SIEMENS

SIMATIC NET

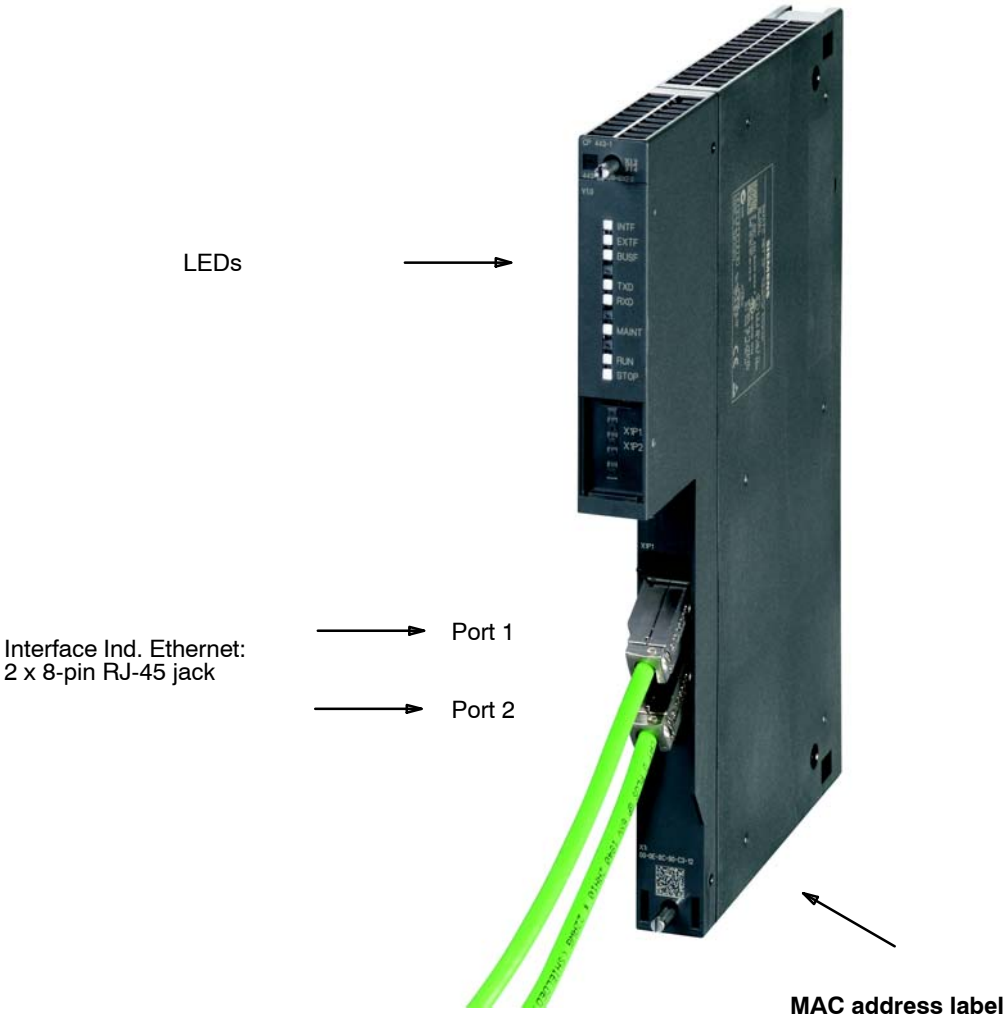
S7–CPs for Industrial Ethernet

Manual Part B

CP 443-1

6GK7 443–1EX20–0XE0 Hardware product version 5, Firmware version V2.1

for SIMATIC S7-400



Release 07/2013
C79000-G8976-C223–08

Notes on the Product

Product names

This description contains information on the following product

- **CP 443–1**
  Order number 6GK7 443–1EX20–0XE0
  Hardware product version 5 and firmware version V2.1
  for SIMATIC S7–400 / C7–400

Note

In the remainder of this document, the term ”CP” will be used instead of the full name of the product.

Compatibility with previous versions

Notice

Make sure that you read the information regarding **extended functions and restrictions** in Chapter 7 of this manual!

Address label: Unique MAC address preset for the CP

The CP ships with a factory-set MAC address.

The MAC address is printed on the housing.

If you configure a MAC address (ISO transport connections), we recommend that you use the MAC address printed on the module for module configuration!

- This ensures that you assign a unique MAC address in the subnet!
- If you replace a module, the MAC address of the predecessor is adopted when you load the configuration data; configured ISO transport connections remain operable.

❑

Contents

Contents – Part A

**S7-CPs for Ind. Ethernet –
Configuring and Commissioning** ..... **See general part**

Note

Please remember that Part A of the manual also belongs to the description of the CP. Among other things, this includes the explanation of the safety notices used, Internet addresses and references as well as information that applies to all S7–CPs for Industrial Ethernet.

The following version of Part B of the manual belongs to the following version of the general Part A: 05/2008 or higher

You can also obtain the current general Part A from the Internet at:

http://support.automation.siemens.com/WW/view/en/30374198

Contents – Part B

1 Properties and Services **B–6**
1.1 Properties of the CP B–6
1.2 Communication services B–6
1.3 Further services and characteristics of the CP B–7
2 Requirements for Use **B–10**
2.1 Configuration limits B–10
2.2 System environment B–10
2.3 Configuration B–13
2.4 Programming B–13
3 Installation and Commissioning **B–15**
3.1 Procedure / steps in installation B–15
3.2 Replacing a module without a programming device B–17
3.3 Force mode B–18
4 Displays **B–20**
5 Performance Data / Operation **B–23**
5.1 General characteristic data B–23
5.2 Characteristic data for S7 communication B–23
5.3 SEND/RECEIVE interface B–24

5.3.1 Characteristic data B–24
5.3.2 Number of simultaneous SEND/RECEIVE calls B–25

5.4 Characteristics of open TCP/IP communication B–27

5.5 PROFINET IO B–28
5.5.1 Characteristic data B–28
5.5.2 How PROFINET IO devices start up with a large operational configuration B–29
5.5.3 Reduce the communication allocation reserved for PROFINET IO when operating alongside other services. B–29

5.6 Characteristic data of TCP connections for HTTP B–29

5.7 Characteristic data of the integrated 2-port switch B–30

6 The CP as Web server B–31

7 Compatibility with Predecessor Products B–32

7.1 Enhanced functions B–32

7.2 Changes B–32

7.3 Replacing older modules: spares / upgrading B–33

8 Further Notes on Operation B–35

8.1 Memory reset / reset to factory defaults B–35

8.2 Network settings with Fast Ethernet B–36

8.3 PROFINET IO mode with IRT communication B–38
8.3.1 Types of synchronization B–38

8.4 Media redundancy B–39

8.5 Time-of-day synchronization B–39

8.6 Recommendations for use with a high communications load B–41

8.7 SNMP agent B–42

8.8 Possible security gaps on standard IT interfaces / preventing illegal access B–44

8.9 Points to note about IP configuration B–45

8.10 Restart after detection of a duplicate IP address in the network B–45

8.11 Prioritized startup in PROFINET IO B–45

8.12 PROFINET IO interface – operating PROFINET IO devices with current firmware B–47

8.13 Interface in the user program B–47
8.13.1 FC call interface B–47
8.13.2 Programmed communication connections with FB55 IP_CONFIG . . . B–48
8.13.3 IP access protection with programmed communication connections . B–48
8.13.4 Open TCP/IP communication B–49
8.13.5 Additions to the FC/FB status condition codes B–50

8.14 Ping: Permitted length of ICMP packets B–50

9 Loading New Firmware B–51

10 Technical Specifications B–53

11 Other Information available about the CP B–54

12 References and Literature B–55

1 Properties and Services

1.1 Properties of the CP

The CP is intended for use in an S7-400 or S7-400H (fault-tolerant) automation system. It allows the S7-400 / S7-400H to be attached to Industrial Ethernet.

To set up small local area networks or to connect several Ethernet devices, a 2-port switch with autocrossing and autosensing has been integrated in the CP.

Each port of the switch is designed for simple diagnostics and is equipped with a combined RXD/TXD / LINK dual LED. For special situations, each port can also be set to a fixed mode manually using STEP 7, for example 10 or 100 Mbps half duplex / full duplex.

Each port can be disabled individually in the project engineering.

1.2 Communication services

The CP supports the following communication services:

- PROFINET IO controller

  PROFINET IO allows direct access to PROFINET IO devices over Industrial Ethernet. PROFINET IO can only be used via the ports of the PROFINET interface.

  - Prioritized startup

    The CP supports prioritized startup. Per PROFINET IO controller, a maximum of 32 PROFINET IO devices can be configured that support prioritized startup. Of these 32 IO devices, simultaneous startup times with values as low as 0.5 s can be achieved by up to 8 IO devices.

  - IRT communication (isochronous real time)

    IRT communication is possible in PROFINET IO.

    If you are using IRT communication, no media redundancy is supported.

  - Shared device

    As a PROFINET IO controller, individual submodules of an IO device can be assigned to the CP. When configuring PROFINET IO systems with shared IO devices, make sure that you read the information in /7/.

- S7 communication with the following functions:
  - PG functions
  - Operator monitoring and control functions
  - Data exchange over S7 connections.

- S5-compatible communication with the following functions:
  - SEND/RECEIVE interface over ISO transport connections;
  - SEND/RECEIVE interface over TCP connections, ISO-on-TCP and UDP connections;

    With the SEND/RECEIVE interface via TCP connections, the CP supports the socket interface to TCP/IP available on practically every end system.

    UDP frame buffering on the CP can be disabled during configuration. When necessary, this allows you to achieve a shorter reaction time between the arrival of a UDP frame and its evaluation on the CPU.
  - Multicast over UDP connection

    The multicast mode is made possible by selecting a suitable IP address when configuring connections.
  - FETCH/WRITE services (server services; corresponding to S5 protocol) via ISO transport connections, ISO-on-TCP connections and TCP connections

    Here, the SIMATIC S7-400 with the CP is always the server (passive connection establishment) while the fetch or write access (client function with active connection establishment) is always initiated by a SIMATIC S5 or a device from another range / PC.
  - LOCK/UNLOCK with FETCH/WRITE services (CPU-dependent; see Chapter 2);

1.3 Further services and characteristics of the CP

- Media redundancy

  Within an Ethernet network with a ring topology, the CP supports the media redundancy protocol MRP. You can assign the role of redundancy manager to the CP.
- Time-of-day synchronization over Industrial Ethernet according to the following configurable method:
  - SIMATIC mode

    The CP receives MMS time-of-day messages and synchronizes its local time.

    You can choose whether or not the time of day is forwarded. You can also decide on the direction in which it is forwarded.

  or
  - NTP mode (NTP: Network Time Protocol)

    The CP sends time-of-day queries at regular intervals to an NTP server and synchronizes its local time of day.

    The time can also be forwarded automatically to the CPU modules in the S7 station allowing the time to be synchronized in the entire S7 station.

- Addressable with the factory-set MAC address

  To assign the IP address to a new CP (direct from the factory), it can be accessed using the preset MAC address on the interface being used. Online address assignment is made in STEP 7.

- SNMP agent

  The CP supports data queries over SNMP version V1 (**S**imple **N**etwork **M**anagement **P**rotocol) according to the MIB II standard.

- Module access protection

  To protect the module form accidental or unauthorized access, protection can be configured at various levels.

- IP Access Protection (IP-ACL)

  Using IP access protection gives you the opportunity of restricting communication over the CP of the local S7 station to partners with specific IP addresses.

- IP configuration

  For the PROFINET interface, you can configure how and with which method the CP is assigned the IP address, the subnet mask and the address of a gateway.

  As an alternative to STEP 7, you have the option of assigning the connection configuration via a block interface in the user program (FB55: IP_CONFIG) (see /10/).

  Note: Does not apply to S7 connections.

- Web diagnostics

  With the aid of Web diagnostics, you can read out the diagnostic data from a station connected via the CP to a PG/PC with an Internet browser.

  If you do not require this function, you can disable it in the STEP 7 configuration and disable the port (properties dialog of the CP > ”IP Access Protection” tab).

- Diagnostic Buffer Extract Request

  With the aid of a Web browser, the CP supports the option of obtaining an extract of the diagnostic buffer containing the most recent diagnostic events of the CPUs and CPs located in the same S7 station as the CP.

- Connection diagnostics with FC10 AG_CNTRL

  With the FC10 AG_CNTRL function, you can diagnose connections. When necessary, you can activate or deactivate connections using the FC or initiate reestablishment of a connection.

- S5/S7 addressing mode

  The addressing mode can be configured for FETCH/WRITE access as the S7 or S5 addressing mode (S7 addressing mode only for data blocks / DBs).

- IP double addressing detected in the network

  To save you time-consuming troubleshooting in the network, the CP detects double addressing in the network.

  The reaction of the CP when double addressing is detected varies as follows:

  – CP during startup

    The CP remains in STOP mode.

  – CP in RUN mode

    There is an LED indication (BUSF LED) and an entry in the diagnostic buffer; the CP remains in RUN mode.

2 Requirements for Use

2.1 Configuration limits

When using the CP type described here, the following limits apply within a rack:

- Max. number of CPs 14
- Number of CPs operating as PROFINET IO controllers: 4

Notice

- The number of CPs operating as PROFINET IO controllers depends on the number of CP 443-5 Extended modules operating as DP masters in the S7-400 station. A total of 10 CPs can be operated as controllers for the distributed I/O (PROFINET IO controllers or DP masters); of those, however, only up to 4 as PROFINET IO controllers.
- Please note the following regarding multiprocessor mode: When operating the CP as a PROFINET IO controller, only the process image of the assigned CPU can be distributed via the CP.

2.2 System environment

General Requirements

- The CP has been released with CPUs as of firmware version 4.1.

  CPUs with firmware version 4.0 must be upgraded to V4.1.
- Open TCP/IP communication is supported by all CPUs as of firmware version V4.1.
- The full range of functions (MRP, IRT, prioritized startup) is available only with CPUs as of firmware version 5.2.

  Note also the information on the required version of the STEP 7 configuration tool in Section 2.3.
- CPUs with firmware version 5.0 must be upgraded to V5.1.

Restrictions for CPUs with older firmware versions

- The use of the blocks FC53 “AG_SSEND” and FC63 “AG_SRECV” is possible only on CPUs with a firmware version V5.1 or higher.

PROFINET IO interface – operating PROFINET IO devices with current firmware version

For the PROFINET IO devices listed below, you should use the latest firmware when operating the CP 443–1.

IM151–3PN with order number 6ES7151–3AA20–0AB0

IM151–3PN with order number 6ES7151–3BA20–0AB0

The current firmware versions are available at the following Internet address:

http://support.automation.siemens.com/WW/view/en/22810435

Table of compatible CPUs

The CP is supported by the S7-400 CPUs with the order numbers and firmware versions as shown in the following table.

The table also contains the following information:

- The number of CPs that can be operated with one CPU
- The number of CPU resources for SEND/RECEIVE calls;
- Which CPUs support the LOCK/UNLOCK function with the FETCH/WRITE services
- Which CPU supports operation of the CP as PROFINET IO controller;

Table 2-1 CPU data relevant to use of the CP

CPU	Order number of the CPU: 6ES7...	as of firmware version	Multiprocessing possible	Max. number of CPs	CPU resources for SEND-/RECEIVE jobs [1]	LOCK/UNLOCK	PROFINET IO [4]
CPU 412–1	..412–1XF04–0AB0	V4.1	+ [2]	14	24	+	–
CPU 412–1	..412–1XJ05–0AB0	as of V5.1	+ [2]	14	24	+	+
CPU 412-2	..412–2XG04–0AB0	V4.1	+ [2]	14	24	+	–
CPU 412-2	..412–2XJ05–0AB0	as of V5.1	+ [2]	14	24	+	+
CPU 412-2	..412–2EK06–0AB0	V6.0.2	+ [2]	14	24	+	+
CPU 414-2	..414–2XK05–0AB0	as of V5.1	+ [2]	14	24	+	+
CPU 414–2	..414–2XG04–0AB0	as of V4.1	+ [2]	14	24	+	+

Table 2-1 CPU data relevant to use of the CP

CPU	Order number of the CPU: 6ES7...	as of firmware version	Multiprocessing possible	Max. number of CPs	CPU resources for SEND-/RECEIVE jobs [1]	LOCK/UNLOCK	PROFINET IO [4]
CPU 414-3	..414–3XJ04–0AB0	V4.1	+ [2]	14	24	+	–
CPU 414-3	..414–3XM05–0AB0	as of V5.1	+ [2]	14	24	+	+
CPU 414-3 PN/DP	..414–3EM05–0AB0	as of V5.1	+ [2]	14	24	+	+
CPU 414-3 PN/DP	..414–3EM06–0AB0	V6.0.2	+ [2]	14	24	+	+
CPU 414-3 PN/DP	..414–3FM06–0AB0	V6.0.2	+ [2]	14	24	+	+
CPU 416-2	..416–2XK04–0AB0	V4.1	+ [2]	14	64	+	–
CPU 416-2	..416–2XN05–0AB0	as of V5.1	+ [2]	14	64	+	+
CPU 416F–2	..416–2FK04–0AB0	V4.1	+ [2]	14	64	+	–
CPU 416F–2	..416–2FN05–0AB0	as of V5.1	+ [2]	14	64	+	+
CPU 416-3	..416–3XL04–0AB0	V4.1	+ [2]	14	64	+	–
CPU 416-3	..416–3XR05–0AB0	as of V5.1	+ [2]	14	64	+	+
CPU 416-3 PN/DP	..416–3ER05–0AB0	V5.1	+ [2]	14	64	+	+
CPU 416-3 PN/DP	..416–3ES06–0AB0	V6.0.2	+ [2]	14	64	+	
CPU 416F–3 PN/DP	..416–3FR05–0AB0	as of V5.1	+ [2]	14	64	+	+
CPU 416F-3 PN/DP	..416–3FS06–0AB0	V6.0.2	+ [2]	14	64	+	
CPU 417-4	..417–4XL04–0AB0	V4.1	+ [2]	14	64	+	–
CPU 417-4	..417–4XT05–0AB0	as of V5.1	+ [2]	14	64	+	+
CPU 412-3H [3]	..412-3HJ14-0AB0	V4.5	+ [2]	14	64	+	–
CPU 414H [3]	..414-4HM14-0AB0	V4.5	+ [2]	14	64	+	–
CPU 414H [3] [5]	..414–4HJ04–0AB0	V4.0	+ [2]	14	64	+	–
CPU 414H [3]	..414-4HR14-0AB0	V4.5	+ [2]	14	64	+	–
CPU 417H [3]	..417–4HT14–0AB0	V4.5	+ [2]	14	64	+	–
CPU 417H [3] [5]	..417–4HL04–0AB0	V4.0	+ [2]	14	64	+	–

Legend:
+ => The feature is supported / the specified mode is possible
– => The feature is **not** supported / the specified the mode is **not** possible

1) The calculation of the maximum number of SEND/RECEIVE calls that can be used simultaneously per CP is described in Section 5.3.2.

2) When using the CP as a PROFINET IO controller, multiprocessor mode is not supported, in other words, only the process image of the assigned CPU can be distributed via the CP (Note: this does not affect communication protocols running at the same time in multiprocessor mode).

3) When operating with H-CPUs, the SSEND / SRECV mode on the SEND/RECV interface is not supported. H−CPUs do not support PROFINET.

4) The PROFINET IO mode shared device requires a CPU as of Version V5.3.

5) When operating these H CPUs, the CP must be configured as module type CP 443−1 EX11.

2.3 Configuration

The following version of STEP 7 is required:

Table 2-2

STEP 7 version	CP 443-1 functionality
as of V5.4 + Service Pack 4	The full functionality as described in this document can be used.

Downloading configuration data

It is possible to download the configuration data to the CP via MPI or LAN/Industrial Ethernet.

2.4 Programming

Programming – FCs / FBs

For some communications services, there are pre-programmed blocks (FCs/FBs) available as the interface in your STEP 7 user program.

Please refer to the documentation of the FCs / FBs in the online help of STEP 7 or in the manual /10/.

Notice

We recommend that you always use the latest block versions for all module types.

You will find information on the current block versions and the current blocks to download from the Internet in our customer support.

http://support.automation.siemens.com/WW/view/en/8797900

With the older module types, this recommendation assumes that you are using the latest firmware for the particular block type.

Using blocks for the SEND/RECEIVE interface

For data transfer on the SEND/RECEIVE interface, there are FCs for short and long blocks of data:

For fast data transmission up to a data length of 1452 bytes, the SPEED SEND/RECEIVE blocks AG_SSEND FC53 and AG_SRECV FC63 are supported.

Table 2-3

Function	Requirements
Transfer of data fields <= 240 bytes	• You require the blocks AG_SEND FC5 and AG_RECV FC6 **or alternatively** the blocks AG_LSEND FC50 and AG_ LRECV FC60.
Transfer of data fields > 240 bytes	• You require the blocks AG_LSEND FC50 and AG_LRECV FC60.
Accelerated transfer of blocks of data <= 1452 bytes	• You require the blocks AG_SSEND FC53 and AG_SRECV FC63.

Note

Note that in multicomputing mode, communication using SPEED-SEND/RECV is possible only via the CP assigned to the CPU.

Note

Note the recommendations in Section 8.6 on operation with a higher communications load.

3 Installation and Commissioning

3.1 Procedure / steps in installation

Caution

When installing the CP for use as a PROFINET IO controller, note the following points about the power supply:

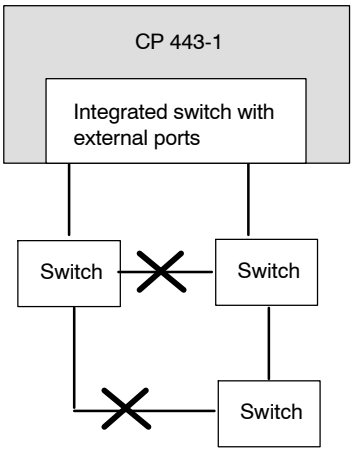
When using the CP in the central rack or in a universal rack operating as central rack, you should not insert or remove the CP when the power is on. If you remove the CP when the power supply is on, the CPU changes to STOP and indicates “I/O error”.

After inserting the module with power applied, it is essential to turn the power supply off and on again.

Note:
If the CP is operated without PROFINET IO, it is possible to insert and remove the CP when the power is no without affecting the CPU.

Installing the CP involves the following steps.

Step	Explanation / meaning
1. Turn off the power supply when you have configured the CP for PROFINET IO communication.	If the CP is configured as a PROFINET IO controller and you remove or insert the module, the CPU assigned in the rack changes to STOP.
2. Inserting the CP: Fit in the CP onto the rack from the top and push in at the bottom.	The CP can be plugged into all racks with slots for P and K bus attachment.
Notice When using the universal rack UR1 or UR2 as an expansion rack, a communication bus transceiver is necessary!	
3. Secure the CP with screws.	Suitable slots in the rack: With the exception of the slots reserved for the power supply, the CP can be operated in all slots with a P and K bus attachment.
4. Turn the power supply on again.	
5. Connect the CP to Industrial Ethernet over an RJ-45 jack.	You will find examples of network attachments in the general Part A of this manual.

Step	Explanation / meaning
6. Where necessary, connect other components to the remaining free RJ-45 jacks.	To set up small local area networks or to connect several Ethernet devices, a 2-port switch has been integrated in the new CP 443-1. With the autocrossing mechanism integrated in the switch, it is possible to establish the connection from a laptop or PG directly using standard cables. A crossover cable is not necessary. Please note the following points: • Manual configuration If a port is set to manual configuration and autonegotiation is disabled, the autocrossing mechanism is also disabled for this port. The port then behaves like the interface of a switch. Which cable you can use depends on the partner device. As default, the ports are set for automatic configuration. For more detailed information, refer to Section 8.2 • Connecting switches If you connect further switches, make sure that no ring is formed in the network. For an MRP configuration, refer to the guidelines for setting up MRP in the general Part A of this manual. You will find examples of network attachments in the general part of this manual. 

Step	Explanation / meaning
7. The remaining steps in commissioning involve downloading the configuration data and user programs. Requirements: You have configured the CP in a STEP 7 project with HW Config and NetPro for the services you want to use.	You can connect the PG when configuring the CP as follows: • via MPI • via Industrial Ethernet For further details, refer to the general Part A of this manual: – for initial addressing (node initialization); – downloading the defined configuration The PG/PC requires a LAN attachment, for example via a CP 1613 or CP 1411 and must have the necessary software (for example the S7 1613 package or SOFTNET IE). The TCP/IP protocol or ISO protocol must be installed. The protocol used must then be applied to the S7ONLINE access point.
8. Use the diagnostic functions during commissioning and to analyze problems.	The following options are available: • Hardware Diagnostics and Troubleshooting with STEP 7; • Communication diagnostics with NCM S7 Diagnostics • Standard information using HW Config • Web diagnostics

Notice

If you use the CP as a replacement (for example for a CP 443–1 “EX11”) with an older CPU, the default communication load setting of 20% for the CPU can lead to overload. In this case, you should set the communication load for the CPU in STEP 7/HW Config (parameter “Scan cycle load from communication”) to a lower value – for example 10%.

With CPUs as of version V5.1, this is unnecessary.

3.2 Replacing a module without a programming device

General procedure

The configuration data of the CP is stored on the CPU. This makes it possible to replace this module with a module of the same type (identical order number) without a PG.

Note

When setting the ISO protocol, remember that MAC address set previously during configuration is transferred by the CPU to the new CP module.

For information on replacing previous modules, please refer to the section “Compatibility”.

Module replacement: Special feature of IP address assignment from a DHCP server

During configuration of the CP you can specify the IP configuration in the properties dialog; one option is to obtain the IP address from a DHCP server.

Notice

When replacing modules, remember that the factory-set MAC address of the new module is different from the previous module. When the factory-set MAC address of the new module is sent to the DHCP server, this will return either a different or no IP address.

Ideally, you should therefore configure IP as follows:

Always configure a client ID if you want to obtain the same IP address from the DHCP server after replacing the module.

If you have configured a new MAC address instead of the factory-set MAC address (generally the exception, for example when using the ISO protocol), the DHCP server always receives the configured MAC address and the CP obtains the same IP address as the replaced module.

3.3 Force mode

You can change the mode of the CP between RUN and STOP using the STEP 7 / NCM S7 engineering software:

- Switch from STOP to RUN:

  The CP reads the configured and/or downloaded data into the work memory and then changes to the RUN mode.

- Switch from RUN to STOP:

  The CP changes to STOP. Established connections (ISO transport, ISO-on-TCP, TCP, UDP connections) are terminated (transitional phase with LED display “STOPPING”);

  The reaction is as follows in STOP:

  – The communications connections mentioned above are terminated;

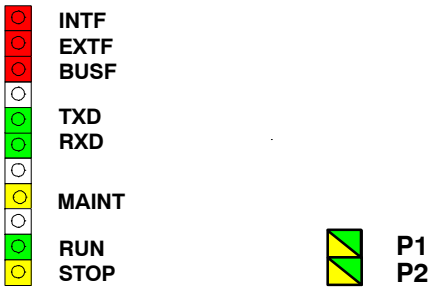
- The configuration and diagnostics of the CP is possible (system connections for configuration, diagnostics, and PG channel routing are retained);
- Functions for topology discovery continue to be supported (LLDP frames are sent).
- HTTP access is possible
- The routing function is active
- The time of day is not forwarded
- PROFINET IO is disabled.

4 Displays

LED display

The display on the front panel consists of 9 LEDs that indicate the operating mode and communication status.

Front panel:



The LEDs have the following meaning:

- INTF: Internal fault
- EXTF: External fault
- BUSF: Bus fault
- TXD: Frame traffic (sending) over Ethernet (not relevant for PROFINET IO data)
- RXD: Frame traffic (receiving) over Ethernet (not relevant for PROFINET IO data)
- MAINT: Maintenance necessary (diagnostic buffer)
- RUN: RUN mode
- STOP: STOP mode
- P1 / P2: Link status of Ethernet port 1 / port 2, Activity of Ethernet port 1 / port 2

Unlabeled LEDs have no significance (only relevant for diagnostics)

CP mode / LED display patterns

INTF (red)	EXTF (red)	BUSF (red)	RUN (green)	STOP (yellow)	CP Operating Mode
○	○	○	☼	●	Starting up (STOP->RUN)
○	○	○	●	○	Running (RUN)
○	○	○	●	☼	Stopping (RUN->STOP)
○	○	○	○	●	Stopped (STOP) In the STOP mode configuring and performing diagnostics on the CP remain possible.
●	○	○	○	●	STOP with internal error or memory reset. (for example IP double addressing detected during startup of the CP in network) The following applies in this status: • The CPU or intelligent modules in the rack remain accessible using PG functions (over MPI or the ISO protocol). • SNMP functionality and access over HTTP are not possible.
–	○	●	–	–	No link (at any port) or duplicate IP address
○	●	☼	●	○	RUN with external error; One or more IO devices are not obtainable.
○	○	●	●	○	• The interface is networked in STEP 7, but there is no Ethernet cable connected. • A duplicate IP address was detected after the CP was in RUN. • There are differences between the actual system structure and the configured settings for the transmission medium or duplex mode.
☼	☼	☼	☼	☼	Module fault / system error

Legend: ● (colored) on ○ off ☼ (colored) flashing "–" any

Firmware download – LED display patterns

The LED display patterns when downloading the firmware are described in Chapter 9.

The “MAINT“ LED (yellow)

Notice

When the “MAINT” LED lights up, important error messages and/or diagnostic interrupts have occurred. The CP continues in RUN mode.

Check the entries in the diagnostic buffer of the device.

CP communications status / LED display patterns

LED	Display status		Meaning
TXD (green)		green	CP sending over Ethernet. Note: Sending over PROFINET IO is not signaled here.
RXD (green)		green	CP is receiving over Ethernet Note: Receiving over PROFINET IO is not signaled here.
P1 / P2 (green / yellow)			Port has no connection over Ethernet.
		green	Existing connection over port to Ethernet (LINK status).
		green / yellow	LED flashes yellow, steady light green: Port sending / receiving over Ethernet or PROFINET IO. Note: All received / sent frames are signaled for the specific ports, This includes those that are simply forwarded by the switch.
		yellow	There is continuous data transfer over Ethernet at the port (for example PROFINET IO).

Legend:  (colored) on  off  (colored) flashing

Module identification

Using the SIMATIC Manager, you can search for and identify the module initially by browsing the connected network with the menu “PLC” > “Edit Ethernet Node”. If you select the found node in the “Browse Network” dialog, and then click -“flash”, all the port LEDs of the PROFINET interface flash.

5 Performance Data / Operation

Note

Measurements of transmission and reaction times in Ethernet, PROFIBUS and PROFINET networks for a series of configurations can be found on the Internet at the following address:

http://support.automation.siemens.com/WW/view/en/25209605

5.1 General characteristic data

Table 5-1

Characteristic	Explanation / values
Total number of connections on Industrial Ethernet	In total (S7 connections + SEND/RECEIVE connections + HTTP), the number of connections is limited to 128.

Example

You can, **for example**, operate:

- 7 S7 or H connections
- 2 ISO-on-TCP connections
- 25 TCP connections
- 25 UDP connections
- 5 ISO transport connections

5.2 Characteristic data for S7 communication

Table 5-2

Characteristic	Explanation / values
Total number of S7 connections on Industrial Ethernet	128 max. of those max. 62 H connections
LAN interface - data field length generated by CP per protocol data unit	
• sending	480 bytes / PDU
• receiving	480 bytes / PDU

Table 5-2 , Fortsetzung

Characteristic	Explanation / values
• Number of PG connections • Number of OP connections	2 max. 30 max.
Repercussions of the number of SEND/RECV connections in SPEED SEND/RECV mode	Note the following with SPEED SEND/RECEIVE: Using SSEND/SRECV reduces the possible configuration limits of S7 communication with each configured SEND/RECV connection in SPEED SEND/RECV mode.

5.3 SEND/RECEIVE interface

5.3.1 Characteristic data

The SEND/RECEIVE interface provides access to communication over TCP, ISO-on-TCP, ISO transport, and UDP connections.

The following characteristics are important:

Table 5-3 Characteristic data of the SEND/RECEIVE interface

Characteristic	Explanation / values
Number of SEND/RECEIVE connections	• TCP connections: 1...64 [1)] • ISO-on-TCP connections 1 to 64 • ISO transport connections 1...64 • UDP connections (specified and free) configurable in total 1 to 64 (of those, up to 48 multicast mode) • Max. number of connections in total: (ISO transport + ISO-on-TCP + TCP + UDP) <= 64 Refer to the example in Section 5.1 [1)] Note: The flow control on TCP connections **cannot** control permanent overload of the receiver. You should therefore make sure that the processing capabilities of a receiving CP are not permanently exceeded by the sender (approximately 150-200 messages per second).
Number of SEND/RECV connections in SPEED SEND/RECV mode	The number depends on the CPU type being used. • Per CPU 412/414 maximum 30 • Per CPU 416/417 maximum 62
Maximum data length for AG_SEND and AG_RECV functions (FCs)	AG_SEND and AG_RECV were shipped with predecessors of the CP and allow the transfer of data fields with a length from 1 to 240 bytes. The version of the CP described here continues to support these blocks.

Table 5-3 Characteristic data of the SEND/RECEIVE interface, Fortsetzung

Characteristic	Explanation / values
Maximum data length for AG_LSEND and AG_LRECV blocks	AG_LSEND and AG_LRECV allow the transfer of data fields with the following lengths: 1. ISO-on-TCP, TCP, ISO Transport: 1 to 8192 bytes 2. UDP: 1 to 2048 bytes
Maximum data length for AG_SSEND and AG_SRECV blocks	AG_SSEND and AG_SRECV allow the transfer of data fields with the following lengths: 1. ISO-on-TCP, TCP, ISO Transport: 1 to 1452 bytes 2. UDP: 1 to 1452 bytes
Restrictions for UDP	
• Transfer is not confirmed	The transmission of UDP frames is unconfirmed, in other words the loss of messages is not detected or displayed by the send blocks (AG_SEND or AG_LSEND).
• No reception of UDP broadcast	To avoid overload due to high broadcast load, the CP does not allow reception of UDP broadcasts. As an alternative, use the multicast function over a UDP connection. This allows you to register the CP as a node in a multicast group.
• UDP frame buffering	Length of the frame buffer with buffering enabled: 2 KB Note: Following a buffer overflow, newly arriving frames are discarded.
LAN interface - max. data field length generated by CP per protocol data unit	• sending ISO transport, ISO-on-TCP, TCP: – 400 bytes / TPDU with AG_SEND / AG_LSEND – 1452 bytes / TPDU with AG_SSEND • receiving – ISO transport: 512 bytes / TPDU – ISO-on-TCP: 1452 bytes / TPDU – TCP: 1452 bytes / TPDU

5.3.2 Number of simultaneous SEND/RECEIVE calls

The number of SEND/RECEIVE calls that can be used at the same time is limited both by the CPU and by the CP.

If the maximum number of simultaneous SEND/RECEIVE calls is exceeded, the value 8302_H (no receive resources) is indicated in the STATUS of the surplus SEND functions. This can, for example, happen when too many SEND/RECEIVE calls are sent at the same time in OB1.

Limitation by the CPU

In productive operation, the number of simultaneous SEND/RECEIVE calls depends on the CPU resources being used. Note the information on the available CPU resources in Section 2.2.

The following CPU resources are required:

- Per SEND job short (FC5) or long (FC50): 1 resource
- Per RECEIVE job short (FC6): 1 resource
- Per RECEIVE job long (FC60): 2 resources
- Per SPEED SEND/RECV job (FC53, FC63): 0 resources

Limitation by the CP

A maximum of 64 SEND/RECEIVE connections can be operated by the CP.

At an assignment of 1 CP per CPU, the maximum number of SEND/RECEIVE calls that can be used at one time is limited as follows:

- SEND calls short (FC5) or long (FC50): max. 32*) / 12**) per CPU
- RECEIVE calls short (FC6): max. 64*) / 24**) per CPU
- RECEIVE calls long (FC60): variable ***)

*) The values apply to the CPU 416 and CPU 417.

*) The values apply to the CPU 412 and CPU 414.

***) The number of FC60s that can be used at the same time depends on the number of SEND calls active at the same time (see Tables 5-4 and 5-5).

Table 5-4 Dependency of the maximum number of RECEIVE calls long (FC60) used at the same time on the number of SEND calls (CPU 412/414)

Number of simultaneous SEND calls	**0**	**1**	**2**	**3. 4**	**5**	**6**	**7**	**8 9**	**10**	**11**	**12**
Max. number of simultaneous FC60s per CPU 412/414	19	18	17	16	15	14	13	12	11	10	9

Table 5-5 Dependency of the maximum number of RECEIVE calls long (FC60) used at the same time on the number of SEND calls (CPU 416/417)

Number of simultaneous SEND calls	**0**	**1**	**2**	**3. 4**	**5**	**6**	**7**	**8 9**	**10**	**11**	**12**	**13 14**	**15**	**16**
Max. number of simultaneous FC60s per CPU 416/417/41x–H	51	50	49	48	47	46	45	44	43	42	41	40	39	38
Number of simultaneous SEND calls	**17**	**18 19**	**20**	**21**	**22**	**23 24**	**25**	**26**	**27**	**28 29**	**30**	**31**	**32**	
Max. number of simultaneous FC60s per CPU 416/417/41x–H	37	36	35	34	33	32	31	30	29	28	27	26	25	

The maximum number of SPEED SEND/RECEIVE calls that can be used simultaneously (FC53, FC63) depends only on the CPU (see above).

5.4 Characteristics of open TCP/IP communication

Table 5-6

Characteristic	**Explanation / values**
Number of dynamically generated connections over Industrial Ethernet	• ISO-on-TCP connections 1 to 64
Max. data length	1452 bytes

5.5 PROFINET IO

5.5.1 Characteristic data

PROFINET IO communication of the CP as of hardware version 3 is IRT-compliant. The CP supports the following maximum configuration as a PROFINET IO controller:

Table 5-7

Characteristic	Explanation / values
Number of CPs that can be operated as PROFINET IO controllers within an S7-400 station	4
Number of possible PROFINET IO devices *)	128, of which • 128 in IRT mode • 32 in ”Prioritized startup” mode
Size of the input area over all PROFINET IO devices	4 Kbytes max.
Size the output area over all PROFINET IO devices	4 Kbytes max.
Size of the IO data area per submodule of a module in an IO device • Inputs • Outputs This information also applies to operation with a shared device	 240 bytes 240 bytes
Size of the consistency area for a submodule	240 bytes

*) The number of operable PROFINET IO devices can be reduced if the devices being used require extensive configuration and parameter assignment data due to large numbers of submodules. In this case, the memory on the CP will not be adequate and you will receive a message in the diagnostic buffer about lack of resources when downloading the configuration data.

Notice

Note the following for PROFINET IO: If you use modules with >=32 bytes of input/output data, this can lead to I/O access errors; access errors are entered in the diagnostic buffer of the CPU.

These I/O errors occur during operation only in the “consistent user data“ mode and at a low OB1 cycle time.

5.5.2 How PROFINET IO devices start up with a large operational configuration

When operating the module with a large configuration (up to 128 communication connections and up to 128 PROFINET IO devices), it may take several minutes when the station starts up before all PROFINET IO devices have received configuration data from the PROFINET IO controller. The IE/PB Link PN IO operating as a PROFINET IO device is particularly affected by this.

To ensure that the CPU does not interrupt the distribution of project engineering data in this situation, the parameter assignment monitoring time must be increased on the CPU.

Possible remedy: Reduce the size of the configuration (for example, distribution on several CPs).

5.5.3 Reduce the communication allocation reserved for PROFINET IO when operating alongside other services.

If cyclic data exchange over PROFINET IO is operating at the same time on the same Ethernet subnet, set the parameter “Communication component for PROFINET IO“ in the properties dialog of the PROFINET IO system to a value <100%.

Reason: At the (default) setting 100%, the communication time is reserved primarily for PROFINET IO data exchange. Reducing the communication component for PROFINET IO increases the system-wide update time for PROFINET IO and creates additional time on the CP for processing other communication services.

5.6 Characteristic data of TCP connections for HTTP

Each HTTP session occupies up to 4 TCP connections as soon as you use one or more Web browsers to display data of the CP.

5.7 Characteristic data of the integrated 2-port switch

Learning addresses / deleting addresses (aging time)

The switch integrated in the CP reads the source addresses included in the data packets. The switch therefore learns the addresses of the end devices connected via a port.

If the switch receives a data packet, it directs this packet only to the port via which the appropriate DTE can be obtained.

The switch monitors the age of the learned addresses. Addresses that exceed the “aging time“ are deleted. The aging time is 5 minutes.

Ports can be deactivated individually

The ports of the switch integrated in the CP can be deactivated individually in STEP 7 / HW Config. This can, for example, be used for service purposes.

To do this, open the properties dialog of the relevant port and select the “disabled” setting under “Options > Transfer medium / duplex”.

The port is turned off completely when it is deactivated. The corresponding LED on the device (for example P1) is then turned off.

6 The CP as Web server

Web diagnostics

The CP provides you with the function of a Web server for access using a Web browser.

The CP provides HTML pages for Web diagnostics.

With the following address, you have access to Web diagnostics:

http:\\<IP address of the CP>

Diagnostic buffer entries are output in English on the diagnostic pages. This is not influenced by the language selected for display of the Web pages.

For detailed information on Web diagnostics, refer to the general Part A of this manual.

Note

The data exchange for productive communication (S7 connections + SEND/RECEIVE connections + PROFINET IO) always has a higher priority than data exchange with the Web browser. This can lead to delays when accessing the HTML pages in the Web browser.

Enabling the Web server function

If you want to use the CP for IP communication with HTTP, you will need to activate port 80 of the CP in the configuration:

Select the option “Activate Web server” under “IP access protection” in the properties dialog of the CP.

The Web server function is enabled as default.

Web browser

To access the HTML pages on the CP, you require a Web browser. The following Web browsers are suitable for communication with the CP (other browsers also possible):

- Internet Explorer (recommended version: 6.0 or higher)
- Opera (recommended version: 9.2 or higher)
- Firefox (recommended version: 2.0 or higher)

These Web browsers support all the requirements necessary for the implementation of the IT functions (Java reference implementation – Java Development Kit) 1.1.x is supported) in conjunction with the CP.

7 Compatibility with Predecessor Products

The short names used below to identify the modules (for example “GX20” or “EX41”) correspond to the last four characters of the mid section of the order number.

7.1 Enhanced functions

New: Enhanced functions compared with the CP 443−1 EX20 V2.0

The CP 443−1 (6GK7 443−1EX20−0XE0 with firmware version 2.1) supports all functions of the predecessor module (6GK7 443−1EX20−0XE0 with firmware version V2.0).

The following features are new and can be used when configuring with STEP 7 as of version 5.5:

- Shared device in PROFINET IO (can be configured as of CPU version V5.3)

Enhanced functions compared with the CP 443−1 EX20 V1.0

The CP 443-1 (6GK7 443-1EX20-0XE0 with firmware version 2.0) supports all functions of the predecessor module (6GK7 443-1EX20-0XE0 with firmware version 1.0).

The following features are new and can be used when configuring with STEP 7 as of version 5.4 SP4:

- IRT communication with PROFINET IO
- Prioritized startup
- Expanded Web diagnostics
- UDP buffering can be disabled
- Support of alarms for operation of an iPAR server
- Clear / reset

  If the CP is configured as a PROFINET IO controller, an you run a clear/reset on the CPU, the CP memory is also reset.

7.2 Changes

Note the following changes compared with the predecessor modules:

- The mode selector is no longer present.

Notice

In principle, you can also replace predecessor modules with IT functionality with a CP 443-1 EX20. The IT functions are, however, then no longer supported!

Notice

The CP 443-1 EX20 and CP 443-1 Advanced GX20 modules are not interchangeable as replacement modules (see below). You can, however, upgrade the EX20 with a GX20 if you change the configuration.

When using the CP with version V4.x CPUs, all functions are supported that were available with the CP 443-1 EX11. Operation as a PROFINET IO controller and SEND/RECV connections in SPEED SEND/RECV mode are not supported.

7.3 Replacing older modules: spares / upgrading

Distinction

When replacing existing modules with the module described here, the following variants must be distinguished:

- **Use as a replacement:**

  The situation described here is when an existing module can be replaced by a new module by removing and inserting it with no change to the configuration.

  When removing and inserting the module, remember the instructions in Section 3.1, in particular, if you are using the CP as a PROFINET IO controller.

- **Upgrading** (functionally compatible module replacement)

  The situation in this case is when the module described here can be used instead of an older module as long as adaptations are made in the configuration. The CP used previously is replaced by the new CP in the configuration.

Unless stated otherwise, the range of functions of the older module continues to be supported in both cases.

You can also upgrade modules listed under “use as a replacement”. This becomes necessary when you want to use new features that were not available on the previously used module.

Use as a replacement:

The CP 443−1 with Order number 6GK7 443−1EX20−0XE0 (firmware version 2.1) described here can be used as a replacement for the following predecessor products:

- CP 443−1 (6GK7 443−1EX20−0XE0) with firmware version 2.0 / 1.0
- CP 443−1 (6GK7 443−1EX11−0XE0) with CPUs as of firmware version 4.1
- CP 443−1 (6GK7 443−1EX10−0XE0) with CPUs as of firmware version 4.1

CPUs with firmware version 4.0 must be upgraded to V4.1.

If a replacement is required with CPUs with a firmware version less than V4.0, 6GK7 443−1EX11−0XE0 or 6GK7 443−1EX41−0XE0 must still be ordered.

With H−CPUs, the EX20 can be used as a replacement 6GK7 443−1EX11−0XE0 even in conjunction with H−CPUs with firmware version V4.0.

Upgrading

The following predecessor products can be upgraded to the CP 443-1 (6GK7 443-1EX20-0XE0) described here:

- See modules in “use as a replacement”

8 Further Notes on Operation

8.1 Memory reset / reset to factory defaults

The CP has a two-level function available for resetting memory:

- Clear / reset
- Resetting to factory settings

Notice

The functions for resetting and resetting to factory defaults described here do not change the configuration data on the CPU! Es werden nur die auf dem CP gehaltenen Daten gelöscht.

If you subsequently upload the configuration data from the CPU to a PG you will always object the configuration data that were previously on the CP (with parameters, connections, IP address).

Notice

If you clear/reset a CPU as of version 5.2, the CP memory is also reset if you are using PROFINET IO.

How to use the functions

You can start the memory reset functions in STEP 7. The CP must be in STOP. If you are using PROFINET IO mode, the CPU must also be in STOP.

- Clear / reset

  In STEP 7/HW Config with **PLC ▸ Clear/Reset**

  or

  In STEP 7 / NCM Diagnostics with **Operating Mode ▸ Clear/Reset Module**

- Resetting to factory settings

  In STEP 7 / SIMATIC Manager über den Menübefehl **Zielsystem ▸ Ethernet–Teilnehmer bearbeiten... ▸** CP auswählen ▸ “OK” ▸ **Rücksetzen auf Werkseinstellungen**

  or

  In STEP 7 / NCM Diagnostics with **Operating Mode ▸ Reset to Factory Defaults**

Clear/reset module – Effects

Following a memory reset, the CP retains the configured MAC address and the IP address. The CP is therefore immediately ready for downloads using the IP address.

The configuration data is retained on the CPU.

The CPU in the S7 station does not recognize that the CP memory was reset. The CP changes to the “stopped with error” state (see Chapter 4). The configuration data must then be reloaded. You can also initiate this loading by cycling power (OFF/ON).

Note

Memory reset – ACL (access control list)

After a memory reset on the module, the following applies:

- ACL remains active.

Rest to factory defaults – Effects

After resetting to factory defaults, the CP always retains the factory set MAC address (as supplied).

Die IP–Adresse und die Projektierungsdaten im CP werden gelöscht. The configuration data is retained on the CPU.

8.2 Network settings with Fast Ethernet

The configuration of the network settings “Transmission medium / duplex” is made in the properties dialog of the relevant port of the interface in the “Options” tab:

Automatic setting or individual network settings

As default, the CP is configured for automatic detection (autosensing).

Notice

In normal situations, the basic setting ensures trouble-free communication. You should only change these in exceptional situations.

If you create a manual configuration for the CP and disable the Autonegotiation option, the automatic negotiation of the network settings (Autonegotiation) is no longer effective.

If, on the other hand, the communication partner works with autonegotiation, no communication will be established.

Only use manual configuration when the communication partner works with the same manually set configuration.

Autocrossing mechanism

With the autocrossing mechanism integrated in the switch, it is possible to use a standard cable to connect the PC/PG. A crossover cable is not necessary.

Notice

Manual configuration

If you have set a port to manual configuration and select the “Disable autonegotiation/autocrossover” option, the autocrossing mechanism is also disabled for this port. The port then behaves like the interface of a switch. In this case, the following applies:

- Connecting an end device

  To connect an end device that does not have the autocrossing mechanism (for example CP 443-1 with order number 6GK7 443-1EX11-0XE0), you must **not** use a crossover cable.
- Connecting to a switch

  To connect a switch, that does not support the autocrossing mechanism, use a crossover cable.

STEP 7 / NCM Diagnostics and Web diagnostics display the network setting

Diagnostics of the port settings for the CP described here is possible using the entries in the diagnostic buffer over SNMP, NCM diagnostics, and the LED displays.

You will find information on the currently used network settings in STEP 7 as follows:

- In NCM Diagnostics under the diagnostic object “Industrial Ethernet” in the “Network Attachment” group box;
- In HW Config with the menu command “PLC > Module Information”;
- In WEB diagnostics.

Further notes:

- 10/100 Mbps network components without “Autonegotiation”

  If you use 10/100 Mbps network components that do not support “Autonegotiation”, it is possible that you will have to set the mode manually.

- Forcing a specific mode instead of “Automatic settings”

  If your application requires a specific mode instead of the automatic settings, you will need to match up the partner devices.

- No reaction to Autonegotiation query with manual configuration

  Remember that if you configure the CP manually and the “Autonegotiation” option is disabled, it will not react to an autonegotiation query! As a result, a connected partner will not be able to set the required mode and communication will not be ideal.

  Example:
  If, for example, the CP is set to “100 Mbps – full duplex” and autonegotiation is disabled, a CP connected as partner will set “100 Mbps – half duplex”. Reason: Due to the fixed setting, an autonegotiation reply is not possible. Although the connected partner detects 100 Mbps with autosensing, it remains at half duplex.

- Recommendation: Change individual network settings only over MPI.

  If you modify the LAN settings in the properties dialog of the CP in the “Options” tab using the “Transmission medium/Duplex” list box, these changes will be adopted by the CP and activated when the configuration data is downloaded to the target system (STEP 7). In some situations, the device may then no longer be obtainable over Ethernet.

  We therefore recommend that you download configuration data to the S7 station over an MPI connection if you change this setting.

  If you download the configuration data over the LAN interface, depending on the selected setting, it is possible that the current download will not be completed due to the changes to the configuration taking immediate effect and an inconsistent configuration is reported.

  Example:
  The download is started initially with the setting TP/ITP at 10 Mbps half duplex. If the “Individual network setting” is now changed to 100 Mbps full duplex, the download cannot be completed.

8.3 PROFINET IO mode with IRT communication

8.3.1 Types of synchronization

Within an IRT domain (Isochronous Real Time), you can use the CP for IRT communication.

You specify the required synchronization parameters in the properties dialog of the ERTEC interface (HW Config: Row “X1 (<device name>)”) in the “Synchronization” tab.

8.4 Media redundancy

You can use the CP in a ring topology with media redundancy. The CP itself can be redundancy manager.

You create the configuration in STEP 7 in the properties dialog of the PROFINET interface in the “Media redundancy” tab (HW Config: Row “X1 (<device name>)”).

For more detailed information on configuration, refer to the online help of the “Media redundancy” tab and in Part A of the manual.

Notice

If you are using IRT communication, no media redundancy is supported.

8.5 Time-of-day synchronization

General rules

The CP supports the two modes explained below for time-of-day synchronization:

- SIMATIC mode

  If the CP receives MMS time-of-day messages, its local time is synchronized providing the NTP mode was not defined during configuration (MMS = Manufacturing Message Specification).

  The advantage of this mode is that it is generally more accurate than the NTP mode (guaranteed +− 1 ms). In contrast to the NTP mode, it is not possible to forward the time of day over routers; in other words, to other subnets.

- NTP mode (NTP: Network Time Protocol) in version SNTP V4.0

  In the NTP mode, the CP sends time queries (in the client mode) at regular intervals to the NTP server in the subnet (LAN). Based on the responses of the server, the most reliable and most accurate time of day is calculated and the time synchronized on the station (in all modules with time-of-day functionality).

  The advantage of this mode is that the time of day can be synchronized beyond the boundaries of the subnet. The accuracy depends on the quality of the NTP server used.

Note

- In NTP, no automatic changeover of standard/daylight−saving time is defined. As a result, you may need to implement this changeover using an application program.
- The CP supports the NTP mode in version SNTP V4.0.

Notice

Note the following regarding time-of-day synchronization in NTP mode:

If the CP recognizes an NTP frame as being “not exact” (example: NTP server is not externally synchronized), it is not forwarded to the communication bus. If this problem occurs, none of the NTP servers is displayed as “NTP master” in the diagnostics; rather all NTP servers are displayed only as being accessible.

Forwarding the time-of-day message

You can configure the direction in which time-of-day messages are forwarded in STEP 7 / NCM S7 in the properties dialog of the CP as follows.

- Configuration “from station to LAN”

  The CP forwards time frames from the CPU to Industrial Ethernet when the local CPU is time master (SIMATIC mode only) or when the time of day is forwarded by a different CP on the K bus.

- Configuration “from LAN to station”

  The CP forwards time frames from the CPU to Industrial Ethernet when one of the following components is time master:

  - In the SIMATIC mode:
    - a remote CPU 41x
    - a SIMATIC NET time transmitter
    - a CP 1430 TF
  - an NTP server when using the NTP mode

As default, time-of-day synchronization is not activated for the CP and it does not therefore forward the time. However, the internal clock of the CP is also synchronized in this situation when a time-of-day frame is received from the communication bus or from Industrial Ethernet.

Synchronization using one of the two modes described here must be configured in STEP 7 in the properties dialog of the CP – “Time-of-Day Synchronization” tab.

For more detailed information on the parameters and options, please refer to the online help in the properties dialog.

Coordinating forwarding of the time of day with several CPs

If there is more than one CP in a station connected to the same network, only one of these CPs is allowed to pass on time-of-day messages.

You can therefore made the following settings in the configuration:

- Automatic

  The CP receives the time-of-day message from the LAN or from the station and forwards it to the station or to the LAN.

  If several CPUs are being operated in the station, this automatic setting can lead to collisions. To avoid this, you can specify the direction of forwarding with the following options:

- From station to LAN
- From LAN to station

Notice

During configuration, there is no consistency check relating to this option when configuring several CPs

8.6 Recommendations for use with a high communications load

Overview

When using the CP described here, the points below will help you to avoid overload situations on your CPU.

In particular when you replace an older CP with the CP described here and are then confronted with overload problems, you should check your application for the pitfalls outlined below.

Known problems

- The functions for sending and receiving (FC5/FC6, FC50/60 or FC53/63) are often called cyclically in OB1. This leads to constant communication between the CPU and CP. As a result, other types of communication such as PG functions cannot be executed or only very slowly.
- HMI systems access data of the CPU too often using S7 functions. This slows down communication generally and can lead to lack of resources on the CPU if SEND/RECEIVE FCs are called in OB1 cyclically (effect: reduced data throughput or increased reaction time).

Remedy

The recommendations below will help to avoid these situations:

- Do not call communication blocks cyclically in OB1!

  Communication should be called time-controlled in a suitable cyclic-interrupt OB. The call interval of this OB should be significantly higher than the average cycle time of OB1.

- You should set a minimum cycle time that is higher than the average runtime of OB1. This frees resources for communication on the CPU. This is, for example, a remedy for existing applications when communication already takes place cyclically in OB1.

- If necessary, reduce the time taken for communication processing on the CPU by changing the parameters set for “cyclic load due to communication” in the properties dialog of the CPU.

8.7 SNMP agent

SNMP (**S**imple **N**etwork **M**anagement **P**rotocol)

The CP supports data queries via SNMP in Version 1. It returns the contents of certain MIB objects according to the MIB II standard, LLDP MIB and automation system MIB.

SNMP is a protocol for managing networks. To transmit data, SNMP uses the connectionless UDP protocol.

The information on the properties of SNMP-compliant devices is entered in MIB files (MIB = Management Information Base).

Where to find further information

For more detailed information on working with MIB files, refer to the documentation of the SNMP client you are using (example of an SNMP client: SNMP OPC Server from SIMATIC NET).

You will find more information on MIB on the following SIMATIC NET Internet page:

http://support.automation.siemens.com/WW/view/en/15177711

Supported MIB objects

The CP supports the following groups of MIB objects of the MIB II standard according to RFC 1213:

- System
- Interfaces
- IP
- ICMP
- TCP
- UDP
- SNMP
- Address Translation (AT)

The other groups of the MIB II standard are not supported:

- EGP
- Transmission

The CP also supports the LLDP-MIB according to IEEE 802.1AB and the PROFINET expansions of the LLDP-MIB (see also IEC 61158-10-6).

Exceptions / restrictions:

- Write access is permitted only for the following MIB objects of the system group:

  sysContact, sysLocation and sysName;

  For all other MIB objects / MIB object groups, only read access is possible for security reasons.
- Traps are not supported by the CP.

“Interfaces” MIB group

The “Interfaces” MIB object provides status information on the CP interfaces, with the following assignment:

This group returns status information about the CP interfaces. The MIB objects of the ifTable provide the status information of the interfaces. The “ifIndex” object identifier is assigned to the CP interfaces as follows:

ifIndex	Type of interface
1–2	Port 1–2
3	Internal CP interface

Access permissions using community name

The CP uses the following community names to control the access rights in the SNMP agent:

Type of access	Community name *)
Read access	public
Read and write access	private

*) Note the use of lower-case letters!

MIB files for your SNMP tools

If you use an SNMP tool, you will find the MIB files relevant to the CP in the STEP 7 installation in the following folder:

<Drive>\<Installation folder>\Siemens\Step7\S7DATA\snmp\mib

For the Automation System MIB, for example, these are the following files:

automationPS.mib
automationSmi.mib
automationSystem.mib
automationTC.mib

8.8 Possible security gaps on standard IT interfaces / preventing illegal access

With various SIMATIC NET components, such as switches, a wide range of parameter assignment and diagnostic functions (for example, Web servers, network management) are available over open protocols and interfaces. The possibility of unauthorized misuse of these open protocols and interfaces by third parties, for example to manipulate data, cannot be entirely excluded.

When using the functions listed above and these open interfaces and protocols (for example, **SNMP**, HTTP, Telnet), you should take suitable security measures to prevent unauthorized access to the components and the network particularly from within the WAN/Internet.

Notice

We expressly point out that automation networks must be isolated from the rest of the company network by suitable gateways (for example using tried and tested firewall systems). We do not accept any liability whatsoever, whatever the legal justification, for damage resulting from non-adherence to this notice.

If you have questions on the use of firewall systems and IT security, please contact your local Siemens office or representative. You will find the address in the SIMATIC catalog IK PI or on the Internet at

http://www.siemens.de/automation/partner

8.9 Points to note about IP configuration

Configured S7 connections cannot be operated if the IP address is assigned over DHCP

Notice

If you obtain the IP address over DHCP, any S7 connections you may have configured will not work. Reason: The configured IP address is replaced by the address obtained over DHCP during operation.

8.10 Restart after detection of a duplicate IP address in the network

To save you time-consuming troubleshooting in the network, the CP detects double addressing in the network. If the CP detects double addressing on the network (new node with an IP address that has already been assigned), a message is generated in the diagnostic buffer and the bus fault LED lights up.

To acknowledge the bus fault LED in RUN mode, set the CP to STOP and then restart it.

When you eliminate the cause by removing the device with the same IP address or changing its address, you must then restart the CP.

8.11 Prioritized startup in PROFINET IO

Functions

If you use RT or IRT communication, the CP supports the PROFINET functionality “prioritized startup” for PROFINET IO devices that also support this function. A maximum of 32 PROFINET IO devices can be configured per IO controller and startup times with values as low as 0.5 s can be achieved simultaneously for a maximum of 8 of these devices.

Prioritized startup is used in fast processes in which IO device are changed often, for example for a fast change of tools on a robot.

The PROFINET “prioritized startup” functionality also achieves a significant improvement in performance in applications in which a fast startup of the IO devices is required following “Power on” or after station failure and station return or when activating IO devices.

Configuration for IO devices

You configure prioritized startup for the IO devices configured in the PROFINET IO system. To do this, go to STEP 7 / HW Config and select the properties dialogs of the PROFINET interfaces for the relevant IO devices.

Prioritized startup required fixed port settings.

For more detailed information, refer to /16/ of the SIMATIC PROFINET system description (see Chapter 12).

Note

After reconfiguring an IO device for prioritized startup, the first startup takes place in the normal time without being prioritized. All subsequent startups will then be completed in the reduced time.

Notice

Including an IO device with prioritized startup in a ring topology with media redundancy serves no practical purpose since the ring is interrupted at each IO device change.

8.12 PROFINET IO interface – operating PROFINET IO devices with current firmware

Firmware versions

For the PROFINET IO devices listed below, you should use the current firmware versions to operate the CP:

- IM151–3PN with order number 6ES7151–3AA20–0AB0
- IM151–3PN with order number 6ES7151–3BA20–0AB0

The current firmware versions are available on the Internet at the following address:

http://support.automation.siemens.com/WW/view/de/22810435

8.13 Interface in the user program

8.13.1 FC call interface

Change call parameters only after job confirmation

Notice

After the job is triggered, you may only change the call parameters on the FC call interface of the FCs AG_SEND / AG_LSEND / AG_SSEND or AG_RECV / AG_LRECV / AG_SRECV again after the FC has confirmed execution of the job with DONE=1 or with ERROR=1.

If this is ignored, it is possible that the execution of the job will be aborted with an error and resources could be permanently occupied on the CPU.

8.13.2 Programmed communication connections with FB55 IP_CONFIG

Downloading the configuration using FB55

FB55 allows program-controlled transfer of the configuration data.

Note

If the CP is in PG STOP mode, the configuration is downloaded using FB55; the CP then changes automatically to RUN.

Points to note / restriction

Notice

- No use of FB55 when using a CP with fault−tolerant S7 connections
  If you configure fault−tolerant S7 connections via the CP, you cannot use FB55 for IP configuration of the CP.

You will find more detailed information on special features and use in fault−tolerant systems in the section “FBs for programmed connections and IP configuration in” in /10/.

8.13.3 IP access protection with programmed communication connections

In principle, it is possible to set up communication connections using FB55 by programming and at the same time by configuring IP access protection. Please note the following point:

Notice

When configuring specified connections in STEP 7 / NCM S7, the IP addresses of the partners are entered automatically in the IP-ACL (IP Access Control List).

The IP addresses of partners with unspecified connections (passive end points) and of partners on programmed communication paths are not entered in the IP-ACL. This means that communication with unspecified nodes is not possible if IP access protection is activated.

How to configure IP access protection is described in the general part of this manual, Part A.

8.13.4 Open TCP/IP communication

Use

To allow the user program to exchange data with other TCP/IP-compliant communication partners, STEP 7 provides a UDT for the connection parameter assignment and four FBs.

- UDT 65 “TCON_PAR” with the data structure for connection parameter assignment
- FB65 “TCON” for connection establishment
- FB66 “TDISCON” for connection termination
- FB63 “TSEND” for sending data
- FB64 “TRCV” for receiving data

TCP/IP communication is connection-oriented. Data can be transmitted only when a connection has been established to the communication partner. The CPU can use several connections to a communications partner at the same time.

The following protocol variants are supported:

- ISO on TCP according to RFC 1006

Programming

Make the following parameter settings in the connection description (UDT 65):

- local_tsap_id: Byte 1 = 0xE0 (value mandatory for correct functionality)
- local_tsap_id: Byte 2 = Rack/slot number
- remote_tsap_id: Byte 1 = 0xE0 (value mandatory for correct functionality)
- remote_tsap_id: Byte 2 = Rack/slot number

Note: The TSAPs can be 2–16 bytes long. The first two bytes must be occupied as described, you can use the other bytes to suit your task.

Notice

Note that the number of dynamically established connections also depends on the number of configured, statically established connections.

You will obtain appropriate condition codes on the call interface of the FBs.

Please refer to the documentation of the FBs in the online help and in the documentation for STEP 7. There, you will also find examples of parameter assignment!

8.13.5 Additions to the FC/FB status condition codes

The following condition codes for the communication FBs/FCs have been added or modified compared with the information in the online help for STEP 7 V5.4 SP4 or the manual /10/ Release 03/2008.

FC10 AG_CNTRL

DONE	ERROR	STATUS	Meaning
0	1	$80B2_H$	The configured slot is not occupied.

8.14 Ping: Permitted length of ICMP packets

Pings with a packet size of more than 1000 bytes are evaluated as an attack and filtered by the CP. This response is deliberate and serves to increase robustness in an industrial environment.

A ping only serves to check reachability. Support of extremely long ICMP packets is not therefore a necessity.

9 Loading New Firmware

Initial situation

You download new firmware to a SIMATIC NET CP using the firmware loader shipped with STEP 7 / NCM S7.

To download firmware, you require an Industrial Ethernet CP module in the PG/PC (for example, CP 1613) or a normal Ethernet module with the “SOFTNET IE” software package.

How to load new firmware

Always start the download using the **current** MAC address of the CP!

Notice

Remember that the CPU changes to STOP during downloading of the firmware if you are using PROFINET IO communication.

	Follow the steps below:
1.	Connect the CP module to the PG/PC via a LAN cable.
2.	Start the download on your PG/PC. The download involves two steps and the following LED patterns are displayed: • Step 1: Downloading the firmware INTF, EXTF, BUSF, MAINT and STOP light up, RUN flashes. • Step 2: Activating the firmware All LEDs light up. If the download is aborted, RUN and STOP flash alternately.
3.	After the firmware download, the CP goes through a warm restart.

What to do if a download is interrupted

Disturbances or collisions on the network can lead to packets being lost. In such cases, this can lead to an interruption of the firmware download. The firmware loader then signals a timeout or negative response from the module being loaded. En entry is made in the diagnostic buffer. The CP works with the firmware that existed before the aborted download.

Repeat the download using the active MAC address after the CP has started up again.

If you cannot start the download again following an aborted attempt, you should turn off the entire rack and turn it on again. You can then restart the firmware download.

10 Technical Specifications

Table 10-1 Technical specifications

Transmission rate	10 Mbps and 100 Mbps
Interfaces Attachment to Industrial Ethernet	 2 x RJ-45 jacks
Aging time (2-port switch)	5 minutes
Current consumption via the S7 backplane bus from 5 V:	 1.4 A
Power loss	7.25 W
Perm. environmental conditions • Operating temperature • Transportation/storage temperature • Relative humidity max. • Altitude	 0 °C to +60 °C −40 °C to +70 °C 95% at +25 °C up to 2000 m above sea level
Design Dimensions, module in casing H x W x D (mm)	 290 x 25 x 210
Weight	approx. 700 g

In addition to this, all the information in the S7-400/M7-400 reference manual /14/ “Module Data” in the section “General Technical Specification” on the topics listed below applies to the CP:

- Electromagnetic compatibility
- Transportation and storage conditions
- Mechanical and climatic ambient conditions
- Insulation tests, class of protection and degree of protection

11 Other Information available about the CP

FAQs on the Internet

You will find detailed information (FAQs) on using the CP described here on the Internet under the following entry number (entry type ”FAQ”):

http://support.automation.siemens.com/WW/news/en/10904077

You will find the following information in the general Part A of the manual /4/:

- A list of the documents require for configuration, commissioning and operation (Preface)
- Detailed descriptions of configuration and commissioning of the module
- Description of Web diagnostics and NCM S7 Diagnostics
- The approvals of the device (Appendix)
- A glossary (Appendix)

When programming the functions (FC) and blocks (FB), refer to the Programming Manual /10/

12 References and Literature

Locating Siemens literature

The order numbers for Siemens documentation can be found in the catalogs ”SIMATIC NET Industrial Communication, catalog IK PI” and ”SIMATIC Products for Totally Integrated Automation and Micro Automation, catalog ST 70”.

You can obtain these catalogs and any further information you require from your local SIEMENS office or national head office.

Some of the documents listed here are also in the SIMATIC NET Manual Collection supplied with every S7-CP.

Many SIMATIC NET manuals are available on the Internet pages of Siemens Customer Support for Automation:

http://support.automation.siemens.com/WW/view/de

Enter the ID of the relevant manual as a search key. The ID is shown below the literature name in brackets.

Manuals that are installed with the online documentation of the STEP 7 installation on your PG/PC, can be selected from the Start menu (Start > SIMATIC > Documentation).

You fill find a overview of the SIMATIC documentation at:

http://www.automation.siemens.com/simatic/portal/html_76/techdoku.htm

On configuration, commissioning and use of the CP

/**1**/ SIMATIC NET
S7 CPs for Industrial Ethernet – device documentation Part B
Manual
Siemens AG
(manual for each CP in the SIMATIC NET Manual Collection)

/**2**/ SIMATIC NET
Version history / current downloads for SIMATIC NET S7 CPs
Siemens AG
(SIMATIC NET Manual Collection)

http://support.automation.siemens.com/WW/view/en/9836605

On configuration with STEP 7 / NCM S7

/**3**/ SIMATIC NET
NCM S7 for Industrial Ethernet
Primer
Siemens AG
Part of the online documentation in STEP 7

/**4**/ SIMATIC NET
S7 CPs for Industrial Ethernet – device documentation Part A
Configuration and Commissioning
Configuration manual
Siemens AG
Part of the online documentation in STEP 7

http://support.automation.siemens.com/WW/view/en/30374198

/**5**/ SIMATIC NET
Commissioning PC Stations – Manual and Quick Start
Configuration manual
Siemens AG
(SIMATIC NET Manual Collection)

http://support.automation.siemens.com/WW/view/en/13542666

/**6**/ SIMATIC
Configuring Hardware and Connections with STEP 7
Part of the STEP 7 documentation package STEP 7 Basic Knowledge”
Part of the online documentation of STEP 7
Siemens AG

/**7**/ SIMATIC
PROFINET System Description
System manual
Siemens AG

http://support.automation.siemens.com/WW/view/en/19292127

On project engineering of PROFINET CBA (components and systems):

/**8**/ Component based Automation – Configuring Plants with SIMATIC iMap
Manual
Siemens AG
(ID: 18404678)

http://support.automation.siemens.com/WW/view/en/18404678

/**9**/ Basic Help in the SIMATIC iMap Engineering Tool (online help)
Siemens AG

You will find further information on SIMATIC iMAP at:

http://support.automation.siemens.com/WW/view/en/10805413

On programming

/**10**/ SIMATIC NET
Functions (FC) and Function Blocks (FBs) for SIMATIC NET S7 CPs
Programming Manual
Siemens AG
(SIMATIC NET Manual Collection)
(ID: 30564821)

http://support.automation.siemens.com/WW/view/en/30564821

/**11**/ Version history of the SIMATIC NET function blocks and functions for SIMATIC S7
Reference work
Siemens AG
(SIMATIC NET Manual Collection)
(ID: 9836605)

http://support.automation.siemens.com/WW/view/en/9836605

/**12**/ SIMATIC – Programming with STEP 7
Part of the STEP 7 documentation package STEP 7 Basic Knowledge
Part of the online documentation of STEP 7
Siemens AG

/**13**/ Automatisieren mit STEP 7 in AWL und SCL (ISBN: 978–3–89578–280–0) /
Automating with STEP 7 in STL and SCL (ISBN: 978–3–89578–295–4)
User manual, programming manual
Berger, Hans
Publicis KommunikationsAgentur GmbH, GWA, 2006

For installation and commissioning of the CP

/**14**/ SIMATIC S7
S7–300 Automation System
– CPU 31xC und 31x Installation: Operating Instructions (ID: 13008499)
– Module Data: Reference Manual (ID: 8859629)
Siemens AG

http://support.automation.siemens.com/WW/view/en/13008499

http://support.automation.siemens.com/WW/view/en/8859629

and

SIMATIC S7
SIMATIC S7
S7−400, M7−400 Automation system
− Installation Manual (ID: 1117849)
− Module Data: Reference Manual (ID: 1117740)
Siemens AG

http://support.automation.siemens.com/WW/view/en/1117849

http://support.automation.siemens.com/WW/view/en/1117740

On using and configuring PROFINET IO

/**15**/ SIMATIC
PROFINET System Description
System Manual
Siemens AG
(Part of the Manual Collection)

/**16**/ SIMATIC
From PROFIBUS DP to PROFINET IO
Programming Manual
Siemens AG
(Part of the Manual Collection)

On the IT functions of the CPs

/**17**/ Creating Java Beans with IBM VisualAge
SIEMENS AG
(ID: 10499820)

http://support.automation.siemens.com/WW/view/en/10499820

/**18**/ S7Beans / Applets for IT−CPs
Programming Aid
SIEMENS AG
(SIMATIC NET Manual Collection)
(ID: 24843908)

http://support.automation.siemens.com/WW/view/en/24843908

On setting up and operating an Industrial Ethernet network

/**19**/ SIMATIC NET
Manual Twisted Pair and Fiber−Optic Networks
Siemens AG
(SIMATIC NET Manual Collection)

/**20**/ SIMATIC NET
Manual Triaxial Networks
(SIMATIC NET Manual Collection)

SIMATIC and STEP 7 basics

/**21**/ Communication with SIMATIC
System Manual
Siemens AG
(ID: 25074283)

http://support.automation.siemens.com/WW/view/en/25074283

/**22**/ Documentation package “STEP 7 Basic Knowledge”
with
− Working with STEP 7 V5.4 Getting Started (ID: 18652511)
− Programming with STEP 7 (ID: 18652056)
− Configuring Hardware and
Communication Connections with STEP 7(ID: 18652631)
− Form S5 to S7, Converter Manual (ID: 1118413)
Siemens AG
Order number 6ES7 810−4CA08−8AW0
Part of the online documentation in STEP 7

/**23**/ Documentation package “STEP 7 Reference”
with
− Statement List (STL) for S7−300/400 (ID: 18653496)
− Ladder Diagram (LAD) for S7−300/400 (ID: 18654395)
− Function Block Diagram (FBD) for S7−300/400 (ID: 18652644)
− System and Standard Functions for S7−300/400 Volumes 1 and 2 (ID: 1214574)
− System software for S7-300/400 System and Standard Functions Part 2
Siemens AG
Order number 6ES7 810−4CA08−8AW1
Part of the online documentation in STEP 7

Other topics

/**24**/ Ethernet, IEEE 802.3 (ISO 8802−3)
(http://www.ieee.org)

/**25**/ RFC1006 (ISO Transport Service on top of the TCP Version: 3)
Request For Comment
(http://www.ietf.org)

/**26**/ RFC793 (TCP)
(http://www.ietf.org)

/**27**/ RFC791 (IP)
(http://www.ietf.org)