AUTOMATION

User Manual

IB IL CNT UM E

Order No.: –

Inline Modular Counter Terminal

PHOENIX CONTACT
INSPIRING INNOVATIONS

AUTOMATION

User Manual
Inline Modular Counter Terminal

06/2008

Designation: IB IL CNT UM E

Revision: 02

Order No.: –

This user manual is valid for:

Designation	Hardware Version	Order No.
IB IL CNT-PAC	01 or later	2861852
IB IL CNT-PAC/CN	01 or later	2878748
IB IL CNT	01 or later	2836667
IB IL CNT-2MBD-PAC	00 or later	2862071
IB IL CNT-2MBD	00 or later	2855813

Please observe the following notes

In order to ensure the safe use of the product described, you have to read and understand this manual. The following notes provide information on how to use this manual.

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Explanation of symbols used and signal words

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

DANGER
This indicates a hazardous situation which, if not avoided, will result in death or serious injury.

WARNING
This indicates a hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION
This indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

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tecdoc@phoenixcontact.com.

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1 Function and structure of the terminal

1.1 Function description

> The functions of the terminals for which this user manual is valid (see inner cover or Section "Ordering data" on page 6-9) are essentially the same. They only differ in the scope of supply and some technical data. Differences are particularly mentioned in the individual sections.

The terminal is a counter terminal designed for use within an Inline station. It is also known as a counter.

The counter terminal reads and processes fast pulse trains from sensors. The terminal has a counter input (source), a control input (gate), and a switching output that can be freely parameterized by the terminal itself. Thus, fast response times can be achieved, irrespective of the bus and the control system.

The terminal can be operated in four different modes: frequency measurement, event counting, time measurement and pulse generation (pulse generator).

Sensors with 24 V DC and 5 V DC supply can be connected to the terminal.

The switching output provides a maximum current of 500 mA.

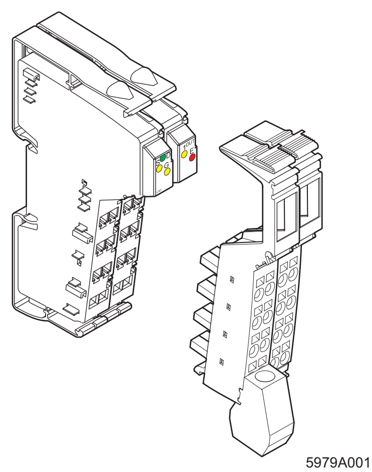


Figure 1-1 The terminal with appropriate connectors

Terminal features:

- Event counting:
  The counting conditions and the output switching behavior can be selected.
- Frequency measurement:
  Time-driven or state-driven frequency measurements with gate times (time in which measurement is performed) from 10 ms to 10 s are possible.
- Time measurement:
  Relation conditions can be evaluated during time measurement. The result of the evaluation can be output via the process data or the digital output. This allows a controlled response when values fall outside the specified range.
- Pulse generation:
  The pulse generator generates square-wave signals with frequencies of 1 kHz to 10 kHz in 500 Hz increments.
- The event counting and frequency measurement modes yield a 24-bit value, the time measurement a 16-bit measured value.
- A combination of source and gate signal can be selected as counter signal.
- During operation, a start or end value can be changed without the counter having to be stopped.
- An RC filter can be connected to source and gate. This allows the use of mechanical switches.
- It is not necessary to send a counter start command to start the counting process. Counting starts immediately after the command for selecting the operating mode is transmitted.
- The counter terminal uses process data operation.

Fields of application

Event counting

Event counting is designed for counting quantities.

Example for event counting

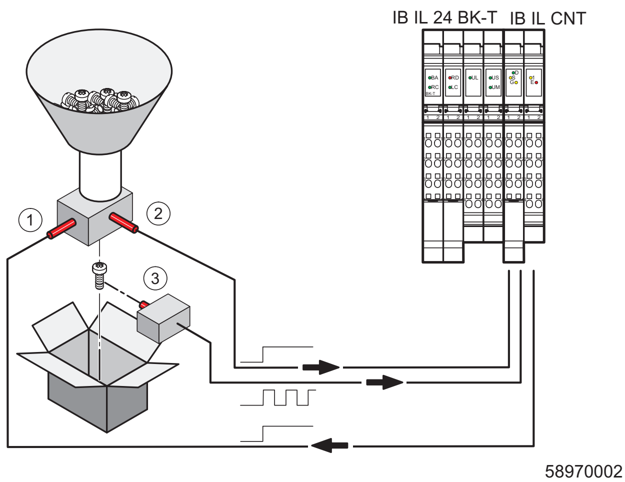


Figure 1-2 Example configuration to count goods

Key:

No.	Sensor/actuator	Associated input/output
1	Valve (flap control)	Switching output
2	Sensor (control signal)	Control input
3	Sensor (counting pulse)	Counter input

In the example shown in Figure 1-2, for instance, sets of 100 screws are to be packed in a cardboard box. The control input (2) enables the count at the counter input (3) when there are screws present in the hopper. Each screw that falls out of the hopper into the box initiates a pulse at the counter input. When there are 100 screws in the box, the switching output (1) is set and the valve triggers the flap to close the hopper. A new box can now be filled.

Frequency measurement

Frequency measurement is suitable for measuring speeds.

Time measurement

Time measurement can be used for an extremely wide variety of applications.

– One conceivable example is calculating the size of a part. Thus, on a conveyor belt, differences in size could be ascertained through differences in time.
– Time measurement can be used to measure speed, if it is necessary to respond to a value falling outside a specified range. For example, the output can be set at a specified maximum speed.

Please note that lower speeds can be measured in time measurement mode than in frequency measurement mode, since the former utilizes 16-bit and the latter 24-bit measured values.

Pulse generator

The pulse generator can be used to produce and output pulse trains with different frequencies.

1.2 Terminal structure

1.2.1 Housing dimensions

Small I/O stations are frequently installed in standard control boxes with a depth of 80 mm. Inline terminals are designed so that they can be used in this type of control box.

The terminal dimensions are determined by the dimensions of the electronics base and those of the connectors.

The electronics base for the terminals has an overall width of 24.4 mm (see Figure 1-3) and a depth of 72 mm.

It accepts two 12.2 mm wide connectors.

The height of the terminal depends on the connectors used.

Either a standard and a shield connector (connector set for the counter terminal), or two standard connectors, can be used on the terminal.

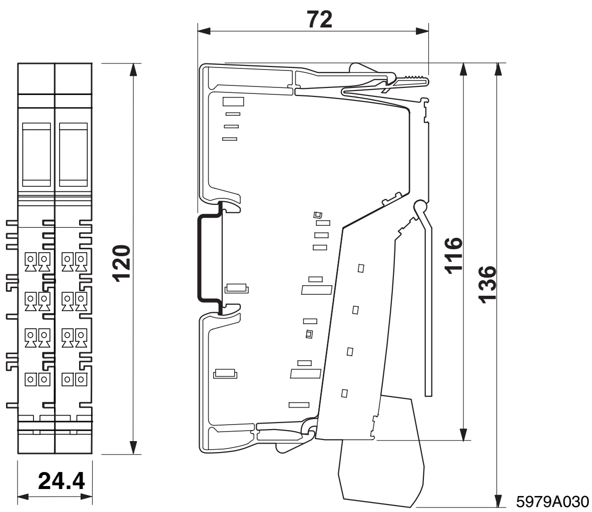


Figure 1-3 Housing dimensions of the terminal (in mm)

1.2.2 Identification of function and transmission speed

The counter terminals have orange labels (in the vicinity of the diagnostic and status indicators) to enable visual identification of their function.

To identify the transmission speed visually, the counter terminals for 2 Mbps are marked with a white strip in the vicinity of the D LED.

1.2.3 Diagnostic and status indicators

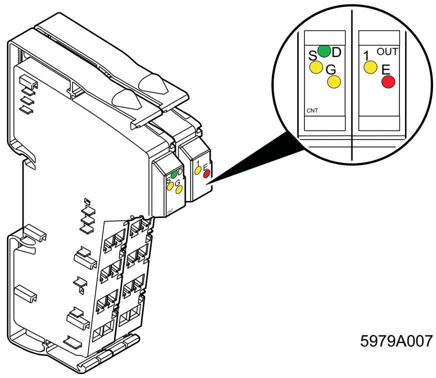


Figure 1-4 Diagnostic and status indicators

Diagnostic and status indicators

The following states can be read from the counter terminal:

Table 1-1 Diagnostic and status indicators

Des.	Color	Meaning
D	Green LED	Diagnostics
	ON:	Local bus active
	Flashing:	
	0.5 Hz (slow)	Communications power present, local bus not active
	2 Hz (medium)	Communications power present, local bus active, I/O error present
	4 Hz (fast)	Communications power present, terminal before the flashing terminal has failed, terminal behind the flashing terminal is not part of the configuration frame
	OFF:	Communications power not present, local bus not active
E	Red LED	Sensor supply short-circuit
	ON:	Connector 1 short-circuited between terminals 1.2 and 1.3 or between terminals 2.2 and 2.3
	OFF:	No error
S	Yellow LED	Counter input status (source)
	ON:	Input set
	OFF:	Input not set
G	Yellow LED	Control input status (gate)
	ON:	Input set
	OFF:	Input not set
1	Yellow LED	Output status
	ON:	Output set
	OFF:	Output not set

1.2.4 Terminal point assignment

The IB IL AO/CNT-PLSET connector set is designed for cable connection. It contains an IB IL SCN-6 SHIELD connector and an IB IL SCN-8 standard connector.

The shield connector has to be used if shielded cables are employed. A shielded cable is required for connecting sensors to the 5 V counter input and the 5 V control input.

Two IB IL SCN-8 standard connectors can be employed if no shielded cables are being used.

The connector marking depends on the product or the connectors used.

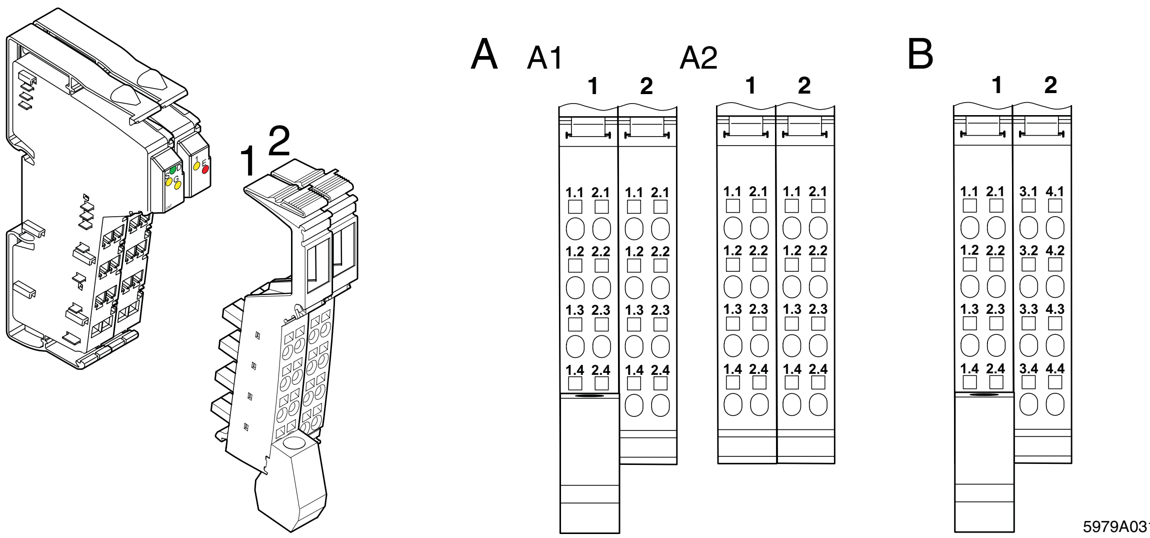


Figure 1-5 Terminal point numbering:
separately numbered connectors (**A**) and consecutively numbered connectors (**B**)

A Separately numbered connectors (each connector from 1.1 to 2.4)

A1
- Use of the IB IL CNT-PAC and IB IL CNT-2MBD-PAC with the connectors provided
- Use of the IB IL AO/CNT-PLSET connector set

A2
- Use of the IB IL SCN 8 connectors (standard connectors)

B Consecutively numbered connectors (from 1.1 to 4.4)
- Use of the IB IL CNT-PAC/CN product.

Table 1-2 Terminal point assignment

Connector	Terminal point		Signal	Assignment
	A	B		
1	1.1	1.1	S+	24 V counter input (source)
	2.1	2.1	G+	Control input 24 V (gate)
	1.2	1.2	U_{INI}	+ 24 V sensor voltage
	2.2	2.2	U_{INI}	+ 24 V sensor voltage
	1.3	1.3	S-	Reference ground for the counter input (source) and the segment voltage
	2.3	2.3	G-	Reference ground for the control input (gate) and the sensor voltage
	1.4	1.4	Shield	Shield connection (high resistance and capacitance to FE)
	2.4	2.4	Shield	Shield connection (high resistance and capacitance to FE)
2	1.1	3.1	S+*	5 V counter input (source)
	2.1	4.1	G+*	Control input 5 V (gate)
	1.2	3.2	OUT	Output The terminal points are jumpered internally.
	2.2	4.2		
	1.3	3.3	GND	Reference ground for the output The terminal points are jumpered internally.
	2.3	4.3		
	1.4	3.4	FE	Functional earth ground (directly to FE)
	2.4	4.4	FE	Functional earth ground (directly to FE)

The short-circuit-protected sensor voltage U_{INI} is generated from the segment voltage U_S. The main voltage U_M is not used directly at the counter terminal points.

1.2.5 Basic circuit diagram

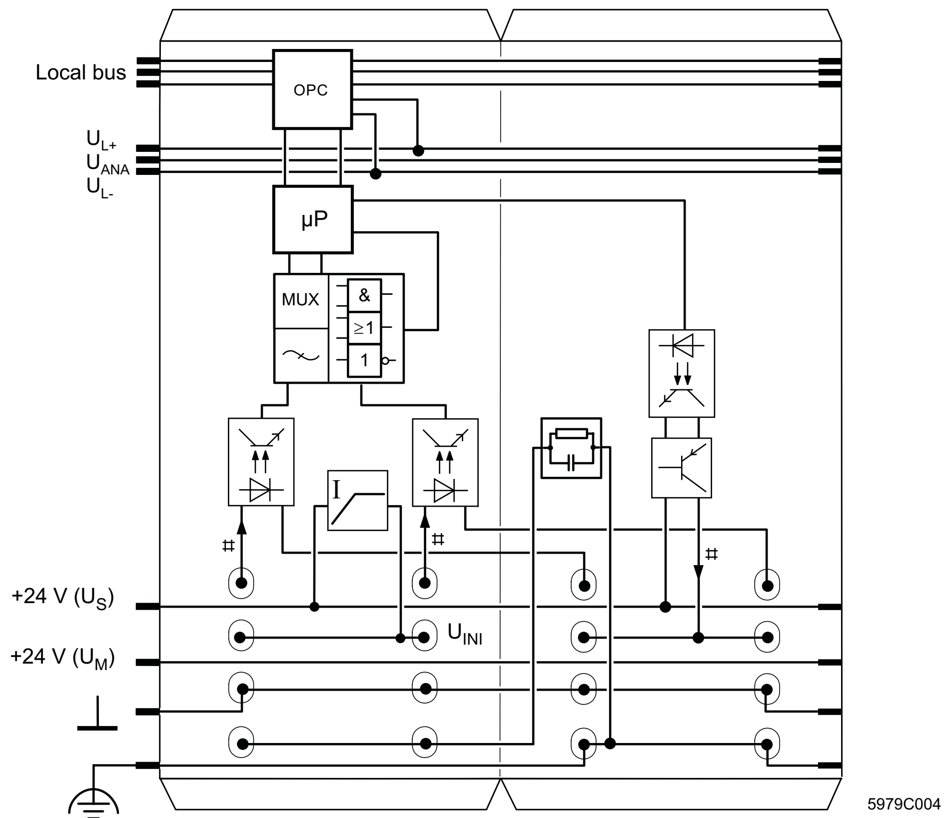
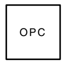
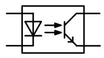
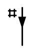
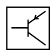
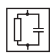
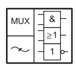


Figure 1-6 Circuit diagram

Key:

Local bus	Data routers for the local bus
U_{L+}	Communications power
U_{L-}	Communications power ground
U_{ANA}	I/O supply for analog terminals
U_M	+24 V main voltage
U_{INI}	+24 V sensor voltage, is generated from the segment voltage
U_S	+24 V segment voltage

	Protocol chip (bus logic including voltage conditioning)
	Microprocessor
	Optocoupler
	Digital input
	Digital output
	Transistor (output driver)
	Coupling network
	Module with multiplexer, filter and logic
	Sensor supply with short-circuit protection
	Ground
	Functional earth ground
	Terminal point
	Potential or data routers with jumper contacts on the side

2 Mounting/removing counter terminals and connecting cables

2.1 Instructions for replacing terminals

NOTE:
Before removing a terminal from or inserting a terminal in the station, disconnect the power to the entire station. Make sure the entire station is reassembled before switching the power back on.

2.2 Mounting and removing the terminal

The terminal is designed for use within an Inline station.

An Inline station is set up by mounting the individual components side by side. No tools are required. Mounting the components side by side automatically creates potential and bus signal connections between the individual station components.

All Inline terminals are mounted on 35 mm standard DIN rails. The terminals are mounted perpendicular to the DIN rails. This ensures that they can be easily mounted and removed even within limited space.

After a station has been set up, individual terminals can be exchanged by pulling them out or plugging them in. Tools are not required.

The setting up of an Inline station and terminal mounting and removal procedure are described in the IL SYS INST UM E user manual.

2.3 Power supply

The terminal is supplied with power through the potential routers. No additional power connections are required.

2.4 Connecting sensors and actuators

The sensors and the actuator are connected to the terminals using connectors. The IB IL AO/CNT-PLSET connector set is designed for the terminal. It consists of a shield connector and a standard connector. The shield connector must be employed if sensors for 5 V signals are used. If such signals are not used, the cables do not need to be shielded and two standard connectors may also be employed.

Connect unshielded cables as described in Section "Connecting unshielded cables" on page 2-6.

Connect shielded cables as described in Section "Connecting shielded cables using the shield connector" on page 2-7.

2.4.1 Connection methods for sensors and actuators

24 V sensors

The 24 V sensors can be connected using the following methods:

- 2-wire technology (signal and 24 V)
- 3-wire technology (signal, 24 V and GND)

5 V sensors

The 5 V sensors can be connected using the following method:

- 2-wire technology (signal, GND) with shield and external 5 V supply

Actuator

The actuator can be connected using the 2-wire technology (signal and GND).

2.4.2 Connecting a 24 V sensor

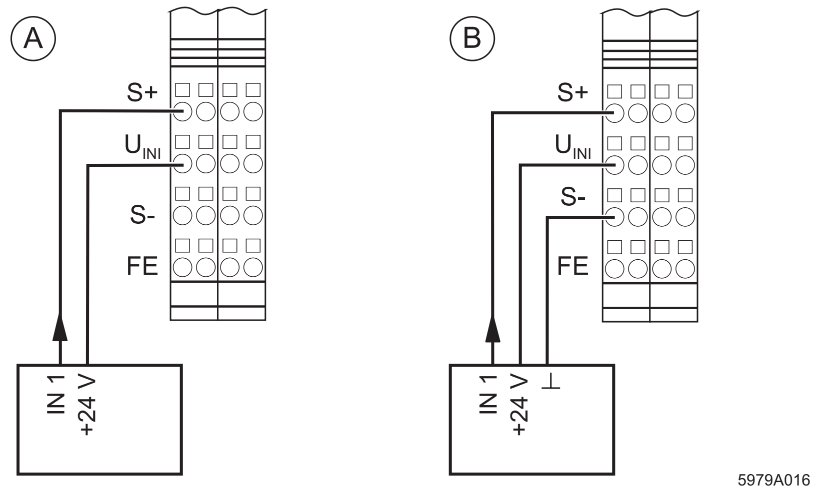


Figure 2-1 Connecting a 24 V sensor (example: counter input)

Signal	Terminal point	Meaning
S+	1/1.1	24 V counter input (source)
U_{INI}	1/1.2	+ 24 V sensor voltage
S-	1/1.3	Reference ground for the counter input and the segment voltage
FE	1/1.4	Functional earth ground

2-wire technology

Detail A shows the connection of a 2-wire sensor to the 24 V counter input. The sensor signal is routed to the S+ terminal point. Sensor power is supplied from the voltage U_{INI}.

3-wire technology

Detail B shows the connection of a 3-wire sensor to the 24 V counter input. The sensor signal is routed to the S+ terminal point. The sensor is supplied with power using the U_{INI} and S- terminal points.

A 24 V sensor is connected to the control input in exactly the same way as to the counter input. Please ensure counter terminal assignment as described in "Terminal point assignment" on page 1-8.

2.4.3 Connecting a 5 V sensor

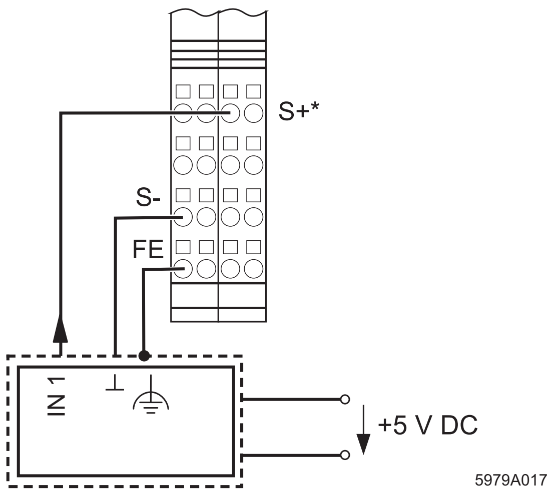


Figure 2-2 Connecting a 5 V sensor

Signal	Terminal point	Meaning
S+*	2/1.1	5 V counter input (source)
S-	1/1.3	Reference ground for the counter input and the segment voltage
FE	1/1.4	Functional earth ground

Figure 2-2 shows the connection of a 2-wire sensor to the 5 V counter input. The sensor signal is routed to the S+* terminal point. The S- terminal point forms the reference ground. The sensor is grounded at the FE (functional earth ground) terminal point of the shield connector. The 5 V supply for the sensor must be made available externally.

A 5 V sensor is connected to the control input in exactly the same way as it is connected to the counter input. Please ensure counter terminal assignment as described in "Terminal point assignment" on page 1-8.

2.4.4 Connecting an actuator

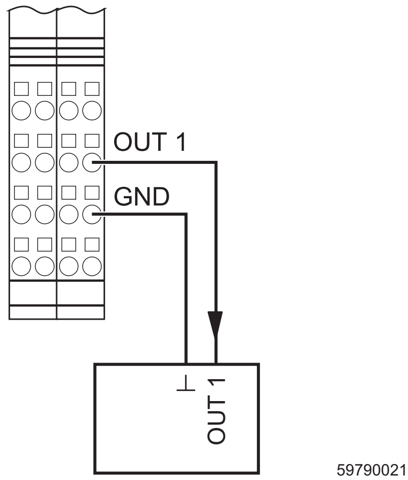


Figure 2-3 Connecting an actuator

Signal	Terminal point	Meaning
OUT 1	2/2.2	Output
GND	2/2.3	Reference ground for the output

Figure 2-3 shows the connection of an actuator. The actuator is supplied with voltage by output OUT1. The load is switched directly via the output.

NOTE: Shutdown when overloaded
The 500 mA maximum current carrying capacity of the output must not be exceeded. If it is, the output will switch off due to overload.

2.5 Connecting cables

Both shielded and unshielded cables can be used with the terminal.

The I/O cables are connected to the Inline connectors using the spring-cage connection method. This method supports the connection of cables with a connection cross-section of 0.2 mm^2 to 1.5 mm^2 (24 - 16 AWG).

2.5.1 Connecting unshielded cables

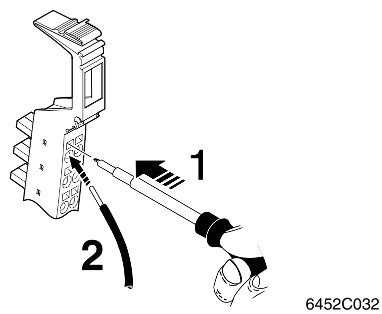


Figure 2-4 Connecting unshielded cables

Wire the connectors according to your application.

> The connector pin assignment is specified in Section "Terminal point assignment" on page 1-8.

When wiring, proceed as follows:

- Strip 8 mm off the cable.

> Inline wiring is normally done without ferrules. However, it is possible to use ferrules. If using ferrules, make sure they are properly crimped.

- Push a screwdriver into the slot of the appropriate terminal point (Figure 2-4, 1), so that you can insert the wire into the spring opening.
  Phoenix Contact recommends using a SZF 1 - 0,6X3,5 screwdriver
  (Order No. 1204517; see Phoenix Contact CLIPLINE catalog).
- Insert the wire (Figure 2-4, 2). Remove the screwdriver from the opening. This clamps the wire.

After installation, you should always label the wires and the terminal points (see also IL SYS INST UM E user manual).

2.5.2 Connecting shielded cables using the shield connector

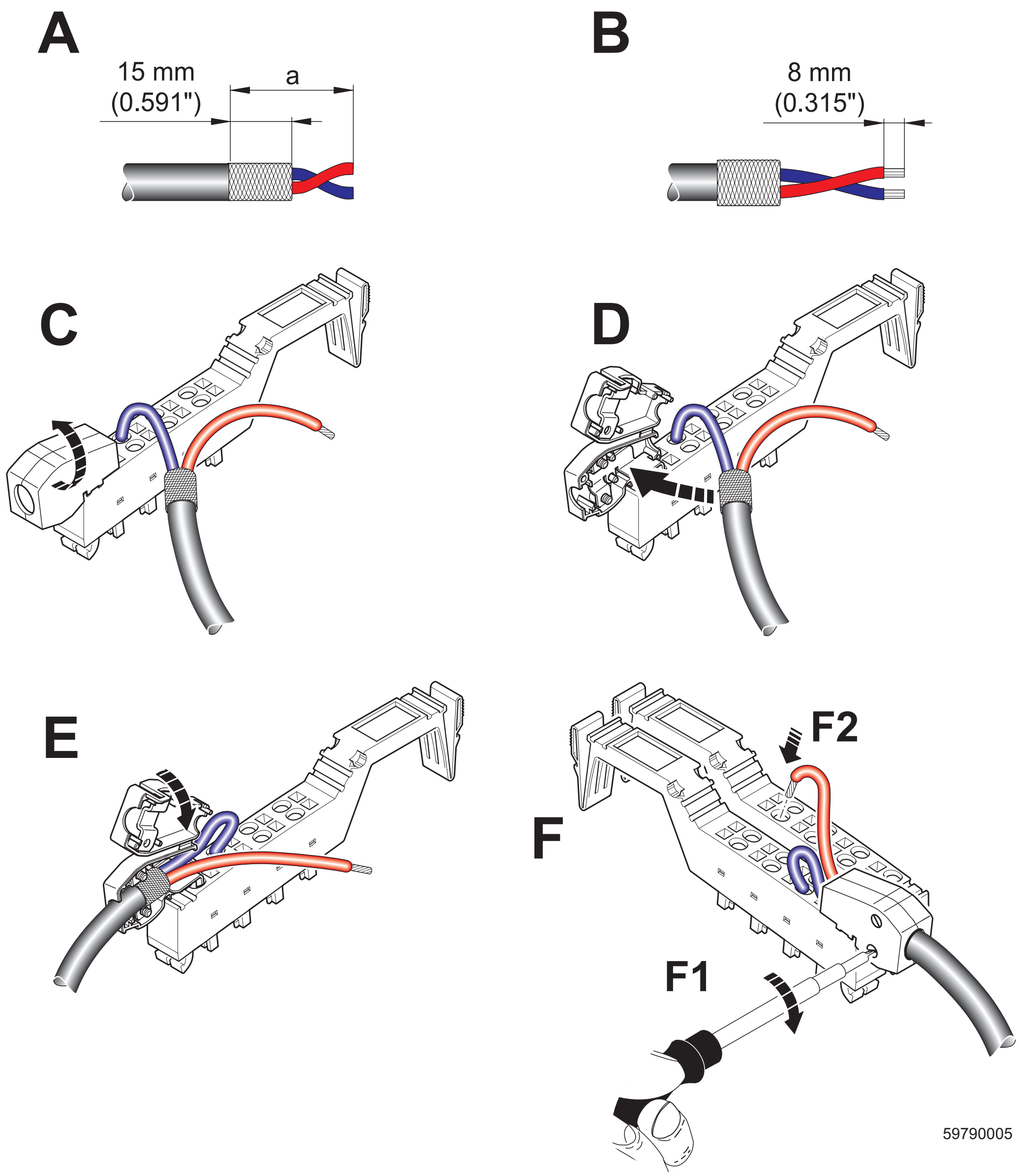


Figure 2-5 Connecting the shield to the shield connector

Only the sensors to the 5 V counter input and the 5 V control input have to be connected through shielded cables. Connection to the 5 V counter input will now be explained. Using the connector pin assignment in Section "Terminal point assignment" on page 1-8, this input must be wired as follows:

5 V counter input	Connector 2	Terminal point 1.1
GND counter input	Connector 1	Terminal point 1.3
Shield	Connector 1	Shield connection

Connection should be carried out as follows (cf. Figure 2-5):

Stripping cables

- Strip the outer cable sheaths to the desired length (a). (A)
  Choose a length (a) that also enables proper connection of the cable to connector 2. The required length (a) also depends on whether the wires are to be generous or tight between the connection points and the shield connection.
- Shorten the braided shield to 15 mm. (A)
- Fold the braided shield back over the outer sheath. (B)
- Remove the protective foil.
- Strip 8 mm off the wires. (B)

> Inline wiring is normally done without ferrules. However, it is possible to use ferrules. If using ferrules, make sure they are properly crimped.

Wiring the connectors

- Push a screwdriver into the slot of the appropriate terminal point (Figure 2-4 on page 2-6, 1), so that you can insert the wire into the spring opening.
  Phoenix Contact recommends using a SFZ 1 - 0,6x3,5 screwdriver
  (Order No. 1204517; see Phoenix Contact CLIPLINE catalog).
- Insert the wire (Figure 2-4 on page 2-6, 2). Remove the screwdriver from the opening. This clamps the wire.

The connector pin assignment can be found in Section "Terminal point assignment" on page 1-8.

Connecting the shield

- Open the shield connector. (C)
- Check the direction of the shield connection clamp in the shield connector (see Figure 2-6).
- Place the cable with the folded braided shield in the shield connector. (D)
- Close the shield connector. (E)
- Fasten the screws for the shield connector using a screwdriver. (F1)
- Connect the second cable to connector 2. (F2)

Shield connection clamp

The shield connection clamp (a in Figure 2-6, 2) in the shield connector can be used in various ways depending on the cross section of the cable. For thicker cables, the dip in the clamp must be turned away from the cable (Figure 2-6, 2). For thinner cables, the dip in the clamp is turned towards the cable (Figure 2-6, 6).

If you need to change the direction of the shield connection clamp, proceed as shown in Figure 2-6:

- Open the shield connector housing (1).
- The shield connection is delivered with the clamp positioned for connecting thicker cables (2).
- Remove the clamp (3), turn it to suit the cross-section of the cable (4), then reinsert the clamp. (5)
- Figure 6 shows the position of the clamp for a thin cable.

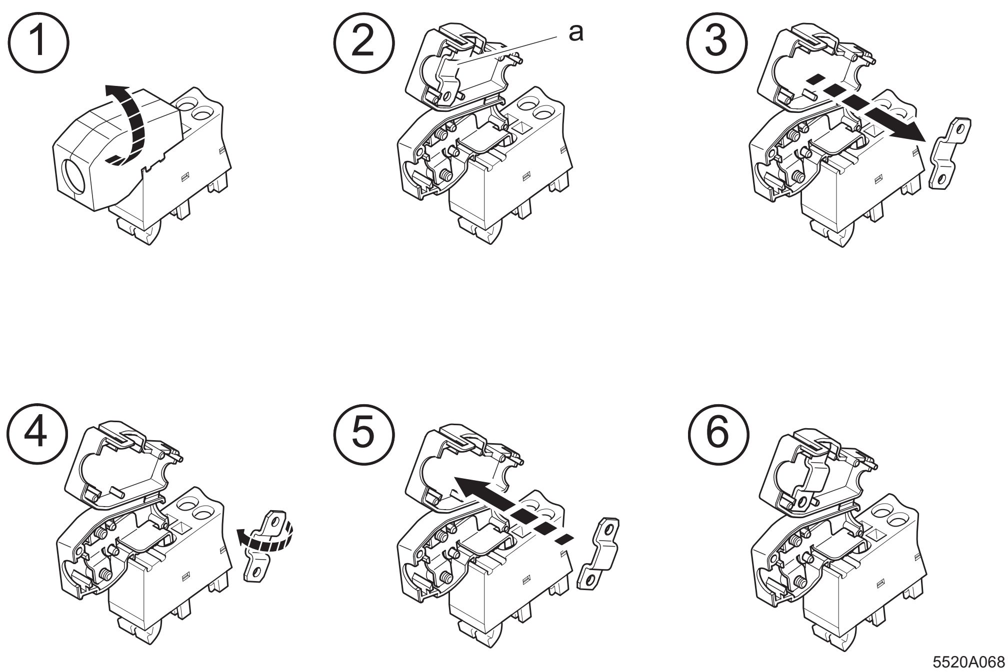


Figure 2-6 Shield connection clamp alignment

3 Process data mode

The counter terminal is configured, controlled and read through process data.

3.1 Process data channel assignment

The process image of the counter terminal on the bus comprises two data words.

NOTE: Misinterpretation of values when the data consistency is violated

Ensure data consistency of two words to prevent the possibility of the values being misinterpreted.

See also Section "Tips for working with the counter terminal" on page 5-9.

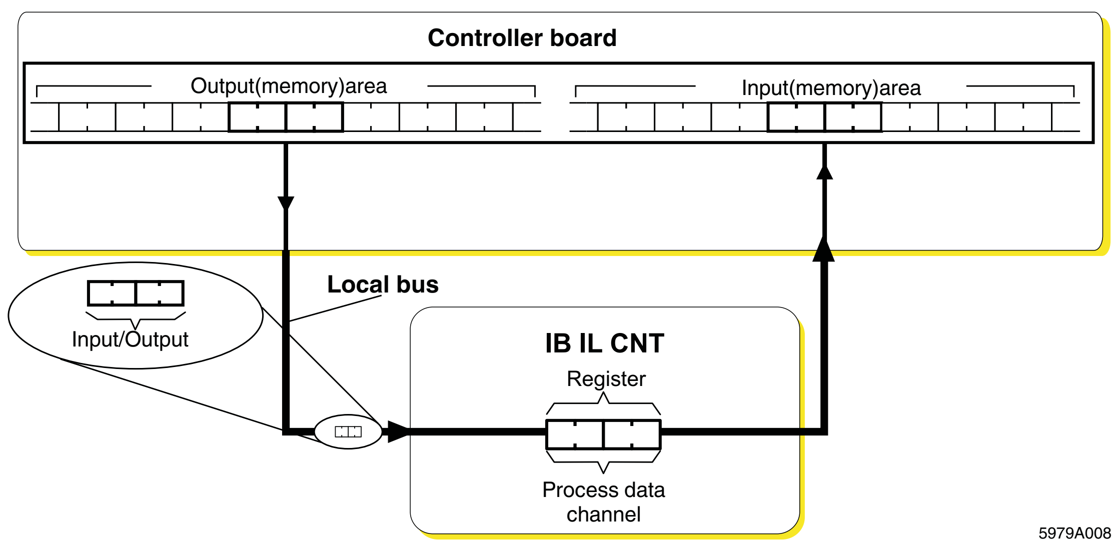


Figure 3-1 Process image in the I/O (memory) area of the controller board

The data words are in the process data (memory) area on the controller board. This memory area is a process image of the entire application, i.e., the bus configuration. The addresses are assigned through the automatic or logical addressing of the controller board.

The process data (memory) area comprises an output (memory) area and an input (memory) area. The two memory areas do not necessarily have to be different.

Direction of output data flow:	From the controller board to the terminal
Direction of input data flow:	From the terminal to the controller board

3.2 Output words

The terminal is configured and controlled via various commands transmitted through the two output words.

The command code and, if necessary, the associated parameters are transmitted from the controller board to the terminal through the output words. If no parameters are required, the assignment of the parameter bits is irrelevant.

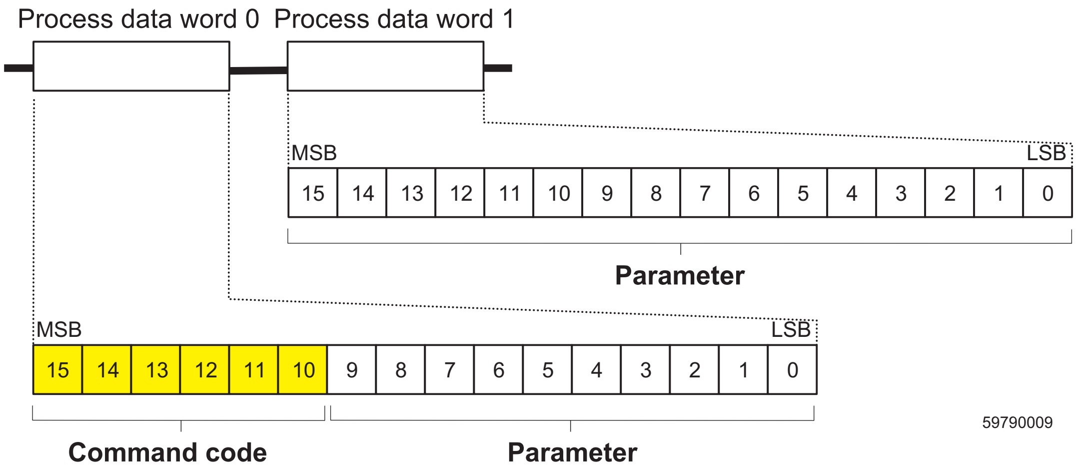


Figure 3-2 Assignment of the output words

Valid command codes are listed in Section 4, "Commands for working with the counter terminal".

3.3 Input words

The terminal uses two input words.

If any command other than *Read Counter* is sent, the command code and any associated parameters are mapped (mirrored) in the input words at the same position as in the output word.

If parameter word 1 is not needed, its assignment is irrelevant. In this case it does **not** mirror the assignment of output word 1.

In bit 15 of input word 0, an error bit is set if:

– The terminal has not yet been configured.
– There is an invalid parameter in the default operating mode.
– The counter is read without an operating mode having been preset.
– A reserved bit has been set.

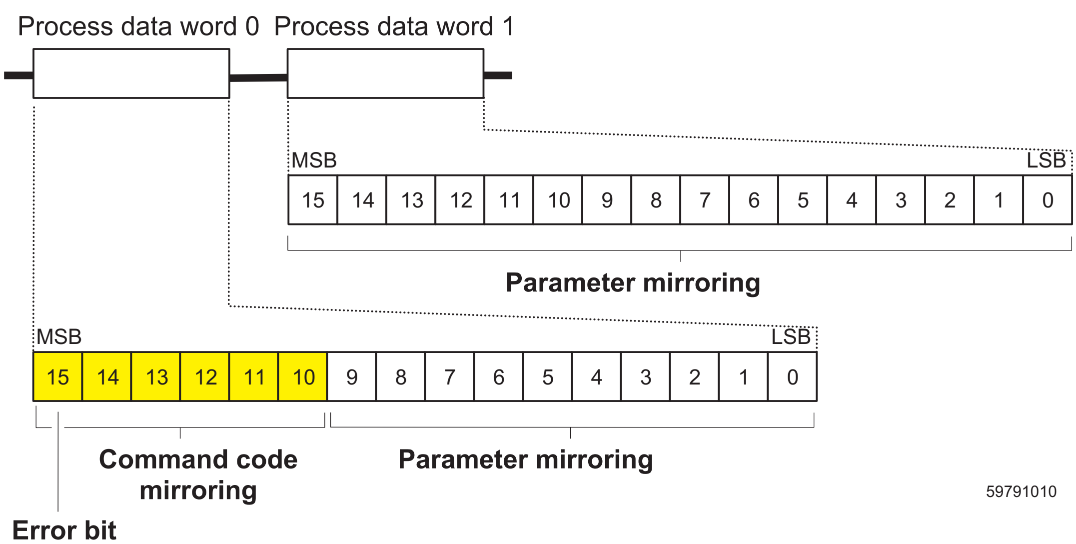


Figure 3-3 Assignment of the input words (except for after *Read Counter*)

Read counter

After the *Read Counter* command has been sent, the command code (00000_{bin}) is mirrored in bits 15 through 10 of input word 0.

The status of the control input (gate) is indicated in bit 9.

The status of the output (Out) or the result of the evaluation of a relation condition is indicated in bit 8 (value outside specified range, see Section "Relation condition" on page 4-9).

Bits 7 through 0 of input word 0 and input word 1 contain the results of the counting performed.

A 16-bit value (time measurement mode) is represented in input word 1. Bits 7 through 0 of input word 0 are not used for this purpose.

A 24-bit value (frequency measurement and event counting modes) is represented in the result bits of input words 0 and 1.

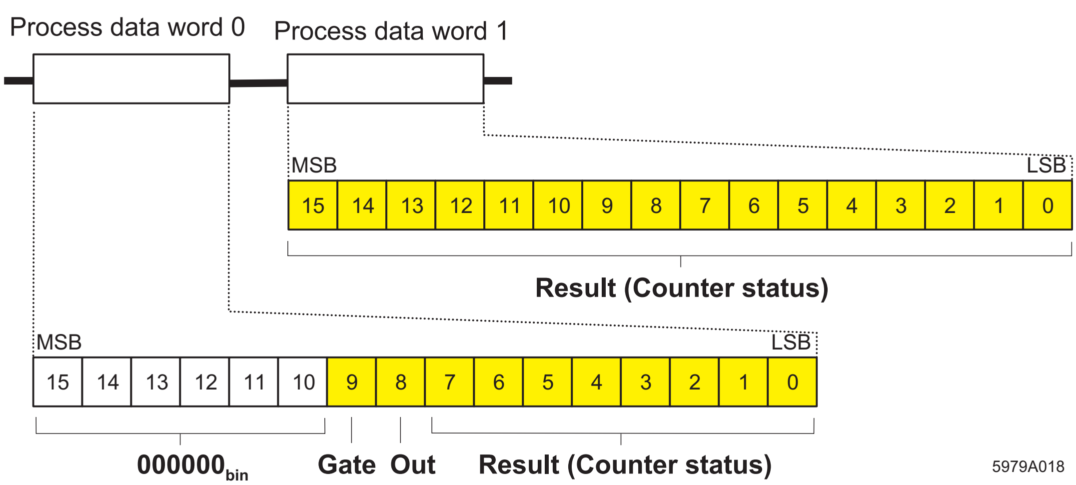


Figure 3-4 Assignment of the input words after *Read Counter*

4 Commands for working with the counter terminal

Various types of commands are available for working with the counter terminal:

– Commands for setting the operating modes
– Commands for controlling the functions
– Commands for specifying general conditions

If general conditions for the operating modes are required, they must be specified before a command is sent to set the mode.

Table 4-1 Commands for working with the counter terminal

Bits 15 through 10 (bin)	Command	Page
0000 00	Read Counter	Page 4-20
0001 00	Frequency Measurement Mode	Page 4-2
0001 01	Event Counting Mode	Page 4-6
0001 10	Time Measurement Mode	Page 4-8
0001 11	Pulse Generator Mode	Page 4-12
0010 00	Control Counter: Stop Counter	Page 4-19
0010 01	Control Counter: Start Counter	Page 4-19
0010 10	Control Counter: Set Counter to Default	Page 4-20
0011 00	System Settings, e. g., input filter, logic operations	Page 4-13
0011 11	Read Firmware Version	Page 4-17
0100 00	Preset Initial Value (24 bits, maximum)	Page 4-18
0101 00	Preset Final Value (24 bits, maximum)	Page 4-18
Other	Reserved	

4.1 Command sequence

When working with the counter terminal, commands must be sent in accordance with a specified sequence.

Step 1: System settings

This step is optional. If no system settings are required, proceed straight to step 2.

If system settings are required and an initial and/or final value is to be set, these values must be specified in the first step.

Step 2: Operating mode

If the system settings have been made, or none were necessary, set the operating mode now.

The following operating modes can be set:
– Frequency measurement
– Event counting
– Time measurement
– Pulse generator

Step 3: Read counter

To obtain the results of the counter terminal in the input words, the command for reading the counter must now be sent.

This step is optional. If the input data is of no interest, the count does not have to be read. The output, for example, can be controlled directly through the terminal according to relation conditions, without any need to access the input data.

4.2 Frequency Measurement Mode command

The Frequency Measurement Mode command comprises the command code and a parameter. The parameter determines the conditions for frequency measurement.

Output word 0 (OUT[0])

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	**0**	**0**	**1**	**0**	**0**	**Parameters**									

The second output word is not used.

Frequency measurement starts immediately after the command is sent.

Table 4-2 Parameters for frequency measurement

Parameters					Measure-ment	Options
(dec)	(hex)	(bin)				
1 ...1000	1 ... 3E8	00 0000 0001	...	11 1110 1000	Time-controlled	Selection of the time after which a count value is accepted
1020 to 1023	3FC to 3FF	11 1111 1100	...	11 1111 1111	State-controlled	Selection of a gate state with which a count value is accepted

When the time or state set is reached, the counter is reset to the initial value.

4.2.1 Time-controlled frequency measurement

With time-controlled frequency measurement, the parameter acts as a factor that specifies the gate time (time during which measurement is performed) as a multiple of 10 ms.

When the gate time has elapsed, the counter is reset to the initial value.

The individual quantities are related as follows:

– Gate time = factor x 10 ms
– Resolution = 1 / gate time
– Resolution = 1 / (factor x 10 ms)
– Frequency = count value x 100 / factor

Table 4-3 Examples of factor, resolution and gate time

Factor (dec)	Control word (hex) (code and factor)	Resolution in Hz/LSB	Gate time in s
1	1001	100	0.01
2	1002	50	0.02
10	100A	10	0.1
50	1032	2	0.5
100	1064	1	1
500	11F4	0.2	5
1000	13E8	0.1	10

The factor range of 1 through 1000 enables the counter terminal to be adjusted exactly as required for each application.

The design engineer must select the optimum factor given that resolution and gate time are inversely proportional.

If the measurement has to be as accurate as possible, good resolution (e.g., 0.1 Hz/LSB) must be selected. However, this resolution leads to long gate times.

If rapid response is important, a short gate time is possible, but will impair resolution.

Simple count value processing may also be necessary for an application. A resolution of 1 Hz/LSB avoids the need for converting the count value into the frequency.

4.2.2 State-controlled frequency measurement

With state-controlled frequency measurement, the parameter specifies the state of the gate input with which counting is performed or the count value accepted.

Table 4-4 Possible values of parameter and state at the gate input

Parameter (dec)	Control word (hex) (code and parameter)	Counting or acceptance of the count value on
1020	13FC	High level
1021	13FD	Low level
1022	13FE	Rising edge
1023	13FF	Falling edge

HIGH level

With this measurement counting takes place while the gate is HIGH. Counting stops when it changes to LOW. The last count value is accepted into the input data. The next HIGH causes counting to restart from 0.

LOW level

With this measurement counting takes place while the gate is LOW. Counting stops when it changes to HIGH. The last count value is accepted into the input data. The next LOW causes the count to restart from 0.

Rising edge

With this measurement counting begins immediately after the frequency measurement command is sent. The current count value is accepted into the input data on each rising of the gate signal. The counter is reset to 0 and counting continues.

Falling edge

With this measurement counting begins immediately after the frequency measurement command is sent. The current count value is accepted in the input data on each falling edge of the gate signal. The counter is reset to 0 and counting continues.

If the condition for counting (e.g., $13FC_{hex}$ HIGH), is already satisfied at the gate when a command is sent, the first count starts immediately. Depending on the application, this counting cycle may have to be rejected, as only part of the gate signal has been registered.

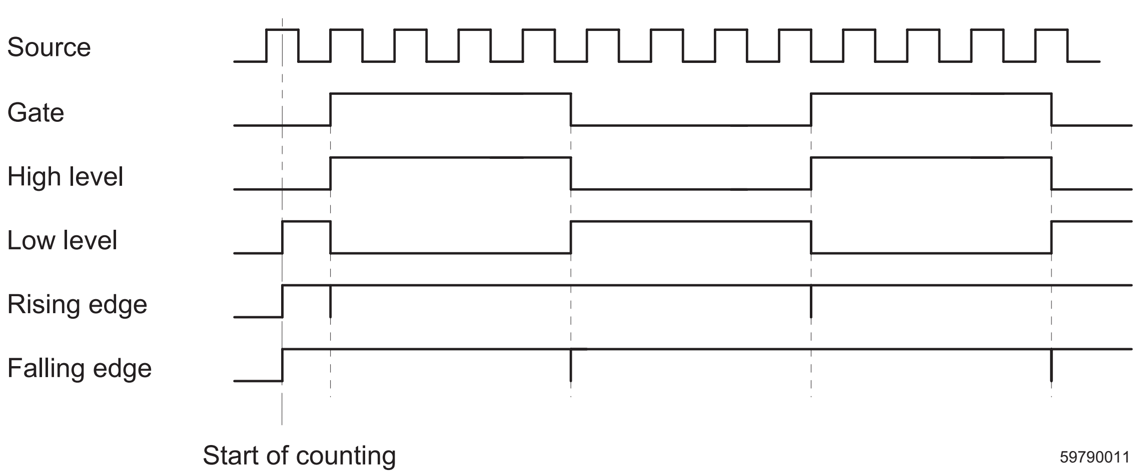


Figure 4-1 Counting phase depending on gate state

In Figure 4-1 the "source" train shows the pulses to be counted. The "gate" pulse train represents the gate signal.

Counting is activated with the transmission of the frequency measurement command. Whether counting actually takes place depends on the parameter selected and the gate signal.

4.3 Event Counting Mode command

The Event Counting Mode command comprises the command code and various parameters. The parameters determine the conditions for event counting.

Output word 0 (OUT[0])

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	**0**	**0**	**1**	**0**	**1**	**0**	**0**	**F**	**Gate**			**R**	**Output**		

The second output word is not used.

Set the unused bits 9 and 8 to 0.

Please note the default counting direction in bit 3. If bit 3 = 0, the counter counts downwards. Starting event counting with 1400_{hex} produces a down counter.

Counting starts immediately after the command is sent.

F: Counting repeat

If counting is only performed once, it is stopped when the final value is reached, and the count value remains at this value. If counting is constantly repeated, the counter is reset when the final value is reached, and the count repeated from the initial value.

Table 4-5 Parameter F: Counting repeat

Bit 7	Meaning
0	Single count
1	Repeated count

Gate

The "gate" parameter describes the gate input condition that has to be satisfied for the counting process.

Table 4-6 Gate parameter

Bits 6 / 5 / 4		Meaning
Bin	Dec	
0 0 0	0	Does not serve any function
0 0 1	1	Counting at HIGH level
0 1 0	2	Counting at LOW level
0 1 1	3	Start of counting on rising edge
1 0 0	4	Start of counting on falling edge
1 0 1	5	Reserved
1 1 0	6	Reserved
1 1 1	7	Counting at HIGH level; the count value is reset by a rising edge

When using the gate signal please observe the response time of 200 µs.
When counting is started by the gate signal, counting pulses within these 200 µs are not registered. The stopping of counting is also delayed relative to the gate signal, so that counting pulses within this response time are also registered.

R: Counting direction

This bit can be used to select up or down counting. If no initial or final value is set, counting goes from 0 to 0 regardless of the counting direction. The final value (terminal count) is reached if an up counter counts from $FFFFFF_{hex}$ to 0, or a down counter from 0 to $FFFFFF_{hex}$.

Table 4-7 Parameter R: Counting direction

Bit 3	Meaning
0	Down
1	Up

Output

This parameter defines the switching behavior of the digital output when the terminal count (final value) is reached.

Table 4-8 Output parameter

Bits 2 / 1 / 0		Designation	Meaning	Initial setting of output
Bin	Dec			
0 0 0	0	Does not serve any function	Output not active	LOW
0 0 1	1	HIGH pulse	Positive pulse generated	LOW
0 1 0	2	LOW pulse	Negative pulse generated	HIGH
0 1 1	3	Toggle (L)	Previous state inverted	LOW
1 0 0	4	Toggle (H)	Previous state inverted	HIGH
1 0 1	5	HIGH	Output HIGH	LOW
1 1 0	6	LOW	Output LOW	HIGH
1 1 1	7	Reserved	Reserved	–

The standard length of a HIGH and a LOW pulse is 100 ms. It can, however, be changed using the S*ystem Settings* command.

If you have selected the repeated count (F = 1), you should select one of the output parameters 1_{dec} to 4_{dec}. Only these parameters indicate the end of counting with a status change or a pulse.

4.4 Time Measurement Mode command

The Time Measurement Mode command comprises the command code and various parameters. The parameters determine the conditions for time measurement.

Output word 0 (OUT[0])

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**Resolution**		**Out**	**Type**	**0**	**Relation condition**		

The second output word is not used.

Set the unused bits 9, 8 and 3 to 0.

The count value during time measurement occupies 16 bits. Measurement starts on a rising edge. Measurement of pulse length ends on a falling edge, measurement of period on the next rising edge. Only when measurement is complete is the count value accepted into the process data. If no counting edge is detected within the timeout, the count value is cleared. An error message is not generated in the event of a timeout.

Resolution

The resolution indicates the value of the LSB.

Table 4-9 Resolution parameter

Bit 7 / 6	Meaning	Maximum time	Timeout after
0 0	2 µs	131 ms (until FW 1.03) 126 ms (FW 1.06 or later)	150 ms (until FW 1.03) 128 ms (FW 1.06 or later)
0 1	2 ms	131 s (2 min 11 s)	131 s
1 0	10 ms	655 s (10 min 55 s)	655 s
1 1	Reserved	–	–

Please note that the indicated resolution is valid for all values, including the presetting of conditions (e.g., initial or final value). If, for example, a resolution of 2 ms per LSB is set, and it is necessary to define an initial value of 50 ms, the value 19_{hex} (25_{dec}) must be entered. At a resolution of 2 ms, this value corresponds to the 50 ms.

Out: output

Table 4-10 Out parameter: Output

Bit 5	Meaning
0	Output not used
1	Output set if relation condition satisfied

Type: Measurement type

Table 4-11 Type parameter: Measurement type

Bit 4	Meaning
0	Measurement of period (a in Figure 4-2)
1	Measurement of pulse length (b in Figure 4-2)

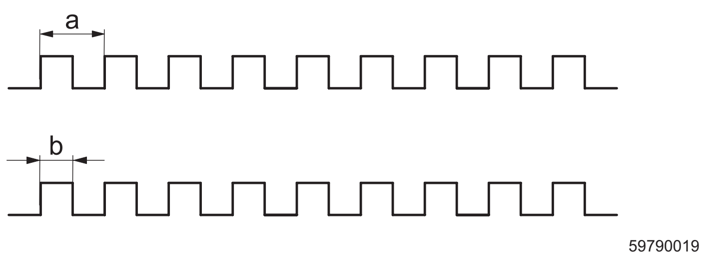


Figure 4-2 Period and pulse length

Relation condition

The relation condition specifies a condition for the output behavior during time measurement. Compliance with the limit values specified in the relation condition is indicated through the output or bit 8 (Out). Only the initial and/or the final value from the event counting can be used as limit values. Since the count value only occupies 16 bits, only the lower 16 bits of the initial value and the final value are taken into account.

Output used

If the output is being used, bit 8 in input word 0 mirrors the state of the output.

If the relation condition is satisfied, the output is set and a "1" is shown in bit 8 of input word 0 for the set output shown.

If the relation condition is not satisfied, the output is reset and a "0" shown in bit 8 of input word 0.

Output not used

If the output is not being used, once the relation condition is satisfied, the bit for the digital output is set (input word 0, bit 8 = 1) in the process data.

If the relation condition is not satisfied, a "0" appears in bit 8 of input word 0 .

If the output is not being used, once the relation condition is satisfied, bit 8 in input word 0 changes to "1" and **remains at 1. It has to be reset by the user**, as bit 8 is set to "1"(OUT[0] = 0100_{hex}) in output word 0, until bit 8 in input word 0 changes to "0".

Table 4-12 Relation conditions parameter

Bits 2 / 1 / 0		Meaning
Bin	Dec	
0 0 0	0	No relation condition
0 0 1	1	Count value greater than or equal to initial value
0 1 0	2	Count value less than initial value
0 1 1	3	Count value within initial and final values
1 0 0	4	Count value outside initial and final values
1 0 1	5	Count value greater than final value with hysteresis
1 1 0	6	Count value less than initial value with hysteresis
1 1 1	7	Reserved

Whether a limit value is included in the condition or not depends on the condition. Internally, each condition is reduced to a comparison of count value less than initial value and/or count value greater than final value.

In Figure 4-3 the relation conditions are shown graphically.

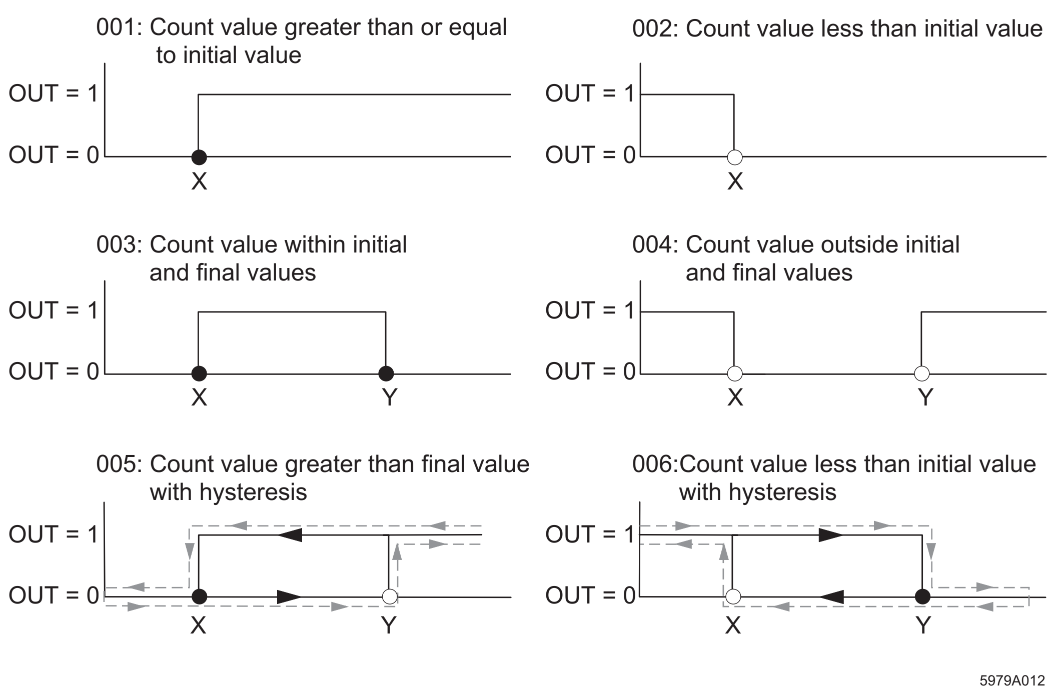


Figure 4-3 Relation conditions

Key:

X	Initial value	●	Limit value included
Y	Final value	○	Limit value not included

Hystereses:

The gray line in those cases with hystereses illustrates the OUT state as a function of the previous state of OUT and the measured value. If, for example, in diagram 006, the measurement is between the initial and final values, OUT can be = 0 or = 1. If OUT was = 0, it remains at 0, if OUT was = 1, it remains at 1.

A hysteresis therefore can be used to stabilize the output behavior of measured values that fluctuate around certain limit values.

Example 1

The effect of a relation condition may be explained by reference to the example of condition "004: count value outside initial and final values".

– If the count value is less than the initial value, the relation condition is satisfied and OUT is set to "1".
– If the count value is greater than or equal to the initial value and less than or equal to the final value, the relation condition is not satisfied and OUT is set to "0".
– If the count value is greater than the final value, the condition is satisfied and OUT is set to "1".

Example 2

The output behavior on a condition with hysteresis may be explained by reference to the example of condition "006: count value less than initial value with hysteresis".

– If the time measured has not yet been greater than or equal to the final value, the condition is satisfied and OUT = 1.
– If the time measured is greater than or equal to the final value, the condition is no longer satisfied, OUT = 0.
– If the time measured becomes smaller, but is still greater than or equal to the initial value, OUT remains = 0.
– If the time measured is less than the initial value, OUT becomes = 1.
– OUT only returns to = 0 again if the measured value becomes greater than or equal to the final value.

4.5 Pulse generator mode

The pulse generator can produce frequencies from 1 kHz through 10 kHz in 500 Hz increments. This operating mode necessitates a certain setting for the input circuit, which is made automatically (see Section "System Settings command" on page 4-13).

The pulse generator command comprises the command code and a factor.

Output word 0 (OUT[0])

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	**0**	**0**	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**Factor**				

The second output word is not used.

The individual quantities are related as follows:

– Pulse frequency = 1000 Hz + (factor x 500 Hz)

Table 4-13 Factor, frequency setpoint, actual frequency and error

Factor dec/hex	$F_{setp.}$ in Hz	$F_{act.}$ in Hz	Error in %
0 / 00	1000	1000	0
1 / 01	1500	1497	-0.2
2 / 02	2000	2000	0
3 / 03	2500	2500	0
4 / 04	3000	3012	0.4
5 / 05	3500	3521	0.6
6 / 06	4000	4000	0
7 / 07	4500	4505	0.11
8 / 08	5000	5000	0
9 / 09	5500	5495	-0.09

Factor dec/hex	$F_{setp.}$ in Hz	$F_{act.}$ in Hz	Error in %
10 / 0A	6000	5988	-0.2
11 / 0B	6500	6494	-0.09
12 / 0C	7000	6993	-0.01
13 / 0D	7500	7519	0.25
14 / 0E	8000	8000	0
15 / 0F	8500	8475	-0.29
16 / 10	9000	9009	0.1
17 / 11	9500	9525	0.25
18 / 12	10000	10000	0

4.6 System Settings command

This command makes settings, some of which affect all operating modes.

It comprises the command code and various parameters.

Output word 0 (OUT[0])

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	**0**	**1**	**1**	**0**	**0**	**IC**		**Logic operation on source-gate**				**Reset**	**Pulse length**		

The second output word is not used.

The *System Settings* command can be used to make basic settings for all operating modes. However, the definition of the various parameters depends on the mode. Not all parameters can be defined in every mode.

Table 4-14 Use of the *System Settings* command parameters in the individual modes

Parameters	Mode(s) in which it may be used
Input configuration IC	
– No input configuration (IC parameter = 00_{bin})	All
– Filter for mechanical switches (IC parameter = 01_{bin})	Frequency measurement, event counting, time measurement
– Settings for pulse generator (IC parameter = 10_{bin})	Pulse generator
– Logic source-gate operation (IC parameter = 11_{bin})	Frequency measurement, event counting, time measurement
Logic operation on source-gate	Frequency measurement, event counting, time measurement
Bus reset behavior	All
Pulse length	Event counting

Apart from the pulse length setting, the system settings are accepted immediately in an activated mode.

IC: Input configuration

The input configuration parameter can be used to connect a filter or influence the effect of the states of the two inputs to be influenced (source-gate logic operation).

If pulse generator mode is set, bits 9 and 8 are automatically set to the bit combination 10_{bin} internally. If bits 9 and 8 have been set otherwise, this setting is ignored.

Table 4-15 Input configuration parameter

Bits 9 and 8 bin	Output word hex	Function
0 0	300x	Source and gate direct, 100 kHz filter each
0 1	310x	Source and gate filter for mechanical contacts
1 0	320x	Setting for pulse generator
1 1	33xx	Source-gate logic operation, see Table 4-16 through Table 4-18.

If mechanical switches (e.g., relays) are being used, source and gate filters should be switched on to eliminate or minimize the effects of the contacts bouncing. In the case of solid-state switches or light barriers these filters must be switched off.
If different types of switches (mechanical and electronic) are used at the source and gate inputs, the effects of a configuration with and without filters must be checked beforehand.

Please note that the counter terminal always accepts the latest input configuration. For example, it is not possible to set a filter for mechanical contacts first and then perform a source-gate logic operation. In this case only the source-gate logic operation would be accepted, the filter would no longer be connected.

The source-gate logic operation can be used in frequency measurement, event counting and time measurement modes.

Source-gate logic operation

With the source-gate logic operation, a signal is formed from the two input signals' source (S) and gate (G) that, after processing according to the logic function, is available as a new source signal. It is designated source' (S'). The original source signal is now no longer available. The original gate signal can continue to be used.

This source-gate logic function can be used to implement the most common logic functions (see Table 4-16), and also any other possible function (see Table 4-18).

Table 4-16 The most common logic functions provided by the source-gate operations

Bits 7 through 4 bin	Output word hex	Function
0 0 0 1	33**1**x	S' = S NOR G
0 0 1 1	33**3**x	S' = $\overline{G}$ (source' = gate inverted)
0 1 0 1	33**5**x	S' = $\overline{S}$ (source' = source inverted)
0 1 1 0	33**6**x	S' = S EXOR G
0 1 1 1	33**7**x	S' = S NAND G
1 0 0 0	33**8**x	S' = S AND G
1 1 0 0	33**C**x	S' = G
1 1 1 0	33**E**x	S' = S OR G

Table 4-17 Source' depending on the inputs and the source-gate operation (most common logic functions)

Gate	Source	OR 1110_{bin}	EXOR 0110_{bin}	AND 1000_{bin}	NOR 0001_{bin}	NAND 0111_{bin}	S' = $\overline{S}$ 0101_{bin}	S' = G 1100_{bin}	S' = $\overline{G}$ 0011_{bin}
0	0	0	0	0	1	1	1	0	1
0	1	1	1	0	0	1	0	0	1
1	0	1	1	0	0	1	1	1	0
1	1	1	0	1	0	0	0	1	0

Table 4-18 Source' depending on the inputs and the source-gate operation (other logic functions)

Gate	Source	0000_{bin}	0010_{bin}	0100_{bin}	1001_{bin}	1010_{bin}	1011_{bin}	1101_{bin}	1111_{bin}
0	0	0	0	0	1	0	1	1	1
0	1	0	1	0	0	1	1	0	1
1	0	0	0	1	0	0	0	1	1
1	1	0	0	0	1	1	1	1	1

Define a function as follows:

- Create a table with the states of source and gate in the specified sequence.

Gate	Source
0	0
0	1
1	0
1	1

- Define the state of source' depending on source and gate. If, for example, source' is always to adopt the state "1", except for when source = "0" and gate = "1" simultaneously, the possible combinations of states for source' are given in the table.

Gate	Source	Source'
0	0	1
0	1	1
1	*0*	*0*
1	1	1

- Derive from this table the bit combination for the source-gate operation that has to be entered in output word 0.

Gate	Source	Source'	Bit in OUT[0]
0	0	1	4
0	1	1	5
1	0	0	6
1	1	1	7

The bit combination for the required source-gate operation is 1011_{bin}.

Reset:
Bus reset behavior

Bus reset behavior can be used to select whether a bus reset is to have an effect on the terminal or not.

Table 4-19 Bus reset behavior parameters

Bit 3	Meaning
0	(Default state) A bus reset resets the output, stops all counting operations, and clears the operating mode set.
1	No response to a bus reset

Pulse length

The pulse length parameter can be used to change the length of a pulse of the digital output in the event counting mode. The default value is 100 ms.

The value of the pulse length can be changed at any time, however, the setting is not accepted and hence is not effective until event counting mode is set.

> If the pulse length is to be changed during event counting, after the value has been changed, the command for setting event counting mode must be resent.

Table 4-20 Pulse length parameter

Bits 2/1/0	Length of pulse
0 0 0	10 ms
0 0 1	50 ms
0 1 0	100 ms
0 1 1	200 ms

Bits 2/1/0	Length of pulse
1 0 0	300 ms
1 0 1	400 ms
1 1 0	500 ms
1 1 1	1000 ms

4.7 Read Firmware Version command

This command can be used to read the firmware version of the counter terminal. This command can be used at any time. The result is shown immediately in input word 1.

Output word

Output word 0 (OUT[0])

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	**0**	**1**	**1**	**1**	**1**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**

x The setting of this bit is irrelevant.

The second output word is not used.

Input word

Input word 0 (IN[0])

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	**0**	**1**	**1**	**1**	**1**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**

x The setting of this bit is irrelevant.

Input word 1 (IN[1]) (example)

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**(0)**	**(0)**	**(0)**	**(0)**

(0) The setting of this bit is irrelevant. In this example the irrelevant bits have been set to 0.

In this example input word 1 has the value 1000_{hex}. The last digit of the hex value is not taken into account. The firmware version is therefore 1.00.

4.8 Preset Initial Value and Preset Final Value commands

These commands are used in the **event counting** and **time measurement** modes.

The *Preset Initial Value* ($40xx_{hex}$) and *Preset Final Value* ($50xx_{hex}$) commands are used to preset defined values for counting and time measurement.

Since event counting works with 24-bit values, initial and final values can be preset in this format.

Time measurement uses 16-bit values, so only the value of output word 1 is used (16 bits) for working in this mode, even if a 24-bit value has been preset.

The commands can be sent at any time and are accepted immediately, even during counting/time measurement.

NOTE: Misinterpretation of values
Ensure data consistency of two words to prevent the possibility of the values being misinterpreted.
See Section "Tips for working with the counter terminal" on page 5-9.

Default initial value

Output word 0 (OUT[0])

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**Initial value**							

Output word 1 (OUT[1])

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Initial value															

Default final value

Output word 0 (OUT[0])

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**Final value**							

Output word 1 (OUT[1])

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Final value															

When entering initial and final values for time measurement, please note any resolution set (see, for example, "Resolution" on page 4-8). A set resolution per LSB also applies to the initial and final values.

If, for example, a resolution of 2 ms has been set for time measurement, and an initial value of 50 ms is to be defined, the value 19_{hex} (25_{dec}) must be entered. At a resolution of 2 ms, this value corresponds to the 50 ms.

If, during a count, a new initial value is set, the counter is set to this value immediately, regardless of its current state.

If, during a count, a new final value is set, this value is accepted immediately for the current count.

> If, for example, no initial value has been set for repeat counting, and the final value is equal to 10, counting starts at 0. The counter counts up to 9 and resets the count value to 0 on the next pulse.

4.9 Stop Counter and Start Counter commands

These commands are only valid in **event counting** mode.

The counter starts counting immediately the mode command is sent. The *Stop Counter* command (2000_{hex}) is used to stop a counting operation. The *Start Counter* command (2400_{hex}) is used to start a counting operation. The count value is frozen after the operation is stopped. Counting is re-started from the frozen count value after a new *Start Counter* command.

Stop counter

Output word 0 (OUT[0])

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	**0**	**1**	**0**	**0**	**0**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**

x The setting of this bit is irrelevant.

The second output word is not used.

Start counter

Output word 0 (OUT[0])

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	**0**	**1**	**0**	**0**	**1**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**

x The setting of this bit is irrelevant.

The second output word is not used.

4.10 Set Counter to Default command

This command can be used for **all** operating modes.

The mode command causes the counter to start counting immediately, the *Start Counter* command does not have to be sent. This is made possible by the fact that not all counter environment variables are cleared when a mode command is sent.

If the counter terminal is to be set to a defined initial state, the *Set Counter to Default* (2800_{hex}) command must be sent. This command clears all of the counter environment variables:

- The pulse length is set to the default value.
- The input circuit is set to 100 kHz.
- The counter is stopped.
- The operating mode is cleared.
- The bus reset behavior remains unchanged.

Output word 0 (OUT[0])

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	**0**	**1**	**0**	**1**	**0**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**

x The setting of this bit is irrelevant.

The second output word is not used.

If the IB IL CNT terminal is being tested to try out various operating modes, it is advisable to send the command 2800_{hex} before parameterizing a new mode.

4.11 Read Counter command

This command can be used for **all** operating modes.

The *Read Counter* command allows the result to be read in the different operating modes.

The command for reading the counter only contains the command code. There are no parameters in this command.

Output word 0 (OUT[0])

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**

x The setting of this bit is irrelevant.

The second output word is not used.

Input word

Assignment of the input words after the *Read Counter* command:

<table>
<tr><td colspan="16">Input word 0</td><td colspan="16">Input word 1</td></tr>
<tr><td colspan="8">HIGH byte</td><td colspan="8">LOW byte</td><td colspan="8">HIGH byte</td><td colspan="8">LOW byte</td></tr>
<tr><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>G</td><td>O</td><td>x</td><td>x</td><td>x</td><td>x</td><td>x</td><td>x</td><td>x</td><td>x</td><td colspan="16">16-bit measured value from time measurement</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>G</td><td>O</td><td colspan="24">24-bit measured value from event counting and frequency measurement</td></tr>
</table>

x The setting of this bit is irrelevant.

G Status of the signal at the gate input (gate)

O During time measurement:
Status of the output or
result of the evaluation of the relation condition without using the output

G: Gate

Bit 9 of input word 1 shows the status of the signal at the control input (gate).

O: OUT (output)

This bit is only used in time measurement mode. In all other modes, bit 8 = 0.

During time measurement, bit 8 of input word 1 indicates the status of the output or the result of the evaluation of a relation condition.

If the output is being used, its status is indicated.

If the output is not being used, and a relation condition has been selected, the result of its evaluation is indicated.

If time measurement mode is being used, please see Section "Time Measurement Mode command" on page 4-8 for additional information about this bit.

Bits 15 to 10

The command is mirrored in bits 15 through 10 of input word 0. Bit 15 is the error bit. If bit 15 = 0, there is no error.

Bits 7 to 0

Bits 7 through 0 are irrelevant in a 16-bit count value. In a 24-bit count value, they represent the most significant byte of the result.

With a 24-bit value the count value must be masked out of the two input words.

Count value = $(IN[0] \,\&\, 00FF_{hex}) \times 65536 + IN[1]$.

4.12 Limit values and limitations on the commands

Table 4-21 Limit values and limitations

Operating mode	Options affected	Operating range
Frequency measurement	All	f ≤ 100 kHz
Event counting	All	f ≤ 100 kHz
Time measurement	Resolution 2 µs, without relation condition	250 µs ≤ t ≤ 131 ms (until FW 1.03) 250 µs ≤ t ≤ 126 ms (FW 1.06 or later)
	Resolution 2 µs, with relation condition	1 µs ≤ t ≤ 131 ms (until FW 1.03) 1 ms ≤ t ≤ 126 ms (FW 1.06 or later)
	Resolution 2 ms	2 ms ≤ t ≤ 131 s
	Resolution 10 ms	10 ms ≤ t ≤ 655 s
Pulse generator		1 kHz ≤ f ≤ 10 kHz

The minimum time measurement periods with a resolution of 2 µs, with and without relation condition, are defined through the processing time by the firmware.

The input signals at source and gate must be digital.

The counter terminal is designed primarily for the use of electronic switching elements, i.e., solid-state switches.

Mechanical contacts can only be used to a limited extent. A filter is provided in the input circuit for this purpose. However, practical tests show that the bouncing of mechanical contacts can present problems even with this filter.

4.13 Overview of all commands

This section provides an overview of all commands. This allows a quick evaluation of which parameters can or must be preset for which command. More detailed information can be found in the separate sections.

Irrelevant bits, which are identified with an "x" in the explanation of the individual commands, are set to "0" in this overview.

In hexadecimal notation the value "X" is not related to the parameter "X" to be entered.

Only the output words used for the corresponding command are shown.

Frequency Measurement Mode

Output word 0 (OUT[0])

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	**0**	**0**	**1**	**0**	**0**	**Parameter (time-controlled/state-controlled)**									
1				**X**				**X**				**X**			

Event Counting Mode

Output word 0 (OUT[0])

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	**0**	**0**	**1**	**0**	**1**	**0**	**0**	**F**	**Gate**			**R**	**Output**		
1				**4**				**X**				**X**			

F Counting repeat

R Counting direction

Time Measurement Mode

Output word 0 (OUT[0])

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**Resolution**		**OUT**	**Type**	**0**	**Relation condition**		
1				**8**				**X**				**X**			

Pulse Generator Mode

Output word 0 (OUT[0])

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	**0**	**0**	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**Factor (pulse)**				
1				**C**				**X**				**X**			

System Settings

Output word 0 (OUT[0])

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	**0**	**1**	**1**	**0**	**0**	**IC**		**Logic operation on source-gate**				**Reset**	**Pulse length**		
3				**0 (X)**				**X**				**X**			

IC Input configuration

Read Firmware Version

Output word 0 (OUT[0])

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	**0**	**1**	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
3				**C**				**0**				**0**			

Default Initial Value

Output word 0 (OUT[0])

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**Initial value**							
4				**0**				**X**				**X**			

Output word 1 (OUT[1])

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Initial value															
X				**X**				**X**				**X**			

Default Final Value

Output word 0 (OUT[0])

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**Final value**							
5				**0**				**X**				**X**			

Output word 1 (OUT[1])

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Final value															
X				**X**				**X**				**X**			

Stop Counter

Output word 0 (OUT[0])

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
2				**0**				**0**				**0**			

Start Counter

Output word 0 (OUT[0])

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	**0**	**1**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
2				**4**				**0**				**0**			

Set Counter to Default

Output word 0 (OUT[0])

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	**0**	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
2				**8**				**0**				**0**			

Read Counter

Output word 0 (OUT[0])

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
0				**0**				**0**				**0**			

5 Examples and tips

Always follow the notes on data consistency on page 5-9 when programming.

5.1 Example of event counting

Task

An up-counter is to be configured. Counting is to start at the initial value 123_{hex}. The light is on when counting starts. The output is to be inverted each time the value 132_{hex} is reached.

Wiring

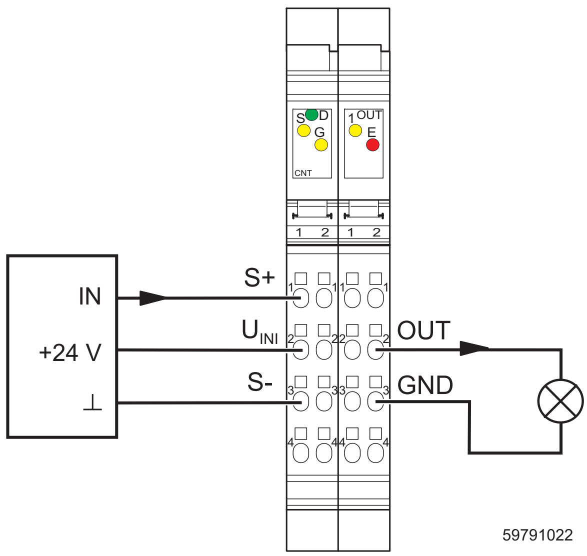


Figure 5-1 Example of wiring for event counting

An optical data link, for example, is connected to the source input (S+, +24 V, S-). This barrier provides the counting pulses. The output is used to control a light.

Programming

Output word 1 for event counting

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	0	1	0	1	0	0	F	Gate			R	Output		
0	0	0	1	0	1	0	0	1	0	0	0	1	1	0	0
1				4				8				C			

F	Repeated count	1_{bin}
Gate	Does not serve any function	000_{bin}
R	Up counting	1_{bin}
Output	Previous state of the output is inverted when the final value is reached; initial state: set (high):	100_{bin}

Table 5-1 Example of event counting

Action	OUT[0] hex	OUT[1] hex	OUT[0] bin	OUT[1] bin
Set Counter to Default	2800	xxxx	**0010 10**00 0000 0000	xxxx xxxx xxxx xxxx
Wait for acknowledgment	Wait until IN[0] = OUT[0]			
	The output word OUT[1] is irrelevant in this case.			
Preset Initial Value 123_{hex}	4000	0123	**0100 00**00 0000 0000	0000 0001 0010 0011
Wait for acknowledgment	Wait until IN[0] = OUT[0] and IN[1] = OUT[1]			
	Check whether the input value corresponds to the value required. Always follow the notes on data consistency on page 5-9.			
Preset Final Value 132_{hex}	5000	0132	**0101 00**00 0000 0000	0000 0001 0011 0010
Wait for acknowledgment	Wait until IN[0] = OUT[0] and IN[1] = OUT[1]			
	Check whether the input value corresponds to the value required. Always follow the notes on data consistency on page 5-9.			
Operating mode event counting, upwards, output active, output = toggle	148C	xxxx	**0001 01**00 1000 1100	xxxx xxxx xxxx xxxx
Wait for acknowledgment	Wait until IN[0] = OUT[0]			
Read Counter	0000	xxxx	**0000 00**00 0000 0000	xxxx xxxx xxxx xxxx
Wait for acknowledgment	Wait until IN[0] = OUT[0]			
Read Count Value	Count value = IN[1]			
	As the counting range in this specific case only extends to values between 123_{hex} and 132_{hex}, the count value only occupies the second input word (IN[1]). If the input word occupies more than 16 bits, the value must be masked out of the two input words: (Count value = (IN[0] & $00FF_{hex}$) x 65536) + IN[1]).			

xxxx	Any value, as it is not used.
0 / **1**	Bold text identifies the command code.
0 / 1	The values that are not in bold represent the parameters for the command code.

If a 24-bit value is preset as initial or final value, the commands take the following format:

Preset Initial Value 123456$_{hex}$	4012	3456	**0100 00**00 0001 0010	0011 0100 0101 0110
Wait for acknowledgment	Wait until IN[0] = OUT[0] and IN[1] = OUT[1]			
Preset Final Value 789ABC$_{hex}$	5078	9ABC	**0101 00**00 0111 1000	1001 1010 1011 1100
Wait for acknowledgment	Wait until IN[0] = OUT[0] and IN[1] = OUT[1]			

5.2 Example of time measurement with relation conditions

Task

The length of pulses is to be measured. The output is to follow a hysteresis loop with the relation condition "Count value < initial value with hysteresis". The hysteresis range is to be 40 ms through 80 ms.

Wiring

The wiring is as shown in Figure 5-1 on page 5-1.

Programming

Output word 1 (OUT[0]) for time measurement

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	0	1	1	0	0	0	Resolu-tion		OUT	Type	0	Relation condition		
0	0	0	1	1	0	0	0	0	1	1	1	0	1	1	0
1				8				7				6			

Resolution	2 ms	01_{bin}
OUT	Output set if relation condition satisfied	1_{bin}
Type	Measurement of pulse length	1_{bin}
Relation condition	Count value < initial value (hysteresis)	110_{bin}

> When specifying initial and final values, please note the resolution specified for time measurement.

Initial value:	40 ms (please note resolution!)	$20_{dec} = 14_{hex}$
Final value:	80 ms (please note resolution!)	$40_{dec} = 28_{hex}$

Table 5-2 Programming the example of time measurement with relation condition

Action	OUT[0] hex	OUT[1] hex	OUT[0] bin	OUT[1] bin
Set Counter to Default command	2800	xxxx	**0010 10**00 0000 0000	xxxx xxxx xxxx xxxx
Wait for acknowledgment	Wait until IN[0] = OUT[0]			
Preset Initial Value command, initial value = 14_{hex}	4000	0014	**0100 00**00 0000 0000	0000 0000 0001 0100
Wait for acknowledgment	Wait until IN[0] = OUT[0]			
Preset Final Value command, final value = 28_{hex}	5000	0028	**0101 00**00 0000 0000	0000 0000 0010 1000
Wait for acknowledgment	Wait until IN[0] = OUT[0]			

Table 5-2 Programming the example of time measurement with relation condition (continued)

Action	OUT[0] hex	OUT[1] hex	OUT[0] bin	OUT[1] bin
Time measurement mode with parameters specified above	1876	xxxx	**0001 10**00 0111 0110	xxxx xxxx xxxx xxxx
Wait for acknowledgment	Wait until IN[0] = OUT[0]			
The following steps are not needed if only the output behavior is of importance.				
Read Counter	0000	xxxx	**0000 00**00 0000 0000	xxxx xxxx xxxx xxxx
Wait for acknowledgment	Wait until (IN[0] & $FC00_{hex}$) = (OUT[0] & $FC00_{hex}$)			
16-bit count value	Count value = IN[1]			
Time in ms	Time = count value x resolution; resolution = 2 ms			

Explanation of output pulse diagram

After the command for the operating mode has been sent, the counter terminal directly begins to count (time measurement) of the signals at the input.

The pulse length starts at 0 ms and is slowly increased (segment A in Figure 5-2). As long as the pulse length is less than the final value (80 ms), the output remains at "1". When the pulse length equals the final value (point B), the output is set to "0". The pulse length continues to increase (segment C) until it reaches 120 ms. It then decreases again (segment D). If the pulse length is equal to the initial value (40 ms) (point E), the output is set to "1". If the pulse length shortens further, the output remains at "1".

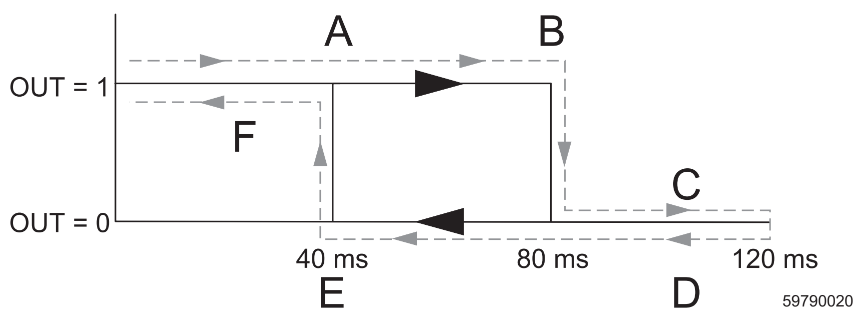


Figure 5-2 Example of a hysteresis

5.3 Example of time measurement with system settings

Task

Limit switches are connected to source and to gate to measure the time during which the signals of the two limit switches are both at "1" simultaneously. If a limit value is exceeded, it will be detected by the bus.

The time is measured in time measurement mode with the pulse length measurement parameter.

Wiring

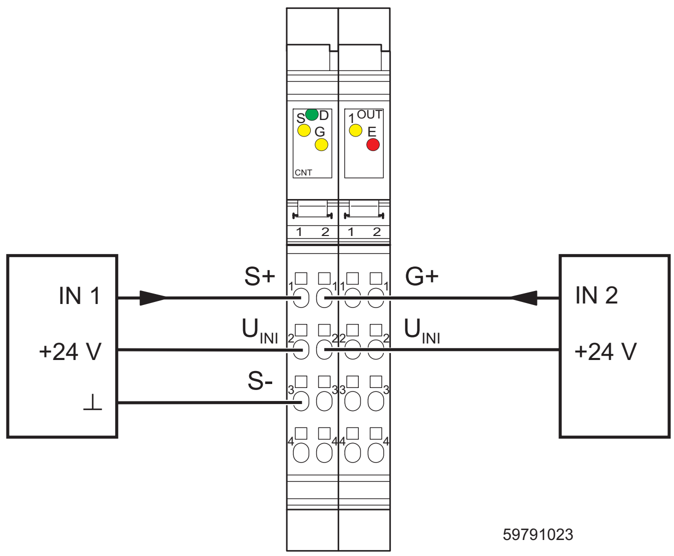


Figure 5-3 Example of wiring for time measurement with source and gate

An light barrier, for example, is connected to the source input (S+, +24 V, S-). Another sensor is connected to the gate input (G+, +24 V). The output is not activated. The result of checking the relation condition is indicated in input word 1 (bit 9).

Programming

The system settings and marginal conditions commands must be sent before the mode selection command.

System settings

The logic operation is performed on the two limit switch signals with the System Settings command. Logical ORing of the signals is selected (source’ equal to "1" if source or gate signal at "1").

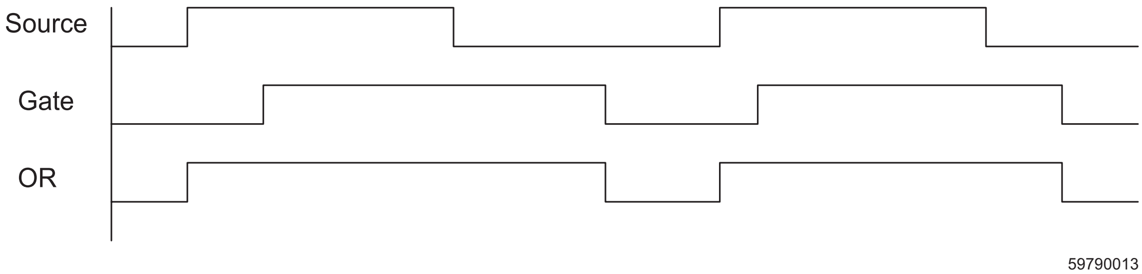


Figure 5-4 Logical ORing of source and gate

Input configuration	Source-gate logic operation	11_{bin}
Source-gate logic operation	OR	1110_{bin}
Reset	No response to a bus reset	0_{bin}
Pulse length	(Pulse length 10 ms) irrelevant, as no output is to be set	000_{bin}

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	1	1	0	0	IC		Logic operation on source-gate				Reset	Pulse length		
0	0	1	1	0	0	1	1	1	1	1	0	0	0	0	0
3				3				E				0			

The System Settings command is $33E0_{hex}$.

Presetting the initial value

The OUT bit in the input word is used to indicate that a limit value has been exceeded. The limit value must be preset as the initial value.

The limit is to be 30 s. An initial value of 30000 ms is therefore preset. The resolution is to be 2 ms. The value to be entered in the parameter word for the Preset Initial Value command is $15000_{dec} = 3A98_{hex}$.

Preset the initial value using

Word 0 = 4000_{hex}

Word 1 = $3A98_{hex}$

> Ensure data consistency of 2 words. If this is not possible in the application, word 1 and then word 0 must be transmitted (see page 5-9).

Selecting the operating mode

The command for selecting the time measurement mode can now be transmitted.

Resolution	2 ms	01_{bin}
OUT	Output not used	0_{bin}
Type	Measurement of pulse length	1_{bin}
Relation condition	Count value ≥ initial value	0001_{bin}

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	0	1	1	0	0	0	Resolution		OUT	Type	0	Relation condition		
0	0	0	1	1	0	0	0	0	1	0	1	0	0	0	1
1				8				5				1			

The time measurement command is thus 1851_{hex}.

Command sequence

Table 5-3 Example of time measurement using system control

Action	OUT[0] hex	OUT[1] hex	OUT[0] bin	OUT[1] bin
Set Counter to Default command	2800	xxxx	**0010 10**00 0000 0000	xxxx xxxx xxxx xxxx
Wait for acknowledgment	Wait until IN[0] = OUT[0]			
System Settings command, logic operation on source-gate active	33E0	xxxx	**0011 00**11 1110 0000	xxxx xxxx xxxx xxxx
Wait for acknowledgment	Wait until IN[0] = OUT[0]			
Preset Initial Value command, initial value = $3A98_{hex}$	4000	3A98	**0100 00**00 0000 0000	0011 1010 1001 1000
Wait for acknowledgment	Wait until IN[0] = OUT[0]			
Time Measurement Mode, pulse length measurement	1851	xxxx	**0001 10**00 0101 0001	xxxx xxxx xxxx xxxx
Wait for acknowledgment	Wait until IN[0] = OUT[0]			
Read Counter	0000	xxxx	**0000 00**00 0000 0000	xxxx xxxx xxxx xxxx
Wait for acknowledgment	Wait until (IN[0] & $FC00_{hex}$) = (OUT[0] & $FC00_{hex}$)			
16-bit count value	Count value = IN[1]			
Time in ms	Time = count value x resolution; resolution = 2 ms			

5.4 Tips for working with the counter terminal

Sequence of the Inline terminals

For the order of the terminals in an Inline station, please refer to the information given in the IL SYS INST UM E user manual.

Ensure data consistency

Ensure data consistency of two words to prevent the possibility of the values being misinterpreted.

If the second output word (OUT[1]) is related to the first (OUT[0]), for example, when presetting an initial value, it is necessary to ensure that the counter terminal receives the required default value together with the command. This can be checked from the input words. Input word 1 (IN[0]) must contain the command code, input word 2 (IN[1]) the **required** default value.

If data consistency is not ensured, the second word will contain **an old** value still present in the input word from an **earlier** transmission. If this happens, the data will not be accepted properly.

If this is the case send output word 1 first with the default value, and any command code other than that required. 000000_{bin} is one possibility for this command code. It is the code for *Read Counter*. This code has no effect on the parameterization of the terminal. If the terminal has not been configured before a value is preset, or no operating mode has yet been preset, bit 15 of the input word IN[0] will indicate an error after the transmission of this code. This error message can be ignored. It has no effect on the preset value.

Then transmit output word 0 with the command required for presetting the value, without changing output word 1. The output words are mirrored in the two input words. Input words 0 and 1 must now contain the command code and the **required** preset. Bit 15 of input word IN[0] must no longer indicate an error now. This shows that the terminal counter has adopted the value required.

Please note that a new value will not be accepted if the same code for presetting the value is transmitted several times in succession. To change a preset value, at least one other command code has to have been transmitted.

If it has become evident that data consistency is no longer ensured, e.g., during transmission of the initial value, the command sequence may appear as shown in Table 5-4.

Table 5-4 Example of presetting an initial value

Action	OUT[0] hex	OUT[1] hex	OUT[0] bin	OUT[1] bin
The initial value has been entered. It is not possible to be sure whether data consistency is ensured.				
Preset Initial Value	4000	1111	**0100 00**00 0000 0000	0001 0001 0001 0001
Wait for acknowledgment	IN[0] = OUT[0]; **IN[1] not equal to OUT[1], e.g. 9999**$_{hex}$			
This acknowledgment shows that data consistency is not ensured. The initial value must be retransmitted taking account of data consistency.				
Step 1: Transmit OUT[1]				
Enter Initial Value	**0000**	1111	**0000 00**00 0000 0000	0001 0001 0001 0001
	OUT[0] may be equal any value other than 4000_{hex}.			
	It is not necessary to wait for the acknowledgment. Whether OUT[1] is mirrored in IN[1] depends on the code transmitted. With the 000000_{hex} code there is no mirroring of the output word.			
	Bit 15 of the input word IN[0] can indicate an error, as OUT[0] corresponds to the code for *Read Counter*. The error message can be ignored in this case.			
Step 2: Transmit OUT[0]				
Re-enter Initial Value	4000	1111	**0100 00**00 0000 0000	0001 0001 0001 0001
Wait for acknowledgment	IN[0] = OUT[0]; IN[1] = OUT[1]			
	Check whether the input value corresponds to the value required.			

5.5 Function blocks on the Internet

Function blocks for working with the counter terminal are available on the Internet at www.download.phoenixcontact.com.

Documentation for working with the function blocks is also available on the Internet.

There are function blocks for various controller boards.

The blocks can be adapted to individual applications for parameterizing the counter terminal.

6 Programming, technical, and ordering data

This data is valid for the preferred mounting position (vertical).

The technical data does not claim to be complete. Technical modifications reserved.

For further technical data on the Inline product family, please refer to the IL SYS INST UM E user manual.

For further technical data regarding other product families, please refer to the corresponding documentation.

6.1 Programming data/configuration data

NOTE: Misinterpretation of values when the data consistency is violated
Ensure data consistency of two words to prevent the possibility of the values being misinterpreted.

6.1.1 Local bus (INTERBUS)

ID code	BF_{hex} (191_{dec})
Length code	02_{hex}
Process data channel	32 bits
Input address area	2 words
Output address area	2 words
Parameter channel (PCP)	0 bytes
Register length (bus)	2 words

6.1.2 Other bus systems

For the programming data/configuration data of other bus systems, please refer to the corresponding electronic device data sheet (e.g., GSD, EDS).

6.2 Process data words

INTERBUS

The IB IL SYS PRO UM E user manual contains a description of INTERBUS software configuration.

The "INTERBUS Addressing" data sheet contains information on the assignment of the process data words to various control and computer systems.

Other bus systems

If you use other bus systems, please use the associated documentation to get information on the software configuration of your bus system.

Output data words for configuring the terminal
(See Section "Output words" on page 3-2)

(Byte.bit) view	Byte	Byte 0								Byte 1							
	Bit	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Word 0	Assign-ment	Command code						Parameters									

(Byte.bit) view	Byte	Byte 2								Byte 3							
	Bit	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Word 1	Assign-ment	Parameters															

Command code: The settings for these bits depend on the command to be transmitted.
Set the bits according to your application and the explanations in Section 4, "Commands for working with the counter terminal".

Parameters: The settings for these bits depend on the command to be transmitted.
Set the bits according to your application and the explanations in Section 4, "Commands for working with the counter terminal".

Input data words
(See Section "Input words" on page 3-3)

Input words during parameterization

During parameterization, the output words are mirrored in the input words.

(Byte.bit) view	Byte	Byte 0								Byte 1							
	Bit	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Word 0	Assignment	Mirrored command code						Mirroring of the parameter									

(Byte.bit) view	Byte	Byte 2								Byte 3							
	Bit	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Word 1	Assignment	Mirroring of the parameter															

Input words after sending the *Read Counter* command:

After the *Read Counter* command has been sent, the input words contain the count values.

(Byte.bit) view	Byte	Byte 0								Byte 1							
	Bit	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Word 0	Assignment	Not used						G	O	Result (counter)							

(Byte.bit) view	Byte	Byte 2								Byte 3							
	Bit	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Word 1	Assignment	Result (counter)															

G: Gate Status of the control input

O: OUT Status of the output or result of the mismatch evaluation

6.3 Technical data

All data relating to terminals in the Inline product range is listed in the IL SYS INST UM E user manual. Here you will only find data that applies specifically to the counter terminal or that differs from the general data.

General data	
Housing dimensions (width x height x depth)	24.4 mm x 136 mm x 72 mm (with connector set)
Weight	94 g (without connectors), 130 g (with connectors)
Operating mode	Process data mode with 2 words
Basic functions	Frequency measurement, Pulse counting, Time measurement, Pulse generator
Connection method for 24 V sensors	2 and 3-wire technology
Connection method for 5 V sensors	2-wire technology with shield and external 5 V supply
Connection method for the actuator	2-wire technology
Connection data for connectors	
Connection type	Spring-cage terminals
Conductor cross-section	0.2 mm^2 to 1.5 mm^2 (solid or stranded), 24 - 16 AWG

Ambient conditions	
Regulations	Developed according to VDE 0160, UL 508
Permissible temperature (operation)	-25°C to +55°C
Permissible temperature (storage/transport)	-25°C to +85°C
Permissible humidity (operation/storage/transport)	10% to 95% according to DIN EN 61131-2
Permissible air pressure (operation/storage/transport)	70 kPa to 106 kPa (up to 3000 m above sea level)
Degree of protection	IP20 according to IEC 60529
Class of protection	Class 3 according to EN 61131-2, IEC 61131-2

Interface	
Local bus	Through data routing

Transmission speed	
IB IL CNT, IB IL CNT-PAC, IB IL CNT-PAC/CN	500 kbps
IB IL CNT-2MBD, IB IL CNT-2MBD-PAC	2 Mbps

Supply of the module electronics and I/O through bus coupler/power terminal	
Connection method	Via potential routing
Remark: Connected to segment circuit U_S:	Switching output Sensor supplies with individual short circuit protection

Power consumption	500 kbps	2 Mbps
Communications power	7.5 V	7.5 V
Current consumption from the local bus (typical)	40 mA, maximum	50 mA, maximum
Current consumption from the local bus (maximum)	50 mA, maximum	60 mA, maximum
Power consumption from the local bus (maximum)	0.375 W	0.450
Segment supply voltage U_S	24 V DC (nominal value)	24 V DC (nominal value)
Nominal current consumption at U_S	1 A, maximum	1 A, maximum

Digital inputs	
Number	4 1 counter input for 24 V signals 1 counter input for 5 V signals 1 control input for 24 V signals 1 control input for 5 V signals
Input resistance of the counter inputs	
24 V input	5.7 kΩ, approximately
5 V input	1.7 kΩ, approximately
Input resistance of the control inputs	
24 V input	5.7 kΩ, approximately
5 V input	1.7 kΩ, approximately
Switching thresholds of the counter inputs	
24 V range	
- Maximum LOW level voltage	U_{Lmax} < 5 V
- Minimum HIGH level voltage	U_{Hmin} > 15 V
5 V range	2.5 V ±1 V
Switching thresholds of the control inputs	
24 V range	
- Maximum LOW level voltage	U_{Lmax} < 5 V
- Minimum HIGH level voltage	U_{Hmin} > 15 V
5 V range	2.5 V ±1 V
Maximum permissible voltage at inputs	
24 V input	30 V
5 V input	8 V
Common potentials	Main supply, ground
Nominal input voltage U_{IN}	24 V DC
Permissible range	-0.5 V < U_{IN} < +30 V DC
Nominal input current for U_{IN}	5 mA
Delay time	<5 µs

Input characteristic curve

Input voltage (V)	Typical input current (mA)
-0.5 < U_{IN} < 0	0
3	0.6
6	1.1
9	1.7
12	2.3
15	2.4
18	3.6
21	4.3
24	5.0
27	5.5
30	6.1

Limitation of simultaneity, derating (inputs)	
Derating	No limitation of simultaneity, no derating

Switching output	
Number	1
Nominal output voltage U_{OUT}	24 V DC
Nominal current I_{nom}	0.5 A, maximum
Differential voltage for I_{nom}	<1 V

Switching output (continued)	
Nominal load	
Ohmic	48 Ω, minimum/12 W, maximum
Lamp	12 W, maximum
Inductive	12 VA, maximum (48 Ω, minimum, 1.2 H, maximum)
Signal delay upon power up of:	
Nominal ohmic load	< 50 µs, typical
Nominal lamp load	< 25 µs, typical
Nominal inductive load	< 1 ms, typical
Signal delay upon power down of:	
Nominal ohmic load	< 1 ms, typical
Nominal lamp load	< 1 ms, typical
Nominal inductive load	< 30 ms, typical
Behavior during	
Ohmic overload	Auto restart after eliminating the overload
Lamp overload	Auto restart after eliminating the overload

A bulb characteristic can delay the auto restart substantially after elimination of the overload. The delay time can be reduced by switching the output briefly.

Inductive overload	Output may be damaged
Short-circuit response	Auto restart after elimination of the overload
Limitation of the voltage induced on circuit interruption	At -18 V, approximately
Overcurrent shutdown	0.7 A, minimum
Reverse voltage protection against short pulses	Protected against reverse voltages
Maximum reverse current	0.5 A
Resistance to permanently applied surge voltages	No

Output characteristic curve when switched on (typical)

Output current (A)	Differential output voltage (V)
0	0
0.1	0.25
0.2	0.35
0.3	0.45
0.4	0.55
0.5	0.65

Limitation of simultaneity, derating (switching output)	
Derating	No limitation of simultaneity, no derating

Sensor supply	
Nominal output voltage U_{OUT}	24 V DC
Nominal current I_{nom}	0.5 A, maximum
Differential voltage for I_{nom}	<1 V
Nominal load	
Ohmic	48 Ω, minimum/12 W, maximum
Lamp	12 W, maximum
Inductive	12 VA, maximum (48 Ω, minimum, 1.2 H, maximum)

Sensor supply (continued)	
Behavior during	
Ohmic overload	Auto restart after eliminating the overload
Lamp overload	Auto restart after eliminating the overload

A bulb characteristic can delay the auto restart substantially after elimination of the overload. The delay time can be reduced by switching the output briefly.

Inductive overload	Output may be damaged
Short-circuit response	Auto restart after elimination of the short circuit; I/O error message, typically after delay of 1.4 s
Overcurrent shutdown	0.7 A, minimum
Reverse voltage protection against short pulses	Protected against reverse voltages
Maximum reverse current	0.5 A
Resistance to permanently applied surge voltages	No

Output characteristic curve when switched on (typical)

Output current (A)	Differential output voltage (V)
0	0
0.1	0.18
0.2	0.22
0.3	0.27
0.4	0.31
0.5	0.36

Limitation of simultaneity, derating

Derating	No limitation of simultaneity, no derating

Error messages to the higher-level control or computer system

Sensor supply short circuit/overload	Yes

If the sensor supply is short-circuited, the red "Error" LED (E) lights up, and after a delay of typically 1.4 s an I/O error message is generated. In addition, the diagnostic LED (D) flashes on the terminal at 2 Hz (medium) under these conditions.

Safety equipment

Switching output (segment circuit)	
Short circuit	Yes, short-circuit-proof (automatic restart)
Overload	Yes
Power supply for the sensors (segment circuit)	
Short circuit	Electronic (automatic restart)

Electrical isolation/isolation of the voltage areas

To provide electrical isolation between the logic level and the I/O area it is necessary to supply the station bus coupler and the terminal described here via the bus coupler or a power terminal from separate power supply units. Interconnection of the power supply units in the 24 V area is not permitted (see also IL SYS INST UM E user manual).

Common potentials

The 24 V main voltage, 24 V segment voltage, and GND have the same potential. FE is a separate potential area.

Separate potentials in the system consisting of bus coupler/power terminal and I/O terminal

Test distance	Test voltage
5 V supply incoming remote bus/7.5 V supply (bus logic)	500 V AC, 50 Hz, 1 min
5 V supply outgoing remote bus/7.5 V supply (bus logic)	500 V AC, 50 Hz, 1 min
7.5 V supply (bus logic) / 24 V supply (I/O)	500 V AC, 50 Hz, 1 min
24 V supply (I/O) / functional earth ground	500 V AC, 50 Hz, 1 min

Limit values and limitations in the operating modes		
Operating mode	**Options affected**	**Operating range**
Frequency measurement	All	f ≤ 100 kHz
Event counting	All	f ≤ 100 kHz
Time measurement	Resolution 2 µs, without relation condition	250 µs ≤ t ≤ 131 ms (until FW 1.03) 250 µs ≤ t ≤ 126 ms (FW 1.06 or later)
	Resolution 2 µs, with relation condition	1 µs ≤ t ≤ 131 ms (until FW 1.03) 1 ms ≤ t ≤ 126 ms (FW 1.06 or later)
	Resolution 2 ms	2 ms ≤ t ≤ 131 s
	Resolution 10 ms	10 ms ≤ t ≤ 655 s
Pulse generator		1 kHz ≤ f ≤ 10 kHz

Notes on using the counter terminal	
Minimum time measurement period	The minimum time measurement periods with a resolution of 2 µs, with and without relation condition, are defined through the processing time by the firmware.
Input signals at source and gate	The input signals at source and gate must be digital.
Switches	The counter terminal is designed primarily for the use of electronic switching elements, i.e., solid-state switches. Mechanical contacts can only be used to a limited extent. A filter is provided in the input circuit for this purpose. However, practical tests show that the bouncing of mechanical contacts can present problems even with this filter.

Conformance with EMC Directive 2004/108/EC

Only the deviations from the standard values of the Inline product family are listed here. Standard values are documented in the IL SYS INST UM E user manual.

Noise immunity test according to EN 61000-6-2		
Surge voltage	EN 61000-4-5/ IEC 61000-4-5	Criterion B Signal cables: 0.5 kV (asymmetrical)

Approvals

For the latest approvals, please visit www.download.phoenixcontact.com or www.eshop.phoenixcontact.com.

6.4 Ordering data

Products

Description	Type	Order No.	Pcs./Pkt.
Inline counter terminal, complete with accessories (separately numbered connectors and labeling fields), transmission speed of 500 kbps	IB IL CNT-PAC	2861852	1
Inline counter terminal, complete with accessories (consecutively numbered connectors and labeling fields), transmission speed of 500 kbps	IB IL CNT-PAC/CN	2878748	1
Inline counter terminal without accessories, transmission speed of 500 kbps	IB IL CNT	2836667	1
Inline counter terminal, complete with accessories (connectors and labeling fields); transmission speed of 2 Mbps	IB IL CNT-2MBD-PAC	2862071	1
Inline counter terminal without accessories, transmission speed of 2 kbps	IB IL CNT-2MBD	2855813	1

The listed connector set is needed for the complete fitting of the IB IL CNT and IB IL CNT-2MBD terminals.

Connectors

Description	Type	Order No.	Pcs./Pkt.
Connector set with a standard connector and a shield connector	IB IL AO/CNT-PLSET	2732664	1
Connectors	IB IL SCN-8	2726337	10
Shield connector for analog Inline terminals	IB IL SCN-6 SHIELD	2726353	5

Accessories

Description	Type	Order No.	Pcs./Pkt.
Keying profile (100 pcs./package)	IL CP	2742683	
Zack marker strip to label the terminals	ZBF 6- ... and ZBF 12-... see "CLIPLINE" catalog		
Labeling field, 12.2 mm width	IB IL FIELD 2	2727501	
DIN mounting rail, material: steel perforated/unperforated, Height 7.5 mm, width 35 mm, length 2 m	NS 35/7,5 PERF NS 35/7,5 UNPERF	0801733 0801681	
Screwdriver, blade: 0.6 x 3.5 x 100 mm, length 180 mm	SZF 1-0,6x3,5	1204517	

Documentation

Description	Type	Order No.	Pcs./Pkt.
"Automation Terminals of the Inline Product Range" user manual	IL SYS INST UM E	2698737	1
"Configuring and Installing the INTERBUS Inline Product Range" user manual	IB IL SYS PRO UM E	2743048	1
"INTERBUS Adressing" data sheet	DB GB IBS SYS ADDRESS	–	–

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B Revision history of technical modifications

Revision	Date	Validity	Modification	
A	09/1999	Until HW 01	First publication	
B	10/2001	HW 02 or later	Modification of the internal wiring	
			Page 1-9	The short-circuit-protected sensor voltage U_{INI} is generated from the **main voltage U_M** . The main voltage U_M is **not directly used** at the counter terminal points. Changed to: The short-circuit-protected sensor voltage U_{INI} is generated from the **segment voltage U_S**. The main voltage U_M is **not used** at the counter terminal points.
			Page 1-10	Circuit diagram modified
			Page 1-10	U_{INI}: +24 V sensor voltage; generated from the **main voltage** Changed to: U_{INI}: +24 V sensor voltage; generated from the **segment voltage**
			Page 6-92	Deleted: A connection is established to the main circuit U_M
			Page 6-92	Nominal current consumption at U_S **500 mA**, maximum Changed to: Nominal current consumption at U_S **1 A**, maximum
			Page 6-92	Deleted: Nominal current consumption at U_M 500 A, maximum
			Page 6-97	Short-circuit protection for the sensor voltage supply (**main circuit**) Changed to: Short-circuit protection for the sensor voltage supply (**segment circuit**)
			Page 6-100	Ordering data of accessories and documentation modified

Revision	Date	Validity	Modification	
02	06/2008	Firmware Version 1.30 or later	User manual extended for all counter terminal variants Firmware modifications led to modified time response for a time measurement with a resolution of 2 µs	
			Global	– Adaptation of the description of all counter variants – Adaptation of the description on the use of the terminal in various bus systems
			Page 1-9	Added: If you have selected the repeated count (F = 1), you should select on of the output parameters 1_{dec} to 4_{dec}. Only these parameters indicate the end of counting with a status change or a pulse.
			Page 4-8	Tabe 4-9 Table completed with data for firmware 1.06 or later
			Page 4-22	Tabe 4-21 Operating range completed with data for firmware 1.06 or later
			Section 6	Technical data revised – Ambient conditions – Data for 2 Mbps added – Values for firmware 1.06 or later added (under "Limit values and limitations on the operating modes")
			Page 5-12	Sequence of the Inline terminals Text replaced with reference to IL SYS INST UM E user manual.