YASKAWA

iC9200 Series

CPU | PMC921xEx | Operating manual

HB700 | CPU | PMC921xEx | en | 24-04

IEC 61131 CPU iC921xM-x - Hardware

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1 General

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1.2 About this manual

Objective and contents

This manual is the translation of the original instructions!

The manual describes the CPU PMC921xEx of the iC9200 Series.

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

Validity of the documentation

Product	Order no.	as of version:	
CPU iC921xM-x	PMC921xEx	CPU HW: 1	CPU FW: V2022.9.1

Icons 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.

⚠ WARNING

Hazardous situation to life and limb of personnel and others.

Non-compliance may 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.

ℹ *Supplementary information and useful tips.*

Liability Limitation

All data and notes in these instructions were prepared with consideration to the statutory standards and regulations, the present state of technology, as well as our many years of knowledge and experience.

The manufacturer accepts no liability for damage caused because:

- Non-compliance with the instructions
- Non-specified use
- Use of untrained personnel

The actual scope of delivery can, by special designs, deviate from the explanations and presentations given here, because of the utilization of additional order options, or because of the most recent technical changes.

The user is responsible for the execution of service and commissioning according to the safety instructions of the prevailing standards and other relevant national and local instructions concerning conductor dimensioning and protection, earthing, disconnector, overcurrent protection and so on.

For damages, which result from the mounting or from the connection, the one is liable, who has carried out the mounting or the installation.

We have checked the contents of this manual for agreement with the hardware and software described. Since deviations cannot be precluded entirely, we cannot guarantee full agreement. However, the data in this manual are reviewed regularly. Necessary corrections are included in subsequent editions.

Suggestions for improvement are welcomed.

For damage, which results from missing or insufficient knowledge of the manual, any liability of the manufacturer is impossible.

Therefore, the operator is recommended to have the instruction of the persons concerned confirmed in writing.

Modifications or functional alternations on the product are not allowed due to safety reasons. Any modification on the product not explicitly authorized by the manufacturer will result in loss of any liability claims to the vendor. The same applies if non authorized parts or equipment are used.

Copyright

This manual is to be treated confidentially. It has been provided only for the personnel, which use the product. The transfer of this document to third parties without the authorization in writing of the vendor is prohibited.

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Use of this manual

This safety manual contains information for the intended use of the iC9200 Series CPUs.

Knowledge of regulations and the proper technical implementation of the safety instructions detailed in this manual performed by qualified personnel are prerequisites for safely planning, engineering, programming, installing and starting up the iC9200 Series CPUs as well as for ensuring safety during their operation and maintenance. ➦ *'Education of the personnel'...page 13*

Yaskawa will not be held liable for severe personal injuries, damage to property or the surroundings caused by any of the following: unqualified personnel working on or with the devices, de-activation or bypassing of safety functions, or failure to comply with the instructions detailed in this manual.

The safety components and systems have been developed, manufactured and tested in compliance with the pertinent safety standards and regulations. They may only be used for the intended applications under the specified environmental conditions.

They must be used only as specified in environmental descriptions and be connected only to approved external devices.

The manual contains safety instructions, description of the modules and information about life cycle.

Applicable documentation

In the safety CPUs components of other manufacturers are possibly integrated. For these purchased parts of the respective manufacturers risk evaluations were carried out. The conformity of the constructions to the valid European and national regulations was declared by the according manufacturer.

Warranty conditions

The warranty conditions can be found in the "General terms and conditions" at ➦ *www.yaskawa.eu.com*.

1.3 Safety instructions

Intended use

> ⚠ WARNING
>
> **Danger by non intended use!**
>
> Any other use beyond the intended use and/or other use of this product can lead to dangerous situations and is prohibited.

The CPU iC921xM-x is constructed and produced for:

- industrial use.
- general control and automation tasks.
- industrial network communication, machine and process control.
- the connection to EtherCAT and PROFINET (optional).
- the installation in a control cabinet with degree of protection IP54 or better.
- operation within the environmental conditions specified in the technical data.

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

Documentation

The manual must be available for:

- Project design department
- Installation department
- Commissioning
- Operation

> CAUTION
>
> **The following conditions must be met before using or commissioning the components described in this manual:**
>
> - Changes to the automation system may only be made when the power supply is disconnected!
> - Installation and hardware modifications only by properly trained personnel.
> - The national rules and regulations of the respective country must be satisfied (installation, safety, EMC ...)

Maintenance

If you keep the prescribed environmental conditions the CPU is maintenance-free.

➦ 'Approvals, directives, standards'...page 19

Spare parts

Please only use original spare parts of Yaskawa.

> WARNING
>
> Incorrect or faulty spare parts can cause damage, malfunction or failure as well as affect security.

Shipping

For shipping always use the original packaging.

Disposal

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

Residual risks

> WARNING
>
> The CPU iC921xM-x was developed as an assembly for functional safety in accordance with the procedure described in the relevant standards. The necessary risk reduction was implemented in the design and the corresponding warnings and requirements for the user are described in this manual. Please note that even with these measures, there is still a small residual risk to life and health of persons and take this into account as part of the risk evaluation for the plant/machine in which the CPU iC921xM-x is used.

1.4 Safety Information for Users

Handling of electrostatic sensitive modules

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

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

Measurements and alterations on electrostatic sensitive modules

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

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

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

1.5 Intended use

General

The product is exclusively designed and constructed for the intended use described in this manual. The product is intended used if all the notes and information of this manual are considered.

> WARNING
>
> **Danger by not intended use!**
>
> Each use of the product, which differs to the intended use can lead to dangerous situations.

Therefore

- Use the product only intended.
- Use the product only together with the recommended components.
- Consider all the data in this manual.
- Ensure that only qualified personnel work with/at the product. ➦ *'Education of the personnel'...page 13*
- Ensure during configuration that the product is operated within its specifications.
- Ensure that the power supply corresponds to the given specifications.
- Only use the product in a technically perfect condition.
- Only use the product in combination with approved components.
- Only use the product in an area of second type (industrial area). The product was developed such as this fulfils the requirements of the category C3. For operation an approved power supply (SELV/PELV) is necessary. Here With the usage of the product in an area of first type, category C2/C1 (living-, business and trade without an interstage transformator directly at a public low-voltage-system) the cabinet builder has to reduce the emission (conducted and radiated) by special measure steps, which are to be demonstrated, since it can come without any additional measures to EMC disturbances. Whether a products described here reaches category C2/C1 with additional measures, cannot be ensured.

Changes and modifications at the product

To avoid endangerments and to ensure the optimal power neither changes nor modifications may be made at the product, which are not specially approved by the manufacturer.

1.6 Responsibility of the user

General

The product is used in the commercial range. The user of the product is subject of the statutory duties to work safety. In addition to the safety instructions in this manual, for the usage environment of the product valid safety, accident prevention and environmental protection regulations must be adhered.

- The user must be informed about the valid industrial safety regulations and determine in an endangerment evaluation additionally dangers, which arise as a result of the special conditions for the product on the place of operation. This is to be transcribed with working instructions for the operation of the product.
- These working instructions must be kept in direct environment of the product and accessible at any time for people, which work with the product.
- The working instructions must fully be adhered.
- The product is only to be operated in a technically flawless condition.

1.7 Protective devices

Degree of protection

The place of installation of the CPU must comply for devices according to IP20.

⚠ WARNING

Serious danger due to improper use

Serious dangers for the user and/or damage to property can result from improper or non-intended use and manipulation of the CPU.

! NOTICE

Property damage due to incorrect use

The IP20 (IEC 60529/EN 60529) protection class of the CPU is intended for a clean and dry environment.

- Do not subject the CPU to mechanical and/or thermal stress that exceeds the limits described.
- Please note that you must install the CPU in a lockable housing or a lockable control cabinet with at least protection class IP54 for proper operation.

1.7.1 Notes on security

! NOTICE

Unauthorized physical access

There is a risk of manipulation of the CPU through unauthorised physical access.

- Protect your system from unauthorised physical access. Use a lockable control cabinet, for example.

! NOTICE

Unauthorized deletion/replacement of the safety-related project possible

- Only provide the roles for user authentication “Admin”, “Commissioner”, and “Engineer” to those users who are authorized to program the safety-related control. Otherwise, the unauthorised exchange or deletion of the safety-related project by the user cannot be ruled out. You can set user roles in the web-based management. ➦ *‘User Authentication’...page 200*
- It is imperative that you install the CPU and the modules in a row in a lockable housing or a lockable control cabinet. The device housing is not protected against manipulation and access to the CPU cannot be validated. Access to the SD card is possible so that data can be read and manipulated. We recommend protecting the slot of the parametrization memory (SD card) on the CPU against manipulation with a seal.

1.8 Education of the personnel

⚠ WARNING

Risk of injury resulting from insufficient qualification!

Improper use can cause considerable personal injury and material damage.

Therefore: The special activities may only be executed by personnel nominated by the respective chapters.

1.8.1 Qualification

In the manual the following qualifications for different activities are defined:

Operating personnel

The automation system may only be operated by persons, which are trained, instructed and authorized. Troubleshooting, maintenance, cleaning, maintenance and replacement must be performed only by skilled or trained personnel. These persons have to know the instruction manual and have to act accordingly. Commissioning and training should only be performed by qualified personnel.

Qualified personnel

These are electrical engineers and electricians of the customer or third party, which are authorized by the manufacturer and which have learned installation and commissioning by the manufacturer and are allowed to ground, mark and install electrical circuits and devices in accordance to the standard safety technology. Qualified personnel is trained and instructed according to the corresponding valid standards in safety technology in the care and use of appropriate safety equipment.

1.9 Personal protective equipment

General

During work, the wearing of personal protective equipment is needed to minimize health hazards.

- Always wear the necessary protective equipment for the corresponding job.
- For your own safety regard the signs, which are in your work space.

Work clothing

is close-fitting clothing with low tensile strength, with tight sleeves and without a protruding part. Depending on the application it should be prevented, that the carrier gets serious injured or is exposed to health risk during work. For reasons of injury no jewellery like rings and chains should be worn.

Protective helmet

for protection against falling and flying objects.

Safety shoes

for protection against falling heavy objects.

Protective gloves

to protect hands from friction abrasions, punctures or injuries, as well as from contact with hot objects.

Wear at special works: Eye protector

to protect eyes from flying parts and liquid splashes.

1.10 Special hazards

General

In the following section the residual risks are listed. Regard the listed safety warnings here and the notes in the whole manual to reduce health hazards and to avoid dangerous situations.

Electric current

> ⚠ DANGER
>
> Risk of death by electric current!
>
> Contact with live parts is immediate danger to life. Damage of the insulation or of components can be danger to life.

Therefore: Immediately turn off the power supply when the insulation is damaged. Work on the electrical system only by qualified personnel. Always power-off and secure the electrical system during the work on it.

Risk by residual energy

> ⚠ DANGER
>
> Risk of death by electric current!
>
> After disconnecting a device from main voltage, parts such as power connections should only be touched when the capacitors are discharged in the device.

Therefore: Regard discharge time of the capacitors, do not touch live parts before. Regard corresponding instructions on the device. If you have connected additional capacitors on the link, the discharge of the link can last considerably longer. In this case you have to determine the required waiting period or even to measure whether the device is free of voltage.

Moved objects

> ⚠ WARNING
>
> Risk of injury from moving parts!
>
> Rotary respectively linear moved parts can cause serious injuries.

Therefore: Do not touch moving parts during operation. Do not open the cover during operation. The mechanical residual energy depends on the application. Driven components rotate respectively move for a certain time even after switching off the power supply. Here serve for suited safety devices.

1.11 Fire fighting

> DANGER
>
> **Risk of death by electric current!**
>
> Risk of an electrical shock when using a conducting fire fighting medium.

Therefore use the following fire fighting medium:

ABC powder / CO2

1.12 Electrical safety

General

The safety CPU is designed according to IEC61131-2 for degree of pollution 2. This means only non-conductive pollution may occur during operation. Temporary conductivity by condensation is only allowed when the module is out of operation.

> WARNING
>
> **Risk of injury from conductive pollution!**
>
> During the operation there is no conductive pollution allowed.

Therefore: Before the system is installed check and guarantee if necessary by additional measures that the degree of pollution 2 is not exceeded (e.g. installation in a cubicle with degree of protection IP54 or better).

Installation and configuration

> WARNING
>
> **Incorrect installation and retrofitting can pose serious risks**
>
> - Devices and their installations in the system must be designed according to these requirements.
> - Existing plants and systems that are retrofitted must also be checked in this regard.

Note on power supply

> WARNING
>
> **Risk of injury by electric current!**
>
> Only devices with safe insulation from the 230V mains may be connected to the CPU. The power supply for generating the 24V power must correspond to the requirements for PELV/SELV according to EN 50178.

> WARNING
>
> **Hazardous shock currents and the loss of functional safety**
>
> Disregarding instructions for electrical safety may result in hazardous shock currents and the loss of functional safety.
>
> In order to ensure electrical safety, please observe the following points:
>
> - Direct/indirect contact
> - Safe isolation

Direct/indirect contact

Ensure protection against direct and indirect contact in accordance with VDE 0100 Part 410 (IEC 60364-4-41) for all components connected to the system. In the event of a fault, parasitic voltages must not occur (single fault security). This also applies to devices and components with dangerous touch voltages that are permanently connected to network and/or diagnostic interfaces of the devices used.

Safe isolation

Only use units with safe isolation if dangerous contact voltages can occur at their connections during normal operation or as a result of an insulation error.

1.13 Safety facilities

> ⚠ WARNING
>
> **Risk of death by non-functioning safety facilities!**
>
> Safety facilities serve for maximum safety during operation. Even if by safety facilities working process become complicated, its never allowed to circumvent them. The security is guaranteed only when the safety facilities are intact.

Therefore: Before beginning the work check whether the safety facilities are installed properly and functional.

1.14 Behavior with dangers and accidents

Preventive measures

- Always be prepared for accidents or fire!
- First-aid equipment (first aid kit, blankets etc.) and keep fire extinguisher handy.
- Make Personal with accident message, first-aid and rescue mechanisms familiar.

In case of emergency: act correctly

- Set immediately the device with emergency stop out of operation.
- Initiate first-aid measures.
- Rescue persons from the danger zone.
- Inform responsible on-site.
- Alarm medical and / or fire department.
- Make free the access routes for emergency vehicles.

1.15 Sign-posting

> ⚠ WARNING
>
> **Danger of injury by illegible symbols**
>
> In course of time stickers and symbols on the devices can get dirty or otherwise become unrecognizable.

Therefore: Please hold all the safety warnings and operation instructions on the device in always well readable condition.

1.15.1 Signs

The following symbols and signs are in the work space. They refer to the direct environment in which they are attached.

Electrical voltage

In the such marked work space only qualified personnel may work. Unauthorized may not touch the marked equipment.

> DANGER
>
> **Danger of life by electrical power!**
>
> Time for discharge > 1 Minute
>
> Stored electrical charge

Therefore: Consider discharge time of capacitor and do not touch live parts before. Consider appropriate instructions on the device. If you have connected additional capacitors at DC, the discharge of the DC link can last longer. In this case you have to determine respectively to measure the required waiting time whether the device is free of voltage.

1.16 Safety hints

The CPU represents the current state of the art and fulfill the valid safety regulations and the appropriate harmonized, European standards (EN)

For the user additionally is valid the:

- relevant rules for the prevention of accidents
- EG directives or other country-specific regulations
- generally accepted safety rules
- general ESD regulations

Disturbances of any kind or other damage must be reported to a responsible person. Protective and safety equipment must not be circumvented or bypassed. Dismounted protective equipment must be mounted and functionally tested before a restart. The modules are to be secured against misuse or accidental use. Original mounted signs, labels, stickers are to be always considered and be held in a readable condition.

1.17 Approvals, directives, standards

Conformity and approval		
Conformity		
CE	2014/30/EU	EMC Directive
	2006/42/EC	Machinery Directive
RoHS (EU)	2011/65/EU	Restriction of the use of certain hazardous substances
UKCA	2016 No. 1091	Electromagnetic Compatibility Regulations
	2008 No. 1597	Supply of Machinery (Safety) Regulation
RoHS (UK)	2012 No. 3032	Use of Certain Hazardous Substances

Protection of persons and device protection		
Type of protection	-	IP20
Electrical isolation		
to the field bus	-	electrically isolated
to the process level	-	electrically isolated
Insulation resistance	EN 61131-2	-
Insulation voltage to reference earth		
Inputs / outputs	-	AC / DC 50V, test voltage AC 500V
Protective measures	-	against short circuit

Environmental conditions to EN 61131-2		
Climatic		
Storage / transport	EN 60068-2-14	-40…+70°C
Operation		
Horizontal installation hanging	EN 61131-2	0…+60°C
Vertical installation	EN 61131-2	0…+55°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 (IP54 or better)
Mounting position	-	Horizontal hanging ➦ *'Assembly possibilities'...page 32*

Approvals, directives, standards

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 1.4GHz ... 6.0GHz, 3V/m
		EN 61000-4-6	HF conducted 150kHz … 80MHz, 10V
		EN 61000-4-4	Burst, degree of severity 3
		EN 61000-4-5	Surge, degree of severity 3[1]

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

Example of lightning protection conductors			
Application	Vendor	Article	Description
Feed	Dehn	BLITZDUCTOR VT BVT AVD 24	External Lightning protection (DC24V/10A)
Digital inputs, test pulse outputs	Dehn	DEHNconnect RK DCO RK ME 24	External Lightning protection (DC24V/0.5A)
Digital outputs	Dehn	DEHNconnect RK DCO RK D 5 24	External Lightning protection (DC24V/10A)
EtherCAT interface	Dehn	DEHNpatch DPA M CLE RJ45B 48	External Lightning protection (RJ45/48V)

Norms and standards	
DIN EN 61508 part 1-7	Functional safety of electrical/electronic/programmable electronic safety-related systems
DIN EN ISO 13849-1	Safety of machinery: Safety-related parts of control systems
DIN EN 61784-3	Functional safety field buses - General rules and profile definitions
DIN EN 60204-1	Electrical equipment of machines
DIN EN 61131-2	Programmable logic controllers, part 2: Equipment requirements and tests
DIN EN 61000-4-11	Mains voltage variation
Row SN 29500	Failure rate, component, expected value, reliability
DIN EN 61496-1	Electro sensitive protective equipment

Requirements to clearance / creep-age current distances and system power supply	
DIN EN 61131-2	The definition of clearance and creep-age current distances takes place in accordance to EN 61131-2. For the safe field bus coupler over-voltage category 2 and degree of pollution 2 are basis.
DIN EN 13849	The acceptance of error exclusions for short-circuits between neighbouring conductor or for short-circuits between neighbouring components must be avoided as far as possible by suitable circuit and layout measures. If an error exclusion is inevitable, measures are to be used in accordance with EN 13849 part of 2.
DIN EN 50178	The device is developed for operation on 24V power supplies, which correspond to the PELV-/SELV regulations in accordance to EN 50178.
DIN EN 61508	The normative requirements of the 61508 (increased EMC requirements and requirements concerning isolation) are to be fulfilled also for the common voltage circuit of the SLIO system.
DIN EN 50178	So that the electrical values for extra-low voltage with safe separation cannot be exceeded on the safe field bus coupler, for the system 24V power supplies are exclusively used, which correspond to the PELV /SELV regulations in accordance with EN 50178.
	In order to protect the safe field bus couplers against over-voltage, a suitable over-voltage protection is provided.
DIN EN 60204-1	The 24V power supply must keep the voltage interrupt according to EN 60204-1.

Requirements for environmental and EMC testing	
DIN EN 61131-2	Programmable logic controllers, part 2: Equipment requirements and tests
DIN EN 62061 Appendix E	For higher EMC immunity tests DIN EN 61326-3-1:2017 is applied.

1.18 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*

2 Basics and mounting

2.1 Safety notes for the user

DANGER

Safety instructions

Observe the following safety instructions! Disregarding these safety regulations may result in death, serious personal injury or damage to equipment.

- Personal and property protection are only guaranteed if the CPU is used in accordance with its intended use.
- Observe the safety regulations of electrical engineering and the employer's liability insurance association!
- Only perform work on the CPU when the power is switched off!
- The CPU may only be installed by qualified personnel in accordance with the specifications in the corresponding documentation.
- Electrical work may only be performed by qualified electricians.
- The CPU may only be commissioned by a person responsible for the safety of the system. Only this person may connect the supply voltage.
- Observe the necessary precautions when handling electrostatically sensitive components (EN 61340-5-1, IEC 61340-5-1)!
- Repairs to the CPU, particularly the opening of the housing, must only be performed by the manufacturer.
- Keep the operating instructions!
- The operator of the CPU or plant is subject to the legal obligations regarding safety at work. The Machinery Directive must therefore be taken into account.

DANGER

Protection against dangerous voltages

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

WARNING

Safety instructions for starting applications

When configuring the start conditions for your plant, take into account:

- The machine or plant may only be started when it has been ensured that no one is in the danger zone.
- Comply with the requirements of EN ISO 13849-1 with regard to the manual reset function. In this way, no machine movement may be initiated and or dangerous situations may be caused, caused by e.g.:
  - Switching on devices
  - Acknowledgement of device error messages
  - Acknowledgement of block error messages in the application
  - Removal of start-up barriers

Please also consider these instructions in order to exclude an unexpected machine start after acknowledgement with an "Operator Acknowledgement"!

2.1.1 Handling and transport

Handling of electrostatic sensitive modules

NOTICE

Electrostatic discharge

The CPU contains components that can be damaged or destroyed by electrostatic discharge.

– When handling the CPU, observe the necessary safety measures against electrostatic discharge (ESD) in accordance with EN 61340-5-1 and IEC 61340-5-1.

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.

NOTICE

Material damage due to non-observance of ESD instructions

If you do not follow the ESD instructions when unpacking and packing, damage to the CPU may occur.

– Please note the ESD instructions when unpacking and packing the CPU.

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

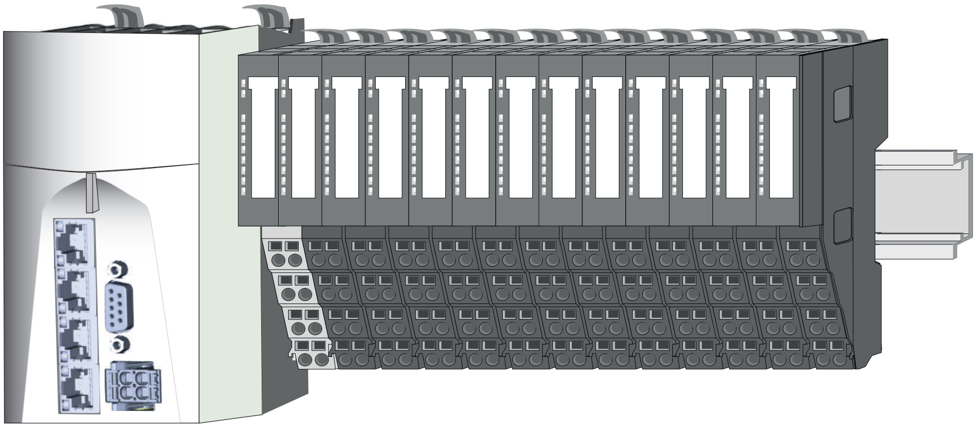
When working with and on electrostatic sensitive modules, make sure that personnel and equipment are adequately grounded.

2.2 System conception

2.2.1 Overview

The *iC9200 Series* is a modular automation system for assembly on a 35mm mounting rail. Due to the compatibility to the System SLIO from Yaskawa you can adapt this system exactly to your automation tasks by using the System SLIO periphery modules in 2-, 4-, 8- and 16-channel versions. An additional PCIe bus makes the system future-proof for future expansions.

More detailed information about the usage of the System SLIO modules may be found in the according manual in the 'Download Center' of www.yaskawa.eu.com under the corresponding order number.



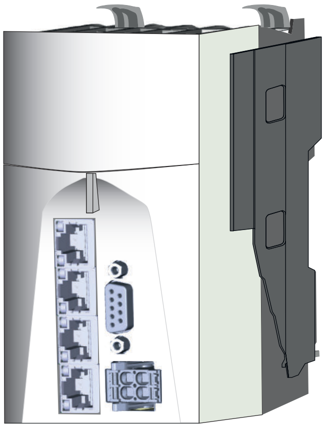
2.2.2 Components

- CPU (head module)
- Power modules
- 8x periphery modules
- 16x periphery modules
- Accessories

CAUTION

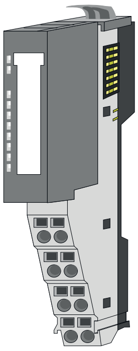
Only modules of Yaskawa may be combined. A mixed operation with third-party modules is not allowed!

CPU iC921xM-x



With the CPU iC921xM-x CPU electronics and power supply are integrated in one housing. The CPU is programmed and configured with iCube Engineer from Yaskawa in IEC 61131-3 . The CPU has a PCIe bus on the left for future expansions. On the right side via the *SliceBus* you can connect System SLIO periphery modules from Yaskawa. As head module via the integrated power module for power supply CPU electronic as well as the electronic of the periphery modules, which are connected via the *SliceBus*. For the connection of the power supply the CPU has a removable connector. To supply the power section of the connected periphery modules, you must always plug in the power module 007-1AB00 - DC 24V 10A directly after the CPU.

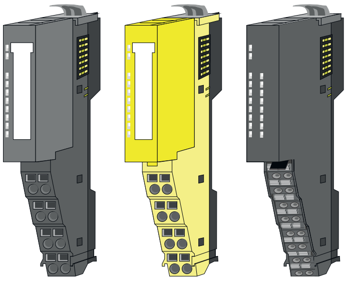
Power modules



When using System SLIO modules, you must always mount the power module 007-1AB00 - DC 24V 10A, because the CPU does not provide a power section supply due to the system.

The color-coded power modules are used when the CPU does not provide power section supply, like the CPU iC921xM-x. These are also to be used if the power section supply of the I/O level or the electronic power supply is no longer sufficient. Depending on the power module used, you have the option of forming isolated groups. The power modules are to be supplied externally with DC 24V. Each power module has over voltage and reverse polarity protection.

Periphery modules

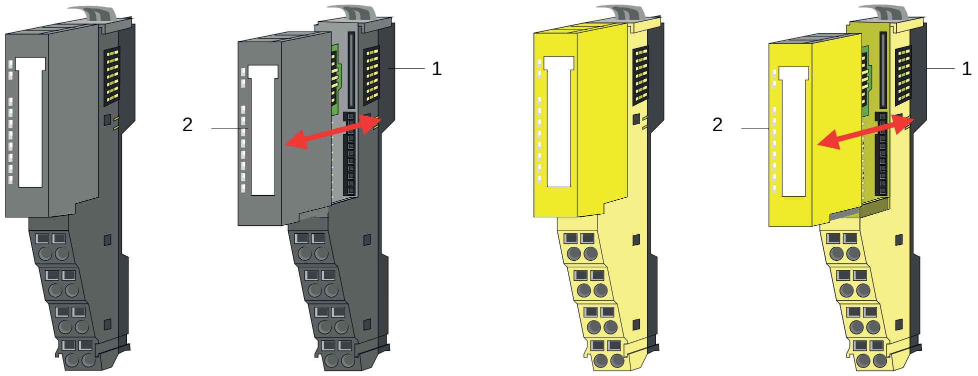


The periphery modules are available in the following versions, whereby of each the electronic part can be replaced with standing wiring:

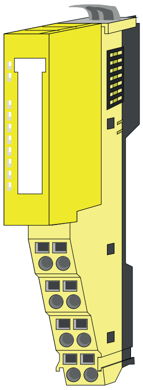
- 8x periphery modules for a maximum of 8 channels.
  - Standard periphery modules
  - Safety periphery modules
- 16x periphery module for a maximum of 16 channels.

8x periphery modules

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

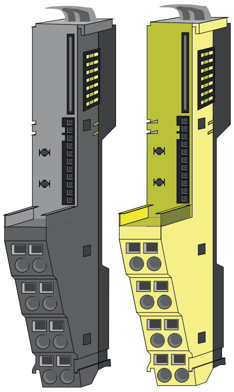


1 Terminal module
2 Electronic module



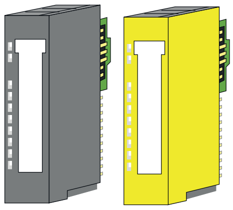
According to structure and dimensions the *safety periphery modules* correspond to the standard periphery modules of the System SLIO. For better recognition the color of the safety modules is yellow. Please consider that the safety electronic module may only be used at an yellow terminal module! The operation with mechanical compatible terminal modules is not allowed.

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 it at a mounting rail. By means of this locking system your system may be assembled outside of your switchgear cabinet to be later mounted there as whole system.

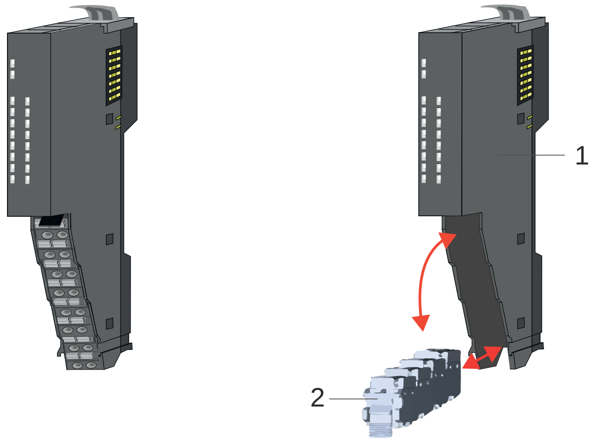
Electronic module



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. Here the wiring persists. At the front side there are LEDs for status indication. For easy wiring, you will find the corresponding connection information for each electronic module on the front and on the side.

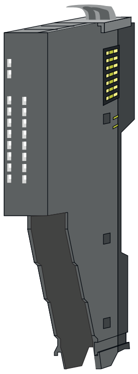
16x periphery modules

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



1 Electronic unit
2 Terminal block

Electronic unit



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

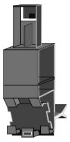
Terminal block

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

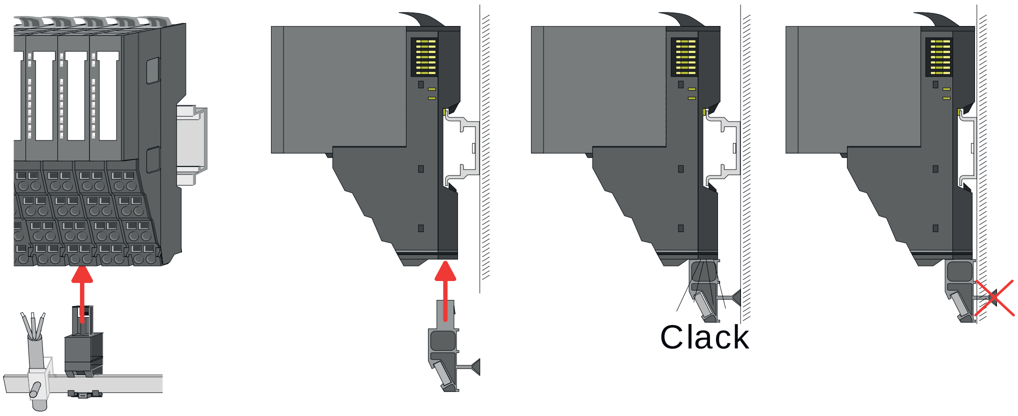
2.2.2.1 Accessories

Shield bus carrier

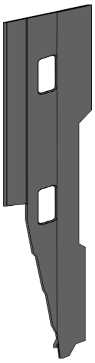
> *Please note that no shield bus carrier can be mounted on the CPU iC921xM-x and a 16x periphery module!*



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



Bus cover



With each head module, to protect the backplane bus connectors, there is a mounted bus cover in the scope of delivery. You have to remove the bus cover of the head module before mounting a System SLIO module. For the protection of the backplane bus connector you always have to mount the bus cover at the last module of your system again. The bus cover has the order no. 000-0AA00.

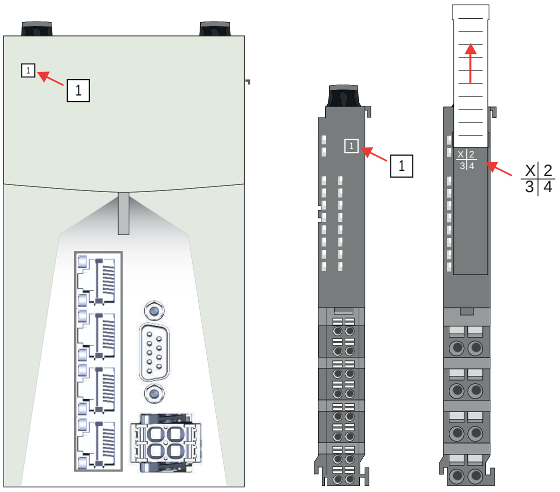
Coding pins

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

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

2.2.3 Hardware revision

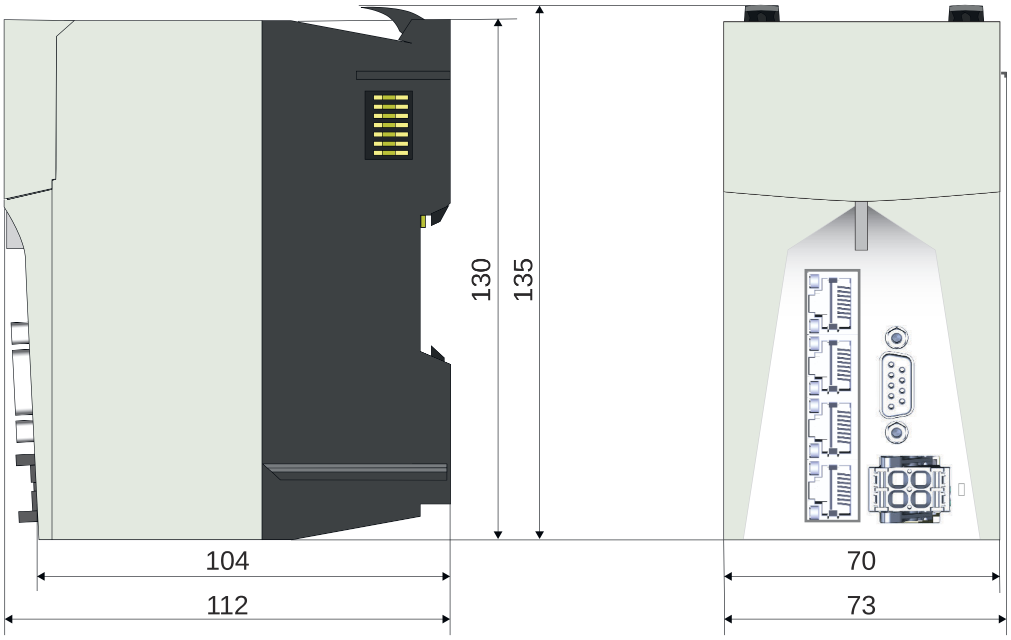
- The hardware revision is printed on every module.
- Since a System SLIO 8x periphery module consists of a terminal and electronic module, you will find a hardware revision printed on each of them.
- Authoritative for the hardware revision of a System SLIO module is the hardware revision of the electronic module. This is always 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 $\boxed{1}$ on the front.
  - With earlier labelling, the 1 is marked with *'X'* on a number grid.



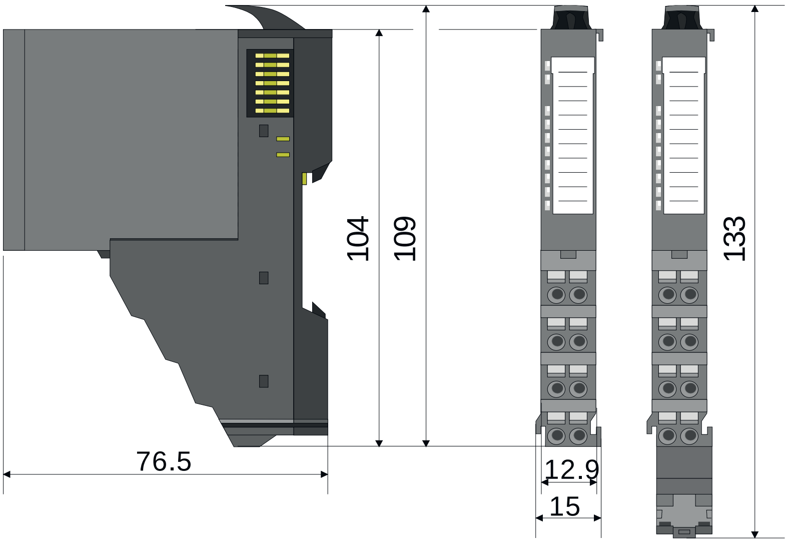
2.3 Dimensions

CPU iC921xM-x

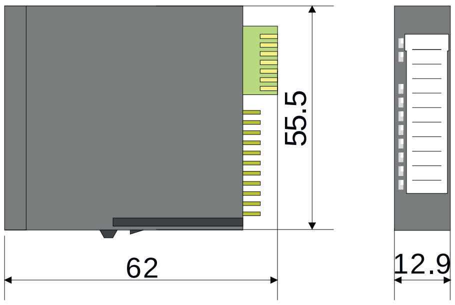
All dimensions are in mm.



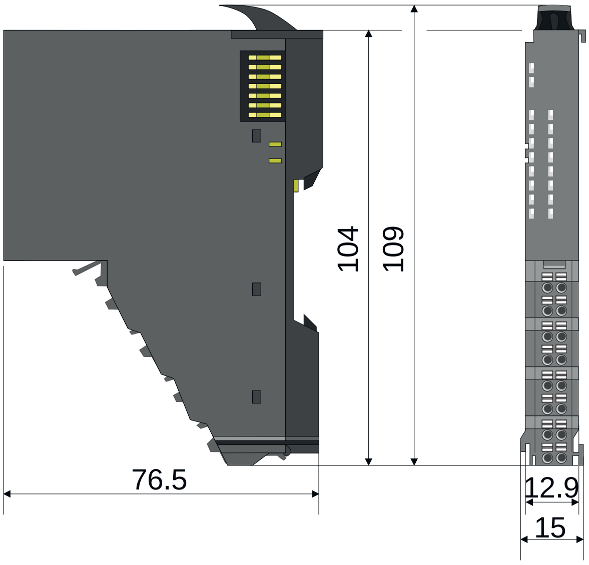
8x periphery module



electronic module



16x periphery module



2.4 Mounting

WARNING

Unintentional machine start-up

- Do not mount or dismount when the power is on!
- Disconnect the CPU from the power supply before mounting or dismounting and secure the power supply against being switched on again!
- Do not switch on the power supply until the system has been completely mounted. Pay attention to the diagnostic indicators and any diagnostic messages.
- The machine/plant may only be started when no hazard can result from the machine/plant.

NOTICE

Electronic damage due to insufficient external fuse protection - No safe release in the event of a fault

Insufficient external fusing will cause electronic damage to the CPU.

- Fuse the supply voltage externally according to the connected load (number of System SLIO F participants/sum of current consumption of each participant).
- Ensure safe triggering of the external fuse.
- If you use a melting fuse, the power supply unit must be able to supply four times the rated current of the melting fuse. This ensures safe triggering in the event of an error.

NOTICE

Damage due to improper handling

- Handle the CPU and components with care!
- When installing the CPU and components, ensure that mechanical damage is avoided!

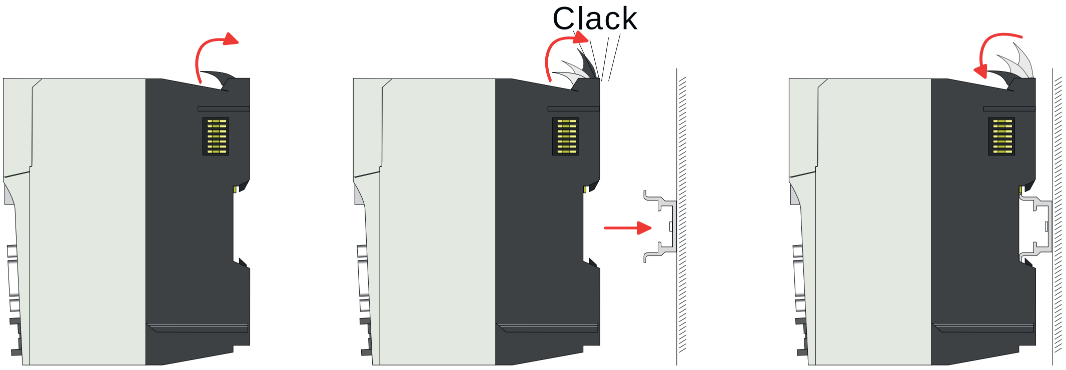
Note on mounting

- *Mount the CPU in a closed control cabinet or control box with degree of protection IP54 or higher on a 35 mm standard mounting rail.*
- *Use a mounting rail according to EN 60715.*

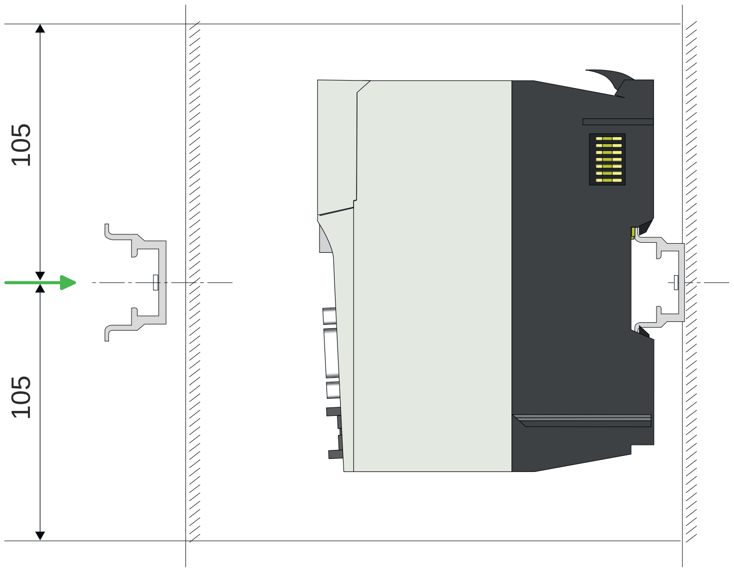
2.4.1 Mounting CPU

Functional principle

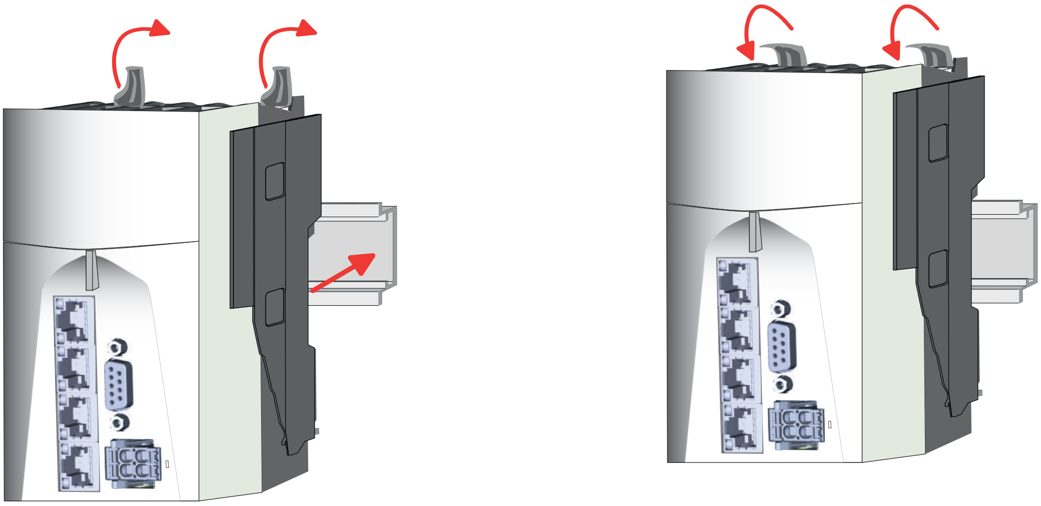
There are locking lever at the top side of the CPU. For mounting and demounting these locking lever are to be turned upwards until these engage. Place the CPU at the mounting rail. The CPU is fixed to the mounting rail by pushing downward the locking levers. The CPU is directly mounted at a mounting rail. Up to 64 System SLIO modules may be mounted. The electronic power supply for the modules is connected via the connection to the backplane bus. The power module 007-1AB00 must always be installed for the power section supply of the modules.



Proceeding



1. Mount the mounting rail! Please consider that a clearance from the middle of the mounting rail of at least 105mm above and below exists.

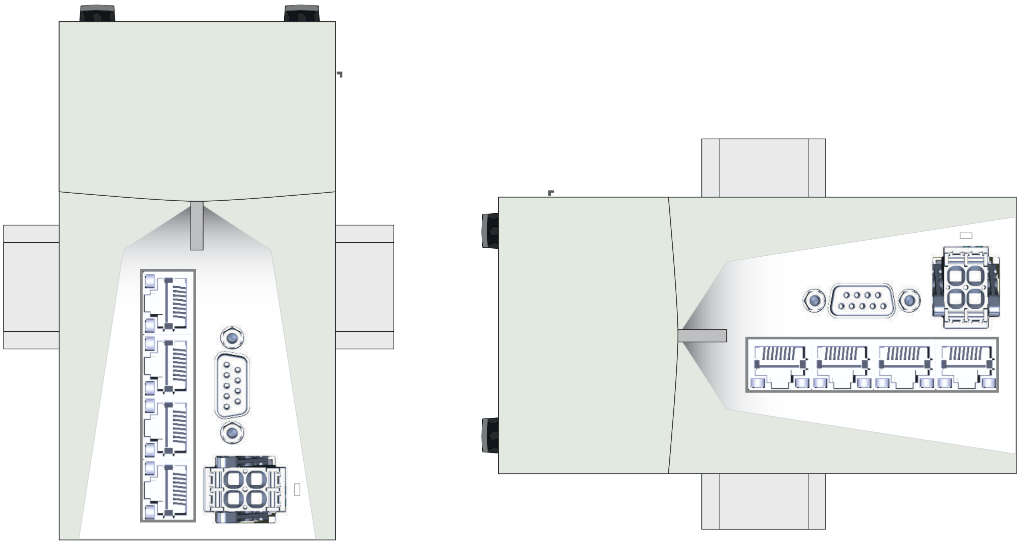


2. Turn the locking lever upwards, place the CPU at the mounting rail and turn the lever downward.

➡ If you want to use the CPU without periphery modules, you can wire it now.

Assembly possibilities

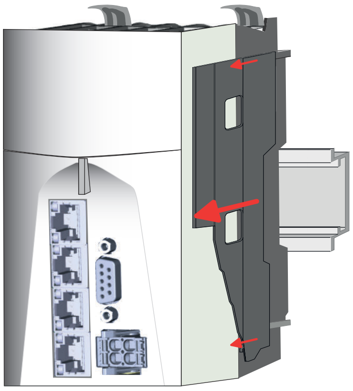
Horizontal hanging or vertical hanging:



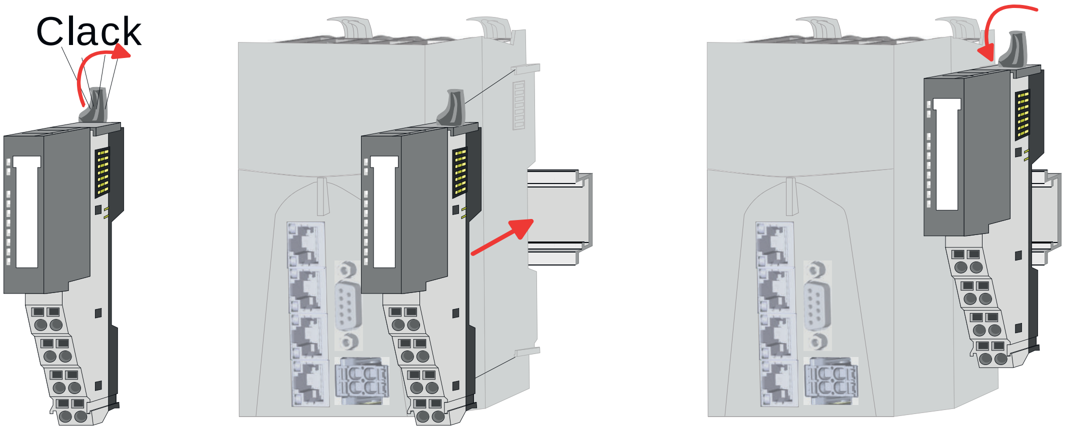
2.4.2 Mounting periphery modules

> *When using System SLIO modules, you must always mount the power module 007-1AB00 - DC 24V 10A, because the CPU does not provide a power section supply due to the system.*

Mounting power module 007-1AB00



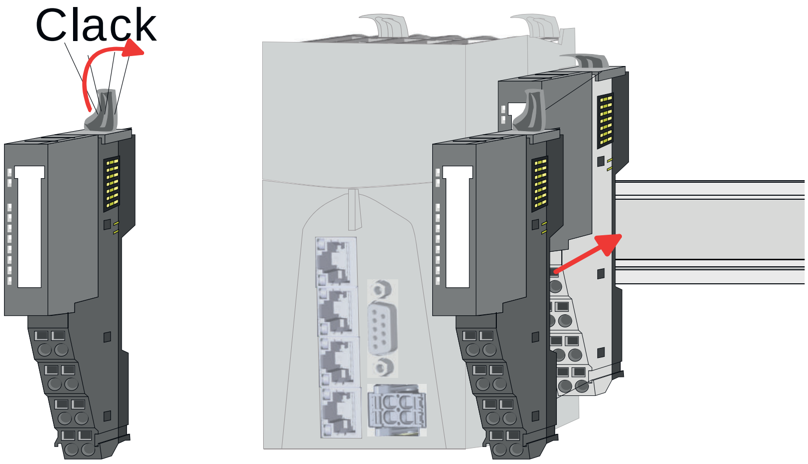
1. Before mounting the periphery modules you have to remove the bus cover at the right side of the CPU by pulling it forward. Keep the cover for later mounting.



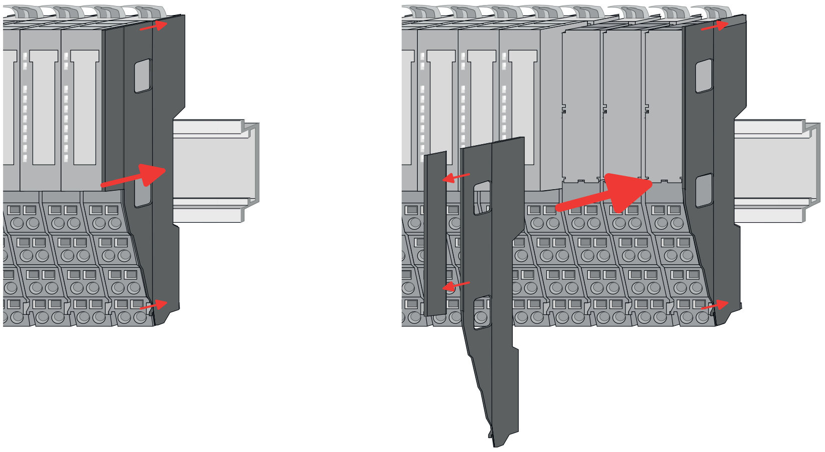
2. Mount the periphery modules you want.

Mounting periphery modules

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



1. Mount the periphery modules you want.



2. 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.

➡ The system can now be wired.

2.5 Wiring

CAUTION

Consider temperature for external cables!

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

CAUTION

Electrical safety - loss of safety function when using unsuitable power supplies

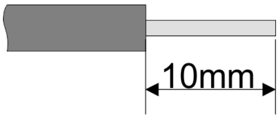
- Only devices with safe insulation from the 230V mains may be connected to the CPU.
- The power supply for generating the DC 24V power must correspond to the requirements for PELV/SELV according to EN 50178. In these, a short circuit between the primary and secondary sides is excluded.

2.5.1 Wiring CPU

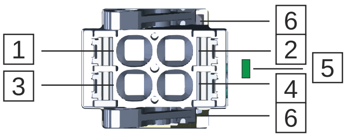
CPU connector

The CPU has a removable connector for the power supply. With the wiring of the connector a "push-in" spring-clip technique is used. This allows a quick and easy connection of your supply lines. The wires are disconnected by means of a screwdriver.

Data



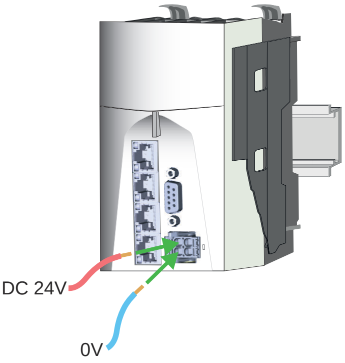
U_{max}	30V DC
I_{max}	10A
Cross section	0.08 ... 1.5mm^2 (AWG 28 ... 16)
Stripping length	10mm



1, 2 Plus DC 24V power supply, bridged in the plug.
3, 4 Ground DC 24V power supply, bridged in the plug.
5 LED indication for power supply.
6 Locking lever

Plug wire

The wiring happens without a tool.



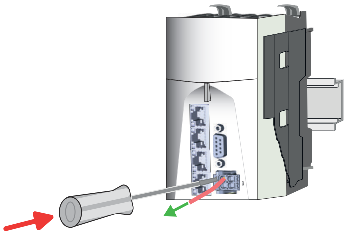
1. Insert through the round connection hole of the according contact your prepared wire until it stops, so that it is fixed.

   ➡ By pushing the contact spring opens, thus ensuring the necessary contact pressure.
2. Determine the pin position according to the pin assignment.
3. Connect the positive pole (+) of your external DC 24V power supply to pin 1 or pin 2.
4. Connect the minus pole (0V) of your external DC 24V power supply to pin 3 or pin 4.

   ➡ As soon as the CPU is power supplied, the associated LED lights up.

Remove wire

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

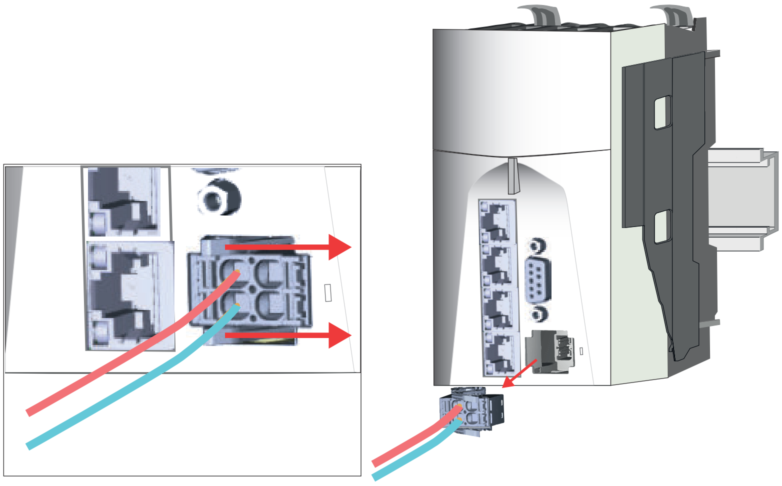


1. Press with your screwdriver vertically at the release button.

   ➡ The contact spring releases the wire.
2. Pull the wire from the round hole.

Remove connector

You have the option to remove the connector of the power supply, e.g. for a module change with fixed wiring. For this the connector has a locking lever. The connector is removed as follows:



1. Remove connector:

   By pressing the release button as shown, the connector is released and can be removed.
2. Plug connector:

   The connector is plugged by plugging it directly into the release lever. Here, the locking levers return to their original position.

2.5.2 Wiring System SLIO periphery

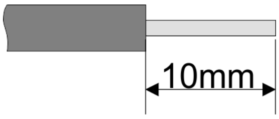
When using System SLIO modules, you must always mount the power module 007-1AB00 - DC 24V 10A, because the CPU does not provide a power section supply due to the system.

2.5.2.1 Wiring power module

Terminal module terminals

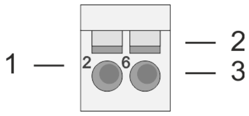
With the power module, terminals with spring clamp technology are used for wiring. The spring clamp technology allows quick and easy connection of your supply lines. In contrast to screw terminal connections this type of connection is vibration proof.

Data

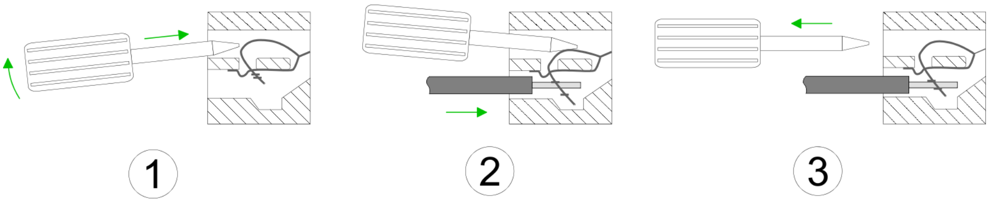


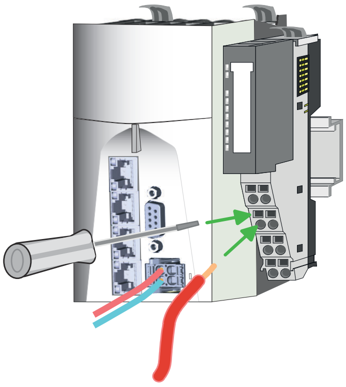
U_{max}	30V DC
I_{max}	10A
Cross section	0.08 ... 1.5mm² (AWG 28 ... 16)
Stripping length	10mm

Wiring proceeding



1 Pin no. at the connector
2 Opening for screwdriver
3 Connection hole for wire



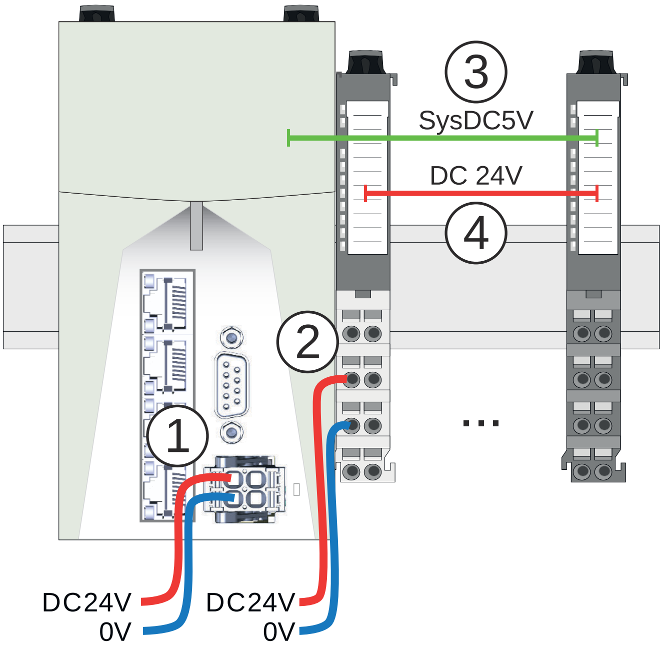


1. Insert a suited screwdriver at an angel into the square opening as shown. Press and hold the screwdriver in the opposite direction to open the contact spring.

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.

Standard wiring



(1) DC 24V supply CPU:
DC 5V electronic section supply I/O area (max. 2A)
(2) Power module 007-1AB00:
DC 24V power section supply (max. 10A)
(3) DC 5V electronic section supply I/O area
(4) DC 24V power section supply I/O area

> ⚠ 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!

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 section supply for CPU an I/O area with a 2A fuse (fast) respectively by a line circuit breaker 2A characteristics Z.

State of the electronic power supply via LEDs

After PowerON the RUN respectively MF LED at every System SLIO module is on, so far as the sum current does not exceed the maximum value. With the CPU this is 3A. If the total current exceeds the maximum value, the LEDs are no longer triggered. Here the power module with the order number 007-1AB10 is to be placed between the periphery modules.

2.5.2.2 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!

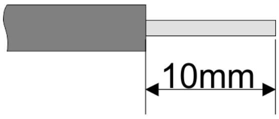
CAUTION

Danger of injury from electrical shock and damage to the CPU respectively to the modules!

Put the iC9200 Series in a safe, powered down state before starting installation, disassembly or wiring of the iC9200 Series modules!

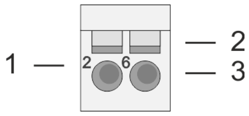
With wiring the terminal modules, terminals with spring clamp technology are used for wiring. The spring clamp technology allows quick and easy connection of your signal and supply lines. In contrast to screw terminal connections this type of connection is vibration proof.

Data

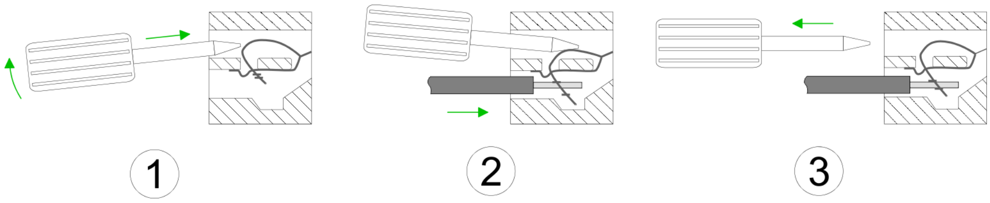


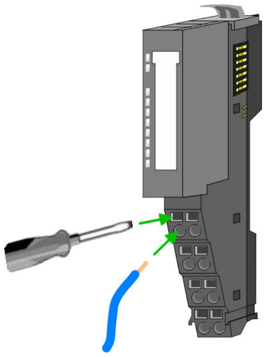
U_{max}	240V AC / 30V DC
I_{max}	10A
Cross section	0.08 ... 1.5mm² (AWG 28 ... 16)
Stripping length	10mm

Wiring proceeding



1 Pin no. 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.

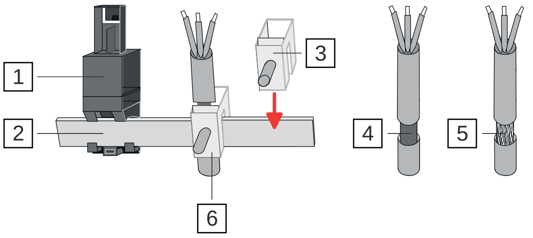
2. Insert the stripped end of wire into the round opening. You can use wires with a cross section of 0.08mm² up to 1.5mm².

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

2.5.2.2.1 Shielding

Overview

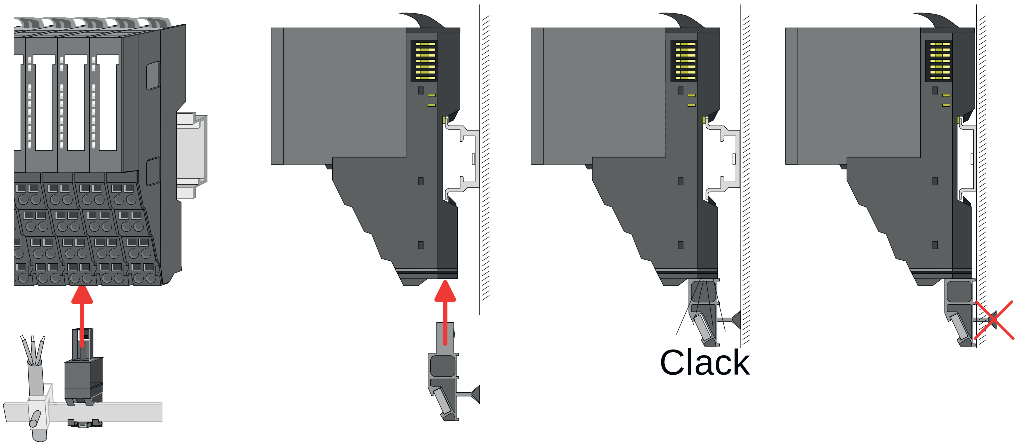
Shielding is required for interference-free signal transmission. This weakens electrical, magnetic or electromagnetic interference fields. To attach the shield the mounting of shield bus carriers are necessary. The shield bus carrier (available as accessory) serves to carry the shield bus to connect cable shields. ➦ *'Installation guidelines'...page 53*



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

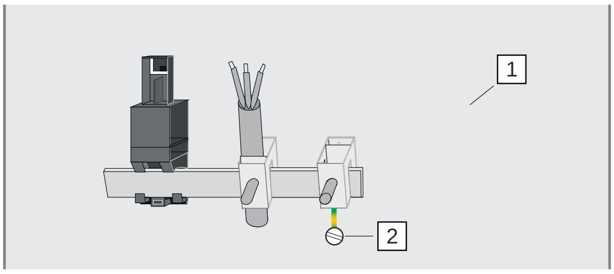
Shield attachment

1. Each iC9200 Series 8x periphery module has a carrier hole for the shield bus carrier. Push the shield bus carrier, until they engage into the module. With a flat mounting rail for adaptation to a flat mounting rail you may remove the spacer of the shield bus carrier.
2. Put your shield bus into the shield bus carrier.



3. Attach the cables with the accordingly stripped cable screen and fix it by the shield clamp with the shield bus.
4. The shield bus must always be earthed. Keep all cable connections as short as possible. To earth the shield bus, connect a PE 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 PE conductor screwed to base plate

2.5.2.3 Wiring 16x periphery modules

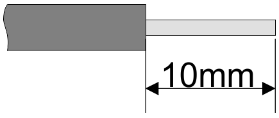
Terminal block connectors

> ⚠ 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 CPU respectively to the modules!**
>
> Put the iC9200 Series in a safe, powered down state before starting installation, disassembly or wiring of the iC9200 Series modules!

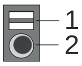
- The 16x periphery module has a removable terminal block for wiring.
- With the wiring of the terminal block a "push-in" spring-clip technique is used. This allows a quick and easy connection of your signal and supply lines.
- The clamping off takes place by means of a screwdriver.
- Please use copper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

Data



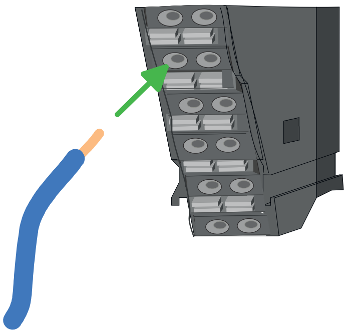
U_{max}	30V DC
I_{max}	10A
Cross section solid wire	0.25 ... 0.75mm^2
Cross section with ferrule	0.14 ... 0.75mm^2
Wire type	CU
AWG	24 ... 16
Stripping length	10mm

Wiring procedure



1 Release area
2 Connection hole for wire

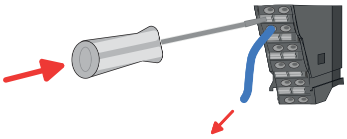
Insert wire



The wiring happens without a tool.

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

Remove wire



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

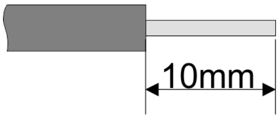
1. Press with your screwdriver vertically at the release button.
   ➡ The contact spring releases the wire.
2. Pull the wire from the round hole.

2.5.2.4 Wiring power modules

Terminal module terminals

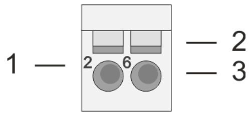
Power modules can be plugged between the periphery modules. With power modules, terminals with spring clamp technology are used for wiring. The spring clamp technology allows quick and easy connection of your signal and supply lines. In contrast to screw terminal connections this type of connection is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

Data

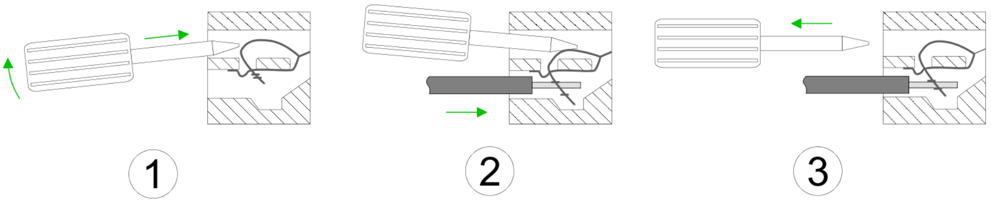


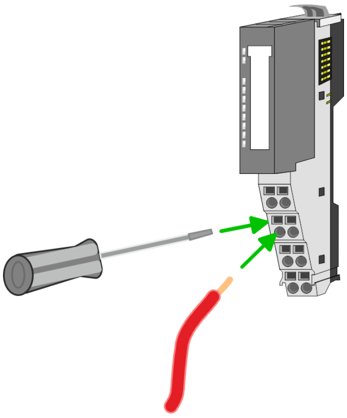
U_{max}	30V DC
I_{max}	10A
Cross section	0.08 ... 1.5mm^2 (AWG 28 ... 16)
Stripping length	10mm

Wiring procedure



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





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

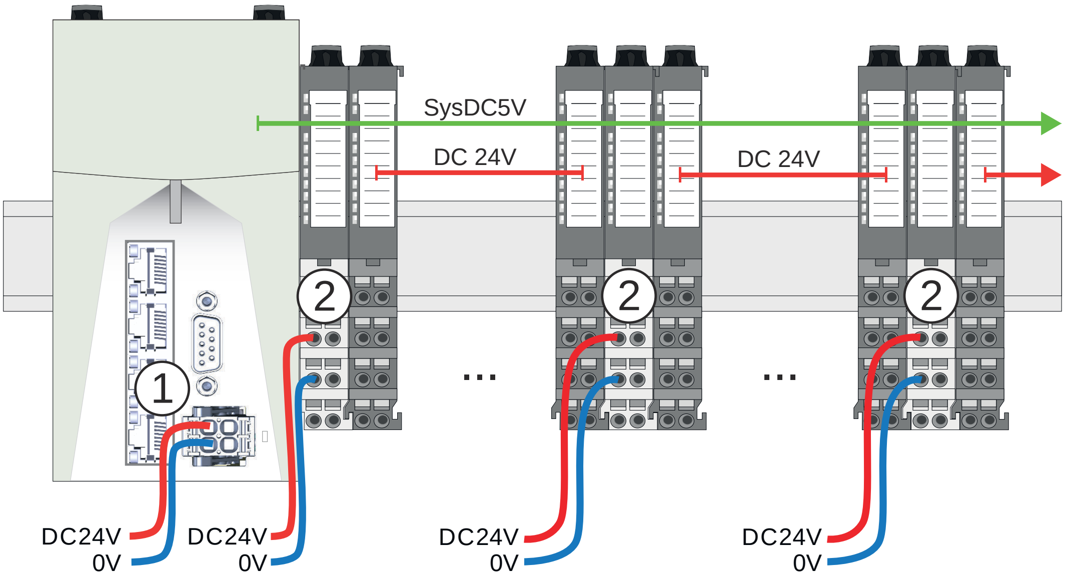
2. Insert the stripped end of wire into the round opening. You can use wires with a cross section of 0.08mm^2 up to 1.5mm^2

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

Deployment of the power modules

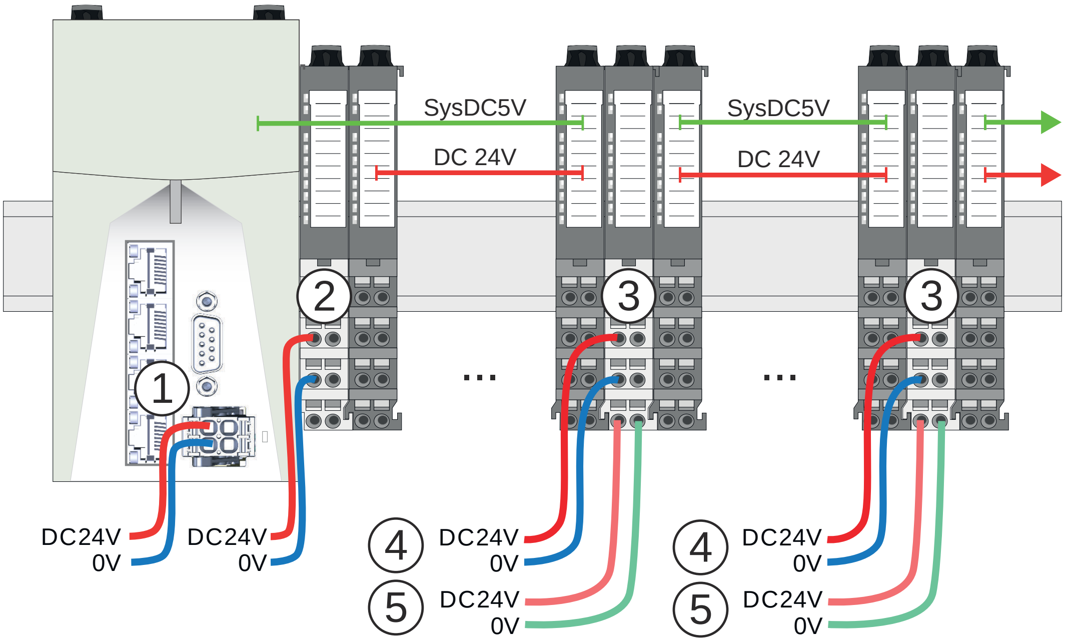
- The CPU does not provide a power section supply for the periphery modules. By plugging the power module with the order no. 007-1AB00 the succeeding periphery modules get a DC 24V power section supply with max. 10A. If the 10A are no longer sufficient, another power module must be plugged. So you have also the possibility to define isolated groups.
- The periphery modules get their electronic power supply from the CPU with max. 3A. 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 a new isolated group for the DC 24V power section supply with max. 4A.
- By plugging the power module 007-1AB10, modules with a maximum total current of the power section supply of 2A can be plugged at the succeeding backplane bus. 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



(1) DC 24V supply CPU:
DC 5V electronic section supply I/O area (max. 2A)
(2) Power module 007-1AB00:
DC 24V power section supply (max. 10A)

Power module 007-1AB10



(1) DC 24V supply CPU:
DC 5V electronic section supply I/O area (max. 2A)
(2) Power module 007-1AB00:
DC 24V power section supply (max. 10A)
(3) Additional power module 007-1AB10:
(4) DC 24V power section supply (max. 4A)
(5) DC 5V electronic section supply I/O area (max. 2A)

⚠ CAUTION

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

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

Fusing

- The power section supply is to be externally protected with a fuse, which corresponds to the maximum current. This means max. 10A is to be protected with a 10A fuse (fast) respectively by a line circuit breaker 10A characteristics Z!
- It is recommended to externally protect the electronic power section supply for CPU an I/O area with a 2A fuse (fast) respectively by a line circuit breaker 2A characteristics Z.

State of the electronic power supply via LEDs

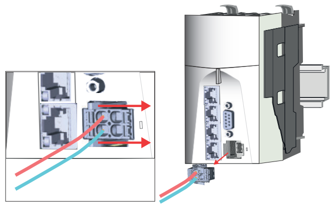
After PowerON the RUN respectively MF LED at every System SLIO module is on, so far as the sum current does not exceed the maximum value. With the CPU this is 3A. If the total current exceeds the maximum value, the LEDs are no longer triggered. Here the power module with the order number 007-1AB10 is to be placed between the periphery modules.

2.6 Demounting

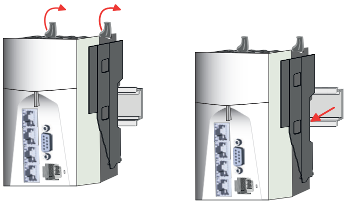
2.6.1 Demounting CPU

Demounting in standalone operation

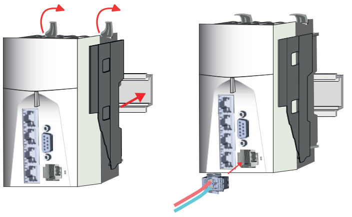
1. Power-off your system.



2. Remove the connector of the power supply of the CPU. By pressing the release button as shown, the connector is released and can be removed.



3. Turn all the locking lever of the CPU upwards.
4. Pull the CPU forward.

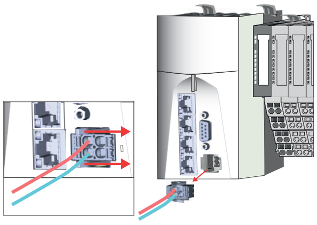


5. Turn the locking lever of the CPU to be mounted upwards, place the CPU at the mounting rail and turn the lever downward.
6. Reconnect the connector of the power supply.

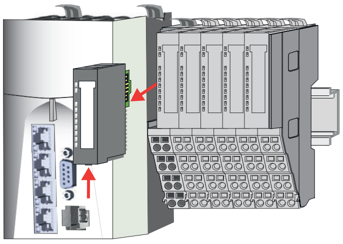
7. Now you can bring your system back into operation.

Demounting on System SLIO

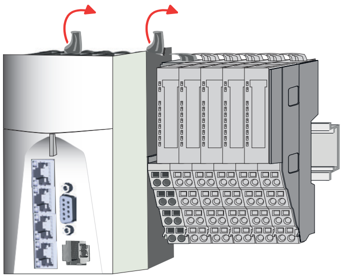
1. Power-off your system.



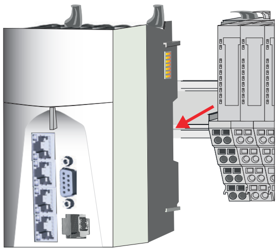
2. Remove the connector of the power supply of the CPU. By pressing the release button as shown, the connector is released and can be removed.



3. For mounting reasons you have to remove the electronic module of the power module located right beside the CPU. Press the unlocking lever at the lower side of the power module and pull it forward.

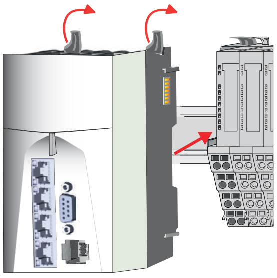


4. Turn all the locking lever of the CPU to be exchanged upwards.



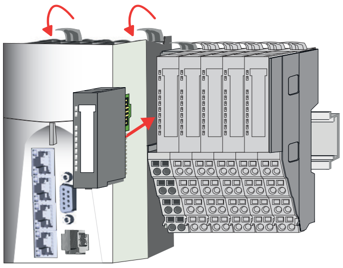
5. Pull the CPU forward.

6. For mounting turn all the locking lever of the CPU to be mounted upwards.

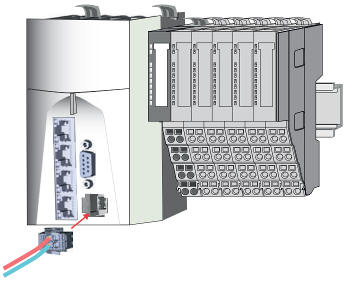


7. To mount the CPU put it to the left periphery module and push it, guided by the stripes, to the mounting rail.

8. Turn all the locking lever downward, again.



9. Plug again the electronic module, which you have removed before. For installation plug the electronic module guided by the strips at the lower side until this engages to the terminal module.



11. Reconnect the connector of the power supply.

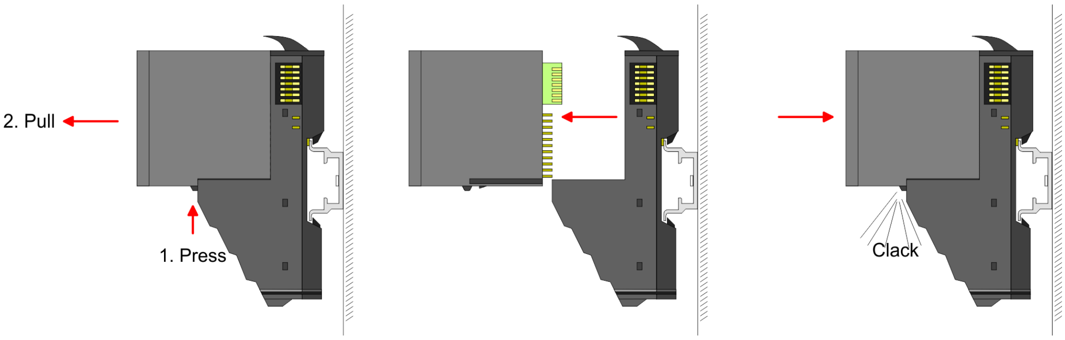
12. Now you can bring your system back into operation.

2.6.2 Demounting 8x periphery modules

Proceeding

Exchange of an electronic module

1. Power-off your system.



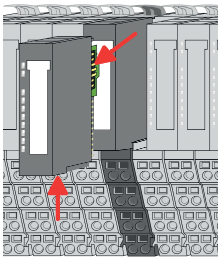
2. For the exchange of a electronic module, the electronic module may be pulled forward after pressing the unlocking lever at the lower side of the module.
3. For installation plug the new electronic module guided by the strips at the lower side until this engages to the terminal module.

   ➡ Now you can bring your system back into operation.

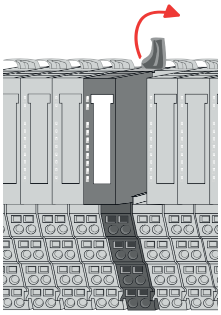
Exchange of a periphery module

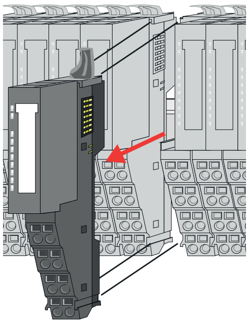
1. Power-off your system.
2. Remove if exists the wiring of the module.
3. *For demounting and exchange of a (head) module or a group of modules, due to mounting reasons you always have to remove the electronic module right beside. After mounting it may be plugged again.*

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

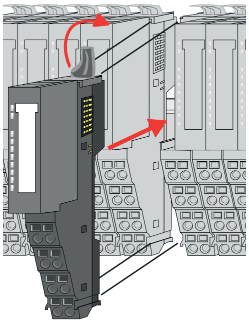


4. Turn the locking lever of the module to be exchanged upwards.

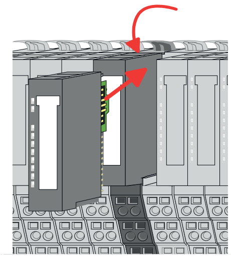




5. Pull the module.
6. For mounting turn the locking lever of the module to be mounted upwards.

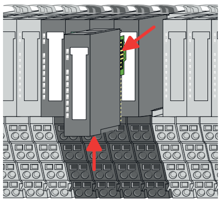


7. To mount the module put it to the gap between the both modules and push it, guided by the stripes at both sides, to the mounting rail.
8. Turn the locking lever downward, again.



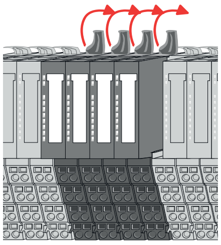
9. Plug again the electronic module, which you have removed before.
10. Wire your module.
    ➡ Now you can bring your system back into operation.

Exchange of a module group

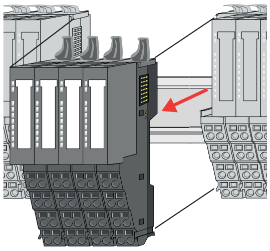


1. Power-off your system.
2. Remove if exists the wiring of the module group.
3. *For demounting and exchange of a (head) module or a group of modules, due to mounting reasons you always have to remove the electronic module right beside. After mounting it may be plugged again.*

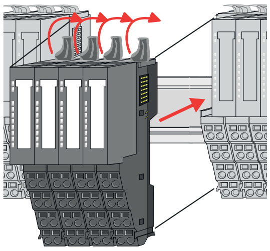
   Press the unlocking lever at the lower side of the just mounted right module near the module group and pull it forward.



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

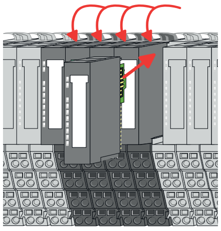


5. Pull the module group forward.
6. For mounting turn all the locking lever of the module group to be mounted upwards.



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

8. Turn all the locking lever downward, again.



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

10. Wire your module group.

   ➡ Now you can bring your system back into operation.

2.6.3 Demounting 16x periphery modules

Proceeding

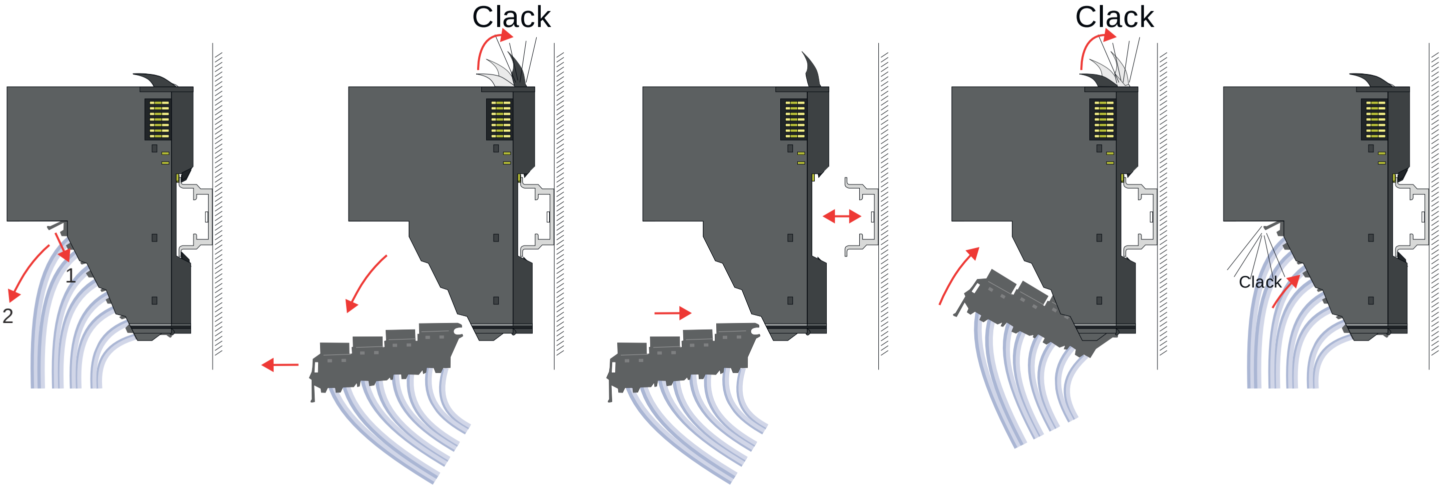
Exchange of an electronic unit

1. Power-off your system.

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

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

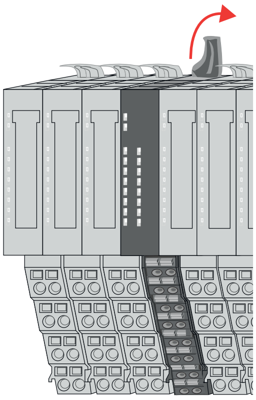
   ➡ Now you can bring your system back into operation.



Exchange of a 16x periphery module

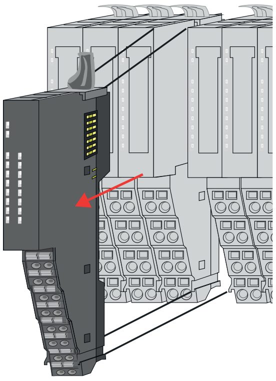
1. Power-off your system.

2. Remove if exists the wiring of the module respectively the wired terminal block.

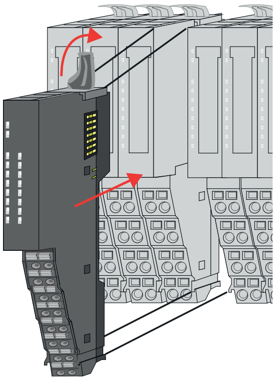


3. *In contrast to 8x periphery modules, you can directly demount and mount 16x periphery modules.*

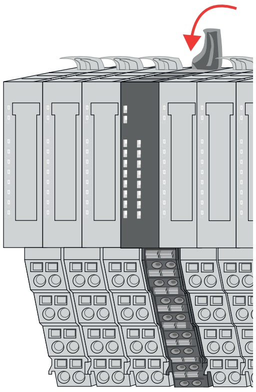
   Turn the locking lever of the module to be exchanged upwards.



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



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

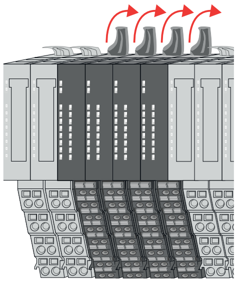


7. Turn the locking lever downward, again.
8. Wire your module respectively plug the wired terminal block again.

   ➡ Now you can bring your system back into operation.

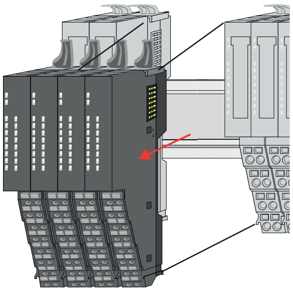
Exchange of a module group

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

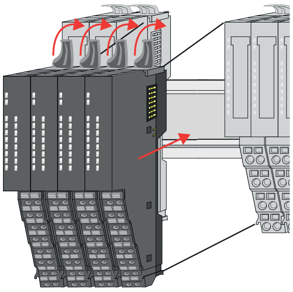


3. In contrast to 8x periphery modules, you can directly demount and mount 16x periphery modules.

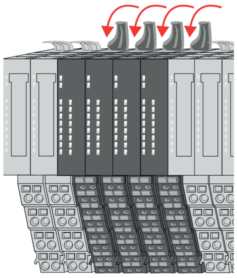
   Turn all the locking lever of the module group to be exchanged upwards.



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



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



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

   ➡ Now you can bring your system back into operation.

2.7 Device replacement and repair

2.7.1 Device replacement

Notes

NOTICE

When changing the safety CPU, always observe the corresponding checklist!

➡ *'Checklist modification and retrofitting'...page 219*

NOTICE

Replacement with an incompatible unit is not permitted!

If the firmware version of the CPU is newer than the firmware version of the CPU to be replaced, you might have to recompile your user program in iCube Engineer. If this is required, you will be informed with the corresponding firmware version.

Proceeding

The new CPU must meet the following conditions:

- Same device type.
- Same or higher firmware version.

1. Demount the CPU to be replaced. ➦ *'Demounting'...page 43*
2. Remove the Yaskawa SD card, if exists.
3. Mount the new CPU. ➦ *'Mounting'...page 30*
4. If exists, you can transfer your project with all access data and IP address to the new CPU by inserting the Yaskawa SD card.
5. To complete the device replacement, proceed according to the checklist. ➦ *'Checklist modification and retrofitting'...page 219*

2.7.1.1 Module replacement FSoE slave

> **!** NOTICE
>
> Please note that when replacing the module of an FSoE slave, all of the manufacturer's requirements must be adhered to!

2.7.2 Device repairs and defects

Repairs may only be carried out by Yaskawa.

- Always contact your national representative of Yaskawa before returning the product.
- Return defective devices to the national representative of Yaskawa for repair or to obtain a replacement device.
- If possible, use the original packaging when returning the product.

2.8 Industrial security and installation guidelines

2.8.1 Industrial security in information technology

Latest version

This chapter can also be found as a guide *'Industrial IT Security'* 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*

2.8.1.1 Protection of hardware and applications

Precautions

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

2.8.1.2 Protection of PC-based software

Precautions

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

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

2.8.2 Installation guidelines

General

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

What does EMC mean?

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

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

Possible interference causes

Electromagnetic interferences may interfere your control via different ways:

- Electromagnetic fields (RF coupling)
- Magnetic fields with power frequency
- Bus system
- Power supply
- Protected earth conductor

Depending on the spreading medium (lead bound or lead free) and the distance to the interference cause, interferences to your control occur by means of different coupling mechanisms.

There are:

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

Basic rules for EMC

In the most times it is enough to take care of some elementary rules to guarantee the EMC. Please regard the following basic rules when installing your PLC.

- Take care of a correct area-wide grounding of the inactive metal parts when installing your components.
  - Install a central connection between the ground and the protected earth conductor system.
  - Connect all inactive metal extensive and impedance-low.
  - Please try not to use aluminium parts. Aluminium is easily oxidizing and is therefore less suitable for grounding.
- When cabling, take care of the correct line routing.
  - Organize your cabling in line groups (high voltage, current supply, signal and data lines).
  - Always lay your high voltage lines and signal respectively data lines in separate channels or bundles.
  - Route the signal and data lines as near as possible beside ground areas (e.g. suspension bars, metal rails, tin cabinet).
- Proof the correct fixing of the lead isolation.
  - Data lines must be shielded.
  - Analog lines must be shielded. When transmitting signals with small amplitudes the one sided laying of the isolation may be favourable.
  - Cables for frequency inverters, servo and stepper motors must be shielded.
  - Lay the line isolation extensively on an isolation/protected earth conductor rail directly after the cabinet entry and fix the isolation with cable clamps.
  - Make sure that the isolation/protected earth conductor rail is connected impedance-low with the cabinet.
  - Use metallic or metallised plug cases for isolated data lines.
- In special use cases you should appoint special EMC actions.
  - Consider to wire all inductivities with erase links.
  - Please consider luminescent lamps can influence signal lines.
- Create a homogeneous reference potential and ground all electrical operating supplies when possible.
  - Please take care for the targeted employment of the grounding actions. The grounding of the PLC serves for protection and functionality activity.
  - Connect installation parts and cabinets with your PLC in star topology with the isolation/protected earth conductor system. So you avoid ground loops.
  - If there are potential differences between installation parts and cabinets, lay sufficiently dimensioned potential compensation lines.

Isolation of conductors

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

When isolating cables you have to regard the following:

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

⚠ CAUTION

Please regard at installation!

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

Remedy: Potential compensation line

2.9 General data for iC9200 Series

Conformity and approval		
Conformity		
CE	2014/30/EU	EMC directive
Approval		
UL	UL 61010-2-201	UL is in preparation
Others		
RoHS	2011/65/EU	Directive on the restriction of the use of certain hazardous substances in electrical and electronic equipment

Protection of persons and device protection		
Type of protection	-	IP20
Electrical isolation		
to the field bus	-	electrically isolated
to the process level	-	electrically isolated
Insulation resistance	EN 61010-2-201	-
Insulation voltage to reference earth		
Inputs / outputs	-	AC / DC 50V, test voltage AC 500V
Protective measures	-	against short circuit

Environmental conditions to EN 61131-2		
Climatic		
Storage / transport	EN 60068-2-14	-40…+85°C
Operation		
Horizontal installation hanging	EN 61131-2	0…+60°C
Horizontal installation lying	EN 61131-2	0…+55°C
Vertical installation	EN 61131-2	0…+40°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, 9...150Hz
Shock	EN 60068-2-27	15g, 11ms

Mounting conditions		
Mounting place	-	Control cabinet or switch box of protection class IP54 or higher on a 35 mm standard mounting rail.
Mounting position	-	Horizontal and vertical ➡ *'Assembly possibilities'...page 32*

EMC	Standard		Comment
Emitted interference	EN 61000-6-4		Class A (Industrial area)
Noise immunity Zone B	EN 61000-6-2		Industrial area
		EN 61000-4-2	ESD 8kV at air discharge (degree of severity 3), 4kV at contact discharge (degree of severity 2),
		EN 61000-4-3	HF irradiation (casing) 80…1000MHz, 10V/m, 80% AM (1kHz) 1.4...6.0GHz, 3V/m, 80% AM (1kHz)
		EN 61000-4-6	HF conducted 150kHz…80MHz, 10V, 80% AM (1kHz)
		EN 61000-4-4	Burst, degree of severity 3
		EN 61000-4-5	Surge, degree of severity 3[1]

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

2.9.1 Use in difficult operating conditions

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

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

3 Hardware description

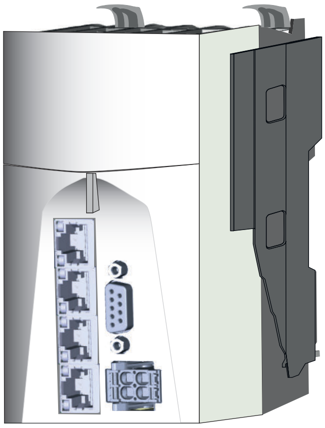
3.1 Properties

CPU
iC9212M-EC - PMC9212E0
iC9216M-EC - PMC9216E0
iC9212M-FSoE - PMC9212ES
iC9216M-FSoE - PMC9216ES

- Programmable in IEC 61131 via Yaskawa iCube Engineer.
- Slot for external Yaskawa SD card.
- Status LEDs for operating state and diagnostics.
- X1: EtherCAT master functionality (PMC921xE0 only).
- X1: EtherCAT FSoE master functionality (PMC921xES only).
- X2: Ethernet interface for future extensions.
- X3/X4: Ethernet (switch) - PROFINET optional.
- Up to 64 System SLIO modules can be connected via *SliceBus*.

Memory

- PMC9212Ex only:
  - 2GB working memory (RAM).
  - 12MB program memory.
  - 32MB data memory.
  - 512kB retentive data memory.
- PMC9216Ex only:
  - 2GB working memory (RAM).
  - 12MB program memory.
  - 32MB data memory.
  - 3072kB retentive data memory.

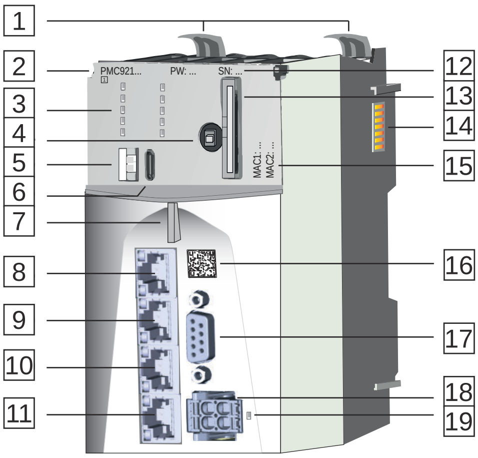


Ordering data

Type	Order number	Description
CPU iC9212M-EC	PMC9212E0	CPU iC9212M-EC with EtherCAT master.
CPU iC9216M-EC	PMC9216E0	CPU iC9216M-EC with EtherCAT master and extended memory.
CPU iC9212M-FSoE	PMC9212ES	CPU iC9212M-FSoE with EtherCAT FSoE master.
CPU iC9216M-FSoE	PMC9216ES	CPU iC9216M-FSoE with EtherCAT FSoE master and extended memory.

3.2 Structure

3.2.1 CPU iC921xM-x



1 Locking lever
2 Order number and hardware revision version
3 LED bars
4 Operating mode switch CPU
5 S1: DIP switch
6 X7: USB-C jack
7 Status LED
8 X1: EtherCAT port
9 X2: Optional
10 X3: Ethernet port (internally switched with X4)
11 X4: Ethernet port (internally switched with X3)
12 Password and serial number
13 Slot for Yaskawa SD card
14 *SliceBus* for System SLIO modules
15 MAC1: MAC address for X3/X4, MAC2: MAC address for X1/X2
16 QR code
17 X5: reserved
18 X6: Connector DC 24V power supply
19 LED DC 24V power supply

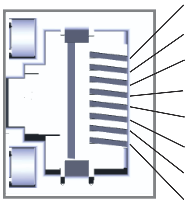
2...6, 12, 13 and 15 are located under the front flap.

Direct access to product information

The QR code 16 at the front takes you to the product-specific website. You will find there all information for deployment and operation of the CPU.

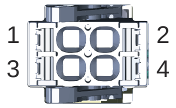
3.2.2 Interfaces

X1/X2 X3/X4



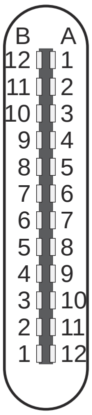
①	TD+	DA+
②	TD-	DA-
③	RD+	DB+
④	n.c.	DC+
⑤	n.c.	DC-
⑥	RD-	DB-
⑦	n.c.	DD+
⑧	n.c.	DD-

X6



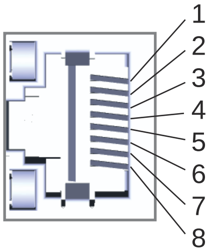
①	+ DC 24V
②	+ DC24V
③	0V
④	0V

X7



A		B	
①	GND	①	GND
②	TX1+	②	TX2+
③	TX1-	③	TX2-
④	VBUS	④	VBUS
⑤	CC1	⑤	CC2
⑥	D+	⑥	D+
⑦	D-	⑦	D-
⑧	n.c.	⑧	n.c.
⑨	VBUS	⑨	VBUS
⑩	RX2-	⑩	RX1-
⑪	RX2+	⑪	RX1+
⑫	GND	⑫	GND

X1: EtherCAT port

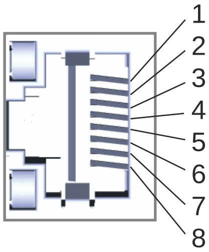


8pin RJ45 jack:

Pin	Signal	Description
1	TD+	Send data +
2	TD-	Send data -
3	RD+	Receive data +
4	n.c.	reserved
5	n.c.	reserved
6	RD-	Receive data -
7	n.c.	reserved
8	n.c.	reserved

- The CPU has an integrated Ethernet communication processors with EtherCAT controller.
- You can use the EtherCAT controller in an EtherCAT system as:
  - EtherCAT master (only PMC921xE0)
  - EtherCAT FSoE master (only PMC921xES)
- It is connected via the integrated EtherCAT port X1.
- Connect this interface with the RJ45 jack "IN" of your EtherCAT slave station.
- EtherCAT uses Ethernet as transfer medium. Standard CAT5 cables are used. Here distances of about 100m between two stations are possible.
- An EtherCAT network always consists of an EtherCAT master and an various number of EtherCAT slaves (coupler).
- Each EtherCAT slave has an "IN" and "OUT" RJ45 jack. The arriving EtherCAT cable from the direction of the master is to be connected to the "IN" jack. The "OUT" jack is to be connected to the next station. With the respective last station the "OUT" jack remains free.

X3/X4: Ethernet port

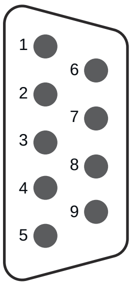


8pin RJ45 jack:

Pin	Signal	Description
1	DA+	Bidirectional pair A + (send data +)
2	DA-	Bidirectional pair A - (send data -)
3	DB+	Bidirectional pair B + (receive data +)
4	DC+	Bidirectional pair C +
5	DC-	Bidirectional pair C -
6	DB-	Bidirectional pair B - (receive data -)
7	DD+	Bidirectional pair D +
8	DD-	Bidirectional pair D -

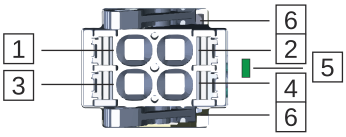
- The CPU has an integrated Ethernet communication processor.
- The connection happens via an integrated 2-port switch (X3/X4).
- Via Ethernet (default: 192.168.1.1, *'MAC1'*) you have access to:
  - Programming / remote maintenance of the CPU.
  - Web-based management WBM of the CPU.
  - *OPC UA* communication of the CPU.
- In the optionally available *'PROFINET IO controller'* operating mode, you can connect your PROFINET devices here.
- In the optionally available *'PROFINET I-Device'* operating mode, you can connect your CPU as I-Device to a PROFINET IO controller here.

X5: reserved



The interface is reserved for future extensions.

X6: Power supply



2-pin connector:

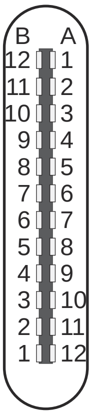
Pos.	Signal	Description
1, 2	DC 24V	Plus DC 24V power supply, bridged in the plug.
3, 4	0V	Ground DC 24V power supply, bridged in the plug.

5 LED indication for power supply.
6 Locking lever

The CPU has an integrated power supply:

- The power supply is to be provided with DC 24V, max. 1.5A. For this, the DC 24V connection is used.
- Both the CPU electronics and the electronics of the System SLIO periphery modules, which are connected via the *SliceBus*, can be supplied with the supply voltage. An additional power module is required for the power section supply of the System SLIO periphery modules.
- The power supply is protected against reverse polarity and overcurrent.
- You have the option to remove the connector of the power supply, e.g. for a module change with fixed wiring. For this the connector has a locking lever. ➦ *'Wiring CPU'...page 34*
- For easy wiring, each pole on the connector is 2-fold.

X7: USB-C



24pin USB-C jack:

Pin A	Signal	Description	Pin B	Signal	Description
1	GND	Ground	1	GND	Ground
2	TX1+	High speed data path 1 +	2	TX2+	High speed data path 2 +
3	TX1-	High speed data path 1 -	3	TX2-	High speed data path 2 -
4	VBUS	Voltage + 5V	4	VBUS	Voltage +5V
5	CC1	Control channel 1 for connector orientation	5	CC2	Control channel 2 for connector orientation
6	D+	USB 2.0 data +	6	D+	USB 2.0 data +
7	D-	USB 2.0 data -	7	D-	USB 2.0 data -
8	n.c.	reserved	8	n.c.	reserved
9	VBUS	Voltage +5V	9	VBUS	Voltage +5V
10	RX2-	High speed data path 2 -	10	RX1-	High speed data path 1 -
11	RX2+	High speed data path 2 +	11	RX1+	High speed data path 1 +
12	GND	Ground	12	GND	Ground

- The interface is located under the front flap.
- The interface is not relevant for customer applications.
- The interface supports the USB 2.0 protocol and is used exclusively as a service interface.

3.2.3 Memory

Internal memory

The CPU has an integrated memory. You will find information on the memory sizes in the technical data. ➦ *'Technical data'...page 69*

The memory is divided into the following parts:

- *Working memory* for temporary data and parts of the user program.
- *Parametrization memory* for current firmware and overlay file system with firmware adjustments, user program and data.
- Non-volatile memory for retentive data.

➦ *'Memory management'...page 93*

Slot for Yaskawa SD card

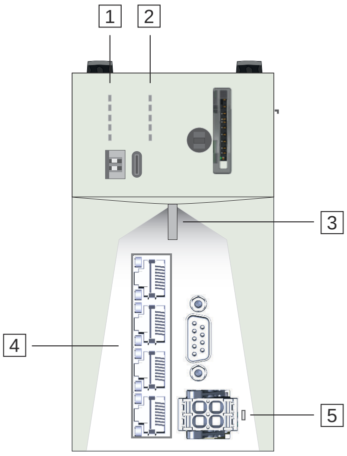
The CPU has a slot for a Yaskawa SD card. Here you can use a Yaskawa SD card as external memory and transfer the *overlay file system* of the CPU to the card.

➦ *'Slot for Yaskawa SD card'...page 95*

3.2.4 Buffering mechanisms

- The iC9200 Series CPU has a capacitor-based mechanism to buffer the internal clock in case of power failure for max. 28 days.
- The retentive data defined during configuration are automatically saved in the non-volatile memory in the event of a power failure.

3.2.5 LEDs



1 LED bar 1
2 LED bar 2
3 Status LED
4 LEDs RJ45 jacks
5 LED power supply

1 and 2 are located under the front flap.

LED bar 1/2 [1], [2]

LED	Color	Function
LED bar 1 [1]		
RN	🟩 green	The CPU is in the RUN state without errors.
ER	🟥 red	An error has occurred in the CPU.
IO ER	🟥 red	An error has occurred on the *SliceBus*.
EC RN	🟩 green	EtherCAT master - status. ➦ *66*
EC_ER	🟥 red	EtherCAT master - error. ➦ *66*
LED bar 2 [2]		
PMC921xE0 and PMC921xES		
PN-C ER	🟥 red	PROFINET controller - bus error. ➦ *67*
PN-D ER	🟥 red	PROFINET device - bus error. ➦ *67*
IO DIAG	🟥 red	A diagnosis has occurred on the *SliceBus*.
Only PMC921xES		
SF RN	🟩 green	EtherCAT FSoE master - status. ➦ *67*
SF ER	🟥 red	EtherCAT FSoE master - error. ➦ *67*

Status LED [3]

LED	Color	Function
🟩	green	The CPU is in RUN state without errors.
🟥	red	The CPU is in STOP state with error.
🟩/🟥	green/red 1Hz	The CPU is in RUN state with error.
🟥/⬜	red 2Hz	There is a system fault. Restart the CPU.
🟨	yellow	The CPU is in STOP state without errors.
🟨/⬜	yellow 1Hz	Used to indicate special functions.
🟨/⬜	yellow 2Hz	Used to indicate special functions.

LEDs CPU 1, 2, 3

Status LED	RN 🟩 green	ER 🟥 red	IO ER 🟥 red	PN-C ER 🟥 red	PN-D ER 🟥 red	IO DIAG 🟥 red	Description
Boot-up after PowerON - as soon as the CPU is supplied with DC 24V, the 🟩 green PW-LED of the power supply is on.							
🟥 red	□	🟥	🟥	🟥	□	□	Error while copying the kernel.
🟥 red	□	🟥	🟥	X	□	□	Runtime system was stopped. Perform a power cycle.
◩ red 2Hz	□	🟥	□	□	□	□	Yaskawa SD card was not recognized.
◩ red 2Hz	□	◩ 1Hz	□	□	□	□	Yaskawa SD card certificate is faulty or was unauthorized removed during operation. Perform a power cycle.
◩ yellow 1Hz	□	□	□	□	□	□	Runtime system is loaded.
◩ red 2Hz	□	□	🟥	□	□	🟥	Runtime system could not be loaded. Perform a power cycle.
Operation							
🟨 yellow	◩ 0.5Hz	X	X	X	X	X	CPU is in STOP state.
🟥 red	◩ 2Hz	◩ 2Hz	X	X	X	X	System watchdog was triggered and the CPU restarted. Execute a reboot via iCube Engineer or set your CPU to RUN state.
🟩 green	🟩	□	X	X	X	X	CPU is in RUN state without error.
🟥 red	◩ 0.5Hz	🟥	X	X	X	X	Error in user program. CPU is in the READY/ STOP/HALT state with an error.
◩ red 2Hz	□	◩ 1Hz	□	□	□	□	Yaskawa SD card certificate is faulty or was unauthorized removed during operation. Perform a power cycle.
◩ red 2Hz	□	◩ 2Hz	□	□	□	□	The overlaying file system in the parametrization memory reports a memory overflow. ➦ *'Fix memory overflow'...page 94*
◩ yellow 2Hz	◩ 1Hz	◩ 1Hz	◩ 1Hz	◩ 1Hz	◩ 1Hz	◩ 1Hz	The CPU requests a power cycle, e.g. after resetting to *factory settings type 1* using a DIP switch.
SliceBus							
X	X	X	□	X	X	X	There are no errors on the *SliceBus*.
◩ red[1]	X	X	🟥	X	X	X	Configuration error on the *SliceBus*.
	X	X	X	X	X	🟥	*SliceBus* reports a diagnosis. ➦ *'SliceBus'...page 184*
not relevant: X 1) The status depends on the operating mode of the CPU.							

LEDs CPU 1, 2, 3

Status LED	RN 🟩 green	ER 🟥 red	IO ER 🟥 red	PN-C ER 🟥 red	PN-D ER 🟥 red	IO DIAG 🟥 red	Description
Reset to factory settings							
🟨 yellow 1Hz	🟩	🟥	□	□	□	□	Request reset to *factory settings type 1*.
🟨 yellow 2Hz	🟩 1Hz	🟥 1Hz	🟥 1Hz	🟥 1Hz	🟥 1Hz	🟥 1Hz	The CPU requests a power cycle after resetting to *factory settings type 1* by means of the DIP switch.
🟨 yellow 2Hz	🟩	🟥	🟥	□	□	□	Request reset to *factory settings type 2*.
Firmware update							
🟨 yellow 1Hz	🟩 0.2s/1s	□	□	□	□	□	Firmware update is in progress.

LEDs Safety 2

SF RN 🟩 green	SF HE 🟥 red	Description
□	□	The safety CPU is not ready for operations.
🟩	□	The Safety CPU is in the SAFE-RUN state. The safety-related user program is executed.
□	🟥	The Safety CPU is in the Fail Safe state *Hard Fail Safe*. ➦ *'Fail safe states'...page 130* Check your hardware setup and perform a power cycle.
□	🟥 1Hz	The Safety CPU is in the Fail Safe state *Soft Fail Safe*. ➦ *'Fail safe states'...page 130* The safety-related user programme is not executed. An error has occurred.
🟩 1Hz	□	The following status is shown depending on the operating mode: ■ PowerON - Initialization – The safety CPU is in the SAFE-STOP state. – Project data is transferred from the parametrization memory to the internal memory of the safety CPU. ■ Data transfer – With iCube Engineer, a project is transferred to the safety CPU. ■ Debug – The safety CPU is in the DEBUG-STOP state. – The safety CPU is in the DEBUG-HALT state.
🟩 2Hz	□	The safety CPU is in the DEBUG-RUN state.

More information on DEBUG operation can be found in the iCube Engineer manual.

LEDs EtherCAT 1

Status LED	EC RN 🟩 green	EC ER 🟥 red	Description
X	□	X	- The EtherCAT master is in INIT state. - The EtherCAT master is not configured.
X	◩ 2.5Hz	X	- The EtherCAT master is in the PreOp state.
X	◩ 0.2s/1s	X	- The EtherCAT master is in the SafeOp state.
X	X	□	- The EtherCAT master does not report any errors.
◩ red[1]	X	◩ 2.5Hz	- The slaves on the EtherCAT master are configured and connected, but the topology is incorrect.
◩ red[1]	X	🟥	- The slaves on the EtherCAT master are configured but not connected.
not relevant: X			

[1] The status depends on the operating mode of the CPU.

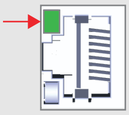
LEDs PROFINET 2
PROFINET optional

Please note that a separate licence is required for the use of PROFINET, which must be activated accordingly!

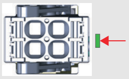
Status LED	PN-C ER 🟥 red	PN-D ER 🟥 red	Description
X	□	X	PROFINET IO controller signals: - The PROFINET IO controller has established an active communication connection to each configured PROFINET IO device. - The PROFINET IO controller is not configured.
◩ red[1]	🟥	X	PROFINET IO controller signals: - Bus error, no link available. - Wrong transfer rate. - Full duplex transfer is not enabled.
	◩ 1Hz	X	PROFINET IO controller signals: - Link status is available, there is no communication connection to at least one PROFINET IO device.
X	X	□	A PROFINET IO controller has established an active communication connection to the CPU iC921xM-x PROFINET I-Device.
X	X	🟥	PROFINET I-Device signals: - Bus error, no connection to PROFINET IO controller.
	X	◩ 1Hz	PROFINET I-Device signals: - Link status exists but no communication connection to the PROFINET IO controller.
◩ yellow 1Hz	X	X	Used for device identification.

Status LED	PN-C ER 🟥 red	PN-D ER 🟥 red	Description
not relevant: X 1) The status depends on the operating mode of the CPU.			

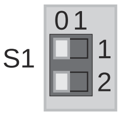
LEDs RJ45 jacks 4

LED	Color	Function
	🟩 green	The according RJ45 jack is physically connected to the Ethernet.
	◩ green flickers	The LED flickers when there is data traffic.

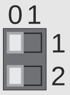
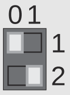
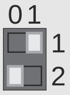
LED power supply 5

LED	Color	Function
	🟩 green	The CPU is power supplied.

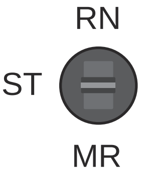
3.2.6 DIP switch



You can trigger the following actions of the CPU with the 2-fold DIP switch under the front flap:

S1	S1-1	S1-2	Action
 0 1 1 2	OFF	OFF	After PowerON the CPU starts in *Standard Mode* - Default setting.
 0 1 1 2	OFF	ON	After PowerON the CPU executes a *reset to factory settings type 1*. ➦ *'Reset to factory settings type 1'...page 97*
 0 1 1 2	ON	OFF	After PowerON the CPU starts in *Safe Mode*. ➦ *'Safe Mode'...page 98*

3.2.7 Operating mode switch



- With the operating mode switch, you can select between the operating modes ST (**ST**OP) and RN (**RUN**) on the CPU.
- With the button position MR (**M**emory **R**eset) you can request a reset of the CPU in different levels. ➦ *'MRESET and reset to factory settings'...page 97*

3.3 Technical data

3.3.1 iC9212M-EC - PMC9212E0

Order no.	PMC9212E0
Type	iC9212M-EC
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)	0.2 A
Current consumption (rated value)	1.5 A
Inrush current	1 A
I^2t	0.3 A^2s
Max. current drain at backplane bus	3 A
Max. current drain load supply	-
Power loss	12 W
Hardware	
CPU	Triton (ARM A17)
CPU cores	3
Frequency	1.26 GHz
RAM	2 GB
eMMC	8 GB
Operating controls	LEDs, Three-point switch, DIP-switches
Integrated SliceBus supply	✓
Connectors	
Serial Com (Sub-D)	-
SliceBus	✓
Number of RJ45 interfaces	4 Ports
External SD card	
External SD card	✓
Operating system	
Operating system	Linux with RT Kernel
Overlay filesystem on internal eMMC	✓
Overlay filesystem on internal eMMC, Capacity	1500 MB
Overlay filesystem on external SD card	✓
Overlay filesystem on external SD card, Capacity	depending on SD card
Firewall	✓

Order no.	PMC9212E0
SSH/SFTP	✓
Synchronization via Ethernet (NTP)	✓
DNS	✓
IEC 61131 runtime system	
Program memory	12 MB
Data memory	32 MB
Retain memory	512 KB
Realtime clock	
Realtime clock	✓
Accuracy Realtime clock	1 minute deviation per month
Buffered time	28 days @ 25°C
Execution and Synchronization Manager (ESM)	
Execution and Synchronization Manager (ESM)	✓
Min. task cycle time (ESM)	500 µs
ESM cores	1
Maximum parallel tasks	16
SliceBus	
Amount of process data per module	up to 60 bytes
Max number of modules	64
Cycle time [ms]	500 µs .. 512 ms
OPC UA	
OPC UA	✓
Server	✓
Max parallel sessions	5
Sampling rates	100 ms .. 5 s
Encryption suite Basic128Rsa15	✓
Encryption suite Basic256	✓
Encryption suite Basic256Sha256	✓
Encryption suite Aes256Sha256RsaPss	✓
Encryption suite Aes128Sha256RsaOaep	✓
Programming	
IEC 61131-3	✓
Web Based Management (WBM)	
Web Based Management (WBM)	✓
Ethernet	
Ethernet-capable ports	X3/X4: 2 Ports x 10/100 Mbit/s (half/full duplex)

Order no.	PMC9212E0
EtherCAT Master	
Number of EtherCAT-slaves	512
Update time	500 µs .. 512 ms
EoE support	-
CoE support	✓
FoE support	-
Distributed Clock support	✓
Hotconnect Slaves	✓
Isochronous mode	✓
Functional safety	
Minimum time	-
Maximum time	-
Program memory safe program	-
Data memory	-
Safety protocol	-
Number of FSoE devices	-
Safety related input data	-
Safety related output data	-
Standard input data	-
Standard output data	-
Max. number of FB instances	-
Safety requirements	-
Motion	
Default Axis Count	4 (servo) + 4 (virtual)
Cyclic Motion Update Performance	up to 4 axes at 250µs up to 16 axes at 500µs up to 32 axes at 1ms up to 64 axes at 2ms up to 128 axes at 4ms
Cam/Gear Cascade Depth	up to 4
Axes Group Count	up to 16 axes groups up to 32 axes per group
PROFINET System	
VendorID	0x0111
DeviceID	0x0368
Specification	Version 2.3
PROFINET-capable ports	X3/X4 (licensable)

Order no.	PMC9212E0
Controller	✓
- Max. number of devices	64@16ms, 32@8ms, 16@4ms, 8@2ms, 4@1ms
- Cycle time	1 ms .. 512 ms
- System Redundancy	✓
- Fast Startup	✓
- Fast Startup, Max. number of devices	32
- Topology	✓
Device	✓
- Device I/O Data	512 Byte / 512 Byte
- Cycle time	1 ms .. 512 ms
- MRP Client supported	✓
Housing	
Material	PC
Mounting	Profile rail 35 mm
Mechanical data	
Dimensions (WxHxD)	72 mm x 134 mm x 112 mm
Net weight	488 g
Weight including accessories	503 g
Gross weight	621 g
Environmental conditions	
Operating temperature	0 °C to 60 °C
Storage temperature	-40 °C to 70 °C
Certifications	
UL certification	-
KC certification	-
UKCA certification	yes
ChinaRoHS certification	yes

3.3.2 iC9216M-EC - PMC9216E0

Order no.	PMC9216E0
Type	iC9212M-EC
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	✓

Order no.	PMC9216E0
Current consumption (no-load operation)	0.2 A
Current consumption (rated value)	1.5 A
Inrush current	1 A
I²t	0.3 A²s
Max. current drain at backplane bus	3 A
Max. current drain load supply	-
Power loss	12 W
Hardware	
CPU	Triton (ARM A17)
CPU cores	3
Frequency	1.26 GHz
RAM	2 GB
eMMC	8 GB
Operating controls	LEDs, Three-point switch, DIP-switches
Integrated SliceBus supply	✓
Connectors	
Serial Com (Sub-D)	-
SliceBus	✓
Number of RJ45 interfaces	4 Ports
External SD card	
External SD card	✓
Operating system	
Operating system	Linux with RT Kernel
Overlay filesystem on internal eMMC	✓
Overlay filesystem on internal eMMC, Capacity	1500 MB
Overlay filesystem on external SD card	✓
Overlay filesystem on external SD card, Capacity	depending on SD card
Firewall	✓
SSH/SFTP	✓
Synchronization via Ethernet (NTP)	✓
DNS	✓
IEC 61131 runtime system	
Program memory	12 MB
Data memory	32 MB
Retain memory	3072 KB
Realtime clock	

Order no.	PMC9216E0
Realtime clock	✓
Accuracy Realtime clock	1 minute deviation per month
Buffered time	28 days @ 25°C
Execution and Synchronization Manager (ESM)	
Execution and Synchronization Manager (ESM)	✓
Min. task cycle time (ESM)	500 µs
ESM cores	1
Maximum parallel tasks	16
SliceBus	
Amount of process data per module	up to 60 bytes
Max number of modules	64
Cycle time [ms]	500 µs .. 512 ms
OPC UA	
OPC UA	✓
Server	✓
Max parallel sessions	5
Sampling rates	100 ms .. 5 s
Encryption suite Basic128Rsa15	✓
Encryption suite Basic256	✓
Encryption suite Basic256Sha256	✓
Encryption suite Aes256Sha256RsaPss	✓
Encryption suite Aes128Sha256RsaOaep	✓
Programming	
IEC 61131-3	✓
Web Based Management (WBM)	
Web Based Management (WBM)	✓
Ethernet	
Ethernet-capable ports	X3/X4: 2 Ports x 10/100 Mbit/s (half/full duplex)
EtherCAT Master	
Number of EtherCAT-slaves	512
Update time	500 µs .. 512 ms
EoE support	-
CoE support	✓
FoE support	-
Distributed Clock support	✓
Hotconnect Slaves	✓

Order no.	PMC9216E0
Isochronous mode	✓
Functional safety	
Minimum time	-
Maximum time	-
Program memory safe program	-
Data memory	-
Safety protocol	-
Number of FSoE devices	-
Safety related input data	-
Safety related output data	-
Standard input data	-
Standard output data	-
Max. number of FB instances	-
Safety requirements	-
Motion	
Default Axis Count	4 (servo) + 4 (virtual)
Cyclic Motion Update Performance	up to 4 axes at 250µs up to 16 axes at 500µs up to 32 axes at 1ms up to 64 axes at 2ms up to 128 axes at 4ms
Cam/Gear Cascade Depth	up to 4
Axes Group Count	uUp to 16 axes groups up to 32 axes per group
PROFINET System	
VendorID	0x0111
DeviceID	0x0368
Specification	Version 2.3
PROFINET-capable ports	X3/X4 (licensable)
Controller	✓
- Max. number of devices	64@16ms, 32@8ms, 16@4ms, 8@2ms, 4@1ms
- Cycle time	1 ms .. 512 ms
- System Redundancy	✓
- Fast Startup	✓
- Fast Startup, Max. number of devices	32
- Topology	✓
Device	✓

Order no.	PMC9216E0
- Device I/O Data	512 Byte / 512 Byte
- Cycle time	1 ms .. 512 ms
- MRP Client supported	✓
Housing	
Material	PC
Mounting	Profile rail 35 mm
Mechanical data	
Dimensions (WxHxD)	72 mm x 134 mm x 112 mm
Net weight	488 g
Weight including accessories	503 g
Gross weight	621 g
Environmental conditions	
Operating temperature	0 °C to 60 °C
Storage temperature	-40 °C to 70 °C
Certifications	
UL certification	-
KC certification	-
UKCA certification	yes
ChinaRoHS certification	yes

3.3.3 iC9212M-FSoE - PMC9212ES

Order no.	PMC9212ES
Type	iC9212M-EC
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)	0.2 A
Current consumption (rated value)	1.5 A
Inrush current	1 A
I^2t	0.3 A^2s
Max. current drain at backplane bus	3 A
Max. current drain load supply	-
Power loss	12 W
Hardware	

Order no.	PMC9212ES
CPU	Triton (ARM A17)
CPU cores	3
Frequency	1.26 GHz
RAM	2 GB
eMMC	8 GB
Operating controls	LEDs, Three-point switch, DIP-switches
Integrated SliceBus supply	✓
Connectors	
Serial Com (Sub-D)	-
SliceBus	✓
Number of RJ45 interfaces	4 Ports
External SD card	
External SD card	✓
Operating system	
Operating system	Linux with RT Kernel
Overlay filesystem on internal eMMC	✓
Overlay filesystem on internal eMMC, Capacity	1500 MB
Overlay filesystem on external SD card	✓
Overlay filesystem on external SD card, Capacity	depending on SD card
Firewall	✓
SSH/SFTP	✓
Synchronization via Ethernet (NTP)	✓
DNS	✓
IEC 61131 runtime system	
Program memory	12 MB
Data memory	32 MB
Retain memory	512 KB
Realtime clock	
Realtime clock	✓
Accuracy Realtime clock	1 minute deviation per month
Buffered time	28 days @ 25°C
Execution and Synchronization Manager (ESM)	
Execution and Synchronization Manager (ESM)	✓
Min. task cycle time (ESM)	500 µs
ESM cores	1
Maximum parallel tasks	16

Order no.	PMC9212ES
SliceBus	
Amount of process data per module	up to 60 bytes
Max number of modules	64
Cycle time [ms]	500 µs .. 512 ms
OPC UA	
OPC UA	✓
Server	✓
Max parallel sessions	5
Sampling rates	100 ms .. 5 s
Encryption suite Basic128Rsa15	✓
Encryption suite Basic256	✓
Encryption suite Basic256Sha256	✓
Encryption suite Aes256Sha256RsaPss	✓
Encryption suite Aes128Sha256RsaOaep	✓
Programming	
IEC 61131-3	✓
Web Based Management (WBM)	
Web Based Management (WBM)	✓
Ethernet	
Ethernet-capable ports	X3/X4: 2 Ports x 10/100 Mbit/s (Half/Full duplex)
EtherCAT Master	
Number of EtherCAT-slaves	512
Update time	500 µs .. 512 ms
EoE support	-
CoE support	✓
FoE support	-
Distributed Clock support	✓
Hotconnect Slaves	✓
Isochronous mode	✓
Functional safety	
Minimum time	5 ms
Maximum time	15 ms
Program memory safe program	64 KB
Data memory	16 KB
Safety protocol	FSoE
Number of FSoE devices	32

Order no.	PMC9212ES
Safety related input data	512 Byte
Safety related output data	512 Byte
Standard input data	128 Byte
Standard output data	128 Byte
Max. number of FB instances	512
Safety requirements	SIL CL 3, PL e, Kat 4
Motion	
Default Axis Count	4 (servo) + 4 (virtual)
Cyclic Motion Update Performance	up to 4 axes at 250µs up to 16 axes at 500µs up to 32 axes at 1ms up to 64 axes at 2ms up to 128 axes at 4ms
Cam/Gear Cascade Depth	up to 4
Axes Group Count	up to 16 axes groups up to 32 axes per group
PROFINET System	
VendorID	0x0111
DeviceID	0x0368
Specification	Version 2.3
PROFINET-capable ports	X3/X4 (licensable)
Controller	✓
- Max. number of devices	64@16ms, 32@8ms, 16@4ms, 8@2ms, 4@1ms
- Cycle time	1 ms .. 512 ms
- System Redundancy	✓
- Fast Startup	✓
- Fast Startup, Max. number of devices	32
- Topology	✓
Device	✓
- Device I/O Data	512 Byte / 512 Byte
- Cycle time	1 ms .. 512 ms
- MRP Client supported	✓
Housing	
Material	PC
Mounting	Profile rail 35 mm
Mechanical data	
Dimensions (WxHxD)	72 mm x 134 mm x 112 mm

Order no.	PMC9212ES
Net weight	488 g
Weight including accessories	503 g
Gross weight	621 g
Environmental conditions	
Operating temperature	0 °C to 60 °C
Storage temperature	-40 °C to 70 °C
Certifications	
UL certification	-
KC certification	-
UKCA certification	yes
ChinaRoHS certification	yes

3.3.4 iC9216M-FSoE - PMC9216ES

Order no.	PMC9216ES
Type	iC9212M-EC
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)	0.2 A
Current consumption (rated value)	1.5 A
Inrush current	1 A
I^2t	0.3 A^2s
Max. current drain at backplane bus	3 A
Max. current drain load supply	-
Power loss	12 W
Hardware	
CPU	Triton (ARM A17)
CPU cores	3
Frequency	1.26 GHz
RAM	2 GB
eMMC	8 GB
Operating controls	LEDs, Three-point switch, DIP-switches
Integrated SliceBus supply	✓
Connectors	

Order no.	PMC9216ES
Serial Com (Sub-D)	-
SliceBus	✓
Number of RJ45 interfaces	4 Ports
External SD card	
External SD card	✓
Operating system	
Operating system	Linux with RT Kernel
Overlay filesystem on internal eMMC	✓
Overlay filesystem on internal eMMC, Capacity	1500 MB
Overlay filesystem on external SD card	✓
Overlay filesystem on external SD card, Capacity	depending on SD card
Firewall	✓
SSH/SFTP	✓
Synchronization via Ethernet (NTP)	✓
DNS	✓
IEC 61131 runtime system	
Program memory	12 MB
Data memory	32 MB
Retain memory	3072 KB
Realtime clock	
Realtime clock	✓
Accuracy Realtime clock	1 minute deviation per month
Buffered time	28 days @ 25°C
Execution and Synchronization Manager (ESM)	
Execution and Synchronization Manager (ESM)	✓
Min. task cycle time (ESM)	500 µs
ESM cores	1
Maximum parallel tasks	16
SliceBus	
Amount of process data per module	up to 60 bytes
Max number of modules	64
Cycle time [ms]	500 µs .. 512 ms
OPC UA	
OPC UA	✓
Server	✓
Max parallel sessions	5

Order no.	PMC9216ES
Sampling rates	100 ms .. 5 s
Encryption suite Basic128Rsa15	✓
Encryption suite Basic256	✓
Encryption suite Basic256Sha256	✓
Encryption suite Aes256Sha256RsaPss	✓
Encryption suite Aes128Sha256RsaOaep	✓
Programming	
IEC 61131-3	✓
Web Based Management (WBM)	
Web Based Management (WBM)	✓
Ethernet	
Ethernet-capable ports	X3/X4: 2 Ports x 10/100 Mbit/s (half/full duplex)
EtherCAT Master	
Number of EtherCAT-slaves	512
Update time	500 µs .. 512 ms
EoE support	-
CoE support	✓
FoE support	-
Distributed Clock support	✓
Hotconnect Slaves	✓
Isochronous mode	✓
Functional safety	
Minimum time	5 ms
Maximum time	15 ms
Program memory safe program	64 KB
Data memory	16 KB
Safety protocol	FSoE
Number of FSoE devices	32
Safety related input data	512 Byte
Safety related output data	512 Byte
Standard input data	128 Byte
Standard output data	128 Byte
Max. number of FB instances	512
Safety requirements	SIL CL 3, PL e, Kat 4
Motion	
Default Axis Count	4 (servo) + 4 (virtual)

Order no.	PMC9216ES
Cyclic Motion Update Performance	up to 4 axes at 250µs up to 16 axes at 500µs up to 32 axes at 1ms up to 64 axes at 2ms up to 128 axes at 4ms
Cam/Gear Cascade Depth	up to 4
Axes Group Count	up to 16 axes groups up to 32 axes per group
PROFINET System	
VendorID	0x0111
DeviceID	0x0368
Specification	Version 2.3
PROFINET-capable ports	X3/X4 (licensable)
Controller	✓
- Max. number of devices	64@16ms, 32@8ms, 16@4ms, 8@2ms, 4@1ms
- Cycle time	1 ms .. 512 ms
- System Redundancy	✓
- Fast Startup	✓
- Fast Startup, Max. number of devices	32
- Topology	✓
Device	✓
- Device I/O Data	512 Byte / 512 Byte
- Cycle time	1 ms .. 512 ms
- MRP Client supported	✓
Housing	
Material	PC
Mounting	Profile rail 35 mm
Mechanical data	
Dimensions (WxHxD)	72 mm x 134 mm x 112 mm
Net weight	488 g
Weight including accessories	503 g
Gross weight	621 g
Environmental conditions	
Operating temperature	0 °C to 60 °C
Storage temperature	-40 °C to 70 °C
Certifications	
UL certification	-

Order no.	PMC9216ES
KC certification	-
UKCA certification	yes
ChinaRoHS certification	yes

4 Deployment CPU iC921xM-EC

4.1 Safety instructions

Deployment safety CPU ➦ 'Deployment CPU iC921xM-FSoE'...page 108.

WARNING

Depending on the application, improper use of the CPU can pose serious risks to the user

When handling the CPU, observe all safety instructions listed in this chapter.

NOTICE

Property damage due to incorrect use

The IP20 (IEC 60529/EN 60529) protection class of the CPU is intended for a clean and dry environment.

- Do not subject the CPU to mechanical and/or thermal stress that exceeds the limits described.
- Please note that you must install the CPU in a lockable housing or a lockable control cabinet with at least protection class IP54 for proper operation.

NOTICE

Electrostatic discharge

The CPU contains components that can be damaged or destroyed by electrostatic discharge.

- When handling the CPU, observe the necessary safety measures against electrostatic discharge (ESD) in accordance with EN 61340-5-1 and IEC 61340-5-1.

NOTICE

Device failure due to foreign objects in the device

Foreign objects in the CPU may lead to malfunctions or even device failure.

- Make sure that no foreign objects get into the CPU (e.g. into the ventilation openings).

NOTICE

Device failure due to operation outside the permissible ambient temperature range

Operating the CPU outside the permissible ambient temperature range may lead to malfunctions or even device failure.

- Make sure that the permissible ambient temperature of the CPU is observed during operation of the CPU. *➦ 'Approvals, directives, standards'...page 19*

NOTICE

Device failure due to operation above the permissible specifications for vibration and shock

Operating the CPU above the permissible vibration and shock specifications may result in malfunctions or even device failure.

– Make sure that the permissible specifications for vibration and shock are observed during operation of the CPU. *➦ 'Approvals, directives, standards'...page 19*

NOTICE

Device defect due to reverse polarity

Reversing the polarity puts a strain on the electronics and can lead to a defect in the CPU.

– To protect the CPU, avoid reversing the polarity of the DC 24V supply.

4.2 Mounting

More information on mounting and wiring ➦ 'Basics and mounting'...page 22.

4.3 Licensing information for open source software

- The CPU works with a Linux operating system.
- You can access license information for the individual Linux packages in Web-based management (WBM) via the *'Legal Information '* button. *➦ 'Web-based management - WBM'...page 174*
- Every open source software that is used in the product is subject to the respective license conditions, which are not affected by the Yaskawa software license conditions (Software License Terms - SLT) for the product.
- The licensee can change the respective open source software in accordance with the applicable license terms.

Notes on OpenSSL

– This product includes software developed by the OpenSSL Project for use in the OpenSSL Toolkit. (➦ http://www.openssl.org/).

– This product includes cryptographic software written by Eric Young (➦ eay@cryptsoft.com).

4.4 Programming and file system

PLCnext Technology

- The CPU is based on PLCnext Technology ® from Phoenix Contact.
- The CPU works with a Linux operating system.

Programming

- You can configure and program the CPU with iCube Engineer according to IEC 61131-3.

Firewall

- *On delivery the firewall in the CPU is disabled!*
- *Security recommendation: Enable the firewall!*
- *In the WBM, you can enable the firewall at 'Security → Firewall'.*
  ➡ 'Firewall'...page 193
- *Please note that you only have access to the firewall settings as an administrator!*

4.4.1 Install iCube Engineer

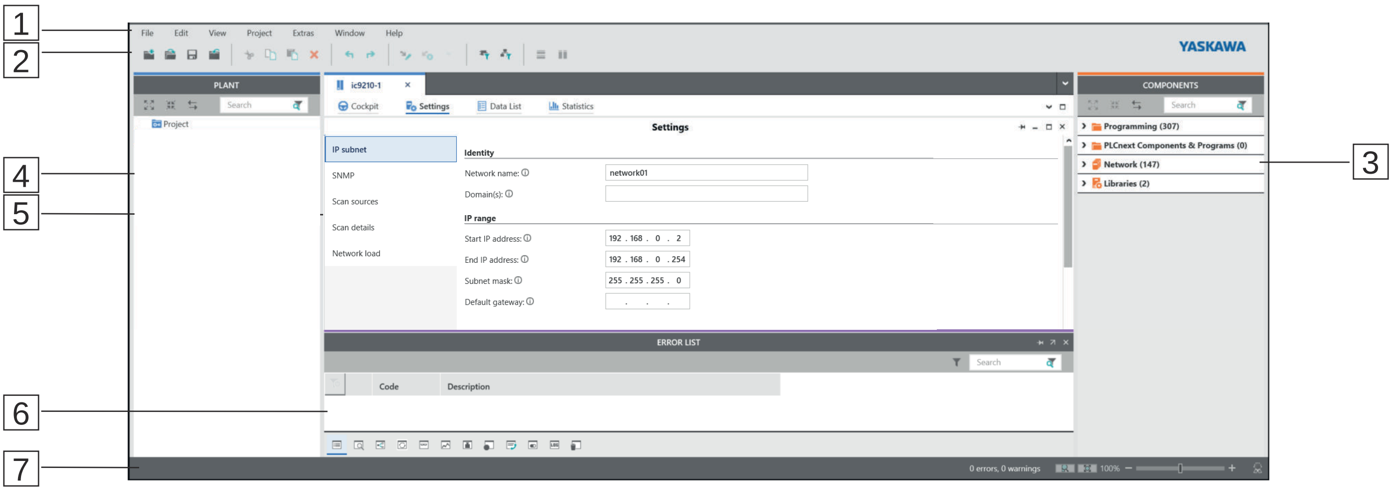
Installation

The software iCube Engineer is required for commissioning the CPU.

1. Download the software iCube Engineer to your PC. You can find this at www.yaskawa.eu.com in the *'Download center'*.
2. Unzip the file in your working directory and start the installation by double-clicking on the exe file.
3. Follow the instructions of the installation wizard.
   ➡ The installation is started.
4. When prompted, restart your system.
   ➡ The installation is finished. You can start iCube Engineer now.

4.4.2 iCube Engineer user interface

Overview



Settings

Identity

Network name: network01

Domain(s):

IP range

Start IP address: 192 . 168 . 0 . 2

End IP address: 192 . 168 . 0 . 254

Subnet mask: 255 . 255 . 255 . 0

Default gateway: . . .

1 Menu bar	5 Editor area
2 Toolbar	6 Cross-functional area
3 *'Components'* area	7 Status bar
4 *'Plant'* area	

Menu bar

The menu bar provides access to a number of project-related commands that do not explicitly relate to a specific engineering task.

Toolbar

The menu bar provides access to a number of project-related commands that do not explicitly relate to a specific engineering task. In addition, the various areas and editors have their own specific toolbars.

***'Components'* area**

The *'Components'* area contains all components available for the project. The components can be divided into the following types based on their function:

- Develop program code (data types, programs, functions and function blocks).
- Show or add all devices available for the *'Plant'* area.
- Insert libraries such as firmware libraries, IEC user libraries, etc.

***'Plant'* area**

In the *'Plant'* area, you map all the physical and logical components of your application as a hierarchical tree structure.

Editor area

- Double-clicking on a node in the *'Plant'* area or on an element in the *'Components'* area opens the associated editor group in the editor area.
- Editor groups are always shown in the center of the user interface.
- Each editor group contains several editors, which can be opened and closed using buttons in the editor group.
- You can identify the corresponding editor based on the color representation of the editor group:
  - Blue: Editor from the area *'Plant'*.
  - Orange: Editor from the area *'Components'*.

Cross-functional area

The cross-functional area contains functions that extend across your entire project.

- ERROR LIST
  - All errors, warnings and messages of the current project are shown here.
- GLOBAL FIND AND REPLACE
  - Here you can find and replace text in the project.
- CROSS REFERENCES
  - All cross references within the project are shown here, such as the use and declaration of all variable types.
- WATCH WINDOW
  - Debug tool - the current values of the added variables are shown here in online mode.
- BREAKPOINTS
  - Debug tool - here you can set and reset breakpoints for troubleshooting.
- CALL STACKS
  - Debug tool - the sequence of calls when the code is executed is shown here and commands for debugging with breakpoints are made available.
- LOGIC ANALYSIS
  - Here variable values can be recorded and visualized during runtime.
- PROTOCOL
  - All errors, warnings and messages are output here.
    'Online': Messages from the runtime environment as well as other errors and warnings relating to online communication.
  - *'Engineering'*: Non-project-related messages about events that affect the software such as device files GSDML etc.
- RECYCLE BIN
  - Items that you have recently deleted from the *'Plant'* or *'Components'* areas are moved to the recycle bin.
  - If necessary, you can restore deleted items.

Status bar

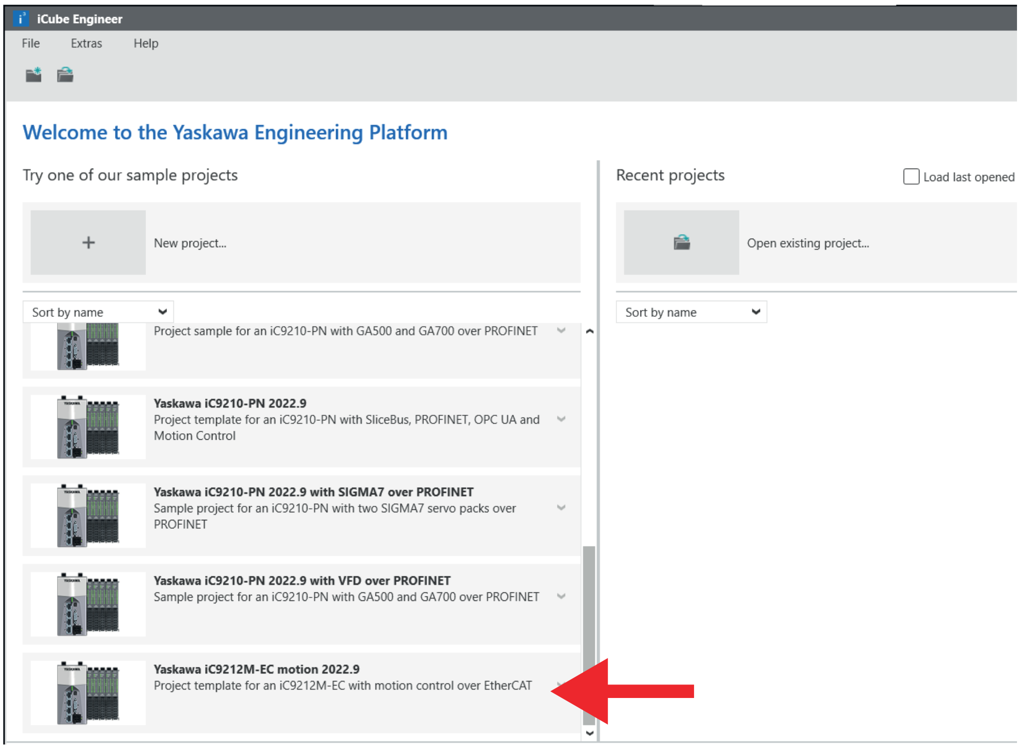
Detected errors and warnings are shown here. In addition, you have a zoom function here for graphical applications.

4.4.3 Create a new project

Proceeding

1. Start iCube Engineer.

2. On the start bar, click on a project template that corresponds to your firmware version, such as Yaskawa CPU iC921xM-x



Welcome to the Yaskawa Engineering Platform

Try one of our sample projects

Recent projects

Project sample for an iC9210-PN with GA500 and GA700 over PROFINET

Yaskawa iC9210-PN 2022.9
Project template for an iC9210-PN with SliceBus, PROFINET, OPC UA and Motion Control

Yaskawa iC9210-PN 2022.9 with SIGMA7 over PROFINET
Sample project for an iC9210-PN with two SIGMA7 servo packs over PROFINET

Yaskawa iC9210-PN 2022.9 with VFD over PROFINET
Sample project for an iC9210-PN with GA500 and GA700 over PROFINET

Yaskawa iC9212M-EC motion 2022.9
Project template for an iC9212M-EC with motion control over EtherCAT

➨ The project template for a blank CPU iC921xM-x opens.

3. Open *‘File → Save Project As’*, assign a meaningful name to your project and close the dialog with [Save].

4.5 Commissioning

4.5.1 Notes on commissioning

WARNING

Prevent automatic start-up

– Take appropriate measures to ensure that automatic start-up of your plant/ machine is prevented.

NOTICE

Acclimatization before start-up

Make sure that commissioning only takes place after the CPU and the associated modules have acclimatized!

NOTICE

Damage due to improper handling

– Handle the CPU and components with care!
– When installing the CPU and components, ensure that mechanical damage is avoided!

NOTICE

Startup of the CPU not guaranteed

– To ensure that the CPU starts up properly, the supply voltage must not be switched on until at least 30 seconds after the device LEDs go out.

NOTICE

Unauthorized access to the SD card possible

Access to the SD card is possible so that data can be read and manipulated.

– Please note ➦ *'Notes on security'...page 13*, especially with regard to access protection for the SD card.

Operation and programming may only be carried out by qualified personnel!

4.5.2 Online access to the CPU

IP address parameters for communication

On delivery the following IP address parameters for the communication are preset in the project template of the CPU:

- Ethernet-Port (X3/X4): 192.168.1.1
- Subnet mask: 255.255.255.0
- Gateway: -

If your CPU has different IP address parameters, you can adapt them for iCube Engineer via the following procedure:

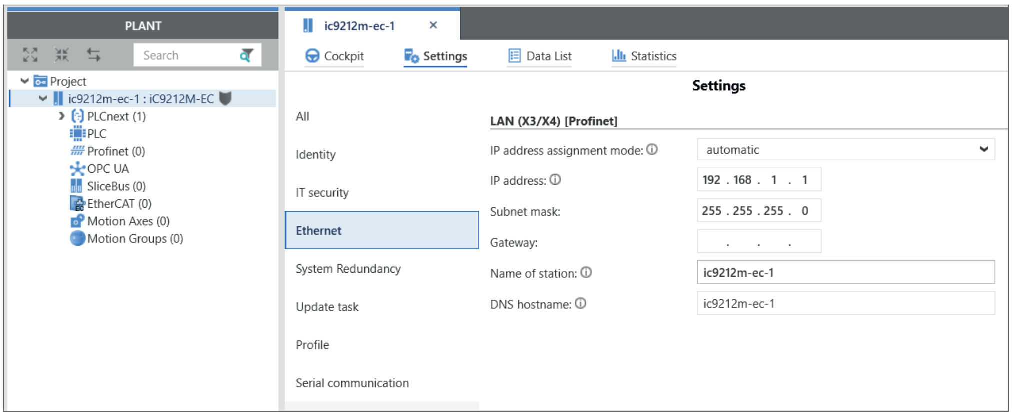
1. In the *'Plant'* area, double-click the CPU node

   ➡ The CPU editor group opens.

2. Select the *'Settings'* editor.

3. Select the *'Ethernet'* view.

   ➡



Settings

LAN (X3/X4) [Profinet]

IP address assignment mode: automatic

IP address: 192 . 168 . 1 . 1

Subnet mask: 255 . 255 . 255 . 0

Gateway: . . .

Name of station: ic9212m-ec-1

DNS hostname: ic9212m-ec-1

4. - At *'LAN (X3/X4)'* the IP address parameters for the connection via the Ethernet-Port (X3/X4) can be set.

   ➡ When establishing an Ethernet connection to the CPU, the IP address parameters specified here are used by iCube Engineer for the corresponding interface.

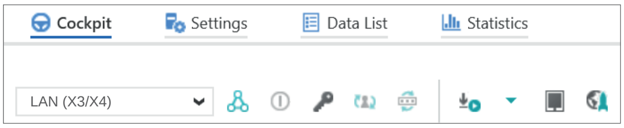
Connecting to the CPU

Please note that the online search is currently only supported by port X3/X4!

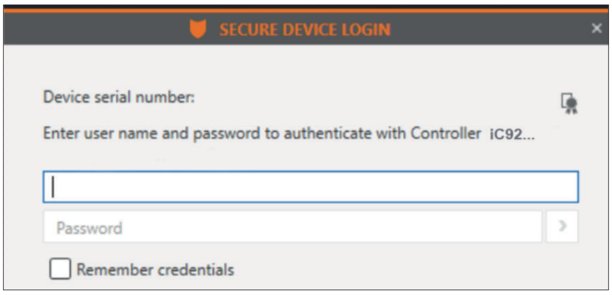
Connect port X3 or X4 to the Ethernet interface of your PC. Please note that for communication via iCube Engineer the network card of the PC and the Ethernet interface of the CPU are in the same IP circle. If necessary, contact your network administrator.

1. In the editor group of the CPU, select the editor *'Cockpit'*.

2. Set the interface *'LAN (X3/X4)'* and click on .



➡ A connection between iCube Engineer and your CPU is established, by means of the IP address parameters, and the login dialog for authentication is opened.


SECURE DEVICE LOGIN

Device serial number:

Enter user name and password to authenticate with Controller iC92...

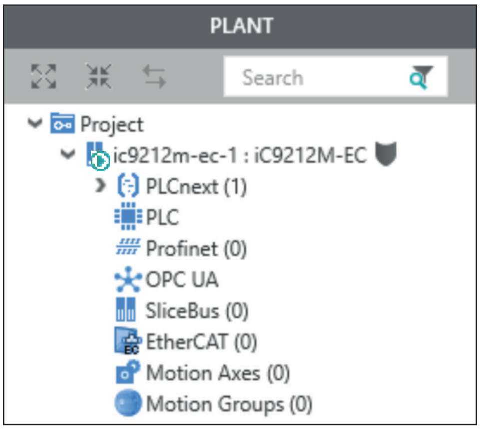
Password

□ Remember credentials

3. Enter your login details and click on ❯.

> *On delivery, the following access data are preset with administrator rights:*
>
> – *Username: admin*
> – *The password is printed under the front flap on the front of the CPU.*

➡ Now you can access your CPU. An existing connection is shown in the Plant area at the node of the CPU by .

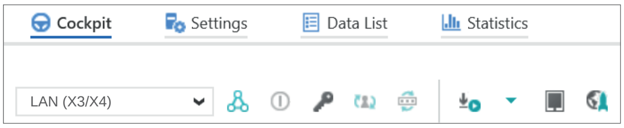


4.5.2.1 Assigning new IP address parameters

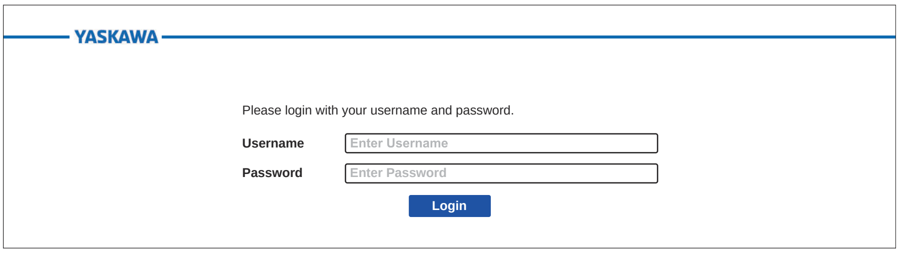
Assignment via WBM

As soon as you are online connected to the CPU, you can assign new IP address parameters to it via WBM (Web-based management).

1. To access WBM, click in the *'Cockpit'* editor at 🌐.



➡ The WBM login page opens.



Please login with your username and password.

Username: Enter Username

Password: Enter Password

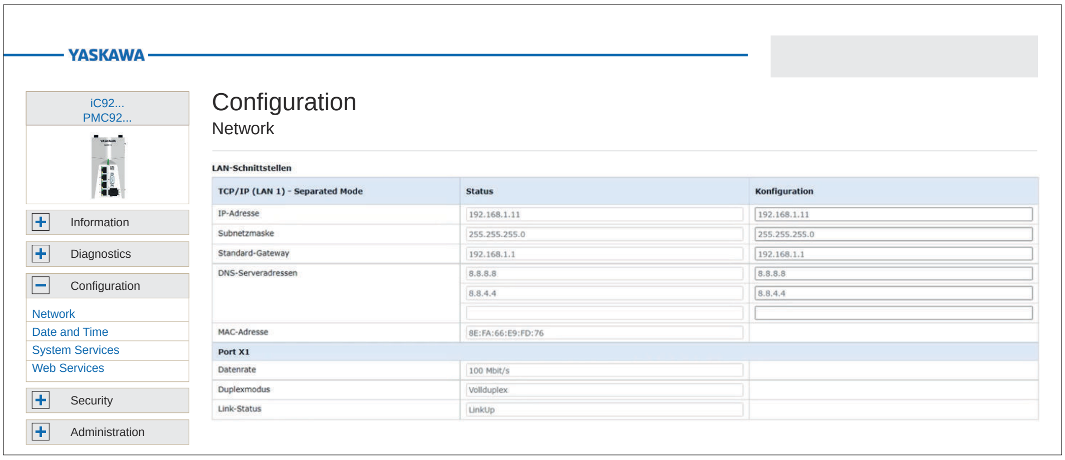
2. Enter your login details and click on [Login].

> ***On delivery, the following access data are preset with administrator rights:***
>
> – *Username: admin*
>
> – *The password is printed under the front flap on the front of the CPU.*

➡ You now have access to the WBM of the CPU with the access rights assigned to you.

3. Navigate to *Network* in the *Configuration* area.

➡ Here you can change the current IP address parameters in the *'Configuration'* column.



Configuration

Network

LAN-Schnittstellen

TCP/IP (LAN 1) - Separated Mode	Status	Konfiguration
IP-Adresse	192.168.1.11	192.168.1.11
Subnetzmaske	255.255.255.0	255.255.255.0
Standard-Gateway	192.168.1.1	192.168.1.1
DNS-Serveradressen	8.8.8.8	8.8.8.8
	8.8.4.4	8.8.4.4
MAC-Adresse	8E:FA:66:E9:FD:76	
Port X1		
Datenrate	100 Mbit/s	
Duplexmodus	Vollduplex	
Link-Status	LinkUp	

4. Enter your new IP address parameters in the *'Configuration'* column.

> **CAUTION**
>
> When assigning the IP address parameters, please note that the number ranges of the IP addresses of X1/X2 and X3/X4 must not overlap if they exist!

5. Click on [Apply and Reboot].

   ➡ The settings are accepted, transferred to the CPU and the CPU is automatically restarted for activation.

   > *The CPU can now only be reached via the new IP address parameters. Please note that these new data are currently not automatically transferred in the settings of iCube Engineer. You have to manually adjust these in the settings there.*

4.6 Memory management

4.6.1 Internal memory

Overview

> *Please note that, depending on the firmware and the components used, not the entire memory area is available.*

Memory

- PMC9212Ex only:
  - 2GB working memory (RAM).
  - 12MB program memory.
  - 32MB data memory.
  - 512kB retentive data memory.
- PMC9216Ex only:
  - 2GB working memory (RAM).
  - 12MB program memory.
  - 32MB data memory.
  - 3072kB retentive data memory.

Working memory

- During operation, the operating system stores temporary data and parts of the user program in the *working memory*.
- With MRESET you can set the CPU to the *Ready* state without a power cycle. This unloads the working memory, among others. ➦ *'MRESET'...page 97*

Parametrization memory

The *parametrization memory* as the sum of program and data memory provides memory for:

- Current firmware version
- *Overlay file system* for user program, configurations, user data and firmware adjustments.

Use of the *overlay file system*:

- As soon as you configure the CPU or make changes to the current firmware version, data are generated in the *overlay file system*.
- By *'Resetting to the factory setting type 1'*, you can delete the *overlay file system*, among others. The current firmware version remains, but all changes to it are discarded. ➦ *'Reset to factory settings type 1'...page 97*
- By *'Resetting to the factory setting type 2'*, you can delete the *overlay file system* and the current firmware version, among others. The current firmware version is overwritten by the original firmware version and the delivery state of the CPU is restored. ➦ *'Reset to factory settings type 2'...page 98*

CAUTION

Damage to the internal parametrization memory due to high data traffic!

– Due to frequent write accesses at applications with high data traffic e.g. data logger applications to the overlay file system, the internal parametrization memory of the CPU may be long term damaged and lead to a device defect.
– For applications with high data traffic, use an external Yaskawa SD card as a storage medium for the overlay file system.

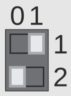
Non-volatile memory for retentive data

- All data that were marked as retentive in iCube Engineer during configuration are permanently stored here.
- In the event of a power failure, retentive data are automatically backed up.
- By MRESET or resetting to factory setting type 1/2 you can, among others, delete the non-volatile memory for retentive data.

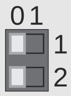
Fix memory overflow

If, during operation or when starting up the CPU, the error indication occurs that the memory of the overlay file system in the parametrization memory has overflowed, the CPU can be restarted via *Safe Mode* as follows:

1. Switch off the power supply of the CPU.
2. Set the DIP switches S1 under the front flap to the following position:

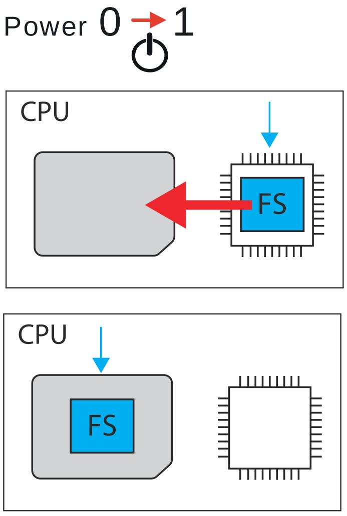
S1	S1-1	S1-2	Action
	ON	OFF	After PowerON the CPU starts in *Safe Mode*.

3. Switch on the power supply of the CPU again.
   ➡ The CPU starts in ➦ *'Safe Mode'...page 98*. Here, a memory area reserved exclusively for *Safe Mode* is enabled, which allows the CPU to restart in the event of a memory overflow. At *Safe Mode* the CPU starts with a default project, but your user programme is still present in the file system.
4. Check your user program for files on the file system that cause the system to overflow, such as log files, recipes, motion data. Use an SSH client to access the file system and delete the causing files if necessary. Then start in *Standard Mode* again.
5. For this, switch off the power supply to the CPU.
6. Set the DIP switches S1 to the default position:

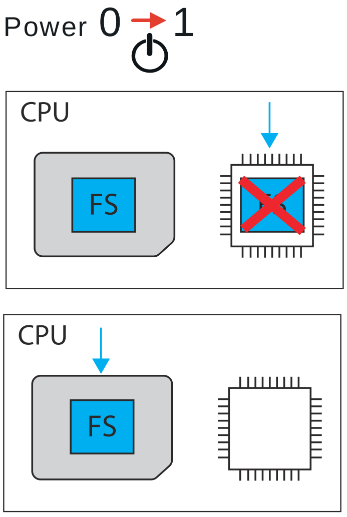
S1	S1-1	S1-2	Action
	OFF	OFF	After PowerON the CPU starts in *Standard Mode* - default setting.

7. Switch on the power supply of the CPU again.
   ➡ The CPU starts in *Standard Mode* again. If a project was loaded in Safe Mode, it is executed in RUN operating mode.

4.6.2 Slot for Yaskawa SD card



- You can only insert a Yaskawa SD card with a valid license file in this slot.
- In the *WBM* at *'Security → SD Card'*, you can enable or disable the use of the SD card and call up information about it. By default, the use of the SD card is enabled. ➦ *'SD Card'...page 197*
- An inserted Yaskawa SD card is only recognized by the CPU after PowerON.
- If a new, unused Yaskawa SD card is detected after PowerON, the *overlay file system* FS with user program, configurations, user data and firmware adjustments, is moved from the internal parametrization memory to the Yaskawa SD card and deleted in the internal parametrization memory. The CPU uses the overlay file system on the Yaskawa SD card, now.



- If, after PowerON, an Yaskawa SD card is recognized on which there is already an *overlay file system* FS, the overlay file system is deleted in the internal parametrization memory without being moved. The CPU uses the existing overlay file system on the Yaskawa SD card, now.

WARNING

Data loss - card removal only when the power supply is switched off!

Only remove the Yaskawa SD card when the power supply of the CPU is switched off. Otherwise this will lead to data loss!

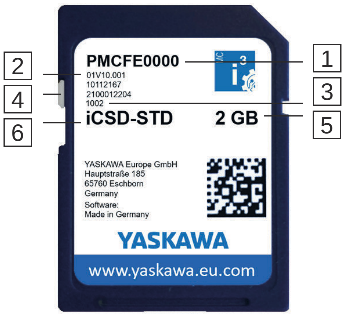
General notes on using the Yaskawa SD card

- *Only Yaskawa SD cards are supported.*
- *The cards are pre-formatted (ext4 format) for use in CPUs of the iC9200 Series.*
- *When formatting again, certain information on the Yaskawa SD card that is required for use in the CPUs of the iC9200 Series will be lost.*
- *Exclude the Yaskawa SD card from being formatted.*
- *The Yaskawa SD card can be read at any time with a conventional SD card reader. Sensitive data on the Yaskawa SD card can be read if you do not physically protect it from unauthorized access.*
- *Make sure that unauthorized persons cannot access the Yaskawa SD card.*

Please note when using without an Yaskawa SD card!

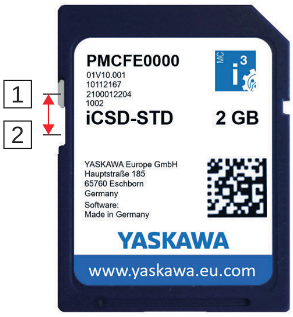
- *By default, support for the Yaskawa SD card is enabled.*
- *Disable the support of the Yaskawa SD card if you want to operate the CPU without YaskawaSD card.*
- *If the support of the Yaskawa SD card remains enabled and the CPU is operated without a Yaskawa SD card, there is a risk of data theft or data manipulation.*
  - *Unauthorized persons may insert a Yaskawa SD card and restart the CPU.*
  - *If a new, unused Yaskawa SD card is detected after PowerON, the overlay file system with user program, configurations, user data and firmware adjustments, is moved from the internal parametrization memory to the Yaskawa SD card and deleted in the internal parametrization memory. Projects and IP configurations saved there are then no longer available!*
- *When changing to operation without Yaskawa SD card, the overlay file system of the internal parametrization memory is activated by the CPU after PowerON and is used now. Please note that no data are used from the Yaskawa SD card. There is also no function for transferring back from the Yaskawa SD card to the internal parametrization memory.*

Yaskawa SD card



The Yaskawa SD card has the following labelling and elements:

1 Order number
2 Product version
3 Serial number
4 Write protection slider - shown disabled here.
5 Memory size
6 Designation



1 In this position the write protection is disabled - delivery state.
2 In this position, the write protection is enabled and the SD card is protected against unintentional overwriting.

4.7 MRESET and reset to factory settings

MRESET

- The CPU is set to the *Ready* state.
- The working memory is unloaded, but the user program remains in the overlay file system.
- The non-volatile memory for retentive data is deleted.

1. Switch your CPU to STOP state.
2. Push the operating mode switch down to position MR.
3. Release the operating mode switch after 3 seconds and press it back to the MR position within 3 seconds.
4. Release the operating mode switch after 3 seconds.
   - ➡ The CPU now executes a MRESET.
   - To confirm, you will receive a diagnostic message that a MRESET was executed. You can output e.g. in iCube Engineer via *'Notifications'* in the *'Cockpit'* editor.

Reset to factory settings type 1

- The overlay file system with user program, configurations, user data and firmware adjustments is deleted.
- The non-volatile memory for retentive data is deleted.
- The current firmware version remains, but all changes to it are discarded.

With operating mode switch

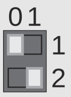
1. Switch off the power supply of the CPU.
2. Press and hold the operating mode switch in position MR and switch on the power supply of the CPU again.
3. As soon as the LEDs show the following behavior after start-up, release the operating mode switch again:

Status	RN	ER	IO ER	PN-C ER	PN-D ER	IO DIAG
🟨 yellow 1Hz	🟩 green	🟥 red	□	□	□	□

➡ The CPU now executes a reset to *factory setting type 1*.

With DIP switch S1

1. Switch off the power supply of the CPU.
2. Set the DIP switches S1 under the front flap to the following position:

S1	S1-1	S1-2	Action
 0 1 1 2	OFF	ON	After PowerON the CPU executes a reset to *factory settings type 1*.

3. Switch on the power supply of the CPU again.

   After the start-up of the CPU it performs a reset to *factory setting type 1* and shows the following LED behavior:

Status	RN	ER	IO ER	PN-C ER	PN-D ER	IO DIAG
🟨 yellow 1Hz	🟩 green	🟥 red	□	□	□	□

The CPU requests a power cycle after a reset to *factory settings type 1*:

Status	RN	ER	IO ER	PN-C ER	PN-D ER	IO DIAG
🟨 yellow 2Hz	🟩 1Hz	🟥 1Hz	🟥 1Hz	🟥 1Hz	🟥 1Hz	🟥 1Hz

4. Switch off the power supply of the CPU.
5. Set the DIP switch S1 to the default position:

S1	S1-1	S1-2	Action
0 1 ◨ 1 ◨ 2	OFF	OFF	After PowerON the CPU starts in *Standard Mode* - Default setting.

6. Switch on the power supply of the CPU again.
   ➡ The CPU starts in *Standard Mode*.

Reset to factory settings type 2

- The overlay file system with user program, configurations, user data and firmware adjustments is deleted.
- The non-volatile memory for retentive data is deleted.
- The current firmware version is overwritten by the original firmware version and the delivery state of the CPU is restored.

1. Switch off the power supply of the CPU.
2. Press and hold the operating mode switch in position MR and switch on the power supply of the CPU again.
3. As soon as the LEDs show the following behavior after start-up, release the operating mode switch again (duration ca. 30s):

Status	RN	ER	IO ER	PN-C ER	PN-D ER	IO DIAG
🟨 yellow 2Hz	🟩 green	🟥 red	🟥 red	□	□	□

   ➡ The CPU now executes a reset to *factory setting type 2* and is then in the delivery state.

4.8 Firmware update

You can update the firmware via the Web-based management WBM. ➦ *'Firmware Update'...page 207*

> *Please note that you can only execute a firmware update with administrator rights!*

4.9 Safe Mode

Start-Up in *Safe Mode*

By means of the DIP switch *'S1'* beneath the front flap you can start your CPU in *Safe Mode*. Here the CPU starts with the following behavior:

- The CPU goes to RUN with the default project.
- A project can be loaded but not executed.
- The SliceBus is switched off.
- All field buses are disabled.
- The parametrization memory with the current firmware version and the *overlay file system* remains unchanged.
- During online access, you are informed that the CPU is in *Safe Mode*.
- The *non-volatile memory* for retentive data remains unchanged.
- The CPU can only be reached via the default IP address.
- Additionally, a memory area reserved exclusively for *Safe Mode* is enabled, which allows the CPU to restart in the event of a memory overflow.

1. Switch off the power supply of the CPU.
2. Set the DIP switches S1 under the front flap to the following position:

S1	S1-1	S1-2	Action
0 1 ■□ 1 □■ 2	ON	OFF	After PowerON the CPU starts in *Safe Mode*.

3. Switch on the power supply of the CPU again.
   ➡ The CPU starts in *Safe Mode* and shows this exclusively during online access.

Start-up in *Standard Mode*

1. Switch off the power supply of the CPU.
2. Set the DIP switches S1 to the default position:

S1	S1-1	S1-2	Action
0 1 □■ 1 □■ 2	OFF	OFF	After PowerON the CPU starts in *Standard Mode* - Default setting.

3. Switch on the power supply of the CPU again.
   ➡ The CPU starts in *Standard Mode* again. If a project was loaded in Safe Mode, it is executed in RUN.

4.10 System variables and status information

4.10.1 General

- This chapter describes system variables that are available for the CPU.
- The CPU has a register set that is used for diagnostics and simple control of the CPU.
- The diagnostic data are stored in the diagnostic status register and in the diagnostic parameter register. These registers are available to the application program as system variables (system flags, global variables).

Access to system variables and data structures

- Some system variables of the CPU are organized as data structures. The data structure of such a system variable contains further system variables.
- In the *'Init Value Configuration'* of iCube Engineer you can see which system variables belong in detail to a system variable organized as a data structure.

To open the *'Init Value Configuration'* for a system variable organized as a data structure, proceed as follows:

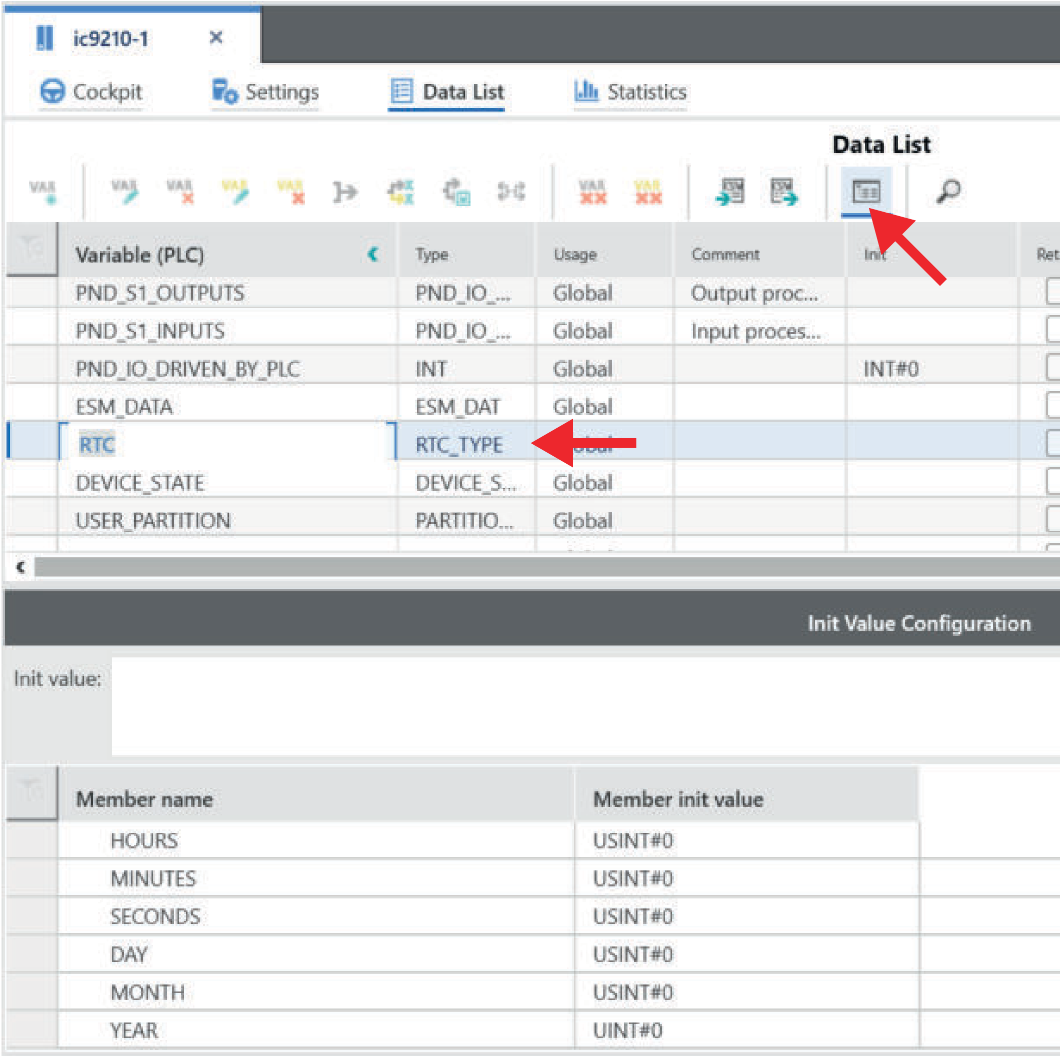
1. In the Plant area, double-click the SPS node.
   ➡ The CPU/SPS editor group opens.
2. Select the editor Data list.

   > *Alternatively, you can open the Data list editor in the area Plant via the CPU node.*

3. Open the System variables section.
4. Click on the arrow in the Variable (PLC) column to show the extended information.
   ➡ The data type of the system variable is shown in the extended information column Type.
5. Select the line of the system variable organized as a data structure whose associated system variables you want to see. To do this, click on the first column in the row of the system variable organized as a data structure.

6. Click the ▤ button.

➡ The *'Init Value Configuration'* of the selected system variable organized as a data structure is opened below the Data list editor.



ic9210-1 ×

Cockpit Settings Data List Statistics

Data List

Variable (PLC)	Type	Usage	Comment	Init	Ret
PND_S1_OUTPUTS	PND_IO_...	Global	Output proc...		□
PND_S1_INPUTS	PND_IO_...	Global	Input proces...		□
PND_IO_DRIVEN_BY_PLC	INT	Global		INT#0	□
ESM_DATA	ESM_DAT	Global			□
RTC	RTC_TYPE	Global			□
DEVICE_STATE	DEVICE_S...	Global			□
USER_PARTITION	PARTITIO...	Global			□

Init Value Configuration

Init value:

Member name	Member init value
HOURS	USINT#0
MINUTES	USINT#0
SECONDS	USINT#0
DAY	USINT#0
MONTH	USINT#0
YEAR	UINT#0

In *'Init Value Configuration'* column Element name lists all system variables which are contained in the system variable organized as a data structure.

4.10.2 System variables

System time

- The system variable RTC is a system variable organized as a data structure.
- You can use the RTC system variable to retrieve information about the system time of the device-internal real-time clock.

System variable		Type - description
RTC		RTC_TYPE - data structure
	HOURS	USINT - system time (hours)
	MINUTES	USINT - system time (minutes)
	SECONDS	USINT - system time (seconds)
	DAY	USINT - system time (day)
	MONTH	USINT - system time (month)
	YEAR	UINT - system time (year)

Function blocks
TLS_SOCKET_2
UDP_SOCKET_2

- With the TLS_SOCKET_2 function block, you open and close IP sockets for IP communication via TCP (Transmission Control Protocol - not secure or TLS (Transport Layer Security - secure). You can control this with the START_TLS input parameter (FALSE: TCP, TRUE: TLS).
- Use the UDP_SOCKET_2 block to open and close IP sockets for IP communication via UDP (User Datagram Protocol).
- You can retrieve the number of open IP sockets using the following system variables:

System variable	Type - description
IP_ACTIVE_SOCKETS	UINT - Number of TCP/UDP sockets opened with the TLS_SOCKET_2 and UDP_SOCKET_2 function blocks.
TLS_ACTIVE_SOCKETS	UINT - Number of TLS sockets opened with the TLS_SOCKET function block.

Device state

- The system variable DEVICE_STATE is a system variable organized as a data structure.
- You can use the DEVICE_STATE system variable to retrieve various information about the device status of the CPU.

System variable	Type - description
DEVICE_STATE	DEVICE_STATE_X152_TYPE - data structure
BOARD_TEMPERATURE	SINT - temperature inside the housing (in °C).
reserved1	BOOL - reserved
reserved2	USINT - reserved
CPU_LOAD_ALL_CORES	USINT - average current utilization of all processor cores (in %).
CPU_LOAD_PER_CORE	CPU_LOAD_PER_CORE_ARRAY - Information on the utilization of each processor core.
[1]	USINT - current utilization of processor core 1 (in %).
[2]	USINT - current utilization of processor core 2 (in %).

Partition

- The system variable USER_PARTITION is a system variable organized as a data structure.
- You can use the USER_PARTITION system variable to retrieve various information and memory statistics on the user partition (overlay file system).
- The partition can be on the external Yaskawa SD card or on the internal memory.
- The memory is organized in blocks.
- A block has a constant, fixed size and a file always uses one or more blocks.
- A certain number of blocks are reserved in the Linux system for the root user. These reserved blocks are only available for the root user and ensure his ability to act even if the memory is occupied (e.g. for log outputs).

System variable	Type - description
USER_PARTITION	PARTITION_INFO - data structure
MEM_TOTAL	ULINT - total memory of the partition in bytes (including reserved blocks).
MEM_FREE	ULINT - free, available memory in bytes (without reserved blocks).
MEM_USED	ULINT - used memory in bytes (including reserved blocks).
MEM_USAGE	ULINT - used memory in % (without reserved blocks).

Task handling

- In iCube Engineer programs and program parts are treated as tasks.
- The Execution & Synchronization Manager (ESM) is responsible for coordinating and processing the individual tasks.
- You can use the ESM_DATA system variable to retrieve information about the ESM's task handling.
- ESM_DATA is a system variable organized as a data structure.

System variable	Type - description
ESM_DATA	ESM_DAT - data structure
ESM_COUNT	USINT - number of ESM (one ESM per processor core).
ESM_INFOS	ESM_INFO_ARRAY
[1] ... [2]	ESM_INFO - Information about the ESM [1 ... 2][2].
TASK_COUNT	UINT - number of tasks that were configured for the ESM.
TICK_COUNT	UDINT - always 0.
TICK_INTERVAL	UDINT - always 0.
TASK_INFOS	TASK_INFO_ARRAY
[1] ... [16]	TASK_INFO - Information about the tasks [1 ... 16].
INTERVAL[1]	LINT - time interval ■ With cyclic tasks: Time interval in µs ■ With acyclic tasks: 0
PRIORITY[1]	INT - priority of the task
WATCHDOG[1]	LINT - watchdog time in µs (0 = no watchdog). ■ Watchdog time you define for the sum of the execution time and the delay time. ■ If the watchdog time is exceeded, the watchdog is triggered.
LAST_EXEC_DURATION	LINT - execution time of the task in the previous cycle in µs. ■ This also includes interruptions due to higher-priority tasks.
MIN_EXEC_DURATION	LINT - Minimum execution time of the task in µs. ■ This also includes interruptions due to higher-priority tasks.
MAX_EXEC_DURATION	LINT - Maximum execution time of the task in µs. ■ This also includes interruptions due to higher-priority tasks.
LAST_ACTIVATION_DELAY	LINT - delay time of the task in the previous cycle in µs. ■ A delay occurs when higher priority tasks are pending at the time of task activation.
MIN_ACTIVATION_DELAY	LINT - Minimum delay time of the task in µs. ■ A delay occurs when higher priority tasks are pending at the time of task activation.
MAX_ACTIVATION_DELAY	LINT - Maximum delay time of the task in µs. ■ A delay occurs when higher priority tasks are pending at the time of task activation.
EXEC_TIME_THRESHOLD[1]	LINT - threshold that you can define for the sum of the execution time and the delay time.
EXEC_TIME_THRESHOLD_CNT	UDINT - If the defined threshold EXEC_TIME_THRESHOLD is exceeded, the value of the variable EXEC_TIME_THRESHOLD_CNT is incremented.

System variable	Type - description
NAME[1]	STRING - name of the task.
EXCEPTION_COUNT	USINT - number of exceptions.
EXCEPTION_INFOS	ESM_EXCEPTION_INFO_ARRAY
[1] ... [2]	ESM_EXCEPTION_INFO - Information on the exceptions [1 ... 2][2].
TYPE_ID	UDINT - ID of the exception.
SUB_TYPE	STRING512 - exception type.
SUB_TYPE_ID	UDINT - ID of the task in which the exception occurred.
TASK_NAME	STRING - name of the task in which the exception occurred.
PROGRAM_NAME	STRING512 - name of the program instance in which the exception occurred.
INFORMATION	STRING512 - information about the exception that occurred.

1) You can set the system variable in the Tasks and events editor of the software iCube Engineer.

2) Please note that some CPUs only support ESM1. *‘Technical data’...page 69*

SliceBus system variables

- *Please consider the System SLIO power and clamp modules do not have any module ID. These cannot be recognized and are therefore not taken into account when listing or assigning the slots.*
- *The counting of the slots starts at 1, i.e. the 1st slot corresponds to bit 0 in the corresponding diagnostic register.*
- *A diagnostic interrupt is not automatically acknowledged. The acknowledgement happens by reading the diagnosis. As long as a diagnostic interrupt is not acknowledged, no further diagnostic interrupt is issued at this slot.*

Diagnostic interrupt handling

- As soon as a module reports a diagnostic interrupt via the backplane bus, this is automatically recognized by the CPU and in *SB_DIAG_ALARM_STATUS* the register bit corresponding to the slot is set.
- The diagnostic interrupt must be enabled for the module in iCube Engineer.
- You can acknowledge a diagnostic message by reading record set 0x00 (diagnostics) or 0x01 (extended diagnostics) from the corresponding slot. Information concerning the structure of the diagnostic data may be found in the manual of the corresponding System SLIO module.
- In iCube Engineer you can use the *Y_SB_DataRecordRead* block from the system library to read the corresponding record set. To do this, you must first add the *‘Y_SliceBus.pcwlx’* system library to your project.

System variable	Type - description
SB_DATA_VALID	BOOL - bus activity ■ This variable is set if data transfer via *SliceBus* is active.
SB_TOPOLOGY_OK	BOOL - bus topology ■ This variable is set when the plugged modules on the *SliceBus* match the configuration.
SB_DIAG_ALARM_STATUS	ULINT - diagnostic status of the modules ■ As soon as a module reports a diagnostic alarm on the *SliceBus*, according to the slot position the corresponding bit is set in the 64-bit register.

System variable	Type - description
SB_DIAG_ALARM_ACK_PENDING	ULINT - acknowledgement diagnostic status of the modules ■ As soon as a module on the *SliceBus* requests an acknowledgement of the diagnostic alarm, according to the slot position the corresponding bit is set in the 64-bit register.

EtherCAT system variables

The system variables for diagnostics of the EtherCAT master and the connected EtherCAT slaves are listed below.

System variable	Description
EC_MASTER_STATE	BYTE - master state ■ Returns the state of the EtherCAT master: – 00h: Unknown - the state is unknown. – 01h: INIT – 02h: PreOp – 04h: SafeOp – 08h: OP
EC_MASTER_LINK_CONNECTED	BOOL - physical connection ■ Set when an Ethernet cable is connected to the EtherCAT master.
EC_TOPOLOGY_OK	BOOL - topology OK ■ Set when current topology and configured topology match.
EC_DC_IN_SYNC	BOOL - distributed clocks ■ Set when the distributed clocks are synchronized.
EC_CYCLIC_LOST_FRAMES	DWORD - missing frames (cyclic) ■ Returns the number of frames lost during cyclic communication.
EC_ACYCLIC_LOST_FRAMES	DWORD - missing frames (acyclic) ■ Returns the number of frames lost during acyclic communication.
EC_NUM_CONFIGURED_SLAVES	WORD - configured number of slaves ■ Returns the number of configured EtherCAT slaves.
EC_NUM_AVAILABLE_SLAVES	WORD - number of slaves in the network ■ Returns the number of EtherCAT slaves found when searching the EtherCAT network.
EC_SLAVES_IN_MASTER_STATE	BOOL - EtherCAT slaves in master state ■ Set when all EtherCAT slaves on the EtherCAT master have the state of the EtherCAT master.
EC_SLAVE_STATION_ADDRESS	ARRAY[0…512] OF WORD[1)] - slave addresses ■ Returns all addresses of the EtherCAT slaves connected to the EtherCAT master.

System variable	Description
EC_SLAVE_STATE	ARRAY[0...512] OF BYTE[1] - slave states - Returns all states of the EtherCAT slaves connected to the EtherCAT master: – 00h: The state is unknown. – 01h: INIT – 02h: PreOp – 03: BootStrap – 04h: SafeOp – 08h: OP
EC_SLAVE_LAST_AL_STATUS_CODE	ARRAY[0...512] OF WORD[1] - Slave AL Status codes - Returns last read AL Status Codes of the EtherCAT slaves connected to the EtherCAT master.
1) Index 0 is reserved. The 1. EtherCAT slave is assigned to Index 1.	

PROFINET system variables optional

ℹ *Please note that a separate licence is required for the use of PROFINET, which must be activated accordingly!*

PROFINET system variables - PROFINET controller functionality

System variable	Type - description
PNIO_SYSTEM_BF	BOOL - Missing connection to a configured PROFINET device. - An error has occurred in the PROFINET network, i.e. no connection could be established to at least one configured PROFINET device. - This value is not set if the "Control BF" parameter on a PROFINET device was set to FALSE. The PROFINET device was thus removed from the connection monitoring.
PNIO_SYSTEM_SF	BOOL - Diagnostic interrupt on a configured PROFINET device. - At least one PROFINET device reports a system error as a diagnostic interrupt or maintenance alarm. - The error priority can be found in the variables PNIO_DIAG_AVAILABLE, PNIO_MAINTENANCE_DEMANDED and PNIO_MAINTENANCE_REQUIRED.
PNIO_MAINTENANCE_DEMANDED	BOOL - maintenance demand - At least one PROFINET device reports a "maintenance demand" - maintenance alarm with high priority when the connection is active. - The PROFINET device can be identified by means of the RALRM diagnostic block.
PNIO_MAINTENANCE_REQUIRED	BOOL - maintenance required - At least one PROFINET device reports a "maintenance required" - maintenance alarm with low priority when the connection is active. The PROFINET device can be identified by means of the RALRM diagnostic block.

System variable	Type - description
PNIO_FORCE_FAILSAFE	BOOL - All PROFINET devices are prompted to set their configured substitute values. ■ The system variable can be written/set from the program if required.
PNIO_CONFIG_STATUS	WORD - configuration status of the PROFINET controller.
PNIO_CONFIG_STATUS_READY	BOOL - PROFINET controller initialized. ■ This variable is set if the PROFINET controller could be initialized without errors. ■ No target iCube Engineer configuration has been loaded yet.
PNIO_CONFIG_STATUS_ACTIVE	BOOL - target configuration loaded. ■ This variable is set when a target configuration was uploaded to the PROFINET controller. ■ In this state, the PROFINET controller tries to establish a connection cyclically to all devices of the target configuration.
PNIO_CONFIG_STATUS_CFG_FAULT	BOOL - target configuration error. ■ The target configuration of the PROFINET controller was not accepted due to a serious error. ■ Please contact our support!
PNIO_FORCE_PRIMARY	BOOL - This variable is used by function blocks for applicative redundancy to specify the SRL role of the PROFINET controller.

PROFINET system variables - PROFINET device functionality

System variable	Type - description
PND_S1_PLC_RUN	BOOL - Status of the higher-level PROFINET controller. ■ Information whether the higher-level PROFINET controller is active. ■ The value is TRUE if the higher-level PROFINET controller is in RUN state and the program is being processed. ■ The indication is only valid with existing PROFINET connection (PND_S1_VALID_DATA_CYCLE).
PND_S1_VALID_DATA_CYCLE	BOOL - the higher-level PROFINET controller has established the connection. ■ Information whether a connection exists and cyclic data is exchanged between PROFINET controller and PROFINET device and the last received frame contained valid data.
PND_S1_OUTPUT_STATUS_GOOD	BOOL - IOP status of the higher-level PROFINET controller. ■ Information whether the PROFINET device has received the input process data (PND_S1_INPUTS) with the status "valid". ■ The value is TRUE if the output data of the higher-level PROFINET controller are valid (provider status).
PND_S1_INPUT_STATUS_GOOD	BOOL - IOC status of the higher-level PROFINET controller.
PND_S1_DATA_LENGTH	WORD - process data length which was configured for the PROFINET device.
PND_S1_OUTPUTS	PND_IO_512 - output process data ■ Memory area for output process data that the PROFINET device sends to the higher-level PROFINET controller.

System variable	Type - description
PND_S1_INPUTS	PND_IO_512 - input process data ■ Memory area for input process data that the PROFINET device receives from the higher-level PROFINET controller.
PND_IO_DRIVEN_BYPLC	INT - Applicative system redundancy ■ Number of the PROFINET controller currently connected to the PROFINET device. ■ Indication from which higher-level PROFINET controller the data in the PROFINET device come from. – 0: No PROFINET controller – 1: PROFINET controller A – 2: PROFINET controller B

5 Deployment CPU iC921xM-FSoE

5.1 Safety instructions

WARNING

Depending on the application, improper use of the CPU can pose serious risks to the user

When handling the CPU, observe all safety instructions listed in this chapter.

WARNING

Avoid danger - outputs can be set

- Take appropriate measures to ensure that there is no danger from your plant/machine.
- In the "DEBUG-RUN" state, variables can be overwritten. These are then also transmitted to the FSoE output devices and output.
- Do not automatically acknowledge an operator acknowledge request from the user program. The acknowledgment must be triggered by a conscious user action.
- If you reintegrate passivated FSoE participants, safety-related outputs can be set! Take appropriate measures to ensure that your plant/machine is not at risk when passivated FSoE participants are reintegrated.

WARNING

Loss of electrical safety and safety function when using unsuitable power supplies

The CPU is designed exclusively for operation with protective extra-low voltage (PELV) according to EN 60204-1. Only protective extra-low voltages in accordance with the specified standard may be used for supply. The following applies to the network (FSoE and System SLIO) and the I/O devices used within it:

- Only use power supplies that comply with EN 61204, with safe isolation with PELV voltage according to IEC 61010-2-201 (PELV). In these, a short circuit between the primary and secondary sides is excluded.

NOTICE

Observe supporting checklists

The checklists listed in the appendix serve to support planning, assembly and electrical installation, commissioning and parametrization as well as validation of the safety CPU and the FSoE system.

NOTICE

Device identification / number of safety devices

- Note that each F address must be unique within a network and overlaps are not permitted.

NOTICE

***'Watchdog'* must not exceed TI/TO$_{\text{FSoEWD\_MAX}}$ max**

- The value specified in iCube Engineer under *'Watchdog'* must not exceed TI/TO$_{\text{FSoEWD\_MAX}}$ ➦ *'Maximum permitted watchdog times'...page 134* from ➦ *'Response times'...page 131*!

NOTICE

Availability requirement

The CPU is not suitable for applications that require increased availability, as operation will be stopped in the event of a fault.

NOTICE

Property damage due to incorrect use

The IP20 (IEC 60529/EN 60529) protection class of the CPU is intended for a clean and dry environment.

- Do not subject the CPU to mechanical and/or thermal stress that exceeds the limits described.
- Please note that you must install the CPU in a lockable housing or a lockable control cabinet with at least protection class IP54 for proper operation.

NOTICE

Electrostatic discharge

The CPU contains components that can be damaged or destroyed by electrostatic discharge.

- When handling the CPU, observe the necessary safety measures against electrostatic discharge (ESD) in accordance with EN 61340-5-1 and IEC 61340-5-1.

NOTICE

Device failure due to foreign objects in the device

Foreign objects in the CPU may lead to malfunctions or even device failure.

- Make sure that no foreign objects get into the CPU (e.g. into the ventilation openings).

NOTICE

Device failure due to operation outside the permissible ambient temperature range

Operating the CPU outside the permissible ambient temperature range may lead to malfunctions or even device failure.

- Make sure that the permissible ambient temperature of the CPU is observed during operation of the CPU.
  ➦ *'Approvals, directives, standards'...page 19*

NOTICE

Device failure due to operation above the permissible specifications for vibration and shock

Operating the CPU above the permissible vibration and shock specifications may result in malfunctions or even device failure.

- Make sure that the permissible specifications for vibration and shock are observed during operation of the CPU.
  ➦ *'Approvals, directives, standards'...page 19*

NOTICE

Device defect due to reverse polarity

Reversing the polarity puts a strain on the electronics and can lead to a defect in the CPU.

– To protect the CPU, avoid reversing the polarity of the DC 24V supply.

5.2 Mounting

More information on mounting and wiring ➦ 'Basics and mounting'...page 22.

5.3 Licensing information for open source software

- The CPU works with a Linux operating system.
- You can access license information for the individual Linux packages in Web-based management (WBM) via the *'Legal Information '* button. ➦ *'Web-based management - WBM'...page 174*
- Every open source software that is used in the product is subject to the respective license conditions, which are not affected by the Yaskawa software license conditions (**S**oftware **L**icense **T**erms - SLT) for the product.
- The licensee can change the respective open source software in accordance with the applicable license terms.

Notes on OpenSSL

– *This product includes software developed by the OpenSSL Project for use in the OpenSSL Toolkit. (➦ http://www.openssl.org/).*

– *This product includes cryptographic software written by Eric Young (➦ eay@cryptsoft.com).*

5.4 Programming and file system

PLCnext Technology

- The CPU is based on PLCnext Technology ® from Phoenix Contact.
- The CPU works with a Linux operating system.

Programming

- The CPU may only programmed and configured with iCube Engineer according to IEC 61131-3.

The scope of the language of the safety function block diagram and the safety function block library can be found in the iCube Engineer documentation.

Firewall

- *On delivery the firewall in the CPU is disabled!*
- *Security recommendation: Enable the firewall!*
- *In the WBM, you can enable the firewall at 'Security → Firewall'.* ➦ *'Firewall'...page 193*
- *Please note that you only have access to the firewall settings as an administrator!*

5.4.1 Install iCube Engineer

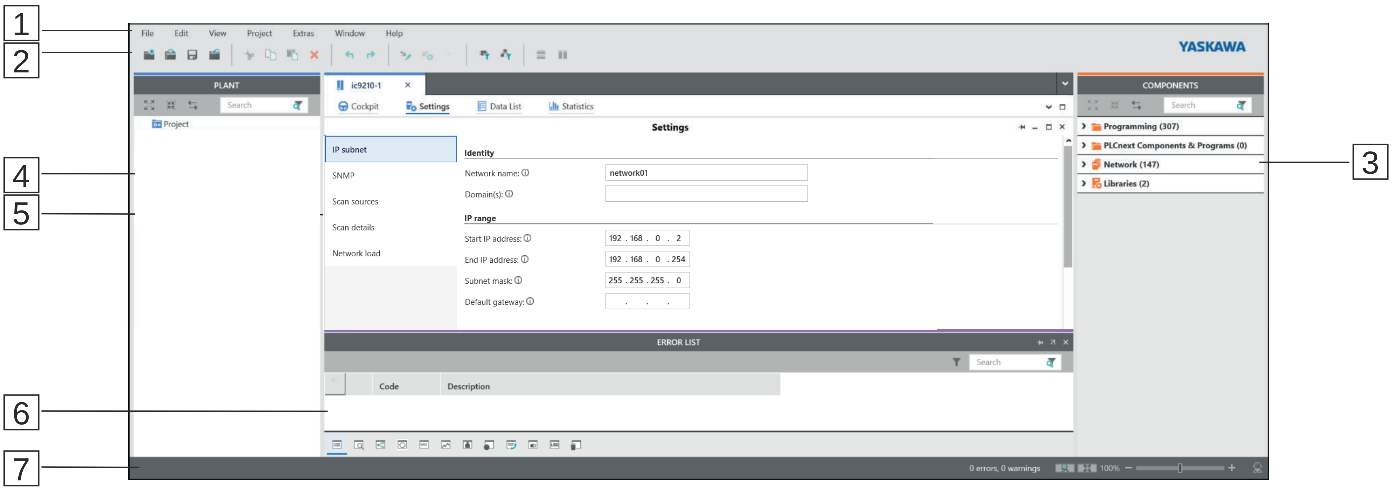
Installation

The software iCube Engineer is required for commissioning the CPU.

1. Download the software iCube Engineer to your PC. You can find this at www.yaskawa.eu.com in the *'Download center'*.
2. Unzip the file in your working directory and start the installation by double-clicking on the exe file.
3. Follow the instructions of the installation wizard.
   ➡ The installation is started.
4. When prompted, restart your system.
   ➡ The installation is finished. You can start iCube Engineer now.

5.4.2 iCube Engineer user interface

Overview



Settings

IP subnet
SNMP
Scan sources
Scan details
Network load

Identity

Network name: network01
Domain(s):

IP range

Start IP address: 192 . 168 . 0 . 2
End IP address: 192 . 168 . 0 . 254
Subnet mask: 255 . 255 . 255 . 0
Default gateway: . . .

1 Menu bar
2 Toolbar
3 *'Components'* area
4 *'Plant'* area
5 Editor area
6 Cross-functional area
7 Status bar

Menu bar

The menu bar provides access to a number of project-related commands that do not explicitly relate to a specific engineering task.

Toolbar

The menu bar provides access to a number of project-related commands that do not explicitly relate to a specific engineering task. In addition, the various areas and editors have their own specific toolbars.

***'Components'* area**

The *'Components'* area contains all components available for the project. The components can be divided into the following types based on their function:

- Develop program code (data types, programs, functions and function blocks).
- Show or add all devices available for the *'Plant'* area.
- Insert libraries such as firmware libraries, IEC user libraries, etc.

'Plant' **area**

In the *'Plant'* area, you map all the physical and logical components of your application as a hierarchical tree structure.

Editor area

- Double-clicking on a node in the *'Plant'* area or on an element in the *'Components'* area opens the associated editor group in the editor area.
- Editor groups are always shown in the center of the user interface.
- Each editor group contains several editors, which can be opened and closed using buttons in the editor group.
- You can identify the corresponding editor based on the color representation of the editor group:
  - Blue: Editor from the area *'Plant'*.
  - Orange: Editor from the area *'Components'*.

Cross-functional area

The cross-functional area contains functions that extend across your entire project.

- ERROR LIST
  - All errors, warnings and messages of the current project are shown here.
- GLOBAL FIND AND REPLACE
  - Here you can find and replace text in the project.
- CROSS REFERENCES
  - All cross references within the project are shown here, such as the use and declaration of all variable types.
- WATCH WINDOW
  - Debug tool - the current values of the added variables are shown here in online mode.
- BREAKPOINTS
  - Debug tool - here you can set and reset breakpoints for troubleshooting.
- CALL STACKS
  - Debug tool - the sequence of calls when the code is executed is shown here and commands for debugging with breakpoints are made available.
- LOGIC ANALYSIS
  - Here variable values can be recorded and visualized during runtime.
- PROTOCOL
  - All errors, warnings and messages are output here.

    'Online': Messages from the runtime environment as well as other errors and warnings relating to online communication.
  - *'Engineering'*: Non-project-related messages about events that affect the software such as device files GSDML etc.
- RECYCLE BIN
  - Items that you have recently deleted from the *'Plant'* or *'Components'* areas are moved to the recycle bin.
  - If necessary, you can restore deleted items.

Status bar

Detected errors and warnings are shown here. In addition, you have a zoom function here for graphical applications.

5.4.3 Create a new project

Proceeding

> **!** NOTICE
>
> The parametrization of the safety parameters is secured by a safety password, which you must assign when creating a project with safety components. Ensure that the safety password is appropriately protected and only pass on the safety password to authorised personnel!

1. Start iCube Engineer.

2. Click on *'New project ...'*

   ➡ The iCube Engineer user interface is opens.

3. At *'Components'* select the corresponding safety CPU and drag&drop it onto the *'Plant''Project'*.

   ➡ To access the safety-related area, you must now assign a safety password.

   - Use strong passwords consisting of upper/lower case, numbers and special characters.
   - The use of a password generator or manager is recommended.
   - The password in the templates of iCube Engineer is "safety".

   Once the password is assigned, the CPU is added to your project.

4. Save your project via *'File → Save as'*. Assign a meaningful name for your project and close the dialog with [Save].

5.4.4 Parametrization of the safety parameters

Safety instructions

> **!** NOTICE
>
> There is a memory area on the CPU for safety variable assignments. Please take the following limitations into account:
>
> – Each safety variable assignment, which is mapped into the process data, occupies 16 bytes.
> – Each variable assignment, which is mapped into the process data, occupies 8 bytes.
> – The total of all variable assignments, which are mapped into the process data, must not exceed 19980 bytes.

> **!** NOTICE
>
> Please note that the *'FSoE device address'* or *'F address'* of the local and Ethernet-connected safety modules is unique and may only be assigned once!

> **!** NOTICE
>
> The parametrization of the safe parameters is protected by a safety password, which you specified when creating the project. Ensure that the safety password is appropriately protected and only pass on the safety password to authorised personnel!

> **!** NOTICE
>
> Please note that the safety CPU generally supports 2-channel safety functions. When designing the safety functions, take into account how far the connected safety components provide 2-channel safety functions. There is no information about this in the safety CPU. More information can be found in the corresponding manufacturer documentation of the safety component.

> ℹ *2-channel capability is required to achieve SIL3/Cat.4/PLe. For SIL2/Cat.3/PLd, 1 channel is sufficient. Please consider the specifications for the test rate and request rate. Further information can be found in the corresponding manufacturer documentation for the safety component.*

If a connected safety component only provides 1-channel safety functions, you can use the ‘SF_Antivalent...’ and ‘SF_Equivalent...’ handling blocks to generate a 2-channel signal from two 1-channel signals. The blocks can be found in the ‘SF Library’, which must be installed if necessary. Information on using the blocks can be found in the corresponding online help.

Preparation

Carry out the hardware configuration of your system by double-clicking on the corresponding component in your project under *‘Plant’* and selecting the relevant *‘Typ’* in the editor. Select your safety modules in the same way.

By entering parts of the order number or the module name, you will get a module selection list, which adapts dynamically as you enter.

1. If available, configure the System SLIO modules, which are connected locally to the backplane bus. To do this, double-click under *‘Plant’* on *‘SliceBus’*.
   ➡ The *‘SliceBus’* editor opens. Here at *‘Type’* you can specify the module for the corresponding slot.
2. To configure your EtherCAT FSoE system, double-click under *‘Plant’* on *‘EtherCAT’*.
   ➡ The editor *‘EtherCAT → Device list’* opens.
3. Select the corresponding EtherCAT coupler.
   ➡ At *‘Plant → EtherCAT’* the corresponding EtherCAT coupler is created.
4. Double-click at *‘Plant → EtherCAT’* on the newly created EtherCAT coupler.
   ➡ The *‘Module list’* editor opens. Here at *‘Type’* you can specify the module for the corresponding slot.

5.4.4.1 Parametrization

Switching the language

Please note that due to the system, the parametrization of the safety parameters is only possible in the English language view.

1. To switch languages, open in iCube Engineer via *‘Extras → Options’* the options dialog.
2. Under *‘International’*, select *‘English’* as language.
3. Save your project and restart iCube Engineer with your project.

Setting of the F-address

NOTICE

Please note that the *‘FSoE device address’* or *‘F address’* of the local and Ethernet-connected safety modules is unique and may only be assigned once!

1. Set the F-address at the F device. For more information on the procedure, please refer to the corresponding documentation.
2. Start iCube Engineer with your project.
3. At Plant, navigate to your F device.
4. Double-click on the corresponding F device in your project.
   ➡ The *‘Safety Parameters’* editor opens.

5. After requesting the password for the safety area, enter the F address that you have set on your F device at *'FSoE device address'*.

Setting the safety parameters

1. At *'Safety parameters'*, you can set the required safety parameters that are provided by the F device.
2. Save and transfer your project to the safety CPU.

For more information on the procedures, refer to ➦ 'Sample application'...page 136.

5.4.5 Assigning safety process data

NOTICE

Wiring of sensors and actuators

When wiring sensors and actuators, ensure that:

- the correct safety-related sensors and actuators are correctly connected.
- the parametrization of the inputs and outputs as well of all devices respectively modules is correct.
- the linking of the block inputs and outputs with the signals of the safety-related sensors respectively actuators is correct on 1/2 channels.
- cross-circuit and line break monitoring is implemented in your application if required.
- all safety-related function blocks and functions in the safety-related code are connected correctly.

Further information on the parametrization of inputs and outputs as well as all devices or modules can be found in the device-specific user documentation.

The detailed procedure for I/O assignment of process data is described in the application example. ➦ 'Sample application'...page 136

5.5 Commissioning

5.5.1 Notes on commissioning

WARNING

Prevent automatic start-up

- Take appropriate measures to ensure that automatic start-up of your plant/machine is prevented.

WARNING

Avoid danger during commissioning

- Take appropriate measures to ensure that there is no danger from your plant/machine during commissioning and validation.

WARNING

Safety function only ensured after validation

- The planned safety function of the plant/machine is only ensured after validation.

WARNING

Organizational or technical measures required for compensation of the CRC checksum

Take technical or organisational measures to ensure that the correct project for the application is started in the CPU by comparing the CRC checksum: ➦ *'Comparison of the checksums'...page 123*

- After transferring a project to the CPU.
  - A valid but incorrect project for the application could be loaded.
- After removing the SD card.
  - There could be a valid project in the internal memory but the incorrect one for the application.
- After inserting or changing the SD card.
  - There could be a valid project on the SD card but the incorrect one for the application.

If you use a technical measure to check the CRC checksum, it must be implemented in such a way that the check done by a third technical instance outside the safety CPU.

WARNING

Safety and availability of the plant/machine

- Ensure the safety and availability of your plant/machine by selecting the appropriate watchdog time FSoE_WD_Time.
- Select the watchdog time high enough so that the safety of your plant/machine is still guaranteed with the highest possible availability.

WARNING

Avoid danger caused by triggering the safety function too late

- Ensure that the maximum permissible values TI_{FSoEWD_MAX} and TO_{FSoEWD_MAX} are not exceeded. ➦ *'Maximum permitted watchdog times'...page 134*

WARNING

Debug operation

- Switching to debug operation means leaving normal operation.
- Make sure that your plant/machine does not pose any danger to people during debug operation and that no damage can be caused.

NOTICE

Acclimatization before start-up

Make sure that commissioning only takes place after the CPU and the associated modules have acclimatized!

NOTICE

Damage due to improper handling

- Handle the CPU and components with care!
- When installing the CPU and components, ensure that mechanical damage is avoided!

NOTICE

Startup of the CPU not guaranteed

- To ensure that the CPU starts up properly, the supply voltage must not be switched on until at least 30 seconds after the device LEDs go out.

NOTICE

Online verification required during commissioning phase

In the commissioning phase, the values for program runtime and cycle time determined offline in the planning phase must be verified online.

Always take the associated checklist into account when commissioning.

➦ 'Checklist commissioning, parametrization and validation'...page 217

Operation and programming may only be carried out by qualified personnel!

Operation and programming may only be carried out via iCube Engineer!

Ensure that a PC system with running iCube Engineer is always available during the entire time of operation!

Otherwise, no later modifications can be done.

Ensure legally compliant documentation and archiving of your engineering project!

5.5.1.1 Notes on initial commissioning

> **WARNING**
>
> **Safety-related steps**
>
> The following steps include safety-related activities in the iCube Engineer software and the safety validation of the FSoE system.
>
> – Please also note the checklists listed in the appendix for the following steps.
>
> – Please also refer to the online help of the iCube Engineer.

> **WARNING**
>
> **Carry out verification in accordance with safety standards**
>
> – For all steps in creating the security program for your application, carry out verification in accordance with the security standards applicable to your application.

> **NOTICE**
>
> **Unauthorized access to the SD card possible**
>
> Access to the SD card is possible so that data can be read and manipulated.
>
> – Please note ➦ *'Notes on security'...page 13*, especially with regard to access protection for the SD card.

5.5.2 Online access to the CPU

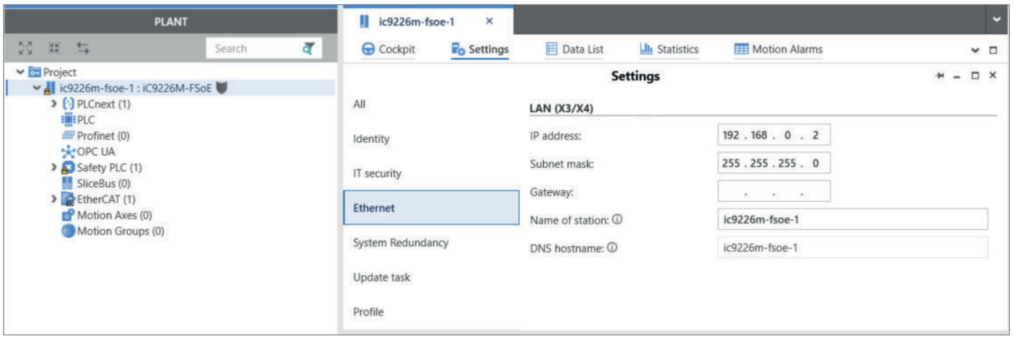
IP address parameters for communication

On delivery the following IP address parameters for the communication are preset in the project template of the CPU:

- Ethernet-Port (X3/X4): 192.168.1.1
- Subnet mask: 255.255.255.0
- Gateway: -

If your CPU has different IP address parameters, you can adapt them for iCube Engineer via the following procedure:

1. Open your project.
2. In the *'Plant'* area, double-click the CPU node
   ➡ The CPU editor group opens.
3. Select the *'Settings'* editor.
4. Select the *'Ethernet'* view.
   ➡



LAN (X3/X4)

IP address: 192 . 168 . 0 . 2

Subnet mask: 255 . 255 . 255 . 0

Gateway: . . .

Name of station: ⓘ ic9226m-fsoe-1

DNS hostname: ⓘ ic9226m-fsoe-1

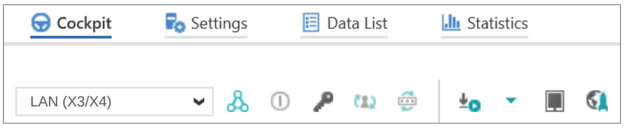
5. ■ At *'LAN (X3/X4)'* the IP address parameters for the connection via the Ethernet-Port (X3/X4) can be set.
   ➡ When establishing an Ethernet connection to the CPU, the IP address parameters specified here are used by iCube Engineer for the corresponding interface.

Connecting to the CPU

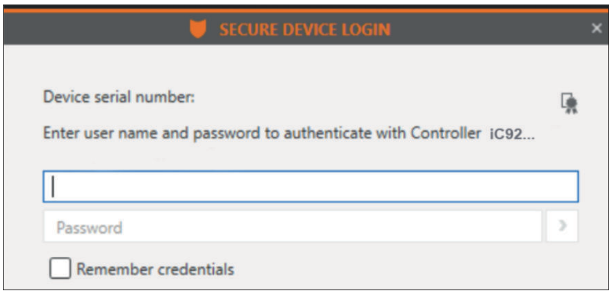
> *Please note that the online search is currently only supported by port X3/X4!*

Connect port X3 or X4 to the Ethernet interface of your PC. Please note that for communication via iCube Engineer the network card of the PC and the Ethernet interface of the CPU are in the same IP circle. If necessary, contact your network administrator.

1. Open your project.
2. In the editor group of the CPU, select the editor *'Cockpit'*.
3. Set the interface *'LAN (X3/X4)'* and click on ⁂.



➡ A connection between iCube Engineer and your CPU is established, by means of the IP address parameters, and the login dialog for authentication is opened.


SECURE DEVICE LOGIN

Device serial number:

Enter user name and password to authenticate with Controller iC92...

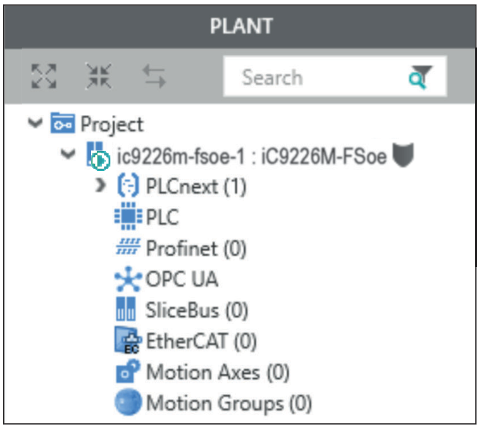
Password

□ Remember credentials

4. Enter your login details and click on ❯.

> ***On delivery, the following access data are preset with administrator rights:***
>
> – *Username: admin*
> – *The password is printed under the front flap on the front of the CPU.*

➡ Now you can access your CPU. An existing connection is shown in the Plant area at the node of the CPU by ▶ .

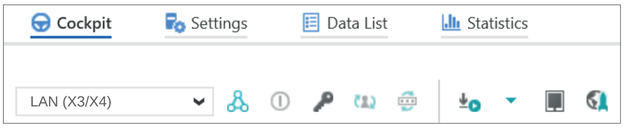


5.5.2.1 Assigning new IP address parameters

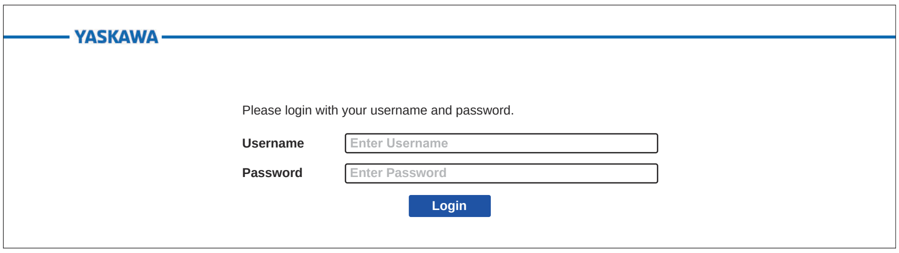
Assignment via WBM

As soon as you are online connected to the CPU, you can assign new IP address parameters to it via WBM (Web-based management).

1. To access WBM, click in the *'Cockpit'* editor at .



➨ The WBM login page opens.



Please login with your username and password.

Username: Enter Username

Password: Enter Password

Login

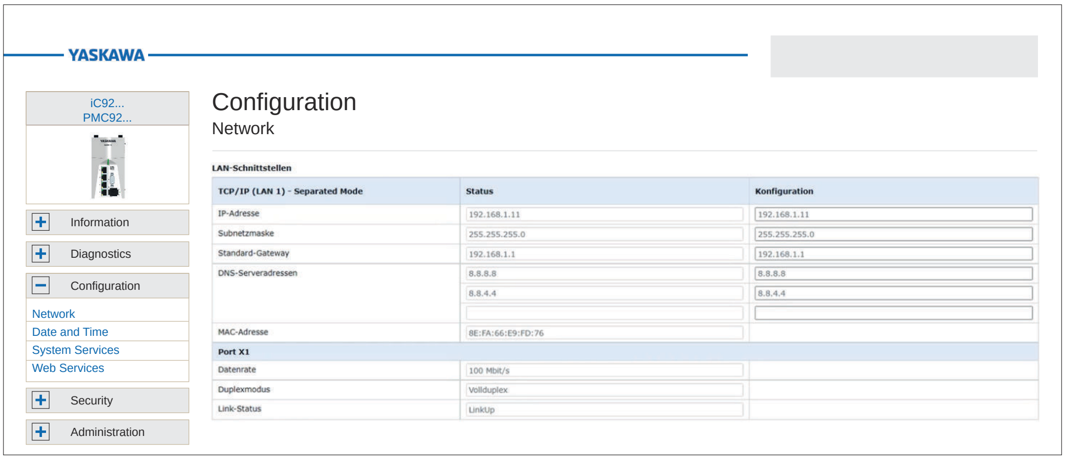
2. Enter your login details and click on [Login].

> ***On delivery, the following access data are preset with administrator rights:***
>
> – *Username: admin*
>
> – *The password is printed under the front flap on the front of the CPU.*

➨ You now have access to the WBM of the CPU with the access rights assigned to you.

3. Navigate to *Network* in the *Configuration* area.

➨ Here you can change the current IP address parameters in the *'Configuration'* column.



Configuration

Network

LAN-Schnittstellen

TCP/IP (LAN 1) - Separated Mode	Status	Konfiguration
IP-Adresse	192.168.1.11	192.168.1.11
Subnetzmaske	255.255.255.0	255.255.255.0
Standard-Gateway	192.168.1.1	192.168.1.1
DNS-Serveradressen	8.8.8.8	8.8.8.8
	8.8.4.4	8.8.4.4
MAC-Adresse	8E:FA:66:E9:FD:76	
Port X1		
Datenrate	100 Mbit/s	
Duplexmodus	Vollduplex	
Link-Status	LinkUp	

4. Enter your new IP address parameters in the *'Configuration'* column.

> **CAUTION**
>
> When assigning the IP address parameters, please note that the number ranges of the IP addresses of X1/X2 and X3/X4 must not overlap if they exist!

5. Click on [Apply and Reboot].
   ➡ The settings are accepted, transferred to the CPU and the CPU is automatically restarted for activation.

   The CPU can now only be reached via the new IP address parameters. Please note that these new data are currently not automatically transferred in the settings of iCube Engineer. You have to manually adjust these in the settings there.

5.5.3 Validation of the system

General

With the first commissioning all the safety functions and the proper functionality of the programmed and installed system must be checked. And the check of the system must be documented.

> WARNING
>
> **Danger with commissioning!**
>
> The control system may be operated only after successful testing by a competent person.
>
> - Perform a complete functional test and check the correct assignment of the connected safety components.
> - Validate the system according to the checklist and document the process accordingly. ➦ *'Checklist commissioning, parametrization and validation'...page 217*
> - Make sure that the service personnel is trained in the handling of the control system.

5.5.3.1 Functional test

Overview

The functional test is an essential part of the validation of the entire system. The functional test can be used to determine the correct assignment of the network's safety components and the programmed logic of the system. Depending on the complexity of the linking logic of the respective project, it is recommended to make graduated functional tests. The following procedure is recommended for functional tests:

- Only connect the actuators and drives to the safety output terminals when no faults have been detected during the wiring check.
- Make a complete I/O test. This means that you set each sensor to all of its possible switching states one by one (usually on and off, or actuated not actuated).
  - Check whether the specified and expected signal state corresponds to the real state.
  - In addition, check whether the assigned variable status also changes accordingly in the connected safety PLC.
  - The same procedure must be followed when controlling the actuators via the safety output modules. Here too, every process state specified in the safety application must be tested.
- Examine a fully functional test with the entire sensors (initiators), switches, actuators and drives.
- Document the result of the functional test.
- For the functional test, trigger all safety functions in sequence and document the reaction of the system. Check whether the reaction corresponds to the expected behavior.

In the iCube Engineer, the following functions support you during the function test:

- Monitoring mode
- Debug mode

You will find more information in the online help of iCube Engineer.

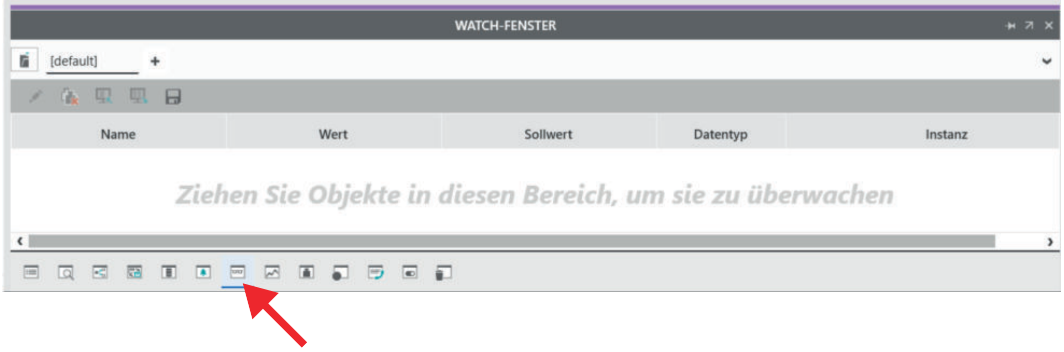
Online access

With online access, a distinction is made between safety-related functionality and standard functionality. Access is controlled by double-clicking on the corresponding node below *'Plant'*. The cockpit of the safety-related CPU can be accessed via the *'Safety PLC'* node. The access is protected by the safety password you have assigned.

Monitoring mode

The monitoring mode enables read-only access to the safety-related PLC. Since the execution of the application cannot be influenced by debug commands, the monitoring mode is considered as a safe mode.

1. Load your project.
2. Double-click in the *'Plant'* area on *'Safety PLC'* node.
   ➨ The cockpit of the safety PLC is opened.
3. Go online with your Safety CPU via .
4. In the *Cross-functional area* in the toolbar at the bottom, click on .



➨ The *'Watch window'* opens. In the watch window you can collect variables and clearly show and monitor the online values while the application is running. You can create multiple watch lists within the WATCH window. Each list can be saved and loaded. In addition, the current online value of list elements can be loaded from the control and used as a *setpoint*.

5. Drag the variables you want to monitor into the Watch window.
6. Activate the monitoring mode with .
   ➨ You now have read access to the variables in your project.

Debug mode

DANGER

Unintended operating state of the CPU

In contrast to the monitoring mode, the debug mode also grants write access to the safety-related PLC. Since the execution of the application can be influenced by debug commands, debug mode must be considered as non-safe mode.

- Ensure that no hazards can arise from intentional or unintentional operations of the safety-related PLC.
- Please also refer the ➦ *'Notes on commissioning'...page 89*.

1. Load your project.

2. Double-click in the *'Plant'* area on *'SafetyPLC'* node.
   ➡ The cockpit of the safety PLC is opened.
3. Go online with your Safety CPU via ⁂ .
4. Activate debug mode with ⓘ .
   ➡ You now have the opportunity to debug your user program and control variables. You can use the force function to specify fixed variable values. You can set breakpoints to temporarily stop your user programme.

5.5.4 Comparison of the checksums

Proceeding

As soon as you place safety components in your project, a checksum is automatically calculated for your safety project. After the project transfer, the checksum of your project and the CPU, which is connected online, must be identical. The checking procedure is as follows:

1. Establish an online connection to the CPU.
2. Double-click on *'SafetyPLC'*.
3. Select the *'Safety cockpit'* editor and click on *'Overview'*.
   ➡ The following checksums must be identical:
   - Checksum CPU: *'Safety PLC project information'*
   - Checksum Project: *'Engineering project information'*

5.6 Memory management

5.6.1 Internal memory

Overview

> *Please note that, depending on the firmware and the components used, not the entire memory area is available.*

Memory

- PMC9212Ex only:
  - 2GB working memory (RAM).
  - 12MB program memory.
  - 32MB data memory.
  - 512kB retentive data memory.
- PMC9216Ex only:
  - 2GB working memory (RAM).
  - 12MB program memory.
  - 32MB data memory.
  - 3072kB retentive data memory.

Working memory

- During operation, the operating system stores temporary data and parts of the user program in the *working memory*.
- With MRESET you can set the CPU to the *Ready* state without a power cycle. This unloads the working memory, among others. ➦ *'MRESET'...page 127*

Parametrization memory

The *parametrization memory* as the sum of program and data memory provides memory for:

- Current firmware version
- *Overlay file system* for user program, configurations, user data and firmware adjustments.

Use of the *overlay file system*:

- As soon as you configure the CPU or make changes to the current firmware version, data are generated in the *overlay file system*.
- By *'Resetting to the factory setting type 1'*, you can delete the *overlay file system*, among others. The current firmware version remains, but all changes to it are discarded. ➦ *'Reset to factory settings type 1'...page 127*
- By *'Resetting to the factory setting type 2'*, you can delete the *overlay file system* and the current firmware version, among others. The current firmware version is overwritten by the original firmware version and the delivery state of the CPU is restored. ➦ *'Reset to factory settings type 2'...page 128*

> CAUTION
>
> **Damage to the internal parametrization memory due to high data traffic!**
>
> – Due to frequent write accesses at applications with high data traffic e.g. data logger applications to the overlay file system, the internal parametrization memory of the CPU may be long term damaged and lead to a device defect.
>
> – For applications with high data traffic, use an external Yaskawa SD card as a storage medium for the overlay file system.

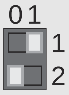
Non-volatile memory for retentive data

- All data that were marked as retentive in iCube Engineer during configuration are permanently stored here.
- In the event of a power failure, retentive data are automatically backed up.
- By MRESET or resetting to factory setting type 1/2 you can, among others, delete the non-volatile memory for retentive data.

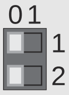
Fix memory overflow

If, during operation or when starting up the CPU, the error indication occurs that the memory of the overlay file system in the parametrization memory has overflowed, the CPU can be restarted via *Safe Mode* as follows:

1. Switch off the power supply of the CPU.
2. Set the DIP switches S1 under the front flap to the following position:

S1	S1-1	S1-2	Action
	ON	OFF	After PowerON the CPU starts in *Safe Mode*.

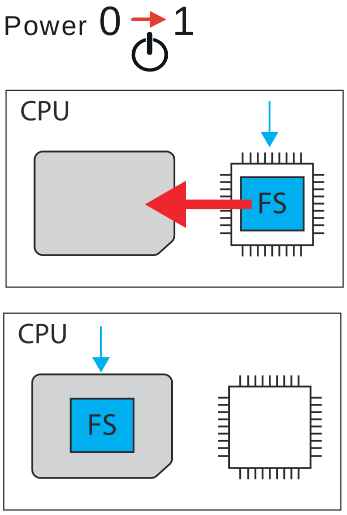
3. Switch on the power supply of the CPU again.
   ➡ The CPU starts in ➦ *'Safe Mode'...page 129*. Here, a memory area reserved exclusively for *Safe Mode* is enabled, which allows the CPU to restart in the event of a memory overflow. At *Safe Mode* the CPU starts with a default project, but your user programme is still present in the file system.
4. Check your user program for files on the file system that cause the system to overflow, such as log files, recipes, motion data. Use an SSH client to access the file system and delete the causing files if necessary. Then start in *Standard Mode* again.
5. For this, switch off the power supply to the CPU.
6. Set the DIP switches S1 to the default position:

S1	S1-1	S1-2	Action
	OFF	OFF	After PowerON the CPU starts in *Standard Mode* - default setting.

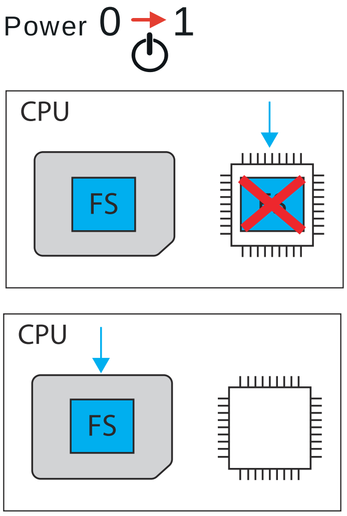
7. Switch on the power supply of the CPU again.

➡ The CPU starts in *Standard Mode* again. If a project was loaded in Safe Mode, it is executed in RUN operating mode.

5.6.2 Slot for Yaskawa SD card



- You can only insert a Yaskawa SD card with a valid license file in this slot.
- In the *WBM* at *'Security → SD Card'*, you can enable or disable the use of the SD card and call up information about it. By default, the use of the SD card is enabled. ➦ *'SD Card'...page 197*
- An inserted Yaskawa SD card is only recognized by the CPU after PowerON.
- If a new, unused Yaskawa SD card is detected after PowerON, the *overlay file system* FS with user program, configurations, user data and firmware adjustments, is moved from the internal parametrization memory to the Yaskawa SD card and deleted in the internal parametrization memory. The CPU uses the overlay file system on the Yaskawa SD card, now.



- If, after PowerON, an Yaskawa SD card is recognized on which there is already an *overlay file system* FS , the overlay file system is deleted in the internal parametrization memory without being moved. The CPU uses the existing overlay file system on the Yaskawa SD card, now.

WARNING

Data loss - card removal only when the power supply is switched off!

– Only remove the Yaskawa SD card when the power supply of the CPU is switched off. Otherwise this will lead to data loss!

– If you remove the SD card during operation, the safety CPU switches to the safe state (failure State).

NOTICE

Project deletion possible when inserting the SD card

Please note the following points if you only use the internal flash memory of the CPU:

– Take mandatory organisational measures that prevent the deletion of the safety-related and non-safety-related project.

– If you insert an SD card while the safety CPU is in operation, the safety-related and non-safety-related project on the internal flash memory will be deleted after a power reset or a restart of the system. In addition, a safety-related project that may be present on the SD card could be loaded into the safety CPU with a different CRC checksum.

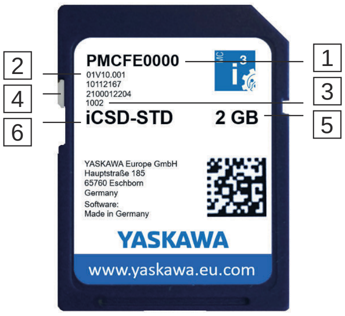
General notes on using the Yaskawa SD card

- *Only Yaskawa SD cards are supported.*
- *The cards are pre-formatted (ext4 format) for use in CPUs of the iC9200 Series.*
- *When formatting again, certain information on the Yaskawa SD card that is required for use in the CPUs of the iC9200 Series will be lost.*
- *Exclude the Yaskawa SD card from being formatted.*
- *The Yaskawa SD card can be read at any time with a conventional SD card reader. Sensitive data on the Yaskawa SD card can be read if you do not physically protect it from unauthorized access.*
- *Make sure that unauthorized persons cannot access the Yaskawa SD card.*

Please note when using without an Yaskawa SD card!

- *By default, support for the Yaskawa SD card is enabled.*
- *Disable the support of the Yaskawa SD card if you want to operate the CPU without YaskawaSD card.*
- *If the support of the Yaskawa SD card remains enabled and the CPU is operated without a Yaskawa SD card, there is a risk of data theft or data manipulation.*
  - *Unauthorized persons may insert a Yaskawa SD card and restart the CPU.*
  - *If a new, unused Yaskawa SD card is detected after PowerON, the overlay file system with user program, configurations, user data and firmware adjustments, is moved from the internal parametrization memory to the Yaskawa SD card and deleted in the internal parametrization memory. Projects and IP configurations saved there are then no longer available!*
- *When changing to operation without Yaskawa SD card, the overlay file system of the internal parametrization memory is activated by the CPU after PowerON and is used now. Please note that no data are used from the Yaskawa SD card. There is also no function for transferring back from the Yaskawa SD card to the internal parametrization memory.*

Yaskawa SD card



The Yaskawa SD card has the following labelling and elements:

1 Order number
2 Product version
3 Serial number
4 Write protection slider - shown disabled here.
5 Memory size
6 Designation

1 In this position the write protection is disabled - delivery state.

2 In this position, the write protection is enabled and the SD card is protected against unintentional overwriting.

5.7 MRESET and reset to factory settings

MRESET

- The CPU is set to the *Ready* state.
- The working memory is unloaded, but the user program remains in the overlay file system.
- The non-volatile memory for retentive data is deleted.

1. Switch your CPU to STOP state.
2. Push the operating mode switch down to position MR.
3. Release the operating mode switch after 3 seconds and press it back to the MR position within 3 seconds.
4. Release the operating mode switch after 3 seconds.

➡ - The CPU now executes a MRESET.
- To confirm, you will receive a diagnostic message that a MRESET was executed. You can output e.g. in iCube Engineer via *'Notifications'* in the *'Cockpit'* editor.

Reset to factory settings type 1

- The overlay file system with user program, configurations, user data and firmware adjustments is deleted.
- The non-volatile memory for retentive data is deleted.
- The current firmware version remains, but all changes to it are discarded.

With operating mode switch

1. Switch off the power supply of the CPU.
2. Press and hold the operating mode switch in position MR and switch on the power supply of the CPU again.
3. As soon as the LEDs show the following behavior after start-up, release the operating mode switch again:

Status	RN	ER	IO ER	PN-C ER	PN-D ER	IO DIAG
🟨 yellow 1Hz	🟩 green	🟥 red	□	□	□	□

➡ The CPU now executes a reset to *factory setting type 1*.

With DIP switch S1

1. Switch off the power supply of the CPU.
2. Set the DIP switches S1 under the front flap to the following position:

S1	S1-1	S1-2	Action
0 1 ◧ 1 ◨ 2	OFF	ON	After PowerON the CPU executes a reset to *factory settings type 1*.

3. Switch on the power supply of the CPU again.

   After the start-up of the CPU it performs a reset to *factory setting type 1* and shows the following LED behavior:

Status	RN	ER	IO ER	PN-C ER	PN-D ER	IO DIAG
🟨 yellow 1Hz	🟩 green	🟥 red	□	□	□	□

   The CPU requests a power cycle after a reset to *factory settings type 1*:

Status	RN	ER	IO ER	PN-C ER	PN-D ER	IO DIAG
🟨 yellow 2Hz	🟩 1Hz	🟥 1Hz	🟥 1Hz	🟥 1Hz	🟥 1Hz	🟥 1Hz

4. Switch off the power supply of the CPU.
5. Set the DIP switch S1 to the default position:

S1	S1-1	S1-2	Action
0 1 1 2	OFF	OFF	After PowerON the CPU starts in *Standard Mode* - Default setting.

6. Switch on the power supply of the CPU again.

   ➡ The CPU starts in *Standard Mode*.

Reset to factory settings type 2

- The overlay file system with user program, configurations, user data and firmware adjustments is deleted.
- The non-volatile memory for retentive data is deleted.
- The current firmware version is overwritten by the original firmware version and the delivery state of the CPU is restored.

1. Switch off the power supply of the CPU.
2. Press and hold the operating mode switch in position MR and switch on the power supply of the CPU again.
3. As soon as the LEDs show the following behavior after start-up, release the operating mode switch again (duration ca. 30s):

Status	RN	ER	IO ER	PN-C ER	PN-D ER	IO DIAG
🟨 yellow 2Hz	🟩 green	🟥 red	🟥 red	□	□	□

   ➡ The CPU now executes a reset to *factory setting type 2* and is then in the delivery state.

5.8 Firmware update

You can update the firmware via the Web-based management WBM. ➦ *'Firmware Update'...page 207*

> *Please note that you can only execute a firmware update with administrator rights!*

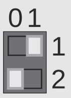
5.9 Safe Mode

Start-Up in *Safe Mode*

By means of the DIP switch *‘S1’* beneath the front flap you can start your CPU in *Safe Mode*. Here the CPU starts with the following behavior:

- The CPU goes to RUN with the default project.
- A project can be loaded but not executed.
- The SliceBus is switched off.
- All field buses are disabled.
- The parametrization memory with the current firmware version and the *overlay file system* remains unchanged.
- During online access, you are informed that the CPU is in *Safe Mode*.
- The *non-volatile memory* for retentive data remains unchanged.
- The CPU can only be reached via the default IP address.
- Additionally, a memory area reserved exclusively for *Safe Mode* is enabled, which allows the CPU to restart in the event of a memory overflow.

1. Switch off the power supply of the CPU.
2. Set the DIP switches S1 under the front flap to the following position:

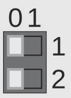
S1	S1-1	S1-2	Action
	ON	OFF	After PowerON the CPU starts in *Safe Mode*.

3. Switch on the power supply of the CPU again.

➡ The CPU starts in *Safe Mode* and shows this exclusively during online access.

Start-up in *Standard Mode*

1. Switch off the power supply of the CPU.
2. Set the DIP switches S1 to the default position:

S1	S1-1	S1-2	Action
	OFF	OFF	After PowerON the CPU starts in *Standard Mode* - Default setting.

3. Switch on the power supply of the CPU again.

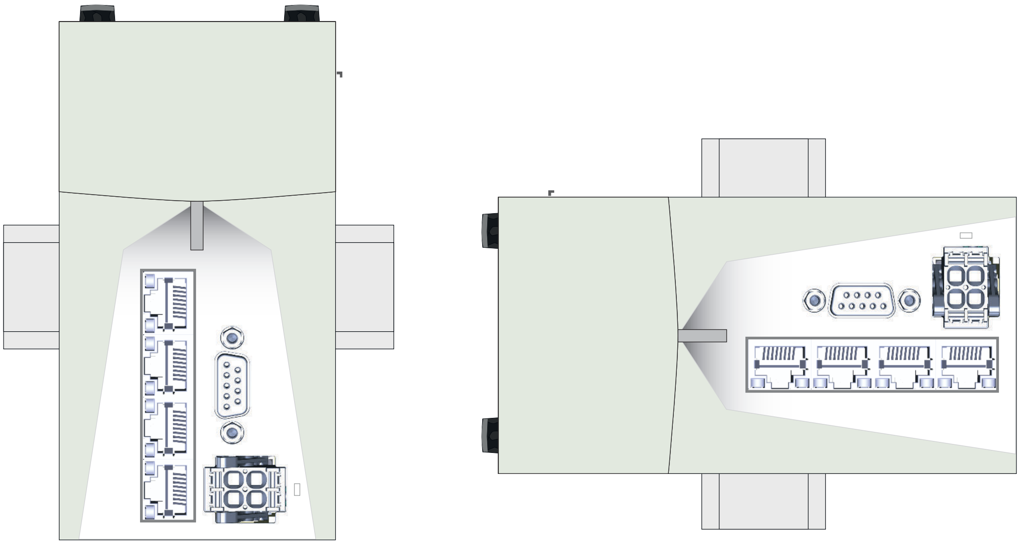
➡ The CPU starts in *Standard Mode* again. If a project was loaded in Safe Mode, it is executed in RUN.

5.10 Temperature behavior

The safety CPU has an integrated temperature monitoring function. The following temperature ranges respectively limits are specified here:

- 0°C to 55°C/60°C: Operating temperature
- < -2°C and > 78°C: Warning limit
- < -7°C and > 83°C: Error limit

Operating temperature



Horizontal hanging or vertical hanging the CPU has the following temperature ranges:

- Horizontal hanging: 0°C to 60°C
- Vertikal hanging: 0°C to 55°C

Warning limits

If the temperature falls below -2°C or exceeds 78°C, a warning message is added to the error stack and the log file of the safety CPU.

Error limit

If the temperature falls below -7°C or exceeds 83°C, the safety CPU switches to the Hard fail safe state. ➦ *'Fail safe states'...page 130*

5.11 Fail safe states

Behavior on error

All detected, serious errors in the CPU that could lead to loss or malfunction of the programmed safety function result in a transition to the safety state (fail safe state). A distinction is made between *Soft fail safe* and *Hard fail safe* states. Here the CPU shows different behavior:

- State *Soft fail safe*
  Behavior
  - The safety outputs of the F devices are set to zero (FALSE).
  - The red SF_ER LED blinks with 1Hz.
  - If you are connected online to the iCube Engineer on error, information about the error is also shown in the software.

  Possible reason
  - Error in parametrization

  Acknowledgement
  - Bug fixing in the project and new upload.
- State *Hard fail safe*
  Behavior
  - The safety outputs of the F devices are set to zero (FALSE).
  - The red SF_ER LED is on.
  - Communication with the CPU is no longer possible.

  Possible reason
  - Hardware error, exceeding the switch-off thresholds of the temperature limits.

  Acknowledgement
  - Check your hardware setup and perform a power cycle.

NOTICE

If your CPU is still in the *Hard fail safe* state after a power cycle and this does not change even after a reset ➦ *'MRESET and reset to factory settings'...page 127*, please contact the Yaskawa hotline.

5.12 Response times

5.12.1 There is no error

Without an error, it is assumed that none of the watchdogs respond and the passage of a signal from the input connector of a safety input module to the output connector of a safety output module is considered:

System SLIO
Safety SDI → Bus coupler → Field bus →
Safety SDO ← Bus coupler ← Field bus ← F-SPS

Maximum expected response time in the case without errors

$$T_{maxNF} = TI_{ST} + TI_{WCDT} + TI_{Slave} + TI_{BUS} + T_{CL} + T_{FPROG} + TO_{BUS} + TO_{Slave} + TO_{WCDT}$$

➦ *'Designations'...page 135*

T_{maxNF} Max. response time without errors (**max** **N**o **F**ault).

TI_{ST} Input smoothing time of the inputs of the safety SDI (**S**moothing **T**ime).

TI/TO_{WCDT} Max. response time without errors (**W**orst **C**ase **D**elay **T**ime).

TI_{Slave} Max. Response time of the decentralised periphery system, i.e. delay caused by the FSoE EtherCAT coupler and the backplane bus.

TI_{BUS} EtherCAT cycle time for EtherCAT bus communication. The EtherCAT cycle time results from the cycle times of all connected EtherCAT slaves.

T_{CL} Cycle time of the safety CPU.

T_{FPROG} Cycle time safety program.

For plant design sensor and actuator run times are to be taken into account:

$$T_{maxNFSA} = T_{SensorDLY} + T_{maxNF} + T_{ActuatorDLY}$$

➦ *'Designations'...page 135*

$T_{maxNFSA}$ Max. response time without errors with sensor and actuator (**max** **N**o **F**ault **S**ensor **A**ctuator).

$T_{SensorDLY}$ Delay time of the sensor (**S**ensor **D**e**L**a**Y**).

T_{maxNF} Max. response time without errors (**max** **N**o **F**ault).

$T_{ActuatorDLY}$ Delay time of the actuator (**A**ctuator **D**e**L**a**Y**).

5.12.2 There is an error

Possible single errors

On error, it is assumed that a watchdog responds and triggers the corresponding error response. Possible causes include errors in the system, incorrect runtime information in the documentation of the standard system or an extension of the runtime beyond the value used in the calculation by changing the configuration of the standard system. The total response time in the error-free case increases by the maximum duration of the possible single errors:

- Discrepancy error in safety SDI. Here, the discrepancy time must also be taken into account: (TI_{DIS})
- A single error occurs in the safety SDI. Here the possibly larger max. response time during an error (TI_{OFDT}) is to be considered with the max. response time in error free case (TI_{WCDT}): (TI_{OFDT} - TI_{WCDT})
- Once or permanent interrupted communication between safety SDI and the safety CPU. The FSoE watchdog time of the Safety SDI and the configured cycle time of the PLC must be considered: (TI_{FSoEWD} + T_{CL})
- Once or permanent interrupted communication between safety SDO and the safety CPU or failure of the safety CPU. Here the watchdog time of the safety SDO and acknowledge time of the safety SDO must be considered: (TO_{FSoEWD} + TO_{DAT})
- A single error occurs in the safety SDO. Here the possibly larger max. response time during an error (TO_{OFDT}) is to be considered with the max. response time in error free case (TO_{WCDT}): (TO_{OFDT} - TO_{WCDT})

Max. response time on error

$$T_{maxOF} = T_{maxNF} + MAX((TI_{DIS}), (TI_{OFDT} - TI_{WCDT}), (TI_{FSoEWD} + T_{CL}), (TO_{FSoEWD} + TO_{DAT}), (TO_{OFDT} - TO_{WCDT}))$$

➡ *'Designations'...page 135*

T_{maxOF}	Max. response time on error (**max** **O**ne **F**ault).
T_{maxNF}	Max. response time without errors (**max** **N**o **F**ault).
TI_{DIS}	With 2-channel evaluation discrepancy time, otherwise 0 (**DIS**crepancy).
TI/TO_{OFDT}	Max. response time on error (**O**ne **F**ault **D**elay **T**ime).
TI/TO_{WCDT}	Max. response time without errors (**W**orst **C**ase **D**elay **T**ime).
TI/TO_{FSoEWD}	Configured FSoE watchdog time (**FSoE** **W**atch**D**og).
T_{CL}	Cycle time of the safety CPU.
TO_{DAT}	Max. acknowledgement time (**D**evice **A**cknowledgement **T**ime).

For plant design sensor and actuator run times are to be taken into account:

$$T_{maxOFSA} = T_{SensorDLY} + T_{maxOF} + T_{ActuatorDLY}$$

➡ *'Designations'...page 135*

$T_{maxOFSA}$	Max. response time on error with sensor and actuator (**max** **O**ne **F**ault **S**ensor**A**ctuator).
$T_{SensorDLY}$	Delay time of the sensor (**S**ensor **D**e**L**a**Y**).
T_{maxOF}	Max. response time on error (**max** **O**ne **F**ault).
$T_{ActuatorDLY}$	Delay time of the actuator (**A**ctuator **D**e**L**a**Y**).

5.12.3 Variable runtimes for single errors

Times to be considered

At variable run times of the standard system in addition to an existing error, it is assumed that the values of all the relevant run times are nearby the limit of the monitored times.

- The max. processing time to and in the safety SDI:
  (TI_{ST} + TI_{DIS} + TI_{WCDT} + TI_{FSoEWD})
- The smallest of the possible monitoring times, from this moment the defined behaviour of an error takes effect:
  (MIN (TI_{FSoEWD}, T_{CL_MAX}, TO_{FSoEWD}))
- The max. processing time to and in the safety SDO:
  (TO_{WCDT} + TO_{FSoEWD})
- The possibly increased processing times in case of an error within the safety modules, here only the larger of them, because it is assumed that there is a single error:
  (MAX ((TI_{OFDT} - TI_{WCDT}), (TO_{OFDT} - TO_{WCDT})))
- For the entire process chain a good FSoE telegram could be sent just before to the safety SDI or SDO. Here the largest of the two timeouts must be considered:
  (MAX (TI_{FSoEWD}, TO_{FSoEWD}))

Max. response time for any run time at one error

$$\begin{aligned}T_{maxRT} &= TI_{ST} + TI_{DIS} + TI_{WCDT} + TI_{FSoEWD}\\&+ \text{MIN}\ (TI_{FSoEWD}, T_{CL\_MAX}, TO_{FSoEWD})\\&+ TO_{WCDT} + TO_{FSoEWD}\\&+ \text{MAX}\ ((TI_{OFDT} - TI_{WCDT}), (TO_{OFDT} - TO_{WCDT}))\\&+ \text{MAX}\ (TI_{FSoEWD}, TO_{FSoEWD})\end{aligned}$$

➦ *'Designations'...page 135*

T_{maxRT}	Max. response time on error with max. runtime (**max** **R**un**T**ime).
TI_{ST}	Input smoothing time of the inputs of the safety SDI (**S**moothing **T**ime).
TI_{DIS}	With 2-channel evaluation discrepancy time, otherwise 0 (**DIS**crepancy).
TI/TO_{WCDT}	Max. response time without errors (**W**orst **C**ase **D**elay **T**ime).
TI/TO_{FSoEWD}	Configured FSoE watchdog time (**FSoE** **W**atch**D**og).
T_{CL_MAX}	Cycle monitoring time of the safety CPU.
TI/TO_{OFDT}	Max. response time on error (**O**ne **F**ault **D**elay **T**ime).

For plant design sensor and actuator run times are to be taken into account:

$$T_{maxRTSA} = T_{SensorDLY} + T_{maxRT} + T_{ActuatorDLY}$$

➦ *'Designations'...page 135*

$T_{maxRTSA}$	Max. response time on error with max. runtime with sensor and actuator (**max** **R**un**T**ime **S**ensor **A**ctuator).
$T_{SensorDLY}$	Delay time of the sensor (**S**ensor **D**e**L**a**Y**).
T_{maxRT}	Max. response time on error with max. runtime (**max** **R**un**T**ime).
$T_{ActuatorDLY}$	Delay time of the actuator (**A**ctuator **D**e**L**a**Y**).

5.12.4 Maximum permitted watchdog times

Dimensioning

The following formula applies for dimensioning TI/TO_{FSoEWD_MAX} in the FSoE system:

$TI_{FSoEWD\_MAX} + TO_{FSoEWD\_MAX} \leq T_{maxRTSA} - TI_{WCDT} - TO_{WCDT}$

➦ *'Designations'...page 135*

TI/TO_{FSoEWD_MAX}	Maximum permitted FSoE watchdog time (**FSoE** **W**atch**D**og **MAX**imum).
$T_{maxRTSA}$	Max. response time on error with max. runtime with sensor and actuator (**max** **R**un**T**ime **S**ensor **A**ctuator).
TI/TO_{WCDT}	Max. response time without errors (**W**orst **C**ase **D**elay **T**ime).

Based on the information in the device-specific user documentation of the F devices, consider whether further information on watchdog times is available within the internal device function.

Timer functions that are used in the safety-related application programme within the safety function must also be taken into account for the calculation.

You can find more information on calculating and optimizing the watchdog time in the documentation of the iCube Engineer.

5.12.5 Cycle time T_{CL} safety CPU

Dimensioning

iCube Engineer:

The following formula applies to the cycle time:

$T_{CL} = T_{FPROG} / 0.7$

T_{FPROG} is to be estimated. The following specifications for totalization apply:

- Add 70µs per F device.
- Add 20µs per safety-related function block instances.

In iCube Engineer, the value is to be specified at *'Plant → Safety PLC'*: *'Tasks and Events → Intervall'* in the range of 5 ... 15ms.

➦ *'Designations'...page 135*

T_{CL}	Cycle time of the safety CPU.
T_{FPROG}	Cycle time safety program.

5.12.6 Cycle monitoring time T_{CL_MAX} safety CPU

Dimensioning

The following formula applies to the cycle monitoring time:

$T_{CL\_MAX} \geq T_{FPROG} / 0.7$

T_{FPROG} is to be estimated. The following specifications for totalization apply:

- Add 70µs per F device.
- Add 20µs per safety-related function block instances.

In iCube Engineer, the value is to be specified at *'Plant → Safety PLC'*: *'Tasks and Events → Watchdog'*.

➦ *'Designations'...page 135*

T_{CL_MAX}	Cycle monitoring time of the safety CPU.
T_{FPROG}	Cycle time safety program.

5.12.7 Designations

Abbreviations sorted by components

Component	Time[1]	Description	Where from
Sensor	$T_{SensorDLY}$	Delay time of the sensor (**S**ensor **D**e**L**a**Y**).	Documentation of the sensor.
Safety SDI	TI_{ST}	Input smoothing time of the inputs of the safety SDI (**S**moothing **T**ime).	Configuration of the F periphery, adapted to the sensor used.
Safety SDI	TI_{DIS}	With 2-channel evaluation discrepancy time, otherwise 0 (**DIS**crepancy).	Configuration of the F periphery, adapted to the sensor used.
Safety SDI Safety SDO	TI_{WCDT} TO_{WCDT}	Max. response time without errors (**W**orst **C**ase **D**elay **T**ime).	Documentation safety module.
Safety SDI Safety SDO	TI_{OFDT} TO_{OFDT}	Max. response time on error (**O**ne **F**ault **D**elay **T**ime).	Documentation safety module.
Safety SDI Safety SDO	TI_{DAT} TO_{DAT}	Max. acknowledgement time (**D**evice **A**cknowledgement **T**ime).	Documentation safety module.
Safety SDI Safety SDO	TI_{FSoEWD} TO_{FSoEWD}	Configured FSoE watchdog time (**FSoE** **W**atch**D**og).	Documentation safety module.
Safety SDI Safety SDO	TI_{FSoEWD_MAX} TO_{FSoEWD_MAX}	Maximum permitted FSoE watchdog time (**FSoE** **W**atch**D**og **MAX**imum).	see formula
Bus coupler	TI_{Slave} TO_{Slave}	Max. Response time of the decentralised periphery system, i.e. delay caused by the FSoE EtherCAT coupler and the backplane bus.	Documentation FSoE EtherCAT coupler
EtherCAT field bus	TI_{BUS} TO_{BUS}	EtherCAT cycle time for EtherCAT bus communication. The EtherCAT cycle time results from the cycle times of all connected EtherCAT slaves.	EtherCAT slave documentation iCube Engineer: Value is to be specified at: *‘Plant → EtherCAT’*: *‘Settings → Cycle time’*
F-PLC / F-Logic	T_{CL}	Cycle time of the safety CPU. $T_{CL} = T_{FPROG}/0.7$	iCube Engineer: Value to be specified at *‘Plant → Safety PLC’*: *‘Tasks and Events → Intervall’* in the range of 5 ... 15ms.
F-PLC / F-Logic	T_{CL_MAX}	Cycle monitoring time of the safety CPU. $T_{CL\_MAX} \geq T_{FPROG}/0.7$	iCube Engineer: Value to be specified at *‘Plant → Safety PLC’*: *‘Tasks and Events → Watchdog’*.
F-PLC / F-Logic	T_{FPROG}	Cycle time safety program. This value must be estimated. The following specifications for totalization apply: ■ Add 70µs per F device. ■ Add 20µs per safety-related function block instances.	Value is estimated.
Actuator	$T_{ActuatorDLY}$	Delay time of the actuator.	Documentation of the actuator

Component	Time[1]	Description	Where from
Total Input to output	T_{maxNF}	Max. response time without errors (**max** **N**o **F**ault).	See formula
Total Sensor to actuator	$T_{maxNFSA}$	Max. response time without errors with sensor and actuator (**max** **N**o **F**ault **S**ensor **A**ctuator).	See formula
Total Input to output	T_{maxOF}	Max. response time on error (**max** **O**ne **F**ault).	See formula
Total Sensor to actuator	$T_{maxOFSA}$	Max. response time on error with sensor and actuator (**max** **O**ne **F**ault **S**ensor**A**ctuator).	See formula
Total Input to output	T_{maxRT}	Max. response time on error with max. runtime (**max** **R**un**T**ime).	See formula
Total Sensor to actuator	$T_{maxRTSA}$	Max. response time on error with max. runtime with sensor and actuator (**max** **R**un**T**ime **S**ensor **A**ctuator).	See formula

[1] "I" or "O" after the "T" represent input or output.

5.13 Sample application

5.13.1 Precondition

Hardware and software

This application example describes the use of the iC9212M-FSoE via EtherCAT. The following hardware and software is required for the application example:

Hardware	Device / module	Designation / order number
Central unit	iCube CPU with integrated EtherCAT (FSoE) safety Master	iC9212M-FSoE
Local SLIO modules	System SLIO DI	SM 021 (021-1BF00)
	System SLIO DO	SM 021 (022-1BF00)
	System SLIO Safety DI	SM 021 (021-1SD10)
	System SLIO Safety DO	SM 022 (022-1SD10)
EtherCAT slave system	System SLIO bus coupler	IM 053EC Slave (053-1EC01)
	System SLIO DI	SM 021 (021-1BF00)
	System SLIO DO	SM 022 (022-1BF00)
	System SLIO safety DI	SM 021 (021-1SD10)
	System SLIO safety DO	SM 022 (022-1SD10)

Software	Function
iCube Engineer	iCube Engineer supports the programming and configuration of PLCs of the iC9200 Series generation and their FSoE variants.

F addresses

Before installing the following modules, set the corresponding F address using the DIP switch:

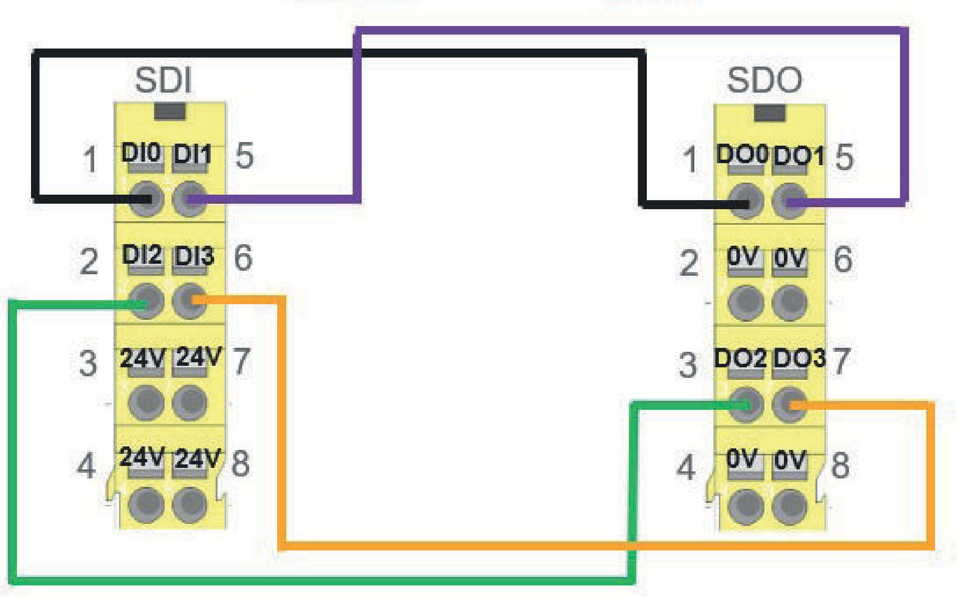
Module	F address decimal	Switch setting
System SLIO DI local	1	0000 0000 0001
System SLIO DO local	2	0000 0000 0010
System SLIO DI EtherCAT	3	0000 0000 0011
System SLIO DO EtherCAT	4	0000 0000 0100

NOTICE

Please note that the *'FSoE device address'* or *'F address'* of the local and Ethernet-connected safety modules is unique and may only be assigned once!

Wiring FSoE modules

Wire the FSoE modules as shown below:



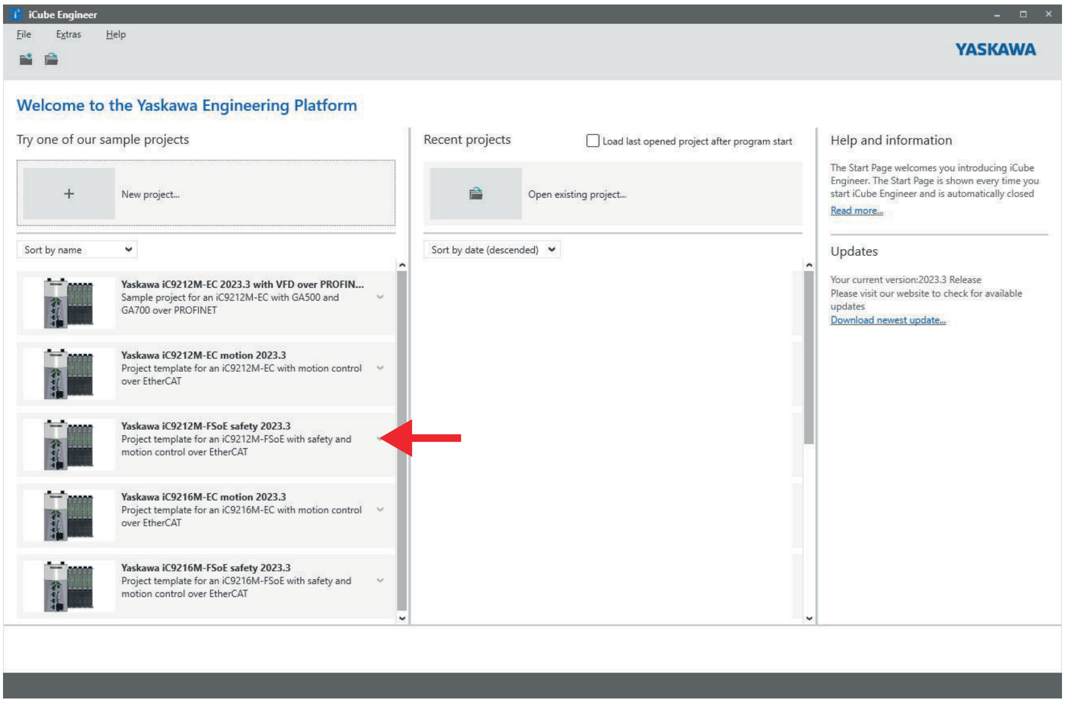
5.13.2 Configuration in iCube Engineer

Proceeding

Further information on the procedure can be found at ➡ 'Programming and file system'...page 86.

1. Open iCube Engineer and select the template for your safety CPU.

➡



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Yaskawa iC9212M-EC motion 2023.3
Project template for an iC9212M-EC with motion control over EtherCAT

Yaskawa iC9212M-FSoE safety 2023.3
Project template for an iC9212M-FSoE with safety and motion control over EtherCAT

Yaskawa iC9216M-EC motion 2023.3
Project template for an iC9216M-EC with motion control over EtherCAT

Yaskawa iC9216M-FSoE safety 2023.3
Project template for an iC9216M-FSoE with safety and motion control over EtherCAT

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Open existing project...

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Help and information

The Start Page welcomes you introducing iCube Engineer. The Start Page is shown every time you start iCube Engineer and is automatically closed

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Your current version:2023.3 Release
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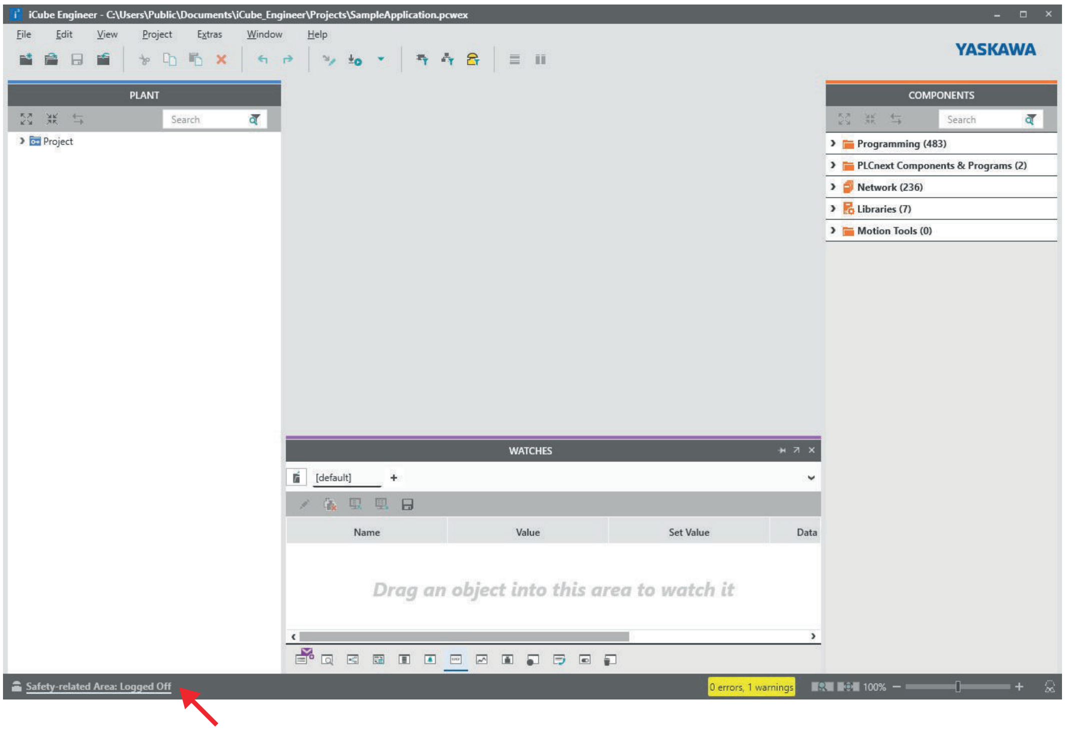
2. Save the project under a suitable project name. Leave the Project path unchanged.

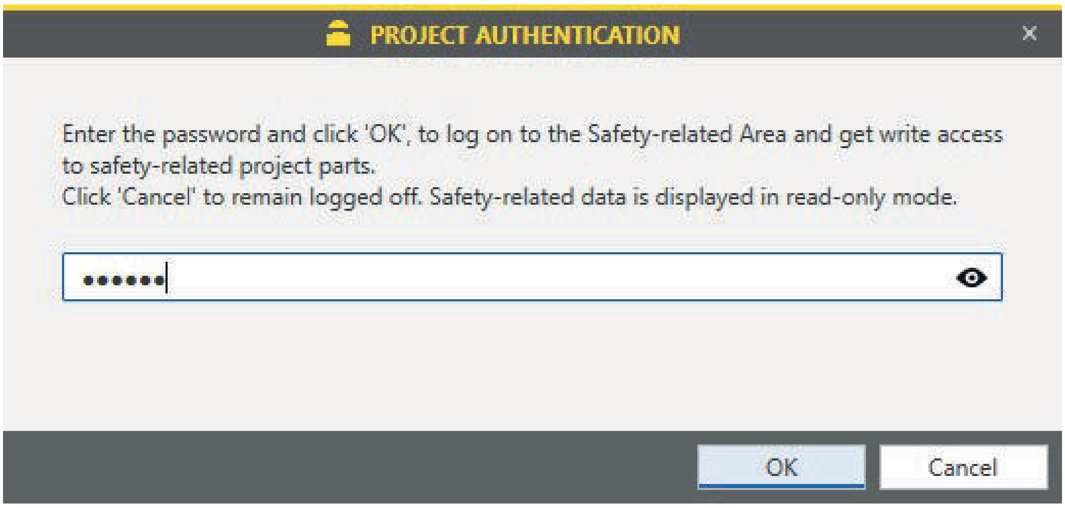
➡


iCube Engineer - C:\Users\Public\Documents\iCube_Engineer\Projects\SampleApplication.pcwex
File Edit View Project Extras Window Help
YASKAWA
PLANT
Search
Project
COMPONENTS
Search
Programming (483)
PLCnext Components & Programs (2)
Network (236)
Libraries (7)
Motion Tools (0)
WATCHES
[default]
Name
Value
Set Value
Data
Drag an object into this area to watch it
Safety-related Area: Logged Off
0 errors, 1 warnings
100%

3. Click on *'Safety-related Area'* and enter the safety password. The password "safety" is used in the template.

   Click [OK].

   ➡

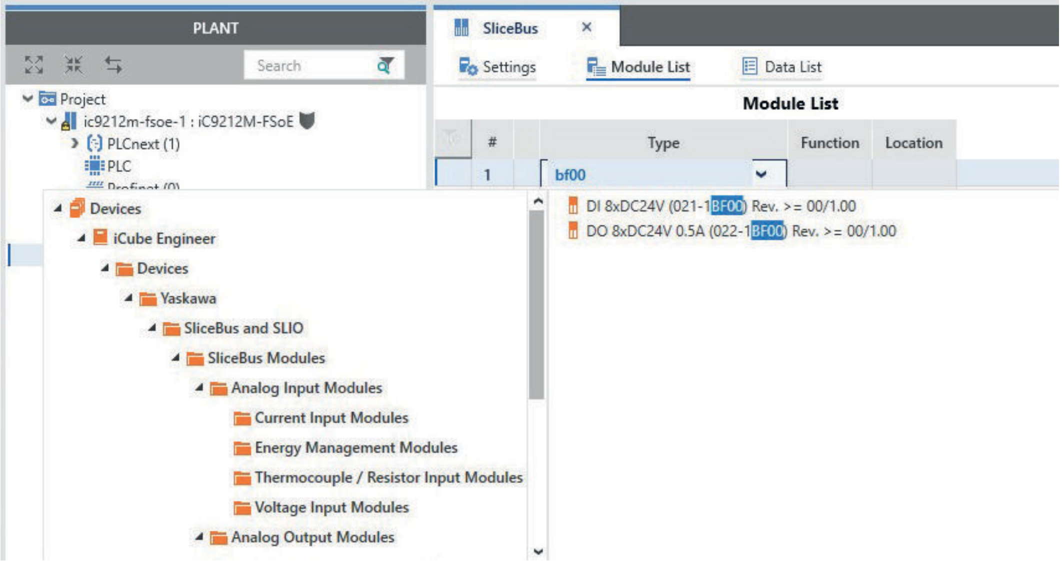


Enter the password and click 'OK', to log on to the Safety-related Area and get write access to safety-related project parts.
Click 'Cancel' to remain logged off. Safety-related data is displayed in read-only mode.

••••••

4. Double-click at *'Plant'* in your project, on *'SliceBus'* and add your local SLIO modules by entering a relevant part of the name and clicking on a suggested module.

   ➡



Module List

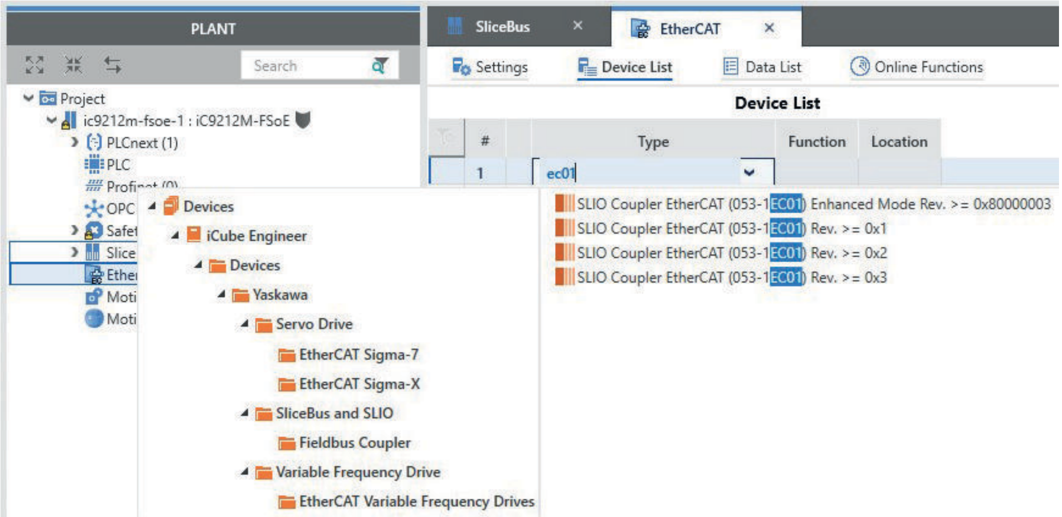
#	Type	Function	Location
1	bf00		

DI 8xDC24V (021-1BF00) Rev. >= 00/1.00
DO 8xDC24V 0.5A (022-1BF00) Rev. >= 00/1.00

5. Double-click under *'Plant'* in your project on *'EtherCAT'* and add your coupler by entering a relevant part of the name and clicking on a suggested version or the coupler with Enhanced Mode.

> *Alternatively, you can perform an 'EtherCAT bus scan' using the right mouse button. In this case, iCube Engineer must not also be connected online to the safety CPU.*

➡



Project
- ic9212m-fsoe-1 : iC9212M-FSoE
  - PLCnext (1)
  - PLC
  - Profinet (0)
  - OPC
  - Safet
  - Slice
  - Ether
  - Moti
  - Moti

- Devices
  - iCube Engineer
    - Devices
      - Yaskawa
        - Servo Drive
          - EtherCAT Sigma-7
          - EtherCAT Sigma-X
        - SliceBus and SLIO
          - Fieldbus Coupler
        - Variable Frequency Drive
          - EtherCAT Variable Frequency Drives

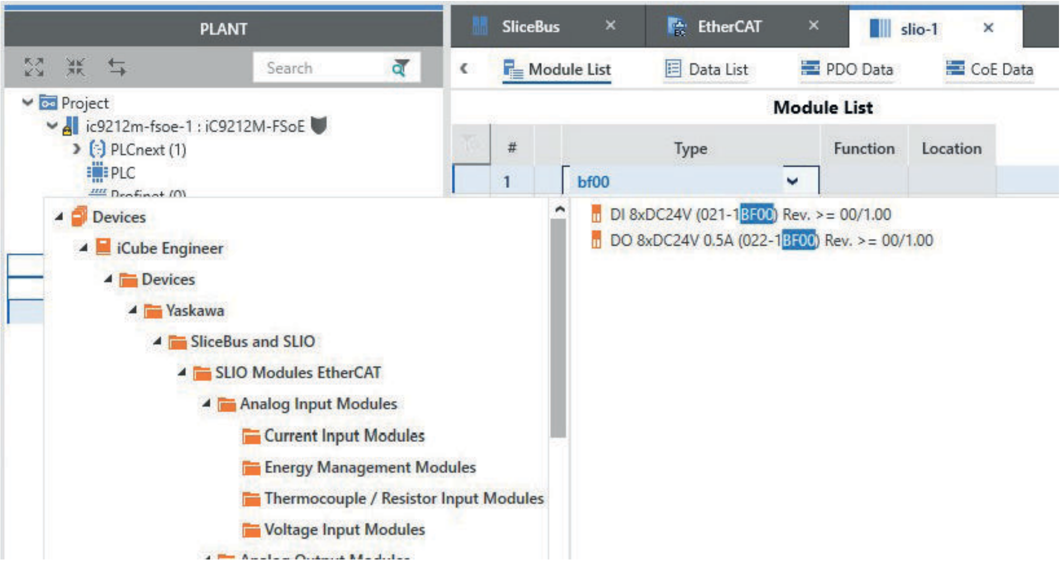
Device List

#	Type	Function	Location
1	ec01		

SLIO Coupler EtherCAT (053-1EC01) Enhanced Mode Rev. >= 0x80000003
SLIO Coupler EtherCAT (053-1EC01) Rev. >= 0x1
SLIO Coupler EtherCAT (053-1EC01) Rev. >= 0x2
SLIO Coupler EtherCAT (053-1EC01) Rev. >= 0x3

6. During the bus scan, the modules are inserted directly. For manual placement, double-click under *'Plant'* the EtherCAT coupler in your project and add your SLIO modules by entering a relevant part of the name and clicking on a suggested module.

➡



Project
- ic9212m-fsoe-1 : iC9212M-FSoE
  - PLCnext (1)
  - PLC
  - Profinet (0)

- Devices
  - iCube Engineer
    - Devices
      - Yaskawa
        - SliceBus and SLIO
          - SLIO Modules EtherCAT
            - Analog Input Modules
              - Current Input Modules
              - Energy Management Modules
              - Thermocouple / Resistor Input Modules
              - Voltage Input Modules
            - Analog Output Modules

Module List

#	Type	Function	Location
1	bf00		

DI 8xDC24V (021-1BF00) Rev. >= 00/1.00
DO 8xDC24V 0.5A (022-1BF00) Rev. >= 00/1.00

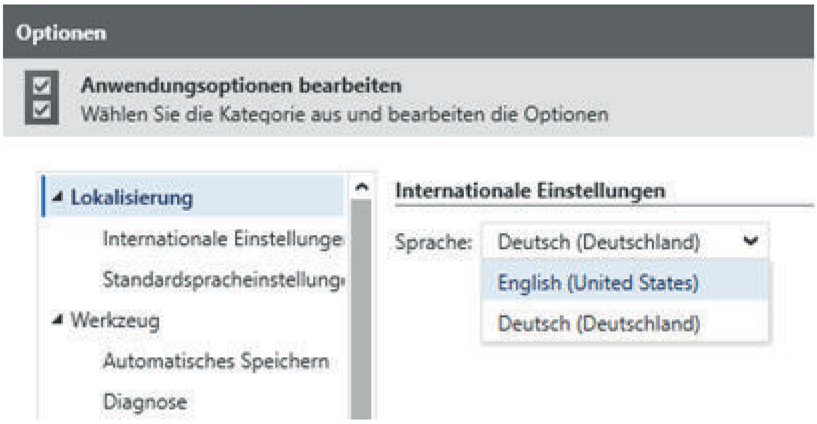
7. Your hardware configuration is now complete.

Save your project.

8. *Please note that, due to the system, the parametrization of the safety module parameters is only possible via the English language view.*

To switch languages, open the menu *'Extras → Options'* and set the language to *'English'* at *'International'*.

➡



Optionen

☑ **Anwendungsoptionen bearbeiten**
Wählen Sie die Kategorie aus und bearbeiten die Optionen

Internationale Einstellungen

Sprache: Deutsch (Deutschland)

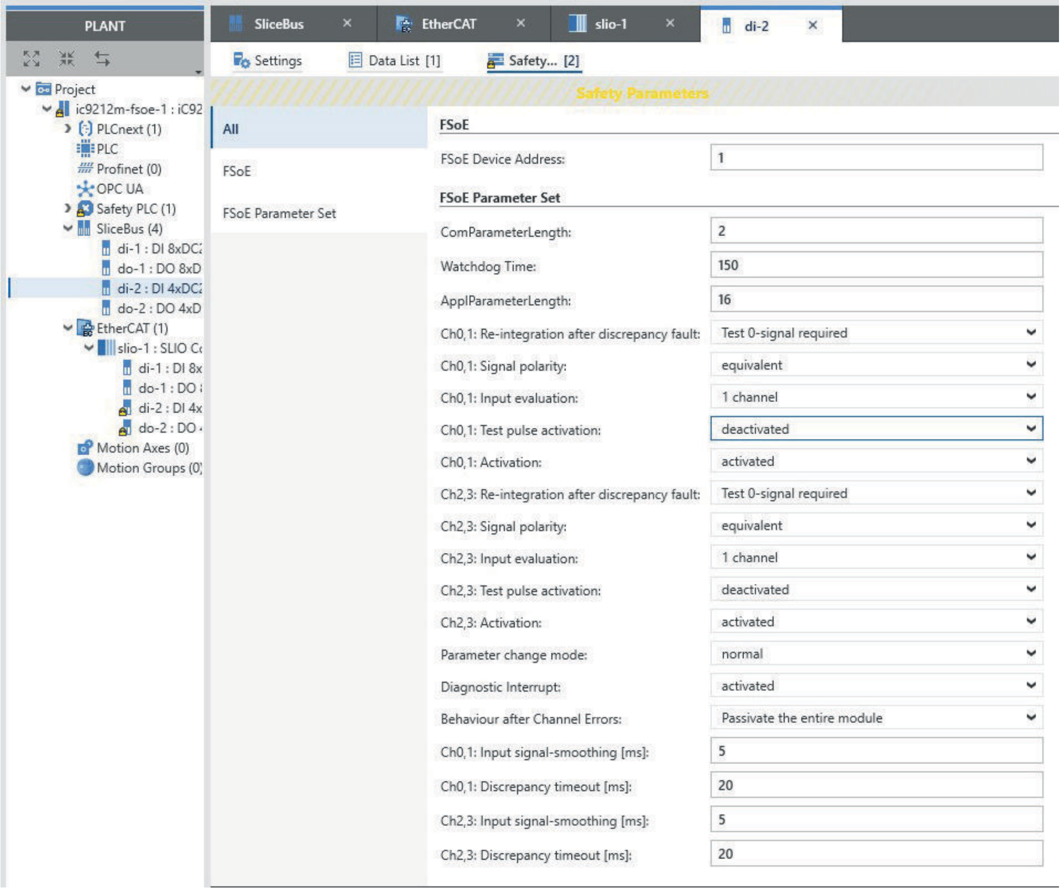
9. Save your project.

10. Restart iCube Engineer with your project.

11. To set the module parameters, double-click on the local safety DI module.

12. Enter the safety password and set the following module parameters:
- *Input evaluation*: 1 channel
- *Input signal-smoothing*: 5ms
- *Test pulse activation*: deactivated

➡



FSoE

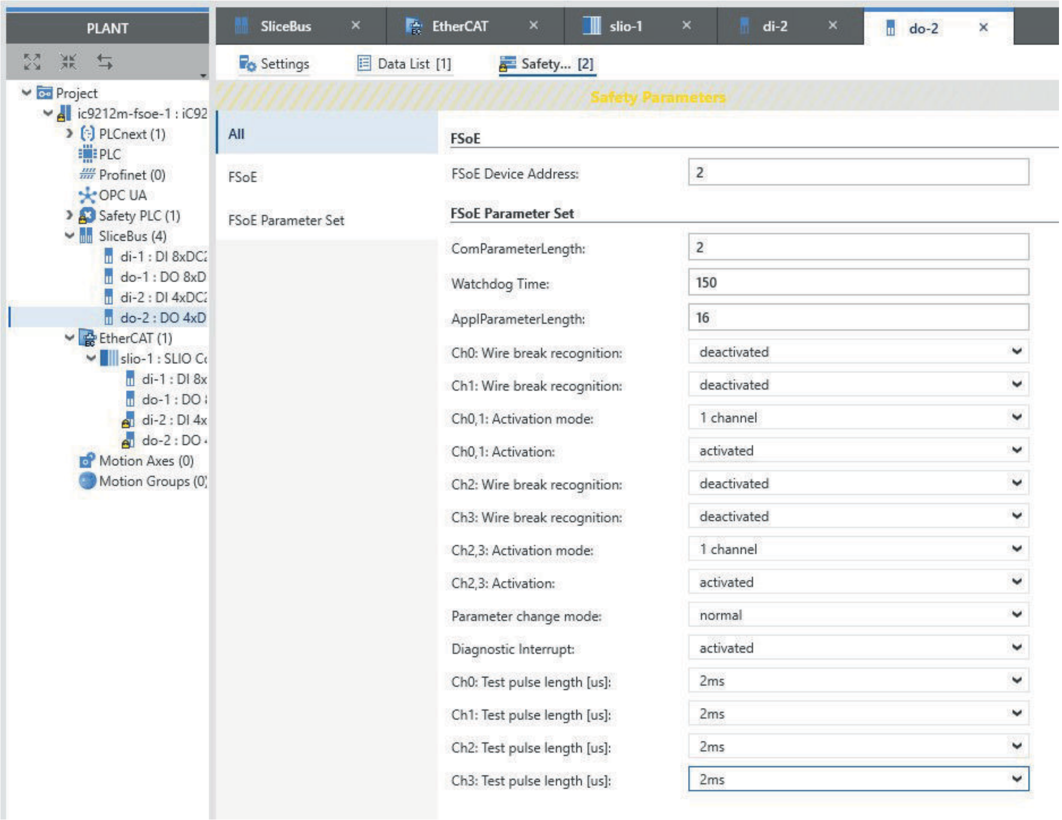
FSoE Device Address:	1

FSoE Parameter Set

ComParameterLength:	2
Watchdog Time:	150
ApplParameterLength:	16
Ch0,1: Re-integration after discrepancy fault:	Test 0-signal required
Ch0,1: Signal polarity:	equivalent
Ch0,1: Input evaluation:	1 channel
Ch0,1: Test pulse activation:	deactivated
Ch0,1: Activation:	activated
Ch2,3: Re-integration after discrepancy fault:	Test 0-signal required
Ch2,3: Signal polarity:	equivalent
Ch2,3: Input evaluation:	1 channel
Ch2,3: Test pulse activation:	deactivated
Ch2,3: Activation:	activated
Parameter change mode:	normal
Diagnostic Interrupt:	activated
Behaviour after Channel Errors:	Passivate the entire module
Ch0,1: Input signal-smoothing [ms]:	5
Ch0,1: Discrepancy timeout [ms]:	20
Ch2,3: Input signal-smoothing [ms]:	5
Ch2,3: Discrepancy timeout [ms]:	20

13. To set the module parameters, double-click on the local safety DO module.

14. Set the following module parameters:
   - *Activation Mode*: 1 channel
   - *Test pule length*: 2ms
   - ➡



Safety Parameters

FSoE

FSoE Device Address: 2

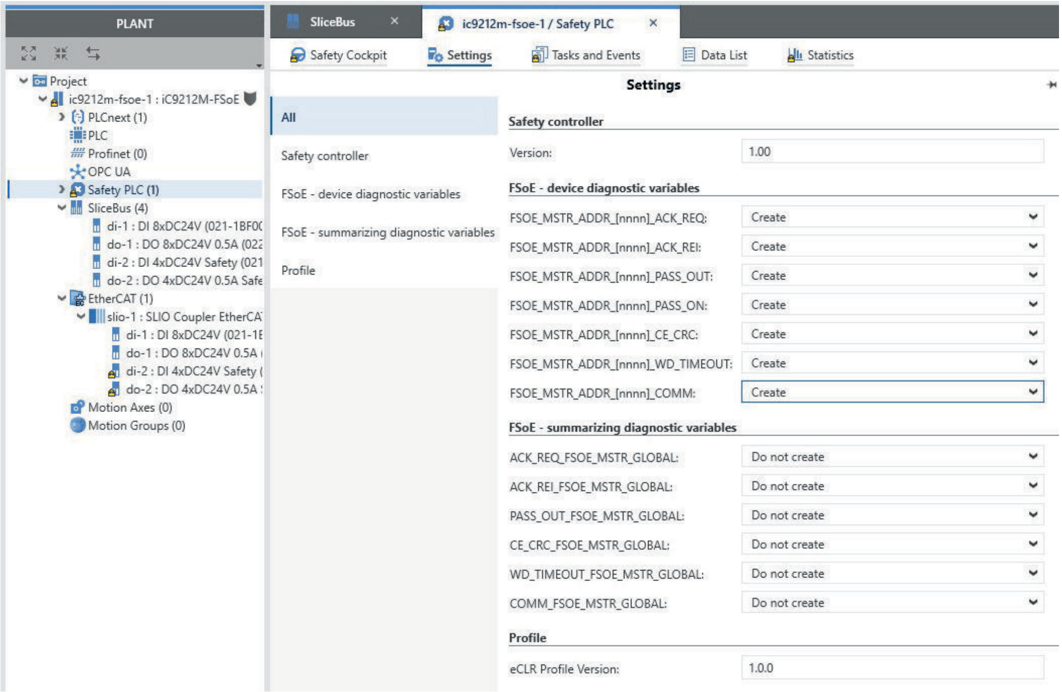
FSoE Parameter Set

ComParameterLength: 2
Watchdog Time: 150
ApplParameterLength: 16
Ch0: Wire break recognition: deactivated
Ch1: Wire break recognition: deactivated
Ch0,1: Activation mode: 1 channel
Ch0,1: Activation: activated
Ch2: Wire break recognition: deactivated
Ch3: Wire break recognition: deactivated
Ch2,3: Activation mode: 1 channel
Ch2,3: Activation: activated
Parameter change mode: normal
Diagnostic Interrupt: activated
Ch0: Test pulse length [us]: 2ms
Ch1: Test pulse length [us]: 2ms
Ch2: Test pulse length [us]: 2ms
Ch3: Test pulse length [us]: 2ms

15. Repeat the parametrization for the safety modules on the FSoE EtherCAT coupler.

16. At *'Plant'*, double-click on the *'Safety PLC'* in your project and open the settings.

17. Enable all *'FSoE device diagnostic variables'* there by activating *'Create'*.


PLANT
SliceBus
ic9212m-fsoe-1 / Safety PLC
Safety Cockpit
Settings
Tasks and Events
Data List
Statistics
Project
ic9212m-fsoe-1 : iC9212M-FSoE
PLCnext (1)
PLC
Profinet (0)
OPC UA
Safety PLC (1)
SliceBus (4)
di-1 : DI 8xDC24V (021-1BF0
do-1 : DO 8xDC24V 0.5A (022
di-2 : DI 4xDC24V Safety (021
do-2 : DO 4xDC24V 0.5A Safe
EtherCAT (1)
slio-1 : SLIO Coupler EtherCA
di-1 : DI 8xDC24V (021-1E
do-1 : DO 8xDC24V 0.5A
di-2 : DI 4xDC24V Safety
do-2 : DO 4xDC24V 0.5A
Motion Axes (0)
Motion Groups (0)
All
Safety controller
FSoE - device diagnostic variables
FSoE - summarizing diagnostic variables
Profile

Settings

Safety controller

Version: 1.00

FSoE - device diagnostic variables

FSOE_MSTR_ADDR_[nnnn]_ACK_REQ: Create
FSOE_MSTR_ADDR_[nnnn]_ACK_REI: Create
FSOE_MSTR_ADDR_[nnnn]_PASS_OUT: Create
FSOE_MSTR_ADDR_[nnnn]_PASS_ON: Create
FSOE_MSTR_ADDR_[nnnn]_CE_CRC: Create
FSOE_MSTR_ADDR_[nnnn]_WD_TIMEOUT: Create
FSOE_MSTR_ADDR_[nnnn]_COMM: Create

FSoE - summarizing diagnostic variables

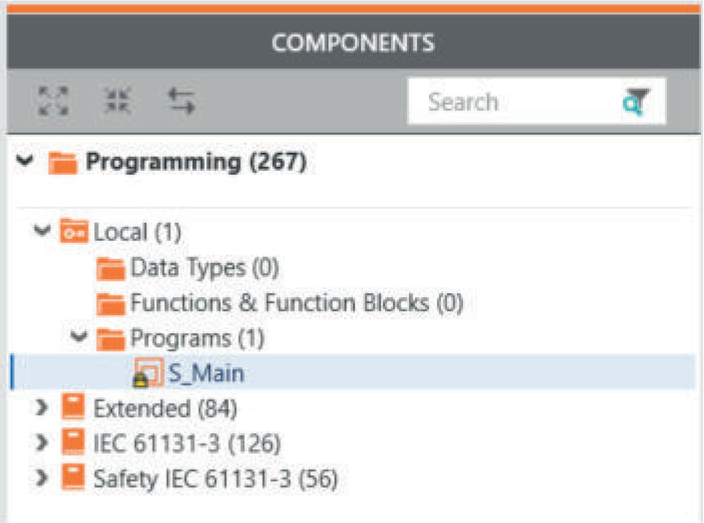
ACK_REQ_FSOE_MSTR_GLOBAL: Do not create
ACK_REI_FSOE_MSTR_GLOBAL: Do not create
PASS_OUT_FSOE_MSTR_GLOBAL: Do not create
CE_CRC_FSOE_MSTR_GLOBAL: Do not create
WD_TIMEOUT_FSOE_MSTR_GLOBAL: Do not create
COMM_FSOE_MSTR_GLOBAL: Do not create

Profile

eCLR Profile Version: 1.0.0

➡ Your parametrization is now complete.

18. Save your project.



- Programming (267)
  - Local (1)
    - Data Types (0)
    - Functions & Function Blocks (0)
    - Programs (1)
      - S_Main
  - Extended (84)
  - IEC 61131-3 (126)
  - Safety IEC 61131-3 (56)

19. Navigate via *'Components'* to *'Programming → Local → Programmes'* and open *'S_Main'*.

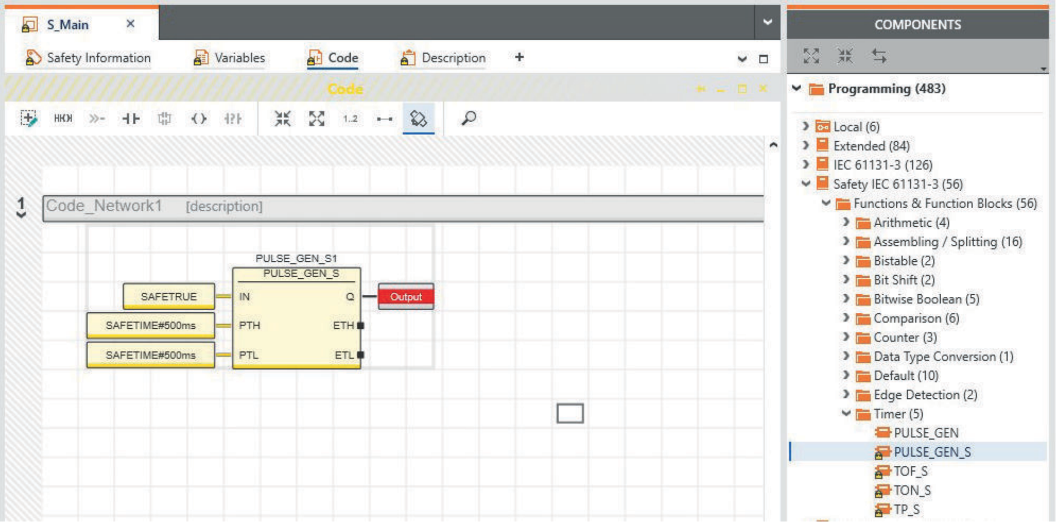
➡ The program editor for your safety application opens.

20. Enter the safety password and click [OK].

21. Program your application in the following order:

- Drag a *PULSE_GEN_S* into the editor.
- Supply the input parameter *IN* with *SAFETRUE*.
- Supply the two time parameters with *SAFETIME#500ms*.
- Name the output *Q* as *Output*.
- Right-click on *Output 'Create new variable → Local'* to create a new local variable.

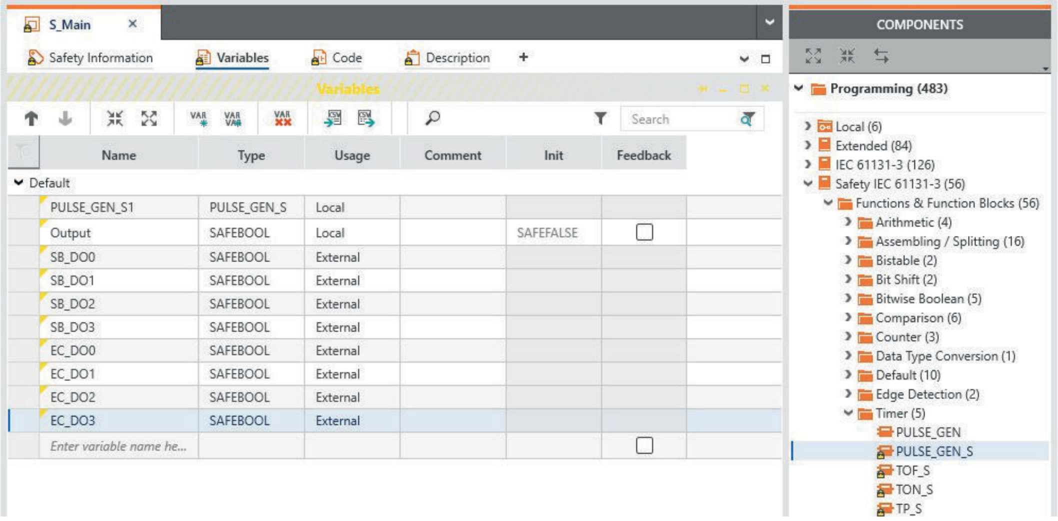
➡



- Programming (483)
  - Local (6)
  - Extended (84)
  - IEC 61131-3 (126)
  - Safety IEC 61131-3 (56)
    - Functions & Function Blocks (56)
      - Arithmetic (4)
      - Assembling / Splitting (16)
      - Bistable (2)
      - Bit Shift (2)
      - Bitwise Boolean (5)
      - Comparison (6)
      - Counter (3)
      - Data Type Conversion (1)
      - Default (10)
      - Edge Detection (2)
      - Timer (5)
        - PULSE_GEN
        - PULSE_GEN_S
        - TOF_S
        - TON_S
        - TP_S

22. Switch to the *'Variables'* tab and create 8 external variables that will later be assigned to the outputs. Here you can copy the created variables.

➡

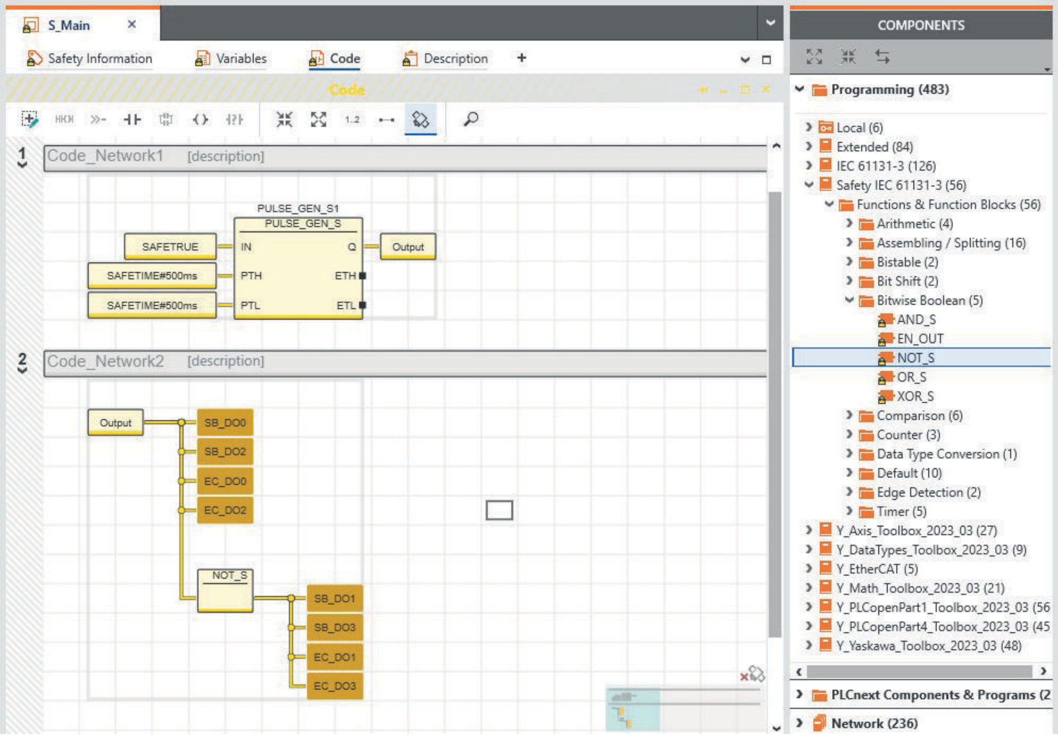


Name	Type	Usage	Comment	Init	Feedback
Default					
PULSE_GEN_S1	PULSE_GEN_S	Local			
Output	SAFEBOOL	Local		SAFEFALSE	☐
SB_DO0	SAFEBOOL	External			
SB_DO1	SAFEBOOL	External			
SB_DO2	SAFEBOOL	External			
SB_DO3	SAFEBOOL	External			
EC_DO0	SAFEBOOL	External			
EC_DO1	SAFEBOOL	External			
EC_DO2	SAFEBOOL	External			
EC_DO3	SAFEBOOL	External			
Enter variable name he...					☐

23. Switch to the *'Code'* tab, insert the *Output* variable and assign it to the output variable with even numbering.

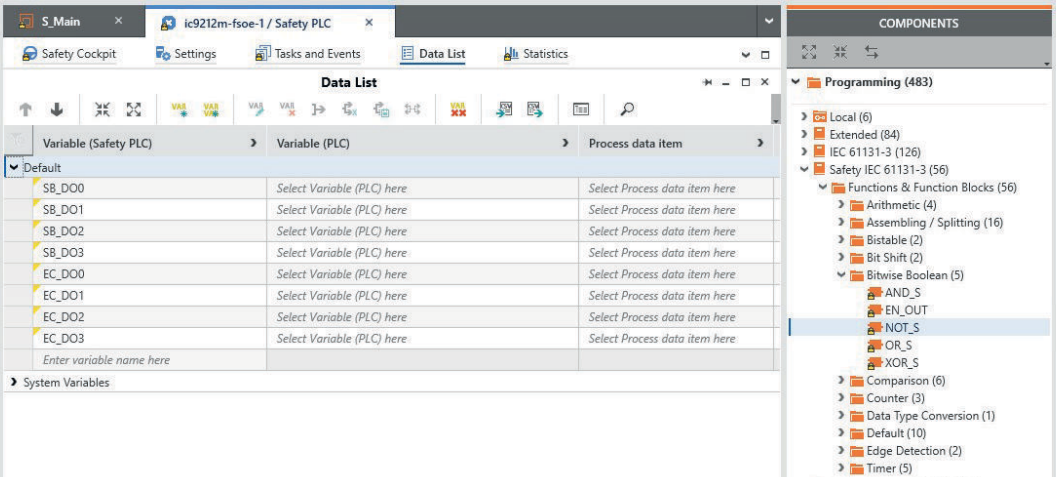
Invert the *output* variable with a *NOT_S* and assign it to the output variable with odd numbering.

➡



24. Double-click on the *'Safety PLC'* and switch to the *'Data list'* tab.

➡



S_Main × | ic9212m-fsoe-1 / Safety PLC ×

Safety Cockpit | Settings | Tasks and Events | Data List | Statistics

Data List

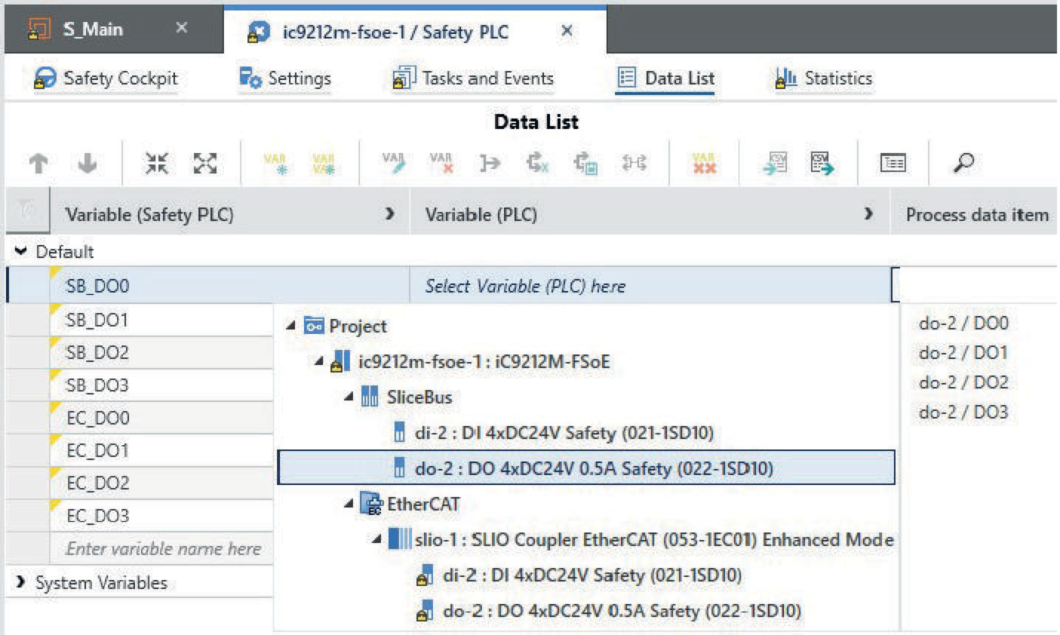
Variable (Safety PLC)	Variable (PLC)	Process data item
Default		
SB_DO0	Select Variable (PLC) here	Select Process data item here
SB_DO1	Select Variable (PLC) here	Select Process data item here
SB_DO2	Select Variable (PLC) here	Select Process data item here
SB_DO3	Select Variable (PLC) here	Select Process data item here
EC_DO0	Select Variable (PLC) here	Select Process data item here
EC_DO1	Select Variable (PLC) here	Select Process data item here
EC_DO2	Select Variable (PLC) here	Select Process data item here
EC_DO3	Select Variable (PLC) here	Select Process data item here
Enter variable name here		
System Variables		

COMPONENTS

- Programming (483)
  - Local (6)
  - Extended (84)
  - IEC 61131-3 (126)
  - Safety IEC 61131-3 (56)
    - Functions & Function Blocks (56)
      - Arithmetic (4)
      - Assembling / Splitting (16)
      - Bistable (2)
      - Bit Shift (2)
      - Bitwise Boolean (5)
        - AND_S
        - EN_OUT
        - NOT_S
        - OR_S
        - XOR_S
      - Comparison (6)
      - Counter (3)
      - Data Type Conversion (1)
      - Default (10)
      - Edge Detection (2)
      - Timer (5)

25. Click in the *'Process data item'* field of the first output variable and select the safety DO on the *'SliceBus'* for better filtering.

➡



S_Main × | ic9212m-fsoe-1 / Safety PLC ×

Safety Cockpit | Settings | Tasks and Events | Data List | Statistics

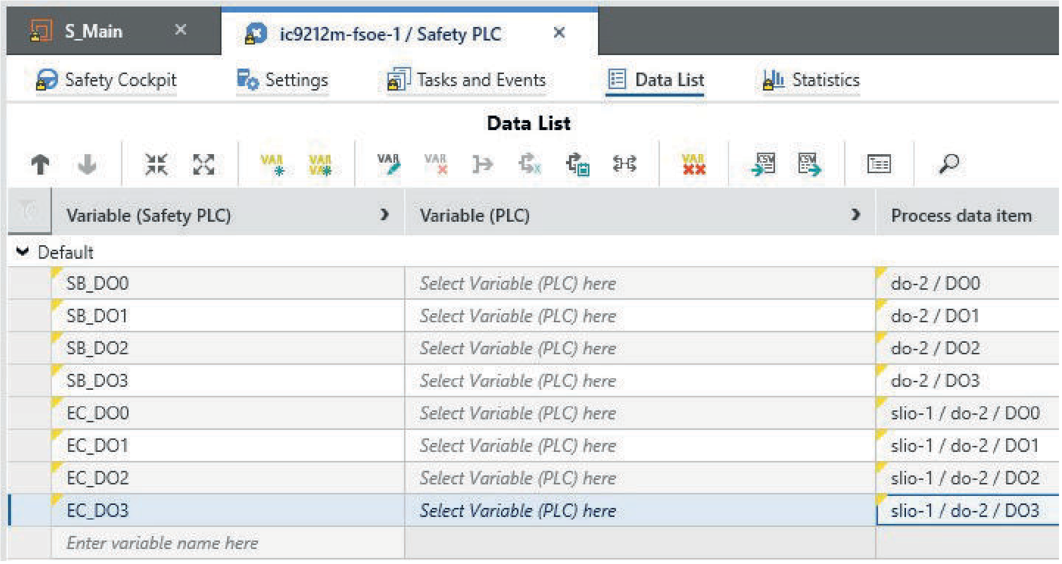
Data List

Variable (Safety PLC)	Variable (PLC)	Process data item
Default		
SB_DO0	Select Variable (PLC) here	
SB_DO1		
SB_DO2		
SB_DO3		
EC_DO0		
EC_DO1		
EC_DO2		
EC_DO3		
Enter variable name here		
System Variables		

- Project
  - ic9212m-fsoe-1 : iC9212M-FSoE
    - SliceBus
      - di-2 : DI 4xDC24V Safety (021-1SD10)
      - do-2 : DO 4xDC24V 0.5A Safety (022-1SD10)
    - EtherCAT
      - slio-1 : SLIO Coupler EtherCAT (053-1EC01) Enhanced Mode
        - di-2 : DI 4xDC24V Safety (021-1SD10)
        - do-2 : DO 4xDC24V 0.5A Safety (022-1SD10)

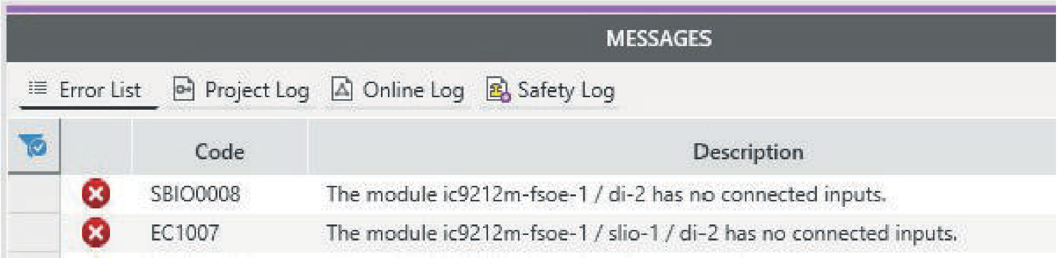
do-2 / DO0
do-2 / DO1
do-2 / DO2
do-2 / DO3

26. Assign all 8 safety outputs.



Variable (Safety PLC)	Variable (PLC)	Process data item
Default		
SB_DO0	Select Variable (PLC) here	do-2 / DO0
SB_DO1	Select Variable (PLC) here	do-2 / DO1
SB_DO2	Select Variable (PLC) here	do-2 / DO2
SB_DO3	Select Variable (PLC) here	do-2 / DO3
EC_DO0	Select Variable (PLC) here	slio-1 / do-2 / DO0
EC_DO1	Select Variable (PLC) here	slio-1 / do-2 / DO1
EC_DO2	Select Variable (PLC) here	slio-1 / do-2 / DO2
EC_DO3	Select Variable (PLC) here	slio-1 / do-2 / DO3
Enter variable name here		

➡ You will receive the following error message:



Code	Description
SBIO0008	The module ic9212m-fsoe-1 / di-2 has no connected inputs.
EC1007	The module ic9212m-fsoe-1 / slio-1 / di-2 has no connected inputs.

27. To avoid error messages, create 8 external variables in *'S_Main'*, which you link to the safety inputs.

28. Once the mapping of the process data is complete, save and translate the project with *'Project → Create new'*.

29. With *Save and rebuild*, the number of warnings has now increased.

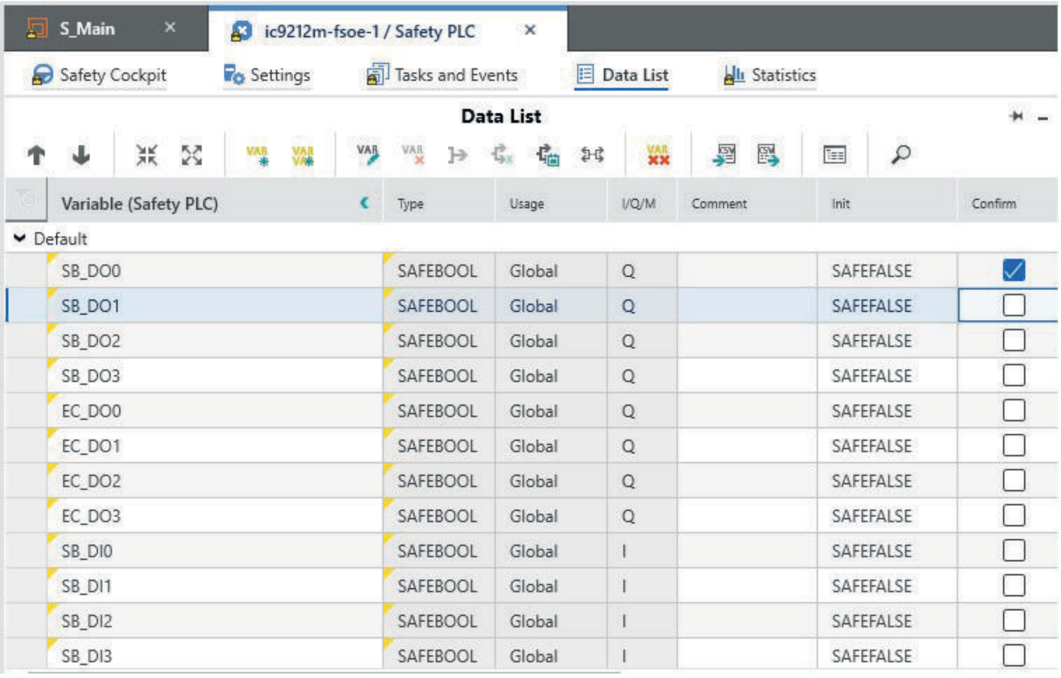
Double-click on the first message in which the user's address is not validated.

➡ The cursor jumps to the first variable in the *'Safety PLC'* data list.

30. To show additional table columns, click on the *'>'* icon in the table header.

31. Navigate to the *'Confirm'* column and enable the checkboxes for all 16 variables.

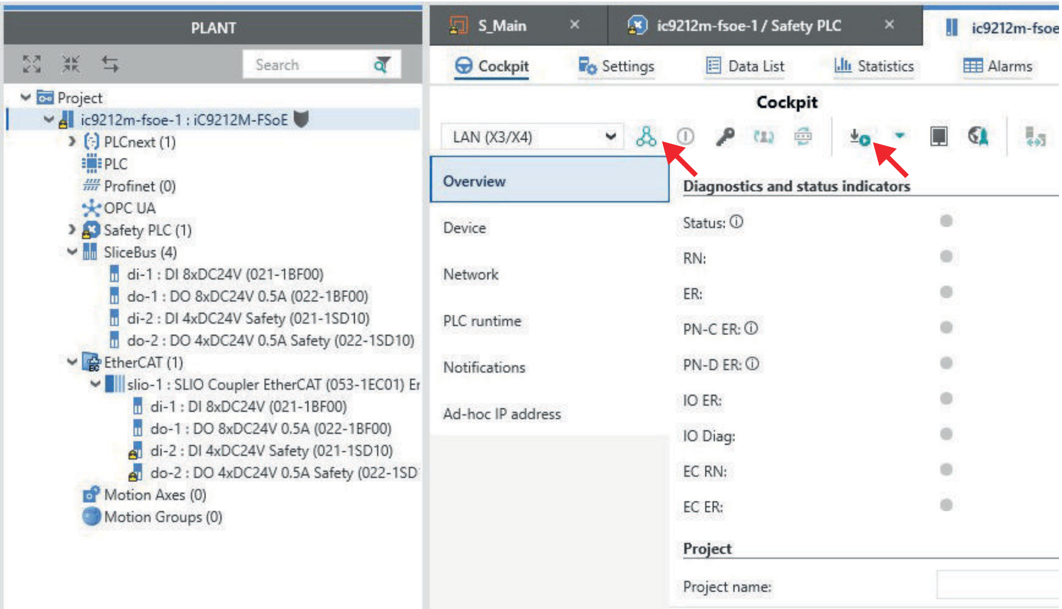
➡



Variable (Safety PLC)	Type	Usage	I/Q/M	Comment	Init	Confirm
SB_DO0	SAFEBOOL	Global	Q		SAFEFALSE	☑
SB_DO1	SAFEBOOL	Global	Q		SAFEFALSE	☐
SB_DO2	SAFEBOOL	Global	Q		SAFEFALSE	☐
SB_DO3	SAFEBOOL	Global	Q		SAFEFALSE	☐
EC_DO0	SAFEBOOL	Global	Q		SAFEFALSE	☐
EC_DO1	SAFEBOOL	Global	Q		SAFEFALSE	☐
EC_DO2	SAFEBOOL	Global	Q		SAFEFALSE	☐
EC_DO3	SAFEBOOL	Global	Q		SAFEFALSE	☐
SB_DI0	SAFEBOOL	Global	I		SAFEFALSE	☐
SB_DI1	SAFEBOOL	Global	I		SAFEFALSE	☐
SB_DI2	SAFEBOOL	Global	I		SAFEFALSE	☐
SB_DI3	SAFEBOOL	Global	I		SAFEFALSE	☐

32. In the *'Plant'* area, double-click the den Controller in your project and switch to *'Cockpit'* tab.

➡


PLANT
Search
Project
ic9212m-fsoe-1 : iC9212M-FSoE
PLCnext (1)
PLC
Profinet (0)
OPC UA
Safety PLC (1)
SliceBus (4)
di-1 : DI 8xDC24V (021-1BF00)
do-1 : DO 8xDC24V 0.5A (022-1BF00)
di-2 : DI 4xDC24V Safety (021-1SD10)
do-2 : DO 4xDC24V 0.5A Safety (022-1SD10)
EtherCAT (1)
slio-1 : SLIO Coupler EtherCAT (053-1EC01) Er
di-1 : DI 8xDC24V (021-1BF00)
do-1 : DO 8xDC24V 0.5A (022-1BF00)
di-2 : DI 4xDC24V Safety (021-1SD10)
do-2 : DO 4xDC24V 0.5A Safety (022-1SD
Motion Axes (0)
Motion Groups (0)
S_Main
ic9212m-fsoe-1 / Safety PLC
ic9212m-fsoe
Cockpit
Settings
Data List
Statistics
Alarms
Cockpit
LAN (X3/X4)
Overview
Device
Network
PLC runtime
Notifications
Ad-hoc IP address
Diagnostics and status indicators
Status:
RN:
ER:
PN-C ER:
PN-D ER:
IO ER:
IO Diag:
EC RN:
EC ER:
Project
Project name:

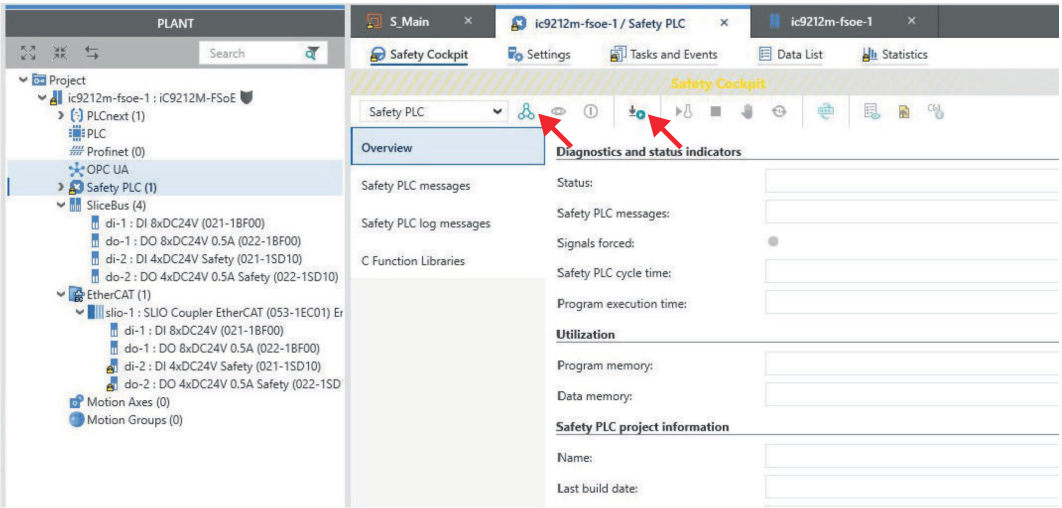
33. Go online via the symbol.

34. Enter the name "Admin" and the printed device password.

35. Use the symbol to transfer the project to the standard component of the safety CPU.

36. Double-click in the *'Plant'* area, on your *'Safety PLC'* and switch to the *'Safety Cockpit'* tab.

➡


PLANT
Search
Project
ic9212m-fsoe-1 : iC9212M-FSoE
PLCnext (1)
PLC
Profinet (0)
OPC UA
Safety PLC (1)
SliceBus (4)
di-1 : DI 8xDC24V (021-1BF00)
do-1 : DO 8xDC24V 0.5A (022-1BF00)
di-2 : DI 4xDC24V Safety (021-1SD10)
do-2 : DO 4xDC24V 0.5A Safety (022-1SD10)
EtherCAT (1)
slio-1 : SLIO Coupler EtherCAT (053-1EC01) Er
di-1 : DI 8xDC24V (021-1BF00)
do-1 : DO 8xDC24V 0.5A (022-1BF00)
di-2 : DI 4xDC24V Safety (021-1SD10)
do-2 : DO 4xDC24V 0.5A Safety (022-1SD
Motion Axes (0)
Motion Groups (0)
S_Main
ic9212m-fsoe-1 / Safety PLC
ic9212m-fsoe-1
Safety Cockpit
Settings
Tasks and Events
Data List
Statistics
Safety Cockpit
Safety PLC
Overview
Safety PLC messages
Safety PLC log messages
C Function Libraries
Diagnostics and status indicators
Status:
Safety PLC messages:
Signals forced:
Safety PLC cycle time:
Program execution time:
Utilization
Program memory:
Data memory:
Safety PLC project information
Name:
Last build date:

37. Go online with the symbol.

38. Use the symbol to transfer the project to the safety component of the safety CPU.

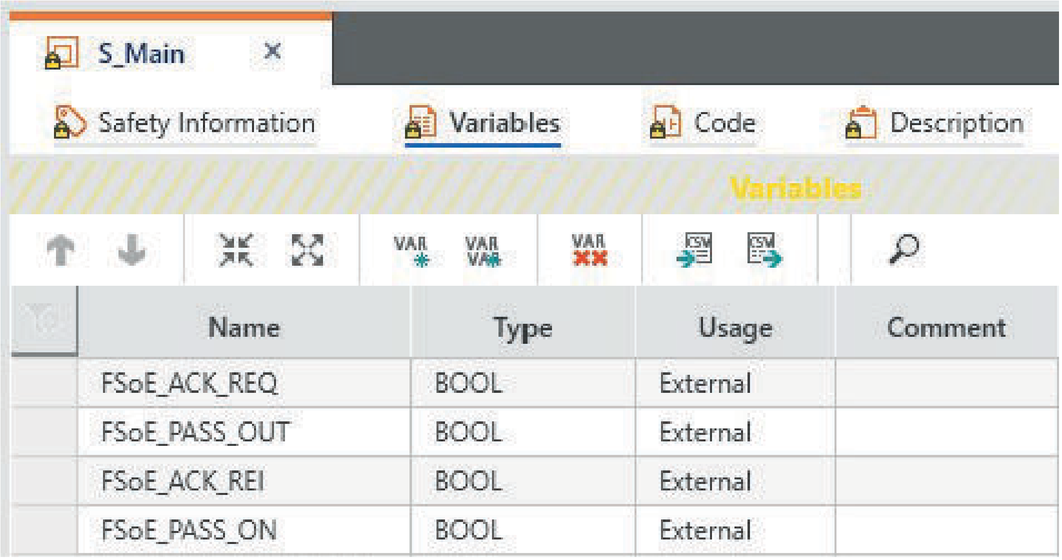
➡ A password query for the safety CPU appears. Assign a new password or enter a password that authorizes you to overwrite the project on the safety CPU.

5.13.3 Modification

- Evaluation of the FSoE device diagnostic variables
- Resetting a passivation

1. Open the *'Variables'* tab in *'S_Main'* and add the following variables:
   - *FSoE_ACK_REQ*
   - *FSoE_PASS_OUT*
   - *FSoE_ACK_REI*
   - *FSoE_PASS_ON*

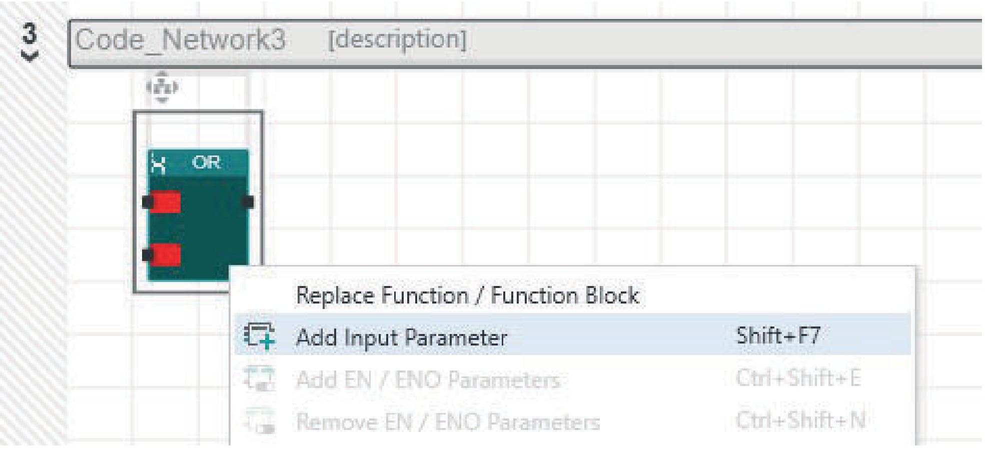
   ➡



Name	Type	Usage	Comment
FSoE_ACK_REQ	BOOL	External	
FSoE_PASS_OUT	BOOL	External	
FSoE_ACK_REI	BOOL	External	
FSoE_PASS_ON	BOOL	External	

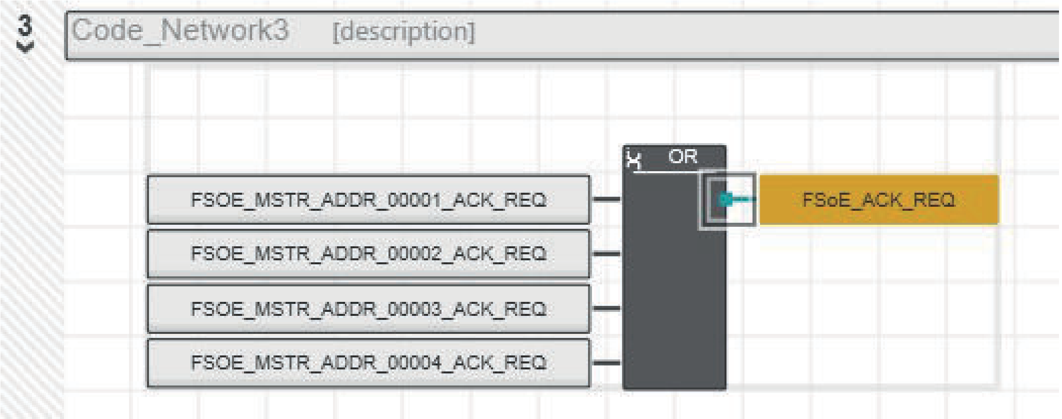
2. Open the *'Code'* tab in *'S_Main'*, drag in an *OR* and add two more input parameters.

➡


3
Code_Network3 [description]
OR
Replace Function / Function Block
Add Input Parameter Shift+F7
Add EN / ENO Parameters Ctrl+Shift+E
Remove EN / ENO Parameters Ctrl+Shift+N

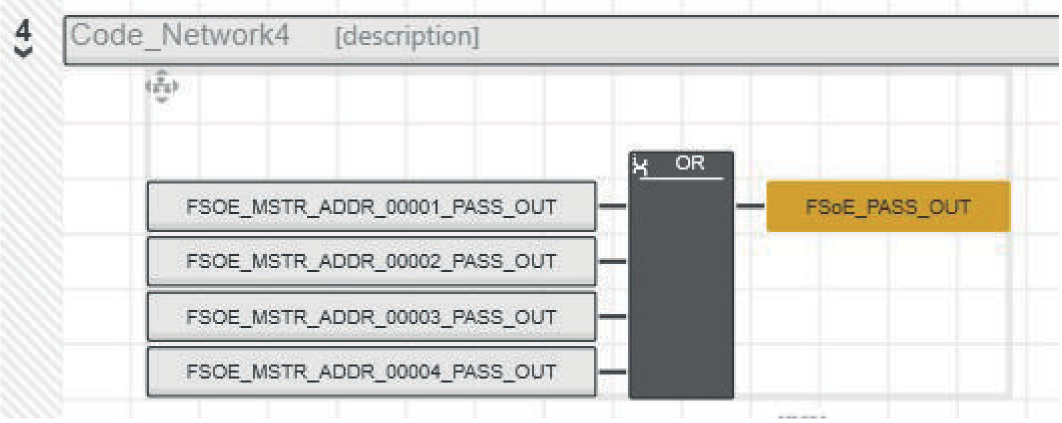
3. Use *'Add input parameter'* to add the input parameters *FSOE_MSTR_ADDR_0000x_ACK_REQ* and the output *FSoE_ACK_REQ*.

➡


3
Code_Network3 [description]
OR
FSOE_MSTR_ADDR_00001_ACK_REQ
FSOE_MSTR_ADDR_00002_ACK_REQ
FSOE_MSTR_ADDR_00003_ACK_REQ
FSOE_MSTR_ADDR_00004_ACK_REQ
FSoE_ACK_REQ

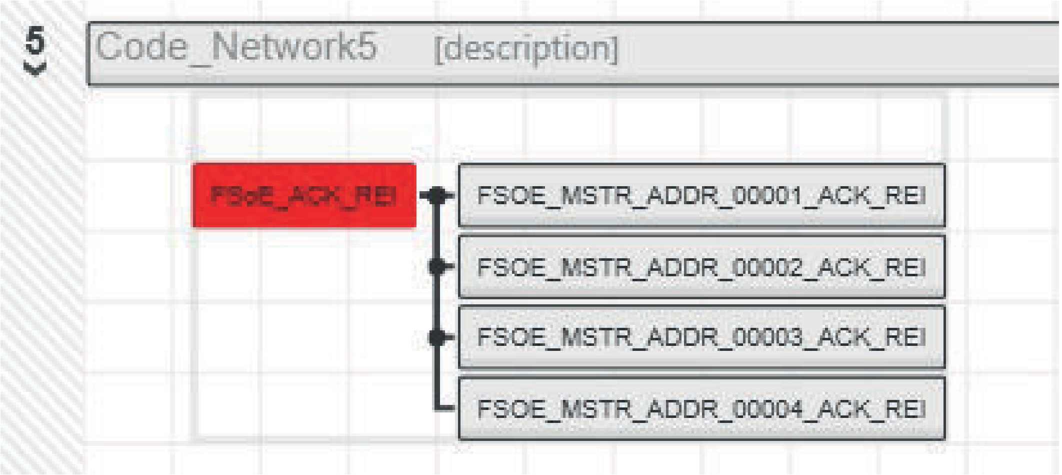
4. Add another *OR* and proceed in the same way with *FSOE_MSTR_ADDR_0000x_PASS_OUT* and *FSoE_PASS_OUT*.

➡


4
Code_Network4 [description]
OR
FSOE_MSTR_ADDR_00001_PASS_OUT
FSOE_MSTR_ADDR_00002_PASS_OUT
FSOE_MSTR_ADDR_00003_PASS_OUT
FSOE_MSTR_ADDR_00004_PASS_OUT
FSoE_PASS_OUT

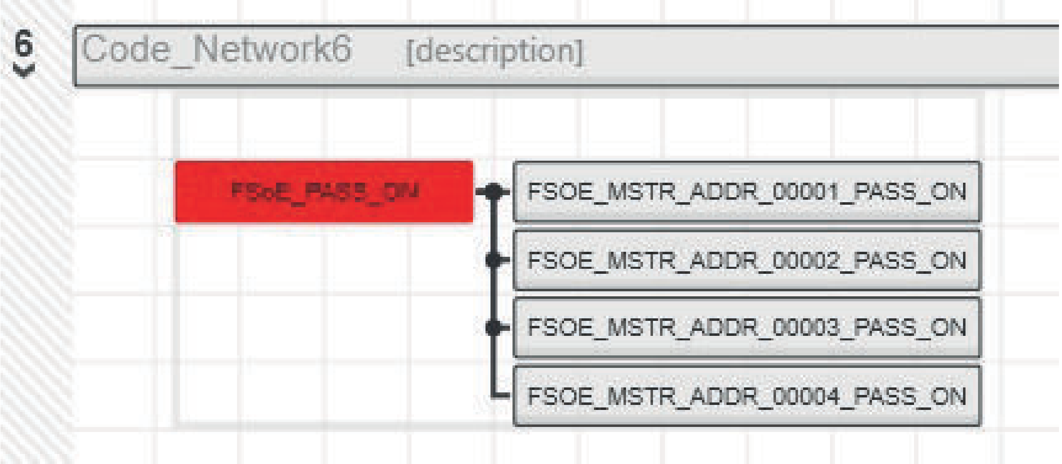
5. Insert *FSoE_ACK_REI* and connect it to all *FSOE_MSTR_ADDR_0000x_ACK_REI*.

➡


5
Code_Network5
[description]
FSoE_ACK_REI
FSOE_MSTR_ADDR_00001_ACK_REI
FSOE_MSTR_ADDR_00002_ACK_REI
FSOE_MSTR_ADDR_00003_ACK_REI
FSOE_MSTR_ADDR_00004_ACK_REI

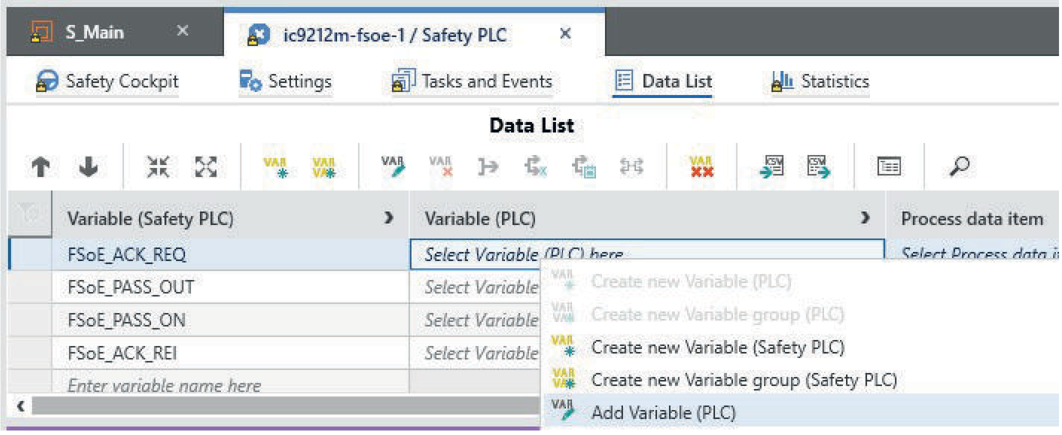
6. Insert *FSoE_PASS_ON* and connect it to all *FSOE_MSTR_ADDR_0000x_PASS_ON*.

➡


6
Code_Network6
[description]
FSoE_PASS_ON
FSOE_MSTR_ADDR_00001_PASS_ON
FSOE_MSTR_ADDR_00002_PASS_ON
FSOE_MSTR_ADDR_00003_PASS_ON
FSOE_MSTR_ADDR_00004_PASS_ON

7. Open the *'Data list'* of the *'Safety PLC'* and add the four FSoE variables to the standard component of the safety CPU via *'Add variable (PLC)'*.

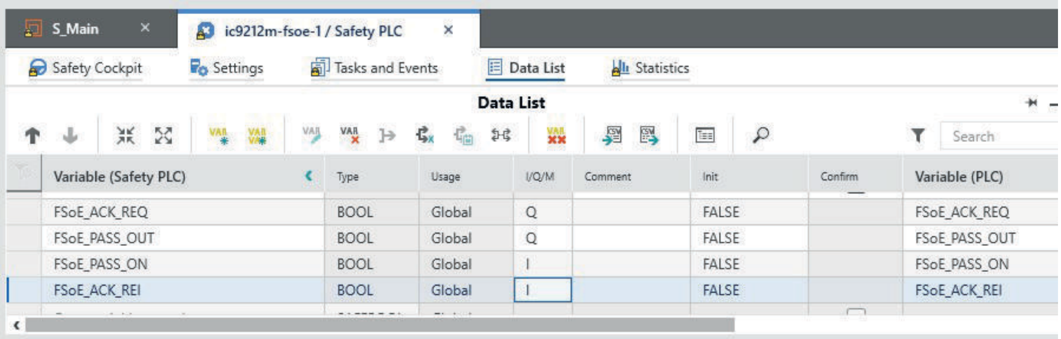
➡


S_Main
ic9212m-fsoe-1 / Safety PLC
Safety Cockpit
Settings
Tasks and Events
Data List
Statistics
Data List
Create new Variable (PLC)
Create new Variable group (PLC)
Create new Variable (Safety PLC)
Create new Variable group (Safety PLC)
Add Variable (PLC)

Variable (Safety PLC)	Variable (PLC)	Process data item
FSoE_ACK_REQ	Select Variable (PLC) here	Select Process data i
FSoE_PASS_OUT	Select Variable	
FSoE_PASS_ON	Select Variable	
FSoE_ACK_REI	Select Variable	
Enter variable name here		

8. Select the data direction at *'I/Q/M'*, *'Q'* for output and *'I'* for input.

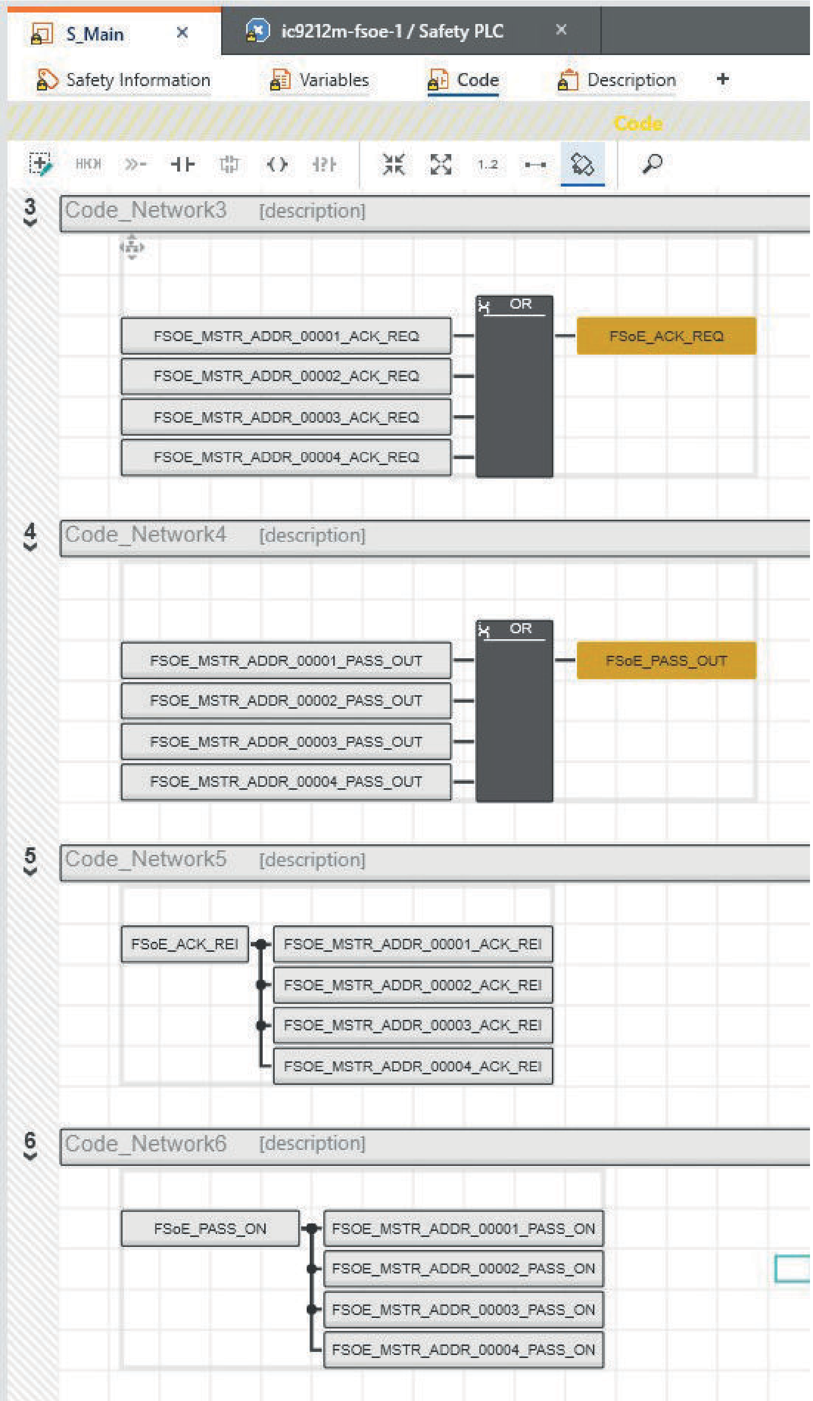
➡



Variable (Safety PLC)	Type	Usage	I/Q/M	Comment	Init	Confirm	Variable (PLC)
FSoE_ACK_REQ	BOOL	Global	Q		FALSE		FSoE_ACK_REQ
FSoE_PASS_OUT	BOOL	Global	Q		FALSE		FSoE_PASS_OUT
FSoE_PASS_ON	BOOL	Global	I		FALSE		FSoE_PASS_ON
FSoE_ACK_REI	BOOL	Global	I		FALSE		FSoE_ACK_REI

9. Nothing should now be highlighted in red in the *'S_Main'* code.

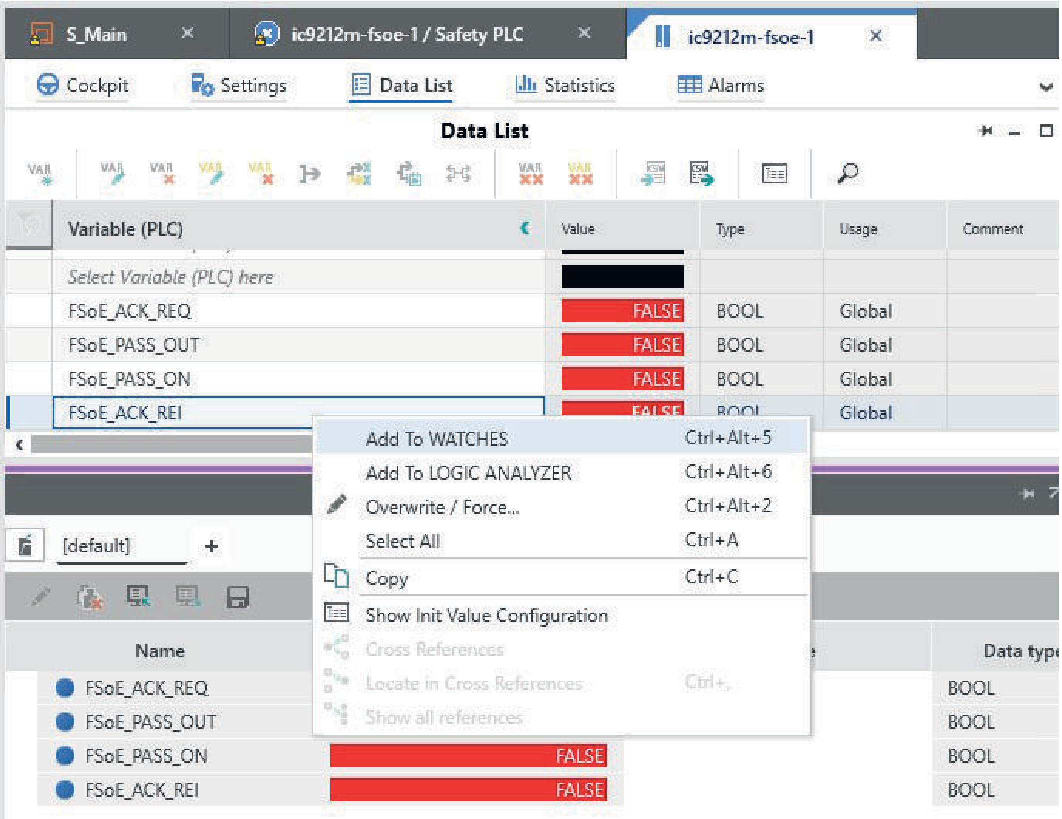
➡


S_Main
ic9212m-fsoe-1 / Safety PLC
Safety Information
Variables
Code
Description
Code
3
Code_Network3 [description]
OR
FSOE_MSTR_ADDR_00001_ACK_REQ
FSOE_MSTR_ADDR_00002_ACK_REQ
FSOE_MSTR_ADDR_00003_ACK_REQ
FSOE_MSTR_ADDR_00004_ACK_REQ
FSoE_ACK_REQ
4
Code_Network4 [description]
OR
FSOE_MSTR_ADDR_00001_PASS_OUT
FSOE_MSTR_ADDR_00002_PASS_OUT
FSOE_MSTR_ADDR_00003_PASS_OUT
FSOE_MSTR_ADDR_00004_PASS_OUT
FSoE_PASS_OUT
5
Code_Network5 [description]
FSoE_ACK_REI
FSOE_MSTR_ADDR_00001_ACK_REI
FSOE_MSTR_ADDR_00002_ACK_REI
FSOE_MSTR_ADDR_00003_ACK_REI
FSOE_MSTR_ADDR_00004_ACK_REI
6
Code_Network6 [description]
FSoE_PASS_ON
FSOE_MSTR_ADDR_00001_PASS_ON
FSOE_MSTR_ADDR_00002_PASS_ON
FSOE_MSTR_ADDR_00003_PASS_ON
FSOE_MSTR_ADDR_00004_PASS_ON

10. Save your project and transfer it.

11. Add all four variables to the *'Watch window'* via *'Insert in watch window'*.

➡

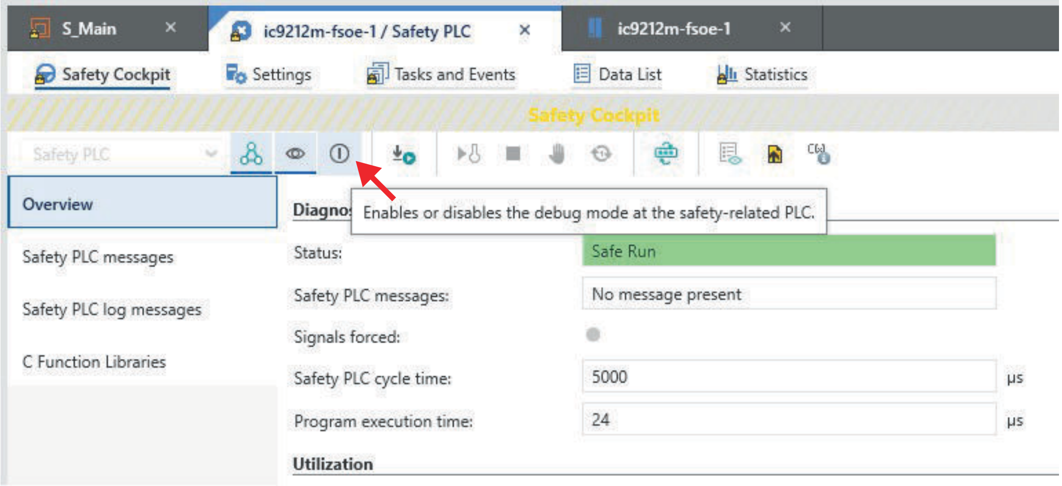

S_Main
ic9212m-fsoe-1 / Safety PLC
ic9212m-fsoe-1
Cockpit
Settings
Data List
Statistics
Alarms
Data List
Add To WATCHES Ctrl+Alt+5
Add To LOGIC ANALYZER Ctrl+Alt+6
Overwrite / Force... Ctrl+Alt+2
Select All Ctrl+A
Copy Ctrl+C
Show Init Value Configuration
Cross References
Locate in Cross References Ctrl+,
Show all references
[default]
+

Variable (PLC)	Value	Type	Usage	Comment
Select Variable (PLC) here				
FSoE_ACK_REQ	FALSE	BOOL	Global	
FSoE_PASS_OUT	FALSE	BOOL	Global	
FSoE_PASS_ON	FALSE	BOOL	Global	
FSoE_ACK_REI	FALSE	BOOL	Global	

Name		Data typ
FSoE_ACK_REQ		BOOL
FSoE_PASS_OUT		BOOL
FSoE_PASS_ON	FALSE	BOOL
FSoE_ACK_REI	FALSE	BOOL

12. Open the *'Cockpit'* of the Safety PLC *'Safety cockpit'* and check whether you are online and also switch on the debug mode via Ⓘ .

➡



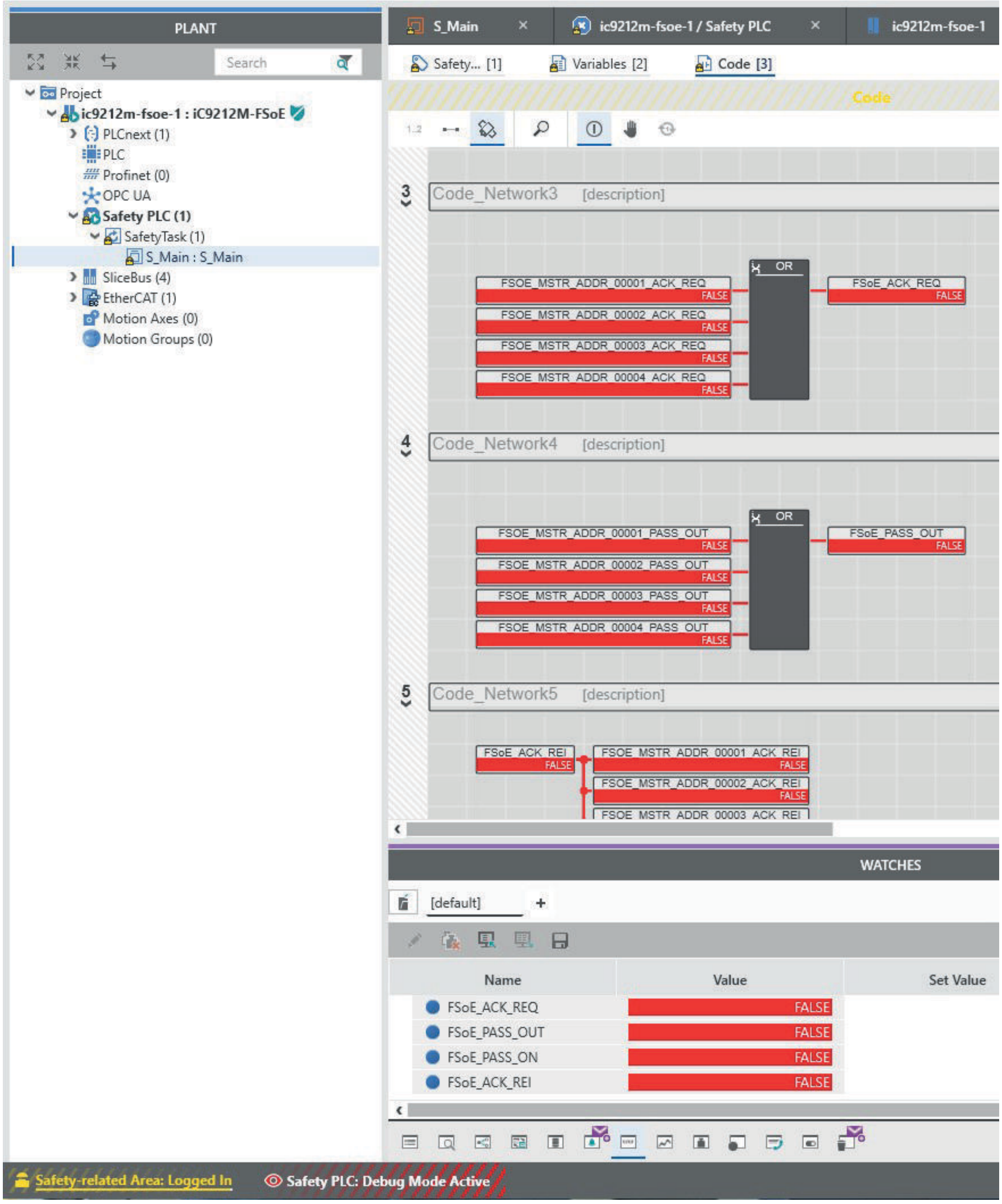
Enables or disables the debug mode at the safety-related PLC.

Status:	Safe Run	
Safety PLC messages:	No message present	
Signals forced:	●	
Safety PLC cycle time:	5000	µs
Program execution time:	24	µs

Utilization

13. Open in *'Safety PLC' 'S_Main:S_Main'*.

➡



PLANT

- Project
  - ic9212m-fsoe-1 : iC9212M-FSoE
    - PLCnext (1)
    - PLC
    - Profinet (0)
    - OPC UA
    - Safety PLC (1)
      - SafetyTask (1)
        - S_Main : S_Main
    - SliceBus (4)
    - EtherCAT (1)
    - Motion Axes (0)
    - Motion Groups (0)

Search
S_Main
ic9212m-fsoe-1 / Safety PLC
ic9212m-fsoe-1
Safety... [1]
Variables [2]
Code [3]
Code
3
Code_Network3 [description]
FSOE_MSTR_ADDR_00001_ACK_REQ FALSE
FSOE_MSTR_ADDR_00002_ACK_REQ FALSE
FSOE_MSTR_ADDR_00003_ACK_REQ FALSE
FSOE_MSTR_ADDR_00004_ACK_REQ FALSE
OR
FSoE_ACK_REQ FALSE
4
Code_Network4 [description]
FSOE_MSTR_ADDR_00001_PASS_OUT FALSE
FSOE_MSTR_ADDR_00002_PASS_OUT FALSE
FSOE_MSTR_ADDR_00003_PASS_OUT FALSE
FSOE_MSTR_ADDR_00004_PASS_OUT FALSE
OR
FSoE_PASS_OUT FALSE
5
Code_Network5 [description]
FSoE_ACK_REI FALSE
FSOE_MSTR_ADDR_00001_ACK_REI FALSE
FSOE_MSTR_ADDR_00002_ACK_REI FALSE
FSOE_MSTR_ADDR_00003_ACK_REI
WATCHES
[default]
+

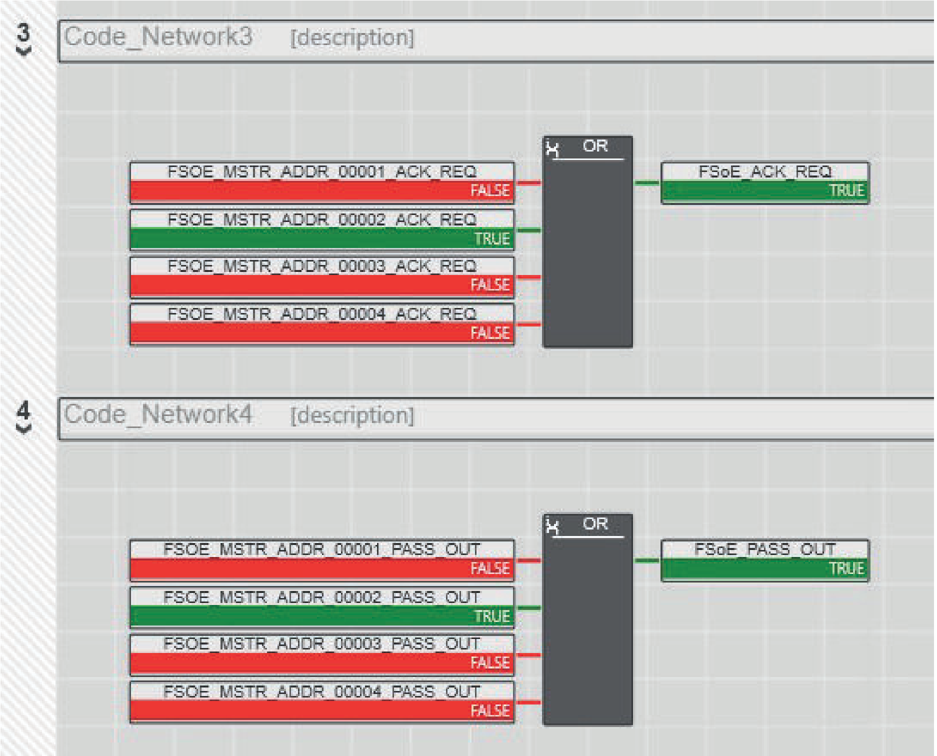
Name	Value	Set Value
FSoE_ACK_REQ	FALSE	
FSoE_PASS_OUT	FALSE	
FSoE_PASS_ON	FALSE	
FSoE_ACK_REI	FALSE	

Safety-related Area: Logged In

Safety PLC: Debug Mode Active

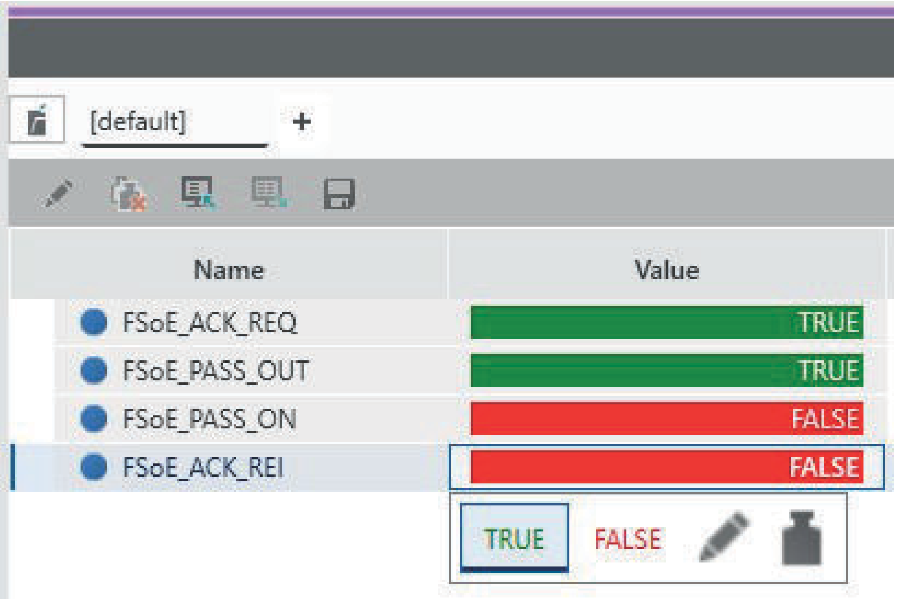
14. Briefly switch the DC 24V power section supply of the IO modules at the backplane bus off and on again.

➡ The safety DO is passivated.


3
Code_Network3 [description]
OR
FSOE_MSTR_ADDR_00001_ACK_REQ
FALSE
FSOE_MSTR_ADDR_00002_ACK_REQ
TRUE
FSOE_MSTR_ADDR_00003_ACK_REQ
FALSE
FSOE_MSTR_ADDR_00004_ACK_REQ
FALSE
FSoE_ACK_REQ
TRUE
4
Code_Network4 [description]
OR
FSOE_MSTR_ADDR_00001_PASS_OUT
FALSE
FSOE_MSTR_ADDR_00002_PASS_OUT
TRUE
FSOE_MSTR_ADDR_00003_PASS_OUT
FALSE
FSOE_MSTR_ADDR_00004_PASS_OUT
FALSE
FSoE_PASS_OUT
TRUE

15. To re-integrate, set *FSoE_ACK_REI* to *True* in the *'Watch window'*.

➡



Name	Value
● FSoE_ACK_REQ	TRUE
● FSoE_PASS_OUT	TRUE
● FSoE_PASS_ON	FALSE
● FSoE_ACK_REI	FALSE

16. As soon as the re-integration is successful, set *FSoE_ACK_REI* back to *False* in the *'Watch window'*.

5.14 Functional safety - safety relevant parameters

General

This chapter describes characteristics associated to functional safety. According to IEC 61508, safety initially means that the overall system has a residual error probability smaller than the limits specified in the standard. In relation to the overall application, internal safety-relevant device faults must be recognised and lead to a safe state.

Safety relevant parameters

The values specified here refer exclusively to the safety CPUs specified in this manual. Safety-relevant parameters can always be found in the corresponding manuals of the modules.

! NOTICE

After expiry of the device life time, the safety CPU must be decommissioned and returned to the vendor!

Parameters according to DIN EN ISO 13849-1	Value	Meaning
Performance level	max. e	Measure of the reliability of a safety function.
Category	max 4	Measure of resistance to errors.
PFH$_D$	1 * 10-9/h	Probability of Failure per Hour: Probability of dangerous error per hour.
DCavg	99%	Diagnostic Coverage average: Medium level of diagnostic coverage.
MTTF$_D$	> 80 years	Mean Time To dangerous Failure: Average time to a dangerous failure.

Parameters according to IEC 62061	Value	Meaning
SIL CL:	max 3	Safety Integrity Level Claim Limit Safety requirement level for classifying the functional safety of the subsystem.
PFH$_D$	1 * 10-9/h	Probability of Failure per Hour: Residual error rate of dangerous error per hour.
HFT	1	Hardware Fault Tolerance Number of faults that can result in a loss of the safety function.
Lifetime	300 month	Device lifetime No maintenance is required during the expected device lifetime.
SFF	99%	Safe Failure Fraction: Proportion of failures that result in the safety state.

Parameters according to IEC 61508	Value	Meaning
SIL	max 3	Safety Integrity Level Safety requirement level for the classification of functional safety.
PFH$_D$	1 * 10-9/h	Probability of Failure per Hour: Residual error rate of dangerous error per hour.
HFT	1	Hardware Fault Tolerance Number of faults that can result in a loss of the safety function.
Lifetime	300 month	Device lifetime No maintenance is required during the expected device lifetime.

5.15 System variables and status information

5.15.1 General

- This chapter describes system variables that are available for the CPU.
- The CPU has a register set that is used for diagnostics and simple control of the CPU.
- The diagnostic data are stored in the diagnostic status register and in the diagnostic parameter register. These registers are available to the application program as system variables (system flags, global variables).

Access to system variables and data structures

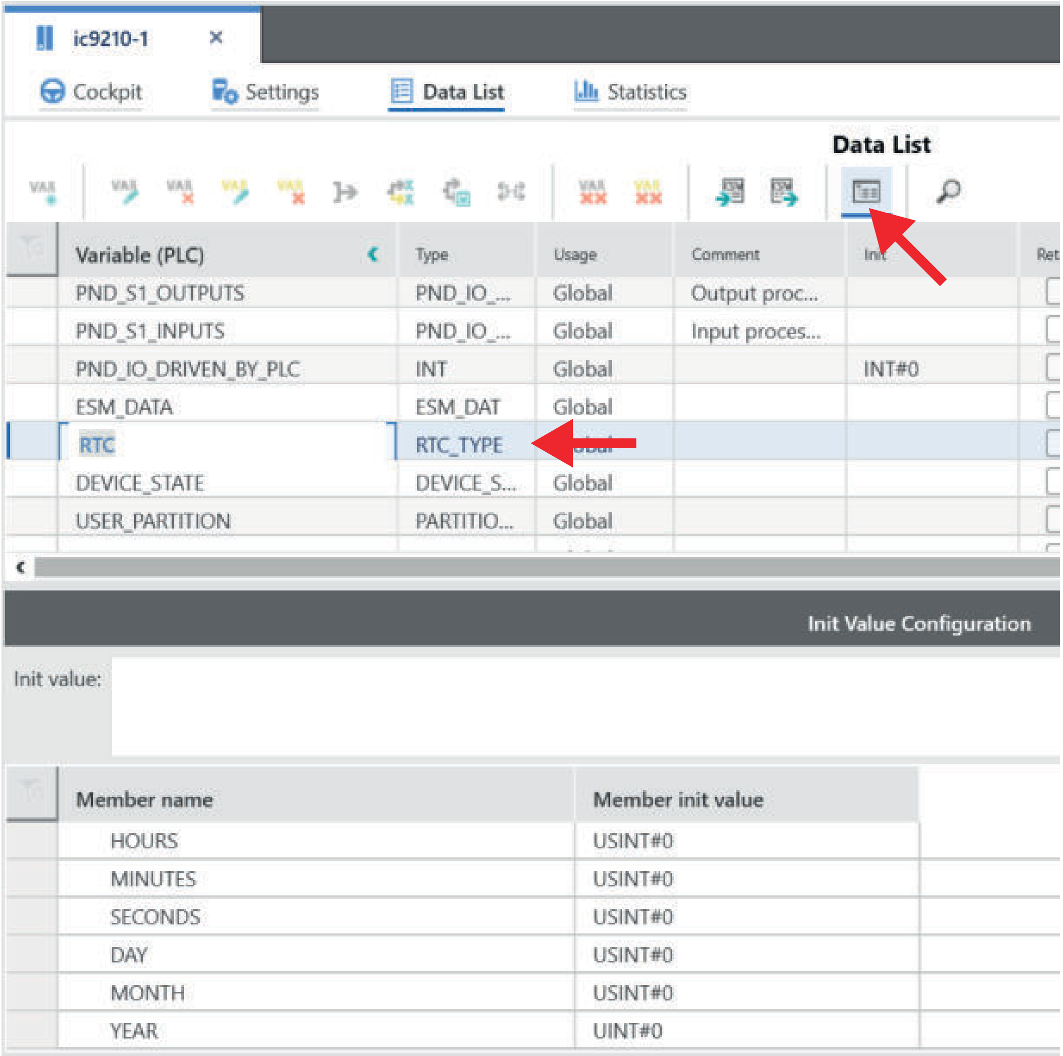
- Some system variables of the CPU are organized as data structures. The data structure of such a system variable contains further system variables.
- In the *'Init Value Configuration'* of iCube Engineer you can see which system variables belong in detail to a system variable organized as a data structure.

To open the *'Init Value Configuration'* for a system variable organized as a data structure, proceed as follows:

1. In the Plant area, double-click the SPS node.
   ➡ The CPU/SPS editor group opens.
2. Select the editor Data list.

   > *Alternatively, you can open the Data list editor in the area Plant via the CPU node.*

3. Open the System variables section.
4. Click on the arrow in the Variable (PLC) column to show the extended information.
   ➡ The data type of the system variable is shown in the extended information column Type.
5. Select the line of the system variable organized as a data structure whose associated system variables you want to see. To do this, click on the first column in the row of the system variable organized as a data structure.
6. Click the ▤ button.
   ➡ The *'Init Value Configuration'* of the selected system variable organized as a data structure is opened below the Data list editor.



Variable (PLC)	Type	Usage	Comment	Init	Ret
PND_S1_OUTPUTS	PND_IO_...	Global	Output proc...		□
PND_S1_INPUTS	PND_IO_...	Global	Input proces...		□
PND_IO_DRIVEN_BY_PLC	INT	Global		INT#0	□
ESM_DATA	ESM_DAT	Global			□
RTC	RTC_TYPE	Global			□
DEVICE_STATE	DEVICE_S...	Global			□
USER_PARTITION	PARTITIO...	Global			□

Init Value Configuration

Init value:

Member name	Member init value
HOURS	USINT#0
MINUTES	USINT#0
SECONDS	USINT#0
DAY	USINT#0
MONTH	USINT#0
YEAR	UINT#0

In *'Init Value Configuration'* column Element name lists all system variables which are contained in the system variable organized as a data structure.

5.15.2 System variables

System time

- The system variable RTC is a system variable organized as a data structure.
- You can use the RTC system variable to retrieve information about the system time of the device-internal real-time clock.

System variable		Type - description
RTC		RTC_TYPE - data structure
	HOURS	USINT - system time (hours)
	MINUTES	USINT - system time (minutes)
	SECONDS	USINT - system time (seconds)
	DAY	USINT - system time (day)
	MONTH	USINT - system time (month)
	YEAR	UINT - system time (year)

Function blocks TLS_SOCKET_2 UDP_SOCKET_2

- With the TLS_SOCKET_2 function block, you open and close IP sockets for IP communication via TCP (Transmission Control Protocol - not secure or TLS (Transport Layer Security - secure). You can control this with the START_TLS input parameter (FALSE: TCP, TRUE: TLS).
- Use the UDP_SOCKET_2 block to open and close IP sockets for IP communication via UDP (User Datagram Protocol).
- You can retrieve the number of open IP sockets using the following system variables:

System variable	Type - description
IP_ACTIVE_SOCKETS	UINT - Number of TCP/UDP sockets opened with the TLS_SOCKET_2 and UDP_SOCKET_2 function blocks.
TLS_ACTIVE_SOCKETS	UINT - Number of TLS sockets opened with the TLS_SOCKET function block.

Device state

- The system variable DEVICE_STATE is a system variable organized as a data structure.
- You can use the DEVICE_STATE system variable to retrieve various information about the device status of the CPU.

System variable			Type - description
DEVICE_STATE			DEVICE_STATE_X152_TYPE - data structure
	BOARD_TEMPERATURE		SINT - temperature inside the housing (in °C).
	reserved1		BOOL - reserved
	reserved2		USINT - reserved
	CPU_LOAD_ALL_CORES		USINT - average current utilization of all processor cores (in %).
	CPU_LOAD_PER_CORE		CPU_LOAD_PER_CORE_ARRAY - Information on the utilization of each processor core.
		[1]	USINT - current utilization of processor core 1 (in %).
		[2]	USINT - current utilization of processor core 2 (in %).

Partition

- The system variable USER_PARTITION is a system variable organized as a data structure.
- You can use the USER_PARTITION system variable to retrieve various information and memory statistics on the user partition (overlay file system).
- The partition can be on the external Yaskawa SD card or on the internal memory.
- The memory is organized in blocks.
- A block has a constant, fixed size and a file always uses one or more blocks.
- A certain number of blocks are reserved in the Linux system for the root user. These reserved blocks are only available for the root user and ensure his ability to act even if the memory is occupied (e.g. for log outputs).

System variable		Type - description
USER_PARTITION		PARTITION_INFO - data structure
	MEM_TOTAL	ULINT - total memory of the partition in bytes (including reserved blocks).
	MEM_FREE	ULINT - free, available memory in bytes (without reserved blocks).
	MEM_USED	ULINT - used memory in bytes (including reserved blocks).
	MEM_USAGE	ULINT - used memory in % (without reserved blocks).

Task handling

- In iCube Engineer programs and program parts are treated as tasks.
- The Execution & Synchronization Manager (ESM) is responsible for coordinating and processing the individual tasks.
- You can use the ESM_DATA system variable to retrieve information about the ESM's task handling.
- ESM_DATA is a system variable organized as a data structure.

System variable	Type - description
ESM_DATA	ESM_DAT - data structure
ESM_COUNT	USINT - number of ESM (one ESM per processor core).
ESM_INFOS	ESM_INFO_ARRAY
[1] ... [2]	ESM_INFO - Information about the ESM [1 ... 2][2].
TASK_COUNT	UINT - number of tasks that were configured for the ESM.
TICK_COUNT	UDINT - always 0.
TICK_INTERVAL	UDINT - always 0.
TASK_INFOS	TASK_INFO_ARRAY
[1] ... [16]	TASK_INFO - Information about the tasks [1 ... 16].
INTERVAL[1]	LINT - time interval ■ With cyclic tasks: Time interval in µs ■ With acyclic tasks: 0
PRIORITY[1]	INT - priority of the task
WATCHDOG[1]	LINT - watchdog time in µs (0 = no watchdog). ■ Watchdog time you define for the sum of the execution time and the delay time. ■ If the watchdog time is exceeded, the watchdog is triggered.
LAST_EXEC_DURATION	LINT - execution time of the task in the previous cycle in µs. ■ This also includes interruptions due to higher-priority tasks.
MIN_EXEC_DURATION	LINT - Minimum execution time of the task in µs. ■ This also includes interruptions due to higher-priority tasks.
MAX_EXEC_DURATION	LINT - Maximum execution time of the task in µs. ■ This also includes interruptions due to higher-priority tasks.
LAST_ACTIVATION_DELAY	LINT - delay time of the task in the previous cycle in µs. ■ A delay occurs when higher priority tasks are pending at the time of task activation.
MIN_ACTIVATION_DELAY	LINT - Minimum delay time of the task in µs. ■ A delay occurs when higher priority tasks are pending at the time of task activation.
MAX_ACTIVATION_DELAY	LINT - Maximum delay time of the task in µs. ■ A delay occurs when higher priority tasks are pending at the time of task activation.
EXEC_TIME_THRESHOLD[1]	LINT - threshold that you can define for the sum of the execution time and the delay time.
EXEC_TIME_THRESHOLD_CNT	UDINT - If the defined threshold EXEC_TIME_THRESHOLD is exceeded, the value of the variable EXEC_TIME_THRESHOLD_CNT is incremented.

System variable	Type - description
NAME[1]	STRING - name of the task.
EXCEPTION_COUNT	USINT - number of exceptions.
EXCEPTION_INFOS	ESM_EXCEPTION_INFO_ARRAY
[1] ... [2]	ESM_EXCEPTION_INFO - Information on the exceptions [1 ... 2][2].
TYPE_ID	UDINT - ID of the exception.
SUB_TYPE	STRING512 - exception type.
SUB_TYPE_ID	UDINT - ID of the task in which the exception occurred.
TASK_NAME	STRING - name of the task in which the exception occurred.
PROGRAM_NAME	STRING512 - name of the program instance in which the exception occurred.
INFORMATION	STRING512 - information about the exception that occurred.

1) You can set the system variable in the Tasks and events editor of the software iCube Engineer.

2) Please note that some CPUs only support ESM1. ➞ *'Technical data'...page 69*

SliceBus system variables

- *Please consider the System SLIO power and clamp modules do not have any module ID. These cannot be recognized and are therefore not taken into account when listing or assigning the slots.*
- *The counting of the slots starts at 1, i.e. the 1st slot corresponds to bit 0 in the corresponding diagnostic register.*
- *A diagnostic interrupt is not automatically acknowledged. The acknowledgement happens by reading the diagnosis. As long as a diagnostic interrupt is not acknowledged, no further diagnostic interrupt is issued at this slot.*

Diagnostic interrupt handling

- As soon as a module reports a diagnostic interrupt via the backplane bus, this is automatically recognized by the CPU and in *SB_DIAG_ALARM_STATUS* the register bit corresponding to the slot is set.
- The diagnostic interrupt must be enabled for the module in iCube Engineer.
- You can acknowledge a diagnostic message by reading record set 0x00 (diagnostics) or 0x01 (extended diagnostics) from the corresponding slot. Information concerning the structure of the diagnostic data may be found in the manual of the corresponding System SLIO module.
- In iCube Engineer you can use the *Y_SB_DataRecordRead* block from the system library to read the corresponding record set. To do this, you must first add the *'Y_SliceBus.pcwlx'* system library to your project.

System variable	Type - description
SB_DATA_VALID	BOOL - bus activity ■ This variable is set if data transfer via *SliceBus* is active.
SB_TOPOLOGY_OK	BOOL - bus topology ■ This variable is set when the plugged modules on the *SliceBus* match the configuration.
SB_DIAG_ALARM_STATUS	ULINT - diagnostic status of the modules ■ As soon as a module reports a diagnostic alarm on the *SliceBus*, according to the slot position the corresponding bit is set in the 64-bit register.

System variable	Type - description
SB_DIAG_ALARM_ACK_PENDING	ULINT - acknowledgement diagnostic status of the modules ■ As soon as a module on the *SliceBus* requests an acknowledgement of the diagnostic alarm, according to the slot position the corresponding bit is set in the 64-bit register.

EtherCAT system variables

The system variables for diagnostics of the EtherCAT master and the connected EtherCAT slaves are listed below.

System variable	Description
EC_MASTER_STATE	BYTE - master state ■ Returns the state of the EtherCAT master: – 00h: Unknown - the state is unknown. – 01h: INIT – 02h: PreOp – 04h: SafeOp – 08h: OP
EC_MASTER_LINK_CONNECTED	BOOL - physical connection ■ Set when an Ethernet cable is connected to the EtherCAT master.
EC_TOPOLOGY_OK	BOOL - topology OK ■ Set when current topology and configured topology match.
EC_DC_IN_SYNC	BOOL - distributed clocks ■ Set when the distributed clocks are synchronized.
EC_CYCLIC_LOST_FRAMES	DWORD - missing frames (cyclic) ■ Returns the number of frames lost during cyclic communication.
EC_ACYCLIC_LOST_FRAMES	DWORD - missing frames (acyclic) ■ Returns the number of frames lost during acyclic communication.
EC_NUM_CONFIGURED_SLAVES	WORD - configured number of slaves ■ Returns the number of configured EtherCAT slaves.
EC_NUM_AVAILABLE_SLAVES	WORD - number of slaves in the network ■ Returns the number of EtherCAT slaves found when searching the EtherCAT network.
EC_SLAVES_IN_MASTER_STATE	BOOL - EtherCAT slaves in master state ■ Set when all EtherCAT slaves on the EtherCAT master have the state of the EtherCAT master.
EC_SLAVE_STATION_ADDRESS	ARRAY[0…512] OF WORD[1)] - slave addresses ■ Returns all addresses of the EtherCAT slaves connected to the EtherCAT master.

System variable	Description
EC_SLAVE_STATE	ARRAY[0…512] OF BYTE[1] - slave states ■ Returns all states of the EtherCAT slaves connected to the EtherCAT master: – 00h: The state is unknown. – 01h: INIT – 02h: PreOp – 03: BootStrap – 04h: SafeOp – 08h: OP
EC_SLAVE_LAST_AL_STATUS_CODE	ARRAY[0…512] OF WORD[1] - Slave AL Status codes ■ Returns last read AL Status Codes of the EtherCAT slaves connected to the EtherCAT master.

1) Index 0 is reserved. The 1. EtherCAT slave is assigned to Index 1.

PROFINET system variables optional

> *Please note that a separate licence is required for the use of PROFINET, which must be activated accordingly!*

PROFINET system variables - PROFINET controller functionality

System variable	Type - description
PNIO_SYSTEM_BF	BOOL - Missing connection to a configured PROFINET device. ■ An error has occurred in the PROFINET network, i.e. no connection could be established to at least one configured PROFINET device. ■ This value is not set if the "Control BF" parameter on a PROFINET device was set to FALSE. The PROFINET device was thus removed from the connection monitoring.
PNIO_SYSTEM_SF	BOOL - Diagnostic interrupt on a configured PROFINET device. ■ At least one PROFINET device reports a system error as a diagnostic interrupt or maintenance alarm. ■ The error priority can be found in the variables PNIO_DIAG_AVAILABLE, PNIO_MAINTENANCE_DEMANDED and PNIO_MAINTENANCE_REQUIRED.
PNIO_MAINTENANCE_DEMANDED	BOOL - maintenance demand ■ At least one PROFINET device reports a "maintenance demand" - maintenance alarm with high priority when the connection is active. ■ The PROFINET device can be identified by means of the RALRM diagnostic block.
PNIO_MAINTENANCE_REQUIRED	BOOL - maintenance required ■ At least one PROFINET device reports a "maintenance required" - maintenance alarm with low priority when the connection is active. The PROFINET device can be identified by means of the RALRM diagnostic block.

System variable	Type - description
PNIO_FORCE_FAILSAFE	BOOL - All PROFINET devices are prompted to set their configured substitute values. ■ The system variable can be written/set from the program if required.
PNIO_CONFIG_STATUS	WORD - configuration status of the PROFINET controller.
PNIO_CONFIG_STATUS_READY	BOOL - PROFINET controller initialized. ■ This variable is set if the PROFINET controller could be initialized without errors. ■ No target iCube Engineer configuration has been loaded yet.
PNIO_CONFIG_STATUS_ACTIVE	BOOL - target configuration loaded. ■ This variable is set when a target configuration was uploaded to the PROFINET controller. ■ In this state, the PROFINET controller tries to establish a connection cyclically to all devices of the target configuration.
PNIO_CONFIG_STATUS_CFG_FAULT	BOOL - target configuration error. ■ The target configuration of the PROFINET controller was not accepted due to a serious error. ■ Please contact our support!
PNIO_FORCE_PRIMARY	BOOL - This variable is used by function blocks for applicative redundancy to specify the SRL role of the PROFINET controller.

PROFINET system variables - PROFINET device functionality

System variable	Type - description
PND_S1_PLC_RUN	BOOL - Status of the higher-level PROFINET controller. ■ Information whether the higher-level PROFINET controller is active. ■ The value is TRUE if the higher-level PROFINET controller is in RUN state and the program is being processed. ■ The indication is only valid with existing PROFINET connection (PND_S1_VALID_DATA_CYCLE).
PND_S1_VALID_DATA_CYCLE	BOOL - the higher-level PROFINET controller has established the connection. ■ Information whether a connection exists and cyclic data is exchanged between PROFINET controller and PROFINET device and the last received frame contained valid data.
PND_S1_OUTPUT_STATUS_GOOD	BOOL - IOP status of the higher-level PROFINET controller. ■ Information whether the PROFINET device has received the input process data (PND_S1_INPUTS) with the status "valid". ■ The value is TRUE if the output data of the higher-level PROFINET controller are valid (provider status).
PND_S1_INPUT_STATUS_GOOD	BOOL - IOC status of the higher-level PROFINET controller.
PND_S1_DATA_LENGTH	WORD - process data length which was configured for the PROFINET device.
PND_S1_OUTPUTS	PND_IO_512 - output process data ■ Memory area for output process data that the PROFINET device sends to the higher-level PROFINET controller.

System variable	Type - description
PND_S1_INPUTS	PND_IO_512 - input process data ■ Memory area for input process data that the PROFINET device receives from the higher-level PROFINET controller.
PND_IO_DRIVEN_BYPLC	INT - Applicative system redundancy ■ Number of the PROFINET controller currently connected to the PROFINET device. ■ Indication from which higher-level PROFINET controller the data in the PROFINET device come from. – 0: No PROFINET controller – 1: PROFINET controller A – 2: PROFINET controller B

5.15.3 System variables

System variable SPLC

- The system variable SPLC is a system variable organized as a data structure.
- The SPLC system variable provides the following information about the safety CPU using the SPNSV2_TYPE data structure.

System variable	Type - description
SPLC	SPNSV2_TYPE - Data structure
PRJ	
Name	STRING - Name of the iCube Engineer project.
CRC	DWORD - Project CRC (32-bit) of the safety CPU boot project.
EXEC_TIME	UDINT - Runtime of the safety CPU programme cycle in µs.
HAS_PRJ	BOOL - Set if safety-related application program and program sources exist in the memory of the safety CPU.
DIAG	
STATUS_REG	WORD - Diagnostic status register of the safety CPU. ■ Contains the status information of the safety CPU. It reflects the status of the safety CPU including any error states of the safety CPU that may have occurred at any time. ■ Additional information and error parameters, especially in the fail safe, are contained in the associated diagnostic parameter registers of the safety CPU (elements SPNS.DIAG.PARAM_REG and SPNS.DIAG.PARAM_2_REG). ➦ *'Diagnostic status register SPLC.DIAG.STATUS_REG.xxx'...page 168*
PARAM_REG	WORD - Diagnostic parameter register 1 of the safety CPU (error code).
PARAM_2_REG	WORD - Diagnostic parameter register 2 of the safety CPU (additional error messages for service/support).
EXT_PARAM_REG	DWORD - Extended diagnostic parameter register of the safety CPU (additional error messages for service/support).
CH2_PARAM_REG	WORD - Diagnostic parameter register 1 of the safety CPU channel 2 (CH2) (error code).
CH2_PARAM_2_REG	WORD - Diagnostic parameter register 2 of the safety CPU channel 2 (CH2) (additional error messages for service/support).

System variable				Type - description
		CH2_EXT_PARAM_REG		DWORD - Extended diagnostic parameter register of the safety CPU channel 2 (CH2) (additional error messages for service/support).
	INFO			
		CYCLE_TIME		UDINT - Safety CPU cycle in µs.
		TEMP		
			TEMP_CURRENT	INT - Current measured temperature of the safety CPU.
			TEMP_MIN	INT - Minimum measured temperature of the safety CPU since the last PowerON of the device.
			TEMP_MAX	INT - Maximum measured temperature of the safety CPU since the last PowerON of the device.
			STATUS_REG	WORD - Safety CPU temperature status register. ■ 0x0000: TThe temperature of the safety CPU is in uncritical range. ■ 0x0080: The temperature of the safety CPU is close to the tolerance limit in the critical range. The CPU remains in the RUN state and returns a warning with the error code 0xFA41. ■ 0x8000: The temperature of the safety CPU is exceeding the permissible range. The safety CPU switches to the safety state and returns an error with the error code 0x924D.
		CPU		
			LOAD_CURRENT	INT - Current CPU load of the safety CPU.
			LOAD_MIN	INT - Minimum CPU load of the safety CPU since the last PowerON of the device.
			LOAD_MAX	INT - Maximum CPU load of the safety CPU since the last PowerON of the device.
			STATUS_REG	WORD - CPU status register of the safety CPU.
		FW_VERSION		
			VERSION_MAJOR	BYTE - Main version of the safety CPU firmware (major version).
			VERSION_MINOR	BYTE - Side version of the safety CPU firmware (minor version).
			VERSION_BUILD	WORD - Build number of the safety CPU firmware.
		FPGA_VERSION		
			VERSION_MAJOR	BYTE - Major version of the Safety CPU hardware FPGA (major version).
			VERSION_MINOR	BYTE - Side version of the safety CPU hardware FPGA (minor version).
			VERSION_BUILD	WORD - Build number of the safety CPU hardware FPGA.
		FW_UPDATE_STATUS		UINT - Status of the safety firmware update.
	SOFT_RESET_REG			WORD - Software reset register of the safety CPU.

NOTICE

The warning threshold for CPU load is 70%, the switch-off threshold is 90%. If the 90% CPU load is exceeded, the safety CPU switches off.

Diagnostic status register SPLC.DIAG.STATUS_REG.xxx

- The following table describes the information of the bits (0 ... 15) in the diagnostic status register (SPLC.DIAG.STATUS_REG.xxx).

System variable/elements	Type - description
SPLC	SPNSV2_TYPE - Data structure
DIAG	
STATUS_REG	
DBG[2]	BOOL - Non-safe debug operation of the safety CPU. ■ The safety CPU is in one of the two DEBUG states (DEBUG-RUN or DEBUG-STOP/DEBUG-HALT).
EST	BOOL - There is an entry in the error memory of the safe operating system (error stack) of the safety CPU. Diagnostic and error messages from the safe operating system of the safety CPU are available. ■ These messages can be read and analyzed via iCube Engineer. ■ The variable always has the value TRUE if at least one entry is contained in the error memory of the safety operating system. ■ As soon as the error memory was read via iCube Engineer and thus cleared, the value of the variable changes to FALSE.
FS	BOOL - Failure state of the safety CPU. ■ An error was detected that puts the safety CPU in fail safe state. ➦ *'Fail safe states'...page 130* ■ In this state, the associated, more detailed error code is contained in the diagnostic parameter registers of the safety CPU (SPLC.DIAG.PARAM_REG and SPLC.DIAG.PARAM_2_REG).
INIT[1]	BOOL - Initialization of the safety CPU. ■ The initialization of the safety CPU firmware (safe operating system) was completed without errors.
IO[1]	BOOL - Initialization of the safety I/O channel communication. ■ The initialization of the FSoE communication to the I/O devices was completed without errors.
PON[1]	BOOL - PowerON process. ■ The safety CPU is powered. The firmware was loaded into the RAM memory of the safety CPU and booted up. The self-test routines of the safety CPU were completed without errors.
POST	BOOL - PowerON self-test of the safety CPU (POWER ON SELF TEST). ■ Self-test of the safety CPU active after PowerON.
PRO[1]	BOOL - Load and start the safety application program. ■ The safety-related application programme created with iCube Engineer was loaded into the safety operating system of the safety CPU and started without errors.

System variable/elements				Type - description
			RUN[2]	BOOL - Execution of the safety application program (RUN). ■ The safety CPU executes the safety application program and is in one of the two RUN states (SAFE-RUN or DEBUG-RUN).
			SYN[1]	BOOL - Synchronization of safety and standard components within the safety CPU. ■ The synchronization of the safety and standard components within the safety CPU was successfully completed.
			WARN	BOOL - Safety CPU warning. ■ There is a collective warning message from the safety CPU.

- 1) The variables reflect the startup status of the safety CPU. The start-up sequence is as follows:
  - PowerON process
  - Initialization of the safety CPU.
  - Loading and starting the safety application program.
  - Synchronization of safety and standard components within the safety CPU.
  - Initialization of safety I/O channel communication.
- 2) The variables indicate the RUN and DEBUG safety CPU operating states.

Meaning of the bits

The diagnostic status register SPLC.DIAG.STATUS_REG contains the status information of the safety CPU. It reflects the status of the safety CPU including any error states of the safety CPU that may have occurred at any time. Additional information and error parameters, especially in the fail safe (FS) state, are contained in the associated diagnostic parameter registers of the safety CPU (SPLC.DIAG.PARAM_REG and SPLC.DIAG.PARAM_2_REG) and in the extended diagnostic parameter register (SPLC.DIAG.EXT_PARAM_REG).

Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
FS	POST	res.	EST	res.	res.	res.	res.	WARN	DBG	RUN	I/O	SYN	PRO	INIT	PON

- Bit 4 ... 0: Start-up status of the safety CPU.
  - PON - Power ON process completed.
    This bit is set as soon as the safety CPU is powered. The firmware was loaded into the RAM memory of the safety CPU and booted up. The self-test routines of the safety CPU were successfully completed.
  - INIT - Initialization of the safety CPU completed.
    This bit is set as soon as the initialization of the safety CPU firmware (safe operating system) was completed without errors.
  - PRO - Safety user program loaded and started.
    This bit is set as soon as the safety user program, which was created with iCube Engineer, was loaded into the safety operating system of the safety CPU and started without errors.
  - SYN - Synchronization of safety and standard components of the safety CPU.
    The bit is set when the safety and standard components of the safety CPU are synchronized.
  - I/O - I/O channel communication initialized.
    This bit is set as soon as the initialization of the safety CPU firmware (safety operating system) was completed without errors.
- Bit 6, 5: Operating status of the safety CPU:
  - RUN - RUN operation of the safety CPU.
    This bit is set if the safety CPU is executing the safety user program and is in one of the two RUN states (SAFE-RUN or DEBUG-RUN).
  - DBG - Non-safe debug operation of the safety CPU.

  This bit is set if the safety CPU is in one of the two DEBUG states (DEBUG-RUN or DEBUG-STOP/DEBUG-HALT). This bit is not set in the SAFE-STOP and SAFE-RUN states.

- Bit 7: Warning
  - WARN - The set WARN bit (WARNING) indicates a collective warning message from the safety CPU.
- Bit 11 ... 8: reserved
- Bit 12: Error stack
  - EST - The EST (error stack) bit indicates that diagnostic and error messages are present from the safety operating system of the safety CPU.

    This bit is set if there is at least one entry in the error memory of the safety operating system. These messages can be read and analyzed via iCube Engineer. As soon as the error memory was read via iCube Engineer and thus cleared, this bit is automatically reset.
- Bit 13: reserved
- Bit 14: POST
  - POST - POWER ON SELF TEST

    This bit is set for the duration of the Power-ON-SelbstTest of the safety CPU. After the self-test is completed, it is reset.
- Bit 15: Fail safe state
  - FS - Failure State

    This bit is set as soon as an error is detected that sets the Safety CPU to the *Fail Safe* state. ➦ *'Fail safe states'...page 130* In this state, the corresponding further error code is contained in the diagnostic parameter registers of the safety CPU (SPLC.DIAG.PARAM_REG and SPLC.DIAG.PARAM_2_REG).

System variables SPLC_CONTROL_COMMAND and SPLC_CONTROL_CONFIRM

- The system variable SPLC_CONTROL_COMMAND is used to request the resetting of diagnostic values from the non-safety project.
- Via the system variable SPLC_CONTROL_CONFIRM, the safety CPU confirms in the non-safety project that the diagnostic values were reset.

SPLC_CONTROL_COMMAND

System variable	Type - description
SPLC_CONTROL_COMMAND	SPLC_CONTROL _TYPE - Data structure with 32 bits for enabling functions of the safety CPU.
CODE	■ DWORD - Bit 0: Request resetting of the minimum and maximum safety round trip times (SRT_MIN, SRT_MAX). – Data direction within the Safety CPU: Standard component → Safety component
PARAM	■ DWORD - Bit 31 ... 1: Reserved

SPLC_CONTROL_CONFIRM

System variable	Type - description
SPLC_CONTROL_CONFIRM	SPLC_CONTROL _TYPE - Data structure with 32 bits for confirming functions of the safety CPU that were requested via the variable SPLC_CONTROL_COMMAND.
CODE	■ DWORD - Bit 0: Confirmation resetting the minimum and maximum safety round trip times (SRT_MIN, SRT_MAX). – Data direction within the Safety CPU: Safety component → Standard component
PARAM	■ DWORD - Bit 31 ... 1: Reserved

System variables FDEV_INx and FDEV_OUTx (x = 0 ... 7)

These system variables are used for data exchange between the standard and safety components of the safety CPU.

- The system variables FDEV_IN0 to FDEV_IN7 contain the input process data (8 * 1 byte) of the safety component of the safety CPU.
- The system variables FDEV_OUT0 to FDEV_OUT7 contain the output process data (8 * 1 byte) of the safety component of the safety CPU.

Data direction

- FDEV_INx = I
- FDEV_OUTx = Q

FDEV_INx and FDEV_OUTx (x = 0 ... 7)

System variable	Type - description
FDEV_IN0 ... FDEV_IN7	SAFEBYTE - Input process data of the safety component of the safety CPU.
FDEV_OUT0 ... FDEV_OUT7	SAFEBYTE - Output process data of the safety component of the safety CPU.

5.15.4 FSoE diagnostic variables

General

Status information is forwarded to the SafeOS Diag IN (DI) area for each FSoE master connection. The FSoE master connection can be controlled by the SafeOS Diag OUT (DQ) area. There are connection-specific diagnostic variables for each FSoE connection and global diagnostic variables. The following table lists the connection-specific diagnostic variables for each FSoE connection. The xxxxx placeholder represents the respective configured FSoE address.

FSoE connection-specific diagnostic variables

Variable name	Data direction
FSOE_MSTR_ADDR_xxxxx_ACK_REQ	DI
Acknowledge request ■ 1: Variable is set to 1 if a previously occured FSoE communication error was resolved and can be acknowledged. This is recognized by an edge change in `SAPL_DataValidChangedClbk()` from *FailSafeData* to *ProcessData*. As long as variable = 1, – fail safe values are forwarded to the SafeOS process image inputs for this communication instance. This also applies if the communication instance has already returned process data (signalled by `SAPL_DataValidChangedClbk()` *ProcessData*). – the outgoing PDU for the communication instance is set via `SSD_IoDataCmdSet()` to fail safe status. ■ 0: Variable is set to 0 if the acknowledge request is confirmed by FSOE_MSTR_ADDR_xxxx_ACK_REI = 1. As long as variable = 0, – the SafeData(*FailSafeData* on *ProcessData*) for this communication instance are directly forwarded to the SafeOS process image inputs.	
FSOE_MSTR_ADDR_xxxxx_ACK_REI	DQ
Acknowledge reintegration ■ 1: The variable FSOE_MSTR_ADDR_xxxx_ACK_REQ is set to 0. ■ 0: There ist no action.	
FSOE_MSTR_ADDR_xxxxx_PASS_OUT	DI
Passivation enabled on input side: The connected FSoE slave sends fail safe on this FSoE connection ■ 1: The variable is set to 1 if `SAPL_DataValidChangedClbk()` returns *FailSafeData*. ■ 0: Variable is set to 0 if `SAPL_DataValidChangedClbk()` returns *ProcessData*.	
FSOE_MSTR_ADDR_xxxxx_PASS_ON	DQ

Variable name	Data direction
Passivation enabled on output side: The FSoE master sends fail safe on this FSoE connection. ■ 1: If the variable = 1, the output message of this communication instance is set to *FailSafeData*. In addition, FSOE_MSTR_ADDR_xxxx_PASS_OUT = 1 is set (input data to fail safe). ■ 0: If the variable = 0, the output message of this communication instance *ProcessData* is set.	

> ⚠ WARNING
>
> **Resetting FSOE_MSTR_ADDR_xxxxx_PASS_ON**
>
> Resetting this variable results in the immediate transfer of the safety input and output data. Take appropriate measures to ensure that there is no danger to your plant/machine when the passivation of the F device is deactivated.

Variable name	Data direction
FSOE_MSTR_ADDR_xxxxx_CE_CRC	DI
CRC error on input side: The FSoE master detected a CRC error in the incoming FSoE PDU. ■ 1: Variable is set to 1 if `SAPL_FsoeErrorClbk()` returns the following error: FSOE_k_COMM_ERR_INV_CRC ■ 0: Variable is set to 0 if – `SAPL_DataValidChangedClbk()` returns *ProcessData*. – `SAPL_FsoeStateChangedClbk()` signals that the *data state* was left.	
FSOE_MSTR_ADDR_xxxxx_WD_TIMEOUT	DI
Watchdog timeout on input side: The FSoE master has a watchdog timeout for the incoming FSoE PDU. ■ 1: Variable is set to 1 if `SAPL_FsoeErrorClbk()` returns the following error: FSOE_k_COMM_ERR_WD_EXPIRED. ■ Variable is set to 0 if – `SAPL_DataValidChangedClbk()` returns *ProcessData*. – `SAPL_FsoeStateChangedClbk()` signals that the *data state* was left.	
FSOE_MSTR_ADDR_xxxxx_COMM	DI
Any other recoverable FSoE communication errors: ■ 1: Variable is set to 1 if `SAPL_FsoeErrorClbk()` returns the following error: – FSOE_K_COMM_ERR_LOCAL_RESET_OR_ACK – FSOE_K_COMM_ERR_INV_CMD – FSOE_K_COMM_ERR_UNK_CMD – FSOE_K_COMM_ERR_INV_CONNID – FSOE_K_COMM_ERR_INV_ADDRESS – FSOE_K_COMM_ERR_INV_DATA – FSOE_K_COMM_ERR_INV_COMMPARALEN – FSOE_K_COMM_ERR_INV_COMPARA – FSOE_K_COMM_ERR_INV_USRPARALEN – FSOE_K_COMM_ERR_INV_USRPARA – FSOE_K_COMM_ERR_INV_SAFEPARA_START ■ 0: Variable is set to 0 if – `SAPL_DataValidChangedClbk()` returns *ProcessData*. – `SAPL_FsoeStateChangedClbk()` signals that the *data state* was left.	

Global diagnostic variables

<table>
<tr><th>Variable name</th><th>Data direction</th></tr>
<tr><td>ACK_REQ_FSOE_MSTR_GLOBAL</td><td>DI</td></tr>
<tr><td colspan="2">Acknowledge request At least one FSoE connection waits for an operator acknowledge request, e.g. after a change from fail-safe to process data communication.
■ Global equivalent to FSOE_MSTR_ADDR_xxxx_ACK_REQ.
■ At least one communication instance behaves as described in FSOE_MSTR_ADDR_xxxx_ACK_REQ.</td></tr>
<tr><td>ACK_REI_FSOE_MSTR_GLOBAL</td><td>DQ</td></tr>
<tr><td colspan="2">Acknowledge reintegration All previous ACK_REQs for this FSoE connection are acknowledged.
■ Global equivalent to FSOE_MSTR_ADDR_xxxx_ACK_REI.
■ Set all communication instances as described in FSOE_MSTR_ADDR_xxxx_ACK_REI.
■ If a specific ACK_REI is set, the global ACK_REI must not be enabled.</td></tr>
<tr><td>PASS_OUT_FSOE_MSTR_GLOBAL</td><td>DI</td></tr>
<tr><td colspan="2">Passivation enabled on input side: At least one FSoE connection sends fail-safe.
■ Global equivalent to FSOE_MSTR_ADDR_xxxx_PASS_OUT.
■ At least one communication instance behaves as described in FSOE_MSTR_ADDR_xxxx_PASS_OUT.</td></tr>
<tr><td>CE_CRC_FSOE_MSTR_GLOBAL</td><td>DI</td></tr>
<tr><td colspan="2">CRC error on input side: At least one FSoE connection has recognized a CRC error in the incoming FSoE PDU.
■ Global equivalent to FSOE_MSTR_ADDR_xxxx_CE_CRC.
■ At least one communication instance behaves as described in FSOE_MSTR_ADDR_xxxx_CE_CRC.</td></tr>
<tr><td>WD_TIMEOUT_FSOE_MSTR_GLOBAL</td><td>DI</td></tr>
<tr><td colspan="2">Watchdog timeout on input side: At least one FSoE connection has a watchdog timeout.
■ Global equivalent to FSOE_MSTR_ADDR_xxxx_WD_TIMEOUT.
■ At least one communication instance behaves as described in FSOE_MSTR_ADDR_xxxx_WD_TIMEOUT.</td></tr>
<tr><td>COMM_FSOE_MATR_GLOBAL</td><td>DI</td></tr>
<tr><td colspan="2">■ Global equivalent to FSOE_MSTR_ADDR_xxxx_COMM.
■ At least one communication instance behaves as described in FSOE_MSTR_ADDR_xxxx_COMM.</td></tr>
</table>

6 Web-based management - WBM

6.1 Overview and first steps

Accessing WBM

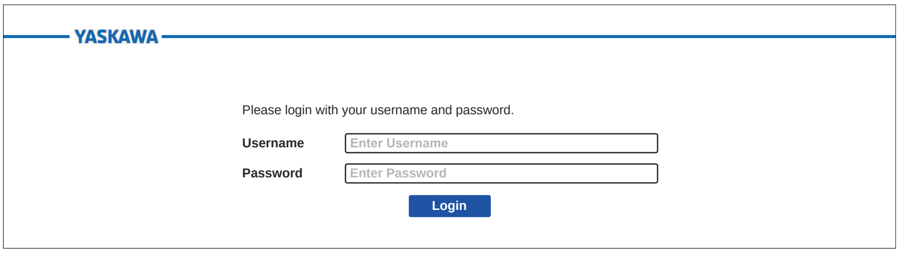
- The CPU has a web-based management (WBM). In the *WBM* you can access static and dynamic information and change certain settings. You may access *WBM* via the Ethernet interfaces of the CPU.
- The communication between the PC and CPU takes place via a security certificate, which must be located on the CPU and PC.
- You may only access WBM if the CPU has a valid IP address.
- In the delivery state, the CPU has the IP address 192.168.1.1 via Ethernet port (X3/ X4).

1. For the initial commissioning, establish a secure connection between the PC and CPU, such as a point-to-point connection via Ethernet.
2. Open the web browser on your PC.
3. You can use the iCube Engineer search to determine the IP address of the corresponding Ethernet interface.

   Enter the URL in the address field such as https://192.168.1.1

   ➡ For secure communication the CPU web server uses a self-signed TLS certificate that is automatically generated by the CPU during the commissioning. Due to the system, you will receive a security message regarding the certificate, as it has not yet been installed on the PC. After logging in, you can install the corresponding certificate from the CPU as a trusted certificate on your PC (see below). This authenticates the CPU to the web browser on the PC.
4. Take note of the security message and only continue if there is a secure connection between the PC and CPU and no third parties can access it!

   ➡ The WBM login page opens.



Please login with your username and password.

Username Enter Username

Password Enter Password

5. Enter your login details and click on [Login].

> ***On delivery, the following access data are preset with administrator rights:***
>
> – *Username: admin*
>
> – *The password is printed under the front flap on the front of the CPU.*

➡ You now have access to the WBM of the CPU with the access rights assigned to you.

Install certificate

> ***First access via TLS certificate***
>
> – *During commissioning, the CPU generates a TLS certificate during the start-up.*
>
> – *The certificate is used for all Ethernet interfaces of the CPU and includes all IP addresses.*
>
> – *When resetting to factory settings, a new certificate is automatically generated.*

To secure communication, the same security certificate must be installed in the PC and CPU. You transfer the certificate generated by the CPU to your PC with the following proceeding:

1. After logging into the WBM, you can view or respectively adjust the contents of the automatically generated certificate via *'Configuration → Web Services'* and re-generate it with [Re-generate HTTPS certificate] . ➦ *'Web Services'...page 188*

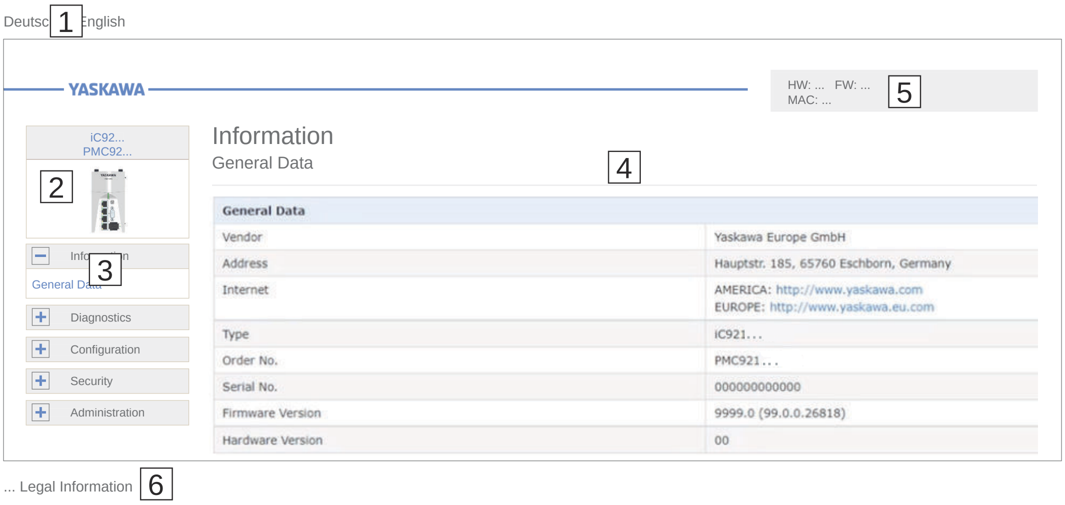
   > – *As soon as you change one of the IP addresses of the CPU, you must regenerate the certificate via [Re-generate HTTPS certificate].*

2. Navigate to the certificates via *'Security → Certificate Authentication'*.
3. Switch to the tab Identity Store.
   ➡ Here you have access to the generated certificate.
4. Load the requested HTTPS certificate onto your PC with ⬇. Here you can also transfer your own existing HTTPS certificate to the CPU. ➦ *'Certificate Authentication'...page 190*
5. Install the certificate according to your Windows system as a trusted root certification authority.
   ➡ After installation, communication between the PC and CPU takes place as a *'secure connection'*.

> **CAUTION**
>
> If the communication between PC and CPU is declared as an *'insecure connection'* during operation, either the certificate has changed, e.g. due to an IP address change, or your system has been compromised by third parties! Always make sure that either the current certificate of the CPU or, if available, an associated higher-level certificate is installed on the PC!

Structural design

The WBM is divided into the following areas:



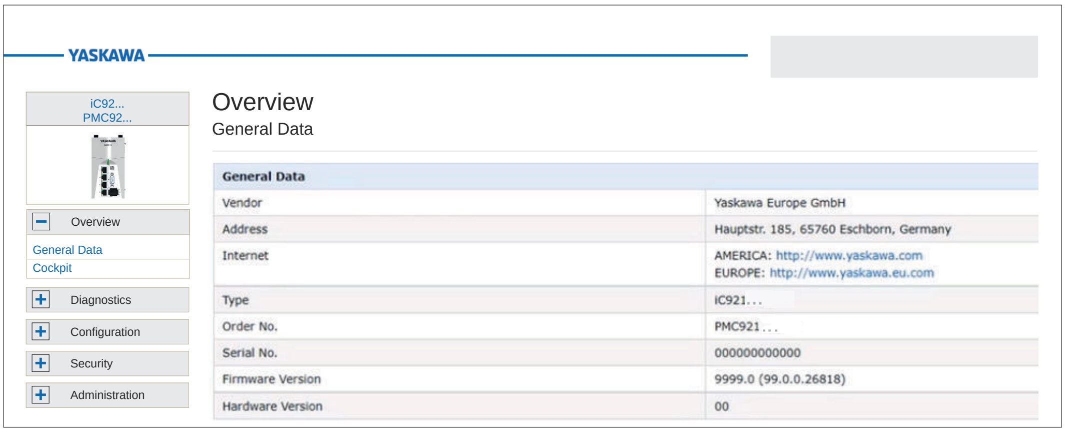
General Data	
Vendor	Yaskawa Europe GmbH
Address	Hauptstr. 185, 65760 Eschborn, Germany
Internet	AMERICA: http://www.yaskawa.com EUROPE: http://www.yaskawa.eu.com
Type	iC921...
Order No.	PMC921...
Serial No.	000000000000
Firmware Version	9999.0 (99.0.0.26818)
Hardware Version	00

1 Language switching between *'German'* and *'English'*.
2 Front view of the CPU with type and order designation.
3 Menu column for navigation.
4 Area for information output and input dialogs
5 Shows the current hardware/firmware version and MAC address of the CPU.
6 Access to the Yaskawa software license conditions (Software License Terms - SLT) and the license information for the individual Linux packages.

6.2 Overview

6.2.1 General Data

Here you will find general details about the CPU, e.g. hardware and firmware versions, order number as well as vendor information.

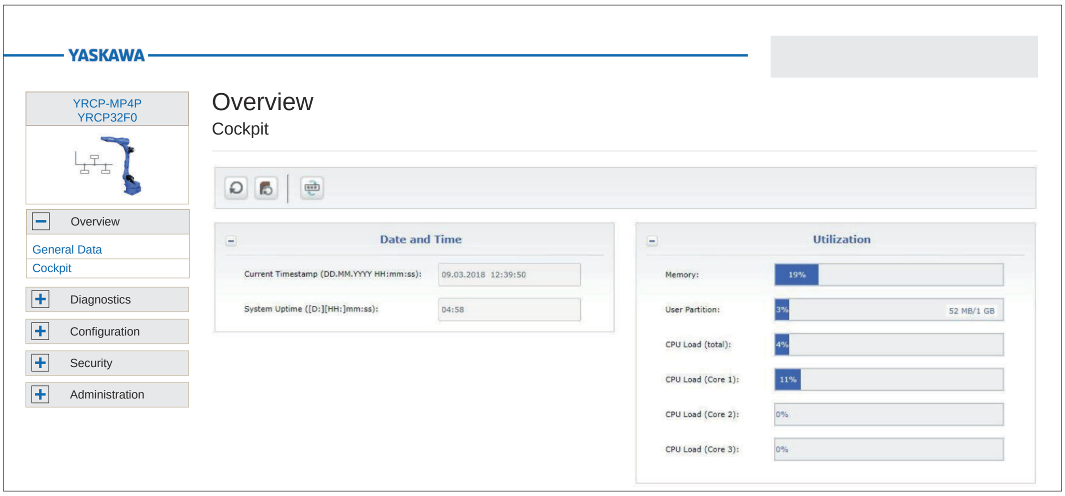


Overview
General Data

General Data	
Vendor	Yaskawa Europe GmbH
Address	Hauptstr. 185, 65760 Eschborn, Germany
Internet	AMERICA: http://www.yaskawa.com EUROPE: http://www.yaskawa.eu.com
Type	iC921...
Order No.	PMC921...
Serial No.	000000000000
Firmware Version	9999.0 (99.0.0.26818)
Hardware Version	00

6.2.2 Cockpit

Here you will find the Cockpit toolbar and information about the time, status and utilization of the CPU.



Overview
Cockpit

Date and Time

Current Timestamp (DD.MM.YYYY HH:mm:ss): 09.03.2018 12:39:50

System Uptime ([D:][HH:]mm:ss): 04:58

Utilization

Memory: 19%

User Partition: 3% 52 MB/1 GB

CPU Load (total): 4%

CPU Load (Core 1): 11%

CPU Load (Core 2): 0%

CPU Load (Core 3): 0%

Cockpit toolbar

The toolbar provides access to the following functions:

- ■: Stop - Stops program execution on the CPU.
- ▸🌡: Hot Start - Performs a hot start. The CPU is restarted and the program continues without initializing the variables.
- ▸🌡: Warm Boot - Performs a warm boot. The CPU is restarted and the program continues with initializing the variables. The values of the variables marked with “Retain” in iCube Engineer are retained.
- ▸🌡Cold Start - Performs a cold start. CPU is restarted and the program continues with initializing all the variables.
- 🖫: Memory download - Saves the retain data locally in a file.
- 🖫: Memory upload - Restores the saved retain data.
- ↻: Reboot - Performs a reboot. The operation corresponds to a power off/on process. The loaded application (code and network configuration) is deleted from the RAM. The controller restarts with the last saved settings and, if available, loads the boot project from the flash memory.

- : Reset - Resets the CPU to factory settings. Similar to the *'Restart'* command, the loaded application (code and network configuration) is deleted from the RAM but also from the flash memory (boot project). Additionally, all communication settings are reset to default settings.
- : Change Password - This allows you to change the password of the current user account for online access to the CPU.

Date and time

The current system time is shown via Current time stamp. System uptime shows the current runtime since PowerON. Date and time are set via ➦ *'Date and Time'...page 186*.

Utilization

CPU memory utilization and the CPU load are shown here.

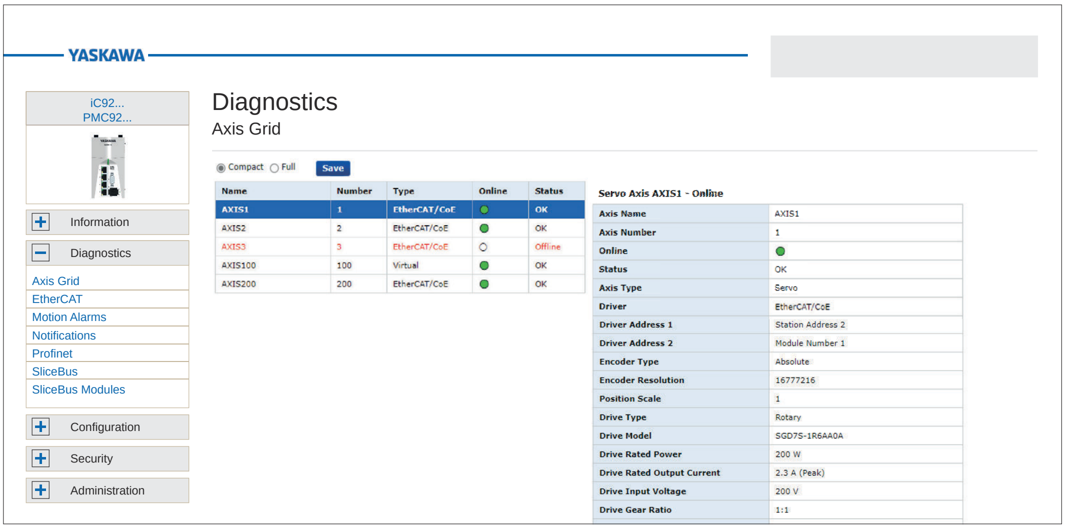
PLC runtime

The CPU status and memory usage in the PLC runtime system are shown here.

6.3 Diagnostics

6.3.1 Axis Grid

Here you will find basic information about configuring your axes such as servo drives.



Diagnostics

Axis Grid

● Compact ○ Full Save

Name	Number	Type	Online	Status
AXIS1	1	EtherCAT/CoE	●	OK
AXIS2	2	EtherCAT/CoE	●	OK
AXIS3	3	EtherCAT/CoE	○	Offline
AXIS100	100	Virtual	●	OK
AXIS200	200	EtherCAT/CoE	●	OK

Servo Axis AXIS1 - Online

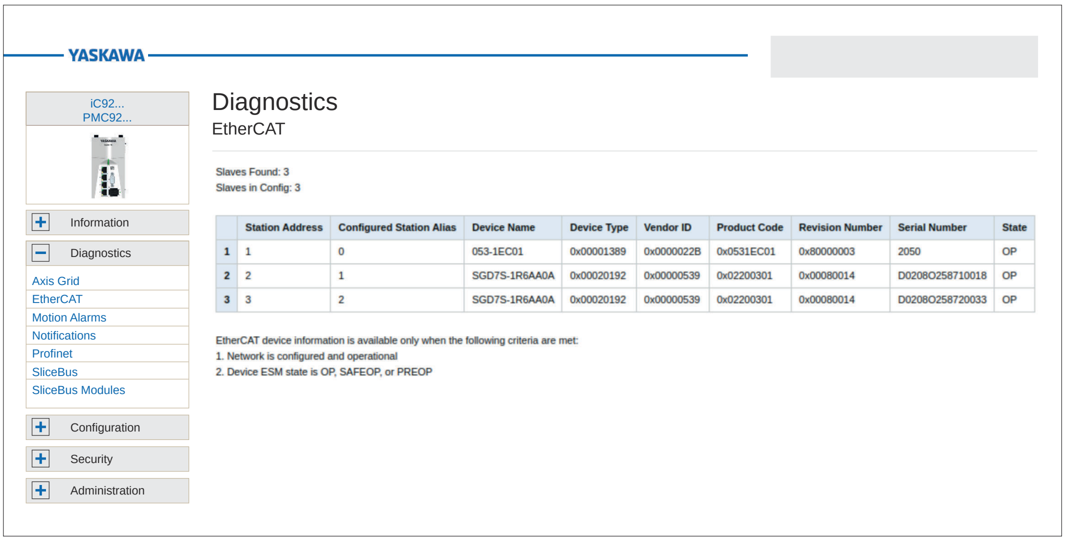
Axis Name	AXIS1
Axis Number	1
Online	●
Status	OK
Axis Type	Servo
Driver	EtherCAT/CoE
Driver Address 1	Station Address 2
Driver Address 2	Module Number 1
Encoder Type	Absolute
Encoder Resolution	16777216
Position Scale	1
Drive Type	Rotary
Drive Model	SGD7S-1R6AA0A
Drive Rated Power	200 W
Drive Rated Output Current	2.3 A (Peak)
Drive Input Voltage	200 V
Drive Gear Ratio	1:1

You have the following display options:

- Compact
  - All axes configured in the CPU and their states are listed here in a compact table.
  - By selecting an axis, you will receive all information about the corresponding axis in the table next to it.
- Full
  - All axes configured in the CPU are listed here with all information in a table.
  - By selecting EtherCAT/CoE or Virtual, you can limit the list to axes connected via FSoE or virtual axes.
- WithSave] you can save the axis information as a CSV file on your PC.

6.3.2 EtherCAT

Here you will find basic information about the EtherCAT slave stations that are connected via the EtherCAT network. Information is only shown here if the EtherCAT network is correctly configured and the EtherCAT slave stations are in the *OP*, *PreOP* or *SafeOP* state. Otherwise you will receive the message *'Invalid network configuration or network not ready for operation'*.



Diagnostics
EtherCAT

Slaves Found: 3
Slaves in Config: 3

	Station Address	Configured Station Alias	Device Name	Device Type	Vendor ID	Product Code	Revision Number	Serial Number	State
1	1	0	053-1EC01	0x00001389	0x0000022B	0x0531EC01	0x80000003	2050	OP
2	2	1	SGD7S-1R6AA0A	0x00020192	0x00000539	0x02200301	0x00080014	D0208O258710018	OP
3	3	2	SGD7S-1R6AA0A	0x00020192	0x00000539	0x02200301	0x00080014	D0208O258720033	OP

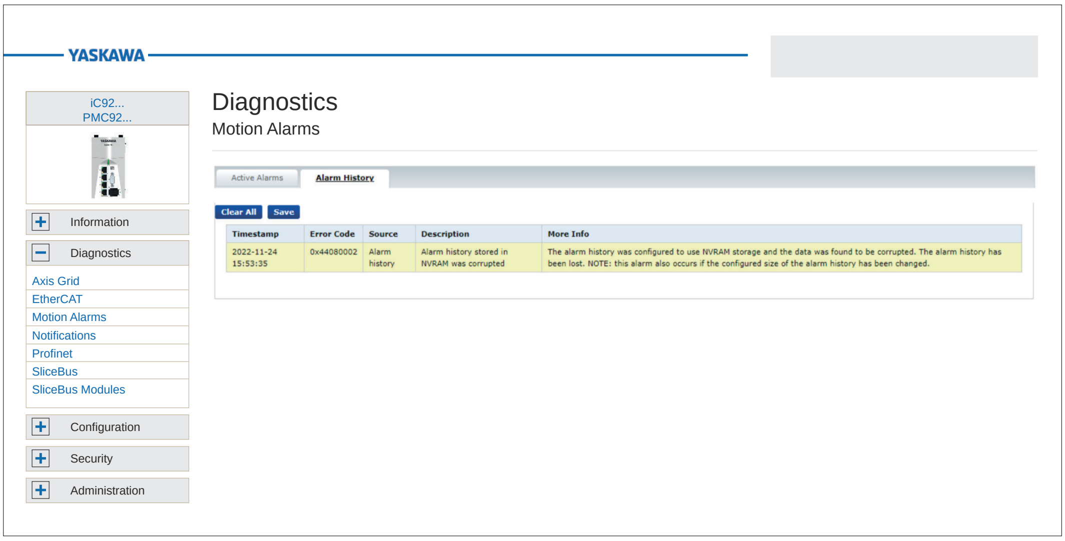
EtherCAT device information is available only when the following criteria are met:
1. Network is configured and operational
2. Device ESM state is OP, SAFEOP, or PREOP

The following information is shown in tabular form:

- Station address and Station alias
- Station name, type and vendor
- Product code, revision number and serial number
- *'State'*: ESM status of the corresponding EtherCAT slave station:
  - OP
    The EtherCAT slave station is in the *Operational* state and exchanges process data cyclically.
  - PreOp
    The EtherCAT slave station is in the *Pre-Operational* state. Process data are not exchanged.
  - SafeOp
    The EtherCAT slave station is in the *Safe-Operational* state. In this case, the input process data are refreshed cyclically but the outputs are disabled.

6.3.3 Motion Alarms

If you have connected a drive to your CPU, you will find the current motion alarms and their history here.



Diagnostics
Motion Alarms

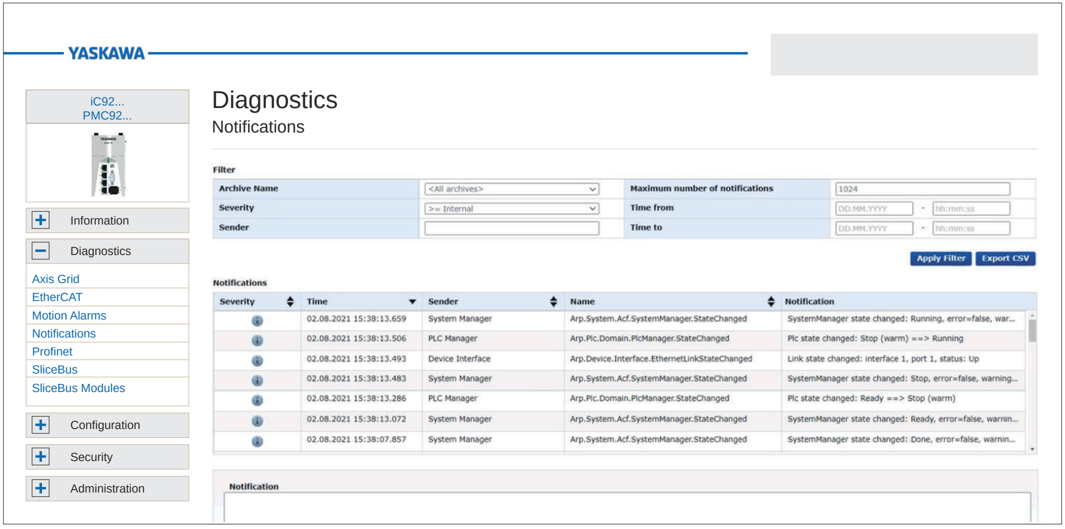
Timestamp	Error Code	Source	Description	More Info
2022-11-24 15:53:35	0x44080002	Alarm history	Alarm history stored in NVRAM was corrupted	The alarm history was configured to use NVRAM storage and the data was found to be corrupted. The alarm history has been lost. NOTE: this alarm also occurs if the configured size of the alarm history has been changed.

- *'Active Alarms'*
  - All currently pending motion alarms are listed here.
  - The table includes error code, source, description and more detailed information about the corresponding motion alarm.

- *'Alarm History'*
  - The last 100 motion alarms are listed here.
  - The table includes error code, source, description and more detailed information about the corresponding motion alarm.

6.3.4 Notifications

Every user with access rights can view and download message entries here. The page contains buttons for filter functions and for the CSV export of the messages, as well as an overview table of all messages and a full text area of a selected message. This information is refreshed once a second.



Diagnostics

Notifications

Filter

Archive Name	<All archives>	Maximum number of notifications	1024
Severity	>= Internal	Time from	DD.MM.YYYY - hh:mm:ss
Sender		Time to	DD.MM.YYYY - hh:mm:ss

Notifications

Severity	Time	Sender	Name	Notification
ⓘ	02.08.2021 15:38:13.659	System Manager	Arp.System.Acf.SystemManager.StateChanged	SystemManager state changed: Running, error=false, war...
ⓘ	02.08.2021 15:38:13.506	PLC Manager	Arp.Plc.Domain.PlcManager.StateChanged	Plc state changed: Stop (warm) ==> Running
ⓘ	02.08.2021 15:38:13.493	Device Interface	Arp.Device.Interface.EthernetLinkStateChanged	Link state changed: interface 1, port 1, status: Up
ⓘ	02.08.2021 15:38:13.483	System Manager	Arp.System.Acf.SystemManager.StateChanged	SystemManager state changed: Stop, error=false, warning...
ⓘ	02.08.2021 15:38:13.286	PLC Manager	Arp.Plc.Domain.PlcManager.StateChanged	Plc state changed: Ready ==> Stop (warm)
ⓘ	02.08.2021 15:38:13.072	System Manager	Arp.System.Acf.SystemManager.StateChanged	SystemManager state changed: Ready, error=false, warnin...
ⓘ	02.08.2021 15:38:07.857	System Manager	Arp.System.Acf.SystemManager.StateChanged	SystemManager state changed: Done, error=false, warnin...

Notification

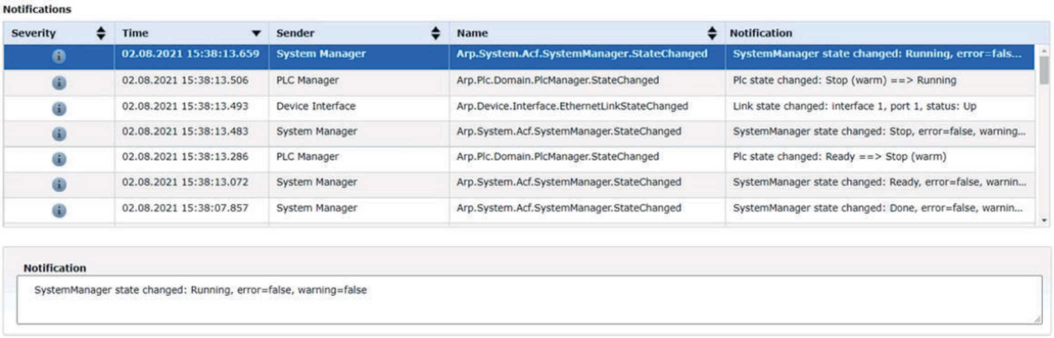
Sort criteria for the message entries

By default, the message entries in the table are sorted in descending order based on the time stamp. To sort the notifications, click on the header of the corresponding table column. The arrows at the column headings have the following meaning:

Double arrow ▲▼	The table is not sorted by this column.
Up arrow ▲	The table is sorted according to this column in ascending order.
Down arrow ▼	The table is sorted according to this column in descending order.

Full text view

Below the table is the full text view of a selected message entry in the table. If no message is selected, the full text view remains empty.



Notifications

Severity	Time	Sender	Name	Notification
ⓘ	02.08.2021 15:38:13.659	System Manager	Arp.System.Acf.SystemManager.StateChanged	SystemManager state changed: Running, error=fals...
ⓘ	02.08.2021 15:38:13.506	PLC Manager	Arp.Plc.Domain.PlcManager.StateChanged	Plc state changed: Stop (warm) ==> Running
ⓘ	02.08.2021 15:38:13.493	Device Interface	Arp.Device.Interface.EthernetLinkStateChanged	Link state changed: interface 1, port 1, status: Up
ⓘ	02.08.2021 15:38:13.483	System Manager	Arp.System.Acf.SystemManager.StateChanged	SystemManager state changed: Stop, error=false, warning...
ⓘ	02.08.2021 15:38:13.286	PLC Manager	Arp.Plc.Domain.PlcManager.StateChanged	Plc state changed: Ready ==> Stop (warm)
ⓘ	02.08.2021 15:38:13.072	System Manager	Arp.System.Acf.SystemManager.StateChanged	SystemManager state changed: Ready, error=false, warnin...
ⓘ	02.08.2021 15:38:07.857	System Manager	Arp.System.Acf.SystemManager.StateChanged	SystemManager state changed: Done, error=false, warnin...

Notification

SystemManager state changed: Running, error=false, warning=false

Filter functions

Specify the filter settings. By clicking on [Apply Filter], the previously made filter settings are activated and the table with the message entries is refreshed accordingly.

There are the following filter options:

- Archive name
  - Here you can filter the message entries by specifying an archive name.

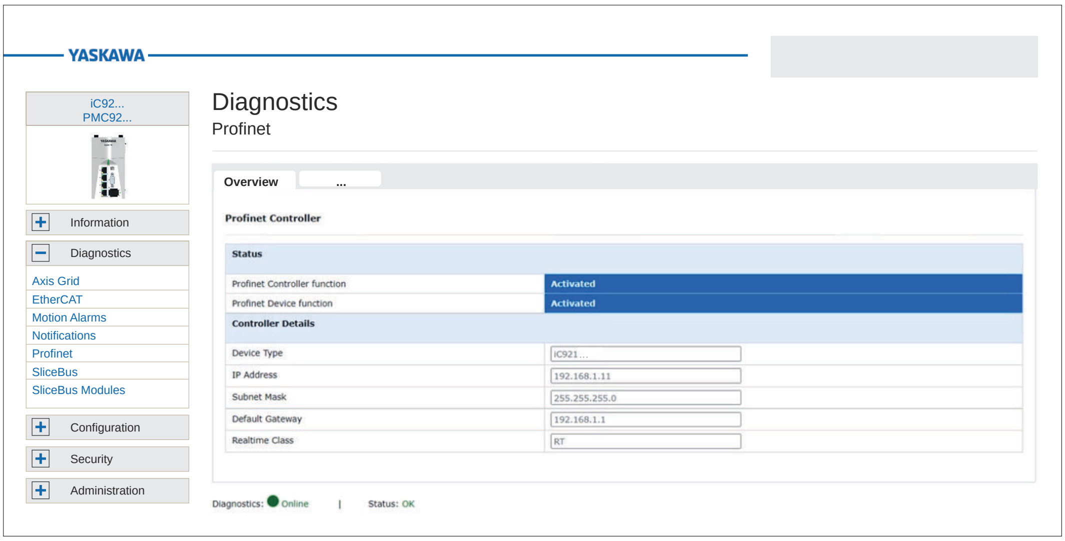
- Severity
  - Here you can limit the message entries based on their severity.
  - The limitation is based on the following graduation for the minimum severity:
    Internal → *Information* → *Warning* → *Error* → *Critical Error* → *Fatal Error*
    For example with *Internal*, all degrees of severity are listed. With the setting *Error*, all *Error*, *Critical Error* and *Fatal Error* are listed.
- Sender
  - Here you can limit the message entries by entering or selecting a sender in the selection field.
  - The currently list of message entries is always decisive for the names in the selection field.
  - When entering a name or part of the name, click on [Apply Filter] to list messages from senders that match or partially match the name you are looking for.
- Maximum number of notifications
  - Here you can limit the number of message entries to be listed.
  - 1024 is set by default, a maximum of 4000 is allowed.
- Time from, Time to
  - Here you can limit the period of the message entries by entering the date and time.
  - Time from: Lists all message entries that are not older than the specified time.
  - Time to: Lists all message entries that are older than the specified time.
  - When filtering by time specification, a date must always be entered and a time can be added.

6.3.5 PROFINET - optional

Tab: *'Overview'*

Here you will find information on the current PROFINET function of the controller and its IP settings.

Please note that a separate licence is required for the use of PROFINET, which must be activated accordingly!



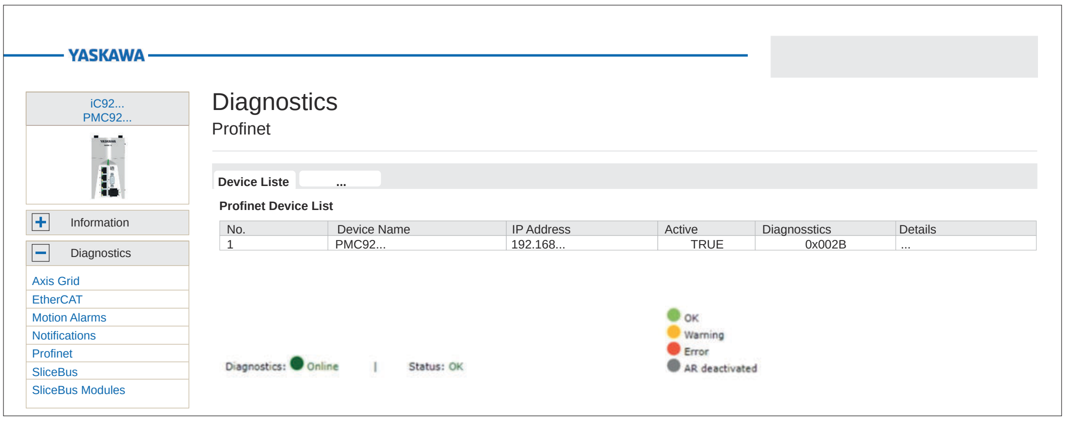
Diagnostics
Profinet

Profinet Controller

Status	
Profinet Controller function	Activated
Profinet Device function	Activated
Controller Details	
Device Type	iC921...
IP Address	192.168.1.11
Subnet Mask	255.255.255.0
Default Gateway	192.168.1.1
Realtime Class	RT

Diagnostics: ● Online | Status: OK

Tab: *'Device List'*



Diagnostics
Profinet

Profinet Device List

No.	Device Name	IP Address	Active	Diagnostics	Details
1	PMC92...	192.168...	TRUE	0x002B	...

Diagnostics: ● Online | Status: OK

Open the WBM of a PROFINET device

To access the WBM of a PROFINET device, click on the corresponding PROFINET device in the Device Name column.

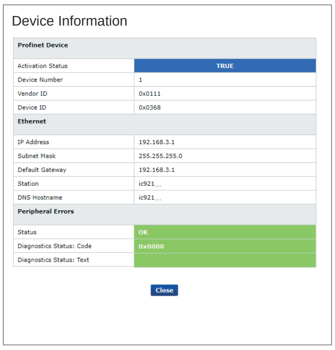
➡ The WBM of the PROFINET device opens in a new tab in the web browser.

Device Information

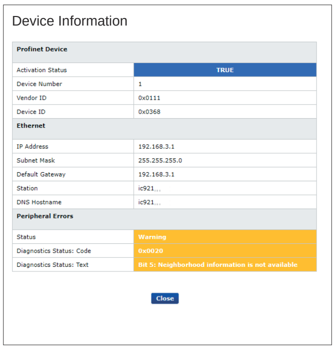
For the corresponding PROFINET device, you will find information on IP settings and diagnostics at Device Information. This information is refreshed once a second.

To show the Device Information of a PROFINET device click in Details column on ▤.

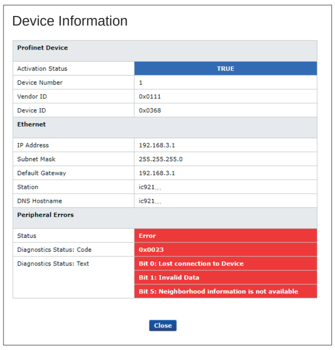
➡ The Device Information view with the current information on IP settings and diagnostics is opened.


Device Information

Profinet Device	
Activation Status	TRUE
Device Number	1
Vendor ID	0x0111
Device ID	0x0368
Ethernet	
IP Address	192.168.3.1
Subnet Mask	255.255.255.0
Default Gateway	192.168.3.1
Station	ic921...
DNS Hostname	ic921...
Peripheral Errors	
Status	OK
Diagnostics Status: Code	0x0000
Diagnostics Status: Text	


Device Information

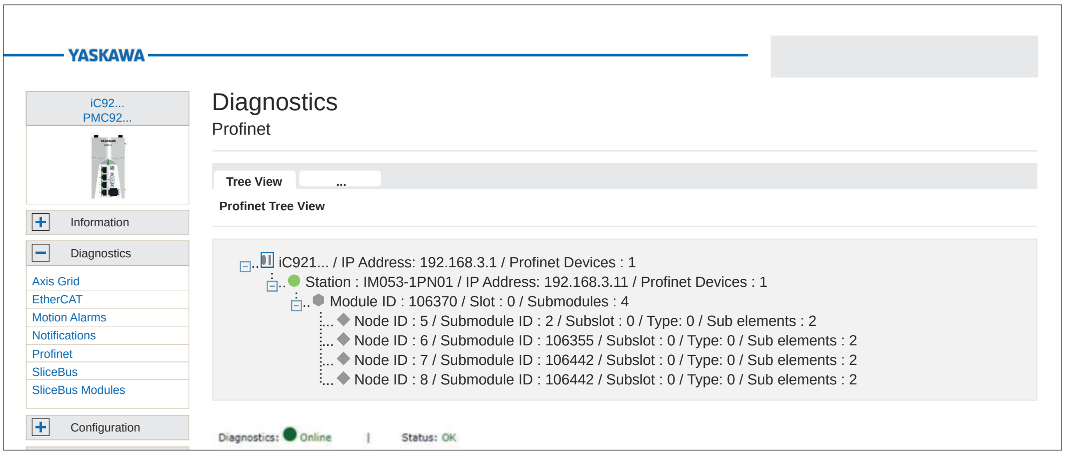
Profinet Device	
Activation Status	TRUE
Device Number	1
Vendor ID	0x0111
Device ID	0x0368
Ethernet	
IP Address	192.168.3.1
Subnet Mask	255.255.255.0
Default Gateway	192.168.3.1
Station	ic921...
DNS Hostname	ic921...
Peripheral Errors	
Status	Warning
Diagnostics Status: Code	0x0020
Diagnostics Status: Text	Bit 5: Neighborhood information is not available


Device Information

Profinet Device	
Activation Status	TRUE
Device Number	1
Vendor ID	0x0111
Device ID	0x0368
Ethernet	
IP Address	192.168.3.1
Subnet Mask	255.255.255.0
Default Gateway	192.168.3.1
Station	ic921...
DNS Hostname	ic921...
Peripheral Errors	
Status	Error
Diagnostics Status: Code	0x0023
Diagnostics Status: Text	Bit 0: Lost connection to Device Bit 1: Invalid Data Bit 5: Neighborhood information is not available

Tab: *'Tree View'*

Here you have a tree view of all configured PROFINET devices. The overview contains the device names of the PROFINET devices, their current IP settings and the diagnostic status of the devices and modules. Via [+] and [-] you can open or close the next level of the Tree View.



Diagnostics
Profinet

Profinet Tree View

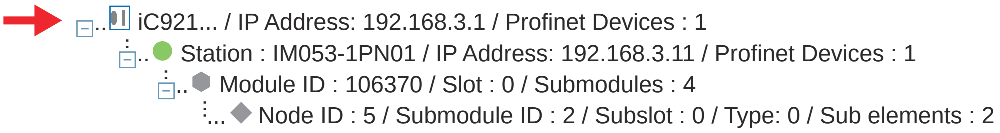
```
iC921... / IP Address: 192.168.3.1 / Profinet Devices : 1
  Station : IM053-1PN01 / IP Address: 192.168.3.11 / Profinet Devices : 1
    Module ID : 106370 / Slot : 0 / Submodules : 4
      Node ID : 5 / Submodule ID : 2 / Subslot : 0 / Type: 0 / Sub elements : 2
      Node ID : 6 / Submodule ID : 106355 / Subslot : 0 / Type: 0 / Sub elements : 2
      Node ID : 7 / Submodule ID : 106442 / Subslot : 0 / Type: 0 / Sub elements : 2
      Node ID : 8 / Submodule ID : 106442 / Subslot : 0 / Type: 0 / Sub elements : 2
```

Diagnostics: ● Online | Status: OK

Controller level

On the PROFINET controller level you will find the following information:

- Controller designation
- IP Address - IP address of the controller
- PROFINET Devices - Number of PROFINET devices



```
iC921... / IP Address: 192.168.3.1 / Profinet Devices : 1
  Station : IM053-1PN01 / IP Address: 192.168.3.11 / Profinet Devices : 1
    Module ID : 106370 / Slot : 0 / Submodules : 4
      Node ID : 5 / Submodule ID : 2 / Subslot : 0 / Type: 0 / Sub elements : 2
```

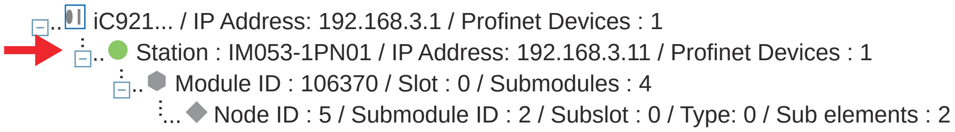
Station level

On station level you will find the following information about the PROFINET devices:

- Station name
- IP Address - IP address of the station
- Vendor ID - the ID of the vendor
- Device ID - the ID of the device
- Modules - number of modules

The following symbols inform about the current diagnostic state of the PROFINET device:

Symbol	Diagnostic status
🟢	OK
🟡 !	Warning
🔴 !	Error

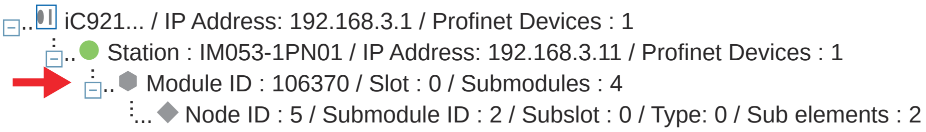


```
iC921... / IP Address: 192.168.3.1 / Profinet Devices : 1
  Station : IM053-1PN01 / IP Address: 192.168.3.11 / Profinet Devices : 1
    Module ID : 106370 / Slot : 0 / Submodules : 4
      Node ID : 5 / Submodule ID : 2 / Subslot : 0 / Type: 0 / Sub elements : 2
```

Module level

On module level you will find the following information:

- Module ID - the ID of the module
- Slot - slot of the module
- Sub modules - the number of sub modules

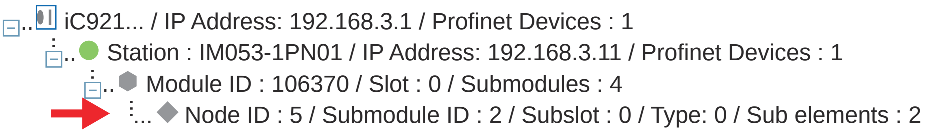


```
iC921... / IP Address: 192.168.3.1 / Profinet Devices : 1
  Station : IM053-1PN01 / IP Address: 192.168.3.11 / Profinet Devices : 1
    Module ID : 106370 / Slot : 0 / Submodules : 4
      Node ID : 5 / Submodule ID : 2 / Subslot : 0 / Type: 0 / Sub elements : 2
```

Sub module level

On sub module level you will find the following information:

- Node ID - node ID of the sub module
- Sub module ID
- Sub slot
- Type
- Sub elements - number of sub module elements



```
iC921... / IP Address: 192.168.3.1 / Profinet Devices : 1
  Station : IM053-1PN01 / IP Address: 192.168.3.11 / Profinet Devices : 1
    Module ID : 106370 / Slot : 0 / Submodules : 4
      Node ID : 5 / Submodule ID : 2 / Subslot : 0 / Type: 0 / Sub elements : 2
```

6.3.5.1 PROFINET Diagnostics Code

Here you can get the status of a connection with an IO controller (Application Relation - AR) bit-coded.

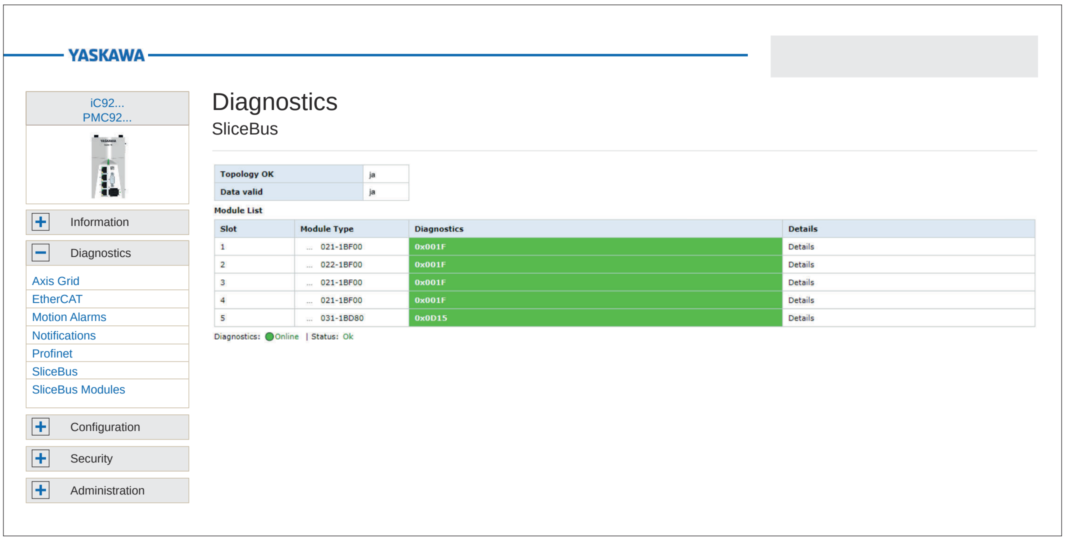
Status AR

Bit	Description and action recommendation
0	Bit 0 is set when there is no connection. ■ The PROFINET controller could not establish a connection with the PROFINET device or the AR was deactivated. – Please check the Ethernet connection and the PROFINET device name with your iCube Engineer configuration tool. – Also check whether the AR was deactivated in the device settings of PROFINET.
1	Bit 1 is set if the data is invalid. ■ The PROFINET device is connected to the PROFINET controller, but the process data were marked as invalid due to an error. The process data were not transferred to the process image. – Please check the diagnosis of the PROFINET device and, if necessary, contact the vendor of the PROFINET device.
2	Bit 2 is set when a diagnostic message is pending. ■ The PROFINET device reports a diagnosis. – Please check the diagnosis of the PROFINET device and, if necessary, contact the vendor of the PROFINET device.
3	Bit 3 is set if the module deviates from the configured module. ■ When the PROFINET connection was initialized, a discrepancy was found between the target and current configuration. – Please check the configuration of the PROFINET device. In the iCube Engineer default setting, the connection remains established in the event of a configuration difference.
4	Bit 4 is set when the AR is disabled. ■ The PROFINET device is configured in the project, but the AR was disabled. – Check the PROFINET device settings and enable the AR.
5	Bit 5 is set if no neighbor information is available. ■ No neighbor information are available in the network used. – This is usually due to the use of components that are not at least compatible with PROFINET Conformance Class-B (CC-B). For a stable PROFINET network, you should only use CC-B or CC-C-compliant PROFINET devices.
6	Bit 6 is set if neighbor information are not uniform. ■ Neighbor information are available in the network used, but not clearly. This means that more than two PROFINET devices can be detected on a port by at least one switch. This is not permitted and may result in the automatic device change not working reliably. – This is usually due to the use of components that are not at least PROFINET Conformance Class-B (CC-B) compatible (e.g. unmanaged switches).
7	Bit 7 is set if the alias name of a device being searched for is already being used by an AR. ■ A DCP identification request (alias) was sent to the network. However, the alias of a device being searched for is already being used by an AR. – This information is only an indication that the control program is probably trying to establish a connection with a device, although a connection is still active.
8	Bit 8 is set when a maintenance request is pending. ■ The PROFINET device has transmitted a maintenance request (maintenance alarm). – Please check the diagnosis of the PROFINET device and, if necessary, contact the vendor of the PROFINET device.

Bit	Description and action recommendation
9	Bit 9 is set when a high-priority maintenance demand is pending. ■ The PROFINET device has transmitted a high-priority maintenance request (maintenance alarm). – Please check the diagnosis of the PROFINET device and, if necessary, contact the vendor of the PROFINET device.
10	Bit 10 is set if a vendor- or channel-specific diagnosis is pending. ■ The PROFINET device has transmitted a vendor- or channel-specific diagnosis. – Please check the diagnosis of the PROFINET device and, if necessary, contact the vendor of the PROFINET device.

6.3.6 SliceBus

Here you will find information on the backplane bus and the connected modules.



Diagnostics

SliceBus

Topology OK	ja
Data valid	ja

Module List

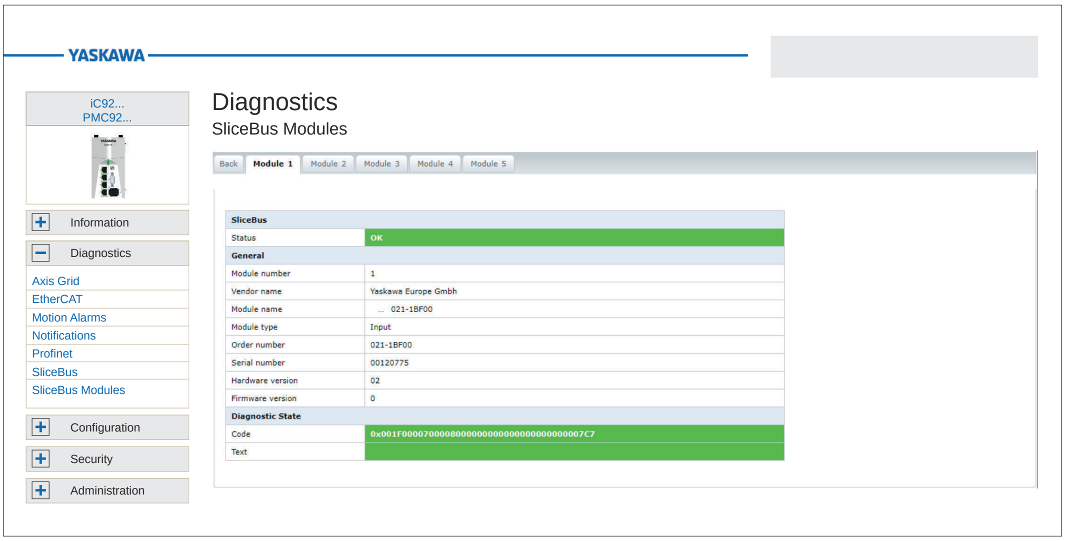
Slot	Module Type	Diagnostics	Details
1	... 021-1BF00	0x001F	Details
2	... 022-1BF00	0x001F	Details
3	... 021-1BF00	0x001F	Details
4	... 021-1BF00	0x001F	Details
5	... 031-1BD80	0x0D15	Details

Diagnostics: ● Online | Status: Ok

- Topology OK
  - The topology is correct if the configured and existing modules are identical.
- Data valid
  - If the data from the backplane bus were transmitted without errors, these are valid.
- Module List
  - The connected modules and the first 2 bytes of the diagnostic data are listed here. You can find more detailed diagnostic information at *'Details'*.

6.3.7 SliceBus Modules

Here you will find detailed information on the diagnoses of the connected modules. The content is dynamically structured and depends on the number of modules on the CPU.



Diagnostics

SliceBus Modules

SliceBus	
Status	OK
General	
Module number	1
Vendor name	Yaskawa Europe Gmbh
Module name	... 021-1BF00
Module type	Input
Order number	021-1BF00
Serial number	00120775
Hardware version	02
Firmware version	0
Diagnostic State	
Code	0x001F00007000080000000000000000000000007C7
Text	

- Module …
  - Here you will find detailed information for the corresponding module:

    At *'General'* the general module information is listed such as order number, hardware and firmware version.

    At *'Diagnostic State'* you will find the diagnostic data. For more information on the structure of the diagnostic data, please refer to the corresponding manual of the module.
- *'Back'*

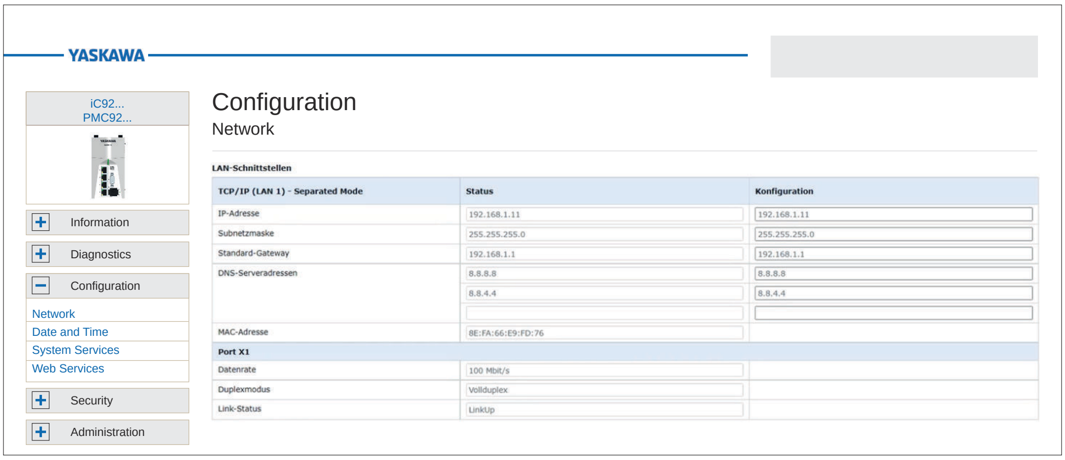
  With *'Back'* you can jump back to the SliceBus diagnosis.

6.4 Configuration

6.4.1 Network

User with read permission

Here you can view the Ethernet settings of your CPU. You only have read access.



Configuration

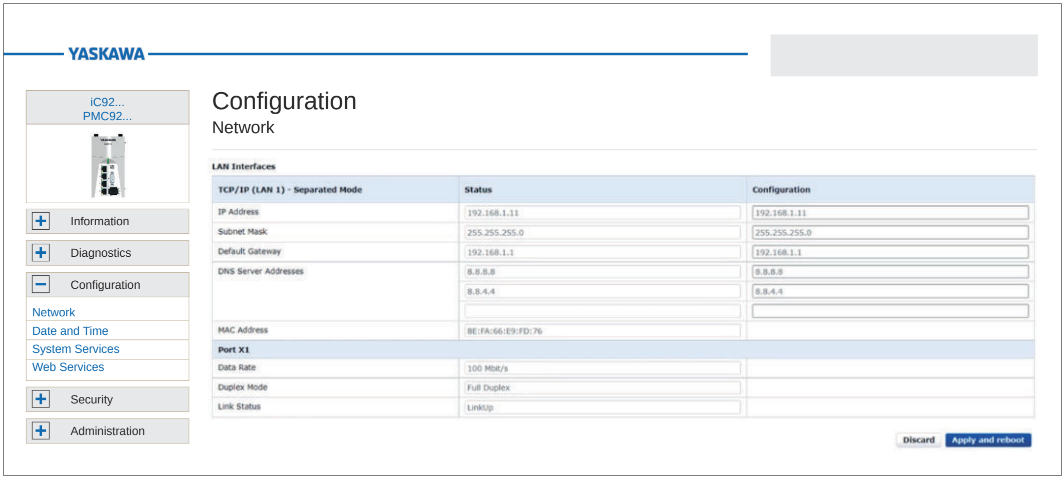
Network

LAN-Schnittstellen

TCP/IP (LAN 1) - Separated Mode	Status	Konfiguration
IP-Adresse	192.168.1.11	192.168.1.11
Subnetzmaske	255.255.255.0	255.255.255.0
Standard-Gateway	192.168.1.1	192.168.1.1
DNS-Serveradressen	8.8.8.8	8.8.8.8
	8.8.4.4	8.8.4.4
MAC-Adresse	8E:FA:66:E9:FD:76	
Port X1		
Datenrate	100 Mbit/s	
Duplexmodus	Vollduplex	
Link-Status	LinkUp	

User with write permission

If you are logged in with administrator rights, you can view the Ethernet settings of your CPU here. You can also change the current network settings in the *'Configuration'* column.



Configuration
Network

LAN Interfaces

TCP/IP (LAN 1) - Separated Mode	Status	Configuration
IP Address	192.168.1.11	192.168.1.11
Subnet Mask	255.255.255.0	255.255.255.0
Default Gateway	192.168.1.1	192.168.1.1
DNS Server Addresses	8.8.8.8 8.8.4.4	8.8.8.8 8.8.4.4
MAC Address	8E:FA:66:E9:FD:76	
Port X1		
Data Rate	100 Mbit/s	
Duplex Mode	Full Duplex	
Link Status	LinkUp	

To change the network settings, proceed as follows:

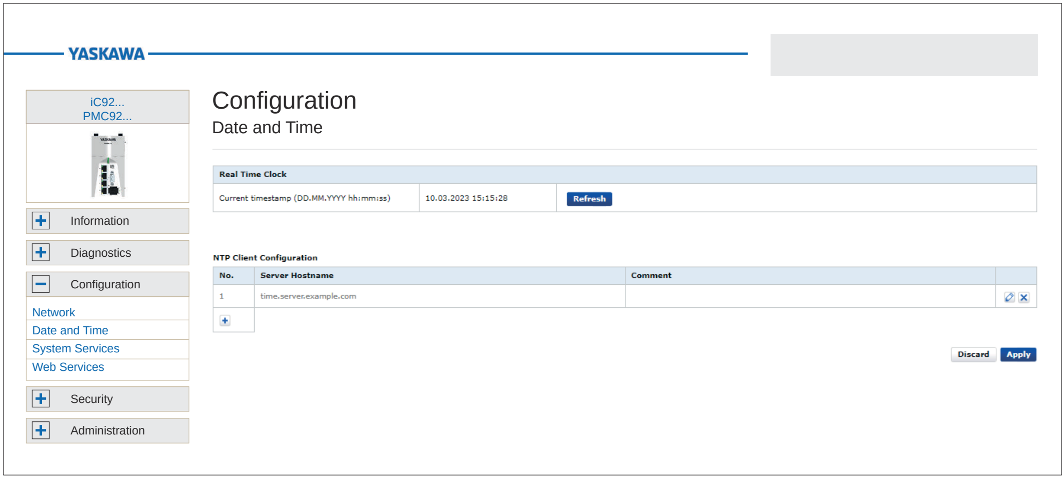
1. Enter your new settings in the *'Configuration'* column.
2. Click on [Apply and Reboot].
   ➡ The settings are adopted, transferred to the CPU and the CPU is automatically restarted for activation.

> *You can also configure the network settings via iCube Engineer. For more details, please refer to the corresponding online help.*

6.4.2 Date and Time

The Date and Time page provides access to the NTP client configuration. NTP stands for **N**etwork **T**ime **P**rotocol and is a standard described in RFC 958 for time synchronisation in end devices connected via a network or the Internet. NTP is based on the connectionless UDP protocol (port 123). For synchronisation, NTP relies on Coordinated Universal Time (UTC), which is obtained from the individual clients and servers in a hierarchical system.

> *All iC9200 Series CPUs use UTC0 as the default setting, which corresponds to the coordinated world time UTC ±00:00.*



Configuration
Date and Time

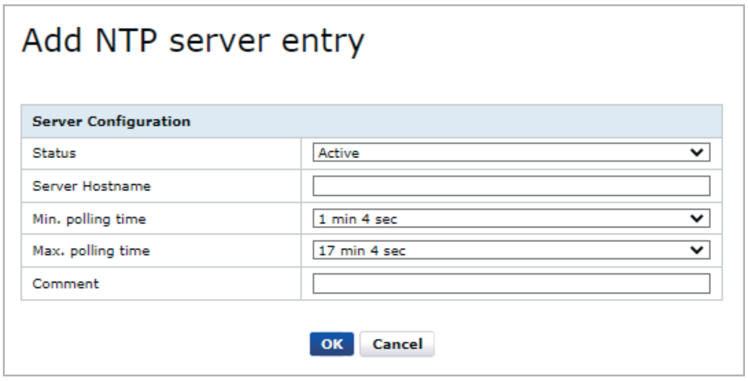
Real Time Clock		
Current timestamp (DD.MM.YYYY hh:mm:ss)	10.03.2023 15:15:28	Refresh

NTP Client Configuration

No.	Server Hostname	Comment	
1	time.server.example.com		
+			

Here you can configure the NTP client by adding new NTP server entries.

1. To do this, click below the table on +.
   - ➨ The dialog for adding an NTP server opens.



Add NTP server entry

Server Configuration	
Status	Active
Server Hostname	
Min. polling time	1 min 4 sec
Max. polling time	17 min 4 sec
Comment	

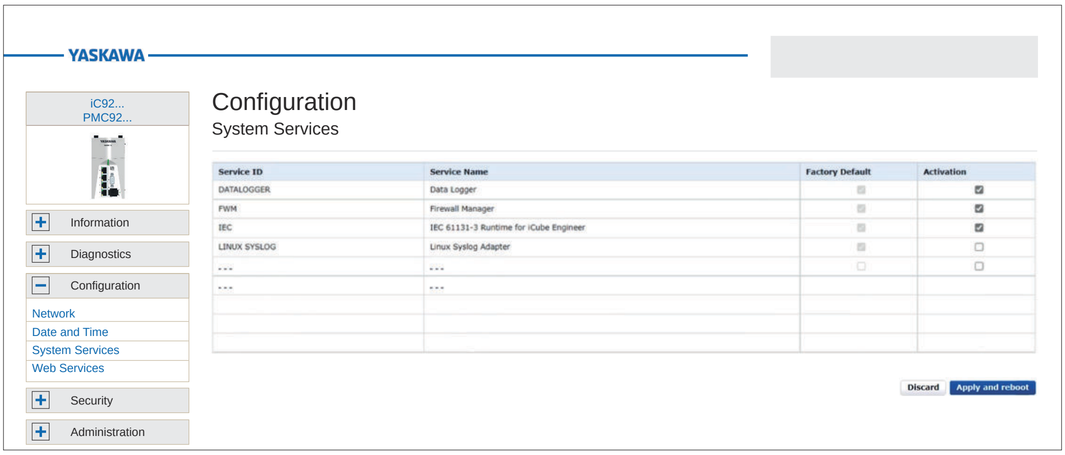
2. Enter the according parameters.
   - Server Host Name
     - Enter the address at which the NTP server can be reached in the network.
   - Comment
     - Here you can assign an internal designation for the NTP server.
   - The other parameters are for information and cannot be changed.
3. Click at [OK].
   - ➨ The dialog is closed and the NTP server is listed in the table.

     You can remove entries with ✕ and edit them with ✎ .
4. Click on [Apply].
   - ➨ You will receive a message that applying the new NTP daemon configuration requires a restart of the NTP daemon and that this may lead to a real-time violation. With [OK], the NTP servers listed in the table are accepted for time-of-day synchronization and the NTP daemon is restarted.

6.4.3 System Services

Here you can find status information about the enabled and disabled system services, as well as their factory default settings. You can increase the efficiency of your system by deactivating services that are not required.

> – *Before disabling a service that is enabled by default, make sure that it is also not required for the entire system.*
>
> – *Please also note that changing a setting always overwrites the entire system services settings.*
>
> – *When PROFINET (optional) is disabled, the DCP protocol, which is used for identification and IP address assignment for participants in the PROFINET network, is also disabled.*



Configuration

System Services

Service ID	Service Name	Factory Default	Activation
DATALOGGER	Data Logger	☑	☑
FWM	Firewall Manager	☑	☑
IEC	IEC 61131-3 Runtime for iCube Engineer	☑	☑
LINUX SYSLOG	Linux Syslog Adapter	☑	□
...	...	□	□
...	...		

Enable/disable system services

1. By selecting or deselecting the corresponding check box, you enable respectively disable a system service in the list.
2. Use the [Apply and Reboot] button to apply the settings for the system services.
   ➡ After a security query, the settings for the system services are adopted and the CPU is restarted.

6.4.4 Web Services

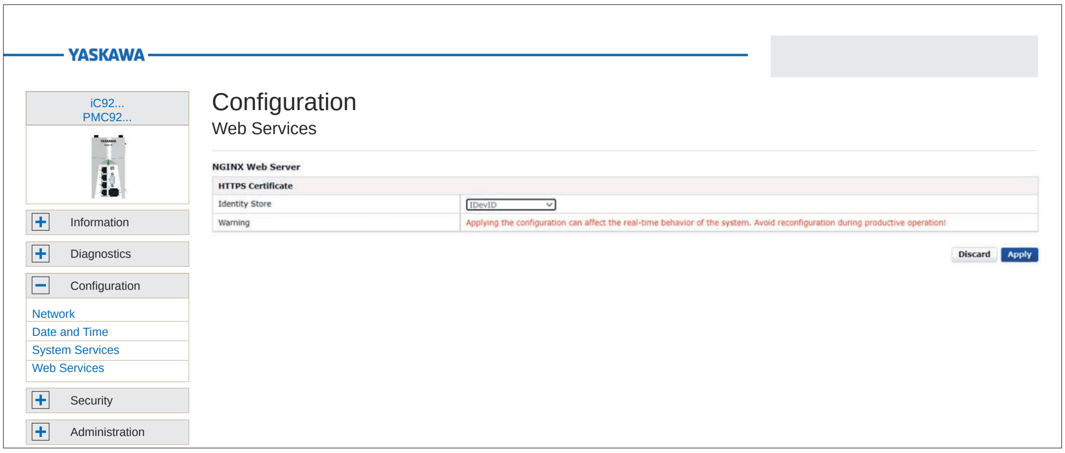
The page provides access to the configuration of web services, e.g. HTTPS certificate, which is used for the NGINX web server.

> *The HTTPS certificate and the associated private key are located as files in the file system of the CPU and are listed as symbolic links on the web page. During a firmware update, the existing certificate and key files are moved to a backup directory and symbolic links are created that refer to this backup.*

6.4.4.1 NGINX Web server

Selected HTTPS certificate

The HTTPS certificate is used to authenticate the CPU to the web server.



Configuration

Web Services

NGINX Web Server

HTTPS Certificate	
Identity Store	IDevID
Warning	Applying the configuration can affect the real-time behavior of the system. Avoid reconfiguration during productive operation!

In the configuration table for the NGINX Web server you have the option of selecting the HTTPS certificate from one of the identity stores stored in the CPU.

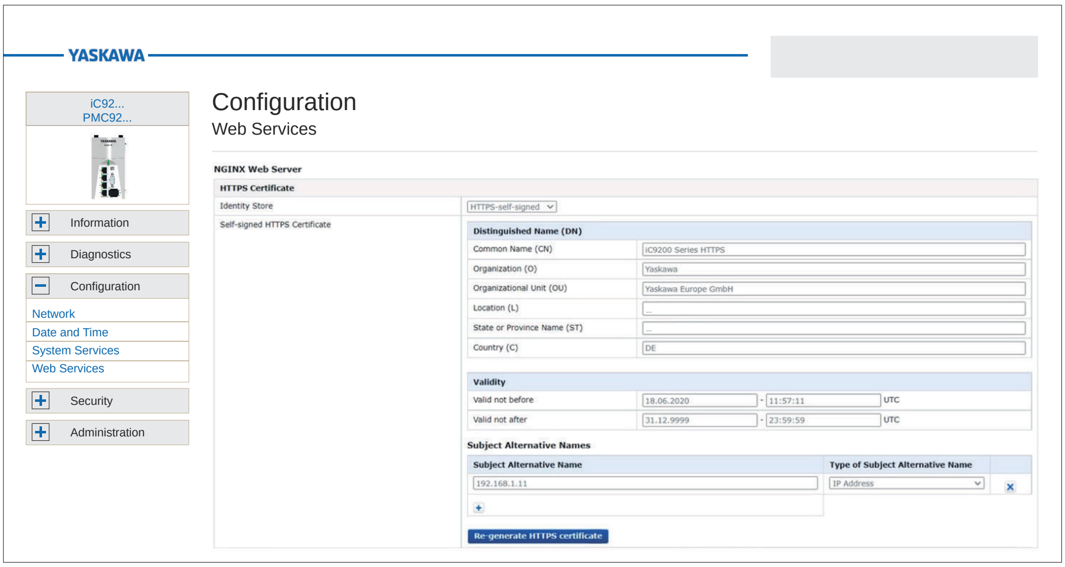
1. Select the corresponding Identity store.
   ➡ The corresponding HTTPS certificate is selected.

2. Click on [Apply].

➡ The certificate is used for authentication in the configuration.

> *Please note that reconfiguring the web service can affect the real-time behavior of your system. Avoid this during productive operation.*

Self-signed HTTPS certificate



Configuration
Web Services

NGINX Web Server

HTTPS Certificate	
Identity Store	HTTPS-self-signed
Self-signed HTTPS Certificate	

Distinguished Name (DN)	
Common Name (CN)	iC9200 Series HTTPS
Organization (O)	Yaskawa
Organizational Unit (OU)	Yaskawa Europe GmbH
Location (L)	...
State or Province Name (ST)	...
Country (C)	DE

Validity			
Valid not before	18.06.2020	11:57:11	UTC
Valid not after	31.12.9999	23:59:59	UTC

Subject Alternative Names

Subject Alternative Name	Type of Subject Alternative Name	
192.168.1.11	IP Address	×

In addition to the HTTPS certificates stored in the CPU, you also have the option of selecting a self-signed certificate created by the firmware.

1. To do this, select in the selection field *'HTTPS-self-signed'*.

   ➡ The configuration of the self-signed HTTPS certificate is listed in a table. You can adapt these accordingly and generate new certificate files with [Apply].

2. Enter the according parameters.

   - Distinguished name
     - Enter your company information here for identification.
   - Validity
     - Enter the date in the format DD.MM.YYYY and the time in hh:mm:ss.
     - If at *Valid not before* the input field is empty, the current date is used.
     - If at *Valid not after* the input field is empty, the date 31.12.9999 and time 23:59:59 are used.
   - Subject alternative names
     - The IP addresses from the network configuration of the CPU are suggested by default.
     - You have the option of expanding or adapting this or specifying a DNS name. Use + to add an entry. Use × to remove an entry.

> *If the web server is to be accessible via different IP addresses without an error message, you have to specify all IP addresses as Subject alternative names of the type IP address. If the CPU can be reached via DNS name, you have also to specify this!*

3. To apply the changes, click on [Re-generate HTTPS certificate].

   ➡ The certificate is regenerated. This overwrites an existing self-signed HTTPS certificate.

4. Click on [Apply].
   - ➡ The certificate is used for authentication in the NGINX configuration.

> ℹ *Please note that reconfiguring the web service can affect the real-time behavior of your system. Avoid this during productive operation.*

6.5 Security

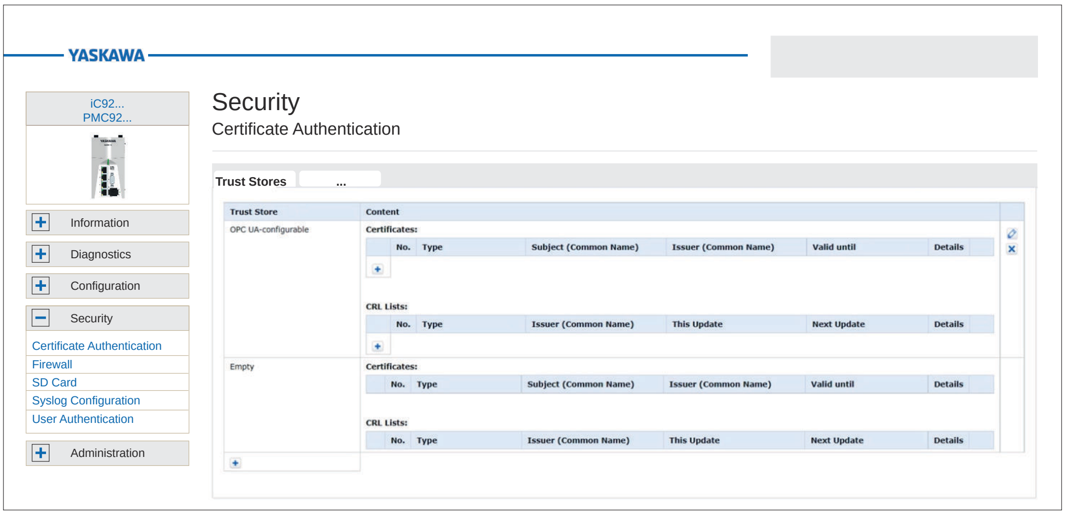
The safety-related settings for the CPU must be configured in the *'Security'* area of the WBM.

6.5.1 Certificate Authentication

At *'Certificate Authentication'* you can manage your certificates for secure CPU communication. *'Certificate Authentication'* is divided into the following tabs:

- Trust Store
  - Trusted certificates and revocation lists of possible communication partners are stored here.
- Identity Store
  - The personally created certificates are stored here.

> ℹ
> - *The name for each store can be used with the interfaces for TLS communication, e.g. TLS_SOCKET block in IEC 61131-3 or TlsSocket class in C ++ or C#.*
> - *The names of the stores are case-sensitive.*



Security

Certificate Authentication

Trust Store	Content
OPC UA-configurable	Certificates:
Empty	Certificates:

	No.	Type	Subject (Common Name)	Issuer (Common Name)	Valid until	Details

CRL Lists:

	No.	Type	Issuer (Common Name)	This Update	Next Update	Details

Tab: Trust Store

Each Trust Store is defined in the WBM by two tables:

- Table *'Certificates'*
  - In this table you can manage trusted Certificates and issuer certificates.
- Table *'CRL lists'*
  - In this table you can manage the revocation lists for the corresponding Trust Store. By storing untrusted certificates and issuer certificates here.

Creating a Trust Store

1. To create a Trust Store, click the + button at the end of the table.
   - ➡ The input dialog opens for entering a name for the Trust Store.
2. Enter a name.

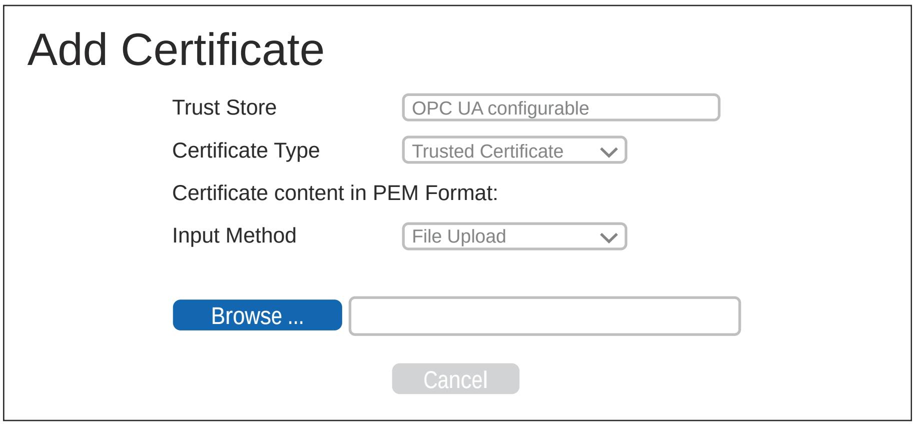
3. Click on [Add].

➡ The dialog is closed and the new Trust Store is added.

You can remove it again with ✕ and rename it with ✎.

Adding a certificate

1. With + below the table *'Certificates'* you can add a certificate via the dialog.



Add Certificate

Trust Store: OPC UA configurable

Certificate Type: Trusted Certificate

Certificate content in PEM Format:

Input Method: File Upload

➡
- Trust Store
  - Name of the Trust Store.
- Certificate Type
  - Specify here whether the certificate is trusted or untrusted.
- Certificate in PEM format
  - Certificate files can only be processed in PEM format.
- Input Method
  - Here you can specify the format in which the certificate is to be added.
  - You can choose between text and file (PEM format).

2. To add a certificate in text format, select at *'Input Method'* the *'Text Content'* parameter, enter the text in the input field and click on [Add].

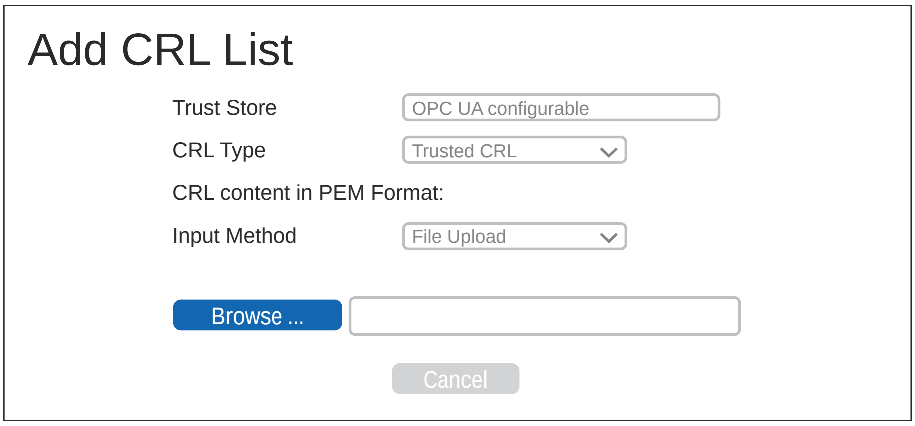
➡ The input dialog is closed and the certificate is added in text format.

3. To add a certificate as file, select at *'Input Method'* the *'File Upload'* parameter, navigate to your certificate in PEM format via [Browse...] and click [Add].

➡ The input dialog is closed and the certificate is added as PEM file.

Adding a revocation list

With + below the table *'CRL lists'* you can add a revocation list via the dialog.



Add CRL List

Trust Store: OPC UA configurable

CRL Type: Trusted CRL

CRL content in PEM Format:

Input Method: File Upload

➡
- Trust Store
  - Name of the Trust Store.
- CRL Type
  - Specify here whether the revocation list is trusted or untrusted.
- Certificate in PEM format
  - Revocation list files can be processed in PEM format only.

- Input Method
  - Here you can specify the format in which the revocation list is to be added.
  - You can choose between text and file (PEM format).

Deleting certificates and revocation lists

1. To delete a certificate or a revocation list, click on the ☒ button for the relevant certificate or revocation list.
2. In the query dialog click on *'Remove'*.

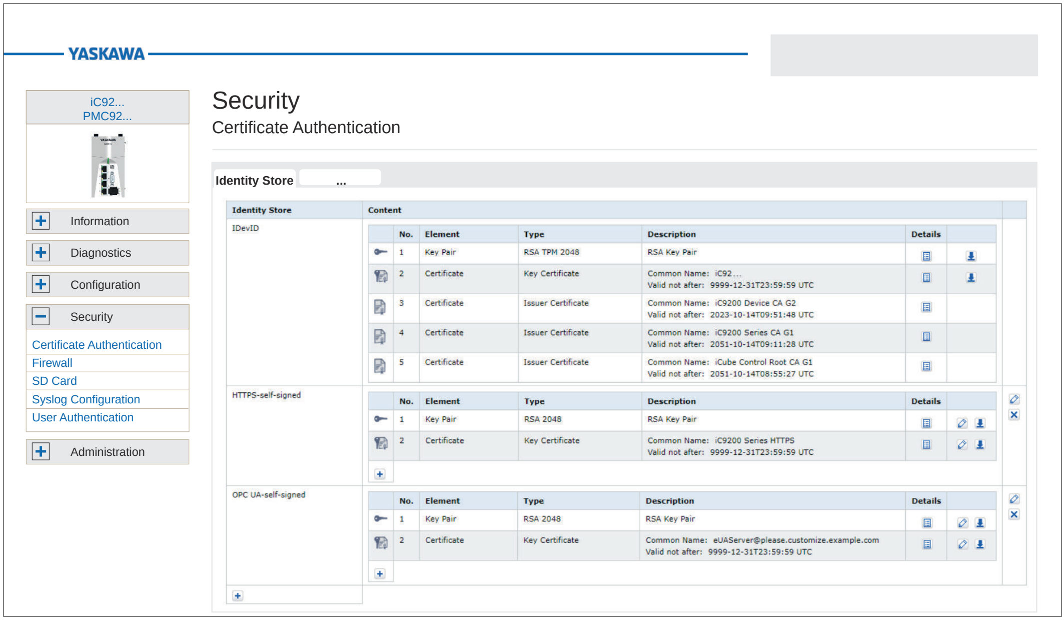
Detail view

The detail views provide detailed information on each certificate and each revocation list:

1. Click on ▤ to open the detail view.
   ➡ The detail view is opened.
2. This is closed again with [Close].

Tab: Identity Store

- You can create and manage multiple identity stores in the *'Identity Store'* tab.
- Each Identity Store usually contains an RSA key pair and the corresponding key certificate.
- Optionally, you can add further issuer certificates to an identity store.
- The IDevID and OPC UA-self-signed identity stores are part of the system and are supplied with the CPU.



Security

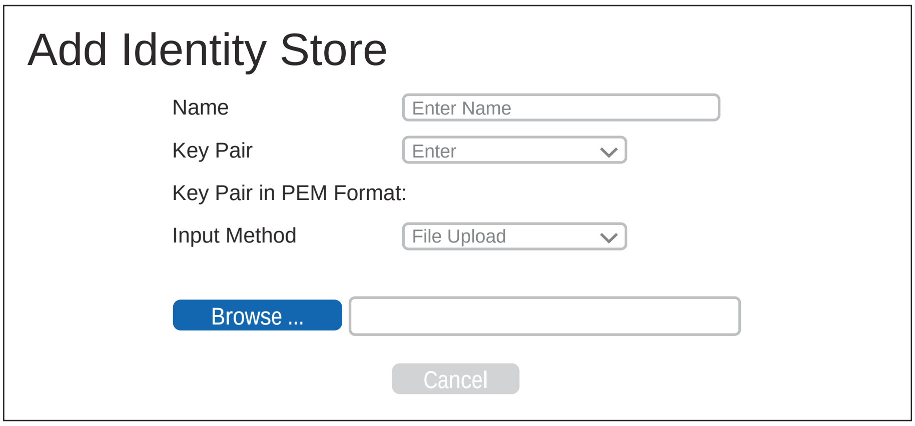
Certificate Authentication

Identity Store | ...

Identity Store	No.	Element	Type	Description
IDevID	1	Key Pair	RSA TPM 2048	RSA Key Pair
	2	Certificate	Key Certificate	Common Name: iC92... Valid not after: 9999-12-31T23:59:59 UTC
	3	Certificate	Issuer Certificate	Common Name: iC9200 Device CA G2 Valid not after: 2023-10-14T09:51:48 UTC
	4	Certificate	Issuer Certificate	Common Name: iC9200 Series CA G1 Valid not after: 2051-10-14T09:11:28 UTC
	5	Certificate	Issuer Certificate	Common Name: iCube Control Root CA G1 Valid not after: 2051-10-14T08:55:27 UTC
HTTPS-self-signed	1	Key Pair	RSA 2048	RSA Key Pair
	2	Certificate	Key Certificate	Common Name: iC9200 Series HTTPS Valid not after: 9999-12-31T23:59:59 UTC
OPC UA-self-signed	1	Key Pair	RSA 2048	RSA Key Pair
	2	Certificate	Key Certificate	Common Name: eUAServer@please.customize.example.com Valid not after: 9999-12-31T23:59:59 UTC

Adding a Identity Store

1. With + below the table *'Identity Store'* you can add a Identity Store via the dialog.



Add Identity Store

Name: Enter Name

Key Pair: Enter

Key Pair in PEM Format:

Input Method: File Upload

➡ - Name
  - Name for the Identity Store.

- Key Pairs
  - Specify here how the key pair is to be added.
  - You can enter the key pair or let it be generated.
- Key Pair in PEM Format
  - Key files can be processed in PEM format only.
- Input Method
  - Here you can specify the format in which the key pair is to be added.
  - You can choose between text and file (PEM format).

2. To add a key pair in text format, select at *'Key Pairs'* the *'Enter'* parameter and at *'Input Method'* the *'Text Content'* parameter, enter the text in the input field and click on [Add].

   ➡ The input dialog is closed and the key pair is added in text format.

3. To add a key pair as file, select at *'Key Pairs'* the *'Enter'* parameter and at *'Input Method'* the *'File Upload'* parameter, navigate to your certificate in PEM format via [Browse...] and click [Add].

   ➡ The input dialog is closed and the key pair is added as PEM file.

4. To add a key pair generated by the CPU, select at *'Key Pairs'* the *'Generate'* parameter, select the encryption method in the dialog and click on [Add].

   ➡ The input dialog is closed and the key pair automatically generated by the CPU is added.

You can add, rename, define and remove key pairs or certificates by using the following buttons in the corresponding table entry:

- +: New element - adds a new key pair or certificate.
- ×: Delete element - Deletes by clicking on *'Remove'* the selected key pair respectively certificate or, if selected, the Identity Store.
- ▤: Details - Shows the detailed view of the corresponding element.
- ⬇: Download - You can download the public key content of a key pair as a PEM file.
  - If a key certificate is available, you can download it as a CRT file.
  - Save the file in a directory of your choice or open the file directly with a suitable tool.
- ✎: Rename - depending on the position within a table, you can use this to rename the corresponding element.

6.5.2 Firewall

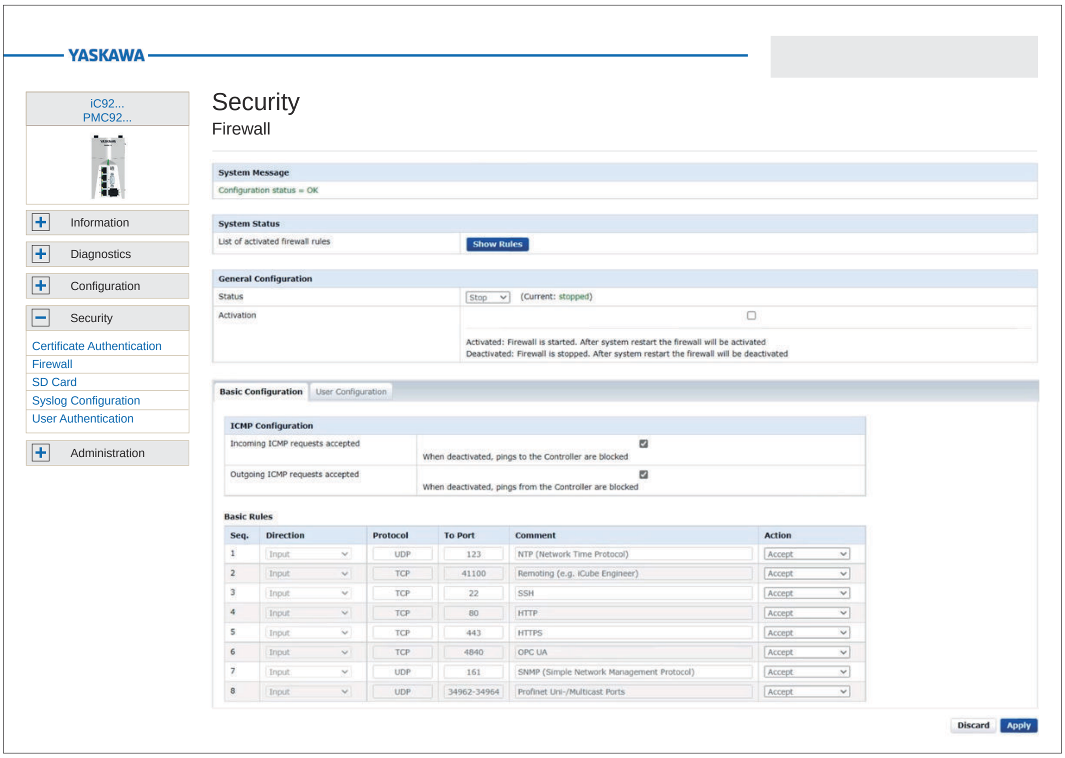
The CPU is delivered with a preset firewall. The Linux® firewall *'nftables'* is used here. As described below, you can create rules from predefined basic rules or create your own new ones.

> – *On delivery, the firewall is disabled!*
>
> – *Please note that you only have access to the firewall settings as an administrator!*

Accessing the firewall

1. Log in to the WBM as an administrator.
2. Navigate to *'Security → Firewall'*.

   ➡ The configuration page for the firewall is opened.



Security

Firewall

System Message

Configuration status = OK

System Status

List of activated firewall rules [Show Rules]

General Configuration

Status: Stop (Current: stopped)

Activation: □

Activated: Firewall is started. After system restart the firewall will be activated
Deactivated: Firewall is stopped. After system restart the firewall will be deactivated

Basic Configuration | User Configuration

ICMP Configuration

Incoming ICMP requests accepted ☑ When deactivated, pings to the Controller are blocked

Outgoing ICMP requests accepted ☑ When deactivated, pings from the Controller are blocked

Basic Rules

Seq.	Direction	Protocol	To Port	Comment	Action
1	Input	UDP	123	NTP (Network Time Protocol)	Accept
2	Input	TCP	41100	Remoting (e.g. iCube Engineer)	Accept
3	Input	TCP	22	SSH	Accept
4	Input	TCP	80	HTTP	Accept
5	Input	TCP	443	HTTPS	Accept
6	Input	TCP	4840	OPC UA	Accept
7	Input	UDP	161	SNMP (Simple Network Management Protocol)	Accept
8	Input	UDP	34962-34964	Profinet Uni-/Multicast Ports	Accept

[Discard] [Apply]

[Apply] and [Discard]

- The changed firewall settings are transferred to the CPU with the [Apply] button.
- With the [Discard] button the settings made are discarded after a security query and the WBM page is reloaded.

'System Message'

Messages regarding the transfer of firewall settings to the CPU are shown at *'System Message'*. The following system messages can occur:

- Status = OK
  - The configured firewall settings were successfully transferred to the CPU.
- Warning
  - The CPU reports a warning, e.g. if one or more additional filter configurations in the system exist. The warning contains the names of all additionally loaded filter tables.
- Error
  - At least one firewall configuration is incorrect.

'System Status'

- When the firewall is enabled, you can use the [Show Rules] button to show an overview of all enabled firewall rules as a txt file.
- With [Save to File] you can save the file locally on your PC as a txt file.

'General Configuration'

At *'General Configuration'* you can see the current firewall status and set it temporarily or permanently.

Temporary enabling

1. Select at *'Status'* the entry *'Start'* or *'Restart'*.
2. Click on [Apply].

➡ The firewall is enabled. After restarting the CPU, the firewall is disabled again.

Temporary disabling

1. Select at *'Status'* the entry *'Stop'*.
2. Click on [Apply].

➡ The firewall is disabled. After restarting the CPU, the firewall is enabled again.

Permanent enabling

1. Activate the *'Activation'* selection field.
2. Click on [Apply].
   - ➡ The firewall is enabled and remains enabled even after a restart.

Permanent disabling

1. Disable the *'Activation'* selection field.
2. Click on [Apply].
   - ➡ The firewall is disabled and remains disabled even after a restart.

> ℹ *By disabling the firewall you endanger the security of your system, especially if it can be reached via the Internet! The firewall should only temporarily be disabled for testing purposes such as troubleshooting.*

Configuration

The configuration of the firewall rules is divided into the following tabs:

- Basic Configuration
  - Here you will find predefined firewall rules which you can enable or disable.
- User Configuration
  - Here you can create, enable or disable your own firewall rules according to defined specifications.

There is a *'Action'* column in both tabs. The firewall settings are applied with the [Apply] button. There are the following setting options for the *'Action'* column:

- Accept
  - The corresponding connection and connection request is accepted.
  - The corresponding connection can be established.
- Drop
  - The corresponding connection is interrupted.
  - There is no answer to the corresponding request.
  - The corresponding package is discarded.
- Reject
  - The corresponding connection is rejected.
  - The sender receives a response to the corresponding request.
- Continue
  - The rule is not executed.
  - This can be used e.g., to skip a rule in the *'Basic Configuration'* and instead create a rule in the *'User Configuration'* and enable it there.

Tab: Basic Configuration

'ICMP Configurations'

- *'Incoming ICMP requests accepted'*
  - enabled: Incoming ICMP echo requests are accepted. The CPU can be reached with a ping request.
  - disabled: Incoming ICMP echo requests are blocked. The CPU can not be reached with a ping request.
- *'Outgoing ICMP requests accepted'*
  - enabled: Outgoing ICMP echo requests are accepted. Ping requests from the CPU are transmitted.
  - disabled: Outgoing ICMP echo requests are blocked. Ping requests from the CPU are blocked.

'Basic Rules'

- Here you will find predefined firewall rules for the corresponding incoming connections. You can control their use accordingly via *'Action'*.
- The settings are valid for all Ethernet interfaces. For individual customization, you can instead create a rule in the*'User Configuration'* and enable it there.

> ***Blocking the WBM access***
>
> – *On the CPU the WBM is accessed via TCP port 443.*
>
> – *By blocking this port with permanently enabled firewall, you have no more access to the WBM of the CPU even after a reboot.*
>
> – *Resetting to the factory settings also resets the firewall to its default settings, among others. This way you get access to the WBM of the CPU again with the original access data.*

> ***Deployment as PROFINET controller (optional)***
>
> – *Connections to PROFINET devices can only be established if you select the rule 'PROFINET unicast / multicast ports' (UDP ports 34962 - 34964) 'Accept'.*

Tab: User Configuration

- In addition or as an alternative to the *'Basic Rules'*, you can define and enable your own user-specific firewall rules for different filter categories.
- You create firewall rules for the output in the *'Output Rules'* tab.
- You create firewall rules for the input in the *'Input Rules'* tab.
- With the order of firewall rules in the table, you define the priority for applying them.
- You can create new rules, delete rules or change the order of the rules by using the following buttons at the end of the table:
  - +: New rule - adds a new firewall rule.
  - ✕: Delete rule - deletes the selected firewall rule.
  - ↑: Rule up - moves the rule up.
  - ↓: Rule down - moves the rule down.
- The firewall settings are applied and enabled with the [Apply] button. An existing configuration will be overwritten.

In addition to *'Action'*, there are the following parameters for specifying a firewall rule:

- *'Seq.'*
  - Numbers the order for the priority according to which the firewall rules are applied.
  - The rules are applied in ascending order from 1.
  - With ↑ and ↓ you can move the firewall rules accordingly.
- *'Interface'*
  - In the *'Input Rules'* tab you can select a single interface from a selection list for which the rule is to be applied.
  - You have no choice in the *'Output Rules'* tab. Here the rule applies to all interfaces.
- *'From IP'*
  - Enter the IP address for connections that are received from this address.
- *'From Port'*
  - Enter the port for connections that are received via this port.
  - You can specify all ports, selected ports, or a range of values.
- *'To IP'*
  - Enter the IP address for connections that are sent to this address.
- *'To Port'*
  - Enter the port for connections that are sent via this port.
  - You can specify all ports, selected ports, or a range of values.

- *'Comment'*
  - Here you can comment your filter rule accordingly.

6.5.3 SD Card

You can use SD Card to enable the deployment of Yaskawa SD cards and retrieve information about them.

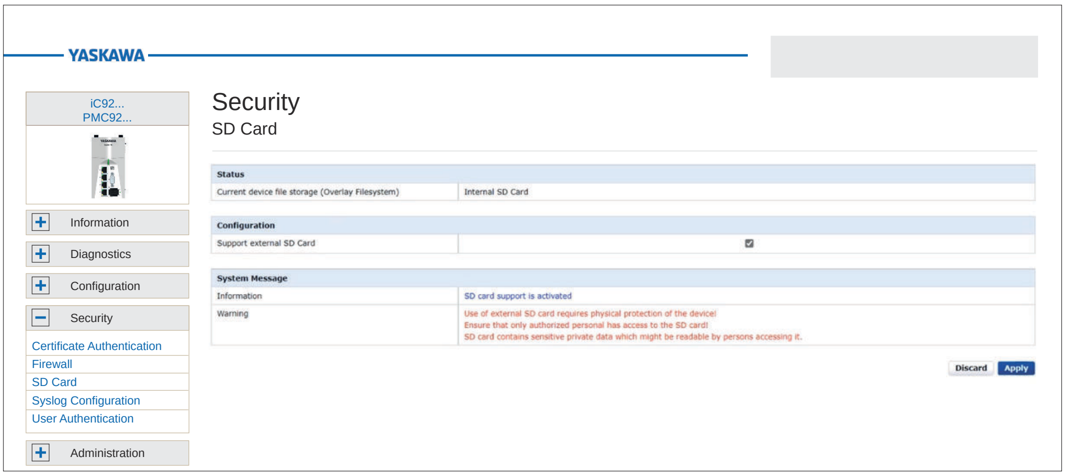
WARNING

Data loss - card removal only when the power supply is switched off!

- Only remove the Yaskawa SD card when the power supply of the CPU is switched off. Otherwise this will lead to data loss!
- If you remove the SD card during operation, the safety CPU switches to the safe state (failure State).

General notes on using the Yaskawa SD card

- *Only Yaskawa SD cards are supported.*
- *The cards are pre-formatted (ext4 format) for use in CPUs of the iC9200 Series.*
- *When formatting again, certain information on the Yaskawa SD card that is required for use in the CPUs of the iC9200 Series will be lost.*
- *Exclude the Yaskawa SD card from being formatted.*
- *The Yaskawa SD card can be read at any time with a conventional SD card reader. Sensitive data on the Yaskawa SD card can be read if you do not physically protect it from unauthorized access.*
- *Make sure that unauthorized persons cannot access the Yaskawa SD card.*



Security

SD Card

Status	
Current device file storage (Overlay Filesystem)	Internal SD Card

Configuration	
Support external SD Card	☑

System Message	
Information	SD card support is activated
Warning	Use of external SD card requires physical protection of the device! Ensure that only authorized personal has access to the SD card! SD card contains sensitive private data which might be readable by persons accessing it.

- Status
  - The status of the currently used file system of the CPU is shown here.
- Configuration
  - Here you can enable (default setting) or disable the support of the Yaskawa SD card by the CPU.
- System Message
  - Information on the current configuration and notes on potential security risks are shown here.
- [Apply] and [Discard]
  - With the [Apply] button the selection is saved at Configuration and accepted after a restart of the CPU.
  - You can discard your selection with the [Discard] button.

Enable SD card deployment

1. Enable the *'Support External SD card'* parameter.
2. Click on [Apply].
   ➨ The setting is saved and only applied when you restart the CPU.
3. Restart the CPU.
   ➨
   - The deployment of the Yaskawa SD card is enabled.
   - If a new Yaskawa SD card is detected during the initialization phase, the overlay file system with user program, configurations, user data and firmware adjustments, is moved from the internal parametrization memory to the Yaskawa SD card and deleted in the internal parametrization memory.
   - The CPU uses the overlay file system on the Yaskawa SD card, now.
   - At *'Status'* *'External SD card'* is shown.

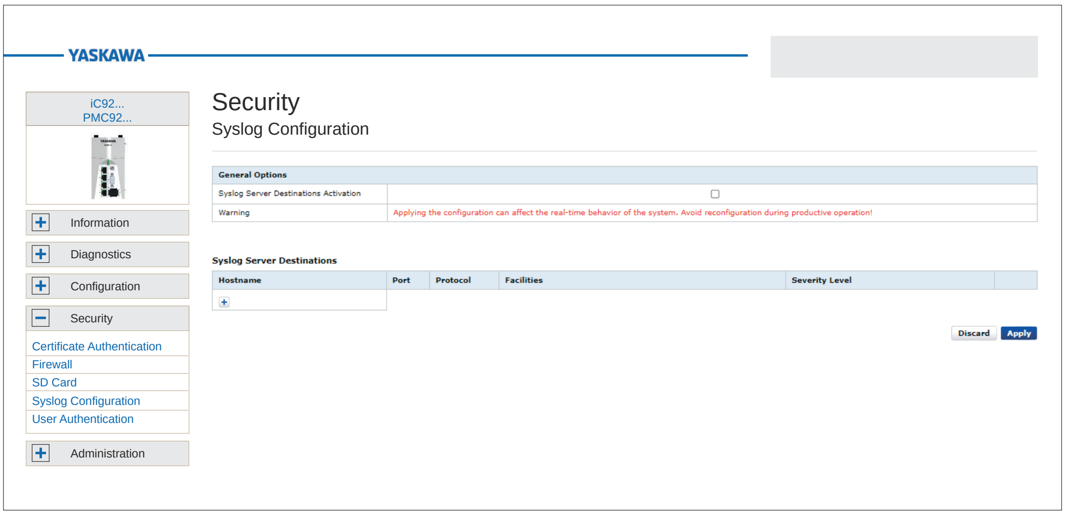
> ***Please note when using without an Yaskawa SD card!***
>
> – *By default, support for the Yaskawa SD card is enabled.*
>
> – *Disable the support of the Yaskawa SD card if you want to operate the CPU without YaskawaSD card.*
>
> – *If the support of the Yaskawa SD card remains enabled and the CPU is operated without a Yaskawa SD card, there is a risk of data theft or data manipulation.*
>
>   – *Unauthorized persons may insert a Yaskawa SD card and restart the CPU.*
>
>   – *If a new, unused Yaskawa SD card is detected after PowerON, the overlay file system with user program, configurations, user data and firmware adjustments, is moved from the internal parametrization memory to the Yaskawa SD card and deleted in the internal parametrization memory. Projects and IP configurations saved there are then no longer available!*
>
> – *When changing to operation without Yaskawa SD card, the overlay file system of the internal parametrization memory is activated by the CPU after PowerON and is used now. Please note that no data are used from the Yaskawa SD card. There is also no function for transferring back from the Yaskawa SD card to the internal parametrization memory.*

Disable SD card deployment

1. Disable the *'Support External SD card'* parameter.
2. Click on [Apply].
   ➨ The setting is saved and only applied when you restart the CPU.
3. Restart the CPU.
   ➨
   - The deployment of the Yaskawa SD card is disabled.
   - The Yaskawa SD card is not recognized by the CPU during the initialization phase and the overlay file system of the internal parametrization memory is enabled.
   - The CPU uses exclusively the internal parametrization memory, now.
   - At *'Status'* *'Internal SD card'* is shown.

6.5.4 Syslog Configuration

Here you can configure *Syslog* servers. *Syslog* respectively *Syslog-ng* is a standard for transmitting log messages in a network.



Security

Syslog Configuration

General Options	
Syslog Server Destinations Activation	□
Warning	Applying the configuration can affect the real-time behavior of the system. Avoid reconfiguration during productive operation!

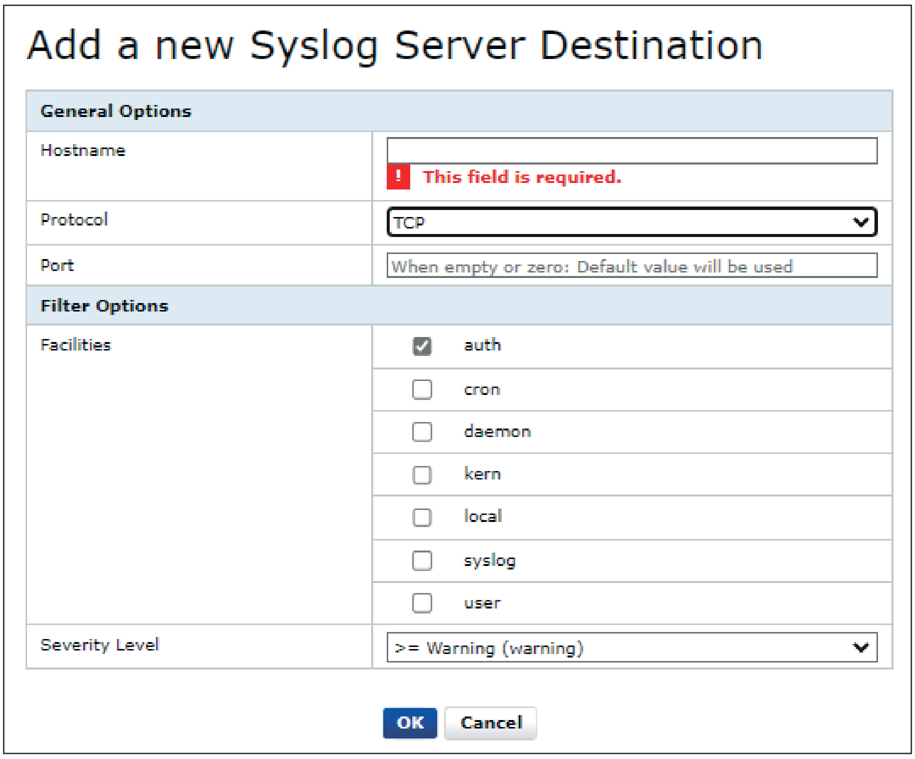
Syslog Server Destinations

Hostname	Port	Protocol	Facilities	Severity Level	
+					

Create Syslog server destination

1. To create a Syslog server destination, click at + at the bottom of the table.

   ➡ The dialog for configuring a Syslog server destination opens.



Add a new Syslog Server Destination

General Options	
Hostname	! This field is required.
Protocol	TCP
Port	When empty or zero: Default value will be used
Filter Options	
Facilities	☑ auth □ cron □ daemon □ kern □ local □ syslog □ user
Severity Level	>= Warning (warning)

2. Under *'General Options'* enter the following parameters:
   - Host Name
     – Host name respectively IP address of the Syslog server to which the log data is to be sent.
   - Protocol
     – Transmission protocol to the server. TLS is recommended for secure transmission; for this purpose, a trust store must be defined for verification. This can be done via ➦ *'Certificate Authentication'...page 190*.

       You can specify the corresponding Trust Store at *'Trust Store'*.
   - Port
     – Port over which the communication with the Syslog server is to take place. Ensure that the port is enabled in the firewall settings for outgoing requests. ➦ *'Firewall'...page 193*

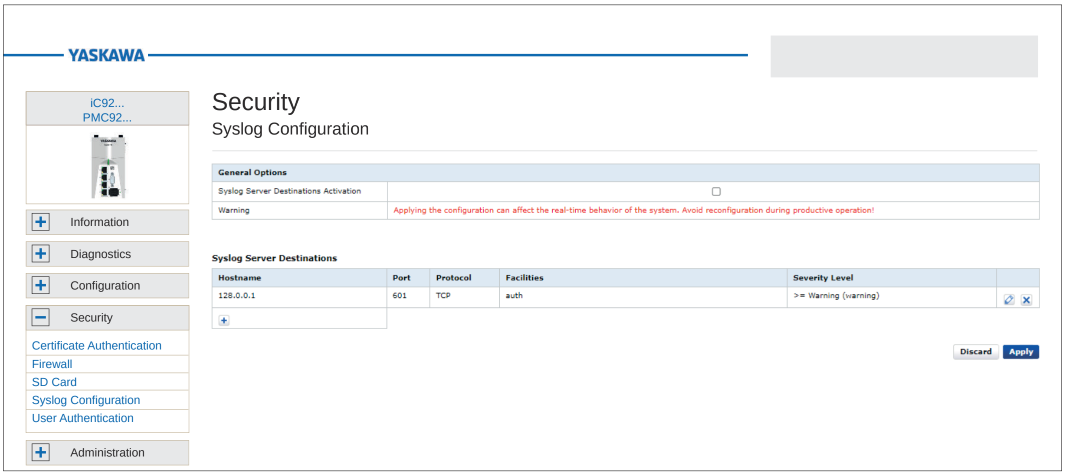
3. Specify the following parameters at Filter Options:
   - Facilities
     - Here you specify the system type of the log data.
   - Severity Level
     - Determine here the severity level from which the log data is sent to the Syslog server.
       Level 1: >= Internal (debug): All messages are sent.
       Level 2: >= Information (info): Messages >= level 2 are sent.
       Level 3: >= Warning (warning): Messages >= level 3 are sent.
       Level 4: >= Error (err): Messages >= level 4 are sent.
       Level 5: >= Critical Error (crit): Messages >= level 5 are sent.
       Level 6: >= Fatal Error (alert): Messages >= level 6 are sent.
       Level 7: Emergency (emerg) Only emergency messages are sent.

4. Click at [OK].

   ➡ The dialog is closed and the Syslog server is listed in the table.

   You can remove entries with ✕ and edit them with ✎ .

Enable or disable Syslog configuration



Security

Syslog Configuration

General Options	
Syslog Server Destinations Activation	□
Warning	Applying the configuration can affect the real-time behavior of the system. Avoid reconfiguration during productive operation!

Syslog Server Destinations

Hostname	Port	Protocol	Facilities	Severity Level	
128.0.0.1	601	TCP	auth	>= Warning (warning)	✎ ✕
+					

Discard Apply

1. By selecting or deselecting the control field of *'Syslog Server Destination Activation'* at *'Syslog Configuration'* you can enable respectively disable the Syslog server targets specified in the table.

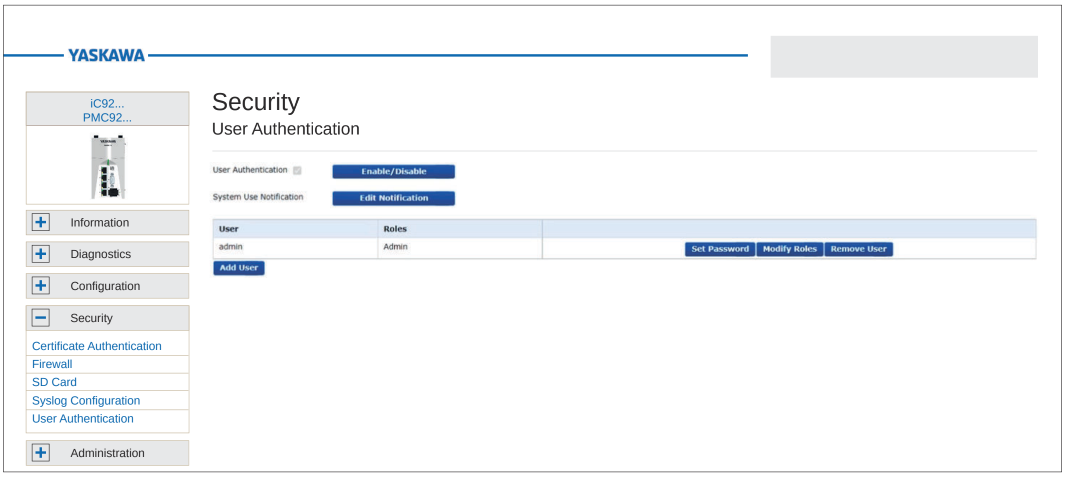
2. Click on [Apply].

   ➡ The settings are accepted.

6.5.5 User Authentication

- At *'User Authentication'* you can enable or disable user authentication.
- If user authentication is enabled, you have access to definable components of the CPU and functions in iCube Engineer exclusively by specifying user name and password.
- If user authentication is disabled, access takes place without a user query. The areas for the administrator remain password-protected.

> – *By default user authentication is enabled. On delivery, the "Admin" user is already created with administrator rights.*
>
> – *Please note that by disabling the user authentication you endanger the security of your system against unauthorized access!*
>
> – *Use the administrator password printed on the CPU only for the initial login to the WBM.*
>
> – *After you have successfully logged in, you should change the administrator password for security reasons.*



Security

User Authentication

User Authentication □

System Use Notification

User	Roles
admin	Admin

Enable/disable User Authentication

1. Click the [Enable/Disable] button next to User Authentication.

   ➡ The user authentication dialog is opened.

2. Here you can enable respectively disable the user authentication by selecting or deselecting the checkbox.

3. With [Save] the changes are applied and the dialog is closed.

Changing System Use Notification

Every time you log on to the CPU via WBM or iCube Engineer, System Use Notification is shown. You can edit this text for customization. The displayed information is independent of the language used for the user interface. You should therefore take into account all required languages when editing.

1. To edit, click [Edit Notification] next to System Use Notification.

   ➡ The dialog window for editing the text is opened.

2. Adjust your text accordingly.

3. With [Save] the changes are applied and the dialog is closed.

User management

User authentication is used to manage the access data of all users who are authorized to access the CPU and to assign the required access authorizations to each user. The user data of the newly created users are stored internally in the CPU.

Adding a user

1. Click the [Add User] button.

   ➡ The dialog window for creating a new user is opened.

2. Enter user name and password.

   > *When assigning user names and passwords, note the length restriction of 127 bytes for passwords and 63 bytes for user names. The characters are encoded with UTF-8 and the number of bytes used depends on which characters are entered. For normal characters (letters a-z or digits 0-9) 1 byte per character is used. Up to 4 bytes per character are used for special characters and umlauts. The length limit therefore limits the number of bytes and not the number of characters.*

3. With [Add] the new user is added to the list and the dialog is closed.

Removing a user

1. In the table behind the user entry that you want to remove, click on the [Remove User] button.

   ➡ A security query follows to remove the user entry.

2. With [Remove] the user entry is removed from the table and the dialog is closed.

Change password

1. Click the [Set Password] button in the table behind the user entry whose password you want to change.

   ➡ The dialog window for entering the password for the corresponding user entry is opened.

2. Enter your new password in the 2 input fields.
3. With [Save] the new password for the user entry is applied and the dialog is closed.

Modifying user roles

You can select one or more user roles with different permissions for each user entry. These permissions control access to:

- SD card / parametrization memory (param. memory) of the CPU
- Operating system
- iCube Engineer
- Web-based management - WBM
- OPC UA server of the CPU

1. Click the [Modify Roles] button in the table behind the user entry whose role you want to change.
   - ➡ The dialog window for assigning roles for the corresponding user entry opens.
2. Assign the corresponding roles to the user entry by selecting them.
3. With [Save] the selected roles for the user entry are applied and the dialog is closed.

User roles and their access rights

Access to SD card / param. memory	Admin	Security Admin	Security Auditor	Cert. Manager	User Manager	Engineer	Commissioner	Service	Data Viewer	Data Changer	Viewer	File Reader	File Writer
SFTP access to the file system with an FTP client Please note: Authentication with user name and password is always required for SFTP access, even if user authentication is disabled.	✓												

Accessing the operating system	Admin	Security Admin	Security Auditor	Cert. Manager	User Manager	Engineer	Commissioner	Service	Data Viewer	Data Changer	Viewer	File Reader	File Writer
SSH access to the operating system Please note: Authentication with user name and password is always required for SSH access, even if user authentication is disabled.	✓												

iCube Engineer	Admin	Security Admin	Security Auditor	Cert. Manager	User Manager	Engineer	Commissioner	Service	Data Viewer	Data Changer	Viewer	File Reader	File Writer
Show values in the cockpit (e.g. utilization).	✓	✓	✓			✓	✓	✓	✓	✓	✓		
Transfer the project to the CPU.	✓					✓	✓						
CPU stop / CPU cold/ warm/restart	✓					✓	✓	✓					
CPU restart (reboot).	✓												
CPU reset (default type 1).	✓												
Read online variables.	✓	✓	✓			✓		✓	✓	✓	✓		
Overwrite variables.	✓					✓		✓		✓			
Set and delete breakpoints.	✓					✓		✓					
Read CPU status.	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Read device information.	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Accessing WBM	Admin	Security Admin	Security Auditor	Cert. Manager	User manager	Engineer	Commissioner	Service	Data Viewer	Data Changer	Viewer	File Reader	File Writer
Information - General Data	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
Diagnostics - EtherCAT	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
Diagnostics - Motion Alarms	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
Diagnostics - Notifications	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
Diagnostics - PROFINET (optional)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
Diagnostics - SliceBus	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
Diagnostics - SliceBus Modules	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
Configuration - Network	✓	✓	✓[1]			✓[1]	✓[1]	✓[1]					
Configuration - Date and Time	✓	✓	✓[1]	✓[1]	✓[1]	✓[1]	✓[1]	✓[1]	✓[1]	✓[1]	✓[1]		
Configuration - System Services	✓	✓											
Configuration - Web Services	✓	✓											
Security - Certificate Authentication	✓	✓		✓									
Security - Firewall	✓	✓											
Security - SD Card	✓	✓											
Security - Syslog Configuration	✓	✓											
Security - User Authentication	✓	✓			✓								
Administration - iCube Apps	✓	✓				✓							
Administration - Firmware Update	✓	✓											

Accessing WBM	Admin	Security Admin	Security Auditor	Cert. Manager	User manager	Engineer	Commissioner	Service	Data Viewer	Data Changer	Viewer	File Reader	File Writer
Administration - License Management	✓	✓											

Accessing OPC UA server	Admin	Security Admin	Security Auditor	Cert. Manager	User Manager	Engineer	Commissioner	Service	Data Viewer	Data Changer	Viewer	File Reader	File Writer
Read online variables.	✓	✓				✓		✓	✓	✓	✓		
Write online variables.	✓					✓		✓		✓			
Read files.	✓											✓[2]	
Write files.	✓												✓[3]

1) Read access only.

2) FileReader can only read files via an OPC UA client if the OPC UA file transfer is activated in iCube Engineer. Information on this can be found in the iCube Engineer online help.

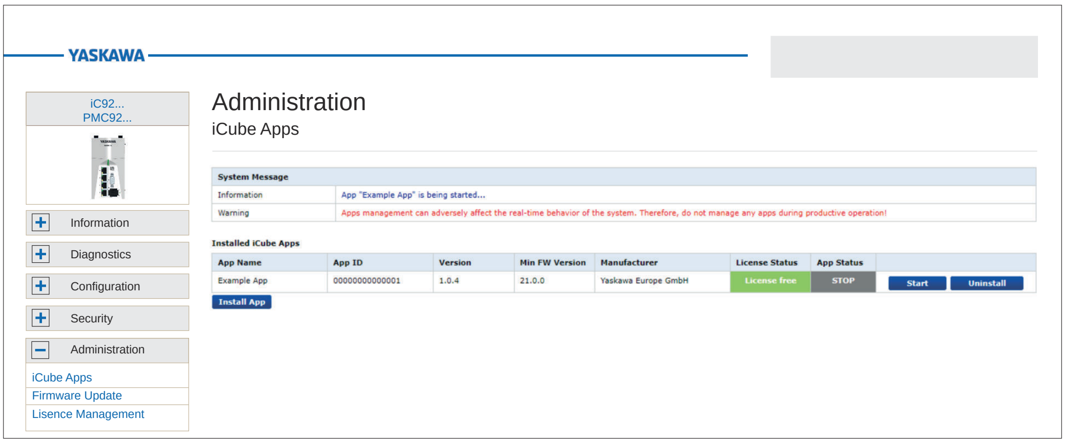
3) FileWriter can only write files via an OPC UA client if the OPC UA file transfer is activated in iCube Engineer. Information on this can be found in the iCube Engineer online help.

6.6 Administration

6.6.1 iCube Apps

Installed iCube Apps

Here you can install and uninstall apps. After successful installation, you can also start and stop the apps from here. iCube Apps are software applications ranging from libraries to complete programmes provided to you by Yaskawa.



Administration

iCube Apps

System Message	
Information	App "Example App" is being started...
Warning	Apps management can adversely affect the real-time behavior of the system. Therefore, do not manage any apps during productive operation!

Installed iCube Apps

App Name	App ID	Version	Min FW Version	Manufacturer	License Status	App Status	
Example App	00000000000001	1.0.4	21.0.0	Yaskawa Europe GmbH	License free	STOP	Start Uninstall

All installed apps are listed in the table with additional app-specific information.

- App Name
  - Name of the App.
- App ID
  - Unique identifier of the app.
- Version
  - Version of the app
- Min FW Version

  - Firmware version of the CPU from which the app can be used.
- Manufacturer
  - Manufacturer of the App.
- License Status
  - License status of the app.

Information and warning messages are listed under *'System Message'*.

> ℹ
> - *Additional apps can have a negative impact on real-time behavior.*
> - *Please note that a licence may be required for installation or use.*

Installing an app

To install an app, proceed as follows:

1. Click at [Install App].
2. In the file explorer that opens, select the app (*.app) to be installed.
3. Click at [Open].
   ➡ The selected app container is now sent to the controller and installed. After successful installation, the app is listed in the Installed iCube Apps table.

Starting an app

➤ To start an app, click in the table *'Installed iCube Apps'* at [Start] behind the corresponding app.
   ➡ The app is started and the app status *'RUN'* in the column *'App Status'* is shown.

> ℹ *Please note that starting multiple apps may require a CPU restart. You will be informed of the impending restart by a dialog that opens.*

Quit an app

➤ To quit an app, click in the table *'Installed iCube Apps'* at [Stop] behind the corresponding app.
   ➡ The app is quit and the app status *'Stop'* in the column *'App Status'* is shown.

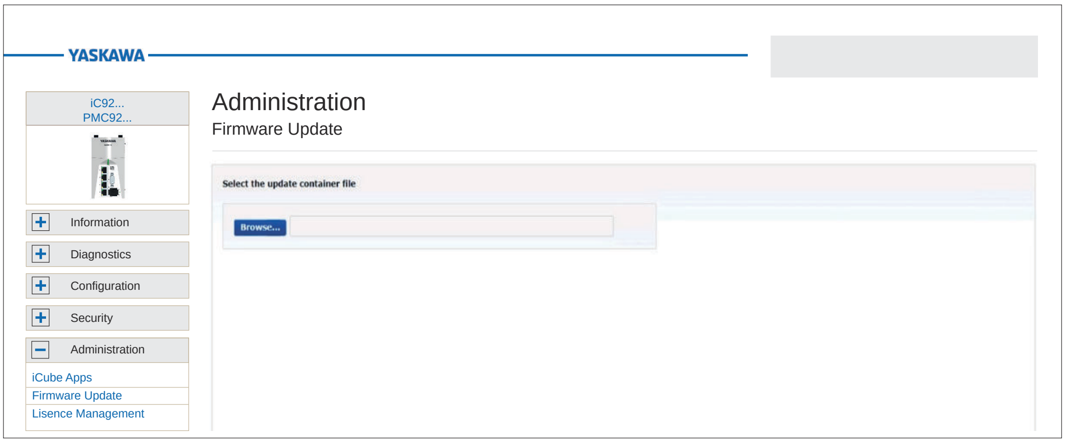
Uninstalling an app

1. To uninstall an app, you must quit it first. To do this, click in the table *'Installed iCube Apps'* at [Stop] behind the corresponding app.
2. To uninstall, click the following in the table *'Installed iCube Apps'* at [Uninstall] behind the corresponding app.
   ➡ After a security prompt, the corresponding app is uninstalled.

6.6.2 Firmware Update

Here you can execute a firmware update on your CPU.

> *Please note that you can only execute a firmware update with administrator rights!*



Administration

Firmware Update

Select the update container file

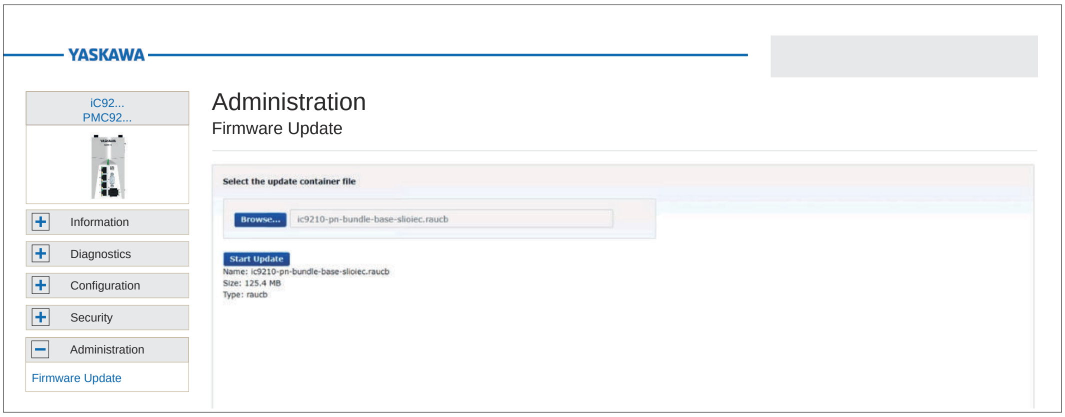
Proceeding

> **CAUTION**
>
> When installing a new firmware you have to be extremely careful. Under certain circumstances you may destroy the CPU, for example if the voltage supply is interrupted during transfer or if the firmware file is defective. In this case, contact our support!

You can find the currently installed firmware version of your CPU in the WBM at *'Information → General Data'*. Here you can also check whether the firmware update was successful.➦ *'General Data'...page 176*

1. The latest firmware can be found in the *'Download Center'* of www.yaskawa.eu.com under the corresponding order number.

   Load the current firmware file into your working directory.
2. Unzip the zip file.
3. Go back to the WBM to *'Firmware Update'* and click on [Browse...].
   - ➡ A file selection window is opened.
4. Navigate to the unzipped raucb file and click on [Open].
   - ➡ The firmware file to be installed is loaded and shown in the WBM.



Administration

Firmware Update

Select the update container file

ic9210-pn-bundle-base-slioiec.raucb

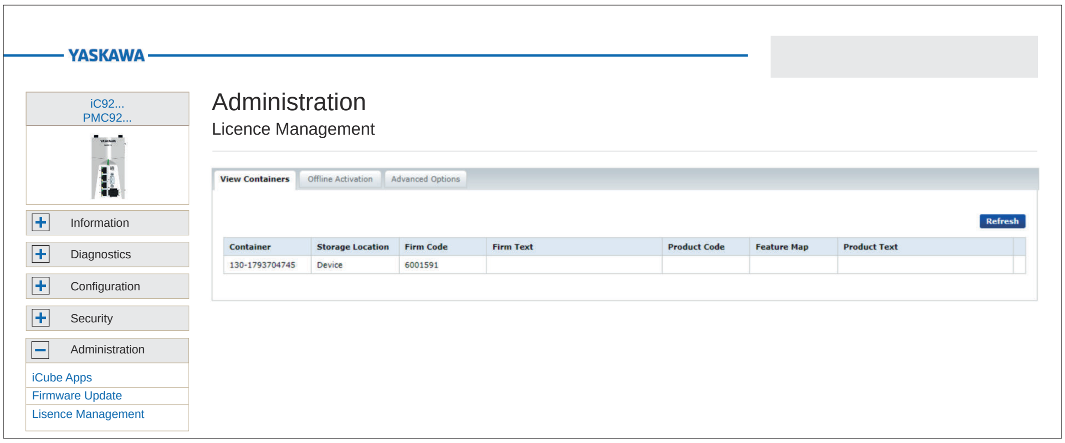
Name: ic9210-pn-bundle-base-slioiec.raucb
Size: 125.4 MB
Type: raucb

5. Click on [Start Update].
   - ➡ The firmware file is transferred to the CPU and the firmware update is started. The status of the file transfer and the status of the update process are shown in the WBM as a progress bar.
6. The connection to the CPU is interrupted during the firmware update. After the start-up of the CPU you have to log on to the WBM of the CPU again. This will refresh the WBM pages.
7. To check the firmware update, in WBM, go to *'Information → General Data'* page. ➦ *'General Data'...page 176*
   - ➡ The new firmware version should be shown here. Otherwise start the update again. If the update does not work, please contact our support.

6.6.3 License Management

Tab: *'View Containers'*

Here you can view and manage the licenses that are installed on the CPU. Several licenses can be combined in one *'container'*.



Administration

Licence Management

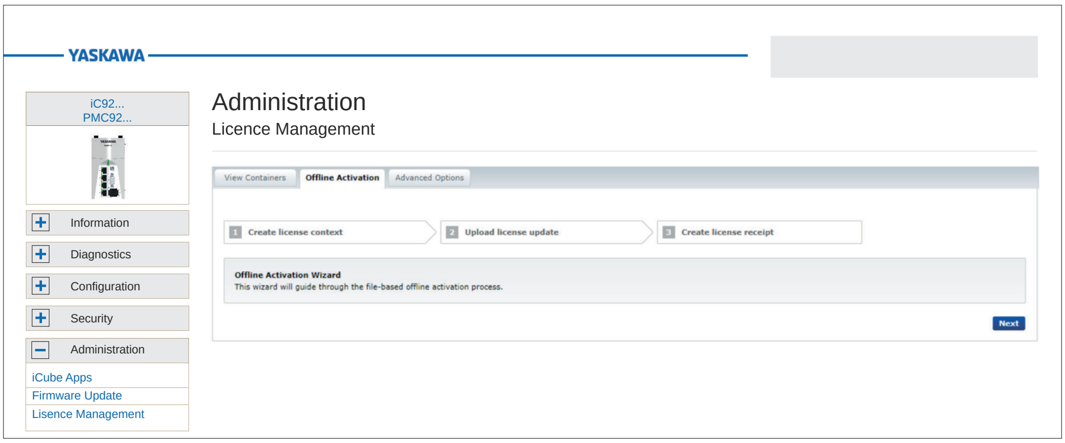
Container	Storage Location	Firm Code	Firm Text	Product Code	Feature Map	Product Text
130-1793704745	Device	6001591				

In the table all containers with the licenses are listed. The [Refresh] button reloads the list.

- Container
  - Serial number of the container in which the licenses are managed.
- Storage Location
  - Storage location where the container is stored.
- Firm Code
  - Identification number of the licensor.
- Firm Text
  - Description of the licensor.
- Product Code
  - Unique identification code of the licensed software.
- Feature Map
  - Information on the functional scope of the software.
- Product Text
  - Description of the license.

Tab: *'Offline Activation'*

Here you can activate a previously purchased license offline by means of a license file. The term "offline" in this context means that the CPU on which the licensed software is running does not have to be connected to the Internet. The offline activation wizard guides you through the activation process and provides further information.



Administration

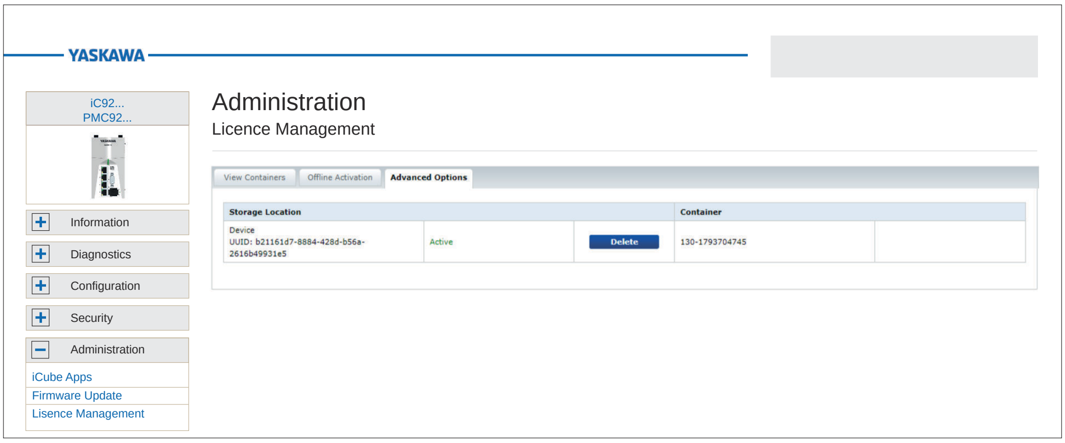
Licence Management

Offline Activation Wizard
This wizard will guide through the file-based offline activation process.

Tab: *'Advanced Options'*

With the button [Create Container] you can create a new license container for your licence files. To delete the corresponding container, click on the corresponding button [Delete].

> *Please note that you cannot undo the deletion of a license container! You should only carry out this action on the instructions of Yaskawa support!*



Administration

Licence Management

Storage Location			Container	
Device UUID: b21161d7-8884-428d-b56a-2616b49931e5	Active	Delete	130-1793704745	

Steps of activation

You have received a license key from Yaskawa. The activation of the license in your CPU takes place according to the following procedure:

1. If there is no container for licenses yet, create one under *'Administration → License Management → Tab: Advanced Options'* and click at [Create Container] to create a new container.
2. Go to the tab: *'Offline Activation'*.
3. Download the corresponding *'licence context file'**.WibuCmRaC to your PC with ⬇ and start the activation process via the button [Next].
4. On your PC, open the web page ➦ *https://lc.codemeter.com/74390/depot/index.php*.
5. Enter your license key at Ticket and click at [Next].
   ➡ Your license is listed.
6. Click at [Activate Licenses].
   ➡ The wizard for activation via file transfer is opened.
7. Mark the relevant license with ☑ .

8. Select the previously loaded *'license context'* file *.WibuCmRaC and click at [Start Activation Now].

9. Click at [Download License Update File Now] and save the *'Licence update'* as a *.WibuCmRaU file on your PC.

10. Switch back to the tab *'Offline Activation'* in the WBM, select the *.WibuCmRaU file and click at [Upload].

    ➡ The license update is added to the license container.

11. Download the "Licence receipt" as a *.WibuCmRaR file to your PC with ⬇ .

12. Switch back to the wizard from ➦ *https://lc.codemeter.com/74390/depot/index.php*.

13. Select the *.WibuCmRaR file and click at [Upload Receipt Now] and click at [Next].

    ➡ The licence is activated and listed at *'My Licenses'* as *'Activated'*.

14. Restart your CPU.

    ➡ After the start-up, the functionalities activated by means of a license are available.

ℹ *Please note that if you have purchased a PROFINET license, you must activate the PROFINET functionality in WBM in the configuration after activation.* ➦ *'System Services'...page 187*

7 Appendix

Checklists - Deployment CPU iC921xM-FSoE

A Checklist planning

Checklist

Run. No.	Requirement	fulfilled		Notes
1	Planning	yes	no	
1.1	Was a risk evaluation established and were the required SIL and performance level according to DIN EN ISO 13849-1 or IEC 62061 determined?			
1.2	Are exclusively power supplies used according to PELV/SELV specification?			
1.3	Does the wiring take place after valid standards and guidelines?			
1.4	Is the power supply for the local I/O modules and field bus components correctly dimensioned?			
1.5	Do all the safety-related system components fulfill the requirements of the determined SIL (IEC 61508), performance level (DIN EN ISO 13849-1) and safety category (DIN EN 954-1)?			
1.6	Does the wiring of the safety components correspond to the requirements of the safety classification specified before?			
1.7	Do the performance data of the safety CPU correspond to the specifications of the application? ➦ *'Technical data'...page 69*			
1.8	Do the components fulfill the environmental conditions of the application?			
1.9	Does the system fulfill the necessary degree of protection?			
1.10	Is degree of pollution 2 kept?			
1.11	Was the maximally permissible response time of the safety functions determined by a hazard analysis?			
1.12	Is the maximally permissible response time reached? Was the proof established by means of a calculation?			
1.13	Is the system protected against mechanical overloading?			
1.14	Is the system protected against aggressive media?			
1.15	Are the specified electrical values of the output terminals kept?			
1.16	Are all the electromechanical sensors supplied with clock pulses for the recognition of short-circuits?			
1.17	Was a list created, which contains all the parameters of the devices and its settings?			

Further information can be found at ➦ *'Sample application'...page 136*.

Date:.........................Name: ....Sign: ....

B Checklist installation

Checklist

Run. No.	Requirement	fulfilled		Notes
2	Installation	yes	no	
2.1	Do the components fulfill the environmental conditions of the application?			
2.2	Does the system fulfill the necessary degree of protection?			
2.3	Is degree of pollution 2 kept?			
2.4	Is the system protected against aggressive media?			
2.5	Are exclusively power supplies used according to PELV/SELV specification?			
2.6	Is it guaranteed that the safety switch devices are not short-circuited due to a wiring fault?			
2.7	Is it guaranteed that the safety switch devices are not short-circuited due to a wiring fault?			
2.8	Was the wiring checked by means of the installation plan?			
2.9	Are all the plugs labelled according to their allocation?			
2.10	Are the connecting terminals with screws applied with the specified breakaway torque?			
2.11	Is guaranteed that the isolation of the lines does not lead to a faulty contact?			
2.12	Was the reliability of all the clamp connections controlled by a mechanical tensile load?			
2.13	Was a visual inspection for any mechanical damage to the installed components done?			
2.14	Were necessary installation distances kept to other components?			
Date:........................Name: ....Sign:				

C Checklist commissioning, parametrization and validation

Checklist

Run. No.	Requirement	fulfilled		Notes
3	Commissioning	yes	no	
3.1	Is guaranteed that all safe communication participants of a system have a clear safe device address (F-address)? This is valid also for participants, which belong to different safety controllers, if the controllers are connected by gateways (e.g. Ethernet).			
3.2	Was the cycle time T_{CI} of the safety CPU determined and adjusted in the safety CPU? ➦ *'Cycle time T_{CL} safety CPU'...page 134*			
3.3	Was the maximum response time with the adjusted cycle time T_{CI} proofed by calculation? ➦ *'Response times'...page 131*			
3.4	Were the device parameters of the safety I/O modules validated? ➦ *'Validation of the system'...page 121*			
3.5	Was the correct project selected?			
3.6	Was a review of the safety programme done?			
3.7	Were the project data copied on a memory card?			
3.8	Was a complete functional test accomplished and documented?			
3.9	Was your engineering project documented and archived legally compliant?			
3.10	Was the service personnel instructed into the handling of the control system?			
Date:.........................Name: ....Sign:				

D Checklist operation

Checklist

Run. No.	Requirement	fulfilled		Notes
4	Operation	yes	no	
4.1	Is it guaranteed that no changes are made to the system configuration during operation of the safety CPU?			
4.2	Is it guaranteed that before expanding the system, removing individual system components and making changes to the wiring, the control system is set to a safe state dependent on the application by competent personnel?			
4.3	Are the ambient conditions specified in the technical data observed? ➦ *'Technical data'...page 69*			
4.4	Is the lifetime of all safety-related components specified by the manufacturer observed?			
4.5	Is it guaranteed that commissioning only takes place after acclimatisation of the safety CPU and the safety modules?			
4.6	Is it guaranteed that a PC system with executable iCube Engineer is available during the entire operating time?			
Date: .... Name: .... Signature:				

E Checklist modification and retrofitting

Checklist

Run. No.	Requirement	fulfilled		Notes
5	Modification and retrofitting	yes	no	
5.1	Is the modification/retrofitting compatible? Are the requirements of the checklists of planning, installation, commissioning and validation further fulfilled? ➦ *'Checklist planning'...page 215* ➦ *'Checklist installation'...page 216* ➦ *'Checklist commissioning, parametrization and validation'...page 217*			
5.2	Was the safety component to be replaced exchanged for a compatible safety component?			
5.3	If non-safety components are changed, is the checksum unchanged?			
5.4	Was the correct security project loaded?			
5.5	Are the calculated reaction times further kept after modification/retrofitting? Proof necessary!			
5.6	Were the project data copied on a memory card?			
5.7	Was a complete functional test accomplished and documented?			

Date:.........................Name: ....Sign: ....

F Checklist decommissioning

Checklist

Run. No.	Requirement	fulfilled		Notes
6	Decommissioning	yes	no	
6.1	Is it guaranteed that the decommissioning is done by authorized and qualified personnel?			
6.2	Has the power supply been switched off at the device to be decommissioned?			
6.3	Has the wiring been removed from the device to be decommissioned?			
	Has the disassembly been carried out according to the disassembly description? ➦ *'Demounting'...page 43*			
6.4	Is it guaranteed that the defective decommissioned device is sent to Yaskawa for disposal in its original packaging?			
Date: .... Name: .... Signature:				