YASKAWA

System SLIO

IM | 053-1ML40 | Manual

HB300 | IM | 053-1ML40 | en | 25-42

Interface module MECHATROLINK-4 - IM 053ML

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053-1ML40_000_IM 053ML,4,EN

Table of contents

1 General

1.1 About this manual

Objective and contents

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

- It describes the structure, configuration and application.
- The manual is targeted at users with good basic knowledge in automation technology.
- The manual does not replace sufficient basic knowledge of automation technology or sufficient familiarity with the specific product.
- 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 version:	
IM 053ML	053-1ML40	HW: 01	FW: 1.2.3

Documentation

In the context of the use of the pertinent Yaskawa product, the manual is to be made accessible to the pertinent qualified personnel in:

- Project engineering
- Installation department
- Commissioning
- Operation

Icons and headings

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

DANGER

- Immediate danger to life and limb of personnel and others.
- Non-compliance will cause death or serious injury.

CAUTION

- Hazardous situation to life and limb of personnel and others. Non-compliance may cause slight injuries.
- This symbol is also used as warning of damages to property.

NOTICE

- Designates a possibly harmful situation.
- Non-compliance can damage the product or something in its environment.

Supplementary information and useful tips.

1.2 Copyright © YASKAWA Europe GmbH

Download Center

By entering the product order number in the *'Download Center'* at www.yaskawa.eu.com, the pertinent manuals, data sheets, declarations of conformity, certificates and other helpful information for your product can be found.

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Tel.: +49 6196 569 500 (hotline)
Email: support@yaskawa.eu

1.3 Safety instructions

General safety instructions

DANGER

Danger to life due to non-compliance with safety instructions

Non-compliance with the safety instructions in the manual can result in serious injury or death. The manufacturer is not responsible for any injuries or damage to the equipment.

CAUTION

Before commissioning and operating the components described in this manual, it is essential to note the following:

- Modifications to the automation system must only be done in a voltage-free state!
- Connection and modification only by trained electricians
- National regulations and guidelines in the respective country of use must be observed and complied with (installation, protective measures, EMC, etc.)

Intended use

- It is the customer's responsibility to comply with all pertinent standards, codes, or regulations applicable to the use of the product, including those that apply when the Yaskawa product is used in combination with other products.
- The customer must confirm that the Yaskawa product is suitable for the customer's plant, machinery and equipment.
- If the Yaskawa product is used in a manner not specified by this manual, the protection provided by the Yaskawa product may be impaired and the use may result in material or immaterial damage.
- Contact Yaskawa to determine whether use is permitted in the following applications. If the use in the respective application is permissible, the Yaskawa product is to be used by considering additional risk assessments and specifications, and safety measures are to be provided to minimise the dangers in the event of a fault. Special caution is required and protective measures must be taken in the case of:
  - Outdoor use, use with possible chemical contamination or electrical interference, or use under conditions or in environments which are not described in product catalogs or manuals
  - Nuclear control systems, combustion systems, railway systems, aviation systems, automotive systems, medical devices, amusement machines and equipment that is specifically regulated by industry or government
  - Systems, machines and devices that can pose a risk to life or property
  - Systems that require a high degree of reliability, such as gas, water or electricity supply systems or systems that operate 24 hours a day
  - Other systems that require a similarly high level of security
- Never use the Yaskawa product in an application where failure of the product could cause serious danger to life, limb, health or property without first ensuring that the system is designed to provide the required level of safety with risk warnings and redundancy to avoid the realisation of such dangers and that the Yaskawa product is properly designed and installed.
- The connection examples and other application examples described in the product catalogs and manuals of Yaskawa are for reference purposes. Check the functionality and safety of the devices and systems actually to be used before using the Yaskawa product.
- To avoid accidental harm to third parties, read and understand all prohibitions on use and precautions, and operate the Yaskawa product correctly.

Field of application

- The Yaskawa product is not suited for use in life-support machines or systems.
- Please contact your Yaskawa representative or Yaskawa distributor if considering the use of the Yaskawa product for special purposes, such as machines or systems used in passenger cars, in medical, aircraft and aerospace applications, for power supply of networks, for electrical power distribution or for underwater applications.

DANGER

The device is not permitted for use

– in explosive environments (EX zone)

The system is designed and manufactured for proper use and use in accordance with the user manual and is designed for:

- Communication and process control
- general control and automation tasks
- for industrial use
- operation within the environmental conditions specified in the technical data
- installation in a cabinet

DANGER

If this Yaskawa product is used in applications where failure of the device can result in the loss of human life, a serious accident or physical injury, you must install appropriate safety devices.

– Death or serious injury can result if you do not install the safety devices properly.

Disclaimer

(1) The contractual and legal liability of Yaskawa and the legal representatives and vicarious agents of Yaskawa for compensation and reimbursement of expenses in relation to the content of this documentation is excluded or limited as follows:

a) For slightly negligent breaches of *Essential Contractual Duties* arising from the contractual obligation, for Yaskawa the amount of liability is limited to the foreseeable damage typical for the contract. *'Essential Contractual Duties'* are those duties that characterise the performance of the contract and on which the Yaskawa customer may reasonably rely.

(b) In each case, Yaskawa is not liable for (i) the slightly negligent breach of duties arising from the duties that are not *Essential Contractual Duties*, as well as (ii) force majeure, i.e. external events that have no operational connection and cannot be averted even by exercising the utmost care that can reasonably be expected.

(2) The aforementioned limitation of liability does not apply (i) in cases of mandatory statutory liability (in particular under the product liability law), (ii) if and to the extent that Yaskawa has assumed a guarantee or same as guaranteed procurement risk according to § 276 BGB, (iii) for culpably caused injuries to life, limb and/or health, also by representatives or vicarious agents, as well as (iv) in case of delay in the event of a fixed completion date.

(3) A reversal of the burden of proof is not associated with the provisions above.

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 extra-low voltage (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.

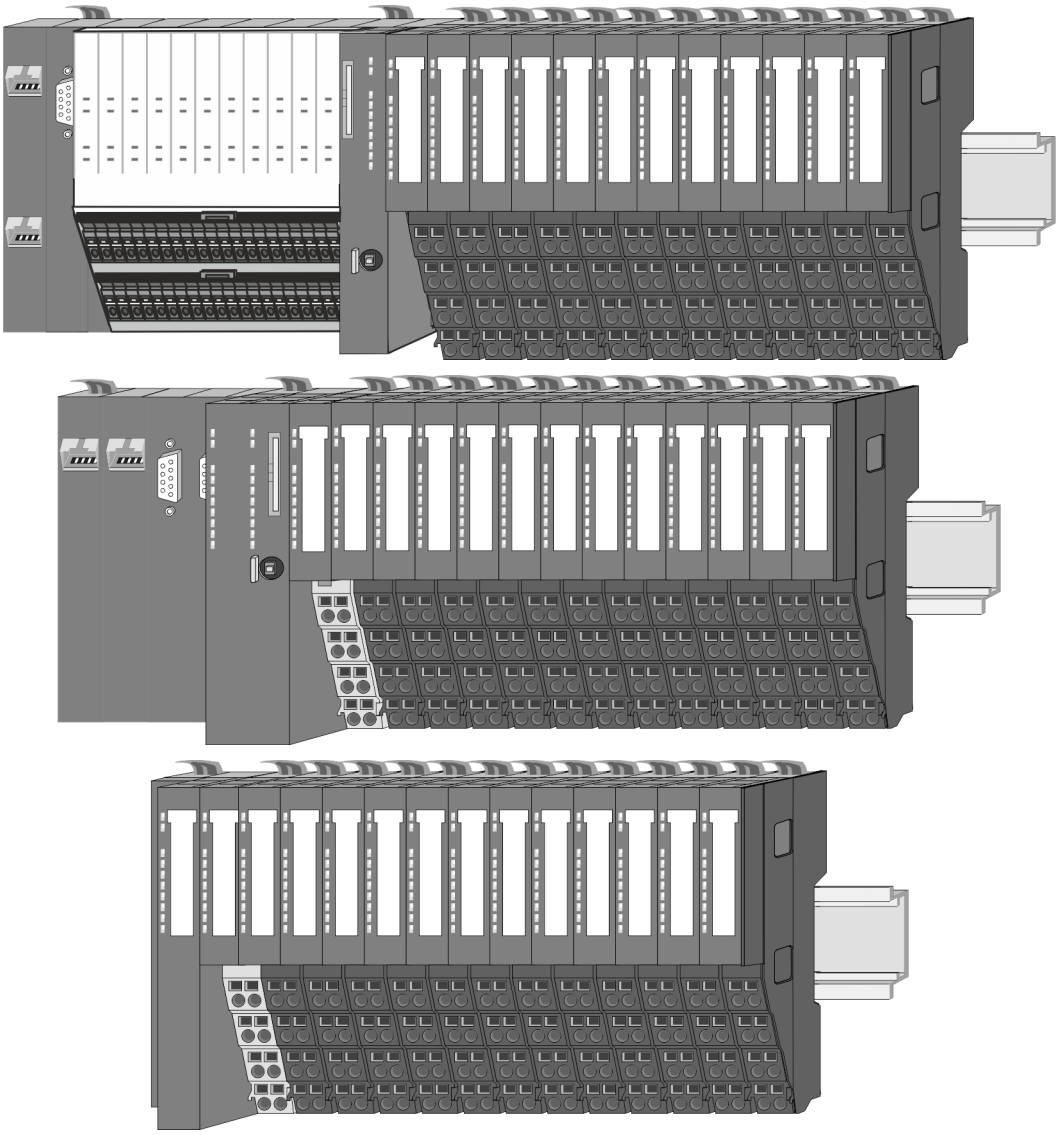
CAUTION

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 profile 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.



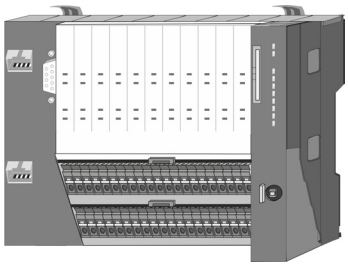
2.2.2 Components

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

CAUTION

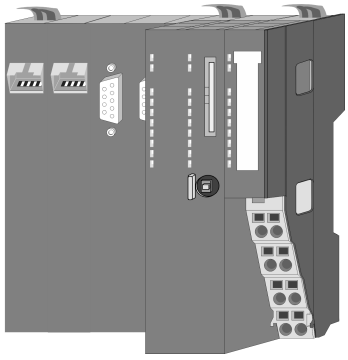
Only Yaskawa modules may be combined. A mixed operation with third-party modules is not allowed!

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



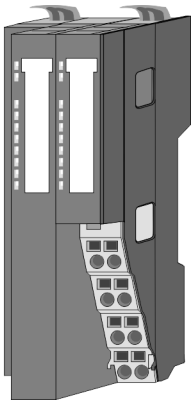
With this CPU 01x, CPU electronic and power supply are integrated to one casing. As head module, via the integrated power module for power supply, CPU electronic and the electronic of the connected periphery modules are supplied. The DC 24V power section supply for the linked periphery modules is established 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



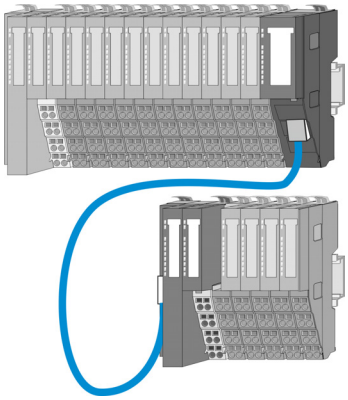
With a bus coupler bus interface and power module is integrated to one casing. With the bus interface you get access to a subordinated bus system. As head module, via the integrated power module for power supply, bus interface and the electronic of the connected periphery modules are supplied. The DC 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!

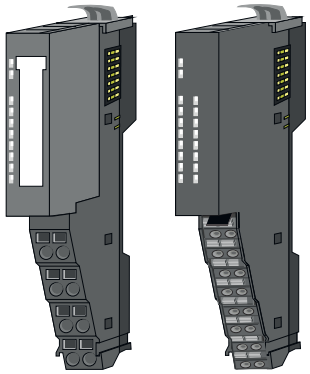
Line extension



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 MainDevice at each end of a line and the subsequent line has to start with a line extension SubDevice. MainDevice and SubDevice are to be connected via a special connecting cable. In this way, you can divide a line on up to 5 lines. Depending on the line extension, the max. number of pluggable modules at the System SLIO bus is decreased accordingly. 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, please refer to the compatibility list. This can be found in the 'Download Center' of www.yaskawa.eu.com under 'System SLIO Compatibility list'.

Periphery modules

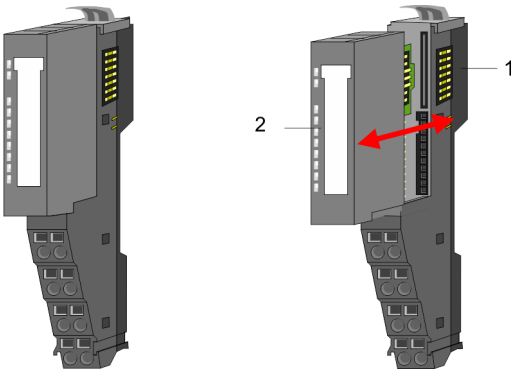


The periphery modules are available in the following 2 versions, whereby of each the electronic part can be replaced with standing wiring:

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

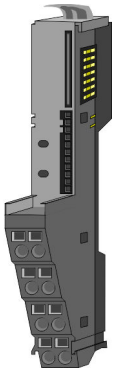
8x periphery modules

Each 8x periphery module consists of a *terminal* and an *electronic module*.



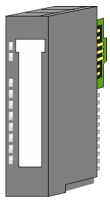
1 Terminal module
2 Electronic module

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 profile 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.

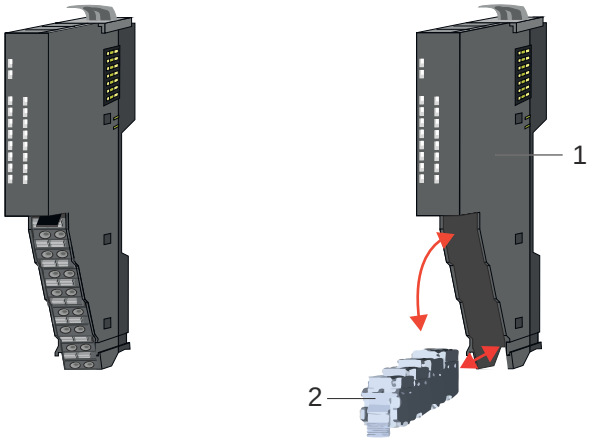
Electronic module



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.

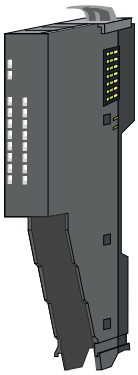
16x periphery modules

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



1 Electronic unit
2 Terminal block

Electronic unit

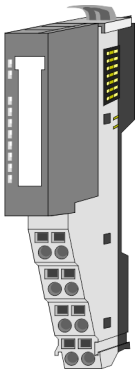


With the 16x periphery module the terminal block is connected to the *electronic unit* via a secure flap mechanism. In the case of an error you can exchange the defective electronic unit for a functional unit with standing wiring. At the front side there are LEDs for status indication. For easy wiring 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 profile 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.

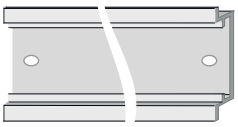
Power module



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

Profile rail



Order no.	Description
290-1AF00	35 mm profile rail length 2000mm
290-1AF30	35 mm profile rail length 530mm

NOTICE

To ensure EMC, the profile rail must be grounded!

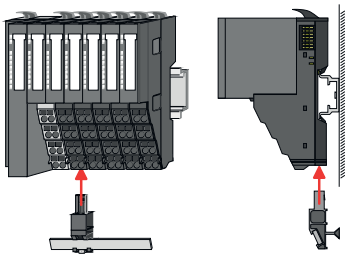
- Ensure that the profile rail is reliably and professionally grounded.
- By mounting them on the grounded profile rail, the modules are automatically connected to the grounding system.

➥ *'Grounding guidelines'...page 20*

➥ *'Installation guidelines'...page 43*

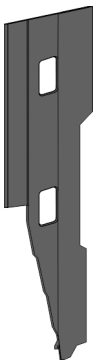
Shield bus carrier

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 profile rail for adaptation to a flat profile 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.

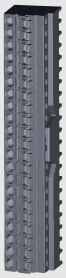
Coding pins

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.

Spare parts

The following spare parts are available for the System SLIO:

Spare part	Order no.	Description	Packaging unit
	092-9BH00	Terminal block for System SLIO 16x periphery module.	5 pieces
	092-9BK00	Connector for System SLIO CPU 013C.	5 pieces

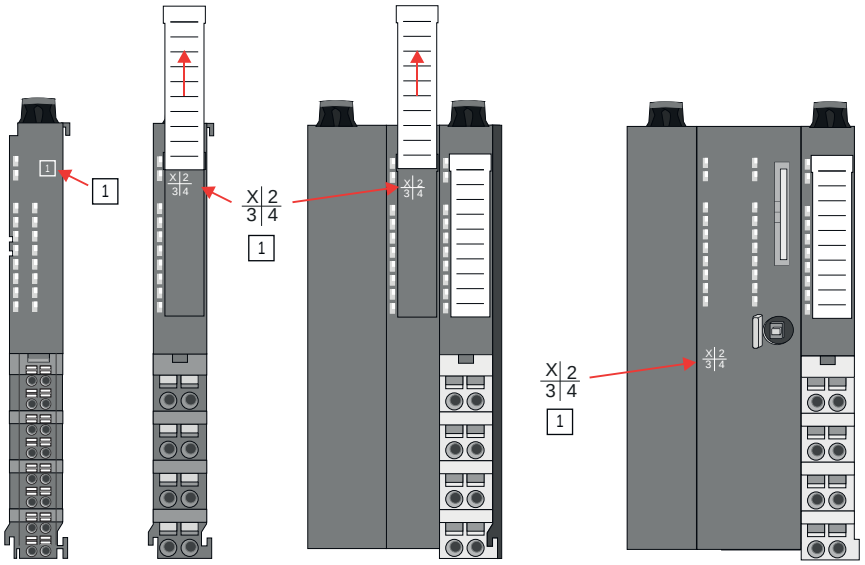
CAUTION

Please note that you may only use the spare parts with Yaskawa modules. Use with third-party modules is not allowed!

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 periphery 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:
  - With current labelling there is a 1 on the front.
  - With earlier labelling, the 1 is marked with *'X'* on a number grid.



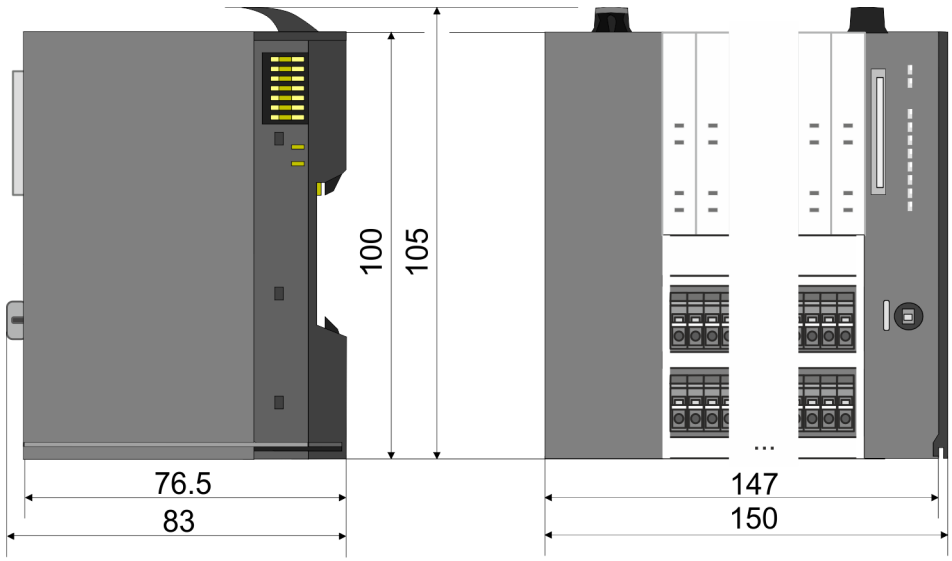
Hardware revision via web server

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

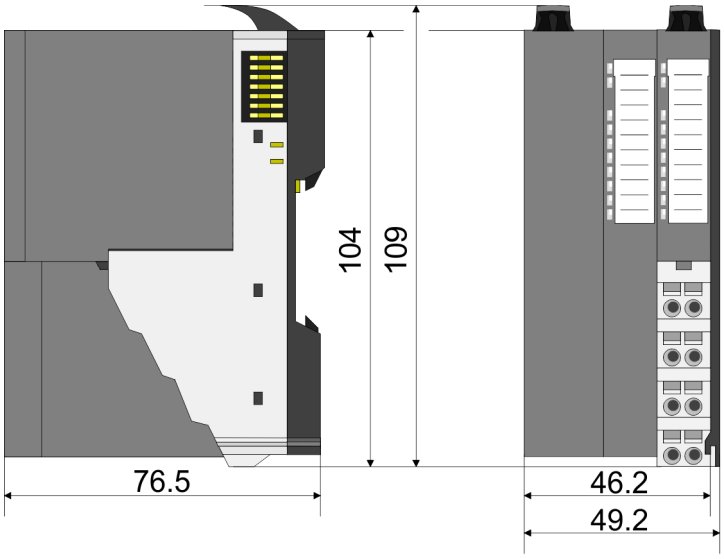
All dimensions are in mm.



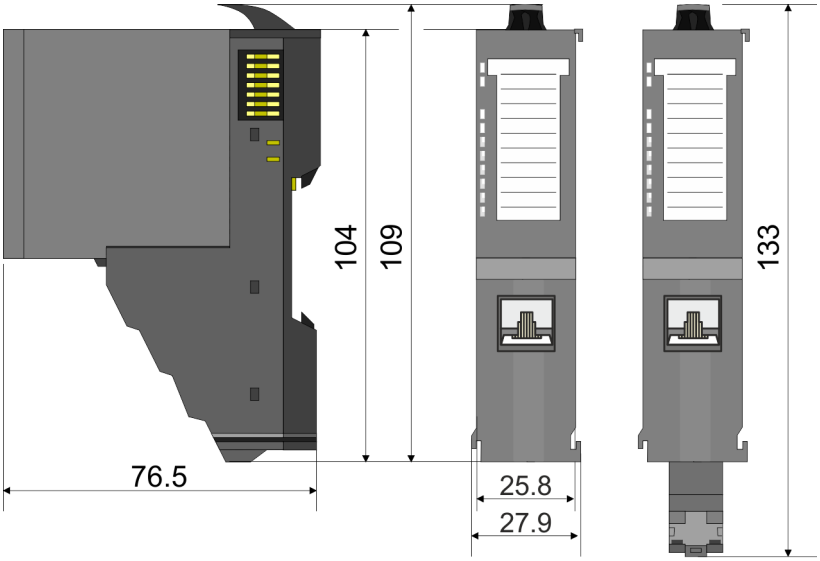
Dimensions

CPU 01x

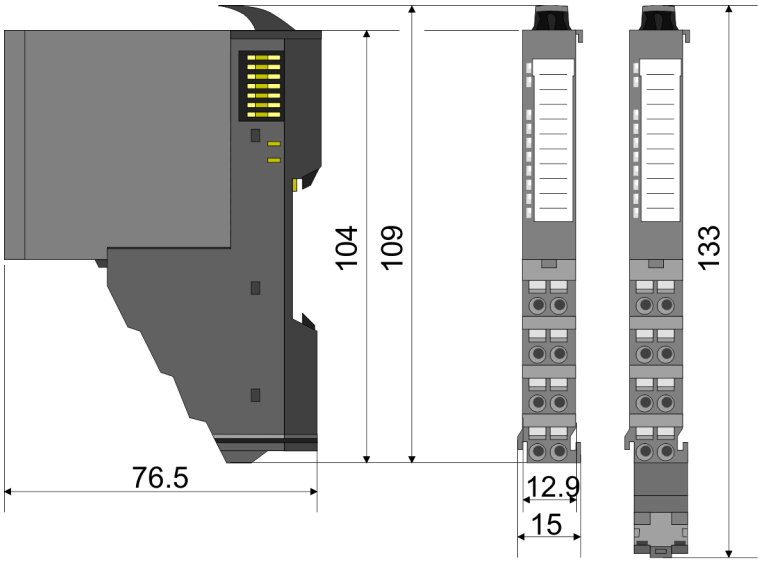
Bus coupler and line extension SubDevice



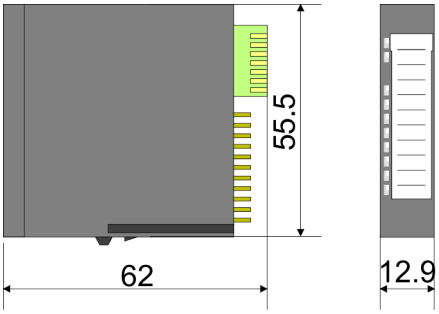
Line extension MainDevice



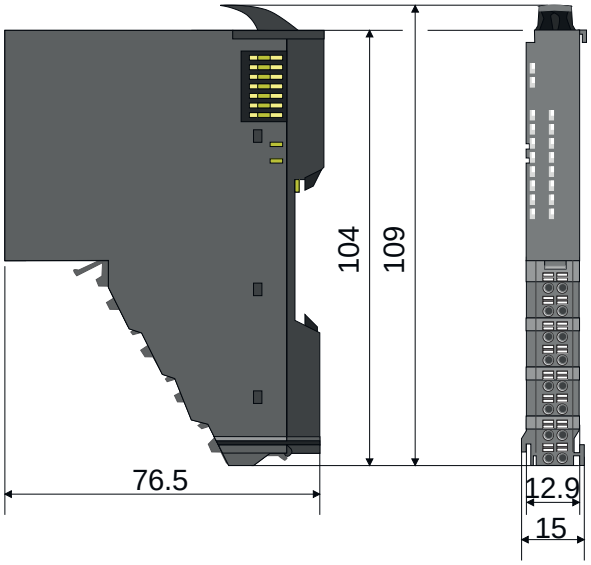
8x periphery module



Electronic module



16x periphery module



2.4 Grounding concept

Grounding guidelines

For reliable grounding, ensure that all common ground connections and the functional earth (FE) of your System SLIO and all connected devices are connected to a central point and grounded there.

NOTICE

To ensure EMC, the profile rail must be grounded!

- Ensure that the profile rail is reliably and professionally grounded.
- By mounting them on the grounded profile rail, the modules are automatically connected to the grounding system.

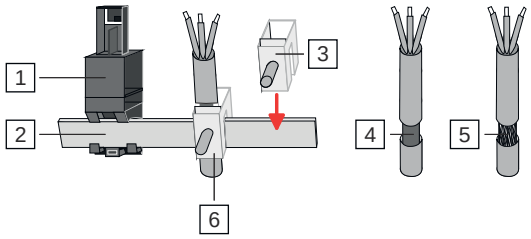
➦ *'Installation guidelines'...page 43*

- To avoid potential differences, use grounding cables that are as short as possible and have a large cross-section.
- When selecting grounding points, observe the applicable safety regulations.
- When assembling your components, ensure that the inactive metal parts are properly grounded over a large area.
  - Connect all inactive metal parts over a large area and with low impedance.
  - Avoid using aluminium parts if possible. Aluminium is easily oxidizing and is therefore less suitable for grounding.

2.4.1 Shielding

Overview

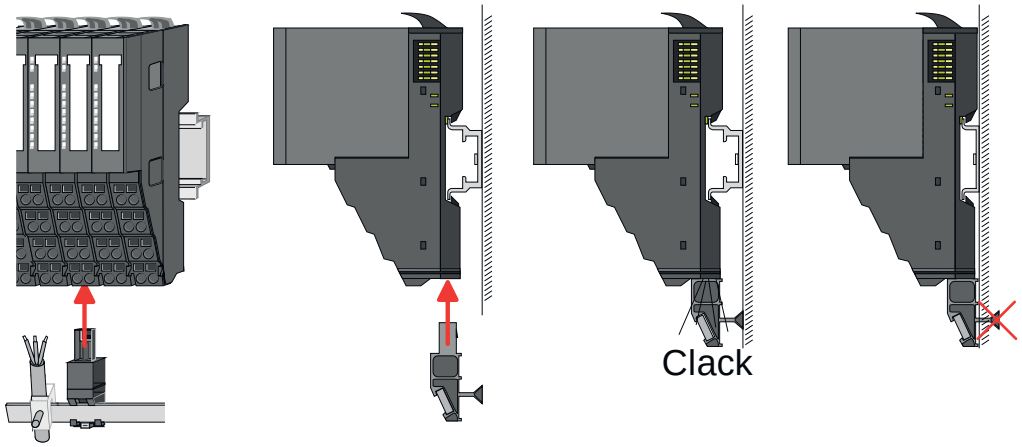
Shielding is required for interference-free signal transmission. This weakens electrical, magnetic or electromagnetic interference fields. To attach the shield the mounting of shield bus carriers are necessary. The shield bus carrier (available as accessory) serves to carry the shield bus to connect cable shields. ➦ *'Installation guidelines'...page 43*



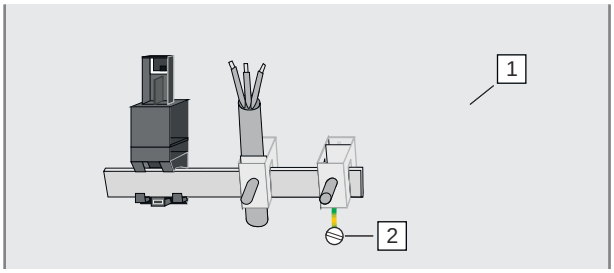
1 Shield bus carrier
2 Shield bus (10mm x 3mm)
3 Shield clamp
4 Cable shield with metal foil
5 Cable shield with wire mesh (close-meshed)
6 Cable shield mounted with shield clamp

Shield attachment

1. System SLIO head and 8x periphery modules have a carrier hole for the shield bus carrier. Push the shield bus carrier, until they engage into the module. With a flat profile rail for adaptation to a flat profile 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.
4. The shield bus must always be grounded. Keep all cable connections as short as possible. To ground the shield bus, connect a FE conductor to the shield bus via a shield clamp and screw it to the base plate as close as possible and with low impedance.



1 Base plate
2 FE conductor screwed to base plate

2.5 Mounting bus coupler

CAUTION

Requirements for UL compliance use

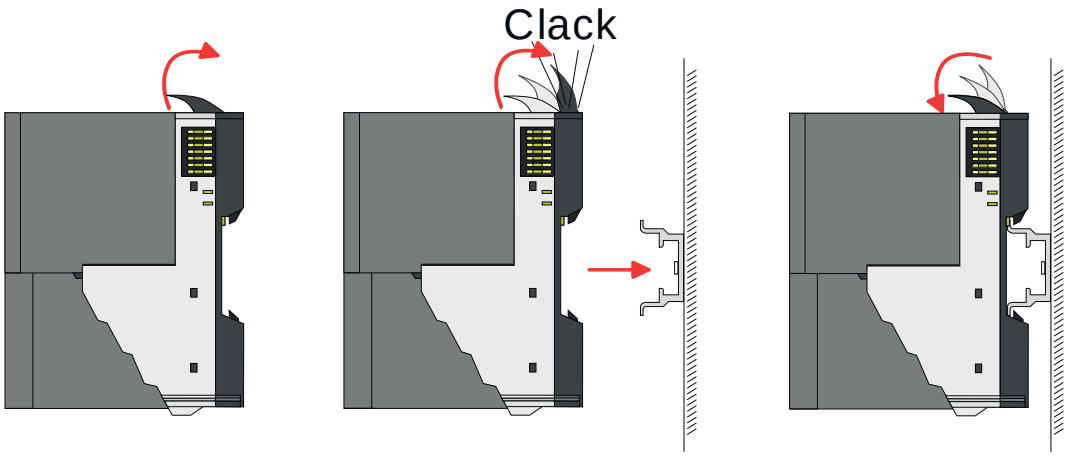
- Use for power supply exclusively SELV/PELV power supplies.
- The System SLIO must be installed and operated in a housing according to IEC 61010-1 9.3.2 c).

CAUTION

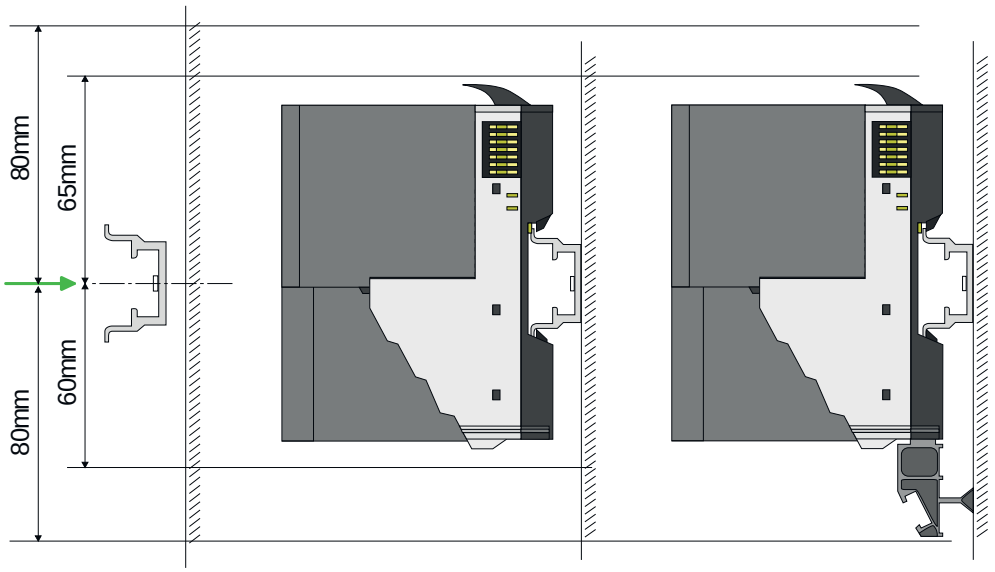
Danger of injury from electrical shock and damage to the unit!

Put the System SLIO in a safe, powered down state before starting installation, disassembly or wiring of the System SLIO modules!

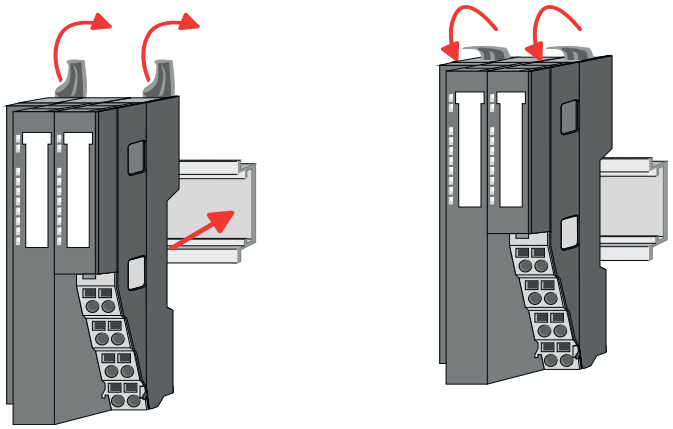
There are locking lever at the top side of the bus coupler. For mounting and demounting these locking lever are to be turned upwards until these engage. Place the bus coupler at the profile rail. The bus coupler is fixed to the profile rail by pushing downward the locking levers. The bus coupler is directly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



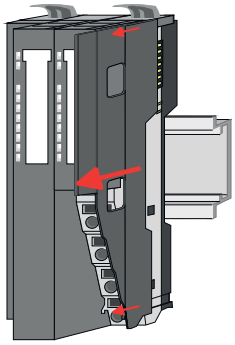
1. Mount the profile rail. Please consider that a clearance from the middle of the profile rail of at least 80mm above and 60mm below, respectively 80mm by deployment of shield bus carriers, exist.



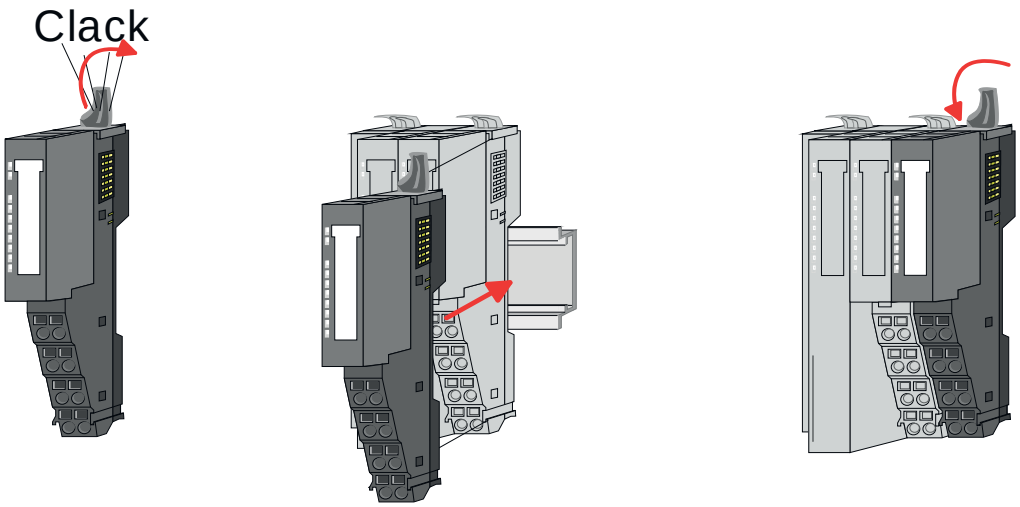
2. Turn the locking lever upwards, place the bus coupler at the profile rail and turn the lever downward.

Mounting periphery modules

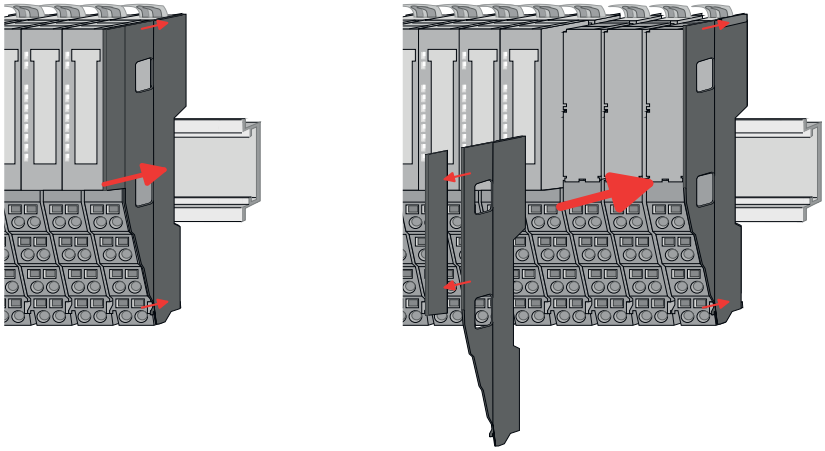
The procedure is identical for 8x and 16x periphery modules.



1. Before mounting the periphery 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.



2. Mount the periphery 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.

2.6 Wiring

CAUTION

Consider temperature for external cables!

Cables may experience temperature increase due to system heat dissipation. Thus the cabling specification must be chosen 25°C above ambient temperature!

CAUTION

Separate insulation areas!

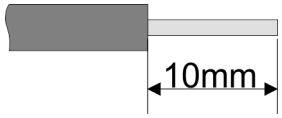
The system is specified for SELV/PELV environment. Devices, which are attached to the system must meet theses specifications. Installation and cable routing other than SELV/PELV specification must be separated from the system's equipment!

2.6.1 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.

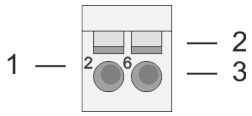
Data



Please use copper wire only!

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

Wiring procedure

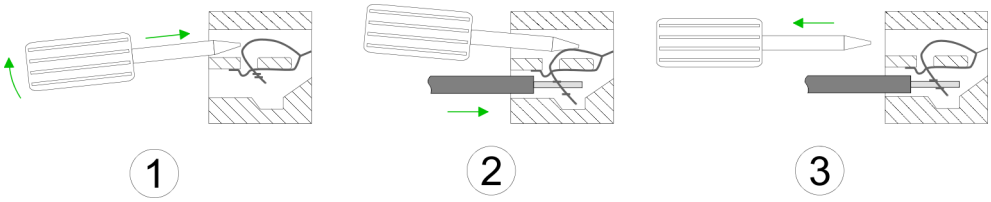


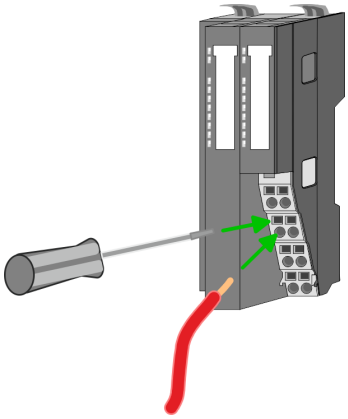
1 Pin number at the connector
2 Opening for screwdriver
3 Connection hole for wire

CAUTION

Danger of injury from electrical shock and damage to the unit!

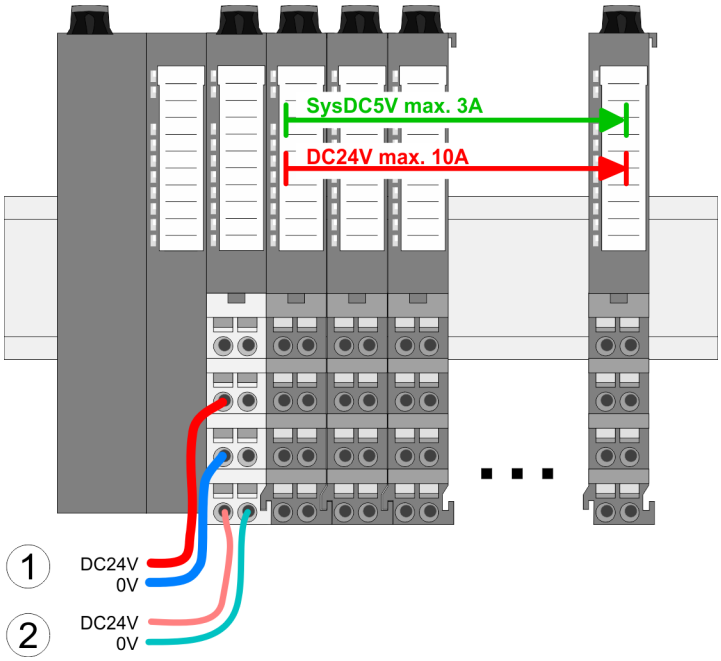
Put the System SLIO in a safe, powered down state before starting installation, disassembly or wiring of the System SLIO modules!





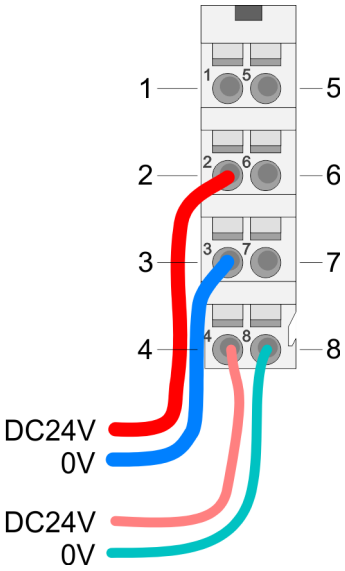
1. Insert a suited screwdriver at an angel into the square opening as shown. Press and hold the screwdriver in the opposite direction to open the contact spring.
2. Insert the stripped end of wire into the round opening. You can use wires with a cross section of 0.08mm² up to 1.5mm²
3. By removing the 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 power 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 power 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 and should be UL approved!

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

➥ *'Shielding'...page 20*

2.6.2 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!

CAUTION

Danger of injury from electrical shock and damage to the unit!

Put the System SLIO in a safe, powered down state before starting installation, disassembly or wiring of the System SLIO modules!

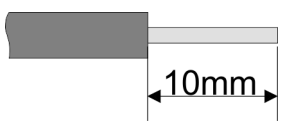
CAUTION

Consider temperature for external cables!

Cables may experience temperature increase due to system heat dissipation. Thus the cabling specification must be chosen 25°C above ambient temperature!

- 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.

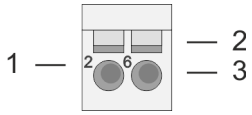
Data



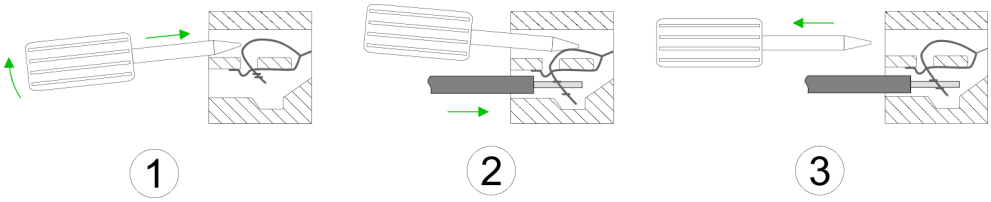
Please use copper wire only!

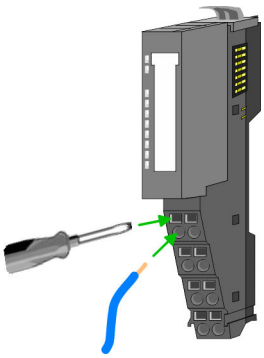
U_{max}	240V AC / 30V DC
I_{max}	10A
Cross section	0.08 ... 1.5mm² (AWG 28 ... 16)
Stripping length	10mm

Wiring procedure



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





1. Insert a suited screwdriver at an angel 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 ➦ *'Shielding'...page 20*

2.6.3 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!

CAUTION

Danger of injury from electrical shock and damage to the unit!

Put the System SLIO in a safe, powered down state before starting installation, disassembly or wiring of the System SLIO modules!

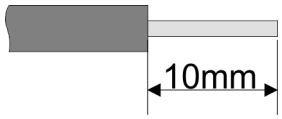
CAUTION

Consider temperature for external cables!

Cables may experience temperature increase due to system heat dissipation. Thus the cabling specification must be chosen 25°C above ambient temperature!

- 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.

Data



Please use copper wire only!

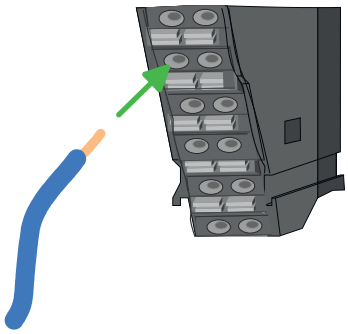
U_{max}	30V DC
I_{max}	10A
Cross section solid wire	0.25 ... 0.75mm²
Cross section with ferrule	0.14 ... 0.75mm²
AWG	24 ... 16
Stripping length	10mm

Wiring procedure

1 Release area
2 Connection hole for wire

Insert wire

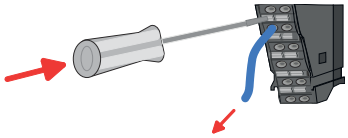
The wiring happens without a tool.



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.



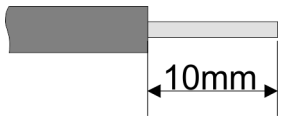
1. Press with your screwdriver vertically at the release button.
   ➡ The contact spring releases the wire.
2. Pull the wire from the round hole.

2.6.4 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.

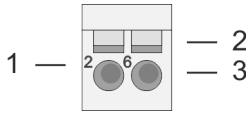
Data



Please use copper wire only!

U_{max}	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

CAUTION

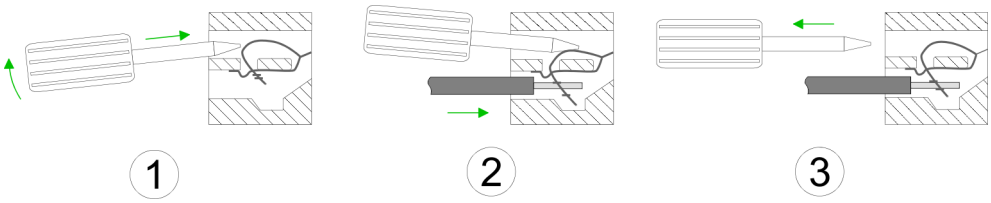
Danger of injury from electrical shock and damage to the unit!

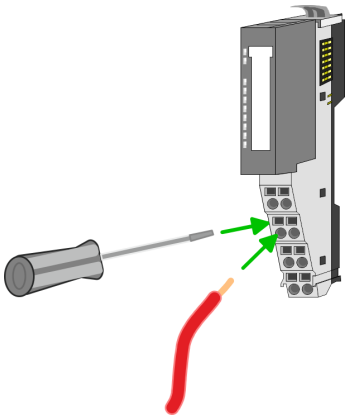
Put the System SLIO in a safe, powered down state before starting installation, disassembly or wiring of the System SLIO modules!

CAUTION

Consider temperature for external cables!

Cables may experience temperature increase due to system heat dissipation. Thus the cabling specification must be chosen 25°C above ambient temperature!

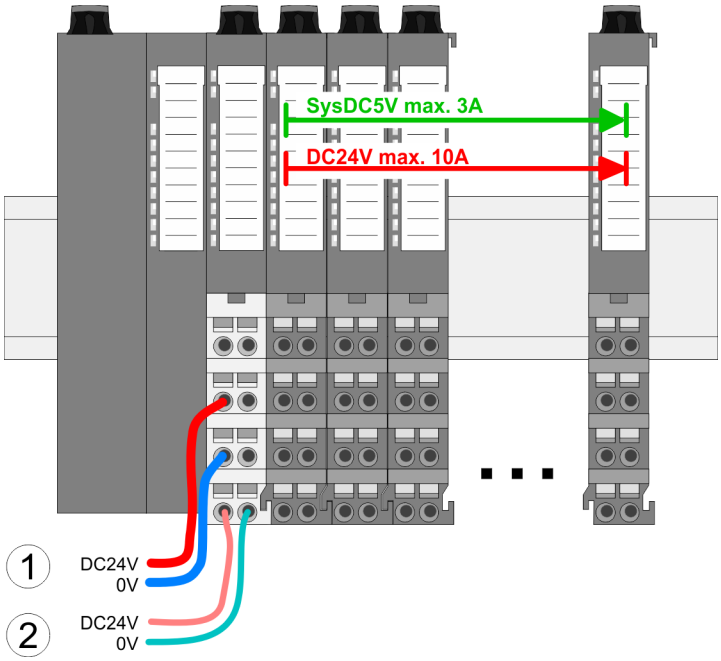




1. Insert a suited screwdriver at an angel into the square opening as shown. Press and hold the screwdriver in the opposite direction to open the contact spring.
2. Insert the stripped end of wire into the round opening. You can use wires with a cross section of 0.08mm² up to 1.5mm²
3. By removing the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

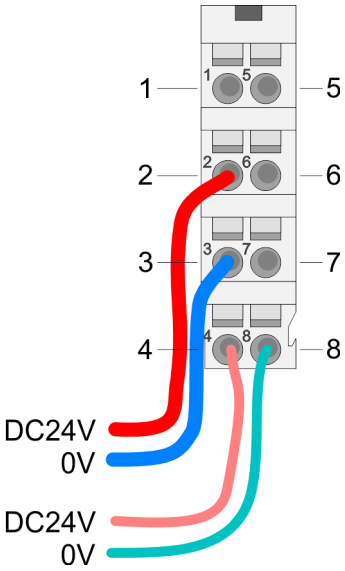
Shield attachment ➦ *'Shielding'...page 20*

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 power 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 power 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 and should be UL approved!

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 and should be UL approved.
  - For modules with positive logic (PNP), place the fuse on the positive connector.
  - For modules with negative logic (NPN), place the fuse on the negative connector.
  - For mixed logic, one fuse must be placed on the negative and one on the positive connector.
- 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 and should be UL approved.
- 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 and should be UL approved.

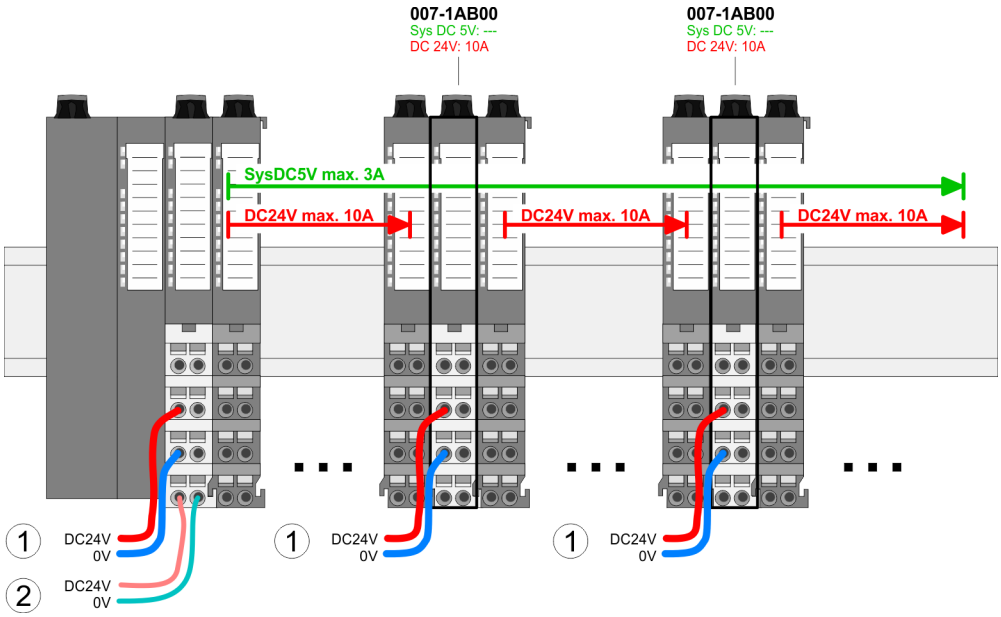
State of the electronic power supply via LEDs

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.

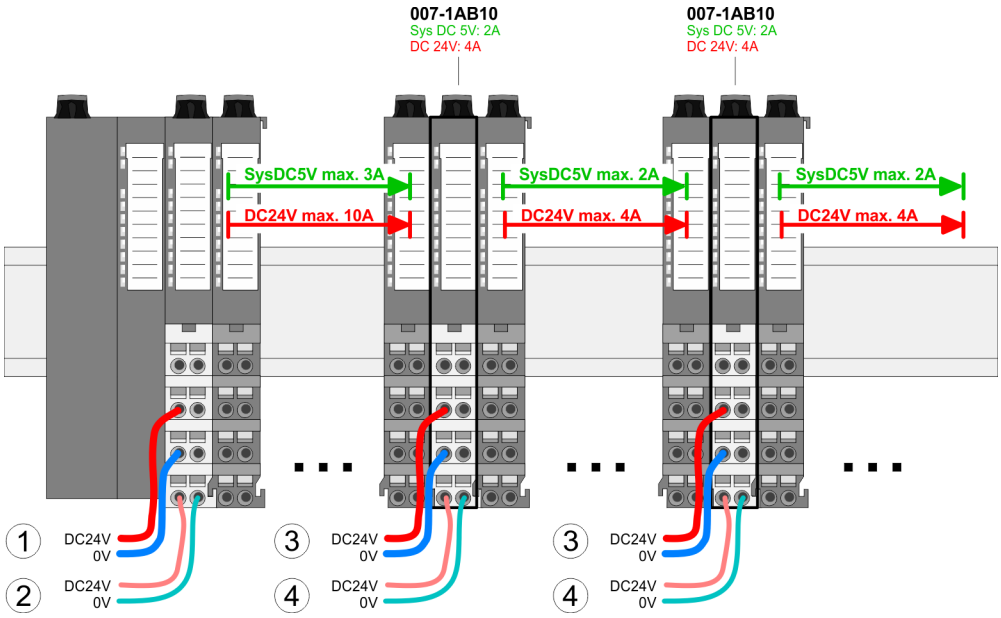
Deployment of the power modules

- 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

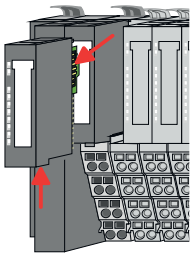
2.7 Demounting

2.7.1 Demounting bus coupler

Proceeding

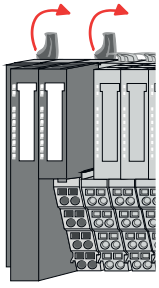
CAUTION

Put the System SLIO in a safe, powered down state before starting disassembly!



1. Power-off your system.
2. Remove if exists the wiring of the bus coupler.
3. Press the unlocking lever at the lower side of the just mounted right module near the bus coupler and pull it forward.

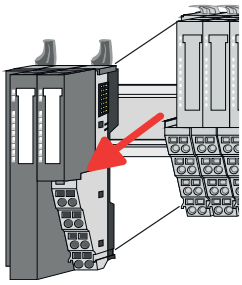
For demounting and exchange of a (head) module or a group of modules, due to mounting reasons you always have to remove the electronic module right beside. After mounting it may be plugged again.



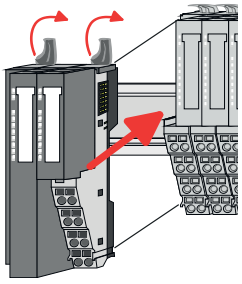
4. Turn all the locking lever of the bus coupler to be exchanged upwards.

CAUTION

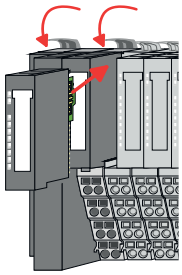
Bus interface and power module may not be separated! Here you may only exchange the electronic module!



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 profile 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.

2.7.2 Demounting 8x periphery modules

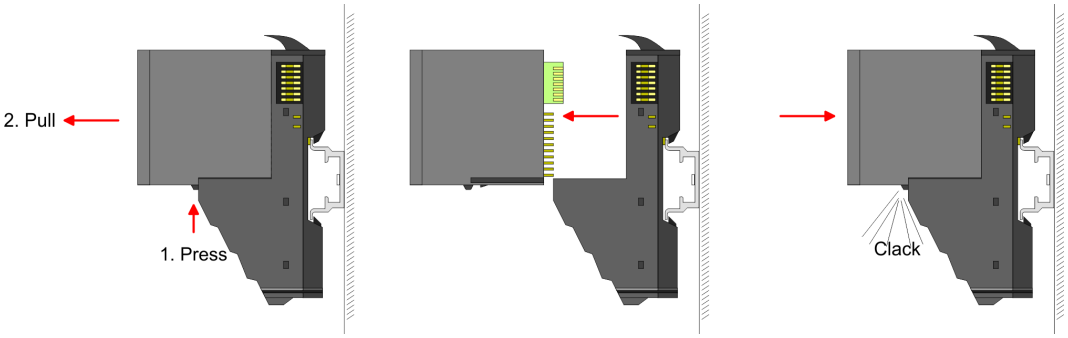
Proceeding

Exchange of an electronic module

CAUTION

Put the System SLIO in a safe, powered down state before starting disassembly!

1. Power-off your system.

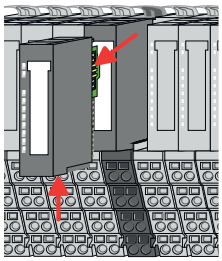


2. For the exchange of a electronic module, the electronic module may be pulled forward after pressing the unlocking lever at the lower side of the module.
3. For installation plug the new electronic module guided by the strips at the lower side until this engages to the terminal module.

➡ Now you can bring your system back into operation.

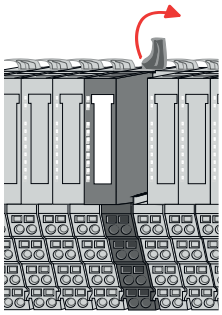
> ***Easy Maintenance***
>
> *'Easy Maintenance' means the support for adding and removing electronic modules during operation without having to restart the system. If this is supported by your head module, you will find more detailed information on this in the "Deployment" chapter.*

Exchange of a periphery module

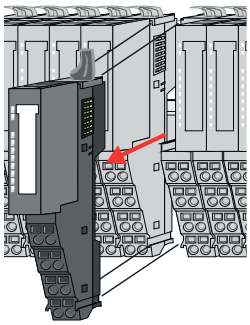


1. Power-off your system.
2. Remove if exists the wiring of the module.
3. > *For demounting and exchange of a (head) module or a group of modules, due to mounting reasons you always have to remove the electronic module right beside. After mounting it may be plugged again.*

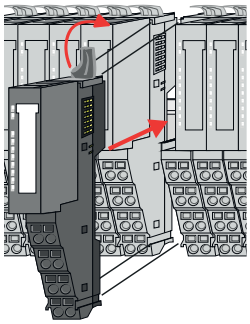
   Press the unlocking lever at the lower side of the just mounted right module and pull it forward.



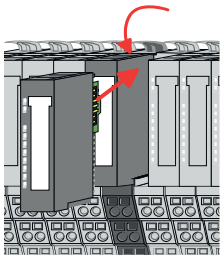
4. Turn the locking lever of the module to be exchanged upwards.



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



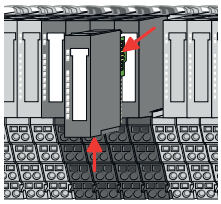
7. To mount the module put it to the gap between the both modules and push it, guided by the stripes at both sides, to the profile rail.
8. Turn the locking lever downward, again.



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

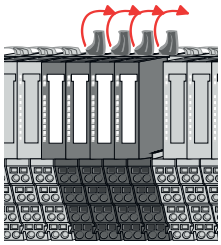
    ➡ Now you can bring your system back into operation.

Exchange of a module group

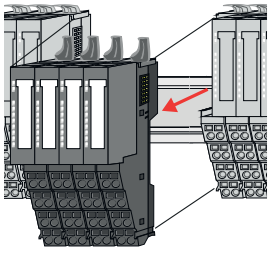


1. Power-off your system.
2. Remove if exists the wiring of the module group.
3. *For demounting and exchange of a (head) module or a group of modules, due to mounting reasons you always have to remove the electronic module right beside. After mounting it may be plugged again.*

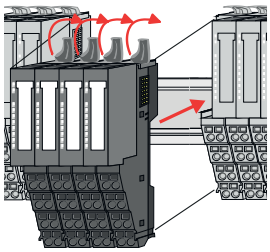
   Press the unlocking lever at the lower side of the just mounted right module near the module group and pull it forward.



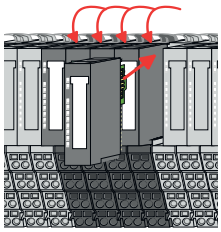
4. Turn all the locking lever of the module group to be exchanged upwards.



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 profile 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.

2.7.3 Demounting 16x periphery modules

Proceeding

Exchange of an electronic unit

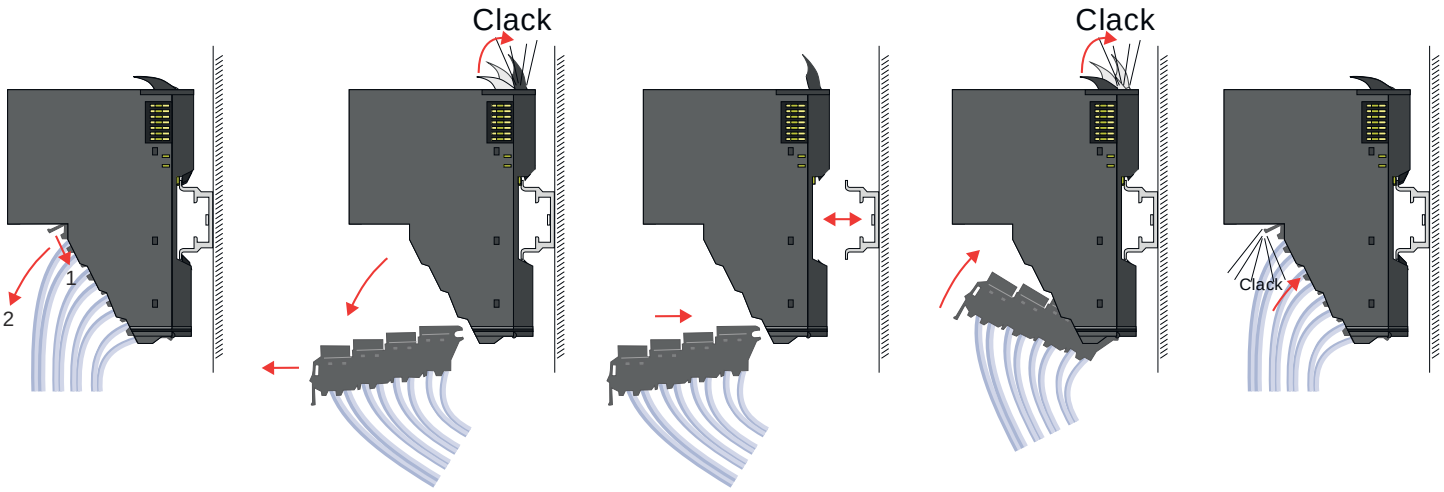
CAUTION

Put the System SLIO in a safe, powered down state before starting disassembly!

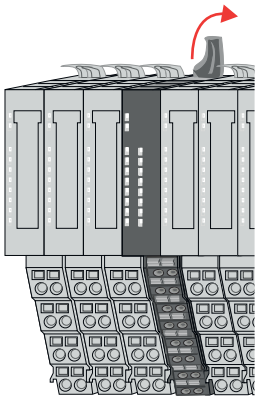
1. Power-off your system.
2. To replace an electronic unit, you can push down and pull off the terminal block after releasing the lock.

   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.

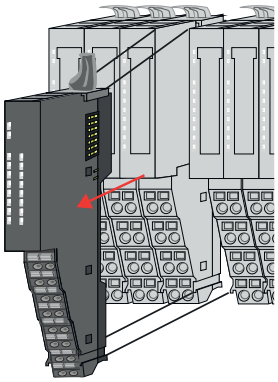


Exchange of a 16x periphery module

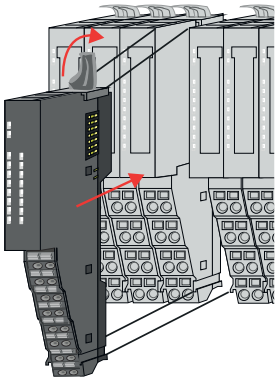


1. Power-off your system.
2. Remove if exists the wiring of the module respectively the wired terminal block.
3. *In contrast to 8x periphery modules, you can directly demount and mount 16x periphery modules.*

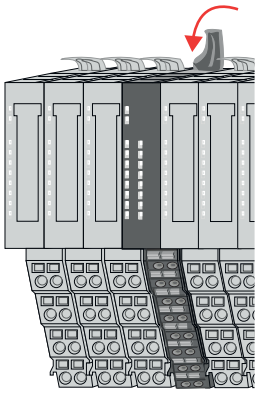
   Turn the locking lever of the module to be exchanged upwards.



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 profile rail.

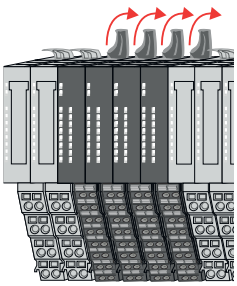


7. Turn the locking lever downward, again.
8. Wire your module respectively plug the wired terminal block again.

➡ Now you can bring your system back into operation.

Exchange of a module group

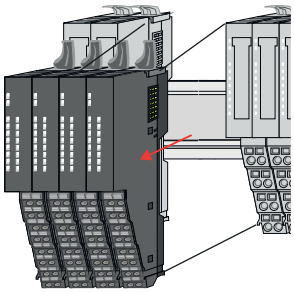
1. Power-off your system.
2. Remove if exists the wiring of the module group respectively the wired terminal blocks.



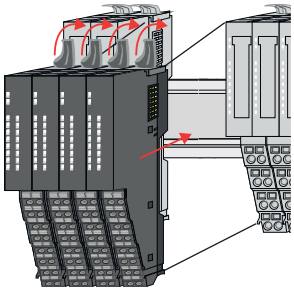
3.

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

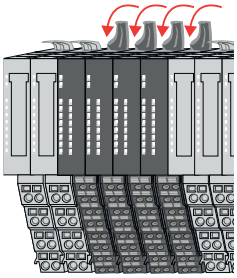
Turn all the locking lever of the module group to be exchanged upwards.



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 profile 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.

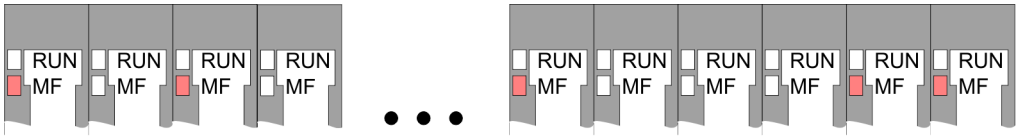
2.8 Trouble shooting - LEDs

General

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

In the following illustrations flashing LEDs are marked by ☼.

Sum current of the electronic power supply exceeded

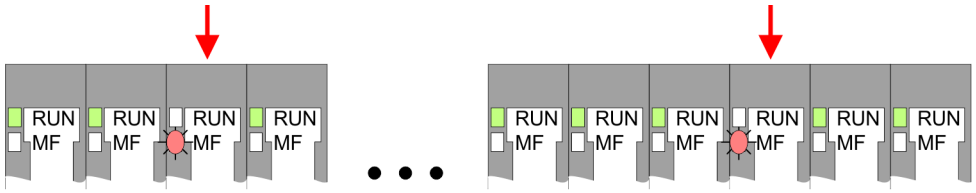


Behavior: After PowerON the RUN LED of each module is off and the MF LED of each module is sporadically on.

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

Remedy: As soon as the sum current of the electronic power supply is exceeded, always place the power module 007-1AB10. ➦ *'Wiring power modules'...page 29*

Error in configuration

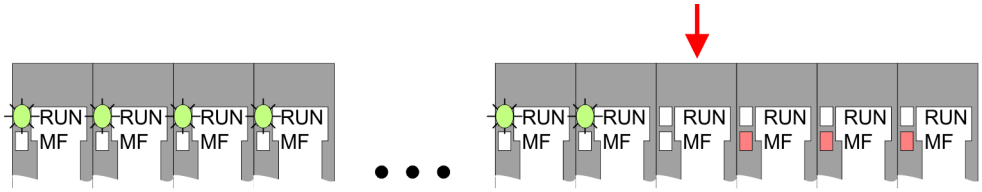


Behavior: After PowerON the MF LED of one module respectively more modules flashes. The RUN LED remains off.

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

Remedy: Match configuration and hardware structure.

Module failure



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

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

Remedy: Replace the defective module.

2.9 Industrial security and installation guidelines

2.9.1 Industrial security in information technology

Latest version

This chapter can also be found as a guide *'Industrial IT Security'* in the *'Download Center'* of 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 save 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*

2.9.1.1 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.

2.9.1.2 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.

2.9.2 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 ground 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.
  - 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 ground conductor rail directly after the cabinet entry and fix the isolation with cable clamps.
  - Make sure that the isolation/protected ground 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 ground 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 ground 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 ground 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.

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

2.10 General data for the System SLIO

Conformity and approval		
Conformity		
CE	2014/35/EU	Low Voltage Directive
	2014/30/EU	EMC Directive
RoHS (EU)	2011/65/EU	Restriction of the use of certain hazardous substances in electrical and electronic equipment
UKCA	2016 No. 1101	Electrical Equipment (Safety) Regulations
	2016 No. 1091	Electromagnetic Compatibility Regulations
RoHS (UK)	2012 No. 3032	Use of Certain Hazardous Substances
Approval		
Certifications	-	Refer to technical data

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 ground		
Inputs / outputs	-	AC / DC 50V, test voltage AC 500V
Protective measures	-	against short circuit

Environmental conditions to EN 61131-2		
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 ... 6GHz, 3V/m, 80% AM (1kHz)
		EN 61000-4-6	HF conducted 150kHz … 80MHz, 10V, 80% AM (1kHz)
		EN 61000-4-4	Burst
		EN 61000-4-5	Surge[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.

2.10.1 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 Designations

MDevice

The MDevice (main device) is the central control unit under MECHATROLINK-4. It assumes the role of the higher-level device that coordinates the communication process and sends commands to the connected SDevices.

SDevice

The SDevice (subordinate device) is a lower-level device under MECHATROLINK-4. This receives the instructions from the MDevice and reacts accordingly. 053-1ML40 is an SDevice.

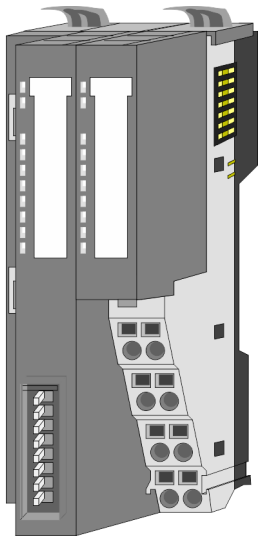
3.2 Properties

053-1ML40

- Field bus: MECHATROLINK-4 according to IEC 61158, IEC 61784-2
- MECHATROLINK-4 coupler for max. 64 periphery modules
- Supports standard I/O profile (16byte and 64byte mode)
- Integrated DC 24V power supply for power and electronic section supply of the periphery modules
- Integrated Web server
- Configuration is done via Web server

MECHATROLINK-4

- Multi SDevice node with max. 15 stations
  - 1 coupler (1st module)
  - Peripheral modules (subsequent modules)
- Max. 1024byte input and 1024byte output data
  - Coupler: 12byte input and 12byte output data
  - Periphery modules: 1012byte input and 1012byte output data

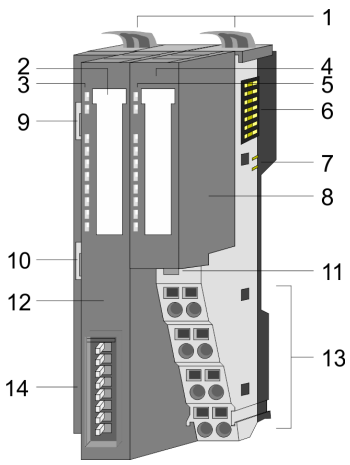


Ordering data

Type	Order number	Description
IM 053ML	053-1ML40	MECHATROLINK-4 coupler for System SLIO

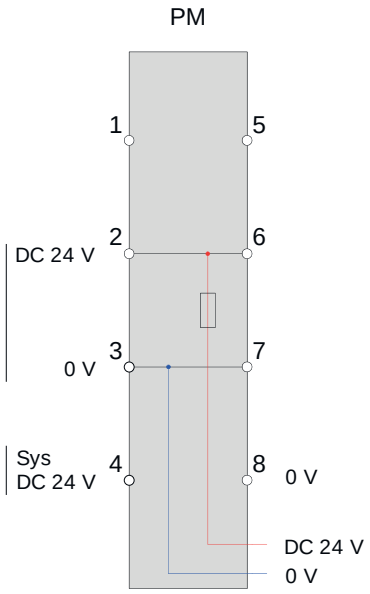
3.3 Structure

053-1ML40

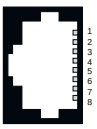


1 Locking lever terminal module
2 Labeling strip bus interface
3 LEDs bus interface
4 Labeling strip power module
5 LEDs power module
6 Backplane bus
7 DC 24V power section supply
8 Power module
9 X1: MECHATROLINK RJ45 bus interface 1
10 X2: MECHATROLINK RJ45 bus interface 2
11 Unlocking lever power module
12 Bus interface
13 Terminal
14 Address switch

3.3.1 Interfaces



2x RJ45
MECHATROLINK



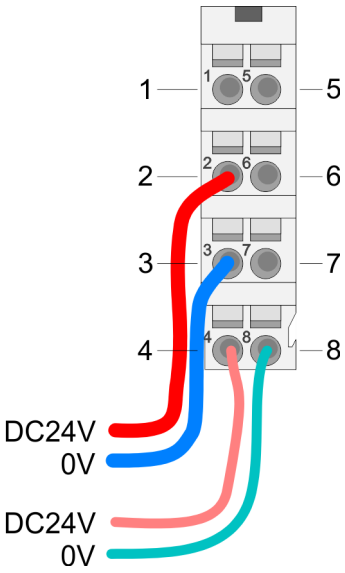
① Transmit +
② Transmit -
③ Receive +
④ -
⑤ -
⑥ Receive -
⑦ -
⑧ -

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 power 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 power supply

I: Input

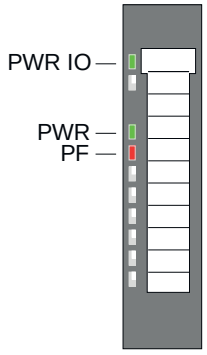
X1/X2: MECHATROLINK interface

RJ45 jacks

- MECHATROLINK-4 connection via 2 RJ45 jacks (2 ports) by means of a MECHATROLINK cable
- MECHATROLINK MDevice in the network required for operation
- Cascade and star topology are possible

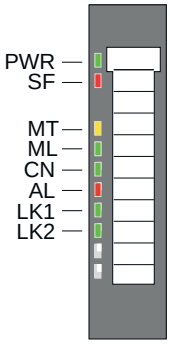
3.3.2 LEDs

LEDs power module



PWR IO green	PWR green	PF red	Description
■	X	□	Power section supply OK.
■	■	□	Electronic section supply OK.
X	X	■	Fuse electronic section supply defective.
not relevant: X			

LEDs bus interface



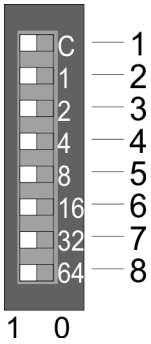
LED	Color	Description
PWR	green	Bus interface is power supplied
SF	red	System error: Error on MECHATROLINK or System SLIO bus
MT	yellow	MECHATROLINK mode status (maintenance mode)
ML	green	MECHATROLINK type status
CN	green	MECHATROLINK connection status
AL	red	MECHATROLINK error status
LK1	green	Link port 1: Physical connection to MECHATROLINK
LK2	green	Link port 2: Physical connection to MECHATROLINK

PWR green	SF red	MT yellow	ML green	CN green	AL red	LK1 green	LK2 green	Description
☐	X	X	X	X	X	X	X	The MECHATROLINK coupler is not power-supplied.
■	X	X	X	X	X	X	X	The MECHATROLINK coupler is power-supplied.
■	☐	X	X	X	X	[■]	[■]	No connection can be established to the MECHATROLINK MDevice, but there is a physical connection. LK1 or LK2 is on.
■	☐	X	X	☐	☐	☐	☐	There is no physical connection to Ethernet. LK1 and LK2 is off.
■	X	X	■	X	X	X	X	The communication takes place via MECHATROLINK-4.
■	■	X	X	X	X	X	X	System error: Error on MECHATROLINK or System SLIO bus. Perform a power cycle.
■	◪ 1Hz	☐	X	X	X	X	X	▪ Error in the configuration. ▪ At least one module does not match the configuration. ▪ The outputs of all output modules are disabled.
■	◪ 2Hz	☐	X	X	X	X	X	▪ There is one module that is not supported. ▪ The outputs of all output modules are disabled.
■	☐	☐	☐	■	X	■	■	The coupler communicates via MECHATROLINK.
■	☐	☐	☐	☐	X	[■]	[■]	The coupler does not communicate via MECHATROLINK.
■	☐	☐	☐	■	X	X	X	A connection via MECHATROLINK is established.
■	☐	☐	☐	◪ 1Hz	X	X	X	There are unconnected stations in the MECHATROLINK network.
■	☐	■	X	X	X	X	X	The MECHATROLINK coupler is in *maintenance mode* and can be configured.
■	☐	☐	X	X	X	X	X	The MECHATROLINK coupler is in *standard mode*.
■	X	X	X	X	■	X	X	MECHATROLINK communication error An error occurred during communication via MECHATROLINK.
■	X	X	X	X	X	■	X	Port 1 is physically linked to MECHATROLINK.
■	X	X	X	X	X	X	■	Port 2 is physically linked to MECHATROLINK.

Option: [ ] | not relevant: X

3.3.3 Address switch

Address switch



An address may only be assigned once in the MECHATROLINK network! Changes of the address switch were only recognized after a power cycle or a reset!

The address set on the address switch must always be identical to the device address in your configuration tool!

The address switch serves for the following settings:

- Adaptation of the MECHATROLINK address for communication via MECHATROLINK-4.
- IP address for accessing the web server.

Position	Designation	Description
1	C	MECHATROLINK-4 ■ Communication takes place exclusively via MECHATROLINK-4. ■ Leave the switch setting at 1 (default setting).
2	$2^0 = 1$	MECHATROLINK address: ■ Octet of the IP address 192.168.1.x with x: 3 ... 127. – Address range: 0x03 ... 0x7F – Hexadecimal value from position 2 ... 8 – Is the address in the range 0x00 ... 0x02, the address 0x03 is used.
3	$2^1 = 2$	
4	$2^2 = 4$	
5	$2^3 = 8$	
6	$2^4 = 16$	
7	$2^5 = 32$	
8	$2^6 = 64$	
0 = disabled, 1 = enabled		

3.4 Technical data

Order no.	053-1ML40
Type	IM 053ML - MECHATROLINK-4
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)	114 mA
Current consumption (rated value)	0.83 A
Inrush current	4.4 A
I^2t	0.3 A^2s
Max. current drain at backplane bus	3 A
Max. current drain load supply	10 A
Power loss	4.9 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	MECHATROLINK-4
Type of interface	Ethernet 100 MBit
Connector	2 x RJ45
Topology	Line
Electrically isolated	✓
Number of participants, max.	-

Order no.	053-1ML40
Node addresses	-
Transmission speed, min.	100 Mbit/s
Transmission speed, max.	100 Mbit/s
Address range inputs, max.	1024 Byte
Address range outputs, max.	1024 Byte
Number of TxPDOs, max.	-
Number of RxPDOs, max.	-
Supported profile	Standard I/O profiles
Supported transfer cycle	125us, 250us, 500us, 750us, 1ms.... 8ms (every 500us)
Cyclic data size per node	16byte (SDevice), 64byte (peripheral)
Max. Number of nodes	9 (00h : for SDevice, 01h-08h for modules)
Supported communication method	Cyclic, Event driven, Message
Supported command "Cyclic"	NOP, ID_RD, CONFIG, ALM_RD, ALM_CLR, SYNC_SET, CONNECT, DISCONNECT, DATA_RWA, DATA_RWS
Supported command "Event driven"	NOP, ID_RD, CONNECT, DISCONNECT
Supported command "Message"	Memory read, Read max. message size
Datasizes	
Input bytes	1024
Output bytes	1024
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	165 g
Weight including accessories	165 g
Gross weight	181 g
Environmental conditions	
Operating temperature	0 °C to 60 °C
Storage temperature	-40 °C to 70 °C
Certifications	
UL certification	yes
KC certification	yes
UKCA certification	yes
ChinaRoHS certification	yes

4 Deployment

4.1 Basics MECHATROLINK-4

Transfer medium

MECHATROLINK-4 is compatible to Ethernet in accordance with the IEEE standards. Connection can be either point-to-point or in *cascade* or *star* topology. For use in star topology, always use an Ethernet switch. The specification of MECHATROLINK-4 is listed below.

Parameter	Properties
Transfer cable	CAT5e STP (shielded twisted-pair cable)
Connection	RJ45
Max. Distance between 2 stations	100m
Number of connected stations	MDevice: max. 8 SDevice max. 127
Transfer rate	100Mbps
Channel coding	4B/5B MLT-3
Access control	MDevice - SDevice
Number of bytes in the information field	8 ... 1492 bytes (can be mixed)
Electrical isolation between device and network	Isolation transformer

– *For a cascaded connection, there is no restriction of the number of couplers to be synchronized, however the synchronization filter must be applied.*

4.2 MECHATROLINK installation guidelines

Generals to data security

- The topic of data security and access protection have 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.
- Threats can arise from internal manipulation like technical errors, operator and program errors respectively from external manipulation like software viruses and worms, trojans and 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 nodes by "Authentication" via save channels.
- Segmenting in protected automation cells, so that only devices in the same group can exchange data.

Guidelines for information security

- With the "VDI/VDE 2182 sheet 1", Information Security in the Industrial Automation - General procedural model, VDI guidelines, the VDI/VDE society for measuring and automation engineering has published a guide for implementing a security architecture in the industrial environment. The guideline can be found at ➦ *www.vdi.de*

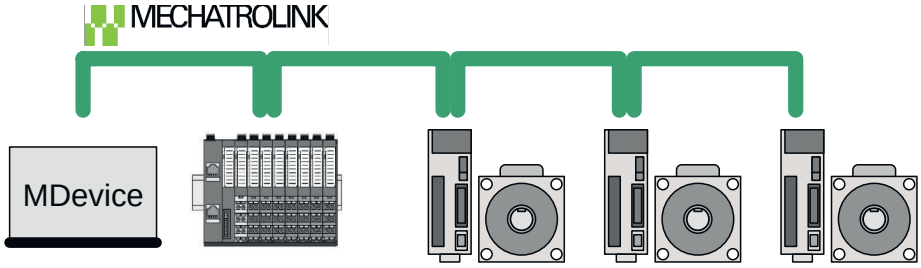
Industrial Ethernet

- Due to the open standard of MECHATROLINK standard Ethernet components may be used. For industrial environment and due to the high transfer rate of 100MBit/s your MECHATROLINK system should consist of Industrial Ethernet components.
- All the devices interconnected to MECHATROLINK are located in one and the same network. All the devices in a network can communicate directly with each other.
- A network is physically limited by a router. If devices need to communicate beyond the limits of a network, you have to configure the router so that it allows this communication to take place.

4.2.1 Topology

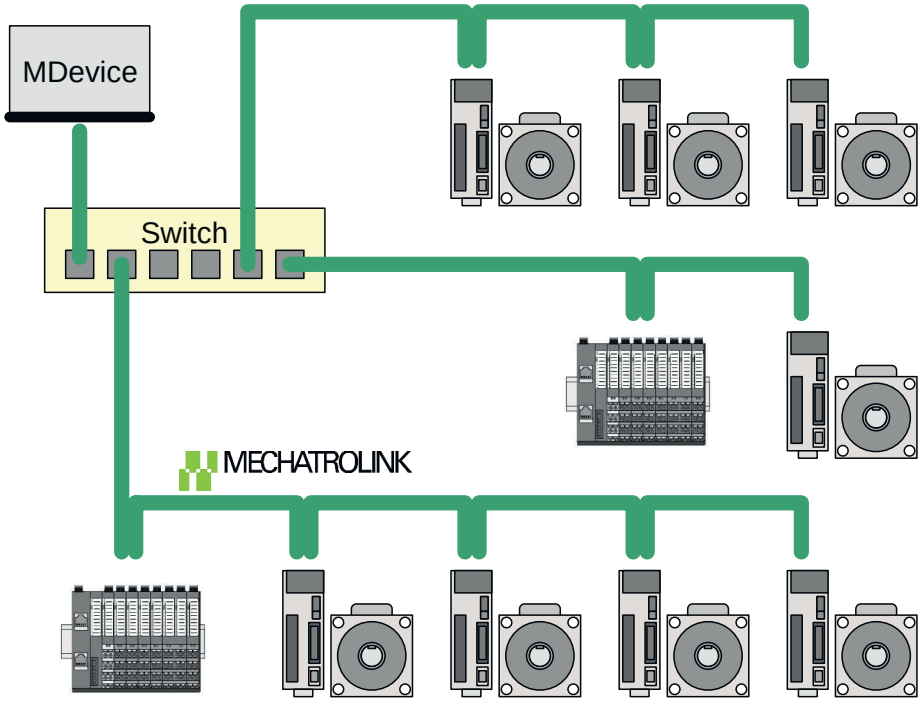
Cascade

- With the cascade structure all the communication devices are connected via a linear bus topology. Here, the line structure is realized via the RJ45 jacks (port ½), which are already integrated in the MECHATROLINK devices.
- If a communication member fails, the communication across the failed member is not possible.



Star

- If you connect communication devices to an Ethernet switch with more than 2 MECHATROLINK interfaces, you automatically create a star network topology.
- If an individual MECHATROLINK device fails, this does not automatically lead to failure of the entire network, in contrast to other structures. Here, only the subnetwork that contains the faulty MECHATROLINK device fails.



4.3 Accessing the System SLIO

4.3.1 Overview

After switching on, the MECHATROLINK coupler automatically detects the modules on the backplane bus and assigns their I/O areas to I/O groups. The assignment happens with the following proceeding:

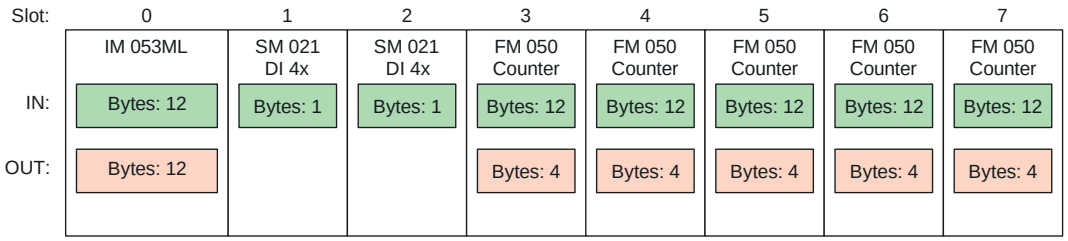
- The MECHATROLINK coupler uses the address extension 00h
- The MECHATROLINK coupler automatically determines the peripheral modules and combines their I/O areas to 60byte groups.
- The MECHATROLINK coupler 053-1ML40 has 15 I/O groups. Each I/O group is assigned to an address extension starting from 01h for the MECHATROLINK coupler and 02h to max. 0Eh for the periphery modules.
- The offset is always 2bytes.
- If the maximum size of 60bytes is exceeded when assigning an input or output area of a peripheral module, the corresponding I/O area is assigned to the next I/O group. This group gets the next higher address extension.

- *Information concerning the allocation of these areas may be found in the description of the corresponding System SLIO module.*
- *Please consider the System SLIO power and clamp modules do not have any module ID. These may not be recognized by the MECHATROLINK coupler and so are not listed respectively considered during slot allocation.*

4.3.2 Example

System

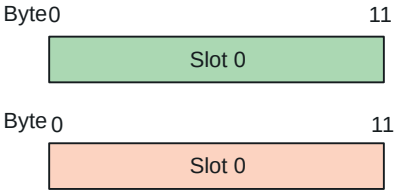
In the following an example of accessing to the System SLIO is shown.



Coupler 053-1ML40

The MECHATROLINK coupler uses 12bytes each and uses the address extension 00h

IM 053ML (0003h):

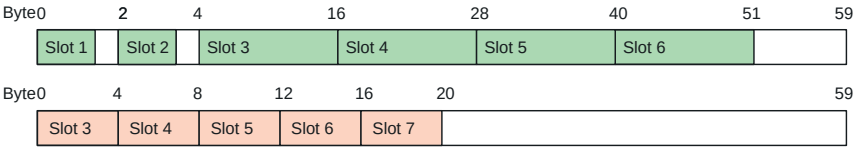


Periphery modules

The MECHATROLINK coupler automatically determines the peripheral modules and combines their I/O areas to 60byte groups.

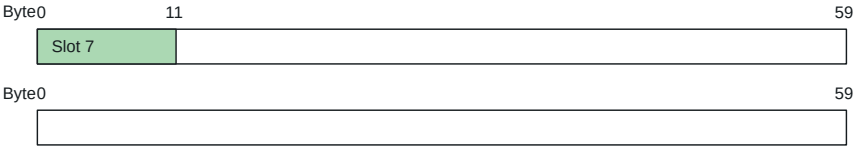
The 1. I/O group gets the address extension 01h

IO Group (0103h):



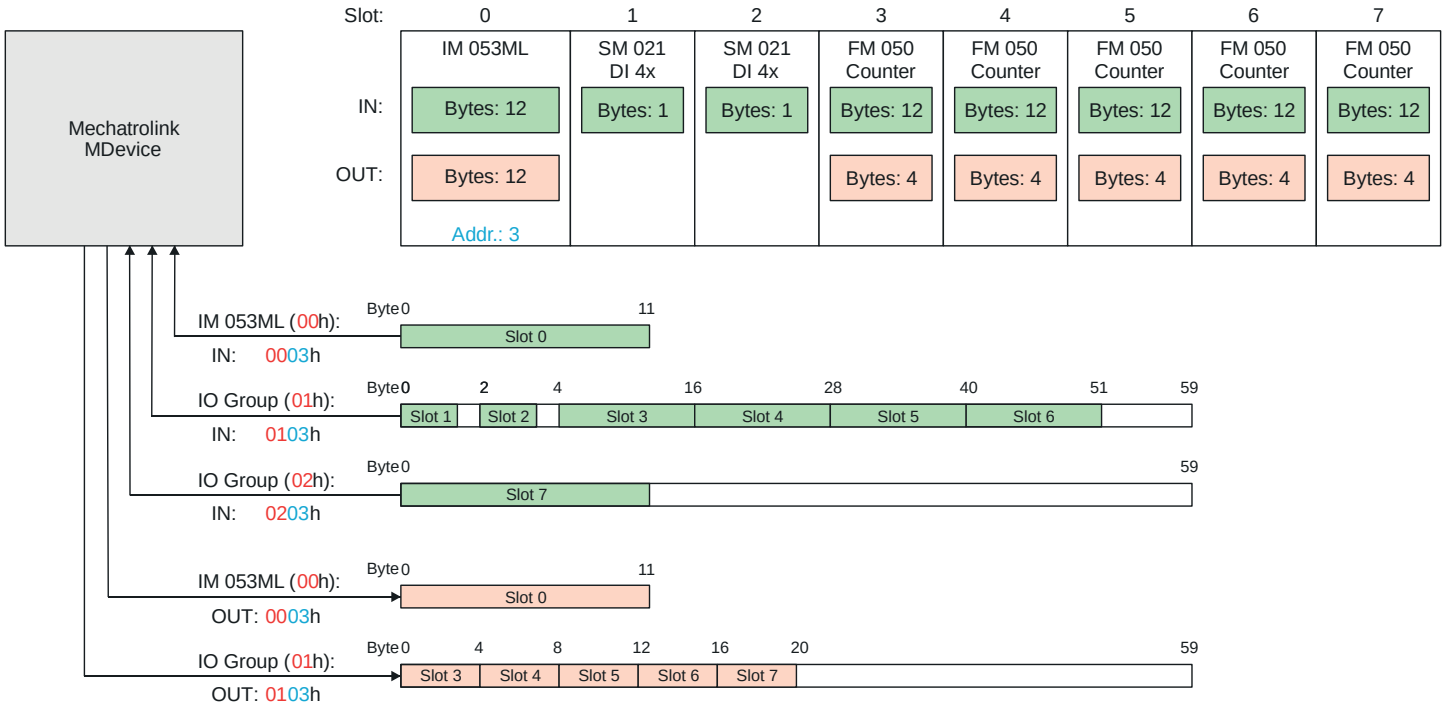
The 2. I/O group is required because the 12bytes no longer fit into group 1 for input.

IO Group (0203h):



4.4 Communication with the MECHATROLINK MDevice

- In the MECHATROLINK MDevice the coupler IM 053ML is handled as a multi-SDevice coupler.
- The I/O areas of the periphery modules are accessed via the coupler address (here address 03) and the address extension of the corresponding I/O group.



4.5 I/O area of the IM 053ML

Structure

The bus coupler uses 12bytes for input data and 12bytes for output data. In cyclic communication you can access the I/O area via *DATA_RWA* (20h) respectively *DATA_RWS* (21h). The I/O area has the following structure:

Byte	Output data	Input data
0 ... 1	Reserved	Status
2	*Coupler command*	*Command response*
3	*Command ID*	*Response ID*
4 ... 11	*Command data*	*Response data*

Status

Byte	Description
0	■ Bit 0: An error occurred while processing *Coupler command*. ■ Bit 1: *Coupler command* is currently being processed. ■ Bit 4: Cycle over error
1	Reserved

- *Cycle over error*

  If cycle over occurred, the input respectively output data are delayed on MECHATROLINK transmission cycle. To avoid a cycle over error you have to preset the MECHATROLINK transmission cycle time, so that it is bigger than the maximum process time.

Coupler command* and *Command response

For sending a command via *Coupler command*, you receive the command code via *Command response* as confirmation.

Code	Name	Description
0x00	Read interrupt counter	Read hardware/diagnostic interrupt data counter
0x01	Read hardware interrupt slot	Read hardware interrupt data module
0x02	Read diagnostic interrupt slot	Read diagnostic interrupt data module
0x03	Reset interrupt data	Delete interrupt data module
0x04	Read memory	Read virtual memory
0x05	Write parameter	Write module parameter
0x06	Write coupler parameter	Write coupler parameter
0x07	Save parameter	Save module parameter to remanent memory
0x08	Reset master counter	Reset the data area of the error counter on the backplane bus (master counter) ➥ *'Diagnostic data area'...page 70*

Command ID* and *Response ID

ID of the coupler command for identification, if you want to use the same command multiple times in a row.

Command data* and *Response data

Use and structure of the data areas depends on the command used.

Read interrupt counter (0x00)

Byte	Command data	Response data
4 ... 7	-	Counter hardware interrupt
8 ... 11	-	Counter diagnostic interrupt

Read hardware interrupt slot (0x01)

Byte	Command data	Response data
4 ... 11	-	Hardware interrupt status ■ Bit 0: Slot 1 ■ Bit 1: Slot 2 ■ ... ■ Bit 63: Slot 64

Read diagnostic interrupt slot (0x02)

Byte	Command data	Response data
4 ... 11	-	Diagnostic interrupt status ■ Bit 0: Slot 1 ■ Bit 1: Slot 2 ■ ... ■ Bit 63: Slot 64

Reset diagnostic data (0x03)

Byte	Command data	Response data
4 ... 5	Slot number (1 ... 64)	Slot number as response
6 ... 11	-	0 (fix)

Read memory (0x04)

Byte	Command data	Response data
4	Byte size (0 ... 8)	Depends on the virtual memory
5		
6 ... 7	Reserved	
8 ... 11	Offset	

Write parameter (0x05)

Byte	Command data	Response data
4	Parameter ID as value of SX from the manual of the module.	■ 0: no error ■ 1: Module or parameter does not exist ■ 2: Faulty parameter size ■ 3: Parameter can not be over-written at runtime
5	Slot number (1 ... 64)	
6 ... 7	Size of parameter data in bytes (1 ... 4)	
8 ... 11	Parameter data	

Write coupler parameter (0x06)

Byte	Command data	Response data
4	Parameters Offset	■ 0: no error ■ 1: Parameter does not exist ■ 2: Faulty parameter size ■ 3: Parameter can not be over-written at runtime
5	reserved	
6 ... 7	Size of parameter data in bytes (1 ... 4)	
8 ... 11	Parameter data	

Save parameter (0x07)

Byte	Command data	Response data
4 ... 11	-	■ 0: no error ■ 1: failed to save module parameter

Reset master counter (0x08)

Byte	Command data	Response data
4 ... 11	-	0 (fix)

Parameters of 053-1ML40

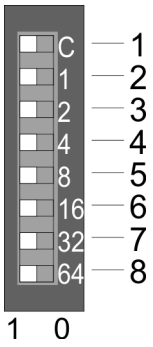
Offset	Parameter name	Size in byte	Default
0	IO refresh mode ■ 00h: Synchronous mode ■ 01h: Free run mode	1	0
1	Maintenance mode ■ 00h: disabled ■ 01h: enabled	1	1

- *Synchronous mode*
  In *Synchronous mode*, the backplane bus communication cycle and the MECHATROLINK transmission cycle are synchronised. To avoid a cycle overrun, set the MECHATROLINK transmission cycle time so that it is greater than the maximum process time. This increases the total cycle time. This mode should be selected if large amounts of data are to be processed isochronously.
- *Free run mode*
  In *Free run mode*, the backplane bus communication cycle and the MECHATROLINK transmission cycle are not synchronised. Here the MECHATROLINK transmission cycle time can be reduced to 125µs. This mode is to be selected if no time-critical data are to be processed.
- *Maintenance mode*
  In this mode, the module can be configured. Configuration is only possible via the integrated web page or via the configuration tool. Here you can carry out the configuration independently of phase 1, 2 or 3. ➥ *'Phases of the communication'...page 75*

Changes to the parameters only take effect after PowerON!

4.6 Web server

Access via IP address



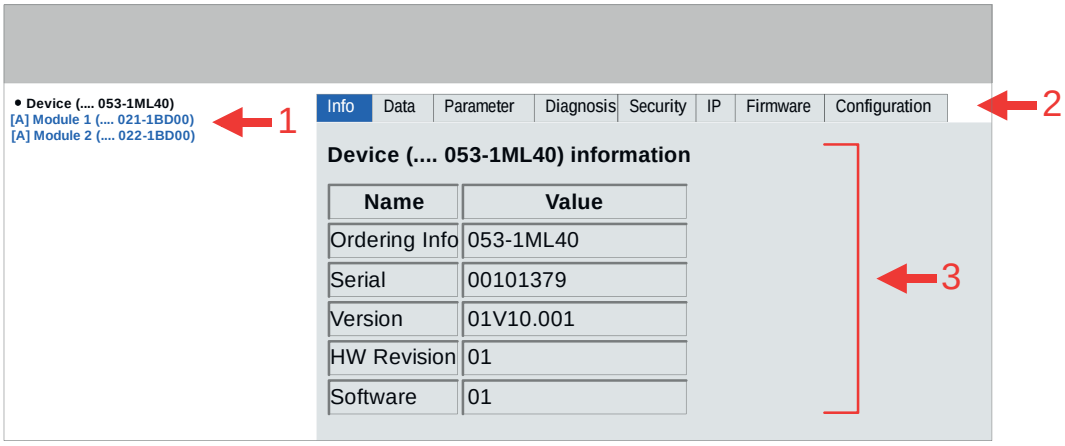
The following procedure is used to access the web server:

1. Switch off the power supply of the *MECHATROLINK* coupler.
2. If you have not already done so, set switch *'C'* (pos. 1) on the address switch to 1: *MECHATROLINK-4*
3. Set the preferred *MECHATROLINK address* as the IP address at the address switch.
   - IP address: 192.168.1.x
   - x = 3 ... 127, corresponds to the decimal value of position 2...8 of the address switch.
   - ➦ *'Address switch'...page 52*
4. Switch on the power supply of the *MECHATROLINK* coupler.
   ➡ After the start-up, you have access to the web server of the *MECHATROLINK coupler* via the set IP address 192.168.1.*x*.

Structure of the web page

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

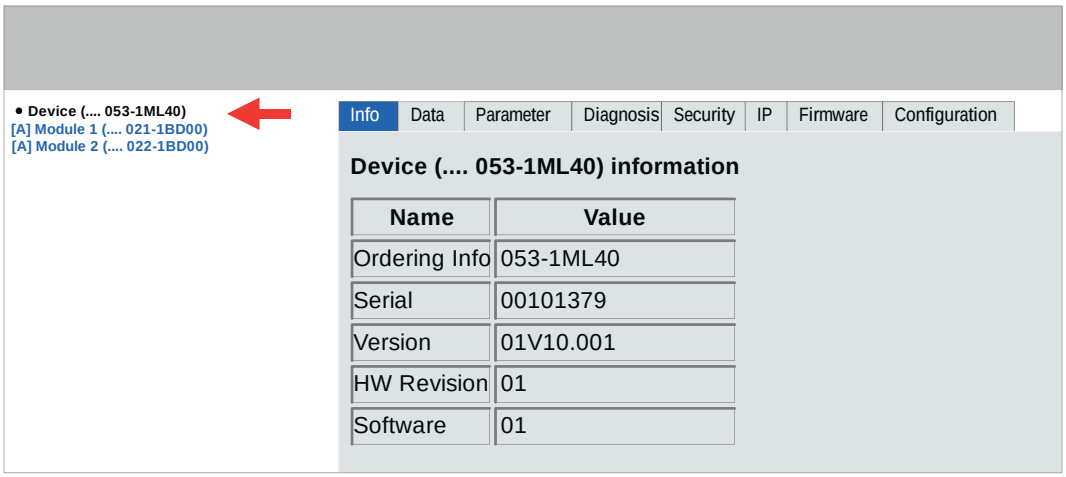
Please consider the System SLIO power and clamp modules do not have any module ID. These may not be recognized by the MECHATROLINK coupler and so are not listed respectively considered during slot allocation.



[1] Module list: *MECHATROLINK* coupler and System SLIO modules in plugged order
[2] Functions for the module, which is selected in the *module list*
[3] Information respectively input field for the according function

For fast diagnostic missing or incorrectly configured modules are shown after updating the web page in the module list in red. The modules in blue are modules with or without configuration.

Web page with selected *MECHATROLINK* coupler



Info Here order number, serial number and the version of firmware and hardware of the *MECHATROLINK* coupler are listed.

Data The size of the process output and the process input image and the offset are shown here.

Parameter Here you have access to the parameters of the *MECHATROLINK* coupler. ➦ *...page 62*

Diagnosis In this register diagnostic messages are shown. Please note that some diagnostic messages may be triggered due to an outdated firmware version. The following diagnostic messages are supported:

Code	Description
E000 00*YY*h	Error at access to the module at slot *YY*. Please retry after reboot.
E010 00*YY*h	Error accessing the retentive memory of the module at slot *YY*. Please try again after a restart respectively delete the parameters in the retentive memory and restart or carry out a firmware update.
A000 00*YY*h	The module version on slot *YY* is not supported.
A010 00*YY*h	
A020 00*YY*h	The assembled module in slot *YY* does not match the configured module in the retentive memory.
A030 00*YY*h	The module in slot *YY* has been configured and stored in retentive memory but not mounted.
A040 00*YY*h	Error writing parameter of the module at slot *YY*. Check your module parameters.

Security This functionality is currently not supported.

IP Here you get the current IP address of the *MECHATROLINK* coupler.

Firmware

With this function you can bring in a firmware update. You can find current firmware versions via *'053-1ML40'* at www.yaskawa.eu.com in the *'Download Center'*. Select the Px000372.pkg file for upload. During the firmware update, SF and MT are blinking alternately. When the update is finished, all the red LEDs are switched ON! After this perform a power cycle.

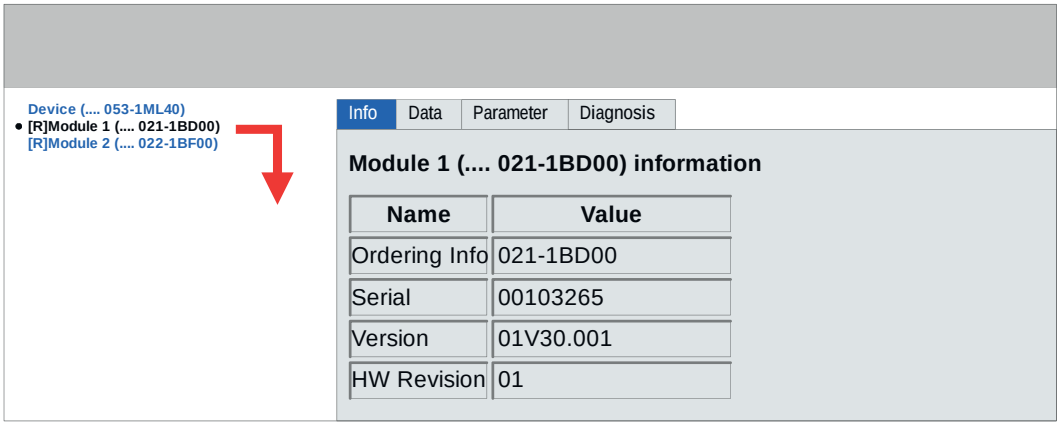
Open Source License Information

- Via [Download] you can access licence information on the open source components used.
- Any open source software, which is used here, is subject to the respective license terms.
- The licensee can change the respective open source software in accordance with the applicable license terms.

Configuration

In this dialog box, you have the option to save the current module configuration of your *MECHATROLINK* coupler externally or to load a saved one. Before saving the module configuration you should delete an existing one.

Web page with selected module



Info

Here product name, order number, serial number, firmware version and hardware state number of the according module are listed.

Data

At *Data* the states of the inputs respectively outputs are listed.

Parameter

If available the parameter data of the corresponding module may be shown and possibly be changed.

Diagnosis

If available the diagnosis data of the selected module can be shown here.

4.7 Virtual memory

Values are transferred in little-endian format, i.e. least significant byte first. These areas are only readable with ➥ *'Read ID command ID_RD (03h)'...page 84*.

Virtual memory has the following structure.

ID area

ID codes	Address	Byte size	Description	Value
-	0000 0000h	4	Reserved	All 0
01h	0000 0004h	4	Vendor ID Code	0000 075 Ch
02h	0000 0008h	4	Device code	0A07 0C04h
03h	0000 000Ch	4	Device version	0000 0100h
04h	0000 0010h	4	Device definition file version	0000 0100h
05h	0000 0014h	4	Extended address	0000 0000h
-	0000 0018h	32	Serial number	Not supported (0 fix)
-	0000 0038h	4	Reserved	0000 0000h
-	0000 003Ch	4	Reserved	0000 0000h
10h	0000 0040h	4	Profile type 1	0000 0031h (standard I/O)
11h	0000 0044h	4	Profile version 1	0000 0100h
12h	0000 0048h	4	Profile type 2	0000 00FFh
13h	0000 004Ch	4	Profile version 2	0000 0000h
14h	0000 0050h	4	Profile type 3	0000 00FFh
15h	0000 0054h	4	Profile version 3	0000 0000h
16h	0000 0058h	4	Reserved	0000 0000h
17h	0000 005Ch	4	Reserved	0000 0000h
18h	0000 0060h	4	Granularity of MECHATROLINK transmission cycle	0000 0003h The following values are supported: 125µs, 250µs, 500µs, 750µs, 1...32ms in steps of 0.5ms
19h	0000 0064h	4	Reserved	0000 0000h
1Ah	0000 0068h	4	Reserved	0000 0000h
1Bh	0000 006Ch	4	Reserved	0000 0000h
1Ch	0000 0070h	4	Reserved	0000 0000h
1Dh	0000 0074h	4	Profile type (current value)	The profile specified by the CONNECT command is output: 0031h at cyclic communication 0001h at acyclic communication
-	0000 0078h	4	Reserved	All 0
-	0000 007Ch	4	Reserved	All 0
20h	0000 0080h	4	Supported communication mode	0000 000Fh The following modes are supported: Message mode, cyclic mode, event-driven mode, Ethernet mode

ID codes	Address	Byte size	Description	Value
-	0000 0084h	10	MAC address	Value depends on device
-	0000 008Ch	52	Reserved	All 0
30h	0000 00C0h	32	List of supported main commands	0000 0003 2000 E079h The following commands are supported: NOP, ID_RD, CONFIG, ALM_RD, ALM_CLR, SYNC_SET, CONNECT, DISCONNECT, DATA_RWA, DATA_RWS, MEM_RD
38h	0000 00E0h	32	List of supported subcommands	All 0
40h	0000 0100h	32	List of supported common parameters	All 0
50h	0000 0140h	4	Transmission data alignment	16
51h	0000 0144h	4	Number of command transmission data (minimum value)	1
52h	0000 0148h	4	Number of command transmission data (maximum value)	1
53h	0000 014Ch	4	Number of command transmission data (current value)	1
54h	0000 0150h	4	Number of response transmission data (minimum value)	1
55h	0000 0154h	4	Number of response transmission data (maximum value)	1
56h	0000 0158h	4	Number of response transmission data (current value)	1
57h	0000 015Ch	4	Minimum value of transmission cycle	125000[1]
58h	0000 0160h	4	Maximum value of transmission cycle	8000000
59h	0000 0164h	4	Minimum value of communication cycle	125000[1]
5Ah	0000 0168h	4	Maximum value of communication cycle	32000000
-	0000 016Ch	4	Device subcode	Not supported (all 0)
-	0000 0120h	32	Reserved	All 0
60h	0000 0180h	32	List of supported MECHATROLINK message communication sub functions	0000 0000 0002 0002h The following sub functions are supported: memory read, read max. message size
68h	0000 01A0h	4	Message relay support	0003 0001h The 3-step message relay is supported.
69h	0000 01A4h	4	Timeout period	5 (5s)
6Ah	0000 01A8h	4	Timeout period (for file access commands)	5 (5s)
-	0000 01ACh	84	Reserved	All 0
80h	0000 0200h	32	Name of the main device	"IM 053ML"
-	0000 0220h	32	Reserved	All 0
-	0000 0240h	32	Name of sub device 1	Not supported (all 0)
-	0000 0260h	4	Version of sub device 1	Not supported (all 0)
-	0000 0264h	28	Reserved	All 0

Virtual memory

ID codes	Address	Byte size	Description	Value
-	0000 0280h	32	Name of sub device 2	Not supported (all 0)
-	0000 02A0h	4	Version of sub device 2	Not supported (all 0)
-	0000 02A4h	28	Reserved	All 0
-	0000 02C0h	32	Name of sub device 3	Not supported (all 0)
-	0000 02E0h	4	Version of sub device 3	Not supported (all 0)
-	0000 02E4h	28	Reserved	All 0

1) This value depends on the processing of the corresponding module. 125µs are only possible in asynchronous communication.

Vendor specific area

Address	Byte size	Description	Value
0000 0300h	4	Using number of slot	0 - 64
0000 0304h	28	Reserved	All 0
0000 0320h	32	Slot 0 device name	"0531ML40"
0000 0340h	4	Slot 0 input extended address	0
0000 0344h	4	Slot 0 input data start offset	0
0000 0348h	4	Slot 0 input data byte size	12
0000 034Ch	4	Slot 0 output extended address	0
0000 0350h	4	Slot 0 output data start offset	0
0000 0354h	4	Slot 0 output data byte size	12
0000 0358h	4	Slot 0 parameter data size	0
0000 035Ch	4	Reserved	All 0
0000 0360h	32	Slot 1 device name	Value depends on device
0000 0380h	4	Slot 1 input extended address	Value depends on device
0000 0384h	4	Slot 1 input data start offset	Value depends on device
0000 0388h	4	Slot 1 input data byte size	Value depends on device
0000 038Ch	4	Slot 1 output extended address	Value depends on device
0000 0390h	4	Slot 1 output data start offset	Value depends on device
0000 0394h	4	Slot 1 output data byte size	Value depends on device
0000 0398h	4	Slot 1 parameter data size	Value depends on device
0000 039Ch	4	Reserved	All 0
...	...	...	...
0000 1320h	32	Slot 64 device name	Value depends on device
0000 1340h	4	Slot 64 input extended address	Value depends on device
0000 1344h	4	Slot 64 input data start offset	Value depends on device
0000 1348h	4	Slot 64 input data byte size	Value depends on device
0000 134Ch	4	Slot 64 output extended address	Value depends on device
0000 1350h	4	Slot 64 output data start offset	Value depends on device

Address	Byte size	Description	Value
0000 1354h	4	Slot 64 output data byte size	Value depends on device
0000 1358h	4	Slot 64 parameter data size	Value depends on device

CDO area

Address	CDO address	Description [1]
1000 0000h ... 1000 001Fh	0000h ... 001Fh	Node object - object information
1000 0020h ... 1000 002Fh	0020h ... 002Fh	Node object - object status
1000 0030h ... 1000 003Fh	0030h ... 003Fh	Node object - control
1000 0040h ... 1000 4FFFh	0040h ... 4FFFh	Node object - configuration
1000 5000h ... 1000 9FFFh	5000h ... 9FFFh	Module object

1) For more information, see the *'MECHATROLINK-4 Protocol User's Manual'* in the download section of ➥ *www.mechatrolink.org*.

Module information area

Address	Byte size	Description
8000 0000h	256	Slot 0 module information (coupler)
8000 0100h	256	Slot 1 module information
8000 0200h	256	Slot 2 module information
...	...	...
8000 3F00h	256	Slot 63 module information
8000 4000h	256	Slot 64 module information

Address information slot x

Address offset	Description	Size	Value example
+0000h	Device name	32	"YASKAWA 053xxxxx"
+0020h	HW version	8	"Vxxxx"
+0028h	FPGA version	8	"V105"
+0030h	SW version	16	"V1.0.0.0"
+0040h	Serial number	32	"12345678"
+0060h	MxFile	16	"Mx000060.105"
+0070h	Product version	16	"V1.2.3.4"
+0080h	Order code	16	"053xxxxx"
+0090h	Module ID	4	12345678h
+0094h	-	108	All 0

Parameter data area

Address	Byte size	Description
8000 5000h	256	Reserved
8000 5100h	256	Slot 1 parameter, depends on module specification.
8000 5200h	256	Slot 2 parameter, depends on module specification.
...	...	...
8000 8F00h	256	Slot 63 parameter, depends on module specification.
8000 9000h	256	Slot 64 parameter, depends on module specification.

Diagnostic data area

Address	Byte size	Description
8000 A000h	4byte	Cycle over counter ■ Initial value is 0 ■ The counter is incremented if the time for the data exchange is greater than the time for the transmission. ■ If there are timeouts, you must increase the cycle time for MECHATROLINK data transmission.
8000 A004h	4byte	Current process time for data exchange [µs]
8000 A008h	4byte	Maximum process time for data exchange [µs]
8000 A00Ch	4byte	Reserved
8000 A010h	4byte	Coupler status ■ Bit 0: Coupler command error ■ Bit 1: Coupler command busy ■ Bit 2 ... 3: reserved ■ Bit 4: Cycle over error ■ Bit 5 ... 31: reserved
8000 A014h	4byte	Last diagnostics message ■ Initial value is 0 ■ Please note that some diagnostic messages may be triggered due to an outdated firmware version. ■ ➦ *'Diagnostic messages '...page 72*
8000 A018h	104byte	Reserved
8000 A080h	4byte	Hardware interrupt counter ■ Initial value is 0 ■ With each process interrupt, the counter is incremented by 1. ■ Reset with coupler command 0x03 ➦ *'I/O area of the IM 053ML'...page 60*.
8000 A084h	4byte	Diagnostic interrupt counter ■ Initial value is 0 ■ With each diagnostics interrupt, the counter is incremented by 1. ■ Reset with coupler command 0x03 ➦ *'I/O area of the IM 053ML'...page 60*.

Address	Byte size	Description
8000 A088h	8byte	Hardware interrupt status ■ Bit 0: Slot 1 ■ Bit 1: Slot 2 ■ ... ■ Bit 63: Slot 64 ■ Reset with coupler command 0x03 ➦ *'I/O area of the IM 053ML'...page 60*.
8000 A090h	8byte	Diagnostics interrupt status ■ Bit 0: Slot 1 ■ Bit 1: Slot 2 ■ ... ■ Bit 63: Slot 64 ■ With each PowerON a diagnostic interrupt is generated. ■ Reset with coupler command 0x03 ➦ *'I/O area of the IM 053ML'...page 60*.
8000 A098h	8byte	Reserved
8000 A0A0h	16byte	Hardware interrupt data of slot 1
8000 A0B0h	16byte	Hardware interrupt data of slot 2
...	...	...
8000 A490h	16byte	Hardware interrupt data of slot 64
8000 A4A0h	32byte	Diagnostic data of slot 1
8000 A4C0h	32byte	Diagnostic data of slot 2
8000 A4E0h	32byte	Diagnostic data of slot 3
...	...	:
8000 AC80h	32byte	Diagnostic data of slot 64
8000 ACA0h	4byte	1. (latest) diagnostics entry
...	...	...
8000 ACDCh	4byte	16. diagnostics entry
8000 ACE0h ... 8000 A0FCh	32byte	Error counters backplane bus (master counter) ■ 8000 ACE0h : Expected length error ■ 8000 ACE2h : TimeOut error ■ 8000 ACE4h : Stop bit error ■ 8000 ACE6h : FCS error ■ 8000 ACE8h : Telegram length error ■ 8000 ACEAh : Telegram type error ■ 8000 ACECh : Alarm retry error ■ 8000 ACEEh : Bus idle time error ■ 8000 ACF0h : Wrong node address ■ 8000 ACF2h : Telegram valid ■ 8000 ACF4h : Master load ■ 8000 ACF6h : One telegram retry counter ■ 8000 ACF8h : Two telegram retry counter ■ 8000 ACFAh : Three or more telegram retry counter ■ 8000 A0FCh : Reserved Reset with coupler command 0x08 ➦ *'I/O area of the IM 053ML'...page 60*.

Diagnostic messages

Code	Description
E000 00*YY*h	Error at access to the module at slot *YY*. Please retry after reboot.
E010 00*YY*h	Error accessing the retentive memory of the module at slot *YY*. Please try again after a restart respectively delete the parameters in the retentive memory and restart or carry out a firmware update.
A000 00*YY*h	The module version on slot *YY* is not supported.
A010 00*YY*h	
A020 00*YY*h	The assembled module in slot *YY* does not match the configured module in the retentive memory.
A030 00*YY*h	The module in slot *YY* has been configured and stored in retentive memory but not mounted.
A040 00*YY*h	Error writing parameter of the module at slot *YY*. Check your module parameters.

4.8 Alarms and warnings

Alarm list

Category	Alarm code	COMM_ ALM	Meaning	Remedy
Communication establishment error	0E40h	B	When receiving a CONNECT command, an unsupported MECHATROLINK transfer cycle was set. ■ Alarm acknowledgement: impossible ■ Output behavior: All is 0	Check the MECHATROLINK transmission cycle setting of the controller.
Communication error	0E50h	C	The WDT value received from the controller during communication phase 3 was not updated every communication cycle. ■ Alarm acknowledgement: possible ■ Output behavior: All is 0	Check the communication settings of the controller. Take countermeasures against faults. To clear the alarm state, send the command ALM_CLR. To recovery to phase 3, send the command SYNC_SET after ALM_CLR.
	0E60h	9	Data reception errors occurred twice in a row after the execution of the CONNECT command was completed. (Influence of noise etc.) ■ Alarm acknowledgement: possible ■ Output behavior: All is 0	Check the communication settings of the controller. Take countermeasures against faults. To clear the alarm state, send the command ALM_CLR. If the alarm persists, replace the coupler.
	0E62h	8	FCS errors occurred twice in a row after completing the CONNECT command. (Influence of noise etc.) ■ Alarm acknowledgement: possible ■ Output behavior: All is 0	Check the communication settings of the controller. Take countermeasures against faults. To clear the alarm state, send the command ALM_CLR.
	0E63h	A	The synchronous frame not received state was detected twice consecutively after completing the execution of the CONNECT command. (Influence of noise etc.) ■ Alarm acknowledgement: possible ■ Output behavior: All is 0	

Category	Alarm code	COMM_ ALM	Meaning	Remedy
System error	0B6Ah	0	The initialization process of the communication LSI failed. ■ Alarm acknowledgement: impossible ■ Output behavior: All is 0	Replace the coupler.

List of warnings - communication error (COMM_ALM)

Category	Warning Code	COMM_ ALM	Meaning	Remedy
Communication warnings	0960h	2	Communication error ■ Alarm acknowledgement: necessary ■ Output behavior: Values still remain	Check the communication settings. Take countermeasures against faults.
	0962h	1	FCS error ■ Alarm acknowledgement: necessary ■ Output behavior: Values still remain	
	0963h	3	Synchronization frame not received ■ Alarm acknowledgement: necessary ■ Output behavior: Values still remain	
	0980h	0	The time for the cyclic data exchange has exceeded the time for the data transfer. ■ Alarm acknowledgement: necessary ■ Output behavior: Values still remain	Increase the cycle time for MECHATROLINK data transmission.

List of warnings - command error (CMD_ALM)

Category	Warning code	CMD_ ALM	Meaning	Remedy
Warning for data setting	094Ah	9	Parameter numbers or data addresses are faulty. ■ Alarm acknowledgement: automatic ■ Output behavior: Values still remain	Check the contents of the command data sent by the controller. (Check the setting for each command and parameter.)
	094Bh	9	The data in the command are invalid. ■ Alarm acknowledgement: automatic ■ Output behavior: Values still remain	
Command warning	095Bh	8	An unsupported command was received. ■ Alarm acknowledgement: automatic ■ Output behavior: Values still remain	Check the command transmission sequence of the controller. (See the conditions for each command.)
	095Fh	8	An invalid command was received. ■ Alarm acknowledgement: automatic ■ Output behavior: Values still remain	
	097Ah	C	A command that is not allowed in this communication phase has been received. ■ Alarm acknowledgement: automatic ■ Output behavior: Values still remain	

List of warnings - device alarm (D_ALM)

Category	CMD_ STAT	Meaning	Remedy
Device error	D_ALM	Output to the modules failed for three consecutive transmission cycles, or input from the modules failed for three consecutive transmission cycles. ■ Alarm acknowledgement: necessary ■ Output behavior: Values still remain	Check that the modules and coupler are properly mated. Take countermeasures against noise. To recover from the alarm state, send the ALM_CLR command. If the alarm continues, replace the coupler or module.

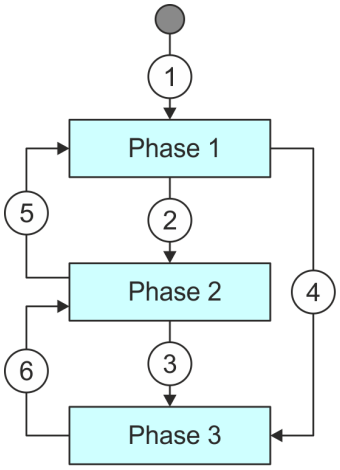
List of warnings - device warning (D_WAR)

Category	CMD_ STAT	Meaning	Remedy
Device warning	D_WAR	Communication warning 0980h occurred ■ Alarm acknowledgement: necessary ■ Output behavior: Values still remain	Increase the cycle time for MECHATROLINK data transmission.

4.9 MECHATROLINK-4 specification

4.9.1 Phases of the communication

4.9.1.1 State machine



Each MECHATROLINK coupler implements a state machine for communication. Here the following phases and transitions are defined.

Phase 1 - Device is waiting for communication set-up.

Phase 2 - Device is in asynchronous data exchange.

Phase 3 - Device is in synchronous data exchange.

1 - Automatic transition to *phase 1* with PowerON.

2 - Transition to *phase 2* with CONNECT ➦ *88*

3 - Transition to *phase 3* with SYNC_SET ➦ *87*

4 - Transition to *phase 3* with CONNECT and set SYNCMODE ➦ *88*

5 - Transition to *phase 1* with DISCONNECT ➦ *89*

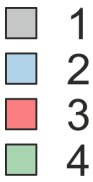
6 - Interrupts triggers transition to *phase 2*.

4.9.1.2 Time chart I/O data

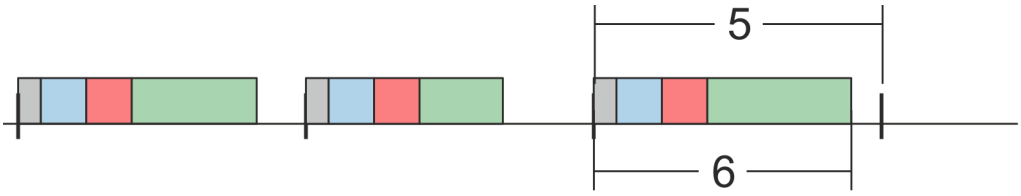
4.9.1.2.1 IO refresh mode: synchronous mode

Behavior

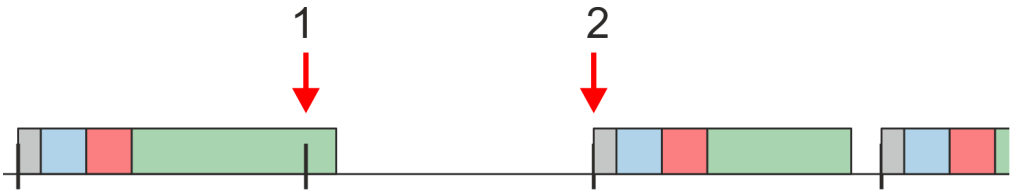
With *IO refresh mode: synchronous mode*, backplane bus and MECHATROLINK communication run synchronously. If there is a cycle overrun, a warning is triggered (A.980) and a change to phase 2 takes place. A diagnostic entry is made here ➦ *'Virtual memory'...page 66*. To avoid this, you must set the MECHATROLINK transmission cycle time so that it is greater than the maximum process time.



1 Network process
2 Output to modules
3 Input from modules
4 Internal process



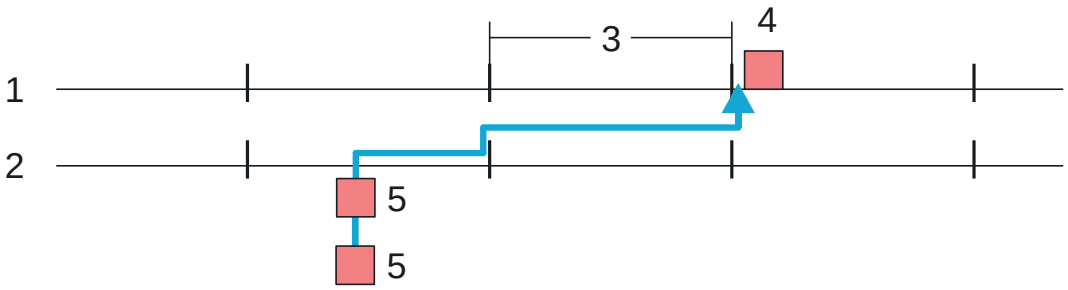
5 MECHATROLINK transmission cycle
6 Process time



1 MECHATROLINK transmission cycle exceeds process time - the next cycle is skipped.
2 The process will be executed at the next transfer interrupt.

Behavior of the input data

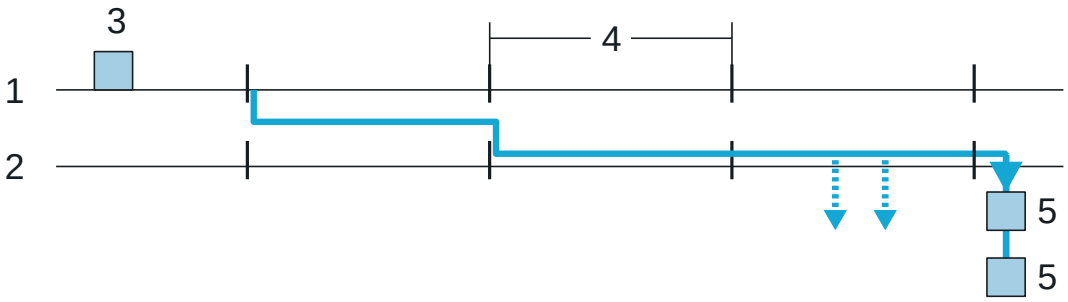
If there is a cycle overrun, the input data are delayed by one MECHATROLINK transfer cycle. The input data are synchronously captured once per cycle.



1 *MECHATROLINK* MDevice
2 *MECHATROLINK* SDevice
3 MECHATROLINK transmission cycle
4 Application detects an input
5 Input from modules

Behavior of the output data

If a cycle overrun occurs, the output data are delayed by one MECHATROLINK transmission cycle. The output data are synchronously output once per cycle.



1 *MECHATROLINK* MDevice
2 *MECHATROLINK* SDevice
3 Output value is set in the application
4 MECHATROLINK transmission cycle
5 Output to modules

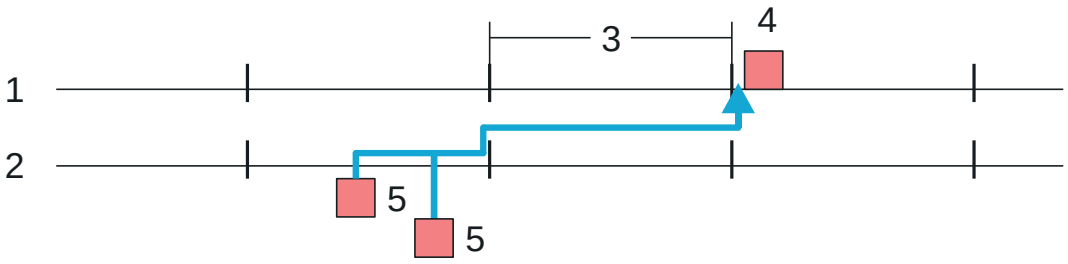
4.9.1.2.2 IO refresh mode: free run mode

Behavior

With *IO refresh mode: free run mode*, communication is not affected by a cycle overrun. The MECHATROLINK transmission cycle can be smaller than the maximum process time.

Behavior of the input data

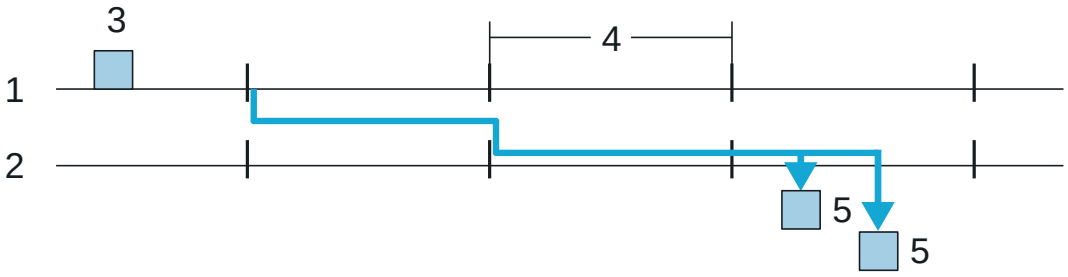
If there is a cycle overrun, the input data are delayed by one MECHATROLINK transfer cycle. For each cycle, the input data are captured at the time they occur. In this case, the capture takes place asynchronously depending on the process time of the coupler.



1 *MECHATROLINK* MDevice
2 *MECHATROLINK* SDevice
3 MECHATROLINK transmission cycle
4 Application detects an input
5 Input from modules

Behavior of the output data

If a cycle overrun occurs, the output data are delayed by one MECHATROLINK transmission cycle. The output data are output at the time of their occurrence in each cycle. The output is asynchronous depending on the process time of the coupler.



1 *MECHATROLINK* MDevice
2 *MECHATROLINK* SDevice
3 Output value is set in the application
4 MECHATROLINK transmission cycle
5 Output to modules

4.9.2 Standard IO profile

4.9.2.1 Standard I/O profile command format

4.9.2.1.1 Overview

The MECHATROLINK communication specifications specify the standard I/O profile for data exchange with the System SLIO. The following table shows the command types, which are applied in the standard I/O profile and indicates whether the command is supported by the corresponding System SLIO module.

Byte	Command	Response	Reference
0	CMD	RCMD	➦ *'Command Code (CMD/RCMD)'...page 78*
1	WDT	RWDT	➦ *'Watchdog Data (WDT/RWDT)'...page 79*
2	CMD_CTRL	CMD_STAT	➦ *'Command Control (CMD_CTRL)'...page 79*
3			➦ *'CMD_STAT'...page 80*
4 ... 63	CMD_DATA	RSP_DATA	➦ *'Command detail'...page 83*

4.9.2.1.2 Command Code (CMD/RCMD)

The following table lists the commands, which are applied in the standard I/O profile and indicates, whether or not each command is supported by the System SLIO.

Profile	Command Code	Command	Operation ➦ see page	Supported by System SLIO
Common commands	00h	NOP	No operation ➦ *83*	Yes
	01h	PRM_RD	Read parameter	No
	02h	PRM_WR	Write parameter	No
	03h	ID_RD	Read ID ➦ *84*	Yes
	04h	CONFIG	Device setup request ➦ *84*	Yes
	05h	ALM_RD	Read alarm/warning ➦ *85*	Yes
	06h	ALM_CLR	Clear alarm/warning state ➦ *86*	Yes
	0Dh	SYNC_SET	Request for establishing synchronization ➦ *87*	Yes
	0Eh	CONNECT	Request for establishing connection ➦ *88*	Yes
	0Fh	DISCONNECT	Request for releasing connection ➦ *89*	Yes
	1Bh	PPRM_RD	Read stored parameter ➦ *90*	No
	1Ch	PPRM_WR	Write stored parameter ➦ *91*	No
	1Dh	MEM_RD	Read memory	Yes
	1Eh	MEM_WR	Write memory	Yes
Standard I/O commands	20h	DATA_RWA	Data read/write command (asynchronous) ➦ *93*	Yes
	21h	DATA_RWS	Data read/write command (synchronous) ➦ *93*	Yes

4.9.2.1.3 Watchdog Data (WDT/RWDT)

During synchronous communications, the C1 MDevice station exchanges synchronous data with its SDevice stations every communication cycle. These synchronous data are called watchdog data. Watchdog data are used for the detection of synchronous communication establishment and imperfect synchronization.

Data format

The *WDT* and *RWDT* field of the C1 MDevice station and each SDevice station are used. MN data come from C1 MDevice and RSN data from SDevice station. The data format of each field is as shown below.

WDT - Command data

Bit 7 ... Bit 4	Bit 3 ... Bit 0
SN: The *RSN* value of *RWDT* to be copied	MN: Incremented by one for each communication

RWDT - Response data

Bit 7 ... Bit 4	Bit 3 ... Bit 0
RSN: Incremented by one for each communication	MN value of WDT to be copied

Error detection

If the watchdog data of the remote station is other than the previous value incremented by 1 during the synchronous communication, an error will be detected except in the following cases:

- The C1 MDevice station transmits a *DISCONNECT* command, as request to release connection, in the next communication cycle.
- A communication error or transmission error has already been detected.

4.9.2.1.4 Command Control (CMD_CTRL)

The following describes the 2 bytes *CMD_CTRL* as part of the MECHATROLINK command format. The *CMD_CTRL* area is specified as shown below by the communication specification. Note that the designation in this field is valid even when a *CMD_ALM* has occurred.

CMD_CTRL

Bit 15 ... 8	Bit 7 ... 6	Bit 5 ... 4	Bit 3	Bit 2 ... 0
Reserved	CMD_ID	Reserved	ALM_CLR	Reserved

ALM_CLR: Clear communication alarm/warning

Value	Reference
0	Clear alarm/warning disabled.
1	Clear alarm/warning triggered.

- Clears the alarm/warning state with edge 0-1.
- The same processing as when *ALM_CLR_MODE* = 0 for the *ALM_CLR* command (the current alarm/warning state is cleared) is performed.
- The *ALM_CLR* bit is used effectively to clear the *COMM_ALM* warning state.

CMD_ID: Command ID

- This is not used with standard I/O profile commands.

4.9.2.1.5 CMD_STAT

The following describes the 2 bytes *CMD_STAT* as part of the MECHATROLINK command format. The *CMD_STAT* area is specified as shown below by the communication specification. Note that the designation in this field is valid even when a *CMD_ALM* has occurred.

Bit 15 ... 12	Bit 11 ... 8	Bit 7 ... 6	Bit 5 ... 4	Bit 3	Bit 2	Bit 1	Bit 0
COMM_ALM	CMD_ALM	RCMD_ID	Reserved	ALM_CLR_CMP	CMDRDY	D_WAR	D_ALM

D_ALM

Value	Reference
1	The device is in the alarm state.
0	Other (includes the states corresponding to *COMM_ALM* or *CMD_ALM*)

- When a device-specific alarm other than the alarm state specified by *COMM_ALM* and *CMD_ALM* has occurred, the *D_ALM* status bit is set to 1.
- *D_ALM* is independent of *COMM_ALM* and *CMD_ALM*.
- When the SDevice station shifts from the device alarm state to the normal state as a result of the execution of the *ALM_CLR* command and *CMD_CTRL.ALM_CLR*, this bit is set to 0.

D_WAR

Value	Reference
1	The device is in the warning state.
0	Other (includes the states corresponding to *COMM_ALM* or *CMD_ALM*)

- The bit that indicates the device warning state of the SDevice station. When a device-specific warning other than the warning state specified by *COMM_ALM* or *CMD_ALM* has occurred, the *D_WAR* status bit is set to 1.
- *D_WAR* is independent of *COMM_ALM* and *CMD_ALM*.
- When the SDevice station shifts from the device warning state to the normal state as a result of the execution of the *ALM_CLR* command and *CMD_CTRL.ALM_CLR*, this bit is set to 0.

CMDRDY

Value	Reference
1	Command reception enabled.
0	Other

- *CMDRDY* = 0 means that command processing is in progress. While *CMDRDY* = 0, the System SLIO continues to process the current command, so the System SLIO will discard new commands received while *CMDRDY* = 0.
- Only the *DISCONNECT* command is executed immediately regardless of the *CMDRDY* value.
- Completion of command execution is confirmed in accordance with the completion confirmation method of each command.
- The hold time for *CMDRDY* = 0 is specified by individual commands.
- If command execution is possible despite an alarm or warning state, *CMDRDY* is set to 1.

ALM_CLR_CMP

Value	Reference
1	Completion of execution of *ALM_CLR*.
0	Other

- *ALM_CLR_CMP* = 1 means that *CMD_CTRL.ALM_CLR* = 1 has been received and alarm clear processing has been completed.
- *ALM_CLR_CMP* can be cancelled by setting "0" for *CMD_CTRL.ALM_CLR*.

RCMD_ID

- This is not used in the standard I/O profile.

CMD_ALM

Code		Contents	Remark
	0	Normal	-
Warning	1	-	These do not occur with this module.
	2	-	
	3	-	
	4	-	
	5	-	
	6	-	
	7	-	
Alarm	8	Unsupported command received	System SLIO notifies the alarm state and the command is not executed.
	9	Invalid data	
	A	-	
	B	-	
	C	Phase error	
	D	-	
	E	-	
	F	-	

Notifies the command error state.

- The code that indicates a command error. *CMD_ALM* is independent of *COMM_ALM*, *D_ALM* and *D_WAR*.
- If a normal command is received after the occurrence of a command error, *CMD_ALM* is automatically cleared.
- The phase doesn't change even if the status of *CMD_ALM* is not "0". ➦ *'Phases of the communication'...page 75*

COMM_ALM

Code		Contents	Remark
	0	Normal	-
Warning	1	FCS error	Occurs when an error is detected once.
	2	Command data not received	
	3	Synchronous frame not received	
	4	-	
	5	-	
	6	-	
	7	-	
Alarm	8	FCS error	Occurs when an error is detected once or continuously. In this case, there is a change from phase 3 to phase 2. ■ Single error – B, C, D: are set ■ Continuous error – 8, 9, A: are set
	9	Command data not received	
	A	Synchronous frame not received	
	B	Synchronization time interval error	
	C	WDT error	
	D	CDO setting error	
	E	-	
	F	-	

Notifies the command error state.

- The code that indicates the error state of MECHATROLINK communication.
- *COMM_ALM* is cleared with edge 0-1 of *CMD_CTRL.ALM_CLR* or by the *ALM_CLR* command.

4.9.2.1.6 Command to extended address

When the following commands are commanded to any extended addresses, they are all processed as commands to the coupler module. If you want to command to peripheral modules, you have to use the *Coupler command* area. ➥ *'I/O area of the IM 053ML'...page 60*

- The commands that are processed on extended address
  - NOP
  - CONNECT
  - DISCONNECT
- The commands that are processed as the command of coupler module
  - ID_RD
  - CONFIG
  - ALM_RD
  - ALM_CLR
  - SYNC_SET
  - MEM_RD
  - MEM_WR

4.9.3 ID information acquisition profile

Data format

Byte	Command	Response	Reference
0	CMD	RCMD	➦ *'Command Code (CMD/RCMD)'...page 83*
1	WDT	RWDT	This function is currently not supported.
2	CMD_CTRL	CMD_START	➦ *'Command Control (CMD_CTRL)'...page 79*
3			➦ *'CMD_STAT'...page 80*
4 ... 15	CMD_DATA	RSP_DATA	➦ *'Command Code (CMD/RCMD)'...page 83*

4.9.3.1 Command Code (CMD/RCMD)

The following table shows the command types, which are applied in the ID information acquisition profile and indicates whether the command is supported by the corresponding System SLIO module.

Command code	Command	Operation ➦ see page	Supported by System SLIO
00h	NOP	No operation ➦ *83*	Yes
03h	ID_RD	Read ID ➦ *84*	Yes
0Eh	CONNECT	Request for establishing connection ➦ *88*	Yes
0Fh	DISCONNECT	Request for releasing connection ➦ *89*	Yes
1Dh	MEM_RD	Read stored parameter ➦ *90*	No

4.9.4 Command detail

4.9.4.1 No operation command *NOP* (00h)

The *NOP* command is used for network control. The current state is returned as a response.

Confirmation of completion

- Confirm that *RCMD* = *NOP* (00h) and *CMD_STAT.CMDRDY* = 1.
- When *CMD_STAT.D_ALM* or *CMD_STAT.D_WAR* = 1, use *ALM_RD* to read out the current alarm code and take appropriate action.
- When *CMD_STAT.CMD_ALM* or *CMD_STAT.COMM_ALM* ≠ 1, take appropriate action according to the codes. ➦ *'CMD_STAT'...page 80*

Command classification

- Device group: Common command group
- Communication type: Asynchronous communication command

Data format

Byte	Command	Response	Reference
0	NOP (00h)	NOP (00h)	
1	WDT	RWDT	➦ *'Watchdog Data (WDT/RWDT)'...page 79*
2	CMD_CTRL	CMD_STAT	➦ *'Command Control (CMD_CTRL)'...page 79*
3			➦ *'CMD_STAT'...page 80*
4 ... 63	Reserved (0)	Reserved (0)	

4.9.4.2 Read ID command ID_RD (03h)

The *ID_RD* command is used to read the ID of a device. This command reads the product information as ID data. The ID data is selected in detail by specifying *ID_CODE*.

Confirmation of completion

- Confirm that *RCMD* = *ID_RD* (03h) and *CMD_STAT.CMDRDY* = 1 and also the setting for *ID_CODE*, *OFFSET* and *SIZE* of the response.
- When *CMD_STAT.D_ALM* or *CMD_STAT.D_WAR* = 1, use *ALM_RD* to read out the current alarm code and take appropriate action.
- When *CMD_STAT.CMD_ALM* or *CMD_STAT.COMM_ALM* ≠ 0, take appropriate action according to the codes. ➦ *'CMD_STAT'...page 80*

Command classification

- Device group: Common command group
- Communication type: Asynchronous communication command

Data format

Byte	Command	Response	Reference
0	ID_RD (03h)	ID_RD (03h)	
1	WDT	RWDT	➦ *'Watchdog Data (WDT/RWDT)'...page 79*
2	CMD_CTRL	CMD_STAT	➦ *'Command Control (CMD_CTRL)'...page 79*
3			➦ *'CMD_STAT'...page 80*
4	ID_CODE	ID_CODE	ID_Code ➦ *'Virtual memory'...page 66*
5	OFFSET	OFFSET	■ Can be used in *phases 2* and *3*. ➦ *'Phases of the communication'...page 75* ■ When the *ID_CODE* data is invalid, 9h is set for *CMD_ALM*. ■ When the *OFFSET* data is invalid, 9h is set for *CMD_ALM*. ■ When the *SIZE* data does not match, 9h is set for *CMD_ALM*. ■ When *CMD_ALM* = 9h occurs, the ID becomes an indefinite value.
6	SIZE	SIZE	
7			
8 ... 63	Reserved (0)	ID	

4.9.4.3 Setup device command CONFIG (04h)

This command is used to set up devices. The contents of the processing to be executed are specified by the product specifications. A product that does not have the corresponding functions must immediately return a response for process completion.

Confirmation of completion

- Confirm that *RCMD* = *CONFIG* (04h) and *CMD_STAT.CMDRDY* = 1 and also the setting for the *CONFIG_MOD* of the response.
- When *CMD_STAT.D_ALM* or *CMD_STAT.D_WAR* = 1, use *ALM_RD* to read out the current alarm or warning codes and take appropriate action.
- When *CMD_STAT.CMD_ALM* or *CMD_STAT.CMD_COMM* ≠ 0, take appropriate action according to the codes. ➦ *'CMD_STAT'...page 80*

Command classification

- Device group: Common command group
- Communication type: Asynchronous communication command

Data format

Byte	Command	Response	Reference
0	CONFIG (04h)	CONFIG (04h)	
1	WDT	RWDT	➦ *'Watchdog Data (WDT/RWDT)'...page 79*
2	CMD_CTRL	CMD_STAT	➦ *'Command Control (CMD_CTRL)'...page 79*
3			➦ *'CMD_STAT'...page 80*
4	CONFIG_MOD	CONFIG_MOD	■ Can be used in *phases 2* and *3*. ➦ *'Phases of the communication'...page 75* ■ When the *CONFIG_MOD* data is invalid, 9h is set for *CMD_ALM*.
5 ... 63	Reserved (0)	ID	

CONFIG_MOD: Configuration mode

Value	Reference
0	Parameter re-calculation and setup
1	Common parameter batch writing into nonvolatile memory (not supported)
2	Parameter initialization to factory defaults

Status during execution of CONFIG command

Status	Before Execution	During Execution	After Execution
ALM	current status	current status	current status
CMDRDY	1	0	1
Other	current status	not defined	current status

- The table shows each status before, during, and after the execution of *CONFIG* command.

4.9.4.4 Read alarm or warning command ALM_RD (05h)

The *ALM_RD* command is used to read the alarm or warning state. The current alarm or warning state is read to *ALM_DATA* as an alarm or warning code.

Confirmation of completion

- Confirm that *RCMD* = *ALM_RD* (05h) and *CMD_STAT.CMDRDY* = 1 and also the setting for the *ALM_RD_MOD* and *ALM_INDEX* of the response.

Command classification

- Device group: Common command group
- Communication type: Asynchronous communication command

Data format

Byte	Command	Response	Reference
0	ALM_RD (05h)	ALM_RD (05h)	
1	WDT	RWDT	➦ *'Watchdog Data (WDT/RWDT)'...page 79*
2	CMD_CTRL	CMD_STAT	➦ *'Command Control (CMD_CTRL)'...page 79*
3			➦ *'CMD_STAT'...page 80*
4	ALM_RD_MOD	ALM_RD_MOD	■ Can be used in *phases 2* and *3*. ➦ *'Phases of the communication'...page 75* ■ If the *ALM_RD_MOD* data is invalid, 9 is set for *CMD_ALM*. ■ If the *ALM_INDEX* data is invalid, 9 is set for *CMD_ALM*.
5			
6	ALM_INDEX	ALM_INDEX	
7			
9 ... 63	Reserved (0)	ALM_DATA	

ALM_RD_MOD: Read mode

Value	Reference
0	■ Reads the current alarm/warning state ■ Max. 12 alarms/warnings (2 bytes / 1 alarm or warning, byte 8 to 31) ■ When the number of alarms/warnings is less than 12, 0 is set to the *ALM_DATA* part where there is no alarm/warning.
1	■ Reads the alarm/warning history ■ Max. 12 records (2 bytes / record, byte 8 to 31) ■ When the number of alarm/warning records is less than 12, 0 is set to the *ALM_DATA* part where there is no alarm/warning.
2	Individually reads the current alarm/warning details (not supported).
3	Individually reads the alarm/warning history details (not supported).

- *ALM_INDEX*: Alarm index (not supported)
  Set to 0.
- *ALM_DATA*: Alarm/warning code

4.9.4.5 Clear alarm or warning command ALM_CLR (06h)

The *ALM_CLR* command is used to clear the alarm or warning state. It changes the state of a SDevice station, but does not eliminate the cause of the alarm or warning. *ALM_CLR* should be used to clear the state after the cause of the alarm or warning has been eliminated. When a communication error (reception error) or synchronous communication error (watchdog data error) occurs during synchronous communications, use *SYNC_SET* to restore synchronous communications after executing *ALM_CLR*.

Confirmation of completion

- Confirm that *RCMD* = *ALM_CLR* (06h) and *CMD_STAT.CMDRDY* = 1 and also the setting for the *ALM_CLR_MOD* of the response.
- When *CMD_STAT.D_ALM* or *CMD_STAT.D_WAR* = 1, use *ALM_RD* to read out the current alarm code and take appropriate action.
- When *CMD_STAT.CMD_ALM* or *CMD_STAT.COMM_ALM* ≠ 0, take appropriate action according to the codes. ➦ *'CMD_STAT'...page 80*

Command classification

- Device group: Common command group
- Communication type: Asynchronous communication command

Data format

Byte	Command	Response	Reference
0	ALM_CLR (06h)	ALM_CLR (06h)	
1	WDT	RWDT	➦ *'Watchdog Data (WDT/RWDT)'...page 79*
2	CMD_CTRL	CMD_STAT	➦ *'Command Control (CMD_CTRL)'...page 79*
3			➦ *'CMD_STAT'...page 80*
4	ALM_CLR_MOD	ALM_CLR_MOD	■ Can be used in *phases 2* and *3*. ➦ *'Phases of the communication'...page 75* ■ If the *ALM_CLR_MOD* data is invalid, 9 is set for *CMD_ALM*.
5			
6 ... 63	Reserved (0)	Reserved (0)	

ALM_CLR_MOD: Clear alarm mode

Value	Reference
0	Clears the current alarm/warning state.
1	Clears the alarm/warning history.

4.9.4.6 Establish synchronous communication command SYNC_SET (0Dh)

The *SYNC_SET* command is used to start synchronous communications. Synchronous communications start at the completion of execution of this command. When synchronous communication is reset to asynchronous communication because of occurrence of an error, such as a communication error, use this command to restore the synchronous communications. Synchronization is established on the base of the edge change of the watchdog data (WDT) in this command. The C1 MDevice station holds this command until the completion of processing of this command. After the completion of execution of this command, the watchdog data error detection will start.

Confirmation of completion

- Confirm that *RCMD* = *SYNC_SET* (0Dh) and *CMD_STAT.CMDRDY* = 1.
- When *CMD_STAT.D_ALM* or *CMD_STAT.D_WAR* = 1, use *ALM_RD* to read out the current alarm code and take appropriate action.
- When *CMD_STAT.CMD_ALM* or *CMD_STAT.COMM_ALM* ≠ 0, take appropriate action according to the codes. ➦ *'CMD_STAT'...page 80*

Command classification

- Device group: Common command group
- Communication type: Asynchronous communication command

Data format

Byte	Command	Response	Reference
0	SYNC_SET (0Dh)	SYNC_SET (0Dh)	
1	WDT	RWDT	➦ *'Watchdog Data (WDT/RWDT)'...page 79*
2	CMD_CTRL	CMD_STAT	➦ *'Command Control (CMD_CTRL)'...page 79*
3			➦ *'CMD_STAT'...page 80*
4 ... 63	Reserved (0)	Reserved (0)	■ In *phase 3*, this command is ignored. ➦ *'Phases of the communication'...page 75* ■ When *COMM_ALM* = 8h (FCS error) or 9h (no response) occurs, send this command to restart synchronous communications.

4.9.4.7 Establish connection command CONNECT (0Eh)

The *CONNECT* command is used to establish a MECHATROLINK connection. When the command has been completed, the control of SDevice stations is started by means of MECHATROLINK communication.

Confirmation of completion

- Confirm that *RCMD* = *CONNECT* (0Eh) and *CMD_STAT.CMDRDY* = 1 and also the setting for *VER*, *COM_MODE*, *COM_TIM* and *PROFILE_TYPE* of the response.
- When *CMD_STAT.D_ALM* or *CMD_STAT.D_WAR* = 1, use *ALM_RD* to read out the current alarm code and take appropriate action.
- When *CMD_STAT.CMD_ALM* or *CMD_STAT.COMM_ALM* ≠ 0, take appropriate action according to the codes. ➦ *'CMD_STAT'...page 80*

Command classification

- Device group: Common command group
- Communication type: Asynchronous communication command

Data format

Byte	Command	Response	Reference
0	CONNECT (0Eh)	CONNECT (0Eh)	
1	WDT	RWDT	➦ *'Watchdog Data (WDT/RWDT)'...page 79*
2	CMD_CTRL	CMD_STAT	➦ *'Command Control (CMD_CTRL)'...page 79*
3			➦ *'CMD_STAT'...page 80*
4	VER	VER	■ Can be used in *phase 1*. ➦ *'Phases of the communication'...page 75* ■ In *phases 2* and *3*, this command is ignored. ■ If the *VER* data is invalid, 1 or 9 is set for *CMD_ALM*. ■ If the *COM_TIM* data is invalid, 1 or 9 is set for *CMD_ALM*. ■ If the *PROFILE_TYPE* data is invalid, 1 or 9 is set for *CMD_ALM*.
5	COM_MOD	COM_MOD	
6	COM_TIM	COM_TIM	
7	PROFILE_TYPE	PROFILE_TYPE	
8 ... 63	Reserved (0)	Reserved (0)	

- *VER*: MECHATROLINK application layer version
  VER = 30h

COM_MOD: Communication mode

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
SUBCMD	Reserved (0)			DTMODE		SYNC-MODE	Reserved (0)

SYNCMODE: Synchronous communication setting

Value	Reference
1	Starts synchronous communications (Watchdog data error detection enabled. Possible to use synchronous communication commands.)
0	Starts asynchronous communications (Watchdog data error detection disabled. Impossible to use synchronous communication commands.)

DTMODE: Communication method

Value	Reference
00	Single transmission
01	Sequential transmission (not supported)
10	Reserved
11	Reserved

SUBCMD: Subcommand setting

Value	Reference
0	Subcommand disabled

COM_TIM: Backplane bus communication cycle setting

Value	Reference
0	Sets multiples of the MECHATROLINK transmission cycle as the Backplane bus communication cycle. Example: The MECHATROLINK transmission cycle is 0.5 ms and the backplane bus communication cycle is 2 ms, then *COM_TIM* = 4 (2/0.5 = 4)

- *PROFILE_TYPE*: Profile type setting
  Sets the profile type to be used.
  - 00h: ID Information Acquisition Profile
  - 30h: Standard I/O profile

4.9.4.8 Release connection command DISCONNECT (0Fh)

When terminating a communication connection, the C1 MDevice station transmits the *DISCONNECT* command for two or more communication cycles. At this time, the SDevice station interrupts current processing and then performs the initialization required to reestablish the connection. It then waits for the connect establishment request from the C1 MDevice station. The *DISCONNECT* command can be sent regardless of the state of the *CMD_STAT.CMDRDY* bit. If the *DISCONNECT* command is sent when the *CMD_STAT.CMDRDY* state bit is 0, processing is interrupted and this command is processed.

Confirmation of completion

- Control with the command sending time of the C1 MDevice station as two or more communication cycles.

Command classification

- Device group: Common command group
- Communication type: Asynchronous communication command

Data format

Byte	Command	Response	Reference
0	DISCONNECT (0Fh)	DISCONNECT (0Fh)	■ Can be used in all *phases*. ➥ *'Phases of the communication'...page 75* ■ Upon receipt of the *DISCONNECT* command, operation shifts to *phase 1*. ■ When the control power is turned OFF at the same time the *DISCONNECT* command is sent, the response data is indefinite.
1 ... 63	Reserved (0)	Reserved (0)	

4.9.4.9 Read memory content command MEM_RD (1Dh)

The *MEM_RD* command is used to read the data on the virtual memory by specifying the starting address and the data size of the virtual memory. If the reading is not successfully completed due to an incorrect designation, such as invalid starting address or data size, a warning will be created. When a warning is detected, the warning bit and warning code are set in the response. The *ADDRESS* and *SIZE* in the response are the values specified in the command, whether or not the reading has been completed. ➦ *'Virtual memory'...page 66*

Confirmation of completion

- Confirm that *RCMD* = *MEM_RD* (1Dh), *CMD_STAT.CMDRDY* = 1 and also the setting for *ADDRESS* and *SIZE* of the response.
- When *CMD_STAT.ALM* or *CMD_STAT.WAR* = 1, use *ALM_RD* to read out the current alarm or warning code and take appropriate action.
- When *CMD_STAT.CMD_ALM* or *CMD_STAT.COMM_ALM* ≠ 0, take appropriate action according to the codes. ➦ *'CMD_STAT'...page 80*

Command classification

- Device group: Common command group
- Communication type: Asynchronous communication command

Data format

Byte	Command	Response	Reference
0	MEM_RD (1Dh)	MEM_RD (1Dh)	
1	WDT	RWDT	➦ *'Watchdog Data (WDT/RWDT)'...page 79*
2	CMD_CTRL	CMD_STAT	➦ *'Command Control (CMD_CTRL)'...page 79*
3			➦ *'CMD_STAT'...page 80*
4	Reserved (0)	Reserved (0)	■ Can be used in *phases 2* and *3*. ➦ *'Phases of the communication'...page 75* ■ If any of the command errors below occur, 9 is set for CMD_ALM – The *MODE* data is invalid – The *DATA_TYPE* data is invalid – *SIZE* > 4 – The *ADDRESS* data is invalid. ■ For errors other than the above, an alarm can be specified in the product specifications Example: By allocating the reserved area to read alarms, etc.
5	MODE/ DATA_TYPE	MODE/ DATA_TYPE	
6	SIZE	SIZE	
7			
8 ... 63	Reserved (0)	Reserved (0)	

MODE/DATA_TYPE: Mode/Data type

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
MODE				DATA_TYPE			

MODE: Read mode

Value	Reference
0	Reserved by system
1	Volatile memory Reads from a volatile memory such as SRAM.
2	Nonvolatile memory (not supported) Reads from an nonvolatile memory such as E^2PROM
3 ... F	Reserved by system

DATA_TYPE: Data type

Value	Reference
0	Reserved by system
1	Byte type (not supported)
2	Short type
3	Long type
4	Long long type (not supported)
5 ... F	Reserved by system

- *SIZE*: Number of data to read
- *ADDRESS*: Starting address to read
- *DATA*: Data

4.9.4.10 Write memory content command MEM_WR (1Eh)

The *MEM_WR* command is used to write data to the virtual memory by specifying the starting address, data size, and the virtual memory date. If the writing processing is not successfully completed due to an incorrect designation such as invalid starting address and data size, a warning is created. When a warning is detected, the warning bit and warning code are set in the response. The *DATA* in the response is the value specified in the command, whether or not the writing has been completed. ➦ *'Virtual memory'...page 66*

Confirmation of completion

- Confirm that *RCMD* = *MEM_WR* (1Eh), *CMD_STAT.CMDRDY* = 1 and also the setting for *ADDRESS*, *SIZE* and *DATA* of the response.
- When *CMD_STAT.ALM* or *CMD_STAT. D_WAR* = 1, use *ALM_RD* to read out the current alarm or warning code and take appropriate action.
- When *CMD_STAT.CMD_ALM* or *CMD_STAT.COMM_ALM* ≠ 0, take appropriate action according to the codes. ➦ *'CMD_STAT'...page 80*

Command classification

- Device group: Common command group
- Communication type: Asynchronous communication command

Data format

Byte	Command	Response	Reference
0	MEM_WR (1Eh)	MEM_WR (1Eh)	
1	WDT	RWDT	➦ *'Watchdog Data (WDT/RWDT)'...page 79*
2	CMD_CTRL	CMD_STAT	➦ *'Command Control (CMD_CTRL)'...page 79*
3			➦ *'CMD_STAT'...page 80*
4	Reserved (0)	Reserved (0)	■ Can be used in *phases 2* and *3*. ➦ *75* ■ If any of the command errors below occur, 9 is set for *CMD_ALM*. – The *MODE* data is invalid. – The *DATA_TYPE* data is invalid. – *SIZE* > 4 – The *ADDRESS* data is invalid. ■ For errors other than the above, an alarm can be specified in the product specifications. Example: By allocating the reserved area to read alarms, etc.
5	MODE/ DATA_TYPE	MODE/ DATA_TYPE	
6	SIZE	SIZE	
7			
8 ... 11	ADDRESS	ADDRESS	
12 ... 63	DATA	DATA	

MODE/DATA_TYPE: Mode/Data type

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
MODE				DATA_TYPE			

MODE: Write mode

Value	Reference
0	Reserved by system
1	Volatile memory Writes to a volatile memory such as SRAM.
2	Nonvolatile memory (not supported) Writes to a nonvolatile memory such as E²PROM.
3 ... F	Reserved by system

DATA_TYPE: Data type

Value	Reference
0	Reserved by system
1	Byte type (not supported)
2	Short type
3	Long type
4	Long long type (not supported)
5 ... F	Reserved by system

- *SIZE*: Number of data to write
- *ADDRESS*: Starting address to write
- *DATA*: Data

4.9.4.11 Data READ/WRITE_A (Asynchronous) command DATA_RWA (20h)

This command updates (asynchronously) I/O data.

Confirmation of completion

- Confirm that *RCMD* = *DATA_RWA* (20h) and *CMD_STAT.CMDRDY* = 1.
- When *CMD_STAT.D_ALM* or *CMD_STAT.D_WAR* = 1, use *ALM_RD* to read out the current alarm code and take appropriate action.
- When *CMD_STAT.CMD_ALM* or *CMD_STAT.COMM_ALM* ≠ 0, take appropriate action according to the codes. ➦ *'CMD_STAT'...page 80*

Command classification

- Device group: I/O command group
- Communication type: Asynchronous communication command

Data format

Byte	Command	Response	Reference
0	DATA_RWA (20h)	DATA_RWA (20h)	
1	WDT	RWDT	➦ *'Watchdog Data (WDT/RWDT)'...page 79*
2	CMD_CTRL	CMD_STAT	➦ *'Command Control (CMD_CTRL)'...page 79*
3			➦ *'CMD_STAT'...page 80*
4 ... 63	OUTPUT data	INPUT data	■ *INPUT data* are always updated. ■ Can be used in *phases 2* and *3*. ➦ *'Phases of the communication'...page 75*

4.9.4.12 Data READ/WRITE_S (Synchronous) command DATA_RWS (21h)

This command updates (synchronously) I/O data.

Confirmation of completion

- Confirm that *RCMD* = *DATA_RWS* (21h) and *CMD_STAT.CMDRDY* = 1
- When *CMD_STAT.D_ALM* or *CMD_STAT.D_WAR* = 1, use *ALM_RD* to read out the current alarm code and take appropriate action
- When *CMD_STAT.CMD_ALM* or *CMD_STAT.COMM_ALM* ≠ 0, take appropriate action according to the codes ➦ *'CMD_STAT'...page 80*

Command classification

- Device group: I/O command group
- Communication type: Synchronous communication command

Data format

Byte	Command	Response	Reference
0	DATA_RWS (21h)	DATA_RWS (21h)	
1	WDT	RWDT	➦ *'Watchdog Data (WDT/RWDT)'...page 79*
2	CMD_CTRL	CMD_STAT	➦ *'Command Control (CMD_CTRL)'...page 79*
3			➦ *'CMD_STAT'...page 80*
4 ... 63	OUTPUT data	INPUT data	■ In *phase 2*, Ch is set for *COM_ALM*. ■ Can be used in *phase 3*. ➦ *'Phases of the communication'...page 75*

4.9.5 MECHATROLINK message communication sub functions

Sub functions

Function code	Sub function	Operation	Option
42h	01h	Memory read	-
	11h	Read max. message size	-

Sub function detail - memory read (01h)

Byte	Command	Normal response	Error response
0	SDevice address	MEM_RD (1Dh)	SDevice address
1	Function code (42h)	Function code (42h)	Function code (42h) + 80h (C2h)
2	Extended address	Extended address	Extended address
3	Command status	Response status	Response status
4	Sub function code (01h)	Sub function code (01h)	Sub function code (01h)
5	MODE/ DATA_TYPE (11h)	MODE/ DATA_TYPE (11h)	Error code ■ 02h: Address error ■ 04h: Data type error
6	Number of data bytes	Number of data bytes	Reserved (00h)
7			
8 ... n	Start address	1. data	Error detected address
...		...	
n		n. data	

MODE/DATA_TYPE: Mode/Data type

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
MODE				DATA_TYPE			

MODE: Read mode

Value	Reference
0	Reserved by system
1	Volatile memory Reads from a volatile memory such as SRAM
2	Nonvolatile memory (not supported) Reads from an nonvolatile memory such as E^2PROM.
3 ... F	Reserved by system

DATA_TYPE: Data type

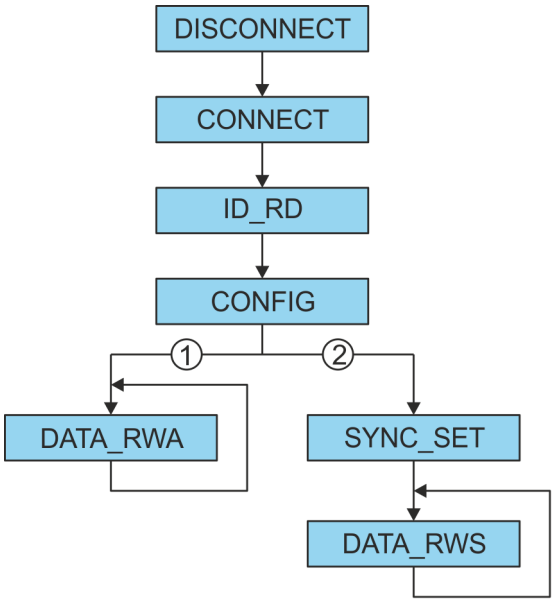
Value	Reference
0	Reserved by system
1	Byte type
2	Short type
3	Long type
4	Long long type
5 ... F	Reserved by system

Sub function detail - read max. message size (11h)

Byte	Command	Normal response	Error response
0	SDevice address	MEM_RD (1Dh)	SDevice address
1	Function code (42h)	Function code (42h)	Function code (42h) + 80h (C2h)
2	Extended address	Extended address	Extended address
3	Command status	Response status	Response status
4	Sub function code (11h)	Sub function code (11h)	Sub function code (01h)
5	Reserved (00h)	Reserved (00h)	Reserved (00h)
6	Reserved (00h)	Reserved (00h)	Reserved (00h)
7			
8 ... n		Max. message size ■ C1 message: 960byte ■ C2 message: 260byte	When the reserved data ≠ 0, you will get an error response.

4.9.6 Command sequence

The following figure shows the basic flow of commands to communicate with the System SLIO.



1 Asynchronous communication
2 Synchronous communication

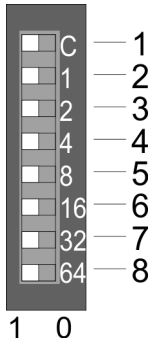
All of the above commands must be commanded to all stations including extended addresses. The next command must be commanded after confirming the completion of all stations including the extended addresses. ➦ *'Command detail'...page 83*

4.10 Sample application

4.10.1 Overview

Below, the operation of a system of a IM 053-1ML40 together with a YASKAWA MP3000 series is shown.

Activation of the web server



1. Switch off the power supply of the *MECHATROLINK* coupler.
2. If you have not already done so, set switch *'C'* (pos. 1) on the address switch to 1: *MECHATROLINK-4*
3. Set the peferred *MECHATROLINK address* as the IP address at the address switch.
   - IP address: 192.168.1.x
   - x = decimal value from position 2...8 of the address switch.
   - *'Address switch'...page 52*
4. Switch on the power supply of the *MECHATROLINK* coupler.
   ➥ After the start-up, you have access to the web server of the *MECHATROLINK coupler* via the set IP address 192.168.1.*x*.

Setting Parameters

1. Start your web browser and open the web side of the *MECHATROLINK* coupler.
2. Here you can change default parameters of the modules, if necessary. For this, click at *'Parameter'* of the according module.
3. To save the configuration, click at the *MECHATROLINK* coupler and save the configuration via the dialog *'Configuration'*.
4. Close you web browser.
5. PowerOFF and disconnect your *MECHATROLINK* coupler

Configuration of the MP3000 series

1. Define I/O area to SVC definition as multi SDevice by using the station number with the following parameters:

...	ADR	ExADR	VENDOR	DEVICE	PROFILE	BYTE	...
	03h	00h	***Vendor	Wild Card Device	Standard I/O	16	
	03h	01h	***Vendor	Wild Card Device	Standard I/O	64	

2. Save the MPE720 project

Starting communication

1. PowerOFF the *MECHATROLINK* coupler and the MP3000.
2. Connect the *MECHATROLINK* coupler with the MP3000 by a *MECHATROLINK* cable.
3. PowerON the *MECHATROLINK* coupler and the MP3000.
4. Transfer the MPE720 project to the MP3000.
5. Check the connection status and the I/O data transfer.

Supported SVC I/O commands

Code	Command name	Coupler Station	Peripheral Station
0	Data I/O	Yes	Yes
1	Read alarms/warnings	Yes	Yes
2	Clear alarms/warnings	Yes	Yes
3	Read parameters	-	-
4	Write parameters	-	-
5	Read non-volatile parameters	-	-
6	Write non-volatile parameters	-	-
7	Read memory	-	-
8	Write memory	-	-
9 ... 14	Reserved	-	-
15	Communication reset	Yes	Yes
16	Network reset	Yes	Yes

4.10.2 Sequence of coupler commands

4.10.2.1 Read diagnostic data - 16 byte from slot 1

Proceeding

1. Confirm coupler command = 0 and response command = 0
   ➥ Response: 0
2. Read byte 1 at the same MECHATROLINK cycle:
   - Set command data
     - Byte size: Byte 4 ... 5: 8
     - Reserved: Byte 6 .. 7: 0
     - Offset: Byte 8 ... 11: 0x8000 8520
   - Set coupler command 1 (read memory)
   - Set command ID = 0
3. Wait until response command = 1 (read memory) and command ID = 0
4. Confirm response data (byte 4 ... 11)
5. Read byte 2 at the same MECHATROLINK cycle:
   - Set command data
     - Byte size: Byte 4 ... 5: 8
     - Reserved: Byte 6 ... 7: 0
     - Offset: Byte 8 ... 11: 0x8000 8528
   - Set coupler command = 1 (read memory)
   - Set command ID = 1
6. Wait until response command = 1 (read memory) and command ID = 1
7. Confirm response data (byte 4 ... 11)
8. NOP at the same MECHATROLINK cycle:
   - Set coupler command = 0 (NOP)
   - Set command ID = 0
9. Wait until response command = 0 (NOP) and command ID = 0

4.10.2.2 Reset diagnostic data - reset slot 1 and slot 2

Proceeding

1. Confirm coupler command = 0 and response command = 0
2. For slot 1 at the same MECHATROLINK cycle:
   - Set command data
     - Slot number: Byte 4 ... 5: 1
   - Set coupler command = 2 (reset diagnostic data)
   - Set command ID = 0
3. Wait until response command = 2 (reset diagnostic data) and command ID = 0
4. Confirm response data (byte 4 ... 5)
5. For slot 2 at the same MECHATROLINK cycle:
   - Set command data
     - Slot number: Byte 4 ... 5: 2
   - Set coupler command = 2 (Reset diagnostic data)
   - Set command ID = 1
6. Wait until response command = 2 (reset diagnostic data) and command ID = 1
7. Confirm response data (byte 4 ... 5)
8. NOP at the same MECHATROLINK cycle:
   - Set coupler command = 0 (NOP)
   - Set command ID = 0
9. Wait until response command = 0 (NOP) and command ID = 1

4.10.3 Communication structure

Standard Operation