VIPA System SLIO

VIPA

Note

Every effort has been made to ensure that the information contained in this document was complete and accurate at the time of publishing. Nevertheless, the authors retain the right to modify the information. This customer document describes all the hardware units and functions known at the present time. Descriptions may be included for units which are not present at the customer site. The exact scope of delivery is described in the respective purchase contract.

CE Conformity Declaration

Hereby, VIPA GmbH declares that the products and systems are in compliance with the essential requirements and other relevant provisions.

Conformity is indicated by the CE marking affixed to the product.

Conformity Information

For more information regarding CE marking and Declaration of Conformity (DoC), please contact your local VIPA customer service organization.

Trademarks

VIPA, SLIO, System 100V, System 200V, System 300V, System 300S, System 400V, System 500S and Commander Compact are registered trademarks of VIPA Gesellschaft für Visualisierung und Prozessautomatisierung mbH.

SPEED7 is a registered trademark of profichip GmbH.

SIMATIC, STEP, SINEC, TIA Portal, S7-300 and S7-400 are registered trademarks of Siemens AG.

Microsoft und Windows are registered trademarks of Microsoft Inc., USA.

Portable Document Format (PDF) and Postscript are registered trademarks of Adobe Systems, Inc.

All other trademarks, logos and service or product marks specified herein are owned by their respective companies.

Information product support

Contact your local VIPA Customer Service Organization representative if you wish to report errors or questions regarding the contents of this document. If you are unable to locate a customer service center, contact VIPA as follows:

VIPA GmbH, Ohmstraße 4, 91074 Herzogenaurach, Germany

Telefax:+49 9132 744 1204
EMail: documentation@vipa.de

Technical support

Contact your local VIPA Customer Service Organization representative if you encounter problems with the product or have questions regarding the product. If you are unable to locate a customer service center, contact VIPA as follows:

VIPA GmbH, Ohmstraße 4, 91074 Herzogenaurach, Germany

Telephone: +49 9132 744 1150 (Hotline)
EMail: support@vipa.de

Contents

About this manual

This manual describes the IM 053-1EC00 EtherCAT coupler of the System SLIO from VIPA. Here you may find every information for commissioning and operation.

Overview   **Chapter 1:   Basics and Assembly**

The focus of this chapter is on the introduction of the VIPA System SLIO. Here you will find the information required to assemble and wire a controller system consisting of System SLIO components.
Besides the dimensions the general technical data of System SLIO will be found.

Chapter 2:   Hardware description

Here the hardware components of the IM 053-1EC00 EtherCAT coupler are more described.
You will find the technical data at the end of this chapter.

Chapter 3:   Deployment

This chapter describes the usage of the IM 053-1EC00 EtherCAT coupler from VIPA. After a short introduction you may find here every information about assembly and project engineering. The chapter closes with the description of the error handling.

Objective and contents

This manual describes the IM 053-1EC00 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_IM and relevant for:

Product	Order number	as of state: HW	FW
IM 053EC	VIPA 053-1EC00	02	1.3.0

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
- an overview of the topics for every chapter

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.

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

Note!
Supplementary information and useful tips.

Safety information

Applications conforming with specifications

The System SLIO is constructed and produced for:

- communication and process control
- general control and automation applications
- 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

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

- Modification to the process control system should only be carried out when the system has been disconnected from power!

- Installation and 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!**

Chapter 1   Basics and Assembly

Overview   The focus of this chapter is on the introduction of the VIPA System SLIO. Here you will find the information required to assemble and wire a controller system consisting of System SLIO components.

Besides the dimensions the general technical data of System SLIO will be found.

Content

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.

Attention!

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

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 colors 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.
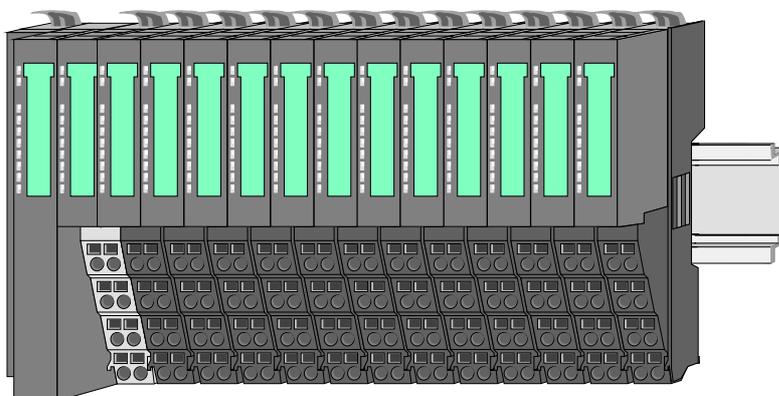
Components   The System SLIO consists of the following components:

- Bus coupler
- Periphery modules
- Power modules
- Accessories
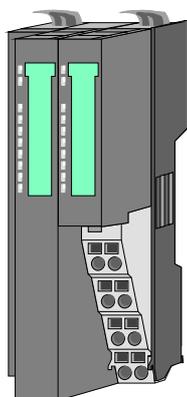
Bus coupler   With a bus coupler bus interface and power module is integrated to one casing. With the bus interface you get access to a subordinated bus system.

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.

Periphery modules   Each periphery module consists of a *terminal* and an *electronic* module.
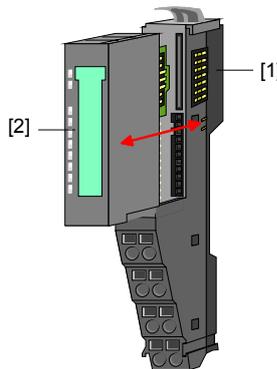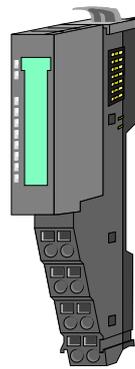
[1]   Terminal module

[2]   Electronic module

Terminal module
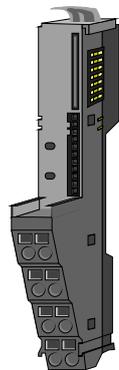
The *terminal module* serves to carry the electronic module, contains the backplane bus with power supply for the electronic, the DC 24V power section supply and the staircase-shaped terminal for wiring.

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
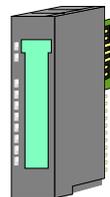
The functionality of a SLIO periphery module is defined by the *electronic module*, which is mounted to the terminal module by a safe sliding mechanism.

With an error the defective module may be exchanged for a functional module with standing installation.

By an integrated coding only the modules may be plugged, which may be combined.

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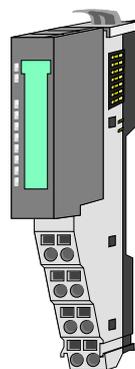
In the System SLIO the power supply is established by power modules. These are either integrated to the bus coupler or may be installed between the periphery modules. Depending on the power module isolated areas of the DC 24V power section supply may be defined respectively the electronic power supply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

For better recognition the color of the power modules are contrasting to the periphery modules.

Accessories

Shield bus carrier

The shield bus carrier 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.

Dimensions

**Dimensions
bus coupler**

104
109
76.5
48.5
49
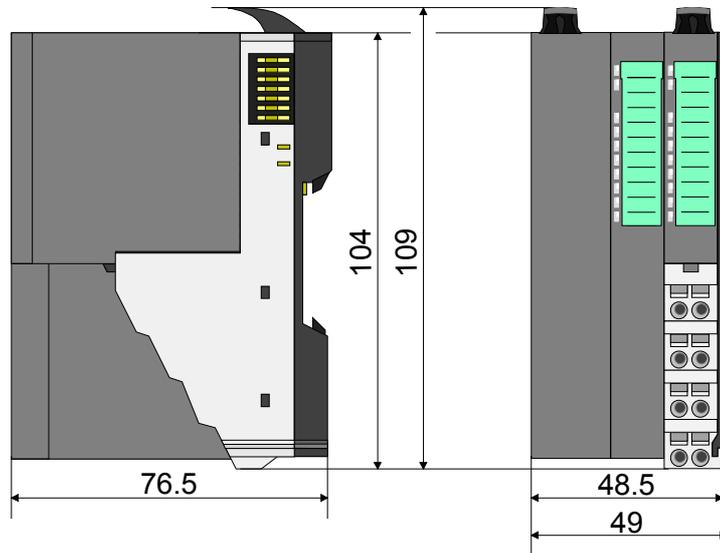
**Dimensions
periphery module**

104
109
133
76.5
12.9
15
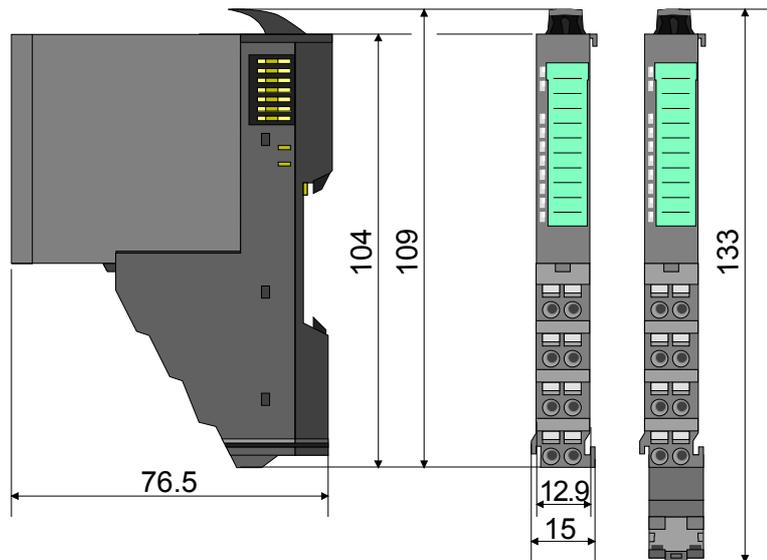
**Dimensions
electronic module**

55.5
62
12.9
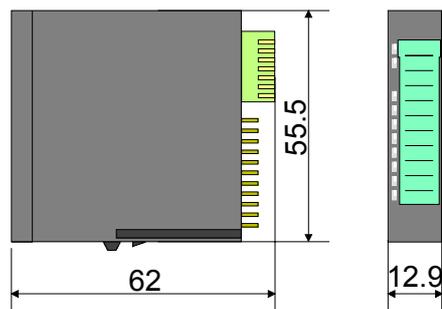
Dimensions in mm

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.

Clack

1   2   3
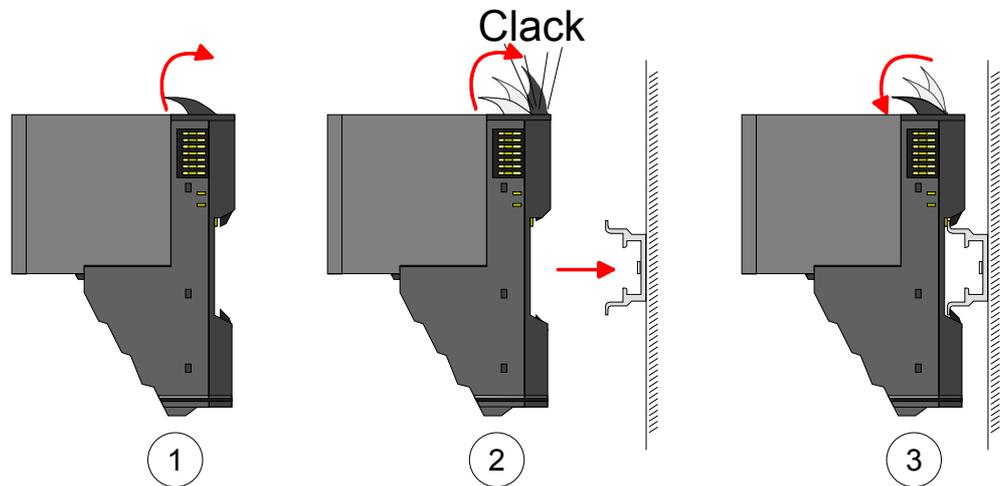
For the exchange of a electronic module, the electronic module may be pulled forward after pressing the unlocking lever at the lower side of the module.

For installation plug the electronic module guided by the strips at the lower side until this engages audible to the terminal module.

2. Pull

1. Press

Clack

1   2   3
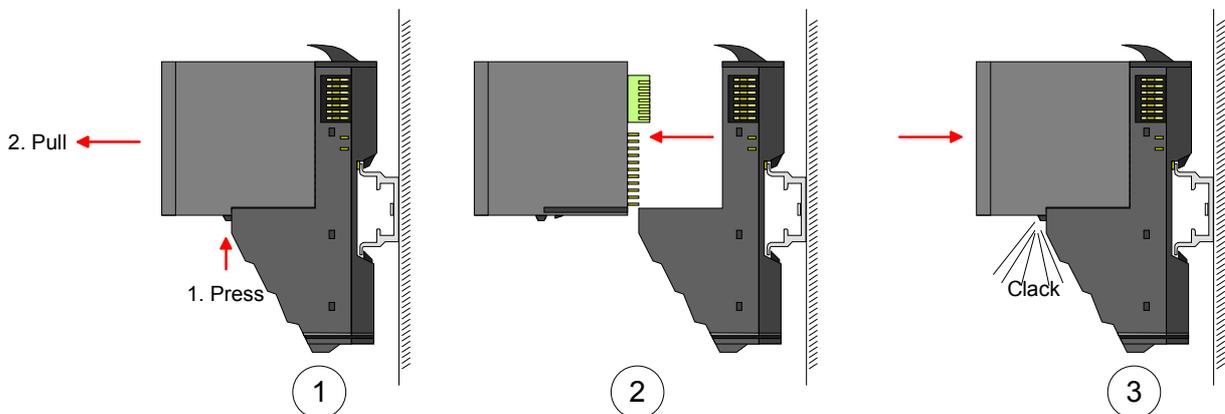
Mounting Proceeding

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. More about this may be found at "Wiring".

Mounting 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.
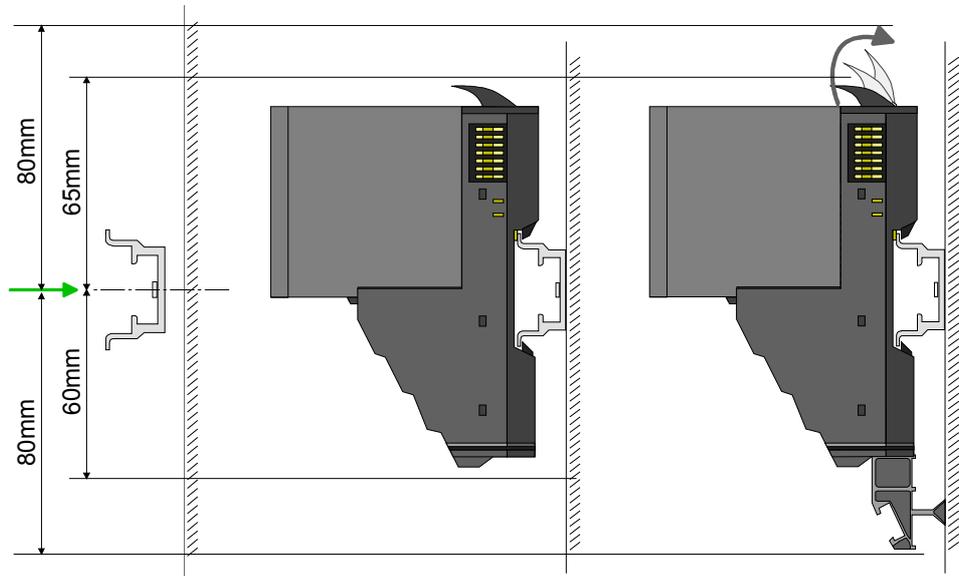
Mounting Head module (e.g. bus coupler)

- 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.

- 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.

①

②
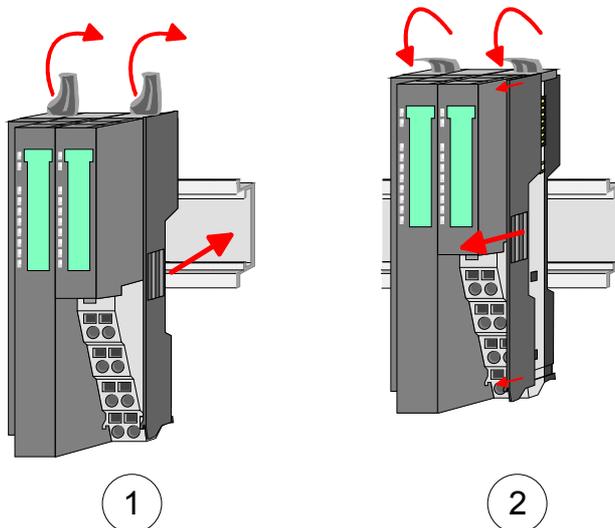
Mounting
periphery modules

- Mount the periphery modules you want.

Clack

1   2   3
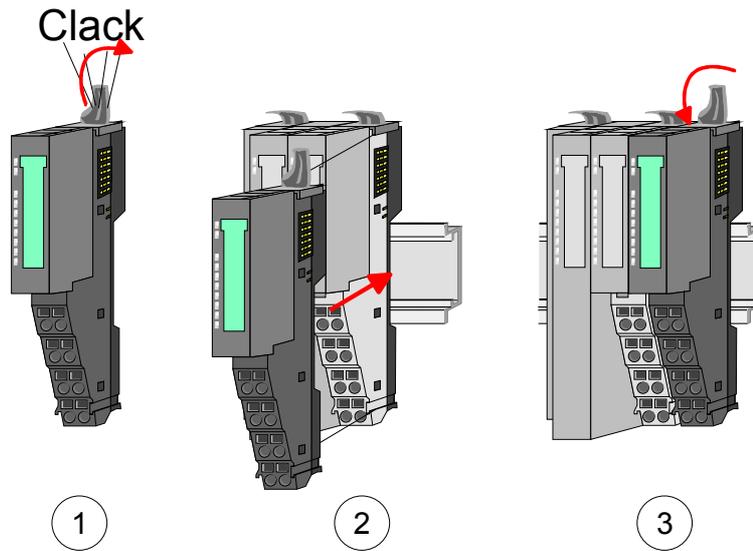
Mounting the
bus cover

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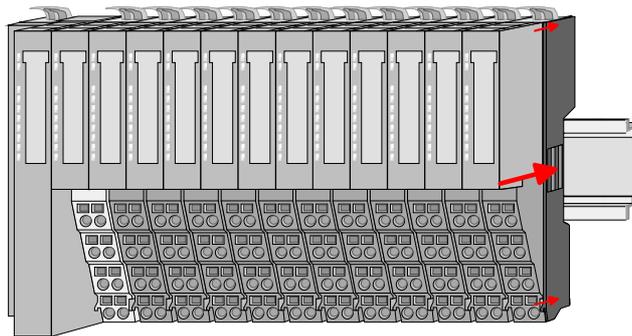
Mounting
shield bus carrier

- 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.

Clack
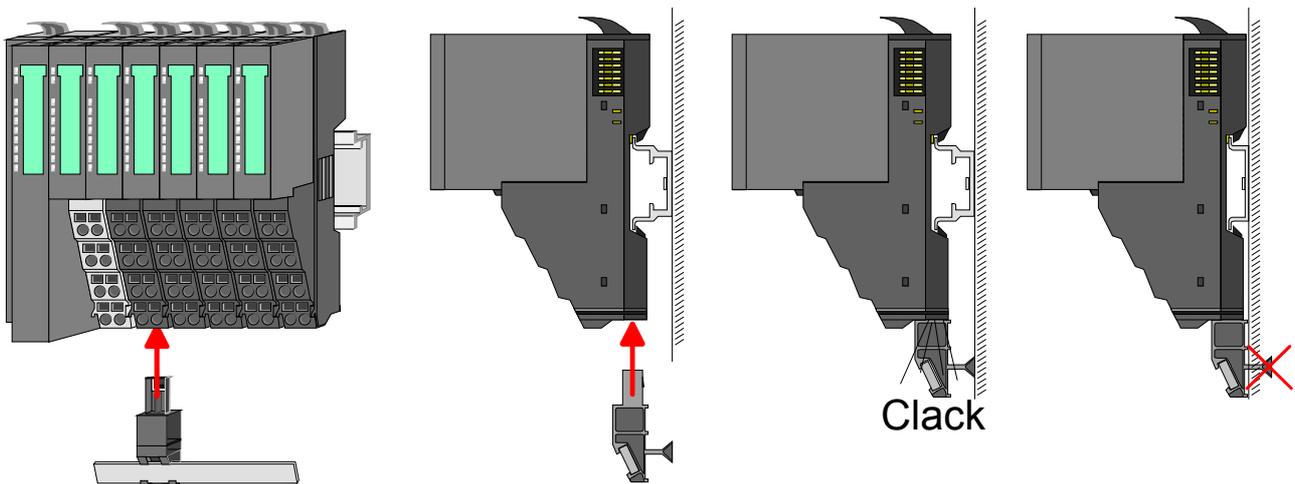
Demounting and module exchange

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 <u>right</u> module. After the mounting it may be plugged again.

Exchange of an electronic module

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.

For installation plug the electronic module guided by the strips at the lower side until this engages audible to the terminal module.
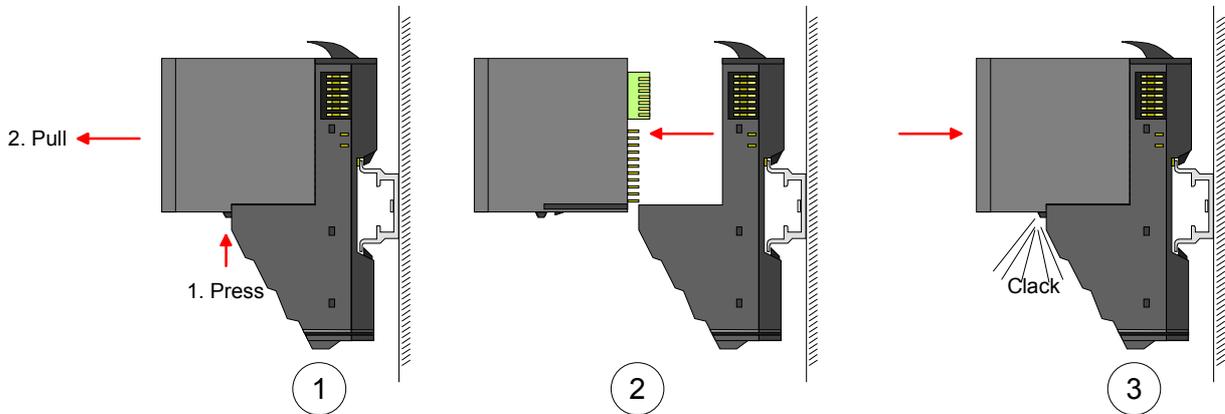
Exchange of a module

- Remove if exists the wiring. More about this may be found at "Wiring".
- Press the unlocking lever at the lower side of the just mounted right module and pull it forward.
- Turn the locking lever of the module to be exchanged upwards.
- Pull the module forward.
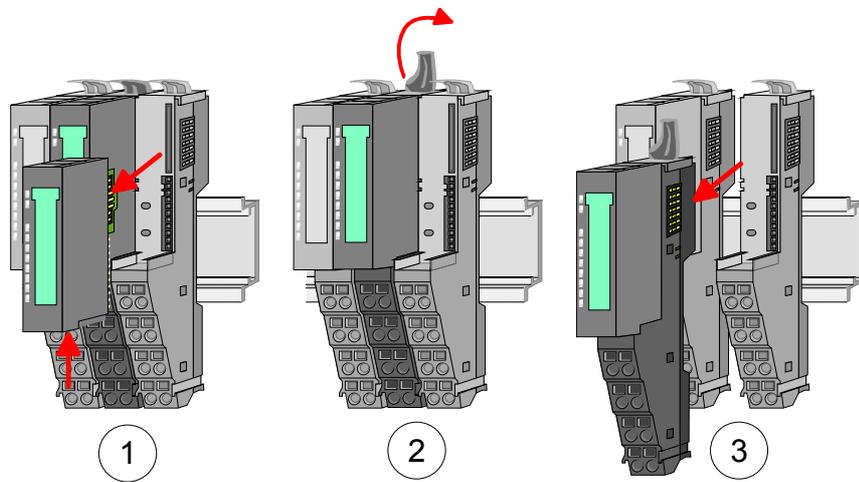
- For mounting turn the locking lever of the module to be mounted upwards.

- 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.

- Turn the locking lever downward again.

- Plug again the electronic module, which you have removed before.
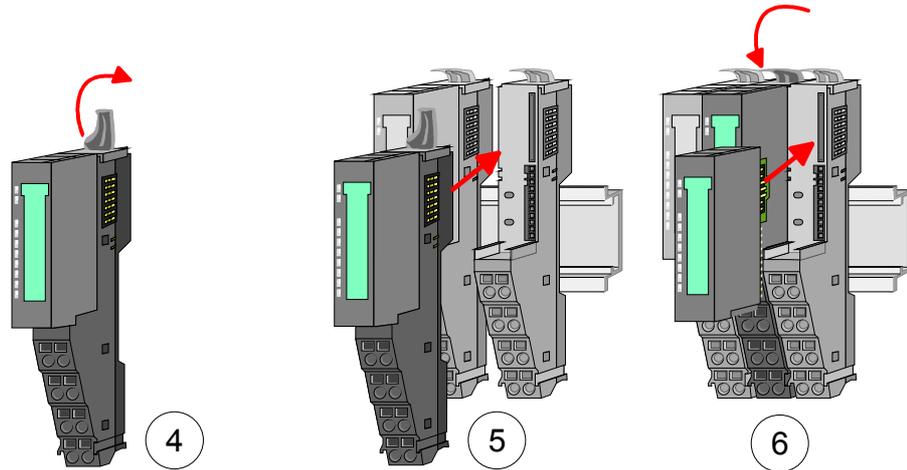
Exchange of a head module
(e.g. bus coupler)

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

- Remove if exists the wiring of the head module. More about this may be found at "Wiring".

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

- Turn all the locking lever of the head module to be exchanged upwards.

- Pull the head module forward.
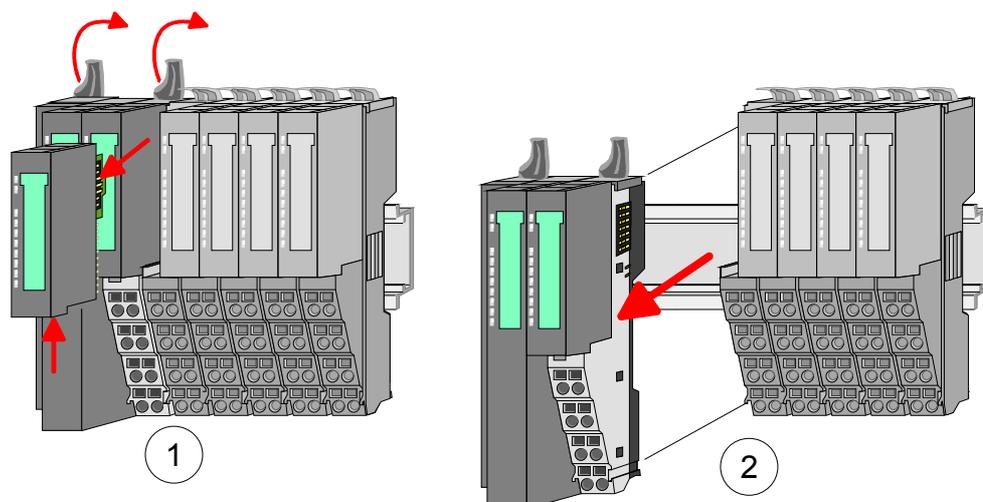
- For mounting turn all the locking lever of the head module to be mounted upwards.
- To mount the head module put it to the left module and push it, guided by the stripes, to the mounting rail.
- Turn all the locking lever downward again.
- Plug again the electronic module, which you have removed before.
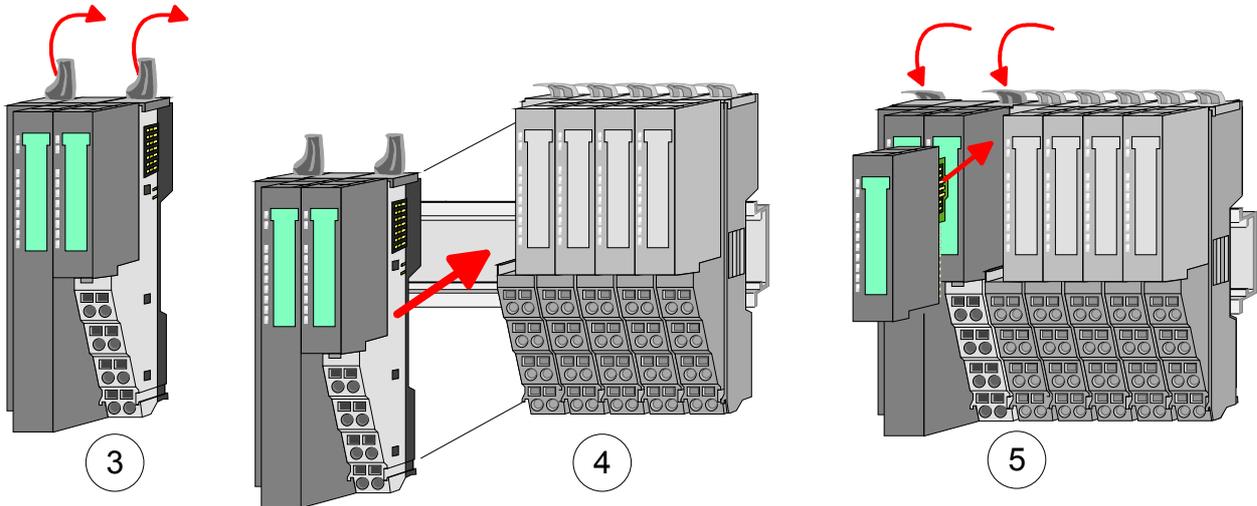
Exchange of a module group

- Remove if exists the wiring of the module group. More about this may be found at "Wiring".
- Press the unlocking lever at the lower side of the just mounted right module of the module group and pull it forward.
- Turn all the locking lever of the module group to be exchanged upwards.
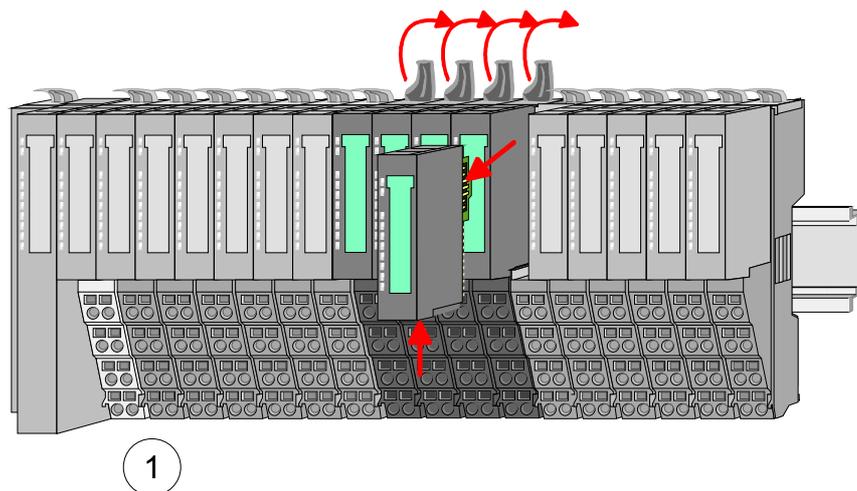
- Pull the module group forward.

2
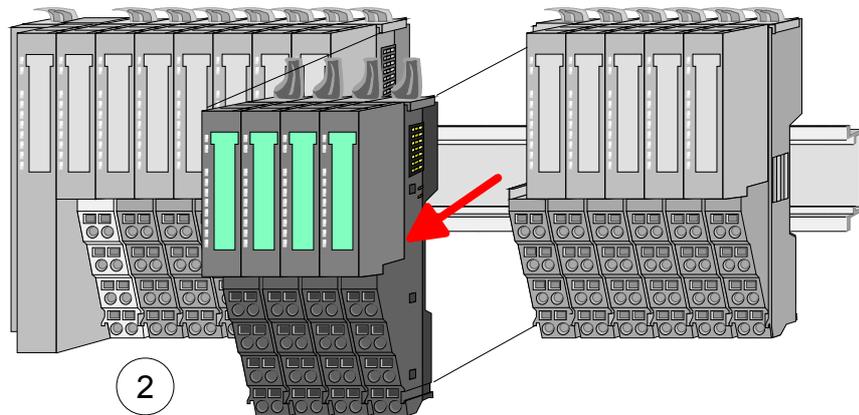
- For mounting turn all the locking lever of the module group to be mounted upwards.
- To mount the module group put it to the gap between the both modules and push it, guided by the stripes at both sides, to the mounting rail.

3

4

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

5
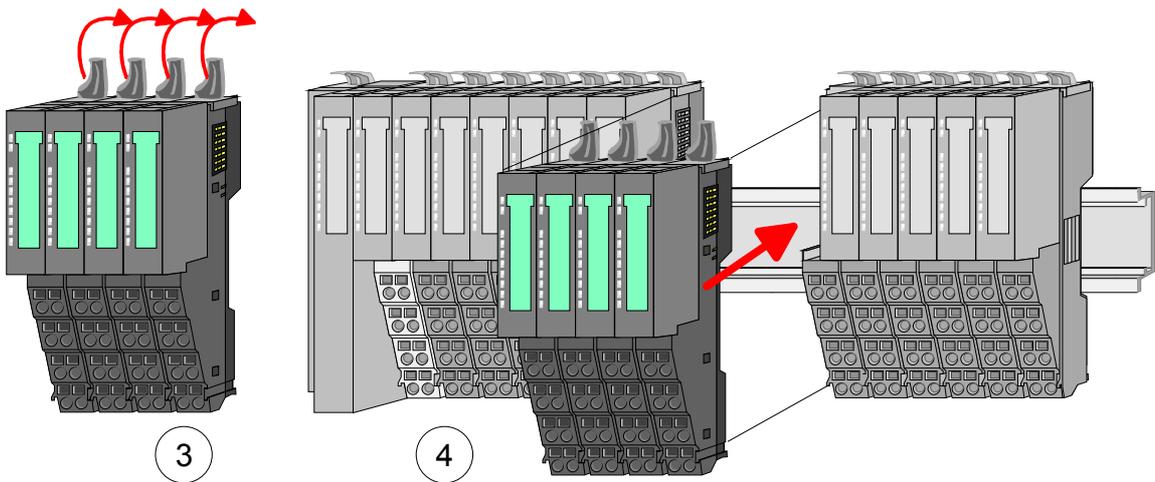
Wiring

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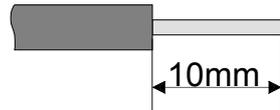
U_{max}: 240V AC / 30V DC

I_{max}: 10A

Cross section: 0.08 ... 1.5mm^2 (AWG 28 ... 16)

Stripping length: 10mm

Wiring procedure
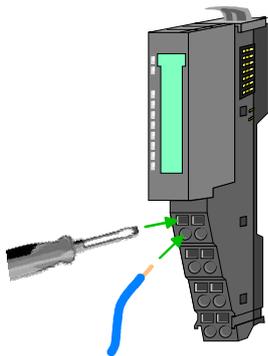
- Insert a suited screwdriver at an angel into the square opening as shown.
  Press and hold the screwdriver in the opposite direction to open the contact spring.

- Insert the stripped end of wire into the round opening. You can use wires with a cross section of 0.08mm^2 to 1.5mm^2.

- By removing the screwdriver, the wire is securely fixed via the spring contact to the terminal.
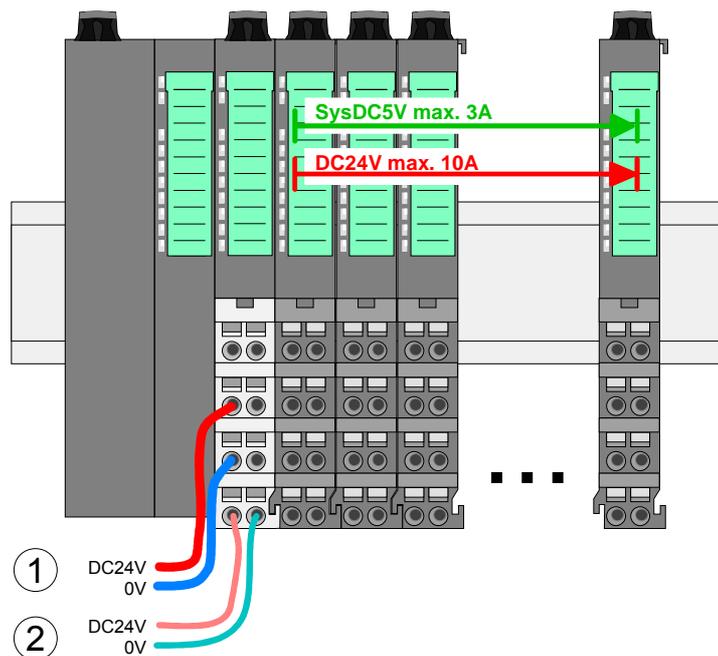
① ② ③

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

Attention!
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!

Note!
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. More concerning this may be found at the following page.

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
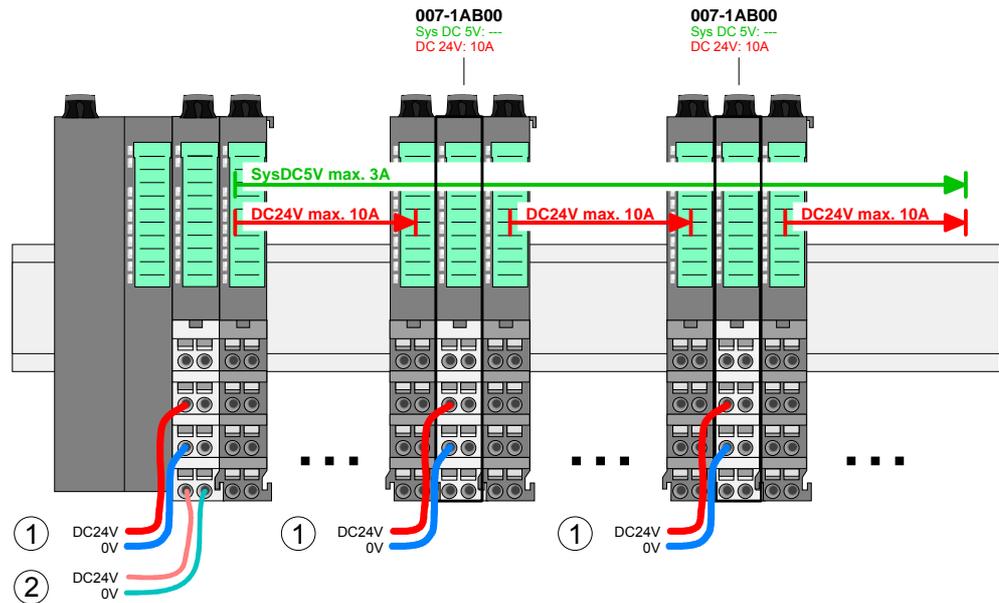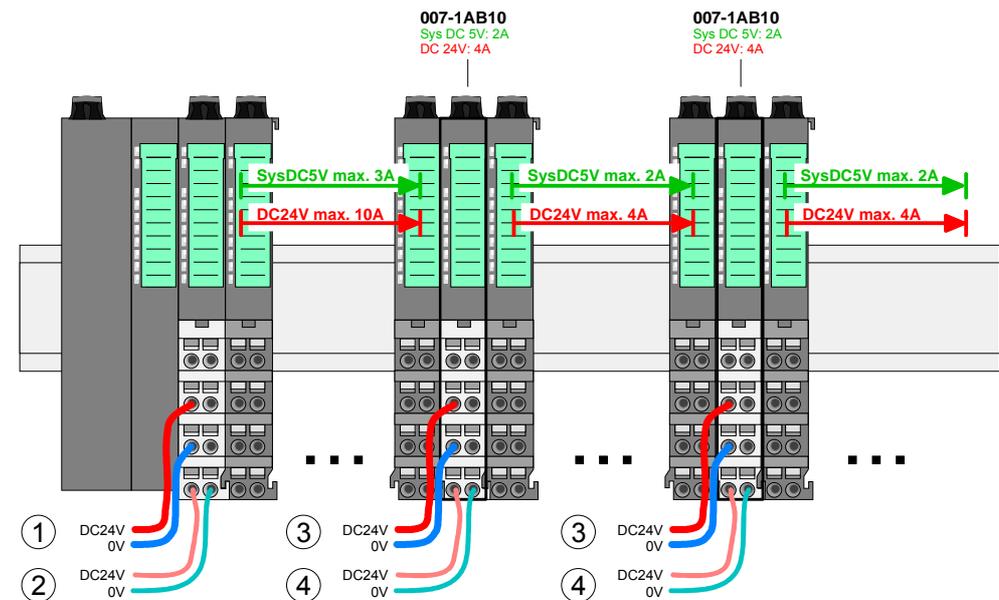
007-1AB00
Sys DC 5V: ---
DC 24V: 10A

007-1AB00
Sys DC 5V: ---
DC 24V: 10A

SysDC5V max. 3A

DC24V max. 10A   DC24V max. 10A   DC24V max. 10A

① DC24V / 0V
② DC24V / 0V

① DC24V / 0V

① DC24V / 0V

Power module 007-1AB10

007-1AB10
Sys DC 5V: 2A
DC 24V: 4A

007-1AB10
Sys DC 5V: 2A
DC 24V: 4A

SysDC5V max. 3A   SysDC5V max. 2A   SysDC5V max. 2A

DC24V max. 10A   DC24V max. 4A   DC24V max. 4A

① DC24V / 0V
② DC24V / 0V

③ DC24V / 0V
④ DC24V / 0V

③ DC24V / 0V
④ DC24V / 0V

(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.

Clack
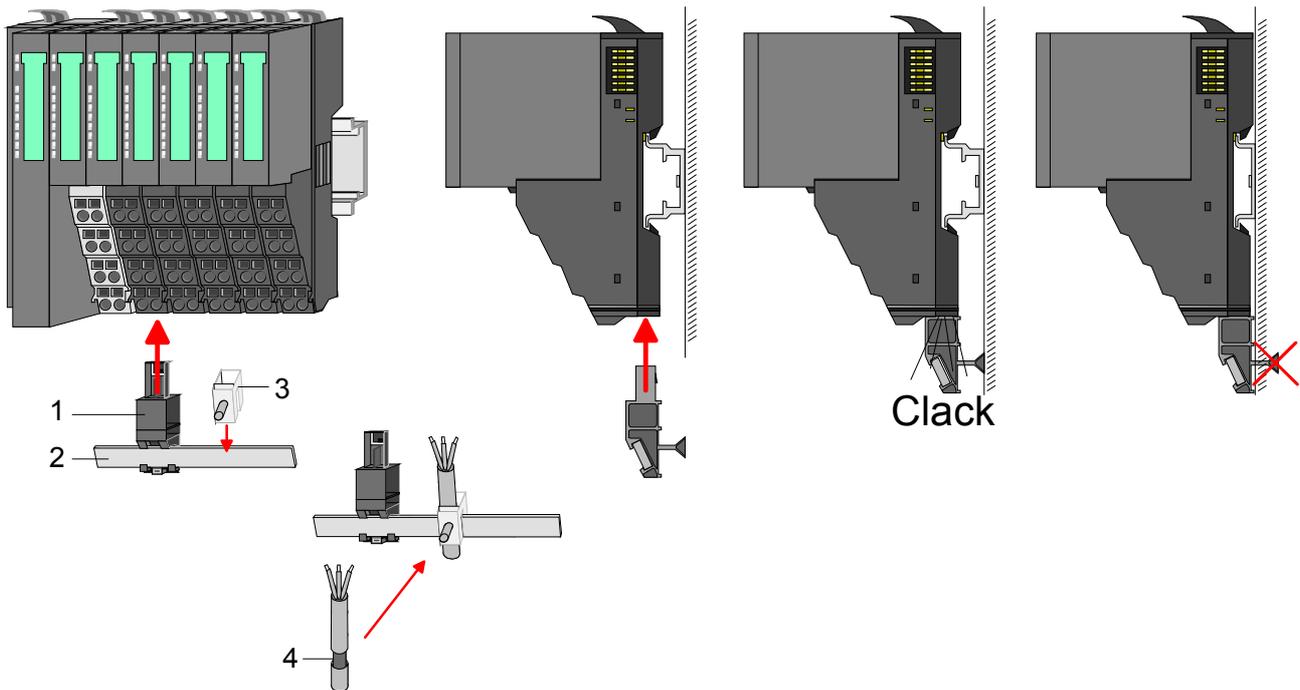
[1]   Shield bus carrier

[2]   Shield bus (10mm x 3mm)

[3]   Shield clamp

[4]   Cable shield

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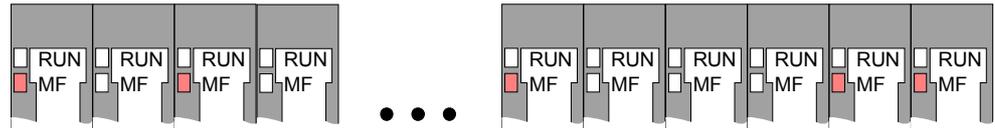
Behavior: After PowerON the RUN LED of each module is off and the MF LED of each module is sporadically on.

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.
More concerning this may be found above at "Wiring".

Error in configuration
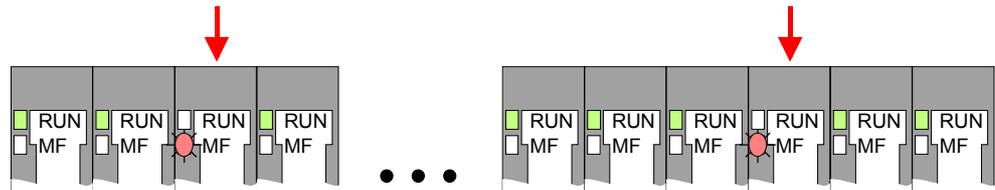
Behavior: After PowerON the MF LED of one module respectively more modules flashes. The RUN LED remains off.

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

Remedy: Match configuration and hardware structure.

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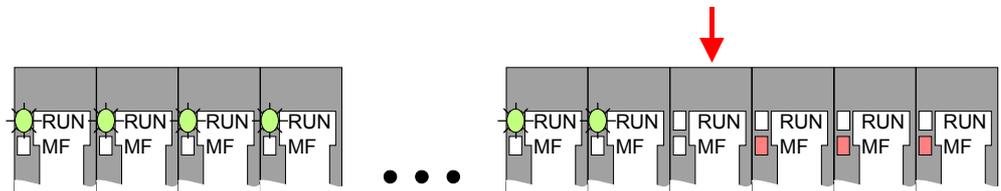
Behavior: After PowerON all of the RUN LEDs up to the defective module are flashing. With all following modules the MF LED is on and the RUN LED is off.

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

Remedy: Replace the defective module.

Installation guidelines

General   The installation guidelines contain information about the interference free deployment of System SLIO. There is the description of the ways, interference may occur in your control, how you can make sure the electromagnetic digestibility (EMC), and how you manage the isolation.

What means EMC?   Electromagnetic digestibility (EMC) means the ability of an electrical device, to function error free in an electromagnetic environment without being interferenced res. without interferencing the environment.

All System SLIO components are developed for the deployment in industrial environments and fulfill high demands on the EMC. Nevertheless you should project an EMC planning before installing the components and take conceivable interference causes into account.

Possible interference causes   Electromagnetic interferences may interfere your control via different ways:

- Electromagnetic fields (RF coupling)
- Magnetic fields with power frequency
- I/O signal conductors
- Bus system
- Current supply
- Protected earth conductor

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.

One differs:

- galvanic coupling
- capacitive coupling
- inductive coupling
- radiant coupling

Basic rules for EMC

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.

- Take care of a correct area-wide grounding of the inactive metal parts when installing your components.
  - 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 aluminum parts. Aluminum is easily oxidizing and is therefore less suitable for grounding.
- When cabling, take care of the correct line routing.
  - Organize your cabling in line groups (high voltage, current supply, signal and data lines).
  - Always lay your high voltage lines and signal res. 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.
  - Data lines must be laid isolated (for details see below).
  - Analog lines must be laid isolated. When transmitting signals with small amplitudes the one sided laying of the isolation may be favorable.
  - 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 metalized plug cases for isolated data lines.
- In special use cases you should appoint special EMC actions.
  - Wire all inductivities with erase links, which are not addressed by the System SLIO modules.
  - For lightening cabinets you should avoid luminescent lamps.
- 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 is a protection and functionality activity.
  - Connect installation parts and cabinets with the System SLIO in star topology with the isolation/protected earth conductor system. So you avoid ground loops.
  - If potential differences between installation parts and cabinets occur, 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. Hereby 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 res. µA) are transferred
  - foil isolations (static isolations) are used.

- With data lines always use metallic or metalized 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 the System SLIO module and **don't** lay it on there again!

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

General data

Conformity and approval		
Conformity		
CE	2006/95/EC	Low-voltage directive
	2004/108/EC	EMC directive
Approval		
UL	UL 508	Approval for USA and Canada
others		
RoHS	-	Product is lead-free

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	EN 61131-2	-
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

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 irradiation (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.

Chapter 2   Hardware description

Overview   Here the hardware components of the IM 053-1EC00 EtherCAT coupler are more described.

You will find the technical data at the end of this chapter.

Properties

Features   The EtherCAT coupler IM 053EC serves for an easy connection of
                      decentralized periphery to EtherCAT. EtherCAT offers real time Ethernet
                      technology on I/O level.

- EtherCAT coupler for max. 64 peripheral modules
- Ethernet-based field bus system with high real-time capability
- Supports the CANopen application profile CoE
  (**C**ANopen **o**ver **E**thernet)
- Online configuration via master system
- Various diagnostics functions
- RJ45 jack 100BaseTX
- Net work LEDs for Link/Activity and Error
- Status LEDs for RUN and Error
- *Distributed Clock* and *Station Alias* are not supported by this version
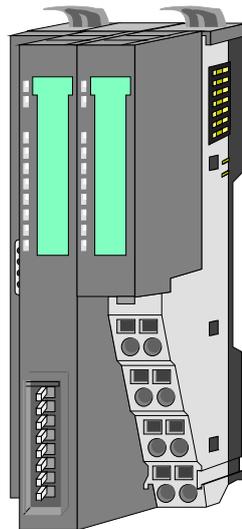
Order data

Type	Order number	Description
IM 053EC	VIPA 053-1EC00	EtherCAT coupler for SLIO

Structure

053-1EC00

[1]	Locking lever terminal module
[2]	Labeling strip bus interface
[3]	LED status indication bus interface
[4]	Labeling strip power module
[5]	LED status indication power module
[6]	Backplane bus
[7]	DC 24V power section supply
[8]	Power module
[9]	EtherCAT RJ45 bus interface "IN"
[10]	EtherCAT RJ45 bus interface "OUT"
[11]	Unlocking lever power module
[12]	Bus interface
[13]	Terminal
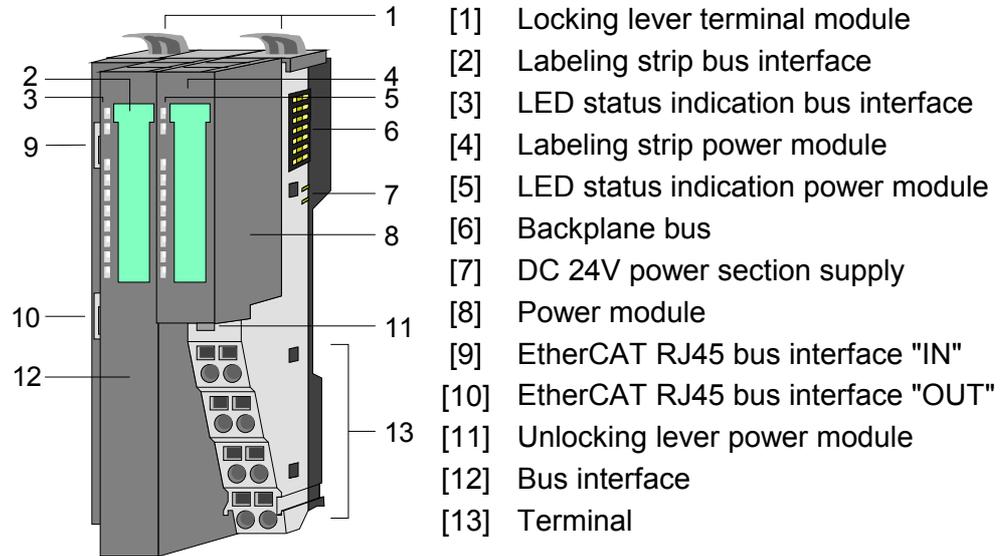
Status indication bus interface
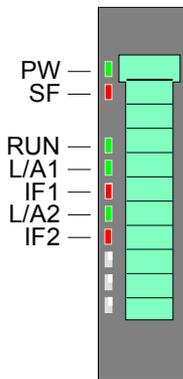
LED	Color		Description
PW	green	●	Bus interface is power supplied
SF	red	☼	*1 flash per s:* With state change due to an error e.g. a module is removed *2 flashes per s:* At EtherCAT-Timeout (watchdog) e.g. EtherCAT master is missing *Blinks with 2Hz:* At error in configuration
RUN	green	○	Bus coupler in state Init
		●	Bus coupler in state Operational
		☼	Blinking with 2Hz: Bus coupler in state Pre-Operational 1 flash per s: Bus coupler in state Safe Operational
L/A1	green	○	No communication to the preceding station
		●	Preceding EtherCAT station is connected
IF1	red	●	Internal error during communication with the preceding station
L/A2	green	○	No communication to the succeeding station
		●	Succeeding EtherCAT station is connected
IF2	red	●	Internal error during communication with the succeeding EtherCAT station

on: ●   off: ○   blinking: ☼

Status indication power module
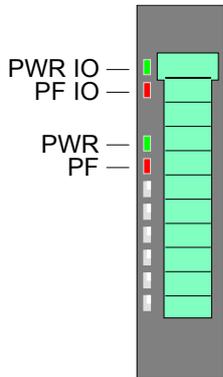
LED	Color	Description
PWR IO	green	● Power section supply OK
PF IO *	red	● Fuse power section supply defective (Power fail)
PWR	green	● Electronic section supply OK
PF	red	● Fuse electronic section supply defective

on: ●

*) This LED is only available on the power module with hardware release 1. Information concerning the hardware release may be found underneath the label strip.

Terminal   For wires with a core cross-section of 0.08mm^2 up to 1.5mm^2.
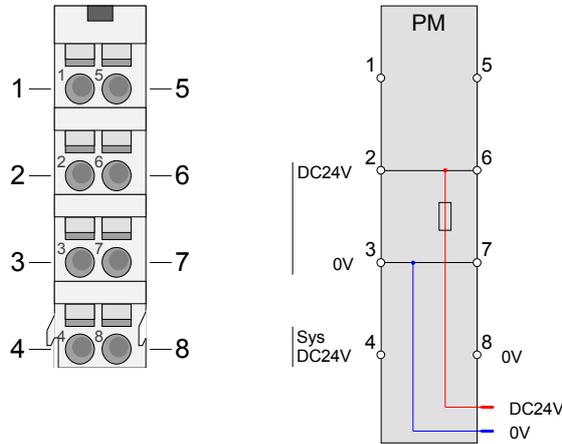
Pos.	Function	Type	Description
1	---	---	not connected
2	DC 24V	I	DC 24V for power section supply
3	0V	I	GND for power section supply
4	Sys DC 24V	I	DC 24V for electronic section supply
5	---	---	not connected
6	DC 24V	I	DC 24V for power section supply
7	0V	I	GND for power section supply
8	Sys 0V	I	GND for electronic section supply

I: Input

**RJ45 EtherCAT
bus interfaces**

With the upper RJ45 "IN" jack, the same as *Port 0*, the EtherCAT coupler is connected to the EtherCAT network.

To connect further EtherCAT slaves the RJ45 "OUT" jack, the same as *Port 1*, below is used.

Each jack has the following pin assignment:
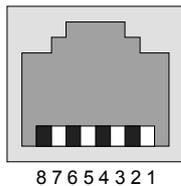
8pin RJ45 jack:

Pin	Signal
1	Transmit +
2	Transmit -
3	Receive +
4	-
5	-
6	Receive -
7	-
8	-

Topology

EtherCAT uses Ethernet as transmitting medium. Standard CAT5 cables are used. Here distances of about 100m between 2 stations are possible.

Only EtherCAT components may be used in an EtherCAT network. For topologies, which depart from the line structure, the corresponding EtherCAT components are necessary. Hubs may not be used.

An EtherCAT network always consists of a master and an various number of EtherCAT salves (coupler). Each EtherCAT slave has an "IN" and "OUT" RJ45 jack. The arriving EtherCAT cable from the direction of the master is to be connected to the "IN" jack. The "OUT" jack is to be connected to the succeeding EtherCAT station. With the respective last EtherCAT station the "OUT" jack remains free.

Technical Data

Order number	053-1EC00
Type	IM 053EC
Module ID	-
Technical data power supply	
Power supply (rated value)	DC 24 V
Power supply (permitted range)	DC 20.4...28.8 V
Reverse polarity protection	✓
Current consumption (no-load operation)	95 mA
Current consumption (rated value)	0.95 A
Inrush current	3.9 A
I²t	0.14 A²s
Max. current drain at backplane bus	3 A
Max. current drain load supply	10 A
Power loss	3 W
Status information, alarms, diagnostics	
Status display	yes
Interrupts	yes, parameterizable
Process alarm	yes, parameterizable
Diagnostic interrupt	yes, parameterizable
Diagnostic functions	yes, parameterizable
Diagnostics information read-out	possible
Supply voltage display	green LED
Service Indicator	-
Group error display	red SF LED
Channel error display	none
Hardware configuration	
Racks, max.	1
Modules per rack, max.	64
Number of digital modules, max.	64
Number of analog modules, max.	64
Communication	
Fieldbus	EtherCAT
Type of interface	Ethernet 100 MBit
Connector	2 x RJ45
Topology	-
Electrically isolated	✓
Number of participants, max.	65535
Node addresses	-
Transmission speed, min.	100 Mbit/s
Transmission speed, max.	100 Mbit/s
Address range inputs, max.	4 KB
Address range outputs, max.	4 KB
Number of TxPDOs, max.	-
Number of RxPDOs, max.	-
Housing	
Material	PPE / PPE GF10
Mounting	Profile rail 35 mm
Mechanical data	
Dimensions (WxHxD)	48.5 x 109 x 76.5 mm
Weight	155 g
Environmental conditions	
Operating temperature	0 °C to 60 °C
Storage temperature	-25 °C to 70 °C
Certifications	
UL508 certification	yes

Chapter 3   Deployment

Overview   This chapter describes the usage of the IM 053-1EC00 EtherCAT coupler from VIPA. After a short introduction you may find here every information about assembly and project engineering. The chapter closes with the description of the error handling.

Basics

General

Field buses were established for many years in the automation technology. Since higher speeds are required but the technical limits of this technology have already been reached, new solutions needed to be found.

At least in theory, the Ethernet, which is familiar to all of us from the office world, is fast with its 100´Mbit/s speed, which is available everywhere today. However, these networks do not offer real-time capability due to the kind of cabling that they use and the rules governing access rights. This effect was corrected with EtherCAT®.

EtherCAT®

EtherCAT® is a registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany.

EtherCAT means **Ether**net for **C**ontroller and **A**utomation **T**echology. It was originally developed by Beckhoff Automation GmbH and is now supported and further developed by the EtherCAT Technology Group (ETG).

ETG is the word biggest international user and producer connection for industrial Ethernet with about 1450 members (data from October 2010).

EtherCAT is an open Ethernet based field bus system, which is standardized at the IEC.

As open field bus system EtherCAT fulfills the user profile for the part of industrial real-time systems.

In opposition to the normal Ethernet communication at EtherCAT the data exchange of I/O data takes place during the frame passes the coupler with 100Mbit/s in full-duplex. Since in this way a frame to send and receive direction reaches the data of many stations, EtherCAT has a rate of user data of over 90%.

The EtherCAT protocol, which is optimized for process data, is directly transported with the Ethernet frame. This again can consist of several sub-frames, which serve for a storage area of the process image.

Transfer medium

EtherCAT uses Ethernet as transmitting medium. Standard CAT5 cables are used. Here distances of about 100m between 2 stations are possible.

Only EtherCAT components may be used in an EtherCAT network. For topologies, which depart from the line structure, the corresponding EtherCAT components are necessary. Hubs may not be used.

Communication principle

At EtherCAT the master sends a telegram to the first station. The station takes its data from the current data stream, inserts its answer data and sends the frame to the succeeding station. Here the frame is handled with the same way.

When the frame has reached the last station this recognizes that no further is connected and sends the frame back to the master.
Here the telegram is sent through every station via the other pair of leads (full-duplex). Due to the plug sequence and the use of the full-duplex technology EtherCAT represents a logical ring.

CoE

CoE means **C**ANopen **o**ver **E**therCAT. Each intelligent EtherCAT coupler (with micro controller) supports the CoE interface.

With CANopen you get a standard user interface, which makes a simplified system structure possible with most different devices.
With CoE the device parameters may comfortably be accessed and data were may be read or written at the same time. Real-time data may be read by PDOs an the parameterization happens by SDOs. Further there are emergency objects available.

Ethernet Frame

DA	SA	Type	Data	CRC

EtherCAT Frame

Header	Datagramm Slave 01	...	Datagramm Slave n

EtherCAT Datagramm

Command Header	Data	Working Counter

EtherCAT Datagramm

Mailbox Header	Mailbox Service Data

Type = CoE (CANopen over EtherCAT)

CANopen Header	CANopen Data

CoE Header

Number	Reserved	Service

Service

0: reserved	5: RxPDO
1: Emergency message	6: Remote request of TxPDO
2: SDO request	7: Remote request of RxPDO
3: SDO response	8: SDO information
4: TxPDO	9...15: reserved

DA: Destination address
SA: Source address
CRC: Checksum

Components   In the following the components of the CoE interface are listed:

EtherCAT State   Via the EtherCAT State Machine the state of the EtherCAT coupler is
Machine   controlled.

Object directory   In the object directory the parameter, diagnostics, Interrupt or other data
                    are listed, which may be written or read via EtherCAT. The object directory
                    may be accessed by the SDO information service. Additionally the object
                    directory may be found in the device master file.

Process data   The EtherCAT data link layer is optimized for the fast transfer of process
                    data. Here it is specified how the process data of the device are assigned
                    to the EtherCAT process data and how the application of the device is
                    synchronized to the EtherCAT cycle.

                    The mapping of the process data happens by PDO mapping and by Sync-
                    Manager-PDO-Assign objects. These describe, which objects of the object
                    directory are transferred as object data via EtherCAT.

                    The cycle time to transfer the process data via EtherCAT and how this is
                    synchronized for the transfer is specified with the Sync-Manager-
                    Communication objects.

Emergencies   Via Emergencies diagnostics, process events and errors at state change of
                    the State Machine may be transferred.

                    Status messages, which show the current state of the device, should
                    directly be transferred within the process data.

ESI files   From VIPA there are ESI files for the EtherCAT coupler available. These
                    files may either be found on the supplied storage media or at the download
                    area of www.vipa.de.

                    Please install the ESI files in your configuration tool. Details on the
                    installation of the ESI files are available from the manual supplied with your
                    configuration tool.

                    For configuration in your configuration tool every SLIO module may the
                    found in the ESI files as XML data.

EtherCAT State Machine

States

Each EtherCAT couple has a State Machine implemented. For each state there is defined which communication service is active via EtherCAT. The State Machine is controlled by the EtherCAT master.
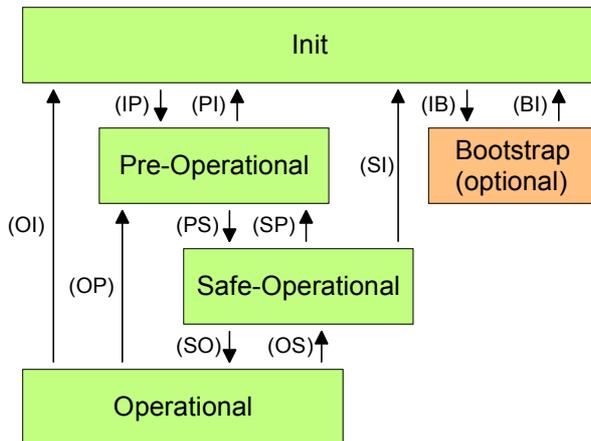
IP: Start mailbox communication
PI: Stop mailbox communication
PS: Start input update
SP: Stop input update
SO: Start output update
OS: Stop output update
OP: Stop input update, stop output update
SI: Stop input update, stop mailbox communication
OI: Stop output update, stop input update, stop mailbox communication
IB: Start mailbox for firmware update in bootstrap mode
BI: Restart/stop mailbox

Init

After power-on the EtherCAT coupler is in state *Init*. There is neither mailbox nor process data communication possible. The EtherCAT master initializes the SyncManager channels 0 and 1 for the mailbox communication.

Pre-Operational (Pre-Op)

During the transition from *Init* to *Pre-Op* the EtherCAT coupler checks whether the mailbox was correctly initialized.

In the state *Pre-Op* mailbox communication is possible but the process data communication is blocked. The EtherCAT master initializes the SyncManager channels for process data (starting with SyncManager channel 2), the FMMU channels and the PDO mapping respectively the SyncManager PDO assignment. Further in this state the settings for process data transfer and the module-specific parameters, which deviate from the default values are transferred.

Safe-Operational (Safe-Op)

With the transition from *Pre-Op* to *Safe-Op* the EtherCAT coupler checks if the SyncManager channels for process data communication are correct.

Before it acknowledges the state change, the EtherCAT coupler copies current input data to the corresponding DP RAM areas of the EtherCAT coupler controller. In the state *Safe-Op* mailbox and process data communication is possible. Here the input data are cyclically updated but the outputs are de-activated.

Operational (Op)

In the state *Op* the EtherCAT coupler copies the output data of the master to its outputs. Here process data and mailbox communication is possible.

Bootstrap - optional (Boot)

In the state *Boot* the firmware of the EtherCAT coupler may be updated. This state may only be reached via *Init*. In the state *Boot* is mailbox communication via the protocol *File-Access over EtherCAT* (FoE) possible. Other mailbox and process data communications are de-activated.

Accessing the System SLIO

Overview

In the following you will find the description of accessing the following System SLIO areas via EtherCAT.

- E/A area
- Parameter data
- Diagnostics data

Information concerning the allocation areas may be found in the description of the corresponding System SLIO module.

Note!

Please consider the System SLIO power and clamp modules do not have any module ID. These may not be recognized by the EtherCAT coupler and so are not listed and considered during slot allocation.

Further within EtherCAT the slots are designated as *EtherCAT-Slot*. The counting always begins with 0.

ESI files

From VIPA you will get ESI files for the EtherCAT coupler. These files may either be found on the supplied storage media or at the download area of www.vipa.de. Install the ESI files at your configuration tool. More information about installing the ESI files may be found in the manual of you configuration tool.

For configuration in your configuration tool, every System SLIO module may be found in the ESI files as XML data.

A configuration should always take place by means of the ESI files.

Accessing I/O area

The I/O area may be accessed via the following objects:

- PDO
- SDO

Access via PDO

As soon as the EtherCAT coupler changes to the state *Safe-Operational*, the input data may be read. In the state *Operational* the output data may also be written.

Information concerning the process data transfer by means of PDO may be found in the manual of your EtherCAT master.

Additionally the in/output data are mapped on SDO objects.

Access via SDO   By means of SDO access the in/output data of the object directory may be read. The following figure shows how the in/output data are mapped on the SDO objects:

	IM 053 EC	SM 021 DI 2x DC24V	SM 022 DO 4x DC24V	SM 031 AI 2x 12Bit	CM 001	FM 050 1x32Bit	SM 021 DI 4x DC24V
		I data	I data	I data	I data	I data	I data
		01h 02h		01h 02h		01h 02h	01h 02h
Input Index:		0x6000	0x6001	0x6002	-	0x6003	0x6004
						04h	04h
		O data	O data	O data	O data	O data	O data
			01h 02h			01h 02h	
Output Index:	0x7000		0x7001	0x7002	-	0x7003	0x7004
			04h			04h	
	053-1EC00	Slot 1	Slot 2	Slot 3	Slot 4	Slot 5	Slot 6
EtherCAT-Slot		0	1	2	-	3	4
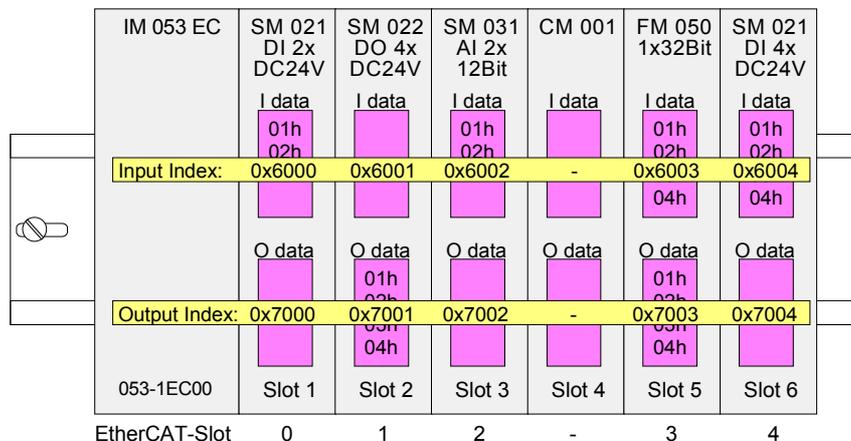
Input data 0x6000 + EtherCAT-Slot

Index	Module	Subindex
0x6000	SM 021 DI 2x DC 24V	01h, 02h
0x6002	SM 031 AI 2x 12Bit	01h, 02h
0x6003	FM 050 1x32Bit	01h, 02h, 03h, 04h
0x6004	SM 021 DI 4x DC 24V	01h, 02h, 03h, 04h

Output data 0x7000 + EtherCAT-Slot

Index	Module	Subindex
0x7001	SM 022 DO 4x DC 24V	01h, 02h, 03h, 04h
0x7003	FM 050 1x32Bit	01h, 02h, 03h, 04h

Read input data   When accessing the input area of a System SLIO module the addressing via index (0x6000 + EtherCAT-Slot) takes place. The corresponding input data may be accessed via subindexes. The allocation of the subindexes may be found in the description of the corresponding System SLIO module.

Index	Sub-index	Name	Type	Attr.	Default value	Meaning
0x6000 ... 0x603F	0x00	Input Data	Unsigned8	ro		Number of subindexes of the input data for the corresponding EtherCAT-Slot.
	0x01			ro		Input data (see module description)
	0x02			ro		
	...	...				

Read output data   With the reading access of the output area of a System SLIO module the addressing via index (0x7000 + EtherCAT-Slot) takes place. The corresponding output data may be read via subindexes. The allocation of the subindexes may be found in the description of the corresponding System SLIO module.

Index	Sub-index	Name	Type	Attr.	Default value	Meaning
0x7000 ... 0x703F	0x00	Output Data	Unsigned8	ro		Number of subindexes of the output data for the corresponding EtherCAT-Slot.
	0x01			ro		Output data (see module description)
	0x02			ro		
	...	...				

**Accessing
parameter data**

The following figure shows how the parameter data are mapped on the SDO objects:

IM 053 EC	SM 021 DI 2x DC24V	SM 022 DO 4x DC24V	SM 031 AI 2x 12Bit	CM 001	FM 050 1x32Bit	SM 021 DI 4x DC24V
	Param	Param	Param 01h 02h	Param	Param 01h 02h	Param
Param Index:	0x3100	0x3101	0x3102	-	0x3103	0x3104
					. 03h 0Fh	
053-1EC00	Slot 1	Slot 2	Slot 3	Slot 4	Slot 5	Slot 6
EtherCAT-Slot	0	1	2	-	3	4
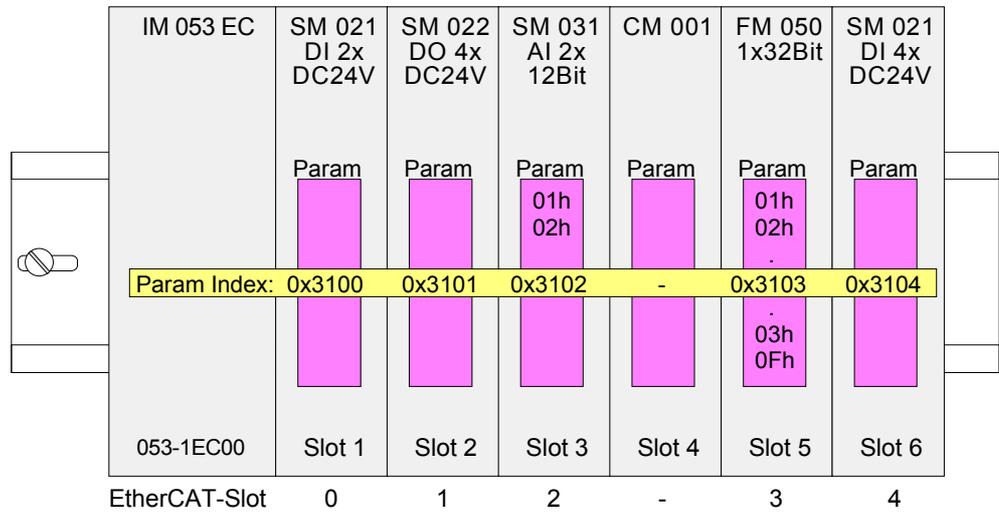
Parameter data 0x3100 + EtherCAT-Slot

Index	Module	Subindex
0x3102	SM 031 AI 2x 12Bit	01h, 02h
0x3103	FM 050 1x32Bit	01h ... 0Fh

Accessing the
parameters

For module parameterization SDO transfer takes place. Here the EtherCAT-Slot is addressed via *index*. Via *subindexes* the corresponding parameters may be accessed. The allocation of the subindexes may be found in the description of the corresponding System SLIO module.

Index	Sub-index	Name	Type	Attr.	Default value	Meaning
0x3100 ... 0x313F	0x00	Parameter	Unsigned8	ro	Number of parameters	Access to the parameters of the System SLIO modules. Only modules with parameters are mapped.
	0x01	Param1		rw		Module parameter data
	0x02	Param2		rw		(see module description)
	...	...				

Note!

Modules with no interrupt capability or whose diagnostic interrupt is de-activated can not send an interrupt message on an error in parameterization. Possible parameterization errors may be detected by means of a diagnostic request after the parameterization.

Accessing diagnostics data   Hardware and diagnostic interrupt data of System SLIO modules with interrupt capability were automatically sent by an emergency telegram if the interrupt is activated by parameterization. There is also the possibility to request diagnostics data via SDO.

Alarm Status   The Alarm Status contains in each case a counter for hardware and diagnostic interrupts for interrupt signaling. These counter are input data of the EtherCAT coupler and were transferred together with the process data.

Index	Sub-index	Name	Type	Attr.	Default value	Meaning
0xF100	0x00	Interrupt Status	Unsigned8	ro	2	
	0x01	Hardware Interrupt Counter	Unsigned32	ro	0x00000000	Counter for hardware interrupt
	0x02	Diagnostic Interrupt Counter	Unsigned32	ro	0x00000000	Counter for diagnostic interrupt

With de-activated *Auto-Acknowledge* (Object 0x3000:01 = 0) of the EtherCAT coupler the corresponding counter is set to 1 until you acknowledge this accordingly. For this you have to write any value you like to subindex 0x06 under the accordingly assigned index.

With activated *Auto-Acknowledge* (Object 0x3000:01 = 1) here you will find the number of hardware and diagnostics interrupts, which happened since the last interrupt reset. To reset the corresponding counter you have to write any value you like to the subindex 0x06 under the accordingly assigned index.

The following index assignments are valid:

- Write to 0x06 of index 0x5000: Reset of counter hardware interrupt
- Write to 0x06 of index 0x5002: Reset of counter diagnostic interrupt

Hardware interrupt data   If the alarm status indicates a hardware interrupt, the current hardware interrupt data may be accessed by index 0x5000. The allocation of the hardware interrupt data may be found in the description of the corresponding module.

Index	Sub-index	Name	Type	Attr.	Default value	Meaning
0x5000	0x00	Hardware Interrupt Data	Unsigned8	ro	6	Current hardware interrupt data
	0x01	Slot Number	Unsigned8	ro	0x00	EtherCAT-Slot of the module which reports an interrupt
	0x02	Hardware Interrupt Data 00	Unsigned8	ro	0x00	Hardware interrupt data (see module description)
	0x03	Hardware Interrupt Data 01	Unsigned8	ro	0x00	
	0x04	Hardware Interrupt Data 02	Unsigned8	ro	0x00	
	0x05	Hardware Interrupt Data 03	Unsigned8	ro	0x00	
	0x06	Acknowledge	Unsigned8	rw	0x00	Any value resets the hardware interrupt counter and acknowledges if necessary the interrupt.

Diagnostic data
(Byte 1 ... 4)
If the Alarm Status indicates a diagnostic interrupt the current diagnostics data may be accessed via index 0x5002. The allocation of the diagnostics data may be found in the description of the corresponding module.

Index	Sub-index	Name	Type	Attr.	Default value	Meaning
0x5002	0x00	Diagnostic Data	Unsigned8	ro	6	Current diagnostics data
	0x01	Slot Number	Unsigned8	ro	0x00	EtherCAT-Slot of the module, which reports an interrupt
	0x02	Diagnostic Data 00	Unsigned8	ro	0x00	Byte 1 ... 4 of the diagnostic data (see module description)
	0x03	Diagnostic Data 01	Unsigned8	ro	0x00	
	0x04	Diagnostic Data 02	Unsigned8	ro	0x00	
	0x05	Diagnostic Data 03	Unsigned8	ro	0x00	
	0x06	Acknowledge	Unsigned8	rw	0x00	Any value resets the diagnostic interrupt counter and acknowledges if necessary the interrupt.

Diagnostic data
(Byte 1 ... n)
The whole diagnostic data of a module may be accessed with this object. Here you may either access current diagnostic data or the diagnostic data of a module on any EtherCAT-Slot.

Index	Sub-index	Name	Type	Attr.	Default value	Meaning
0x5005	0x00	Diagnostic Data	Unsigned8	ro	18	
	0x01	Slot	Unsigned8	rw	0	By reading this index here the EtherCAT-Slot of the module may be found, to which the following diagnostic data belong to. By writing of an EtherCAT-Slot to this index the diagnostic data of the corresponding module may be read.
	0x02		Unsigned8	ro	0	Diagnostics data of the module (see module description)
	0x03		Unsigned8	ro	0	
	0x04		Unsigned8	ro	0	
	0x05		Unsigned8	ro	0	
	0x06		Unsigned8	ro	0	
	0x07		Unsigned8	ro	0	
	0x08		Unsigned8	ro	0	
	0x09		Unsigned8	ro	0	
	0x0A		Unsigned8	ro	0	
	0x0B		Unsigned8	ro	0	
	0x0C		Unsigned8	ro	0	
	0x0D		Unsigned8	ro	0	
	0x0E		Unsigned8	ro	0	
	0x0F		Unsigned8	ro	0	
	0x10		Unsigned8	ro	0	
	0x11		Unsigned8	ro	0	
	0x12		Unsigned32	ro	0	

Data transfer via PDO and SDO

Overview
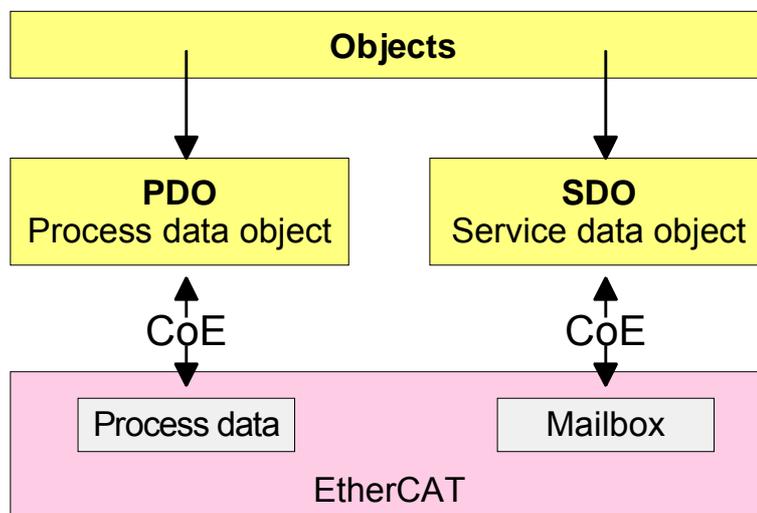
PDO

PDO means **P**rocess **D**ata **O**bject. Process data may be transferred during run-time by means of PDOs. Here the Inputs respectively outputs are directly addressed within the frame.

More concerning the process data transfer during run-time may be found in the manual of your EtherCAT master.

SDO

SDO means **S**ervice **D**ata **O**bject. Within a SDO message the parameter data of your system may be accessed. Here the parameters are addressed by according indexes and subindexes.

An overview of the objects may be found in the object directory below.

Variable PDO mapping via SDO

Overview

Some modules like the ETS and CP modules of the System SLIO have a variable process image.

If your master system supports variable PDO mapping, on modules with variable process image the size of the process image may be preset by a appropriate adjustment of the PDO contents.

More information about PDO mapping may be found in the manual of your master system.

Functionality

- The ESI file the modules are defined, which have a variable process image. When modules with a variable process image are used, so startup commands are automatically inserted to the startup list of the master. These startup commands are SDO write accesses to the areas 0x16yy and 0x1Ayy (PDO mapping), where the structure of the process data of a module is described. The startup commands are executed with each change from Pre-Op to Safe-Op condition of the appropriate EtherCAT coupler.

- Within your EtherCAT master system / EtherCAT configurator the PDO contents may be removed or added. Here the startup command are automatically adjusted.

Note!

With the adjustment of the PDO contents please always consider the data structure of the I/O data of the corresponding module.

Information about the data structure of the I/O data of a module may be found in the additional system SLIO manual.

- So that the new configuration can be taken, the master system is to be initialized again, respectively when a EtherCAT configurator is used the new configuration can be loaded into the EtherCAT master.
  With the change from Pre-Op to Safe-Op the new startup commands were transferred to the EtherCAT coupler and thus the new PDO mapping is adjusted.

- The EtherCAT coupler configures the corresponding module and automatically adjusts the length of the module parameters in the object directory 0x31yy an.

Note!

The adjustment of the process image of modules with a variable process image size should not be made by the object, since otherwise only the length in the module is adjusted but EtherCAT coupler and master further use the standard length!

Object Dictionary

Object overview

Index	Object Dictionary Area
0x0000 ... 0x0FFF	Data Type Area
0x1000 ... 0x1FFF	Communication Area
0x2000 ... 0x5FFF	Manufacturer Specific Area
0x6000 ... 0x6FFF	Input Area
0x7000 ... 0x7FFF	Output Area
0x8000 ... 0x8FFF	Configuration Area
0x9000 ... 0x9FFF	Information Area
0xA000 ... 0xAFFF	Diagnosis Area
0xB000 ... 0xBFFF	Service Transfer Area
0xC000 ... 0xEFFF	Reserved Area
0xF000 ... 0xFFFF	Device Area

Note!

Please consider the System SLIO power and clamp modules do not have any module ID. These may not be recognized by the EtherCAT coupler and so are not listed and considered during slot allocation.

Further within EtherCAT the slots are designated as *EtherCAT-Slot*. The counting always begins with 0.

Example

In the following example at the physical slot 2 a clamp module (CM) is connected. Since the clamp module does not have any module ID, this is not recognized by the EtherCAT coupler. So in EtherCAT the next module is mapped to EtherCAT-Slot 1 and so on.

physical slot number	1	2	3	4
Module	DI	CM	DI	DI
Index	0x6000	-	0x6001	0x6002
EtherCAT-Slot	0	-	1	2

Device Type

Index	Sub-index	Name	Type	Attr.	Default value	Meaning
0x1000	0x00	Device Type	Unsigned32	ro	0x00001389	0x00001389 means MDP

Device Name

Index	Sub-index	Name	Type	Attr.	Default value	Meaning
0x1008	0x00	Device name	Visible string	ro	VIPA 053-1EC00	

Hardware Version

Index	Sub-index	Name	Type	Attr.	Default value	Meaning
0x1009	0x00	Hardware version	Visible string	ro		

Software Version

Index	Sub-index	Name	Type	Attr.	Default value	Meaning
0x100A	0x00	Software version	Visible string	ro		

System Version

Index	Sub-index	Name	Type	Attr.	Default value	Meaning
0x100B	0x00	System version	Unsigned8	ro		State depends on the FPGA version of the coupler and the modules, at least system version 2

Identity Object

Index	Sub-index	Name	Type	Attr.	Default value	Meaning
0x1018	0x00	Identity Object	Visible string	ro	0x04	
	0x01	Vendor ID	Unsigned32	ro	0x0000AFFE	
	0x02	Product Code	Unsigned32	ro	0x0531EC00	
	0x03	Revision Number	Unsigned32	ro	0x00000011	
	0x04	Serial Number	Unsigned32	ro		

**Output Mapping
Modules**

Index	Sub-index	Name	Type	Attr.	Default value	Meaning
0x1600 ... 0x163F	0x00	RxPDO Map	Unsigned8	ro/rw*	Number of outputs on this slot	Only available at slots with output modules.
	0x01	Output Mapping	Unsigned32	ro/rw*		e.g.: 0x7000:01, 1 > at slot 0 the first output has a length of 1 bit.
	0x02	Output Mapping	Unsigned32	ro/rw*		
	...	...				

*) rw only at output modules with variable process output image.

**Input Mapping
Modules**

Index	Sub-index	Name	Type	Attr.	Default value	Meaning
0x1A00 ... 0x1A3F	0x00	TxPDO Map	Unsigned8	ro/rw*	Number of inputs on this slot	Only available at slots with input modules.
	0x01	Input Mapping	Unsigned32	ro/rw*		e.g.: 0x6000:01, 8 > at slot 0 the first input has a length of 8 bit.
	0x02	Input Mapping	Unsigned32	ro/rw*		
	...	...				

*) rw only at input modules with variable process input image.

**Input Mapping
Coupler**

Index	Sub-index	Name	Type	Attr.	Default value	Meaning
0x1AFF	0x00	Status PDO	Unsigned8	ro	2	Mapping for the interrupt counters of the coupler
	0x01	Input Mapping	Unsigned32	ro	0xF100:01,32	Mapping for the hardware interrupt counter
	0x02	Input Mapping	Unsigned32	ro	0xF100:02,32	Mapping for the diagnostic interrupt counter

Note!

Due to the system the mapping should not be changed in the configuration tool, otherwise the process image could be influenced!

**Sync Manager
Type**

Index	Sub-index	Name	Type	Attr.	Default value	Meaning
0x1C00	0x00	Sync Manager Type	Unsigned8	ro	4	
	0x01	Subindex 01	Unsigned8	ro	1	
	0x02	Subindex 02	Unsigned8	ro	2	
	0x03	Subindex 03	Unsigned8	ro	3	
	0x04	Subindex 04	Unsigned8	ro	4	

RxPDO Assign

Index	Sub-index	Name	Type	Attr.	Default value	Meaning
0x1C12	0x00	RxPDO Assign	Unsigned8	ro	Number of modules with process output data	
	0x01	Subindex 001	Unsigned16	ro		
	...	...	...	...		
	0x40	Subindex 064	Unsigned16	ro		

TxPDO Assign

Index	Sub-index	Name	Type	Attr.	Default value	Meaning
0x1C13	0x00	TxPDO Assign	Unsigned8	ro	Number of input PDOs from coupler and modules	
	0x01	Subindex 001	Unsigned16	ro		
	0x02	Subindex 002	Unsigned16	ro		
	...	...	...	...		
	0x40	Subindex 064	Unsigned16	ro		

The EtherCAT coupler also has process input data, which show the alarm status. So there is in the first place the assignment 0x1AFF for the input PDOs of the coupler.

**SM Output
Parameter**

Index	Sub-index	Name	Type	Attr.	Default value	Meaning
0x1C32	0x00	SM output parameter	Unsigned8	ro	6	
	0x01	Sync mode	Unsigned16	rw		
	0x02	Cycle time	Unsigned32	rw		
	0x03	Shift time	Unsigned32	ro		
	0x04	Sync modes supported	Unsigned16	ro		
	0x05	Minimum cycle time	Unsigned32	ro		
	0x06	Minimum shift time	Unsigned32	ro		

**SM Input
Parameter**

Index	Sub-index	Name	Type	Attr.	Default value	Meaning
0x1C33	0x00	SM input parameter	Unsigned8	ro	6	
	0x01	Sync mode	Unsigned16	rw		
	0x02	Cycle time	Unsigned32	rw		
	0x03	Shift time	Unsigned32	ro		
	0x04	Sync modes supported	Unsigned16	ro		
	0x05	Minimum cycle time	Unsigned32	ro		
	0x06	Minimum shift time	Unsigned32	ro		

Parameter SLIO   Here the EtherCAT coupler may be parameterized.
EtherCAT Coupler

Index	Sub-index	Name	Type	Attr.	Default value	Meaning
0x3000	0x00	Coupler parameter	Unsigned8	ro	1	
	0x01	Auto-Acknowledge	Unsigned8	rw	1	Defines the mode, how interrupts are handled.

- With Auto-Acknowledge = 0 you are responsible for the acknowledgement. So you are informed with every interrupt. As soon as an interrupt is not acknowledged other interrupts are blocked

- With Auto-Acknowledge = 1 each interrupt is automatically acknowledged by the EtherCAT coupler. In this mode the diagnostics data were always overwritten. Default setting is Auto-Acknowledge = 1.
  For continuous use Auto-Acknowledge should be activated.

Parameter SLIO   With this object the parameters of a System SLIO module may be
Module   accessed. Here the addressing by index takes place. Via subindexes the corresponding parameters may be accessed. The allocation of the subindexes may be found in the description of the corresponding System SLIO module.

Also here it is valid that power and clamp modules are not recognized by the EtherCAT coupler and so are not listed and considered during slot allocation.

Index	Sub-index	Name	Type	Attr.	Default value	Meaning
0x3100 ... 0x313F	0x00	Parameter	Unsigned8	ro	Number of parameters	Parameters of the System SLIO modules. Only modules with parameters are mapped.
	0x01	Param1		rw		Module parameter data
	0x02	Param2		rw		(see module description)
	...	...				

If the module has parameters it is valid

Index 0x3100: Access to EtherCAT-Slot 0

Index 0x3101: Access to EtherCAT-Slot 1

...

Index 0x313F: Access to EtherCAT-Slot 64

Example   In the following example via index 0x3102 the parameters of the module at the physically slot 4 may be accessed.

physically slot number	1	2	3	4
Module	DI	CM	DO	AI
Index	*0x3100**	-	*0x3101**	**0x3102**
EtherCAT-Slot	0	-	1	**2**

*) This entry is not listed, because the module has no parameters.

**Clear SLIO
Counter**

Index	Sub-index	Name	Type	Attr.	Default value	Meaning
0x4000	0x00	Clear Slio Counter	Unsigned8	ro	2	Writing of a value you want to the corresponding index clears the counter
	0x01	Clear Master Counter	Unsigned8	rw	0	
	0x02	Clear Module Counter	Unsigned8	rw	0	

Master Counter

Index	Sub-index	Name	Type	Attr.	Default value	Meaning
0x4001	0x00	Master Counter	Unsigned8	ro	11	
	0x01	Expected Length Error	Unsigned16	ro		
	0x02	TimeOut Error	Unsigned16	ro		
	0x03	StopBit Error	Unsigned16	ro		
	0x04	FCS Error	Unsigned16	ro		
	0x05	Telegram Length Error	Unsigned16	ro		
	0x06	Telegram Type Error	Unsigned16	ro		
	0x07	Alarm Retry Error	Unsigned16	ro		
	0x08	Bus Idle Time Error	Unsigned16	ro		
	0x09	Wrong Node Address	Unsigned16	ro		
	0x0A	Telegram Valid	Unsigned16	ro		
	0x0B	Master Load	Unsigned16	ro		
	0x0C	1 telegram retry counter	Unsigned16	ro		
	0x0D	2 telegram retry counter	Unsigned16	ro		
	0x0E	3 telegram retry counter	Unsigned16	ro		

**Module MDL
Counter**

Index	Sub-index	Name	Type	Attr.	Default value	Meaning
0x4002	0x00	Module MDL Counter	Unsigned8	ro	64	
	0x01	Slot 1	Unsigned16	ro	0	
	0x02	Slot 2	Unsigned16	ro	0	
	...	...			0	
	0x40	Slot 64	Unsigned16	ro	0	

**Module NDL
Counter**

Index	Sub-index	Name	Type	Attr.	Default value	Meaning
0x4003	0x00	Module MDL Counter	Unsigned8	ro	64	
	0x01	Slot 1	Unsigned16	ro	0	
	0x02	Slot 2	Unsigned16	ro	0	
	...	...				
	0x40	Slot 64	Unsigned16	ro	0	

**Version
Components
EtherCAT Coupler**

Here the value of the versions of the components of the EtherCAT coupler may be accessed.

Index	Sub-index	Name	Type	Attr.	Default value	Meaning
0x4100	0x00	SLIO Version	Unsigned8	ro	4	Version of the components of the coupler
	0x01	Master FPGA	Unsigned16	ro		Version of the FPGA
	0x02	SLIO Bus	Unsigned16	ro		Version of the SLIO backplane bus
	0x03	Firmware Packet	Unsigned32	ro		Version package
	0x04	Mx-File	Visible string	ro		Name and version of the Mx file of the coupler

**FPGA Version
Modules**

The FPGA version of the SLIO module at the slot in EtherCAT may be determined by this object.

Index	Sub-index	Name	Type	Attr.	Default value	Meaning
0x4101	0x00	Module FPGA Version	Unsigned8	ro		FPGA versions of the modules
	0x01	Slot 1	Unsigned16	ro		EtherCAT-Slot
	0x02	Slot 2	Unsigned16	ro		
	..	…	...	ro		
	0x64	Slot 64	Unsigned16	ro		

**Firmware Version
Modules**

Via this object you may determine the firmware version of the SLIO module at the EtherCAT-Slot.

Index	Sub-index	Name	Type	Attr.	Default value	Meaning
0x4102	0x00	Module Firmware Version	Unsigned8	ro		Firmware versions of the modules
	0x01	Slot 1	Unsigned32	ro		EtherCAT-Slot
	0x02	Slot 2	Unsigned32	ro		
	...	…	...	ro		
	0x64	Slot 64	Unsigned32	ro		

**Serial Number
Modules**

With this object the serial number of the SLIO module at the EtherCAT-Slot may be determined.

Index	Sub-index	Name	Type	Attr.	Default value	Meaning
0x4103	0x00	Module Serial Number	Unsigned8	ro		Serial number of the module
	0x01	Slot 1	Visible string	ro		EtherCAT-Slot
	0x02	Slot 2	Visible string	ro		
	..	…	...	ro		
	0x64	Slot 64	Visible string	ro		

Hardware Interrupt Data   If the object 0xF100 (see below) indicates a hardware interrupt here the current hardware interrupt data may be accessed. The allocation of the hardware interrupt data may be found in the description of the corresponding module.

Index	Sub-index	Name	Type	Attr.	Default value	Meaning
0x5000	0x00	Hardware Interrupt Data	Unsigned8	ro	6	Current hardware interrupt data
	0x01	Slot Number	Unsigned8	ro	0x00	EtherCAT-Slot of the module which reports an interrupt
	0x02	Hardware Interrupt Data 00	Unsigned8	ro	0x00	Hardware interrupt data (see module description)
	0x03	Hardware Interrupt Data 01	Unsigned8	ro	0x00	
	0x04	Hardware Interrupt Data 02	Unsigned8	ro	0x00	
	0x05	Hardware Interrupt Data 03	Unsigned8	ro	0x00	
	0x06	Acknowledge	Unsigned8	rw	0x00	Any value resets the hardware interrupt counter and acknow-ledges if necessary the interrupt.

With de-activated *Auto-Acknowledge* of the EtherCAT coupler the *hardware interrupt counter* of object 0xF100 is reset and the hardware interrupt is acknowledged. For this you have to write any value you like to subindex 0x06 of index 0x5000.

Diagnostic Data (Byte 1 ... 4)   If the object 0xF100 (see below) indicates a diagnostic interrupt here the first 4 bytes of the current diagnostics interrupt data may be accessed. The allocation of the diagnostic interrupt data may be found in the description of the corresponding module.

Index	Sub-index	Name	Type	Attr.	Default value	Meaning
0x5002	0x00	Diagnostic Data	Unsigned8	ro	6	Current diagnostics data
	0x01	Slot Number	Unsigned8	ro	0x00	EtherCAT-Slot of the module, which reports an interrupt
	0x02	Diagnostic Data 00	Unsigned8	ro	0x00	Byte 1 ... 4 of the diagnostic data (see module description)
	0x03	Diagnostic Data 01	Unsigned8	ro	0x00	
	0x04	Diagnostic Data 02	Unsigned8	ro	0x00	
	0x05	Diagnostic Data 03	Unsigned8	ro	0x00	
	0x06	Acknowledge	Unsigned8	rw	0x00	Any value resets the diagnostic interrupt counter and acknow-ledges if necessary the interrupt.

With de-activated *Auto-Acknowledge* of the EtherCAT coupler the *diagnostic interrupt counter* of object 0xF100 is reset and the diagnostic interrupt is acknowledged. For this you have to write any value you like to subindex 0x06 of index 0x5002.

Diagnostic Data (Byte 1 ... n)   The whole diagnostic data of a module may be accessed with this object. Here you may either access current diagnostic data or the diagnostic data of a module on any EtherCAT-Slot.

Index	Sub-index	Name	Type	Attr.	Default value	Meaning
0x5005	0x00	Diagnostic Data	Unsigned8	ro	18	
	0x01	Slot	Unsigned8	rw	0	By reading this index here the EtherCAT-Slot of the module may be found, to which the following diagnostic data belong to. By writing of an EtherCAT-Slot to this index the diagnostic data of the corresponding module may be read.
	0x02		Unsigned8	ro	0	Diagnostics data of the module (see module description)
	0x03		Unsigned8	ro	0	
	0x04		Unsigned8	ro	0	
	0x05		Unsigned8	ro	0	
	0x06		Unsigned8	ro	0	
	0x07		Unsigned8	ro	0	
	0x08		Unsigned8	ro	0	
	0x09		Unsigned8	ro	0	
	0x0A		Unsigned8	ro	0	
	0x0B		Unsigned8	ro	0	
	0x0C		Unsigned8	ro	0	
	0x0D		Unsigned8	ro	0	
	0x0E		Unsigned8	ro	0	
	0x0F		Unsigned8	ro	0	
	0x10		Unsigned8	ro	0	
	0x11		Unsigned8	ro	0	
	0x12		Unsigned32	ro	0	

Read Input Data   With this object the input data of a System SLIO module may be read. Here the addressing of the EtherCAT-Slot via index (0x6000 + EtherCAT-Slot) takes place. The corresponding input data may be accessed via subindexes. The allocation of the subindexes may be found in the description of the corresponding System SLIO module.

Index	Sub-index	Name	Type	Attr.	Default value	Meaning
0x6000 ... 0x603F	0x00	Input Data	Unsigned8	ro		Number of subindexes of the input data for the corresponding EtherCAT-Slot
	0x01			ro		Input data
	0x02			ro		(see module description)
	...	...				

Read Output Data   With this object the output data of a System SLIO may be read. Here the addressing via index (0x7000 + EtherCAT-Slot) takes place. The corresponding output data may be read via subindexes. The allocation of the subindexes may be found in the description of the corresponding System SLIO module.

Index	Sub-index	Name	Type	Attr.	Default value	Meaning
0x7000 ... 0x703F	0x00	Output Data	Unsigned8	ro		Number of subindexes of the output data for the corresponding EtherCAT-Slot
	0x01			ro		Output data
	0x02			ro		(see module description)
	...	...				

Note!

Information concerning the write access to outputs may be found in the manual of your EtherCAT master.

Modular Device Profile

Index	Sub-index	Name	Type	Attr.	Default value	Meaning
0xF000	0x00	Modular Device Profile	Unsigned8	ro	5	
	0x01	Module Index Distance	Unsigned16	ro	1	
	0x02	Maximum Number of Modules	Unsigned16	ro	0x40 (64)	
	0x03	Standard Entries in Object 0x8yy0	Unsigned32	ro	0	
	0x04	Standard Entries in Object 0x9yy0	Unsigned32	ro	0	
	0x05	Module PDO Group	Unsigned8	ro	0	

Module List

Index	Sub-index	Name	Type	Attr.	Default value	Meaning
0xF010	0x00	Module List	Unsigned8	ro		Module ID of the modules
	0x01	Subindex 001	Unsigned32	ro		
	0x02	Subindex 002	Unsigned32	ro		
	...	...	...	...		
	0x40	Subindex 064	Unsigned32	ro		

Configured Module List

Index	Sub-index	Name	Type	Attr.	Default value	Meaning
0xF030	0x00	Configured Module List	Unsigned8	rw		Module ID of the configured modules
	0x01	Subindex 001	Unsigned32	rw		
	0x02	Subindex 002	Unsigned32	rw		
	...	...	...	...		
	0x40	Subindex 064	Unsigned32	rw		

- When writing to a subindex the entered value is compared with the module ID of the same subindex of index 0xF050. So the configuration may be checked.
- Some configuration tools cannot automatically write to this index, thus some configuration errors may not be detected.

Detected Address List

Index	Sub-index	Name	Type	Attr.	Default value	Meaning
0xF040	0x00	Detected Address List	Unsigned8	ro		Addresses of the modules, which were recognized by the coupler
	0x01	Subindex 001	Unsigned16	ro		
	0x02	Subindex 002	Unsigned16	ro		
	...	...	...	...		
	0x40	Subindex 064	Unsigned16	ro		

Detected Module List

Index	Sub-index	Name	Type	Attr.	Default value	Meaning
0xF050	0x00	Detected Module List	Unsigned8	ro		Module IDs of the modules, which were recognized by the coupler
	0x01	Subindex 001	Unsigned32	ro		
	0x02	Subindex 002	Unsigned32	ro		
	...	...	...	...		
	0x40	Subindex 064	Unsigned32	ro		

Alarm Status   This object contains in each case a counter for hardware and diagnostic interrupts for interrupt signaling. These counter are input data of the EtherCAT coupler and were transferred together with the process data.

Index	Sub-index	Name	Type	Attr.	Default value	Meaning
0xF100	0x00	Interrupt Status	Unsigned8	ro	2	
	0x01	Hardware Interrupt Counter	Unsigned32	ro	0x00000000	Counter for hardware interrupt
	0x02	Diagnostic Interrupt Counter	Unsigned32	ro	0x00000000	Counter for diagnostic interrupt

With de-activated *Auto-Acknowledge* of the EtherCAT coupler the corresponding counter is set to 1 until you acknowledge this accordingly. For this you have to write any value you like to subindex 0x06 under the accordingly assigned index.

With activated *Auto-Acknowledge* here you will find the number of hardware and diagnostics interrupts, which happened since the last interrupt reset. To reset the corresponding counter you have to write any value you like to the subindex 0x06 under the accordingly assigned index.

The following index assignments are valid:

- Write to 0x06 of index 0x5000: Reset of counter hardware interrupt

- Write to 0x06 of index 0x5002: Reset of counter diagnostic interrupt

Error handling

Overview   In EtherCAT there are the following two types of error messages:

- Emergency error message
- Standard error message

Emergency error messages   Emergency error messages are generated on errors during state changes respectively at hardware and diagnostic interrupts if the interrupt is activated by parameterization.

Emergency error messages are released within device-internal mechanisms and sent to the master by means of the mailbox service.

Frame structure   Byte

0	1	2	3	4	5	6	7
EEC		ER		DATA			

EEC - Emergency error code   Emergency Error Codes following ETG specifications:

0xFFxx: Vendor-specific emergency message (VIPA = 0xFF00)

0xA0xx: State Machine transition error, e.g. due to a configuration error (length, address, settings).
More information concerning this may be found at ETG.

ER - Error register   State of the EtherCAT State Machine:

01: Init   04: Safe-Op

02: Pre-Op   08: Op

03: Bootstrap

DATA - Error data   Here more information concerning the error may be found.

With a hardware interrupt or diagnostic interrupt respectively in DATA the *Manufacturer Specific Error Field* (MEF) may be found.
The field has the following structure:

Byte

0	1	2	3	4	5	6	7
EEC		ER	SLOT	TYPE	DIAG		
			MEF				

SLOT - EtherCAT-Slot

EtherCAT-Slot of the module where is the error from

TYPE - Interrupt type

01: Hardware interrupt
02: Diagnostic interrupt

DIAG - Diagnostic data

Error code, which is described at corresponding module.

Standard error messages

Standard error messages are released within device-internal mechanisms and sent to the master. The following standard error messages my occur:

AL Status Code

To get more information about the error the EtherCAT master reads the AL Status Code (AL = application layer). This is allocated in the EtherCAT coupler in register 0x0134. Besides the EtherCAT-specific error codes the vendor-specific error codes may also be found.

EtherCAT specific error messages

Code	Description	Current State	Resulting State
0x0000	No error	Any	Current state
0x0001	Unspecified error	Any	Any + E
0x0002	No Memory	Any	Any + E
0x0011	Invalid requested state change	I → S, I → O, P → O, O → B, S → B, P → B	Current state + E
0x0012	Unknown requested state	Any	Current state + E
0x0013	Bootstrap not supported	I → B	I + E
0x0014	No valid firmware	I → P	I + E
0x0015	Invalid mailbox configuration	I → B	I + E
0x0016	Invalid mailbox configuration	I → P	I + E
0x0017	Invalid SyncManager configuration	P → S, S → O	Current state + E
0x0018	No valid inputs available	O, S → O	S + E
0x0019	No valid outputs	O, S → O	S + E
0x001A	Synchronization error	O, S → O	S + E
0x001B	SyncManager watchdog (see below)	O, S	S + E
0x001C	Invalid SyncManager Types	O, S, P → S	S + E
0x001D	Invalid Output Configuration	O, S, P → S	S + E
0x001E	Invalid Input Configuration	O, S, P → S	P + E
0x001F	Invalid Watchdog Configuration	O, S, P → S	P + E
0x0020	Coupler needs cold start	Any	Current state + E
0x0021	Coupler needs INIT	B, P, S, O	Current state + E
0x0022	Coupler needs PREOP	S, O	S + E, O + E
0x0023	Coupler needs SAFEOP	O	O + E
0x0024	Invalid Input Mapping	P → S	P + E
0x0025	Invalid Output Mapping	P → S	P + E
0x0026	Inconsistent Settings	P → S	P + E
0x0027	Free-run not supported	P → S	P + E
0x0028	Synchronization not supported	P → S	P + E
0x0029	Free-run needs 3 Buffer Mode	P → S	P + E
0x002A	Background Watchdog	S, O	P + E
0x002B	No Valid Inputs and Outputs	O, S → O	S + E
0x002C	Fatal Sync Error	O	S + E
0x002D	No Sync Error	S → O	S + E
0x0030	Invalid DC SYNC Configuration	O, S → O, P → S	P + E, S + E
0x0031	Invalid DC Latch Configuration	O, S → O, P → S	P + E, S + E
0x0032	PLL Error	O, S → O	S + E
0x0033	DC Sync IO Error	O, S → O	S + E
0x0034	DC Sync Timeout Error	O, S → O	S + E
0x0035	DC Invalid Sync Cycle Time	P → S	P + E
0x0036	DC Sync0 Cycle Time	P → S	P + E
0x0037	DC Sync1 Cycle Time	P → S	P + E
0x0041	MBX_AOE	B, P, S, O	Current state + E
0x0042	MBX_EOE	B, P, S, O	Current state + E
0x0043	MBX_COE	B, P, S, O	Current state + E
0x0044	MBX_FOE	B, P, S, O	Current state + E
0x0045	MBX_SOE	B, P, S, O	Current state + E
0x004F	MBX_VOE	B, P, S, O	Current state + E
0x0050	EEPROM No Access	Any	Any + E
0x0051	EEPROM Error	Any	Any + E
0x0060	Coupler Restarted Locally	Any	I
< x8000	Reserved		

SyncManager
watchdog 0x001B

If there is no communication to the master possible e.g. line is interrupted, you will get the error message 0x001B after the SyncMaster watchdog time has been elapsed. The time is to be configured in the master.

Due to the fixed watchdog time of the System SLIO the SyncManager watchdog time must be less than or equal to 0.5s! Otherwise a restart is necessary when the SyncManager has released.

Vendor-specific
error messages

Code	Description	Current State	Resulting State
0x8000	no module recognized or present	I	I + E
0x8001	Module at system bus needs update	P > S	P + E
0x8002	Init error	P > S	P + E
0x8003	unexpected restart (Watchdog)	P > S	P + E
0x8004	Error reading EEPROM	P > S	P + E
0x8005	SLIO IO area too big or small	P > S	P + E

I: Init, P: Pre-Operational, S: Safe-Operational, O: Operational,
B: Bootstrap, E: Error

SDO error code

If a SDO request is negative evaluated, an according SDO error code is released.

In the following table the possible errors are listed.

Code	Description
0x05030000	Toggle bit not alternated
0x05040000	SDO protocol timed out
0x05040001	Client/server command specifier not valid or unknown
0x05040002	Invalid block size (block mode only)
0x05040003	Invalid sequence number (block mode only)
0x05040004	CRC error (block mode only)
0x05040005	Out of memory
0x06010000	Unsupported access to an object
0x06010001	Attempt to read a write only object
0x06010002	Attempt to write a read only object
0x06020000	Object does not exist in the object dictionary
0x06040041	Object cannot be mapped to the PDO
0x06040042	The number and length of the objects to be mapped would exceed PDO length
0x06040043	General parameter incompatibility reason
0x06040047	General internal incompatibility in the device
0x06060000	Access failed due to an hardware error
0x06070010	Data type does not match, length of service parameter does not match
0x06070012	Data type does not match, length of service parameter too high
0x06070013	Data type does not match, length of service parameter too low
0x06090011	Subindex does not exist
0x06090030	Value range of parameter exceeded (only for write access)
0x06090031	Value of parameter written too high
0x06090032	Value of parameter written too low
0x06090036	Maximum value is less than minimum value
0x08000000	General error
0x08000020	Data cannot be transferred or stored to the application
0x08000021	Data cannot be transferred or stored to the application because of local control
0x08000022	Data cannot be transferred or stored to the application because of the present device state
0x08000023	Object directory dynamic generation fails or no object directory is present (e.g. object directory is generated from file and generation fails because of an file error)