



Your Global Automation Partner

BL20-E-1CNT

BL20 Counter Module

Instructions for Use

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1 About these Instructions

These instructions describe the setup, functions and use of the product and help you to operate the product according to its intended purpose. Read these instructions carefully before using the product. This will prevent the risk of personal injury and damage to property. Keep these instructions safe during the service life of the product. If the product is passed on, pass on these instructions as well.

1.1 Target groups

These instructions are written for specifically trained personnel and must be read carefully by anyone entrusted with the installation, commissioning, operation, maintenance, disassembly or disposal of the device.

When using the device in Ex areas, the user must also have knowledge of explosion protection (IEC/EN 60079-14 etc.).

1.2 Explanation of symbols

The following symbols are used in these instructions:



DANGER

DANGER indicates a hazardous situation with a high level of risk, which, if not avoided, will result in death or serious injury.



WARNING

WARNING indicates a hazardous situation with a medium level of risk, which, if not avoided, will result in death or serious injury.



CAUTION

CAUTION indicates a hazardous situation with a medium level of risk, which, if not avoided, will result in moderate or minor injury.



NOTICE

CAUTION indicates a situation which, if not avoided, may cause damage to property.



NOTE

NOTE indicates tips, recommendations and important information about special action steps and issues. The notes simplify your work and help you to avoid additional work.



MANDATORY ACTION

This symbol denotes actions that the user must carry out.



RESULT OF ACTION

This symbol denotes the relevant results of an action.

1.3 Other documents

Besides this document, the following material can be found on the Internet at www.turck.com:

- Data sheet
- Instruction for use for BL20gateways
- Instruction for use for BL20 I/O modules
- Declarations of conformity (current version)
- Approvals

1.4 Feedback about these instructions

We make every effort to ensure that these instructions are as informative and as clear as possible. If you have any suggestions for improving the design or if some information is missing in the document, please send your suggestions to techdoc@turck.com.

2 Notes on the product

2.1 Product identification

These instructions are valid for the following BL20 counter module:

- BL20-E-1CNT

2.2 Scope of delivery

The delivery consists of the following:

- Counter module
- Quick Start Guide

2.3 Turck service

Turck supports you in your projects – from the initial analysis right through to the commissioning of your application. The Turck product database at www.turck.com offers you several software tools for programming, configuring or commissioning, as well as data sheets and CAD files in many export formats.

The contact data for Turck branches is provided at [► 88].

3 For your safety

The product is designed according to state of the art technology. Residual hazards, however, still exist. Observe the following safety instructions and warnings in order to prevent danger to persons and property. Turck accepts no liability for damage caused by failure to observe these safety instructions.

3.1 Intended use

The BL20 counter module is part of the BL20 system and is used for connecting a pulse encoder for counting 24 VDC signals (11...30 VDC) up to a frequency of 200 kHz. The data collected in the counter module is forwarded via the internal module bus of the BL20 station to the BL20 gateway and from there to the higher-level controller.

Many components of the BL20 system are suitable for use in Zone 2. When used in Zone 2, only use BL20 components that are approved and marked for use in Zone 2.

The device must only be used as described in these instructions. Any other use is not in accordance with the intended use. Turck accepts no liability for any resulting damage.

3.2 General safety instructions

- The device must only be fitted, installed, operated, parameterized and maintained by trained and qualified personnel.
- Only use the device in compliance with the applicable national and international regulations, standards and laws.
- The device meets the EMC requirements for the industrial areas. When used in residential areas, take measures to prevent radio frequency interference.

3.3 Notes on Ex protection

- When using the device in Ex areas, the user must have knowledge of explosion protection (IEC/EN 60079-14 etc.).
- Observe national and international regulations for explosion protection.
- Only use the device within the permissible operating and ambient conditions (see certification data and Ex approval specifications).

3.4 Ex approval requirements for use in Ex area

- Mount the device in a housing according to EN IEC 60079-0 with a protection class of at least IP54 according to IEC/EN 60529.
- Only use the device in an area of not more than pollution degree 2.
- Only open the housing if there is no potentially explosive atmosphere.

3.5 Notes on UL approval

- Use copper conductors only.
- The connection lines must be designed for a temperature of at least 75 °C.

4 Product description

The BL20 counter module BL20-E-1CNT has ten tension spring connection terminals for connecting 24 VDC encoders (incremental encoders and pulse encoders).

The BL20 module provides the power supply for encoders with 24 VDC.

The device can process signals generated from the following sensors:

- 24 VDC incremental encoder with two 90° phase-shifted channels
- 24 VDC pulse encoders with and without direction level, e.g. photoelectric sensors for piece goods counting

The digital output is used to output a comparison state or for direct control, e.g. to issue a hardware release of the counting, or for measuring process or to initiate the synchronization as well as the latch retrigger function.

The BL20-E-1CNT counter module is functionally compatible with the predecessor module BL20-1CNT-24VDC to a large extent and can be used as a replacement for the predecessor module. For more detailed information, please refer to the chapter "Commissioning the device as a replacement for BL20-1CNT-24VDC" ► 38].

4.1 Device overview

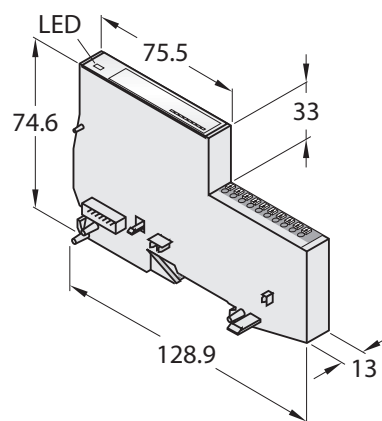


Fig. 1: Device overview BL20-E-1CNT

4.1.1 Display elements

The unit has the following LED indicators:

- Sensor supply
- Status:
 - Counter input, measuring input, direction input
 - Digital channels
 - Module bus communication
- Diagnostics

4.3 Operating principle

In count mode, the counter module counts signals from 24 VDC encoders. In measurement mode, the module measures frequencies of frequency transmitters. The measured values are forwarded to the gateway via the internal module bus.

4.4 Functions and operating modes

4.4.1 Count mode

The device supports the following count modes:

- Continuous count [► 43]
This operating mode is used, for example, for position measurement with 24 VDC incremental encoders.
The counter counts continuously between the upper and lower count limits from the load value after release (hardware or software release).
- Single count [► 44]
This operating mode is used, for example, to count piece goods up to a maximum limit.
The counter counts once from the load value to the upper or lower end value depending on the parameterized main count direction after release (hardware or software release).
- Periodical count [► 48]
This operating mode is e.g. suitable for applications with repeated counting processes.
The counter counts after release (hardware or software release) depending on the parameterized main counting direction within the parameterized counting range.

Maximum count range

- Upper count limit: $2^{31}-1 = +2\,147\,483\,647$
- Lower count limit: $-2^{31} = -2\,147\,483\,648$

Limit values

The following conditions must be fulfilled in order to ensure that internal events and external events are processed correctly. Internal events are, for example, the loading of the counter when a limit value is reached or the switching of the reference value at the output. External events are the count signal (A) and or the direction signal (B):

- Minimum number of count pulses between two events [► 71]
- Minimum time interval between direction signal (B) and count signal (A) [► 71]

Main count direction

The main count direction determines the behavior of the counter when a parameterized count limit is reached. On reaching a count limit, the count value jumps to a defined value. Three different values are possible:

- Lower limit
- Upper limit
- Load value

Which of the three values the counter accepts when a parameterized count limit is reached depends not only on the main count direction but also on the selected operating mode (continuous count, single count or periodical count) [► 72].

4.4.2 Measurement mode

The device supports the following measurement modes:

- Frequency measurement
The module determines the frequency from the number of pulses arriving within a defined integration time.
- Rotational speed measurement
The module determines the speed of a connected motor based on the defined encoder pulses per revolution of the encoder and the actually counted pulses within a defined integration time.
- Period duration measurement
The module measures the time between two rising edges of the counter signal in ms and determines a period duration by averaging.

Limit values

The limit values can be defined by parameterization and also subsequently via the control interface (process output data). The limit values differ depending on the measuring mode and whether they are defined via parameterization or via the process output data.

- Limit values for frequency measurement [► 61]
- Limit values for rotational speed measurement [► 62]
- Limit values for period duration measurement [► 63]

4.4.3 Release

A release signal is required in order to start counting resp. measuring. The counter module controls the starting and stopping of the counting or measuring operation via gates. To enable this control by software via the process output data (control interface) as well as via a physical output, a software gate and a hardware gate exist [► 51].

4.4.4 Synchronization

When synchronization is activated, the counter value is synchronized with the load value. A rising edge of a reference signal at the input triggers the synchronization. Synchronization distinguishes between one-time and periodic synchronization [► 53].

4.4.5 Latch-retrigger function

The latch-retrigger function [► 52] enables the event-driven evaluation of the count. The current internal counter value of the electronic module is held with an edge at the digital input. The response interface (process input data) supplies the "frozen" value. The internal counter value is re-triggered, i.e. the value for the "load value in preparation" is taken as the counter value. The counter continues counting from the load value.

4.4.6 Digital input (DI)

The digital input (DI) can be operated with different sensors (plus switch or push-pull). The input signal can be inverted (exception: In "latch-retrigger function"). The STS_DI status bit indicates the status of the digital input.

Functions of the digital input in count mode:

- Digital input
- Hardware release (HW gate)
- Latch-retrigger function when edge positive
- Synchronization when edge positive

Functions of the digital input in measurement mode:

- Digital input
- Hardware release (HW gate)

4.4.7 Digital outputs (DO1 and DO2)

The module has a physical digital output (DO1) and a virtual digital output (DO2) that is only present as a status bit in the response interface (process input data).

Count mode

The digital outputs can be activated depending on the count value and reference values. Two reference values, each assigned to the digital outputs, can be defined.

In addition, a hysteresis can be set for the digital outputs.

Measurement mode

In measurement mode only the physical output DO1 is active. The digital output can be used as normal digital output or can indicate the status of the measured value (e.g. measured value outside the limits, measured value below lower limit, etc.).

4.4.8 Signal-evaluation options for encoders

The evaluation options are set via the configuration of the BL20 counter module (s. parameter „Signal evaluation (A, B)” [► 40]).

Scan points with different evaluations

Depending on the configuration, the device counts up or down depending on rising or falling edges of signals A and B.

- Single evaluation (count mode and measurement mode):
Evaluation of the rising edge of signal A
- Double evaluation (count mode):
Evaluation of the rising and falling edge of signal A
- Quadruple evaluation (count mode):
Evaluation of the rising and falling edges of signal A and signal B

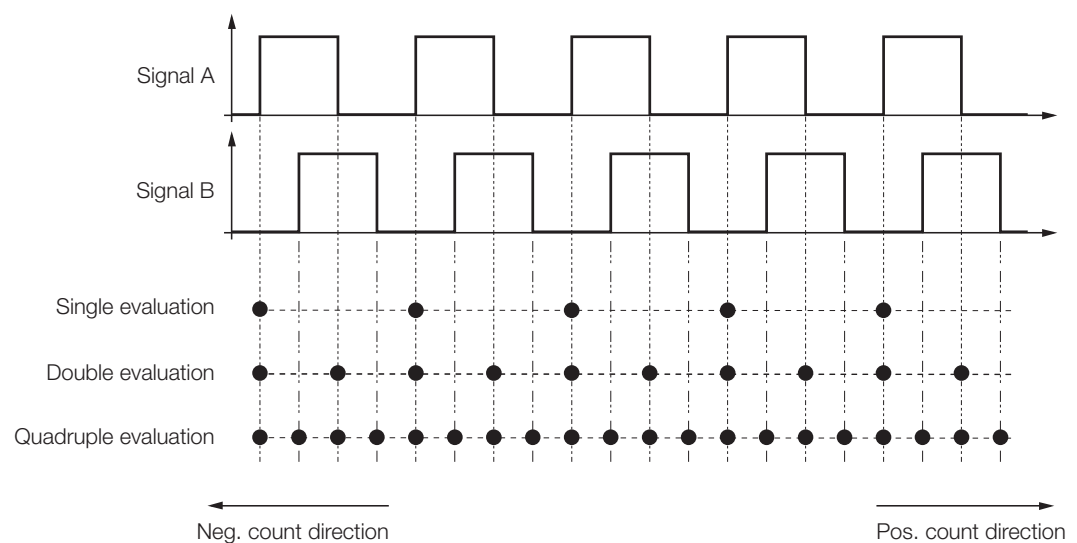


Fig. 3: Evaluation options for counting mode (measurement mode: single evaluation only)

4.4.9 Pulse and direction

Count mode

Input A receives the counter signal and input B the direction signal. Depending on the state of input B, a signal at input A increases or decreases the count value.

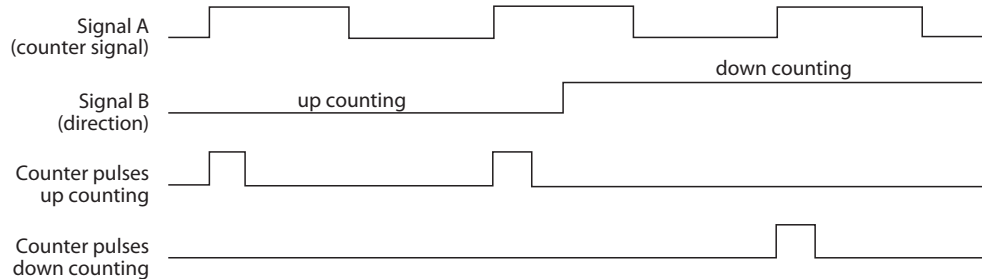


Fig. 4: Change of the count value at count signal and direction signal

Pulse duration on reaching the reference value

Only valid for the setting „Function DO...“ = „pulse when count value = reference value“

The pulse duration can be specified to match the actuators used and defines how long the output should be set when the defined comparison value has been reached. The pulse duration can be preselected between 0 and 510 ms in steps of 2 ms. If the pulse duration = 0, the output is set until the comparison condition is no longer fulfilled. If the count value jumps above the reference value, e.g. when counting up from the upper to the lower limit, no pulse is generated.

Measurement mode

In this mode input B receives a signal for rotational direction. The response interface (process input data) returns the status (rotation direction) via STS_DN and STS_UP [► 73]. The signals at A and B can be inverted.

4.4.10 Load value (direct and in preparation)

Load value direct

The count value can be set directly via the process output data (byte n...n+3, [► 67]) and the control bit LOAD_VAL. The load value is prepared either via the connected controller or via the BL20-DTM.

Load value in preparation

The count value can be set in preparation via the process output data (byte n...n+3, [► 67]) and the control bit LOAD_PREPARE. The load value is prepared either via the connected controller or via the BL20-DTM.

The load value is accepted as the new count value when the following events occur:

- Reaching the lower or upper count limit if no main count direction is parameterized
- Reaching the upper count limit with the main count direction set to up
- Reaching the lower count limit with the main count direction set to down

4.5 BL20 accessories

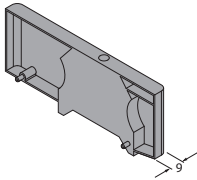
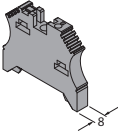
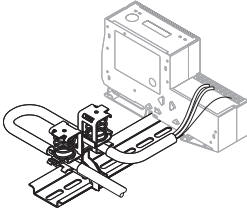
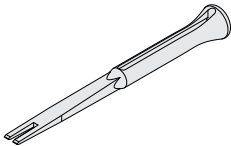
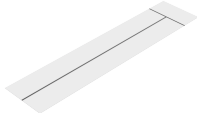
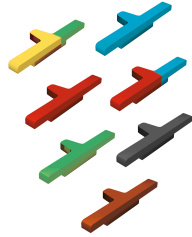
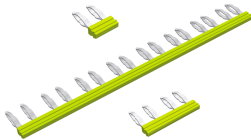
Figure	Type	ID	Description
	BL20-ABPL	6827123	End plate Mechanical end of BL20 station to the right, 2 pieces
	BL20-WEW-35/2-SW	6827124	End bracket black Mechanical fixation of BL20 station, 10 pieces
	BS3511/KLBUE4-31.5	6827342	Shielding terminal
	ZBW5	6827129	Tension spring tool
	BL20-LABEL/SCHEIBE	6827070	Labels for electronic modules in slice design, 3 × DIN A5 sheet, slice, pre-perforated (laser printing), 3 × 19 labels

Figure	Type	ID	Description
	BL20-ANBZ-...		Color coding for clear potential identification of the connection level on the base modules:
	BL20-ANBZ-BL	6827072	10 × strip of 6, blue
	BL20-ANBZ-RT	6827073	10 × strip of 6, red
	BL20-ANBZ-GN	6827074	10 × strip of 6, green
	BL20-ANBZ-SW	6827075	10 × strip of 6, black
	BL20-ANBZ-BR	6827076	10 × strip of 6, brown
	BL20-ANBZ-RT/BL-BED	6827077	10 × strip of 6, red/blue
	BL20-ANBZ-GN/GE-BED	6827078	10 × strip of 6, green/yellow
	BL20-ANBZ-WS	6827079	10 × strip of 6, white
	BL20-QV/...		Cross connector relay (QVR) For bridging the 4th connection level (14/24) for base modules for relays (10 pieces)
	BL20-QV/1	6827104	1 grid
	BL20-QV/2	6827105	2 grid
	BL20-QV/3	6827106	3 grid
	BL20-QV/4	6827107	4 grid
	BL20-QV/5	6827108	5 grid
	BL20-QV/6	6827109	6 grid
	BL20-QV/7	6827110	7 grid
	BL20-QV/8	6827111	8 grid

5 Mounting



DANGER

Potentially explosive atmosphere

Explosion due to ignitable sparks

For use in zone 2:

- ▶ Only install the device if there is no potentially explosive atmosphere present.
- ▶ Disconnect and connect circuits only when no voltage is present.
- ▶ Only actuate the switches when there is no voltage present.
- ▶ Mount the mounting rail on a conductive mounting plate with a thickness of at least 2 mm to establish a reference potential for protective and functional earth. For mounting rails that are not pre-drilled, observe a hole spacing of max. 150 mm.
- ▶ Observe the Ex approval requirements.



WARNING

Open electrical contacts

Danger to life due to electric shock when using 120/230 VAC

- ▶ Cover open contacts on the last base module of each station with end plate or place a power feeding module (24 V) to form a new potential group.

- A BL20 station consists of at least one gateway and one electronic module.
- BL20 stations must be mounted on the DIN rail using two end brackets (BL20-WEW-35/2-SW).
- The BL20 station can be mounted vertically or horizontally.
- For vertical installation, the gateway can be positioned either above or below. In this case, sufficient ventilation and heat dissipation must be ensured.
- Keep space to the left of the gateway free for the first end bracket.
- Mount the end plate after the last BL20 module.
- The gateway is the first electronics component on a BL20 station.
- The gateway is followed by the I/O modules in any order.
- Power Feeding and Bus Refreshing modules are used for potential separation and can be mounted between the other modules if necessary.
- If required, potential distribution modules can be used. A maximum of two potential distribution modules may be mounted directly next to each other.
- Protect the installation site against heat radiation, rapid temperature fluctuations, dust, dirt, moisture and other environmental influences.

Mount the DIN rail

Recommendation for mounting the BL20 system on a DIN rail in the control cabinet:

- ▶ Mount the DIN rail on a rust-proof, electrically conductive mounting plate. A reference potential for protective and functional earth can be established through the mounting plate.

The minimum thickness of the mounting plate depends on the material:

- Steel and stainless steel: min. 2 mm
- Aluminum: min. 3 mm
- ▶ Fasten the DIN rail to the mounting plate using suitable rivets (A) or screws (B) as shown in the figure below "DIN rail mounting". The choice of rivets or screws depends on the condition of the mounting plate.
- ▶ When mounting several DIN rails on top of each other: ensure sufficient distance between the top-hat rails (C). The arrangement of the components in the control cabinet depends on the application.
- ▶ Keep a distance of min. 10 mm to passive components.
- ▶ Keep a distance of min. 75 mm to active components (e. g. power supply units).

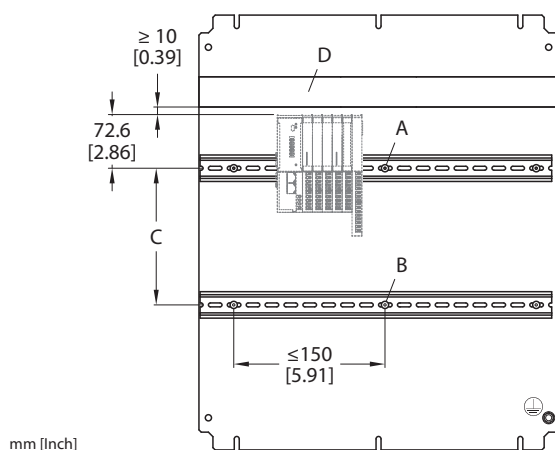


Fig. 5: DIN rail mounting

5.1 Mounting the gateway

- The DIN rail must already be mounted.
- An end bracket must be mounted in front of the gateway. The end bracket can be mounted at the beginning or after the complete station has been mounted.
- The gateway is the first electronic element of each BL20 station.
- ▶ Hang the groove of the gateway into the DIN rail from below.
- ▶ Turn the upper end of the gateway to the rear.
- ▶ Press the gateway against the DIN rail until the latching hook audibly engages.

5.2 Mounting ECO modules

- The gateway must already be mounted.
- The ECO modules are mounted on the DIN rail to the right of the gateway.
- ▶ Insert the groove of the ECO module into the DIN rail from below.
- ▶ Swing the upper end of the ECO module backwards.
- ▶ Press the ECO module against the DIN rail until the locking hook audibly engages.
- ▶ Push the ECO module to the left until the two lateral snap-in hooks on the left engage.

5.3 Mounting end bracket and end plate

- BL20 stations must be mounted on the DIN rail using two end brackets (BL20-WEW-35/2-SW).
- The first end bracket must be mounted in front of the gateway.
- The second end bracket is integrated in the end plate and must be mounted after the last module.

Mounting the end bracket in front of the gateway

- ▶ If necessary, loosen the screw in the end bracket.
- ▶ Snap the end bracket onto the DIN rail on the left of the gateway.
- ▶ Push the end bracket close to the gateway.
- ▶ Screw the end bracket tight.

Mounting the end plate

- ▶ If necessary, loosen the screw in the end bracket.
- ▶ Insert the end bracket into the recess provided in the end plate.
- ▶ The end bracket and end plate should be held so that the connectors on the end plate are facing the last module of the BL20 station.
- ▶ Snap the end plate with the end bracket onto the mounting rail.
- ▶ Press the end plate with the end bracket tightly against the last module of the BL20 station.
- ▶ Insert the connectors of the end plate firmly into the recesses of the module.
- ▶ Screw the end bracket tight (through the end plate).

6 Connecting

The counter module BL20-E-1CNT is part of the BL20 system and is supplied with voltage via the BL20 gateway or via power feeding or bus refreshing modules.



DANGER

Potentially explosive atmosphere

Explosion due to ignitable sparks

For use in zone 2:

- ▶ Only connect the device if there is no potentially explosive atmosphere.
 - ▶ Disconnect and connect circuits only when no voltage is present.
 - ▶ Only actuate the switches when there is no voltage present.
 - ▶ Provide conductor ends of stranded wires with wire end ferrules.
 - ▶ Observe the Ex approval requirements.
-

6.1 Connecting the power supply

The module is part of the BL20 system and is supplied with voltage via the module bus from the BL20 gateway or from power feeding or bus refreshing modules. An additional voltage supply for the module is not necessary.

6.2 Connecting encoders

The device has ten push-in terminals for connecting encoders. The permissible conductor cross-section is 0.2...1.5 mm² (AWG 24...AWG 16).

- Connect the rotary encoder to the counter module according to the terminal assignment and connection diagram.

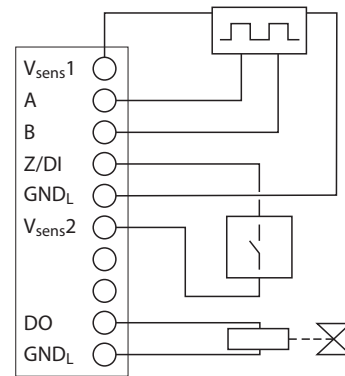
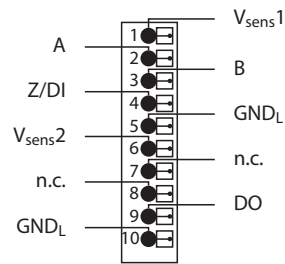


Fig. 6: Terminal assignment BL20-E-1CNT

Fig. 7: Wiring diagram BL20-E-1CNT

Terminal	Assignment	Meaning
1	V _{sens1}	Sensor supply 1 (from U _L) , limited to 0.5 A, short-circuit proof
2	A	Counter input or pulse input
3	B	Counter input or direction input
4	DI	Digital input
5	GND _L	Ground
6	V _{sens2}	Sensor supply 2 (from U _L) , limited to 0.5 A, short-circuit proof
7	n. c.	
8	n. c.	
9	DO	Digital output
10	GND _L	Ground

7 Commissioning

7.1 Setting the operation mode

7.1.1 Setting the operation mode in PROFINET and PROFIBUS

The GSDML or GSD file contains two entries for the BL20-E-1CNT:

- Count mode: BL20-E-1CNT (C)
- Measurement mode: BL20-E-1CNT (M)

7.1.2 Setting the operation mode in EtherNet/IP

The device can be configured via the web server of the BL20 gateway or via the DTM in PACTware.

The operating mode is set via the parameters "operating mode" and "count mode" [► 40] or "measurement mode" [► 58] in the parameter bytes of the BL20 station. The structure of the parameter data depends on the structure of the BL20 station.

- ▶ Set operating mode (counter or measurement) in parameter byte 0, bit 5 of the BL20-E-1CNT (e. g.: 0 = counter).
- ▶ Set counting mode in parameter byte 0, bit 0...1 of the BL20-E-1CNT (e.g.: 01 = count once)

7.1.3 Setting the operation mode in Modbus TCP

The device can be configured via the web server of the BL20 gateway, via the DTM in PACTware or via the Modbus parameter registers..

The operating mode is set via the parameters "Count mode" [► 40] or "Measurement mode [► 58]" in the parameter registers (0xB000...0xB400) of the BL20 station. The structure of the Modbus registers depends on the structure of the BL20 station. The BL20 DTM in PACTware shows a detailed mapping table of the process, parameter and diagnostic data for Modbus TCP.

- ▶ Set the operating mode (counter or measurement) via bit 5 of the parameter register (e.g. 0 = counter).
- ▶ Set counting mode via bit 0...4 of the parameter register (e.g.: 00001 = single count)

7.1.4 Setting the operation mode in EtherCAT

The ESI file for the EtherCAT gateway BL20-E-GW-EC-20 contains two entries for the BL20-E-1CNT:

- Count mode: BL20-E-1CNT (C)
- Measurement mode: BL20-E-1CNT (M)

During the EtherCAT network scan (e.g. in TwinCAT) the counter module is read in by default as a module in counting mode. If the device is to be used in measurement mode, the BL20-E-1CNT (C) module must be manually deleted and replaced by the BL20-E-1CNT (M) module.

7.2 Commissioning the device in counter mode

The following examples contain brief instructions for commissioning the BL20-E-1CNT on a BL20-E-GW-EN using the integrated web server integrated. The instructions are transferable for the use of the counter module with other BL20 gateways in different fieldbuses.

7.2.1 Example: continuous counting, software release only (SW gate)

Starting the count operation

- ✓ The **operation mode** is set to **counter**.
- ▶ Set parameter for the counter operation mode [▶ 40] as follows:
- ▶ Set parameter **count mode** to **continuous count**.
- ▶ Under **signal evaluation**, select the signal source. Here in the example, the option **rotary sensor: single** is used.
- ▶ Set the function of the digital input **Function DI** to **input**.
- ▶ Write the values to the device via the **Write** button.

The screenshot displays the web server interface for configuring the BL20-E-GW-EN Slot 4: E-1CNT. The interface is divided into a sidebar on the left and a main content area on the right. The sidebar contains navigation links for MAIN, DOCUMENTATION, and LOGOUT. The main content area shows the parameter settings for the counter module. The parameters are listed in a table with dropdown menus for selection. The following parameters are highlighted with red boxes:

- Operation mode:** counter
- Count mode:** continuous count
- Function DI:** input
- Signal evaluation (A,B):** rotary sensor: single

Other parameters visible in the table include Gate function (abort count procedure), Invert digital input DI (no), Synchronization (single-action), Main count direction (none), Lower count limit (0), Upper count limit (2147483647), Hysteresis (0), Pulse duration DO1,DO2 [n*2ms] (0), Substitute value DO1 (0), Deactivate diagnostics DO1 (no), Function of DO1 (output), Function of DO2 (output), Sensor/input filter (A) (2.5 µs (200 kHz)), Sensor/input filter (B) (2.5 µs (200 kHz)), and Sensor/input filter (DI) (2.5 µs (200 kHz)).

Fig. 8: Web server, parameter setting: Continuous count with SW release

- In the process output data [► 67], set the SW_GATE control bit to 1.

The screenshot shows the TURCK web server interface. The left sidebar contains a menu with options: MAIN, DOCUMENTATION, and LOGOUT. Below these are sections for different slots: BL20-E-GW-EN, SLOT 1: E-8DI-24VDC-P, SLOT 2: E-8DO-24VDC-0.5A-P, SLOT 3: E-1CNT, and SLOT 4: E-1CNT. The SLOT 4: E-1CNT section is expanded, showing options for Parameter, Diagnosis, Input, and Output. The Output option is selected. The main content area displays the configuration for BL20-E-GW-EN - Slot 4: E-1CNT - Output. It includes a Counter section with a Value field set to 0. Below this is a table of control bits and their values:

Control Bit	Value
Control bit SW Gate SW_GATE	1
Release synchronization CTRL_SYN	0
Trigger reset of status bits RES_STS	0
Control bit DO1_SET_DO1	0
Release DO1_CTRL_DO1	0
Control bit DO2_SET_DO2	0
Release DO2_CTRL_DO2	0
Diagnostics error acknowledgement EXT_F_ACK	0
Load counter direct LOAD_VAL	0
Load counter in preparation LOAD_PREPARE	0
Load reference value 1 LOAD_CMP_VAL1	0
Load reference value 2 LOAD_CMP_VAL2	0
Function and behavior of DO1/DO2 change LOAD_DO_PARAM	0

Fig. 9: Web server: Setting the SW release

- ⇒ The pulses of a rotating encoder are counted. The process input data **Inputs** show the **counter value**. The active software release is indicated via the **STS_GATE** status bit, **STS_DN** indicates the counting direction (downwards).

The screenshot shows the TURCK web server interface for the BL20-E-GW-EN device. The sidebar on the left lists various functions: Info, Parameter, Diagnosis, Event log, Ex- / Import, Change Password, and Firmware. Below these are slots for different modules: SLOT 1: E-8DI-24VDC-P, SLOT 2: E-8DO-24VDC-0.5A-P, SLOT 3: E-1CNT, and SLOT 4: E-1CNT. The main area is titled 'BL20-E-GW-EN - Slot 4: E-1CNT - Input'. It shows a 'Counter' section with a 'Counter value' of 211003618. Below this, there are several status bits: 'Status internal gate STS_GATE' (1), 'Status DI STS_DI' (0), 'Status DO1 STS_DO1' (0), 'Status DO2 STS_DO2' (0), 'Status direction up STS_UP' (0), 'Status direction down STS_DN' (1), 'Status synchronization STS_SYN' (0), 'Status reference value 1 STS_CMP1' (0), 'Status reference value 2 STS_CMP2' (0), 'Upper count limit STS_OFLW' (0), and 'Lower count limit STS_UFLW' (0).

Fig. 10: Web server: count down with software gate

Stopping the count operation

- ▶ In the process output data [▶ 67], reset the SW_GATE control bit to 0.
- ⇒ The count operation stops.

Resetting the counter or setting it to a defined value

- Enter the load value into **Value** in the process output data and execute the function directly via the process output bit **LOAD_VAL** (0 → 1). In this example the counter value is reset to 0.

The screenshot displays the TURCK web server interface for the BL20-E-GW-EN - Slot 4: E-1CNT - Output. The left sidebar shows the navigation menu with options like Info, Parameter, Diagnosis, Event log, Ex- / Import, Change Password, and Firmware. The main content area shows the configuration for the counter. The 'Counter' section has a 'Value' field set to 0. Below this, a list of control bits and their states is shown. The 'Load counter direct LOAD_VAL' bit is highlighted with a red box and is set to 1.

Control bit	State
Control bit SW Gate SW_GATE	0
Release synchronization CTRL_SYN	0
Trigger reset of status bits RES_STS	0
Control bit DO1_SET_DO1	0
Release DO1_CTRL_DO1	0
Control bit DO2_SET_DO2	0
Release DO2_CTRL_DO2	0
Diagnostics error acknowledgement EXT_F_ACK	0
Load counter direct LOAD_VAL	1
Load counter in preparation LOAD_PREPARE	0
Load reference value 1 LOAD_CMP_VAL1	0
Load reference value 2 LOAD_CMP_VAL2	0
Function and behavior of DO1/DO2 change LOAD_DO_PARAM	0

Fig. 11: Web server: Resetting the counter value

⇒ The active load operation is indicated by the STS_LOAD status bit.

TURCK

MAIN DOCUMENTATION LOGOUT

BL20-E-GW-EN

- Info
- Parameter
- Diagnosis
- Event log
- Ex- / Import
- Change Password
- Firmware

SLOT 1: E-8DI-24VDC-P

SLOT 2: E-8DO-24VDC-0.5A-P

SLOT 3: E-1CNT

SLOT 4: E-1CNT

- Parameter
- Diagnosis
- Input
- Output

BL20-E-GW-EN - Slot 4: E-1CNT - Input

Tab view Print

Counter

Counter value 0

Load function running STS_LOAD	1
Error with load function ERR_LOAD	0
Reset of the status bits running RES_STS_A	0
Parameterization error ERR_PARA	0
Overcurrent/wire break ERR_DO	0
Overcurrent sensor supply ERR_24Vdc	0
Status internal gate STS_GATE	0
Status DI STS_DI	0
Status DO1 STS_DO1	0
Status DO2 STS_DO2	0
Status direction up STS_UP	0
Status direction down STS_DN	1
Status synchronization STS_SYN	0
Status reference value 1 STS_CMP1	0
Status reference value 2 STS_CMP2	0
Upper count limit STS_OFLW	0
Lower count limit STS_UFLW	0

Fig. 12: Web server: Load operation active

- Stop the loading operation by resetting the **LOAD_VAL** bit (1 → 0).

7.2.2 Example: continuous counting with SW release (SW gate) and hardware release (HW gate)

Starting the count operation

- ✓ The **operation mode** is set to **counter**.
- ▶ Set parameter for the counter operation mode [▶ 40] as follows:
- ▶ Set parameter **count mode** to **continuous count**.
- ▶ Set the function of the digital input **Function DI** to **HW gate** (HW release)
- ▶ Under **signal evaluation**, select the signal source. Here in the example, the option **rotary sensor: single** is used.
- ▶ Write the values to the device via the **Write** button.

TURCK

MAIN DOCUMENTATION LOGOUT

BL20-E-GW-EN

Info
Parameter
Diagnosis
Event log
Ex- / Import
Change Password
Firmware

SLOT 1: E-8DI-24VDC-P

SLOT 2: E-8DO-24VDC-0.5A-P

SLOT 3: E-1CNT

SLOT 4: E-1CNT

Parameter
Diagnosis
Input
Output

BL20-E-GW-EN - Slot 4: E-1CNT - Parameter

Read Write Tab view Print

Counter

Operation mode	counter	?
Count mode	continuous count	?
Gate function	abort count procedure	?
Invert digital input DI	no	?
Function DI	HW gate	?
Synchronization	single-action	?
Main count direction	none	?
Lower count limit	0	
Upper count limit	2147483647	
Hysteresis	0	?
Pulse duration DO1,DO2 [n*2ms]	0	?
Substitute value DO1	0	?
Deactivate diagnostics DO1	no	?
Function of DO1	output	?
Function of DO2	output	?
Signal evaluation (A,B)	rotary sensor: single	?
Sensor/Inpt filter (A)	2.5 µs (200 kHz)	?
Sensor/Inpt filter (B)	2.5 µs (200 kHz)	?
Sensor/Inpt filter (DI)	2.5 µs (200 kHz)	?

Fig. 13: Web server, parameter setting: Continuous count with software and hardware release

- In the process output data [► 67], set the SW_GATE control bit to 1.

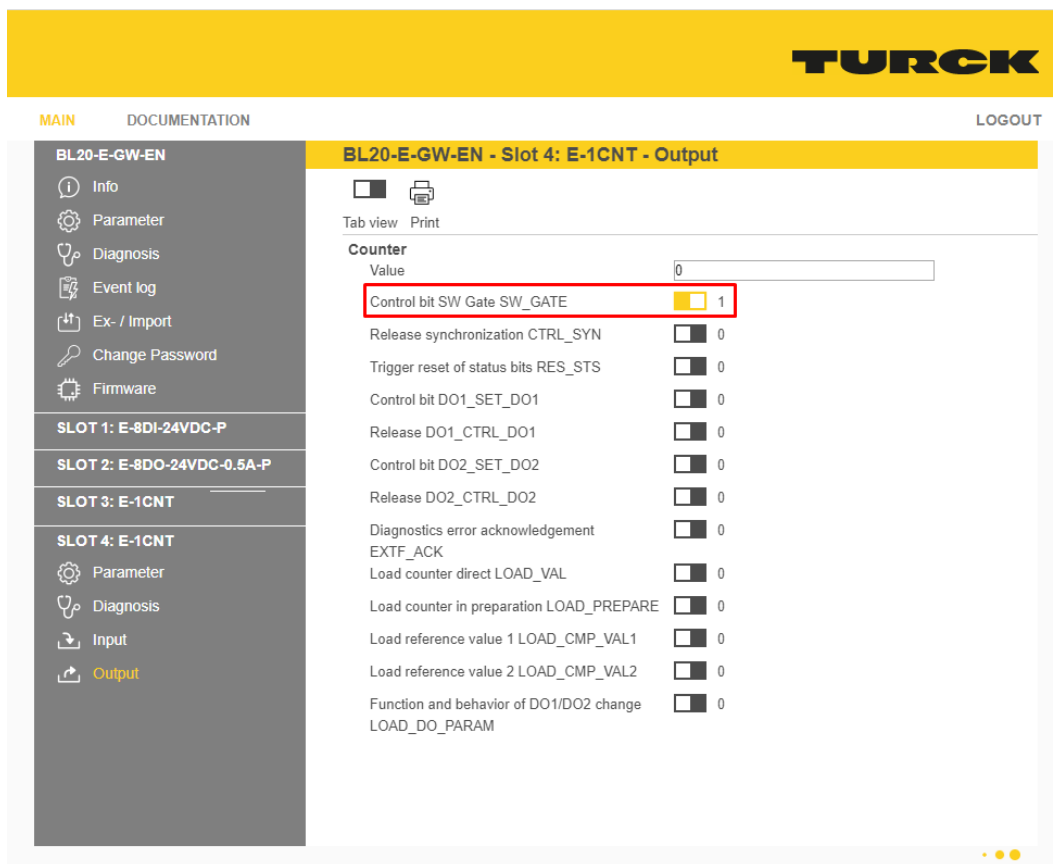


Fig. 14: Web server: Setting the SW release

- ⇒ A positive signal at the digital input (if parameter "digital input D" = normal [► 40]) starts the hardware release (HW gate).

- ⇒ The process input data **Inputs** show the **counter value**. The active hardware release (signal at DI) is indicated via the **STS_DI** status bit and the active software release via the **STS_GATE** status bit **STS_UP** indicated the count direction (up) an.

TURCK

MAIN DOCUMENTATION LOGOUT

BL20-E-GW-EN

- Info
- Parameter
- Diagnosis
- Event log
- Ex- / Import
- Change Password
- Firmware

SLOT 1: E-8DI-24VDC-P

SLOT 2: E-8DO-24VDC-0.5A-P

SLOT 3: E-1CNT

SLOT 4: E-1CNT

- Parameter
- Diagnosis
- Input**
- Output

BL20-E-GW-EN - Slot 4: E-1CNT - Input

Tab view Print

Counter

Counter value	216181003
Load function running STS_LOAD	0
Error with load function ERR_LOAD	0
Reset of the status bits running RES_STS_A	0
Parameterization error ERR_PARA	0
Overcurrent/wire break ERR_DO	0
Overcurrent sensor supply ERR_24Vdc	0
Status internal gate STS_GATE	1
Status DI STS_DI	1
Status DO1 STS_DO1	0
Status DO2 STS_DO2	0
Status direction up STS_UP	1
Status direction down STS_DN	0
Status synchronization STS_SYN	0
Status reference value 1 STS_CMP1	0
Status reference value 2 STS_CMP2	0
Upper count limit STS_OFLW	0
Lower count limit STS_UFLW	0

Fig. 15: Web server: count up with software and hardware release

Stopping the count operation

- ▶ Reset either the SW_GATE control bit in the process output data [▶ 67] or the signal at the digital input (hardware gate).
- ⇒ The count operation stops.

7.3 Commissioning the device measurement mode

7.3.1 Example: Frequency measurement, software release only (SW gate)

Starting the count operation

- ✓ The **operation mode** is set to measurement.
 - ▶ Set parameter for the measurement mode [▶ 58] as follows:
 - ▶ Set parameter **measurement mode** to **frequency measurement** [▶ 58].
 - ▶ Set the function of the digital input **Function DI** to **input**.
 - ▶ Define the upper and the lower measurement limit via the parameters **Lower limit** and **Upper limit** [▶ 58]. The example uses the following values: **Lower limit** = 0, **Upper limit** = 250000
 - ▶ Define the **integration time** [▶ 58], here 10 (Default) = 10 × 10 ms.
 - ▶ Define the **sensor pulses per revolution** depending on the connected encoder. In this example, an encoder with 3000 rpm is used.
 - ▶ Under **signal evaluation**, select the signal source. Here in the example, the option **rotary sensor: single** is used.
 - ▶ Write the values to the device via the **Write** button.

TURCK

MAIN DOCUMENTATION LOGOUT

BL20-E-GW-EN

- Info
- Parameter
- Diagnosis
- Event log
- Ex- / Import
- Change Password
- Firmware

SLOT 1: E-8DI-24VDC-P

SLOT 2: E-8DO-24VDC-0.5A-P

SLOT 3: E-1CNT

SLOT 4: E-1CNT

- Parameter
- Diagnosis
- Input
- Output

BL20-E-GW-EN - Slot 4: E-1CNT - Parameter

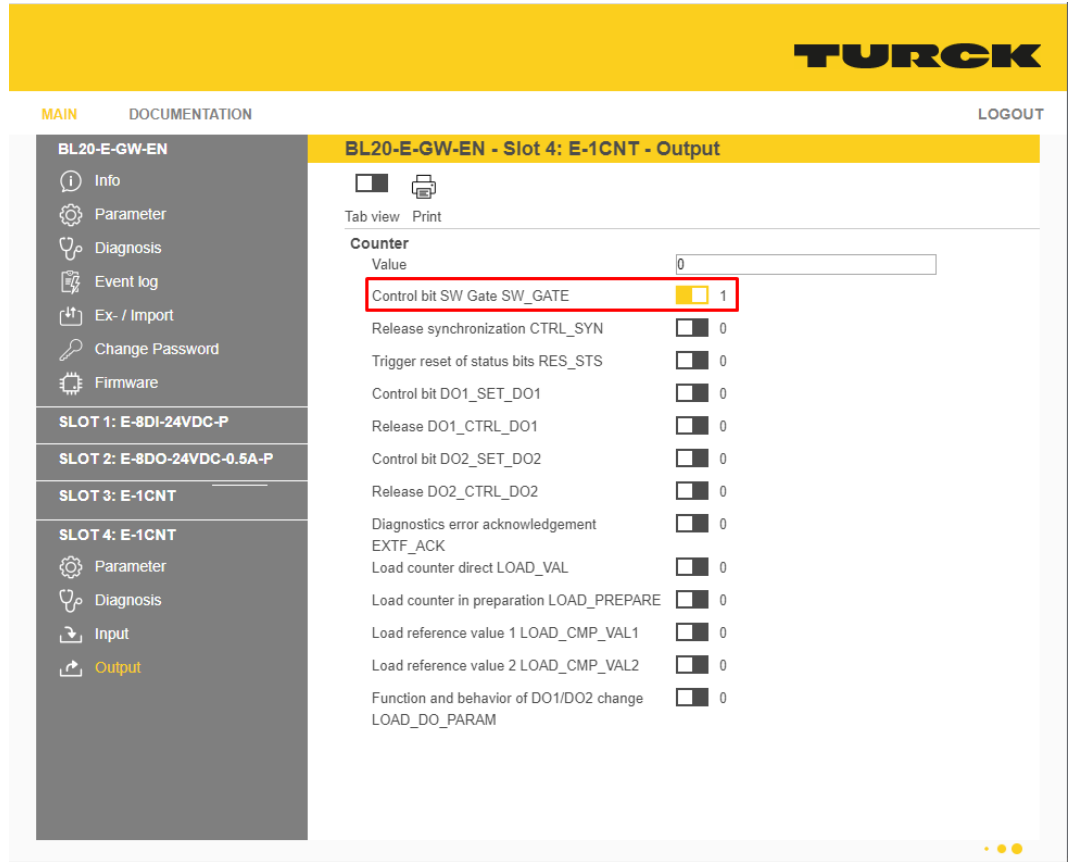
Read Write Tab view Print

Counter

Operation mode	measurement	?
Measurement mode	frequency measurement	?
Invert digital input DI	no	?
Function DI	input	?
Lower limit	0	
Upper limit	250000	
Integration time [n x 10 ms]	10	?
Sensor pulses per revolution	3000	
Substitute value DO1	0	
Deactivate diagnostics DO1	no	?
Function DO1	output	?
Signal evaluation (A,B)	rotary sensor: single	?
Sensor/Input (A)	2.5 µs (200 kHz)	?
Sensor/Input (B)	2.5 µs (200 kHz)	?
Sensor/Input (DI)	2.5 µs (200 kHz)	?
Invert sensor (A)	no	?
Invert direction input (B)	no	?
Deactivate group diagnostics	no	?
Behavior CPU/Master stops	turn off DO1	?

Fig. 16: Web server, parameter setting: Frequency measurement with SW release

- In the process output data [► 75], set the SW_GATE control bit to 1.



The screenshot shows the TURCK web server interface. The left sidebar contains a menu with options: MAIN, DOCUMENTATION, and LOGOUT. Under MAIN, there are sections for BL20-E-GW-EN, SLOT 1: E-8DI-24VDC-P, SLOT 2: E-8DO-24VDC-0.5A-P, SLOT 3: E-1CNT, and SLOT 4: E-1CNT. The SLOT 4: E-1CNT section is expanded, showing options for Parameter, Diagnosis, Input, and Output. The Output option is selected. The main content area displays the configuration for BL20-E-GW-EN - Slot 4: E-1CNT - Output. It includes a Counter section with a Value field set to 0. Below this is a list of control bits and their values:

Control Bit	Value
Control bit SW Gate SW_GATE	1
Release synchronization CTRL_SYN	0
Trigger reset of status bits RES_STS	0
Control bit DO1_SET_DO1	0
Release DO1_CTRL_DO1	0
Control bit DO2_SET_DO2	0
Release DO2_CTRL_DO2	0
Diagnostics error acknowledgement EXT_F_ACK	0
Load counter direct LOAD_VAL	0
Load counter in preparation LOAD_PREPARE	0
Load reference value 1 LOAD_CMP_VAL1	0
Load reference value 2 LOAD_CMP_VAL2	0
Function and behavior of DO1/DO2 change LOAD_DO_PARAM	0

Fig. 17: Web server: Setting the SW release

- ⇒ The measurement operation starts. The process input data **Inputs** show the measured value under **counter value**. The active software release is indicated via the **STS_GATE** status bit.

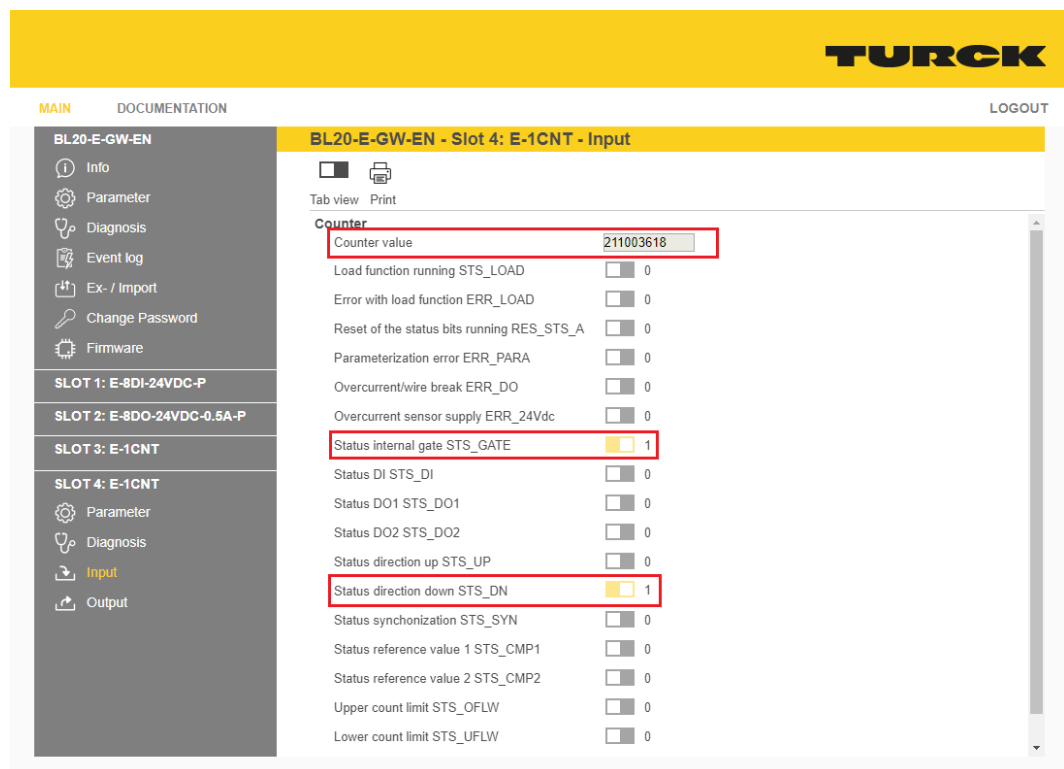


Fig. 18: Web server: Frequency measurement with software gate

Stopping the measurement operation

- ▶ In the process output data [► 75]: Reset the **SW_GATE** control bit to 0.
- ⇒ The measurement operation stops.

7.3.2 Example: Frequency measurement with SW release (SW gate) and hardware release (HW gate)

Starting the measurement operation

- ✓ The **operation mode** is set to **measurement**.
 - ▶ Set parameter for the measurement mode [▶ 58] as follows:
 - ▶ Set the function of the digital input **Function DI** to **HW gate** (HW release)
 - ▶ Define the upper and the lower measurement limit via the parameters **Lower limit** and **Upper limit** [▶ 58]. The example uses the following values: **Lower limit** = 0, **Upper limit** = 250000
 - ▶ Define the **integration time** [▶ 58], here 10 (Default) = 10 × 10 ms.
 - ▶ Define the **sensor pulses per revolution** depending on the connected encoder. In this example, an encoder with 3000 rpm is used.
 - ▶ Under **signal evaluation**, select the signal source. Here in the example, the option **rotary sensor: single** is used.
 - ▶ Write the values to the device via the **Write** button.

TURCK

MAIN DOCUMENTATION LOGOUT

BL20-E-GW-EN

- Info
- Parameter
- Diagnosis
- Event log
- Ex- / Import
- Change Password
- Firmware

SLOT 1: E-8DI-24VDC-P

SLOT 2: E-8DO-24VDC-0.5A-P

SLOT 3: E-1CNT

SLOT 4: E-1CNT

- Parameter
- Diagnosis
- Input
- Output

BL20-E-GW-EN - Slot 4: E-1CNT - Parameter

Read Write Tab view Print

Counter		
Operation mode	measurement	?
Measurement mode	frequency measurement	?
Invert digital input DI	no	?
Function DI	HW gate	?
Lower limit	0	
Upper limit	250000	
Integration time [n x 10 ms]	10	?
Sensor pulses per revolution	3000	
Substitute value DO1	0	
Deactivate diagnostics DO1	no	?
Function DO1	output	?
Signal evaluation (A,B)	rotary sensor: single	?
Sensor/Input (A)	2.5 µs (200 kHz)	?
Sensor/Input (B)	2.5 µs (200 kHz)	?
Sensor/Input (DI)	2.5 µs (200 kHz)	?
Invert sensor (A)	no	?
Invert direction input (B)	no	?
Deactivate group diagnostics	no	?
Behavior CPU/Master stops	turn off DO1	?

Fig. 19: Web server, parameter setting: Frequency measurement with software and hardware release

- In the process output data [► 75], set the SW_GATE control bit to 1.

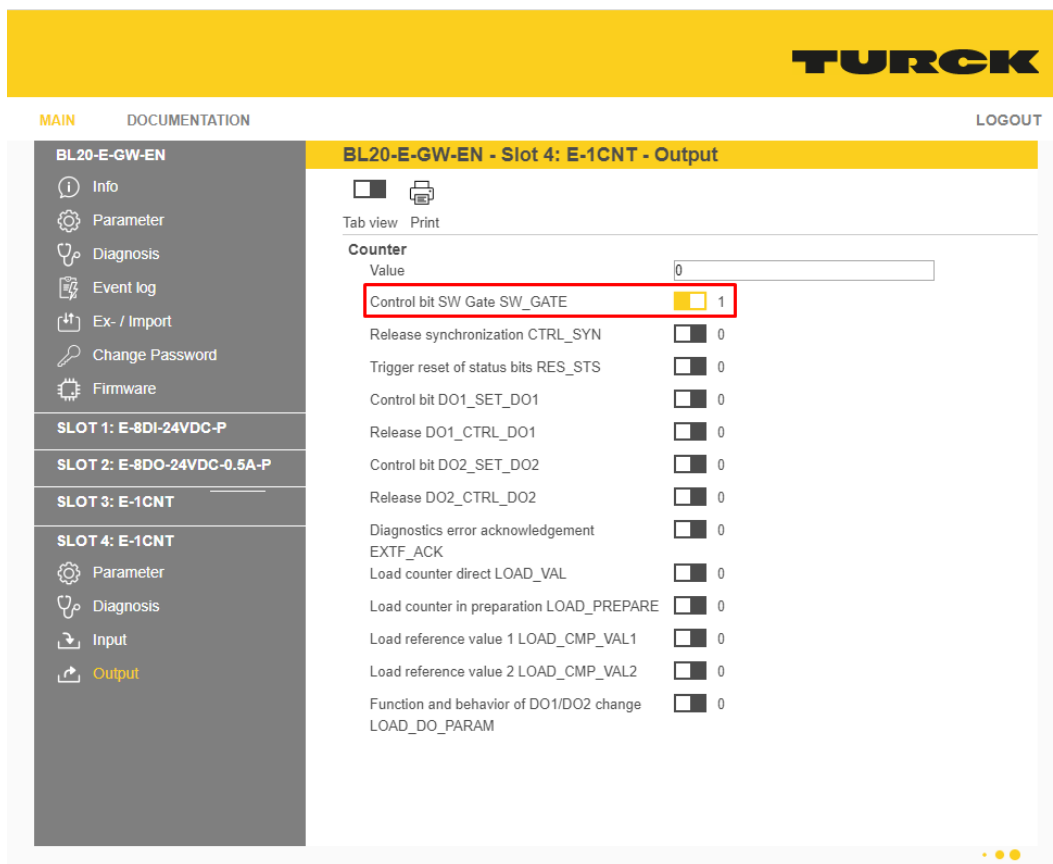


Fig. 20: Web server: Setting the SW release

- ⇒ A positive signal at the digital input (if parameter "digital input D" = normal [► 58]) starts the hardware release (HW gate).

- ⇒ The process input data **Inputs** show the measured value under **counter value**. The active hardware release (signal at DI) is indicated via the **STS_DI** status bit. **STS_GATE** indicates that in addition to the hardware release also the software release has been done (AND operation).

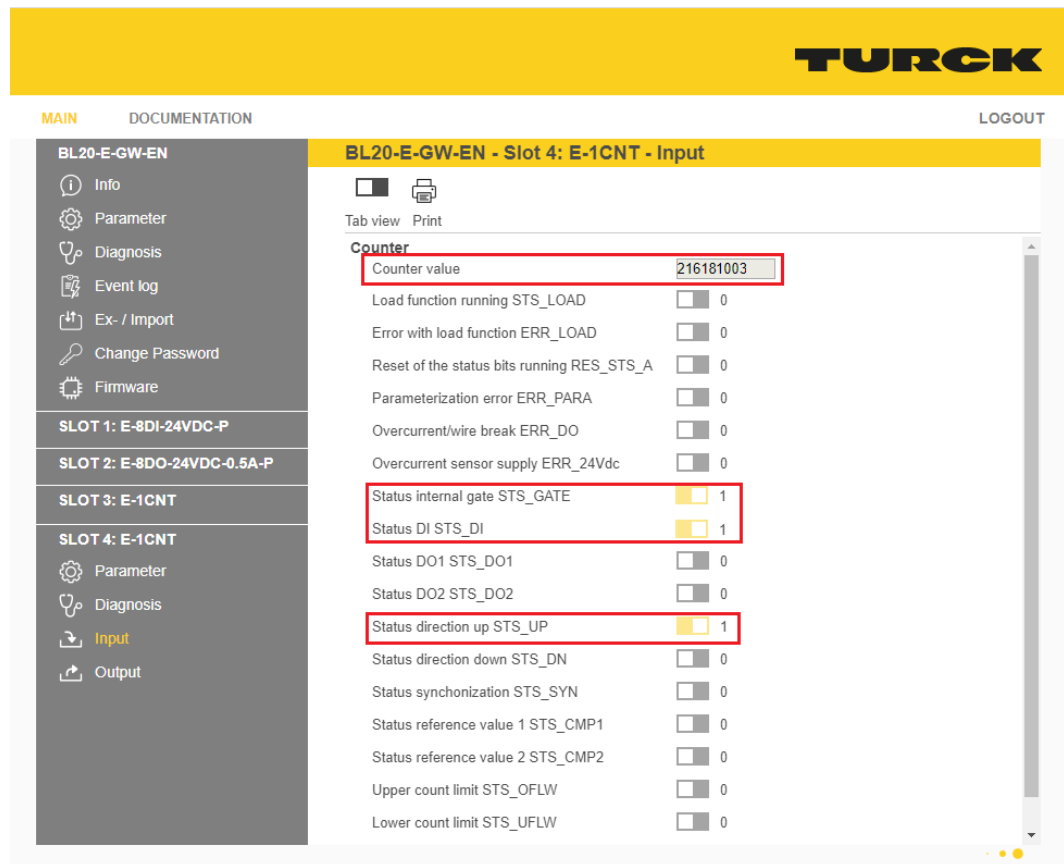


Fig. 21: Web server: Frequency measurement with software and hardware gate

Stopping the measurement operation

- ▶ In the process output data [► 75], reset the SW_GATE control bit to 0.
- ⇒ The measurement operation stops.

7.4 Commissioning the device as a replacement for BL20-1CNT-24VDC

The BL20 counter module BL20-E-1CNT can be used as a replacement for the predecessor module BL20-1CNT-24VDC.



NOTE

Since both, the module ID and the parameters of the two devices are identical, the BL20-1CNT-24VDC, for example, can be used amongst others in the DTM to configure the new BL20-E-1CNT.

The following functional changes must be observed.

Signal evaluation options for encoders

The edge evaluation of signals A and B is defined as follows:

Count direction	BL20-E-1CNT	BL20-1CNT-24VDC
Up	Signal A before signal B	Signal B before signal A
Down	Signal B before signal A	Signal A before signal B

Hysteresis for DO1/DO2

The switching of the outputs DO1 or DO2 at a programmed hysteresis is defined as follows:

Count value $\geq$ reference value	BL20-E-1CNT	BL20-1CNT-24VDC
DO1 or DO2 switches	when reaching the...	
0 $\rightarrow$ 1	Count value	Count value + hysteresis
1 $\rightarrow$ 0	Count value - hysteresis	Count value - hysteresis

Count value $\leq$ reference value	BL20-E-1CNT	BL20-1CNT-24VDC
DO1 or DO2 switches	when reaching the...	
0 $\rightarrow$ 1	Count value	Count value - hysteresis
1 $\rightarrow$ 0	Count value + hysteresis	Count value + hysteresis

Zero crossing STS_ND

The STS_ND status bit for the zero crossing is set for the following events:

	BL20-E-1CNT	BL20-1CNT-24VDC
STS_ND 0 $\rightarrow$ 1	When counting (forward or backward), the count value 0 is reached.	When counting (forward or backward), the count value 0 is reached and the counting continues in the same counting direction beyond the count value 0.

Function DI, latch retrigger

Before the first edge after setting the software release, a different value is used as the start value depending on the gate function:

- Gate function "Abort count procedure": the load value (in preparation) is displayed and used internally as the start value.
- Gate function "Interrupt count procedure": the current internal count value is displayed and used internally as the start value.

	BL20-E-1CNT	BL20-1CNT-24VDC
Count value	The displayed value is updated when the software release is switched on.	The displayed value is not updated when the software release is switched on.

8 Parameterizing and configuring

8.1 Parameterizing the device in count mode

Changing a parameter re-parameterizes the entire module. Values that were previously changed, e.g. via the process data, are volatile and overwritten with the current parameters.

8.1.1 Parameters: counter mode

Standard byte oriented	Word oriented	PROFIBUS/ PROFINET	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte	Word	Byte								
0	0	15	-		Operation mode	Count mode				
1		14	-	Main count direction	Synchro- nization	Function DI		Invert digital input DI	Gate function	
2	1	13	Lower count limit (HIGH WORD)							
3		12								
4	2	11	Lower count limit (LOW WORD)							
5		10								
6	3	9	Upper count limit (HIGH WORD)							
7		8								
8	4	7	Upper count limit (LOW WORD)							
9		6								
10	5	5	Hysteresis							
11		4	Pulse duration DO1, DO2 [n × 2 ms]							
12	6	3	-	Function DO2		-	Function DO1		Deactivate diagnostics DO1	Substitute value DO1
13		2	Invert direction input (B)	-	Invert sensor (A)	Sensor/input filter DI B A			Signal evaluation (A , B)	
14	7	1	-		Behavior CPU/master stop		-			Deactivate group diagnostics
15		0	-							

The default values are written in **bold**.

Parameter name	Value	Meaning	Description
Count mode	00000	Continuous count	After release, the counter counts continuously between the upper and lower count limits from the load value. [► 43]
	00001	Single count	After release, the counter counts once from the load value to the upper or lower end value depending on the main count direction [► 44].
	00010	Periodical count	After release, the counter module counts within the parameterized counting range depending on the main counting direction [► 48].
Operation mode	0	Counter	The device is parameterized in the counting mode. Counting modes: continuous count, single count and periodical count [► 10]
	1	Measurement	The device is parameterized in the measurement mode. Measurement modes: frequency measurement, rotational speed measurement, period duration measurement [► 11]
Gate function	0	Abort count operation	The count operation is aborted if the software gate or the hardware gate are not active.
	1	Interrupt count operation	The counting operation is interrupted if the software gate or the hardware gate are not active.
Invert digital input DI	0	No	
	1	Yes	The input signal at the digital input is inverted.
Function DI	00	Input	The DI is used as input.
	01	HW gate	The DI is used as hardware release [► 51].
	10	Latch retrigger when edge positive	A positive edge at the DI activates the latch retrigger function [► 52].
	11	Synchronization when edge pos.	A positive edge at the DI activates the synchronization [► 53].
Synchronization	0	Single	Synchronization is performed once or periodically [► 53].
	1	Periodical	
Main count direction	00	None	The main count direction determines the behavior of the counter when a parameterized count limit is reached [► 10].
	01	Up	
	10	Down	
Lower count limit	-2 147 483 648 (-2^{31})...0		
Lower count limit (HWORD)	-32768 ...0 (Signed16)		
Lower count limit (LWORD)	-32768...32767 (Signed16); 0		
Upper count limit	0...+ 2147483647 ($2^{31}-1$)		
Upper count limit (HWORD)	0... 32767 (Unsigned16)		
Upper count limit (LWORD)	0... 65535 (Unsigned16)		
Hysteresis	0 ...255 (Unsigned8)		Sets the hysteresis for the digital outputs DO1 and DO2 [► 55].

Parameter name	Value	Meaning	Description
Pulse duration DO1, DO2 [n × 2 ms]	0...255 (Unsigned8)		Sets the pulse duration for adaptation to the actuators used [► 15].
Substitute value DO	0	0	The digital output is set to 0 on failure of the module bus communication or the fieldbus communication.
	1	1	The digital output is set to 1 on failure of the module bus communication or the fieldbus communication.
Deactivate diagnostics DO1	0	No	Diagnostics activated for digital output DO1.
	1	Yes	Diagnostics deactivated for digital output DO1.
Function DO1	00	Output	Digital output DO1 is used as digital output.
	01	On if count value ≥ reference value	Digital output DO1 is set when one of the comparison events occurs [► 55].
	10	On if count value ≤ reference value	
	11	Pulse at counter value = reference value	
Function DO2	00	Output	Digital output DO2 is used as digital output.
	01	On if count value ≥ reference value	Digital output DO2 is set when one of the comparison events occurs [► 55].
	10	On if count value ≤ reference value	
	11	Pulse at counter value = reference value	
Signal evaluation (A , B)	00	Pulse and direction	Sets the signal evaluation for encoders [► 14].
	01	Rotary sensor: single	
	10	Rotary sensor: double	
	11	Rotary sensor: fourfold	
Sensor/input filter(A)	0	2.5 µs (200 kHz)	All pulses ≥ 2,5 µs or ≥ 25 µs are detected.
	1	25 µs (20 kHz)	
Sensor/input filter(B)	0	2.5 µs (200 kHz)	
	1	25 µs (20 kHz)	
Sensor/input filter(DI)	0	2.5 µs (200 kHz)	
	1	25 µs (20 kHz)	
Invert sensor (A)	0	No	
	1	Yes	
Invert direction input (B)	0	No	
	1	Yes	
Deactivate group diagnostics	0	No	Group diagnostics is activated.
	1	Yes	Group diagnostics is deactivated.
Behavior CPU/ master stop	00	Turn off DO1	The parameter defines the behavior of digital output DO1 when the higher-level controller changes to the stop state.
	01	Continue operation mode	
	10	DO1 switch to substitute value	
	11	DO1 hold last value	

8.1.2 Continuous count

The counter counts continuously between the upper and lower count limits from the load value after release (hardware or software release). In this mode the function does not depend on the main count direction.

- **Counting up:** When the counter reaches the upper count limit and another counter pulse is detected, the counter jumps to the lower count limit and continues counting from there.
- **Counting down:** When counter reaches the lower count limit and another count pulse is detected, the counter jumps to the upper count limit and continues counting from there.

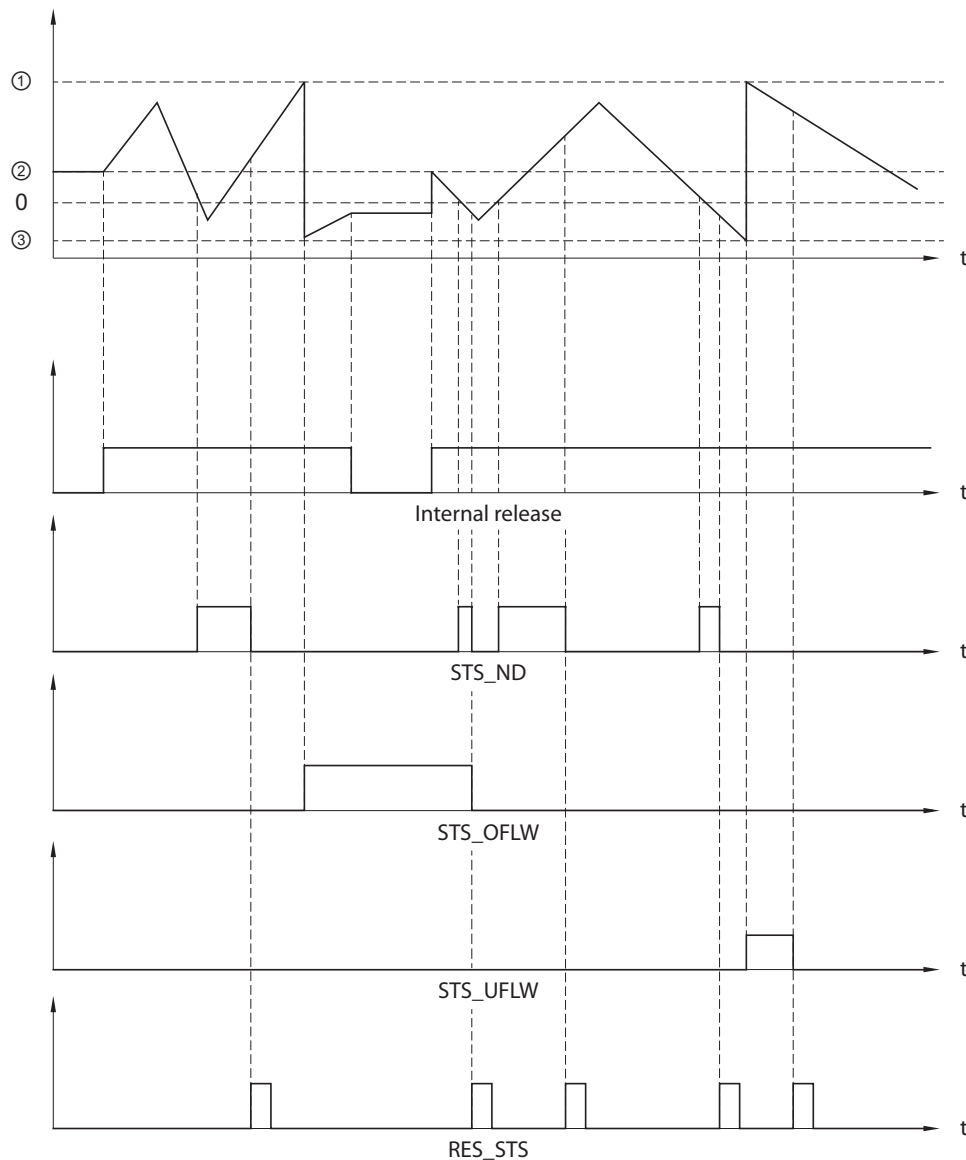


Fig. 22: Counting mode: continuous count

- ① Upper count limit
- ② Load value
- ③ Lower count limit

8.1.3 Single count

The counter module counts once from the load value to the upper or lower end value depending on the parameterized main count direction after release (hardware or software release). When the counter has reached the end value and another counter pulse is detected, the counter jumps to a defined value, depending on the main counting direction:

No main count direction

- **Counting up:** When the counter reaches the upper count limit and another counting pulse is detected, the counter jumps to the lower count limit and the internal release is automatically reset.
- **Counting down:** When the counter reaches the lower count limit and another counting pulse is detected, the counter jumps to the upper count limit and the internal enable is automatically reset.

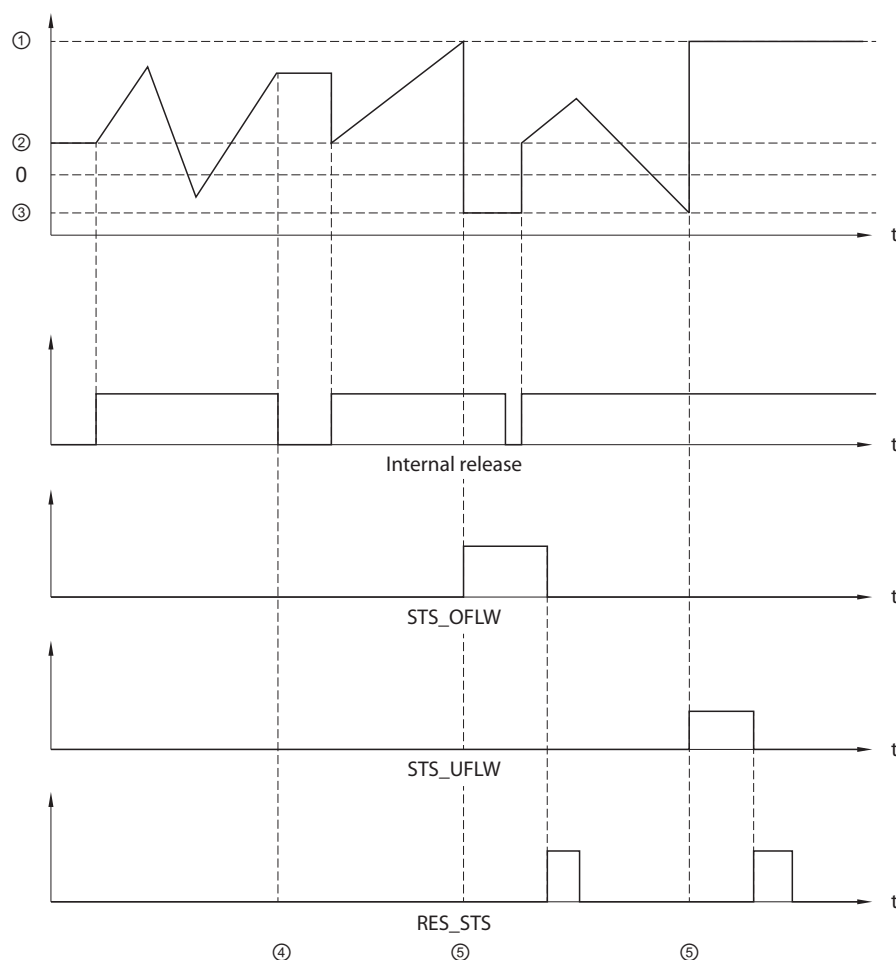


Fig. 23: Counter mode: single count, no main count direction

- ① Upper count limit
- ② Load value
- ③ Lower count limit
- ④ Release stop, internal release
- ⑤ Release stop, automatic

Main count direction up

- **Counting up:** When the counter reaches the upper count limit and another counting pulse is detected, the counter jumps to the load value and the internal release is automatically reset.
- **Counting down:** When the counter reaches the lower count limit and another counting pulse is detected, the counter jumps to the upper count limit and the internal enable is automatically reset.

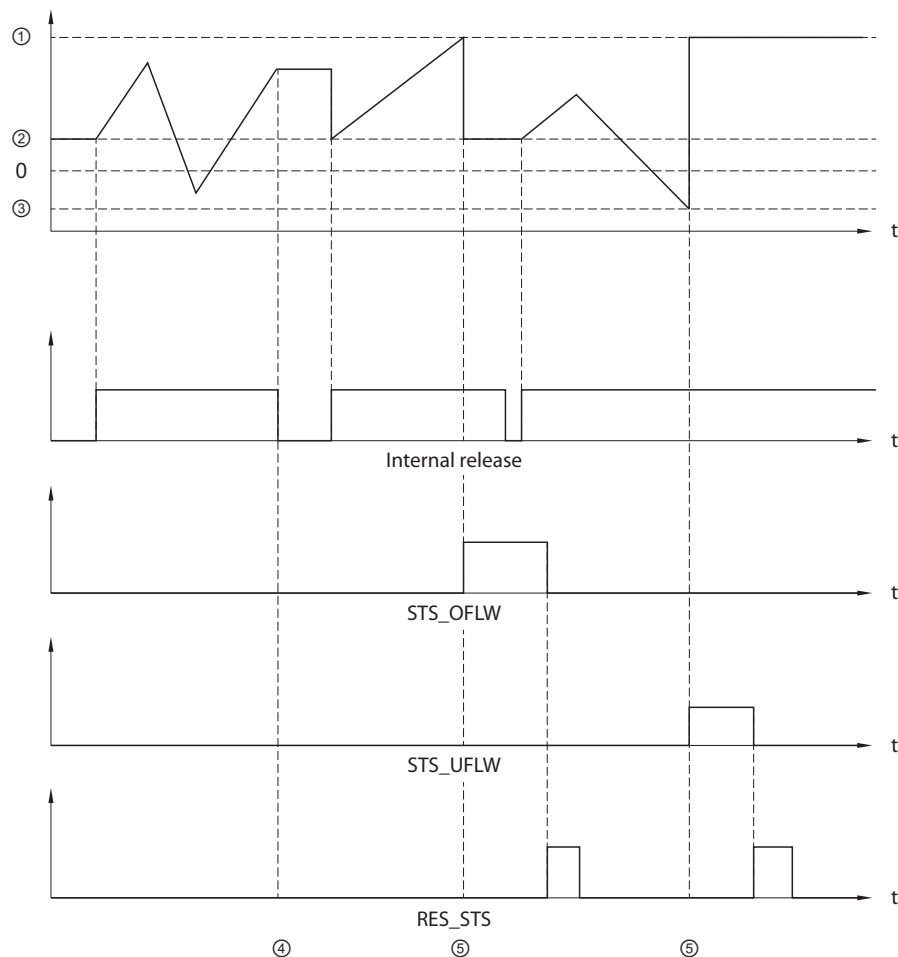


Fig. 24: Counter mode: single count with main count direction up

- ① Upper count limit
- ② Load value
- ③ Lower count limit
- ④ Release stop, internal release
- ⑤ Release stop, automatic

Main count direction down

- **Counting up:** When the counter reaches the upper count limit and another counting pulse is detected, the counter jumps to the lower count limit and the internal release is automatically reset.
- **Counting down:** When the counter reaches the lower count limit and another counting pulse is detected, the counter jumps to the upper count limit and the internal release is automatically reset.

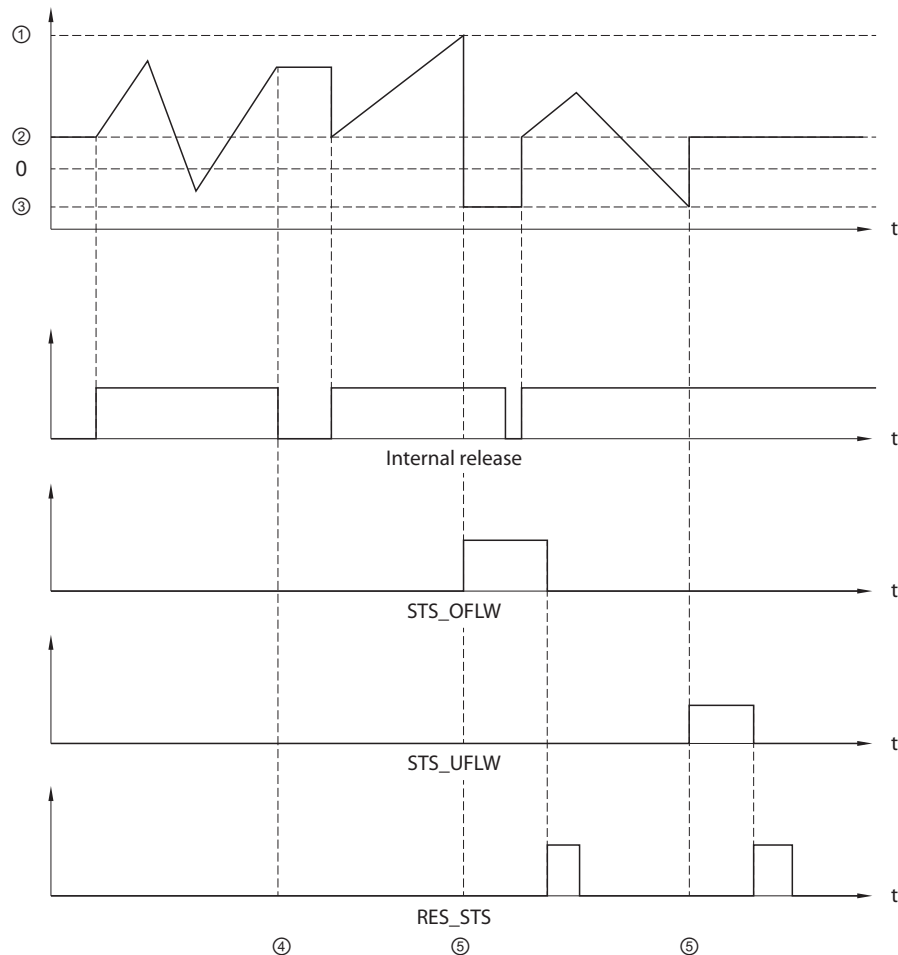


Fig. 25: Counter mode: single count with main count direction down

- ① Upper count limit
- ② Load value
- ③ Lower count limit
- ④ Release stop, internal release
- ⑤ Release stop, automatic

Internal release (all count directions)

The internal release is automatically reset by overflow or underflow at the count limits. The counting process is restarted by a rising edge, which is achieved as follows:

- ▶ Reset hardware release (digital input, if this is parameterized as "HW gate") and set again.
- or
- ▶ Reset software release (SW_GATE bit in the control interface, process output) and set again.

8.1.4 Periodical count

The module counts after release (hardware or software release) depending on the parameterized main count direction within the parameterized count range.

No main count direction

- **Counting up:** When the counter reaches the upper count limit and another count pulse is detected, the counter jumps to the load value and continues counting from there.
- **Counting down:** When counter reaches the lower count limit and another count pulse is detected, the counter jumps to the load value and continues counting from there.

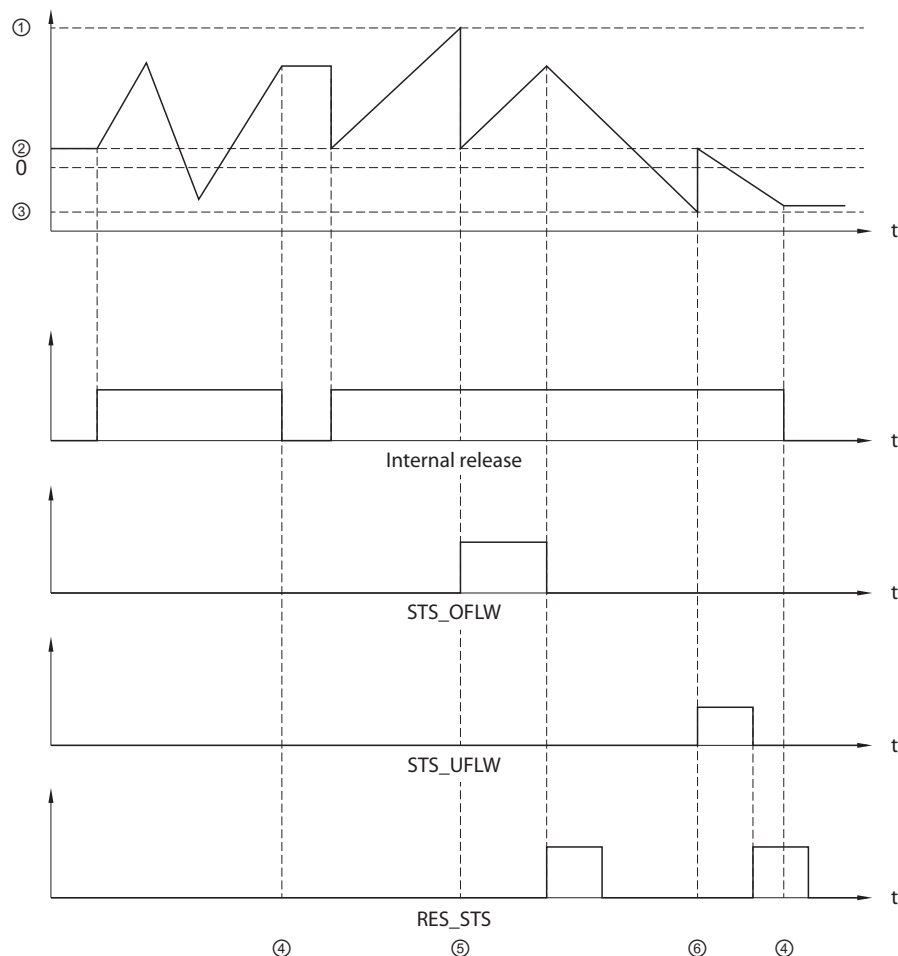


Fig. 26: Counter mode: periodical count without main count direction

- ① Upper count limit
- ② Load value
- ③ Lower count limit
- ④ Release stop, internal release
- ⑤ Overrun
- ⑥ Underrun

Main count direction up

- **Counting up:** When the counter reaches the upper count limit and another counter pulse is detected, the counter jumps to the load value.
- **Counting down:** When counter reaches the lower count limit and another count pulse is detected, the counter jumps to the upper count limit and continues counting from there.

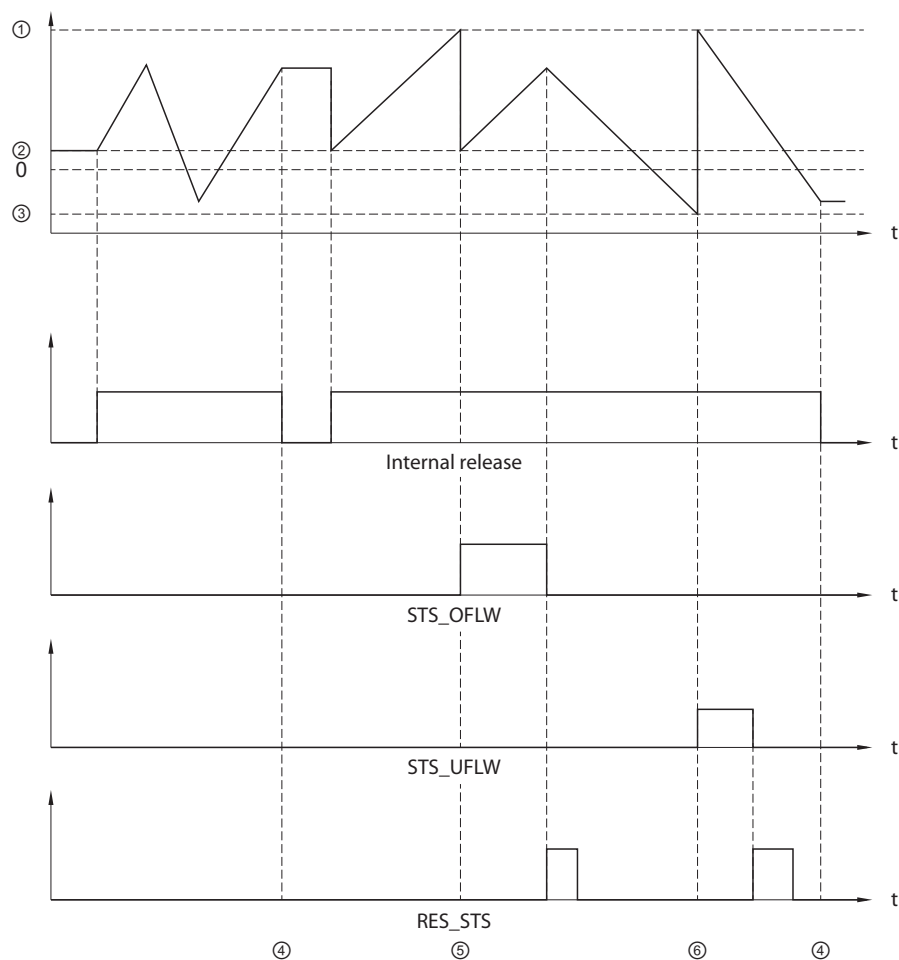


Fig. 27: Counter mode: periodical count with main count direction up

- ① Upper count limit
- ② Load value
- ③ Lower count limit
- ④ Release stop, manual
- ⑤ Overrun
- ⑥ Underrun

Main count direction down

- **Counting up:** When the counter reaches the upper count limit and another counter pulse is detected, the counter jumps to the lower count limit and continues counting from there.
- **Counting down:** When counter reaches the lower count limit and another count pulse is detected, the counter jumps to the load value and continues counting from there.

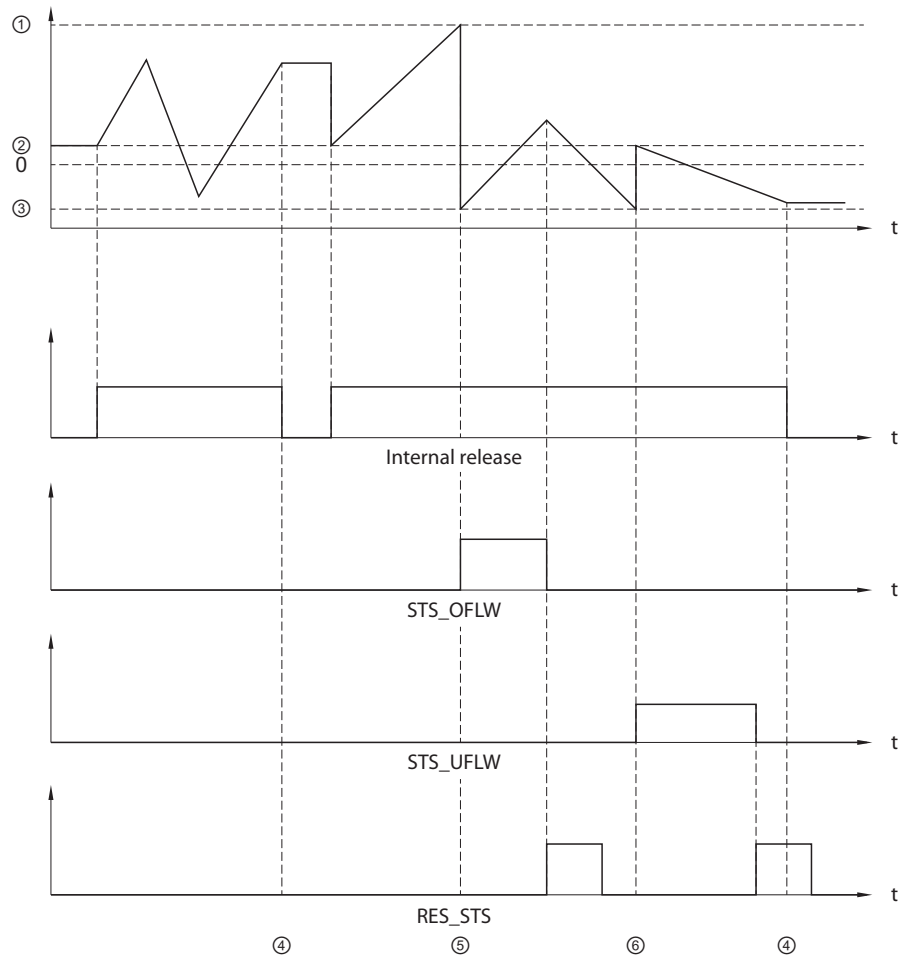


Fig. 28: Counter mode: periodical count with main count direction down

- ① Upper count limit
- ② Load value
- ③ Lower count limit
- ④ Release stop, manual
- ⑤ Overrun
- ⑥ Underrun

8.1.5 Releasing the count or measurement procedure

The release is set on an edge change $0 \rightarrow 1$ at the corresponding input and reset on an edge change $1 \rightarrow 0$. The edge change can be reversed by inverting the digital input („Invert DI” = „yes”).

If the counting procedure is interrupted, the counter starts counting from the load value when the counting process is restarted. If the counting process is interrupted, the counter continues the counting process with the current count value after the start.

Software gate

The software gate initiates the release via the SW_GATE control bit. The release is activated by the rising edge from $0 \rightarrow 1$ in bit SW_GATE.

If at the same time the „Function DI” = „HW gate” is parameterized, a high signal must be present at the digital input (24 VDC for „Invert digital input DI” = „No”). By resetting the control bit SW_GATE $1 \rightarrow 0$ the counting or measuring operation is stopped. If „Function DI” = „HW gate” is set, the counting resp. measuring operation can be stopped either by the software gate or the hardware gate.

Hardware gate

The hardware gate (HW gate) enables a release via a 24 VDC signal at the digital input (with parameter „Invert digital input DI” = „No”). This function is set with „Function DI” = „HW gate”. The release is only possible if the bit SW_GATE bit = 1 at the same time.

8.1.6 Latch retrigger function

To execute the latch-retrigger- function, the counting mode must be enabled with the software release. Bit STS_DI (Status DI) indicates the status of the latch and retrigger signal. Inverting the edge is not possible.

Before the first edge after setting the software release, a different value is used as the start value depending on the gate function:

- Gate function "Abort count procedure": the load value (in preparation) is displayed and used internally as the start value.
- Gate function "Interrupt count procedure": the current internal count value is displayed and used internally as the start value.

Direct loading of the counter does not change the displayed counter state.



NOTE

The DI input must not be inverted. Inverting results in an error message or diagnosis.

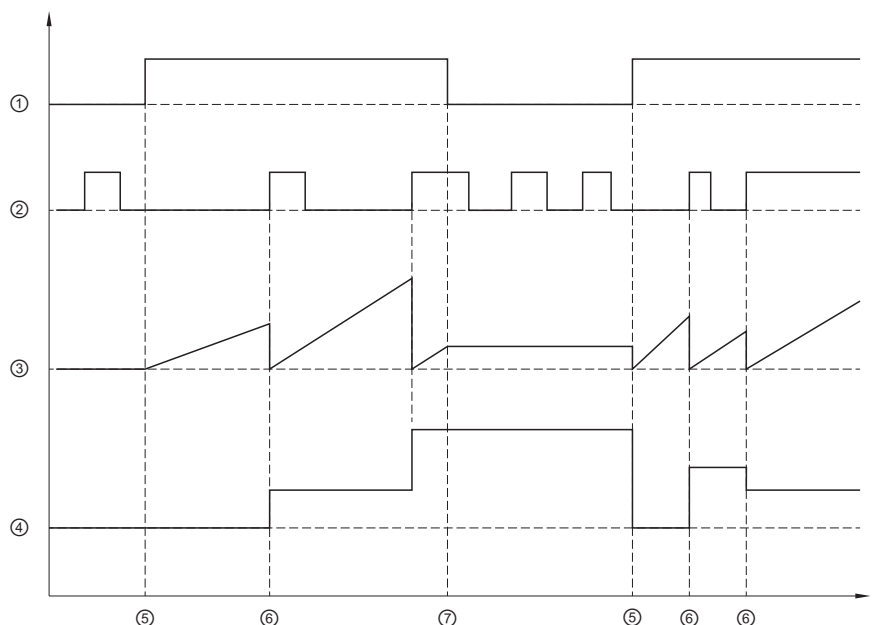


Fig. 29: Latch retrigger function for parameterized abort of the counting process

- ① Software release
- ② Digital input
- ③ Internal Count value value
- ④ Displayed Count value value
- ⑤ Manual start
- ⑥ Latch
- ⑦ Stop

8.1.7 Synchronizing count value and load value

The synchronization has to be configured before operating the counter module ("Function DI" = "synchronization when edge positive"). The rising edge of a reference signal at the input is used to set the counter to the load value. A single or periodical synchronization can be selected.

The signal of a bounce-free switch or the zero mark of a rotary encoder can serve as a reference signal.

The following must be observed:

- The counting operation was started with the software release.
- The control bit CRTL_SYN (enable synchronization) must be set.
- In case of single synchronization, the first edge ($0 \rightarrow 1$) at the digital input loads the counter with the load value after the release bit has been set.
- In case of periodical synchronization, the first and each further edge ($0 \rightarrow 1$) at the digital input loads the counter with the load value after the release bit has been set.
- After synchronization is successfully completed the STS_SYN status bit is set. It can only reset by the RES_STS control bit.
- The STS_DI status bit indicates the level of the reference signal at the digital input.

If a single synchronization has been performed a subsequent synchronization process can be initiated by resetting and setting the CRTL_SYN control bit (release synchronization). This subsequent synchronization is executed on the next positive edge $0 \rightarrow 1$ at the digital input.

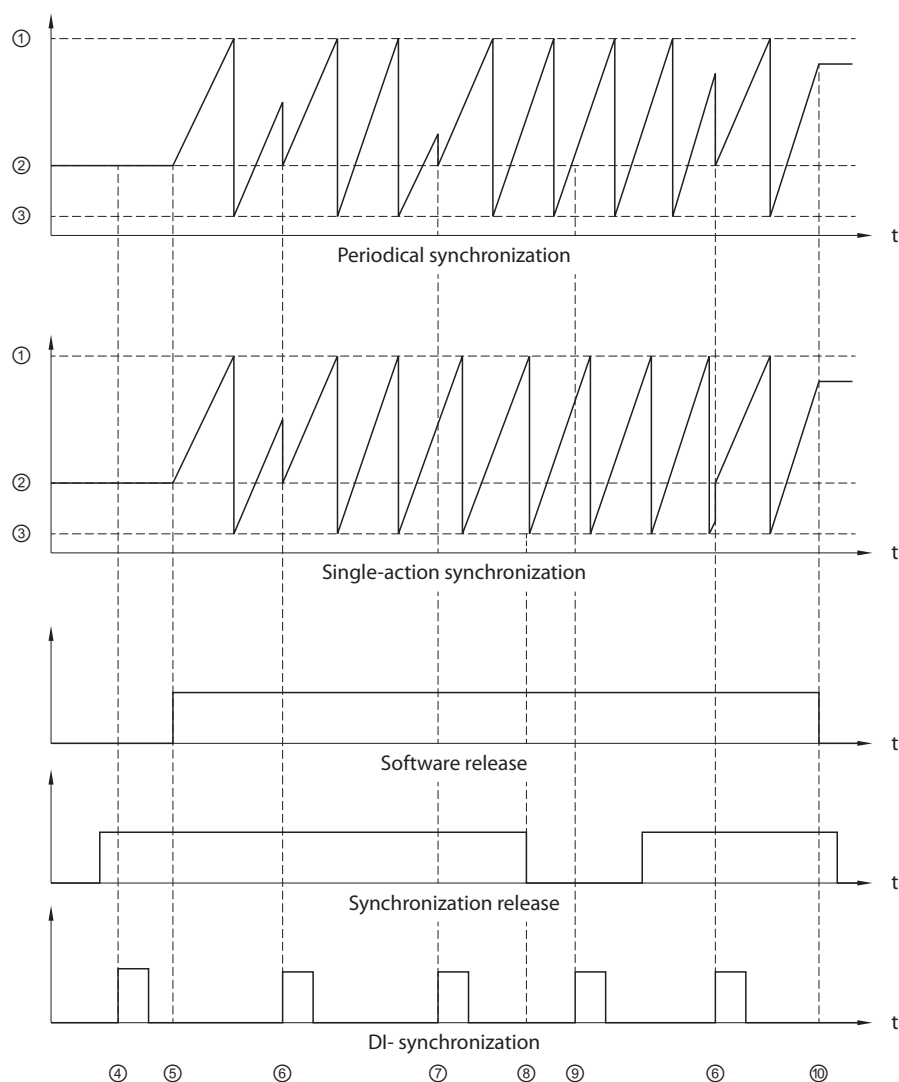


Fig. 30: Synchronization with continuous counting

- ① Upper count limit
- ② Load value
- ③ Lower count limit
- ④ Synchronization without release
- ⑤ Release set
- ⑥ 1. synchronization
- ⑦ 2. synchronization
- ⑧ Stop synchronization
- ⑨ no synchronization
- ⑩ Release reset

8.1.8 Functions of the digital outputs DO1 and DO2 in count mode

Digital output DO1 and DO2 in count mode

Functions of the digital outputs:

- Output (no switching via reference value)
- Set if count value $\geq$ reference value
- Set if count value $\leq$ reference value
- Pulse at counter value = reference value

Reference results for comparator 1 are assigned to physical output DO1. Reference results for comparator 2 are assigned to virtual output DO2.

Permissible value range for the two reference values:
lower count limit...upper count limit

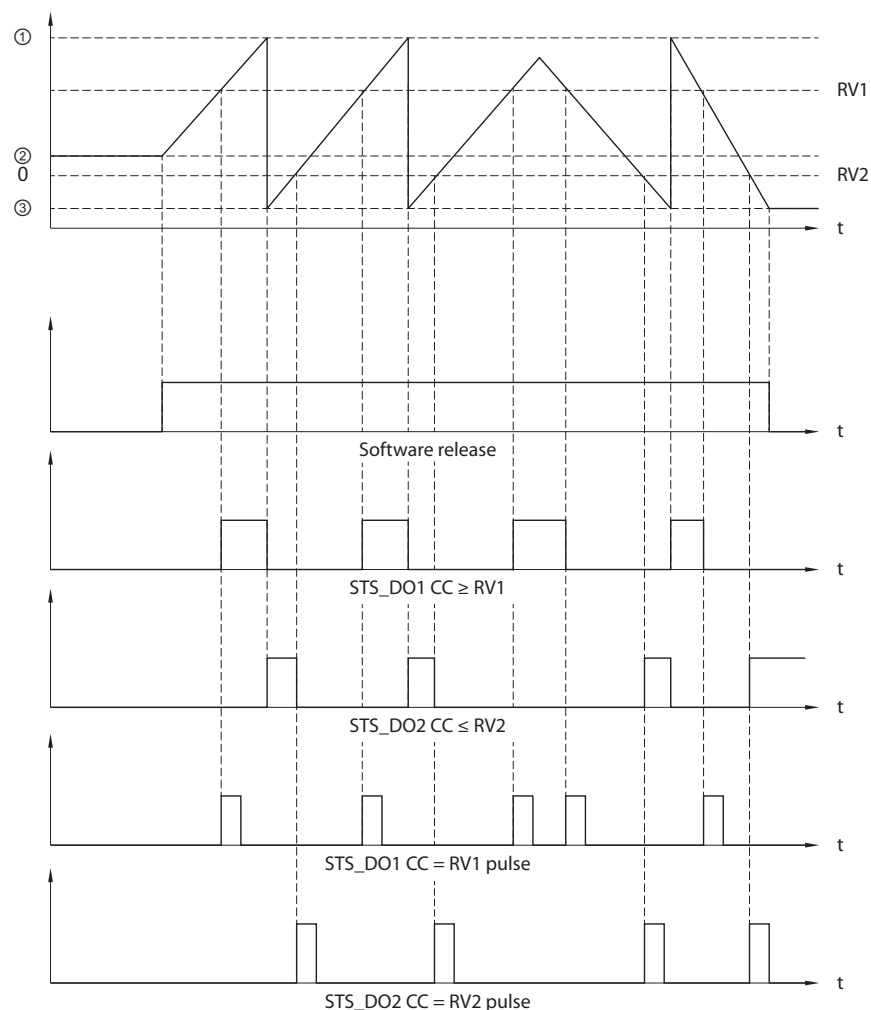


Fig. 31: Continuous counting with release function

- ① Upper count limit
- ② Load value
- ③ Lower count limit
- RV1 = Reference value 1
- RV2 = reference value 2
- CV = Count value

The upper and lower count limits are the parameterized count limits. The behavior of the digital outputs depend on:

- Hysteresis
- Pulse duration

The behavior of the digital outputs can be configured before operation or by means of a control command during operation.

Digital output DO1 and DO2 in mode "output"

If DO1 and DO2 are parameterized as pure outputs, setting and resetting via the control interface (process output) is possible if the respective output is released (CTRL_DO... = 1).

Hysteresis for digital outputs DO1 and DO2

In the counting mode, the hysteresis influences the switching of the digital outputs DO1 and DO2 in the comparison mode. This hysteresis can be set between 0 and 255 (0 = no hysteresis). The hysteresis can also be changed using the LOAD_DO_PARAM control command.

An encoder can stop at a certain position and then "oscillate" around this position, i.e. the count value fluctuates around a certain value. If the reference value RV1 or RV2 is in this fluctuation range, the digital output DO1 or DO2 is switched on and off in the rhythm of these fluctuations. To prevent this switching in case of small fluctuations, the counter module is equipped with a programmable hysteresis.

If the output is set for "switching $\geq$ reference value", the following behavior results (exemplary for DO1, DO2 behaves accordingly).

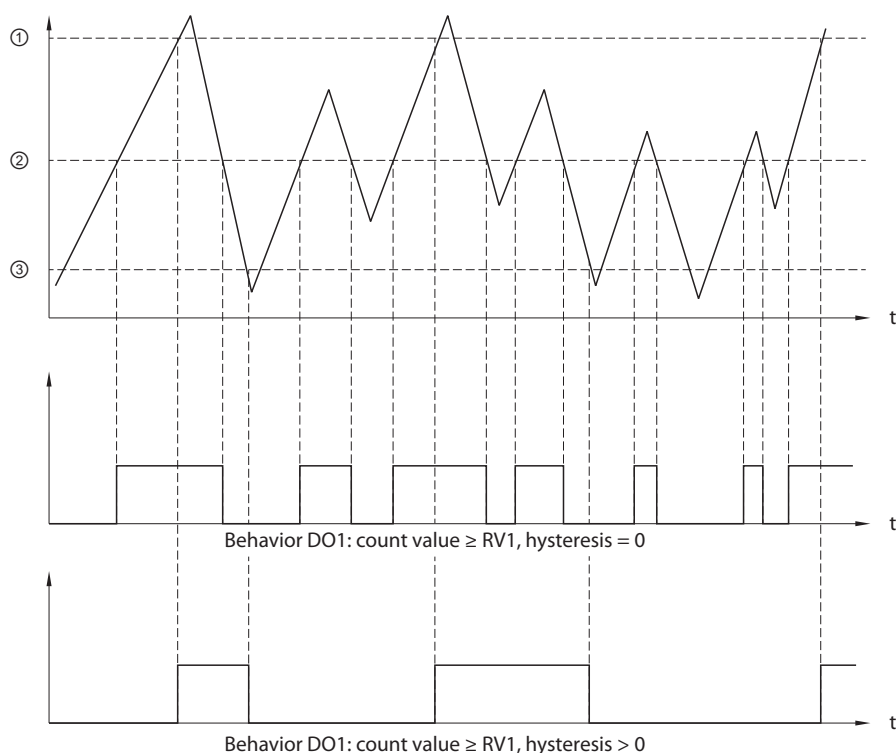


Fig. 32: Hysteresis with output set to "switch $\geq$ reference value"

- ① Reference value + hysteresis
- ② Reference value RV1
- ③ Reference value - hysteresis

If the output is parameterized with "switching at count value = reference value", a pulse is generated at output DO1.

8.2 Parameterizing the device in Measurement mode mode

Changing a parameter re-parameterizes the entire module. Values that were previously changed, e.g. via the process data, are volatile and overwritten with the current parameters.

8.2.1 Parameters: Measurement mode

Standard byte oriented	Word oriented	PROFIBUS/ PROFINET	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte	Word	Byte								
0	0	15	-		Operation mode	Measurement mode				
1		14								
2	1	13	Lower limit value (HIGH BYTE)							
3		12	...							
4	2	11	Lower limit value (LOW BYTE)							
5		10	Upper limit value (HIGH BYTE)							
6	3	9	...							
7		8	Upper limit value (LOW BYTE)							
8	4	7	Integration time [n × 10 ms]							
9		6								
10	5	5	Sensor pulses per revolution							
11		4								
12	6	3	-	-	-	-	Function DO1		Deactivate diagnostics DO1	Substitute value DO1
13		2	Invert direction input (B)	-	Invert sensor (A)	Sensor/input filter				
						DI	B	A		
14	7	1	-		Behavior CPU/ master stop	-				Deactivate group diagnostics
15		0								

The default values are written in **bold**.

Parameter name	Value	Meaning	Description
Measurement mode	00000	Frequency measurement	[▶ 61]
	00001	Rotational speed measurement	[▶ 62]
	00010	Period duration measurement	[▶ 63]
Operation mode	0	Counter	[▶ 10]
	1	Measurement	[▶ 11]
Invert digital input DI	0	No	
	1	Yes	The input signal at the digital input is inverted.

Parameter name	Value	Meaning	Description
Function DI	00	Input	[► 13]
	01	HW gate	
Lower limit	0...16 777 214 × 10 ⁻³		
Lower limit (HWORD)	-32768...0 (Signed16)		
Lower limit (LWORD)	0...255 (Unsigned8)		
Upper limit	1...16 777 215 × 10 ⁻³		
Upper limit (HWORD)	0...255 (Unsigned8)		
Upper limit (LWORD)	0...65535 (Unsigned16)		
Integration time	1...1000, 10		
Sensor pulses per revolution	Depending on connected encoder sensor		
Pulse duration DO1, DO2 [n × 2 ms]	1...65535, 10		
Substitute value DO	0	0	The digital output is set to 0 on failure of the module bus communication or the fieldbus communication.
	1	1	The digital output is set to 1 on failure of the module bus communication or the fieldbus communication.
Deactivate diagnostics DO1	0	No	Diagnostics activated for digital output DO1.
	1	Yes	Diagnostics deactivated for digital output DO1.
Function DO1	00	Output	Digital output DO1 is used as digital output.
	01	Value outside of the set limits	Digital output DO1 is set when the measured value is outside the measuring limits [► 55].
	10	Below lower limit	
	11	Above upper limit	
Signal evaluation (A, B)	00	Pulse and direction	[► 14]
	01	Rotary sensor: single	
Sensor/input filter(A)	0	2.5 µs (200 kHz)	All pulses ≥ 2.5 µs or ≥ 25 µs are detected.
	1	25 µs (20 kHz)	
Sensor/input filter(B)	0	2.5 µs (200 kHz)	
	1	25 µs (20 kHz)	
Sensor/input filter(DI)	0	2.5 µs (200 kHz)	
	1	25 µs (20 kHz)	
Invert sensor (A)	0	No	The sensor signal at counter input A is inverted.
	1	Yes	
Invert direction input (B)	0	No	The sensor signal at direction input B is inverted.
	1	Yes	

Parameter name	Value	Meaning	Description
Deactivate group diagnostics	0	No	Group diagnostics is activated.
	1	Yes	Group diagnostics is deactivated.
Behavior CPU/ master stop	00	Turn off DO1	The parameter defines the behavior of digital output DO1 when the higher-level controller changes to the stop state.
	01	Continue operation mode	
	10	DO1 switch to substitute value	
	11	DO1 hold last value	

8.2.2 Frequency measurement

The counter module counts the pulses received within a specified integration time. The integration time can be set by a parameter or via the control interface (process output data) during operation. The setting is made in 10 ms steps in the range from 10 ms to 10 s. The value of the determined frequency is made available as a 10^{-3} Hz value. The response interface (process input data) shows the measured frequency value. The displayed value is updated at the earliest after the integration time has elapsed.

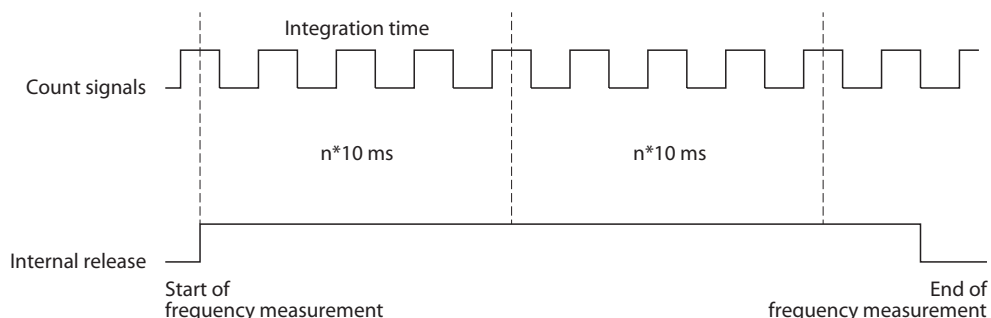


Fig. 33: Frequency measurement with enable function

Limit value monitoring

The limit values can be defined by parameterization and also subsequently via the control interface (process output data). Depending on the setting (parameter or process output data), different limit values result:

- Limit value definition via parameterization:

The value range is restricted by the 3 byte parameter length.

The upper limit must lie above the lower limit. A parameterization outside the permissible value range is signaled by the diagnostic messages "upper limit wrong" and "lower limit wrong". The diagnostics messages are cleared when valid parameters are entered.

- Lower limit (n_l): $0 \dots 16\,777\,214 \times 10^{-3}$ Hz
- Upper limit (n_o): $1 \dots 16\,777\,215 \times 10^{-3}$ Hz

- Limit value definition via process output data:

The limit values are set via the process output data bits LOAD_PREPARE and LOAD_VAL.

The upper limit must lie above the lower limit. An error is indicated by the ERR_LOAD status bit via the process input data. The status bit is cleared when a valid value is entered.

- Lower limit (n_l): $0 \dots 199\,999\,999 \times 10^{-3}$ Hz
- Upper limit (n_o): $1 \dots 200\,000\,000 \times 10^{-3}$ Hz

Possible measurement ranges

Integration time	$f_{\min}$	$f_{\max}$
10 s	0.1 Hz	200000 Hz
1 s	1 Hz	200000 Hz
0.1 s	10 Hz	200000 Hz
0.01 s	100 Hz	200000 Hz

8.2.3 Rotational speed measurement

The counter module counts the pulses received within a specified integration time. The number of "encoder pulses per revolution" of the connected encoder must be defined via the parameters. The number of "sensor pulses per revolution" and the pulses counted determine the speed of the connected motor. The integration time is specified by measurement parameters and can be set between 10 ms and 10 s in steps of 10 ms. The rotational speed is reported back in the unit 1×10^{-3} rpm.

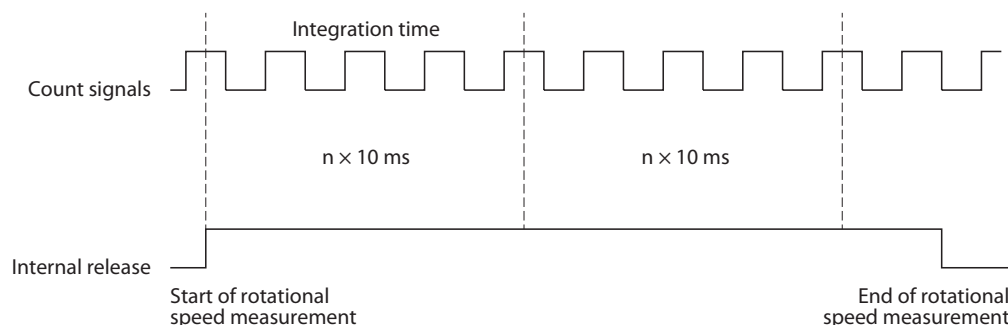


Fig. 34: Revolutions measurement with release function

Limit value monitoring

The limit values can be defined by parameterization and also subsequently via the control interface (process output data). Depending on the setting (parameter or process output data), different limit values result:

■ Limit value definition via parameterization:

The value range is restricted by the 3 byte parameter length.

The upper limit must lie above the lower limit. A parameterization outside the permissible value range is signaled by the diagnostic messages "upper limit wrong" and "lower limit wrong". The diagnostics messages are cleared when valid parameters are entered.

- Lower limit (n_{L}): $0 \dots 16\,777\,214 \times 10^{-3}$ rpm
- Upper limit (n_{H}): $1 \dots 16\,777\,215 \times 10^{-3}$ rpm

■ Limit value definition via process output data:

The limit values are set via the process output data bits LOAD_PREPARE and LOAD_VAL.

The upper limit must lie above the lower limit. An error is indicated by the ERR_LOAD status bit via the process input data. The status bit is cleared when a valid value is entered.

- Lower limit (n_{L}): $0 \dots 24\,999\,999 \times 10^{-3}$ rpm
- Upper limit (n_{H}): $1 \dots 25\,000\,000 \times 10^{-3}$ rpm

Possible measuring ranges (rotary encoder with "pulses per sensor revolution" = 60)

Integration time	n_{min}	n_{max}
10 s	1 rpm	200000 rpm
1 s	1 rpm	200000 rpm
0.1 s	10 rpm	200000 rpm
0.01 s	100 rpm	200000 rpm

Possible measuring ranges (rotary encoder with "pulses per sensor revolution" = 60000)

Integration time	$n_{\min}$	$n_{\max}$
10 s	1 rpm	200 rpm
1 s	1 rpm	200 rpm
0.1 s	1 rpm	200 rpm
0.01 s	1 rpm	200 rpm

8.2.4 Period duration measurement

The counter module measures the exact time between two rising edges of the count signal in ms by counting the pulses of an internal quartz-accurate reference frequency (1 MHz). Averaging can be done over 1...1000 periods and is specified by the parameter "integration time" or by the status bit LOAD_INTTIME in the control interface (process output data). After the parameterized number of periods, the displayed measurement result is updated. The measurement result is displayed in the unit ms in the feedback interface (process input data).

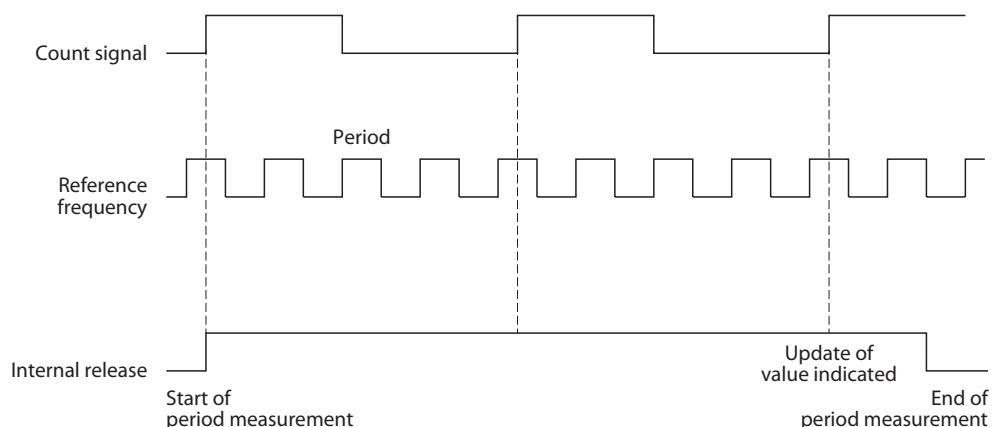


Fig. 35: Period duration measurement with release function, number of periods = 2

Limit value monitoring

The limit values can be defined by parameterization and also subsequently via the control interface (process output data). Depending on the setting (parameter or process output data), different limit values result:

■ Limit value definition via parameterization:

The value range is restricted by the 3 byte parameter length.

The upper limit must lie above the lower limit. A parameterization outside the permissible value range is signaled by the diagnostic messages "upper limit wrong" and "lower limit wrong". The diagnostics messages are cleared when valid parameters are entered.

- Lower limit (n_{lo}): 0...16 777 214 ms
- Upper limit (n_{hi}): 1...16 777 215 ms

■ Limit value definition via process output data:

The limit values are set via the process output bits LOAD_PREPARE and LOAD_VAL. The upper limit must lie above the lower limit. An error is indicated by the ERR_LOAD status bit via the process input data. The status bit is cleared when a valid value is entered.

- Lower limit (n_{lo}): 0...99 999 999 ms
- Upper limit (n_{hi}): 1...100 000 000 ms

Possible measurement ranges

Measuring cycle via number of periods	$t_{\min}$	Update after	$t_{\max}$	Update after
1000	10 μs	10 ms	10000 μs	10 s
100	10 μs	1 ms	100000 μs	10 s
10	100 μs	1 ms	1000000 μs	10 s
1	1000 μs	1 ms	10000000 μs	10 s

With the measuring cycles selected here the display is updated after a maximum of 10 s.

8.2.5 Functions of digital output DO1 in measurement mode

Functions of the digital outputs:

- Output (no switching when upper or lower measuring limit reached)
- Measured value outside of the set limits
- Measurement value below lower limit
- Measurement value above upper limit

Enable output

If the output has been activated, it can be enabled again via the CTRL_DO1 control bit. The SET_DO1 control bit switches the enabled output on and off. The status of the output can be read out in the response interface (process input data) via the status bit (STS_DO1).

DO1 in mode "output"

If DO1 and DO2 are parameterized as pure outputs, setting and resetting via the control interface (process output data) is possible if the respective output is enabled (CTRL_DO1 = 1). A setting or resetting (SET_DO1) can then be carried out irrespective of the count value.

9 Operating

9.1 Process data: Count mode

The position of the I/O data of the module within the process data of the overall station is defined via the hardware configuration in the respective control environment. For DeviceNet, EtherNet/IP and Modbus TCP a detailed mapping table of the complete station can also be generated with the BL20-DTM in PACTware.

9.1.1 Counter mode: process input data

Standard	PROFINET/ PROFIBUS	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte	Byte								
Inputs									
n	n + 7	Count value							
n + 1	n + 6								
n + 2	n + 5								
n + 3	n + 4								
Diagnostics									
n + 4	n + 3	ERR_ 24 VDC	ERR_ DO	ERR_ PARA	-	-	RES_ STS_A	ERR_ LOAD	STS_ LOAD
Status									
n + 5	n + 2	STS_DN	STS_UP	-	STS_DO2	STS_DO1	-	STS_DI	STS_GATE
n + 6	n + 1	STS_ND	STS_UFLW	STS_OFLW	STS_CPM2	STS_CMP1	-	-	STS_SYN
n + 7	n	Reserved							

n = process data offset in input data, depending on station configuration and the corresponding fieldbus or protocol

Meaning of the process data bits

Bit	Meaning
ERR_24 VDC	Short-circuit or over temperature at sensor supply 1 and or sensor supply 2 Acknowledgment via process output data required, control bit: EXTF_ACK 0 → 1
ERR_DO	Short circuit or over temperature at output DO1
ERR_PARAM	Parameter error: ERR_PARAM is a group diagnostic bit. With the separate diagnostics, the errors in parameterization are detailed in bits 3...6.
RES_STS_A	0: The last telegram of the process output data contained RES_STS = 0. 1: Resetting of status bits running. The last telegram of the process output data contained RES_STS = 1.
ERR_LOAD	Error during load function The control bits LOAD_DO_PARAM, LOAD_CMP_VAL2, LOAD_CMP_VAL1, LOAD_PREPARE and LOAD_VAL must not be set simultaneously during the transfer. An incorrect value was transferred with the control bits. Example: The values for "Load value direct" or "Load value in preparation" were selected above the upper count limit or below the lower count limit.
STS_LOAD	Status load function: Load function active
STS_DN	Status direction down: counter counts down

Bit	Meaning
STS_UP	Status direction up: counter counts up
STS_DO2	The DO2 status bit indicates the status of digital output DO2: 0: DO1 inactive 1: DO2 active
STS_DO1	The DO1 status bit indicates the status of digital output DO1: 0: DO1 inactive 1: DO1 active
STS_DI	The DI status bit indicates the status of the digital input DI: 0: no input signal 1: input signal at DI
STS_GATE	1: count operation running
STS_ND	Zero crossing: The bit is set if a zero crossing is reached when counting without main direction.
STS_UFLW	Lower count limit: The bit is set when the value falls below the lower count limit.
STS_OFLW	Upper count limit: The bit is set when the upper count limit has been exceeded.
STS_CMP2	1: Comparator 2: This status bit indicates a comparison result to reference value 2 when output DO2 is enabled with CTRL_DO2 = 1 and a comparison is performed via MODE_DO2 = 01 (on at count value $\geq$ compare value), 10 (on at count value $\leq$ compare value) or 11 (pulse at count value = compare value). If no comparison is performed, STS_CMP2 indicates that the output is or was set. STS_CMP2 is also set if output DO2 was not enabled but SET_DO2 is 1. Acknowledgment via process output data required, control bit: RES_STS 0 $\rightarrow$ 1
STS_CMP1	1: Comparator 1: This status bit indicates a comparison result to reference value 1 when output DO1 enabled with CTRL_DO1 = 1 and a comparison is performed via MODE_DO1 = 01 (on at count value $\geq$ compare value), 10 (on at count value $\leq$ compare value) or 11 (pulse at count value = compare value). If no comparison is performed STS_CMP1 indicates that the output is or was set. STS_CMP1 is also set if output DO1 was not enabled but SET_DO1 is 1. Acknowledgment via process output data required, control bit: RES_STS 0 $\rightarrow$ 1
STS_SYN	Synchronization: The bit is set after a successful synchronization.

9.1.2 Counter mode: process output data



NOTE

Settings made via the process output data are volatile.

The structure of the process output data depends on the parameterization of the module.

■ Process output data with parameter values for:

- Load value direct or
- Load value in preparation or
- Compare value 1 or
- Reference value 2

Standard	PROFINET/ PROFIBUS	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte	Byte								
Outputs									
n	n + 7	Load value direct, load value in preparation, reference value1, reference value 2, (depending on the parametrization)							
n + 1	n + 6								
n + 2	n + 5								
n + 3	n + 4								
Control									
n + 4	n + 3	EXTF_ACK	CTRL_DO2	SET_DO2	CTRL_DO1	SET_DO1	RES_STS	CTRL_SYN	SW_GATE
n + 5	n + 2	Reserved			LOAD _ DO_ PARAM	LOAD_ CMP_ VAL2	LOAD_ CMP_ VAL1	LOAD_ PREPARE	LOAD _VAL
n + 6	n + 1				Reserved				
n + 7	n								

n = process data offset in output data, depending on station configuration and the corresponding fieldbus or protocol

- Process output data with parameter values for:
 - Function DO1/DO2

Standard	PROFINET/ PROFIBUS	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte	Byte								
Outputs									
n	n + 7	-		MODE_DO2		-		MODE_DO1	
n + 1	n + 6	Hysteresis value							
n + 2	n + 5	Pulse duration							
n + 3	n + 4	Reserved							
Control									
n + 4	n + 3	EXTF_ACK	CTRL_DO2	SET_DO2	CTRL_DO1	SET_DO1	RES_STS	CTRL_SYN	SW_GATE
n + 5	n + 2	Reserved			LOAD _ DO_ PARAM	LOAD_ CMP_ VAL2	LOAD_ CMP_ VAL1	LOAD _ PREPARE	LOAD _ VAL
n + 6	n + 1	Reserved							
n + 7	n								

n = process data offset in output data, depending on station configuration and the corresponding fieldbus or protocol

Meaning of the process data bits

Bit	Meaning
MODE_DO2	MODE_DO2 defines which function DO2 should perform: 00: The output DO2 shows the status of the control bit SET_DO2. This must be enabled with CTRL_DO2 = 1. 01: Output DO2 indicates: count value $\geq$ reference value 2 10: Output DO2 indicates: count value $\leq$ reference value 2 11: Output DO2 indicates: Count value = reference value 2, a pulse is generated for indicating equal values. The pulse duration is defined by byte 2 of this process output data. The virtual output DO2 can show the status of the data bit SET_DO2 or comparison results if CTRL_DO2 = 1. MODE_DO2 is only valid, if LOAD_DO_PARAM: 0 $\rightarrow$ 1.
MODE_DO1	MODE_DO1 defines which function DO1 should perform: 00: The output DO1 shows the status of the control bit SET_DO1. This must be enabled with CTRL_DO1 = 1. 01: Output DO1 indicates: count value $\geq$ reference value 1 10: Output DO1 indicates: count value $\leq$ reference value 1 11: Output DO1 indicates: Count value = reference value 1, a pulse is generated for indicating equal values. The pulse duration is defined by byte 2 of this process output data. The virtual output DO1 can show the status of the data bit SET_DO1 or comparison results if CTRL_DO1 = 1. MODE_DO1 is only valid, if LOAD_DO_PARAM: 0 $\rightarrow$ 1.
Hysteresis value	0...255 A hysteresis value can be assigned to the comparison value 1 or 2 in order to influence the switching behavior at DO1 or DO2. The hysteresis prevents DO1 or DO2 from being switched on and off too frequently when the counter value fluctuates rapidly around the comparison value.

Bit	Meaning
Pulse duration	0...255 in unit: ms If the outputs DO1 or DO2 are parameterized to display „count value value = reference value“, a longer pulse may be necessary to detect the parity, s. "Pulse duration on reaching the reference value" [► 15].
EXTF_ACK	Error acknowledgment The error bits must be acknowledged with the control bit EXTF_ACK after the cause of the fault has been eliminated. This control bit must then be reset again. As long as the control bit EXTF_ACK is set, no new error messages are set.
CTRL_DO2	0: The virtual output DO2 is blocked. 1: The virtual output DO2 is enabled.
SET_DO2	If CTRL_DO2 = 1 and the virtual output DO2 is set to indicate the value SET_DO2, DO2 can be set and reset directly with SET_DO2. The parameterization of DO2 for this function is activated via MODE_DO2 = 00 and LOAD_DO_PARAM 0 → 1. DO2 is parameterized by default for the output of the value SET_DO2.
CTRL_DO1	0: The virtual output DO1 is blocked. 1: The virtual output DO1 is enabled.
SET_DO1	If CTRL_DO1 = 1 and the virtual output DO1 is set to indicate the value SET_DO1, DO1 can be set and reset directly with SET_DO1. DO1 can be activated for this function via the MODE_DO1 = 00 and LOAD_DO_PARAM 0 → 1. DO1 is parameterized by default for the output of the value SET_DO1.
RES_STS	0 → 1: Resetting the status bits Status bits STS_ND STS_UFLW, STS_OFLW, STS_CMP2, STS_CMP1, STS_SYN (process input data) are reset. Bit RES_STS_A = 1 (process input data) acknowledges that the reset command has been received. RES_STS is then reset to 0.
CTRL_SYN	0 → 1: Releasing synchronization The counter value at the physical input DI can be set (synchronized) to the load value once or periodically.
SW_GATE	Software gate: If the enable has been parameterized via the hardware gate, a positive signal must be present at this input to activate the software gate (logical AND operation). 0 → 1: Counting is started (release) 1 → 0: Counting is stopped
LOAD_DO_PARAM	Parameter definition of the DO1 physical output and the virtual output DO2 (0 → 1). DO1 and DO2 can indicate the status of data bit SET_DO1 and SET_DO2 or comparison results. The latest telegram (MODE_DO1 and MODE_DO2) indicates the function required for DO1 and DO2. Note: The parameterization of the output is done non-volatile via the parameters of the module. Settings via the process data with MODE_DO... = 00 and LOAD_DO_PARAM = 0 → 1 are volatile and are overwritten by a voltage reset or a parameter change at the device.
LOAD_CMP_VAL2	Reference value 2 0 → 1: The value in bytes 0...3 is accepted as a reference value 2.
LOAD_CMP_VAL1	Reference value 1 0 → 1: The value in bytes 0...3 is accepted as a reference value 2.
LOAD_PREPARE	The bit activates the preparatory loading of the counter value with the value in "load value in preparation" (byte n...n+3).

Bit	Meaning
LOAD_VAL	The bit activates the direct loading of the counter value with the value in "Load value direct" (byte n...n+3).
STS_SYN	Synchronization: The bit is set after a successful synchronization.

9.1.3 Limit values for count mode

Minimum number of count pulses between internal events

To ensure that internal calculations have been processed by the counter before a new count event occurs, certain minimum intervals of count pulses must be observed when parameterizing the values for "upper count limit", "comparison value", load value" and "lower count limit".

The following diagram shows the minimum number of counter pulses between two events as a function of the counting frequency (f) in Hz.

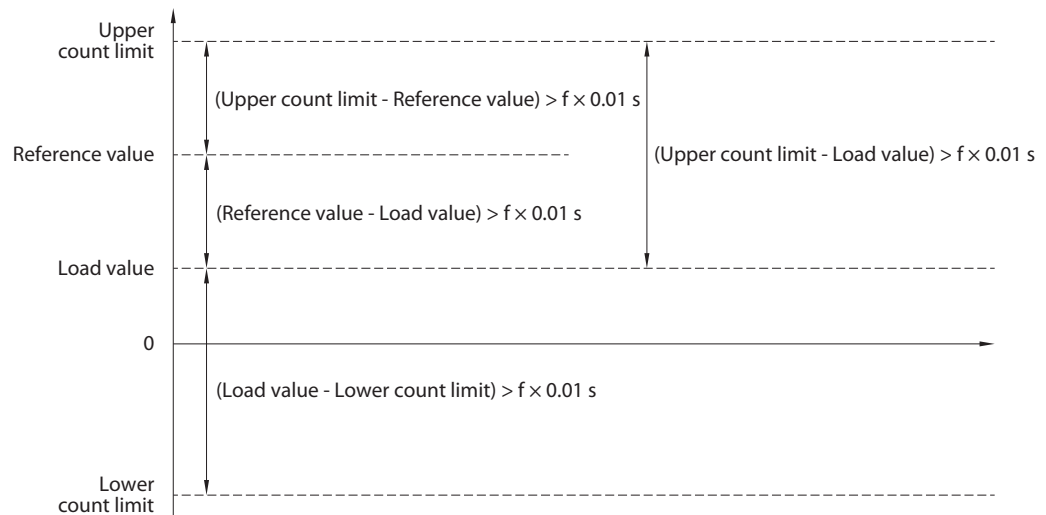


Fig. 36: Counter mode – minimum number of counter pulses

Counter frequency	Minimum number of counter pulses at different count frequencies
200 kHz	2000
100 kHz	1000
50 kHz	500
10 kHz	100
1 kHz	10

Minimum time interval between direction signal (B) and count signal (A)

When connecting pulse generators with direction level (e.g. light barriers for piece good counting), there must be a time span of at least 5 μ s or 50 μ s between direction signal (B) and counting signal (A), depending on the parameterized input filter.

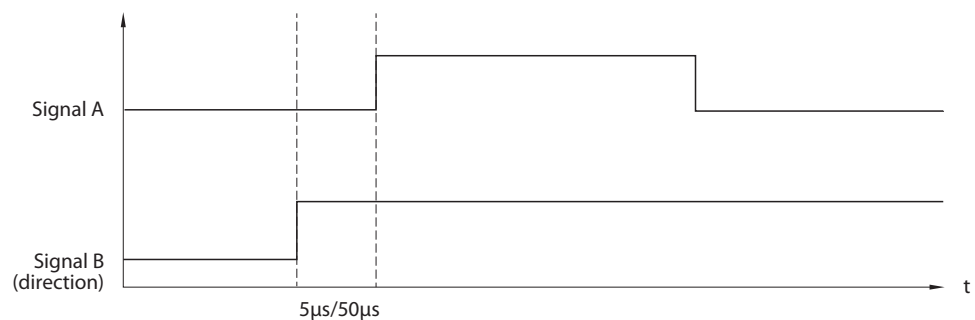


Fig. 37: Counter mode – time span between direction signal and counter signal

9.1.4 Behavior of the counter when a count limit is reached (main count direction)

The counter assumes the following values depending on the "Main counting direction" and the operating mode:

Main count direction	Upper limit	Lower limit
Operating mode: continuous count		
None	Jump to lower limit	Jump to upper limit
Up		
Down		
Operation mode: Single count		
None	Jump to lower limit	Jump to upper limit
Up	Jump to load value	Jump to upper limit
Down	Jump to lower limit	Jump to load value
Operating mode: periodical count		
None	Jump to load value	Jump to load value
Up	Jump to load value	Jump to upper limit
Down	Jump to lower limit	Jump to load value

9.1.5 Reset states after power-on or power interruption

The reset states after a power loss or after switching on the power supply are defined as follows:

Value	Reset state
Load value	0
Count value	0
Reference value DO1	0
Reference value DO2	0



NOTE

The values (load value, count value, reference value) can only be changed via the process output data. Changing the parameters (via the parameter interface) has no influence on these values. The reset states are independent of the main count direction.

9.2 Process data: Measurement mode

The measuring operation is started by setting the internal software release or, if the digital input is parameterized as hardware release, by setting hardware and software release.

The measurement takes place within a parameterizable integration time, which can be changed via the control interface (process output data). The measured value is then updated. After the integration time has elapsed, STS_MVAL indicates that an actual measured value is present. This bit must be in the control interface reset by the RES_STS control bit.

The position of the I/O data of the module within the process data of the overall station is defined via the hardware configuration in the respective control environment. For DeviceNet, EtherNet/IP and Modbus TCP a detailed mapping table of the complete station can also be generated with the BL20-DTM in PACTware.

9.2.1 Measurement mode: process input data

Standard	PROFINET/ PROFIBUS	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte	Byte								
Inputs									
n	n + 7	Measurement value							
n + 1	n + 6								
n + 2	n + 5								
n + 3	n + 4								
Diagnostics									
n + 4	n + 3	ERR_ 24 VDC	ERR_ DO	ERR_ PARA	-	-	RES_ STS_A	ERR_ LOAD	STS_ LOAD
Status									
n + 5	n + 2	STS_DN	STS_UP	-	-	STST_DO1	-	STS_DI	STS_GATE
n + 6	n + 1	-	STS_UFLW	STS_OFLW	-	STS_CMP1	-	-	-
n + 7	n	Reserved							

n = process data offset in input data, depending on station configuration and the corresponding fieldbus or protocol

Meaning of the process data bits

Bit	Meaning
ERR_24 VDC	Short-circuit or over temperature at sensor supply 1 and or sensor supply 2 Acknowledgment via process output data required, control bit: EXTF_ACK 0 → 1
ERR_DO	Short-circuit or over temperature at output DO1 Acknowledgment via process output data required, control bit: EXTF_ACK 0 → 1
ERR_PARA	Parameter error: ERR_PARA is a group diagnostic bit. With the separate diagnostics, the errors in parameterization are detailed in bits 3...6.
RES_STS_A	Resetting of status bits running. The last telegram of the process output data contained RES_STS = 1.

Bit	Meaning
ERR_LOAD	Error during load function The control bits LOAD_UPLIMIT and LOAD_LOLIMIT must not be set simultaneously during the transfer. The value of LOAD_UPLIMIT and LOAD_LOLIMIT was selected outside the possible range. Permissible values for LOAD_LOLIMIT: 0...199 999 999 × 10⁻³ Hz 0...24 999 999 × 10⁻³ U/min. 0...99 999 999 ms Permissible values for LOAD_UPLIMIT: 1...200 000 000 × 10⁻³ Hz 1...25 000 000 × 10⁻³ U/min. 1...100 000 000 ms
STS_LOAD	Load function active
STS_DN	Status direction: down The direction is determined by a signal at the physical input B. The "signal evaluation parameter (A, B)" must be set to "pulse and direction".
STS_UP	Status direction: up The direction is determined by a signal at the physical input B. The "signal evaluation parameter (A, B)" must be set to "pulse and direction".
STS_DO1	The DO1 status bit indicates the status of digital output DO1: 0: DO1 inactive 1: DO1 active
STS_DI	The DI status bit indicates the status of the digital input DI: 0: no input signal 1: input signal at DI
STS_GATE	1: Measurement running
STS_UFLW	1: The lower measuring limit was undercut.
STS_OFLW	1: The upper measuring limit was exceeded. Acknowledgment via process output data required, control bit: RES_STS 0 → 1
STS_CMP1	1: Measurement ended After each elapsed time interval, the measured value is updated. The end of a measurement (after the time interval has elapsed) is signaled with STS_CMP1 = 1. Acknowledgment via process output data required, control bit: RES_STS 0 → 1
STS_SYN	Synchronization: The bit is set after a successful synchronization. Acknowledgment via process output data required, control bit: RES_STS 0 → 1

9.2.2 Measurement mode: process output data



NOTE

Settings made via the process output data are volatile.

The structure of the process output data depends on the parameterization of the module.

- Process output data with parameter values for:

– Function DO1

Standard	PROFINET/ PROFIBUS	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte	Byte								
Outputs									
n	n + 7	-						MODE_DO1	
n + 1	n + 6	Reserved							
n + 2	n + 5								
n + 3	n + 4								
Control									
n + 4	n + 3	EXTF_ACK	-		CTRL_DO1	SET_DO1	RES_STS	-	SW_GATE
n + 5	n + 2	Reserved			LOAD _ DO_ PARAM	-	LOAD_ INTTIME	LOAD _ UPLIMIT	LOAD _ LOLIMIT
n + 6	n + 1	Reserved							
n + 7	n								

n = process data offset in output data, depending on station configuration and the corresponding fieldbus or protocol

- Process output data with parameter values for:

– Upper limit or lower limit

Standard	PROFINET/ PROFIBUS	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte	Byte								
Outputs									
n	n + 7	Upper limit or lower limit							
n + 1	n + 6								
n + 2	n + 5								
n + 3	n + 4								
Control									
n + 4	n + 3	EXTF_ACK	-		CTRL_DO1	SET_DO1	RES_STS	-	SW_GATE
n + 5	n + 2	Reserved			LOAD _ DO_ PARAM	-	LOAD_ INTTIME	LOAD _ UPLIMIT	LOAD _ LOLIMIT
n + 6	n + 1	Reserved							
n + 7	n								

n = process data offset in output data, depending on station configuration and the corresponding fieldbus or protocol

- Process output data with parameter values for:
 - Integration time

Standard	PROFINET/ PROFIBUS	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte	Byte								
Outputs									
n	n + 7	Integration time							
n + 1	n + 6								
n + 2	n + 5	Reserved							
n + 3	n + 4								
Control									
n + 4	n + 3	EXTF_ACK	-		CTRL_DO1	SET_DO1	RES_STS	-	SW_GATE
n + 5	n + 2	Reserved			LOAD _ DO_ PARAM	-	LOAD_ INTTIME	LOAD _ UPLIMIT	LOAD _ LOLIMIT
n + 6	n + 1				Reserved				
n + 7	n								

n = process data offset in output data, depending on station configuration and the corresponding fieldbus or protocol

Meaning of the process data bits

Bit	Meaning
MODE_DO1	MODE_DO1 defines which function DO1 should perform: 00: The output DO1 shows the status of the control bit SET_DO1. This must be enabled with CTRL_DO1 = 1. 01: The DO1 output signals a measurement outside the limits, i.e. exceeding the upper measuring limit or falling below the lower measuring limit. STS_OFLW = 1 or STS_UFLW = 1 (process input data). 10: Output DO1 signals that the value has fallen below the lower measuring limit. STS_UFLW = 1 (process input data) 11: The DO1 output signals that the upper measuring limit has been exceeded. STS_OFLW = 1 (process input) The virtual output DO1 can show the status of the data bit SET_DO1 or comparison results if CTRL_DO1 = 1. MODE_DO1 is only valid, if LOAD_DO_PARAM: 0 → 1.
Upper limit or lower limit	Value for the upper or lower limit of the measured value, which is taken over, if bit LOAD_UPLIMIT or the bit LOAD_UPLIMIT are set.
Integration time	Value for the integration time that is taken over when the LOAD_INTIME bit is set.
EXTF_ACK	Error acknowledgment The error bits must be acknowledged with the control bit EXTF_ACK after the cause of the fault has been eliminated. This control bit must then be reset again. As long as the control bit EXTF_ACK is set, no new error messages are set.
CTRL_DO1	0: The virtual output DO1 is blocked. 1: The virtual output DO1 is enabled.

Bit	Meaning
SET_DO1	If CTRL_DO1 = 1 and the virtual output DO1 is set to indicate the value SET_DO1, DO1 can be set and reset directly with SET_DO1. DO1 can be activated for this function via the MODE_DO1 = 00 and LOAD_DO_PARAM 0 → 1. DO1 is parameterized by default for the output of the value SET_DO1.
RES_STS	0 → 1: Resetting the status bits Status bits STS_UFLW, STS_OFLW and STS_CMP1 (process input data) are reset. Bit RES_STS_A = 1 (process input data) acknowledges that the reset command has been received. RES_STS is then reset to 0.
SW_GATE	Software gate: If the release has parameterized via the hardware gate, a positive signal must be present at this input to activate the software gate (logical AND operation). 0 → 1: Measurement is started (release) 1 → 0: Measurement is stopped
LOAD DO_PARAM	Parameterization of the physical output DO1: the output can reflect the state of different data bits as a signal. The current telegram (MODE_DO1, byte 0) is used to determine to which data bits DO1 must refer. Note: The parameterization of the output is done non-volatile via the parameters of the module. Settings via the process data with MODE_DO... = 00 and LOAD_DO_PARAM = 0 → 1 are volatile and are overwritten by a voltage reset or a parameter change at the device.
LOAD_INTTIME	Parameterization "Integration time" 0 → 1: Bytes 0...1 of this process output data represent a factor for defining the integration time for frequency measurement and for determining the rotational speed. The integration time can be set in the range between 10 ms and 10 s in steps of 10 ms and results from the multiplication: factor × 10 ms. In period duration measurement, this factor determines the number of periods measured to form an average value. A factor 1...1000 (0x0001...0x03E8) is permissible.
LOAD_UPLIMIT	Parameter setting of the upper measuring limit 0 → 1: The value in bytes 0...3 is accepted as upper measuring limit. LOAD_UPLIMIT: 1...200 000 000 × 10 ⁻³ Hz 1...25 000 000 × 10 ⁻³ rpm 1... 000 000 000 ms
LOAD_LOLIMIT	Parameter setting of the lower measuring limit 0 → 1: The value in bytes 0...3 is accepted as lower measuring limit. LOAD_LOLIMIT: 0...199 999 999 × 10 ⁻³ Hz 0...24 999 999 × 10 ⁻³ rpm 0... 999 000 999 ms

9.3 Accepting values (load function)

The acceptance of values (load values, comparison values, measurement limits, etc.) is requested by the controller and executed by the BL20 module.

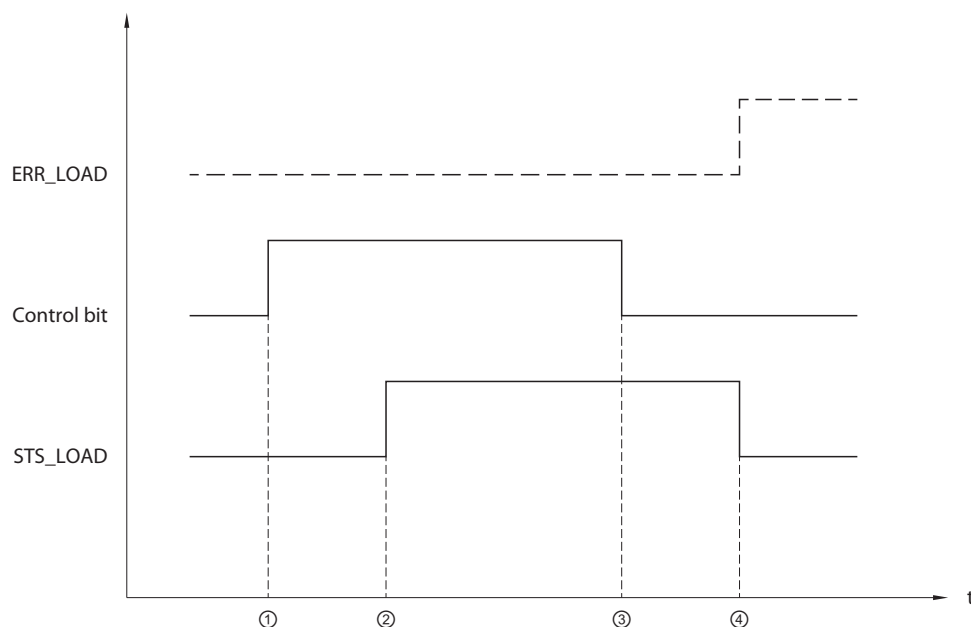


Fig. 38: Accepting values with the load function

- ① Controller requests value acceptance, value is provided
- ② BL20 module has received the request
- ③ Request for value acceptance canceled by the controller
- ④ Value accepted, transfer completed

Load function in counting mode

The following values can be changed using the load function during operation:

- Count value (LOAD_VAL)
- Load value (LOAD_PREPARE)
- Reference value1 (LOAD_CMP_VAL1)
- Reference value2 (LOAD_CMP_VAL2)
- Behavior of the digital outputs DO1/DO2 (LOAD_DO_PARAM)

When changing the behavior of the digital output via the control interface (process output data LOAD_DO_PARAM), observe:

The values for pulse duration and hysteresis are also changed. The changes are stored volatile. After a reset of the module by pulling and plugging again, the values are overwritten and replaced by the values stored in the gateway.

Load function in measuring mode

The following values can be changed using the load function during operation:

- Behavior of the digital output DO1 (LOAD_DO_PARAM)
- Lower limit (LOAD_LOLIMIT)
- Upper limit (LOAD_UPLIMIT)

9.4 LED displays

The device has the following LED indicators:

- LED DIA
 - Diagnostics, module bus communication, parameter error
- LED A and LED B
 - Status sensor supply
 - Status counter input, measuring input, direction input
- LED DI
 - Status: Digital input
- LED DO
 - Status: Digital output

LED DIA	Meaning	Remedy
Red flashing (0.5 Hz)	Parameter error	▶ Check the parameterization of the counter module.
Red	Module bus communication disturbed	▶ Check if more than 2 adjacent electronic modules are pulled. ▶ Check module bus supply or supply at gateway.
Off	No error messages or diagnostics	

LED A	Meaning	Remedy
Red flashing (1 Hz)	Error sensor supply 1 (V_{sens1})	▶ Check the of connection sensor supply 1.
Green	Counter input or measuring input active	
Off	Counter input or measuring input inactive	

LED B	Meaning	Remedy
Red flashing (1 Hz)	Error sensor supply 2 (V_{sens2})	▶ Check the of connection sensor supply 2.
Green	Count input or measuring input active	
Off	Count input or measuring input not active	

LED DI	Meaning
Green	Input signal at DI
Off	No input signal

LED DO	Meaning	Remedy
Red	Error at digital output	▶ Check the wiring at the digital output.
Green	Output active	
Off	Output inactive	

9.5 Software diagnostic messages

The device provides the following software diagnostic messages:

- Device status
- Short-circuit diagnostics: Digital output, sensor supply
- Parameter error

9.5.1 Diagnostic messages: Counter mode

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	-	Operation mode wrong	Main count direction wrong	Invert-DI at L-retr. error	Lower count limit wrong	Upper count limit wrong	ERR_24 VDC	ERR_DO

Diagnostics	Meaning
ERR_DO	Short-circuit or over temperature at output DO1 Acknowledgment via process output data required, control bit: EXT_F_ACK 0 → 1
ERR_24 VDC	Group diagnostics: Short-circuit or over temperature at sensor supply 1 and or sensor supply 2 Acknowledgment via process output data required, control bit: EXT_F_ACK 0 → 1
Parameter error	
Upper count limit wrong	Possible causes: ■ Upper count limit = lower count limit ■ Upper count limit < 0
Lower count limit wrong	Possible causes: ■ Lower count limit = upper count limit ■ Lower count limit > 0
Invert-DI at latch-retr. error	Inverting the digital input level is not allowed with the latch retrigger function.
Main count direction wrong	Invalid parameter value, possible values [▶ 40]
Operation mode wrong	Invalid parameter value, possible values [▶ 40]

9.5.2 Diagnostic messages: Measurement mode

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Operation mode	Operation mode wrong	Lower limit wrong	Upper limit wrong	Integration time wrong	Sensor pulses wrong	ERR_24 VDC	ERR_DO

Diagnostics	Meaning	
ERR_DO	Short-circuit or over temperature at output DO1 Acknowledgment via process output data required, control bit: EXT_F_ACK 0 → 1	These bits are also mapped in the process input data.
ERR_24 VDC	Group diagnostics: Short-circuit or over temperature at sensor supply 1 and or sensor supply 2 Acknowledgment via process output data required, control bit: EXT_F_ACK 0 → 1	
Parameter error		
Sensor pulses wrong	Wrong value for pulses per revolution, permissible value range: 1...65535	
Integration time wrong	Wrong value for integration time, permissible value range: 1...1000 [► 58]	
Upper limit wrong	Wrong value for upper limit, permissible value range: 1...16 777 215 × 10 ⁻³ , [► 58]	The upper limit must be above the lower limit. If not, both diagnostic bits are set.
Lower limit wrong	Wrong value for upper limit, permissible value range: 0...16 777 214 × 10 ⁻³ , [► 58]	
Operation mode wrong	Invalid parameter value, possible values [► 58]	
Operation mode	This message is always displayed in conjunction with other diagnostic messages and indicates that measurement mode is active.	

9.6 Resetting the status bits

The reset of the status bits requested by the controller.

Status bits:

- STS_ND (status zero crossing)
- SSTS_UFLW (status lower count limit underrun)
- STS_OFLW (status upper count limit exceeded)
- STS_CMP1 (status compare 1)
- STS_CMP2 (status compare 2)
- STS_SYN (status synchronization)

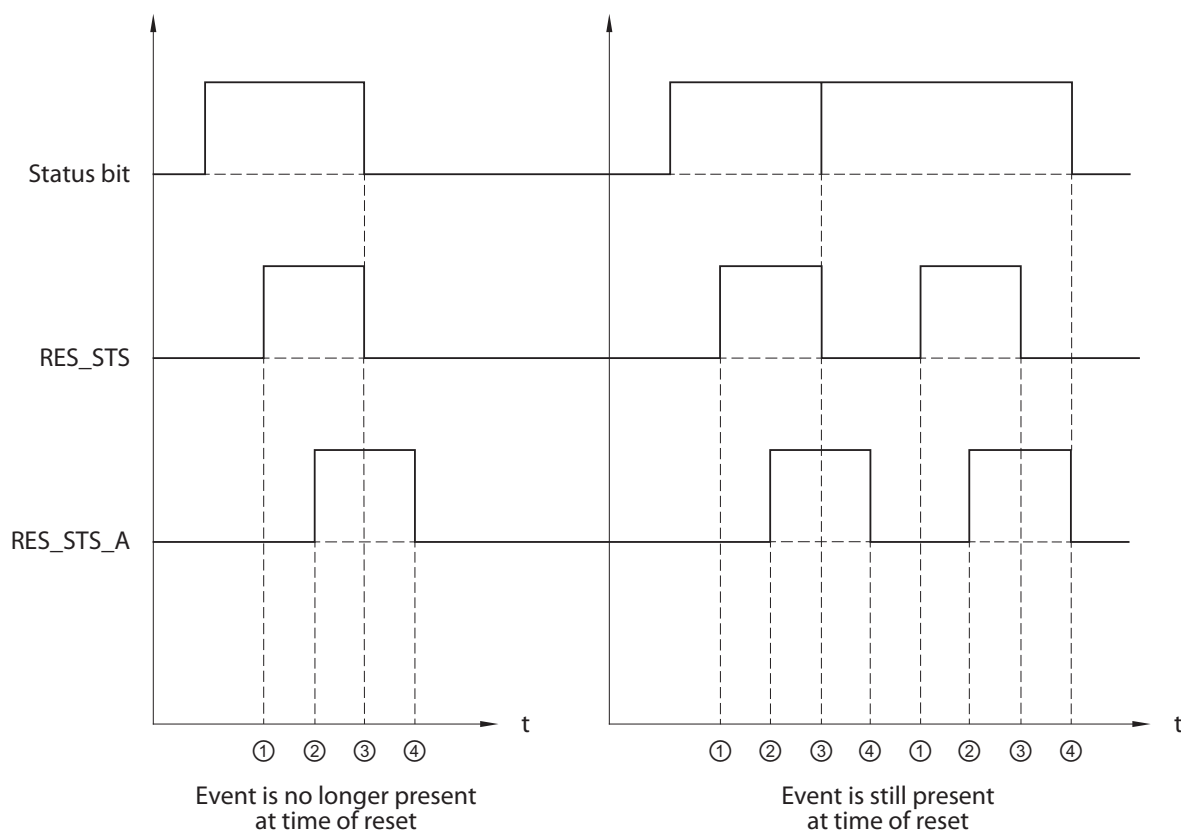


Fig. 39: Resetting the status bits

- ① Controller requests the reset of bits
- ② Reset of bits by BL20 module
- ③ Request for reset taken back by controller
- ④ Reset completed

9.7 Error acknowledgment

The status bits "digital output error" (ERR_DO) and "short circuit sensor supply" (ERR_24 VDC) must be acknowledged. The errors are detected by the counter module and the corresponding bits are set in the response interface (process input data). In addition, they trigger a diagnostic message if the parameters are set accordingly.

The following figure shows the temporal relationship between occurring error and acknowledgment:

Error bit: ERR_DO or ERR_24 VDC

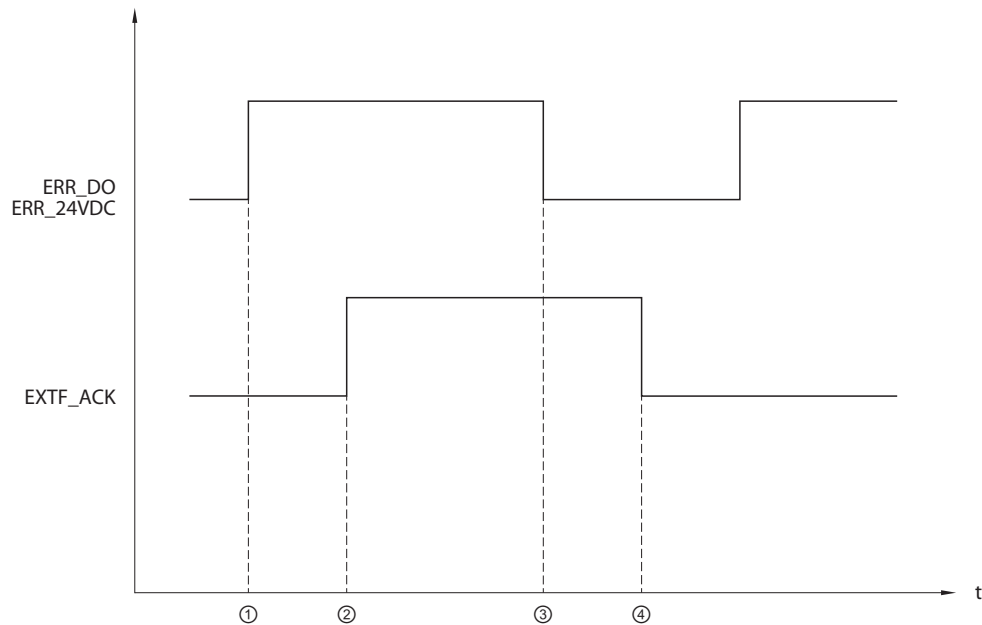


Fig. 40: Error acknowledgment

- ① Error occurred, the module sets the error bit and sends a diagnostic (if parameterized), error detection is running
- ② Error occurred, the module sets the error bit and sends a diagnostic (if parameterized), error detection is running
- ③ Error bit is reset, no further error detection
- ④ Status bit EXTF_ACK is reset, error detection is continued

10 Troubleshooting

If the device does not work as expected, proceed as follows:

- ▶ Exclude environmental disturbances.
- ▶ Check the connections of the I/O module and the gateway for errors.
- ▶ Check I/O module and gateway for parameterization errors.
- ▶ Check the BL20 station for errors in the station structure.

If the malfunction persists, there is a device fault. In this case, take the device out of operation and replace it with a new device of the same type.

11 Repair

The device is not intended for repair by the user. The device must be decommissioned if it is faulty. Observe our return acceptance conditions when returning the device to Turck.

11.1 Returning devices

If a device has to be returned, bear in mind that only devices with a decontamination declaration will be accepted. This is available for download at <https://www.turck.de/en/return-service-6079.php> and must be completely filled in, and affixed securely and weather-proof to the outside of the packaging.

12 Decommissioning

12.1 Dismounting the BL20 station from the DIN rail

Dismount the BL20 station step by step in the following sequence:



WARNING

Dangerous electric voltage at modules with 120/230 VAC

Acute danger to life due to electric shock!

- ▶ Switch off the power supply.
 - ▶ Secure the power supply against being switched on again.
 - ▶ Ensure that the unit is de-energized.
-
- ▶ Switch off voltage at gateway and supply modules.
 - ▶ Disconnect the connection to the fieldbus.
 - ▶ Pull the electronics modules out of the base modules.
 - ▶ Disconnect the wiring.
 - ▶ Loosen the screws in the end brackets and remove end brackets from the DIN rail.
 - ▶ Loosen the base modules and ECO modules from the right and remove them from the DIN rail. If a module in the middle of a station is to be removed, all modules mounted to the right of it must first be removed from the DIN rail.
 - ▶ If necessary, remove cross-connectors beforehand (base modules for relay modules).
 - ▶ Loosen the gateway from the DIN rail and remove it from the DIN rail.

13 Disposal



The devices must be disposed of properly and do not belong in the domestic waste.

14 Technical data

Technical data	
Supply voltage/auxiliary voltage	The auxiliary power supply must comply with the stipulations of SELV (Safety Extra Low Voltage) according to IEC 364-4- 41.
Nominal value U_L (through supply terminal)	24 VDC
Permissible range	18...30 VDC, according to EN 61131-2/ IEC 1131
Residual ripple	According to EN 61131-2/IEC 1131
Nominal current from supply terminal I_L	≤ 35 mA (at load current = 0) ≤ 2.5 A (at full load)
Nominal current from module bus I_{MB}	≤ 18 mA
Power loss of the module, typical	≤ 1.3 W
Sensor supply	
Output voltage	L+ (-0.8 V)
Output current	≤ 0.5 A, short-circuit-proof
Potential isolation	Isolation of electronics and field level via optocoupler
Field supply/functional earth	500 VAC
Field supply/module bus connector	500 VAC
Functional earth/module bus connector	500 VAC
Inputs	
Number of channels	1
Input voltage	24 VDC
Input type	PNP
Signal voltage	
■ Low level U_{LOW}	-3...8.6 VDC
■ High level U_{HIGH}	11...30 VDC
Signal current	
■ Low level I_{LOW}	-8...1.5 mA
■ High level I_{HIGH}	2...10 mA
Minimum pulse width (maximum counter frequency)	
Filter on	≥ 25 μ s (20 kHz)
Filter off	≤ 2.5 ms (200 kHz)
Outputs	
Number of channels	1
Output voltage	24 VDC
Output current per channel	1 A
Load type	Resistive
Load type (UL condition)	General use, resistive
Switching frequency	≤ 100 Hz
Short-circuit protection	Yes
Count mode	

Technical data

Signal evaluation (A,B)	■ Pulse and direction ■ Rotary sensor, single ■ Rotary sensor, double ■ Rotary sensor, fourfold
Count mode	■ Continuous count ■ Single count ■ Periodical count
Hysteresis	0...255
Pulse duration	0...255
Synchronization	■ Single-action ■ Periodical
Count limits	
■ Upper count limit	0x00000000...0x7FFFFFFF
■ Lower count limit	0x80000000...0x00000000

Measurement mode

Signal evaluation (A,B)	■ Pulse and direction ■ Rotary sensor, single
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Measurement ranges

Frequency measurement	0.1...200 kHz
Rotational speed measurement	1...25 000 rpm
Period duration measurement	5...120 s

Number of parameter bytes	16
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General Information

Dimensions (w × l × h)	13 × 128.9 × 74.6 mm
Operating temperature	0...+55 °C
Storage temperature	-25...+85 °C
Relative humidity	15...95 % (indoor), level RH-2, no condensation

Corrosive gas

■ SO ₂	0.5 ppm (rel. humidity < 60 %, no condensation)
■ H ₂ S	1.0 ppm (rel. humidity < 60 %, no condensation)

Vibration test	According to EN 61131
Shock test	According to IEC 60068-2-27
Drop and topple	IEC 68-2-31
Free fall	According to IEC 68-2-3

Electromagnetic compatibility

Degree of protection	IP20 (not evaluated by UL)
MTTF	429 years acc. to SN 29500 (Ed. 99) 20 °C

15 Turck branches — contact data

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Australia	Turck Australia Pty Ltd Building 4, 19-25 Duerdin Street, Notting Hill, 3168 Victoria www.turck.com.au
Austria	Turck GmbH Graumannsgasse 7/A5-1, A-1150 Vienna www.turck.at
Belgium	TURCK MULTIPROX Lion d'Orweg 12, B-9300 Aalst www.multiprox.be
Brazil	Turck do Brasil Automação Ltda. Rua Anjo Custódio Nr. 42, Jardim Anália Franco, CEP 03358-040 São Paulo www.turck.com.br
Canada	Turck Canada Inc. 140 Duffield Drive, CDN-Markham, Ontario L6G 1B5 www.turck.ca
China	Turck (Tianjin) Sensor Co. Ltd. 18,4th Xinghuazhi Road, Xiqing Economic Development Area, 300381 Tianjin www.turck.com.cn
Czech Republic	TURCK s.r.o. Na Brně 2065, CZ-500 06 Hradec Králové www.turck.cz
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USA	Turck Inc. 3000 Campus Drive, USA-MN 55441 Minneapolis www.turck.us

16 Appendix: Approvals and Markings

Approvals	
FM 07A ATEX 0040 X TURCK Ex-07003HX	 II 3 G Ex ec IIC T4 Gc  II 3 G Ex ec nC IIC T4 Gc (relay modules only)
IECEX FME 07.0004X	Ex ec IIC T4 Gc Ex ec nC IIC T4 Gc (relay modules only)
Ambient temperature $T_{amb.}$:	
Standard devices	0...+55 °C
Devices with extended temperature range (.../ ET)	-25...+60 °C
■ BL20-PG-EN-V3, BL20-PG-EN-V3-WV	-20...+60 °C

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