Manual

VIPA CP443

Order-no.: VIPA HB102E

Rev. 01/35

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The contents of this manual were verified with respect to the hard- and software.

However, we assume no responsibility for any discrepancies or errors. The information in this manual is verified on a regular basis and any required corrections will be included in subsequent editions.

Suggestions for improvement are always welcome.

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About this manual

This manual describes the utilization and application of the communication processor CP443 in a Siemens S7-400. Here you can read about the hardware, the configuration as well as the integrated functions and applications on a network.

Overview

Chapter 1: Principles

This chapter contains a collection of the basic information that is required to use the module successfully.

In addition to details on possible applications for the module this chapter also provides an overview of the mode of operation of the CP.

Chapter 2: Hardware description

This chapter concentrates on the description of the hardware components of the CP443. In addition to the system properties the chapter also contains the technical data of the module.

Chapter 3: Twisted Pair networks

This chapter describes the structure of Twisted Pair networks. This includes networking components as well as details of the TCP/IP protocol.

The chapter is concluded by a set of notes on the planning of a network and a summary of the applicable standards.

Chapter 4: CP443 applications

This chapter contains information pertaining to practical applications of the CP443. The project design and integration with the PLC are described by means of examples.

The chapter also contains the steps required for commissioning and the use of the PG functions.

Chapter 5: Handler functions and communications

This chapter contains a description of the handler functions and the communication modules that are supplied as with the CP443.

The chapter also contains information on the analysis of the indicator word and the configuration error byte (PAFE).

Contents

User considerations

Objective and contents

This manual describes the VIPA CP443 communication processor. It contains a description of the construction, project implementation and the application of the product.

The CP443 is compatible with the Siemens S7-400 Rack.

Target audience

The manual is targeted at users who have a background in automation technology and PLC-programming.

Structure of the manual

The manual consists of 5 chapters. Every page 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.

ℹ

Note!

Supplementary information and useful tips

Safety information

Applications conforming with specifications

The CP443 module is constructed and produced for

- applications in a Siemens S7-400 Rack
- communication and process control
- industrial applications
- operation within the environmental conditions specified in the technical data
- installation into a cubicle

Danger!
This device is not certified for applications in

- in explosive environments (EX-zone)

Documentation

The manual must be available to all personnel in the

- project design department
- installation department
- commissioning
- operation

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 Principles

Outline

This introduction contains notes on the safe handling and information on possible applications and the respective environment for the CP443 module.

Below follows a description of:

- Safety information for users
- Construction and operation of the CP443 module
- Application areas and operation

Contents

Topic **Page**

Ordering information

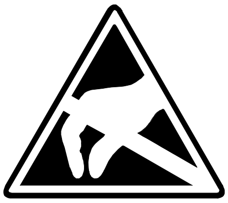
Type	Order number	Description
CP443	VIPA 443-1VX00	Communication processor TCP/IP, 10/100MBit, diagnostic LCD, 4-port hub
CP443WEB	VIPA 443-1VX10	Communication processor TCP/IP, 10/100MBit, diagnostic LCD, 4-port hub, PS2 ports for keyboard, mouse and DVI

Safety information for users

Handling of electrostatically 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 electrostatically sensitive equipment.

It is possible that electrostatically 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 electrostatically sensitive modules and they can damage components thereby causing the module to become inoperable or unusable.

Modules that have been damaged by electrostatic discharge are usually not detected immediately. The respective failure can only become apparent after a period of operation.

Components damaged by electrostatic discharges can fail after a temperature change, mechanical shock or changes in the electrical load.

Only the consistent implementation of protective devices and meticulous attention to the applicable rules and regulations for handling the respective equipment can prevent failures of electrostatically sensitive modules.

Shipping of modules

Modules must be shipped in the original packing material.

Measurements and alterations on electrostatically sensitive modules

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

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

You should only use soldering irons with grounded tips when you are making modifications on electrostatically sensitive modules.

Attention!

Personnel and instruments should be grounded when working on electrostatically sensitive modules.

General information on the CP443

VIPA Library of blocks for the integration in PLCs

You can integrate the CP via Siemens STEP$^{®}$7 into the PLC environment by means of the VIPA function library that is supplied with the module.

Configuration of the communica-tion environment by means of WinNCS

You can configure the communication properties of the CP by means of the VIPA configuration tool WinNCS that provides a user-friendly method of configuring the TCP/IP properties.

Integrated display for diagnostics and mode of operation

The current CP443 module does not have an LCD display. The LCD display is being developed and will be integrated with the modules that are available in the near future.

The Display will provide you with extensive diagnostic and operating facilities. You will be able to control the Display by means of push buttons that are located below the Display.

Versions

At present two versions of the CP443 are available.

- **CP443** Order-no.: VIPA 443-1VX00
  Communication processor TCP/IP, 10/100MBit, 4-port hub, diagnostic LCD (under development)
- **CP443WEB** Order-no.: VIPA 443-1VX10
  Communication processor TCP/IP, 10/100MBit, 4-port hub, PS2 ports for mouse & keyboard, DVI, diagnostic LCD (under development)

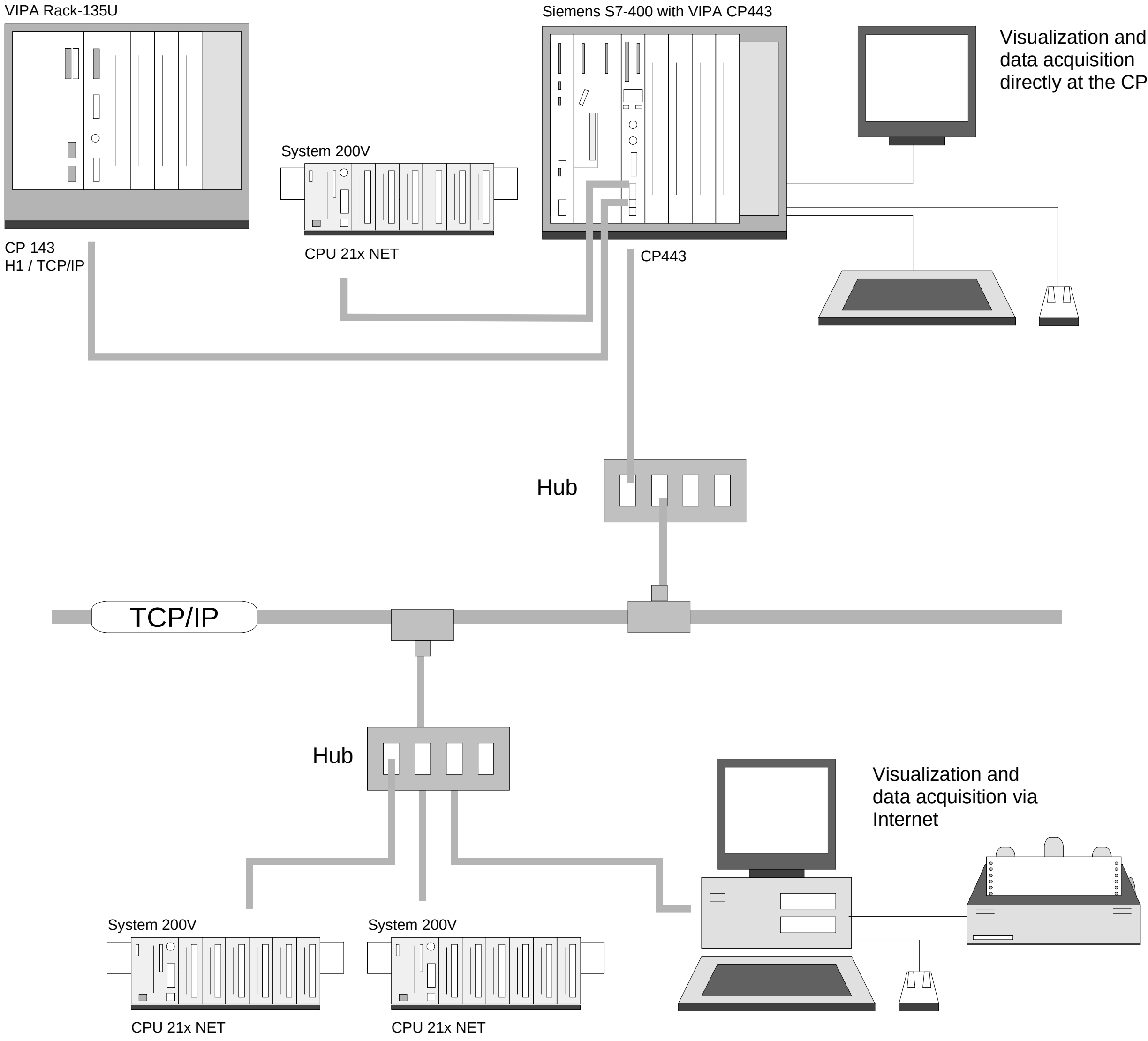
CP443

CP443WEB

Applications

The CP443 provides process interfacing options to a Siemens S7-400 via Ethernet. You can use standardized programs and commands to interrogate sensors, transfer measured values and create complex visualisations for the PLCs or for the links between the PLC and the PC.

With the use of the TCP/IP protocol you can also use the Internet for this purpose.


VIPA Rack-135U
Siemens S7-400 with VIPA CP443
Visualization and data acquisition directly at the CP443
System 200V
CP 143
H1 / TCP/IP
CPU 21x NET
CP443
Hub
TCP/IP
Hub
Visualization and data acquisition via Internet
System 200V
System 200V
CPU 21x NET
CPU 21x NET

Operation

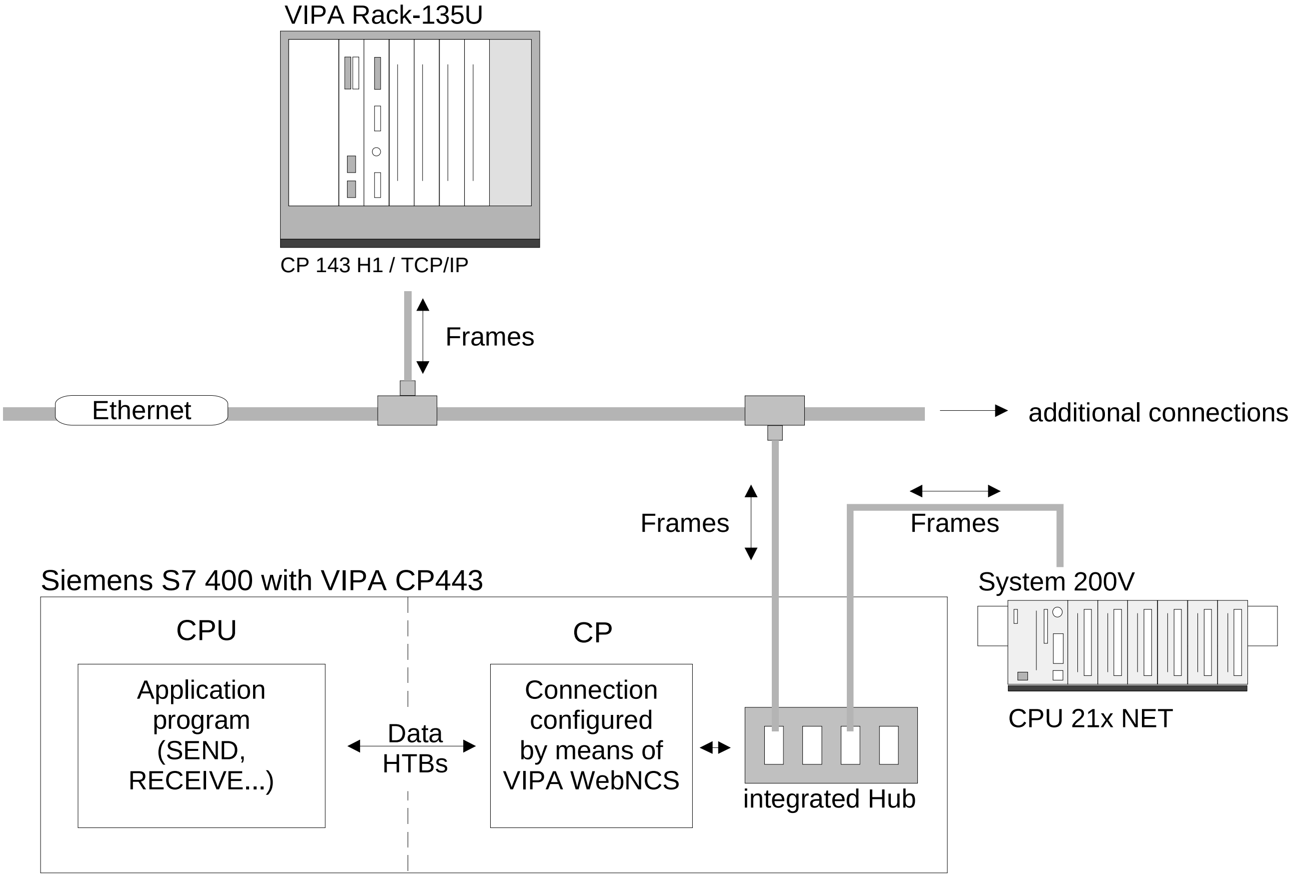
The CP443 is inserted directly into the Siemens S7-400-Rack.

The CPU and the CP443 communicate via the back-panel bus using 4 page frames. The page frames are available on the CPU as standard CP-Interface. The data is exchanged by means of handler blocks (SEND, RECEIVE ...) that are supplied in a function library.

Network communications controls those links that are configured by means of the VIPA configuration tool WinNCS. These are transferred into the CP443 via the network. The IP address of the CP443 is used for identification purposes.

The CP443 controls the exchange of data via the network thereby reducing the load on the CPU. This covers all the layers of the ISO-OSI model.

The integriated hub of the CP443 can be used to connect up to 3 additional Ethernet stations.



Chapter 2 Hardware description

Overview

The CP443 is available in different versions that are described in this chapter.

Additional notes on available system extension and -restrictions are located under "System properties".

A summary of the technical data concludes the chapter.

The following section contains descriptions of:

- the components of the CP443 along with controls and displays
- system properties
- technical data

Contents

Topic **Page**

System overview

CP443

CP443WEB

Ordering details

Type	Order number	Description
CP443	VIPA 443-1VX00	Communication processor TCP/IP, 10/100MBit, diagnostic LCD, 4-porth hub
CP443WEB	VIPA 443-1VX10	Communication processor TCP/IP, 10/100MBit, diagnostic LCD, 4-porth hub, PS2 port for keyboard & mouse, DVI

General

Application areas

The CP443 is suitable for installation in the Siemens S7-400 system and it is integrated in your system by means of the Siemens STEP®7 manager. The module is supplied with an extensive function library.

The configuration on the CP is performed by means of the VIPA project configuration tool WinNCS from version 3.

DiskOnChip to store configuration data

The CP contains a DiskOnChip drive (DOC) for storage and retrieval of configurations.

CompactFlash

In this version the CompactFlash slot is used exclusively for firmware updates.

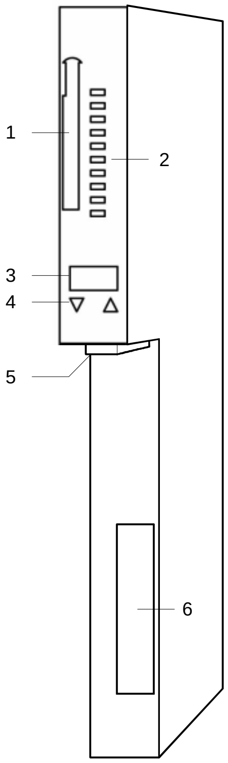
In the future the CompactFlash will also be used as an external memory. You can obtain CompactFlash memory from VIPA.

Properties

- Mini-Hub 4x RJ45 (10/100 Mbit/s)
- COM-port for configuration and commissioning
- Reduced bus load due to the use of event-controlled communications (IPK)
- PG functionality
- Up to a max. of 100 connections are possible
- Passive FETCH, WRITE and IPK functions are supported by the connections
- SEND and RECEIVE via job no’s
- User-friendly commissioning by means of VIPA WinNCS
- 2x Mini-DIN and 1x DVI interface for servicing and for future extensions have been integrated (only VIPA 443WEB)
- The unit has been prepared for the integration of an LCD display for user-friendly diagnostics and status displays

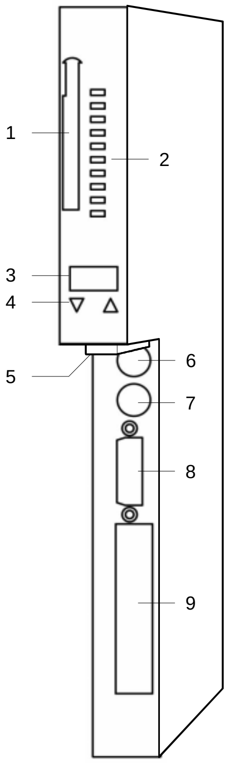
Construction

Construction CP443



[1] Slot for memory module
[2] LED indicator
[3] LCD display
[4] Navigation buttons for LED display
[5] COM port / RS 232
[6] 4-port RJ 45-mini hub

Construction CP443WEB



[1] Slot for memory module
[2] LED indicator
[3] LCD display
[4] Navigation buttons for LED display
[5] COM port / RS 232
[6] Mini-DIN for a keyboard
[7] Mini-DIN for a mouse
[8] DVI interface
[9] 4-port RJ 45-mini hub

Components

CP443

LEDs

The CPs have different LEDs that are used to display the status of the program being executed. The purpose and the respective color of the diagnostic LEDs is explained by the following table.

Pos.	Name	Color	Description
1	RN	green	CP in RUN mode
2	ST	red	CP in STOP mode
3			
4			
5	Col 100	yellow	Collision when using 100MBit transfer rate
6	Col 10	yellow	Collision when using 10MBit transfer rate
7			
8	AC	yellow	blinks when data is being transferred (activity)
9	LN	yellow	ON when a physical network connection exists (link)
10	SP	green	ON when a 100Mbit network is detected (speed)

Slot for CompactFlash®

Here you can install a type II memory card.

At present we do not support CompactFlash® memory card. This slot is only used for updates to the firmware.

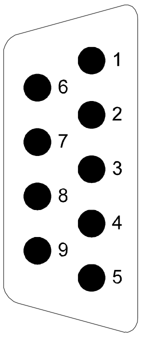
COM-port RS232C

The RS232C interface is addressed as COM 1 and it is restricted to data communications over a maximum distance of 15m at up to 57,6 KB. The interface communicates by means of data, signaling and control lines.

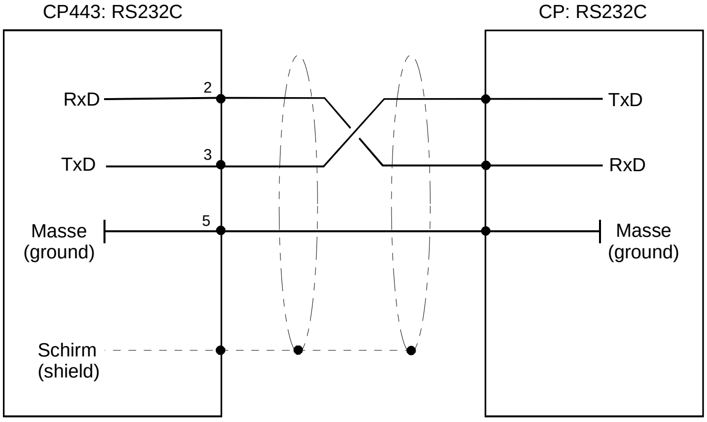
You require a null-modem cable for data communications between your PC and the CP.

The figure shows the connections that are required on the null-modem cable without hardware handshake:

if you intend to used the hardware handshake you must also link pins 4 and 6 and pins 7 and 8 on each side.

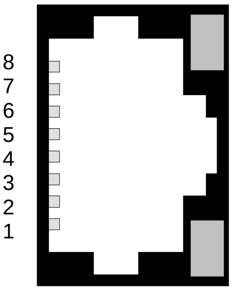


Pin	Assignment
1	DCD-
2	RXD
3	TXD
4	DTR-
5	GND
6	DSR-
7	RTS-
8	CTS-
9	RI-



RJ45 socket

Every RJ45 socket is configured as follows and the LEDs indicate the status shown:



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

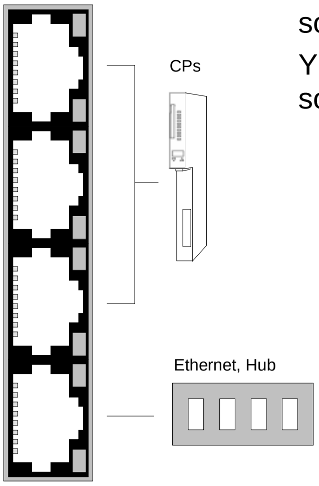
LED	
Ethernet activity (yellow)	ON when the Ethernet connection is active, blinks when data is being transferred
Speed (green)	ON when 100MBit transfer rate has been detected, otherwise the LED is off.

Mini-hub 4-port

The front of the CP contains a 4-port Mini-hub providing the twisted pair interface to the Ethernet network.

For an uplink port to additional hubs you must used the lowest RJ45 socket.

You can connect other CPs directly to the CP443 via the upper 3 RJ45 sockets.



CP443WEB

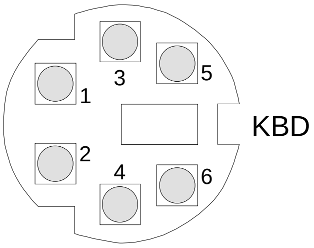
Additional the CP443WEB has interfaces for a keyboard, a mouse, and a monitor.

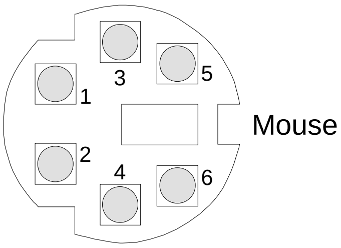
At present these are only used for service purposes at the time of commissioning. The CP does not support these interfaces at any other time.

In future these interfaces are intended for the control and the display of visualization programs.

KBD/MOUSE

The pin-assignment of the two Mini-DIN sockets is identical. Connect your keyboard to the socket labeled "KBD" and your mouse to the socket labeled "MOUSE".



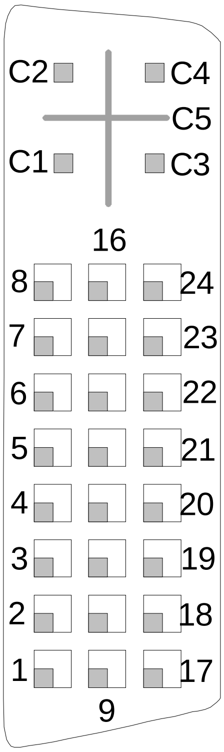


Pin	Assignment
1	+ KBD-Data (I/O)
2	reserved
3	GND
4	+5V
5	+ KBD-Clock (I/O)
6	reserved

DVI-interface

The DVI-socket is compatible with analog and digital displays or monitors with a max. resolution of 1280 x 1024 pixels.

The socket has the following Pin-assignment:



Pin	Signal
C1	Analog Red
C2	Analog Green
C3	Analog Blue
C4	Analog Horizontal Sync
C5	Analog RGB Return
1	T.M.D.S Data2-
2	T.M.D.S Data2+
3	T.M.D.S Data2/4 Shield
4	T.M.D.S Data4-
5	T.M.D.S Data4-
6	DDC Clock
7	DDC Data
8	Analog Vertical Sync
9	T.M.D.S Data1-
10	T.M.D.S Data1+
11	T.M.D.S Data1/3 Shield
12	T.M.D.S Data3-
13	T.M.D.S Data3+
14	+5V Power
15	Ground (return for +5V, HSync and VSync)
16	Hot Plug Detect
17	T.M.D.S Data0-
18	T.M.D.S Data0+
19	T.M.D.S Data0/5 Shield
20	T.M.D.S Data5-
21	T.M.D.S Data5+
22	T.M.D.S Clock Shield
23	T.M.D.S Clock+
24	T.M.D.S Clock-

System properties of the CP443

Note

The system properties of a CP must not be regarded as restrictions or interpreted as operational faults. The respective functionality was not possible or to the disadvantage of the overall system.

When the CP443 is turned on it requires a certain amount of time to start up. This start-up time is taken into account by the integrated SYNCHRON block.

System properties

- The default length (-1, 0xFFFF) is not permitted as entry for the ORG-format length, i.e. the user must define an exact length for the receive data.
- Jobs with a priority 0/1 can transmit and/or receive a maximum quantity of data as defined by the SYNCHRON-HTB. Jobs of this priority are not blocked. This results in a maximum data transfer rate of 512 bytes per job for a block-size of 255 (also refer to block-size).
- RECEIVE jobs that are mapped to the communication-type UDP cannot receive all data-messages from a fast cyclic transmitter. Messages that have not been received are discarded.
- A maximum of 128 connections are possible
- Passive FETCH-, WRITE and IPK functions for a single connection
- SEND and RECEIVE via a single job no.
- One UDP connection must have been specified, i.e. the local and the remote port must be defined!

The TCP/IP protocol stack has a global buffer-pool where the receive and transmit buffers are located. This is where system collisions can occur if:

- Data for a receive-job is not collected. After a period of time a lack of resources will occur and the other connections will terminate connections. It is only possible to re-establish proper communications when the receive buffers of one connection have been released (connection terminated) or when the data has been retrieved by means of RECEIVE.
- one or more cyclic stations place a load on a CP. When resource bottlenecks are encountered the CP can also initiate the termination of connections.
- a station transmits two or more messages and the receiver did not have a chance to accept them then the reception of the unknown data would cause collisions in the receiver. However, the CP prevents this. The PLC-application requires a defined size for the reception of data and the default or wild-card length is not permitted. The size of the receive stack of Prio1 - RECEIVE jobs is defined implicitly by the pre-defined block-size
- VIPA recommends the use of acknowledgment messages on the user-level to ensure that data transfers are 100 % safe.

Technical data

CP443
CP443WEB

Electrical data	VIPA CP443-1VX00 CP443	VIPA CP443-1VX10 CP443WEB
Supply voltage	5V DC	
Current consumption from 5V DC	2A typ.	
Dissipation	10 W	
Transmission rate	10/100 Mbit/s	
Interfaces		
Configuration	COM ports / RS 232	
Diagnostic	LCD display (under development)	
B+B / HMI	-	DVI-interface
Keyboard	-	1xMiniDIN
Mouse	-	1xMiniDIN
Mode of operation	LED indicators	
Ethernet/TCP/IP		
	4-port RJ 45-Mini HUB	
Operating conditions		
Operating temperature	0...+55°C	
Storage temperature	-40...70°C	
Relative humidity	95% max. (without condensation)	
Protection class	IP 20	
Dimensions and weight		
Enclosure	single width for Siemens S7-400	
Width x height x depth	25x290x210 mm	
Weight	ca. 750g	ca. 800g

Chapter 3 Twisted Pair networks

Overview

This chapter describes the Twisted Pair network technology. It provides basic information on the various networking components and details on the construction of Twisted Pair networks.

A summary of the applicable standards concludes the chapter.

The following section contains descriptions of:

- the components of Twisted Pair networks
- the principles of the TCP/IP protocol
- the structure of an IP address
- the basic principles applicable to the planning of a network
- Standards

Contents

Topic **Page**

The principles of Twisted Pair networks

Network

A network provides the communication link between the different stations that are connected to the network.

Network stations can consist of PCs, IPCs, TCP/IP boards, etc.

The different stations are connected to the networking cable separated by a minimum distance. The combination of stations and the networking cable represent a segment.

All the segments of a network combined are referred to as Ethernet (the physical 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 CP443 module has a twisted-pair connector.

The twisted pair cable consists of 4 cores that are twisted together in pairs. Due to these twists this system is provides an increased level of immunity to electrical interference.

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 hub/switch by means of a separate cable. The hub/switch provides the interface to the Ethernet.

Hub

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 with thin- and/or thick-Ethernet or to another hub.

Switch Hub

In addition to the standard functionality of a hub that provides the link between multiple stations on the network the switch hub provides the option to connect standard Ethernet (10MBit) stations to Fast Ethernet (100MBit) stations. Every port of the switch hub detects automatically whether a station operates at 10 or 100MBit.

The bridge-functionality of the switch hub reduces the load on the network. A point-to-point connection between two stations that are connected to the same switch hub communicates only via the switch hub. The remaining network is not used.

Access control

Ethernet supports the principle of random bus accesses: every station on the network accesses the bus independently as and when required. These accesses are coordinated by a CSMA/CD (Carrier Sense Multiple Access/Collision Detection) 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 us 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.

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 (TCP/IP implementations also exist for IBM-systems) and special processors like vector processors and parallel computers. For this reason TCP/IP is often used to assemble heterogeneous system pools.

TCP/IP can be employed to establish extensive open network solutions between the different business units of an enterprise.

For example, TCP/IP can be used for the following applications:

- centralized control and supervision of production plants
- transfer of the state of production machines
- management information
- production statistics
- the transfer of large quantities of data

TCP and IP only provide support for two of the protocols required for a complete architecture. Programs like " FTP " and " Telnet " are available for the application layer of the PC.

The application layer of the CP is defined by the application program using the standard handler blocks.

These application programs exchange data by means of the TCP or UDP protocols of the transportation layer. These communicate with the IP-protocol of the Internet layer.

IP (Internet Protocol)

The main purpose of IP is to provide the addressing to data packets. This means that IP has the same function as an envelope has for a letter. The address is used by the network to determine the destination and to route the data-packets accordingly.

The protocol divides the data into small portions since different networks use different size data packets.

A number is assigned to each packet. This is used to acknowledge reception and to reassemble the original data. To transfer these sequence numbers via the network TCP and IP is provided with a unique envelope where these numbers are recorded.

TCP (Transport Control Protocol)

A packet of data is inserted into a TCP-envelope. This is then inserted into an IP-envelope and transferred to the network. TCP provides for the secure transfer of data via network. TCP detects and corrects communication errors.

For this reason the TCP-connections are relatively safe.

UDP provides a much faster communication link. However, it does not cater for missing data packets, nor does it check the sequence of the packets. UDP is an unsecured protocol.

TCP/IP services

OPEN / CONNECT Opens a virtual connection to communication partner when the station is in active mode and waits for a connection from a communication partner in passive mode.

SEND Transfers a data buffer to TCP for transmission to a communication partner.

RECEIVE Receives data from a communication partner.

CLOSE Terminates a virtual connection.

Structure of an IP-address

The IP-address is a 32-bit address that must be unique on the network. The IP-address consists of 4 numbers that are separated by a full stop.

The IP address consists of the following elements: XXX.XXX.XXX.XXX

Range: 000.000.000.000 to 255.255.255.255

The broadcast address (message to all stations) is always:

255.255.255.255

Subnet masks

The IP-addressing range is filtered by means of masks. These are called subnet masks and consist of 32-bit addresses with the same structure as IP-addresses.

Subnet masks can be employed to limit access to certain addressing ranges.

IP-addresses and subnet masks are assigned by the network administrator.

Attention!

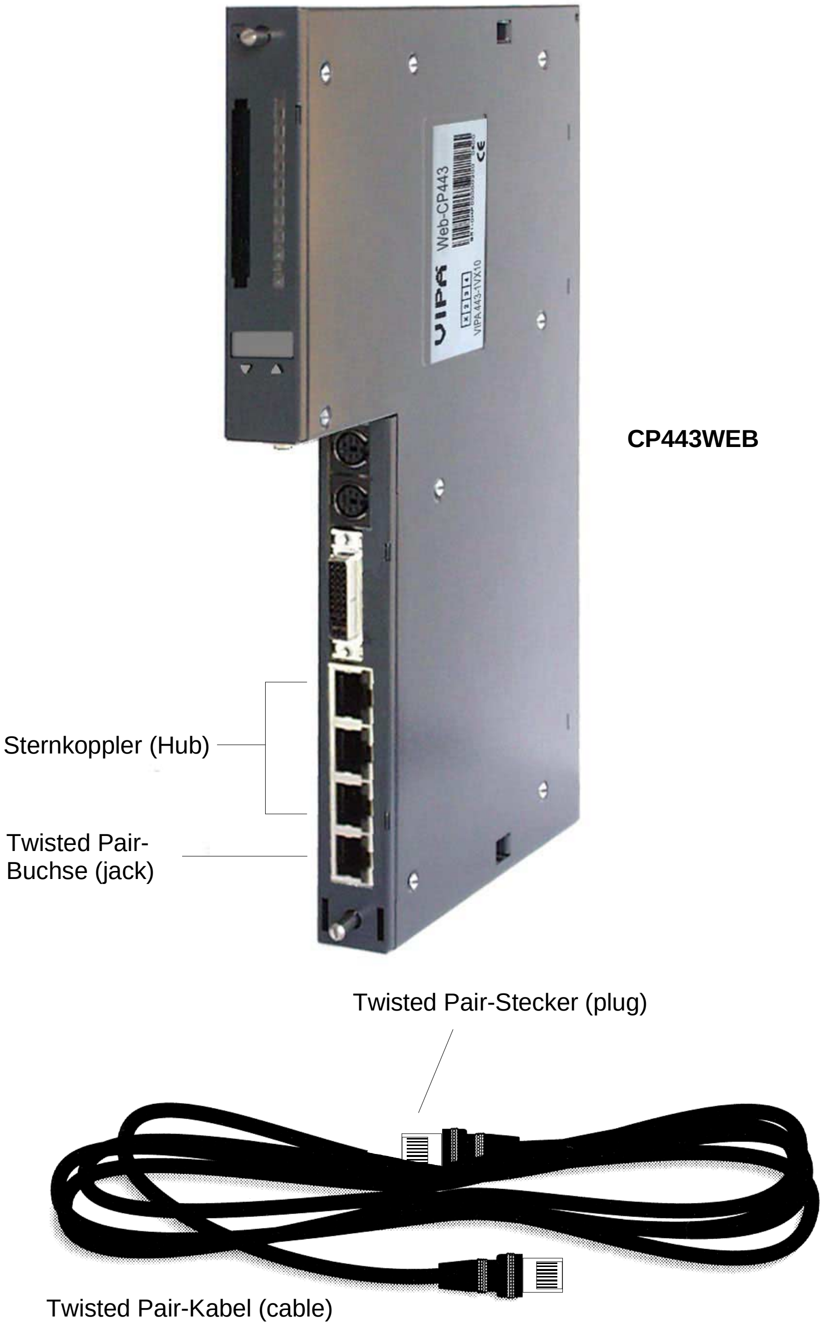
Certain IP-addresses are restricted! These addresses are reserved for special services!

Network planning

Twisted pair network hardware

A twisted pair network can only be constructed with a star topology. This requires a hub to connect the different stations.

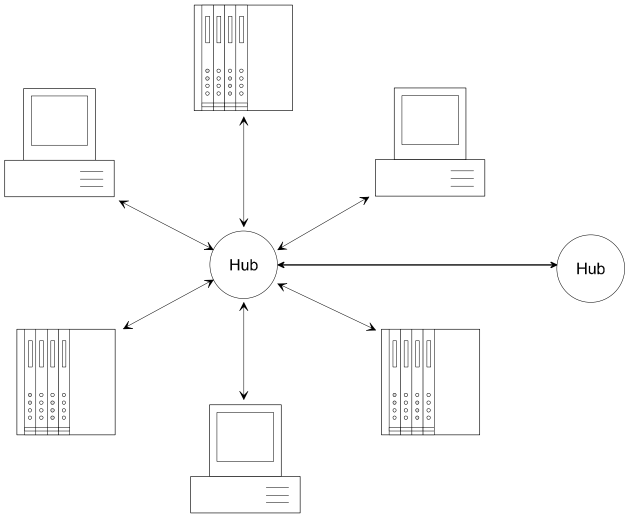
A twisted pair cable has four conductors twisted together in pairs. The different conductors have a diameter of 0.4 to 0.6 mm.


CP443WEB
Sternkoppler (Hub)
Twisted Pair-Buchse (jack)
Twisted Pair-Stecker (plug)
Twisted Pair-Kabel (cable)

Restrictions

Here follows a summary of the restrictions and rules applicable to Twisted Pair:

• Maximum number of coupler elements per segment	2
• Maximum length of a segment	100 m



Determination of network requirements

- What is the size of the area that must be served by the network?
- How many network segments provide the best solution for the physical (space, interference related) conditions encountered on site?
- How many network stations (SPS, IPC, PC, transceiver, bridges if required) must be connected to the cable?
- What is the distance between the different stations on the network?
- What is the expected “growth rate” and the expected number of connections that must be catered for by the system?

Drawing of a network diagram

Draw a diagram of the network. Identify every hardware item (i.e. station cable, Hub). Observe the applicable rules and restrictions.

Measure the distance between all components to ensure that the maximum length is not exceeded.

Standards and norms

That main property of the bus structure is that it consists of a single physical connection. The physical communication medium consists of:

- one or more electrical cables (twisted pair cable)
- coaxial cable (Triaxial cable)
- fiber optic cables

The applicable rules and regulations must be satisfied in order to establish reliable communications between the different stations.

These agreements define the form of the data protocol, the method of access to the bus and other principles that are important for reliable communications.

The VIPA CP443 was developed in accordance with the standards defined by ISO.

Standards and guidelines

International and national committees have defined the following standards and guidelines for networking technologies:

ANSI
American National Standards Institute
The ANSI X3T9.5 standard currently defines the provisions for high speed LAN's (100 MB/s) based on fiber optic technology.
(FDDI) Fiber Distributed Data Interface.

CCITT
Committee Consultative Internationale de Telephone et Telegraph.
Amongst others, this advisory committee has produced the provisions for the connection of industrial networks (MAP) to office networks (TOP) on Wide Area Networks (WAN).

ECMA
European Computer Manufacturers Association.
Has produced various MAP and TOP standards.

EIA
Electrical Industries Association (USA)
This committee has issued standard definitions like RS-232 (V.24) and RS-511.

IEC
International Electrotechnical Commission.
Defines certain special standards, e.g. for the Field Bus.

ISO
International Organization for Standardization.
This association of national standards organizations developed the OSI-model (ISO/TC97/SC16). It provides the framework for the standardization of data communications. ISO standards are included in different national standards like for example UL and DIN.

IEEE
Institute of Electrical and Electronic Engineers (USA).
The project-group 802 determines LAN-standards for transfer rates of 1 to 20 MB/s. IEEE standards often form the basis for ISO-standards, e.g. IEEE 802.3 = ISO 8802.3.

Chapter 4 CP443 applications

Outline

This chapter describes practical applications for the CP443. An example shows how the unit is configured by means of the VIPA WinNCS version 3.0 or above and how it can be integrated into the PLC environment.

In addition to the instructions on step-by-step commissioning this chapter also contains a description of the integrated PG facilities.

The following section contains a description of:

- The configuration by means of WinNCS V3.0
- Integration with the PLC
- Sample configuration and diagnostics on the PLC side
- The different commissioning steps
- Applications for the PG facilities

Contents

Topic **Page**

Outline

Project design

Instead of Siemens "NetPro" the unit is configured by means of the VIPA-tool WinNCS, version 3.0 or higher. You must be aware that the IP-address by which you can gain access to the VIPA-CP via the Ethernet connection can only be defined by means of the VIPA configuration tool WinNCS.

Plug-in location

The CP443 can be installed in all those module racks that have plug-in locations with combined P- and K-Bus interfaces.

PG-functions

As mentioned above the VIPA-tool WinNCS V3.0 is used to configure the connections. You must be remember that the IP-address by which you can gain access to the VIPA-CP via the Ethernet connection can only be defined and modified by means of the VIPA configuration tool WinNCS. IP-addresses that are defined by means of the Siemens Hardware-Manager are not accepted by the VIPA-CP.

You must specify the same IP-address in the Siemens Hardware Configurator under “Properties” in order that the Siemens-PG can recognize the IP-addresses of the VIPA-CP, i.e. to save these addresses in the project.

You can only go online when the CPU has been selected in the Siemens SIMATIC-Manager.

Target system functions can only be used for the CPU. A communication error will be returned in the PG if you select other modules.

With the exception of the "Hardware diagnostics" all target system functions are available for the CPU. This function is being developed at present.

Configuration of the CP443

Outline

During configuration the CP behaves much like the VIPA CP 143 H1/TCP/IP-module.

The configuration procedure consists of two portions:

- **CP-configuration** by means of the VIPA WinNCS (to implement the Ethernet connection).
- **PLC-programming** by means of the application program (implementing the connection to the PLC).

CP side configuration using WinNCS V3.0

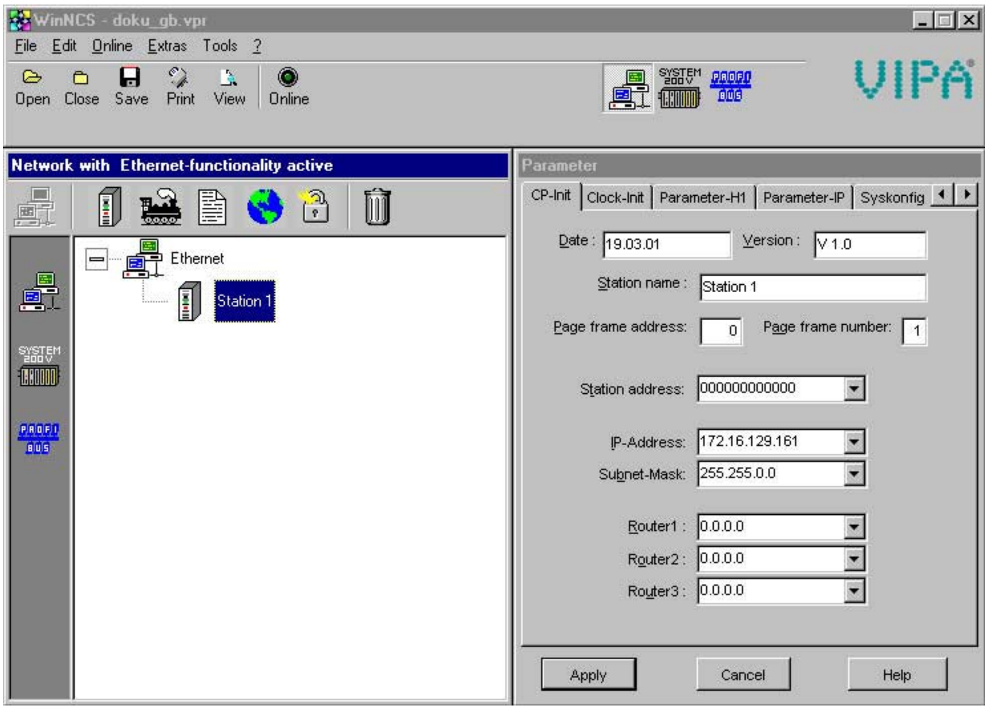
The CP is only configured by means of WinNCS and this consists of the following 3 portions:

- Basic CP configuration,
- Configuration of connection blocks,
- Transferring the configuration into the CP.

Basic CP configuration

This is where the addresses and other identification parameters of a station are configured.

Insert a new station under the "Ethernet" functionality in the network window and configure your station in the Parameter window.


WinNCS - doku_gb.vpr
File Edit Online Extras Tools ?
Open Close Save Print View Online
SYSTEM 200V
PROFI BUS
VIPA
Network with Ethernet-functionality active
Ethernet
Station 1
Parameter
CP-Init Clock-Init Parameter-H1 Parameter-IP Syskonfig
Apply Cancel Help

Date: 19.03.01 Version: V 1.0

Station name: Station 1

Page frame address: 0 Page frame number: 1

Station address: 000000000000

IP-Address: 172.16.129.161

Subnet-Mask: 255.255.0.0

Router1: 0.0.0.0

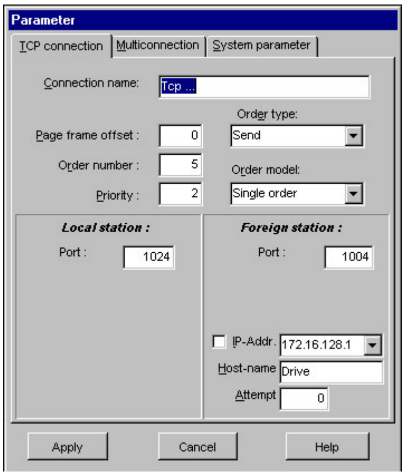
Router2: 0.0.0.0

Router3: 0.0.0.0

The basic CP configuration determines the behavior of your station on the network.

Connection block configuration

A connection block includes remote parameters, i.e. parameters for the communication partner in the network, and local parameters , i.e. parameters for the PLC program in a connection. You can configure TCP/IP connections by selecting the icon of the station and inserting the required connection.



Connection name: Tcp ...

Page frame offset : 0

Order number : 5

Priority : 2

Order type: Send

Order model: Single order

Local station :

Port : 1024

Foreign station :

Port : 1004

☐ IP-Addr. 172.16.128.1

Host-name Drive

Attempt 0

Initial configuration

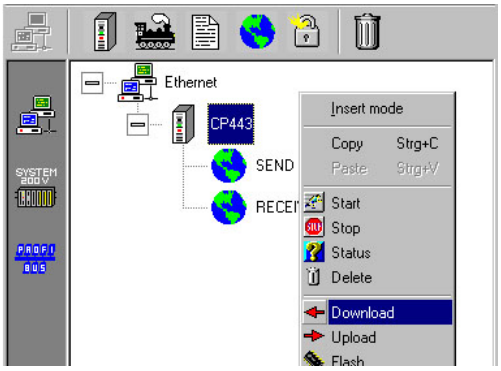
During initial commissioning of a CP's you must configure the parameters via the serial port since the module does not have an IP-address at this point. For details please refer to the section under "Commissioning " below.

Transferring parameters to the CP

When all the connection parameters have been defined these must be transferred into the CP. WinNCS provides the required "Online functions".

You can easily used these online functions to transfer your settings via the network into the VIPA-CP.

For this purpose you select the CP in the network-window of WinNCS and click the right mouse key. This opens a context menu.



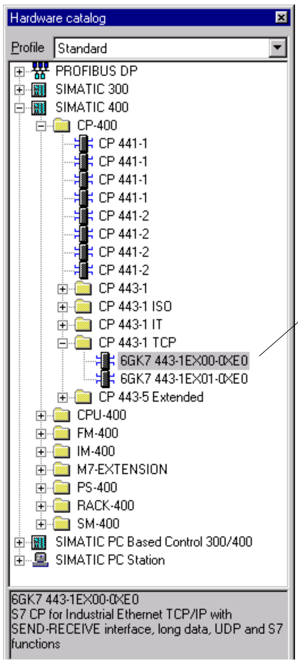
When you select "Download" your data is transferred into the CP via the network and saved immediately in Flash-ROM, in contrast to the CP143 H1/TCP/IP.

Configuration for the PLC side

The configuration on PLC-side is completed by means of the Siemens Hardware-Configurator. The hardware configuration can not be transferred by the Siemens Simatic-Manager.

Alternate-CP in the Siemens Hardware-Catalog

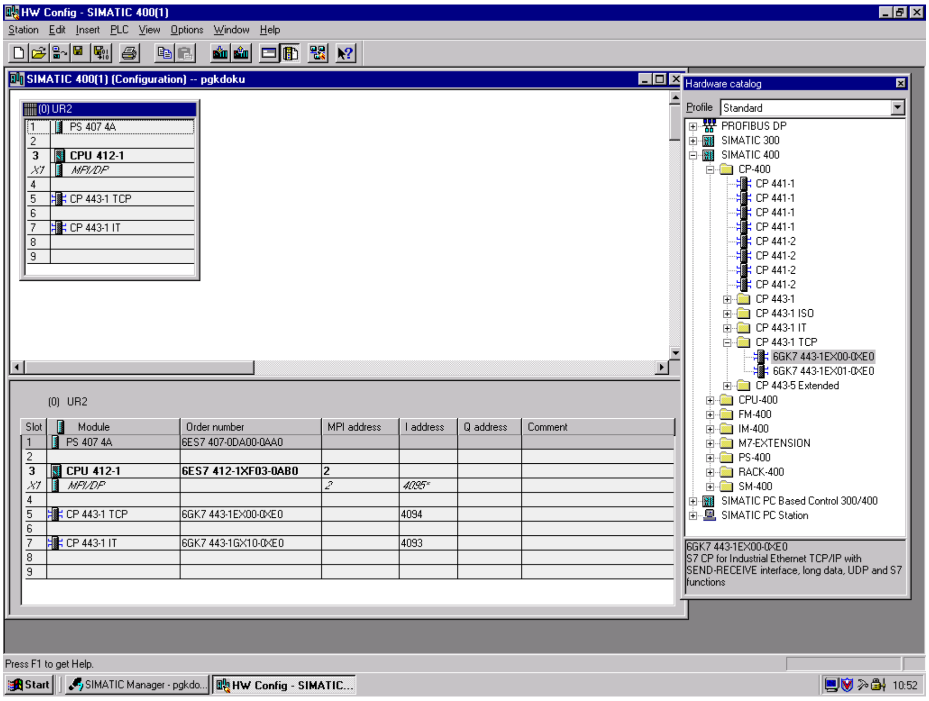
Since you cannot directly select the VIPA CP in the Siemens Hardware-Catalog you must select a substitute for the VIPA CP from the CPs provided by Siemens with the following order no.:



6GK7 443-1EX00-0XE0
S7 CP for Industrial Ethernet TCP/IP with SEND-RECEIVE interface, long data, UDP and S7 functions

Substitute-CP for VIPA-CP: 6GK7 443-1EX00-0XE0

Select the substitute CP with the order no.: "6GK7 443-1EX00-0XE0" and save it at the required plug-in location in your Hardware-Configurator.



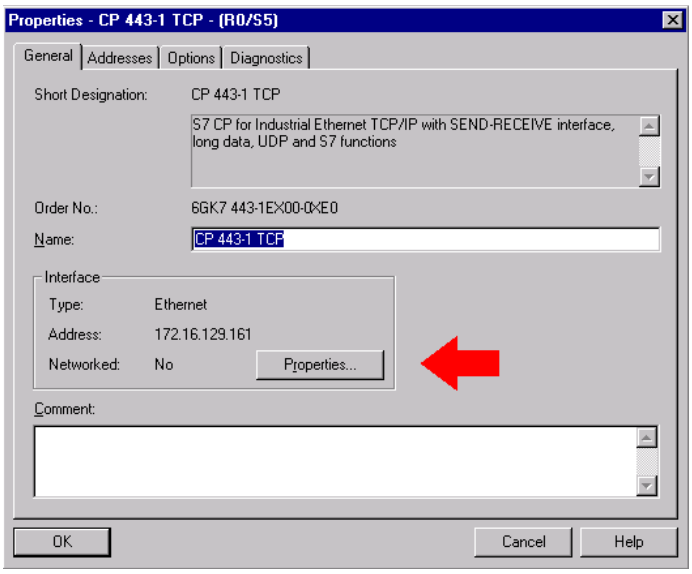
(0) UR2

Slot	Module	Order number	MPI address	I address	Q address	Comment
1	PS 407 4A	6ES7 407-0DA00-0AA0				
2						
3	**CPU 412-1**	**6ES7 412-1XF03-0AB0**	**2**			
X1	*MPI/DP*		*2*	*4095**		
4						
5	CP 443-1 TCP	6GK7 443-1EX00-0XE0		4094		
6						
7	CP 443-1 IT	6GK7 443-1GX10-0XE0		4093		
8						
9						

6GK7 443-1EX00-0XE0
S7 CP for Industrial Ethernet TCP/IP with SEND-RECEIVE interface, long data, UDP and S7 functions

Specifying the IP-address

You can open the properties dialog box for the CP by double-clicking the CP.



Properties - CP 443-1 TCP - (R0/S5)

Short Designation: CP 443-1 TCP

S7 CP for Industrial Ethernet TCP/IP with SEND-RECEIVE interface, long data, UDP and S7 functions

Order No.: 6GK7 443-1EX00-0XE0

Name: CP 443-1 TCP

Interface

Type: Ethernet

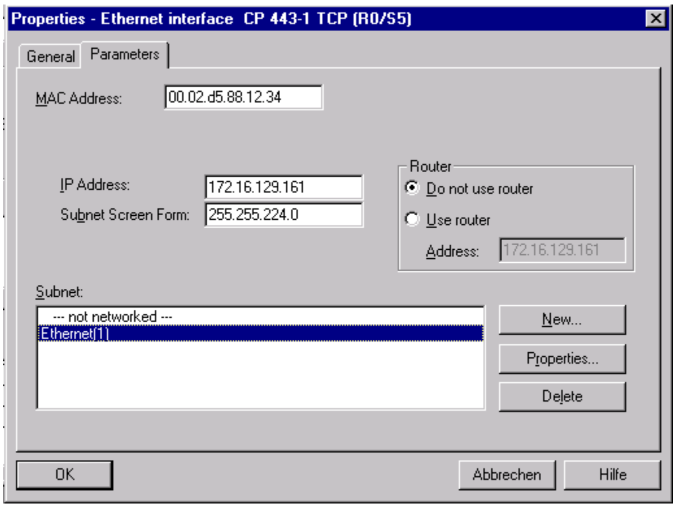
Address: 172.16.129.161

Networked: No

Comment:

Here you click “Properties”.

A dialog box will be displayed where you can enter the MAC- and the IP-address that you will be using for communicating with the VIPA-CP via the network:



Properties - Ethernet interface CP 443-1 TCP (R0/S5)

MAC Address: 00.02.d5.88.12.34

IP Address: 172.16.129.161

Subnet Screen Form: 255.255.224.0

Router

● Do not use router

○ Use router

Address: 172.16.129.161

Subnet:

--- not networked ---

Ethernet(1)

Attention!

Please remember that the addresses you select here are not transferred to the VIPA-CP. These Ethernet- or IP-addresses can only be transferred into the VIPA-CP by means of the VIPA configuration tool WinNCS.

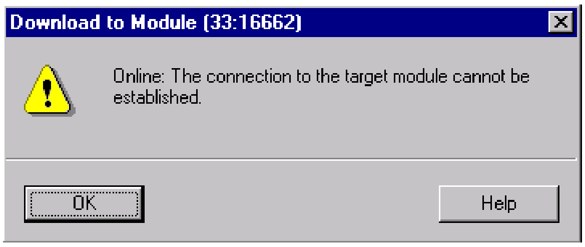
Please refer to “Commissioning" for details.

As far as programming is concerned you must specify the same IP-address in the Siemens Hardware-Configurator!

"Download to Module" for the VIPA-CP

You can access the dialog box where you can specify the target module by clicking **Target system** > *Download to module ...* and by clicking [OK].

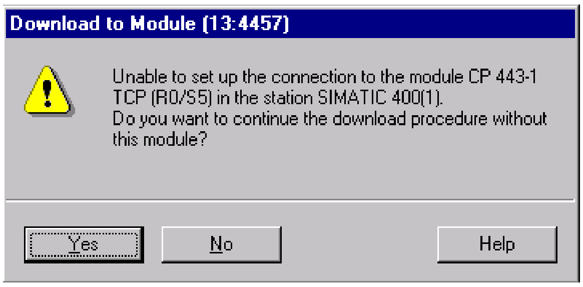
The following error message will be displayed since the VIPA-CP ignores the configuration data received from the CPU:


Download to Module (33:16662)

Online: The connection to the target module cannot be established.

Click [OK] to acknowledge the error message.

However, you must click [YES] in the following dialog box to ensure that the other modules installed in the rack are configured properly.


Download to Module (13:4457)

Unable to set up the connection to the module CP 443-1 TCP (R0/S5) in the station SIMATIC 400(1).
Do you want to continue the download procedure without this module?

Note!

The two error messages shown above will only be displayed if you have also selected your VIPA-CP in the dialog box "Download to module".

PLC application programming

To process connect requests, the PLC requires that a PLC application program is active in the CPU. These make use of the handler blocks (Send, Receive, ...) that are supplied with the CP.

The PLC-program also requires that a communication channel be specified first between the CPU and the CP ("synchronization"). This function is performed by the Synchron-block.

Transmission and reception is initiated by means of Send and Receive. A data transfer is initiated by means of Send-All or Receive-All.

Error messages will appear in the indicator word.

The following table lists the required handler blocks.

Handler functions		Description
Send	FC120	Transmit a job to the CP.
Send_All	FC120 with ANR=0	Initiate a file transfer between the CPU and the CP.
Receive	FC121	Reception of a job from the CP.
Recv_All	FC121 with ANR=0	Initiate a file transfer between the CPU and the CP.
Fetch	FC122	The Fetch block starts a data fetch operation. A Fetch-HTB is only permitted with the RW-identifier and it provides the initialization for the read job.
Control	FC123	The Control-block is used for status requests related to a job, i.e. the ANZW of a specific job is updated.
Reset	FC124	The Reset-block initiates a reset of the job for the specified connection.
Reset_All	FC124 with ANR=0	Reset-All forces a system-reset of the CPs.
Synchron	FC125	During start-up, Synchron provides the synchronization between AG and CP. At the same time the page frame is erased and the block size between PLC and CP is negotiated. Active data communications can only occur via synchronized page.

Synchronization

When a CP starts up every one of the configured interfaces of the CPs must be synchronized by means of Synchron.

After power is turned on the CP requires a certain amount of time to complete the boot procedure. If the CP should issue a request a synchronization during this time an error is returned in the configuration error byte PAFE. This message is removed when the CP module has completed the boot process.

The timer in this block is initially set to 30s. The CP will STOP and the module will return an error if the synchronization is not completed properly within this period.

The following table shows the available block sizes.

Value	Block size
0	The block uses default parameters (set to 512 bytes for the CP443)
1	16 byte blocks
2	32 byte blocks
3	64 byte blocks
4	128 byte blocks
5	256 byte blocks
6	512 byte blocks

>6 and < 255 are treated like 0.

Cycle

Send and receive blocks Send and Receive, which initiate the sending and receiving operations, must be configured in the cycle program OB1. The actual data-transfer is performed by the blocks Send_All and Receive_All.

Purely passive connections only require the components Send All or Receive All.

To protect the data-transfer you should integrate various checkpoints that evaluate the indicator word.

Configuration example

Outline and requirements

This chapter is intended to provide an introduction to use of the VIPA CP443. This introduction is centered on the VIPA configuration software WinNCS.

The object of this chapter is to create a small communication system between a CPU 21x NET and a VIPA CP443 that provides a simple approach to the control of the communication processes.

CP handler blocks are standard function blocks. These provide the options required to utilize the communication functions in the programs of the programmable logic controllers.

The minimum technical equipment required for the examples is as follows:

1 CPU 21x NET from VIPA,

1 System 400 Rack with a CPU

1 CP443 from VIPA

Communication line consisting of:

- 1 bus cable

Software packages

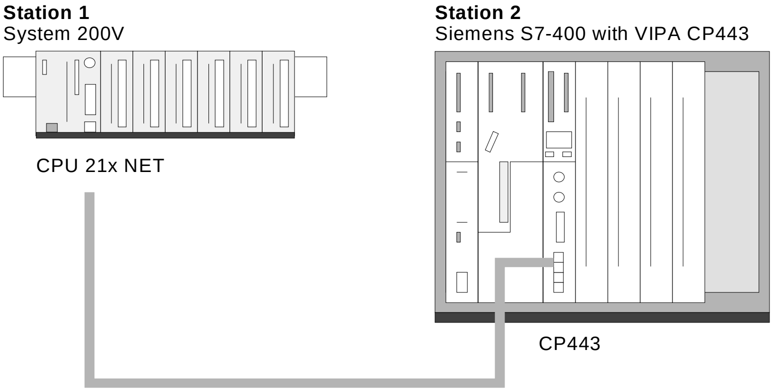
- Configuration software WinNCS 3.0 from VIPA
- The Siemens STEP®7 Manager
- A null-modem cable to communicate between the PC and the CP

The following example explains the requirements of the problem in detail. The implementation of the example requires that the two PLC-systems be programmed as well as the configuration of the communication processors in WinNCS.

Problem

The introductory example for the application of the TCP/IP protocol is based upon a communication task that is described in detail in the following passage:

System structure



Purpose of the 2 stations

The purpose of station 1 (CPU 21x NET)

- Data block DB 11 transfers data words DW 0 to DW 99 at an interval of 100ms.
- Data word DW 0 in DB 11 is used as message counter. It is only incremented if the preceding transmit command was processed correctly (completed without error). The remaining data words (DW 1 to DW 99) can be used for the transfer of user data.
- SEND is configured with job number A_Nr. = 11 and with a page frame offset SSNR = 0.
- The source parameters must be configured directly.

The purpose of station 2 (System 400 and CP443)

- Data transmitted by station 1 must be received by station 2 and saved in data block DB 12. This is done by means of the handler block RECEIVE.
- Handler block RECEIVE is configured with a job number A_NR = 12 and a page frame offset SSNR = 0.
- The destination parameters are stored in data block DB 12 from data word DW 0.
- The entered page frame offset SSNR = 0 must be accompanied by a suitable configuration of the CP443 module. In this example this is identical to the configuration of the CP-portion of station 1.

At this point the purpose and the required settings have been outlined. Additional details of the configuration of the handler blocks are provided by the programs. A detailed description of a suitable configuration of the CP's under control of TCP/IP is also included.

Configuration in WinNCS

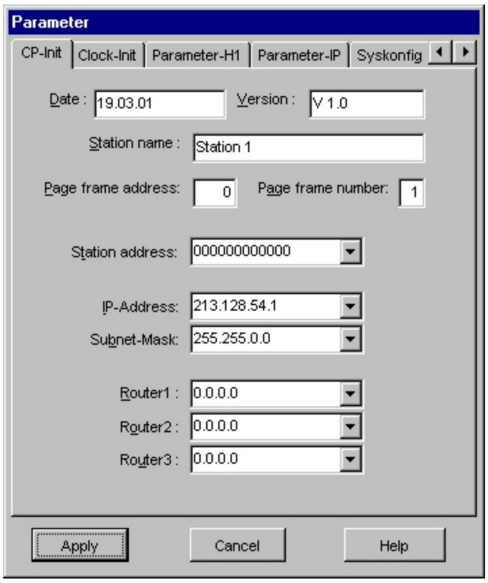
The two CPs are configured by means of WinNCS 3.0. Start WinNCS and create a project containing the function group "Ethernet". The procedure is the same for both stations. It differs only in the parameters that must be defined and is divided into the following 3 parts:

- Basic CP configuration
- Configuration of connection blocks
- Transfer of configuration data into the CP

Basic CP configuration

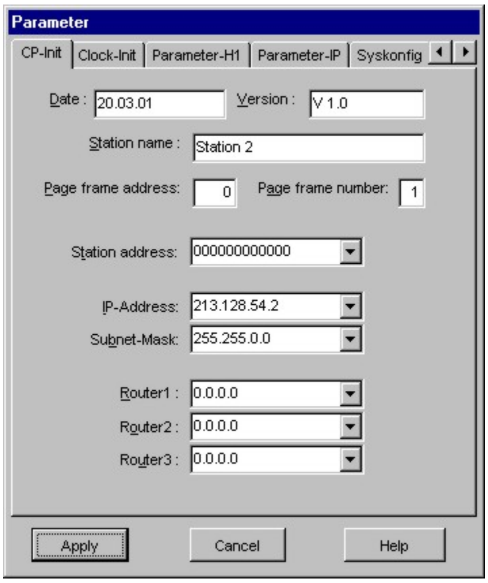
Define the two stations and select the following settings:

Station 1



Date : 19.03.01
Version : V 1.0
Station name : Station 1
Page frame address: 0
Page frame number: 1
Station address: 000000000000
IP-Address: 213.128.54.1
Subnet-Mask: 255.255.0.0
Router1 : 0.0.0.0
Router2 : 0.0.0.0
Router3 : 0.0.0.0

Station 2



Date : 20.03.01
Version : V 1.0
Station name : Station 2
Page frame address: 0
Page frame number: 1
Station address: 000000000000
IP-Address: 213.128.54.2
Subnet-Mask: 255.255.0.0
Router1 : 0.0.0.0
Router2 : 0.0.0.0
Router3 : 0.0.0.0

Request the required station addresses from your system administrator.

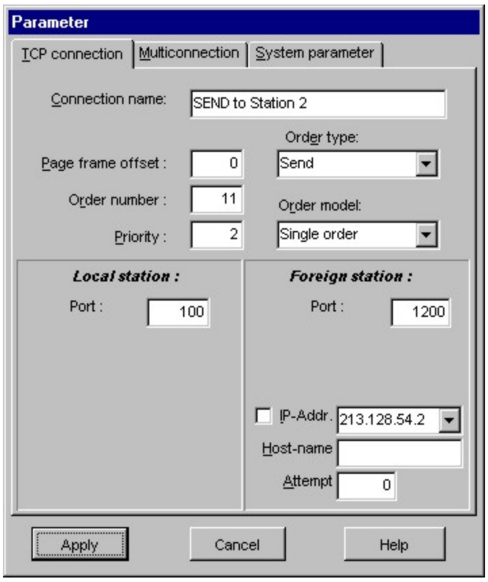
If necessary, you can enter additional settings into the configuration windows. Details are obtainable from your system administrator.

You must also observe the procedure for initial commissioning as outlined below in this chapter.

Connection block configuration

You configure your TCP/IP connection by inserting a TCP-connection below the stations by means of 🌐 and entering the following parameters:

Station 1



Parameter

TCP connection | Multiconnection | System parameter

Connection name: SEND to Station 2

Page frame offset : 0

Order type: Send

Order number : 11

Order model: Single order

Priority : 2

Local station :

Port : 100

Foreign station :

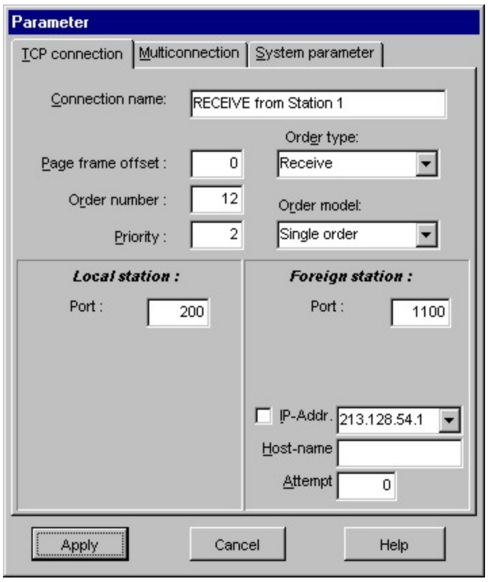
Port : 1200

□ IP-Addr. 213.128.54.2

Host-name

Attempt 0

Station 2



Parameter

TCP connection | Multiconnection | System parameter

Connection name: RECEIVE from Station 1

Page frame offset : 0

Order type: Receive

Order number : 12

Order model: Single order

Priority : 2

Local station :

Port : 200

Foreign station :

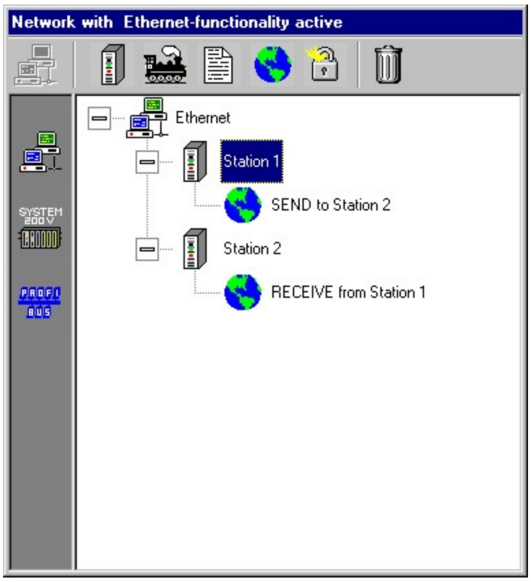
Port : 1100

□ IP-Addr. 213.128.54.1

Host-name

Attempt 0

Your network box should have the following contents:



Network with Ethernet-functionality active

- Ethernet
  - Station 1
    - SEND to Station 2
  - Station 2
    - RECEIVE from Station 1

Transferring the configuration data into the CP

You can transfer your configuration online via the network into the respective CP. Create the system structure as shown above, connect the two CPs via the network, and start both CPs.

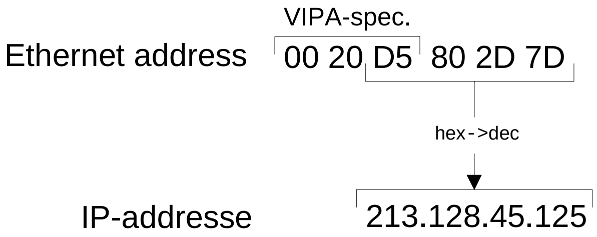
For the data transfer you must place both CPs in STOP mode.

You can configure station 1 directly via the network.

When you configure the CPU 21x NET for the first time the module has the original Ethernet address.

This address is stated on a label located on the side of the module.

Only for the initial commissioning is this Ethernet address used to calculate a unique IP-address from the following formula.



Note!

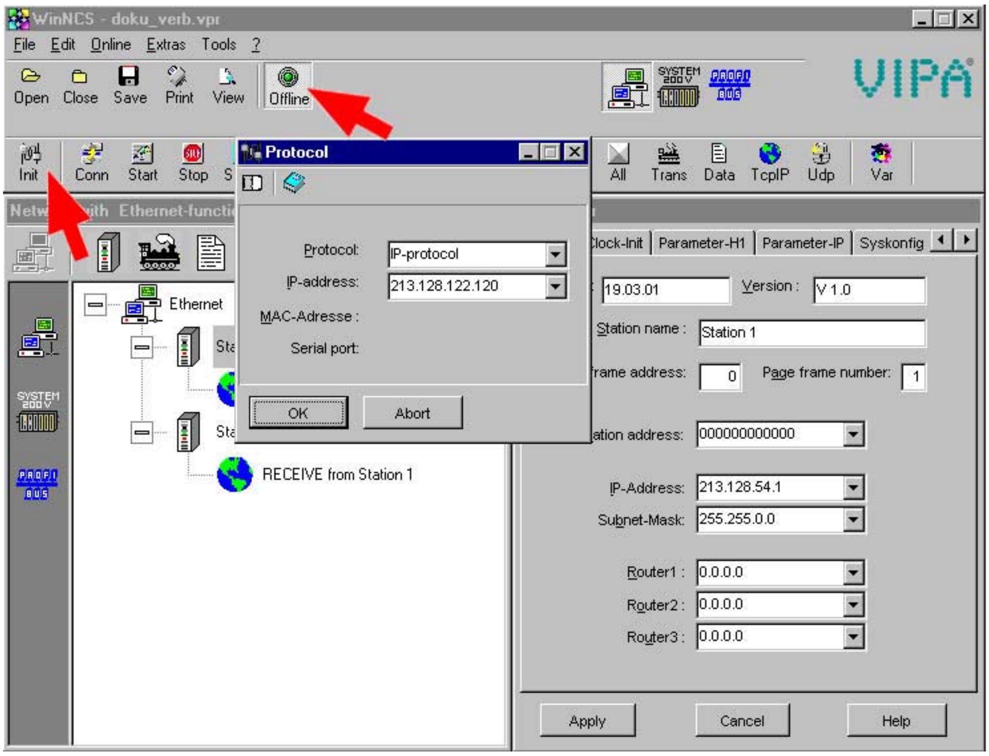
Only during the initial configuration does a relationship exist between the Ethernet and the IP-addresses.

You can change the address at any time by means of CP-Init in WinNCS.

Attention!

The original Ethernet address can not be restored since it is not possible to erase the CP-portion.

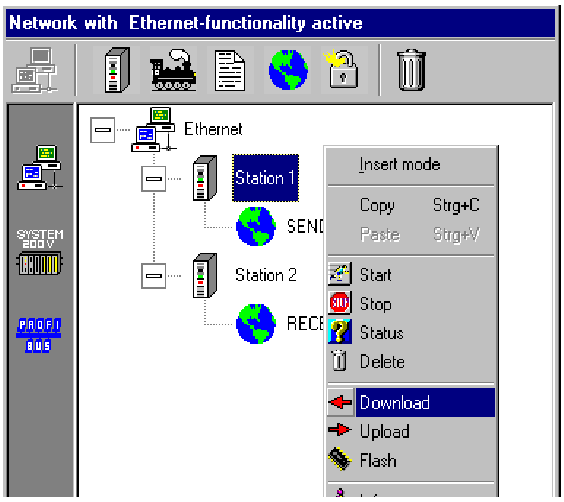
You can transfer the configuration data by selecting the Online functions and clicking INIT:


WinNCS - doku_verb.vpr
File Edit Online Extras Tools ?
Open Close Save Print View Offline
Init Conn Start Stop S
All Trans Data TcpIP Udp Var
VIPA
Network with Ethernet-functionality active
Ethernet
RECEIVE from Station 1
Protocol
OK Abort
lock-Init Parameter-H1 Parameter-IP Syskonfig
Apply Cancel Help

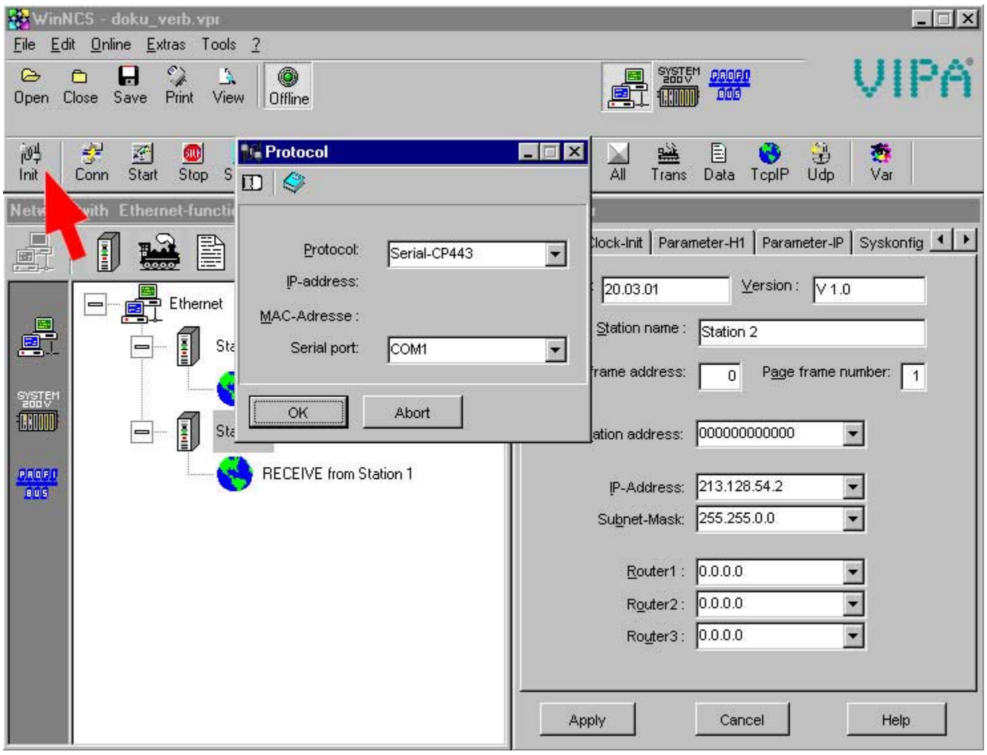
Protocol: IP-protocol
IP-address: 213.128.122.120
MAC-Adresse :
Serial port:

19.03.01 Version : V 1.0
Station name : Station 1
rame address: 0 Page frame number: 1
ation address: 000000000000
IP-Address: 213.128.54.1
Subnet-Mask: 255.255.0.0
Router1 : 0.0.0.0
Router2 : 0.0.0.0
Router3 : 0.0.0.0

Click the right mouse key when you have selected station 1 and select the Download command.



Remember that you can only configure station 2 (the CP443) via the serial port during the initial configuration phase. For this purpose you select the serial mode for the Online functions under INIT:



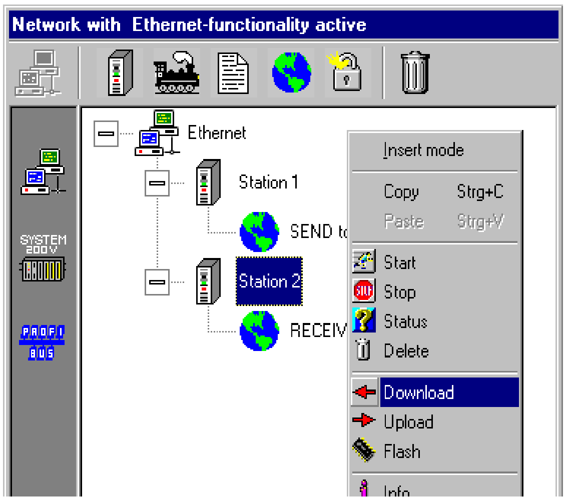
Protocol: Serial-CP443
IP-address:
MAC-Adresse :
Serial port: COM1

20.03.01 Version : V 1.0
Station name : Station 2
rame address: 0 Page frame number: 1
ation address: 000000000000
IP-Address: 213.128.54.2
Subnet-Mask: 255.255.0.0
Router1 : 0.0.0.0
Router2 : 0.0.0.0
Router3 : 0.0.0.0

WinNCS - doku_verb.vpr
File Edit Online Extras Tools ?
Open Close Save Print View Offline
VIPA
Init Conn Start Stop
Protocol
OK Abort
All Trans Data TcpIP Udp Var
Ethernet
RECEIVE from Station 1
lock-Init Parameter-H1 Parameter-IP Syskonfig
Apply Cancel Help

Connect the CP443 by means of a null-modem cable.

Click the right mouse key when you have selected station 2 and select the Download command.



Place both CPs in RUN mode. At this point both CPs are connected to the network under the IP-address you have defined above.

This concludes the configuration of the CP-side. The following section contains a description of the programming required on the PLC-side.

PLC programs for the CPUs

Program for station 1 (CPU 21x NET)

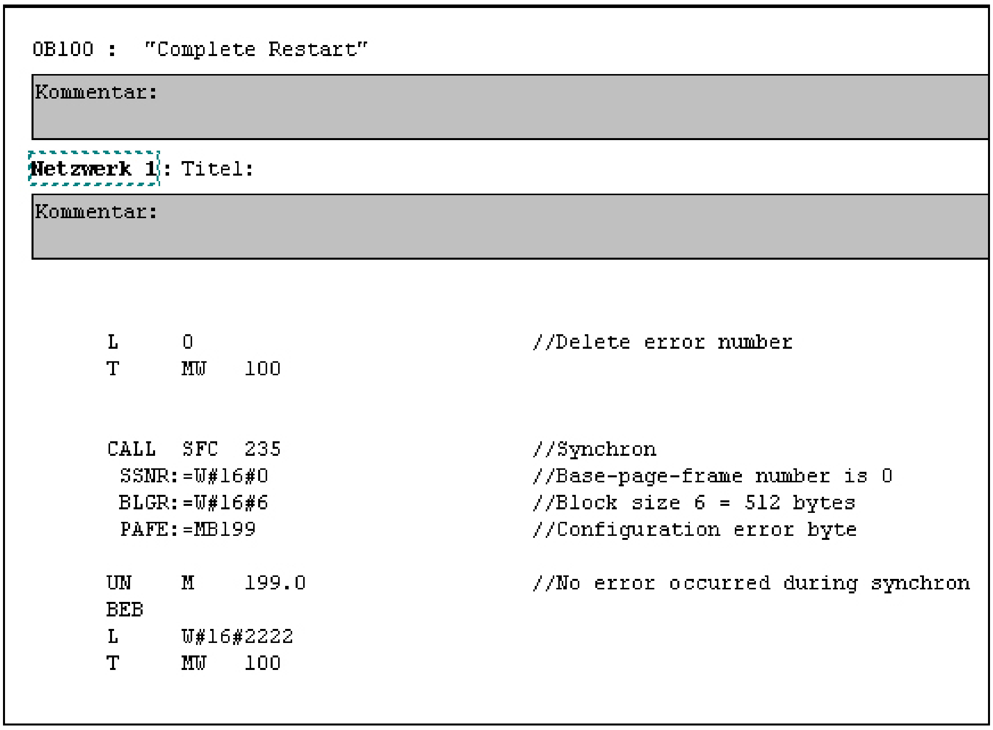
Synchronization of the interfaces

The interface used on the CP must be configured in the start-up-OB OB 100 of the CPU by means of the handler block Synchron.

OB 100 verifies that the synchronization was completed without errors. If errors are encountered an error number is entered into MW 100.

The following block must be transferred to station 1.

Operation block OB 100: Reboot



```
OB100 :  "Complete Restart"
Kommentar:

Netzwerk 1: Titel:
Kommentar:


      L     0                            //Delete error number
      T     MW   100


      CALL  SFC  235                     //Synchron
       SSNR:=W#16#0                      //Base-page-frame number is 0
       BLGR:=W#16#6                      //Block size 6 = 512 bytes
       PAFE:=MB199                       //Configuration error byte

      UN    M    199.0                   //No error occurred during synchron
      BEB
      L     W#16#2222
      T     MW   100
```

After a restart the CP requires a certain amount of time to boot up. This time is observed by the Synchron block.

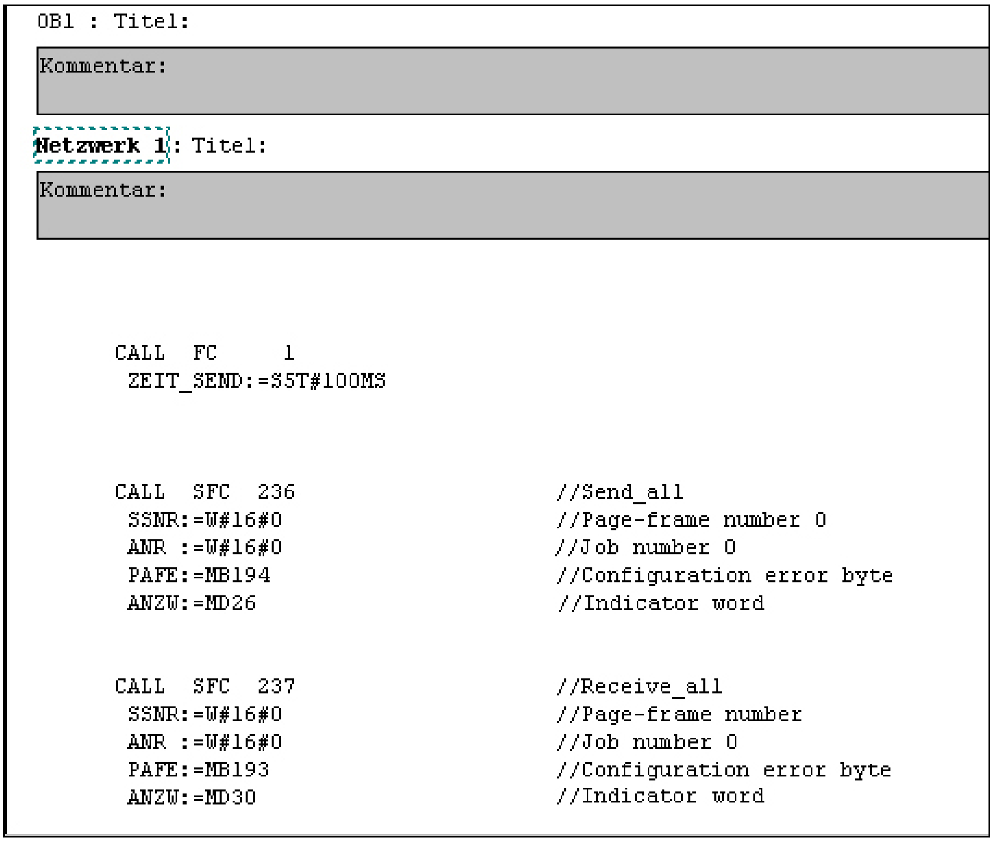
The timer in this block is initially set to 30s. If a proper synchronization request is not received in this time the CP is placed in STOP mode and the block is terminated with an error (check PAFE).

Cycle-OB, FC and DB

The initiation of transmission in station 1 is issued by means of a Send handler block. This is called in function block FC 1.

The jump command to FC 1 is the first command in the cycle organization block OB 1. The transmit command is configured as follows.

Cycle operation block OB 1:

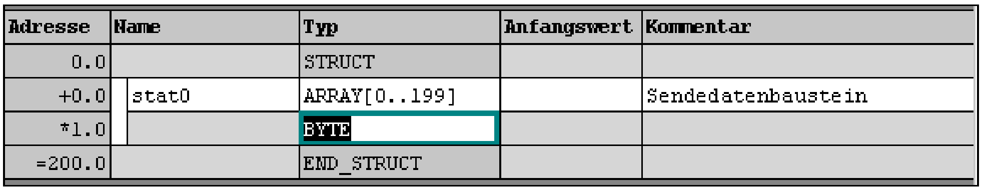


```
OB1 : Titel:
Kommentar:

Netzwerk 1: Titel:
Kommentar:

      CALL  FC     1
       ZEIT_SEND:=S5T#100MS


      CALL  SFC  236                       //Send_all
       SSNR:=W#16#0                        //Page-frame number 0
       ANR :=W#16#0                        //Job number 0
       PAFE:=MB194                         //Configuration error byte
       ANZW:=MD26                          //Indicator word

      CALL  SFC  237                       //Receive_all
       SSNR:=W#16#0                        //Page-frame number
       ANR :=W#16#0                        //Job number 0
       PAFE:=MB193                         //Configuration error byte
       ANZW:=MD30                          //Indicator word
```

Note!

The default programming contains a SEND_ALL and a RECEIVE_ALL in this section. However, we only require the SEND_ALL!

Data block DB 11:



Adresse	Name	Typ	Anfangswert	Kommentar
0.0		STRUCT		
+0.0	stat0	ARRAY[0..199]		Sendedatenbaustein
*1.0		BYTE		
=200.0		END_STRUCT		

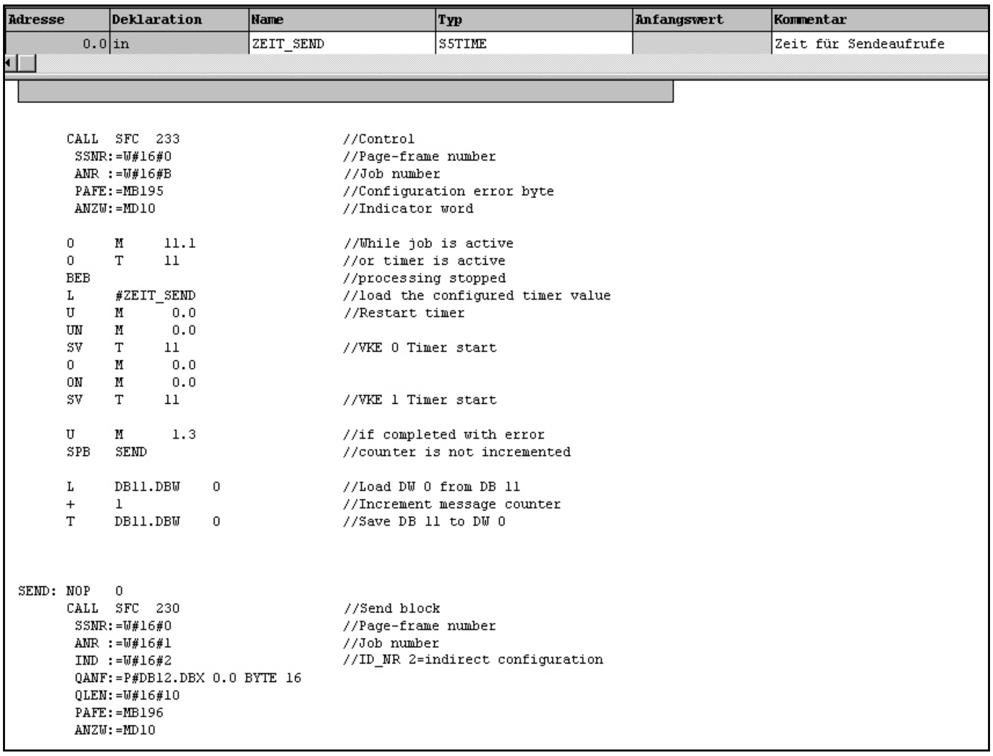
Send data block

The frequency with which a Send job is issued depends on the time that was configured for the FC1 call. This Timer is programmed for 100ms in this example. The sample-program initiates the Send job at a rate of once every 100ms.

Data-word DW 0 of the data block DB 11 is incremented ahead of the SEND call that actually transmits a message. This occurs in function block FC 1.

DW 0 can be accompanied by 29 user data items.

Function FC 1:



Adresse	Deklaration	Name	Typ	Anfangswert	Kommentar
0.0	in	ZEIT_SEND	S5TIME		Zeit für Sendeaufrufe

```
      CALL  SFC  233                  //Control
       SSNR:=W#16#0                   //Page-frame number
       ANR :=W#16#B                   //Job number
       PAFE:=MB195                    //Configuration error byte
       ANZW:=MD10                     //Indicator word

      O     M     11.1                //While job is active
      O     T     11                  //or timer is active
      BEB                             //processing stopped
      L     #ZEIT_SEND                //load the configured timer value
      U     M      0.0                //Restart timer
      UN    M      0.0
      SV    T     11                  //VKE 0 Timer start
      O     M      0.0
      ON    M      0.0
      SV    T     11                  //VKE 1 Timer start

      U     M      1.3                //if completed with error
      SPB   SEND                      //counter is not incremented

      L     DB11.DBW    0             //Load DW 0 from DB 11
      +     1                         //Increment message counter
      T     DB11.DBW    0             //Save DB 11 to DW 0



SEND: NOP   0
      CALL  SFC  230                  //Send block
       SSNR:=W#16#0                   //Page-frame number
       ANR :=W#16#1                   //Job number
       IND :=W#16#2                   //ID_NR 2=indirect configuration
       QANF:=P#DB12.DBX 0.0 BYTE 16
       QLEN:=W#16#10
       PAFE:=MB196
       ANZW:=MD10
```

FC 1 is a simple send block with the evaluation of the indicator word flags:

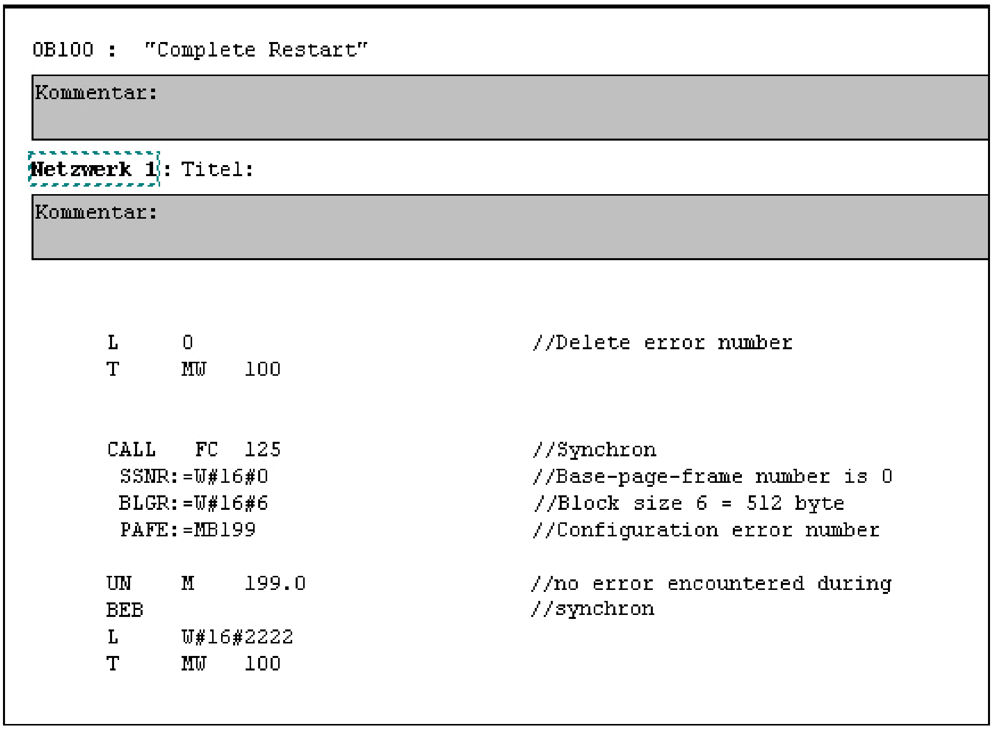
- Job active
- Completed with errors

Program for station 2 (CP443)

Synchronization of the interfaces

As for station 1 every interface that is used must also be synchronized by means of the Synchron block: the following block must be transferred into station 2.

Operation block OB 100: Complete Restart



```
OB100 :  "Complete Restart"
Kommentar:

Netzwerk 1: Titel:
Kommentar:


      L     0                             //Delete error number
      T     MW   100


      CALL   FC  125                      //Synchron
       SSNR:=W#16#0                       //Base-page-frame number is 0
       BLGR:=W#16#6                       //Block size 6 = 512 byte
       PAFE:=MB199                        //Configuration error number

      UN    M    199.0                    //no error encountered during
      BEB                                 //synchron
      L     W#16#2222
      T     MW   100
```

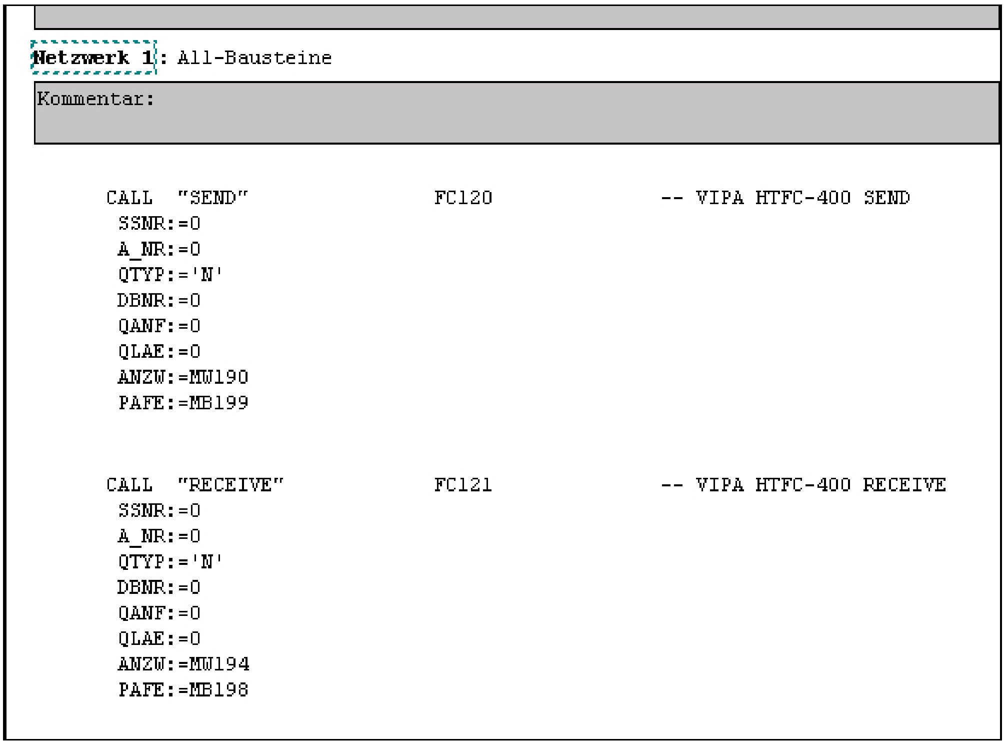
The CP requires a certain amount of time to boot up after a complete restart. This time is taken into account by the Synchron block.

The timer in this block is initially set to 30s. The CP is placed in STOP mode and the block is completed with an error if proper synchronization does not take place during this period.

Cycle-OB, -FC and -DB

The data sent by station 1 are retrieved by station 2 by means of handler block RECEIVE. The respective call is issued in organization block OB 1.

Cycle operation block OB 1:

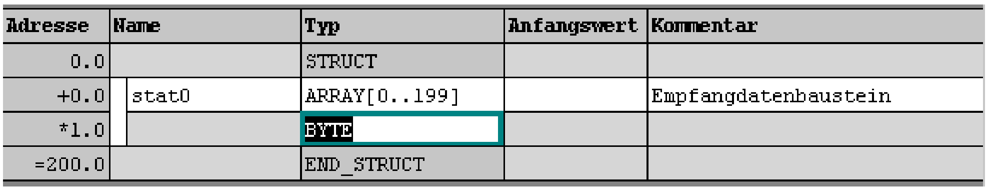


```
Netzwerk 1: All-Bausteine
Kommentar:

      CALL  "SEND"             FC120            -- VIPA HTFC-400 SEND
       SSNR:=0
       A_NR:=0
       QTYP:='N'
       DBNR:=0
       QANF:=0
       QLAE:=0
       ANZW:=MW190
       PAFE:=MB199


      CALL  "RECEIVE"          FC121            -- VIPA HTFC-400 RECEIVE
       SSNR:=0
       A_NR:=0
       QTYP:='N'
       DBNR:=0
       QANF:=0
       QLAE:=0
       ANZW:=MW194
       PAFE:=MB198
```

Note!

The default programming contains a SEND_ALL and a RECEIVE_ALL in this section. However, we only require the RECEIVE_ALL!

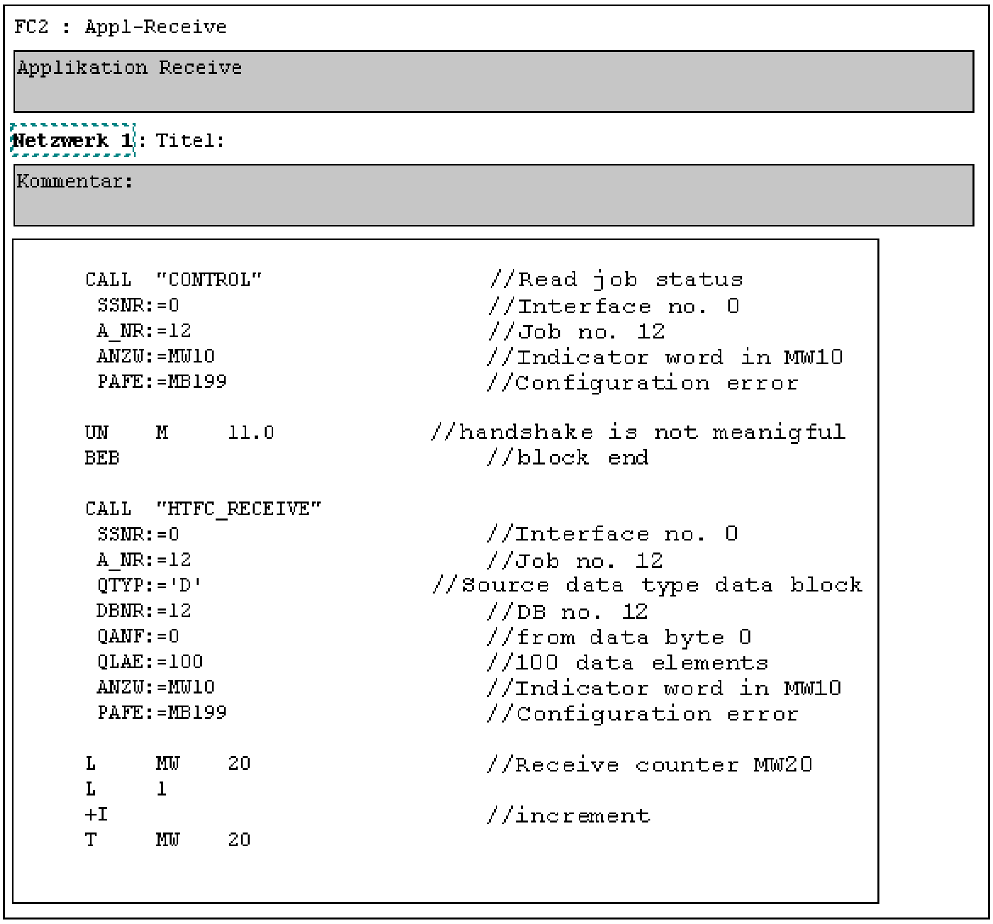
Data block DB 12:



Adresse	Name	Typ	Anfangswert	Kommentar
0.0		STRUCT		
+0.0	stat0	ARRAY[0..199]		Empfangdatenbaustein
*1.0		BYTE		
=200.0		END_STRUCT		

Receive data block

Function FC 2:



FC2 : Appl-Receive

Applikation Receive

Netzwerk 1: Titel:

Kommentar:

```
      CALL  "CONTROL"                  //Read job status
       SSNR:=0                         //Interface no. 0
       A_NR:=12                        //Job no. 12
       ANZW:=MW10                      //Indicator word in MW10
       PAFE:=MB199                     //Configuration error

      UN    M     11.0            //handshake is not meanigful
      BEB                              //block end

      CALL  "HTFC_RECEIVE"
       SSNR:=0                         //Interface no. 0
       A_NR:=12                        //Job no. 12
       QTYP:='D'                  //Source data type data block
       DBNR:=12                        //DB no. 12
       QANF:=0                         //from data byte 0
       QLAE:=100                       //100 data elements
       ANZW:=MW10                      //Indicator word in MW10
       PAFE:=MB199                     //Configuration error

      L     MW    20                   //Receive counter MW20
      L     1
      +I                               //increment
      T     MW    20
```

FC 2 is a simple receive block with analysis of the indicator word flags:

- Handshake makes sense
- Completed with errors

Monitoring the transfer with the Siemens STEP®7 Manager

When monitoring of connection jobs is required CPs as well as the CPUs must be programmed.

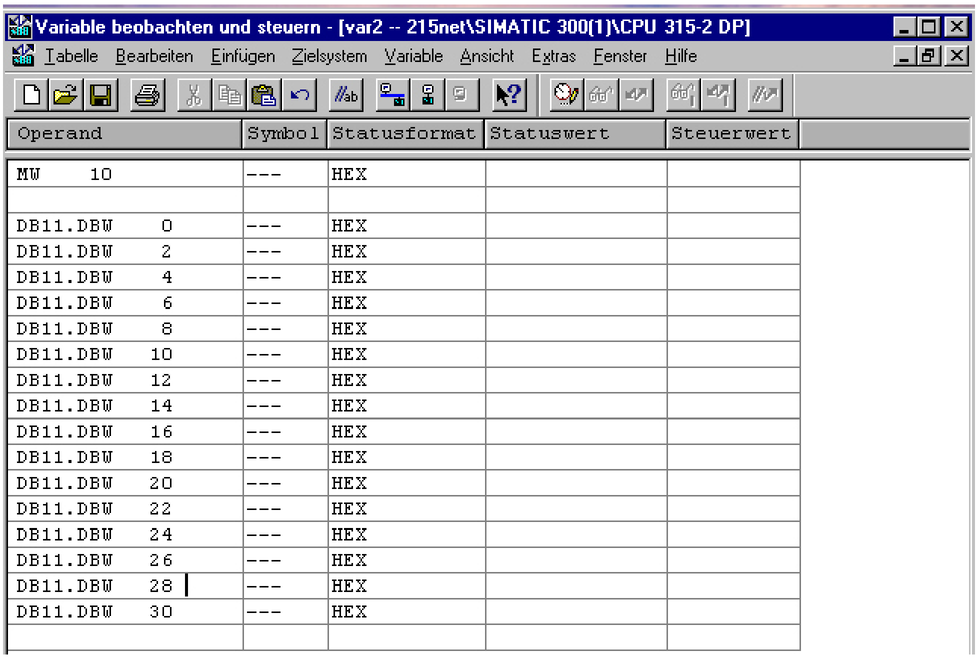
The starting point is a set of configured CPs and CPUs that have been reset, with the RUN/STOP switch in position STOP.

You must now load the above PLC programs into your CPUs and start these by placing them in RUN mode.

At this point communications between the modules is established. This is indicated by the COMM-LED.

Start the Siemens STEP®7 Manager and execute the following steps monitor the transmit job:

- **Target system** > *Control/monitor variable*
- Enter the required data block no. and the data word into the field under "Operand" (DB11.DW0-99).
- Establish a connection and click "Monitor" .


Variable beobachten und steuern - [var2 -- 215net\SIMATIC 300(1)\CPU 315-2 DP]
Tabelle Bearbeiten Einfügen Zielsystem Variable Ansicht Extras Fenster Hilfe

Operand	Symbol	Statusformat	Statuswert	Steuerwert
MW 10	---	HEX		
DB11.DBW 0	---	HEX		
DB11.DBW 2	---	HEX		
DB11.DBW 4	---	HEX		
DB11.DBW 6	---	HEX		
DB11.DBW 8	---	HEX		
DB11.DBW 10	---	HEX		
DB11.DBW 12	---	HEX		
DB11.DBW 14	---	HEX		
DB11.DBW 16	---	HEX		
DB11.DBW 18	---	HEX		
DB11.DBW 20	---	HEX		
DB11.DBW 22	---	HEX		
DB11.DBW 24	---	HEX		
DB11.DBW 26	---	HEX		
DB11.DBW 28	---	HEX		
DB11.DBW 30	---	HEX		

Entering user data

User data can be entered from DW 1. For this purpose you place the cursor on *Steuerwert* (control value) and enter the value that you wish to transfer, e.g. W#16#1111.

The value is transferred with every cycle when you click or once only when you click .

Installation

Installation checklist

- Decide on a plug-in location
- Turn the power supply for the PLC off
- Insert the module into the rack
- Connect the Twisted Pair Ethernet cable
- Turn the power supply for the PLC on
- transfer the project into the CP
- Place CP in RUN mode
- The CP must start without errors

Decide on a plug-in location

The CP443 is compatible with all module racks that have plug-in locations supporting a combined P- and K-bus interface.

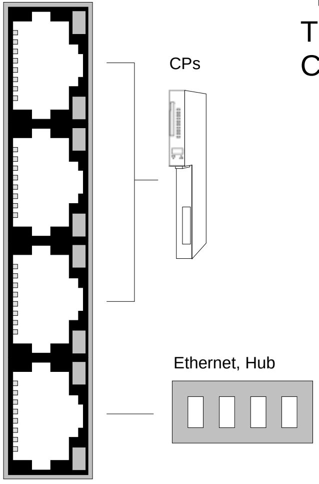
Attention!

The K-bus coupling is required when the Universal rack UR1 or UR2 is used as expansion rack!

Ethernet interface

The CP443 has an integrated 4-port hub. Use the lower RJ45-Buchse for uplinks to other hubs.

The upper 3 RJ45 sockets are provided for the connection of additional CPs directly to the CP443.



Note!

You can “hot-swap” the CP443, i.e. you can remove and insert the module when the power is turned on!

Initial configuration or initial “setup" only by means of the serial port

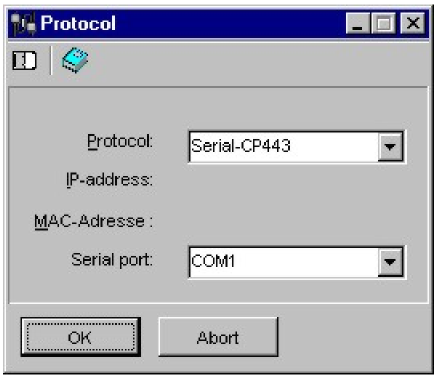
The initial configuration which is often also referred to as initial “setup” is the process required to specify the parameters for a module that has been received in its virgin state. With the exception of an Ethernet address such a module does not have any addresses.

Since the CP443 can not be accessed via the network when it is in this state (CP does not have an IP-Address) the initial configuration of the module must be completed via the serial port.

Note!

The IP address for access to the CP443 via Ethernet can only be defined and modified by means of the VIPA configuration tool WinNCS from version 3.0.

- Connect your CP to the PG and turn the power supply of the rack on.
- Start WinNCS, load your project and select the target station in the network window.
- Click Online in the main window. *This opens the online communication toolbar*
- Click Init. *The following dialog box is opened:*



Protocol

Protocol: Serial-CP443

IP-address:

MAC-Adresse :

Serial port: COM1

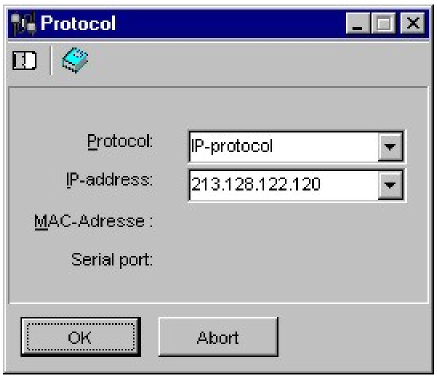
- Use the drop-down to select "Seriell-CP443" and click [OK]
- When you click Conn an attempt is made to establish a link.
- You can transfer your project to the CP by clicking CP PC. *The project is transferred and saved to Flash-ROM.*
- Use the Start control to place your CP in Run mode. *The CP is rebooted to activate the IP address.*

When the CP has completed the boot procedure the STOP-LED is turned off and the RUN LED is turned on. Now you can access the CP via the IP address. You can also force the CP to use the IP address by switching power off and on (NETZ AUS/EIN).

CP configuration via Ethernet

After the initial configuration has been completed you can access the CP by means of the IP address. You must always use the VIPA tool WinNCS from version 3.0 for the configuration of VIPA-CP's. For this reason you must remember that IP address for Ethernet access to the VIPA-CP can only be defined and modified by means of WinNCS.

- Connect your CP to the PG by means of the Ethernet and turn the power supply of your rack on.
- Start WinNCS and load your project. Select the target station in the network window
- Open the online functions [Online] as described under "Initial configuration" and click [Init]. *The following dialog box is displayed*



Protocol

Protocol: IP-protocol

IP-address: 213.128.122.120

MAC-Adresse :

Serial port:

- Select "IP-Protocol" and enter the IP address that you have assigned to the CP during the initial configuration. Click [OK]
- When you click [Conn] the link is established
- Click [CP PC] to transfer the project into the CP. The project is transmitted to the CP and saved in Flash-ROM.

Note!

The new IP address is used when the CP reboots, provided that Ethernet is on-line and that you have assigned a new IP-address.

As a consequence the CP is no longer accessible by WinNCS. The online link is terminated.

From this point onwards you can access the CP by the new IP address.

If you have been using the serial connection the link is not interrupted.

PG functions

Outline

When you are using a VIPA CP443 in a Siemens S7-400 system you can access the CPU online via the CP under observation of certain system-related restrictions to load, change, monitor and to save blocks and to execute "target-system" functions.

Differences with respect to the PG-functionality of a Siemens CP443

- Instead of "NetPro" from Siemens the connection is configured by means of the VIPA tool WinNCS V3.0. For this reason you must remember that the IP address to access the VIPA-CP on the network can only be defined and/or modified by the VIPA configuration tool WinNCS. AN IP address entered by means of the Siemens hardware manager is not accepted by the VIPA-CP.

  To ensure that the Siemens PG is aware of the IP address of the VIPA-CP, i.e. that it has stored it in the project, you must also specify the IP address of the VIPA-CP in the Siemens Hardware Configurator under "Properties".

- You should only go online if the CPU was selected in the Siemens SIMATIC manager.

  Target system functions can only be used for the CPU. A communication error is returned by the PG if you should have selected other modules.

  All target system functions are available for the CPU with the exception of the function "hardware diagnostics". This function is currently being developed.

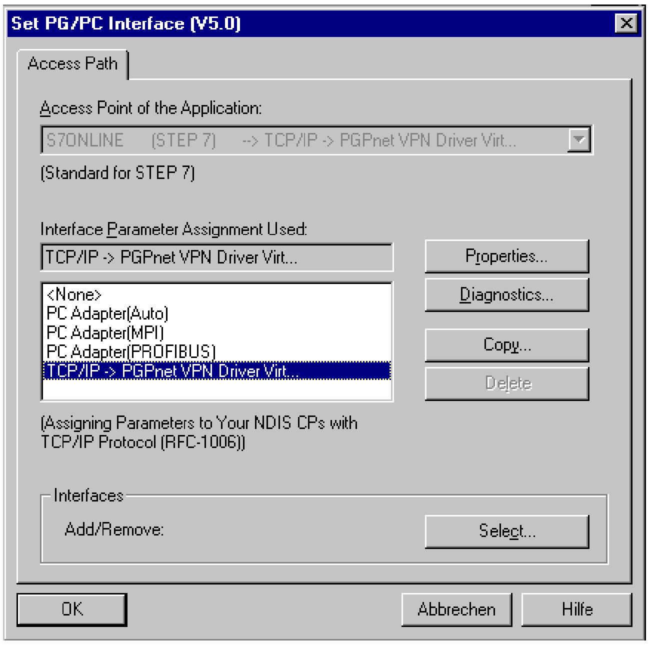
Online operation with the Siemens SIMATIC Manager

Conditions

- All data and programs have been transferred into CPU and the CPs.
- The VIPA-CPs were configured by means of WinNCS
- CPU and CPs are in RUN mode

Procedure

Start the Siemens SIMATIC Manager, load your project and open the following dialog box by clicking **Options** > *Set PG/PC Interface*



Set PG/PC Interface (V5.0)

Access Point of the Application:
S7ONLINE (STEP 7) --> TCP/IP -> PGPnet VPN Driver Virt...
(Standard for STEP 7)

Interface Parameter Assignment Used:
TCP/IP -> PGPnet VPN Driver Virt...

<None>
PC Adapter(Auto)
PC Adapter(MPI)
PC Adapter(PROFIBUS)
TCP/IP -> PGPnet VPN Driver Virt...

(Assigning Parameters to Your NDIS CPs with TCP/IP Protocol (RFC-1006))

Interfaces
Add/Remove:

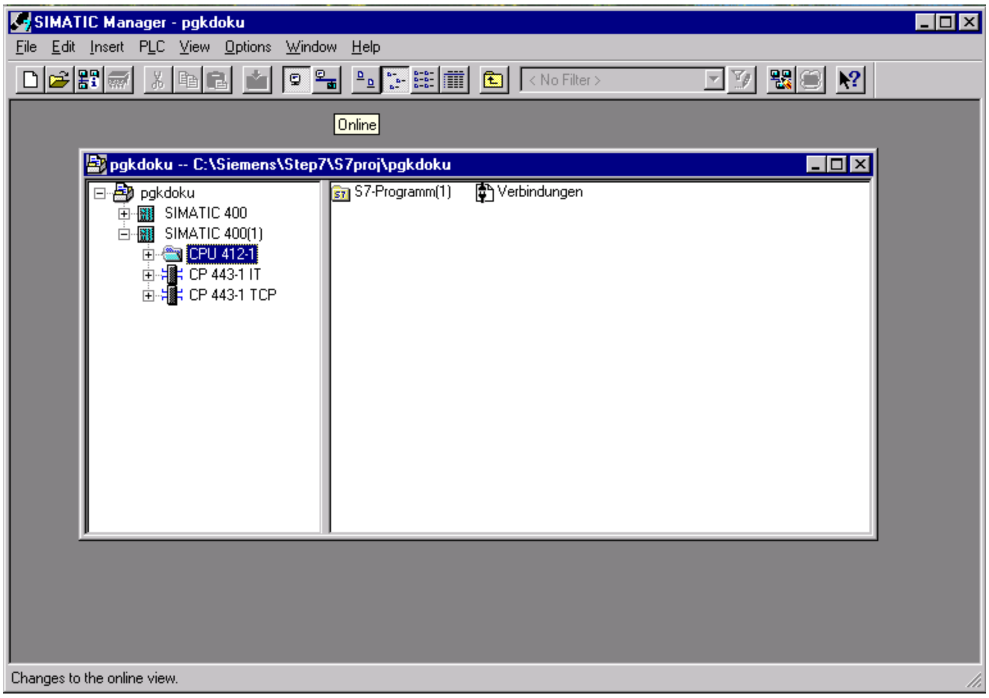
Select the following configuration for the interface as shown:

TCP/IP -> PGPnet VPN Driver Virt...

and confirm the entries by clicking [OK].

Online only when the CPU has been selected

You must only go online if the CPU has been selected in the Siemens SIMATIC Manager.


SIMATIC Manager - pgkdoku
File Edit Insert PLC View Options Window Help
< No Filter >
Online
pgkdoku -- C:\Siemens\Step7\S7proj\pgkdoku
pgkdoku
SIMATIC 400
SIMATIC 400(1)
CPU 412-1
CP 443-1 IT
CP 443-1 TCP
S7-Programm(1)
Verbindungen

Changes to the online view.

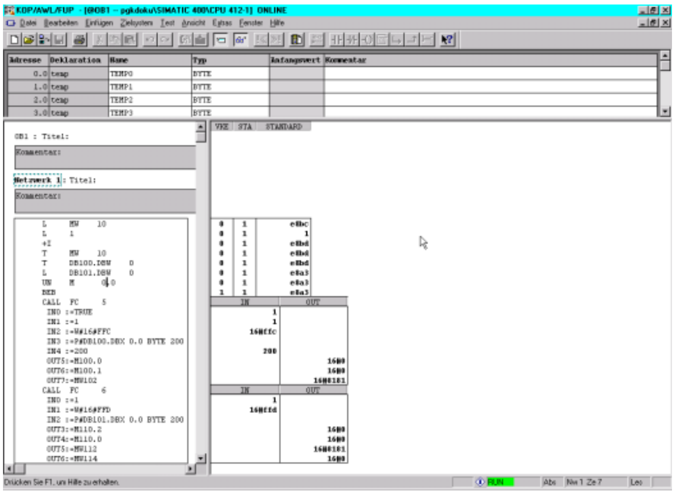
Note!

Should you have installed several CPs on your system you must specify one CP for network communications by specifying the respective IP address during the initial configuration. These settings are stored permanently in the project and are used automatically when the next online session is initiated.

Select the CPU as shown above and change to online mode. If you encounter problems turn the rack off, re-start the Siemens SIMATIC manager change to online operation.

Online block functions

As soon as you are online you have access to all the block related functions like upload block, edit, monitor, save, etc. The VIPA-CP supports all block functions.


KOP/AWL/FUP - [@OB1 -- pgkdoku\SIMATIC 400\CPU 412-1] ONLINE
Datei Bearbeiten Einfügen Zielsystem Test Ansicht Extras Fenster Hilfe
Drücken Sie F1, um Hilfe zu erhalten.
RUN
Abs
Nw 1 Ze 7

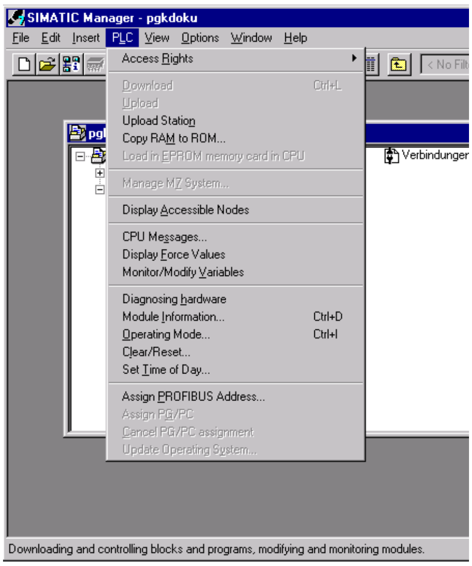
Adresse	Deklaration	Name	Typ	Anfangswert	Kommentar
0.0	temp	TEMP0	BYTE		
1.0	temp	TEMP1	BYTE		
2.0	temp	TEMP2	BYTE		
3.0	temp	TEMP3	BYTE		

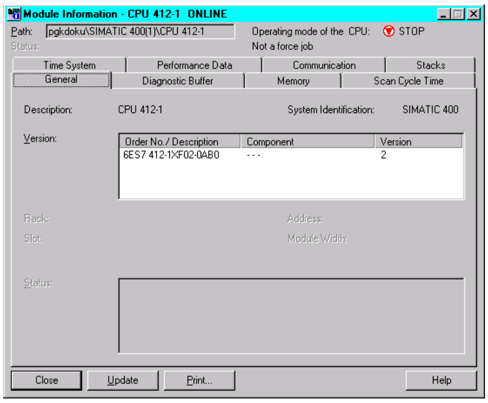
```
OB1 : Titel:
Kommentar:

Netzwerk 1: Titel:
Kommentar:

      L     MW    10
      L     1
      +I
      T     MW    10
      T     DB100.DBW    0
      L     DB101.DBW    0
      UN    M        0.0
      BEB
      CALL  FC      5
       IN0 :=TRUE
       IN1 :=1
       IN2 :=W#16#FFC
       IN3 :=P#DB100.DBX 0.0 BYTE 200
       IN4 :=200
       OUT5:=M100.0
       OUT6:=M100.1
       OUT7:=MW102
      CALL  FC      6
       IN0 :=1
       IN1 :=W#16#FFD
       IN2 :=P#DB101.DBX 0.0 BYTE 200
       OUT3:=M110.2
       OUT4:=M110.0
       OUT5:=MW112
       OUT6:=MW114
```

```
VKE  STA  STANDARD
 0    1       e8bc
 0    1          1
 0    1       e8bd
 0    1       e8bd
 0    1       e8bd
 0    1       e8a3
 0    1       e8a3
 1    1       e8a3
        IN          OUT
             1
             1
        16#ffc

           200
                      16#0
                      16#0
                   16#8181
        IN          OUT
             1
        16#ffd

                      16#0
                      16#0
                   16#8181
                      16#0
```

Online target system functions

The VIPA-CP supports all target system functions with the exception of the "diagnosing hardware" function. This function is being developed.





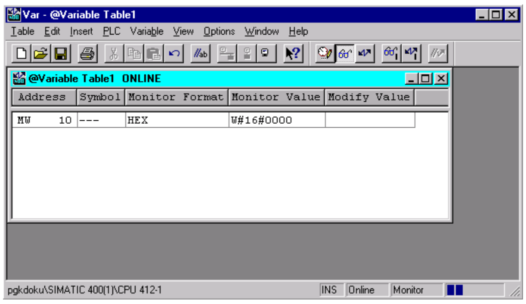
Path: pgkdoku\SIMATIC 400(1)\CPU 412-1
Operating mode of the CPU: STOP
Status:
Not a force job

Description: CPU 412-1
System Identification: SIMATIC 400

Version:

Order No./ Description	Component	Version
6ES7 412-1XF02-0AB0	- - -	2

Rack:
Slot:
Address:
Module Width:
Status:


Var - @Variable Table1
Table Edit Insert PLC Variable View Options Window Help
@Variable Table1 ONLINE
pgkdoku\SIMATIC 400(1)\CPU 412-1
INS
Online
Monitor

Address	Symbol	Monitor Format	Monitor Value	Modify Value
MW 10	---	HEX	W#16#0000	

Attention!

You must only go online if the CPU has been selected as shown in the figure above!

A communication error is returned by the PG if you should have selected other modules.

Chapter 5 Handler functions and communication

Outline

This chapter deals with handler function for TCP/IP communications that are supplied in the form of an FC library.

In addition to the handler blocks and transfer parameters the description also includes the indicator word and the configuration error-byte.

The chapter is concluded by certain information on interfacing to foreign systems by means of specifications for the ORG format and on the structure PLC-header.

The following are described below:

- An outline of all the parameters for the handler functions
- Configuration options for the handler functions
- Indicator word and PAFE
- Handler functions for TCP/IP communications
- Interfacing with foreign systems, ORG format, PLC header and TRADA

Contents

Topic **Page**

Outline

About handler functions

Handler functions or "HTFCs" permit the use of the CP in a Siemens S7-400.

Handler functions control the entire exchange of data between the CPU, the CPs and IPs.

Advantages of handler functions:

- reduces the amount of wasted application program memory
- quicker execution times for blocks.

Handler functions do not require:

- bit memory
- timer domains
- counter domains.

Overview

The following handler functions are available for the Siemens S7-400:

Type	No.	Title	Function
FC	120	SEND *	Send data
FC	121	RECEIVE *	Receive data
FC	122	FETCH	Fetch data
FC	123	CONTROL	Control processing of jobs
FC	124	RESET	Erase a job
FC	125	SYNCHRON	Establish an interface

* The time required depends on the size of the data block that must be transferred.

Parameters for the handler functions

All the handler functions below have a standardized interface with respect to the application program (also refer to the parameter description).

The following parameters are employed:

Parameter	Description	Range	Type
SSNR	Interface number	0 ... 255	INTEGER
A_NR	Job number	0 ... 223	INTEGER
QTYP/ZTYP*	Type of data source or of the data destination	D for DB, M for MB, R for RW	CHAR
DBNR*	Data block number for D, R	CPU dependent	INTEGER
QANF/ZANF*	Start address of the source/destination data block	0 ... 32764	INTEGER
QLAE/ZLAE*	Length of the source/destination block	0 ... 32767 no default length permitted (-1)	INTEGER
ANZW	Indicator word (double word)	MW	WORD
BLGR	Block size	0 ... 255	INTEGER
PAFE	Configuration error	MB	BYTE

*) Parameters that are not required by certain calls (e.g. "ALL" function) can be skipped by pressing "CR" when the block is being configured.

Parameter description for handler functions

SSNR

Interface number

The number of the logical interface (page-frame address) for the respective job.

Parameter type	: Integer
Useful range	: 0 ... 255

A_NR

Job number

The job number that was used for the logical interface

Parameter type	: Integer
Useful range	: 0 ... 223

In this case job number 0 has the special function "ALL" that is not permitted for the FETCH block.

(see example of the ALL function).

QTYP/ZTYP

Type of data source or data destination

This parameter can be used to define the type of data source (SEND) or data destination (RECEIVE and FETCH) by means of an ASCII string.

Parameter type	: Char
Useful range	: D, M, R

Letter	indicates ...
D	DB
M	MB
R	RW

DBNR

Data block number for TYP R, D

If the identifier R or D was specified for QTYP/ZTYP then the number of the required data block must be supplied with this parameter.

Parameter type	: Integer
Useful range	: the range is determined by the CPU that is employed.

QANF/ZANF

Start address of the source/destination data block (byte address)

If type R was used (indirect parameter) the DB number is specified where the parameters are located. Otherwise the parameter refers absolutely to the specified range.

Parameter type	: Integer
Possible range	: 0 ... 32764

QLAE/ZLAE Length of the source/destination data block

This parameter is specified in bytes or words, depending on the source/destination type.

Parameter type : Integer

Possible range : 0 ... 32767

The entered value must be divisible by 4. A default value (-1) is not supported at present.

ANZW Indicator word (double word)

Address of the indicator double word located in the application memory where the completion of the job specified under A_NR is signaled.

Parameter type : Word

Valid range : MW occupied is stored in MW and MW+2

Structure of the ANZW: see structure of indicator word below.

BLGR Block size

After a complete restart the handler block "SYNCHRON" negotiates the block size (size of the data blocks) between the stations.

In this respect a large block size = high data throughput but also increased run times resulting in additional load on the cycle time.

Small block size = reduced data throughput but also reduced run times for the blocks.

Parameter type : Integer

Possible range : 0 ... 255

Available block sizes:

Value	Block size
0	the block uses default parameters (set to 512 bytes on the CP443)
1	16 byte blocks
2	32 byte blocks
3	64 byte blocks
4	128 byte blocks
5	256 byte blocks
6	512 byte blocks

>6 and < 255 interpreted as 0.

PAFE Error indicator for configuration errors

The specified byte in bit memory is set if the block detects a "configuration error", e.g. interface (connection) does not exist or illegal QTYP/ZTYP; QANF/ZANF;QALAE/ZLAE parameter setting.

Parameter type : Byte

Useful range : MB 0...MB 255

Configuration of SSNR, A_NR, ANZW and BLGR

SSNR and A_NR are of the type integer. The indicator word ANZW occupies a flag word.

Direct adressing

```
    CALL  "HTFC_RECEIVE_0.6  //SFC121
    SSSR:=0                  //Interface number 0
    A_NR:=3                  //Job number 3
    QTYP:=′D′                //Data source
    DBNR:=12                 //DB-No. 12
    QANF:=0                  //Data source at DBW0
    QLAE:=100                //Quantity of data: 100 words
    ANZW:=MW100              //Indicator word MW100
    PAFE:=MB199              //Configuration error byte MB199
```

Indirect adressing

```
L      0
T      MW   0                //Interface number 0
L      3
T      MW   2                //Job number 3
L      ′D′
T      MB   4                //Data source
L      12
T      MW   5                //DB-No. 12
L      0
T      MW   7                //Data source at DBW0
L      100
T      MW   9                //Quantity of data: 100 words
```

```
    CALL  "HTFC_RECEIVE_0.6  //SFC121
    SSSR:=MW0                //Interface number 0
    A_NR:=MW2                //Job number 3
    QTYP:=MB4                //Data source
    DBNR:=MW5                //DB-No. 12
    QANF:=MW7                //Data source at DW0
    QLAE:=MW9                //Quantity of data: 100 words
    ANZW:=MW100              //Indicator word MW100
    PAFE:=MB199              //Configuration error byte MB199
```

Indirect configuration of source and destination settings

Parameter

Parameter used for indirect configuration R (READ/WRITE)
DB-NR = DBNR if the high byte = 0

QANF + 0 CHAR	QTYP except for R	Description "data source"
1 INTEGER	DBNR DB-NR. for "Typ" D	
2 INTEGER	QANF source start address	
3 INTEGER	QLAE source length	
4 CHAR	ZTYP except for R	Description "data destination"
5 INTEGER	DBNR DB-NR for "ZTYP" D	
6 INTEGER	ZANF destination start address	
7 INTEGER	ZLAE destination length	

Available QTYP/ZTYP parameters

QTYP/ZTYP Description	R	D	M
	Indirect add-ressing without data exchange; Source/destination parameters are available in a DB.	Source/destination data from/into DB in main memory.	Source/destination data from/to bit memory area.
DBNR significance	DB where the source/ destination parameters are available.	DB where the source - data can be retrieved or into which destination data is transferred.	irrelevant
Valid range	2...255	2...255	
QANF/ ZANF significance	[1] DB-No. from where the stored parameters start.	[1] DB-No. from where the data can be retrieved or where it can be saved.	Bit-memory No. from where the data can be retrieved or where it can be saved.
Valid range	0....2047	0...2047	0...255
QLAE/ ZLAE significance	irrelevant	Length of source/ destination data block in Words.	Length of source/ destination data block in byte.
Valid range		1...2048	1...255

[1] When the source/destination is a CP for the Siemens S5 this location must contain the address of a data word instead of a data byte.

Indicator word structure

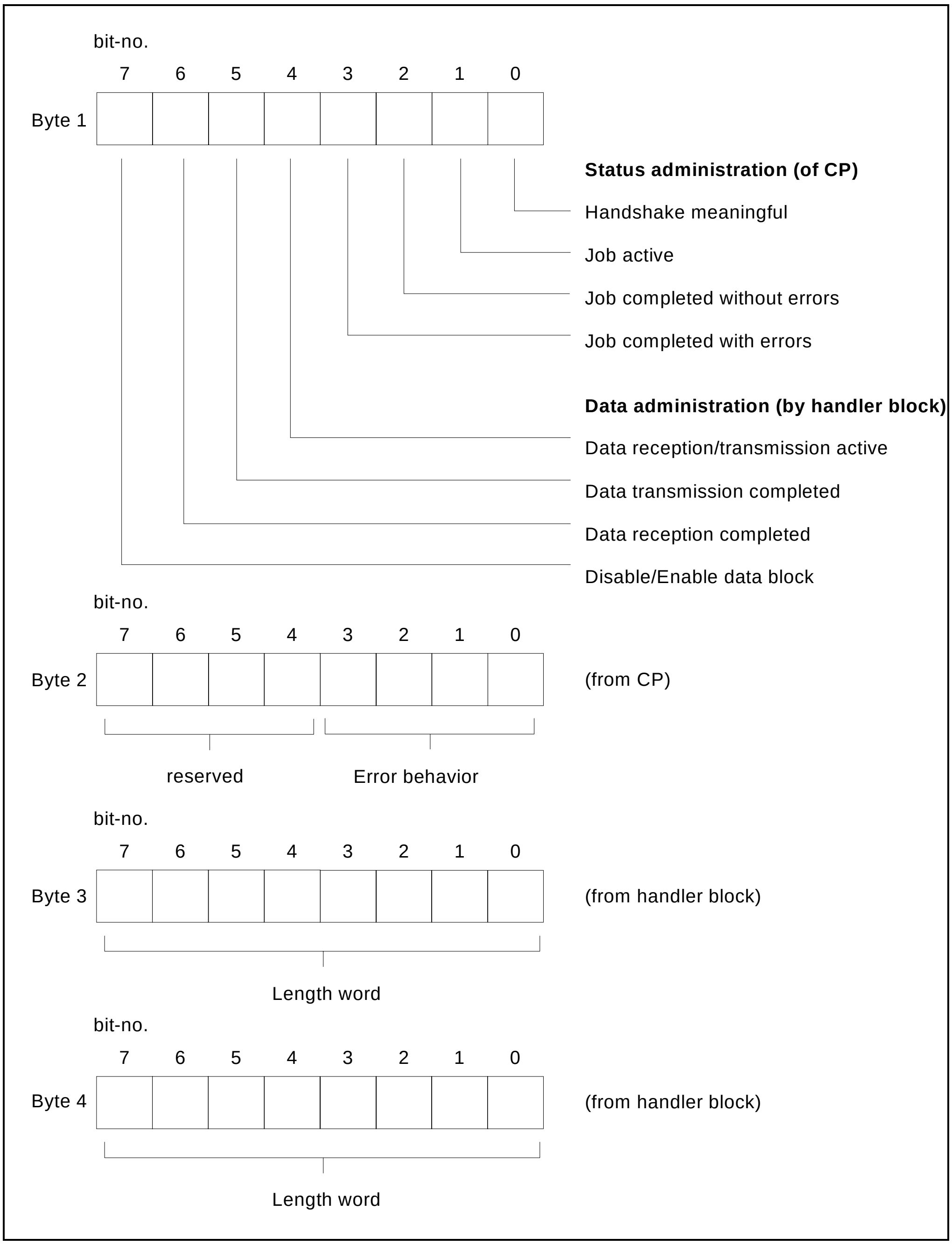
Status and error indicators

Status and error indicators are returned by handler functions:

- in indicator word ANZW (information on processing of jobs),
- in configuration error byte PAFE (indication of a bad parameter configuration for the job).

Contents and structure of indicator word ANZW

The basic structure of the indicator word is as follows:



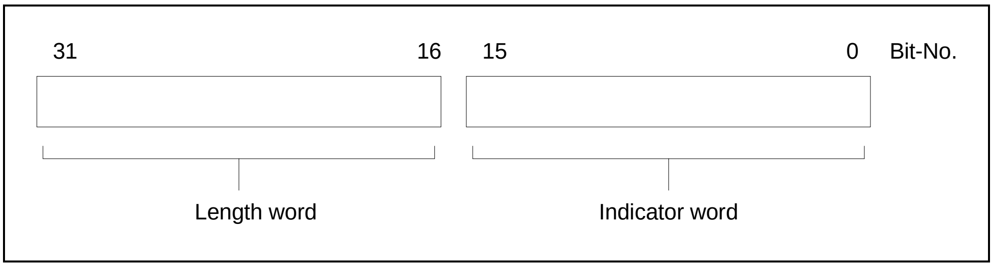
Status and error indicator in the indicator word

Function description

The “indicator word” contains the status for a specific job on the CP.

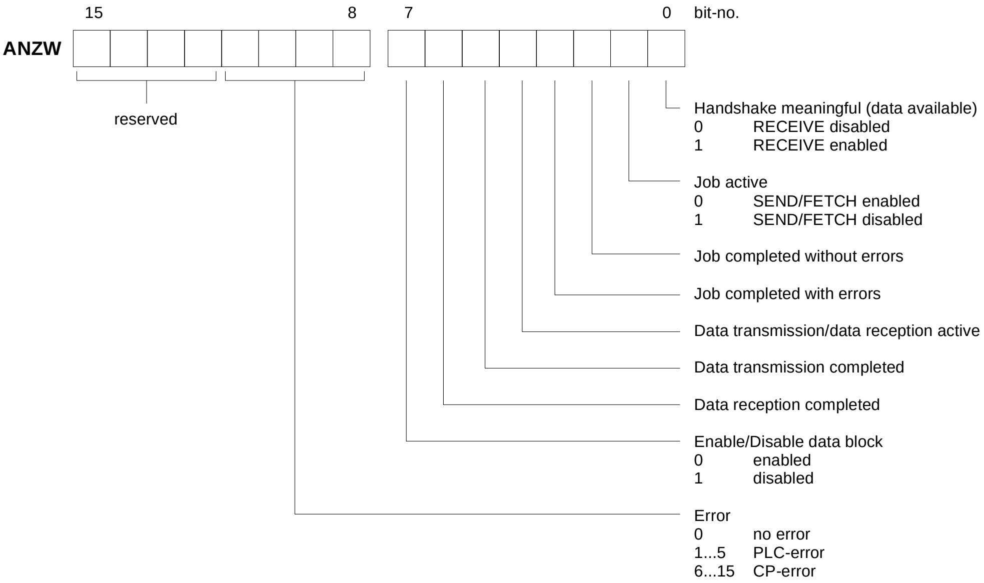
In the PLC program every defined job should be associated with a separate "indicator word".

The "indicator word" has the following structure:



The handler blocks (SEND, RECEIVE) save the data that was already transferred for the respective job in the length word; received data in receive jobs; data that has already been transmitted in send jobs.

The contents of the "length word" are always in bytes and absolute.



Indicator word

Status administration byte 1 bit 0 ... bit 3

This byte indicates whether a job has been started, whether errors have occurred or whether the job, has been locked, for example if the virtual connection does not exist.

Bit 0: Handshake meaningful

Set: by the interface, in accordance with the "delete" indicator in the job status bit. Handshake meaningful (=1) is used with the RECEIVE-block. (message available with PRIO 1 or RECEIVE triggering possible with PRIO 2/3)

Evaluation: by the RECEIVE-block: only if this bit is set does the RECEIVE handshake with the CP. By the application: For RECEIVE-requests (check whether a message is available for PRIO 1).

Bit 1: Job active

Set: by the interface, when job was issued to the CP.

Delete: by the interface, when a job has been completed (e.g. acknowledgment received).

Evaluation: by the Handler blocks: a new job is only issued when the "old" job has been completed.

By the user: to check whether it is possible to trigger a new job.

Bit 2: Job completed without errors

Set: by the interface, when the respective job was completed without errors.

Delete: by the interface, when the job is triggered again.

Evaluation: by the user to check whether the job was completed without errors.

Bit 3: Job completed with errors

Set: by the interface, when the respective job was completed with errors. The reason for the error is encoded in the high-portion of the indicator word.

Delete: by the interface, when the job is triggered again.

Evaluation: by the user: to check whether the job was completed with errors. If the identifier "Job completed with errors" is set the high byte of the indicator word contains the reason for the error.

Data administration byte 1, bit 4 to bit 7

This area contains the encoded instruction whether the data transfer for the job is still active or whether the data transfer as well as data reception has already been completed. The "Enable / Disable" bit can be used to inhibit data transfers for the job. (Disable = 1; Enable = 0).

Bit 4: Data reception / Data transfer active

Set: by means of handler blocks SEND, RECEIVE, when the transfer/reception was started for a job, e.g. if data is exchanged by means of the ALL function (DMA-replacement) but the action was triggered by means of SEND-DIREKT.

Delete: by means of handler blocks SEND, RECEIVE, if the data exchange has been completed for a job (last sub-block was transferred).

Evaluate: By the user: during CP << >> INC data-transfer the user must not change the record for the job. In PRIO 0/1 jobs this is not critical since the data transfer can be completed in a single cycle through the block. Larger quantities of data can, however, only be transferred in blocks. The respective blocks are distributed over several CPU cycles. To maintain data consistency it must be checked whether the data block is being transferred before its contents is altered.

Bit 5: Data transfer completed

Set: by the handler block SEND when the data transfer for a job has been completed.

Delete: By handler block SEND the data transfer for a new job (new trigger) was started .

By the user: If the evaluation took place (edge generation).

Evaluate: By the user: this bit checks whether the record for a job was already transferred to the CP or at what time a new record can be supplied for an active job (e.g. cyclic transfer).

Bit 6: Data transfer completed

Set: By the handler block RECEIVE, when the data transfer for a job has been completed.

Delete: By the handler block RECEIVE, when the data transfer to the CPU was started for a new job. By the user, when the evaluation is being done (edge generation).

Evaluate: By the user: The user can use this bit to determine whether a data record of a job was already transferred to the CPU or not or when a new record for the active job was transferred into the CPU.

Bit 7: Disable / Enable data block

Set: By the user, to prevent overwriting of a memory area by the RECEIVE block or to prevent the SEND block from reading data from a memory area (only for the 1st data block).

Delete: By the user, to release the respective data blocks.

Evaluate: By handler blocks SEND and RECEIVE. If bit 7 is set the block will not start a data transfer but instead report an error to the CP.

Error management byte 2, bit 0 to bit 3

This is where the error indicators of the job are stored. These error indicators are only valid if bit "Job completed with errors" in the status bit was set simultaneously.

The following error messages can be displayed:

0 no error

If the bit “Job completed with errors” is set the CP was forced to re-establish the communication link, e.g. after a reboot or a RESET.

1 bad Q/ZTYP at the HTB

The job was configured with an incorrect TYP-identifier

2 Area does not exist in the CPU

The job was started with a bad DB (DBNR).

3 Area in CPU too small

The sum of Q/ZANF and Q/ZLAE exceeds the boundaries of the area. The boundaries for data blocks are determined by the block size. In case of flags, timers, counters etc. the area size depends on the CPU.

4 reserved

5 Indicator word errors

The specified indicator word cannot be processed. This error occurs if a data word as well as a double word were specified with ANZW and the respective words are not yet or no longer available in the specified data block, i.e. DB too small or it does not exist.

6 no valid ORG-format

The destination or source for the data was not specified in the handle block (Q/TYP="NN") or in the connection block.

7 Reserved

8 no unused transport connections

The transport connection capacity was exceeded. Delete all unnecessary connections.

9 Remote error

An error occurred at the communication partner in a READ/WRITE job.

A Connection error

The connection required for a job does not exist. This error is cleared as soon as a connection can be established. If all the connections of the CP have been are interrupted this indicates a defective module or bus cable. The error can also be caused by bad configuration, e.g. incorrect addressing.

B Handshake error

This can be a system error or the data block size that was selected is too high.

C Triggering error

An incorrect handler block was used to trigger the job or the transferred data block was too large.

D Termination after RESET

This is an operational message. For priority 1 and 2 the connection was interrupted and it is being re-established as soon as the communication partner is ready for a new connection. In case of priority 3 connections the connection was cleared, it can be re-triggered.

E Job with bootstrap function

This is an operational message. The job is a READ/WRITE-PASSIV and it can not be started from the CPU.

F Job does not exist

The requested job was not configured on the CP. This error can occur when the SSNR/A-NR combination is entered incorrectly into the handler block or if a connection block was not entered.

Bits 4 to 7 of byte 2 are reserved for future expansion.

Length word byte 3 ... byte 4

The handler blocks (SEND, RECEIVE) deposit the quantity of data that has already been transferred for the respective job in the length word, i.e. for receive jobs the quantity that has already been received, for transmit jobs the quantity of data that has already been transmitted.

Description: During the data exchange SEND, RECEIVE calculates the "Length word" from:

actual quantity transferred + quantity already transferred

Delete: By overwriting as well as with every new SEND, RECEIVE, FETCH.

When the bit "Job completed without errors" or "Data-transfer/reception completed" is set the "length word" contains the up to date source or destination length.

If the bit "Job completed with error" is set then the length word contains the quantity of data that was transferred before the error occurred.

Important status and error indicators of the CP443

The following section describes important status and error messages that can appear in the "indicator word". The representation makes use of "HEX"-patterns. The X means "undefined" or "irrelevant"; No. is the error-number.

Possible indicator words

Indicator word: X F X A

Error indicator ”F" shows that the respective job was not defined on the CP 443. Status indicator A inhibits the job (for SEND / FETCH and RECEIVE).

Indicator word: X A X A

Error indicator “A” shows that the connection for the communication task was not or not yet established. Status indicator "A" inhibits both SEND as well as RECEIVE and FETCH.

Indicator word: X 0 X 8

The connection was re-established (e.g. after a CP-reboot), SEND is enabled (communication task SEND).

Indicator word: X 0 X 9

The connection was re-established, RECEIVE is enabled. (communication task RECEIVE).

Indicator word: X 0 2 4

SEND was processed without errors, the data was transferred.

Indicator word: X 0 4 5

RECEIVE was processed without errors, the data was transferred into the PLC.

Indicator word: X 0 X 2

The SEND-, RECEIVE-, READ- or WRITE job is active. In case of SEND the partner has not yet changed to RECEIVE mode. For RECEIVE the partner has not yet issued the SEND.

Important indicator word status combinations

The following table shows the most important status combinations of the indicator word :

Indicators during SEND/RECEIVE

Status	Prio 2
after a complete restart	0 A 0 A
after a connection has been established	X 0 X 9
after a send job was triggered	X 0 X 2 X 0 X 3
RECEIVE handshake is meaningful and SEND job active	X 0 X 3
RECEIVE handshake is meaningful and SEND job completed	X 0 X 5 X 0 X 9
SEND completed without errors	X 0 X 4 X 0 X 5
SEND completed with errors	X Nr. X 8 X Nr. X 9
after a RESET	X D X A

Due to the combination of send and receive operations in a single job no. SEND is managed by bit 1 "job active" and RECEIVE by bit 0 "handshake meaningful" in the indicator word.

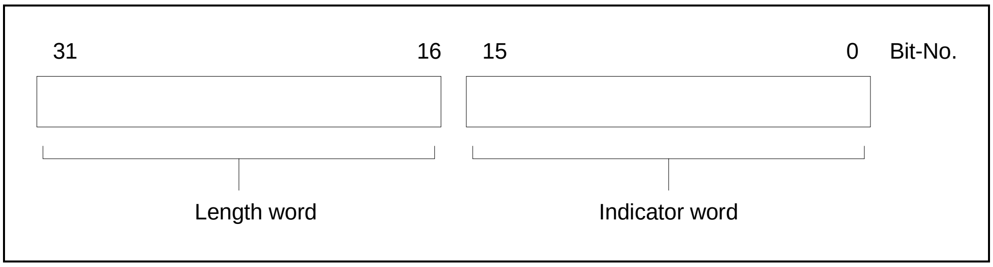
Note!

You should define different data-areas for the indicator words SEND and RECEIVE so that the indicator word and the length word can be processed differently by the ALL blocks during data reception and transmission!

Indicators during READ/WRITE-AKTIV

Status	Prio 2
after a complete restart	0 A 0 A
when connection is established	X 0 0 8
after a trigger	X 0 X 2
READ complete	X 0 4 4
WRITE complete	X 0 2 4
complete with errors	X Nr X 8
after RESET	X D X A

Length word



The handler block (SEND, RECEIVE) deposits the data that that it has transferred for the respective job in the length word ; received data in receive jobs; transmitted data in send jobs.

The entry in the "length word" is always in bytes and absolute.

Length word byte 3 and byte 4

Handler blocks (SEND, RECEIVE) deposit the quantity of data that has already been transferred for the respective job in the length word, i.e. for receive jobs the quantity that has already been received, for transmit jobs the quantity of data that has already been transmitted.

Description: During the data exchange SEND, RECEIVE calculates the "Length word" from:

actual quantity transferred + quantity already transferred

Delete: By overwriting as well as with every new SEND, RECEIVE, FETCH.

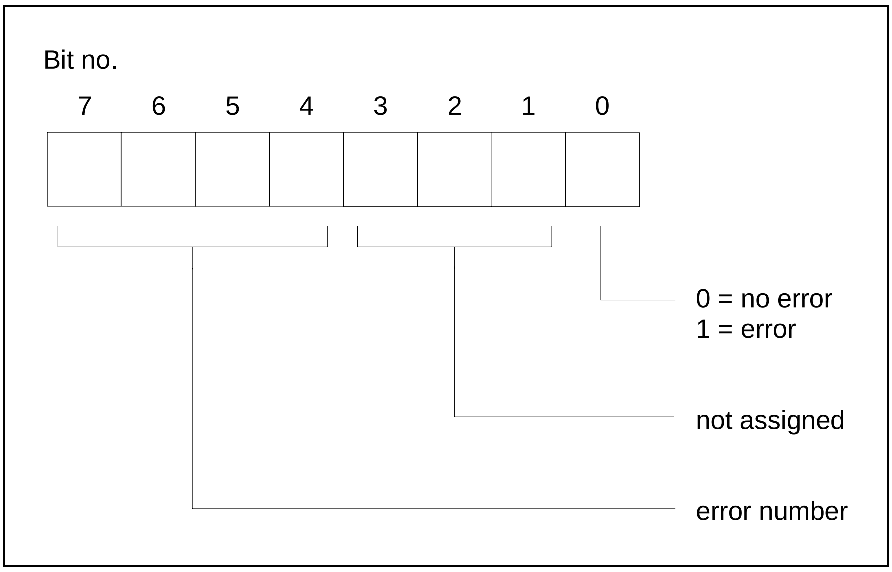
When the bit "Job completed without errors" or "Data-transfer/reception completed" is set the "length word" contains the up to date source or destination length.

If the bit "Job completed with error" is set then the length word contains the quantity of data that was transferred before the error occurred.

Structure of the configuration error byte - PAFE

PAFE configuration error byte

The PAFE is set when a handler block has detected a configuration error.

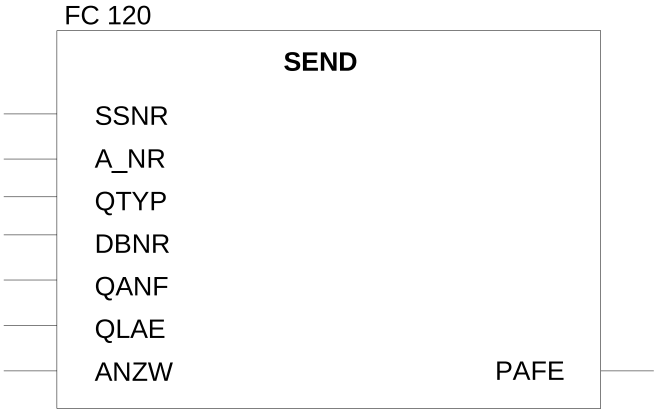


Error numbers:

0	no error
1	bad ORG format
2	area does not exist
3	area too small
4	reserved
5	bad indicator word
6	no source/destination parameter for SEND / RECEIVE ALL
7	interface does not exist
8	interface faulty
9	interface overload
A	not used
B	illegal job number ANR
C	interface does not acknowledge or not enabled
D	not assigned
E	not assigned
F	not assigned

FC 120 - SEND

The SEND block is used to initiate a job for a CP with or without data transfer.



Parameters

SSNR: Interface number, number of the logical interface

A_NR: the job that must be initiated at the interface, i.e. start transmission of a message

QTYP: Type of data source where the data originates

DBNR: Number of the data block for QTYP XX, RW (read/write), DB

QANF: "Relative start address" of the data Source

QLAE: Source data quantity (in bytes or words)

ANZW: Address of the indicator word (double word) where the progress of the started job is being displayed

PAFE: Error indicator for configuration errors

SEND-ALL

Description of the SEND-ALL-function

For the SEND-ALL function (job number 0) the block only requires parameters: SSNR, A-NR = 0, ANZW and PAFE.

All other parameters are irrelevant for this job. For the SEND-ALL-function the CP must supply the address of the indicator word, the specification of the data type, the quantity and the start address of the data in the communication area.

In the indicator word, that is assigned to the relevant job the bits for "ENABLE/DISABLE", "Data transfer completed" as well as "Data-transfer active" can be tested or modified. The quantity of data for a job is displayed by SEND-ALL in the data or flag word following the ANZW.

The block-indicator-word (indicator word, that was configured in the SEND-ALL-block) contains the current job number (0 means dummy run). The quantity of data that must be transferred for a job is displayed by SEND-ALL in the data word that follows after the indicator word.

The SEND-ALL-function (i.e. the call to the send-block including the ALL-configuration) must be called at least once within a PLC-cycle for every interface when:

- the CP can request data independently from a PLC.
- a CP-job is initiated by a SEND-DIREKT, but the CP only requests the data for this job via “background communications” from the PLC.
- the quantity of data that is transferred to the CP with SEND-DIREKT is larger than the specified block size.

SEND-DIRECT

Description of the SEND-DIREKT function

The block required the following parameters for the "DIREKT"-function:

- interface number
- job number >< 0
- specification of the indicator word
- specification of the error byte "PAFE"
- source type with DBNR
- source start address
- the quantity of source data.

Normally the "SEND-DIREKT"-block is called from the cyclic portion of the application program. It is possible to include the block in the interrupt or watchdog section of the program, but the indicator word (ANZW) can not be updated cyclically in this case (it must be transferred by means of the CONTROL-block).

For the data transfer and for the activation of the send trigger the connection to the CP is only established when:

- FC was supplied with VKE "1".
- the CP has enabled the job. (Bit "Job active" in ANZW =0).

Only the indicator word is updated when the block is idle (when VKE "0" is transferred).

If the QTYP-parameter contains identifier "NN" the source-parameters of the CP are used. If these parameters are also not available then the job is terminated with an error-message.

If the CP can obtain on the data directly the SEND-block transfers the requested data in one process into the CP. However, if the CP signals that it only requires the parameters of the job or if the quantity of the data that must be transferred is too high only the parameters (QTYP/QLAE etc.) or the parameters of the first data block are transferred to the CP. The data or the subsequent blocks for these jobs are requested by the CP by means of the SEND ALL function from the PLC. For this purpose it is necessary that the SEND ALL block be called at least once in every PLC-cycle.

The operator interface is same for all "triggering types", only the time of the data-transfer is postponed by at least one cycle for the last cases mentioned above.

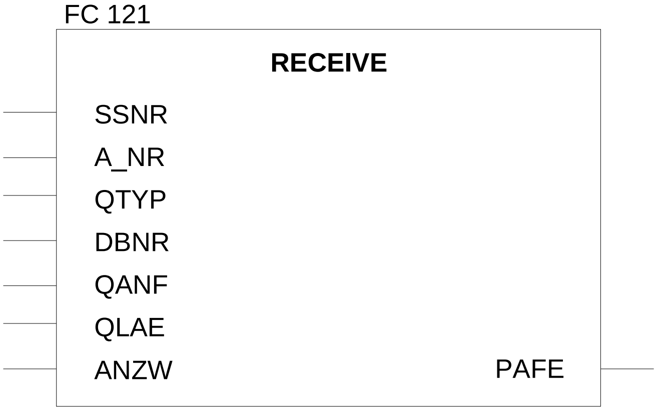
WRITE function

Description of the WRITE-function

Indirectly specified source and destination parameters are transferred to the CP during configuration with QTYP = "RW" using "SEND". In this case the destination parameters together with the user data (that were requested by means of SEND ALL) is transmitted to the communication partner ("WRITE"-function).

FC 121 - RECEIVE

The RECEIVE-block requests the status of or starts a RECEIVE-job on a CP, with or without data transfer.



Parameter

SSNR: Interface number, number of the logical interface

A_NR: RECEIVE-job of the interface, interrogation after a message was received along with the data transfer

QTYP: The type of data destination where the data should be stored.

DBNR: Number of the DB for QTYP XX, DB

QANF: "Relative start address" of the data destination

QLAE: Quantity of data that must be transferred

ANZW: Address of the indicator word (double word) where the completion of the job is displayed

PAFE: Error indicator for configuration errors

RECEIVE-ALL

Description of the RECEIVE-ALL-function

For the RECEIVE-ALL-function (job number " 0 ") the block only requires the interface number, the job number = 0, the output "PAFE" and the indicator word. All other parameters are irrelevant for this operating mode. For the RECEIVE ALL function the address of the indicator word, the specification of the type, the start address and the quantity of destination data is provided to the FC by the CP via the communication area. In the indicator word assigned to the job that must be processed, the bits "Enable/Disable", "Data transfer completed" as well as "Data transfer/read active" are tested or modified and the length of received data is stored in the next word.

The current job number for which the RECEIVE ALL was active is saved in the block indicator word (configured indicator word of RECEIVE ALL). When RECEIVE ALL is idle the block indicator word id empty.

The RECEIVE ALL (i.e. the RECEIVE-block with the ALL-configuration) must be called at least once per PLC-cycle when:

- the CP must transfer data automatically to the PLC.
- a data block that is larger than the defined block size must be received by means of RECEIVE-DIREKT.

The function block "RECEIVE-ALL" can be called by the user in:

- the cyclic portion of the program (e.g. in OB 1),
- the timer controlled portion of the program (e.g. watchdog block),
- interrupt controlled program portion (process alarms).

RECEIVE-DIRECT

The block requires the following parameters for the RECEIVE-DIRECT function:

• SSNR	interface number
• A-NR	job number ><0
• ANZW	definition of the indicator word
• PAFE	specification of the error byte "PAFE"
• QTYP	destination type possibly with DBNR
• QANF	destination/start address
• QLAE	quantity of data to be transferred

Normally the RECEIVE-block is called in the cyclic portion of the application program. The program can also be included in the interrupt or watchdog portion of the program, however, in this case the indicator word is not updated cyclically. This must then be done by the CONTROL-block.

The handshaking traffic with the CP (i.e. the triggering of a job) is only accepted by the RECEIVE block in the "DIREKT"-function when:

- VKE "1" is transferred to the FC and
- the CP has enabled the job. (bit "Handshake meaningful” = 1).

Only the indicator word will be updated when the block is “idle”.

The RECEIVE-(DIRECT)-block reacts differently, depending on the type of input and on the CP-reaction:

- If the indicator "NN" is entered into the QTYP-parameter the block expects the destination parameters (type, start, length of destination data-block) from the CP. If the CP supplied a parameter set and the RECEIVE-block has already been provided with destination parameters, (QTYP><NN) then the parameters of the block are preferred over the ones supplied by the CP.
- Large quantities of data can only be transferred in blocks. For this purpose this set of linked blocks must be transferred into the PLC by means of the RECEIVE-ALL. The call to RECEIVE-ALL must occur at least once per cycle (for every CP-interface) when it is necessary that large quantities of data are exchanged with a CP. It is also necessary to include the RECEIVE-ALL in the cycle when the CP uses the RECEIVE-DIREKT only to release a received message and to transfer the data via the "background communication routine" into the PLC.
- In the RECEIVE the configuration with QTYP = "RW" is illegal.

FC 122 - FETCH

The FETCH-block issues a fetch job to a partner station.

The FETCH-job defines the source and destination for the data and this is then transferred to the partner station.

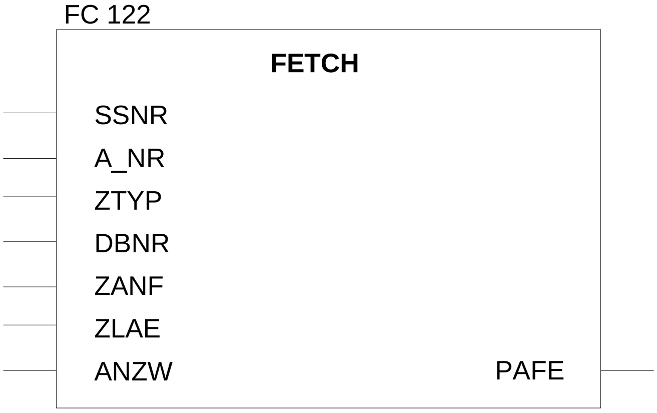
For the VIPA CPU 24x the source and destination is specified indirectly in a DB. The respective number for the FETCH is entered into DBNR. The identification of the indirect specification is done by means of ZTYP=RW.

The partner station prepares the data and returns this via SEND-ALL to the requesting station. The data is received by means of RECEIVE-ALL and are saved on the destination.

The update of the indicator word is handled by the FETCH or the CONTROL.

The handshaking exchange for triggering the FETCH is only started when

- the block was supplied with VKE "1"
- the function was released in the respective CP-indicator word (job active = 0).



Parameter

SSNR:	Interface number, number of the logical interface
A_NR:	FETCH- or READ-job that must be started
ZTYP:	Type of data destination (DB, flag, etc.)
DBNR:	Number of the DB for ZTYP XX, RW, DB
ZANF:	"Relative start address" of the data destination
ZLAE:	Quantity of data that must be transferred.
ANZW:	Indicator word (address of indicator word).
PAFE:	Error indicator for configuration errors.

Note!

Detailed information on the indirect configuration is available on page 5-7.

FC 123 - CONTROL

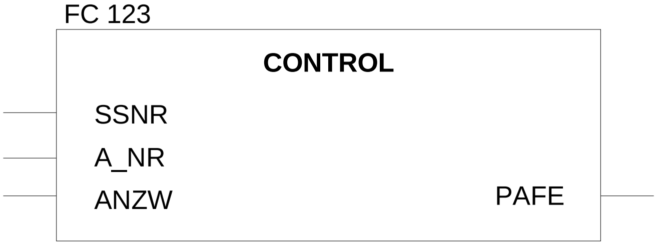
The purpose of the CONTROL-block is as follows:

- to update the indicator word (job number >< 0 was configured).
- check whether a certain job of the CP is “active” at the moment, e.g. check after a message was received (job no. >< 0 was configured).
- check which job is currently being processed by the CP (job no. = 0 was configured).

The CONTROL block does not enter into handshaking traffic with the CP, it only transfers the indicators from the "job-status" into the configured indicator word. This block does not depend on the status of the VKE should be called in the cyclic portion of the program.

The indicator word for the CONTROL-DIRECT function (parameter A-NR><0) has the same contents and it is processed in the same manner as all other "handler blocks" (see description of block parameter ANZW).

If the "job number" parameter is provided with a 0 the CONTROL-command transfers the contents of the job-status-cell 0 to the LOW-portion of the indicator word. The CP stores the number of the current job (that is the job, that is being processed right now, e.g. the job number of a message) into the job-status-cell 0.



Parameter

SSNR: Interface number

A_NR: Job on the CP that must be monitored, e.g. test, whether the started job was completed with or without errors.

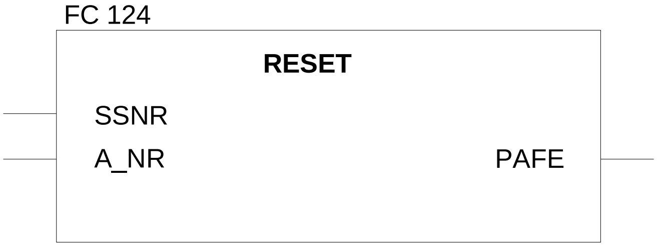
ANZW: Indicator word returning the result of the test to the user.

PAFE: Error byte when configuration errors are encountered.

FC 124 - RESET

The RESET ALL-function is selected by means of job number 0. This resets all the jobs of this logical interface; for instance, it deletes all job data and breaks terminates all active jobs. A "direct" function (job number><0) only resets the specified job on the logical interface.

The block depends on the status of the VKE and can be called from the cyclic, the timer controlled or the alarm controlled portion of the program.



Parameter

SSNR:	Interface number
A-NR:	Number of the job that must be reset
PAFE:	Error byte when configuration errors are encountered.

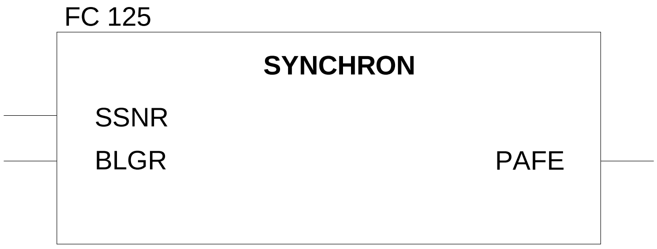
Operating modes

The block recognizes the following operating modes:

- RESET ALL
- RESET DIREKT.

FC 125 - SYNCHRON

This block initiates the synchronization between the PLC and the CP and for this reason it must be called during the start-up OBs. At the same time the transfer area of the interface is cleared and set to the default and the block-size between CP and PLC is negotiated.



Parameter

SSNR:	Interface number
BLGR:	Block size
PAFE:	Parameter error

Block sizes

The following block sizes can be selected:

Value	Block size
0	The block uses default parameters (set to 512 byte on the CP443)
1	16 byte blocks
2	32 byte blocks
3	64 byte blocks
4	128 byte blocks
5	256 byte blocks
6	512 byte blocks

>6 and < 255 is treated as 0.

Communication links to foreign systems

ORG format

The organization-format is the abbreviated description of a data-source or a data-destination in a PLC environment. The following table lists the available ORG-formats.

In the case of READ and WRITE the ORG-block is optional.

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
Quantity	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
ORG identifier	01h	02h
Description	Source/destination data from/into data block in main memory.	source/destination data from/into flag area.
DBNR valid range:	DB from where the source data is retrieved or to where the destination data is transferred. 1...255	irrelevant
Start address Significance valid range:	DW-No. from where the data is retrieved or where data is saved. 1...2047	MB- No. from where the data is retrieved or where data is saved. 0...255
Quantity Significance valid range:	Length of the source/destination data - block in words. 1...2048	Length of the source/destination data - block in words. 1...256

Structure of PLC header

For every READ and WRITE the CP generates PLC headers for request messages and for acknowledgment messages. Normally the length of these headers is 16 bytes and they have the following structure:

for WRITE

Request message

System identifier	="S"
	="5"
Length of header	=16d
Ident.OP-code	=01
Length of OP-code	=03
OP-Code	**=03**
ORG-block	=03
Length of ORG-block	=08
ORG identifier	
DBNR	
Start address	H
	L
Length	H
	L
Dummy block	=FFh
Length of dummy bl.	=02
Up to 64K data but only if error no.=0	

Acknowledgment message

System identifier	="S"
	="5"
Length of header	=16d
Ident.OP-code	=01
Length of OP-code	=03
OP-Code	**=04**
Ack. block	=0Fh
Length of Ack-block	=03
Error No.	=Nr.
Dummy block	=FFh
Length of dummy bl.	=07
not used	

for READ

Request message

System identifier	="S"
	="5"
Length of header	=16d
Ident.OP-code	=01
Length of OP-code	=03
OP-Code	**=05**
ORG-block	=03
Length of ORG-block	=08
ORG identifier	
DBNR	
Start address	H
	L
Length	H
	L
Dummy block	=FFh
Length of dummy block=02	

Acknowledgment message

System identifier	="S"
	="5"
Length of header	=16d
Ident.OP-code	=01
Length of OP-code	=03
OP-Code	**=06**
Ack. block	=0Fh
Length of Ack-block	=03
Error No.	=Nr.
Dummy block	=FFh
Length Dummy block	=07
not used	
Up to 64K data but only if error no.=0	

SEND / RECEIVE of the type TRADA

TRADA stands for **Tr**ansparent **Da**ta exchange. A transparent data exchange can transfer application data with varying block lengths. A 16-byte header that defines the length of the application data precedes the application data.

With TRADA you can enter a default length into the PLC application program.

If you enter -1 as the length into the RECEIVE-FC (parameter: ZLAE) you are defining a variable length (default length) for the application data. With the default length the actual length of the data is retrieved from the respective TRADA header.

With the TRADA functionality the following header will precede a SEND job and it is analyzed by the RECEIVE function.

SEND of type TRADA
OP-Code = 07

System identifier	="S"	
	="5"	
Length of header	=16d	
Ident.OP-code	=01	
Length of OP-code	=03	
OP-Code	=**07**	
ORG-block	=03	
Length of ORG-block	=08	
ORG identifier		
DBNR (**irrelevant**)		→ Length of the application data
Start address	H	
	L	
Length	**H**	
	L	
Dummy block	=FFh	
Length of dummy block	=02	
Up to 64K data but only if error no.=0		

Length

The length filed contains the number of bytes in a data block.

If you are synchronizing with a block size of 6 (512 bytes) the length is entered in words.

Appendix

A Index

M.Stich