

SIMATIC NET S7-CPs for PROFIBUS

Manual

Part A – General Application

A

Part B – CP Descriptions

CP 342-5 / CP342-5 FO

Order no.: 6GK7 342-5DA02-0XE0 /
Order no.: 6GK7 342-5DF00-0XE0
(C79000-G8976-C146-03)

B1

CP 343-5

Order no.: 6GK7 343-5FA01-0XE0
(C79000-G8976-C160-02)

B2

CP 443-5 Basic

Order no.: 6GK7 443-5FX01-0XE0
(C79000-G8976-C161-02)

B3

CP 443-5 Extended

Order no.: 6GK7 443-5DX03-0XE0
(C79000-G8976-C162-02)

B4

03/2002

C79000-G8976-C154

Release 02

Classification of Safety-Related Notices

This manual contains notices which you should observe to ensure your own personal safety, as well as to protect the product and connected equipment. These notices are highlighted in the manual by a warning triangle and are marked as follows according to the level of danger:



Danger

indicates that death or severe personal injury **will** result if proper precautions are not taken.



Warning

indicates that death or severe personal injury **can** result if proper precautions are not taken.



Caution

with warning triangle indicates that minor personal injury can result if proper precautions are not taken.

Caution

without warning triangle indicates that damage to property can result if proper precautions are not taken.

Notice

indicates that an undesirable result or status can result if the relevant notice is ignored.

Note

highlights important information on the product, using the product, or part of the documentation that is of particular importance and that will be of benefit to the user.

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Only **qualified personnel** should be allowed to install and work on this equipment. Qualified persons are defined as persons who are authorized to commission, to ground, and to tag circuits, equipment, and systems in accordance with established safety practices and standards.

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Note the following:



Warning

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Before you use the supplied sample programs or programs you have written yourself, make certain that no injury to persons nor damage to equipment can result in your plant or process.

EU Directive: Do not start up until you have established that the machine on which you intend to run this component complies with the directive 89/392/EEC.

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Warning

This software may only be used for the applications described in the catalog or the technical description, and only in connection with software products, devices, or components from other manufacturers which have been approved or recommended by Siemens.

Before you use the supplied sample programs or programs you have written yourself, make certain that no injury to persons nor damage to equipment can result in your plant or process.

Prior to Startup

Prior to startup, note the following:

Caution

Prior to startup, note the information and follow the instructions in the latest documentation. You will find the ordering data for this documentation in the relevant catalogs or contact your local Siemens office.

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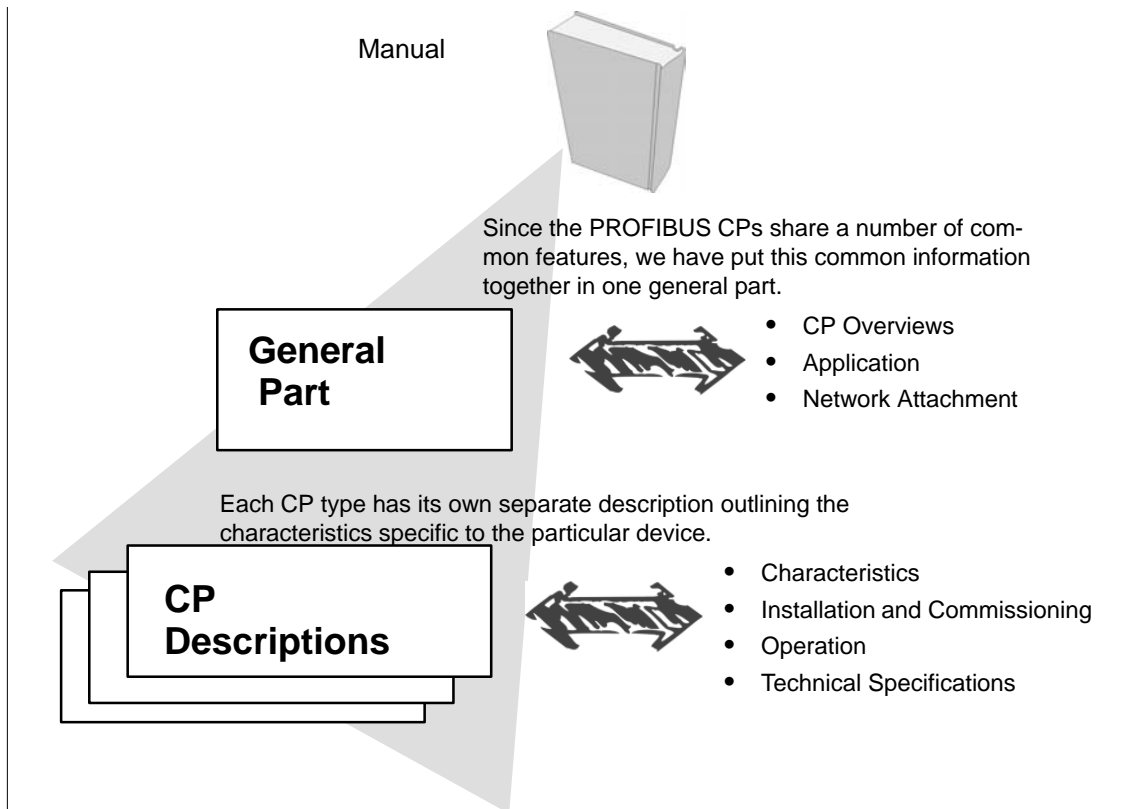
We have checked the contents of this manual for agreement with the hardware and software described. Since deviations cannot be precluded entirely, we cannot guarantee full agreement. However, the data in this manual are reviewed regularly and any necessary corrections included in subsequent editions.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

Subject to technical change.

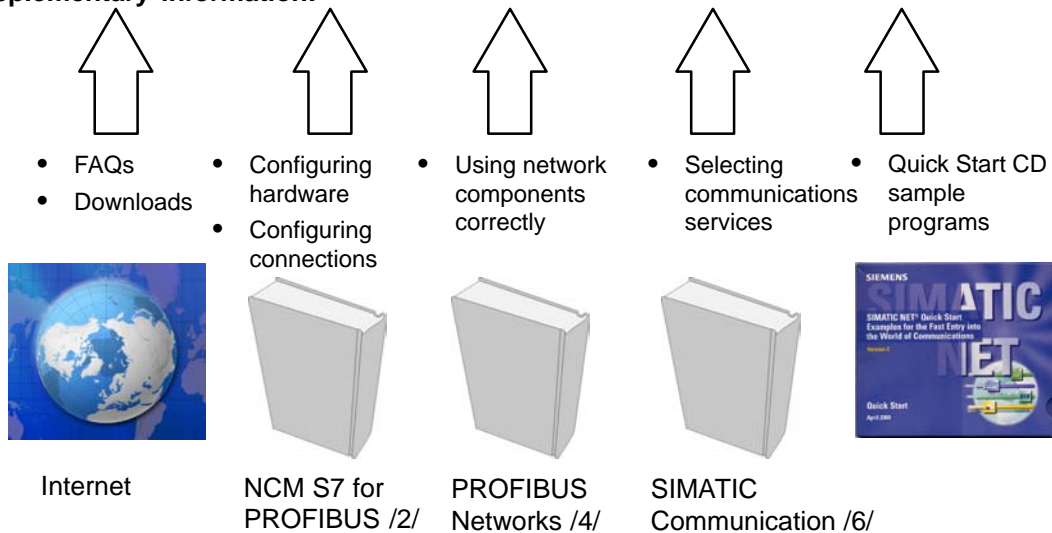
This SIMATIC NET PROFIBUS CP Manual...

... helps you to use the device in your SIMATIC S7 PLCs successfully and effectively.

To provide you with a clear overview and quick access to the information you require on our PROFIBUS CPs, we have structured the manual as shown below:



Supplementary information:



CP Documentation on the Manual Collection CD (order no. A5E00069051)

You receive the SIMATIC NET Manual Collection CD with every S7-CP. This CD is updated at regular intervals and contains the latest manuals and descriptions valid at the time it is written.

The paper versions of the CP descriptions are included in the NCM S7 for PROFIBUS manual package.

Latest Documentation on the Internet

The latest descriptions of the currently available products are available on the Internet on the pages shown in the following sections and tables.

Version History / Current Downloads for the SIMATIC NET S7-CPs

The document "Version History / Current Downloads for the SIMATIC NET S7-CPs" contains information on all PROFIBUS CPs for SIMATIC S7 that have been available up to now. You will find the latest version of this document at:

<http://www4.ad.siemens.de/view/cs/en/9836605>

Information on the Current Block Versions (FCs/FBs)

When writing new user programs, you should always use the latest versions of the blocks. You will find Information on the current block versions and download links for the current blocks on the Internet at:

<http://www4.ad.siemens.de/view/cs/en/8797900>

If you are replacing an existing module, please follow the instructions in Part B of this manual for your specific device.

Additional Information – The Documentation Package NCM S7 for PROFIBUS

This manual is also part of the NCM S7 for PROFIBUS documentation package. The table below provides you with an overview of the contents.

Title	Topic
NCM S7 for PROFIBUS, Primer	Based on simple examples, the primer introduces you to the methods of connecting and networking SIMATIC S7 stations with CPs on PROFIBUS. You will see how the communication calls in the user program should appear to make optimum use of the services via the SEND/RECEIVE interface. You will learn how simple it is to create a configuration for standard applications using STEP 7 and the NCM S7 optional package. http://www4.ad.siemens.de/view/cs/en/1157760
NCM S7 for PROFIBUS Manual Volumes 1 and 2	The manual is intended as a guide and reference work for configuring and programming a PROFIBUS CP. When working with the configuration software, you can also call up the online help in specific situations. http://www4.ad.siemens.de/view/cs/en/1158693 http://www4.ad.siemens.de/view/cs/en/1158418
NCM S7 PC Manual	The manual contains all the information required to configure SIMATIC PC stations. Quick start sections help you to achieve success quickly.



Tip:

You should also refer to the recommended reading on topics such as the Web, HTML etc. in the appendix of this manual and in Chapter 5.

This symbol appears in the margin to draw your attention to useful tips.

Quick Start CD: Samples on all aspects of communication



The Quick Start CD can be ordered separately and is a treasure-trove of sample programs and configurations.

You can also order this directly on the Internet.

Additional Information on SIMATIC S7 and STEP 7

The following documentation contains additional information about the STEP 7 standard software of the SIMATIC programmable controllers and can be obtained from your local Siemens office.

Topic	Document
Basic information for technical personnel using the STEP 7 standard software for control tasks with S7-300/400 programmable controllers.	STEP 7 basics with <ul style="list-style-type: none">• User manual• Programming manual• Manual for converting from S5 to S7• Primer for a quick start
The reference works describing the programming languages LAD/FBD and STL as well as the standard and system functions in addition to the STEP 7 basic knowledge.	STEP 7 reference manuals with <ul style="list-style-type: none">• Manuals for LAD/FBD/STL• Standard and System Functions for S7-300/400

You will also find information on the SIMATIC programmable controllers on the Quick Start CD and in the Customer Support online services at:

<http://www.ad.siemens.de/net> general information

or

<http://www.ad.siemens.de/csi/net> product information and downloads

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Contents – Part B

see CP-specific description

on Manual Collection CD

or via Internet:

CP 342-5 / 342-5 FO: <http://www4.ad.siemens.de/view/cs/de/8773570>

CP 343-5: <http://www4.ad.siemens.de/view/cs/de/8778841>


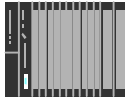
CP 443-5 Basic: <http://www4.ad.siemens.de/view/cs/de/8776422>

CP 443-5 Extended: <http://www4.ad.siemens.de/view/cs/de/8777196>

1 Introduction

1.1 The Communication Services of the PROFIBUS CPs

Depending on the module type, the S7-CPs support the following communication options:

Programmable Controller	Module	Functions Supported					
		PG/OP	S7	S5-comp.	Standard (FMS)	DP Mode	
						Master	Slave
S7/C7-300 	CP 342-5	●	●	●		● ¹⁾	● ¹⁾
	CP 342-5 FO	●	●	●		● ¹⁾	● ¹⁾
	CP 343-5	●	●	●	●		
S7-400/S7-400H 	CP 443-5 Basic	●	●	●	●		
	CP 443-5 Extended	●	●	●		●	

1) DP mode: either DP master or DP slave

- **PG/OP Communication**

PG/OP communication is used to download programs and configuration data, to run test and diagnostic functions, and to monitor and control a plant/process at an OP.

- **S7 Communication**

S7 communication forms a simple and efficient interface between SIMATIC S7 stations and PGs/PCs using communication function blocks.

- **S5-compatible Communication (SEND/RECEIVE Interface)**

The SEND/RECEIVE interface allows program-controlled communication on a configured connection from a SIMATIC S7 PLC to another SIMATIC S7 PLC, a SIMATIC S5 PLC and to a SIMATIC PC station.

- **Standard Communication (FMS Interface)**

(complying with EN 50170 Vol. 2; FMS client and server function)

The FMS interface allows program-controlled, neutral transmission of structured data via a configured connection from SIMATIC S7 PLCs to devices that support the FMS protocol.








- **PROFIBUS-DP**

(complying with EN 50170 Vol. 2; DP master or DP slave)

The distributed peripheral I/Os (DP) allow you to use a large number of analog and digital input/output modules in the immediate vicinity of the process in a distributed configuration.

Communication Options Provided by the Device Families

The following table shows the communication options between the device types with the various types of communication:

	 S7-300	 S7-400	 S5-115U to -155U/H S5-95U S5-95U/DP Master S5-95U/DP Slave	 PC	 Field device
 S7-300	S7 communication ²⁾ SEND/RECEIVE FMS PROTOCOL DP PROTOCOL	S7 communication SEND/RECEIVE FMS PROTOCOL DP PROTOCOL	S5-95U with PROFIBUS interface: SEND/RECEIVE <hr/> S5-95U/DP master/slave: DP PROTOCOL <hr/> S5-115U to -155U/H: SEND/RECEIVE DP PROTOCOL FMS PROTOCOL	PG/OP communication ¹⁾ S7 communication ¹⁾ FMS PROTOCOL SEND/RECEIVE DP PROTOCOL	DP PROTOCOL FMS PROTOCOL
 S7-400	S7 communication FMS PROTOCOL SEND/RECEIVE DP PROTOCOL	S7 communication FMS PROTOCOL SEND/RECEIVE	S5-95U with PROFIBUS interface: SEND/RECEIVE <hr/> S5-95U/DP master/slave: DP PROTOCOL <hr/> S5-115U to -155U/H: SEND/RECEIVE DP PROTOCOL FMS PROTOCOL	PG/OP communication ¹⁾ S7 communication ¹⁾ FMS PROTOCOL SEND/RECEIVE DP PROTOCOL	DP PROTOCOL FMS PROTOCOL

1) PC only as client

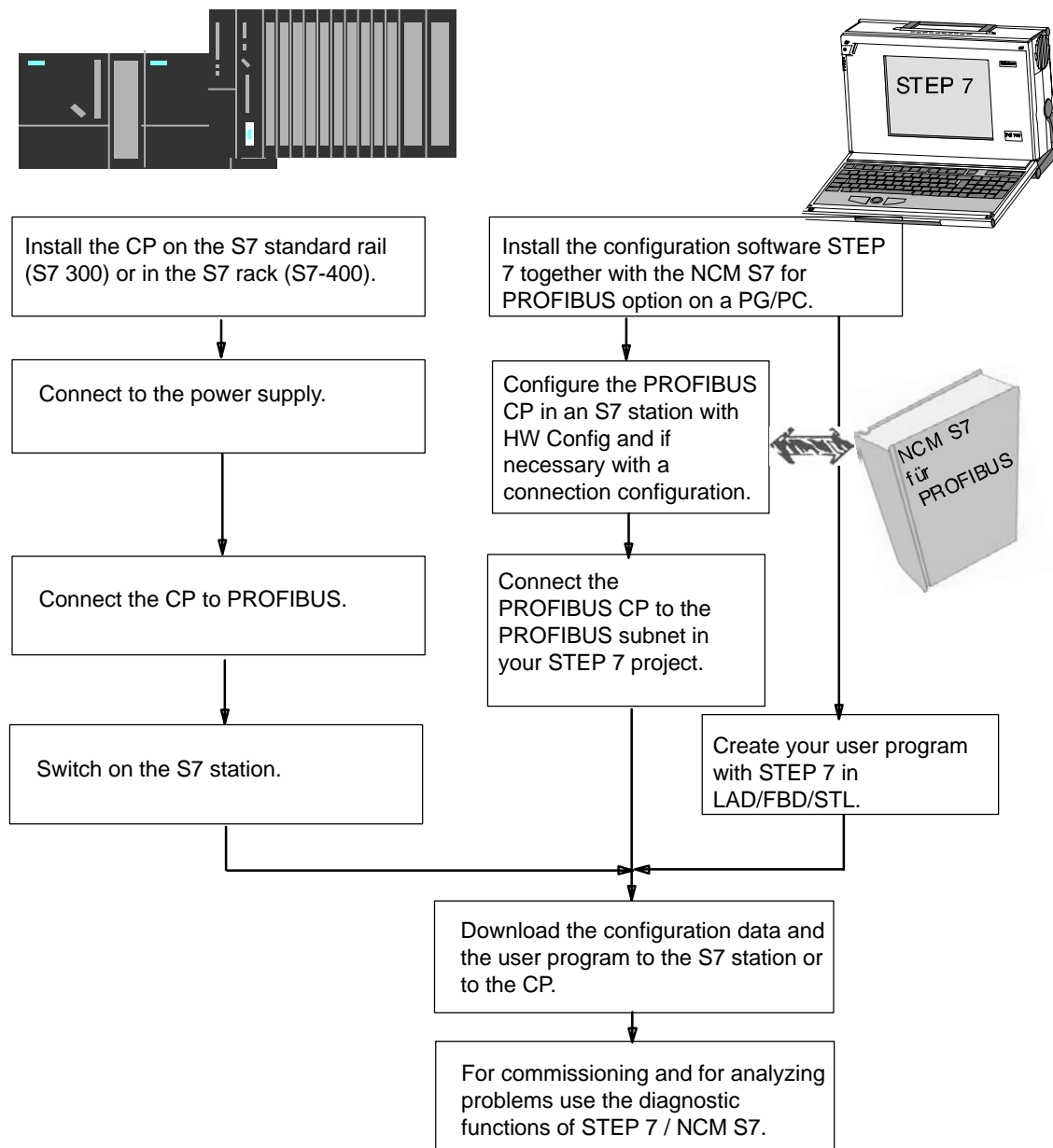
2) If the S7-300 is also a client, communication blocks and a connection configuration are necessary

1.2 How to Commission a PROFIBUS CP

The following overview shows the essential steps when commissioning a PROFIBUS CP:

Notice

The following diagram shows the basic procedure. Follow the instructions for your specific device in "Installation and Commissioning" in Part B of this manual for your specific CP.



Configuring and Diagnostics with STEP 7 and NCM S7 for PROFIBUS

To attach the PROFIBUS CP to the network and to configure it, you require the STEP 7 configuration software. Depending on the communication services/CPs you want to use, you may also require the SIMATIC NET NCM S7 for PROFIBUS option.

Communication Device	The NCM S7 for PROFIBUS option must also be installed in addition to the STEP 7 basic package
S7 communication	X
SEND/RECEIVE interface	X
FMS interface	X
DP protocol	–

NCM S7 for PROFIBUS is installed as a STEP 7 option and is therefore integrated in STEP 7. NCM S7 for PROFIBUS also provides a wide range of diagnostic functions for the various types of communication.

Programming – Using Blocks

“Off-the-peg” blocks (FCs/FBs) form the interface in your STEP 7 user program to some of the communication services available with the PROFIBUS CP. You will find a detailed description of these blocks in the NCM S7 for PROFIBUS manuals.

Notice

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

You will find information on the latest block version and links to download the current blocks in our Customer Support on the Internet:

<http://www4.ad.siemens.de/view/cs/en/8797900>

If you are using older block types, this recommendation only applies if you also have the latest firmware version.

You will find further information and Internet addresses in the Preface.

1.3 Diagnostics During Commissioning and Operation

Diagnostic Options in STEP 7

STEP 7 provides you with a graded concept allowing you to query information about the status of your SIMATIC S7 components and functions and to sort out problems in a variety of different situations. These options cover the following:

- **Communication Diagnostics with NCM S7 Diagnostics**

The NCM S7 Diagnostics described here provides dynamic information on the status of the communication functions of online CPs.

- **Hardware Diagnostics and Troubleshooting with STEP 7**

Hardware diagnostics provides dynamic information on the status of modules including CPs when the S7 station is online.

You can recognize the existence of diagnostic information for a module by the diagnostics icon in the project window of the SIMATIC Manager. Diagnostics icons show the status of the corresponding module and also the operating mode of CPUs.

Detailed diagnostic information is displayed in the “module information” that you can open by double-clicking a diagnostics icon in the quick view or the diagnostic view.

- **HW Config Provides Static Information**

Static information means the configured communication properties of an online or offline CP and you can display this at any time using the hardware configuration shown by HW Config.

- **Online Status in NetPro**

In STEP 7, NetPro status information about connections can be displayed when the S7 station is online.

Functions of NCM S7 Diagnostics

The diagnostic functions can be grouped as follows:

- General diagnostic and statistical functions
- Type and mode-dependent diagnostic functions

General Diagnostic and Statistical Functions

Regardless of the configured mode of the PROFIBUS CP, the following diagnostic functions are possible:

- Querying the operating mode on PROFIBUS and the configured mode of the PROFIBUS CP
- Querying the current PROFIBUS bus parameters (including the real Ttr)
- Obtaining station-related statistical information
- Querying the event messages recorded on the PROFIBUS CP (diagnostic buffer)
- Displaying the PROFIBUS station overview
- Displaying address information and location of firmware and hardware output

Type and Mode-Dependent Diagnostic Functions

Depending on the configured mode of the PROFIBUS CP, the following diagnostic functions are possible:

- DP master diagnostics
Querying the status of the DP master and the communication status of all configured slaves
It is possible to call DP slave diagnostic data for specific DP slaves.
- DP slave diagnostics

Note

Note that NCM S7 Diagnostics cannot be used for a passive DP slave on PROFIBUS.

- Connection diagnostics

1.4 Loadable Firmware

The PROFIBUS CP supports firmware updates using the Firmware Loader. After power up with the mode selector set to STOP, the CP remains in the "waiting for firmware update" status for 10 seconds.

After the firmware update, the rack must be turned off and on again before normal operation is resumed!

Note

For more detailed information on loading firmware, refer to the NCM S7 for PROFIBUS manual /2/ the README file of the NCM S7 for PROFIBUS configuration software.

2 Structure

2.1 Communications Processors for S7-300

The modules are designed to match the components of the S7-300/C7-300 programmable logic controller and have the following features:

- Compact modules (double or single-width) for simple installation on the S7 standard rail
- The operator controls and displays are all located on the front panel
- Direct backplane bus connection via the supplied bus connector
- 9-pin sub-D female connector or duplex sockets for connecting the CP to PROFIBUS
- The modules can be configured via MPI or LAN/PROFIBUS.

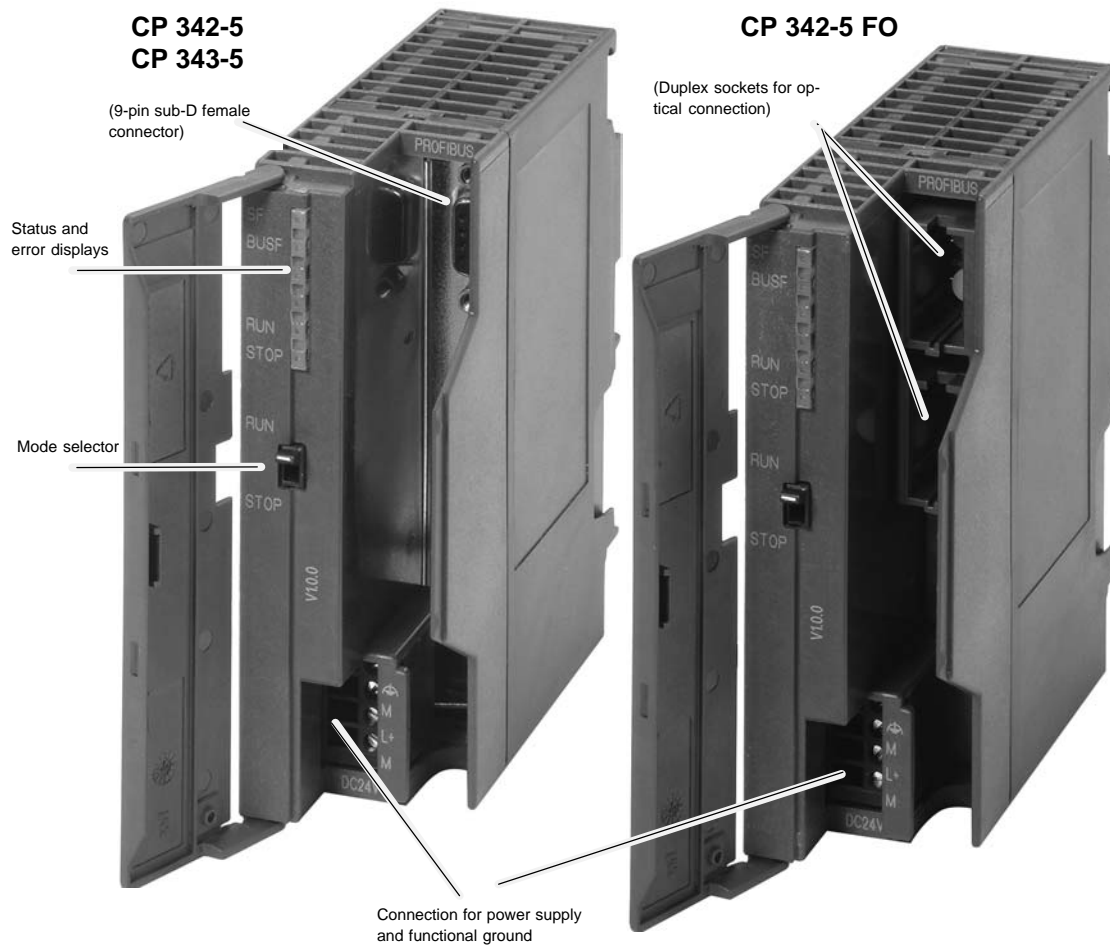


Figure 2-1 Example: Front View of the CPs 342-5 / 342-5 FO / CP 343-5

2.2 Communications Processors for S7-400

The modules are designed to match the components of the S7-400 / S7-400H (H station) programmable logic controller and have the following features:

- Single-width module for simple installation in the S7-400 / S7-400H (H station) rack
- The operator controls and displays are all located on the front panel
- Can be used in central or expansion racks
- No fan necessary
- 9-pin sub-D female connector for connecting the CP to PROFIBUS
- The modules can be configured via MPI or LAN/PROFIBUS.

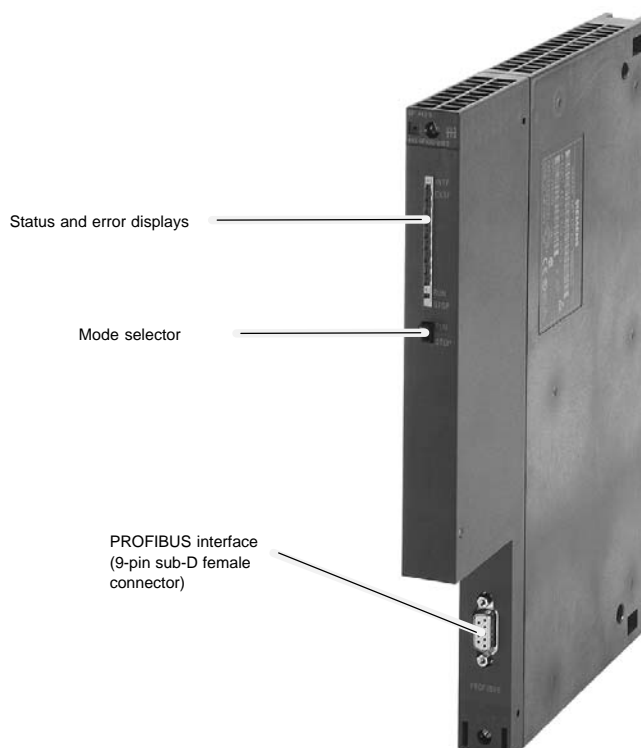


Figure 2-2 Example: Front View of a CP 443-5 Basic / Extended

3 Attaching to PROFIBUS

Below, you will see several typical possible attachments.

For further information on attachment options and PROFIBUS structures, refer to the PROFIBUS network manual /4/. For ordering data and information on further components, please refer to the IK PI catalog or the CA01 electronic ordering catalog on CD, and on the Internet at:

<http://www3.ad.siemens.de/ca01online>

3.1 Electrical Attachment

The following options are available for electrical attachment of the CPs to PROFIBUS:

- **Bus Connector (Fast-Connect)**

The bus cable is led directly to the CP and attached to the CP using the bus connector.

- **Bus Terminal**

The bus cable is connected at the bus terminal (6GK1 500-0AA10). The CP is connected using the cable integrated in the bus terminal.

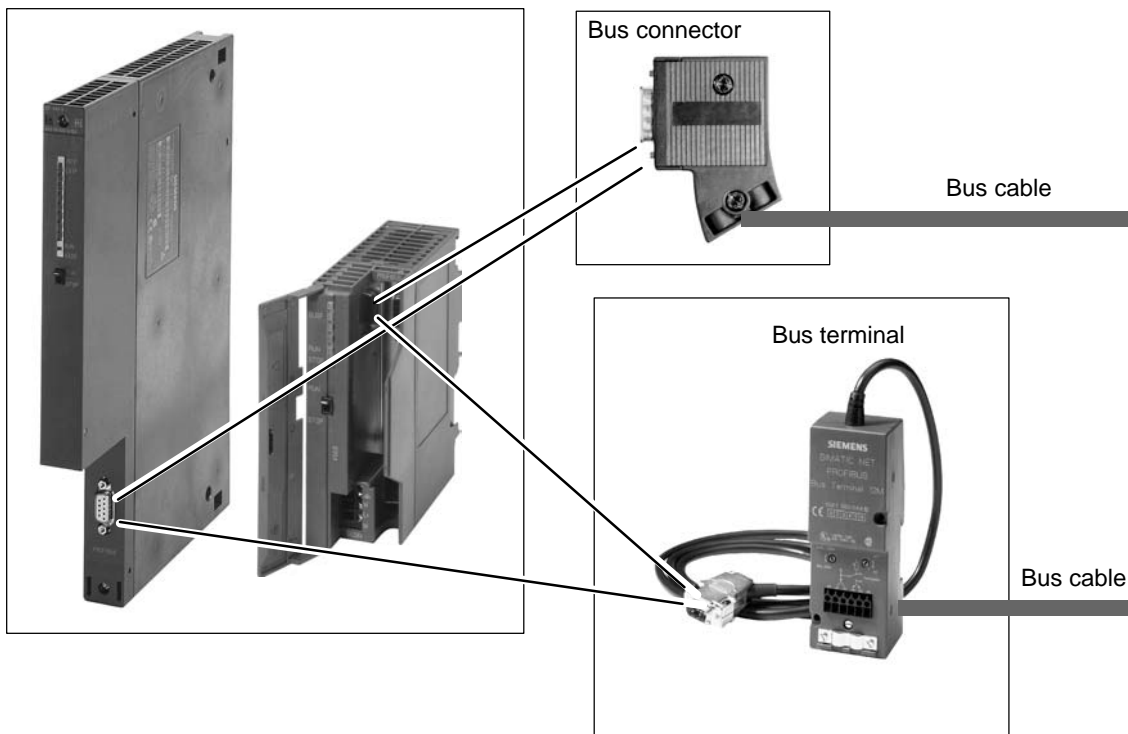


Figure 3-1 Electrical Attachment of the CPs to PROFIBUS

3.2 Optical Attachment

- **Transition from Electrical to Optical Attachment**

The optical link modules (OLM) or optical bus terminals (OBT) are available for attaching to the optical version of PROFIBUS. The attachment depends on the type of network components used: glass, plastic or PCF optical cable.

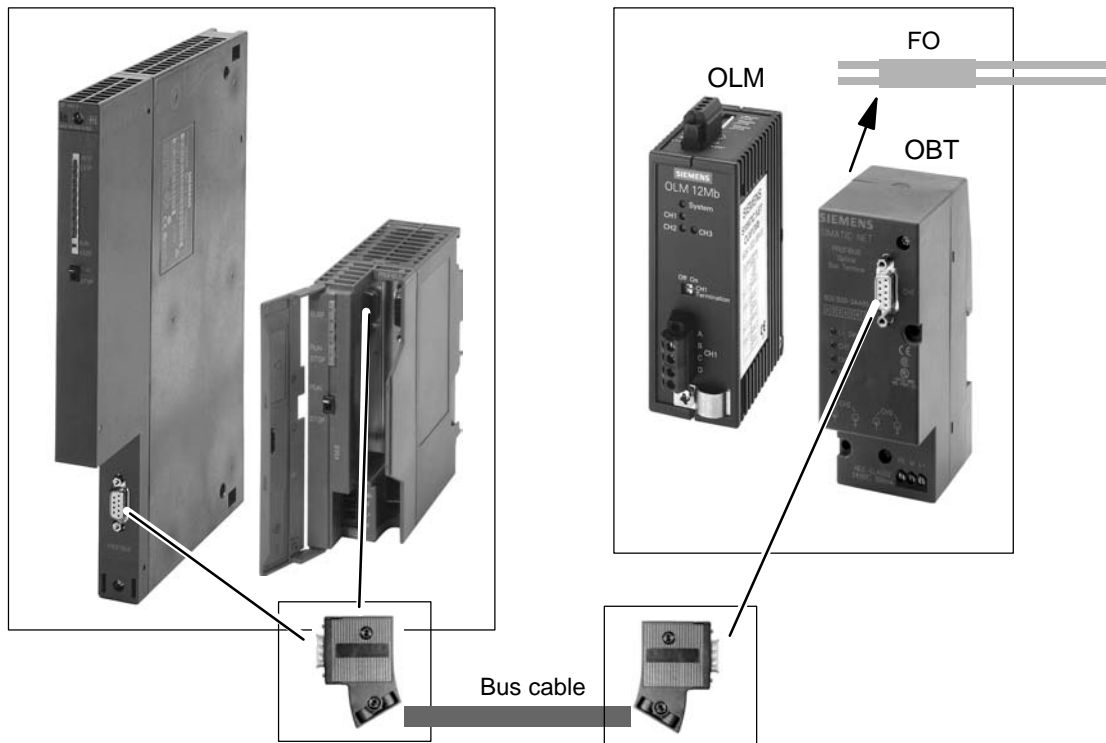


Figure 3-2 Transition from Electrical to Optical Attachment

Note

For data rates higher than 1.5 Mbps (12 Mbps), the optical link module approved for higher data transmission rates must be used.

- **Direct Optical Attachment**

Modules such as the CP 342-5 FO allow direct fiber-optic cable attachment via suitably assembled connectors.

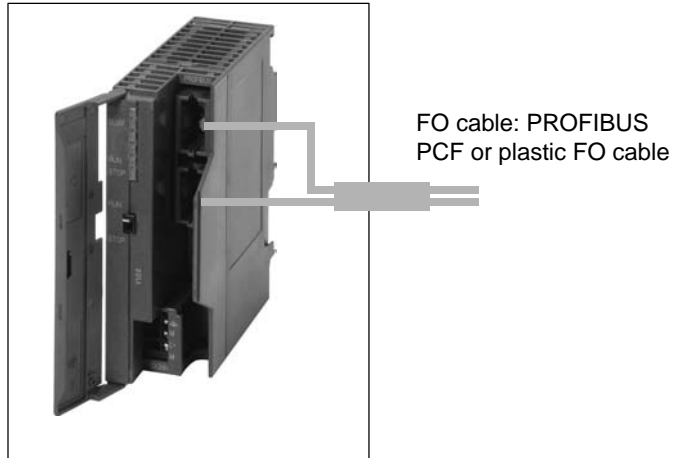


Figure 3-3 Direct Optical Attachment

4 Slot Rules and Configurations

4.1 SIMATIC S7-300

4.1.1 Permissible Slots

In the SIMATIC S7/M7-300 there is no set slot assignment for the SIMATIC NET CPs. Slots 4 to 11 are permissible (1, 2 and 3 cannot be used for CPs).

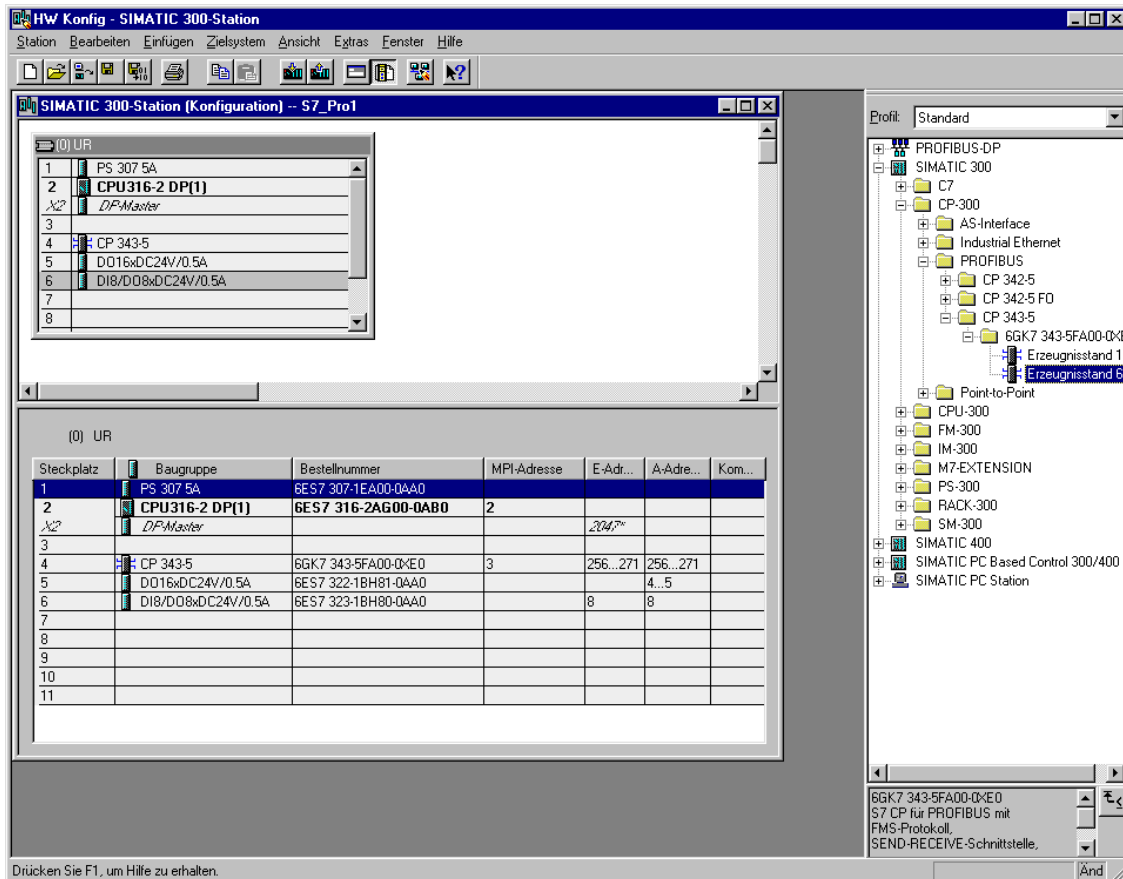


Figure 4-1 Example: Hardware Configuration S7-300 with SIMATIC NET CPs in the Central Rack

The SIMATIC NET CPs can be installed both in the central rack and in an extension rack, linked to the central rack via an IM 360/IM 361 (K-bus connection).

4.1.2 Number of SIMATIC NET CPs

In typical S7-300 configurations, the simultaneous operation of up to 4 CPs of the same type has been tested successfully. The actual number of SIMATIC NET CPs that can be operated at the same time is determined by the system (for example by the CPU resources).

The connection resources available in the CPU can result in a further limitation.

The load on the CPU resulting from communication jobs may also represent a further restriction. The following factors should be noted:

- Execution Time of the Blocks:

For communication between the S7-300 CPU and SIMATIC NET CPs, blocks (FCs/FBs) are necessary. How often these blocks are called depends on the number of connections or the number of SIMATIC NET CPs. Depending on the amount of data transmitted, every block call extends the time required by the user program.

- Data conversion:

It may also be necessary for the information to be converted before transmission or after reception.

4.1.3 Multicomputing

This functionality is not supported by the SIMATIC S7/C7-300.

4.1.4 Replacing Modules

Removing and inserting the SIMATIC NET CPs for the SIMATIC S7-300 while the power is on is possible without damaging the modules.

If the CP supports the option of saving the configuration data on the CPU, it is also possible to replace a module without a PG (see CP-specific description).

Note

With **old CPs** removing and inserting is **not** supported by the S7-300 system. Note that by removing a module from the rack, all modules on the other side of it will be disconnected from the CPU.

In this case, a PG is required to download the configuration after replacing a module.

4.1.5 CPU Connection Resources and Optimized Utilization

Note that when using older S7-300 CPUs (\leq CPU 316), a maximum of four S7 type connections for CP communication are supported. Of these four connections, one is reserved for a PG and another for an OP (HMI = Human Machine Interface). The newer CPUs (from 10/99 onwards) support twelve and the CPU 318-2DP supports 32 S7 connections.

As a result, the older S7-300 CPUs have only two “free” S7 connections available. These two connections can be used for S7 communication, for PROFIBUS-FMS, or for longer data with Industrial Ethernet.

If you use CPs that support multiplexing of OP connections and S7 communication with loadable communication blocks, only one connection resource is occupied when the multiplex channel is used.

4.2 SIMATIC S7-400

4.2.1 Permissible Slots

An S7-400 CP can be inserted both in the central rack and in the extension rack with a K bus interface. For the total number of CPs you can install, please refer to the information on the relevant CP in the “Properties” chapter.

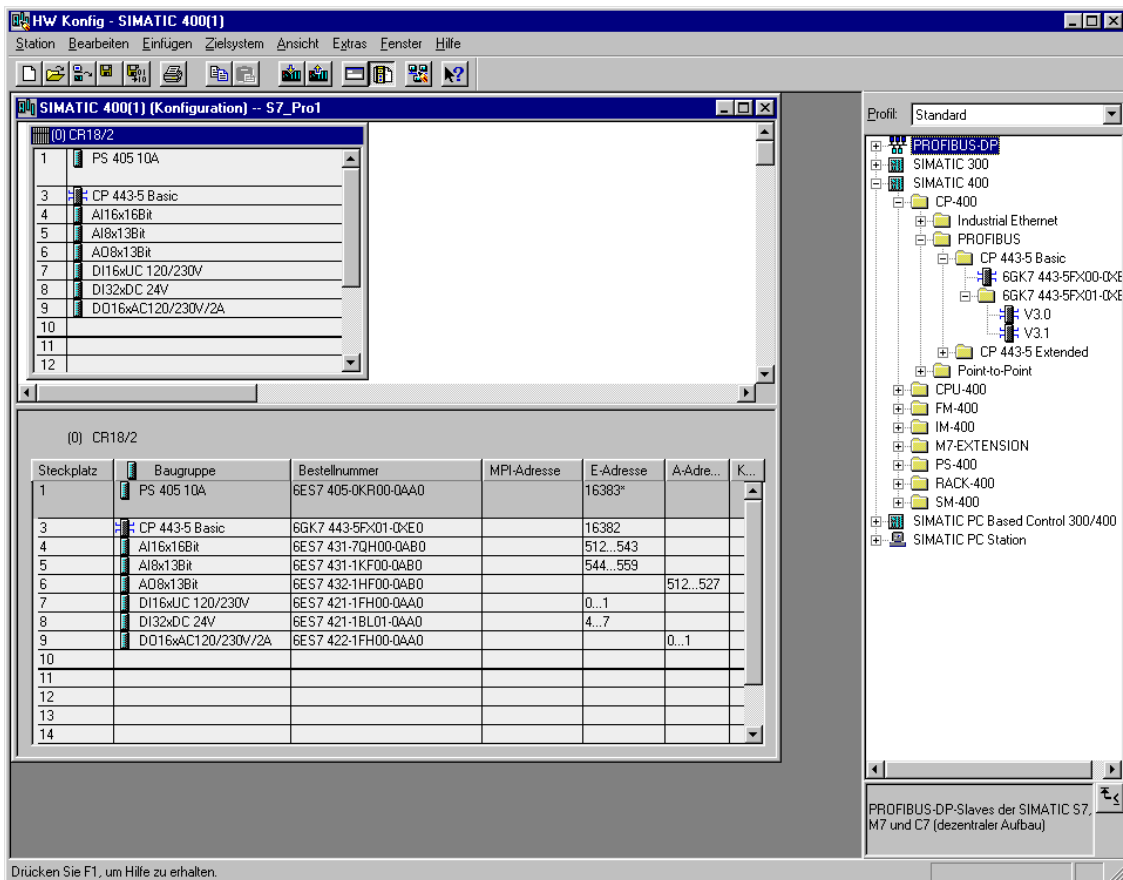


Figure 4-2 Example: Hardware Configuration S7-400 with SIMATIC NET CPs in the Central Rack

In the SIMATIC S7/M7-400 there is no set slot assignment for the SIMATIC NET CPs. Slots 2 to 18 are permissible. Note, however, that depending on the power supply module installed, slot 1 may also occupy slots 2–3 (4 during redundant operation).

Note

PROFIBUS-DP cannot be used in the extension rack.

Note the following restrictions depending on the services being used:

- SEND/RECEIVE interface

See the CP-specific section of this manual

- S7 communication

The maximum number of modules that can be inserted is limited by the number of S7 connections of the CPU; see the CP-specific section of this manual.

4.2.2 Number of SIMATIC NET CPs

The number of SIMATIC NET CPs that can be operated simultaneously is limited by the specific characteristics of the CPU. The exact number can be found in the CP-specific section of this manual.

4.2.3 Configurations with PROFIBUS-DP

In a SIMATIC S7-400, a maximum of 10 external PROFIBUS-DP chains can be set up. The configuration rules are as follows:

- A maximum of 4 SIMATIC S7/M7-400 CPUs with integrated PROFIBUS-DP interface can be inserted (multicomputing CPUs).
- A maximum of 14 modules can be inserted (CPU specific; see CP-specific section of this description), with which a further PROFIBUS-DP chain can be set up (CP 443-5 Extended).

Note: A CP 443-5 Extended is also identified as a DP module when the CPU starts up, even if the CP is **not** configured as a DP master. This means that in the central rack, a maximum of 10 CP 443-5 Extended modules can be inserted.

Note if a module is used for the PROFIBUS-DP protocol, it must be installed in the central rack.

4.2.4 Number of Connections with PROFIBUS-FMS

PROFIBUS-FMS is mapped on S7 communication. This means that **all** FMS connections of a module are mapped on **two** (client and server) S7 connections of the S7-400 CPU. Therefore the number of SIMATIC NET CPs that can be operated depends on the number of S7 connections available with the S7-400 CPU.

Example:

The CPU 412 supports a maximum of sixteen S7 connections. Of these sixteen S7 connections, two S7 connections are reserved for a PG and an OP (HMI), so that in this case a maximum of fourteen S7 connections are available. Since two further connections are reserved for FMS, a maximum of six CP 443-5 Basic modules that communicate over PROFIBUS-FMS can be inserted.

An overview of the number of S7 connections supported by the S7-400 CPU can be found in the CP-specific sections of this manual.

4.2.5 Multicomputing

The communication load can be distributed by installing several SIMATIC NET CPs (distribution of load). If, however, you want to increase the number of available connection resources, you can insert several CPUs in a rack (multicomputing). All S7-400 CPUs in a rack can communicate via one or more SIMATIC NET CPs.

The following communication services support multicomputing:

- PROFIBUS-FMS
- FDL connections
- S7 communication

Exception: PROFIBUS-DP

With PROFIBUS-DP it is **not** possible for several S7-400 CPUs to share a PROFIBUS-DP chain. In this case a PROFIBUS-DP chain is always assigned to **one** S7-400 CPU.

It is possible, however, for up to ten DP masters to be inserted per S7-400 CPU.

4.2.6 Removing / Inserting (Replacing Modules)

Removing and inserting the SIMATIC NET CPs for the S7-400 while the power is on is possible without damaging the modules.

If a CP is replaced with a new CP with the same order number, the configuration data simply needs to be downloaded again if it is not stored on the CPU (see also CP-specific sections of this manual).

Exception: The CP 443-5 Extended module must already be installed in the rack before startup.

Starting Up a Station

If the SIMATIC NET CPs are configured, but not installed at startup, the CPU will nevertheless start up. Later installation of the CPs is possible, but the configuration data must be downloaded to the CP with the CPU in the STOP mode.

If the configuration data was stored on the CPU, it will be transferred to the CP after installation.

Exception: The CP 443-5 Extended module must already be installed in the rack before startup.

4.2.7 Note on the S7-400 CPU: Connection Resources

Note that in the S7-400 CPU, one S7 connection is reserved for a PG and a further one for an OP (HMI = Human Machine Interface).

- PG connection via MPI/integrated PROFIBUS-DP interface:

To execute ONLINE functions (for example module diagnostics) from a PG on an S7-400 CP via the MPI/integrated PROFIBUS-DP interface, **two** connection resources (addressing of the interface and the K-bus) are necessary on the S7-400 CPU. These two connection resources should be taken into account in the number of S7 connections.

Example: The CPU 412-1 has sixteen free resources for S7 functions available. If a PG is to be used for diagnostics on the S7-400 CP and is connected to the MPI/PROFIBUS-DP interface, two connection resources are required on the S7-400 CPU, so that 14 connection resources remain available.

- PG connection via PROFIBUS or Industrial Ethernet

If the PG is connected to the LAN (PROFIBUS or Industrial Ethernet), in order to execute PG functions on the S7-400 CPU and diagnostics on an S7-400 CP, only **one** connection resource on the S7-400 CPU is necessary.

5 Services – Additional Information

This chapter provides an overview and additional information on the services that the PROFIBUS CPs support.

With PROFIBUS, the following communications services are available with SIMATIC NET CPs:

- S5-compatible communication – SEND/RECEIVE interface
- S7 communication
- PROFIBUS-DP
- PROFIBUS-FMS

Please note that these services are explained in greater detail in the following sources:

- Communication with SIMATIC Manual
- Manual: NCM S7 for PROFIBUS
- STEP 7 Help
- Automation with STEP 7 in STL and SCL /7/
- Distribution with PROFIBUS-DP /8/
- PROFIBUS-DP/DPV1 Basics, Tips and Tricks for Users /9/

Quick Start CD: Samples on all aspects of communication



The Quick Start CD can be ordered separately and is a treasure-trove of sample programs and configurations.

You can also order this directly on the Internet.

5.1 S5–Compatible Communication – SEND/RECEIVE Interface

Overview

These functions transfer data from the SIMATIC S7 to the SIMATIC S5. The SEND/RECEIVE interface originates from SIMATIC S5 and has been retained in SIMATIC S7 in the form of “S5–compatible communication”.

Data blocks can be exchanged on a bidirectional communication connection over the SEND/RECEIVE interface. The major features are listed below:

- The user interface to PROFIBUS and Industrial Ethernet has an identical structure.
- The S7 user program can be used for PROFIBUS and for Industrial Ethernet without program changes (except with long data packets in Industrial Ethernet – up to a maximum of 8 Kbytes).
- Although different modules are used for the S7–300 and S7–400, the user interface is identical.
- Sending and receiving frames is possible on one connection (full duplex).
- The maximum data length with PROFIBUS is 240 bytes and 8 Kbytes with Industrial Ethernet.

The FDL connections, based on the SEND/RECEIVE interface, are completely compatible with the transport interface connections in the world of SIMATIC S5. They correspond to the SDA service (Send Data with Acknowledge) of the free layer 2.

In addition to the SDA service, the SDN service (Send Data with no Acknowledge) is also available.

Alongside PROFIBUS–DP and PROFIBUS–FMS, FDL connections allow transfer between SIMATIC S7 and SIMATIC S5, and to SIMATIC PC stations.

Configuration

NCM S7 for PROFIBUS/Industrial Ethernet is used to configure the SEND/RECEIVE interface of the SIMATIC NET CPs.

Function calls (FC: Function Call) are integrated in the STEP 7 user program in the SIMATIC S7 CPU for triggering data transmission and are supplied with the NCM S7 for PROFIBUS/Industrial Ethernet configuration software.

Sample programs for using the SEND/RECEIVE interface on SIMATIC S7 PLCs are included in the NCM S7 for PROFIBUS/Industrial Ethernet package (and on the Quick Start CD).

5.2 S7 Communication

Overview

S7 communication provides the user with functions for data exchange between SIMATIC S7 controllers and SIMATIC PC stations. S7 communication is integrated in every SIMATIC S7 device.

Note the following features:

- From the user's point of view, S7 communication appears to be identical on PROFIBUS and Industrial Ethernet.
- The S7–300/400 CPU or FM is the endpoint for S7 connections. This means that performance data of these S7–300/400 modules apply in S7 communication.
Exception:
When running diagnostic functions on an active K–bus module, a SIMATIC S7 CP for example, this becomes the endpoint of the S7 connection.

Notice

The written or read information is transferred from the S7 user program to the operating system, or copied from the operating system into the S7 user program in blocks of 8 or 32 bytes (depending on the firmware version).

If information in the word or double–word format is stored so that it crosses such a boundary, data errors may occur during transmission with S7 communication.

Configuring

Configuration of S7 communication with an S7–300 station is only necessary if it is operating as a client (FB calls).

Notes on Operating the S7–300 as Server (non–configured Connection)

The connection partner establishes the connection to the S7/M7–300. In this case, note that with an S7 connection via a SIMATIC NET CP, it is the S7/M7–300 CPU that must be addressed and not the SIMATIC NET CP, as all S7 communication is handled by the S7/M7–300 CPU.

The SIMATIC NET CP only passes on the communication protocol (communications relay).

When reading or writing in the S7/M7–300 CPU, the partner must give the S7/M7 address of the data area it wants to access on the S7/M7 CPU.

Addressing using a name is not possible.

- Special feature of newer CP 342–5 modules – server operation over the multiplex channel

With the CP 342–5 hardware version 1/firmware version 5.0 and higher, the server functionality described here is also possible over the multiplex channel. This allows the connection resources on the S7–300 CPU to be optimized. In this case, the addressing is not over the S7/M7–300 CPU as described above but rather using the rack/slot assignment of the CP.

For more detailed information, refer to the online help of STEP 7.

5.3 PROFIBUS–DP (complying with EN 50170)

Overview of the DP Interface with the CP 342–5 / CP 342–5FO

The CPs provide fast data exchange with distributed I/O devices at the field level.

PROFIBUS–DP services allow transparent communication with distributed I/Os. PROFIBUS–DP corresponds to the standard EN 50170 Vol. 2 PROFIBUS Master/Slave and allows open communication to distributed I/Os and field devices.

Communication between an S7–300 CPU, and S7–300 CPs (CP 342–5/CP 342–5FO) is handled by the DP–SEND and DP–RECEIVE blocks.

Data consistency is therefore guaranteed over the whole DP data area (inputs and outputs of the DP slaves). This applies to the CP 342–5/CP 342–5FO as PROFIBUS–DP master and as PROFIBUS–DP slave.

In contrast to the integrated DP interface of the CPU 315–2, DP data areas can exist not only in the process image input and output area / peripheral I/O area of the controller, but also be stored in the bit memory or data area of the controller.

PROFIBUS–DP Master

As well as operating as DP master for DP standard slaves, the CP 342–5/CP 342–5FO and the CP 443–5 Extended module as DP master can also:

- Send the SYNC and FREEZE synchronization frames.
- Read the input and output data of any DP slave, even if it is assigned to another DP master in the cyclic data exchange. One process signal, for example, can therefore be acquired by several DP masters which means that less DP slaves are required in the field (shared input/output).

PROFIBUS–DP Slave

The CP 342–5 / CP 342–5FO can be used as an intelligent DP slave.

Configuration / Programming

With the SIMATIC S7–400, no special FBs or FCs are required for DP operation. The distributed I/Os are connected directly or via SFCs of the CPU.

With the SIMATIC S7–300 with a CP 342–5/CP 342–5FO, FCs 1–4 are available to run DP (DP–SEND/DP–RECV/DP–DIAG/DB–CNTRL).

Diagnostics

For diagnostics of the PROFIBUS–DP protocol on the CP 342–5/CP 342–5FO two options are available:

- from the STEP 7 user program user program using FC–DIAG
- with NCM S7 for PROFIBUS

5.4 PROFIBUS–FMS (complying with EN 50170)

Overview

Data exchange involving extensive communication tasks.

PROFIBUS with the FMS layer 7 protocol is intended for automation engineering applications in the immediate vicinity of the process.

PROFIBUS CPs with FMS allow transmission of messages with the FMS services READ, WRITE and INFORMATION REPORT.

With these services, variables of the communication partner can be read or written by the user program using the variable index or variable names. Other features include:

- Alternate access to variable values is supported.
- The FMS services IDENTIFY (requesting the identification characteristics of the partner) and STATUS (requesting partner status) can also be started.
- The SIMATIC NET CPs cannot send high priority FMS messages, but can receive them.

The following connection types are supported:

- MMAC: Master–master acyclic
- MSAC: Master–slave acyclic
- MSAC_SI: Master–slave acyclic with slave initiative
- MSCY: Master slave cyclic
- BRCT (broadcast): Sending to all FMS stations

Configuring / Programming

PROFIBUS–FMS is configured with NCM S7 for PROFIBUS V3.2 and higher.

For communication between the SIMATIC S7–CPU and the SIMATIC NET CP, function blocks (FBs) must be included in the STEP 7 user program. By installing NCM S7 for PROFIBUS, these FBs are installed in the block library.

5.5 Combimaster: PROFIBUS–DP and PROFIBUS–FMS

In the SIMATIC S7/M7 there is **no** combimaster complying with EN 50170. PROFIBUS–DP and PROFIBUS–FMS are available on **separate** modules.

6 Pinout

Pinout – 9-Pin Sub-D Female Connector

Pin No.	Signal Name	PROFIBUS Designation	Used by SIMATIC NET CPs
1	PE	Protective earth	yes
2	–	–	–
3	RxD/TxD-P	Data line B	yes
4	RTS (AG)	Control-A	–
5	M5V2	Data reference potential	yes
6	P5V2	Power supply plus	yes
7	BATT	–	–
8	RxD/TxD-N	Data line-A	yes
9	–	–	–

7 Notes on the CE Mark of SIMATIC NET S7 CPs

Product Name:

- | | |
|---------------------|---------------------------------|
| • CP 342-5 | Order no.: 6GK7 342-5DA02-0XE0 |
| • CP 342-5 FO | Order no.: 6GK7 342-5DF00-0XE0 |
| • CP 343-5 | Order no.: 6GK7 343-5FA01-0XE0 |
| • CP 443-5 Basic | Order no.: 6GK7 443-5FX01-0XE0 |
| • CP 443-5 Extended | Order no.: 6GK7 443-5FDX03-0XE0 |

EU Directive EMC 89/336/EEC



The SIMATIC NET products listed above meet the requirements of the EU directive 89/336/EEC "Electromagnetic Compatibility".

The EU conformity certificate is available for the relevant authorities according to the EU directives and is kept at the following address:

- Siemens Aktiengesellschaft
Bereich A&D
Industrielle Kommunikation SIMATIC NET
Postfach 4848
D-90327 Nuremberg
Germany

Notice for Australia



The products meet the requirements of the AS/NZS 2064 (class A) standard.

Notice for Canada

This class A digital device meets the requirements of the Canadian ICES-003 standard.

AVIS CANADIEN

Cet appareil numérique de la classe A est conforme à la norme NMB-003 du Canada.

Area of Application

The product is designed for use in an industrial environment.

Area of Application	Requirements	
	Noise emission	Noise immunity
Industrial	EN 50081-2 : 1993	EN 50082-2 : 1995

Directive on Machines

The product remains a component in compliance with Article 4(2) of the EU directive on machines 89/392/EEC.

According to the directive on machines, we are obliged to point out that this product is intended solely for installation in a machine. Before the final product is started up, it must be established that it conforms to the directive 89/392EEC.

Installation Guidelines

The product conforms to the requirements if the guidelines mentioned in this manual and in documents /1/, /2/, /3/ und /4/ are followed.

A References

Manuals and Other Information

The following documentation contains further detailed information for configuration and operation:

- /1/** For installing and commissioning the CP-5/-5FO S7-300, Installation and Hardware Manual
- /2/** For using and configuring the CP-5/-5FO SIMATIC NET NCM S7 for PROFIBUS, manual Volume 1 and "Primer"
- /3/** For using and configuring the CP with FMS services SIMATIC NET NCM S7 for PROFIBUS, manual Volume 2 and "Primer"
- /4/** For installing and operating a SIMATIC NET PROFIBUS network Industrial Communication Networks PROFIBUS Networks manual
- /5/** On the topic of configuring:
STEP 7 User Manual
- /6/** On the topic of general communication:
Communication with SIMATIC Manual
- /7/** On the topic of configuring:
Automating with STEP 7 in STL und SCL
User manual, Programming Manual
Berger, H. / Publicis-MCD-Verlag, 2001
- /8/** On the topic of PROFIBUS:
Distributing with PROFIBUS-DP
Setup, Configuring and Installation
Weigmann, J.; Kilian, G. / Publicis-MCD-Verlag, 2000

- /9/** On the topic of PROFIBUS:
PROFIBUS-DP/DPV1
Basics, Tips and Tricks for Users
Popp, M. / Hüthig-Verlag

Order Numbers

The order numbers for the SIEMENS documentation listed above can be found in the catalogs "SIMATIC NET Industrial Communication, Catalog IK PI" and "SIMATIC Programmable Logic Controllers SIMATIC S7 / M7 / C7 – Components for Fully Integrated Automation, Catalog ST 70". These catalogs and additional information about the products and training courses can be obtained from your local SIEMENS office.

B SIMATIC NET – Support and Training

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 - at fax polling no. +49 (0) 8765-93 02 77 95 00
- Updated product information, FAQs, Tips and Tricks, and useful downloads are available from the following sources:
 - on the Internet at
<http://www.siemens.de/automation/service&support>
 - From the bulletin board system (BBS) in Nuremberg (*SIMATIC Customer Support Mailbox*) at the number +49 (0) 911 895-7100.

To dial the mailbox, use a modem with up to V.34 (28.8 Kbaud), with the following parameters: 8, N, 1, ANSI, or dial on ISDN (x.75, 64 Kbits).

Training Center

Courses are available to help you become familiar with the SIMATIC S7 automation system and programmable controllers. Please contact your regional training center or the central training center in D 90327 Nuremberg.

Tel. +49 (0) 911–895–3154

Infoline: Tel. +49 (0) 1805 23 56 11
Fax. +49 (0) 1805 23 56 12

Internet: <http://www.sitrain.com>

E-mail: AD–Training@nbgm.siemens.de

The H/F Competence Center in Nuremberg offers a special workshop on the topic of fault-tolerant SIMATIC S7 programmable controllers. The H/F Competence Center also supports you during configuration, when putting your system into operation and if you have problems on site.

Tel. +49 – (0) 911 – 895 – 4759

Fax. +49 – (0) 911 – 895 – 5193

E-mail: hf–cc@nbgm.siemens.de
CoC–SI@nbgm.siemens.de

Further Support

If you have further questions about SIMATIC NET products, contact your local Siemens representative.

You will find the addresses:

- In our catalog IK PI
- on the Internet at
<http://www.siemens.de/automation/partner>
- in the interactive catalog CA01
<http://www.siemens.de/automation/ca01>
- on the Quick Start CD



C Glossary

C.1 General Section

Baud rate

→ transmission rate

Bus Segment

Part of a → subnet. Subnets can consist of bus segments and connectivity devices such as repeaters and bridges. Segments are transparent for addressing.

Client

A client is a device or, in general terms, an object that requests a service from a → server.

Configuration Data

Parameters that determine the modes and functions of a → CP. They are set and downloaded using the NCM S7 configuration tool.

CP

Communications processor. Module for communications tasks.

CSMA/CD

CSMA/CD (Carrier Sense Multiple Access with Collision Detection)

FC

STEP 7 logic block of the type "function".

Frame

A message from one PROFIBUS/Ethernet station/node to another.

Frame Header

A frame header consists of an identifier for the → frame and the source and destination address.

Frame Trailer

A frame trailer consists of a checksum and the end identifier of the → frame.

Gateway

Intelligent connectivity device that connects local area→ networks of different types at the ISO Layer 7 level.

Industrial Ethernet

A fieldbus complying with IEEE 802.3 (ISO 8802–2)

NCM S7 for Industrial Ethernet

Configuration software for configuration and diagnostic functions on an Ethernet CP.

NCM S7 for PROFIBUS

Configuration software for configuration and diagnostic functions on a PROFIBUS CP.

Network

A network consists of one or more interconnected → subnets with any number of → stations. Several networks can exist side by side.

PG Mode

A mode of the PROFIBUS/Ethernet CP in which the SIMATIC S7-CPU is programmed, configured or checked via PROFIBUS/Ethernet. This mode is handled by the S7 functions.

Process Image

The process image is a special memory area in the programmable logic controller. At the start of the cyclic program, the signal states of the input modules are transferred to the process input image. At the end of the cyclic program, the process output image is transferred as a signal state to the output modules.

Protocol

A set of rules for transferring data. Using these rules, both the formats of the frames and the data flow are specified.

Segment

Synonym for → bus segment.

Server

A server is a device, or in general terms, an object that provides certain services. A service is started at the instigation of a → client.

Services

Services provided by a communication protocol.

SIMATIC NET

Siemens SIMATIC Network and Communication. Product name for → networks and network components from Siemens (previously SINEC).

SIMATIC NET for Ind. Ethernet

SIMATIC NET bus system for industrial applications based on Ethernet (previously SINEC H1)

SINEC

Previous product name for → networks and network components from Siemens. Now: SIMATIC NET

Station

A station is identified by a

- MAC address in the Ethernet network.
- PROFIBUS address in the PROFIBUS network.

Subnet

A subnet is part of a → network whose parameters (for example → PROFIBUS) must be matched. It includes the bus components and all attached stations. Subnets can, for example, be connected together by → gateways to form a network.

A → system consists of several subnets with unique → subnet numbers. A subnet consists of several → stations with unique → PROFIBUS or MAC addresses (Industrial Ethernet).

System

This means all the electrical equipment within a system. A system includes, among other things, programmable logic controllers, devices for operation and monitoring, bus systems, field devices, actuators, supply lines.

Transmission Rate

According to DIN 44302, this is the number of binary decisions transmitted per time unit. The set or selected transmission rate depends on various conditions, for example the distance across the network. In Ethernet, there is a fixed transmission rate of 10 Mbps.

Transport Interface

The transport interface of a SIMATIC S5 PLC is the access to the connection-oriented services of the transport layer on the CP. The transport interface presents itself to the control program in the form of handling blocks (HDBs).

Transport Layer

The transport layer is layer 4 of the ISO/OSI reference model for open system interconnection. The purpose of the transport layer is to transfer data reliably from device to device. Transport connections can be used for the transmission.

TSAP

Transport Service Access Point

Watchdog

Mechanism for monitoring operability.

C.2 PROFIBUS

Base Address

Logical address of a module in S7 systems.

- For PROFIBUS
The PROFIBUS base address is the address starting at which all addresses that are calculated automatically in the project are assigned.
- For Industrial Ethernet
The base MAC address is the address starting at which all addresses that are calculated automatically in the project are assigned.

Bus Parameter

Bus parameters control the data transmission on the bus. Each → station on the → PROFIBUS network must use bus parameters that match those of other stations.

CLEAR Mode

Mode of the DP master. Inputs are read cyclically, outputs remain set to 0.

Communication

A communication variable is a variable of the programmable controller that is ready for communication using FMS services.

With S7, communication variables must be configured. After configuration, a neutral structure (in terms of devices) complying with EN 50170 is stored for the variable.

Control Job

Global control jobs are control commands for the DP mode such as CLEAR, SYNC, FREEZE, UNFREEZE.

Device Database

Device database files (DDB files) contain DP slave descriptions complying with EN 50170, Vol. 2. The use of device databases data makes it easier to configure → DP masters and → DP slaves.

Distributed I/Os (DP)

Input and output modules used at a distance (distributed) from the CPU (central processing unit of the controller). The connection between the programmable controller and the distributed I/Os is established on the → PROFIBUS system. The programmable logic controllers do not recognize any difference between these I/Os and local process inputs and outputs.

DP I/O Module

DP slaves have a modular design. A → DP slave has at least one DP I/O module.

DP I/O Type

The DP I/O type identifies a → DP I/O module. The following modules are possible:

- Input module
- Output module
- Input/Output module
- –Empty module

DP Master

A → station with master functions in → PROFIBUS DP. Masters come into the following categories:

–DP master (class 1) or DP master 1

The DP master 1 handles the exchange of user data with the → DP slaves assigned to it.

–DP master (class 2) or DP master 2

The DP master 2 provides services such as the following:

- Reading the input/output data
- Diagnostics
- Global control

DP Master System

A → DP master and all → DP slaves with which the DP master exchanges data.

DP Mode

The following operating modes are possible for the connection between the → DP master and → DP slaves:

- OFFLINE
- STOP
- CLEAR
- RUN

Each of these modes is characterized by defined actions between the → DP master and → DP slave.

DP Module Name

Name of a → DP I/O module entered in the DP module list.

DP Module Type

Type identifier of a → DP I/O module in the device master data of a → DP slave complying with EN 50170, Vol 2.

DP Slave

A → station with slave functions on → PROFIBUS DP.

DP Slave Name

A DP slave name is entered in the DP slave list to identify a → DP slave in the DP configuration.

DP Subnet

PROFIBUS subnet on which only → distributed I/Os are operated.

FDL

Fieldbus Data Link. Layer 2 on the → PROFIBUS.

FDL Connection

FDL connections allows program/event-controlled communication between a SIMATIC S7 PLC on PROFIBUS and the following:

- SIMATIC S7 PLC with PROFIBUS CP
- SIMATIC S5 PLC with CP 5430/31
- SIMATIC S5-95U with PROFIBUS interface
- PC/PG with CP 5412A1/A2

The transfer of blocks of data on an FDL connection is bi-directional.

FMS

Field (bus) Message Specification complying with EN 50170, Vol. 2.

FMS Connection

FMS connections allow program/event-controlled communication between devices complying with the FMS standard. Characteristics of the data of a specific device are neutralized during transmission.

FMS Variable

→ Communication variable

FREEZE Mode

(a synchronization control frame).

Gap Update Factor

A free address area (gap) between two active stations/nodes is checked cyclically to find out whether or not another station/node is requesting to enter the logical ring.

GetOD

FMS service for reading the object dictionary (containing, for example, the variable descriptions) of a → VFD.

Group Identifier

The DP slaves can be assigned to one or more groups using a group identifier. The global control frames can be addressed to specific groups of → DP slaves using the group identifier.

Highest PROFIBUS Address

A → bus parameter for → PROFIBUS. This specifies the highest PROFIBUS address of an active → station on PROFIBUS. Addresses higher than the highest station address (HSA) are possible for passive stations (possible values: HSA 1 to 126).

Master

Active station on → PROFIBUS, that can send → frames unsolicited when it is in possession of the token.

Maximum Station Delay

A bus parameter for → PROFIBUS. The maximum station delay (max. TSDR) specifies the longest interval required by a → station in the → subnet between receiving the last bit of an acknowledged frame and sending the first bit of the next frame. After sending an unacknowledged frame, a sender must wait for the maximum TSDR to expire before sending a further frame.

Minimum Station Delay

A → bus parameter for → PROFIBUS. The minimum station delay (min. TSDR) specifies the minimum time that the receiver of a → frame must wait before sending the acknowledgment or sending a new frame. The min. TSDR takes into account the longest interval required by a station in the subnet for receiving an acknowledgment after sending a frame.

Polling

Cyclic processing: In this case, for example, cyclic processing of the "polling list" on the PROFIBUS CP.

PROFIBUS

A fieldbus system complying with EN 50170, Vol. 2 (previously SINEC L2).

PROFIBUS Address

The PROFIBUS address is a unique identifier for a station/node connected to → PROFIBUS. The L2 address is transferred in the frame to identify a station/node.

PROFIBUS DP

A distributed I/O mode complying with EN 50170, Vol. 2.

PROFIBUS-FMS

PROFIBUS Fieldbus Message Specification. Upper sublayer of layer 7 of the ISO/OSI reference model on → PROFIBUS.

PROFIBUS PA

PROFIBUS PA is a guideline of the PROFIBUS user organization extending the PROFIBUS EN 50170 by including an intrinsically safe area.

Reorganization Token Ring

All the → masters on → PROFIBUS form a logical token ring. Within this token ring, the token is passed on from node to node. If the transmission of the token is incorrect or if a master is removed from the ring, this leads to an error when the token is passed on (the token is not accepted by this node) and the node is excluded from the ring. The number of exclusions is counted in the internal token error counter. If this counter reaches an upper limit value, the logical token ring is then reorganized.

SCOPE L2

Diagnostic product for → PROFIBUS, with which traffic on the → network can be recorded and analyzed.

Setup Time

A → bus parameter for → PROFIBUS. The setup time specifies the minimum interval on the sender between receiving an acknowledgment and sending a new call frame.

SIMATIC NET for PROFIBUS

SIMATIC NET bus system for industrial applications based on PROFIBUS (previously SINEC L2)

Slave

A passive node on → PROFIBUS.

Slot Time

A bus parameter for → PROFIBUS. The slot time (TSL) is the time during which the sender of a → frame waits for the acknowledgment from the receiver before detecting a timeout.

Station (PROFIBUS)

A station is identified by a → PROFIBUS address in the → PROFIBUS network.

SYNC Mode

The SYNC mode in which one, several (group) or all → DP slaves transfer data to their process outputs at a certain time. The time at which the data is transferred is indicated in the SYNC command (a control command for synchronization).

Target Rotation Time

A → bus parameter for → PROFIBUS. The token represents the right to transmit for a → station on PROFIBUS. A station compares the actual token rotation time it has measured with the target rotation time and, depending on the result, can then send high or low priority frames.

Token Bus

Network access technique used to assign bus access with several active stations (used on PROFIBUS). The token is passed on from active station to active station. A complete token rotation takes place between a station sending the token and receiving it again.

UNFREEZE

Job for resetting the → FREEZE mode.

UNSYNC

Job for resetting the → SYNC mode.

Virtual Field Device (VFD)

A virtual field device (VFD) is an image of a programmable controller in a neutral description. The data and the behavior of the device are described.

Watchdog Time

A monitoring time that can be set on a → DP slave to detect the failure of the its → DP master.

