VIPA System 300S

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art of automation

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VIPA GmbH, Ohmstraße 4, 91074 Herzogenaurach, Germany

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

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

VIPA GmbH, Ohmstraße 4, 91074 Herzogenaurach, Germany

Telephone: +49 9132 744 1150/1180 (Hotline)
EMail: support@vipa.de

Contents

About this manual

This manual describes the System 300S SPEED7 CPU 315SN/NET from VIPA. Here you may find every information for commissioning and operation.

Outline   **Chapter 1:   Principles**

This Basics contain hints for the usage and information about the project engineering of a SPEED7 system from VIPA.

General information about the System 300S like dimensions and environment conditions will also be found.

Chapter 2:   Assembly and installation guidelines

In this chapter you will find all information, required for the installation and the cabling of a process control with the components of the System 300 with a CPU 315SN/NET.

Chapter 3:   Hardware description

Here the hardware components of the CPU 315SN/NET are described.
The technical data are at the end of the chapter.

Chapter 4:   Deployment CPU 315SN/NET

This chapter describes the employment of a CPU 315SN/NET with SPEED7 technology in the System 300. The description refers directly to the CPU and to the employment in connection with peripheral modules that are mounted on a profile rail together with the CPU at the standard bus.

Chapter 5:   Deployment PtP communication

Content of this chapter is the employment of the RS485 slot for serial PtP communication. Here you'll find all information about the protocols, the activation and project engineering of the interface which are necessary for the serial communication using the RS485 interface.

Chapter 6:   Deployment Profibus communication

Content of this chapter is the deployment of the CPU 315SN/NET with Profibus. After a short overview the project engineering and parameterization of a CPU 315SN/NET with integrated Profibus-Part from VIPA is shown. Further you get information about usage as DP master and DP slave of the Profibus part. The chapter is ending with notes to Commissioning and Start-up behavior.

Chapter 7:   Deployment Ethernet communication

In this chapter the communication via Ethernet is described. Please regard the chapter "Fast introduction" where you find all information compressed required for the project engineering of the CPU 315SN/NET with *CP 343*. After the fast introduction, the mentioned steps are described in detail.

Chapter 8:   WinPLC7

In this chapter the programming and simulation software WinPLC7 from VIPA is presented. WinPLC7 is suited for every with Siemens STEP®7 programmable PLC.

Besides the system presentation and installation here the basics for using the software is explained with a sample project.

More information concerning the usage of WinPLC7 may be found in the online help respectively in the online documentation of WinPLC7.

Objective and contents

This manual describes the System 300S SPEED7 CPU 315SN/DPM from VIPA. It contains a description of the construction, project implementation and usage.

This manual is part of the documentation package with order number HB140E_CPU and relevant for:

Product	Order number	as of state: CPU-HW	CPU-FW	DPM-FW	CP-FW
CPU 315SN/NET	VIPA 315-4NE12	01	V343	V312	V217

Target audience

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

Structure of the manual

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

Guide to the document

The following guides are available in the manual:

- an overall table of contents at the beginning of the manual
- an overview of the topics for every chapter
- an index at the end of the manual.

Availability

The manual is available in:

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

Icons Headings

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

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

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

Note!
Supplementary information and useful tips.

Safety information

Applications conforming with specifications

The SPEED7 CPU is constructed and produced for:
- all VIPA System 300 components
- communication and process control
- general control and automation applications
- industrial applications
- operation within the environmental conditions specified in the technical data
- installation into a cubicle

Danger!
This device is not certified for applications in
- in explosive environments (EX-zone)

Documentation

The manual must be available to all personnel in the
- project design department
- installation department
- commissioning
- operation

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

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

- Installation and modifications only by properly trained personnel

- The national rules and regulations of the respective country must be satisfied (installation, safety, EMC ...)

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

Chapter 1   Basics

Overview   These basics contain hints for the usage and information about the project engineering of a SPEED7 system from VIPA.

General information about the System 300S like dimensions and environment conditions will also be found.

Content   **Topic**   **Page**

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 electrostatic sensitive modules

Modules must be shipped in the original packing material.

Measurements and alterations on electrostatic sensitive modules

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

• Floating instruments must be discharged before use.

• Instruments must be grounded.

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

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

General description of the System 300

The System 300   The System 300 is a modular automation system for middle and high performance needs, which may be used either central or decentral. The single modules are directly clipped to the profile rail and are connected together with the help of bus clips at the backside.

The CPUs of the System 300 are instruction set compatible to S7-300 from Siemens.

System 300V
System 300S   VIPA differentiates between System 300V and System 300S.

- System 300V

    The System 300V allows you to resolve automation tasks central and decentral. The single modules of the System 300V from VIPA are similar in construction to Siemens. Due to the compatible backplane bus, the modules from VIPA and Siemens can be mixed.

- System 300S

    The System 300S extends the central area with high-speed CPUs that have the integrated SPEED7 chip. Additionally some CPU's have got a parallel SPEED-Bus that allows the modular connection of fast peripheral modules like IOs or bus master.
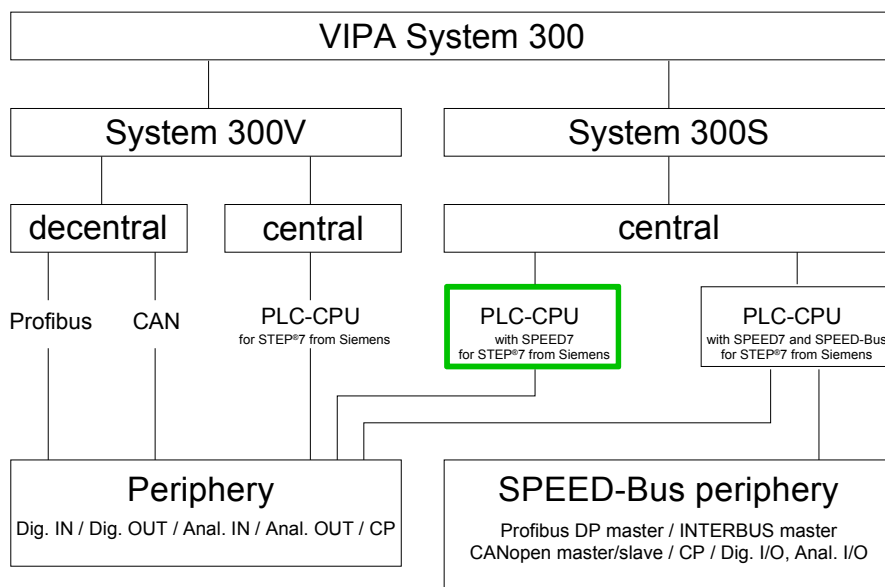
Manual overview   This manual describes a CPU from the System 300S with integrated SPEED7 technology.

The description of the System 300V CPU 31x without SPEED7 and the concerning peripheral modules like digital and analog in-/output modules, power supplies and bus coupler is to find in the HB 130.

Operating structure of a CPU

General   The CPU contains a standard processor with internal program memory. In combination with the integrated SPEED7 technology the unit provides a powerful solution for process automation applications within the System 300S family.

A CPU supports the following modes of operation:

- cyclic operation
- timer processing
- alarm controlled operation
- priority based processing

Cyclic processing   **Cyclic** processing represents the major portion of all the processes that are executed in the CPU. Identical sequences of operations are repeated in a never-ending cycle.

Timer processing   Where a process requires control signals at constant intervals you can initiate certain operations based upon a **timer**, e.g. not critical monitoring functions at one-second intervals.

Alarm controlled processing   If a process signal requires a quick response you would allocate this signal to an **alarm controlled** procedure. An alarm can activate a procedure in your program.

Priority based processing   The above processes are handled by the CPU in accordance with their **priority**. Since a timer or an alarm event requires a quick reaction, the CPU will interrupt the cyclic processing when these high-priority events occur to react to the event. Cyclic processing will resume, once the reaction has been processed. This means that cyclic processing has the lowest priority.

Applications

The program that is present in every CPU is divided as follows:

- System routine
- User application

System routine

The system routine organizes all those functions and procedures of the CPU that are not related to a specific control application.

User application

This consists of all the functions that are required for the processing of a specific control application. The operating modules provide the interfaces to the system routines.

Operands

The following series of operands is available for programming the CPU:

- Process image and periphery
- Bit memory
- Timers and counters
- Data blocks

Process image and periphery

The user application can quickly access the process image of the inputs and outputs PAA/PAE. You may manipulate the following types of data:

- individual Bits
- Bytes
- Words
- Double words

You may also gain direct access to peripheral modules via the bus from user application. The following types of data are available:

- Bytes
- Words
- Blocks

Bit Memory

The bit memory is an area of memory that is accessible by means of certain operations. Bit memory is intended to store frequently used working data.

You may access the following types of data:

- individual Bits
- Bytes
- Words
- Double words

Timers and counters

In your program you may load cells of the timer with a value between 10ms and 9990s. As soon as the user application executes a start-operation, the value of this timer is decremented by the interval that you have specified until it reaches zero.

You may load counter cells with an initial value (max. 999) and increment or decrement these when required.

Data Blocks

A data block contains constants or variables in the form of bytes, words or double words. You may always access the current data block by means of operands.

You may access the following types of data:

- individual Bits
- Bytes
- Words
- Double words

CPU 315SN/NET

Overview   The CPU 315SN/NET bases upon the SPEED7 technology. This supports the CPU at programming and communication by means of co-processors that causes a power improvement for highest needs.

The SPEED7 CPUs from VIPA are instruction compatible to the programming language STEP®7 from Siemens and may be programmed via WinPLC7 from VIPA or via the Siemens SIMATIC Manager. Here the instruction set of the S7-400 from Siemens is used.

Modules and CPUs of the System 300 from VIPA and Siemens may be used at the bus as a mixed configuration.

The user application is stored in the battery buffered RAM or on an additionally pluggable MMC storage module.

Due to the automatic address allocation, the deployment of the CPU 315SN/NET allows to address 32 peripheral modules.

The CPU is configured as CPU 318-2 (6ES7 318-2AJ00-0AB0/V3.0) from Siemens.

Access
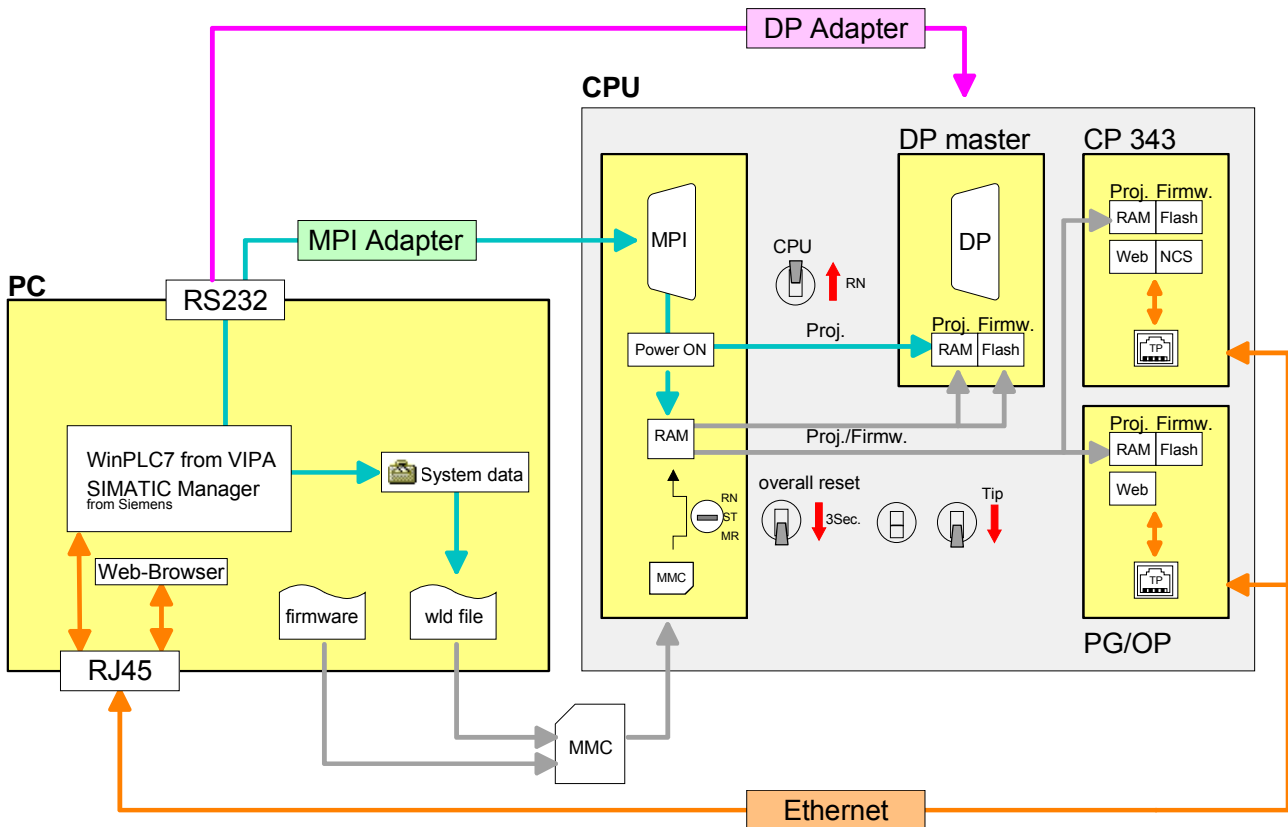
Note!

Please do always use the **CPU 318-2 (6ES7 318-2AJ00-0AB0/V3.0)** from Siemens of the hardware catalog to project this CPU from VIPA.
For the project engineering, a thorough knowledge of the Siemens SIMATIC Manager and the hardware configurator from Siemens is required!

Memory management

The CPU has an integrated *work memory* with 1Mbyte. During program run the total memory is divided into 50% for program code and 50% for data. There is the possibility to extend the total memory to its maximum of 2Mbyte by means of a MCC memory extension card.
The size of the *load memory* is fixed at 2Mbyte.

Integrated Profibus DP master

The CPU has an integrated Profibus DP master. Via the DP master with a data range of 1kbyte for in- and output you may address up to 124 DP slaves. The project engineering takes place in WinPLC7 from VIPA or in the hardware configurator from Siemens.

Integrated CP 343

The integrated CP 343 offers you a communication processor. This serves 32 PG/OP channels and 8 configurable productive connections.

Integrated Ethernet PG/OP channel

The CPU has an Ethernet interface for PG/OP communication. Via the "PLC" functions you may directly access the Ethernet PG/OP channel and program res. remote control your CPU. A max. of 4 PG/OP connections is available.

You may also access the CPU with a visualization software via these connections.

Operation Security

- Wiring by means of spring pressure connections (CageClamps) at the front connector
- Core cross-section 0.08...2.5mm^2
- Total isolation of the wiring at module change
- Potential separation of all modules to the backplane bus
- ESD/Burst acc. IEC 61000-4-2/IEC 61000-4-4 (up to level 3)
- Shock resistance acc. IEC 60068-2-6 / IEC 60068-2-27 (1G/12G)

Environmental conditions

- Operating temperature: 0 ... +60°C
- Storage temperature: -25 ... +70°C
- Relative humidity: 5 ... 95% without condensation
- Ventilation by means of a fan is not required

Dimensions/ Weight

- Dimensions of the basic enclosure:
  2tier width: (WxHxD) in mm: 80x125x120

Integrated power supply

The CPU comes with an integrated power supply. The power supply is to be supplied with DC 24V. By means of the supply voltage, the internal electronic is supplied as well as the connected modules via backplane bus. The power supply is protected against inverse polarity and overcurrent.

Chapter 2   Assembly and installation guidelines

Overview   In this chapter you will find every information, required for the installation and the cabling of a process control with the components of the System 300 with a CPU 315SN/NET.

Overview

General

The single modules are directly installed on a profile rail and connected via the backplane bus connector. Before installing the modules you have to clip the backplane bus connector to the module from the backside.

The backplane bus connector is delivered together with the peripheral modules.

Profile rail
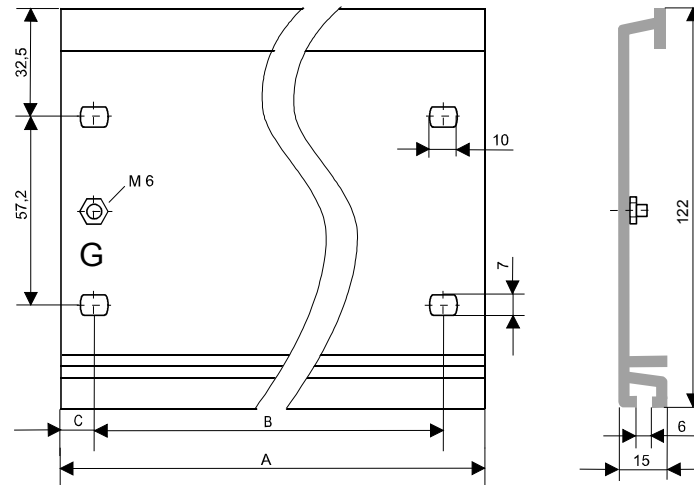
Order number	A	B	C
VIPA 390-1AB60	160mm	140mm	10mm
VIPA 390-1AE80	482mm	466mm	8.3mm
VIPA 390-1AF30	530mm	500mm	15mm
VIPA 390-1AJ30	830mm	800mm	15mm
VIPA 390-9BC00*	2000mm	Drillings only left	15mm

* Unit pack: 10 pieces

Bus connector

For the communication between the modules the System 300 uses a backplane bus connector. Backplane bus connectors are included in the delivering of the peripheral modules and are clipped at the module from the backside before installing it to the profile rail.
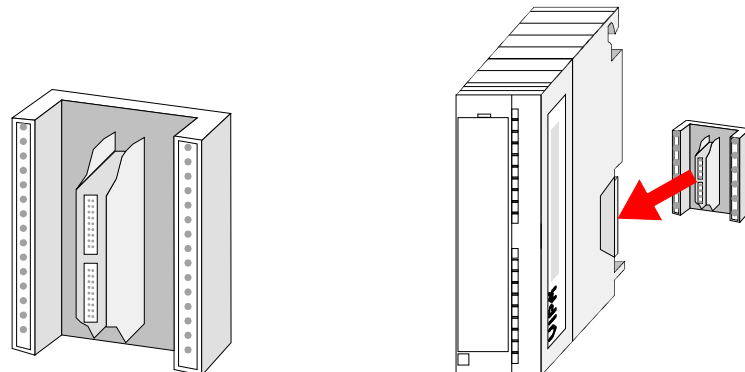
Installation dimensions

Dimensions   2tier width (WxHxD) in mm: 80 x 125 x 120
Basic enclosure

Dimensions

65mm

122mm

40mm

**Installation
dimensions**

125mm

120mm

125 mm

175mm

Assembly Standard-Bus

waagrechter Aufbau

senkrechter Aufbau

liegender Aufbau

Assembly possibilities

Please regard the allowed environment temperatures:

- horizontal assembly: from 0 to 60°C
- vertical assembly: from 0 to 40°C
- lying assembly: from 0 to 40°C

Approach

- Bolt the profile rail with the background (screw size: M6), so that you still have minimum 65mm space above and 40mm below the profile rail.

- If the background is a grounded metal or device plate, please look for a low-impedance connection between profile rail and background.

- Connect the profile rail with the protected earth conductor. For this purpose there is a bolt with M6-thread.

- The minimum cross-section of the cable to the protected earth conductor has to be 10mm^2.

- Stick the power supply to the profile rail and pull it to the left side to the grounding bolt of the profile rail.

- Fix the power supply by screwing.

- Take a backplane bus connector and click it at the CPU from the backside like shown in the picture.

- Stick the CPU to the profile rail right from the power supply and pull it to the power supply.

- Click the CPU downwards and bolt it like shown.

- Repeat this procedure with the peripheral modules, by clicking a backplane bus connector, stick the module right from the modules you've already fixed, click it downwards and connect it with the backplane bus connector of the last module and bolt it.

Danger!

- The power supplies must be released before installation and repair tasks, i.e. before handling with the power supply or with the cabling you must disconnect current/voltage (pull plug, at fixed connection switch off the concerning fuse)!

- Installation and modifications only by properly trained personnel!

Cabling

Overview   The CPUs are exclusively delivered with CageClamp contacts. The connection of the I/O periphery happens by 40pole front screw connection.

Danger!
- The power supplies must be released before installation and repair tasks, i.e. before handling with the power supply or with the cabling you must disconnect current/voltage (pull plug, at fixed connection switch off the concerning fuse)!
- Installation and modifications only by properly trained personnel!

CageClamp technology (green)   For the cabling of power supply of a CPU, a green plug with CageClamp technology is deployed.

The connection clamp is realized as plug that may be clipped off carefully if it is still cabled.
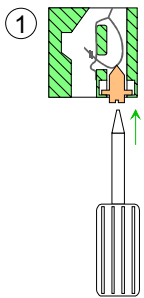
① Here wires with a cross-section of $0.08mm^2$ to $2.5mm^2$ may be connected. You can use flexible wires without end case as well as stiff wires.
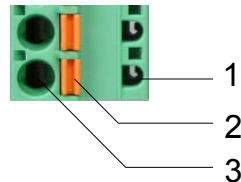
[1]   Test point for 2mm test tip
[2]   Locking (orange) for screwdriver
[3]   Round opening for wires
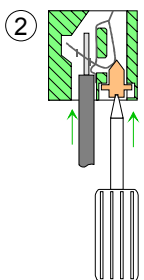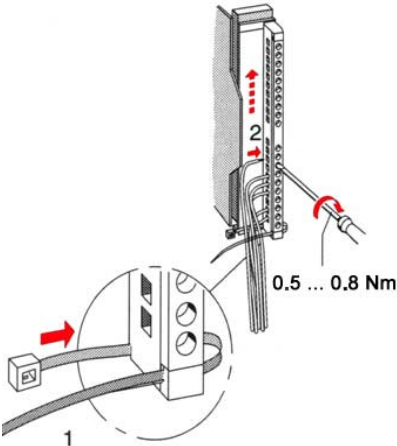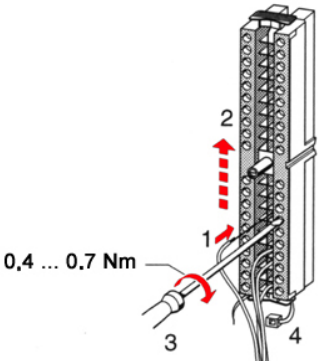
② The picture on the left side shows the cabling step by step from top view.

- For cabling you push the locking vertical to the inside with a suiting screwdriver and hold the screwdriver in this position.
- Insert the de-isolated wire into the round opening. You may use wires with a cross-section from $0.08mm^2$ to $2.5mm^2$.
- By removing the screwdriver the wire is connected safely with the plug connector via a spring.

③
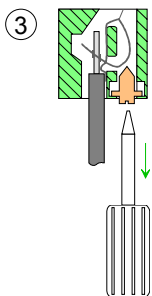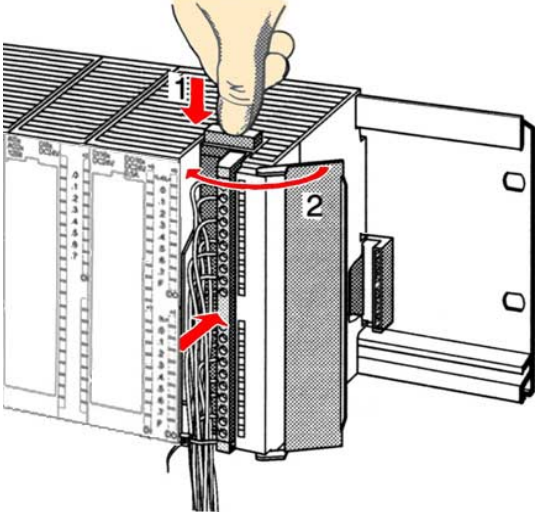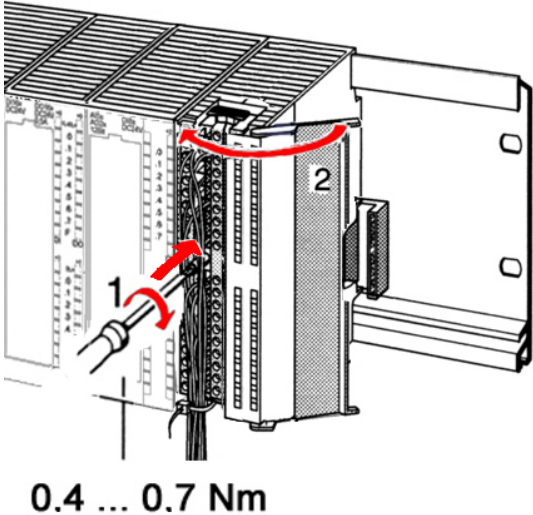
Front connectors of the in-/output modules

In the following the cabling of the two variants are shown:

20pole screw connection VIPA 392-1AJ00	40pole screw connection VIPA 392-1AM00
Open the front flap of your I/O module.	
Bring the front connector in cabling position. For this you plug the front connector on the module until it locks. In this position the front connector juts out of the module and has no contact yet.	
De-isolate your wires. If needed, use core end cases.	
Thread the included cable binder into the front connector.	
If you want to lead out your cables from the bottom of the module, start with the cabling from bottom to top, res. from top to bottom, if the cables should be led out at the top.	
Bolt also the connection screws of not cabled screw clamps.	
	Put the included cable binder around the cable bundle and the front connector.
Fix the cable binder for the cable bundle.	

... continue

20pole screw connection VIPA 392-1AJ00	40pole screw connection VIPA 392-1AM00
Push the release key at the front connector on the upper side of the module and at the same time push the front connector into the module until it locks. 	Bolt the fixing screw of the front connector. 0.4 ... 0.7 Nm

Now the front connector is electrically connected with your module.
Close the front flap.
Fill out the labeling strip to mark the single channels and push the strip into the front flap.

Installation guidelines

General

The installation guidelines contain information about the interference free deployment of System 300 systems. There is the description of the ways, interference may occur in your control, how you can make sure the electromagnetic digestibility (EMC), and how you manage the isolation.

What means EMC?

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

All System 300 components are developed for the deployment in hard industrial environments and fulfill high demands on the EMC. Nevertheless you should project an EMC planning before installing the components and take conceivable interference causes into account.

Possible interference causes

Electromagnetic interferences may interfere your control via different ways:

- Fields
- I/O signal conductors
- Bus system
- Current supply
- Protected earth conductor

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

One differs:

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

Basic rules for EMC

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

- Take care of a correct area-wide grounding of the inactive metal parts when installing your components.
  - Install a central connection between the ground and the protected earth conductor system.
  - Connect all inactive metal extensive and impedance-low.
  - Please try not to use aluminum parts. Aluminum is easily oxidizing and is therefore less suitable for grounding.
- When cabling, take care of the correct line routing.
  - Organize your cabling in line groups (high voltage, current supply, signal and data lines).
  - Always lay your high voltage lines and signal res. data lines in separate channels or bundles.
  - Route the signal and data lines as near as possible beside ground areas (e.g. suspension bars, metal rails, tin cabinet).
- Proof the correct fixing of the lead isolation.
  - Data lines must be laid isolated.
  - Analog lines must be laid isolated. When transmitting signals with small amplitudes the one sided laying of the isolation may be favorable.
  - Lay the line isolation extensively on an isolation/protected earth conductor rail directly after the cabinet entry and fix the isolation with cable clamps.
  - Make sure that the isolation/protected earth conductor rail is connected impedance-low with the cabinet.
  - Use metallic or metalized plug cases for isolated data lines.
- In special use cases you should appoint special EMC actions.
  - Wire all inductivities with erase links, which are not addressed by the System 300V modules.
  - For lightening cabinets you should prefer incandescent lamps and avoid luminescent lamps.
- Create a homogeneous reference potential and ground all electrical operating supplies when possible.
  - Please take care for the targeted employment of the grounding actions. The grounding of the PLC is a protection and functionality activity.
  - Connect installation parts and cabinets with the System 300V in star topology with the isolation/protected earth conductor system. So you avoid ground loops.
  - If potential differences between installation parts and cabinets occur, lay sufficiently dimensioned potential compensation lines.

Isolation of conductors

Electrical, magnetically and electromagnetic interference fields are weakened by means of an isolation, one talks of absorption.

Via the isolation rail, that is connected conductive with the rack, interference currents are shunt via cable isolation to the ground. Hereby you have to make sure, that the connection to the protected earth conductor is impedance-low, because otherwise the interference currents may appear as interference cause.

When isolating cables you have to regard the following:

- If possible, use only cables with isolation tangle.
- The hiding power of the isolation should be higher than 80%.
- Normally you should always lay the isolation of cables on both sides. Only by means of the both-sided connection of the isolation you achieve high quality interference suppression in the higher frequency area.

  Only as exception you may also lay the isolation one-sided. Then you only achieve the absorption of the lower frequencies. A one-sided isolation connection may be convenient, if:

  - the conduction of a potential compensating line is not possible
  - analog signals (some mV res. µA) are transferred
  - foil isolations (static isolations) are used.

- With data lines always use metallic or metalized plugs for serial couplings. Fix the isolation of the data line at the plug rack. Do not lay the isolation on the PIN 1 of the plug bar!
- At stationary operation it is convenient to strip the insulated cable interruption free and lay it on the isolation/protected earth conductor line.
- To fix the isolation tangles use cable clamps out of metal. The clamps must clasp the isolation extensively and have well contact.
- Lay the isolation on an isolation rail directly after the entry of the cable in the cabinet. Lead the isolation further on to the System 300V module and **don't** lay it on there again!

Please regard at installation!

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

Remedy: Potential compensation line

Chapter 3   Hardware description

Overview   Here the hardware components of the CPU 315SN/NET are described.
The technical data are at the end of the chapter.

Properties

CPU 315SN/NET
315-4NE12

- SPEED7 technology integrated
- 1Mbyte work memory integrated (50% code, 50% data)
- Memory expandable to max. 2Mbyte (50% code, 50% data)
- Load memory 2Mbyte
- Profibus DP master integrated (DP-V0, DP-V1)
- MPI interface
- MCC slot for external memory cards and memory extension
- Status LEDs for operating state and diagnosis
- Real-time clock battery buffered
- Ethernet PG/OP interface integrated
- RS485 interface configurable for Profibus DP master respectively PtP communication
- CP 343 integrated
  8 configurable productive connections by Siemens NetPro and
  8 configurable productive connections by user program and
  32 PG/OP connections
- I/O address range digital/analog 8191byte
- 512 timer
- 512 counter
- 8192 flag byte
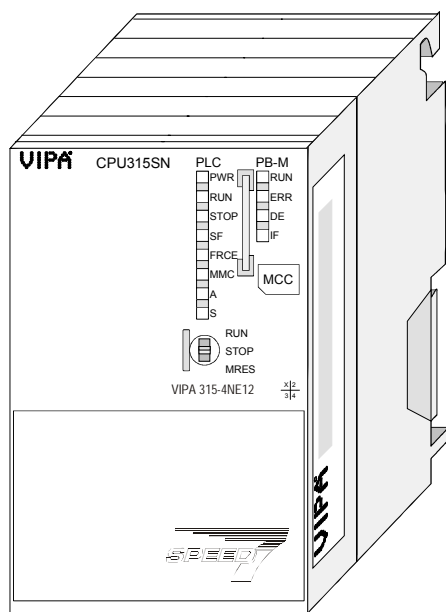
Ordering data

Type	Order number	Description
315SN/NET	VIPA 315-4NE12	MPI interface, card slot, real time clock, Ethernet interface for PG/OP, Profibus DP master, CP 343

Structure

CPU 315SN/NET
315-4NE12
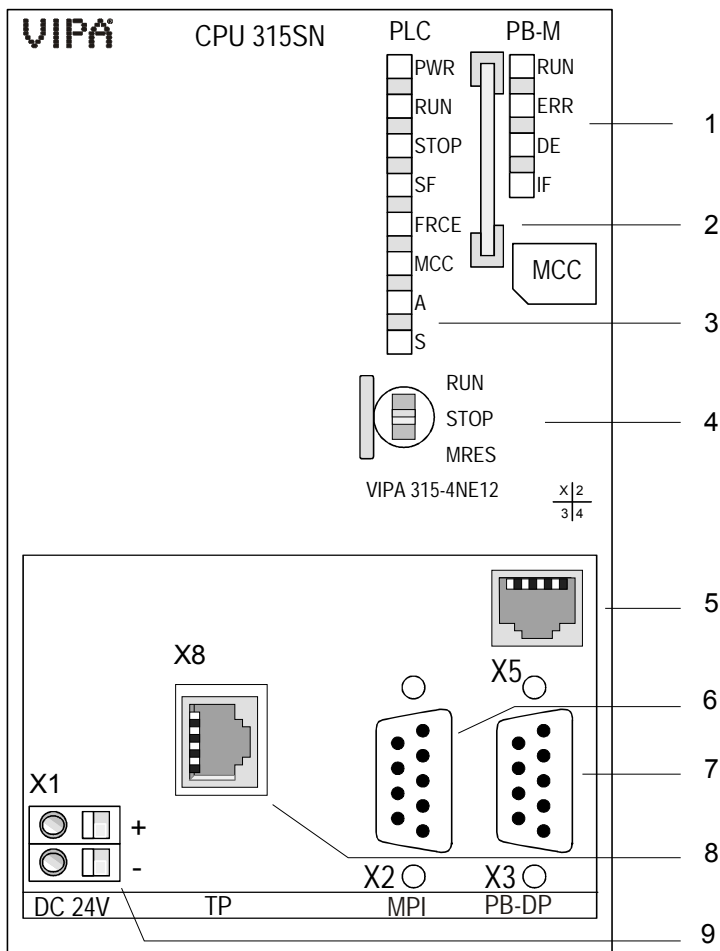
[1]   LEDs of the integrated
      Profibus DP master
[2]   Storage media slot
[3]   LEDs of the CPU part
[4]   Operating mode switch CPU

**The following components
are under the front flap**

[5]   Twisted pair interface
      for Ethernet PG/OP channel
[6]   MPI interface
[7]   Profibus DP/PtP interface
[8]   Twisted pair interface
      for CP 343
[9]   Slot for DC 24V power supply

Components

Operating mode switch

With the operating mode switch you may switch the CPU between STOP and RUN. The operating mode START-UP is driven automatically from the CPU between STOP and RUN.

RUN
STOP
MRES

Placing the switch to Memory Reset (MRES), you request an overall reset with following load from MMC (project or firmware).

Ethernet PG/OP channel

The RJ45 jack serves the interface to the Ethernet PG/OP channel. This interface allows you to program res. remote control your CPU, to access the internal website or to connect a visualization via up to 4 PG/OP connections. Here a transfer rate of 10Mbit at half duplex is supported.

For online access to the CPU via Ethernet PG/OP channel valid IP address parameters have to be assigned to this. More may be found at chapter "Deployment CPU ..." at "Initialization Ethernet PG/OP channel".

The jack has the following assignment:

8pin RJ45 jack:

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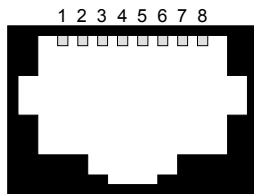
Pin	Assignment	Pin	Assignment
1	Transmit +	5	-
2	Transmit -	6	Receive -
3	Receive +	7	-
4	-	8	-

MPI interface

The MPI interface handles the data exchange between CPU and PC. Via a bus communication you may transfer applications and data between the CPUs that are connected via MPI.

For a serial transfer from your PC you normally need a MPI transducer.

The MPI-slot has the following pin assignment:

9pin D-type jack:

5
9
4
8
3
7
2
6
1
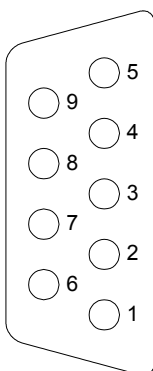
Pin	Assignment
1	reserved (must not be connected)
2	M24V
3	RxD/TxD-P (Line B)
4	RTS
5	M5V
6	P5V
7	P24V
8	RxD/TxD-N (Line A)
9	n.c.

LEDs

The CPU has got one row of LEDs on the front side. The following table shows you the usage of the LEDs and the according colors:

Label	Color	Meaning
PWR	green	CPU part is provided with internal 5V
RUN	green	CPU is in the operating mode RUN
STOP	yellow	CPU is in the operating mode STOP
SF	red	On at system errors (hardware defect)
FRCE	yellow	On as soon as variables are forced (fixed)
MCC	yellow	Blinks at storage media access
A	green	Activity: on: physically connected off: no physical connection blinks: shows Ethernet activity
S	green	Speed: on: 100Mbit off: 10Mbit

Note!

All LEDs of the CPU are blinking three times, when accessing an invalid storage media or when it is pulled out during the reading process.

Power supply

The CPU has an integrated power supply. The power supply has to be provided with DC 24V. For this serves the double DC 24V slot, that is underneath the flap.

Via the power supply not only the internal electronic is provided with voltage, but by means of the backplane bus also the connected modules. The power supply is protected against polarity inversion and overcurrent. The internal electronic is galvanically connected with the supply voltage.

The power supply may provide the backplane bus with max. 3A.
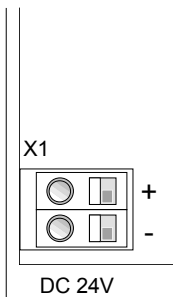
Memory management

The CPU has a *load memory* and a *work memory*. These are battery buffered. After project transfer the *load memory* contains the user program together with its system data. During operation the operation-relevant program code and the user data are copied to the *work memory* by the operating system of the CPU.

The CPU 315-4NE12 has a *work memory* of about 1Mbyte. During program run the work memory is divided into 50% for program and 50% for data.

There is the possibility to expand the work memory to max 2Mbyte by means of a MCC memory extension card.
The size of the *load memory* is fixed at 2Mbyte.

Storage media slot

As external storage medium for applications and firmware you may use a MMC storage module (**M**ulti**m**edia **c**ard) or a MCC memory extension card. The MCC can additionally be used as an external storage medium.

Both VIPA storage media are pre-formatted with the PC format FAT16 and can be accessed via a card reader. An access to the storage media always happens after an overall reset and PowerON.

RS485 interface with configurable functionality

The CPU has an integrated RS485 interface. The functionality of this interface can be configured by the mean of the parameter "Function RS485" in the hardware configuration of the virtual SPEED-Bus.

Profibus functionality

Using the *Profibus* functionality the integrated Profibus DP master is connected to Profibus via RS485 interface. At master operation there is access to up to 124 DP slaves. For this the project engineering happens in the hardware configurator from Siemens.

For state display the CPU has a row of LEDs at its front side. Dependent on the mode of operation these give information according to the following pattern over the operating condition of the Profibus part:

Master operation

RUN green	ERR red	DE green	IF red	Meaning
○	○	○	○	Master has no project, this means the interface is deactivated respectively PtP is active.
●	○	○	○	Master has bus parameters and is in RUN without slaves.
●	○	☼	○	Master is in "clear" state (safety state). The inputs of the slaves may be read. The outputs are disabled.
●	○	●	○	Master is in "operate" state, this means data exchange between master and slaves. The outputs may be accessed.
●	●	☼	○	At least 1 slave is missing.
○	○	○	●	Initialization error at faulty parameterization.
○	●	○	●	Waiting state for start command from CPU.

Slave operation

RUN green	ERR red	DE green	IF red	Meaning
○	○	○	○	Slave has no project respectively PtP is active.
☼	○	○	○	Slave is without master.
☼	○	☼	○	Alternate flashing at configuration faults.
●	○	●	○	Slave exchanges data between master.

on: ●   off: ○   flashing: ☼

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. Here the following protocols are supported:

ASCII, STX/ETX, 3964R, USS and Modbus-Master (ASCII, RTU)

RS485 interface   RS485 interface of both functionalities have the same pin assignment:

9-pin Profibus SubD jack:
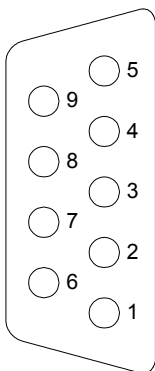
Pin	Assignment
1	shield
2	M24V
3	RxD/TxD-P (Line B)
4	RTS
5	M5V
6	P5V
7	P24V
8	RxD/TxD-N (Line A)
9	n.c.

Communication processor CP 343
     The CP 343 offers you a communication processor.
This serves the following possibilities for connections:

- 32 PG/OP channels (each 1 connection is reserved for PG and OP)
- 8 productive connections configurable with Siemens NetPro respectively by user program

The project engineering happens as CP 343-1EX11.

Via the RJ45 jack you may connect the CP 343 to Twisted-Pair-Ethernet.

The slot has the following pin assignment:

8pin RJ45 plug:
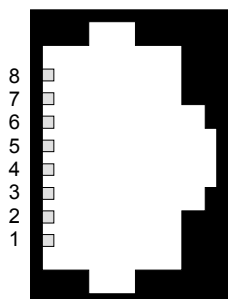
Pin	Assignment
1	Transmit +
2	Transmit -
3	Receive +
4	-
5	-
6	Receive -
7	-
8	-

Technical Data

Electrical data	VIPA 315-4NE12
Power supply Current consumption Output current to backplane bus	DC 24V max. 1A max. 3A
Status display	via LEDs at the front

Work memory
  - integrated
     Code
     Data
  - expandable
     Code
     Data
	
	512kbyte
	512kbyte
	
	1Mbyte
	1Mbyte

Load memory	2Mbyte
External storage media	MMC (Memory Card), MCC memory extension card
Battery buffer / clock	Lithium battery, 30 days buffer / yes

Execution time CPU
  - for bit operation, min.
  - for word operation, min.
  - for fixed-point calculation, min.
  - for floating-point calculation, min.
	
	0.010µs
	0.010µs
	0.010µs
	0.058µs

Flag byte / Timer / Counter	8192 / 512 / 512
Number of blocks	FBs 2048, FCs 2048, DBs 4095
Slots / Interfaces	

MPI	*MPI interface*
	  - Transfer rate: max. 12Mbaud
	  - max. 32 connections

RJ45 PG/OP channel	PG/OP channel via Ethernet with max. 4 connections

RS485	Configurable functionality via project engineering:
	deactivated
	Profibus DP Communication
	  - Transfer rate: 9.6kbaud to 12Mbaud
	  - max. number of partners: 32 stations in every segment
	    without repeater, with Repeater expandable to 126.
	  - Protocol: DP-V0, DP-V1, PG/OP communication
	PtP Communication
	  - Transfer rate: 0.15kbaud to 115.2kbaud
	  - max. number of partners: ASCII, RTX/ETX, 3964R: 1
	    Modbus: 256 Stations, USS: 64 Stations
	  - Protocol: ASCII, STX/ETX, 3964R, USS$_{Master}$,
	    Modbus ASCII$_{Master}$/RTU$_{Master}$

... continue

... Slots / Interfaces	

RJ45 - CP 343	*Twisted-Pair-Ethernet for CP Communication*
	  - Transfer rate: 10/100Mbit
	  - Total length: max. 100m per Segment

Number of productive connections by Siemens NetPro	max. 8
Number of productive connections by user program	max. 8 (starting with CP firmware version V2.2.8 for ISO transport connections as well)
Siemens S7 connections	USEND, URCV, BSEND, BRCV, GET, PUT, remote-CPU functions. Connection establishment active and passive, supports unspecified connection partner
TCP connections	SEND, RECEIVE, FETCH PASSIVE, WRITE PASSIVE Connection establishment active and passive, supports unspecified connection partner
ISO-on-TCP connections (RFC1006)	SEND, RECEIVE, FETCH PASSIVE, WRITE PASSIVE Connection establishment active and passive, supports unspecified connection partner
UDP connections	SEND and RECEIVE The transfer of the telegrams is not acknowledged, i.e. the loss of messages is not recognized by the send block.
UDP Broadcast connection	SEND
UDP Multicast connection	SEND and RECEIVE (max. 16 multicast circles)
Data block length	max. 64kbyte (max. 2kbyte at UDP)
VIPA handling blocks - Siemens S7 connection	FB/SFB VIPA handling blocks USEND, URCV, BSEND, BRCV, GET, PUT, remote CPU functions; any call without lock in all OBs.
- Send/Receive connections	FC VIPA handling blocks AG_SEND, AG_RECEIVE; any call without lock in all OBs
Number of PG/OP connections	max. 32 (each 1 connection is reserved for PG and OP)
Diagnostic	supports NCM diagnostic via Ethernet
Search within network	supports Siemens SIMATIC manager search
Measurements and Weight	
Measurements (WxHxD) in mm Weight in g	80x125x120 430

Chapter 4   Deployment CPU 315SN/NET

Overview   This chapter describes the deployment of a CPU 315SN/NET with SPEED7 technology in the System 300. The description refers directly to the CPU and to the deployment in connection with peripheral modules, mounted on a profile rail together with the CPU at the standard bus.

Assembly Standard-Bus

waagrechter Aufbau

senkrechter Aufbau

liegender Aufbau

Assembly possibilities

Please regard the allowed environment temperatures:

- horizontal assembly: from 0 to 60°C
- vertical assembly: from 0 to 40°C
- lying assembly: from 0 to 40°C

Approach

- Bolt the profile rail with the background (screw size: M6), so that you still have minimum 65mm space above and 40mm below the profile rail.

- If the background is a grounded metal or device plate, please look for a low-impedance connection between profile rail and background.

- Connect the profile rail with the protected earth conductor. For this purpose there is a bolt with M6-thread.

- The minimum cross-section of the cable to the protected earth conductor has to be 10mm^2.

- Stick the power supply to the profile rail and pull it to the left side to the grounding bolt of the profile rail.

- Fix the power supply by screwing.

- Take a backplane bus connector and click it at the CPU from the backside like shown in the picture.

- Stick the CPU to the profile rail right from the power supply and pull it to the power supply.

- Click the CPU downwards and bolt it like shown.

- Repeat this procedure with the peripheral modules, by clicking a backplane bus connector, stick the module right from the modules you've already fixed, click it downwards and connect it with the backplane bus connector of the last module and bolt it.

1 Nm

Danger!

- The power supplies must be released before installation and repair tasks, i.e. before handling with the power supply or with the cabling you must disconnect current/voltage (pull plug, at fixed connection switch off the concerning fuse)!

- Installation and modifications only by properly trained personnel!

Start-up behavior

Turn on power supply

After the power supply has been switched on, the CPU changes to the operating mode the operating mode lever shows.

Now you may transfer your project to the CPU via MPI from your configuration tool res. plug in a MMC with your project and run an overall reset.

Overall reset

The following picture shows the approach once more:
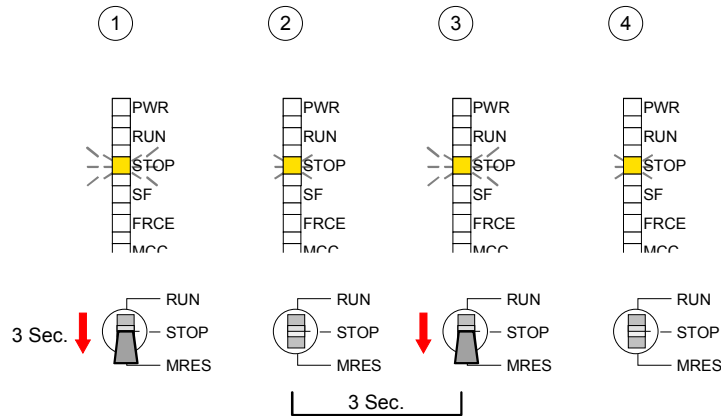
Note!

The transfer of the application program from the MMC into the CPU takes always place after an overall reset!

Default boot procedure, as delivered

When the CPU is delivered it has been reset.

After a STOP→RUN transition the CPU switches to RUN without program.

Boot procedure with valid data in the CPU

The CPU switches to RUN with the program stored in the battery buffered RAM.

Boot procedure with empty battery

The accumulator/battery is automatically loaded via the integrated power supply and guarantees a buffer for max. 30 days. If this time is exceeded, the battery may be totally discharged. This means that the battery buffered RAM is deleted.

In this state, the CPU executes an overall reset. If a MMC is plugged, program code and data blocks are transferred from the MMC into the work memory of the CPU.

If no MMC is plugged, the CPU transfers permanent stored "protected" blocks into the work memory if available.

Information about storing protected blocks in the CPU is to find in this chapter at "Extended Know-how protection".

Depending on the position of the RUN/STOP lever, the CPU switches to RUN res. remains in STOP.

This event is stored in the diagnostic buffer as: "Start overall reset automatically (unbuffered PowerON)".

Addressing

Overview

To provide specific addressing of the installed peripheral modules, certain addresses must be allocated in the CPU.

At the start-up of the CPU, this assigns automatically peripheral addresses for digital in-/output modules starting with 0 and ascending depending on the slot location.

If no hardware project engineering is available, the CPU stores at the addressing analog modules to even addresses starting with 256.

Addressing Backplane bus I/O devices

The CPU 315SN/NET provides an I/O area (address 0 ... 8191) and a process image of the in- and outputs (each address 0 ... 255).

The process image stores the signal states of the lower address (0 ... 255) additionally in a separate memory area.

The process image this divided into two parts:

- process image to the inputs (PII)
- process image to the outputs (PIQ)
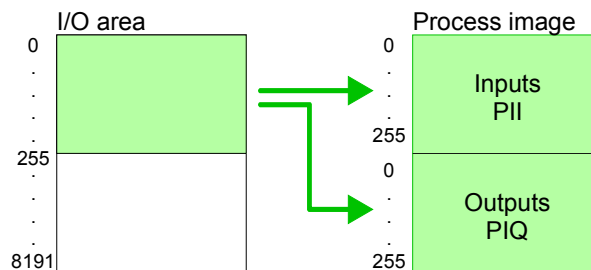
The process image is updated automatically when a cycle has been completed.

Max. number of pluggable modules

Maximally 8 modules may be addressed by the CPU 315SN/NET.

For the project engineering of more than 8 modules you may use virtual line interface connections. For this you set in the hardware configurator the module IM 360 from the hardware catalog to slot 3 of your 1st profile rail. Now you may extend your system with up to 3 profile rails by starting each with an IM 361 from Siemens at slot 3.

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 comes into force.

At the automatic address allocation DIOs occupy depending on the slot location always 4byte and AIOs, FMs, CPs always 16byte at the bus.

Depending on the slot location the start address from where on the according module is stored in the address range is calculated with the following formulas:

DIOs: Start address = 4·(slot -1)

AIOs, FMs, CPs: Start address = 16·(slot -1)+256
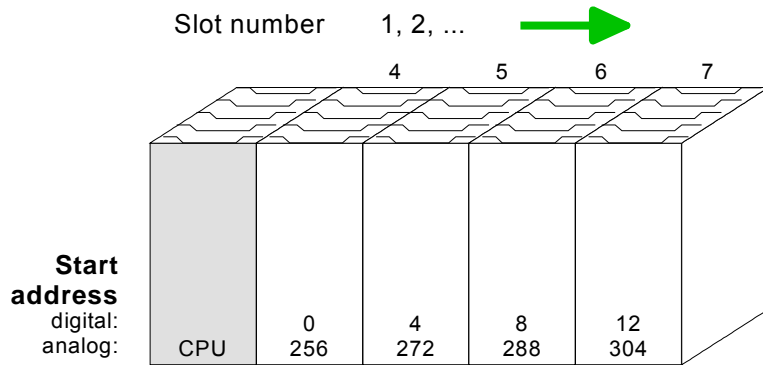
Example for automatic address allocation

The following sample shows the functionality of the automatic address allocation:
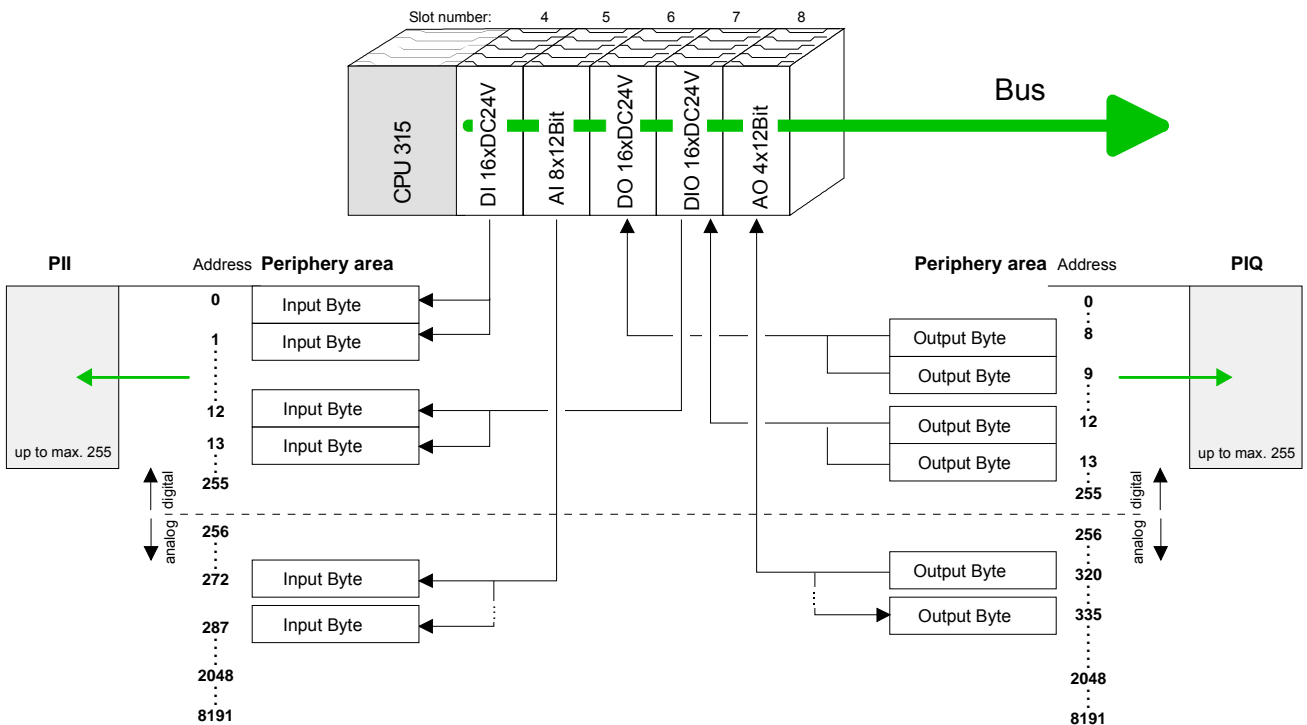
Initialization Ethernet PG/OP channel

Overview
The CPU 315SN/NET has an integrated Ethernet PG/OP channel. This channel allows you to program and remote control your CPU with up to 4 connections.

The 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.

For online access to the CPU via Ethernet PG/OP channel valid IP address parameters have to be assigned to this by means of the Siemens SIMATIC manager. This is called "initialization".

Possibilities for Initialization
There are the following possibilities for assignment of IP address parameters (initialization):

- PLC functions with *Assign Ethernet address*
  (starting with firmware V. 1.6.0)

- Hardware project engineering with CP (Minimal project)

Requirements
For the hardware configuration the following software is necessary:

- SIMATIC Manager from Siemens V. 5.1 or higher

- SIMATIC NET

Initialization via PLC functions
Please consider that this functionality is supported starting from the firmware version V. 1.6.0. The initialization takes place after the following proceeding:

- Determine the current Ethernet (MAC) address of your Ethernet PG/OP channel. This always may be found as 1. address under the front flap of the CPU on a sticker on the left side.

Ethernet-Address   **PG/OP channel**
1. Ethernet-PG/OP
2. CP343

- Establish a network connection between Ethernet PG/OP channel of the CPU and PC.
- Start the Siemens SIMATIC manager at the PC
- Set via **Options** > *Set PG/PC Interface* the Access Path to "TCP/IP -> Network card .... Protocol RFC 1006".
- Open with **PLC** > *Assign Ethernet Address* the dialog window for "initialization" of a station.
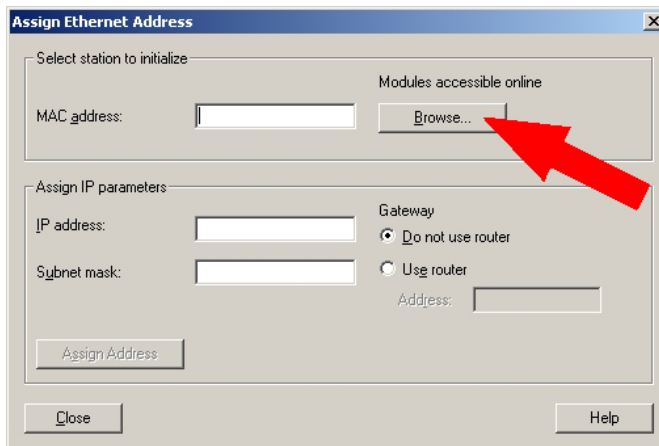
- Use the [Browse] button to determine the CPU components via MAC address.
  As long as the Ethernet PG/OP channel was not initialized yet, this owns the IP address 0.0.0.0 and the station name "Onboard PG/OP".
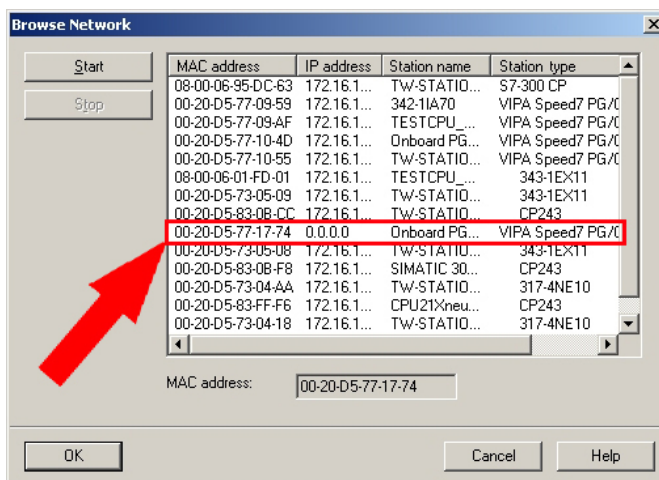
- Choose the determined module and click to [OK].
- Set the IP configuration by entering IP address, subnet mask and net transition. In addition an IP address may be received from a DHCP server. For this depending upon the selected option the MAC address, device name or the Client ID, which may be entered here, is to be conveyed to the DHCP server. The Client-ID is a character sequence from maximally 63 characters.
  Here the following indications may be used: Dash "-", 0-9, A-z, A-Z
- Confirm your settings by button [Assign Address]

  Direct after the assignment the Ethernet PG/OP channel may be reached by the Siemens SIMATIC manager by means of these IP address parameters and the *Access Path* "TCP/IP -> Network card .... Protocol RFC 1006".

Initialization via minimal project

- Establish a network connection between Ethernet PG/OP channel of the CPU and PC.
- Start the SIMATIC Manager from Siemens and create a new project.
- Add a new System 300 station via **Insert** > *Station* > *SIMATIC 300-Station*.
- Activate the station "SIMATIC 300" and open the hardware configurator by clicking on "Hardware".
- Engineer a rack (SIMATIC 300 \ Rack-300 \ Profile rail)
- For the SPEED7-CPUs are configured as CPU 318-2, choose the CPU 318-2 with the order no. 6ES7 318-2AJ00-0AB0 V3.0 from the hardware catalog. You'll find this at SIMATIC 300 \ CPU 300 \ CPU 318-2.
- Include the CP 343-1EX11 at slot 4 (SIMATIC 300 \ CP 300 \ Industrial Ethernet \ CP 343-1).
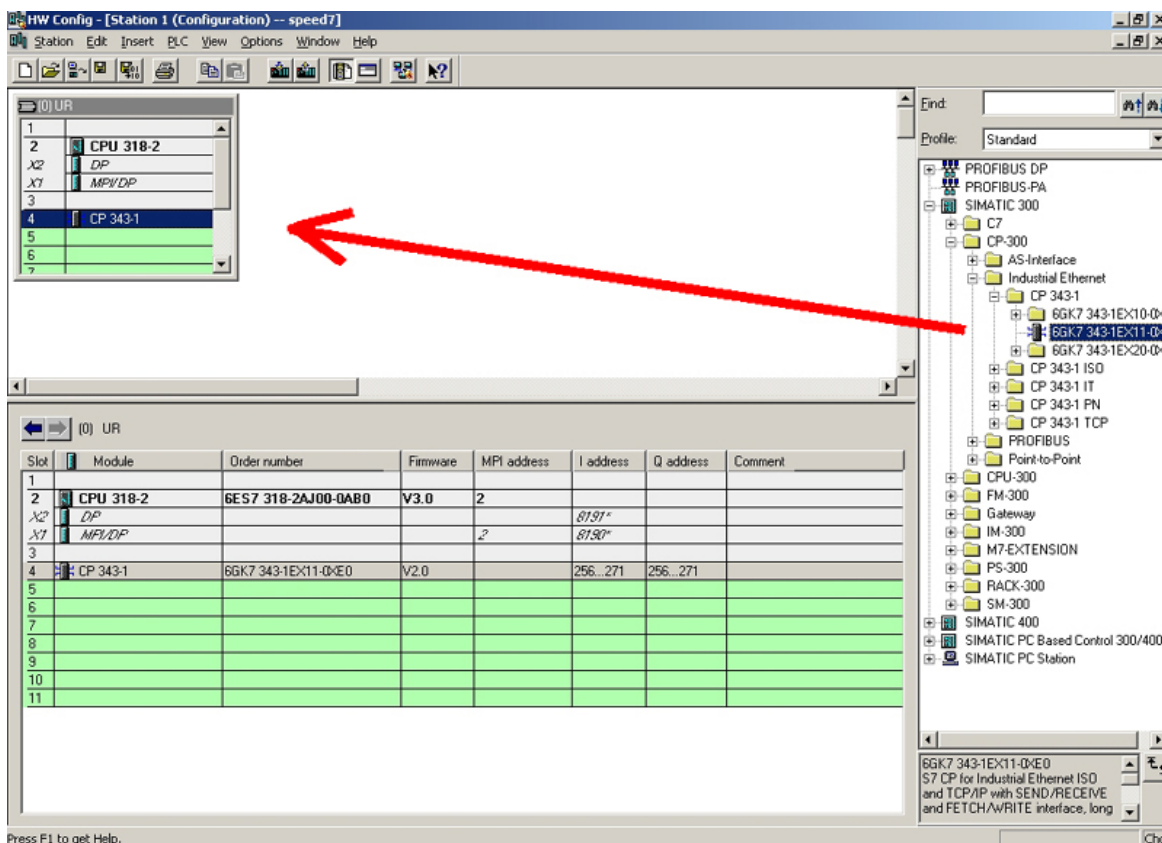
- Type the wanted IP address and subnet mask into the dialog window of "Properties" of the CP 343-1 and connect the CP with "Ethernet".
- Save and compile your project.
- Transfer your project via MPI or MMC into your CPU. More information about transfer methods may be found in the chapter "Project transfer".

Direct after the assignment the Ethernet PG/OP channel may be reached by the Siemens SIMATIC manager by means of these IP address parameters and the *Access Path* "TCP/IP -> Network card .... Protocol RFC 1006".

Access to the internal Web page

Access to the web page

The Ethernet PG/OP channel provides a web page that you may access via an Internet browser by its IP address. The web page contains information about firmware versions, current cycle times etc.

The current content of the web page is stored on MMC by means of the MMC-Cmd WEBPAGE. More information may be found at "MMC-Cmd - Auto commands".

Requirements

A PG/OP channel connection should be established between PC with Internet browser and CPU 315SN/NET. This may be tested by *Ping* to the IP address of the PG/OP channel.

Web page
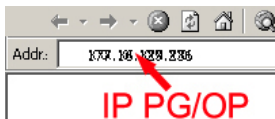
The access takes place via the IP address of the Ethernet PG/OP channel. The web page only serves for information output. The monitored values are not alterable.

IP PG/OP

```
CPU WITH ETHERNET PG/OP
Slot 100
  VIPA 315-4NE12 V.... Px000079.pkg,
  SERIALNUMBER 05439
  SUPPORTDATA :
  PRODUCT V3420, HARDWARE V0111, 5679L-V10,
  Hx000029.100,Bx000227 V6420, Ax000086 V1200,
  Ax000056 V0000, fx000007.wld V1120,
  FlashFileSystem : V102
  Memorysizes (Bytes): LoadMem : 1048576,
  WorkMemCode : 524288, WorkMemData : 524288


  OnBoardEthernet : MacAddress : 0020D577153F,
  IP-Address : , SubnetMask : , Gateway :
  Cpu state : Stop
  FunctionRS485 X2/COM1: MPI
  FunctionRS485 X3/COM2: DPM-async
  Cycletime [microseconds] : min=0 cur=0 ave=0
  max=0


  MCC-Trial-Time: 70:23



  ArmLoad [percent] : cur11, max=35



Slot 201
  VIPA 342-1DA70 V3.1.9 Px000062.pkg,
  SUPPORTDATA :
  PRODUCT  V3190,  BB000218  V5190,  AB000068
  V4160,  ModuleType  CB2C0010,  Cycletime
  [microseconds] : min=65535000 cur=0 ave=0
  max=0 cnt=0
```

Order no., firmware vers., package, serial no.
Information for support

Information about memory configuration, load memory, work memory (code/data)
Ethernet PG/OP: Addresses

CPU status
Operating mode RS485
(MPI: MPI operation, DPM: DP master)
CPU cycle time:
min= minimal
cur= current
max= maximal

Remaining time in hh:mm for deactivation of the expansion memory if MCC is removed.
Information for support

Additional CPU components:

Slot 201 (DP master):
Name, firmware version, package
Information for support

continued ...

... continue

```
Slot 206
  VIPA 343-1EX71 V2.2.7 Px000058.pkg,
  SUPPORTDATA :
  Bb000165 V2270, AB000060 V0320

  PRODUCT V2270, Hx000003 V1400
  ModuleType ACDB0000
  Address Input 1024...1039
  Address Output 1024...1039
```

Slot 206 (CP 343):
Name, firmware version, package
Information for support

```
Standard Bus
  BaudRate Read Mode1, BaudRate Write Mode1
```

Modules at the standard bus
Information for the support

```
Line 1: ModuleType 94F9:IM36x

Rack 0 /Slot 4
  ModuleType:9FC3: Digital Input 32
  Baseaddress Input 0

Rack 0 /Slot 5 ...
...
Line 2: ModuleType A4FE:IM36x

Rack 1 /Slot 4
  ModuleType:9FC3: Digital Input 32
  Baseaddress Input 0

Rack 1 /Slot 5 ...
```

IM interface if exists
Rack no. / Slot no.
Type of module
Configured base address
if exists firmware no. and package
Rack no. / slot no.

IM interface if exists

Type of module
Configured base address
if exists firmware no. and package
Rack no. / slot no.

Project engineering

Overview

The project engineering of the VIPA CPU 315-4NE12 takes place at the Siemens hardware configurator and is divided into the following parts:

- Project engineering CPU 315-4NE12 as CPU 318-2 from Siemens (318-2AJ00-0AB00 V3.0).
- Project engineering of the modules plugged at the bus.
- Project engineering Ethernet PG/OP channel as CP 343-1 (343-1EX11).
- Project engineering internal CP 343 as CP 343-1 (343-1EX11).

Requirements

The hardware configurator is a part of the Siemens SIMATIC Manager. It serves the project engineering. The modules, which may be configured here are listed in the hardware catalog. If necessary you have to update the hardware catalog with **Options** > *Update Catalog*.

For project engineering a thorough knowledge of the Siemens SIMATIC manager and the Siemens hardware configurator are required!

Fast introduction

To be compatible with the Siemens SIMATIC manager the following steps should be executed:

Slot	Module
1	
2	**CPU 318-2**
X2	*DP*
X1	*MPI/DP*
3	
Modules at the bus	
	343-1EX11 (Ethernet PG/OP)
	343-1EX11 (internal CP 343)

- Start the Siemens hardware configurator.
- Configure Siemens CPU 318-2 (6ES7 318-2AJ00-0AB0/V3.0). Configure the internal DP master of your CPU via the internal DP master of the CPU 318-2. Leave *MPI/DP* of the CPU 318-2 in MPI mode. The *Profibus* mode is not supported.
- Place the System 300 modules in the plugged sequence starting with slot 4.
- For the internal Ethernet PG/OP channel you have to configure a Siemens CP 343-1 (343-1EX11) <u>always as 1.</u> module after the modules at the bus.
- Configure the integrated CP 343 of the CPU 315-4NE12 always as <u>2. CP</u> after the placed Ethernet PG/OP channel as CP343-1 (343-1EX11).

These steps are described in the following.

Steps of the project engineering

The project engineering is separated into 3 parts:

- Project engineering of the CPU with DP master
- Project engineering of the modules at the bus
- Project engineering Ethernet PG/OP channel and CP 343

Project engineering of the CPU with DP master

- Start the hardware configurator from Siemens with a new project and insert a profile rail from the hardware catalog.
- Place the following Siemens CPU at slot 2:
  CPU 318-2 (318-2AJ00-0AB00 V3.0).
- The Profibus DP master of the CPU 315-4NE12 is to be configured and connected by the sub module DP of the CPU 318-2. Leave the sub module *MPI/DP* of the CPU 318-2 in *MPI* mode. The *Profibus* mode is not supported.
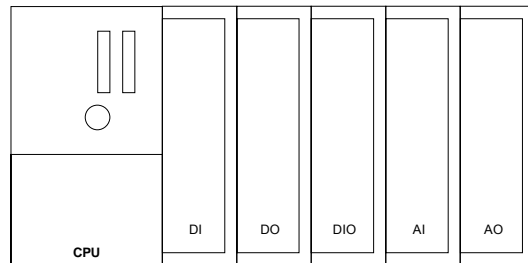
Slot	Module
1	
2	**CPU 318-2**
X1	*DP*
X2	*MPI/DP*
3	
4	
5	

Project engineering of the modules at the bus

The modules at the bus are configured with the following approach:

- Include your System 300 modules at the bus in the plugged sequence starting with slot 4.
- Parameterize the CPU res. the modules where appropriate. The parameter window opens by a double click on the according module.
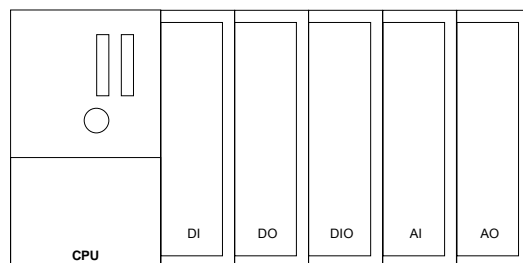
Slot	Module
1	
2	**CPU 318-2**
X2	*DP*
X1	*MPI/DP*
3	
4	DI
5	DO
6	DIO
7	AI
8	AO
9	
10	
11	

Project engineering Ethernet PG/OP channel and CP 343

For the internal Ethernet PG/OP channel you have to configure a Siemens CP 343-1 (343-1EX11) <u>always</u> after the modules at the bus. This may be found at the hardware catalog at SIMATIC 300 \ CP 300 \ Industrial Ethernet \ CP 343-1 \ 6GK7 343-1EX11-0XE0.

The integrated CP 343 of the CPU 315-4NE12 is also configured and connected as CP 343-1 (343-1EX11) but always as 2. module below the configured PG/OP channel before.

Slot	Module
1	
2	**CPU 318-2**
X2	*DP*
X1	*MPI/DP*
3	
4	DI
5	DO
6	DIO
7	AI
8	AO
9	343-1EX11
10	343-1EX11
11	

Ethernet PG/OP channel
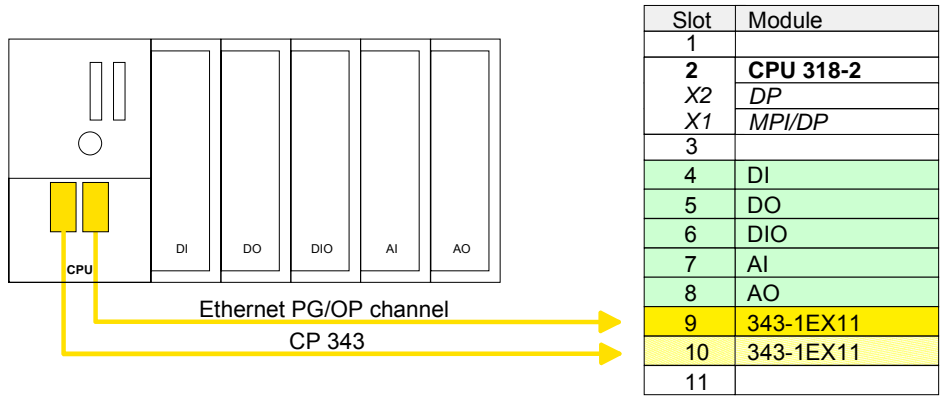
CP 343

Set IP parameters

Open the property window via double-click on the CP 343-1EX11. Enter "General" and click at [Properties]. Type in the *IP address*, *subnet mask* and *gateway* for the CP and select the wanted *subnet*.

Setting standard CPU parameters

Parameterization via Siemens CPU 318-2AJ00

Since each CPU 31xS from VIPA is to be configured as Siemens CPU 318-2 (CPU 318-2AJ00 V3.0) in the Siemens hardware configurator, the standard parameters of the VIPA CPU 31xS may be set with "Object properties" of the CPU 318-2 during hardware configuration.

Via a double-click on the CPU 318-2 the parameter window of the CPU may be accessed.

Using the registers you get access to every standard parameter of the CPU.
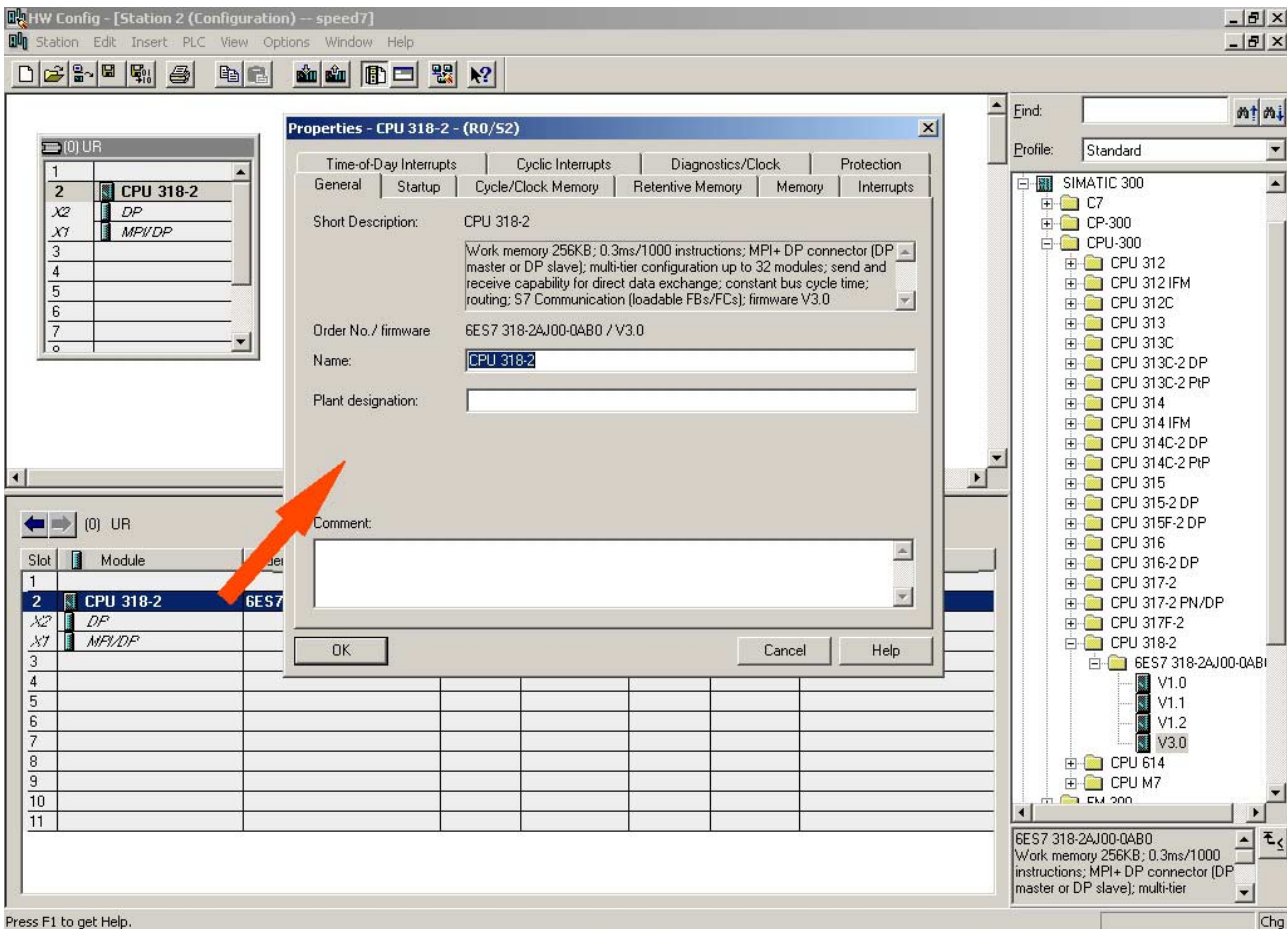
Supported parameters	The CPU does not evaluate each parameter, which may be set at the hardware configuration.
	The following parameters are supported by the CPU at this time:

General

Short description	Since every CPU 31xS from VIPA is configured as CPU 318-2AJ00 from Siemens, here the short description CPU 318-2 stands.
Order No. / Firmware	Order number and firmware are identical to the details in the "hardware catalog" window.
Name	The *Name* field provides the *short description* of the CPU. If you change the name the new name appears in the Siemens SIMATIC manager.
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. This has a hierarchical structure and confirms to IEC 1346-1.
Comment	In this field information about the module may be entered.

Startup

Startup when expected/actual configuration differs	If the checkbox for "Startup when expected/actual configuration differ" is *deselected* and at least one module is not located at its configured slot or if another type of module is inserted there instead, then the CPU switches to STOP mode.
	If the checkbox for "Startup when expected/actual configuration differ" is *selected*, then the CPU starts even if there are modules not located in their configured slots of if another type of module is inserted there instead, such as during an initial system start-up.
Monitoring time for ready message by modules [100ms]	This operation specifies the maximum time for the ready message of every configured module after PowerON. If the modules do not send a ready message to the CPU by the time the monitoring time has expired, the actual configuration becomes unequal to the preset configuration.
Monitoring time for transfer of parameters to modules [100ms]	The maximum time for the transfer of parameters to parameterizable modules. If not every module has been assigned parameters by the time this monitoring time has expired; the actual configuration becomes unequal to the preset configuration.

Cycle/Clock memory

Update OB1 process image cyclically

Activate the checkbox for cyclic updates of the OB1 process image.

Updating increases the cycle time.

Scan cycle monitoring time

Here the scan cycle monitoring time in milliseconds may be set. If the scan cycle time exceeds the scan cycle monitoring time, the CPU enters the STOP mode. Possible reasons for exceeding the time are:

• Communication processes

• a series of interrupt events

• an error in the CPU program

Minimum scan cycle time

The minimum scan cycle time specifies the time interval, in which the CPU program is called.

If the scan cycle time is less than the specified minimum scan cycle time, the CPU waits until the minimum scan cycle time is reached.

Scan cycle load from Communication

Using this parameter you can control the duration of communication processes, which always extend the scan cycle time so it does not exceed a specified length.

If there are no additional asynchronous events, the scan cycle time of OB1 is increased by following factor:

$$\frac{100}{100 - \text{cycle load from communication \%}}$$

If the cycle load from communication is set to 50%, the scan cycle time of OB 1 can be doubled. At the same time, the scan cycle time of OB 1 is still being influenced by asynchronous events (e.g. process interrupts) as well.

Size of the process image input/output area

Here the size of the process image max. 2048 for the input/output periphery may be fixed.

OB85 call up at I/O access error

The preset reaction of the CPU may be changed to an I/O access error that occurs during the update of the process image by the system.

Each CPU 31xS from VIPA is preset such that OB 85 is not called if an I/O access error occurs and no entry is made in the diagnostic buffer either.

Clock memory

Activate the check box if you want to use clock memory and enter the number of the memory byte.

Note!

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

Retentive Memory

Number of Memory Bytes from MB0	Enter the number of retentive memory bytes from memory byte 0 onwards.
Number of S7 Timers from T0	Enter the number of retentive *S7 timers* from T0 onwards. Each *S7 timer* occupies 2bytes.
Number of S7 Counters from C0	Enter the number of retentive *S7 counter* from C0 onwards.
Areas	Since with every VIPA CPU 31xS each data block is remanent stored, the settings at *Areas* are non-relevant and they are ignored.

Memory

Local data (priority classes)	In these fields you may define the number of local data (temporary data) for the priority classes 1 to 29.

Interrupts

Priority	Here the priorities may be specified according to which the hardware interrupt OBs are processed (hardware interrupt, time-delay interrupt, async. error interrupts). *Interrupts for DPV1* are not supported.
	With priority "0" the corresponding OB is deactivated. Please regard that this is not supported by each OB.

Time-of-day interrupts

Priority	Here the priorities may be specified according to which the time-of-day interrupt is processed.
	With priority "0" the corresponding OB is deactivated.
Active	Activate the check box of the time-of-day interrupt OBs if these are to be automatically started on complete restart.
Execution	Select how often the interrupts are to be triggered. Intervals ranging from every minute to yearly are available. The intervals apply to the settings made for *start date* and *time*.
Start date / time	Enter date and time of the first execution of the time-of-day interrupt.
Process image partition	This is not supported.

Cyclic interrupts

Priority   Here the priorities may be specified according to which the corresponding cyclic interrupt is processed. With priority "0" the corresponding interrupt is deactivated.

Execution   Enter the time intervals in ms, in which the watchdog interrupt OBs should be processed. The start time for the clock is when the operating mode switch is moved from STOP to RUN.

Phase offset   Enter the delay time in ms for current execution for the watch dog interrupt. This should be performed if several watchdog interrupts are enabled. Phase offset allows to distribute processing time for watchdog interrupts across the cycle.

Process image   Is not supported.
partition

Diagnostics/Clock

Report cause of   Activate this parameter, if the CPU should report the cause of STOP to PG
STOP   respectively OP on transition to STOP.

Number of   Here the number of diagnostics are displayed, which may be stored in the
messages in the   diagnostics buffer (circular buffer).
diagnostics buffer

Synchronization   You can specify whether the CPU clock should be used to synchronize
type   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   Select the time intervals within which the synchronization is to be carried out.

Correction factor   Lose or gain in the clock time may be compensated within a 24 hour period by means of the correction factor in ms. If the clock is 1s slow after 24 hours, you have to specify a correction factor of "+1000" ms.

Protection

Level of protection   Here 1 of 3 protection levels may be set to protect the CPU from unauthorized access.

Protection level 1 (default setting):

- No password adjustable, no restrictions

Protection level 2 with password:

- Authorized users: read and write access

- Unauthorized user: read access only

Protection level 3:

- Authorized users: read and write access

- Unauthorized user: no read and write access

Parameter for DP   The properties dialog of the Profibus part is opened via a double click to the sub module DP.

General

Short description   Here the short description "DP" for Profibus-DP is specified.

Order no.   Nothing is shown here.

Name   Here "DP" is shown. If you change the name, the new name appears in the Siemens SIMATIC manager.

Interface   The Profibus address is shown here.

Properties   With this button the properties of the Profibus-DP interface may be preset.

Comment   You can enter the purpose of the DP master in this box.

Addresses

Diagnostics   A diagnostics address for Profibus-DP is to be preset here. In the case of an error the CPU is informed via this address.

Operating mode   Here the operating mode of the Profibus part may be preset. More may be found at chapter "Deployment Profibus Communication".

Configuration   Within the operating mode "DP-Slave" you may configure your slave system. More may be found at chapter "Deployment Profibus communication".

Clock   These parameters are not supported.

Parameter for MPI/DP	The properties dialog of the MPI interface is opened via a double click to the sub module MPI/DP.

General

Short description	Here the short description "MPI/DP" for the MPI interface is specified.
Order no.	Nothing is shown here.
Name	At *Name* "MPI/DP" for the MPI interface is shown. If you change the name, the new name appears in the Siemens SIMATIC manager.
Type	Please regard only the type "MPI" is supported by the VIPA CPU 31xS.
Interface	Here the MPI address is shown.
Properties	With this button the properties of the MPI interface may be preset.
Comment	You can enter the purpose of the MPI interface in this box.

Addresses

Diagnostics	A diagnostics address for the MPI interface is to be preset here. In the case of an error the CPU is informed via this address.
Operating mode, Configuration, Clock	These parameters are not supported.

Setting VIPA specific CPU parameters

Overview

Except of the VIPA specific CPU parameters the CPU parameterization takes place in the parameter dialog of the CPU 318-2AJ00.

With installing of the SPEEDBUS.GSD the VIPA specific parameters may be set during hardware configuration.

Here the following parameters may be accessed:

- Function RS485 (Synchronization DP master and CPU)
- Token Watch
- Number remanence flag
- Priority OB 28, OB 29, OB 33, OB 34
- Execution OB 33, OB 34
- Phase offset OB 33, OB 34

Requirements

Since the VIPA specific CPU parameters may be set, the installation of the SPEEDBUS.GSD from VIPA in the hardware catalog is necessary.

The CPU may be configured in a Profibus master system and the appropriate parameters may be set after installation.

Installation of the SPEEDBUS.GSD

The GSD (**G**eräte-**S**tamm-**D**atei) is online available in the following language versions. Further language versions are available on inquires.

Name	Language
SPEEDBUS.GSD	german (default)
SPEEDBUS.GSG	german
SPEEDBUS.GSE	english

The GSD files may be found at www.vipa.de at the "Service" part.

The integration of the SPEEDBUS.GSD takes place with the following proceeding:

- Browse to www.vipa.de.
- Click to *Service > Download > GSD- and EDS-Files > Profibus*.
- Download the file *Cx000023_Vxxx*.
- Extract the file to your work directory. The SPEEDBUS.GSD is stored in the directory *VIPA_System_300S*.
- Start the hardware configurator from Siemens.
- Close every project.
- Select **Options** > *Install new GSD-file.*
- Navigate to the directory *VIPA_System_300S* and select **SPEEDBUS.GSD**.

The SPEED7 CPUs and modules of the System 300S from VIPA may now be found in the hardware catalog at *Profibus-DP / Additional field devices / I/O / VIPA_SPEEDBUS*.

Hardware configuration

The hardware configuration happens as described at "Project engineering".

Slot	Module
1	
2	**CPU 318-2**
X2	*DP*
X1	*MPI/DP*
3	
Modules at the bus	
	343-1EX11 (Ethernet PG/OP)
	343-1EX11 (internal CP 343)

- Start the Siemens hardware configurator.
- Configure the Siemens CPU 318-2AJ00 (6ES7 318-2AJ00-0AB0/V3.0).
- Place the System 300 modules in the plugged sequence starting with slot 4.
- Configure a Siemens CP 343-1 (343-1EX11) for the internal Ethernet PG/OP channel below the really plugged System 300 modules.
- The integrated CP 343 of the CPU 315SN/NET is also configured as CP 343-1 (343-1EX11) but always as 2. CP below the configured PG/OP channel before.

Embedding by virtual Profibus DP master system

Slot	Module
1	
2	**CPU 318-2**
X2	*DP*
X1	*MPI/DP*
3	
Modules at the bus	
	343-1EX11 (Ethernet PG/OP)
	343-1EX11 (internal CP 343)
always as last module 342-5DA02 V5.0	

virtual DP-Master for CPU

(100) VIPA
SPEEDbus

CPU:
Addr.:100

VIPA_SPEEDbus

Slot	Order No.
0	315-4NE12 315SN/NE

Object properties

The embedding of the CPU 315-4NE12 happens by means of a virtual Profibus master system with the following approach:

- Configure always as last module a Siemens DP master CP 342-5 (342-5DA02 V5.0). Connect and parameterize it at operation mode "DP-Master".
- Connect the slave system "VIPA_SPEEDbus". After installing the SPEEDBUS.GSD this may be found in the hardware catalog at *Profibus-DP / Additional field devices / I/O / VIPA / VIPA_SPEEDBUS.*
- For the slave system set the Profibus address 100.
- Configure at slot 0 the VIPA CPU 315-4NE12 of the hardware catalog from VIPA_SPEEDbus.
- By double clicking the placed CPU 315-4NE12 the properties dialog of the CPU may be opened. These parameters are described at the following pages.

As soon as the project is transferred together with the PLC user program to the CPU, the parameters will be taken after start-up.

VIPA specific parameters

The following parameters may be accessed by means of the properties dialog of the VIPA-CPU.

Function RS485

Per default the RS485 interface is used for the Profibus DP master.

Using this parameter the RS485 interface may be switched to PtP communication (**p**oint **t**o **p**oint) respectively the synchronization between DP master system and CPU may be set:

Deactivated	Deactivates the RS485 interface
PtP	With this operating mode the Profibus DP master is deactivated and 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.
	More about this may be found at chapter "Deployment RS485 for PtP communication" in this manual.
Profibus-DP async	Profibus DP master operation asynchronous to CPU cycle
	The RS485 interface is preset at default to *Profibus-DP async.* Here CPU cycle and cycles of every VIPA Profibus DP master run independently.
Profibus-DP syncIn	The CPU is waiting for DP master input data.
Profbus-DP syncOut	The DP master system is waiting for CPU output data.
Profibus-DP syncInOut	CPU and DP master system are waiting on each other and form thereby a cycle.

Default: Profibus-DP async

Synchronization between master system and CPU

Normally the cycles of CPU and DP master run independently. The cycle time of the CPU is the time needed for one OB1 cycle and for reading respectively writing the inputs respectively outputs. The cycle time of a DP master depends among others on the number of connected slaves and the baud rate, thus every plugged DP master has its own cycle time.

Due to the asynchronism of CPU and DP master the whole system gets relatively high response times.

The synchronization behavior between every VIPA Profibus DP master and the CPU may be configured by means of a hardware configuration as shown above.

The different modes for the synchronization are in the following described.

Profibus-DP SyncInOut	In *Profibus-DP SyncInOut* mode CPU and DP-Master-System are waiting on each other and form thereby a cycle. Here the whole cycle is the sum of the longest DP master cycle and CPU cycle.

By this synchronization mode you receive global consistent in-/ output data, since within the total cycle the same input and output data are handled successively by CPU and DP master system.

If necessary the time of the *Watchdog* of the bus parameters should be increased at this mode.
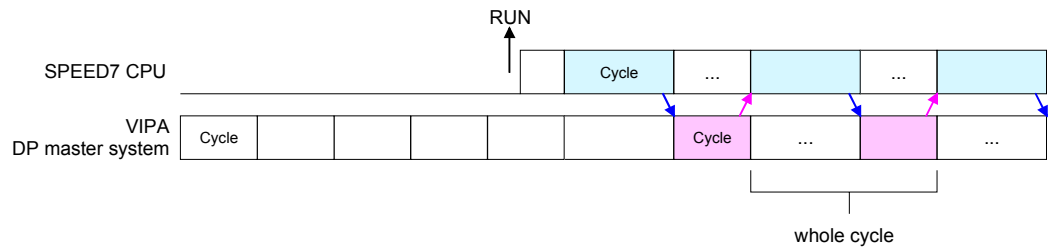
Profibus-DP SyncOut	In this operating mode the cycle time of the VIPA DP master system depends on the CPU cycle time. After CPU start-up the DP master gets synchronized.

As soon as their cycle is passed they wait for the next synchronization impulse with output data of the CPU. So the response time of your system can be improved because output data were directly transmitted to the DP master system. If necessary the time of the *Watchdog* of the bus parameters should be increased at this mode.
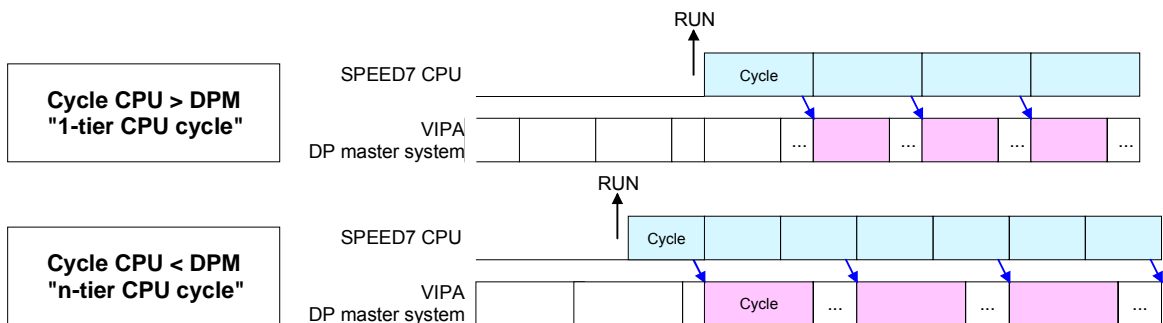
Profibus-DP SyncIn	In the operating mode *Profibus-DP SyncIn* the CPU cycle is synchronized to the cycle of the VIPA Profibus DP master system.

Here the CPU cycle depends on the VIPA DP master with the longest cycle time. If the CPU gets into RUN it is synchronized with each Profibus DP master. As soon as the CPU cycle is passed, it waits for the next synchronization impulse with input data of the DP master system.

If necessary the *Scan Cycle Monitoring Time* of the CPU should be increased.

Token Watch   This is a VIPA internal parameter. Nothing should be changed here.

Default: On

Number   Here the number of flag bytes may be set. With 0 the value *Retentive*
remanence flag   *memory > Number of memory bytes starting with MB0* set at the
parameters of the Siemens CPU 318-2 is used. Otherwise the adjusted
value (1 ... 8192) is used.

Default: 0

Phase offset and   The CPU offers additional cyclic interrupts, which interrupt the cyclic
execution of OB33   processing in certain distances. Point of start of the time interval is the
and OB34   change of operating mode from STOP to RUN.

To avoid that the cyclic interrupts of different cyclic interrupt OBs receive a
start request at the same time and so a time out may occur, there is the
possibility to set a phase offset respectively a time of execution.

The *phase offset* (0 ... 60000ms) serves for distribution processing times
for cyclic interrupts across the cycle.

The time intervals, in which the cyclic interrupt OB should be processed
may be entered with *execution* (1 ... 60000ms).

Default: Phase offset: 0
          Execution: OB33: 500ms
                      OB34: 200ms

Priority of OB28,   The priority fixes the order of interrupts of the corresponding interrupt OB.
OB29, OB33 and   Here the following priorities are supported:
OB34   0 (Interrupt-OB is deactivated), 2,3,4,9,12,16,17,24

Default: 24

Parameterization of modules

Approach

By using the SIMATIC Manager from Siemens you may set parameters for configurable System 300 modules at any time.

For this, double-click during the project engineering at the slot overview on the module you want to parameterize In the appearing dialog window you may set the wanted parameters.
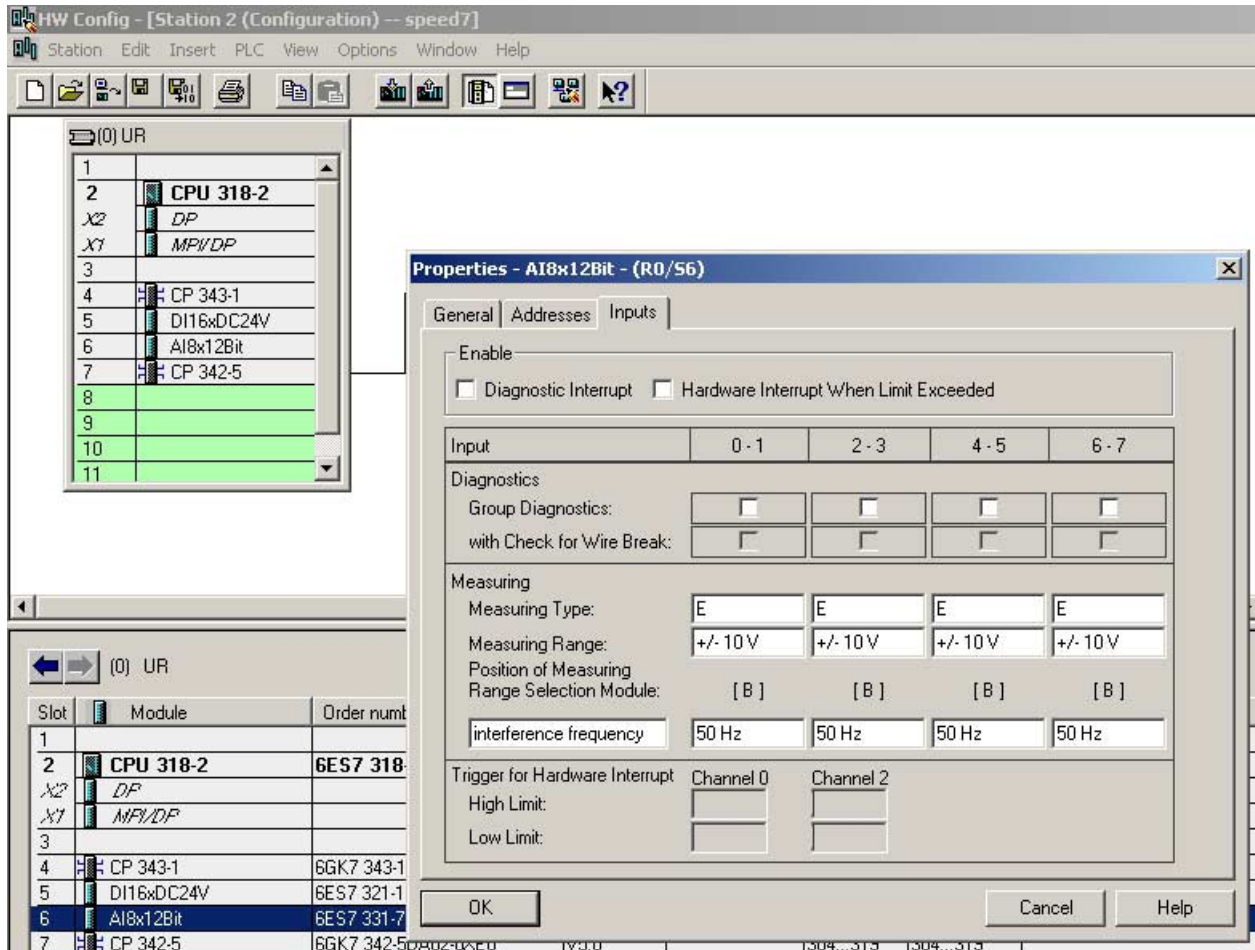
Parameterization during runtime

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.

Project transfer

Overview

There are the following possibilities for project transfer into the CPU:
- Transfer via RS485
- Transfer via MMC
- Transfer via Ethernet

Transfer via RS485

For transfer via RS485 there are the following 2 interfaces:
- MPI interface supports maximally 32 PG/OP channels
- PB-DP/PtP interface supports maximally 31 PG/OP channels (exclusive at Profibus DP master operation)

MPI programming cable

The MPI programming cables are available at VIPA in different variants. The deployment of the cables is identical. The cables provide a bus enabled RS485 plug for the CPU and a RS232 res. USB plug for the PC.

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.

Net structure

The structure of a MPI net is in the principal identical with the structure of a 1.5Mbaud 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.

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 provided with voltage during start-up and operation.

MPI programming cable

Terminating   MPI/Profibus net   Terminating
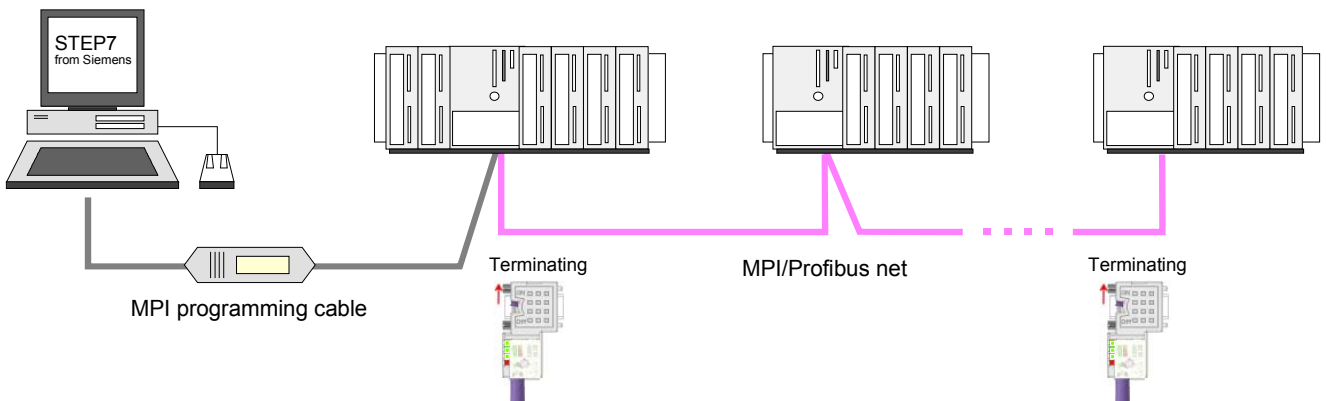
Approach transfer
via MPI interface

- Connect your PC to the MPI jack of your CPU via a MPI programming cable.

- Load your project in the SIMATIC Manager from Siemens.

- Choose in the menu **Options** > *Set PG/PC interface*

- Select in the according list the "PC Adapter (MPI)"; if appropriate you have to add it first, then click on [Properties].

- Set in the register *MPI* the transfer parameters of your MPI net and type a valid *address*.

- Switch to the register *Local connection*

- Set the COM port of the PC and the transfer rate 38400Baud for the MPI programming cable from VIPA.

- Via **PLC** > *Load to module* you may transfer your project via MPI to the CPU and save it on a MMC via **PLC** > *Copy RAM to ROM* if one is plugged.

Approach transfer
via Profibus
interface

- Connect your PC to the DP-PB/PtP jack of your CPU via a MPI programming cable.

- Load your project in the Siemens SIMATIC Manager.

- Choose in the menu **Options** > *Set PG/PC interface*

- Select in the according list the "PC Adapter (Profibus)"; if appropriate you have to add it first, then click on [Properties].

- Set in the register *Profibus* the transfer parameters of your Profibus net and type a valid *Profibus address*. The *Profibus address* must be assigned to the DP master by a project before.

- Switch to the register *Local connection*

- Set the COM port of the PCs and the transfer rate 38400Baud for the MPI programming cable from VIPA.

- Via **PLC** > *Load to module* you may transfer your project via Profibus to the CPU and save it on a MMC via **PLC** > *Copy RAM to ROM* if one is plugged.

Note!

Transfer via Profibus is only available by DP master, if projected as master and assigned with a Profibus address before.

Transfer via MMC

The MMC (**Me**mory **C**ard) serves as external transfer and storage medium for programs and firmware. It has the PC compatible FAT16 file system.

There may be stored several projects and sub-directories on a MMC storage module. Please regard that your current project respectively the file with the reserved file name is stored in the root directory.

With an overall reset, PowerON or CPU-STOP the MMC is automatically read. By presetting a reserved file name the functionality of the CPU may be influenced.

Reserved file names

File name	Description
S7PROG.WLD	Project file - is read after overall reset respectively may be written by CPU by an order.
AUTOLOAD.WLD	Project file - is read after PowerON.
PROTECT.WLD	Protected project file (see "Extended know-how protection").
VIPA_CMD.MMC	Command file - once executed at CPU-STOP up to the next PowerON. (see "MMC-Cmd - Auto command").
*.pkg	Firmware file - is recognized after PowerON and may be installed by means of an update request (see "Firmware update").

Transfer MMC → CPU

The transfer of the application program from the MMC into the CPU takes place depending on the file name after overall reset or PowerON. The blinking of the LED "MCC" of the CPU marks the active transfer.
A transfer from CPU to MMC only happens if the size of the user memory exceeds the size of the user program. Else a compression is necessary.

Transfer CPU → MMC

When the MMC has been installed, the write command stores the content of the battery buffered RAM as **S7PROG.WLD** at the MMC. The write command is controlled by means of the Siemens hardware configurator via **PLC** > *Copy RAM to ROM*. During the write process the "MCC"-LED of the CPU is blinking. When the LED expires the write process is finished.

Transfer control

After a write process on the MMC, an according ID event is written into the diagnostic buffer of the CPU. To monitor the diagnosis entries, you select **PLC** > *Module Information* in the Siemens SIMATIC Manager. Via the register "Diagnostic Buffer" you reach the diagnosis window.

When writing on the MMC, the following events may occur:

Event-ID	Meaning
0xE100	MMC access error
0xE101	MMC error file system
0xE102	MMC error FAT
0xE200	MMC writing finished successful

Transfer via Ethernet

For transfer via Ethernet the CPU has the following 2 interfaces:

- Ethernet PG/OP channel - supports maximally 4 PG/OP connections
- CP343 - supports maximally 32 PG/OP connections

Initialization

So that you may access the corresponding Ethernet interface you have to assign IP address parameters by means of the "initialization".

Determine Ethernet address

During initialization the Ethernet (MAC) address of the corresponding interface is to be assigned. This may be found beneath the front flap of the CPU on the left side on a sticker. The address begins with "EA: ...". The highest sticker always shows the address of the Ethernet PG/OP channel. The address of the CP343 may the found at the sticker below.

Proceeding

- Establish a network connection between the corresponding Ethernet interface and your PC.
- Set at Siemens SIMATIC manager via **Options** > *Set PG/PC Interface* the access path to "TCP/IP -> Network card .... Protocol RFC 1006".
- Open with **PLC** > *Edit Ethernet Node* the dialog window for "initialization" of a station.
- Determine the station via Ethernet (MAC) address and assign it to IP address parameters. As long as an Ethernet interface was not initialized yet, this owns the IP address 0.0.0.0.

Directly after allocation the corresponding Ethernet interface of the CPU may be accessed with the Siemens SIMATIC manager by the assigned IP address parameters. More information concerning this may be found at "Initialization Ethernet PG/OP channel".

Transfer

- For transfer open your project in the Siemens SIMATIC manager.
- If not already happen, set at Siemens SIMATIC manager via **Options** > *Set PG/PC Interface* the access path to "TCP/IP -> Network card .... Protocol RFC 1006".
- Click to **PLC** > Download → the dialog "Select target module" is opened. Select your target module and enter the IP address parameters of the corresponding Ethernet interface as address for connection. Provided that no new hardware configuration is transferred to the CPU, the entered Ethernet connection is permanently stored in the project as transfer channel.
- With [OK] the transfer is started. System dependent you get a message that the projected system differs from target system. This message may be accepted by [OK] → your project is transferred and may be executed in the CPU after transfer.

Operating modes

Overview

The CPU can be in one of 4 operating modes:

- Operating mode STOP
- Operating mode START-UP
- Operating mode RUN
- Operating mode HOLD

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.
- Outputs are inhibited, i.e. 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 length of this OB is not limited. 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, i.e. outputs are inhibited.
- RUN-LED   blinks
- STOP-LED   off

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

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.
- The BASP-signal (outputs inhibited) is deactivated, i.e. all digital outputs are enabled.
- RUN-LED   on
- STOP-LED   off

Operating mode HOLD

The CPU gives you the opportunity to define up to 4 breakpoints for program diagnosis. Setting and deletion of breakpoints happens in your programming environment. As soon as a breakpoint is reached, you may process your program step by step and in- and outputs can be activated.

Precondition

For the usage of breakpoints, the following preconditions have to be fulfilled:

- Testing in single step mode is only possible with STL. If necessary switch the view via **View** > *STL* to STL.
- The block must be opened online and must not be protected.
- The open block must not be altered in the editor.

Approach for working with breakpoints

- Activate **View** > *Breakpoint Bar*.
- Set the cursor to the command line where you want to insert a breakpoint.
- Set the breakpoint with **Debug** > *Set Breakpoint*. The according command line is marked with a circle.
- To activate the breakpoint click on **Debug** > *Breakpoints Active*. The circle is changed to a filled circle.
- Bring your CPU into RUN. When the program reaches the breakpoint, your CPU switches to the state HOLD, the breakpoint is marked with an arrow and the register contents are monitored.
- Now you may execute the program code step by step via **Debug** > *Execute Next Statement* or run the program until the next breakpoint via **Debug** > *Resume*.
- Delete (all) breakpoints with the option **Debug** > *Delete All Breakpoints*.

Behavior in operating state HOLD

- The LED RUN blinks and the LED STOP is on.
- The execution of the code is stopped. No level is further executed.
- All times are frozen.
- The real-time clock runs on.
- The outputs are closed, but may be released for test purposes.
- Passive CP communication is possible.

Note!

The usage of breakpoints is always possible. Switching to the operating mode test operation is not necessary.

With more than 3 breakpoints, a single step execution is not possible.

**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 set to 0V.
	central analog outputs	The voltage supply for the output channels is switched off.
	decentral outputs	The outputs are set to 0V.
	decentral inputs	The inputs are read constantly from the slave 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.
	central analog outputs	The behavior of the outputs at restart can be preset.
	decentral inputs	The inputs are read constantly from the slave and the recent values are put at disposal.
RUN	general	The program execution happens cyclically and can therefore be foreseen: Read PII → OB 1 → Write PIO.

PII = Process image inputs

PIO = Process image outputs

Overall reset

Overview

During the overall reset the entire user memory (RAM) is erased. Data located in the memory card is not affected.

You have 2 options to initiate an overall reset:

- initiate the overall reset by means of the function selector switch
- initiate the overall reset by means of the Siemens SIMATIC Manager

Note!

You should always issue 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.

Overall reset by means of the function selector

Condition

The operating mode of the CPU is STOP. Place the function selector on the CPU in position "STOP" → the STOP-LED is on.

Overall reset

- Place the function selector in the position MRES and hold it in this position for app. 3 seconds. → The STOP-LED changes from blinking to permanently on.
- Place the function selector in the position STOP and switch it to MRES and quickly back to STOP within a period of less than 3 seconds.
  → The STOP-LED blinks (overall reset procedure).
- 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:
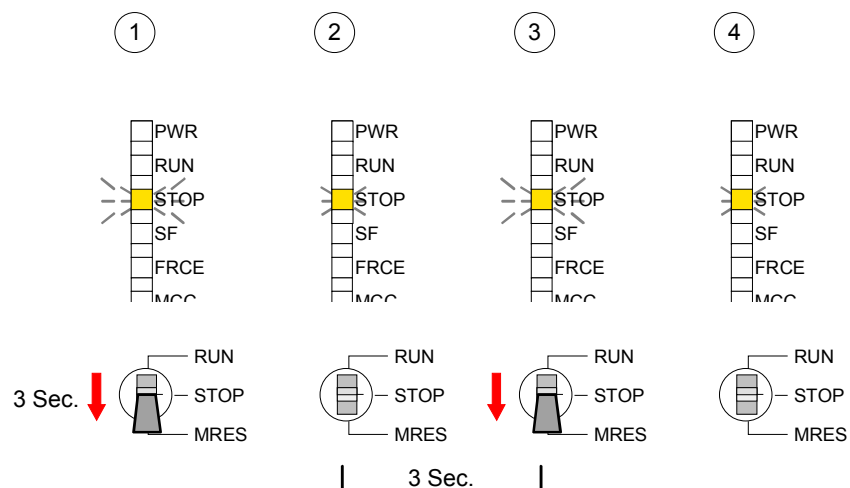
Automatic reload

At this point the CPU attempts to reload the parameters and the program from the memory card. → The MCC-LED blinks.

When the reload has been completed the LED expires. The operating mode of the CPU will be STOP or RUN, depending on the position of the function selector.

Overall reset by means of the Siemens SIMATIC Manager

Condition

The operating mode of the CPU must be STOP.
You may place the CPU in STOP mode by the menu command **PLC** > *Operating mode*.

Overall reset

You may request the overall reset by means of the menu command **PLC** > *Clean/Reset*.

In the dialog window you may place your CPU in STOP mode and start the overall reset if this has not been done as yet.

The STOP-LED blinks during the overall reset procedure.

When the STOP-LED is on permanently the overall reset procedure has been completed.

Automatic reload

At this point the CPU attempts to reload the parameters and the program from the memory card. → The MCC-LED blinks.

When the reload has been completed, the LED expires. The operating mode of the CPU will be STOP or RUN, depending on the position of the function selector.

Set back to factory setting

The following approach deletes the internal RAM of the CPU completely and sets it back to the delivery state.

Please regard that the MPI address is also set back to default 2!

- Push down the reset lever for app. 30 seconds. The ST-LED blinks. After a few seconds the LED turns to static light. Count the number of static light phases because now the LED switches between static light and blinking.

- After the 6. static light you release the reset lever and push it down again shortly. Now the green RUN-LED is on once. This means that the RAM is totally deleted.

- Turn the power supply off and on again.

More information may be found at the part "Factory reset" further below.

Firmware update

Overview

There is the opportunity to execute a firmware update for the CPU and its components via MMC. For this an accordingly prepared MMC must be in the CPU during the startup.

So a firmware files can be recognized and assigned with startup, a pkg file name is reserved for each updateable component an hardware release, which begins with "px" and differs in a number with six digits.

The pkg file name of every updateable component may be found at a label right down the front flap of the module.

As soon as with startup a pkg file is on the MMC and the firmware is more current than in the components, all the pkg file assigned components within the CPU get the new firmware.

Firmware package and version

Latest Firmware at ftp.vipa.de

The latest firmware versions are to be found in the service area at www.vipa.de and at the ftp server at ftp.vipa.de/support/firmware.

For example the following files are necessary for the firmware update of the CPU 315-4NE12 and its components (Profibus, CP) with hardware release 1:

- 315-4NE12, Hardware release 1:   Px000079_V ... .zip
- Profibus DP-Master: Px000062_V ... .zip
- Ethernet-CP 343 (integrated):   Px000058_V ... .zip

Attention!

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 of the SPEED7 system via Web Site

The CPU has an integrated website that monitors information about firmware version of the SPEED7 components. The Ethernet PG/OP channel provides the access to this web site.

To activate the PG/OP channel you have to enter according IP parameters.

This can be made in Siemens SIMATIC manager either by a hardware configuration, loaded by MMC respectively MPI or via Ethernet by means of the MAC address with **PLC** > *Assign Ethernet Address*.

After that you may access the PG/OP channel with a web browser via the IP address of the project engineering. More detailed information is to find in the manual at "Access to Ethernet PG/OP channel and website".

Load firmware and transfer it to MMC

- Go to www.vipa.de.
- Click on Service > Download > Firmware Updates.
- Click on "Firmware for System 300S"
- Choose the according modules (CPU, DPM...) and download the firmware Px......zip to your PC.
- Extract the zip-file and copy the extracted file to your MMC.
- Following this approach, transfer all wanted firmware files to your MMC.

Preconditions for ftp access

For the display of ftp sites in your web browser you may have to execute the following adjustments:

Internet Explorer

ftp access only with version 5.5 or higher

Options > *Internet options*, Register "Advanced" in the area "Browsing":

    - activate: "Enable folder view for ftp sites"

    - activate: "Use passive ftp ..."

Netscape

ftp- access only with version 6.0 or higher

No further adjustments are required

If you still have problems with the ftp access, please ask your system operator.

Attention!

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 the firmware update you should execute a "Set back to factory settings" (see following page).

Transfer firmware from MMC into CPU

1. Get the RUN-STOP lever of your CPU in position STOP. Turn off the voltage supply. Plug the MMC with the firmware files into the CPU. Please take care of the correct plug-in direction of the MMC. Turn on the voltage supply.

2. After a short boot-up time, the alternate blinking of the LEDs SF and FRCE shows that at least a more current firmware file was found on the MMC.

3. You start the transfer of the firmware as soon as you tip the RUN/STOP lever downwards to MRES within 10s.

4. During the update process, the LEDs SF and FRCE are alternately blinking and MCC LED is on. This may last several minutes.

5. The update is successful finished when the LEDs PWR, STOP, SF, FRCE and MCC 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 current firmware versions are available at the MMC. If so, again the LEDs SF and FRCE flash after a short start-up period. Continue with point 3.

   If the LEDs do not flash, the firmware update is ready.

   Now a *factory reset* should be executed (see next page). After that the CPU is ready for duty.
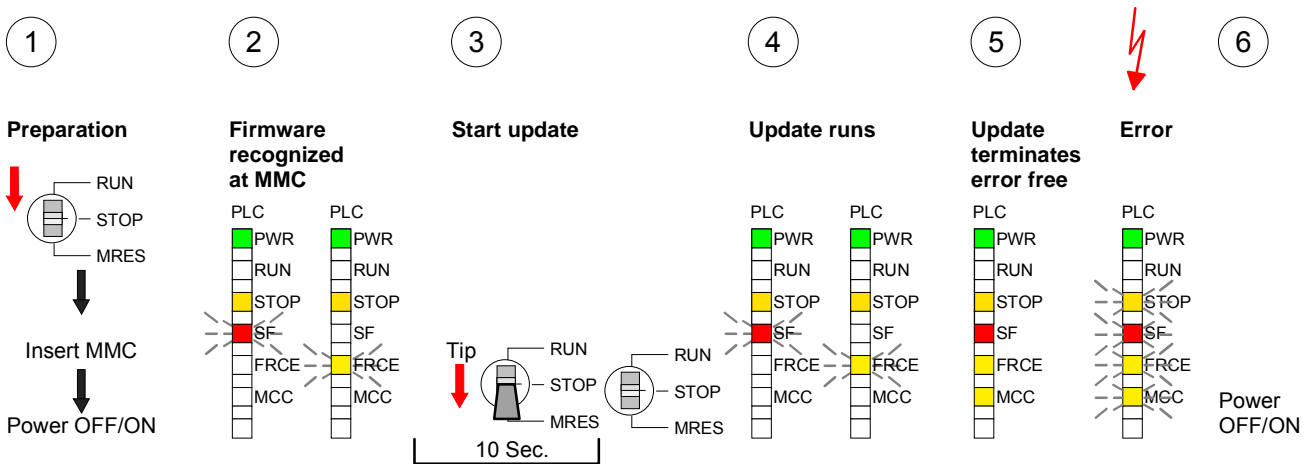
Factory reset

Proceeding   With the following proceeding the internal RAM of the CPU is completely deleted and the CPU is reset to delivery state. Please note that here also the IP address of the Ethernet PG/OP channel is set to 0.0.0.0 and the MPI address is reset to the address 2!

A factory reset may also be executed by the MMC-Cmd FACTORY_ RESET. More information may be found at "MMC-Cmd - Auto commands".

1. Switch the CPU to STOP.
2. Push the operating switch down to position MRES for 30s. 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. Starting here count the static light states.
3. After the 6. static light release the operating mode switch and tip it downwards to MRES within 1s.
4. For the confirmation of the resetting procedure the green run LED gets ON within 0.5s. 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 exactly 6 times.
5. After factory reset switch the power supply off and on.

The proceeding is shown in the following Illustration:
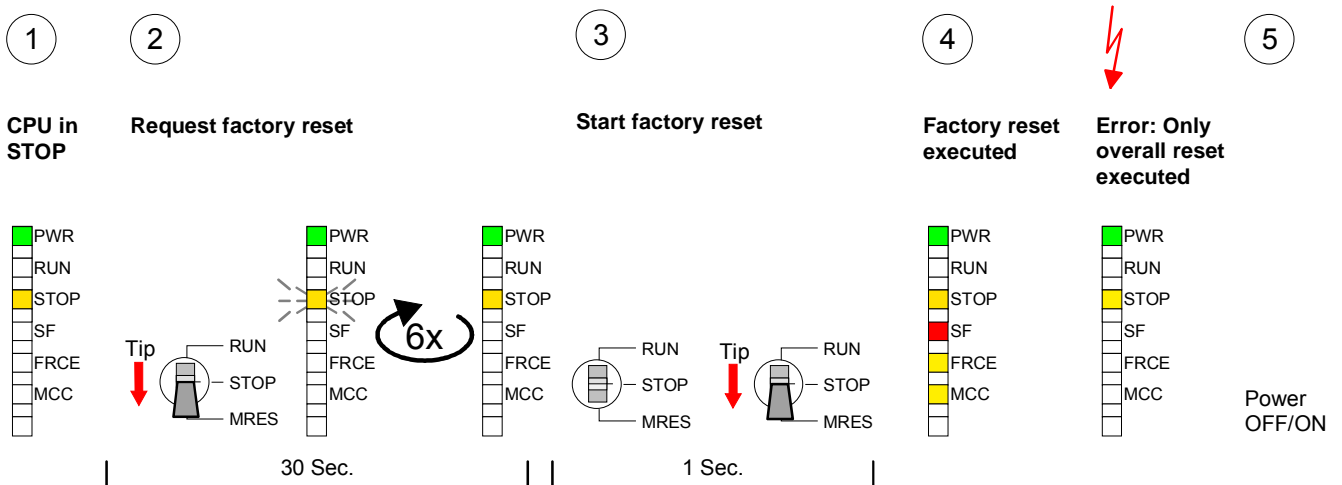
Note!

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

Memory extension with MCC

Overview

There is the possibility to extend the work memory of the CPU.

For this, a MCC memory extension card is available from VIPA. The MCC is a specially prepared MMC (**M**ulti**m**edia **C**ard). By plugging the MCC into the MCC slot and then an overall reset the according memory expansion is released. There may only one memory expansion be activated at the time.

On the MCC there is the file *memory.key*. This file may not be altered or deleted. You may use the MCC also as "normal" MMC for storing your project.

Approach

To extend the memory, plug the MCC into the card slot at the CPU labeled with "MCC" and execute an overall reset.
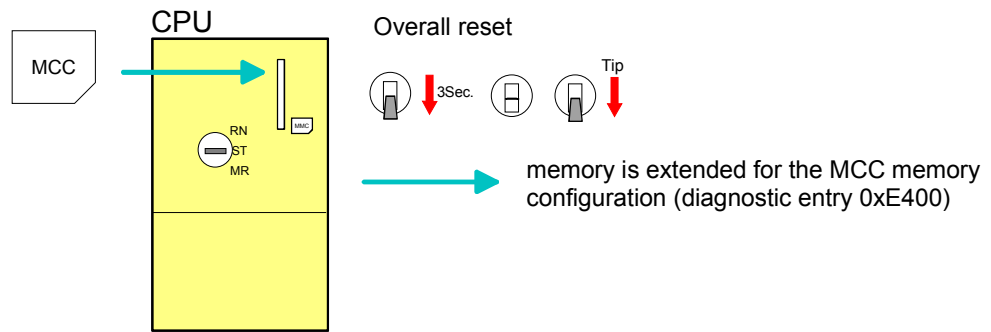
If the memory expansion on the MCC exceeds the maximum extendable memory range of the CPU, the maximum possible memory of the CPU is automatically used.

You may determine the recent memory extension via the integrated web page or with the Siemens SIMATIC Manager at *Module Information - "Memory"*.

Attention!

Please regard that the MCC must remain plugged when you've executed the memory expansion at the CPU. Otherwise the CPU switches to STOP after 72 hours. The MCC <u>cannot</u> be exchanged with a MCC of the same memory configuration.

Behavior

When the MCC memory configuration has been taken over you may find the diagnosis entry 0xE400 in the diagnostic buffer of the CPU.

After pulling the MCC the entry 0xE401 appears in the diagnostic buffer, the SF-LED is on and after 72 hours the CPU switches to STOP. A reboot is only possible after plugging-in the MCC again or after an overall reset.

The remaining time after pulling the MCC is always been shown with the parameter *MCC-Trial-Time* on the web page.

After re-plugging the MCC, the SF-LED extinguishes and 0xE400 is entered into the diagnostic buffer.

You may reset the memory configuration of your CPU to the initial status at any time by executing an overall reset without MCC.

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.

At the "extended" protection you transfer the protected blocks into a WLD-file named protect.wld. By plugging the MMC and following overall reset, 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 source remains in the CPU and is thus protected for accesses of 3. persons.
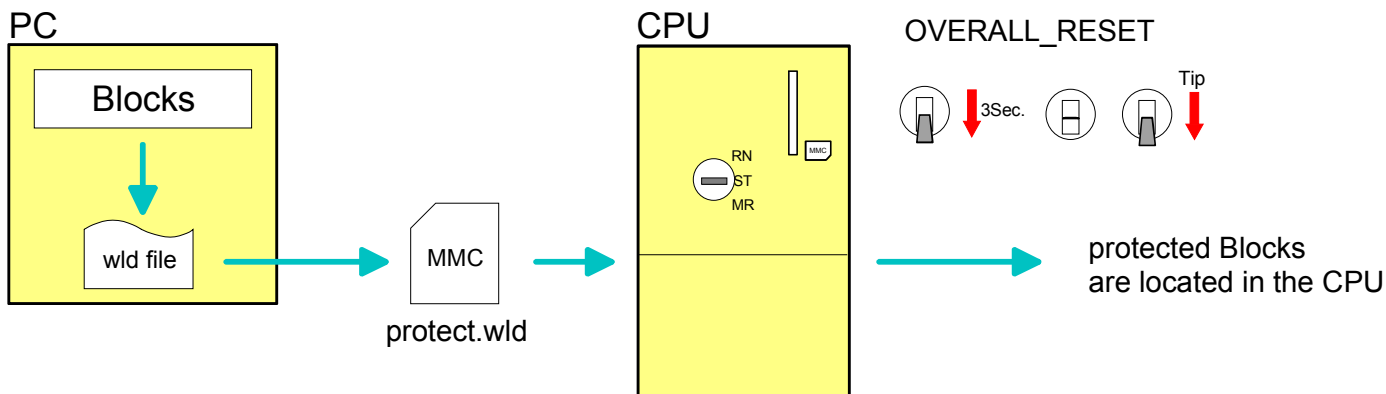
Protect blocks with protect.wld
Create a new wld-file in your project engineering tool with **File** > *Memory Card file > New* and rename it to "protect.wld".

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 MMC storage module, plug the MMC into the CPU and execute an overall reset with the following approach:
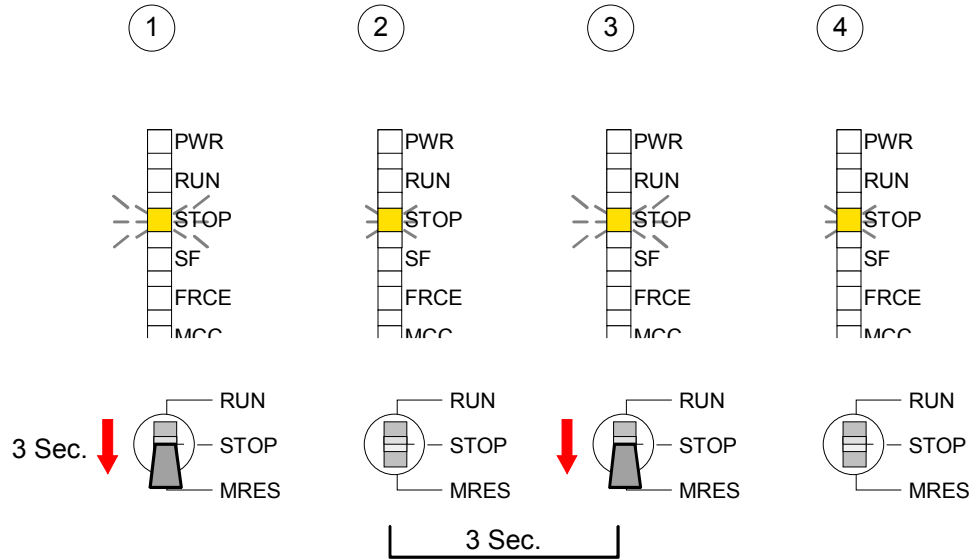
The overall reset stores the blocks in protect.wld permanently in the CPU protected from accesses of 3. persons.

**Protection
behavior**

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.

By transferring an empty protect.wld from the MMC 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 out of all protected blocks. Delete all networks in the blocks so that these only contain the variable definitions in the according symbolism.

MMC-Cmd - Auto commands

Overview   A *command file at a MMC may be started* automatically when the MMC is stuck and the CPU is in STOP. As soon as the MMC is stuck the command file is once executed at CPU STOP up to the next PowerON.

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 MMC.

The file has to be started by *CMD_START* as 1. command, followed by the desired commands (no other text) und 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 MMC in the log file logfile.txt. In addition for each executed command a diagnostics entry may be found in the diagnostics buffer.

Commands   In the following there is an overview of the 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 diagnostic entry if *CMD_START* is missing	0xE8FE
WAIT1SECOND	Waits ca. 1 second.	0xE803
WEBPAGE	The current web page of the CPU is stored at the MMC as "webpage.htm".	0xE804
LOAD_PROJECT	The function "Overall reset and reload from MMC" 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 MMC. If the file just exists it is renamed to "s7prog.old".	0xE806
FACTORY_RESET	Executes "factory reset".	0xE807
DIAGBUF	The current diagnostics buffer of the CPU is stored as "diagbuff.txt" at the MMC.	0xE80B
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 xxx.xxx.xxx.xxx 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)
WEBPAGE	Store web page as "webpage.htm" (0xE804)
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)
SET_NETWORK 172.16.129.210,255.255.224.0,172.16.129.210	IP parameter (0xE80E)
WAIT1SECOND	Wait ca. 1s (0xE803)
WAIT1SECOND	Wait ca. 1s (0xE803)
WEBPAGE	Store web page as "webpage.htm" (0xE804)
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.

Note!

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.

VIPA specific diagnostic entries

Entries in the diagnostic buffer

You may read the diagnostic buffer of the CPU via the Siemens SIMATIC Manager. Besides of the standard entries in the diagnostic buffer, the VIPA CPUs support some additional specific entries in form of event-IDs.

The current content of the diagnostics buffer is stored on MMC by means of the MMC-Cmd DIAGBUF. More information may be found at "MMC-Cmd - Auto commands".

Note!

Every register of the module information is supported by the VIPA CPUs. More information may be found at the online help of the Siemens SIMATIC manager.

Monitoring the diagnostic entries

To monitor the diagnostic entries you choose the option **PLC** > *Module Information* in the Siemens SIMATIC Manager. Via the register "Diagnostic Buffer" you reach the diagnostic window:
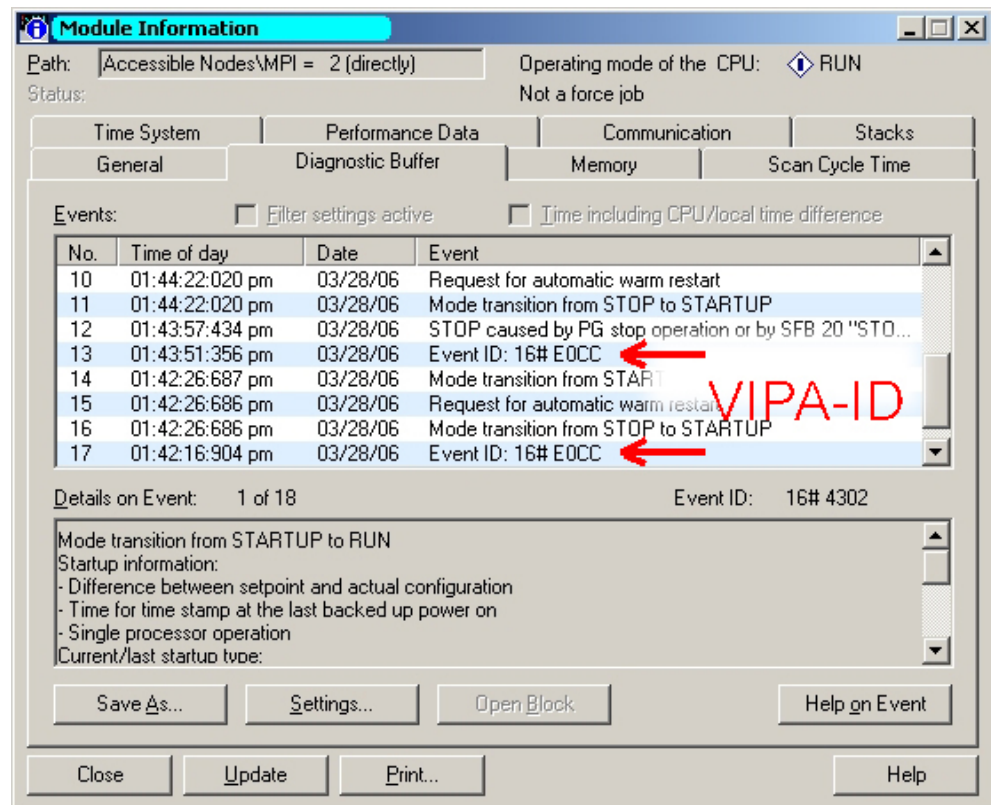
The diagnosis is independent from the operating mode of the CPU. You may store a max. of 100 diagnostic entries in the CPU.

The following page shows an overview of the VIPA specific Event-IDs.

**Overview of the
Event-IDs**

Event-ID	Description
0xE003	Error at access to I/O devices
	Zinfo1: I/O address
	Zinfo2: Slot
0xE004	Multiple parameterization of a I/O address
	Zinfo1: I/O address
	Zinfo2: Slot
0xE005	Internal error - Please contact the VIPA-Hotline!
0xE006	Internal error - Please contact the VIPA-Hotline!
0xE007	Configured in-/output bytes do not fit into I/O area
0xE008	Internal error - Please contact the VIPA-Hotline!
0xE009	Error at access to standard back plane bus
0xE010	Not defined module group at backplane bus recognized
	Zinfo2: Slot
	Zinfo3: Type ID
0xE011	Master project engineering at Slave-CPU not possible or wrong slave configuration
0xE012	Error at parameterization
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 (32=page frame master)
0xE016	Maximum block size at master transfer exceeded
	Zinfo1: I/O address
	Zinfo2: Slot
0xE017	Error at access to integrated slave
0xE018	Error at mapping of the master I/O devices
0xE019	Error at standard back plane bus system recognition
0xE01A	Error at recognition of the operating mode (8 / 9bit)
0xE01B	Error - maximum number of plug-in modules exceeded
0xE030	Error of the standard bus
0xE0B0	SPEED7 is not stoppable (probably undefined BCD value at timer)
0xE0C0	Not enough space in work memory for storing code block (block size exceeded)
0xE0CC	Communication error MPI / Serial
0xE0CD	Error at DPV1 job management
0xE0CE	Error: Timeout at sending of the i-slave diagnostics
0xE100	MMC access error
0xE101	MMC error file system
0xE102	MMC error FAT
0xE104	MMC error at saving
0xE200	MMC writing finished (Copy Ram2Rom)

... continue

Event-ID	Description
0xE210	MMC reading finished (reload after overall reset)
0xE21F	MMC reading: error at reload (after overall reset), read error, out of memory
0xE400	Memory expansion MCC has been plugged
0xE401	Memory expansion MCC has been removed
0xE801	MMC-Cmd: CMD_START recognized and successfully executed
0xE802	MMC-Cmd: CMD_END recognized and successfully executed
0xE803	MMC-Cmd: WAIT1SECOND recognized and successfully executed
0xE804	MMC-Cmd: WEBPAGE recognized and successfully executed
0xE805	MMC-Cmd: LOAD_PROJECT recognized and successfully executed
0xE806	MMC-Cmd: SAVE_ PROJECT recognized and successfully executed
0xE807	MMC-Cmd: FACTORY_RESET recognized and successfully executed
0xE80B	MMC-Cmd: DIAGBUF recognized and successfully executed
0xE80E	MMC-Cmd: SET_NETWORK recognized and successfully executed
0xE8FB	MMC-Cmd: Error: Initialization of the Ethernet PG/OP channel by means of SET_NETWORK is faulty.
0xE8FC	MMC-Cmd: Error: Not every IP-Parameter is set at SET_NETWORK.
0xE8FE	MMC-Cmd: Error: CMD_START was not found
0xE8FF	MMC-Cmd: Error: Reading the CMD file is faulty (MMC error)
0xE901	Check sum error
0xEA00	Internal error - Please contact the VIPA-Hotline!
0xEA01	Internal error - Please contact the VIPA-Hotline!
0xEA02	SBUS: Internal error (internal plugged sub module not recognized) Zinfo1: Internal slot
0xEA04	SBUS: Multiple parameterization of a I/O address Zinfo1: I/O 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 Zinfo2: Slot Zinfo3: Output data width of the plugged module

continued ...

... continue

Event-ID	Description
0xEA10	SBUS: Input address outside input area Zinfo1: I/O address Zinfo2: Slot Zinfo3: Data width
0xEA11	SBUS: Output address outside output area Zinfo1: I/O 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 parameterization of a I/O address (Diagnostic address) Zinfo1: I/O address Zinfo2: Slot Zinfo3: Data width
0xEA15	Internal error - Please contact the VIPA-Hotline!
0xEA18	SBUS: Error at mapping of the master I/O devices Zinfo2: Master slot
0xEA19	Internal error - Please contact the VIPA-Hotline!
0xEA20	Error - RS485 interface is not set to Profibus DP master but there is a Profibus DP master configured.
0xEA21	Error - Project engineering RS485 interface X2/X3: Profibus DP master is configured but missing Zinfo2: Interface x
0xEA22	Error - RS485 interface X2 - value is out of range Zinfo: Configured value X2
0xEA23	Error - RS485 interface X3 - value is out of range Zinfo: Configured value X3
0xEA24	Error - Project engineering RS485 interface X2/X3: Interface/Protocol is missing, the default settings are used. Zinfo2: Configured value X2 Zinfo2: Configured value X3
0xEA30	Internal error - Please contact the VIPA-Hotline!
0xEA40	Internal error - Please contact the VIPA-Hotline!
0xEA41	Internal error - Please contact the VIPA-Hotline!
0xEA98	Timeout at waiting for reboot of a SBUS module (Server)
0xEA99	Error at file reading via SBUS
0xEE00	Internal error - Please contact the VIPA-Hotline!

Using test functions for control and monitoring of variables

Overview

For troubleshooting purposes and to display the status of certain variables you can access certain test functions via the menu item **Debug** of the Siemens SIMATIC Manager.

The status of the operands and the VKE can be displayed by means of the test function **Debug** > *Monitor*.

You can modify and/or display the status of variables by means of the test function **PLC** > *Monitor/Modify Variables*.

Debug > *Monitor*

This test function displays the current status and the VKE of the different operands while the program is being executed.

It is also possible to enter corrections to the program.

Note!

When using the test function "Monitor" the PLC must be in RUN mode!

The processing of the states may be interrupted by means of jump commands or by timer and process-related alarms. At the breakpoint the CPU stops collecting data for the status display and instead of the required data it only provides the PG with data containing the value 0.

For this reason, jumps or time and process alarms can result in the value displayed during program execution remaining at 0 for the items below:

- the result of the logical operation VKE
- Status / AKKU 1
- AKKU 2
- Condition byte
- absolute memory address SAZ. In this case SAZ is followed by a "?".

The interruption of the processing of statuses does not change the execution of the program. It only shows that the data displayed is no longer.

PLC >
Monitor/Modify Variables

This test function returns the condition of a selected operand (inputs, outputs, flags, data word, counters or timers) at the end of program-execution.

This information is obtained from the process image of the selected operands. During the "processing check" or in operating mode STOP the periphery is read directly from the inputs. Otherwise only the process image of the selected operands is displayed.

Control of outputs

It is possible to check the wiring and proper operation of output-modules.

You can set outputs to any desired status with or without a control program. The process image is not modified but outputs are no longer inhibited.

Control of variables

The following variables may be modified:

I, Q, M, T, C and D.

The process image of binary and digital operands is modified independently of the operating mode of the CPU.

When the operating mode is RUN the program is executed with the modified process variable. When the program continues they may, however, be modified again without notification.

Process variables are controlled asynchronously to the execution sequence of the program.

Chapter 5   Deployment PtP communication

Overview

Content of this chapter is the deployment of the RS485 interface for serial PtP communication.

Here you'll find every information about the protocols, the activation and project engineering of the interface, which are necessary for the serial communication using the RS485 interface.

Fast introduction

General
Via a hardware configuration you may de-activate the Profibus part integrated to the SPEED7 CPU and thus release the RS485 interface for PtP (**p**oint-**t**o-**p**oint) communication.

The RS485 interface supports in PtP operation the serial process connection to different source res. destination systems.

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

Switch of RS485 for ptp operation
Per default, every CPU uses the RS485 interface for Profibus communication. A hardware configuration allows you to switch the RS485 interface to point-to-point operation using *Object properties* and the parameter "Function RS485".

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

Communication
The SFCs are controlling the communication. Send takes place via SFC 217 (SER_SND) and receive via SFC 218 (SER_RCV).

The repeated call of the 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 SFC 218 SER_RCV after SER_SND.

The SFCs are included in the consignment of the CPU.

Overview SFCs for serial communication
The following SFCs are used for the serial communication:

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

Principle of the data transfer

Overview

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

Principle

Data, which are written into the according data channel by the PLC, is stored in a FIFO send buffer (**f**irst **i**n **f**irst **o**ut) 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 PLC.

If the data is transferred via a protocol, the adoption 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 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 call of the SFC 218 SER_RCV.

RS485 PtP communication
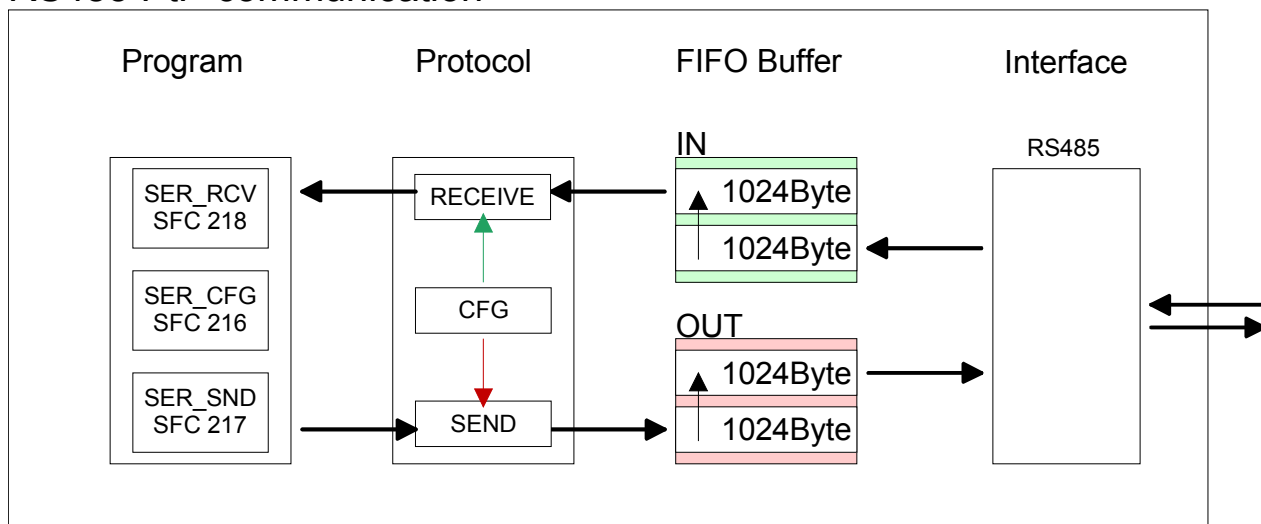
Deployment of RS485 interface for PtP

Switch to PtP operation

Per default, the RS485 interface X3 of the CPU is used for the Profibus DP master. Via hardware configuration the RS485 interfaces may be switched to point-to-point communication via the Parameter *Function RS485 X3* of the *Properties*.

Hardware configuration

The hardware configuration happens as described at "Setting VIPA specific CPU parameters" by means of a virtual Profibus master system with the following approach:

Slot	Module
1	
2	**CPU 318-2**
X2	*DP*
X1	*MPI/DP*
3	
Modules at the bus	
	343-1EX11 (Ethernet PG/OP)
	343-1EX11 (internal CP 343)
always as last module 342-5DA02 V5.0	

virtual DP-Master for CPU

(100) VIPA SPEEDbus — CPU: Addr.:100
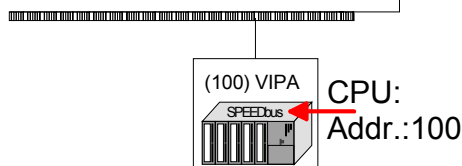
VIPA_SPEEDbus

Slot	Order No.
0	315-4NE12 315SN/NE

Object properties

- Start the Siemens hardware configurator and install the VIPA GSD file SPEEDBUS.GSD.
- Configure the Siemens CPU 318-2AJ00 (6ES7 318-2AJ00-0AB0/V3.0).
- Place the System 300 modules in the plugged sequence starting with slot 4.
- Configure a Siemens CP 343-1 (343-1EX11) for the internal Ethernet PG/OP channel below the really plugged System 300 modules.
- The integrated CP 343 of the CPU 315SN/NET is also configured as CP 343-1 (343-1EX11) but always as 2. CP below the configured PG/OP channel before.
- Configure always as last module a Siemens DP master CP 342-5 (342-5DA02 V5.0). Connect and parameterize it at operation mode "DP-Master".
- Connect the slave system "VIPA_SPEEDbus". After installing the SPEEDBUS.GSD this may be found in the hardware catalog at *Profibus-DP / Additional field devices / I/O / VIPA / VIPA_SPEEDBUS.*
- For the slave system set the Profibus address 100.
- Configure at slot 0 the VIPA CPU 315-4NE12 of the hardware catalog from VIPA_SPEEDbus.
- By double clicking the placed CPU 315-4NE12 the properties dialog of the CPU may be opened.
- Switch the Parameter *Function RS485 X3* to "PtP".

As soon as the project is transferred together with the PLC user program to the CPU, the parameters will be taken after start-up.

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

Connection RS485
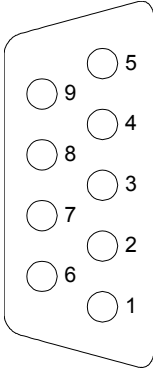
9pin jack

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
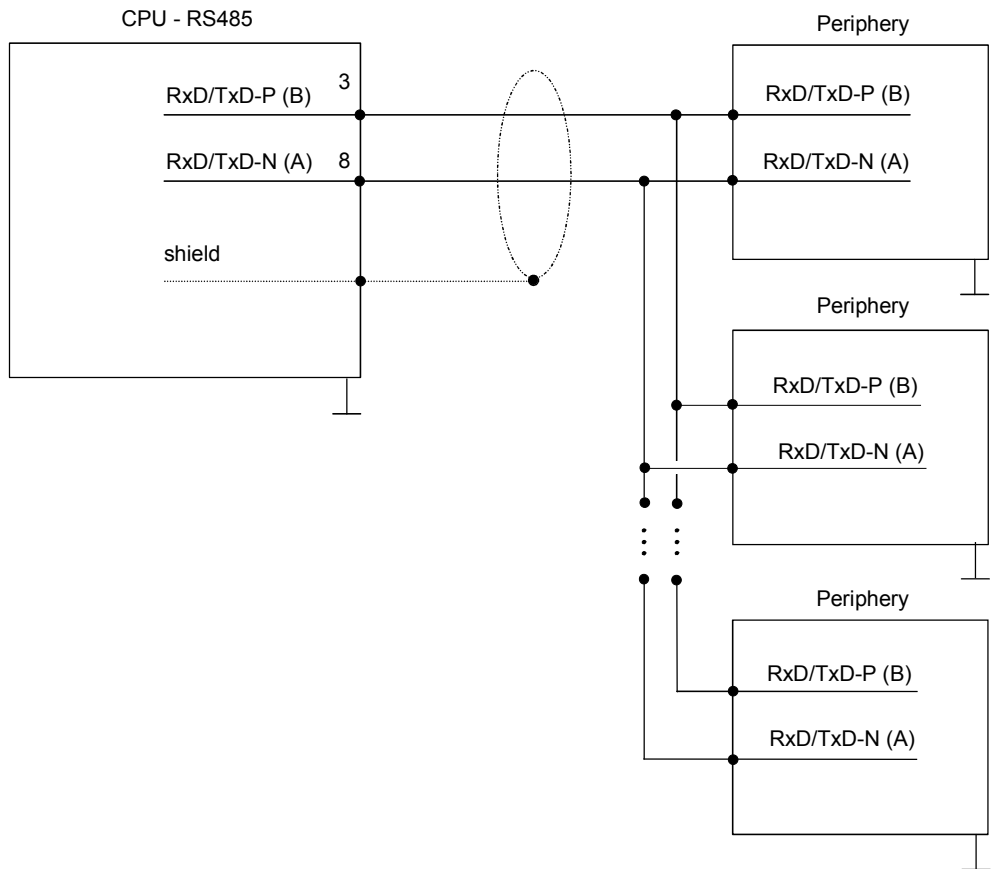
Parameterization

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

Name	Declaration	Type	Comment
Protocol	IN	BYTE	1=ASCII, 2=STX/ETX, 3=3964R
Parameter	IN	ANY	Pointer to protocol parameters
Baudrate	IN	BYTE	Velocity of data transfer
CharLen	IN	BYTE	0=5bit, 1=6bit, 2=7bit, 3=8bit
Parity	IN	BYTE	0=None, 1=Odd, 2=Even
StopBits	IN	BYTE	1=1bit, 2=1.5bit, 3=2bit
FlowControl	IN	BYTE	1 (fix)
RetVal	OUT	WORD	Error Code (0 = OK)

Parameter description
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 $\approx$ 154bit $\rightarrow$ (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)

Note!

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

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)
DBW4:	CharTimeout	WORD	(Character delay time)
DBW6:	ConfTimeout	WORD	(Acknowledgement delay time)

Data block at USS

DBW0:	Timeout	WORD	(Delay time in)

Data block at Modbus-Master

DBW0:	Timeout	WORD	(Respond delay time)

Baud rate   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=0, when receiving RTS=1.

RetVal SFC 216 (Error message SER_CFG)

Return values sent by the block:

Error code	Description
0000h	no error
809Ah	interface not found
8x24h	Error at 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 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"
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
	...

Communication

Overview

The communication happens via the send and receive blocks SFC 217 (SER_SND) and SFC 218 (SER_RCV).

The SFCs are included in the consignment of the CPU.

SFC 217 (SER_SND)

This block sends data via the serial interface.

The repeated call of the 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 SFC 218 SER_RCV after SER_SND.

Parameter

Name	Declaration	Type	Comment
DataPtr	IN	ANY	Pointer to Data Buffer for sending data
DataLen	OUT	WORD	Length of data sent
RetVal	OUT	WORD	Error Code (0 = OK)

DataPtr

Here you define a range of the type Pointer for the send buffer where the data that has to be sent 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 the sent bytes is stored.

At **ASCII** if data were sent by means of 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 SFC 217
(Error message
SER_SND)**

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)
8x24h	Error in 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 or interface is used for 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)

... Continue RetVal SFC 217 SER_SND

USS

Error code	Description
2000h	Send ready without error
8080h	Receive buffer overflow (no space for receipt)
8090h	Acknowledgement delay time exceeded
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 without error
2001h	Send ready with error
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

```
SFC 217
SER_SND

Busy ?  --J-->  (loop back to SFC 217)
  |N

RetVal 8xxxh / 90xxh ?  --J-->  Error evaluation --> End
  |N

RetVal 2001h ?  --J-->  Error evaluation --> End
  |N

RetVal 2000h ?  --J-->  Data evaluation --> End
  |N
(loop back to SFC 217)
```

```
SFC 217
SER_SND

Busy ?  --J-->  (loop back to SFC 217)
  |N

RetVal 8xxxh / 90xxh ?  --J-->  SFC 218 SER_RCV --> Error evaluation --> End
  |N

RetVal 2001h ?  --J-->  (to Error evaluation)
  |N

RetVal 2000h ?  --J-->  SFC 218 SER_RCV --> Data evaluation --> End
  |N
(loop back to SFC 217)
```

ASCII / STX/ETX

```
SFC 217
SER_SND

RetVal 900xh  --J-->  Error evaluation
  |N

End
```

**SFC 218
(SER_RCV)**

This block receives data via the serial interface.

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

Parameter

Name	Declaration	Type	Comment
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	Error Code (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 (Stopbit 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 SFC 218
(Error message
SER_RCV)**

Return values of the block:

Error code	Description
0000h	no error
1000h	Receive buffer too small (data loss)
8x24h	Error at 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.
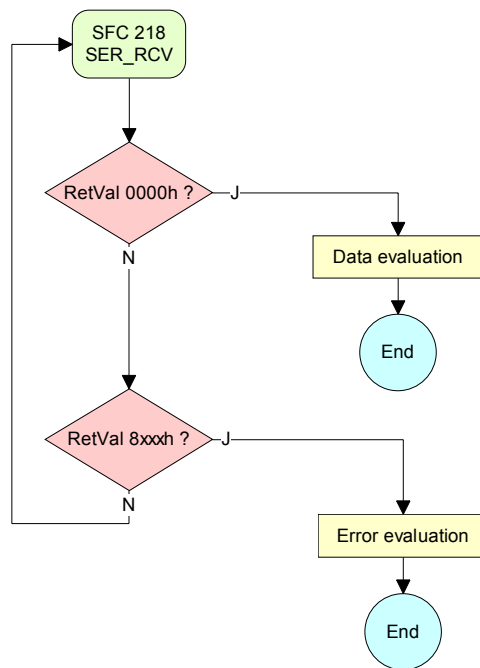
Protocols and procedures

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-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.de.

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.

The STX/ETX procedure is suitable for the transfer of ASCII characters. It does not use block checks (BCC). 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 PLC when the End has been received.

When data is send from the PLC to a peripheral device, any user data is handed to the SFC 217 (SER_SND) and is transferred with added Start- and End-ID to the communication partner.

Message structure:
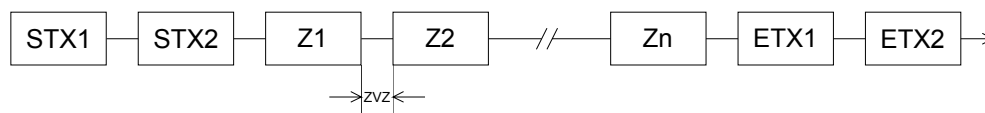
You may define up to 2 Start- and End-IDs.

You may work with 1, 2 or no Start- and with 1, 2 or no End-ID. 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). If no End-ID is defined, all read characters are transferred to the PLC after a parameterizable character delay time (Timeout).

3964R

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 **Tex**t
- DLE   **D**ata **L**ink **E**scape
- ETX   **E**nd of **Tex**t
- BCC   **B**lock **C**heck **C**haracter
- NAK   **N**egative **Ack**nowledge

Procedure

Active partner   Passive partner

STX →

Monitor delayed acknowledgment
← DLE

Message-data →

DLE →

ETX →

BCC →

Monitor delayed acknowledgment
← DLE
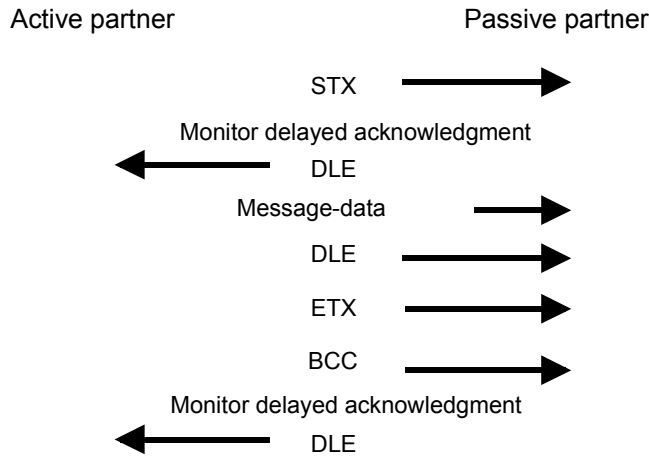
You may transfer a maximum of 255byte per message.

Note!

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

You may connect 1 master and max. 31 slaves at the bus where 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 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	

where 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

7	6	5	4	3	2	1	0
		1					
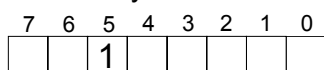
Broadcast

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 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 SFC 218 SER_RCV.

The request telegrams send by the master and the respond telegrams of a slave have the following 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 SFC 218 SER_RCV.

Only write commands may be sent as broadcast.

ASCII, RTU mode

Modbus offers 2 different transfer modes:

• 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.

The mode selection happens during runtime by using the SFC 216 SER_CFG.

Supported Modbus protocols

The following Modbus Protocols are supported by the RS485 interface

• Modbus RTU Master

• Modbus ASCII Master

Modbus - Function codes

Naming convention

Modbus has some naming conventions:

```
                                   IN: "Input Status"
                        Bit =      OUT: "Coil Status"
                        Coil
        [ ][ ][ ][ ][ ][█][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ]

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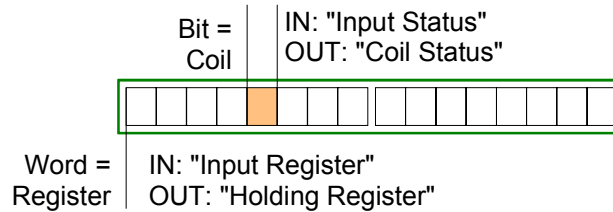
- Modbus differentiates between bit and word access;
  Bits = "Coils" and Words = "Register".
- Bit inputs are referred to as "Input-Status" and Bit outputs as "Coil-Status".
- Word inputs are referred to as "Input-Register" and Word outputs as "Holding-Register".

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

```
              1x0001
              1x0002                  1x0022
              1x0003
   IN [█][ ][ ][ ]...[ ][ ][ ][█][ ]...[ ][ ][ ]...[ ]
         3x0001              3x0002            3x0003

              0x0001
              0x0002                  0x0022
              0x0003
   OUT[█][ ][ ][ ]...[ ][ ][ ][█][ ]...[ ][ ][ ]...[ ]
         4x0001              4x0002            4x0003
```
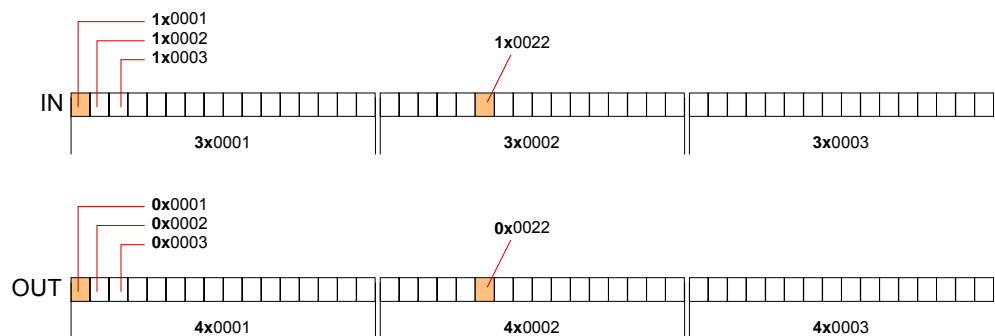
A description of the function codes follows below.

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

For the Byte sequence in a Word is always valid:

1 Word

High Low
Byte 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
1 Byte	1 Byte	1 Word	1 Word	1 Word

Respond telegram

Slave address	Function code	Number of read Bytes	Data 1. Byte	Data 2. Byte	...	Check sum CRC/LRC
1 Byte	1 Byte	1 Byte	1 Byte	1 Byte max. 250 Byte		1 Word

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
1 Byte	1 Byte	1 Word	1 Word	1 Word

Respond telegram

Slave address	Function code	Number of read Bytes	Data 1. Word	Data 2. Word	...	Check sum CRC/LRC
1 Byte	1 Byte	1 Byte	1 Word	1 Word max. 125 Words		1 Word

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 $\rightarrow$ Bit = 0

"Status Bit" = FF00h $\rightarrow$ Bit = 1

Command telegram

Slave address	Function code	Address Bit	Status Bit	Check sum CRC/LRC
1 Byte	1 Byte	1 Word	1 Word	1 Word

Respond telegram

Slave address	Function code	Address Bit	Status Bit	Check sum CRC/LRC
1 Byte	1 Byte	1 Word	1 Word	1 Word

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
1 Byte	1 Byte	1 Word	1 Word	1 Word

Respond telegram

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

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	Function code	Address 1. Bit	Number of Bits	Number of Bytes	Data 1. Byte	Data 2. Byte	...	Check sum CRC/LRC
1 Byte	1 Byte	1 Word	1 Word	1 Byte	1 Byte	1 Byte	1 Byte	1 Word
						max. 250 Byte		

Respond telegram

Slave address	Function code	Address 1. Bit	Number of Bits	Check sum CRC/LRC
1 Byte	1 Byte	1 Word	1 Word	1 Word

Write n Words 10h

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

Command telegram

Slave address	Function code	Address 1. Word	Number of words	Number of Bytes	Data 1. Word	Data 2. Word	...	Check sum CRC/LRC
1 Byte	1 Byte	1 Word	1 Word	1 Byte	1 Word	1 Word	1 Word	1 Word
						max. 125 Words		

Respond telegram

Slave address	Function code	Address 1. Word	Number of Words	Check sum CRC/LRC
1 Byte	1 Byte	1 Word	1 Word	1 Word

Modbus – Example communication

Outline

The example establishes a communication between a master and a slave via Modbus. The following combination options are shown:

Modbus master (M)   Modbus slave (S)
CPU 31xS   CPU 21xSER-1

Components

The following components are required for this example:

- CPU 31xS as Modbus RTU master
- CPU 21xSER-1 as Modbus RTU slave
- Siemens SIMATIC Manager and possibilities for the project transfer
- Modbus cable connection

Approach

- Assemble a Modbus system consisting of a CPU 31xS as Modbus master and a CPU 21xSER-1 as Modbus slave and Modbus cable.
- Execute the project engineering of the master!
  For this you create a PLC user application with the following structure:
  OB 100:   Call SFC 216 (configuration as Modbus RTU master) with timeout setting and error evaluation.
  OB 1:   Call SFC 217 (SER_SND) where the data is send with error evaluation. Here you have to build up the telegram according to the Modbus rules.
  Call SFC 218 (SER_RECV) where the data is received with error evaluation.
- Execute the project engineering of the slave!
  The PLC user application at the slave has the following structure:
  OB 100:   Call SFC 216 (configuration as Modbus RTU slave) with timeout setting and Modbus address in the DB and error evaluation.
  OB 1:   Call SFC 217 (SER_SND) for data transport from the slave CPU to the output buffer.
  Call SFC 218 (SER_RECV) for the data transport from the input buffer to the CPU. Allow an according error evaluation for both directions.

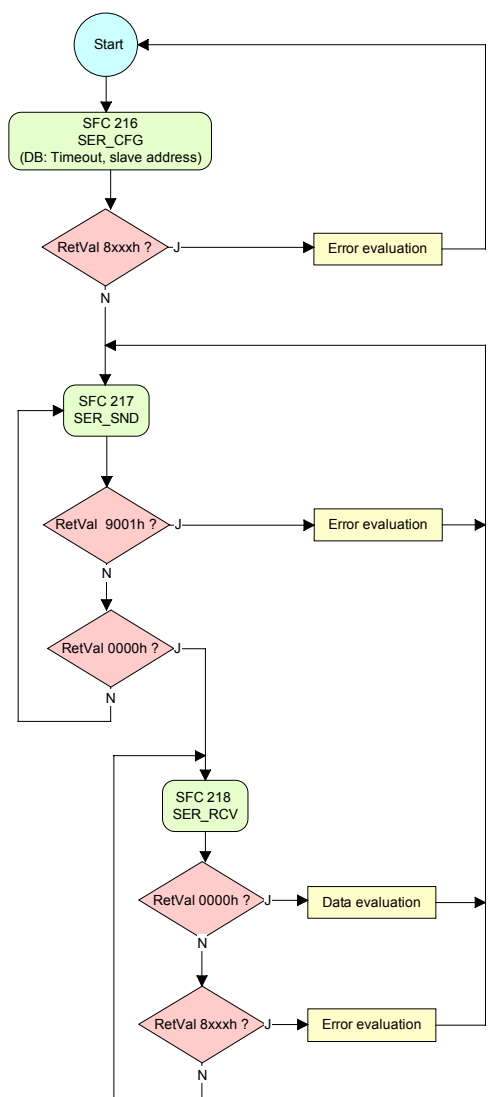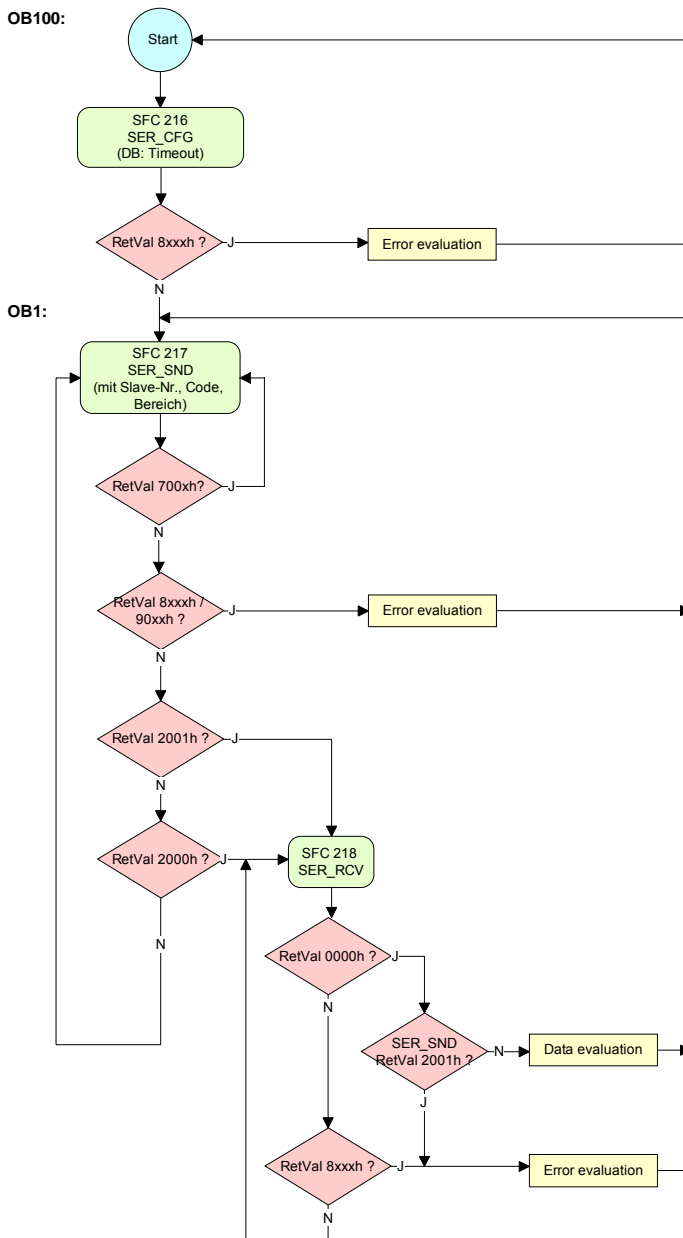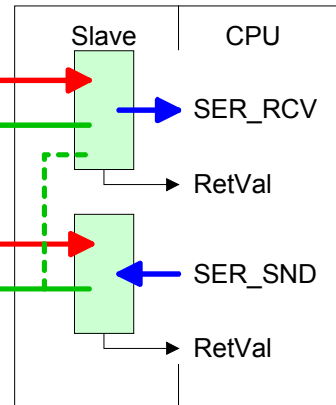The following page shows the structure for the according PLC programs for master and slave.

Master

Slave

CPU 31xS
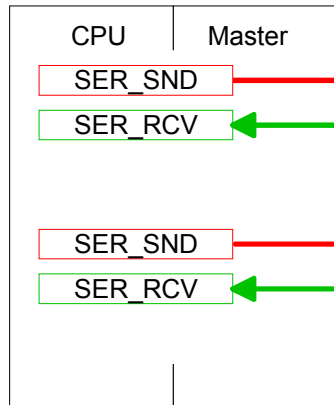
CPU 21xSER-1

Chapter 6   Deployment Profibus communication

Overview   Content of this chapter is the deployment of the CPU 315SN/NET with Profibus. After a short overview the project engineering and parameterization of a CPU 315SN/NET with integrated Profibus-Part from VIPA is shown.

Further you get information about usage as DP master and DP slave of the Profibus part.

The chapter is ending with notes to Commissioning and Start-up behavior.

Overview

Profibus-DP

Profibus is an international standard applicable to an open and serial field bus for building, manufacturing and process automation that can be used to create a low (sensor-/actuator level) or medium (process level) performance network of programmable logic controllers.

Profibus comprises an assortment of compatible versions. The following details refer to Profibus-DP.

Profibus-DP is a special protocol intended mainly for automation tasks in a manufacturing environment. DP is very fast, offers Plug'n'Play facilities and provides a cost-effective alternative to parallel cabling between PLC and remote I/O. Profibus-DP was designed for high-speed data communication on the sensor-actuator level.

The data transfer referred to as "Data Exchange" is cyclical. During one bus cycle, the master reads input values from the slaves and writes output information to the slave.

CPU with DP master

The Profibus DP master is to configure via the hardware configurator from Siemens. Therefore you have to choose the Siemens-CPU 318-2AJ00 in the hardware configurator from Siemens.

The transmission of your project engineering into the CPU takes place by means of MPI, MMC or Ethernet PG/OP channel. This is internally passing on your project data to the Profibus master part.

During the start-up the DP master automatically includes his data areas into the address range of the CPU. Project engineering in the CPU is not required.

As external storage medium the Profibus DP master uses the MMC (**M**ulti **M**edia **C**ard) together with the CPU.

Deployment of the DP-Master with CPU

Via the Profibus DP master up to 124 Profibus DP slaves may be coupled to the CPU. The DP master communicates with the DP slaves and links up its data areas with the address area of the CPU. There may be created maximal 1024byte Input and 1024byte Output data.

At every POWER ON res. overall reset the CPU fetches the I/O mapping data from the master. At DP slave failure, the ER-LED is on and the OB 86 is requested. If this is not available, the CPU switches to STOP and BASP is set. As soon as the BASP signal comes from the CPU, the DP master is setting the outputs of the connected periphery to zero. The DP master remains in the operating mode RUN independent from the CPU.

Profibus address 1 is reserved

Please regard that the Profibus address 1 is reserved for the system. The address 1 should not be used!

DP slave operation

For the deployment in a super-ordinated master system you first have to project your slave system as CPU 318-2 (6ES7 318-2AJ00-0AB0/V3.0) in *Slave* operation with configured in-/output areas. Afterwards you configure your master system. Assign your slave system to your master system by dragging the SPEED7-CPU from the hardware catalog at *Configured stations* onto the master system, choose your slave system and connect it.

Project engineering CPU with integrated Profibus master

Overview

For the project engineering of the Profibus DP master you have to use the hardware manager from Siemens. Your Profibus projects are transferred via MPI to the CPU by means of the "PLC" functions. The CPU passes the data on to the Profibus DP master.

Preconditions

For the project engineering of the Profibus DP master in the CPU 315SN/NET the following preconditions have to be fulfilled:

- Siemens SIMATIC Manager has to be installed.
- With Profibus DP slaves of the Systems 100V, 200V and 300 from VIPA: GSD Files are included into the hardware configurator.
- There is a transfer possibility between configuration tool and CPU.

i

Note!

For the project engineering of the CPU and the Profibus DP master a thorough knowledge of the Siemens SIMATIC manager is required!

Install Siemens Hardware configurator

The hardware configurator is a part of the Siemens SIMATIC Manager. It serves the project engineering. The modules that may be configured here, are listed in the hardware catalog.

For the deployment of the Profibus DP slaves of the Systems 100V, 200V and 300V from VIPA you have to include the modules into the hardware catalog by means of the GSD file from VIPA.

Configure DP master

- Create a new project System 300.
- Add a profile rail from the hardware catalog.
- In the hardware catalog the CPU with Profibus master is listed as: `Simatic300/CPU-300/CPU318-2/`**`6ES7 318-2AJ00-0AB0`**
- Insert the **CPU 318-2** (**6ES7 318-2AJ00-0AB0**).
- Type the Profibus address of your master (e.g. 2).
- Click on DP, choose the operating mode "DP master" under *object properties* and confirm your entry with OK.
- Click on "DP" with the right mouse button and choose "add master system".
- Create a new Profibus subnet via NEW.
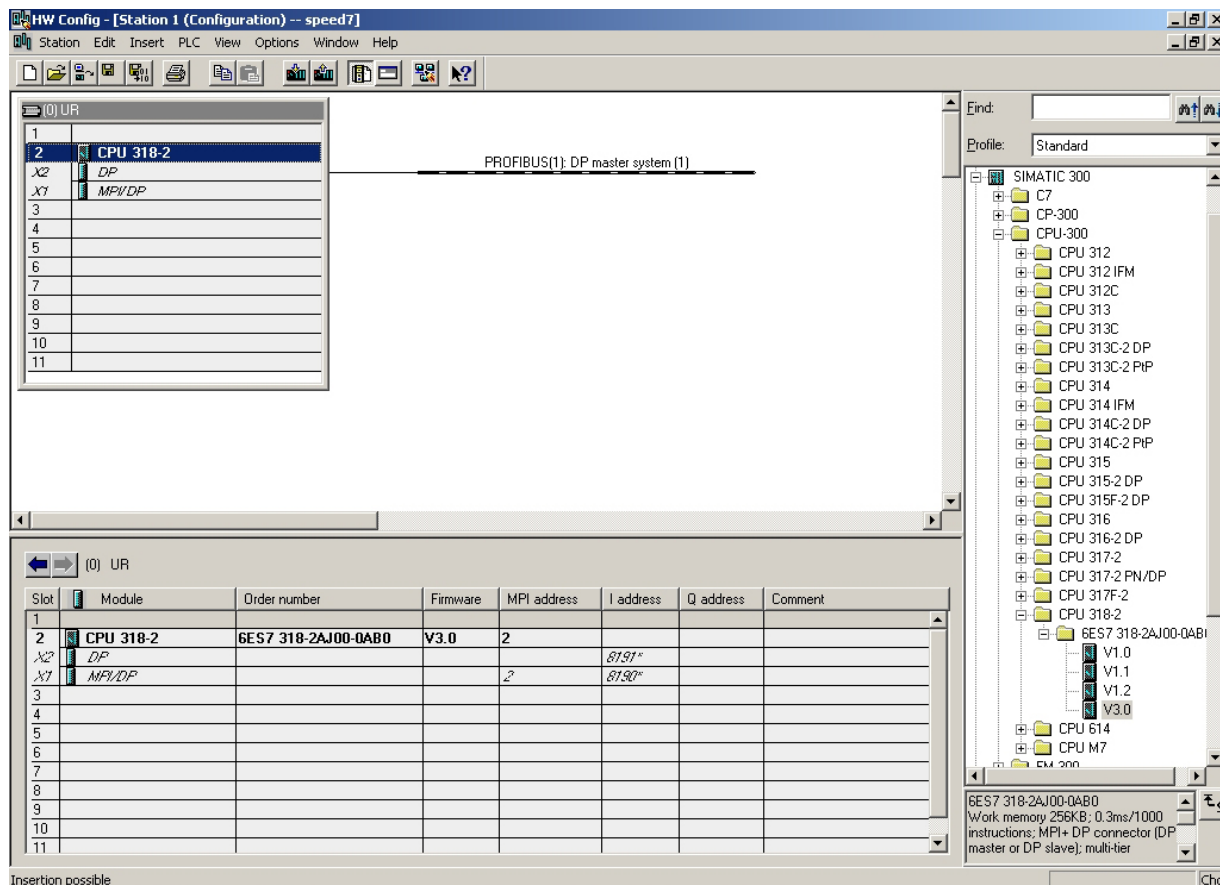
Now the project engineering of your Profibus DP master is finished. Please link up now your DP slaves with periphery to your DP master.

- For the project engineering of Profibus DP slaves you search the concerning Profibus-DP slave in the *hardware catalog* and drag&drop it in the subnet of your master.

- Assign a valid Profibus address to the DP slave.

- Link up the modules of your DP slave system in the plugged sequence and add the addresses that should be used by the modules.

- If needed, parameterize the modules.

- Save, compile and transfer your project. More detailed information about project engineering and project transfer may be found at chapter "Deployment CPU 315SN/NET".

Note!

If you deploy an IM153 from Siemens under a VIPA CPU 315SN/NET, please use the "compatible" DP slave modules.

These are listed in the hardware catalog under
```
PROFIBUS-DP/Additional Field Devices/
Compatible Profibus-DP-Slaves.
```

Slave operation possible

You may deploy your Profibus part from your SPEED7-CPU as DP slave. The approach is described on the following page.

Deployment as Profibus DP slave

Fast introduction

The deployment of the Profibus section as "intelligent" DP slave happens exclusively at master systems that may be configured in the Siemens SIMATIC manager. The following steps are required:
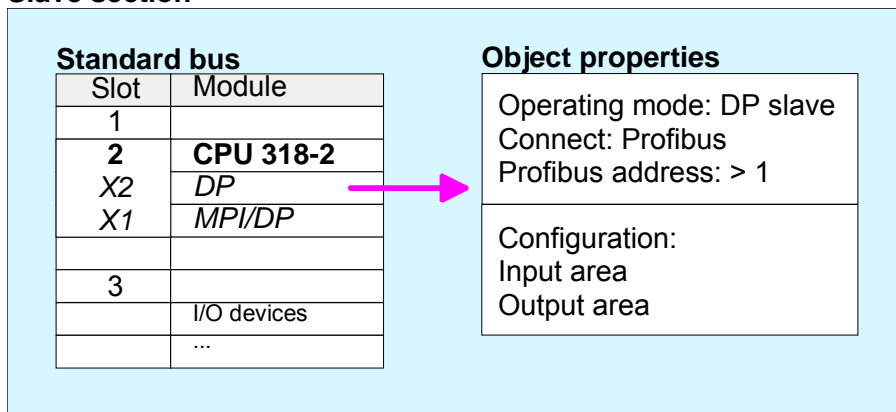
- Start the Siemens SIMATIC manager and configure a CPU 318-2 with the operating mode *DP slave*.
- Connect to Profibus and configure the in-/output area for the slave section.
- Save and compile your project.
- Configure another station as CPU 318-2 with operating mode *DP master*.
- Connect to *Profibus* and configure the in-/output ranges for the master section
- Save and compile your project.

In the following these steps are more detailed.

Project engineering of the slave section

- Start the Siemens SIMATIC manager with a new project.
- Insert a *SIMATIC 300 station* and name it as "...DP slave"
- Open the hardware configurator and insert a profile rail from the hardware catalog.
- Place the following Siemens CPU at slot 2:
  CPU 318-2 (6ES7 318-2AJ00-0AB0 V3.0)
- Add your modules according to the real hardware assembly.
- Connect the CPU to *Profibus,* set a Profibus address >1 (preferably 3) and switch the Profibus section via *operating mode* to "slave operation".
- Via *Configuration* you define the in-/output address area of the slave CPU that shall be assigned to the DP slave.
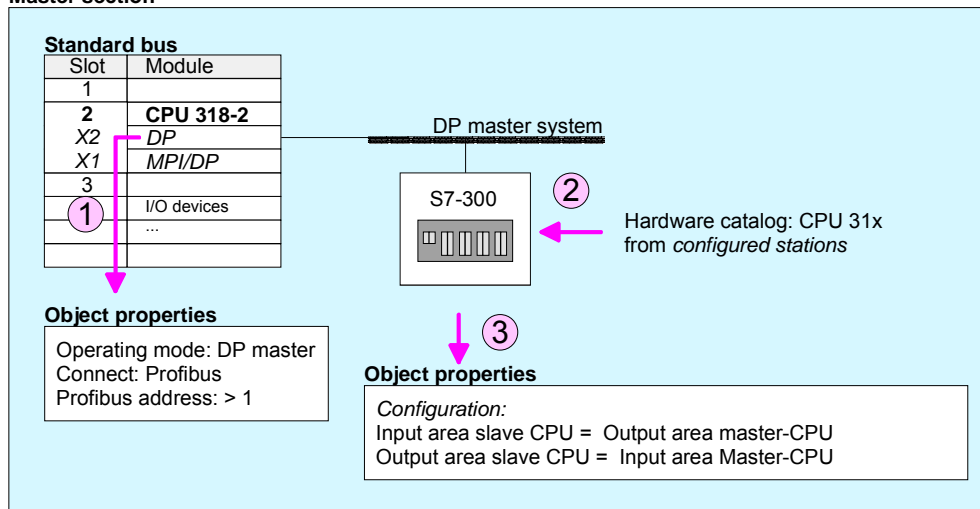- Save and compile your project.

Slave section

Standard bus		Object properties
Slot	Module	Operating mode: DP slave Connect: Profibus Profibus address: > 1
1		
2	**CPU 318-2**	
X2	*DP*	
X1	*MPI/DP*	Configuration: Input area Output area
3		
	I/O devices	
	...	

Project engineering of the master section

- Insert another *SIMATIC 300 station* and name it as "...DP master".
- Open the hardware configurator and insert a profile rail from the hardware catalog.
- Place the following Siemens CPU at slot 2:
  CPU 318-2 (6ES7 318-2AJ00-0AB0 V3.0)
- Add your modules according to the real hardware assembly.
- Connect the CPU to *Profibus*, set a Profibus address >1 (preferably 2) and switch the Profibus section via *operating mode* to "master operation".
- Connect your slave system to the master system by dragging the CPU 31x from the hardware catalog at *configured stations* onto the master system and select your slave system.
- Open the *Configuration* at *Object properties* of your slave system.
- Via double click to the according configuration line you assign the according input address area on the master CPU to the slave output data and the output address area to the slave input data.
- Save, compile and transfer your project. More detailed information about project engineering and project transfer may be found at chapter "Deployment CPU 315SN/NET".

Master section

Slot	Module
1	
2	**CPU 318-2**
X2	*DP*
X1	*MPI/DP*
3	
	I/O devices
	...

Standard bus

Object properties

Operating mode: DP master
Connect: Profibus
Profibus address: > 1

DP master system

S7-300 ②

Hardware catalog: CPU 31x
from *configured stations*

③

Object properties

Configuration:
Input area slave CPU = Output area master-CPU
Output area slave CPU = Input area Master-CPU

①

Profibus installation guidelines

Profibus in general

- A Profibus-DP network may only be built up in linear structure.
- Profibus-DP consists of minimum one segment with at least one master and one slave.
- A master has always been deployed together with a CPU.
- Profibus supports max. 126 participants.
- Per segment a max. of 32 participants is permitted.
- The max. segment length depends on the baud rate:

9.6 ... 187.5kbaud	$\rightarrow$	1000m
500kbaud	$\rightarrow$	400m
1.5Mbaud	$\rightarrow$	200m
3 ... 12Mbaud	$\rightarrow$	100m

- Max. 10 segments may be built up. The segments are connected via repeaters. Every repeater counts for one participant.
- All participants are communicating with the same baudrate. The slaves adjust themselves automatically on the baudrate.
- The bus has to be terminated at both ends.
- Master and slaves are free combinable.

Transfer medium

As transfer medium Profibus uses an isolated twisted-pair cable based upon the RS485 interface.

The RS485 interface is working with voltage differences. Though it is less irritable from influences than a voltage or a current interface. You are able to configure the network as well linear as in a tree structure.

Your VIPA CPU includes a 9pin slot where you connect the Profibus coupler into the Profibus network as a slave.

Max. 32 participants per segment are permitted. The segments are connected via repeaters. The maximum segment length depends on the transfer rate.

Profibus-DP uses a transfer rate between 9.6kbaud and 12Mbaud, the slaves are following automatically. All participants are communicating with the same baudrate.

The bus structure under RS485 allows an easy connection res. disconnection of stations as well as starting the system step by step. Later expansions don't have any influence on stations that are already integrated. The system realizes automatically if one partner had a fail down or is new in the network.

Bus connection   The following picture illustrates the terminating resistors of the respective start and end station.
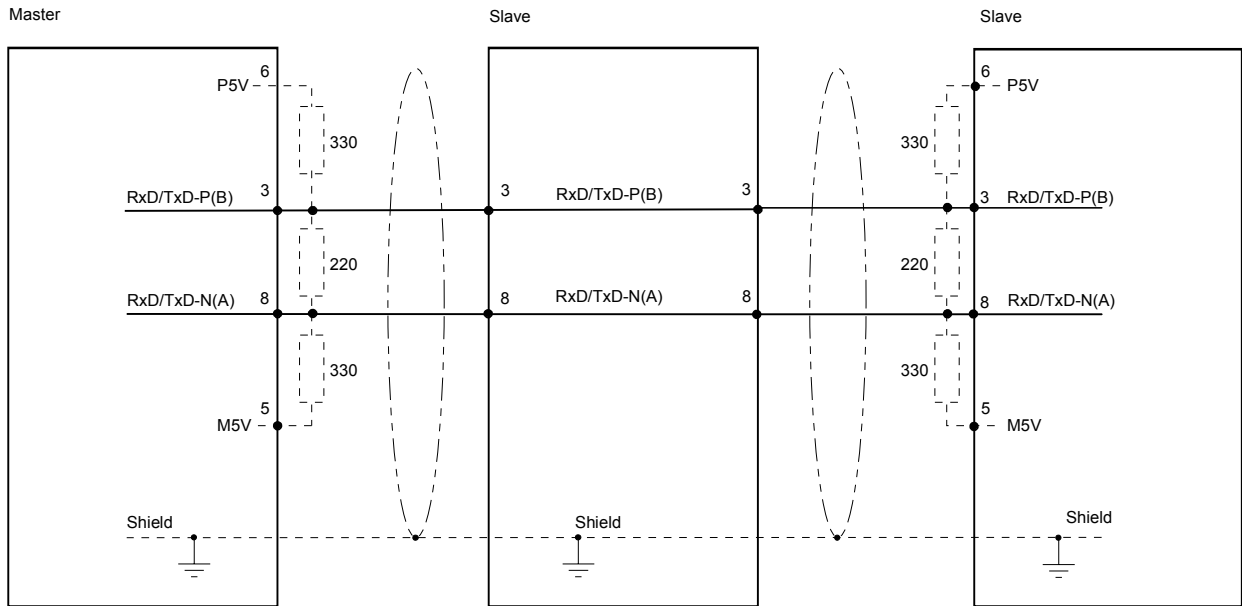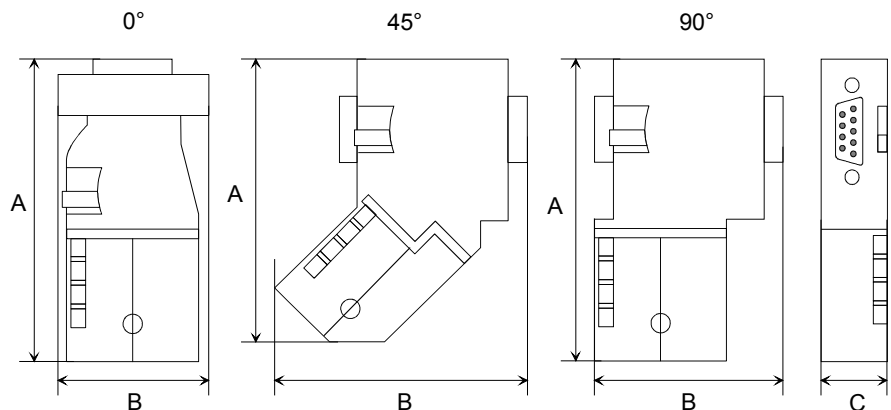

Note!

The Profibus line has to be terminated with its ripple resistor. Please make sure to terminate the last participants on the bus at both ends by activating the terminating resistor.

EasyConn
bus connector

In systems with more than two stations all partners are wired in parallel. For that purpose, the bus cable must be feed-through uninterrupted.

Via the order number VIPA 972-0DP10 you may order the bus connector "EasyConn". This is a bus connector with switchable terminating resistor and integrated bus diagnostic.

|	0°	45°	90°
A	64	61	66
B	34	53	40
C	15.8	15.8	15.8

all in mm

Note!

To connect this EasyConn plug, please use the standard Profibus cable type A (EN50170). Starting with release 5 you also can use highly flexible bus cable: Lapp Kabel order no.: 2170222, 2170822, 2170322.
With the order no. 905-6AA00 VIPA offers the "EasyStrip" de-isolating tool that makes the connection of the EasyConn much easier.

Dimensions in mm

Termination with "EasyConn"

The "EasyConn" bus connector is provided with a switch that is used to activate a terminating resistor.
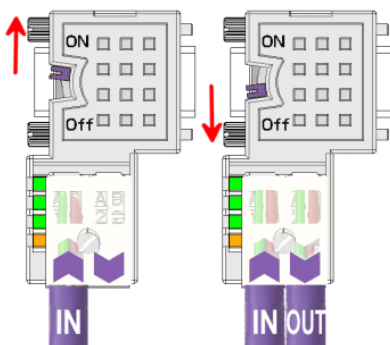
Attention!

The terminating resistor is only effective, if the connector is installed at a slave and the slave is connected to a power supply.

Note!

A complete description of installation and deployment of the terminating resistors is delivered with the connector.

Assembly
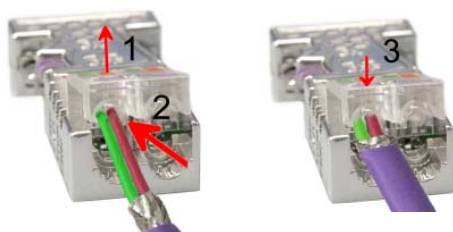
- Loosen the screw.
- Lift contact-cover.
- Insert both wires into the ducts provided (watch for the correct line color as below!)
- Please take care not to cause a short circuit between screen and data lines!
- Close the contact cover.
- Tighten screw
  (max. tightening torque 4Nm).

Please note: The green line must be connected to A, the red line to B!

Commissioning and Start-up behavior

Start-up on delivery

In delivery the CPU is overall reset. The Profibus part is deactivated and its LEDs are off after Power ON.

Online with bus parameter without slave project

The DP master can be served with bus parameters by means of a hardware configuration. As soon as these are transferred the DP master goes online with his bus parameter. This is shown by the RUN LED. Now the DP master can be contacted via Profibus by means of his Profibus address. In this state the CPU can be accessed via Profibus to get configuration and DP slave project.

Slave configuration

If the master has received valid configuration data, he switches to *Data Exchange* with the DP Slaves. This is indicated by the DE-LED.

CPU state controls DP master

After PowerON respectively a receipt of a new hardware configuration the configuration data and bus parameter were transferred to the DP master.

The DP master does not have any operation switch. His state is controlled by the RUN/STOP state of the CPU.

Dependent on the CPU state the following behavior is shown by the DP master:

Master behavior at CPU RUN

- The global control command "Operate" is sent to the slaves by the master. Here the DE-LED is ON.
- Every connected DP slave is cyclically attended with an output telegram containing recent output data.
- The input data of the DP slaves were cyclically transferred to the input area of the CPU.

Master behavior at CPU STOP

- The global control command "Clear" is sent to the slaves by the master. Here the DE-LED is blinking.
- DP slaves with f*ail safe mode* were provided with output telegram length "0".
- DP slaves without *fail safe mode* were provided with the whole output telegram but with output data = 0.
- The input data of the DP slaves were further cyclically transferred to the input area of the CPU.

Chapter 7   Deployment Ethernet communication

Overview

In this chapter the communication via Ethernet is described. Please regard the chapter "Fast introduction" where you will find every information compressed required for the project engineering of the CPU 315SN/NET with *CP 343*. After the fast introduction, the mentioned steps are described in detail.
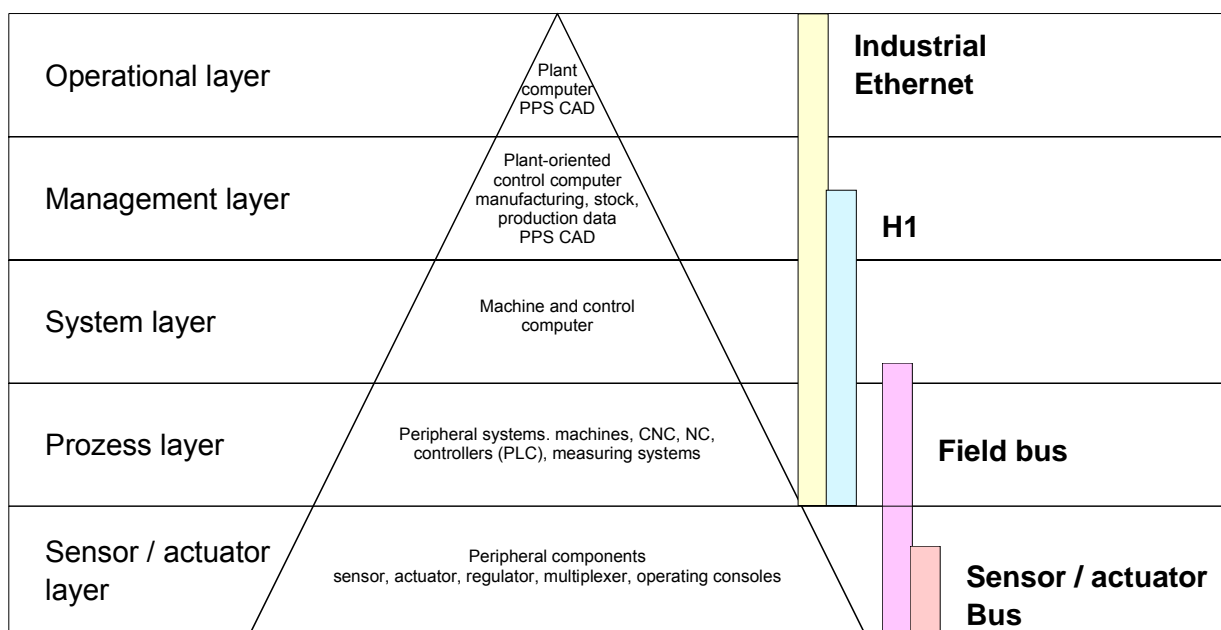
Content

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:

Operational layer	Plant computer PPS CAD	**Industrial Ethernet**
Management layer	Plant-oriented control computer manufacturing, stock, production data PPS CAD	**H1**
System layer	Machine and control computer	
Prozess layer	Peripheral systems. machines, CNC, NC, controllers (PLC), measuring systems	**Field bus**
Sensor / actuator layer	Peripheral components sensor, actuator, regulator, multiplexer, operating consoles	**Sensor / actuator Bus**

Industrial Ethernet
Industrial Ethernet is an electrical net based on shielded twisted pair cabling or optical net based on optical fiber.

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.

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	Function
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.

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 (**I**nternet **P**rotocol) 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.

Layers continued...

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.

Basics - Terms

Network (LAN)   A network res. LAN (**L**ocal **A**rea **N**etwork) 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 analyzes 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.

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 computer communication is the so called ISO/OSI layer model, a model based upon seven layers with rules for the usage of hardware and software (see ISO/OSI reference model above).

The CPU from VIPA uses the following protocols:

- Siemens S7 connections
- TCP/IP
- UDP
- RFC1006 (ISO on TCP)
- ISO transport (once H1)

The protocols are described in the following:

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.

Besides the communication connection a CPU may be controlled by an other CPU by means of the remote functions with the appropriate function block to set these e.g. to STOP.

Precondition for the Siemens S7 communication is a configured connection table, which contains the defined connections for communication.

Here WinPLC7 from VIPA or NetPro from Siemens may be used.

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.

Note!

More about the usage of the FB/SFB VIPA handling blocks concerning the S7 connections may be found in the manual "Operation list" of the CPU.

TCP/IP

TCP/IP protocols are available on all major systems. At the bottom end this applies to simple PCs, through to the typical mini-computer up to mainframes.

For the wide spread of Internet accesses and connections, TCP/IP is often used to assemble heterogeneous system pools.

TCP/IP, standing for **T**ransmission **C**ontrol **P**rotocol and **I**nternet **P**rotocol, collects a various range of protocols and functions.

TCP and IP are only two of the protocols required for the assembly of a complete architecture. The application layer provides programs like "FTP" and "Telnet" for the PC.

The application layer of the Ethernet CP is defined with the user application using the standard handling blocks.

These user applications use the transport layer with the protocols TCP and UDP for the data transfer which themselves communicate via the IP protocol with the Internet layer.

IP

The Internet protocol covers the network layer (Layer 3) of the ISO/OSI layer model.

The purpose of IP is to send data packages from on PC to another passing several other PCs. These data packages are referred to as datagrams. The IP doesn't neither guarantee the correct sequence of the datagrams nor the delivery at the receiver.

For the unambiguous identification between sender and receiver 32Bit addresses (IP addresses) are used that are normally written as four octets (exactly 8bit), e.g. 172.16.192.11.

These Internet addresses are defined and assigned worldwide from the DDN network (Defense Department Network), thus every user may communicate with all other TCP/IP users.

One part of the address specifies the network; the rest serves the identification of the participants inside the network. The boarder between the network and the host part is variable and depends on the size of the network.

To save IP addresses, so called *NAT router* are used that have one official IP address and cover the network. Then the network can use any IP address.

TCP

The TCP (**T**ransmission **C**ontrol **P**rotocol) bases directly on the IP and thus covers the transport layer (layer 4) of the ISO/OSI layer model. TCP is a connection orientated end-to-end protocol and serves the logic connection between two partners.

TCP guarantees the correct sequence and reliability of the data transfer. Therefore you need a relatively large protocol overhead that slows down the transfer speed.

Every datagram gets a header of at least 20Byte. This header also contains a sequence number identifying the series. This has the consequence that the single datagrams may reach the destination on different ways through the network.

Using TCP connections, the telegram length is not transmitted. This means that the recipient has to know how many bytes belong to a message. To transfer data with variable length you may begin the user data with the length information and evaluate this at the counter station.

Properties TCP/IP

- Besides of the IP address ports are used for the addressing. A port address should be within the range of 2000...65535. Partner and local ports may only be identical at one connection.

- Not depending on the used protocol, the PLC needs the VIPA handling blocks AG_SEND (FC 5) and AG_RECV (FC 6) for data transfer.

UDP

The UDP (**U**ser **D**atagram **P**rotocol) is a connection free transport protocol. It has been defined in the RFC768 (**R**equest **f**or **C**omment). Compared to TCP, it has much fewer characteristics.

The addressing happens via port numbers.

UDP is a fast unsafe protocol for it doesn't neither care about missing data packages nor about their sequence.

ISO-on-TCP RFC1006

The TCP transport service works stream orientated. This means that data packages assembled by the user not necessarily have to receive the partner in the same packaging. Depending on the data amount, packages may though come in the correct sequence but differently packed. This causes that the recipient may not recognize the package borders anymore. For example you may send 2x 10Byte packages but the counter station receives them as 20Byte package. But for most of the applications the correct packaging is important.

Due to this you need another protocol above TCP. This purpose is defined in the protocol RFC1006. The protocol definition describes the function of an ISO transport interface (ISO 8072) basing upon the transport interface TCP (RFC793).

The basic protocol of RFC1006 is nearly identical to TP0 (Transport Protocol, Class 0) in ISO 8073.

For RFC1006 is run as protocol for TCP, the decoding takes place in the data section of the TCP package.

Properties

- The receipt of data is confirmed by a TCP layer.

- Instead of ports TSAPs are used for the addressing besides of the IP address. The TSAP length may be 1 ... 16 characters. The entry may happen in ASCII or Hex format. Remote and local TSAPs may only be identical at 1 connection.

- Not depending on the used protocol, the PLC needs the VIPA handling blocks AG_SEND (FC 5) and AG_RECV (FC 6) for data transfer.

- Contrary to TCP different telegram lengths can be received using RFC1006.

ISO transport (once H1)

The ISO transport service (ISO 8073 class 4) corresponds to the transport layer (Layer 4) of the ISO/OSI reference model. With ISO transport connections there is the possibility for program and event controlled communication via Industrial Ethernet. Here data blocks may be exchanged bi-directional.

The ISO transport connection offers services for a safety transfer of data by means of configured connections. Large data blocks may be transferred by means of blocking.

The transmission reliability is very high by the automatic repetition, by additional block test mechanisms and by the receipt acknowledgement at the receiver side. ISO transport connections are exclusively transferred via Industrial Ethernet and they are optimized for the deployment in a closed manufacturing area.

Properties

- ISO transport connections are only suited for Industrial Ethernet
- The receipt of data is acknowledged by the partner station. Here different telegram lengths may be processed.
- The addressing happens by MAC address (Ethernet address) and TSAPs (**T**ransport **S**ervice **A**ccess **P**oint).
- The data transfer is made by the services SEND/RECEIVE and FETCH/WRITE.
- Independent on the used protocol, the PLC needs the VIPA handling blocks AG_SEND (FC 5) and AG_RECV (FC 6) for data transfer.

Basics - IP address and subnet

IP address structure

Industrial Ethernet exclusively supports IPv4. 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 its structure is as follows: **XXX.XXX.XXX.XXX**

Range: 000.000.000.000 to 255.255.255.255

The network administrator also defines IP addresses.

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

Subnet

A TCP-based communication via point-to-point, hub or switch connection is only possible between stations with identical Network-ID and Subnet-ID! Different area must be connected with a router.

The subnet mask allows you to sort the resources following your needs. This means e.g. that every department gets an own subnet and thus does not interfere another department.

Address at first start-up

At the first start-up of the CPU, the Ethernet PG/OP channel and the CP 343 part of the CPU do not have an IP address. The assignment takes place using the following possibilities:

- Using Siemens SIMATIC manager switch PG/PC interface to "TCP/IP... RFC1006". Via "Assign Ethernet address" search the appropriate CP and assign IP parameters. After that the CP is directly assigned to the new IP parameters without any restart of the CPU.

- You may assign an IP address and a subnet mask to your CP with the help of a "minimum project" and transfer this via MMC or MPI into the CPU. After a reboot of the CPU and after switching the PG/PC interface to "TCP/IP... RFC1006" you may now configure your CPU online via the favored CP.

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   To build up private IP-Networks within the Internet, RFC1597/1918 reserves the following address areas:

Network class	Start IP	End 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.)

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.

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

Note!

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.)

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 labeled 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 three 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
At the first-start-up the CP 343 of the CPU has an unique MAC address. This may be found on a label beneath the front flap.

Note!

Please regard for the configuration of the network in the Siemens SIMATIC manager that it is necessary to activate the ISO protocol and to preset a valid MAC address within the properties dialog of the Ethernet interface of the CP!

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**
An ISO transport connection is specified by a local and a remote connection endpoint.

Station A				Station B
remote TSAP	→	ISO transport-	→	local TSAP
local TSAP	←	connection	←	remote TSAP
MAC address A				MAC address B
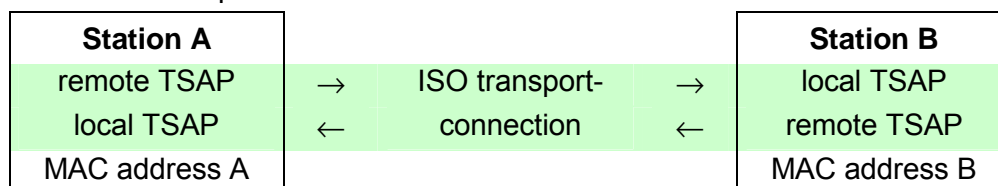
The TSAPs of an ISO transport connection must match as follows:

Remote TSAP (in CP) = local TSAP (in destination station)

Local TSAP (in CP) = remote TSAP (in destination station)

Fast introduction

Overview

At the first start-up respectively at an over all reset the Ethernet PG/OP channel and CP 343 of the CPU <u>do not have</u> any IP address. The CPs may only be contacted by its MAC addresses. IP address parameters may be assigned to the CPs by means of the MAC addresses, which may be found on labels beneath the front flap with the sequence 1. address PG/OP channel and beneath address of the CP 343. The assignment takes place directly via the hardware configuration of the Siemens SIMATIC manager.

For the project engineering of a CPU 315SN/NET with CP 343 please follow this approach:

- **Assembly and commissioning**
- **Hardware configuration** (Inclusion of CP in CPU)
- **CP project engineering** via NetPro (connection to Ethernet)
- **PLC programming** via user application (connection to PLC)
- **Transfer of the complete project to CPU**

Note

> **To be compatible to the Siemens SIMATIC manager, the CPU 315SN/NET from VIPA has to be configured as**
>
> **CPU 318-2 (6ES7 318-2AJ00-0AB0)!**
>
> **The Ethernet PG/OP channel of the CPU 315SN/NET is always to be configured as 1. module after the really plugged modules at the standard bus as CP343-1 (343-1EX11) from Siemens. The CP 343 of the CPU is always to be configured below the before configured PG/OP channel also as CP343-1 (343-1EX11).**

Assembly and commissioning

- Install your System 300S with the CPU 315SN/NET.
- Wire the system by connecting cables for voltage supply, signals and Ethernet. A detailed description is to be found in the chapter "Assembly and installation guidelines".
- Switch on the power supply. → After a short boot time, the CP is in idle. At the first commissioning res. after an overall reset of the CPU, Ethernet PG/OP channel and CP have no IP address. For control purposes you may now reach the CP via the MAC address. The MAC address is to be found beneath the front flap on the left side of the module at a small label on the module.

Assign IP Address parameters

You get valid IP address parameters from your system administrator. For the assignment of the IP address parameters such as IP address, Subnet mask etc. you have the following possibilities:

- Online using Siemens SIMATIC manager via "Assign Ethernet Address" (at least CP-Firmware 1.7.4)

- With a project with IP address and IP parameters transferred via MMC or MPI to the CPU. After a reboot of the CPU and after switching the PG/PC interface to "TCP/IP... RFC1006" you may now configure your CPU online via the CP.

Address assignment with "Assign Ethernet Address"

Please regard this functionality is available with CP firmware version 1.7.4 and up. In the following the proceeding with the Siemens SIMATIC manager starting with version V 5.3 & SP3 is described:

- Start the Siemens SIMATIC manager.

- Switch to "TCP/IP... RFC1006" using **Options** > *Set PG/PC interface*.

- The dialog for initialization of a station opens by **PLC** > *Edit Ethernet Node*.

- To get the stations and their MAC address, use the [Browse] button or type in the MAC Address. The Mac address can be found at a label beneath the front flap of the CP.

- Choose if necessary the known MAC address of the list of found stations.

- Either type in the IP configuration like IP address, subnet mask and gateway. Or your station is automatically provided with IP parameters by means of a DHCP server. Depending of the chosen option the DHCP server is to be supplied with MAC address, equipment name or client ID. The client ID is a numerical order of max. 63 characters. The following characters are allowed: "hyphen", 0-9, a-z, A-Z

- Confirm with [Assign ...].

Directly after the assignment the CP is online reachable using the set IP parameters.

Address
assignment with
minimal project

- Start Siemens SIMATIC manager with new project.
- Place a new System 300 station with **Insert** > *Station* > *SIMATIC 300 station*
- Activate the station "SIMATIC 300" and open the hardware configurator by clicking on "Hardware".
- Configure a rack (SIMATIC 300 \ Rack-300 \ Profile rail).
- Configure in deputy of your CPU 315SN/NET the Siemens CPU 318-2 with the order no. 6ES7 318-2AJ00-0AB0 V. 3.0 which is to be found at SIMATIC 300 \ CPU 300 \ CPU 318-2 \ 318-2AJ00-0AB00. If needed, parameterize the CPU 318-2.
- Place the System 300 modules in plugged sequence starting with plug-in location 4.
- Configure the internal PG/OP channel directly under the really plugged modules as virtual **CP 343-1 (343-1EX11)** from Siemens.
- Set IP address, subnet mask and gateway at CP properties.
- Always configure as 2. CP the internal CP 343 as **CP 343-1 (343-1EX11)** by setting another IP address, subnet mask and gateway.
- Set IP address, subnet mask and gateway at CP properties and save and compile your project. This is the end of the *Minimal project*. After the *Minimal project* is transferred to CPU, the CP can be accessed by means of IP address and Subnet mask of the project.

Deployment of ISO transport connections

For deployment of the ISO transport connections they must be enabled in the Ethernet properties of the CP at the project above.

Here there is the possibility to assign the CP to a MAC address. With each start-up of the CPU the new MAC address is transferred to the CP.

Configure connections with NetPro

The link-up between the stations happens with the graphical interface NetPro. Start NetPro by clicking on a network in your project res. on connections in the CPU directory.
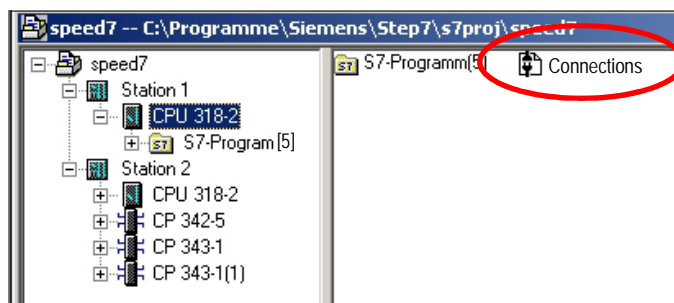
Link-up stations   For the project engineering of connections, connected stations are presumed. To link-up stations, point on the colored net mark of the according CP with the mouse and drag it to the network you want to assign. The connection is displayed graphically by a line.

Configure   For the project engineering of new connections click on the according CPU
connections   and choose "Insert new connection" from the context menu.
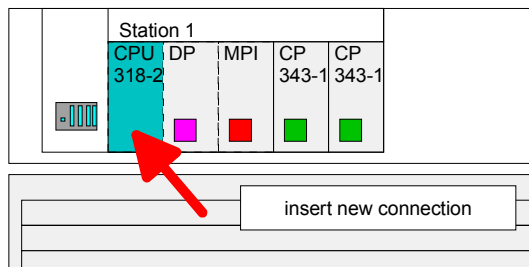
                          Via the dialog window you may set the parameters for a connection. The parameters ID and LADDR are required for the usage on the blocks AG_SEND res. AG_RECV.

                          With deployment of Siemens S7 connections the parameter *ID* is to be passed to the respective FB/SFB VIPA handling blocks.

                          Always use the 2. CP from the route

                          Please take care to always choose the 2. CP from the route for communication. As 1. CP you will always see the Ethernet PG/OP channel that does not support configurable connections.

Save and compile   Save and compile your project and close NetPro.
connections
                          To store the CP project engineering data in the system data, you have to activate the option "Save configuration data on the CPU" (default setting) under *object properties* area *Options* in the hardware configuration of the CP.

**PLC user   For the execution of connection commands at the PLC, your CPU requires
application**   an user application. For this, exclusively the VIPA handling blocks are used, which you may get from VIPA as a library.

                          More information about the deployment of the blocks may be found in the manual "Operation list" of your CPU.

                          Depending upon the connection type there are function blocks for Siemens S7 connections and Send/Receive connections.

Project transfer   Information about transferring a project may be found at chapter "Deployment CPU 315SN/NET" at "Project transfer".

                          The following pages provide a more detailed description of the steps of the fast introduction.

Hardware configuration

Overview

For the Hardware configuration the hardware configurator from Siemens is used. Here you set amongst others the IP address of the CP and configure the hardware components of your PLC.

Due to the fact that neither the Ethernet PG/OP channel nor the CP 343 have an IP address in delivery state you may engineer the CPU exclusively via MPI or MMC.

For the access to the CPU via the Ethernet PG/OP channel res. the CP 343 it is required that the CPU has a hardware project engineering where IP address and subnet mask for Ethernet PG/OP res. CP 343 are defined.

Requirements

For the hardware configuration the following software is required:
- Siemens SIMATIC manager V. 5.1 or higher and vipa_speedbus.gsd
- SIMATIC NET

Note!

For the project engineering a thorough knowledge of the SIMATIC manager and the hardware configurator from Siemens are required and assumed!

Note

To be compatible to the Siemens SIMATIC Manager, the CPU 315SN/NET from VIPA is to be configured as

CPU 318-2 (6ES7 318-2AJ00-0AB0)!

The Ethernet PG/OP channel of the CPU 315SN/NET is always to be configured as 1. module after the really plugged modules at the standard bus as CP343-1 (343-1EX11) from Siemens. The CP 343 of the CPU is always to be configured below the before configured PG/OP channel also as CP343-1 (343-1EX11).

Steps of the project engineering

The following text shows the approach of the project engineering in the hardware configurator from Siemens in an abstract sample.

The project engineering is divided into 3 parts:

- Project engineering of the CPU
- Project engineering of the really plugged modules at the standard bus
- Project engineering Ethernet PG/OP channel and CP 343

Hardware assembly

Standard bus (serial) ⟶

CPU 315SN/NET   DI   DO   DIO   AI   AO
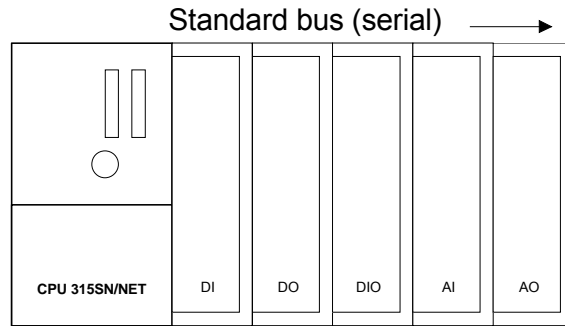
Project engineering of the CPU

- Start the hardware configurator from Siemens with a new project and insert a profile rail from the hardware catalog.
- Place the following Siemens CPU at slot 2:
  CPU 318-2 (6ES7 318-2AJ00-0AB0 V. 3.0)

Project engineering of the modules at the standard bus

The modules at the right side of the CPU at the standard bus are configured with the following approach:

- Include your System 300V modules at the standard bus in the plugged sequence starting with slot 4.
- Parameterize the CPU res. the modules where appropriate. The parameter window opens by a double click on the according module.

Standard bus (serial) ⟶

CPU 315SN/NET   DI   DO   DIO   AI   AO
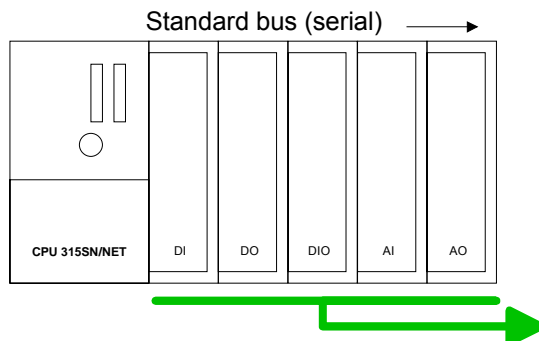
Standard bus

Slot	Module
1	
2	**CPU 318-2**
X2	*DP*
X1	*MPI/DP*
3	
4	DI
5	DO
6	DIO
7	AI
8	AO
9	
10	
11	

Project engineering Ethernet PG/OP channel and CP 343

For the internal Ethernet PG/OP channel you have to configure a Siemens CP 343-1 (SIMATIC 300 \ CP 300 \ Industrial Ethernet \CP 343-1 \ 6GK7 343-1EX11 0XE0) <u>always </u>as 1. module below the really plugged modules.

The integrated CP 343 of the CPU 315SN/NET is also configured as **CP 343-1 (343-1EX11)** but always below the before configured CP 343-1.
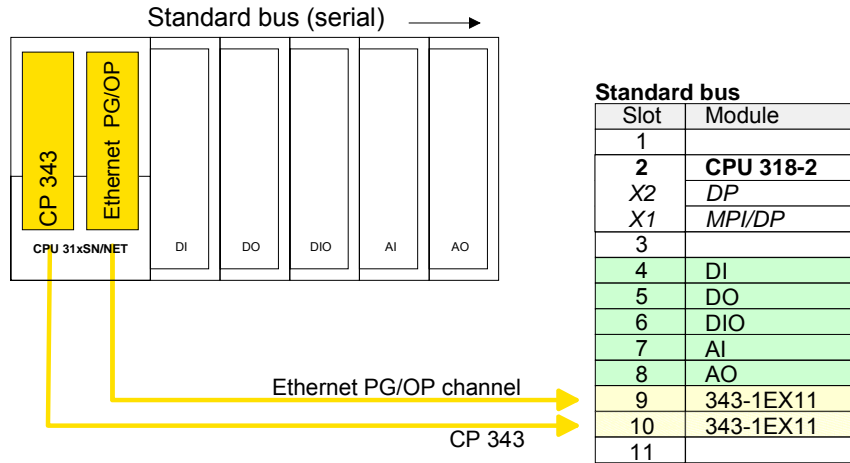
Open the property window via double-click on the CP 343-1EX11 and enter at properties the IP address, subnet mask and gateway for the CPs and select the wanted subnet.
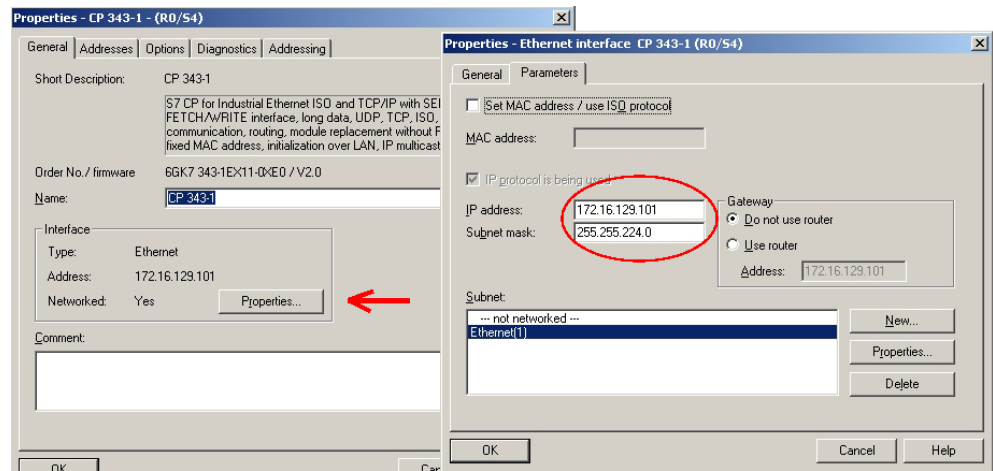
Bus extension with IM 360 and IM 361

To extend the bus you may use virtually the IM 360 from Siemens where you may virtually connect up to 3 further extension racks via the IM 361. Bus extensions are always placed at slot 3.

Configure connections

Overview

The project engineering of connections i.e. the "link-up" between stations happens in NetPro from Siemens. NetPro is a graphical user interface for the link-up of stations.

A communication connection enables the program controlled communication between two participants at the Industrial Ethernet. The communication partners may here be part of the same project or - at multi projects - separated within related part projects.

Communication connections to partners outside of a project are configured via the object "In unknown project" or via deputy objects like "Other stations" or Siemens "SIMATIC S5 Station".

By means of the handling block like FB 55 - IP_CONFIG there is the possibility to establish program controlled communication connections. More may be found in the manual "Operation list" of the CPU.

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.
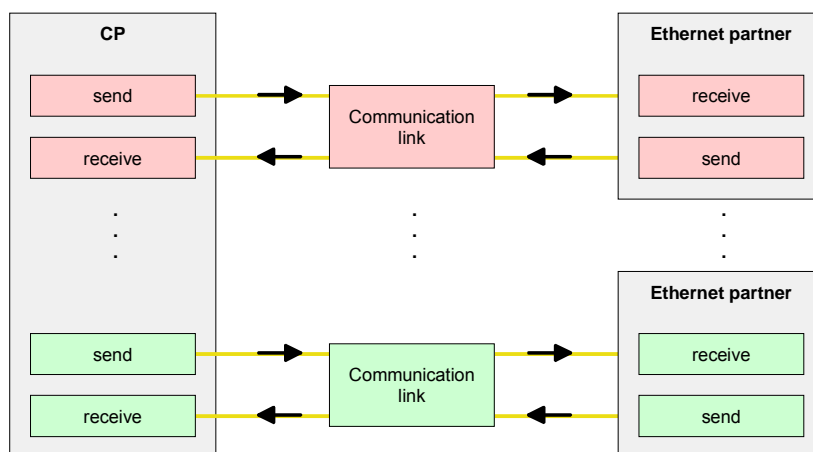
Requirements

- Siemens SIMATIC manager V.5.1 or higher and SIMATIC NET are installed.
- The CP has been engineered at the hardware configuration, entered into the hardware configuration and linked-up to the Ethernet subnet.
- The CP as bus participant has an IP address respectively a MAC address for ISO transport connections.

Note!

Every station outside of the recent project must be configured as replacement objects like e.g. Siemens "SIMATIC S5" or "other station" or with the object "In unknown project".

When creating a connection you may also choose the partner type "unspecified" and set the required remote parameter directly in the connection dialog.

Work environment of NetPro

For the project engineering of connections, a thorough knowledge with NetPro from Siemens is required! The following passage only describes the basic usage of NetPro. More detailed information about NetPro is to be found in the according online manual res. documentation.

Start NetPro by clicking on a "net" in the Siemens SIMATIC manager or on "connections" within the CPU.

The environment of NetPro has the following structure:

1   *Graphic 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   *Net objects*

This area displays all available net objects in a directory view. By dragging a wanted object to the net view you may include further net objects and open them in the hardware configurator.

3   *Connection table*

The connection table lists all connections in a table. This list is only shown when you highlighted a connectable module like e.g. a CPU.

You may insert new connections into this table with the according command.
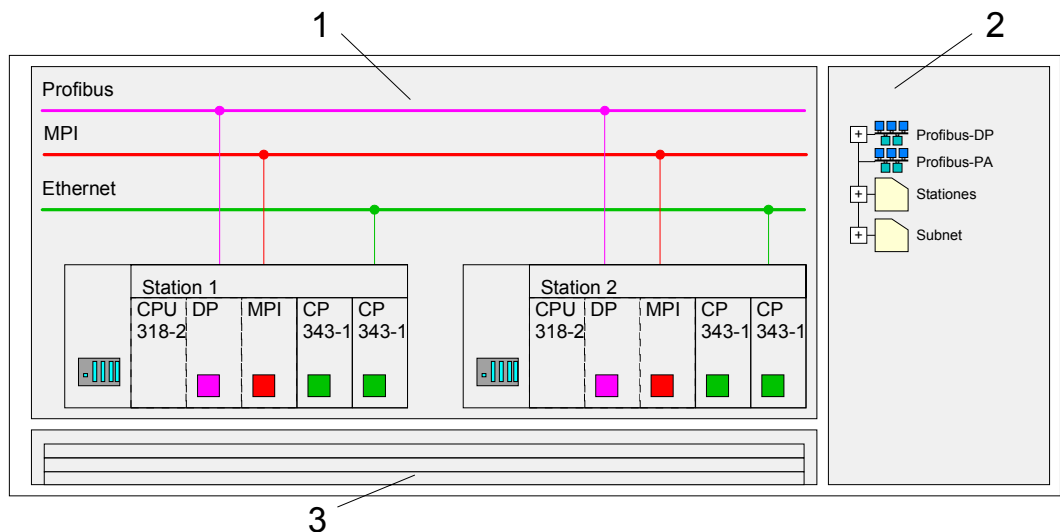
PLC stations

You receive the following graphical display for every PLC station and their component. By selecting the single components, the context menu offers you several functions:
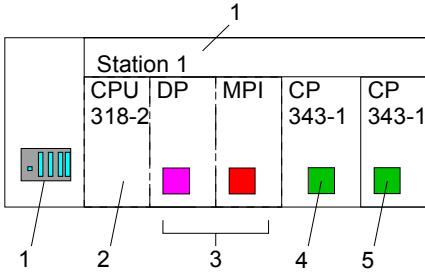
1   *Station*

This includes a PLC station with rack, CPU and communication components. Via the context menu you may configure a station added from the *net objects* and its concerning components in the hardware configurator. After returning to NetPro, the new configured components are shown.

2   *CPU*

A click onto the CPU shows the connection table. The connection table shows all connections that are configured for the CPU.

3   *Internal communication components*

This displays the communication components that are available in your CPU. For the NET-CPU is configured as CPU 318-2 the internal components do not show the CP.

Due to this, the CPs that are included in the NET-CPU must be configured as external CPs behind the really plugged modules. The CPs are then also shown in NetPro as external CPs (4, 5) in the station.

4   *Ethernet PG/OP channel*

The internal *Ethernet PG/OP channel* must always be configured as 1. CP in the hardware configuration. This CP only serves the PG/OP communication. You may not configure connections.

5   *CP 343*

The internal CP 343 must always be configured as 2. CP in the hardware configuration after the *Ethernet PG/OP channel*.

Link up stations

NetPro offers you the option to link-up the communicating stations. You may link-up the stations via the properties in the hardware configuration or graphically via NetPro. For this you point the mouse on the colored net mark of the according CP and drag and drop it to the net you want to link. Now the CP is linked up to the wanted net by means of a line.
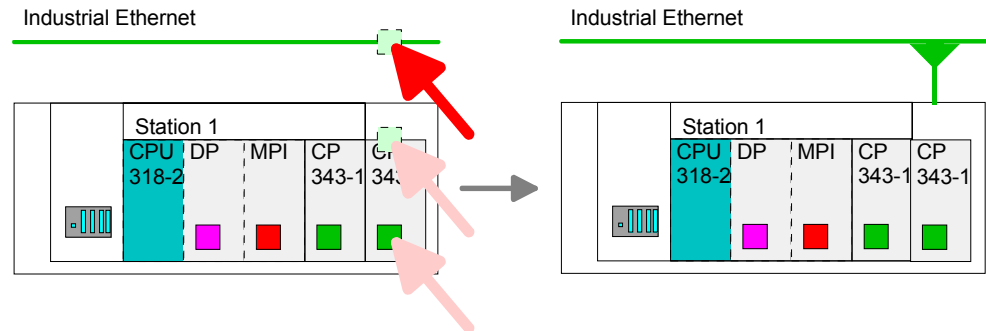
Projecting connections	For the project engineering of connections, open the connection list by selecting the according CPU. Choose *Insert new connection* in the context menu:
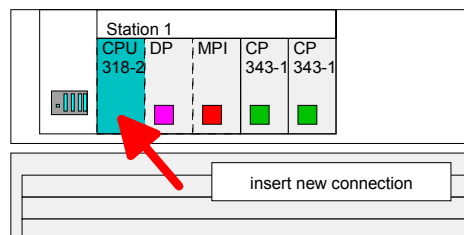
Connection partner (partner station)	A dialog window opens where you may choose the *connection partner* and the *connection type*.
Specified connection partner	Each station configured in the Siemens SIMATIC manager is listed in the table of connection partner. These stations are unique *specified* by an IP address and a subnet mask.
Unspecified connection partner	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 connection name, which is to be used in the projects of both stations. Due to this allocation the connection remains *unspecified*.
All broadcast stations	Exclusive at UDP connections you may send to every reachable participant. The receipt of user data is not possible. The broadcast participants are specified by <u>one</u> port and <u>one</u> broadcast address at sender and receiver.
	Per default, broadcasts that are only serving the Ethernet communication, like e.g. ARP-Requests (Search MAC <> IP address), are received and accordingly processed. For the identification of the broadcast participants within the net, you have to define a valid broadcast address as partner IP during project engineering of a broadcast connection. Additionally to the broadcast address you have to set a common port for sender and receiver.
All multicast stations	By selecting *All Multicast stations* you define that UDP telegrams have to be sent res. received by all participants of a multicast group. In opposite to broadcast here a reception is possible. For the identification of the multicast participants within the net, you have to define <u>one</u> valid multicast group address and <u>one</u> port for sender and receiver.
	The maximum number of multicast circles, which are supported by the CP, is identical to the maximum number of connections.

Connection types   The following connection types are available for communication:

- **Siemens S7 connections, Send/Receive connections (TCP, ISO-on-TCP** and **ISO transport)** for secured data transfer of data blocks between two Ethernet stations

- **UDP** for not secured data transfer of data blocks between two stations.

**Open the
properties dialog**   Choose the connection partner and the type of connection and confirm with [OK].

If activated, a properties dialog for the according connection opens as link to your PLC user program.

At the following pages the relevant parameters of the different connection types are shortly described. More information about this may be found in the online help of Siemens NetPro respectively of VIPA WinPLC7.
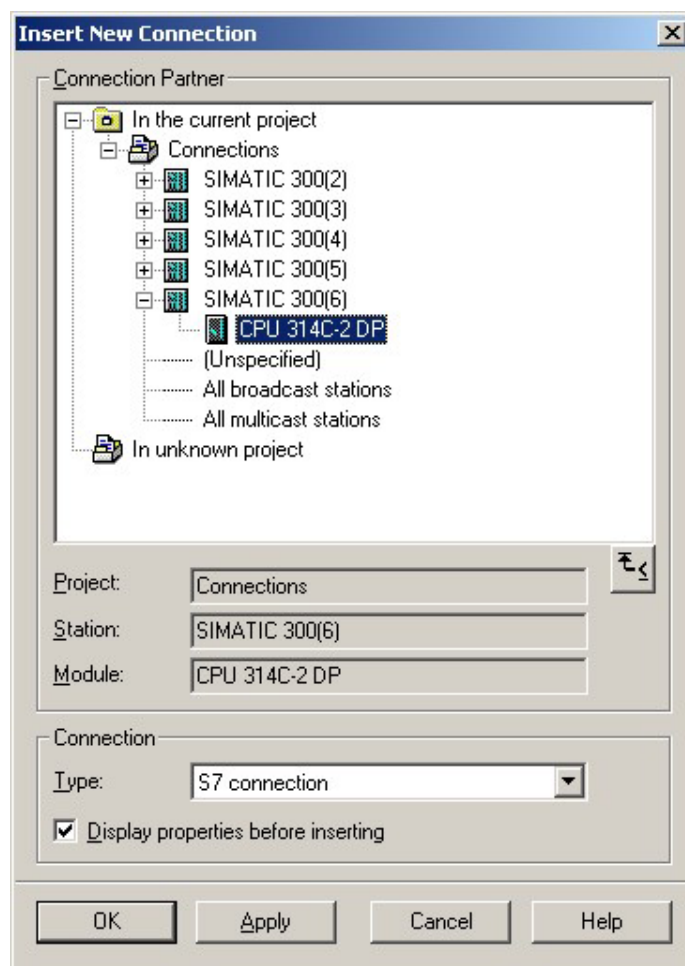
**Save and compile
connections**   After every connection was configured by this way, you may save and compile your project and exit NetPro.

To store the CP project engineering data in the system data, you have to activate the option "Store project data in the CPU" (default setting) at *object properties* area *Options* in the hardware configuration of the CP.

Siemens S7 connection

For data transfer with Siemens S7 connections the FB/SFB VIPA 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. A link. At Siemens S7 connections the TSAPs must be congruent crosswise.

The following parameters define a connection end point:

Station A		Siemens		Station B
remote TSAP	→	Siemens	→	local TSAP
local TSAP	←	S7 connection	←	remote TSAP
ID A				ID B
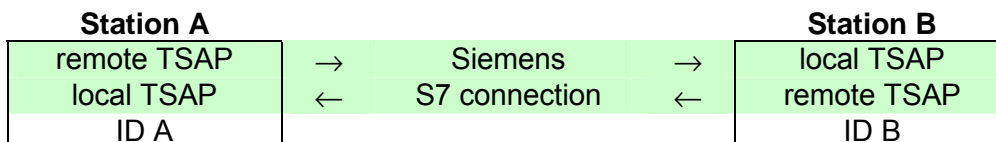
Possibilities of combination

The following table shows the combination options with Siemens S7 connections with deployment of the FB/SFB VIPA handling blocks.

The handling blocks are more described in the manual "Operation list" of the CPU.

Connection partner	Connection establishing	Connection
specified in NetPro (in the current project)	active/passive	specified
unspecified in NetPro (in the current project)	active	specified
	passive	unspecified
unspecified in NetPro (in the unknown project)	active/passive	specified (connection name in an other project)

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

Local connection end point

Here you may define how the connection is to be established. Since the Siemens SIMATIC manager can identify the communication options by means of the end points, some options are already preset and may not be changed.

Establish an active connection

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 establish a connection. Here the job is to be made by the partner station.

One-way

If activated only one-way communication blocks like PUT and GET may be used for communication in the user program. Here the partner station acts as server, which neither may send active nor receive active

Block parameters

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 VIPA handling block.

[Default]   As soon as you click at [Default], the ID is reset to system generated ID.

Connection path   In this part of the dialog window the connection path between the local and
                             the partner station may be set. Depending on the linking of the modules the
                             possible interfaces for communication are listed in a selection field.

[Address details]   With this button a dialog window is opened, which shows address
                             information about the local and partner station. The parameters may also
                             be changed.

TSAP   With Siemens S7 connections a TSAP is automatically generated of the
                             connection resource (one-way/two-way) and state of place (rack/slot
                             respectively system internal ID at PC stations).

Connection   The connection resource is part of the TSAP of the local station
resource   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.

Operating mode   With deploying of Siemens S7 connections the operating may be
                             determined by deployment of the FB/SFB VIPA handling blocks in the user
                             program. To use this blocks configured communication connections are
                             always necessary in the active station.
                             More about the usage of these blocks may be found in the manual
                             "Operation list" of your CPU.
                             The following blocks may be used with Siemens S7 connections:

FB/SFB	Name	Description
FB/SFB 8	USEND	Uncoordinated data transmission
FB/SFB 9	URCV	Uncoordinated data reception
FB/SFB 12	BSEND	Sending data in blocks
FB/SFB 13	BRCV	Receiving data in blocks
FB/SFB 14	GET	Remote CPU read
FB/SFB 15	PUT	Remote CPU write
FB 55	IP_CONFIG	Programmed communication Connections

Send/Receive connections

At the PLC side for data transfer with these connections the VIPA handling blocks AG_SEND (FC 5) and AG_RECV (FC 6) are to be used.

The following connections are Send/Receive connections:

- TCP (SEND-RECEIVE, FETCH-WRITE PASSIVE)
- ISO-on-TCP (SEND-RECEIVE, FETCH-WRITE PASSIVE)
- ISO transport (SEND-RECEIVE, FETCH-WRITE PASSIVE)
- UDP (SEND-RECEIVE)

Here the following parameters define a connection end point:

remote port	$\rightarrow$	TCP	$\rightarrow$	local port
local port	$\leftarrow$	connection	$\leftarrow$	remote port
IP address A				IP address B

remote TSAP	$\rightarrow$	ISO-on-TCP	$\rightarrow$	local TSAP
local TSAP	$\leftarrow$	connection	$\leftarrow$	remote TSAP
IP address A				IP address B

remote TSAP	$\rightarrow$	ISO transport	$\rightarrow$	local TSAP
local TSAP	$\leftarrow$	connection	$\leftarrow$	remote TSAP
MAC address A				MAC address B

remote port	$\rightarrow$	UDP-	$\rightarrow$	local port
local port	$\leftarrow$	connection	$\leftarrow$	remote port
IP address A				IP address B

Possibilities of combination

The following table shows the combination options with the different operating modes:

Connection partner	Connection type	Conn. establ.	Connection	Operating mode
Specified in NetPro (in recent project)	TCP / ISO-on-TCP / ISO transport	active/passive	specified	SEND/RECEIVE
	UDP	-		
Unspecified in NetPro (in recent project)	TCP / ISO-on-TCP / ISO transport	active	specified	SEND/RECEIVE
		passive	part specified (Port/TSAP)	SEND/RECEIVE FETCH PASSIV WRITE PASSIV
			unspecified	
	UDP	-	specified	SEND/RECEIVE
Unspecified in NetPro (in unknown project)	TCP / ISO-on-TCP / ISO transport	active	specified (connection name in an other project)	SEND/RECEIVE
		passive		SEND/RECEIVE FETCH PASSIV WRITE PASSIV
	UDP	-		SEND/RECEIVE
All Broadcast stations	UDP	-	specified (Port, Broadcast addr.)	SEND
All Multicast stations	UDP	-	specified (Port, Multicast group)	SEND/RECEIVE

In the following each relevant parameters of the different connection types are described.

General information   In this tab the general connection parameters are listed, which identify the local connection end point.

ID   This entry is identical to the entry of the connection table. The value may always be changed. Please also regard to adjust the ID parameter of the call interface of the FC.

Note!

If a CP is exchanged by another one, this must at least provide the same services and must at least have the same version level. Only this can guarantee the connections configured via the CP to remain consistent and useable.

Name   This field contains the name of the connection. The name is generated by the system and may be changed on every time.

Via CP   Here is the CP listed, which should be used for connection. With the button
[Route]   [Route] the appropriate CP may be selected for communication.

Do not select the 1. CP of the route for communication connections. The 1. CP is always the Ethernet-PG/OP channel, which <u>does not</u> support configurable connections.

Active connection   If activated the connection to the partner is active established by the local
establishment   station. Here the partner is to be specified in the tab "Addresses".
At an unspecified connection the connection is passive established.

Block parameters   Here the parameters *ID* and *LADDR* for your user program are shown. Both are parameters, which are to be preset if you use the FC 5 and FC 6 (AG_SEND, AG_RECEIVE). Please always use the VIPA FCs, which you may receive from VIPA.

Addresses   The Addresses tab displays the relevant local and remote address information as proposed values. Depending on the kind of communication the address information may remain unspecified.

Ports   Ports res. port addresses are defining the access point to the user application within the station/CPU. These must be unambiguous. A port address should be within the range of 2000...65535. Remote and local ports may only be identical with one connection.

TSAP   ISO-on-TCP and ISO transport support TSAP lengths (**T**ransport **S**ervice **A**ccess **P**oint) of 1...16 byte. You may enter the TSAP in ASCII or hexadecimal format. The calculation of the length happens automatically.

Options   Dependent on the specification of the connecting partner the operating
                        mode may be set respectively displayed.

Mode   *SEND/RECEIVE*

                        The SEND/RECEIVE interface allows the program-controlled com-
                        munication to any partner station via a configured connection. Here the
                        data transfer happens by a call from your user application. The FC5 and
                        FC6 that are part of the VIPA block library are serving as interface.

                        This enables your control to send messages depending on process events.

                        FETCH/WRITE PASSIVE

                        With the help of FETCH/WRITE services partner systems have the direct
                        access to memory areas of the CPU. These are "passive" communication
                        connections that have to be configured. The connections are "actively"
                        established by the connection partner (e.g. Siemens-S5).

                        FETCH PASSIVE (request data)

                        FETCH allows a partner system to request data.

                        WRITE PASSIVE (write data)

                        This allows a partner system to write data in the data area of the CPU.

Overview   Here every configured connections of this station and its partner are
                        displayed. These data are information and may not be changed.

Note!

By appropriate shift respectively delete activities in the Siemens SIMATIC
manager connections may lose the allocation to the CP.
These connections are marked with "!" at ID of the overview.

Communication connections in the user program

Overview

For the execution of connection commands at the PLC, your CPU requires an user application. For this, exclusively the VIPA handling blocks are to be used, which you may get as library from VIPA.

More information about the deployment of the blocks may be found in the manual "Operation list" of the CPU.

Depending on the connection type there are blocks for Siemens *S7 connections* and *Send/Receive connections*.

In the following the proceeding with both connection types is described.

User program at Siemens S7 connections

Larger data sets may be transferred between PLC systems based on Siemens STEP®7 by means of Siemens S7 connections. Here the stations are to be linked by Ethernet.

Using remote functions with the appropriate function block you can control a CPU with another CPU and switch it e.g. to STOP.

The communication connections are static, this means they are to be configured by a connection table.

Communication functions

With the SPEED7 CPUs of VIPA there are two possibilities for the deployment of the communication functions:

- *Siemens S7-300 communication functions*

  By integration of the function blocks FB 8 ... FB 55 from VIPA you may access the Siemens S7-300 communication functions.

- *Siemens S7-400 communication functions*

  For the Siemens S7-400 communication functions the SFB 8 ... SFB 15 are to be used, which were integrated to the operating system of the CPU. Here copy the interface description of the SFBs from the standard library at system function block to the directory container, generate an instance data block for each call and call the SFB with the associated instance data block.

Configuring

Precondition for Siemens S7 communication is a configured connection table in which the communication links are defined. For this e.g. WinPLC7 from VIPA or NetPro from Siemens can be used. A communication link is specified by a connection ID for each communication partner. Use the *local ID* to initialize the FB/SFB in the PLC from which the connection is regarded and the *partner ID* to configure the FB/SFB in the partner PLC.

Function blocks   The following function blocks may be used for Siemens S7 communications. More information about the deployment of the blocks may be found in the manual "Operation list" of the CPU.

FB/SFB	Label	Description
FB/SFB 8	USEND	*Uncoordinated data transmission* FB/SFB 8 USEND may be used to transmit data to a remote partner FB/SFB of the type URCV (FB/SFB 9). You must ensure that parameter *R_ID* of both FB/SFBs is identical. The transmission is started by a positive edge at control input *REQ* and proceeds without coordination with the partner FB/SFB.
FB/SFB 9	URCV	*Uncoordinated data reception* FB/SFB 9 URCV can be used to receive data asynchronously from a remote partner FB/SFB of the type USEND (FB/SFB 8). You must ensure that parameter *R_ID* of both FB/SFBs is identical. The block is ready to receive then there is a logical 1 at the *EN_R* input. An active job can be cancelled with *EN_R*=0.
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. With this type of data transfer, more data can be transported between the communications partners than is possible with all other communication FBs/SFBs for configured S7 connections, namely 65534bytes.
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.
FB 55	IP_CONFIG	*Programmed Communication Connections* With this block you may flexible transfer data blocks with configuration data to the CP within the user program.

User program at   The following connections are Send/Receive connections:
Send/Receive
connections   • TCP (SEND-RECEIVE, FETCH-WRITE PASSIVE)

• ISO-on-TCP (SEND-RECEIVE, FETCH-WRITE PASSIVE)

• ISO Transport (SEND-RECEIVE, FETCH-WRITE PASSIVE)

• UDP (SEND-RECEIVE)

For the communication between CPU and CP, the following FCs are available:

AG_SEND (FC 5)

This block transfers the user data from the data area given in *SEND* to the CP specified via *ID* and *LADDR*. As data area you may set a PA, bit memory or data block area. When the data area has been transferred without errors, "order ready without error" is returned.

AG_RECV (FC 6)

The block transfers the user data from the CP into a data area defined via *RECV*. As data area you may set a PA, bit memory or data block area. When the data area has been transferred without errors, "order ready without error" is returned.

Note!

Please regard that you may only use the SEND/RECV-FCs from VIPA in your user application for the communication with VIPA-CPs. At a change to VIPA-CPs in an already existing project, the present AG_SEND/ AG_LSEND res. AG_RECV/AG_LRECV may be replaced by AG_SEND res. AG_RECV from VIPA without adjustment. Due to the fact that the CP automatically adjusts itself to the length of the data to transfer, the L variant of SEND res. RECV is not required for VIPA CPs.

Status displays   The CP processes send and receive commands independently from the CPU cycle and needs for this transfer time. The interface with the FC blocks to the user application is here synchronized by means of acknowledgements/receipts.

For status evaluation the communication blocks return parameters that may be evaluated directly in the user application.

These status displays are updated at every block call.

Deployment at   Do not use cyclic calls of the communication blocks in OB 1. This causes a
high communi-   permanent communication between CPU and CP. Program instead the
cation load   communication blocks within a time OB where the cycle time is higher res.
                         event controlled.

FC call is faster than CP transfer time

If a block is called a second time in the user application before the data of the last time is already completely send res. received, the FC block interface reacts like this:

AG_SEND

No command is accepted until the data transfer has been acknowledged from the partner via the connection. Until this you receive the message "Order running" before the CP is able to receive a new command for this connection.

AG_RECV

The order is acknowledged with the message "No data available yet" as long as the CP has not received the receive data completely.

AG_SEND, AG_RECV in the user application

The following illustration shows a possible sequence for the FC blocks together with the organizations and program blocks in the CPU cycle:
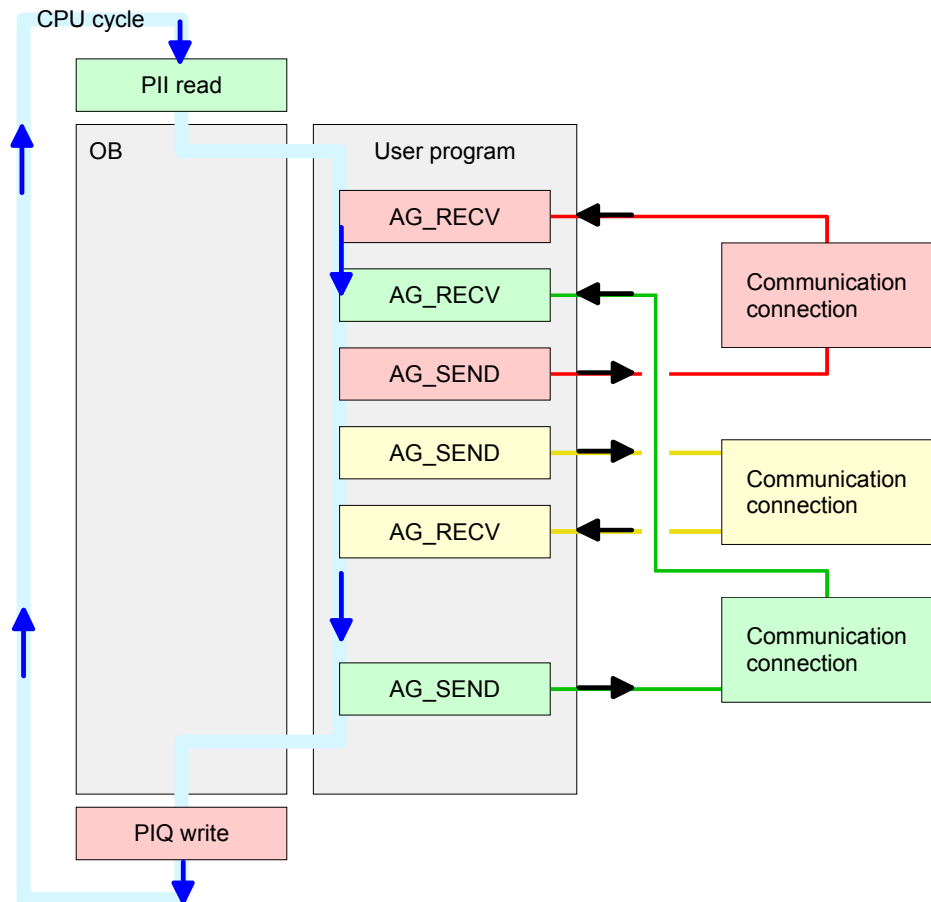
The FC blocks with concerning communication connection are summed up by color. Here you may also see that your user application may consist of any number of blocks. This allows you to send or receive data (with AG_SEND res. AG_RECV) event or program driven at any wanted point within the CPU cycle.

You may also call the blocks for **one** communication connection several times within one cycle.

AG_SEND (FC 5)   By means of AG_SEND the data to send are transferred to the CP.

Parameter

Parameter	Declaration	Type	Description
ACT	Input	BOOL	Activation of the sender 0: Updates DONE, ERROR and STATUS 1: The data area defined in SEND with the length LEN is send
ID	Input	INT	Connection number 1 ... 16 (identical with ID of NetPro)
LADDR	Input	WORD	Logical basic address of the CP (identical with LADDR of NetPro)
SEND	Input	ANY	Data area
LEN	Input	INT	Number of bytes from data area to transfer
DONE	Output	BOOL	Status parameter for the order 0: Order running 1: Order ready without error
ERROR	Output	BOOL	Error message 0: Order running (at DONE = 0) 0: Order ready without error (at DONE = 1) 1: Order ready with error
STATUS	Output	WORD	Status message returned with DONE and ERROR. More details are to be found in the following table.

AG_RECV (FC 6)   By means of AG_RECV the data received from the CP are transferred to the CPU.

Parameter

Parameter	Declaration	Type	Description
ID	Input	INT	Connection number 1 ... 16 (identical with ID of NetPro)
LADDR	Input	WORD	Logical basic address of the CP (identical with LADDR of NetPro)
RECV	Input	ANY	Data area for the received data
NDR	Output	BOOL	Status parameter for the order 0: Order running 1: Order ready data received without error
ERROR	Output	BOOL	Error message 0: Order running (at NDR = 0) 0: Order ready without error (at NDR = 1) 1: Order ready with error
STATUS	Output	WORD	Status message returned with NDR and ERROR. More details are to be found in the following table.
LEN	Output	INT	Number of bytes that have been received

DONE, ERROR, STATUS

The following table shows all messages that can be returned by the CP after a SEND res. RECV command.

A "-" means that this message is not available for the concerning SEND res. RECV command.

DONE (SEND)	NDR (RECV)	ERROR	STATUS	Description
1	-	0	0000h	Order ready without error
-	1	0	0000h	New data received without error
0	-	0	0000h	No order present
-	0	0	8180h	No data available yet
0	0	0	8181h	Order running
0	0	1	8183h	No CP project engineering for this order
0	-	1	8184h	System error
-	0	1	8184h	System error (destination data area failure)
0	-	1	8185h	Parameter LEN exceeds source area SEND
	0	1	8185h	Destination buffer (RECV) too small
0	0	1	8186h	Parameter ID invalid (not within 1 ...16)
0	-	1	8302h	No receive resources at destination station, receive station is not able to process received data fast enough res. has no receive resources reserved.
0	-	1	8304h	The connection is not established. The send command shouldn't be send again before a delay time of >100ms.
-	0	1	8304h	The connection is not established. The receive command shouldn't be send again after a delay time of >100ms.
0	-	1	8311h	Destination station not available under the defined Ethernet address.
0	-	1	8312h	Ethernet error in the CP
0		1	8F22h	Source area invalid, e.g. when area in DB not present Parameter LEN < 0
-	0	1	8F23h	Source area invalid, e.g. when area in DB not present Parameter LEN < 0
0	-	1	8F24h	Range error at reading a parameter.
-	0	1	8F25h	Range error at writing a parameter.
0	-	1	8F28h	Orientation error at reading a parameter.
-	0	1	8F29h	Orientation error at writing a parameter.
-	0	1	8F30h	Parameter is within write protected 1. recent data block
-	0	1	8F31h	Parameter is within write protected 2. recent data block
0	0	1	8F32h	Parameter contains oversized DB number.
0	0	1	8F33h	DB number error
0	0	1	8F3Ah	Area not loaded (DB)

continued...

... continue

DONE (SEND)	NDR (RECV)	ERROR	STATUS	Description
0	-	1	8F42h	Acknowledgement delay at reading a parameter from peripheral area.
-	0	1	8F43h	Acknowledgement delay at writing a parameter from peripheral area.
0	-	1	8F44h	Address of the parameter to read locked in access track
-	0	1	8F45h	Address of the parameter to write locked in access track
0	0	1	8F7Fh	Internal error e.g. invalid ANY reference e.g. parameter LEN = 0 .
0	0	1	8090h	Module with this module start address not present or CPU in STOP.
0	0	1	8091h	Module start address not within double word grid.
0	0	1	8092h	ANY reference contains type setting unequal BYTE.
-	0	1	80A0h	Negative acknowledgement at reading the module
0	0	1	80A4h	reserved
0	0	1	80B0h	Module doesn't recognize record set.
0	0	1	80B1h	The length setting (in parameter LEN) is invalid.
0	0	1	80B2h	reserved
0	0	1	80C0h	Record set not readable.
0	0	1	80C1h	The set record set is still in process.
0	0	1	80C2h	Order accumulation.
0	0	1	80C3h	The operating sources (memory) of the CPU are temporarily occupied.
0	0	1	80C4h	Communication error (occurs temporarily; a repetition in the user application is reasonable.)
0	0	1	80D2h	Module start address is wrong.

Status parameter at reboot At a reboot of the CP, the output parameters are reset as follows:

- DONE = 0

- NDR = 0

- ERROR = 8180h (at AG_RECV)
  ERROR = 8181h (at AG_SEND)

Project transfer Information about transferring a project may be found at chapter "Deployment CPU ..." at "Project transfer".

NCM diagnostic - Help for error diagnostic

Check list for error search

This page shall help you with the error diagnostic. The following page lists a number of typical problems and their probable causes:

Question	Solution with "no"
CPU in Run?	Control DC 24V voltage supply.
	Set RUN/STOP lever in position RUN.
	Check PLC program and transfer it again.
AG_SEND, AG_RECV in user application?	These 2 blocks are required in the user application for the data transfer between CP and CPU. Both blocks must also be called with a passive connection.
Is CP able to connect?	Check Ethernet cable (at a point-to-point connection a crossed Ethernet cable is to be used).
	Check IP address.
Can data be transferred?	Check Port no. for read and write.
	Check source and destination areas.
	Check if the 2. CP is selected in the route.
	Enlarge the receive res. send buffer defined via the ANY pointer.
Is the complete data block sent at ISO-on-TCP?	Check the LEN parameter at AG_SEND.
	Set the receive res. send buffer defined via the ANY pointer to the required size.

Siemens NCM S7 diagnostic

The CP supports the Siemens NCM diagnostic tool. The NCM diagnostic tool is part of the Siemens SIMATIC manager. This tool delivers information about the operating state of the communication functions of the online CPs dynamically.

The following diagnostic functions are available:

- Check operating state at Ethernet
- Read the diagnostic buffer of the CP
- Diagnostic of connections

The following pages contain a short description of the NCM diagnostic. More details about the function range and for the deployment of the Siemens NCM diagnostic tool is to be found in the according online help res. the manual from Siemens.

Start NCM diagnostic

There are two options to start the diagnostic tool:

- Via *Windows-START menu > SIMATIC ... NCM S7 > Diagnostic*
- Within the project engineering res. the hardware configuration via the register "Diagnostic" in the "Property" dialog with [Execute].

Structure

The working surface of the diagnostic tool has the following structure:

The *navigation area* at the left side contains the hierarchical listed diagnostic objects. Depending on CP type and configured connections there is an adjusted object structure in the navigation area.

The *information area* at the right side always shows the result of the navigation function you chose in the *navigation area*.
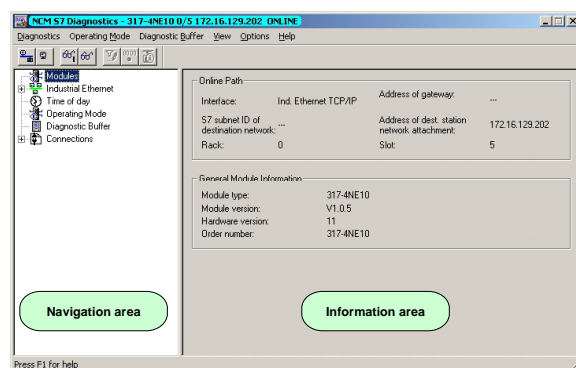
No diagnostic without connection

A diagnostic always requires an online connection to the CP you want to control. For this click at [icon] at the symbol bar. The following dialog window appears:
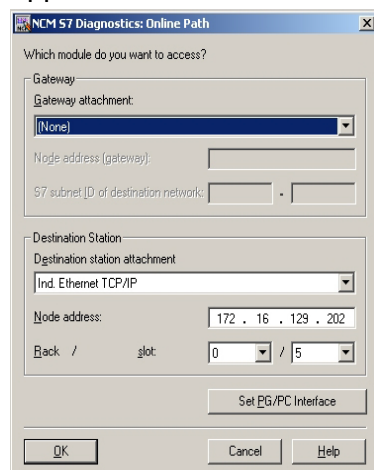
Set the following parameters at *destination station*:

Connection...: Ind. Ethernet TCP/IP

Station addr.: Enter the IP address of the CP

Module rack/slot:

Enter the *module rack* and *slot* of the CP 343 that you've placed at the 2. slot.

Set your PG/PC interface to TCP/IP...RFC1006. Via [OK] you start the online diagnostic.

Read diagnostic buffer

The CP has a diagnostic buffer. This has the architecture of a ring memory and may store up to 100 diagnostic messages. The NCM diagnostic allows you to monitor and evaluate the CP diagnostic messages via the diagnostic object *Diagnostic buffer*.

Via a double click on a diagnostic message the NCM diagnostic shows further information.

Approach for diagnostic

You execute a diagnostic by clicking on a diagnostic object in the navigation area. More functions are available via the menu and the symbol bar.

Note!

Please always control the preconditions for an operative communication using the check at the beginning of this chapter.

For the aimed diagnostic deployment the following approach is convenient:

• Start diagnostic.

• Open the dialog for the online connection with , enter connection parameters and establish the online connection with [OK].

• Identify the CP and check the recent state of the CP via module status.

• Check the connections for particularities like:
  - Connection status
  - Receive status
  - Send status

• Control and evaluate the diagnostic buffer of the CP via *diagnostic buffer*.

• As needed, alter project engineering res. programming and restart diagnostic.

Coupling to other systems

Overview

The operating mode FETCH/WRITE supported at TCP res. ISO-on-TCP can be used for accesses of partner devices to the PLC system memory. To be able to use this access also for example for implementation in PC applications you have to know the telegram structure for orders. The specific headers for request and acknowledgement telegrams have per default a length of 16Byte and are described at the following pages.

ORG format

The organization format is the abbreviated description of a data source or a data destination in a PLC environment. The available ORG formats are listed in the following table.

The ERW-identifier is used for the addressing of data blocks. In this case the data block number is entered into this identifier. The start address and quantity provide the address for the memory area and they are stored in HIGH-/LOW- format (Motorola-formatted addresses)

Description	Type	Range
ORG identifier	BYTE	1...x
ERW identifier	BYTE	1...255
Start address	HILOWORD	0...y
Length	HILOWORD	1...z

The following table contains a list of available ORG-formats. The "length" must not be entered as -1 (FFFFh).

ORG identifier 01h-04h

CPU area	DB	MB	EB	AB
ORG identifier	01h	02h	03h	04h
Description	Source/destination data from/into data Block in main memory.	Source/destination data from/into flag memory area	Source/destination data from/into process image of the inputs (PII).	Source/destination data from/into process image of the outputs (PIQ).
ERW identifier (DBNO)	DB, from where the source data is retrieved or to where the destination data is transferred.	irrelevant	irrelevant	irrelevant
Start address significance	DBB-No., from where the data is retrieved or where the data is saved.	MB-No., from where the data is retrieved or where the data is saved.	IB-No., from where the data is retrieved or where the data is saved.	QB-No., from where the data is retrieved or where the data is saved.
Length significance	Length of the source/destination data block in <u>words</u>	Length of the source/destination data block in bytes	Length of the source/destination data block in bytes	Length of the source/destination data block in bytes

> **Note!**
> Information about the valid range can be found at Chapter "Hardware description of the CPU".

ORG identifier 05h-0Ah

CPU area	PB	ZB	TB
ORG identifier	05h	06h	07h
Description	source/destination data from/into peripheral modules. Input module for source data, output module for destination data.	source/destination data from/into counter cells.	Source/destination data from/into timer cells.
ERW identifier (DBNO)	irrelevant	irrelevant	irrelevant
Start address Significance	PB-No., from where the data can be retrieved or where it is saved.	ZB-No., from where the data can be retrieved or where it is saved.	TB-No., from where the data can be retrieved or where it is saved.
Length Significance	Length of the source/destination data block in bytes.	Length of the source/destination data block in words (counter cell = 1 word).	Length of the source/destination data block in words (counter cell = 1 word).

Transfer of blocks with numbers >255

ORG identifier 81h-FFh

To transfer data blocks of the number range 256 ... 32768 you may use the ORG identifier 81h-FFh.

For the setting of a DB No. >255 needs a length of one word, the $DBNO_{new}$ is assembled from the content of the ORG identifier and the DBNO.

$DBNO_{new}$ is created as word as follows:

$DBNO_{new}$

High-Byte								Low-Byte							
1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

ORG identifier (0XXXXXXX)   DBNO (XXXXXXXX)
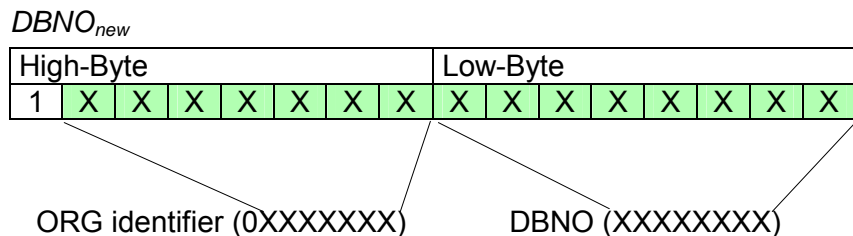
If the highest bit of the ORG identifier is set, the Low-Byte of $DBNO_{new}$ is defined via DBNO and the High-Byte of $DBNO_{new}$ via ORG identifier, where the highest bit of the ORG identifier is eliminated.

The following formula illustrates this:

$DBNO_{new} = 256 \times (ORG\text{-identifier AND } 7Fh) + DBNO$

Structure of PLC-Header

For every FETCH and WRITE the CP generates PLC header for request and acknowledgment messages. Normally the length of these headers is 16Bytes and have the following structure:

WRITE

Request telegram
Remote Station

System ID ="S5" (Word)		
Length Header	=10h	(Byte)
ID OP-Code	=01h	(Byte)
Length OP-Code	=03h	(Byte)
OP-Code	**=03h**	(Byte)
ORG block	=03h	(Byte)
Length ORG block	=08h	(Byte)
*ORG identifier**		*(Byte)*
ERW identifier		*(Byte)*
Start address (Word)		
Length (Word)		
Empty block	=FFh	(Byte)
Length empty block	=02h	(Byte)
Data up to 64kByte (only if error no.=0)		

Acknowledgement telegram CP

System ID ="S5" (Word)		
Length Header	=10h	(Byte)
ID OP-Code	=01h	(Byte)
Length OP-Code	=03h	(Byte)
OP-Code	**=04h**	(Byte)
Ackn. block	=0Fh	(Byte)
Length Ack. block	=03h	(Byte)
Error no.		(Byte)
Empty block	=FFh	(Byte)
Length empty block	=07h	(Byte)
5 empty bytes attached		

FETCH

Request telegram
Remote Station

System ID ="S5" (Word)		
Length Header	=10h	(Byte)
ID OP-Code	=01h	(Byte)
Length OP-Code	=03h	(Byte)
OP-Code	**=05h**	(Byte)
ORG block	=03h	(Byte)
Length ORG block	=08h	(Byte)
*ORG identifier**		*(Byte)*
ERW identifier		*(Byte)*
Start address (Word)		
Length (Word)		
Empty block	=FFh	(Byte)
Length empty block	=02h	(Byte)

Acknowledgement telegram CP

System ID ="S5" (Word)		
Length Header	=10h	(Byte)
ID OP-Code	=01h	(Byte)
Length OP-Code	=03h	(Byte)
OP-Code	**=06h**	(Byte)
Ackn. block	=0Fh	(Byte)
Length Ackn. block	=03h	(Byte)
Error no.		(Byte)
Empty block	=FFh	(Byte)
Length empty block	=07h	(Byte)
5 empty bytes attached		
Data up to 64kByte (only if error no.=0)		

*) More details to the data area is to be found at "ORG-Format" above.

Note!

Please regard that in opposite to Siemens-S5 systems, the block addressing of these CPUs takes the start address as byte number and the length as number of words.

Messages of error no.

The following messages can be returned via *error no.*:

Error no.	Message
00h	No error occurred
01h	The defined area cannot be read res. written

Chapter 8   WinPLC7

Overview   In this chapter the programming and simulation software WinPLC7 from VIPA is presented. WinPLC7 is suited for every with Siemens STEP$^{®}$7 programmable PLC.

Besides the system presentation and installation here the basics for using the software is explained with a sample project.

More information concerning the usage of WinPLC7 may be found in the online help respectively in the online documentation of WinPLC7.

System presentation

General

WinPLC7 is a programming and simulation software from VIPA for every PLC programmable with Siemens STEP$^{®}$7.

This tool allows you to create user applications in FBD, LAD and STL.

Besides of a comfortable programming environment, WinPLC7 has an integrated simulator that enables the simulation of your user application at the PC without additional hardware.

This "Soft-PLC" is handled like a real PLC and offers the same error behavior and diagnosis options via diagnosis buffer, USTACK and BSTACK.

Note!

Detailed information and programming samples may be found at the online help respectively in the online documentation of WinPLC7.

Alternatives

There is also the possibility to use the Siemens SIMATIC manager instead of WinPLC7 from VIPA. Here the proceeding is part of this manual.

System requirements

- Pentium with 233MHz and 64Mbyte work space
- Graphics card with at least 16bit color - we recommend a screen resolution of at least 1024x768 pixel.
- Windows 98SE/ME, Windows 2000, Windows XP (Home and Professional), Windows Vista

Source

You may receive a *demo version* from VIPA. Without any activation with the *demo version* the CPUs 11x of the System 100V from VIPA may be configured.

To configure the SPEED7 CPUs a license for the "profi" version is necessary. This may be online received and activated.

There are the following sources to get WinPLC7:

Online

At www.vipa.de in the service area at *Downloads* a link to the current demo version and the updates of WinPLC7 may be found.

CD

Order no.	Description
SW211C1DD	WinPLC7 Single license, CD, with documentation in german
SW211C1ED	WinPLC7 Single license, CD, with documentation in english
SW900T0LA	ToolDemo VIPA software library free of charge respectively demo versions, which may be activated

Installation

Preconditions   The project engineering of a SPEED7 CPU from VIPA with WinPLC7 is only possible using an activated "Profi" version of WinPLC7.

Installation WinPLC7 Demo

The installation and the registration of WinPLC7 has the following approach:

- For installation of WinPLC7 start the setup program of the corresponding CD respectively execute the online received exe file.
- Choose the according language.
- Agree to the software license contract.
- Set an installation directory and a group assignment and start the installation.

Activation of the "Profi" version

- Start WinPLC7. A "Demo" dialog is shown.
- Press the <q> key. The following dialog for activation is shown:
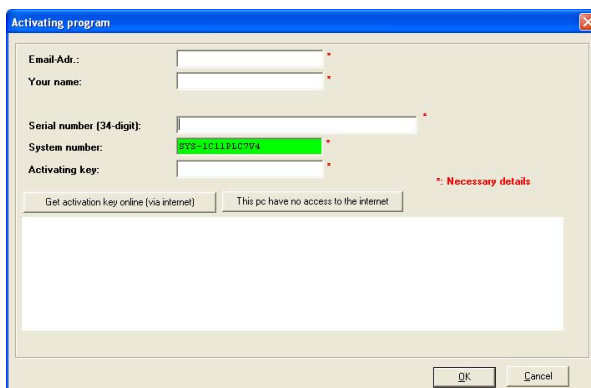
- Fill in the following fields:
  Email-Addr., *Your Name* und *Serial number*. The serial number may be found on a label at the CD case.
- If your computer is connected to Internet you may online request the *Activation Key* by [Get activation key via Internet]. Otherwise click at [This PC has no access to the internet] and follow the instructions.
- With successful registration the activation key is listed in the dialog window respectively is sent by email.
- Enter the activation key and click to [OK]. Now, WinPLC7 is activated as "Profi" version.

Installation of WinPCAP for station search via Ethernet

To find a station via Ethernet (accessible nodes) you have to install the WinPCAP driver. This driver may be found on your PC in the installation directory at WinPLC7-V4/WinPcap_4_0.exe.
Execute this file and follow the instructions.

Example project engineering

Job definition In the example a FC 1 is programmed, which is cyclically called by the OB 1. By setting of 2 comparison values (*value1* and *value2*) during the FC call, an output of the PLC-System should be activated depending on the comparison result.

Here it should apply:

if *value1* = *value2* activate output Q 124.0

if *value1* > *value2* activate output Q 124.1

if *value1* < *value2* activate output Q 124.2

Precondition
- You have administrator rights for your PC.
- WinPLC7 is installed and activated as "Profi" version.
- One CPU and one digital output module are installed and cabled.
- The Ethernet PG/OP channel of the CPU is connected to your Ethernet network. Your CPU may be connected to your PC with an Ethernet cable either directly or via hub/switch.
- WinPCap for station search via Ethernet is installed.
- The power supply of the CPU and the I/O periphery are activated and the CPU is in STOP state.

Project engineering
- Start WinPLC7 ("Profi" version)
- Create and open a new project by **File** > *Open/create a project*.

Hardware configuration
- For the call of the hardware configurator it is necessary to set WinPLC7 from the *Simulator*-Mode to the *Offline*-Mode. For this and the communication via Ethernet set "Target: TCP/IP Direct".
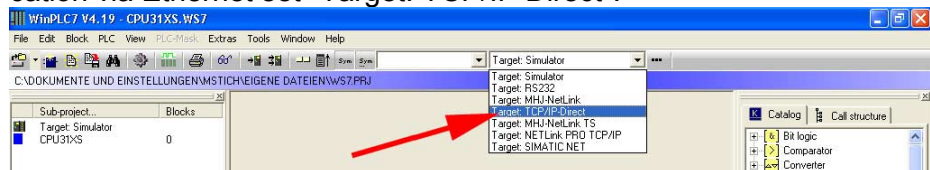
- Start the hardware configurator with . Please regard an object is selected with a double click at an object in the hardware configurator.
- Choose in the register *Select PLC-System* the parameter "VIPA SPEED7" and click to [Create]. A new station is created.
- Save the empty station. A station name and a comment may be entered before saving.
- By double click choose the according VIPA CPU in the hardware catalog at CPU SPEED7.
- For output place a digital output module and assign the start address 124.
- Save the hardware configuration.

Online access via
Ethernet PG/OP
channel

- Open the *CPU-Properties*, by double clicking to the CPU at slot 2 in the hardware configurator.
- Click to the button [Ethernet CP-Properties (PG/OP-channel)]. The *Properties CP343* is opened.
- Chose the register *Common Options*.
- Click to [Properties Ethernet].
- Choose the subnet "PG_OP_Ethernet".
- Enter a valid IP address-and a subnet mask. You may get this from your system administrator.
- Close every dialog window with [OK].
- Select, if not already done, "Target: External TCP/IP direct".
- Open with **Online** > *Send configuration to the CPU* a dialog with the same name.
- Click to [Accessible nodes]. Please regard to use this function it is necessary to install WinPCap before!
- Choose your network card and click to [Determining accessible nodes]. After a waiting time every accessible station is listed. Here your CPU with IP 0.0.0.0 is listed, too. To check this the according MAC address is also listed. This MAC address may be found at a label beneath the front flap of the CPU.
- For the temporary setting of an IP address select you CPU and click to [Temporary setting of the IP parameters]. Please enter the same IP parameters, you configured in the CPU properties and click to [Write Parameters].
- Confirm the message concerning the overall reset of the CPU. The IP parameters are transferred to the CPU and the list of accessible stations is refreshed.
- Select you CPU and click to [Confirm]. Now you are back in the dialog "Send configuration".

Transfer hardware
configuration

- Choose your network card and click to [Send configuration]. After a short time a message is displayed concerning the transfer of the configuration is finished.

Note!

Usually the online transfer of the hardware configuration happens within the hardware configurator.

With **File** > *Save active station in the WinPL7 sub project* there is also the possibility to store the hardware configuration as a system file in WinPLC7 to transfer it from WinPLC7 to the CPU.

The hardware configuration is finished, now and the CPU may always be accessed by the IP parameters as well by means of WinPLC7.

Programming of the FC 1	The PLC programming happens by WinPLC7. Close the hardware configurator and return to your project in WinPLC7.

The PLC program is to be created in the FC 1.

Creating block FC 1	• Choose **File** > *Create new block*.

• Enter "FC1" as block and confirm with [OK]. The editor for FC 1 is called.

Creating parameters	In the upper part of the editor there is the *parameter table*. In this example the 2 integer values *value1* und *value2* are to be compared together. Since both values are read only by the function, these are to be defined as "in".

• Select the "in   -->" row at the *parameter table* and enter at the field *Name* "value1". Press the [Return] key. The cursor jumps to the column with the data type.

• The data type may either directly be entered or be selected from a list of available data types by pressing the [Return] key. Set the data type to INT and press the [Return] key. Now the cursor jumps to the *Comment* column.

• Here enter "1. compare value" and press the [Return] key. A new "in -->" row is created and the cursor jumps to *Name*.

• Proceed for *value2* in the same way as described for *value1*.

• Save the block.

The parameter table shows the following entries, now:

Enter the program	As requested in the job definition, the corresponding output is activated depending on the comparison of *value1* and *value2*. For each comparison operation a separate network is to be created.

• The program is to be created as FBD (function block diagram). Here change to the FBD view by clicking at FBD.
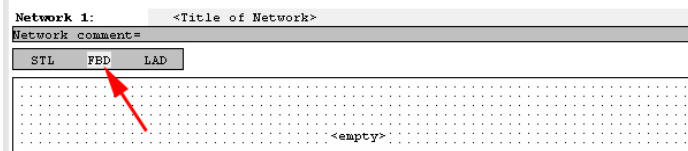
• Click to the input field designated as "empty".
The available operations may be added to your project by drag&drop from the hardware catalog or by double click at them in the hardware catalog.

- Open in the catalog the category "Comparator" and add the operation "CMP==I" to your network.
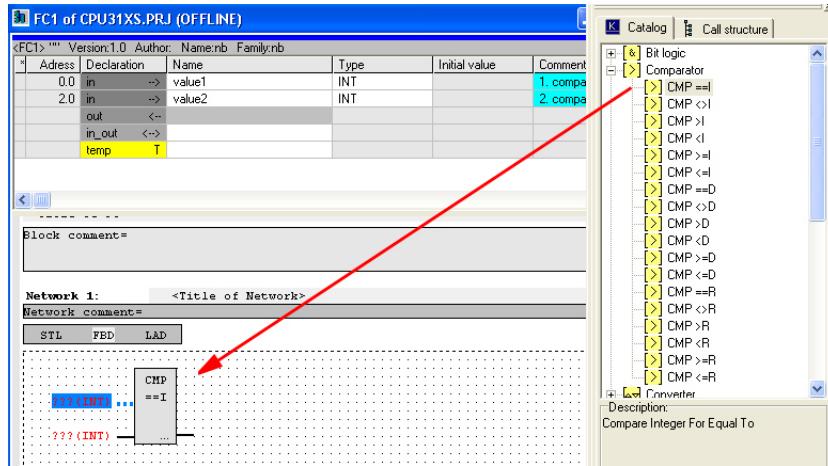
- Click to the input left above and insert *value1*. Since these are block parameters a selection list of block parameters may be viewed by entering "#".

- Type in "#" and press the [Return] key.

- Choose the corresponding parameter and confirm it with the [Return] key.

- Proceed in the same way with the parameter *value2*.

The allocation to the corresponding output, here Q 124.0, takes place with the following proceeding:

- Click to the output at the right side of the operator.
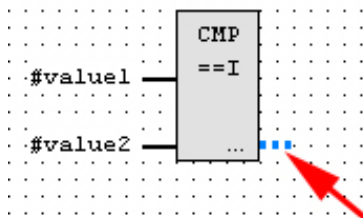
- Open in the catalog the category "Bit logic" and select the function "--[=]". The inserting of "--=" corresponds to the WinPLC7 shortcut [F7].

- Insert the output Q 124.0 by clicking to the operand.
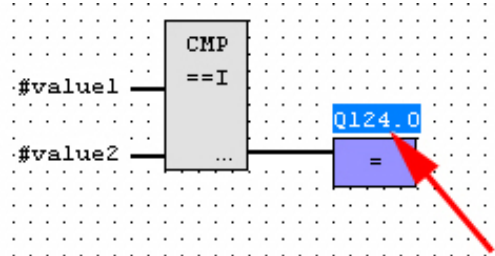
Network1 is finished, now.

Adding a new
network

For further comparisons the operations "CMP>I" at Q 124.1 and "CMP<I" at Q 124.2 are necessary. Create a network for both operations with the following proceeding:

- Move your mouse at an arbitrary position on the editor window and press the right mouse key.
- Select at the context menu "Insert new network". A dialog field is opened to enter the position and number of the networks.
- Proceed as described for "Network 1".
- Save the FC 1 with **File** > *Save content of focused window* respectively press [Strg]+[S].

After you have programmed the still missing networks, the FC 1 has the following structure:
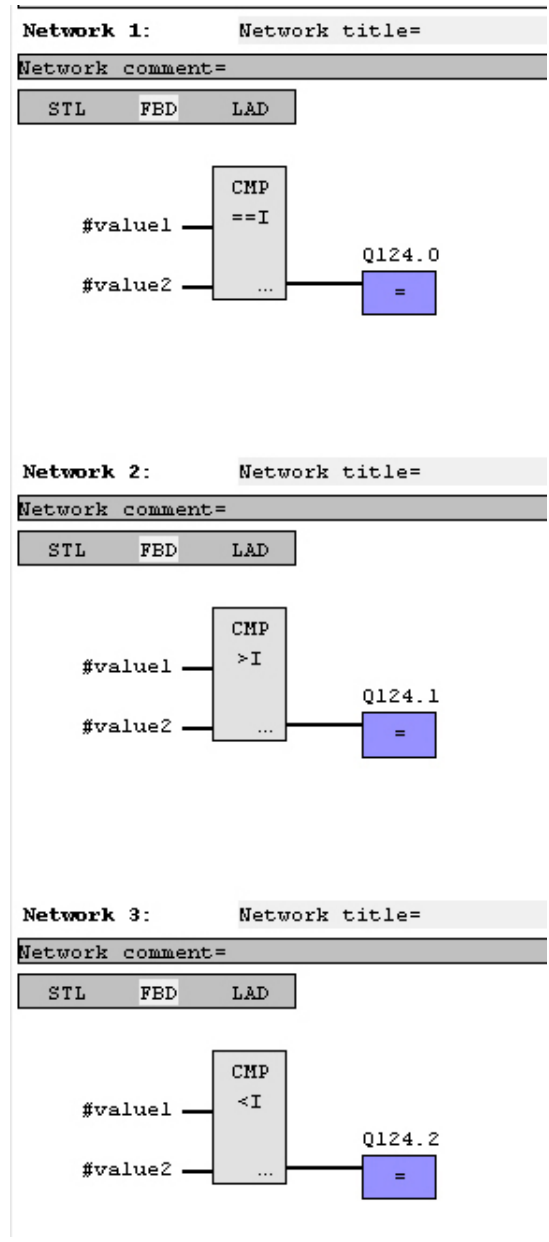
Creating the block OB 1

The FC 1 is to be called from the cycle OB 1.

- To create the OB 1 either you select **File** > *Create new block* or click to button [Display OB 1] and create the OB 1.
- Change to the STL view.
- Type in "Call FC 1" and press the [Return] key. The FC parameters are automatically displayed and the following parameters are assigned:

- Save the OB 1 with **File** > *Save content of focused window* respectively *press* [Strg]+[S].

Test the PLC program in the *Simulator*

With WinPLC7 there is the possibility to test your project in a *simulator*.

- Here select "Target: Simulator".

- Transfer the blocks to the simulator with **PLC** > *Send all* blocks.
- Switch the CPU to RUN, by clicking to the photo "Switch/Operating mode" and select in the dialog window the button [Warm restart]. The displayed state changes from STOP to RUN.
- To view the process image select **View** > *Display process image window*.
- Double click to the process image and enter at "Line 2" the address PQB124. Confirm with [OK]. A value marked by red color corresponds to a logical "1".
- Open the OB 1 with the button [Display OB 1].
- Change the value of one variable, save the OB 1 and transfer it to the simulator. According to your settings the process image changes immediately. The status of your blocks may be displayed with **Block** > *Monitoring On/Off*.

Visualization via
PLC mask

A further component of the simulator is the *PLC mask*. Here a CPU is graphically displayed, which may be expanded by digital and analog peripheral modules.

As soon as the CPU of the simulator is switched to RUN state, inputs may be activated by mouse and outputs may be displayed.

- Open the PLC mask with **view** > *PLC mask*. A CPU is graphically displayed.

- By clicking the right mouse button within the PLC mask the context menu is opened. Choose for this example "Insert 16-port digital input module". The module is displayed at the right side of the CPU.

- Double-click to the output module, open its properties dialog and enter the *Module address* 124.

- Switch the operating mode switch to RUN by means of the mouse. Your program is executed and displayed in the simulator, now.
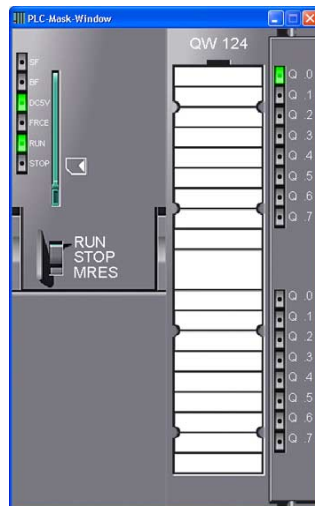
Transfer PLC program to CPU and its execution

- For transfer to the CPU set the transfer mode to "Target: TCP/IP-Direct".

- For presetting the Ethernet data click to [...] and click to [Accessible nodes].

- Choose your network card and click to [Determining accessible nodes]. After a waiting time every accessible station is listed.

- Choose your CPU, which was provided with TCP/IP address parameters during the hardware configuration and click to [Confirm].

- Close the "Ethernet properties" dialog with [OK].

- Transfer the blocks to your CPU with **PLC** > *Send all blocks*.

- Switch your CPU to RUN state.

- Open the OB 1 with the button [Display OB 1].

- Change the value of one variable, save the OB 1 and transfer it to the CPU. According to your settings the process image changes immediately. The status of your blocks may be displayed with **Block** > *Monitoring On/Off*.

Appendix

A Index

M.Stich