

SIMATIC

ET 200SP HA SIMATIC ET 200SP HA Technology Modules

Equipment Manual

Fast input and output and counter functions
(6DL1138-6EA00-0EH1);
Fast controllers (6DL1138-6EB00-0EH1);
Vibration protection (6DL1138-6EC00-0EH1)

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Legal information

Warning notice system

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

DANGER

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

WARNING

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

CAUTION

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

NOTICE

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

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

Qualified Personnel

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

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WARNING

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

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Disclaimer of Liability

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

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Cybersecurity information

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

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

For additional information on industrial cybersecurity measures that may be implemented, please visit
<https://www.siemens.com/cybersecurity-industry>.

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

To stay informed about product updates, subscribe to the Siemens Industrial Cybersecurity RSS Feed under
<https://new.siemens.com/cert>.

Preface

Validity of the documentation

This manual describes the following I/O modules:

System family	I/O module	Article number	Firmware version
SIMATIC; Distributed I/O System; ET 200SP HA	Fast inputs and outputs and counter functions	6DL1138-6EA00-0EH1	V1.2 or higher
	Fast controllers	6DL1138-6EB00-0EH1	
	Vibration protection	6DL1138-6EC00-0EH1	

It supplements the system manual "ET 200SP HA Distributed I/O System" (see <https://support.industry.siemens.com/cs/ww/en/view/109976547> (<https://support.industry.siemens.com/cs/ww/de/view/109976547/en>)).

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

The information in this manual and the system/function manuals enables you to commission the ET 200SP HA.

Appendices

Appendices A and B of this document provide information that is relevant for using the ET 200SP HA outside the Siemens process control systems.

Conventions

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 and on the section of the documentation to which particular attention should be paid.

Product overview

3.1 General properties of the technology modules

Overview

The functions of the technology modules and their system integration differ depending on the configuration. The abbreviated designations of the configurations are generally used in the document.

This manual describes the following ET200SP HA technology modules:

- Module type 1: Fast inputs and outputs and counter functions; TM FIO & Counter (article number: 6DL1138-6EA00-0EH1)
 - Configuration 1: Fast input and output
 - Configuration 2: Fast input and output and counter functions
 - Configuration 3: Fast input and output and speed measurement
- Module type 2: Fast controllers; TM Contr (article number: 6DL1138-6EB00-0EH1)
 - Configuration 4: Fast controllers, small process image and fast input and output
 - Configuration 5: Fast controllers and speed measurement, small process image and fast input and output
 - Configuration 6: Fast controllers and speed measurement, medium process image and fast input and output
 - Configuration 7: Fast controllers and speed measurement, large process image and fast input and output
- Module type 3: Vibration protection; TM VibProt (article number: 6DL1138-6EC00-0EH1)
 - Configuration 8: Fast input and output (without AI) and 4 vibration protection function chains
 - Configuration 9: Fast input and output (without AI) and 8 vibration protection function chains
 - Configuration 10: Fast input and output and 4 vibration protection function chains
 - Configuration 11: Fast input and output and 8 vibration protection function chains

Depending on the desired configuration, you must select the required technology module version from the module catalog of the Siemens process control system. See section Module/channel parameters (Page 33).

The following section provides an overview of the general properties of the ET200SP HA technology modules that apply to all modules as well as properties of the specific module types.

3.1 General properties of the technology modules

Module view

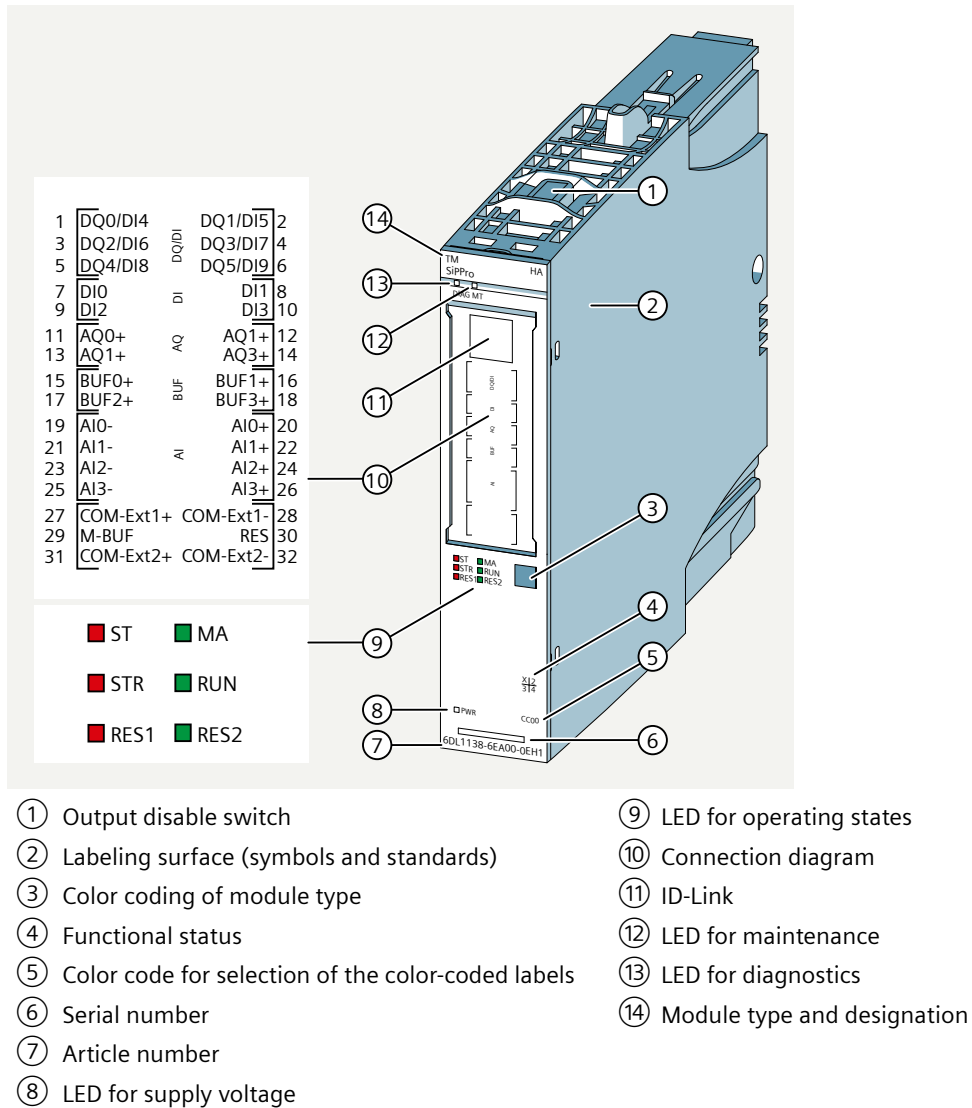


Figure 3-1 Technology module view

Hardware channel overview

The technology modules have the following hardware channels.

- 4x analog input (AI)
- 4x analog output (AQ)
- 4x digital input (DI)
- 6x combined digital input and output (DI/DQ)

- 4x buffer output (BUF)
- 2x RS485 serial interfaces (for communication in case of redundancy for the "Fast controllers" type or trigger signal forwarding for the "Vibration protection" type)

NOTICE**Short-term falsification of the measured value during redundant voltage measurement with functional status (FS) ≤ 2**

With a redundant voltage measurement, a short-term (approx. 3-4 seconds) falsification of the measured value can occur in the following situations:

- When you switch on the supply voltage
- When you plug in the module when the supply voltage is present

This is caused by a brief reduction in the input impedance. The behavior only occurs with functional statuses (FS) ≤ 2 .

Properties

The technology modules have the following common technical properties:

Hardware I/Os	Functions
Analog outputs: Quantity 4	<ul style="list-style-type: none"> • Max. current +/- 50 mA • Output current: 0 to 20 mA, 4 to 20 mA; -20 to 20 mA; -30 to 30 mA; -50 to 50 mA • Max. burden: 500 Ω; depending on output range • Inductive load: max. 1 H • Resolution: 16 bits including sign • Channel-specific configurable diagnostics: Wire break; deviation from specified current; underflow; overflow • Parameterizable as sensor supply +24 V; -24 V for vibration protection sensors
Analog inputs Quantity 4	<ul style="list-style-type: none"> • Current and voltage measurement type for 2-wire transmitter / 4-wire transmitter • Measuring ranges: 0 to 20 mA, 4 to 20 mA; -20 to 20 mA; -30 to 30 mA; -20 to 0 mA; -20 to 0 V; 0 to 10 V; 0 to 20 V; -10 to 10 V • Channel-specific configurable diagnostics: Power supply AI internal; sensor supply; short circuit to L+; overflow; underflow; wire break (4...20 mA) • Parameterizable wire break limit • Interference frequency suppression: 10 Hz, 50 Hz or 60 Hz • Resolution internal up to 24 bits including sign, external 16 bits including sign

3.1 General properties of the technology modules

Hardware I/Os	Functions
Voltage outputs: Quantity 4	<ul style="list-style-type: none"> Output range -10 ... 10 V Resolution: 16 bits including sign Channel-specific configurable diagnostics: Overflow; underflow Output of a CPU value
Digital inputs Quantity 4	<ul style="list-style-type: none"> Rated voltage 24 V DC Input current 2.6 mA Sensor types: <ul style="list-style-type: none"> - P switch - M switch - P/M switch Pulse stretching Input delay Channel-specific configurable diagnostics: Wire break (P/M switch); sensor supply
Digital inputs/digital outputs DI/DO: Quantity 6	<ul style="list-style-type: none"> Parameterizable as digital input and output DI functions: <ul style="list-style-type: none"> - Pulse stretching - Input delay - Channel-specific configurable diagnostics: Sensor supply - Input current: 3.5 mA DO functions: <ul style="list-style-type: none"> - Source Output (P switch); - Max. output current: 500 mA - Channel-specific configurable diagnostics: Short circuit to M; wire break; sensor or transmitter supply - DO protected against short circuit and overload Rated voltage 24 V DC

- Module-specific configurable diagnostics for missing supply voltage L+
- Power supply protected against polarity reversal

The technology modules support the following functions for all modules:

- Firmware update
- I&M identification data
- Parameter reassignment in RUN
- Value status QI
- IO redundancy
- Output disable switch

You can configure the technology modules with STEP 7 HW Config and integrate them into your system.

Output disable switch

WARNING

Personal injury and damage to property may occur

Note the following information for use in hazardous areas:

- Personal injury and property damage can be incurred if the ET 200SP HA connectors are pulled out during operation or if the output disable switch is pressed.
- In hazardous areas, always ensure that power to the ET 200SP HA is turned off before removing the plug connections or pressing the output disable switch.

NOTICE

Dangerous plant conditions possible (disconnect the load)

If you want to put these modules into operation, **you need to press the activation button for 3 seconds** to disconnect the load from the module.

Only then it is permissible to pull out the module during operation.

I/O modules with no load can run again only after restarting the IM or a pulling/plugging.

Failure to comply may result in material damage to the IO device or to the connected sensors.

Pull and plug an I/O module only with disconnected load.

When the output disable switch has been pressed for 3 seconds, the LED DIAG flashes red, the LED MT lights up yellow and the technology module generates a diagnostics message. See section Status indicators of the technology modules (Page 69).

Note

Pressing the output disable switch interrupts any ongoing firmware update. A firmware update cannot be performed when the device is deenergized.

Accessories

The following accessories must be ordered separately:

- Labeling strips
- Color-coded labels
- Reference identification label
- Shield connector

3.3 Module type properties "Fast input and output, counter functions and speed measurement" (6DL1138-6EA00-0EH1)

3.2 Scannable code on the product

Scannable code on the product

For information on the scannable code on the product, refer to the System Manual: ET 200SP HA System Manual (<https://support.industry.siemens.com/cs/ww/de/view/109976547/en>)

3.3 Module type properties "Fast input and output, counter functions and speed measurement" (6DL1138-6EA00-0EH1)

You can configure up to four counter channels and up to three speed measurement channels per module. The digital inputs and outputs can be freely assigned to the counter and measuring functions. The counter can be started or stopped in any counter operating mode by the user program (SW gate) or hardware signals (HW gate). (see Command: Open and close gate (Page 103))

The counter function is available for TM FIO & Counter configuration 2 "Fast input and output and counter functions".

The speed measurement function is available for TM FIO & Counter configuration 3 as well as for TM Contr configurations 5, 6 and 7.

IO redundancy is supported by this module type.

Note

No support of I/O redundancy for "Fast input and output and counter functions"

It is not possible to synchronize the counter readings because of the fast counting processes. This means a redundant configuration is not possible in this operating mode.

Assignment of the hardware inputs and outputs during counting

The number of supported counter channels depends on the connected sensor types and from additionally required hardware inputs and outputs.

The hardware assignment is variable and not tied to a specific hardware input or output. Example: Output result of the comparison function counter channel 1 (DQ0) via DI/DQ3.

The following hardware inputs and outputs are used for the counter function (max. 10 signals):

- Up to 4 DIs
- Up to 6 DI/DQs

The maximum supported counter frequency is reduced from 70 kHz to 7 kHz when the sensor signals are connected to the combined DI/DO. (See also section Explanation of parameters for the Counting operating mode (Page 119))

3.3 Module type properties "Fast input and output, counter functions and speed measurement" (6DL1138-6EA00-0EH1)

Sensor types	Description
Incremental encoder with 24 V signals	<ul style="list-style-type: none"> Signals A*, B* and N* are connected to the assigned DI, DI/DO channel. The module inputs are assigned to the counter function. The signals A* and B* are phase-shifted by 90°. <p>If parameterized accordingly, signals A* and B* are used for counting and signal N* is used for setting the counter to the load value (hereafter also referred to as "zero mark").</p>
Pulse generator without direction signal	<ul style="list-style-type: none"> Signal A* is connected to the assigned DI, DI/DO channel.
Pulse generator with direction signal	<ul style="list-style-type: none"> Count signal A* is connected to the assigned DI, DI/DO channel. Direction signal B* is connected to the assigned DI, DI/DO channel.

The following figure shows the time profile of the incremental encoder with 24 V signals:

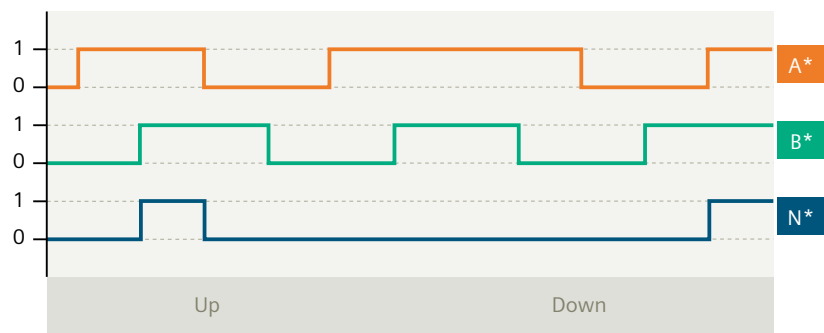


Figure 3-2 Time profile of the incremental encoder with 24 V signals

The following figure shows the time profile of the pulse generator signals and the resulting count pulses:

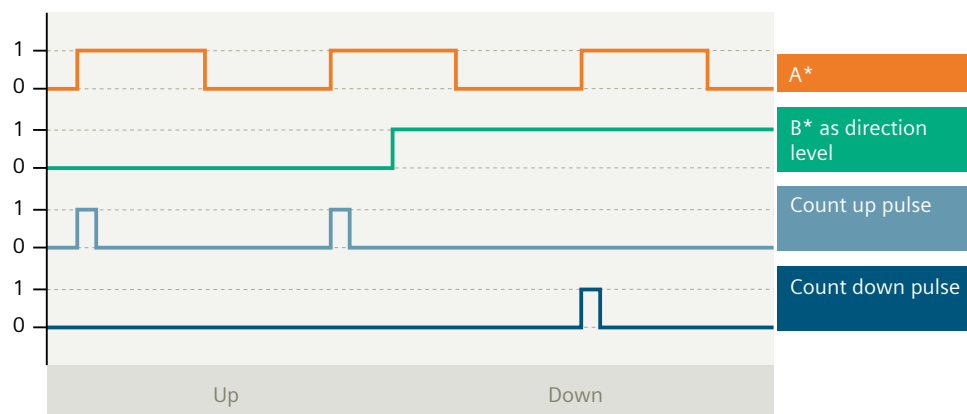


Figure 3-3 Time profile of the pulse generator signals and the resulting count pulses

3.3 Module type properties "Fast input and output, counter functions and speed measurement" (6DL1138-6EA00-0EH1)

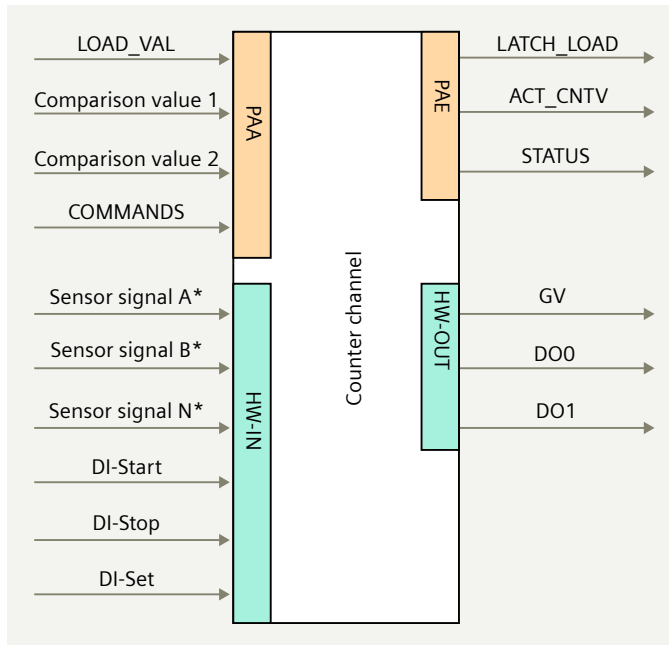


Figure 3-4 Overview of counter function

One load value per counter is carried as a counter start value via the process image.

Two comparison values can be loaded per counter channel via the process image. Various comparison functions can be configured and assigned digital outputs can be controlled directly.

Various commands (e.g. apply load value, load comparison values, open SW gate) can be transferred to the module via the process image (COMMANDS).

Latch load values (LATCH_LOAD), current counter readings and status signals can be read via the process image.

Assignment of the hardware inputs and outputs during speed measurement

The technology module supports a speed measurement function that covers a large speed range from very low to very high speeds.

The technology module supports up to three speed measurement channels.

The hardware assignment is variable as with the counter functions and is not tied to a specific hardware input or output.

The following hardware inputs and outputs are used for the speed measurement:

- Up to 4 DIs for counter and direction signals
- Up to 6 DI/DOs for counter and direction signals as well as for sensor supply

The maximum supported counter frequency is reduced from 70 kHz to 7 kHz when the sensor signals are connected to the combined DI/DO. (See also section Basics (Page 130))

3.3 Module type properties "Fast input and output, counter functions and speed measurement" (6DL1138-6EA00-0EH1)

The technology module supports the following sensor types:

Sensor types	Description
Pulse generator without direction signal	<ul style="list-style-type: none"> The signal A* is connected to the assigned DI, DI/DO channel.
Incremental encoder with direction signal	<ul style="list-style-type: none"> The counter signal A* is connected to the assigned DI, DI/DO channel. The direction signal B* is connected to the assigned DI, DI/DO channel. The signals A* and B* are phase-shifted by 90°.

Note

Sequence of the signals

For a normal direction, signal A* comes in before signal B*. In case of a counter direction, the signs change from + to -.

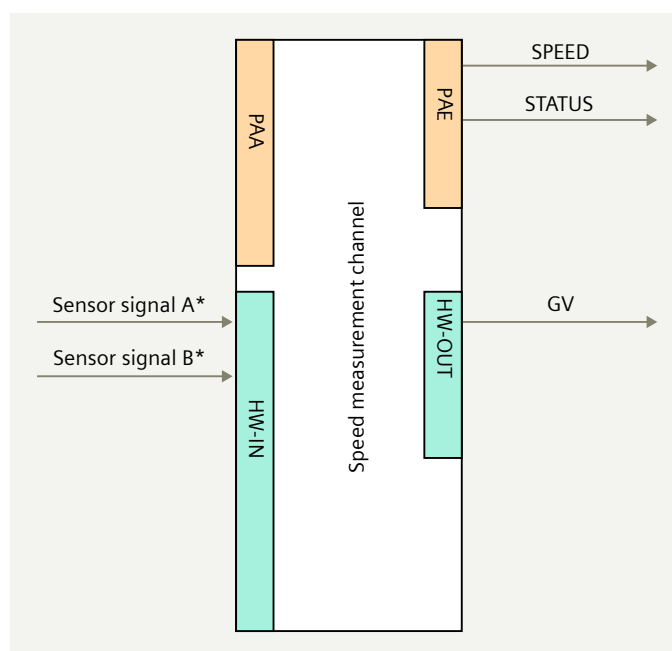


Figure 3-5 Overview of speed measurement function

See also

Setting the counter using the application software (Page 108)

3.4 Properties of the module type "Fast controllers" (6DL1138-6EB00-0EH1)

Overview

The fast controllers are available for all configurations of the TM Contr module type. In addition, configurations 5, 6 and 7 support speed measurements.

The controller structure (application software) can be configured using the graphical configuration user interface (function diagram editor) of the higher-level DCS system and downloaded to the module. The loaded application software is processed by the processor of the technology module (TM-CPU) on the module.

IO and cross-station redundancy are supported by this module type.

See also

Module type properties "Fast input and output, counter functions and speed measurement" (6DL1138-6EA00-0EH1) (Page 16)

Fast controllers - TM Contr (Page 122)

3.5 Properties of the module type "Vibration protection" (6DL1138-6EC00-0EH1)

Overview

The TM VibProt supports up to 8 vibration protection function chains. Up to four characteristic values can be calculated per function chain.

This module version does not support IO redundancy. Process redundancy can be configured with standard means that are made available by the Siemens process control systems.

This module has the following additional properties:

Hardware I/Os	Functions
Analog outputs	<ul style="list-style-type: none">• Sensor supply +/- 24 V DC 50 mA
Analog inputs	<ul style="list-style-type: none">• Sampling rate: Up to 102.4 kHz• Voltage ranges: -20 to 0 V; 0 to +20 V with internal sensor supply 4 mA or 8 mA• AI2 and AI3 can also be used as trigger input for function chains
Voltage outputs	<ul style="list-style-type: none">• Direct output of the AI measured value

Connecting

4.1 Terminal blocks for the technology modules

Terminal blocks are not included in the scope of delivery of the technology modules and must be ordered separately.

Note

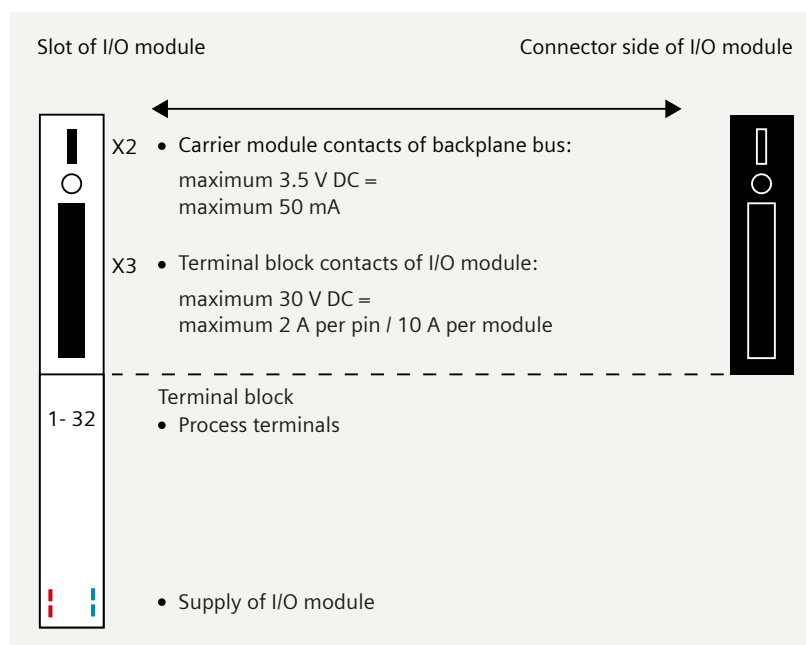
Cables for process signals

All process signals (analog, binary, counter signals) must be connected using shielded cables.

Note

You can find additional information on the configuration in the system manual (see <https://support.industry.siemens.com/cs/ww/en/view/109761547/129592945931>).

Connections on the slot and technology modules



Information on the pin assignment of the I/O module (terminal block) can be found in the following sections.

4.2 Pin assignment of the technology modules

General pin assignment

Table 4-1 Pin assignment of the technology modules

Terminal	assignment	Terminal	assignment	Explanations
1	DQ ₀ / DI ₄	2	DQ ₁ / DI ₅	Terminal 1 to 10: DQ _n : Digital output/encoder supply, channel n DI _n : Digital input signal, channel n
3	DQ ₂ / DI ₆	4	DQ ₃ / DI ₇	
5	DQ ₄ / DI ₈	6	DQ ₅ / DI ₉	Terminal 11 to 14: AQ _n +: Analog output "+", channel n
7	DI ₀	8	DI ₁	
9	DI ₂	10	DI ₃	Terminal 15 to 18: BUF _n +: Voltage output "+", channel n
11	AQ ₀ +	12	AQ ₁ +	
13	AQ ₂ +	14	AQ ₃ +	Terminal 19 to 26: AI _n -: Analog input signal "-", channel n AI _n +: Analog input signal "+", channel n
15	BUF ₀ +	16	BUF ₁ +	
17	BUF ₂ +	18	BUF ₃ +	Terminal 27 to 32: COM-Ext ₁ : External communication interface COM-Ext ₂ : External communication interface M-BUF: Ground reference of the buffer outputs RES: Reserved
19	AI ₀ -	20	AI ₀ +	
21	AI ₁ -	22	AI ₁ +	1P1: Supply voltage L+ of the voltage bus 1P 2P1: Supply voltage L+ of the voltage bus 2P 1P2: Ground reference of the voltage bus 1P 2P2: Ground reference of the voltage bus 2P
23	AI ₂ -	24	AI ₂ +	
25	AI ₃ -	26	AI ₃ +	
27	COM-Ext ₁ +	28	COM-Ext ₁ -	
29	M-BUF	30	RES	
31	COM-Ext ₂ +	32	COM-Ext ₂ -	
1P1	L+	1P2	M	
2P1 ¹	L+	2P2	M	
				<p>1 DQ0/DI4 2 DQ1/DI5 3 DQ2/DI6 4 DQ3/DI7 5 DQ4/DI8 6 DQ5/DI9 7 DI0 8 DI1 9 DI2 10 DI3 11 AQ0+ 12 AQ1+ 13 AQ2+ 14 AQ3+ 15 BUF0+ 16 BUF1+ 17 BUF2+ 18 BUF3+ 19 AI0- 20 AI0+ 21 AI1- 22 AI1+ 23 AI2- 24 AI2+ 25 AI3- 26 AI3+ 27 COM-Ext1+ 28 COM-Ext1- 29 M-BUF 30 RES 31 COM-Ext2+ 32 COM-Ext2- 1P1 L+ 24VDC M 1P2 2P1 L+ 24VDC M 2P2 MAX. 10 A</p>
Recommended color-coded label: CC00				

¹ If the module is inserted in a TB45R-P32 terminal block suitable for IO redundancy, the voltage at this terminal is 1P3.

See also

Explanation of the digital input parameters (Page 60)

Explanation of the parameters of the combined digital inputs and outputs (Page 62)

Explanation of the analog input parameters (Page 54)

Explanation of the analog output parameters (Page 58)

4.3 Connection scheme

Digital input: Wiring using channel 0 as an example:

The figure below shows the wiring of a digital input, using the example of channel 0:

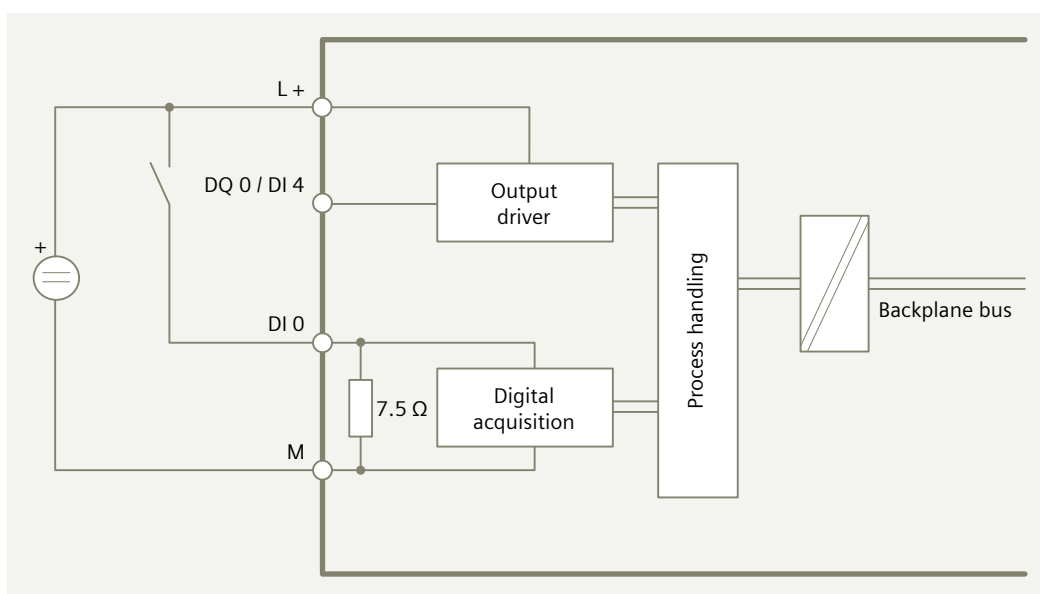


Figure 4-1 Wiring of a digital input

You can also connect a digital sensor with sensor supply via an assigned digital output DQ_x/DI_y .

In this case, monitoring is available for digital input DI_0 .

You can find information on assigning parameters to the digital output in the following sections:

- Section "Explanation of the digital input parameters (Page 60)"
- Section "Explanation of the parameters of the combined digital inputs and outputs (Page 62)"

Analog inputs

Analog input: 2-wire connection of a transducer using channel 0 as an example:

The figure below shows the 2-conductor terminal of a measuring transducer (4...20 mA), using the example of channel 0:

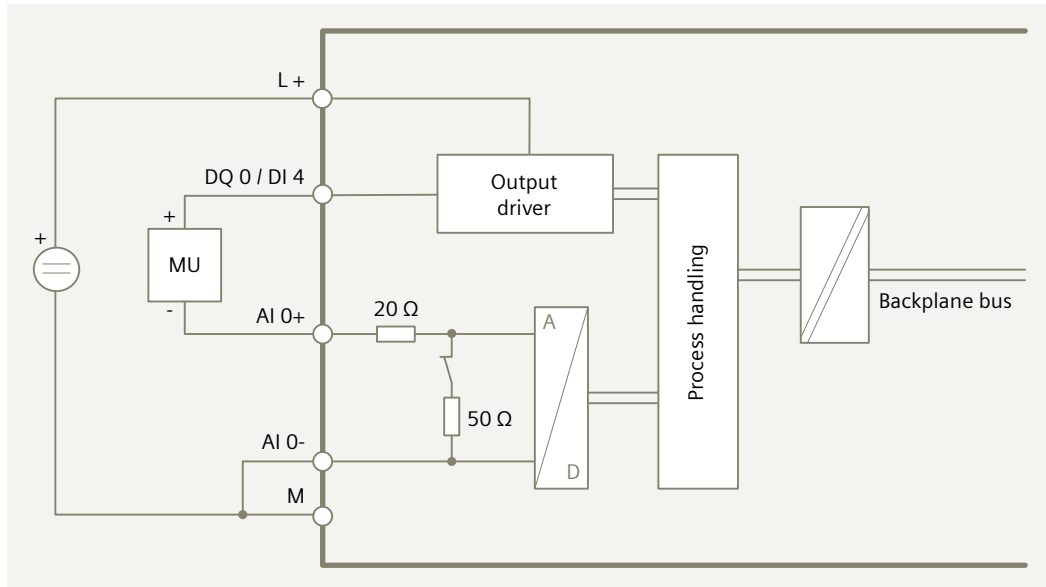


Figure 4-2 2-wire connection of a transducer

You can also use a measuring transducer that supplies a voltage output signal (e.g. -10...+10 V).

In this case, the 50 ohm measurement resistance of the module is switched off.

NOTICE

The analog inputs do not have an internal ground reference.

The connected measured signal (terminal AI-) must be applied externally to the ground (terminal M).

Analog input: Non-isolated connection of a 4-wire transducer:

The figure below shows the non-isolated connection of a 4-wire transducer, using the example of channel 0:

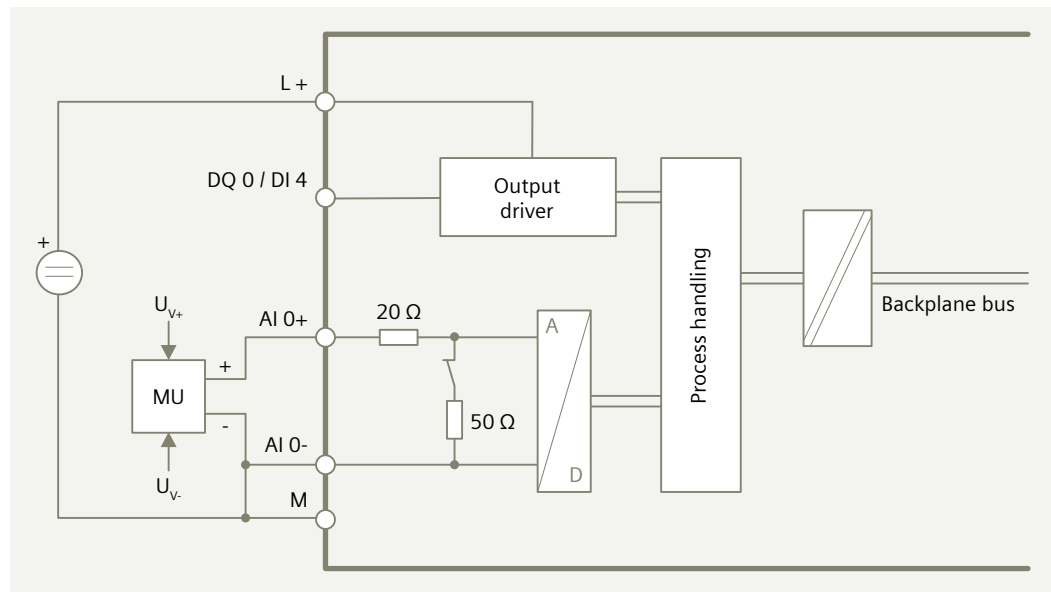


Figure 4-3 Non-isolated connection of a 4-wire transducer using channel 0 as an example:

Connection of a 4-wire transducer is one type of wiring variant to connect transducers.

You can also supply the 4-wire transmitter via an assigned digital output DQ_x/DI_y . Reference potential of the supply is M.

In this case, sensor supply monitoring is available for the analog input I_0 .

You can also use a measuring transducer that supplies a voltage output signal (e.g. -10...+10 V).

In this case, the 50 ohm measurement resistance of the module is switched off.

You can find information on assigning parameters to the digital output in the following section:

- Section "Explanation of the analog input parameters (Page 54)"

Analog outputs

Analog output: Connection of an actuator using channel AQ0 as an example:

The following figure shows the connection of an actuator using channel AQ0 as an example:

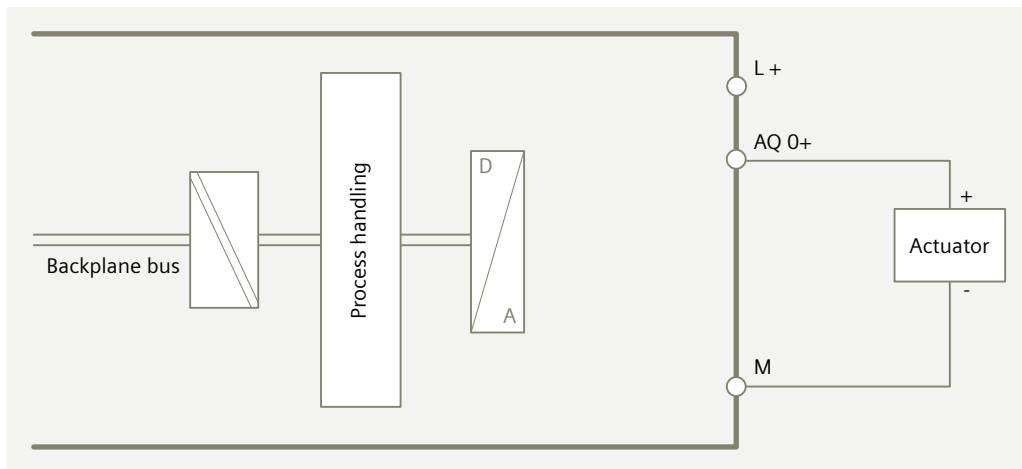


Figure 4-4 Actuator connection

Analog output: Connection of an actuator for a redundant technology module configuration using channel AQ0 as an example:

The following figure shows the connection of an actuator for a redundant technology module configuration using channel AQ0 as an example:

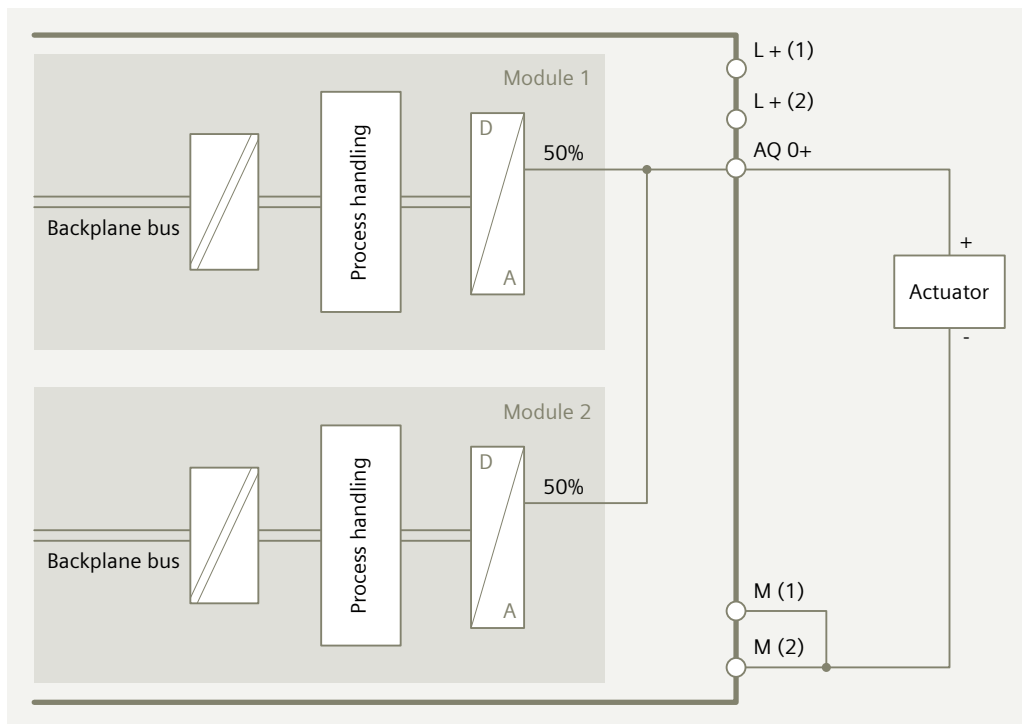


Figure 4-5 Actuator connection for a redundant technology module

In the error-free state, both technology modules supply 50 % of the required output current.

If one module of the redundancy pair fails, the remaining module supplies 100 % of the required output current. When the faulty module is replaced, the switch is made back to

50 %/50 % mode. The adaptation of the 50 %/50 % distribution takes place over a ramp to prevent bumps.

You can find information on assigning parameters to the digital output in the following section:

- Section "Explanation of the analog output parameters (Page 58)"

Vibration sensors

Vibration sensor: 2-wire connection of a vibration sensor using channel 0 as an example:

The following connections can be used for speed as well as acceleration sensors.

The figure below shows the 2-wire connection of a vibration sensor (4...20 mA), using channel 0 as an example:

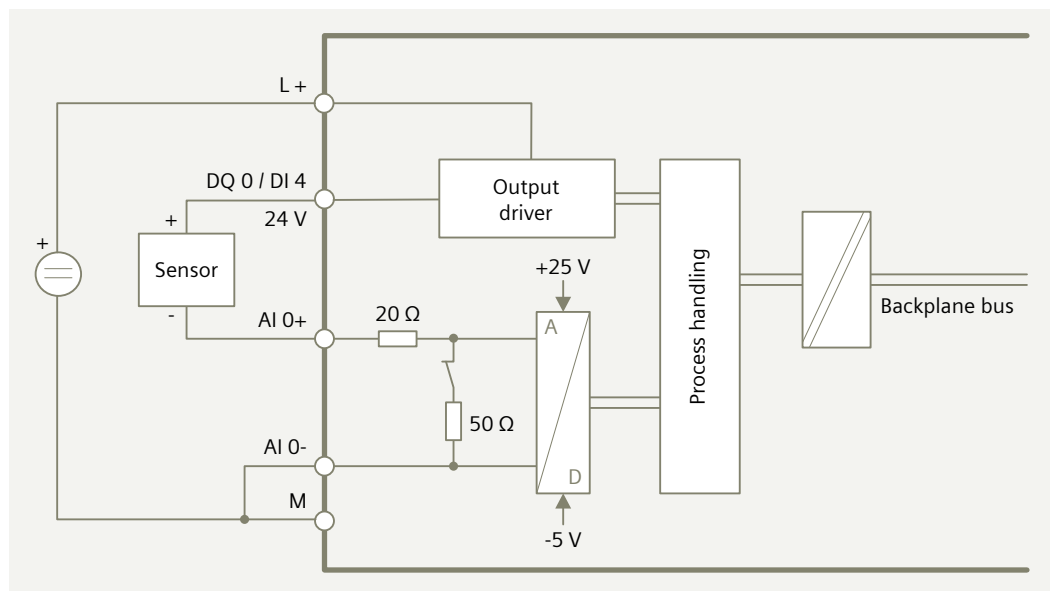


Figure 4-6 2-wire connection of the vibration sensors

Vibration sensor: Connection of plunger coil sensors using channel 0 as an example:

The figure below shows the connection of plunger coil sensors (± 10 V) using channel 0 as an example:

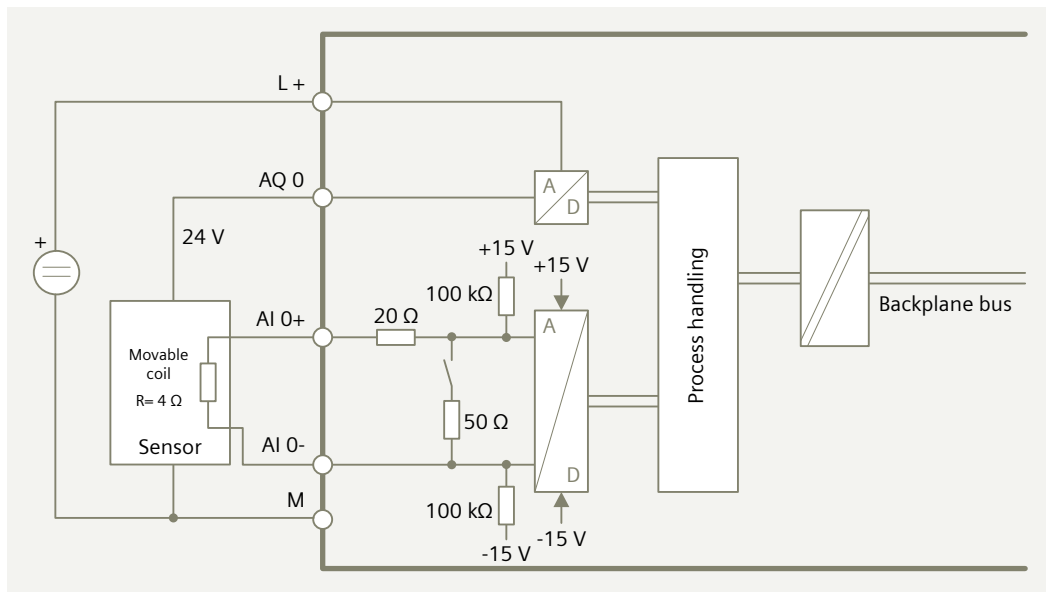


Figure 4-7 Connection of plunger coil sensors

You can also supply the plunger coil sensor via an assigned analog output with controlled output voltage ($\pm 24\text{ V}$) or externally.

Reference potential of the supply is M.

Vibration sensor: Connection of constant current sensor using channel 0 as an example:

The following figure shows the connection of a constant current sensor (CCS) using channel 0 as an example:

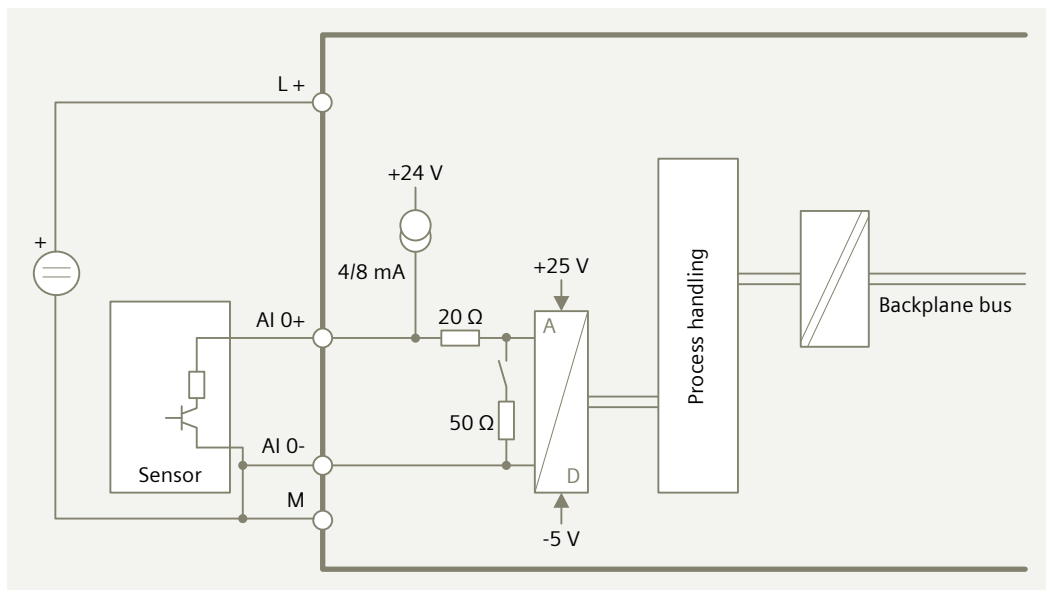


Figure 4-8 Connection of constant current sensor

The sensor is supplied by the internal power source.

You can parameterize the sensor current to 4 mA or 8 mA.

Vibration sensor: Connection of vibration sensors with -24 V / +24 V power supply using channel 0 as an example:

The following figure shows the connection of vibration sensors with -24 V / +24 V power supply using channel 0 as an example:

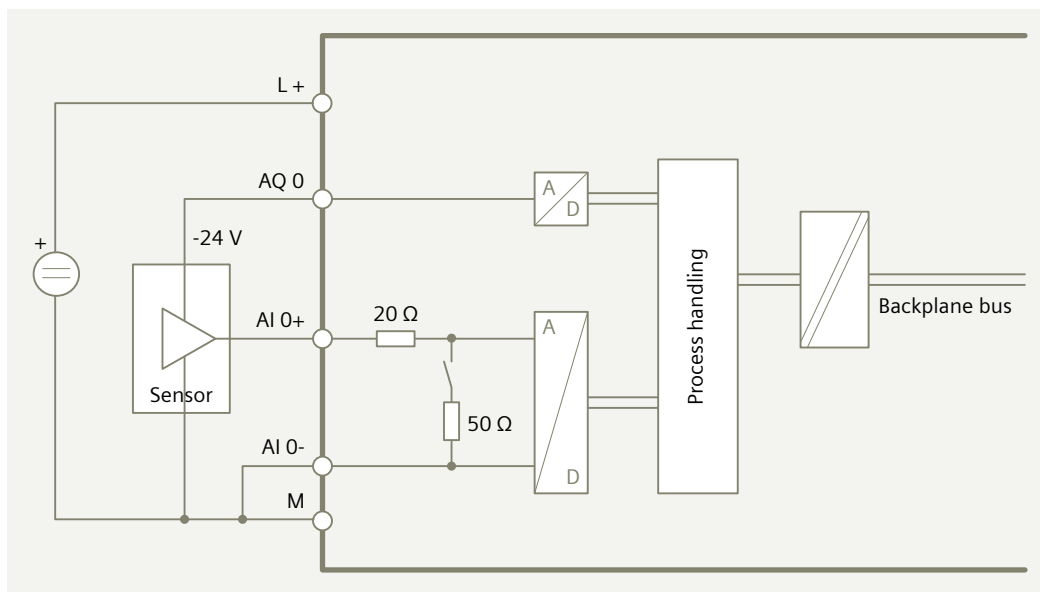


Figure 4-9 Connection of the vibration sensors with ± 24 V power supply

The figure above shows an example of a terminal version with a negative power supply. The sensor supply takes place over an assigned analog output AQ.

You can set the sensor supply as needed to +24 V or -24 V.

4.4 Schematic circuit diagram

The following figure shows the block diagram of the technology modules.

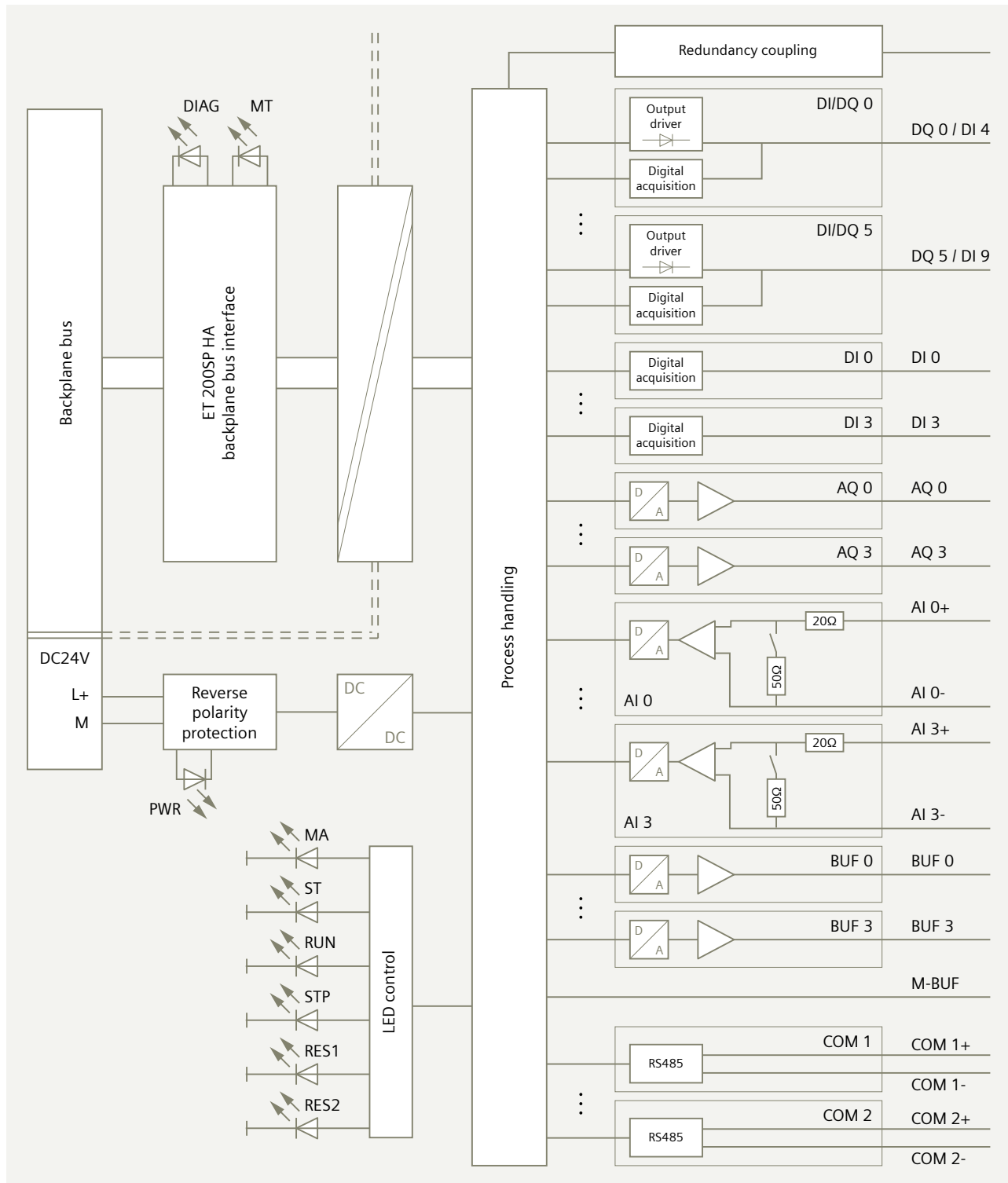


Figure 4-10 Schematic circuit diagram of the technology modules

Supply voltage L+/M

Connect supply voltage L+ of 24 V DC to terminals L+ and M. An internal protective circuit protects the technology modules from reverse polarity. The technology modules monitor whether the supply voltage L+ is connected and available.

Firmware update

The supply voltage L+ must be available on the technology module at the start of firmware updates and during the update.

(See also system manual <https://support.industry.siemens.com/cs/ww/en/view/109761547/129592945931>)

Parameter

5.1 Module/channel parameters

The following tables show the parameters of the individual channels that apply to all technology modules.

The parameters for the counting function, speed measurement, and vibration protection are available in the section Functions (Page 73).

General module parameters

Parameter	Value range	Default	Parameter reassignment in RUN	Efficiency range
Diagnostics: Missing supply voltage L+	<ul style="list-style-type: none"> Enabled Disabled 	Enabled	Yes	Module
Redundancy	<ul style="list-style-type: none"> None Primary module Secondary module 	None	Yes	Module
Redundancy mode	<ul style="list-style-type: none"> IO Cross-station 	IO	Yes	Module
Potential group	<ul style="list-style-type: none"> Use potential group of the left module Enable new potential group 	Use potential group of the left module	No	Module

Parameters of the analog inputs

Parameter	Value range	Default	Parameter reassignment in RUN	Efficiency range
AI sampling frequency (can only be set for TM VibProt)	<ul style="list-style-type: none"> 102.4 kHz 51.2 kHz 25.6 kHz 12.8 kHz 6.4 kHz 3.2 kHz 1.6 kHz 	102.4 kHz (For all other module types set permanently to 1.6 kHz.)	Yes Analog signal acquisition is restarted after the change.	Module
Measurement type	<ul style="list-style-type: none"> Disabled Current Voltage VIB Voltage Transmitter (TM VibProt) VIB Const Current Transmitter (CCS sensor) (TM VibProt) 	Disabled	Yes	Channel
Measuring range	<ul style="list-style-type: none"> Disabled 0 to 20 mA 4 to 20 mA -20 to +20 mA -30 to +30 mA -20 mA to 0 mA 0 to +10 V -10 to +10 V 0 to +20 V -20 to 0 V 0 to +20 V with sensor supply 4 mA (TM VibProt) 0 to +20 V with sensor supply 8 mA (TM VibProt) 	Disabled	Yes	Channel
Smoothing	<ul style="list-style-type: none"> None Weak Medium Strong 	None	Yes	Channel
Wire break limit	<ul style="list-style-type: none"> 1.185 mA 3.6 mA 	1.185 mA	Yes	Channel
Unit sensitivity (only TM VibProt)	<ul style="list-style-type: none"> V mV mA μA 	V	Yes	Channel

5.1 Module/channel parameters

Parameter	Value range	Default	Parameter reassignment in RUN	Efficiency range
Diagnostics: Internal AI power supply	<ul style="list-style-type: none"> Enabled Disabled 	Disabled	Yes	Channel
Diagnostics Sensor supply	<ul style="list-style-type: none"> Enabled Disabled 	Enabled	Yes	Channel
Diagnostics: Short-circuit to L+	<ul style="list-style-type: none"> Enabled Disabled 	Enabled	Yes	Channel
Diagnostic: Wire break	<ul style="list-style-type: none"> Enabled Disabled 	Enabled	Yes	Channel
Diagnostics: Underflow	<ul style="list-style-type: none"> Enabled Disabled 	Enabled	Yes	Channel
Diagnostics: Overflow	<ul style="list-style-type: none"> Enabled Disabled 	Enabled	Yes	Channel
Sensitivity (only TM VibProt)	<ul style="list-style-type: none"> Value 	100	Yes	Channel
Physical unit of sensitivity (only TM VibProt)	<ul style="list-style-type: none"> m/s² inch/s² g mm/s inch/s mils V mV A mA μA mbar bar Pa psi eu Hz cpm rpm s ms 	m/s ²	Yes	Channel
Interference frequency suppression	<ul style="list-style-type: none"> None 60 Hz (50 ms integration time) 50 Hz (20 ms integration time) 10 Hz (100 ms integration time) 	None	Yes	Channel

5.1 Module/channel parameters

Parameter	Value range	Default	Parameter reassignment in RUN	Efficiency range
Measuring range high limit (in physical unit)	<ul style="list-style-type: none"> Value 	100 (%)	Yes	Channel
Measuring range low limit (in physical unit)	<ul style="list-style-type: none"> Value 	0 (%)	Yes	Channel
Limit overflow	<ul style="list-style-type: none"> Measuring range high limit + x Example: $27648 + (27648 / 100) * x$ 	+10 %, according to the measuring range	Yes	Channel
Limit underflow	<ul style="list-style-type: none"> Measuring range low limit - x Example: $0 - (27648 / 100) * x$ 	-10 %, according to the measuring range	Yes	Channel

Parameters of the analog outputs

Parameter	Value range	Default	Parameter reassignment in RUN	Efficiency range
Type of output	<ul style="list-style-type: none"> Disabled Output CPU Output TM CPU VIB Sensor supply (TM VibProt) 	Disabled	Yes	Channel
Output range	<ul style="list-style-type: none"> Disabled 0 to 20 mA 4 to 20 mA -20 to +20 mA -30 to +30 mA -50 to +50 mA Sensor supply +24 V (TM VibProt) Sensor supply -24 V (TM VibProt) 	Disabled	Yes	Channel
Diagnostic: Wire break	<ul style="list-style-type: none"> Enabled Disabled 	Enabled	Yes	Channel
Diagnostics deviation output current	<ul style="list-style-type: none"> Enabled Disabled 	Enabled	Yes	Channel
Diagnostics: Overflow	<ul style="list-style-type: none"> Enabled Disabled 	Enabled	Yes	Channel
Diagnostics: Underflow	<ul style="list-style-type: none"> Enabled Disabled 	Enabled	Yes	Channel

Parameter	Value range	Default	Parameter reassignment in RUN	Efficiency range
Reaction to CPU STOP	<ul style="list-style-type: none"> Shutdown Keep last value Output substitute value Close with defined ramp 	Shutdown	Yes	Channel
Substitute value/closing time	<ul style="list-style-type: none"> Standardized substitute values Closing time (100% to 0%) in ms 	0	Yes	Channel
Output current monitoring	<ul style="list-style-type: none"> No monitoring 4 % 10 % 33 % 	No monitoring	Yes	Channel
Output range high limit (in physical unit)	<ul style="list-style-type: none"> Value 	100 %	Yes	Channel
Output range low limit (in physical unit)	<ul style="list-style-type: none"> Value 	0 %	Yes	Channel

Parameters of the digital inputs

Parameter	Value range	Default	Parameter reassignment in RUN	Efficiency range
Channel operating mode DI (configuration 1, 4, 8, 9, 10, 11)	<ul style="list-style-type: none">DisabledEnabled	Disabled	Yes	Channel

Parameter	Value range	Default	Parameter reassignment in RUN	Efficiency range
Channel operating mode DI (configuration 2)	<ul style="list-style-type: none"> Disabled Enabled Pulse generator signal A (counter/measuring function 1) Pulse generator signal B (counter/measuring function 1) Pulse generator signal N (counter/measuring function 1) HW gate start/DI start (counter/metering function 1) HW gate stop/DI stop (counter/metering function 1) Set HW signal (counter 1) Pulse generator signal A (counter/measuring function 2) Pulse generator signal B (counter/measuring function 2) Pulse generator signal N (counter/measuring function 2) HW gate start/DI start (counter/metering function 2) HW gate stop/DI stop (counter/metering function 2) Set HW signal (counter 2) 	Disabled	<p>Yes</p> <p>Changes in the hardware assignment result in a restart of the counter and measuring function.</p>	Channel

5.1 Module/channel parameters

Parameter	Value range	Default	Parameter reassignment in RUN	Efficiency range
	<ul style="list-style-type: none"> Pulse generator signal A (counter/measuring function 3) Pulse generator signal B (counter/measuring function 3) Pulse generator signal N (counter/measuring function 3) HW gate start/DI start (counter/metering function 3) HW gate stop/DI stop (counter/metering function 3) Set HW signal (counter 3) Pulse generator signal A (counter/measuring function 4) Pulse generator signal B (counter/measuring function 4) Pulse generator signal N (counter/measuring function 4) HW gate start/DI start (counter/metering function 4) HW gate stop/DI stop (counter/metering function 4) Set HW signal (counter 4) 			

Parameter	Value range	Default	Parameter reassignment in RUN	Efficiency range
Channel operating mode DI (configuration 3, 5, 6, 7)	<ul style="list-style-type: none"> Disabled Enabled Pulse generator signal A (speed measurement 1) 	Disabled	Yes Changes in the hardware assignment result in a restart of the counter and measuring function.	Channel
	<ul style="list-style-type: none"> Pulse generator signal B (speed measurement 1) Pulse generator signal A (speed measurement 2) Pulse generator signal B (speed measurement 2) Pulse generator signal A (speed measurement 3) Pulse generator signal B (speed measurement 3) 			
Sensor type	<ul style="list-style-type: none"> P switch M switch P/M switch 	P switch	Yes	Channel
Input delay	<ul style="list-style-type: none"> 0.05 ms 0.1 ms 0.4 ms 0.8 ms 1.6 ms 3.2 ms 12.8 ms 20 ms None 	0.05 ms	Yes	Channel
Pulse stretching	<ul style="list-style-type: none"> None 0.05 s 0.1 s 0.2 s 0.5 s 1 s 2 s 	None	Yes	Channel

5.1 Module/channel parameters

Parameter	Value range	Default	Parameter reassignment in RUN	Efficiency range
Diagnostic: Wire break	<ul style="list-style-type: none">• Enabled• Disabled	Enabled	Yes	Channel
Diagnostics Sensor supply	<ul style="list-style-type: none">• Enabled• Disabled	Enabled	Yes	Channel

Parameters of the combined digital inputs and outputs

Parameter	Value range	Default	Parameter reassignment in RUN	Efficiency range
Channel operating mode DI/DO (configuration 1, 8, 9, 10, 11)	<ul style="list-style-type: none"> • Disabled • Digital input • Digital output CPU • Sensor supply for AI 0 • Sensor supply for AI 1 • Sensor supply for AI 2 • Sensor supply for AI 3 • Sensor supply for DI 0 • Sensor supply for DI 1 • Sensor supply for DI 2 • Sensor supply for DI 3 	Disabled	Yes	Channel
Channel operating mode DI/DO (configuration 2)	<ul style="list-style-type: none"> • Disabled • Digital input • Digital output CPU • Sensor supply for AI 0 • Sensor supply for AI 1 • Sensor supply for AI 2 • Sensor supply for AI 3 • Sensor supply for DI 0 • Sensor supply for DI 1 • Sensor supply for DI 2 	Disabled	Yes Changes in the hardware assignment result in a restart of the counter and measuring function.	Channel

5.1 Module/channel parameters

Parameter	Value range	Default	Parameter reassignment in RUN	Efficiency range
	<ul style="list-style-type: none"> • Sensor supply for DI 3 • Pulse generator signal A (counter/measuring function 1) • Pulse generator signal B (counter/measuring function 1) • Pulse generator signal N (counter/measuring function 1) • HW gate start/DI start (counter/metering function 1) • HW gate stop/DI stop (counter/metering function 1) • Set HW signal (counter 1) • Pulse generator signal A (counter/measuring function 2) • Pulse generator signal B (counter/measuring function 2) • Pulse generator signal N (counter/measuring function 2) • HW gate start/DI start (counter/metering function 2) • HW gate stop/DI stop (counter/ 			

Parameter	Value range	Default	Parameter reassignment in RUN	Efficiency range
	<p>metering function 2)</p> <ul style="list-style-type: none">• Set HW signal (counter 2)• Pulse generator signal A (counter/measuring function 3)• Pulse generator signal B (counter/measuring function 3)• Pulse generator signal N (counter/measuring function 3)			

5.1 Module/channel parameters

Parameter	Value range	Default	Parameter reassignment in RUN	Efficiency range
	<ul style="list-style-type: none"> • HW gate start/DI start (counter/metering function 3) • HW gate stop/DI stop (counter/metering function 3) • Set HW signal (counter 3) • Pulse generator signal A (counter/measuring function 4) • Pulse generator signal B (counter/measuring function 4) • Pulse generator signal N (counter/measuring function 4) • HW gate start/DI start (counter/metering function 4) • HW gate stop/DI stop (counter/ 			

Parameter	Value range	Default	Parameter reassignment in RUN	Efficiency range
	metering function 4) <ul style="list-style-type: none"> • Set HW signal (counter 4) • Sensor supply (counter/measuring function 1) • Digital output 0 (counter/measuring function 1) • Digital output 1 (counter 1) • Sensor supply (counter/measuring function 2) • Digital output 0 (counter/measuring function 2) • Digital output 1 (counter 2) • Sensor supply (counter/measuring function 3) 			
	<ul style="list-style-type: none"> • Digital output 0 (counter/measuring function 3) • Digital output 1 (counter 3) • Sensor supply (counter/measuring function 4) • Digital output 0 (counter/measuring function 4) • Digital output 1 (counter 4) 			

5.1 Module/channel parameters

Parameter	Value range	Default	Parameter reassignment in RUN	Efficiency range
Channel operating mode DI/DO (configuration 3)	<ul style="list-style-type: none"> • Disabled • Digital input • Digital output CPU • Sensor supply for AI 0 • Sensor supply for AI 1 • Sensor supply for AI 2 • Sensor supply for AI 3 • Sensor supply for DI 0 • Sensor supply for DI 1 • Sensor supply for DI 2 • Sensor supply for DI 3 • Pulse generator signal A (speed measurement 1) • Pulse generator signal B (speed measurement 1) • Pulse generator signal A (speed measurement 2) 	Disabled	Yes Changes in the hardware assignment result in a restart of the counter and measuring function.	Channel

Parameter	Value range	Default	Parameter reassignment in RUN	Efficiency range
	<ul style="list-style-type: none"> Pulse generator signal B (speed measurement 2) Pulse generator signal A (speed measurement 3) Pulse generator signal B (speed measurement 3) Sensor supply (speed measurement 1) Sensor supply (speed measurement 2) Sensor supply (speed measurement 3) 			
Channel operating mode DI/DO (configuration 4)	<ul style="list-style-type: none"> Disabled Digital input Digital output CPU Digital output TM CPU Sensor supply for AI 0 Sensor supply for AI 1 Sensor supply for AI 2 Sensor supply for AI 3 Sensor supply for DI 0 Sensor supply for DI 1 Sensor supply for DI 2 Sensor supply for DI 3 Digital output TM CPU 	Disabled	Yes	Channel

5.1 Module/channel parameters

Parameter	Value range	Default	Parameter reassignment in RUN	Efficiency range
Channel operating mode DI/DO (configuration 5, 6, 7)	<ul style="list-style-type: none"> • Disabled • Digital input • Digital output CPU • Sensor supply for AI 0 • Sensor supply for AI 1 • Sensor supply for AI 2 • Sensor supply for AI 3 • Sensor supply for DI 0 • Sensor supply for DI 1 • Sensor supply for DI 2 • Sensor supply for DI 3 • Pulse generator signal A (speed measurement 1) • Pulse generator signal B (speed measurement 1) • Pulse generator signal A (speed measurement 2) • Pulse generator signal B (speed measurement 2) • Pulse generator signal A (speed measurement 3) 	Disabled	Yes Changes in the hardware assignment result in a restart of the counter and measuring function.	Channel

Parameter	Value range	Default	Parameter reassignment in RUN	Efficiency range
	<ul style="list-style-type: none"> Pulse generator signal B (speed measurement 3) Sensor supply (speed measurement 1) Sensor supply (speed measurement 2) Sensor supply (speed measurement 3) Digital output TM CPU 			
Input delay	<ul style="list-style-type: none"> Enabled Disabled 	Enabled	Yes	Channel
Pulse stretching	<ul style="list-style-type: none"> Enabled Disabled 	Enabled	Yes	Channel
Only for digital outputs				
Diagnostic: Wire break	<ul style="list-style-type: none"> Enabled Disabled 	Enabled	Yes	Channel
Diagnostics: Short-circuit to M	<ul style="list-style-type: none"> Enabled Disabled 	Enabled	Yes	Channel
Reaction to CPU STOP	<ul style="list-style-type: none"> Shutdown Keep last value Output substitute value 	Shutdown	Yes	Channel
Substitute value	<ul style="list-style-type: none"> 0 1 	0	Yes	Channel
Reaction to cross-station redundancy	<ul style="list-style-type: none"> switch off on passive module activated on passive module 	switch off on passive module	Yes	Channel

5.2 Explanation of the general module parameters

Parameters of the buffer outputs

Parameter	Value range	Default	Parameter reassignment in RUN	Efficiency range
Type of output	<ul style="list-style-type: none"> Disabled Output CPU Output TM CPU (TM Contr) Output AI measured value (TM Vib-Prot) 	Disabled	Yes	Channel
Output range	<ul style="list-style-type: none"> Disabled Voltage -10 to +10 V 	Disabled	Yes	Channel
Diagnostics: Overflow	<ul style="list-style-type: none"> Enabled Disabled 	Enabled	Yes	Channel
Diagnostics: Underflow	<ul style="list-style-type: none"> Enabled Disabled 	Enabled	Yes	Channel
Reaction to CPU STOP	<ul style="list-style-type: none"> Shutdown Keep last value Output substitute value 	Shutdown	Yes	Channel
Substitute value	<ul style="list-style-type: none"> Standardized substitute values 	0	Yes	Channel
Output range high limit (in physical unit)	Value	100 %	Yes	Channel
Output range low limit (in physical unit)	Value	0 %	Yes	Channel
Reaction to cross-station redundancy	<ul style="list-style-type: none"> switch off on passive module activated on passive module 	switch off on passive module	Yes	All channels

5.2 Explanation of the general module parameters

The following explanations of the parameters apply to all technology modules unless expressly excluded.

Diagnostics: Missing supply voltage L+

Enabling of the diagnostics for missing or insufficient supply voltage L+.

IO redundancy

You can configure two identical modules redundantly. To do so, plug both modules into a redundant terminal block side-by-side. You can find additional information on mounting modules in an IO redundancy configuration in the ET 200SP HA System Manual, section "Installing", "Installing terminal block". In IO redundancy mode, the left module is the primary and the right module is the secondary. In error-free redundant operation, the primary module assumes the "active" state and the secondary module assumes the "passive" state.

In error-free redundant operation, the "active" and the "passive" module each output half the specified current via the analog outputs (AO). When a module error is detected, the faulty module goes into STOP mode. All outputs are shut off. This can cause a redundancy switchover. This means that the secondary module can assume the "active" state. If an error occurs, the complete specified AO current is output over the module that is still available.

After solving the problem (e.g. module replacement), the redundant modules synchronize again. If the primary module has been replaced, the secondary module initially remains in the "active" state and the newly started primary module assumes the "passive" state. The synchronization phase lasts 30 seconds. During this time, the power outputs are gradually reduced to half the specified current to prevent bumps.

Once synchronization is complete, a redundancy switchover is performed again, if necessary. This means that the primary module resumes the "active" state, and the secondary module resumes the "passive" state.

Note

Interruptions of the output signals during redundancy switchover

If the "active" module fails during the synchronization phase, this results in a redundancy switchover. This may cause minor interruptions of the output current.

The buffer outputs and the digital outputs are only output by the active module. When a redundancy switchover is required, the output signals may be interrupted for ≤ 10 ms.

Note

Firmware update

A firmware update from a version $<V1.2$ to a version $\geq V1.2$ is not possible bumpless with IO redundancy.

Cross-station redundancy (TM Contr only)

Special safety-critical applications require a certain spatial separation of the redundant modules. For this purpose, the modules can be distributed over two racks as part of the cross-station redundancy. Although essentially identical, there are numerous differences compared to the IO redundancy.

You can find additional information on redundancy under: Fast controllers - TM Contr (Page 122)

5.3 Explanation of the analog input parameters

Potential group

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

A potential group begins with a light-colored terminal block through which the required voltage is supplied for all I/O modules of the potential group. The light-colored terminal block interrupts the self-assembling voltage buses to the left neighbor.

All other I/O modules of this potential group are plugged into dark terminal blocks. I/O modules on dark terminal blocks take the potentials of self-assembling voltage rails from the left neighbor.

A potential group ends with the dark terminal block which follows a light-colored terminal block or a server module in the station configuration.

You can find additional information on the configuration of the potential group in the system manual *SIMATIC; Distributed I/O System; ET 200SP HA*.

5.3 Explanation of the analog input parameters

The following explanations of the parameters apply to the analog inputs of all technology modules unless expressly excluded.

AI sampling frequency (TM VibProt)

Defines the sampling frequency with which the analog signals are read. The setting applies to all AI channels of the module.

Measurement type/measuring range

The technology modules support the following measuring ranges.

Measurement type	Measuring range
Disabled	Disabled
Current	0 to 20 mA
	4 to 20 mA
	-20 to +20 mA
	-30 to +30 mA
	-20 mA to 0 mA
Voltage	0 to +10 V
	-10 to +10 V
	0 to +20 V
	-20 to 0 V
VIB Constant Current Transmitter (only TM VibProt)	0 to +20 V with sensor supply 4 mA
	0 to +20 V with sensor supply 8 mA

The resolution depends on the set measuring range. The maximum internal resolution is 24 bits including sign. The prepared analog value is standardized for the CPU. (see Analog value display (Page 269))

The resolution, in this case, is 16 bits including sign.

For module type "Vibration protection (6DL1138-6EC00-0EH1)", an internal sensor supply of 4 mA or 8 mA can be configured for the voltage measuring range 0 to +20 V.

The maximum permissible common mode voltage for the voltage inputs is ± 0.3 V. In addition the applied voltage must not exceed or fall below the selected measuring range $\pm 10\%$.

Smoothing

The individual measured values are filtered to smooth them. Smoothing can be set in 4 levels.

Smoothing time = number of module cycles (k) x cycle time of the analog signal acquisition (0.625 ms for TM FIO & Counter and TM Contr; 1.25 ms for TM VibProt).

The figure below shows the number of module cycles after which the smoothed analog value approaches 100 %, depending on the set smoothing. This applies to every signal change at the analog input.

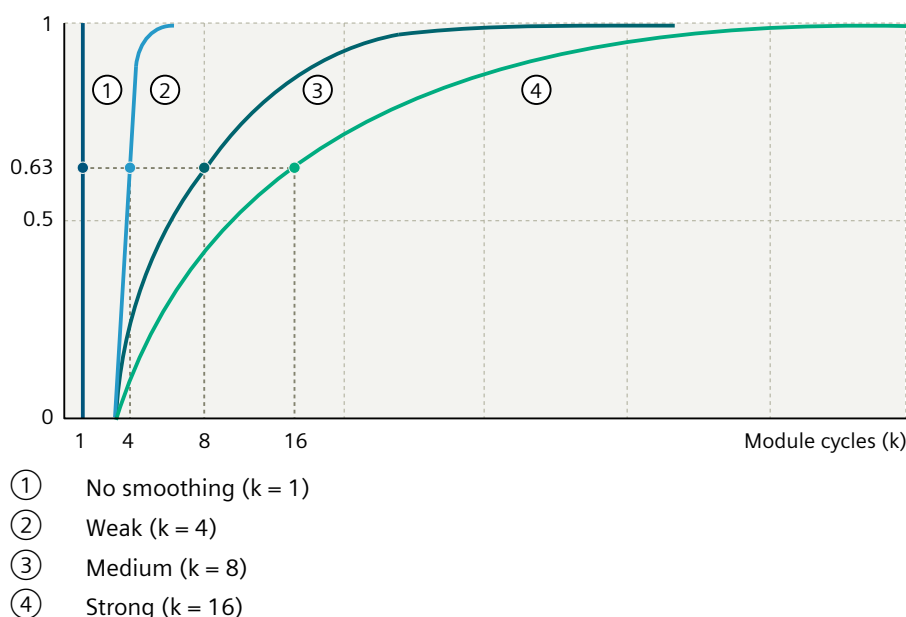


Figure 5-1 Smoothing of the analog value

Wire break limit

You use this to specify the current limit for detecting wire breaks. If the current falls below the configured wire break limit, the measured value is declared invalid and, if wire break diagnostics is enabled, corresponding diagnostics information is generated. The value status of the analog input is set to "bad".

With a wire break limit of 3.6 mA, the measured value becomes invalid when the current falls below 3.6 mA and is marked as valid again when it rises above 3.8 mA.

5.3 Explanation of the analog input parameters

There is no hysteresis for a wire break limit of 1.185 mA.

Unit sensitivity (only TM VibProt)

Defines the physical unit of the input signal. See the data sheet of the sensor used for more details (e.g. 100 mV/g).

Diagnostics Internal AI power supply

Enable the diagnostic message AI voltage supply. Each analog input has a separate internal power supply.

When the diagnostic message is enabled and the internal power supply is outside the permissible range, the diagnostic message is sent.

Monitoring is always active.

Diagnostics Sensor supply

Enable the diagnostic message sensor supply.

If AI sensor supply is over a digital output of the technology module (DI/DO channel operating mode "Sensor supply for AI x"), the sensor supply of the analog input is monitored for overload and short circuit to M.

When the diagnostic message is enabled and the sensor supply is faulty, the diagnostic message is sent.

Table 5-1 Example configuration

AI _x	DO/DI _y	
Diagnostics: <ul style="list-style-type: none"> Sensor supply 	Channel operating mode: <ul style="list-style-type: none"> Sensor supply for AI_x 	Diagnostics (enables DQ monitoring): <ul style="list-style-type: none"> Wire break (optional I_{gv} > 35 mA) Short circuit to M

Diagnostics Short circuit to L+

Enable the diagnostic message short circuit to L+. When the diagnostic message is enabled and the analog input is short-circuited to L+, the diagnostic message is sent.

Monitoring is always active.

Short circuit and overflow diagnostics can be enabled simultaneously. If both diagnostics occur simultaneously, the short circuit diagnostics is output.

Diagnostics Wire break

Enable the diagnostic message wire break.

Wire-break monitoring is active for the measuring range 4 to 20 mA. Monitoring is triggered when the current flow is below the configured wire break limit.

When the diagnostic message is enabled and monitoring detects a wire break, the diagnostic message is sent.

You can activate the diagnostics wire break and underflow at the same time. If both diagnostics occur simultaneously, the diagnostics wire break is output.

Diagnostics: Underflow

Enable the diagnostic message underflow. When the diagnostic message is enabled and the measured value drops below the underflow limit, the diagnostic message is sent.

Monitoring is always active.

Diagnostics: Overflow

Enable the diagnostic message overflow. When the diagnostic message is enabled and the measured value exceeds the overflow limit, the diagnostic message is sent.

Monitoring is always active.

Sensitivity (only TM VibProt)

Defines the amount of sensor sensitivity. See the data sheet of the sensor used for more details (e.g. 100 mV/g).

Physical unit of sensitivity (only TM VibProt)

Standard physical units of the sensor measured variable are available for selection. The selection depends on the selected function chain. If the unit of the sensor that is used is not offered, you can use the unit 'eu' (Engineering Unit) instead.

Interference frequency suppression

Suppresses the interference that is caused by the frequency of the AC voltage network used.

The frequency of the AC voltage network can interfere with the measured value, in particular in low voltage ranges.

Measuring range high limit (in physical unit)

Defines the physical measuring range of the analog value sensor.

Measuring range low limit (in physical unit)

Defines the physical measuring range of the analog value sensor.

5.4 Explanation of the analog output parameters

Limit overflow

Defines the overflow measuring range.

Limit underflow

Defines the underflow measuring range.

5.4 Explanation of the analog output parameters

The following explanations of the parameters apply to the analog outputs of all technology modules unless expressly excluded.

Output type/range

The technology modules support the following output ranges:

Type of output	Output range
Disabled	Disabled
Output CPU	0 to 20 mA
	4 to 20 mA
	-20 to +20 mA
	-30 to +30 mA
	-50 to +50 mA
Output TM CPU (TM Contr)	0 to 20 mA
	4 to 20 mA
	-20 to +20 mA
	-30 to +30 mA
	-50 to +50 mA
VIB Sensor supply (TM VibProt)	Sensor supply +24 V
	Sensor supply -24 V

Diagnostics, Wire break

Enable the diagnostic message wire break. When the diagnostic message is enabled and monitoring detects a wire break, the diagnostic message is sent.

Monitoring is always active. Monitoring is effective from an output current of $\pm 730 \mu\text{A}$.

Monitoring detects a wire break when the current that is to be output drops below the absolute value of $730 \mu\text{A}$ for more than 10 ms.

Monitoring resets the wire break when the current that is to be output once again exceeds the absolute value of $730 \mu\text{A}$ for more than 100 ms.

Diagnostics deviation output current

Enable the diagnostic message deviation output current.

The monitoring "Deviation output current" can be enabled and disabled with the "Output current monitoring" parameter, and the limit can be specified.

If the diagnostic message is enabled with configured monitoring and the output current deviates from the current that is to be output for more than 10 ms from the configured permissible deviation, the diagnostic message is sent.

The diagnostic message "Deviation output current" is reset when the output current is back in the permissible tolerance band for more than 100 ms.

Diagnostics overflow

Enable the diagnostic message overflow. When the diagnostic message is enabled and the specified output value exceeds the overrange, the diagnostic message is sent.

The current output is limited to the end of the overrange.

Monitoring is always active.

Diagnostics underflow

Enable the diagnostic message underflow. When the diagnostic message is enabled and the specified output value exceeds the underrange, the diagnostic message is sent.

The current output is limited to the end of the underrange.

Monitoring is always active.

Reaction to CPU STOP

Specifies the reaction of the technology module to CPU STOP, TM CPU STOP or failure of communication between the interface module and CPU.

The following settings are possible:

- Shutdown
- Keep last value
- Output substitute value
- Close with defined ramp

Substitute value/closing time

The substitute value is output by the module at CPU STOP if you set the "Reaction to CPU STOP" parameter to "Substitute value".

The substitute value must not exceed the overrange limit and must not fall below the underrange limit.

The analog value is set to 0 by the module at CPU STOP with the configured closing time when the "Reaction to CPU STOP" parameter is set to "Close with defined ramp". The closing time is specified in ms for the range of 100% to 0%.

5.5 Explanation of the digital input parameters

Output current monitoring

Enables or configures the maximum permissible deviation of the monitoring function of the analog outputs. In a redundant configuration, an output current deviation detected by one side results in a redundancy switchover and stop of the faulty module.

Output range high limit (in physical unit)

Defines the high limit of the physical output range, for example, 0 up to 50 mm traversing range of the actuator.

Output range low limit (in physical unit)

Defines the low limit of the physical output range.

5.5 Explanation of the digital input parameters

The following explanations of the parameters apply to the digital inputs of all technology modules unless expressly excluded.

Channel operating mode DI (configuration 1, 4, 8, 9, 10, 11)

Specifies whether the digital input is enabled or disabled.

Channel operating mode DI (configuration 2)

Specifies whether the digital input is enabled, disabled or is to be used as an input signal (pulse generator signal, HW gate or set signal) for the counter function.

Channel operating mode DI (configuration 3, 5, 6, 7)

Specifies whether the digital input is enabled or disabled or is to be operated as a pulse generator signal for speed measurement.

Sensor type

Specifies the type of sensor to be connected for the channel.

The module supports the following sensor types:

- P switch
- M switch
- P/M switch

Input delay

Signal faults at the digital input can be suppressed with this parameter. Signal changes are only recorded if they are steadily pending for longer than the set input delay time.

Pulse stretching

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, the pulse is not changed.

Pulse stretching has no effect on counting/frequency measurement.

Principle of pulse stretching

The figure below provides examples to illustrate whether and how input pulses are changed.

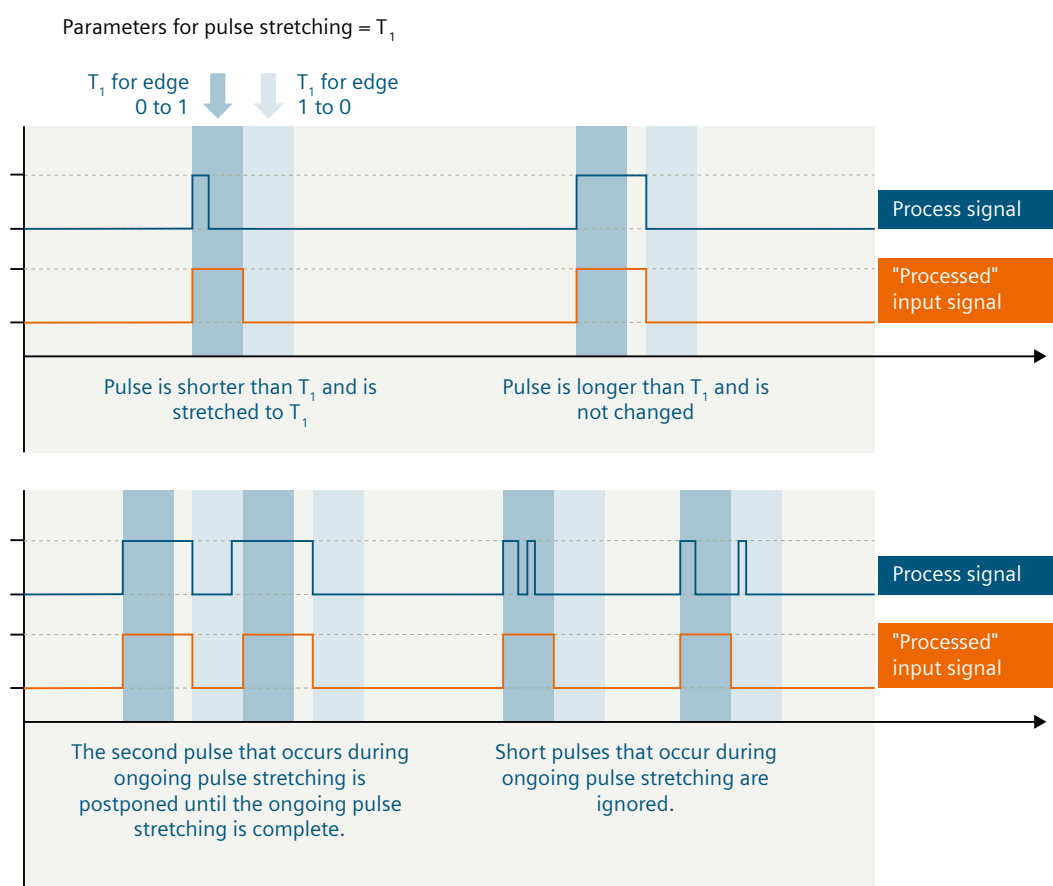


Figure 5-2 Principle of pulse stretching

Diagnostics Wire break

Enable the diagnostic message wire break. When the diagnostic message is enabled and the digital input is not connected to either the M or P potential, the diagnostic message is sent.

Monitoring is always active.

Only applies to the sensor type "P/M switch".

5.6 Explanation of the parameters of the combined digital inputs and outputs

Diagnostics Sensor supply

Enable the diagnostic message sensor supply.

If DI sensor supply is over a digital output of the technology module (DI/DO channel operating mode "Sensor supply for DI x"), the sensor supply of the digital input is monitored for overload and short-circuit to M.

When the diagnostic message is enabled and the sensor supply is faulty, the diagnostic message is sent.

Table 5-2 Example configuration

DI _x	DO/DI _y	
Diagnostics: <ul style="list-style-type: none"> Sensor supply 	Channel operating mode: <ul style="list-style-type: none"> Sensor supply for DI_x 	Diagnostics (enables DQ monitoring): <ul style="list-style-type: none"> Wire break (optional I_{gv} > 35 mA) Short-circuit to M

5.6 Explanation of the parameters of the combined digital inputs and outputs

The following explanations of the parameters apply to the combined digital inputs and outputs of all technology modules unless expressly excluded.

Diagnostic: Wire break

Enable the diagnostic message and monitoring for wire break at the digital output. Monitoring is only active when the diagnostics is enabled.

When the diagnostic message is enabled and the module with enabled digital output detects no current or a current that is too weak at the output configured accordingly, the diagnostic message is sent.

Note

Minimum load necessary

A minimum load of 45 mA is necessary for wire-break monitoring to distinguish between wire break and no wire break.

Diagnostics: Short-circuit to M

Enable the diagnostic message short-circuit to M. When the diagnostic message is enabled and the digital output is short-circuited to M, the diagnostic message is sent.

Monitoring is always active.

5.6 Explanation of the parameters of the combined digital inputs and outputs

A short-circuit to M is only recognized when the output is switched on (output value = 1).

Note

Short-circuit signal

If the output is disabled with pending short-circuit (output value = 0), the Short-circuit to M diagnostics is reset.

Reaction to CPU STOP

Specifies the reaction of the technology module to CPU STOP, TM CPU STOP or failure of communication between the interface module and CPU.

The following settings are possible:

- Shutdown
- Keep last value
- Output substitute value

Substitute value

The substitute value is output by the module at CPU STOP if you set the "Reaction to CPU STOP" parameter to "Substitute value".

Reaction to cross-station redundancy

In redundant mode, only the active module determines the output value. This parameter defines whether a parallel output by both modules is to take place in case of cross-station redundancy.

- switch off on passive module
- activated on passive module

Channel operating mode DI/DO (configuration 1, 8, 9, 10, 11)

Specifies the use of the combined DI/DQ. The following settings are possible:

- Disabled
- Digital input
- Digital output CPU (output of a digital value from the CPU)
- Sensor supply for AI, DI

If the corresponding output is operated in "sensor supply" mode, the sensor supply of the assigned digital input or analog input is monitored for overload and short-circuit to M if the corresponding diagnostics of the DI/DO are enabled.

Channel operating mode DI/DO (configuration 2)

Specifies the use of the combined DI/DQ. The following settings are possible:

- Disabled
- Digital input
- Digital output CPU (output of a digital value from the CPU)
- Sensor supply for AI, DI, pulse generator
- Input signal for counter function (pulse generator, HW gate, or set signal)
- Output signal counter function (comparator 1, comparator 2) Comparing (Page 95)

If the corresponding output is operated in "sensor supply" mode, the sensor supply of the assigned digital input or analog input is monitored for overload and short-circuit to M if the corresponding diagnostics of the DI/DO are enabled.

Channel operating mode DI/DO (configuration 3)

Specifies the use of the combined DI/DQ. The following settings are possible:

- Disabled
- Digital input
- Digital output CPU
- Sensor supply for AI, DI, pulse generator
- Input signal for speed measurement (pulse generator signal)

If the corresponding output is operated in "sensor supply" mode, the sensor supply of the assigned digital/analog/speed measurement channel is monitored for overload and for short-circuit to M if the corresponding diagnostics of the DI/DO are enabled.

Channel operating mode DI/DO (configuration 4)

Specifies the use of the combined DI/DQ. The following settings are possible:

- Disabled
- Digital input
- Digital output CPU (output of a digital value from the CPU)
- Digital output TM CPU
- Sensor supply for AI, DI

If the corresponding output is operated in "sensor supply" mode, the sensor supply of the assigned digital input or analog input is monitored for overload and short-circuit to M if the corresponding diagnostics of the DI/DO are enabled.

Channel operating mode DI/DO (configuration 5, 6, 7)

Specifies the use of the combined DI/DQ. The following settings are possible:

- Disabled
- Digital input
- Digital output CPU
- Digital output TM CPU
- Sensor supply for AI, DI, pulse generator
- Input signal for speed measurement (pulse generator signal)

If the corresponding output is operated in "sensor supply" mode, the sensor supply of the assigned digital/analog/speed measurement channel is monitored for overload and for short-circuit to M if the corresponding diagnostics of the DI/DO are enabled.

5.7 Explanation of the parameters of the buffer outputs

The following explanations of the parameters apply to the buffer outputs of all technology modules unless expressly excluded.

Output type/range

The technology modules support the following output ranges:

Table 5-3 Output types and their output ranges

Type of output	Output range
Disabled	Disabled
Output of a CPU value	-10 to +10 V
Output of a TM CPU value (TM Contr)	-10 to +10 V
Output of an AI measured value (TM VibProt)	-10 to +10 V

Scaling AI measured value

If the buffer output is configured for direct output of the AI measured values, scaling takes place depending on the set AI measuring range.

The following table shows the resulting buffer output range:

Table 5-4 AI voltage ranges

AI	BUF
0 to +10 V	0 to 5.6 V
± 10 V	± 5.6 V
0 to +20 V	0 to 11.21 V
-20 to 0 V	-11.21 to 0 V

5.7 Explanation of the parameters of the buffer outputs

Table 5-5 AI current ranges

AI	BUF
0 to 20 mA	0 to 7.44 V
4 to 20 mA	1.49 to 7.44 V
± 20 mA	± 7.44 V
± 30 mA	± 11.21 V
-20 to 0 mA	-7.44 to 0 V

Note

The output of the AI value to the buffer outputs is delayed with a dead time

The dead time is 34 times the sampling time (1/sampling frequency), for example, 0.332 ms = 34 x 1/102.4 KS/s.

Diagnostics: Overflow

Enable the diagnostic message overflow. When the diagnostic message is enabled and the output value exceeds the overrange, the diagnostic message is sent.

The voltage output is limited to the end of the overrange.

Monitoring is always active.

Diagnostics: Underflow

Enable the diagnostic message underflow. When the diagnostic message is enabled and the output value drops below the underrange, the diagnostic message is sent.

The voltage output is limited to the end of the underrange.

Monitoring is always active.

Reaction to CPU STOP

Specifies the reaction of the technology module to CPU STOP, TM CPU STOP or failure of communication between the interface module and CPU.

The following settings are possible:

- Shutdown
- Keep last value
- Output substitute value

Substitute value

The substitute value is output by the module at CPU STOP if you set the "Reaction to CPU STOP" parameter to "Substitute value".

The substitute value must not exceed the overflow limit and must not fall below the underflow limit.

Output range high limit (in physical unit)

Defines the high limit of the physical output range.

Output range low limit (in physical unit)

Defines the low limit of the physical output range.

Reaction to cross-station redundancy

In redundant mode, only the active module determines the output value. This parameter defines whether a parallel output by both modules is to take place in case of cross-station redundancy.

- switch off on passive module
- activated on passive module

The parameter affects all buffer outputs.

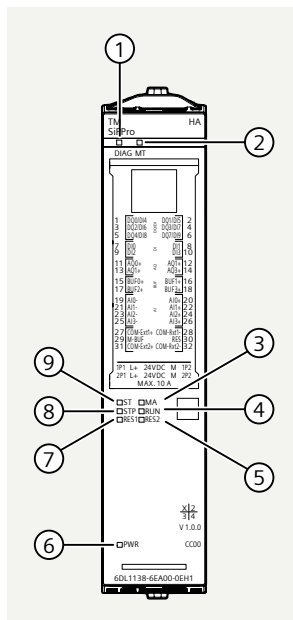
5.7 Explanation of the parameters of the buffer outputs

Displays and interrupts

6.1 Status indicators of the technology modules

LED displays

The following figure shows the status and fault displays of the technology modules.



- ① DIAG LED (green/red)
- ② MT LED (yellow)
- ③ MA LED (green)
- ④ RUN LED (green)
- ⑤ RES2 LED (green)
- ⑥ PWR LED (green)
- ⑦ RES1 LED (red)
- ⑧ STP LED (red)
- ⑨ ST LED (red)

Meaning of the LED displays

The tables below explain the status, error and maintenance displays. Measures for dealing with diagnostics messages can be found in the section Diagnostics messages and maintenance events (Page 251).

DIAG LED

Table 6-1 Diagnostics display of the DIAG LED

DIAG LED	Meaning
 Off	The backplane bus supply of the ET 200SP HA is disrupted or switched off.
 Flashes	Module is not configured.
 on	Module is configured, a diagnostics message is not pending.
 Flashes	Module is configured, at least one diagnostic message is pending.

MT LED

Table 6-2 Maintenance display of the MT LED

MT LED	Meaning
 Off	There is no maintenance required.
 on	Maintenance is required, i.e. at least one maintenance event has occurred.

PWR LED

Table 6-3 Status display of the PWR LED

PWR LED	Meaning
 Off	Supply voltage L+ missing.
 on	Supply voltage L+ present.

LED MA/ST

Table 6-4 Status display of the MA/ST LED

LED MA/ST	Meaning
 MA flashes	TM CPU is restarted (e.g. after switching on L+ or after a firmware upgrade)
 MA	Module is active.
 ST	Module is passive.

LED STP/RUN

The STP/RUN LEDs are only used with TM Contr and TM VibProt for signaling.

Table 6-5 Status display of the STP/RUN LED

LED STP/RUN	Meaning
 STOP	The execution system for the application software is in STOP.
 RUN	The execution system for the application software is in RUN.

LED RES1/RES2

The RES1/RES2 LEDs are only used with TM FIO & Counter and TM Contr for signaling.

Table 6-6 Status display of the RES1/RES2 LED

LED RES1/RES2	Meaning
 RES1	Communication with redundancy partner is faulty.

RES2 is not controlled and is reserved for future applications.

6.2 Interrupts

The technology module supports diagnostics interrupts.

Diagnostics interrupts

Diagnostics interrupts are used by the technology modules to output both diagnostic messages and maintenance events; see also the appendix Diagnostics messages and maintenance events (Page 251).

The technology modules generate a diagnostic interrupt for the following events:

- Wire break digital input
- Overtemperature
- Wire break at a digital output
- Wire break at an analog input
- AI, AO, BUF (overflow)
- AI, AO, BUF (underflow)
- Parameter assignment error
- Supply voltage L+ missing/low
- Channel/component temporarily unavailable
- Module is faulty
- Short-circuit of an analog input to transducer supply or L+
- Digital output short-circuit to M
- Error sensor supply AI, DI, speed measurement
- Button switch-off
- Retentive memory in carrier module defective
- Retentive memory in the terminal block defective
- Redundancy partner has different hardware/firmware
- IO redundancy warning
- IO redundancy parameter assignment inconsistent
- Error partner channel
- Internal AI power supply
- Output current deviation
- TM application software faulty
- Cycle overflow TM application software
- Fault redundancy connection 1/2 (for cross-station redundancy)

Note

A pending "Module is defective" or "Excess temperature" or "Button switch-off" diagnostic is deleted by the module after a restart.

Functions

7.1 Counter functions - TM FIO & Counter

7.1.1 Basics

The counter function is available for TM FIO & Counter, configuration 2. This function can be combined with the functions of the fast input and output.

Load value

The load value is the counter reading from which the technology module starts counting.

- If you specify a load value `LOAD_VAL` during operation, the start value is overwritten.
- If you specify a load value `LOAD_VAL` during operation and set the control signal `L_DIRECT`, the load value is applied directly as the current counter value.
- You can only load the load value as preparation (control signal `L_PREPAR`).

A load value that is loaded as preparation is applied as a new counter value by the counter for the following events:

- In the types of counting mode Single counting and Periodic counting
 - Reaching the count low or high limit when no main counting direction is configured.
 - Reaching the configured count high limit for main counting direction up and counting in main counting direction
 - Reaching the configured count high limit for main counting direction up and counting against the main counting direction after an underflow.
 - Reaching 0 for main counting direction down.
 - Exceeding 0 for main counting direction down and counting against the main counting direction after an overflow.
- In all types of counting modes
 - Start counting through the canceling gate function (SW gate or HW gate) (the load value is not applied when counting continues).
 - Synchronization with external signal (see section Command: Set counter (Page 107))
 - Latch/Retrigger (see section Command: Latch/Retrigger (Page 112))

Gate control

You can use the hardware gate (HW gate) and the software gate (SW gate) to control the count processes of the technology module, that is, to start and stop counting.

The HW gate can be configured as follows:

- level-controlled
- edge-controlled

Main counting direction

In counter operating modes with main counting direction, you can limit the maximum counting range to a narrower counting range by configuring a count high limit. The configured counting range, in this case, ranges from 0 and the configured count high limit. This makes it possible, for example, to resolve incremental or decremental counting applications. The configured main counting direction does not affect the direction evaluation (up or down) when acquiring the count pulses.

Counting ranges

The following applies to the 31-bit counting range:

- The high counting range limit is set to +2 147 483 647 ($2^{31} - 1$).
- The low counting range limit is set to -2 147 483 648 (-2^{31}).

The following applies to the 32-bit counting range:

- The high counting range limit is set to +4 294 967 295 ($2^{32} - 1$).
- The low counting range limit is set to 0 (zero).

Maximum counting range without main counting direction

A 32-bit wide counter register is available on the module for each counter channel. With the counting range setting, you select whether the module only counts in the positive range or if bit 32 is interpreted as a sign bit and negative numbers can thus be represented.

Depending on the selected counting range, 0 to 2^{+32} bits and 2^{-31} to 2^{+31} bits, the technology module counts within different count limits. An overflow or underflow is detected at the respective count limits.

In the counting range 2^{-31} to 2^{+31} bits, the counter reading is shown as two's complement.

Table 7-1 Modes for the 32-bit binary counter depending on the parameter assignment

	Counting range "0 to +32 bits" (32 bits without sign)	Counting range "-31 to +31 bits" (31 bits with sign)
Counting range decimal	0 to +4 294 967 295	-2 147 483 648 to +2 147 483 647
Counting range hexadecimal	0000 0000 to FFFF FFFF	8000 0000 to 7FFF FFFF
	When the counter reading (hexadecimal) changes from FFFF FFFF to 0, an overflow is detected; when it changes from 0 to FFFF FFFF, an underflow is detected.	When the counter reading (hexadecimal) changes from 7FFF FFFF to 8000 0000, an overflow is detected; when it changes from 8000 0000 to 7FFF FFFF, an underflow is detected.

Zero point

When the count value exceeds zero or is below zero, the status bit STS_ZERO is set in the process image. The zero point does not influence the gate control.

Start values after the parameter assignment

Table 7-2 Start values

Value	Main counting direction	Start value
Load value	None	0
	Up	0
	Down	Configured count high limit
Count value	None	0
	Up	0
	Down	Configured count high limit
Comparison value 1 and 2	None	0
	Up	0
	Down	Configured count high limit
Latch start value	None	0
	Up	0
	Down	Configured count high limit

Commands for the counter operating modes

You can influence the counting process with five commands during operation:

Table 7-3 Commands of the technology module

Designation	Description
Open and close gate	The counting process is started by opening a gate and ended by closing the gate.
Set counter	The counter can be set to the load value using various signals.
Latch/Retrigger	Saving the counter reading and loading the counter with the load value with a positive edge at DI Start.
Latch	Saving the counter reading with a positive edge at DI Start.
Measuring times between two edges	Measuring times between two consecutive edges at the DI Start digital input.

Status indicators

The following table provides an overview of the status indicators of the counter functions:

STS_SW_GATE	This bit shows the status of the SW gate. 0 = Gate closed 1 = Gate open
STS_GATE	This bit shows the status of the gate. 0 = Gate closed 1 = Gate open
STS_SYNC	Counter was set with the external signal DI_SET.
STS_UFLW	This bit shows that an underflow has occurred. The saved state is reset by acknowledgment with RES_ZERO.
STS_OFLW	This bit shows that an overflow has occurred. The saved state is reset by acknowledgment with RES_ZERO.
STS_ZERO	This bit shows the saved state that the counter reading had a zero crossing. The saved state is reset by acknowledgment with RES_ZERO.
STS_DIR	This bit shows the counting direction of the counter: 0 = Up 1 = Down
STS_RUN	Counter is running. This bit corresponds to bit 20 of the counter.
STS_COMP2	This bit shows the saved state that the comparator output 1 was set. This is also true when the output DQ1 was not enabled with EN_DQ1. The saved state is reset by acknowledgment with RES_ZERO.
STS_COMP1	This bit shows the saved state that the comparator output DQ0 was set. This is also true when the output DQ0 was not enabled with EN_DQ0. The saved state is reset by acknowledgment with RES_ZERO.
STS_DQ_COMP2	Status of the output DQ1.
STS_DQ_COMP1	Status of the output DQ0.
STS_STP	Status of the digital input DI-Stop.
STS_STA	Status of the digital input DI-Start.
STS_SET	Status of the digital input DI-Set.
STS_RES_ZERO	Acknowledgment bit for resetting the saved states in the feedback bits STS_ZERO, STS_OFLW, STS_UFLW, STS_COMP1 and STS_COMP2.
STS_RES_SYNC	Acknowledgment bit for resetting the feedback bit STS_SYNC.
STS_T_CMP_V2	Acknowledgment bit for applying the comparison value 2.
STS_T_CMP_V1	Acknowledgment bit for applying the comparison value 1.
STS_L_PREPAR	Acknowledgment bit for the load request with STS_L_PREPAR.

STS_L_DIRECT	Acknowledgment bit for the load request with STS_L_DIRECT.
OT_ERR	This bit is set when an error occurred while loading the load value or the comparison values. It is reset when the OT_ERR_A bit is set.

Control bit

The following table provides an overview of the control bits of the counter functions:

SW_GATE	You open and close the SW gate with this bit.
GATE_STP	You close the internal gate with this bit.
EN_SET_UP	With this bit, you enable loading of the counter when counting up.
EN_SET_DN	With this bit, you enable loading of the counter when counting down.
L_DIRECT	With this bit, you load the counter directly.
L_PREPAR	With this bit, you load the load value as preparation.
T_CMP_V1	With this bit, you load the comparison value 1.
T_CMP_V2	With this bit, you load the comparison value 2.
RES_SYNC	With this bit, you reset the status bit STS_SYNC and thus acknowledge loading of the counter through the synchronization input DI-Set.
RES_ZERO	With this bit, you reset the status bits STS_ZERO, STS_OFLW, STS_UFLW, STS_COMP1 and STS_COMP2.
ENABLE_DQ0	Enable DQ0 With this bit, you enable the output DQ0.
ENABLE_DQ1	Enable DQ1 With this bit, you enable the output DQ1.
OT_ERR_A	With this bit, you acknowledge a loading error of the load value or the comparison values.

See also

Continuous counting (Page 79)

Single counting (Page 82)

Periodic counting (Page 89)

7.1.2 Signal evaluation

Principle of signal evaluation

Single evaluation

In this mode, only one edge of the signal A* can be evaluated.

Pulses to count up are acquired with a positive edge by A^* and with a low level by B^* .

Pulses to count down are acquired with a negative edge by A^* and with a low level by B^* .

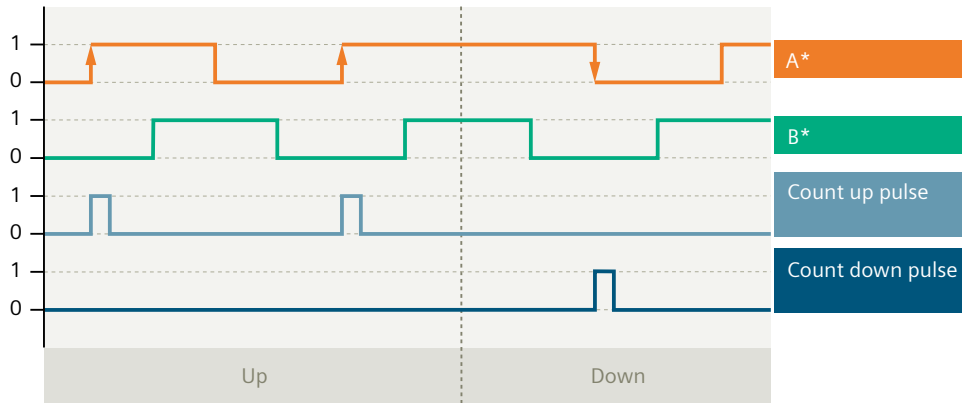


Figure 7-1 Single signal evaluation

Double evaluation

The double evaluation refers to the evaluation of the positive and negative edges of signal A^* .

The generation of pulses for counting up or down depends on the level of signal B^* .

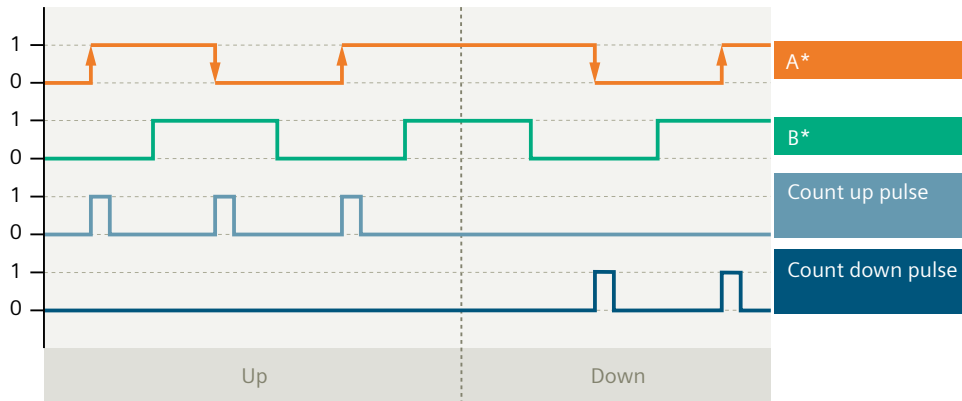


Figure 7-2 Double signal evaluation

Four-fold evaluation

The four-fold evaluation refers to the evaluation of the positive and negative edges of signal A^* and B^* .

The generation of pulses for counting up or down depends on the levels of the signals A^* and B^* .

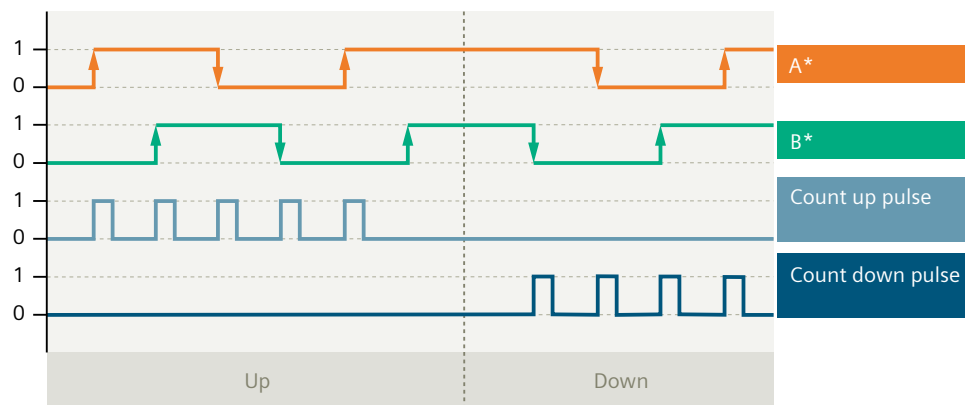


Figure 7-3 Four-fold signal evaluation

7.1.3 Overview of counting modes

The Counting mode parameter specifies the behavior of the counter channel.

The table provides an overview of the counting modes.

Table 7-4 Counting modes

Designation	Description
Continuous counting (Page 79) <ul style="list-style-type: none"> with SW gate or HW gate without SW gate or HW gate 	The technology module counts indefinitely starting from the current counter reading.
Single counting (Page 82) <ul style="list-style-type: none"> with SW gate or HW gate without SW gate or HW gate 	The technology module counts with opening of the gate from the load value to the counting limit.
Periodic counting (Page 89) <ul style="list-style-type: none"> with SW gate or HW gate without SW gate or HW gate 	The technology module counts with opening of the gate between the load value and the counting limit.

To execute one of the counting modes, you must configure the technology module.

7.1.4 Continuous counting

7.1.4.1 Overview

In this operating mode, the technology module counts continuously as of the counter reading.

The "Continuous counting" counting mode supports the command: Latch/Retrigger or Latch.

Reaching the count limits

- When the counter reaches the count high limit during count up and when another count pulse is received, the counter jumps to the count low limit and continues counting from there without pulse loss.
- When the counter reaches the count low limit during count down and when another count pulse is received, the counter jumps to the count high limit and continues counting from there without pulse loss.

See also

Command: Latch/Retrigger (Page 112)

Command: Latch (Page 114)

7.1.4.2 Behavior at the counting limits

Overview

If the counter has reached the high or low counting limit and when another count pulse is received, the counter is set to the other counting limit. A corresponding status bit is set in the process image.

Table 7-5 Behavior at the counting limits (continuous counting)

Counting limit reached	Status bit in the process image
High counting limit	STS_OFLW is set
Low counting limit	STS_UFLW is set

7.1.4.3 Selecting the gate control

In this operating mode, you can select the gate control. You can choose from the following options:

- SW gate
- HW gate, level-controlled or edge-controlled
- Without gate (default)

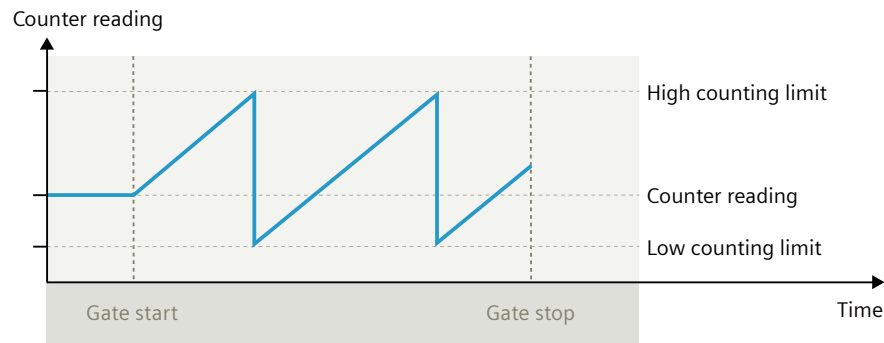


Figure 7-4 Continuous counting with gate control

Open and close SW gate

You open and close the SW gate with the control signal SW_GATE in the process image.

Table 7-6 Triggering opening/closing of the SW gate (continuous counting)

Action	...is triggered by
Opening the SW gate	Set SW_GATE
Closing the SW gate	Reset SW_GATE

When opening the SW gate, the counting process continues with the current counter reading.

Open and close HW gate

By applying or removing the corresponding signals at the digital inputs DI Start and DI Stop you open and close the HW gate.

Table 7-7 Triggering opening/closing of the HW gate (continuous counting)

Action	...is triggered by
Open HW gate (level-controlled)	Apply signal at DI Start digital input
Close HW gate (level-controlled)	Remove signal at DI Start digital input
Open HW gate (edge-controlled)	Apply positive edge at DI Start digital input
Close HW gate (edge-controlled)	Apply positive edge at DI Stop digital input

When opening the HW gate, the counting process continues with the current counter reading.

Without gate

In this configuration, neither the software nor the hardware gate is evaluated. Incoming counting pulses are counted independently of the state of the HW or SW gate.

The gate stop function also has no effect in this configuration, i.e. the input signals GATE_STP in the process image or the hardware signal DI Stop have no effect on the counting process.

7.1.4.4 Stop counting process with gate stop function

Overview

You can control the counting process in the process image with the GATE_STP input signal.

The GATE_STP input signal has an effect on the SW gate and the HW gate.

The gate stop function is triggered when the GATE_STP input signal or the DI Stop hardware signal is set.

7.1.5 Single counting

7.1.5.1 Overview

Depending on the configured main counting direction, the technology module counts up to a count limit and then stops counting automatically.

Parameter assignment of the behavior

You can configure the following behavior:

Behavior	Counting range
Single counting - No main counting direction	Configurable: <ul style="list-style-type: none"> • 2^{-31} to 2^{+31} bits • 0 to 2^{+32} bits
Single counting - Main counting direction up	Configurable: <ul style="list-style-type: none"> • 0 to 2^{+32} bits
Single counting - Main counting direction down	Configurable: <ul style="list-style-type: none"> • 0 to 2^{+32} bits

7.1.5.2 Single counting - No main counting direction

In the operating mode 'Single counting without main counting direction', the technology module counts up or down after opening the gate from the load value until one of the count limits is exceeded.

Behavior

When one of the count limits is exceeded,

- the gate is closed,
- the bit STS_OFLW or STS_UFLW is set in the process image,
- the counter is loaded to the opposite count limit.

The count limits are set permanently to the maximum counting range. With a counter reading of zero, the STS_ZERO bit is set.

To start the counting process again, you must open the gate again.

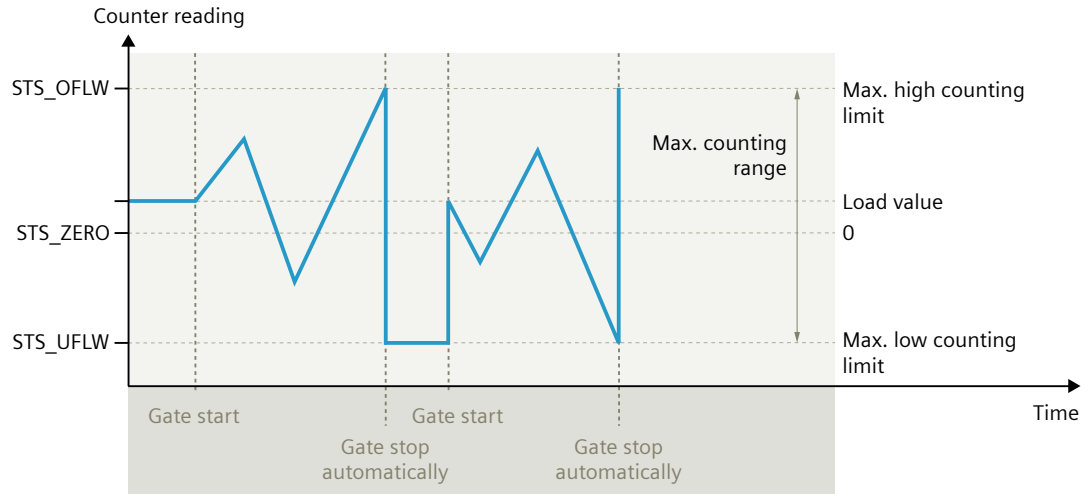


Figure 7-5 Single counting without main counting direction; canceling gate function

7.1.5.3 Single counting - Main counting direction up

In the operating mode 'Single counting with main counting direction up', the technology module counts up or down after opening the gate from the load value until the count high limit is exceeded.

Behavior

Counting in main counting direction (up)

When the count high limit -1 is exceeded,

- the gate is closed,
- the bit TS_OFLW is set in the process image,
- the counter with the load value is loaded so that the high limit is never reached.

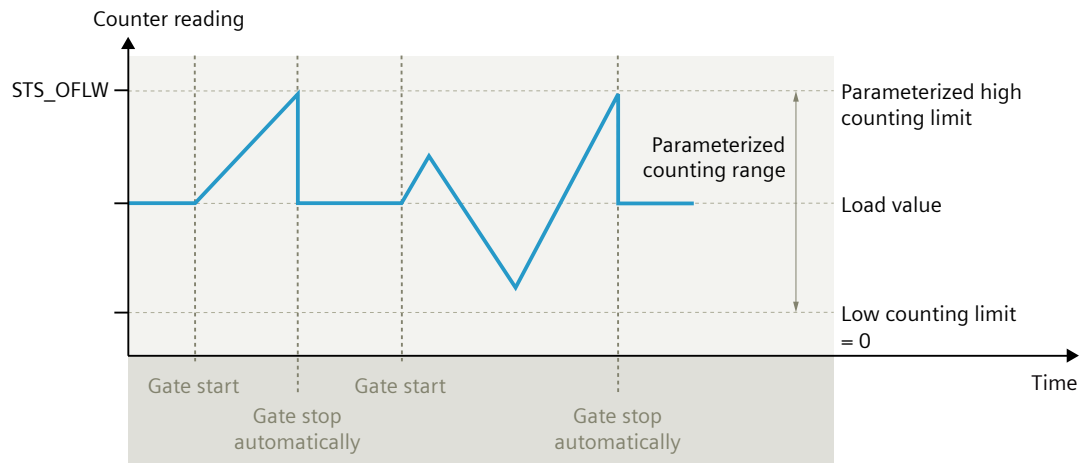


Figure 7-6 Single counting with main counting direction forward; canceling gate function

Counting against the main counting direction (down)

When reaching the count low limit and receiving another count pulse in down direction,

- the counter is set to the maximum high count value from where it continues counting,
- the bit STS_ZERO is not set.
- When reaching the count high limit and receiving another count pulse in down direction,
 - the gate is closed,
 - the bit STS_UFLW is set in the process image,
 - the counter with the load value is loaded.

The high and count low limits can be configured. The load value has its start value and can be changed via the process image.

To start the counting process again, you must open the gate again.

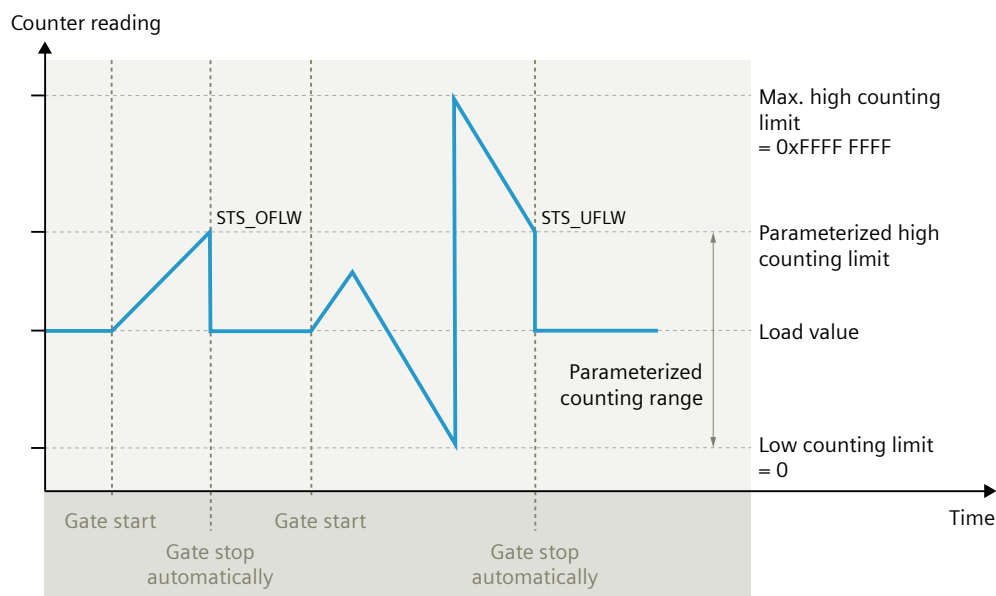


Figure 7-7 Single counting with main counting direction up; counting against the main counting direction

7.1.5.4 Single counting - Main counting direction down

In the operating mode 'Single counting with main counting direction down', the technology module counts up or down after opening the gate from the load value until the count low limit is exceeded.

In this counter operating mode, you can configure the count high limit to a value that is lower than the maximum count limit.

Behavior

Counting in main counting direction (down)

When reaching the count low limit +1 and receiving another count pulse in down direction,

- the gate is closed,
- the bit STS_UFLW is set in the process image,
- the counter with the load value is loaded so that the low limit is never reached and STS_ZERO is not set.

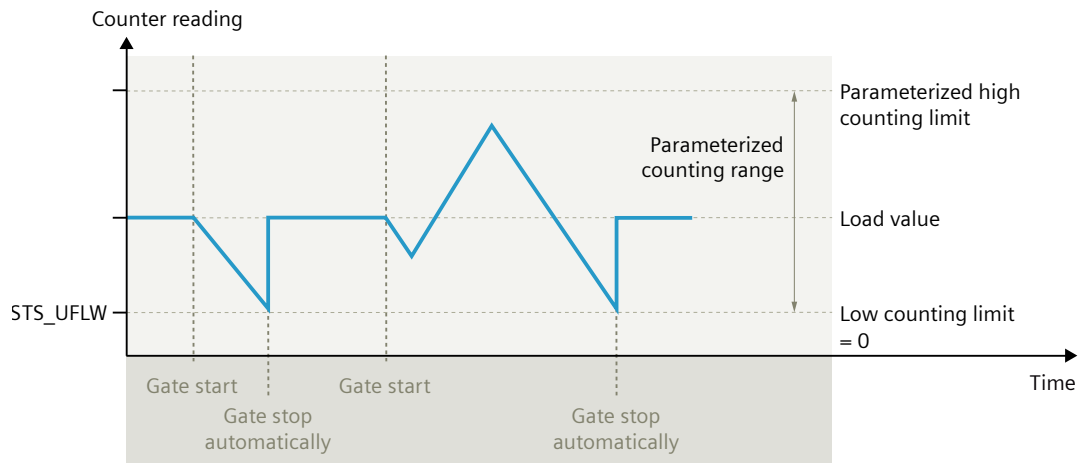


Figure 7-8 Single counting with main counting direction down; canceling gate function

Counting against the main counting direction (up)

When reaching the count high limit and receiving another count pulse in up direction,

- the counter is set to the maximum high count value +1 from where it continues counting.

When reaching the max. count high limit (0xFFFF FFFF) and receiving another count pulse in up direction,

- the counter is set to the low count value from where it continues counting,
- the bit STS_ZERO is not set.
- When reaching the count low limit and receiving another count pulse in up direction,
 - the gate is closed,
 - the bit TS_OFLW is set in the process image,
 - the counter with the load value is loaded.

The count low limit is 0. The load value has its start value and can be changed via the process image. To start the counting process again, you must open the gate again.

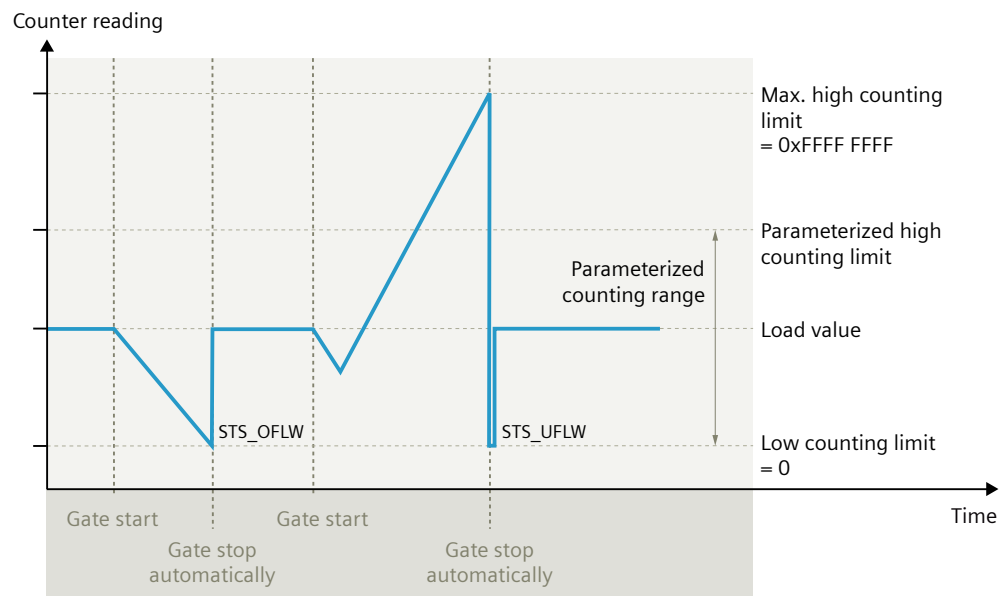


Figure 7-9 Single counting with main counting direction down; counting against the main counting direction

7.1.5.5 Selecting the gate control

In the "Single counting" operating mode, you can select the gate control. You can choose from the following options:

- SW gate
- HW gate, level-controlled or edge-controlled

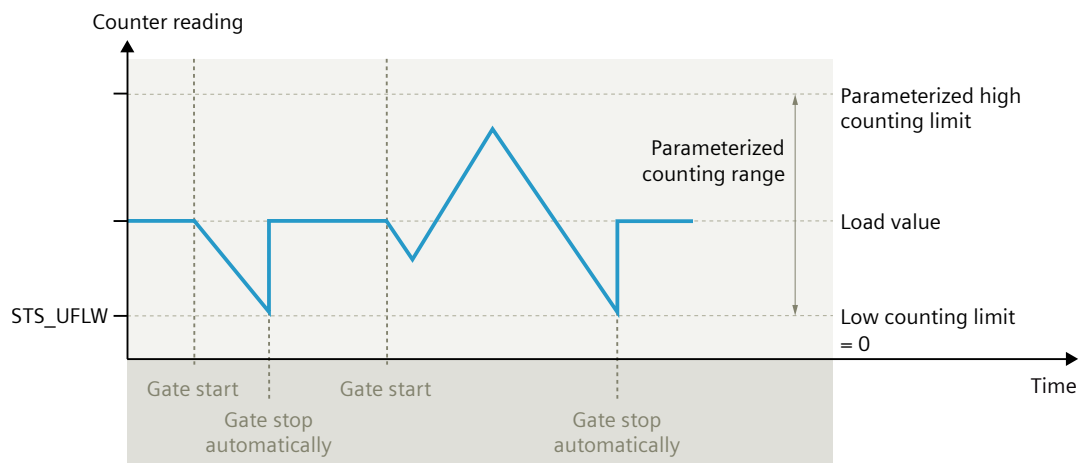


Figure 7-10 Single counting with load value and gate control

Open and close SW gate

You open and close the SW gate and set the counter to the load value with the control signal SW_GATE in the process image.

Table 7-8 Triggering opening/closing of the SW gate (single counting)

Action	...is triggered by
Opening the SW gate	Set SW_GATE
Closing the SW gate	Reset SW_GATE

Open and close HW gate

By applying or removing the corresponding signals at the digital inputs DI Start and DI Stop you open and close the HW gate and set the counter to the load value.

Table 7-9 Triggering opening/closing of the HW gate (single counting)

Action	...is triggered by
Open HW gate (level-controlled)	Apply signal at DI Start digital input
Close HW gate (level-controlled)	Remove signal at DI Start digital input
Open HW gate (edge-controlled)	Apply positive edge at DI Start digital input
Close HW gate (edge-controlled)	Apply positive edge at DI Stop digital input

The gate is opened again and the counter is set to the load value in a level-controlled HW gate by a signal at the DI Start.

If a positive edge is applied again at the DI Start with an edge-controlled HW gate, the counter starts counting again as of the load value, regardless of whether the gate is closed or still open (retrigger), provided the DI Stop is not set.

7.1.5.6 Stop counting process with gate stop function

Overview

You can end the counting process at any time with the gate stop function. To do so, you set the input signal GATE_STP in the process image.

7.1.5.7 Behavior at the counting limits

Overview

If the counter has reached the high or low counting limit and when another count pulse is received, the counter is set to the other counting limit or the load value. A corresponding status bit is set in the process image.

The following table summarizes the behavior at the counting limits:

Table 7-10 Reactions during counting when a limit is exceeded

Main counting direction for counting process	When the high counting limit was exceeded:	When the low counting limit was exceeded:
without main counting direction	<ul style="list-style-type: none"> Count value = Low counting limit Status bit STS_OFLW = 1 	<ul style="list-style-type: none"> Count value = High counting limit Status bit STS_UFLW = 1
Main counting direction "up"	<ul style="list-style-type: none"> Count value = load value Status bit STS_OFLW = 1 	<ul style="list-style-type: none"> Count value = Maximum high count value Continue counting until high counting limit When high counting limit is not reached <ul style="list-style-type: none"> Count value = load value STS_UFLW = 1
Main counting direction "down"	<ul style="list-style-type: none"> Continue counting until maximum high counting limit When reaching the max. high counting limit Count value = Low counting limit When the low counting limit is exceeded <ul style="list-style-type: none"> Count value = load value STS_OFLW = 1 	<ul style="list-style-type: none"> Count value = load value Status bit STS_UFLW = 1

The gate is closed when one of the counting limits is reached.

If you want to restart the counter, you must set the control signal SW_GATE once again or open the HW gate once again. The counting process is then continued as of the load value.

7.1.6 Periodic counting

7.1.6.1 Overview

In this operating mode, the technology module counts periodically with an open gate and without stopping the counting process at the count limits.

Parameter assignment of the behavior

You can configure the following behavior:

Behavior	Counting range
Periodic counting - No main counting direction	Configurable: <ul style="list-style-type: none"> • 2^{-31} to 2^{+31} bits • 0 to 2^{+32} bits
Periodic counting - Main counting direction up	Configurable: <ul style="list-style-type: none"> • 0 to 2^{+32} bits
Periodic counting - Main counting direction down	Configurable: <ul style="list-style-type: none"> • 0 to 2^{+32} bits

7.1.6.2 Periodic counting - No main counting direction

In the operating mode 'Periodic counting without main counting direction', the technology module counts up or down after opening the gate from the load value until one of the counting limits is exceeded.

Behavior

When one of the counting limits is exceeded,

- the bit STS_OFLW or STS_UFLW is set in the process image,
- the counter is set to the load value from which counting continues.
- The counting limits are set permanently to the maximum counting range. With a counter reading of zero, the STS_ZERO bit is set.

The counting process continues until the gate is closed.

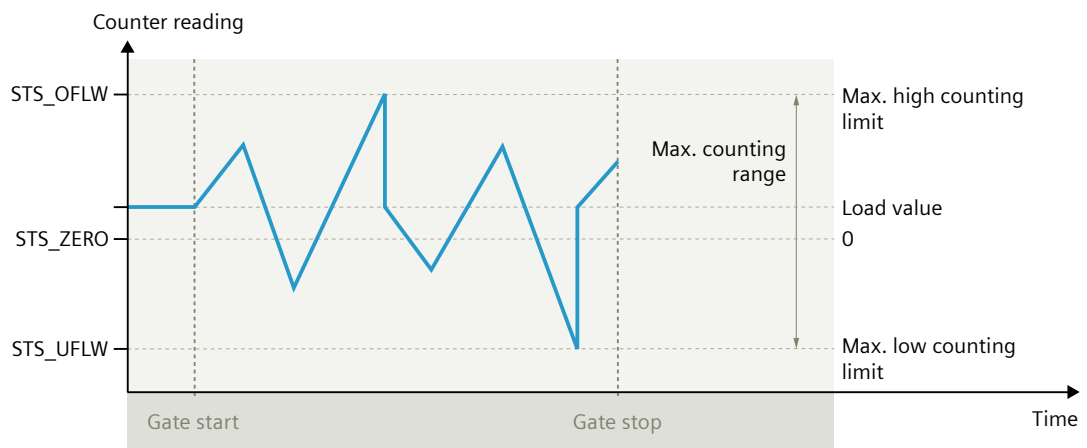


Figure 7-11 Periodic counting without main counting direction

7.1.6.3 Periodic counting - Main counting direction up

In the operating mode 'Periodic counting with main counting direction up', the technology module counts up or down after opening the gate from the load value until the count high limit is exceeded.

Behavior

Counting in main counting direction (up)

When reaching the count high limit -1 and receiving another count pulse in forward direction,

- the bit TS_OFLW is set in the process image,
- the counter is set to the load value from which counting continues so that the high limit is never reached.

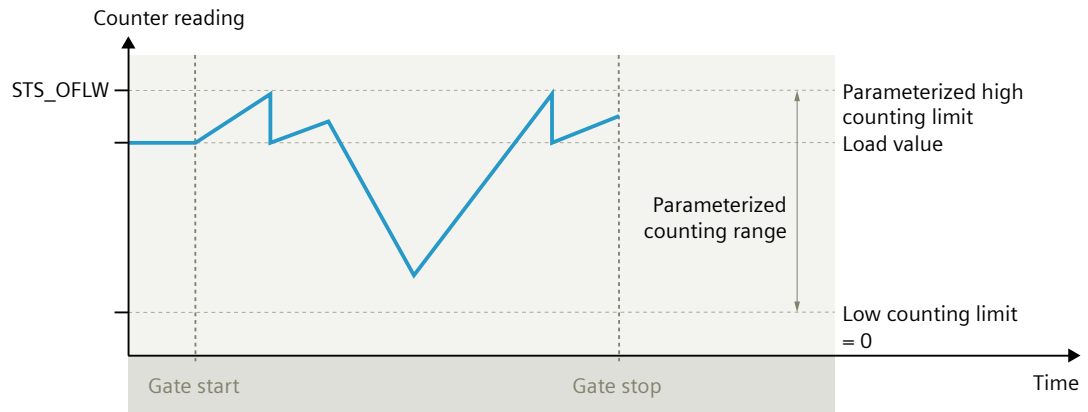


Figure 7-12 Periodic counting with main counting direction up

Counting against the main counting direction (down)

When reaching the count low limit and receiving another count pulse in down direction,

- the counter is set to the maximum high count value from where it continues counting,
- the bit STS_ZERO is not set.
- When reaching the count high limit and receiving another count pulse in down direction,
 - the bit STS_UFLW is set in the process image,
 - the counter is set to the load value from which counting continues.

The count high limit is configurable. The load value has its start value and can be changed via the process image.

The counting process continues until the gate is closed.

7.1.6.4 Periodic counting - Main counting direction down

In the operating mode 'Periodic counting with main counting direction down', the technology module counts up or down after opening the gate from the load value until the count low limit is undershot.

In this counter operating mode, you can configure the count high limit to a value that is lower than the maximum count limit.

Behavior

Counting in main counting direction (down)

When reaching the count low limit +1 and receiving another count pulse in down direction,

- the bit STS_UFLW is set in the process image,
- the counter is set to the load value from which counting continues.

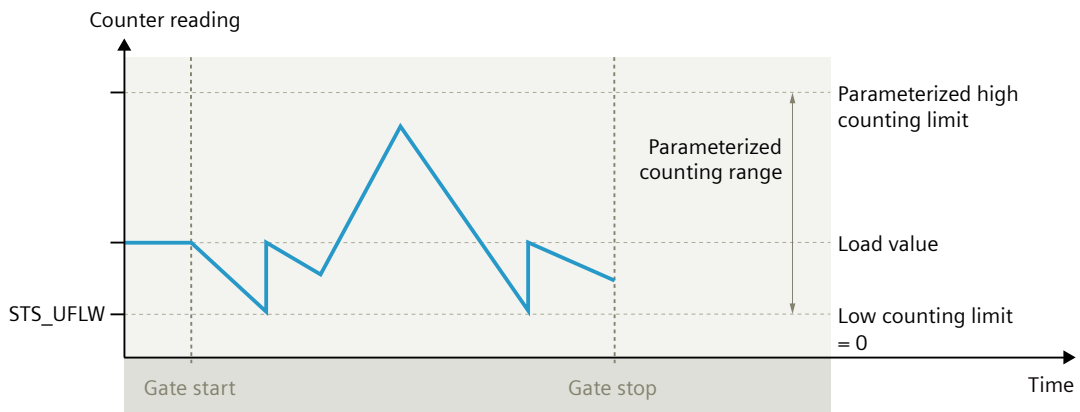


Figure 7-13 Periodic counting with main counting direction down

Counting against the main counting direction (up)

When reaching the count high limit and receiving another count pulse in up direction,

- the counter is set to the high count value +1 from where it continues counting.
- When reaching the maximum count high limit and receiving another count pulse in forward direction,
 - the counter is set to the count low limit from where it continues counting,
 - the bit STS_ZERO is not set.

When reaching the high or count low limit and receiving another count pulse in forward direction,

- the bit TS_OFLW is set in the process image,
- the counter is set to the load value from which counting continues.

The count low limit is 0. The load value has its start value and can be changed via the process image. The counting process continues until the gate is closed.

7.1.6.5 Selecting the gate control

In this operating mode, you can select the gate control. You can choose from the following options:

- SW gate
- HW gate, level-controlled or edge-controlled

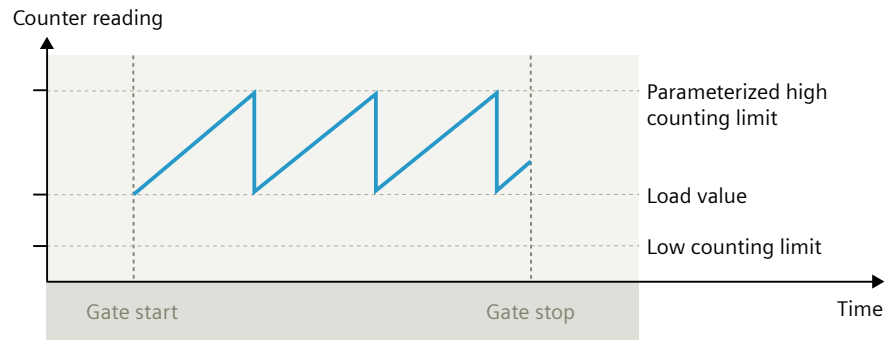


Figure 7-14 Periodic counting with load value and gate control

Open and close SW gate

You open and close the SW gate and set the counter to the load value with the control signal SW_GATE in the process image.

Table 7-11 Open/close the SW gate

Action	...is triggered by
Opening the SW gate	Set SW_GATE
Closing the SW gate	Reset SW_GATE

Open and close HW gate

By applying or removing the corresponding signals at the digital inputs DI Start and DI Stop you open and close the HW gate and set the counter to the load value.

Table 7-12 Triggering opening/closing of the HW gate (periodic counting)

Action	...is triggered by
Open HW gate (level-controlled)	Apply signal at DI Start digital input
Close HW gate (level-controlled)	Remove signal at DI Start digital input
Open HW gate (edge-controlled)	Apply positive edge at DI Start digital input
Close HW gate (edge-controlled)	Apply positive edge at DI Stop digital input

If a positive edge is applied again at the DI Start digital input with an edge-controlled HW gate, the counter starts counting again as of the load value, regardless of whether the gate is closed or still open (retrigger), provided the DI Stop digital input is not set.

7.1.6.6 Stop counting process with gate stop function

Overview

You can end the counting process at any time with the gate stop function. To do so, you set the input signal GATE_STP.

7.1.6.7 Behavior at the counting limits

Overview

When the counter

- reaches one of the counting limits when counting without main counting direction,
- reaches the high counting limits for counting with main counting direction up,
- reaches the low counting limits for counting with main counting direction down,

and another count pulse is received, the counter is set to the load value from which counting continues. A corresponding status bit is set in the process image.

The following table summarizes the behavior at the counting limits:

Table 7-13 Reactions during counting when a limit is exceeded

Main counting direction for counting process	When the high limit was exceeded:	When the low limit was under-shot:
without main counting direction	<ul style="list-style-type: none"> • Count value = Low limit • Status bit STS_OFLW = 1 	<ul style="list-style-type: none"> • Count value = High limit • Status bit STS_UFLW = 1
Main counting direction "up"	<ul style="list-style-type: none"> • Count value = load value • Status bit STS_OFLW = 1 	<ul style="list-style-type: none"> • Count value = Maximum high count value • Continue counting until high counting limit <ul style="list-style-type: none"> – Count value = load value – STS_UFLW = 1
Main counting direction "down"	<ul style="list-style-type: none"> • Continue counting until maximum high counting limit • When reaching the max. high counting limit Count value = Low counting limit • When the low counting limit is exceeded <ul style="list-style-type: none"> – Count value = load value – STS_OFLW = 1 	<ul style="list-style-type: none"> • Count value = load value • Status bit STS_UFLW = 1

7.1.7 Comparing

7.1.7.1 Comparison values

You can configure up to two comparison functions for each counter channel with one assigned comparison value each. The result of the comparison functions (digital value) can be output over freely assigned digital outputs of the module (here referred to as DO0 and DO1). See parameter "Channel operating mode DI/DQ".

The assigned output can be set depending on the counter reading and the comparison value. This section describes the supported comparison functions as well as the behavior of the assigned digital outputs.

Comparison values 1 and 2

The comparison functions are processed directly by the counter function of the technology module. This means the outputs DQ0 and DQ1 can be controlled directly if the comparison conditions have been met. This process is always independent of the processing cycle of the technology module.

You enter the two comparison values via the process image and transfer them to the technology module by setting the request bits T_CMP_V1 or T_CMP_V2 (see section Address space in operating mode "Fast input and output and counter functions and speed measurement" (Page 254)). The technology module acknowledges the request with STS_T_CMP_V1 or STS_T_CMP_V2.

When you reset the request bit T_CMP_V1 or T_CMP_V2, the technology module applies the comparison values with the negative edge of T_CMP_V1 and T_CMP_V2 and resets the acknowledgment STS_T_CMP_V1 or STS_T_CMP_V2. This does not affect the counting process.

The comparison values must be within the limits of the respective counting range. The comparison value is interpreted according to the selected counting range. If you specify the comparison value FFFF FFFF hex, for example, then this value is interpreted within the counting range 0 to +32 bits as 4 294 967 295 and within the counting range 2^{-31} bis 2^{+31} bits as -1.

Table 7-14 Permissible range of values for comparison values

Range of values for comparison values	Main counting direction		
	None	Up	Down
Low limit	Maximum count low limit	-2^{31}	1
High limit	Maximum count high limit	Configured count high limit - 1	$2^{+31} - 1$

7.1.7.2 Enabling the outputs

Overview

Before the outputs can be controlled, you must first enable them by setting the corresponding bits via the process image (see section Address space in operating mode "Fast input and output and counter functions and speed measurement" (Page 254)). When you reset one of these bits, the associated output is switched off immediately even if you have configured it for a pulse duration.

Table 7-15 Enabling the outputs

Output	...is released through enable bit
DO0	ENABLE_DQ0
DO1	ENABLE_DQ1

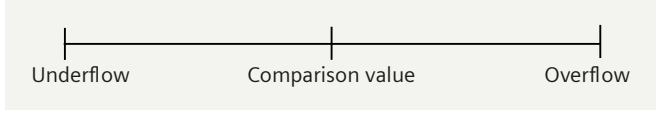
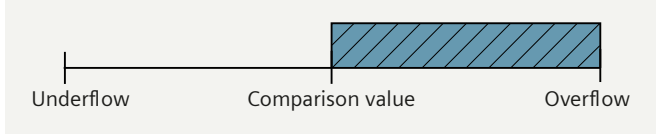
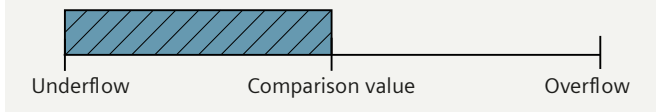
7.1.7.3 Comparison functions

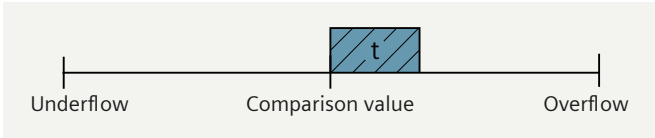
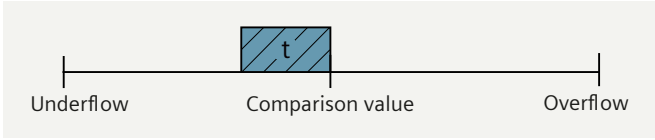
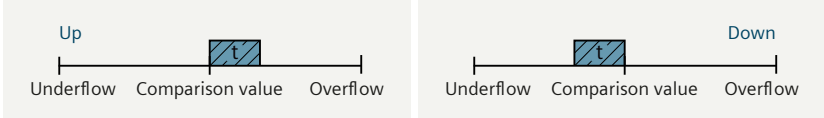
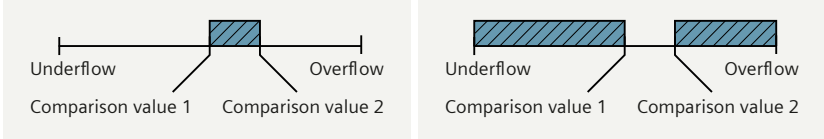
Behavior of the digital outputs

The technology module supports seven different comparison functions. You can assign up to two free digital outputs (DI/DO) of the module to a counter channel or the comparison functions.

You can see the different comparison functions as well as the reactions to reaching the comparison value in the following table.

Table 7-16 Behavior of the digital outputs depending on parameter assignment

Comparison function	Behavior of the digital outputs
Inactive	 <p>The comparator function is deactivated. No digital outputs are required.</p>
Active from comparison value to overflow *	 <p>Output = 1, if count value between comparison value and overflow</p>
Active from comparison value to underflow *	 <p>Output = 1, if count value between underflow and comparison value</p>

Comparison function	Behavior of the digital outputs
Active when reaching the comparison value for pulse duration forward*	 <p>Output = pulse with pulse duration $t_{imp \times r}$ if count value_{up} = comparison value</p> <p>Alternative requirement:</p> <ul style="list-style-type: none"> • Main counting direction none • Main counting direction up
Active when reaching the comparison value for pulse duration down	 <p>Output = pulse with pulse duration $t_{imp \times r}$ if count value_{down} = comparison value</p> <p>Alternative requirement:</p> <ul style="list-style-type: none"> • Main counting direction none • Main counting direction down
Active when reaching the comparison value for pulse duration up/down	 <p>independent of counting direction</p> <p>output = pulse with pulse duration $t_{imp \times r}$ if count value = comparison value</p> <p>Requirement:</p> <ul style="list-style-type: none"> • Main counting direction none
DO1: Switching at comparison values DO0 is inactive	 <p>independent of counting direction</p> <p>Output = pulse with pulse duration $t_{imp \times r}$ if conditions 1. and 2. are met:</p> <ol style="list-style-type: none"> 1. Comparison value 1 < comparison value 2 2. Count value between comparison value 1 and comparison value 2 <p>or</p> <ol style="list-style-type: none"> 1. Comparison value 2 < comparison value 1 2. Count value not between comparison value 2 and comparison value 1 <p>The output DO1 switches when the counter reading is in the area between the two comparison values.</p>

* Note the constraints

A hatched area in the table means: The output is active.

t = pulse duration

State of the outputs and status bits

You can recognize the state of the comparison functions and the assigned digital outputs DO at the corresponding status bits in the process image.

The status bits STS_COMP1 and STS_COMP2 are set by a comparison condition that has been met; they remain set until you acknowledge the status bits with RES_ZERO.

The states of the assigned digital outputs are displayed by the status bits STS_DQ_COMP1 and STS_DQ_COMP2. They are set with an existing enable through ENABLE_DO0 and ENABLE_DO1 in case a comparison condition has been met; they are reset when the comparison condition has not been met.

Switching at comparison values

The assigned digital output DO1 switches at two comparison values when the following conditions are met:

- You have configured the comparison function COMP1 "Inactive".
- You have configured the comparison function COMP2 "Active for switching at comparison values".
- You have loaded the two comparison values CMP_V1 and CMP_V2.
- You have enabled the output DO1 with CRTL_DO1.

The following table shows you when the DO1 is switched on and switched off:

Table 7-17 Output DO1: Switching at comparison values

Comparison values CMP_V1 and CMP_V2	DO1 is switched on when	DO1 is switched off when
$CMP_V1 < CMP_V2$	$CMP_V1 \leq \text{counter reading} \leq CMP_V2$	Counter reading $< CMP_V1$ or Counter reading $> CMP_V2$
$CMP_V1 = CMP_V2$	$CMP_V1 = \text{counter reading} = CMP_V2$	$CMP_V1 \neq \text{counter reading} \neq CMP_V2$
$CMP_V1 > CMP_V2$	Counter reading $< CMP_V2$ or Counter reading $> CMP_V1$	$CMP_V2 \leq \text{counter reading} \leq CMP_V1$

The comparison result is displayed with the status bit STS_COMP2.

You can only acknowledge and thus reset the status bit STS_COMP2 when the comparison condition is no longer being met.

The state of the output DO1 is displayed with the status bit STS_COMP2. There is no hysteresis for this output behavior.

Control of the output DO1 through the control bit SET_DO1 is not possible for this output behavior.

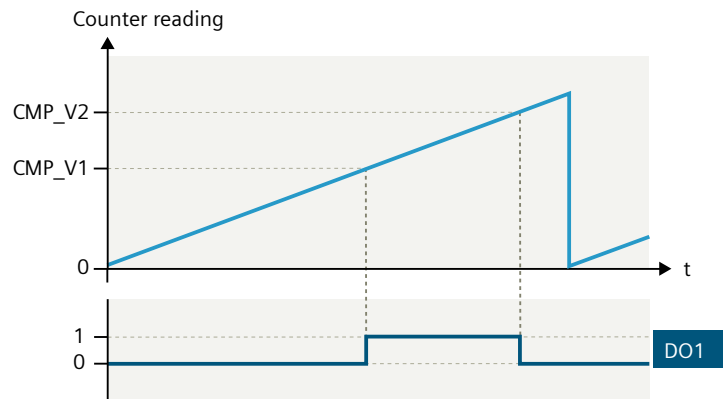


Figure 7-15 V2 is greater than V1 when the counting process starts.

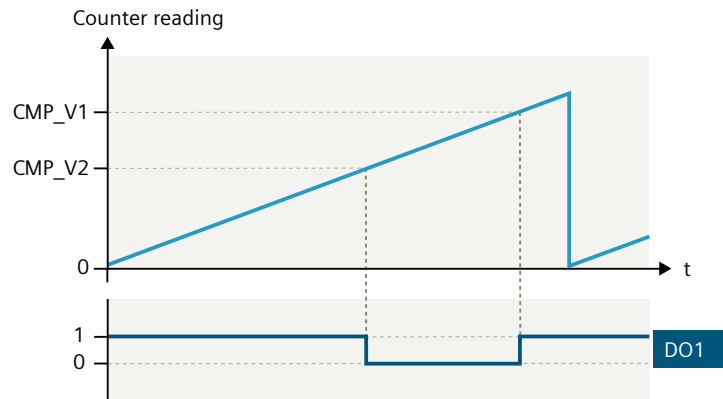


Figure 7-16 V2 is less than V1 when the counting process starts.

Pulse duration

You can specify a pulse duration to adapt the actuators (contactors, actuators, etc.) that are used in your process. The pulse duration specifies how long the outputs DO0 and DO1 are active when a comparison value has been reached.

For counter functions with configured main counting direction up or down, the pulse duration is only active in the main counting direction.

For a parameter assignment without main counting direction, the pulse duration can be active in both counting directions.

The pulse duration starts when the output is set. The inaccuracy of the pulse duration is less than 1 ms.

You can specify a value between 0 and 500 ms for the pulse duration. This value applies to both outputs.

For pulse duration = 0 ms, the output is set when the comparison value has been reached and is reset with the next count pulse.

The default value for the pulse duration is 0.

Note

If you specify a pulse duration of 0 ms, the output is switched on as long as the counter reading is equal to the comparison value.

Due to the switching times of the digital outputs (make time maximum 1 ms, break time maximum 200 μ s), control pulses can be lost at the outputs when the interval between the count pulses is less than the switching times of the digital outputs.

This means you have to ensure that the interval between the count pulses is greater than the switching times of the digital outputs.

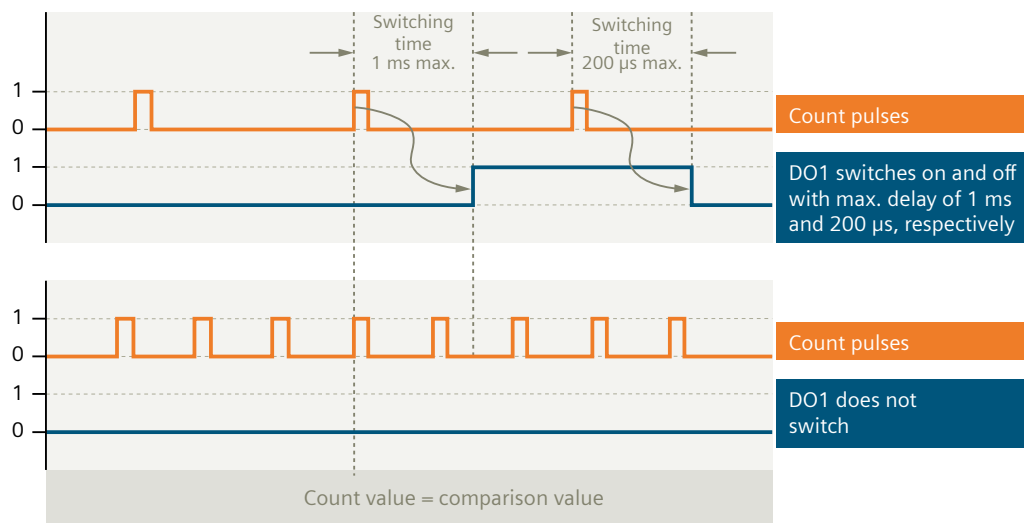


Figure 7-17 Reactions of an output for pulse duration equal to 0 ms

Basic requirements for behavior of the digital outputs

If you want to configure an output "Active from comparison value to overflow or underflow", you must ensure that the time between these events is greater than the minimum switching time of the outputs (switching time: 1 ms ON delay, 200 μ s OFF delay); otherwise the control pulses are lost at the outputs.

When the counter reading reaches the comparison value again while the output is still active, no new pulse is triggered. Another pulse can only be triggered when the output is no longer active.

7.1.7.4 Hysteresis

Basic principle of hysteresis

A sensor can stop at a specific position and then "swing" around this position. This state causes the counter reading to fluctuate around a certain value. If a comparison value is now located in this area of fluctuation, for example, an assigned digital output would be switched on and off in the rhythm of these fluctuations. To prevent this switching for small fluctuations, the technology module is equipped with a configurable hysteresis.

You can configure values between 0 and 255 for the hysteresis.

Table 7-18 Effect of the hysteresis

Hysteresis	Effect
Hysteresis value $n = 0, 1$	The hysteresis has no effect (switched off). The output reacts to even the smallest change of the counter reading.
$2 \leq \text{hysteresis value } n \leq 255$	The hysteresis has an effect. The output only reacts when the counter reading has changed n units from the comparison value.

The hysteresis is also in effect for overflow and underflow.

Effect of the hysteresis with parameter assignment "Active from comparison value to underflow"

The following figure shows an example of the effect of the hysteresis. The different behavior of an output with a configured hysteresis of 0 (= switched off) and a hysteresis of 3 is shown in the figure. The comparison value is 5 in the example.

The parameter assignment for this example is:

- Main counting direction up
- Active from comparison value to overflow

The hysteresis becomes active when the comparison condition (counter reading = 5) has been reached. The comparison result will remain unchanged with an active hysteresis.

If the count value leaves the hysteresis range, which happens at count value 2 or 8 in the example, the hysteresis is no longer active. The comparator switches once again according to its comparison conditions, at count value 5 in the example.

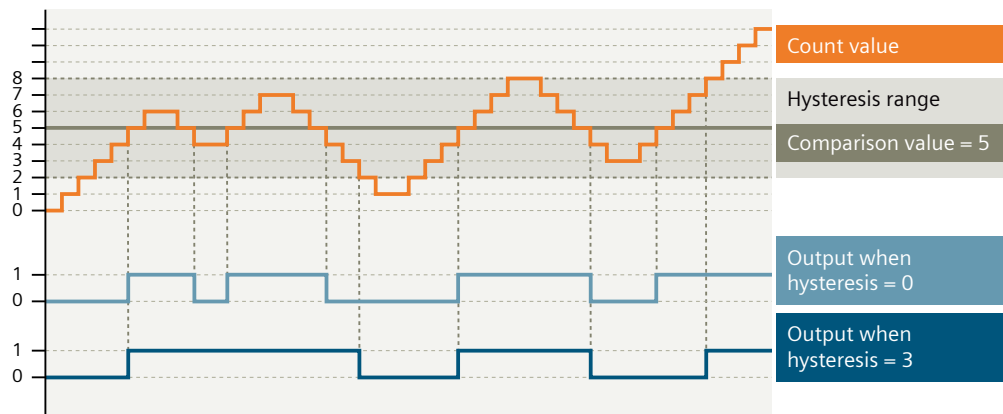


Figure 7-18 Example of the effect of the hysteresis

Effect of the hysteresis for parameter assignment "Active when reaching the comparison value for pulse duration forward/backward"

The following figure shows an example of the effect of the hysteresis. The different behavior of an output with a configured hysteresis of 0 (= switched off) and a hysteresis of 3 is shown in the figure. The comparison value is 5 in the example.

The parameter assignment for this example is:

- Main counting direction none
- Active when reaching the comparison value for pulse duration up
- Pulse duration > 0

The hysteresis becomes active when the comparison condition (counter reading = 5) has been reached, and a pulse of the configured duration is output at the output.

If the count value leaves the hysteresis range, the hysteresis is no longer active.

If the hysteresis becomes active, the technology module saves the counting direction. If the hysteresis range is exited against the saved direction, a pulse is output.

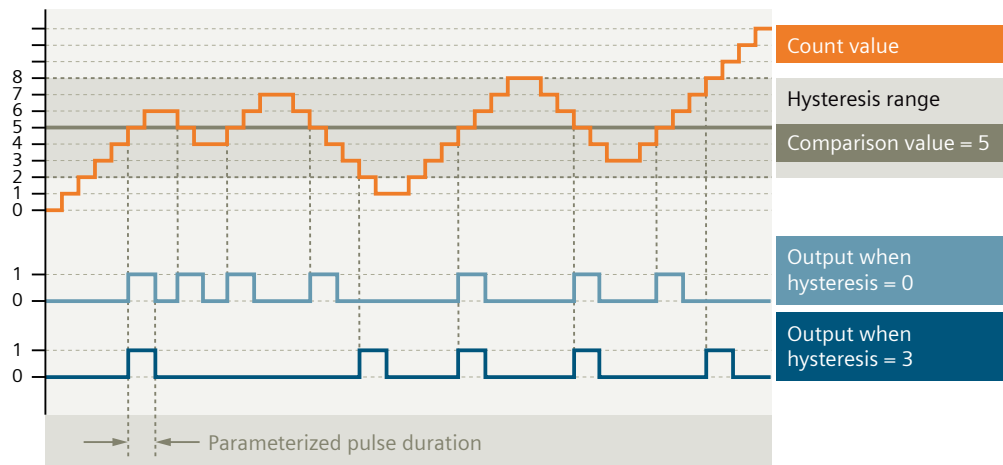


Figure 7-19 Hysteresis for parameter assignment "Active when reaching the comparison value for pulse duration forward/backward"

7.1.8 Gate control

7.1.8.1 Command: Open and close gate

Overview

The technology module has the following gates per counter channel:

- One hardware gate (HW gate) that you can operate either level-controlled or edge-controlled.
- One software gate (SW gate) that you can open and close using the control bits in the user program of the higher-level automation system.

Select and control gate and functions

You use the "Gate control" parameter to specify which gate you want to use for the counting process.

You use the "HW gate" parameter to specify whether the HW gate is to operate level-controlled or edge-controlled.

The technology module offers the following options to open and close the gates:

Options to open or close the gates	Open the gate	Close the gate
Level-controlled opening and closing of the HW gate (Page 104)	Digital input DI Start = 1	Digital input DI Start = 0
Edge-controlled opening and closing of the HW gate (Page 104)	Positive edge at DI Start digital input (0-->1)	Positive edge at DI Stop digital input (0-->1)
Opening and closing of the SW gate (Page 105)	Input signal in process image SW_GATE = 1	Input signal in process image SW_GATE = 0
Canceling and interrupting gate function (Page 106)	-	Input signal in process image SW_GATE = 1. Note: Must be enabled again for counter operation.

See the supplementary information in the corresponding sections.

Information on the gate status

Status object	Display
Gate status	STS_GATE = status bit of the gate
SW gate	STS_SW_GATE = status bit of the SW gate

Default

The gates must be opened by the corresponding signals. If they are open, the count pulses are counted.

7.1.8.2 Level-controlled opening and closing of the HW gate

Open gate for counting

The level-controlled HW gate opens with the first change of the signal state from "0" to "1" at the digital input DI Start after parameter assignment or new configuration.

The count pulses reach the counter and are counted as long as DI Start is set.

If the gate was closed due to an overflow or underflow, it can be opened again by the reset or by resetting to digital input DI Start.

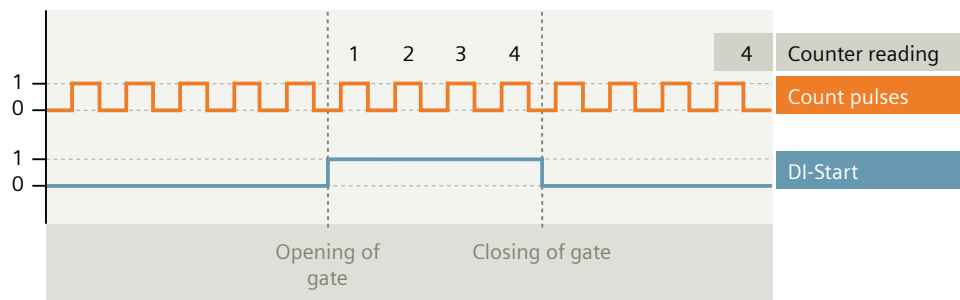


Figure 7-20 Level-controlled opening and closing of the HW gate

Close the gate

If the digital input DI Start is set to 0, the gate closes. The pulses are no longer counted, the counter stops.

Status digital input DI Start

The state of the digital input DI Start is displayed by the status bit STS_STA.

7.1.8.3 Edge-controlled opening and closing of the HW gate

Open gate for counting

The edge-controlled HW gate opens with the first positive edge at the digital input DI Start.

The count pulses reach the counter and are counted.

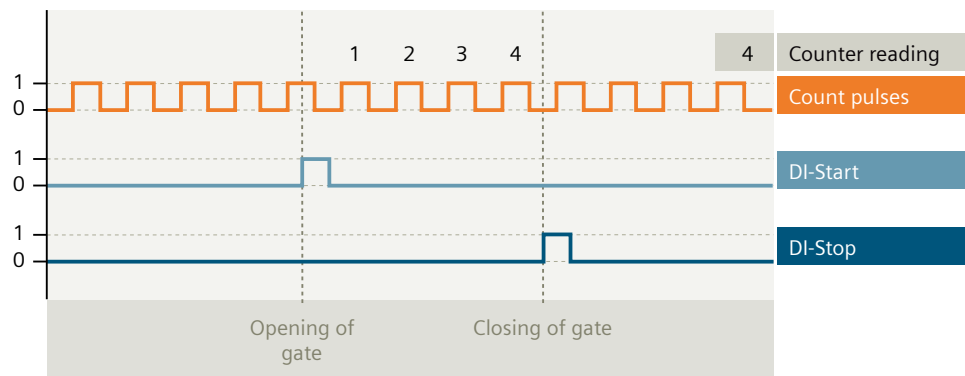


Figure 7-21 Edge-controlled opening and closing of the HW gate

Note

If the digital input DI Stop is set, a positive edge at the digital input DI Start cannot open the gate.

Close the gate

The gate is closed by a positive edge at the digital input DI Stop. The pulses are no longer counted, the counter stops.

With simultaneous positive edges at both inputs:

- An open gate is closed.
- A closed gate remains closed.

Status digital inputs DI Start, DI Stop:

The state of the digital input DI Start is displayed by the status bit STS_STA.

The state of the digital input DI Stop is displayed via the status bit STS_STP.

7.1.8.4 Opening and closing of the SW gate

The SW gate is opened and closed by setting and resetting the control signal SW_GATE.

Note

An edge-controlled opening and closing of the SW gate is not possible.

Opening the SW gate

The SW is opened by setting the control signal SW_GATE.

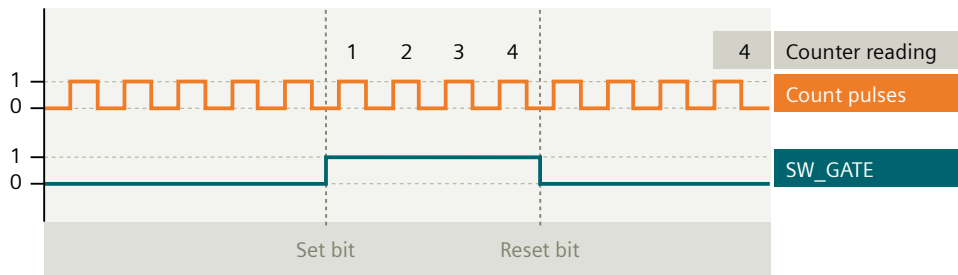


Figure 7-22 Opening and closing the SW gate

Closing the SW gate

The SW gate is closed by resetting the SW_GATE control signal.

The closed gate can be opened again by resetting and setting the control signal SW_GATE once again.

Status of the SW gate

The status of the SW gate is displayed at the status bit STS_SW_GATE of the process image.

7.1.8.5 Canceling and interrupting gate function

During parameter assignment of the gate function, you can specify whether the gate is to cancel or interrupt the counting process.

Canceling gate function

With the canceling gate function, the counting process starts after closing the gate and restarting the gate with the load value (time ① in the figure below):

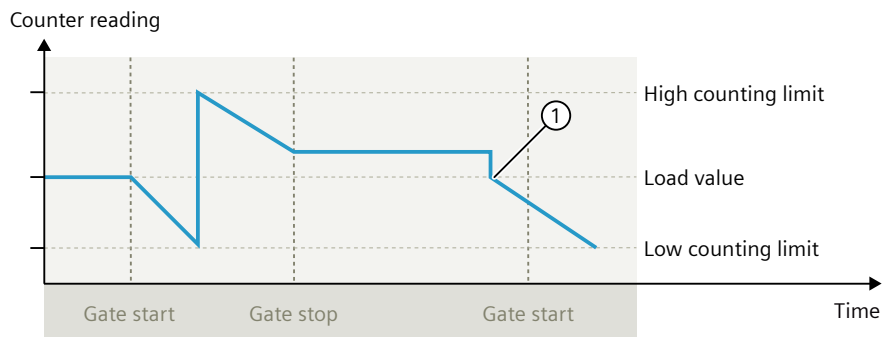


Figure 7-23 Continuous counting, down, canceling gate function

Interrupting gate function

With an interrupting gate function, the counting process is stopped when the gate closes and continued at the last current count value when the gate is started again (time ① in the figure below):

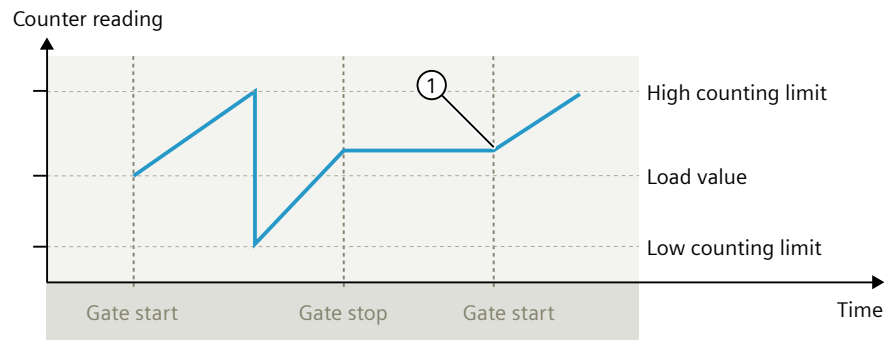


Figure 7-24 Continuous counting, up, interrupting gate function

Stop counting process with gate stop function

You can stop the counting process independent of the created signals or the state of the SW gate and HW gate with the gate stop function.

To do so, you set the input signal GATE_STP.

You must reset the input signal GATE_STP to open the gate again:

You have the following options for the reset:

- At the HW gate:
Set positive edge at DI Start digital input
- At the SW gate:
Set the control signal SW_GATE

7.1.9 Command: Set counter

7.1.9.1 Load value

The counting process can be started with the initialization value or from the so-called load value. If you want to start the counting process from the load value, you must configure the signal with which the counter is to be set to the load value.

Setting the counter

You can set the counter as follows:

- With the control signals (bits) L_DIRECT or L_PREPAR of the input process image
- With an external signal that is read via a freely assigned digital input of the module (referred to as DI Set here), either directly or in combination with the zero mark of the sensor.

Load value

You can specify a number within the counting range as the load value.

The load value is interpreted according to the selected counting range. When you specify the comparison value FFFF FFFF hex, for example, then this value is interpreted within the counting range 0 to +32 bits as 4 294 967 295 and within the counting range 2^{-31} to 2^{+31} bits as -1.

The load value is transferred to the module via the process image. The counter is then set to the load value,

- with the negative edge of the control bit L_DIRECT directly and as preparation,
- with the negative edge of the control bit L_PREPAR only as preparation.

You enter the load values via the process image and transfer them to the technology module by setting the control bits L_DIRECT or L_PREPAR. The technology module acknowledges the load request with STS_L_DIRECT or STS_L_PREPAR.

When you reset the control bit L_DIRECT or L_PREPAR, the technology module applies the load values and resets the acknowledgment STS_L_DIRECT or STS_L_PREPAR.

The following value ranges are permissible for the load value:

Table 7-19 Permissible range of values for load values

Range of values for load values	Main counting direction		
	None	Up	Down
Low limit	Maximum count low limit	$-2^{31} + 1$	2
High limit	Maximum count high limit	Configured count high limit - 2	$2^{+31} - 1$

7.1.9.2 Setting the counter using the application software

Overview

Regardless of external events, you can set the counter via the process image with the control bit L_DIRECT. The technology module acknowledges the request with STS_L_DIRECT.

When you reset the control bit L_DIRECT, the technology module applies the values with the negative edge from L_DIRECT and resets the acknowledgment STS_L_DIRECT. This does not affect the counting process.

7.1.9.3 Setting the counter with an external signal

A new load value is loaded as preparation with the control bit L_PREPAR.

Setting the counter

You use the parameter "Load value synchronization" to select the external signals with which the counter is to be set to the load value:

- DI-Set without zero mark of the sensor
- DI-Set in combination with the zero mark of the sensor

You use the zero mark of the sensor when you want to synchronize the counter to a specific counter reading at a specific point in your process. This will achieve a greater precision of the counting process.

Setting the counter is independent of the operating mode of the counter.

After the counter has been set with an external signal, the bit STS_SYNC is set in the process image. The bit STS_SYNC is deleted by the control bit RES_SYNC.

Note

Synchronization of a counter with the zero mark only makes sense when the gate is open. If you have enabled only one counting direction when setting a counter with an external signal, you must note that the current counting direction is saved (frozen) when you close the gate. This allows for synchronization of the counter against the enabled counting direction.

7.1.9.4 Setting the counter with DI-Set

The counter can be loaded with the load value using a positive edge at the assigned digital input DI Set.

You can specify the behavior of the technology module counter function with a positive edge at the assigned digital input DI Set using the process image control bits EN_SET_UP and EN_SET_DN and with the parameter assignment.

Table 7-20 Setting the counter with DI Set

Control bits/Parameter	Behavior of the technology module
EN_SET_UP set	The counter is only set when counting up.
EN_SET_DN set	The counter is only set when counting down.
EN_SET_UP and EN_SET_DN set	The counter is set when counting up and counting down.
"Set counter once" parameter assignment	The counter is only set with the first positive edge at DI Set. If the counter is to be set again, you must first reset EN_SET_UP or EN_SET_DN and then set it again. The counter is then reset with the next positive edge at DI Set.
"Set counter multiple times" parameter assignment	The counter is set with each positive edge at DI Set as long as EN_SET_UP or/and EN_SET_DN are set.

Note

In either case, you must set one of the two variables EN_SET_UP or/and EN_SET_DN so that the counter can be set using the digital input DI Set.

Setting once with DI Set

The figure below shows the single setting of the counter with the digital input DI Set. The case in which only EN_SET_UP is set is shown here, which means the counter is only set when counting up.

The counter is set with the first positive edge at the digital input DI Set as long as EN_SET_UP is set as well. If you want to set the counter again, you must first reset EN_SET_UP and then set it again. In this case, the next positive edge at the digital input DI Set will set the counter.

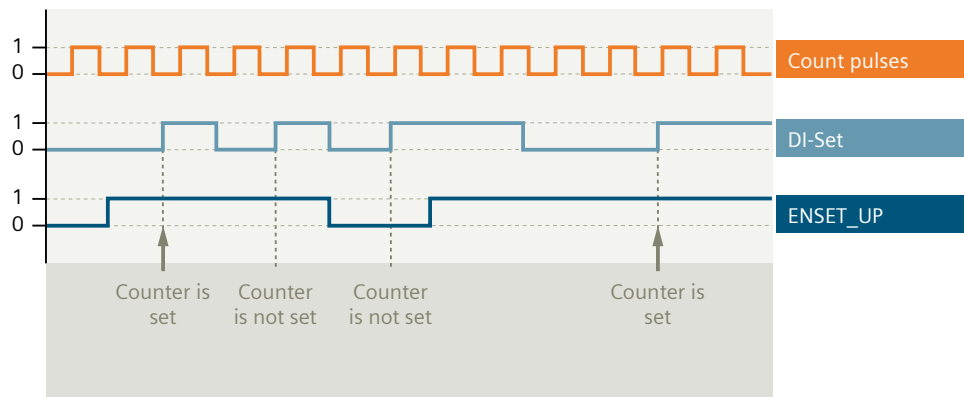


Figure 7-25 Setting once with DI Set

Setting multiple times with DI Set

The figure below shows the multiple setting of the counter with DI Set. The case in which only EN_SET_UP is set is shown here, which means the counter is only set when counting up.

The counter is set with each positive edge at DI Set as long as EN_SET_UP is set as well. When you reset EN_SET_UP, the counter is not set by DI Set. Only when you have set EN_SET_UP again will the next positive edge at DI Set set the counter.

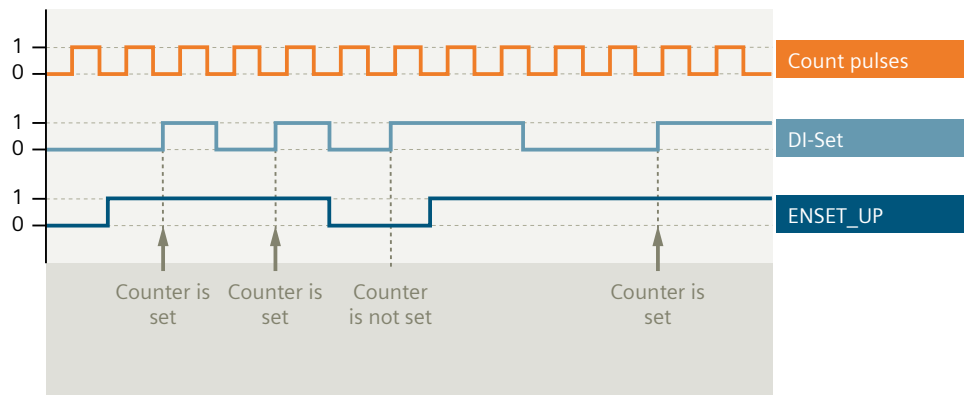


Figure 7-26 Setting multiple times with DI Set

Setting the counter with DI Set and zero mark

When you configure the setting of the counter with the zero mark of the sensor, the counter is set with the positive edge of the zero mark.

The setting only takes place when the DI Set is also set at the time of the positive edge of the zero mark.

You can specify the behavior of the technology module counter function with a positive edge of the zero mark using the process image control bits EN_SET_UP and EN_SET_DN and with the parameter assignment.

Table 7-21 Setting the counter with DI Set and zero mark

Control bits/Parameter	Behavior of the technology module
EN_SET_UP set	The counter is only set when counting up.
EN_SET_DN set	The counter is only set when counting down.
EN_SET_UP and EN_SET_DN set	The counter is set when counting up and counting down.
"Set counter once" parameter assignment	The counter is only set with the first positive edge of the zero mark. If the counter is to be set again, you must first reset EN_SET_UP or EN_SET_DN and then set it again. The counter is then reset with the next positive edge of the zero mark.
"Set counter multiple times" parameter assignment	The counter is set with each positive edge of the zero mark as long as EN_SET_UP or/and EN_SET_DN are set.

Note

In either case, you must set one of the two variables EN_SET_UP or/and EN_SET_DN so that the counter can be set with the zero mark.

Setting once with DI Set and zero mark

The figure below shows the single setting of the counter with the zero mark. The case in which only EN_SET_UP is set is shown here, which means the counter is only set when counting up.

The counter is set with the first positive edge of the zero mark as long as EN_SET_UP and DI Set are set.

If you want to set the counter again, you must first reset EN_SET_UP and then set it again. If DI Set is not set, setting takes place with the first zero mark after setting DI Set. If DI Set is set, setting takes place with the next zero mark.

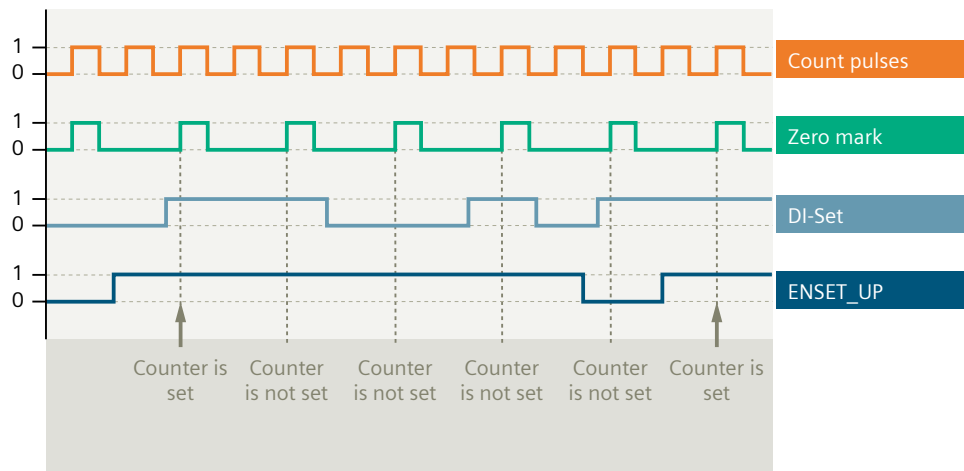


Figure 7-27 Setting the counter once with the zero mark

Setting the counter multiple times with DI Set and zero mark

The figure below shows the multiple setting of the counter with the zero mark. The case in which only EN_SET_UP is set is shown here, which means the counter is only set when counting up.

The counter is set with each positive edge of the zero mark as long as EN_SET_UP and DI Set are set.

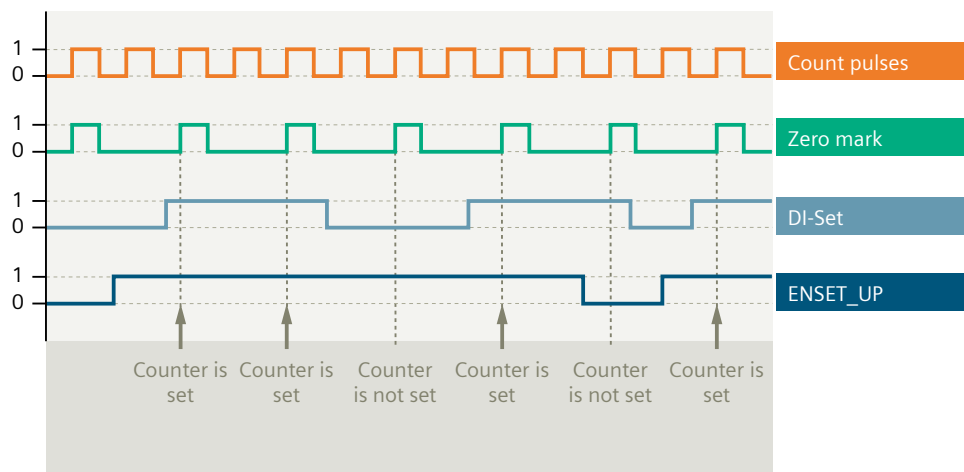


Figure 7-28 Setting the counter multiple times with the zero mark

7.1.10 Command: Latch/Retrigger

7.1.10.1 Command overview: Latch/Retrigger

You can use the Latch/Retrigger command to save counter readings with positive or negative edges at the DI Start digital input (latch). The counter is set to the load value after each save and continues counting from the load value (retrigger).

Requirement

For the command: Latch/Retrigger, you must use the SW gate.

The minimum distance of the latch edges is 0.625 ms. If the time between edges is shorter, the values may be lost.

Selection of edges

You can configure the following behavior:

- Latch/Retrigger with a positive edge at DI Start
- Latch/Retrigger with a negative edge at DI Start
- Latch/Retrigger with both edges at DI Start

Operating principle

The counting function is enabled with the opening of the SW gate.

Counter reading and latch value have their start value. They remain unchanged by opening the SW gate.

The counting process starts with the load value as of the first edge at DI Start. The load value is always loaded into the counter with every additional edge at DI start.

The counter value is latched with the second and the following edges at the DI start input. The latch value is always exactly the counter reading at the time of the edge. The state of the DI Start digital input is displayed by the status bit STS_STA in the process image. The latch value is displayed with LATCH_LOAD in the process image.

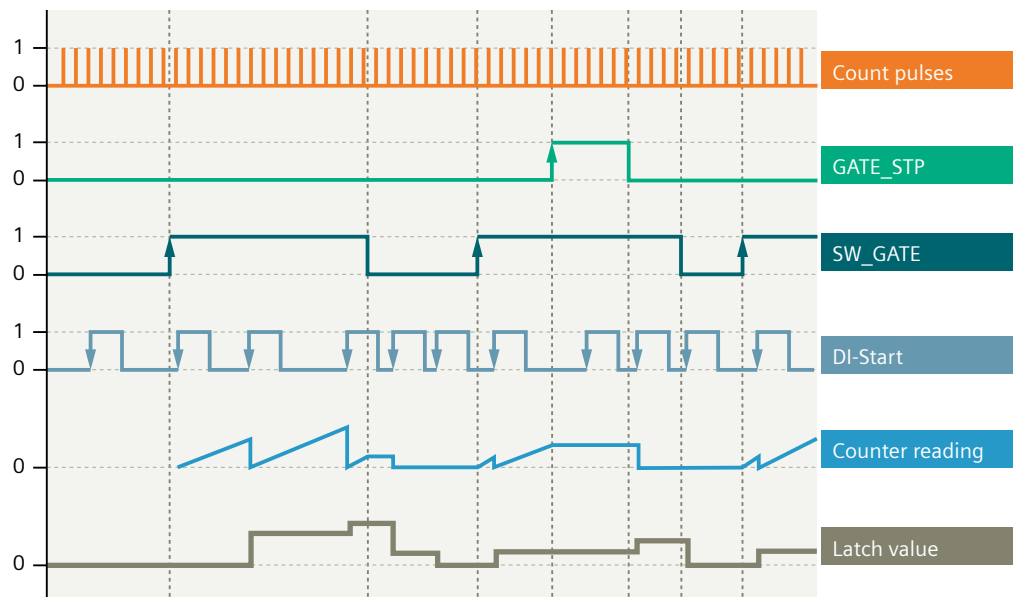


Figure 7-29 Latch_Retrigger with load value = 0 and positive edge at DI Start

7.1.10.2 Interrupting and terminating the command: Latch/Retrigger

Overview

When you close the SW gate, the counting process is interrupted (interrupting gate function), which means the counting process is resumed with the last current count value when the SW gate is opened again.

Even when the SW gate is closed, the current counter reading is saved with an edge at the DI Start digital input and the counting process resumes with the load value.

However, when you close the SW gate with the control bit GATE_STP, the counting process stops. This means that no counter readings can be saved with DI Start as long as the control bit GATE_STP is set.

The counting process can only be restarted by setting the control bit SW_GATE again with the next edge at the DI Start digital input.

The requirement is that the control bit "GATE_STP" is no longer set.

7.1.11 Command: Latch

7.1.11.1 Command: Latch

You use the Latch command to save counter readings with edges at the DI Start digital input (latch). This does not change the counter reading.

Requirement

You must use the SW gate for this command.

The minimum distance of the latch edges is 0.625 ms. If the time between edges is shorter, the values may be lost.

Selection of edges

You can configure the following behavior:

- Latch with a positive edge at DI Start
- Latch with a negative edge at DI Start
- Latch with both edges at DI Start

Operating principle

Counter reading and latch value have their start value.

The counting function is started with the opening of the SW gate. The counter starts with the load value.

The latch value is always exactly the counter reading at the time of the edge. The state of the DI Start digital input is displayed by the status bit STS_STA in the process image. The latch value is displayed with LATCH_LOAD in the process image.

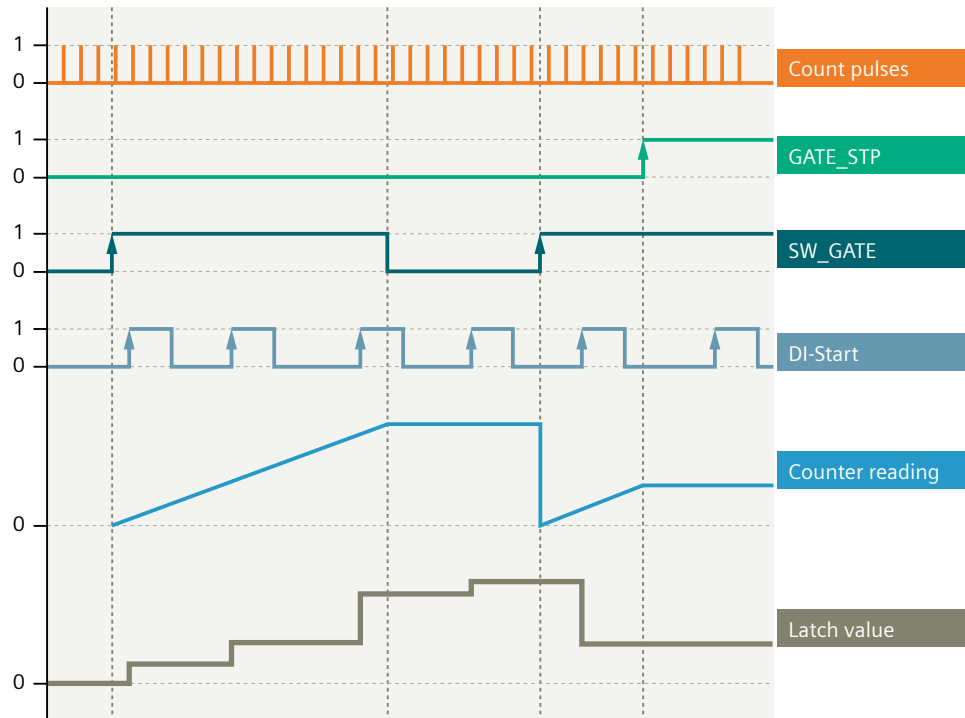


Figure 7-30 Latch with load value = 0 and positive edge at DI Start

7.1.11.2 Canceling and exiting the command

Overview

When you close the SW gate, the counting process is canceled (canceling gate function), which means the counting process resumes with the load value when the SW gate is opened again.

Even when the SW gate is closed, the current counter reading is saved with an edge at the DI Start digital input and the counter reading does not change.

However, when you close the SW gate with the control bit GATE_STP, the counting process stops. This means that no counter readings can be saved with DI Start.

The counting process can only be restarted by setting the control bit SW_GATE again. The requirement is that the control bit "GATE_STP" is no longer set.

7.1.12 Command overview: Measuring times between two edges

With this command, you can measure the times between two consecutive edges at the DI Start digital input.

Requirement

This command has the following requirements:

- Do not connect an external sensor to the technology module.
- Configure any counting mode for the operating modes.
- For gate control, configure: Latch/Retrigger.
- For the sensor, configure the signal type: internal time basis 1 MHz.

Selection of edges

Table 7-22 Selection of edges for time measurement

For time measurement between two consecutive...	... configure
positive edges at DI Start	Latch with positive edge
negative edges at DI Start	Latch with negative edge
any edges at DI Start	Latch with both edges

Operating principle

To measure the time, the technology module needs an internal time basis of 1 MHz. Time measurement starts with the first edge at DI Start. For every additional edge at DI Start, it is the time in μs which has elapsed since the last edge that is saved as latch value LATCH_LOAD in the process image.

7.1.13 Parameters of the counting function

The following tables show the parameters for the counting function.

Counting function configuration

You have the following setting options when the technology module "Fast inputs and outputs and counter functions 6DL1138-6EA000EH1; configuration 2 - Fast input and output and counter functions" is configured:

Table 7-23 Parameters in the counting function configuration

Parameter	Value range	Default	Parameter reassignment in RUN	Efficiency range
Operating mode	<ul style="list-style-type: none"> Disabled Counting 	Disabled	Yes Change of the operating mode results in restart of the counter function.	Counter channel
Sensor type	<ul style="list-style-type: none"> Incremental sensor 24 V Pulse generator without direction signal Pulse generator with direction signal Internal time basis 1 MHz 	Incremental sensor 24 V	Yes Change of the sensor type results in restart of the counter function.	Counter channel
Type of counting mode	<ul style="list-style-type: none"> Continuous counting Single counting Periodic counting 	Continuous counting	Yes Change of the counting mode results in restart of the counter function.	Counter channel
Signal evaluation	<ul style="list-style-type: none"> Single Double Quadruple 	Single	Yes	Counter channel
Counting direction	<ul style="list-style-type: none"> Normal Inverted 	Normal	Yes	Counter channel
Sensor signals filtering	<ul style="list-style-type: none"> 5 μs 25 μs 	5 μ s	Yes	Counter channel
Counting range	<ul style="list-style-type: none"> 0 to 2^{+32} bits 2^{-31} to 2^{+31} bits 	0 to 2^{+32} bits	Yes Change of the counting range results in restart of the counter function.	Counter channel

Parameter	Value range	Default	Parameter reassignment in RUN	Efficiency range
Gate control	<ul style="list-style-type: none"> Without gate (only for continuous counting) SW gate HW gate Latch Latch/Retrigger 	Without gate (only for continuous counting)	Yes	Counter channel
HW gate	<ul style="list-style-type: none"> Level-controlled hardware gate Edge-controlled hardware gate 	Level-controlled hardware gate	Yes	Counter channel
Gate function	<ul style="list-style-type: none"> Cancel counting Interrupt counting 	Cancel counting	Yes	Counter channel
Latching edge evaluation	<ul style="list-style-type: none"> None Rising edge Falling edge Rising and falling edge 	None	Yes	Counter channel
Main counting direction	<ul style="list-style-type: none"> None Up Down 	None	Yes Change of the main counting direction results in restart of the counter function.	Counter channel
Count high limit	<ul style="list-style-type: none"> -2^{31} to $2^{31}-1$ or 0 to $2^{32}-1$ 	7FFF FFFF hex	Yes	Counter channel
Comparison function Comp1	<ul style="list-style-type: none"> Disabled Enabled by comparison value 1 to overflow Enabled by comparison value 1 to underflow Enabled when reaching the comparison value 1 for pulse duration up/down Enabled when reaching the comparison value 1 for pulse duration up Enabled when reaching the comparison value 1 for pulse duration down 	Disabled	Yes	Counter channel

Parameter	Value range	Default	Parameter reassignment in RUN	Efficiency range
Comparison function Comp2	<ul style="list-style-type: none"> Disabled Enabled by comparison value 1 to overflow Enabled by comparison value 1 to underflow Enabled when reaching the comparison value 1 for pulse duration up/down Enabled when reaching the comparison value 1 for pulse duration up Enabled when reaching the comparison value 1 for pulse duration down Switching at setpoints 	Disabled	Yes	Counter channel
Hysteresis	<ul style="list-style-type: none"> 0 - 255 	0	Yes	Counter channel
Pulse duration for HW output of Comp1 and Comp2	<ul style="list-style-type: none"> 0 ms to 500 ms 	0	Yes	Counter channel
Load value synchronization	<ul style="list-style-type: none"> HW input DI Set without zero mark of the sensor HW input DI Set in combination with the zero mark of the sensor 	HW input DI Set without zero mark of the sensor	Yes	Counter channel
Load value type	<ul style="list-style-type: none"> Single Multiple 	Single	Yes	Counter channel

7.1.14 Explanation of parameters for the Counting operating mode

The parameters are only available with the following configuration:

Counting operating mode

Operating mode

The parameter defines the operating mode of the counter channel. Operating modes:

- Disabled
- Counting

Sensor type

Specifies the type of sensor to be connected for the counter channel.

The module supports the following sensor types:

- Incremental sensor 24 V
- Pulse generator without direction signal
- Pulse generator with direction signal
- Internal time basis 1 MHz

Type of counting mode

Specifies the response of the counter in "Counting" mode:

- Continuous counting
- Single counting
- Periodic counting

Signal evaluation

Specifies how the edges of the sensor signals are counted.

The following configurations are supported:

- Single evaluation
- Double evaluation
- Quadruple evaluation

Multiple evaluation is only supported for incremental sensors that return A* and B* with a phase offset of 90°.

Counting direction

Changed the direction of the counter.

Sensor signals filtering

To suppress interferences, you can configure input filters (digital filters) for the 24 V inputs with a filter time. This is how you specify the filter time of the sensor signals and thus the maximum count frequency. The following two input filters are available:

Table 7-24 Input filters for 24 V sensor signals

Characteristics	Input filter 1 (default)	Input filter ¹ 2
Typical input delay	5 µs	25 µs
Maximum count frequency	70 kHz	18 kHz
Minimum pulse width of the count signals	7 µs	27 µs

¹ When using the combined DIDO digital inputs, the filter time is set permanently to 25 µs.

Counting range

Specifies the maximum counting range.

If you have configured a counting mode with main counting direction, you can further limit the maximum counting range with the "Count high limit" parameter.

Gate control

Specifies the values for the gate control.

HW gate

Specifies the type of controller for the HW gate.

Gate function

Specifies the counting behavior for the gate function.

Latching edge evaluation

Specifies the edge with which the counter reading is to be latched at the DI Start digital input.

- None
- Rising edge
- Falling edge
- Rising and falling edge

Main counting direction

Specifies the main counting direction for the types of counting mode "Single counting" and "Periodic counting".

Count high limit

With this parameter, you can limit the maximum high count value.

Comparison function Comp1

Specifies the comparison mode for the comparison function Comp1.

Comparison function Comp2

Specifies the comparison mode for the comparison function Comp2.

Hysteresis

Specifies the hysteresis of the comparison functions Comp1 and Comp 2 and thus prevents the switching on and off in case of small fluctuations.

Pulse duration for HW output of Comp1 and Comp2

Specifies the pulse duration in ms for the HW output of Comp1 and Comp2.

The same value is set for both comparison functions.

Load value synchronization

Specifies how the counter is set to the load value as preparation with the external signal DI Set.

- HW input DI Set without zero mark of the sensor
- HW input DI Set in combination with the zero mark of the sensor

Load value type

Specifies whether the counter is to be set to the load value once or multiple times with a positive edge at the DI Set digital input.

7.2 Fast controllers - TM Contr

7.2.1 Basics

The fast controllers are provided for TM Contr in the configurations 4, 5, 6 and 7. This function can be combined with the functions of the fast input and output and the speed measurement.

The technology module allows for the processing of time-sensitive functions directly on the module. The application to be processed can be configured using the graphical configuration user interface (function diagram editor) of the higher-level DCS system. The permissible size of the application software depends on the set cycle time and the types of function blocks used.

In a redundant configuration of the technology module, the internal states of the application software are synchronized between the redundancy partners to enable a bumpless changeover.

An offline calculation of the permissible application size is only supported for the technology module of the higher-level DCS system.

Downloading

The configuration created this way is compiled by the graphical configuration user interface and then downloaded to the technology module.

Changes of the application software (e.g. parameter changes) can be downloaded to the technology module during operation.

The technology module supports the download of the application software in STOP and RUN of the execution system.

Behavior of the execution system

Event	Behavior of the execution system
Cycle overflow during processing of the application software	<ul style="list-style-type: none"> • The TM execution system is stopped. • Diagnostic message TM execution system Cycle overflow/ Stop • Hardware outputs are set to configured substitute values
Connection to the automation server is interrupted	<ul style="list-style-type: none"> • The TM execution system is stopped. • The TM execution system is not started automatically when the connection is restored. • Hardware outputs are set to the configured substitute values

Cycle

The technology module permits setting of the cycle time for processing the application software in a range from 0.625 to 20 ms.

Supported cycle times are:

- 0.625 ms*
- 1.25 ms
- 2.5 ms
- 5 ms
- 10 ms
- 20 ms

*Not adjustable for Configuration 7: Fast controllers and speed measurement, large process image and fast input and output

Application software

The technology module supports the download of the application software in STOP and RUN of the execution system.

The technology module supports the download and execution of configurable application software (e.g. position control) which requires fast cyclic execution.

Access to inputs and outputs of the hardware and software

The application software can access the following by using special function blocks:

- Analog as well as digital inputs and outputs of the technology module
- Process image for data exchange with the higher-level automation system

Backup of the application software

The application software is saved on the higher-level automation server. There is no persistent backup on the technology module.

The application software is automatically downloaded to the technology module in case of a restart after a power outage.

7.2.2 Special features of cross-station redundancy

Although cross-station redundancy retains much of the functionality of IO redundancy, the changed topology results in some differences, which are explained in the following sections.

Note

Availability depends on functional status

The cross-station redundancy is only available on modules as of a HW functional status FS04 and a firmware FW V1.2.0.

Interconnection of the redundancy connection

Due to the cross-station arrangement, redundancy information can no longer be exchanged internally (via the backplane bus). The redundant modules are connected via the RS485 connections Link 1 (terminal 27/28) and Link 2 (terminal 31/32). For this purpose, a PROFIBUS DP-compliant cable with a wave impedance in the range of 100 to 170 ohms is used, the shielding of which is connected to the device ground on both sides.

The cable length must not exceed 10 meters.

Use of the sensors and actuators

Due to the omission of the common terminal block, all signals must be connected twice. Cross-station redundancy combines two modules with their respective connections to form a redundant unit. In the context of the following sections, it should always be noted that no additional signals become available in the process and that the quantity structure remains unchanged. It is always the same signal in terms of meaning and parameter assignment, which must be switched on twice.

Note

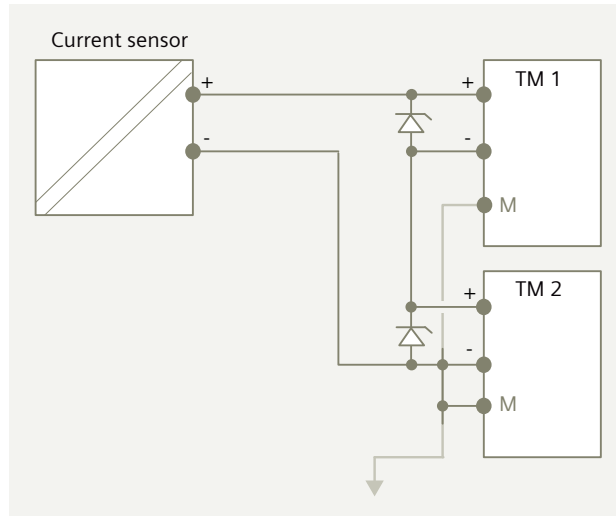
Common ground reference

The G connection of the two partner modules in the terminal block in case of IO redundancy must be established with a separate connection of the two G ports in case of cross-station redundancy.

- **Analog inputs (AI):**

To ensure safe detection of currents, the two modules must be wired independently. If no redundant transmitters are available for this purpose, this must be ensured in general by an additional, external RC circuit.

An exception is the structure displayed in the figure below. The measuring current is guided serially through both modules. Z-diodes maintain the current flow as soon as a module is defective or pulled.



When Z-diodes are selected, the avalanche voltage and the DC leakage current to be expected in normal operation have to be taken into account. In case of interference of the B-module the avalanche voltage of the lower Z-diode may not exceed the common mode voltage V_{CM} at the analog input of the upper module A. This may not exceed 9 Volt. During normal operation the terminal voltage is up to 1.5 Volt, for 72 Ohm internal resistance and 20 mA sensor current. Depending on the selected diode type, significant DC leakage currents which influence the measurement occur in this voltage range despite higher avalanche voltage.

In general, Z-diodes with an avalanche voltage between 3.6 and 5.0 Volt are suitable. The DC leakage currents in normal operation should, however, be estimated and always taken into account according to the data sheet.

Voltages, on the other hand, can be applied in parallel.

- **Digital inputs (DI):**

There are no specific special features for the digital inputs. The signals now wired in parallel are evaluated in the same way as for IO redundancy.

- **Analog outputs (AQ):**

New options are available here. It is now possible to operate two separate actuators. The distribution of the output currents ("balancing") corresponds to the behavior of the IO redundancy. However, the output currents of the two modules are now flexible in their use and can be connected serially to one actuator, or separately to control two actuators.

- **Digital outputs (DQ):**

- With cross-station redundancy, the response of the digital outputs to the passive module can be set for each channel. Simultaneous output by both modules or operation on one side can be selected. Default setting is the operation on one side by the active module, according to the operation mode of the IO redundancy. This also has an effect on the operating mode as power supply.
- In the case of output on one side, the modules assume a non-redundant sensor and declare the dependent measured values of both modules invalid in the event of a fault (BAD quality). In contrast, in the case of output on both sides, only the measured value of the faulty module is treated as faulty, because redundant actuators with separate supply by modules A and B are assumed.

Note

Simultaneous output

In case of simultaneous output by both modules, parallel connection of the channels is only allowed with decoupling by diodes.

Additional information is available at:

- Parameter "Reaction to cross-station redundancy" (Page 62)

- **Buffer outputs (BUF):**

- The buffer outputs are only operated by the active module during IO redundancy.
- In case of cross-station redundancy, output on both sides, as group for all buffers, can be enabled.

Note

Output on both sides

With output on both sides, the buffer outputs must not be connected in parallel.

Additional information is available at:

- Parameter "Reaction to cross-station redundancy" (Page 65)

- **Self diagnostics and redundancy switchover:**

The separate interconnection of cross-station redundancy severely limits the ability to detect hardware faults. Only the internal voltage supply of the analog inputs and the overload/ actual value diagnostics of the digital outputs can be used to analyze the module status. This means that detected problems are still reported to the user via diagnostics and qualities, but they only lead to a redundancy switchover in the two cases above.

AS arbitration

Redundancy communication, based on two external RS485 connections, can be disrupted simultaneously (by the interruption of both cables within one millisecond) or continuously.

In the first case, the modules assume a sudden failure of the partner module and initially become active immediately. In the second case, the modules remain in their current state.

In both cases, this interim state is resolved by the automation system after one second. To do this the modules evaluate the PACT bit of their process image input to evaluate the status of

the partner module. If no partner module is active, the module itself transitions to the active state. If both modules are active, the preferred position is established by a passive B module.

Additional information is available at:

- Address space in operating mode "Fast controllers" (Page 258)

7.2.3 Function block types

The following tables show the function block types supported by the technology module.

Time-independent analog calculating functions

Function block type	Meaning
ABS	Forming the absolute value
ADD	Adding two input signals
ASIG	Analog signal sensor (constant)
AVER	Averaging of up to four analog signals
AXFR	Analog signal selector switch
COMP	Analog comparison function
CONV	Scaling
DB	Deadband
DIV	Dividing two input signals
EXP	Calculation of the exponential function to base e of an input value
LN	Calculation of the natural logarithm
MAX	Maximum value selection
MIN	Minimum value selection
MINMAX	MINIMUMMAXIMUM limiter
MONIT	Threshold value monitoring
MULTIPLY	Multiplying two input signals
NROOT	Calculation of the nth root of an input signal
POLY	Interpolation through polyline
POWER	Calculation of x to the power of y
SUB	Subtracting two input signals

Time-dependent calculation functions

Type	Meaning
DERIV	Differentiator
INT	Integrator
LEADLAG	Lead/lag function
PT1	First-order lag
RAXFR	Analog signal selector switch with adjustable ramps

Time-independent binary logic functions

Type	Meaning
AND	AND logic operation of max. eight binary inputs
BSEL	Binary signal selection
BSIG	Binary signal sensor
BXFR	Binary signal selector switch
EXOR	Exclusive Or logic operation
JK_FF	JK flip flop
NOT	Negation of a binary signal
OR	OR logic operation of max. eight binary inputs
RS_FF	RS flip flop

Time-dependent binary logic functions

Type	Meaning
LPULSE	Latching pulse formation
MINPULS	Minimum pulse generation
PULSE	Monoflop
T_LON	Latching ON delay
T_OFF	OFF delay
T_ON	ON delay

Controller

Type	Meaning
PID	Continuous controller
DELAY	Signal delay

Analog signal monitoring

Type	Meaning
ANA	Analog input/output connection to HW proxies
ASEL2	Selection for two analog values
ASEL3	Selection for three analog values
ASMON	Analog signal monitoring function
BIN	Binary input HW proxy

System functions

Type	Meaning
GET_SET_QTY	Access to the quality state of an input signal

7.3 Speed measurement function - TM FIO & Counter and TM Contr

7.3.1 Basics

Speed measurement is made available for the technology modules "Fast inputs and outputs and counter functions 6DL1138-6EA00-0EH1; configuration 3" and "Fast controllers 6DL1138-6EB00-0EH1; configurations 5, 6 and 7". This function can be combined with the functions of the fast input and output and the fast controller.

The maximum supported speed depends on the number of pulses per revolution and the inputs used.

- DI: 70 kHz
- DI/DQ: 7 kHz

This results in the following maximum speed at 60 pulses per revolution:

- DI: 70,000 rpm
- DI/DQ: 7,000 rpm

The calculated speed value can be filtered on the technology module using a Bessel filter (third-order low pass filter).

The supported minimum speed is limited by the substitute value calculation and thus depends on the number of pulses per revolution and the configured update time. If less than three pulses are received in the configured update time, a substitute value is calculated.

Precision

The precision that can be achieved depends on the encoders used (pulses per revolution):

Pulses per revolution	Speed [n/min]	Frequency [Hz]	Measuring frequency [Hz]	Absolute error [n/min]	Error in relation to speed [mHz]	Error
30	3000	50	1500	± 0.36	± 6	± 120 ppm
30	3600	60	1800	± 0.432	± 7.2	± 120 ppm
60	3000	50	3000	± 0.36	± 6	± 120 ppm
60	3600	60	3600	± 0.432	± 7.2	± 120 ppm
120	3000	50	6000	± 0.36	± 6	± 120 ppm
120	3600	60	7200	± 0.432	± 7.2	± 120 ppm

7.3.2 Update time

You specify the update time with the parameter 'Update time' and can change it during operation. The update time specifies the minimum time in which the speed values are calculated.

The standard update time is 20 ms.

The update time can be set in the value range from 1 to 10000 ms.

Maximum dynamic update time

To increase the accuracy, the module works internally with a dynamic update time.

The dynamic update time is the time measured between n pulses and is always greater than the configured update time.

The maximum dynamic update time is calculated as follows:

$$t_{\text{dyn max}} = \text{Maximum count value} / \text{internal cycle}$$

$$t_{\text{dyn max}} = 2^{32} / 26.2144 \text{ MHz}$$

$$t_{\text{dyn max}} = 163.84 \text{ s}$$

Measured values

The technology module updates the measured values cyclically.

The technology module calculates a new speed value when the dynamic measurement time is greater than or equal to the configured update time.

If fewer than three pulses are received during the configured update time, the technology module calculates a substitute value. This gradually reduces the speed value to 0.

The speed value is set to 0 no later than after the maximum dynamic update time has expired.

Substitute value

If no pulses are received any longer due to an error (e.g. wire break of the sensor), the technology module calculates a substitute value. The value status of the speed value remains valid in this case and is not set to "BAD". The speed value is set to 0 no later than after the maximum dynamic update time has expired.

The substitute value is calculated according to the following formula:

$$\text{Substitute value} = \text{Last valid speed value} * (2 * \text{cycle} / t_{\text{dyn}}) * K$$

T_{upd} : Configured update time

t_{dyn} : Dynamic update time

K: Internal factor ($K = 1.1$)

The calculated substitute value is only applied when the substitute value is less than the last valid speed value.

Example:

7.3 Speed measurement function - TM FIO & Counter and TM Contr

The following table shows the curve of the calculated substitute values for a configured update time of $T_{\text{upd}} = 20 \text{ ms}$. The time t specifies the time after the pulses cease.

t (ms)	Substitute value (rpm)
0.000	3000.000
40.000	1624.615
50.000	1303.704
60.000	1088.660
70.000	934.513
80.000	818.605
90.000	728.276
100.000	655.901
200.000	330.000
300.000	220.000
400.000	165.000
500.000	132.000
1000.000	66.000
2000.000	33.000
3000.000	22.000
4000.000	16.500
5000.000	13.200
10000.000	6.600
50000.000	1.320
163840.000	0.000

Note

Please note that the speed value is initialized with 0 on startup of the module and is marked as valid. The initial value remains valid until the first speed value can be calculated, that is, at least three pulses must be received within the configured update time.

In addition to the quality code evaluation, an evaluation of the maximum value should be implemented in the higher-level automation device for selecting the speed value of the redundant modules in case of a redundant configuration.

7.3.3 Parameters of the speed measurement function

The following tables show the parameters for the speed measurement function.

Speed measurement function configuration

If the technology module is configured in the "speed measurement function" configuration, you have the following setting options:

Table 7-25 Parameters in the speed measurement function configuration

Parameter	Value range	Default	Parameter reassignment in RUN	Efficiency range
Operating mode	<ul style="list-style-type: none"> Disabled Measure speed 	Disabled	Yes	
Sensor type	<ul style="list-style-type: none"> Pulse generator without direction signal Incremental encoder with direction signal 	Pulse generator with direction signal	Yes	
Pulses per sensor revolution (number of gears)	<ul style="list-style-type: none"> 1 to 65535 	1	Yes	
Time constant of the output filter	<ul style="list-style-type: none"> 0 2...30.000 ms 	Disabled	Yes	
Unit of speed measurement	<ul style="list-style-type: none"> Revolution per minute Revolution per second 	Revolution per minute	Yes	
Update time	<ul style="list-style-type: none"> 1 to 1000 (10 to 10000 ms) 	2 (20 ms)	Yes	
Diagnostics Sensor supply	<ul style="list-style-type: none"> Disabled Enabled 	Disabled	Yes	
Diagnostics Wire break	<ul style="list-style-type: none"> Disabled Enabled 	Enabled	Yes	

7.3.4 Explanation of the parameters for the Measure speed operating mode

Operating mode

The parameter defines the operating mode of the speed measurement channel. Operating modes:

- Disabled
- Measure speed

Sensor type

Specifies the type of the sensor to be connected for the speed measurement channel.

The module supports the following sensor types:

- Pulse generator without direction signal
- Pulse generator with direction signal

For pulse generators with direction signal, the signals A* and B* are phase-shifted by 90°.

Pulses per sensor revolution (number of gears)

Specifies the pulses per sensor revolution that the speed encoder provides.

Time constant of the output filter

Specifies the time constant of the Bessel filter. The filter time can be set in the range from 2 to 30.0000 ms. The time constant T is standardized so that a limit frequency f_q with $f_q = 1/T$ is attenuated in its amplitude by 3 dB.

The following diagram shows the step response of the Bessel filter for a speed jump from 0 to 3000 rpm for various filter settings.

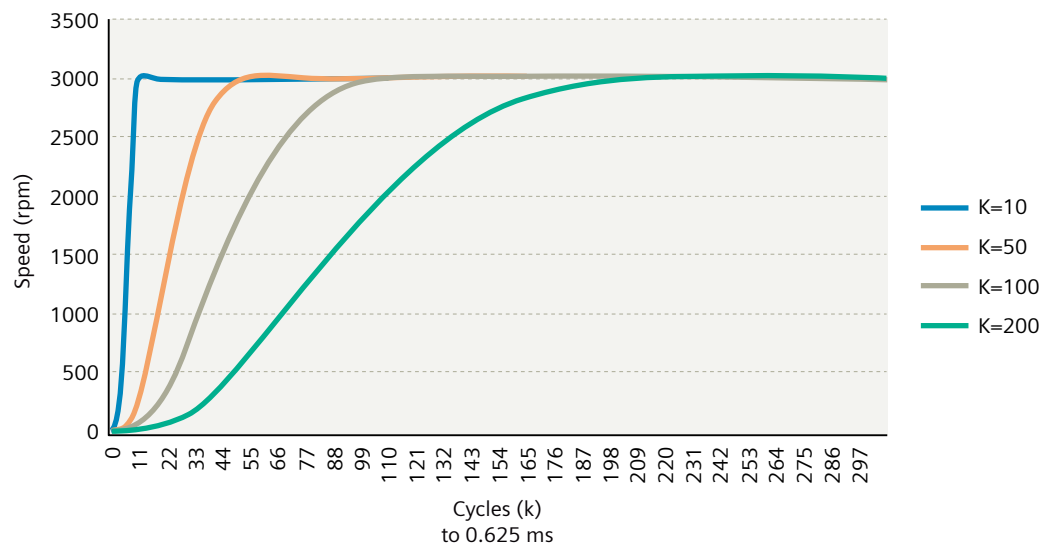


Figure 7-31 Step response of the Bessel filter

Unit of speed measurement

Specifies the unit of speed measurement.

The following units can be configured for the speed measurement:

- Revolutions / minute
- Revolutions / second

Update time

Sets the update time in ms. (See section Update time (Page 131))

Diagnostics Sensor supply

Enable the diagnostic message sensor supply.

If the sensor supply of the pulse generators is over a digital output of the technology module (DI/DO channel operating mode "Sensor supply for speed measurement x"), the sensor supply of the pulse generator is monitored for overload and short-circuit to M.

When the diagnostic message is enabled and the sensor supply is faulty, the diagnostic message is sent.

Table 7-26 Example configuration

DI _x	DO/DI _y	
Diagnostics: <ul style="list-style-type: none"> Sensor supply 	Channel operating mode: <ul style="list-style-type: none"> Sensor supply for DI_x 	Diagnostics (enables DQ monitoring): <ul style="list-style-type: none"> Wire break (optional I_{gv} > 45 mA) Short-circuit to M

Diagnostics Wire break

If the pulse generators are connected to a DI₀..DI₃, wire-break monitoring can be conducted.

Enable the diagnostic message wire break. When the diagnostic message is enabled and the digital input is not connected to either the M or P potential, the diagnostic message is sent.

Monitoring is always active.

Only applies to the sensor type "P/M switch".

7.4 Vibration protection - TM VibProt

7.4.1 Basics

The module type TM VibProt calculates characteristic values that are required for machine protection. This function can be combined with the functions of the fast input and output.

The module permanently measures and calculates characteristic values that represent the vibration state of your plant. The calculated characteristic values can be monitored in the higher-level automation system for limit violations. The continuous monitoring allows for reliable and direct detection of unwanted machine states. When critical or dangerous operating states occur, the higher-level automation system can initiate shutdown of the machine or plant.

The technology module TM VibProt supports the configuration of up to 8 function chains per module. Multiple function chains can be assigned to an analog input channel (e.g. four function chains are assigned to the analog input signal AI₀).

The sampling frequency of the analog signals can be set in a range from 6.4 kHz to 102.4 kHz.

All analog input channels are designed with the same sampling frequency. The function chains are executed independently of the set AI sampling frequency every 1.25 ms.

Note

Select sampling frequency

The sampling frequency must be selected so that it is more than twice as large as the frequencies parameterized in the chains (e.g. for a low-pass filter).

Function chains

A function chain consists of various function blocks. These function blocks prepare the sensor signals connected to the analog input in an appropriate manner. The structure of the function chains is pre-defined in the factory.

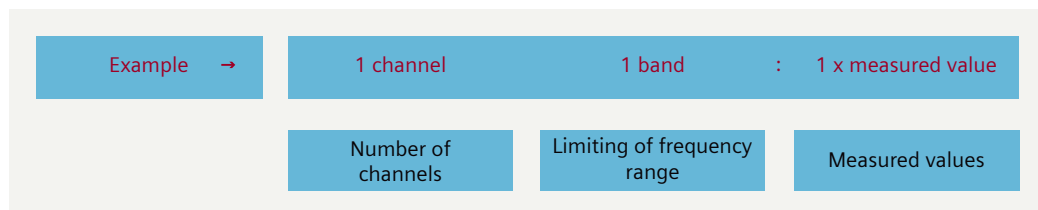
A part of the function chains requires a reference signal in addition to the sensor signals. The reference signal provides information on the rotation angle of the rotor (reference mark). The reference signals can be read via the analog inputs 2 and 3 of the technology module TM VibProt (see also section Trigger function (Page 137)).

Labeling scheme for the function chains

The function chain label always contains information on:

- The number of used channels
- The limitation of the frequency band
- The generated measured values

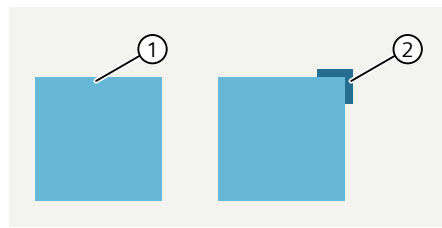
The following figure shows the labeling scheme using the function chain "1 channel broadband: 1 x SUM" as an example:



Function blocks

The TM VibMon function blocks provide closed functions that are required for calculation of the function chains. Function blocks include, for example, filters and characteristic value generator.

Various icons illustrate the individual function blocks. The representations differ as follows:



- ① Function block
- ② Function block that can signal characteristic values via the process image

Vibration protection versions

Four vibration protection versions are provided:

- 4 vibration protection function chains per module with AI values in the AS process image
- 4 vibration protection function chains per module without AI values in the AS process image
- 8 vibration protection function chains per module with AI values in the AS process image
- 8 vibration protection function chains per module without AI values in the AS process image

The versions are required to reduce the size of the process picture for most applications.

7.4.2 Trigger function

The analog inputs 2 and 3 can be used to read trigger signals for shaft synchronization or speed calculation. The trigger time is calculated from the analog signal.

Operating principle

The technology module supports the synchronization of function chains that are calculated by different technology modules. To this end, up to 10 technology modules can be interconnected in a so-called trigger domain using the serial interface COM-EXT2. In this case a technology module acts as a "trigger source". This trigger source forwards trigger events of channel AI3 with the trigger times to other modules within the trigger domain. Within a trigger domain, only one technology module may be configured as a trigger source.

Modules can use the trigger channel AI3 of the trigger source as trigger channel AI3.

The AI2 channel is generally only available as a local trigger channel.

The maximum length of the serial connection COM-EXT2 is 10 m. The modules of the trigger domain can be located in the same or in different ET200SP HA stations.

Note

The AI sampling frequencies must be the same within a trigger domain.

Note

When using the Shaft Synchronization feature, the technology modules used must be operated in the same 24V potential group. If an independent 24V supply of the single modules is mandatory, the different TM potential groups are to be connected by jumper on the ground (see following figure).

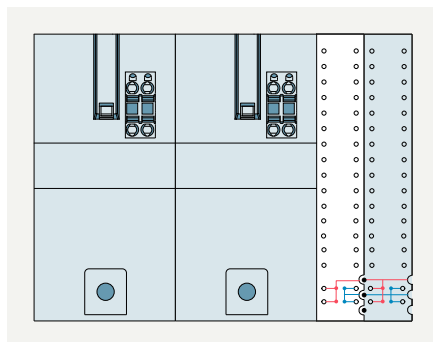
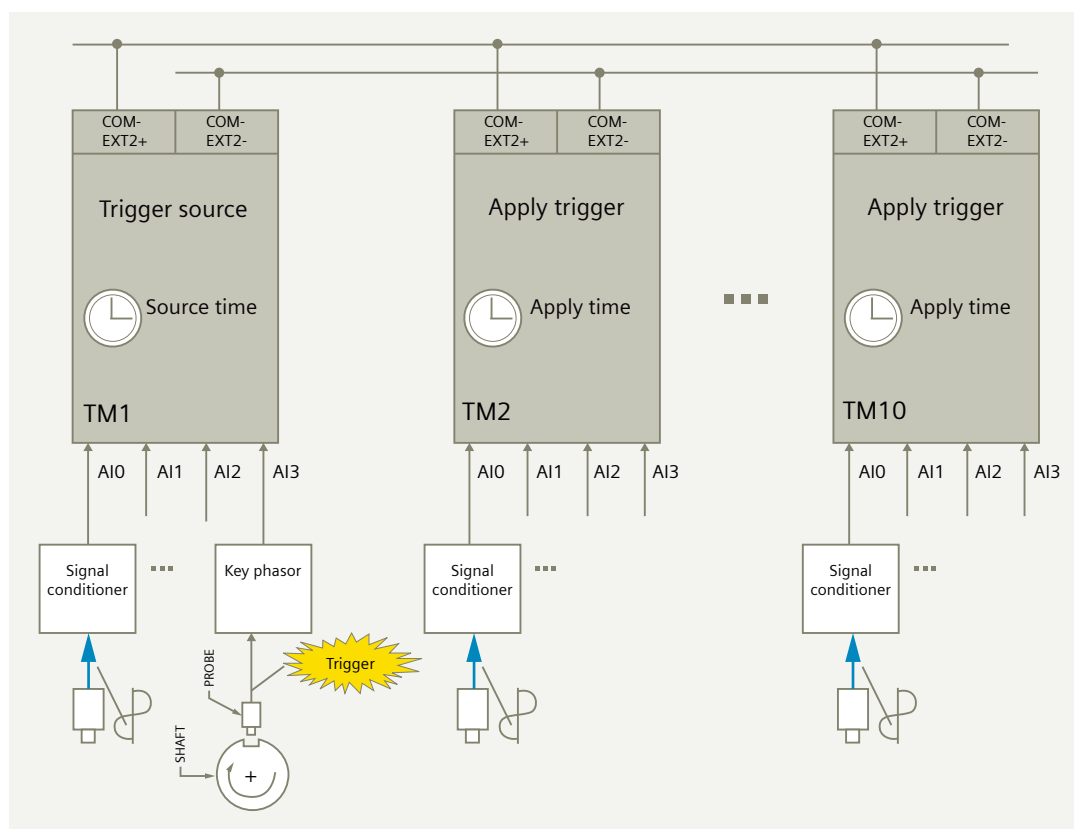


Figure 7-32 Structure of a trigger domain

7.4.2.1 Parameters of the trigger function

The analog inputs 2 and 3 can be used to read trigger signals. The trigger time is calculated from the analog signal.

The following table shows the parameters of the trigger function.

Parameter

Parameter	Value range	Default	Parameter reassignment in RUN	Efficiency range
Trigger routing	<ul style="list-style-type: none"> local Trigger source Use other trigger 	local	Yes	Module
Trigger mode	<ul style="list-style-type: none"> Local trigger disabled Local trigger - manual mode Local trigger - automatic mode 	Local trigger disabled	Yes	Channel
Trigger level	<ul style="list-style-type: none"> Value 	(high limit - low limit) / 2	Yes	Channel
Trigger hysteresis	<ul style="list-style-type: none"> Value 	0.8 V	Yes	Channel
Trigger edge	<ul style="list-style-type: none"> Negative Positive 	Negative	Yes	Channel
Relative trigger level	<ul style="list-style-type: none"> 25 to 75 % 	50 %	Yes	Channel
Trigger timeout	<ul style="list-style-type: none"> 1 s to 1000 s 	1 s	Yes	Channel

7.4.2.2 Explanation of the parameters of the trigger function

"Trigger routing" parameter

Specifies whether the technology module is to operate locally or as a trigger source in the trigger domain. Alternatively, the module can accept the signals from a trigger source.

The trigger source sends the trigger signals of channel AI3 to the other modules in the trigger domain.

Technology modules with the "local" setting do not apply any trigger signals from the trigger domain. Only local trigger signals are processed.

"Trigger mode" parameter

- "Automatic"

The switching thresholds from the signal amplitude (peak-to-peak) are calculated cyclically (see "Timeout" parameter).

You can make the following settings:

 - Relative switching threshold (relative trigger level)
 - Switching direction (signal edge)

All other parameters are preset in automatic mode.
- "Manual"

No parameter is specified in manual mode. All parameters must be set.

"Trigger level" parameter

You set the "Trigger level" parameter in manual mode.

The adjustment range depends on the set AI measuring range.

The trigger level can be set as follows:

AI measuring range	Trigger level
0 to 20 mA	0 to 22.0 V
4 to 20 mA	3.6 to 22.0 mA
-20 to +20 mA	-22.0 to 22.0 mA
-30 to +30 mA	-33.0 to 33.0 mA
-20 to 0 mA	-22.0 to 0 mA
0 to +10 V	0 to 11.0 V
-10 to +10 V	-11.0 to 11.0 V
0 to +20 V	0 to 22.0 V
-20 to 0 V	-22.0 to 0 V
0 to +20 V with sensor supply 4 mA	0 to 22.0 V
0 to +20 V with sensor supply 8 mA	0 to 22.0 V

"Trigger hysteresis" parameter

The adjustment range depends on the set AI measuring range.

The trigger hysteresis can be set as follows:

AI measuring range	Trigger hysteresis
0 to 20 mA	0.1 to 22.0 mA
4 to 20 mA	0.1 to 22.0 mA
-20 to +20 mA	0.1 to 22.0 mA
-30 to +30 mA	0.1 to 33.0 mA
-20 to 0 mA	0.1 to 22.0 mA
0 to +10 V	0.1 to 11.0 V
-10 to +10 V	0.1 to 11.0 V
0 to +20 V	0.1 to 22.0 V
-20 to 0 V	0.1 to 22.0 V
0 to +20 V with sensor supply 4 mA	0.1 to 22.0 V
0 to +20 V with sensor supply 8 mA	0.1 to 22.0 V

"Signal edge" parameter

Positive or negative edge of the signal releases the trigger.

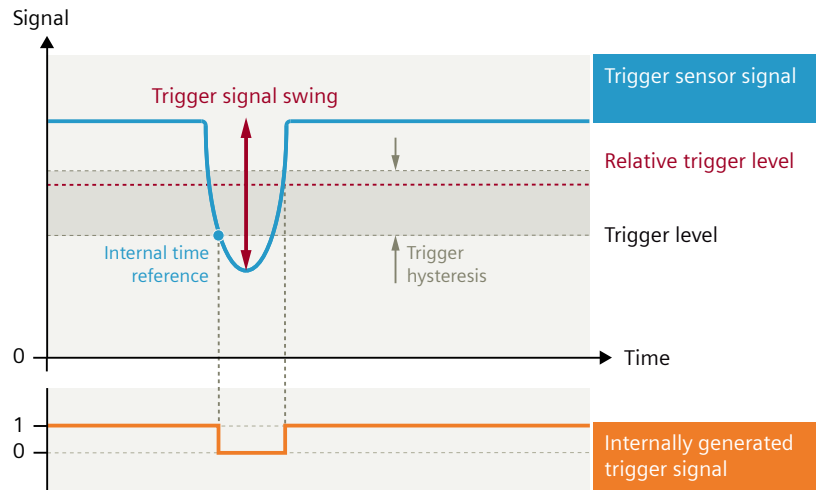


Figure 7-33 Trigger: negative signal edge

"Rel. trigger level" parameter

You can set the "Relative trigger level" parameter in automatic mode.

Setting the relative trigger level in reference to the total trigger signal level range (pp value of the trigger signal). Values from 25 to 75 % can be set for this parameter. The trigger level is then set to X % of the measured signal level range.

"Timeout" parameter

The "Timeout" parameter specifies the following:

- Calculation interval of the switching thresholds in automatic mode
- Time after which chains that use the triggers go BAD

7.4.3 Function chains

The function chains have a fixed structure that cannot be changed by the user. They are configured to adapt the standard function chains to the project-specific measuring tasks.

The technology module supports up to four characteristic values of the float type (floating point number/32 bits) per function chain. In addition, one status bit is supported per characteristic value.

Supported function chains

The following function chains are supported by the technology module:

- 1 channel broadband: 1 x Sum
- 2 channels broadband: 1 x Smax
- 2 channels broadband: 1 x Max
- 1 channel broadband: 1 x DC
- 2 channels broadband: 1 x RSE (1 x Diff DC)
- 2 channels broadband: 1 x ASV (SUM)
- 1 channel: Speed
- 2 channels: Direction of rotation
- 2 channels TNB-2N: 2 x peak and 2x phase

7.4.4 1 channel broadband: 1 x Sum

7.4.4.1 Applications and configuration

Number of calculated characteristics: 1

- Root-mean-square RMS, peak value, peak-peak value or peak-peak value / 2

Applications

This function sequence is used for the following measurement tasks:

- Absolute case vibration (acceleration)
- Absolute case vibration (vibration velocity)
- Combustion chamber acceleration
- Rolling bearing status
- Relative shaft vibration (peak or peak-peak)

Structure

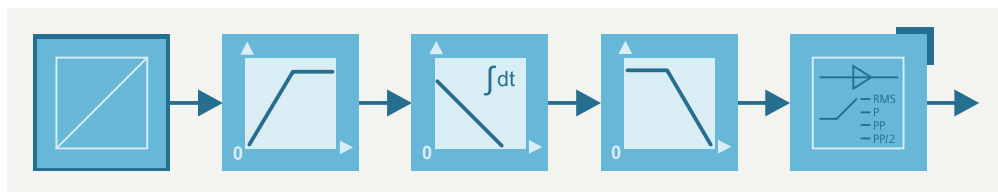
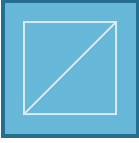
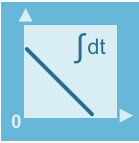


Figure 7-34 Function chain "1 channel broadband: 1 x Sum"

Function blocks / parameters

Function blocks / parameters	
	<p>Sensor:</p> <ul style="list-style-type: none"> The parameters are assigned via TM-As. The parameters must be adapted. Parameters (see Explanation of the analog input parameters (Page 54)): Measurement type, Measuring range, Sensor supply (via AI sensor type or channel operating mode DI/DQ) sensitivity, Sensitivity unit input, Sensitivity physical unit, Limit value overflow, Limit value underflow, Wire break limit, Diagnostics
	<p>High-pass filter:</p> <ul style="list-style-type: none"> Parameters: Filter base frequency, filter slope
	<p>Integrator:</p> <ul style="list-style-type: none"> Parameters: Integrator level
	<p>Low-pass filter:</p> <ul style="list-style-type: none"> Parameters: Filter base frequency, filter slope
	<p>Detector:</p> <ul style="list-style-type: none"> Parameters: Detector type, unit, averaging time, decay time

7.4.4.2 Parameters of the function chain 1 channel broadband: 1 x Sum

The following table shows the parameters of the function chain 1 channel broadband: 1 x Sum.

Parameter

Parameter	Value range	Default	Parameter reassignment in RUN	Efficiency range
Function chain ID	<ul style="list-style-type: none"> 0 to 3 or 0 to 7 	0	Yes	Function chain
High-pass filter: Filter base frequency	<ul style="list-style-type: none"> 0.1 Hz to 50000.0 Hz 	10.0 Hz	Yes	Function chain
High-pass filter: Filter slope	<ul style="list-style-type: none"> 24 dB/octave 60 dB/octave 	24 dB/octave	Yes	Function chain
Low-pass filter: Filter base frequency	<ul style="list-style-type: none"> 0.1 Hz to 50000.0 Hz 	1000.0 Hz	Yes	Function chain
Low-pass filter: Filter slope	<ul style="list-style-type: none"> 24 dB/octave 60 dB/octave 	24 dB/octave	Yes	Function chain

Parameter	Value range	Default	Parameter reassignment in RUN	Efficiency range
Integrator: Integrator level	<ul style="list-style-type: none"> No integration 1x 2x 	No integration	Yes	Function chain
Detector: Detector type	<ul style="list-style-type: none"> RMS Peak value Peak-peak value Peak-peak value / 2 	RMS	Yes	Function chain
Detector: Mean time for RMS/signal drop-out time for peak modes	<ul style="list-style-type: none"> 10 ms to 65535 ms 	800 ms	Yes	Function chain
Detector: Unit	<ul style="list-style-type: none"> m/s² inch/s² g mm/s inch/s μm mm inch mil V mV A mA μA mBar Bar Pascal Psi eu 	μm	Yes	Function chain

7.4.4.3 Explanation of the parameters of the function chain 1 channel broadband: 1 x Sum

Function chain ID

Unique identification of the function chains. The function chain ID must be in the range 0 to 3 or 0 to 7.

The function chain ID determines the position of the parameters as well as the IO data in the address space of the technology module. (see also sections Structure of data record 129 (Page 227) and Address space in operating mode "Vibration protection" (Page 263))

High-pass filter: Filter base frequency

The technology module supports a high-pass filter with a configurable filter base frequency and a filter sequence.

The filter base frequency can be set freely in the range from 0.1 Hz to 50000.0 Hz. The maximum value depends on the selected base frequency of the low-pass filter.

High-pass filter: Filter slope

DIN ISO 10816 prescribes a 4th order filter (24 dB/octave). For applications that require greater selectivity, 10th order filters (60 dB/octave) are available.

- 24 dB/octave
- 60 dB/octave

Low-pass filter: Filter base frequency

The technology module supports a low-pass filter with a configurable basic frequency and a filter sequence.

The basic frequency filter can be set in the range from 0.1 Hz to 50000.0 Hz.

Low-pass filter: Filter slope

DIN ISO 10816 prescribes a 4th order filter (24 dB/octave). For applications that require greater selectivity, 10th order filters (60 dB/octave) are available.

- 24 dB/octave
- 60 dB/octave

Integrator: Integrator level

Activation of the integration or double integration is done automatically based on the set sensor and the selected unit of the measurement variable.

Detector: Detector type

Specifies the character of the value to be calculated.

Detector: Signal drop-out time

Specifies the time that a value needs to drop down to 10 % of its starting point after it has reached its maximum value.

Detector: Unit

Specifies the unit of the value.

7.4.5 2 channels broadband: 1 x $S_{\max}$

7.4.5.1 Applications and configuration

Number of calculated characteristics: 4

- Max
- $S_{\max}$
- Peak value 1
- Peak value 2

Applications

This function sequence is used for the following measurement task:

Relative shaft vibration $S_{\max}$

Structure

The form of the function sequence is schematically represented below:

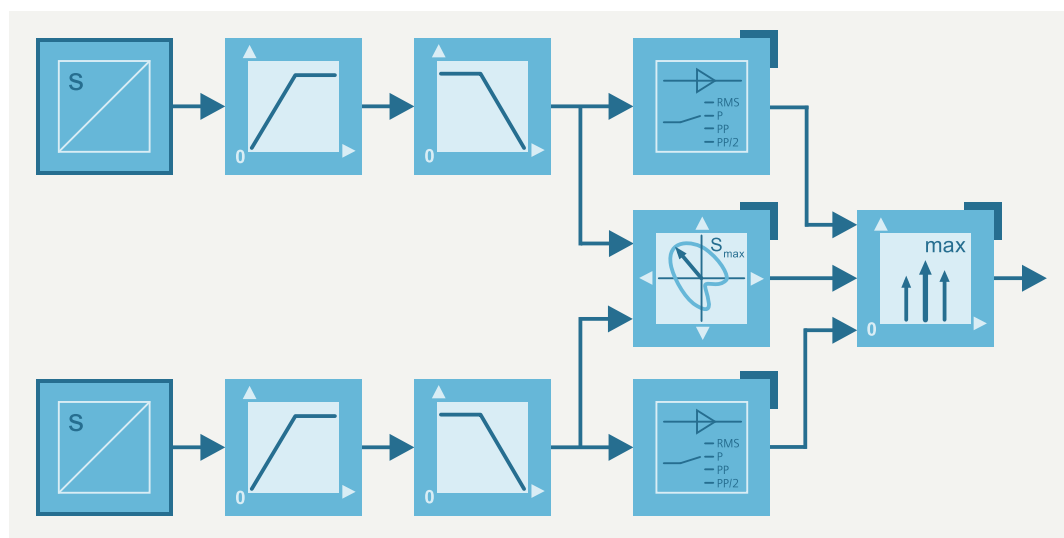
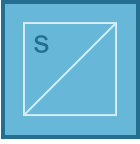
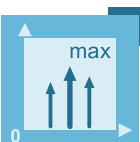


Figure 7-35 Function chain "2 channels broadband: 1 x $S_{\max}$ "

Function blocks / parameters

Table 7-27 2 channels broadband: 1 x Smax

Function blocks / parameters	
	<p>Sensors 1 and 2:</p> <ul style="list-style-type: none"> The parameters are assigned via TM-AIs. The parameters must be adapted. Parameters (see Explanation of the analog input parameters (Page 54)): Measurement type, Measuring range, Sensor supply (via AI sensor type or channel operating mode DI/DQ) sensitivity, Sensitivity unit input, Sensitivity physical unit, Limit value overflow, Limit value underflow, Wire break limit, Diagnostics
	<p>High-pass filters 1 and 2:</p> <ul style="list-style-type: none"> Parameters: Filter base frequency, filter slope The settings for filter 2 are automatically adopted from filter 1.
	<p>Low-pass filters 1 and 2:</p> <ul style="list-style-type: none"> Parameters: Filter base frequency, filter slope The settings for filter 2 are automatically adopted from filter 1.
	<p>Peak values 1 and 2:</p> <ul style="list-style-type: none"> Parameters: Decay time, unit The settings for peak value 2 are automatically adopted from peak value 1.
"Max (X,Y)": A blue square with a white graph showing a sinusoidal wave with a peak labeled Smax." data-bbox="101 502 189 569"/>	<p>Smax"/"Max (X,Y):</p> <ul style="list-style-type: none"> Parameters: Decay time, unit
	<p>Max:</p> <ul style="list-style-type: none"> No parameters can be set. This function block transfers the maximum value of the inputs.

7.4.5.2 Parameters of the function chain 2 channels broadband: 1 x Smax

The following table shows the parameters of the function chain 2 channels broadband: 1 x Smax.

Parameter

Parameter	Value range	Default	Parameter reassignment in RUN	Efficiency range
Function chain ID	<ul style="list-style-type: none"> 0 to 3 or 0 to 7 	0	Yes	Function chain
High-pass filters 1 and 2: Filter base frequency	<ul style="list-style-type: none"> 0.1 Hz to 50000.0 Hz 	10.0 Hz	Yes	Function chain
High-pass filters 1 and 2: Filter slope	<ul style="list-style-type: none"> 24 dB/octave 60 dB/octave 	24 dB/octave	Yes	Function chain
Low-pass filters 1 and 2: Filter base frequency	<ul style="list-style-type: none"> 0.1 Hz to 50000.0 Hz 	10000.0 Hz	Yes	Function chain
Low-pass filters 1 and 2: Filter slope	<ul style="list-style-type: none"> 24 dB/octave 60 dB/octave 	24 dB/octave	Yes	Function chain
Detector 1 and 2: Signal drop-out time	<ul style="list-style-type: none"> 10 ms to 65535 ms 	2300 ms	Yes	Function chain
Detector 1 and 2: Unit	<ul style="list-style-type: none"> μm mm inch mil 	μm	Yes	Function chain
SMAX: Sensor angle difference	<ul style="list-style-type: none"> 0° to 180° 	90°	Yes	Function chain

7.4.5.3 Explanation of the parameters of the function chain 2 channels broadband: 1 x Smax

Function chain ID

Unique identification of the function chains. The function chain ID must be in the range 0 to 3 or 0 to 7.

The function chain ID determines the position of the parameters as well as the IO data in the address space of the technology module. (see also sections Structure of data record 129 (Page 227) and Address space in operating mode "Vibration protection" (Page 263))

High-pass filter: Filter base frequency

The technology module supports a high-pass filter with a configurable filter base frequency and a filter sequence.

The filter base frequency can be set freely in the range from 0.1 Hz to 50000.0 Hz. The maximum value depends on the selected base frequency of the low-pass filter.

High-pass filter: Filter slope

DIN ISO 10816 prescribes a 4th order filter (24 dB/octave). For applications that require greater selectivity, 10th order filters (60 dB/octave) are available.

- 24 dB/octave
- 60 dB/octave

Low-pass filter: Filter base frequency

The technology module supports a low-pass filter with a configurable basic frequency and a filter sequence.

The basic frequency filter can be set in the range from 0.1 Hz to 50000.0 Hz.

Low-pass filter: Filter slope

DIN ISO 10816 prescribes a 4th order filter (24 dB/octave). For applications that require greater selectivity, 10th order filters (60 dB/octave) are available.

- 24 dB/octave
- 60 dB/octave

Detector: Detector type

Specifies the character of the value to be calculated.

SMAx: Signal drop-out time

Specifies the time that a value needs to drop down to 10 % of its starting point after it has reached its maximum value.

SMAx: Unit

Specifies the unit of the value.

SMAx: Sensor angle difference

Specifies the relative angles below the sensors.

7.4.6 2 channels broadband: 1 x Max

7.4.6.1 Applications and configuration

Number of calculated characteristics: 3

- Max
- Peak-peak value 1
- Peak-peak value 2

Applications

This function sequence is used for the following measurement task:

Relative shaft vibration Max (X, Y), peak-peak measurement

Structure

The form of the function sequence is schematically represented below:

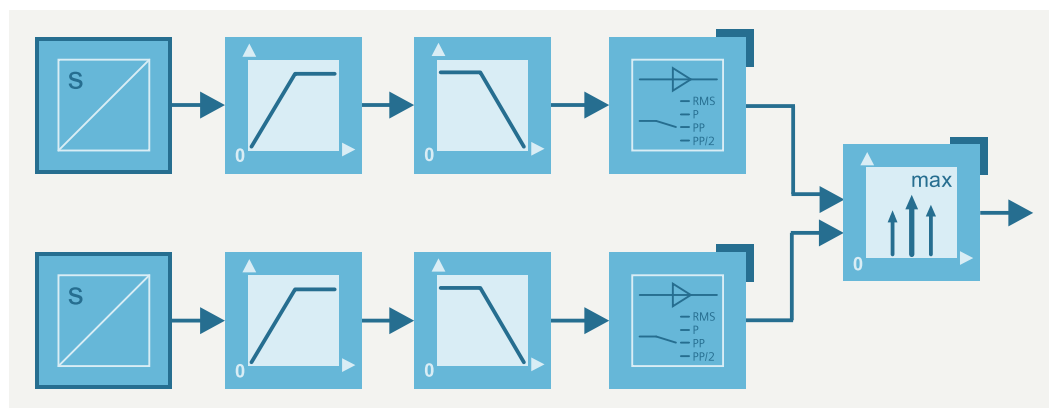
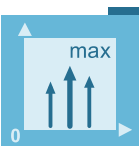


Figure 7-36 Function chain "2 channels broadband: 1 x Max"

Function blocks / parameters

Function blocks / parameters	
	<p>Sensors 1 and 2:</p> <ul style="list-style-type: none"> • The parameters are assigned via TM-AIs. The parameters must be adapted. Parameters (see Explanation of the analog input parameters (Page 54)): Measurement type, Measuring range, Sensor supply (via AI sensor type or channel operating mode DI/DQ) sensitivity, Sensitivity unit input, Sensitivity physical unit, Limit value overflow, Limit value underflow, Wire break limit, Diagnostics
	<p>High-pass filters 1 and 2:</p> <ul style="list-style-type: none"> • Parameters: Filter base frequency, filter slope The settings for filter 2 are automatically adopted from filter 1.

Function blocks / parameters	
	<p>Low-pass filters 1 and 2:</p> <ul style="list-style-type: none"> Parameters: Filter base frequency, filter slope The settings for filter 2 are automatically adopted from filter 1.
	<p>Peak-peak value 1 and 2:</p> <ul style="list-style-type: none"> Parameters: Decay time, unit The settings for peak-peak value 2 are automatically adopted from peak-peak value 1.
	<p>"Max" function block</p> <ul style="list-style-type: none"> No parameters can be set. This function block transfers the maximum value of the inputs.

7.4.6.2 Parameters of the function chain 2 channels broadband: 1 x Max

The following table shows the parameters of the function chain 2 channels broadband: 1 x Max.

Parameter

Parameter	Value range	Default	Parameter reassignment in RUN	Efficiency range
Function chain ID	<ul style="list-style-type: none"> 0 to 3 or 0 to 7 	0	Yes	Function chain
High-pass filters 1 and 2: Filter base frequency	<ul style="list-style-type: none"> 0.1 Hz to 50000.0 Hz 	10.0 Hz	Yes	Function chain
High-pass filters 1 and 2: Filter slope	<ul style="list-style-type: none"> 24 dB/octave 60 dB/octave 	24 dB/octave	Yes	Function chain
Low-pass filters 1 and 2: Filter base frequency	<ul style="list-style-type: none"> 0.1 Hz to 50000.0 Hz 	1000 Hz	Yes	Function chain
Low-pass filters 1 and 2: Filter slope	<ul style="list-style-type: none"> 24 dB/octave 60 dB/octave 	24 dB/octave	Yes	Function chain
Detector 1 and 2: Signal drop-out time	<ul style="list-style-type: none"> Value 	2300	Yes	Function chain
Detector 1 and 2: Unit	<ul style="list-style-type: none"> µm mm inch mil 	µm	Yes	Function chain

7.4.6.3 Explanation of the parameters of the function chain 2 channels broadband: 1 x Max

Function chain ID

Unique identification of the function chains. The function chain ID must be in the range 0 to 3 or 0 to 7.

The function chain ID determines the position of the parameters as well as the IO data in the address space of the technology module. (see also sections Structure of data record 129 (Page 227) and Address space in operating mode "Vibration protection" (Page 263))

High-pass filter: Filter base frequency

The technology module supports a high-pass filter with a configurable filter base frequency and a filter sequence.

The filter base frequency can be set freely in the range from 0.1 Hz to 50000.0 Hz. The maximum value depends on the selected base frequency of the low-pass filter.

High-pass filter: Filter slope

DIN ISO 10816 prescribes a 4th order filter (24 dB/octave). For applications that require greater selectivity, 10th order filters (60 dB/octave) are available.

- 24 dB/octave
- 60 dB/octave

Low-pass filter: Filter base frequency

The technology module supports a low-pass filter with a configurable basic frequency and a filter sequence.

The basic frequency filter can be set in the range from 0.1 Hz to 50000.0 Hz.

Low-pass filter: Filter slope

DIN ISO 10816 prescribes a 4th order filter (24 dB/octave). For applications that require greater selectivity, 10th order filters (60 dB/octave) are available.

- 24 dB/octave
- 60 dB/octave

Detector: Signal drop-out time

Specifies the time that a value needs to drop down to 10 % of its starting point after it has reached its maximum value.

Detector: Unit

Specifies the unit of the value.

7.4.7 1 channel broadband: 1 x DC**7.4.7.1 Applications and configuration**

Number of calculated characteristics: 1

- DC

Applications

The function sequence is used for measurement and monitoring tasks:

- Axial shaft position
- Position
- DC measurement

Structure

The form of the function sequence is schematically represented below:

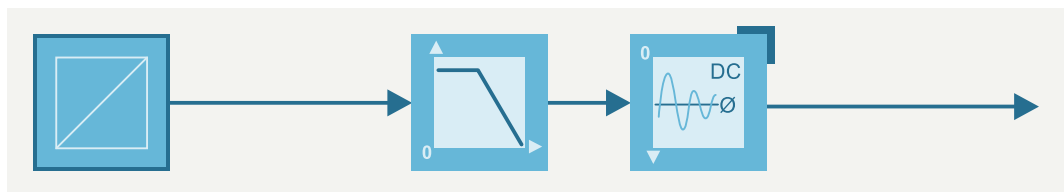


Figure 7-37 Function chain "1 channel broadband: 1 x DC"

Function blocks / parameters

Function blocks / parameters	
	<p>Function block "Sensor":</p> <ul style="list-style-type: none"> The parameters are assigned via TM-AIs. The parameters must be adapted. Parameters (see Explanation of the analog input parameters (Page 54)): Measurement type, Measuring range, Sensor supply (via AI sensor type or channel operating mode DI/DQ) sensitivity, Sensitivity unit input, Sensitivity physical unit, Limit value overflow, Limit value underflow, Wire break limit, Diagnostics
	<p>"Low-pass filter" function block:</p> <ul style="list-style-type: none"> Parameters: Filter base frequency, filter slope
	<p>Function block "DC":</p> <ul style="list-style-type: none"> Parameters: Averaging time, unit, reference value, scaling factor

7.4.7.2 Parameters of the function chain 1 channel broadband: 1 x DC

The following table shows the parameters of the function chain 1 channel broadband: 1 x DC.

Parameter

Parameter	Value range	Default	Parameter reassign-ment in RUN	Efficiency range
Function chain ID	<ul style="list-style-type: none"> 0 to 3 or 0 to 7 	0	Yes	Function chain
Low-pass filter: Filter base frequency	<ul style="list-style-type: none"> 0.1 Hz to 50000.0 Hz 	10000.0 Hz	Yes	Function chain
Low-pass filter: Filter slope	<ul style="list-style-type: none"> 24 dB/octave 60 dB/octave 	24 dB/octave	Yes	Function chain
DC: Averaging time	<ul style="list-style-type: none"> 10 to 65535 	1000	Yes	Function chain

Parameter	Value range	Default	Parameter reassignment in RUN	Efficiency range
DC: Unit	<ul style="list-style-type: none"> • m/s² • inch/s² • g • mm/s • inch/s • µm • mm • inch • mil • V • mV • A • mA • µA • mBar • Bar • Pascal • Psi • eu • Hz • CPM • RPM • s • ms • °C • F • K 	mm	Yes	Function chain
DC: Reference value	<ul style="list-style-type: none"> • -99999.99 to +99999.99 	-1000.0	Yes	Function chain
DC: Scaling factor	<ul style="list-style-type: none"> • -99999.99 to +99999.99 	1.0	Yes	Function chain

7.4.7.3 Explanation of the parameters of the function chain 1 channel broadband: 1 x DC

Function chain ID

Unique identification of the function chains. The function chain ID must be in the range 0 to 3 or 0 to 7.

The function chain ID determines the position of the parameters as well as the IO data in the address space of the technology module. (see also sections Structure of data record 129 (Page 227) and Address space in operating mode "Vibration protection" (Page 263))

Low-pass filter: Filter base frequency

The technology module supports a low-pass filter with a configurable basic frequency and a filter sequence.

The basic frequency filter can be set in the range from 0.1 Hz to 50000.0 Hz.

Low-pass filter: Filter slope

DIN ISO 10816 prescribes a 4th order filter (24 dB/octave). For applications that require greater selectivity, 10th order filters (60 dB/octave) are available.

- 24 dB/octave
- 60 dB/octave

DC: Averaging time

The averaging time specifies the time over which the sensor signal is averaged. A corresponding number of sample values is therefore always contained in the characteristic value.

The averaging method works "rolling" in which a new characteristic value is provided every 1.25 ms at the output.

DC: Unit

The physical unit of the DC value.

The selection is limited to the units that match the selected sensor type (sensitivity; physical unit).

DC: Reference value

The reference value can be used to specify the zero position of the sensing object. When using eddy current displacement sensors, the distance to the measurement object measured at rest should be selected as a reference value. The resulting characteristic value then shows the deviation from the specified zero position.

DC: Scaling factor

The scaling factor as a multiplier changes the characteristic value.

Calculation regulation: $DC = \text{Scaling factor} \times \text{measured value} - \text{reference value}$.

7.4.8 2 channels broadband: 1 x RSE

7.4.8.1 Applications and configuration

Number of calculated characteristics: 3

- Expansion
- Position 1
- Position 2

Applications

The function sequence is only used to monitor the relative shaft expansion. Relative shaft expansion is an axial expansion of the rotor relative to the machine case opposite to the locating bearing. The play between the rotor and stator / case is altered by thermal expansion with:

- Starting up the machine
- Contraction when shutting down the machine

Measuring methods

The relative expansion value can be outside the measuring range of a single displacement sensor. The system therefore offers measurement system types with expanded measuring range. The measurement system types always work with a variety of sensor configurations. They include:

- Shaft shoulder method
- Double shaft cone method
- Single shaft cone method

Structure

The form of the function sequence is schematically represented below:

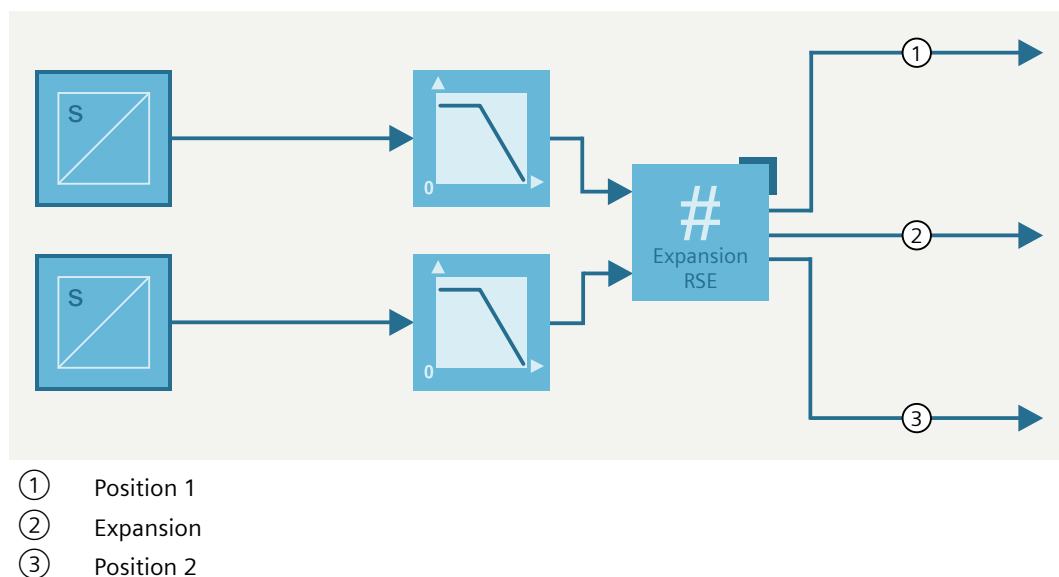


Figure 7-38 Function chain "2 channels broadband: 1 x RSE"

Function blocks / parameters

Function blocks / parameters	
	<p>Sensor 1 and 2:</p> <ul style="list-style-type: none"> The parameters are assigned via TM-AIs. The parameters must be adapted. <p>Parameters (see Explanation of the analog input parameters (Page 54)): Measurement type, Measuring range, Sensor supply (via AI sensor type or channel operating mode DI/DQ) sensitivity, Sensitivity unit input, Sensitivity physical unit, Limit value overflow, Limit value underflow, Wire break limit, Diagnostics</p>
	<p>Low-pass filters 1 and 2:</p> <ul style="list-style-type: none"> Parameters: Filter base frequency, filter slope
	<p>"Extension measurement RSE" function block:</p> <ul style="list-style-type: none"> Parameters: Mode, unit, position: Reference value 1, sensor 1 inverted, position: Reference value 2, sensor 2 inverted, averaging time

7.4.8.2 Parameters of the function chain 2 channels broadband: 1 x RSE

The following table shows the parameters of the function chain 2 channels broadband: 1 x RSE.

Parameter

Parameter	Value range	Default	Parameter reassignment in RUN	Efficiency range
Function chain ID	<ul style="list-style-type: none"> 0 to 3 or 0 to 7 	0	Yes	Function chain
Low-pass filters 1 and 2: Filter base frequency	<ul style="list-style-type: none"> 0.1 Hz to 50000.0 Hz 	1.0 Hz	Yes	Function chain
Low-pass filters 1 and 2: Filter slope	<ul style="list-style-type: none"> 24 dB/octave 60 dB/octave 	24 dB/octave	Yes	Function chain
RSE: Mode	<ul style="list-style-type: none"> Shaft shoulder (2 sensors) Double shaft cone Single shaft cone 	Shaft shoulder (2 sensors)	Yes	Function chain
RSE: Unit	<ul style="list-style-type: none"> µm mm inch mil 	mm	Yes	Function chain
RSE: Sensor 1 inverted	<ul style="list-style-type: none"> Yes No 	No	Yes	Function chain
RSE: Position of reference value 1	<ul style="list-style-type: none"> -99999.99 to +99999.99 	0.0	Yes	Function chain
RSE: Sensor 2 inverted	<ul style="list-style-type: none"> Yes No 	No	Yes	Function chain
RSE: Position of reference value 2	<ul style="list-style-type: none"> -99999.99 to +99999.99 	0.0	Yes	Function chain
RSE: Averaging time	<ul style="list-style-type: none"> 10 ms to 65535 ms 	800 ms	Yes	Function chain
RSE: Cone angle	<ul style="list-style-type: none"> 1° to 90° 	45.0°		

7.4.8.3 Explanation of the parameters of the function chain 2 channels broadband: 1 x RSE**Function chain ID**

Unique identification of the function chains. The function chain ID must be in the range 0 to 3 or 0 to 7.

The function chain ID determines the position of the parameters as well as the IO data in the address space of the technology module. (see also sections Structure of data record 129 (Page 227) and Address space in operating mode "Vibration protection" (Page 263))

Low-pass filter: Filter base frequency

The technology module supports a low-pass filter with a configurable basic frequency and a filter sequence.

The basic frequency filter can be set in the range from 0.1 Hz to 50000.0 Hz.

Low-pass filter: Filter slope

DIN ISO 10816 prescribes a 4th order filter (24 dB/octave). For applications that require greater selectivity, 10th order filters (60 dB/octave) are available.

- 24 dB/octave
- 60 dB/octave

RSE: Mode

Specifies the calculation mode. The following calculation modes are available:

- Shaft shoulder (2 sensors)
- Double shaft cone
- Single shaft cone

RSE: Unit

Customary distance units are available.

RSE: Sensor 1 inverted / sensor 2 inverted

The following values can be set for both parameters:

- "Yes" (inverted)
- "No"

"Yes" must be selected when the sensor generates a dropping voltage with increasing distance (usually a voltage that increases in amount but is a negative voltage).

The "Sensor inverted" parameter is, for example, enabled for those sensors whose output voltage is getting more negative with increasing distance.

Example: A sensor (8 mV/μm) supplies -1 V at 125 μm and -2 V at 250 μm ⇒ this sensor is "inverted".

RSE: Position of reference value 1 / position of reference value 2

The reference value can be used to specify the zero position of the sensing object.

The setting depends on the required display in the zero position of the sensing object.

RSE: Averaging time

The averaging time specifies the time over which the sensor signal is averaged. A corresponding number of sample values is therefore always contained in the characteristic value.

The averaging method works "rolling" in which a new characteristic value is provided every 1.25 ms at the output.

RSE: Cone angle

Only for the operating modes "Double shaft cone" and "Single shaft cone".

Value range: 1 ... 90 °

7.4.9 2 channels broadband: 1 x ASV (SUM)**7.4.9.1 Applications and configuration**

Number of calculated characteristics: 1

- Root-mean-square RMS, peak value, peak-peak value or peak-peak value / 2

Applications

The function sequence is used to monitor absolute shaft vibrations.

Structure

The form of the function sequence is schematically represented below:

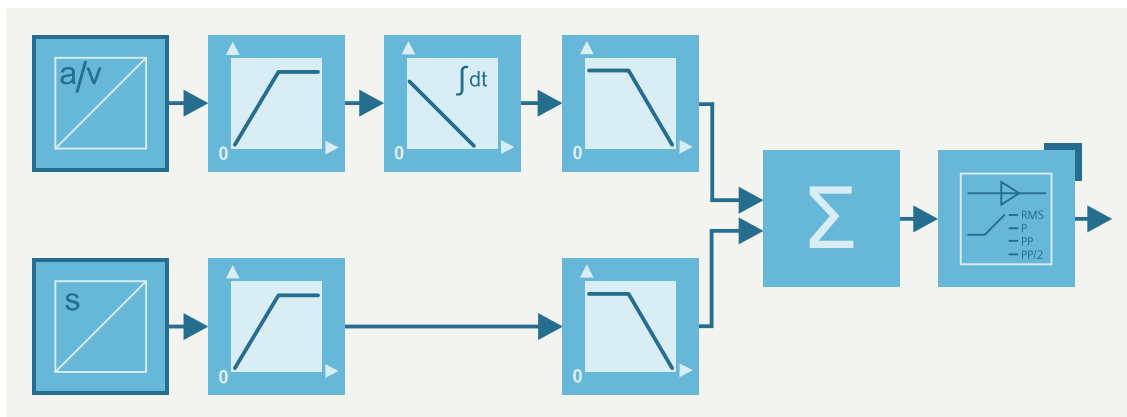
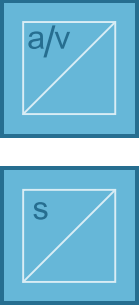


Figure 7-39 "Absolute shaft vibrations ASV" function sequence

Function blocks / parameters

Function blocks / parameters	
	<p>Acceleration / velocity sensor and position sensor:</p> <ul style="list-style-type: none"> The parameters are assigned via TM-AIs. The parameters must be adapted. Parameters (see Explanation of the analog input parameters (Page 54)): Measurement type, Measuring range, Sensor supply (via AI sensor type or channel operating mode DI/DQ) sensitivity, Sensitivity unit input, Sensitivity physical unit, Limit value overflow, Limit value underflow, Wire break limit, Diagnostics
	<p>High-pass filters 1 and 2:</p> <ul style="list-style-type: none"> Parameters: Filter base frequency, filter slope The settings for filter 2 are automatically adopted from filter 1.
	<p>Integrator:</p> <ul style="list-style-type: none"> Parameters: Integrator level
	<p>Low-pass filters 1 and 2:</p> <ul style="list-style-type: none"> Parameters: Filter base frequency, filter slope The settings for filter 2 are automatically adopted from filter 1.
	<p>This function block adds the time signals of both sensors.</p> <ul style="list-style-type: none"> Parameters: Sensor angle
	<ul style="list-style-type: none"> Parameters: Detector type

7.4.9.2 Parameters of the function chain 2 channels broadband: 1 x ASV (SUM)

The following table shows the parameters of the function chain 2 channels broadband: 1 x ASV (SUM).

Parameter

Parameter	Value range	Default	Parameter reassignment in RUN	Efficiency range
Function chain ID	<ul style="list-style-type: none"> 0 to 3 or 0 to 7 	0	Yes	Function chain
Sensor angle	<ul style="list-style-type: none"> 0° or 180° 	0°	Yes	Function chain
High-pass filters 1 and 2: Filter base frequency	<ul style="list-style-type: none"> 0.1 Hz to 50000.0 Hz 	1.0 Hz	Yes	Function chain
High-pass filters 1 and 2: Filter slope	<ul style="list-style-type: none"> 24 dB/octave 60 dB/octave 	24 dB/octave	Yes	Function chain
Integrator: Integrator level	<ul style="list-style-type: none"> 1x 2x 	Integration	Yes	Function chain
Low-pass filters 1 and 2: Filter base frequency	<ul style="list-style-type: none"> 0.1 Hz to 50000.0 Hz 	10000.0 Hz	Yes	Function chain
Low-pass filters 1 and 2: Filter slope	<ul style="list-style-type: none"> 24 dB/octave 60 dB/octave 	24 dB/octave	Yes	Function chain
Detector: Detector type	<ul style="list-style-type: none"> RMS Peak value Peak-peak value Peak-peak value / 2 	RMS	Yes	Function chain
Detector: Averaging time	<ul style="list-style-type: none"> 10 bis 65535 ms 	800 ms	Yes	Function chain
Detector: Unit	<ul style="list-style-type: none"> µm mm inch mil 	µm	Yes	Function chain

7.4.9.3 Explanation of the parameters of the function chain 2 channels broadband: 1 x ASV (SUM)

Function chain ID

Unique identification of the function chains. The function chain ID must be in the range 0 to 3 or 0 to 7.

The function chain ID determines the position of the parameters as well as the IO data in the address space of the technology module. (see also sections Structure of data record 129 (Page 227) and Address space in operating mode "Vibration protection" (Page 263))

Correlation: Sensor angle

Specifies the relative angles below the sensors.

High-pass filter: Filter base frequency

The technology module supports a high-pass filter with a configurable filter base frequency and a filter sequence.

The filter base frequency can be set freely in the range from 0.1 Hz to 50000.0 Hz. The maximum value depends on the selected base frequency of the low-pass filter.

High-pass filter: Filter slope

DIN ISO 10816 prescribes a 4th order filter (24 dB/octave). For applications that require greater selectivity, 10th order filters (60 dB/octave) are available.

- 24 dB/octave
- 60 dB/octave

Integrator: Integrator level

Activation of the integration or double integration is done automatically based on the set sensor and the selected unit of the measurement variable.

Low-pass filter: Filter base frequency

The technology module supports a low-pass filter with a configurable basic frequency and a filter sequence.

The basic frequency filter can be set in the range from 0.1 Hz to 50000.0 Hz.

Low-pass filter: Filter slope

DIN ISO 10816 prescribes a 4th order filter (24 dB/octave). For applications that require greater selectivity, 10th order filters (60 dB/octave) are available.

- 24 dB/octave
- 60 dB/octave

Detector: Detector type

Specifies the character of the value to be calculated.

Detector: Averaging time

Specifies the time that a value needs to drop down to 10 % of its starting point after it has reached its maximum value.

Detector: Unit

Specifies the unit of the value.

7.4.10 1 channel: Speed

7.4.10.1 Applications and configuration

Number of calculated characteristics: 1

- Speed

Applications

The function sequence is used to monitor the machine speed.

This function chain can only be set for the channels 2 and 3 of the technology module.

Structure

The form of the function sequence is schematically represented below:

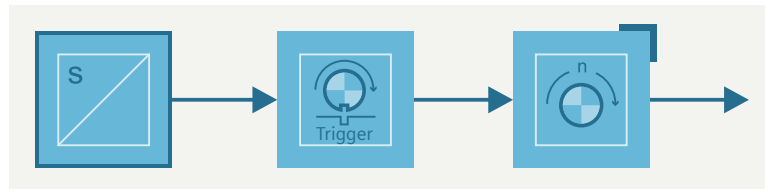
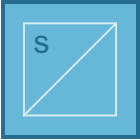


Figure 7-40 Function chain "1 channel speed" when using local triggers

Function blocks / parameters

Function blocks / parameters	
	<p>Function block "Sensor":</p> <ul style="list-style-type: none"> • The parameters are assigned via TM-AIs. The parameters must be adapted. Parameters (see Explanation of the analog input parameters (Page 54)): Measurement type, Measuring range, Sensor supply (via AI sensor type or channel operating mode DI/DQ) sensitivity, Sensitivity unit input, Sensitivity physical unit, Limit value overflow, Limit value underflow, Wire break limit, Diagnostics
	<p>Function block "Trigger":</p> <ul style="list-style-type: none"> • Parameters: Trigger mode, trigger level, trigger hysteresis, signal edge, min. rel. trigger amp., max. rel. trigger amp., timeout, reference channel, unit <p>For the use of triggers, see also chapter Trigger function (Page 137).</p>
	<p>"Speed" function block:</p> <ul style="list-style-type: none"> • Parameters: Average mode, max. averaging time, counter, divider, analog trigger

7.4.10.2 Parameters of the function chain 1 channel: Speed

The following table shows the parameters of the function chain 1 channel: Speed.

Parameter

Parameter	Value range	Default	Parameter reassignment in RUN	Efficiency range
Function chain ID	<ul style="list-style-type: none"> 0 to 3 or 0 to 7 	0	Yes	Function chain
Speed: Unit	<ul style="list-style-type: none"> Hz CPM RPM 	Hz	Yes	Function chain
Speed: Averaging type	<ul style="list-style-type: none"> Automatic Normal 	Normal	Yes	Function chain
Speed: Max. averaging time	<ul style="list-style-type: none"> 10 ms to 65535 ms 	100 ms	Yes	Function chain
Speed: Counter	<ul style="list-style-type: none"> 1 to 65535 	1	Yes	Function chain
Speed: Divider	<ul style="list-style-type: none"> 1 to 65535 	1	Yes	Function chain

7.4.10.3 Explanation of the parameters of the function chain 1 channel: Speed**Function chain ID**

Unique identification of the function chains. The function chain ID must be in the range 0 to 3 or 0 to 7.

The function chain ID determines the position of the parameters as well as the IO data in the address space of the technology module. (see also sections Structure of data record 129 (Page 227) and Address space in operating mode "Vibration protection" (Page 263))

Speed: Unit

Specifies the unit of the value.

Speed: Averaging type

In the "Automatic" setting, the technology module specifies the averaging time adapted to the current trigger signal independently.

- At constant speed, the averaging time is set to a high value.
- With changing speed, the averaging time is reduced.

The averaging time is always at least three signal periods long. Averaging times of consecutive periods must not deviate from each other by more than 15%. Otherwise, the measured value status is set to "BAD".

The "Normal" setting requires the manual specification of a maximum averaging time. As soon as the set averaging time has expired, a new measured value is displayed.

Speed: Max. averaging time

Specifies the maximum time period.

Speed: Counter

The displayed speed is the product of measured speed and counter.

Speed: Divider

The displayed speed is the quotient of measured speed and divider.

7.4.11 2 channels: Direction of rotation**7.4.11.1 Applications and configuration**

Number of calculated characteristics: 1

- Speed

Applications

The function sequence is used to monitor the direction of rotation.

This function chain can only be set for the channels 2 and 3 of the technology module.

Structure

The form of the function sequence is schematically represented below:

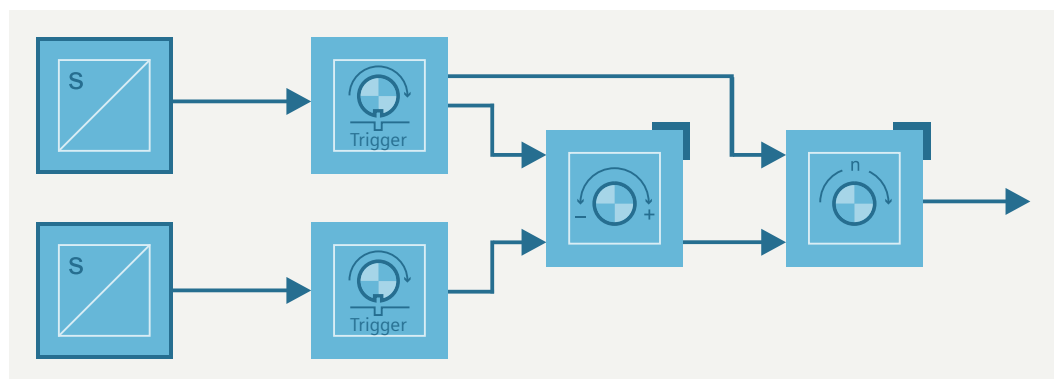
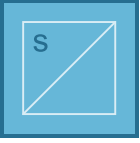


Figure 7-41 Function chain "2 channels: Direction of rotation" when using local triggers

Function blocks / parameters

Function blocks / parameters	
	<p>Sensors 1 and 2:</p> <ul style="list-style-type: none"> The parameters are assigned via TM-AIs. The parameters must be adapted. <p>Parameters (see Explanation of the analog input parameters (Page 54)): Measurement type, Measuring range, Sensor supply (via AI sensor type or channel operating mode DI/DQ) sensitivity, Sensitivity unit input, Sensitivity physical unit, Limit value overflow, Limit value underflow, Wire break limit, Diagnostics</p>
	<p>Trigger 1 and 2:</p> <ul style="list-style-type: none"> Parameters: Trigger mode, trigger level, trigger hysteresis, signal edge, min. rel. trigger amp., max. rel. trigger amp., timeout, reference channel, unit <p>For the use of triggers, see also chapter Trigger function (Page 137).</p>
	<p>Function block "Direction of rotation":</p> <ul style="list-style-type: none"> Parameters: Sign
	<p>"Speed" function block:</p> <ul style="list-style-type: none"> Parameters: Unit, averaging method, max. averaging time, counters, dividers

7.4.11.2 Parameters of the function chain 2 channels: Direction of rotation

The following table shows the parameters of the function chain 2 channels: Direction of rotation.

Parameter

Parameter	Value range	Default	Parameter reassignment in RUN	Efficiency range
Function chain ID	<ul style="list-style-type: none"> 0 to 3 or 0 to 7 	0	Yes	Function chain
Direction of rotation: Sign	<ul style="list-style-type: none"> Positive Negative 	Positive	Yes	Function chain
Speed: Unit	<ul style="list-style-type: none"> Hz CPM RPM 	Hz	Yes	Function chain
Speed: Averaging type	<ul style="list-style-type: none"> Automatic Normal 	Normal	Yes	Function chain
Speed: Max. averaging time	<ul style="list-style-type: none"> 10 ms to 65535 ms 	1000 ms	Yes	Function chain

Parameter	Value range	Default	Parameter reassignment in RUN	Efficiency range
Speed: Counter	• 1 to 65535	1	Yes	Function chain
Speed: Divider	• 1 to 65535	1	Yes	Function chain

7.4.11.3 Explanation of the parameters of the function chain 2 channels: Direction of rotation

Function chain ID

Unique identification of the function chains. The function chain ID must be in the range 0 to 3 or 0 to 7.

The function chain ID determines the position of the parameters as well as the IO data in the address space of the technology module. (see also sections Structure of data record 129 (Page 227) and Address space in operating mode "Vibration protection" (Page 263))

Direction of rotation: Sign

Inverts the calculated direction of rotation. Possible settings are:

- Positive
- Negative

Speed: Unit

Specifies the unit of the value.

Speed: Averaging type

In the "Automatic" setting, the technology module specifies the averaging time adapted to the current trigger signal independently.

- At constant speed, the averaging time is set to a high value.
- With changing speed, the averaging time is reduced.

The averaging time is always at least three signal periods long. Averaging times of consecutive periods must not deviate from each other by more than 15%. Otherwise, the measured value status is set to "BAD".

The "Normal" setting requires the manual specification of a maximum averaging time. As soon as the set averaging time has expired, a new measured value is displayed.

Speed: Max. averaging time

Specifies the maximum time period.

Speed: Counter

The displayed speed is the product of measured speed and counter.

Speed: Divider

The displayed speed is the quotient of measured speed and divider.

7.4.12 2 channels TNB-2N: 2x Pk & 2 x Phase

7.4.12.1 Applications and configuration

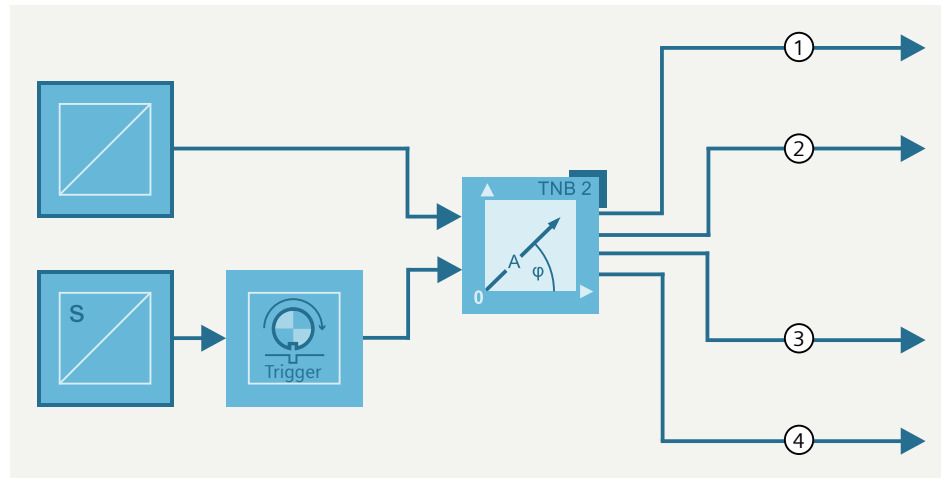
Number of calculated characteristics: 4

- Amplitude 1 (peak 1)
- Phase 1
- Amplitude 2 (peak 2)
- Phase 2

Applications

The function chain is used to monitor two narrowband characteristic values (each with amplitude and phase). These characteristic values are typically used for balancing turbine blades.

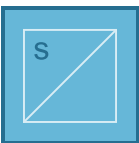
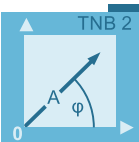
Configuration



- ① Amplitude 1
- ② Phase 1
- ③ Amplitude 2
- ④ Phase 2

Figure 7-42 Function chain "Narrowband 2" when using local triggers

Function blocks / parameters

Function blocks / parameters	
	<p>Function block "Sensor":</p> <ul style="list-style-type: none"> The parameters are assigned via TM-AIs. The parameters must be adapted. Parameters (see Explanation of the analog input parameters (Page 54)): Measurement type, Measuring range, Sensor supply (via AI sensor type or channel operating mode DI/DQ) sensitivity, Sensitivity unit input, Sensitivity physical unit, Limit value overflow, Limit value underflow, Wire break limit, Diagnostics
	<p>Function block "Trigger":</p> <ul style="list-style-type: none"> Parameters: Trigger mode, Trigger level, Trigger hysteresis, Signal edge, Min. rel. trigger amp., Max. rel. trigger amp., Timeout, Reference channel, Unit <p>For the use of triggers, see also chapter Trigger function (Page 137).</p>
	<p>"Narrowband 2 (Tracking TNB 2)" function block:</p> <ul style="list-style-type: none"> Parameter: Sensor channel, reference channel, unit, signal evaluation, averaging time, counter, divider, integrator

7.4.12.2 Parameters of the function chain 2 channels TNB-2N: 2x Pk & 2 x Phase

The following table shows the parameters of the function chain 2 channels TNB-2N: 2x Pk & 2 x Phase

Parameter

Parameter	Value range	Default	Parameter reassignment in RUN	Efficiency range
Function chain ID	<ul style="list-style-type: none"> 0 to 3 or 0 to 7 	0	Yes	Function chain
Narrowband 2: Unit	<ul style="list-style-type: none"> m/s² inch/s² g mm/s inch/s μm mm inch mil V mV A mA μA mBar Bar Pascal Psi eu 	m/s ²	Yes	Function chain
Narrowband 2: Signal evaluation	<ul style="list-style-type: none"> RMS Peak value 	Peak value	Yes	Function chain
Narrowband 2: Averaging time	<ul style="list-style-type: none"> 10 ms to 65535 ms 	400 ms	Yes	Function chain
Narrowband 2: Harmonic 1	<ul style="list-style-type: none"> 1 to 999 	1	Yes	Function chain
Narrowband 2: Harmonic 2	<ul style="list-style-type: none"> 1 to 999 	1	Yes	Function chain
Narrowband 2: Reference frequency counter	<ul style="list-style-type: none"> 1 to 65535 	1	Yes	Function chain
Narrowband 2: Reference frequency divider	<ul style="list-style-type: none"> 1 to 65535 	1	Yes	Function chain

Parameter	Value range	Default	Parameter reassignment in RUN	Efficiency range
Narrowband 2: Integration steps	<ul style="list-style-type: none"> No integration 1x 2x 	No integration	Yes	Function chain
Narrowband 2: Phase reference	<ul style="list-style-type: none"> $\sin(\Omega + \Phi)$ $\sin(\Omega - \Phi)$ $\cos(\Omega + \Phi)$ $\cos(\Omega - \Phi)$ 	$\sin(\Omega + \Phi)$	Yes	Function chain

7.4.12.3 Explanation of the parameters of the function chain 2 channels TNB-2N: 2x Pk & 2x Phase

Function chain ID

Unique identification of the function chains. The function chain ID must be in the range 0 to 3 or 0 to 7.

The function chain ID determines the position of the parameters as well as the IO data in the address space of the technology module. (see also sections Structure of data record 129 (Page 227) and Address space in operating mode "Vibration protection" (Page 263))

Narrowband 2: Unit

The selection of the physical unit of the characteristic value depends on the selected sensor (sensitivity; physical unit).

Narrowband 2: Signal evaluation

Setting options:

- RMS
- Peak value

Narrowband 2: Averaging time

The averaging time specifies the signal duration via which the measured value is determined by using narrowband filtering.

The selectivity of the narrowband filter is proportional to the averaging time at constant signal frequency (speed of the monitored rotor). A greater averaging time increases the selectivity of the filter at constant speed or allows for the measurement of subharmonic signal components.

Narrowband 2: Harmonic 1, Harmonic 2

The "Harmonic" parameters specify the relationship between the filter center frequency and the trigger frequency. The setting of these parameters enables the selective measurement of harmonics that are subsequently subtracted from the rms value and peak value. When you set the parameters to "0", this component is not taken into account in the subtraction.

Narrowband 2: Reference frequency counter/divider

The "Reference frequency counter" and "Reference frequency divider" parameters specify the relationship between the filter center frequency and the trigger frequency. This enables the selective measurement of harmonics or subharmonics of the speed.

Narrowband 2: Integration steps

Specifies the signal integration mode.

Narrowband 2: Phase reference

Specifies the mode that represents the relationship between trigger occurrence and monitored harmonic phases.

7.4.13 1 channel triggered broadband: 1 x PkPk/time

7.4.13.1 Applications and configuration

Number of calculated characteristics: 1

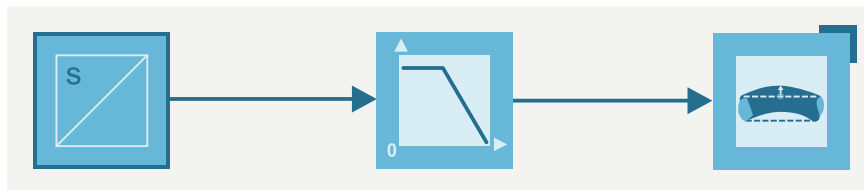
- Number of calculated characteristics: 1

Applications

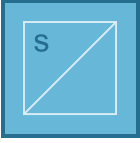
The function chain is used to monitor the eccentricity. Eccentricity measurement measures the shaft curvature(*). The monitoring time is specified as a parameter.

*(The deviation of the geometric shaft centerline from the axis of rotation.)

Configuration



Function blocks / parameters

Function blocks / parameters	
	Sensor: <ul style="list-style-type: none"> Parameter: Sensor status, supply voltage, signal range, channel, sensitivity, sensitivity unit input, sensitivity physical unit, redundancy status, OK high limit, OK low limit, error latching, error delay
	Low-pass filter: <ul style="list-style-type: none"> Parameter: Filter base frequency, filter slope
	Eccentricity: <ul style="list-style-type: none"> Parameter: Monitoring time, unit

7.4.13.2 Parameters of the function chain "1 channel triggered bandwidth: 1 x PkPk/time"

The following table shows the parameters of the function chain.

Parameter

Parameter	Value range	Default	Parameter reassignment in RUN	Efficiency range
Function chain ID	<ul style="list-style-type: none"> 0 to 3 or 0 to 7 	0	Yes	Function chain
Low-pass filter: Filter base frequency	<ul style="list-style-type: none"> 0.1 Hz to 50000.0 Hz 	10000.0 Hz	Yes	Function chain
Low-pass filter: Filter slope	<ul style="list-style-type: none"> 24 dB/octave, 60 dB/octave 	24 dB/octave	Yes	Function chain
Eccentricity: Unit	<ul style="list-style-type: none"> um, mm, inch, mils, eu 			
Eccentricity: Monitoring time	<ul style="list-style-type: none"> 10 ms to 65535 ms 	1000 ms	Yes	Function chain

7.4.13.3 Explanation of the parameters of the function chain "1 channel triggered bandwidth: 1 x PkPk/time"

Function chain ID

Unique identification of the function chains. The function chain ID must be in the range 0 to 3 or 0 to 7.

The function chain ID determines the position of the parameters and the IO data in the address space of the technology module. (See also section Structure of the data record 129 (Page 227) and Address space in "Vibration protection" operating mode (Page 263))

Low-pass filter: Filter base frequency

The technology module supports a low-pass filter with a configurable basic frequency and a filter sequence.

The basic frequency filter can be set in the range from 0.1 Hz to 50000.0 Hz.

Low-pass filter: Filter slope

DIN ISO 10816 prescribes a 4th order filter (24 dB/octave). For applications that require greater selectivity, 10th order filters (60 dB/octave) are available.

- 24 dB/octave
- 60 dB/octave

Eccentricity: Unit

Specifies the unit of the value.

Eccentricity: Monitoring time

The monitoring time determines the range of values used for the calculation and the update rate of the output.

7.4.14 1 channel triggered broadband: 1 x PkPk/revolution

7.4.14.1 Applications and configuration

Number of calculated characteristics: 1

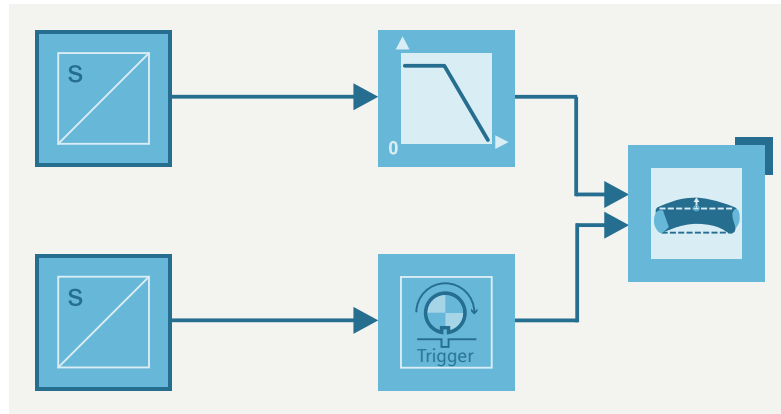
- Eccentricity (peak - peak)

Applications

The function chain is used to monitor the eccentricity. Eccentricity measurement measures the shaft curvature(*). The monitoring time is derived from a trigger signal.

*(The deviation of the geometric shaft centerline from the axis of rotation.)

Configuration



Function blocks / parameters

Function blocks / parameters	
	Sensor: <ul style="list-style-type: none"> Parameter: Sensor status, supply voltage, signal range, channel, sensitivity, sensitivity unit input, sensitivity physical unit, redundancy status, OK high limit, OK low limit, error latching, error delay
	Trigger: <ul style="list-style-type: none"> Parameter: Trigger mode, Trigger level, Trigger hysteresis, Signal edge, Minimum relative trigger amplitude, Maximum relative trigger amplitude, Timeout, Reference channel, Unit
	Low-pass filter: <ul style="list-style-type: none"> Parameter: Filter base frequency, filter slope
	Eccentricity: <ul style="list-style-type: none"> Parameter: Reference channel, unit

7.4.14.2 Parameters of the function chain "1 channel triggered bandwidth: 1 x PkPk/revolution"

The following table shows the parameters of the function chain.

Parameter

Parameter	Value range	Default	Parameter reassignment in RUN	Efficiency range
Function chain ID	• 0 to 3 or 0 to 7	0	Yes	Function chain
Low-pass filter: Filter base frequency	• 0.1 Hz to 50000.0 Hz	10000.0 Hz	Yes	Function chain
Low-pass filter: Filter slope	• 24 dB/octave, 60 dB/octave	24 dB/octave	Yes	Function chain
Eccentricity: Unit	• um, mm, inch, mils, eu			
Eccentricity: Counters	• 1 to 65535	1	Yes	Function chain
Eccentricity: Divider	• 1 to 65535	1	Yes	Function chain

7.4.14.3 Explanation of the parameters of the function chain "1 channel triggered bandwidth: 1 x PkPk/revolution"

Function chain ID

Unique identification of the function chains. The function chain ID must be in the range 0 to 3 or 0 to 7.

The function chain ID determines the position of the parameters and the IO data in the address space of the technology module. (See also section Structure of the data record 129 (Page 227) and Address space in "Vibration protection" operating mode (Page 263))

Low-pass filter: Filter base frequency

The technology module supports a low-pass filter with a configurable basic frequency and a filter sequence.

The basic frequency filter can be set in the range from 0.1 Hz to 50000.0 Hz.

Low-pass filter: Filter slope

DIN ISO 10816 prescribes a 4th order filter (24 dB/octave). For applications that require greater selectivity, 10th order filters (60 dB/octave) are available.

- 24 dB/octave
- 60 dB/octave

Eccentricity: Unit

Specifies the unit of the value.

Eccentricity: Counters

The displayed eccentricity is the product of the measured eccentricity and counter.

Eccentricity: Divider

The displayed eccentricity is the quotient of the measured eccentricity and divider.

Technical specifications

8.1 Power supply

The supply and input voltages of the ET 200SP HA system must always be generated with voltage/current supplies with protection by electrical separation (SELV/PELV according to IEC/UL 61010-2-201) with a nominal value of 24 V DC  $\pm 20\%$.

8.2 Technical specifications of the technology module "Fast input and output and counter functions (6DL1138-6EA00-0EH1)"

8.2 Technical specifications of the technology module "Fast input and output and counter functions (6DL1138-6EA00-0EH1)"

Article number	6DL1138-6EA00-0EH1
General information	
Product type designation	Fast Multi IO & Counter
HW functional status	FS04
Firmware version	V1.2
• FW update possible	Yes
Usable terminal block	TB type H1, M1 and N0
Color code for module-specific color identification plate	CC00
Product function	
• I&M data	Yes; I&M0 to I&M3
• Isochronous mode	No
Engineering with	
• STEP 7 TIA Portal configurable/integrated from version	V18
• STEP 7 configurable/integrated from version	V5.6 with HSP 298 or higher
• PCS 7 configurable/integrated from version	V9.1 SP1
• SPPA-T3000 can be configured/integrated from version	V8.2 SP2
Operating mode	
• DI	Yes
• Counter	Yes
• DQ	Yes
Redundancy	
• Redundancy capability	Yes; With TB type M1
CiR - Configuration in RUN	
Reparameterization possible in RUN	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 (rated value)	150 mA; without load
Current consumption, max.	2 A; At 24 V DC
from backplane bus 24 V DC, max.	21 mA
Encoder supply	
Number of outputs	6; max. depending on parameterization
Output voltage (DC)	24 V
Output voltage, min.	18.2 V
Short-circuit protection	Yes; per channel, electronic

8.2 Technical specifications of the technology module "Fast input and output and counter functions (6DL1138-6EA00-0EH1)"

Article number	6DL1138-6EA00-0EH1
24 V encoder supply	
<ul style="list-style-type: none"> 24 V Short-circuit protection Output current per channel, max. Output current per module, max. 	Yes Yes; per channel, electronic 0.5 A 2 A
Power loss	
Power loss, typ.	4 W
Address area	
Address space per module	
<ul style="list-style-type: none"> Address space per module, max. 	130 byte; Quick input and output: 30 bytes. Of which 13 bytes for inputs, 17 bytes for outputs. Quick input and output and counter function: 130 bytes. Of which 57 bytes for inputs, 73 bytes for outputs. Quick input and output and speed measurement: 42 bytes. Of which 25 bytes for inputs, 17 bytes for outputs
Hardware configuration	
Automatic encoding	
<ul style="list-style-type: none"> Mechanical coding element 	Yes; A, B coding; mounting position B8
Digital inputs	
Number of digital inputs	10; Of these, 6 combined DI/DQ
Digital inputs, parameterizable	Yes
Source/sink input	Yes; DI0 ... DI3 (param.); sinking DIDQ4 ... DIDQ9
Input characteristic curve in accordance with IEC 61131, type 1	Yes
Pulse extension	Yes
<ul style="list-style-type: none"> Length 	2 s; off, 50 ms, 100 ms, 200 ms, 500 ms, 1 s, 2 s
Digital input functions, parameterizable	
<ul style="list-style-type: none"> Gate start/stop 	Yes; Selectable: Standard DI, encoder signals A, B, N, gate start, gate stop, set counter
<ul style="list-style-type: none"> Freely usable digital input 	Yes
<ul style="list-style-type: none"> Counter 	Yes
<ul style="list-style-type: none"> <ul style="list-style-type: none"> Number, max. Counting frequency, max. 	4 70 kHz; 70 kHz for DI; 7 kHz for DI/DQ; each for P/M encoder and 50 m cable length; 10 kHz for DI; 0.7 kHz for DI/DQ; each for P encoder and 50 m cable length
<ul style="list-style-type: none"> <ul style="list-style-type: none"> Counting width Counting direction up/down 	32 bit Yes
<ul style="list-style-type: none"> Digital input with oversampling 	
<ul style="list-style-type: none"> <ul style="list-style-type: none"> Number, max. 	4
Input voltage	
<ul style="list-style-type: none"> Rated value (DC) for signal "0" for signal "1" 	24 V 0 ... 5 V +11 to +30V

8.2 Technical specifications of the technology module "Fast input and output and counter functions (6DL1138-6EA00-0EH1)"

Article number	6DL1138-6EA00-0EH1
Input current <ul style="list-style-type: none"> for signal "1", typ. 	2.6 mA; 2.6 mA DI, 3.5 mA DIDQ
Input delay (for rated value of input voltage) for standard inputs <ul style="list-style-type: none"> parameterizable 	Yes; 0.05 / 0.1 / 0.4 / 0.8 / 1.6 / 3.2 / 12.8 / 20 ms (in each case + delay of 30 to 500 µs, depending on line length)
for technological functions <ul style="list-style-type: none"> parameterizable 	Yes; Adjustable filter: 5 µs, 25 µs
Cable length <ul style="list-style-type: none"> shielded, max. 	1 000 m
Digital outputs	
Number of digital outputs	6; max. depending on parameterization
Current-sinking	No
Current-sourcing	Yes
Short-circuit protection	Yes
• Response threshold, typ.	0.95 A
Open-circuit detection	Yes
• Response threshold, typ.	45 mA
Overload protection	Yes
• Response threshold, typ.	950 mA
Limitation of inductive shutdown voltage to	L+ -(37 to 41V)
Controlling a digital input	Yes
Digital output functions, parameterizable <ul style="list-style-type: none"> Switching tripped by comparison values <ul style="list-style-type: none"> Hysteresis Freely usable digital output 	Yes; As output signal of a high-speed counter Yes; Parameterizable Yes
Switching capacity of the outputs <ul style="list-style-type: none"> with resistive load, max. 	0.5 A
Load resistance range <ul style="list-style-type: none"> lower limit 	48 Ω
Output voltage <ul style="list-style-type: none"> for signal "1", min. 	18.1 V
Output current <ul style="list-style-type: none"> for signal "1" rated value 	0.5 A
Output delay with resistive load <ul style="list-style-type: none"> "0" to "1", typ. "1" to "0", typ. 	1 ms 100 µs
Parallel switching of two outputs <ul style="list-style-type: none"> for logic links for uprating for redundant control of a load 	No No Yes
Switching frequency	

8.2 Technical specifications of the technology module "Fast input and output and counter functions (6DL1138-6EA00-0EH1)"

Article number	6DL1138-6EA00-0EH1
<ul style="list-style-type: none"> with resistive load, max. 	800 Hz
Total current of the outputs	
<ul style="list-style-type: none"> Current per channel, max. 	0.5 A
<ul style="list-style-type: none"> Current per module, max. 	2 A
Cable length	
<ul style="list-style-type: none"> shielded, max. 	1 000 m
Analog inputs	
Number of analog inputs	4
permissible input voltage for voltage input (destruction limit), max.	30 V
permissible input current for current input (destruction limit), max.	50 mA; Protection available against destruction
Input ranges	
<ul style="list-style-type: none"> Voltage 	Yes; 0 ... 10 V, -10 ... 10 V, 0 ... 20 V, -20 ... 0 V
<ul style="list-style-type: none"> Current 	Yes; 0 ... 20 mA, 4 ... 20 mA, -20 ... 20 mA, -30 ... 30 mA, -20 ... 0 mA
Input ranges (rated values), voltages	
<ul style="list-style-type: none"> 0 to +10 V 	Yes
<ul style="list-style-type: none"> – Input resistance (0 to 10 V) 	100 kΩ
<ul style="list-style-type: none"> -10 V to +10 V 	Yes
<ul style="list-style-type: none"> – Input resistance (-10 V to +10 V) 	100 kΩ
Input ranges (rated values), currents	
<ul style="list-style-type: none"> 0 to 20 mA 	Yes; 0 mA or 4 mA to 20 mA
<ul style="list-style-type: none"> – Input resistance (0 to 20 mA) 	70 Ω
<ul style="list-style-type: none"> -20 mA to +20 mA 	Yes
<ul style="list-style-type: none"> – Input resistance (-20 mA to +20 mA) 	70 Ω
<ul style="list-style-type: none"> 4 mA to 20 mA 	Yes; and 0 to 20 mA
<ul style="list-style-type: none"> – Input resistance (4 mA to 20 mA) 	70 Ω
Cable length	
<ul style="list-style-type: none"> shielded, max. 	600 m
Analog outputs	
Number of analog outputs	8; 4 AQ-I, 4 AQ-U
Voltage output, short-circuit protection	Yes; per channel, electronic to chassis
Voltage output, short-circuit current, max.	10 mA
Current output, no-load voltage, max.	24 V
Current signal at analog output	Yes; -50 ... 50 mA
Output ranges, voltage	
<ul style="list-style-type: none"> -10 V to +10 V 	Yes
Output ranges, current	
<ul style="list-style-type: none"> 0 to 20 mA 	Yes
<ul style="list-style-type: none"> -20 mA to +20 mA 	Yes; ±30 mA, ±50 mA
<ul style="list-style-type: none"> 4 mA to 20 mA 	Yes
Connection of actuators	

8.2 Technical specifications of the technology module "Fast input and output and counter functions (6DL1138-6EA00-0EH1)"

Article number	6DL1138-6EA00-0EH1
<ul style="list-style-type: none"> for voltage output two-wire connection 	Yes
Load impedance (in rated range of output)	
<ul style="list-style-type: none"> with current outputs, max. 	330 Ω; 150 ohms at ±50 mA
Analog value generation for the inputs	
Measurement principle	integrating (Sigma-Delta)
Integration and conversion time/resolution per channel	
<ul style="list-style-type: none"> Resolution with overrange (bit including sign), max. 	24 bit
Smoothing of measured values	
<ul style="list-style-type: none"> parameterizable Step: None Step: low Step: Medium Step: High 	Yes Yes Yes Yes Yes
Analog value generation for the outputs	
Integration and conversion time/resolution per channel	
<ul style="list-style-type: none"> Resolution with overrange (bit including sign), max. 	16 bit
Encoder	
Connection of signal encoders	
<ul style="list-style-type: none"> for voltage measurement for current measurement as 2-wire transducer 	Yes Yes
Connectable encoders	
<ul style="list-style-type: none"> Single contact / changeover contact unconnected 2-wire sensor <ul style="list-style-type: none"> permissible quiescent current (2-wire sensor), max. 	Yes Yes 1.5 mA
Errors/accuracies	
Linearity error (relative to input range), (+/-)	0.05 %
Temperature error (relative to input range), (+/-)	0.0025 %/K
Crosstalk between the inputs, min.	60 dB
Operational error limit in overall temperature range	
<ul style="list-style-type: none"> Voltage, relative to input range, (+/-) Current, relative to input range, (+/-) 	0.3 % 0.3 %
Interrupts/diagnostics/status information	
Diagnostics function	Yes
Substitute values connectable	Yes
Alarms	
<ul style="list-style-type: none"> Diagnostic alarm 	Yes

8.2 Technical specifications of the technology module "Fast input and output and counter functions (6DL1138-6EA00-0EH1)"

Article number	6DL1138-6EA00-0EH1
Diagnoses	
• Monitoring the supply voltage	Yes
• Wire-break	Yes; AI 4 ... 20 mA, AQ, DQ, DI 0 ... 3
• Short-circuit to M	Yes; Encoder supply to M, channel by channel
• Short-circuit to L+	Yes; Analog inputs
• Group error	Yes
• Overflow/underflow	Yes
Diagnostics indication LED	
• RUN LED	Yes; green LED
• MAINT LED	Yes; Yellow LED
• Monitoring of the supply voltage (PWR-LED)	Yes; green PWR LED
• for module diagnostics	Yes; green/red DIAG LED
Integrated Functions	
Frequency measurement	Yes; Speed measurement
Counting functions	
• Continuous counting	Yes
• Counter response parameterizable	Yes
• Hardware gate via digital input	Yes
• Software gate	Yes
Measuring functions	
• Dynamic measurement period adjustment	Yes; Speed measurement
Measuring range	
– Frequency measurement, min.	0.1 Hz
– Frequency measurement, max.	70 kHz; 70 kHz for DI; 7 kHz for DI/DQ; each for P/M encoder and 50 m cable length; 10 kHz for DI; 0.7 kHz for DI/DQ; each for P encoder and 50 m cable length
Potential separation	
Potential separation channels	
• between the channels and backplane bus	Yes
Permissible potential difference	
between different circuits	75 V DC/60 V AC between L+ and backplane bus
Isolation	
Isolation tested with	1 500 V DC/1 min, type test
Ambient conditions	
Ambient temperature during operation	
• horizontal installation, min.	-40 °C
• horizontal installation, max.	70 °C; Observe derating
• vertical installation, min.	-40 °C
• vertical installation, max.	60 °C
Altitude during operation relating to sea level	
• Installation altitude above sea level, max.	3 500 m
Dimensions	

8.2 Technical specifications of the technology module "Fast input and output and counter functions (6DL1138-6EA00-0EH1)"

Article number	6DL1138-6EA00-0EH1
Width	22.5 mm
Height	115 mm
Depth	138 mm
Weights	
Weight, approx.	200 g

Derating

Horizontal mounting position

The following tables show the deratings that must be observed for the inputs and outputs AI, AO, DI, DO:

IO type	Quantity	Nominal ranges	Up to 70 °C	Up to 60 °C
AI	4	± 30 mA	± 20 mA	± 30 mA
AQ ²	4	± 50 mA	± 50 mA (total 80 mA)	± 50 mA (total 120 mA) ¹
DI	4/10	2.5 mA	Total 5 mA	Total 10 mA
DIDQ	6	500 mA (total 2 A)	Total 0.3 A	Total 1 A

¹ 200 mA peak for 10 s and duty cycle < 10 %

² Minimal burden AQ 10 Ohms

Vertical mounting position

The following tables show the deratings that must be observed for the inputs and outputs AI, AO, DI, DO:

IO type	Quantity	Nominal ranges	Up to 60 °C	Up to 50 °C
AI	4	± 30 mA	± 20 mA	± 30 mA
AQ ²	4	± 50 mA	± 50 mA (total 80 mA)	± 50 mA (total 120 mA) ¹
DI	4/10	2.5 mA	Total 5 mA	Total 10 mA
DIDQ	6	500 mA (total 2 A)	Total 0.3 A	Total 1 A

¹ 200 mA peak for 10 s and duty cycle < 10 %

² Minimal burden AQ 10 Ohms

Cycle time

The cycle time describes the period in which the hardware signals are acquired, processed and made available at the PROFINET, and the outputs controlled. The cycle time depends on the configured version.

- Configuration 1: Fast input and output
1 ms
- Configuration 2: Fast input and output and counter functions
8 ms
- Configuration 3: Fast input and output and speed measurement
1 ms

Channel-specific parameter assignments such as smoothing, input delay, and pulse stretching must be observed.

Redundancy failover time

Analog outputs AQ 0... AQ 3

In IO redundancy mode, both I/O modules output half the specified current.

If one I/O module fails, failover to the partner module occurs and the partner module outputs the full current. The maximum changeover time (signal failure) for the analog outputs is 2 ms.

Note

Detection of AQ-related hardware errors

The detection of AQ-related hardware errors (deviation/wire break) takes 25 ms and thus extends the signal dip accordingly.

Analog outputs BUF 0... BUF 3

In IO redundancy mode, the voltage outputs are only output by the active I/O module.

If one I/O module fails, failover to the partner module occurs and the activated module outputs the voltage outputs. The maximum changeover time (signal failure) for the voltage outputs is 10 ms.

Digital outputs DIDO 4... DIDQ 9

In IO redundancy mode, the digital outputs are only output by the active I/O module.

If one I/O module fails, failover to the partner module occurs and the activated module outputs the digital outputs. The maximum changeover time (signal failure) for the digital outputs is 10 ms.

8.3 Technical specifications of the technology module "Fast controllers (6DL1138-6EB00-0EH1)"

Article number	6DL1138-6EB00-0EH1
General information	
Product type designation	Closed-loop controller
HW functional status	FS04
Firmware version	V1.2
• FW update possible	Yes
Usable terminal block	TB type H1, M1 and N0
Color code for module-specific color identification plate	CC00
Product function	
• I&M data	Yes; I&M0 to I&M3
• Isochronous mode	No
Engineering with	
• SPPA-T3000 can be configured/integrated from version	V8.2 SP2
Operating mode	
• DI	Yes
• Counter	No
• DQ	Yes
Redundancy	
• Redundancy capability	Yes; With TB type M1
CiR - Configuration in RUN	
Reparameterization possible in RUN	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 (rated value)	150 mA; without load
Current consumption, max.	2 A; At 24 V DC
from backplane bus 24 V DC, max.	21 mA
Encoder supply	
Number of outputs	6; max. depending on parameterization
Output voltage (DC)	24 V
Output voltage, min.	18.2 V
Short-circuit protection	Yes; per channel, electronic
24 V encoder supply	
• 24 V	Yes
• Short-circuit protection	Yes; per channel, electronic
• Output current per channel, max.	0.5 A

8.3 Technical specifications of the technology module "Fast controllers (6DL1138-6EB00-0EH1)"

Article number	6DL1138-6EB00-0EH1
• Output current per module, max.	2 A
Power loss	
Power loss, typ.	4 W
Address area	
Address space per module	
• Address space per module, max.	250 byte; Fast closed-loop control, small quantity structure: 82 bytes. Of which 43 bytes for inputs, 39 bytes for outputs. Fast closed-loop control and speed measurement: 94 bytes. Of which 55 bytes for inputs, 39 bytes for outputs. Fast closed-loop control and speed measurement, medium quantity structure: 146 bytes. Of which 85 bytes for inputs, 61 bytes for outputs. Fast closed-loop control and speed measurement, large quantity structure: 250 bytes. Of which 145 bytes for inputs, 105 bytes for outputs.
Hardware configuration	
Automatic encoding	
• Mechanical coding element	Yes; A, B coding; mounting position B8
Digital inputs	
Number of digital inputs	10; Of these, 6 combined DI/DQ
Digital inputs, parameterizable	Yes
Source/sink input	Yes; DI0 ... DI3 (param.); sinking DIDQ4 ... DIDQ9
Input characteristic curve in accordance with IEC 61131, type 1	Yes
Input characteristic curve in accordance with IEC 61131, type 2	No
Pulse extension	Yes
• Length	2 s; off, 50 ms, 100 ms, 200 ms, 500 ms, 1 s, 2 s
Input voltage	
• Rated value (DC)	24 V
• for signal "0"	0 ... 5 V
• for signal "1"	+11 to +30V
Input current	
• for signal "1", typ.	2.6 mA; 2.6 mA DI, 3.5 mA DIDQ
Input delay (for rated value of input voltage) for standard inputs	
– parameterizable	Yes; 0.05 / 0.1 / 0.4 / 0.8 / 1.6 / 3.2 / 12.8 / 20 ms (in each case + delay of 30 to 500 µs, depending on line length)
Cable length	
• shielded, max.	1 000 m
Digital outputs	
Number of digital outputs	6; max. depending on parameterization
Current-sinking	No
Current-sourcing	Yes

8.3 Technical specifications of the technology module "Fast controllers (6DL1138-6EB00-0EH1)"

Article number	6DL1138-6EB00-0EH1
Short-circuit protection	Yes
• Response threshold, typ.	0.95 A
Open-circuit detection	Yes
• Response threshold, typ.	45 mA
Overload protection	Yes
• Response threshold, typ.	950 mA
Limitation of inductive shutdown voltage to	L+ -(37 to 41V)
Controlling a digital input	Yes
Switching capacity of the outputs	
• with resistive load, max.	0.5 A
Load resistance range	
• lower limit	48 Ω
Output voltage	
• for signal "1", min.	18.1 V
Output current	
• for signal "1" rated value	0.5 A
Output delay with resistive load	
• "0" to "1", typ.	1 ms
• "1" to "0", typ.	100 μs
Parallel switching of two outputs	
• for logic links	No
• for uprating	No
• for redundant control of a load	Yes
Switching frequency	
• with resistive load, max.	800 Hz
Total current of the outputs	
• Current per channel, max.	0.5 A
• Current per module, max.	2 A
Cable length	
• shielded, max.	1 000 m
Analog inputs	
Number of analog inputs	4
permissible input voltage for voltage input (destruction limit), max.	30 V
permissible input current for current input (destruction limit), max.	50 mA; Protection available against destruction
Cycle time (all channels), min.	625 μs
Input ranges	
• Voltage	Yes; 0 ... 10 V, -10 ... 10 V, 0 ... 20 V, -20 ... 0 V
• Current	Yes; 0 ... 20 mA, 4 ... 20 mA, -20 ... 20 mA, -30 ... 30 mA, -20 ... 0 mA
Input ranges (rated values), voltages	
• 0 to +10 V	Yes

8.3 Technical specifications of the technology module "Fast controllers (6DL1138-6EB00-0EH1)"

Article number	6DL1138-6EB00-0EH1
<ul style="list-style-type: none"> – Input resistance (0 to 10 V) 	100 kΩ
<ul style="list-style-type: none"> • -10 V to +10 V 	Yes
<ul style="list-style-type: none"> – Input resistance (-10 V to +10 V) 	100 kΩ
Input ranges (rated values), currents	
<ul style="list-style-type: none"> • 0 to 20 mA 	Yes; 0 mA or 4 mA to 20 mA
<ul style="list-style-type: none"> – Input resistance (0 to 20 mA) 	70 Ω
<ul style="list-style-type: none"> • -20 mA to +20 mA 	Yes
<ul style="list-style-type: none"> – Input resistance (-20 mA to +20 mA) 	70 Ω
<ul style="list-style-type: none"> • 4 mA to 20 mA 	Yes; and 0 to 20 mA
<ul style="list-style-type: none"> – Input resistance (4 mA to 20 mA) 	70 Ω
Cable length	
<ul style="list-style-type: none"> • shielded, max. 	600 m
Analog outputs	
Number of analog outputs	8; 4 AQ-I, 4 AQ-U
Voltage output, short-circuit protection	Yes; per channel, electronic to chassis
Voltage output, short-circuit current, max.	10 mA
Current output, no-load voltage, max.	24 V
Cycle time (all channels), min.	625 μs
Current signal at analog output	Yes; -50 ... 50 mA
Output ranges, voltage	
<ul style="list-style-type: none"> • -10 V to +10 V 	Yes
Output ranges, current	
<ul style="list-style-type: none"> • 0 to 20 mA 	Yes
<ul style="list-style-type: none"> • -20 mA to +20 mA 	Yes; ±30 mA, ±50 mA
<ul style="list-style-type: none"> • 4 mA to 20 mA 	Yes
Connection of actuators	
<ul style="list-style-type: none"> • for voltage output two-wire connection 	Yes
Load impedance (in rated range of output)	
<ul style="list-style-type: none"> • with current outputs, max. 	330 Ω; 150 ohms at ±50 mA
Analog value generation for the inputs	
Measurement principle	integrating (Sigma-Delta)
Integration and conversion time/resolution per channel	
<ul style="list-style-type: none"> • Resolution with overrange (bit including sign), max. 	24 bit
Smoothing of measured values	
<ul style="list-style-type: none"> • parameterizable 	Yes
<ul style="list-style-type: none"> • Step: None 	Yes
<ul style="list-style-type: none"> • Step: low 	Yes
<ul style="list-style-type: none"> • Step: Medium 	Yes
<ul style="list-style-type: none"> • Step: High 	Yes
Analog value generation for the outputs	

8.3 Technical specifications of the technology module "Fast controllers (6DL1138-6EB00-0EH1)"

Article number	6DL1138-6EB00-0EH1
Integration and conversion time/resolution per channel	
<ul style="list-style-type: none"> Resolution with overrange (bit including sign), max. 	16 bit
Encoder	
Connection of signal encoders	
<ul style="list-style-type: none"> for voltage measurement 	Yes
<ul style="list-style-type: none"> for current measurement as 2-wire transducer 	Yes
Connectable encoders	
<ul style="list-style-type: none"> Single contact / changeover contact unconnected 	Yes
<ul style="list-style-type: none"> 2-wire sensor 	Yes
<ul style="list-style-type: none"> – permissible quiescent current (2-wire sensor), max. 	1.5 mA
Errors/accuracies	
Linearity error (relative to input range), (+/-)	0.05 %
Temperature error (relative to input range), (+/-)	0.0025 %/K
Crosstalk between the inputs, min.	60 dB
Operational error limit in overall temperature range	
<ul style="list-style-type: none"> Voltage, relative to input range, (+/-) 	0.3 %
<ul style="list-style-type: none"> Current, relative to input range, (+/-) 	0.3 %
Interrupts/diagnostics/status information	
Diagnostics function	Yes
Substitute values connectable	Yes
Alarms	
<ul style="list-style-type: none"> Diagnostic alarm 	Yes
Diagnoses	
<ul style="list-style-type: none"> Monitoring the supply voltage 	Yes
<ul style="list-style-type: none"> Wire-break 	Yes; AI 4 ... 20 mA, AQ, DQ, DI 0 ... 3
<ul style="list-style-type: none"> Short-circuit to M 	Yes; Encoder supply to M, channel by channel
<ul style="list-style-type: none"> Short-circuit to L+ 	Yes; Analog inputs
<ul style="list-style-type: none"> Group error 	Yes
<ul style="list-style-type: none"> Overflow/underflow 	Yes
Diagnostics indication LED	
<ul style="list-style-type: none"> RUN LED 	Yes; green LED
<ul style="list-style-type: none"> MAINT LED 	Yes; Yellow LED
<ul style="list-style-type: none"> Monitoring of the supply voltage (PWR-LED) 	Yes; green PWR LED
<ul style="list-style-type: none"> for module diagnostics 	Yes; green/red DIAG LED
Integrated Functions	
Frequency measurement	Yes; Speed measurement
Measuring functions	

8.3 Technical specifications of the technology module "Fast controllers (6DL1138-6EB00-0EH1)"

Article number	6DL1138-6EB00-0EH1
• Dynamic measurement period adjustment	Yes; Speed measurement
Measuring range	
– Frequency measurement, min.	0.1 Hz
– Frequency measurement, max.	70 kHz; 70 kHz for DI; 7 kHz for DI/DQ; each for P/M encoder and 50 m cable length; 10 kHz for DI; 0.7 kHz for DI/DQ; each for P encoder and 50 m cable length
Potential separation	
Potential separation channels	
• between the channels and backplane bus	Yes
Permissible potential difference	
between different circuits	75 V DC/60 V AC between L+ and backplane bus
Isolation	
Isolation tested with	1 500 V DC/1 min, type test
Ambient conditions	
Ambient temperature during operation	
• horizontal installation, min.	-40 °C
• horizontal installation, max.	70 °C; Observe derating
• vertical installation, min.	-40 °C
• vertical installation, max.	60 °C
Altitude during operation relating to sea level	
• Installation altitude above sea level, max.	3 500 m
Dimensions	
Width	22.5 mm
Height	115 mm
Depth	138 mm
Weights	
Weight, approx.	200 g

Derating

Horizontal mounting position

The following tables show the deratings that must be observed for the inputs and outputs AI, AO, DI, DO:

IO type	Quantity	Nominal ranges	Up to 70 °C	Up to 60 °C
AI	4	± 30 mA	± 20 mA	± 30 mA
AQ ²	4	± 50 mA	± 50 mA (total 80 mA)	± 50 mA (total 120 mA) ¹
DI	4/10	2.5 mA	Total 5 mA	Total 10 mA
DIDQ	6	500 mA (total 2 A)	Total 0.3 A	Total 1 A

¹ 200 mA peak for 10 s and duty cycle < 10 %

² Minimal burden AQ 10 Ohms

Vertical mounting position

The following tables show the deratings that must be observed for the inputs and outputs AI, AO, DI, DO:

IO type	Quantity	Nominal ranges	Up to 60 °C	Up to 50 °C
AI	4	± 30 mA	± 20 mA	± 30 mA
AQ ²	4	± 50 mA	± 50 mA (total 80 mA)	± 50 mA (total 120 mA) ¹
DI	4/10	2.5 mA	Total 5 mA	Total 10 mA
DIDQ	6	500 mA (total 2 A)	Total 0.3 A	Total 1 A

¹ 200 mA peak for 10 s and duty cycle < 10 %

² Minimal burden AQ 10 Ohms

Cycle time

The cycle time describes the period in which the hardware signals are acquired, processed and made available at the PROFINET, and the outputs controlled. The cycle time depends on the configured version.

- Configuration 4: Fast input and output, fast controllers small process image
8 ms
- Configuration 5: Fast input and output, speed measurement, fast controllers small process image
8 ms
- Configuration 6: Fast input and output, speed measurement, fast controllers medium process image
8 ms
- Configuration 7: Fast input and output, speed measurement, fast controllers large process image
16 ms

Channel-specific parameter assignments such as smoothing, input delay, and pulse stretching must be observed.

The configured cycle time of the execution system applies to signals that are processed directly on the module by the module-internal execution system (setting range 0.625 ms to 20 ms).

Redundancy failover time

Analog outputs AQ 0... AQ 3

In IO redundancy mode, both I/O modules output half the specified current.

8.3 Technical specifications of the technology module "Fast controllers (6DL1138-6EB00-0EH1)"

If one I/O module fails, failover to the partner module occurs and the partner module outputs the full current. The maximum changeover time (signal failure) for the analog outputs is 2 ms.

Note

Detection of AQ-related hardware errors

The detection of AQ-related hardware errors (deviation/wire break) takes 25 ms and thus extends the signal dip accordingly.

Analog outputs BUF 0... BUF 3

In IO redundancy mode, the voltage outputs are only output by the active I/O module.

If one I/O module fails, failover to the partner module occurs and the activated module outputs the voltage outputs. The maximum changeover time (signal failure) for the voltage outputs is 10 ms.

Digital outputs DIDQ 4... DIDQ 9

In IO redundancy mode, the digital outputs are only output by the active I/O module.

If one I/O module fails, failover to the partner module occurs and the activated module outputs the digital outputs. The maximum changeover time (signal failure) for the digital outputs is 10 ms.

8.4 Technical specifications of the technology module "Vibration protection (6DL1138-6EC00-0EH1)"

Article number	6DL1138-6EC00-0EH1
General information	
Product type designation	Vibration protection module 4 channels
HW functional status	FS04
Firmware version	V1.2
• FW update possible	Yes
Usable terminal block	TB type H1 and N0
Color code for module-specific color identification plate	CC00
Product function	
• I&M data	Yes; I&M0 to I&M3
• Isochronous mode	No
Engineering with	
• STEP 7 configurable/integrated from version	V5.6 with HSP 298 or higher
• PCS 7 configurable/integrated from version	V9.1 SP1
• SPPA-T3000 can be configured/integrated from version	V8.2 SP2
Operating mode	
• DI	Yes
• DQ	Yes
CiR - Configuration in RUN	
Reparameterization possible in RUN	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 (rated value)	150 mA; without load
Current consumption, max.	2 A; At 24 V DC
from backplane bus 24 V DC, max.	21 mA
Encoder supply	
Number of outputs	6; max. depending on parameterization
Output voltage (DC)	24 V
Output voltage, min.	18.2 V
Short-circuit protection	Yes; per channel, electronic
24 V encoder supply	
• 24 V	Yes
• Short-circuit protection	Yes; per channel, electronic
• Output current per channel, max.	0.5 A
• Output current per module, max.	2 A

8.4 Technical specifications of the technology module "Vibration protection (6DL1138-6EC00-0EH1)"

Article number	6DL1138-6EC00-0EH1
Power loss	
Power loss, typ.	4 W
Address area	
Address space per module	
<ul style="list-style-type: none"> Address space per module, max. 	162 byte; Quick inputs and outputs (without AI) and 4 vibration protection function chains: 88 bytes. Of which 71 bytes for inputs, 17 bytes for outputs. Quick inputs and outputs (without AI) and 8 vibration protection function chains: 154 bytes. Of which 137 bytes for inputs, 17 bytes for outputs. Quick inputs and outputs (with AI) and 4 vibration protection function chains 96 bytes. Of which 79 bytes for inputs, 17 bytes for outputs. Quick inputs and outputs (with AI) and 8 vibration protection function chains: 162 bytes. Of which 145 bytes for inputs, 17 bytes for outputs.
Hardware configuration	
Automatic encoding	
<ul style="list-style-type: none"> Mechanical coding element 	Yes; A, B coding; mounting position B8
Digital inputs	
Number of digital inputs	10; Of these, 6 combined DI/DQ
Digital inputs, parameterizable	Yes
Source/sink input	Yes; DI0 ... DI3 (param.); sinking DIDQ4 ... DIDQ9
Input characteristic curve in accordance with IEC 61131, type 1	Yes
Pulse extension	Yes
<ul style="list-style-type: none"> Length 	2 s; off, 50 ms, 100 ms, 200 ms, 500 ms, 1 s, 2 s
Input voltage	
<ul style="list-style-type: none"> Rated value (DC) 	24 V
<ul style="list-style-type: none"> for signal "0" 	0 ... 5 V
<ul style="list-style-type: none"> for signal "1" 	+11 to +30V
Input current	
<ul style="list-style-type: none"> for signal "1", typ. 	2.6 mA; 2.6 mA DI, 3.5 mA DIDQ
Input delay (for rated value of input voltage) for standard inputs	
<ul style="list-style-type: none"> parameterizable 	Yes; 0.05 / 0.1 / 0.4 / 0.8 / 1.6 / 3.2 / 12.8 / 20 ms (in each case + delay of 30 to 500 µs, depending on line length)
Cable length	
<ul style="list-style-type: none"> shielded, max. 	1 000 m
Digital outputs	
Number of digital outputs	6; max. depending on parameterization
Current-sinking	No
Current-sourcing	Yes
Short-circuit protection	Yes
<ul style="list-style-type: none"> Response threshold, typ. 	0.95 A

8.4 Technical specifications of the technology module "Vibration protection (6DL1138-6EC00-0EH1)"

Article number	6DL1138-6EC00-0EH1
Open-circuit detection	Yes
• Response threshold, typ.	45 mA
Overload protection	Yes
• Response threshold, typ.	950 mA
Limitation of inductive shutdown voltage to	L+ -(37 to 41V)
Controlling a digital input	Yes
Digital output functions, parameterizable	
• Freely usable digital output	Yes
Switching capacity of the outputs	
• with resistive load, max.	0.5 A
Load resistance range	
• lower limit	48 Ω
Output voltage	
• for signal "1", min.	18.1 V
Output current	
• for signal "1" rated value	0.5 A
Output delay with resistive load	
• "0" to "1", typ.	1 ms
• "1" to "0", typ.	100 μs
Switching frequency	
• with resistive load, max.	800 Hz
Total current of the outputs	
• Current per channel, max.	0.5 A
• Current per module, max.	2 A
Cable length	
• shielded, max.	1 000 m
Analog inputs	
Number of analog inputs	4
permissible input voltage for voltage input (destruction limit), max.	30 V
permissible input current for current input (destruction limit), max.	50 mA; Protection available against destruction
Cycle time (all channels), min.	1.25 ms; For up to 128 samples per channel
Input ranges	
• Voltage	Yes; 0 ... 10 V, -10 ... 10 V, 0 ... 20 V, -20 ... 0 V
• Current	Yes; 0 ... 20 mA, 4 ... 20 mA, -20 ... 20 mA, -30 ... 30 mA, -20 ... 0 mA
Input ranges (rated values), voltages	
• 0 to +10 V	Yes
– Input resistance (0 to 10 V)	100 kΩ
• -10 V to +10 V	Yes
– Input resistance (-10 V to +10 V)	100 kΩ
Input ranges (rated values), currents	

8.4 Technical specifications of the technology module "Vibration protection (6DL1138-6EC00-0EH1)"

Article number	6DL1138-6EC00-0EH1
<ul style="list-style-type: none"> 0 to 20 mA <ul style="list-style-type: none"> Input resistance (0 to 20 mA) -20 mA to +20 mA <ul style="list-style-type: none"> Input resistance (-20 mA to +20 mA) 4 mA to 20 mA <ul style="list-style-type: none"> Input resistance (4 mA to 20 mA) 	Yes; 0 mA or 4 mA to 20 mA 70 Ω Yes 70 Ω Yes; and 0 to 20 mA 70 Ω
Cable length	
<ul style="list-style-type: none"> shielded, max. 	600 m
Analog outputs	
Number of analog outputs	8; 4 AQ-I, 4 AQ-U
Voltage output, short-circuit protection	Yes; per channel, electronic to chassis
Voltage output, short-circuit current, max.	10 mA
Current output, no-load voltage, max.	24 V
Cycle time (all channels), min.	625 μs
Current signal at analog output	Yes; -50 ... 50 mA
Output ranges, voltage	
<ul style="list-style-type: none"> -10 V to +10 V 	Yes
Output ranges, current	
<ul style="list-style-type: none"> 0 to 20 mA -20 mA to +20 mA 4 mA to 20 mA 	Yes Yes; ±30 mA, ±50 mA Yes
Connection of actuators	
<ul style="list-style-type: none"> for voltage output two-wire connection 	Yes
Load impedance (in rated range of output)	
<ul style="list-style-type: none"> with current outputs, max. 	330 Ω; 150 ohms at ±50 mA
Analog value generation for the inputs	
Measurement principle	integrating (Sigma-Delta)
Integration and conversion time/resolution per channel	
<ul style="list-style-type: none"> Resolution with overrange (bit including sign), max. 	24 bit
Smoothing of measured values	
<ul style="list-style-type: none"> parameterizable Step: None Step: low Step: Medium Step: High 	Yes Yes Yes Yes Yes
Analog value generation for the outputs	
Integration and conversion time/resolution per channel	
<ul style="list-style-type: none"> Resolution with overrange (bit including sign), max. 	16 bit
Encoder	

8.4 Technical specifications of the technology module "Vibration protection (6DL1138-6EC00-0EH1)"

Article number	6DL1138-6EC00-0EH1
Connection of signal encoders	
• for voltage measurement	Yes
• for current measurement as 2-wire transducer	Yes
• for current measurement as 4-wire transducer	Yes
Connectable encoders	
• Single contact / changeover contact unconnected	Yes
• 2-wire sensor	Yes
– permissible quiescent current (2-wire sensor), max.	1.5 mA
Errors/accuracies	
Linearity error (relative to input range), (+/-)	0.05 %
Temperature error (relative to input range), (+/-)	0.0025 %/K
Crosstalk between the inputs, min.	60 dB
Operational error limit in overall temperature range	
• Voltage, relative to input range, (+/-)	0.3 %
• Current, relative to input range, (+/-)	0.3 %
Interrupts/diagnostics/status information	
Diagnostics function	Yes
Substitute values connectable	Yes
Alarms	
• Diagnostic alarm	Yes
Diagnoses	
• Monitoring the supply voltage	Yes
• Wire-break	Yes; AI 4 ... 20 mA, AQ, DQ, DI 0 ... 3
• Short-circuit to M	Yes; Encoder supply to M, channel by channel
• Short-circuit to L+	Yes; Analog inputs
• Group error	Yes
• Overflow/underflow	Yes
Diagnostics indication LED	
• RUN LED	Yes; green LED
• MAINT LED	Yes; Yellow LED
• Monitoring of the supply voltage (PWR-LED)	Yes; green PWR LED
• for module diagnostics	Yes; green/red DIAG LED
Potential separation	
Potential separation channels	
• between the channels and backplane bus	Yes
Permissible potential difference	
between different circuits	75 V DC/60 V AC between L+ and backplane bus
Isolation	

8.4 Technical specifications of the technology module "Vibration protection (6DL1138-6EC00-0EH1)"

Article number	6DL1138-6EC00-0EH1
Isolation tested with	1 500 V DC/1 min, type test
Ambient conditions	
Ambient temperature during operation	
• horizontal installation, min.	-40 °C
• horizontal installation, max.	70 °C; Observe derating
• vertical installation, min.	-40 °C
• vertical installation, max.	60 °C
Altitude during operation relating to sea level	
• Installation altitude above sea level, max.	3 500 m
Dimensions	
Width	22.5 mm
Height	115 mm
Depth	138 mm
Weights	
Weight, approx.	200 g

Derating

Horizontal mounting position

The following tables show the deratings that must be observed for the inputs and outputs AI, AO, DI, DO:

IO type	Quantity	Nominal ranges	Up to 70 °C	Up to 60 °C
AI	4	± 30 mA	± 20 mA	± 30 mA
AQ ²	4	± 50 mA	± 50 mA (total 80 mA)	± 50 mA (total 120 mA) ¹
DI	4/10	2.5 mA	Total 5 mA	Total 10 mA
DIDQ	6	500 mA (total 2 A)	Total 0.3 A	Total 1 A

¹ 200 mA peak for 10 s and duty cycle < 10 %

² Minimal burden AQ 10 Ohms

Vertical mounting position

The following tables show the deratings that must be observed for the inputs and outputs AI, AO, DI, DO:

IO type	Quantity	Nominal ranges	Up to 60 °C	Up to 50 °C
AI	4	± 30 mA	± 20 mA	± 30 mA
AQ ²	4	± 50 mA	± 50 mA (total 80 mA)	± 50 mA (total 120 mA) ¹

8.4 Technical specifications of the technology module "Vibration protection (6DL1138-6EC00-0EH1)"

IO type	Quantity	Nominal ranges	Up to 60 °C	Up to 50 °C
DI	4/10	2.5 mA	Total 5 mA	Total 10 mA
DIDQ	6	500 mA (total 2 A)	Total 0.3 A	Total 1 A

¹ 200 mA peak for 10 s and duty cycle < 10 %

² Minimal burden AQ 10 Ohms

Cycle time

The cycle time describes the period in which the hardware signals are acquired, processed and made available at the PROFINET, and the outputs controlled. The cycle time depends on the configured version.

- Configuration 8: Fast input and output (without AI) and 4 vibration protection function chains
8 ms
- Configuration 9: Fast input and output (without AI) and 8 vibration protection function chains
16 ms
- Configuration 10: Fast input and output and 4 vibration protection function chains
8 ms
- Configuration 11: Fast input and output and 8 vibration protection function chains
16 ms

Channel-specific parameter assignments such as smoothing, input delay, and pulse stretching must be observed.

Drivers, parameters, diagnostics messages and address space

A

A.1 Concept of the driver and diagnostics blocks

Tasks of the driver and diagnostic blocks (driver blocks)

In process control systems, certain demands are placed on the diagnostics/signal processing. This includes the monitoring of modules as well as the I/O bus systems for malfunctions and failures.

To enable this, blocks are available in the system library that implement the interface to the hardware including test functions.

These blocks perform two basic tasks:

- They provide signals from the process to the AS for further processing.
- They monitor modules as well as I/O systems for failure.

When the process signals are read in, these blocks access the process image input (or process image partition) (PII) and when the process signals are output, they access the process image output (or process image partition) (PIQ).

Concept

The concept of the driver and diagnostics blocks is characterized by the following:

- The separation between user data processing (CHANNEL blocks) and diagnostic data processing (MODULE blocks)
- The symbolic addressing of the I/O signals
- The automatic generation of the MODULE blocks by CFC

This block concept supports all modules from the list of approved modules.

When new Siemens or non-Siemens module types are integrated, the meta-knowledge for the driver generator can be extended by additional XML files (object and action lists).

Note

Note the following:

- The library with the driver blocks has to be installed using the Setup program on the PC. This is the only method of ensuring that the meta-knowledge required for the driver generator is available. You must not copy the library from another computer.
 - You can also use driver blocks from another library (for example, your own blocks from your own library). You can specify this additional library in the "Generate module drivers" dialog box. The driver generator then searches for the block to be imported in the library specified here. If the block is not found here, it is searched for in the library specified in the control file (XML file).
-

Time-optimized processing

To enable time-optimized processing during runtime, the organization blocks for error handling (for example, OB85, OB86) are automatically divided into runtime groups and the driver blocks are integrated in the corresponding runtime groups.

If an error occurs, the SUBNET block, for example, activates the relevant runtime group, the RACK block or MODULE block contained in the runtime group detects the error, evaluates it and outputs a process control message to the OS.

The diagnostics information of the module block (OMODE_xx output) is also transferred to the corresponding CHANNEL block (MODE input). If necessary, this information can be displayed using a system block that can be operated and monitored on the OS or through a user block in a process picture (color change of the measured value or flashing display, etc.).

A.2 Parameter assignment

Parameter assignment in the user program

You can reconfigure individual channels of the module in RUN without this having an effect on the other channels.

You can also, for example, change the configuration of individual channels in RUN from digital input to digital output without affecting other channels.

Changing parameters in RUN

In the STEP 7 environment, the parameters are transferred to the module with the "WRREC" instruction.

- Module/channel parameters via data records 128 and 129
The structure of data record 128 is the same for all modules and configured versions.
Data record 129 is different.
- The TM application software is loaded via data record 79.

The parameters assigned with STEP 7 are not changed permanently in the CPU, which means the parameters assigned with STEP 7 are valid again after a restart.

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.

The STATUS output parameter is 4 bytes long and is configured as followed:

- Byte1: Function_Num, general error code
- Byte2: Error_DeCode, location of the error code
- Byte3: Error_Code_1, error code
- Byte4: Error_Code_2, manufacturer-specific extension of the error code

Module-specific errors are displayed via Error_Decode = 0x80 and Error_Code_1 / Error_Code_2.

Er-ror_ Code _1	Er-ror_ Code _2	Cause	Solution	IO type
0xB0	0x00	Number of the data record unknown	Enter valid number for data record.	
0xB1	0x01	Length of the data record is incorrect	Enter valid value for data record length.	
0xB2	Variable	Module cannot be reached	<ul style="list-style-type: none"> • Check station - is the module plugged in correctly? • Check the parameters of the WRREC instruction. 	
0xE0	0x01	Wrong version in header	Correct the version number of the parameter block.	
0xE0	0x02	Header error (number or length of parameter block)	Correct the length and number of the parameter blocks.	

A.2 Parameter assignment

Er- ror_ Code _1	Er- ror_ Code _2	Cause	Solution	IO type
0xE1	0x01	Reserved bit set	Check and correct the parameters	DIDQ, DI
0xE1	0x02	Invalid diagnostics enable bit set for operating mode		DIDQ, DI, AI
0xE1	0x07	Invalid coding for input delay		DIDQ, DI
0xE1	0x0B	Invalid coding for pulse stretching		DIDQ, DI
0xE1	0x20	Invalid coding CPU-STOP for DIDQ		DIDQ
0xE1	0x12	Invalid coding for Sampling Frequency		AI
0xE1	0x08	Invalid coding for interference frequency suppression / integration time		AI
0xE1	0x09	Invalid coding for smoothing		AI
0xE1	0x10	Invalid measurement type / output type		DI, DIDQ, AI, AQ
0xE1	0x11	Invalid measuring range / output area		AI, AQ, BUF
0xE1	0x21	Invalid coding Physical Unit		AI
0xE1	0x22	Invalid coding AQ Deviation		AQ
0xE1	0x23	Invalid operating mode Counter/Measuring Function		CNT
0xE1	0x24	Invalid coding Counter Mode		CNT
0xE1	0x25	Invalid encoding encoder type		CNT, SPEED
0xE1	0x26	Invalid signal Evaluation Coding		CNT
0xE1	0x27	Invalid coding Main Count Direction		CNT
0xE1	0x28	Invalid coding Gate Control		CNT
0xE1	0x29	Invalid coding Comparison Function COMP1		CNT
0xE1	0x2A	Invalid coding Comparison Function COMP2		CNT
0xE1	0x2B	Pulse duration parameter outside the valid range		CNT
0xE1	0x2C	Hysteresis comparison function parameter outside the valid range		CNT
0xE1	0x2D	Invalid operating mode Speed Measurement		SPEED
0xE1	0x2E	Update time parameter outside the valid range		SPEED
0xE1	0x2F	Pulses per encoder revolution parameter outside the valid range		SPEED
0xE1	0x30	Input filter parameter outside the valid range		SPEED
0xE1	0x31	Invalid function chains type		VIB
0xE1	0x32	Invalid AI channel number		VIB
0xE1	0x33	Invalid high pass filter cut-off frequency		VIB
0xE1	0x34	Invalid high pass filter slope		VIB
0xE1	0x35	Invalid low pass filter cut-off frequency		VIB
0xE1	0x36	Invalid low pass filter slope		VIB
0xE1	0x37	Invalid integration level		VIB
0xE1	0x38	Invalid detector type		VIB
0xE1	0x39	Invalid drop-out time		VIB

Er- ror_ Code _1	Er- ror_ Code _2	Cause	Solution	IO type
0xE1	0x3A	Invalid unit		VIB
0xE1	0x3B	High pass filter cutoff frequency 1 and 2 different		VIB
0xE1	0x3C	High pass filter slope 1 and 2 different		VIB
0xE1	0x3D	Low pass filter corner frequency 1 and 2 different		VIB
0xE1	0x3E	Low pass filter slope 1 and 2 different		VIB
0xE1	0x3F	Invalid sensor angle difference		VIB
0xE1	0x40	Detector units 1 and 2 different		VIB
0xE1	0x41	Invalid averaging time		VIB
0xE1	0x42	Invalid offset		VIB
0xE1	0x43	Invalid scaling factor		VIB
0xE1	0x44	Invalid RSE mode		VIB
0xE1	0x45	"Inverted" parameter outside the valid range		VIB
0xE1	0x46	Invalid reference value		VIB
0xE1	0x47	Invalid averaging method		VIB
0xE1	0x48	Invalid counter		VIB
0xE1	0x49	Invalid divisor		VIB
0xE1	0x4A	Sign parameter outside the valid range		VIB
0xE1	0x4B	Harmonic parameter outside the valid range		VIB

Valid parameters

Only the values specified in the following are permitted. Values that are not listed are rejected by the module.

Each parameter data record is checked by the technology module. If an incorrect parameter is detected, the entire data record is rejected and the parameters of the module remain unchanged.

A.3 Parameter assignment and structure of the module and channel parameters

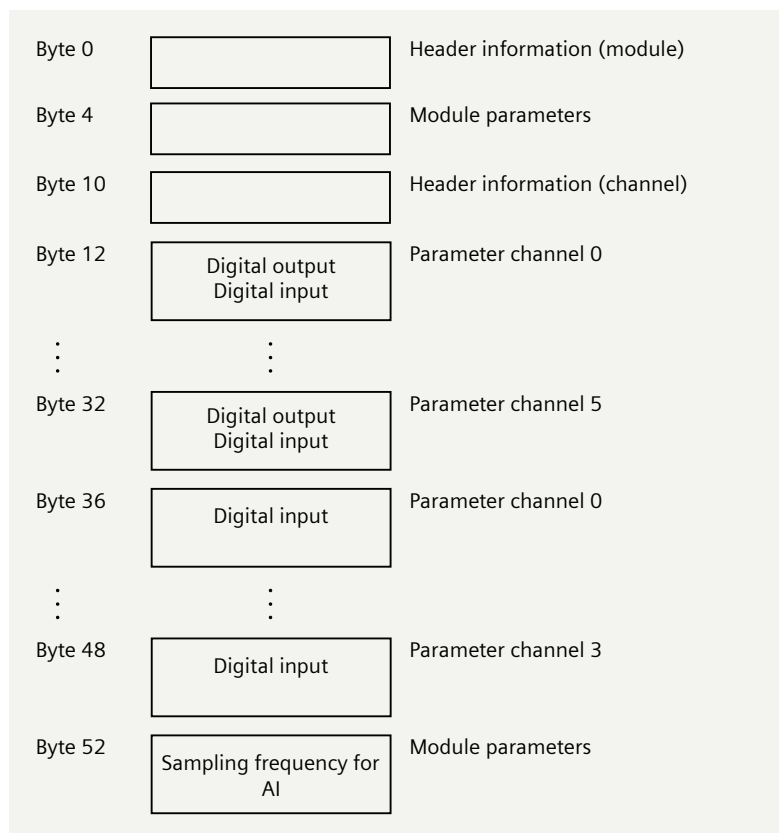
Structure of data record 128

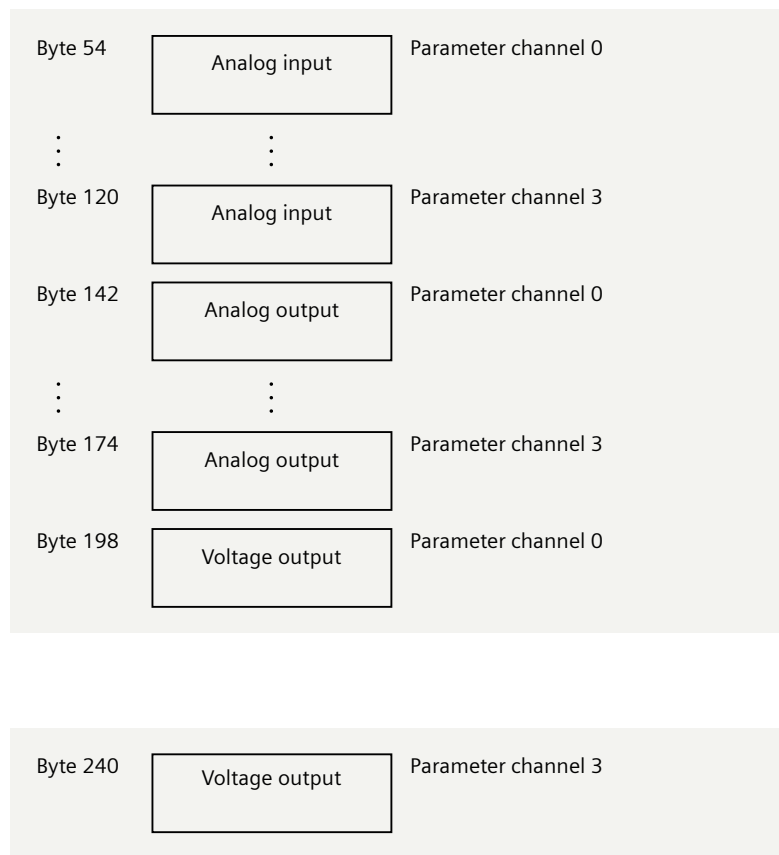
Data record 128 has a fixed length and the structure is identical for all modules and their configurations.

The data record is divided into the following main components:

- Header information (module), module parameters, header information (channel)
- Channel parameters (channel or technology parameters)
The channel or technology parameters are divided into parameters that affect the actual signal acquisition or settings and diagnostics enables.

Parameter structure





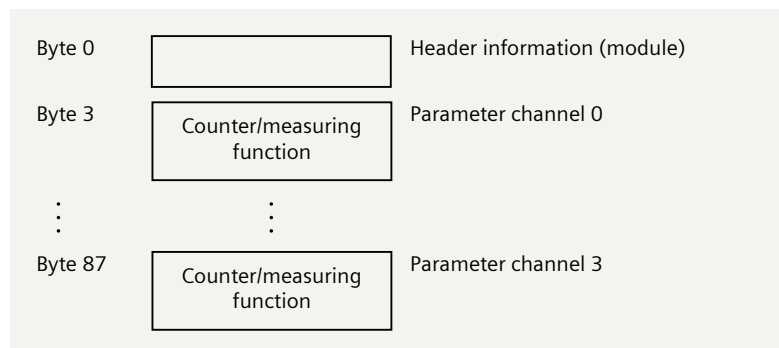
Structure of data record 129

Data record 129 is variable in length and therefore different for the respective configurations.

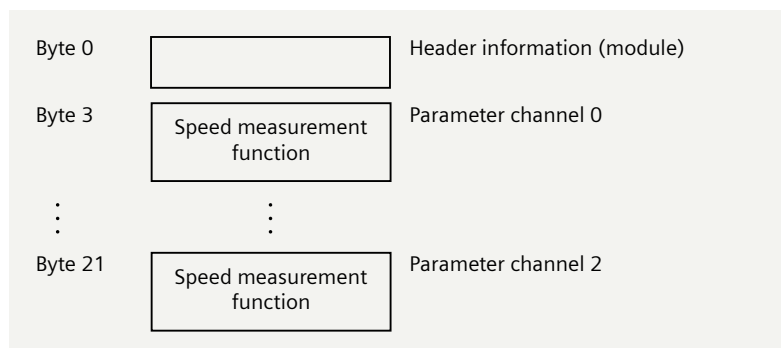
The data record is divided into the following main components:

- Header information (module), module parameters, header information (channel)
- Channel parameters (channel or technology parameters)
The channel or technology parameters are divided into parameters that affect the actual signal acquisition or settings and diagnostics enables.

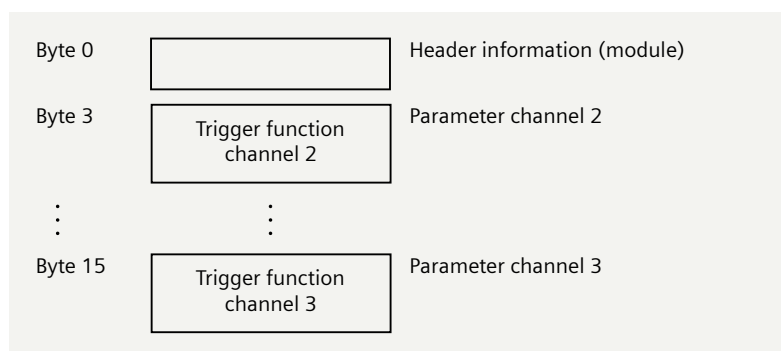
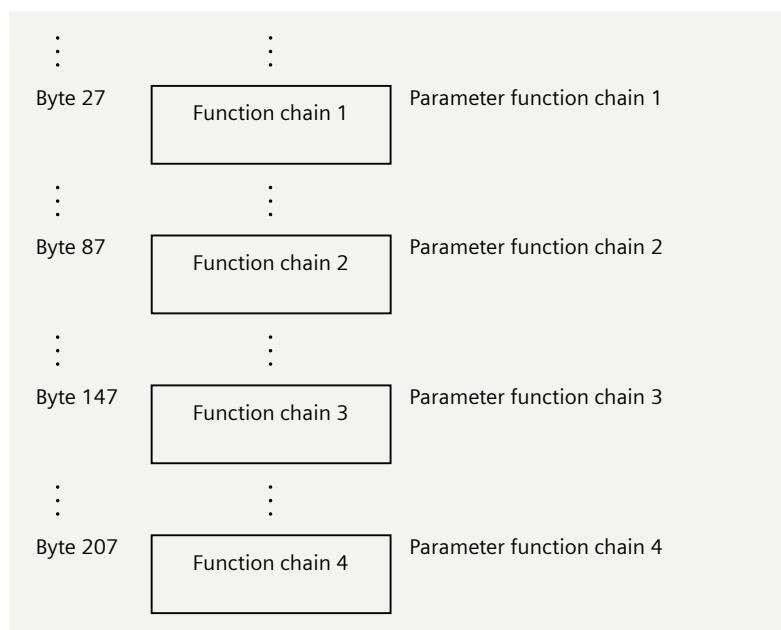
Parameter structure TM FIO & Counter; configuration 2

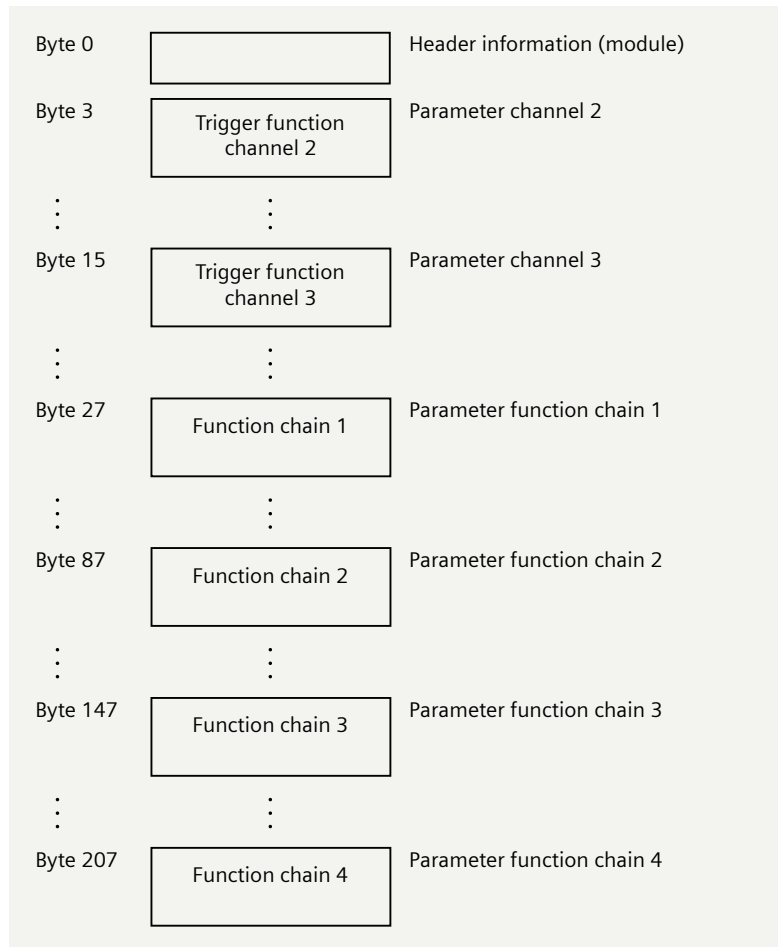


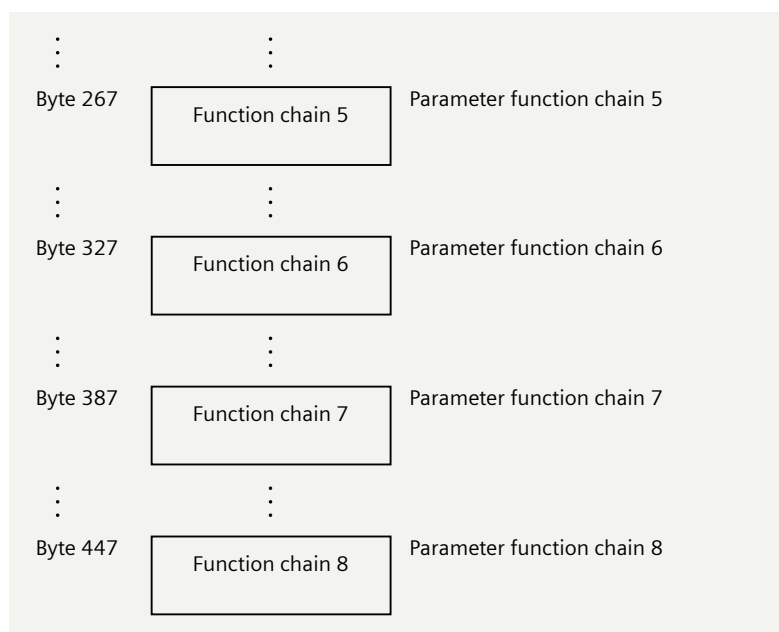
Parameter structure TM FIO & Counter; configuration 3 and TM Contr; configurations 5, 6 and 7



Parameter structure TM VibProt; configurations 8 and 10



Parameter structure TM VibProt; configurations 9 and 11



A.4 Structure of the module and channel parameter blocks of data record 128

This section shows the following information on the structure of the parameter blocks:

- Header information and module parameters
- Channel or technology parameters
 - Length of channel or technology parameters
 - Start of channel parameters
 - Channel parameters digital input/digital output
 - Channel parameters of the digital input
 - Channel parameters of the analog input
 - Channel parameters analog output
 - Channel parameters voltage output

The figures below show the configuration-specific structure of the respective parameters.

All unused bits and the bits or bytes marked as "reserved" must be set to zero.
You activate a channel parameter by setting the corresponding bit to "1" or the corresponding value.

Header information and module parameters

The following figure shows the structure of the header information and module parameters.

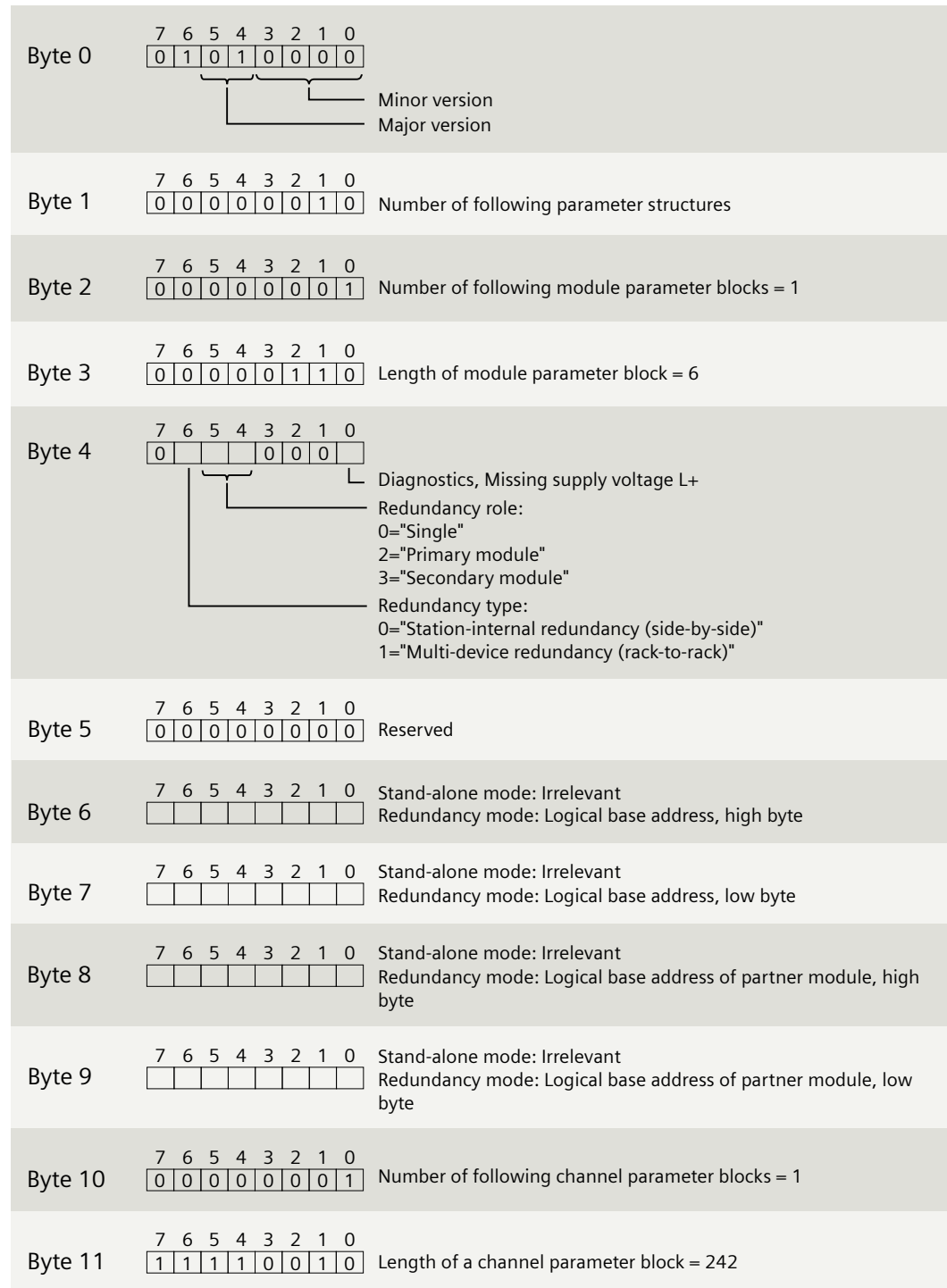
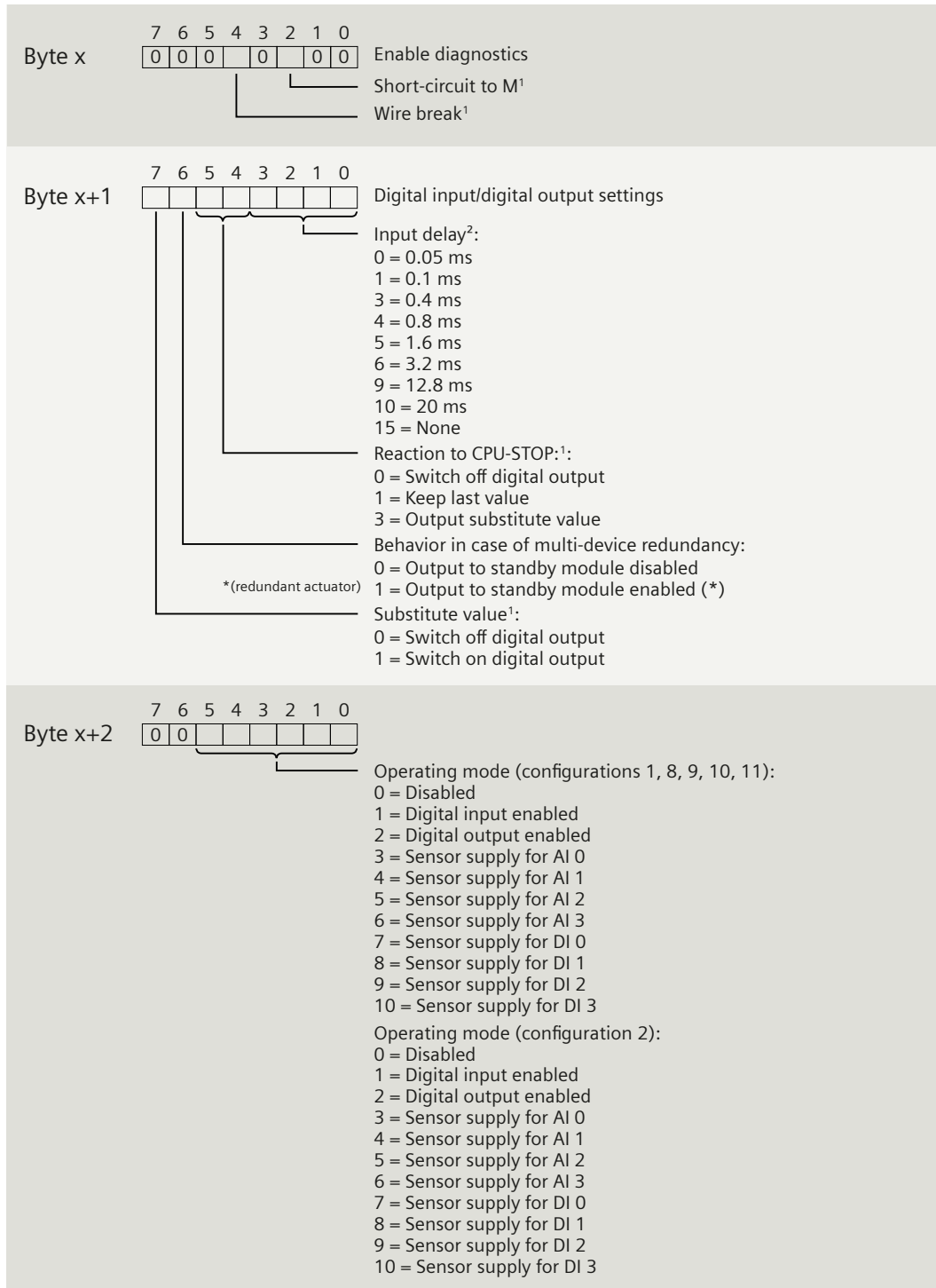


Figure A-1 Data record 128: Header information and module parameters

Channel parameters digital input/digital output



A.4 Structure of the module and channel parameter blocks of data record 128

11 = Pulse generator signal A (counter/measuring function 1)
 12 = Pulse generator signal B (counter/measuring function 1)
 13 = Pulse generator signal N (counter/measuring function 1)
 14 = HW gate start (counter/measuring function 1)
 15 = HW gate stop (counter/measuring function 1)
 16 = Set HW signal (counter 1)
 17 = Pulse generator signal A (counter/measuring function 2)
 18 = Pulse generator signal B (counter/measuring function 2)
 19 = Pulse generator signal N (counter/measuring function 2)
 20 = HW gate start (counter/measuring function 2)
 21 = HW gate stop (counter/measuring function 2)
 22 = Set HW signal (counter 2)
 23 = Pulse generator signal A (counter/measuring function 3)
 24 = Pulse generator signal B (counter/measuring function 3)
 25 = Pulse generator signal N (counter/measuring function 3)
 26 = HW gate start (counter/measuring function 3)
 27 = HW gate stop (counter/measuring function 3)
 28 = Set HW signal (counter 3)
 29 = Pulse generator signal A (counter/measuring function 4)
 30 = Pulse generator signal B (counter/measuring function 4)
 31 = Pulse generator signal N (counter/measuring function 4)
 32 = HW gate start (counter/measuring function 4)
 33 = HW gate stop (counter/measuring function 4)
 34 = Set HW signal (counter 4)
 35 = Sensor supply (counter/measuring function 1)
 36 = Digital output 0 (counter/measuring function 1)
 37 = Digital output 1 (counter 1)
 38 = Sensor supply (counter/measuring function 2)
 39 = Digital output 0 (counter/measuring function 2)
 40 = Digital output 1 (counter 2)
 41 = Sensor supply (counter/measuring function 3)
 42 = Digital output 0 (counter/measuring function 3)
 43 = Digital output 1 (counter 3)
 44 = Sensor supply (counter/measuring function 4)
 45 = Digital output 0 (counter/measuring function 4)
 46 = Digital output 1 (counter 4)

Operating mode (configuration 3):

0 = Disabled
 1 = Digital input enabled
 2 = Digital output enabled
 3 = Sensor supply for AI 0
 4 = Sensor supply for AI 1
 5 = Sensor supply for AI 2
 6 = Sensor supply for AI 3
 7 = Sensor supply for DI 0
 8 = Sensor supply for DI 1
 9 = Sensor supply for DI 2
 10 = Sensor supply for DI 3
 11 = Pulse generator signal A (speed measurement 1)
 12 = Pulse generator signal B (speed measurement 1)
 17 = Pulse generator signal A (speed measurement 2)
 18 = Pulse generator signal B (speed measurement 2)
 23 = Pulse generator signal A (speed measurement 3)
 24 = Pulse generator signal B (speed measurement 3)
 35 = Sensor supply (speed measurement 1)
 38 = Sensor supply (speed measurement 2)
 41 = Sensor supply (speed measurement 3)

A.4 Structure of the module and channel parameter blocks of data record 128

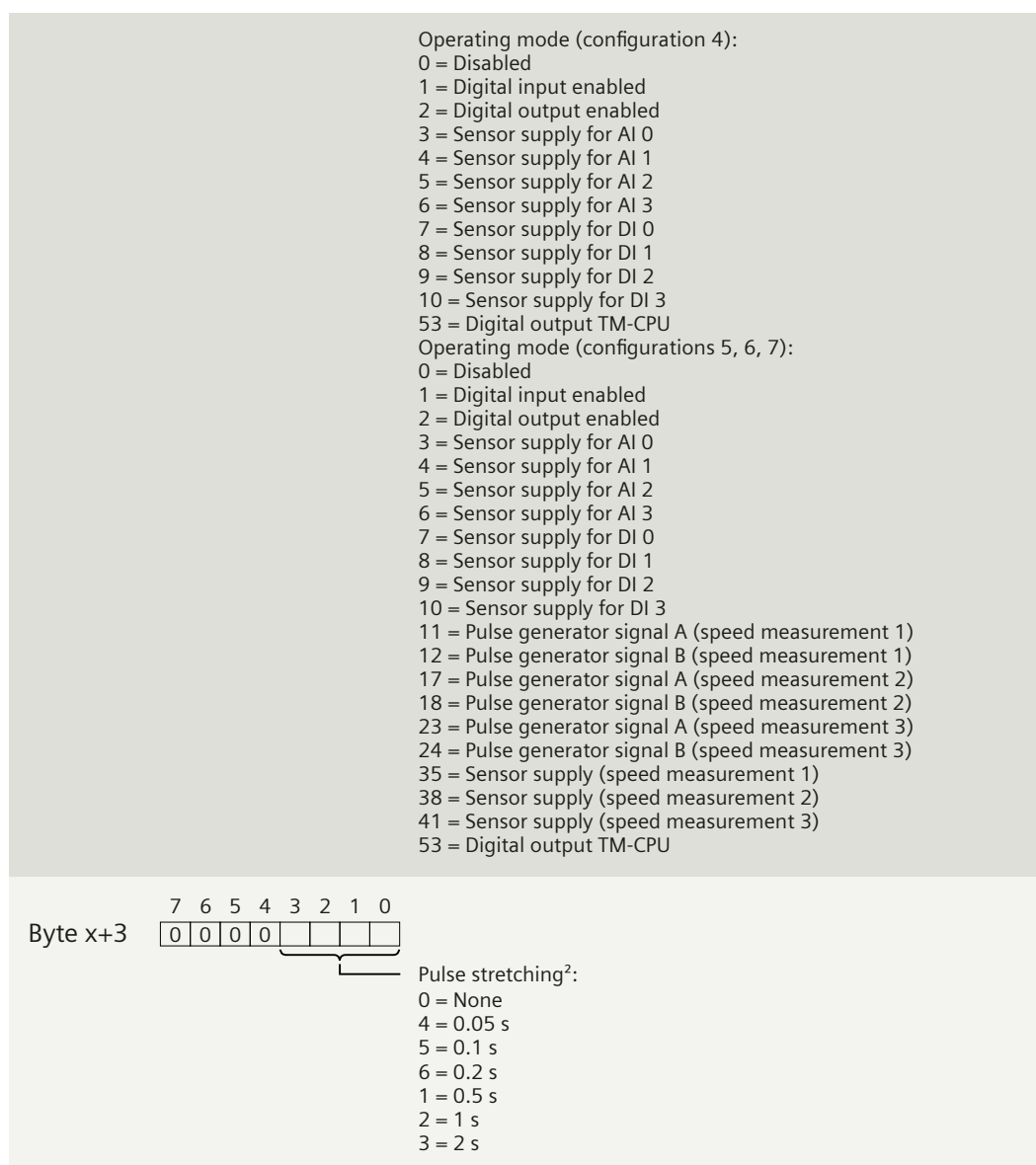
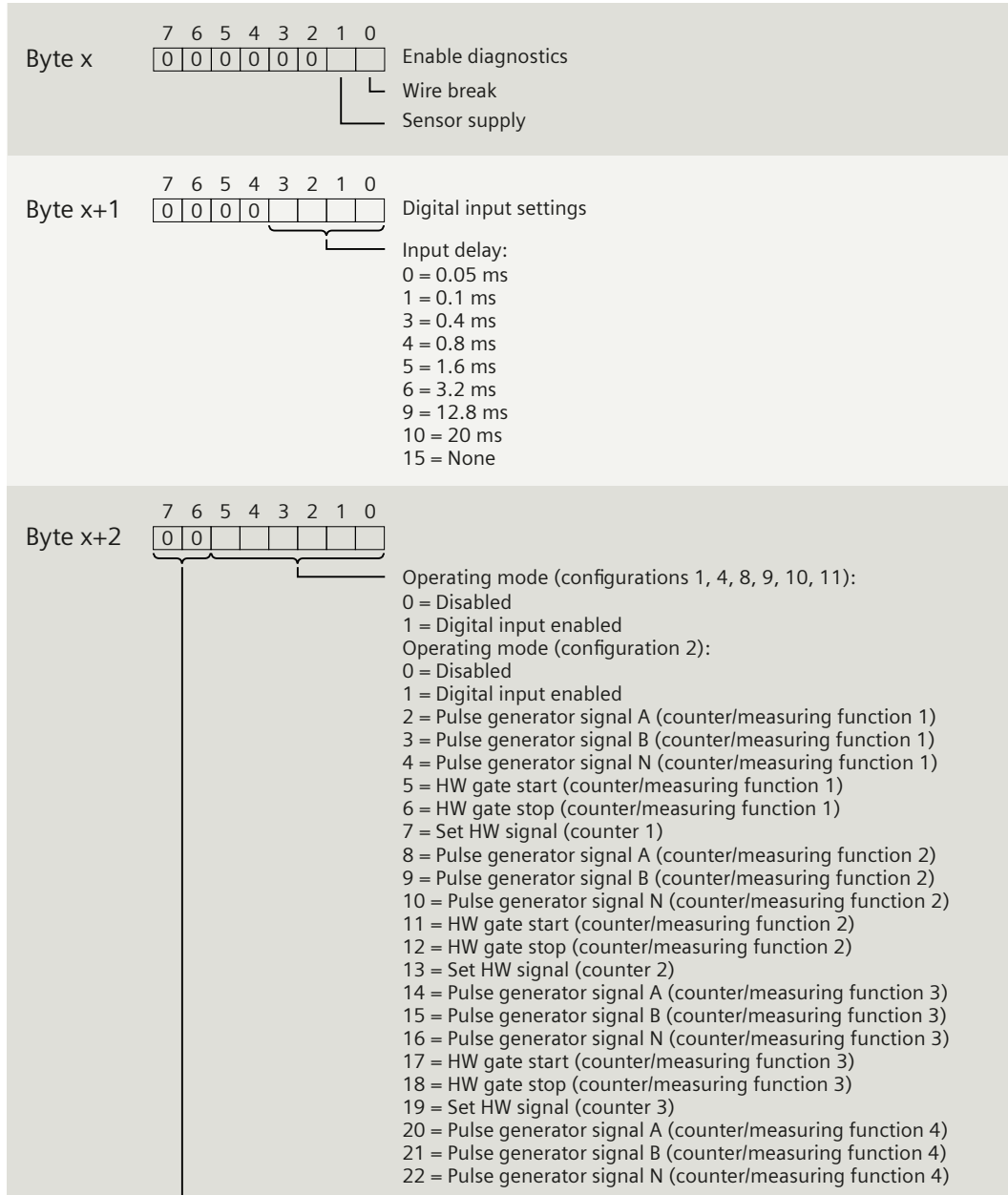


Figure A-2 Data record 128: Structure of bytes x to x+3 for the channels DI/DQ 0 to DI/DQ 5

¹Only for DQ

²Only for DI

Channel parameters of the digital input



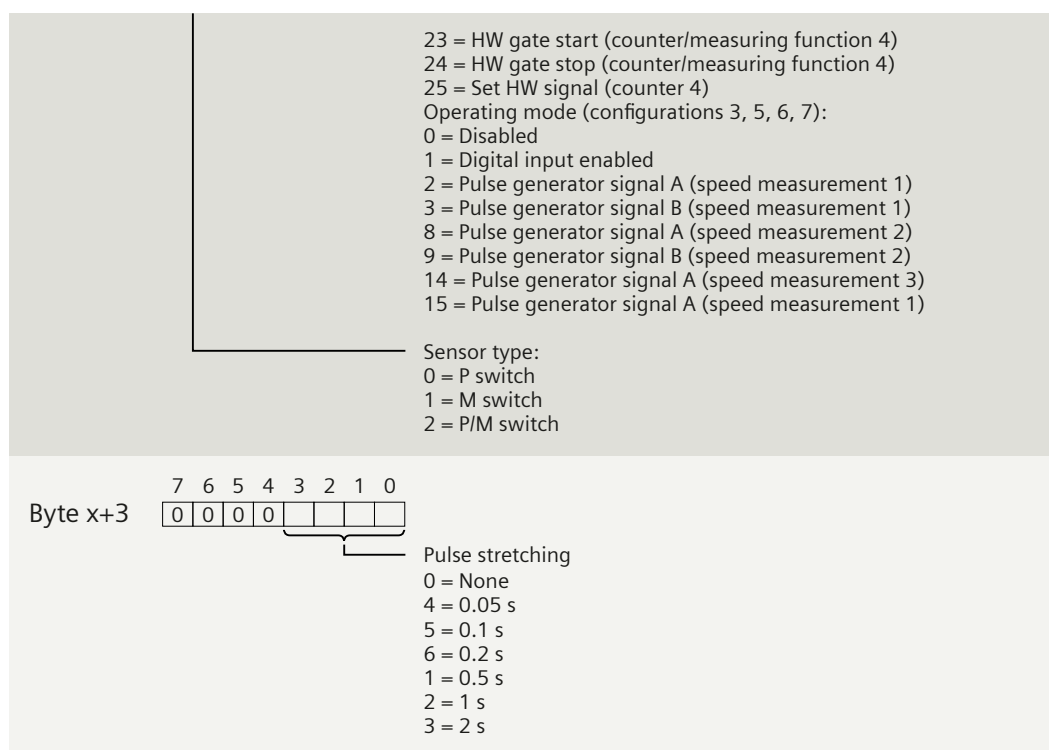


Figure A-3 Data record 128: Structure of bytes x to x+3 for the channels DI 0 to DI 3

Frequency parameters AI sampling

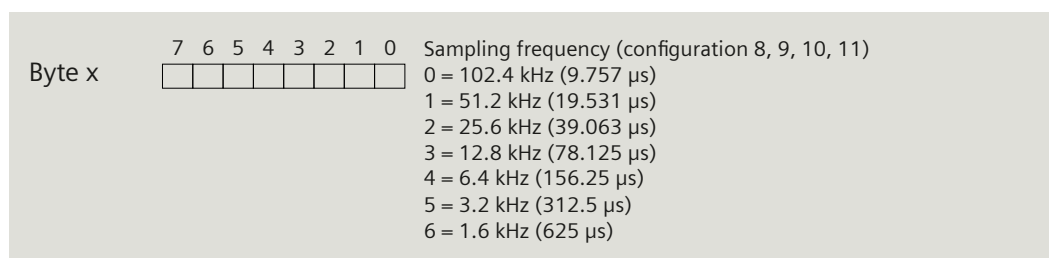


Figure A-4 Data record 128: Structure of bytes x to x+1 for the AI sampling frequency

Trigger-routing frequency parameters or behavior of the buffers

Note

Trigger routing or behavior of the buffers

The coding of byte 53 depends on the module type.

- Type B: Read the behavior of the buffers
- Type C: Read trigger routing

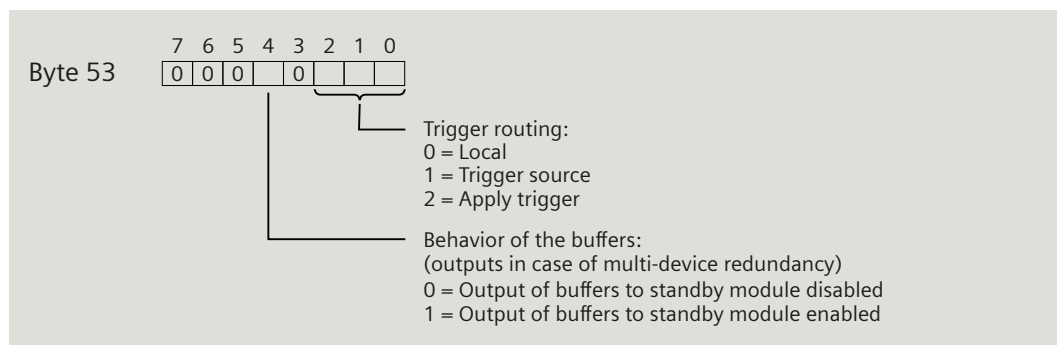
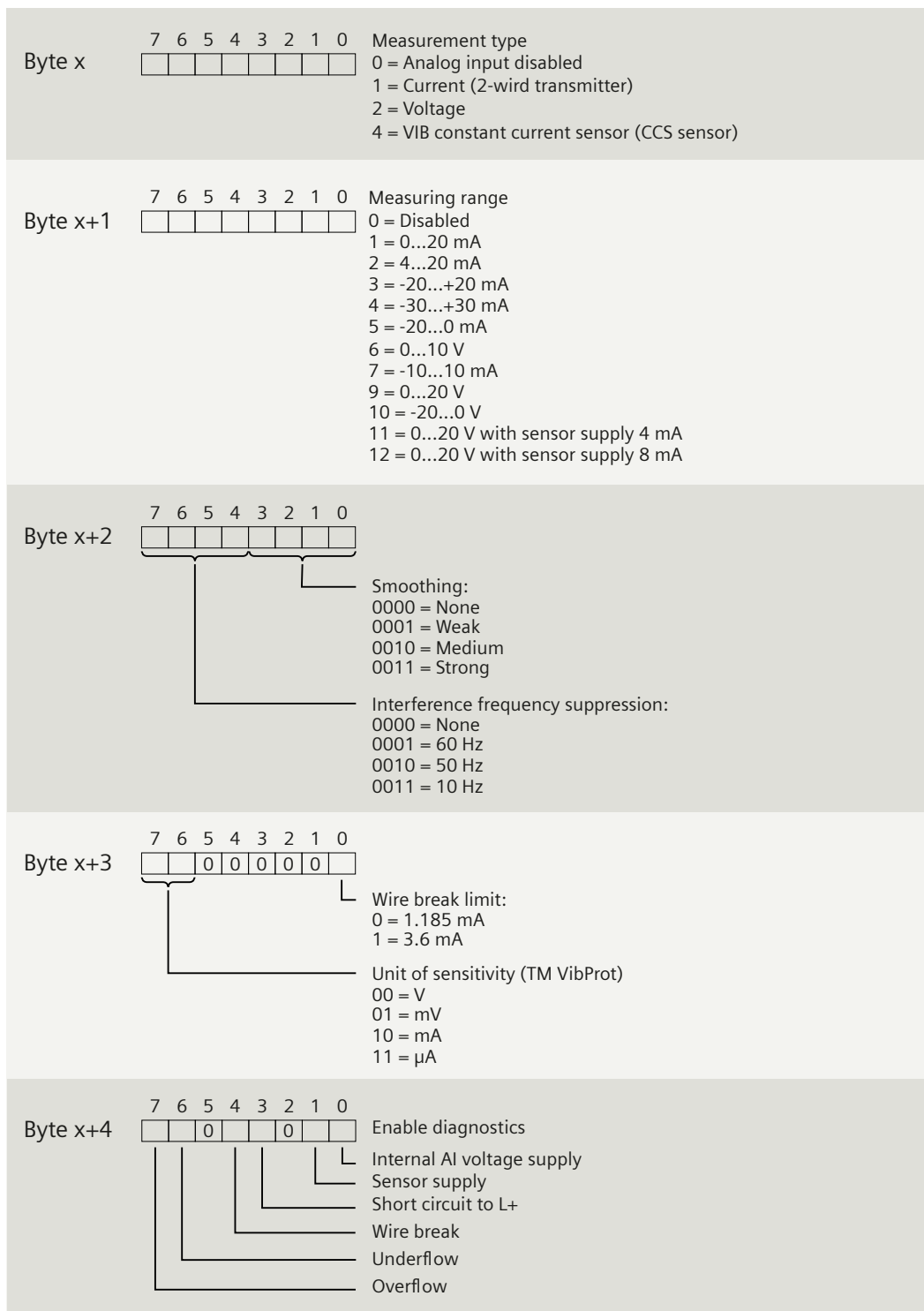
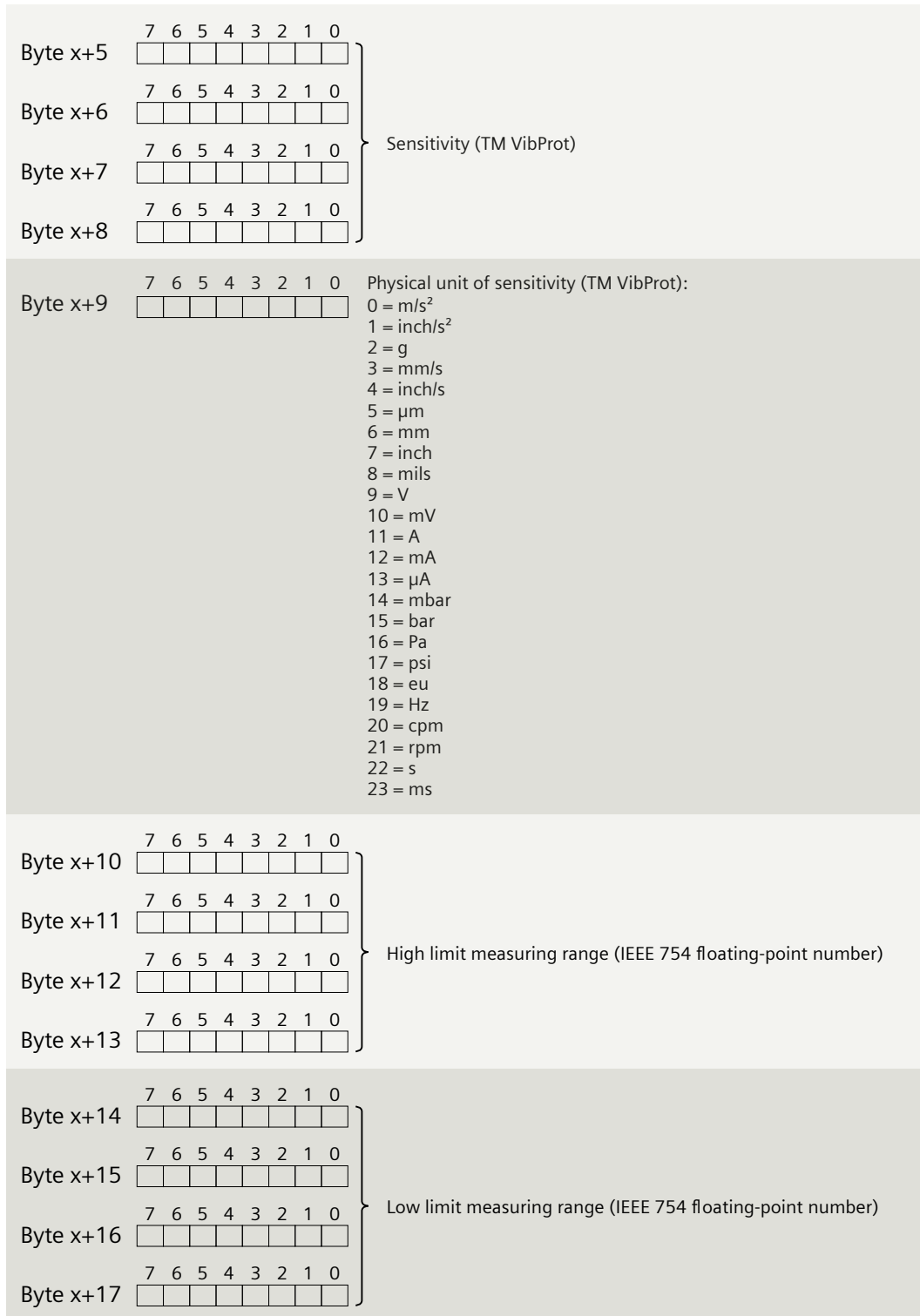


Figure A-5 Data record 128: Structure byte 53 for trigger routing or behavior of the buffers

Channel parameters of the analog input



A.4 Structure of the module and channel parameter blocks of data record 128



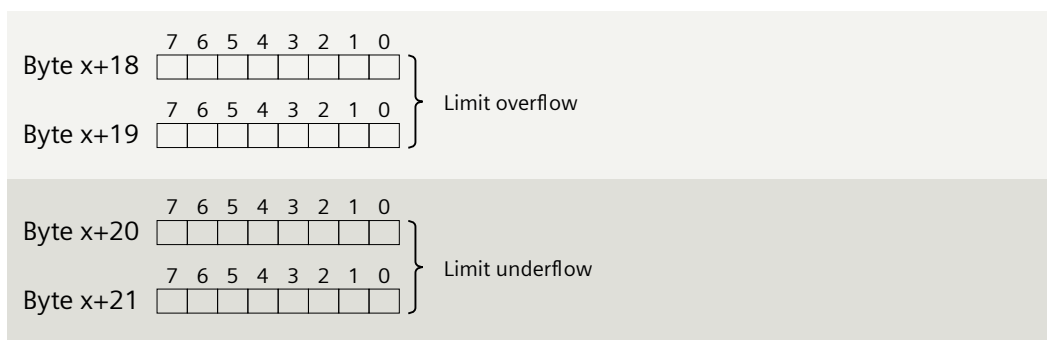
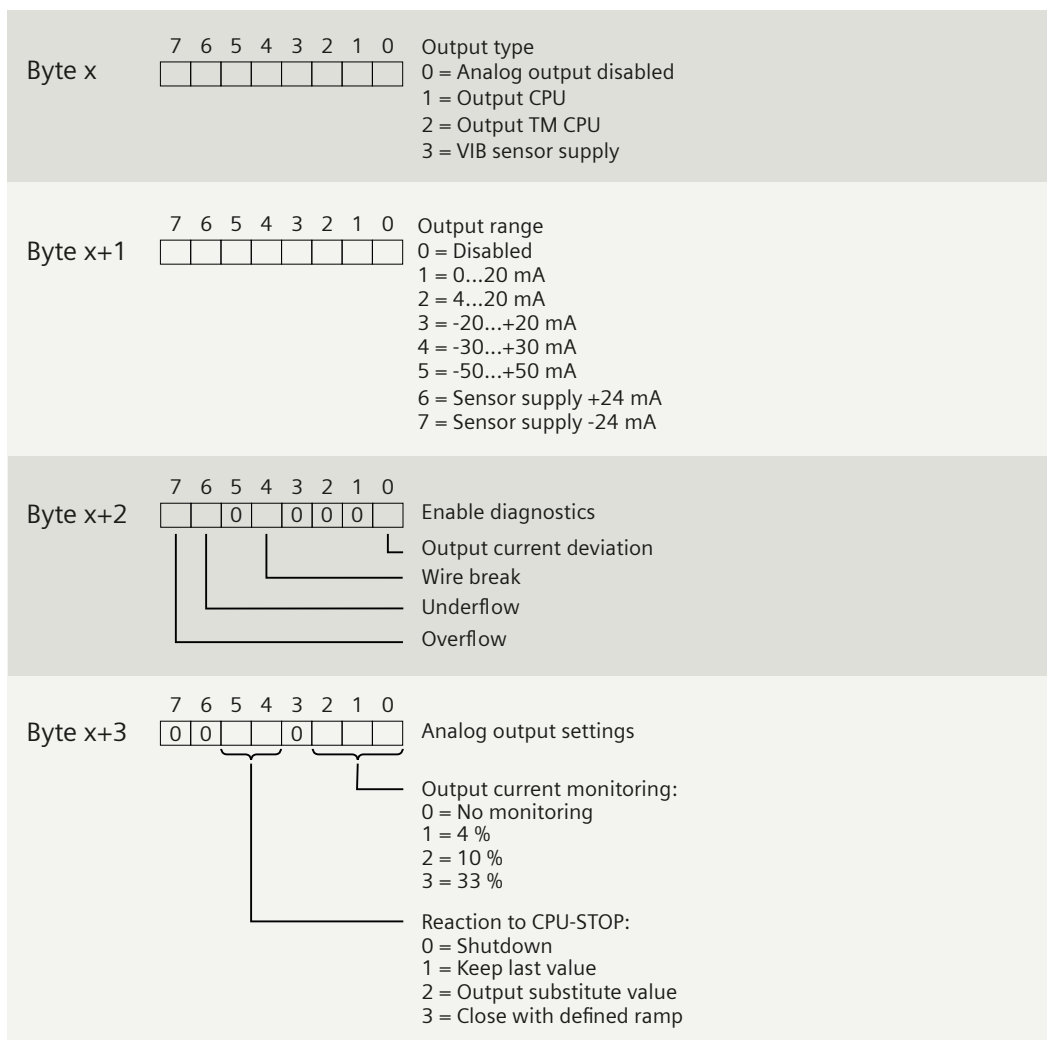


Figure A-6 Data record 128: Structure of bytes x to x+21 for channels AI 0 to AI 3

Channel parameters analog output



A.4 Structure of the module and channel parameter blocks of data record 128

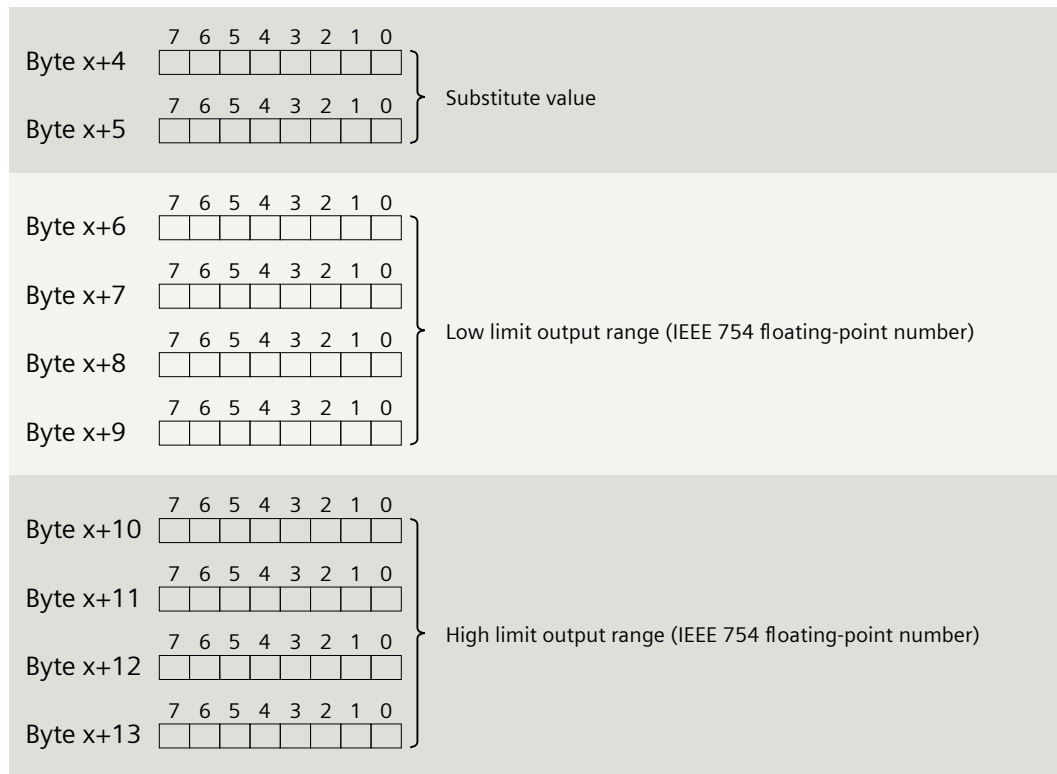


Figure A-7 Data record 128: Structure byte x to x+13 for the channels AQ 0 to AQ 3

Channel parameters voltage output

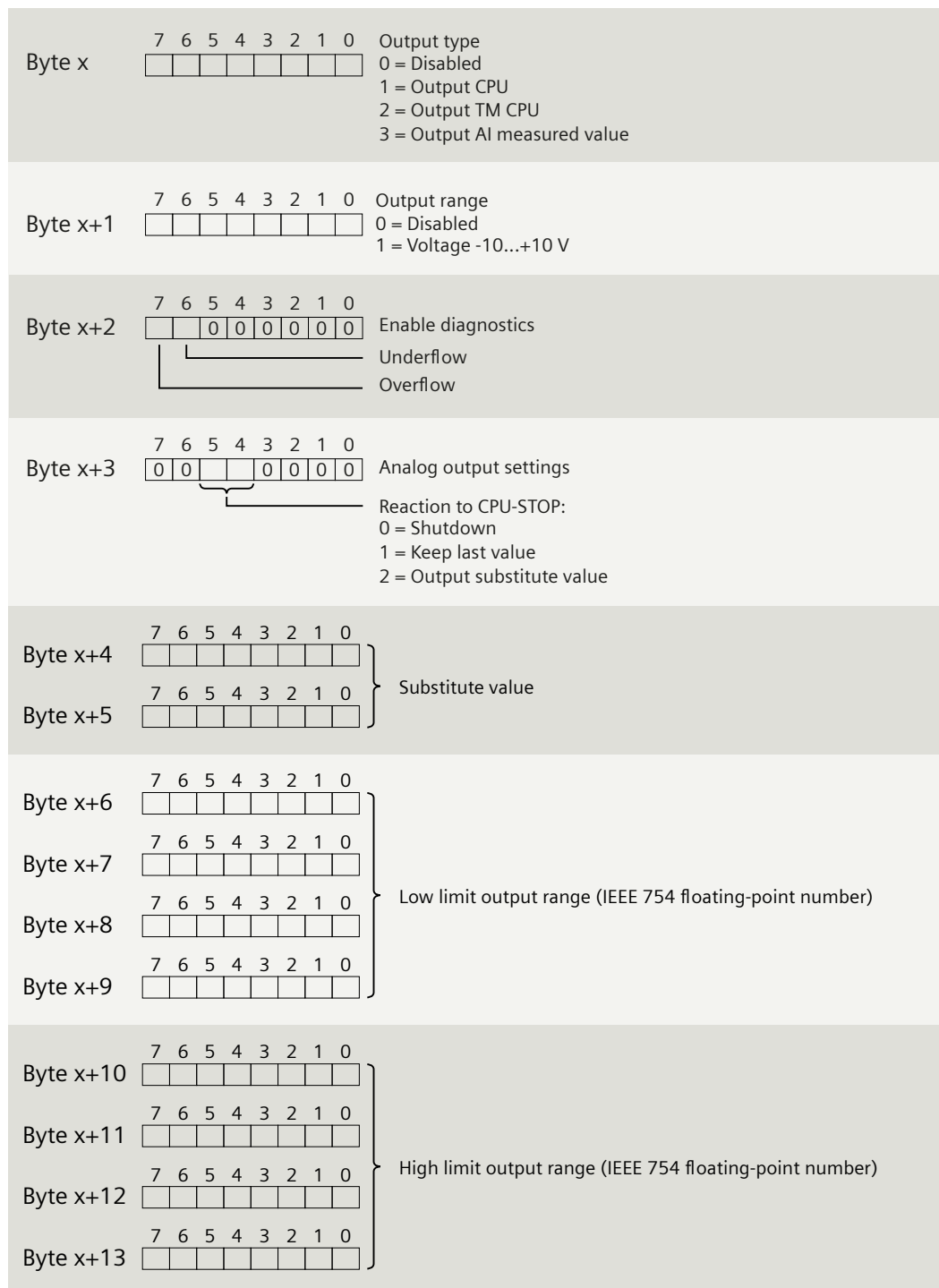


Figure A-8 Data record 128: Structure bytes x to x+13 for the channels BUF 0 to BUF 3

A.5 Structure of data record 129

This section shows the following information on the structure of the parameter blocks:

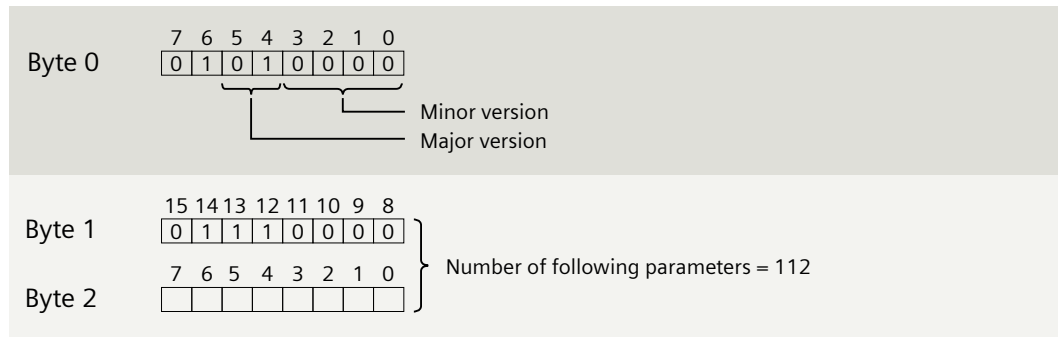
- Header information of the data record
- Channel or technology parameters
 - Length of channel or technology parameters
 - Start of channel parameters
 - Channel parameters counting function
 - Channel parameters speed measurement function
 - Channel parameters trigger
 - Channel parameters VibMon

The figures below show the configuration-specific structure of the respective parameters.

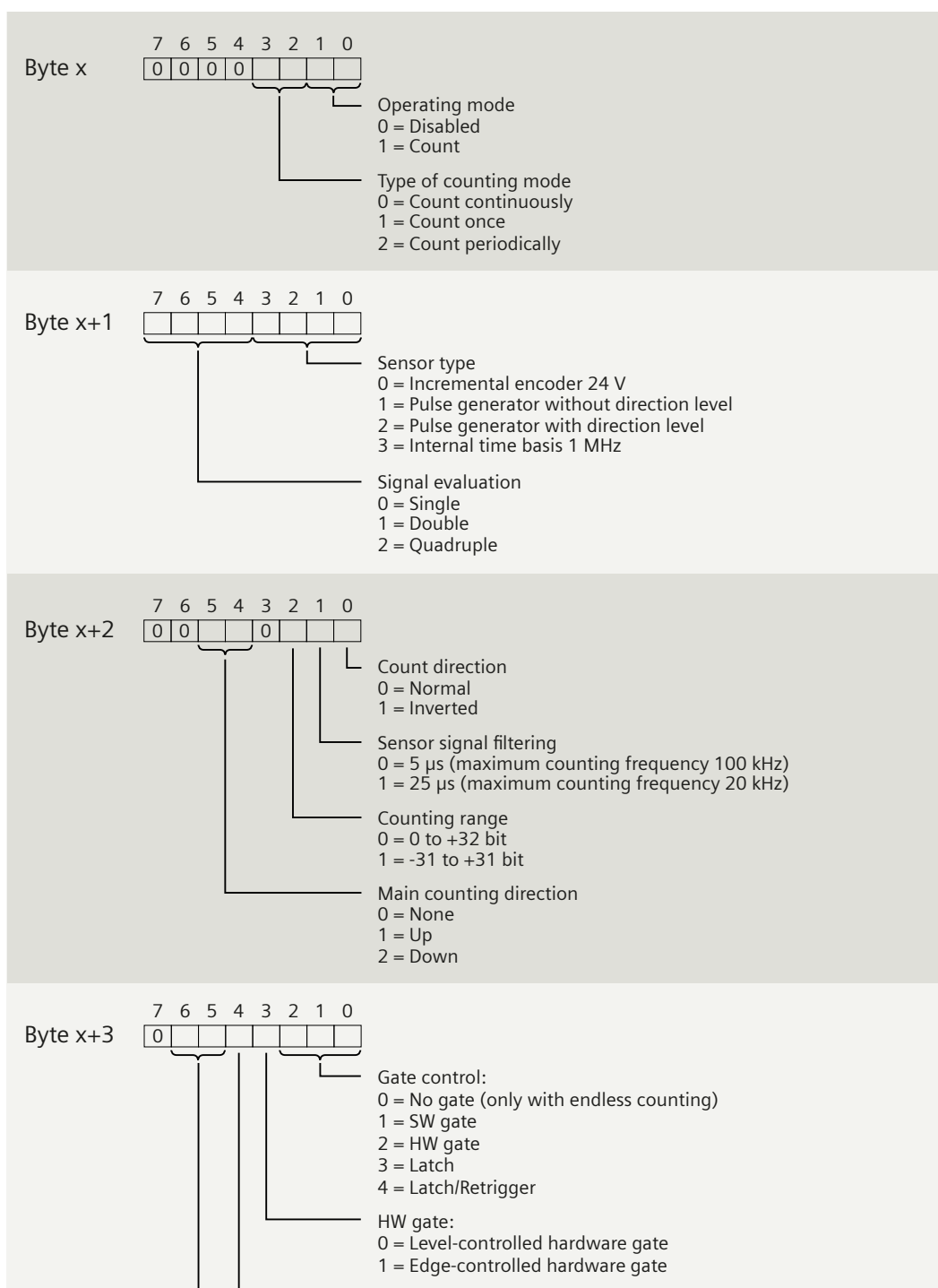
All unused bits and the bits or bytes marked as "reserved" must be set to zero.
You activate a channel parameter by setting the corresponding bit to "1" or the corresponding value.

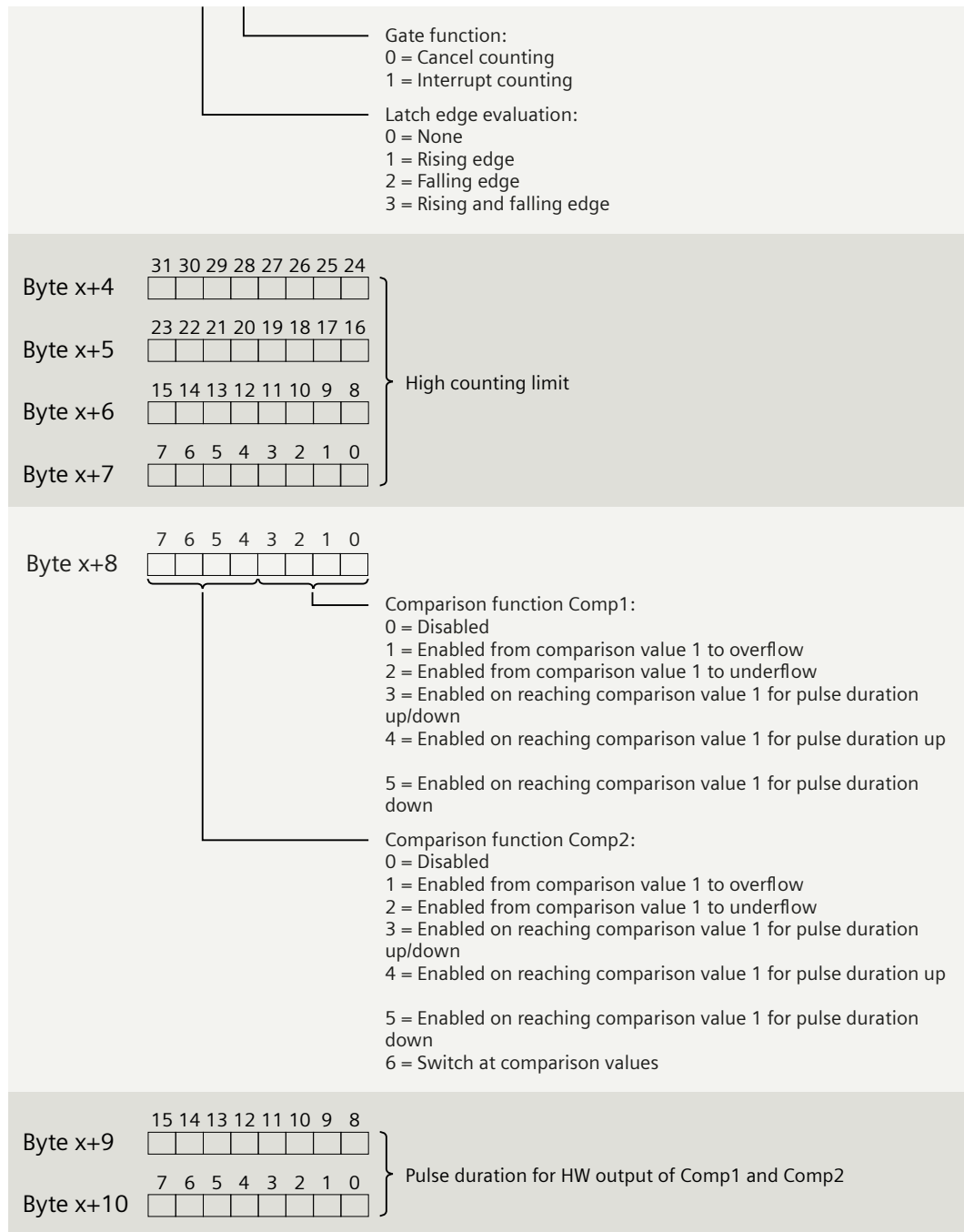
Header information and module parameters TM FIO & Counter; configuration 2 - Counter function

The following figure shows the structure of the header information and module parameters of data record 129 in the TM FIO & Counter; configuration 2 - Counter functions.



A.5 Structure of data record 129





A.5 Structure of data record 129

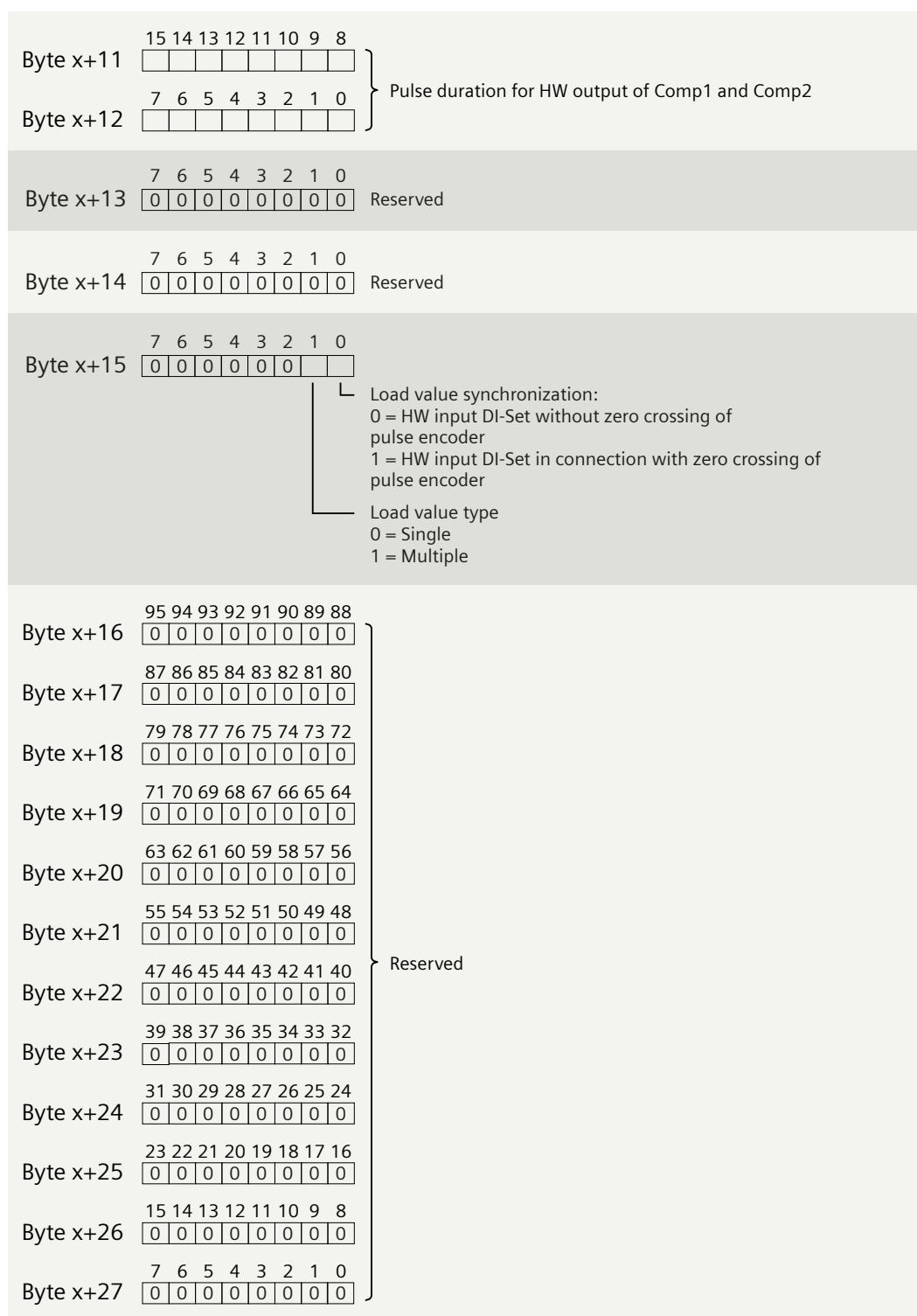


Figure A-9 Data record 129: Structure of bytes x to x+27 for channels Counting

Header information and module parameters TM FIO & Counter; configuration 3 - Speed measurement and TM Contr; configurations 5, 6, 7

The following figure shows the structure of the header information and module parameters of data record 129 in the TM Contr.

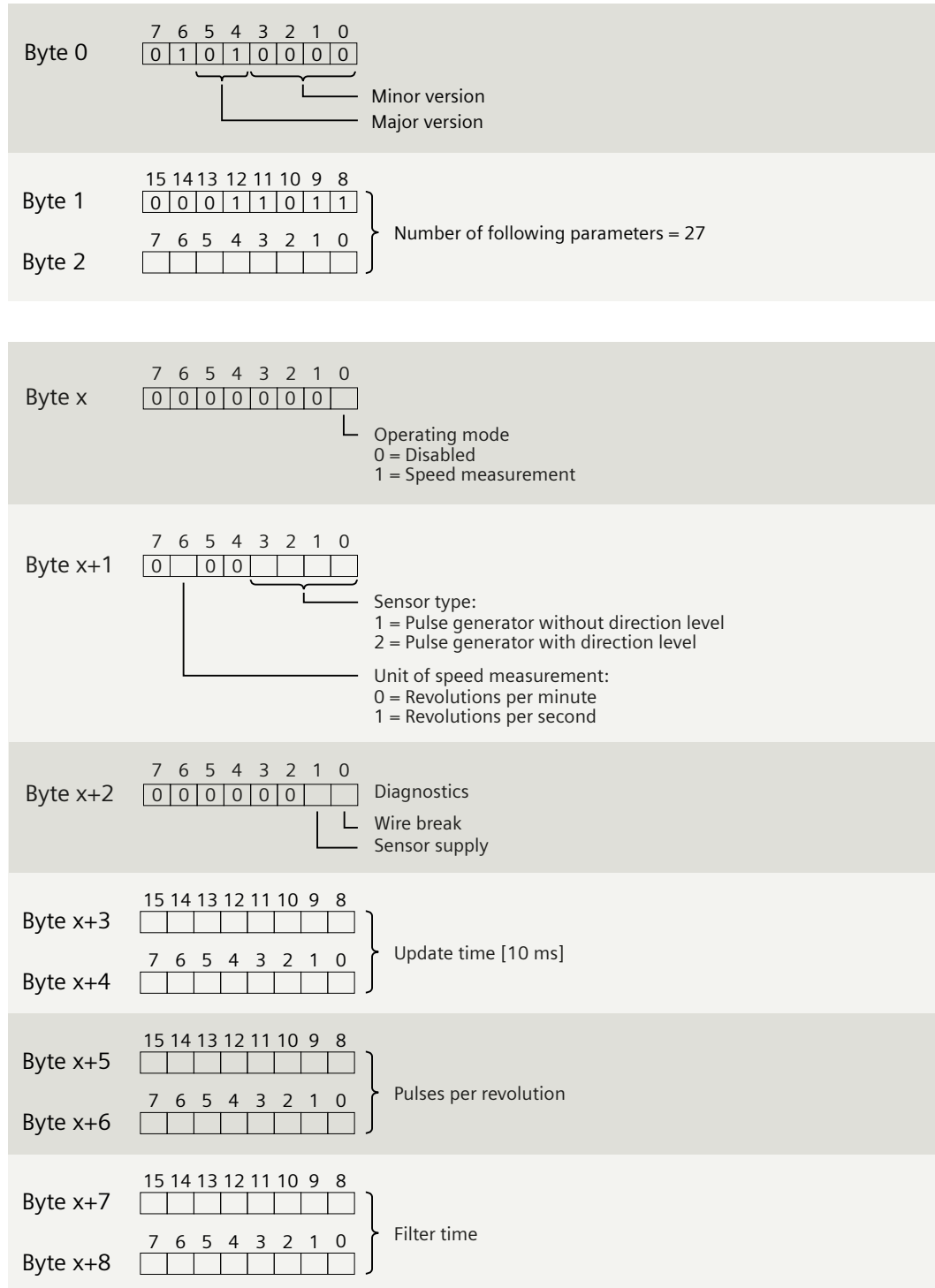


Figure A-10 Data record 129: Structure of bytes x to x+8 for channels Measure speed

Header information and module parameters TM VibProt

The following figure shows the structure of the header information and module parameters of data record 129 in the TM VibProt.

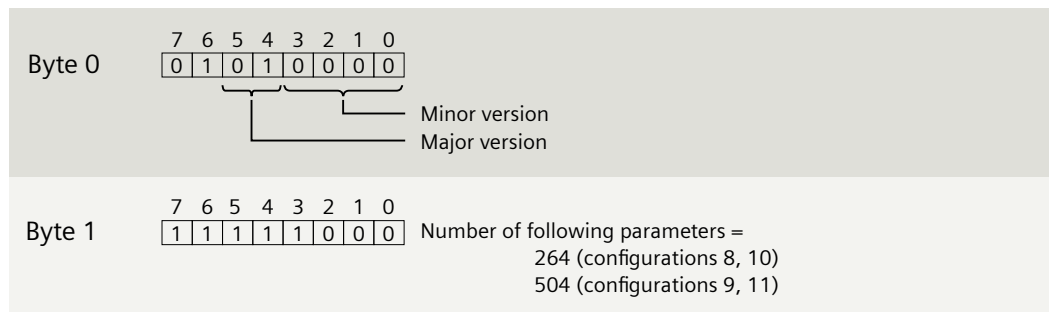


Figure A-11 Parameter 129: Header information and module parameters fast IO and vibration protection function chains

Channel parameters trigger function for AI2 and AI3

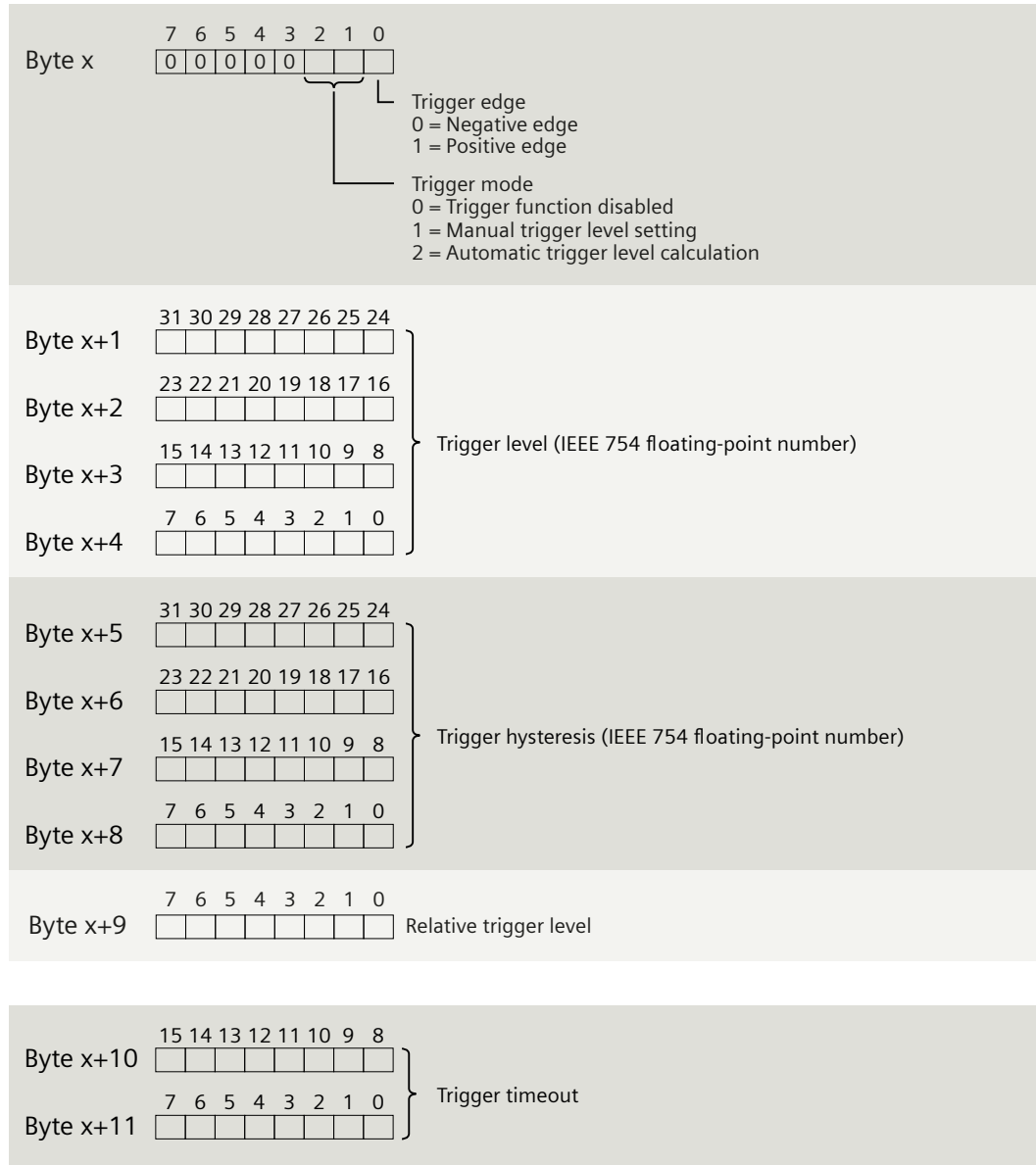


Figure A-12 Data record 129: Structure of bytes x to x+11 for channels Trigger AI2 and AI3

Channel parameters of function chain 1 channel broadband: 1 x Sum

Byte x	7 6 5 4 3 2 1 0 0 0 0 0 0 0 0 1	Function chain type
Byte x+1	7 6 5 4 3 2 1 0 	AI channel number (0 to 3)
Byte x+2	31 30 29 28 27 26 25 24 	High-pass filter: Filter base frequency (IEEE 754 floating-point number)
Byte x+3	23 22 21 20 19 18 17 16 	
Byte x+4	15 14 13 12 11 10 9 8 	
Byte x+5	7 6 5 4 3 2 1 0 	
Byte x+6	7 6 5 4 3 2 1 0 	High-pass filter: Filter slope 4 = 24 dB/octave 6 = 60 dB/octave
Byte x+7	31 30 29 28 27 26 25 24 	Low-pass filter: Filter base frequency (IEEE 754 floating-point number)
Byte x+8	23 22 21 20 19 18 17 16 	
Byte x+9	15 14 13 12 11 10 9 8 	
Byte x+10	7 6 5 4 3 2 1 0 	
Byte x+11	7 6 5 4 3 2 1 0 	Low-pass filter: Filter slope 4 = 24 dB/octave 6 = 60 dB/octave
Byte x+12	15 14 13 12 11 10 9 8 	Integration: Integrator level 0 = No integration 1 = 1x 2 = 2x
Byte x+13	7 6 5 4 3 2 1 0 	
Byte x+14	7 6 5 4 3 2 1 0 	Detector: Detector type: 1 = RMS 2 = Peak value 3 = Peak-peak value 4 = Peak-peak value / 2

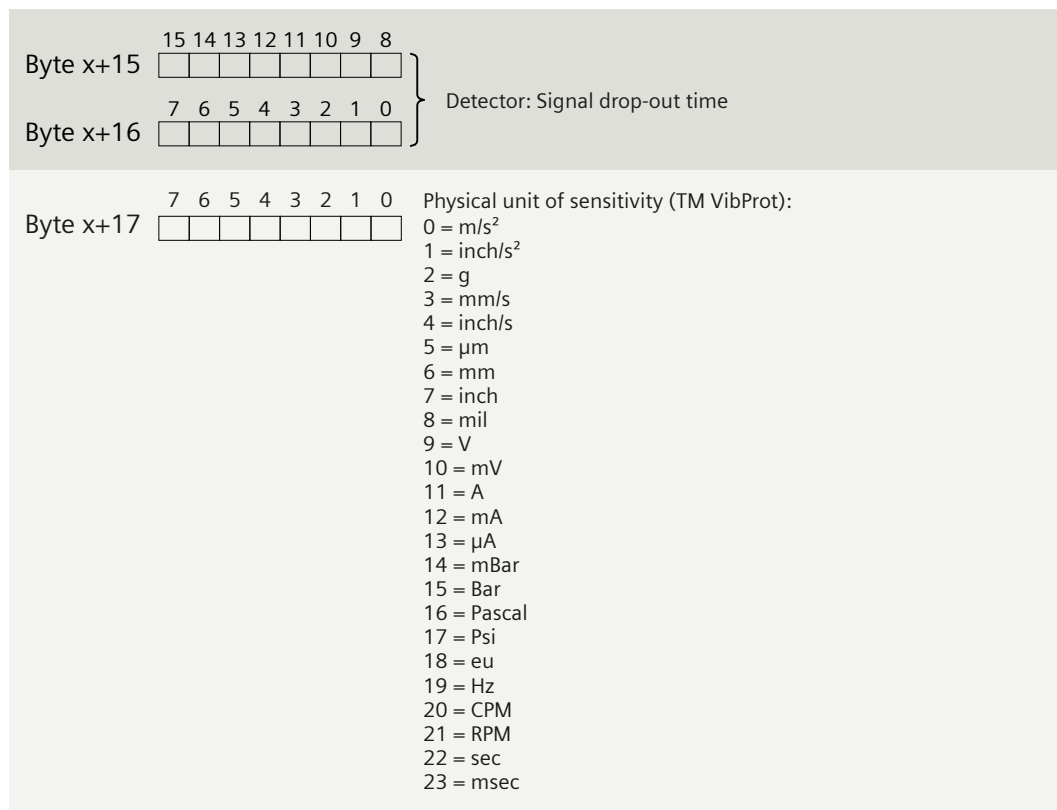
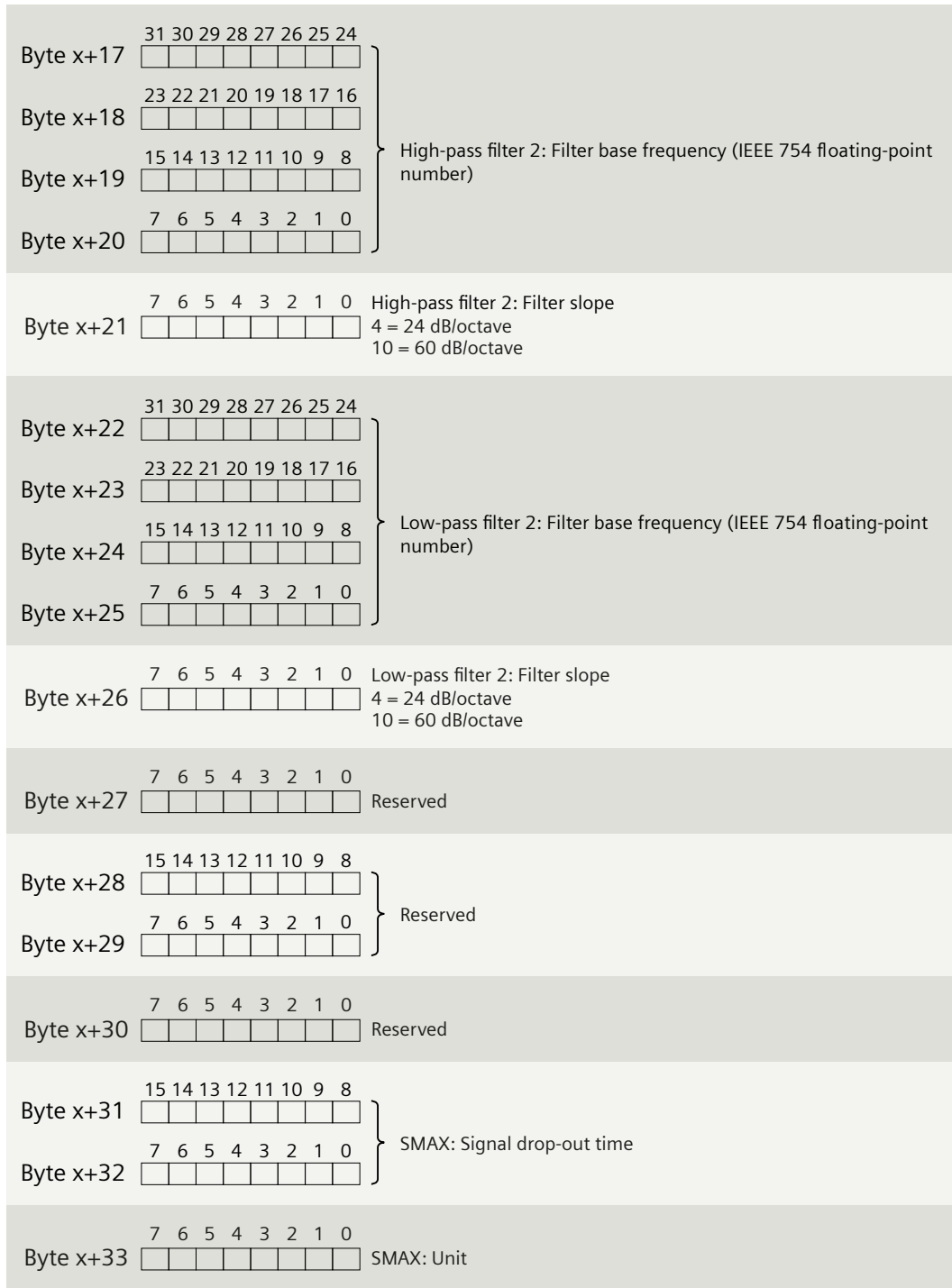


Figure A-13 Data record 129: Structure of bytes x to x+17 for the channels of the function chain 1
channel broadband: 1 x Sum

Channel parameters of function chain 2 channels broadband: 1 x Smax

Byte x	7 6 5 4 3 2 1 0 0 0 0 0 0 0 1 0	Function chain type
Byte x+1	7 6 5 4 3 2 1 0 □ □ □ □ □ □ □ □	AI channel number 1 (0 to 3)
Byte x+2	7 6 5 4 3 2 1 0 □ □ □ □ □ □ □ □	AI channel number 2 (0 to 3)
Byte x+3	31 30 29 28 27 26 25 24 □ □ □ □ □ □ □ □	High-pass filter 1: Filter base frequency (IEEE 754 floating-point number)
Byte x+4	23 22 21 20 19 18 17 16 □ □ □ □ □ □ □ □	
Byte x+5	15 14 13 12 11 10 9 8 □ □ □ □ □ □ □ □	
Byte x+6	7 6 5 4 3 2 1 0 □ □ □ □ □ □ □ □	
Byte x+7	7 6 5 4 3 2 1 0 □ □ □ □ □ □ □ □	High-pass filter 1: Filter slope 4 = 24 dB/octave 10 = 60 dB/octave
Byte x+8	31 30 29 28 27 26 25 24 □ □ □ □ □ □ □ □	Low-pass filter 1: Filter base frequency (IEEE 754 floating-point number)
Byte x+9	23 22 21 20 19 18 17 16 □ □ □ □ □ □ □ □	
Byte x+10	15 14 13 12 11 10 9 8 □ □ □ □ □ □ □ □	
Byte x+11	7 6 5 4 3 2 1 0 □ □ □ □ □ □ □ □	
Byte x+12	7 6 5 4 3 2 1 0 □ □ □ □ □ □ □ □	Low-pass filter 1: Filter slope 4 = 24 dB/octave 10 = 60 dB/octave
Byte x+13	7 6 5 4 3 2 1 0 □ □ □ □ □ □ □ □	Reserved
Byte x+14	15 14 13 12 11 10 9 8 □ □ □ □ □ □ □ □	Reserved
Byte x+15	7 6 5 4 3 2 1 0 □ □ □ □ □ □ □ □	
Byte x+16	7 6 5 4 3 2 1 0 □ □ □ □ □ □ □ □	Reserved



A.5 Structure of data record 129

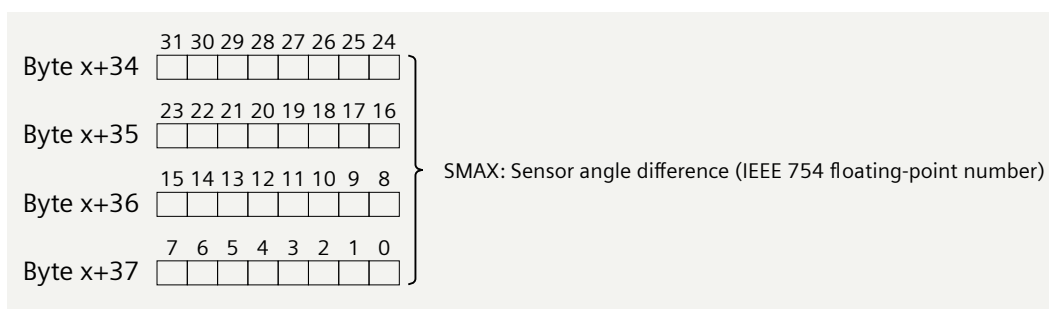


Figure A-14 Data record 129: Structure of bytes x to x+37 for the channels of the function chain 2
channels broadband: 1 x Smax

Parameters of the function chain 2 channels broadband: 1 x Max

Byte x	7 6 5 4 3 2 1 0	0 0 0 0 0 0 1 1	Function chain type
Byte x+1	7 6 5 4 3 2 1 0		AI channel number 1
Byte x+2	7 6 5 4 3 2 1 0		AI channel number 2
Byte x+3	31 30 29 28 27 26 25 24		High-pass filter 1: Filter base frequency (IEEE 754 floating-point number)
Byte x+4	23 22 21 20 19 18 17 16		
Byte x+5	15 14 13 12 11 10 9 8		
Byte x+6	7 6 5 4 3 2 1 0		
Byte x+7	7 6 5 4 3 2 1 0		High-pass filter 1: Filter slope 4 = 24 dB/octave 10 = 60 dB/octave
Byte x+8	31 30 29 28 27 26 25 24		Low-pass filter 1: Filter base frequency (IEEE 754 floating-point number)
Byte x+9	23 22 21 20 19 18 17 16		
Byte x+10	15 14 13 12 11 10 9 8		
Byte x+11	7 6 5 4 3 2 1 0		
Byte x+12	7 6 5 4 3 2 1 0		Low-pass filter 1: Filter slope 4 = 24 dB/octave 10 = 60 dB/octave
Byte x+13	7 6 5 4 3 2 1 0		Detector 1: Detector type:
Byte x+14	15 14 13 12 11 10 9 8		Detector 1: Signal drop-out time
Byte x+15	7 6 5 4 3 2 1 0		

A.5 Structure of data record 129

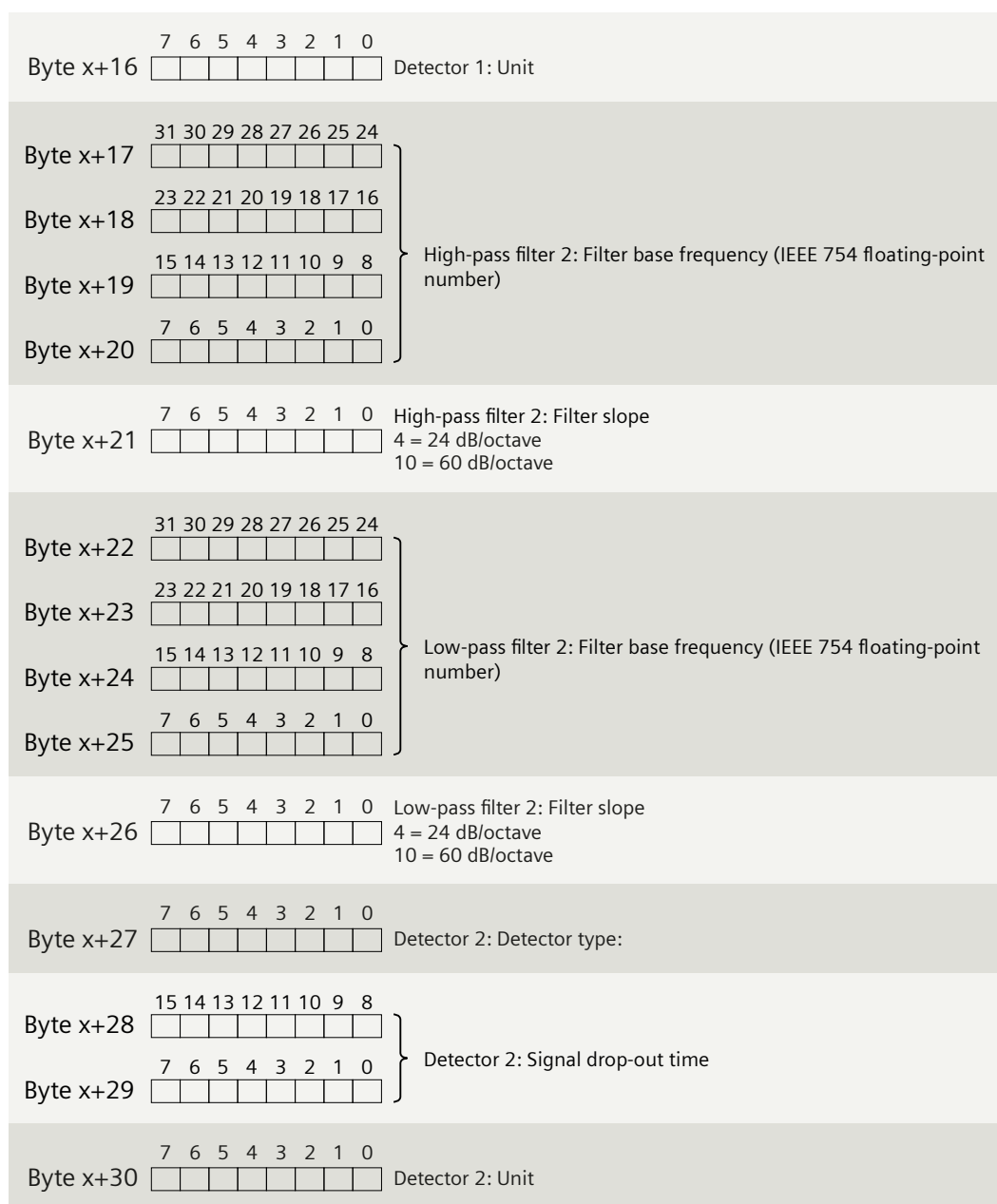
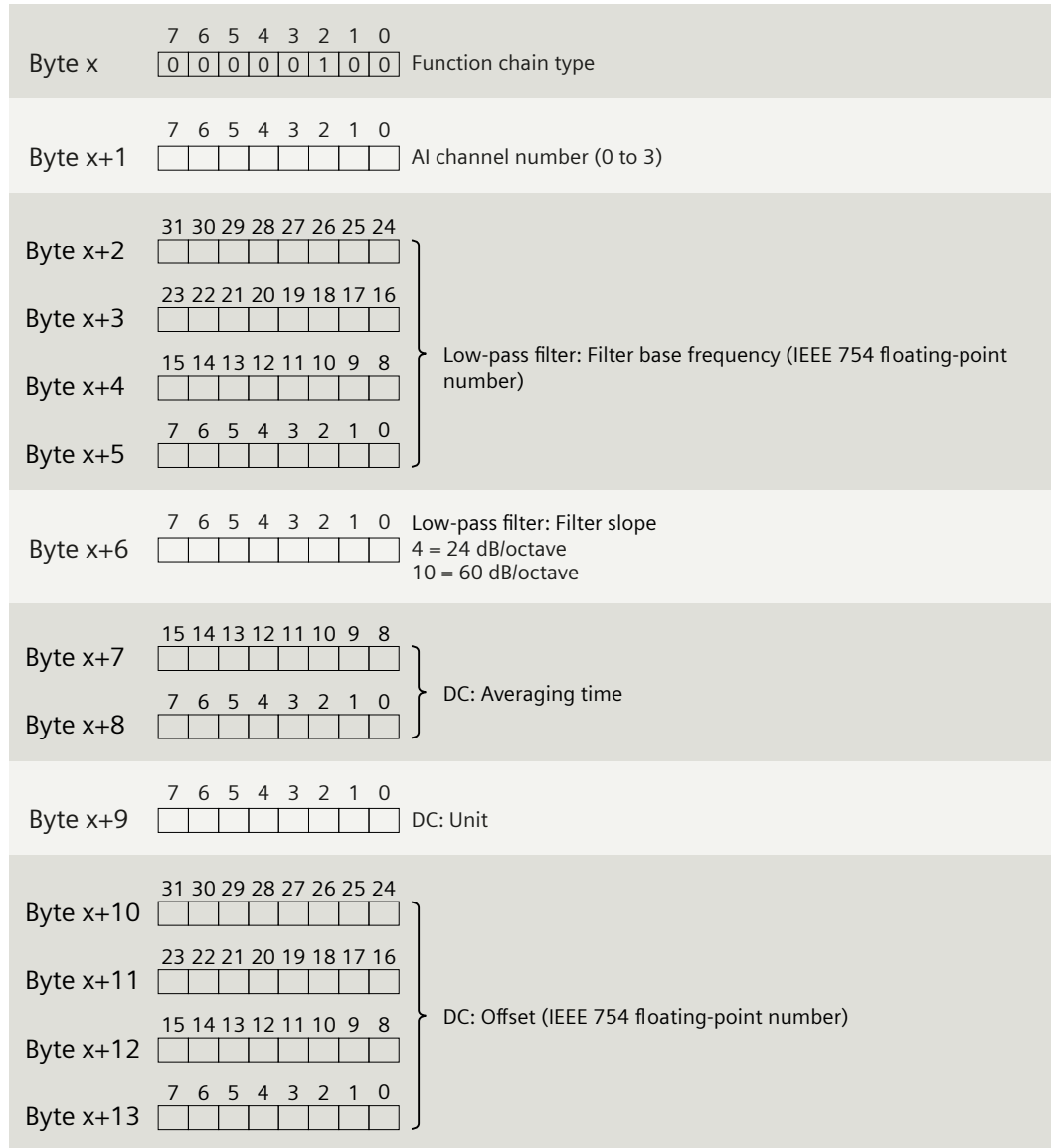


Figure A-15 Data record 129: Structure of bytes x to x+30 for the channels of the function chain 2 channels broadband: 1 x Max

Channel parameters of function chain 1 channel broadband: 1 x DC

A.5 Structure of data record 129

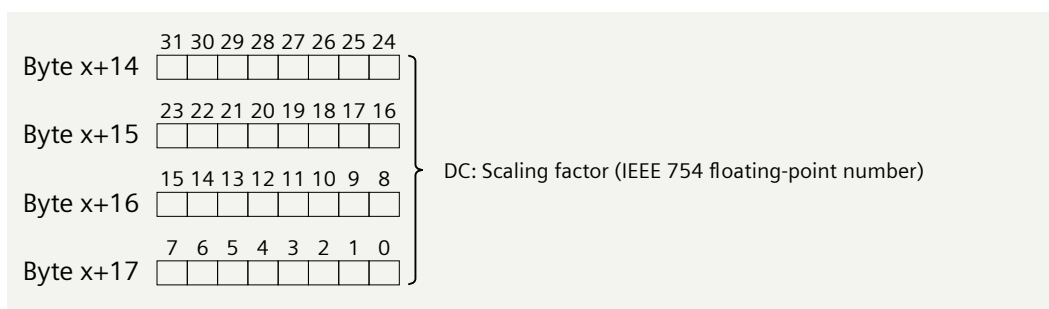


Figure A-16 Data record 129: Structure of bytes x to x+17 for the channels of the function chain 1
channel broadband: 1 x DC

Channel parameters of function chain 2 channels broadband: 1 x DC (RSE)

Byte x	7 6 5 4 3 2 1 0 0 0 0 0 0 1 0 1	Function chain type
Byte x+1	7 6 5 4 3 2 1 0 	AI channel number 1 (0 to 3)
Byte x+2	7 6 5 4 3 2 1 0 	AI channel number 2 (0 to 3)
Byte x+3	31 30 29 28 27 26 25 24 	Low-pass filter 1: Filter base frequency (IEEE 754 floating-point number)
Byte x+4	23 22 21 20 19 18 17 16 	
Byte x+5	15 14 13 12 11 10 9 8 	
Byte x+6	7 6 5 4 3 2 1 0 	
Byte x+7	7 6 5 4 3 2 1 0 	Low-pass filter 1: Filter slope 4 = 24 dB/octave 10 = 60 dB/octave
Byte x+8	31 30 29 28 27 26 25 24 	Low-pass filter 2: Filter base frequency (IEEE 754 floating-point number)
Byte x+9	23 22 21 20 19 18 17 16 	
Byte x+10	15 14 13 12 11 10 9 8 	
Byte x+11	7 6 5 4 3 2 1 0 	
Byte x+12	7 6 5 4 3 2 1 0 	Low-pass filter 2: Filter slope 4 = 24 dB/octave 10 = 60 dB/octave
Byte x+13	7 6 5 4 3 2 1 0 	RSE: Mode 1 = Shaft shoulder (2 sensors) 2 = Double shaft cone 3 = Single shaft cone
Byte x+14	7 6 5 4 3 2 1 0 	RSE: Unit
Byte x+15	7 6 5 4 3 2 1 0 	RSE: Sensor 1 inverted 0 = Not inverted 1 = Inverted

A.5 Structure of data record 129

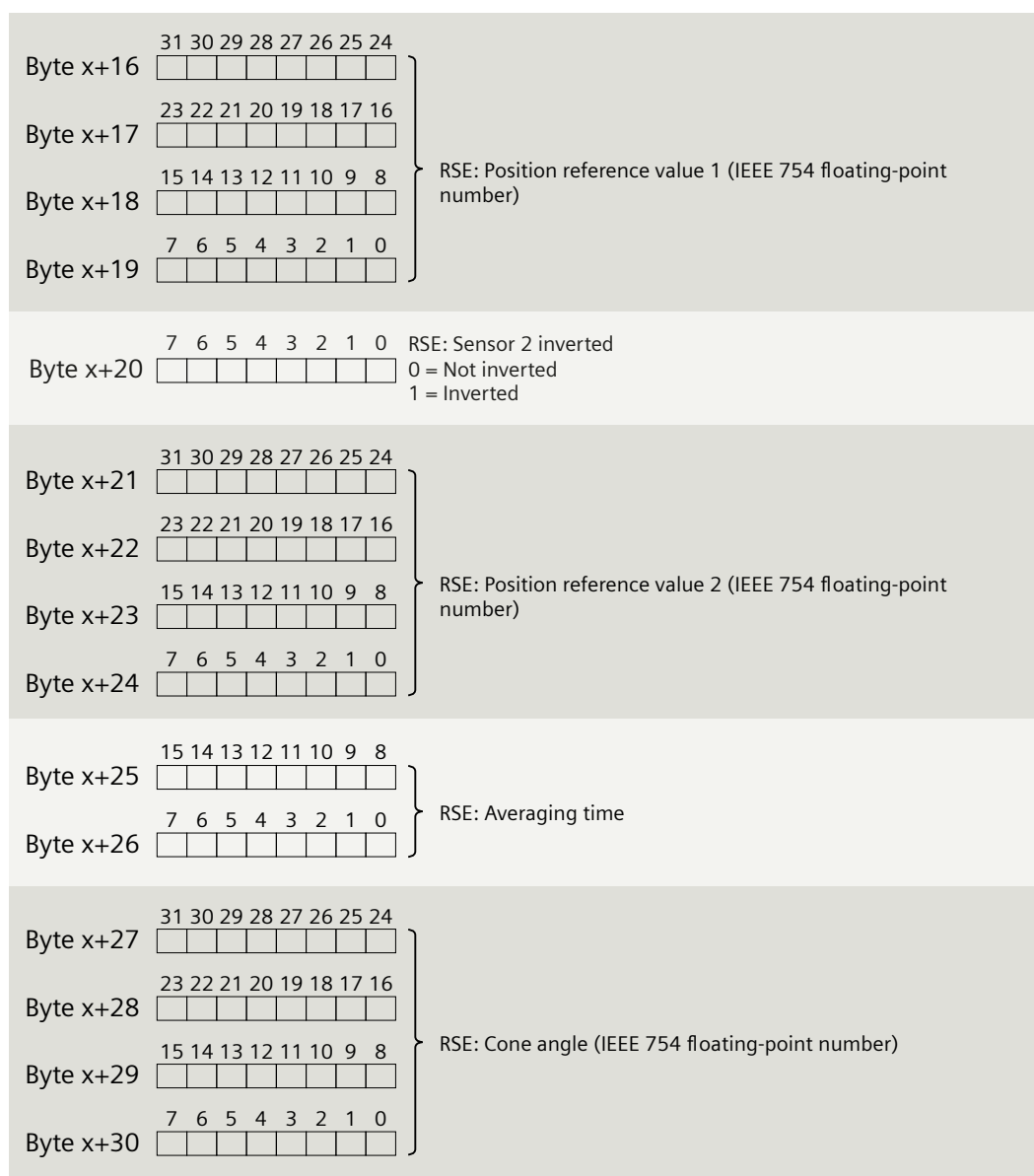


Figure A-17 Data record 129: Structure of bytes x to x+30 for the channels of the function chain 2 channels broadband: 1 x DC (RSE)

Channel parameters of function chain 2 channels broadband: 1 x ASV (SUM)

Byte x	7 6 5 4 3 2 1 0 0 0 0 0 0 1 1 0	Function chain type
Byte x+1	7 6 5 4 3 2 1 0 	AI channel number 1 (0 to 3)
Byte x+2	7 6 5 4 3 2 1 0 	AI channel number 2 (0 to 3)
Byte x+3	7 6 5 4 3 2 1 0 	Sensor angle
Byte x+4	31 30 29 28 27 26 25 24 	High-pass filter 1: Filter base frequency (IEEE 754 floating-point number)
Byte x+5	23 22 21 20 19 18 17 16 	
Byte x+6	15 14 13 12 11 10 9 8 	
Byte x+7	7 6 5 4 3 2 1 0 	
Byte x+8	7 6 5 4 3 2 1 0 	High-pass filter 1: Filter slope 4 = 24 dB/octave 10 = 60 dB/octave
Byte x+9	7 6 5 4 3 2 1 0 	Integration: Integrator level 1 = 1x 2 = 2x
Byte x+10	31 30 29 28 27 26 25 24 	Low-pass filter 1: Filter base frequency (IEEE 754 floating-point number)
Byte x+11	23 22 21 20 19 18 17 16 	
Byte x+12	15 14 13 12 11 10 9 8 	
Byte x+13	7 6 5 4 3 2 1 0 	
Byte x+14	7 6 5 4 3 2 1 0 	Low-pass filter 1: Filter slope 4 = 24 dB/octave 10 = 60 dB/octave

A.5 Structure of data record 129

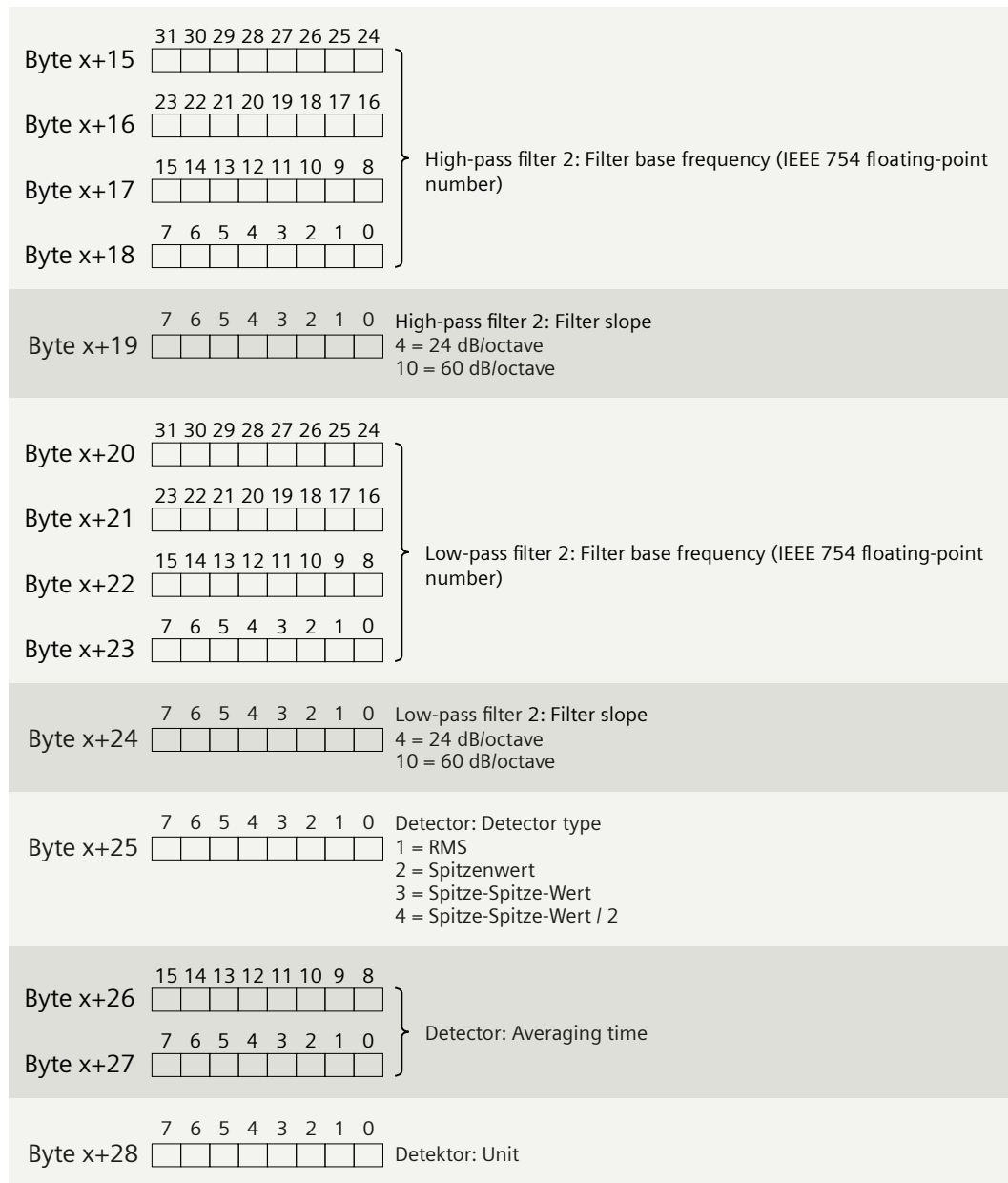


Figure A-18 Data record 129: Structure of bytes x to x+28 for the channels of the function chain 2 channels broadband: 1 x ASV (SUM)

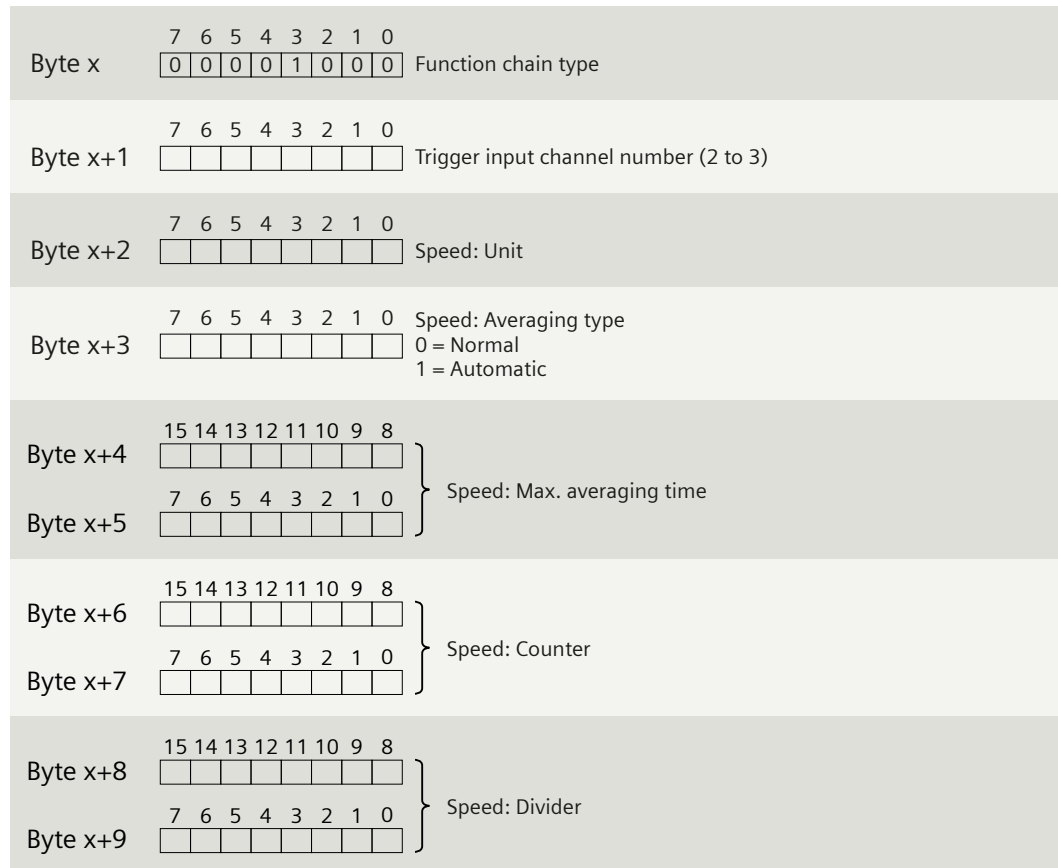
Channel parameters of function chain 1 channel: Speed

Figure A-19 Data record 129: Structure of bytes x to x+9 for the channels of the function chain 1 channel: Speed

Channel parameters of function chain 2 channels: Direction of rotation

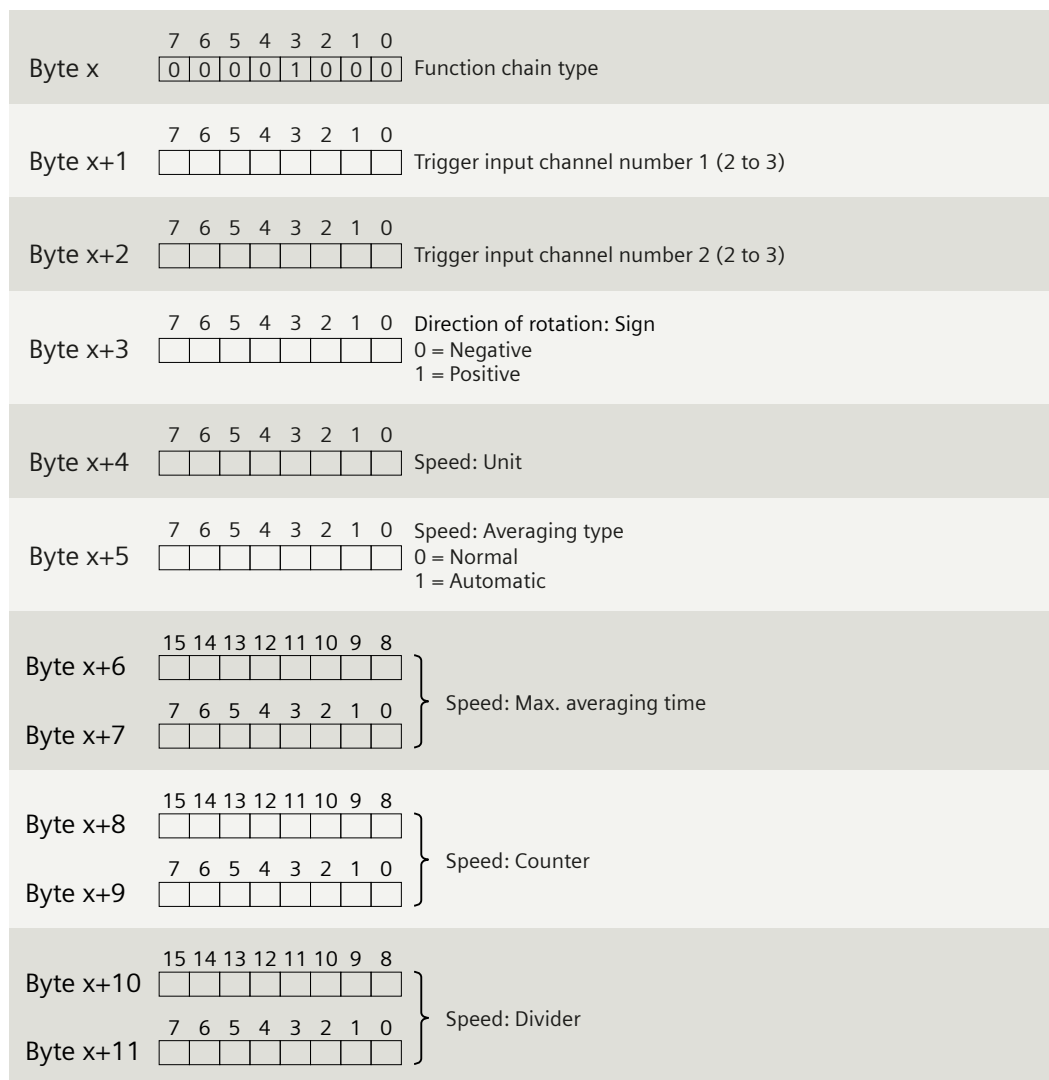


Figure A-20 Data record 129: Structure of bytes x to x+11 for the channels of the function chain 2 channels: Direction of rotation

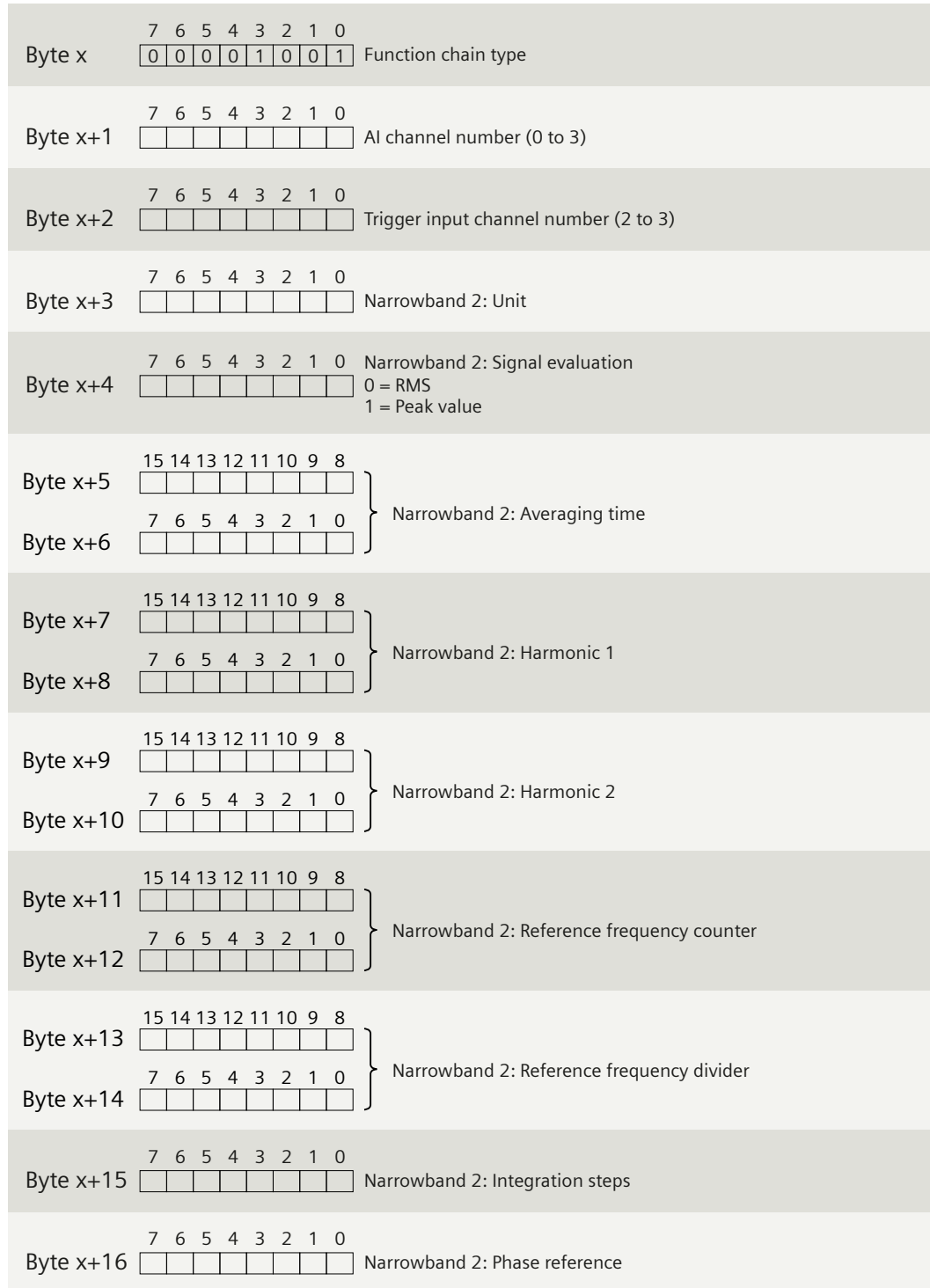
Channel parameters of function chain 2 channels TNB-2N: 2x Pk & 2 x Phase

Figure A-21 Data record 129: Structure of bytes x to x+16 for the channels of the function chain narrowband 2

Channel parameters function chain 1 channel triggered broadband: 1 x PkPk/time

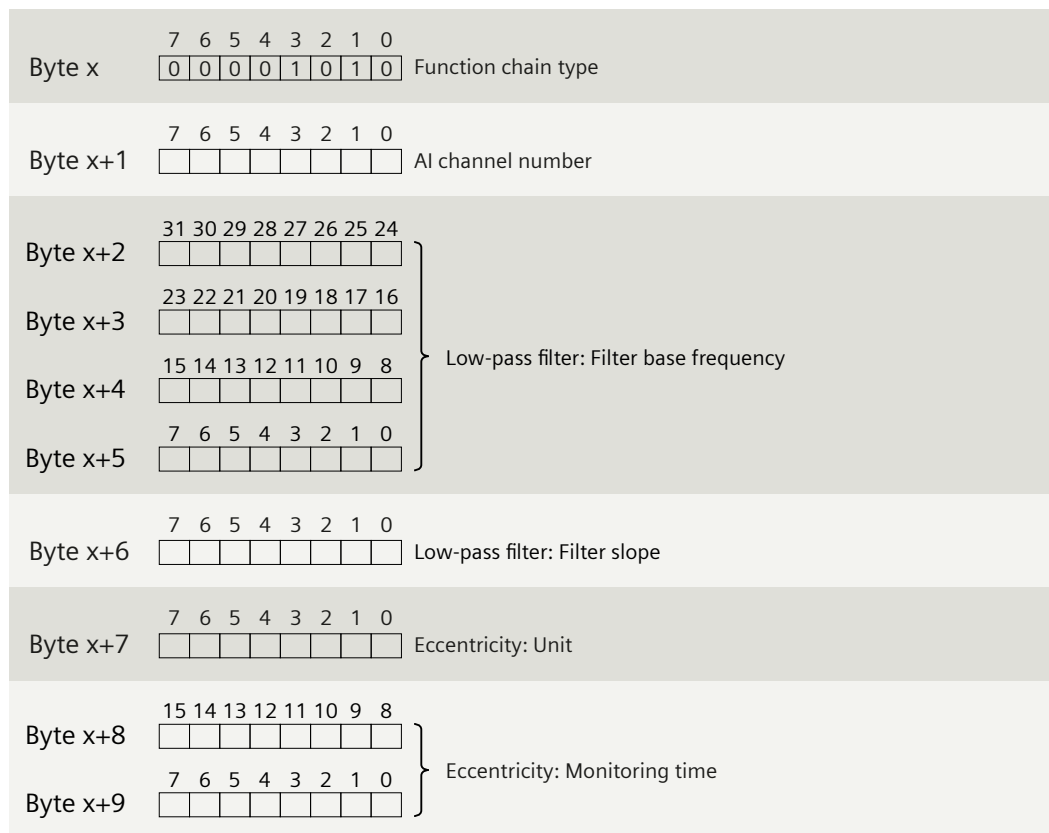


Figure A-22 Data record 129: Structure of byte x to x+9 for channel triggered broadband (1x PKPK/time)

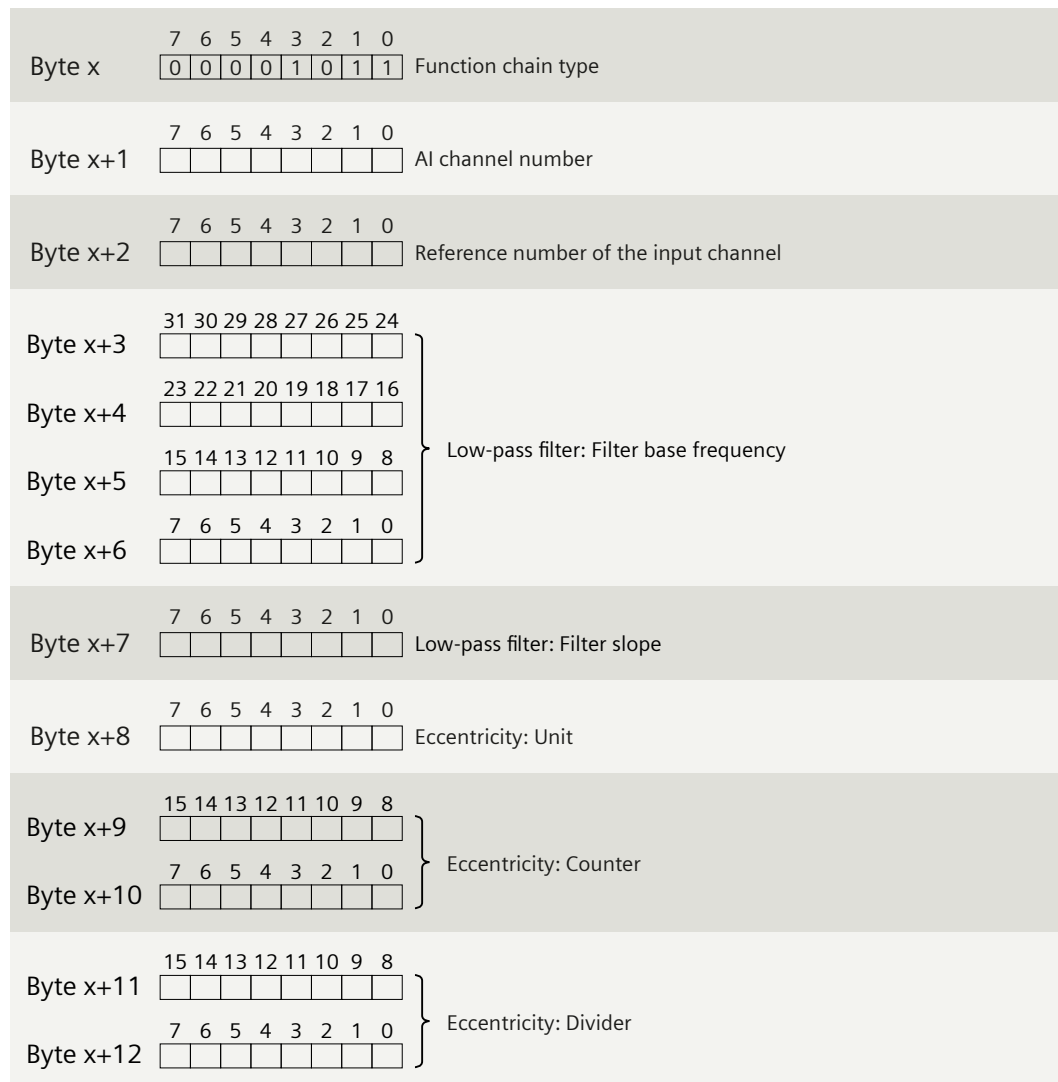
Channel parameters function chain 1 channel triggered broadband: 1 x PkPk/revolution

Figure A-23 Data record 129: Structure of bytes x to x+12 for channel triggered broadband (1x PKPK/revolution)

A.6 Diagnostics messages and maintenance events

Diagnostic messages

A diagnostic message is generated for each detected diagnostic event, and the DIAG LED flashes on the I/O module.

The diagnostics messages can, for example, be read from the diagnostic buffer of the CPU.

A.6 Diagnostics messages and maintenance events

Diagnostics messages are assigned either channel-specific to an input or output or assigned as module message to all inputs or outputs. For diagnostics messages which affect the entire module, all channels are switched off. For diagnostics messages that relate to individual channels, only the corresponding digital output, digital input, analog input or analog output is affected.

Table A-1 Diagnostics messages, their meaning and how to deal with them

Diagnostics message	Error code	Assignment	Meaning/cause	Remedy
Channel/component temporarily unavailable	1F _H	Module	Update of the firmware is being performed or has been canceled. The module does not perform any measurements during this time.	<ul style="list-style-type: none"> Restart firmware update Wait for firmware update
Overtemperature	5 _H	Module	<ul style="list-style-type: none"> Ambient temperature is too high Total current of the digital and analog outputs too high Short-circuit in one or more digital or sensor supplies 	<ul style="list-style-type: none"> Check wiring Check derating/ambient conditions <p>In addition: Eliminate the cause of the excess temperature and restart the module.</p>
Wire break	6 _H	Analog input, analog output, digital input, digital output, speed measurement	<ul style="list-style-type: none"> Wire break between the module and sensor/actuator Channel not connected (open) 	<ul style="list-style-type: none"> Connect the cable Disable diagnostics
High limit violated	7 _H	Analog input, analog output, BUF output	The analog value is above the over-range.	Correct the output value
Low limit violated	8 _H	Analog input, analog output, BUF output	The analog value is below the under-range.	Correct the output value
Parameter assignment error	10 _H	Module	<ul style="list-style-type: none"> Parameter assignment does not match the terminal block used Incorrect parameter assignment 	<ul style="list-style-type: none"> Correct the parameter assignment Check terminal block¹
Supply voltage missing	11 _H	Module	Missing or insufficient supply voltage L+	<ul style="list-style-type: none"> Check wiring of the supply voltage L+ on the terminal block Check the terminal block type
Module is faulty	100 _H	Module	Internal module error has occurred	Replace module
Short-circuit to L+	105 _H	Analog input	Short-circuit of the analog input to sensor supply or L+	Correct process wiring
Short-circuit to M	106 _H	Digital output	Short-circuit of the actuator supply or sensor supply to M. The error is only recognized in the activated state (output value = 1).	Correct process wiring
Short-circuit/overload at external sensor supply	10E _H	Analog input, digital input, speed measurement	<ul style="list-style-type: none"> Short-circuit of the sensor supply to M Overload of the sensor supply 	<ul style="list-style-type: none"> Correct the module/sensor tuning Check the wiring

Diagnostics message	Error code	Assignment	Meaning/cause	Remedy
Switch-off following button operation	122 _H	Module	Off button pressed	Pull module
Inconsistent parameter assignment	123 _H	Module	Error in the redundancy parameters transferred to the module	<ul style="list-style-type: none"> Check the parameter assignment Check the slot and terminal block
Deviation of output signal	127 _H	Analog output	<ul style="list-style-type: none"> A cable to the actuator is broken Actuator inductance is too high Actuator is faulty Rate of change of the output is too high The output driver of the module is faulty Channel not connected (open) 	<ul style="list-style-type: none"> Check the wiring Check the actuator Increase permissible deviation Disable diagnostics Replace module
Internal power supply AI faulty	129 _H	Analog input	Internal power supply of the analog channel is faulty	Replace module
Error during processing of the TM application software	12A _H	Module	Cycle timeout	<ul style="list-style-type: none"> Increase the set cycle time Reduce the application software
Retentive memory in carrier module defective	154 _H	Module	An error of the memory block on the support module was detected during start-up	Replace carrier module
Retentive memory in the terminal block defective	155 _H	Module	An error of the memory block on the terminal block was detected during start-up	Replace terminal block

¹ Only the terminal blocks (TB 45R ...) are suitable for use of technology modules in IO redundancy.

Maintenance events

A maintenance event is generated whenever a maintenance requirement is determined. The MT LED lights up on the module.

Maintenance messages are assigned to all outputs as a module message.

A.7 Address space in operating mode "Fast input and output and counter functions and speed measurement"

Maintenance messages have no direct effect on the function of the module, or the digital inputs/outputs or of analog value acquisition, analog value output.

Table A-2 Maintenance messages, their meaning and possible remedies

Maintenance message	Error code	Assignment	Meaning / Cause	Remedy
Redundancy partner has different hardware/firmware version	120 _H	Module	The redundantly configured and interconnected I/O modules are not compatible	<ul style="list-style-type: none"> Check and replace modules Update firmware
IO redundancy warning	121 _H	Module	Unable to correctly communicate with the partner module	<ul style="list-style-type: none"> Check/replace right module Check/replace left module Check/replace terminal block <p>See also system manual <i>Distributed I/O System; ET 200SP HA</i>, section "Replacing an I/O module for I/O redundancy"</p>
Retentive memory in carrier module defective	154 _H	Module	Fault detected in the data block on the carrier module during operation	Replace carrier module
Retentive memory in the terminal block defective	155 _H	Module	An error of the memory block on the terminal block was detected during operation	Replace terminal block

A.7 Address space in operating mode "Fast input and output and counter functions and speed measurement"

Abbreviations

- "QB" stands for output byte, that is the module start address in the output area
- "ACT" stands for technology module is active (1) or passive (0)
- "DI" stands for digital input
- "DQ" stands for digital output
- "IB" stands for input byte, that is, the module start address in the input area
- "PACT" stands for partner module is active (1) or passive (0)
- "QAI_n" stands for value status (QI) of analog input n
- "QAQ_n" stands for value status (QI) of analog output n
- "QC" stands for Quality Code
- "QCNT_n" stands for value status (QI) of counter n
- "QDI_n" stands for the value status (QI) of digital input n

A.7 Address space in operating mode "Fast input and output and counter functions and speed measurement"

- "QDQn" stands for the value status (QI) of digital output n
- "QFI n" stands for the value status (QI) of the speed measurement n

Address space

The following tables show the allocation of the address space in the following configuration:
Fast input and output and counter functions and speed measurement
(6DL1138-6EA00-0EH1)

If not designated otherwise, all WORD and DWORD entries are integer values.

Input area

Table A-3 Address space in the configuration "Fast input and output"

IB x +	7	6	5	4	3	2	1	0
0...1	Analog value, analog input 0							
:								
6...7	Analog value, analog input 3							
8	Reserved	Reserved	Reserved	Reserved	QAI3	QAI2	QAI1	QAI0
9	DI7	DI6	DI5	DI4	DI3	DI2	DI1	DI0
10	QAQ3	QAQ2	QAQ1	QAQ0	Reserved	ACT	DI9	DI8
11	QDI7	QDI6	QDI5	QDI4	QDI3	QDI2	QDI1	QDI0
12	QDQ5	QDQ4	QDQ3	QDQ2	QDQ1	QDQ0	QDI9	QDI8

Table A-4 Address space in the configuration "Fast input and output and counter functions"

IB x +	7	6	5	4	3	2	1	0
0...1	Analog value, analog input 0							
:								
6...7	Analog value, analog input 3							
8	QCNT3	QCNT2	QCNT1	QCNT0	QAI3	QAI2	QAI1	QAI0
9	DI7	DI6	DI5	DI4	DI3	DI2	DI1	DI0
10	QAQ3	QAQ2	QAQ1	QAQ0	Reserved	ACT	DI9	DI8
11	QDI7	QDI6	QDI5	QDI4	QDI3	QDI2	QDI1	QDI0
12	QDQ5	QDQ4	QDQ3	QDQ2	QDQ1	QDQ0	QDI9	QDI8
Counter channel 0								
13...16	LATCH_LOAD							
17...20	ACT_CNTV							
21	STS_RUN	STS_DIR	STS_ZER O	STS_OF LW	STS_UFL W	STS_SYN C	STS_GAT E	STS_SW_G ATE
22	STS_RES_ ZERO	STS_SET	STS_STA	STS_STP	STS_DQ_ COMP1	STS_DQ_ COMP2	STS_COM P1	STS_COMP 2
23	OT_ERR	Reserved	Reserved	STS_L_DI RECT	STS_L_PR EPAR	STS_T_C MP_V1	STS_T_C MP_V2	STS_RES_S YNC

A.7 Address space in operating mode "Fast input and output and counter functions and speed measurement"

IB x +	7	6	5	4	3	2	1	0
Counter channel 1								
24...27	LATCH_LOAD							
28...31	ACT_CNTV							
32	STS_RUN	STS_DIR	STS_ZER O	STS_OF LW	STS_UFL W	STS_SYN C	STS_GAT E	STS_SW_G ATE
33	STS_RES_ ZERO	STS_SET	STS_STA	STS_STP	STS_DQ_ COMP1	STS_DQ_ COMP2	STS_COM P1	STS_COMP 2
34	OT_ERR	Reserved	Reserved	STS_L_DI RECT	STS_L_PR EPAR	STS_T_C MP_V1	STS_T_C MP_V2	STS_RES_S YNC
Counter channel 2								
35...38	LATCH_LOAD							
39...42	ACT_CNTV							
43	STS_RUN	STS_DIR	STS_ZER O	STS_OF LW	STS_UFL W	STS_SYN C	STS_GAT E	STS_SW_G ATE
44	STS_RES_ ZERO	STS_SET	STS_STA	STS_STP	STS_DQ_ COMP1	STS_DQ_ COMP2	STS_COM P1	STS_COMP 2
45	OT_ERR	Reserved	Reserved	STS_L_DI RECT	STS_L_PR EPAR	STS_T_C MP_V1	STS_T_C MP_V2	STS_RES_S YNC
Counter channel 3								
46...49	LATCH_LOAD							
50...53	ACT_CNTV							
54	STS_RUN	STS_DIR	STS_ZER O	STS_OF LW	STS_UFL W	STS_SYN C	STS_GAT E	STS_SW_G ATE
55	STS_RES_ ZERO	STS_SET	STS_STA	STS_STP	STS_DQ_ COMP1	STS_DQ_ COMP2	STS_COM P1	STS_COMP 2
56	OT_ERR	Reserved	Reserved	STS_L_DI RECT	STS_L_PR EPAR	STS_T_C MP_V1	STS_T_C MP_V2	STS_RES_S YNC

Table A-5 Address space in the configuration "Fast input and output and speed measurement"

IB x +	7	6	5	4	3	2	1	0
0...1	Analog value, analog input 0							
:								
6...7	Analog value, analog input 3							
8	QFI2	QFI1	QFI0	Reserved	QAI3	QAI2	QAI1	QAI0
9	DI7	DI6	DI5	DI4	DI3	DI2	DI1	DI0
10	QAQ3	QAQ2	QAQ1	QAQ0	Reserved	ACT	DI9	DI8
11	QDI7	QDI6	QDI5	QDI4	QDI3	QDI2	QDI1	QDI0
12	QDQ5	QDQ4	QDQ3	QDQ2	QDQ1	QDQ	QDI9	QDI8
13...16	Speed measured value 0 (float)							
17...20	Speed measured value 1 (float)							
21...24	Speed measured value 2 (float)							

A.7 Address space in operating mode "Fast input and output and counter functions and speed measurement"

Output range

Table A-6 Address space in the configuration "Fast input and output"

QB x +	7	6	5	4	3	2	1	0
0...1	Analog value, analog output 0							
:								
6...7	Analog value, analog output 3							
8...9	Analog value, voltage output 0							
:								
14...15	Analog value, voltage output 3							
16	Reserved	PACT	DQ5	DQ4	DQ3	DQ2	DQ1	DQ0

Table A-7 Address space in the configuration "Fast input and output and counter functions"

QB x +	7	6	5	4	3	2	1	0
0...1	Analog value, analog output 0							
:								
6...7	Analog value, analog output 3							
8...9	Analog value, voltage output 0							
:								
14...15	Analog value, voltage output 3							
16	Reserved	PACT	DQ5	DQ4	DQ3	DQ2	DQ1	DQ0
Counter channel 0								
17...20	Load value							
21...24	Comparison value 1							
25...28	Comparison value 2							
29	T_CMP_V 2	T_CMP_V 1	L_PREPAR	L_DIRECT	EN_SET_ DN	EN_SET_ UP	GATE_ST P	SW_GATE
30	OT_ERR_ A	Reserved	Reserved	Reserved	ENA- BLE_DQ1	ENA- BLE_DQ0	RES_ZER O	RES_SYNC
Counter channel 1								
31...34	Load value							
35...38	Comparison value 1							
39...42	Comparison value 2							
43	T_CMP_V 2	T_CMP_V 1	L_PREPAR	L_DIRECT	EN_SET_ DN	EN_SET_ UP	GATE_ST P	SW_GATE
44	OT_ERR_ A	Reserved	Reserved	Reserved	ENA- BLE_DQ1	ENA- BLE_DQ0	RES_ZER O	RES_SYNC
Counter channel 2								
45...48	Load value							
49...52	Comparison value 1							
53...56	Comparison value 2							
57	T_CMP_V 2	T_CMP_V 1	L_PREPAR	L_DIRECT	EN_SET_ DN	EN_SET_ UP	GATE_ST P	SW_GATE

A.8 Address space in operating mode "Fast controllers"

QB x +	7	6	5	4	3	2	1	0
58	OT_ERR_A	Reserved	Reserved	Reserved	ENA-BLE_DQ1	ENA-BLE_DQ0	RES_ZERO	RES_SYNC
Counter channel 3								
59...62	Load value							
63...66	Comparison value 1							
67...70	Comparison value 2							
71	T_CMP_V2	T_CMP_V1	L_PREPAR	L_DIRECT	EN_SET_DN	EN_SET_UP	GATE_STP	SW_GATE
72	OT_ERR_A	Reserved	Reserved	Reserved	ENA-BLE_DQ1	ENA-BLE_DQ0	RES_ZERO	RES_SYNC

Table A-8 Address space in the configuration "Fast input and output and speed measurement"

QB x +	7	6	5	4	3	2	1	0
0...1	Analog value, analog output 0							
:								
6...7	Analog value, analog output 3							
8...9	Analog value, voltage output 0							
:								
14...15	Analog value, voltage output 3							
16	Reserved	PACT	DQ5	DQ4	DQ3	DQ2	DQ1	DQ0

See also

Value status (Page 267)

A.8 Address space in operating mode "Fast controllers"

Abbreviations

- "QB" stands for output byte, that is the module start address in the output area
- "ACT" stands for technology module is active (1) or passive (0)
- "DI" stands for digital input
- "DQ" stands for digital output
- "IB" stands for input byte, that is, the module start address in the input area
- "PACT" stands for partner module is active (1) or passive (0)
- "TM CPU STATE" stands for the state of the execution system for the application software
- "QAI_n" stands for value status (QI) of analog input n
- "QAQ_n" stands for value status (QI) of analog output n

- "QDI_n" stands for the value status (QI) of digital input n
- "QDQ_n" stands for the value status (QI) of digital output n
- "QFI_n" stands for the value status (QI) of the speed measurement n

Address space

The following tables show the allocation of the address space in the following configuration:
Fast controllers (6DL1138-6EB00-0EH1)

If not designated otherwise, all WORD and DWORD entries are integer values.

Input area

Table A-9 Address space in configuration "Fast controllers, small process image"

IB x +	7	6	5	4	3	2	1	0
0...1	Analog value, analog input 0							
:								
6...7	Analog value, analog input 3							
8	Reserved	Reserved	Reserved	Reserved	QAI3	QAI2	QAI1	QAI0
9	DI7	DI6	DI5	DI4	DI3	DI2	DI1	DI0
10	QAQ3	QAQ2	QAQ1	QAQ0	TM CPU STATE	ACT	DI9	DI8
11	QDI7	QDI6	QDI5	QDI4	QDI3	QDI2	QDI1	QDI0
12	QDQ5	QDQ4	QDQ3	QDQ2	QDQ1	QDQ0	QDI9	QDI8
TM CPU outputs								
13...16	Analog value, analog input 0							
:								
37...40	Analog value, analog input 6							
41	DI7	DI6	DI5	DI4	DI3	DI2	DI1	DI0
42	DI15	DI14	DI13	DI12	DI11	DI10	DI9	DI8

Table A-10 Address space in the configuration "Fast controllers and speed measurement, small process image and fast input and output"

IB x +	7	6	5	4	3	2	1	0
0...1	Analog value, analog input 0							
:								
6...7	Analog value, analog input 3							
8	QFI2	QFI1	QFI0	Reserved	QAI3	QAI2	QAI1	QAI0
9	DI7	DI6	DI5	DI4	DI3	DI2	DI1	DI0
10	QAQ3	QAQ2	QAQ1	QAQ0	TM CPU STATE	ACT	DI9	DI8
11	QDI7	QDI6	QDI5	QDI4	QDI3	QDI2	QDI1	QDI0

A.8 Address space in operating mode "Fast controllers"

IB x +	7	6	5	4	3	2	1	0
12	QDQ5	QDQ4	QDQ3	QDQ2	QDQ1	QDQ0	QDI9	QDI8
13...16	Input speed measured value 0 (float)							
17...20	Input speed measured value 1 (float)							
21...24	Input speed measured value 2 (float)							
TM CPU outputs								
25...28	Analog value analog input 0 (float)							
:								
49...52	Analog value analog input 6 (float)							
53	DI7	DI6	DI5	DI4	DI3	DI2	DI1	DI0
54	DI15	DI14	DI13	DI12	DI11	DI10	DI9	DI8

Table A-11 Address space in the configuration "Fast controllers and speed measurement, medium process image and fast input and output"

IB x +	7	6	5	4	3	2	1	0
0...1	Analog value, analog input 0							
:								
6...7	Analog value, analog input 3							
8	QFI2	QFI1	QFI0	Reserved	QAI3	QAI2	QAI1	QAI0
9	DI7	DI6	DI5	DI4	DI3	DI2	DI1	DI0
10	QAQ3	QAQ2	QAQ1	QAQ0	TM CPU STATE	ACT	DI9	DI8
11	QDI7	QDI6	QDI5	QDI4	QDI3	QDI2	QDI1	QDI0
12	QDQ5	QDQ4	QDQ3	QDQ2	QDQ1	QDQ0	QDI9	QDI8
13...16	Input speed measured value 0 (float)							
17...20	Input speed measured value 1 (float)							
21...24	Input speed measured value 2 (float)							
TM CPU outputs								
25...28	Analog value analog input 0 (float)							
:								
77...80	Analog value analog input 13 (float)							
81	DI7	DI6	DI5	DI4	DI3	DI2	DI1	DI0
:								
84	DI31	DI30	DI29	DI28	DI27	DI26	DI25	DI24

Table A-12 Address space in the configuration "Fast controllers and speed measurement, large process image and fast input and output"

IB x +	7	6	5	4	3	2	1	0
0...1	Analog value, analog input 0							
:								
6...7	Analog value, analog input 3							

IB x +	7	6	5	4	3	2	1	0
8	QFI2	QFI1	QFI0	Reserved	QAI3	QAI2	QAI1	QAI0
9	DI7	DI6	DI5	DI4	DI3	DI2	DI1	DI0
10	QAQ3	QAQ2	QAQ1	QAQ0	TM CPU STATE	ACT	DI9	DI8
11	QDI7	QDI6	QDI5	QDI4	QDI3	QDI2	QDI1	QDI0
12	QDQ5	QDQ4	QDQ3	QDQ2	QDQ1	QDQ0	QDI9	QDI8
13...16	Input speed measured value 0 (float)							
17...20	Input speed measured value 1 (float)							
21...24	Input speed measured value 2 (float)							
TM CPU outputs								
25...28	Analog value analog input 0 (float)							
:								
133...136	Analog value analog input 27 (float)							
137	DI7	DI6	DI5	DI4	DI3	DI2	DI1	DI0
:								
144	DI63	DI62	DI61	DI60	DI59	DI58	DI57	DI56

Output range

Table A-13 Address space in configuration "Fast controllers, small process image"

QB x +	7	6	5	4	3	2	1	0
0...1	Analog value, analog output 0							
:								
6...7	Analog value, analog output 3							
8...9	Analog value, voltage output 0							
:								
14...15	Analog value, voltage output 3							
16	Reserved	PACT	DQ5	DQ4	DQ3	DQ2	DQ1	DQ0
TM CPU inputs								
17...20	Analog value analog output 0 (float)							
:								
33...36	Analog value analog output 4 (float)							
37	DQ7	DQ6	DQ5	DQ4	DQ3	DQ2	DQ1	DQ0
38	DQ15	DQ14	DQ13	DQ12	DQ11	DQ10	DQ9	DQ8

Table A-14 Address space in the configuration "Fast controllers and speed measurement, small process image and fast input and output"

QB x +	7	6	5	4	3	2	1	0
0...1	Analog value, analog output 0							
:								
6...7	Analog value, analog output 3							
8...9	Analog value, voltage output 0							
:								
14...15	Analog value, voltage output 3							
16	Reserved	PACT	DQ5	DQ4	DQ3	DQ2	DQ1	DQ0
TM CPU inputs								
17...20	Analog value analog output 0 (float)							
:								
33...36	Analog value analog output 4 (float)							
37	DQ7	DQ6	DQ5	DQ4	DQ3	DQ2	DQ1	DQ0
38	DQ15	DQ14	DQ13	DQ12	DQ11	DQ10	DQ9	DQ8

Table A-15 Address space in the configuration "Fast controllers and speed measurement, medium process image and fast input and output"

QB x +	7	6	5	4	3	2	1	0
0...1	Analog value, analog output 0							
:								
6...7	Analog value, analog output 3							
8...9	Analog value, voltage output 0							
:								
14...15	Analog value, voltage output 3							
16	Reserved	PACT	DQ5	DQ4	DQ3	DQ2	DQ1	DQ0
TM CPU inputs								
17...20	Analog value analog output 0 (float)							
:								
53...56	Analog value analog output 9 (float)							
57	DQ7	DQ6	DQ5	DQ4	DQ3	DQ2	DQ1	DQ0
:								
60	DQ31	DQ30	DQ29	DQ28	DQ27	DQ26	DQ25	DQ24

Table A-16 Address space in the configuration "Fast controllers and speed measurement, large process image and fast input and output"

QB x +	7	6	5	4	3	2	1	0
0...1	Analog value, analog output 0							
:								
6...7	Analog value, analog output 3							
8...9	Analog value, voltage output 0							
:								
14...15	Analog value, voltage output 3							
16	Reserved	PACT	DQ5	DQ4	DQ3	DQ2	DQ1	DQ0
TM CPU inputs								
17...20	Analog value analog output 0 (float)							
:								
93...96	Analog value analog output 19 (float)							
97	DQ7	DQ6	DQ5	DQ4	DQ3	DQ2	DQ1	DQ0
:								
104	DQ63	DQ62	DQ61	DQ60	DQ59	DQ58	DQ57	DQ56

See also

Value status (Page 267)

A.9 Address space in operating mode "Vibration protection"

Abbreviations

- "IB" stands for input byte, that is, the module start address in the input area
- "QB" stands for output byte, that is the module start address in the output area
- "DI" stands for digital input
- "TM CPU STATE" stands for the state of the execution system for the application software and function chains
- "QDI_n" stands for the value status (QI) of digital input n
- "QDQ_n" stands for the value status (QI) of digital output n
- "QAI_n" stands for value status (QI) of analog input n
- "QAA_n" stands for value status (QI) of analog output n
- "QCV_nMC_n" stands for value status (QI) of the characteristic value n and function chain n

Address space

The following tables show the allocation of the address space in the following configuration:
Vibration protection (6DL1138-6EC00-0EH1)

If not designated otherwise, all WORD and DWORD entries are integer values.

Input area

Table A-17 Address space in the configuration "Fast input and output (without AI) and 4 vibration protection function chains"

IB x +	7	6	5	4	3	2	1	0
0	Reserved	Reserved	Reserved	Reserved	QAI3	QAI2	QAI1	QAI0
1	DI7	DI6	DI5	DI4	DI3	DI2	DI1	DI0
2	QAQ3	QAQ2	QAQ1	QAQ0	TM CPU STATE	Reserved	DI9	DI8
3	QDI7	QDI6	QDI5	QDI4	QDI3	QDI2	QDI1	QDI0
4	QDQ5	QDQ4	QDQ3	QDQ2	QDQ1	QDQ0	QDI9	QDI8
5...8	Characteristic value 1, function chain 1 (float)							
9...12	Characteristic value 2, function chain 1 (float)							
13...16	Characteristic value 3, function chain 1 (float)							
17...20	Characteristic value 4, function chain 1 (float)							
:								
65...68	Characteristic value 4, function chain 4 (float)							
69	QCV4MC 2	QCV3MC 2	QCV2MC 2	QCV1MC 2	QCV4MC 1	QCV3MC 1	QCV2MC 1	QCV1MC 1
70	QCV4MC 4	QCV3MC 4	QCV2MC 4	QCV1MC 4	QCV4MC 3	QCV3MC 3	QCV2MC 3	QCV1MC 3

Table A-18 Address space in the configuration "Fast input and output (without AI) and 8 vibration protection function chains"

IB x +	7	6	5	4	3	2	1	0
0	Reserved	Reserved	Reserved	Reserved	QAI3	QAI2	QAI1	QAI0
1	DI7	DI6	DI5	DI4	DI3	DI2	DI1	DI0
2	QAQ3	QAQ2	QAQ1	QAQ0	TM CPU STATE	Reserved	DI9	DI8
3	QDI7	QDI6	QDI5	QDI4	QDI3	QDI2	QDI1	QDI0
4	QDQ5	QDQ4	QDQ3	QDQ2	QDQ1	QDQ0	QDI9	QDI8
5...8	Characteristic value 1, function chain 1 (float)							
9...12	Characteristic value 2, function chain 1 (float)							
13...16	Characteristic value 3, function chain 1 (float)							
17...20	Characteristic value 4, function chain 1 (float)							
:								
129...132	Characteristic value 4, function chain 8 (float)							

IB x +	7	6	5	4	3	2	1	0
133	QCV4MC 2	QCV3MC 2	QCV2MC 2	QCV1MC 2	QCV4MC 1	QCV3MC 1	QCV2MC 1	QCV1MC 1
134	QCV4MC 4	QCV3MC 4	QCV2MC 4	QCV1MC 4	QCV4MC 3	QCV3MC 3	QCV2MC 3	QCV1MC 3
135	QCV4MC 6	QCV3MC 6	QCV2MC 6	QCV1MC 6	QCV4MC 5	QCV3MC 5	QCV2MC 5	QCV1MC 5
136	QCV4MC 8	QCV3MC 8	QCV2MC 8	QCV1MC 8	QCV4MC 7	QCV3MC 7	QCV2MC 7	QCV1MC 7

Table A-19 Address space in the configuration "Fast input and output and 4 vibration protection function chains"

IB x +	7	6	5	4	3	2	1	0
0...1	Analog value, analog input 0							
2...3	Analog value, analog input 1							
4...5	Analog value, analog input 2							
6...7	Analog value, analog input 3							
8	Reserved	Reserved	Reserved	Reserved	QAI3	QAI2	QAI1	QAI0
9	DI7	DI6	DI5	DI4	DI3	DI2	DI1	DI0
10	QAQ3	QAQ2	QAQ1	QAQ0	TM CPU STATE	Reserved	DI9	DI8
11	QDI7	QDI6	QDI5	QDI4	QDI3	QDI2	QDI1	QDI0
12	QDQ5	QDQ4	QDQ3	QDQ2	QDQ1	QDQ0	QDI9	QDI8
13...16	Characteristic value 1, function chain 1 (float)							
17...20	Characteristic value 2, function chain 1 (float)							
21...24	Characteristic value 3, function chain 1 (float)							
25...28	Characteristic value 4, function chain 1 (float)							
:								
73...76	Characteristic value 4, function chain 4 (float)							
77	QCV4MC 2	QCV3MC 2	QCV2MC 2	QCV1MC 2	QCV4MC 1	QCV3MC 1	QCV2MC 1	QCV1MC 1
78	QCV4MC 4	QCV3MC 4	QCV2MC 4	QCV1MC 4	QCV4MC 3	QCV3MC 3	QCV2MC 3	QCV1MC 3

Table A-20 Address space in the configuration "Fast input and output and 8 vibration protection function chains"

IB x +	7	6	5	4	3	2	1	0
0...1	Analog value, analog input 0							
2...3	Analog value, analog input 1							
4...5	Analog value, analog input 2							
6...7	Analog value, analog input 3							
8	Reserved	Reserved	Reserved	Reserved	QAI3	QAI2	QAI1	QAI0

A.9 Address space in operating mode "Vibration protection"

IB x +	7	6	5	4	3	2	1	0
9	DI7	DI6	DI5	DI4	DI3	DI2	DI1	DI0
10	QAQ3	QAQ2	QAQ1	QAQ0	TM CPU STATE	Reserved	DI9	DI8
11	QDI7	QDI6	QDI5	QDI4	QDI3	QDI2	QDI1	QDI0
12	QDQ5	QDQ4	QDQ3	QDQ2	QDQ1	QDQ0	QDI9	QDI8
13...16	Characteristic value 1, function chain 1 (float)							
17...20	Characteristic value 2, function chain 1 (float)							
21...24	Characteristic value 3, function chain 1 (float)							
25...28	Characteristic value 4, function chain 1 (float)							
:								
137...140	Characteristic value 4, function chain 8 (float)							
141	QCV4MC 2	QCV3MC 2	QCV2MC 2	QCV1MC 2	QCV4MC 1	QCV3MC 1	QCV2MC 1	QCV1MC 1
142	QCV4MC 4	QCV3MC 4	QCV2MC 4	QCV1MC 4	QCV4MC 3	QCV3MC 3	QCV2MC 3	QCV1MC 3
143	QCV4MC 6	QCV3MC 6	QCV2MC 6	QCV1MC 6	QCV4MC 5	QCV3MC 5	QCV2MC 5	QCV1MC 5
144	QCV4MC 8	QCV3MC 8	QCV2MC 8	QCV1MC 8	QCV4MC 7	QCV3MC 7	QCV2MC 7	QCV1MC 7

Output range

The same output range of the address space is in effect for the following configurations:

- Fast input and output (without AI) and 4 vibration protection function chains
- Fast input and output (without AI) and 8 vibration protection function chains
- Fast input and output and 4 vibration protection function chains
- Fast input and output and 8 vibration protection function chains

QB x +	7	6	5	4	3	2	1	0
0...1	Analog value, analog output 0							
2...3	Analog value, analog output 1							
4...5	Analog value, analog output 2							
6...7	Analog value, analog output 3							
8...9	Analog value, voltage output 0							
10...11	Analog value, voltage output 1							
12...13	Analog value, voltage output 2							
14...15	Analog value, voltage output 3							
16	Reserved	Reserved	DQ5	DQ4	DQ3	DQ2	DQ1	DQ0

See also

Value status (Page 267)

A.10 Value status

The value status provides information on the state of the process value. If the process value is OK, it is "good". If the process value is not OK, it is "bad".

Evaluating value status

There is a bit value status for each DI, DI/DQ, AI, AQ, counter and speed measurement channel in the input address space.

Irrespective of the diagnostics enables, each value status (each QI bit) provides information on the validity of the corresponding process value.

- Value status = 1: Process value okay, "good"
- Value status = 0: Process value not OK, "bad"

Value status of the digital outputs (QDIDQx)

Generally, the value status is set to "good" when the process value can be output without errors. The value status is set to "bad" in the following cases:

- The process value cannot be output as a result of an error
- The digital output is disabled or configured as digital input or assigned to the sensor supply, counter function or speed measurement.

Note

The value status is not set to "bad" when there is a wire break on the DQ channel and the DQ wire break diagnostics is disabled.

Value status of the digital inputs (QDIx or DIDQ-DIx)

The value status is set to "good" when the process value can be acquired without errors. The value status is set to "bad" in the following cases:

- The process value cannot be acquired as a result of an error
- The digital input is disabled or configured as digital output or assigned to the counter function or speed measurement.

Value status of the analog inputs (QAIx)

Generally, the value status is set to "good" when the analog value can be acquired without error. The value status is set to "bad" in the following cases:

- The analog value cannot be acquired as a result of an error
- The analog input is disabled

Value status of the analog outputs (QAQx)

Generally, the value status is set to "good" when the process value can be output without errors. The value status is set to "bad" in the following cases:

- The value range is incorrect (exceeded/undershot).
- A wire break was detected.
- An output current deviation was detected.
- The analog output is deactivated.

Note

The value status is not set to "bad" when there is a current deviation on the AQ channel and the output current monitoring is disabled.

Value status of the counter (QCNTx)

The value status is generally set to "good" when the counter channel is configured. The value status is set to "bad" in the following cases:

- The channel is not configured.
- There is a module-internal connection fault.

Value status of the speed measurement (QFix)

The value status is generally set to "good" when the speed channel is configured. The value status is set to "bad" in the following cases:

- The channel is not configured.
- There is a module-internal connection fault.

Analog value display

B.1 Representation of analog values AI current measuring ranges

Bipolar analog inputs

Table B-1 Representation / current measuring ranges -20 to 20 mA

Values		Current measuring range	Range
Dec.	Hex.	-20 to 20 mA	
32767	7FFF	>23.53 mA	Overflow
32511	7EFF	23.52 mA	Overrange
27649	6C01		
27648	6C00	20 mA	Nominal range
20736	5100	15 mA	
1	1	723.4 nA	
0	0	0 mA	
-1	FFFF	-723.4 nA	
-20736	AF00	-15 mA	
-27648	9400	-20 mA	
-27649	93FF		Underrange
-32512	8100	-23.52 mA	
-32768	8000	<-23.52 mA	Underflow

Table B-2 Representation / current measuring ranges -30 to 30 mA

Values		Current measuring range	Range
Dec.	Hex.	-30 to 30 mA	
32767	7FFF	>35.28 mA	Overflow
32511	7EFF	35.28 mA	Overrange
27649	6C01		
27648	6C00	30 mA	Nominal range
20736	5100	22.5 mA	
1	1	1085.1 nA	
0	0	0 mA	
-1	FFFF	-1085.1 nA	
-20736	AF00	-22.5 mA	
-27648	9400	-30 mA	

Values		Current measuring range	Range
-27649	93FF		Underrange
-32512	8100	-35.28 mA	
-32768	8000	<-35.28 mA	Underflow

Unipolar analog inputs

Table B-3 Representation / current measuring ranges 0 to 20 mA

Values		Current measuring range	Range
Dec.	Hex.	0 to 20 mA	
32767	7FFF	>23.52 mA	Overflow
32511	7EFF	23.52 mA	Overrange
27649	6C01		
27648	6C00	20 mA	Nominal range
20736	5100	15 mA	
1	1	723.4 nA	
0	0	0 mA	
-1	FFFF		
-4864	ED00	-3.52 mA	Underrange
-32768	8000	<-3.52 mA	
			Underflow

Table B-4 Representation / current measuring range 4 to 20 mA

Values		Current measuring range	Range
Dec.	Hex.	4 to 20 mA	
32767	7FFF	>22.81 mA	Overflow
32511	7EFF	22.81 mA	Overrange
27649	6C01		
27648	6C00	20 mA	Nominal range
20736	5100	16 mA	
1	1	4 mA + 578.7 mA	
0	0	4 mA	
-1	FFFF		
-4864	ED00	1.185 mA	Underrange
-32768	8000	< 1.185 mA	
			Underflow

Table B-5 Representation / current measuring range -20 to 0 mA

Values		Current measuring range	Range
Dec.	Hex.	-20 to 0 mA	
32767	7FFF	>3.53 mA	Overflow
32511	7EFF	3.52 mA	Overrange
27649	6C01		
27648	6C00	0 mA	
20736	5100	-5 mA	Nominal range
1	1	-20 mA + 723.4 mA	
0	0	-20 mA	
-1	FFFF		Underrange
-4864	ED00	-23.52 mA	
-32768	8000	<-23.52 mA	Underflow

B.2 Representation of analog values AI voltage measurement ranges

Unipolar analog inputs

Table B-6 Representation / voltage measuring range 0 to 10 V

Values		Voltage measuring range	Range
Dec.	Hex.	0 to 10 V	
32767	7FFF	>11.76 V	Overflow
32511	7EFF	11.76 V	Overrange
27649	6C01		
27648	6C00	10 V	
20736	5100	7.5 V	Nominal range
1	1	361.7 µV	
0	0	0 V	
-1	FFFF		Underrange
-4864	ED00	-1.76 V	
-32768	8000	<-1.76 V	Underflow

Table B-7 Representation / voltage measuring range 0 to 20 V

Values		Voltage measuring range	Range
Dec.	Hex.	0 to 20 V	
32767	7FFF	> 23.52 V	Overflow

Values		Voltage measuring range	Range
32511	7FFF	23.52 V	Ovrange
27649	6C01		
27648	6C00	20 V	Nominal range
20736	5100	15 V	
1	1	723.4 μ V	
0	0	0 V	
-1	FFFF		Underrange
-4864	ED00	-3.52 V	
-32768	8000	<-3.52 V	Underflow

Table B-8 Representation / voltage measuring range -20 to 0 V

Values		Voltage measuring range	Range
Dec.	Hex.	-20 to 0 V	
32767	7FFF	>3.53 V	Overflow
32511	7EFF	3.52 V	Ovrange
27649	6C01		
27648	6C00	0 V	Nominal range
20736	5100	-5 V	
1	1	-20 V + 723.4 μ V	
0	0	-20 V	
-1	FFFF		Underrange
-4864	ED00	-23.52 V	
-32768	8000	<-23.52 V	Underflow

Bipolar analog inputs

Table B-9 Representation / voltage measuring range -10 to +10 V

Values		Voltage measuring range	Range
Dec.	Hex.	0 to 10 V	
32767	7FFF	>11.76 V	Overflow
32511	7EFF	11.76 V	Ovrange
27649	6C01		
27648	6C00	10 V	Nominal range
20736	5100	7.5 V	
1	1	361.7 μ V	
0	0	0 V	
-1	FFFF	-361.7 μ V	
-20736	AF00	-7.5 V	
-27648	9400	-10 V	

Values		Voltage measuring range	Range
-27649	93FF		Underrange
-32512	8100	-11.76 V	
-32768	8000	<-11.76 V	Underflow

B.3 Representation of analog values AI current outputs

Bipolar output ranges

Table B-10 Representation / current measuring range -20 to 20 mA

Values		Current measuring range	Range
Dec.	Hex.	-20 to 20 mA	
32767	7FFF	>23.53 mA	Overflow
32511	7EFF	23.52 mA	Overrange
27649	6C01		
27648	6C00	20 mA	Nominal range
20736	5100	15 mA	
1	1	723.4 nA	
0	0	0 mA	
-1	FFFF	-723.4 nA	
-20736	AF00	-15 mA	
-27648	9400	-20 mA	
-27649	93FF		Underrange
-32512	8100	-23.52 mA	
-32768	8000	<-23.52 mA	Underflow

Table B-11 Representation / current measuring range -30 to 30 mA

Values		Current measuring range	Range
Dec.	Hex.	-30 to 30 mA	
32767	7FFF	>35.28 mA	Overflow
32511	7EFF	35.28 mA	Overrange
27649	6C01		

Values		Current measuring range	Range
27648	6C00	30 mA	Nominal range
20736	5100	22.5 mA	
1	1	1085.1 nA	
0	0	0 mA	
-1	FFFF	-1085.1 nA	
-20736	AF00	-22.5 mA	
-27648	9400	-30 mA	
-27649	93FF		Underrange
-32512	8100	-35.28 mA	
-32768	8000	<-35.28 mA	Underflow

Table B-12 Representation / current measuring range -50 to 50 mA

Values		Current measuring range	Range
Dec.	Hex.	-50 to 50 mA	
32767	7FFF	>58.79 mA	Overflow
32511	7EFF	58.79 mA	Overrange
27649	6C01		
27648	6C00	50 mA	Nominal range
20736	5100	37.5 mA	
1	1	1808.4 nA	
0	0	0 mA	
-1	FFFF	-1808.4 nA	
-20736	AF00	-37.5 mA	
-27648	9400	-50 mA	
-27649	93FF		Underrange
-32512	8100	-58.79 mA	
-32768	8000	<-58.79 mA	Underflow

Unipolar output ranges

Table B-13 Representation / current measuring range 0 to 20 mA

Values		Current measuring range	Range
Dec.	Hex.	0 to 20 mA	
32767	7FFF	>23.52 mA	Overflow
32511	7EFF	23.52 mA	Overrange
27649	6C01		

Values		Current measuring range	Range
27648	6C00	20 mA	Nominal range
20736	5100	15 mA	
1	1	723.4 nA	
0	0	0 mA	
-1	FFFF	0 mA	Underrange
-6912	E500	0 mA	
-32768	8000	0 mA	Underflow

Table B-14 Representation / current measuring range 4 to 20 mA

Values		Current measuring range	Range
Dec.	Hex.	4 to 20 mA	
32767	7FFF	>22.81 mA	Overflow
32511	7EFF	22.81 mA	Overrange
27649	6C01		
27648	6C00	20 mA	
20736	5100	16 mA	Nominal range
1	1	4 mA + 578.7 nA	
0	0	4 mA	
-1	FFFF	4 mA – 578.7 nA	
-6912	E500	0 mA	Underrange
-32768	8000	0 mA	
			Underflow

B.4 Representation of analog values BUF voltage outputs

Bipolar voltage ranges

Table B-15 Representation / output range -10 to 10 V

Values		Output range	Range
Dec.	Hex.	-10 to 10 V	
32767	7FFF	>11.76 V	Overflow
32511	7EFF	11.76 V	Overrange
27649	6C01		

B.4 Representation of analog values BUF voltage outputs

Values		Output range	Range
27648	6C00	10 V	Nominal range
20736	5100	7.5 V	
1	1	361.7 μ V	
0	0	0 V	
-1	FFFF	-361.7 μ V	
-20736	AF00	-7.5 V	
-27648	9400	-10 V	
-27649	93FF		Underrange
-32512	8100	-11.76 V	
-32768	8000	<-11.76 V	Underflow

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