

Chapter 9 SM 238C - Combination module

Overview

In this chapter follows the description of the combination module SM 238C that includes a digital in-/output module with counter function and an analog in-/output module.

The combination module can only be used together with a CPU 21x or with the DP-V1 Profibus coupler (253-xDP01)! Here the max. number of modules is limited to 2.

Below follows a description of:

- combination module SM 238C
- analog part
- digital part
- counter function

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Overview

General

The combination module includes a digital in-/output module with counter function and an analog in-/output module.

The following components are integrated:

- Analog input: 3xU/I, 1xPT100x12Bit
- Analog output: AO 2x12Bit COM
- Digital input: 16(12)xDC24V with parameterizable counter functions
- Digital output: 0(4)xDC24V 1A
- Counter: max. 3 counter with the operating modes: endless, single or periodic counting.

Project engineering

The combination module can only be used together with a CPU 21x or with the DP-V1 Profibus coupler (253-xDP01)! Here the max. number of modules is limited to 2.

The operation at a other bus coupler is not permitted.

The necessary GSD files can be found at "service" on ftp.vipa.de.

The project engineering takes place in the Siemens SIMATIC manager. For this the import of the corresponding GSD file is required.

After installation of the GSD the combination module can be found at the hardware catalog at:

Additional Field devices > I/O > VIPA_System_200V >...

as 2 modules:

238-2BC00 (1/2) AI4/AO2*12Bit

238-2BC00 (2/2) Counter

For the module has a digital and an analog part, you have to configure for each one component during the hardware configuration.

Counter

The control of the counter happens via digital input channels. For the counter you may configure alarms that influence one digital output channel per counter.

Ordering data

DI 16xDC24V / AI 4/AO 2x12Bit Combination module VIPA 238-2BC00

In-/Output part

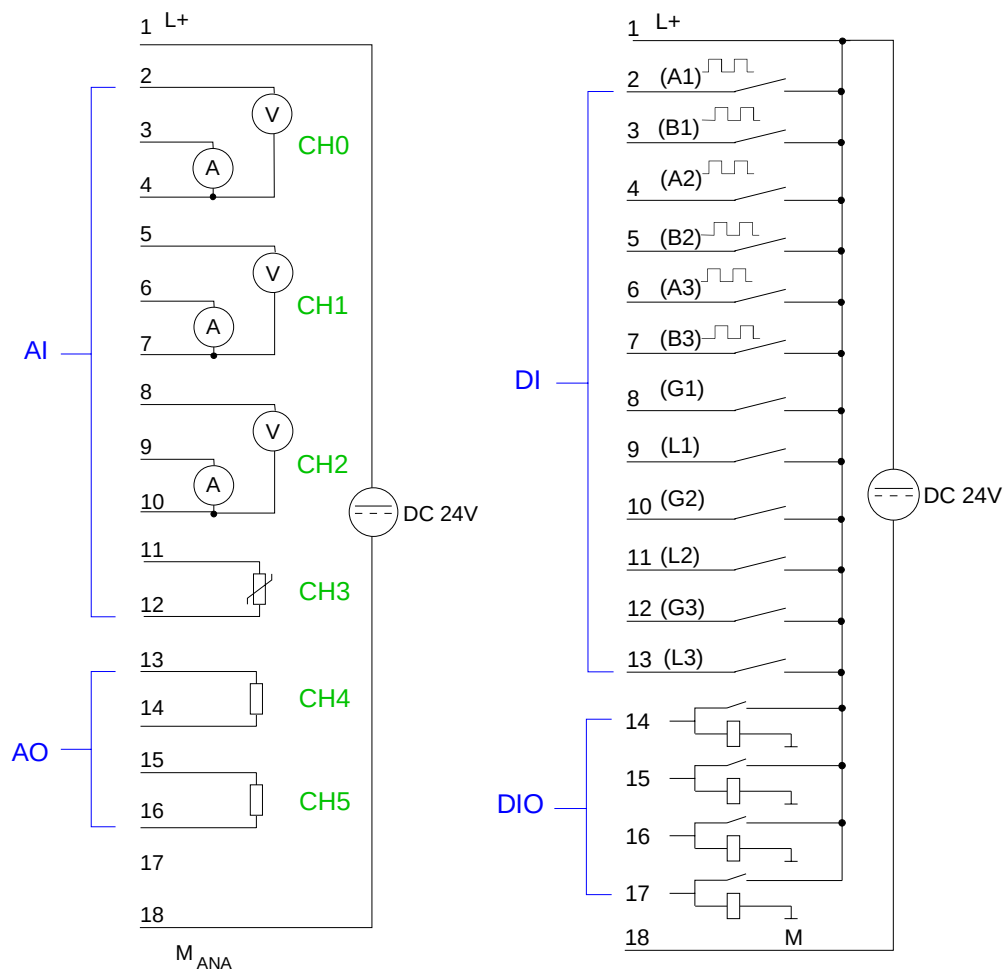
Structure



Pin assignment

Analog part

Digital part



Analog part

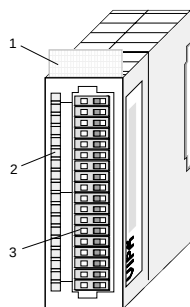
Properties

The analog part has 4 analog inputs and 2 analog outputs that may be configured individually. The module occupies a total of 8Byte of input and 4Byte of output data.

Galvanic isolation between the channels on the module and the backplane bus is provided by means of DC/DC converters and opto couplers.

- 4inputs and 2 outputs with common ground
- In-/Outputs with individually configurable functions
- Channel 0 to 2 suitable for encoder with input ranges of:
voltage $\pm 10V$, 1 ... 5V, 0 ... 10V, $\pm 4V$, $\pm 400mV$
current $\pm 20mA$, 4...20mA, 0 ... 20mA
- Channel 3 suitable for encoder with input ranges of:
Pt100, Pt1000, NI100, NI1000
resistant measuring 600Ω , 3000Ω
- Channel 4 to 5 Suitable for actuators with output ranges of:
 $\pm 10V$, 1 ... 5V, 0 ... 10V, $\pm 20mA$, 0 ... 20mA or 4 ... 20mA

Construction



- [1] Label for the name of the module
- [2] LED status indicator
- [3] Edge connector

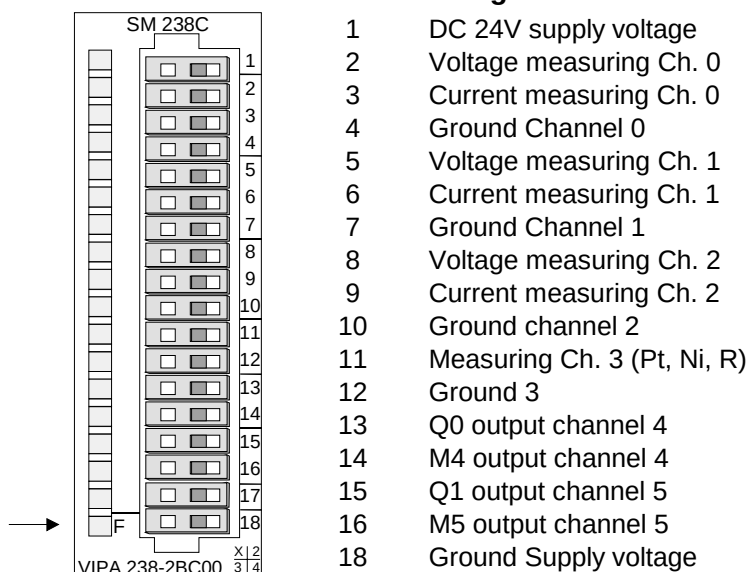
Status indicator

Pin assignment

LED Description

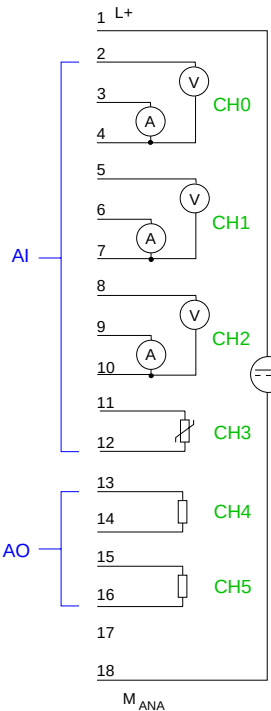
- F Sum error LED (red)
turned on as soon as an
channel error is detected
res. an entry in the
diagnostic bytes happened

Pin Assignment

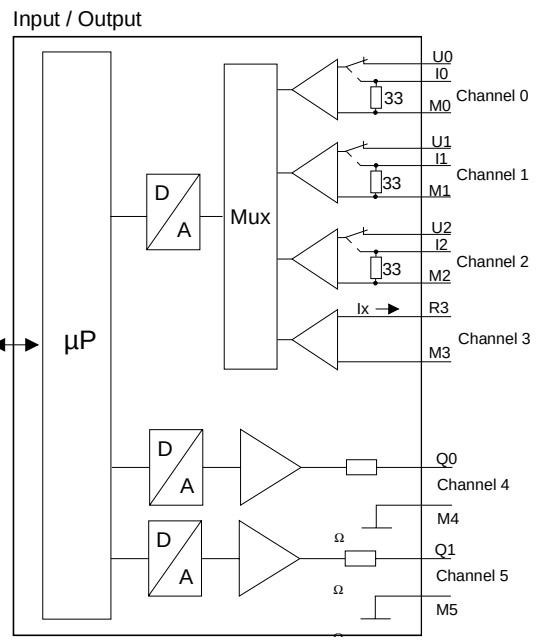


Circuit and schematic diagram

Circuit diagram



Schematic diagram



Attention!

Temporarily not used inputs have to be connected with the concerning ground at activated channel. When deactivating unused channels by means of FFh, this is not required.

Numeric notation in Siemens S7 format

The analog values are represented in two's complement format. Depending on the parameterized transformation speed the lowest value bits of the measuring value are irrelevant. With increasing sampling rate, the resolution decreases.

The following table lists the resolution in dependence of the sampling rate.

	Analog value															
	High-Byte								Low-Byte							
Bit number	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Resolution	sign	Measuring value														
15 Bit + sign	sign	Relevant output value (at 3.7 ... 30Hz)														
14 Bit + sign	sign	Relevant output value (at 60Hz)														X*
13 Bit + sign	sign	Relevant output value (at 120Hz)													X	X
11 Bit + sign	sign	Relevant output value (at 170Hz)											X	X	X	X
9 Bit + sign	sign	Relevant output value (at 200Hz)									X	X	X	X	X	X

* The lowest value irrelevant bits of the output value are marked with "X".

Algebraic sign bit (sign) Bit 15 serves as algebraic sign bit. Here is:
 Bit 15 = "0" → positive value
 Bit 15 = "1" → negative value

Digital/Analog conversion

In the following all measuring ranges are listed that are supported by the analog part.

The here listed formulas allow you to transform an evaluated measuring value (digital value) to a value assigned to the measuring range and vice versa.

+/- 10V

Voltage	Decimal	Hex
-10V	-27648	9400
-5V	-13824	CA00
0V	0	0
5V	13824	3600
10V	27648	6C00

Formulas for the calculation:

$$Value = 27648 \cdot \frac{U}{10}, \quad U = Value \cdot \frac{10}{27648}$$

U: voltage, Value: decimal value

0...10V

Voltage	Decimal	Hex
0V	0	0
5V	13824	3600
10V	27648	6C00

Formulas for the calculation:

$$Value = 27648 \cdot \frac{U}{10}, \quad U = Value \cdot \frac{10}{27648}$$

U: voltage, Value: decimal value

1...5V

Voltage	Decimal	Hex
1V	0	0
3V	13824	3600
5V	27648	6C00

Formulas for the calculation:

$$Value = 27648 \cdot \frac{U-1}{4}, \quad U = Value \cdot \frac{4}{27648} + 1$$

U: voltage, Value: decimal value

+/-4V

Voltage	Decimal	Hex
-4V	-27648	9400
0V	0	0
4V	27648	6C00

Formulas for the calculation:

$$Value = 27648 \cdot \frac{U}{4}, \quad U = Value \cdot \frac{4}{27648}$$

U: voltage, Value: decimal value

+/-400mV

Voltage	Decimal	Hex
-400mV	-27648	9400
0V	0	0
400mV	27648	6C00

Formulas for the calculation:

$$Value = 27648 \cdot \frac{U}{400}, \quad U = Value \cdot \frac{400}{27648}$$

U: voltage, Value: decimal value

0...20mA

Current	Decimal	Hex
0mA	0	0
12mA	13824	3600
20mA	27648	6C00

Formulas for the calculation:

$$Value = 27648 \cdot \frac{I-4}{16}, \quad I = Value \cdot \frac{16}{27648} + 4$$

I: current, Value: decimal value

4...20mA

Current	Decimal	Hex
4mA	0	0
12mA	13824	3600
20mA	27648	6C00

Formulas for the calculation:

$$Value = 27648 \cdot \frac{I-4}{16}, \quad I = Value \cdot \frac{16}{27648} + 4$$

I: current, Value: decimal value

+/- 20mA

Current	Decimal	Hex
-20mA	-27648	9400
-10mA	-13824	CA00
0mA	0	0
10mA	13824	3600
20mA	27648	6C00

Formulas for the calculation:

$$Value = 27648 \cdot \frac{I}{20}, \quad I = Value \cdot \frac{20}{27648}$$

I: current, Value: decimal value

Analog part - Project engineering

Access to the analog part

The combination module can only be used together with a CPU 21x or with the DP-V1 Profibus coupler (253-xDP01)! The project engineering takes place in the Siemens SIMATIC manager. For this the import of the corresponding GSD file is required which can be found at "service" on ftp.vipa.de.

After installation of the GSD file the combination module can be found at the hardware catalog at:

Additional Field devices > I/O > VIPA_System_200V > ...

as 2 modules:

238-2BC00 (1/2) AI4/AO2*12Bit

238-2BC00 (2/2) Counter

Please take care that you always configure both module parts in the sequence shown above

Data input/ data output range

For data input 8Bytes and for data output 4Bytes are available with the following assignment:

Data input range:

During the measuring, the measuring values are stored in the data input area.

Byte	Bit 7 ... 0
0	High-Byte channel 0
1	Low-Byte channel 0
2	High-Byte channel 1
3	Low-Byte channel 1
4	High-Byte channel 2
5	Low-Byte channel 2
6	High-Byte channel 3
7	Low-Byte channel 3

Data output range:

For output of the data you set a value in the data output area.

Byte	Bit 7 ... 0
0	High-Byte channel 4
1	Low-Byte channel 4
2	High-Byte channel 5
3	Low-Byte channel 5

Behavior at errors

As soon as a measuring value exceeds the overdrive res. underdrive region, the following value is returned:

Measuring value > Overdrive region: 32767 (7FFFh)

Measuring value < Underdrive region: -32768 (8000h)

When exceeding the predefined range the analog output is set to 0V res. 0A!

Parameter data

16Byte of parameter data are available for the configuration. These parameters are stored in non-volatile memory and are available after the unit has been powered off.

By using the SFC 55 "WR_PARM" you may alter the parameterization in the module during runtime. The time needed until the new parameterization is valid can last up to 50ms. During this time, the measuring value output is 7FFFh.

The following table shows the structure of the parameter data:

Parameter area
Record set 0

Byte	Bit 7 ... 0	Default
0	Wire break recognition channel 0 Bit 0: 0 = deactivated 1 = activated Wire break recognition channel 1 Bit 1: 0 = deactivated 1 = activated Wire break recognition channel 2 Bit 2: 0 = deactivated 1 = activated Wire break recognition channel 3 Bit 3: 0 = deactivated 1 = activated Bit 4, 5: reserved Diagnostic alarm Bit 6: 0 = diagnostic alarm inhibited 1 = diagnostic alarm enabled Bit 7: reserved	00h
1	Bit 3 ... 0: reserved CPU-Stop reaction for channel 4 Bit 4: 0 = Set replacement value *) 1 = Store last value CPU-Stop reaction for channel 5 Bit 5: 0 = Set replacement value *) 1 = Store last value Bit 7 ... 6: reserved	00h
2	Function-no. channel 0 (see table input ranges)	28h
3	Function-no. channel 1 (see table input ranges)	28h
4	Function-no. channel 2 (see table input ranges)	28h
5	Function-no. channel 3 (see table input ranges)	01h
6	Option-Byte channel 0 (see table next page)	00h
7	Option-Byte channel 1 (see table next page)	00h
8	Option-Byte channel 2 (see table next page)	00h
9	Option-Byte channel 3 (see table next page)	00h
10	Function-no. channel 4 (see table output ranges)	09h
11	Function-no. channel 5 (see table output ranges)	09h
12	High-Byte replacement value channel 4	00h
13	Low-Byte replacement value channel 4	00h
14	High-Byte replacement value channel 5	00h
15	Low-Byte replacement value channel 5	00h

*) If you want to get 0A res. 0V as output value at CPU-STOP, you have to set the following replacement values at current output (4...20mA) res. voltage output (1...5V):
E500h for the S7-format from Siemens.

Parameters

Wire break recognition

Via the Bits 0 and 3 of Byte 0, the wire break recognition is activated for the input channels. The wire break recognition is only available for the current measuring range of 4...20mA and at (thermo) resistance measuring. A wire break is recognized when the current input during current measuring sinks under 1.18mA res. when the resistance at (thermo) resistance measuring reaches infinite. This causes an entry in the diagnostic area and is shown via the SF-LED.

If a diagnostic alarm is activated, a diagnostic message is sent to the superordinated system.

Diagnostic alarm

With the help of Bit 6 of Byte 0, you may release the diagnostic alarm. In case of an error like e.g. wire break, the superordinated system receives *record 0* (4Byte). For an extended diagnostic you may then call *record 1* (12Byte). More detailed information is to find below under "Diagnostic data".

CPU-Stop reaction and replacement value

With Bit 4 and 5 of Byte 1 and Byte 12 ... 15 you may set the reaction of the module at CPU-Stop for every output channel.

Via Byte 12 ... 15 you predefine a replacement value for the output channel as soon as the CPU switches to Stop.

By setting Bit 4 res. 5, the last output value remains in the output at CPU-Stop. A reset sets the replacement value.

Function No.

Here you set the function no. of your measuring res. output function for every channel. Please see the according table above.

Meas. cycle

Here you may set the transducer velocity for every input channel. Please regard that a higher transducer velocity causes a lower resolution because of the lower integration time.

The data transfer format remains unchanged. Only the lower Bits (LSBs) are not longer relevant for the analog value.

Structure Meas. cycle Byte:

Byte	Bit 7 ... 0	Resolution	Default
6 ... 7	Bit 3 ... 0: Velocity per channel		00h
	0000 15 conversions/s	16	
	0001 30 conversions/s	16	
	0010 60 conversions/s	15	
	0011 120 conversions/s	14	
	0100 170 conversions/s	12	
	0101 200 conversions/s	10	
	0110 3.7 conversions/s	16	
	0111 7.5 conversions/s	16	
	Bit 7 ... 4: reserved		

**Function-no.
assignment**

The assignment of a function no. to a certain channel happens during parameterization. The function no. 00h does not influence the function no. stored in the permanent parameterization data.

By entering FFh you may deactivate the concerning channel.

The following tables list all functions that are supported by the depending channel.

You may find the corresponding connection type at the "circuit diagram" above.

**Note!**

When exceeding the overdrive region, the value 7FFFh (32767) is thrown, at underrun of the underdrive region the value is 8000h (-32768).

Input range (channel 0 ... 2)

No.	Function	Measuring range / representation
00h	Does not affect permanently stored configuration data.	
7Dh	Voltage 0 ... 10V Siemens S7-format	-1.76 ... 11.76V / 11.76V= End overdrive region (32511) 0...10V= nominal range (0...27648) -1.76V= End underdrive region (-4864) two's complement
7Ah	Voltage 1 ... 5V Siemens S7-format	0.3 ... 5.70V / 5.70V= End overdrive region (32511) 1...5V= nominal range (0...27648) 0.30V= End underdrive region (-4804) two's complement
28h	Voltage $\pm 10V$ Siemens S7-format	$\pm 11.76V$ / 11.76V= End overdrive region (32511) -10...10V= nominal range (-27648...27648) -11.76V= End underdrive region (-32512) two's complement
29h	Voltage $\pm 4V$ Siemens S7-format	$\pm 4.70V$ / 4.70V= End overdrive region (32511) -4...4V= nominal range (-27648...27648) -4.70V= End underdrive region (-32512) two's complement
2Ah	Voltage $\pm 400mV$ Siemens S7-format	$\pm 470mV$ / 470mV= End overdrive region (32511) -400...400mV= nominal range (-27648...27648) -470mV= End underdrive region (-32512) two's complement

continued ...

... continue function-no. input range (channel 0...2)

7EH	Current 0 ... 20mA Siemens S7-format	-3.51 ... 23.51mA / 23.51mA = End overdrive region (32511) 0...20mA = nominal range (-27648...27648) -3.51mA = End underdrive region (-4864) two's complement
2Ch	Current ± 20 mA Siemens S7-format	± 23.51 mA / 23.51mA = End overdrive region (32511) -20...20mA = nominal range (-27648...27648) -23.51mA = End underdrive region (-32512) two's complement
2Dh	Current 4...20mA Siemens S7-format	1.185...+22.81mA / 22.81mA = End overdrive region (32511) 4...20mA = nominal range (0...27648) 1.18mA = End underdrive region (-4864) two's complement
FFh	Channel not active (turned off)	

Input range (channel 3)

No.	Function	Measuring range / representation
00h	Does not affect permanently stored configuration data.	
01h	Pt100 in 2wire mode	-200 .. +850°C / in units of 1/10°C, two's complement
02h	Pt1000 in 2wire mode	-200 .. +500°C / in units of 1/10°C, two's complement
03h	NI100 in 2wire mode	-50 .. +250°C / in units of 1/10°C, two's complement
04h	NI1000 in 2wire mode	-50 .. +250°C / in units of 1/10°C, two's complement
06h	Resistance measurement 600Ohm 2wire	- / 600 Ω = Limit value (32767)
07h	Resistance measurement 3000Ohm 2wire	- / 3000 Ω = Limit value (32767)
FFh	Channel not active (turned off)	

Output range (Channel 4, Ch. 5)

No.	Function	Output range
00h	Does not affect permanently stored configuration data	
09h	Voltage $\pm 10V$ Siemens S7-format	$\pm 11.76V$ 11.76V = End overdrive region (32511) -10V...10V = nominal range (-27648...27648) -11.76 = End underdrive region (-32512) two's complement
0Ah	Voltage 1...5V Siemens S7-format	0...5.704V 5.704V = End overdrive region (32511) 1...5V = nominal range (0...27648) 0V = End underdrive region (-6912) two's complement
0Dh	Voltage 0...10V Siemens S7-format	0...11.76V 11.76V = End overdrive region (32511) 0...10V = nominal range (0...27648) no underdrive region available
0Bh	Current $\pm 20mA$ Siemens S7-format	$\pm 23.52mA$ 23.52mA = End overdrive region (32511) -20...20mA = nominal range (-27648...27648) -23.52mA = End underdrive region (-32512) two's complement
0Ch	Current 4...20mA Siemens S7-format	0...22.81mA 22.81mA = End overdrive region (32511) 4...20mA = nominal range (0...27648) 0mA = End underdrive region (-6912) two's complement
0Eh	Current 0...20mA Siemens S7-format	0...23.52mA 23.52mA = End overdrive region (32511) 0...20mA = nominal range (0...27648) no underdrive region available
FFh	Channel not active (turned off)	

**Note!**

When exceeding the predefined range, 0V res. 0A is shown as value!

Analog part - Alarm and diagnostic

Diagnostic functions

As soon as you've activated the diagnostic alarm release in the parameterization, the following events can release a diagnostic alarm:

- Wire break
- Parameterization error
- Measuring range overflow
- Measuring range underflow

At accumulated diagnostic the CPU interrupts the user application and branches to the OB82 for diagnostic (incoming). This OB allows you with an according programming to monitor detailed diagnostic information via the SFCs 51 and 59 and to react to it. After the execution of the OB82 the user application processing is continued. The diagnostic data is consistent until leaving the OB82.

After error correction automatically a diagnostic (going) occurs if the diagnostic alarm release is still active.

In the following the record sets for diagnostic (incoming) and diagnostic (going) are specified:

Record set 0 Diagnostic (incoming)

Record set 0 (Byte 0 to 3:)

Byte	Bit 7 ... 0	Default
0	Bit 0: Module malfunction Bit 1: reserved Bit 2: External error Bit 3: Channel error present Bit 4: external supply voltage is missing Bit 5,6: reserved Bit 7: Wrong parameters in the module	00h
1	Bit 3 ... 0: Module class 0101 Analog module Bit 4: Channel information present Bit 7 ... 5: reserved	15h
2	reserved	00h
3	reserved	00h

Record set 0 Diagnostic (going)

After error correction automatically a diagnostic (going) occurs if the diagnostic alarm release is still active.

Record set 0 (Byte 0 to 3:)

Byte	Bit 7 ... 0	Default
0	00h (fix)	00h
1	Bit 3 ... 0: Module class 0101 Analog module Bit 4: Channel information present Bit 7 ... 5: reserved	15h
2	reserved	00h
3	reserved	00h

Record set 1
Addition diagnostic
(incoming)

The record set 1 contains the 4Byte of record set 0 and additional 8Byte module specific diagnostic data.

The diagnostic bytes have the following assignment:

Record set 1 (Byte 0 to 11):

Byte	Bit 7 ... 0	Default
0 ... 3	Content record set 0 (see page before)	-
4	Bit 6 ... 0: Channel type 70h: Digital input 71h: Analog input 72h: Digital output 73h: Analog output 74h: Analog in-/output Bit 7: reserved	74h
5	Number of diagnostic bits per channel	04h
6	Number of identical channels of a module	06h
7	Bit 0: Channel error Channel 0 Bit 1: Channel error Channel 1 Bit 2: Channel error Channel 2 Bit 3: Channel error Channel 3 Bit 4: Channel error Channel 4 Bit 5: Channel error Channel 5 Bit 7 ... 6: reserved	00h
8	Bit 0: Wire break Channel 0 Bit 1: Parameterization error Channel 0 Bit 2: Measuring range underflow Channel 0 Bit 3: Measuring range overflow Channel 0 Bit 4: Wire break Channel 1 Bit 5: Parameterization error Channel 1 Bit 6: Measuring range underflow Channel 1 Bit 7: Measuring range overflow Channel 1	00h
9	Bit 0: Wire break Channel 2 Bit 1: Parameterization error Channel 2 Bit 2: Measuring range underflow Channel 2 Bit 3: Measuring range overflow Channel 2 Bit 4: Wire break Channel 3 Bit 5: Parameterization error Channel 3 Bit 6: Measuring range underflow Channel 3 Bit 7: Measuring range overflow Channel 3	00h
10	Bit 0: Wire break at current output res. short circuit at voltage output Channel 4 Bit 1: Parameterization error Channel 4 Bit 2,3: reserved Bit 4: Wire break at current output res. short circuit at voltage output Channel 5 Bit 5: Parameterization error Channel 5 Bit 6,7: reserved	00h
11	reserved	00h

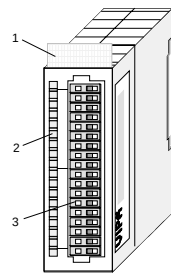
Digital part

Properties

The digital input part accepts binary control signals from the process and provides an electrically isolated interface to the central bus system. It has 16 channels that indicate the respective status by means of LEDs. Additionally, the first 12 inputs may control 3 counter.

- 16 inputs, isolated from the backplane bus
whereof 4 inputs are switchable as outputs
- 3 configurable counter (continuously, once and periodically)
parameterizable via the first 12 inputs / 3 counter outputs
- Status indicator for each channel by means of an LED

Construction



[1] Label for module description

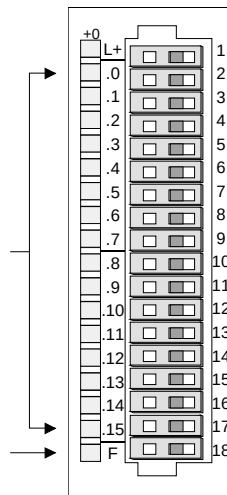
[2] LED status indicator

[3] Edge connector

Status indicator

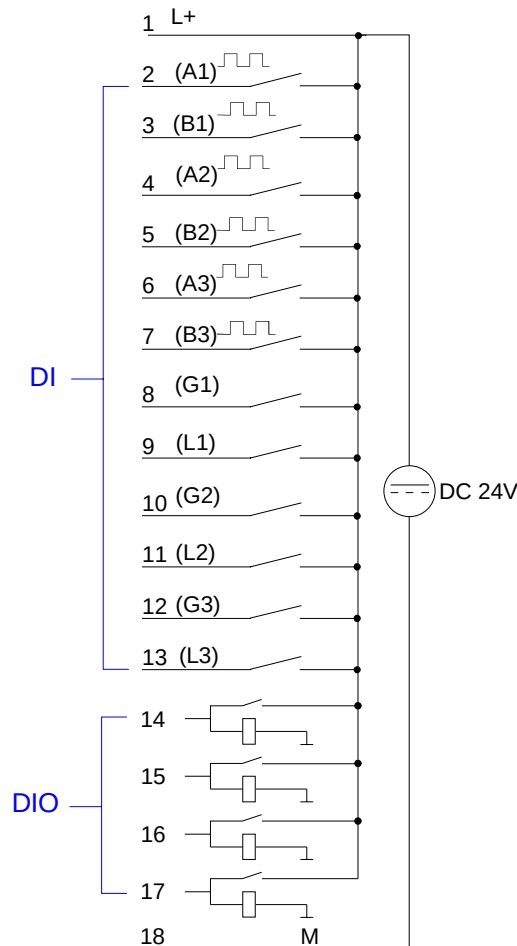
Pin assignment

LED	Description	Pin	Assignment	
			Counter activated	Counter deactivated
L+	LED (green) Supply voltage available	1	Power supply DC 24V	
.0...15	LEDs (green) I.0 up to I.15 when the input signal is "1" or the output is active the respective LED is turned on	2	Input Counter (A1)	I.0 (Byte 3.0)
		3	Input Counter (B1)	I.1 (Byte 3.1)
		4	Input Counter (A2)	I.2 (Byte 7.0)
		5	Input Counter (B2)	I.3 (Byte 7.1)
		6	Input Counter (A3)	I.4 (Byte 11.0)
		7	Input Counter (B3)	I.5 (Byte 11.1)
		8	Input I.6: Byte 12.0: Gate 1	
		9	Input I.7: Byte 12.4: Latch 1	
		10	Input I.8: Byte 12.1: Gate 2	
		11	Input I.9: Byte 12.5: Latch 2	
		12	Input I.10: Byte 12.2: Gate 3	
		13	Input I.11: Byte 12.6: Latch 3	
		14	I/Q.12 Counter out 1 (Byte 12.0) / Input (Byte 15.0)	
		15	I/Q.13 Counter out 2 (Byte 12.1) / Input (Byte 15.1)	
		16	I/Q.14 Counter out 3 (Byte 12.2) / Input (Byte 15.2)	
		17	I/Q.15 Output (Byte 12.3) / Input (Byte 15.3)	
F	LED (red) Overload, overheat or short circuit error	18	Ground	

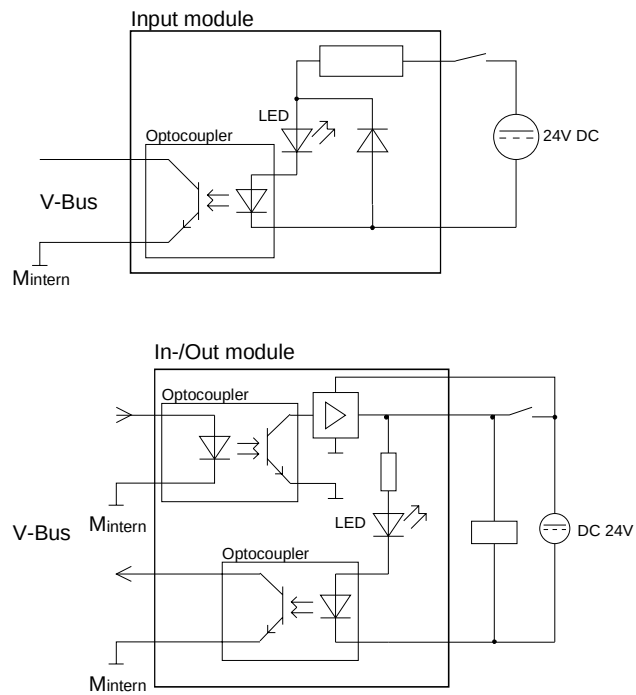


Wiring and
schematic
diagram

Wiring diagram



Schematic diagram



Digital part - Counter - Fast introduction

Include GSD

The combination module can only be used together with a CPU 21x or with the DP-V1 Profibus coupler (253-xDP01)! The project engineering takes place in the Siemens SIMATIC manager. For this the import of the corresponding GSD file is required which can be found at "service" on ftp.vipa.de.

After installation of the GSD file the combination module can be found at the hardware catalog at:

Additional Field devices > I/O > VIPA_System_200V > ...

as 2 modules:

238-2BC00 (1/2) AI4/AO2*12Bit

238-2BC00 (2/2) Counter

Please take care that you always configure both module parts in the sequence shown above

The combination module has 3 parameterizable integrated counter that are controlled via the input channels. During the counter process, the counter signal is registered and evaluated. Operating mode and additional functions are set via the parameterization.

Counter preset and parameterization

By placing both module parts within hardware configuration the counter parameters can be set with the "238-2BC00 (2/2) Counter" properties.

The digital part has to be provided with 60Byte *parameter* data. Here you define among others:

- Alarm behavior
- Assignment I/O
- Counter operating mode res. behavior
- Start value for load value, end value and comparison value register

You may alter the parameters during runtime by using the SFC 55, 56, 57 and 58, except of the parameters in record set 0. Here you have to send the wanted parameters to the counter by means of the user application using the according SFC and sending the data as record set.

Control counter by commands

The controlling of the counters happens by the output image. Here the respective counter can be controlled by commands and the software gate can be (re-)set.

After transmitting a command, the respective counter confirms the successful processing of the command by setting the corresponding handshake bit. To enable the respective counter to accept a new command, you have to transmit the command 00h to the counter. After writing the command 00h, the handshake bit assigned to this counter will be reset. The counter is released for a new command.

Counter start/stop The counter is controlled via the internal gate (I-gate). The I-gate is the result of logic operation of hardware- (HW) and Software-gate (SW), where the HW-gate evaluation may be deactivated via the parameterization.

HW-gate: Input at Gate_x-input at module

SW-gate: Open (activate): Output image Byte 12, set Bit 4 ... 6 depending on counter

Close (deactivate): Output image Byte 12, reset Bit 4 ... 6 depending on counter

The following states influence the gates:

SW-gate	HW-gate	influences I-gate
0	0	0
1	0	0
0	1	0
1	1	1
0	deactivated	0
1	deactivated	1

Access to counter values via input image

The module sends back a 16Byte input image that is mapped into the memory area of the CPU. Here the current values and states of the counter can be found among others.

Counter inputs (connections)

For every counter, the following inputs are available:

Pulse/A (A_x)

Pulse input for counter signal res. line A of an encoder. Here you may connect encoders with 1-, 2- or 4-thread evaluation.

Direction/B (B_x)

Here you connect the direction signal res. line B of the encoder.

You may invert the direction signal by parameterization.

Latch (L_x)

A positive edge at the digital input „Latch“ stores the recent internal counter value.

HW Gate (G_x)

You start the counter via the digital input „Hardware gate“.

Counter output

Every counter has an assigned output channel. You may set the following behavior for the according output channel via the parameterization:

- No comparison: Output is not called
- Counter value $\geq$ comparison value: Output is set
- Counter value $\leq$ comparison value: Output is set
- Pulse at comparison value: Set output for a configurable pulse duration

Digital part - Counter - Project engineering

Overview

By including the appropriate GSD into your hardware configurator the module is available via the hardware catalog.

Please take care that you always configure both module parts in the sequence:

238-2BC00 (1/2) AI4/AO2*12Bit

238-2BC00 (2/2) Counter

You may employ a max. of 2 combination modules at one system!

Parameterization

The parameterization happens in the hardware configurator. Here 60Byte parameter data are transferred:

Byte	Record set	Description
0 ... 2	0	Basic parameter (Alarm behavior, assignment I/O)
3 ... 21	81h (129)	Counter parameter counter 1
22 ... 40	82h (130)	Counter parameter counter 2
41 ... 59	83h (131)	Counter parameter counter 3

By using SFC 55, 56 and 57 you may alter the parameterization in the module during runtime. On this occasion 60Byte parameter data are stored at record set 0, 81h, 82h and 83h.

Basic parameter Record set 0

The basic parameters allow you to control the alarm behavior of the digital part and the assignment of the I/O channels that can be accessed by the according counter as output.

Byte	Description
0	Alarm generation 0 = no 1 = yes
1	Alarm selection 00h = None 01h = Diagnostics 02h = Process alarm 03h = Diagnostics- und Process alarm
2	Assignment of the in-/output channels. Here you define the assignment of the 4 I/O channels. If an I/O channel is used as input, you may output the status of the input via Byte 15 of the input image. For the operation as output, a detailed definition of the control is required in the parameter section of the according counter. Bit 0: 0 = Input I.12 1 = Output Q.12 / Counter output Q.12 Bit 1: 0 = Input I.13 1 = Output Q.13 / Counter output Q.13 Bit 2: 0 = Input I.14 1 = Output Q.14 / Counter output Q.14 Bit 3: 0 = Input I.15 1 = Output Q.15

Counter parameter The parameters for the counter 1 (C1) to 3 (C3) consist of 3 identical
Record set 81h : C1 parameter groups with each a size of 19Byte.
Record set 82h : C2 For every counter you may set a function and start data.
Record set 83h : C3

Byte	Description
0	Function 00h = counting continuously 01h = once without main counting direction 02h = once with main counting direction up 03h = once with main counting direction down 04h = periodically without main counting direction 05h = periodically with main counting direction up 06h = periodically with main counting direction down 07h = counter off If the counter is deactivated, the further parameters of this counter are ignored and the according I/O channel is set as "normal" output if you want to use this channel as output. At the main counting direction "up" the counter counts from the load value to the parameterized end value in positive direction and jumps then back again to the load value with the next following encoder pulse. At the main counting direction "down" the counter counts from the load value to the parameterized end value in negative direction and jumps then back again to the load value with the next following encoder pulse.
1	Signal evaluation Bit 1...0: 00b = Impulse/Direction (Impulse at A1 / Direction at B1) 01b = Rotary encoder single (at A1 and B1) 10b = Rotary encoder double (at A1 and B1) 11b = Rotary encoder quadruple (at A1 and B1) Counter direction inverted Bit 7: 0 = Off (Count direction at B1 not inverted) 1 = On (Count direction at B1 inverted)
2	Gate function (Behavior at interruption and gate restart) Bit 0: 0 = abort (counter process starts with load value) Bit 0: 1 = interrupt (counter process continues with counter value)
	HW gate (Hardware gate via input E.6) Bit 7: 0 = Off (Counter starts with set SW gate) 1 = On (Counter only starts with set HW and SW gate)
3	Behavior of the output 0 = no comparison (Output is not influenced by counter) 1 = if counter value $\geq$ comparison value, set output 2 = if counter value $\leq$ comparison value, set output 3 = gives a pulse to the output as soon as the comparison value has been reached. The pulse duration is configured via Byte 9.

continued ...

... continue

4	Hysteresis 0 = off 1 = off 2 ... 255: The hysteresis serves the avoidance of many toggle processes of the output and the alarm, if the counter value is in the range of the comparison value.
5	Pulse duration (Pulse duration for the output) 0 = Counter value = comparison value (without delay) 1 = 2ms 2 = 4ms ... 255 = 510ms Only even values are permitted.
6	Alarm masking Bit 0: 0 = deactivated 1 = Alarm at opening the HW gate
	Bit 1: 0 = deactivated 1 = Alarm at closing HW gate
	Bit 2: 0 = deactivated 1 = Alarm at over-/underrun
	Bit 3: 0 = deactivated 1 = Alarm at reaching comparison value
	Bit 4: 0 = deactivated 1 = Alarm at counter pulse loss
7 ... 10	Load value (Presetting a load value) Here you may load counter 1 with a value
11 ...14	End value (Presetting a end value) The end value for counter 1 is not relevant if there is no main counting direction defined (forwards or backwards).
15 ... 18	Compare value (Presetting a comparison value) The counter value is compared with the comparison value and depending on that the behavior of the according output of counter 1 is controlled.

**Attention!**

Please regard you have to store the record sets 81h, 82h and 83h within a data block starting with an **odd** address, otherwise you have shifts and incorrect double word accesses!

**Data to digital part
(output image)**

The digital part gets its data from the CPU in form of a 16Byte data block.
The data block has the following structure:

Byte	Description
0 ... 3	Value counter 1
4 ... 7	Value counter 2
8 ... 11	Value counter 3
12	Bit 0: Output Bit Q.12 / Release counter output 1 ¹⁾ Bit 1: Output Bit Q.13 / Release counter output 2 Bit 2: Output Bit Q.14 / Release counter output 3 Bit 3: Output Bit Q.15 Bit 4: Software Gate counter 1 Bit 5: Software Gate counter 2 Bit 6: Software Gate counter 3 Bit 7: not evaluated
13	Command for counter 1
14	Command for counter 2
15	Command for counter 3

¹⁾ The outputs may only be used as digital output if you parameterized them as "output" in the basic parameterization.

**Communication via
handshake bit**

After transmitting a command, the respective counter confirms the successful processing of the command by setting the corresponding handshake bit. To enable the respective counter to accept a new command, you have to transmit the command 00h to the counter. After writing the command 00h, the handshake bit assigned to this counter will be reset. The counter is released for a new command.

Command overview

The following commands are available:

Command	Function	Description
00h	Reset command handshake	Release for a new command (must precede each command)
A0h	Set counter value	By means of these commands, a value set under "Value counter ..." is transferred to the according register of a counter.
A1h	Set load value	
A2h	Set comparison value	
A3h	Set end value	
A4h	Set latch value	
A5h	Set hysteresis value	
A6h	Set value of pulse duration	
A7h	reserved	These commands cause the counter to send back a certain register value in the input image of the corresponding counter.
80h	Counter value	
81h	Load value	
82h	Comparison value	
83h	End value	
84h	Latch (display latch value)	
85h	Hysteresis value	
86h	Pulse duration value	
87h	reserved	

Data from digital part (input image)

The module sends back a 16Byte input image that maps into the memory area of the CPU. The structure of input data depends on counter activation:

Byte	Counter activated	Counter deactivated
0 ... 3	Image counter 1	Byte 0 ... 2: 0 Byte 3: Bit 0: I.0 Bit 1: I.1
4 ... 7	Image counter 2	Byte 4 ... 6: 0 Byte 7: Bit 0: I.2 Bit 1: I.3
8 ... 11	Image counter 3	Byte 8 ... 10: 0 Byte 11: Bit 0: I.4 Bit 1: I.5
12	Gate/Latch Bit 0: Input I.6: Status input HW gate counter 1 Bit 1: Input I.8: Status input HW gate counter 2 Bit 2: Input I.10: Status input HW gate counter 3 Bit 3: 0 (fix) Bit 4: Input I.7: Status input Latch 1 Bit 5: Input I.9: Status input Latch 2 Bit 6: Input I.11: Status input Latch 3 Bit 7: 0 (fix)	
13	Internal gate / last counter direction If the counter operating mode is set to "off", these Bits are "0". Bit 0: Status internal gate 1 Bit 1: Status internal gate 2 Bit 2: Status internal gate 3 Bit 3: 0 (fix) Bit 4: 0= counter direction counter 1 down 1= counter direction counter 1 up Bit 5: 0= counter direction counter 2 down 1= counter direction counter 2 up Bit 6: 0= counter direction counter 3 down 1= counter direction counter 3 up Bit 7: 0 (fix)	0
14	Status of the counter outputs/command handshake Bit 0: Status internal counter output counter 1 Bit 1: Status internal counter output counter 2 Bit 2: Status internal counter output counter 3 Bit 3: 0 (fix) Bit 4: Status command handshake counter 1 Bit 5: Status command handshake counter 2 Bit 6: Status command handshake counter 3 Bit 7: 0 (fix)	0
15	Status inputs If the channel is set as output, the according Bit is "0" Bit 0: Status input I.12 Bit 1: Status input I.13 Bit 2: Status input I.14 Bit 3: Status input I.15 Bit 7 ... 4: 0 (fix)	

Digital part - Counter - Functions

Operating modes	The combination module has 3 parameterizable integrated counter that are controlled via the input channels. During the counter process, the counter signal is registered and evaluated. Operating mode and additional functions are set via the parameterization. For the counter, the following operating modes are available: • Count endless – Distance measuring with incremental encoder • Count once – Count to a maximum limit • Count periodic– Count with repeated counter process The operating modes "Count once" and "Count periodic" allow you to transfer the counter area as start res. end value via the parameterization. Each counter is parameterizable with additional functions like gate function, latch function, comparison, hysteresis an process alarm.
Counter inputs (connections)	For every counter, the following inputs are available: <i>Pulse/A (A_x)</i> Pulse input for counter signal res. line A of an encoder. Here you may connect encoders with 1-, 2- or 4-thread evaluation. <i>Direction/B (B_x)</i> Here you connect the direction signal res. line B of the encoder. You may invert the direction signal by parameterization. <i>Latch (L_x)</i> A positive edge at the digital input „Latch“ stores the recent internal counter value. <i>HW Gate (G_x)</i> You start the counter via the digital input „Hardware gate“.
Counter output	Every counter has an assigned output channel. You may set the following behavior for the according output channel via the parameterization: • No comparison: Output is not called • Counter value $\geq$ comparison value: Output is set • Counter value $\leq$ comparison value: Output is set • Pulse at comparison value: Set output for a configurable pulse duration

Maximum counter frequency

At the designation of maximum counter frequency, two types of indication are distinguished:

- Maximum pulse frequency

The maximum pulse frequency is the maximum frequency the adjacent signal may have, i.e. the maximum frequency at which the pulses arrive at the module. At this module the maximum pulse frequency depends on the counter-signal-evaluation chosen.

Signal evaluation	Maximum pulse frequency
single	30kHz
duplicate	15kHz
quaduplicate	7.5kHz

- Maximum counter frequency

The maximum counter frequency is the frequency at which can be internally counted to the maximum.

At employment of all 3 counters, every counter may use a frequency of max. 30kHz. If you employ only 1 counter channel, the counter supports a max. frequency of 100kHz.

Main counting direction

The parameterization allows you to define a main counting direction for every counter.

If you choose "none", the complete counting range is available:

	Valid value range
Lower count limit	- 2 147 483 648 (-2^{31})
Upper count limit	+ 2 147 483 647 ($2^{31}-1$)

Main counting direction forward

Upper restriction of the count range. The counter counts 0 res. load value in positive direction until the parameterized end value -1 and jumps then back to the load value with the next following encoder pulse.

Main counting direction backwards

Lower restriction of the count range. The counter counts from the parameterized start- res. load value in negative direction to the parameterized end value $+1$ and jumps then back to the start value with the next following encoder pulse.

Abort - interrupt*Abort count process*

The count process starts after closing and restart of the gate beginning with the load value.

Interrupt count process

The count process continuous after closing and restart of the gate beginning with the last recent counter value.

Digital part - Counter - Operating modes

Overview

For the counter, the following operating modes are available separate configurable:

- Count endless – Distance measuring with incremental encoder
- Count once – Count to a maximum limit
- Count periodic– Count with repeated counter process

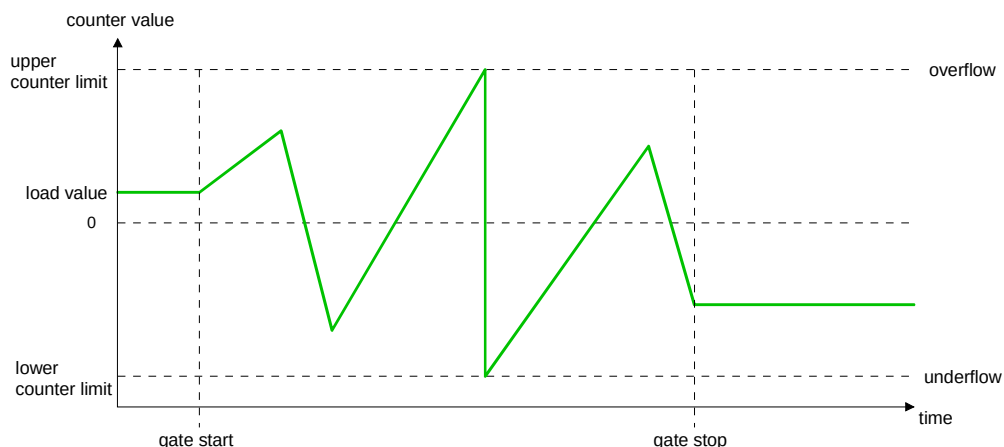
Continuously

In this operating mode, the counter counts from 0 res. from the load value. When the counter counts forward and reaches the upper count limit and another counting pulse in positive direction arrives, it jumps to the lower count limit and counts from there on.

When the counter counts backwards and reaches the lower count limit and another counting pulse in negative direction arrives, it jumps to the upper count limit and counts from there on.

The count limits are set to the maximum count range.

	Valid value range
Lower count limit	- 2 147 483 648 (-2^{31})
Upper count limit	+ 2 147 483 647 ($2^{31}-1$)
Counter value	- 2 147 483 648 (-2^{31}) to + 2 147 483 647 ($2^{31}-1$)
Load value	- 2 147 483 647 ($-2^{31}+1$) to + 2 147 483 646 ($2^{31}-2$)



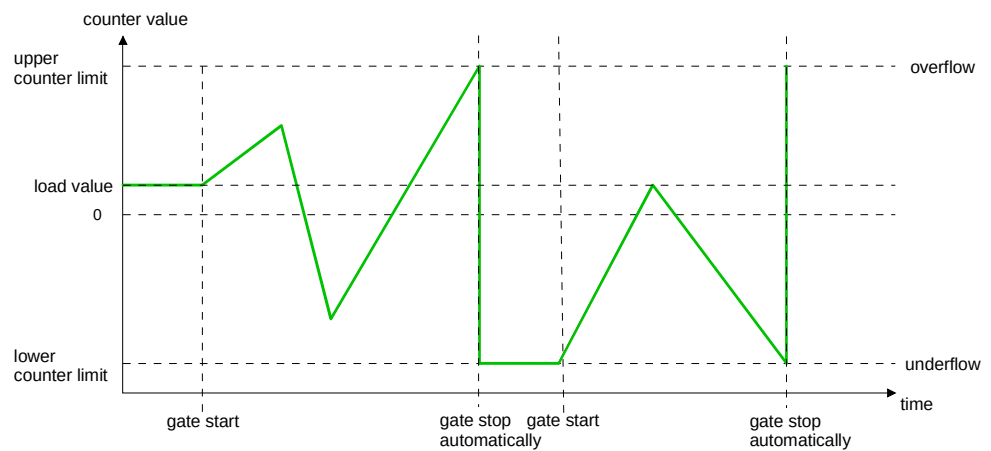
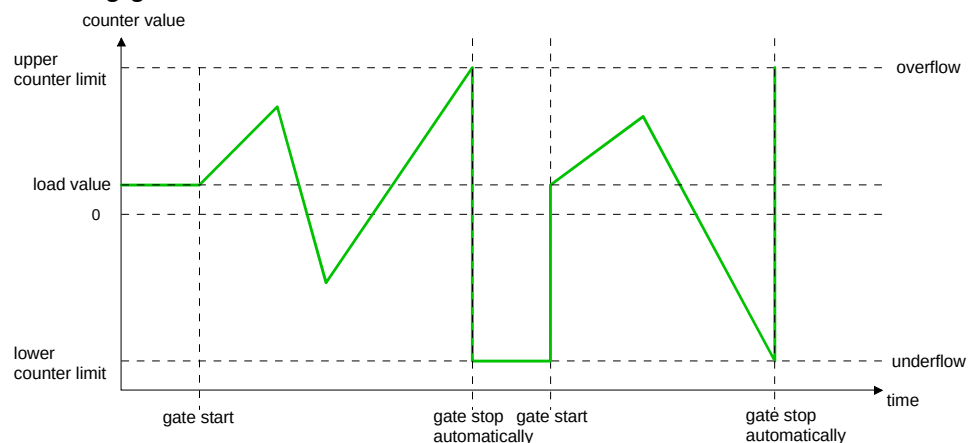
Note!

When counting continuously the parameter *main counting direction* is ignored!

Once*No main counting direction*

- The counter counts once starting with the load value.
- You may count forward and backwards.
- The count limits are set to the maximum count range.
- At over- or underrun at the count limits, the counter jumps to the according other count limit and counts from there on. The gate is automatically closed.
- To restart the count process, you must create a positive edge of the gate.
- At interrupting gate control, the count process continuous with the last recent counter value.
- At aborting gate control, the counter starts with the load value.

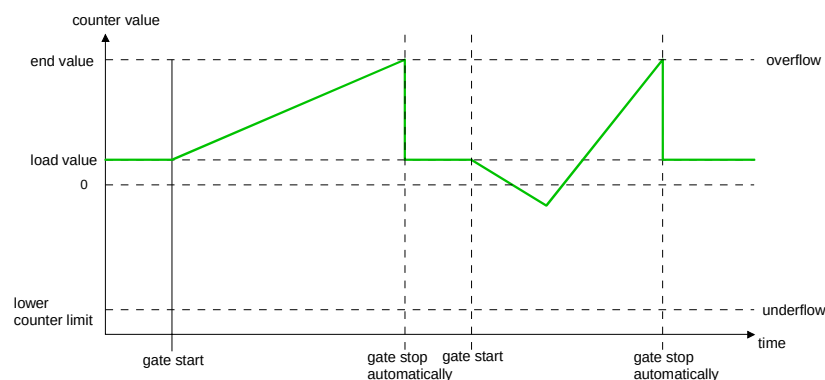
	Valid value range
Lower count limit	- 2 147 483 648 (-2^{31})
Upper count limit	+ 2 147 483 647 ($2^{31}-1$)
Counter value	- 2 147 483 648 (-2^{31}) to + 2 147 483 647 ($2^{31}-1$)
Load value	- 2 147 483 647 ($-2^{31}+1$) to + 2 147 483 646 ($2^{31}-2$)

Interrupting gate control:*Aborting gate control:*

Main counting direction forward

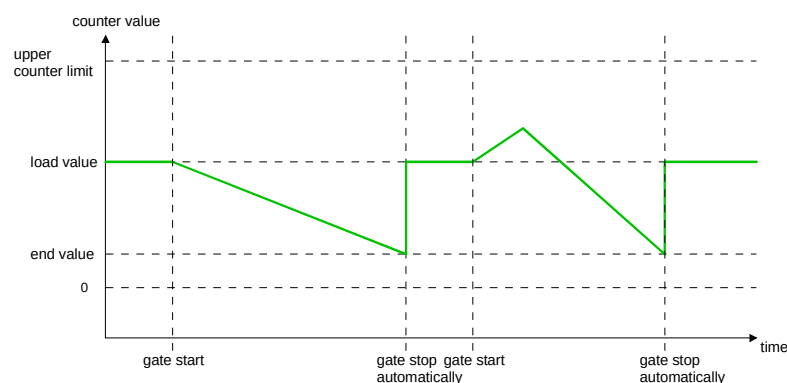
- The counter counts starting with the load value.
- When the counter reaches the end value -1 in positive direction, it jumps to the load value at the next positive count pulse and the gate is automatically closed.
- To restart the count process, you must create a positive edge of the gate. The counter starts with the load value.

	Valid value range
End value	$-2\,147\,483\,646 (-2^{31}+1)$ to $+2\,147\,483\,646 (2^{31}-1)$
Lower count limit	$-2\,147\,483\,648 (-2^{31})$
Counter value	$-2\,147\,483\,648 (-2^{31})$ to end value -1
Load value	$-2\,147\,483\,648 (-2^{31})$ to end value -2

*Main counting direction backwards*

- The counter counts starting with the load value.
- When the counter reaches the end value in negative direction, it jumps to the load value at the next negative count pulse and the gate is automatically closed.
- To restart the count process, you must create a positive edge of the gate. The counter starts with the load value.

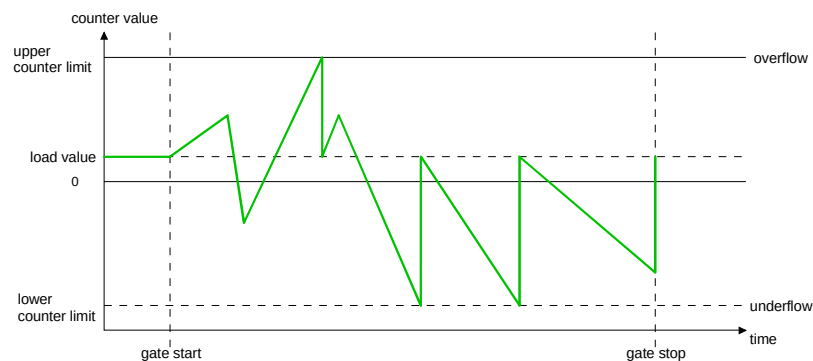
	Valid value range
End value	$-2\,147\,483\,646 (-2^{31}+1)$ to $+2\,147\,483\,646 (2^{31}-1)$
Upper count limit	$+2\,147\,483\,646 (2^{31}-1)$
Counter value	$-2\,147\,483\,646 (-2^{31}+1)$ to $+2\,147\,483\,646 (2^{31}-1)$
Load value	$-2\,147\,483\,646 (-2^{31}+1)$ to $+2\,147\,483\,646 (-2^{31}-1)$



Periodically*No main counting direction:*

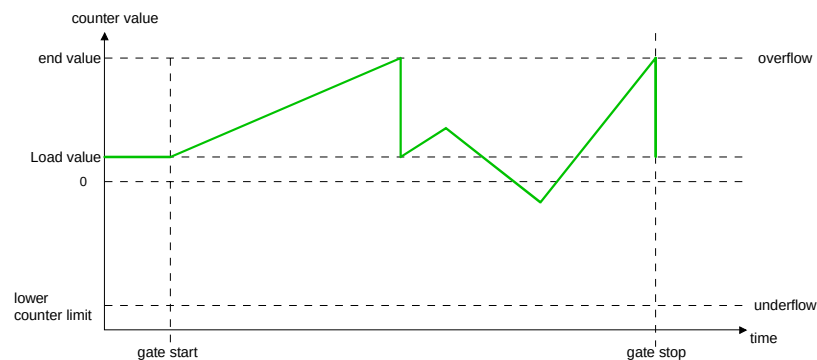
- The counter counts starting with the load value.
- At over- or underrun at the count limits, the counter jumps to the according other count limit and counts from there on.
- The count limits are set to the maximum count range.

	Valid value range
Lower count limit	$-2\,147\,483\,648 (-2^{31})$
Upper count limit	$+2\,147\,483\,647 (2^{31}-1)$
Counter value	$-2\,147\,483\,648 (-2^{31})$ to $+2\,147\,483\,647 (2^{31}-1)$
Load value	$-2\,147\,483\,647 (-2^{31}+1)$ to $+2\,147\,483\,646 (2^{31}-2)$

*Main counting direction forward*

- The counter counts starting with the load value.
- When the counter reaches the end value -1 in positive direction, it jumps to the load value at the next positive count pulse.

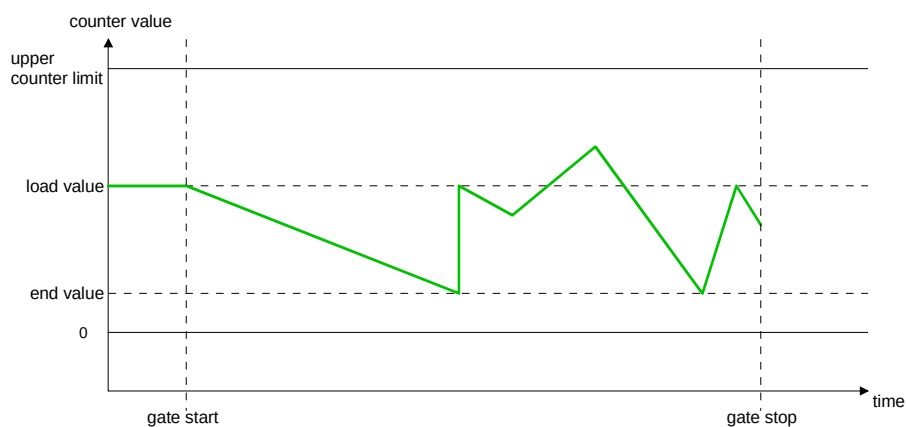
	Valid value range
Limit value	$-2\,147\,483\,647 (-2^{31}+1)$ to $+2\,147\,483\,647 (2^{31}-1)$
Lower count limit	$-2\,147\,483\,648 (-2^{31})$
Counter value	$-2\,147\,483\,648 (-2^{31})$ to end value -1
Load value	$-2\,147\,483\,648 (-2^{31})$ to end value -2



Main counting direction backwards

- The counter counts starting with the load value.
- When the counter reaches the end value in negative direction, it jumps to the load value at the next negative count pulse.
- You may exceed the upper count limit.

	Valid value range
Limit value	- 2 147 483 647 ($-2^{31}+1$) to + 2 147 483 647 ($2^{31}-1$)
Upper count limit	+2 147 483 647 ($2^{31}-1$)
Counter value	- 2 147 483 647 ($-2^{31}+1$) to +2 147 483 647 ($2^{31}-1$)
Load value	- 2 147 483 647 ($-2^{31}+1$) to +2 147 483 647 ($2^{31}-1$)



Digital part - Counter - Additional functions

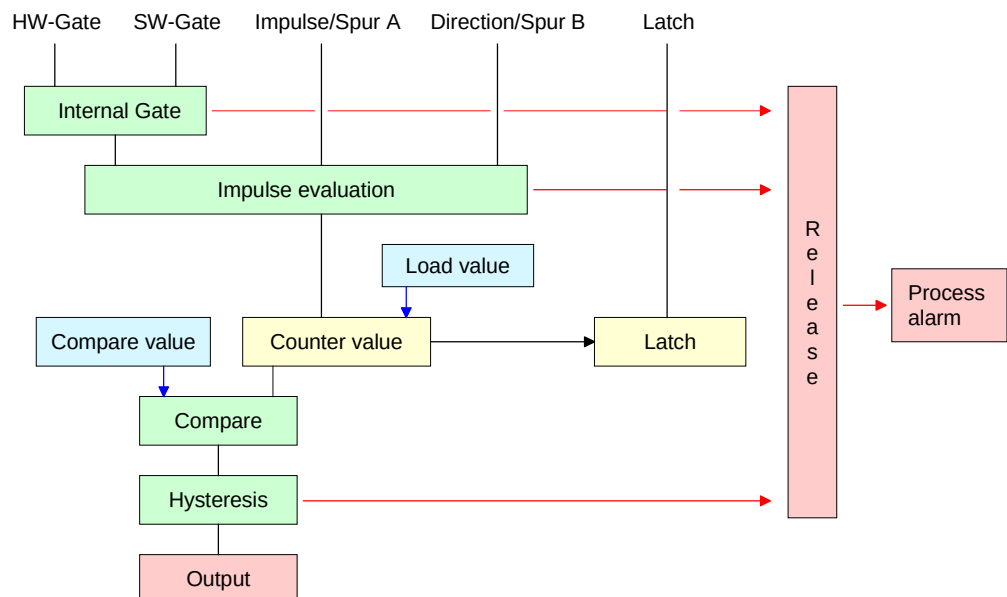
Overview

The additional functions listed in the following can be set for every counter via the parameterization:

- Gate function
The gate function serves the start, stop and interruption of a counter function
- Latch function
As soon as a positive edge is registered at the latch input, a recent counter value is stored in the latch register.
- Comparison
You may set a comparison value that activates a digital output res. throws a process alarm depending on the recent counter value.
- Hysteresis
By setting a hysteresis you may prevent a continuous toggling of an output if the value of an encoder signal fluctuates around a comparison value.
- Alarm
For the following events you may parameterize an alarm:
 - status change of the HW gate
 - Over- res. underrun
 - Reaching a comparison value
 - Loss of a counter pulse

Schematic structure

The illustration shows how the additional functions influence the counter behavior. The following pages give you a more detailed explanation of the additional functions:



Gate function

The counter is controlled via the internal gate (I-gate). The I-gate is the result of logic operation of hardware- (HW) and Software-gate (SW), where the HW-gate evaluation may be deactivated via the parameterization.

HW-gate: Input at Gate_x-input at module

SW-gate: Open (activate): Output image Byte 12, set Bit 4 ... 6 depending on counter

Close (deactivate): Output image Byte 12, reset Bit 4 ... 6 depending on counter

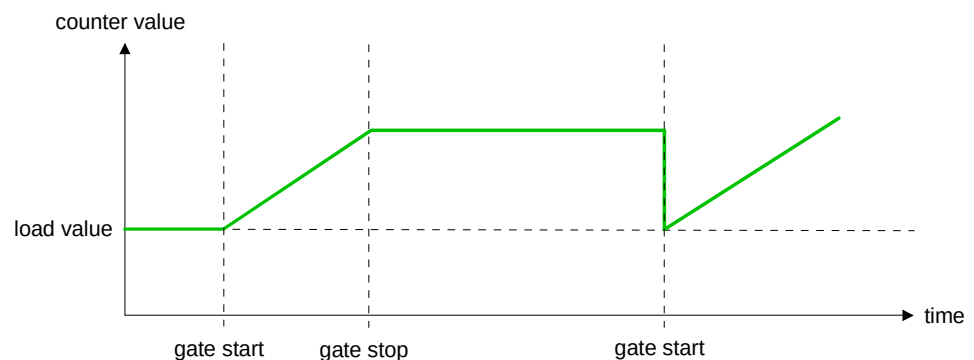
The following states influence the gates:

SW-gate	HW-gate	influences I-gate
0	0	0
1	0	0
0	1	0
1	1	1
0	deactivated	0
1	deactivated	1

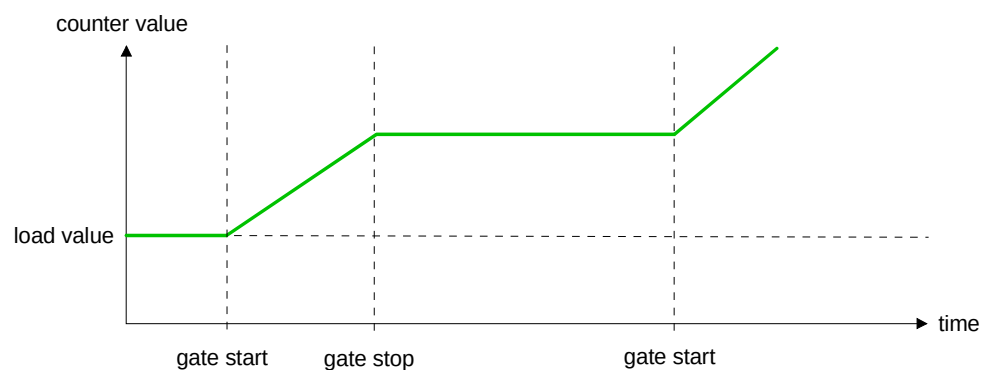
Gate function Abort and Interrupt

The parameterization defines if the gate interrupts or aborts the counter process.

- At *abort function* the counter starts counting with the load value after gate restart.



- At *interrupt function*, the counter starts counting with the last recent counter value after gate restart.



Latch function As soon as a positive edge at the "latch input" results from the counter process, a recent counter value is stored in the according latch register.
The "input image" gives you access to the latch register.

Compare function The parameterization presets the behavior of the counter output:

- No comparison
- Counter value $\geq$ comparison value
- Counter value $\leq$ comparison value
- Pulse at comparison value

No comparison

The output is set like a normal output.

Counter value $\geq$ comparison value

If the counter value is equal or higher than the comparison value, the output is set.

Counter value $\leq$ comparison value

If the counter value is smaller or equal than the comparison value, the output is set.

Pulse at comparison value

When the counter reaches the comparison value, the output is set active for the parameterized pulse duration.

If you've set a main counter direction, the output is only set off the main counter direction at reaching the comparison value.

Pulse duration

The pulse duration tells for what time the output is set. It can be preset in steps of 2ms between 0 and 510ms. Please regard that the counter pulse times must be higher than the minimum toggle times of the digital output.

If the pulse duration = 0, the output is set active until the comparison condition is not longer fulfilled.

The pulse duration starts with the setting of the according digital output. The inaccuracy of the pulse duration is smaller than 1ms.

There is no finish triggering of the pulse duration if the comparison value is not met for a short time during a pulse output.

Hysteresis

The hysteresis serves the avoidance of many toggle processes of the output and the alarm, if the counter value is in the range of the comparison value.

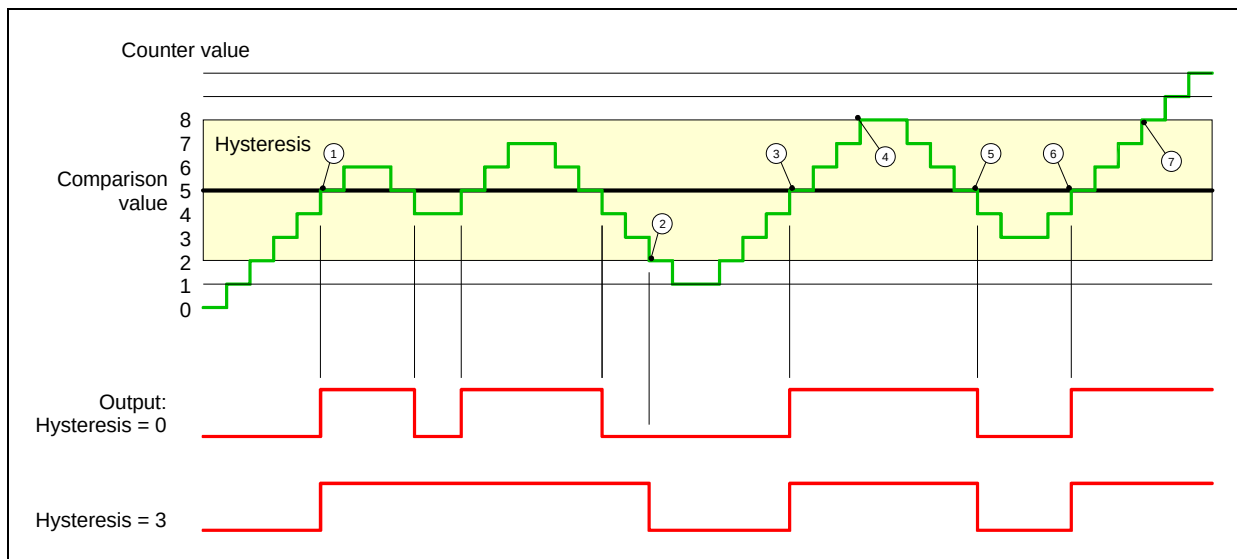
You may set a range of 0 to 255. The settings 0 and 1 deactivate the hysteresis. The hysteresis also influences the over- and underflow.

An activated hysteresis remains active after a change. The new hysteresis range is taken over at the next reach of the comparison value.

The view below shows the action of the at hysteresis 0 and 3

In the following illustration the behavior of the output is represented with hysteresis 0 and hysteresis 3 for the appropriate conditions:

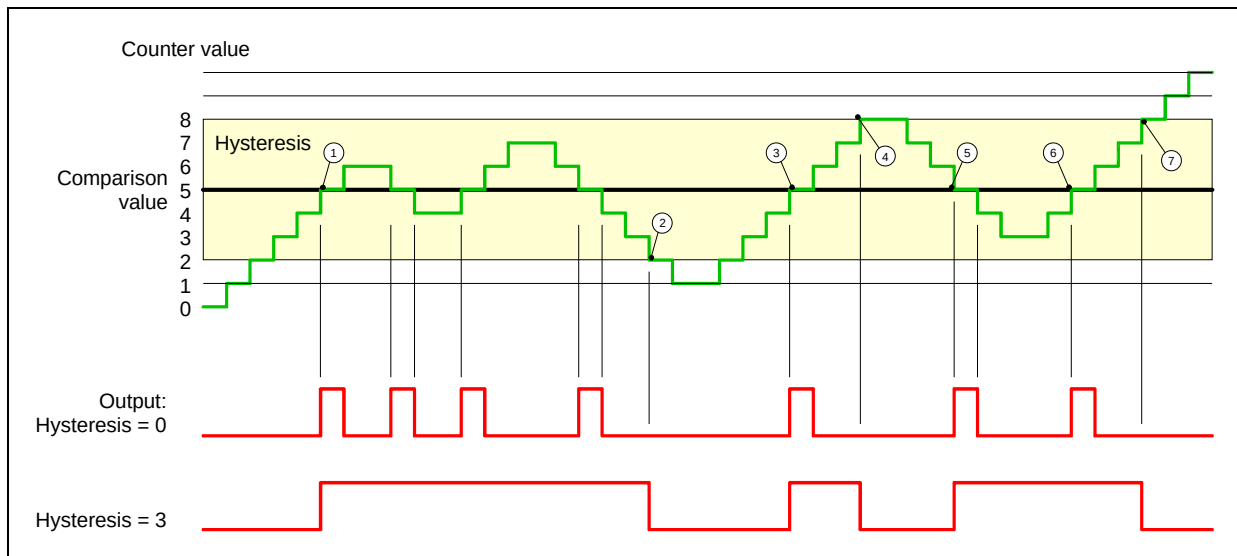
Action when Counter value $\geq$ Comparison value



- ① Counter value $\geq$ Comparison value $\rightarrow$ Output is set and hysteresis is activated
- ② Leaving the hysteresis area $\rightarrow$ Output is reset
- ③ Counter value $\geq$ Comparison value $\rightarrow$ Output is set and hysteresis is activated
- ④ Leaving the hysteresis area, output is just set as Counter value $\geq$ Comparison value
- ⑤ Counter value $<$ Comparison value and hysteresis not activated $\rightarrow$ Output is reset
- ⑥ Counter value $\geq$ Comparison value $\rightarrow$ Output is set and hysteresis is activated
- ⑦ Leaving the hysteresis area, output is just set as Counter value $\geq$ Comparison value

As reaching the comparison condition the hysteresis is activated. The comparison result is as static as the counter value leaves the parameterized hysteresis area.

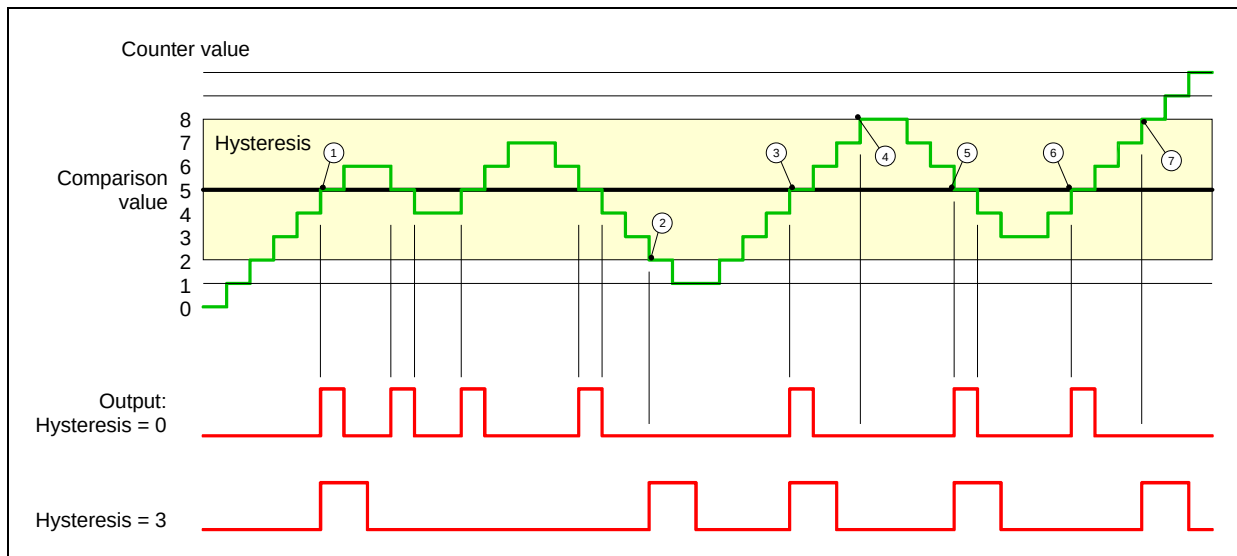
After leaving the hysteresis area only again with reaching comparison condition the hysteresis is activated.

Action at pulse at comparison value and Pulse width equal to zero

- ① Counter value = Comparison value → Output is set and hysteresis is activated
- ② Leaving the hysteresis area → Output is reset
- ③ Counter value = Comparison value → Output is set and hysteresis is activated
- ④ Counter value > Comparison value and leaving the hysteresis area so output is reset
- ⑤ Counter value = Comparison value → Output is set and hysteresis is activated
- ⑥ Counter value = Comparison value and hysteresis is just activated → Output is static set
- ⑦ Leaving the hysteresis area and Counter value > Comparison value → Output is reset

As reaching the comparison condition the hysteresis is activated. The comparison result is as static as the counter value leaves the parameterized hysteresis area.

After leaving the hysteresis area only again with reaching comparison condition the hysteresis is activated.

Action at pulse at comparison value and Pulse width not equal to zero

- ① Counter value = Comparison value → Hysteresis is switched active, a pulse of the specified length is output and the counting direction is stored
- ② Leaving the hysteresis area against the stored counter direction → A pulse of the specified length is output and the hysteresis deactivated
- ③ Counter value = Comparison value → Hysteresis is switched active, a pulse of the specified length is output and the counting direction is stored
- ④ Leaving Hysteresis area without changing counting direction → Hysteresis is deactivated
- ⑤ Counter value = Comparison value → Hysteresis is switched active, a pulse of the specified length is output and the counting direction is stored
- ⑥ Counter value = Comparison value and hysteresis is activated → no pulse
- ⑦ Leaving the hysteresis area against the stored counting direction → A pulse of the specified length is output and the hysteresis deactivated

As reaching the comparison condition the hysteresis is activated and a pulse of the specified length is output. As long as the counter value is within the hysteresis area no further pulse is output. With hysteresis activation the counting direction is stored by the PLC.

If the counter value leaves the hysteresis area against the stored counting direction, an impulse of the of the specified length is output. When leaving the hysteresis area without change of counter direction there is no pulse output.

Digital part - Counter - Alarm and diagnostic

Overview

The parameterization allows you to define the following trigger for a process alarm:

- Status change of the HW gate
- Over- / Underflow
- Reaching a comparison value
- Loss of a counter pulse

You may globally activate a diagnostic alarm for all channels. A diagnostic alarm occurs as soon as at processing a process alarm a process alarm is initialized in OB40 for the same channel and the same event.

Process alarm

A process alarm causes the call of OB40. Within the OB40 you may search the logical basic address of the module that threw the process alarm by using the *local word 6*.

The *local word 8* allows you to access the data that the module provides in case of an alarm. The *local word 8* has the following structure:

Local word	Bit
8	4...0: Alarm data Channel 0 Bit 0: HW gate open Bit 1: HW gate closed Bit 2: Overflow Bit 3: Comparison value reached Bit 4: Pulse lost 9...5: Alarm data Channel 1 Bit 5: HW gate open Bit 6: HW gate closed Bit 7: Overflow Bit 8: Comparison value reached Bit 9: Pulse lost 14...10: Alarm data Channel 2 Bit 10: HW gate open Bit 11: HW gate closed Bit 12: Overflow Bit 13: Comparison value reached Bit 14: Pulse lost 15: reserved

Release diagnostic alarm

During a process alarm is processed by the PLC in OB40 a diagnostic alarm can be released (if activated) by the same event at the same channel.

This interrupts the current process alarm execution in OB40 and branches to OB82 for processing the diagnostic alarm (incoming). If during the diagnostic alarm execution further events at other channels occur that may also initialize a process res. diagnostic alarm, these are temporarily stored.

After finishing the current diagnostic alarm execution, the sum diagnostic message "process alarm lost" informs the CPU that in the meantime other process alarms has occurred.

Diagnostic alarm

As soon as you've activated the diagnostic alarm a diagnostic alarm occurs during the processing a process alarm in OB40 for the same channel and the same event.

At accumulated diagnostic the CPU interrupts the user application and branches to the OB82 for diagnostic (incoming). This OB allows you with an according programming to monitor detailed diagnostic information via the SFCs 51 and 59 and to react to it.

After the execution of the OB82 the user application processing is continued. The diagnostic data is consistent until leaving the OB82.

After error correction automatically a diagnostic (going) occurs if the diagnostic alarm release is still active.

In the following the record sets for diagnostic (incoming) and diagnostic (going) are specified:

Record set 0
Diagnostic (incoming)

Record set 0 (Byte 0 to 3):

Byte	Bit 7 ... 0	Default
0	Bit 0: Module malfunction Bit 1: internal error Bit 2: reserved Bit 3: channel error present Bit 7 ... 4: reserved	00h
1	Bit 3 ... 0: Module class 1000: Function module Bit 4: Channel information present Bit 7 ... 5: reserved	18h
2	00h (fix)	00h
3	Bit 5 ... 0: reserved Bit 6: process alarm lost Bit 7: reserved	00h

Record set 0
Diagnostic (going)

After error correction automatically a diagnostic (going) occurs if the diagnostic alarm release is still active.

Record set 0 (Byte 0 to 3):

Byte	Bit 7 ... 0	Default
0	00h (fix)	00h
1	Bit 3 ... 0: Module class 1000: Function module Bit 4: Channel information present Bit 7 ... 5: reserved	18h
2	00h (fix)	00h
3	00h (fix)	00h

Record set 1
Extended diagnostic
(incoming)

Byte 0 to 11:

The record set 1 contains the 4Byte of the record set 0 and additionally 8Byte of module specific diagnostic data.

Record set 1 (Byte 0 to 11):

Byte	Bit 7 ... 0	Default
0 ... 3	Content record set 0 (see page before)	-
4	Bit 6 ... 0: Channel type 76h: Counter Bit 7: reserved	76h
5	Number of diagnostic bits per channel	08h
6	Number of similar channels (Counter)	03h
7	Bit 0: Channel error channel 0 Bit 1: Channel error channel 1 Bit 2: Channel error channel 2 Bit 7 ... 3: reserved	00h
8	Error screen channel 0 Bit 0: HW gate open Bit 1: HW gate closed Bit 2: Overflow Bit 3: Comparison value reached Bit 4: Pulse lost Bit 7 ... 5: reserved	00h
9	Error screen channel 1 Bit 0: HW gate open Bit 1: HW gate closed Bit 2: Overflow Bit 3: Comparison value reached Bit 4: Pulse lost Bit 7 ... 5: reserved	00h
10	Error screen channel 2 Bit 0: HW gate open Bit 1: HW gate closed Bit 2: Overflow Bit 3: Comparison value reached Bit 4: Pulse lost Bit 7 ... 5: reserved	00h
11	reserved	00h

Technical Data

General

Dimensions and weight	238-2BC00
Current consumption via back plane bus	280mA
Dimensions (WxHxD) in mm	50.8x76x88mm
Weight	100g

Analog In-/Output

Electrical Data	VIPA 238-2BC00 (1/2) AI4/AO2*12Bit							
Number of Current-/Voltage input	3							
Number of resistance input	1							
Number of outputs	2							
Length of cable: shielded	200m							
Voltages, Currents, Potentials								
Supply voltage	DC 24V (20.4 ... 28.8V)							
- reverse polarity protection	yes							
Constant current for resistance-type sensor	1.25mA							
Isolation								
- channels / backplane bus	yes							
- channel / power supply of the electronic	yes							
- between the channels	no							
Permitted potential difference								
- between the inputs (U_{CM})	DC 4V							
- between the inputs and $M_{INTERNAL}$ (U_{ISO})	DC 75V/AC 60V							
Isolation tested with	DC 500V							
Current consumption								
- from the power supply L+	60mA (no load)							
Power dissipation of the module	2W							
Analog value calculation input	Conversion time/Resolution (per channel)							
Measuring principle	Sigma-Delta							
Parameterizable	Yes							
Conversion rate (Hz)	200	170	120	60	30	15	7.5	3.7
Integration time (ms)	5	6	8	17	33	67	133	270
Basic conversion time (ms)	7	8	10	19	35	69	135	272
Resolution (Bit) incl. overrange	10	12	14	15	16	16	16	16
Noise suppression for frequency f1 (Hz)	no					50 and 60Hz		
Basic execution time of the module, in ms (all channels enabled)	28	32	40	76	140	276	540	1088
Smoothing of the measured values	none							
Analog value calculation output channels								
Resolution (incl. overrange)								
±10V, ±20mA	11Bit + sign							
4 ... 20mA, 1 ... 5V	10Bit							
0 ... 10V, 0 ... 20mA	11Bit							
Conversion time (per channel)	1.5ms							
Settling time								
impedance load	0.3ms							
capacitive load	1.0ms							
inductive load	0.5ms							

continued ...

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Suppression of interference, limits of error input channels		
Noise suppression for f=n x (f1 ±1%) (f1=interference frequency, n=1,2,...)		
Common-mode interference (U _{CM} < 5V)	> 80dB	
Series-mode noise (peak value of noise < nominal value of input range)	> 80dB	
Crosstalk between the inputs	> 50dB	
Operational limit (only valid to 120W/s) (in the entire temperature range, referring to input range)		
	Measuring range	Tolerance
voltage input	±400mV, ±4V, ±10V	±0.3%
	1 ... 5V	±0.7%
	0 ... 10V	±0.4%
current input	±20mA	±0.3%
	0 ... 20mA	±0.6%
	4 ... 20mA	±0.8%
Resistors	0 ... 600Ω, 0 ... 3kΩ	±0.4%
Resistance thermometer	Pt100, Pt1000	±0.4%
	Ni100, Ni1000	±1.0%
Basic error limit (only valid to 120W/s) (during temperature is 25°C, referring to input range)		
	Measuring range	Tolerance
Voltage input	400mV, ±4V, ±10V	±0.2%
	1 .. 5V	±0.5%
	0 ... 10V	±0.3%
Current input	±20mA	±0.2%
	0 ... 20mA	±0.4%
	4 ... 20mA	±0.5%
Resistors	0 ...600Ω, 0 ... 3kΩ	±0.2%
Resistance thermometer	Pt100, Pt1000	±0.2%
	Ni100, Ni1000	±0.5%
Temperature error (with reference to the input range) measuring current		±0.005%/K ±0.015%/K
Linearity error (with reference to the input range)		±0.02%
Repeatability (in steady state at 25°C referred to the input range)		±0.05%
Suppression of interference, limits of error output channels		
Crosstalk between the outputs	> 40dB	
Operational limit (in the entire temperature range, referring to output range)		
	Measuring range	Tolerance
Voltage output	±10V	±0.4% ¹⁾
	0 ... 10V	±0.6% ¹⁾
	1 ... 5V	±0.8% ¹⁾
Current output	±20mA	±0.3% ²⁾
	0 ... 20mA	±0.6% ²⁾
	4 ... 20mA	±0.8% ²⁾

continued ...

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Basic error limit (during temperature is 25°C, referring to output range)		
Voltage output	Measuring range	Tolerance
	1 ... 5V	±0.4% ¹⁾
	0 ... 10V	±0.3% ¹⁾
Current output	±10V	±0.2% ¹⁾
	±20mA	±0.2% ²⁾
	0 ... 20mA	±0.4% ²⁾
	4 ... 20mA	±0.5% ²⁾
Temperature error (with reference to the output range)	±0.01%/K	
Linearity error (with reference to the output range)	±0.05%	
Repeatability (in steady state at 25°C referred to the output range)	±0.05%	
Output ripple; range 0 to 50kHz (referred to output range)	±0.05%	
States, Alarms, Diagnostic		
Diagnostic alarm	parameterizable	
Diagnostic functions		
- Sum error monitor	red LED (SF)	
- Diagnostic information readable	possible	
Substitute value can be applied	yes	
Data for choosing an encoder		
Voltage input		
±400mV	10MΩ	
±4V, ±10V, 1 ... 5V, 0 ... 10V	120kΩ	
Current input		
±20mA, 0 ... 20mA, 4 ... 20mA	33Ω	
Resistors		
0...600Ω, 0...3kΩ	10MΩ	
Resistance thermometer		
Pt100, Pt1000, Ni100, Ni1000	10MΩ	
Maximum input voltage for voltage input (destruction limit)	25V	
Maximum input current for current input (destruction limit)	30mA	
Connection of the sensor		
For measuring voltage	yes	
For measuring current		
as 2wire transmitter	possible with external power supply	
as 4wire transmitter	yes	
For measuring resistance		
with 2conductor connection	yes	
Characteristic linearization for RTD	Pt100, Pt1000, Ni100, Ni1000	

continued ...

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Data for choosing an actuator	
Output ranges (rated values) Voltage Current	$\pm 10V$, 1 ... 5V, 0 ... 10V $\pm 20mA$, 0 ... 20mA, 4 ... 20mA
Load resistance (in nominal range of the output) At voltage outputs - capacitive load At current output - Inductive load	min. 1k Ω max. 1 μF max. 500 Ω max. 10mH
Voltage outputs Short-circuit protection Short-circuit current	yes max. 31mA
Current outputs No-load voltage	max. 13V
Destruction limit against voltages/currents applied from outside Voltage at outputs to M _{ANA} Current	max. 15V max. 30mA
Connection of actuators for voltage output for current output	2conductor connection 2conductor connection
Parameter data	
Input data Output data Parameter data Diagnostic data	8Byte (1 Word per channel) 4Byte (1 Word per channel) 16Byte 12Byte

¹⁾ The error limits are measured with a load of R=1G Ω . For voltage output the output impedance is 50 Ω .

²⁾ The error limits are measured with a load of R=10 Ω .

Digital Input

Elektrical Data	VIPA 238-2BC00 (2/2) Counter
Number of inputs Counter Nominal input voltage Signal voltage "0" Signal voltage "1" Input filter time delay Input filter pulse input Maximum counter frequency Input current Supply voltage Isolation Status monitor	16 3 (2 inputs each A, B) DC 24V (20.4 ... 28.8V) 0 ... 5V 15 ... 28.8V 3ms 100 μs 30kHz typ. 7mA 5V via backplane bus 500Veff (field voltage - backplane bus) via LEDs at the front side
Parameter data	
Input data Output data Parameter data Diagnostic data	16Byte 16Byte 60Byte 12Byte

