VIPA System SLIO

CPU | 015-CEFNR00 | Manual

HB300 | CPU | 015-CEFNR00 | GB | 16-03

SPEED7 CPU 015N

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015-CEFNR00_000_CPU 015N,2,GB - © 2016

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1 General

1.1 Copyright © VIPA GmbH

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1.2 About this manual

Objective and contents

This manual describes the CPU 015N of the System SLIO from VIPA. It contains a description of the construction, project implementation and usage.

Product	Order no.	as of state:		
		CPU HW	CPU FW	CP FW
Basic CPU 015N	015-CEFNR00	01	V1.3.5	V3.0.5

Target audience

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

Structure of the manual

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

Guide to the document

The following guides are available in the manual:

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

Availability

The manual is available in:

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

Icons Headings

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

DANGER!
Immediate or likely danger. Personal injury is possible.

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

Supplementary information and useful tips.

1.3 Safety information

Applications conforming with specifications

The system is constructed and produced for:

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

DANGER!
This device is not certified for applications in

– in explosive environments (EX-zone)

Documentation

The manual must be available to all personnel in the

- project design department
- installation department
- commissioning
- operation

CAUTION!

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

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

Disposal

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

2 Basics and mounting

2.1 Safety information for users

Handling of electrostatic sensitive modules

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

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

Shipping of modules

Modules must be shipped in the original packing material.

Measurements and alterations on electrostatic sensitive modules

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

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

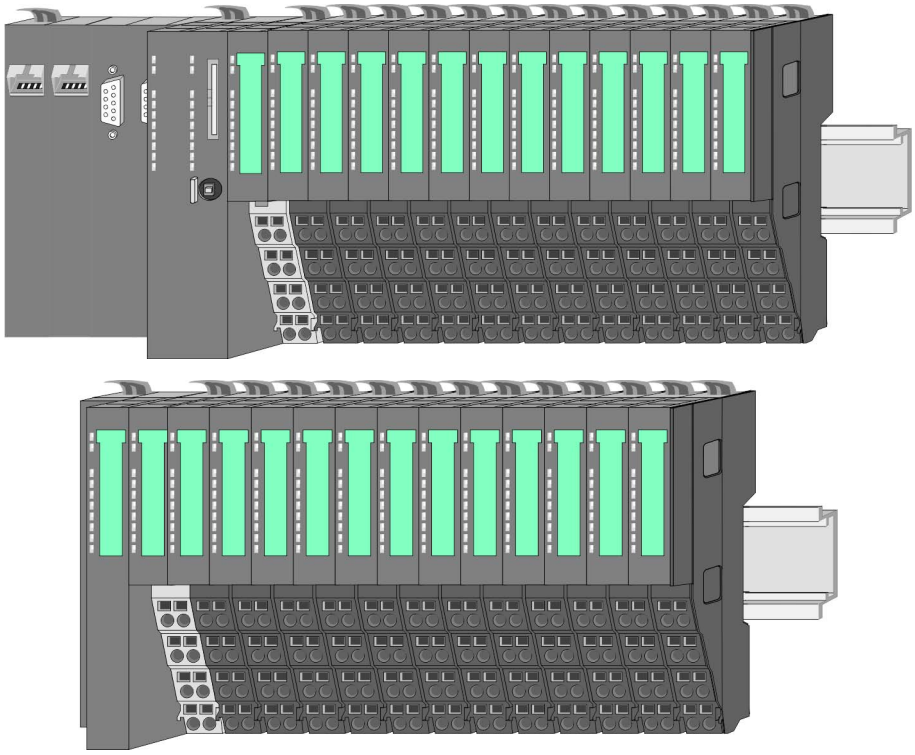
Modifying electrostatic sensitive modules you should only use soldering irons with grounded tips.

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

2.2 System conception

2.2.1 Overview

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



2.2.2 Components

- CPU (head module)
- Bus coupler (head module)
- Line extension
- Periphery modules
- Accessories

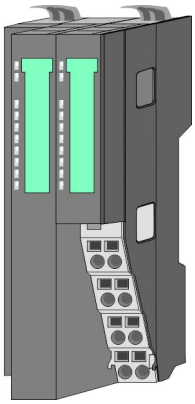
CAUTION!
Only modules of VIPA may be combined. A mixed operation with third-party modules is not allowed!

CPU 01x

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

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

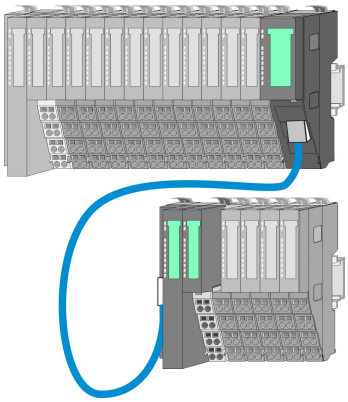
Bus coupler



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

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

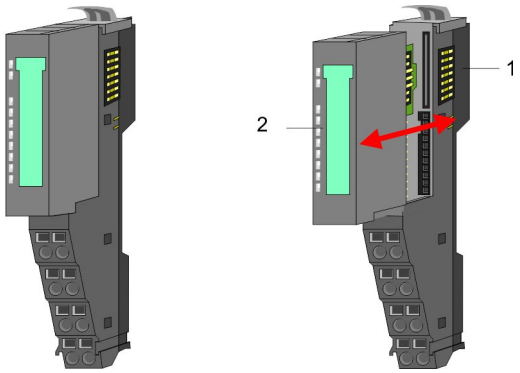
Line extension



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

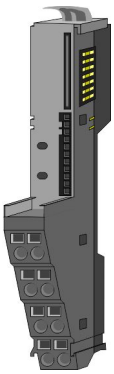
Periphery modules

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



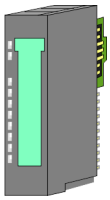
1 Terminal module
2 Electronic module

Terminal module



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

Electronic module

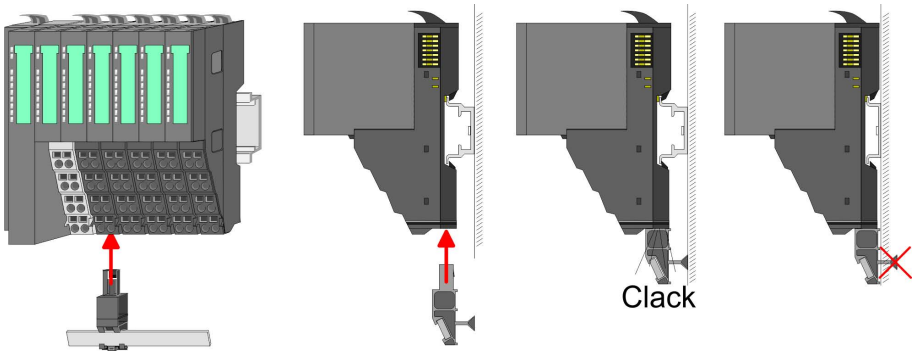


The functionality of a SLIO periphery module is defined by the *electronic* module, which is mounted to the terminal module by a sliding mechanism. With an error the defective module may be exchanged for a functional module with standing installation. At the front side there are LEDs for status indication.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

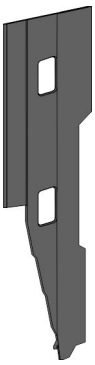
2.2.3 Accessories

Shield bus carrier

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

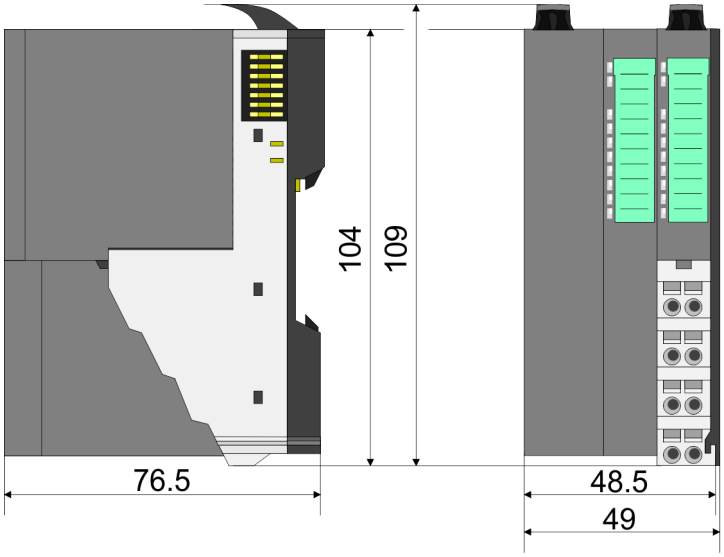
Coding pins

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

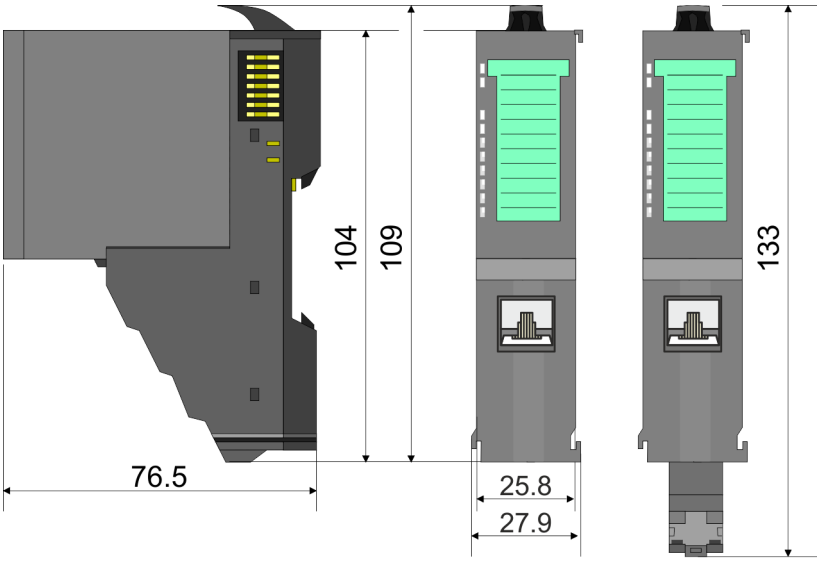
2.3 Dimensions

Dimensions CPU 01x

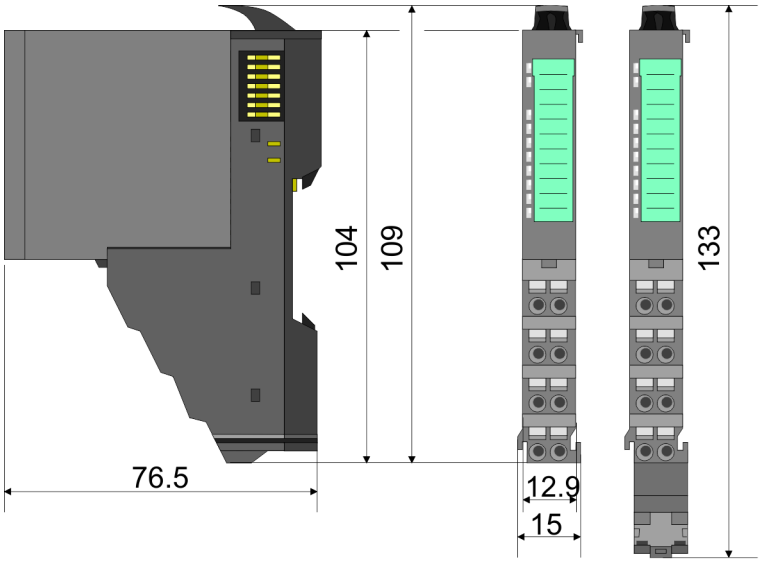
Dimensions bus coupler and line extension slave



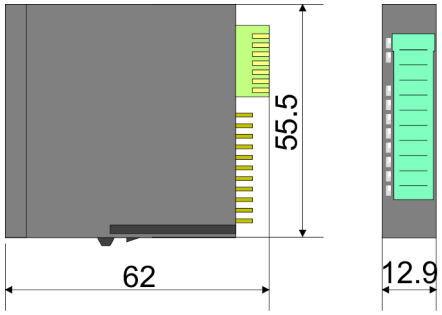
Dimensions line extension master



Dimension periphery module



Dimensions electronic module

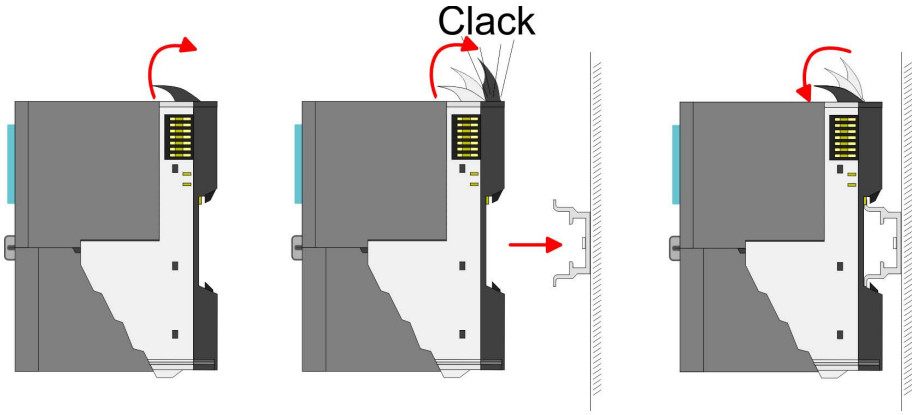


Dimensions in mm

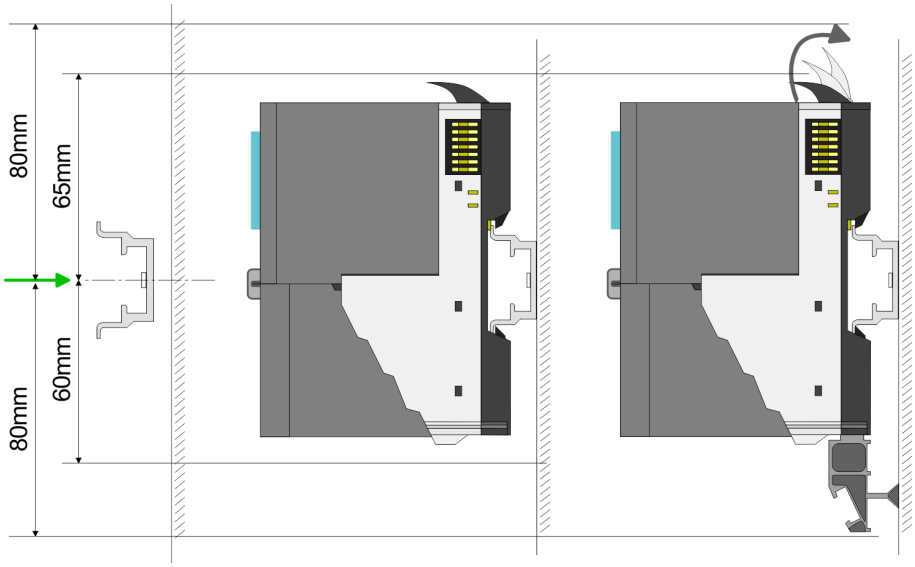
2.4 Mounting

2.4.1 Mounting CPU 01x

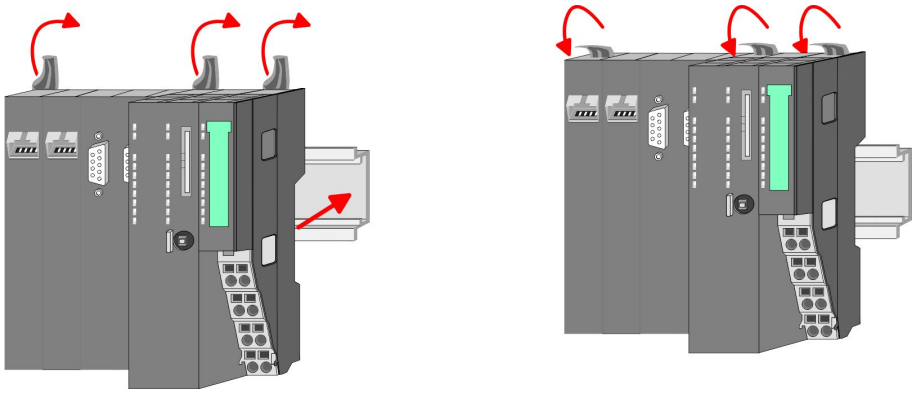
There are locking lever at the top side of the CPU. For mounting and demounting these locking lever are to be turned upwards until these engage. Place the CPU at the mounting rail. The CPU is fixed to the mounting rail by pushing downward the locking levers. The CPU is directly mounted at a mounting rail. Up to 64 modules may be mounted. The electronic and power section supply are connected via the backplane bus. Please consider here that the sum current of the electronic power supply does not exceed the maximum value of 3A. By means of the power module 007-1AB10 the current of the electronic power supply may be expanded accordingly.



Proceeding

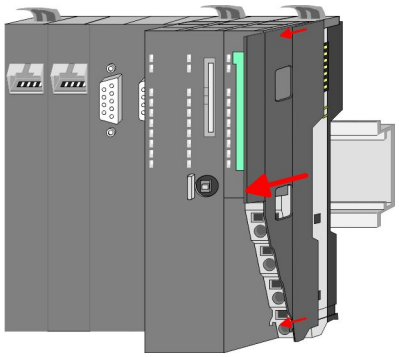


1. Mount the mounting rail! Please consider that a clearance from the middle of the mounting rail of at least 80mm above and 60mm below, respectively 80mm by deployment of shield bus carriers, exist.

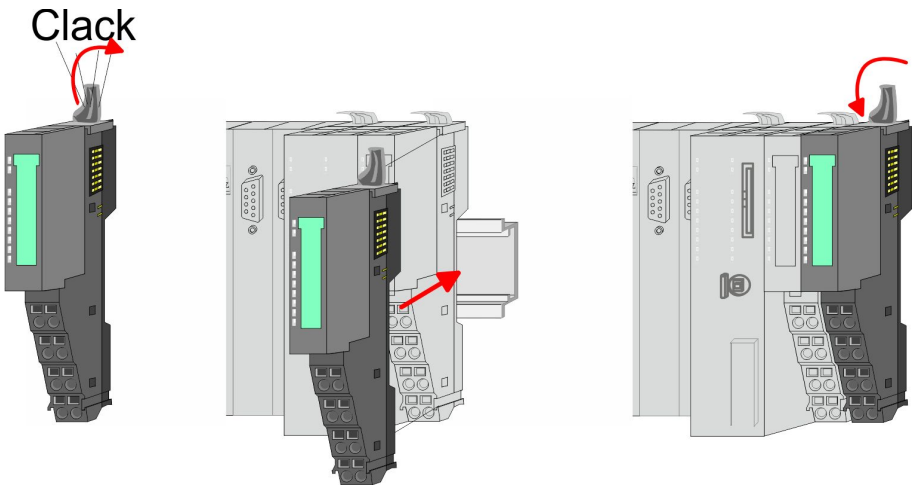


2. Turn the locking lever upwards, place the CPU at the mounting rail and turn the lever downward.

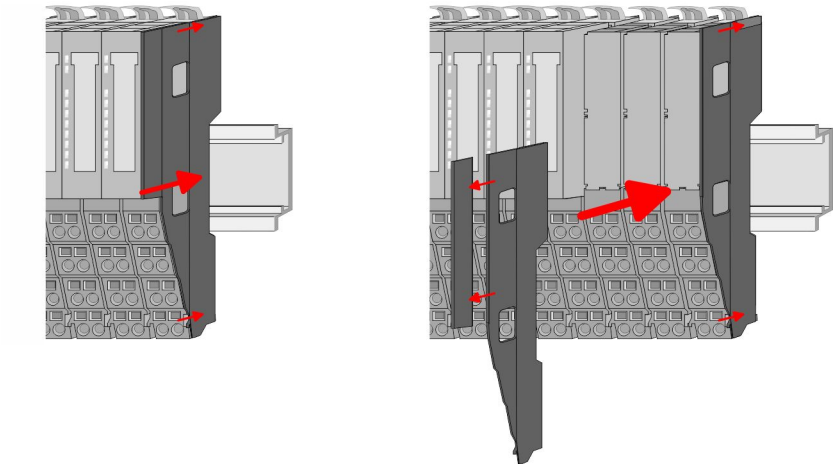
Mounting periphery modules



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.



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

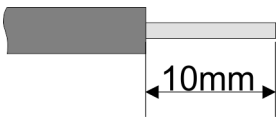
2.5 Wiring

2.5.1 Wiring CPU 01x

Terminal module terminals

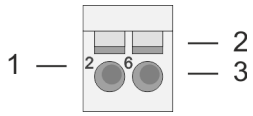
The System SLIO CPUs have a power module integrated. Terminals with spring clamp technology are used for wiring. The spring clamp technology allows quick and easy connection of your signal and supply lines.

Data

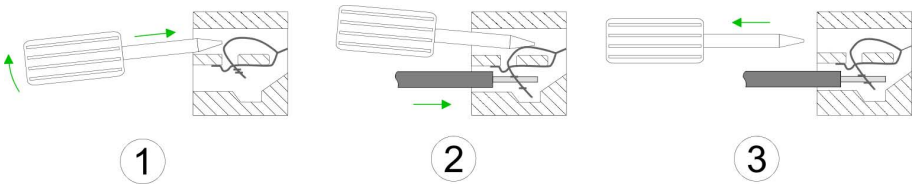


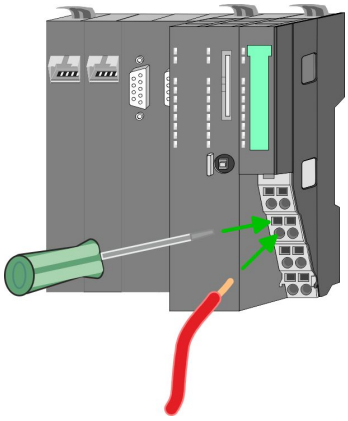
U_{max}	240V AC / 30V DC
I_{max}	10A
Cross section	0.08 ... 1.5mm^2 (AWG 28 ... 16)
Stripping length	10mm

Wiring procedure



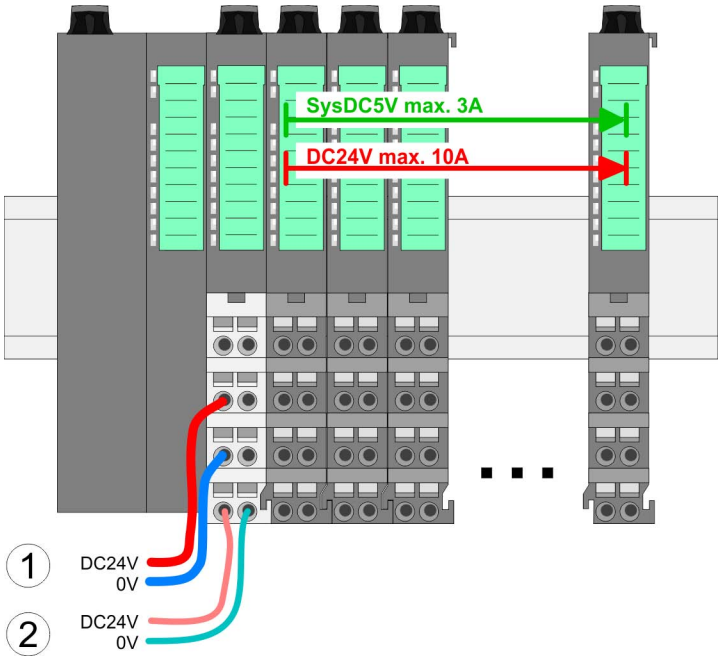
1 Pin number at the terminal module
2 Opening for screwdriver
3 Connection hole for wire





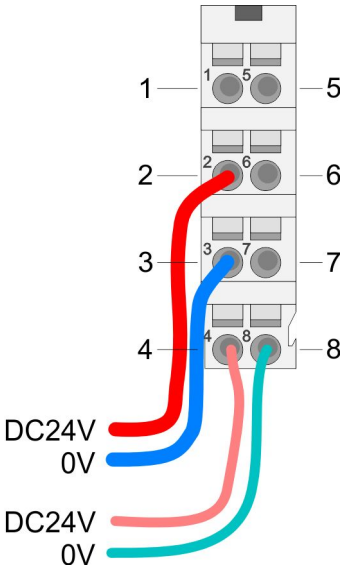
1. Insert a suited screwdriver at an angel into the square opening as shown. Press and hold the screwdriver in the opposite direction to open the contact spring.
2. Insert the stripped end of wire into the round opening. You can connect wires with a cross section of 0.08mm^2 up to 1.5mm^2.
3. By removing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

Standard wiring



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

PM - Power module



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

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

I: Input

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

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

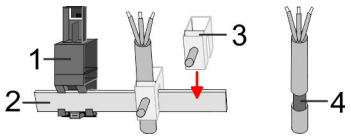
Fusing

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

State of the electronic power supply via LEDs

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

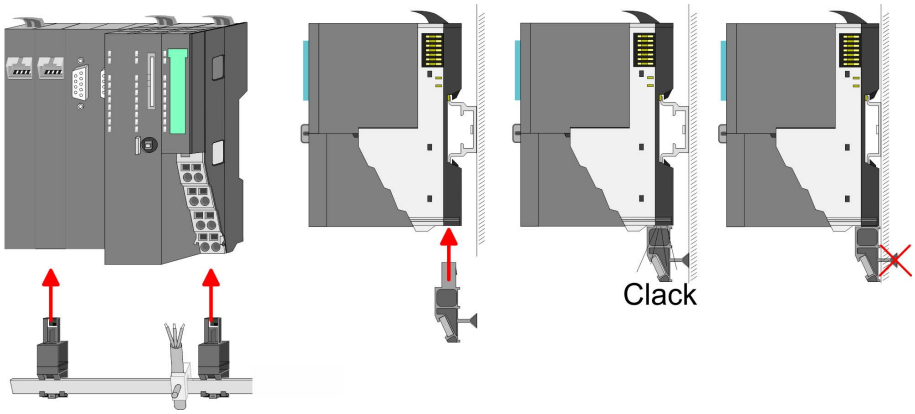
Shield attachment



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

To attach the shield the mounting of shield bus carriers are necessary. The shield bus carrier (available as accessory) serves to carry the shield bus to connect cable shields.

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



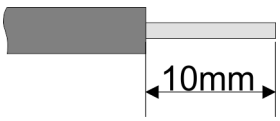
3. Attach the cables with the accordingly stripped cable screen and fix it by the shield clamp with the shield bus.

2.5.2 Wiring periphery modules

Terminal module terminals

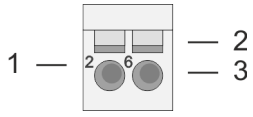
With wiring the terminal modules, terminals with spring clamp technology are used for wiring. The spring clamp technology allows quick and easy connection of your signal and supply lines. In contrast to screw terminal connections this type of connection is vibration proof.

Data

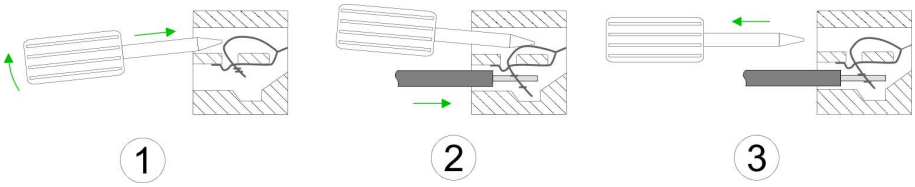


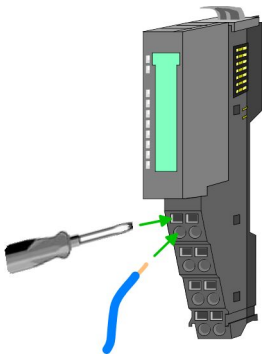
U_{max}	240V AC / 30V DC
I_{max}	10A
Cross section	0.08 ... 1.5mm^2 (AWG 28 ... 16)
Stripping length	10mm

Wiring procedure



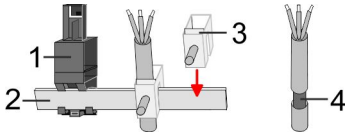
1 Pin number at the connector
2 Opening for screwdriver
3 Connection hole for wire





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.

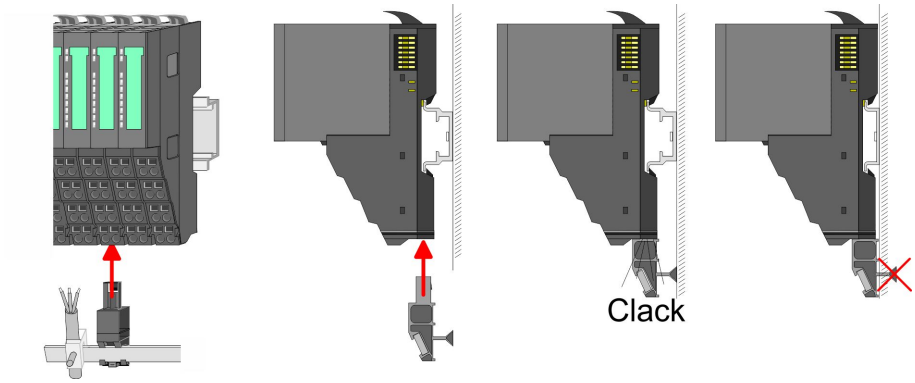
Shield attachment



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

To attach the shield the mounting of shield bus carriers are necessary. The shield bus carrier (available as accessory) serves to carry the shield bus to connect cable shields.

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



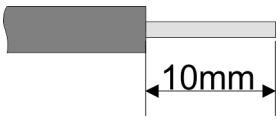
3. Attach the cables with the accordingly stripped cable screen and fix it by the shield clamp with the shield bus.

2.5.3 Wiring power modules

Terminal module terminals

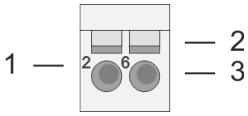
Power modules are either integrated to the head module or may be installed between the periphery modules. With power modules, terminals with spring clamp technology are used for wiring. The spring clamp technology allows quick and easy connection of your signal and supply lines. In contrast to screw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

Data

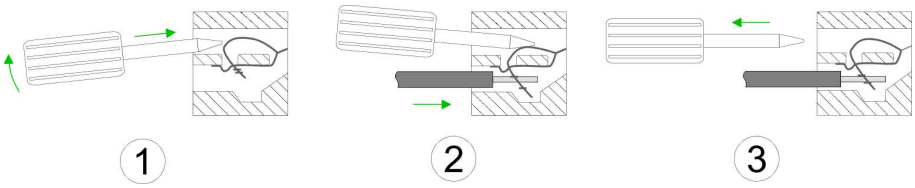


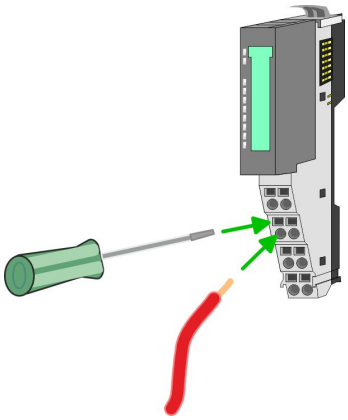
U_{max}	240V AC / 30V DC
I_{max}	10A
Cross section	0.08 ... 1.5mm^2 (AWG 28 ... 16)
Stripping length	10mm

Wiring procedure



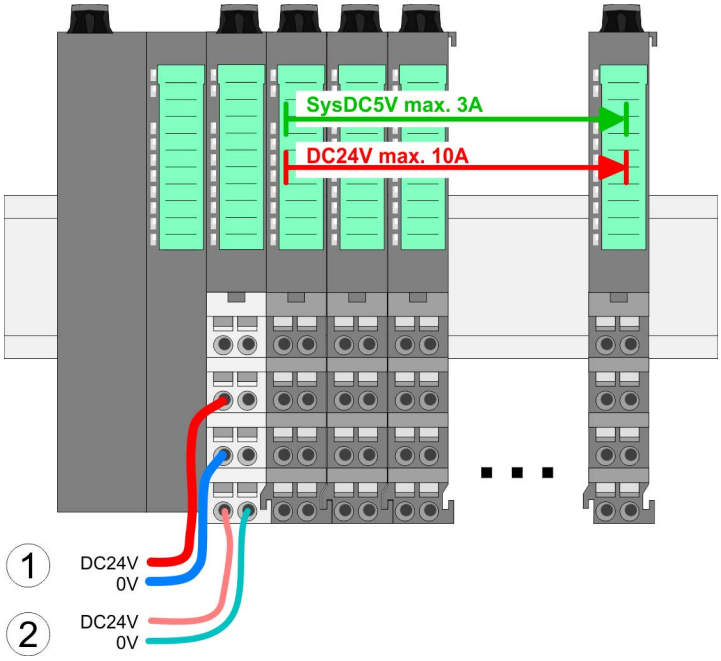
1 Pin number at the connector
2 Opening for screwdriver
3 Connection hole for wire





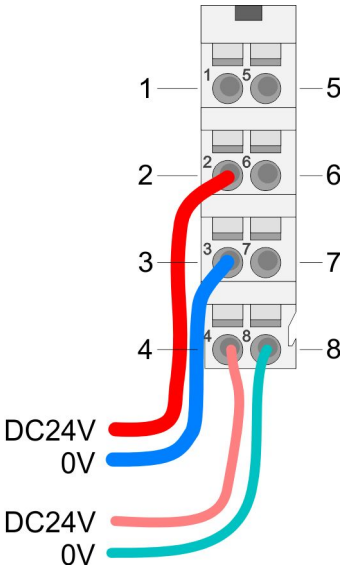
1. Insert a suited screwdriver at an angel into the square opening as shown. Press and hold the screwdriver in the opposite direction to open the contact spring.
2. Insert the stripped end of wire into the round opening. You can use wires with a cross section of 0.08mm^2 up to 1.5mm^2
3. By removing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

Standard wiring



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

PM - Power module



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

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

I: Input

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

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

Fusing

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

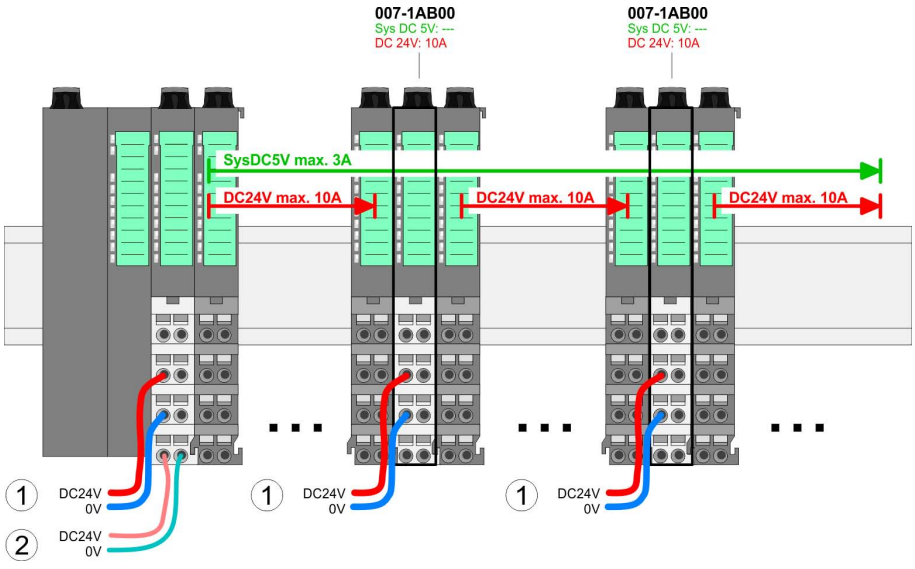
State of the electronic power supply via LEDs

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

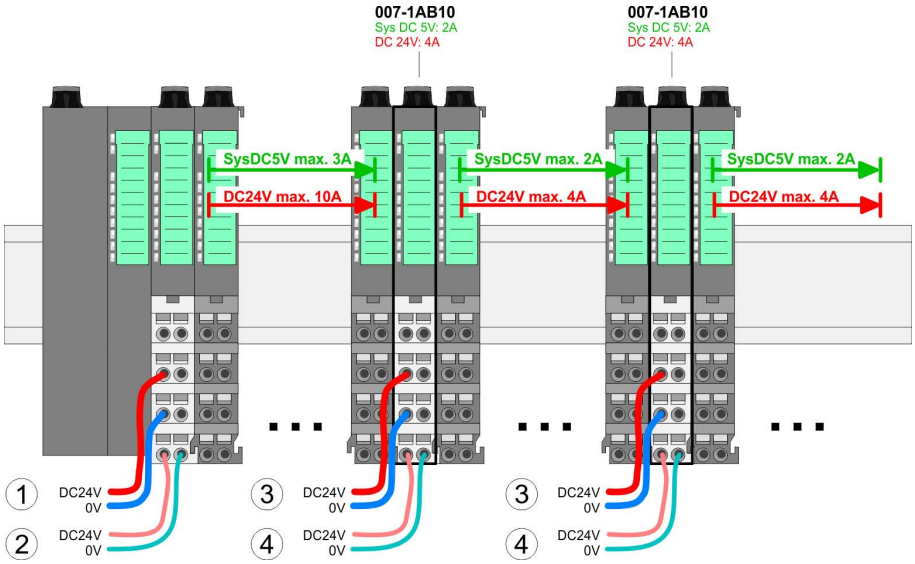
Deployment of the power modules

- If the 10A for the power section supply is no longer sufficient, you may use the power module from VIPA with the order number 007-1AB00. So you have also the possibility to define isolated groups.
- The power module with the order number 007-1AB10 is to be used if the 3A for the electronic power supply at the backplane bus is no longer sufficient. Additionally you get an isolated group for the DC 24V power section supply with max. 4A.
- By placing the power module 007-1AB10 at the following backplane bus modules may be placed with a sum current of max. 2A. Afterwards a power module is to be placed again. To secure the power supply, the power modules may be mixed used.

Power module 007-1AB00

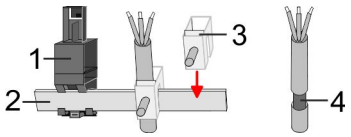


Power module 007-1AB10



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

Shield attachment

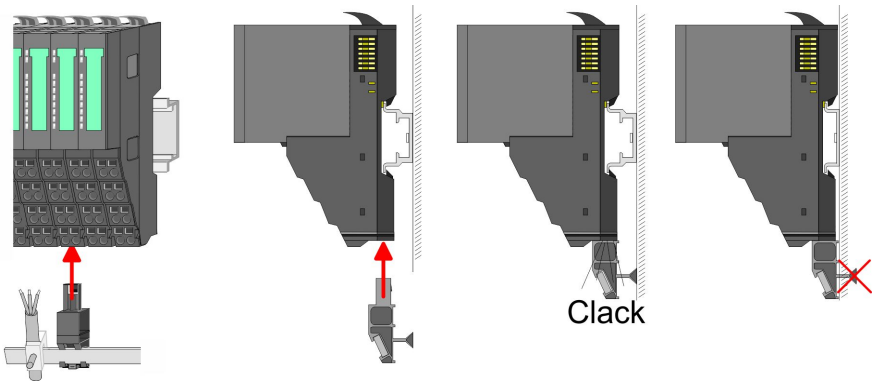


1 Shield bus carrier
2 Shield bus (10mm x 3mm)
3 Shield clamp
4 Cable shield

To attach the shield the mounting of shield bus carriers are necessary. The shield bus carrier (available as accessory) serves to carry the shield bus to connect cable shields.

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

2. Put your shield bus into the shield bus carrier.



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

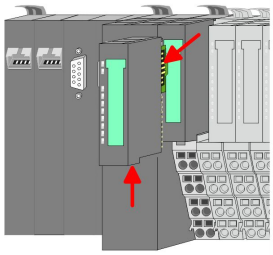
2.6 Demounting

2.6.1 Demounting CPU 01x

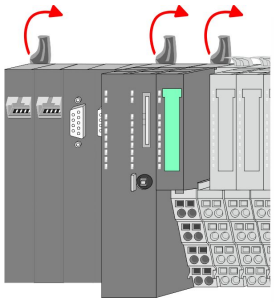
Proceeding

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

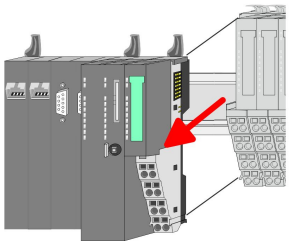
1. Power-off your system.
2. Remove if exists the wiring of the CPU.
3. *For demounting and exchange of a (head) module or a group of modules, due to mounting reasons you always have to remove the electronic module right beside. After mounting it may be plugged again.*



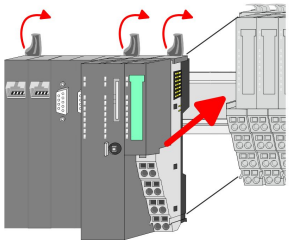
Press the unlocking lever at the lower side of the just mounted right module near the CPU and pull it forward.



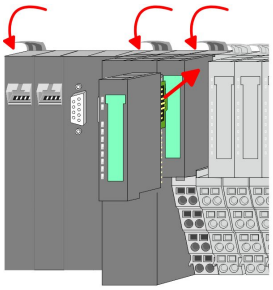
4. Turn all the locking lever of the CPU to be exchanged upwards.



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.



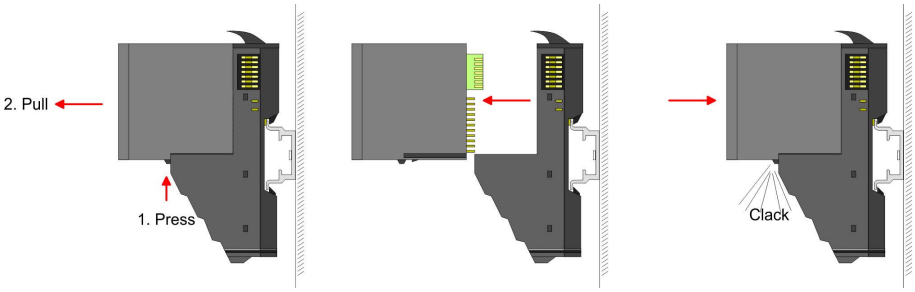
9. Plug again the electronic module, which you have removed before. For installation plug the electronic module guided by the strips at the lower side until this engages to the terminal module.
10. Wire your CPU.
    ⇨ Now you can bring your system back into operation.

2.6.2 Demounting periphery modules

Proceeding

Exchange of an electronic module

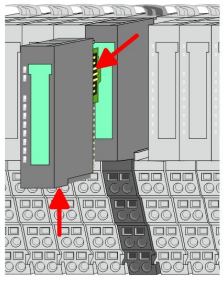
1. Power-off your system.



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

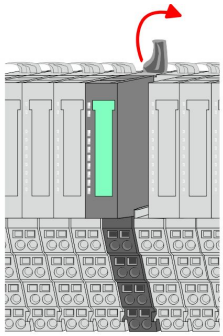
1. Power-off your system.
2. Remove if exists the wiring of the module.
3.

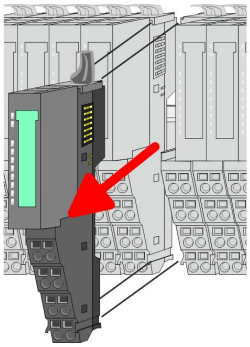


For demounting and exchange of a (head) module or a group of modules, due to mounting reasons you always have to remove the electronic module right beside. After mounting it may be plugged again.

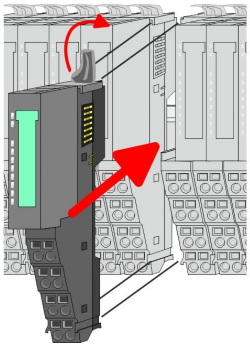
Press the unlocking lever at the lower side of the just mounted right module and pull it forward.

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

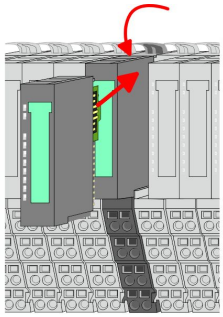




5. Pull the module.
6. For mounting turn the locking lever of the module to be mounted upwards.



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.

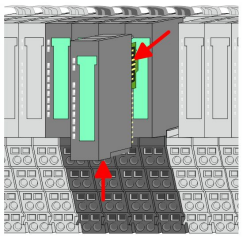


9. Plug again the electronic module, which you have removed before.
10. Wire your module.

    ⇨ Now you can bring your system back into operation.

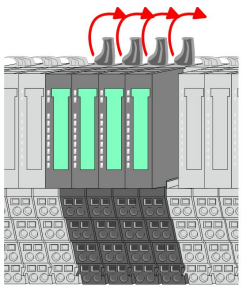
Exchange of a module group

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

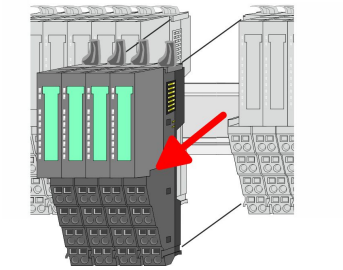


For demounting and exchange of a (head) module or a group of modules, due to mounting reasons you always have to remove the electronic module right beside. After mounting it may be plugged again.

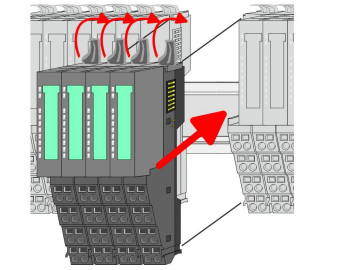
Press the unlocking lever at the lower side of the just mounted right module near the module group and pull it forward.



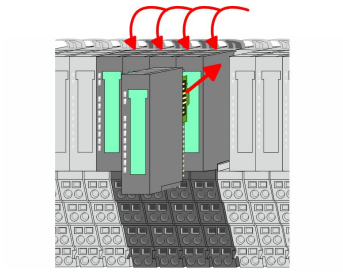
4. Turn all the locking lever of the module group to be exchanged upwards.



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.

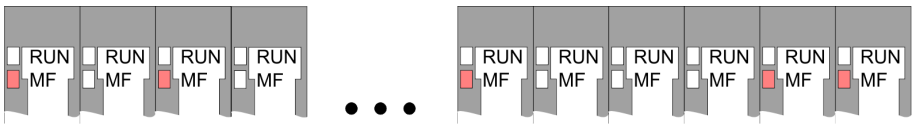
2.7 Trouble shooting - LEDs

General

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

In the following illustrations flashing LEDs are marked by ☼.

Sum current of the electronic power supply exceeded

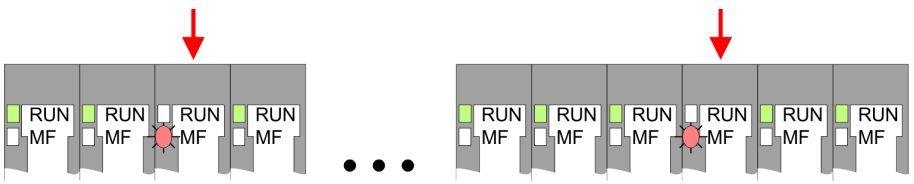


Behaviour: After PowerON the RUN LED of each module is off and the MF LED of each module is sporadically on.

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

Remedy: As soon as the sum current of the electronic power supply is exceeded, always place the power module 007-1AB10. ↳ *Chapter 2.5.3 'Wiring power modules' on page 24*

Error in configuration

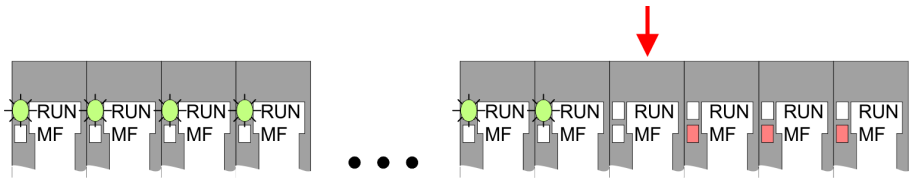


Behaviour: After PowerON the MF LED of one module respectively more modules flashes. The RUN LED remains off.

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

Remedy: Match configuration and hardware structure.

Module failure



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

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

Remedy: Replace the defective module.

2.8 Installation guidelines

General

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

What does EMC mean?

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

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 laid isolated.
  - Analog lines must be laid isolated. When transmitting signals with small amplitudes the one sided laying of the isolation may be favourable.
  - Lay the line isolation extensively on an isolation/protected earth conductor rail directly after the cabinet entry and fix the isolation with cable clamps.
  - Make sure that the isolation/protected earth conductor rail is connected impedance-low with the cabinet.
  - Use metallic or metallised plug cases for isolated data lines.
- In special use cases you should appoint special EMC actions.
  - Consider to wire all inductivities with erase links.
  - Please consider luminescent lamps can influence signal lines.
- Create a homogeneous reference potential and ground all electrical operating supplies when possible.
  - Please take care for the targeted employment of the grounding actions. The grounding of the PLC serves for protection and functionality activity.
  - Connect installation parts and cabinets with your PLC in star topology with the isolation/protected earth conductor system. So you avoid ground loops.
  - If there are potential differences between installation parts and cabinets, lay sufficiently dimensioned potential compensation lines.

Isolation of conductors

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

When isolating cables you have to regard the following:

- If possible, use only cables with isolation tangle.
- The hiding power of the isolation should be higher than 80%.

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

CAUTION!

Please regard at installation!

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

Remedy: Potential compensation line

2.9 General data

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

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

Environmental conditions to EN 61131-2		
Climatic		
Storage / transport	EN 60068-2-14	-25…+70°C
Operation		
Horizontal installation hanging	EN 61131-2	0…+60°C
Horizontal installation lying	EN 61131-2	0…+55°C
Vertical installation	EN 61131-2	0…+50°C
Air humidity	EN 60068-2-30	RH1 (without condensation, rel. humidity 10… 95%)
Pollution	EN 61131-2	Degree of pollution 2
Installation altitude max.	-	2000m
Mechanical		
Oscillation	EN 60068-2-6	1g, 9Hz ... 150Hz
Shock	EN 60068-2-27	15g, 11ms

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

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

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

3 Hardware description

3.1 Properties

CPU 015N

- SPEED7 technology integrated
- programmable via VIPA *SPEED7 Studio*
- 256kbyte work memory integrated (128kbyte code, 128kbyte data)
- Work memory expandable up to 512kbyte (256kbyte code, 256kbyte data)
- 512kbyte load memory integrated
- Slot for external storage media (lockable)
- Status LEDs for operating state and diagnostics
- X1/X5: Ethernet PG/OP channel integrated
- X2: PtP(MPI) interface Serial integrated interface for PtP communication with the protocols: ASCII, STX/ETX , USS, 3964(R), MODBUS RTU, master/slave switch able to MPI communication
- X3: MPI interface: Serial integrated interface for MPI communication
- X4: Ethernet interface Ethernet interface with via VSC unlockable EtherCAT master functionality
- X6: NET CP: Ethernet-interface for TCP/IP communication
- up to 64 SLIO modules placeable
- I/O address area digital/analog 2048byte
- 512 timer/counter, 8192 flag byte

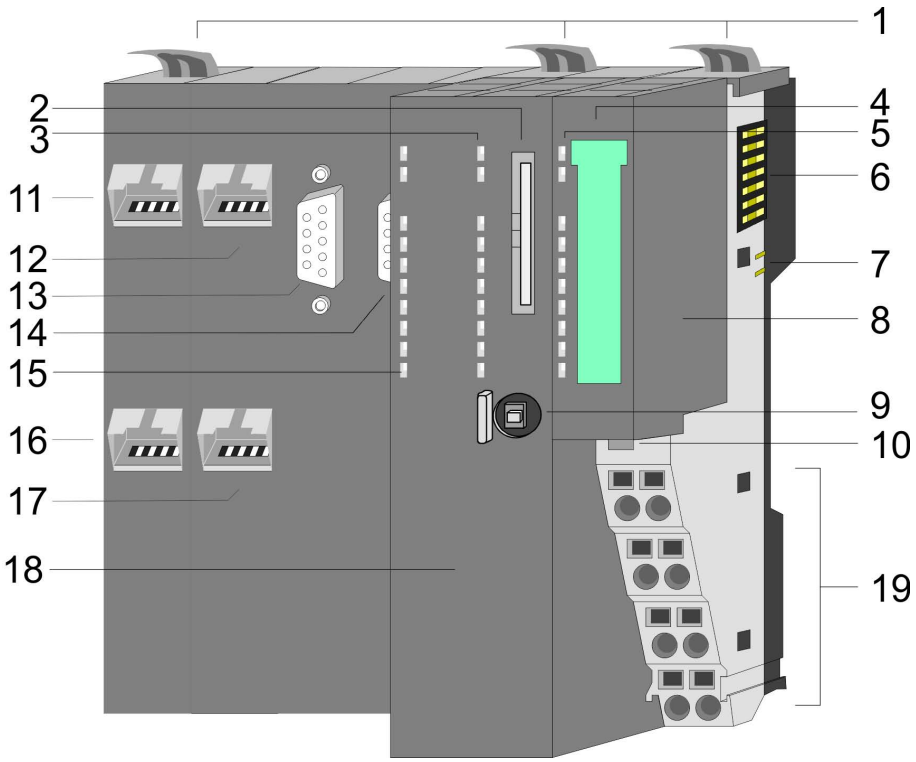
Ordering data

Type	Order number	Description
CPU 015N	015-CEFNR00	Basic CPU 015N with NET CP Communication processor and options to extend work memory and bus interface

3.2 Structure

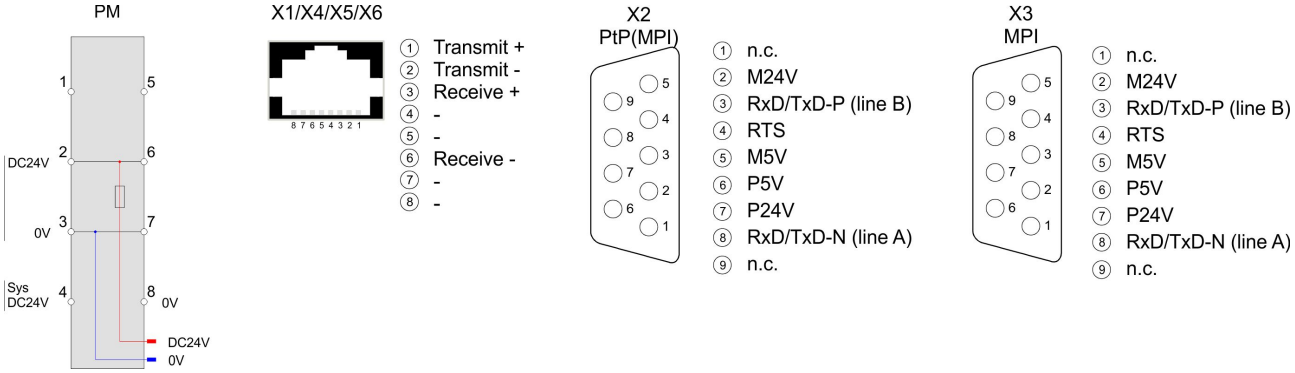
3.2.1 Basic CPU

CPU 015N



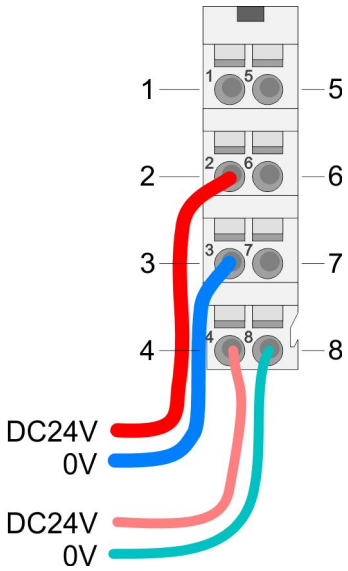
1 Locking lever
2 Slot for external storage media (lockable)
3 LEDs CPU part
4 Labelling strip power module
5 LED status indication power module
6 Backplane bus
7 DC 24V power section supply
8 Power module
9 Operating mode switch CPU
10 Unlocking lever power module
11 X4: EtherCAT master (optional)
12 X1: Ethernet PG/OP channel (switch)
13 X2: PtP(MPI) interface
14 X3: MPI interface
15 LED status indication EtherCAT master (optional)
16 X6: NET CP
17 X5: Ethernet PG/OP channel (switch)
18 CPU part
19 Terminal power module

3.2.2 Interfaces



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

PM - Power module



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

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

I: Input

X1/X5: Ethernet PG/OP channel

8pin RJ45 jack:

- The RJ45 jack serves as interface to the Ethernet PG/OP channel.
- This interface allows you to program respectively remote control your CPU and to access the internal web server.
- The connection happens via an integrated 2-port switch
- Configurable connections are not possible.
- For online access to the CPU via Ethernet PG/OP channel, you have to assign IP address parameters to this.

Chapter 4.6 'Hardware configuration - Ethernet PG/OP channel' on page 58

X2: PtP(MPI) interface

9pin SubD jack: (isolated):

The interface supports the following functions, which are switch able via the *VIPA specific CPU parameters* 61:

- PtP (default / after overall reset)
  Per default, the RS485 interface is set to PtP functionality. Using the *PtP* functionality the RS485 interface is allowed to connect via serial point-to-point connection to different source res. target systems.
  The following protocols are supported:
  – ASCII
  – STX/ETX
  – 3964R
  – USS
  – Modbus master (ASCII, RTU)
- MPI
  The MPI interface serves for the connection between programming unit and CPU. By means of this the project engineering and programming happens. In addition MPI serves for communication between several CPUs or between HMIs and CPU. Standard setting is MPI address 2.

X3: MPI interface

9pin SubD jack:

- The MPI interface serves for the connection between programming unit and CPU.
- By means of this the project engineering and programming happens.
- MPI serves for communication between several CPUs or between HMIs and CPU.
- Standard setting is MPI Address 2.

X4: Optional: EtherCAT master

8pin RJ45 jack:

- Connect this interface with the RJ45 jack "IN" of your slave station.
- EtherCAT uses Ethernet as transfer medium. Standard CAT5 cables are used. Here distances of about 100m between 2 stations are possible.
- Only EtherCAT components may be used in an EtherCAT network. For topologies, which depart from the line structure, the corresponding EtherCAT components are necessary. Hubs may not be used.
- An EtherCAT network always consists of a master and an various number of EtherCAT salves (coupler).
- Each EtherCAT slave has an "IN" and "OUT" RJ45 jack. The arriving EtherCAT cable from the direction of the master is to be connected to the "IN" jack. The "OUT" jack is to be connected to the next station. With the respective last station the "OUT" jack remains free.

CAUTION!
Using a switch
When using an EoE terminal (Ethernet over EtherCAT) X4 and X6 must not be connected to the same switch! Due to the internal connection, this leads to a ring closure on Ethernet.

Activate additional functions by means of VSC in the CPU
In order to use the additional functions, you must activate them by means of a VSC storage media from VIPA. By plugging the VSC storage card and then an overall reset the following functions are activated:

- *Isochronous mode with enabling OB 60 and OB 61*
- *EtherCAT master functionality*
- *Memory expansion to 512kB work respectively load memory*

'Overview' on page 82

X6: NET CP

8pin RJ45 jack:

- NET CP Ethernet interface for TCP/IP communication
- Productive connections via configuration
- Productive connections via user program
- PG/OP connections

3.2.3 Memory management

General

The CPU has an integrated memory. Information about the capacity of the memory may be found at the front of the CPU. The memory is divided into the following parts:

- Load memory 512kbyte
- Code memory (50% of the work memory)
- Data memory (50% of the work memory)
- Work memory 256kbyte
  - There is the possibility to extend the work memory to its maximum capacity 512kbyte by means of a VSC.

3.2.4 Slot for storage media

Overview

At this slot the following storage media can be plugged:

- VSD - **V**IPA **SD**-Card
  - External memory card for programs and firmware.
- VSC - **V**IPA**S**et**C**ard
  - External memory card (VSD) for programs and firmware with the possibility to unlock optional functions like work memory and field bus interfaces.
  - These functions can be purchased separately. *Chapter 4.15 'Deployment storage media - VSD, VSC' on page 82*
  - To activate the corresponding card is to be installed and a *Overall reset* is to be established. *'Overall reset' on page 77*

A list of the currently available VSD respectively VSC can be found at www.vipa.com.

3.2.5 Buffering mechanisms

The SLIO CPU has a capacitor-based mechanism to buffer the internal clock in case of power failure for max. 30 days. With PowerOFF the content of the RAM is automatically stored in the Flash (NVRAM).

CAUTION!

Please connect the CPU for approximately 1 hour to the power supply, so that the internal buffering mechanism is loaded accordingly.

In case of failure of the buffer mechanism Date and Time 01.09.2009 00:00:00 set. Additionally, you receive a diagnostics message. *'VIPA specific diagnostic entries' on page 89*

3.2.6 Operating mode switch

General

- With the operating mode switch you may switch the CPU between STOP and RUN.
- During the transition from STOP to RUN the operating mode START-UP is driven by the CPU.
- Placing the switch to MR (**M**emory **R**eset), you request an overall reset with following load from memory card, if a project there exists.

3.2.7 LEDs

CPU part

PW		Meaning
green	●	As soon as the CPU is supplied with 5V, the green PW-LED (Power) is on.
	○	The CPU is not power-supplied.
on: ● | off: ○		

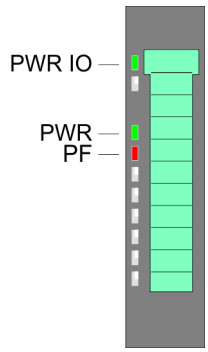
RN	ST	SF	FC	SD	Meaning
green	yellow	red	yellow	yellow	
Boot-up after PowerON					
●	X	BB	●	●	Flickers: Firmware is loaded.
●	●	●	●	●	Initialization: Phase 1
●	●	●	●	○	Initialization: Phase 2
●	●	●	○	○	Initialization: Phase 3
○	●	●	○	○	Initialization: Phase 4
Operation					
○	●	X	X	X	CPU is in STOP state.
BB	○	X	X	X	CPU is in start-up state. Blinking with 2Hz: The RUN LED blinks during start-up (OB100) at least for 3s.
○	BB	X	X	X	Blinking with 10Hz: Activation of a new hardware configuration
●	○	○	X	X	CPU is in state RUN without error.
X	X	●	X	X	There is a system fault. More information can be found in the diagnostics buffer of the CPU.
X	X	X	●	X	Variables are forced.
X	X	X	X	●	Accessing the memory card
X	BB	X	X	X	Blinking with 10Hz: Configuration is loaded
Overall reset					
○	BB	X	X	X	Blinking with 1Hz: Overall reset is requested
○	BB	X	X	X	Blinking with 2Hz: Overall reset is executed
○	BB	X	X	X	Blinking with 10Hz: Overall reset with none hardware configuration respectively with hardware configuration from memory card.
Reset to factory setting					
●	●	○	○	○	Reset to factory setting is executed

RN	ST	SF	FC	SD	Meaning
○	●	●	●	●	Reset to factory setting finished without error. Then a power cycle is necessary
Firmware update					
○	●	BB	BB	●	The alternate blinking indicates that there is new firmware on the memory card.
○	○	BB	BB	●	The alternate blinking indicates that a firmware update is executed.
○	●	●	●	●	Firmware update finished without error.
○	BB	BB	BB	BB	Blinking with 10Hz: Error during Firmware update.
on: ● | off: ○ | blinking: BB | not relevant: X					

Ethernet PG/OP channel

L/A (Link/ Activity)	S (Speed)	Meaning
green	green	
●	X	The Ethernet PG/OP channel is physically connected to the Ethernet interface.
○	X	There is no physical connection.
BB	X	Shows Ethernet activity.
●	●	The Ethernet interface of the Ethernet PG/OP channel has a transfer rate of 100Mbit.
●	○	The Ethernet interface of the Ethernet PG/OP channel has a transfer rate of 10Mbit.
on: ● | off: ○ | blinking: BB | not relevant: X		

LEDs power module



PWR IO	PWR	PF	Description
green	green	red	
○	○	○	Both power supplies are missing
●	X	○	Power section supply OK
●	●	○	Electronic section supply OK
X	X	●	Fuse electronic section supply defective
on: ● | off: ○ | not relevant: X			

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

LEDs EtherCAT interface X4

BS1	MT	BF1	Meaning
green	yellow	red	
○	○	○	Master is in INIT state
BB	○	○	Master is in Pre-Op state
P	○	○	Master is in Safe-Op state
●	○	○	Master is in OP state
X	○	X	There is no maintenance event pending
X	●	X	There is a maintenance event pending. More may be found in the diagnostics data
X	X	○	There is no error on the EtherCAT bus pending
X	X	●	■ EtherCAT bus error, no connection to sub net ■ Wrong transfer rate ■ Full-duplex transfer is de-activated
X	X	B	■ Failure of a connected IO device ■ At least one IO device cannot be reached (topology mismatch) ■ Error in configuration
○	B4	B4	Error in configuration: 0xEA64 was added to the diagnostics buffer, additionally the SF-LED of the CPU is on.
○	BB*	BB*	* The alternating flashing with 4Hz indicates that the firmware update of the EtherCAT masters is performed.
●	●	●	Firmware update of the EtherCAT master was finished without error.

on: ● | off: ○ | blinking (1Hz): B | blinking (2Hz): BB | B4: blinking (4s on, 1s off) | pulsing: P | not relevant: X

LEDs L/A

The green L/A-LED (Link/Activity) indicates the physical connection of the EtherCAT master to Ethernet. Irregular flashing of the L/A-LED indicates communication of the EtherCAT master via Ethernet.

3.3 Technical data

Order no.	015-CEFNR00
Type	SLIO CPU 015N
Module ID	-
Technical data power supply	
Power supply (rated value)	DC 24 V

Order no.	015-CEFNR00
Power supply (permitted range)	DC 20.4...28.8 V
Reverse polarity protection	✓
Current consumption (no-load operation)	175 mA
Current consumption (rated value)	1.1 A
Inrush current	3 A
I^2t	0.1 A^2s
Max. current drain at backplane bus	3 A
Max. current drain load supply	10 A
Power loss	8 W
Load and working memory	
Load memory, integrated	512 KB
Load memory, maximum	512 KB
Work memory, integrated	256 KB
Work memory, maximal	512 KB
Memory divided in 50% program / 50% data	✓
Memory card slot	SD/MMC-Card with max. 2 GB
Hardware configuration	
Racks, max.	1
Modules per rack, max.	64
Number of integrated DP master	-
Number of DP master via CP	-
Operable function modules	64
Operable communication modules PtP	64
Operable communication modules LAN	-
Command processing times	
Bit instructions, min.	0.01 µs
Word instruction, min.	0.01 µs
Double integer arithmetic, min.	0.01 µs
Floating-point arithmetic, min.	0.06 µs
Timers/Counters and their retentive characteristics	
Number of S7 counters	512
S7 counter remanence	adjustable 0 up to 512
S7 counter remanence adjustable	C0 .. C7
Number of S7 times	512
S7 times remanence	adjustable 0 up to 512

Order no.	015-CEFNR00
S7 times remanence adjustable	not retentive
Data range and retentive characteristic	
Number of flags	8192 Byte
Bit memories retentive characteristic adjustable	adjustable 0 up to 8192
Bit memories retentive characteristic preset	MB0 .. MB15
Number of data blocks	4096
Max. data blocks size	64 KB
Number range DBs	1 ... 8191
Max. local data size per execution level	4096 Byte
Max. local data size per block	4096 Byte
Blocks	
Number of OBs	24
Maximum OB size	64 KB
Total number DBs, FBs, FCs	4096
Number of FBs	4096
Maximum FB size	64 KB
Number range FBs	0 ... 8191
Number of FCs	4096
Maximum FC size	64 KB
Number range FCs	0 ... 8191
Maximum nesting depth per priority class	16
Maximum nesting depth additional within an error OB	4
Time	
Real-time clock buffered	✓
Clock buffered period (min.)	30 d
Type of buffering	Goldcap
Load time for 50% buffering period	15 min
Load time for 100% buffering period	1 h
Accuracy (max. deviation per day)	10 s
Number of operating hours counter	8
Clock synchronization	✓
Synchronization via MPI	Master/Slave
Synchronization via Ethernet (NTP)	Slave
Address areas (I/O)	
Input I/O address area	2048 Byte

Order no.	015-CEFNR00
Output I/O address area	2048 Byte
Process image adjustable	✓
Input process image preset	128 Byte
Output process image preset	128 Byte
Input process image maximal	2048 Byte
Output process image maximal	2048 Byte
Digital inputs	16384
Digital outputs	16384
Digital inputs central	512
Digital outputs central	512
Integrated digital inputs	-
Integrated digital outputs	-
Analog inputs	1024
Analog outputs	1024
Analog inputs, central	256
Analog outputs, central	256
Integrated analog inputs	-
Integrated analog outputs	-
Communication functions	
PG/OP channel	✓
Global data communication	✓
Number of GD circuits, max.	8
Size of GD packets, max.	22 Byte
S7 basic communication	✓
S7 basic communication, user data per job	76 Byte
S7 communication	✓
S7 communication as server	✓
S7 communication as client	-
S7 communication, user data per job	160 Byte
Number of connections, max.	32
Functionality Sub-D interfaces	
Type	X2
Type of interface	RS485
Connector	Sub-D, 9-pin, female
Electrically isolated	✓
MPI	✓

Order no.	015-CEFNR00
MP²I (MPI/RS232)	-
DP master	-
DP slave	-
Point-to-point interface	✓
Functionality Sub-D interfaces	
Type	X3
Type of interface	RS485
Connector	Sub-D, 9-pin, female
Electrically isolated	✓
MPI	✓
MP²I (MPI/RS232)	-
DP master	-
DP slave	-
Point-to-point interface	-
Functionality MPI	
Number of connections, max.	32
PG/OP channel	✓
Routing	✓
Global data communication	✓
S7 basic communication	✓
S7 communication	✓
S7 communication as server	✓
S7 communication as client	-
Transmission speed, min.	19.2 kbit/s
Transmission speed, max.	12 Mbit/s
Functionality PROFIBUS master	
PG/OP channel	-
Routing	-
S7 basic communication	-
S7 communication	-
S7 communication as server	-
S7 communication as client	-
Activation/deactivation of DP slaves	-
Direct data exchange (slave-to-slave communication)	-
DPV1	-

Order no.	015-CEFNR00
Transmission speed, min.	-
Transmission speed, max.	-
Number of DP slaves, max.	-
Address range inputs, max.	-
Address range outputs, max.	-
User data inputs per slave, max.	-
User data outputs per slave, max.	-
Functionality PROFIBUS slave	
PG/OP channel	-
Routing	-
S7 communication	-
S7 communication as server	-
S7 communication as client	-
Direct data exchange (slave-to-slave communication)	-
DPV1	-
Transmission speed, min.	-
Transmission speed, max.	-
Automatic detection of transmission speed	-
Transfer memory inputs, max.	-
Transfer memory outputs, max.	-
Address areas, max.	-
User data per address area, max.	-
Point-to-point communication	
PtP communication	✓
Interface isolated	✓
RS232 interface	-
RS422 interface	-
RS485 interface	✓
Connector	Sub-D, 9-pin, female
Transmission speed, min.	150 bit/s
Transmission speed, max.	115.5 kbit/s
Cable length, max.	500 m
Point-to-point protocol	
ASCII protocol	✓
STX/ETX protocol	✓

Order no.	015-CEFNR00
3964(R) protocol	✓
RK512 protocol	-
USS master protocol	✓
Modbus master protocol	✓
Modbus slave protocol	✓
Special protocols	-
Functionality interfaces RJ45	
Type	X1
Type of interface	Ethernet 10/100 MBit Switch
Connector	RJ45
Electrically isolated	✓
PG/OP channel	✓
Number of connections, max.	4
Productive connections	-
Functionality interface 2. RJ45	
Type	X5
Type of interface	Ethernet 10/100 MBit Switch
Connector	RJ45
Electrically isolated	✓
PG/OP channel	✓
Number of connections, max.	4
Productive connections	-
Functionality interface 3. RJ45	
Type	X4
Type of interface	Ethernet 100 MBit
Connector	RJ45
Electrically isolated	✓
PG/OP channel	-
Number of connections, max.	-
Productive connections	-
Functionality interface 3. RJ45	
Type	X6
Type of interface	Ethernet 10/100 MBit
Connector	RJ45
Electrically isolated	✓
PG/OP channel	✓

Order no.	015-CEFNR00
Number of connections, max.	8
Productive connections	✓
Ethernet communication CP	
Number of productive connections, max.	8
Number of productive connections by Siemens NetPro, max.	8
S7 connections	BSEND, BRCV, GET, PUT, Connection of active and passive data handling
User data per S7 connection, max.	32 KB
TCP-connections	FETCH PASSIV, WRITE PASSIV, Connection of passive data handling
User data per TCP connection, max.	64 KB
ISO-connections	-
User data per ISO connection, max.	-
ISO on TCP connections (RFC 1006)	FETCH PASSIV, WRITE PASSIV, Connection of passive data handling
User data per ISO on TCP connection, max.	32 KB
UDP-connections	-
User data per UDP connection, max.	-
UDP-multicast-connections	-
UDP-broadcast-connections	-
Ethernet open communication	
Number of connections, max.	8
User data per ISO on TCP connection, max.	8 KB
User data per native TCP connection, max.	8 KB
User data per ad hoc TCP connection, max.	1460 Byte
User data per UDP connection, max.	1472 Byte
EtherCAT Master	
Number of EtherCAT-slaves	128
Update time	1 ms .. 512 ms
Address range inputs, max.	2 KB
Address range outputs, max.	2 KB
EoE support	✓
FoE support	✓
Distributed Clock support	✓
Hotconnect Slaves	✓
Isochronous mode	✓
Management & diagnosis	

Order no.	015-CEFNR00
Protocols	ICMP DCP
Web based diagnosis	-
NCM diagnosis	-
Housing	
Material	PPE / PPE GF10
Mounting	Profile rail 35 mm
Mechanical data	
Dimensions (WxHxD)	131.5 mm x 109 mm x 83 mm
Weight	325 g
Environmental conditions	
Operating temperature	0 °C to 60 °C
Storage temperature	-25 °C to 70 °C
Certifications	
UL certification	in preparation
KC certification	yes

4 Deployment CPU 015

4.1 Assembly

Information about assembly and cabling ↳ *'Basics and mounting' on page 11*

4.2 Start-up behavior

Turn on power supply

- The CPU checks whether a project AUTOLOAD.WLD exists on the memory card. If so, an overall reset is executed and the project is automatically loaded from the memory card.
- The CPU checks whether a command file with the name VIPA_CMD.MMC exists on the memory card. If so the command file is loaded from the memory card and the commands are executed.
- After PowerON and CPU STOP the CPU checks if there is a *.pkg file (firmware file) on the memory card. If so, this is shown by the CPU by blinking LEDs and the firmware may be installed by an update request. ↳ *further information on page 80*
- The CPU checks if a previously activated VSC is inserted. If not, the SD LED gets on and a diagnostics entry is released. The CPU switches to STOP after 72 hours. With a just installed VSC activated functions remain activated. ↳ *Chapter 4.19 'VIPA specific diagnostic entries' on page 89*

After this the CPU switches to the operating mode, which is set on the operating mode switch.

Delivery state

In the delivery state the CPU is overall reset. After a STOP→RUN transition the CPU switches to RUN without program.

4.3 Addressing

4.3.1 Overview

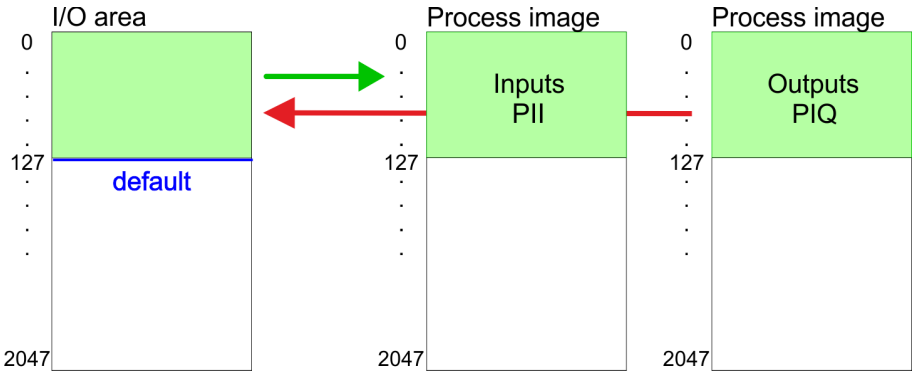
To provide specific addressing of the installed peripheral modules, certain addresses must be allocated in the CPU. This address mapping is in the CPU as hardware configuration. If there is no hardware configuration, depending on the slot, the CPU assigns automatically peripheral addresses for digital in-/output modules starting with 0 and analog modules are assigned to even addresses starting with 256.

4.3.2 Addressing backplane bus periphery

The CPU 015-CEFNR00 provides an I/O area (address 0 ... 2047) and a process image of the in- and outputs (each address default 0 ... 127). The process image stores the signal states of the lower address (default 0 ... 127) in an additional memory area. The size of the process image can be preset via the parameterization. ↳ *'Cycle/ Clock memory' on page 63*

The process image is divided into two parts:

- process image to the inputs (PII)
- process image to the outputs (PIQ)



The process image is updated automatically when a cycle has been completed.

Max. number of pluggable modules

Up to 64 SLIO modules can be connected to a SLIO CPU. This sum includes power and clamp modules.

Define addresses by hardware configuration

You may access the modules with read res. write accesses to the peripheral bytes or the process image. To define addresses a hardware configuration may be used. For this, click on the properties of the according module and set the wanted address.

Automatic addressing

If you do not like to use a hardware configuration, an automatic addressing is established. Here the address assignment follows the following specifications:

- Starting with slot 1, the central plugged modules are assigned with ascending logical addresses.
- The length of the memory area corresponds to the size of the process data of the according module. Information about the sizes of the process data can be found in the according manual of the module.
- The memory areas of the modules are assigned without gaps separately for input and output area.
- Digital modules are mapped starting at address 0 and all other modules are mapped starting from address 256. ETS modules are mapped starting from address 256.
- As soon as the mapping of digital modules exceeds the address 256, by regarding the order, these are mapped starting from address 256.

Example for automatic address allocation

Slot	Type	Description	Length	I address	O address
1	021-1BF00	DI 8x	1 Byte	0	
2	021-1BF00	DI 8x	1 Byte	1	
3	022-1BF00	DO 8x	1 Byte		0
4	031-1BB30	AI 2x	4 Byte	256...259	
5	032-1BB30	AO 2x	4 Byte		256...259
6	031-1BD40	AI 4x	8 Byte	260...267	
7	032-1BD40	AO 4x	8 Byte		260...267
8	022-1BF00	DO 8x	1 Byte		1
9	021-1BF00	DI 8x	1 Byte	2	

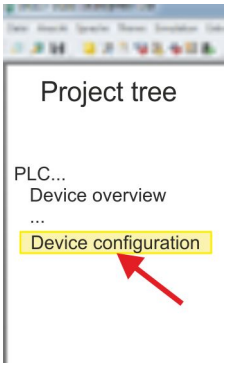
4.4 Hardware configuration - CPU

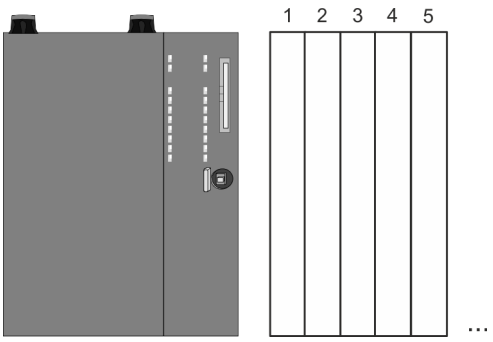
Precondition

For project engineering a thorough knowledge of the SPEED7 Studio is required!

Proceeding

1. Start the *SPEED7 Studio*.
2. Create a new project in the *Work area* with *'New project'*.
   ⇨ A new project is created and the view *'Devices and networking'* is shown.
3. Click in the *Project tree* at *'Add new device ...'*.
   ⇨ A dialog for device selection opens.
4. Select from the *'Device templates'* your CPU and click at [OK].
   ⇨ The CPU is inserted in *'Devices and networking'* and the *'Device configuration'* is opened.





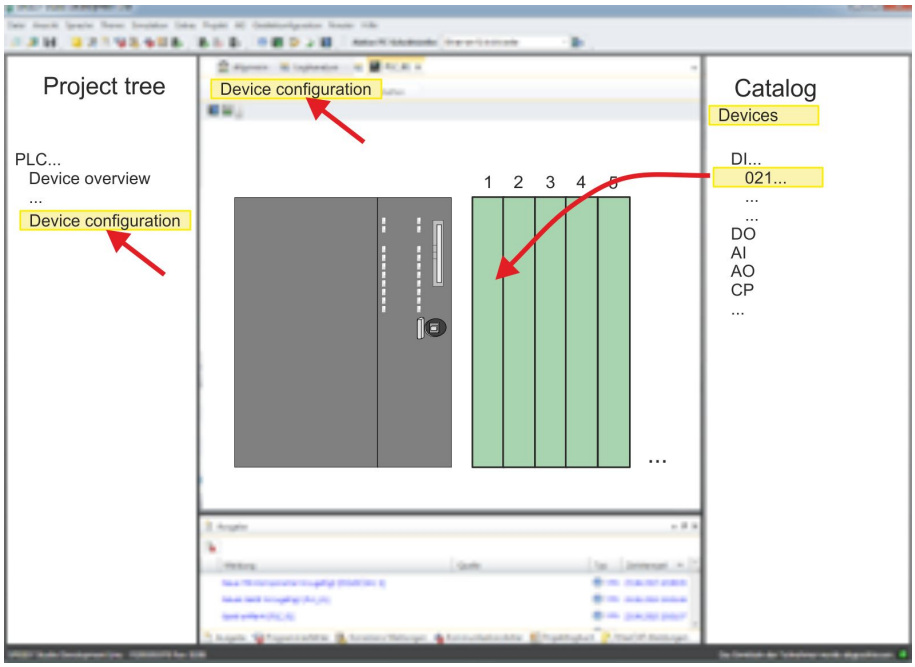
Device configuration

Slot	Module	...	...	...	...
0	CPU 015-CEFNR00				
-X1	PG_OP_Ethernet				
-X2	MPI interface				
...	...			...	

4.5 Hardware Configuration - I/O modules

Hardware configuration of the modules

1. Click in the *'Project tree'* at *'PLC... > Device configuration'*.
2. Starting with slot 1 place in the *'Device configuration'* your System SLIO modules in the plugged sequence. For this drag from the hardware catalog the corresponding module to the corresponding position in the *Device configuration*.



Parametrization

For parametrization double-click in the *'Device configuration'* on the module you want to parameterize. Then the parameters of the module are shown in a dialog. Here you can make your parameter settings.

Parametrization during runtime

By using the SFCs 55, 56 and 57 you may alter and transfer parameters for wanted modules during runtime. For this you have to store the module specific parameters in so called "record sets". More detailed information about the structure of the record sets is to find in the according module description.

4.6 Hardware configuration - Ethernet PG/OP channel

Overview

The CPU has an integrated Ethernet PG/OP channel. This channel allows you to program and remote control your CPU.

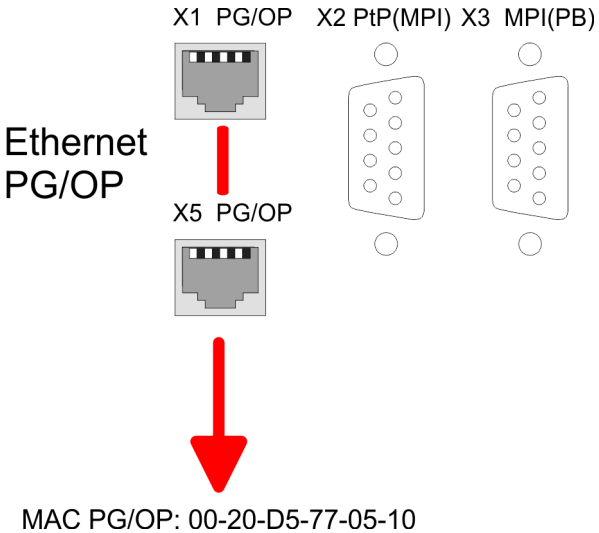
- The Ethernet PG/OP channel (X1/X5) is designed as switch. This enables PG/OP communication via the connections X1 and X5.
- The Ethernet PG/OP channel also gives you access to the internal web page that contains information about firmware version, connected I/O devices, current cycle times etc.
- At the first commissioning respectively after a factory reset the Ethernet PG/OP channel has no IP address.
- For online access to the CPU via the Ethernet PG/OP channel, valid IP address parameters have to be assigned to this. This is called "initialization".
- This can be done with the *SPEED7 Studio*.

Assembly and commissioning

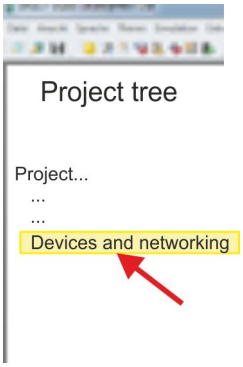
1. Install your System SLIO with your CPU.
2. Wire the system by connecting cables for voltage supply and signals.
3. Connect the one of the Ethernet jack (X1, X5) of the Ethernet PG/OP channel to Ethernet.
4. Switch on the power supply.
   ⇨ After a short boot time the CP is ready for communication. He possibly has no IP address data and requires an initialization.

"Initialization"

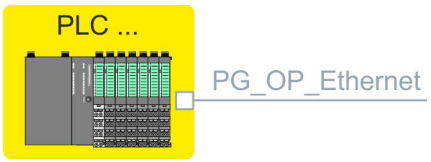
You get valid IP address parameters from your system administrator. The assignment of the IP address data happens online in the *SPEED7 Studio*with the following proceeding:



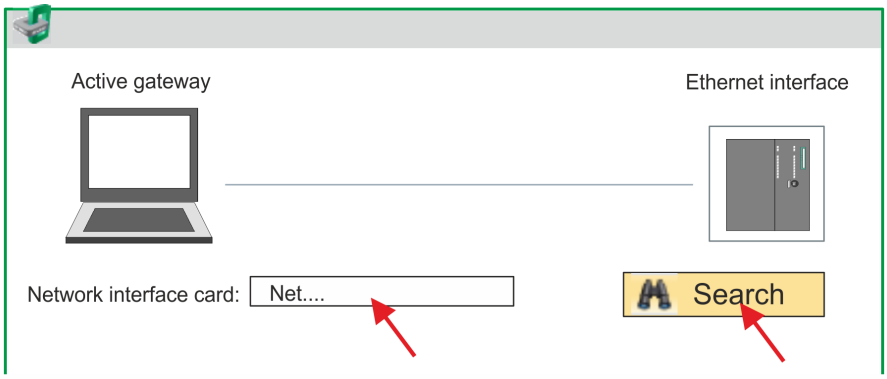
1. Determine the current Ethernet (MAC) address of your Ethernet PG/OP channel. This can be found at the front of the CPU labelled as "MAC PG/OP: ...".
2. Start the *SPEED7 Studio* with your project.



3. Click in the *Project tree* at *'Devices and networking'*.
   ⇨ You will get a graphical object view of your CPU.



4. Click at the network *'PG_OP_Ethernet'*.
5. Select *'Context menu ➔ Determine accessible partner'*.
   ⇨ A dialog window opens.



6. Select the according network interface card, which is connected to the Ethernet PG/OP channel and click at *'Search'* to determine the via MAC address reachable device.
   ⇨ The network search is started and the found stations are listed in a table.

7.

	Devices..	IP...	MAC...	Device...	...	...
1		172.20. ..	00:20: ...	VIPA ...		
2		...	...	...		

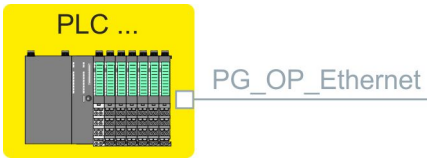
   Click in the list at the module with the known MAC address. This can be found at the front of the CPU labelled as "MAC PG/OP: ...".

8. Click at *'Set IP address'*. Now set the IP configuration by entering *'IP address'*, *'Subnet mask'* and *'Gateway'*.
9. Click at *'Set IP address'*.
   ⇨ The IP address is transferred to the module and the list is refreshed. Directly after the assignment the Ethernet PG/OP channel is online reachable using the set IP address data. The value remains as long as it is reassigned, it is overwritten by a hardware configuration or a factory reset is executed.
10. With clicking at *'Apply settings'* the IP address data a stored in the project.

Take IP address parameters in project

If you are not online, you can assign IP address data to your Ethernet PG/OP channel with following proceeding:

1. Start the *SPEED7 Studio* with your project.
2. Click in the *Project tree* at *'Devices and networking'*.
   ⇨ You will get a graphical object view of your CPU.



3. Click at the network *'PG_OP_Ethernet'*.
4. Select *'Context menu ➔ Interface properties'*.
   ⇨ A dialog window opens. Here you can enter the IP address data for your Ethernet PG/OP channel.
5. Confirm with [OK].
   ⇨ The IP address data are stored in your project listed in *'Devices and networking'* at *'Local components'*.

   After transferring your project your CPU can be accessed via Ethernet PG/OP channel with the set IP address data.

Local components

Slot	Module	...	...	...IP address	...
0	CPU ...			...	
-X1	PG_OP_Ethernet			172.20.120.40	
-X2	MPI interface			...	
...	...			...	

4.7 Hardware configuration communication

The hardware configuration of PtP and NET-CP is described at the following pages:

- PtP
  - PtP: *Chapter 5.3 'Deployment of RS485 interface for PtP' on page 150*
- NET-CP
  - NET-CP: *Chapter 6.7 'Fast introduction' on page 179*

4.8 Setting CPU parameters

Proceeding

1. Click in the *'Project tree'* at *'PLC... > Device configuration'*.
2. Click at the CPU and select *'Context menu ➔ Components properties'*.

   ⇨ The properties dialog is opened. Here you can adjust all the CPU parameters.

Depending on the CPU, the settings are different. Selection or input fields that are grayed out can not be edited at this CPU type.

4.8.1 Parameter CPU

General

Here you can make general settings for the current CPU.

- Name
  - Name of the PLC. This name is shown in the project tree.
- Plant designation
  - Here is the possibility to specify a plant designation for the CPU.
  - This plant designation identifies parts of the plant according to their function.
  - Its structure is hierarchic according to IEC 1346-1.
- Location designation
  - The location designation is part of the resource designation.
  - Here the exact location of your module within a plant may be specified.
- MPI data
  - Here you can adjust the setting of the MPI subnet (Multi Point Interface) for serial connection between the MPI participants.
  - Address: Here you can enter the MPI address. Standard setting of the VIPA CPUs is MPI address 2. The address 0 is reserved for programming devices.
  - Highest address: By specifying the highest address number you can limit the range of addresses.
  - Secondary transmission speed MPI The transmission rate (Bit/s) of the MPI subnet must not be higher than the transmission rate of the slowest accessible MPI partner.

Feature set

Clicking at *'EtherCAT master functionality ...'* the following additional functions can be activated:

- Isochronous mode with enabling OB 60 and OB 61
- EtherCAT master functionality
- Memory expansion to 512kB work respectively load memory

With *'inactive'* the additional functions can be disabled.

Please consider the additional functions in the SPEED7 Studio can only be activated, if you have valid license for these functions!

Start-up

Here you can make general configurations for the start-up behaviour of the current CPU.

- Start-up if present configuration does not match actual configuration
  - The expected configuration is the configuration of the components which is defined in the project and uploaded to the CPU.
  - The actual configuration is the implemented configuration of the components.
  - If this option is deselected, the CPU remains in the STOP mode for the following cases:

    One or more components are not located in the configured slot.

    A component of another type is located in the configured slot.
  - If this option is selected, the CPU switches to the RUN mode even if the components are not located in the configured slots or if components of another type are located there.
- Deleting PAA after warm restart
  - If this option is selected, the process image of the outputs (PAA) is deleted after the warm restart of the CPU.
- Disable hot restart by operator
  - The types of start-up are restricted when triggered by the operation or communication job.
  - If this option is selected, only restart or cold start are possible. Warm restart is not possible.
  - If this option is deselected, all types of start-up are possible.
- Start-up after Power On
  - Here you can select whether a restart, warm restart or cold start should be made after having activated the power supply (powerON).
  - Cold start: All variables and memory blocks are initialised.
  - Restart (warm start) The non-retentive memory areas are initialised, the retentive memory areas are restored.
  - Warm restart: The user program is continued where it has been interrupted.
- Monitoring time for ...
  - The time base of the following parameters is 100 milliseconds. Multiply the entered value with the time base. Example: Entered value 650 * 100 ms = 65.000 ms of monitoring time
  - Finished message from modules (100 ms): Maximum duration of the Ready signal of all configured components after having switched on the power supply (powerON).
  - Transfer of parameters to modules (100 ms) Maximum duration of the parameter transfer to the parameterizable components.
  - Hot restart (100 ms) Maximum duration of the warm restart. If the time between powerOFF and PowerON or between STOP mode and RUN mode is longer than the time entered here, there is no warm restart. The CPU remains in STOP mode.

Cycle/Clock memory

Here you can make general configurations for the start-up behaviour of the current CPU.

- Refresh process image cyclically
  - If this option is selected, the process image of the organisation block OB 1 is cyclically updated. This expands the cycle time.
- Scan cycle monitoring time (ms)
  - Here you can enter the scan cycle monitoring time in ms.
  - If the run time of the user program exceeds the scan cycle monitoring time, the CPU switches to STOP mode.
  - Reasons for time-out:
    - Communication principle
    - Accumulation of alarm events
    - Error in the CPU program
- Minimum scan cycle time (ms)
  - Guaranteed compliance with a minimum scan cycle time: The start of a new cycle is delayed until the minimum cycle time has been reached.
- Scan cycle load from communication (%)
  - Percentage of communication processes compared to the complete cycle time.
  - With this parameter you can control the duration of communication processes within certain limits, which always extend the cycle time.
  - If e.g. set to 50%, the cycle time might double. In addition, the OB 1 cycle will be extended by asynchronous events (e.g. process interrupts).
- OB 85 calling at periphery access errors
  - Reaction of the CPU after periphery access errors during the update of the process image.
  - The VIPA CPU is preset such that on a periphery access error the OB 85 is not called and there is no entry made to the diagnostic buffer.
- Size of the process-image input/output area
  - Here you can define the size of the process image max. 2048 for input and output periphery (default: 128).
- Clock memory
  - Clock memory Enable this option, if the CPU should provide clock memories. Clock memories periodically change their value in pre-set intervals.
  - Memory byte: Number of the memory byte for the clock memory. The memory byte is used only if you select the *'Clock memory'* option.

The selected memory byte cannot be used for temporary data storage.

Retentive memory

In order to maintain data in case of power failure, certain data areas can be marked as retentive. A restart (warm start) will restore the values of the retentive memory areas from the last program cycle.

- Number of memory bytes starting with MB0
  - Here you can enter the number of retentive memory bytes starting from memory byte 0. Example: Example: Input value 16 = memory bytes 0 to 15 are retentive.
- Number of timers starting with T0
  - Here you can enter the number of retentive timers starting from T0.
- Number of counters starting with Z0
  - Here you can enter the number of retentive counter starting from Z0.
- Areas
  - You can define up to 8 retentive memory areas in the data blocks:
  - DB no.: Number of the retentive data block
  - Byte address: Starting address within the retentive data block
  - Number of bytes: Number of retentive bytes from the starting address within the data block.

Interrupts

Here you can define the order for processing the individual interrupt organisation blocks. OBs with the smallest number have lowest priority. OBs with priority 0 are not processed.

- Priority: The following interrupt OBs are listed:
  - OB 40 - OB 47: Hardware interrupts
  - OB 20 - OB 23: Time delay interrupts
  - OB 50, OB 51, OB 55 - OB 57: Communication interrupts
  - OB 81 - OB 87: Async. error interrupts

Time of day interrupts

The time of day interrupt organisation blocks OB10 to OB17 can interrupt the processing of OB1 once or at a certain interval. Depending on the CPU used, you can parameterize up to 8 time of day interrupts.

- Priority
  - Order in which a time of day interrupt organisation block is processed.
  - OBs with the smallest number have lowest priority.
  - OBs with priority 0 are not processed.
- Active
  - By selecting *'Active'* the time of day interrupt is activated.
- Execution
  - Here you can select the execution of interrupts once or at certain intervals.
  - The intervals from every minute to yearly are related to the settings at *Start date* and *Time*.
- Start date/time
  - Here you can define the time of the initial execution of the time of day interrupt.

Cyclic interrupts

The cyclic interrupt organisation blocks OB 30 to OB 38 can interrupt the processing of OB1 once or at a certain interval. Depending on the CPU used, you can parameterize up to 9 cyclic interrupts.

- Priority
  - Order in which a cyclic interrupt organisation block is processed.
  - OBs with the smallest number have lowest priority.
  - OBs with priority 0 are not processed.
- Execution
  - Specify the time intervals in ms, in which the watchdog interrupt OBs should be processed.
  - The starting time is the switching from STOP mode to RUN mode.
- Phase shift
  - Time in milliseconds by which the execution time of the cyclic interrupt is to be delayed.
  - By selecting several cyclic interrupts, you can use the phase offset to make sure that the cyclic interrupts do not start at the same time.

Diagnostics/Clock

Here you can define, which clock is to be synchronised with which clock.

- Extended functions
  - The expanded range of functions for diagnostics is not supported.
- Report cause of STOP
  - Activate this parameter, if on transition to STOP the CPU has to report a cause for the STOP to PG respectively OP.
- Clock
  - Here you can define, which clock is to be synchronised with another clock.
- Synchronization type
  - Here you specify whether the clock synchronizes other clocks or not.
  - As slave: The clock is synchronized by another clock.
  - As master: The clock synchronizes other clocks as master.
  - none: There is no synchronization.
- Time interval
  - Time intervals within which the synchronization should take place.
- Correction factor
  - By specifying a correction factor in ms, you can compensate the deviation of the clock within 24 hours.
  - If the clock runs slow by 1 second within 24 hours, you can adjust this deviation with the correction factor "+1000".

Protection

- Protection Level
  - Here you can configure a protection level to protect the CPU against unauthorised access.
  - *No protection* (default):
    No password adjustable; no restrictions
  - *Write-protection* with password:
    Known password: Read and write access
    Unknown password: Read access only.
  - *Read/write protection* with password:
    Known password: Read and write access
    Unknown password: No read and write access
- Password
  - Here you can specify a password for the write and read protection.
  - Depending on the setting of the protection level for read respectively write access a password is requested.

Extended configurations

Here you can adjust the functionality of the interface and specify the number of flags, timers and counters:

- Function X2
  - Function PtP(MPI) interface X2
  - PtP (default): With this operating mode the RS485 interface acts as an interface for serial point-to-point communication. Here data may be exchanged between two stations by means of protocols.
  - MPI: With this operating mode the interface serves for the connection between programming unit and CPU via MPI. By means of this e.g. the project engineering and programming happens. In addition MPI serves for communication between several CPUs or between HMIs and CPU.
- MPI address X2
  - With *MPI* you can specify the MPI address here. With *PTP* this parameter is ignored by the CPU.
  - Range of values: 2 (default) ... 31
- MPI Baud rate X2:
  - With *MPI* you can specify the MPI transmission rate here. With *PTP* this parameter is ignored by the CPU.
  - Range of values: 19.2kB/s ... 12MB/s, default: 187.5kB/s
- Additional retentive memory
  - Here enter the number of retentive memory bytes. With 0 the preset value of *'Number of memory bytes starting with MB0'* of *'Retentive memory'* is taken.
  - Range of values: 0 (default) ... 8192
- Additional retentive timer
  - Here enter the number of timer. With 0 the preset value of *'Number of timer starting with T0'* of *'Retentive memory'* is taken.
  - Range of values: 0 (default) ... 512
- Additional retentive counter
  - Enter here the number of counter. With 0 the preset value of *'Number of counter starting with Z0'* of *'Retentive memory'* is taken.
  - Range of values: 0 (default) ... 512

4.8.2 Parameter MPI interface

Via double-click at *'MPI interface'* of *'Device configuration'* the properties dialog of the MPI interface is opened.

- MPI data
  - Here you can adjust the setting of the MPI subnet (Multi Point Interface) for serial connection between the MPI participants.
  - Address: Here you can enter the MPI address. Standard setting of the VIPA CPUs is MPI address 2. The address 0 is reserved for programming devices.
  - Highest address: By specifying the highest address number you can limit the range of addresses.
  - Secondary transmission speed MPI: The transmission rate (Bit/s) of the MPI subnet must not be higher than the transmission rate of the slowest accessible MPI partner.

4.8.3 Parameter Ethernet

Via double-click at *'Ethernet'* of *'Device configuration'* the properties dialog of the NET CP interface (X6) is opened.

- General
  - General: Here you can enter a name for your station.
  - Subnet ID The subnet ID is used to uniquely identify your network.
- IP configuration
  - IP address: Here you can assign an IP address to your NET CP.
  - Subnet: Here you can enter the subnet mask of your network.

4.9 Project transfer

Overview

There are the following possibilities for project transfer into the CPU:

- Transfer via MPI
- Transfer via Ethernet
- Transfer via memory card

4.9.1 Transfer via MPI

General

For transfer via MPI the CPU has the following interface:

- X3: MPI *'X3: MPI interface' on page 40*
- X2: PtP(MPI) *'X2: PtP(MPI) interface' on page 40*

With an overall reset CPU the configuration via X2 PtP(MPI) is not possible!

Net structure

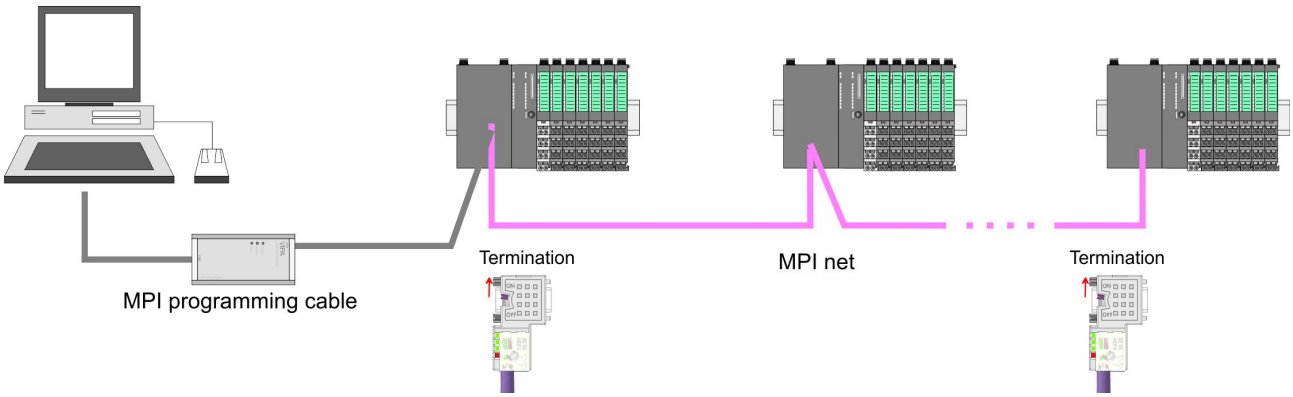
The structure of a MPI net is electrically identical with the structure of a PROFIBUS net. This means the same rules are valid and you use the same components for the build-up. The single participants are connected with each other via bus interface plugs and PROFIBUS cables. Per default the MPI net runs with 187.5kbaud. VIPA CPUs are delivered with MPI address 2.

MPI programming cable

The MPI programming cables are available at VIPA in different variants. The cables provide a RS232 res. USB plug for the PC and a bus enabled RS485 plug for the CPU. Due to the RS485 connection you may plug the MPI programming cables directly to an already plugged plug on the RS485 jack. Every bus participant identifies itself at the bus with an unique address, in the course of the address 0 is reserved for programming devices.

Terminating resistor

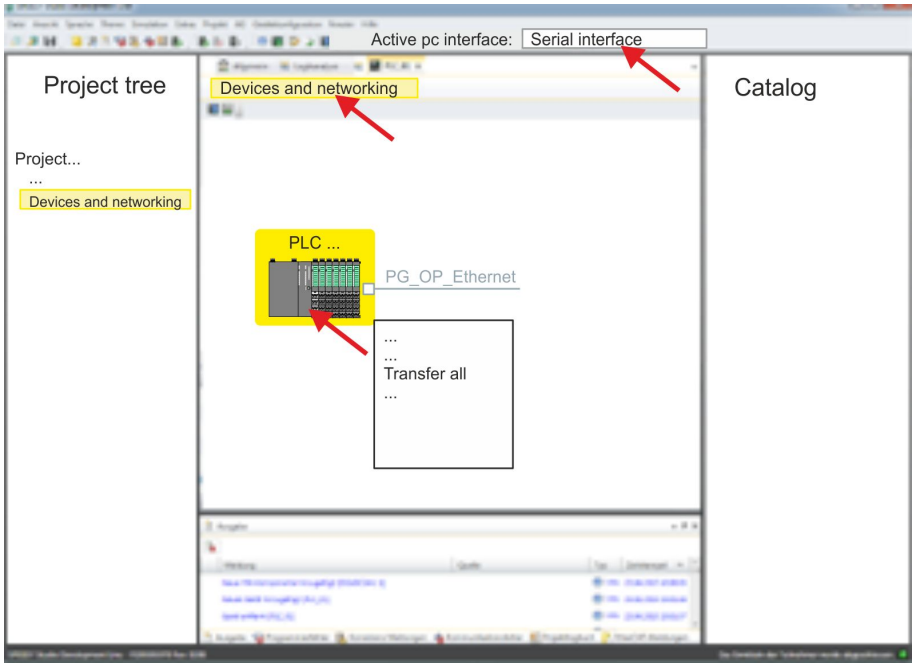
A cable has to be terminated with its surge impedance. For this you switch on the terminating resistor at the first and the last participant of a network or a segment. Please make sure that the participants with the activated terminating resistors are always power supplied. Otherwise it may cause interferences on the bus.



Proceeding transfer via MPI

1. Connect your PC to the MPI jack of your CPU via a MPI programming cable.
2. Switch-ON the power supply of your CPU and start the *SPEED7 Studio* with your project.
3. Set at *'Active PC interface'* the "Serial interface".
4. Click in the *'Project tree'* to your project and select *'Context menu ➔ Recompile'*.

   ⇨ Your project will be translated and prepared for transmission.



5. To transfer the user program and hardware configuration click in the *Project tree* at your CPU and select *'Context menu ➔ Transfer all'*.

   ⇨ A dialog window for project transfer opens

6. Select the *'Port type'* "Serial interface" and start the transfer with *'Transfer'*.

7. Confirm the request that the CPU is to be brought into the state STOP.

   ⇨ The user program and the hardware configuration are transferred via MPI to the CPU.

8. Close after transmission the dialog.

9. With *'Context menu ➔ Copy RAM to ROM'* you can save your project on a memory card, if one is plugged.

4.9.2 Transfer via Ethernet

Proceeding transfer via Ethernet

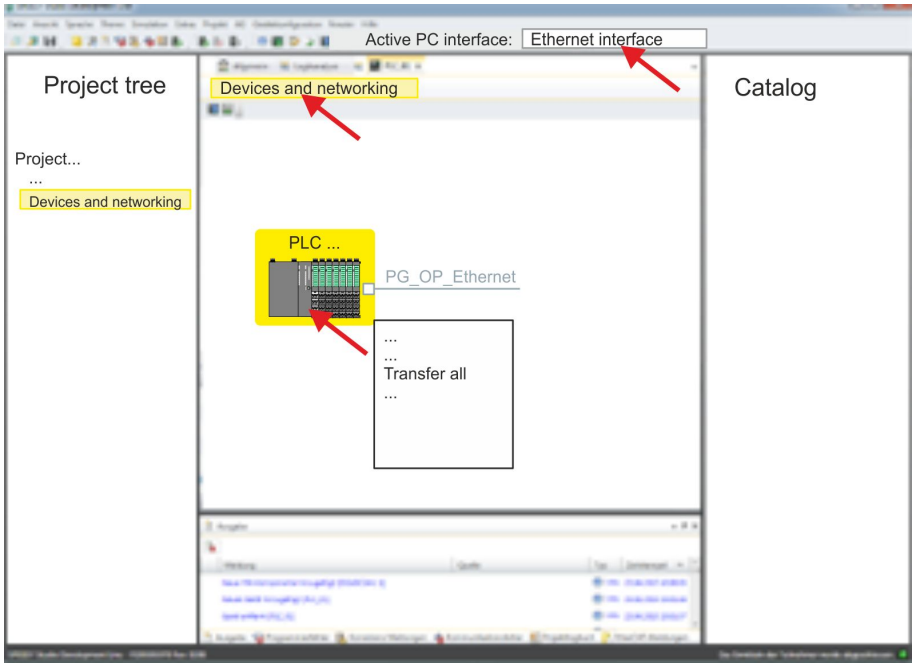
For transfer via Ethernet the CPU has an Ethernet PG/OP channel. For online access to this, you have to assign IP address parameters to this by means of "initialization" and transfer them into your project. For the transfer, connect, if not already done, the Ethernet PG/OP channel jack to your Ethernet. The connection happens via an integrated 2-port switch (X1, X5)

1. Switch-ON the power supply of your CPU and start the *SPEED7 Studio* with your project.

2. Set at *'Active PC interface'* the "Ethernet interface".

3. Click in the *'Project tree'* to your project and select *'Context menu ➔ Recompile'*.

   ⇨ Your project will be translated and prepared for transmission.



4. To transfer the user program and hardware configuration click in the *Project tree* at your CPU and select *'Context menu ➔ Transfer all'*.

   ⇨ A dialog window for project transfer opens

5. Select the *'Port type'* "Ethernet interface" and start the transfer with *'Transfer'*.

6. Confirm the request that the CPU is to be brought into the state STOP.

   ⇨ The user program and the hardware configuration are transferred via Ethernet to the CPU.

7. Close after transmission the dialog.

8. With *'Context menu ➔ Copy RAM to ROM'* you can save your project on a memory card, if one is plugged.

4.9.3 Transfer via memory card

Proceeding transfer via memory card

The memory card serves as external storage medium. There may be stored several projects and sub-directories on a memory card. Please regard that your current project is stored in the root directory and has one of the following file names:

- S7PROG.WLD
- AUTOLOAD.WLD

1. Start the *SPEED7 Studio* with your project.

2. Click in the *'Project tree'* at the CPU.

3. Create in the *SPEED7 Studio* with *'Context menu ➔ Export device configuration (WLD)'* a wld file.

   ⇨ The wld file is created. This contains the user program and the hardware configuration

4. Copy the wld file at a suited memory card. Plug this into your CPU and start it again.

   ⇨ The transfer of the application program from the memory card into the CPU takes place depending on the file name after an overall reset or PowerON.

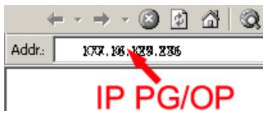
   S7PROG.WLD is read from the memory card after overall reset.

   AUTOLOAD.WLD is read from the memory card after PowerON.

   The blinking of the SD LED of the CPU marks the active transfer. Please regard that your user memory serves for enough space for your user program, otherwise your user program is not completely loaded and the SF LED gets on.

4.10 Accessing the web server

4.10.1 Access via the Ethernet PG/OP channel



There is a web server, which can be accessed via the IP address of the Ethernet PG/OP channel with an Internet browser. At the web page information about the CPU and its connected modules can be found. *Chapter 4.6 'Hardware configuration - Ethernet PG/OP channel' on page 58*

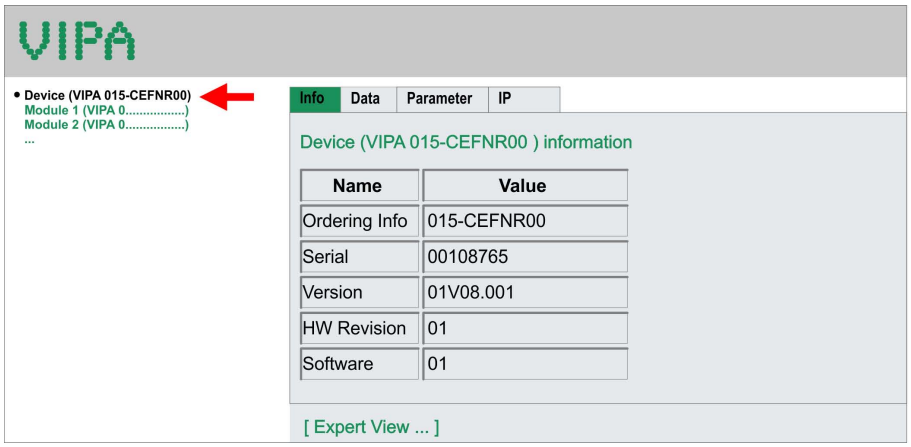
It is assumed that there is a connection between PC and CPU with Internet browser via the Ethernet PG/OP channel. This may be tested by Ping to the IP address of the Ethernet PG/OP channel.

4.10.2 Structure of the web page

The web page is built dynamically and depends on the number of modules, which are connected to the CPU. The web page only shows information. The shown values cannot be changed

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

4.10.3 Web page with selected CPU



Info - Overview

Here order number, serial number and the version of firmware and hardware of the CPU are listed. [Expert View] takes you to the advanced "Expert View".

Info - Expert View

Runtime Information		
Operation Mode	RUN	CPU: Status information
Mode Switch	RUNP	
System Time	24.07.15 11:08:38	CPU: Date, time
OB1-Cycle Time	cur = 2000us, min = 2000us, max = 5000us, avg = 2335us	CPU: Cyclic time: min = minimum cur = current max = maximum avg = average
Interface Information		
X1	PG/OP Ethernet Port 1	Operating mode of the interfaces
X2	PTP	
X3	MPI	
X4	EtherCAT Port	
X5	PG/OP Ethernet Port 2	
X6	Ethernet Port	
VIPASetCard Info		
VSD...		Activated VSD respectively VSC with Information for the support
...		

VSC...		
...		
VSC-Trial-Time	71:59	Remaining time in hh:mm for deactivation of the expansion memory respectively bus functionality and the CPU goes to STOP (abnormal operation), if the VSC is removed. This parameter is only visible when the VSC of an enabled function is removed.
Memory Extension	0 bytes	Size of the additional memory, which was activated by means of a VSC.
PROFIBUS	not activated	Type of the PROFIBUS functionality, which was activated by means of a VSC.
EtherCAT	EtherCAT Master	
Motion	20 Axes	
Memory Usage		
LoadMem	118368/524288 bytes	CPU: Information to memory configuration
WorkMemCode	42656/262144 bytes	Load memory, working memory (code/data)
WorkMemData	33204/262144 bytes	
PG/OP Network Information		
Device Name	PLC_01	Ethernet PG/OP channel:
IP Address	192.168.10.124	Address information
Subnet Mask	255.255.255.0	
Gateway Address	192.168.10.124	
MAC Address	00:20:D5:02:05:4A	
Network Information Port X1		Link mode of the interfaces
Link Mode	100 Mbps - Full Duplex	
Network Information Port X5		
Link Mode	Not Available	
CP Network Information (According To Project Settings)		
Device Name		EtherCAT CP:
IP Address	192.168.0.1	Address information

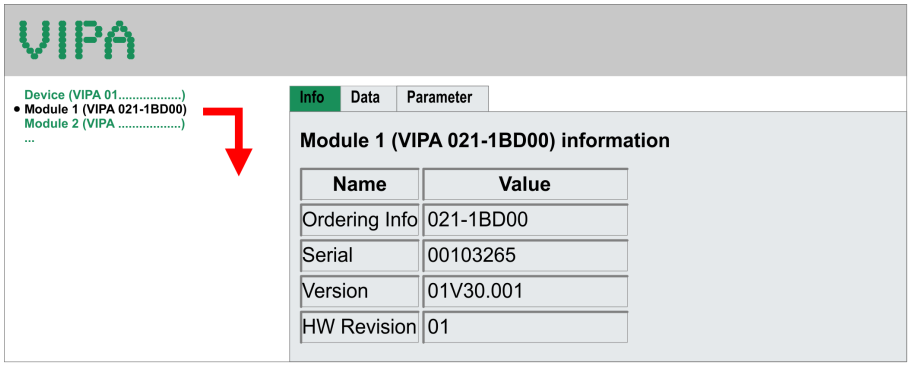
Subnet Mask	255.255.255.0	
Gateway Address	192.168.0.1	
CP Firmware Information		
Bx000689	V3.0.0.32	EtherCAT CP: Information for the support
PRODUCT	VIPA EtherCAT CP V3.0.0.32 Px000249.pkg	EtherCAT CP: Name, firmware version, package
MX000269	V1.0.2.0	EtherCAT CP: Information for the support
Diagnosis Address	2046	
CPU Firmware Information		
File System	V1.0.2	CPU: Information for the support
PRODUCT	VIPA 015-CEFNR00 V1.3.0.255 Px000247.pkg SVN_REV = 39784, BUILD_ID = 2015-07-23_17-40-41, USER = SWBuildServer	CPU: Name, firmware version, package
HARDWARE	V0.1.0.0 5841G-V11 MX000267.003	CPU: Information for the support
Bx000501	V1.3.0.255	
Ax000136	V1.0.4.0	
Ax000150	V1.1.2.0	
fx000018.wld	V1.0.1.0	
syslibex.wld	n/a	
Protect.wld	n/a	
ARM Processor Load		
Measurement Cycle Time	10ms	
Last Value	29%	
Maximum Load	32%	

Data Currently nothing is displayed here.

Parameter Currently nothing is displayed here.

IP Here the IP address data of your Ethernet PG/OP channel are shown

4.10.4 Web page with selected module



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

Data Here the address and the state of the inputs respectively outputs are listed.

Parameter With parameterizable modules e.g. analog modules the parameter setting is shown here. These come from the hardware configuration.

4.11 Operating modes

4.11.1 Overview

The CPU can be in one of 3 operating modes:

- Operating mode STOP
- Operating mode START-UP
  (OB 100 - restart / OB 102 - cold start *)
- Operating mode RUN

Certain conditions in the operating modes START-UP and RUN require a specific reaction from the system program. In this case the application interface is often provided by a call to an organization block that was included specifically for this event.

Operating mode STOP

- The application program is not processed.
- If there has been a processing before, the values of counters, timers, flags and the process image are retained during the transition to the STOP mode.

- Command output disable (BASP) is activated this means the all digital outputs are disabled.
- RUN-LED off
- STOP-LED on

Operating mode START-UP

- During the transition from STOP to RUN a call is issued to the start-up organization block OB 100. The processing time for this OB is not monitored. The START-UP OB may issue calls to other blocks.
- All digital outputs are disabled during the START-UP, this means BASP is activated.
- RUN-LED
  blinks as soon as the OB 100 is operated and for at least 3s, even if the start-up time is shorter or the CPU gets to STOP due to an error. This indicates the start-up.
- STOP-LED off

When the CPU has completed the START-UP OB, it assumes the operating mode RUN.

**** OB 102 (cold start)***

If there is a "Watchdog" error the CPU still remains in STOP state. With such an error the CPU must be manually started again. For this the OB 102 (cold start) must exist. The CPU will not go to RUN without the OB 102. Alternatively you can bring your CPU in RUN state again by an overall reset respectively by reloading your project.

Please consider that the OB 102 (cold start) may exclusively be used for treatment of a watchdog error.

Operating mode RUN

- The application program in OB 1 is processed in a cycle. Under the control of alarms other program sections can be included in the cycle.
- All timers and counters being started by the program are active and the process image is updated with every cycle.
- BASP is deactivated, i.e. all outputs are enabled.
- RUN-LED on
- STOP-LED off

4.11.2 Function security

The CPUs include security mechanisms like a Watchdog (100ms) and a parameterizable cycle time surveillance (parameterizable min. 1ms) that stop res. execute a RESET at the CPU in case of an error and set it into a defined STOP state. The VIPA CPUs are developed function secure and have the following system properties:

Event	concerns	Effect
RUN → STOP	general	BASP (**B**efehls-**A**usgabe-**Sp**erre, i.e. command output lock) is set.
	central digital outputs	The outputs are disabled.

Event	concerns	Effect
	central analog outputs	The outputs are disabled. ■ Voltage outputs issue 0V ■ Current outputs 0...20mA issue 0mA ■ Current outputs 4...20mA issue 4mA If configured also substitute values may be issued.
	decentral outputs	Same behaviour as the central digital/analog outputs.
	decentral inputs	The inputs are cyclically be read by the decentralized station and the recent values are put at disposal.
STOP → RUN res. PowerON	general	First the PII is deleted, then OB 100 is called. After the execution of the OB, the BASP is reset and the cycle starts with: Delete PIO → Read PII → OB 1.
	decentral inputs	The inputs are be read by the decentralized station and the recent values are put at disposal.
RUN	general	The program is cyclically executed: Read PII → OB 1 → Write PIO.

PII = Process image inputs

PIO = Process image outputs

4.12 Overall reset

Overview

During the overall reset the entire user memory is erased. Data located in the memory card is not affected. You have 2 options to initiate an overall reset:

- Overall reset by means of the operating mode switch
- Overall reset by means of the *SPEED7 Studio*

You should always establish an overall reset to your CPU before loading an application program into your CPU to ensure that all blocks have been cleared from the CPU.

4.12.1 Overall reset by means of the operating mode switch

Procedure

Precondition

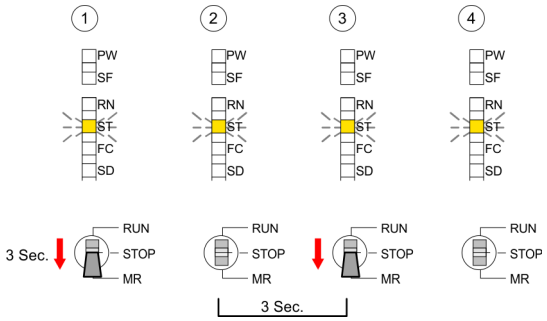
Your CPU must be in STOP state. For this switch the operating mode switch to "STOP".

⇨ The STOP-LED is on.

Overall reset

1. Hold the operating mode switch for ca. 3 seconds in MR position.
   ⇨ The STOP-LED changes from blinking to permanently on.
2. Switch the operating mode switch in STOP position and switch it to MR and quickly back to STOP within a period of 3 seconds.
   ⇨ The STOP-LED blinks (overall reset procedure).
3. The overall reset has been completed when the STOP-LED is on permanently.
   ⇨ The STOP-LED is on.

The following figure illustrates the above procedure:



4.12.2 Overall reset via *SPEED7 Studio*

Proceeding

For the following proceeding you must be online connected to your CPU.

1. For an overall reset the CPU must be switched to STOP state. For this enable with *'View ➔ CPU control centre'* the *CPU control centre* and there switch your CPU to STOP state.
2. Request an overall reset via the *CPU control centre* or with *'Device ➔ Clear memory'*.
   ⇨ A dialog window opens. Here you can bring your CPU in STOP state, if not already done, and start the overall reset. During the overall reset procedure the STOP-LED flashes. When the STOP-LED is on permanently the overall reset procedure has been completed.

4.12.3 Actions after a memory reset

Activating functionality by means of a VSC

If there is a VSC from VIPA plugged, after an overall reset the according functionality is automatically activated. *'VSD' on page 82*

Automatic reload

If there is a project S7PROG.WLD on the memory card, after an overall reset the CPU attempts to reload this project from the memory card. → The SD LED is on. When the reload has been completed the LED expires. The operating mode of the CPU will be STOP respectively RUN, depending on the position of the operating mode switch.

Reset to factory setting

The *Reset to factory setting* deletes completely the internal RAM of the CPU and resets this to delivery state. Please regard that the MPI address is also set back to default 2! *Chapter 4.14 'Factory reset' on page 81*

4.13 Firmware update

Overview

There is the opportunity to execute a firmware update for the CPU and its components via memory card. For this an accordingly prepared memory card must be in the CPU during the start-up. So a firmware files can be recognized and assigned with start-up, a pkg file name is reserved for each update-able component and hardware release, which begins with "px" and differs in a number with 6 digits. The pkg file name of every update-able component can be found at a label on the module. The SLIO CPU has no label. Here the pkg file name can be shown via the web page. After PowerON and operating mode switch in STOP position, the CPU checks if there is a *.pkg file at the memory card. If this firmware version is different to the existing firmware version, this is indicated by blinking of the LEDs and the firmware may be installed by an update request.

Current firmware at www.vipa.com

The latest firmware versions can be found in the "service" area at www.vipa.com. For example the following files are necessary for the firmware update of the CPU and its components with hardware release 1:

- CPU 015, Hardware release 1: Px000247.pkg
- CP: Px000249.pkg

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, please call the VIPA Hotline!

Please regard that the version of the update firmware has to be different from the existing firmware otherwise no update is executed.

Display the firmware version via web page

The CPU has an integrated web page that monitors information about the firmware version of the SPEED7 components. The Ethernet PG/OP channel provides the access to this web page. To activate the PG/OP channel you have to enter according IP parameters. This happens in the *SPEED7 Studio* via the "Initialization". After that you may access the PG/OP channel with a web browser via the set IP address. *Chapter 4.6 'Hardware configuration - Ethernet PG/OP channel' on page 58*

Load firmware and transfer it to memory card

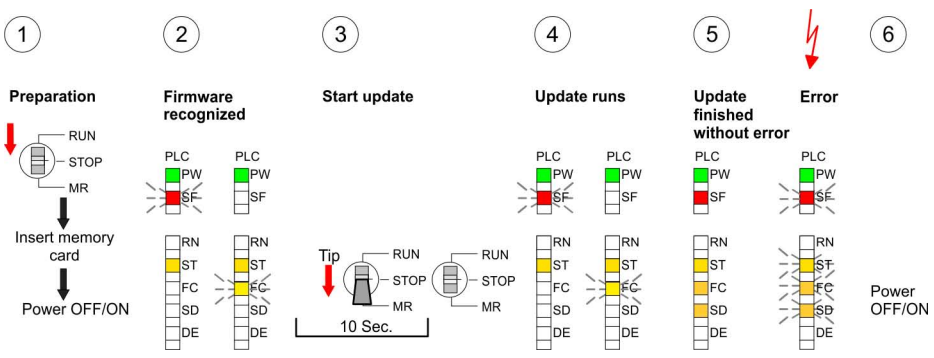
1. Go to www.vipa.com
2. Click *'Service Support ➔ Downloads ➔ Firmware'*.
3. Via *'System SLIO ➔ CPU'* navigate to your CPU and download the zip file to your PC.
4. Unzip the zip file and copy the pkg file to the root directory of your memory card.

CAUTION!
With a firmware update an overall reset is automatically executed. If your program is only available in the load memory of the CPU it is deleted! Save your program before executing a firmware update! After a firmware update you should execute a "Reset to factory setting".
Chapter 4.14 'Factory reset' on page 81

Transfer firmware from memory card into CPU

Please note that with some firmware versions an additional firmware update via alternate blinking of the LEDs SF and FC can be indicated even when the operating mode switch is in RUN position. In this state the CPU can only restart, if you establish a further firmware update process. For this tap the operating mode switch shortly downwards to MR and follow the procedures described below.

1. Switch the operating mode switch of your CPU in position STOP. Turn off the power supply. Plug the memory card with the firmware files into the CPU. Please take care of the correct plug-in direction of the memory card. Turn on the power supply.
2. After a short boot-up time, the alternate blinking of the LEDs SF and FC shows that at least a more current firmware file was found at the memory card.
3. You start the transfer of the firmware as soon as you tip the operating mode switch downwards to MR within 10s and then leave the switch in STOP position.
4. During the update process, the LEDs SF and FC are alternately blinking and SD LED is on. This may last several minutes.
5. The update is successful finished when the LEDs PW, ST, SF, FC and SD are on. If they are blinking fast, an error occurred.
6. Turn power OFF and ON. Now it is checked by the CPU, whether further firmware updates are to be executed. If so, again the LEDs SF and FC flash after a short start-up period. Continue with 3. If the LEDs do not flash, the firmware update is finished.
7. Now a *Reset to factory setting* as described next should be executed. After that the CPU is ready for duty. *Chapter 4.14 'Factory reset' on page 81*



4.14 Factory reset

Proceeding

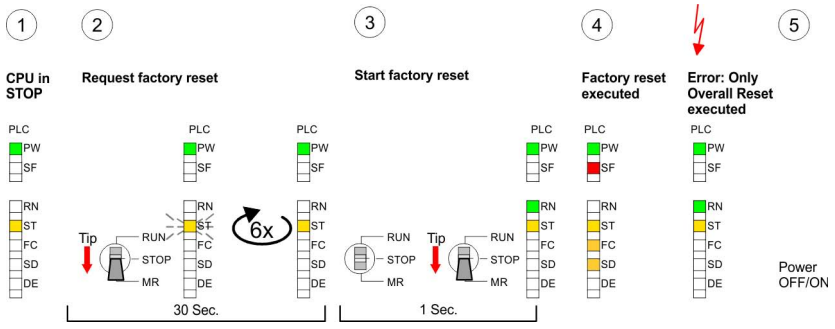
With the following proceeding the internal RAM of the CPU is completely deleted and the CPU is reset to delivery state.

Please regard that the MPI address is also reset to default 2 and the IP address of the Ethernet PG/OP channel is reset to 0.0.0.0!

A factory reset may also be executed by the command FACTORY_RESET. *'CMD - Auto commands' on page 85*

1. Switch the CPU to STOP.
2. Push the operating mode switch down to position MR for 30 seconds. Here the STOP-LED flashes. After a few seconds the STOP LED changes to static light. Now the STOP LED changes between static light and flashing. Start here to count the static light of the STOP LED.
3. After the 6. static light release the operating mode switch and tip it downwards to MR. Now the RUN LED lights up once. This means that the RAM was deleted completely.
4. For the confirmation of the resetting procedure the LEDs PW, ST, SF, FC and MC get on. If not, the factory reset has failed and only an overall reset was executed. In this case you can repeat the procedure. A factory reset can only be executed if the STOP LED has static light for exact 6 times.
5. The end of factory reset is shown by static light of the LEDs PW, ST, SF, FC and SD. Switch the power supply off and on.

The following figure illustrates the procedure above:



After a firmware update of the CPU you always should execute a Factory reset.

4.15 Deployment storage media - VSD, VSC

Overview

At the front of the CPU there is a slot for storage media. Here the following storage media can be plugged:

- VSD - **V**IPA **SD**-Card
  - External memory card for programs and firmware.
- VSC - **V**IPA**S**et**C**ard
  - External memory card (VSD) for programs and firmware with the possibility to unlock optional functions like work memory and field bus interfaces.
  - These functions can be purchased separately.
  - To activate the corresponding card is to be installed and a *Overall reset* is to be established. ↬ *Chapter 4.12 'Overall reset' on page 77*

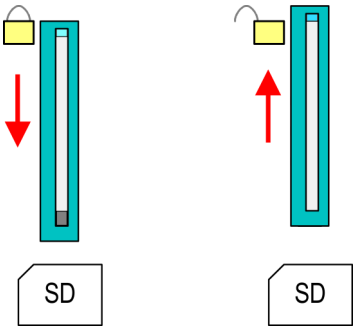
A list of the currently available VSD respectively VSC can be found at www.vipa.com

You can cause the CPU to load a project automatically respectively to execute a command file by means of pre-defined file names.

VSD

VSDs are external storage media based on SD memory cards. VSDs are pre-formatted with the PC format FAT 16 (max. 2GB) and can be accessed via a card reader. After PowerON respectively an overall reset the CPU checks, if there is a VSD with data valid for the CPU.

Push the VSD into the slot until it snaps in leaded by a spring mechanism. This ensures contacting. By sliding down the sliding mechanism, a just installed VSD card can be protected against drop out.



To remove, slide the sliding mechanism up again and push the storage media against the spring pressure until it is unlocked with a click.

CAUTION!
If the media was already unlocked by the spring mechanism, with shifting the sliding mechanism, a just installed memory card can jump out of the slot!

VSC

The VSC is a VSD with the possibility to enable optional functions. Here you have the opportunity to accordingly expand your work memory respectively enable field bus functions. Information about the enabled functions can be shown via the web page. ↬ *Chapter 4.10 'Accessing the web server' on page 71*

CAUTION!
Please regard that the VSC must remain plugged when you've enabled optional functions at your CPU. Otherwise the SF LED is on and the CPU switches to STOP after 72 hours. As soon as an activated VSC is not plugged, the SF LED is on and the "TrialTimer" counts downwards from 72 hours to 0. After 72 hours the CPU switches to STOP state. By plugging the VSC, the SF LED expires and the CPU is running again without any restrictions.

The VSC cannot be replaced by a VSC of the same optional functions. The activation code is fixed to the VSD by means of an unique serial number. Here the function as an external memory card is not affected.

Accessing the storage medium

To the following times an access takes place on a storage medium:

After overall reset

- The CPU checks if a VSC is inserted. If so, the corresponding optional functions are enabled.
- The CPU checks whether a project S7PROG.WLD exists. If so, it is automatically loaded.

After PowerON

- The CPU checks whether a project AUTOLOAD.WLD exists. If so, an overall reset is executed and the project is automatically loaded.
- The CPU checks whether a command file with the name VIPA_CMD.MMC exists. If so the command file is loaded and the commands are executed.
- After PowerON and CPU STOP the CPU checks if there is a *.pkg file (firmware file). If so, this is shown by the CPU by blinking LEDs and the firmware may be installed by an update request.
↳ *further information on page 80*

Once in STOP state

- If a memory card is plugged, which contains a command file VIPA_CMD.MMC, the command file is loaded and the containing instructions are executed.

The FC/SFC 208 ... FC/SFC 215 and FC/SFC 195 allow you to include the memory card access into your user application. More can be found in the manual operation list (HB00_OPL_SP7) of your CPU.

4.16 Extended know-how protection

Overview

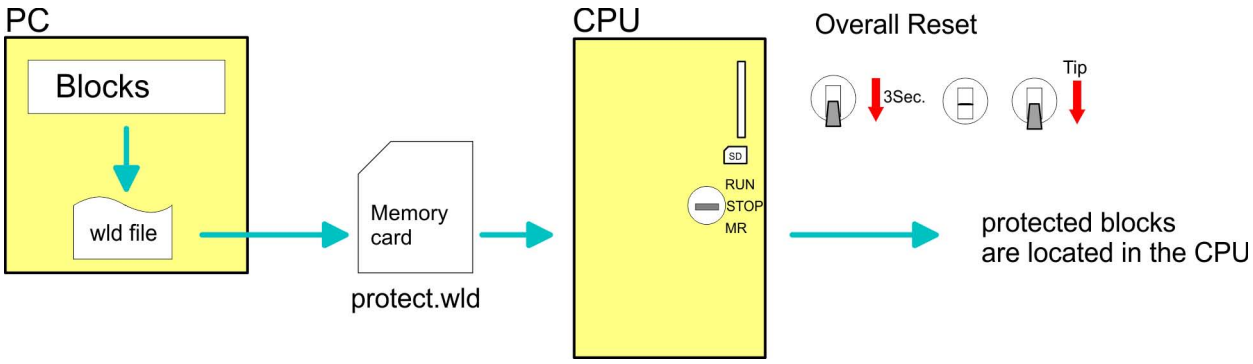
Besides the "standard" Know-how protection the SPEED7-CPUs from VIPA provide an "extended" know-how protection that serves a secure block protection for accesses of 3. persons.

Standard protection

The standard protection from Siemens transfers also protected blocks to the PG but their content is not displayed But with according manipulation the Know-how protection is not guaranteed.

Extended protection

The "extended" know-how protection developed by VIPA offers the opportunity to store blocks permanently in the CPU. With the "extended" protection you transfer the protected blocks to a memory card into a WLD-file named protect.wld. By plugging the memory card and then an overall the blocks in the protect.wld are permanently stored in the CPU. You may protect OBs, FBs and FCs. When back-reading the protected blocks into the PG, exclusively the block header are loaded The block code that is to be protected remains in the CPU and cannot be read

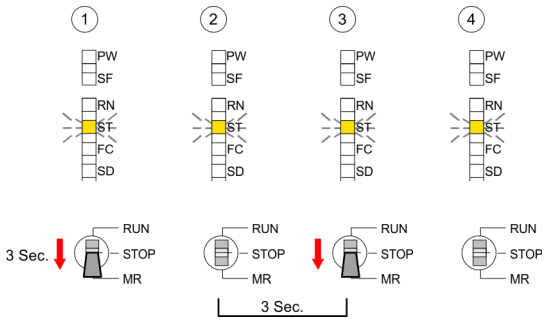


Protect blocks with protect.wld

Create a new wld-file in your project engineering tool with *'File ➔ Memory Card file ➔ New'* and rename it to "protect.wld". Transfer the according blocks into the file by dragging them with the mouse from the project to the file window of protect.wld.

Transfer protect.wld to CPU with overall reset

Transfer the file protect.wld to a memory card, plug the memory card into the CPU and execute an overall reset with the following approach:



The overall reset stores the blocks in protect.wld permanently in the CPU protected from accesses of 3. persons.

Protection behaviour

Protected blocks are overwritten by a new protect.wld. Using a PG 3. persons may access protected blocks but only the block header is transferred to the PG. The block code that is to be protected remains in the CPU and cannot be read

Change respectively delete protected blocks

Protected blocks in the RAM of the CPU may be substituted at any time by blocks with the same name. This change remains up to next overall reset. Protected blocks may permanently be overwritten only if these are deleted at the protect.wld before. A factory reset does not affect the protected blocks. By transferring an empty protect.wld from the memory card with an overall reset, you may delete all protected blocks in the CPU.

Usage of protected blocks

Due to the fact that reading of a "protected" block from the CPU monitors no symbol labels it is convenient to provide the "block covers" for the end user. For this, create a project of all protected blocks. Delete all networks in the blocks so that these only contain the variable definitions in the according symbolism.

4.17 CMD - Auto commands

Overview

A *Command* file at a memory card is automatically executed under the following conditions:

- CPU is in STOP and memory card is plugged
- After each PowerON

Command file

The *Command* file is a text file, which consists of a command sequence to be stored as **vipa_cmd.mmc** in the root directory of the memory card. The file has to be started by CMD_START as 1. command, followed by the desired commands (no other text) and must be finished by CMD_END as last command.

Text after the last command *CMD_END* e.g. comments is permissible, because this is ignored. As soon as the command file is recognized and executed each action is stored at the memory card in the log file logfile.txt. In addition for each executed command a diagnostics entry may be found in the diagnostics buffer.

Commands

Please regard the command sequence is to be started with *CMD_START* and ended with *CMD_END*.

Command	Description	Diagnostics entry
CMD_START	In the first line CMD_START is to be located.	0xE801
	There is a diagnostics entry if CMD_START is missing.	0xE8FE
WAIT1SECOND	Waits about 1 second.	0xE803
LOAD_PROJECT	The function "Overall reset and reload from memory card" is executed. The wld file located after the command is loaded else "s7prog.wld" is loaded.	0xE805
SAVE_PROJECT	The recent project (blocks and hardware configuration) is stored as "s7prog.wld" at the memory card. If the file just exists it is renamed to "s7prog.old". If your CPU is password protected so you have to add this as parameter. Otherwise there is no project written. Example: SAVE_PROJECT password	0xE806
FACTORY_RESET	Executes "factory reset".	0xE807
DIAGBUF	The current diagnostics buffer of the CPU is stored as "diagbuff.txt" at the memory card.	0xE80B

Command	Description	Diagnostics entry
SET_NETWORK	IP parameters for Ethernet PG/OP channel may be set by means of this command. The IP parameters are to be given in the order IP address, subnet mask and gateway in the format x.x.x.x each separated by a comma. Enter the IP address if there is no gateway used.	0xE80E
CMD_END	In the last line CMD_END is to be located.	0xE802

Examples The structure of a command file is shown in the following. The corresponding diagnostics entry is put in parenthesizes.

Example 1

`CMD_START`	Marks the start of the command sequence (0xE801)
`LOAD_PROJECT proj.wld`	Execute an overall reset and load "proj.wld" (0xE805)
`WAIT1SECOND`	Wait ca. 1s (0xE803)
`DIAGBUF`	Store diagnostics buffer of the CPU as "diagbuff.txt" (0xE80B)
`CMD_END`	Marks the end of the command sequence (0xE802)
`... arbitrary text ...`	Text after the command CMD_END is not evaluated.

Example 2

`CMD_START`	Marks the start of the command sequence (0xE801)
`LOAD_PROJECT proj2.wld`	Execute an overall reset and load "proj2.wld" (0xE805)
`WAIT1SECOND`	Wait ca. 1s (0xE803)
`WAIT1SECOND`	Wait ca. 1s (0xE803)
	IP parameter (0xE80E)
`SET_NETWORK 172.16.129.210,255.255.224.0,172.16.129.210`	
`WAIT1SECOND`	Wait ca. 1s (0xE803)
`WAIT1SECOND`	Wait ca. 1s (0xE803)
`DIAGBUF`	Store diagnostics buffer of the CPU as "diagbuff.txt" (0xE80B)
`CMD_END`	Marks the end of the command sequence (0xE802)
`... arbitrary text ...`	Text after the command CMD_END is not evaluated.

The parameters IP address, subnet mask and gateway may be received from the system administrator. Enter the IP address if there is no gateway used.

4.18 Control and monitoring of variables with test functions

Overview

For troubleshooting purposes and to display the status of certain variables you can access certain test functions in the *SPEED7 Studio*

- Test of the user program in the PLC simulator
- Monitoring blocks in the editor
- Viewing and changing variables in watch tables
- Recording of signals by logic analysis

4.18.1 Test of the user program in the PLC simulator

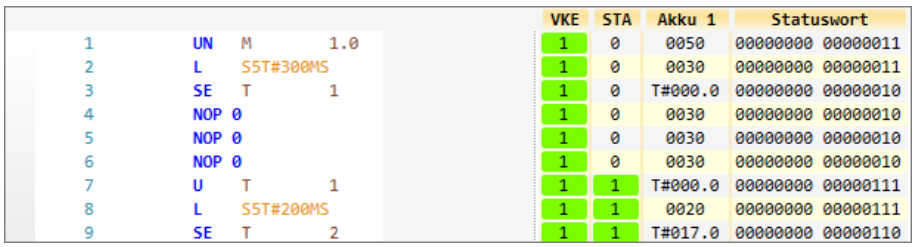
With the PLC simulator, you can test your application program in a virtual CPU before loading it into your PLC. The happens with the following proceeding:

1. Load your user program.
2. Compile your user program.
3. Set at *'Active PC interface'* the virtual interface *'Simulation'*.
4. Open the dialog *'PLC simulation settings'* and make your simulation adjustments if necessary.
5. Start the simulation with *'Simulation ➔ Start PLC simulation'*
   ⇨ The simulation is started.
6. Here you can test your application program, e.g. monitor values of variables or signal states or overwrite variables with values.
7. With *'Simulation ➔ Stop PLC simulation'* the simulation is stopped.

4.18.2 Monitoring blocks in the editor

In the *SPEED7 Studio* you can monitor variables of a block in the block editor. For this the block to be monitored must be loaded in the CPU and you must be online connected to the CPU.

1. Open the block of type OB, FB, FC or DB in the block editor.
2. Click at  .
   ⇨ The variable values are cyclically read from the PLC and shown. Please note that in this case you can not make any changes at the block.



				VKE	STA	Akku 1	Statuswort
1	UN	M	1.0	1	0	0050	00000000 00000011
2	L	S5T#300MS		1	0	0030	00000000 00000011
3	SE	T	1	1	0	T#000.0	00000000 00000010
4	NOP 0			1	0	0030	00000000 00000010
5	NOP 0			1	0	0030	00000000 00000010
6	NOP 0			1	0	0030	00000000 00000010
7	U	T	1	1	1	T#000.0	00000000 00000111
8	L	S5T#200MS		1	1	0020	00000000 00000111
9	SE	T	2	1	1	T#017.0	00000000 00000110

   Depending on the editor the result of logic operation (RLO), status bit (STA) and values of the accu and status word register are shown.
3. To stop the monitoring click again at  .

4.18.3 Viewing and changing variables in watch tables

In the watch table you can monitor (read) and control (write) variables. You can specify , which variables of the CPU are to be read and controlled. You can create more watch tables if you want. This information is obtained from the corresponding area of the selected operands. During the controlling of variables respectively in operating mode STOP the input area is directly read. Otherwise only the process image of the selected operands is displayed.

Inputs can be monitored, but not be controlled. Outputs can be controlled, but not be observed.

Add a watch table

1. Click in the project tree within a PLC beneath *'PLC program'* at *' ➔ Add watch table'*.
   ⇨ The dialog *'Add watch table'* is opened.
2. *'Name'*: Enter a name if needed.
3. *'Comment'*: Enter a comment if needed, e.g. add or description
4. Click at *'OK'*.
   ⇨ The watch table is added and listed in the project tree.
5. Open the watch table
6. Enter via the first line of the table the variables, which you want to monitor respectively control.
7. Marc with ☑ in the column *'Watch'* all the variables, you want to monitor.
8. Click at , to cyclically read data from the PLC.
9. Marc with ☑ in the column *'Control'* all the variables, you want to control.
10. Click at , to write all control values to the PLC with each PLC cycle.

CAUTION!
Please consider that controlling of output values represents a potentially dangerous condition.

These functions should only be used for test purposes respectively for troubleshooting.

4.18.4 Recording of signals by logic analysis

With the logic analysis you can cyclically record PLC signals. Please consider for this an appropriate license for the *SPEED7 Studio* is necessary. To start the logic analysis choose *'View ➔ Logic analysis'*. More information about the usage may be found in the online help of the *SPEED7 Studio*.

4.19 VIPA specific diagnostic entries

Accessing diagnostic data

- You may read the diagnostic buffer of the CPU via the *SPEED7 Studio*. To show the diagnostic entries you choose in the *SPEED7 Studio 'Device ➔ Status of component'*. Here via *'Diagnostic buffer'* you can access the diagnostic buffer.
- The current content of the diagnostic buffer is stored at the memory card by means of the CMD DIAGBUF. *Chapter 4.17 'CMD - Auto commands' on page 85*
- The diagnostic is independent from the operating mode of the CPU. You may store a max. of 100 diagnostic entries in the CPU.

Overview of event IDs

Event-ID	Meaning
0x1141	PROFINET hardware interrupt
	ZInfo1: Logical address
	ZInfo2: Interrupt data
	ZInfo3: Interrupt data
	DatID: Reserved
	DatID: Input
	DatID: Output
0x115C	Vendor-specific interrupt (OB 57) at EtherCAT
	OB: OB number
	ZInfo1: Logical address of the slave that triggered the interrupt
	ZInfo2: Interrupt type
	0x00: Reserved
	0x01: Diagnostic interrupt (incoming)
	0x02: Hardware interrupt
	0x03: Pull interrupt
	0x04: Plug interrupt
	0x05: Status interrupt
	0x06: Update interrupt
	0x07: Redundancy interrupt
	0x08: Controlled by the supervisor
	0x09: Enabled
	0x0A: Wrong sub module plugged
	0x0B: Restoration of the sub module
	0x0C: Diagnostic interrupt (outgoing)
	0x0D: Cross traffic connection message
	0x0E: Neighbourhood change message
	0x0F: Synchronisation message (bus)

Event-ID	Meaning
	0x10: Synchronisation message (device)
	0x11: Network component message
	0x12: Clock synchronisation message (bus)
	0x1F: Pull interrupt module
	ZInfo3: CoE error code
0x1381	Manual restart- (warm-start) -request
	PK: Priority
	OB: OB number
	ZInfo1: STOP cause
0x1382	Automatic restart (warm-start) request
	PK: Priority
	OB: OB number
	ZInfo1: STOP cause
0x1383	Manual restart request
	PK: Priority
	OB: OB number
	ZInfo1: STOP cause
0x1384	Automatic restart request
	PK: Priority
	OB: OB number
	ZInfo1: STOP cause
0x1385	Manual cold start request
	PK: Priority
	OB: OB number
	ZInfo1: STOP cause
0x1386	Automatic cold start request
	PK: Priority
	OB: OB number
	ZInfo1: STOP cause
0x1387	Master CPU: Manual cold start request
	OB: Not relevant to the user or unknown
0x1388	Master CPU: Automatic cold start request
	OB: Not relevant to the user or unknown
0x138A	Master CPU: Manual restart- (warm-start) -request
	OB: Not relevant to the user or unknown
0x138B	Master CPU: Automatic restart (warm-start) request

Event-ID	Meaning
	OB: Not relevant to the user or unknown
0x138C	Standby CPU: Manual start-up request
	OB: Not relevant to the user or unknown
0x138D	Standby CPU: Automatic restart request
	OB: Not relevant to the user or unknown
0x2521	BCD conversion error
	ZInfo1: Affected register
	0: ACCU 1
	1: ACCU 2
	2: ACCU 3
	3: ACCU 4
	4: AR1
	5: AR2
	ZInfo2: OB number
	ZInfo3: Block address
0x2522	Area length error when reading
0x2523	Area length error when writing
0x2524	Area error when reading
0x2525	Area error when writing
0x2526	Timer number error
0x2527	Counter number error
0x2528	Alignment error when reading
0x2529	Alignment error when writing
0x2530	Write error data block
0x2531	Write error instance data block
0x2532	Block number error DB
0x2533	Block number error DI
0x2534	Block number error FC
0x2535	Block number error FB
0x253A	DB not loaded
0x253C	FC not loaded
0x253D	SFC not found
0x253E	FB not loaded
0x253F	SFB not found
0x2942	I/O access error during reading
0x2943	I/O access error during writing

Event-ID	Meaning
0x3267	End of module reconfiguration
0x32C4	Activating a DP slave with SFC 12 (D_ACT_DP) by MODE = 3
	OB: OB number
	PK: Priority
	ZInfo1: Logical base address of the DP master
	ZInfo2: Station number
	ZInfo2: IO system ID
	ZInfo3: Logical base address of the station
	ZInfo3: Output
	ZInfo3: Input
0x32C9	Activating a DP slave with SFC 12 (D_ACT_DP) by MODE = 3
	OB: OB number
	PK: Priority
	ZInfo1: Logical base address of the DP master
	ZInfo2: Station number
	ZInfo2: IO system ID
	ZInfo3: Logical base address of the station
	ZInfo3: Output
	ZInfo3: Input
0x32CF	Activating a PROFINET IO device with SFC 12 (D_ACT_DP) by MODE = 3 / MODE = 4
	OB: OB number
	PK: Priority
	ZInfo1: Logical base address of the IO controller
	ZInfo2: Station number
	ZInfo2: IO system ID
	ZInfo3: Logical base address of the station
	ZInfo3: Output
	ZInfo3: Input
0x33C4	De-activating a DP slave with SFC 12 (D_ACT_DP) by MODE = 4
	OB: OB number
	PK: Priority
	ZInfo1: Logical base address of the DP master
	ZInfo2: Station number
	ZInfo2: IO system ID
	ZInfo3: Logical base address of the station

Event-ID	Meaning
	ZInfo3: Output
	ZInfo3: Input
0x33C9	De-activating a DP slave with SFC 12 (D_ACT_DP) by MODE = 4
	OB: OB number
	PK: Priority
	ZInfo1: Logical base address of the DP master
	ZInfo2: Station number
	ZInfo2: IO system ID
	ZInfo3: Logical base address of the station
	ZInfo3: Output
	ZInfo3: Input
0x33CE	PN_HandlingDeviceAlarm DES_DEACTIVATE_CALL_OB DEVICE_WIEDER-KEHR_PARAMETER_ERROR
0x33CF	Activating a PROFINET IO device with SFC 12 (D_ACT_DP) by MODE = 4
	OB: OB number
	PK: Priority
	ZInfo1: Logical base address of the IO controller
	ZInfo2: Station number
	ZInfo2: IO system ID
	ZInfo3: Logical base address of the station
	ZInfo3: Output
	ZInfo3: Input
0x34A4	PROFINET Interface DB can be addressed again
0x3501	Cycle time exceeded
	OB: OB number
	PK: Priority
	DatID: Reserved
	ZInfo1: Cyclic time
0x3507	Multiple OB request errors caused internal buffer overflow
	PK: Priority
	OB: OB number
0x3508	Synchronous cycle interrupt-timing error
	PK: Priority
	OB: OB number
0x3509	Interrupt loss due to excess interrupt load
	OB: Not relevant to the user or unknown

Event-ID	Meaning
0x350A	Resume RUN mode after CiR
	OB: Not relevant to the user or unknown
0x350B	Technology synchronization interrupt - timing error
	OB: Not relevant to the user or unknown
0x3571	Nesting depth too high in nesting levels
0x3572	Nesting depth for master control relays too high
0x3573	Nesting depth too high after synchronous errors
0x3574	Nesting depth for block calls (U stack) too high
0x3575	Nesting depth for block calls (B stack) too high
0x3576	Local data allocation error
0x3578	Unknown instruction
	OB: Not relevant to the user or unknown
0x357A	Jump instruction to target outside of the block
	OB: Not relevant to the user or unknown
0x3582	Memory error detected and corrected by operating system
	OB: Not relevant to the user or unknown
0x3583	Accumulation of detected and corrected memory errors
	OB: Not relevant to the user or unknown
0x3585	Error in the PC operating system (only with Win AC controllers)
	OB: Not relevant to the user or unknown
0x3587	Multi-bit memory error detected and corrected
	OB: Not relevant to the user or unknown
0x35A1	User interface (OB respectively FRB) not found
	PK: Priority
	OB: OB number
0x35A2	OB not loaded (started by SFC due to configuration)
	OB: Not relevant to the user or unknown
0x35A3	Error on accessing a block
	OB: Not relevant to the user or unknown
0x35A4	PROFINET Interface DB cannot be addressed
	OB: Not relevant to the user or unknown
0x35B1	I/O access error during reading PII
0x35B2	I/O access error during writing PIQ
	PK: Priority
	OB: OB number
0x35D2	Diagnostic entries cannot currently be sent

Event-ID	Meaning
	OB: Not relevant to the user or unknown
0x35D3	Synchronization frames cannot be sent
	OB: Not relevant to the user or unknown
0x35D4	Not permitted time jump resulting from clock synchronization
	OB: Not relevant to the user or unknown
0x35D5	Error on taking the synchronization time
	OB: Not relevant to the user or unknown
0x35E1	Global data (GD): Wrong frame ID
	OB: Not relevant to the user or unknown
0x35E2	Global data (GD): Packet status cannot be entered in DB
	OB: Not relevant to the user or unknown
0x35E3	Global data (GD): Frame length error
	OB: Not relevant to the user or unknown
0x35E4	Global data (GD): Not permitted packet number received
	OB: Not relevant to the user or unknown
0x35E5	Error accessing DB in communication SFBs for configured S7 connections
	OB: Not relevant to the user or unknown
0x35E6	Global data (GD): Overall status cannot be entered in DB
	OB: Not relevant to the user or unknown
0x3821	BATTF: Failure on at least one backup battery of the central rack problem eliminated
	OB: Not relevant to the user or unknown
0x3822	BATTF: Failure of backup voltage on central rack problem eliminated
	OB: Not relevant to the user or unknown
0x3823	BATTF: DC 24V supply failure on central rack problem eliminated
	OB: Not relevant to the user or unknown
0x3825	BATTF: Failure on at least one backup battery of the redundant central rack problem eliminated
	OB: Not relevant to the user or unknown
0x3826	BATTF: Failure of backup voltage on redundant central rack problem eliminated
	OB: Not relevant to the user or unknown
0x3827	BATTF: DC 24V supply failure on redundant central rack problem eliminated
	OB: Not relevant to the user or unknown
0x3831	BATTF: Failure on at least one backup battery of at least one redundant expansion unit problem eliminated
	OB: Not relevant to the user or unknown
0x3832	BATTF: Failure of backup voltage on at least one expansion unit problem eliminated
	OB: Not relevant to the user or unknown

VIPA specific diagnostic entries

Event-ID	Meaning
0x3833	BATTF: DC 24V supply failure on at least one expansion unit problem eliminated
0x3842	Diagnostic interrupt (module/sub module OK)
	PK: PrioLevel
	DatID: Reserved
	DatID: Input module
	DatID: Output module
	ZInfo1: Logical base address of the module, in which the error occurred
	ZInfo2: Module failure
	ZInfo2: Internal error
	ZInfo2: External error
	ZInfo2: Channel error exists
	ZInfo2: External power supply was not found
	ZInfo2: Front plug not found
	ZInfo2: Module not parameterized
	ZInfo2: Wrong parameters in module
	ZInfo2: Module class
	ZInfo2: Channel information available
	ZInfo2: User information available
	ZInfo2: Diagnostic interrupt from substitute
	ZInfo2: Maintenance required
	ZInfo3: Application module wrong / missing
	ZInfo3: Communication error
	ZInfo3: Operation mode: RUN
	ZInfo3: Operation mode: STOP
	ZInfo3: Watchdog was triggered
	ZInfo3: Module internal power supply failure
	ZInfo3: Battery empty
	ZInfo3: Total failed buffering
	ZInfo3: Maintenance request
	ZInfo3: Expansion unit failure
	ZInfo3: Processor failure
	ZInfo3: EPROM error
	ZInfo3: RAM error
	ZInfo3: ADC/DAC error
	ZInfo3: Fuse failure
	ZInfo3: Hardware interrupt lost

Event-ID	Meaning
0x3854	PROFINET IO sub module/module plugged and matches the configured sub module/ module
	ZInfo1: Logical address
	ZInfo2: Device ID
	ZInfo2: Subnet ID
	DatID: Reserved
	DatID: Input
	DatID: Output
0x3855	PROFINET IO sub module/module plugged, but does not match the configured sub module/module
0x3856	PROFINET IO sub module/module plugged, but error in module parameter assign- ment
0x3858	PROFINET IO sub module access error corrected
	ZInfo1: Logical address
	ZInfo2: Device ID
	ZInfo2: Subnet ID
	DatID: Reserved
	DatID: Input
	DatID: Output
0x3861	Module/interface module plugged, module type OK
	OB: Not relevant to the user or unknown
0x3863	Module/interface module plugged, but wrong module type
	OB: Not relevant to the user or unknown
0x3864	Module/interface module plugged, but causing problem (module ID unreadable)
	OB: Not relevant to the user or unknown
0x3865	Module plugged, but error in module parameter assignment
	OB: Not relevant to the user or unknown
0x3866	Module can be addressed again, load voltage error removed
	OB: Not relevant to the user or unknown
0x3881	Interface error, outgoing
	OB: Not relevant to the user or unknown
0x38B1	I/O access error during reading PII
	ZInfo2: Length
	ZInfo3: Offset
0x38B2	I/O access error during writing PIO
	ZInfo2: Length
	ZInfo3: Offset

VIPA specific diagnostic entries

Event-ID	Meaning
0x38B3	I/O access error during reading PII
	PK: Priority
	OB: OB number
	DatID: Length information
	ZInfo1: Res1
	ZInfo2: Length
	ZInfo3: RetVal
0x38B4	I/O access error during writing PIO
	PK: Priority
	OB: OB number
	DatID: Length information
	ZInfo1: Res1
	ZInfo2: Length
	ZInfo3: RetVal
0x38C1	Restoration expansion unit
	OB: OB number
	PK: Priority
	ZInfo1: Logical base address of the IM
	ZInfo2: 1. Expansion unit
	ZInfo2: 2. Expansion unit
	ZInfo2: 3. Expansion unit
	ZInfo2: 4. Expansion unit
	ZInfo2: 5. Expansion unit
	ZInfo2: 6. Expansion unit
	ZInfo2: 7. Expansion unit
	ZInfo2: 8. Expansion unit
	ZInfo2: 9. Expansion unit
	ZInfo2: 10. Expansion unit
	ZInfo2: 11. Expansion unit
	ZInfo2: 12. Expansion unit
	ZInfo2: 13. Expansion unit
	ZInfo2: 14. Expansion unit
	ZInfo2: 15. Expansion unit
	ZInfo3: 16. Expansion unit
	ZInfo3: 17. Expansion unit
	ZInfo3: 18. Expansion unit

Event-ID	Meaning
	ZInfo3: 19. Expansion unit
	ZInfo3: 20. Expansion unit
	ZInfo3: 21. Expansion unit
	ZInfo3: Restoration of at least one expansion rack
0x38C2	Expansion unit restoration (expansion unit failure outgoing with deviation between set and current configuration)
	OB: OB number
	PK: Priority
	ZInfo1: Logical base address of the IM
	ZInfo2: 1. Expansion unit
	ZInfo2: 2. Expansion unit
	ZInfo2: 3. Expansion unit
	ZInfo2: 4. Expansion unit
	ZInfo2: 5. Expansion unit
	ZInfo2: 6. Expansion unit
	ZInfo2: 7. Expansion unit
	ZInfo2: 8. Expansion unit
	ZInfo2: 9. Expansion unit
	ZInfo2: 10. Expansion unit
	ZInfo2: 11. Expansion unit
	ZInfo2: 12. Expansion unit
	ZInfo2: 13. Expansion unit
	ZInfo2: 14. Expansion unit
	ZInfo2: 15. Expansion unit
	ZInfo3: 16. Expansion unit
	ZInfo3: 17. Expansion unit
	ZInfo3: 18. Expansion unit
	ZInfo3: 19. Expansion unit
	ZInfo3: 20. Expansion unit
	ZInfo3: 21. Expansion unit
	ZInfo3: Restoration of at least one expansion unit
0x38C4	Restoration of a DP station
	OB: OB number
	PK: Priority
	ZInfo1: Logical base address of the DP master
	ZInfo2: Station number

VIPA specific diagnostic entries

Event-ID	Meaning
	ZInfo2: IO system ID
	ZInfo3: Logical base address of the station
	ZInfo3: Output
	ZInfo3: Input
0x38C5	Restoration DP station but faulty
	OB: OB number
	PK: Priority
	ZInfo1: Logical base address of the DP master
	ZInfo2: Station number
	ZInfo2: IO system ID
	ZInfo3: Logical base address of the station
	ZInfo3: Output
	ZInfo3: Input
0x38C6	Expansion unit operational again, but error(s) in module parameter assignment
	OB: OB number
	PK: Priority
	ZInfo1: Logical base address of the IM
	ZInfo2: 1. Expansion unit
	ZInfo2: 2. Expansion unit
	ZInfo2: 3. Expansion unit
	ZInfo2: 4. Expansion unit
	ZInfo2: 5. Expansion unit
	ZInfo2: 6. Expansion unit
	ZInfo2: 7. Expansion unit
	ZInfo2: 8. Expansion unit
	ZInfo2: 9. Expansion unit
	ZInfo2: 10. Expansion unit
	ZInfo2: 11. Expansion unit
	ZInfo2: 12. Expansion unit
	ZInfo2: 13. Expansion unit
	ZInfo2: 14. Expansion unit
	ZInfo2: 15. Expansion unit
	ZInfo3: 16. Expansion unit
	ZInfo3: 17. Expansion unit
	ZInfo3: 18. Expansion unit
	ZInfo3: 19. Expansion unit

Event-ID	Meaning
	ZInfo3: 20. Expansion unit
	ZInfo3: 21. Expansion unit
	ZInfo3: Restoration of at least one expansion rack
0x38C7	Restoration DP station, but error(s) in module parameter assignment
	OB: OB number
	PK: Priority
	ZInfo1: Logical base address of the DP master
	ZInfo2: Station number
	ZInfo2: IO system ID
	ZInfo3: Logical base address of the station
	ZInfo3: Output
	ZInfo3: Input
0x38C8	Restoration DP station but mismatch between set and current configuration
	OB: OB number
	PK: Priority
	ZInfo1: Logical base address of the DP master
	ZInfo2: Station number
	ZInfo2: IO system ID
	ZInfo3: Logical base address of the station
	ZInfo3: Output
	ZInfo3: Input
0x38CB	PROFINET IO station restoration
	OB: OB number
	PK: Priority
	DatID: Reserved_1
	ZInfo1: Logical address of the IO system
	ZInfo2: Station number
	ZInfo2: IO system ID
	ZInfo3: Logical base address of the station
	ZInfo3: Output
	ZInfo3: Input
0x38CC	PROFINET IO station restoration with failure or maintenance
	OB: OB number
	PK: Priority
	DatID: Reserved_1
	ZInfo1: Logical base address of the IO controller

Event-ID	Meaning
	ZInfo2: Station number
	ZInfo2: IO system ID
	ZInfo3: Logical base address of the station
	ZInfo3: Output
	ZInfo3: Input
0x38CD	PROFINET IO station restoration, but expected configuration does not match actual configuration
	OB: OB number
	PK: Priority
	ZInfo1: Logical base address of the IO controller
	ZInfo2: Station number
	ZInfo2: IO system ID
	ZInfo3: Logical base address of the station
	ZInfo3: Output
	ZInfo3: Input
0x38CE	PROFINET IO station restoration, but error(s) in module parameter assignment
	OB: OB number
	PK: Priority
	ZInfo1: Logical base address of the IO controller
	ZInfo2: Station number
	ZInfo2: IO system ID
	ZInfo3: Logical base address of the station
	ZInfo3: Output
	ZInfo3: Input
0x38F8	Restoration of the part of the sub modules of a PROFINET I device
	OB: OB number
	PK: Priority
	ZInfo1: Logical base address of the IO controller
	ZInfo2: Station number
	ZInfo2: IO system ID
	ZInfo3: Logical base address of the station
	ZInfo3: Output
	ZInfo3: Input
0x38F9	Restoration of the part of the sub modules of a PROFINET I device with device configuration difference
	OB: OB number
	PK: Priority

Event-ID	Meaning
	ZInfo1: Logical base address of the IO controller
	ZInfo2: Station number
	ZInfo2: IO system ID
	ZInfo3: Logical base address of the station
	ZInfo3: Output
	ZInfo3: Input
0x3921	BATTF: Failure on at least one backup battery of the central rack
	OB: Not relevant to the user or unknown
0x3922	BATTF: Failure of backup voltage on central rack
	OB: Not relevant to the user or unknown
0x3923	BATTF: Failure of backup voltage on central rack problem eliminated
	OB: Not relevant to the user or unknown
0x3925	BATTF: Failure on at least one backup battery of the redundant central rack
	OB: Not relevant to the user or unknown
0x3926	BATTF: Failure of backup voltage on redundant central rack
	OB: Not relevant to the user or unknown
0x3927	BATTF: DC 24V supply failure on redundant central rack
	OB: Not relevant to the user or unknown
0x3931	BATTF: Failure on at least one backup battery of at least one redundant expansion unit
	OB: Not relevant to the user or unknown
0x3932	BATTF: Failure of backup voltage on at least one expansion unit
0x3933	BATTF: DC 24V supply failure on at least one expansion unit
	OB: Not relevant to the user or unknown
0x3942	Diagnostic interrupt (module/sub module fault or maintenance required or both)
	PK: Priority level
	DatID: Reserved
	DatID: Input module
	DatID: Output module
	ZInfo1: Logical base address of the module, in which the error occurred
	ZInfo2: Module failure
	ZInfo2: Internal error
	ZInfo2: External error
	ZInfo2: Channel error exists
	ZInfo2: External power supply was not found
	ZInfo2: Front plug not found

VIPA specific diagnostic entries

Event-ID	Meaning
	ZInfo2: Module not parameterized
	ZInfo2: Wrong parameters in module
	ZInfo2: Module class
	ZInfo2: Channel information available
	ZInfo2: User information available
	ZInfo2: Diagnostic interrupt from substitute
	ZInfo2: Maintenance required
	ZInfo3: Application module wrong / missing
	ZInfo3: Communication error
	ZInfo3: Operation mode: RUN
	ZInfo3: Operation mode: STOP
	ZInfo3: Watchdog was triggered
	ZInfo3: Module internal power supply failure
	ZInfo3: Battery empty
	ZInfo3: Total failed buffering
	ZInfo3: Maintenance request
	ZInfo3: Expansion unit failure
	ZInfo3: Processor failure
	ZInfo3: EPROM error
	ZInfo3: RAM error
	ZInfo3: ADC/DAC error
	ZInfo3: Fuse failure
	ZInfo3: Hardware interrupt lost
0x3951	PROFINET IO module removed
	ZInfo1: Logical address
	ZInfo2: Device ID
	ZInfo2: Subnet ID
	DatID: Reserved
	DatID: Input
	DatID: Output
0x3954	PROFINET IO sub module/module removed
	ZInfo1: Logical address
	ZInfo2: Device ID
	ZInfo2: Subnet ID
	DatID: Reserved
	DatID: Input

Event-ID	Meaning
	DatID: Output
0x3961	Module/interface module removed respectively cannot be addressed
	OB: Not relevant to the user or unknown
0x3966	Module cannot be addressed, load voltage error
	OB: Not relevant to the user or unknown
0x3968	Module reconfiguration has ended with error
	OB: Not relevant to the user or unknown
0x3981	Interface error, incoming
	OB: Not relevant to the user or unknown
0x3986	Performance of an H-Sync link negatively affected
	OB: Not relevant to the user or unknown
0x39B1	I/O access error when updating the process image input table
	OB: Not relevant to the user or unknown
0x39B2	I/O access error when transferring the process image to the output modules
	OB: Not relevant to the user or unknown
0x39B3	I/O access error during reading PII
	PK: Priority
	OB: OB number
	DatID: Length information
	ZInfo1: Res1
	ZInfo2: Length
	ZInfo3: RetVal
0x39B4	I/O access error during reading PII
	PK: Priority
	OB: OB number
	DatID: Length information
	ZInfo1: Res1
	ZInfo2: Length
	ZInfo3: RetVal
0x39C1	Expansion unit failure
	OB: OB number
	PK: Priority
	ZInfo1: Logical base address of the IM
	ZInfo2: 1. Expansion unit
	ZInfo2: 2. Expansion unit
	ZInfo2: 3. Expansion unit

Event-ID	Meaning
	ZInfo2: 4. Expansion unit
	ZInfo2: 5. Expansion unit
	ZInfo2: 6. Expansion unit
	ZInfo2: 7. Expansion unit
	ZInfo2: 8. Expansion unit
	ZInfo2: 9. Expansion unit
	ZInfo2: 10. Expansion unit
	ZInfo2: 11. Expansion unit
	ZInfo2: 12. Expansion unit
	ZInfo2: 13. Expansion unit
	ZInfo2: 14. Expansion unit
	ZInfo2: 15. Expansion unit
	ZInfo3: 16. Expansion unit
	ZInfo3: 17. Expansion unit
	ZInfo3: 18. Expansion unit
	ZInfo3: 19. Expansion unit
	ZInfo3: 20. Expansion unit
	ZInfo3: 21. Expansion unit
	ZInfo3: Failure of at least one expansion unit
0x39C3	Distributed I/Os: Failure of a DP master system
	OB: OB number
	PK: Priority
	ZInfo1: Logical base address of the DP master
	ZInfo2: DM master ID
0x39C4	Failure of a DP station
	OB: OB number
	PK: Priority
	ZInfo1: Logical base address of the DP master
	ZInfo2: No. of the DP station
	ZInfo2: DM master ID
	ZInfo3: Logical base address of an S7 slave station respectively diagnostic address of a standard DP slave station
	ZInfo3: Output
	ZInfo3: Input
0x39CA	PROFINET IO system failure
	OB: OB number

Event-ID	Meaning
	PK: Priority
	ZInfo1: Logical address of the IO system
	ZInfo2: Interrupt reason
	ZInfo3: Station number
	ZInfo3: IO system ID
0x39CB	PROFINET IO station failure
	OB: OB number
	PK: Priority
	DatID: Reserved_1
	ZInfo1: Logical address of the IO system
	ZInfo2: Station number
	ZInfo2: IO system ID
	ZInfo3: Logical base address of the station
	ZInfo3: Output
	ZInfo3: Input
0x39CD	PROFINET IO station restoration, but expected configuration does not match actual configuration
0x39CE	PROFINET IO station restoration, but error(s) in module parameter assignment
0x39D0	SLIO master failure
	OB: OB number
	PK: Priority
	ZInfo1: Logical address of the SLIO IO system
	ZInfo2: Logical address of the virtual SLIO device
	ZInfo3: Station number
	ZInfo3: IO system ID
0x39F8	Failure of the part of the sub modules of a PROFINET I device
	OB: OB number
	PK: Priority
	ZInfo1: Logical base address of the IO controller
	ZInfo2: Station number
	ZInfo2: IO system ID
	ZInfo3: Logical base address of the station
	ZInfo3: Output
	ZInfo3: Input
0x4300	Backed-up Power ON
0x4301	Mode transition from STOP to STARTUP

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Event-ID	Meaning
	ZInfo1: STOP cause
0x4302	Mode transition from STARTUP to RUN
0x4303	STOP caused by STOP switch operation
0x4304	STOP caused by PG STOP operation or by SFB 20 "STOP"
0x4305	HALT: Breakpoint reached
0x4306	HALT: Breakpoint left
0x4307	Start overall reset by PU operation
0x4308	Start overall reset by switch setting
0x4309	Start overall reset automatically (no backed-up Power ON)
0x430A	HOLD left, transition to STOP
0x430D	STOP caused by other CPU in multi-computing
0x430E	Overall reset executed
0x430F	STOP on the module due to STOP on a CPU
0x4318	Start of CiR
	OB: Not relevant to the user or unknown
0x4319	CiR completed
0x4357	Module watchdog started
	OB: Not relevant to the user or unknown
0x4358	All modules are ready for operation
	OB: Not relevant to the user or unknown
0x4359	One or more modules not ready for operation
	OB: Not relevant to the user or unknown
0x43B0	Firmware update/-backup successfully done.
	OB: Not relevant to the user or unknown
0x43B4	Error in firmware backup
	OB: Not relevant to the user or unknown
0x43B6	Firmware updates cancelled by redundant modules
	OB: Not relevant to the user or unknown
0x43D0	Link-up aborted due to violation of coordination rules
	OB: Not relevant to the user or unknown
0x43D1	Link-up/updating sequence aborted
	OB: Not relevant to the user or unknown
0x43D3	STOP on standby CPU
	OB: Not relevant to the user or unknown
0x43D5	Link-up rejected due to mismatched CPU memory configuration of the sub-PLC
	OB: Not relevant to the user or unknown

Event-ID	Meaning
0x43D6	Link-up rejected due to mismatched system program of the sub-PLC
	OB: Not relevant to the user or unknown
0x43D7	Link-up rejected due to change in user program or in configuration
	OB: Not relevant to the user or unknown
0x43DC	Abort during link-up with switch-over
0x43DD	Link-up rejected due to running test or other online functions
0x43DE	Updating aborted due to monitoring time being exceeded during the n-th attempt, new update attempt initiated
0x43DF	Updating aborted for final time due to monitoring time being exceeded after completing the maximum amount of attempts. User intervention required.
0x43E0	Transition from solo to link-up mode
0x43E1	Change from link-up to updating
0x43E2	Change from updating to redundant mode
0x43E3	Master CPU: Transition from redundant to solo mode
0x43E4	Standby CPU: Transition from redundant to troubleshooting mode
0x43E5	Standby CPU: Transition from troubleshooting mode to link-up or STOP
0x43E6	Link-up aborted on the standby CPU
0x43E7	Updating aborted on the standby CPU
0x43E8	Standby CPU: Transition from link-up to start-up
0x43E9	Standby CPU: Change from start-up to updating
0x43F1	Standby master switch-over
0x43F2	Coupling of incompatible H-CPUs blocked by system program
0x43F4	Standby CPU: Link-up/updating by means of SFC90 is locked in the master CPU
0x4510	STOP violation of the CPU's data range
0x4520	DEFECTIVE: STOP not reachable
0x4521	DEFECTIVE: Failure of instruction processing processor
0x4522	DEFECTIVE: Failure of clock chip
0x4523	DEFECTIVE: Failure of clock pulse generator
0x4524	DEFECTIVE: Failure of timer update function
0x4525	DEFECTIVE: Failure of multi-computing synchronization
0x4527	DEFECTIVE: Failure of I/O access monitoring
0x4528	DEFECTIVE: Failure of cycle time monitoring
0x4530	DEFECTIVE: Memory test error in internal memory
	OB: Not relevant to the user or unknown
0x4532	DEFECTIVE: Failure of core resources
	OB: Not relevant to the user or unknown
0x4536	DEFECTIVE: Operating mode switch defective

Event-ID	Meaning
0x4540	STOP: Memory expansion of the internal work memory has gaps First memory expansion too small or missing.
0x4541	STOP caused by priority class system
	OB: Not relevant to the user or unknown
0x4542	STOP caused by object management system
	OB: Not relevant to the user or unknown
0x4543	STOP caused by test functions and commissioning
0x4544	STOP caused by diagnostic system
0x4545	STOP caused by communication system
	ZInfo1: Error status
0x4546	STOP caused by CPU memory management
0x4547	STOP caused by process image management
0x4548	STOP caused by I/O management
	OB: Not relevant to the user or unknown
0x454A	STOP caused by I/O management: An OB deselected with STEP 7 was being loaded into the CPU during start-up
0x454B	STOP: Maximum number of time-outs of a synchronous OB reached
	PK:
	OB: CPU mode
	DatID: Block type
0x4550	DEFECTIVE: Internal system error
	ZInfo1: Not relevant to the user
0x4555	No restart possible, monitoring time elapsed
0x4556	STOP: Overall reset request due to inconsistency in communication/data
0x4562	STOP caused by programming error (OB not loaded or not possible
0x4563	STOP caused by I/O access error (OB not loaded or not possible
0x4567	STOP caused by H event
0x4568	STOP caused by time error (OB not loaded or not possible)
	PK:
	OB: CPU mode
	DatID: Block type
0x456A	STOP caused by diagnostic interrupt (OB not loaded or not possible)
	PK:
	OB: CPU mode
	DatID: Block type
0x456B	STOP caused by removing/plugging module (OB not loaded or not possible)
	OB: Not relevant to the user or unknown

Event-ID	Meaning
0x456C	STOP caused by CPU hardware error (OB not loaded or not possible)
	OB: Not relevant to the user or unknown
0x456D	STOP caused by program sequence error (OB not loaded or not possible)
	PK:
	OB: CPU mode
	DatID: Block type
0x456E	STOP caused by communication error (OB not loaded or not possible)
	OB: Not relevant to the user or unknown
0x456F	STOP caused by rack failure OB (OB not loaded or not possible)
	PK:
	OB: CPU mode
	DatID: Block type
0x4570	STOP caused by process interrupt (OB not loaded or not possible)
0x4571	STOP caused by nesting stack error
0x4572	STOP caused by master control relay stack error
0x4573	STOP caused by exceeding the nesting depth for synchronous errors
0x4574	STOP caused by exceeding U stack nesting depth in the priority class stack
0x4575	STOP caused by exceeding B stack nesting depth in the priority class stack
0x4576	STOP caused by error when allocating the local data
	PK: Priority
	OB: OB number
0x4578	STOP caused by unknown opcode
0x457A	STOP caused by code length error
0x457B	STOP caused by DB not being loaded on on-board I/Os
0x457D	Overall reset request due to the version of the internal interface to the integrated technology was changed
0x457F	STOP caused by STOP command
	PK: Priority
	OB:
	DatID: Block type
	ZInfo1: Priority error OB
	ZInfo2: Error OB
	ZInfo3: Address
0x4580	STOP: Back-up buffer contents inconsistent (no transition to RUN)
0x4590	STOP caused by overloading the internal functions
	OB: Not relevant to the user or unknown

Event-ID	Meaning
0x4926	DEFECTIVE: Failure of the watchdog for I/O access
0x4931	STOP respectively DEFECTIVE: Memory test error in module memory
0x4933	Checksum error
0x4934	DEFECTIVE: Memory not found
0x4935	DEFECTIVE: Cancelled by watchdog/processor exceptions
	ZInfo1: Not relevant to the user
	ZInfo2: Not relevant to the user
	ZInfo3: Not relevant to the user
0x4949	STOP caused by continuous hardware interrupt
0x494D	STOP caused by I/O error
0x494E	STOP caused by power failure
	OB: Mode
	DatID: Not relevant to the user
0x494F	STOP caused by configuration error
	ZInfo1: Error status
0x4959	One or more modules not ready for operation
0x497C	STOP caused by integrated technology
0x49A0	STOP caused by parameter assignment error or non-permissible variation of set and actual configuration: Start-up blocked.
	ZInfo2: Diagnostic address
0x49A1	STOP caused by parameter assignment error Overall reset request
0x49A2	STOP caused by error in parameter modification: Start-up blocked.
0x49A3	STOP caused by error in parameter modification: Memory reset request
0x49A4	STOP: Inconsistency of the configuration data
0x49A5	STOP: Distributed I/Os: Configuration data do not match
0x49A6	STOP: Distributed I/Os: invalid configuration information
0x49A7	STOP: Distributed I/Os: Project information not found
0x49A8	STOP: Error indicated by the interface module for the distributed I/Os
0x49B1	Firmware update: Firmware update data incorrect
	DatID: Not relevant to the user
0x49B2	Firmware update: Hardware type does not match the firmware
	DatID: Not relevant to the user
0x49B3	Firmware update: Module type does not match the firmware
0x49D2	Standby CPU changed to STOP due to STOP on the master CPU during link-up
0x49D4	STOP on a master, since partner CPU is also a master (link-up error)
0x49D8	STOP/Troubleshooting/DEFECTIVE Hardware error detected due to another error

Event-ID	Meaning
0x49D9	STOP due to SYNC module error
0x49DA	STOP due to synchronization error between H CPUs
0x510F	A problem has occurred with WinLC. This problem has caused the CPU to go into STOP or DEFECTIVE mode
0x530D	New start-up information in the STOP mode
0x5311	Start-up despite not ready message from module(s)
0x5371	Distributed I/Os: End of the synchronization with a DP master
	ZInfo1: Slave status
	ZInfo3: Version
0x5380	Diagnostic buffer entries of interrupt and asynchronous errors disabled
	OB: OB number
	PK: Priority
	ZInfo1: OB number
	ZInfo1: Mode
0x5395	Distributed I/Os: Reset of a DP master
0x53A2	Download of technology firmware successful
0x53A4	Download of technology DB not successful
0x53FF	Reset to factory setting
0x5445	End of system reconfiguration due to plant changes in RUN mode
0x5481	All licenses for runtime software are complete again
0x5498	End of inconsistency with DP master systems due to CiR
0x5545	Start of system reconfiguration due to plant changes in RUN mode
0x55A5	Version conflict of the internal interface to the integrated technology
0x55A6	The maximum number of technology objects has been exceeded
0x55A7	A technology DB of this type already exists
0x5868	Emergency address of an Ethernet interface disabled
0x5879	Diagnostic message from DP interface: EXTF LED off
0x5961	Parametrization error
	OB: OB number
	PK: Priority
	ZInfo2: Module address
0x5962	Parameter assignment error preventing start-up
	OB: Not relevant to the user or unknown
0x5963	Parameter assignment error with overall reset request
0x5966	Parameter assignment error when switching
0x5967	Parametrization error: Unknown configuration data

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Event-ID	Meaning
0x5968	Emergency address of an Ethernet interface enabled
0x5969	Parameter assignment error preventing start-up
0x596A	PROFINET IO: IP address of an IO device already present
0x596B	IP address of an Ethernet interface already exists
0x596C	Name of an Ethernet interface already exists
0x596D	The existing network configuration does not match the system requirements or configuration
0x5979	Diagnostic message from DP interface: EXTF LED on
0x597C	DP Global Control command failed or moved
0x59A0	The interrupt can not be associated in the CPU
0x59A1	Configuration error of the integrated technology
0x59A3	Error when downloading the integrated technology
0x6253	Firmware update: End of the firmware download via the network
0x6316	Interface error during start-up of the automation system
0x6353	Firmware update: Start of firmware download via the network
0x6390	Formatting of micro memory card complete
0x6500	Connection ID exists twice on module
0x6501	Connection resources insufficient
0x6502	Error in the connection description
0x6510	CFB structure error detected in instance DB when evaluating EPROM
0x6514	GD packet number exists twice on the module
0x6515	Inconsistent length specifications in GD configuration information
0x6521	Neither module nor internal memory available
0x6522	Not permitted module: Module replacement and overall reset required
0x6523	Overall reset request due to error accessing module
0x6524	Overall reset request due to error in block header
0x6526	Overall reset request due to memory replacement
0x6527	Memory replaced, therefore restart not possible
0x6528	Object handling function in STOP/HOLD, no restart possible
0x6529	No start-up possible during the "load user program" function
0x652A	No start-up because block exists twice in user memory
0x652B	No start-up because block is too long for module: Module replacement required
0x652C	No start-up due to not permitted OB on the module
0x6532	No start-up due to not permitted configuration information on module
0x6533	Overall reset request due to invalid module content
0x6534	No start-up: Block exists more than once on module

Event-ID	Meaning
0x6535	No start-up: Not enough memory to transfer block from module
	OB: CPU mode
0x6536	No start-up: Module contains not permitted block number
0x6537	No start-up: Module contains a block with not permitted length
0x6538	Local data or write-protection ID (for DB) of a block not permitted for CPU
0x6539	Not permitted command in block (detected by compiler)
0x653A	Overall reset request due to local OB data on module too short
0x6543	No start-up: Block type not permitted
0x6544	No start-up: Attribute "relevant for processing" not permitted
0x6545	Source language not permitted
0x6546	Maximum number of blocks of one block type reached
0x6547	Parameter assignment error of modules (not via P bus, but cancelled download)
0x6548	Plausibility error during block check
0x6549	Structure error in block
0x6550	A block has an error in the CRC
0x6551	A block has no CRC
0x6560	SCAN overflow
0x6805	Resource problem on fix configured connections problem eliminated
0x6881	Interface error outgoing
0x6905	Resource problem on fix configured connections
0x6981	Interface error incoming
	ZInfo1: Slave number
	ZInfo2: Slot
0xE003	Error on accessing the periphery
	ZInfo1: Transfer type
	ZInfo2: Periphery address
	ZInfo3: Slot
0xE004	Multiple configuration of a periphery address
	ZInfo1: Periphery address
	ZInfo2: Slot
0xE005	Internal error - Please contact the VIPA Hotline!
	ZInfo1: Not relevant to the user
	ZInfo2: Not relevant to the user
	ZInfo3: Not relevant to the user
0xE007	Configured in-/output bytes do not fit into periphery area
0xE008	Internal error - Please contact the VIPA Hotline!

VIPA specific diagnostic entries

Event-ID	Meaning
0xE009	Error on accessing the standard backplane bus
0xE010	There is a undefined module at the backplane bus
	ZInfo2: Slot
	ZInfo3: Type ID
0xE011	Master project engineering at slave CPU not possible or wrong slave configuration
0xE012	Error at parametrization
0xE013	Error at shift register access to standard bus digital modules
0xE014	Error at Check_Sys
0xE015	Error at access to the master
	ZInfo2: Slot of the master
	ZInfo2: Page frame master
0xE016	Maximum block size at master transfer exceeded
	ZInfo1: Periphery address
	ZInfo2: Slot
0xE017	Error at access to integrated slave
0xE018	Error at mapping of the master periphery
0xE019	Error at standard back plane bus system recognition
0xE01A	Error at recognition of the operating mode (8 / 9 bit)
0xE01B	Error - maximum number of plug-in modules exceeded
0xE020	Error - interrupt information is not defined
	ZInfo2: Slot
	ZInfo3: Not relevant to the user
	DatID: Interrupt type
0xE030	Error of the standard bus
0xE033	Internal error - Please contact the VIPA Hotline!
0xE0B0	SPEED7 is not stoppable (e.g. undefined BCD value at timer)
	ZInfo1: Not relevant to the user
	ZInfo2: Not relevant to the user
	ZInfo3: Not relevant to the user
	DatID: Not relevant to the user
0xE0C0	Not enough space in work memory for storing code block (block size exceeded)
0xE0CB	Error at SSL access
	ZInfo1: Error
	4: SSL wrong
	5: Sub-SSL wrong
	6: Index wrong

Event-ID	Meaning
	ZInfo2: SSL-ID
	ZInfo3: Index
0xE0CC	Communication error MPI/serial
	ZInfo1: Error code
	1: Wrong priority
	2: Buffer overflow
	3: Telegram format error
	4: Wrong SSL request (SSL-ID not valid)
	5: Wrong SSL request (SSL-Sub-ID invalid)
	6: Wrong SSL request (SSL-Index not valid)
	7: Wrong value
	8: Wrong return value
	9: Wrong SAP
	10: Wrong connection type
	11: Wrong sequence number
	12: Faulty block number in the telegram
	13: Faulty block type in the telegram
	14: Inactive function
	15: Wrong size in the telegram
	20: Error in writing on MMC
	90: Faulty buffer size
	98: Unknown error
	99: Internal error
0xE0CD	Error at DP-V1 job management
	ZInfo1: Not relevant to the user
	ZInfo2: Not relevant to the user
	ZInfo3: Not relevant to the user
	DatID: Not relevant to the user
0xE0CE	Error: Timeout at sending of the I-slave diagnostics
0xE100	Memory card access error
0xE101	Memory card error file system
0xE102	Memory card error FAT
0xE104	Memory card error at saving
	ZInfo3: Not relevant to the user
0xE200	Memory card writing finished (Copy Ram2Rom)
	PK: Not relevant to the user

Event-ID	Meaning
	OB: Not relevant to the user
0xE210	Memory card reading finished (reload after overall reset)
	ZInfo1: Not relevant to the user
	PK: Not relevant to the user
	OB: Not relevant to the user
0xE21E	Memory card reading: Error at reload (after overall reset), file "Protect.wld" too big
	OB: Not relevant to the user
0xE21F	Memory card reading: Error at reload (after overall reset), file read error, out of memory
	PK: Not relevant to the user
	OB: Not relevant to the user
	ZInfo1: Not relevant to the user
	ZInfo2: BstTyp
	0x38: OB
	0x45: FB
	0x43: FC
	0x41: DB
	0x42: SDB
	0x44: SFC
	0x46: SFB
	ZInfo3: BstNr
0xE300	Internal flash writing finished (Copy Ram2Rom)
0xE310	Internal flash writing finished (reload after battery failure)
0xE400	FSC card was plugged
	DatID: FeatureSet Trialtime in minutes
	ZInfo1: Memory extension in kB
	ZInfo2: FeatureSet PROFIBUS
	ZInfo2: FeatureSet field bus
	ZInfo2: FeatureSet motion
	ZInfo2: Reserved
0xE401	FSC card was removed
	DatID: FeatureSet Trialtime in minutes
	ZInfo1: Memory extension in kB
	ZInfo2: FeatureSet PROFIBUS
	ZInfo2: FeatureSet field bus
	ZInfo2: FeatureSet motion

Event-ID	Meaning
	ZInfo2: Reserved
0xE402	A configured functionality is not activated
	ZInfo1: FCS ErrorCode
	1: The PROFIBUS functionality is disabled The interface acts further as MPI interface
	2: The EtherCAT functionality is not enabled
	3: The number of configured axis is not enabled
0xE403	FSC can not be activated in this CPU
	ZInfo1: Memory extension in kB
	ZInfo2: FeatureSet PROFIBUS
	ZInfo2: FeatureSet field bus
	ZInfo2: FeatureSet motion
	ZInfo2: Reserved
0xE404	FeatureSet deleted due to CRC error
	DatID: Not relevant to the user
0xE405	The trial time of a feature set or MMC has expired
	DatID: Not relevant to the user
0xE410	A CPU feature set was activated
	DatID: Not relevant to the user
0xE500	Memory management: Deleted block without corresponding entry in BstList
	ZInfo2: Block type
	0x38: OB
	0x45: FB
	0x43: FC
	0x41: DB
	0x42: SDB
	0x44: SFC
	0x46: SFB
	ZInfo3: Block no.
0xE501	Parser error
	ZInfo3: SDB number
	ZInfo1: ErrorCode
	1: Parser error: SDB structure
	2: Parser error: SDB is not a valid SDB type.
	ZInfo2: SDB type
0xE604	Multiple parametrization of a periphery address for Ethernet PG/OP channel
	ZInfo1: Periphery address

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Event-ID	Meaning
	ZInfo3: 0: Periphery address is input, 1: Periphery address is output
0xE610	Onboard PROFIBUS/MPI: Bus error fixed
	ZInfo1: Interface
	ZInfo2: Not relevant to the user
	ZInfo3: Not relevant to the user
	PK: Not relevant to the user
	DatID: Not relevant to the user
0xE701	Internal error - Please contact the VIPA Hotline!
	ZInfo1: Not relevant to the user
	ZInfo2: Not relevant to the user
	ZInfo3: Not relevant to the user
	DatID: Not relevant to the user
0xE703	Internal error - Please contact the VIPA Hotline!
	ZInfo1: Master system ID
	ZInfo2: Slave address
	ZInfo3: Not relevant to the user
	PK: Not relevant to the user
	DatID: Not relevant to the user
0xE710	Onboard PROFIBUS/MPI: Bus error occurred
	ZInfo1: Interface
	ZInfo2: Not relevant to the user
	ZInfo3: Not relevant to the user
	PK: Not relevant to the user
	DatID: Not relevant to the user
0xE720	Internal error - Please contact the VIPA Hotline!
	ZInfo1: Slave no
	ZInfo2: Not relevant to the user
	ZInfo3: Not relevant to the user
	DatID: Master system ID
0xE721	Internal error - Please contact the VIPA Hotline!
	ZInfo1: Not relevant to the user
	ZInfo2: Master system ID
	ZInfo3: Not relevant to the user
	DatID: Not relevant to the user
0xE722	Internal error - Please contact the VIPA Hotline!
	ZInfo1: Channel-Event

Event-ID	Meaning
	0x00: Channel offline
	0x01: Bus error
	0x02:
	ZInfo2: Master system ID
	DatID: Not relevant to the user
0xE723	Internal error - Please contact the VIPA Hotline!
	ZInfo1: Error code
	0x01: Parameter error
	0x02: Error in configuration
	ZInfo2: Master system ID
	DatID: Not relevant to the user
0xE780	Internal error - Please contact the VIPA Hotline!
0xE801	CMD - Auto command: CMD_START recognized and successfully executed
0xE802	CMD - Auto command: CMD_End recognized and successfully executed
0xE803	CMD - Auto command: WAIT1SECOND recognized and successfully executed
0xE804	CMD - Auto command: WEBPAGE recognized and successfully executed
0xE805	CMD - Auto command: LOAD_PROJECT recognized and successfully executed
0xE806	CMD - Auto command: SAVE_PROJECT recognized and successfully executed
	ZInfo3: Status
	0: Error
	1: OK
	0x8000: Wrong password
0xE807	CMD - Auto command: FACTORY_RESET recognized and successfully executed
0xE808	Internal error - Please contact the VIPA Hotline!
	ZInfo2: Not relevant to the user
	ZInfo3: Not relevant to the user
0xE809	Internal error - Please contact the VIPA Hotline!
	ZInfo3: Not relevant to the user
0xE80A	Internal error - Please contact the VIPA Hotline!
	ZInfo3: Status
	0: OK
	0xFE81: File create error
	0xFEA1: File write error
	0xFEA2:
0xE80B	CMD - Auto command: DIAGBUF recognized and successfully executed
	ZInfo3: Status

Event-ID	Meaning
	0: OK
	0xFE81: File create error
	0xFEA1: File write error
	0xFEA2:
0xE80C	Internal error - Please contact the VIPA Hotline!
	ZInfo3: Status
	0: OK
	0xFE81: File create error
	0xFEA1: File write error
	0xFEA2:
0xE80D	Internal error - Please contact the VIPA Hotline!
0xE80E	CMD - Auto command: SET_NETWORK recognized and successfully executed
0xE80F	Internal error - Please contact the VIPA Hotline!
	ZInfo3: Status
	0: OK
	0xFE81: File create error
	0xFEA1: File write error
	0xFEA2:
0xE810	Internal error - Please contact the VIPA Hotline!
0xE811	Internal error - Please contact the VIPA Hotline!
0xE812	Internal error - Please contact the VIPA Hotline!
0xE813	Internal error - Please contact the VIPA Hotline!
0xE816	CMD - Auto command: SAVE_PROJECT recognized but not executed, because the CPU memory is empty
0xE8FB	CMD - Auto command: Error: Initialization of the Ethernet PG/OP channel by means of SET_NETWORK is faulty
0xE8FC	CMD - Auto command: Error: Some IP parameters missing in SET_NETWORK
0xE8FE	CMD - Auto command: Error: CMD_START missing
0xE8FF	CMD - Auto command: Error: Error while reading CMD file (memory card error)
0xE901	Check sum error
	ZInfo1: Not relevant to the user
	ZInfo2: Not relevant to the user
	DatID: Not relevant to the user
0xE902	Internal error - Please contact the VIPA Hotline!
	ZInfo1: Not relevant to the user
	ZInfo2: Not relevant to the user
	DatID: Not relevant to the user

Event-ID	Meaning
0xEA00	Internal error - Please contact the VIPA Hotline!
	PK: Not relevant to the user
	DatID: Not relevant to the user
0xEA01	Internal error - Please contact the VIPA Hotline!
	ZInfo1: Slot
	PK: Not relevant to the user
	DatID: Not relevant to the user
0xEA02	SBUS: Internal error (internal plugged sub module not recognized)
	ZInfo1: Slot
	ZInfo2: Type ID set
	ZInfo3: Type ID
	PK: Not relevant to the user
	DatID: Not relevant to the user
0xEA03	SBUS: Communication error CPU - PROFINET IO controller:
	ZInfo1: Slot
	ZInfo2: Status
	0: OK
	1: Error
	2: Busy
	3: Timeout
	4: Blocked
	5: Unknown
	PK: Not relevant to the user
	DatID: Not relevant to the user
0xEA04	SBUS: Multiple configuration of a periphery address
	ZInfo1: Periphery address
	ZInfo2: Slot
	ZInfo3: Data width
0xEA05	Internal error - Please contact the VIPA Hotline!
0xEA07	Internal error - Please contact the VIPA Hotline!
0xEA08	SBUS: Parameterized input data width unequal to plugged input data width
	ZInfo1: Parameterized input data width
	ZInfo2: Slot
	ZInfo3: Input data width of the plugged module
0xEA09	SBUS: Parameterized output data width unequal to plugged output data width
	ZInfo1: Parameterized output data width

Event-ID	Meaning
	ZInfo2: Slot
	ZInfo3: Output data width of the plugged module
0xEA10	SBUS: Input periphery address outside the periphery area
	ZInfo1: Periphery address
	ZInfo2: Slot
	ZInfo3: Data width
0xEA11	SBUS: Output periphery address outside the periphery area
	ZInfo1: Periphery address
	ZInfo2: Slot
	ZInfo3: Data width
0xEA12	SBUS: Error at writing record set
	ZInfo1: Slot
	ZInfo2: Record set number
	ZInfo3: Record set length
0xEA14	SBUS: Multiple parametrization of a periphery address (diagnostics address)
	ZInfo1: Periphery address
	ZInfo2: Slot
	ZInfo3: Data width
0xEA15	Internal error - Please contact the VIPA Hotline!
	ZInfo2: Slot of the master
0xEA18	SBUS: Error at mapping of the master periphery
	ZInfo2: Slot of the master
0xEA19	Internal error - Please contact the VIPA Hotline!
	ZInfo2: HW slot
	ZInfo3: Interface type
	PK: Not relevant to the user
	DatID: Not relevant to the user
0xEA1A	SBUS: Error at access to the FPGA address table
	ZInfo2: HW slot
	ZInfo3: Table
	0: Reading
	1: Writing
	PK: Not relevant to the user
	DatID: Not relevant to the user
0xEA20	Error - RS485 interface is not pre-set to PROFIBUS DP master bus a PROFIBUS DP master is configured

Event-ID	Meaning
0xEA21	Error - Configuration RS485 interface X2/X3: PROFIBUS DP master is configured but was not found
	ZInfo2: Interface X is faulty configured.
0xEA22	Error - RS485 interface X2 - Value exceeds the limits
	ZInfo2: Project engineering for X2
0xEA23	Error - RS485 interface X3 - Value exceeds the limits
	ZInfo2: Project engineering for X3
0xEA24	Error - Configuration RS485 interface X2/X3: Interface/protocol was not found, default settings are used
	ZInfo2: Project engineering for X2
	ZInfo3: Project engineering for X3
0xEA30	Internal error - Please contact the VIPA Hotline!
	ZInfo1: Status
	ZInfo2: Not relevant to the user
	ZInfo3: Not relevant to the user
0xEA40	Internal error - Please contact the VIPA Hotline!
	OB6100: User slot of the CP
	ZInfo1: Version of the CP
	ZInfo2: Not relevant to the user
	ZInfo3: Not relevant to the user
	DatID: Not relevant to the user
0xEA41	Internal error - Please contact the VIPA Hotline!
	OB: Slot of the CP
	ZInfo1: Version of the CP
	ZInfo2: Not relevant to the user
	ZInfo3: Not relevant to the user
	DatID: Not relevant to the user
0xEA50	PROFINET IO controller: Error in the configuration
	ZInfo1: Rack/slot of the controller
	ZInfo2: Device-No.
	ZInfo3: Slot at the device
	OB: Not relevant to the user
	PK: Not relevant to the user
	DatID: Not relevant to the user
0xEA51	PROFINET IO CONTROLLER: There is no PROFINET IO controller at the configured slot
	ZInfo1: Rack/slot of the controller

Event-ID	Meaning
	ZInfo2: Recognized ID at the configured slot
	PK: Not relevant to the user
	DatID: Not relevant to the user
0xEA53	PROFINET IO CONTROLLER: PROFINET configuration: There are too many PROFINET IO devices configured
	ZInfo1: Number of configured devices
	ZInfo2: Slot
	ZInfo3: Maximum possible number of devices
0xEA54	PROFINET IO controller: IO controller reports multiple parametrization of a periphery address
	ZInfo1: Periphery address
	ZInfo2: Slot
	ZInfo3: Data width
	PK: Not relevant to the user
	DatID: Not relevant to the user
0xEA61	Internal error - Please contact the VIPA Hotline!
	PK: Controller slot
	OB: File no.
	DatID: Line
	ZInfo1: Firmware major version
	ZInfo2: Firmware minor version
0xEA62	Internal error - Please contact the VIPA Hotline!
	PK: Controller slot
	OB: File no.
	DatID: Line
	ZInfo1: Firmware major version
	ZInfo2: Firmware minor version
0xEA63	Internal error - Please contact the VIPA Hotline!
	PK: Controller slot
	OB: File no.
	DatID: Line
	ZInfo1: Firmware major version
	ZInfo2: Firmware minor version
0xEA64	PROFINET IO controller/EtherCAT-CP: Error in the configuration
	ZInfo1: Too many devices
	ZInfo1: Too many devices per second
	ZInfo1: Too many input bytes per ms

Event-ID	Meaning
	ZInfo1: Too many output bytes per ms
	ZInfo1: Too many input bytes per ms
	ZInfo1: Too many output bytes per device
	ZInfo1: Too many productive connections
	ZInfo1: Too many input bytes in the process image
	ZInfo1: Too many output bytes in the process image
	ZInfo1: Configuration not available
	ZInfo1: Configuration not valid
	ZInfo1: Refresh time too short
	ZInfo1: Cycle time too big
	ZInfo1: Not valid device number
	ZInfo1: CPU is configured as I device
	ZInfo1: Use different method to obtain IP address Is not supported for the IP address of the controller
	ZInfo2: Incompatible configuration (SDB version not supported)
	ZInfo2: EtherCAT: EoE configured but not supported
0xEA65	Internal error - Please contact the VIPA Hotline!
	PK: Platform
	0: none
	8: CP
	16: CPU
	9: Ethernet CP
	10: PROFINET CP
	12: EtherCAT CP
	ZInfo1: ServiceID in which the error occurred
	ZInfo2: Command in which the error occurred
	1: Request
	2: Connect
	3: Error
0xEA66	PROFINET IO controller: Error in communication stack
	PK: Rackslot
	OB: StackError.Service
	DatID: StackError.DeviceRef
	ZInfo1: StackError.Error.Code
	ZInfo2: StackError.Error.Detail
	ZInfo3: StackError.Error.AdditionalDetail

Event-ID	Meaning
	ZInfo3: StackError.Error.AreaCode
0xEA67	PROFINET IO controller: Error reading record set
	PK: Error type
	0: Record set error local
	1: Record set error stack
	2: Record set error station
	OB: Rackslot controller
	DatID: Device
	ZInfo1: Record set number
	ZInfo2: Record set handle (caller)
	ZInfo3: Internal error code from PN stack
0xEA68	PROFINET IO controller: Error at writing record set
	PK: Error type
	0: Record set error local
	1: Record set error stack
	2: Record set error station
	OB: Rack/slot of the controller
	DatID: Device
	ZInfo1: Record set number
	ZInfo2: Record set handle (caller)
	ZInfo3: Internal error code from PN stack
0xEA69	Internal error - Please contact the VIPA Hotline!
	ZInfo1: Minimum version for the FPGA
	ZInfo2: Loaded FPGA version
0xEA6A	PROFINET IO controller: Service error in communication stack
	PK: Rackslot
	OB: Service ID
	ZInfo1: ServiceError.Code
	ZInfo2: ServiceError.Detail
	ZInfo3: StackError.Error.AdditionalDetail
	ZInfo3: ServiceError.AreaCode
0xEA6B	PROFINET IO controller: Faulty vendor ID
	ZInfo1: Device ID
	ZInfo2: Not relevant to the user
	ZInfo3: Not relevant to the user
	OB: PLC-Mode

Event-ID	Meaning
	0x00: Unknown
	0x01: STOP update
	0x02: STOP overall reset
	0x03: STOP initialization
	0x04: STOP internal
	0x06: Cold start
	0x07: Warm start
	0x08: Run
	0x0A: Halt
	0x0D: Malfunction
	0xFD:
	0xFE:
	0xFF:
	PK: Rackslot
	DatID: Not relevant to the user
0xEA6C	PROFINET IO controller: Faulty device ID
	ZInfo1: Device ID
	PK: Rackslot
	OB: PLC-Mode
	0x00: Unknown
	0x01: STOP update
	0x02: STOP overall reset
	0x03: STOP initialization
	0x04: STOP internal
	0x06: Cold start
	0x07: Warm start
	0x08: Run
	0x0A: Halt
	0x0D: Malfunction
	0xFD:
	0xFE:
	0xFF:
0xEA6D	PROFINET IO controller: No empty Name
	ZInfo1: Device ID
	ZInfo2: Not relevant to the user
	ZInfo3: Not relevant to the user

Event-ID	Meaning
	OB: PLC-Mode
	0x00: Unknown
	0x01: STOP update
	0x02: STOP overall reset
	0x03: STOP initialization
	0x04: STOP internal
	0x06: Cold start
	0x07: Warm start
	0x08: Run
	0x0A: Halt
	0x0D: Malfunction
	0xFD:
	0xFE:
	0xFF:
	PK: Rackslot
	DatID: Not relevant to the user
0xEA6E	PROFINET IO controller: Waiting for RPC answer
	ZInfo1: Device ID
	ZInfo2: Not relevant to the user
	ZInfo3: Not relevant to the user
	OB: PLC-Mode
	0x00: Unknown
	0x01: STOP update
	0x02: STOP overall reset
	0x03: STOP initialization
	0x04: STOP internal
	0x06: Cold start
	0x07: Warm start
	0x08: Run
	0x0A: Halt
	0x0D: Malfunction
	0xFD:
	0xFE:
	0xFF:
	PK: Rackslot
	DatID: Not relevant to the user

Event-ID	Meaning
0xEA6F	PROFINET IO controller: PROFINET module deviation
	ZInfo1: Device ID
	ZInfo2: Not relevant to the user
	ZInfo3: Not relevant to the user
	OB: PLC-Mode
	0x00: Unknown
	0x01: STOP update
	0x02: STOP overall reset
	0x03: STOP initialization
	0x04: STOP internal
	0x06: Cold start
	0x07: Warm start
	0x08: Run
	0x0A: Halt
	0x0D: Malfunction
	0xFD:
	0xFE:
	0xFF:
	PK: Rackslot
	DatID: Not relevant to the user
0xEA81	Internal error - Please contact the VIPA Hotline!
	ZInfo1: Filenamehash[0-3]
	ZInfo2: Filenamehash[4-7]
	ZInfo3: Line
	OB: Not relevant to the user
	PK: Not relevant to the user
	DatID: SvnRevision
0xEA82	Internal error - Please contact the VIPA Hotline!
	ZInfo1: Filenamehash[0-3]
	ZInfo2: Filenamehash[4-7]
	ZInfo3: Line
	OB: Not relevant to the user
	PK: Not relevant to the user
	DatID: SvnRevision
0xEA83	Internal error - Please contact the VIPA Hotline!
	ZInfo1: Filenamehash[0-3]

Event-ID	Meaning
	ZInfo2: Filenamehash[4-7]
	ZInfo3: Line
	OB: Not relevant to the user
	PK: Not relevant to the user
	DatID: SvnRevision
0xEA91	Internal error - Please contact the VIPA Hotline!
	ZInfo1: Filenamehash[0-3]
	ZInfo2: Filenamehash[4-7]
	ZInfo3: Line
	OB: Current OB number
	PK: Core status
	0: INIT
	1: STOP
	2: READY
	3: PAUSE
	4: RUN
	DatID: Current job number
0xEA92	Internal error - Please contact the VIPA Hotline!
	ZInfo1: Filenamehash[0-3]
	ZInfo2: Filenamehash[4-7]
	ZInfo3: Line
	OB: Current OB number
	PK: Core status
	0: INIT
	1: STOP
	2: READY
	3: PAUSE
	4: RUN
	DatID: Current job number
0xEA93	Internal error - Please contact the VIPA Hotline!
	ZInfo1: Filenamehash[0-3]
	ZInfo2: Filenamehash[4-7]
	ZInfo3: Line
	OB: Current OB number
	PK: Core status
	0: INIT

Event-ID	Meaning
	1: STOP
	2: READY
	3: PAUSE
	4: RUN
	DatID: Current job number
0xEA97	Internal error - Please contact the VIPA Hotline!
	ZInfo3: Slot
0xEA98	Timeout at waiting for reboot of a SBUS module (server)
	PK: Not relevant to the user
	DatID: Not relevant to the user
0xEA99	Error at file reading via SBUS
	ZInfo3: Slot
	PK: Not relevant to the user
	DatID: Not relevant to the user
0xEAA0	Emac Error occurred
	OB: Current PLC mode
	0x00: Unknown
	0x01: STOP update
	0x02: STOP overall reset
	0x03: STOP initialization
	0x04: STOP internal
	0x06: Cold start
	0x07: Warm start
	0x08: Run
	0x0A: Halt
	0x0D: Malfunction
	0xFD:
	0xFE:
	0xFF:
	ZInfo1: Diagnostics address of the master
	ZInfo2: no Rx queue is full
	ZInfo2: No send buffer available
	ZInfo2: Send stream was cut off; sending failed
	ZInfo2: Exhausted retries
	ZInfo2: No receive buffer available in Emac DMA
	ZInfo2: Emac DMA transfer interrupted

Event-ID	Meaning
	ZInfo2: Queue overflow
	ZInfo2: Unexpected frame received
	ZInfo3: Number of errors, which occurred
0xEAB0	Link mode not valid
	ZInfo1: Diagnostics address of the master
	ZInfo2: Current connection mode
	0x01: 10Mbit full-duplex
	0x02: 100Mbit half-duplex
	0x03: 100Mbit full-duplex
	0x05: 10Mbit half-duplex
	0xFF: Link mode undefined
	OB: Current PLC mode
	0: Run
	1: Stop
	2: MRES
0xEAC0	Internal error - Please contact the VIPA Hotline!
	ZInfo1: Error code
	0x01:
	0x02:
	0x03:
	0x04:
	0x05:
	0x06:
	0x07:
	0x08:
0xEAD0	Error in configuration SyncUnit
0xEB03	SLIO error: IO mapping
	ZInfo1: Type of error
	0x01: SDB parser error
	0x02: Configured address already used
	0x03: Mapping error
	PK: Not relevant to the user
	DatID: Not relevant to the user
	ZInfo2: Slot (0=not be determined)
0xEB05	SLIO error: Bus structure for Isochron process image not suitable
	PK: Not relevant to the user

Event-ID	Meaning
	DatID: Not relevant to the user
0xEB10	SLIO error: Bus error
	ZInfo1: Type of error
	0x60: Bus enumeration error
	0x80: General error
	0x81: Queue execution error
	0x82: Error interrupt
	PK: Not relevant to the user
	DatID: Not relevant to the user
0xEB11	SLIO error during bus initialization
	PK: Not relevant to the user
	DatID: Not relevant to the user
0xEB20	SLIO error: Interrupt information undefined
0xEB21	SLIO error: Accessing configuration data
	ZInfo2: Not relevant to the user
	ZInfo3: Not relevant to the user
	DatID: Not relevant to the user
0xEC03	EtherCAT: Error in configuration
	ZInfo1: Error code
	1: Number of slaves is not supported.
	2: Master system ID not valid
	03:00
	4: Master configuration not valid
	5: Master type not valid
	6: Slave diagnostic address invalid
	7: Slave address not valid
	8: Slave module IO configuration invalid.
	9: Logical address already in use.
	10:00
	11: IO mapping error
	12: Error
	13: Error in initialising the EtherCAT stack (is entered by the CP)
	PK: Not relevant to the user
	DatID: Not relevant to the user
0xEC04	EtherCAT: Multiple configuration of a periphery address
	ZInfo1: Periphery address

Event-ID	Meaning
	ZInfo2: Slot
	PK: Not relevant to the user
	DatID: Not relevant to the user
0xEC05	EtherCAT: Check the set DC mode of the YASKAWA Sigma 5/7 drive
	PK: Not relevant to the user
	OB: PLC-Mode
	0x00: Unknown
	0x01: STOP update
	0x02: STOP overall reset
	0x03: STOP initialization
	0x04: STOP internal
	0x06: Cold start
	0x07: Warm start
	0x08: Run
	0x0A: Halt
	0x0D: Malfunction
	0xFD:
	0xFE:
	0xFF:
	DatID: Not relevant to the user
	ZInfo1: Station address of the EtherCAT device
	ZInfo2: Error code
	1: WARNING: For the drive the DC Beckhoff mode is recommended (DC reference clock is not in Beckhoff Mode)
	2: NOTE: For the drive the DC Beckhoff mode is recommended (DC reference clock is not in Beckhoff Mode)
	3: The station address could not be determined for checking (station address in Zinfo1 is accordingly 0)
	4: The slave information could not be determined for checking (station address in Zinfo1 is accordingly 0)
	5: The EtherCAT status of the drive could not be determined
	6: Error when sending the SDO request (for further information, the (subsequent) event with the ID 0xED60 is to be analysed on the CP)
	7: Drive returns error in the SDO response (for further information, the (subsequent) event with the ID 0xED60 is to be analysed on the CP)
	8: SDO timeout, DC mode could not be determined (for further information, the (subsequent) event with the ID 0xED60 is to be analysed on the CP)
	ZInfo3: Not relevant to the user
0xEC10	EtherCAT: Restoration bus with its slaves

Event-ID	Meaning
	ZInfo1: Old status
	0x00: Undefined/Unkown
	0x01: INIT
	0x02: PreOp
	0x03: BootStrap
	0x04: SafeOp
	0x08: Op
	ZInfo1: New status
	0x00: Undefined/Unkown
	0x01: INIT
	0x02: PreOp
	0x03: BootStrap
	0x04: SafeOp
	0x08: Op
	ZInfo2: Diagnostics address of the station
	ZInfo3: Number of stations, which are not in the same state as the master
	DatID: Input address
	DatID: Output address
	DatID: Station not available
	DatID: Station available
0xEC11	EtherCAT: Restoration bus with missing slaves
	ZInfo1: Old status
	0x00: Undefined/Unkown
	0x01: INIT
	0x02: PreOp
	0x03: BootStrap
	0x04: SafeOp
	0x08: Op
	ZInfo1: New status
	0x00: Undefined/Unkown
	0x01: INIT
	0x02: PreOp
	0x03: BootStrap
	0x04: SafeOp
	0x08: Op
	ZInfo2: Diagnostics address of the master

Event-ID	Meaning
	ZInfo3: Number of stations, which are not in the same state as the master
	DatID: Input address
	DatID: Output address
	DatID: Station not available
	DatID: Station available
0xEC12	EtherCAT: Restoration slave
	ZInfo1: Old status
	0x00: Undefined/Unkown
	0x01: INIT
	0x02: PreOp
	0x03: BootStrap
	0x04: SafeOp
	0x08: Op
	ZInfo1: New status
	0x00: Undefined/Unkown
	0x01: INIT
	0x02: PreOp
	0x03: BootStrap
	0x04: SafeOp
	0x08: Op
	ZInfo2: Diagnostics address of the station
	ZInfo3: AL Statuscode
	DatID: Input address
	DatID: Output address
	DatID: Station not available
	DatID: Station available
0xEC30	EtherCAT: Topology OK
	ZInfo2: Diagnostics address of the master
0xEC50	EtherCAT: DC out of sync
	ZInfo1: Diagnostics address of the master
	ZInfo3: Table
	0: DC master out of sync
	1: DC slaves out of Sync
0xED10	EtherCAT: Bus failure
	ZInfo1: Old status
	0x00: Undefined/Unkown

Event-ID	Meaning
	0x01: INIT
	0x02: PreOp
	0x03: BootStrap
	0x04: SafeOp
	0x08: Op
	ZInfo1: New status
	0x00: Undefined/Unkown
	0x01: INIT
	0x02: PreOp
	0x03: BootStrap
	0x04: SafeOp
	0x08: Op
	ZInfo2: Diagnostic address of the master
	ZInfo3: Number of stations, which are not in the same state as the master
	DatID: Input address
	DatID: Output address
	DatID: Station not available
	DatID: Station available
0xED12	EtherCAT: Slave failure
	ZInfo1: Old status
	0x00: Undefined/Unkown
	0x01: INIT
	0x02: PreOp
	0x03: BootStrap
	0x04: SafeOp
	0x08: Op
	ZInfo1: New status
	0x00: Undefined/Unkown
	0x01: INIT
	0x02: PreOp
	0x03: BootStrap
	0x04: SafeOp
	0x08: Op
	ZInfo2: Diagnostics address of the station
	ZInfo3: AlStatusCode
	0x0000: No Error

Event-ID	Meaning
	0x0001: Unspecified error
	0x0011: Invalid requested status change
	0x0012: Unknown requested status
	0x0013: Bootstrap not supported
	0x0014: No valid firmware
	0x0015: Invalid mailbox configuration
	0x0016: Invalid mailbox configuration
	0x0017: Invalid sync manager configuration
	0x0018: No valid inputs available
	0x0019: No valid outputs available
	0x001A: Synchronisation error
	0x001B: Sync manager watchdog
	0x001C: Invalid sync manager types
	0x001D: Invalid output configuration
	0x001E: Invalid input configuration
	0x001F: Invalid watchdog configuration
	0x0020: Slave needs cold start
	0x0021: Slave needs INIT
	0x0022: Slave needs PreOp
	0x0023: Slave needs SafeOp
	0x002D: Invalid output FMMU configuration
	0x002E: Invalid input FMMU configuration
	0x0030: Invalid DC Sync configuration
	0x0031: Invalid DC satch configuration
	0x0032: PLL error
	0x0033: Invalid DC IO error
	0x0034: Invalid DC timeout error
	0x0042: Mailbox-EOE
	0x0043: Mailbox-COE
	0x0044: Mailbox-FOE
	0x0045: Mailbox-SOE
	0x004F: Mailbox-VOE
	DatID: Input address
	DatID: Output address
	DatID: Station not available
	DatID: Station available

Event-ID	Meaning
0xED20	EtherCAT: Bus state change without calling OB 86
	ZInfo1: Old status
	0x00: Undefined/Unkown
	0x01: INIT
	0x02: PreOp
	0x03: BootStrap
	0x04: SafeOp
	0x08: Op
	ZInfo1: New status
	0x00: Undefined/Unkown
	0x01: INIT
	0x02: PreOp
	0x03: BootStrap
	0x04: SafeOp
	0x08: Op
	ZInfo2: Diagnostics address of the master
	ZInfo3: Number of stations, which are not in the same state as the master
	DatID: Input address
	DatID: Output address
	DatID: Station not available
	DatID: Station available
0xED21	EtherCAT: Faulty bus status change
	ZInfo1: Old status
	0x00: Undefined/Unkown
	0x01: INIT
	0x02: PreOp
	0x03: BootStrap
	0x04: SafeOp
	0x08: Op
	ZInfo1: New status
	0x00: Undefined/Unkown
	0x01: INIT
	0x02: PreOp
	0x03: BootStrap
	0x04: SafeOp
	0x08: Op

VIPA specific diagnostic entries

Event-ID	Meaning
	ZInfo2: Diagnostics address of the master
	ZInfo3: Error code
	0x0008: Busy
	0x000B: Invalid parameters
	0x000E: Invalid status
	0x010: Timeout
	DatID: Input address
	DatID: Output address
	DatID: Station not available
	DatID: Station available
0xED22	EtherCAT: Slave state change without calling OB 86
	ZInfo1: Old status
	0x00: Undefined/Unkown
	0x01: INIT
	0x02: PreOp
	0x03: BootStrap
	0x04: SafeOp
	0x08: Op
	ZInfo1: New status
	0x00: Undefined/Unkown
	0x01: INIT
	0x02: PreOp
	0x03: BootStrap
	0x04: SafeOp
	0x08: Op
	ZInfo2: Diagnostics address of the station
	ZInfo3: AlStatusCode
	0x0000: No Error
	0x0001: Unspecified error
	0x0011: Invalid requested status change
	0x0012: Unknown requested status
	0x0013: Bootstrap not supported
	0x0014: No valid firmware
	0x0015: Invalid mailbox configuration
	0x0016: Invalid mailbox configuration
	0x0017: Invalid sync manager configuration

Event-ID	Meaning
	0x0018: No valid inputs available
	0x0019: No valid outputs available
	0x001A: Synchronisation error
	0x001B: Sync manager watchdog
	0x001C: Invalid sync manager types
	0x001D: Invalid output configuration
	0x001E: Invalid input configuration
	0x001F: Invalid watchdog configuration
	0x0020: Slave needs cold start
	0x0021: Slave needs INIT
	0x0022: Slave needs PreOp
	0x0023: Slave needs SafeOp
	0x002D: Invalid output FMMU configuration
	0x002E: Invalid input FMMU configuration
	0x0030: Invalid DC Sync configuration
	0x0031: Invalid DC satch configuration
	0x0032: PLL error
	0x0033: Invalid DC IO error
	0x0034: Invalid DC timeout error
	0x0042: Mailbox-EOE
	0x0043: Mailbox-COE
	0x0044: Mailbox-FOE
	0x0045: Mailbox-SOE
	0x004F: Mailbox-VOE
	DatID: Input address
	DatID: Output address
	DatID: Station not available
	DatID: Station available
0xED23	EtherCAT: Timeout while changing the master status to OP, after CPU has changed to RUN
	OB: PLC-Mode
	0x00: Unknown
	0x01: STOP update
	0x02: STOP overall reset
	0x03: STOP initialization
	0x04: STOP internal

Event-ID	Meaning
	0x06: Cold start
	0x07: Warm start
	0x08: Run
	0x0A: Halt
	0x0D: Malfunction
	0xFD:
	0xFE:
	0xFF:
	ZInfo1: Master status
	0x00: Undefined/Unkown
	0x01: INIT
	0x02: PreOp
	0x03: BootStrap
	0x04: SafeOp
	0x08: Op
	ZInfo2: There is an EtherCAT configuration
	0: There is no EC configuration
	1: There is an EC configuration
	ZInfo3: DC in sync
	0: not in sync
	1: in sync
0xED30	EtherCAT: Topology deviation
	ZInfo2: Diagnostics address of the master
0xED31	EtherCAT: Overflow of the interrupt queue
	ZInfo2: Diagnostics address of the master
0xED50	EtherCAT: DC slaves in sync
	ZInfo1: Diagnostics address of the master
	ZInfo3: Table
	0: DC master in sync
	1: DC slaves in sync
0xED60	EtherCAT: Diagnostics buffer CP: Slave state change
	OB: PLC-Mode
	0x00: Unknown
	0x01: STOP update
	0x02: STOP overall reset
	0x03: STOP initialization

Event-ID	Meaning
	0x04: STOP internal
	0x06: Cold start
	0x07: Warm start
	0x08: Run
	0x0A: Halt
	0x0D: Malfunction
	0xFD:
	0xFE:
	0xFF:
	ZInfo1: New status
	0x00: Undefined/Unkown
	0x01: INIT
	0x02: PreOp
	0x03: BootStrap
	0x04: SafeOp
	0x08: Op
	ZInfo2: Slave address
	ZInfo3: AlStatusCode
	0x0000: No Error
	0x0001: Unspecified error
	0x0011: Invalid requested status change
	0x0012: Unknown requested status
	0x0013: Bootstrap not supported
	0x0014: No valid firmware
	0x0015: Invalid mailbox configuration
	0x0016: Invalid mailbox configuration
	0x0017: Invalid sync manager configuration
	0x0018: No valid inputs available
	0x0019: No valid outputs available
	0x001A: Synchronisation error
	0x001B: Sync manager watchdog
	0x001C: Invalid sync manager types
	0x001D: Invalid output configuration
	0x001E: Invalid input configuration
	0x001F: Invalid watchdog configuration
	0x0020: Slave needs cold start

VIPA specific diagnostic entries

Event-ID	Meaning
	0x0021: Slave needs INIT
	0x0022: Slave needs PreOp
	0x0023: Slave needs SafeOp
	0x002D: Invalid output FMMU configuration
	0x002E: Invalid input FMMU configuration
	0x0030: Invalid DC Sync configuration
	0x0031: Invalid DC satch configuration
	0x0032: PLL error
	0x0033: Invalid DC IO error
	0x0034: Invalid DC timeout error
	0x0042: Mailbox-EOE
	0x0043: Mailbox-COE
	0x0044: Mailbox-FOE
	0x0045: Mailbox-SOE
	0x004F: Mailbox-VOE
	DatID: Cause for slave status change
	0: Regular slave status change
	1: Slave failure
	2: Restoration slave
	3: Slave is in an error state
	4: Slave has unexpectedly changed its status
0xED61	EtherCAT: Diagnostics buffer CP: CoE emergency
	PK: EtherCAT station address (low byte)
	OB: EtherCAT station address (high byte)
	DatID: Error code
	ZInfo1: Error register
	ZInfo1: MEF-Byte1
	ZInfo2: MEF-Byte2
	ZInfo2: MEF-Byte3
	ZInfo3: MEF-Byte4
	ZInfo3: MEF-Byte5
0xED62	EtherCAT: Diagnostics buffer CP: Error on SDO access
	PK: EtherCAT station address (low byte)
	OB: EtherCAT station address (high-byte)
	DatID: Subindex
	ZInfo1: Index

Event-ID	Meaning
	ZInfo2: SDOErrorCode (high word)
	ZInfo3: SDOErrorCode (low word)
0xED63	EtherCAT: Diagnostics buffer CP: Error in the response to an INIT command
	PK: EtherCAT station address (low byte)
	OB: EtherCAT station address (high byte)
	ZInfo1: Error type
	1: No response
	2: Validation error
	3: INIT command failed, requested station could not be reached
0xED70	EtherCAT: Diagnostics buffer CP: Twice HotConnect group found
	OB: PLC-Mode
	0x00: Unknown
	0x01: STOP update
	0x02: STOP overall reset
	0x03: STOP initialization
	0x04: STOP internal
	0x06: Cold start
	0x07: Warm start
	0x08: Run
	0x0A: Halt
	0x0D: Malfunction
	0xFD:
	0xFE:
	0xFF:
	ZInfo1: Diagnostics address of the master
	ZInfo2: EtherCAT station address
0xEE00	Additional information at UNDEF_OPCODE
	ZInfo1: Not relevant to the user
	ZInfo2: Not relevant to the user
	ZInfo3: Not relevant to the user
	OB: Not relevant to the user
	DatID: Not relevant to the user
0xEE01	Internal error - Please contact the VIPA Hotline!
	ZInfo3: SFB number
0xEEEE	CPU was completely overall reset, since after PowerON the start-up could not be finished

Event-ID	Meaning
0xEF00	Internal error - Please contact the VIPA Hotline!
	DatID: Not relevant to the user
0xEF01	Internal error - Please contact the VIPA Hotline!
	DatID: Not relevant to the user
	ZInfo1: Not relevant to the user
	ZInfo2: Not relevant to the user
	ZInfo3: Not relevant to the user
0xEF11	Internal error - Please contact the VIPA Hotline!
0xEF12	Internal error - Please contact the VIPA Hotline!
0xEF13	Internal error - Please contact the VIPA Hotline!
0xEFFE	Internal error - Please contact the VIPA Hotline!
	ZInfo3: Not relevant to the user
	PK: Not relevant to the user
	DatID: Not relevant to the user
0xEFFF	Internal error - Please contact the VIPA Hotline!
	ZInfo3: Not relevant to the user
	PK: Not relevant to the user
	DatID: Not relevant to the user

5 Deployment PtP communication

5.1 Fast introduction

General

The CPU has a RS485 interface, which is per default set to PtP communication (point to point). This allows to connect via serial process connection to different source or target systems.

Protocols

The protocols respectively procedures ASCII, STX/ETX, 3964R, USS and Modbus are supported.

Parametrization

The parametrization of the serial interface happens during runtime using the FC/SFC 216 (SER_CFG). For this you have to store the parameters in a DB for all protocols except ASCII.

Communication

The FCs/SFCs are controlling the communication. Send takes place via FC/SFC 217 (SER_SND) and receive via FC/SFC 218 (SER_RCV). The repeated call of the FC/SFC 217 SER_SND delivers a return value for 3964R, USS and Modbus via RetVal that contains, among other things, recent information about the acknowledgement of the partner station. The protocols USS and Modbus allow to evaluate the receipt telegram by calling the FC/SFC 218 SER_RCV after SER_SND. The FCs/SFCs are included in the consignment of the CPU.

Use FCs in the SPEED7 Studio

To ensure compatibility with other programming tools, these blocks are available as FC and SFC and therefore designated as "FC/SFC". In the SPEED7 Studio you should always use FCs. This increases the compatibility with other programming tools.

Overview FCs/SFCs for serial communication

The following FCs/SFCs are used for the serial communication:

FC/SFC		Description
FC/SFC 216	SER_CFG	RS485 parameterize
FC/SFC 217	SER_SND	RS485 send
FC/SFC 218	SER_RCV	RS485 receive

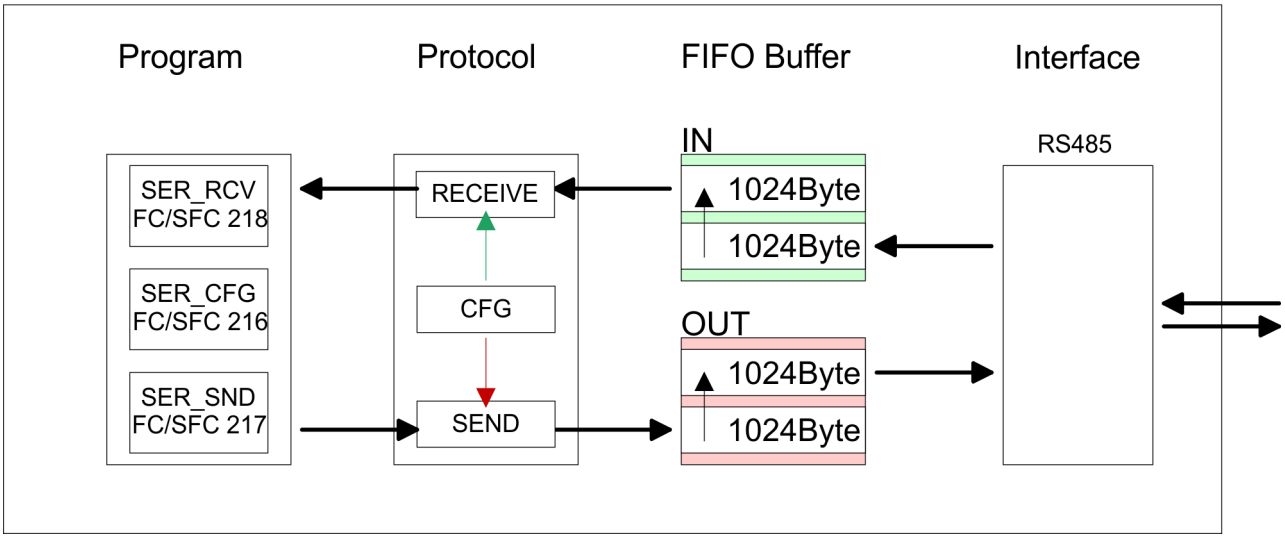
5.2 Principle of the data transfer

Overview

The data transfer is handled during runtime by using FC/SFCs. The principle of data transfer is the same for all protocols and is shortly illustrated in the following.

- Data, which are written into the according data channel by the CPU, is stored in a FIFO send buffer (first in first out) with a size of 2x1024byte and then put out via the interface.
- When the interface receives data, this is stored in a FIFO receive buffer with a size of 2x1024byte and can there be read by the CPU.
- If the data is transferred via a protocol, the embedding of the data to the according protocol happens automatically.
- In opposite to ASCII and STX/ETX, the protocols 3964R, USS and Modbus require the acknowledgement of the partner.
- An additional call of the FC/SFC 217 SER_SND causes a return value in RetVal that includes among others recent information about the acknowledgement of the partner.
- Further on for USS and Modbus after a SER_SND the acknowledgement telegram must be evaluated by a call of the FC/SFC 218 SER_RCV.

RS485 PtP communication



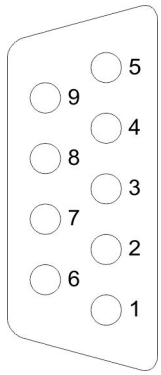
5.3 Deployment of RS485 interface for PtP

Properties RS485

- Logical states represented by voltage differences between the two cores of a twisted pair cable
- Serial bus connection in two-wire technology using half duplex mode
- Data communications up to a max. distance of 500m
- Data communication rate up to 115.2kbaud

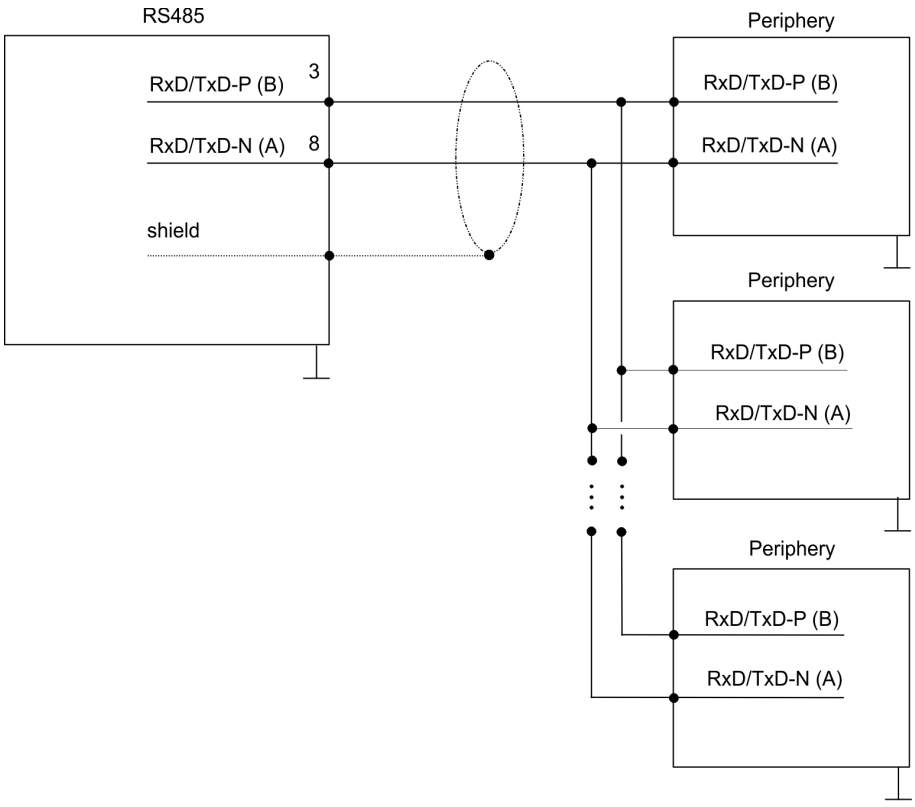
RS485

9pin SubD jack



Pin	RS485
1	n.c.
2	M24V
3	RxD/TxD-P (Line B)
4	RTS
5	M5V
6	P5V
7	P24V
8	RxD/TxD-N (Line A)
9	n.c.

Connection



5.4 Parametrization

5.4.1 FC/SFC 216 - SER_CFG

Description

The parametrization happens during runtime deploying the FC/SFC 216 (SER_CFG). You have to store the parameters for STX/ETX, 3964R, USS and Modbus in a DB.

Parameters

Parameter	Declaration	Data type	Description
PROTOCOL	IN	BYTE	1=ASCII, 2=STX/ETX, 3=3964R
PARAMETER	IN	ANY	Pointer to protocol-parameters
BAUDRATE	IN	BYTE	Number of baudrate
CHARLEN	IN	BYTE	0=5bit, 1=6bit, 2=7bit, 3=8bit
PARITY	IN	BYTE	0=Non, 1=Odd, 2=Even
STOPBITS	IN	BYTE	1=1bit, 2=1.5bit, 3=2bit
FLOWCONTROL	IN	BYTE	1 (fix)
RETVAL	OUT	WORD	Return value (0 = OK)

All time settings for timeouts must be set as hexadecimal value. Find the Hex value by multiply the wanted time in seconds with the baudrate.

Example:

Wanted time 8ms at a baudrate of 19200baud

Calculation: 19200bit/s x 0.008s ≈ 154bit → (9Ah)

Hex value is 9Ah.

PROTOCOL

Here you fix the protocol to be used.

You may choose between:

1: ASCII

2: STX/ETX

3: 3964R

4: USS Master

5: Modbus RTU Master

6: Modbus ASCII Master

PARAMETER (as DB)

At ASCII protocol, this parameter is ignored.

At STX/ETX, 3964R, USS and Modbus you fix here a DB that contains the communication parameters and has the following structure for the according protocols:

Data block at STX/ETX			
DBB0:	STX1	BYTE	(1. Start-ID in hexadecimal)
DBB1:	STX2	BYTE	(2. Start-ID in hexadecimal)
DBB2:	ETX1	BYTE	(1. End-ID in hexadecimal)
DBB3:	ETX2	BYTE	(2. End-ID in hexadecimal)
DBW4:	TIMEOUT	WORD	(max. delay time between 2 telegrams)

The start res. end sign should always be a value <20, otherwise the sign is ignored!

With not used IDs please always enter FFh!

Data block at 3964R			
DBB0:	Prio	BYTE	(The priority of both partners must be different)
DBB1:	ConnAttmptNr	BYTE	(Number of connection trials)
DBB2:	SendAttmptNr	BYTE	(Number of telegram retries)
DBB4:	CharTimeout	WORD	(Char. delay time)
DBW6:	ConfTimeout	WORD	(Acknowledgement delay time)

Data block at USS			
DBW0:	Timeout	WORD	(Delay time)

Data block at Modbus master			
DBW0:	Timeout	WORD	(Respond delay time)

BAUDRATE

Velocity of data transfer in bit/s (baud)							
04h:	1200baud	05h:	1800baud	06h:	2400baud	07h:	4800baud
08h:	7200baud	09h:	9600baud	0Ah:	14400baud	0Bh:	19200baud
0Ch:	38400baud	0Dh:	57600baud	0Eh:	115200baud		

CHARLEN

Number of data bits where a character is mapped to.			
0: 5bit	1: 6bit	2: 7bit	3: 8bit

PARITY

The parity is -depending on the value- even or odd. For parity control, the information bits are extended with the parity bit, that amends via its value ("0" or "1") the value of all bits to a defined status. If no parity is set, the parity bit is set to "1", but not evaluated.

0: NONE	1: ODD	2: EVEN

STOPBITS

The stop bits are set at the end of each transferred character and mark the end of a character.

1: 1bit	2: 1.5bit	3: 2bit

FLOWCONTROL

The parameter *FLOWCONTROL* is ignored. When sending RTS=1, when receiving RTS=0.

RETVAL FC/SFC 216 (Return values)

Return values send by the block:

Error code	Description
0000h	no error
809Ah	Interface not found e. g. interface is used by PROFIBUS In the VIPA SLIO CPU with FeatureSet PTP_NO only the ASCII protocol is configurable. If another protocol is selected the FC/SFC216 also left with this error code.
8x24h	Error at FC/SFC-Parameter x, with x: 1: Error at *PROTOCOL* 2: Error at *PARAMETER* 3: Error at *BAUDRATE* 4: Error at *CHARLENGTH* 5: Error at *PARITY* 6: Error at *STOPBITS* 7: Error at *FLOWCONTROL*
809xh	Error in FC/SFC parameter value x, where x: 1: Error at *PROTOCOL* 3: Error at *BAUDRATE* 4: Error at *CHARLENGTH* 5: Error at *PARITY* 6: Error at *STOPBITS* 7: Error at *FLOWCONTROL* (parameter is missing)
8092h	Access error in parameter DB (DB too short)
828xh	Error in parameter x of DB parameter, where x: 1: Error 1. parameter 2: Error 2. parameter ...

5.5 Communication

5.5.1 Overview

The communication happens via the send and receive blocks FC/SFC 217 (SER_SND) and FC/SFC 218 (SER_RCV). The FCs/SFCs are included in the consignment of the CPU.

5.5.2 FC/SFC 217 - SER_SND

Description

This block sends data via the serial interface. The repeated call of the FC/SFC 217 SER_SND delivers a return value for 3964R, USS and Modbus via RETVAL that contains, among other things, recent information about the acknowledgement of the partner station.

The protocols USS and Modbus require to evaluate the receipt telegram by calling the FC/SFC 218 SER_RCV after SER_SND.

Parameters

Parameter	Declaration	Data type	Description
DATAPTR	IN	ANY	Pointer to Data Buffer for sending data
DATALEN	OUT	WORD	Length of data sent
RETVAL	OUT	WORD	Return value (0 = OK)

DATAPTR

Here you define a range of the type Pointer for the send buffer where the data to be sent are stored. You have to set type, start and length.

Example:

Data is stored in DB5 starting at 0.0 with a length of 124byte.

DataPtr:=P#DB5.DBX0.0 BYTE 124

DATALEN

Word where the number of the sent Bytes is stored.

At **ASCII** if data were sent by means of FC/SFC 217 faster to the serial interface than the interface sends, the length of data to send could differ from the DATALEN due to a buffer overflow. This should be considered by the user program.

With **STX/ETX**, **3964R**, **Modbus** and **USS** always the length set in *DATAPTR* is stored or 0.

RETVAL FC/SFC 217 (Return values)

Return values of the block:

Error code	Description
0000h	Send data - ready
1000h	Nothing sent (data length 0)
20xxh	Protocol executed error free with xx bit pattern for diagnosis
7001h	Data is stored in internal buffer - active (busy)
7002h	Transfer - active
80xxh	Protocol executed with errors with xx bit pattern for diagnosis (no acknowledgement by partner)
90xxh	Protocol not executed with xx bit pattern for diagnosis (no acknowledgement by partner)

Error code	Description
8x24h	Error in FC/SFC parameter x, where x: 1: Error in *DATAPTR* 2: Error in *DATALEN*
8122h	Error in parameter *DATAPTR* (e.g. DB too short)
807Fh	Internal error
809Ah	interface not found e.g. interface is used by PROFIBUS
809Bh	interface not configured

Protocol specific RETVAL values

ASCII

Value	Description
9000h	Buffer overflow (no data send)
9002h	Data too short (0byte)

STX/ETX

Value	Description
9000h	Buffer overflow (no data send)
9001h	Data too long (>1024byte)
9002h	Data too short (0byte)
9004h	Character not allowed

3964R

Value	Description
2000h	Send ready without error
80FFh	NAK received - error in communication
80FEh	Data transfer without acknowledgement of partner or error at acknowledgement
9000h	Buffer overflow (no data send)
9001h	Data too long (>1024byte)
9002h	Data too short (0byte)

USS

Error code	Description
2000h	Send ready without error
8080h	Receive buffer overflow (no space for receipt)
8090h	Acknowledgement delay time exceeded

Error code	Description
80F0h	Wrong checksum in respond
80FEh	Wrong start sign in respond
80FFh	Wrong slave address in respond
9000h	Buffer overflow (no data send)
9001h	Data too long (>1024byte)
9002h	Data too short (<2byte)

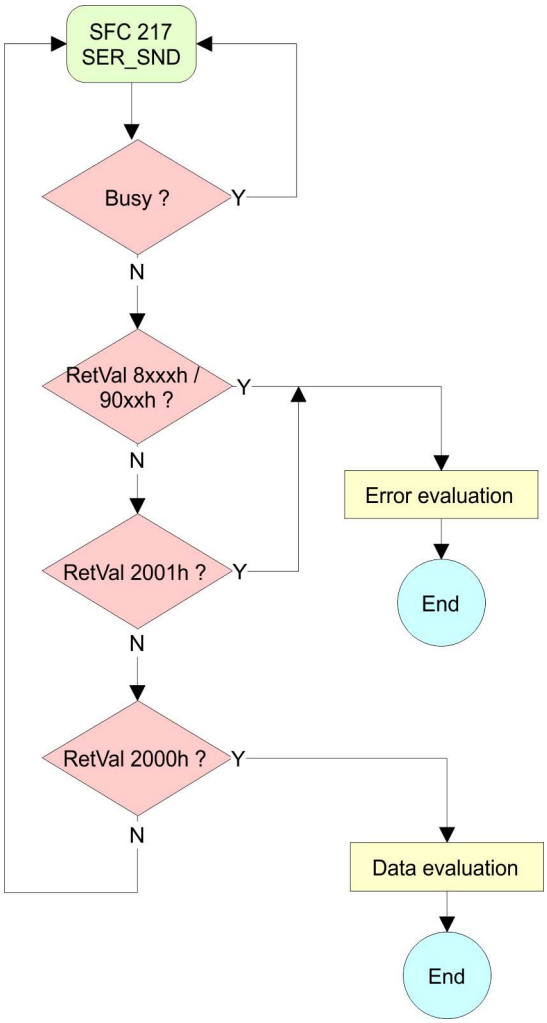
Modbus RTU/ASCII Master

Error code	Description
2000h	Send ready (positive slave respond)
2001h	Send ready (negative slave respond)
8080h	Receive buffer overflow (no space for receipt)
8090h	Acknowledgement delay time exceeded
80F0h	Wrong checksum in respond
80FDh	Length of respond too long
80FEh	Wrong function code in respond
80FFh	Wrong slave address in respond
9000h	Buffer overflow (no data send)
9001h	Data too long (>1024byte)
9002h	Data too short (<2byte)

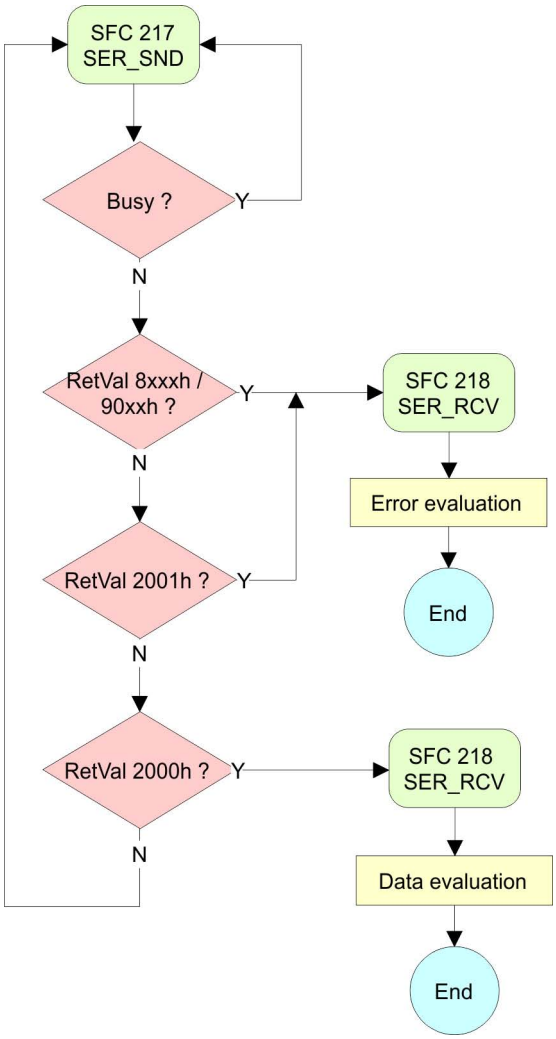
Principles of programming

The following text shortly illustrates the structure of programming a send command for the different protocols.

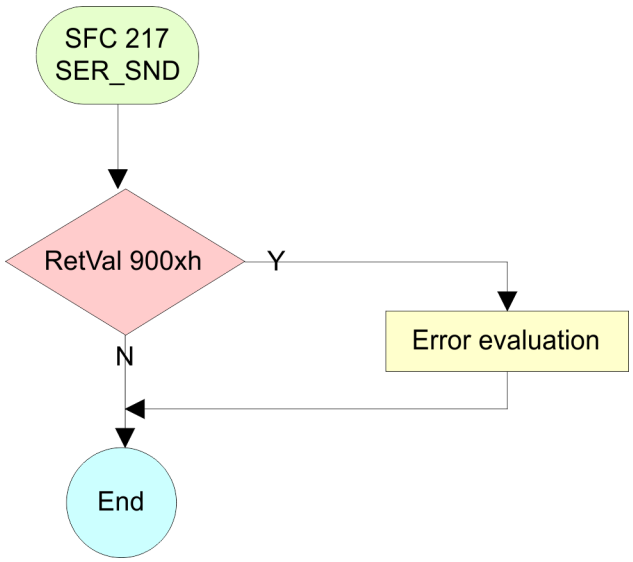
3964R



USS / Modbus



ASCII / STX/ETX



5.5.3 FC/SFC 218 - SER_RCV

Description

This block receives data via the serial interface.

Using the FC/SFC 218 SER_RCV after SER_SND with the protocols USS and Modbus the acknowledgement telegram can be read.

Parameters

Parameter	Declaration	Data type	Description
DATAPTR	IN	ANY	Pointer to Data Buffer for received data
DATALEN	OUT	WORD	Length of received data
ERROR	OUT	WORD	Error Number
RETVAL	OUT	WORD	Return value (0 = OK)

DATAPTR

Here you set a range of the type Pointer for the receive buffer where the reception data is stored. You have to set type, start and length.

Example:

Data is stored in DB5 starting at 0.0 with a length of 124byte.

DataPtr:=P#DB5.DBX0.0 BYTE 124

DATALEN

Word where the number of received Bytes is stored.

At **STX/ETX** and **3964R**, the length of the received user data or 0 is entered.

At **ASCII**, the number of read characters is entered. This value may be different from the read telegram length.

ERROR

This word gets an entry in case of an error.

The following error messages may be created depending on the protocol:

ASCII

Bit	Error	Description
0	overrun	Overflow, a sign couldn't be read fast enough from the interface
1	framing error	Error that shows that a defined bit frame is not coincident, exceeds the allowed length or contains an additional bit sequence (Stop bit error)
2	parity	Parity error
3	overflow	Buffer is full

STX/ETX

Bit	Error	Description
0	overflow	The received telegram exceeds the size of the receive buffer.
1	char	A sign outside the range 20h ... 7Fh has been received.
3	overflow	Buffer is full.

3964R / Modbus RTU/ASCII Master

Bit	Error	Description
0	overflow	The received telegram exceeds the size of the receive buffer.

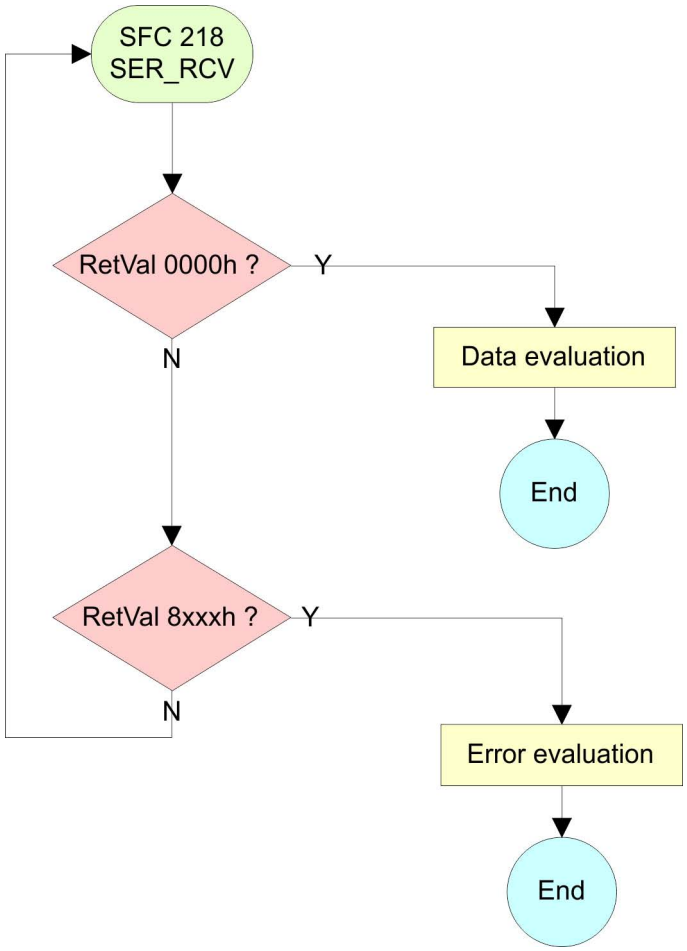
RETVAL FC/SFC 218 (Return value)

Return values of the block:

Error code	Description
0000h	no error
1000h	Receive buffer too small (data loss)
8x24h	Error at FC/SFC-Parameter x, with x: 1: Error at *DATAPTR* 2: Error at *DATALEN* 3: Error at *ERROR*
8122h	Error in parameter *DATAPTR* (e.g. DB too short)
809Ah	Serial interface not found res. interface is used by PROFIBUS
809Bh	Serial interface not configured

Principles of programming

The following picture shows the basic structure for programming a receive command. This structure can be used for all protocols.



5.6 Protocols and procedures

Overview

The CPU supports the following protocols and procedures:

- ASCII communication
- STX/ETX
- 3964R
- USS
- Modbus

ASCII

ASCII data communication is one of the simple forms of data exchange. Incoming characters are transferred 1 to 1. At ASCII, with every cycle the read FC/SFC is used to store the data that is in the buffer at request time in a parameterized receive data block. If a telegram is spread over various cycles, the data is overwritten. There is no reception acknowledgement. The communication procedure has to be controlled by the concerning user application. An according Receive_ASCII FB may be found within the VIPA library in the service area of www.vipa.com.

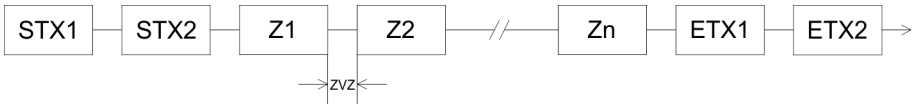
STX/ETX

STX/ETX is a simple protocol with start and end ID, where STX stands for **S**tart of **Tex**t and ETX for **E**nd of **Tex**t.

- Any data transferred from the periphery must be preceded by a Start followed by the data characters and the end character. Depending of the byte width the following ASCII characters can be transferred: 5bit: not allowed: 6bit: 20...3Fh, 7bit: 20...7Fh, 8bit: 20...FFh.
- The effective data, which includes all the characters between Start and End are transferred to the CPU when the End has been received.
- When data is send from the CPU to a peripheral device, any user data is handed to the FC/SFC 217 (SER_SND) and is transferred with added Start- and End-ID to the communication partner.
- You may work with 1, 2 or no Start- and with 1, 2 or no End-ID.
- If no End-ID is defined, all read characters are transferred to the CPU after a parameterizable character delay time (Timeout).

As Start-res. End-ID all Hex values from 01h to 1Fh are permissible. Characters above 1Fh are ignored. In the user data, characters below 20h are not allowed and may cause errors. The number of Start- and End-IDs may be different (1 Start, 2 End res. 2 Start, 1 End or other combinations). For not used start and end characters you have to enter FFh in the hardware configuration.

Message structure:



3964

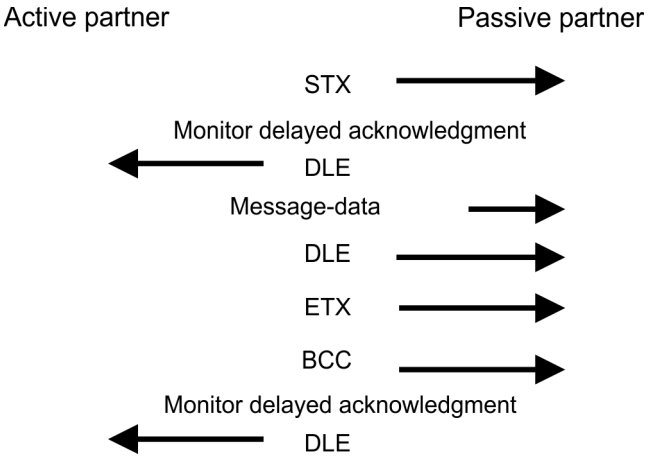
The 3964R procedure controls the data transfer of a point-to-point link between the CPU and a communication partner. The procedure adds control characters to the message data during data transfer. These control characters may be used by the communication partner to verify the complete and error free receipt.

The procedure employs the following control characters:

- STX: **S**tart of **Te**x**t**
- DLE: **D**ata **L**ink **E**scape
- ETX: **E**nd of **Te**x**t**
- BCC: **B**lock **C**heck **C**haracter
- NAK: **N**egative **Ac**k**nowledge**

You may transfer a maximum of 255byte per message.

Procedure



When a DLE is transferred as part of the information it is repeated to distinguish between data characters and DLE control characters that are used to establish and to terminate the connection (DLE duplication). The DLE duplication is reversed in the receiving station.

The 3964R procedure requires that a lower priority is assigned to the communication partner. When communication partners issue simultaneous send commands, the station with the lower priority will delay its send command.

USS

The USS protocol (**U**niverselle **s**erielle **S**chnittstelle = universal serial interface) is a serial transfer protocol defined by Siemens for the drive and system components. This allows to build-up a serial bus connection between a superordinated master and several slave systems. The USS protocol enables a time cyclic telegram traffic by presetting a fix telegram length.

The following features characterize the USS protocol:

- Multi point connection
- Master slave access procedure
- Single master system
- Max. 32 participants
- Simple and secure telegram frame

It is essential:

- You may connect 1 master and max. 31 slaves at the bus
- The single slaves are addressed by the master via an address sign in the telegram.
- The communication happens exclusively in half-duplex operation.
- After a send command, the acknowledgement telegram must be read by a call of the FC/SFC 218 SER_RCV.

The telegrams for send and receive have the following structure:

Master slave telegram

STX	LGE	ADR	PKE		IND		PWE		STW		HSW		BCC
02h			H	L	H	L	H	L	H	L	H	L	

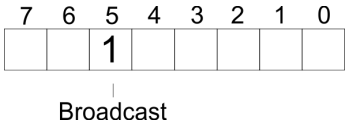
Slave master telegram

STX	LGE	ADR	PKE		IND		PWE		ZSW		HIW		BCC
02h			H	L	H	L	H	L	H	L	H	L	

with

STX - Start sign
STW - Control word
LGE - Telegram length
ZSW - State word
ADR - Address
HSW - Main set value
PKE - Parameter ID
HIW - Main effective value
IND - Index
BCC - Block Check Character
PWE - Parameter value

Broadcast with set bit 5 in ADR byte



A request can be directed to a certain slave ore be send to all slaves as broadcast message. For the identification of a broadcast message you have to set bit 5 to 1 in the ADR byte. Here the slave addr. (bit 0 ... 4) is ignored. In opposite to a "normal" send command, the broadcast does not require a telegram evaluation via FC/SFC 218 SER_RCV. Only write commands may be sent as broadcast.

Modbus

- The Modbus protocol is a communication protocol that fixes a hierarchic structure with one master and several slaves.
- Physically, Modbus works with a serial half-duplex connection. There are no bus conflicts occurring, because the master can only communicate with one slave at a time.

- After a request from the master, this waits for a preset delay time for an answer of the slave. During the delay time, communication with other slaves is not possible.
- After a send command, the acknowledgement telegram must be read by a call of the FC/SFC 218 SER_RCV.
- The request telegrams send by the master and the respond telegrams of a slave have the following structure:

Telegram structure

Start sign	Slave address	Function Code	Data	Flow control	End sign

Broadcast with slave address = 0

- A request can be directed to a special slave or at all slaves as broadcast message.
- To mark a broadcast message, the slave address 0 is used.
- In opposite to a "normal" send command, the broadcast does not require a telegram evaluation via FC/SFC 218 SER_RCV.
- Only write commands may be sent as broadcast.

ASCII, RTU mode

Modbus offers 2 different transfer modes. The mode selection happens during runtime by using the FC/SFC 216 SER_CFG.

- ASCII mode: Every byte is transferred in the 2 sign ASCII code. The data are marked with a start and an end sign. This causes a transparent but slow transfer.
- RTU mode: Every byte is transferred as one character. This enables a higher data pass through as the ASCII mode. Instead of start and end sign, a time control is used.

Supported Modbus protocols

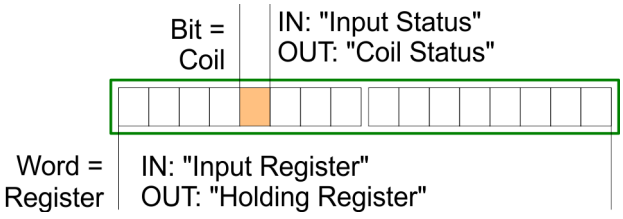
The following Modbus Protocols are supported by the RS485 interface:

- Modbus RTU Master
- Modbus ASCII Master

5.7 Modbus - Function codes

Naming convention

Modbus has some naming conventions:



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

Range definitions

Normally the access at Modbus happens by means of the ranges 0x, 1x, 3x and 4x.

0x and 1x gives you access to digital bit areas and 3x and 4x to analog word areas.

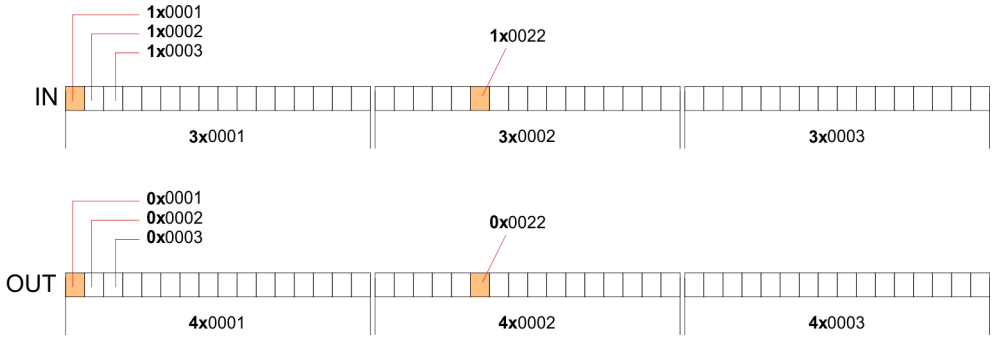
For the CPs from VIPA is not differentiating digital and analog data, the following assignment is valid:

0x - Bit area for master output data
Access via function code 01h, 05h, 0Fh

1x - Bit area for master input data
Access via function code 02h

3x - word area for master input data
Access via function code 04h

4x - word area for master output data
Access via function code 03h, 06h, 10h



A description of the function codes follows below.

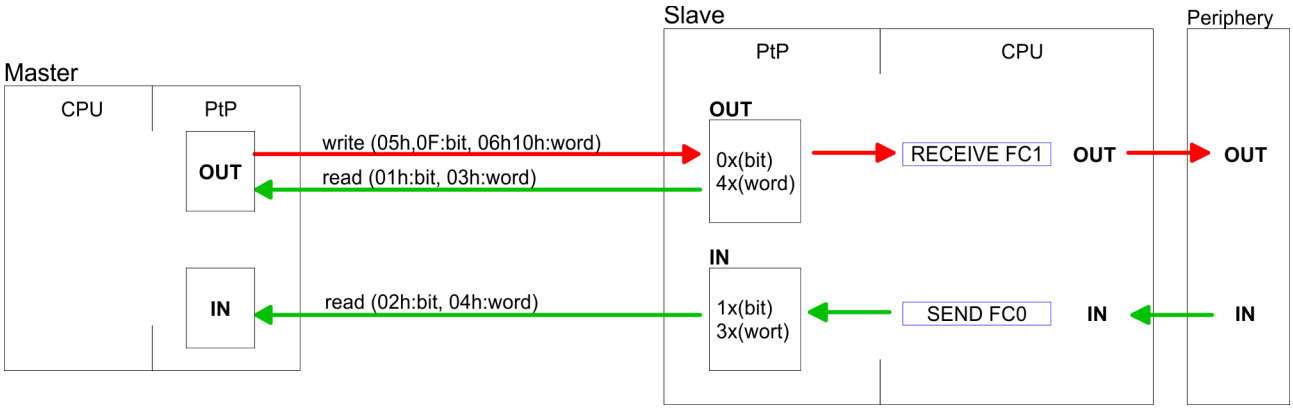
Overview

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

Code	Command	Description
01h	Read n bits	Read n bits of master output area 0x
02h	Read n bits	Read n bits of master input area 1x
03h	Read n words	Read n words of master output area 4x
04h	Read n words	Read n words master input area 3x
05h	Write 1 bit	Write 1 bit to master output area 0x
06h	Write 1 word	Write 1 word to master output area 4x
0Fh	Write n bits	Write n bits to master output area 0x
10h	Write n words	Write n words to master output area 4x

Point of View of "Input" and "Output" data

The description always takes place from the point of view of the master. Here data, which were sent from master to slave, up to their target are designated as "output" data (OUT) and contrary slave data received by the master were designated as "input" data (IN).



Respond of the slave

If the slave announces an error, the function code is send back with an "ORed" 80h.

Without an error, the function code is sent back.

Slave answer:	Function code OR 80h	→ Error
	Function code	→ OK

Byte sequence in a word

1 word	
High-byte	Low-byte

Check sum CRC, RTU, LRC

The shown check sums CRC at RTU and LRC at ASCII mode are automatically added to every telegram. They are not shown in the data block.

Read n bits 01h, 02h

Code 01h: Read n bits of master output area 0x

Code 02h: Read n bits of master input area 1x

Command telegram

Slave address	Function code	Address 1. bit	Number of bits	Check sum CRC/ LRC
1byte	1byte	1word	1word	1word

Respond telegram

Slave address	Function code	Number of read bytes	Data 1. byte	Data 2. byte	...	Check sum CRC/LRC
1byte	1byte	1byte	1byte	1byte		1word
			max. 250byte			

Read n words 03h, 04h

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

Command telegram

Slave address	Function code	Address 1. bit	Number of words	Check sum CRC/ LRC
1byte	1byte	1word	1word	1word

Respond telegram

Slave address	Function code	Number of read bytes	Data 1. word	Data 2. word	...	Check sum CRC/LRC
1byte	1byte	1byte	1word	1word		1word
			max. 125words			

Write 1 bit 05h

Code 05h: Write 1 bit to master output area 0x
A status change is via "Status bit" with following values:
"Status bit" = 0000h → Bit = 0
"Status bit" = FF00h → Bit = 1

Command telegram

Slave address	Function code	Address bit	Status bit	Check sum CRC/ LRC
1byte	1byte	1word	1word	1word

Respond telegram

Slave address	Function code	Address bit	Status bit	Check sum CRC/ LRC
1byte	1byte	1word	1word	1word

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

Command telegram

Slave address	Function code	Address word	Value word	Check sum CRC/ LRC
1byte	1byte	1word	1word	1word

Respond telegram

Slave address	Function code	Address word	Value word	Check sum CRC/ LRC
1byte	1byte	1word	1word	1word

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

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

Command telegram

Slave address	Func- tion code	Address 1. bit	Number of bits	Number of bytes	Data 1. byte	Data 2. byte	...	Check sum CRC/ LRC
1byte	1byte	1word	1word	1byte	1byte	1byte	1byte	1word
					max. 250byte			

Respond telegram

Slave address	Function code	Address 1. bit	Number of bits	Check sum CRC/ LRC
1byte	1byte	1word	1word	1word

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

Command telegram

Slave address	Func-tion code	Address 1. word	Number of words	Number of bytes	Data 1. word	Data 2. word	...	Check sum CRC/ LRC
1byte	1byte	1word	1word	1byte	1word	1word	1word	1word
					max. 125words			

Respond telegram

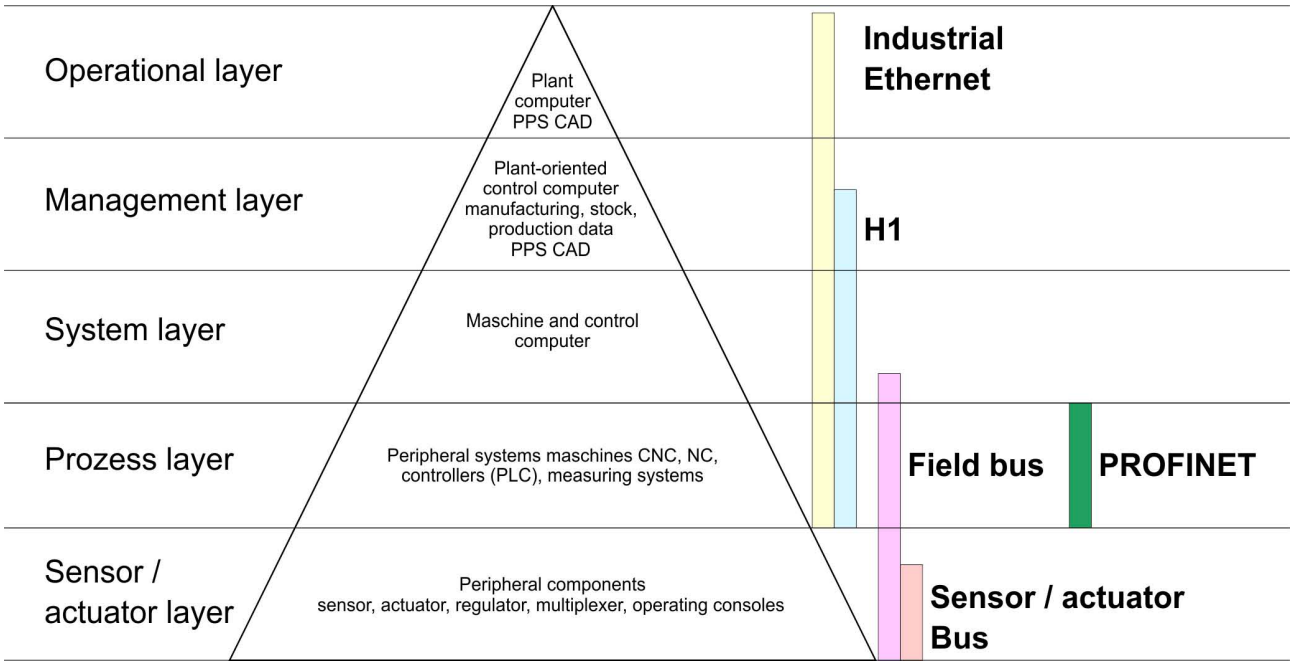
Slave address	Function code	Address 1. word	Number of words	Check sum CRC/ LRC
1byte	1byte	1word	1word	1word

6 Deployment Ethernet communication - productive

6.1 Basics - Industrial Ethernet in automation

Overview

The flow of information in a company presents a vast spectrum of requirements that must be met by the communication systems. Depending on the area of business the bus system or LAN must support a different number of users, different volumes of data must be transferred and the intervals between transfers may vary, etc. It is for this reason that different bus systems are employed depending on the respective task. These may be subdivided into different classes. The following model depicts the relationship between the different bus systems and the hierarchical structures of a company:



Industrial Ethernet

Industrial Ethernet is an electrical net based on shielded twisted pair cabling or optical net based on optical fibre. Industrial Ethernet is defined by the international standard IEEE 802.3

The net access of Industrial Ethernet corresponds to IEEE 802.3 - CSMA/CD (**C**arrier **S**ense **M**ultiple **A**ccess/**C**ollision **D**etection) scheme:

- Every station "listens” on the bus cable and receives communication messages that are addressed to it.
- Stations will only initiate a transmission when the line is unoccupied.
- In the event that two participants should start transmitting simultaneously, they will detect this and stop transmitting to restart after a random delay time has expired.
- Using switches there is the possibility for communication without collisions.

6.2 Basics - ISO/OSI reference model

Overview

The ISO/OSI reference model is based on a proposal that was developed by the International Standards Organization (ISO). This represents the first step towards an international standard for the different protocols. It is referred to as the ISO-OSI layer model. OSI is the abbreviation for **O**pen **S**ystem **I**nterconnection, the communication between open systems. The ISO/OSI reference model does not represent a network architecture as it does not define the services and protocols used by the different layers. The model simply specifies the tasks that the different layers must perform. All current communication systems are based on the ISO/OSI reference model, which is defined by the ISO 7498 standard. The reference model structures communication systems into 7 layers that cover different communication tasks. In this manner the complexity of the communication between different systems is divided amongst different layers to simplify the task.

The following layers have been defined:

- Layer 7 - Application Layer
- Layer 6 - Presentation Layer
- Layer 5 - Session Layer
- Layer 4 - Transport Layer
- Layer 3 - Network Layer
- Layer 2 - Data Link Layer
- Layer 1- Physical Layer

Depending on the complexity and the requirements of the communication mechanisms a communication system may use a subset of these layers.

Layer 1 - Bit communication layer (physical layer)

The bit communication layer (physical layer) is concerned with the transfer of data bits via the communication channel. This layer is therefore responsible for the mechanical, electrical and the procedural interfaces and the physical communication medium located below the bit communication layer:

- Which voltage represents a logical 0 or a 1?
- The minimum time the voltage is present to be recognized as a bit.
- The pin assignment of the respective interface.

Layer 2 - Security layer (data link layer)

This layer performs error-checking functions for bit strings transferred between two communicating partners. This includes the recognition and correction or flagging of communication errors and flow control functions. The security layer (data link layer) converts raw communication data into a sequence of frames. This is where frame limits are inserted on the transmitting side and where the receiving side detects them. These limits consist of special bit patterns that are inserted at the beginning and at the end of every frame. The security layer often also incorporates flow control and error detection functions. The data security layer is divided into two sub-levels, the LLC and the MAC level. The MAC (**M**edia **A**ccess **C**ontrol) is the lower level and controls how senders are sharing a single transmit channel. The LLC (**L**ogical **L**ink **C**ontrol) is the upper level that establishes the connection for transferring the data frames from one device into the other.

Layer 3 - Network layer

The network layer is an agency layer. Business of this layer is to control the exchange of binary data between stations that are not directly connected. It is responsible for the logical connections of layer 2 communications. Layer 3 supports the identification of the single network addresses and the establishing and disconnecting of logical communication channels. Additionally, layer 3 manages the prior transfer of data and the error processing of data packets. IP (Internet Protocol) is based on Layer 3.

Layer 4 - Transport layer

Layer 4 connects the network structures with the structures of the higher levels by dividing the messages of higher layers into segments and passes them on to the network layer. Hereby, the transport layer converts the transport addresses into network addresses. Common transport protocols are: TCP, SPX, NWLink and NetBEUI.

Layer 5 - Session layer

The session layer is also called the communication control layer. It relieves the communication between service deliverer and the requestor by establishing and holding the connection if the transport system has a short time fail out. At this layer, logical users may communicate via several connections at the same time. If the transport system fails, a new connection is established if needed. Additionally this layer provides methods for control and synchronization tasks.

Layer 6 - Presentation layer

This layer manages the presentation of the messages, when different network systems are using different representations of data. Layer 6 converts the data into a format that is acceptable for both communication partners. Here compression/decompression and encrypting/decrypting tasks are processed. This layer is also called interpreter. A typical use of this layer is the terminal emulation.

Layer 7 - Application layer

The application layer is the link between the user application and the network. The tasks of the application layer include the network services like file, print, message, data base and application services as well as the according rules. This layer is composed from a series of protocols that are permanently expanded following the increasing needs of the user.

6.3 Basics - Terms

Network (LAN)

A network res. LAN (Local Area Network) provides a link between different stations that enables them to communicate with each other. Network stations consist of PCs, IPCs, TCP/IP adapters, etc. Network stations are separated by a minimum distance and connected by means of a network cable. The combination of network stations and the network cable represent a complete segment. All the segments of a network form the Ethernet (physics of a network).

Twisted Pair

In the early days of networking the Triaxial- (yellow cable) or thin Ethernet cable (Cheapernet) was used as communication medium. This has been superseded by the twisted-pair network cable due to its immunity to interference. The CPU has a twisted-pair connector. The twisted-pair cable consists of 8 cores that are twisted together in pairs. Due to these twists this system is provides an increased level of immunity to electrical interference. For linking please use twisted pair cable which at least corresponds to the category 5. Where the

coaxial Ethernet networks are based on a bus topology the twisted-pair network is based on a point-to-point scheme. The network that may be established by means of this cable has a star topology. Every station is connected to the star coupler (hub/switch) by means of a separate cable. The hub/switch provides the interface to the Ethernet.

Hub (repeater)

The hub is the central element that is required to implement a twisted-pair Ethernet network. It is the job of the hub to regenerate and to amplify the signals in both directions. At the same time it must have the facility to detect and process segment wide collisions and to relay this information. The hub is not accessible by means of a separate network address since it is not visible to the stations on the network. A hub has provisions to interface to Ethernet or to another hub res. switch.

Switch

A switch also is a central element for realizing Ethernet on Twisted Pair. Several stations res. hubs are connected via a switch. Afterwards they are able to communicate with each other via the switch without interfering the network. An intelligent hardware analyses the incoming telegrams of every port of the switch and passes them collision free on to the destination stations of the switch. A switch optimizes the bandwidth in every connected segment of a network. Switches enable exclusive connections between the segments of a network changing at request.

6.4 Basics - Protocols

Overview

Protocols define a set of instructions or standards that enable computer to establish communication connections and exchange information as error free as possible. A commonly established protocol for the standardization of the complete communication is the ISO/OSI layer model. ↳ *Chapter 6.2 'Basics - ISO/OSI reference model' on page 173*

The following protocols are used:

- Communication connections
  - Siemens S7 connections
- Open communication
  - UDP according to RFC 793
  - ISO on TCP according to RFC 1006
  - UDP according to RFC 768

Siemens S7 connections

With the Siemens S7 connection large data sets may be transferred between PLC systems based on Siemens STEP®7. Here the stations are connected via Ethernet. Precondition for the Siemens S7 communication is a configured connection table, which contains the defined connections for communication. This can be configured in *SPEED7 Studio*.

Properties:

- A communication connection is specified by a connection ID for each connection partner.
- The acknowledgement of the data transfer is established from the partner station at level 7 of the ISO/OSI reference model.
- At the PLC side FB/SFB VIPA handling blocks are necessary for data transfer for the Siemens S7 connections.

More about the usage of the handling blocks may be found in the manual Operation list HB00_OPL_SP7.

Open communication

In the *Open communication* the communication takes place via the user program by means of handling blocks. These blocks are part of the *SPEED7 Studio*. These can be found in the *'Catalog'* at *'Blocks'*.

- *Connection-oriented protocols:*
  Connection-oriented protocols establish a (logical) connection to the communication partner before data transmission is started. And if necessary they terminate the connection after the data transfer was finished. Connection-oriented protocols are used for data transmission when reliable, guaranteed delivery is of particular importance. Also the correct order of the received packets is ensured. In general, many logical connections can exist on one physical line. The following connection-oriented protocols are supported with FBs for open communication via industrial Ethernet:
  - *TCP native accord. to RFC 793:*
    During data transmission, no information about the length or about the start and end of a message is transmitted. However, the receiver has no means of detecting where one message ends in the data stream and the next one begins. The transfer is stream-oriented. For this reason, it is recommended that the data length of the FBs is identical for the sending and receiving station. If the number of received data does not fit to the preset length you either will get not the whole data, or you will get data of the following job.
  - *ISO on TCP according to RFC 1006:*
    During data transmission, information on the length and the end of the message is also transmitted. The transfer is block-oriented If you have specified the length of the data to be received greater than the length of the data to be sent, the receive block will copy the received data completely into the receive range.
- *Connection-less protocol:*
  There is thus no establishment and termination of a connection with a remote partner. Connection-less protocols transmit data with no acknowledge and with no reliable guaranteed delivery to the remote partner.
  - *UDP according to RFC 768:*
    In this case, when calling the sending block you have to specify the address parameters of the receiver (IP address and port number). During data transmission, information on the length and the end of the message is also transmitted. Analog after finishing the receive block you get a reference to the address parameter of the sender (IP address and port no.) In order to be able to use the sending and receiving blocks first you have to configure the local communications access point at both sides. With each new call of the sending block, you reference the remote partner by specifying its IP address and its port number.

6.5 Basics - IP address and subnet

IP address structure

Exclusively IPv4 is supported. At IPv4 the IP address is a 32bit address that must be unique within the network and consists of 4 numbers that are separated by a dot. Every IP address is a combination of a *Net-ID* and a *Host-ID* and has the following

Structure: **xxx.xxx.xxx.xxx**

Range: 000.000.000.000 to 255.255.255.255

Net-ID, Host-ID

The **Net**work-ID identifies a network res. a network controller that administrates the network. The Host-ID marks the network connections of a participant (host) to this network.

Subnet mask

The Host-ID can be further divided into a *Subnet-ID* and a new *Host-ID* by using a bit for bit AND assignment with the Subnet mask.

The area of the original Host-ID that is overwritten by 1 of the Subnet mask becomes the Subnet-ID, the rest is the new Host-ID.

Subnet mask	binary all "1"		binary all "0"
IPv4 address	Net-ID	Host-ID	
Subnet mask and IPv4 address	Net-ID	Subnet-ID	new Host-ID

Address at first start-up

At the first commissioning the Ethernet PG/OP channel and the NET-CP have no IP address.

How IP address data are assigned to the Ethernet PG/OP channel ↳ *Chapter 4.6 'Hardware configuration - Ethernet PG/OP channel' on page 58*.

How IP address data are assigned to the NET-CP ↳ *Chapter 6.8 'Commissioning and Initialization' on page 179*.

Address classes

For IPv4 addresses there are five address formats (class A to class E) that are all of a length of 4byte = 32bit.

Class A	0	Network-ID (1+7bit)	Host-ID (24bit)
Class B	10	Network-ID (2+14bit)	Host-ID (16bit)
Class C	110	Network-ID (3+21bit)	Host-ID (8bit)
Class D	1110	Multicast group	
Class E	11110	Reserved	

The classes A, B and C are used for individual addresses, class D for multicast addresses and class E is reserved for special purposes. The address formats of the 3 classes A, B, C are only differing in the length of Network-ID and Host-ID.

Private IP networks

These addresses can be used as net-ID by several organizations without causing conflicts, for these IP addresses are neither assigned in the Internet nor are routed in the Internet. To build up private IP-Networks within the Internet, RFC1597/1918 reserves the following address areas:

Network class	from IP	to IP	Standard subnet mask
A	10.0.0.0	10.255.255.255	255.0.0.0
B	172.16.0.0	172.31.255.255	255.255.0.0
C	192.168.0.0	192.168.255.255	255.255.255.0
(The Host-ID is underlined.)			

Reserved Host-IDs

Some Host-IDs are reserved for special purposes.

Host-ID = "0"	Identifier of this network, reserved!
Host-ID = maximum (binary complete "1")	Broadcast address of this network

Never choose an IP address with Host-ID=0 or Host-ID=maximum! (e.g. for class B with subnet mask = 255.255.0.0, the "172.16.0.0" is reserved and the "172.16.255.255" is occupied as local broadcast address for this network.)

6.6 Basics - MAC address and TSAP

MAC address

There is a unique MAC address (**M**edia **A**ccess **C**ontrol) necessary for each CP. Usually a module is labelled with its MAC address by the manufacturer. This address should be used for project engineering of the CP. The MAC address has a length of 6bytes. On delivery the first three bytes specify the manufacturer. These bytes are assigned by the IEEE committee. The last 3 bytes may be assigned by the manufacturer. In a network several stations with the same MAC address may not exist. The MAC address may be changed at any time. You will get a valid MAC address from your network administrator.

- Broadcast address
  - The MAC address, with which all bits are set to 1, is:
    FF-FF-FF-FF-FF-FF
    This address is used as Broadcast address and addresses all participants in the net.
- Address at first start-up
  - Each CP of a VIPA CPU has an unique MAC address. This may be found on a label beneath the front flap.

TSAP

TSAP means **T**ransport **S**ervice **A**ccess **P**oint. ISO transport connections support TSAP length of 1...16byte. TSAPs may be entered in ASCII format or hexadecimal.

Address parameters

Station A				Station B
remote TSAP	→	ISO transport connection	→	local TSAP
local TSAP	←		←	remote TSAP
MAC address A				MAC address B

An ISO transport connection is specified by a local and a remote connection endpoint. The TSAPs of an ISO transport connection must match as follows:

- Remote TSAP (in CP) = local TSAP (in destination station)
- Local TSAP (in CP) = remote TSAP (in destination station)

6.7 Fast introduction

Overview

At the first commissioning respectively after an overall reset with PowerON again of the CPU, the Ethernet PG/OP channel and the NET-CP have no IP address. These are only reachable by its MAC address. By means of the MAC address, which is printed at the front with the sequence address NET-CP and beneath address Ethernet PG/OP channel, you can assign IP address data to the according component. The assignment takes place directly via the device configuration in *SPEED7 Studio*.

Steps of configuration

For the configuration of the NET-CP for productive connections should be done by the follow approach:

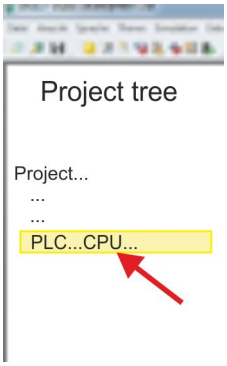
- Assembly and commissioning
- Hardware configuration - CPU
- Configure connections
  - Siemens S7 connections
    (Configuration happens via *'Device and networking'* in the *SPEED7 Studio*, the communication via VIPA handling blocks)
  - Open communication
    (Configuration and communication happens by handling blocks)
- Transfer of the entire project to the CPU

6.8 Commissioning and Initialization

Assembly and commissioning

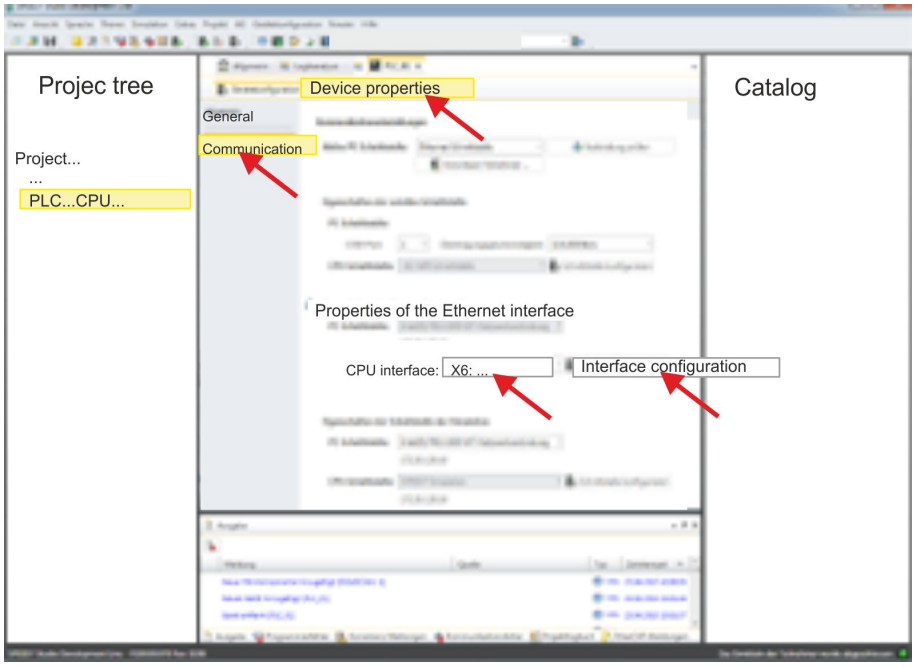
1. Install your System SLIO with your CPU.
2. Wire the system by connecting cables for voltage supply and signals.
3. Connect the Ethernet jack of the NET-CP (X6) to Ethernet.
4. Switch on the power supply.
   ⇨ After a short boot time the CP is ready for communication. He possibly has no IP address data and requires an initialization.

"Initialization"



You get valid IP address parameters from your system administrator. The assignment of the IP address data happens in the *SPEED7 Studio*with the following proceeding:

1. Start the *SPEED7 Studio* with your project.
2. Click in the *Project tree* at the CPU *'PLC ... CPU ...'*
3. Select *'Context menu ➔ Device properties'*.
   ⇨ The dialogue *'Device properties'* opens.



4. Here click at *'Communication'*
5. Select at *'Properties Ethernet interface'* as *'CPU-interface'* the interface *'X6:...'*.
6. Click at the button [Interface configuration].
7. Enter the wanted IP address data and confirm with [OK].
   ⇨ The IP address data are stored in your current project. After transferring your project, the NET-CP can be accessed via the set IP address data.

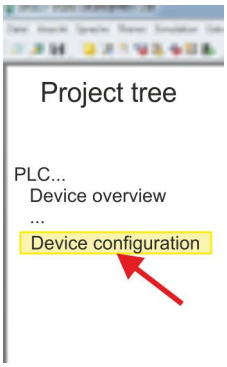
6.9 Hardware configuration - CPU

Precondition

For project engineering a thorough knowledge of the SPEED7 Studio is required!

Proceeding

1. Start the *SPEED7 Studio*.
2. Create a new project in the *Work area* with *'New project'*.
   ⇨ A new project is created and the view *'Devices and networking'* is shown.

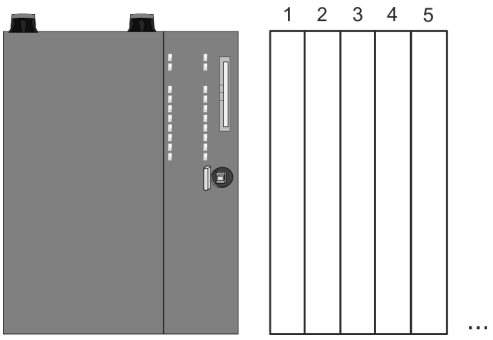


3. Click in the *Project tree* at *'Add new device ...'*.

⇨ A dialog for device selection opens.

4. Select from the *'Device templates'* your CPU and click at [OK].

⇨ The CPU is inserted in *'Devices and networking'* and the *'Device configuration'* is opened.



Device configuration

Slot	Module	...	...	...	...
0	CPU 015-CEFNR00				
-X1	PG_OP_Ethernet				
-X2	MPI interface				
...	...			...	

6.10 Configure Siemens S7 connections

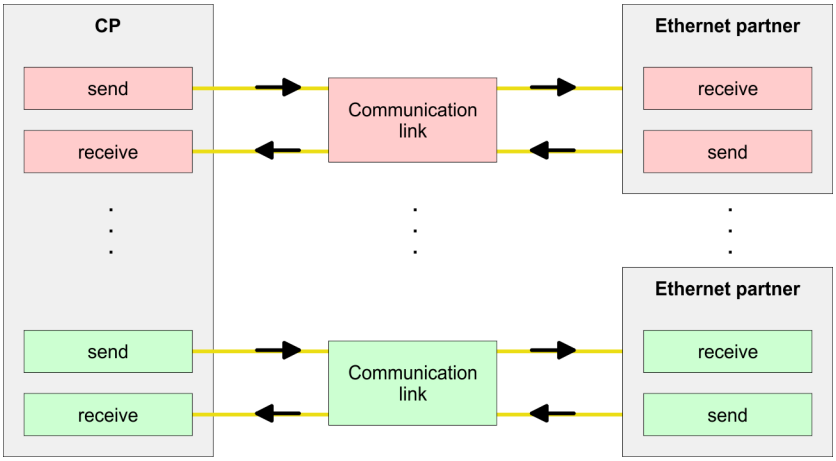
Overview

The configuration of S7 connections, i.e. the "link-up" between the stations happens in the *SPEED7 Studio* at *'Devices and networking'*. Here you can configure in tabular form communication connections In addition, the physical connections between the stations are graphically shown. A communication connection enables the program controlled communication between two participants at the Industrial Ethernet. The communication is controlled by the user program with VIPA handling blocks. To use this blocks, configured communication connections are always necessary in the active station.

Properties communication connection

The following properties are characterizing a communication connection:

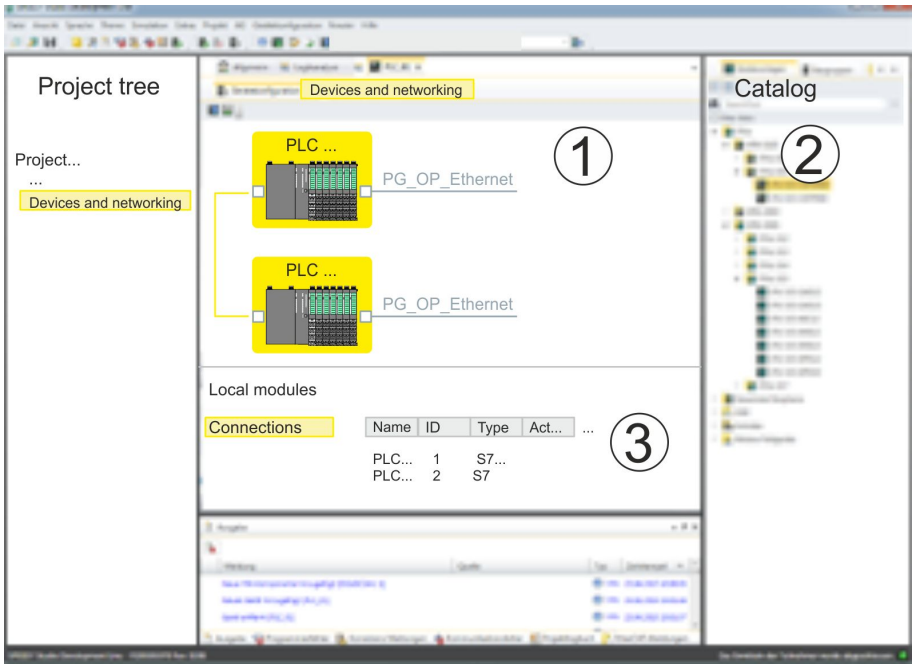
- One station always executes an active connection establishment.
- Bi-directional data transfer (Send and receive on one connection)
- Both participant have equal rights, i.e. every participant may initialize the send res. receive process event controlled.
- Except of the UDP connection, at a communication connection the address of the communication partner is set via the project engineering. Here the connection is active established by one station.



Working environment *'Devices and networking'*

For the configuration of connections a thorough knowledge of the *SPEED7 Studio* is required! The following passage only describes the basic usage *'Devices and networking'*. More information can be found in the online help respectively in documentation. After loading your project, *'Devices and networking'* can directly be called via the *Project tree*.

The working environment of *'Devices and networking'* has the following structure:

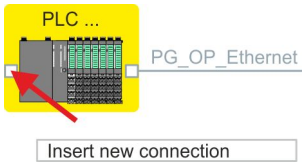


1 *Net view*: All stations and networks are displayed in a graphic view. By clicking on the according component you may access and alter the concerning properties.
2 *Catalog*: This area displays all available modules respectively net objects are shown in a directory view. By dragging a wanted object to the *net view* you may include further net objects.
3 *Connection table*: As soon as you select a module in the *net view*, the configured connections of this module are listed in the connection table. When you select a connection, via the context menu there is the option to edit, delete or to create a new connection.

Link up stations and configure connections

With *SPEED7 Studio* you can link up the communicating stations. The link up takes place in *Devices and networking* via the context menu of the NET-CP net marker with the following approach:

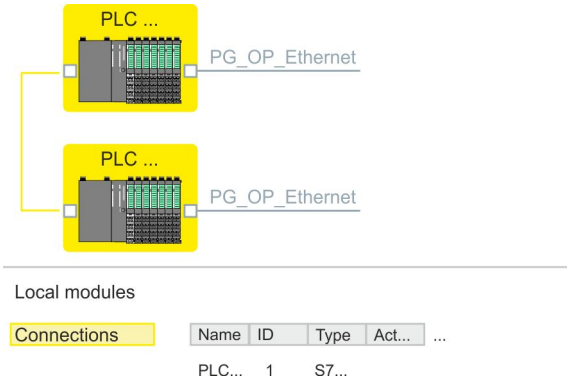
1. Select with the mouse the NET-CP net marker



2. Open with *'Context menu ➔ Insert new connection'* the dialog to establish a new connection.
3. Choose partner station and connection type and confirm with [OK].
   - *Connection partner - Station of your project*
     Each station configured in *SPEED7 Studio* is listed in the table of connection partner.
   - *Connection partner - unspecified*
     Here the connection partner may exist in the current project or in an unknown project. Connection jobs to an unknown project must be defined by an unique IP address. Due to this allocation the connection remains *unspecified*.

   ⇨ A dialogue for setting the connection parameters opens.
4. Enter the according parameters and confirm with [OK].

   ⇨ The connection is established, listed in the *Connection table* and shown as graphical connection line between the stations at *Devices and networking*.



5. Configure in this way further connections. You also can edit you connections via the *Connection table* by selecting a connection and executing an according function via context menu like *'Insert new connection'*.

Connection types

With this CPU exclusively Siemens S7 connections may be configured with *SPEED7 Studio*.

Siemens S7 connection

- For data transfer with Siemens S7 connections the FB/SFB handling blocks are necessary; the deployment is described in the manual "Operation list" of your CPU.
- At Siemens S7 connections the communication connections are specified by a connection ID for each communication partner.

- A connection is specified by the local and partner connection end point.
- At Siemens S7 connections the TSAPs must be congruent crosswise.

The following parameters define a connection end point:

Station A				Station B
remote TSAP	→	Siemens	→	local TSAP
local TSAP	←	S7-Verbindung	←	remote TSAP
ID A				ID B

Combination options with deployment of the FB/SFB VIPA handling blocks

Connection partner	Connection establishing	Connection
specified in the current project	active/passive	specified
unspecified	active	specified
	passive	unspecified

In the following every relevant parameter of a Siemens S7 connection is described:

- General
  - *End point:*
    Here you may define how the connection is to be established. Since the *SPEED7 Studio* can identify the communication options by means of the end points, some options are already preset and may not be changed.
  - *Name:*
    Here you can enter a name for your station
  - *Interface:*
    Here you can select the interfaces of your local and partner station.
  - *Address:*
    Here you can enter the MPI address of your local and partner station.
- Local ID
  - The ID is the link to your PLC program. The ID must be identical to the ID of the call interface of the FB/SFB handling block. Here you also can find the parameters *'ID'* and *'LADDR'*, which you have to specify in the handing blocks.

- Special features
  - *Active connection establishment:*
    An established connection is precondition for data transfer. By activating the option *'Establish an active connection'* the local station establishes the connection. Please regard not every station is able to active establish a connection. Here the job is to be made by the partner station.
- Address details
  - *Rack/slot:*
    Here you will find information about rack and slot of the local and the partner station.
  - Via this button a dialog window opens to show or enter address information of the local or partner station.
  - *Connection resources*
    The connection resource is part of the TSAP of the local station respectively of the partner. Not every connection resource may be used for every connection type. Depending on the connection partner and the connection type the range of values is limited respectively the connection resource is fix specified.
  - *TSAP:*
    With Siemens S7 connections a TSAP is automatically generated of the connection resource (one-way/two-way) and state of place (rack/slot).

Function blocks

FB/SFB	Designation	Description
FB/SFB 12	BSEND	Sending data in blocks FB/SFB 12 BSEND sends data to a remote partner FB/SFB of the type BRCV (FB/SFB 13). The data area to be transmitted is segmented. Each segment is sent individually to the partner. The last segment is acknowledged by the partner as it is received, independently of the calling up of the corresponding FB/SFB/FB BRCV. Due to the segmentation up to 65534byte data can be transferred with one send job.
FB/SFB 13	BRCV	Receiving data in blocks: The FB/SFB 13 BRCV can receive data from a remote partner FB/SFB of the type BSEND (FB/SFB 12). The parameter R_ID of both FB/SFBs must be identical. After each received data segment an acknowledgement is sent to the partner FB/SFB and the LEN parameter is updated.
FB/SFB 14	GET	Remote CPU read: The FB/SFB 14 GET can be used to read data from a remote CPU. The respective CPU must be in RUN mode or in STOP mode.
FB/SFB 15	PUT	Remote CPU write: The FB/SFB 15 PUT can be used to write data to a remote CPU. The respective CPU may be in RUN mode or in STOP mode.

6.11 Configure open communication

Connection-oriented protocols

- Connection-oriented protocols establish a (logical) connection to the communication partner before data transmission is started.
- And if necessary they terminate the connection after the data transfer was finished.
- Connection-oriented protocols are used for data transmission when reliable, guaranteed delivery is of particular importance.
- In general, many logical connections can exist on one physical line.

The following connection-oriented protocols are supported with FBs for open communication via Industrial Ethernet:

- *TCP/IP native according to RFC 793 (connection types 01h and 11h):*
  - During data transmission, no information about the length or about the start and end of a message is transmitted.
  - The receiver has no means of detecting where one message ends in the data stream and the next one begins.
  - The transfer is stream-oriented. For this reason, it is recommended that the data length of the FBs is identical for the sending and receiving station.
  - If the number of received data does not fit to the preset length you either will get not the whole data, or you will get data of the following job. The receive block copies as many bytes into the receive area as you have specified as length. After this, it will set NDR to TRUE and write RCVD_LEN with the value of LEN. With each additional call, you will thus receive another block of sent data.
- *ISO on TCP according to RFC 1006:*
  - During data transmission, information on the length and the end of the message is also transmitted.
  - The transfer is block-oriented
  - If you have specified the length of the data to be received greater than the length of the data to be sent, the receive block will copy the received data completely into the receive range. After this, it will set NDR to TRUE and write RCVD_LEN with the length of the sent data.
  - If you have specified the length of the data to be received less than the length of the sent data, the receive block will not copy any data into the receive range but instead will supply the following error information: ERROR = 1, STATUS = 8088h.

Connection-less protocol

- There is thus no establishment and termination of a connection with a remote partner.
- Connection-less protocols transmit data with no acknowledge and with no reliable guaranteed delivery to the remote partner.

The following connection-oriented protocol is supported with FBs for open communication via Industrial Ethernet:

- *UDP according to RFC 768 (with connection type 13h):*
  - In this case, when calling the sending block you have to specify the address parameters of the receiver (IP address and port number).
  - During data transmission, information on the length and the end of the message is also transmitted.
  - In order to be able to use the sending and receiving blocks first you have to configure the local communications access point at both sides.
  - With each new call of the sending block, you re-reference the remote partner by specifying its IP address and its port number.
  - If you have specified the length of the data to be received greater than the length of the data to be sent, the receive block will copy the received data completely into the receive range. After this, it will set NDR to TRUE and write RCVD_LEN with the length of the sent data.
  - If you have specified the length of the data to be received less than the length of the sent data, the receive block will not copy any data into the receive range but instead will supply the following error information: ERROR = 1, STATUS = 8088h.

Handling blocks

Those in the following listed UTDs and FBs serve for "open communication" with other Ethernet capable communication partners via your user program. These blocks are part of the *SPEED7 Studio*. You will find these in the *'Standard Library'*. Please consider when using the blocks for open communication that the partner station does not have to be configured with these blocks. This can be configured with AG_SEND/AG_RECEIVE or IP_CONFIG.

UDTs

FB	Designation	Connection-oriented protocols: TCP native as per RFC 793, ISO on TCP as per RFC 1006	Connectionless protocol: UDP as per RFC 768
UDT 65	TCON_PAR	Data structure for assigning connection parameters	Data structure for assigning parameters for the local communications access point
UDT 66	TCON_ADR		Data structure for assigning addressing parameters for the remote partner

FBs

FB	Designation	Connection-oriented protocols: TCP native as per RFC 793, ISO on TCP as per RFC 1006	Connectionless protocol: UDP as per RFC 768
FB 63	TSEND	Sending data	
FB 64	TRCV	Receiving data	

FB	Designation	Connection-oriented protocols: TCP native as per RFC 793, ISO on TCP as per RFC 1006	Connectionless protocol: UDP as per RFC 768
FB 65	TCON	Establishing a connection	Configuring the local communications access point
FB 66	TDISCON	Terminating a connection	Closing the local communications access point
FB 67	TUSEND		Sending data
FB 68	TURCV		Receiving data

7 Option: Ethernet communication - EtherCAT

Activate additional functions by means of VSC in the CPU

In order to use the additional functions, you must activate them by means of a VSC storage media from VIPA. By plugging the VSC storage card and then an overall reset the following functions are activated:

- *Isochronous mode with enabling OB 60 and OB 61*
- *EtherCAT master functionality*
- *Memory expansion to 512kB work respectively load memory*

'Overview' on page 82

7.1 Basics EtherCAT

7.1.1 General

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

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

EtherCAT®

- For EtherCAT® is valid: EtherCAT® is a registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany.
- EtherCAT means Ethernet for Controller and Automation Technology. It was originally developed by Beckhoff Automation GmbH and is now supported and further developed by the EtherCAT Technology Group (ETG). ETG is the word biggest international user and producer connection for industrial Ethernet
- EtherCAT is an open Ethernet based field bus system, which is standardized at the IEC.
- As open field bus system EtherCAT matches the user profile for the part of industrial real-time systems.
- In opposition to the normal Ethernet communication at EtherCAT the data exchange of I/O data takes place during the frame passes the coupler with 100Mbit/s in full-duplex. Since in this way a frame to send and receive direction reaches the data of many stations, EtherCAT has a rate of user data of over 90%.
- The EtherCAT protocol, which is optimized for process data, is directly transported with the Ethernet frame. This again can consist of several sub-frames, which serve for a storage area of the process image.

Transfer medium

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

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

Communication principle

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

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

EtherCAT State Machine

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

Object dictionary (SDOs)

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

Process data (PDOs)

The EtherCAT data link layer is optimized for the fast transfer of process data. Here it is specified how the process data of the device are assigned to the EtherCAT process data and how the application of the device is synchronized to the EtherCAT cycle. The mapping of the process data happens by PDO mapping and by Sync-Manager-PDO-Assign objects. These describe, which objects of the object directory are transferred as object data via EtherCAT. The cycle time to transfer the process data via EtherCAT and how this is synchronized for the transfer is specified with the Sync-Manager-Communication objects.

Emergencies

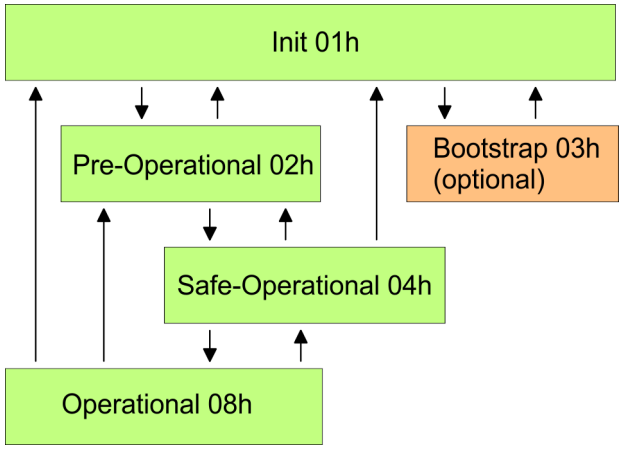
Via Emergencies diagnostics, process events and errors at state change of the State Machine may be transferred.

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

7.1.2 EtherCAT State Machine

States

In each EtherCAT communication device a *state machine* is implemented. For each state there is defined which communication service is active via EtherCAT. The state machine is controlled by the EtherCAT master.



Init - 01h

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

Pre-Operational (Pre-Op) - 02h

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

Safe-Operational (Safe-Op) - 04h

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

Operational (Op) - 08h

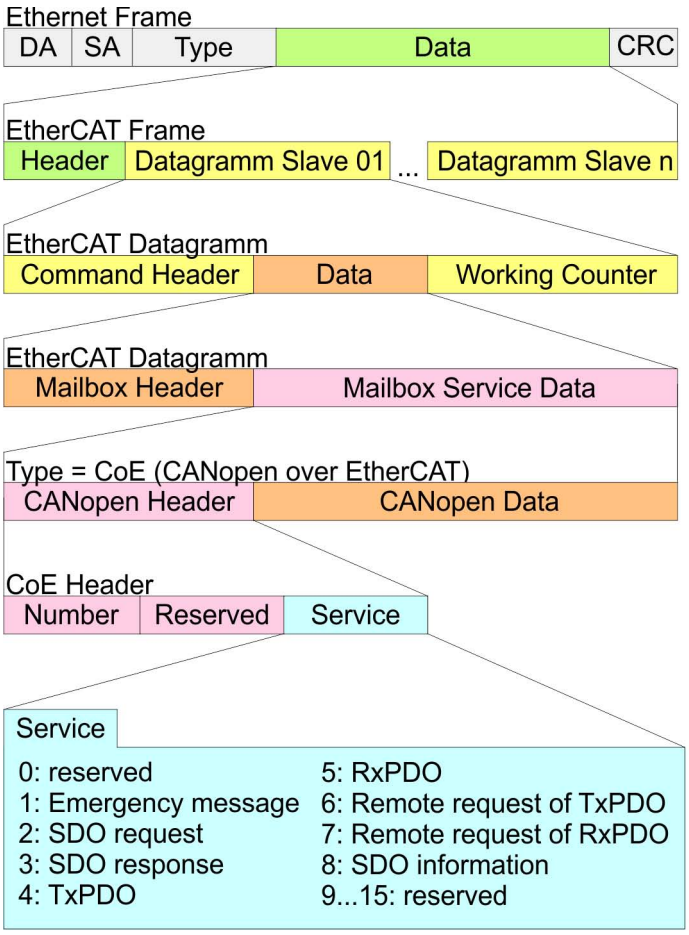
In the state *Op* the EtherCAT coupler copies the output data of the master to its outputs. Here process data and mailbox communication is possible.

Bootstrap - option (Boot) - 03h

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

7.1.3 CoE - CANopen over Ethernet

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



DA Destination address
SA Source address
CRC Checksum

7.2 Commissioning and start-up behavior

7.2.1 Precondition

Activate additional functions by means of VSC in the CPU

In order to use the additional functions, you must activate them by means of a VSC storage media from VIPA. By plugging the VSC storage card and then an overall reset the following functions are activated:

- *Isochronous mode with enabling OB 60 and OB 61*
- *EtherCAT master functionality*
- *Memory expansion to 512kB work respectively load memory*

'Overview' on page 82

7.2.2 Assembly and commissioning

1. Install your System SLIO with your CPU.
2. Wire the system by connecting cables for voltage supply and signals.
3. Connect your EtherCAT master to EtherCAT.
4. Switch on the power supply.

7.2.3 Start-up behavior

Preconditions for start-up

After PowerON and start-up (incl. OB100) the CPU is switched to RUN. This brings the EtherCAT master to *Op* state and he requests the *Op* state from its connected EtherCAT slave devices. Before the OB1 is called, the CPU waits for a defined time, that the EtherCAT slave stations have changed to *Op* state. You can specify the *Monitoring time* via the CPU parameter *'Transfer of parameters to modules'* in the property register *'start-up'*.

Using the EtherCAT master the following start-up behavior is distinguished. The terms and conditions can be found in the following table:

- **CPU switches to RUN, if topology is OK**
  The CPU waits for all the slaves, which mandatory have to exist, maximum until the *Monitoring time* expires and then switches to RUN. The topology mus be OK.
- **CPU switches to RUN mode regardless of topology or optional slaves**
  The CPU waits for all the slaves, which mandatory have to exist, maximum until the *Monitoring time* expires and then switches to RUN regardless of topology or optional slaves.

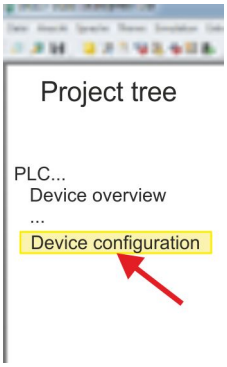
Is the CPU parameter: *'Start-up is preset configuration does not match actual configuration'* activated?	Y	N	N	N	N	N	N	N	N	N
Are all the mandatory slaves configured?	x	Y	N	Y	Y	Y	Y	N	N	Y
Are there optional slaves configured (hot connect group)?	x	N	Y	Y	x	Y	x	N	N	x
Do all the mandatory slaves exist?	x	Y	N	Y	x	Y	x	x	x	N
Do optional slaves exist (not all must exist)?	x	N	Y	Y	x	Y	x	x	x	x
Is there at least one mandatory slave with a wrong module?	x	N	N	N	Y	x	x	x	x	x
Is there at least one optional slave with a wrong module?	x	N	N	N	x	Y	x	x	x	x
Does at least on not configured slave exist?	x	N	N	N	x	x	Y	Y	N	x
	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
CPU switches to RUN, if topology is OK.	Y									
CPU switches to RUN mode regardless of topology or optional slaves.		Y	Y	Y	N	N	N	N	Y	N
Yes: Y | No: N | not relevant: X										

7.3 Hardware configuration - CPU

The CPU is to be configured in the *SPEED7 Studio*. With the integrated *SPEED7 EtherCAT Manager* you can configure your EtherCAT network.

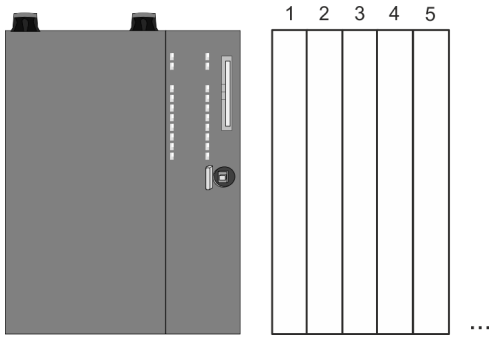
Proceeding

1. Start the *SPEED7 Studio*.
2. Create a new project in the *Work area* with *'New project'*.
   ⇨ A new project is created and the view *'Devices and networking'* is shown.
3. Click in the *Project tree* at *'Add new device ...'*.
   ⇨ A dialog for device selection opens.



4. Select from the *'Device templates'* your CPU and click at [OK].

⇨ The CPU is inserted in *'Devices and networking'* and the *'Device configuration'* is opened.



Device configuration

Slot	Module	...	...	...	...
0	CPU 015-CEFNR00				
-X1	PG_OP_Ethernet				
-X2	MPI interface				
...	...			...	

Please consider the additional functions in the SPEED7 Studio can only be activated, if you have valid license for these functions!

Proceeding

1. Click at the CPU in the *'Device configuration'* and select *'Context menu ➔ Components properties'*.

⇨ The properties dialog of the CPU is opened

2. Click at *'Feature Sets'* and activate at *'Motion Control'* the parameter *'EtherCAT Master functionality+Motion Control+...'*.

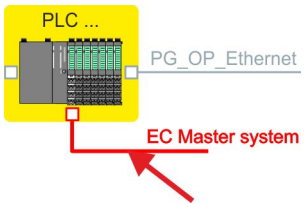
3. Confirm your input with [OK].

⇨ The additional functions are now available in your project. More information about the usage may be found in the online help of the *SPEED7 Studio*.

Activated additional functions:

- Isochronous mode with enabling OB 60 and OB 61
- EtherCAT master functionality
- Memory expansion to 512kB work respectively load memory

Configuration EtherCAT master



1. Click in the Project tree at *'Add new device ...'*.
2. Click here at *'EC-Master system'* and select *'Context menu ➔ Bus system properties'*.
   ⇨ The *SPEED7 EtherCAT Manager* opens. Here you can configure the EtherCAT master system.
   More information about the usage of the *SPEED7 EtherCAT Manager* may be found in the online help of the *SPEED7 Studio*.
3. By closing the *SPEED7 EtherCAT Manager* the EtherCAT configuration is taken to the project and the *SPEED7 EtherCAT Manager* is closed. You can always edit your EtherCAT configuration in the *SPEED7 EtherCAT Manager*, since the configuration is stored in your project.

Since slave and module parameters are transmitted by means of SDO respectively SDO Init command, the configuration remains active, until a power cycle is performed or new parameters for the same SDO objects are transferred.

With an overall reset the slave and module parameters are not reset!

Activate additional functions by means of VSC in the CPU

In order to use the additional functions, you must activate them by means of a VSC storage media from VIPA. By plugging the VSC storage card and then an overall reset the following functions are activated:

- *Isochronous mode with enabling OB 60 and OB 61*
- *EtherCAT master functionality*
- *Memory expansion to 512kB work respectively load memory*

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7.4 EtherCAT Diagnostics

Overview

There are the following ways to get diagnostics information from your system:

- Diagnostics via *SPEED7 EtherCAT Manager*
- Diagnostics during runtime in the user program (OB 1, SFB 52)
- Diagnostics via system status lists - SSL
- Diagnostics via OB start information
- Diagnostics via diagnostics CPU or CP
- Diagnostics via status LEDs

7.4.1 Diagnostics via *SPEED7 EtherCAT Manager*

Information

The *SPEED7 EtherCAT Manager* offers various opportunities for diagnostics:

- Diagnostics EtherCAT master
- Diagnostics EtherCAT slave station

More information about the usage of the SPEED7 EtherCAT Manager may be found in the online help.

7.4.2 Diagnostics during runtime in the user program (OB 1, SFB 52)

Handling block SFB 52 RDREC

With SFB 52 RDREC (read record) you can access diagnostics data from your user program e.g. in OB1. The SFB 52 RDREC operates asynchronously, that is, processing covers multiple SFB calls.

More information about the usage of the SFB 52 may be found in the online help of your programming tool or in the manual "SPEED7 Operation List" from VIPA.

The following data can be accessed with the SFB 52:

- CoE emergency messages (record set 0x4000 ... 0x4003)
- EtherCAT specific identification data (record set 0x1000)
- EtherCAT interface informations (record set 0x1037)
- EtherCAT register from slave station (record set 0x3000, 0x3001)
- EtherCAT register master (record set 0x3001)
- Analysis bus behavior and DC (record set 0x5000 ... 0x5029)

7.4.2.1 Accessing the CoE emergency messages

Record set 0x4000 ... 0x4003

With SFB 52 RDREC (read record) you can access CoE emergency messages from your user program e.g. in OB 1 by means of the record sets 0x4000 ... 0x4003. The SFB 52 RDREC operates asynchronously, that is, processing covers multiple SFB calls. An entry for the record sets 0x4000 ... 0x4003, which are described here, consists of the CoE emergency himself (8byte) and the station address of the CoE emergency comes from (2byte).

Record set structure

Index [byte]	Content	Description
0	NumberOfEntries	Number of following CoE emergency entries (0 ...n)
1		
2 + (n*12)	n * *CoE emergency entry*	CoE emergency entry according to the requested record set

CoE emergency entry

Index [byte]	Content	Description
0	Error Code	CoE emergency
1		
2	Error Register	
3	Error Data	
4		
5		
6		
7		
8	Station Address	Address of the station, which has sent the emergency.
9		
10	Reserved	
11		

Record sets

Record set	Description
0x4000	The record set provides the last CoE emergency of each slave (on CoE emergency entry per slave, which has supplied a CoE emergency). There are no entries for slaves with no CoE emergency. Parameters: None NumberOfEntries: 0 ... 512
0x4001	The record set provides the last CoE emergency of a specific slave. If a slave ID is passed, which does not exist, an error is returned. If the slave ID is valid but no CoE emergency for this slave exists, the number of sent entries is equivalent to 0. Parameters: Slave ID (1 ... 512) NumberOfEntries: 0 ... 1
0x4002	The record set provides the last 20 CoE emergencies of the whole system (this means multiple entries for one slave can be reported). Is there a total of less than 20 entries, the number of messages is correspondingly smaller. Parameters: None NumberOfEntries: 0 ... 20
0x4003	The record set provides the last 10 CoE emergency of a specific slave. If a slave ID is passed, which does not exist, an error is returned. If the slave ID is valid but less than 10 CoE emergencies for this slave exist, the number of sent entries is correspondingly smaller. Parameters: Slave ID (1 ... 512) NumberOfEntries: 0 ... 10

Example OB 1

For cyclical access to a record set of the diagnostics data of an EtherCAT slave station, you can use the following example program in OB 1:

```
UN M10.3 'Read process finished (BUSY=0)
UN M10.1 'If there is no job activation
         'then (REQ=0)
S  M10.1 'start record set transfer (REQ:=1)
L  W#16#4000 'record set number(here record set
0x4000)
T  MW12
CALL SFB 52, DB52 'Call SFB 52 with instance DB
  REQ :=M10.1 'Start flag
  ID :=DW#16#0018 'Address of the EtherCAT slave
  INDEX :=MW12
  MLEN :=14 'Length record set 0x4000 with 1. entry
  VALID :=M10.2 'Validity of the record set
  BUSY :=M10.3 'Shows if job just running
  ERROR :=M10.4 'Error bit during read access
  STATUS :=MD14 'Error codes
  LEN :=MW16 'Length of the read record set
  RECORD :=P#M 100.0 Byte 40 'Target (MB100,
40byte)
U M10.1
R M10.1 'Reset of REQ
```

7.4.2.2 Accessing EtherCAT specific identification data

Record set 0x1000

The record set 0x1000 contains EtherCAT specific identification data, which can be read with the SFB 52. The values *Device Type*, *Serial Number*, *Hardware Version* and *Software Version* are directly retrieved via CoE from the slave station. If a slave station does not support CoE or one of these values in the object directory, the values are substituted with 0xFF. The record set has the following structure:

Index	Designation	Data type
1	Address	Unsigned32
2	Device Name	Array of char[32]
3	Vendor ID	Unsigned32
4	Product Code	Unsigned32
5	Device Type	Unsigned32
6	Serial Number	Unsigned32
7	Revision	Unsigned32
8	Hardware Version	Array of char[8]
9	Software Version	Array of char[8]

7.4.2.3 Accessing information of the EtherCAT interface

Record set 0x1037

The record set 0x1037 contains information about the Ethernet interface of the EtherCAT master, which can be read with the SFB 52. The record set has the following structure:

Index	Designation	Data type
1	Logical address	Unsigned16
2	IP address	Unsigned32
3	Subnet mask	Unsigned32
4	Default Router	Unsigned32
5	MAC address	Array of Unsigned8[6]
6	Source	Unsigned8
7	reserved	Unsigned8
8	DCP Mod Timestamp	Array of Unsigned8[8]
9	phys_mode_1	Unsigned8
10	phys_mode_2	Unsigned8
11	phys_mode_3	Unsigned8
12	phys_mode_4	Unsigned8
13	phys_mode_5	Unsigned8
14	phys_mode_6	Unsigned8
15	phys_mode_7	Unsigned8
16	phys_mode_8	Unsigned8
17	phys_mode_9	Unsigned8
18	phys_mode_10	Unsigned8
19	phys_mode_11	Unsigned8
20	phys_mode_12	Unsigned8
21	phys_mode_13	Unsigned8
22	phys_mode_14	Unsigned8
23	phys_mode_15	Unsigned8
24	phys_mode_16	Unsigned8
25	reserved	Unsigned8

7.4.2.4 Accessing the EtherCAT register from slave stations

Record set 0x3000

With the record set 0x3000 you can access the registers of an EtherCAT slave station, by calling it with the SFB 52. The record set has the following structure:

Byte	Content	Register
0	AL Status	0x0130, 0x0131
1		
2	AL Control	0x0120, 0x0121

Byte	Content	Register
3		
4	AI Status Code	0x0134, 0x0135
5		
6	ESC DL Status	0x0110, 0x0111
7		
8	Processing Unit Error Counter	0x030C
9	PDI Error Counter	0x030D
10	Link Lost Counter Port A	0x0310
11	Link Lost Counter Port B	0x0311
12	Link Lost Counter Port C	0x0312
13	Link Lost Counter Port D	0x0313
14	reserved	-
15	reserved	-

Record set 0x3001

The record set can be used to read the last reported *AL Status Code* of an EtherCAT slave station. The content of the record set remains until an overall reset is made or a new configuration is loaded.

Byte	Content	Register
0	AI Status Code	0x0134, 0x0135
1		

If you use an invalid slave address (slave ID) you will receive an error. If the slave ID is available but the EtherCAT slave station has not just reported an AL Status Code, so you also get an error.

7.4.2.5 Accessing the EtherCAT master register

Record set 0x3001

The record set can be used to read the last reported *AL Status Codes* of all the EtherCAT slave stations. If an EtherCAT slave station did not report a bug by the time of reading, so the returned *AI Status Code* is 0. The content of the record set remains until an overall reset is made or a new configuration is loaded.

Structure record set

Byte	Content
0	Data block for slave ID 1
4	Data block for slave ID 2

Byte	Content
...	...
2043	Data block for slave ID 512

Structure data block

Byte	Content	Description
0	AI Status Code	*AL Status Code* of the corresponding EtherCAT slave station
1		
2	Validity	Validity: ■ 0: *AL Status Code* not valid (slave ID is not configured or EtherCAT slave station has not reported an *AL Status Code*, yet). ■ 1: *AL Status Code* is valid
3	reserved	-

Validity is only set to 1 if an AI Status Code is reported from the EtherCAT slave station. With an error-free EtherCAT slave station this byte is 0.

7.4.2.6 Analysis bus behavior and DC

Record set 0x5000 ... 0x5029

With SFB 52 RDREC (read record) you can analyse bus behavior and DC from your user program e.g. in OB 1 by means of the record sets 0x5000 ... 0x5029.

Overview

Record set	Access	Description
0x5000	R	Diagnostic DC status
0x5001	R	Diagnostic number bus cycle time violations
0x5010	R	Extended diagnostic bus cycle
0x5020	R/W	Request mode for the records 0x5021 ... 0x5029
0x5021	R	Request EtherCAT ms counter
0x5023	R	Request bus time DC master
0x5024	R	Request sync signal time difference
0x5025	R	Request DC master time difference
0x5026	R	Request DC master error
0x5027	R	Request DC master and DC slave in sync

Record set	Access	Description
0x5028	R	Request slaves in sync
0x5029	R	Request difference system time in ms

7.4.2.6.1 Record set 0x5000

This record set informs about the current status of the DC system.

- These values are only updated with corresponding messages, which also generate a diagnostic buffer entry.
  - The parameters DC_InSync and DC_Deviation are updated with the message "EC_NOTIFY_DC_SLV_SYNC".
  - The parameters DCM_InSync, DCM_CtlErrorCur, DCM_CtlErrorAvg and DCM_CtlErrorMax are updated with the message "EC_NOTIFY_DCM_SYNC".
- Except the counter of "out of sync" the data come from the EtherCAT stack. For this reason, the nomenclature of the EtherCAT stack is taken for this data.

Structure of the data on reading

Index	Name	Type	Description	Default value
1	DC_InSync	DWORD	Indicates whether the DC slaves are synchronized with each other. 0: out of sync 1: in sync	0
2	DC_Deviation	DINT	Deviation in ns	0
3	DC_OutOfSyncCnt	DWORD	Counter, how often DC slaves were "out of sync". The counter is reset when an overall reset is performed or when a new configuration is loaded to the CPU.	0
4	DCM_InSync	DWORD	Indicates whether the DC master and Reference-Clock are synchronized with each other. 0: out of sync 1: in sync	0
5	DCM_CtlErrorCur	DINT	Current DC master deviation in ms	0
6	DCM_CtlErrorAvg	DINT	Average DC master deviation in ns.	0
7	DCM_CtlErrorMax	DINT	Maximum DC master deviation in ns	0
8	DCM_OutOfSyncCnt	DWORD	Counter, how often DC master was "out of sync". The counter is reset when an overall reset is performed or when a new configuration is loaded to the CPU.	0

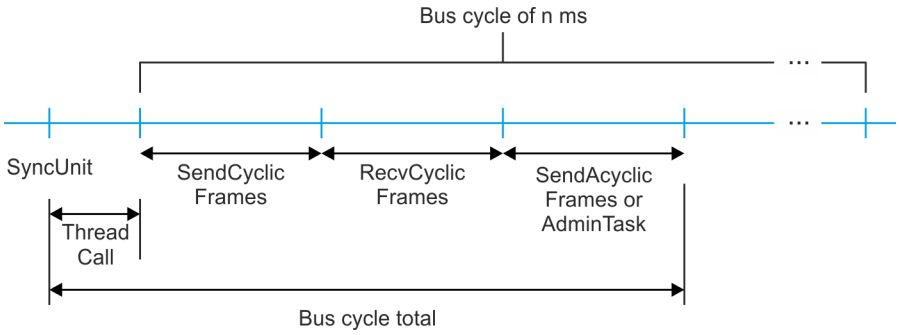
7.4.2.6.2 Record set 0x5001

This record set serves for extended information about the number of bus cycle time violations.

Index	Name	Type	Description	Default value
1	BusCycleViolationA-larmCount	DWORD	Number of interrupts that have been sent due to bus cycle time violations.	0
2	BusCycleViolation-Count	DWORD	Number of bus cycle time violations (regardless of whether an interrupt has been reported in 3 subsequent bus cycle violations).	0
3	BaseCycleViolation-Count	DWORD	Number of violations of the basic clock of 500µs.	0
4	CyclicViolationCount	DWORD	Number of basic clock violations caused by sending and receiving cyclic frames.	0
5	AcyclicViolationCount	DWORD	Number of basic clock violations caused by sending and receiving acyclic frames.	0
6	AdminViolationCount	DWORD	Number of basic clock violations caused by administrative tasks.	0

7.4.2.6.3 Record set 0x5010

With this record set extended statistics values can be requested regarding the bus cycle.



Structure of the data on reading

Index	Name	Type	Description	Default value
1	ThreadCall_Min	DWORD	Minimum, maximum and average value of the spent time from Syn-cUnit to the thread call of the bus cycle.	0
2	ThreadCall_Max	DWORD		0
3	ThreadCall_Avg	DWORD		0

Index	Name	Type	Description	Default value
4	SendCyclicFrames_Min	DWORD	Minimum, maximum and average value of the spent time for sending of cyclic frames.	0
5	SendCyclicFrames_Max	DWORD		0
6	SendCyclicFrames_Avg	DWORD		0
7	RecvCyclicFrames_Min	DWORD	Minimum, maximum and average value of the spent time for receiving and evaluating of cyclic frames.	0
8	RecvCyclicFrames_Max	DWORD		0
9	RecvCyclicFrames_Avg	DWORD		0
10	SendAcyclicFrames_Min	DWORD	Minimum, maximum and average value of the spent time for sending of acyclic frames.	0
11	SendAcyclicFrames_Max	DWORD		0
12	SendAcyclicFrames_Avg	DWORD		0
13	AdminTask_Min	DWORD	Minimum, maximum and average value of the spent time for performing administrative tasks of the stack.	0
14	AdminTask_Max	DWORD		0
15	AdminTask_Avg	DWORD		0
16	BusCycleTotal_Min	DWORD	Minimum, maximum and average value of the spent time for every bus cycle task.	0
17	BusCycleTotal_Max	DWORD		0
18	BusCycleTotal_Avg	DWORD		0
19	CycleType1_Min	DWORD	Minimum, maximum and average value of the spent time [1].	0
20	CycleType1_Max	DWORD		0
21	CycleType1_Avg	DWORD		0
22	CycleType2_Min	DWORD	Minimum, maximum and average value of the spent time [2].	0
23	CycleType2_Max	DWORD		0
24	CycleType2_Avg	DWORD		0
25	CycleType3_Min	DWORD	Minimum, maximum and average value of the spent time [3].	0
26	CycleType3_Max	DWORD		0
27	CycleType3_Avg	DWORD		0
28	CycleType4_Min	DWORD	Minimum, maximum and average value of the spent time [4].	0
29	CycleType4_Max	DWORD		0
30	CycleType4_Avg	DWORD		0

Further explanations:

- [1)] CycleType1 = ThreadCall + SendCyclicFrames + RecvCyclicFrames + SendAcyclicFrames
- [2)] CycleType2 = ThreadCall + SendCyclicFrames + RecvCyclicFrames + AdminTask
- [3)] CycleType3 = ThreadCall + SendAcyclicFrames
- [4)] CycleType4 = ThreadCall + AdminTask

Depending on the cycle time, it is possible that, for CycleType2, the values are 0. This is due to the bus cycle concept. Only at a bus cycle time of 500µs, CycleType2 has valid values.

7.4.2.6.4 Record set 0x5020 ... 0x5029

With the record sets listed below, you can record DC values and read accordingly. Via record set 0x5020 you can control the recording. When the recording was finished, via *Index* of the record sets 0x5021 ... 0x5029 you can read the corresponding values.

Example data:

Index	0x5021 Time	0x5023 BusTime	0x5024 CtlError	0x5025 Drift	0x5026 Error-Code	0x5027 DCM InSync	0x5028 DC InSync	0x5029 System-Time-Diff
0	7288	2613991646	-8902	100	0	1	1	-5
1	7289	2615997039	-8404	121	0	1	1	-5
2	7290	2616990436	-8894	135	0	1	1	-5
3	7291	2616990436	-9214	143	0	1	1	-5
4	7292	2617998192	-10674	143	0	1	1	-5
…	…	…	…	…	…	…	…	…

Record set 0x5020

With this record set, you can specify the mode, how the record sets 0x5021 ... 0x5029 are requested. The settings are retained until you switch off the power supply.

Structure of the data on reading and writing

Index	Name	Type	Description	Default value
1	Mode	DWORD	See below	0
2	Count	DWORD		16383
3	DCM_Count	DWORD		1
4	Recording	DWORD		0

Mode

Indicates which data are to be returned at reading the next record set.

- 0: no data recording
- 1: Recording the first DC master values of the bus start-up. The number of values is defined by the parameter *Count*.
- 2: Recording the last DC master values. The number of values is defined by the parameter *Count*.
- 3: From the write access DC master values are recorded. The number of values is defined by the parameter Count. During the recording the parameter *Recording* has the value 1.
- 4: From the write access DC master values are recorded until a certain number of "DCM out of sync" (DCM_Count) is reached. The number of values is defined by the parameter *Count*. During the recording the parameter *Recording* has the value 1.

- *Especially the mode 1 is relevant when loading the configuration to the CPU. Modes 2, 3 and 4 can also be started later without loading the configuration to the CPU.*
- *If record set is written with 0x5020 Mode 0, the previously collected statistics values of the following records are reset.*

Count

Number of DC master values to be returned when reading the next record set.

- Min: 1
- Max: 16383

DCM_Count

Only for Mode = 4 relevant.

- It is recorded until the defined number of "DCM out of sync" messages has been reached.
- Min: 1
- Max: 10

If this value is greater than 1, it can still happen that the entire recording "DCM out of sync" has only once occurred.

Recording

- On read access:
  - 0: Recording finished / no recording
  - 1: Recording is still running.
- On write access:
  - 0: there is no recording
  - 1: Recording should be started

Especially in mode 1 and 2 please make sure that the parameter Recording is set to 1. Otherwise, the recording will not start when you reload the configuration to the CPU!

Furthermore on mode 2 a write access must be done with Recording = 0, so that the following record sets are consistent to each other.

Example with record mode 1

With record Mode 1, the data is recorded at the Bus start-up, i.e. the recording starts as soon as you load the system data blocks in your CPU.

1. Define via record set 0x5020 the recording parameter:
   - Mode = 1
   - Count = 10000
   - DCM_Count = 0 (not relevant at Mode 1)
   - Recording = 1 (otherwise no recording is performed during start-up)

2. Load the system data blocks in your CPU.
   ⇨ The recording is started.
3. Check with record set 0x5020 whether the recording has finished.
4. Request the according information with record set 0x5021 to 0x5029.

Example with record Mode 3

With Record Mode 3, from the beginning of the write access to record set 0x5020, the data are recorded.

1. Define via record set 0x5020 the recording parameter:
   - Mode = 3
   - Count = 10000
   - DCM_Count = 0 (not relevant at Mode 3)
   - Recording = 1 (starts the recording)
2. Check with record set 0x5020 whether the recording has finished.
3. Request the according information with record set 0x5021 to 0x5029.

Record sets 0x5021 ... 0x5029

When reading these records, there are the following restrictions:

- Due to the possible maximum size of records, 4 parallel jobs are allowed.
- Read access to this record sets is allowed only if no record is currently running. Otherwise, the read record sets are not consistent. In a currently running recording you get an error. Via the parameter *Recording* in record set 0x5020 you can request the status of the recording.

Record set with index 1…n	Name	Type	Description	Default value
0x5021	Time	DWORD	The returned values of this record set correspond to a millisecond counter in the EtherCAT stack.	0
0x5023	BusTime	DWORD	The returned values of this record set correspond to the current bus time of the DC master. Low-DWORD of the bus time in ns	0
0x5024	nCtlErrorCur	DINT	In the EtherCAT Master a value is set to which time difference the sync signal of the DC slaves is to be moved in accordance to the reference clock at the time of sending cyclic frames. The values of this record set correspond to the deviation of the current value of the EtherCAT master and the set value in ms.	0
0x5025	Drift	DINT	Current deviation between DC master and Reference-Clock in ppm.	0

Record set with index 1…n	Name	Type	Description	Default value
0x5026	ErrorCode	DWORD	Indicates if there is a DC master error at the beginning of the measurement.	0
0x5027	DCM_InSync	BYTE	Indicates whether the DC master is in sync with the DC slave. 0: out of sync 1: in sync	0
0x5028	DC_InSync	BYTE	Indicates whether the DC slaves are synchronized with each other. 0: out of sync 1: in sync	0
0x5029	SystemTime-Difference	DINT	See below	0

SystemTimeDifference

Over several cycles the DC master requests the times of all the DC slaves. These are compared with the Reference-Clock and from this a deviation is calculated by the DC master. With this the DC master determines if the DC slaves and the Reference-Clock are in sync. The record set provides the time deviation. Please note here:

- The difference of the system time always varies around 0.
- Due to master status changes and the line-up, during the start-up the deviation could be higher than if the system is in state *OP*.
- Also when switching between STOP and RUN, the maximum value of the deviation may more vary from the average.
- The values of the time difference system are dependent on the particular configuration. There are no specific limits known.

7.4.3 Diagnostics via system status lists - SSL

SSL partial lists

In the following all the possible SSL partial lists with additional SSL-ID are listed, which are supported by the EtherCAT master system.

More information about the usage of the SSLs can be found in the manual "SPEED7 Operation List" from VIPA.

SSL partial lists	SSL-ID
SSL content	xy00h
Module identification	xy11h
Status of all LEDs	xy19h
Status of the LEDs	xy74h
Status information CPU	xy91h

SSL partial lists	SSL-ID
Stations status information	xy94h
Module status information	xy96h
Diagnostic buffer of the CPU	xyA0h
Information EtherCAT Master/Slave	xyE0h
EtherCAT bus system	xyE1h
Type ID modules central bus system	xyF0h
Status of the VSC features from the System SLIO CPU	xyFCh

7.4.4 Diagnostics via OB start information

On an error the faulty system generates a diagnostics message for the CPU. Then the CPU calls the according diagnostics OB. Here the CPU operating system transfers start information to the local data of the OB. By evaluating the start information of the according OB you can get information about cause and location of the error. During runtime you can access the start information with the system function SFC 6 RD_SINFO. Please consider that you can even read the start information in the OB himself, because the data are temporary data.

Depending on the type of error, the following OBs are called in a diagnostics event:

- OB 82 on an error of an module at the EtherCAT slave station (Diagnostics alarm) *'Interrupt handling in the CPU' on page 216*
- OB 86 on failure respectively restart of an EtherCAT slave station *'Enter OB start information and call OB' on page 215*
- OB 57 Vendor specific interrupt

More information about OBs may be found in the online help of your programming tool or in the manual "SPEED7 Operation List" from VIPA.

7.4.5 Diagnostics via diagnostics buffer CPU respectively CP

7.4.6 Diagnostics via status LEDs

LEDs EtherCAT interface X4

BS1	MT	BF1	Meaning
green	yellow	red	
○	○	○	Master is in INIT state
BB	○	○	Master is in Pre-Op state
P	○	○	Master is in Safe-Op state

BS1	MT	BF1	Meaning
●	○	○	Master is in OP state
X	○	X	There is no maintenance event pending
X	●	X	There is a maintenance event pending. More may be found in the diagnostics data
X	X	○	There is no error on the EtherCAT bus pending
X	X	●	■ EtherCAT bus error, no connection to sub net ■ Wrong transfer rate ■ Full-duplex transfer is de-activated
X	X	B	■ Failure of a connected IO device ■ At least one IO device cannot be reached (topology mismatch) ■ Error in configuration
○	B4	B4	Error in configuration: 0xEA64 was added to the diagnostics buffer, additionally the SF-LED of the CPU is on.
○	BB*	BB*	* The alternating flashing with 4Hz indicates that the firmware update of the EtherCAT masters is performed.
●	●	●	Firmware update of the EtherCAT master was finished without error.

on: ● | off: ○ | blinking (1Hz): B | blinking (2Hz): BB | B4: blinking (4s on, 1s off) | pulsing: P | not relevant: X

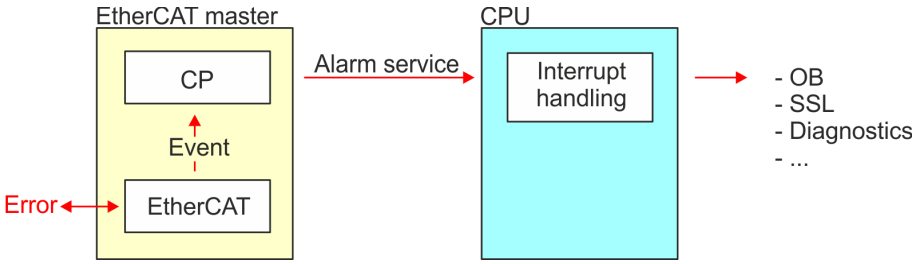
LEDs L/A

The green L/A-LED (Link/Activity) indicates the physical connection of the EtherCAT master to Ethernet. Irregular flashing of the L/A-LED indicates communication of the EtherCAT master via Ethernet.

7.5 Interrupt behaviour

7.5.1 Overview

As soon as an error occurs, this is recognized by the EtherCAT master and this internally reports an event (notification) to the CP. In the CP an interrupt is generated, which is transferred as a defined data structure to the CPU. During the interrupt handling in the CPU the CPU determines, if an OB is to be called, the data of a SSL is to be updated or further actions are necessary. The EtherCAT master may not send an interrupt to the CPU, as long as he has not reported any configuration to the CPU.



7.5.2 Interrupt types

Interrupt types

- MANUFACTURER_SPECIFIC_ALARM_MIN (0x0020 or 0x0021)
- PROZESS_ALARM (0x0002) - OB 40 (process interrupt)
- BUS_STATE_CHANGED (0x8001) - OB 86

- DIAGNOSE_ALARM_GEHEND (0x000C) - OB 82 (diagnostics interrupt going)
- DIAGNOSE_ALARM_KOMMEND (0x0001) - OB 82 (diagnostics interrupt coming)
- SLAVE_STATE_CHANGED (0x8002) - OB 86
- TOPOLOGY_MISMATCH (0x8004) - OB 86
- TOPOLOGY_OK (0x8003) - OB 86

7.5.2.1 MANUFACTURER_SPECIFIC_ALARM_MIN (0x0020 or 0x0021)

Properties

Triggering event

- EC_NOTIFY_MBOXRCV - Mailbox message received - with the type eMbxTferType_COE_EMERGENCY

Supplied data

- Slave address
- CoE emergency

Conditions

- The error code of the CoE emergency has to come from a VIPA slave station.
  - The error code of the CoE emergency must diver to 0x0000.
  - The error code of the CoE emergency must diver to 0xA000.
  - The error code of the CoE emergency must diver to 0xA001.
  - The error code of the CoE emergency must diver to 0xFF00.
  - If the error code is 0xFF00, then the 2. byte must be equal to 1 or 2.
- The error code of the CoE emergency has to come from another slave station.
  - Each emergency is reported as OB 57.
- A CoE emergency occurred during an topology change.
  - The error code of the CoE emergency must diver to 0x0000.
  - The error code of the CoE emergency must diver to 0xA000 and 0xA001.

Interrupt handling in the CPU

Enter OB start information and call OB

Structure element	Data type	Description
Eventless	BYTE	0x11
FLT_ID	BYTE	0x5C
PrioLevel	BYTE	0x02
OBNo	BYTE	57
Reserved1	BYTE	0xCC
IoFlag	BYTE	0x54 or 0x55 (depending on the address type of the alarm-triggering module)
Info1	WORD	Diagnostics address of the slave
Info2	WORD	Error code of CoE emergency
Info3	WORD	Slave state of CoE emergency

Structure element	Data type	Description
User1	WORD	InterruptPrio, InterruptRef
User2	WORD	EtherCAT slave address

Update SSL data

Manufacturer specific interrupts do not change SSLs.

Caching the interrupt

Snapshot at the time of interrupt events - can be evaluated via SFB 54.

Write to the diagnostics buffer

EventId:= Eventclass, StartEvent	OBNo.	PK:	Dat ID ½	Info1	Info2	Info3
0x115C	57	0x02	0x54CC	Diagnostics address of the slave	Interrupt type	Error code CoE emergency

7.5.2.2 PROZESS_ALARM (0x0002) - hardware interrupt

Properties

Triggering event

- EC_NOTIFY_MBOXRCV - Mailbox message received - with the type eMbxTferType_COE_EMERGENCY

Supplied data

- Slave address
- CoE emergency

Conditions

- The error code of the CoE emergency must be equal to 0xFF00 and the CoE emergency has to come from a VIPA slave station.
- The 2. byte of *MEF* must be 1.

Interrupt handling in the CPU

Enter OB start information and call OB

Structure element	Data type	Description
EventClass	BYTE	0x11
FLT_ID	BYTE	0x41
PrioLevel	BYTE	Priority of the OB 40
OBNo	BYTE	40
Reserved1	BYTE	reserved

Structure element	Data type	Description
IoFlag	BYTE	0x54 or 0x55 (depending on the address type of the alarm-triggering module)
Info1	WORD	Diagnostics address of the slave
Info2	WORD	Error code of CoE emergency
Info3	WORD	Slave state of CoE emergency
User1	WORD	Alarmprio, AlarmRef
User2	WORD	EtherCAT slave address

Update SSL data

Hardware interrupts do not change SSLs.

Caching the interrupt

Snapshot at the time of interrupt events - can be evaluated via SFB 54.

Write to the diagnostics buffer

There is no diagnostics buffer entry.

7.5.2.3 BUS_STATE_CHANGED (0x8001)

Properties

Triggering event

- EC_NOTIFY_STATECHANGED - Bus state was changed

Supplied data

- Old and new state of the master and the number of slave modules, which are not in master state.

Conditions

- none

Interrupt handling in the CPU

In the event the master switches to "Operational" *'EtherCAT State Machine' on page 190*, OB86 is released. Via its event class you can see, whether all configured slave stations have carried the state change. Should any or all slave stations are not be able to establish the state to "Operational", so you can check this via a SSL.

Enter OB start information and call OB

Structure element	Data type	Description
EventClass	BYTE	0xEC on restoration or 0xED on failure or other VusStateChanged
FLT_ID	BYTE	0x10 failure or restoration with all slaves, 0x11 restoration with missing salve(s), 0x20 other BusStateChanged
PrioLevel	BYTE	Priority of the OB86
OBNo	BYTE	86
Reserved1	BYTE	1, if slave available, otherwise 0
IoFlag	BYTE	0x54 at input address in ZInfo1, 0x55 at output address
Info1	WORD	0xXXYY: XX=OldState, YY=NewState
Info2	WORD	Diagnostics address of the master
Info3	WORD	Number of missing salves
User1	WORD	0xXXYY: XX=InterruptPrio, YY=InterruptRef
User2	WORD	EtherCAT slave address

EtherCAT diagnostics *197*

Update SSL data

In the SSL 0x0294, 0x0694 and 0x0994 the corresponding bits are updated for each slave. Each to the CPU reported state change as interrupt event generates a diagnostics buffer entry and may be read in the SSL 0xE0.

Update I/O peripheral structure

I/O state of the slaves and its modules are set to EA_STATUS_BG_VORHANDEN (module available) on restoration and EA_STATUS_BG_NICHTVORHANDEN (module do not exist) on failure.

Caching the interrupt

Snapshot at the time of interrupt events - can be evaluated via SFB 54.

Write to the diagnostics buffer

EventId:= Eventclass, StartEvent	PrioLevel	OBNo.	Reserved1, IOFlag	Info1	Info2	Info3
0xEC10, 0xEC11, 0xED10 or 0xED20 (depends on state change)	PrioLevel of OB86	86	see OB-Startinfo Reserved1, IOFlag	old and new state of the slave	Diagnostics address master	Number of slaves, which differ from the status of the master

7.5.2.4 DIAGNOSE_ALARM_GEHEND (0x000C) - diagnostics interrupt going

Properties

Triggering event

- EC_NOTIFY_MBOXRCV - Mailbox message received - with the type eMbxTferType_COE_EMERGENCY

Supplied data

- Slave address
- CoE emergency

Conditions

- The error code of the CoE emergency must be equal to 0x0000 ("no error respectively "error resolved") and the CoE emergency has to come from a VIPA slave station.

Interrupt handling in the CPU

Enter OB start information and call OB

Structure element	Data type	Description
EventClass	BYTE	0x38
FLT_ID	BYTE	0x42
PrioLevel	BYTE	Priority of the OB 82
OBNo	BYTE	82
Reserved1	BYTE	0xC5
IoFlag	BYTE	0x54
Info1	WORD	Diagnostics address of the slave
Info2	WORD	Error code of CoE emergency
Info3	WORD	Slave state of CoE emergency
User1	WORD	InterruptPrio, InterruptRef
User2	WORD	EtherCAT slave address

Update SSL data

In SSL 0694 and 0692 the corresponding bit is updated for each slave.

Caching the interrupt

Snapshot at the time of interrupt events - can be evaluated via SFB 54.

Write to the diagnostics buffer

EventId:= Eventclass, StartEvent	PrioLevel	OBNo.	Reserved1, IOFlag	Info1	Info2	Info3
0x3842	PrioLevel of OB 82	82	0xC554	Diagnostics address slave	EtherCAT error code	Slave state

7.5.2.5 DIAGNOSE_ALARM_Kommend (0x0001) - diagnostics interrupt coming

Properties

Triggering event

- EC_NOTIFY_MBOXRCV - Mailbox message received - with the type eMbxTferType_COE_EMERGENCY

Supplied data

- Slave address
- CoE emergency

Conditions

- The error code of the CoE emergency must diver to 0x0000
- The error code of the CoE emergency must diver to 0xA000 and 0xA001

Interrupt handling in the CPU

Enter OB start information and call OB

Structure element	Data type	Description
EventClass	BYTE	0x39
FLT_ID	BYTE	0x42
PrioLevel	BYTE	Priority of the OB 82
OBNo	BYTE	82
Reserved1	BYTE	0xC5
IoFlag	BYTE	0x54
Info1	WORD	Diagnostics address of the slave
Info2	WORD	Error code of CoE emergency
Info3	WORD	Slave state of CoE emergency

Structure element	Data type	Description
User1	WORD	InterruptPrio, InterruptRef
User2	WORD	EtherCAT slave address

Update SSL data

In SSL 0694 and 0692 the corresponding bit is updated for each slave.

Caching the interrupt

Snapshot at the time of interrupt events - can be evaluated via SFB 54.

Write to the diagnostics buffer

EventId:= Eventclass, StartEvent	PrioLevel	OBNo.	Reserved1, IOFlag	Info1	Info2	Info3
0x3942	PrioLevel of OB 82	82	0xC554	Diagnostics address slave:	EtherCAT error code	Slave state

7.5.2.6 SLAVE_STATE_CHANGED (0x8002)

Properties

Triggering event

- EC_NOTIFY_SLAVE_UNEXPECTED_STATE - Slave is not in the requested state.
- The application has successfully set a slave in a different state.

Supplied data

- current new state

*Especially when a master status change is performed , this message is **not** sent to the CPU, since the overall result for error slaves of the status change in the event BUS_STATE_CHANGED is transmitted.*

Interrupt handling in the CPU

For each slave the current state is stored inside the CPU.

Enter OB start information and call OB

Structure element	Data type	Description
EventClass	BYTE	0xEC on restoration or 0xED on failure or other VusStateChanged
FLT_ID	BYTE	0x12 failure or restoration, 0x22 other BusStateChanged
PrioLevel	BYTE	Priority of the OB 86
OBNo	BYTE	86
Reserved1	BYTE	1, if slave available, otherwise 0
IoFlag	BYTE	0x54 at input address in ZInfo1, 0x55 at output address
Info1	WORD	0xXXYY: XX=OldState, YY=NewState
Info2	WORD	Diagnostics address of the slave
Info3	WORD	AI Status Code
User1	WORD	0xXXYY: XX=InterruptPrio, YY=InterruptRef
User2	WORD	EtherCAT slave address

Update SSL data

In the SSL 0x0294, 0x0694 and 0x0994 the corresponding bits are updated for each slave. Each to the CPU reported state change as interrupt event generates a diagnostics buffer entry and may be read in the SSL 0xE0.

Update I/O peripheral structure

I/O state of the slaves and its modules are set to EA_STATUS_BG_VORHANDEN (module available) on restoration and EA_STATUS_BG_NICHTVORHANDEN (module do not exist) on failure.

Caching the interrupt

Snapshot at the time of interrupt events - can be evaluated via SFB 54.

Write to the diagnostics buffer

EventId:= Eventclass, StartEvent	PrioLevel	OBNo.	Reserved1, IOFlag	Info1	Info2	Info3
0xEC10, 0xEC11, 0xED10 or 0xED20 (depends on state change)	PrioLevel of OB 86	86	see OB-Startinfo Reserved1, IOFlag	old and new state of the slave	Diagnostics address master	Number of slaves, which differ from the status of the master

7.5.2.7 TOPOLOGY_MISMATCH (0x8004)

Properties

Triggering event

- Interrupt is triggered, if topology was OK and the event EC_NOTIFY_SB_MISMATCH occurs. The Interrupt is only triggered with an existing configuration.

Supplied data

- none

Conditions

- none

Interrupt handling in the CPU

Enter OB start information and call OB

Structure element	Data type	Description
EventClass	BYTE	0xED
FLT_ID	BYTE	0x30
PrioLevel	BYTE	Priority of the OB 86
OBNo	BYTE	86
Reserved1	BYTE	0
IoFlag	BYTE	0
Info1	WORD	0
Info2	WORD	Diagnostics address of the master
Info3	WORD	0
User1	WORD	0
User2	WORD	0

Update SSL data

In the SSL xy94 the difference of set point and effective value is entered.

Write to the diagnostics buffer

EventId:= Eventclass, StartEvent	PrioLevel	OBNo.	Reserved1, IOFlag	Info1	Info2	Info3
0xED30	PrioLevel of OB 86	86	0x0000	0	Diagnostics address master	0

7.5.2.8 TOPOLOGY_OK (0x8003)

Properties

Triggering event

- Interrupt is triggered, if topology was OK and the event EC_NOTIFY_SB_STATUS with pScanBusStatus occurs.→dwResultCode = 0 occurs. The Interrupt is only triggered with an existing configuration.

Supplied data

- none

Conditions

- none

Interrupt handling in the CPU

Enter OB start information and call OB

Structure element	Data type	Description
EventClass	BYTE	0xED
FLT_ID	BYTE	0x30
PrioLevel	BYTE	Priority of the OB 86
OBNo	BYTE	86
Reserved1	BYTE	0
IoFlag	BYTE	0
Info1	WORD	0
Info2	WORD	Diagnostics address of the master
Info3	WORD	0
User1	WORD	0
User2	WORD	0

Update SSL data

In the SSL xy94 the difference of set point and effective value is entered.

Write to the diagnostics buffer

EventId:= Eventclass, StartEvent	PrioLevel	OBNo.	Reserved1, IOFlag	Info1	Info2	Info3
0xED30	PrioLevel of OB 86	86	0x0000	0	Diagnostics address master	0

7.6 System characteristics

Behavior on topology changes

Changes on the topology of the EtherCAT bus can result in a bus cycle timeout. Please do not change the topology in state *Op* respectively *SafeOp*. If necessary you have to manually change the status of the EtherCAT master by means of the *SPEED7 EtherCAT Manager* or with SDO access. Bus cycle timeouts can be determined with the OB 86. Information about the usage of the SFB 54 can be found in the manual "SPEED7 Operation list" from VIPA.

Configuration of more than 128 EtherCAT slave stations

From a configuration of more than 128 EtherCAT slave stations the EtherCAT states can not be updated correctly whenever a configuration is downloaded to the module. Here the EC LED of the EtherCAT master shows the state *PreOp* although it is in *SafeOP* state. Also the state *PreOp* is reported to the CPU.

Cause: The CP application can not handle the large number of Stack-Notifications, because with each change of status of each slave station, a notification is sent.

Remedy: By performing a STOP/RUN transition of the CPU, the entire EtherCAT system switches to *OP* state.

SM Watchdog

If you use long cycle times (> 100ms) you should always accordingly raise or switch off the *'SM Watchdog'* in the *SPEED7 EtherCAT Manager*. Otherwise your slave station changes after laps of SM Watchdog time to Safe-Op and releases OB 86. From now on you can only manually set the slave to Op! Without adjusting the *'SM Watchdog'* time you always get the error message AIStatusCode 0x1B when using the EtherCAT slave stations from VIPA with cycle times of > 100 ms. Here the CPU leaves the slaves station in its current state, this means it is ignored when polling. The state can be changed via SDO access respectively by means of the *SPEED7 EtherCAT Manager*.

Since slave and module parameters are transmitted by means of SDO respectively SDO Init command, the configuration remains active, until a power cycle is performed or new parameters for the same SDO objects are transferred.

With an overall reset the slave and module parameters are not reset!

7.7 Firmware update

EtherCAT master

Chapter 4.13 'Firmware update' on page 79

EtherCAT slave station

Firmware update via *SPEED7 EtherCAT Manager*. More may be found in the according manual respectively online help.

7.8 Accessing the object dictionary

7.8.1 Overview

Blocks

With the following blocks you have at run-time access to the object dictionary of the EtherCAT slave stations and EtherCAT master:

- FB 52 - Read SDO - Read access to object dictionary
- FB 53 - Write SDO - Write access to object dictionary

These are VIPA-specific blocks. More information about the usage of these blocks may be found in the manual "Operation list".

Please consider when accessing the object dictionary, depending on your master system, the byte order can be rotated!

7.8.2 FB 52 - Read SDO - Read access to Object Dictionary Area

Description

With this block, you will have read access to the object directory of the EtherCAT slave stations and EtherCAT master. The block operates asynchronously, that is, processing covers multiple FB calls. Start the job by calling FB 52 with REQ = 1. The job status is displayed via the output parameters BUSY and RETVAL. The record set transmission is completed when the output parameter BUSY = FALSE.

The error handling happens with the parameters ERROR, ERROR_ID and RETVAL.

Parameters

Parameter	Declaration	Data type	Description
REQ	IN	BOOL	REQ = 1: activates the SDO access at rising edge.
ID	IN	WORD	Logical base address of the EtherCAT slave station respectively master in the hardware configuration. With an output module bit 15 must be set (example for address 5: ID:=DW#16#8005). With a combination module you have to set the lower one of the two addresses.
INDEX	IN	WORD	Index of the object for the SDO access.
SUBINDEX	IN	BYTE	Sub index of the object for the SDO access.
COMPL_ACCESS	IN	BOOL	This parameter defines whether only a single sub-index, or the entire object is to be read.
MLEN	IN	INT	Maximum length of the data to be read.
VALID	OUT	BOOL	indicates that a new record set was received and is valid.
BUSY	OUT	BOOL	This parameter indicates the status of the SDO access. *BUSY* = 1: SDO access is not yet terminated.
ERROR	OUT	BOOL	*ERROR* = 1: A read error has occurred.
RETVAL	OUT	INT	Return value (0 = OK)
ERROR_ID	OUT	DWORD	Bus specific error code. If there was an error during the SDO access, the SDO abort error code (EtherCAT error code) can be found here.
LEN	OUT	INT	Length of the read data.
RECORD	INOUT	ANY	Area of the read data.

Special features at *COMPL_ACCESS* (CompleteAccess)

With the activation of the parameter *COMPL_ACCESS* the following is to be considered:

- With *COMPL_ACCESS* = true only *SUBINDEX* 0 or 1 is allowed! Otherwise you will get an error message.
- With *COMPL_ACCESS* = true for *SUBINDEX* 0 2bytes are read, because *SUBINDEX* 1 has an offset of 2bytes.

RETVAL (return value)

In addition to the module specific error codes, which are listed here, also the general error codes for FC/SFC as return value are possible.

RETVAL	Description	Error code in *ERROR_ID*
0x80A0	Negative acknowledgement while reading the module.	yes
0x80A1	Negative acknowledgement while writing the module.	yes

RETVAL	Description	Error code in *ERROR_ID*
0x80A3	General protocol error.	yes
0x80A5	Internal error.	Value = 0: no
		Value ≠ 0: yes
0x80A7	Module is occupied (Timeout).	yes
0x80A9	Feature not supported by the module.	yes
0x80AA	Module reports a manufacturer-specific error in its application.	yes
0x80B0	Data record not known in module / Illegal data record number.	yes
0x80B4	Module reports access to an invalid area.	yes
0x80B5	Module not ready.	yes
0x80B6	Module denies access.	yes
0x80B7	Module reports an invalid range for a parameter or value.	yes
0x80B8	Module reports an invalid parameter.	yes
0x80B9	Module reports an invalid type: Buffer too small (reading subsets is not possible).	yes
0x80C2	The module currently processes the maximum possible jobs for a CPU.	yes
0x80C3	The required operating resources are currently occupied.	no
0x80C4	Internal temporary error: Job could not be carried out.	yes
0x80C5	Module not available.	yes
0x80D2	Error on reading an SDO due to wrong call parameters.	yes

ERROR_ID

If the parameter *RETVAL* has the value see above, the corresponding error message can be found in *ERROR_ID*. Otherwise *ERROR_ID* is 0.

Internal error

ERROR_ID	RETVAL	Description
0x00000000	0	No error
0x98110001	0x80A9	Feature not supported
0x98110002	0x80B0	Invalid Index
0x98110003	0x80B4	Invalid Offset
0x98110005	0x80B9	Invalid Size
0x98110006	0x80AA	Invalid Data
0x98110007	0x80C2	Not ready

ERROR_ID	RETVAL	Description
0x98110008	0x80C4	Busy
0x9811000A	0x80C4	No Memory left
0x9811000B	0x80B8	Invalid Parameter
0x9811000C	0x80C5	Not Found
0x9811000E	0x80B5	Invalid state
0x98110010	0x80C4	Timeout
0x98110011	0x80AA	Open Failed
0x98110012	0x80A3	Send Failed
0x98110014	0x80A9	Invalid Command
0x98110015	0x80A3	Unknown Mailbox Protocol Command
0x98110016	0x80B6	Access Denied
0x98110024	0x80C5	Slave error
0x9811002D	0x80C5	Ethernet link cable disconnected
0x98110031	0x80A9	No mailbox support

CoE Error codes

Value	Text	Possible error codes
0x98110040	SDO: Toggle bit not alternated	CoE abort code 0x05030000 of slave
0x98110041	SDO protocol timed out	CoE abort code 0x05040000 of slave
0x98110042	SDO: Client/server command specifier not valid or unknown	CoE abort code 0x05040001 of slave
0x98110043	SDO: Invalid block size (block mode only)	CoE abort code 0x05040002 of slave
0x98110044	SDO: Invalid sequence number (block mode only)	CoE abort code 0x05040003 of slave
0x98110045	SDO: CRC error (block mode only)	CoE abort code 0x05040004 of slave
0x98110046	SDO: Out of memory	CoE abort code 0x05040005 of slave
0x98110047	SDO: Unsupported access to an object	CoE abort code 0x06010000 of slave
0x98110048	SDO: Attempt to read a write only object	CoE abort code 0x06010001 of slave
0x98110049	SDO: Attempt to write a read only object	CoE abort code 0x06010002 of slave
0x9811004A	SDO: Object does not exist in the object dictionary	CoE abort code 0x06020000 of slave
0x9811004B	SDO: Object cannot be mapped to the PDO	CoE abort code 0x06040041 of slave
0x9811004C	SDO: The number and length of the objects to be mapped would exceed PDO length	CoE abort code 0x05040002 of slave
0x9811004D	SDO: General parameter incompatibility reason	CoE abort code 0x06040043 of slave
0x9811004E	SDO: General internal incompatibility in the device	CoE abort code 0x06040047 of slave
0x9811004F	SDO: Access failed due to an hardware error	CoE abort code 0x06060000 of slave
0x98110050	SDO: Data type does not match, length of service parameter does not match	CoE abort code 0x06070010 of slave

Value	Text	Possible error codes
0x98110051	SDO: Data type does not match, length of service parameter too high	CoE abort code 0x06070012 of slave
0x98110052	SDO: Data type does not match, length of service parameter too low	CoE abort code 0x06070013 of slave
0x98110053	SDO: Sub-index does not exist	CoE abort code 0x06090011 of slave
0x98110054	SDO: Value range of parameter exceeded (only for write access)	CoE abort code 0x06090030 of slave
0x98110055	SDO: Value of parameter written too high	CoE abort code 0x06090031 of slave
0x98110056	SDO: Value of parameter written too low	CoE abort code 0x06090032 of slave
0x98110057	SDO: Maximum value is less than minimum value	CoE abort code 0x06090036 of slave
0x98110058	SDO: General error	CoE abort code 0x08000000 of slave
0x98110059	SDO: Data cannot be transferred or stored to the application	CoE abort code 0x08000020 of slave
0x9811005A	SDO: Data cannot be transferred or stored to the application because of local control	CoE abort code 0x08000021 of slave
0x9811005B	SDO: Data cannot be transferred or stored to the application because of the present device state	CoE abort code 0x08000022 of slave
0x9811005C	SDO: Object dictionary dynamic generation fails or no object dictionary is present (e.g. object dictionary is generated from file and generation fails because of an file error)	CoE abort code 0x08000023 of slave
0x9811005D	SDO: Unknown code	Unknown CoE abort code of slave
0x9811010E	Command not executed	Slave is not present at the bus

7.8.3 FB 53 - Write SDO - Write access to Object Dictionary Area

Description

With this block, you will have write access to the object directory of the EtherCAT slave stations and EtherCAT master. The block operates asynchronously, that is, processing covers multiple FB calls. Start the job by calling FB 53 with *REQ* = 1. The job status is displayed via the output parameters *BUSY* and *RETVAL*. The record set transmission is completed when the output parameter *BUSY* = FALSE.

The error handling happens with the parameters *ERROR*, *ERROR_ID* and *RETVAL*.

Parameters

Parameter	Declaration	Data type	Description
REQ	IN	BOOL	REQ = 1: activates the SDO access at rising edge.
ID	IN	WORD	Logical base address of the EtherCAT slave station respectively master in the hardware configuration. With an output module bit 15 must be set (example for address 5: ID:=DW#16#8005). With a combination module you have to set the lower one of the two addresses.
INDEX	IN	WORD	Index of the object for the SDO access.
SUBINDEX	IN	BYTE	Sub index of the object for the SDO access.
COMPL_ACCESS	IN	BOOL	This parameter defines whether only a single subindex, or the entire object is to be written.
LEN	IN	INT	Maximum length of the data to be written.
DONE	OUT	BOOL	indicates that a new record set was written.
BUSY	OUT	BOOL	This parameter indicates the status of the SDO access. *BUSY* = 1: SDO access is not yet terminated.
ERROR	OUT	BOOL	*ERROR* = 1: A write error has occurred.
RETVAL	OUT	INT	Return value (0 = OK)
ERROR_ID	OUT	DWORD	Bus specific error code. If there was an error during the SDO access, the SDO abort error code (EtherCAT error code) can be found here.
LEN	OUT	INT	Length of the data to be written.
RECORD	INOUT	ANY	Area of the data to be written.

Special features at *COMPL_ACCESS* (CompleteAccess)

With the activation of the parameter *COMPL_ACCESS* the following is to be considered:

- With *COMPL_ACCESS* = true only *SUBINDEX* 0 or 1 is allowed! Otherwise you will get an error message.
- With *COMPL_ACCESS* = true for *SUBINDEX* 0 2bytes are written, because *SUBINDEX* 1 has an offset of 2byte.

RETVAL (return value)

In addition to the module specific error codes, which are listed here, also the general error codes for FC/SFC as return value are possible.

RETVAL	Description	Error code in *ERROR_ID*
0x80A0	Negative acknowledgement while reading the module.	yes
0x80A1	Negative acknowledgement while writing the module.	yes

RETVAL	Description	Error code in *ERROR_ID*
0x80A3	General protocol error.	yes
0x80A5	Internal error.	Value = 0: no
		Value ≠ 0: yes
0x80A7	Module is occupied (Timeout).	yes
0x80A9	Feature not supported by the module.	yes
0x80AA	Module reports a manufacturer-specific error in its application.	yes
0x80B0	Data record not known in module / Illegal data record number.	yes
0x80B4	Module reports access to an invalid area.	yes
0x80B5	Module not ready.	yes
0x80B6	Module denies access.	yes
0x80B7	Module reports an invalid range for a parameter or value.	yes
0x80B8	Module reports an invalid parameter.	yes
0x80B9	Module reports an invalid type: Buffer too small (writing subsets is not possible).	yes
0x80C2	The module currently processes the maximum possible jobs for a CPU.	yes
0x80C3	The required operating resources are currently occupied.	no
0x80C4	Internal temporary error: Job could not be carried out.	yes
0x80C5	Module not available.	yes
0x80D2	Error on reading an SDO due to wrong call parameters.	yes

ERROR_ID

If the parameter *RETVAL* has the value see above, the corresponding error message can be found in *ERROR_ID*. Otherwise *ERROR_ID* is 0.

Internal error

ERROR_ID	RETVAL	Description
0x00000000	0	No error
0x98110001	0x80A9	Feature not supported
0x98110002	0x80B0	Invalid Index
0x98110003	0x80B4	Invalid Offset
0x98110005	0x80B9	Invalid Size
0x98110006	0x80AA	Invalid Data
0x98110007	0x80C2	Not ready

ERROR_ID	RETVAL	Description
0x98110008	0x80C4	Busy
0x9811000A	0x80C4	No Memory left
0x9811000B	0x80B8	Invalid Parameter
0x9811000C	0x80C5	Not Found
0x9811000E	0x80B5	Invalid state
0x98110010	0x80C4	Timeout
0x98110011	0x80AA	Open Failed
0x98110012	0x80A3	Send Failed
0x98110014	0x80A9	Invalid Command
0x98110015	0x80A3	Unknown Mailbox Protocol Command
0x98110016	0x80B6	Access Denied
0x98110024	0x80C5	Slave error
0x9811002D	0x80C5	Ethernet link cable disconnected
0x98110031	0x80A9	No mailbox support

CoE Error codes

Value	Text	Possible error codes
0x98110040	SDO: Toggle bit not alternated	CoE abort code 0x05030000 of slave
0x98110041	SDO protocol timed out	CoE abort code 0x05040000 of slave
0x98110042	SDO: Client/server command specifier not valid or unknown	CoE abort code 0x05040001 of slave
0x98110043	SDO: Invalid block size (block mode only)	CoE abort code 0x05040002 of slave
0x98110044	SDO: Invalid sequence number (block mode only)	CoE abort code 0x05040003 of slave
0x98110045	SDO: CRC error (block mode only)	CoE abort code 0x05040004 of slave
0x98110046	SDO: Out of memory	CoE abort code 0x05040005 of slave
0x98110047	SDO: Unsupported access to an object	CoE abort code 0x06010000 of slave
0x98110048	SDO: Attempt to read a write only object	CoE abort code 0x06010001 of slave
0x98110049	SDO: Attempt to write a read only object	CoE abort code 0x06010002 of slave
0x9811004A	SDO: Object does not exist in the object dictionary	CoE abort code 0x06020000 of slave
0x9811004B	SDO: Object cannot be mapped to the PDO	CoE abort code 0x06040041 of slave
0x9811004C	SDO: The number and length of the objects to be mapped would exceed PDO length	CoE abort code 0x05040002 of slave
0x9811004D	SDO: General parameter incompatibility reason	CoE abort code 0x06040043 of slave
0x9811004E	SDO: General internal incompatibility in the device	CoE abort code 0x06040047 of slave
0x9811004F	SDO: Access failed due to an hardware error	CoE abort code 0x06060000 of slave
0x98110050	SDO: Data type does not match, length of service parameter does not match	CoE abort code 0x06070010 of slave

Value	Text	Possible error codes
0x98110051	SDO: Data type does not match, length of service parameter too high	CoE abort code 0x06070012 of slave
0x98110052	SDO: Data type does not match, length of service parameter too low	CoE abort code 0x06070013 of slave
0x98110053	SDO: Sub-index does not exist	CoE abort code 0x06090011 of slave
0x98110054	SDO: Value range of parameter exceeded (only for write access)	CoE abort code 0x06090030 of slave
0x98110055	SDO: Value of parameter written too high	CoE abort code 0x06090031 of slave
0x98110056	SDO: Value of parameter written too low	CoE abort code 0x06090032 of slave
0x98110057	SDO: Maximum value is less than minimum value	CoE abort code 0x06090036 of slave
0x98110058	SDO: General error	CoE abort code 0x08000000 of slave
0x98110059	SDO: Data cannot be transferred or stored to the application	CoE abort code 0x08000020 of slave
0x9811005A	SDO: Data cannot be transferred or stored to the application because of local control	CoE abort code 0x08000021 of slave
0x9811005B	SDO: Data cannot be transferred or stored to the application because of the present device state	CoE abort code 0x08000022 of slave
0x9811005C	SDO: Object dictionary dynamic generation fails or no object dictionary is present (e.g. object dictionary is generated from file and generation fails because of an file error)	CoE abort code 0x08000023 of slave
0x9811005D	SDO: Unknown code	Unknown CoE abort code of slave
0x9811010E	Command not executed	Slave is not present at the bus

7.9 Object dictionary

7.9.1 Object overview

Index	Object Dictionary Area
0x0000 ... 0x0FFF	Data Type Area Objects
0x1000 ... 0x1FFF	CoE Communication Area Objects
0x2000 ... 0x20FF	Generic Master Area Objects
0x2100 ... 0x21FF	Distributed Clocks Objects
0x3000 ... 0x3FFF	Slave Configuration / Information Objects
0x4000 ... 0x7FFF	Reserved Area
0x8000 ... 0x8FFF	CoE Slave Configuration Objects
0x9000 ... 0x9FFF	CoE Slave Information Objects
0xA000 ... 0xAFFF	CoE Slave Diagnosis Data Objects
0xB000 ... 0xEFFF	Reserved Area
0xF000 ... 0xFFFF	CoE Device Area Objects

7.9.2 CoE Communication Area Objects: 0x1000-0x1FFF

Index	Object Type	Name	Type
0x1000	VAR	Device Type	Unsigned32
0x1001	VAR	Error Register	Unsigned8
0x1008	VAR	Manufacturer Device Name String	VisibleString
0x1009	VAR	Manufacturer Hardware Version String	VisibleString
0x100A	VAR	Manufacturer Software Version String	VisibleString
0x1018	RECORD	Identity Object	Identity (0x23)
0x10F3	RECORD	History Object	History (0x26)

7.9.2.1 Device Type 0x1000

Sub-index	Name	Type	Access	Value	Meaning
0x00	Device Type	Unsigned32	ro	0x00001389	0x00001389 means MDP

7.9.2.2 Device Name 0x1008

Sub-index	Name	Type	Access	Value	Meaning
0x00	Device name	Visible string	ro	VIPA 31x	Name of the EtherCAT device

7.9.2.3 Hardware Version 0x1009

Sub-index	Name	Type	Access	Value	Meaning
0x00	Hard-ware version	Visible string	ro	"V MM.mm.ss.bb"" MM = Major Version mm = Minor Version ss = Service Pack bb = Build e.g. "V 01.05.02.02"	Hardware version of the EtherCAT device

7.9.2.4 Software Version 0x100A

Sub-index	Name	Type	Access	Value	Meaning
0x00	Software version	Visible string	ro	"V MM.mm.ss.bb"" MM = Major Version mm = Minor Version ss = Service Pack bb = Build e.g. "V 01.05.02.02"	Software version of the EtherCAT device

7.9.2.5 Identity Object 0x1018

Sub-index	Name	Type	Access	Value	Meaning
0x00	Number of Entries	Unsigned8	ro	0x04 (default)	
0x01	Vendor ID	Unsigned32	ro	0x0000022B (default)	Vendor ID of the EtherCAT device
0x02	Product Code	Unsigned32	ro	0x00001636 (default)	Product Code of the EtherCAT device
0x03	Revision Number	Unsigned32	ro	0x00000000 (default)	Revision Number (EtherCAT master software version)
0x04	Serial Number	Unsigned32	ro	0x00000000 (default)	Serial Number of the EtherCAT device

7.9.2.6 History Object 0x10F3

Sub-index	Name	Type	Access	Value	Meaning
0	Number of Entries	Unsigned8	ro		
1	Maximum number of Diag messages	Unsigned8	ro		
2	Subindex of newest Diag message	Unsigned8	ro		
3	Subindex of newest acknowledged Diag message	Unsigned8	r/w		
4	New Diag messages available	BOOL32	ro		

Sub-index	Name	Type	Access	Value	Meaning
5	Flags (UINT16, r/w)	Unsigned16	r/w	0	Bit 0 = 1: Enable Emergency sending (default = 0) Bit 1 = 1: Disable Storing Info Messages (default = 0) Bit 2 = 1: Disable Storing Warning Messages (default = 0) Bit 3 = 1: Disable Storing Error Messages (default = 0) Bit 4...15: reserved for future use
6 ... 255			ro		

7.9.2.6.1 Diagnosis Messages Object 0x10F3: 6-255

Byte-Offset	Name	Type	Access	Value	Meaning
0	Diag-Number	Unsigned32	ro		Bit 0...11: free use Bit 12...15 = 14: to be comp. with Emergency Error Bit 16...31 = 0: reserved Bit 16...31 = 0xFFFE: free use Bit 16...31 = 0xFFFF: reserved
4	Flags	Unsigned16	ro		Bit 0...3: Diag type (0 = Info, 1 = warning, 2 = error) Bit 4...15: reserved
6	Text ID	Unsigned16	ro		0 = no Text ID 1-65535 = Reference to a Text ID with formatted string
8	Time Stamp in ns (from DC)	Unsigned64	ro		
16	Flags parameter 1	Unsigned16	ro		
18	Parameter 1	several	ro		

Byte-Offset	Name	Type	Access	Value	Meaning
N	Flags parameter n	Unsigned16	ro		
N+2	Parameter n	several	ro		

7.9.3 Generic Master Objects: 0x2000-0x20FF

Index	Object Type	Name	Type
0x2000	VAR	Master State Change Command Register	Unsigned32
0x2001	VAR	Master State Summary	Unsigned32
0x2002	RECORD	Bus Diagnosis Object	BusDiagnostic (0x40)
0x2005	RECORD	MAC Address	MACAddress (0x41)
0x2010	VAR	Debug Register	Unsigned48
0x2020	RECORD	Master Init. Parameters	MasterInitParm (0x42)

7.9.3.1 Master State Change Command Register 0x2000

Sub-index	Name	Type	Access	Value	Meaning
0x00	Master State	Unsigned32	r/w	0 = invalid 1 = init 2 = pre-operational 3 = bootstrap mode 4 = safe operational 8 = operational	

7.9.3.2 Master State Summary 0x2001

Sub-index	Name	Type	Access	Value	Meaning
0x00	Master State	Unsigned32	ro		Bit 0: = 1 Master OK Bit 1...3: reserved Bit 4...7: Master State Bit 8: Slaves in requested State Bit 9: Master in requested State Bit 10: Bus Scan Match Bit 11: reserved Bit 12: DC is enabled Bit 13: DC In-Sync Bit 14: DC Busy Bit 15: Reserved Bit 16: Link Up Bit 17...31: reserved

Master is OK if topology is Ok (Mismatch if slave exists, which is not configured). Master must be in *Op* state, slaves must be in *Op* state and *Distributed Clocks* must be *insync* if activated.

Parameter Flags Bit 12...15	Parameter Flags Bit 0...11	Type of Data	Data
0	CoE DataType e.g. 0x0007 = UINT32	Data Type	Data defined through CoE DataType
1	Length in Byte	Byte Array	Byte stream byData[Size]
2	Length in Byte	ASCII-String	String szString[Length] (not '\0' terminated)
3	Length in Byte	Unicode String	String wszString[Length/2] (not L'\0' terminated)
4	0	Text Id	Text Id (Word)

7.9.3.3 Bus Diagnosis Object 0x2002

Object Type: RECORD, Manufacturer Specific Identity 0x40

Subindex	Description	Type	Access
0x00	Number of Entries	Unsigned8	ro
0x01	Reserved	Unsigned16	ro

Subindex	Description	Type	Access
0x02	Configuration Checksum CRC32	Unsigned32	ro
0x03	Number of found Slave	Unsigned32	ro
0x04	Number of found DC Slave	Unsigned32	ro
0x05	Number of Slaves in Configuration	Unsigned32	ro
0x06	Number of Mailbox Slaves in Configuration	Unsigned32	ro
0x07	Counter: TX frames	Unsigned32	ro
0x08	Counter: RX frames	Unsigned32	ro
0x09	Counter: Lost frames	Unsigned32	ro
0x10	Counter: Cyclic frames	Unsigned32	ro
0x11	Counter: Cyclic datagrams	Unsigned32	ro
0x12	Counter: Acyclic frames	Unsigned32	ro
0x13	Counter: Acyclic datagrams	Unsigned32	ro
0x14	Clear Counters by writing 1 to bit(s) Bit 0: Clear all Counters Bit 1: Clear Tx Frame Counter (Idx 7) Bit 2: Clear Rx Frame Counter (Idx 8) Bit 3: Clear Lost Frame Counter (Idx 9) Bit 4: Clear Cyclic Frame Counter (Idx 10) Bit 5: Clear Cyclic Datagram Counter (Idx 11) Bit 6: Clear Acyclic Frame Counter (Idx 12) Bit 7: Clear Acyclic DataGram Counter (Idx 13) Bit 8...31: Reserved	Unsigned32	r/w

7.9.3.4 MAC Address 0x2005

Object Type: RECORD, Manufacturer Specific Identity 0x41

Subindex	Description	Type	Access
0x00	Number of Entries	Unsigned8	ro
0x01	Hardware	Unsigned48	ro
0x02	Red Hardware	Unsigned48	ro
0x03	Configuration Source	Unsigned48	ro
0x04	Configuration Destination	Unsigned48	

7.9.3.5 Debug Register 0x2010

Sub-index	Name	Type	Access	Value	Meaning
0x00	Debug Register	Unsigned38	r/w	Upper 16bit: 0: activate LinkError Messages 1...15: reserved Lower 32bit: Definition of parameter dwStateChangeDebug in structure EC_T_MASTER_CONFIG	

7.9.3.6 Master Init Parameters 0x2020

Object Type: RECORD, Manufacturer Specific Identity 0x42

Sub-index	Description	Type	Access
00	Number of Entries	Unsigned8	ro
01	EC_T_INITMASTERPARMS.dwVersion Application	Unsigned32	ro
02	dwVersion Master	Unsigned32	ro
03	EC_T_MASTER_CONFIG.nSlaveMultiplier	Unsigned32	ro
04	EC_T_MASTER_CONFIG.dwEcatCmdTimeout in millisec	Unsigned32	ro
05	EC_T_MASTER_CONFIG.dwEcatCmdMaxRetries	Unsigned32	ro
06	EC_T_MASTER_CONFIG.dwCycTimeout in millisec	Unsigned32	ro
07	EC_T_MASTER_CONFIG.dwEoeTimeout in millisec	Unsigned32	ro
08	EC_T_MASTER_CONFIG.dwFoeBusyTimeout in millisec	Unsigned32	ro
09	EC_T_MASTER_CONFIG.dwMaxQueuedEthFrames	Unsigned32	ro
10	EC_T_MASTER_CONFIG.dwMaxSlaveCmdPerFrame	Unsigned32	ro
11	EC_T_MASTER_CONFIG.dwMaxQueuedCoeSlaves	Unsigned32	ro
12	EC_T_MASTER_CONFIG.dwMaxQueuedCoeCmds	Unsigned32	ro
13	EC_T_MASTER_CONFIG.dwStateChangeDebug	Unsigned32	ro
14	EC_T_LINK_DEV_PARAM.szDriverIdent	VisibleString	ro
15	EC_T_LINK_DEV_PARAM.bPollingModeActive	Bool32	ro
16	EC_T_LINK_DEV_PARAM.bAllocSendFrameActive	Bool32	ro

7.9.4 Distributed Clocks Objects: 0x2100-0x21FF

Index	Object Type	Name	Type
0x2100	VAR	DC Slave Sync Deviation Limit	Unsigned32
0x2101	VAR	DC Current Deviation	Signed32
0x2102	VAR	DC Reserved	Unsigned32
0x2103	VAR	DC Reserved	Unsigned32

7.9.4.1 Distributed Clocks Slave Sync Deviation Limit 0x2100

Sub-index	Name	Type	Access	Value	Meaning
0x00	Master State	Unsigned32	ro	dwDevLimit	

7.9.4.2 Distributed Clocks Current Deviation 0x2101

Sub-index	Name	Type	Access	Value	Meaning
0x00	Master State	Unsigned32	ro	dwDeviation	

7.9.4.3 Reserved: 0x2102 / 0x2103

This value is reserved.

7.9.5 Slave specific objects

Slave Configuration / Information Objects: 0x3000-0x3FFF

Index	Object Type	Name	Type
0x3000 ... 0x3FFF	RECORD	Slave Configuration and Information Objects	SlaveCfgInfo (0x43)

CoE Slave Configuration Objects: 0x8000-0x8FFF

Index	Object Type	Name	Type
0x8000 ... 0x8FFF	RECORD	One index entry for each configured slave (from ESI)	SlaveCfg (0x45)

CoE Slave Information Objects: 0x9000-0x9FFF

Index	Object Type	Name	Type
0x9000 ... 0x9FFF	RECORD	One index entry for each connected BUS-slave (updated during BUS scan)	SlaveInfo (0x46)

CoE Slave Diagnosis Data Objects: 0xA000-0xAFFF

Index	Object Type	Name	Type
0xA000 ... 0xAFFF	RECORD	One subindex entry for each connected BUS-slave (cyclic updated)	SlaveDiag (0x47)

7.9.5.1 Slave Configuration and Information Object 0x3000-0x3FFF

Object Type: RECORD, Manufacturer Specific Identity 0x43

Subindex	Description	Type	Access
0	Number of Entries	Unsigned8	ro
1	Entry Valid	Bool32	ro
2	VendorId (Bus)	Unsigned32	ro
3	ProductCode (Bus)	Unsigned32	ro
4	Revision No (Bus)	Unsigned32	ro
5	Serial No (Bus)	Unsigned32	ro
6	Device Name (Config)	Visible_String[80]	ro
7	Auto Increment Address (Bus)	Unsigned16	ro
8	Physical Address (Bus)	Unsigned16	ro
9	Config Physical Address (Config)	Unsigned16	ro
10	Alias Address (Bus)	Unsigned16	ro

Subindex	Description	Type	Access
11	PortState (Bus)	Unsigned16	ro
12	DC Support (Bus)	Bool32	ro
13	DC Support 64Bit (Bus)	Bool32	ro
14	Mailbox Support (Config)	Bool32	ro
15	Requested State (slave instance)	Unsigned32	r/w
16	Current State (slave instance)	Unsigned32	ro
17	Error Flag Set (slave instance)	Bool32	ro
18	Enable Linkmessages (slave instance)	Bool32	r/w
19	Error code (slave instance)	Unsigned32	ro
20	Sync Pulse active (Config, slave instance)	Bool32	ro
21	DC Sync 0 Period (Config, slave instance)	Unsigned32	ro
22	DC Sync 1 Period (Config, slave instance)	Unsigned32	ro
23	SB Error Code (Bus Topology)	Unsigned32	ro
24	RX Error Counter Port 0 (Bus)	Unsigned16	ro
25	RX Error Counter Port 1 (Bus)	Unsigned16	ro
26	RX Error Counter Port 2 (Bus)	Unsigned16	ro
27	RX Error Counter Port 3 (Bus)	Unsigned16	ro
28	Forwarded RX Error Counter Port 0 (Bus)	Unsigned8	ro
29	Forwarded RX Error Counter Port 1 (Bus)	Unsigned8	ro
30	Forwarded RX Error Counter Port 2 (Bus)	Unsigned8	ro
31	Forwarded RX Error Counter Port 3 (Bus)	Unsigned8	ro
32	EtherCAT Processing Unit Error Counter (Bus)	Unsigned8	ro
33	PDI Error Counter (Bus)	Unsigned8	ro
34	Reserved	Unsigned16	ro
35	Lost Link Counter Port 0 (Bus)	Unsigned8	ro
36	Lost Link Counter Port 1 (Bus)	Unsigned8	ro
37	Lost Link Counter Port 2 (Bus)	Unsigned8	ro
38	Lost Link Counter Port 3 (Bus)	Unsigned8	ro
39	FMMU’s supported (Bus)	Unsigned8	ro

Subindex	Description	Type	Access
40	Sync Managers supported (Bus)	Unsigned8	ro
41	RAM Size in kByte (Bus)	Unsigned8	ro
42	Port Descriptor (Bus)	Unsigned8	ro
43	ECS Type (Config)	Unsigned8	ro
44	Slave is optional (Config)	Bool32	ro
45	Slave is present (Bus)	Bool32	ro
46	Hot connect group ID	Unsigned32	ro

7.9.5.2 CoE Slave Configuration Objects: 0x8000-0x8FFF

Object Type: RECORD, Manufacturer Specific Identity 0x45

The configuration data contain information about the EtherCAT slaves.

Subindex	Description	Type	Access
0	Number of Entries	Unsigned8	ro
1	Fixed Station Address	Unsigned16	ro
2	Type	Visible_String[64]	ro
3	Name	Visible_String[64]	ro
4	Device Type	Unsigned32	ro
5	Vendor ID	Unsigned32	ro
6	Product Code	Unsigned32	ro
7	Revision Number	Unsigned32	ro
8	Version Number	Unsigned32	ro
33	Mailbox Out Size (if mailbox slave)	Unsigned16	ro
34	Mailbox In Size (if mailbox slave)	Unsigned16	ro

7.9.5.3 CoE Slave Information Objects: 0x9000-0x9FFF

Object Type: RECORD, Manufacturer Specific Identity 0x46

Information about the connected EtherCAT-Slaves can be found in the information data. They are available when the scan command has been executed.

Subindex	Description	Type	Access
0	Number of Entries	Unsigned8	ro
1	**Fixed Station Address** of the Nth EtherCAT slave found (same value as 0xF040: 01)	Unsigned16	ro
5	**Vendor ID** of the Nth EtherCAT slave found (entry 0x1018: 01 of the EtherCAT slave)	Unsigned32	ro
6	**Product Code** of the Nth EtherCAT slave found (entry 0x1018: 02 of the EtherCAT slave)	Unsigned32	ro
7	**Revision Number** of the first EtherCAT slave found (entry 0x1018: 03 of the EtherCAT slave)	Unsigned32	ro
8	**Version Number** of the first EtherCAT slave found (entry 0x1018: 04 of the EtherCAT slave)	Unsigned32	ro
32	**DL Status** (Register 0x110-0x111) of the Nth EtherCAT slave found.	Unsigned16	ro

7.9.5.4 CoE Slave Diagnosis Data Objects: 0xA000-0xAFFF

Object Type: RECORD, Manufacturer Specific Identity 0x47

The diagnostics data contain status and diagnostics information of the EtherCAT slaves or the connections of the EtherCAT slaves.

Subindex	Description	Type	Access
0	**Number of Entries**	Unsigned8	ro
1	**AL Status** (Register 0x130-0x131) of the Nth EtherCAT slave configured.	Unsigned16	ro
2	**AL Control** (Register 0x120-0x121) of the Nth EtherCAT slave configured.	Unsigned16	r/w

7.9.6 CoE Device Area Objects: 0xF000-0xFFFF

Index	Object Type	Name	Type
0xF000	RECORD	Modular Device Profile	DeviceProfile (0x48)
0xF002	RECORD	Detect Modules Command	DetectCmd (0x49)
0xF020 ... 0xF02F	RECORD	Configured Address List	ConfAddrList (0x50)
0xF040 ... 0xF04F	RECORD	Detected Address List	ConnAddrList (0x51)

7.9.6.1 Modular Device Profile Object 0xF000

Object Type: RECORD, Manufacturer Specific Identity 0x48

Subindex	Description	Type	Access
0	**Number of Entries**	Unsigned8	ro
1	**Index distance** between two modules. This value is always read as 1.	Unsigned16	ro
2	**Maximum number of EtherCAT slaves** connected to the EtherCAT bus. This value is read as 512.	Unsigned16	ro
3	**Available entries in objects 0x8xxx** (number of configured slaves).	Unsigned32	ro
4	**Available entries in objects 0x9xxx** (number of connected slaves).	Unsigned32	ro

7.9.6.2 Configured Address List Object 0xF020-0xF02F

Object Type: RECORD, Manufacturer Specific Identity 0x50

Subindex	Description	Type	Access
0	**Number of Entries**	Unsigned8	ro
1	Fixed Station Address of the first EtherCAT slave configured.	Unsigned16	ro
2	Fixed Station Address of the second EtherCAT slave configured.	Unsigned16	ro
…	…		ro
255	Fixed Station Address of the 255. EtherCAT slave configured.	Unsigned16	ro

Subindex	Description	Type	Access
0	**Number of Entries**	Unsigned8	ro
1	Fixed Station Address of the 256. EtherCAT slave configured.	Unsigned16	ro
…	...		

7.9.6.3 Detected Address List Object 0xF040-0xF04F

Object Type: RECORD, Manufacturer Specific Identity 0x51

Subindex	Description	Type	Access
0	**Number of Entries**	Unsigned8	ro
1	Fixed Station Address of the first EtherCAT slave detected.	Unsigned16	ro
2	Fixed Station Address of the second EtherCAT slave detected.	Unsigned16	ro
...	...		ro
255	Fixed Station Address of the 255. EtherCAT slave detected.	Unsigned16	ro
0	**Number of Entries**	Unsigned8	ro
1	Fixed Station Address of the 256. EtherCAT slave detected.	Unsigned16	ro
...	...		

7.10 Deployment *SPEED7 EtherCAT Manager*

7.10.1 Overview

Properties

- Serves to configure EtherCAT master.
- Is called within the *SPEED7 Studio*.
- Synchronizes the address areas with the *SPEED7 Studio*.
- Saves the configuration in the *SPEED7 Studio* project.
- Expanded functionality by choose-able *'Expert'* mode.

Functions

- Automatic configuration
- Manual configuration
- Diagnosis

Starting the *SPEED7 EtherCAT Manager*

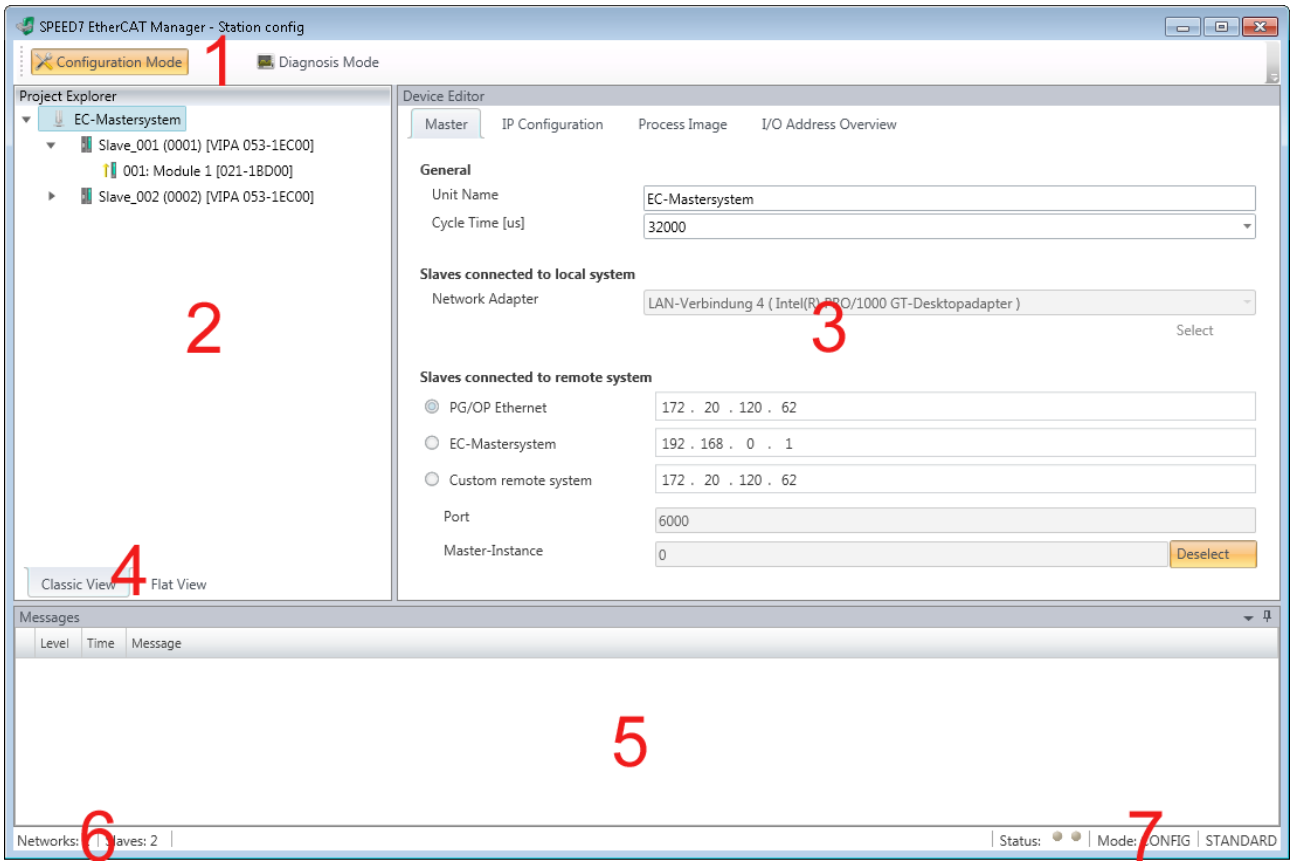
In *SPEED7 Studio* you can call via the *'Project tree'*, *'Field periphery'* of the EtherCAT CPU the *SPEED7 EtherCAT Manager* with *'Bus system properties'*.

Exit the *SPEED7 EtherCAT Manager*

By clicking at [X] in the *SPEED7 EtherCAT Manager*, the dialog is closed and the configuration is taken to the *SPEED7 Studio*.

Work environment of the *SPEED7 EtherCAT Manager*

The work environment of the *SPEED7 EtherCAT Manager* is divided into the following parts:



1 Tool bar: Here you can switch between *Configuration* and *Diagnosis*.
2 Project explorer: Here master and slave stations of your system are listed.
3 Device editor: Properties dialog of a device (parameter) respectively information area.
4 Selection of the view: In *Classic View* all the subordinate stations are shown indented. In *Flat View* all the subordinate stations are shown at the same level.
5 Here all the messages are listed.
6 In this section you can find the number of networks and slave stations.
7 Status area: With an online connection the 2 *Status* LEDs flash alternately. At *Modus* it is shown whether you are in operating mode *Diagnosis* or *Configuration*, followed by the selected dialog sight *Standard* respectively *Expert*.

'Expert mode'

In *SPEED7 Studio* you can call via the *'Project tree'*, *'Field periphery'* of the EtherCAT CPU the *SPEED7 EtherCAT Manager* with *'Bus system properties (Expert)'*. When enabled, the properties dialogs are extended accordingly. In *'Expert mode'* you will have the full scope of the *SPEED7 EtherCAT Manager*. Additionally in the status area *'Expert'* is shown.

Input area - numeric format

Some input fields have [Dec] respectively [Hex] buttons. By selecting the corresponding button you can select the input format *decimal* respectively *hexadecimal* for the input field.

7.10.2 Automatic configuration of a slave system

Precondition

The automatic configuration assumes that your EtherCAT system is mounted and can be reached on-line.

There are the following possibilities for on-line connection:

- Slaves connected to the local system
  - You are directly connected to a slave station via EtherCAT by means of a separate network adapter. Here the on-line connection is established by specifying the *Network Adapter*.
- Slaves connected to remote system
  - You are connected to the PG/OP channel of your CPU and can use this to access the EtherCAT master. The on-line connection is established by specifying *IP Address*, *Port* and *Master Instance*. With VIPA *Port* 6000 and *Master Instance* 0 is to be set.

Proceeding

1. Open if not already done the *SPEED7 EtherCAT Manager*
2. Click in the *'Project Explorer'* at *'EC-Mastersystem'*
3. Set depending on the on-line access in the *'Device Editor > Master'* as follows:
   - If you are directly locally connected to a slave station via EtherCAT by means of a separate network adapter, select your *Network adapter* and click at [Select].
   - If you are connected to the PG/OP channel of you CPU, please enter *IP Address*, *Port* and *Master Instance* and click at [Select]. With VIPA set *Port* to 6000 and *Master Instance* to 0.

   ⇨ The *SPEED7 EtherCAT Manager* uses the set connection for communication. By clicking on [Deselect] you can change the connection parameters.

   When called from the SPEED7 Studio the IP address is taken from your project. If you change the IP address you need to adjust this in your project and start the SPEED7 EtherCAT Manager again!
4. Click in the *'Project Explorer'* at *'EC-Mastersystem'* and select from the context menu *'Scan EtherCAT network'*

   ⇨ You might be asked if you want to delete the existing slaves. Confirm with [Yes].

   Then the master is listed with its slaves and the associated PDO configuration in the *'Project Explorer'*, which was found by the network scan. The system can now be configured accordingly.

If there is no connection possible with the local master, the an anti virus software could block the connection. Then disabling the packet filter of the protocols of the network card in the anti virus software could help.

7.10.3 Manual configuration of a slave system

Precondition

With the manual configuration the system need not be built and connected online. The system can freely be configured in the *SPEED7 EtherCAT Manager*.

Proceeding

1. Open if not already done the *SPEED7 EtherCAT Manager*.
2. Click in the *'Project Explorer'* at *'EC-Mastersystem'* and select from the context menu *'Insert Slave'*.
   ⇨ A dialog opens to insert slave systems
3. Select the according slave from the list, enter the number of slaves and confirm with [OK].
   ⇨ The corresponding slave systems are inserted and can be configured now.

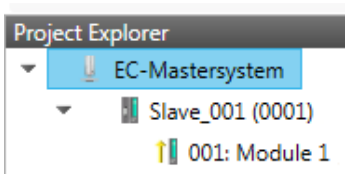
7.10.4 Configuration - EC-Mastersystem

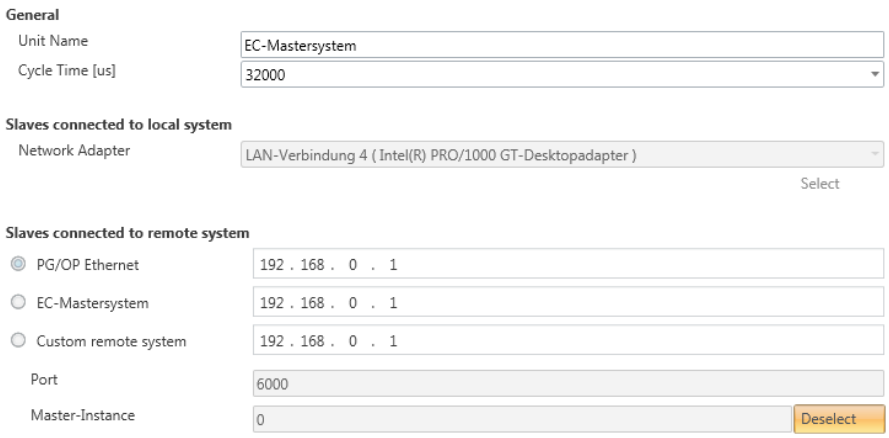
7.10.4.1 Preparation

Click in the Toolbar at [Configuration] and select *'EC-Mastersystem'* in the *'Project Explorer'*. As soon you have configured at least one slave station, the following registers are available:

- Master
- Process Image
- Advanced Options - only at *'Expert mode'*
- Distributed Clocks - only at *'Expert mode'*
- I/O Address Overview

7.10.4.2 Master





Here you can perform master and bus-specific settings.

- General
  - Unit Name: Name of the master
  - Cyclic time: Interval in µs, in which the process data are read and written (PDO cycle time).
- Slaves connected to the local system
  - You are directly connected to a slave station via EtherCAT by means of a separate network adapter. Here the on-line connection is established by specifying the *Network Adapter*.
- Slaves connected to remote system
  - You are connected to the PG/OP channel of your CPU and can use this to access the EtherCAT master. The on-line connection is established by specifying *IP Address*, *Port* and *Master Instance*.

    IP Address: Enter the IP Address of the PG/OP channel of the remote CPU.

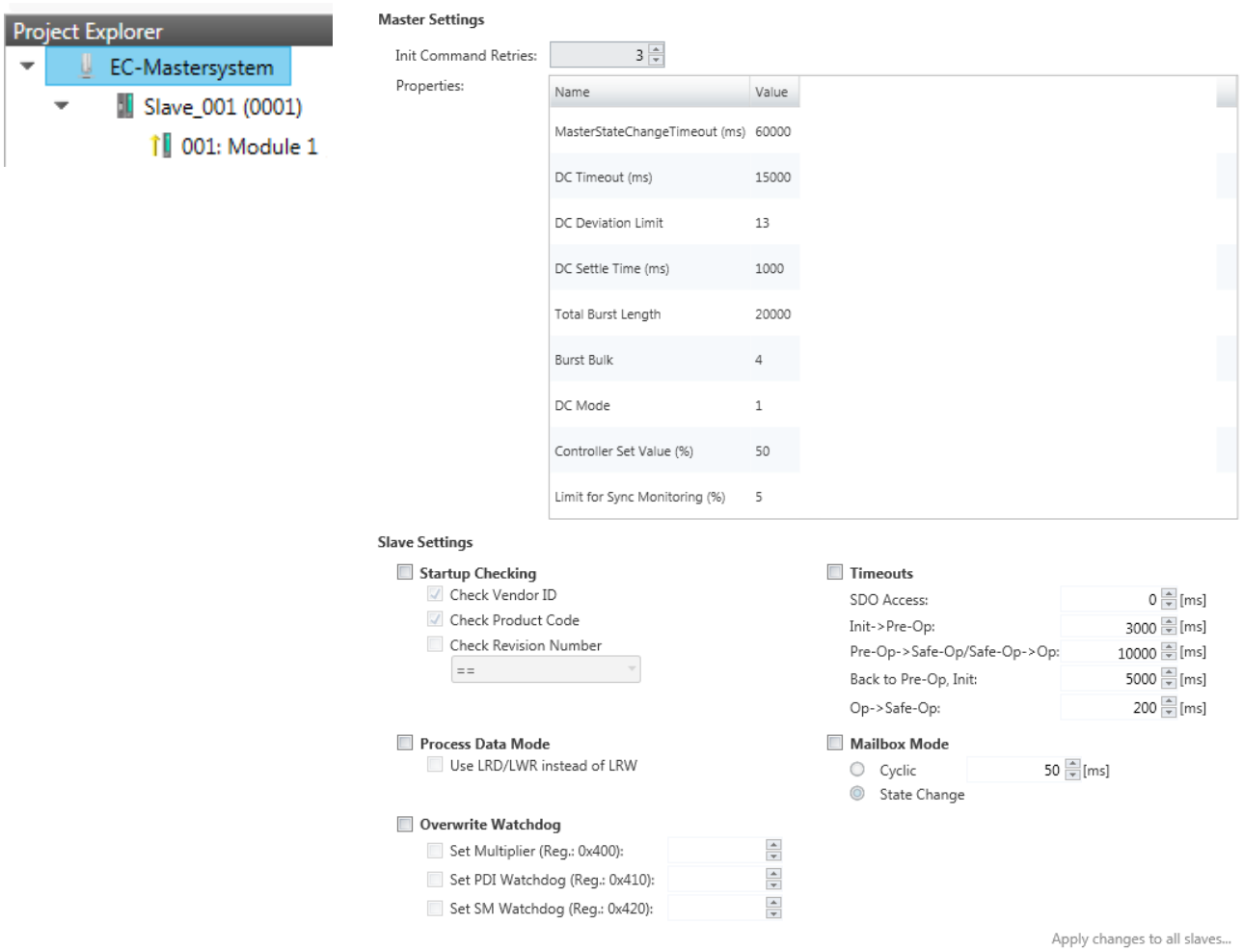
    Port: Port, over which the communication takes place with the remote CPU. With VIPA use Port 6000.

    Master-Instance: Serves for the master instance of the remote system. With VIPA the master instance is 0.

With [Select] the *SPEED7 EtherCAT Manager* uses the set connection for communication. By clicking on [Deselect] you can change the connection parameters.

When called from the SPEED7 Studio the IP address is taken once from your project. If you change the IP address you need to adjust this in your project and then start the SPEED7 EtherCAT Manager again.

7.10.4.3 Advanced Options (Expert mode)



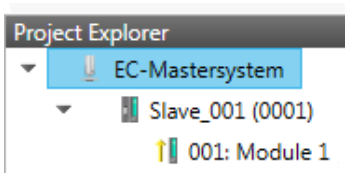
This dialog is only visible in the *'Expert mode'*! In this dialog the parameters of the master system can be adjusted and the default settings for all the slave stations can be defined.

- Master Settings
  - Init Command Retries: Number of retries, beyond which a transmission error is returned. (default: 3)
  - MasterStateChangeTimeout: Here you can define a timeout for the state change of the master and its slave stations (default: 60000ms). If the *MasterStateChangeTimeout* is too short, the EtherCAT master reports the error message 0xED21.
  - DC Timeout: Timeout for the initialization of the synchronization of the distributed clocks. Here offset and propagation of the distributed clocks are evaluated. (default: 15000ms)
  - DC Deviation Limit: Maximum permissible deviation between the distributed clocks of the slave stations. The deviation is only evaluated if in the configuration of the EC-Mastersystem at *'DC clocks'* the parameter *'Sync Window Monitoring'* is activated. (default: 13) *Chapter 7.10.4.4 'Distributed Clocks (Expert mode)' on page 253*
  - DC Settle Time: During start-up the slave stations "oscillate" with the reference clock. Here you can specify settle time to avoid additional bus load due to multiple notifications. (default: 1000ms)
  - Total Burst Length: Number of burst frames that are sent in total. (default: 20000)
  - Burst Bulk: Maximum number of burst frames that are sent until the response is received to earlier messages. (default: 4)
  - DC Mode: Mode of distributed clocks - possible value:
    0: deactivated
    1: Busshift (default)
    2: MasterShift
    3: MasterRefClock
  - Controller Set Value: Deviation of the cyclic telegram from the base time of the distributed clocks on the bus. (default: 50%)
  - Limit for Sync Monitoring: Deviation for InSyncMonitoring. (default: 5%)
- Slave Settings
  - In this area default parameters can be applied for all the slave stations. The settings are applied for all slave stations as default stetting by clicking on [Apply changes (to all slaves)]. By selecting the slave station in the *'Project Explorer'* you always have the possibility to customize the slave parameters via the register *'Advanced Options'*.

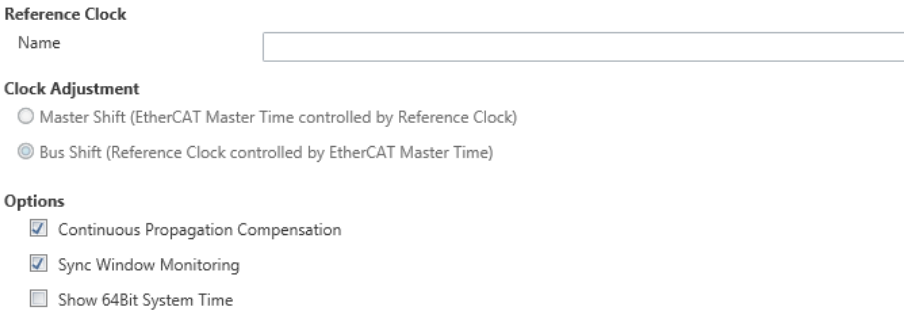
- Slave Settings - Parameters
  - Start-up checking: Here you can define the items, the EtherCAT master has to check during the transition *'Init→Pre-Op'*.
  - Process Data Mode: Here you specify the command that should be used for process data access.
    'LRD/LWR:' Read access with **L**ogical-**R**ea**d** command to inputs and write access with **L**ogical-**Wr**ite command to outputs. This needs 2 frames.
    LRW: With one **L**ogical-**R**ea**d**-**L**ogical-**Wr**ite command inputs are read and also outputs are set. This needs 1 frame.
    Use *'LRD/LWR'* for cable redundancy and *'LRW'* for slave-to-slave-copy.
  - Overwrite Watchdog: Writes the configured value in the relevant register of the slave station. Here among others you can set the time of the *'SM Watchdog'* (SyncManager-Watchdog).
  - Timeouts:
    'SDO Access': Internal master timeout for SDO access
    'Init→Pre-Op': Internal master timeout for slave state change from *Init* to *Pre-Op*
    'Pre-Op→Safe-Op/Safe-Op→Op': Internal master timeout for slave state change from *Pre-Op* to *Safe-Op* and then to *Op.*
    'Back to Pre-Op, Init': Internal master timeout for slave state change to *Pre-Op* and *Init*
    'Op→Safe-Op': Internal master timeout for slave state change from *Op* to *Safe-Op* *Chapter 7.1.2 'EtherCAT State Machine' on page 190*
  - Mailbox Mode: The *'Mailbox'* is an a-cyclic communication channel. Here mostly *'Emergencies'* messages and *'SDOs'* are buffered. The way of accessing the just unread mailbox data can be specified here.
    'Cyclic': Interval in ms within which the mailbox is to be read (polling mode). If you want short interrupt response times, you should select the mode *'Cyclic'* and set a short time e.g. 1ms.
    'State change': The mailbox is read only on a state bit change.

- *When changing the 'Process Data Mode' you have to refresh the addresses in the Register 'Process Image'.*
- *If the Process Data Mode 'LRW' is used, the input and the output address of the EtherCAT process image must be identical. Here address leaks can occur between slave stations. If an EtherCAT address exceeds the maximum address area of the CPU, the current configuration gets invalid. You need to reduce the configuration or change to process data mode 'LRD/LWR'.*
- *If you use long cycle times (> 100ms) you should always accordingly raise the 'SM Watchdog'. Otherwise your slave station changes after laps of 'SM Watchdog' time to Safe-Op and releases OB 86. From now on you can only manually set the slave to Op!*

7.10.4.4 Distributed Clocks (Expert mode)



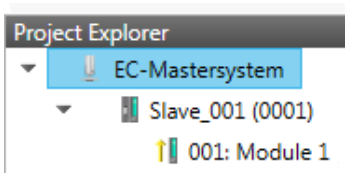
Due to the hardware, with local connections the function 'distributed clocks' is not supported.

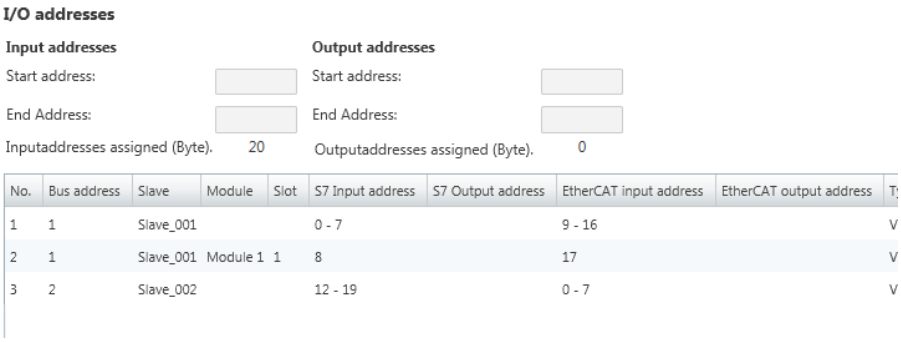


This dialog is only visible in the *'Expert mode'*! Here you can adjust the clock functionality accordingly. In EtherCAT "Distributed Clocks" means a logical combination of "clocks", which are located in the EtherCAT devices. With this there is the possibility to locally provide a synchronized time in each bus device. If an EtherCAT device supports the Distributed Clocks functionality, it has its own clock. After PowerON this first locally works, based on an own pulse generator. By selecting an EtherCAT slave station, which has to provide the reference time, the distributed clocks can be synchronized. This reference clock so represents the system time.

- Reference clock: Here you get information about the clock, which provides the reference time.
  - Name: Name of the reference clock. Per default this is always the 1. slave station, which supports the "Distributed Clock (DC)" functionality.
- Clock adjustment
  - Master Shift: The EtherCAT master time is synchronized by the reference clock.
  - Bus Shift: The reference clock is synchronized by the EtherCAT master time.
- Options
  - Continuous Propagation Compensation: A command (datagram) will be inserted in the cyclic frame which allows the EtherCAT master to measure and compensate the propagation delay time by time.
  - Sync Window Monitoring: A command (datagram) will be inserted in the cyclic frame to read the ESC registers 0x092C. If this is selected the master will throw a notification about the state (*sync* respectively *out-of-sync*) of your system.
  - 64bit system time: Master supports slaves with 32bit and 64bit system time register (0x0910). If this is selected he will interpret it as 64bit system time.

7.10.4.5 Process Image



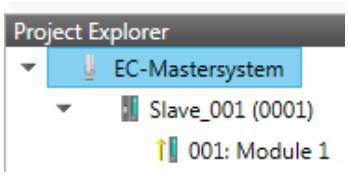


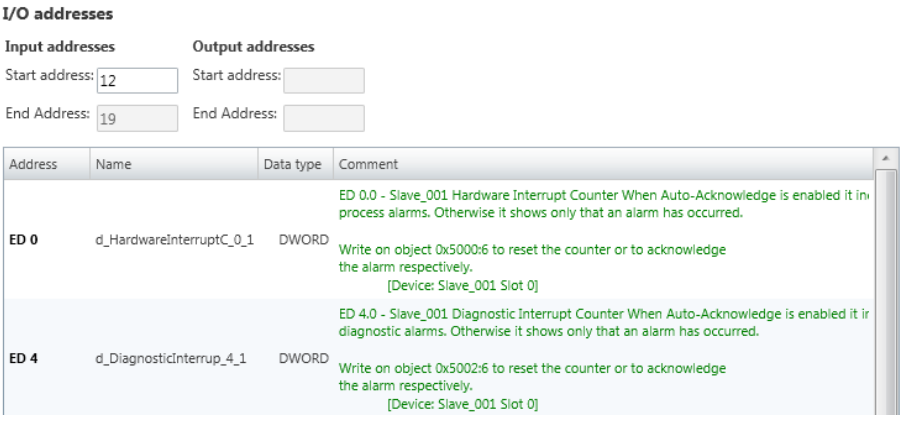
Here you have a list of S7 respectively EtherCAT addresses, which are used by the modules of all the slave stations. The *'S7 address'* corresponds to the address in the address area of the CPU. By entering a new *'Start Address'* you can adjust the S7 addressing of the input and output areas of the modules accordingly.

Information about the assignment of the in/output area can be found in the manual of your module.

The *'I/O Addresses EtherCAT'* are only visible in *'Expert mode'*!
'I/O Addresses EtherCAT' are the offset addresses, which are used within the EtherCAT process image. You cannot change the address. You can use the addresses e.g. for EtherCAT network analysis.

7.10.4.6 I/O Address Overview





Here you have a list of addresses that are used by the I/O components of all the modules in the address area of the CPU. By entering a new *'Start address'* you can adjust the addressing of the input and output areas accordingly. You can edit *'Name'* and *'Comment'* by clicking at the corresponding entry.

Information about the assignment of the in/output area can be found in the manual of your module.

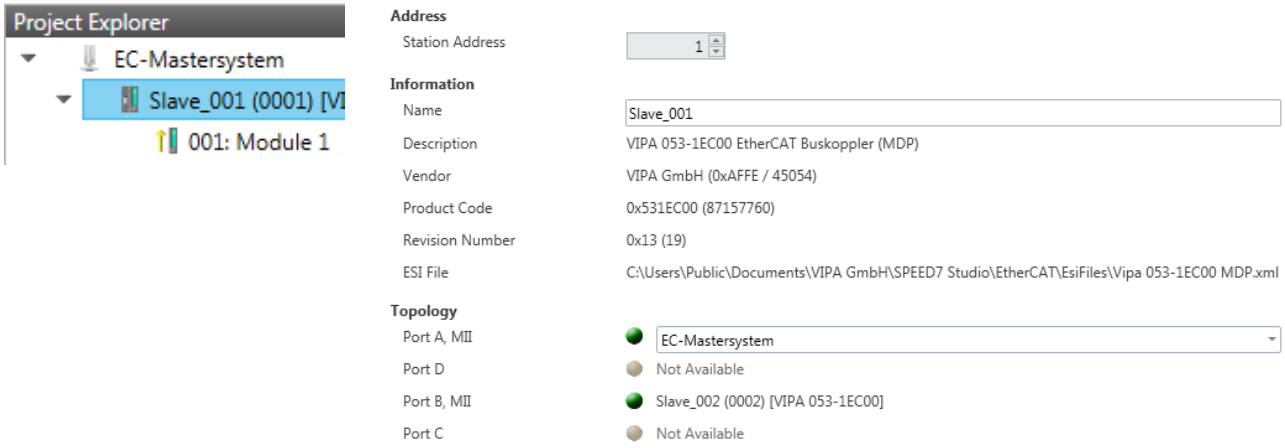
7.10.5 Configuration - slave station

7.10.5.1 Preparation

Click in the Toolbar at [Configuration] and select the Slave-Station *'Slave_...'* in the *'Project Explorer'*. The following registers are available now:

- General
- Modules
- PDO Mapping
- Group - if a group exists for this slave station *Chapter 7.10.9 'Grouping logic' on page 272*
- Advanced Options - only at *'Expert mode'*
- Distributed Clocks - if supported - only at *'Expert mode'*
- Init Commands - only at *'Expert mode'*
- CoE Object Dictionary - only at *'Expert mode'*
- Process Image
- I/O Address Overview

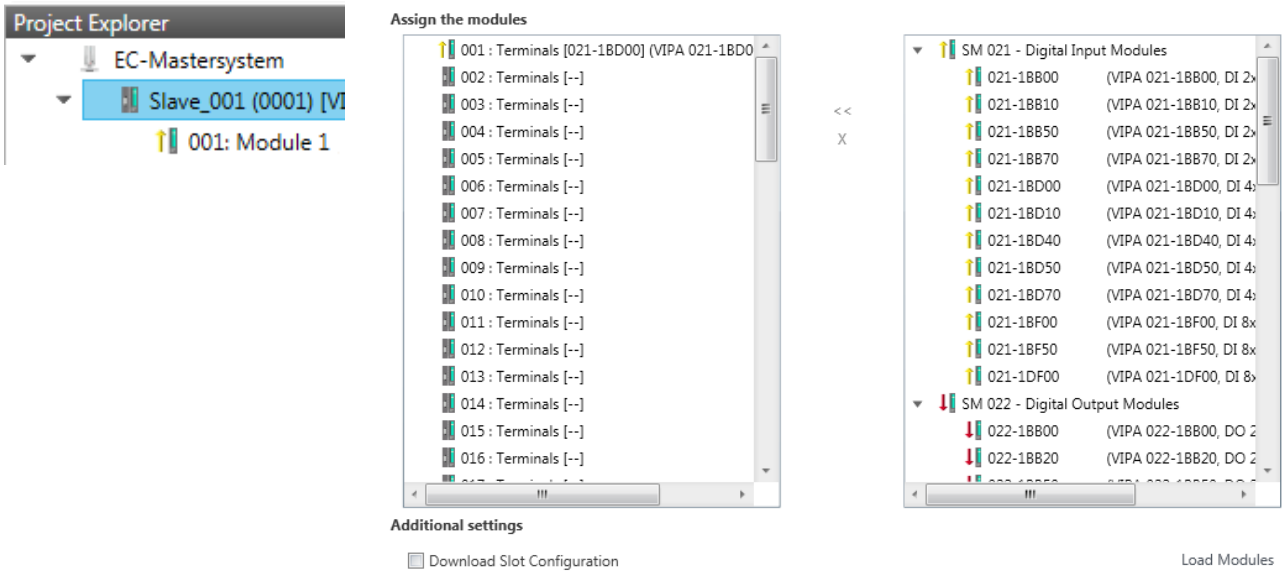
7.10.5.2 General



Here you can perform slave-specific settings such as assignment of name and address to a station. It is also possible to change the connection to the station.

- Address:
  - Station Address: EtherCAT address of the slave station.
- Information
  - Name: Name of the slave station can be assigned accordingly
  - Description: Description of the slave station
  - Vendor: Name of the vendor
  - Product Code: Internal product code of the slave station
  - Revision Number: Internal revision number of the slave station
  - ESI file: Path and name of the device file, in which the data of the slave station is stored.
- Topology
  - Port A / Port B: Here you will find the device that is connected to the corresponding port.

7.10.5.3 Modules



With an E-Bus slave this dialog is hidden. ↬ *'Slave types' on page 272*

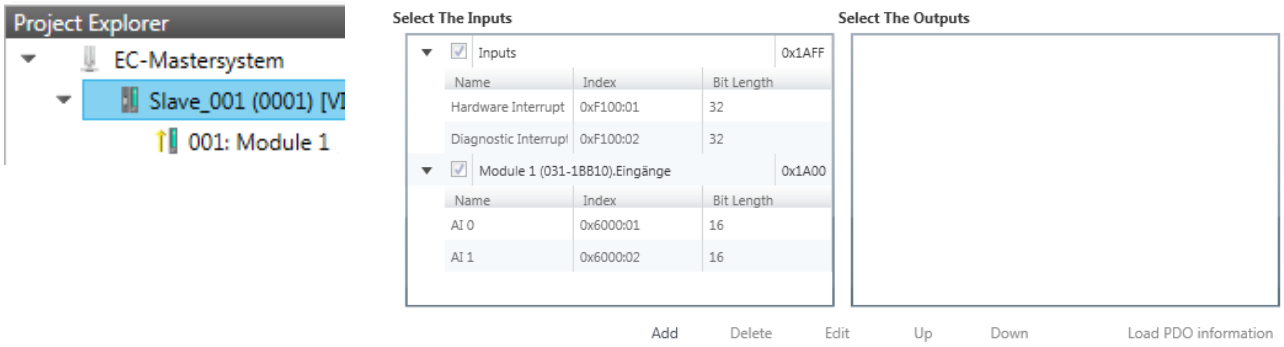
In this dialog you can assign modules to the appropriate slot.

- Assign module to a slot ("<<")
  Select your module from the list on the right and add it to a selected slot *'Terminals'* in the left list by clicking [<<]. This takes place according to the following rules:
  – If no modules are configured, the module is connected to the highlighted slot. Each additional module is inserted below.
  – If modules are already exist, the module is added to the highlighted slot and the following modules are moved accordingly.
- Remove module from a slot ("X")
  – Select from the left list the appropriate slot, which you want to disconnect from the module again and click at ["X"].

There is also the possibility to add or remove slave stations via the context menu of the 'Project Explorer'.

- Option field - *'Download slot configuration'*
  When enabled, an Init Command is created, which contains the slot configuration with the unique module identifier. During start-up of the slave station the slot configuration serves for comparison between configured and inserted modules. This can prevent misconfigurations.
- Button - [Load modules]
  With this function you can load the configuration from the EtherCAT master for the selected slave station.

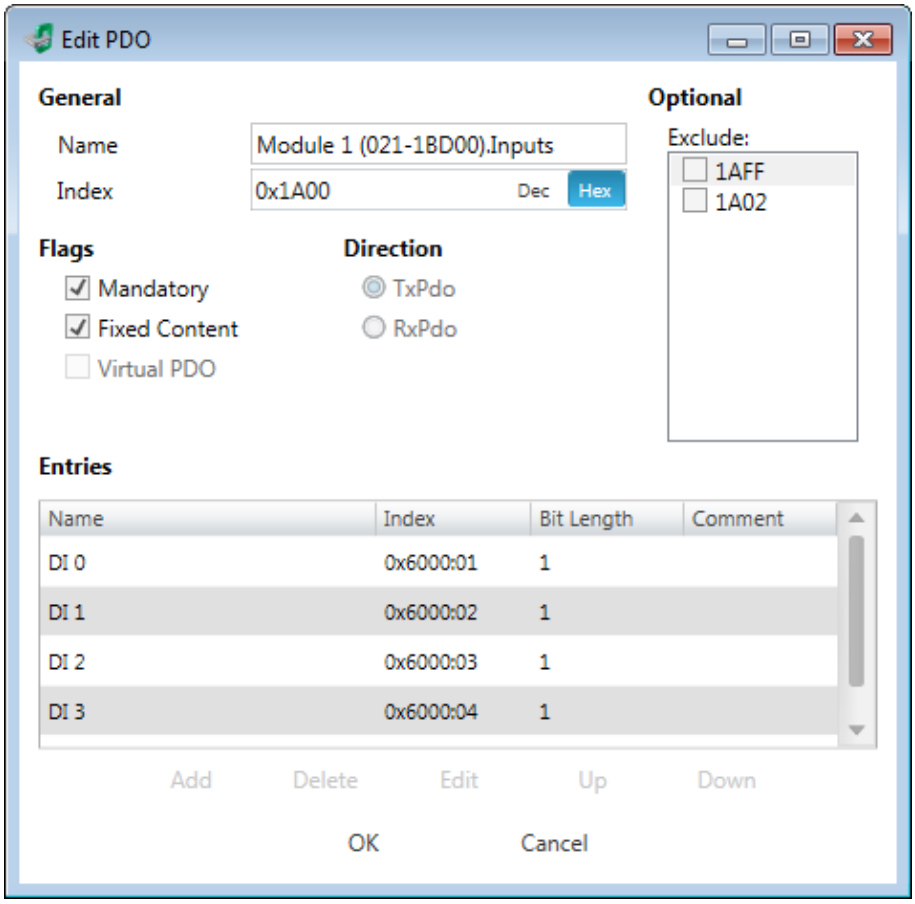
7.10.5.4 PDO Mapping



This dialog shows a list of the assigned PDOs. With some slave stations it is possible to activate respectively de-activate certain PDO configurations.

- Select the Inputs
  - If your slave station supports it, you can hide the corresponding input PDO from the configuration by disabling the checkbox.
- Select the Outputs
  - If your slave station supports it, you can hide the corresponding output PDO from the configuration by disabling the checkbox.

7.10.5.4.1 Edit PDO (Expert mode)

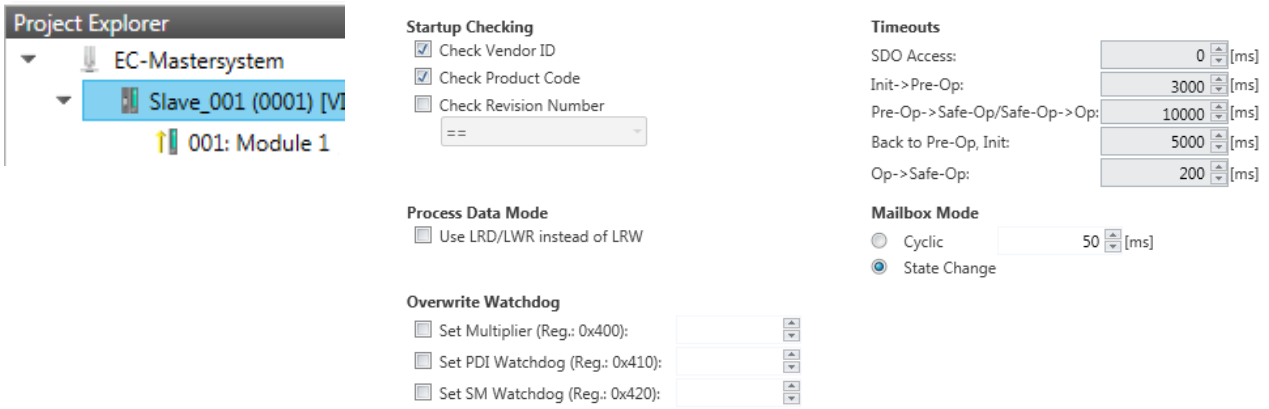


PDOs can only be edited in the *'Expert mode'*! Otherwise, the buttons are hidden. With [Edit] the dialog *'Edit PDO'* opens.

- General
  - Name: Name of the PDO
  - Index: Index of the PDO (can be entered in hexadecimal or decimal)
- Flags
  - Mandatory: If activated the PDO cannot be deleted.
  - Fixed Content: If activated the content of the PDO is write protected. to create new or to edit existing PDOs you have to disable *'Fixed Content'*.
  - Virtual PDO: If activated the PDO has no entries.
- Direction
  - TxPDO: Send PDO of the slave station for input data.
  - RxPDO: Receive PDO of the slave station for output data.
- Optional
  - Exclude: Select the PDOs which cannot be activated if this PDO is activated.
- Entries
  - Here is the list of configured PDO entries shown.

After editing the PDOs, the addresses need to be re-calculated! For this jump to register 'Process Image' and click at [Recalculate].

7.10.5.5 Advanced Options (Expert mode)

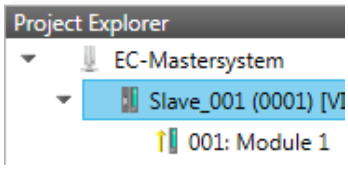


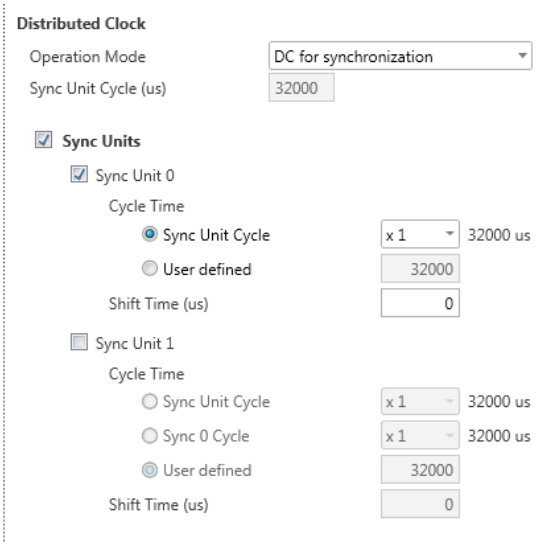
This dialog is only visible in the *'Expert mode'*! Here you can make further adjustments to the slave station.

- Slave Settings - Parameters
  - Start-up checking: Here you can define the items, the EtherCAT master has to check during the transition *'Init→Pre-Op'*.
  - Process Data Mode: Here you specify the command that should be used for process data access.
    'LRD/LWR:' Read access with **L**ogical-**R**ea**d** command to inputs and write access with **L**ogical-**Wr**ite command to outputs. This needs 2 frames.
    LRW: With one **L**ogical-**R**ea**d**-**L**ogical-**Wr**ite command inputs are read and also outputs are set. This needs 1 frame.
    Use *'LRD/LWR'* for cable redundancy and *'LRW'* for slave-to-slave-copy.
  - Overwrite Watchdog: Writes the configured value in the relevant register of the slave station. Here among others you can set the time of the *'SM Watchdog'* (SyncManager-Watchdog).
  - Timeouts:
    'SDO Access': Internal master timeout for SDO access
    'Init→Pre-Op': Internal master timeout for slave state change from *Init* to *Pre-Op*
    'Pre-Op→Safe-Op/Safe-Op→Op': Internal master timeout for slave state change from *Pre-Op* to *Safe-Op* and then to *Op.*
    'Back to Pre-Op, Init': Internal master timeout for slave state change to *Pre-Op* and *Init*
    'Op→Safe-Op': Internal master timeout for slave state change from *Op* to *Safe-Op* ↳ *Chapter 7.1.2 'EtherCAT State Machine' on page 190*
  - Mailbox Mode: The *'Mailbox'* is an a-cyclic communication channel. Here mostly *'Emergencies'* messages and *'SDOs'* are buffered. The way of accessing the just unread mailbox data can be specified here.
    'Cyclic': Interval in ms within which the mailbox is to be read (polling mode). If you want short interrupt response times, you should select the mode *'Cyclic'* and set a short time e.g. 1ms.
    'State change': The mailbox is read only on a state bit change.

- *When changing the 'Process Data Mode' you have to refresh the addresses in the Register 'Process Image'.*
- *If the Process Data Mode 'LRW' is used, the input and the output address of the EtherCAT process image must be identical. Here address leaks can occur between slave stations. If an EtherCAT address exceeds the maximum address area of the CPU, the current configuration gets invalid. You need to reduce the configuration or change to process data mode 'LRD/LWR'.*
- *If you use long cycle times (> 100ms) you should always accordingly raise the 'SM Watchdog'. Otherwise your slave station changes after laps of 'SM Watchdog' time to Safe-Op and releases OB 86. From now on you can only manually set the slave to Op!*

7.10.5.6 Distributed Clocks (Expert mode)





This dialog is only visible in the *'Expert mode'* if this is supported by your slave station! Here you can adjust the clock functionality accordingly. In EtherCAT "Distributed Clocks" (DC) means a logical combination of "clocks", which are located in the EtherCAT devices. With this there is the possibility to locally provide a synchronized time in each bus device. If an EtherCAT device supports the *Distributed Clocks* functionality, it has its own clock. After PowerON this first locally works, based on an own pulse generator. By selecting an EtherCAT slave station, which has to provide the reference time, the distributed clocks can be synchronized. This *reference clock* so represents the system time.

- Reference clock
  - Operation Mode: Here you can set the operation mode of the reference clock. More may be found in the manual of your slave station.
  - Sync Unit Cycle: Cycle time of the master. *Chapter 7.10.4 'Configuration - EC-Mastersystem' on page 248*
- Sync Units
  - Sync Unit 0

    - Cycle Time: Here you can specify the cycle time in relation to the *'Master Cycle'* or *'User defined'*.

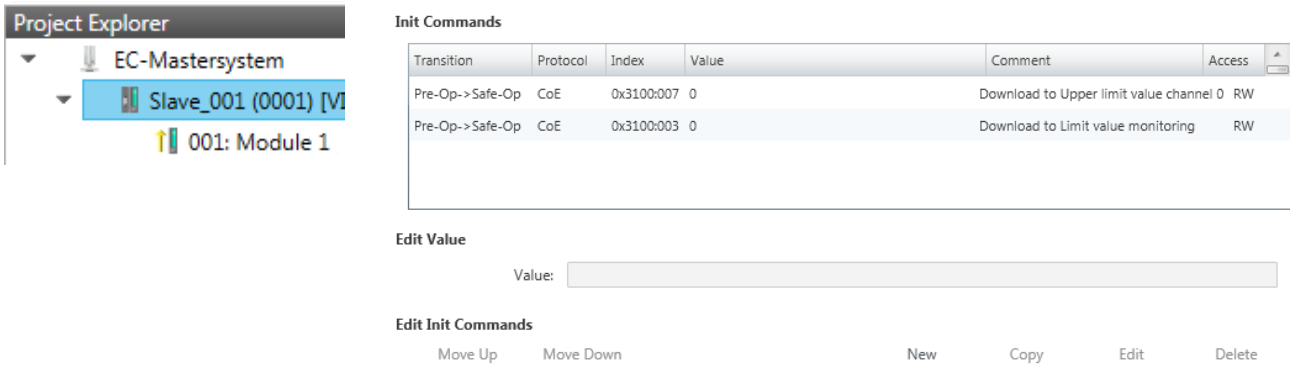
    - Time Shift: Specify here a time shift. This is used for fine adjustment.
  - Sync Unit 1

    - Cycle Time: Here you can specify the cycle time in relation to the *'Master Cycle'*, to the cycle of Sync Unit 0 *'Sync 0 Cycle'* or *'User defined'*.

    - Time Shift: Specify here a time shift. This is used for fine adjustment.

Due to the hardware with a local connection Distributed Clocks (connection via network adapter) is not supported!

7.10.5.7 Init Commands (Expert mode)



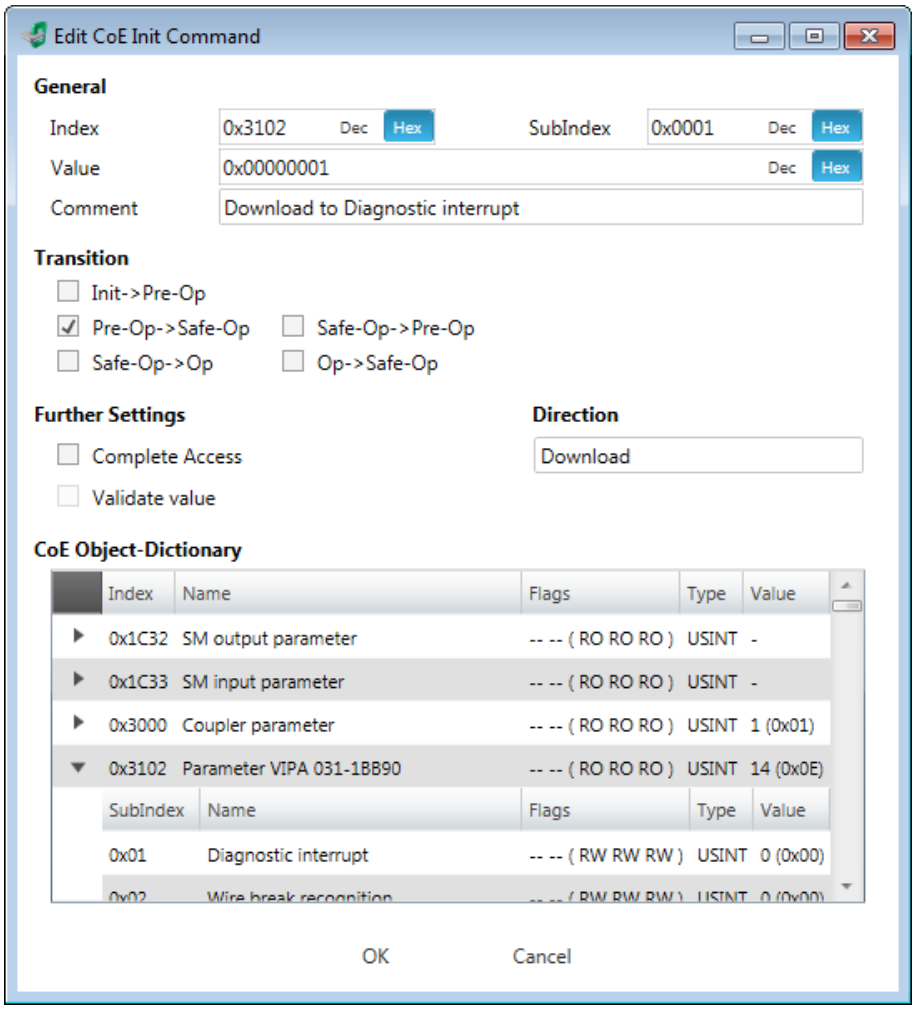
This dialog is only visible in the *'Expert mode'*!

- *For each parameter of a slave station or module, which differs from the standard setting you have to create an Init command!*
- *If a write access to an object in the configuration mode is performed, and the written value does not reflect to the default value of the object, so this command is automatically added to the 'Init Commands'.* *'CoE Object Dictionary (Expert mode) ' on page 263*

Here you can see a list of the current configured Init Commands and if it is allowed you can also add/edit/delete the commands.

- Init Commands: Init Commands come from the ESI file or are automatically generated on write access to CoE objects or can be created by the user. You either have full-access (RW = Read/ Write) or only read access (RO = Read-only). Init commands from ESI files are automatically listed here. These cannot be changed or deleted.
- Button
  - New, Copy, Edit, Delete: Used for changing Init Commands.
  - Move Up, Move Down: Moving the selected Init Command up or down.

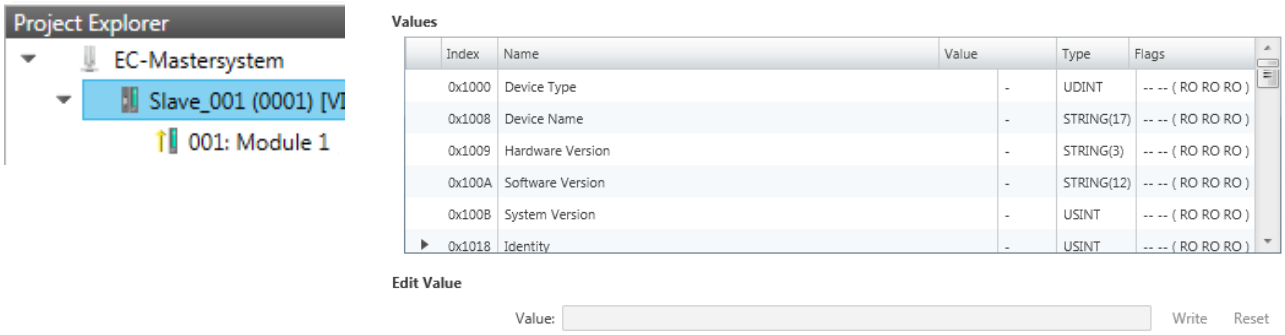
7.10.5.7.1 CoE Init Command (Expert mode)



This dialog is only visible in the *'Expert mode'*! With [New] the dialog *'Add CoE Init Command'* opens. This dialog also opens to edit CoE Init Commands, which just exist.

- General
  - Index/Subindex: CoE-Index respectively Subindex of the Init Command
  - Value: Value of the Init Command, which should be written in the chose transition (only available if *'Direction'* is set to *'Download'*). If type of data is unknown, the hex format must be used. (Example: "0011 2233 …").
  - Comment: Here you can comment your Init Command.
- Transition
  - Determines in which transition the Init Command will be executed.
- Further Settings
  - Complete Access: Determines if the complete SDO object should be written/read.
- Direction
  - Download: Writes value to slave station.
  - Upload: Reads value from slave.
- CoE Object Dictionary: Select here the value in the CoE Object Dictionary of the slave station, you want to edit.

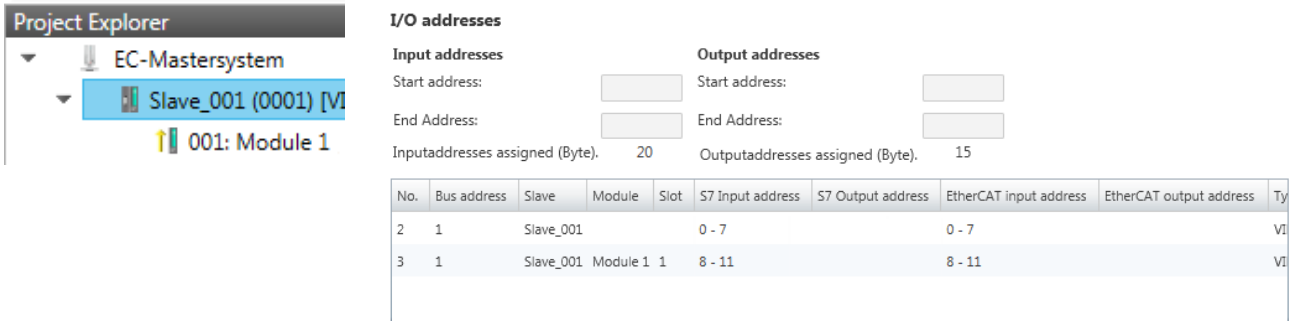
7.10.5.8 CoE Object Dictionary (Expert mode)



This dialog is only visible in the *'Expert mode'*! Here you will have read and write access to the CoE Object Dictionary of the slave station. This can be changed if your slave station permits. It is indicated by the *'Flags'* of each object, if write access is permitted. Information about the structure of the Object Dictionary can be found in the manual of your slave station.

If a write access to an object in the configuration mode is performed, and the written value does not reflect to the default value of the object, so this command is automatically added to the 'Init Commands'. *Chapter 7.10.5.7 'Init Commands (Expert mode)' on page 261*

7.10.5.9 Process Image

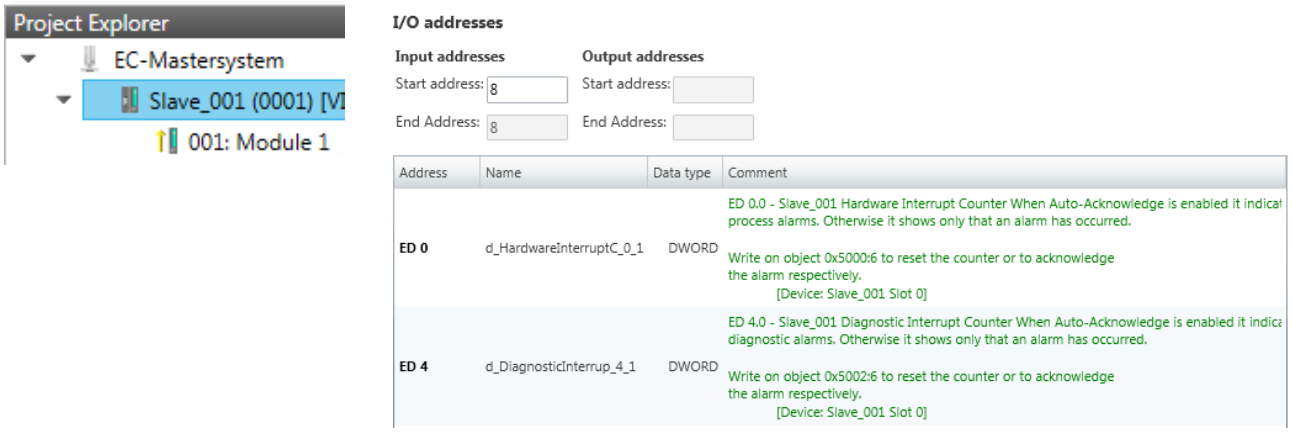


Here you have a list of S7 respectively EtherCAT addresses, which are used by the modules of the slave system. The *'S7 address'* corresponds to the address in the address area of the CPU. By entering a new *'Start address'* you can adjust the S7 addressing of the input and output areas of the modules accordingly.

Information about the assignment of the in/output area can be found in the manual of your module.

The *'I/O addresses EtherCAT'* are only visible in *'Expert mode'*! *'I/O addresses EtherCAT'* are the addresses, which are used within the EtherCAT bus. You cannot change the address. You can use the addresses e.g. for EtherCAT network analysis.

7.10.5.10 I/O Address Overview



Here you have a list of addresses, which are used by the I/O components of the modules of the selected slave system in the address area of the CPU. By entering a new *'Start address'* you can adjust the addressing of the input and output areas accordingly. You can edit *'Name'* and *'Comment'* by clicking at the corresponding entry.

Information about the assignment of the in/output area can be found in the manual of your module.

7.10.6 Configuration - modules

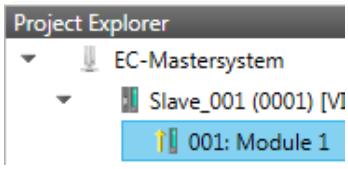
With an E-Bus slave the dialogs of the module configuration are hidden! ↳ *'Slave types' on page 272*

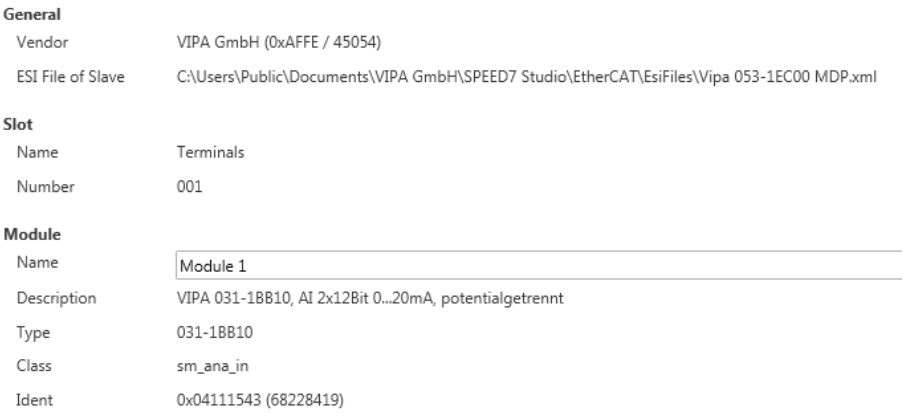
7.10.6.1 Preparation

Select in the configuration mode in the *'Project Explorer'* the module of the according slave station. The following registers are available now:

- MDP Slot Properties
- Process Image
- I/O Address Overview

7.10.6.2 MDP Slot Properties

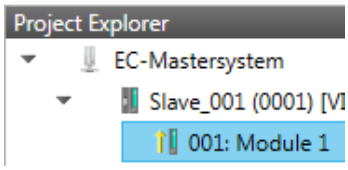


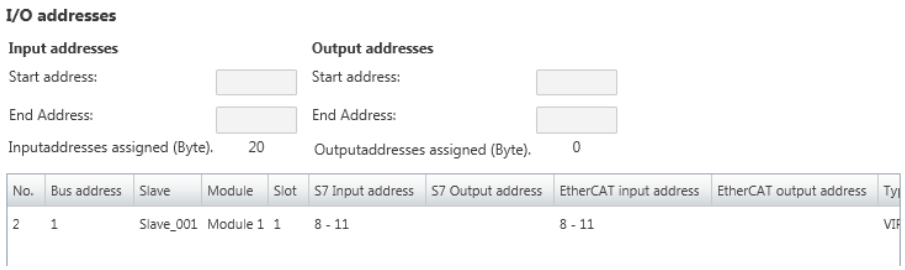


Here you can see the MDP Slot Properties of the corresponding module. This dialog serves for information. You cannot change something.

- General
  - Vendor: Name of the vendor of the module.
  - ESI file: Path and name of the device file, in which the data of the module and the associated slave station is stored.
- Slot
  - Name: Name of the slot
  - Number: Number of the slot
- Module
  - Name: Name of the module
  - Type: Order number of the module
  - Class: Module class
  - Identificator: Identification number of the according module class.

7.10.6.3 Process Image



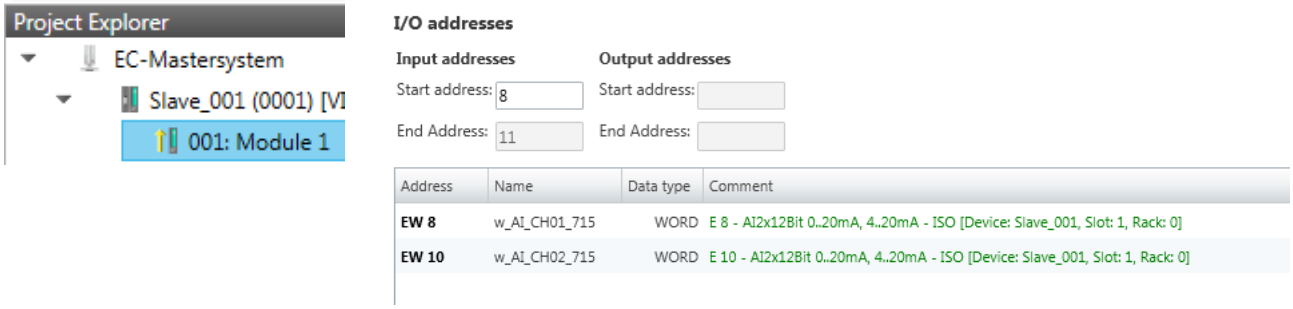


Here you have a list of S7 respectively EtherCAT addresses, which are used by the modules of all the slave stations. The *'S7 address'* corresponds to the address in the address area of the CPU. By entering a new *'Start Address'* you can adjust the S7 addressing of the input and output areas of the modules accordingly.

Information about the assignment of the in/output area can be found in the manual of your module.

The *'I/O Addresses EtherCAT'* are only visible in *'Expert mode'*!
'I/O Addresses EtherCAT' are the addresses, which are used within the EtherCAT bus. You cannot change the addresses. You can use the addresses e.g. for EtherCAT network analysis.

7.10.6.4 I/O Address Overview



Here you have a list of addresses that are used by the module in the address area of the CPU. By entering a new *'Start address'* you can adjust the addressing of the input and output areas accordingly. You can edit *'Name'* and *'Comment'* by clicking at the corresponding entry.

Information about the assignment of the in/output area can be found in the manual of your module.

7.10.7 Diagnostics - EC-Mastersystem

7.10.7.1 Preparation

To use the *'Diagnostics'* functions, you must be connected online with your EtherCAT system.

1. Click in the Toolbar at [Configuration] and select *'EC-Mastersystem'* in the *'Project Explorer'*.
2. Activate in the *'Device editor'* the register *'Master'*.
3. Set depending on the on-line access in the *'Device Editor > Master'* as follows:
   - If you are directly connected to a slave station via EtherCAT by means of a separate network adapter, select your *Network Adapter* and click at [Select].
   - If you are connected to the PG/OP channel of you CPU, please enter *IP Address*, *Port* and *Master Instance* and click at [Select]. With VIPA *Port* 6000 and *Master Instance* 0 is to be set.

   ⇨ The *SPEED7 EtherCAT Manager* uses the set connection for communication. By clicking on [Deselect] you can change the connection parameters.

4. Click in the Toolbar at [Diagnosis Mode].

⇨ An online connection to your EtherCAT system is established via the preset communication channel and the current project configuration in the *'Project Explorer'*.

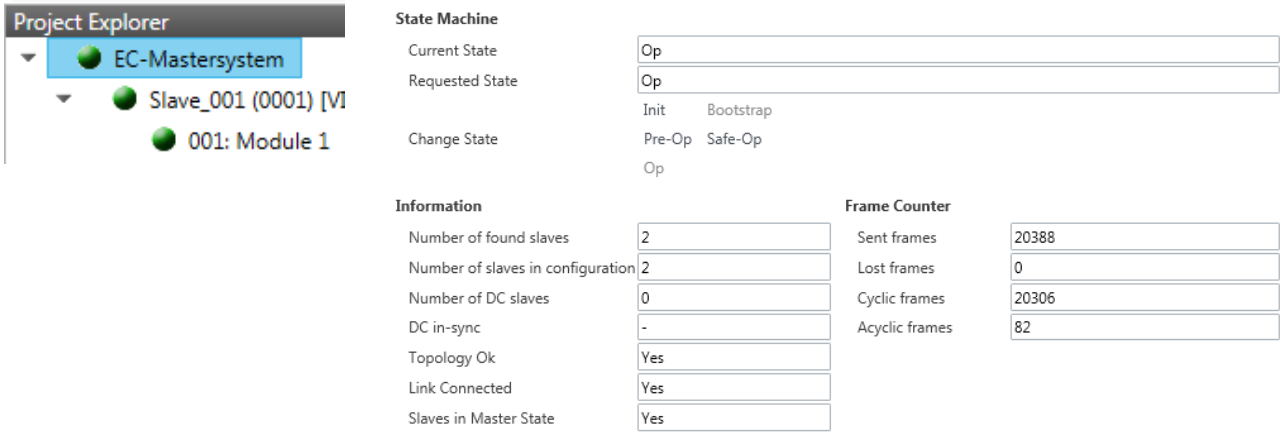
With an online connection the 2 LEDs flash alternately in the *'Status area'*. In addition *'Modus'* switches to *'Diagnosis'*.

5. Click in the *'Project Explorer'* at Master.

The following registers are available now:

- General
- CoE Object Directory

7.10.7.2 General



Colors and states

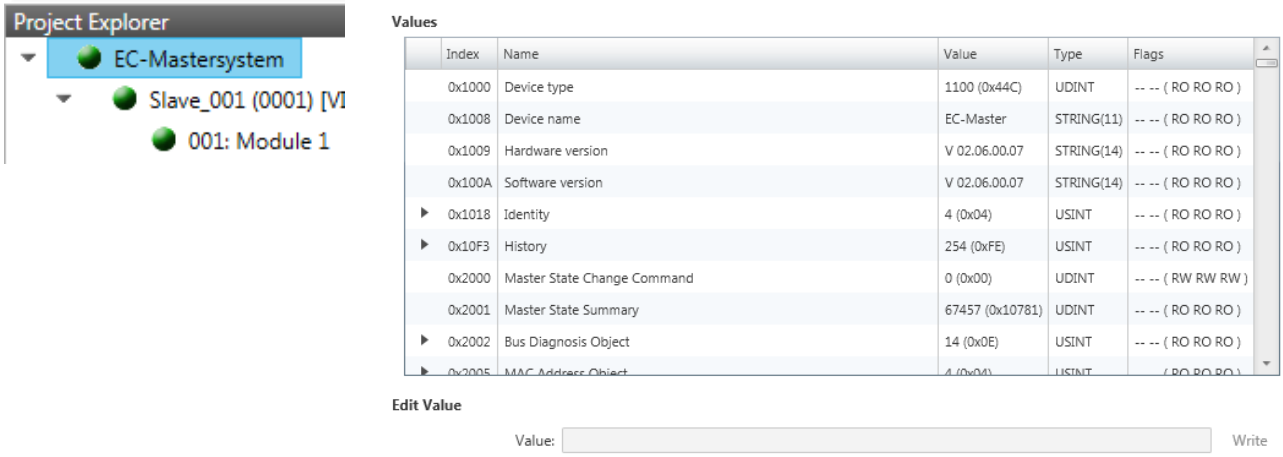
The state of the state machine can be determined via the color according to the following specifications:

Color	State of the state machine
- red	Init / Bootstrap
- blue	Pre-Op
- yellow	Safe-Op
- green	Op

Here you will get master and bus-specific information.

- State Machine
  - Current State: Shows the current state of master. *Chapter 7.1.2 'EtherCAT State Machine' on page 190*
  - Requested State: Shows the currently requested state of the master which was requested by *'Change State '*.
  - Change State: Here you can change the state of the master.
- Information
  - Number of found slaves: Shows number of found slave stations at the bus.
  - Number of slaves in configuration: Shows number of configured slave stations at the bus.
  - Number of DC slaves: Shows the number of slave stations, which support distributed clocks functionality (DC).
  - DC in-sync: If distributed clocks is configured you can find here information about the synchronization status of the system.
  - Topology OK: The *'Topology'* is OK (*'Yes'*), if the number of configured matches the number of found slave stations. Here only the mandatory slaves stations are considered.
  - Link Connected: Here you will find *'Yes'*, if there is a physical connection to the configured slave stations.
  - Slaves in Master State: Here you will find *'Yes'*, if every configured slave station is in master state.
- Frame Counter
  - Sent frames: Number of sent frames since the last power cycle.
  - Lost frames: Number of lost frames since the last power cycle.
  - Cyclic frames: Number of cyclic frames since the last power cycle.
  - Acyclic frames: Number of acyclic frames since the last power cycle.

7.10.7.3 CoE Object Directory



Here you will have read and write access to the CoE Object Dictionary of the slave station. This can be changed if your slave station permits. It is indicated by the *'Flags'* of each object, if write access is permitted. Information about the structure of the Object Dictionary can be found in the manual of your slave station.

7.10.8 Diagnostics - slave station

7.10.8.1 Preparation

To use the *'Diagnostics'* functions, you must be connected online with your EtherCAT system.

1. Click in the Toolbar at [Configuration] and select *'EC-Mastersystem'* in the *'Project Explorer'*.
2. Activate in the *'Device editor'* the register *'Master'*.
3. Set depending on the on-line access in the *'Device Editor > Master'* as follows:
   - If you are directly connected to a slave station via EtherCAT by means of a separate network adapter, select your *Network Adapter* and click at [Select].
   - If you are connected to the PG/OP channel of you CPU, please enter *IP Address*, *Port* and *Master Instance* and click at [Select]. With VIPA *Port* 6000 and *Master Instance* 0 is to be set.

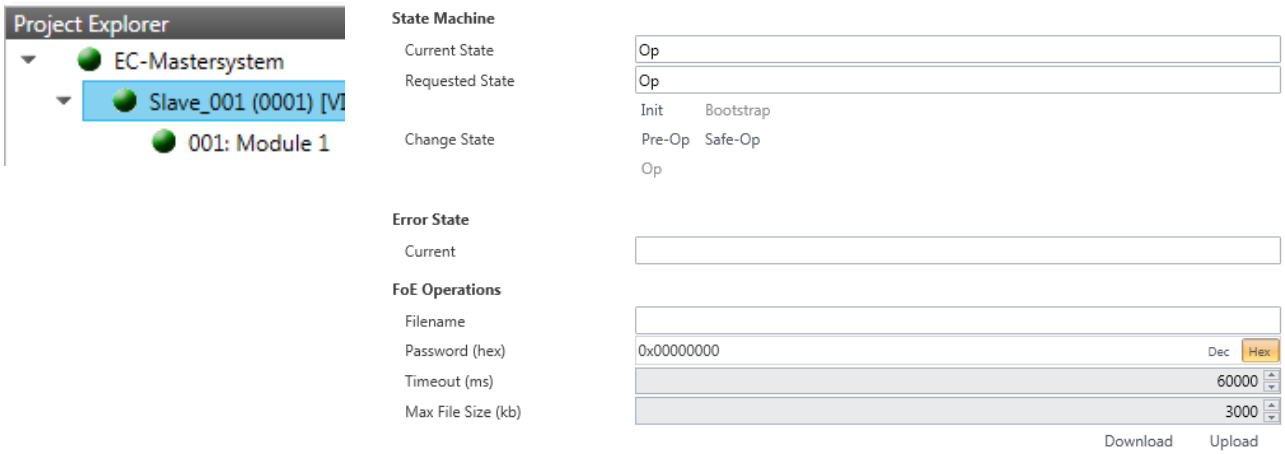
   ⇨ The *SPEED7 EtherCAT Manager* uses the set connection for communication. By clicking on [Deselect] you can change the connection parameters.
4. Click in the Toolbar at [Diagnosis Mode].

   ⇨ An online connection to your EtherCAT system is established via the preset communication channel and the current project configuration in the *'Project Explorer'*

   With an online connection the 2 LEDs flash alternately in the *'Status area'*. In addition *'Modus'* switches to *'Diagnosis'*.
5. Click in the *'Project Explorer'* at the according slave station *'Slave_...'*

   The following registers are available now:
   - General
   - ESC Register - only at *'Expert mode'*
   - EEPROM - only at *'Expert mode'*
   - Extended Diagnosis - only at *'Expert mode'*
   - DC Diagnosis - only at *'Expert mode'*

7.10.8.2 General



Colors and states

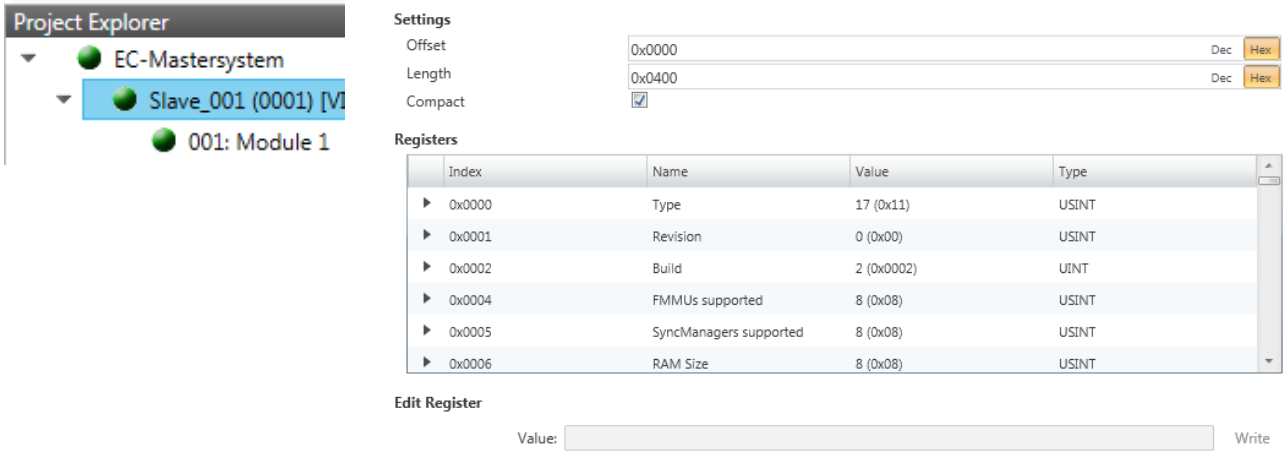
The state of the state machine can be determined via the color according to the following specifications:

Color	State of the state machine
- red	Init / Bootstrap
- blue	Pre-Op
- yellow	Safe-Op
- green	Op

- State Machine
  - Current State: Shows the current state of the state machine of the slave station. *Chapter 7.1.2 'EtherCAT State Machine' on page 190*
  - Requested State: Shows the requested state of the slave station.
  - Change State: Here you can change the state of the state machine of the slave station.
- Error State
  - Current: Slave error which occurred during state transition.
- FoE Operations (file access via EtherCAT)

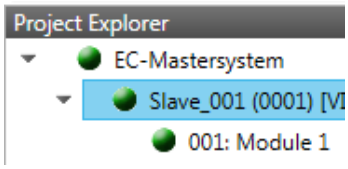
  With this function you have the possibility to transfer files between PC and slave station (if this is supported by the device). If the slave station is in state *Bootstrap*, a firmware update of the slave station can be established via FoE. Here you have to enter the file name without extension. *'Firmware update - VIPA System SLIO IM 053-1EC00' on page 277*
  - Filename: Name of the file
  - Password: Password for the access of the slave station
  - Timeout: Maximum time for data transfer
  - Max. File Size: Maximum File Size.

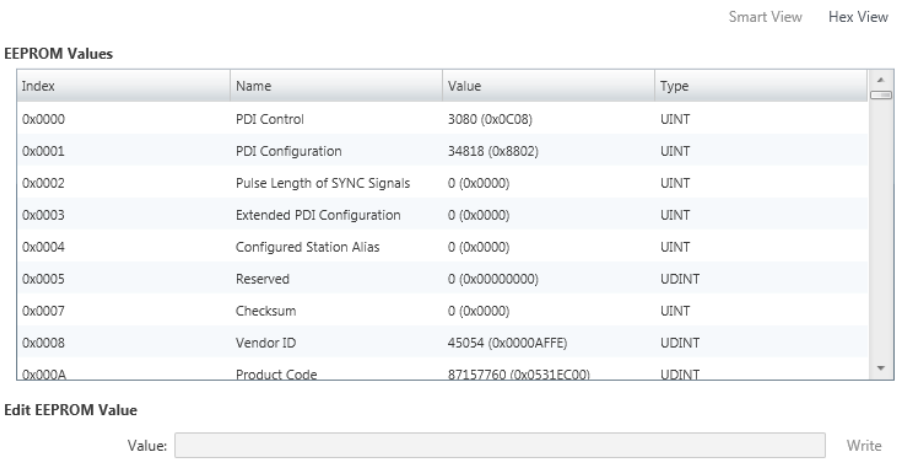
7.10.8.3 ESC Register (Expert mode)



This dialog is only visible in the *'Expert mode'*! Here you can directly access the registers of the EtherCAT ASIC. You should not make any changes here!

7.10.8.4 EEPROM (Expert mode)

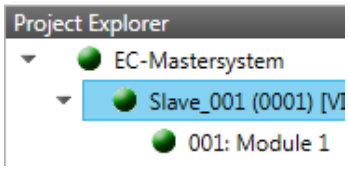


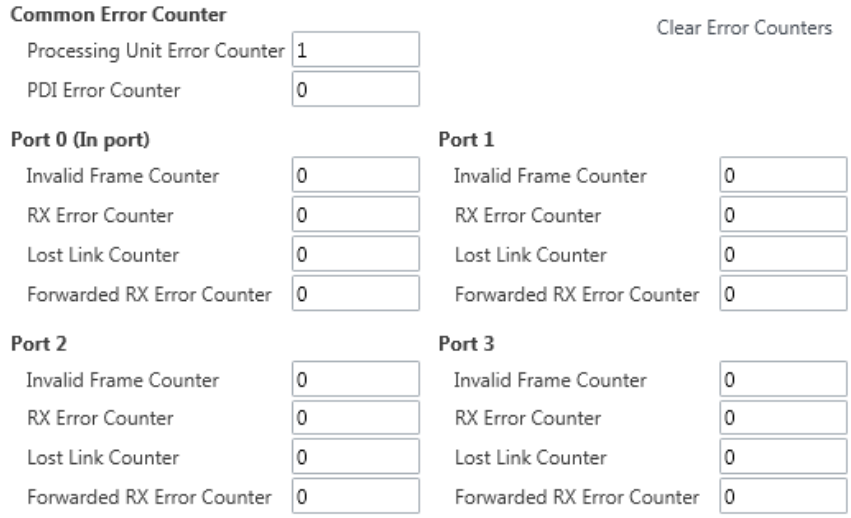


This dialog is only visible in the *'Expert mode'*! Here you can access the contents of the EEPROM of the slave station. Currently you can only change the parameter *'Configured Station Alias'*. This can be used for forming groups. *Chapter 7.10.9 'Grouping logic' on page 272*

CAUTION!
Please regard that your slave station can get unusable by entering incorrect values especially in *'Hex view'*! In this case, any warranty of the vendor is excluded!

7.10.8.5 Extended Diagnosis (Expert mode)

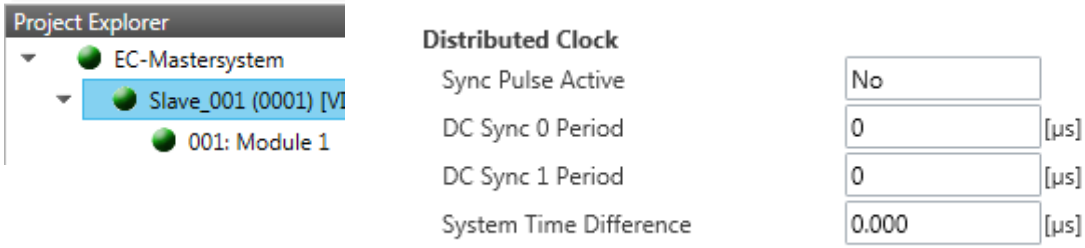




This dialog is only visible in the *'Expert mode'*!

- Common Error Counter
  - Processing Unit Error Counter: Number of received frames by the slave station, which are no EtherCAT frames.
  - PDI Error Counter: Number of PDI access errors (**P**rocess **D**ata **I**nterface). These are physical errors, which were detected by the PDI at the EtherCAT bus.
  - With [Clear Error Counters] the error counters can be reset.
- Port 0...3
  - Invalid Frame Counter: Number of invalid frames from *Port* y (access at register 0x300+y*2)
  - RX Error Counter: Number of RX errors from *Port* y (access at register 0x300+y*2+8bit)
  - Lost Link Counter: Number of lost connections from *Port* y (access at register 0x310+y)
  - Forwarded RX Error Counter: Number of forwarded RX errors from *Port* y (access at register 0x380+y)

7.10.8.6 DC Diagnosis (Expert mode)



This dialog is only visible in the *'Expert mode'*! Here status information for the distributed clock of your slave station is shown. More may be found in the manual of the slave station.

7.10.9 Grouping logic

7.10.9.1 Overview

Slave types

With EtherCAT, the following slave types are distinguished:

MII slave - MII corresponds to **M**edia **I**ndependant **I**nterface. An MII slave has an EtherCAT interface to connect to EtherCAT for integration into a system bus (backplane bus) for connecting peripheral modules. The MII slave receives data via EtherCAT and passes them through its backplane to the according peripheral module. Conversely, it reads the input data and passes it via EtherCAT. The System SLIO 053-1EC00 e.g. is a MII-Slave.

E-Bus slave - In an E-Bus slave the EtherCAT protocol is used for communication on the backplane bus For this reason, the attached peripheral modules are also shown as a slave station in the *SPEED7 EtherCAT Manager*

Possibilities

The EtherCAT Manager supports the following ways to group the individual slave stations. Each group may consist of 1 .. n slave stations. Group nesting is not supported:

- Group with Pinned Process Data Offset
- Hot Connect group with Dynamic Position in Topology
- Hot Connect group with Fixed Position in Topology
- Hot Connect group with Pinned or Dynamic Process Data Offset

Please consider that Hot Connect groups are not possible with E-Bus slaves!

Create Group

1. Click in the Toolbar of the *SPEED7 EtherCAT Manager* at [Configuration].
2. Click in the *Project Explorer* at the slave station and select *'Context menu ➔ Create Group'*.
   ⇨ The dialog *'Create Group'* opens. Here always the 1. slave station is selected. You can either select more slave stations or depending on the group type selection, the necessary save stations are automatically selected.

With the *'Create Group'* functionality you have two different functions:

- You can create a new group if the selected slave station is not yet part of a group.
- If the selected slave station is already part of a group, the current group is divided into two sub-groups from the selected slave station.

Remove Group

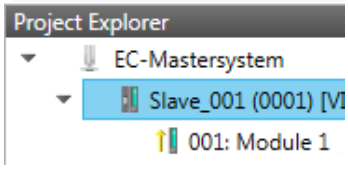
To remove a group click in the *SPEED7 EtherCAT Manager* at a slave station and select *'Context menu ➔ Remove Group'*.
⇨ The group is removed. Depending on the group, the previously grouped slave stations are reintegrated into the topology or remain at the current position.

Edit Group

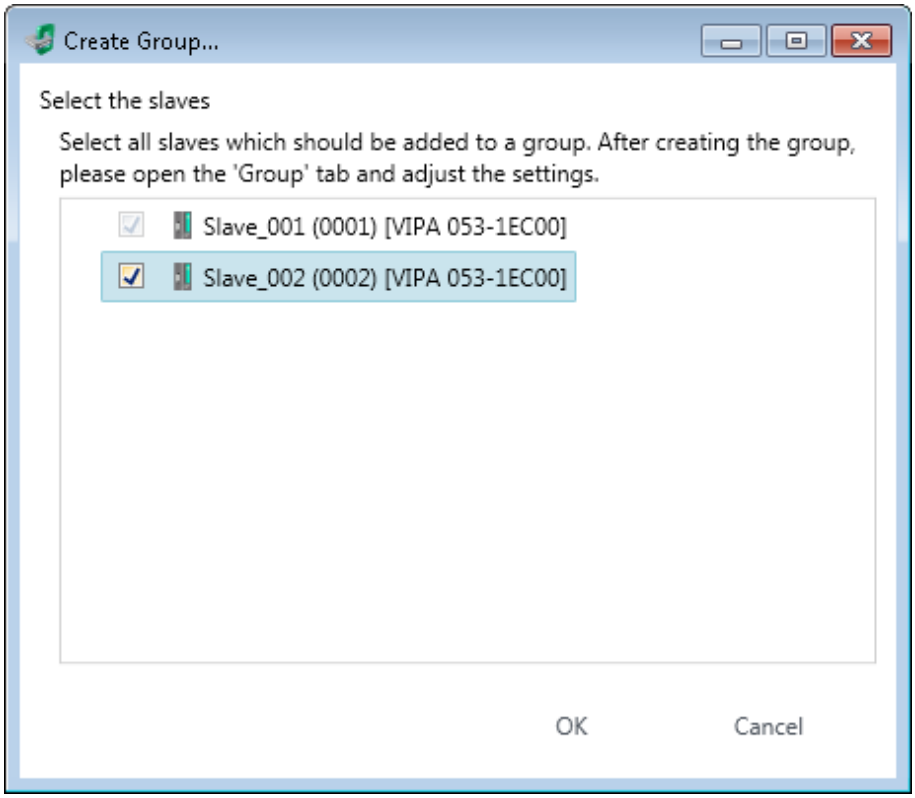
After creating a group, the *'Device Editor'* of the slave station is extended with the register *'Group'*. Here you can adjust the group properties accordingly.

7.10.9.2 Create group with pinned process data offset

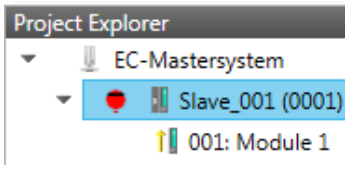
Proceeding

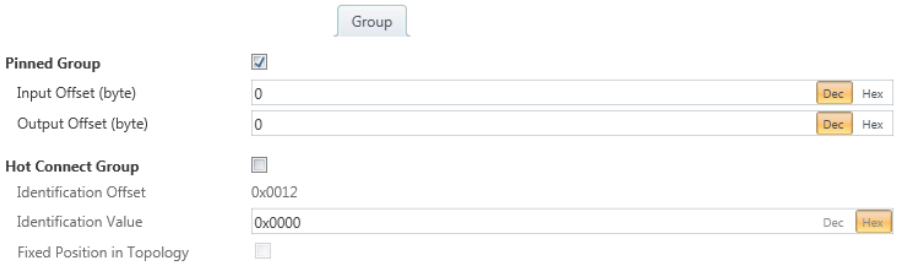


This group may start at any slave station and either end at himself, at a following slave station, at a following group or at the last slave station. The group functionality is possible with each slave type. The slave stations of this group are pinned at a fix position in the topology.



1. Click in the *'Project Explorer'* at the according slave station and select *'Context menu ➔ Create group'*.
   ⇨ A dialog opens to create a group.
2. Choose from *'Select the slaves'* the slave stations, which you want to include in the *'Pinned group'*.
   ⇨ The dialog is closed, the slave station is marked as group in the *'Project Explorer'* and a tab "Group" is created in the *'Device Editor'*.

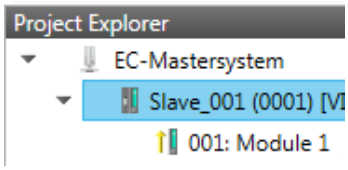




3. Enable the option *'Pinned Group'*.
4. Enable the option *'Input Offset = Output Offset'* if the input and output addresses are identical.
   ⇨ The group is now defined as *Pinned Group*.

7.10.9.3 Create Hot Connect group

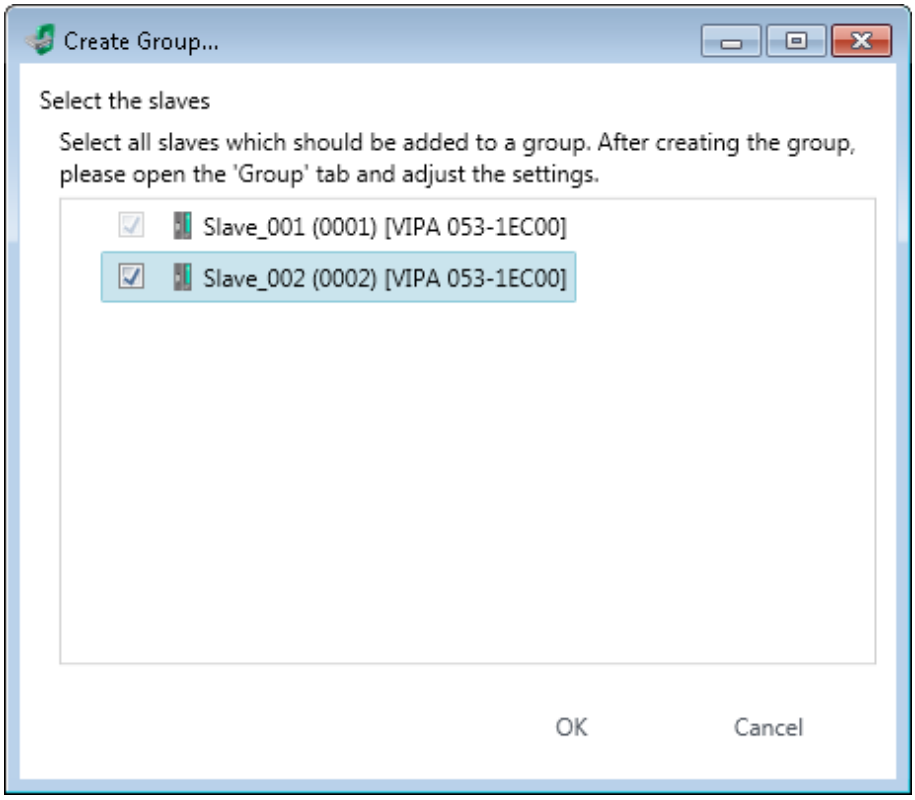
Proceeding



In a *Hot Connect group* several slave stations can be located, which must only optional be available at the EtherCAT bus. So you have the possibility to take or add pre-configured sections from the traffic before starting the system or during the operation. This can be done by disconnecting/connecting the communication path or enabling/disabling the participant.

Please consider that the first slave station after the EtherCAT master must not be optional!

To use the hot connect function with E-Bus slave stations, the E-Bus head station and the connected slave stations must be in the same group! ↳ *'Slave types' on page 272*

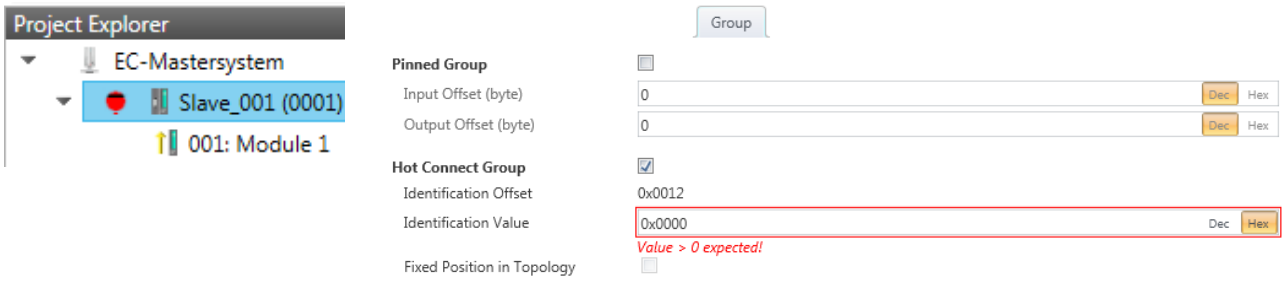


1. Click in the *'Project Explorer'* at the according slave station and select *'Context menu ➔ Create group'*.

   ⇨ A dialog opens to create a group.

2. Choose from *'Select the slaves'* the slave stations, which you want to include in the *'Hot connect group'*.

   ⇨ The dialog is closed, the slave station is marked as group in the *'Project Explorer'* and a tab "Group" is created in the *'Device Editor'*.



3. Enable the option *'Hot connect group'*.
4. Enter an *'Identification value'*: This is the *Station-Alias-Address*, which you have to assign before to the slave station in the *'Diagnosis'* Mode. *Chapter 7.10.8.4 'EEPROM (Expert mode)' on page 271*

   Please regard that the slave station takes the new address after a power-cycle.
5. For a fix position of the group in the topology the option *'Pinned group'* can be enabled.

7.10.9.3.1 Combination possibilities

Hot Connect group with Dynamic Position in Topology

The group must start with a MII slave. Here, all slave stations below the selected are automatically added to the group. This group ends at himself, at a following slave station, at a following group or at the last slave station.

Hot Connect group with Fixed Position in Topology

The group is fix coupled to a predecessor slave station and its port. You always have the possibility to change the link to the previous slave station via the dialog box. If the group is removed, the slave stations remain in place.

A Hot Connect group with Fixed Position in Topology cannot be removed, if the slave stations before are a part of another Hot Connect group with Fixed Position in Topology!

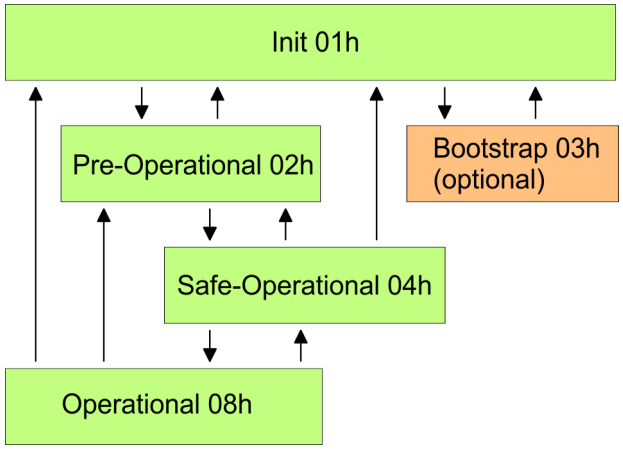
Hot Connect group with Pinned or Dynamic Process Data Offset

This group does not depend on slave station or port. The group has no predecessor slave station and is moved to the end of the tree when created. When the group is removed it is searched for a suited free port starting from the end of the main tree. If there is no suited slave station available, the group will be rejected! Due to the system the group has no predecessor slave station, the connection cannot be changed via the dialog box.

7.10.10 EtherCAT State Machine

States

In each EtherCAT communication device a *state machine* is implemented. For each state there is defined which communication service is active via EtherCAT. The state machine is controlled by the EtherCAT master.



Init - 01h

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

Pre-Operational (Pre-Op) - 02h

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

Safe-Operational (Safe-Op) - 04h

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

Operational (Op) - 08h

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

Bootstrap - option (Boot) - 03h

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

7.10.11 Firmware update - VIPA System SLIO IM 053-1EC00

Current firmware at www.vipa.com

The latest firmware versions are to be found in the service area at www.vipa.com.

For example the following files are necessary for the firmware update of the System SLIO IM 053-1EC00 with hardware release 1: Px000106.pkg. Load this file from the VIPA service area.

CAUTION!
When installing a new firmware you have to be extremely careful. Under certain circumstances you may destroy the slave station, for example if the voltage supply is interrupted during transfer or if the firmware file is defective. In this case, please call the VIPA Hotline!

Please regard that the version of the update firmware has to be different from the existing firmware otherwise no update is executed.

Precondition

- There is an Ethernet respectively remote connection between the PC and the VIPA EtherCAT slave station, where a firmware update is to be established.

Proceeding

Below the proceeding is shown by the example of the VIPA System SLIO slave station. For other devices, please follow the procedures described in the according manual.

1. Open if not already done the *SPEED7 EtherCAT Manager*.
2. Click in the *'Project Explorer'* at *'EC-Mastersystem'*.
3. Select in *'Device Editor > Master'* at *'Network Adapter'* your network card and enter at *'IP Address'* the IP address of the PG/OP channel of the CPU and click at [Select].
4. Click in the Toolbar at [Diagnosis Mode].
   ⇨ An online connection to your EtherCAT system is established via the preset communication channel and the current project configuration in the *'Project explorer'*.
5. Click in the *'Project explorer'* at the master.
6. Select in the register *'General'* at *'State Machine'* the state *'Init'*. Wait, until all slave station response the state *'Init'*.
7. Click in the *'Project explorer'* at the slave, where the firmware update is to be established.
8. Select in the register *'General'* at *'State Machine'* the state *'Bootstrap'*.
9. Enter in the register *'General'* at *'FoE Operations'* as follows:
   - Filename: Px000106
   - Password (hex): 0x0000000
   - Timeout (ms): 60000
   - Max File Size (kb): 3000
10. Click at [Download].
    ⇨ A dialog for file selection opens.

11. Select the file. The transfer starts with [OK].
    ⇨ There will be a progress bar displayed, which informs you about the transfer state.
12. After successful download bring your slave in the *'Init'* state.
    ⇨ With this operation the firmware file is taken.

8 Option: Deployment - Isochronous

Activate additional functions by means of VSC in the CPU

In order to use the additional functions, you must activate them by means of a VSC storage media from VIPA. By plugging the VSC storage card and then an overall reset the following functions are activated:

- *Isochronous mode with enabling OB 60 and OB 61*
- *EtherCAT master functionality*
- *Memory expansion to 512kB work respectively load memory*

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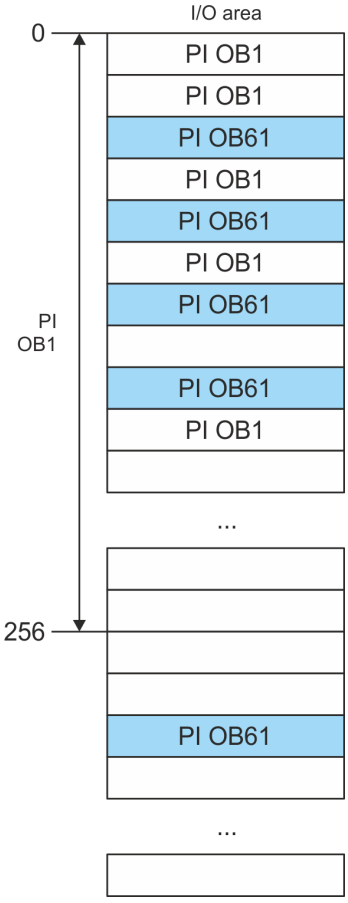
8.1 Process Image



The CPU determines by reading the input values the current state of a system and achieves by selectively controlling of output values the required system behavior (functionality). If the operand areas of the process data are accessed by the user program, so an area of the system memory is accessed. This memory area is called *Process image* (PI). Direct access to the process image has the advantage that for the duration of cyclic program processing the CPU has a consistent image of process signals. The update of the process image can be interrupted by an organization block with higher priority. This is only possible on the consistency points, which are defined by module limits.

Process images

The CPU has an I/O data area to store process images. There are the following PIs:

PI	Remark
PI OB 1	■ Triggering: Internal ■ Assignment: OB 1 (fix) ■ Start address: 0 ■ End address configurable ■ Gaps: Usage by PI OB 61 permitted
PI OB 61	■ Triggering: Internal by OB 61 ■ Assignment: OB 61 (configurable) ■ Start address: configurable ■ End address: configurable ■ Gaps: Gaps and overlapping addresses are not allowed

Here is valid:

- Each address can be assigned to only one PI.
- The data of a PI are consistent for the duration of the OB for which the process image has been configured.
- The input data of the configured process images for the corresponding OB are read before starting the OB and the output data are written after completion of the OB.
- The data of a PI can be accessed from any OB.

To use isochronous you have to place the address range (S7 addresses) of the EtherCAT slaves respectively System SLIO modules, for which you wish Isochronous, in the PI OB61! The other addresses may be assigned to the PI OB 1.

In particular, the processing of motion function blocks is only in the PI OB61 possible.

8.2 Isochronous

Isochronous and Sync-signal

The detection or output of input or output signals synchronized with a reference signal in the central system and decentralized via a connected field bus system is called *Isochronous*. In decentralized automation structures many processing cycles are not synchronized to each other. In the process input signals are detected, evaluated in the user program and the according reactions are connected to the output components. Here the cycles correlate to each other. Due to the telegram runtime of the corresponding bus, the process reaction time can vary respectively the process data are not transferred at a consistent time.

For the synchronization of I/O data, a basic clock is required. This is derived as *Sync-signal* from the EtherCAT system. With each *Sync-signal* all the input and out data are consistently transferred i.e. all data of the process image belong logically and chronologically together. The *Sync-signal* serves as a clock generator within its cycle the following functions are performed:

- The current centralized and decentralized input data are latched.
- The input data, which were cached within the previous *Sync-signal* are processed in OB 61 and the output data are latched for the output.
- The output data, which were cached *Sync-signal* cycle are centralized and decentralized output. All output data get simultaneously active.

The isochronous functionality on EtherCAT is called Distributed Clocks (DC). For synchronization on EtherCAT DC-capable EtherCAT slaves are required, where DC is also activated. If only modules on the System SLIO backplane bus are to be synchronized, so to generate the Sync-signal, you have to configure EtherCAT without slaves.

Isochronous interrupt OB 61

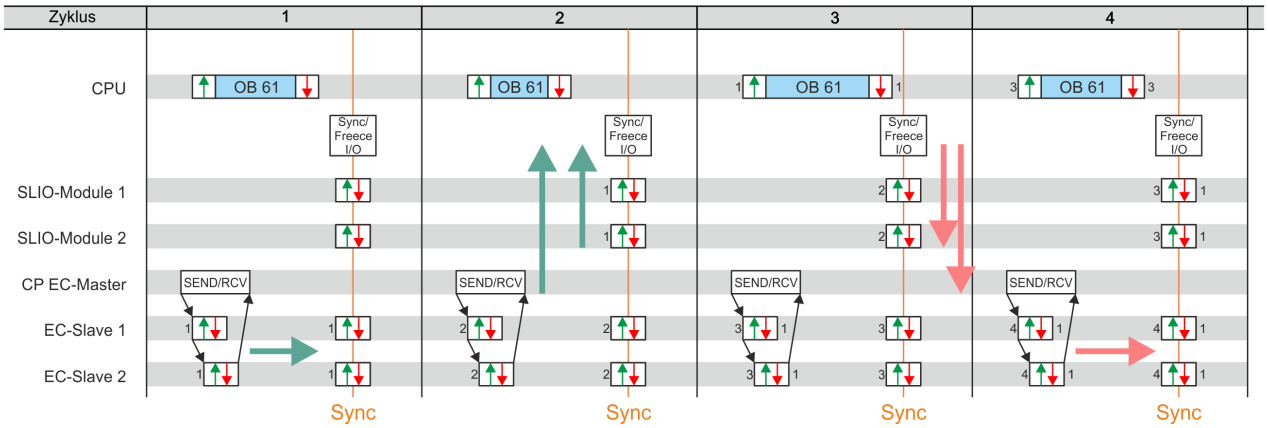
With OB 1 no isochronous is possible. For this the high-priority OB 61 is to be used. For isochronous use the OB 61 is started in a defined time interval. The processing of the OB 61 happens in accordance to the following steps, where the steps must be within the *Sync-signal* cycle, to ensure that the output data can be output with the *Sync-signal*.

1. The input process image of the OB 61 is refreshed.
2. The user program of the OB 61 is executed.
3. The output process image of the OB 61 is refreshed.

A maximum of 1 cycle can pass before data changes to the next *Sync-signal* can be detected.

CAUTION!
If the *Sync-Signal* cycle is exceeded due to the user program in the OB 61, so the OB 80 (time error) is called. If this is not available, the CPU switches to STOP.

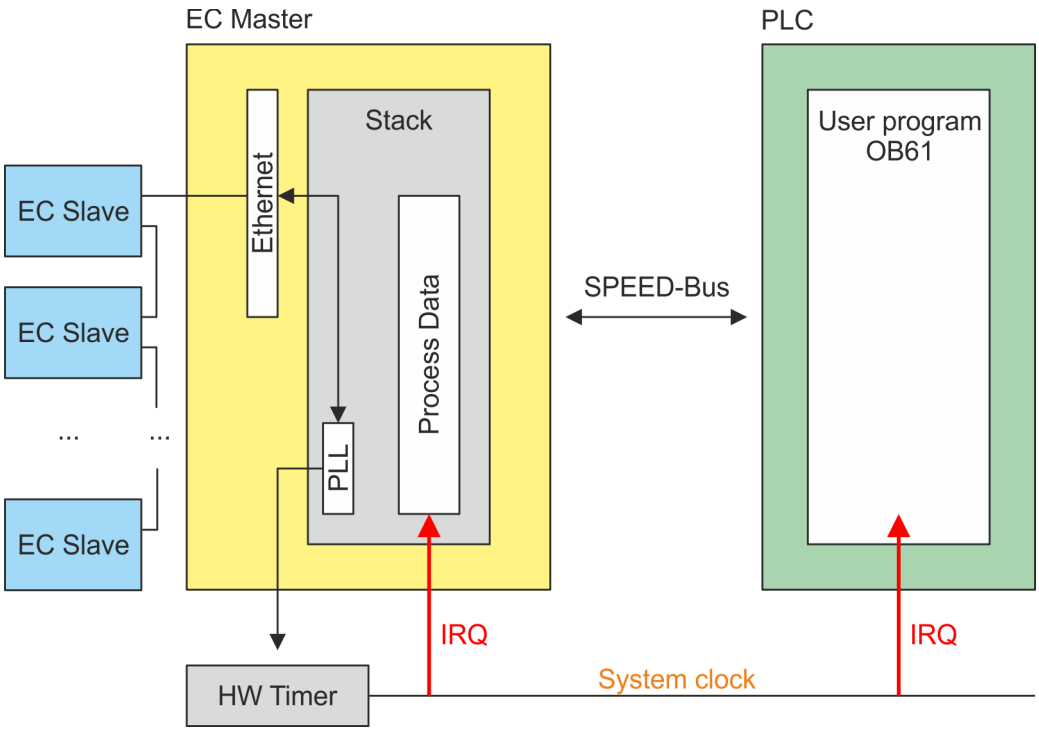
Sequence of data transfer



- Sequence OB 61 with System SLIO modules
  - Cycle 1: The input signals if the input modules are read with the *Sync-signal* and forwarded to the CPU.
  - Cycle 2: The input process image forwarded to the OB 61, the OB 61 is processed and with the *Sync-signal* the output process image of the OB 61 is refreshed.
  - Cycle 3: With the *Sync-signal* the output process image is switched to the outputs.
- Sequence OB 61 with EtherCAT master system
  - Cycle 1: With the *Sync-signal* the input signals of the EtherCAT input modules are read.
  - Cycle 2: With the *Sync-signal* the input process image is forwarded to the CPU via the EtherCAT master.
  - Cycle 3: The input process image forwarded to the OB 61, the OB 61 is processed and with the *Sync-signal* the output process image of the OB 61 is refreshed.
  - Cycle 4: With the *Sync-signal* the output process image is transferred to the EtherCAT master and switched to the outputs of the EtherCAT output modules.

Mechanism of synchronization

The CPU components PLC and EtherCAT Master are synchronized by an interrupt. This interrupt is generated from the SLIO bus timer and the EtherCAT bus cycle time. The synchronization of EtherCAT slaves happens by DC. EtherCAT slaves that do not support DC are not synchronized. At VIPA always the 1. DC capable EtherCAT slave in the network has the DC reference time. The synchronization between the DC-reference time and the EtherCAT master takes place in the EtherCAT master. Here also the System SLIO bus timer is synchronized. The EtherCAT bus cycle time can be configured in *SPEED7 Studio*.

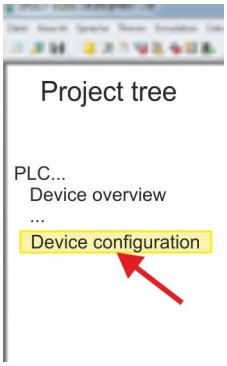


8.3 Configuration

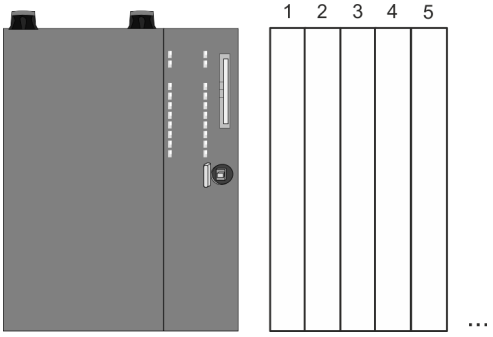
8.3.1 Hardware configuration CPU

Proceeding

1. Start the *SPEED7 Studio*.
2. Create a new project in the *Work area* with *'New project'*.
   ⇨ A new project is created and the view *'Devices and networking'* is shown.
3. Click in the *Project tree* at *'Add new device ...'*.
   ⇨ A dialog for device selection opens.



4. Select from the *'Device templates'* your CPU and click at [OK].
   ⇨ The CPU is inserted in *'Devices and networking'* and the *'Device configuration'* is opened.



Device configuration

Slot	Module	...	...	...	...
0	CPU 015-CEFNR00				
-X1	PG_OP_Ethernet				
-X2	MPI interface				
...	...			...	

8.3.2 Activate isochronous

Please consider the additional functions in the SPEED7 Studio can only be activated, if you have valid license for these functions!

Proceeding

1. Click at the CPU in the *'Device configuration'* and select *'Context menu ➔ Components properties'*.
   ⇨ The properties dialog of the CPU is opened
2. Click at *'Feature Sets'* and activate at *'Motion Control'* the parameter *'EtherCAT Master functionality+Motion Control+...'*.
3. Confirm your input with [OK].
   ⇨ The additional functions are now available in your project. More information about the usage may be found in the online help of the *SPEED7 Studio*.

Activated additional functions:

- Isochronous mode with enabling OB 60 and OB 61
- EtherCAT master functionality
- Memory expansion to 512kB work respectively load memory

Activate additional functions by means of VSC in the CPU

In order to use the additional functions, you must activate them by means of a VSC storage media from VIPA. By plugging the VSC storage card and then an overall reset the following functions are activated:

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OB 60

By activating of the function *'Motion Control'* in the *SPEED7 Studio* the OB 60 is automatically created. The OB is used internally and can not be edited. It used to manage the service data objects (SDO) and diagnostic data. The OB 60 has a higher priority than OB 1. The cycle time for this OB can be configured in the *SPEED7 Studio*.

OB 61

By activating of the function *'Motion Control'* in the *SPEED7 Studio* the OB 61 is automatically created. Within the OB 61 should be the functions which are synchronously should be executed. For the OB a separate process image PI OB 61 is created, which data are consistent during the execution of the OB. OB 61 has a higher priority than OB 60.