

VIPA System SLIO

FM | 050-1BA00 | Manual

HB300 | FM | 050-1BA00 | GB | 14-36

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1 General

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1.2 About this manual

Objective and contents

This manual describes the FM 050-1BA00 of the System SLIO from VIPA. It contains a description of the structure, project engineering and deployment.

This manual is part of the documentation package with order number VIPA HB300E_FM and relevant for:

Product	Order number	as of state:
		HW
FM 050	050-1BA00	01

Target audience

The manual is targeted at users who have a background in automation technology.

Structure of the manual

The manual consists of chapters. Every chapter provides a self-contained description of a specific topic.

Guide to the document

The following guides are available in the manual:

- An overall table of contents at the beginning of the manual
- References with page numbers

Availability

The manual is available in:

- printed form, on paper
- in electronic form as PDF-file (Adobe Acrobat Reader)

Icons Headings

Important passages in the text are highlighted by following icons and headings:

**DANGER!**

Immediate or likely danger. Personal injury is possible.

**CAUTION!**

Damages to property is likely if these warnings are not heeded.



Supplementary information and useful tips.

1.3 Safety information

Applications conforming with specifications

The system is constructed and produced for:

- communication and process control
- industrial applications
- operation within the environmental conditions specified in the technical data
- installation into a cubicle

**DANGER!**

This device is not certified for applications in
– in explosive environments (EX-zone)

Documentation

The manual must be available to all personnel in the

- project design department
- installation department
- commissioning
- operation

**CAUTION!**

The following conditions must be met before using or commissioning the components described in this manual:

- Hardware modifications to the process control system should only be carried out when the system has been disconnected from power!
- Installation and hardware modifications only by properly trained personnel.
- The national rules and regulations of the respective country must be satisfied (installation, safety, EMC ...)

Disposal

National rules and regulations apply to the disposal of the unit!

2 Basics and Assembly

2.1 Safety information for users

Handling of electrostatic sensitive modules

VIPA modules make use of highly integrated components in MOS-Technology. These components are extremely sensitive to over-voltages that can occur during electrostatic discharges. The following symbol is attached to modules that can be destroyed by electrostatic discharges.



The Symbol is located on the module, the module rack or on packing material and it indicates the presence of electrostatic sensitive equipment. It is possible that electrostatic sensitive equipment is destroyed by energies and voltages that are far less than the human threshold of perception. These voltages can occur where persons do not discharge themselves before handling electrostatic sensitive modules and they can damage components thereby, causing the module to become inoperable or unusable. Modules that have been damaged by electrostatic discharges can fail after a temperature change, mechanical shock or changes in the electrical load. Only the consequent implementation of protection devices and meticulous attention to the applicable rules and regulations for handling the respective equipment can prevent failures of electrostatic sensitive modules.

Shipping of modules

Modules must be shipped in the original packing material.

Measurements and alterations on electrostatic sensitive modules

When you are conducting measurements on electrostatic sensitive modules you should take the following precautions:

- Floating instruments must be discharged before use.
- Instruments must be grounded.

Modifying electrostatic sensitive modules you should only use soldering irons with grounded tips.



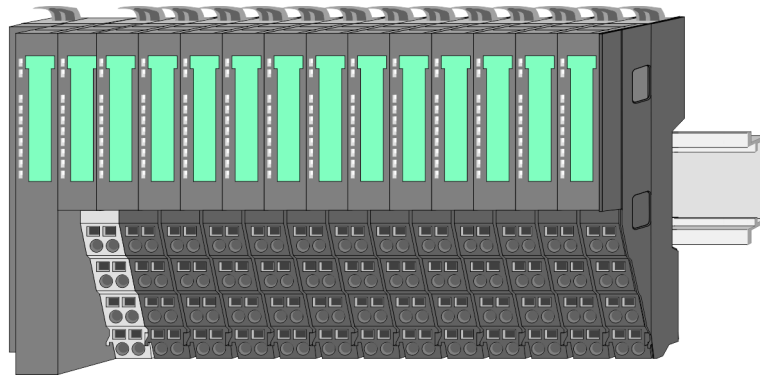
CAUTION!

Personnel and instruments should be grounded when working on electrostatic sensitive modules.

2.2 System conception

Overview

System SLIO is a modular automation system for assembly on a 35mm mounting rail. By means of the peripheral modules with 2, 4 or 8 channels this system may properly be adapted matching to your automation tasks. The wiring complexity is low, because the supply of the DC 24V power section is integrated to the backplane bus and defective modules may be replaced with standing wiring. By deployment of the power modules in contrasting colours within the system, further isolated areas may be defined for the DC 24V power section supply, respectively the electronic power supply may be extended with 2A.



Components

- CPU (head module)
- Bus coupler (head module)
- Periphery modules
- Power modules
- Accessories



CAUTION!

Only modules of VIPA may be combined. A mixed operation with third-party modules is not allowed!

CPU



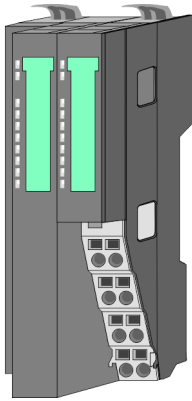
With a CPU, CPU electronic and power module are integrated to one casing. As head module via the integrated power module for power supply the CPU electronic is supplied as well as the electronic of the connected periphery modules. The DC 24 power section supply for the linked periphery modules is established via a further connection at the power module. By installing of up to 64 periphery modules at the CPU, these are electrically connected, this means these are assigned to the backplane bus, the electronic modules are power supplied and each periphery module is connected to the DC 24V power section supply.



CAUTION!

CPU part and power module of a CPU may not be separated! Here you may only exchange the electronic module!

Bus coupler



With a bus coupler bus interface and power module are integrated to one casing. With the bus interface you get access to a subordinated bus system. As head module via the integrated power module for power supply the bus interface is supplied as well as the electronic of the connected periphery modules. The DC 24 power section supply for the linked periphery modules is established via a further connection at the power module. By installing of up to 64 periphery modules at the bus coupler, these are electrically connected, this means these are assigned to the backplane bus, the electronic modules are power supplied and each periphery module is connected to the DC 24V power section supply.

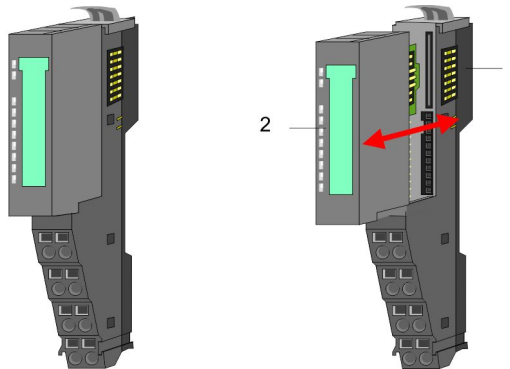


CAUTION!

Bus interface and power module of the bus coupler may not be separated! Here you may only exchange the electronic module!

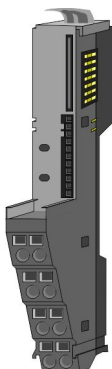
Periphery modules

Each periphery module consists of a *terminal* and an *electronic module*.



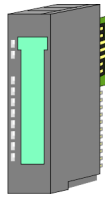
- 1 Terminal module
- 2 Electronic module

Terminal module



The *terminal module* serves to carry the electronic module, contains the backplane bus with power supply for the electronic, the DC 24V power section supply and the staircase-shaped terminal for wiring. Additionally the terminal module has a locking system for fixing at a mounting rail. By means of this locking system your SLIO system may be assembled outside of your switchgear cabinet to be later mounted there as whole system.

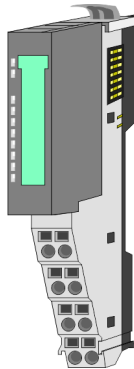
Electronic module



The functionality of a SLIO periphery module is defined by the *electronic module*, which is mounted to the terminal module by a safe sliding mechanism. With an error the defective module may be exchanged for a functional module with standing installation.

At the front side there are LEDs for status indication. For simple wiring each module shows a corresponding connection diagram at the front and at the side.

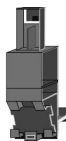
Power module



In the System SLIO the power supply is established by power modules. These are either integrated to the bus coupler or may be installed between the periphery modules. Depending on the power module isolated areas of the DC 24V power section supply may be defined respectively the electronic power supply may be extended with 2A. For better recognition the colour of the power modules are contrasting to the periphery modules.

Accessories

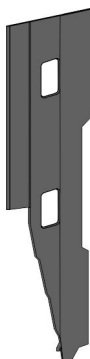
Shield bus carrier



The shield bus carrier (order no. 000-0AB00) serves to carry the shield bus (10mm x 3mm) to connect cable shields. Shield bus carriers, shield bus and shield fixings are not in the scope of delivery. They are only available as accessories.

The shield bus carrier is mounted underneath the terminal of the terminal module. With a flat mounting rail for adaption to a flat mounting rail you may remove the spacer of the shield bus carrier.

Bus cover



With each bus coupler, to protect the backplane bus connectors, there is a mounted bus cover in the scope of delivery. You have to remove the bus cover of the bus coupler before mounting a SLIO module. For the protection of the backplane bus connector you always have to mount the bus cover at the last module of your system again.

The bus cover has the order no. 000-0AA00.

Coding pins



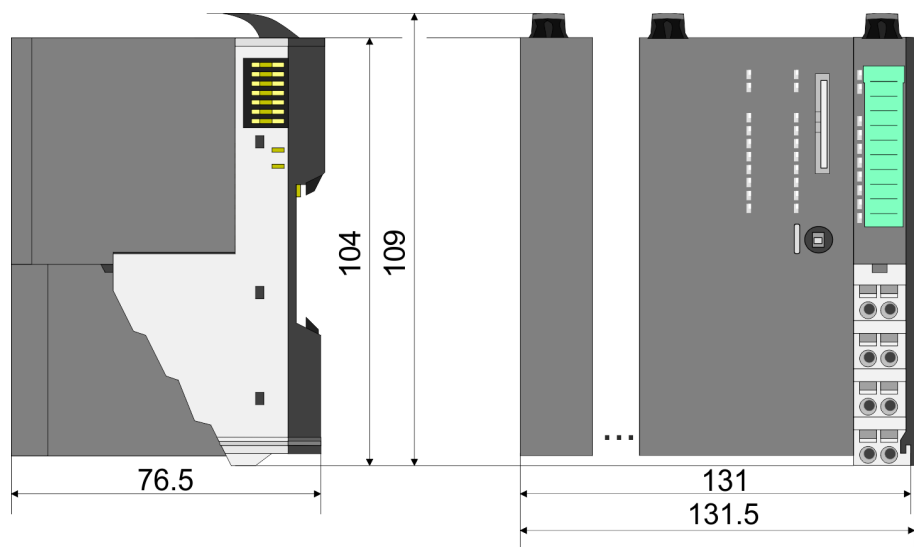
There is the possibility to fix the assignment of electronic and terminal module. Here coding pins (order number 000-0AC00) from VIPA can be used.

The coding pin consists of a coding jack and a coding plug. By combining electronic and terminal module with coding pin, the coding jack remains in the electronic module and the coding plug in the terminal module.

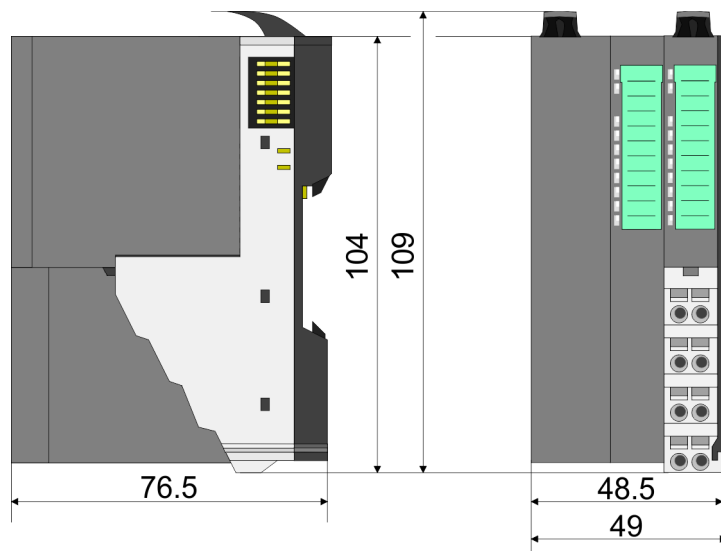
This ensures that after replacing the electronics module just another electronic module can be plugged with the same encoding.

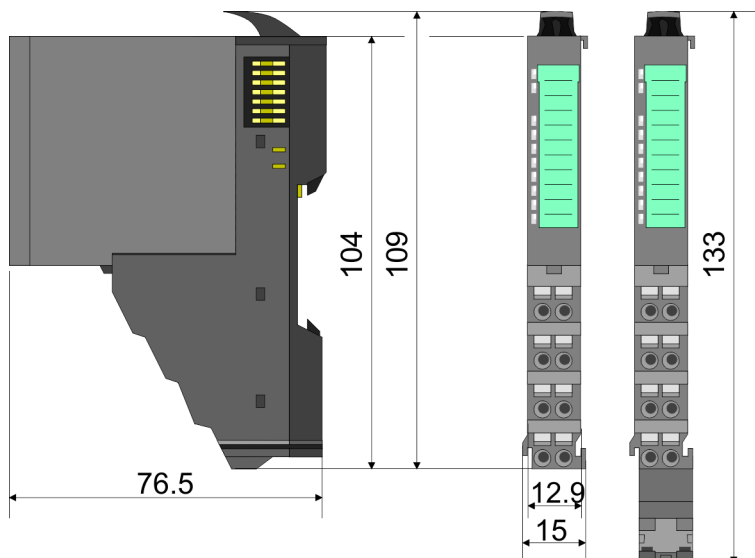
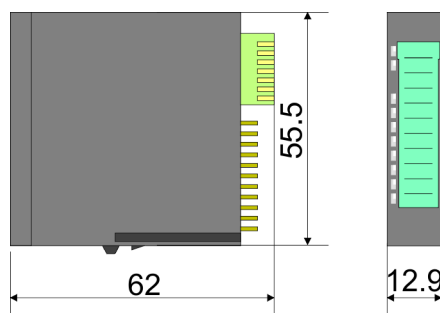
2.3 Dimensions

Dimensions CPU



Dimensions bus coupler

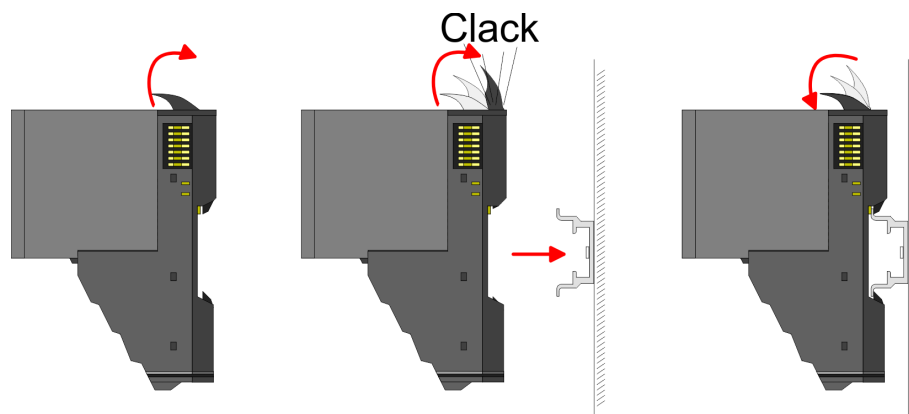


Dimensions periphery module**Dimensions electronic module**

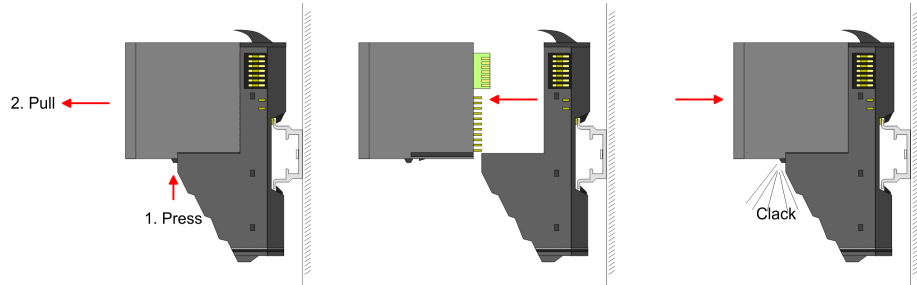
Dimensions in mm

2.4 Installation**Functional principle**

There is a locking lever at the top side of the terminal module. For mounting and demounting this locking lever is to be turned upwards until this engages audible. Now the module may be pulled forward. For mounting plug the module to the module installed before and push the module to the mounting rail guided by the strips at the upper and lower side of the module. The module is fixed to the mounting rail by pushing downward the locking lever. The modules may either separately be mounted to the mounting rail or as block. Here is to be considered that each locking lever is opened.



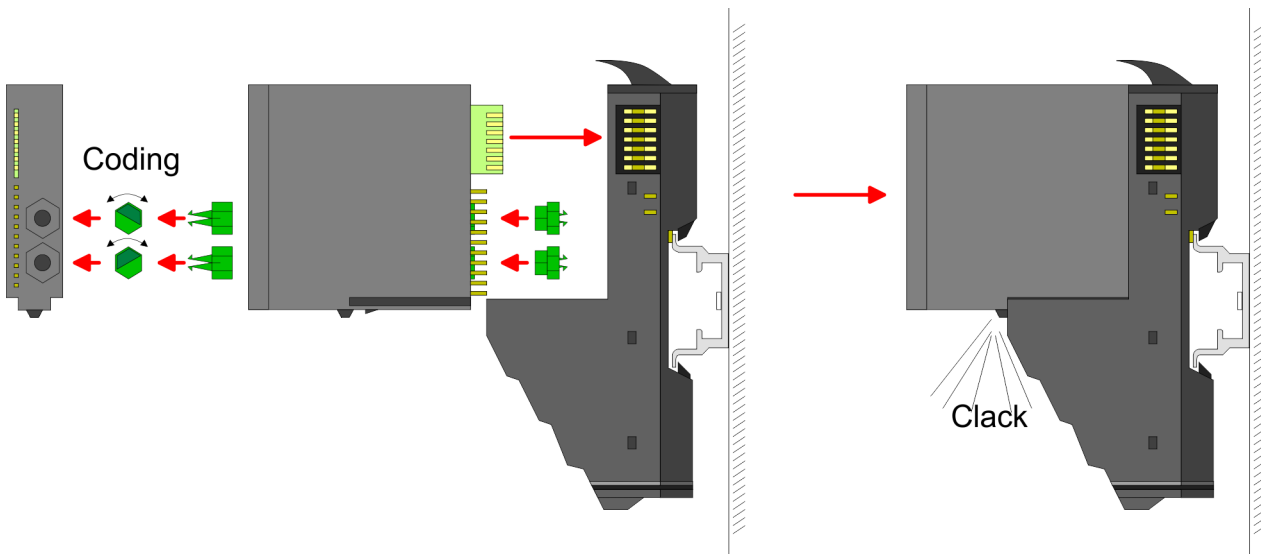
For the exchange of a electronic module, the electronic module may be pulled forward after pressing the unlocking lever at the lower side of the module. For installation plug the electronic module guided by the strips at the lower side until this engages audible to the terminal module.



Coding



There is the possibility to fix the assignment of electronic and terminal module. Here coding pins (order number 000-0AC00) from VIPA can be used. The coding pin consists of a coding jack and a coding plug. By combining electronic and terminal module with coding pin, the coding jack remains in the electronic module and the coding plug in the terminal module. This ensures that after replacing the electronics module just another electronic module can be plugged with the same encoding.



Each electronic module has on its back 2 coding sockets for coding jacks. Due to the characteristics, with the coding jack 6 different positions can be plugged, each. Thus there are 36 possible combinations for coding with the use of both coding sockets.

1. ► Plug, according to your coding, 2 coding jacks in the coding sockets of your electronic module until they lock.
2. ► Now plug the according coding plugs into the coding jacks.
3. ► To fix the coding put both the electronic and terminal module together until they lock.

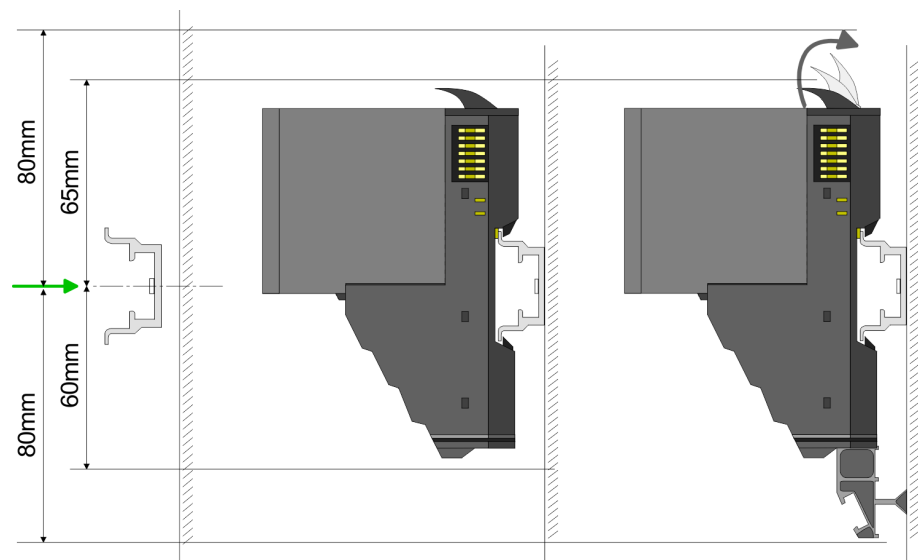
**CAUTION!**

Please consider that when replacing an already coded electronic module, this is always be replaced by an electronic module with the same coding.

Even with an existing coding on the terminal module, you can plug an electronic module without coding. The user is responsible for the correct usage of the coding pins. VIPA assumes no liability for incorrectly attached electronic modules or for damages which arise due to incorrect coding!

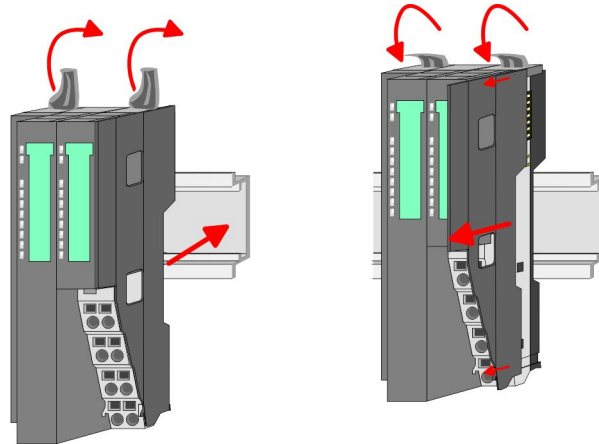
Mounting Proceeding

The modules were directly be mounted to the mounting rail and so connected to the backplane bus and the power supply for the electronic and power section. Up to 64 modules may be mounted. Please consider here that the sum current of the electronic power supply does not exceed the maximum value of 3A. By means of the power module 007-1AB10 the current of the electronic power supply may be expanded with 2A. ↪ *Chapter 2.6 'Wiring' on page 22*

Mounting rail

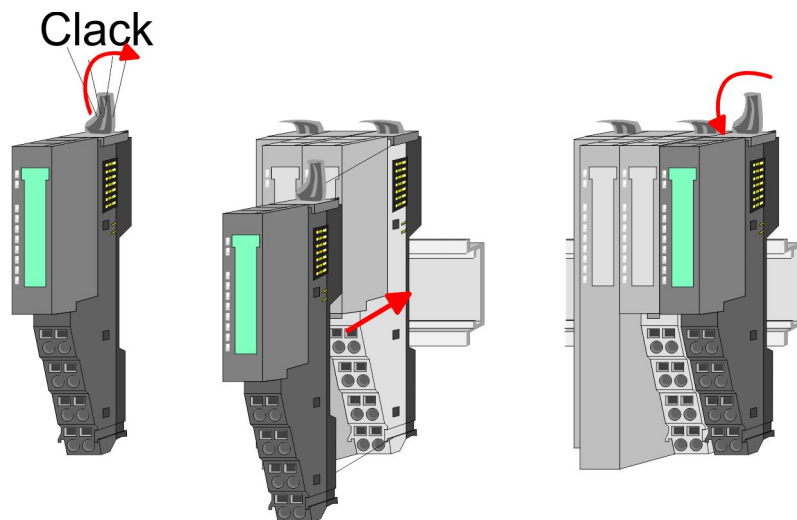
➔ Mount the mounting rail! Please consider that a clearance from the middle of the mounting rail of at least 80mm above and 60mm below, respectively 80mm by deployment of shield bus carriers, exist.

Mounting Head module (e.g. bus coupler)



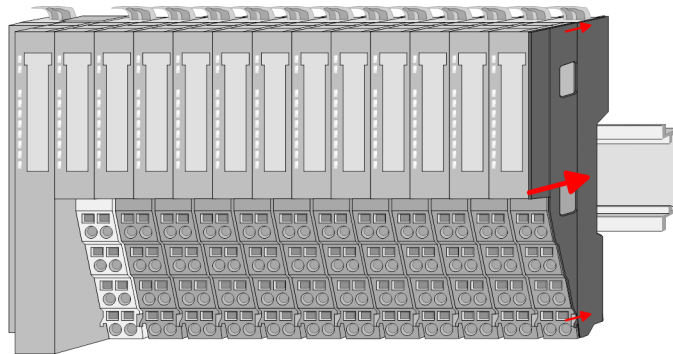
1. ➤ Start at the left side with the head module (e.g. bus coupler). For this turn both locking lever upwards, put the head module to the mounting rail and turn both locking lever downward.
2. ➤ Before mounting the periphery modules you have to remove the bus cover at the right side of the Head module by pulling it forward. Keep the cover for later mounting.

Mounting periphery modules



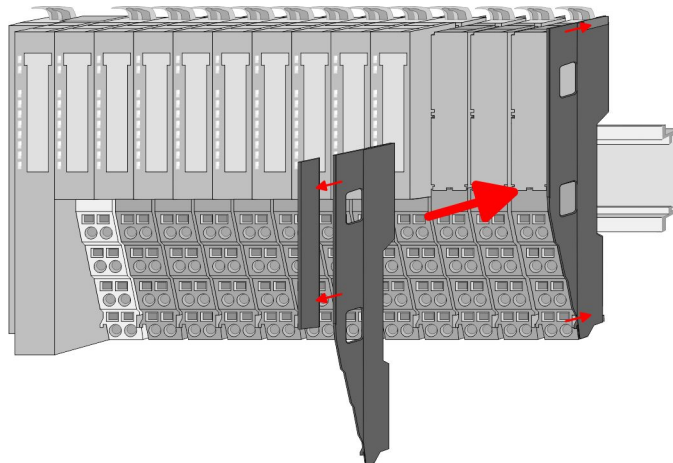
- Mount the periphery modules you want.

Mounting the bus cover



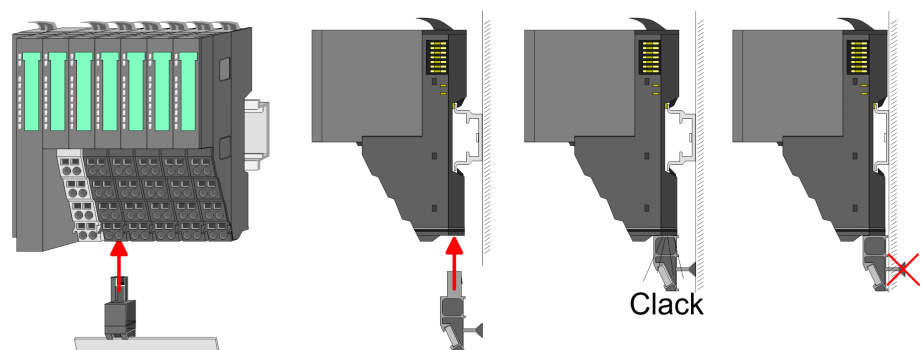
- ➔ After mounting the whole system, to protect the backplane bus connectors at the last module you have to mount the bus cover, now.

Mounting the bus cover at a clamp module



- ➔ If the last module is a clamp module, for adaptation the upper part of the bus cover is to be removed

Mounting shield bus carrier



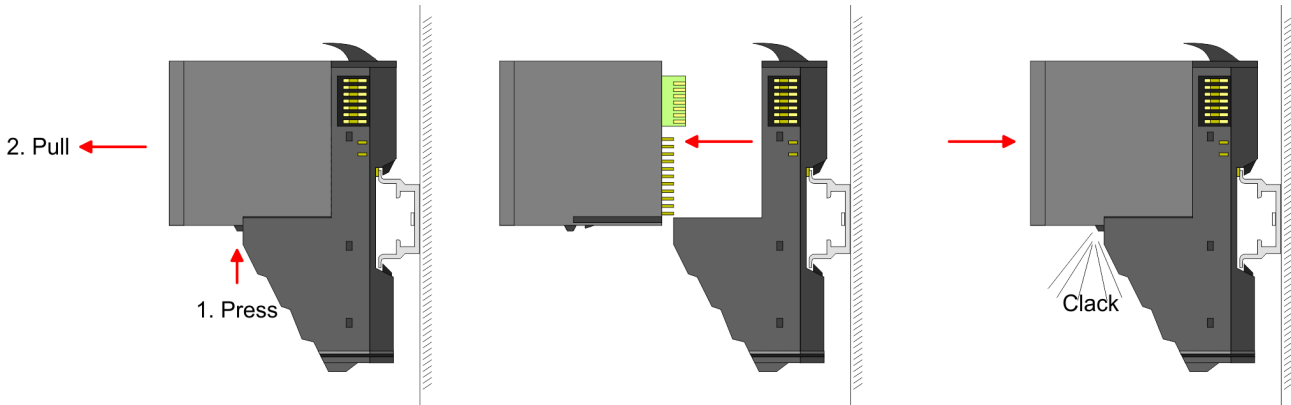
- ➔ The shield bus carrier (available as accessory) serves to carry the shield bus to connect cable shields. The shield bus carrier is mounted underneath the terminal of the terminal module. With a flat mounting rail for adaption to a flat mounting rail you may remove the spacer of the shield bus carrier.

2.5 Demounting and module exchange

Proceeding

With demounting and exchange of a module, head module (e.g. bus coupler) or a group of modules for mounting reasons you have always to remove the electronic module of the just mounted right module. After the mounting it may be plugged again.

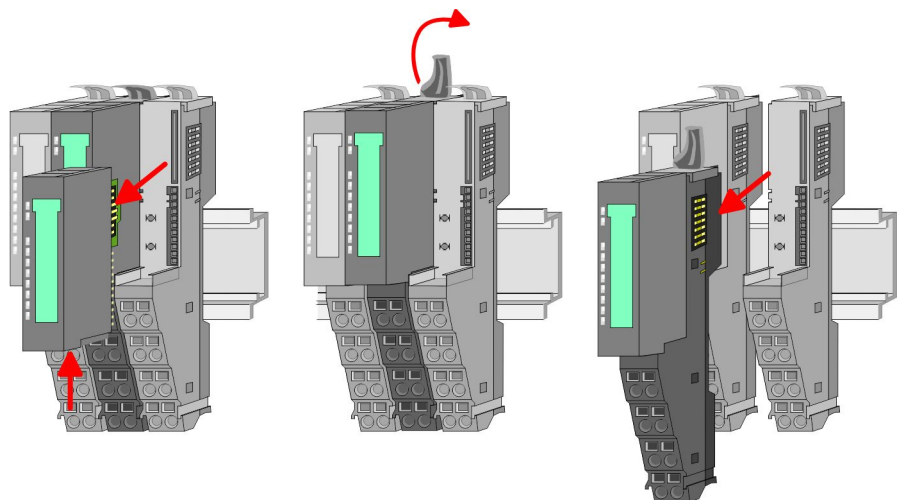
Exchange of an electronic module



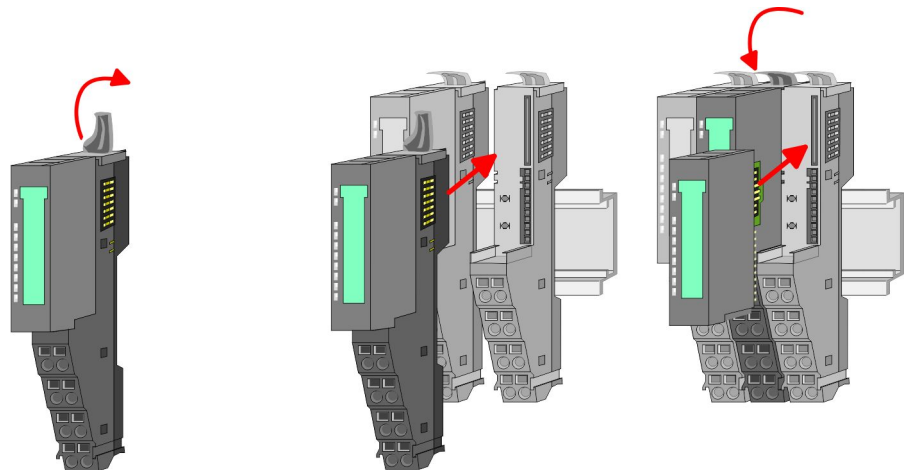
1. ➤ For the exchange of an electronic module, the electronic module may be pulled forward after pressing the unlocking lever at the lower side of the module.
2. ➤ For installation plug the electronic module guided by the strips at the lower side until this engages audible to the terminal module.

Exchange of a module

1. ➤ Remove if exists the wiring. ↪ *Chapter 2.6 'Wiring' on page 22.*



2. ➤ Press the unlocking lever at the lower side of the just mounted right module and pull it forward.
3. ➤ Turn the locking lever of the module to be exchanged upwards.
4. ➤ Pull the module forward.



5. ➤ For mounting turn the locking lever of the module to be mounted upwards.
6. ➤ To mount the module put it to the gap between the both modules and push it, guided by the stripes at both sides, to the mounting rail.
7. ➤ Turn the locking lever downward again.
8. ➤ Plug again the electronic module, which you have removed before.

Exchange of a head module (e.g. bus coupler)

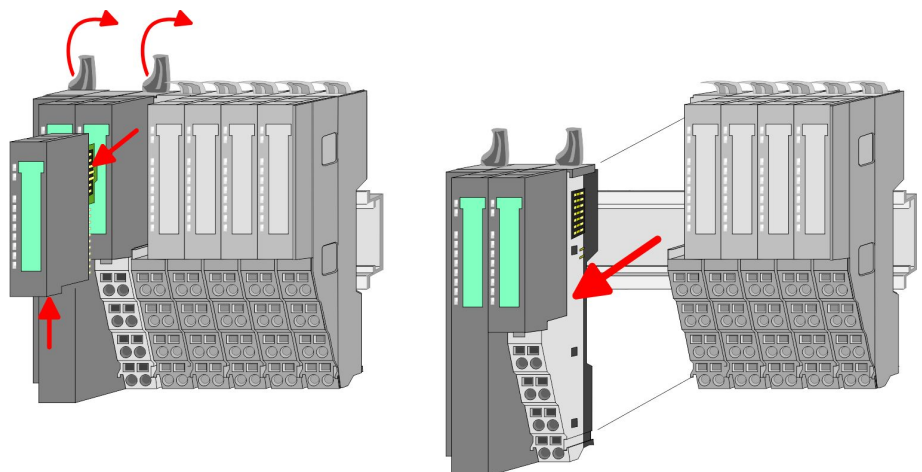


CAUTION!

Bus interface and power module of a head module may not be separated!

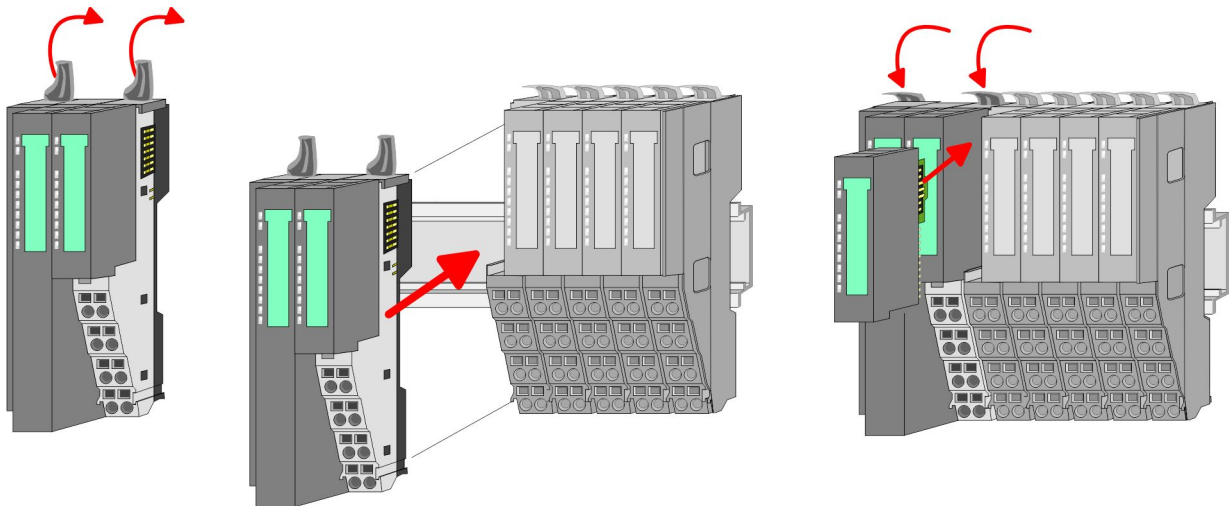
Here you may only exchange the electronic module!

1. ➤ Remove if exists the wiring of the head module. ↗ *Chapter 2.6 'Wiring' on page 22.*



2. ➤ Press the unlocking lever at the lower side of the just mounted right module and pull it forward.
3. ➤ Turn all the locking lever of the head module to be exchanged upwards.
4. ➤ Pull the head module forward.

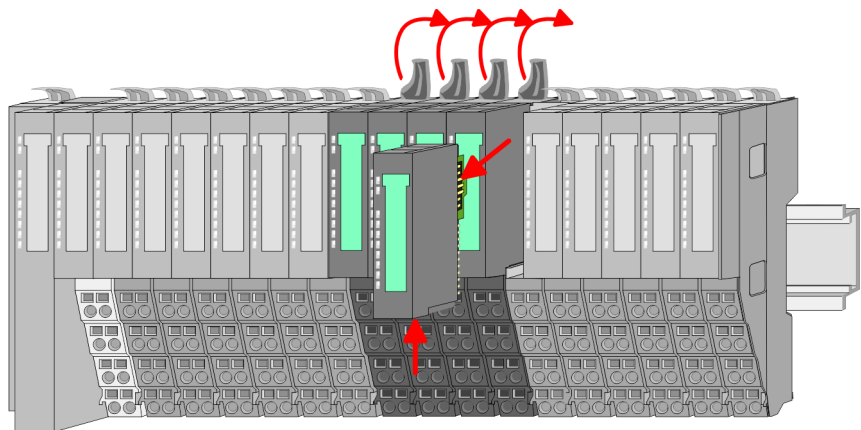
Demounting and module exchange



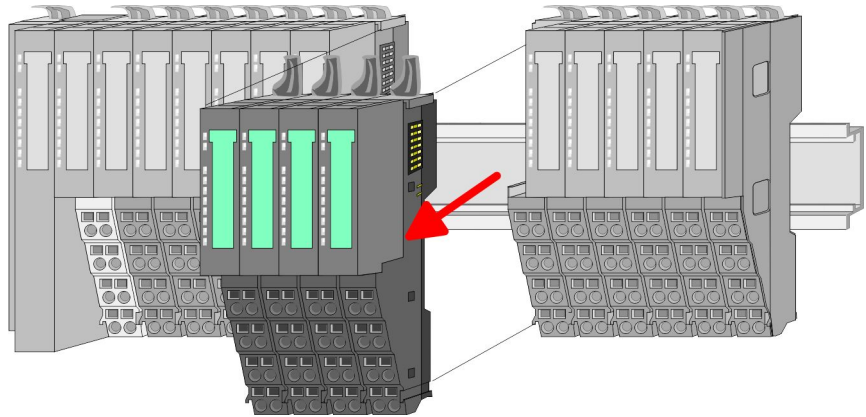
5. ▶ For mounting turn all the locking lever of the head module to be mounted upwards.
6. ▶ To mount the head module put it to the left module and push it, guided by the stripes, to the mounting rail.
7. ▶ Turn all the locking lever downward again.
8. ▶ Plug again the electronic module, which you have removed before.

Exchange of a module group

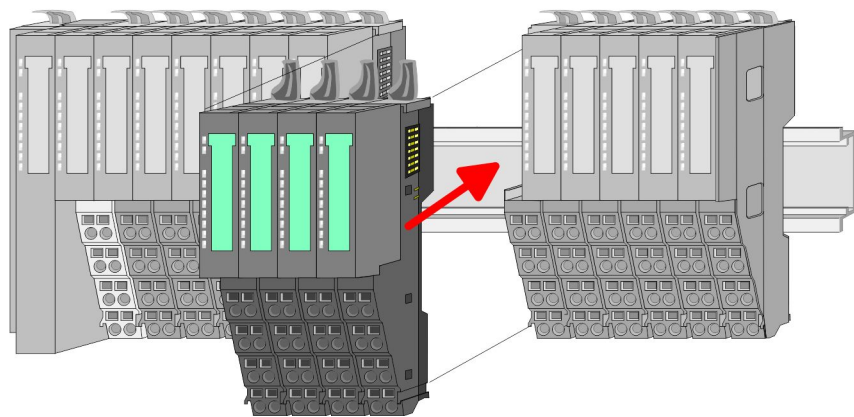
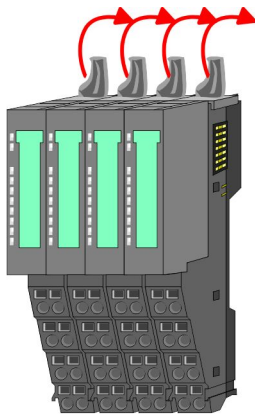
1. ▶ Remove if exists the wiring of the module group. ↪ *Chapter 2.6 'Wiring' on page 22.*



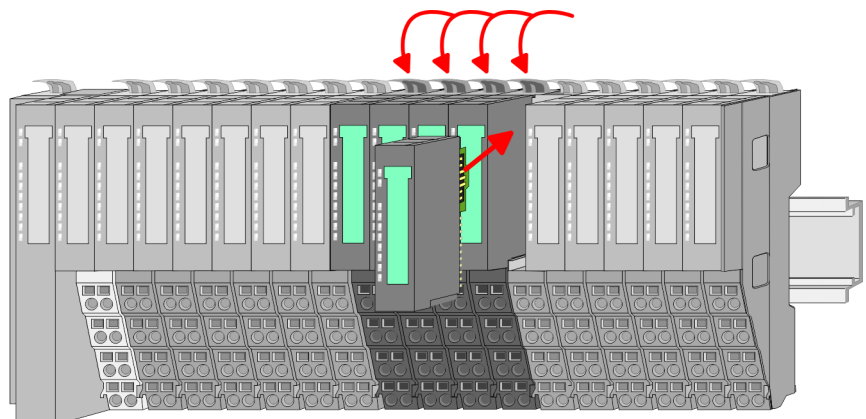
2. ▶ Press the unlocking lever at the lower side of the just mounted right module of the module group and pull it forward.



3. ➤ Turn all the locking lever of the module group to be exchanged upwards.
4. ➤ Pull the module group forward.



5. ➤ For mounting turn all the locking lever of the module group to be mounted upwards.
6. ➤ To mount the module group put it to the gap between the both modules and push it, guided by the stripes at both sides, to the mounting rail.



7. ➤ Turn all the locking lever downward again.
8. ➤ Plug again the electronic module, which you have removed before.

2.6 Wiring

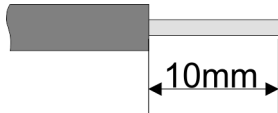
Connectors

Terminals with spring clamp technology are used for wiring.

The spring clamp technology allows quick and easy connection of your signal and supply lines.

In contrast to screw terminal connections this type of connection is vibration proof.

Data



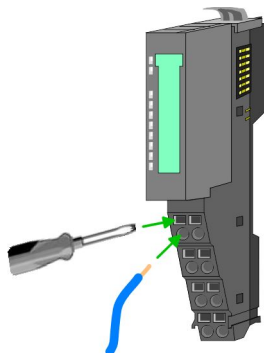
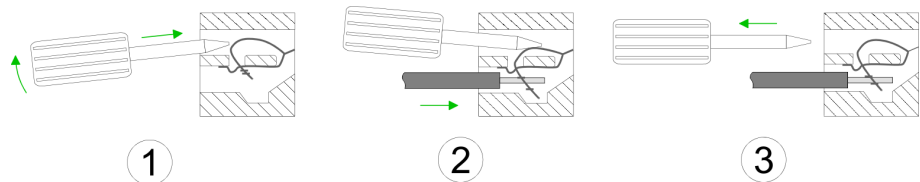
U_{\max} : 240V AC / 30V DC

I_{\max} : 10A

Cross section: 0.08 ... 1.5mm² (AWG 28 ... 16)

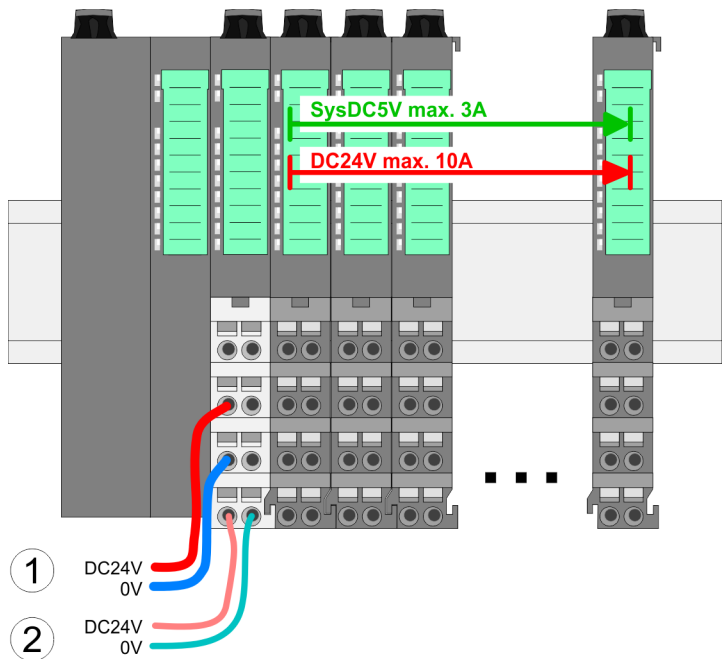
Stripping length: 10mm

Wiring procedure



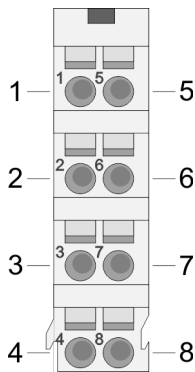
1. Insert a suited screwdriver at an angle into the square opening as shown. Press and hold the screwdriver in the opposite direction to open the contact spring.
2. Insert the stripped end of wire into the round opening. You can use wires with a cross section of 0.08mm² to 1.5mm².
3. By removing the screwdriver, the wire is securely fixed via the spring contact to the terminal.

Standard wiring



- (1) DC 24V for power section supply I/O area (max 10A)
- (2) DC 24V for electronic power supply bus coupler and I/O area

PM - Power module



For wires with a core cross-section of 0.08mm² up to 1.5mm².

Pos.	Function	Type	Description
1	---	---	not connected
2	DC 24V	I	DC 24V for power section supply
3	0V	I	GND for power section supply
4	Sys DC 24V	I	DC 24V for electronic section supply
5	---	---	not connected
6	DC 24V	I	DC 24V for power section supply
7	0V	I	GND for power section supply
8	Sys 0V	I	GND for electronic section supply

I Input



CAUTION!

Since the power section supply is not internally protected, it is to be externally protected with a fuse, which corresponds to the maximum current. This means max. 10A is to be protected by a 10A fuse (fast) respectively by a line circuit breaker 10A characteristics Z!



The electronic power section supply is internally protected against higher voltage by fuse. The fuse is within the power module. If the fuse releases, its electronic module must be exchanged!

Fusing

- The power section supply is to be externally protected with a fuse, which corresponds to the maximum current. This means max. 10A is to be protected with a 10A fuse (fast) respectively by a line circuit breaker 10A characteristics Z!
- It is recommended to externally protect the electronic power supply for bus coupler and I/O area with a 2A fuse (fast) respectively by a line circuit breaker 2A characteristics Z.
- The electronic power supply for the I/O area of the power module 007-1AB10 should also be externally protected with a 1A fuse (fast) respectively by a line circuit breaker 1A characteristics Z.

State of the electronic power supply via LEDs

After PowerON of the System SLIO the LEDs RUN respectively MF get on so far as the sum current does not exceed 3A.

With a sum current greater than 3A the LEDs may not be activated.

Here the power module with the order number 007-1AB10 is to be placed between the peripheral modules.

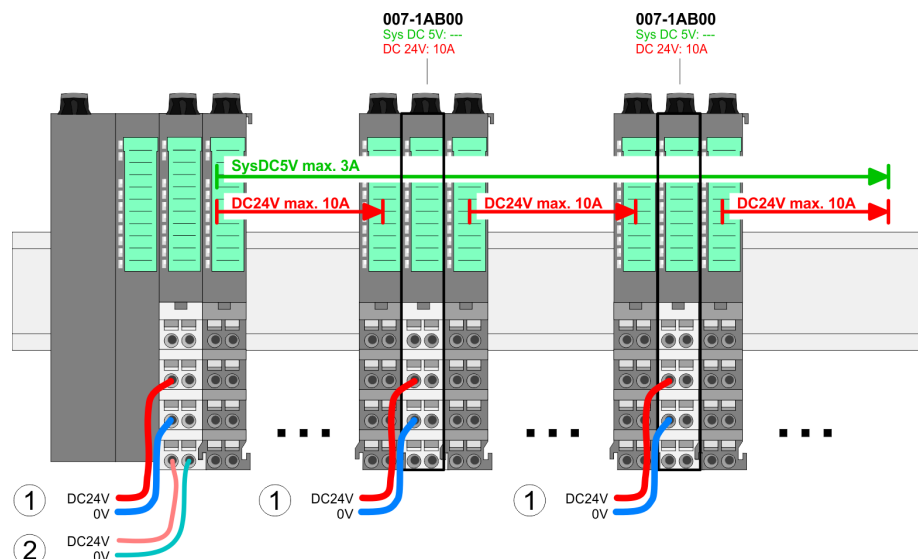
Deployment of the power modules

If the 10A for the power section supply is no longer sufficient, you may use the power module from VIPA with the order number 007-1AB00. So you have also the possibility to define isolated groups.

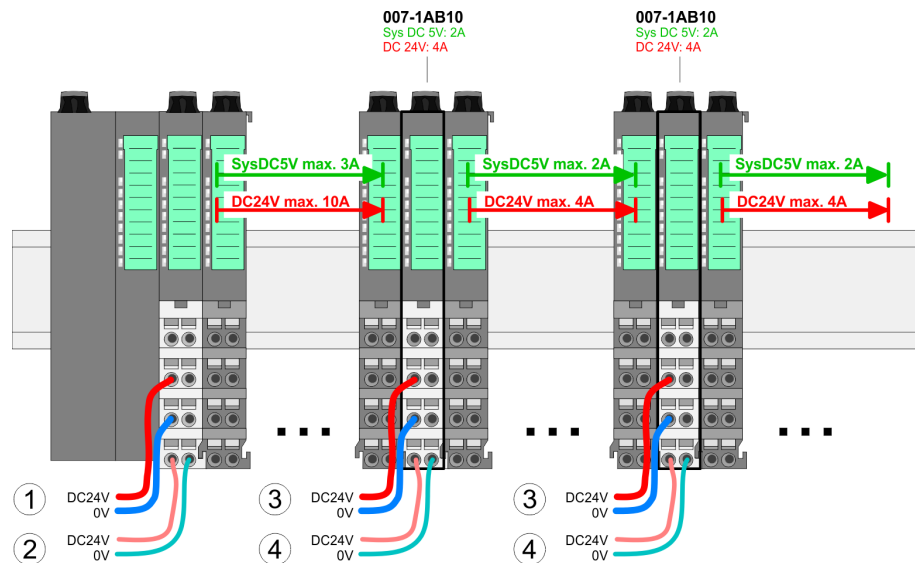
The power module with the order number 007-1AB10 is to be used if the 3A for the electronic power supply at the backplane bus is no longer sufficient. Additionally you get an isolated group for the DC 24V power section supply with 4A.

By placing the power module 007-1AB10 at the following backplane bus modules may be placed with a sum current of max. 2A. Afterwards the power module 007-1AB10 is to be placed again. To secure the power supply, the power modules may be mixed used.

Power module 007-1AB00



Power module 007-1AB10



- (1) DC 24V for power section supply I/O area (max. 10A)
- (2) DC 24V for electronic power supply bus coupler and I/O area
- (3) DC 24V for power section supply I/O area (max. 4A)
- (4) DC 24V for electronic power supply I/O area

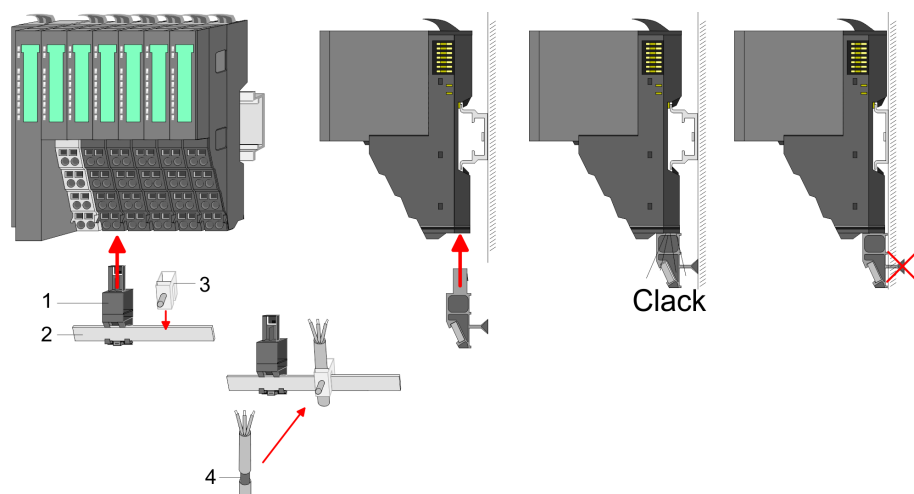
Shield attachment

To attach the shield the mounting of shield bus carriers are necessary.

The shield bus carrier (available as accessory) serves to carry the shield bus to connect cable shields.

The shield bus carrier is mounted underneath the terminal of the terminal module. With a flat mounting rail for adaption to a flat mounting rail you may remove the spacer of the shield bus carrier.

After mounting the shield bus carrier with the shield bus, the cables with the accordingly stripped cable screen may be attached and fixed by the shield clamp.



- 1 Shield bus carrier
- 2 Shield bus (10mm x 3mm)
- 3 Shield clamp
- 4 Cable shield

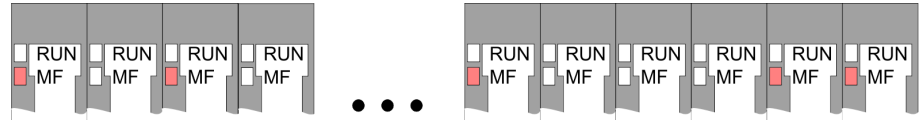
2.7 Trouble shooting - LEDs

General

Each module has the LEDs RUN and MF on its front side. Errors or incorrect modules may be located by means of these LEDs.

In the following illustrations flashing LEDs are marked by ☼.

Sum current of the electronic power supply exceeded



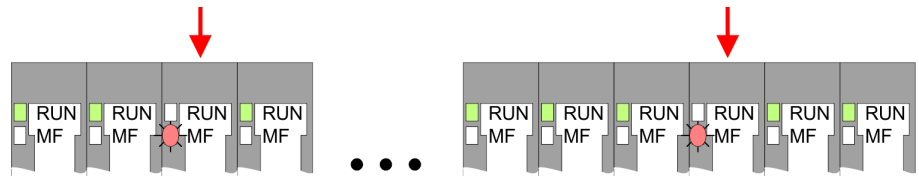
Behaviour: After PowerON the RUN LED of each module is off and the MF LED of each module is sporadically on.

Reason: The maximum current for the electronic power supply is exceeded.

Remedy: As soon as the sum current of the electronic power supply is exceeded, always place the power module 007-1AB10.

☞ Chapter 2.6 'Wiring' on page 22.

Error in configuration

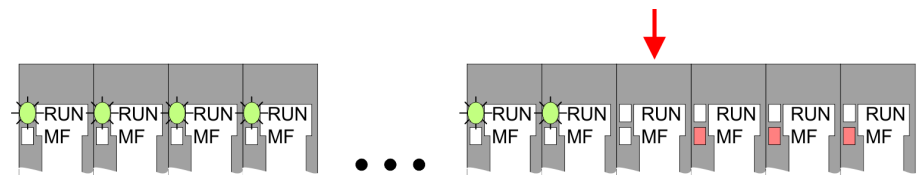


Behaviour: After PowerON the MF LED of one module respectively more modules flashes. The RUN LED remains off.

Reason: At this position a module is placed, which does not correspond to the configured module.

Remedy: Match configuration and hardware structure.

Module failure



Behaviour: After PowerON all of the RUN LEDs up to the defective module are flashing. With all following modules the MF LED is on and the RUN LED is off.

Reason: The module on the right of the flashing modules is defective.

Remedy: Replace the defective module.

2.8 Installation guidelines

General

The installation guidelines contain information about the interference free deployment of a PLC system. There is the description of the ways, interference may occur in your PLC, how you can make sure the electromagnetic compatibility (EMC), and how you manage the isolation.

What does EMC mean?	<p>Electromagnetic compatibility (EMC) means the ability of an electrical device, to function error free in an electromagnetic environment without being interfered respectively without interfering the environment.</p> <p>The components of VIPA are developed for the deployment in industrial environments and meets high demands on the EMC. Nevertheless you should project an EMC planning before installing the components and take conceivable interference causes into account.</p>
Possible interference causes	<p>Electromagnetic interferences may interfere your control via different ways:</p> <ul style="list-style-type: none">■ Electromagnetic fields (RF coupling)■ Magnetic fields with power frequency■ Bus system■ Power supply■ Protected earth conductor <p>Depending on the spreading medium (lead bound or lead free) and the distance to the interference cause, interferences to your control occur by means of different coupling mechanisms.</p> <p>There are:</p> <ul style="list-style-type: none">■ galvanic coupling■ capacitive coupling■ inductive coupling■ radiant coupling
Basic rules for EMC	<p>In the most times it is enough to take care of some elementary rules to guarantee the EMC. Please regard the following basic rules when installing your PLC.</p> <ul style="list-style-type: none">■ Take care of a correct area-wide grounding of the inactive metal parts when installing your components.<ul style="list-style-type: none">– Install a central connection between the ground and the protected earth conductor system.– Connect all inactive metal extensive and impedance-low.– Please try not to use aluminium parts. Aluminium is easily oxidizing and is therefore less suitable for grounding.■ When cabling, take care of the correct line routing.<ul style="list-style-type: none">– Organize your cabling in line groups (high voltage, current supply, signal and data lines).– Always lay your high voltage lines and signal respectively data lines in separate channels or bundles.– Route the signal and data lines as near as possible beside ground areas (e.g. suspension bars, metal rails, tin cabinet).■ Proof the correct fixing of the lead isolation.<ul style="list-style-type: none">– Data lines must be laid isolated.– Analog lines must be laid isolated. When transmitting signals with small amplitudes the one sided laying of the isolation may be favourable.– Lay the line isolation extensively on an isolation/protected earth conductor rail directly after the cabinet entry and fix the isolation with cable clamps.– Make sure that the isolation/protected earth conductor rail is connected impedance-low with the cabinet.– Use metallic or metallised plug cases for isolated data lines.

- In special use cases you should appoint special EMC actions.
 - Consider to wire all inductivities with erase links.
 - Please consider luminescent lamps can influence signal lines.
- Create a homogeneous reference potential and ground all electrical operating supplies when possible.
 - Please take care for the targeted employment of the grounding actions. The grounding of the PLC serves for protection and functionality activity.
 - Connect installation parts and cabinets with your PLC in star topology with the isolation/protected earth conductor system. So you avoid ground loops.
 - If there are potential differences between installation parts and cabinets, lay sufficiently dimensioned potential compensation lines.

Isolation of conductors

Electrical, magnetically and electromagnetic interference fields are weakened by means of an isolation, one talks of absorption. Via the isolation rail, that is connected conductive with the rack, interference currents are shunt via cable isolation to the ground. Here you have to make sure, that the connection to the protected earth conductor is impedance-low, because otherwise the interference currents may appear as interference cause.

When isolating cables you have to regard the following:

- If possible, use only cables with isolation tangle.
- The hiding power of the isolation should be higher than 80%.
- Normally you should always lay the isolation of cables on both sides. Only by means of the both-sided connection of the isolation you achieve high quality interference suppression in the higher frequency area. Only as exception you may also lay the isolation one-sided. Then you only achieve the absorption of the lower frequencies. A one-sided isolation connection may be convenient, if:
 - the conduction of a potential compensating line is not possible.
 - analog signals (some mV respectively μ A) are transferred.
 - foil isolations (static isolations) are used.
- With data lines always use metallic or metallised plugs for serial couplings. Fix the isolation of the data line at the plug rack. Do not lay the isolation on the PIN 1 of the plug bar!
- At stationary operation it is convenient to strip the insulated cable interruption free and lay it on the isolation/protected earth conductor line.
- To fix the isolation tangles use cable clamps out of metal. The clamps must clasp the isolation extensively and have well contact.
- Lay the isolation on an isolation rail directly after the entry of the cable in the cabinet. Lead the isolation further on to your PLC and don't lay it on there again!



CAUTION!

Please regard at installation!

At potential differences between the grounding points, there may be a compensation current via the isolation connected at both sides.

Remedy: Potential compensation line

2.9 General data

Conformity and approval

Conformity		
CE	2006/95/EG	Low-voltage directive
	2004/108/EG	EMC directive
Approval		
UL	UL 508	Approval for USA and Canada
others		
RoHS	2011/65/EU	Product is lead-free; Restriction of the use of certain hazardous substances in electrical and electronic equipment

Protection of persons and device protection

Type of protection	-	IP20
Electrical isolation		
to the field bus	-	electrically isolated
to the process level	-	electrically isolated
Insulation resistance		-
Insulation voltage to reference earth		
Inputs / outputs	-	AC / DC 50V, test voltage AC 500V
Protective measures	-	against short circuit

Environmental conditions to EN 61131-2

Climatic		
Storage / transport	EN 60068-2-14	-25...+70°C
Operation		
Horizontal installation	EN 61131-2	0...+60°C
Vertical installation	EN 61131-2	0...+60°C
Air humidity	EN 60068-2-30	RH1 (without condensation, rel. humidity 10... 95%)
Pollution	EN 61131-2	Degree of pollution 2
Mechanical		
Oscillation	EN 60068-2-6	1g, 9Hz ... 150Hz
Shock	EN 60068-2-27	15g, 11ms

General data

Mounting conditions

Mounting place	-	In the control cabinet
Mounting position	-	Horizontal and vertical

EMC	Standard	Comment
Emitted interference	EN 61000-6-4	Class A (Industrial area)
Noise immunity zone B	EN 61000-6-2	Industrial area
		EN 61000-4-2 ESD 8kV at air discharge (degree of severity 3), 4kV at contact discharge (degree of severity 2)
		EN 61000-4-3 HF field immunity (casing) 80MHz ... 1000MHz, 10V/m, 80% AM (1kHz) 1.4GHz ... 2.0GHz, 3V/m, 80% AM (1kHz) 2GHz ... 2.7GHz, 1V/m, 80% AM (1kHz)
		EN 61000-4-6 HF conducted 150kHz ... 80MHz, 10V, 80% AM (1kHz)
		EN 61000-4-4 Burst, degree of severity 3
		EN 61000-4-5 Surge, installation class 3 *

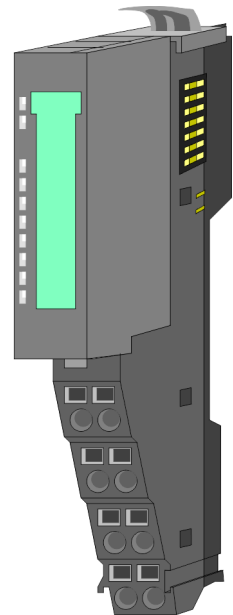
*) Due to the high-energetic single pulses with Surge an appropriate external protective circuit with lightning protection elements like conductors for lightning and overvoltage is necessary.

3 Hardware description

3.1 Properties

Features

- 1 counter 32bit (AB) invertible, DC 24V
- Counting frequency max 400kHz (AB 1/2/4-fold evaluation or pulse and direction)
- Latch value, comparison value, set value, input filter (configurable)
- HW gate, reset, digital output for comparison
- Interrupt and diagnostics function with μ s time stamp
- μ s time stamp for counter value (e.g. for speed calculation)

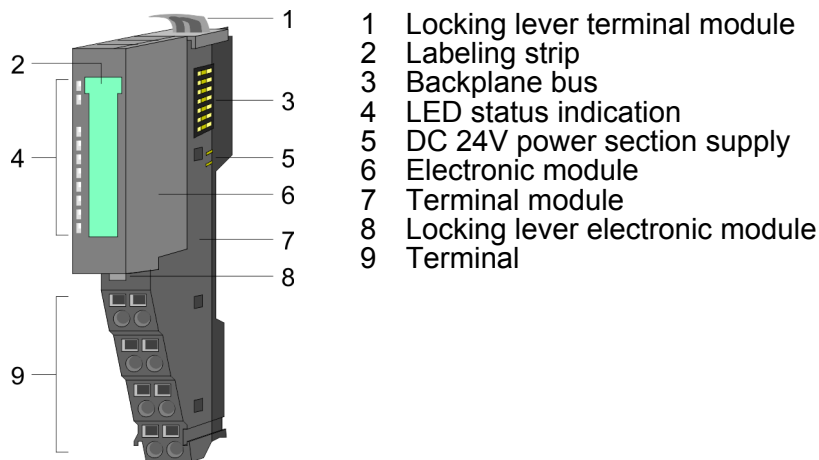


Order data

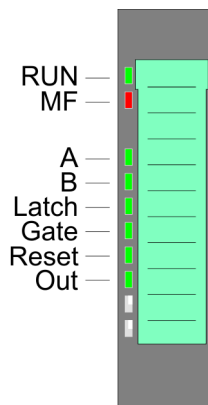
Type	Order number	Description
FM 050	050-1BA00	Counter module advanced 1x32bit DC 24V, DO 1xDC 24V 0.5A









3.2 Structure


050-1BA00



Status indication

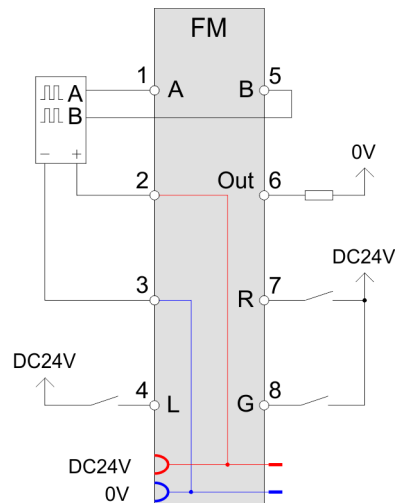
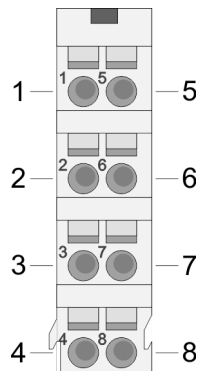


LED		Description	
RUN green 	MF red 		
●	○	Bus communication is OK Module status is OK	
●	●	Bus communication is OK Module status reports an error	
○	●	Bus communication is not possible Module status reports an error	
○	○	Error at bus power supply	
B	B	Error in configuration  <i>Chapter 2.7 'Trouble shooting - LEDs' on page 26</i>	
A	green 	●	Digital input 1 A/pulse is set
B	green 	●	Digital input 5 B/direction is set
Latch	green 	●	Digital input 4 Latch is set
Gate	green 	●	Digital input 8 hardware gate is set
Reset	green 	●	Digital input 7 Reset is set

LED		Description
OUT	green 	<ul style="list-style-type: none"> Digital output 6 is set
on: ● off: ○ blinks with 2Hz: B		

Pin assignment

For wires with a cross section of 0.08mm² up to 1.5mm².



Pos.	Function	Type	Description
1	A	I	A / pulse Pulse input for counter signal respectively track A of an encoder for 1-, 2- or 4-fold evaluation.
2	DC 24V	O	DC 24V for encoder
3	0V	O	GND
4	L	I	Latch Input to store the current <i>counter value</i> as <i>latch value</i> in the input area. The storage happens with an edge 0-1 respectively a level-triggered signal.
5	B	I	B / direction direction signal respectively track B of an encoder (invertible via parameterization)
6	Out	O	Digital output controlled by means of the comparison functions.
7	R	I	Reset Input to reset the counter, if the reset functionality was enabled within the parameterization.
8	G	I	Hardware gate Input to control the HW gate. The HW gate is controlled by a high level.

I: Input, O: Output

3.3 Technical data

Order no.	050-1BA00
Type	FM 050
Module ID	08C1 3800
Current consumption/power loss	
Current consumption from backplane bus	75 mA
Power loss	1 W
Technical data digital inputs	
Number of inputs	5
Cable length, shielded	100 m
Cable length, unshielded	-
Rated load voltage	DC 20.4...28.8 V
Reverse polarity protection of rated load voltage	-
Current consumption from load voltage L+ (without load)	20 mA
Rated value	DC 20.4...28.8 V
Input voltage for signal "0"	DC 0...5 V
Input voltage for signal "1"	DC 15...28.8 V
Input voltage hysteresis	-
Frequency range	-
Input resistance	-
Input current for signal "1"	3 mA
Connection of Two-Wire-BEROs possible	✓
Max. permissible BERO quiescent current	0.5 mA
Input delay of "0" to "1"	0.8 µs
Input delay of "1" to "0"	0.8 µs
Number of simultaneously utilizable inputs horizontal configuration	5
Number of simultaneously utilizable inputs vertical configuration	5
Input characteristic curve	IEC 61131-2, type 1
Initial data size	12 Byte
Technical data digital outputs	
Number of outputs	1
Cable length, shielded	100 m
Cable length, unshielded	100 m
Rated load voltage	DC 20.4...28.8 V

Order no.	050-1BA00
Current consumption from load voltage L+ (without load)	-
Output delay of "0" to "1"	30 µs
Output delay of "1" to "0"	30 µs
Minimum load current	-
Lamp load	10 W
Parallel switching of outputs for redundant control of a load	not possible
Parallel switching of outputs for increased power	not possible
Actuation of digital input	✓
Switching frequency with resistive load	max. 10 kHz
Switching frequency with inductive load	max. 0.5 Hz
Switching frequency on lamp load	max. 10 kHz
Internal limitation of inductive shut-off voltage	L+ (-52 V)
Short-circuit protection of output	yes, electronic
Trigger level	1 A
Number of operating cycle of relay outputs	-
Switching capacity of contacts	-
Output data size	10 Byte
Technical data counters	
Number of counters	1
Counter width	32 Bit
Maximum input frequency	100 kHz
Maximum count frequency	400 kHz
Mode incremental encoder	✓
Mode pulse / direction	✓
Mode pulse	-
Mode frequency counter	-
Mode period measurement	-
Gate input available	✓
Latch input available	✓
Reset input available	✓
Counter output available	✓
Status information, alarms, diagnostics	
Status display	yes
Interrupts	yes, parameterizable

Technical data

Order no.	050-1BA00
Process alarm	yes, parameterizable
Diagnostic interrupt	yes, parameterizable
Diagnostic functions	yes, parameterizable
Diagnostics information read-out	possible
Module state	green LED
Module error display	red LED
Channel error display	none
Isolation	
Between channels	-
Between channels of groups to	-
Between channels and backplane bus	✓
Between channels and power supply	-
Max. potential difference between circuits	-
Max. potential difference between inputs (U _{cm})	-
Max. potential difference between Mana and Mintern (U _{iso})	-
Max. potential difference between inputs and Mana (U _{cm})	-
Max. potential difference between inputs and Mintern (U _{iso})	-
Max. potential difference between Mintern and outputs	-
Insulation tested with	DC 500 V
Datasizes	
Input bytes	12
Output bytes	10
Parameter bytes	25
Diagnostic bytes	20
Housing	
Material	PPE / PPE GF10
Mounting	Profile rail 35 mm
Mechanical data	
Dimensions (WxHxD)	12.9 mm x 109 mm x 76.5 mm
Weight	60 g
Environmental conditions	
Operating temperature	0 °C to 60 °C
Storage temperature	-25 °C to 70 °C

Order no.	050-1BA00
Certifications	
UL508 certification	yes

4 Deployment

4.1 Fast introduction

Counter range

Limits	Valid range of values
Lower counter limit	-2 147 483 648 (-2^{31})
Upper counter limit	+2 147 483 647 ($2^{31}-1$)

The maximum counter frequency is 400kHz.

Address areas

At CPU, PROFIBUS and PROFINET the input respectively output area is embedded to the corresponding address area.

IX - Index for access via CANopen

SX - Subindex for access via EtherCAT

Input area

Addr.	Name	Bytes	Function	IX	SX
+0	CV_I	4	Counter value	5400h	01h
+4	CL_I	4	Latch value	5401h	02h
+8	CSTS_I	2	Counter status	5402h	03h
+10	C_US	2	µs ticker	5403h	04h

Output area

Addr.	Name	Bytes	Function	IX	SX
+0	CC_I	4	Comparison value	5600h	01h
+4	CS_I	4	Set value	5601h	02h
+8	CCTRL_I	2	Control word	5602h	03h

CSTS_I Counter status

Bit	Name	Function
0	STS_SYNC	Reset was active
1	STS_CTRL_DO	Is set when digital output is enabled
2	STS_SW-GATE	Status software gate (set when SW gate is active)
3	STS_RST	Status reset input
4	STS_STRT	Status hardware gate (set when HW gate is active)
5	STS_GATE	Status internal gate (set when internal gate active)

Bit	Name	Function
6	STS_DO	Status digital counter output (DO)
7	STS_C_DN	Status set at counter direction backward
8	STS_C_UP	Status set at counter direction forward
9	STS_CMP*	Status comparison is set when the comparison condition is met. If comparison is parameterized <i>never</i> , the bit is never set.
10	STS_END*	Status is set when <i>end value</i> was reached
11	STS_OFLW*	Status is set at overflow
12	STS_UFLW*	Status is set at underflow
13	STS_ZP*	Status is set at zero run
14	STS_LTCH	Status of the latch input
15	-	reserved

*) The bits remain set until reset with RES_SET (bit 6 control word).

CCTRL_I Control word

Bit	Name	Function
0	CTRL_SYNC_SET	activates the reset mode
1	CTRL_DO_SET	enables the digital output
2	SW_GATE_SET	sets the software gate
3 ... 4	-	reserved
5	COUNTERVAL_SET	sets counter temporarily to the value of <i>set value</i>
6	RES_SET	resets the bits STS_CMP, STS_END, STS_OFLW, STS_UFLW and STS_ZP with edge 0-1
7	-	reserved
8	CTRL_SYNC_RESET	deactivates the reset mode
9	CTRL_DO_RESET	disables the digital output
10	SW_GATE_RESET	resets the software gate
11 ... 15	-	reserved

Parameters

DS - Data set for access via CPU, PROFIBUS and PROFINET

IX - Index for access via CANopen

SX - Subindex for access via EtherCAT

Name	Bytes	Function	Default	DS	IX	SX
DIAG_EN	1	Diagnostic interrupt*	00h	00h	3100h	01h
CH0A	1	Input frequency track A	02h	01h	3101h	02h
CH1B	1	Input frequency track B	02h	01h	3102h	03h
CH2L	1	Input frequency Latch	02h	01h	3103h	04h
CH3G	1	Input frequency Gate	02h	01h	3104h	05h
CH4R	1	Input frequency Reset	02h	01h	3105h	06h
CH5	1	0 (fix)	00h	01h	3106h	07h
INT_I	1	Interrupt behavior*	80h	80h	3107h	08h
FCT_I	1	Counter function*	40h	80h	3108h	09h
MODE2_I	1	Counter mode 2*	00h	80h	3109h	0Ah
MODE3_I	1	Counter mode 3*	00h	80h	310Ah	0Bh
END_I	4	End value	00h	81h	310Bh... 310Eh	0Ch
LOAD_I	4	Load value	00h	81h	310Fh... 3112h	0Dh
HYST_I	1	Hysteresis	00h	81h	3113h	0Eh
PULSE_I	1	Pulse	00h	81h	3114h	0Fh

*) This parameter may only be transferred at STOP state.

Control counter

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

HW gate:

Open (activate):

edge 0-1 at the gate input of the module

Close (de-activate):

edge 1-0 at the gate input of the module

SW gate:

Open (activate):

in user program by edge 0-1 SW_GATE_SET in the *control word*

Close (deactivate):

in user program by edge 0-1 SW_GATE_RESET in the *control word*

Counter output

The following behavior for the output channel may be set via the parameterization:

- No comparison: output is not influenced
- *Counter value* \geq *comparison value*: output is set
- *Counter value* \leq *comparison value*: output is set
- *Counter value* = *comparison value*: output is set

Please consider that the output may only be controlled, when the bit STS_CTRL_DO in the *counter status* is set.

4.2 In-/Output area

Bei CPU, PROFIBUS und PROFINET wird der Ein- bzw. Ausgabebereich im entsprechenden Adressbereich eingeblendet.

IX - Index für Zugriff über CANopen

SX - Subindex für Zugriff über EtherCAT

Input area 12byte

Addr.	Name	Bytes	Function	IX	SX
+0	CV_I	4	Counter value	5400h	01h
+4	CL_I	4	Latch value	5401h	02h
+8	CSTS_I	2	Counter status	5402h	03h
+10	C_US	2	µs ticker	5403h	04h

CV_I Counter value

The *counter value* always contains the current value of the counter.

CL_I Latch value

With an edge 0-1 at the Latch input the recent *counter value* is stored at *Latch value*.

CSTS_I Counter status

Bit	Name	Function
0	STS_SYNC	Reset was active
1	STS_CTRL_DO	Is set when digital output is enabled
2	STS_SW-GATE	Status software gate (set when <i>SW gate</i> is active)
3	STS_RST	Status reset input
4	STS_STRT	Status hardware gate (set when <i>HW gate</i> is active)
5	STS_GATE	Status internal gate (set when internal gate active)
6	STS_DO	Status digital counter output (DO)
7	STS_C_DN	Status set at counter direction backward

Bit	Name	Function
8	STS_C_UP	Status set at counter direction forward
9	STS_CMP*	Status comparison is set when the comparison condition is met. If comparison is parameterized <i>never</i> , the bit is never set
10	STS_END*	Status is set when <i>end value</i> was reached
11	STS_OFLW*	Status is set at overflow
12	STS_UFLW*	Status is set at underflow
13	STS_ZP*	Status is set at zero run
14	STS_LTCH	Status of the latch input
15	-	reserved

*) The bits remain set until reset with RES_SET (bit 6 control word).

C_US μ s ticker

In the SLIO module there is a timer (μ s ticker). With PowerON the timer starts counting with 0. After 65535 μ s the timer starts with 0 again. With each change of the *counter value* the timer value is stored as 16bit μ s value together with the *counter value* in the *input area*.

Output area 10byte

Addr.	Name	Bytes	Function	IX	SX
+0	CC_I	4	Comparison value	5600h	01h
+4	CS_I	4	Set value	5601h	02h
+8	CCTRL_I	2	Control word	5602h	03h

CC_I Comparison value

With *comparison value* a value may be preset that may influence the counter output res. throw a process interrupt when compared with the recent *counter value*. The behavior of the output res. the process interrupt may be set via the parameter MODE2_I respectively INT_I.

CS_I Set value

By means of the *set value* there is the possibility to preset the counter with the *set value*. The set value is kept by the counter by edge 0-1 of the bit COUNTERVAL_SET in the *control word*.

CCTRL_I Control word

Bit	Name	Function
0	CTRL_SYNC_SET	activates the reset mode
1	CTRL_DO_SET	enables the digital output

Bit	Name	Function
2	SW_GATE_SET	sets the software gate
3 ... 4	-	reserved
5	COUNTERVAL_SET	sets counter temporarily to the value of <i>set value</i>
6	RES_SET	resets the bits STS_CMP, STS_END, STS_OFLW, STS_UFLW and STS_ZP with edge 0-1
7	-	reserved
8	CTRL_SYNC_RESET	deactivates the reset mode
9	CTRL_DO_RESET	disables the digital output
10	SW_GATE_RESET	resets the software gate
11 ... 15	-	reserved

4.3 Parameter data

Via parameterization you may define among others:

- Interrupt behavior
- Input filter
- Counter operating mode res. behavior

Parameters

DS - Data set for access via CPU, PROFIBUS and PROFINET

IX - Index for access via CANopen

SX - Subindex for access via EtherCAT

Name	Bytes	Function	Default	DS	IX	SX
DIAG_EN	1	Diagnostic interrupt*	00h	00h	3100h	01h
CH0A	1	Input frequency track A	02h	01h	3101h	02h
CH1B	1	Input frequency track B	02h	01h	3102h	03h
CH2L	1	Input frequency Latch	02h	01h	3103h	04h
CH3G	1	Input frequency Gate	02h	01h	3104h	05h
CH4R	1	Input frequency Reset	02h	01h	3105h	06h
CH5	1	reserved	00h	01h	3106h	07h
INT_I	1	Interrupt behavior*	80h	80h	3107h	08h
FCT_I	1	Counter function*	40h	80h	3108h	09h
MODE2_I	1	Counter mode 2*	00h	80h	3109h	0Ah

Parameter data

Name	Bytes	Function	Default	DS	IX	SX
MODE3_I	1	Counter mode 3*	00h	80h	310Ah	0Bh
END_I	4	End value	00h	81h	310Bh... 310Eh	0Ch
LOAD_I	4	Load value	00h	81h	310Fh... 3112h	0Dh
HYST_I	1	Hysteresis	00h	81h	3113h	0Eh
PULSE_I	1	Pulse	00h	81h	3114h	0Fh

*) This parameter may only be transferred at STOP state.

DIAG_EN Diagnostic interrupt

Byte	Bit 7...0
0	Diagnostic interrupt <ul style="list-style-type: none"> ■ 00h = disable ■ 40h = enable

- Here you activate res. de-activate the diagnostic function.

CHxx Input frequency

Byte	Function	Possible values
0	Input frequency track A	<ul style="list-style-type: none"> ■ 02h: 100kHz ■ 03h: 60kHz ■ 04h: 30kHz ■ 06h: 10kHz ■ 07h: 5kHz ■ 08h: 2kHz ■ 09h: 1kHz Other values are not permissible!
1	Input frequency track B	
2	Input frequency Latch	
3	Input frequency Gate	
4	Input frequency Reset	
5	0 (fix)	

- *Input frequency* allows you to preset a filter for I1, I4, I5, I7 and I8. With the help of filters you may e.g. filter signal peaks at a blurred input signal.

INT_I Interrupt behavior

Byte	Bit 7 ... 0
0	<i>Bit 6 ... 0: Interrupt behavior</i> <ul style="list-style-type: none"> ■ Bit 0: Proc. interrupt <i>HW gate</i> open ■ Bit 1: Proc. interrupt <i>HW gate</i> closed ■ Bit 2: Proc. interrupt overflow ■ Bit 3: Proc. interrupt underflow ■ Bit 4: Proc. interrupt <i>comparison value</i> ■ Bit 5: Proc. interrupt <i>end value</i> ■ Bit 6: interrupt <i>latch value</i> ■ Bit 7: 1 (fix)

- Setting the appropriate bit activates the associated process interrupt

FCT_I Counter function

Byte	Bit 7 ... 0
0	<ul style="list-style-type: none"> ■ <i>Bit 5 ... 0: Counter function</i> <ul style="list-style-type: none"> – 000000b = count endless – 000001b = once: forward – 000010b = once: backwards – 000100b = once: no main direction – 001000b = periodic: forward – 010000b = periodic: backwards – 100000b = periodic: no main direction ■ <i>Bit 6: 1 (fix)</i> ■ <i>Bit 7: 0 (fix)</i>

MODE2_I Counter mode 2

Byte	Bit 7 ... 0
0	<ul style="list-style-type: none"> ■ <i>Bit 2 ... 0: Output set (... when following condition is met)</i> <ul style="list-style-type: none"> – 000b = never – 001b = counter value \geq comparison value – 010b = counter value \leq comparison value – 100b = counter value = comparison value ■ <i>Bit 3: Counter direction track B inverted</i> <ul style="list-style-type: none"> – 0 = No (not inverted) – 1 = Yes (inverted) ■ <i>Bit 6 ... 4: Reset</i> <ul style="list-style-type: none"> – 000b = de-activated – 001b = high level – 011b = edge 0-1 – 101b = edge 0-1 once ■ <i>Bit 7: 0 (fix)</i>

- For activation of the output the bit CTRL_DO_SET (bit 1) of the *control word* must be set!
- For activation of reset the bit CTRL_SYNC_SET (bit 0) of the *control word* must be set!

MODE3_I Counter mode 3

Byte	Bit 7 ... 0
0	<ul style="list-style-type: none"> ■ <i>Bit 2 ... 0: Signal evaluation</i> <ul style="list-style-type: none"> – 000b = Counter de-activated – 001b = Rotary encoder single (at A and B) – 010b = Rotary encoder double (at A and B) – 011b = Rotary encoder quadruple (at A and B) – 100b = Direction (pulse at A and direction at B) ■ <i>Bit 6 ... 3: HW gate</i> <ul style="list-style-type: none"> – 0000b = de-activated – 0001b = activated ■ <i>Bit 7: Gate function (internal gate)</i> <ul style="list-style-type: none"> – 0 = abort – 1 = interrupt

- At de-activated counter the further parameter settings are ignored.
- With de-activated *HW gate* the counter starts by setting *SW gate*.

- With activated *HW gate* activate a high level at gate the *HW gate*. The counter may only start when *HW gate* and *SW gate* are set.
- With gate function "abort" counting begins again at the load value. With "interrupt" counting is continued with the count.

END_I,LOAD_I End value, Load value

You may set an upper and a lower limit by setting a *load value* as start and an *end value*.

HYST_I Hysteresis

The *hysteresis* serves the avoidance of many toggle processes of the output and/or the interrupt, 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* influences zero run, comparison, over- and underflow.

PULSE_I Pulse (duration)

The *pulse duration* tells for what time the output is set when the parameterized comparison criterion is reached. The *pulse duration* can be set in steps of 2.048ms between 0 and 522.24ms. If the *pulse duration* = 0, the output is set active until the comparison condition is not longer fulfilled.

4.4 Counter - Functions

Overview

You may count forward and backwards and choose between the following counter functions:

- Count endless, e.g. distance measuring with incremental encoder
- Count once, e.g. count to a maximum limit
- Count periodic, e.g. count with repeated counter process

In the operating modes "Count once" and "Count periodic" you may define a counter range as start and end value via the parameterization. For every counter additional parameterizable functions are available like gate function, comparison, hysteresis and process interrupt.

Main counting direction

Via the parameterization you have the opportunity to define a main counting direction for every counter. If "none" is chosen, the complete counting range is available:

Limits	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.

**Gate function abort/
interrupt**

If the HW gate is enabled, only the HW gate may be influenced by the gate functions. An opening and closing of the SW gate only interrupts the count process.

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.

Count continuously

In this operating mode, the counter counts 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.

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

With overflow or underflow the status bits STS_OFLW respectively STS_UFLW are set. These bits remain set until these are reset with RES_STS. If enabled additionally a process interrupt is triggered.

**Count Once***No main counting direction*

- The counter counts once starting with the *load value*.
- You may count forward or backwards.
- The count limits are set to the maximum count range.
- At over- or underflow at the count limits, the counter jumps to the according other count limit and the internal gate is automatically closed and the status bits STS_OFLW respectively STS_UFLW are set. If enabled additionally a process interrupt is triggered.
- To restart the count process, you have to re-open the internal 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*.

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

Interrupting gate control:



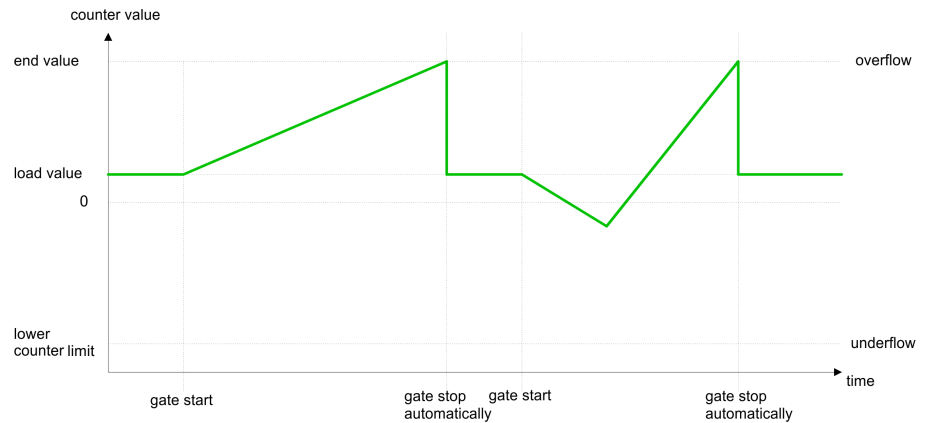
Aborting gate control:



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.

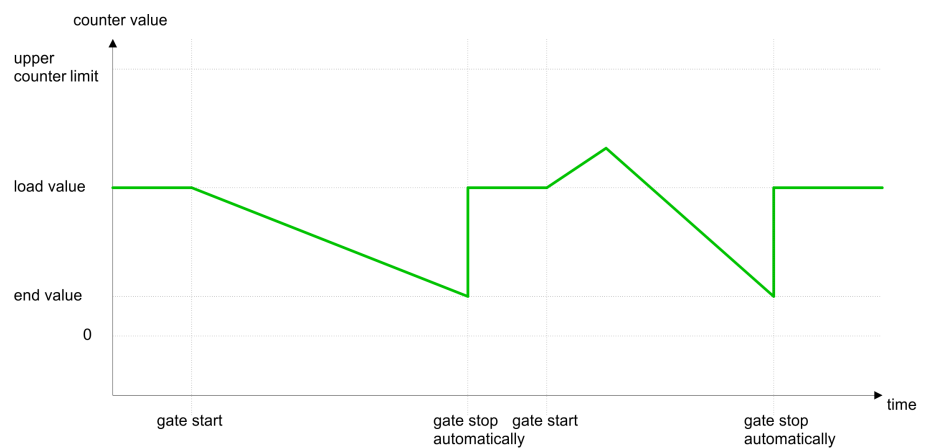
Limits	Valid value range
Limit value	-2 147 483 647 ($-2^{31} + 1$) to +2 147 483 647 ($2^{31} - 1$)
Lower count limit	-2 147 483 648 (-2^{31})



Main counting direction backwards

- The counter counts backwards starting with the *load value*.
- When the counter reaches the end value + 1 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.

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

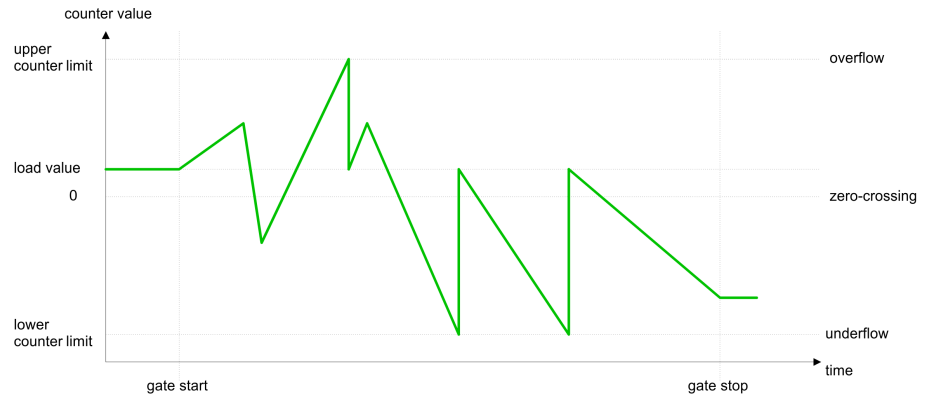


Count Periodically

No main counting direction

- The counter counts forward or backwards 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.

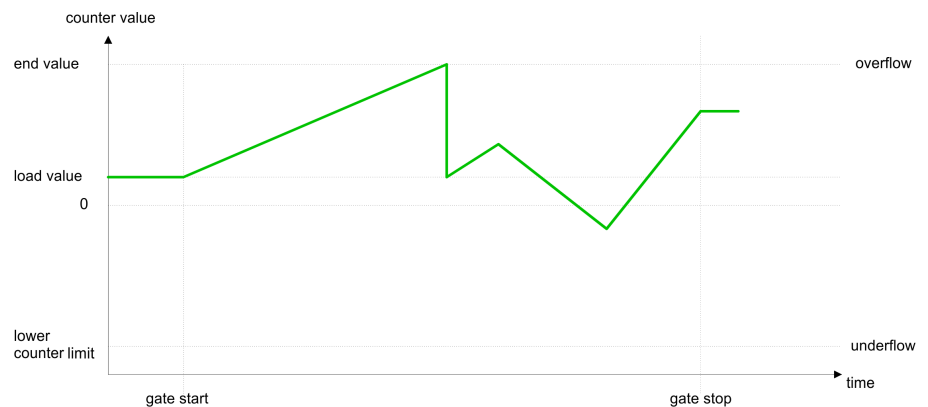
Limits	Valid value range
Lower count limit	-2 147 483 648 (-2^{31})
Upper count limit	+2 147 483 647 ($2^{31} - 1$)



Main counting direction forward

- The counter counts forward 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.

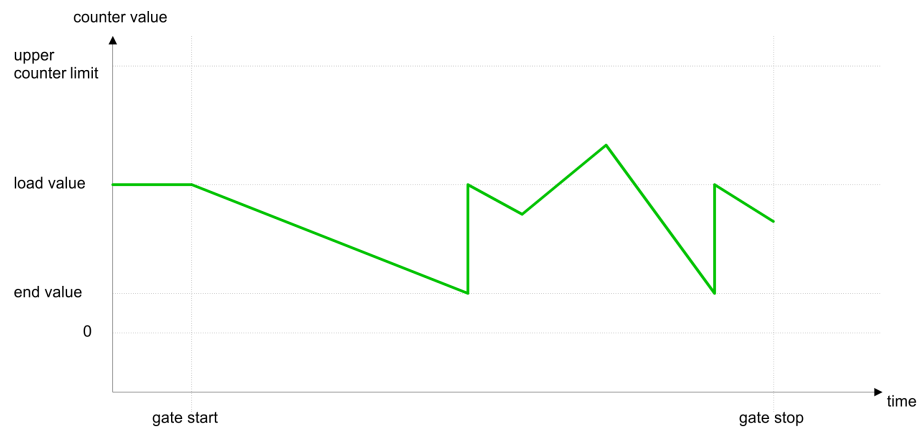
Limits	Valid value range
Limit value	-2 147 483 647 ($-2^{31} + 1$) to +2 147 483 647 ($2^{31} - 1$)
Lower count limit	-2 147 483 648 (-2^{31})



Main counting direction backwards

- The counter counts backwards starting with the *load value*.
- When the counter reaches the *end value* $+1$ in negative direction, it jumps to the *load value* at the next negative count pulse.
- You may exceed the upper count limit.

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



4.5 Counter additional functions

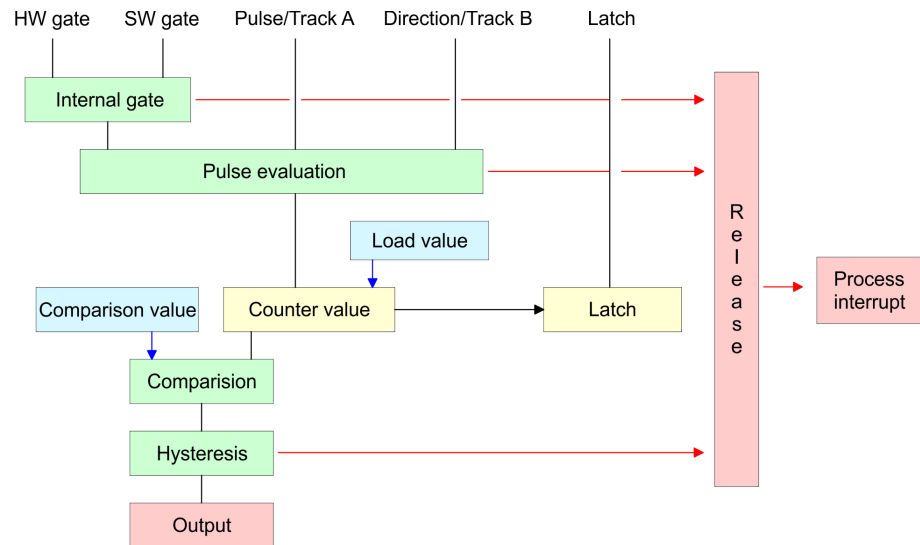
Overview

The following additional functions may be set for the counter via the parameterization of the 050-1BA00:

- Gate function:
 - The gate function serves for the start, stop and interrupt of a count function.
- Latch function:
 - An edge 0-1 at the digital input "Latch" stores the recent *counter value* in the latch register.
- Comparison:
 - You may set a *comparison value* that activates res. de-activates the digital output res. releases a process interrupt depending on the *counter value*.
- Hysteresis:
 - The setting of a *hysteresis* for example serves the avoidance of many toggle processes of the output and/or the interrupt, when the value of an encoder signal shifts around a *comparison value*.

Schematic structure

The illustration shows how the additional functions influence the counting behavior. The following pages describe these functions in detail:



Gate function

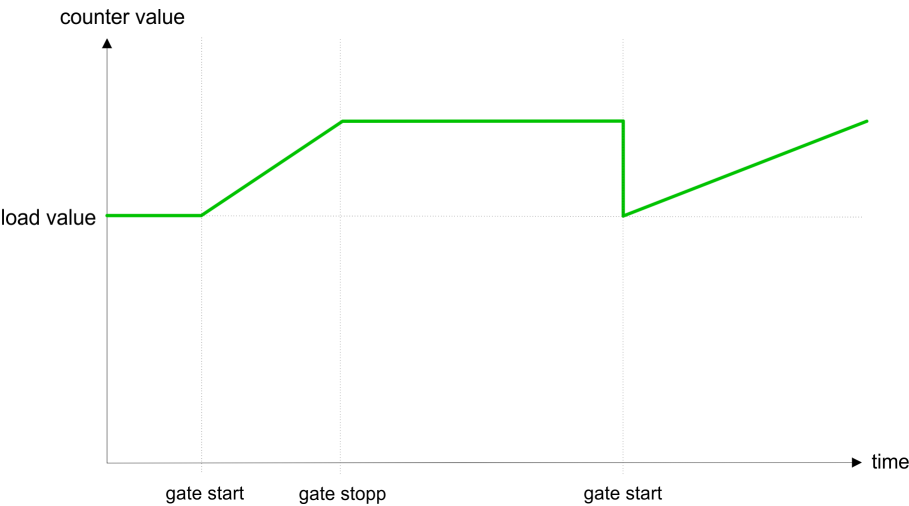
The activation res. de-activation of the counter happens via an internal gate (I gate). The I gate is the AND operation of the software gate (SW gate) and the hardware gate (HW gate). The *SW gate* is opened (activated) via your user application by an edge 0-1 of the bit `SW_GATE_SET` of `CCTRL_I` in the *output area*. The *software gate* is closed (de-activated) by an edge 0-1 of the bit `SW_GATE_RESET`. The HW gate is controlled via the concerning "Gate" input. The parameterization allows you to de-activate the consideration of the *HW gate* so that the counter activation can take place only via the *SW gate*. The following states influence the I gate:

SW gate	HW gate	influences I gate
0	with edge 0-1	0
1	with edge 0-1	1
with edge 0-1	1	1
with edge 0-1	0	0
with edge 0-1	de-activated	1

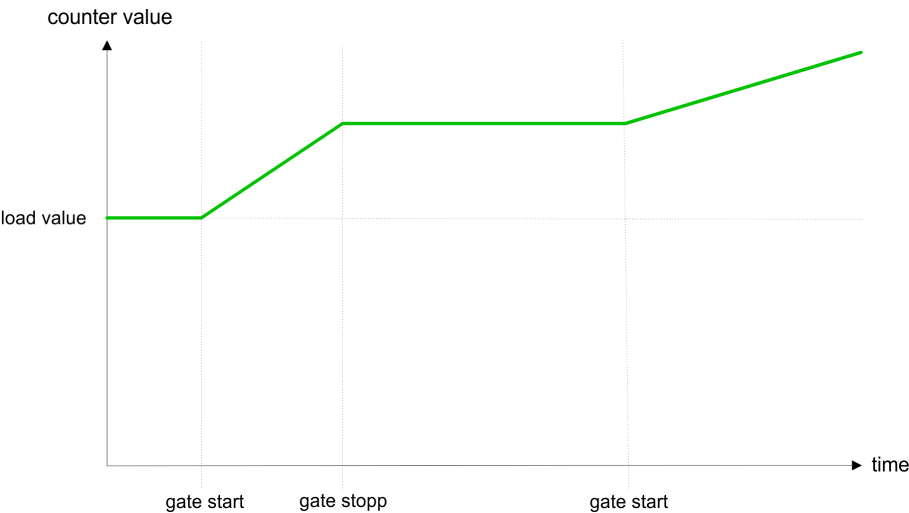
Gate function abort and interrupt

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 recent counter value after gate restart.



Gate control abort, interruption

Gate control via SW gate, aborting

SW gate	HW gate	Reaction Counter
edge 0-1	de-activated	Restart with <i>load value</i>

Gate control via SW gate, interrupting

SW gate	HW gate	Reaction Counter
edge 0-1	de-activated	Continue

Gate control via SW/HW gate, aborting

SW gate	HW gate	Reaction Counter
edge 0-1	1	Continue
1	edge 0-1	Restart with <i>load value</i>

Gate control via SW/HW gate, interrupting

SW gate	HW gate	Reaction Counter
edge 0-1	1	Continue
1	edge 0-1	Continue

Gate control "Count once"

Gate control via *SW/HW gate*, operating mode "Count once": If the internal gate has been closed automatically it may only be opened again under the following conditions:

SW gate	HW gate	Reaction I gate
1	edge 0-1	1
edge 0-1 (after edge 0-1 at HW gate)	1	1

Latch function

As soon as during a count process an edge 0-1 is recognized at the "Latch" input of the counter, the recent *counter value* is stored in the latch register. You may access the latch register via the *input area*. After a STOP-RUN transition latch is always 0.

Comparison

The *compare value* is to be pre-defined by CC_I. As soon as a comparison condition is kept, the bit STS_DO of the counter status is set. Please consider that the bit STS_DO may only be influenced when in the *counter status* the bit STS_CTRL_DO is set. You pre-define the behavior of the counter output via the parameterization (MODE2_I):

- output never switches
- output switches when *counter value* \geq *comparison value*
- output switches when *counter value* \leq *comparison value*
- output switches at *comparison value*

Output never switches

The output never switches.

Output switches when counter value \geq comparison value

The output remains set as long as the *counter value* is higher or equal *comparison value*.

Output switches when counter value \leq comparison value

The output remains set as long as the counter value is lower or equal comparison value.

Pulse at comparison value

When the counter reaches the *comparison value* the output is set for the parameterized *pulse duration*. If the pulse duration = 0 the output is set until the comparison condition is no longer met. When you've set a main counting direction the output is only set at reaching the *comparison value* from the main counting direction.

Pulse duration

The *pulse duration* defines how long the output is set. It may be preset in steps of 2.048ms between 0 and 522.24ms. The *pulse duration* starts with the setting of the according digital output. The inaccuracy of the *pulse duration* is less than 2.048ms. There is no past triggering of the *pulse duration* when the *comparison value* has been left and reached again during pulse output.



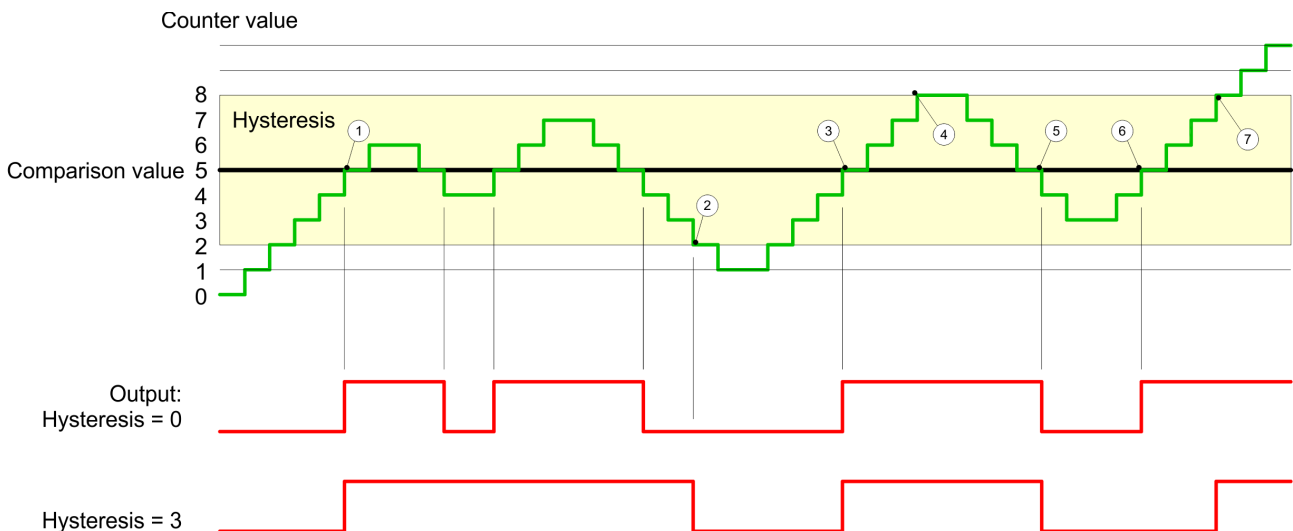
The bit *STS_DO* is set together with the bit *STS_CMP* in the counter status. In contrast to the bit *STS_DO* this bit remains set as long as it is reset by setting the bit *RES_SET* in the control word.

Hysteresis

- The *hysteresis* serves the avoidance of many toggle processes of the output and the interrupt, if the *counter value* is in the range of the *comparison value*.
- For the hysteresis you may set a range of 0 to 255.
- The settings 0 and 1 deactivate the *hysteresis*.
- The *hysteresis* influences zero run, comparison, over- and under-flow.
- An activated *hysteresis* remains active after a change. The new *hysteresis* range is activated with the next *hysteresis* event.

The following pictures illustrate the output behavior for *hysteresis* 0 and *hysteresis* 3 for the according conditions:

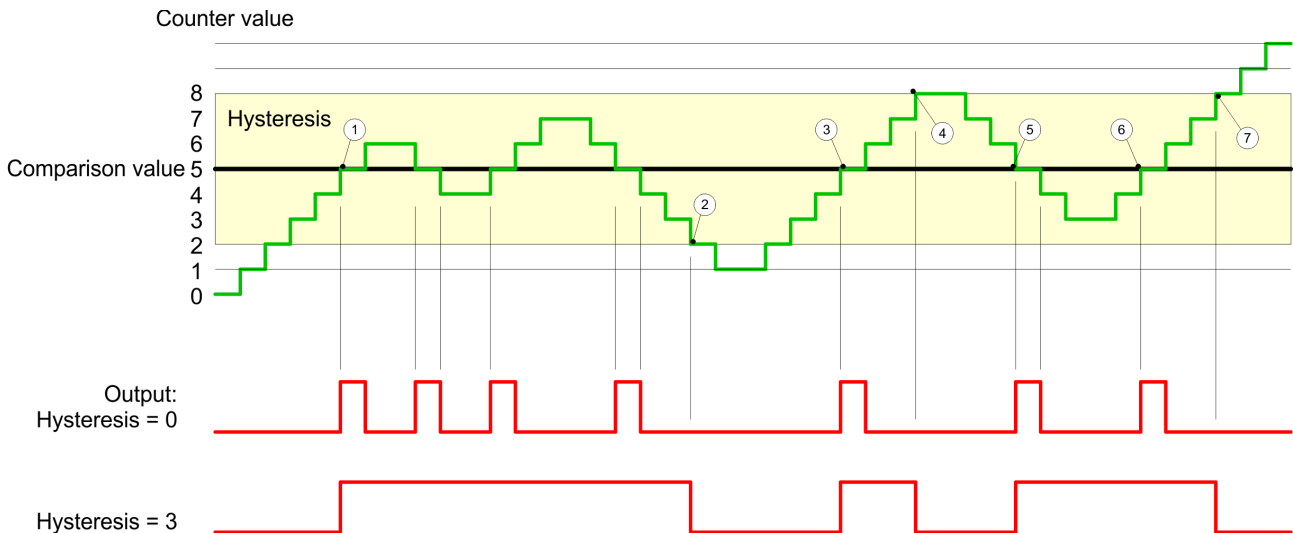
Effect at counter value \geq comparison value



- 1 *Counter value* \geq *comparison value* \rightarrow output is set and *hysteresis* activated
- 2 Leave *hysteresis* range \rightarrow output is reset
- 3 *Counter value* \geq *comparison value* \rightarrow output is set and *hysteresis* activated
- 4 Leave *hysteresis* range, output remains set for *counter value* \geq *comparison value*
- 5 *counter value* $<$ *comparison value* and *hysteresis* active \rightarrow output is reset
- 6 *counter value* \geq *comparison value* \rightarrow output is not set for *hysteresis* active
- 7 Leave *hysteresis* range, output remains set for *counter value* \geq *comparison value*

With reaching the comparison condition the *hysteresis* gets active. At active *hysteresis* the comparison result remains unchanged until the *counter value* leaves the set *hysteresis* range. After leaving the *hysteresis* range a new *hysteresis* is only activated with again reaching the comparison conditions.

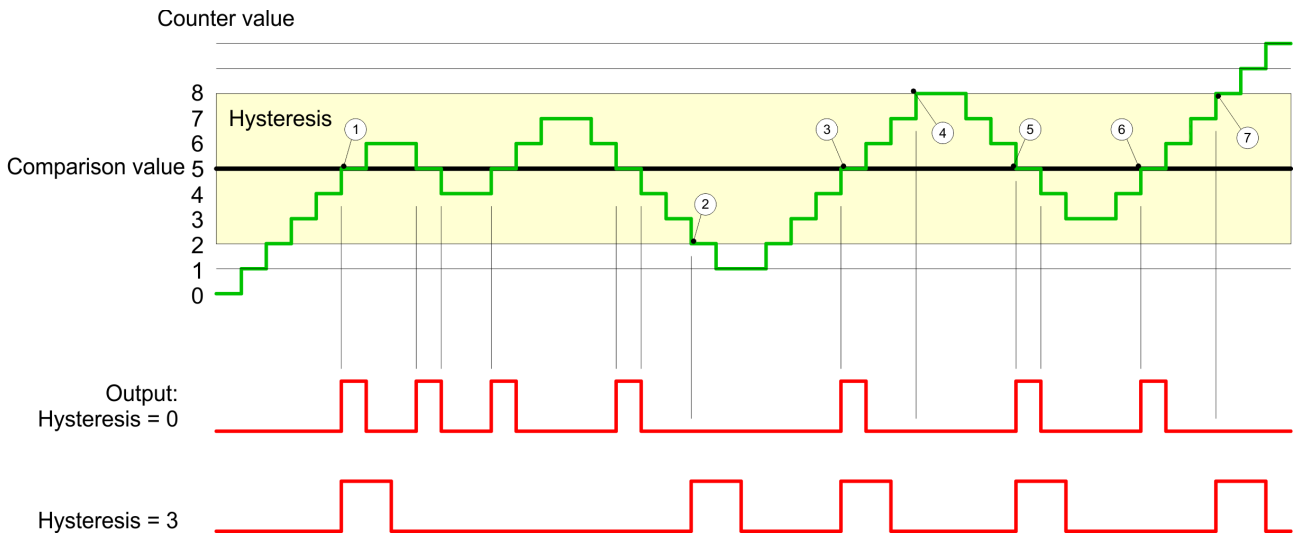
Effect at pulse at comparison value with pulse duration Zero



- 1 Counter value = comparison value → output is set and *hysteresis* activated
- 2 Leave *hysteresis* range → output is reset and *counter value* < *comparison value*
- 3 Counter value = comparison value → output is set and *hysteresis* activated
- 4 Output is reset for leaving *hysteresis* range and *counter value* > *comparison value*
- 5 Counter value = comparison value → output is set and *hysteresis* activated
- 6 Counter value = comparison value and *hysteresis* active → output remains set
- 7 Leave *hysteresis* range and *counter value* > *comparison value* → output is reset

With reaching the comparison condition the *hysteresis* gets active. At active *hysteresis* the comparison result remains unchanged until the *counter value* leaves the set *hysteresis* range. After leaving the *hysteresis* range a new *hysteresis* is only activated with again reaching the comparison conditions.

Effect at pulse at comparison value with pulse duration not zero



- 1 Counter value = comparison value → pulse of the parameterized pulse duration is put out, the hysteresis is activated and the counting direction stored
- 2 Leaving the hysteresis range contrary to the stored counting direction → pulse of the parameterized pulse duration is put out, the hysteresis is de-activated
- 3 Counter value = comparison value → pulse of the parameterized pulse duration is put out, the hysteresis is activated and the counting direction stored
- 4 Leaving the hysteresis range without changing counting direction → hysteresis is de-activated
- 5 Counter value = comparison value → pulse of the parameterized pulse duration is put out, the hysteresis is activated and the counting direction stored
- 6 Counter value = comparison value and hysteresis active → no pulse
- 7 Leaving the hysteresis range contrary to the stored counting direction → pulse of the parameterized pulse duration is put out, the hysteresis is de-activated

With reaching the comparison condition the hysteresis gets active and a pulse of the parameterized duration is put out. As long as the counter value is within the hysteresis range, no other pulse is put out. With activating the hysteresis the counting direction is stored in the module. If the counter value leaves the hysteresis range contrary to the stored counting direction, a pulse of the parameterized duration is put out. Leaving the hysteresis range without direction change, no pulse is put out.

4.6 Diagnostic and interrupt

Overview

Event	Process interrupt	Diagnostics interrupt	parameterizable
HW gate open	X	-	X
HW gate closed	X	-	X

Event	Process interrupt	Diagnostics interrupt	parameterizable
Overflow	X	-	X
Underflow	X	-	X
Comparison value	X	-	X
End value	X	-	X
Latch value	X	-	X
Diagnostics buffer overflow	-	X	-
Process interrupt lost	-	X	X
Overload at output	-	X	X

Process interrupt

So you may react to asynchronous events, there is the possibility to activate a process interrupt. A process interrupt interrupts the linear program sequence and jumps depending on the master system to a corresponding Interrupt routine. Here you can react to the process interrupt accordingly.

With CANopen the process interrupt data are transferred via an emergency telegram. Operating with CPU, PROFIBUS and PROFINET the process interrupt data were transferred via diagnostics telegram.

SX - Subindex for access via EtherCAT.

Name	Bytes	Function	Default	SX
PRIT_A	1	Process interrupt data	00h	02h
PRIT_B	1	State of the inputs	00h	03h
PRIT_US	2	µs ticker	00h	04h ... 05h

PRIT_A Process interrupt data

Byte	Bit 7 ... 0
0	Process interrupt data <ul style="list-style-type: none"> ■ Bit 0: HW gate opened ■ Bit 1: HW gate closed ■ Bit 2: Overflow, underflow or end value reached ■ Bit 3: Comparison value reached ■ Bit 4: Latch value reached ■ Bit 7 ... 5 reserved

PRIT_B State of the inputs

Byte	Bit 7 ... 0
0	State of the inputs at the moment of the process interrupt <ul style="list-style-type: none"> ■ Bit 0: Input value channel 0 (TrackA) ■ Bit 1: Input value channel 1 (TrackB) ■ Bit 2: Input value channel 2 (Latch) ■ Bit 3: Input value channel 3 (HW gate) ■ Bit 4: Input value channel 4 (Reset) ■ Bit 7 ... 5 reserved

PRIT_US μ s ticker

Byte	Bit 7 ... 0
0 ... 1	Value of the μ s ticker at the moment of the process interrupt

 μ s ticker

In the SLIO module there is a timer (μ s ticker). With PowerON the timer starts counting with 0. After $2^{16}-1\mu$ s the timer starts with 0 again.

Diagnostic data

Via the parameterization you may activate a diagnostic interrupt for the module. With a diagnostic interrupt the module serves for diagnostic data for diagnostic interrupt_{incoming}. As soon as the reason for releasing a diagnostic interrupt is no longer present, the diagnostic interrupt_{going} automatically takes place. All events of a channel between diagnostic interrupt_{incoming} and diagnostic interrupt_{going} are not stored and get lost. Within this time window (1. diagnostic interrupt_{incoming} until last diagnostic interrupt_{going}) the MF-LED of the module is on.

DS - Record set for access via CPU, Profibus and ProfiNET. The access happens by DS 01h. Additionally the first 4 bytes may be accessed by DS 00h.

IX - Index for access via CANopen. The access happens by IX 2F01h. Additionally the first 4 bytes may be accessed by IX 2F00h.

SX - Subindex for access via EtherCAT.

Name	Bytes	Function	Default	DS	IX	SX
ERR_A	1	Diagnostic	00h	01h	2F01h	02h
MODTYP	1	Module information	18h			03h
ERR_C	1	reserved	00h			04h
ERR_D	1	Diagnostic	00h			05h
CHTYP	1	Channel type	76h			06h
NUMBIT	1	Number diagnostics bits per channel	08h			07h
NUMCH	1	Number channels of the module	01h			08h

Name	Bytes	Function	Default	DS	IX	SX
CHERR	1	Channel error	00h			09h
CH0ERR	1	Channel-specific error	00h			0Ah
CH1ERR... CH7ERR	7	reserved	00h			0Bh ... 11h
DIAG_US	4	µs ticker	00h			12h

ERR_A Diagnostic

Byte	Bit 7 ... 0
0	<ul style="list-style-type: none"> ■ Bit 0: set at module failure ■ Bit 1: reserved ■ Bit 2: set at external error ■ Bit 3: set at channel error ■ Bit 4: set at overload at output ■ Bit 7 ... 5: reserved

MODTYP Modul information

Byte	Bit 7 ... 0
0	<ul style="list-style-type: none"> ■ Bit 3 ... 0: Module class <ul style="list-style-type: none"> – 1000b: Function module ■ Bit 4: set at channel information present ■ Bit 7 ... 5: reserved

ERR_C reserved

Byte	Bit 7 ... 0
0	reserved

ERR_D Diagnostic

Byte	Bit 7 ... 0
0	<ul style="list-style-type: none"> ■ Bit 2 ... 0: reserved ■ Bit 3: set at internal diagnostics buffer overflow ■ Bit 5 ... 4: reserved ■ Bit 6: Process interrupt lost ■ Bit 7: reserved

CHTYP Channel type

Byte	Bit 7 ... 0
0	<ul style="list-style-type: none"> ■ Bit 6 ... 0: Channel type <ul style="list-style-type: none"> – 76h: Counter module ■ Bit 7: reserved

NUMBIT Diagnostic bits

Byte	Bit 7 ... 0
0	Number of diagnostics bits of the module per channel (here 08h)

NUMCH Channels

Byte	Bit 7 ... 0
0	Number of channels of the module (here 01h)

CHERR Channel error

Byte	Bit 7 ... 0
0	<ul style="list-style-type: none"> ■ Bit 0: set at error in channel group 0 ■ Bit 7 ... 1: reserved

CH0ERR channel-specific

Byte	Bit 7 ... 0
0	Diagnostic interrupt due to process interrupt lost at ... <ul style="list-style-type: none"> ■ Bit 0: Hardware gate open ■ Bit 1: Hardware gate closed ■ Bit 2: Overflow/underflow/end value ■ Bit 3: Comparison value reached ■ Bit 4: Latch value stored ■ Bit 7 ... 5: reserved

CH1ERR ... CH7ERR reserved

Byte	Bit 7 ... 0
0	reserved

DIAG_US μ s ticker

Byte	Bit 7 ... 0
0 ... 3	Value of the μ s ticker at the moment of the diagnostic

 μ s ticker

In the SLIO module there is a timer (μ s ticker). With PowerON the timer starts counting with 0. After $2^{32}-1\mu$ s the timer starts with 0 again.