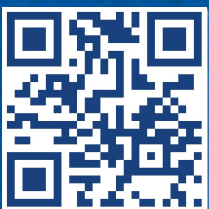


System SLIO

IM | 053-1MT01 | Manual

HB300 | IM | 053-1MT01 | en | 22-30

Interface module Modbus/TCP - IM 053MT



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1 General

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1.2 About this manual

Objective and contents

This manual describes the IM 053MT of the System SLIO.

- It describes the structure, configuration and application.
- The manual is targeted at users who have a background in automation technology.
- The manual consists of chapters. Each chapter describes a completed topic.
- For guidance, the manual provides:
 - An overall table of contents at the beginning of the manual.
 - References with pages numbers.

Validity of the documentation

Product	Order no.	as of state:	
IM 053MT	053-1MT01	HW: 01	FW: V1.0.0

Icons Headings

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



DANGER!

Immediate or likely danger. Personal injury is possible.



CAUTION!

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



Supplementary information and useful tips.

1.3 Safety information

Applications conforming with specifications

The system is constructed and produced for:

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



DANGER!

This device is not certified for applications in

- in explosive environments (EX-zone)

Documentation

The manual must be available to all personnel in the

- project design department
- installation department
- commissioning
- operation

**CAUTION!**

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

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

Disposal

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

2 Basics and mounting

2.1 Safety notes for the user



DANGER!

Protection against dangerous voltages

- When using System SLIO modules, the user must be protected from touching hazardous voltage.
- You must therefore create an insulation concept for your system that includes safe separation of the potential areas of ELV and hazardous voltage.
- Here, observe the insulation voltages between the potential areas specified for the System SLIO modules and take suitable measures, such as using PELV/SELV power supplies for System SLIO modules.

Handling of electrostatic sensitive modules

The modules are equipped with highly integrated components in MOS technology. These components are highly sensitive to over-voltages that occur, e.g. with electrostatic discharge. The following symbol is used to identify these hazardous modules:



The symbol is located on modules, module racks or on packaging and thus indicates electrostatic sensitive modules. Electrostatic sensitive modules can be destroyed by energies and voltages that are far below the limits of human perception. If a person who is not electrically discharged handles electrostatic sensitive modules, voltages can occur and damage components and thus impair the functionality of the modules or render the modules unusable. Modules damaged in this way are in most cases not immediately recognized as faulty. The error can only appear after a long period of operation. Components damaged by static discharge can show temporary faults when exposed to temperature changes, vibrations or load changes. Only the consistent use of protective devices and responsible observance of the handling rules can effectively prevent malfunctions and failures on electrostatic sensitive modules.

Shipping of modules

Please always use the original packaging for shipping.

Measurement and modification of electrostatic sensitive modules

For measurements on electrostatic sensitive modules the following must be observed:

- Floating measuring instruments must be discharged before use.
- Measuring instruments used must be grounded.

When modifying electrostatic sensitive modules, ensure that a grounded soldering iron is used.



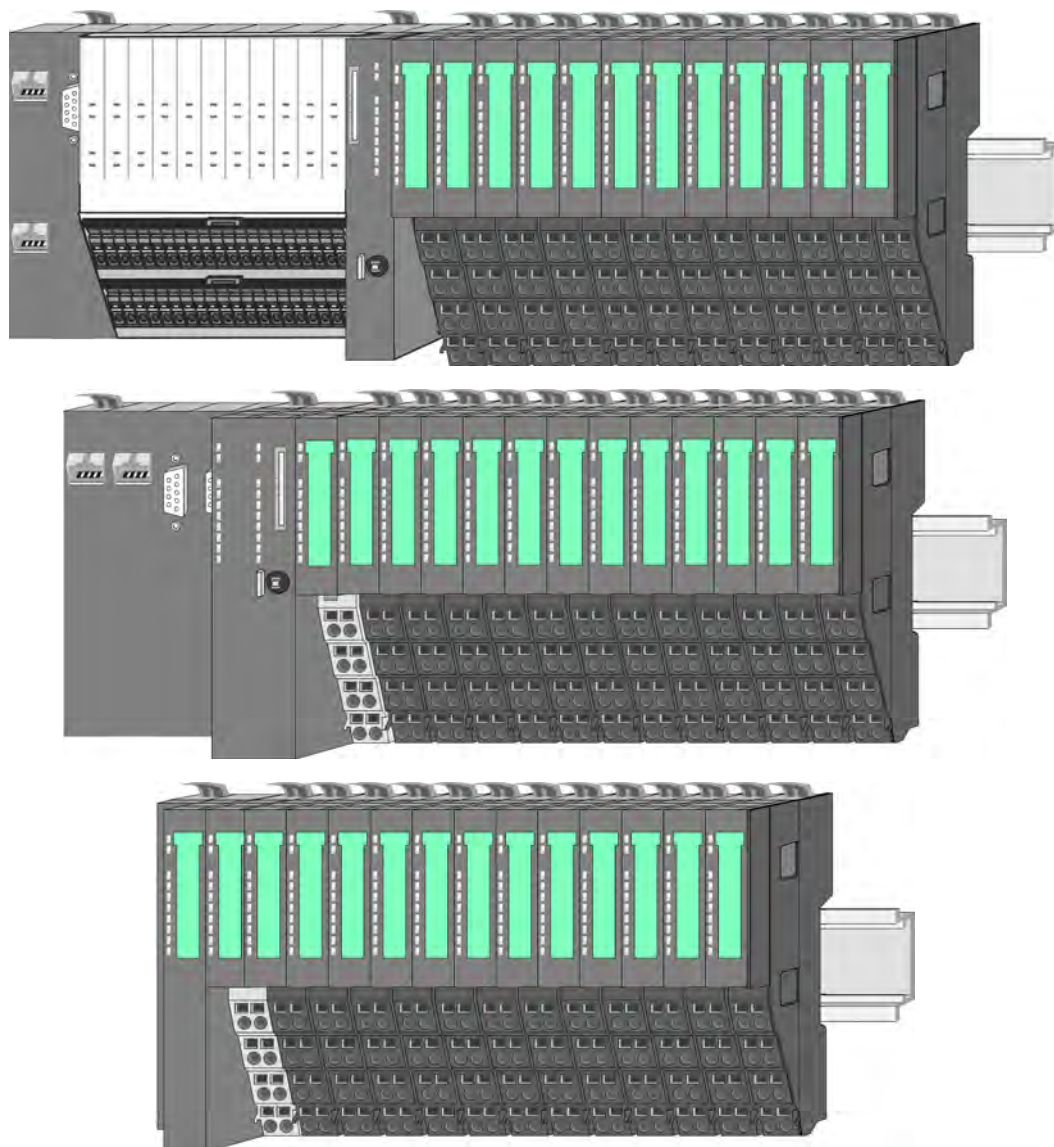
CAUTION!

When working with and on electrostatic sensitive modules, make sure that personnel and equipment are adequately grounded.

2.2 System conception

2.2.1 Overview

The System SLIO is a modular automation system for assembly on a 35mm mounting rail. By means of the periphery modules with 2, 4, 8 and 16 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 supply 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.



2.2.2 Components

- CPU (head module)
- Bus coupler (head module)
- Line extension
- 8x periphery modules
- 16x periphery modules
- Power modules
- Accessories



CAUTION!

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

CPU 01xC



With the CPU 01xC electronic, input/output components and power supply are integrated to one casing. In addition, up to 64 periphery modules of the System SLIO can be connected to the backplane bus. As head module via the integrated power module for power supply CPU electronic and the I/O components are supplied as well as the electronic of the periphery modules, which are connected via backplane bus. To connect the power supply of the I/O components and for DC 24V power section supply of via backplane bus connected periphery modules, the CPU has removable connectors. By installing of up to 64 periphery modules at the backplane bus, 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.

CPU 01x



With this CPU 01x, CPU electronic and power supply are integrated to one casing. As head module, via the integrated power module for power supply, CPU electronic and the electronic of the connected periphery modules are supplied. The DC 24V power section supply for the linked periphery modules is established via a further connection of the power module. By installing of up to 64 periphery modules at the backplane bus, these are electrically connected, this means these are assigned to the backplane bus, the electronic modules are power supplied and each periphery module is connected to the DC 24V power section supply.



CAUTION!

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

Bus coupler



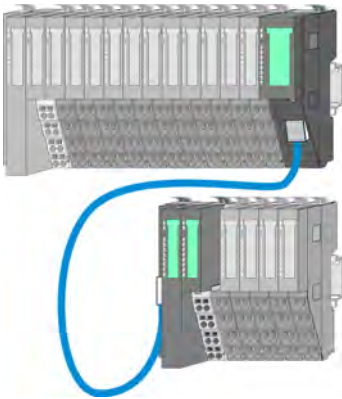
With a bus coupler bus interface and power module is integrated to one casing. With the bus interface you get access to a subordinated bus system. As head module, via the integrated power module for power supply, bus interface and the electronic of the connected periphery modules are supplied. The DC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



CAUTION!

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

Line extension

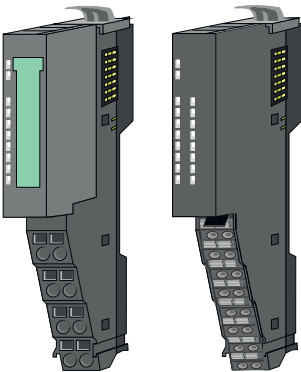


In the System SLIO there is the possibility to place up to 64 modules in on line. By means of the line extension you can divide this line into several lines. Here you have to place a line extension master at each end of a line and the subsequent line has to start with a line extension slave. Master and slave are to be connected via a special connecting cable. In this way, you can divide a line on up to 5 lines. For each line extension the maximum number of pluggable modules at the System SLIO bus is decreased by 1. To use the line extension no special configuration is required.



Please note that some modules do not support line extensions due to the system. For more information, see the 'System SLIO - Compatibility List' at www.yaskawa.eu.com

Periphery modules

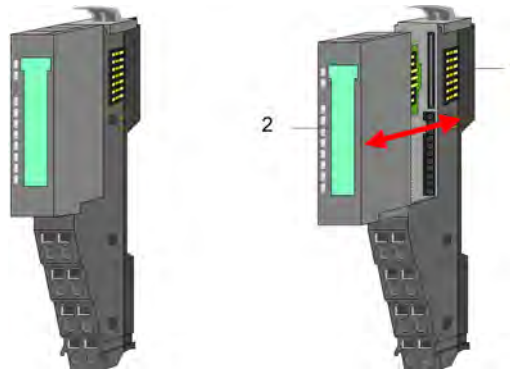


The periphery modules are available in the following 2 versions, whereby of each the electronic part can be replaced with standing wiring:

- 8x periphery module for a maximum of 8 channels.
- 16x periphery module for a maximum of 16 channels.

8x periphery modules

Each 8x 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 system may be assembled outside of your switchgear cabinet to be later mounted there as whole system.

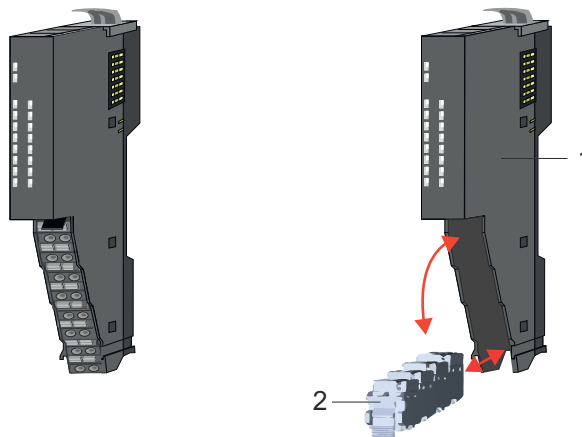
Electronic module



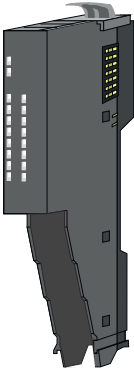
The functionality of a periphery module is defined by the *electronic module*, which is mounted to the terminal module by a sliding mechanism. With an error the defective electronic module may be exchanged for a functional module with standing installation. At the front side there are LEDs for status indication. For simple wiring each module shows corresponding connection information at the front and at the side.

16x periphery modules

Each 16x periphery module consists of an *electronic unit* and a *terminal block*.



- 1 Electronic unit
- 2 Terminal block

Electronic unit

The functionality of a 16x periphery module is defined via the terminal block, which is connected to the *electronic unit* via a secure flap mechanism. In the case of an error you can exchange the defective electronic unit for a functional unit with standing wiring. At the front side there are LEDs for status indication. For easy wiring each electronic unit shows corresponding connection information at the side. The electronic unit provides the slot for the terminal block for the wiring and contains the backplane bus with power supply for the electronic and the connection to the DC 24V power section supply. Additionally the electronic unit has a locking system for fixing it at a mounting rail. By means of this locking system your system may be assembled outside of your switchgear cabinet to be later mounted there as whole system.

Terminal block

The *terminal block* provides the electrical interface for the signalling and supplies lines of the module. When mounting the terminal block, it is attached to the bottom of the electronic unit and turned towards the electronic unit until it clicks into place. With the wiring a "push-in" spring-clip technique is used. This allows a quick and easy connection of your signal and supply lines. The clamping off takes place by means of a screwdriver.

Power module

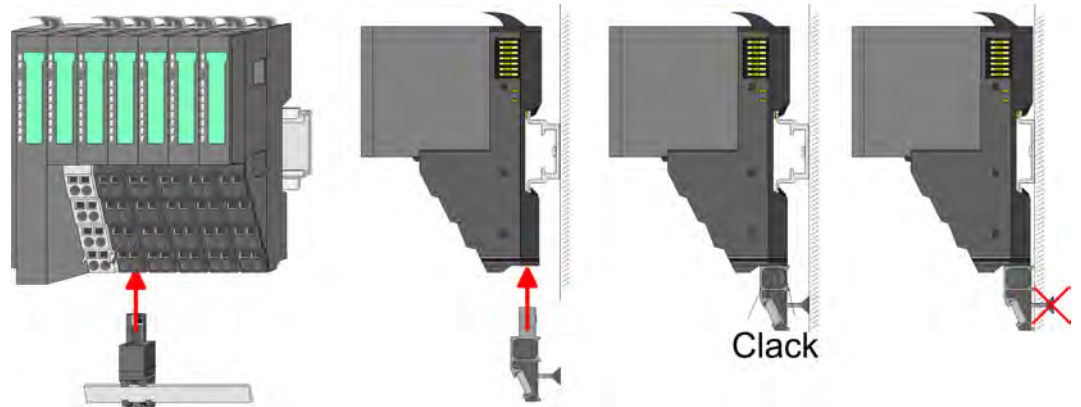
In the System SLIO the power supply is established by power modules. These are either integrated to the head module or may be installed between the periphery modules. Depending on the power module isolated areas of the DC 24V power section supply may be defined respectively the electronic power supply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

2.2.3 Accessories**Shield bus carrier**

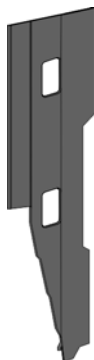
Please note that a shield bus carrier cannot be mounted on a 16x periphery module!



The shield bus carrier (order no.: 000-0AB00) serves to carry the shield bus (10mm x 3mm) to connect cable shields. Shield bus carriers, shield bus and shield fixings are not in the scope of delivery. They are only available as accessories. The shield bus carrier is mounted underneath the terminal of the terminal module. With a flat mounting rail for adaptation to a flat mounting rail you may remove the spacer of the shield bus carrier.



Bus cover



With each head module, 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 head module before mounting a System SLIO module. For the protection of the backplane bus connector you always have to mount the bus cover at the last module of your system again. The bus cover has the order no. 000-0AA00.

Coding pins



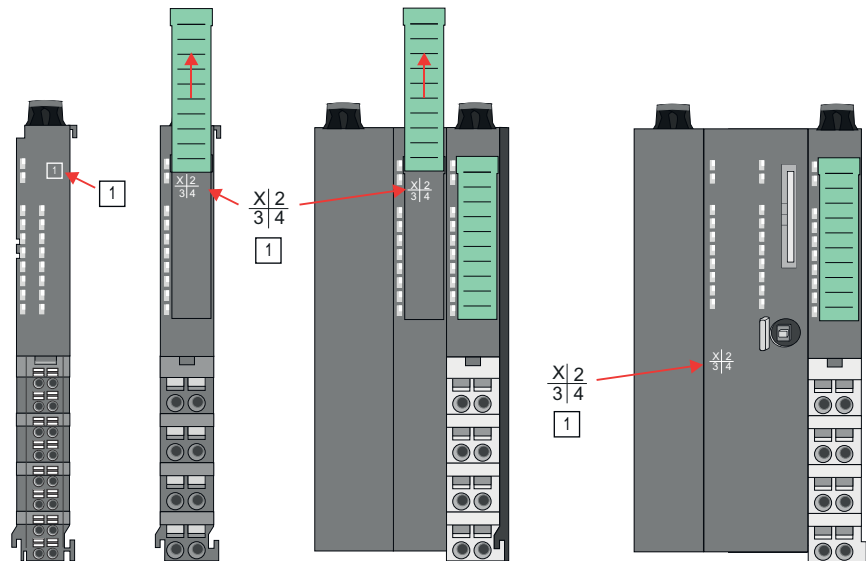
Please note that a coding pin cannot be installed on a 16x periphery module! Here you have to make sure that the associated terminal block is plugged again when the electronics unit is replaced.

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

2.2.4 Hardware revision

Hardware revision on the front

- The hardware revision is printed on every System SLIO module.
- Since a System SLIO 8x peripheral module consists of a terminal and electronic module, you will find a hardware revision printed on each of them.
- Authoritative for the hardware revision of a System SLIO module is the hardware revision of the electronic module. This is located under the labeling strip of the corresponding electronic module.
- Depending on the module type, there are the following 2 variants e.g. to indicate hardware revision 1:
 - Current modules have a 1 on the front.
 - With earlier modules, the 1 is marked with 'X' on a number grid.



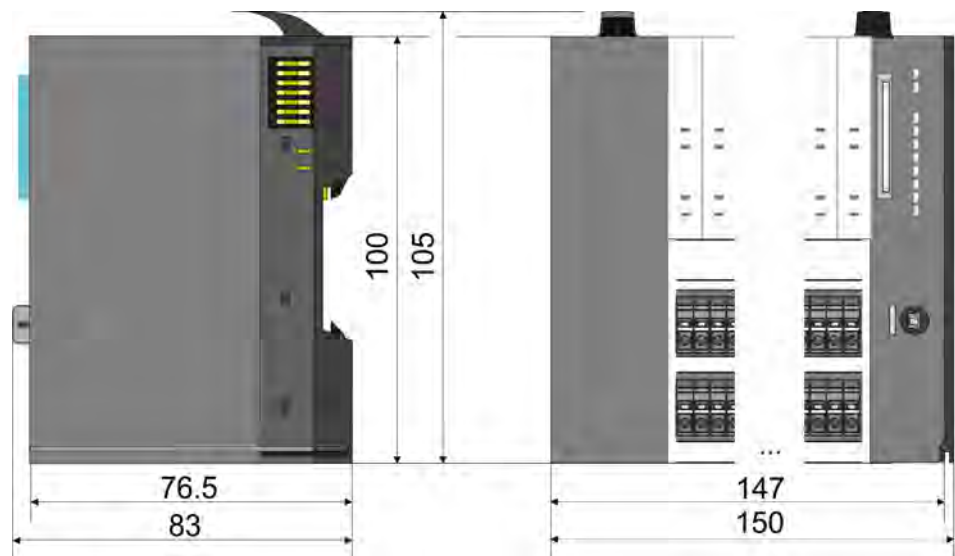
Hardware revision via web server

On the CPUs and some bus couplers, you can check the hardware revision 'HW Revision' via the integrated web server.

2.3 Dimensions

CPU 01xC

All dimensions are in mm.

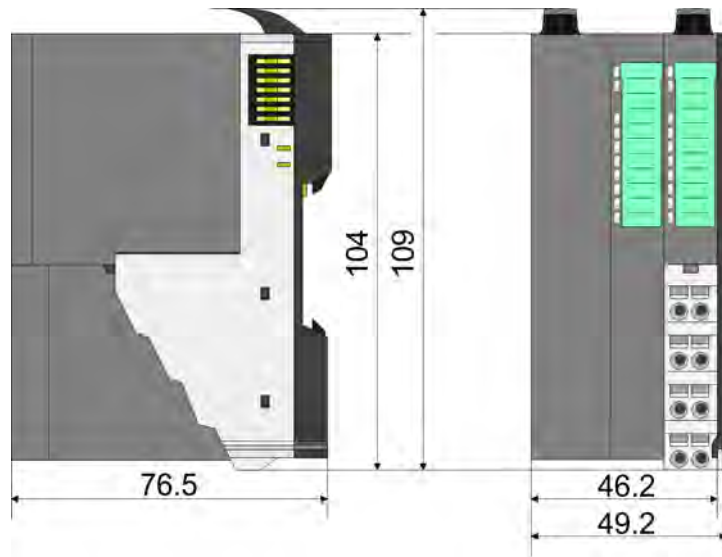


Dimensions

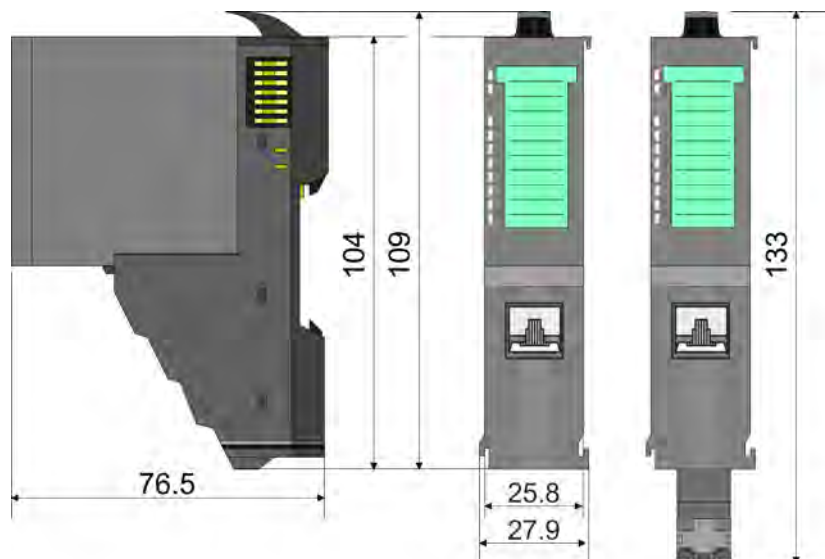
CPU 01x



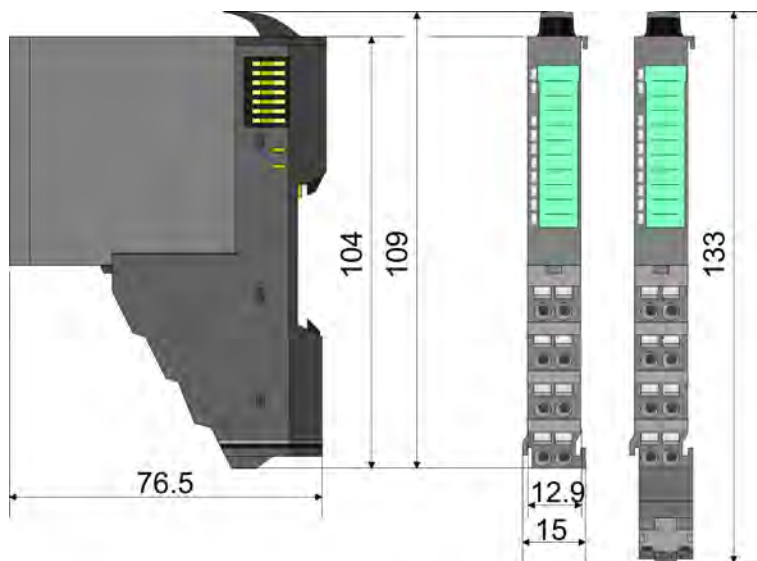
Bus coupler and line extension slave



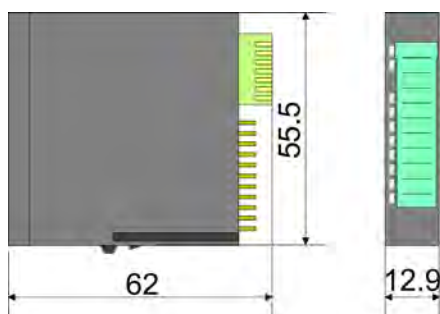
Line extension master



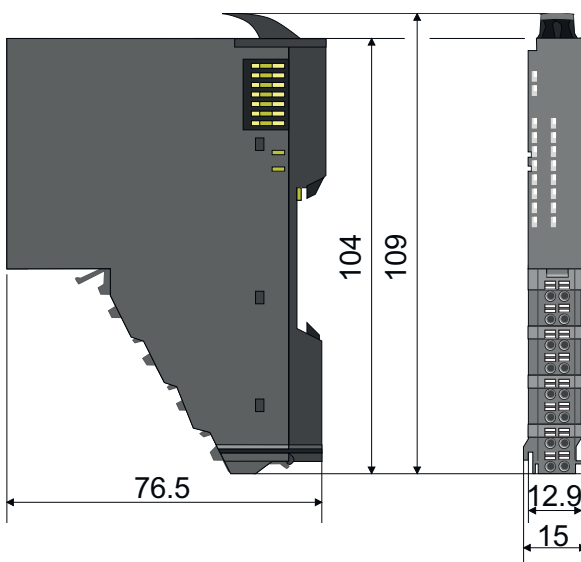
8x periphery module



Electronic module



16x periphery module



2.4 Mounting bus coupler

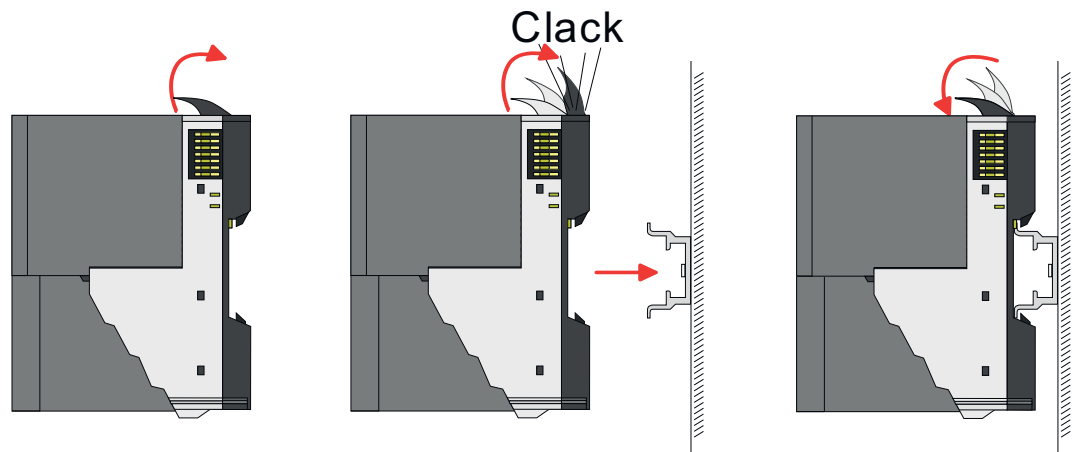


CAUTION!

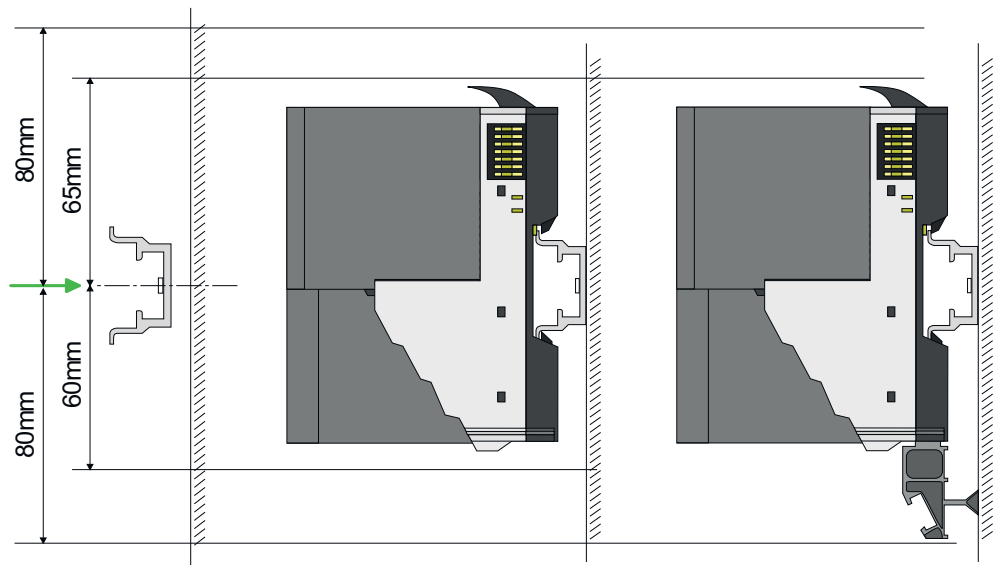
Requirements for UL compliance use

- Use for power supply exclusively SELV/PELV power supplies.
- The System SLIO must be installed and operated in a housing according to IEC 61010-1 9.3.2 c).

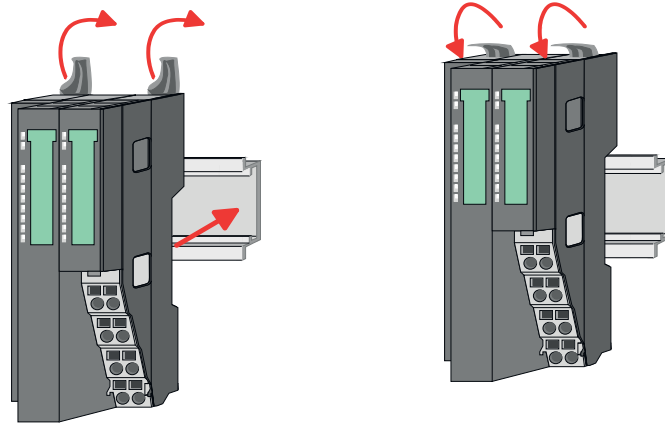
There are locking lever at the top side of the bus coupler. For mounting and demounting these locking lever are to be turned upwards until these engage. Place the bus coupler at the mounting rail. The bus coupler is fixed to the mounting rail by pushing downward the locking levers. The bus coupler is directly mounted at a mounting rail. Up to 64 modules may be mounted. The electronic and power section supply are connected via the back-plane bus. 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 accordingly.



Proceeding



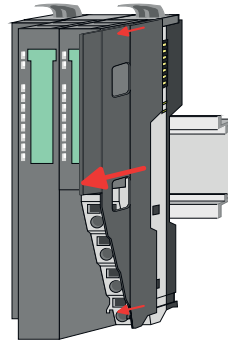
1. ➔ Mount the mounting rail! Please consider that a clearance from the middle of the mounting rail of at least 80mm above and 60mm below, respectively 80mm by deployment of shield bus carriers, exist.



2. Turn the locking lever upwards, place the bus coupler at the mounting rail and turn the lever downward.

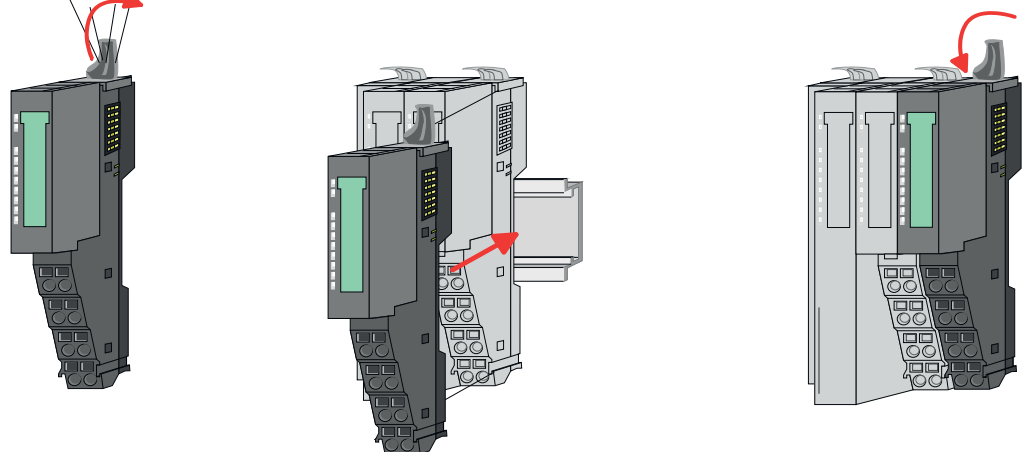
Mounting peripheral modules

The procedure is identical for 8x and 16x peripheral modules.

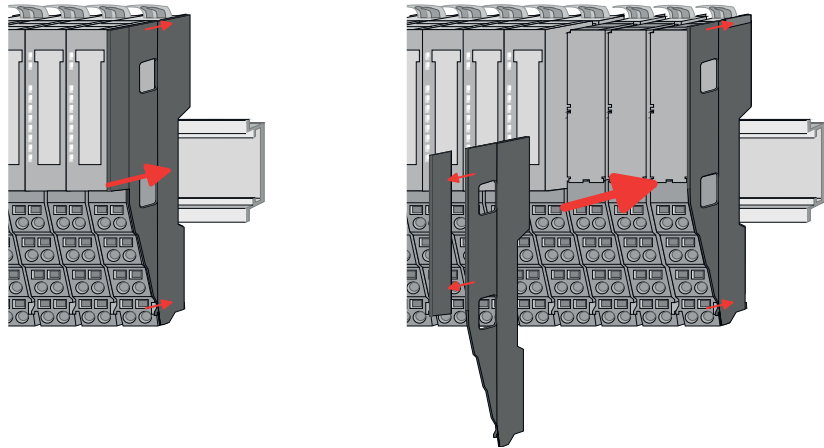


1. Before mounting the peripheral modules you have to remove the bus cover at the right side of the bus coupler by pulling it forward. Keep the cover for later mounting.

Clack



2. Mount the peripheral modules you want.



3. After mounting the whole system, to protect the backplane bus connectors at the last module you have to mount the bus cover, now. If the last module is a clamp module, for adaptation the upper part of the bus cover is to be removed.

2.5 Wiring



CAUTION!

Consider temperature for external cables!

Cables may experience temperature increase due to system heat dissipation. Thus the cabling specification must be chosen 5°C above ambient temperature!



CAUTION!

Separate insulation areas!

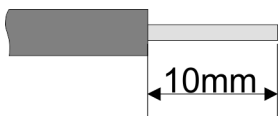
The system is specified for SELV/PELV environment. Devices, which are attached to the system must meet these specifications. Installation and cable routing other than SELV/PELV specification must be separated from the system's equipment!

2.5.1 Wiring bus coupler

Terminal module terminals

The System SLIO bus coupler have a power module integrated. 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

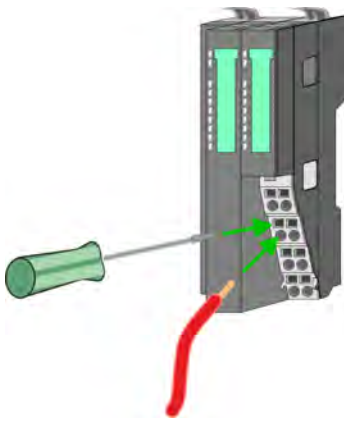
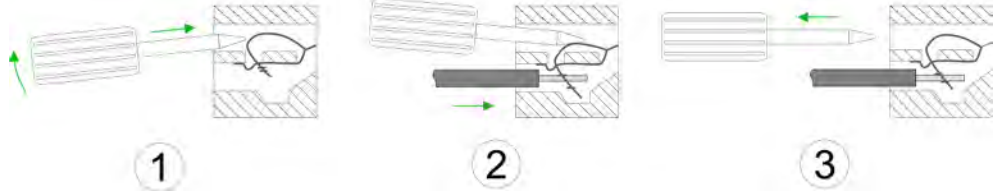


U_{max}	30V DC
I_{max}	10A
Cross section	0.08 ... 1.5mm ² (AWG 28 ... 16)
Stripping length	10mm

Wiring procedure

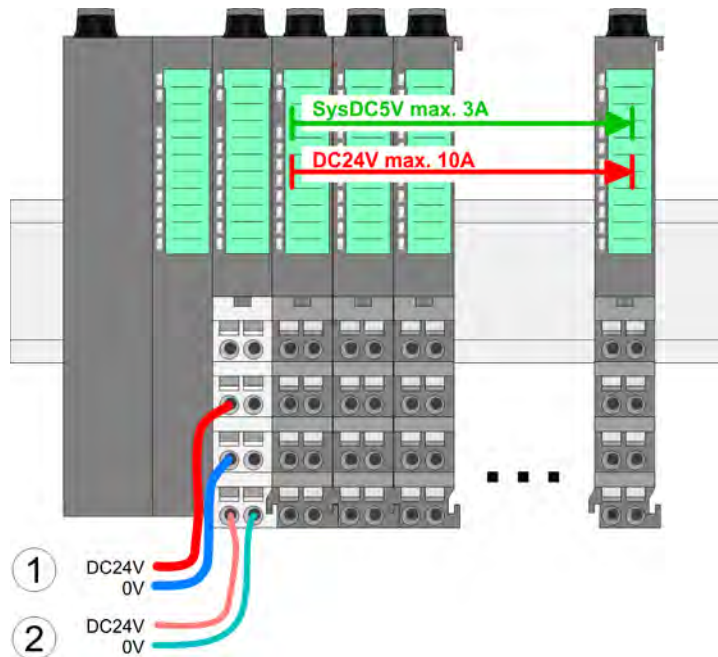


- 1 Pin number at the connector
- 2 Opening for screwdriver
- 3 Connection hole for wire



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

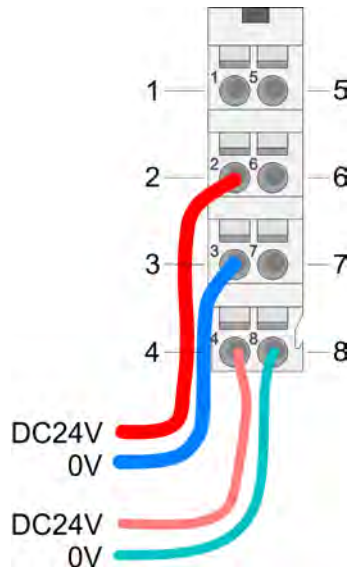
Standard wiring



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

PM - Power module

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



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

I: Input



CAUTION!

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



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

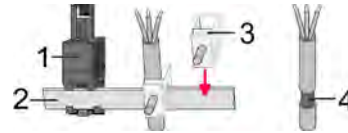
Fusing

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

State of the electronic power supply via LEDs

After PowerON of the System SLIO the LEDs RUN respectively MF get on so far as the sum current does not exceed 3A. With a sum current greater than 3A the LEDs may not be activated. Here the power module with the order number 007-1AB10 is to be placed between the peripheral modules.

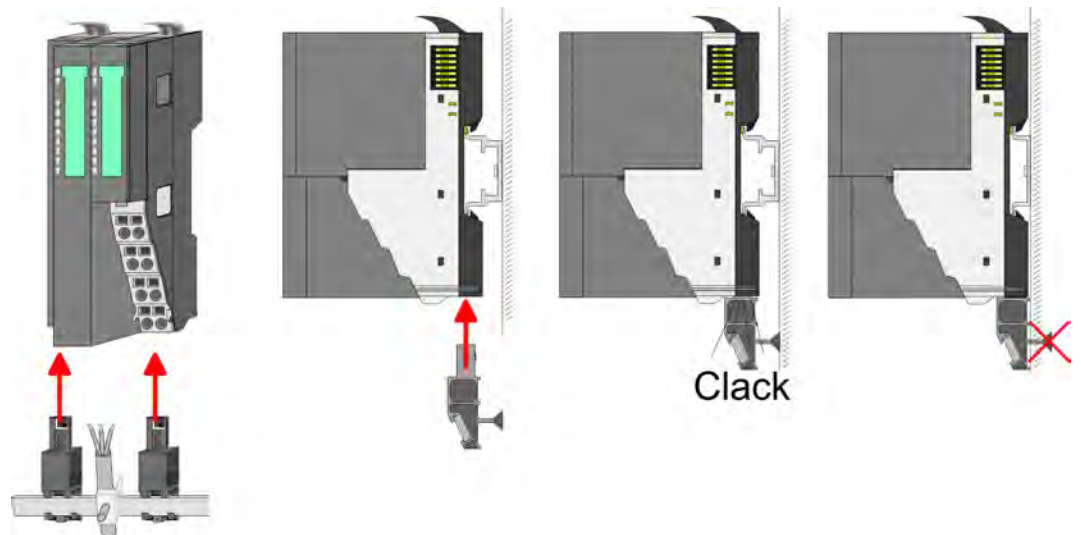
Shield attachment



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

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.

1. ➤ Each System SLIO module has a carrier hole for the shield bus carrier. Push the shield bus carrier, until they engage into the module. With a flat mounting rail for adaptation to a flat mounting rail you may remove the spacer of the shield bus carrier.
2. ➤ Put your shield bus into the shield bus carrier.



3. ➤ Attach the cables with the accordingly stripped cable screen and fix it by the shield clamp with the shield bus.

2.5.2 Wiring 8x periphery modules

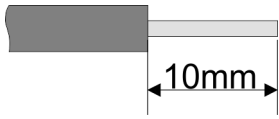
Terminal module terminals

**CAUTION!****Do not connect hazardous voltages!**

If this is not explicitly stated in the corresponding module description, hazardous voltages are not allowed to be connected to the corresponding terminal module!

- With wiring the terminal modules, terminals with spring clamp technology are used for wiring. The spring clamp technology allows quick and easy connection of your signal and supply lines. In contrast to screw terminal connections this type of connection is vibration proof.

Data

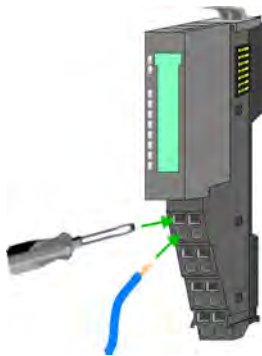
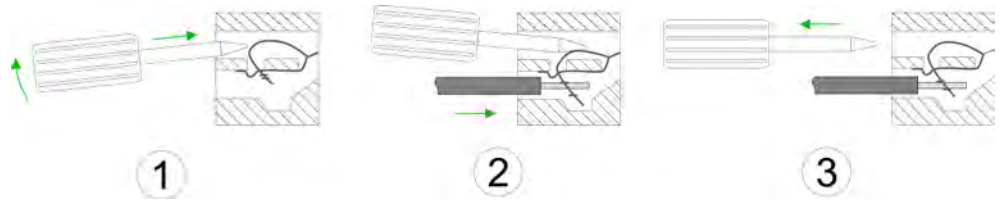


U_{max} 240V AC / 30V DC
 I_{max} 10A
 Cross section 0.08 ... 1.5mm² (AWG 28 ... 16)
 Stripping length 10mm

Wiring procedure

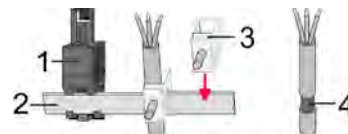


- 1 Pin number at the connector
- 2 Opening for screwdriver
- 3 Connection hole for wire



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

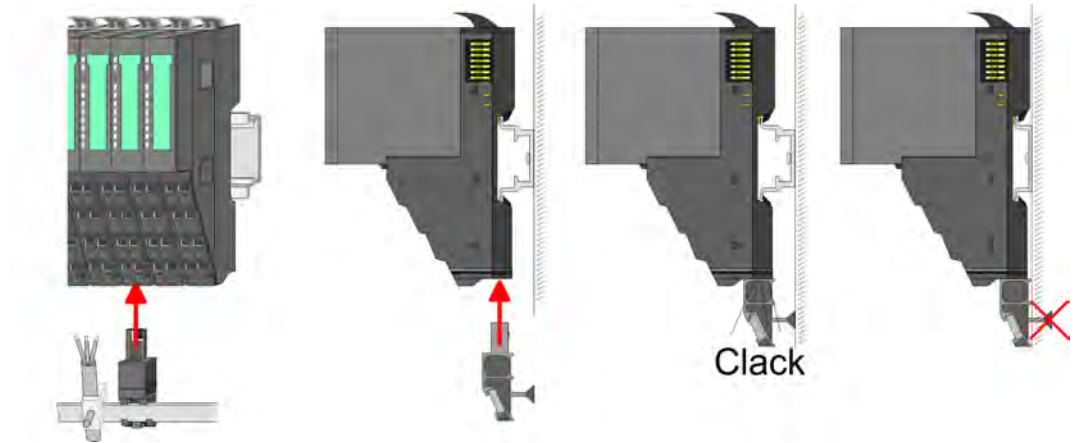
Shield attachment



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

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.

1. Each System SLIO 8x periphery module has a carrier hole for the shield bus carrier. Push the shield bus carrier, until they engage into the module. With a flat mounting rail for adaptation to a flat mounting rail you may remove the spacer of the shield bus carrier.
2. Put your shield bus into the shield bus carrier.



3. Attach the cables with the accordingly stripped cable screen and fix it by the shield clamp with the shield bus.

2.5.3 Wiring 16x periphery modules

Terminal block connectors



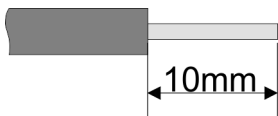
CAUTION!

Do not connect hazardous voltages!

If this is not explicitly stated in the corresponding module description, hazardous voltages are not allowed to be connected to the corresponding terminal block!

- The 16x periphery module has a removable terminal block for wiring.
- With the wiring of the terminal block a "push-in" spring-clip technique is used. This allows a quick and easy connection of your signal and supply lines.
- The clamping off takes place by means of a screwdriver.
- Please use copper wire only!

Data



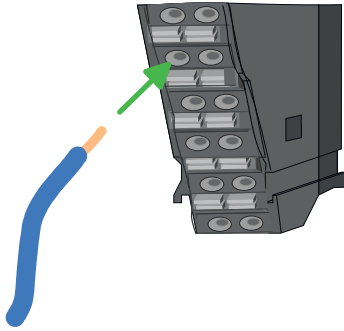
U_{max}	30V DC
I_{max}	10A
Cross section solid wire	0.25 ... 0.75mm ²
Cross section with ferrule	0.14 ... 0.75mm ²
Wire type	CU
AWG	24 ... 16
Stripping length	10mm

Wiring procedure



- 1 Release area
- 2 Connection hole for wire

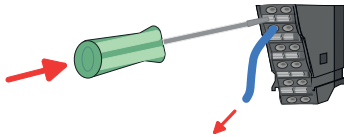
Insert wire



The wiring happens without a tool.

1. Determine according to the casing labelling the connection position.
2. Insert through the round connection hole of the according contact your prepared wire until it stops, so that it is fixed.
 - ⇒ By pushing the contact spring opens, thus ensuring the necessary contact pressure.

Remove wire



The wire is to be removed by means of a screwdriver with 2.5mm blade width.

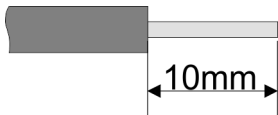
1. Press with your screwdriver vertically at the release button.
 - ⇒ The contact spring releases the wire.
2. Pull the wire from the round hole.

2.5.4 Wiring power modules

Terminal module terminals

Power modules are either integrated to the head module or may be installed between the periphery modules. With power modules, 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

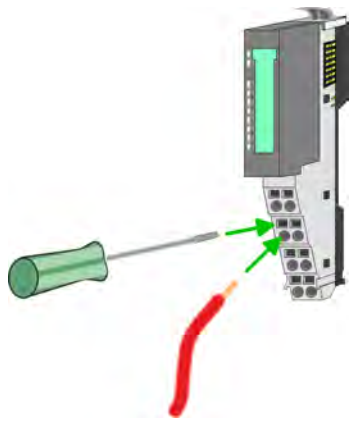
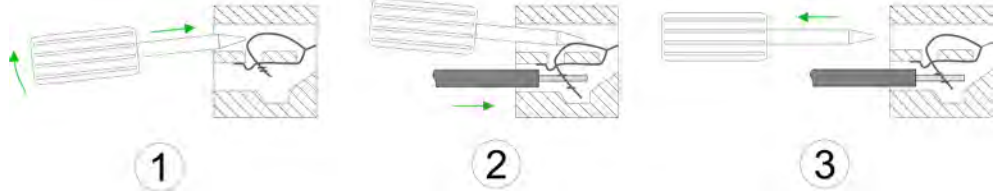


U_{max}	30V DC
I_{max}	10A
Cross section	0.08 ... 1.5mm ² (AWG 28 ... 16)
Stripping length	10mm

Wiring procedure

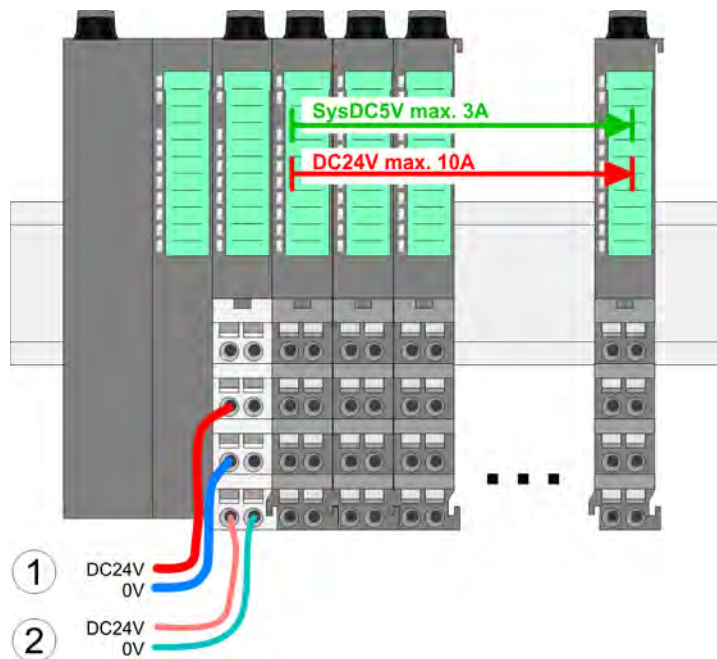


- 1 Pin number at the connector
- 2 Opening for screwdriver
- 3 Connection hole for wire



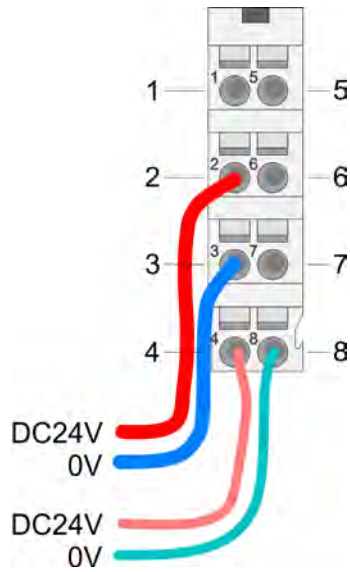
- 1. Insert a suited screwdriver at an angle into the square opening as shown. Press and hold the screwdriver in the opposite direction to open the contact spring.
- 2. Insert the stripped end of wire into the round opening. You can use wires with a cross section of 0.08mm² up to 1.5mm²
- 3. By removing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

Standard wiring



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

PM - Power module



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

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

I: Input



CAUTION!

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



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

Fusing

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

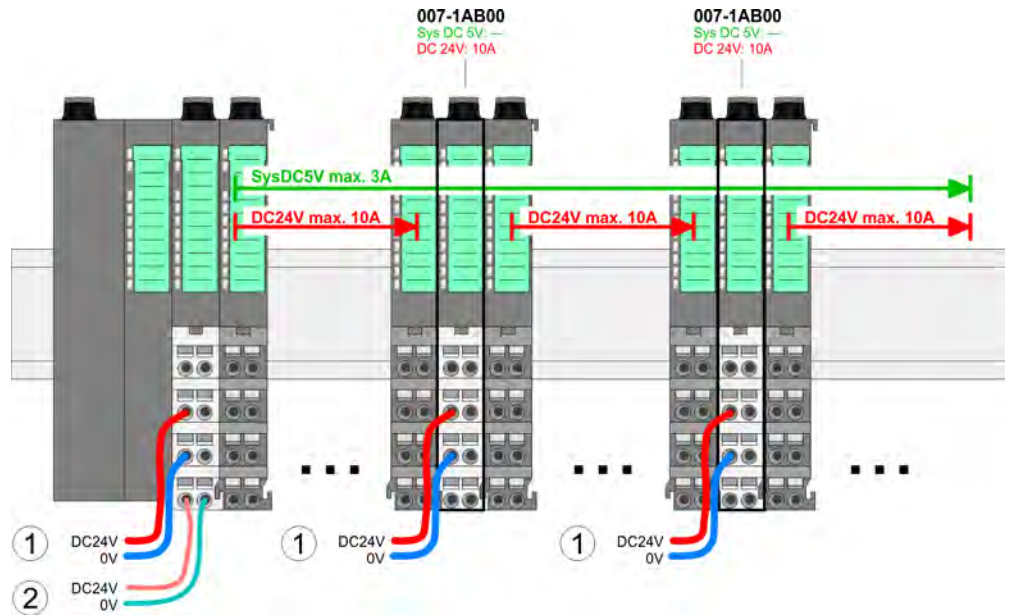
State of the electronic power supply via LEDs

After PowerON of the System SLIO the LEDs RUN respectively MF get on so far as the sum current does not exceed 3A. With a sum current greater than 3A the LEDs may not be activated. Here the power module with the order number 007-1AB10 is to be placed between the peripheral modules.

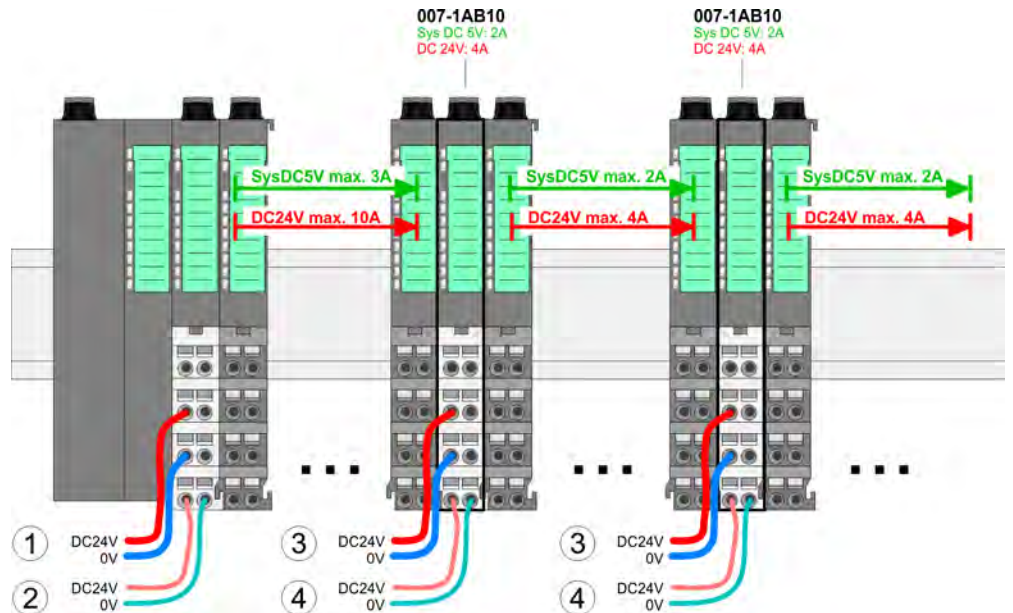
Deployment of the power modules

- If the 10A for the power section supply is no longer sufficient, you may use the power module 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 max. 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 a power module is to be placed again. To secure the power supply, the power modules may be mixed used.

Power module 007-1AB00

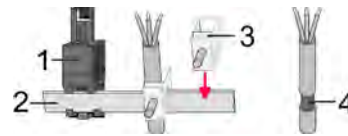


Power module 007-1AB10



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

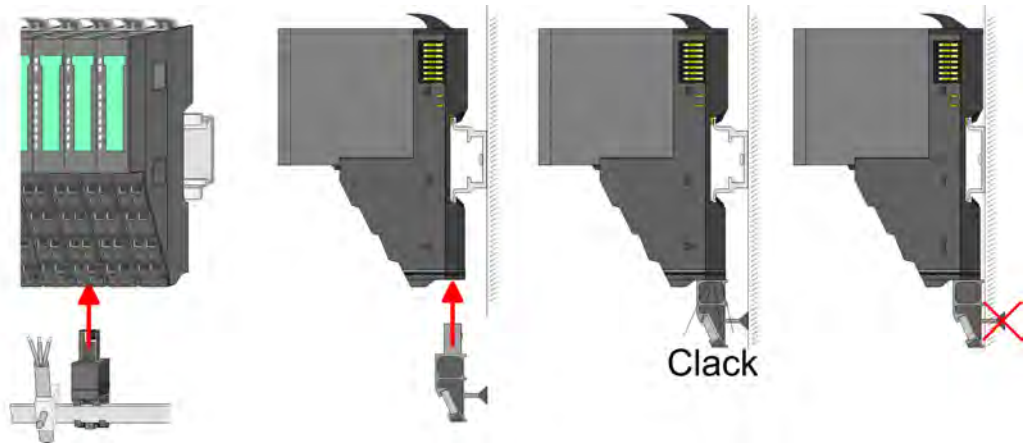
Shield attachment



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

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.

1. ➤ Each System SLIO 8x peripheral module has a carrier hole for the shield bus carrier. Push the shield bus carrier, until they engage into the module. With a flat mounting rail for adaptation to a flat mounting rail you may remove the spacer of the shield bus carrier.
2. ➤ Put your shield bus into the shield bus carrier.



3. ➤ Attach the cables with the accordingly stripped cable screen and fix it by the shield clamp with the shield bus.

2.6 Demounting

2.6.1 Demounting bus coupler

Proceeding



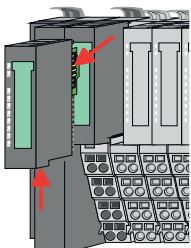
CAUTION!

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

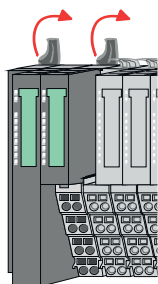
1. ➤ Power-off your system.
2. ➤ Remove if exists the wiring of the bus coupler.
3. ➤



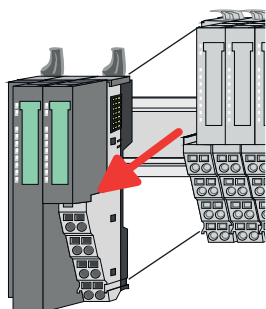
For demounting and exchange of a (head) module or a group of modules, due to mounting reasons you always have to remove the electronic module right beside. After mounting it may be plugged again.



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

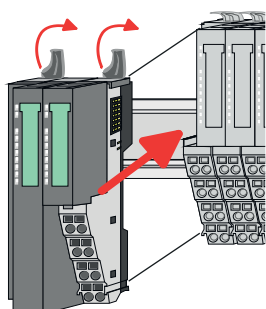


4. Turn all the locking lever of the bus coupler to be exchanged upwards.



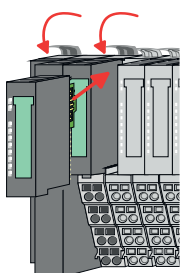
5. Pull the bus coupler forward.

6. For mounting turn all the locking lever of the bus coupler to be exchanged upwards.



7. To mount the bus coupler put it to the left periphery module and push it, guided by the stripes, to the mounting rail.

8. Turn all the locking lever downward, again.



9. Plug again the electronic module, which you have removed before.

10. Wire your bus coupler.

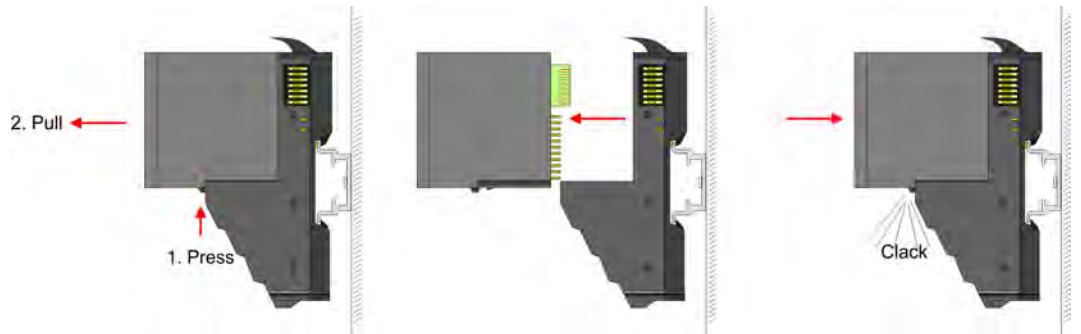
⇒ Now you can bring your system back into operation.

2.6.2 Demounting 8x periphery modules

Proceeding

Exchange of an electronic module

1. ➤ Power-off your system.

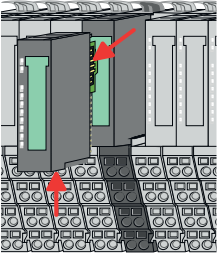


2. ➤ For the exchange of a electronic module, the electronic module may be pulled forward after pressing the unlocking lever at the lower side of the module.
3. ➤ For installation plug the new electronic module guided by the strips at the lower side until this engages to the terminal module.
 - ⇒ Now you can bring your system back into operation.



Easy Maintenance

'Easy Maintenance' means the support for adding and removing electronic modules during operation without having to restart the system. If this is supported by your head module, you will find more detailed information on this in the "Deployment" chapter. ↪ Chap. 4.6 'Easy Maintenance' page 75

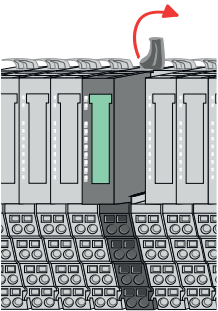
Exchange of a periphery module

1. ➤ Power-off your system.
2. ➤ Remove if exists the wiring of the module.
3. ➤

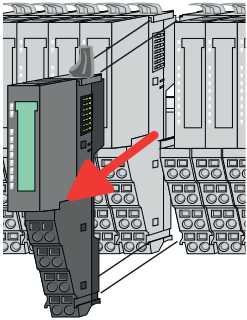


For demounting and exchange of a (head) module or a group of modules, due to mounting reasons you always have to remove the electronic module right beside. After mounting it may be plugged again.

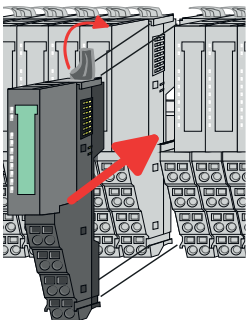
Press the unlocking lever at the lower side of the just mounted right module and pull it forward.



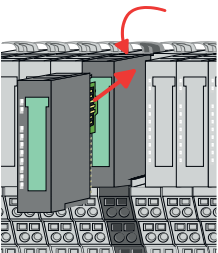
4. ➤ Turn the locking lever of the module to be exchanged upwards.



5. ➤ Pull the module.
6. ➤ For mounting turn the locking lever of the module to be mounted upwards.

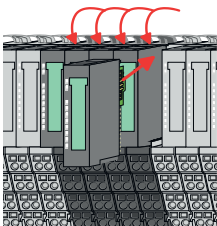
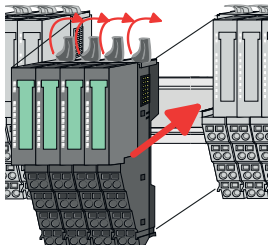
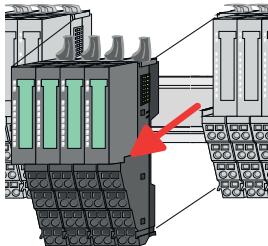
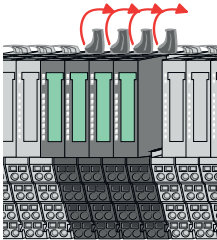
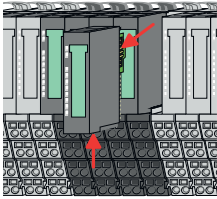


7. ➤ To mount the module put it to the gap between the both modules and push it, guided by the stripes at both sides, to the mounting rail.
8. ➤ Turn the locking lever downward, again.



9. ➤ Plug again the electronic module, which you have removed before.
10. ➤ Wire your module.
 - ⇒ Now you can bring your system back into operation.

Exchange of a module group



1. ➤ Power-off your system.
2. ➤ Remove if exists the wiring of the module group.

3. ➤

i For demounting and exchange of a (head) module or a group of modules, due to mounting reasons you always have to remove the electronic module right beside. After mounting it may be plugged again.

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

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

5. ➤ Pull the module group forward.

6. ➤ For mounting turn all the locking lever of the module group to be mounted upwards.

7. ➤ 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.

8. ➤ Turn all the locking lever downward, again.

9. ➤ Plug again the electronic module, which you have removed before.

10. ➤ Wire your module group.

⇒ Now you can bring your system back into operation.

2.6.3 Demounting 16x periphery modules

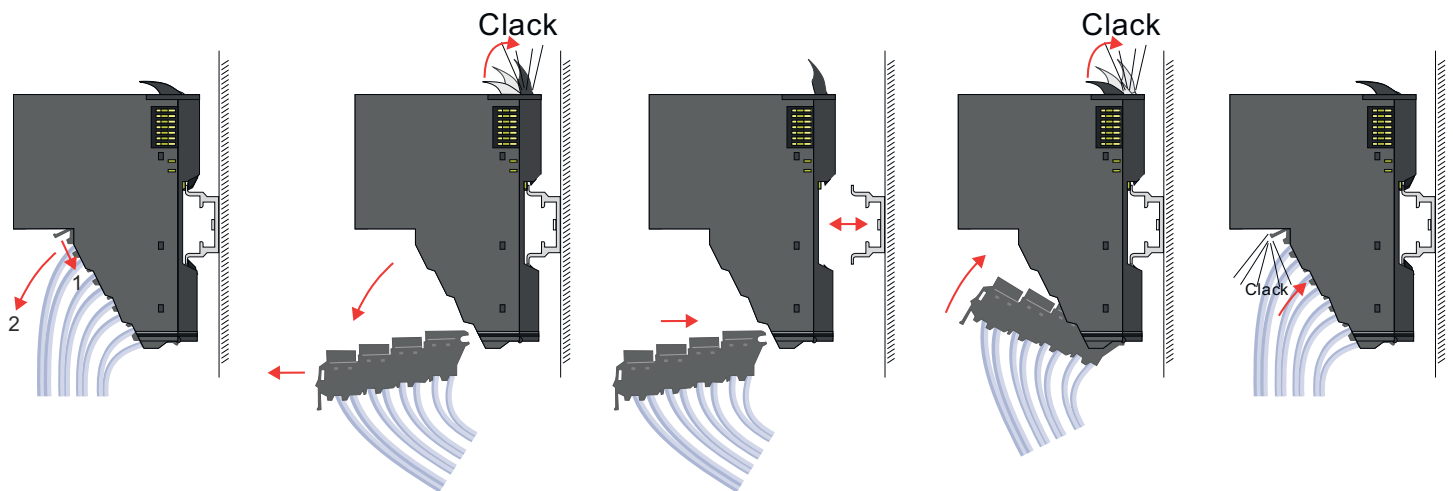
Proceeding

Exchange of an electronic unit

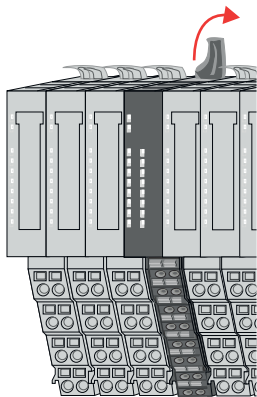
1. ➤ Power-off your system.
2. ➤ To replace an electronic unit, you can push down and pull off the terminal block after releasing the lock.

To mount the terminal block, place it horizontally on the lower side of the electronic unit and push it towards the electronic unit until it clicks into place.

⇒ Now you can bring your system back into operation.



Exchange of a 16x periphery module

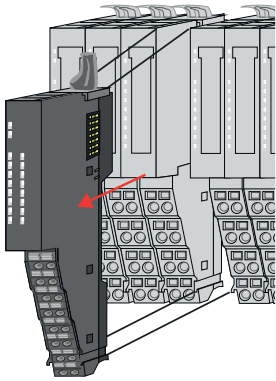


1. ➤ Power-off your system.
2. ➤ Remove if exists the wiring of the module respectively the wired terminal block.
3. ➤

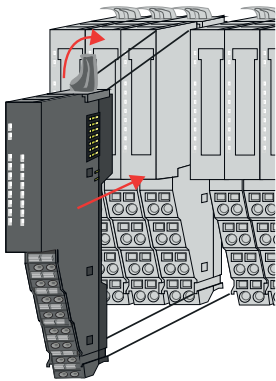


In contrast to 8x periphery modules, you can directly demount and mount 16x periphery modules.

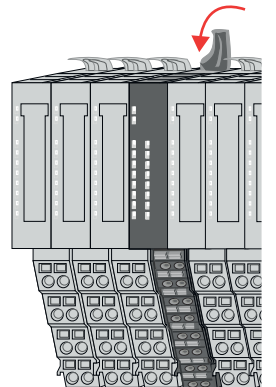
Turn the locking lever of the module to be exchanged upwards.



4. ➤ Pull the module.
5. ➤ For mounting turn the locking lever of the module to be mounted upwards.

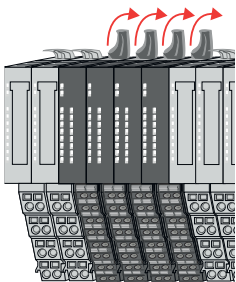


6. ➤ To mount the module put it to the gap between the both modules and push it, guided by the stripes at both sides, to the mounting rail.



7. ➤ Turn the locking lever downward, again.
8. ➤ Wire your module respectively plug the wired terminal block again.
 - ⇒ Now you can bring your system back into operation.

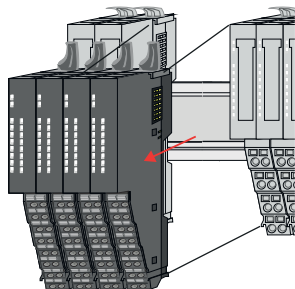
Exchange of a module group



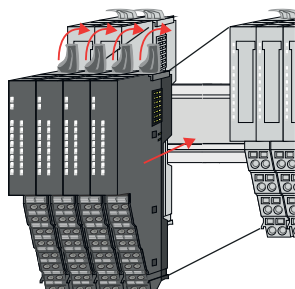
1. ➤ Power-off your system.
2. ➤ Remove if exists the wiring of the module group respectively the wired terminal blocks.
3. ➤

i *In contrast to 8x periphery modules, you can directly demount and mount 16x periphery modules.*

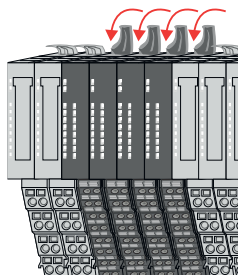
Turn all the locking lever of the module group to be exchanged upwards.



4. ➤ Pull the module group forward.
5. ➤ For mounting turn all the locking lever of the module group to be mounted upwards.



6. ➤ To mount the module group put it to the gap between the both modules and push it, guided by the stripes at both sides, to the mounting rail.



7. ➤ Turn all the locking lever downward, again.
8. ➤ Wire your module group respectively plug the wired terminal blocks again.
⇒ Now you can bring your system back into operation.

2.7 Trouble shooting - LEDs

General

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

In the following illustrations flashing LEDs are marked by ☼.

Sum current of the electronic power supply exceeded

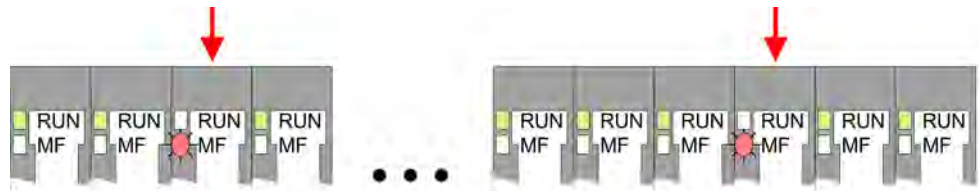


Behaviour: After PowerON the RUN LED of each module is off and the MF LED of each module is sporadically on.

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

Remedy: As soon as the sum current of the electronic power supply is exceeded, always place the power module 007-1AB10. ↪ Chap. 2.5.4 'Wiring power modules' page 26

Error in configuration



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

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

Remedy: Match configuration and hardware structure.

Module failure



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

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

Remedy: Replace the defective module.

2.8 Industrial security and installation guidelines

2.8.1 Industrial security in information technology

Latest version

This chapter can also be found as a guide '*Industrial IT Security*' at www.yaskawa.eu.com

Hazards

The topic of data security and access protection has become increasingly important in the industrial environment. The increased networking of entire industrial systems to the network levels within the company together with the functions of remote maintenance have all served to increase vulnerability. Hazards can arise from:

- Internal manipulation such as technical errors, operating and program errors and deliberate program or data manipulation.
- External manipulation such as software viruses, worms and Trojans.
- Human carelessness such as password phishing.

Precautions

The most important precautions to prevent manipulation and loss of data security in the industrial environment are:

- Encrypting the data traffic by means of certificates.
- Filtering and inspection of the traffic by means of VPN - "Virtual Private Networks".
- Identification of the user by "Authentication" via safe channels.
- Segmenting in protected automation cells, so that only devices in the same group can exchange data.
- Deactivation of unnecessary hardware and software.

Further Information

You can find more information about the measures on the following websites:

- Federal Office for Information Technology www.bsi.bund.de
- Cybersecurity & Infrastructure Security Agency us-cert.cisa.gov
- VDI / VDE Society for Measurement and Automation Technology www.vdi.de

2.8.1.1 Protection of hardware and applications

Precautions

- Do not integrate any components or systems into public networks.
 - Use VPN "Virtual Private Networks" for use in public networks. This allows you to control and filter the data traffic accordingly.
- Always keep your system up-to-date.
 - Always use the latest firmware version for all devices.
 - Update your user software regularly.
- Protect your systems with a firewall.
 - The firewall protects your infrastructure internally and externally.
 - This allows you to segment your network and isolate entire areas.
- Secure access to your plants via user accounts.
 - If possible, use a central user management system.
 - Create a user account for each user for whom authorization is essential.
 - Always keep user accounts up-to-date and deactivate unused user accounts.
- Secure access to your plants via secure passwords.
 - Change the password of a standard login after the first start.
 - Use strong passwords consisting of upper/lower case, numbers and special characters. The use of a password generator or manager is recommended.
 - Change the passwords according to the rules and guidelines that apply to your application.
- Deactivate inactive communication ports respectively protocols.
 - Only the communication ports that are used for communication should be activated.
 - Only the communication protocols that are used for communication should be activated.
- Consider possible defence strategies when planning and securing the system.
 - The isolation of components alone is not sufficient for comprehensive protection. An overall concept is to be drawn up here, which also provides defensive measures in the event of a cyber attack.
 - Periodically carry out threat assessments. Among others, a comparison is made here between the protective measures taken and those required.
- Limit the use of external storage media.
 - Via external storage media such as USB memory sticks or SD memory cards, malware can get directly into a system while bypassing a firewall.
 - External storage media or their slots must be protected against unauthorized physical access, e.g. by using a lockable control cabinet.
 - Make sure that only authorized persons have access.
 - When disposing of storage media, make sure that they are safely destroyed.
- Use secure access paths such as HTTPS or VPN for remote access to your plant.
- Enable security-related event logging in accordance with the applicable security policy and legal requirements for data protection.

2.8.1.2 Protection of PC-based software

Precautions

Since PC-based software is used for programming, configuration and monitoring, it can also be used to manipulate entire systems or individual components. Particular caution is required here!

- Use user accounts on your PC systems.
 - If possible, use a central user management system.
 - Create a user account for each user for whom authorization is essential.
 - Always keep user accounts up-to-date and deactivate unused user accounts.
- Protect your PC systems with secure passwords.
 - Change the password of a standard login after the first start.
 - Use strong passwords consisting of upper/lower case, numbers and special characters. The use of a password generator or manager is recommended.
 - Change the passwords according to the rules and guidelines that apply to your application.
- Enable security-related event logging in accordance with the applicable security policy and legal requirements for data protection.
- Protect your PC systems by security software.
 - Install virus scanners on your PC systems to identify viruses, trojans and other malware.
 - Install software that can detect phishing attacks and actively prevent them.
- Always keep your software up-to-date.
 - Update your operating system regularly.
 - Update your software regularly.
- Make regular backups and store the media at a safe place.
- Regularly restart your PC systems. Only boot from storage media that are protected against manipulation.
- Use encryption systems on your storage media.
- Perform security assessments regularly to reduce the risk of manipulation.
- Use only data and software from approved sources.
- Uninstall software which is not used.
- Disable unused services.
- Activate a password-protected screen lock on your PC systems.
- Always lock your PC systems as soon as you leave your PC workstation.
- Do not click any links that come from unknown sources. If necessary ask, e.g. on e-mails.
- Use secure access paths such as HTTPS or VPN for remote access to your PC system.

2.8.2 Installation guidelines

General

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

What does EMC mean?

Electromagnetic compatibility (EMC) means the ability of an electrical device, to function error free in an electromagnetic environment without being interfered respectively without interfering the environment.

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

Possible interference causes

Electromagnetic interferences may interfere your control via different ways:

- Electromagnetic fields (RF coupling)
- Magnetic fields with power frequency
- Bus system
- Power 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.

There are:

- 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 aluminium parts. Aluminium 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 respectively data lines in separate channels or bundles.
 - Route the signal and data lines as near as possible beside ground areas (e.g. suspension bars, metal rails, tin cabinet).
- Proof the correct fixing of the lead isolation.
 - Data lines must be shielded.
 - Analog lines must be shielded. When transmitting signals with small amplitudes the one sided laying of the isolation may be favourable.
 - Cables for frequency inverters, servo and stepper motors must be shielded.
 - Lay the line isolation extensively on an isolation/protected earth conductor rail directly after the cabinet entry and fix the isolation with cable clamps.
 - Make sure that the isolation/protected earth conductor rail is connected impedance-low with the cabinet.
 - Use metallic or metallised plug cases for isolated data lines.
- In special use cases you should appoint special EMC actions.
 - Consider to wire all inductivities with erase links.
 - Please consider luminescent lamps can influence signal lines.
- Create a homogeneous reference potential and ground all electrical operating supplies when possible.
 - Please take care for the targeted employment of the grounding actions. The grounding of the PLC serves for protection and functionality activity.
 - Connect installation parts and cabinets with your PLC in star topology with the isolation/protected earth conductor system. So you avoid ground loops.
 - If there are potential differences between installation parts and cabinets, lay sufficiently dimensioned potential compensation lines.

Isolation of conductors

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

When isolating cables you have to regard the following:

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

**CAUTION!****Please regard at installation!**

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

Remedy: Potential compensation line

2.9 General data for the System SLIO**Conformity and approval**

Conformity		
CE	2014/35/EU	Low-voltage directive
	2014/30/EU	EMC directive
Approval		
UL	-	Refer to Technical data
Others		
RoHS	2011/65/EU	Restriction of the use of certain hazardous substances in electrical and electronic equipment

General data for the System SLIO

Protection of persons and device protection

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

Environmental conditions to EN 61131-2

Climatic		
Storage / transport	EN 60068-2-14	-25...+70°C
Operation		
Horizontal installation hanging	EN 61131-2	0...+60°C
Horizontal installation lying	EN 61131-2	0...+55°C
Vertical installation	EN 61131-2	0...+50°C
Air humidity	EN 60068-2-30	RH1 (without condensation, rel. humidity 10...95%)
Pollution	EN 61131-2	Degree of pollution 2
Installation altitude max.	-	2000m
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 field immunity (casing) 80MHz ... 1000MHz, 10V/m, 80% AM (1kHz) 1.4GHz ... 2.0GHz, 3V/m, 80% AM (1kHz) 2GHz ... 2.7GHz, 1V/m, 80% AM (1kHz)
		EN 61000-4-6	HF conducted 150kHz ... 80MHz, 10V, 80% AM (1kHz)
		EN 61000-4-4	Burst, degree of severity 3
	EN 61000-4-5	Surge, degree of severity 3 ¹	

1) 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.

2.9.1 Use in difficult operating conditions



Without additional protective measures, the products must not be used in locations with difficult operating conditions; e.g. due to:

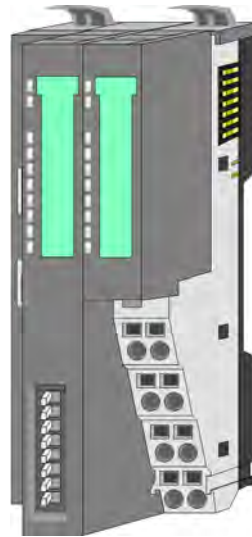
- *dust generation*
- *chemically active substances (corrosive vapors or gases)*
- *strong electric or magnetic fields*

3 Hardware description

3.1 Properties

Features

- Ethernet coupler with Modbus/TCP protocol for max. 64 peripheral modules
- X1/X2: RJ45 interface 100BaseTX as switch for communication via Modbus/TCP
- I/O access via up-to 8 stations
- Integrated Web server
- Online parametrization via Web server
- Automatic polarity and speed recognition (auto negotiation)
- Automatic recognition of parallel or crossed cable (auto crossover)
- Supports Easy Maintenance
- Network LEDs for link/activity and speed
- Status LEDs for Ready and Error

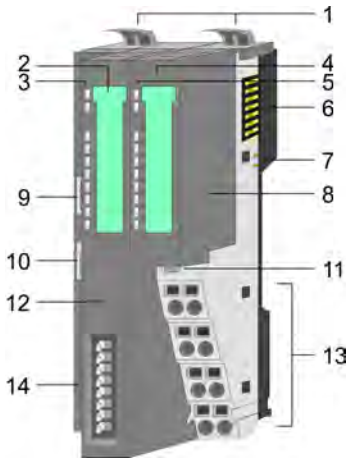


Order data

Type	Order number	Description
IM 053MT	053-1MT01	Modbus/TCP Ethernet coupler for System SLIO

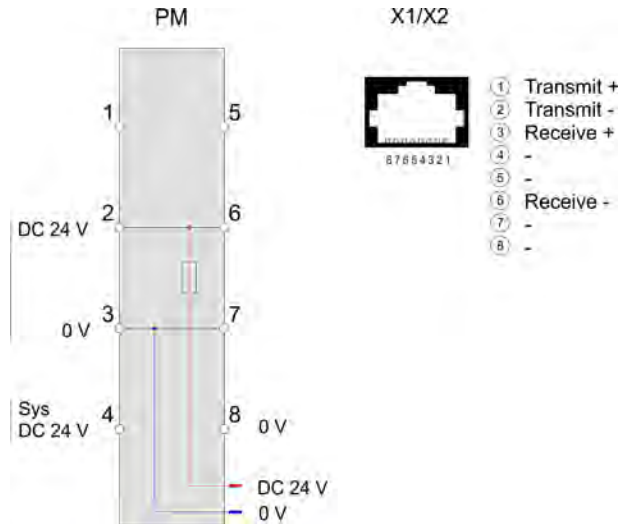
3.2 Structure

053-1MT01



- 1 Locking lever terminal module
- 2 Labelling strip bus interface
- 3 LED status indication bus interface
- 4 Labelling strip power module
- 5 LED status indication power module
- 6 Backplane bus
- 7 DC 24V power section supply
- 8 Power module
- 9 X1: RJ45 interface for communication via Modbus/TCP (switch)
- 10 X2: RJ45 interface for communication via Modbus/TCP (switch)
- 11 Unlocking lever power module
- 12 Bus interface
- 13 Terminal
- 14 Address switch

3.2.1 Interfaces



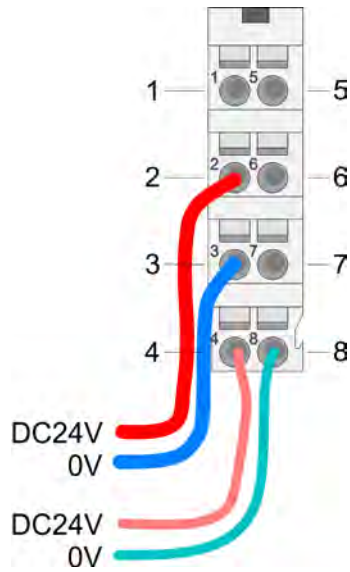
CAUTION!

Bus interface and power module of the bus coupler may not be separated!

Here you may only exchange the electronic module!

PM - Power module

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



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

I: Input

X1/X2: RJ45 interface:

2x 8pin RJ45 jacks

- The RJ45 jacks serve as interface for connection to Ethernet to communicate via Modbus/TCP.
- The interface is designed as switch.
- So that you can access your System SLIO modules via Modbus/TCP, you have to assign valid IP address data to the IM 053-1MT01. ↪ *Chap. 4.3 'Setting the IP address' page 58*

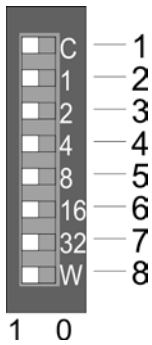
Address switch



- Changes to the address switch are only accepted after a power cycle or an automatic reset. Changes during the normal operation are not recognized!
- Configurations set via web server are only valid or active after a power cycle or an automatic reset if all switches of the address switch are in position "0"!

The address switch serves for the following settings:

- Selection of the address usage
- Presetting of the IP address
- Activation of the web server



Position	Description		
1	DHCP client <ul style="list-style-type: none"> ■ 0 = disabled ■ 1 = enabled 		
2	1	$2^0 = 1$	IP address data for Modbus/TCP: Subnet mask: 255.255.255.0 IP address: 192.168.1.x with x = decimal value from position 2 ... 7
3	2	$2^1 = 2$	
4	4	$2^2 = 4$	
5	8	$2^3 = 8$	
6	16	$2^4 = 16$	
7	32	$2^5 = 32$	
8	Web server <ul style="list-style-type: none"> ■ 0 = disabled ■ 1 = enabled 		

Ranking for the IP address configuration

- The switch for DHCP activation pos. 1 has the highest priority.
- If there is no DHCP server, the IP address (192.168.1.x) set at the switches pos. 2 ... 7 is used.
- If no address is set, i.e. all set to "0", the stored IP address (default 10.0.0.1) is used.

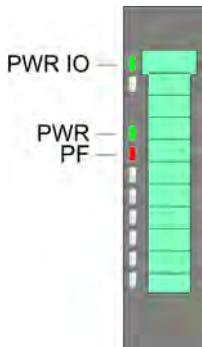
Essential switch settings

Position	State	Behavior at start-up
1 ... 7	0	Default setting
8	1	<ul style="list-style-type: none"> ■ Via web server set configuration is valid (default 10.0.0.1). ■ The web server is activated.
1 ... 8	0	<ul style="list-style-type: none"> ■ Via web server set configuration is valid (default 10.0.0.1). ■ The web server is de-activated.
1	1	<ul style="list-style-type: none"> ■ DHCP client is activated. ■ The IP address data are requested via DHCP. ■ If there is no DHCP server, the IP address set at the switches (192.168.1.x) will be used.
1	0	<ul style="list-style-type: none"> ■ DHCP client is de-activated.

Position	State	Behavior at start-up
8	1	<ul style="list-style-type: none"> Web server is activated.
2 ... 7	[1 ... 63]	IP address data for Modbus/TCP: <ul style="list-style-type: none"> Subnet mask: 255.255.255.0 IP address: 192.168.1.x with x = decimal value from position 2 ... 7

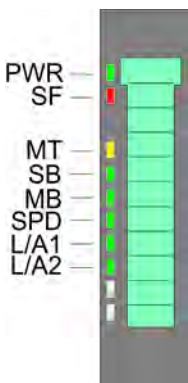
3.2.2 LEDs

LEDs power module





































































PWR IO	PWR	PF	Description
<input checked="" type="checkbox"/> green	<input checked="" type="checkbox"/> green	<input checked="" type="checkbox"/> red	
<input type="checkbox"/>	X	<input type="checkbox"/>	Power section supply OK
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Electronic section supply OK
X	X	<input checked="" type="checkbox"/>	Fuse electronic section supply defective
not relevant: X			

LEDs bus interface



LED	Color	Description
PWR	<input checked="" type="checkbox"/> green	Bus interface is power supplied
SF	<input checked="" type="checkbox"/> red	System error: Error on System SLIO bus
MT	<input type="checkbox"/> yellow	Maintenance
SB	<input checked="" type="checkbox"/> green	Communication via System SLIO bus
MB	<input checked="" type="checkbox"/> green	Communication via Modbus/TCP
SPD	<input checked="" type="checkbox"/> green	Transfer speed 100Mbit/s
L/A1	<input checked="" type="checkbox"/> green	Port 1: Link/Activity
L/A2	<input checked="" type="checkbox"/> green	Port 2: Link/Activity

PWR  green	SF  red	MT  yellow	SB  green	MB  green	SPD  green	L/A(1/2)  green	Description
Operating modes ↗ 55							
				X	X	X	<i>Init</i>
	x			X	X	X	<i>DHCP discovery</i>
	x			X	X	X	<i>Update config</i>
				X	X	X	<i>Run</i>
				X	X	X	<i>Commissioning</i>
	x			X	X	X	<i>Maintenance</i>
				X	X	X	<i>Firmware update¹</i>
				X	X	X	<i>Error</i>
Operation							
	X	X	X	X	X	X	The Ethernet coupler is power supplied.
		X			X		The Ethernet coupler communicates without error via Ethernet
	X	X	X		X	X	The Ethernet coupler is ready for Modbus/TCP communication
	X	X	X		X	X	No Modbus/TCP communication is possible
	X	X		X	X	X	BASP (B efehls- A usgabe- S perre i.e. command output disable) is activated
		X		X			There is no physical connection to Ethernet.
	X	X	X		X	X	Configuration is in progress
	X		X	X	X	X	Ethernet coupler is located, the identification was initiated by the user and takes 10s.
	X	X	X	X		X	Speed: 100MBit/s
							Error: Power OFF-ON required
not relevant: X							
1) LEDs blink alternately							

3.3 Technical data

Order no.	053-1MT01
Type	IM 053MT
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
I^2t	0.14 A ² s
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	yellow LED
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	Modbus / TCP/IP
Type of interface	Ethernet 100 MBit
Connector	2 x RJ45
Topology	Line, Star
Electrically isolated	✓

Order no.	053-1MT01
Number of participants, max.	-
Node addresses	-
Transmission speed, min.	100 Mbit/s
Transmission speed, max.	100 Mbit/s
Address range inputs, max.	1 KB
Address range outputs, max.	1 KB
Number of TxPDOs, max.	-
Number of RxPDOs, max.	-
Supported profile	-
Supported transfer cycle	-
Cyclic data size per node	-
Max. Number of nodes	-
Supported communication method	-
Supported command "Cyclic"	-
Supported command "Event driven"	-
Supported command "Message"	-
Datasizes	
Input bytes	-
Output bytes	-
Parameter bytes	-
Diagnostic bytes	-
Housing	
Material	PPE / PPE GF10
Mounting	Profile rail 35 mm
Mechanical data	
Dimensions (WxHxD)	48.5 mm x 109 mm x 76.5 mm
Net weight	160 g
Weight including accessories	160 g
Gross weight	175 g
Environmental conditions	
Operating temperature	0 °C to 60 °C
Storage temperature	-25 °C to 70 °C
Certifications	
UL certification	yes
KC certification	yes

4 Deployment

4.1 Basics

General

Typical field bus systems are divided into master and slave systems. Master systems are CPUs, coupled to a CPU, allowing remote programming res. visualization of the according CPU as well as the data transfer between several TCP/IP participants. Slave systems on the other hand are "data collectors" that deliver the I/O data of the connected modules to the requesting master. The Ethernet coupler described in this chapter is a slave system. For the communication happens via TCP/IP, the slave system is referred to as server and a master as client. The Yaskawa Ethernet coupler allows you to connect up to 64 modules of your System SLIO via Ethernet. Up to 8 clients may communicate simultaneously with the Ethernet coupler.

Automatic address mapping

After startup of the Ethernet coupler the modules connected to the backplane bus are determined and mapped to his address area. With address mapping there is an area for input and an area for output data. Using the integrated Web server, you have access to the current mapping. Here you can also parameterize your modules.

Communication

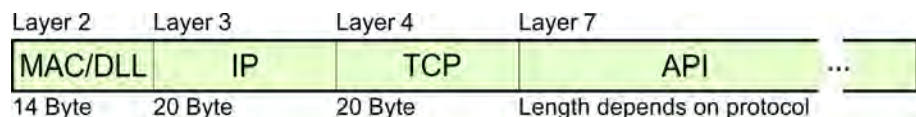
The Ethernet coupler is connected with the modules via the backplane bus. It collects their data and places this as "server" (slave) at the disposal of the superordinated "client" (master system). The communication happens via TCP/IP with leading Modbus/TCP protocol. Vice versa, the Ethernet coupler receives the data, addressed to it by IP address and port, and transfers it to its output periphery.

Protocols

Protocols define rules or standards for communication. The so called ISO/OSI layer model is generally accepted for the standardization of computer communication. The layer model is based upon seven layers with guidelines for the deployment of hard- and software.

Layer	Function	Protocol
Layer 7	Application Layer (application)	Modbus/TCP
Layer 6	Presentation Layer (presentation)	
Layer 5	Session Layer (session)	
Layer 4	Transport Layer (transport)	TCP
Layer 3	Network Layer (network)	IP
Layer 2	Data Link Layer (security)	
Layer 1	Physical Layer (bit transfer)	

Telegram structure



MAC/DLL

While the Ethernet physics covers with its standard signal levels Layer 1, MAC/DLL covers the conditions of the security layer (Layer 2). With MAC (Medium Access Control) / DLL (Data Link Layer) the communication happens at the lowest Ethernet level using MAC addresses. Every Ethernet communication participant has a MAC address that must be unique at the network. The deployment of MAC addresses specifies source and destination unambiguously.

IP

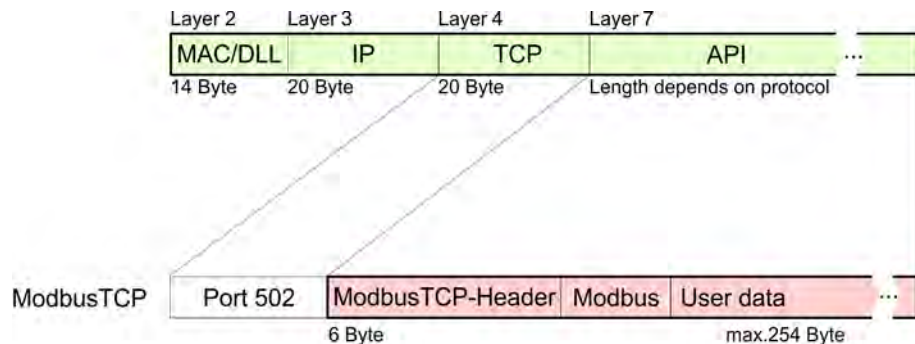
The Internet Protocol covers the network layer (layer 3) of the ISO/OSI layer model. The main purpose of IP is to send data packages from one station to another, passing several other stations. This data packages are referred to as datagrams. The IP does neither serve the according sequence nor the deliverance at the receiver. For the unambiguous distinction between sender and receiver, 32bit addresses are used (IP addresses) that are normally written in four octets of each 8bit, e.g. 172.16.192.11. One octet may represent numbers between 0 and 255. A part of the address specifies the network, the rest identifies the single stations in the network. The proportions of network part and station part is floating and depends on the network size.

TCP

The TCP (Transmission Control Protocol) puts directly upon the IP and covers therefore the transport layer (layer 4) of the ISO/OSI layer model. TCP is a connection orientated end-to-end protocol and serves the logical connection between two partners. TCP ensures the sequential correct and reliable data transfer. Every datagram is preceded by a header of at least 20 octets that contains, among others, the serial number for the according sequence. This causes that within a network, the single datagrams may reach their destination on different ways.

API

API means **A**pplication **P**rogramming **I**nterface. API covers the conditions of the Application Layer (Layer 7). Here, the header and user data of the according protocols are stored. The Ethernet coupler uses the Modbus/TCP protocol, described further below.

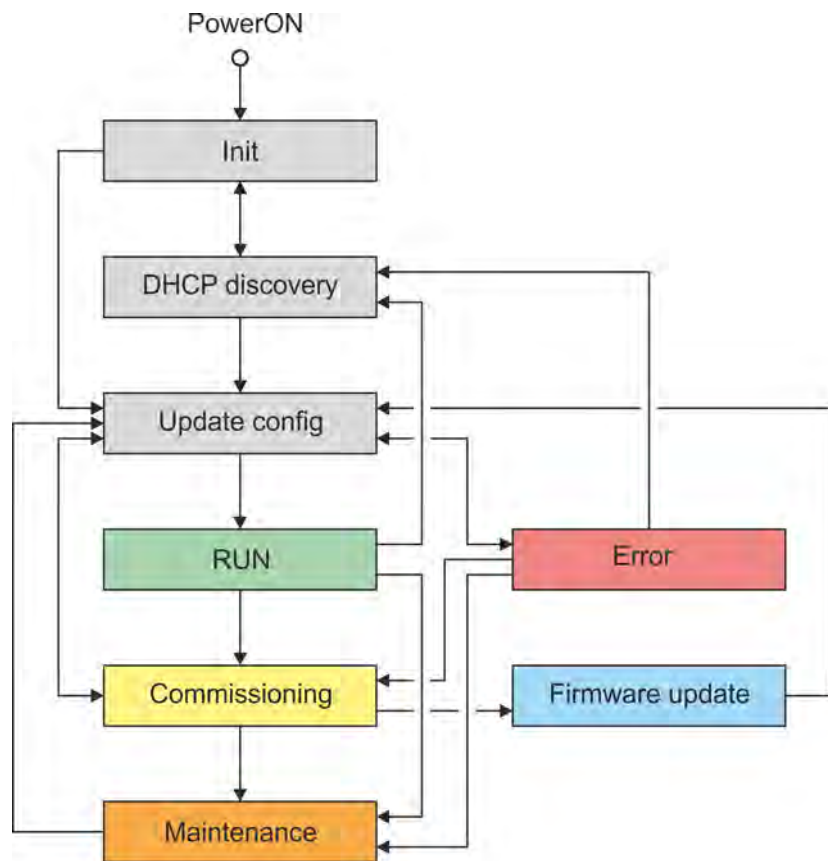
**Modbus/TCP**

Modbus/TCP is a Modbus-RTU protocol, put upon TCP/IP. The Modbus protocol is a communication protocol supporting a hierarchic structure with one master and several slaves. Modbus/TCP extends Modbus to a client server communication where several client may access a server. For the addressing happens by means of the IP addresses, the address integrated in the Modbus telegram irrelevant. Furthermore, the check sum is not required because the sequence insurance happens via TCP/IP. After the request of a client, this awaits the answer of the server for a configurable time. Modbus/TCP exclusively uses the RTU format. Every byte is transferred as one sign. This enables a higher data pass-through than the Modbus-ASCII format. The RTU time supervision is omitted for the header contains the size of the telegram length to be received. Data that are transferred via Modbus/TCP may contain bit and word information. At bit chains, the highest bit is send first, i.e. in a word it is at the most left position. At words, the highest byte is send first. The access to a Modbus slave happens via function codes that are described in detail in this chapter further below.

4.2 Operating modes**Overview**


The Ethernet coupler can assume operating states which it also indicates via its LEDs. These states are described below.

State / LEDs	SF	MT	SB
	■ red	■ yellow	■ green
<i>Init</i>	■	<input type="checkbox"/>	<input type="checkbox"/>
<i>DHCP discovery</i>	x	<input checked="" type="checkbox"/> 2Hz	<input checked="" type="checkbox"/> 2Hz
<i>Update config</i>	x	<input type="checkbox"/>	<input checked="" type="checkbox"/> 2Hz
<i>Run</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
<i>Commissioning</i>	<input type="checkbox"/>	<input checked="" type="checkbox"/> 1Hz	<input checked="" type="checkbox"/>
<i>Maintenance</i>	x	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<i>Firmware update</i>	<input checked="" type="checkbox"/> 1Hz	<input checked="" type="checkbox"/> 1Hz	<input type="checkbox"/>
<i>Error</i>	■	<input type="checkbox"/>	<input checked="" type="checkbox"/> 2Hz



Init After PowerON, the Ethernet coupler is in *Init* state. Here, the Ethernet coupler performs a self-test and the system is initialized. If successful, the Ethernet coupler automatically switches to either *DHCP discovery* or *Update config*, depending on the setting of the address switch.

DHCP discovery The Ethernet coupler changes to this state as soon as an IP configuration is requested via DHCP. In this state, the Modbus/TCP server is stopped and BASP (**B**efehls-**A**usgabe-**S**perre, i.e. command output dis-able) becomes active and thus process data communication is stopped. After assigning the IP address data, it automatically changes to the state *Update config*. If no IP address could be determined via DHCP, the Ethernet coupler automatically restarts and changes to the *Init* state.

Update config	In this state, the Ethernet coupler checks the module configuration and transfers the corresponding parameters to the connected modules. If no errors occur, the Ethernet coupler automatically switches to <i>Run</i> .
Run	In the <i>Run</i> state, BASP is deactivated and process data communication is started via the System SLIO backplane bus. The Ethernet coupler copies the output data received from the client (master system) to its output modules and forwards the input values to the client.
Commissioning	<p>Only in this state is it possible to save and delete the configuration in the Ethernet coupler. Here you can parametrize the Ethernet coupler and the connected modules via the web server. This will disable BASP. Only in this state is write access to the process output data possible via the web server. In this state Modbus/TCP requests are returned with an error. Also, you can only perform a firmware update via the web server in this state. For the firmware update, the Ethernet coupler switches to the state <i>Firmware update</i>.</p> <div data-bbox="453 779 1519 936" style="background-color: #f0f0f0; padding: 10px;"> <i>Please note that the outputs are reset when changing to and from the "Commissioning" state.</i></div>
Maintenance	This state is automatically activated in the case of physical changes to the backplane bus or in the event of a bus error. This activates BASP and stops the process data communication. Modbus/TCP requests are returned with an error. As soon as the bus error is corrected or the physical structure corresponds to the configured structure, the Ethernet coupler automatically changes to the state <i>Update config</i> .
Firmware update	In this state, a firmware update is performed. This activates BASP and stops the process data communication. Modbus/TCP requests are returned with an error. After the firmware update a restart takes place and the Ethernet coupler changes to the state <i>Init</i> . If no firmware update could be done, the Ethernet coupler changes to the state <i>Update config</i> .
Error	<p>Condition that exists when at least one of the following criteria is met:</p> <ul style="list-style-type: none">■ Configuration not valid■ Parametrization is incorrect■ Ethernet cable was removed■ Timeout on Modbus/TCP communication <p>This activates BASP and stops the process data communication. Modbus/TCP requests are returned with the corresponding error.</p>

4.3 Setting the IP address

Setting possibilities

- Setting the IP address via web page
- Setting the IP address via address switch
- Setting the IP address via SPEED7 Modbus Tool



- With the IM 053MT you should always use a static IP address.
- If the IM 053MT is configured via DHCP, this must provide a valid gateway address, otherwise the IP address is not accepted!
- When using a DHCP server, make sure that the IP address assignment (lease) in the DHCP server is not changed. Otherwise, after a restart, the IM 053MT can not be found by the master.

4.3.1 Setting the IP address via web page

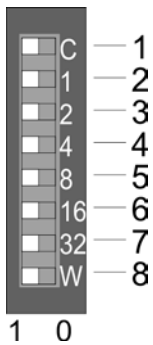
Delivery state

On delivery the Modbus/TCP coupler has the following settings:

- Password and module parameter are deleted.
- On delivery, the switches pos. 2 ... 7 of the address switch ↗ 49 are set to '0'.
 - Subnet mask: 255.255.255.0
 - IP address: 10.0.0.1

If the systems are in the same IP circle, you can use this address to access the web page P address allows you to access the web page of the integrated web server ↗ 61 and change the IP address data accordingly via tab 'IP'.

4.3.2 Setting the IP address via address switch



Ranking for the IP address configuration

- The switch for DHCP activation pos. 1 has the highest priority.
- If there is no DHCP server, the IP address (192.168.1.x) set at the switches pos. 2 ... 7 is used.
- If no address is set, i.e. all switches pos. 2 ... 7 are set to "0", the stored IP address (default 10.0.0.1) is used.

If your systems are in the same IP circle, you can access the IM 053MT via the IP address.

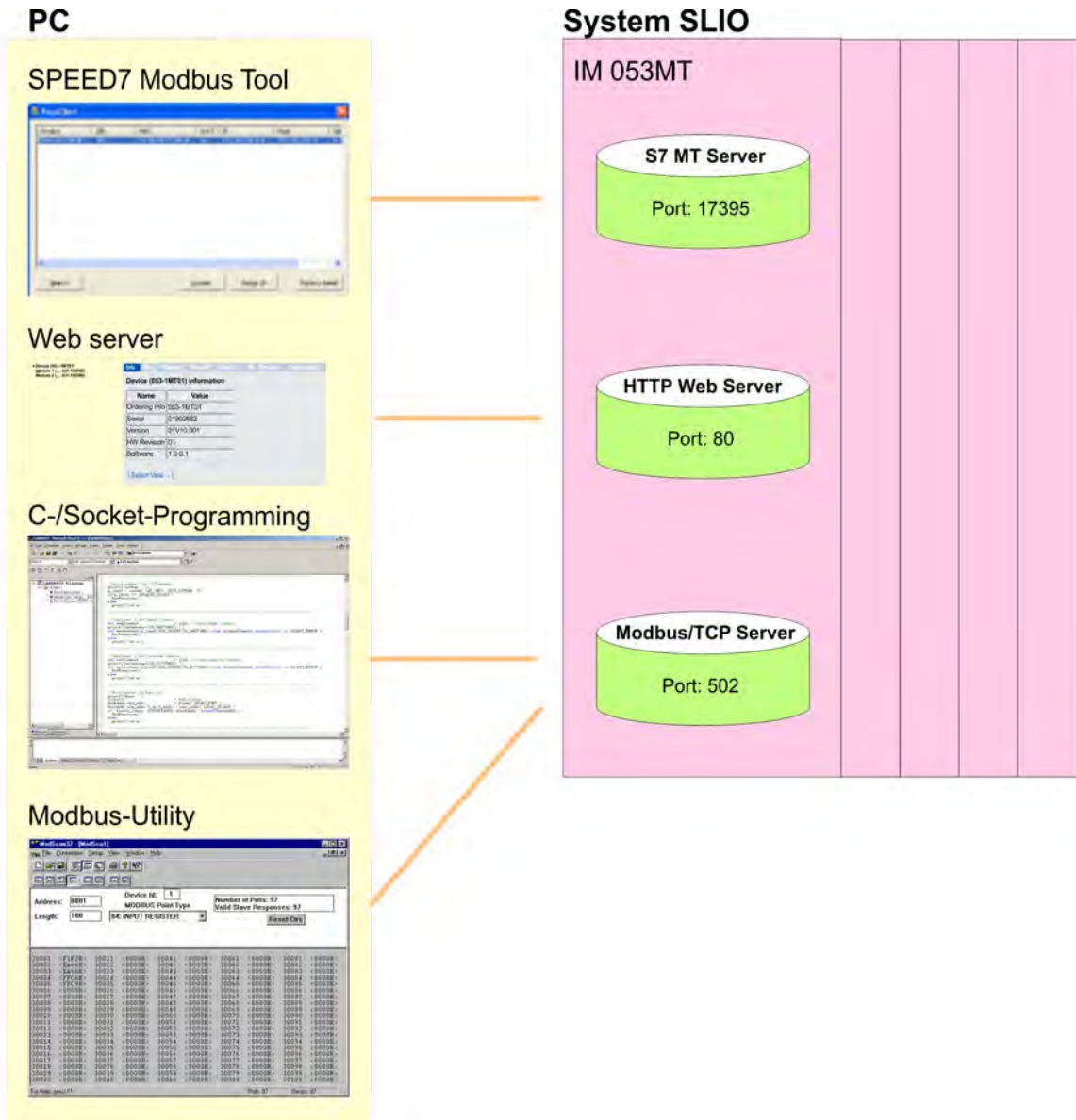
4.3.3 Setting the IP address via SPEED7 Modbus Tool

The *SPEED7 Modbus tool* can be found in the 'Download Center' of www.yaskawa.eu.com at '*SPEED7 Modbus Tool*'. Load and execute this program. With the *SPEED7 Modbus Tool* the Ethernet coupler may be identified within the network, assigned with IP address data or reset to factory settings. In the following these functions are more described. Every Ethernet coupler, which was found in the local network by means of a broadcast, is listed. With several Ethernet coupler in the network the search may be limited by product name, serial number or MAC address. For the search, your systems do not have to be in the same IP circle. ↗ 60

4.4 Access to the Ethernet coupler

4.4.1 Overview

The following illustration shows the Ethernet coupler access possibilities.



4.4.2 SPEED7 Modbus Tool

The *SPEED7 Modbus Tool* can be found in the 'Download Center' of www.yaskawa.eu.com at '*SPEED7 Modbus Tool*'. Load and execute this program. With the *SPEED7 Modbus Tool* the Ethernet coupler may be identified within the network, assigned with IP address data or reset to factory settings. In the following these functions are more described.

Searching the Ethernet coupler

Every Ethernet coupler, which was found in the local network by means of a broadcast, is listed. With several Ethernet coupler in the system the search may be limited by product name, serial number or MAC address.

Localizing the Ethernet coupler

With [Locate] a listed Ethernet coupler may be localized. During the localization the MT LED flashes for 10s on the corresponding Ethernet coupler for clear identification.

IP address assignment

With [Assign IP] you may assign to a listed Ethernet coupler IP address data. You get valid IP address parameters from your system administrator.



If the IM 053-1MT01 has been protected with a password via the integrated web server, a [WP] (WriteProtected) is attached to the product name. In this case, a new IP assignment via VSCP is not possible.
 ↪ Chap. 4.4.3 'Web server' page 61



System dependent, a password query is not possible with the SPEED7 Modbus Tool.

Factory reset

A factory reset is only possible during the localization within 10s and takes place with the following approach:

1. ➤ Chose from the search list of Ethernet couplers the Ethernet coupler, which is to be reset to factory settings.
2. ➤ Click at [Locate].
 - ⇒ The MT LED of the corresponding IM 053-1MT01 flashes.
3. ➤ For the factory reset now you have to click at [Factory RESET] within 10s.
 - ⇒ The Ethernet coupler is reset to delivery state.

Delivery state:


- Ethernet coupler has default parameters
- Password and module parameters are deleted
- IP address: 10.0.0.1
- Subnet mask: 255.255.255.0


4.4.3 Web server

4.4.3.1 Access

Delivery state


On delivery the Modbus/TCP coupler has the following settings:

- Password and module parameter are deleted.
- On delivery, the switches pos. 2 ... 7 of the address switch  49 are set to '0'.
 - Subnet mask: 255.255.255.0
 - IP address: 10.0.0.1








If the systems are in the same IP circle, you can use this address to access the web page P address allows you to access the web page of the integrated web server  61 and change the IP address data accordingly via tab 'IP'.

Changing the IP address

To change the IP address you have the following possibilities:

- Changing by means of the *SPEED7 Modbus Tool*  60
- By shortly changing the IP address of the PC network card (described below).

To change the IP address of the Modbus/TCP coupler the communicating systems must be in the same IP circuit. For this you have to shortly change the IP address of your PC network card. Please consider that this is only possible as a user with administrative rights. Otherwise, contact your system administrator. The adaptation happens with the following proceeding:

1.  Connect your Modbus/TCP coupler via Ethernet with the network card of your PC and switch-on the power supply of the Modbus/TCP coupler.
2.  Call the 'Network setting' of the 'Control Panel'.
3.  Open the 'Properties' of your network adapter and open the properties dialog of 'Internet protocol TCP/IP...'.
 4.  Write down the IP address settings.
 5.  Now enter an IP address, which differs in the last number of 10.0.0.1 such as 10.0.0.2 and the subnet mask 255.255.255.0. If IP address data just exist, you can add the new as additional data.
 6.  Confirm your input and close all the dialogs.
 - ⇒ Now you can access the web server of the Modbus/TCP coupler. Here you have the possibility to change the IP address data via the register 'IP'.
 7.  Open, after you have adjusted the IP address data at the Modbus/TCP coupler via the web server, on your PC the properties dialog of 'Internet protocol TCP/IP...' again, enter the original IP address data, confirm your entries and close all the dialogs.
 - ⇒ If the systems are in the same IP circle, you can access the web server of the Modbus/TCP coupler.

Access to the Ethernet coupler > Web server

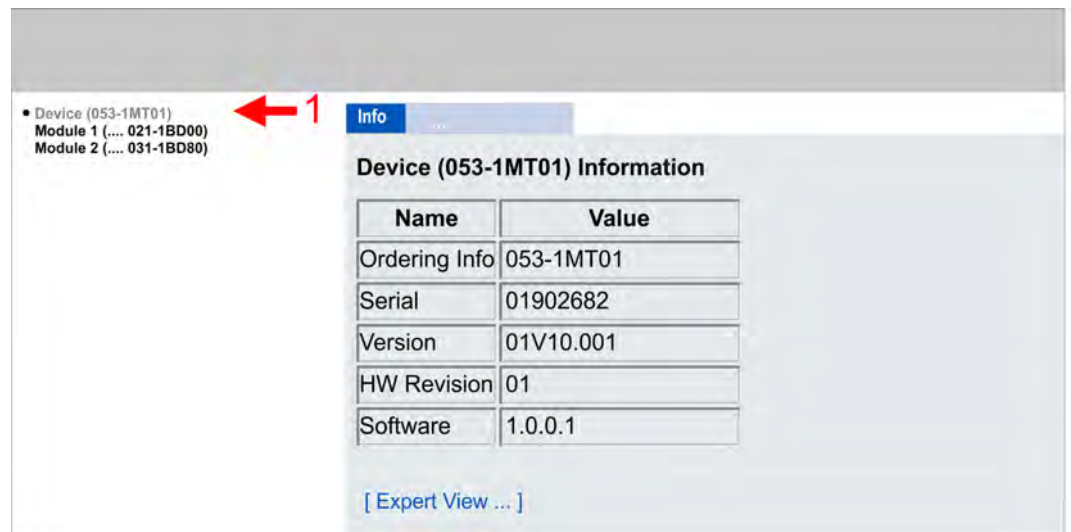
4.4.3.2 Structure of the web page of the web server

The web page is built dynamically and depends on the number of modules, which are connected to the Ethernet coupler.



- 1 Module list: IM 053MT and System SLIO modules in installed order
- 2 Functions for the module selected in the *module list*
- 3 Information respectively input area of the corresponding function

4.4.3.3 Web page of the selected Ethernet coupler



Tab: Info

Here order number, serial number and firmware version of the IM 053MT are listed.

Tab: Data

Here, the process data of the IM 053MT and of the modules are shown.

Tab: Parameter

Here you can change the current parameters of the IM 053MT.



To change the parameters, the IM 053MT should be in BASP status.

Parameter	Data type	Area	Default value	Description
Link monitoring	BOOL	TRUE/FALSE	FALSE	Link monitoring Ethernet
Communication timeout [ms]	UINT_32	■ 0 ... 30000	0	Timeout Ethernet communication
Socket timeout [ms]	UINT_32	■ 0 ... 30000	0	Timeout Modbus socket connection
IO cycle [μs]	UINT_32	■ 0 ■ 1000 ■ 2000 ■ 4000 ■ 8000 ■ 10000	1000	System SLIO bus cycle

- Link monitoring
 - As soon as both Ethernet cables are pulled with enabled *Link monitoring*, the communication is finished by the IM 053MT, BASP (**B**efehls-**A**usgabe-**S**perre, i.e. command output disable) is activated and this is indicated with flashing SB LED. Link monitoring reacts only when both Ethernet cables are pulled.
- Communication timeout
 - At *Communication Timeout [ms]* you can specify a timeout value for Ethernet communication in ms.
 - If there is no Modbus communication for the specified time, BASP is set on the System SLIO bus.
 - With the value 0, you can deactivate the time monitoring.
- Socket Timeout
 - At *Socket Timeout [ms]* you can specify a timeout value for the Modbus socket connection in ms.
 - If there is no Modbus communication on a specific Modbus socket connection for the specified time, the corresponding socket is closed.
 - With the value 0, you can deactivate the time monitoring.
- IO cycle
 - With *IO cycle*, you can specify the cycle for the System SLIO bus within which the I/O image is to be refreshed.
 - With the value 0 you can set the maximum possible cycle time (no delay).

Tab: Diagnosis

- Configuration State
 - Deviations between the setpoint and actual configuration are shown here (OK: no deviation).
- Diagnosis Entries
 - Here all pending diagnostic messages are shown.
- Diagnosis Buffer
 - Here the content of the diagnostics buffer is listed.

Tab: Security


All functions for the writing access to the Ethernet coupler can be secured by a password.


Tab: IP

Here you may assign to your Ethernet coupler IP address data. For valid IP address data please contact your system administrator.

Delivery state

On delivery the Modbus/TCP coupler has the following settings:

- Password and module parameter are deleted.
- On delivery, the switches pos. 2 ... 7 of the address switch  49 are set to '0'.
 - Subnet mask: 255.255.255.0
 - IP address: 10.0.0.1

If the systems are in the same IP circle, you can use this address to access the web page P address allows you to access the web page of the integrated web server  61 and change the IP address data accordingly via tab 'IP'.

Tab: Firmware






With this function you can perform a firmware update.

**CAUTION!**

- When installing a new firmware you have to be extremely careful. Under certain circumstances you may destroy the IM 053-1MT01, for example if the voltage supply is interrupted during transfer or if the firmware file is defective. In this case, please call the Yaskawa Hot-line!
- Please regard that the version of the update firmware has to be different from the existing firmware otherwise no update is executed.




Please note that a firmware update is only possible if the Ethernet coupler is in the Commissioning state.

1.  You can find current firmware versions at www.yaskawa.eu.com in the 'Download Center'.
2.  Select the Px000326.pkg file for download and load it into your working directory.
3.  Select the *Configuration* tab and activate 'Activate Commissioning mode'.
4.  Select the 'Firmware' tab.
5.  Navigate to your work directory and load the file Px000326.pkg to the IM 053-1MT01.



- After the package has been completely transferred to the IM 053-1MT01 the firmware update starts automatically. Here the SF and MT LEDs blink.
- During this process, the IM 053-1MT01 must never be disconnected from the power supply!

6.  The firmware update of the IM 053-1MT01 is finished, when the LEDs SF and MT are no longer blinking.
 - ⇒ After the firmware update a restart takes place and the Ethernet coupler changes to *Init* state. If no firmware update could be done, the Ethernet coupler changes to the state *Update config*.

Tab: Configuration

Each System SLIO module has a unique identification number - module ID. The modules are listed on the web server by means of their module ID. As soon as a module is configured, the ID of the corresponding module is listed. In this dialog field you have the possibility to store the current module configuration or to import a module configuration. With [Delete] the parameterization of all the modules may be deleted in the Ethernet coupler.

- Activate Commissioning mode
 - With [Activate], the Ethernet coupler enters the *Commissioning* state.
 - When changing to the "Commissioning" state, all outputs are reset.
 - BASP (**B**efehls**a**usgab**e**s**p**erre i.e. command output disable) is not activated, i.e. all module outputs can be controlled and the inputs can be read.
 - In the *Commissioning* state you have the following options:
 - Outputs can be set via the web page in the 'Data' tab of the selected module.
 - Parameters can be written via the web page in the 'Parameter' tab of the selected module.
 - You can perform a firmware update.
 - With [Deactivate] you leave the *Commissioning* state
 - When leaving *Commissioning* all outputs are reset.
 - BASP is activated, i.e. all module outputs are switched off and the inputs are not read.

**CAUTION!**

- Please consider that controlling of output values represents a potentially dangerous condition.
- As long as *Commissioning* state is activated, set variables retain their value.
- *Commissioning* state should only be used for test purposes respectively for troubleshooting.

- Export Station Configuration

With [Save] a window is opened and shows the configuration as XML. Select 'File → Save as' and save the current configuration as XML file.
- Import Station and Modules Configuration

Select with [Search...] the according XML file and load this with [Load]. While loading the parameters of the IM 053MT and the modules are loaded.
- Import Modules Configuration

Select with [Search...] the according XML file and load this with [Load]. While loading only the parameters of the modules are loaded. The parameters of the IM 053MT further exist.
- Save Configuration of all Modules

With [Save] the current configuration is stored in the IM 053MT. If the current module ID deviates from the just configured module ID of the stored configuration of the IM 053MT after a system start-up, the IM 053MT does not go into RUN and shows the error on its web server.
- Delete Configuration of all Modules

With [Delete] the configuration in the IM 053MT may be deleted.



Only there is a configuration for a module, this may be used to check preset and current configuration. If the current configuration differs from the preset (e.g. module was removed) the system reports an error and does not go to RUN. If there is no preset module configuration and the current configuration is changed during operation, the IM 053MT performs a restart and switches again to RUN.

Tab: Register Overview

Slot	Module	0x	1x	3x	4x
01	021-1BF00	-	0x0001 (1)	0x0001 (1)	-
02	022-1BF00	0x0001 (1)	-	-	0x0001 (1)
03	021-1BF00	-	0x0009 (9)	0x0001 (1)	-
04	022-1BF00	0x0009 (9)	-	-	0x0001 (1)
05	031-1BD80	-	0x0011 (17)	0x0002 (2)	-

- Here you get a general overview of the Modbus addressing of the modules, which are currently on the backplane bus.
 - The addresses of the registers for bit or word access are shown for each module. It is shown in hexadecimal form - decimal in brackets.
 - Normally the access with Modbus happens by means of the ranges 0x, 1x, 3x and 4x. The following assignment is valid:
 - 0x - Bit area for master output
Access via function code 01h, 05h, 0Fh
 - 1x - Bit area for master input
Access via function code 02h
 - 3x - Word area for master input
Access via function code 04h, 17h
 - 4x - Word area for master output
Access via function code 03h, 06h, 10h, 16h, 17h
- 🔗 *Chap. 4.10 'Modbus function codes' page 78*

4.4.3.4 Web page with selected module

Name	Value
Ordering Info	021-1BF00
Serial	00101556
Version	01V30.003
HW Revision	01
Software	1.2.8.0

[Expert View ...]

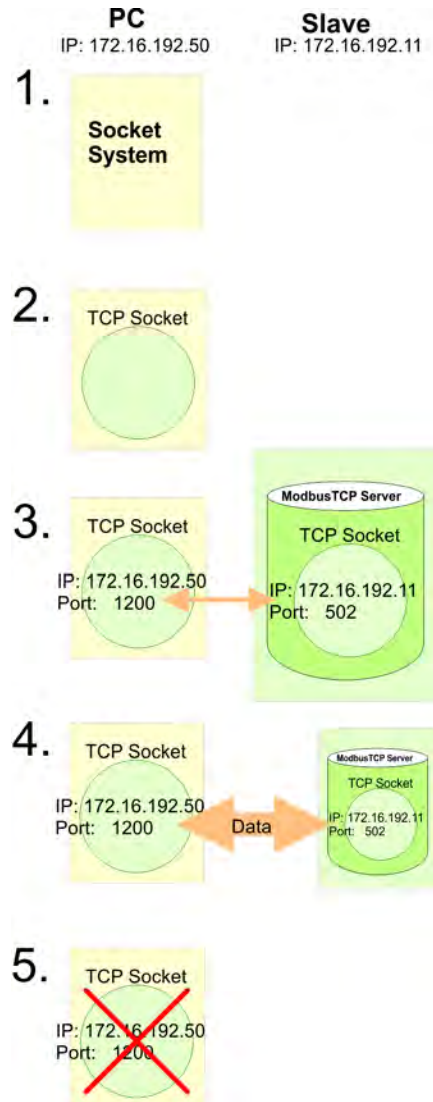
Tab: Info

Here order number, serial number and firmware version of the according module are listed.

- Tab: *Data*** At *Data* the states of the inputs respectively outputs are listed. In addition, you can directly control the outputs of the corresponding module.
- Tab: *Parameter*** If available the parameter data of the corresponding module may be shown and changed if necessary.
- Tab: *Diagnosis***
- Configuration State
 - The current configuration status is shown here.
 - Diagnosis Entries
 - Here all pending diagnostic messages are shown.
 - Diagnosis Buffer
 - Here the content of the diagnostics buffer is listed.
- Expert View** [Expert View] takes you to the advanced "Expert View".

4.4.4 C-/Socket programming

The Modbus/TCP server is accessed via port 502. Via simple C program it is possible to transfer data between PC and Ethernet coupler with Modbus/TCP. For the deployment of the Ethernet couplers at a PC you should have a thorough knowledge in C programming, especially in socket programming. In the following the steps of programming are shown.



1. Start Microsoft Socket System

```
⇒ WSStartup (wVersionRequested, &wsaData);
```

2. Reserve Socket resources for TCP

```
⇒ m_lsock = socket (AF_INET, SOCK_STREAM, 0);
```

3. Establish connection to external device

```
⇒ SockAddr.sin_port = htons
(m_wPort); SockAddr.sin_addr.S_un.S_addr =
inet_addr(m_szIpAddress); connect(m_lsock, (LPSOCKADDR)
&SockAddr, sizeof(SockAddr));
```

4. ➤ For write res. read access you have to build up telegrams according to the protocol and store them in `sndBuf`. `sndBufLen` contains the number of bytes to be sent.

↓↑	Read access	
	Send <code>sndBuf</code> (Request)	<code>send(m_lsock, (char *)sndBuf, sndBufLen, 0);</code>
	Receive telegram in <code>rcvBuf</code> (Response+data)	<code>recv(m_lsock, (char *)rcvBuf, sizeof(rcvBuf), 0);</code>
	Write access	
	Send <code>sndBuf</code> (Request +data)	<code>send(m_lsock, (char *)sndBuf, sndBufLen, 0);</code>
	Receive telegram in <code>rcvBuf</code> (Response)	<code>recv(m_lsock, (char *)rcvBuf, sizeof(rcvBuf), 0);</code>

5. ➤ Close socket again
 ⇒ `closesocket(m_lsock);`

4.4.5 Modbus utility

The access is via port 502 at the Modbus/TCP server. Modbus utility means all tools and programs that have a Modbus/TCP interface. For example, you may find the demo tool "ModbusScan32" from WinTech for download at www.win-tech.com.

4.5 Accessing the System SLIO

4.5.1 Overview

So that you can access the System SLIO modules with Modbus/TCP, you have to assign valid IP address data to the Ethernet coupler. ↪ *Chap. 4.4.3 'Web server' page 61*

In the following you will find the description of accessing the following System SLIO areas via Modbus/TCP.

- I/O area
- Parameter data
- Diagnostics data

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



Usage of the modules CP 040-1BA00 respectively CP 040-1CA00

- Depending on the system you may use a maximum of 16 System SLIO modules of CP 040-1xA00.
- Otherwise, this could cause bus errors!



Please consider the System SLIO power and clamp modules do not have any module ID. These may not be recognized by the Ethernet coupler and so are not listed and considered during slot allocation. Further within Modbus/TCP the slots are designated as Modbus/TCP-Slot. The counting always begins with 0.

4.5.2 Address-Mapping

To individually call the connected peripheral modules, certain addresses in the Ethernet coupler have to be assigned to them. For input and output area, the Ethernet coupler has an address range of each 1024byte. The address allocation (also called mapping) happens automatically and may not be influenced. The mapping may be seen via the web server of the coupler.

Rules

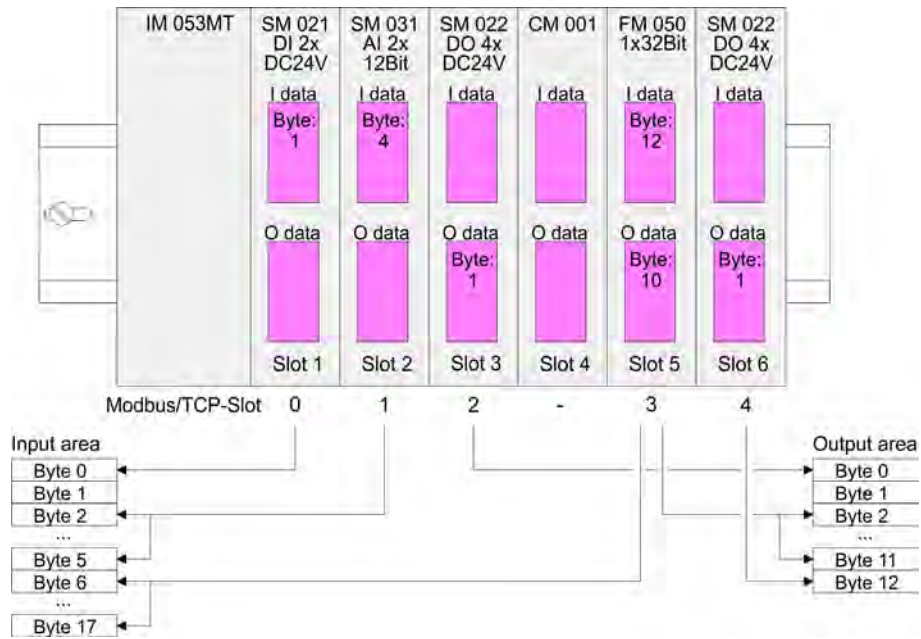
At boot-up, the Ethernet coupler assigns automatically addresses for its in-/ output periphery following this rules:

- All modules are mapped from left (Ethernet coupler) to right in ascending sequence starting with address 0.
- It is separated between in- and output area (if a module has in- and output data, these are stored at different addresses).
- There is no separation between digital and analog data. The Ethernet coupler creates cohere areas for in- and output data.



A description of the in- and output areas that are occupied by a module is to find in the concerning module description. Please regard that modules that are occupying more than 1byte like e.g. analog modules, are automatically stored starting with an even address.

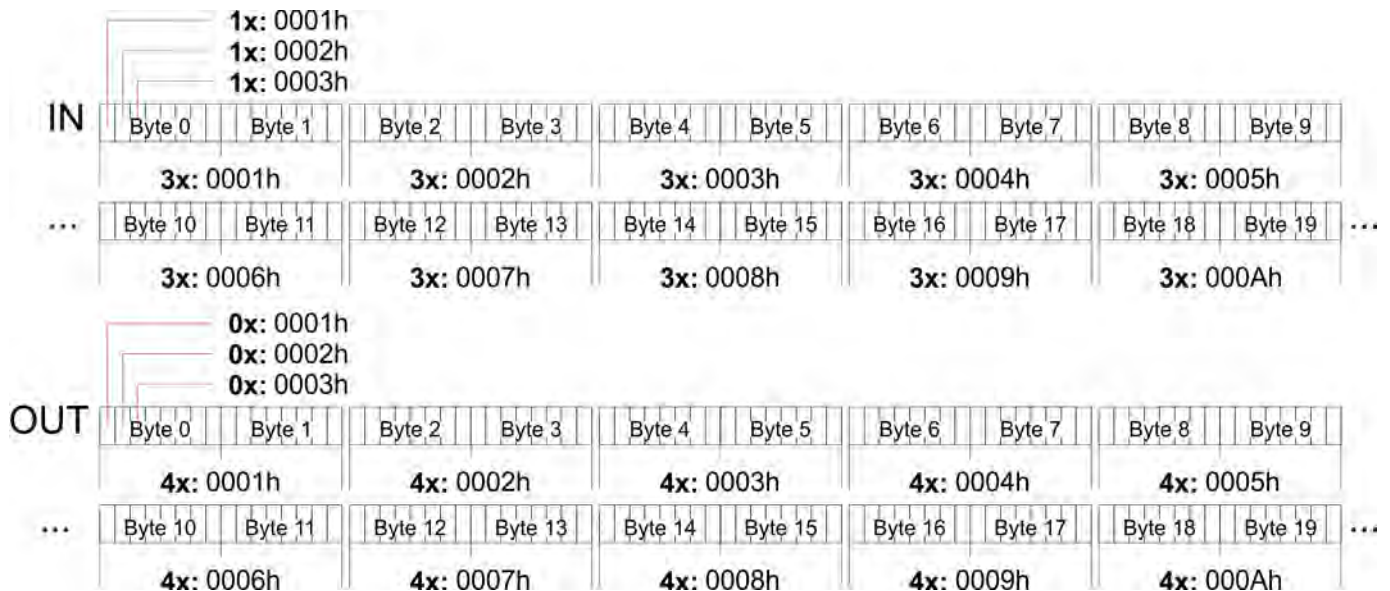
Example



4.5.3 Accessing I/O area

Normally the access with Modbus happens by means of the ranges 0x, 1x, 3x and 4x. 0x and 1x gives you access to digital bit areas and 3x and 4x to analog word areas. For the Yaskawa IM 053-1MT01 is not differentiating digital and analog data, the following assignment is valid:

- 0x - Bit area for master output
 - Access via function code 01h, 05h, 0Fh
- 1x - Bit area for master input
 - Access via function code 02h
- 3x - Word area for master input
 - Access via function code 04h, 17h
- 4x - Word area for master output
 - Access via function code 03h, 06h, 10h, 16h, 17h



4.5.4 Accessing parameter data

- With the first start-up modules, which were parameterizable, operate with their default parameters.
- If you want to change parameters the Ethernet coupler respectively the corresponding modules may be parameterized via the integrated web server. ↪ *Chap. 4.4.3 'Web server' page 61*
- Here by means of the corresponding *Modbus/TCP-Slot* parameter may be viewed and changed.



Parametrization is only possible in the Commissioning state.

↪ *Chap. 4.2 'Operating modes' page 55*

4.5.5 Accessing diagnostics data

- If configured System SLIO modules provide interrupt data on failure.
- As soon as one or more modules report an interrupt, the interrupt data of the appropriate slot location is received and acknowledged by the Ethernet coupler. After that the bit assigned to the *Modbus/TCP Slot* is set in the internal *alarm information* image and the corresponding interrupt data are stored.



Please note that automatic acknowledgement (AutoAcknowledge) is always activated in the Ethernet coupler. This means that received interrupts are immediately acknowledged by the System SLIO bus. This can overwrite older interrupt data of the same module. Here you have to ensure a corresponding temporary storage.

- In System SLIO we distinguish between *hardware interrupt* and *diagnostic interrupt*.
- To distinguish there is a 64bit wide field (bit 0 = *Modbus/TCP Slot 1* to bit 63 = *Modbus/TCP Slot 64*) in the diagnostic image each for hardware and diagnostics interrupt. Then for each slot 16byte hardware interrupt data or 32byte diagnostics interrupt data are following.
- To acknowledge the diagnostics and hardware interrupt status may be write accessed. The alarm data may only be read.

Diagnostics

Address	Function Code	Access to
4001h ... 4040h	0x01	Bit access to hardware interrupt state:
	0x02	4001h: Hardware interrupt state Modbus/TCP Slot 1
	0x05	... 4040h: Hardware interrupt state Modbus/TCP Slot 64
4001h ... 4200h	0x04	Word access to hardware interrupt data:
	0x17	4001h ... 4008h: Modbus/TCP Slot 1
	0x0F	... 41F8h ... 4200h: Modbus/TCP Slot 64
4001h ... 4008h	04h	16byte hardware interrupt data Modbus/TCP Slot 1
4009h ... 4010h	04h	16byte hardware interrupt data Modbus/TCP Slot 2
41F8h ... 4200h	04h	16byte hardware interrupt data Modbus/TCP Slot 64
5001h ... 5040h	0x01	Bit access to diagnostics interrupt state:
	0x02	5001h: Diagnostics interrupt state Modbus/TCP Slot 1
	0x05	... 5040h: Diagnostics interrupt state Modbus/TCP Slot 64
5001h ... 5400h	0x04	Word access to diagnostics interrupt state:
	0x17	5001h ... 5010h: Diagnostics interrupt state Modbus/TCP Slot 1
	0x0F	... 53F0h ... 5400h: Diagnostics interrupt state Modbus/TCP Slot 64
5001h ... 5010h	04h	32byte diagnostics data from Modbus/TCP Slot 1
5011h ... 5020h	04h	32byte diagnostics data from Modbus/TCP Slot 2
53F0h ... 5400h	04h	32byte diagnostics data from Modbus/TCP Slot 64

4.6 Easy Maintenance

Overview

Easy Maintenance means the support for adding and removing System SLIO modules during operation without having to restart the system. There are the following behaviors:

- As soon as a module is removed, the IM 053-1MT01 detects this and automatically switches to *Maintenance* state. In this state, all input and output data become invalid. By re-plugging the module or a compatible module, the *Maintenance* state is left again.
- As soon as a module is added to the existing modules, the IM 053-1MT01 detects this and automatically refreshes its reference configuration.



Please always replace only one module in your configuration.

4.6.1 Examples

Module is removed

If a module is removed, the IM 053-1MT01 behaves as follows:

1. ➤ The IM 053-1MT01 switches automatically to *Maintenance* state.
2. ➤ The process data communication is ended.
 - ⇒ ■ The SF LED remains off.
 - The MT LED lights up.
 - The SB LED turns off.
 - The message "Missing Module (ID ...)" is shown on the website.

Compatible module is added again

If a compatible module is inserted into the slot of a previously removed module during an active bus connection, the IM 053-1MT01 behaves as follows:

1. ➤ The System SLIO backplane bus is refreshed.
2. ➤ The process data communication is continued after the bus scan.
 - ⇒ ■ The SF LED remains off.
 - The MT LED turns off.
 - The SB LED lights up.
 - After updating the website, the correct module configuration is shown again instead of "Missing Module (ID ...)".

Incompatible module is added again

If an incompatible module is inserted into the slot of a previously removed module, the IM 053-1MT01 behaves as follows:

1. ➤ The IM 053-1MT01 remains in *Maintenance* state.
2. ➤ The process data communication remains interrupted.
 - ⇒ ■ The SF-LED lights up.
 - The SB LED blinks.
 - The MF LED of the wrong module blinks.
 - The message "Wrong Module ..." is shown on the website.

Replace Modbus/TCP IM 053-1MT00 with IM 053-1MT01

4.7 Firmware update



- Please note that a firmware update is only possible if the Ethernet coupler is in the Commissioning state.
- You can apply a firmware update via the integrated web server. ↗ 64

4.8 Replace Modbus/TCP IM 053-1MT00 with IM 053-1MT01



- The Modbus/TCP Ethernet coupler IM 053-1MT01 is compatible with the IM 053-1MT00 if the configuration of the IM 053-1MT00 is not imported.

Adapting the configuration file

Since the product name is evaluated within the configuration file during import, inappropriate configurations are rejected and not adopted. For the import of a configuration file this can be adapted accordingly:

1. ➤ Open the configuration file to be imported in a text editor.
2. ➤ Search for the entry `product="VIPA 053-1MT00"`
3. ➤ Change the entry to `product="VIPA 053-1MT01"`
4. ➤ Save the configuration file and load it into your IM 053-1MT01 by means of the web page.
 - ⇒ The configuration is applied and the IM 053-1MT01 is restarted.

4.9 Modbus/TCP

General

Modbus/TCP is a Modbus protocol put upon TCP/IP, where the IP address serves the addressing. Modbus/TCP allows a client-server-communication, several clients may be provided from one server.

Telegram structure incl. TCP/IP

The request telegrams sent by a master and the respond telegrams of the slave have the same structure:

Modbus/TCP	Slave address	Function code	Data
6byte header with number of following bytes	1byte data	1byte data	max. 254byte

Modbus/TCP header (6byte)

For send and receive telegrams, Modbus/TCP uses a header of 6byte with the following structure:

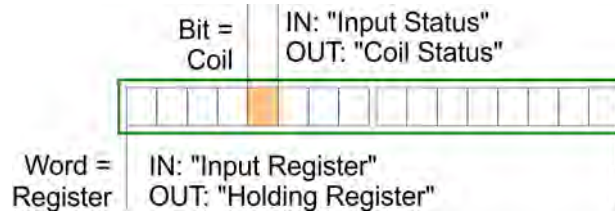
Byte	Name	Description
0	Transaction identifier (High byte)	Is sent back by the server (user-defined)
1	Transaction identifier (Low byte)	Is sent back by the server (user-defined)
2	Protocol identifier (High byte)	Always 0
3	Protocol identifier (Low byte)	Always 0
4	Length field (High byte)	Always 0 because messages < 256byte
5	Length field (Low byte)	Number of following bytes

Normally, byte 0 ... 4 have the value 0. You may also increase byte 0 and 1 in the slave and thus establish an additional control.

4.10 Modbus function codes

Naming convention

Modbus has some naming conventions:

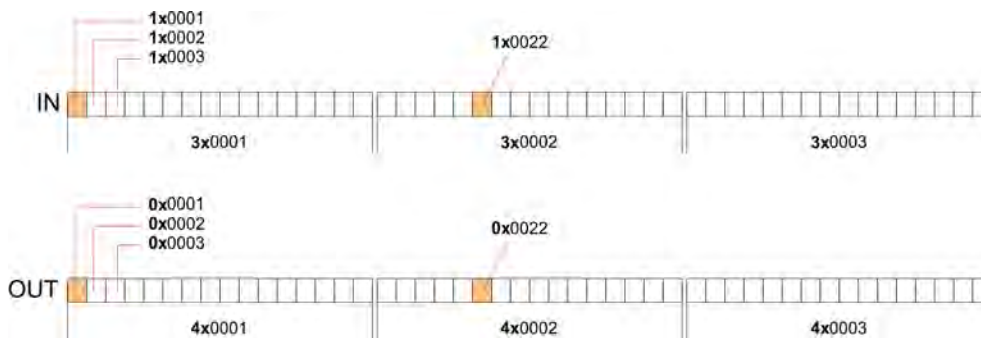


- Modbus differentiates between bit and word access; Bits = "Coils" and Words = "Register".
- Bit inputs are referred to as "Input-Status" and bit outputs as "Coil-Status".
- Word inputs are referred to as "Input-Register" and word outputs as "Holding-Register".

Range definitions

Normally the access with Modbus happens by means of the ranges 0x, 1x, 3x and 4x. 0x and 1x gives you access to *digital* bit areas and 3x and 4x to *analog* word areas. For the Yaskawa modules is not differentiating digital and analog data, the following assignment is valid:

- 0x - Bit area for master output
Access via function code 01h, 05h, 0Fh
- 1x - Bit area for master input
Access via function code 02h
- 3x - Word area for master input
Access via function code 04h, 17h
- 4x - Word area for master output
Access via function code 03h, 06h, 10h, 16h, 17h



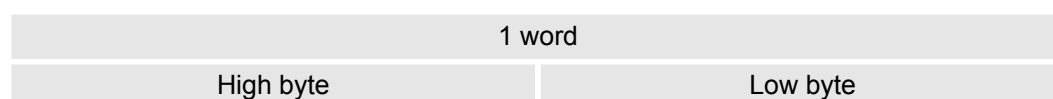
Overview

With the following Modbus function codes a Modbus master can access a Modbus slave. The description always takes place from the point of view of the master:

Code	Command	Description
01h	Read n Bits	Read n bits of master output area 0x
02h	Read n Bits	Read n bits of master input area 1x
03h	Read n Words	Read n words of master output area 4x

Code	Command	Description
04h	Read n Words	Read n words master input area 3x
05h	Write 1 Bit	Write 1 bit to master output area 0x
06h	Write 1 Word	Write 1 word to master output area 4x
0Fh	Write n Bits	Write n bits to master area 0x
10h	Write n Words	Write n words to master area 4x
16h	Mask 1 Word	Mask 1 word in master output area 4x
17h	Write n Words and Read m Words	Write n words into master output area 4x and the respond contains m read words of the master input area 3x

Byte sequence in a word



Respond of the coupler

If the slave announces an error, the function code is sent back with a "OR" and 80h. Without an error, the function code is sent back.

Coupler answer:	Function code OR 80h	→ Error & error number
	Function code	→ OK

If the slave announces an error, the function code is sent back with a "OR" and 80h. Without an error, the function code is sent back.

01h: Function number is not supported

02h: Addressing errors

03h: Data errors

04h: System SLIO bus is not initialized

07h: General error

Modbus function codes

Read n Bits 01h, 02h Code 01h: Read n bits of master output area 0x.
 Code 02h: Read n bits of master input area 1x.

Command telegram

Modbus/TCP-Header						Slave address	Function code	Address1. bit	Number of bits
x	x	0	0	0	6				
6byte						1byte	1byte	1word	1word

Respond telegram

Modbus/TCP-Header						Slave address	Function code	Number of read bytes	Data 1. byte	Data 2. byte	...
x	x	0	0	0							
6byte						1byte	1byte	1byte	1byte	1byte	
									max. 252byte		

Read n words 03h, 04h 03h: Read n words of master output area 4x.
 04h: Read n words master input area 3x.

Command telegram

Modbus/TCP-Header						Slave address	Function code	Address word	Number of words
x	x	0	0	0	6				
6byte						1byte	1byte	1word	1word

Respond telegram

Modbus/TCP-Header						Slave address	Function code	Number of read bytes	Data 1. word	Data 2. word	...
x	x	0	0	0							
6byte						1byte	1byte	1byte	1word	1word	
									max. 126words		

Write 1 bit 05h

Code 05h: Write 1 bit to master output area 0x.

A status change is via "Status bit" with following values:

"Status bit" = 0000h → Bit = 0

"Status bit" = FF00h → Bit = 1

Command telegram

Modbus/TCP-Header						Slave address	Function code	Address bit	Status bit
x	x	0	0	0	6				
6byte						1byte	1byte	1word	1word

Respond telegram

Modbus/TCP-Header						Slave address	Function code	Address bit	Status bit
x	x	0	0	0	6				
6byte						1byte	1byte	1word	1word

Write 1 word 06h

Code 06h: Write 1 word to master output area 4x.

Command telegram

Modbus/TCP-Header						Slave address	Function code	Address word	Value word
x	x	0	0	0	6				
6byte						1byte	1byte	1word	1word

Respond telegram

Modbus/TCP-Header						Slave address	Function code	Address word	Value word
x	x	0	0	0	6				
6byte						1byte	1byte	1word	1word

Write n bits 0Fh

Code 0Fh: Write n bits to master output area 0x.

Please regard that the number of bits are additionally to be set in byte.

Command telegram

Modbus/TCP-Header						Slave address	Function code	Address1 . bit	Number of bits	Number of bytes	Data 1. byte	Data 2. byte	...
x	x	0	0	0									
6byte						1byte	1byte	1word	1word	1byte	1byte	1byte	1byte
										max. 248byte			

Respond telegram

Modbus/TCP-Header						Slave address	Function code	Address 1. bit	Number of bits
x	x	0	0	0	6				
6byte						1byte	1byte	1word	1word

Write n words 10h

Code 10h: Write n words to master output area 4x.

Command telegram

Modbus/TCP-Header						Slave address	Function code	Address1 . word	Number of words	Number of bytes	Data 1. word	Data 2. word	...
x	x	0	0	0									
6byte						1byte	1byte	1word	1word	1word	1word	1word	1word
										max. 124byte			

Respond telegram

Modbus/TCP-Header						Slave address	Function code	Address 1. word	Number of words
x	x	0	0	0	6				
6byte						1byte	1byte	1word	1word

Mask a word 16h

Code 16h: This function allows to mask a word in the master output area 4x.

Command telegram

Modbus/TCP-Header						Slave address	Function code	Address word	AND Mask	OR Mask
x	x	0	0	0	8					
6byte						1byte	1byte	1word	1word	1word

Respond telegram

Modbus/TCP-Header						Slave address	Function code	Address word	AND Mask	OR Mask
x	x	0	0	0	8					
6byte						1byte	1byte	1word	1word	1word

Write n words and Read m words 17h

Code 17h: This function allows to write n words to the master output area 4x and read m words from the master input area 3x with one request.

Command telegram

Modbus/TCP-Header						Slave address	Function code	Read address	Read number words	Write address	Write number words	Write number bytes	Write Data 1.word	Write Data 2.word	...
x	x	0	0	0											
6byte						1byte	1byte	1Wort	1Wort	1word	1word	1byte	1word	1word	
												max. 122words			

Respond telegram

Modbus/TCP-Header						Slave address	Function code	Read number bytes	Read Data 1. word	Read Data 2. word	...
x	x	0	0	0							
6byte						1byte	1byte	1byte	1word	1word	
									max. 126words		

Modbus function codes

4.11 Register allocation

I/O data

Address	Access to
1x: 0001h ... 2000h	Bit access to input area
3x: 0001h ... 0200h	Word access to input area
0x: 0001h ... 2000h	Bit access to output area
4x: 0001h ... 0200h	Word access to output area

Status information

The status information in the register area 3001h ... 3003h provides status information about the System SLIO. You have read-only access to the status registers.

Address	Function Code	Access to
3001h	0x01	BASP state
	0x02	<ul style="list-style-type: none"> ■ 0: BASP is not set ■ 1: BASP is set
3002h	0x01	Collection bit for process interrupt, if at least one process interrupt has not yet been acknowledged by the IM 053MT/module
	0x02	
3003h	0x01	Collection bit for diagnostic interrupts if at least one diagnostic interrupt has not yet been acknowledge by the IM 053MT/module
	0x02	

Diagnostics

Address	Function Code	Access to
4001h ... 4040h	0x01	Bit access to hardware interrupt state: 4001h: Hardware interrupt state Modbus/TCP Slot 1 ... 4040h: Hardware interrupt state Modbus/TCP Slot 64
	0x02	
	0x05	
4001h ... 4200h	0x04	Word access to hardware interrupt data: 4001h ... 4008h: Modbus/TCP Slot 1 ... 41F8h ... 4200h: Modbus/TCP Slot 64
	0x17	
	0x0F	
4001h ... 4008h	04h	16byte hardware interrupt data Modbus/TCP Slot 1
4009h ... 4010h	04h	16byte hardware interrupt data Modbus/TCP Slot 2
41F8h ... 4200h	04h	16byte hardware interrupt data Modbus/TCP Slot 64
5001h ... 5040h	0x01	Bit access to diagnostics interrupt state: 5001h: Diagnostics interrupt state Modbus/TCP Slot 1 ... 5040h: Diagnostics interrupt state Modbus/TCP Slot 64
	0x02	
	0x05	
5001h ... 5400h	0x04	Word access to diagnostics interrupt state: 5001h ... 5010h: Diagnostics interrupt state Modbus/TCP Slot 1 ... 53F0h ... 5400h: Diagnostics interrupt state Modbus/TCP Slot 64
	0x17	
	0x0F	




































































Register allocation

Address	Function Code	Access to
5001h ... 5010h	04h	32byte diagnostics data from Modbus/TCP Slot 1
5011h ... 5020h	04h	32byte diagnostics data from Modbus/TCP Slot 2
53F0h ... 5400h	04h	32byte diagnostics data from Modbus/TCP Slot 64

4.12 LED status indication

General

The LEDs installed to display the status allow extensive diagnostics during the PowerON procedure as well as during operation. The result of the diagnosis is determined by the combination of the different LEDs and the current operating mode.

PWR	SF	MT	SB	MB	SPD	L/A(1/2)	Description
 green	 red	 yellow	 green	 green	 green	 green	
Operating modes  55							
				X	X	X	<i>Init</i>
	x			X	X	X	<i>DHCP discovery</i>
	x			X	X	X	<i>Update config</i>
				X	X	X	<i>Run</i>
				X	X	X	<i>Commissioning</i>
	x			X	X	X	<i>Maintenance</i>
				X	X	X	<i>Firmware update¹</i>
				X	X	X	<i>Error</i>
Operation							
	X	X	X	X	X	X	The Ethernet coupler is power supplied.
		X			X		The Ethernet coupler communicates without error via Ethernet
	X	X	X		X	X	The Ethernet coupler is ready for Modbus/TCP communication
	X	X	X		X	X	No Modbus/TCP communication is possible
	X	X		X	X	X	BASP (B efehls- A usgabe- S perre i.e. command output disable) is activated
		X		X			There is no physical connection to Ethernet.
	X	X	X		X	X	Configuration is in progress
	X		X	X	X	X	Ethernet coupler is located, the identification was initiated by the user and takes 10s.
	X	X	X	X		X	Speed: 100MBit/s
							Error: Power OFF-ON required
not relevant: X							
1) LEDs blink alternately							

Appendix

Content

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A History of changes

Rev.	Changes
19-40	The manual was created.
21-01	Chapter "Basics and Mounting" <ul style="list-style-type: none">■ Description "System conception" was changed.■ Description "Hardware revision" was changed. Chapter "Deployment" <ul style="list-style-type: none">■ Description "LED status indication" was changed.■ Description "Web page of the selected Ethernet coupler" was changed.■ Description "Easy Maintenance" was changed.
22-30	General <ul style="list-style-type: none">■ CI adjustment was made. Chapter "General" <ul style="list-style-type: none">■ The chapter was restructured. Chapter "Basics and Mounting" <ul style="list-style-type: none">■ Description "Hardware revision" was changed.■ Description "Wiring periphery modules" was changed.■ Description "Demounting periphery modules" was changed.■ Description "Industrial security and installation guidelines" was changed.■ Description "Use in difficult operating conditions" was added.