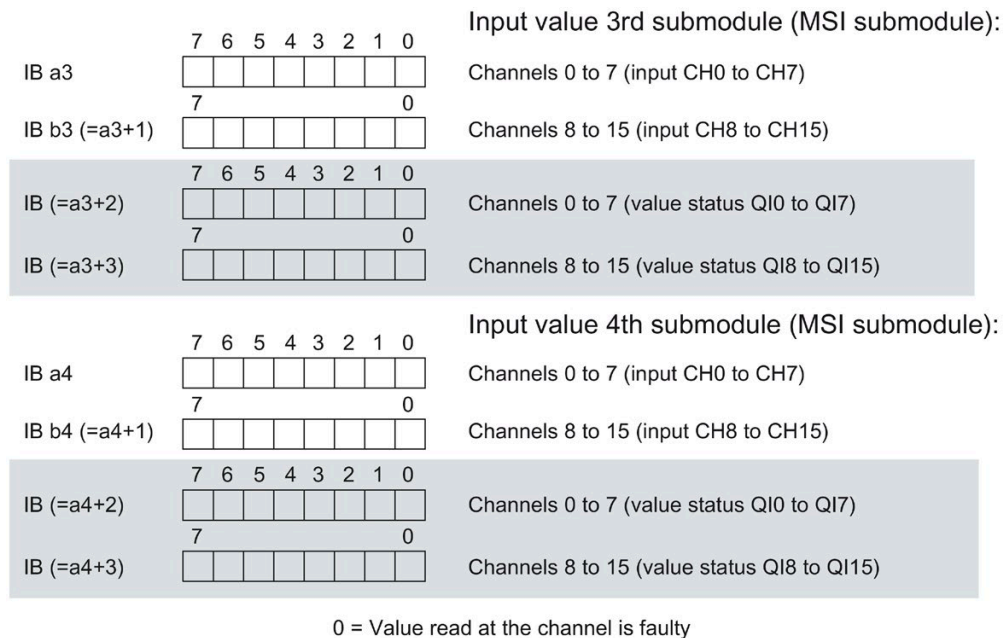


Figure 4-6 Address space when configured as 1 x 16-channel DI 16xNAMUR HF MSI

Reference

You can find information about the Module Internal Shared Input/Shared (MSI/MSO) function in the PROFINET (<https://support.industry.siemens.com/cs/ww/en/view/49948856>) function manual.

4.8.3 Address space Counting mode

Address space when configured as 1 x 16-channel DI 16xNAMUR HF Count

The address space from channel 0 to 3, which is used for counting, consists of the control and feedback interface. The "Counting" function is controlled directly via the two interfaces. With suitable parameter assignment, a hardware interrupt is triggered.

If you use the module in Count mode (channels 0 and 3), the module occupies the following address areas:

- 32 bytes in the process image output (control interface).
- 36 bytes in the process image of the inputs (feedback interface).

Control interface

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

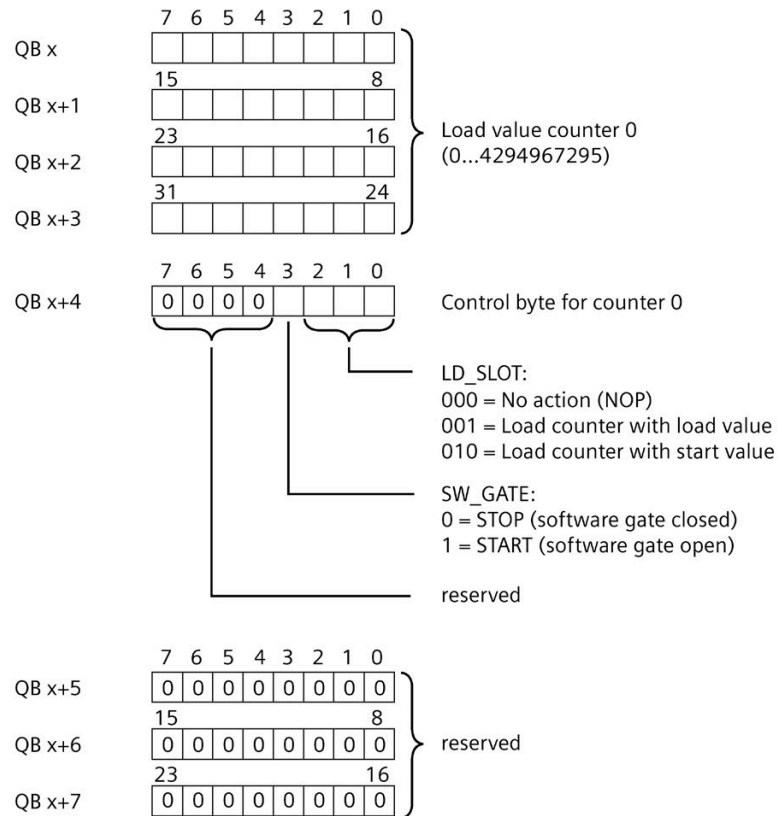


Figure 4-7 Assignment of the address space of the control interface of the DI 16xNAMUR HF Count (bytes 0 to 7)

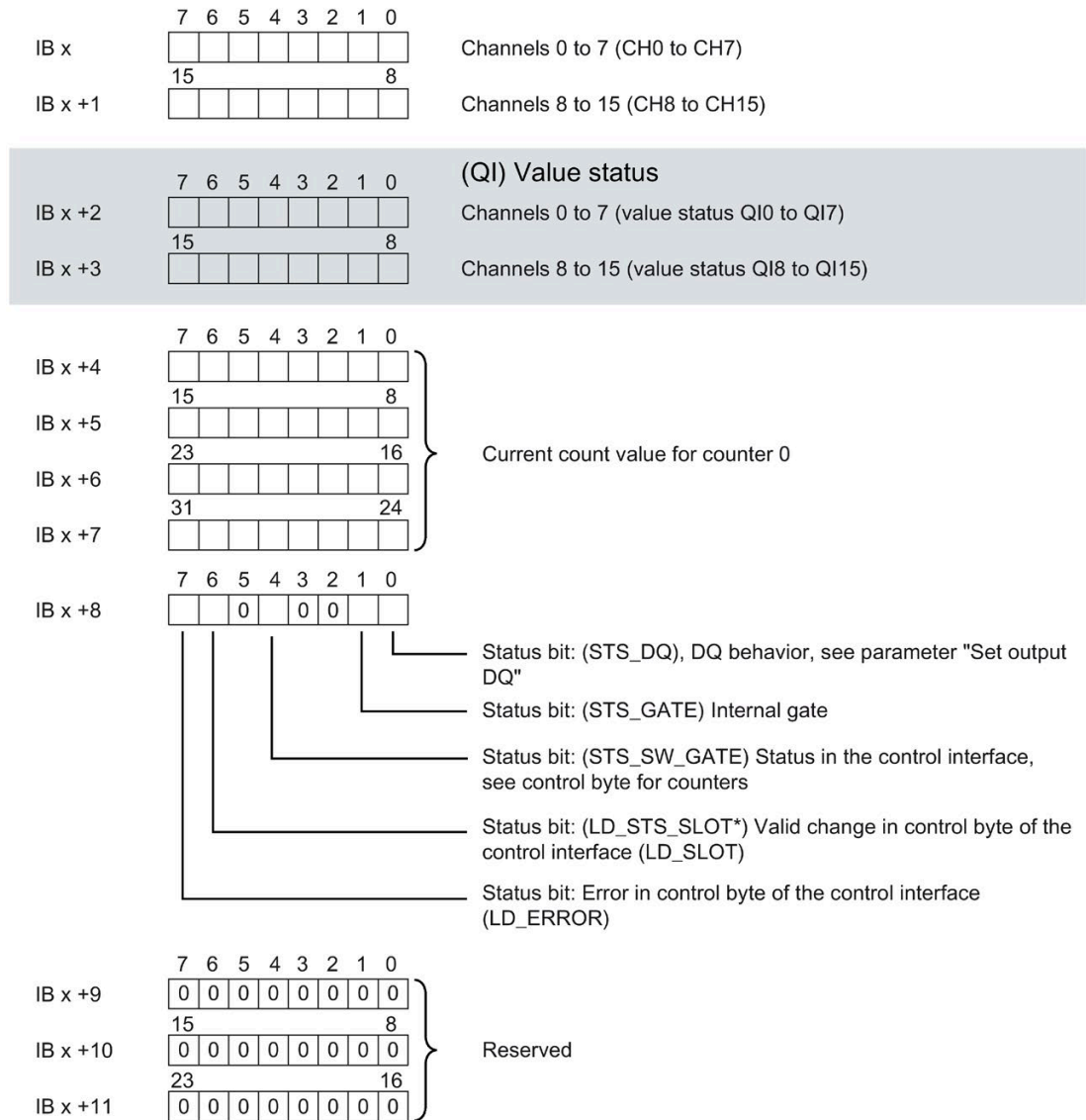
The configuration is identical for counters 0 to 3:

- Counter 0: QB x to QB x+7
- Counter 1: QB x+8 to QB x+15
- Counter 2: QB x+16 to QB x+23
- Counter 3: QB x+24 to QB x+31

Feedback interface

The figure below shows the address assignment of the module in the process image of the inputs. The feedback interface for the counters (channels 0 to 3) starts from input byte x+4.

Via the feedback interface, the user program receives current counted values and status information from the module.



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

Figure 4-8 Assignment of the address space of the feedback interface of the DI 16xNAMUR HF Count (bytes 0 to 11)

The configuration is identical for counters 0 to 3:

- Counter 0: IB x+4 to IB x+11
- Counter 1: IB x+12 to IB x+19
- Counter 2: IB x+20 to IB x+27
- Counter 3: IB x+28 to IB x+35

4.9 Examples of counting

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

See also

Address space Counting mode (Page 36)

4.9.1 Reaction to violation of a counting limit - Stop counting

Reaction to violation of a counting limit - Stop counting

The following section describes the effects of the parameter "Reaction to violation of a counting limit = Stop counting". To control the counter, the bits of the control byte of the control interface are used, see section Address space Counting mode (Page 36).

Counting begins at the current counted value (the SW_GATE is set in the control byte). The bit string in the control byte of the control interface is 0000 1000.

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

To restart the counting process, you need to reset the SW_GATE bit via the control interface and set it again. With hardware gate control, you need to reset the hardware gate and set it again.

Whether the counting process restarts with the current counter value or with the start value depends on the control byte in the control interface.

Bit string in the control byte of the control interface:

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

If the SW_GATE bit in the control byte of the control interface is reset before the high counting limit is reached, the counting process stops.

4.9 Examples of counting

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

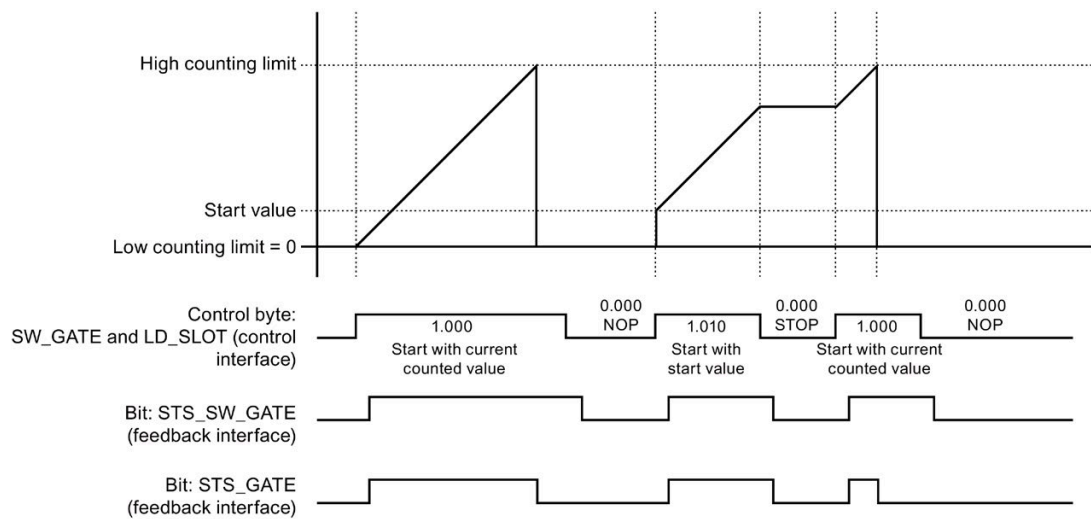


Figure 4-9 Principle: Stop counting

4.9.2 Reaction to violation of a counting limit - Continue counting

Reaction to violation of a counting limit - Continue counting

The following section describes the effects of the parameter "Behavior when a counting limit is exceeded = Continue counting". To control the counter, the bits of the control byte of the control interface are used, see section Address space Counting mode (Page 36), subsection Control interface.

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

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

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

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

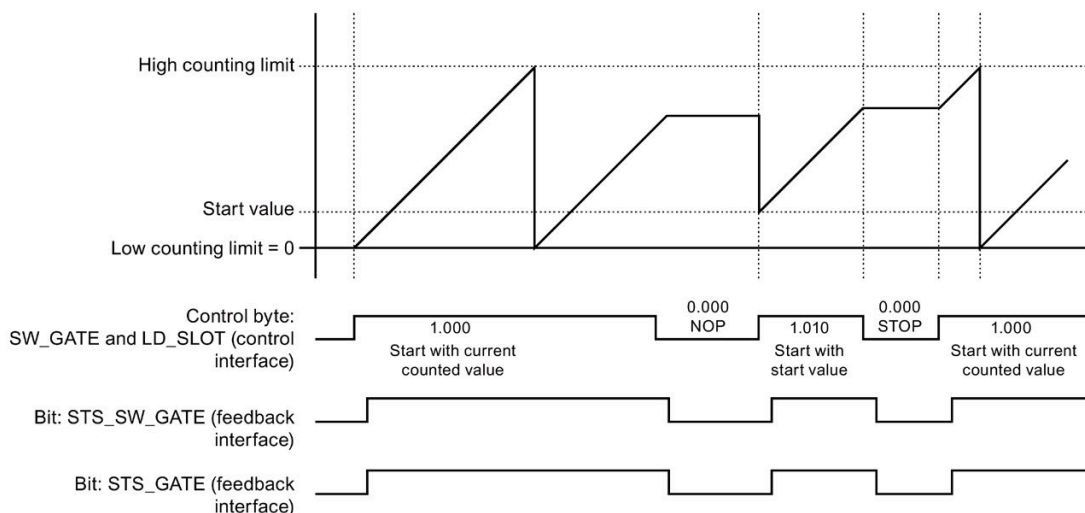


Figure 4-10 Principle: Continue counting

4.9.3 Set output DQ - behavior of the STS_DQ bit

Set output DQ - behavior of the STS_DQ bit

The following section shows the behavior of the STS_DQ bit with the parameter assignment "Set output DQ = Between comparison value and high counting limit".

The STS_DQ bit is set to 1 when the comparison value $\leq$ counted value $\leq$ high counting limit is reached.

Optionally, you can enable a hardware interrupt via the parameter assignment. This is generated with the parameter rising edge of the STS_DQ bit.

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

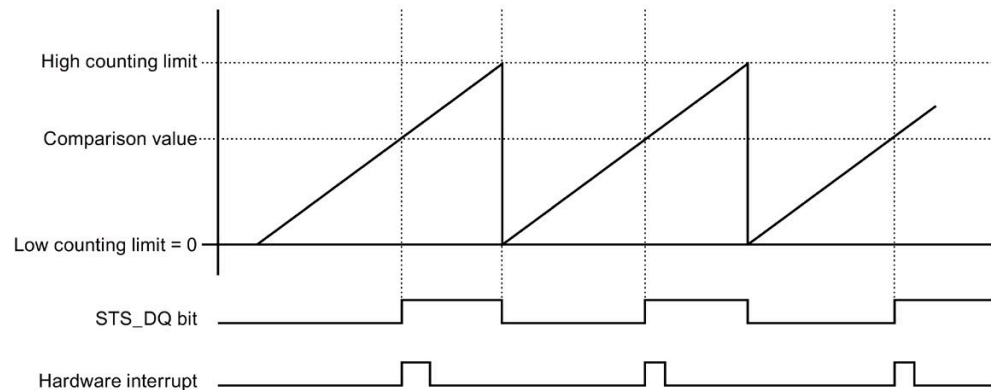


Figure 4-11 Behavior of the STS_DQ bit and hardware interrupt

The following section shows the behavior of the STS_DQ bit with the parameter assignment "Set output DQ = Between low counting limit and comparison value".

The STS_DQ bit is set to 1 when the low counting limit $\leq$ counted value $\leq$ comparison value is reached.

Optionally, you can enable a hardware interrupt via the parameter assignment. This is generated with the parameter rising edge of the STS_DQ bit.

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

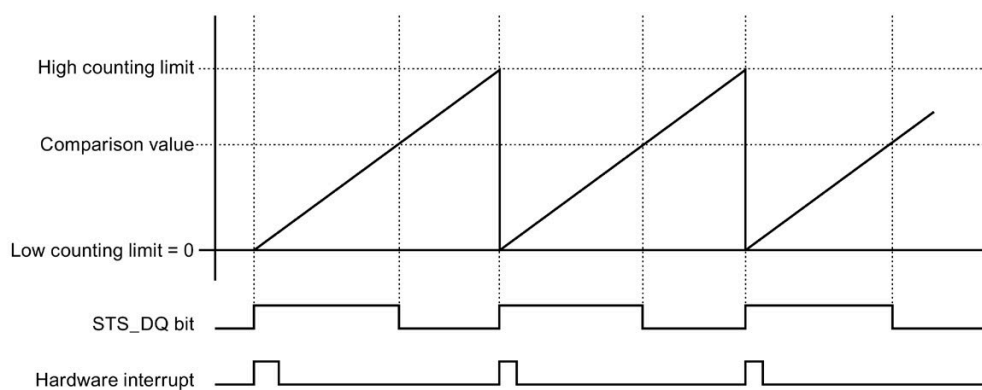


Figure 4-12 Behavior of the STS_DQ bit and hardware interrupt

4.9.4 Counting once with direction setting via digital input

Counting once with direction setting via digital input

The following section describes the direction setting via a digital input.

The "Digital input" count direction is set via the parameters. This means that the count direction is specified via the "Partner digital input".

Count direction:

- "0" up
- "1" down

The start command determines the behavior when starting the counter:

- The counting process starts with the current counter value.
- The counting process starts with the start value that was specified via parameter/command interface.

The following figure shows an example of the principle for counting with direction setting via a digital input.

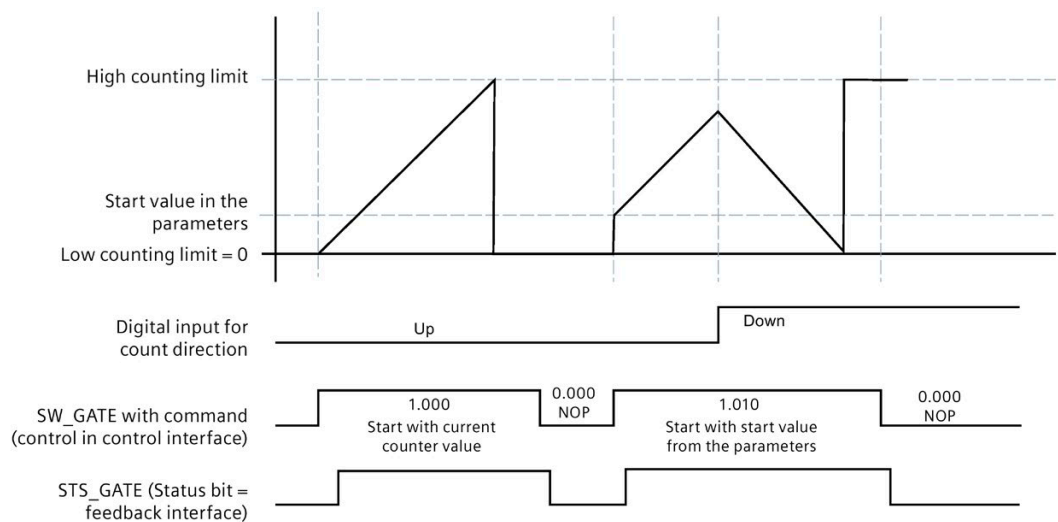


Figure 4-13 Principle: Counting with direction specification

4.9.5 Counting once with hardware gate

Counting once with hardware gate

The following section describes the one-time counting with hardware gate (HW_Gate).

The counting process stops when the high counting limit is violated. The counted value jumps to the low counting limit (=0).

When counting with hardware gate, the software gate (SW_Gate) and the hardware gate must be set (AND operation). When counting once, the software gate must be set and the hardware gate is used for control, i.e. the counter stops when the limit is reached and the counter only restarts when the hardware gate is reset and set again.

If the "SW_Gate" control bit or the hardware gate is reset before the high counting limit is reached, the counter stops.

The following figure shows an example of the principle for counting with hardware gate.

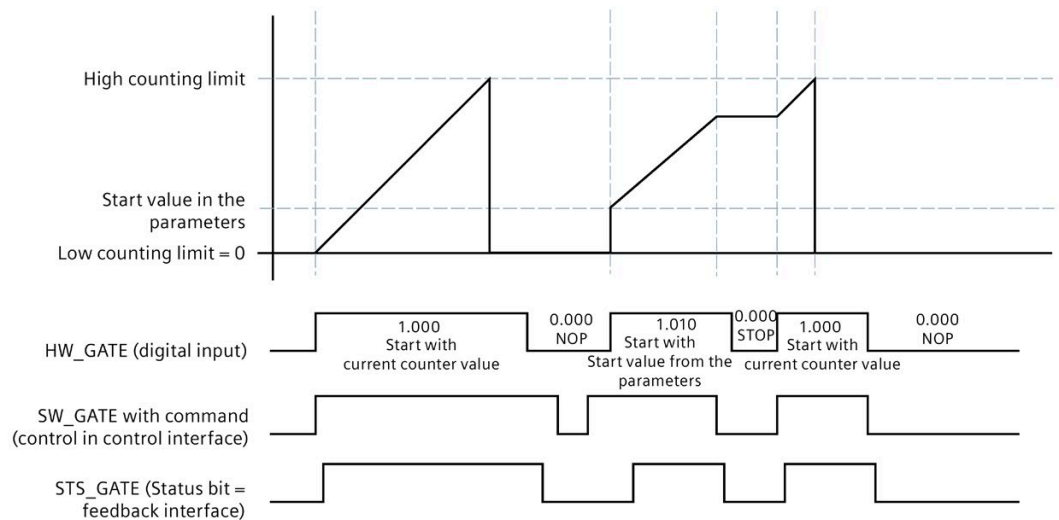


Figure 4-14 Principle: Counting with hardware gate

4.9.6 Parameters

Counting limits

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

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

Low counting limit (not settable): 0

You can continue or terminate (automatic gate stop) counting if a counting limit is exceeded, see the parameter "Reaction to violation of a counting limit".

Start value/load value

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

Comparison values

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

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

Gate control

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

Hardware gate

Opening and closing of the hardware gate (HW-GATE) defines the time window in which the counting signals are acquired. The hardware gate is controlled by the user program.

Reference

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

Interrupts/diagnostics alarms

5.1 Status and error displays

LED displays

The following figure shows the LED displays (status and error displays) of the DI 16xNAMUR HF.

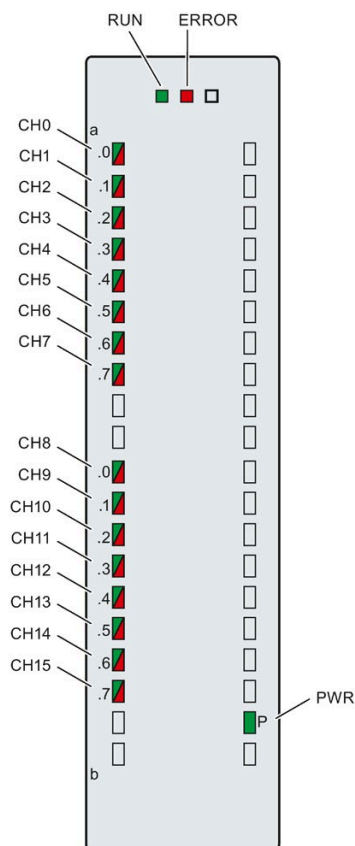


Figure 5-1 LED displays of the DI 16xNAMUR HF module

Meaning of the LED displays

The following tables explain the meaning of the status and error displays. Remedial measures for diagnostic reports can be found in chapter Diagnostics alarms (Page 51).

RUN and ERROR LED

Table 5- 1 Status and error displays RUN and ERROR

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

PWR LED

Table 5- 2 PWR status display

PWR LED	Meaning	Solution
 Off	Supply voltage L+ too low or missing	Check supply voltage L+.
 On	Supply voltage L+ is present and OK	---

CHx LED

Table 5- 3 CHx status display

CHx LED	Meaning	Solution
 Off	0 = Status of the input signal	---
 On	1 = Status of the input signal	---
 On	Diagnostics: Wire break	Check the wiring. When using simple switches, disable diagnostics or connect a resistor (10 kΩ) to the sensor contacts.
	Supply voltage L+ too low or missing or supply voltage short circuit	Check supply voltage L+.

5.2 Interrupts

The DI 16xNAMUR HF digital input module supports diagnostics interrupt and hardware interrupt.

Detailed information on the error event is available in the error organization block by executing the "RALRM" instruction (read additional interrupt information) and in the STEP 7 Online Help.

Diagnostics interrupt

The module generates a diagnostic interrupt at the following events:

- No supply voltage L+
- Wire break
- Parameter assignment error
- Short circuit sensor supply
- Chatter error

Hardware interrupt

The module generates a hardware interrupt at the following events:

- Rising edge
- Falling edge
- Rising and falling edge
- Comparison event occurred for DQ (only in "Counting mode")

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

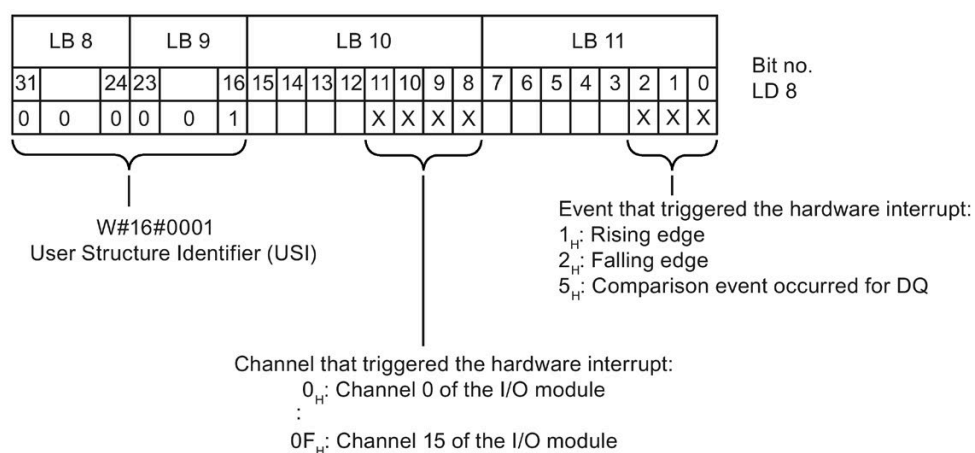


Figure 5-2 Start information of the organization block

Structure of the additional interrupt information

Table 5- 4 Structure of USI = W#16#0001

Data block name	Contents	Comment	Bytes
USI (User Structure Identifier)	W#16#0001	Additional interrupt info for hardware interrupts of the I/O module	2
The channel that triggered the hardware interrupt follows.			
Channel	B#16#00 to B#16#0F	Number of the event-triggering channel (channel 0 to channel 15 of the module)	1
It follows the error event that triggered the hardware interrupt.			
Event	B#16#01	Rising edge	1
	B#16#02	Falling edge	
	B#16#05	Comparison event occurred for DQ (only in "Counting mode")	

5.3 Diagnostics alarms

Diagnostics alarms

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

Table 5- 5 Diagnostics alarms, meaning and corrective measures

Diagnostics alarm	Fault code	Meaning	Solution
Short circuit (NAMUR sensor supply only)	1H	Short circuit on signal line to sensor to ground	Correct the process wiring
		Impedance of sensor circuitry is too high	Use other sensor type or wire differently
		Load impedance too low	Use a sensor with a higher impedance
Wire break (NAMUR sensor only, sensor wired with 10 kΩ and single contact wired with 10 kΩ).	6H	Signal line to a sensor interrupted	Correct the process wiring
		Sensor defective	Replace the sensor
		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
No load voltage	11H	Supply voltage L+ of the module is missing	Connect supply voltage L+ to module/channel
Fault 1 in actuator/sensor = signal chatters	1DH	Chatter error: Signal chatters: too many signal changes within the monitoring window If the module no longer detects chattering of the input signal within the triple monitoring window, the module triggers an outgoing diagnostics interrupt. 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

Technical specifications

6.1 Technical specifications

Technical specifications of DI 16xNAMUR HF

The following table shows the technical specifications as of 07/2021.

You can find a data sheet with the latest technical specifications on the Internet (<https://support.industry.siemens.com/cs/ww/en/pv/6ES7521-7TH00-0AB0>). Enter the article number or the short designation of the module on the website.

Article number	6ES7521-7TH00-0AB0
General information	
Product type designation	DI 16xNAMUR HF
HW functional status	From FS01
Firmware version	V1.0.0
• FW update possible	Yes
Product function	
• I&M data	Yes; I&M0 to I&M3
• Isochronous mode	Yes
• Prioritized startup	Yes
Engineering with	
• STEP 7 TIA Portal configurable/integrated from version	STEP 7 V17 or higher
• STEP 7 configurable/integrated from version	V5.5 SP3 / -
• PROFIBUS from GSD version/GSD revision	V1.0 / V5.1
• PROFINET from GSD version/GSD revision	V2.3 / -
Operating mode	
• DI	Yes
• Counter	Yes
• Oversampling	No
• MSI	Yes
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.	220 mA; with 19.2 V supply

Article number	6ES7521-7TH00-0AB0
Encoder supply	
Number of outputs	16; 2x 8.2 V DC
Short-circuit protection	Yes
NAMUR encoder supply	
• 8.2 V	Yes
• Short-circuit protection	Yes; Per group, electronic
• Output current, max.	100 mA; per group
• Output current per module, max.	200 mA
Power	
Power available from the backplane bus	0.6 W
Power loss	
Power loss, typ.	3.7 W
Digital inputs	
Number of digital inputs	16; NAMUR
Digital inputs, parameterizable	Yes
Source/sink input	P-reading
Pulse extension	Yes; 0.05 s, 0.1 s, 0.2 s, 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; software/hardware gate
• Freely usable digital input	Yes
• Counter	
– Number, max.	4; See manual for details
– Counting frequency, max.	20 kHz; See manual for details
– Counting width	32 bit
– Counting direction up/down	Yes; forward / backward
Input voltage	
• Rated value (DC)	8.2 V
Input current	
• for signal "1", typ.	10 mA
for 10 k switched contact	
– for signal "0"	0.35 to 1.2 mA
– for signal "1"	2.1 ... 10 mA
for unswitched contact	
– for signal "0", max. (permissible quiescent current)	0.35 to 1.2 mA
– for signal "1"	2.1 ... 10 mA

6.1 Technical specifications

Article number	6ES7521-7TH00-0AB0
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.	10 mA
Input delay (for rated value of input voltage)	
for standard inputs	
– parameterizable	Yes; 0.05 / 0.1 / 0.4 / 1.6 / 3.2 / 12.8 / 20 ms
– at "0" to "1", min.	0.05 ms
– at "0" to "1", max.	20 ms
– at "1" to "0", min.	0.05 ms
– at "1" to "0", max.	20 ms
for interrupt inputs	
– parameterizable	Yes
for technological functions	
– parameterizable	Yes
for NAMUR inputs	
– at "0" to "1", max.	20 ms
– at "1" to "0", max.	20 ms
Cable length	
• shielded, max.	200 m; 200 m for technological functions; depending on input frequency, encoder and cable quality; max. 50 m at 20 kHz
Encoder	
Connectable encoders	
• NAMUR encoder/changeover contact according to EN 60947	Yes; no CO contact
• Single contact / changeover contact unconnected	Yes; no CO contact
• Single contact / changeover contact connected with 10 kΩ	Yes; no CO contact
• 2-wire sensor	Yes
– permissible quiescent current (2-wire sensor), max.	1.2 mA
Isochronous mode	
Filtering and processing time (TCI), min.	60 μs; At 50 μs filter time
Bus cycle time (TDP), min.	250 μs
Interrupts/diagnostics/status information	
Diagnostics function	Yes

Article number	6ES7521-7TH00-0AB0
Alarms	
• Diagnostic alarm	Yes
• Hardware interrupt	Yes
Diagnoses	
• Monitoring the supply voltage	Yes
• Monitoring of encoder power supply	Yes; short-circuit
• Wire-break	Yes; to I < 350 µA
• Short-circuit	No
Diagnostics indication LED	
• RUN LED	Yes; green LED
• ERROR LED	Yes; red LED
• Monitoring of the supply voltage (PWR-LED)	Yes; green LED
• Channel status display	Yes; green LED
• for channel diagnostics	Yes; red LED
• for module diagnostics	Yes; red LED
Potential separation	
Potential separation channels	
• between the channels	No
• between the channels, in groups of	8
• between the channels and backplane bus	Yes
• Between the channels and load voltage L+	Yes
• between the channels and the power supply of the electronics	No
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.	40 °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

6.1 Technical specifications

Article number	6ES7521-7TH00-0AB0
Dimensions	
Width	35 mm
Height	147 mm
Depth	129 mm
Weights	
Weight, approx.	240 g

Tolerances of the programmable input delay

Input delay	Tolerance range
0.05 ms	43 µs to 57 µs
0.1 ms	86 µs to 114 µs
0.4 ms	344 µs to 456 µs
1.6 ms	1.5 ms to 1.9 ms
3.2 ms (preset)	3 ms to 4 ms
12.8 ms	12 ms to 15 ms
20 ms	19 ms to 23 ms

Dimension drawing

A.1 Dimensional drawing

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

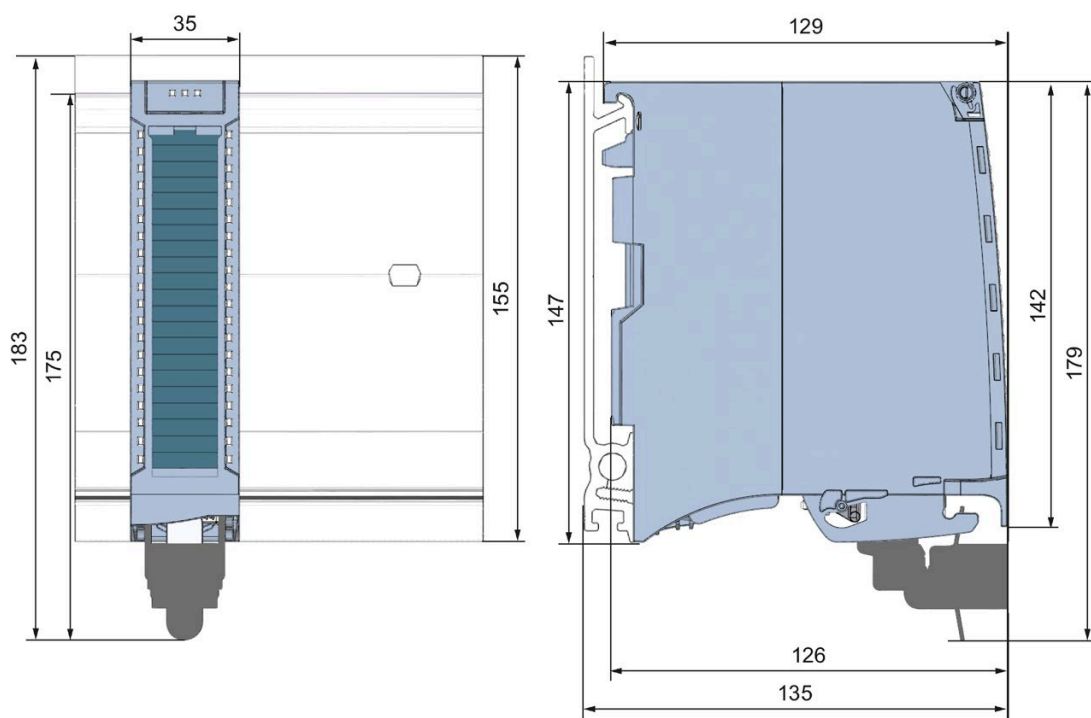


Figure A-1 Dimension drawing of the DI 16xNAMUR HF module



Figure A-2 Dimension drawing of the DI 16xNAMUR HF module in side view with open front cover

Parameter data record

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

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

Isochronous mode

In isochronous mode, you need to observe the following parameter rules:

- Input delay: 0.05 ms
- Diagnostics: Chatter monitoring: Disabled
- Pulse stretching: None
- Chatter monitoring: Disabled

Dependencies for configuration with GSD file

When configuring the module with a GSD file, note that the settings of some parameters are interdependent. The parameters are only checked for plausibility by the module after the transfer to the module.

DI mode: No dependencies. You can assign the individual parameters in any combination.

Counting mode: The following table lists the parameters that are mutually dependent:

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

Device-specific parameters (GSD file)	Dependent parameters
Comparison value	0 ... high counting limit
Start value	0 ... high counting limit

Parameter assignment in the user program

You have the option of re-configuring the module in RUN, (e.g. change values for input delay of individual channels without this affecting the other channels).

Changing parameters in RUN

The WRREC instruction is used to transfer the parameters to the module using data records 0 to 15. Here, the parameters set with STEP 7 are not changed in the CPU, i.e. after a startup the parameters set with STEP 7 are valid again.

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

Output parameter STATUS

If errors occur during the transfer of 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 can find a description of the WRREC instruction and the error codes in the online help of STEP 7.

Operation of the module behind a PROFIBUS DP interface module

If the module is operated behind a PROFIBUS DP interface module, the parameter data records 0 and 1 cannot be read back. You obtain the diagnostics data records 0 and 1 with the read back parameter data records 0 and 1. You can find additional information in the equipment manual for the PROFIBUS DP interface module, section on interrupts on the Internet.

B.2 Structure of the parameter data records DI mode

Assignment of data record and channel

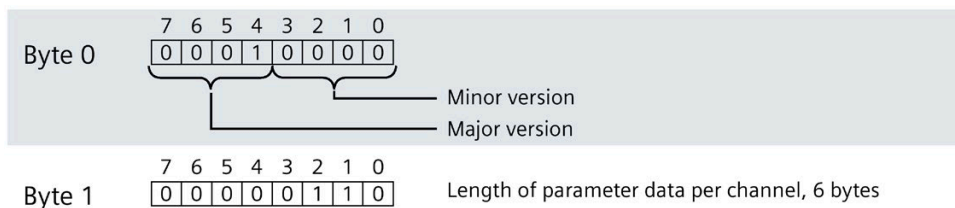
For the configuration with 1 x 16 channels, the parameters are located in data records 0 to 15 and are assigned as follows:

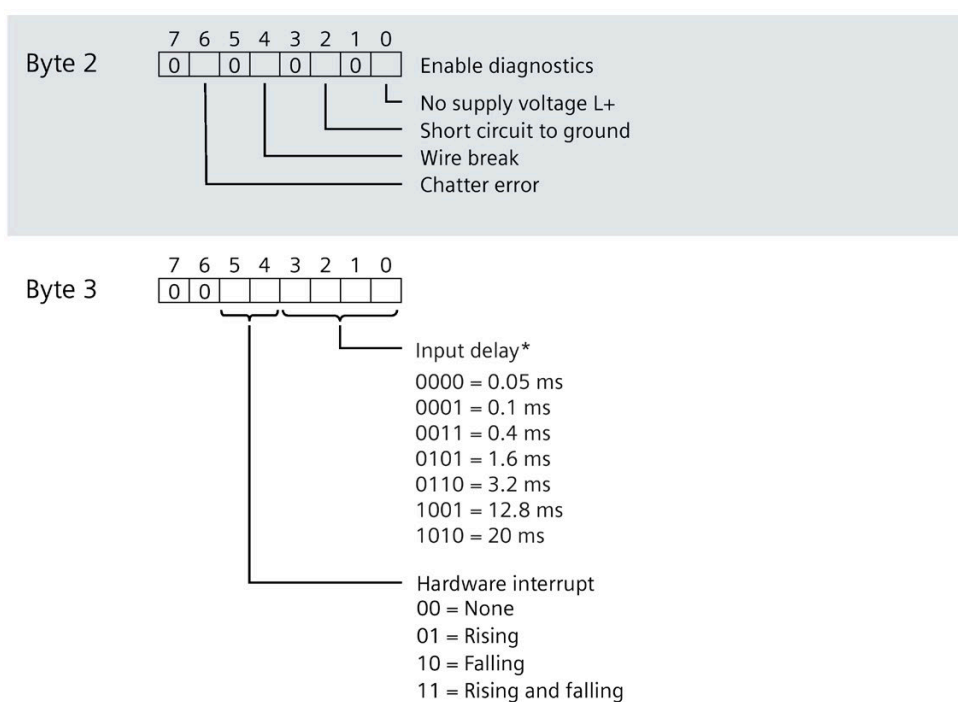
- Data record 0 for channel 0
- Data record 1 for channel 1
- ...
- Data record 14 for channel 14
- Data record 15 for channel 15

Structure of a data record in the DI mode

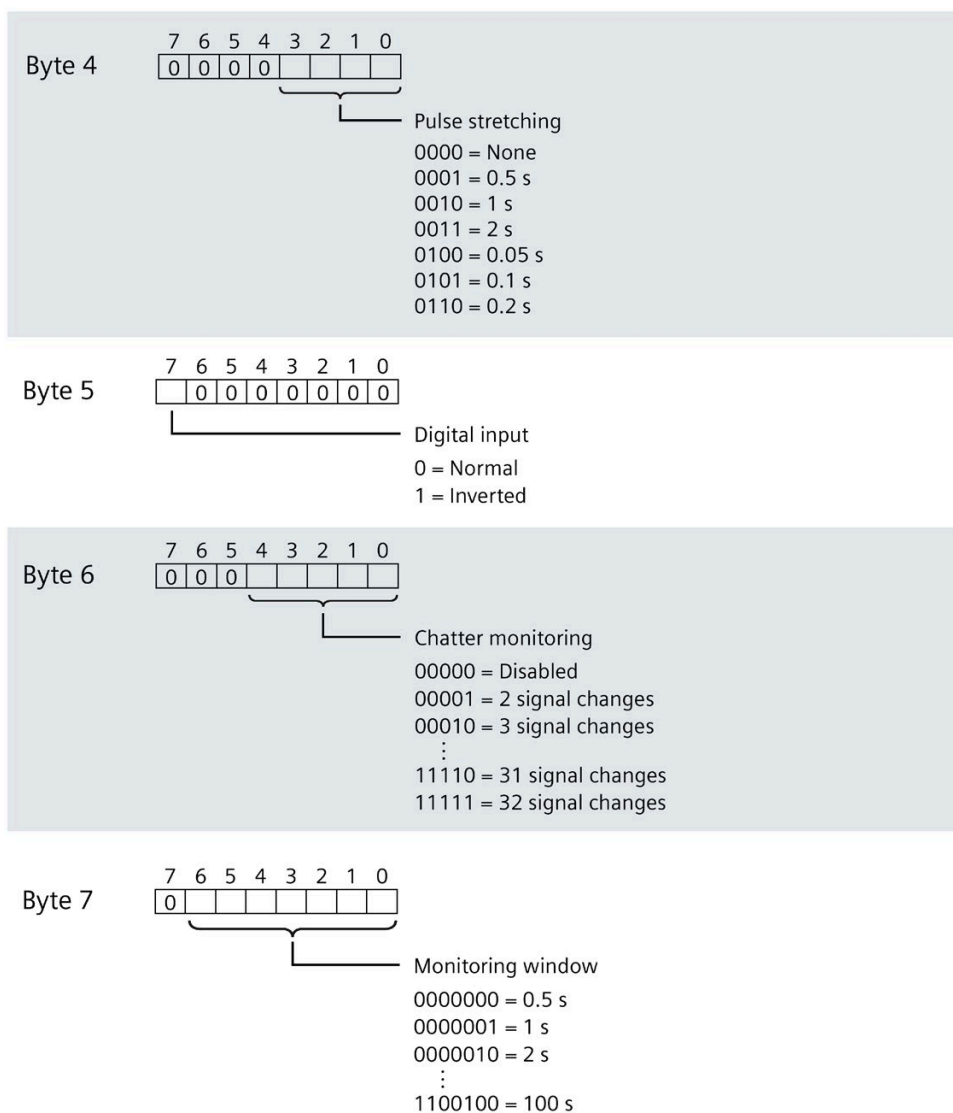
The figure below shows the structure of data record 0 for channel 0 as an example. The structure is identical for channels 1 to 15. The values in byte 0 and byte 1 are fixed and may not be changed.

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





B.2 Structure of the parameter data records DI mode



B.3 Structure of the parameter data records Counting mode

Assignment of data record and channel

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

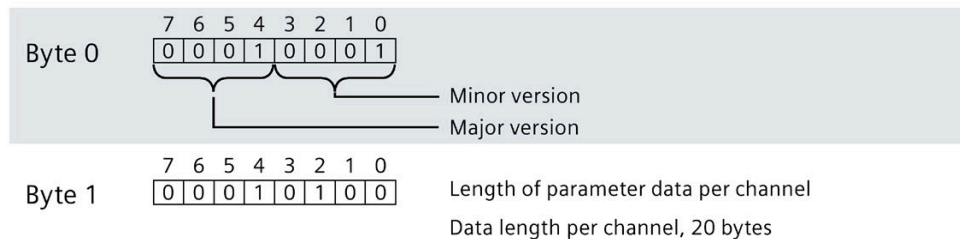
- Data record 0 for channel 0 with counting function
- Data record 1 for channel 1 with counting function
- Data record 2 for channel 2 with counting function
- Data record 3 for channel 3 with counting function
- Data record 4 for channel 4 (structure as in DI mode)
- ...
- Data record 14 for channel 14 (structure as in DI mode)
- Data record 15 for channel 15 (structure as in DI mode)

Structure of data record 0 of the Counting mode

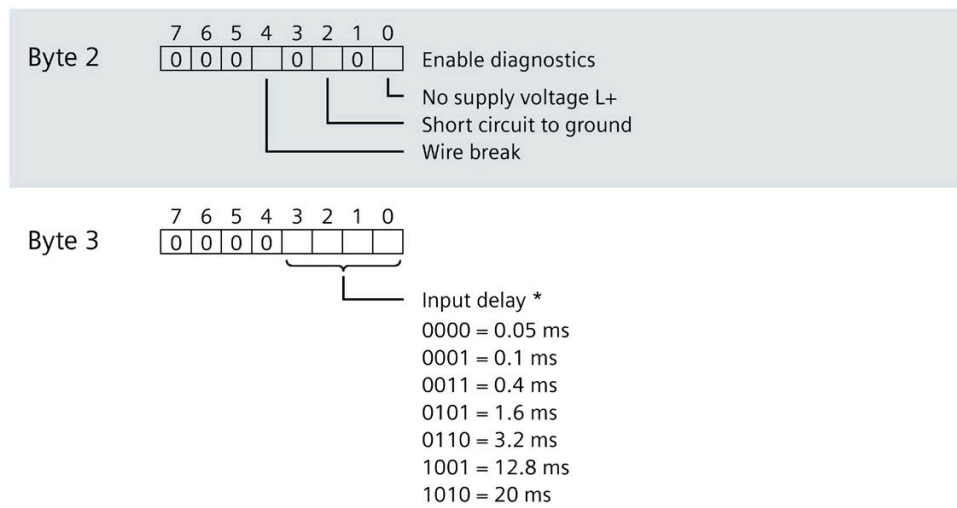
The figure below shows the structure of data record 0 for channel 0 as an example. The structure is identical for channel 1 to 3, the values are in data record 1 to 3.

The values in byte 0 and byte 1 are fixed and may not be changed.

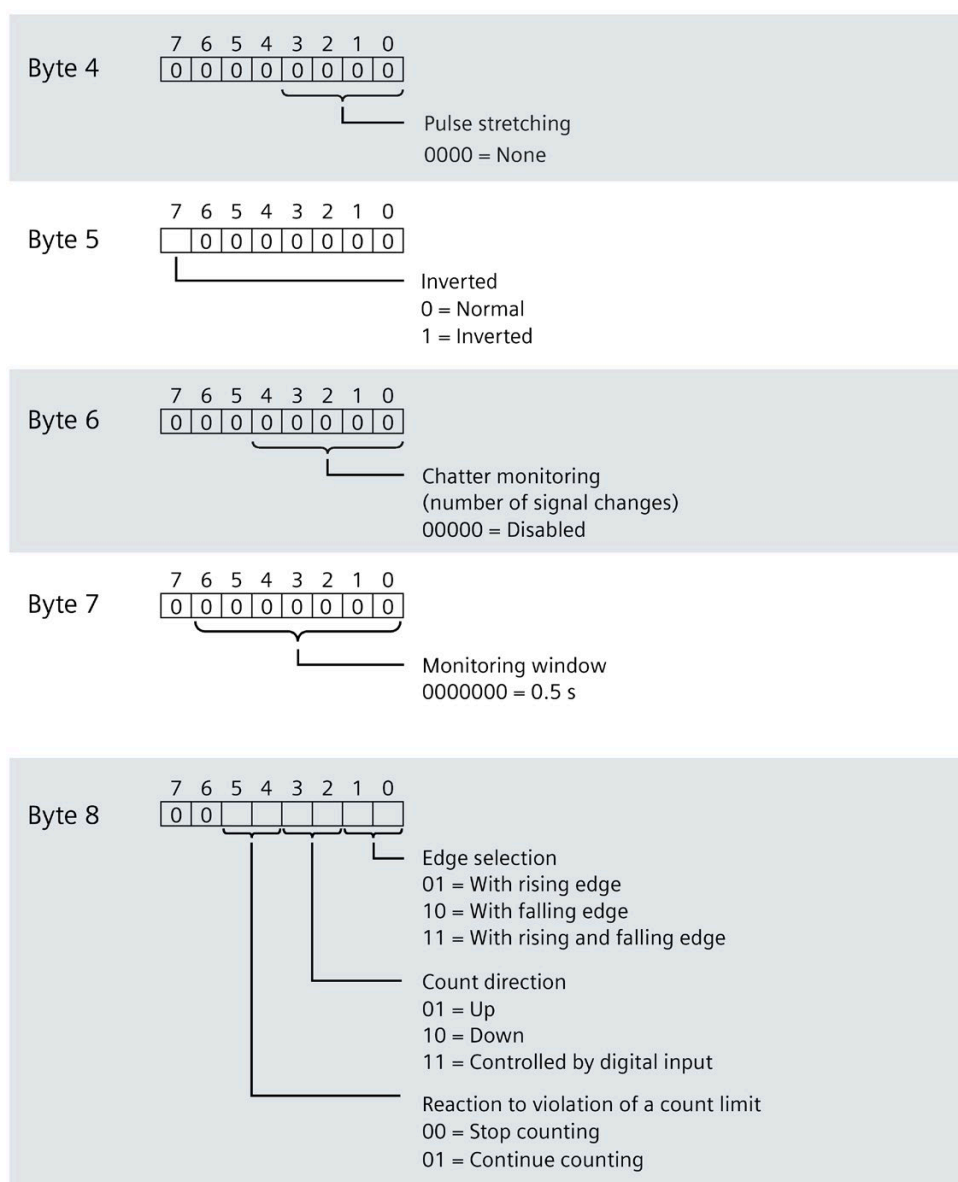
Enable a parameter by setting the corresponding bit to "1".



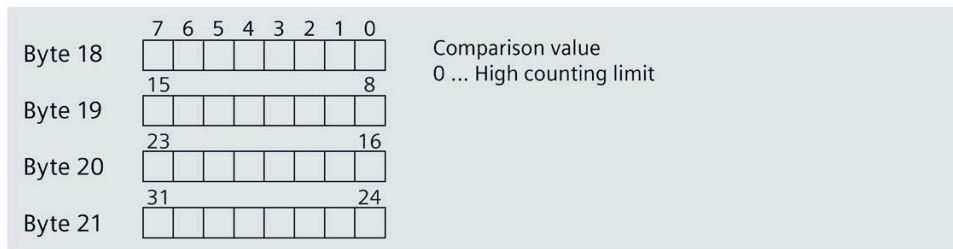
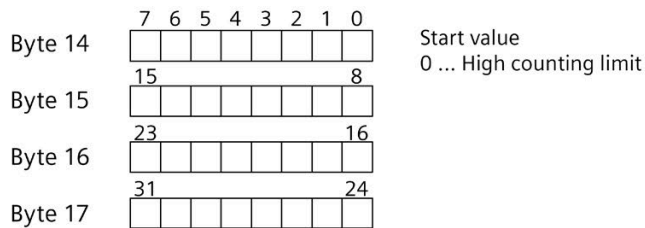
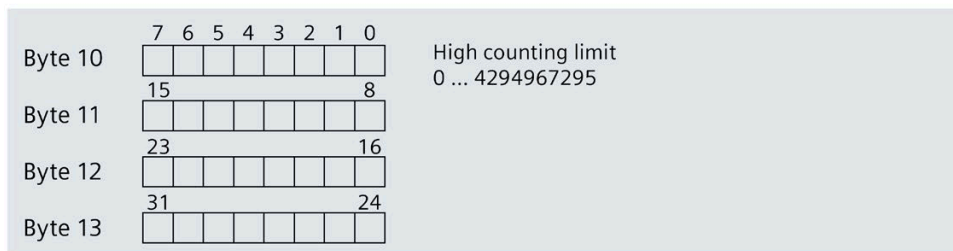
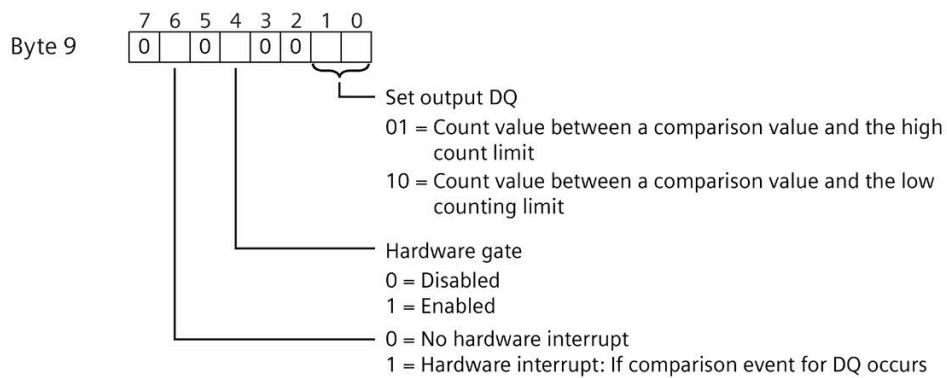
B.3 Structure of the parameter data records Counting mode



B.3 Structure of the parameter data records Counting mode



B.3 Structure of the parameter data records Counting mode



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

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

Structure of data records 4 to 15

The structure of data records 4 to 15 for channels 4 to 15 is identical to the structure in DI mode, see section Structure of the parameter data records DI mode (Page 60), figure Structure of data record 0: Bytes 0 to 3.