SIEMENS

SIMATIC NET

S7-CPs for PROFIBUS Configuring and Commissioning

Manual

Release 06/2005
C79000-G8976-C181-02

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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Safety Instructions Regarding your Product:

Before you use the product described here, read the safety instructions below thoroughly.

Qualified Personnel

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.

Correct Usage of Hardware Products

Note the following:

Warning

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

This product can only function correctly and safely if it is transported, stored, set up, and installed correctly, and operated and maintained as recommended.

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.

Correct Usage of Software Products

Note the following:

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.

Disclaimer of Liability

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.

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Automation and Drives
Industrial Communication
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Technical data subject to change.

Siemens Aktiengesellschaft

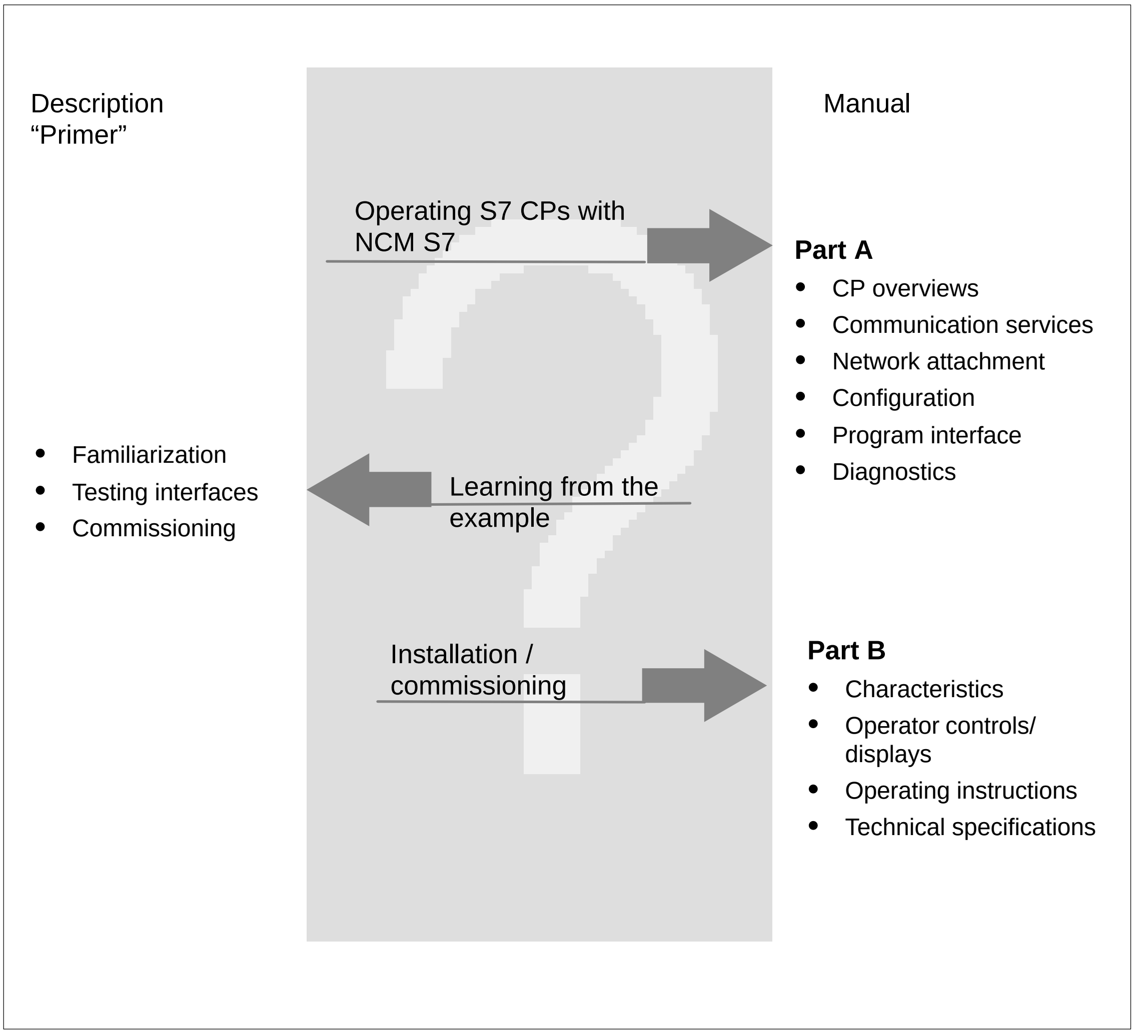
G79000-G8976-C181-01

This manual...

... supports you when commissioning your SIMATIC NET CP modules in an S7 station.

... supports you so that your applications can communicate successfully and efficiently over the SIMATIC NET CPs.

... in tandem with the “Primer” description, provides you with all the information you require to implement your communications tasks:



These two descriptions of your S7 CPs and NCM S7 are both on the SIMATIC NET Manual CD and on the paper version that can be ordered separately.

The examples described in “Primer” can also be found in the project folder for sample programs after you have installed STEP 7.

Audience

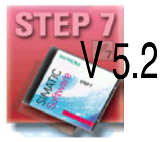
This manual is intended for installation personnel, programmers of STEP 7 programs and service personnel.

Scope of this Manual

This manual applies to version V5.x and higher of the NCM S7 configuration software and to version V5.x and higher of the STEP 7 software.

Notice

If functions are described that require higher versions, this is indicated by an additional icon.

Example: 

New in this version

- New structure of the manual

  In this release we have put together the previously separate manuals NCM S7 and S7 CPs in one manual.

  This also takes into account that the NCM S7 configuration tool is no longer installed separately for PROFIBUS and Industrial Ethernet. The functions of NCM S7 are now installed automatically when STEP 7 is installed.

- Printed Version Release 06/2005

  The descriptions of the following modules have been updated in Part B of this manual:

  - CP 342-5
  - CP 443-5 Extended

Notice

Please note that the availability of new functions depends on the device type you are using. You can check which functions your module supports in the description in the Properties dialog in STEP 7 and in the catalog in HW Config.

The Documentation in the "S7-CPs / NCM S7" Documentation Package and on the Internet

You can order this manual along with other documents in a manual package.

The following table provides you with an overview of the content and the addresses for downloading from the Web.

Title	Content / Web Addresses
Configuring and Commissioning S7-CPs for PROFIBUS Manual	This is available on the Internet at: • General Section: http://www4.ad.siemens.de/view/cs/en/8777865 • CP 342-5/342-5 FO: http://www4.ad.siemens.de/view/cs/en/8773570 • CP 343-5: http://www4.ad.siemens.de/view/cs/en/8778841 • CP 443-5 Basic: http://www4.ad.siemens.de/view/cs/en/8776422 • CP 443-5 Extended: http://www4.ad.siemens.de/view/cs/en/8777196
NCM S7 for PROFIBUS/FMS	This is available on the Internet at: http://www4.ad.siemens.de/view/cs/en/1158418
NCM S7 for SIMATIC NET S7-CPs Primer	This is available on the Internet at: http://www4.ad.siemens.de/view/cs/en/1157760
Information Technology in SIMATIC S7 with CP 343-1 IT/CP 443-1 IT Manual	This manual is intended as a guide and source of reference when working with the IT-CP. In addition to the functions provided by an Ethernet CP, the IT-CP also provides functions for Internet technology.
	This is available on the Internet at: http://www4.ad.siemens.de/view/cs/en/1172744
Commissioning PC Stations Manual and Quick Start	The manual supports you and helps you to make efficient use of communications with your PC applications in conjunction with the SIMATIC NET modules. It shows you how to configure PC modules and the steps required in project engineering with NCM S7.
	This is available on the Internet at: http://www4.ad.siemens.de/view/cs/
Configuring and Commissioning S7-CPs for Industrial Ethernet Manual	You will find the Web addresses of the current documents of this manual at the address shown below for the Version History.

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

The SIMATIC NET Manual Collection CD ships with each S7-CP. This CD is updated at regular intervals; the CD therefore contains the latest device manuals and descriptions available at the time the CD was written.

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

In the “Version History/Current Downloads for the SIMATIC NET S7-CPs”, you will find information on all previously available CPs for SIMATIC S7 (Ind. Ethernet, PROFIBUS and IE/PB-Link).

You will find the latest release of these documents at:

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

Information on the Current Block Versions (FCs/FBs)

For new user programs, please make sure that you use the latest block versions. You will find information on the current block versions and the current blocks to download from the Internet at:

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

If you require replacements, please follow the instructions in the device-specific Part B of this manual.

SIMATIC NET Quick Start CD: Samples Covering all Aspects of Communication

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

You can order this directly over the Internet at:

http://www4.ad.siemens.de/view/cs/en/574211

Additional Information on SIMATIC S7 and STEP 7

The additional documentation on the basic software STEP 7 of the SIMATIC programmable controllers is included in electronic format in your STEP 7 installation.

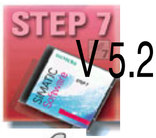
You will also find information on SIMATIC programmable controllers on the Quick Start CD and from the Customer Support Online services at:

http://www.siemens.de/simatic-net General information

or

http://www.ad.siemens.de/csi/net Product information and downloads

Symbols Used in this Manual



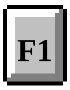
This symbol indicates functions requiring STEP 7 version V5.2.

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

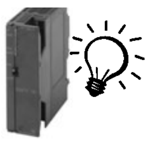
This symbol indicates recommended documentation.

HLP

Where you see this symbol, you should also refer to additional information in the basic help system of STEP 7.



This symbol indicates where detailed context-sensitive help is available. You can display these help texts with the F1 key or by clicking on the “Help” button in the relevant dialog.



This symbol indicates characteristics that differ depending on the version of the PROFIBUS CP. The symbol indicates the behavior of the latest modules. Where this symbol appears, you should check the manual of your specific PROFIBUS CP for further information (the symbol is also used there). You will also find the symbol in the online help of STEP 7.

Conventions

References to other manuals and documentation are indicated by numbers in slashes /.../. These numbers refer to the titles of manuals listed in the References section of the Appendix.

❑

Contents

Contents - Part A

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 Communication via PROFIBUS CPs in S7 Stations

The PROFIBUS CPs for SIMATIC S7 (simply known as PROFIBUS CP) provide a series of communications services for different tasks.

This chapter explains the following:

- The types of communication possible with a PROFIBUS CP on PROFIBUS
- The tasks handled by the PROFIBUS CP for the various services
- How to create the conditions for your communications requirements

You will find further information in the following sources:

- When installing the PROFIBUS CP, please refer to the instructions in the documentation /2/ supplied with the PROFIBUS CP. This also contains further information about the performance of the PROFIBUS CP.
- For the functions and use of the STEP 7 configuration software, some of which is used to configure the CP (such as hardware configuration), please refer to /7/ and /8/

1.1 PROFIBUS

Definition

PROFIBUS is the network for the cell and field area in the open, heterogeneous SIMATIC NET communications system.

Physically, PROFIBUS is an electrical network based on a shielded twisted pair or an optical network using fiber optic cable.

Standardized Transmission

The PROFIBUS network corresponds to the European Process and Fieldbus standard PROFIBUS EN 50170 Vol. 2.

All-Round Communication in the Industrial Sector

PROFIBUS is integrated in the SIMATIC NET concept that allows comprehensive networking of the management, cell and field levels along with Industrial Ethernet and the AS-Interface (AS-i).

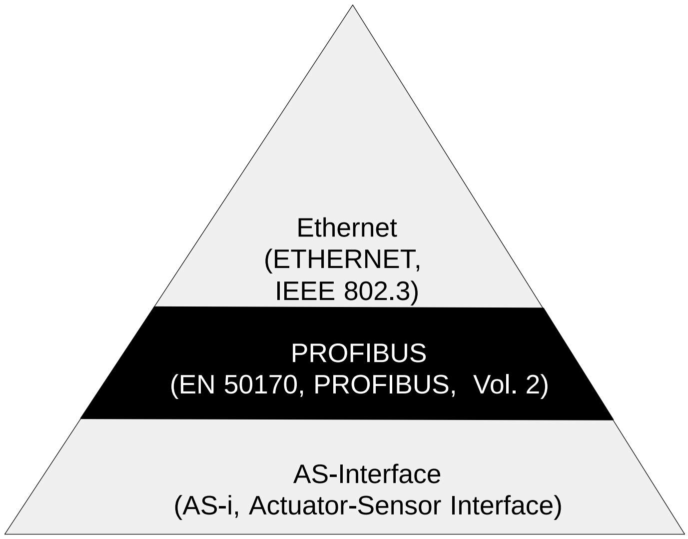


Figure 1-1 PROFIBUS in the SIMATIC NET Concept

Network Access Techniques

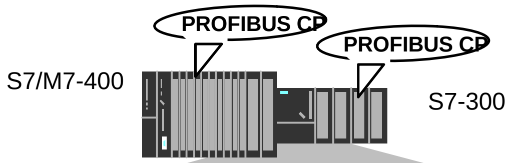
Network access in PROFIBUS uses the methods specified in EN 50170 Vol. 2.

- Token bus for access to the bus by active stations
- Master-slave for communication with passive stations

1.2 SIMATIC S7 Communication With a PROFIBUS CP

1.2.1 Type of Communication

The PROFIBUS CP supports the following types of communication (depending on the CP being used):



Possible types of communication	Interfaces / Services / Protocols
• **PG/OP communication** • **S7 communication**	over - S7 Protocol (Application Layer)
• **S5-compatible communication**	with the SEND / RECEIVE interface over - FDL layer
• **Standard communication**	over the FMS interface
• **DP mode**	alternatively in the - DP master mode or - DP slave mode (with S7-300)

- **PG/OP communication**

  PG/OP communication is used to download programs and configuration data, to run tests and diagnostic functions, and to control and monitor a plant from OPs.

- **S7 communication**

  The 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 PCs/PGs.

- **Standard Communication (FMS Interface)**
  (complying with EN 50170 Vol. 2 /12/; FMS Client and Server Function)

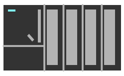
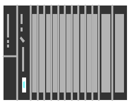
  The FMS interface allows the program-controlled, neutral transmission of structured data over a configured connection from SIMATIC S7 PLCs to devices that support the FMS protocol **(for more detailed information, refer to Volume 2 of this manual)**.

- **PROFIBUS DP**
  (complying with EN 50170 Vol. 2 /12/; 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.

1.2.2 The Communication Services of the PROFIBUS CPs

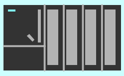
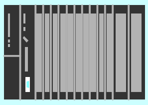
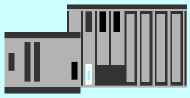
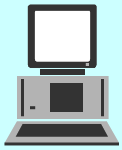
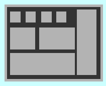
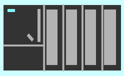
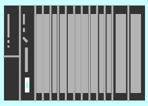
Depending on the module type, the S7-CPs support the following communication options:

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

Possibilities for Communication between Device Types

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 communication2) SEND/RECEIVE FMS PROTOCOL DP PROTOCOL	S7 communication SEND/RECEIVE FMS PROTOCOL DP PROTOCOL	S5-95U with PROFIBUS interface: SEND/RECEIVE S5-95U/DP master/slave: DP PROTOCOL S5-115U to -155U/H: SEND/RECEIVE DP PROTOCOL FMS PROTOCOL	PG/OP communication1) S7 communication1) 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 S5-95U/DP master/slave: DP PROTOCOL S5-115U to -155U/H: SEND/RECEIVE DP PROTOCOL FMS PROTOCOL	PG/OP communication1) S7 communication1) FMS PROTOCOL SEND/RECEIVE DP PROTOCOL	DP PROTOCOL FMS PROTOCOL

1) PC only as client

2) If you also want the S7-300 to be a client (possible with the CP 342-5), you will require communication blocks and a connection configuration.

1.2.3 Configuration and Diagnostics

To connect and configure the PROFIBUS CP, you require the STEP 7 project engineering software and the SIMATIC NET NCM S7 option.

SIMATIC NET NCM S7 is installed as a STEP 7 option and is therefore integrated in STEP 7.

SIMATIC NET NCM S7 for PROFIBUS also provides a wide range of diagnostic functions for the various types of communication.

1.3 PG/OP Communication on PROFIBUS

Application

PG/OP communication provides functions that are already integrated in every SIMATIC S7/M7/C7 device.

A distinction must be made between the following two types of function:

- PG Operation

  PG operation with STEP 7 PLCs on PROFIBUS means the following:

  - You can use the complete range of functions of STEP 7 on PROFIBUS.
  - You can use programming, diagnostic, operating and monitoring functions on all modules in the SIMATIC S7 PLC via PROFIBUS.

- OP Operation

  PG/OP communication on PROFIBUS allows the operation and monitoring of all modules in a SIMATIC S7 PLC using operator interface systems (TD/OP).

The PROFIBUS CP acts as a "communications relay" that relays the PG/OP communication via PROFIBUS.

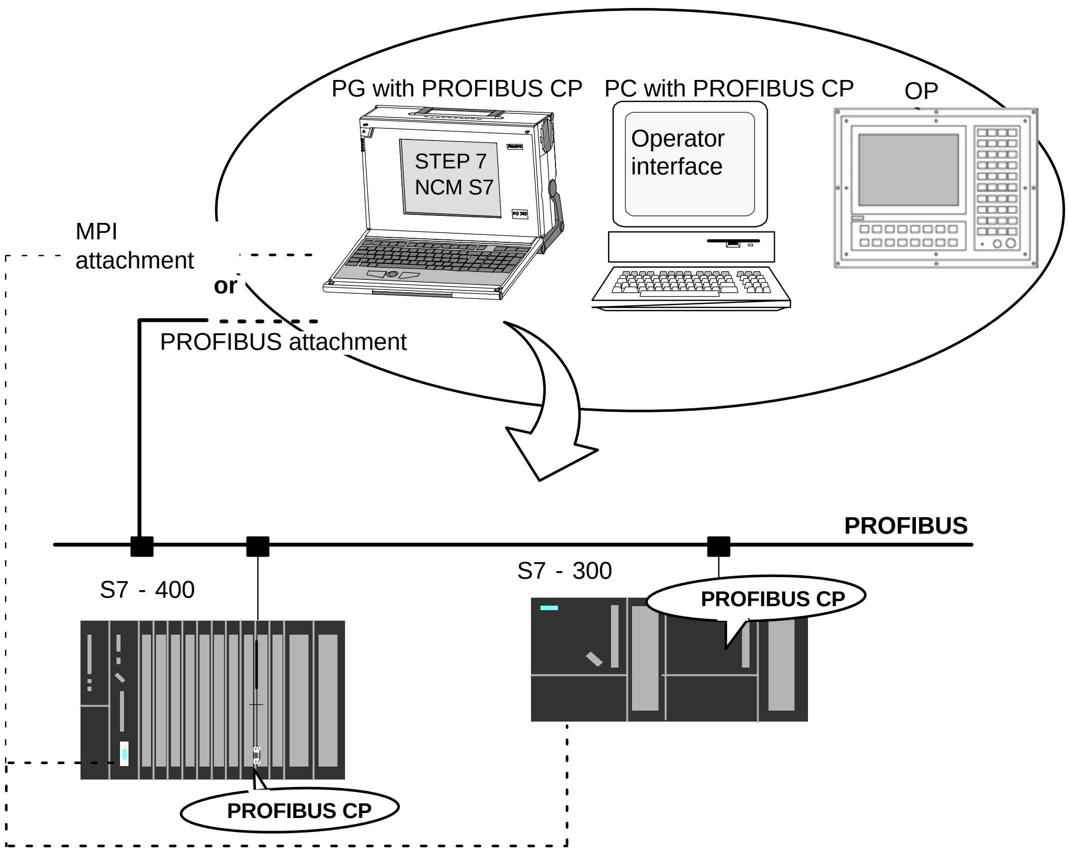


Figure 1-2 Configuration for PG/OP Operation

1.3.1 PG Communication with STEP 7 over PROFIBUS

Requirements for PG Communication

PG communication is possible when the following requirements are met:

- A PROFIBUS CP must be installed in the PG.
- The CPs in the S7 stations have a PROFIBUS address (node initialization - see Section 3.3.8).

Networking the PG / Engineering Station

Depending on the configuration of the PG or Engineering Station, the following two situations are possible when using PG communication:

- PG / Engineering Station in the Configured Mode

  If you select this configuration when you commission the PG / engineering station, the interfaces of the communication modules you are using are already known. The option in “Set PG/PC Interface” is automatically set to “PC-internal”.

  Once you have downloaded this configuration to your PG / engineering station, you can exchange PG functions with the accessible nodes in the network with STEP 7 without requiring any further settings.

- PG / Engineering Station in PG Operation

If your PG or engineering station is configured for this mode, you must specify the interface on the PG or engineering station explicitly with “Set PG/PC Interface”.

Follow the steps outlined below:

1. Open the “Set PG/PC Interface” dialog box in the Windows Control Panel.
2. Set the PG/PC interface according to the CPs available on your PG and according to the bus attachment (interface parameter assignment used).

For more detailed information on the topic of PG operation and engineering station, refer to /5/.

1.3.2 OP Operation: Connecting Operator Interface Devices via PROFIBUS

Requirements

Operation allowing operator interface functions is possible when the following conditions are met:

- A PROFIBUS CP is installed in the operator interface device.
- The CPs in the S7 stations have a PROFIBUS address (node initialization - see Section 3.3.8).

Procedure

To use the S7 communication, you address the required module in the SIMATIC S7 PLC from your operator interface device. For more detailed information, refer to the description of your operator interface device.

1.4 S7 Communication on PROFIBUS

Application

S7 communication via PROFIBUS allows program-controlled communication using communication SFBs/FBs and configured S7 connections. Per job, up to 64 Kbytes of user data can be transmitted.

The CP acts as an “S7 communications relay” that relays the communications functions via PROFIBUS

From the perspective of the user, S7 communication is identical over PROFIBUS and Industrial Ethernet.

Stations

Two situations must be distinguished depending on device type and plant configuration:

- **Client and server functionality at both ends (S7 connections configured at both ends)**

  S7 connections can be operated between the following nodes with the entire functionality of S7 communication:

  - between S7-300 and S7-400 S7 stations (and also between each other);
  - between S7 stations and PG/PC stations with a PROFIBUS CP.

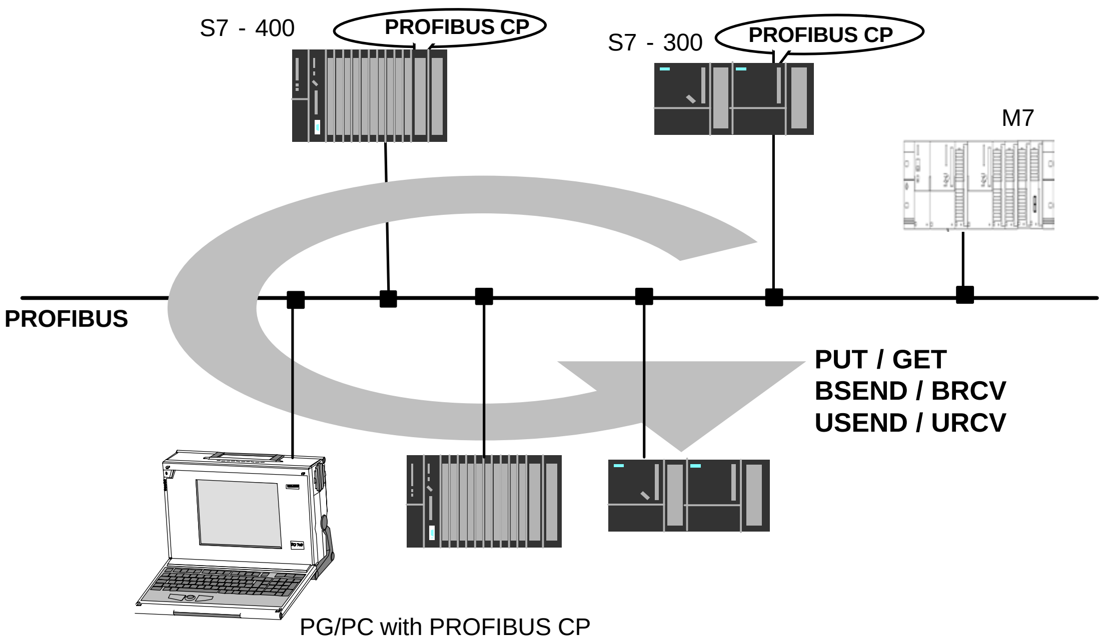


Figure 1-3 Nodes Communicating on S7 Connections over PROFIBUS

- **Client and server functionality at one end only (S7 connections configured at one end)**

  In the following situations, write and read functions can be implemented with PUT / GET on single-ended S7 connections:

  - S7 communication with connectivity devices:

    between PG/PC stations (client) and S7 stations if the PG/PC stations are connected to a different subnet (PROFIBUS / Ethernet) via gateways (for example, an IE/PB Link or PROFIBUS CPs in an S7 station); in this case, S7 stations are servers.

    S7 communication is possible over a gateway.

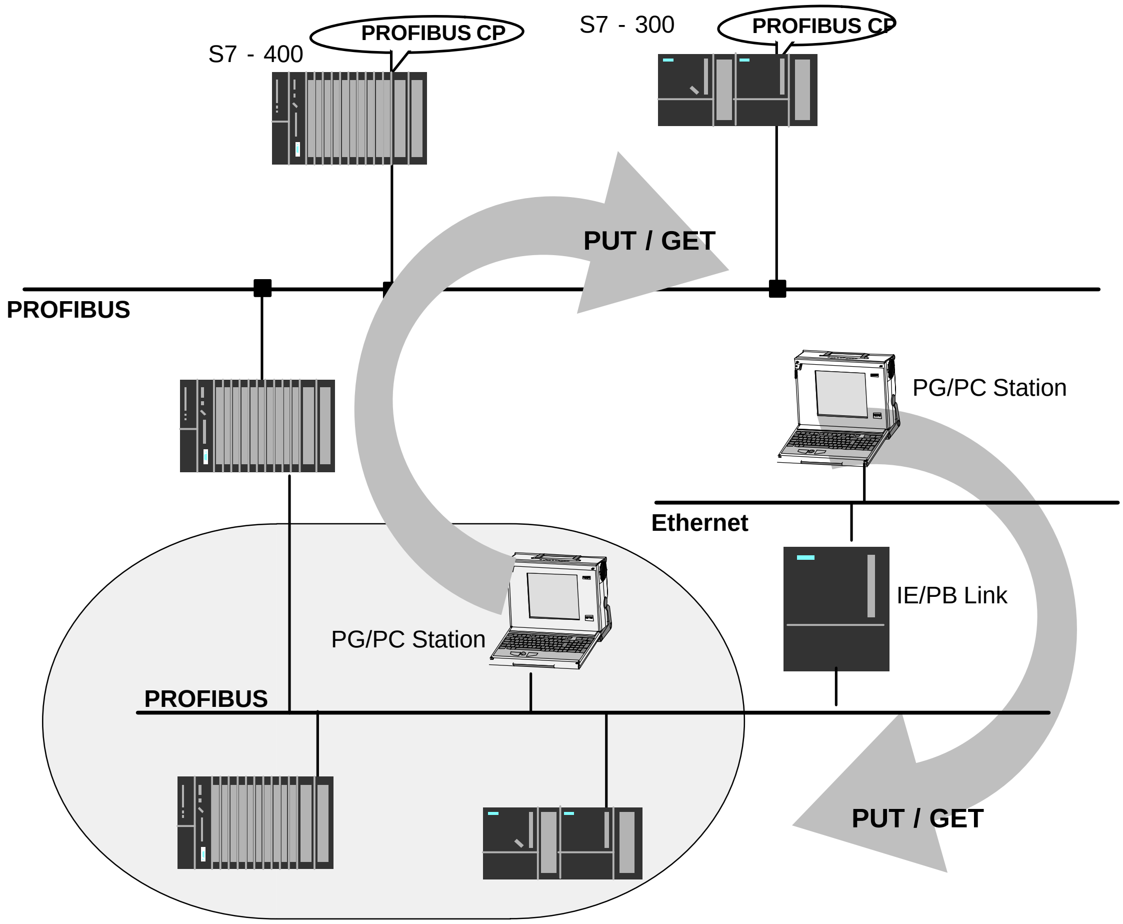


Figure 1-4 PG/PC Station Communicates with S7 Stations on an Underlying PROFIBUS or Ethernet Network via a Gateway

For more detailed information on the features supported by your PROFIBUS CP, refer to the manual /2/.

Configuring S7 Connections

Create S7 connections to use S7 communication for data exchange between two SIMATIC S7 stations.

For more detailed information, refer to the STEP 7 Description /8/.

Interface in the User Program of the S7 Station

You use SFBs (for S7-400) and FBs (for S7-300) in the user program.

Block type 1)		Client	Server	Described in
SFB / FB12	BSEND	x	-	STEP 7 Documentation /9/
SFB / FB13	BRCV		x	
SFB / FB15	PUT	x	- 1)	
SFB / FB14	GET	x	- 1)	
SFB / FB8	USEND	x	-	
SFB / FB9	URCV	-	x	
SFC / FC62	CONTROL (S7-400) / C_CNTRL (S7-300)	x	x 2)	

1) you do not need to configure a connection on the server

2) for S7-300

Notice

Please remember the following points regarding data consistency in your user program:

In the CPU of the S7 station, the read or written information is taken from the S7 user program into the operating system or copied from the operating system to 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 located across such boundaries, data inconsistency may arise during transmission using S7 communication!

For more detailed information, refer to the STEP 7 documentation /7/.

Notes on S7 communication between PG/PC station and S7 station

Applications in a PG/PC station communicate with the S7 station over an OPC interface or SAPI-S7 interface for operator intervention, monitoring and control.

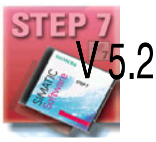
The S7 stations use the integrated communication SFBs/FBs (client and server functionality at both ends).

The following general requirements must be met by a PC/PG station for S7 communication:

- On the PC/PG:
  - A PROFIBUS CP must be installed
  - there is an interface for S7 communication installed: SOFTNET S7 for PROFIBUS or S7-5613/ WIN 95, WIN NT, MS-DOS, Windows.

To use S7 communication with a SIMATIC S7 PLC from a PC, address the required **CPU** module in the SIMATIC S7 PLC that you want to reach via the PROFIBUS CP in your PC application.

S7 communication over routers (one-ended client and server functionality)



It is possible to reach the S7 station from a PG/PC station that is attached to another subnet. The subnets must be connected over a gateway such as the IE/PB Link. An S7 station or a PC connected to both subnets can also serve as a gateway.

In this configuration, the S7 station can only be addressed by the PG/PC station as a communications server on S7 connections configured at one end.

The requirements for configuring the PG/PC station are identical to those for operating in the same subnet (see above).

In this situation, configure a **one-ended** S7 connection to the S7 station in the other subnet for the PG/PC station in STEP 7 NetPro. You can then access data in the S7 station in your user program using the functions PUT or Write (writing) and GET or Read (reading).

1.5 S5-compatible Communication (SEND/RECEIVE Interface)[1)]

Application

Data transmission on a configured FDL connection is suitable for the transmission of related blocks of data between two or more PROFIBUS stations.

The following must be distinguished:

- Specified FDL connection

  The communications nodes are specified by configuring connections.

- Unspecified FDL connection (free layer 2 access)

  The communications nodes are identified by address information in the communication job of the user program. This means that up to 126 nodes can be reached via one configured unspecified FDL connection providing they support FDL connections.

- Broadcast

  All the nodes ready to receive broadcast messages can be reached on PROFIBUS.

- Multicast

  All the nodes belonging to the multicast group can be reached on PROFIBUS.

SEND/RECEIVE Interface in the User Program

Data transfer is triggered by the user program. The interface to the user program in the SIMATIC S7 is formed by special SIMATIC S7 blocks of the type FC (functions).

1) The **previous name** of the SEND/RECEIVE interface on FDL connections was **S5S5 connections**

Stations

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

- SIMATIC S7 PLC with PROFIBUS CP
- SIMATIC S5 PLC with PROFIBUS CP (for example CP 5430/31)
- SIMATIC S5-95U with PROFIBUS interface
- PC stations with PROFIBUS CP (for example CP 5613)

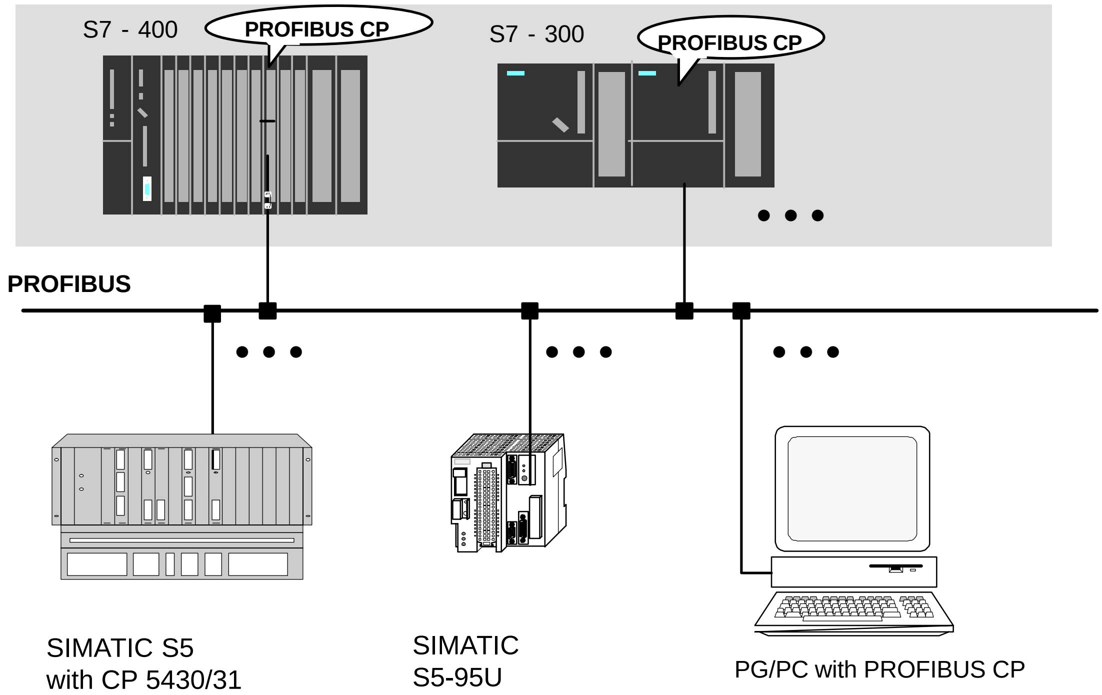


Figure 1-5 SIMATIC S7 PLC with Possible Communication Partners on FDL Connections

1.6 PROFIBUS DP

Application

Data transmission on PROFIBUS DP provides a standardized interface (EN 50170 Vol. 2) for the transfer of process input data and process output data between a SIMATIC S7 PLC and field devices (DP slaves).

The data exchange on PROFIBUS DP is characterized by the fast cyclic data exchange between the DP master and DP slaves.

Method

The user program in the SIMATIC S7 PLC controls and monitors communication over PROFIBUS-DP using special SIMATIC S7 blocks of the type FC (functions - S7-300 only [1)]). The FCs handle the following tasks:

- The transfer of process output data from a specified data area on the S7 CPU to the field device
- The entry of process input data read from the field device into a specified data area on the S7-CPU
- The handling of monitoring and diagnostic jobs

Stations in the DP System

According to the PROFIBUS DP standard (EN 50170 Vol. 2), a DP system consists of the following stations:

- DP master (class 1)
  A device in this function class handles the actual control task. It sends and receives process input and output signals (for example SIMATIC S7-PLC with a PROFIBUS CP, SIMATIC S5 PLC with a CP 5430/31).
- DP slave
  This is a device in the field area that reads in or outputs process signals. The devices can be modular (for example the Siemens ET 200 U) or compact (for example the ET 200 B/C).
- DP master (class 2) - optional
  This is a programming device, diagnostic unit, or management device that provides diagnostic and service functions.

1) with an S7-400, there is direct I/O access and for special tasks there are SFCs.

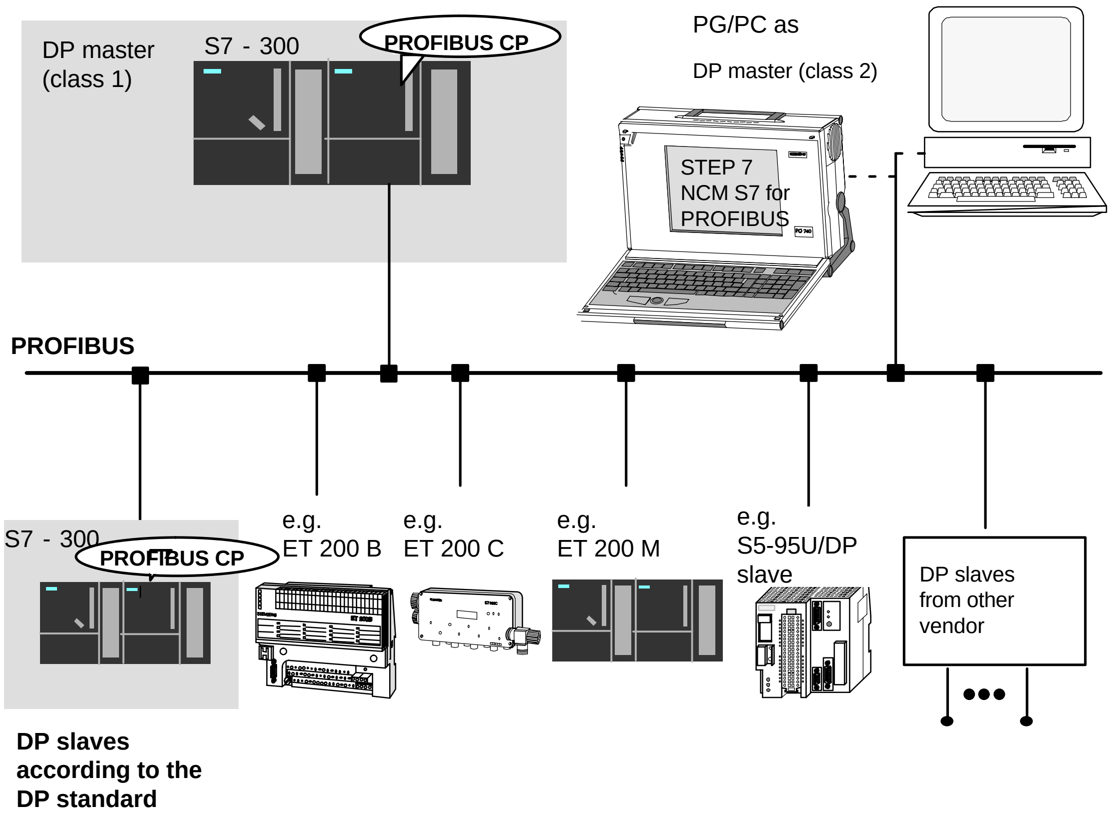


Figure 1-6 PROFIBUS DP System with Possible DP Slaves from Siemens or other Vendors

DP Modes with the PROFIBUS CP in an S7-300

The PROFIBUS CP in an S7-300 station can be operated in one of the two following modes:

- DP master mode
  PROFIBUS DP allows the attachment of all PROFIBUS DP nodes (for example, ET 200) to the S7-300. The PROFIBUS CP functions as the DP master.
- DP slave mode
  With the PROFIBUS CP functioning as a slave, the SIMATIC S7-300 can be operated as an intelligent slave station, for example belonging to a SIMATIC S5 control system or with a different DP master.

I/O Systems from Siemens

Depending on the area of application, various versions of I/O devices are available.

You will find more detailed information on the devices currently available in the SIMATIC ET 200 family, the areas of application, and possible attachments in the catalog IK PI.

1.6.1 Network Configuration with One DP Master

Characteristics

In a network configuration with one master, **one** DP master (active station) and no further active station can be operated on the PROFIBUS.

Network Configuration

The following diagram illustrates a possible network configuration with **one** PROFIBUS CP as the DP master.

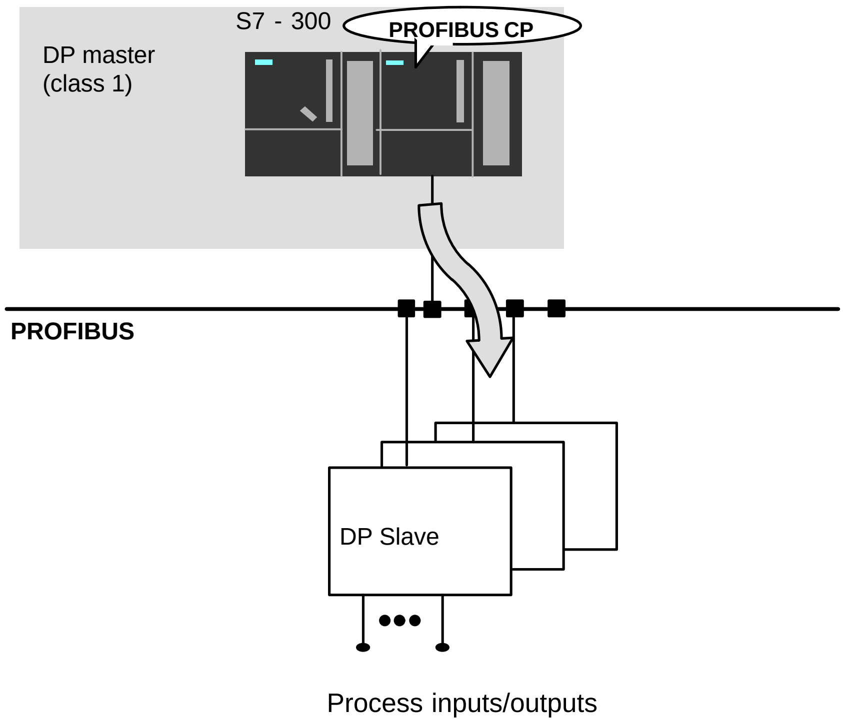


Figure 1-7 Bus Configuration with one PROFIBUS CP as DP master

1.6.2 DP Multimaster Network Configuration

Characteristics

A multimaster configuration with DP masters means the operation of more than one DP master each with its own DP master system on **one** PROFIBUS bus.

Network Configuration

The following diagram illustrates a possible network configuration with **more than one** PROFIBUS CP as the DP master.

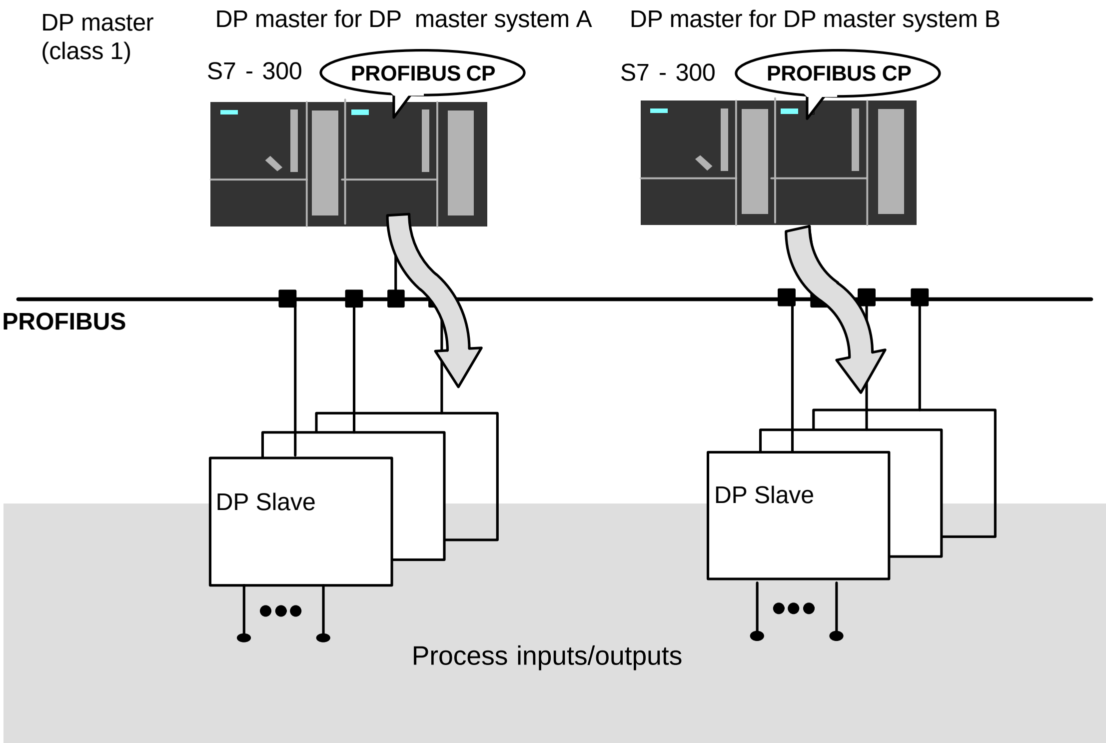


Figure 1-8 Bus Configuration with PROFIBUS CPs (DP Multimaster)

1.6.3 Multimaster Network Configuration

Characteristics

In this situation, the multimaster configuration means the simultaneous operation of a DP master system and other master-slave systems, for example FMS, on the same PROFIBUS.

FMS Master

An FMS master (for example SIMATIC S5 PLC with a CP 5431 or SIMATIC S7-400 with CP 443-5 Basic / SIMATIC S7-300 with CP 343-5) communicates with the FMS slaves assigned to it according to the field bus standard PROFIBUS EN 50170 Vol. 2 /12/.

Possible Network Configuration with DP Master and “Non-DP” Masters

The following diagram is an example illustrating a possible mode for the PROFIBUS CP in a multimaster configuration.

In this example, a SIMATIC S5 system communicates with the connected FMS slaves using FMS services.

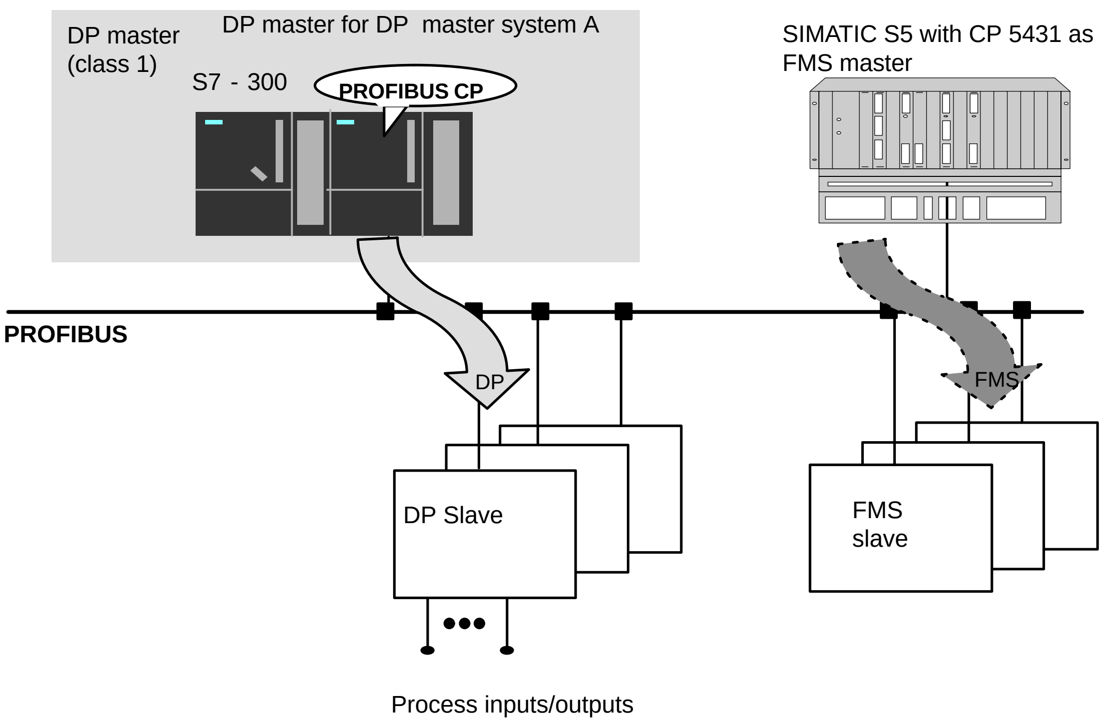


Figure 1-9 Bus Configuration with PROFIBUS DP and FMS (More than One Master)

1.6.4 DP Slave Mode

Application

The SIMATIC S7-300 with the PROFIBUS CP in the DP slave mode is suitable for applications in which local intelligent preprocessing of signals is required.

Network Configuration

The following diagram illustrates the PROFIBUS CP as a DP slave along with devices that can be operated as DP masters.

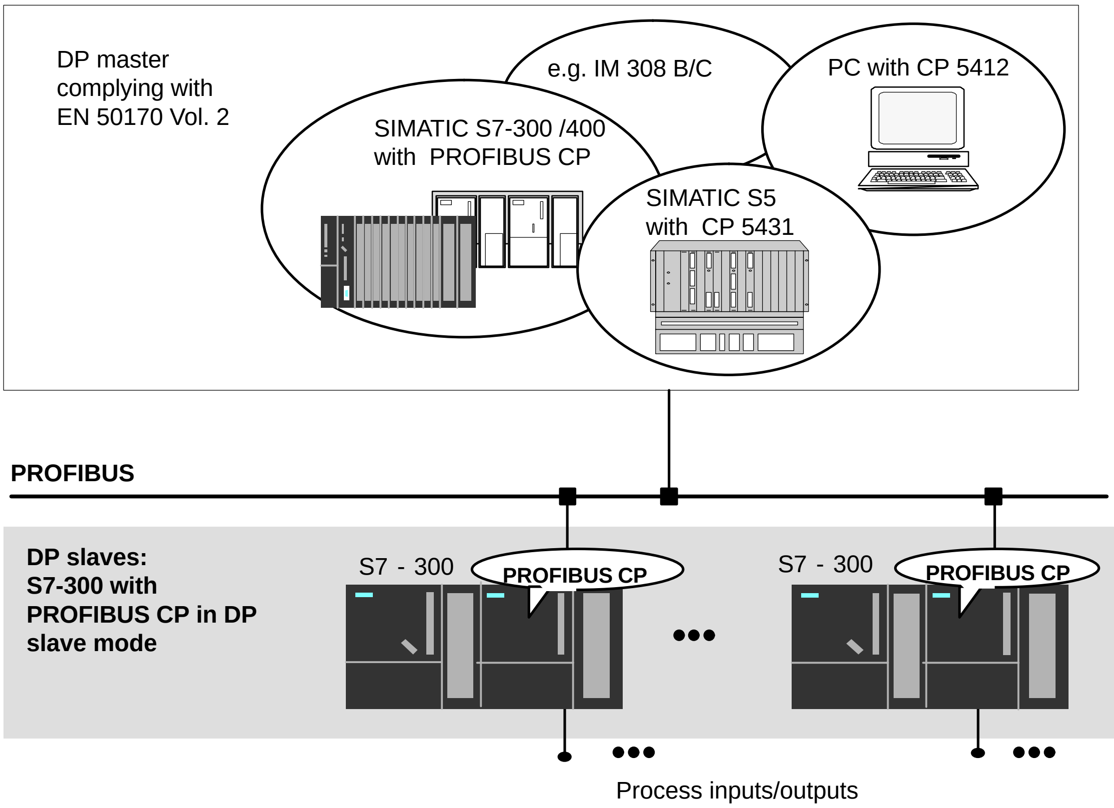


Figure 1-10 Network Configuration with SIMATIC S7-300 as DP Slave

DP Slave Mode and Simultaneously Active Node on PROFIBUS

The PROFIBUS CP 342-5 / CP 342-5 FO can also be operated as an active node on PROFIBUS. This means that S7 communication and S5-compatible communication is possible alongside the DP mode.

1.7 Networking Stations with STEP 7

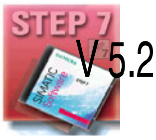
Configuring

To allow SIMATIC stations and “other stations” to communicate with each other, the networks must be configured in the STEP 7 projects.

Configuring a network or subnet involves the following:

1. You create one or more subnets of the required subnet type in the project.
2. You select the properties of the subnet. Normally the default settings are adequate.
3. You connect the station “logically” to the subnet.
4. You set up connections for communication.

Networking in a Multiproject



STEP 7 as of Version V5.2 supports configuration in a multiproject.

Using a multiproject, for example, you can create a project for distributed editing by various editors and distribute the stations to the projects according to their editors. To allow this, functions are available for branching and merging (sub) projects.

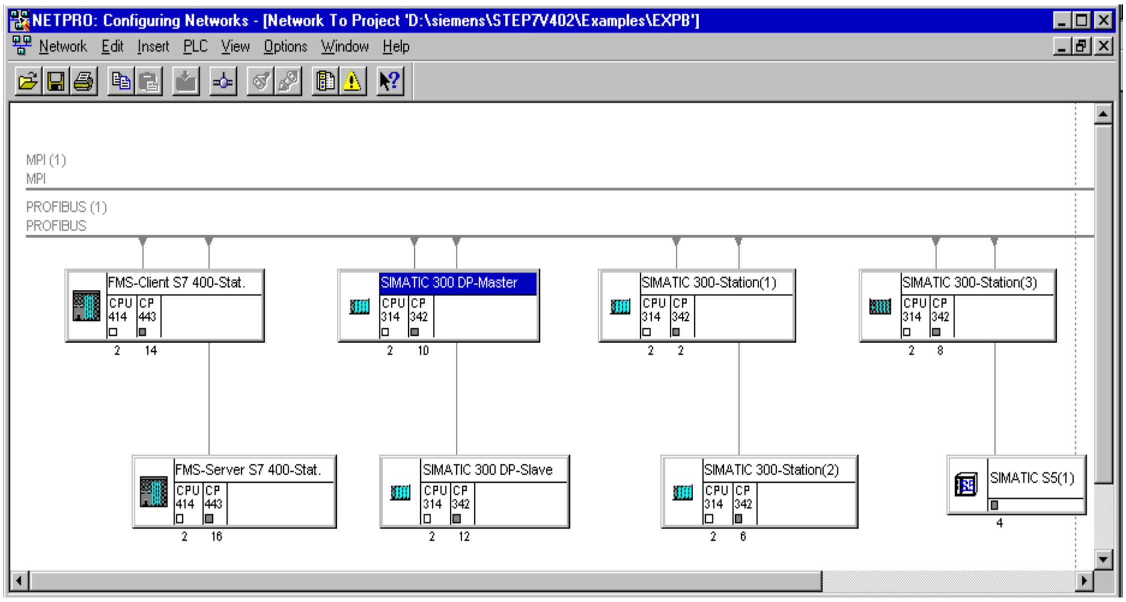
Interproject subnets and connections can be created.

Notice

FMS connections between stations in different projects are not supported in a multiproject.

Tools

The SIMATIC Manager provides convenient tools for configuring and documenting networks (also graphically with NetPro).




HLP

The chapter describing network configuration in /7/ and the online help system also contain information about configuring SIMATIC S7 networks.

Variants

Before configuring networks with STEP 7, you should be aware of the various configurations possible in the STEP 7 project. The following configurations are typical for stations networked with CPs:

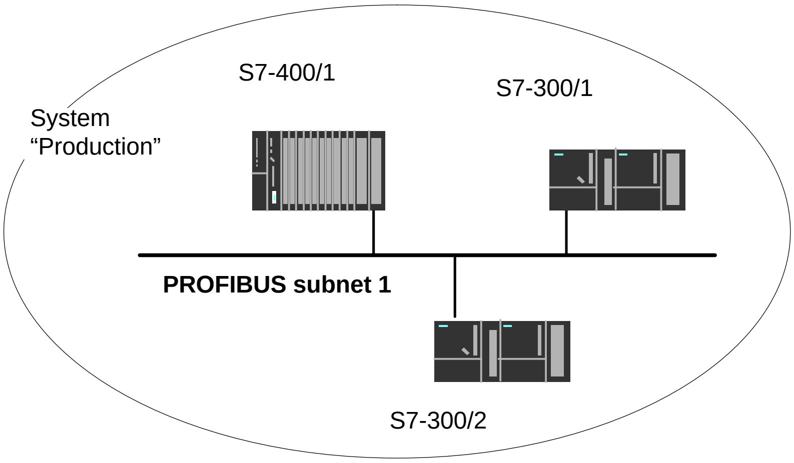
Variant (examples)	Characteristics/Configuration
1	1 subnet - 1 project
2	Additional SIMATIC S5 stations and stations with equipment of other vendors
3	2 or more subnets - 1 project
4	1 subnet - more than one project
5	More than one subnet - more than one project

These variants will be used as a basis to illustrate how real configurations can be created in STEP 7 projects.

1.7.1 Network/Project Variant: One Subnet - One Project

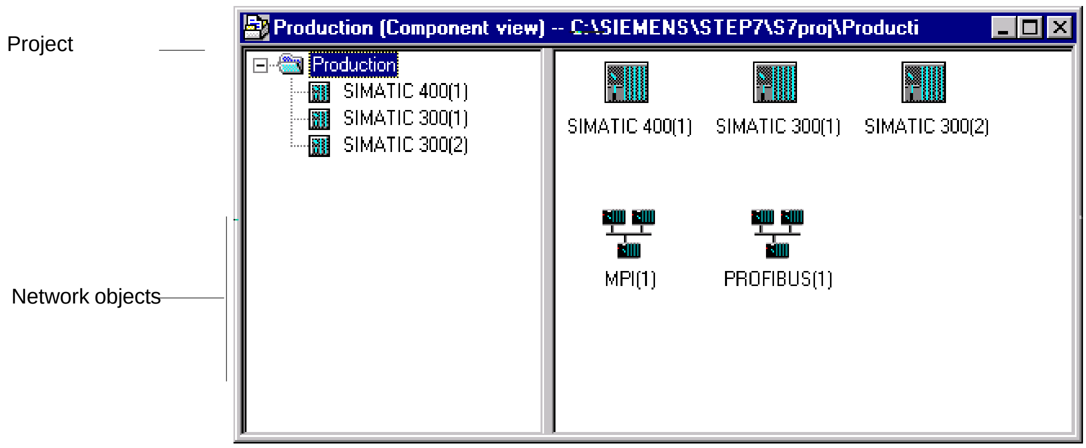
Configuration of the System

In the simplest case, your system consists of SIMATIC S7 stations connected by **one** subnet, for example of the type PROFIBUS subnet.



View in a STEP 7 Project

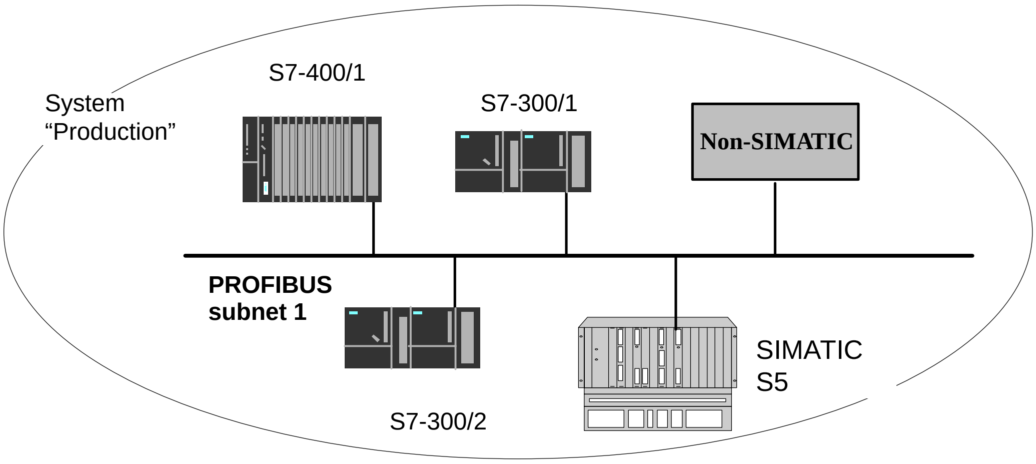
You create a PROFIBUS subnet object in the STEP 7 project. Stations created in the same project refer to this object as soon as they are configured as network nodes.



1.7.2 Network/Project Variant: SIMATIC S5 and Other Devices on the Subnet

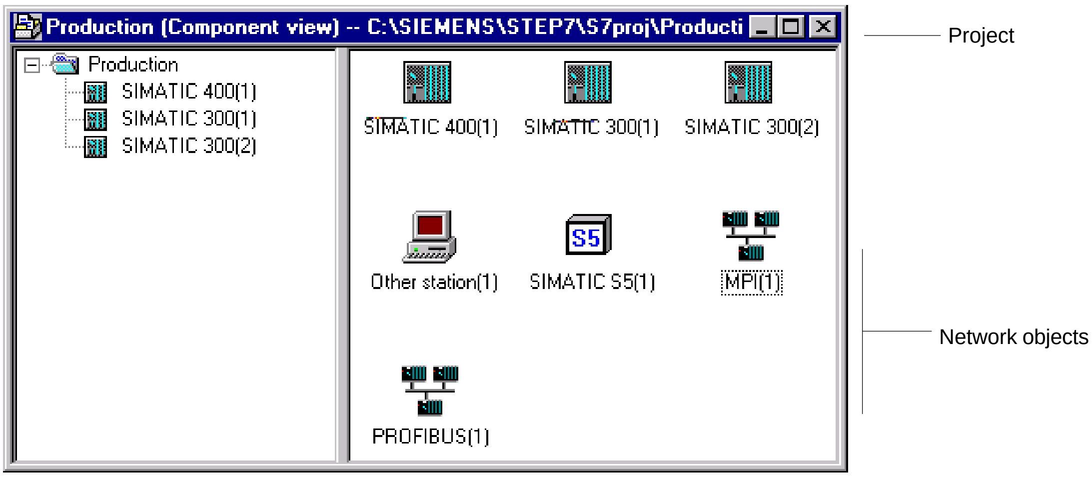
Configuration of the System

In addition to SIMATIC S7 stations, SIMATIC S5 stations and non-SIMATIC devices can be included in your system.



View in a STEP 7 Project

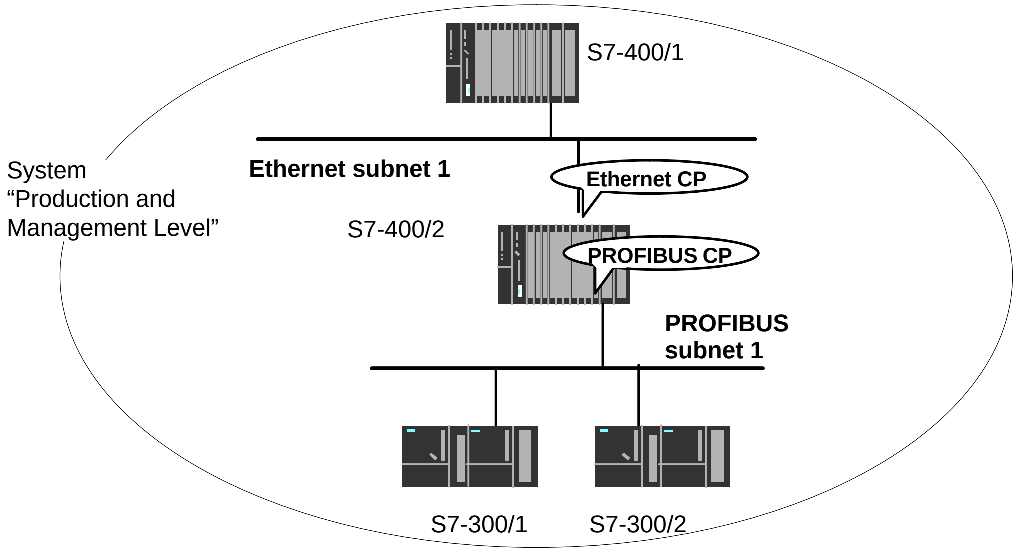
SIMATIC S5 stations and other devices you intend to include in the communication must be entered in the configuration as **S5 stations or other stations**.



1.7.3 Network/Project Variant: Two or More Subnets - One Project

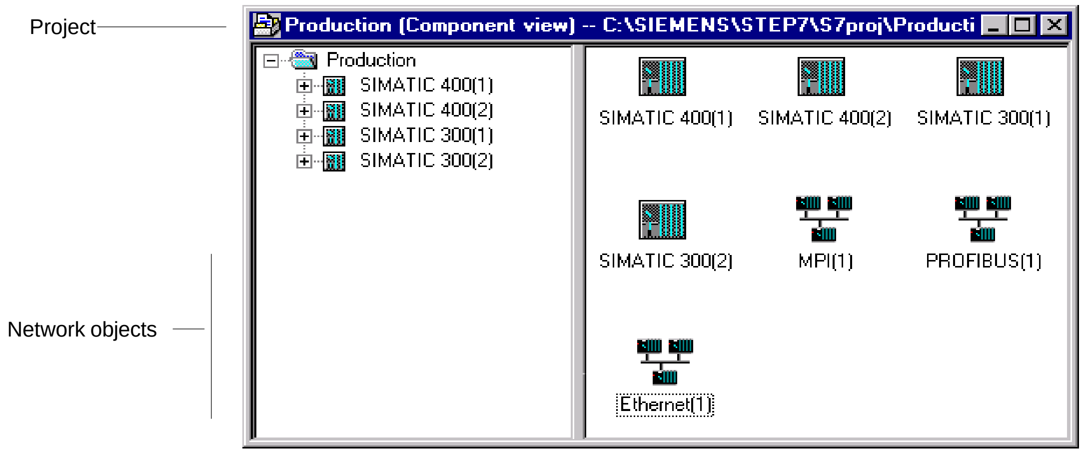
Configuration of the System

Due to the different tasks of the stations or due to the extent of the system it may be necessary to operate more than one network.



View in a STEP 7 Project

You can create the subnets in **one** STEP 7 project and configure the stations for communication.



This representation illustrates the following:

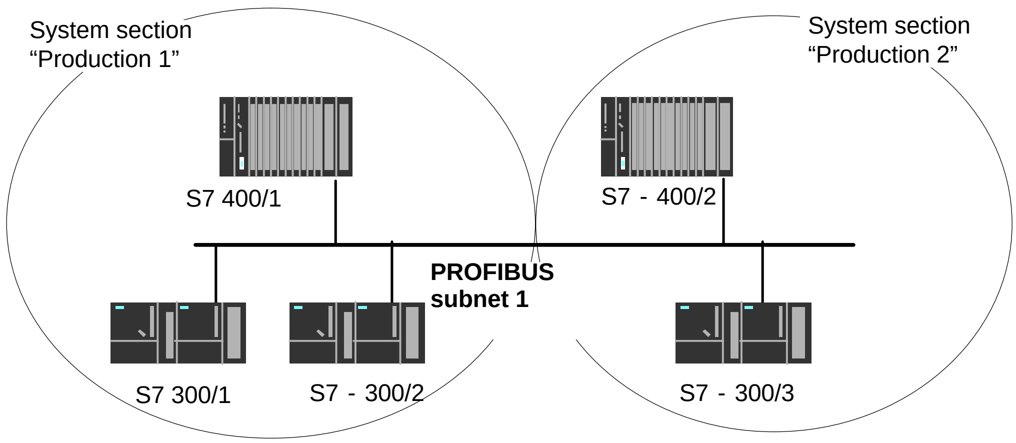
- More than one subnet can be managed in one project.
- Each station is created once in the project.
- Each station can be assigned to more than one subnet by assigning its CPs suitably.

1.7.4 Network/Project Variant: One Subnet - Several Projects

Configuration of the System

In complex networked systems, during configuration it is sometimes more efficient to manage plant sections in different (sub) projects.

The situation can arise that communication takes place over an interproject subnet and that interproject connections must then also be created.



Organization in a Multiproject

User-friendly and consistent configuration of such communication is supported in STEP 7 as of Version V5.2 with the multiproject.

The functions for multiprojects in STEP 7 allow the following:

- Several projects can be managed in one multiproject and edited separately
- Projects can be branched and merged

Two different strategies can be distinguished in a multiproject:

- Several employees work at the same time on a multiproject in a networked environment. The projects of the multiproject are in different network folders. In this case, all connection partners are available for configuring connections.
- One employee manages the multiproject centrally. This person creates the structures for projects (when necessary locally) and contracts individual projects out for external editing. The central configuration engineer then returns these projects to the multiproject and synchronizes the interproject data with system support and where necessary with the required interproject functions.

In this case, agreement is necessary, for example, regarding the assignment of connection names (reference) because it will be far easier when synchronizing the projects to bring connections with identical connection names together.


HLP

The topic of multiprojects is dealt with in detail in the STEP 7 basic help.

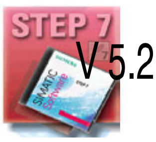
Here, you will find information on the following topics:

- Requirements for interproject functions
- How to create multiprojects
- How to create a new project in a multiproject
- How to separate a project from a multiproject
- How to include projects in the multiproject
- How to synchronize projects in a multiproject
- Moving stations within a multiproject (when a station is moved from one project of a multiproject to another project of the same multiproject (for example using drag & drop), the interproject connections are retained).
- Possible problems in distributed projects and tips on how to avoid them

Possibilities for stations outside the current project

The addition of the multiproject functionality means that the following situations can arise:

- Connection to a partner in an unknown project



  The new multiproject functionality allows you to create a connection to a partner in an unknown project. In this case, you can specify a connection name as a reference in the properties dialog of the connection. When the projects are merged, STEP 7 then supports you with automatic synchronization of the separately configured connections.

  The connection remains unspecified until the projects have been merged and the connections synchronized. Only following this synchronization can the configuration data be downloaded to the local station without inconsistencies.

  You should therefore use this variant when you know that the projects will be merged in a multiproject.

- Specified connections with representative objects

  To allow you to create specified connections to stations in a different project (for example production 2) or that are not managed with STEP 7, you can configure these stations as **other stations** (example in the project production 1).

  This makes it possible to create consistent, fully specified configuration data and to download it to the local station.

  It is also possible to create specified connections between these stations in different, independent projects. The stations can then communicate immediately over the created connections after the configuration data have been downloaded.

Use this variant when you want to operate projects separately due to the complexity.

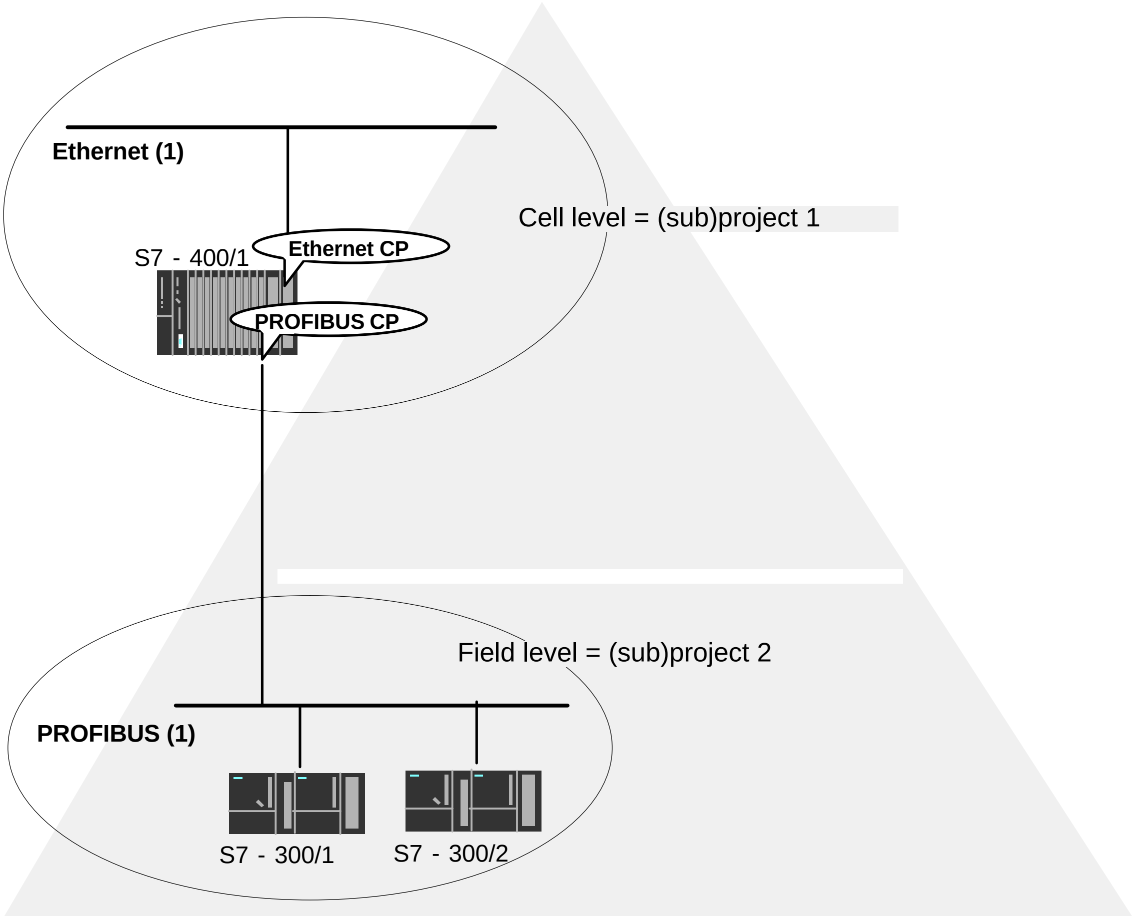
Stations of the type SIMATIC S5 function in just the same way as representative objects.

1.7.5 Network/Project Variant: Several Subnets in Several Projects

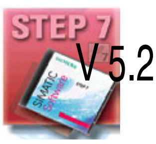
Configuration of the System

If several network types need to be used and if these need to be managed in different projects due to the different tasks of the stations or due to the large span of the plant, stations can be created as follows:

- Using (sub) projects in the “multiproject”
- by configuring **”Other stations / SIMATIC S5”** in the other project.



Organization in a Multiproject



If you use a multiproject organization, follow the steps below to connect the S7-400/1 station to the PROFIBUS (1) subnet:

Create a subnet of the type PROFIBUS in both subprojects and merge these two subnets in NetPro.

2 Characteristics of PROFIBUS CPs

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.

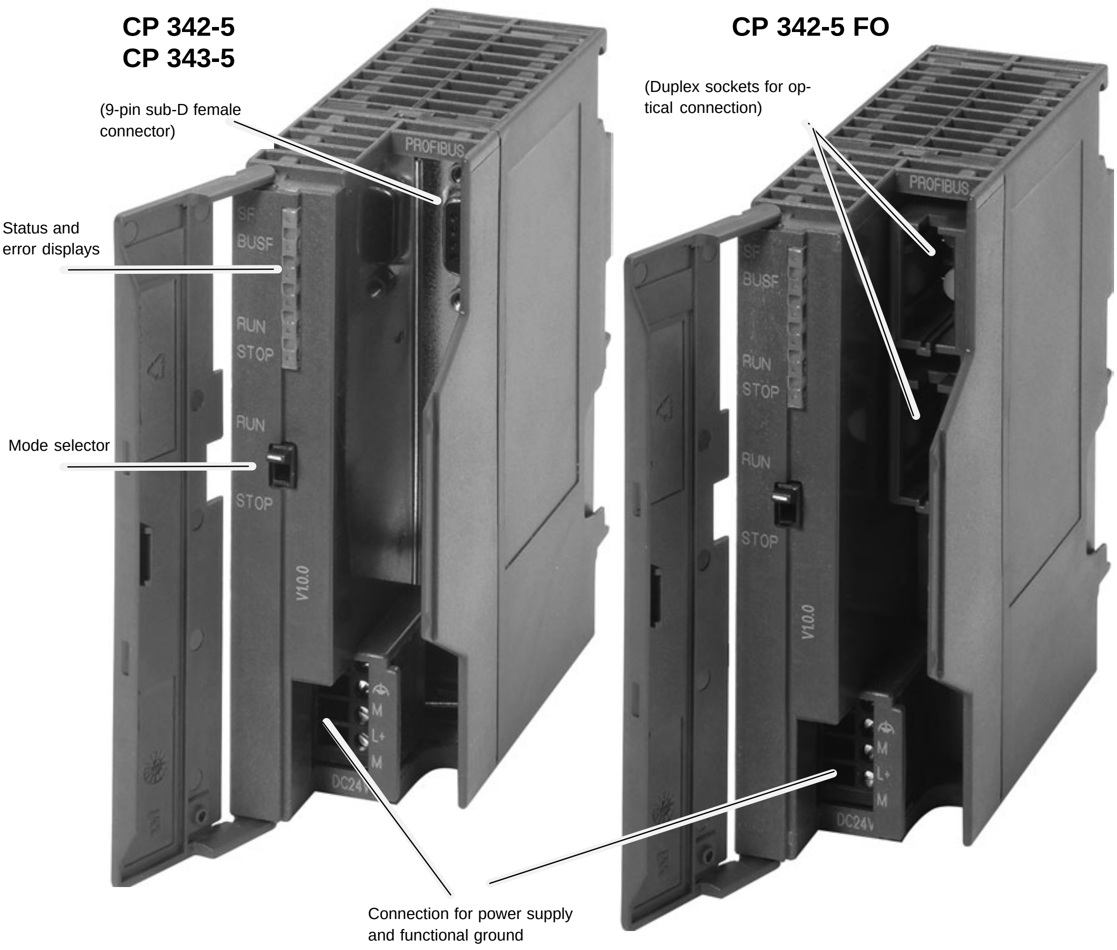


Figure 2-1 Example: Front View of the CPs 342-5 / 342-5 FO / CP 343-5

2.2 Communications Processors for S7-400

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

- Single-width module for simple installation in the S7-400 / S7-400H (redundant system) 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.

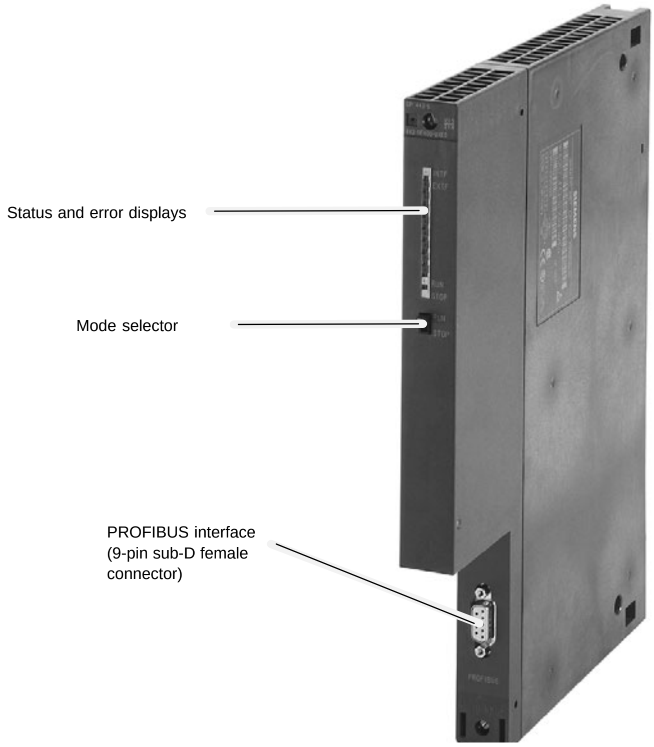


Figure 2-2 Example: Front View of a CP 443-5 Basic / Extended

2.3 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 /6/. 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

2.3.1 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.

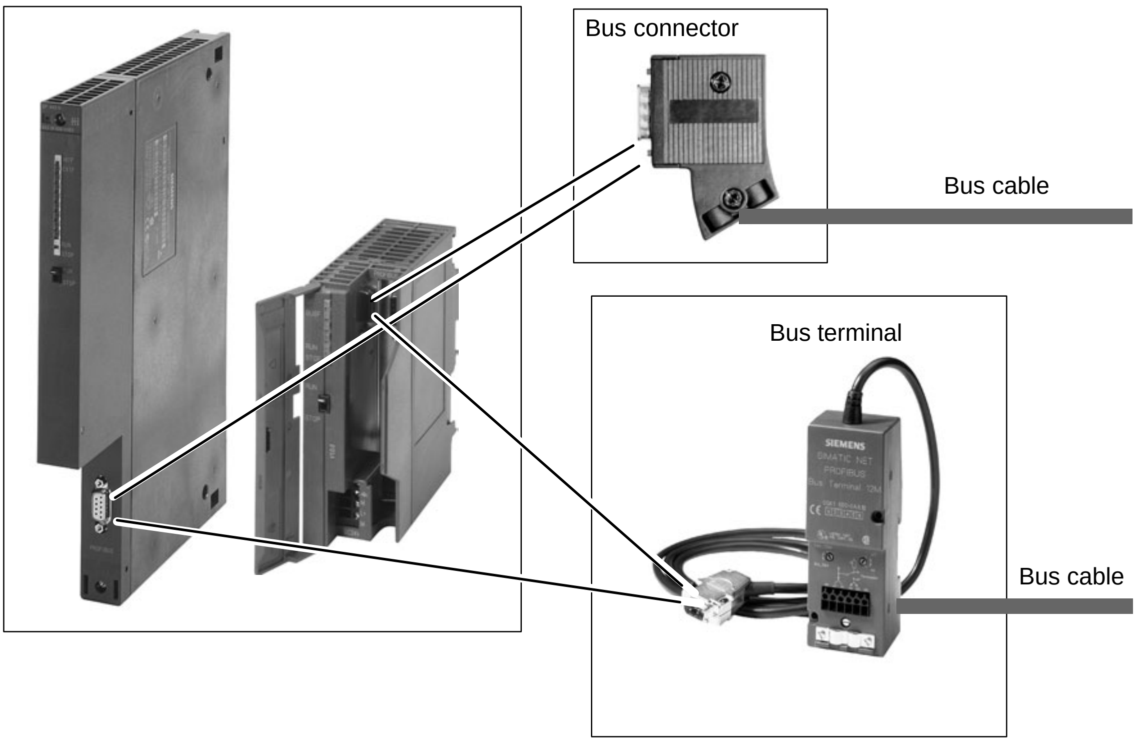


Figure 2-3 Electrical Attachment of the CPs to PROFIBUS

2.3.2 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.

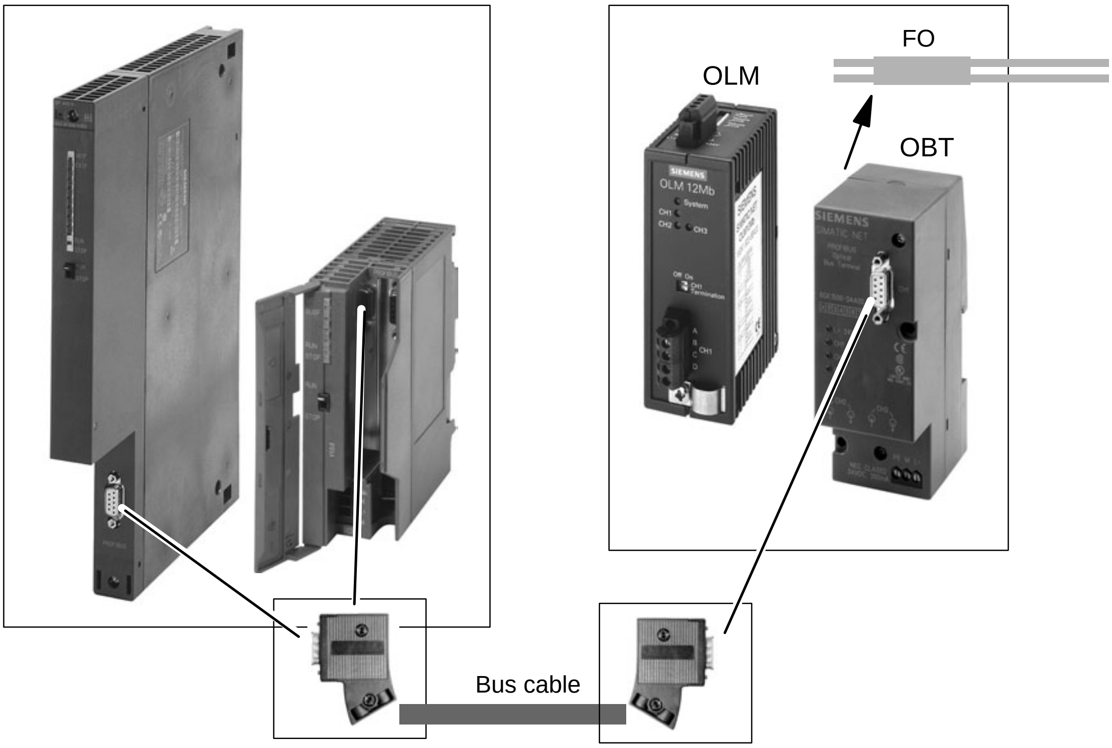


Figure 2-4 Transition from Electrical to Optical Attachment

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.

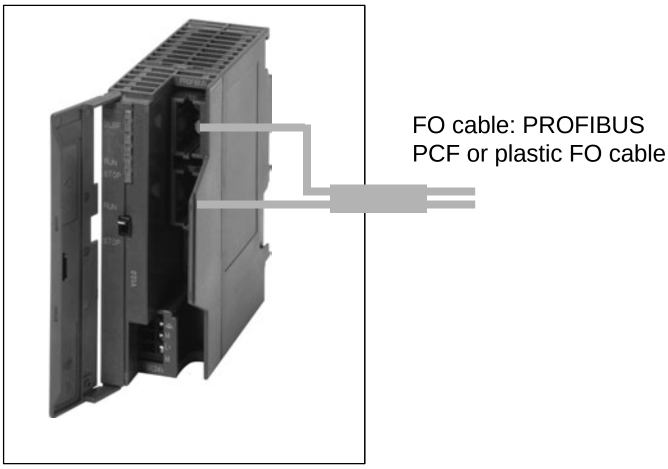


Figure 2-5 Direct Optical Attachment

2.4 Slot Rules and further Information on the SIMATIC S7-300 Series

2.4.1 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).

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).

2.4.2 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.

2.4.3 Multicomputing

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

2.4.4 CPU Connection Resources and Optimized Utilization

Note that when using older S7-300 CPUs (up to September 1999), 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 up to 12 S7 connections, 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.

2.5 Slot Rules and further Information on the SIMATIC S7-400 Series

2.5.1 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.

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.

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.

2.5.2 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.

2.5.3 Multicomputing

This functionality is supported by the SIMATIC S7-400 (see specific sections).

2.5.4 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 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 only one connection resource on the S7-400 CPU is necessary.

3 Operating the PROFIBUS CP with NCM S7

To attach a SIMATIC station to a PROFIBUS subnet using a PROFIBUS CP, you configure the CP with the NCM S7 configuration software. This chapter explains the following:

- How the CP is configured in the STEP 7 project
- How the various network configurations are managed (setting up access to other systems)
- How to control and supply the CP with data using NCM S7.

You will find further information in the following sources:

- When installing the PROFIBUS CP, please refer to the instructions in the product information / manual /2/ supplied with the PROFIBUS CP. This also contains further information about the performance of the PROFIBUS CP.
- For more information about the functions and uses of STEP 7 in which the NCM S7 option is integrated, please refer to the manuals /7/ and /8/.

  You will find this information in the online help integrated in STEP 7 by selecting **Help ▸ Contents.**

HLP

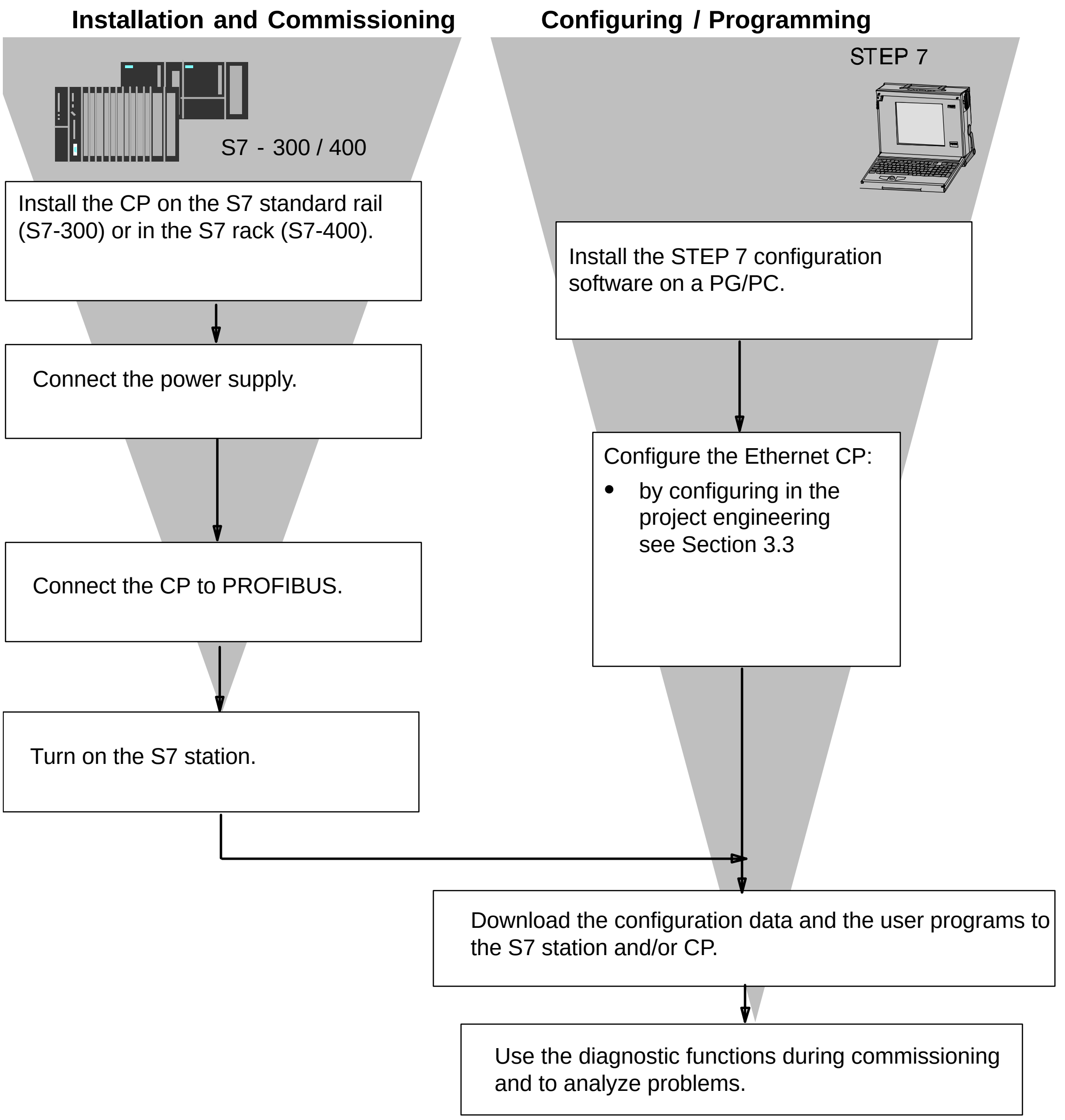
- You will find examples of configurations in the “Primer” /4/.

3.1 How to Commission a PROFIBUS CP

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

Notice

The chart below shows the basic steps. Please read the device-specific instructions in “Installation and Commissioning” in the description of your CP (Manual Part B).



3.2 General Information on STEP 7 / NCM S7

Installation

The functions of NCM S7 are available automatically immediately after installing STEP 7.

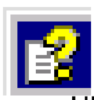
Functions

NCM S7 consists of the following:

- CP-specific index dialogs that you call using the properties dialog box of the modules.
- Dialog functions for connection configuration.
- Diagnostic functions that you obtain as follows:
  - Using the Diagnostics tab in the Properties dialog
  - Using the standard Start menu of Windows with which you can call the SIMATIC program group
- Functions displayed with **SIMATIC ▸ NCM...** in the Start menu of Windows:
  - Diagnostics
  - Help for functions (FCs)
  - “Readme” file with current information about NCM
  - Firmware loader

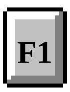
Access to Online Help of STEP 7 and NCM S7

With the online help, you can obtain the following information:



HLP

- You can display the contents of the STEP 7 basic help system with the menu command **Help -> Contents.**



- Context-sensitive help on the selected object using the **Help -> Context-Sensitive Help** menu command, the **F1** key or the **question mark** in toolbar.

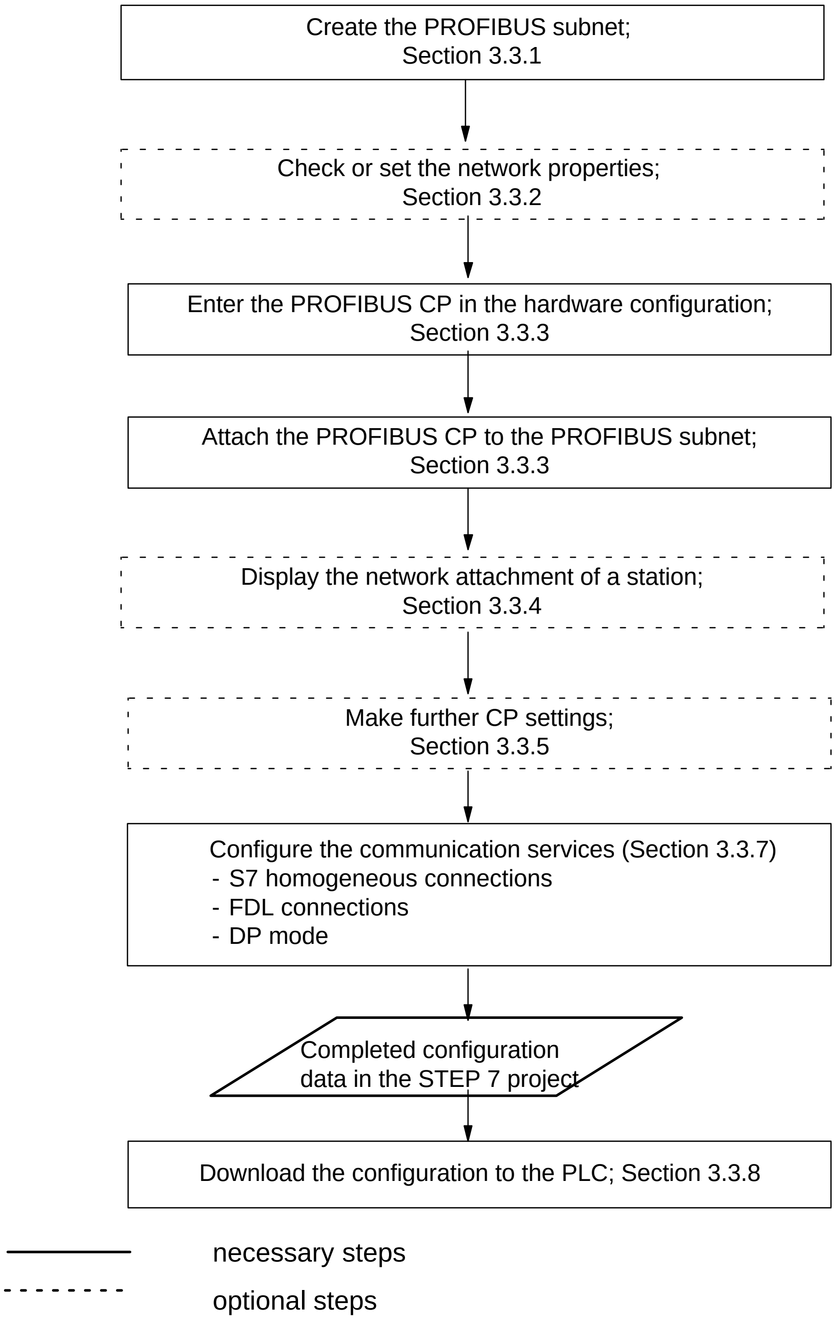
  You can then access further information relating to the current topic.
- Glossary for all STEP 7 applications by clicking the **“Glossary”** button.

Please note that each STEP 7 application has its own contents and context-sensitive help.

3.3 Configuring - Follow the steps below:

A CP is managed in an S7 project just as the other modules. You use STEP 7 to configure the hardware and create and manage the user software (see /7/).

Configuring a CP involves the following basic steps (the broken lines indicate options):



3.3.1 Creating a PROFIBUS Subnet

Aims

To be able to attach the SIMATIC stations to a subnet, you create the subnet in your project. This means that all the parameters for the entire subnet are managed centrally.

Procedure

It is advisable to create the subnet before you configure the stations since the assignment of the SIMATIC stations is then performed largely automatically.

It is also possible to create the subnet at a later point in time when configuring a CP. This is explained in more detail later in the chapter.

Follow the steps outlined below:

1. Select the project in the SIMATIC Manager.
2. Select **Insert ▸Subnet ▸PROFIBUS.**

   Result: An object of the type network is created in the project. This allows all the SIMATIC stations created in the project to be attached to this subnet.

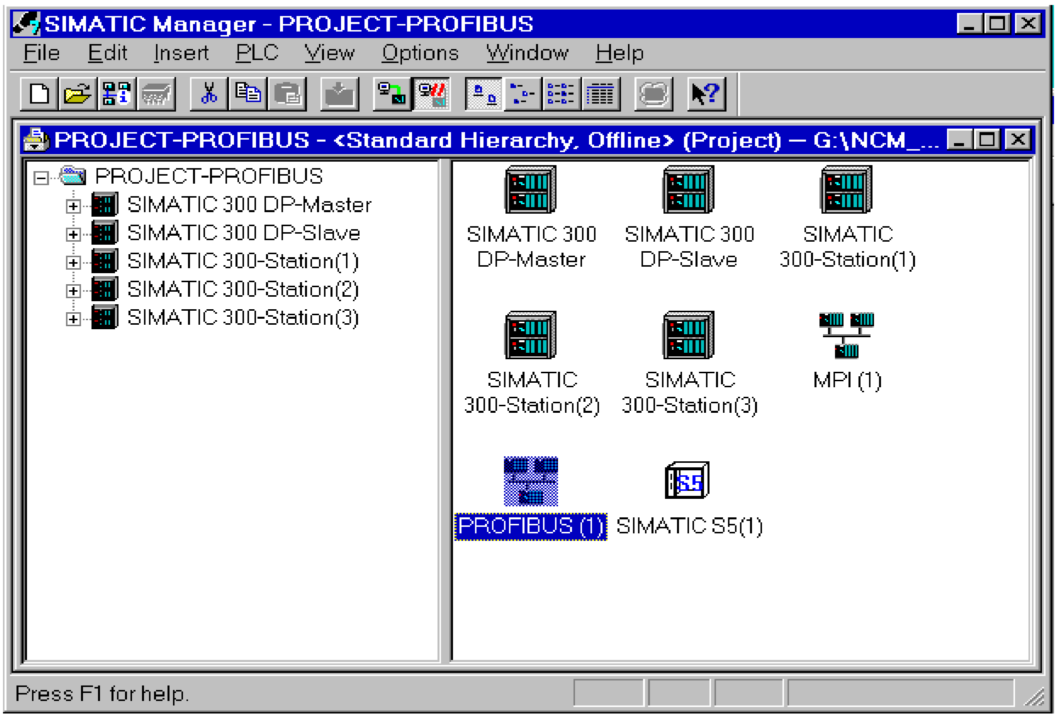


Figure 3-1 Project With Assigned PROFIBUS Subnet

3. If you prefer a NetPro graphic network display, select the network object ”PROFIBUS” and confirm with **Edit ▸ Open Object.**

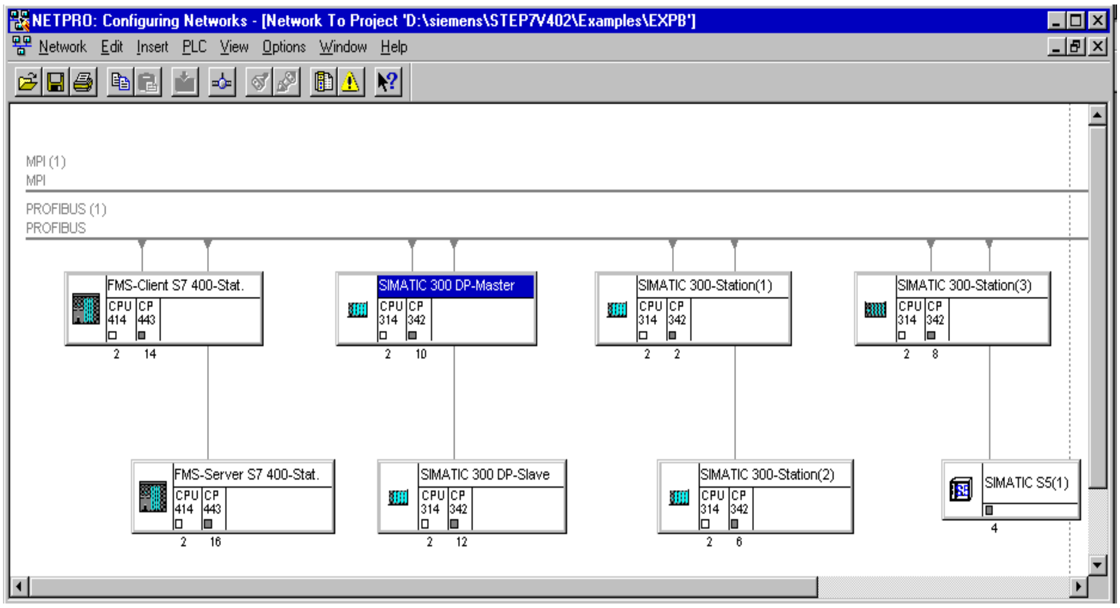


Figure 3-2 Graphical Network Representation - here with stations already networked

From this graphical representation, you can also access all the functions for networking and configuring connections with PROFIBUS CPs.

You can also create the subnets in NetPro! Open the catalog using the menu command **Insert ▸ Network Objects.**

Organization in a Multiproject

If you use the multiproject form of organization, this has the following effects when creating subnets.

You create subnets initially in the subprojects as described above. To be able to network S7 stations, you will, for example, need to create a suitable subnet of the type Industrial Ethernet in each subproject.

If this is physically a subnet that extends beyond the boundaries of the subproject, you should first merge the subnets before configuring the communication connections between the S7 stations.

If you do not merge the subnets, NetPro assumes that you are connecting the subnets via routers and displays warning messages to this effect.

Properties of Merged Subnets (Multiproject)

When you merge subnets, transferable subnet properties such as the subnet ID of the master subnet will be transferred to the other subnets of the group.

Some parameters relate specifically to a subproject and remain unchanged; these include, for example, descriptive parameters such as the name, author, and any comments.

Notice

Preserving Consistency in Merged Subnets

After merging the subnets, you should check the consistency throughout the multiproject using the menu command Network > Check Interproject Consistency in NetPro to make sure that there is consistency throughout the multiproject. This check detects, for example, S7 subnet IDs that are not unique within the multiproject.

3.3.2 Checking and Setting Network Properties

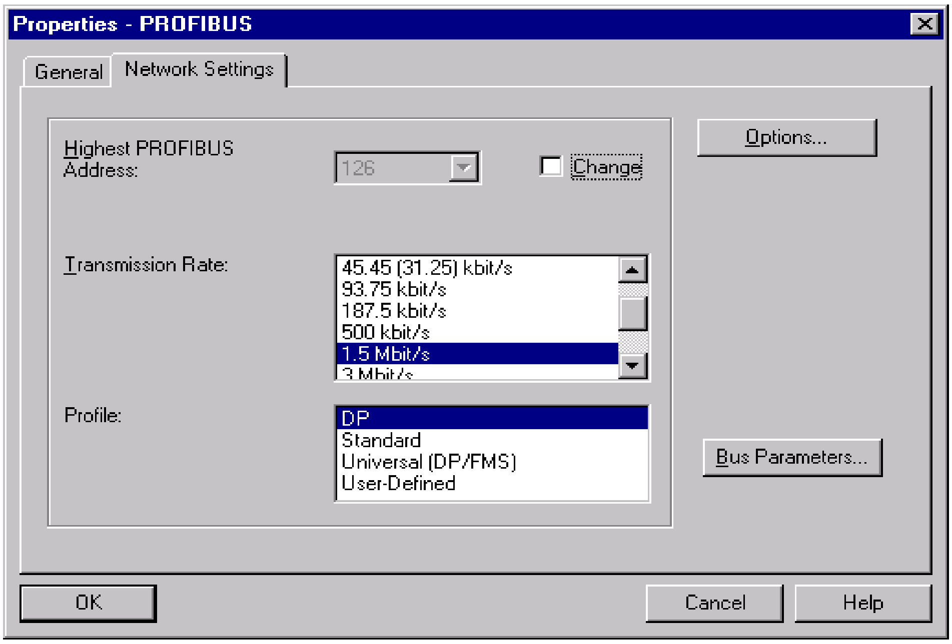
Procedure

The parameters that describe the properties of the PROFIBUS subnet generally have default values. Using the procedure described below, you can check the settings and adapt them to your situation.

1. Select the network object in NetPro and select the menu option **Edit ▸Object Properties**.

   Result: The “General” tab is opened in the “Properties PROFIBUS” dialog.

2. Enter a suitable subnet name in the “General” tab and if required any further information to describe the subnet.
3. Check the entries in the “Network Settings” tab.



Settings

The values in the dialog box are used as basic values for the subsequent calculation of the bus parameters.

You can see the results of this calculation in the next dialog box. After entering or checking the values, simply click the “Bus Parameters” button.

Table 3-1 Basic Values for Bus Parameters

Parameter	Meaning
Highest PROFIBUS Address (HSA)	This specifies the highest PROFIBUS address of an active station on the bus system. Passive stations can have addresses higher than the highest station address (possible values: highest active address in the network ... 126).
Transmission Rate	Transmission rate on the bus. (Values depending on profile, see below: 9.6 Kbps, 19.2 Kbps, 45.45 (31.25) Kbps, 93.75 Kbps, 187.5 Kbps, 500 Kbps, 1.5 Mbps, 3 Mbps, 6 Mbps, 12 Mbps). For the permitted transmission rates, please refer to the information in the product information bulletins / manual /2/ for your particular CP.
Profile	Here you can decide on the method (algorithm) used to calculate the fundamental bus parameters for PROFIBUS operation. Various algorithms are available that have been optimized for the particular mode of the subnet. These algorithms result in stable network operation. • DP You can operate a homogeneous DP network with a maximum of **one** DP master class 1 and no further DP masters (an additional PG is possible). This algorithm must be used exclusively for the DP protocol. • Standard This is for the multiprotocol and multimaster mode with fast stations. The stations in this case are equipped with newer ASICs such as ASPC2, SPC2 etc. This includes all SIMATIC S7 PROFIBUS CPs. • Universal (default setting) This is for CPs that cannot be operated in the DP or standard categories. • User-defined In this case, you yourself define the bus parameters.

Notice

If you are operating subnets to which SIMATIC S5 components are attached by means of the CP 5430/5431, please use the universal profile.

Caution

Only trained specialists should use the user-defined algorithm.

Setting or Checking Further Bus Parameters

By clicking the ”Bus Parameters” button, you open the Bus Parameters” tab. This displays the calculated or default values for the bus parameters.

For more information about the meaning and effects of the parameters in the “Bus Parameters” tab, please use the integrated help system.

Depending on the algorithm you have selected, the values in this dialog box will be displayed in one of two ways, as follows:

- User-defined
  The default values are displayed and you can change them.
- DP, Standard, Universal
  The calculated values are displayed. You cannot modify the displayed values.

Note on the “Bus Parameters” dialog
* Bit time:
This is the time required to send one bit (reciprocal of the transmission rate in bps). The advantage of using the “bit time” is that the parameters are not dependent on the transmission rate.
To calculate the time in milliseconds from the number of bit time units, use the following formula:

$$\text{Time (in milliseconds)} = \frac{\text{Number of bit time units}}{\text{transmission rate (in Kbps)}}$$

Checking the Effects of the Network Configuration

To activate the calculation of the bus parameters for a network configuration that differs from the current network configuration, select the “Options” button in the “Properties PROFIBUS / Network Settings” tab.

Here, you define a network configuration for which the bus parameters will be recalculated. The online help explains the possible settings.

HLP

3.3.3 Entering a PROFIBUS CP in the Hardware Configuration

Procedure

By inserting the PROFIBUS CP in the rack of a SIMATIC station and assigning it to the station, you establish the logical attachment between the CP and subnet.

1. Place the station in your project that you want to attach to PROFIBUS using the PROFIBUS CP.
2. Select the CP in the hardware configuration just like any other module by selecting it in the hardware catalog and then selecting the slot in the rack.

   You select CPs in the hardware catalog using a short text and the order number. Some CPs are only available in the catalog after you have installed NCM S7.

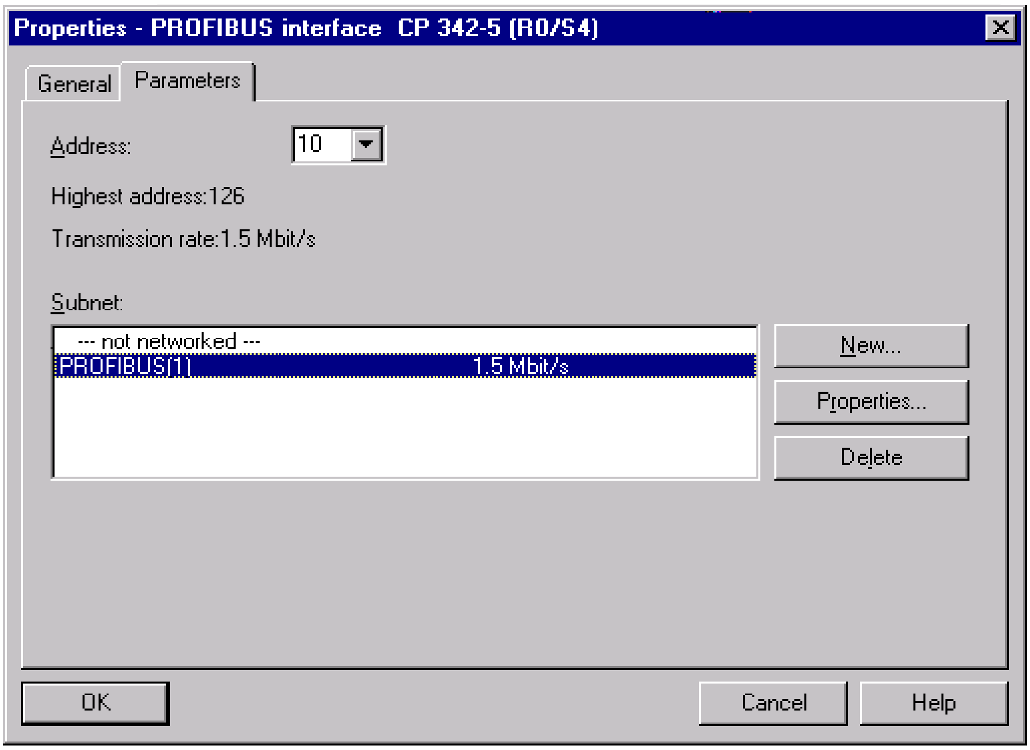
   Result: The CP is assigned to the SIMATIC station.

   For information about the permitted slots, refer to /2/.

   How to configure a module is described in detail in /7/.

Subnet Attachment

To allow you to activate the network attachment of the PROFIBUS CP, the SIMATIC Manager displays the following dialog:



Note

You can open the dialog for setting the interface at any time from the Properties dialog of the CP in the “General” tab.

3. If you have not yet created a subnet in the project or have not yet created the selected subnet, you can now create a subnet. To do this, select the “New” button.

   Result: An object of the type network is created in the project.

   Now follow the steps as outlined in Section 3.3.2.

4. Check the PROFIBUS address and if necessary change it. The system first enters the next free PROFIBUS address automatically as the PROFIBUS address.

   Über weitere Möglichkeiten der programmgesteuerten Adreßeinstellung informiert Kap. 3.4

5. Select the required subnet type in the “Subnet” list box.
6. You can display the properties dialog box for the selected subnet by clicking the Properties button. For more detailed information about the PROFIBUS network properties dialog, refer to Section 3.3.2.
7. Enter information specific to the subnet node in the “General” tab.
8. You must finally confirm your input with OK, otherwise the networking is not entered (refer to Point 6)

Result: The CP is now configured as a network node for the corresponding S7 station.

Automatic Check if Bus Parameters are Changed

If you change the assignment to the subnet, the system automatically checks whether the CP mode is compatible with the profile of the newly selected subnet. If they are not compatible, you will receive a message prompting you to set suitable subnet parameters.

3.3.4 Displaying the Network Attachments of a Station

Procedure

You can easily get an overview of the network attachment configurations of a SIMATIC station in one of the following ways:

- A graphic overview in NetPro;
- An overview in table form in the Properties dialog of the station

Graphic Overview in NetPro

The NetPro view provides you with a good overview of the networked stations:

Follow the steps below:

1. Double-click one of the network objects, for example PROFIBUS in your project in the SIMATIC Manager.

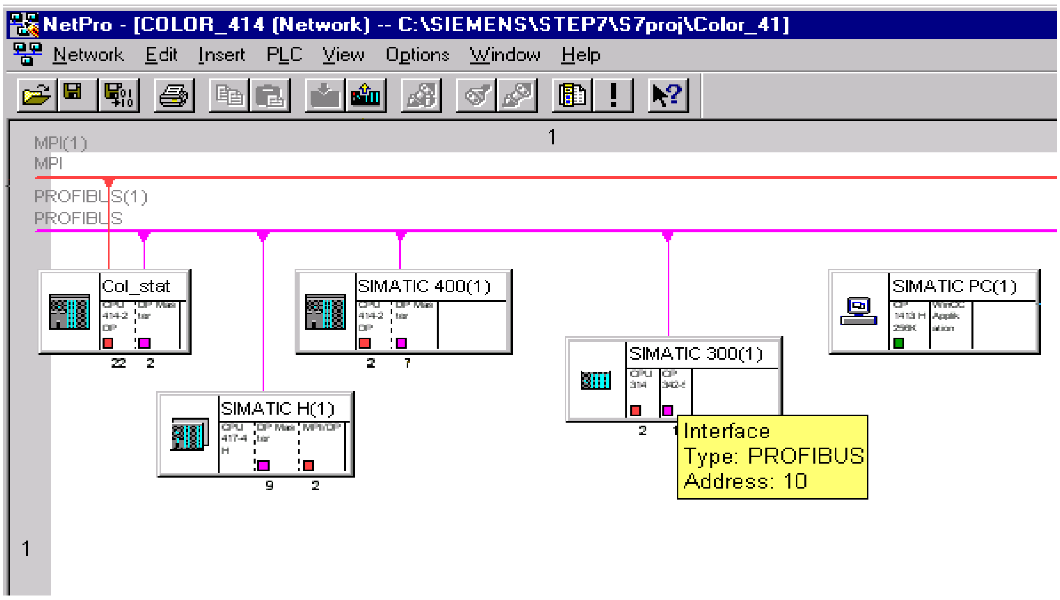


Figure 3-3 NetPro View of a PROFIBUS Subnet

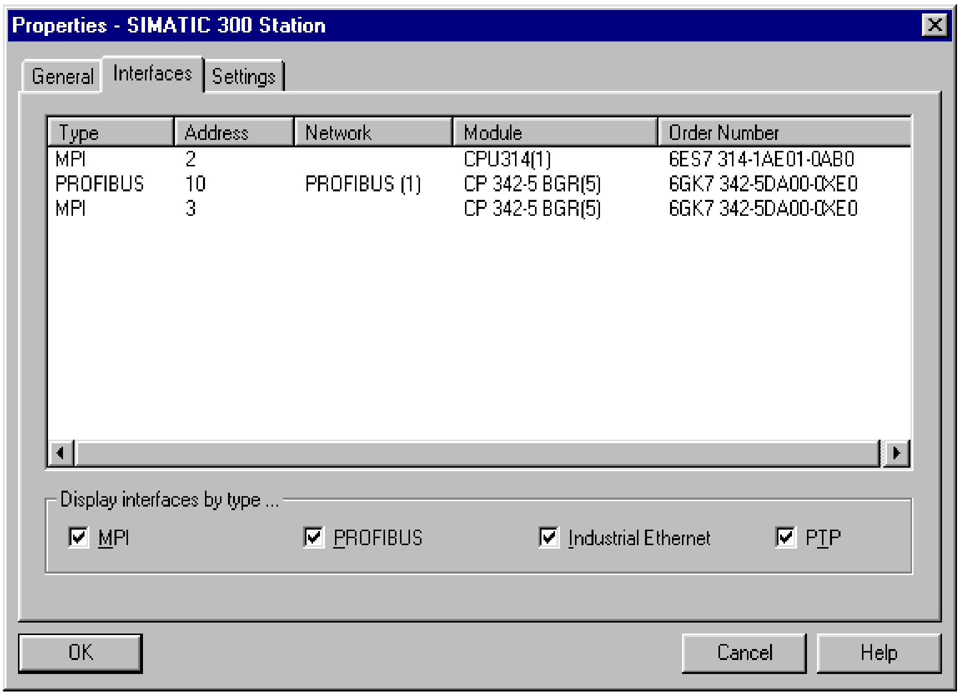
Overview in Table Form

The table view in the Properties dialog of the station provides a detailed overview of the components used for network attachment.

Follow the steps below:

1. Using the SIMATIC Manager, select the station in your project that you want to check.
2. Select the **Object Properties** using the menu option **Edit ▸ Object Properties** or by double-clicking the station symbol.
3. Select the ”Interfaces” tab.

   Result: The following dialog box is displayed.



In the displayed dialog, you can see the subnet attachments that were configured for the SIMATIC station.

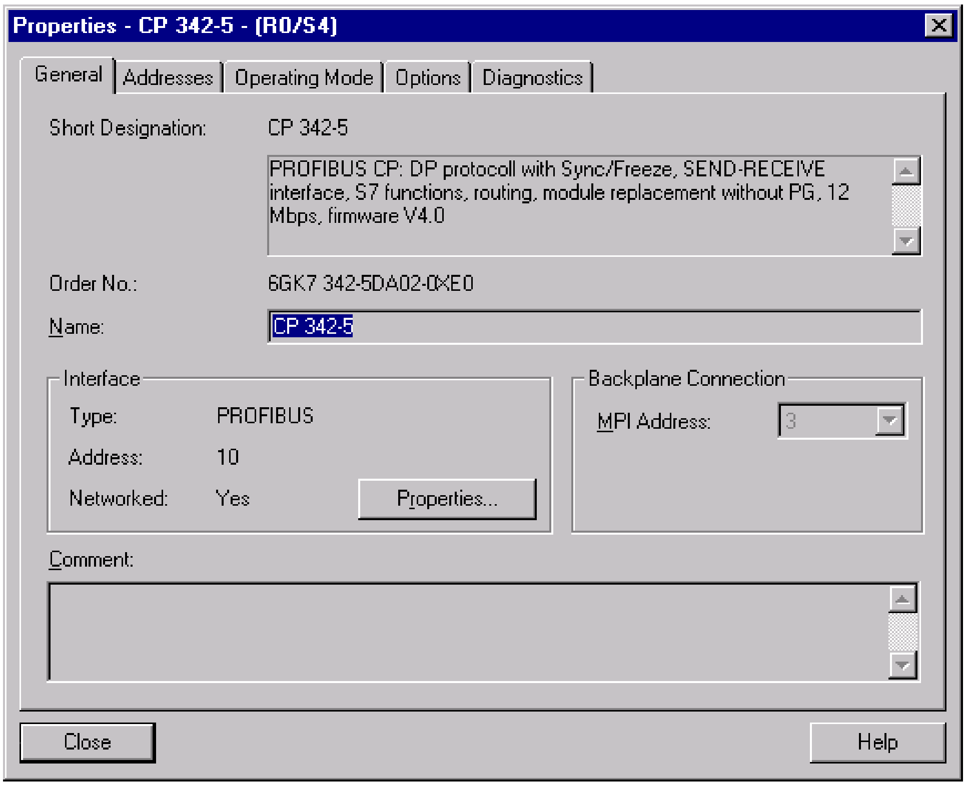
You can select what is displayed using the check box under “Display interfaces by type”.

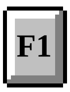
3.3.5 Setting further CP Properties

Overview

In addition to the network attachment, you can also make further settings for the specific module or you can call functions.

1. Select the PROFIBUS CP in the hardware configuration.
2. Select **Edit ▸ Object Properties**. In the dialog, you will see further tabs in addition to the “General” tab described in Section 3.3.3 depending on the type and CP, some of which are shown in the example of a CP 342-5:





Please read the description of the Properties dialog of the CP in the integrated help. The functions are explained in detail there.

Addresses Tab

The “Addresses” tab displays the address at which the module can be addressed by the user program. You require this address when calling the FCs for DP and for FDL connections.

-> See Chapter 8

Notice

Please note the following information on S7-300 stations:

If you selected the option ”Update OB1 process image cyclically” in the CPU configuration, (default), make sure that the start address of the PROFIBUS CP is outside the process image area (start addresses in the ”Addresses” tab).

Example: if the process image selected for the CPU = 1024 (0...1023), an address >= 1024 must be selected for the PROFIBUS CP.

Operating Mode Tab

In this tab, you can activate the DP master mode if required for CPs with DP functions. If the CP can also be operated as a DP slave (for example the CP 342-5), the DP master or DP slave mode must be selected (see Table 3-2).

Note

When selecting the mode, please make sure you follow the instructions
-> in Section 4.6 Checking or Setting the CP Mode DP Master
-> in Section 6.3.2 Checking or Setting the CP Mode DP Slave

Table 3-2 Configurable CP Modes and Possible CP Functions

Configurable CP mode	Possible CP functions				
	PG/OCM PROFIBUS	FDL/FMS on PROFIBUS	S7 comm. Client / Server	DP Master	DP Slave
No DP mode	X	X	X	-	-
DP master mode	X	X	X	X	-
DP slave active	X	X	X	-	X
DP slave passive	-	-	-	-	X

Refer to the CP Product Information for the protocols supported by the CP!

Note

PG functions and test functions are always possible on the MPI regardless if the selected mode.

In the “passive” mode, no PG functions are possible via PROFIBUS.

Options Tab

Depending on the CP type, the following settings can be made:

Table 3-3 Settings in the “Options” Tab

Option	Meaning / Effect
• Time-of-Day Synchronization	Here, you decide whether the CP forwards time-of-day frames or not. You require this function if you have several CPs in a station since only one CP is permitted to pass on the time synchronization messages.
	Note The time-of-day synchronization function does not exist for all module types.
• Replace Module without PG	With this option, you can have the configuration data of the CP stored on the CPU. If you then replace CP, the configuration data for the new CP are downloaded automatically from the CPU when the CP is started up. If you select this option, the configuration data are stored long-term on the CPU instead of in the EEPROM of the CP. Remember, however, that long-term storage on the CPU is only safe from power outages if the CPU is protected by battery backup or by using an S7 Memory Card.
	Notes • If you store the configuration data on the CPU, please read the note below. The following functions do not modify the configuration data on the CPU: - Reset module memory - Resetting to factory settings 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). • On H systems you must activate the option. • The CP 443-5 Extended can only be operated with the option (not selectable).

Table 3-3 Settings in the “Options” Tab , continued

Option	Meaning / Effect
	• Resources Required on the CPU If you select this option, you utilize additional resources on your CPU. When you download the user programs and the configuration data, you will be informed if there is not enough memory. You can avoid problems arising from a lack of memory by using an S7 memory card. Tip: If you find you have a lack of resources and do not want to use an S7 memory card, you can also deselect the option and store the configuration data on the CP. You can then later write the configuration data to an S7 memory card so that the option ”replace module without PG” is activated. When you insert the S7 memory card in the CPU, you can then replace the CP at any time. The configuration data are then automatically loaded from the CPU or from the S7 memory card when the CP is started up.
• Field Device Parameter Assignment (Data Record Routing)	By selecting this option, you can use the CP as a router for data records intended for field devices (DP slaves). The CP then passes data records transferred by devices that are not directly attached to PROFIBUS and do not therefore have direct access to the field devices (DP slaves) on to the field devices. One tool that creates such data records for assigning parameters to field devices is SIMATIC PDM (Process Device Manager). As default, the function is activated. Since the function requires additional memory resources, you can deactivate this option if you are utilizing a lot of memory resources on the CP (connections etc.) and do not require the ”data record routing” function.
• Multiplex OP Connections / Reserve Internal CPU Connection Resources	To attach TD/OPs or HMI devices, you can optimize the connection resources on the S7-300 CPU by having up to 16 of these devices communication on a single CPU connection resource (multiplex mode). If you do not use this option, the number of operable TD/OPs or HMI devices depends on the number of available connection resources of the CPU you are using. As default, this option is deactivated. This means that a CPU connection resource is used for multiplex only when necessary. Configured S7 connections over the CP use the same multiplex channel as you use for multiplexing the HMI connections. If you configure S7 connections, this means that one CPU connection resource is already used. Please note: PG connections do not use the multiplexer; if you use a PG, one connection resource is always occupied. Note on Programming: When you use the multiplex mode, you must specify the rack/slot assignment of the CP for addressing on TD/OP/HMI connections instead of the rack/slot assignment of the CPU! Applications (for example ProAgent) that require block-related messages (Alarm_S: SFC17-19) are not supported in the multiplex mode.

Communication Variables Tab

In this tab, you can make the settings required for the communications variables on FMS connections.

Diagnostics Tab

In the “Diagnostics” tab, you can start NCM S7 PROFIBUS diagnostics.

-> see Chapter 9 Diagnostics for a description

3.3.6 Substitute Objects in the STEP 7 Project

Overview

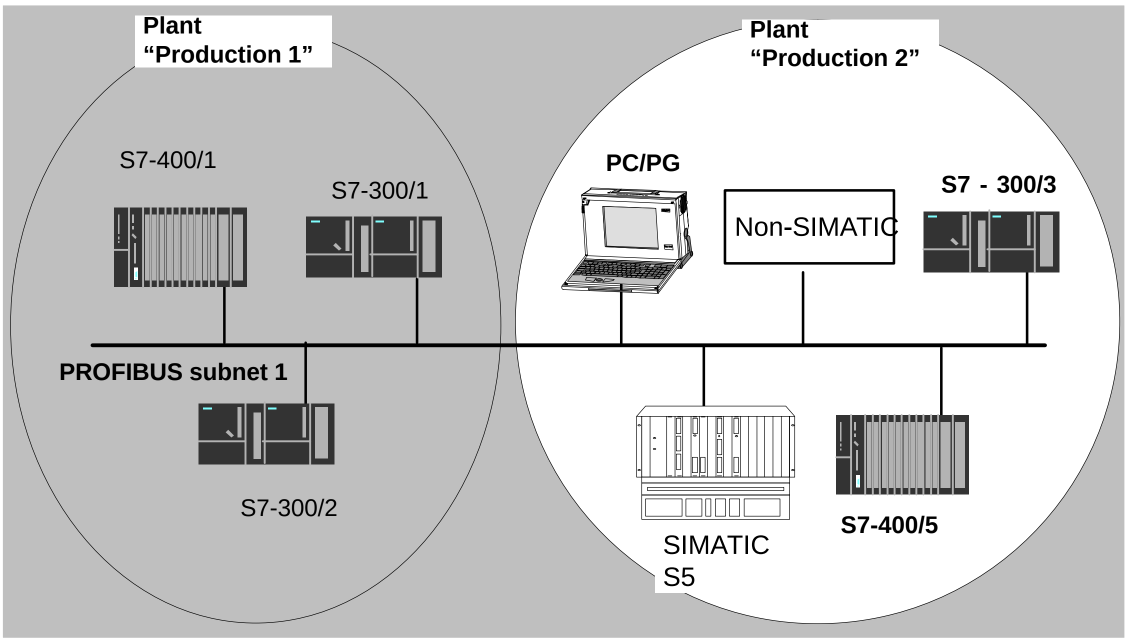
Communication connections can be configured fully when the communications partners are available in the current project. For the stations on the PROFIBUS subnet, whose configuration data were not created in STEP 7 or whose configuration data are not managed in the currently active project, the following substitute objects can be created in the project:

- SIMATIC S5 stations
- PG/PC
- Other stations
  - for devices of other manufacturers
  - for SIMATIC S7 stations in another project (not necessary in a multiproject)

Note

Instead of creating substitute objects, you can also configure unspecified connections for connections to the stations listed above.

In the Properties dialog of these connections, you must then specify the full partner address. These partners do not appear in the NetPro plant view.



Procedure

To enter a substitute in the project, following the steps below:

1. Select the project in the SIMATIC Manager.
2. Select the station type with the menu option **Insert ▶Station ▶...**

   Result: An object of the type “Other Station” or “SIMATIC S5” is created in the project.

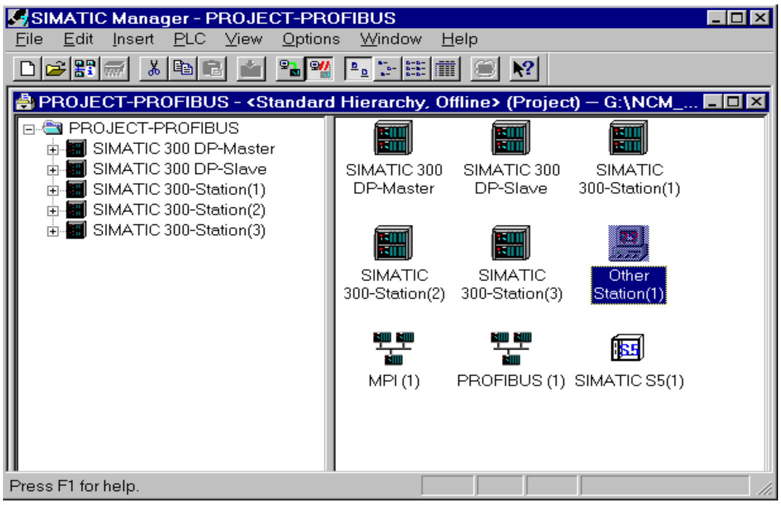


Figure 3-4 Project with Substitute Objects Configured

Attaching Non-S7 Stations to the Subnet

The next step is to assign the substitute object to the subnet, as follows:

1. Select the object in the project and select **Edit ▶ Object Properties.**
2. Select the “New” button in the “Interfaces” tab of the “Properties” dialog.

Result: opens the ”New Interface - Type Selection” dialog box.

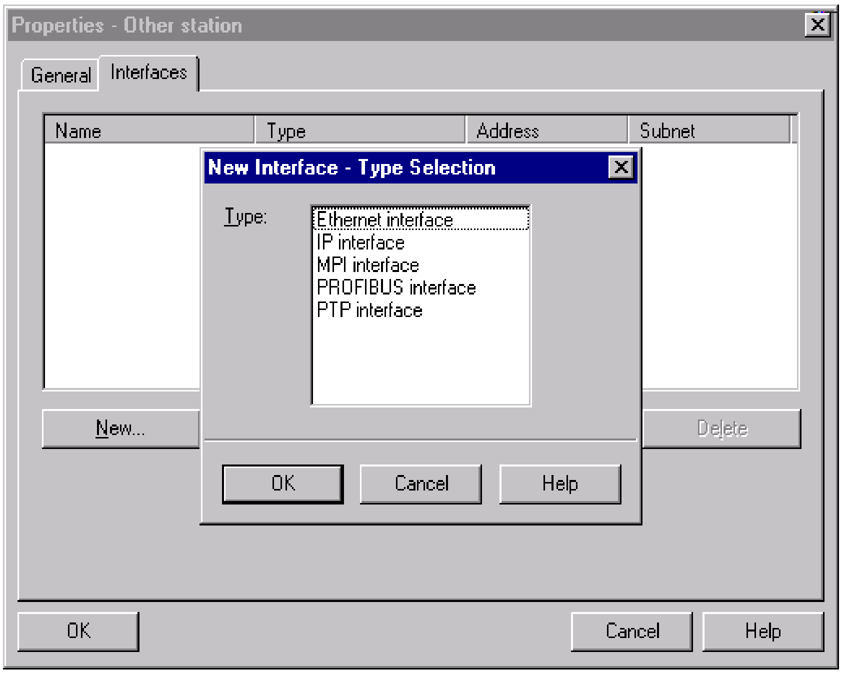


Figure 3-5 Selecting the Subnet Type for Other Stations

3. Select a subnet for the station.

   Result:
   The ”Properties - PROFIBUS Interface”, “Parameters” tab is displayed.

4. Check the PROFIBUS address and if necessary change it. The system first enters the next free PROFIBUS address automatically as the PROFIBUS address.

Notice

The PROFIBUS address configured here and the bus parameters must actually be set on the relevant station! Use the appropriate software tool (for example COM 5431).

5. Select the subnet to which you want to attach the station and confirm with OK.

   Result: The CP is assigned to the first subnet displayed in the subnet table. If you have created more than one subnet, you can select the required subnet here.
6. You can display the properties dialog box for the selected subnet by clicking the Properties button. For more detailed information about the PROFIBUS properties dialog, refer to Section 3.3.2.
7. Enter information specific to the subnet node in the “General” tab.

Result: You have created a network node and attached the station to the subnet. All the SIMATIC stations in the project can establish communication relationships to this station.

The station is now also included in the calculation of the bus parameters.

Modifications

If you want to change the address or any other settings for the SIMATIC S5 or other station, select the node name again in the node list and click the “Properties” button.

Multiple Assignment

The station can also be assigned to more than one subnet node providing there are enough possible attachments. To do this, repeat the procedure for attaching “Other Stations” to the subnet.

3.3.7 Configuring Communication Services

Setting Up Connections

You must set up connections for the connection-oriented services supported by the PROFIBUS CP, see also Table in Section 1.2.

- S7 connections
  see the STEP 7 user manual /7/;
- FDL connections
  see Chapter 7;
- FMS connections
  see Volume 2 of this manual

The procedure described in the STEP 7 User Manual /7/ in the Section ”Configuring Connections” also applies to the additional connection types possible with the CP.

Configuring the DP Mode

If you use the CP for DP communication, you must configure the required mode.

- DP master mode
  Configuring and programming the DP master system, see Chapter 4 and the STEP 7 user manual /7/.
- DP slave mode
  Configuring and programming the DP slave mode, see Chapter 6

3.3.8 Downloading the Configuration to the PLC

Principle

The configuration data of the PROFIBUS CP are downloaded from the hardware configuration. All the configuration data of the S7 station are downloaded including the central configuration, all relevant DP master systems and all the selected parameters.

The data of the **configured connections** must **also be downloaded,** see below.

Type of Interface

You can download the configuration data to the S7 station on the following paths (interfaces):

- MPI Interface

  You always use this interface when you download the configuration data for the first time (node initialization).

  During the so-called “Node Initialization”, you supply the PROFIBUS CP with a PROFIBUS address and with bus parameters for the first time. You have then configured the CP so that further configuration is possible working on the PG connected to the PROFIBUS. You download the configuration data either via MPI or via a different CP that already has an address.

- PROFIBUS

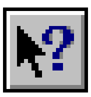
  Here, you use the PG mode of the PROFIBUS CP in the S7 station (see also Section 1.3). The node must previously have been initialized via the MPI interface (see above).

Procedure

To download the configuration data to the S7 station, follow the steps outlined below:

1. Open the ”Set PG/PC Interface” dialog box, for example, using the Start menu **SIMATIC ▸ STEP 7 ▸ Set PG/PC Interface**.
2. Set the PG/PC interface according to the CPs available on your PG and according to the bus attachment (interface parameter assignment used). Make sure that you set consistent bus parameters.

   For more detailed information, refer to the integrated help system.



3. Select the menu command **PLC ▸ Download to Module.**

STEP 7 then guides you through dialog boxes.

Refer to the other information available in **Help ▸ Contents...** in STEP 7 or in the STEP 7 manual, in the section ”Configuring and Assigning Parameters to Modules” in /7/.

Saving the Configuration Data in Non-Volatile Memory

You can download the configuration data step-by-step or all at once. If you download step-by-step, you will be prompted to start the download function separately for each module. You must select this method if you want to save the configuration data in non-volatile memory on the PROFIBUS CP.

Downloading the Configured Connections

To download configured connections, you use a corresponding download function in the connection configuration.

Notice

If you have assigned a new PROFIBUS address to the PROFIBUS CP and have also configured connections (S7, FDL, or FMS connections), you must always download the connection configuration again.

Remember that you also make suitable address adaptations for the other stations or “substitute objects”.

Relocating the CP in the Hardware Configuration

If you are using communication services with configured connections, the connection IDs also identify the slot of the CP. If you “drag” a CP you have already configured to a different slot, note the following:

Note

If you drag the CP to a different slot, the data of the connection configuration are automatically updated. The data of the connection configuration must, however, be downloaded again!

3.4 Additional Functions

3.4.1 Changing the Mode and PROFIBUS Address with the User Program

With newer CPs: Modification during operation is possible

If your module is a CP 342-5 (order no.: 6GK7 342-5DA02-0XE0) / CP 342-5 FO (order no.: 6GK7 342-5DF00-0XE0) or a module with a later version, you can use the function described here.

Note the information in the manual for your PROFIBUS CP.

Solution

By transferring data record 3 to the PROFIBUS CP using the ”Write data record” function (SFC 58), you can modify the configured mode and PROFIBUS address of the module from the user program of the CPU. For more detailed information on SFC 58, refer to the SIMATIC S7 documentation /9/.

The data record is made up of the following three bytes:

Table 3-4 Structure of Data Record 3

Parameter	Type	Possible Values	Meaning
1. Ctrl-Type	Byte	0,1	0: no change 1: allow change A change to the mode and/or the PROFIBUS address of the module is only made when this byte is set to ”1”.
2. Mode	Byte	0 .. 3	0: no DP 1: DP master 2: passive DP slave 3: active DP slave Specifies the new mode in which the module will operate.

Table 3-4 Structure of Data Record 3, continued

Parameter	Type	Possible Values	Meaning
3. PROFIBUS Address	Byte	0 .. HSA	New address of the module on PROFIBUS Specifies the new PROFIBUS address. This address can be between 0 and the HSA specified in the configuration. Note: If you do not want to change the PROFIBUS address, simply transfer the first two bytes of data record 3.

Example: Sending data record 3 to the CP 342-5

The following example shows how to set parameters for SFC 58 to allow you to change both the configured mode and the PROFIBUS address.

Table 3-5 CALL SFC 58 ”WR_REC” (write data record)

```
STL                                Explanation
REQ     :=M10.0                   // Trigger bit for the job
IOID    :=B#16#54                 // Module base address of the PROFIBUS CP is in the
                                  // input area (PI)
LADDR   :=W#16#100                // Module base address of the PROFIBUS CP
RECNUM  :=B#16#3                  // Select data record 3
RECORD  :=P#DB45.DBX 0.0 BYTE 3   // Data area for data record 3 - data in DB 45
RET_VAL :=MW12                    // Return value of block in memory word 12
BUSY    :=M10.1                   // SFC returns code: job active (1),
                                  // Job done (0)
```

Table 3-6 DB 45

(Relative) Address	Parameter / Name	Type	Comment
0	Ctrl-Type	Byte	0: no change 1: allow change
1	Mode	Byte	New mode
2	PROFIBUS address	Byte	New PROFIBUS address

Notice

- The module can then only be operated in the DP master mode if it was configured in the hardware configuration as DP master.
- If an invalid mode (>3) or an invalid PROFIBUS address (> HSA) is specified, no change is made. SFC 58 does not, however, signal an error to the user program.

Caution

- The change is retained until power off/on on the station or until it is reconfigured using data record 3.

  After power off/on, the CP returns to the configured mode and PROFIBUS address (default).

4 DP Master Mode with a PROFIBUS CP in an SIMATIC S7-300 System

To use the PROFIBUS CP in a SIMATIC S7-300 in the DP master mode, you configure a DP master system in your project with STEP 7. In principle, this is the same procedure as described in the STEP 7 manual /7/. Please refer to the sections describing the configuration examples for the distributed I/Os.

This chapter contains additional information you will require for the following:

- Addressing DP data areas in the user program
- Using control mechanisms to adapt the communication to the requirements of your automation task. This includes mechanisms for synchronizing data input and data output.
- Using the SIMATIC S7 programmable controller as a DP master (class 2).

You will find further information in the following sources:

- If you want to use the PROFIBUS CP in the DP slave mode, refer to Chapter 6 in this manual.
- DP diagnostics in the user program is discussed in Chapter 5 in this manual.
- The use of the FCs DP_SEND, DP_RECV, DP_DIAG and DP_CTRL is explained in Chapter 8 in this manual.
- NCM diagnostics with special functions for the DP master mode is described in Chapter 9.

Please read the information in the manual. Depending on the version, the available CPU types may react slightly differently. This symbol draws your attention to such differences!

4.1 Overview

Differences Compared with the Integrated DP Interface

When using the PROFIBUS CP, note the following differences compared with the integrated DP interfaces in the CPU:

- In the configuration:
  - The DP master system is created when the CP is configured and not when the CPU is configured.
- In the programming:
  - Reading and writing process and diagnostic data must be started using an FC.
  - In addition to the process image, memory bits or data blocks can also be used as peripheral data areas.
- In the use of the variable table VAT:
  - Direct enabling of the process image PI is not supported since the outputs of the peripheral I/Os are set by blocks (FCs).

4.2 Procedure

Steps

Programming and configuring the DP master system involves the following steps:

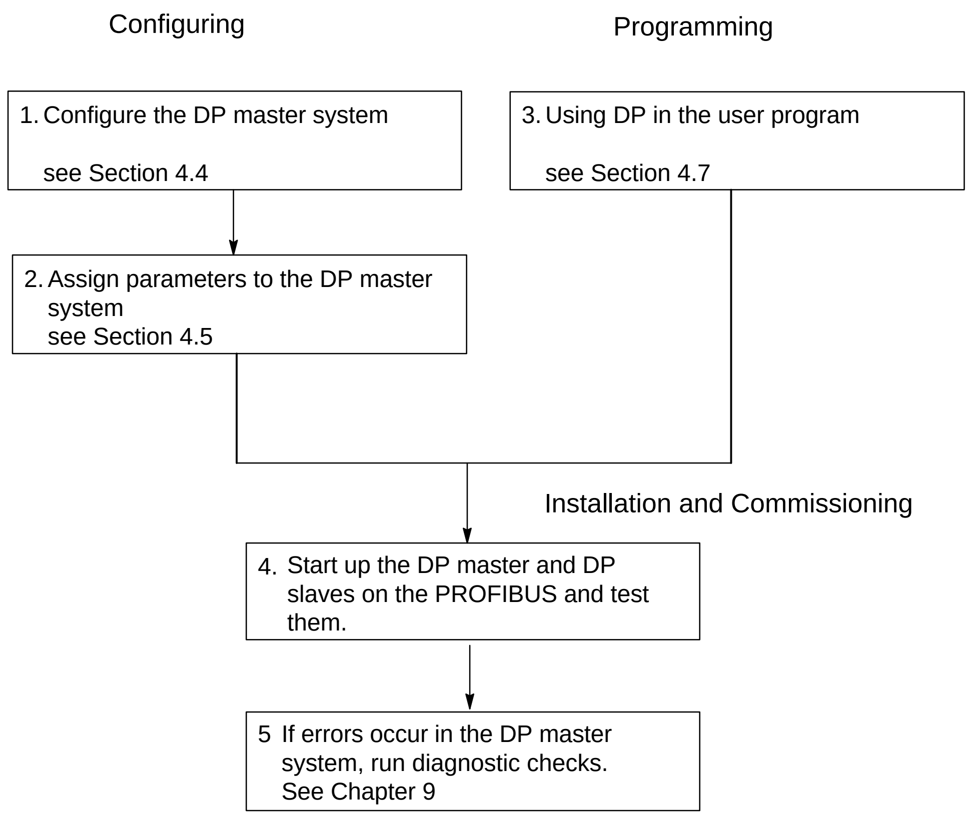


Figure 4-1 Operating the DP Master With a PROFIBUS CP

Configuring

Configuration allows the DP slaves to be installed regardless of the program. Two steps are necessary, as follows:

- Configuring the DP master system

  You specify the DP master and corresponding DP slave in the configuration table.

- Assigning parameters to the DP master system

Programming

You program the following in the user program of the CPU, for example with Ladder Logic or Statement List:

1. Access to the process data. This involves the following:
   - The evaluation of a DP input signal (analog or binary signal) in the specified DP input area.
   - Setting or deleting a binary output signal or the value of an analog signal in the specified DP output area.
2. The DP communication in the program execution on the CPU. This involves the following:
   - The process data transfer or acceptance within the CPU cycle using FCs (DP_SEND or DP_RECV).
   - The querying and evaluation of diagnostic information using an FC (DP_DIAG).
   - Controlling the distributed peripheral I/Os using control jobs, for example with synchronization instructions using an FC (DP_CTRL).

How you use the functions (FCs) in your user program for the DP master mode is described in the following sections of this chapter. The exact syntax of the FCs and the meaning of the block parameters is described in Chapter 8.

Obtaining the Functions (FCs)

The functions described here (blocks of the type FC) are supplied with the standard STEP 7 package and the NCM S7 for PROFIBUS option. For further information, refer to Section 8.1

4.3 The SIMATIC S7-300 in the DP Master Mode with the PROFIBUS CP

Characteristics of the PROFIBUS CP

The PROFIBUS CP operates as a DP master class 1. The PROFIBUS CP can also support services of the DP master (class 2) (please refer to the information in the CP product information bulletin /2/).

The PROFIBUS CP can be operated as the only DP master or as a DP master in a multimaster configuration as illustrated in Figures 1-7 and 1-8.

Tasks of the PROFIBUS CP

During the operating phase of a DP master system, the PROFIBUS CP has the following tasks when acting as the DP master:

- Initialization of the DP system

  The PROFIBUS CP checks that the DP slaves are ready for operation by fetching diagnostic data. With this function, the PROFIBUS CP can, for example, determine whether another DP master has already configured and assigned parameters to the DP slave.

- Assigning parameters to the DP slaves

  The DP slaves are supplied with the parameter data configured on the DP master.

- Checking the configuration of the DP slaves

  The configurations of the DP slaves stored on the DP master are compared with the current DP configurations of the DP slaves.

- Cyclic data transfer to the DP slaves

  The values of the process inputs are read into the DP input area and the values in the DP output area are written to the process outputs.

- Monitoring the DP slaves

  Unobtainable DP slaves are detected and signaled.

- Acquiring and preparing diagnostic information

  Diagnostic information can be collected using the user program or using diagnostic devices operating as DP masters class 2. The latter also includes a PG operating with DP diagnostics under NCM S7 for PROFIBUS.

- Processing control requests from the user program
  - Synchronization of the inputs/outputs
  - Starting/stopping the DP master
  - Setting the DP status for PLC or CP stop
- Reading inputs or outputs of a DP slave that is assigned to another DP master class 1 (shared input or shared output).
- Bringing the DP system to a safe status if the CPU or CP stops.
- Further DP master special functions (for example activating/deactivating DP slaves).

Bus Parameters

The transmission rate, the PROFIBUS address and the mode (DP master, DP slave active, DP slave passive, no DP mode, see Section 4.6) can only be selected when configuring with STEP 7.

The CP adopts these settings after the configured data have been downloaded.

The PROFIBUS address and the mode (DP master, DP slave active, DP slave passive, no DP mode, see Section 4.6) can be set as follows:

- By configuring;

  The CP adopts this setting after the configured data have been downloaded. This variant is described for setting the mode in this chapter. This is the standard situation for a fixed setting.
- Using a job in the user program;

  For an example, refer to Section 3.4
- Using a DP master (class 2) job.

  For more detailed information, refer to Section 4.6.

4.3.1 Principle of Data Exchange

Cyclic Data Exchange between DP Master and DP Slave

Data exchange between the DP master and DP slave is cyclic (DP polling cycle) and uses send and receive buffers on the PROFIBUS CP (DP data buffers). The data exchange is started by the DP master which sends output data to the DP slave and fetches input data from the DP slave.

Functions

For the data exchange using the STEP 7 user program, two FCs are available:

- DP_SEND

  This FC transfers the data of a specified DP data area on the CPU to the send buffer of the PROFIBUS CP for transmission to the DP slaves.

- DP_RECV

  This FC takes the data read from the DP slaves from the receive buffer of the PROFIBUS CP and enters it in the specified DP data area of the CPU.

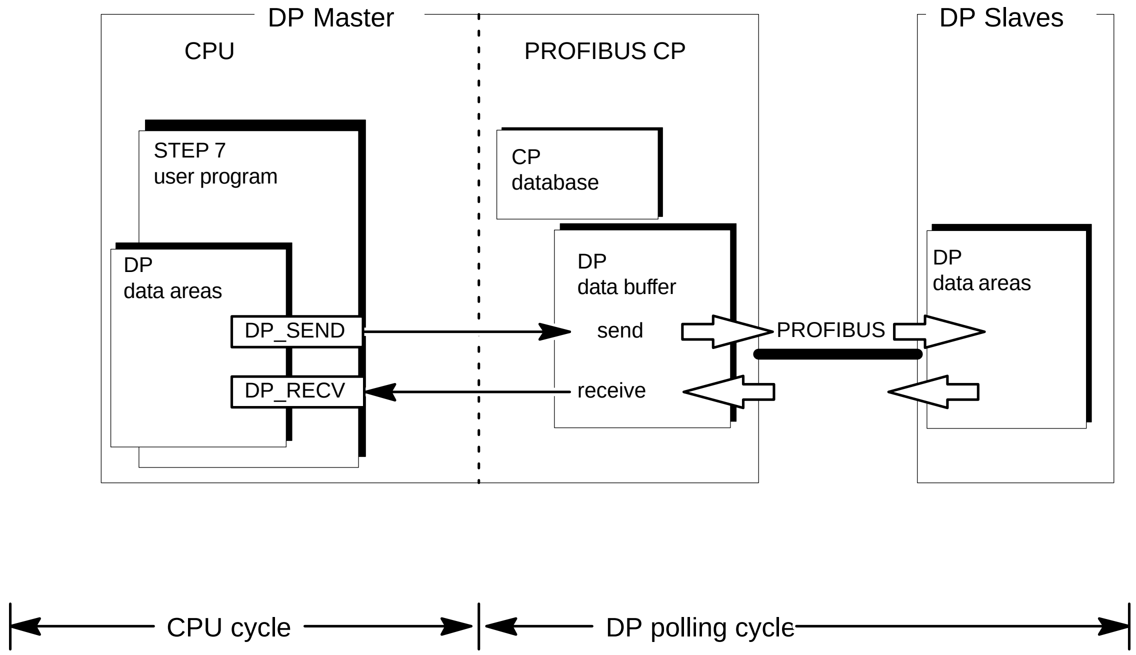


Figure 4-2 Interaction of the CPU and PROFIBUS CP in the DP Master Mode

CPU Cycle and DP Polling Cycle

The CPU cycle and the DP cycle are independent of each other. The CPU-CP interface that can be addressed by the user program with the functions DP_SEND and DP_RECV is designed so that complete data transfer is ensured when handled correctly.

Handling correctly means that the data transfer with DP_SEND and the reception with DP_RECV requires evaluation of the block status codes in the user program.

For a detailed description of the data exchange with flow charts, refer to the description of the FCs in Chapter 8.

To ensure that data is transferred completely when the CPU cycle time is short compared with the DP polling cycle time, the following procedure is used:

DP_SEND:
No new data are transferred to the PROFIBUS CP until the data have been transferred completely to the send buffer of the PROFIBUS CP. The user program must evaluate the status codes of the FC and can only update the data in the DP data area after this has been enabled.

DP_RECV:
New data are only transferred to the DP data area of the CPU after the user program has been informed of a complete data transfer and when DP_RECV is called again.

Note

The data (received data) in the DP data buffer of the PROFIBUS CP are updated regardless of whether or not the user program in the CPU has fetched data from the DP data buffer (receive buffer). This means that data can be overwritten.

4.3.2 The DP States of the DP Masters

Overview

Communication between the DP master and DP slaves can be divided into four modes:

- OFFLINE
- STOP
- CLEAR
- RUN

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

Mode	Meaning	Priority [1)]
OFFLINE	There is no communication whatsoever between the DP master and the DP slaves. This is the initial status of the DP master. If an assignment to a master was saved on the DP slave, this is cleared when the slave enters the offline mode so that the DP slave can then have parameters assigned and be configured by other DP masters.	1
STOP [2)]	There is also no communication between the DP master and DP slaves in this mode. If an assignment to a master was saved on the DP slave, this is not cleared when the slave enters the stop mode so that the DP slave cannot have parameters assigned and be configured by other DP masters.	2
CLEAR	In this mode, the master configures and assigns parameters to all DP slaves entered in the CP database and activated. Following this, the cyclic data exchange between the DP master and DP slaves begins. In the CLEAR mode, the value 0H or configured substitute values is sent to the slaves with process output or an empty frame, in other words,. process output is deactivated. Process inputs remain active.	3
RUN [3)]	The cyclic data transfer to the DP slaves takes place in the RUN mode. This is the productive phase. In this mode, the DP slaves are addressed one after the other by the DP master. The call frame contains the current output data and the corresponding response frame contains the current input data.	4

1 If different modes are requested by the DP system (for example by the CPU or a master class 2), the mode with the highest priority is adopted (1 = highest; 4 = lowest).

2)

Note: With newer modules (refer to the information in the manual /2/), the STOP mode is now the OFFLINE mode.

3) corresponds to OPERATE in the DP standard.

Sequence of the Modes

Initially, the DP master is in the OFFLINE or STOP mode. Starting from the OFFLINE/STOP mode, the DP master changes to CLEAR/RUN and then configures and assigns parameters to the DP slaves.

OFFLINE / STOP -> CLEAR -> RUN

Changing the Modes of the DP Master

The causes of a mode change on the DP master are explained in Section 4.8.

4.3.3 DP Input Area and DP Output Area on the CPU

Concept

The distributed I/Os connected via PROFIBUS behave like local process signal I/Os in terms of the user program. This means that no special access mechanisms are necessary for the DP data area.

DP Input Area and DP Output Area in the CPU

The DP interface is so flexible that different data areas can be used on the CPU for storing the DP process data. Which data area you assign for this purpose depends on the CPU type and the particular task. The following options are available for the DP input area and DP output area:

- Process image
  This assumed that a continuous input or output area can be reserved for distributed I/Os in the process image of the CPU. This can, however, be restricted by the size of the process image and the number of signal modules installed centrally.
- Bit memory address area
  Just like the process image, this area is also suitable for global storage of DP signals. The bit memory address area can, for example, be used when the space left free by central signal modules in the process image is too small.
- Data block (DB)
  Data blocks can also be used to store DP signals. This location is preferable when the DP data area is processed by **one** program block.

The following diagram illustrates the assignment of the DP input and output area to the various data areas of the CPU mentioned above.

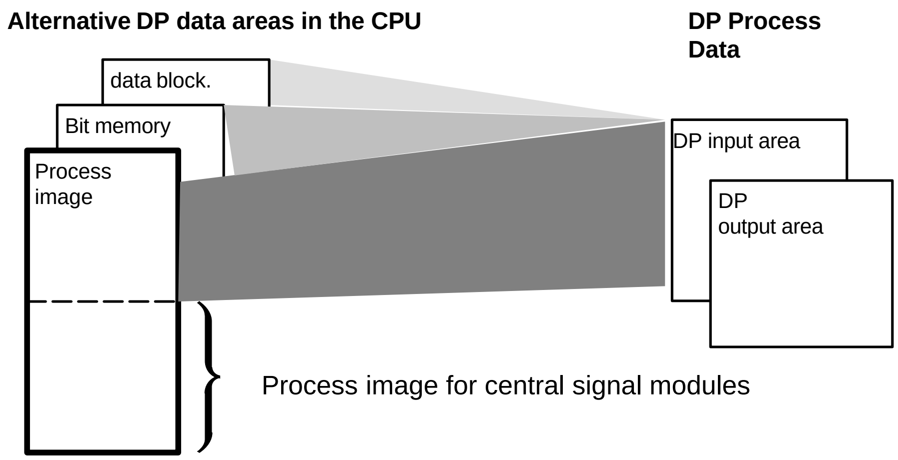


Figure 4-3 Assignment of the DP Process Image to the PLC Data Areas

Examples

Depending on the location of the DP input / DP output area, the control program also uses operations such as those shown below when accessing DP:

- A I 2.0
  to read data in the process image (PII)
- AN M 4.5
  to read a memory bit.

Note

The DP input area and DP output area are both transferred into or from one of these data areas on the CPU in their entirety.

Differences Compared With the Integrated DP Interface

With the DP interface integrated on the CPU, the DP input our output data are always saved in the peripheral I/O area.

The data transfer procedure with the PROFIBUS CP using the FCs DP_SEND and DP_RECV allows data to be saved in the alternative areas listed above (process image, bit memory area or in a data block).

When DP_SEND or DP_RECV is called, the addresses of the continuous DP data areas (inputs or outputs) must be specified. In contrast to the integrated DP interface, during configuration you do not specify **absolute addresses but relative addresses** known as the address offset.

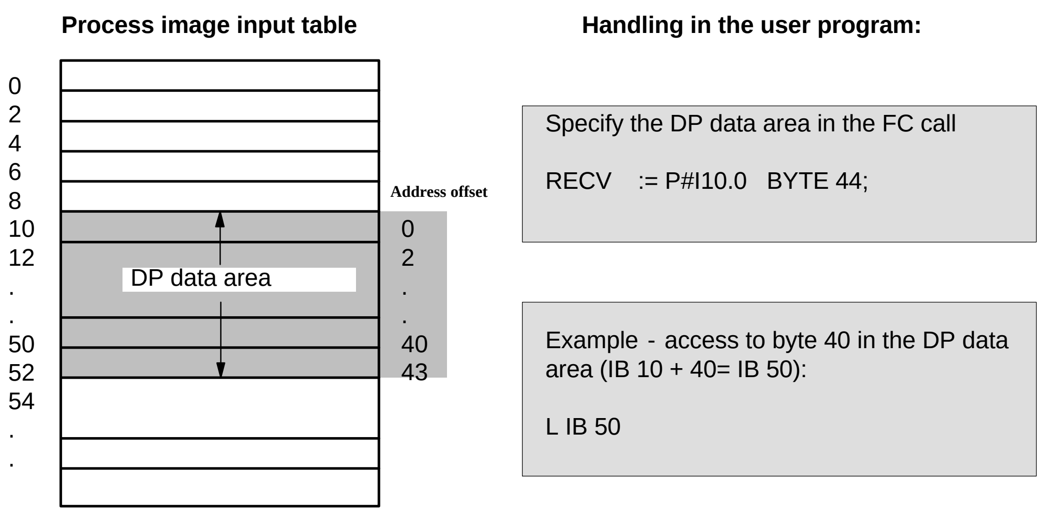


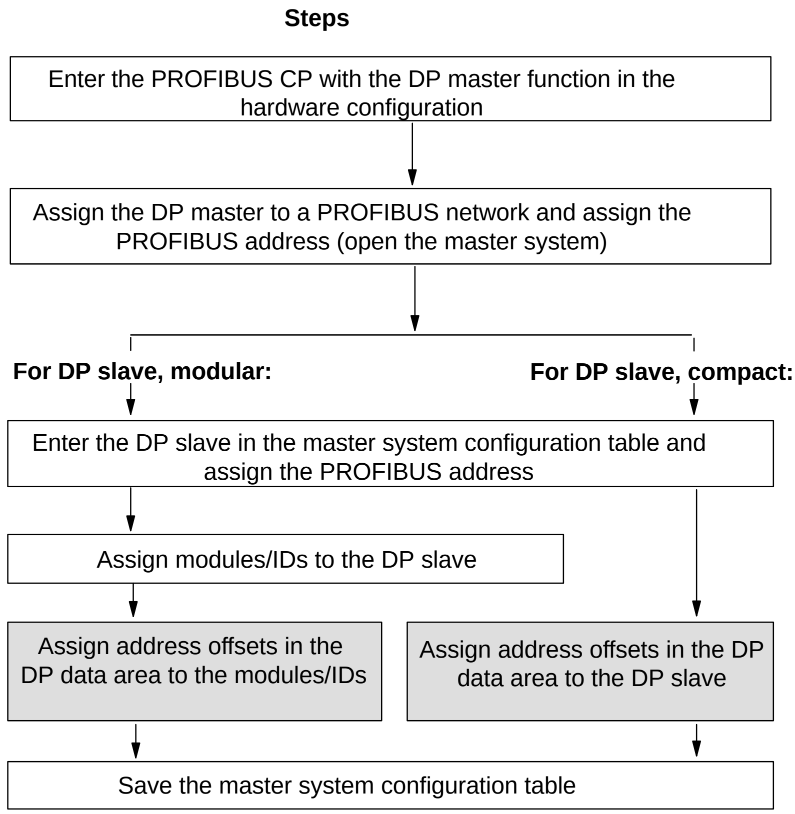
Figure 4-4 Specifying the DP Data Area as an Address Offset with the PROFIBUS CP

4.4 Configuring the DP Master System

Procedure

Basically, you configure a DP master system in exactly the same way as a centrally installed SIMATIC S7 station.

The chapter “Configuring a PROFIBUS DP Network” in the STEP 7 manual /7/ describes the following procedure:



The steps marked in gray differ from the procedure described in /7/ and are explained below.

Assigning an Address Offset

Each input/output of a DP slave is assigned exactly one address offset in the DP data area with which the input or output is addressed. You must therefore assign a start address (address offset) to every module of a DP slave.

STEP 7 automatically assigns default addresses when the module is created. The addresses are specified without gaps and without conflicts. The addresses and their length are entered in the columns “I address” or “Q address” and “Length” in the detailed view. The setting can be changed.

Note

When configuring the DP master system with the CP 342-5 as DP master in the SIMATIC S7-300, note the CP type (order number) in the hardware catalog when selecting DP slaves. For more detailed information, refer to the following section.

Slave Selection with the CP 342-5 as DP Master

When you select the DP slaves from the hardware catalog, there are two possibilities when the CP 342-5 is used as the DP master in an S7-300 station. Which variant you use depends on the module type that you can identify by its order number.

- CP 342-5 with order number 6GK7 342-5DA0**0**-0XE0

  This CP type supports DP standard slaves; you **must** therefore use the DP slaves available in the subfolder “CP 342-5 as DP Master”.

- CP 342-5 with order number 6GK7 342-5DA0**1**-0XE0 and 6GK7 342-5DA0**2**-0XE0 or CP 342-5 FO with order number 6GK7 342-5DF00-0XE0

  For this CP type, you can use the DP slaves available in the standard catalog. This means that in the DP mode the additional functions of the DP slaves in the SIMATIC family are available. These additional functions include the following:

  - hardware interrupts
  - diagnostic interrupts
  - substitute values

Note

Please note any differences as explained in the product information bulletin / manual of the CP type your are using!

Configuration Table

The following figure shows an example of a configuration after configuring in the “Master System Configuration Table” with the detailed view of a selected slave.

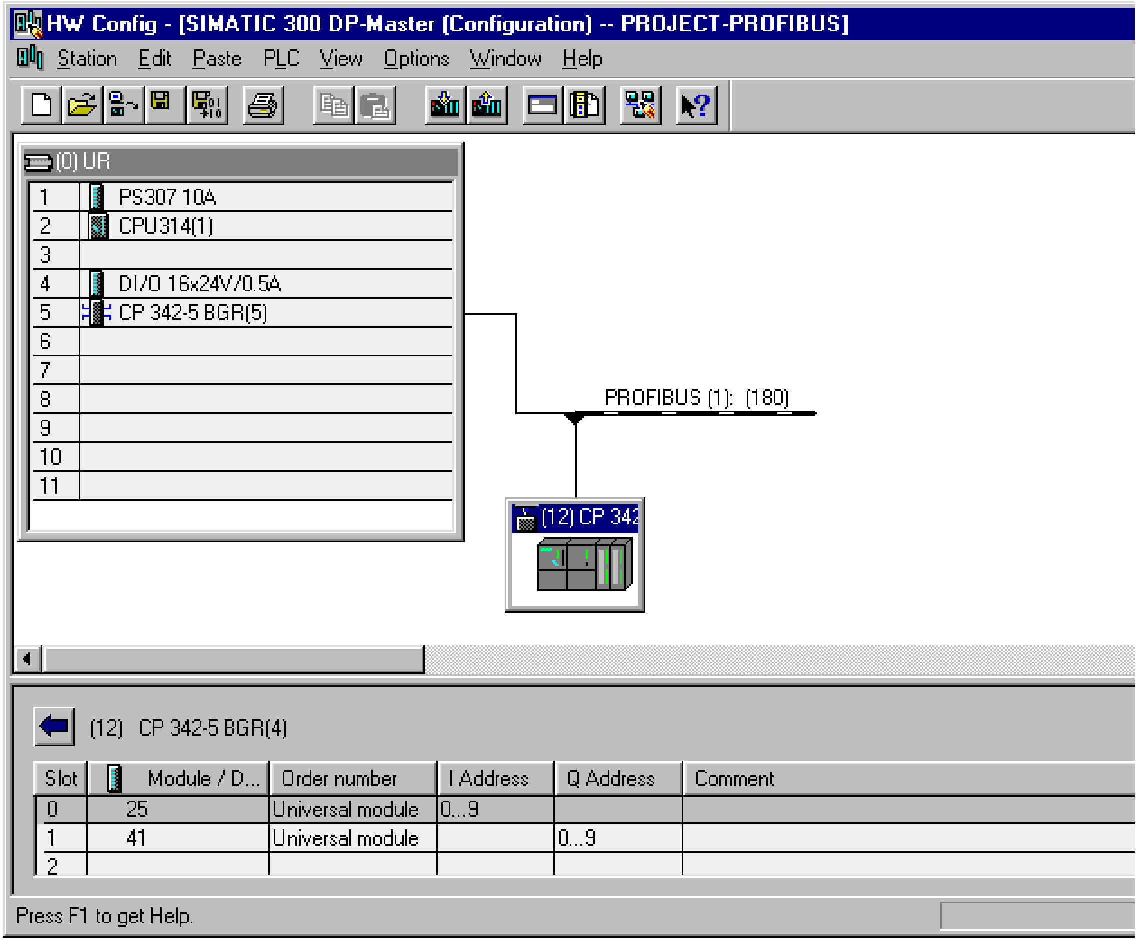


Figure 4-5 “Master System Configuration Table” with Detailed View of a DP Slave

Size of the Total Area

The following limit applies to the entire DP data area:

- DP total input/output area; each max. 240 bytes

The areas must always be continuous since only the start address and the length of the DP process image is transferred on the DP transfer interface.

Note

Please note any differences as explained in the product information bulletin / manual /2/ of the CP type your are using!

DP Data Area in the Process Image

If the DP data area is located in the process image, the available area is not only restricted by the values mentioned above but also by the following:

$\text{length}_{\text{DPmax}} = \text{length}_{\text{process image}} - \text{length}_{\text{I/Os occupied centrally}}$;
where the $\text{length}_{\text{process image}}$ depends on the CPU type used.

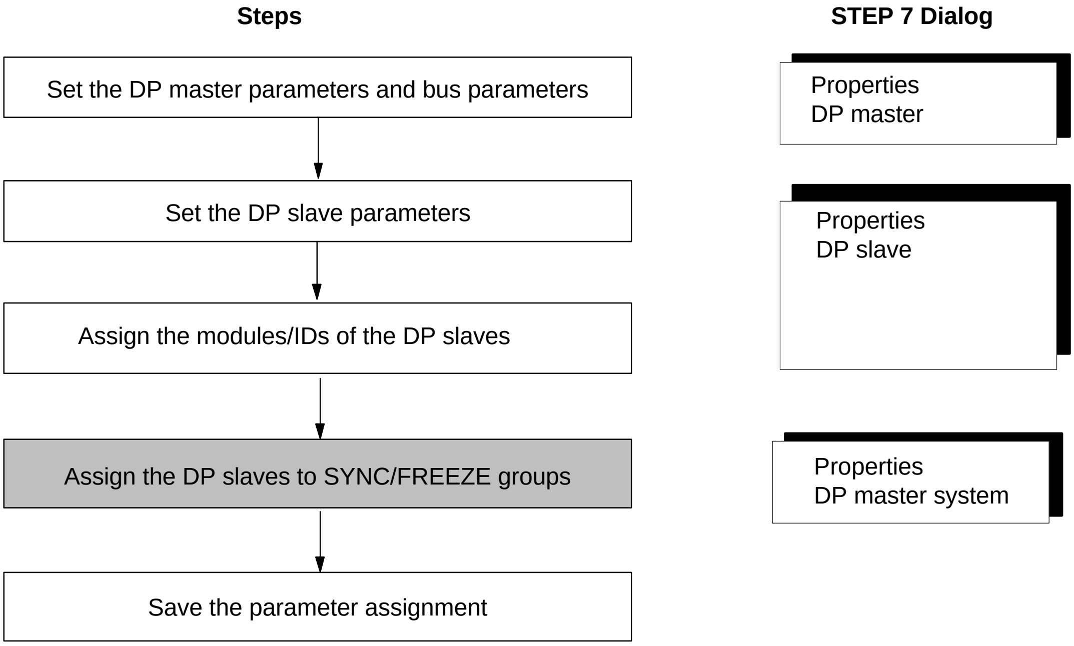
Note

Remember that the input and output addresses shown in the configuration table are address **offsets**, in other words addresses relative to the DP data areas specified in the FC call (see also Figure 4-4).

4.5 Assigning Parameters for the DP Master System

Procedure

To assign parameters for a DP master system, follow the procedure described in the “STEP 7 Manual” /7/ in the chapter “Configuring the Distributed I/O (DP)”.



The steps marked in gray differ from the procedure described in /7/ and are explained below in greater detail.

4.5.1 Synchronization of the Data Output

Synchronization of the Data Output Using Global Control SYNC / UNSYNC

By programming a global control job (SYNC) you can synchronize the updating of the data at the process outputs. The following two options must be distinguished:

- Acyclic synchronization

  Example of an application:
  A manufacturing process must only be started by the output of several binary signals when the required devices have indicated that they have completed their start up. The signal output must be exactly synchronized.

- Cyclic synchronization

  The analog process values acquired in the control program must be set at the process outputs at exactly the same time after they have been re-calculated.

  Example of an application:
  Starting up synchronized motors or resynchronizing motors.

Global Control Job and Synchronization Frames

The PROFIBUS CP is instructed by the user program to **send once acyclically** by transferring a DP_CTRL function or to send a synchronization frame **cyclically** (global control frame).

The synchronization frame is always sent to the DP slaves at the **end** of a transfer cycle. This updates the process outputs on the DP slaves belonging to the addressed slave group. The process outputs can then no longer be changed until a further synchronization frame is sent.

Table 4-1 Overview of the Types of Synchronization for DP Data Output

Type of Synchronization and Global Control	Procedure	Application / Uses	Configuration Parameter “Group Identification”
No synchronization	The DP slaves update the process outputs immediately after receiving an output frame.	Fastest possible updating of the process outputs.	not relevant
Acyclic synchronization of the data output with SYNC	As a result of the control job from the user program, **one** synchronization frame is sent at the end of the transfer cycle. The updating of the process outputs is then synchronized.	Controlled updating • To achieve synchronization at a specific point in time. • To update the data of a group of slaves at the same time providing that all DP slaves are in the data transfer phase.	relevant and can be referenced in the control call
Cyclic synchronization of the data input with SYNC	After receiving the control job, the PROFIBUS CP automatically sends synchronization frames at the end each transfer cycle. This means that the setting of the process outputs is synchronized **after every** transfer cycle.	To ensure that data are updated at the same time in a DP slave group in every cycle.	relevant and can be referenced in the control call

Requirements for the Synchronous Mode

The PROFIBUS CP only accepts the synchronization frame job when all the DP slaves to be addressed with the control job are in the data transfer phase. If this is not the case, the control job is not processed.

The DP slaves only accept synchronization if they support the synchronization mode. If a group of DP slaves is addressed, the synchronization mode must be supported by all the DP slaves in the group.

You can configure the system so that when the DP slave starts up it is checked to establish whether or not it supports the SYNC mode (see also the STEP 7 User Manual /7/).

Switching the SYNC Mode On/Off

The synchronization mode is switched on when the first SYNC synchronization frame is sent to the DP slaves.

The synchronization mode is switched off when the UNSYNC synchronization frame is sent to the DP slaves.

4.5.2 Synchronization (Freezing) of the Data Input

Synchronization of the Data Input Using Global Control FREEZE/ UNFREEZE

Using the global control jobs FREEZE/UNFREEZE, you can make sure that the process inputs on the DP slaves are read in once. The data that have been read remain “frozen” until a further FREEZE command allows them to be updated again.

Analogous to data output, cyclic and acyclic synchronization is possible.

Example of application:
Time-controlled logging of process values.

Control Job and Synchronization Frame

Synchronization frames (global control frame with the job parameter FREEZE) are sent by the PROFIBUS CP to the DP slaves once. The PROFIBUS CP must first be instructed to send a synchronization frame **acyclically** or **cyclically** by the user program transferring the DP_CTRL function.

The process inputs on the DP slave are then protected from any further change until a further synchronization frame (global control job with job parameter FREEZE/UNFREEZE) is sent.

Table 4-2 Overview of the Types of Synchronization for DP Data Input

Type of Synchronization and Global Control	Procedure	Application / Uses	Configuration Parameter “Group Identification”
No synchronization	The DP slaves update the process inputs immediately when they receive an input frame.	Fastest possible updating of the process inputs.	not relevant
Acyclic synchronization of data input with FREEZE	As a result of the control job from the user program, **one** synchronization frame is sent at the end of the transfer cycle. The process inputs are then frozen.	Controlled, simultaneous scanning of process signals.	relevant and can be referenced in the control call
Cyclic synchronization of data input with FREEZE	After receiving the control job, the PROFIBUS CP automatically sends synchronization frames at the end of **every** transfer cycle. The process inputs are then frozen.	Continuous, simultaneous scanning of the process signals of a DP slave group.	relevant and can be referenced in the control call

Requirements for the FREEZE Mode

The PROFIBUS CP only accepts the synchronization frame job when all the DP slaves to be addressed with the control job are in the data transfer phase. If this is not the case, the control job is not processed.

The DP slaves only accept the FREEZE mode if they support the FREEZE mode. If a group of DP slaves is addressed, the FREEZE mode must be supported by all the DP slaves in the group.

You can configure the system so that when the DP slave starts up it is checked to establish whether or not it supports the FREEZE mode (see also the STEP 7 User Manual /7/).

Switching the FREEZE Mode On/Off

The synchronization mode is switched on when the first FREEZE synchronization frame is sent to the DP slaves.

The synchronization mode is switched off when the UNFREEZE synchronization frame is sent to the DP slaves.

4.6 Checking or Setting the CP Mode DP Master

Overview

When you create a DP master system by entering the PROFIBUS CP in the configuration table as described in Section 4.4 and in /7/, the CP is configured automatically for the DP master mode.

You can also send or change the mode as follows:

- Using a job in the user program of local CPU;
- Using the DP master-master service of the DP master (class 2) via PROFIBUS

Procedure

To check the mode setting in the “Operating Mode” tab in the properties dialog, follow the steps outlined below:

1. Select the PROFIBUS CP in the hardware configuration.
2. Select **Edit ▸ Object Properties**. Select the “Operating Mode” tab in the dialog as shown below:

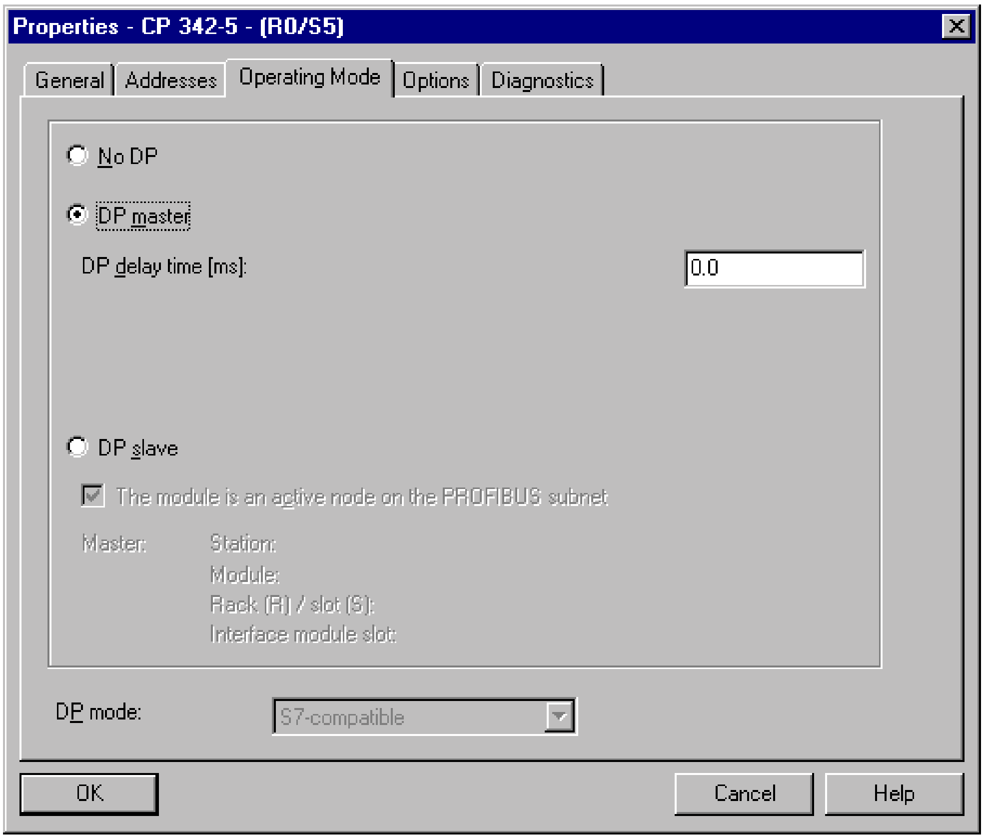


Figure 4-6 Example of the Properties Dialog for a PROFIBUS CP with the DP Master Function

If you have performed the appropriate steps, you will see that the DP master mode is already activated in the properties dialog.

Recommendation

Do not modify the mode setting since this is normally made automatically.

Note

If you change the mode from DP master to DP slave and confirm the change, the DP master configuration is deleted!

- Using a job in the user program of local CPU;

  Using the job in the user program, you can adapt both the CP mode and the PROFIBUS address dynamically to the situation in your plant.

  For an example, refer to Section 3.4

- Using DP master-master services (DDLM_Download / DLM_Act_Para_Brct see /12/) of the DP master (class 2) via PROFIBUS

  This involves transferring bus parameters on the bus; this also allows both the CP mode and the PROFIBUS address to be adapted dynamically to the situation in your plant.

Reaction Time of the Master

The PROFIBUS CP processes the pending communication jobs cyclically. You can determine the time response using the parameters used below.

To allow parallel operation of DP and other protocols, the time response of the PROFIBUS CP must be adapted using the DP delay time setting (T_{AddOn}). With this setting you can delay the DP protocol to make sure that there is time available for handling other jobs (for example FDL connections).

The “DP Reaction Time” field always contains the value of the expected polling cycle time (T_{poll}) + DP delay time (T_{AddOn}), in other words if the delay is changed, the reaction time will be recalculated immediately and displayed.

Remember that an **estimated** DP reaction time is displayed. The real DP reaction time can be displayed in the diagnostic buffer when using diagnostic functions.

Table 4-3 Parameters for the “DP Reaction Time” Dialog Box

Parameter	I/O	Explanation	Possible Values [Default]
DP Delay Time	I	Here, you can set an additional waiting time that must elapse after the polling list has been processed until it is processed again. Once all the jobs in the DP polling list have been processed, the processing of the DP polling list only starts again after the DP delay time has elapsed.	Depending on CP type: in 1 ms steps: 0 to 100 ms or in 100 us steps: 0.0 to 100.0 ms

Note

It is important to remember that if you are using a mixed mode, the token rotation time (TTR) plays an important role in the calculation of the DP reaction time. If the actual token rotation time is much shorter than the configured TTR, the actual reaction time is very much shorter.

4.7 Programming DP Communication

Updating DP Data Areas

Programmed FC calls in the user program of the CPU trigger the transfer of the DP data areas to the PROFIBUS CP and monitor the transfer. The location of the DP data area is specified in the call parameters of the FC.

Functions

To activate DP in the control program, there are four functions (FCs) available, as follows:

- DP_SEND
  This block transfers the data of a specified DP output area to the PROFIBUS CP for output to the distributed I/Os.
- DP_RECV
  This block receives the processed data of the distributed I/Os and status information in a specified DP input area.
- DP_CTRL
  This block executes control functions for the distributed I/Os.
- DP_DIAG
  This block queries diagnostic data on the DP master and DP slaves.

CPU Cycle

One possible sequence in which the DP functions (FCs) can be used in conjunction with organization and program blocks in the CPU cycle is shown below.

The example illustrates a situation in which process data are read in at the beginning of the CPU cycle and the output data generated after the user programs have been run are output to the process I/Os.

A separate diagnostic program is included for monitoring the DP slaves.

One of the user programs also sends a control job, for example a synchronization job for output data. This synchronization job could, for example, apply to the group of slaves whose process variables are processed by this user program.

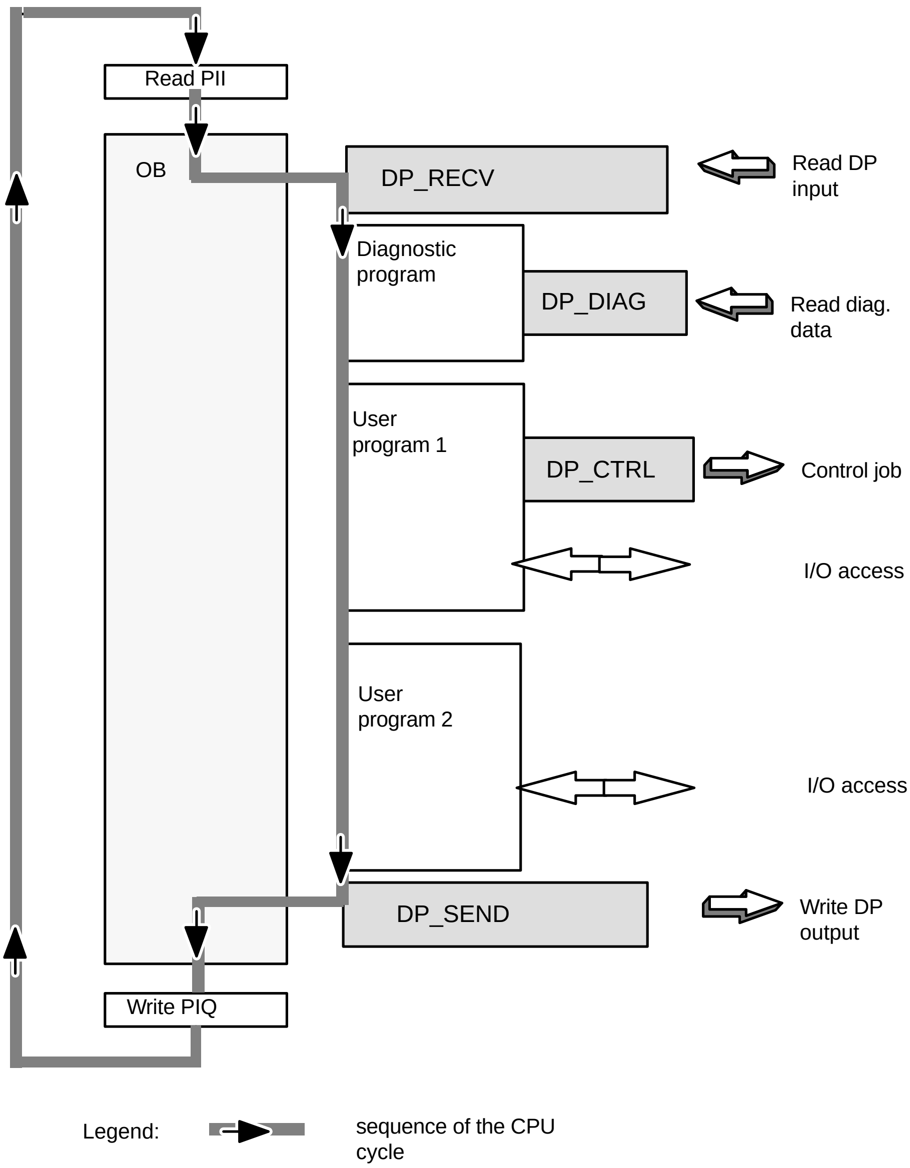


Figure 4-7 Typical Sequence of DP Function Calls in the CPU Cycle

Examples

Examples of calls and a detailed explanation of the call parameters for the FCs can be found in the following:

- in Chapter 8 in this manual;
- and the NCM S7 “Primer” /4/.

4.8 Changing the Mode of the DP Master

DP Modes

The following modes of the DP master are described in greater detail in Section 4.3.2:

- OFFLINE
- STOP
- CLEAR
- RUN

*) Note: With newer modules (refer to the information in the manual), the STOP mode is now the OFFLINE mode.

Changing DP Modes

The mode of the DP master can be changed as follows:

- By system events or user intervention:
  - Switch setting on the PROFIBUS CP or CPU or using the PG functions
  - Other disturbances (for example problems on the bus)
- By a DP Start/Stop control job in the user program.

4.8.1 DP Mode Changes Caused by System Events or User Intervention

PG Function or Switch Setting

The following table describes the mode changes that can be caused by system events or user interventions.

Table 4-4 Reactions to PG Functions or Changed Switch Settings on the CP or CPU

Event	Initial Mode on the DP Master	Resulting Mode on the DP Master	Change in the Behavior of the DP Master
CPU Run->Stop	RUN	CLEAR (default mode)	- sends DP status “Clear” - sends ’0’ to all slaves with process output
CPU Stop->Run	CLEAR (default mode)	RUN	- sends process values to all slaves with process output
CP Run->Stop	RUN,	OFFLINE (default mode)	- sends DP mode ’Clear’ - stops cyclic updating and releases the DP slaves for other DP masters.
CP Stop->Run	OFFLINE (default mode)	RUN	- startup

Resulting Mode

The resulting mode is the default mode shown in the table. Depending on the system status and on the defaults selected with DP_CTRL, other modes are possible (for the priority of the modes refer to Section 4.3.2).

Changing the Default Mode

Using a control job DP_CTRL, a different default mode resulting from CPU run -> stop or CPU run -> stop/stop -> run can be selected.

4.8.2 Control Job in the User Program

Control Job with DP_CTRL

The DP_CTRL function (see Section 8.3.4) provides you, among other things, with the DP start-stop job type. This allows you to influence the operation of the DP system directly, in other words you can request the RUN, STOP, OFFLINE, CLEAR modes directly.

Whether or not the job can be executed as specified, depends on the current system status.

4.9 Communication With DP Master (Class 2)

Note

The following section refers to the **responder functionality** of the DP master class 1.

Overview

The PROFIBUS CP supports jobs of a DP master (class 2) on the PROFIBUS complying with the DP standard.

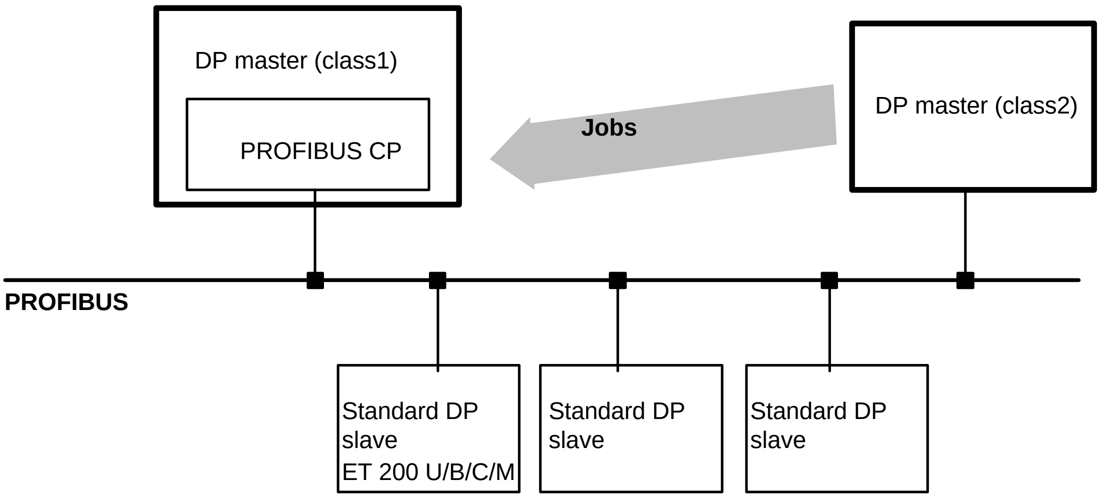


Figure 4-8 Single Master Bus Configuration with DP Master (Class 2)

Services

The CP provides the services complying with the DP standard shown in the following table (see /12/) when acting in the responder role.

Table 4-5 DP Master (Class 2) Jobs That Can be Sent to the DP Master (Class 1)

Function	Explanation/Comment
DDLM_Get_Master_Diag	The DP master (class 2) reads diagnostic data of the DP master (class 1). The following parameters can be transferred: Identifier: 1..125 (= PROFIBUS address of the DP slave, from which the diagnostic data will be read) 126 System diagnostics 127 Master status 128 Data transfer list These diagnostic functions are described in detail in Section 5.5 “Diagnostic queries with the DP master (class 2)”.
DDLM_Upload	The DP master (class 2) reads the current bus parameter record from the DP master.
DDLM_Download	The DP master (class 2) transfers a new bus parameter record to the DP master. The following parameters can be transferred: • L2 address • 1st byte in the master user data with the following code: 0x00 = no DP mode 0x01 = DP master mode 0x02 = DP slave mode (passive) 0x03 = DP slave mode (active)
DDLM_Act_Para_Brct	Activate bus parameter record (unacknowledged) The DP master is instructed to activate the bus parameter record transferred with the download. (broadcast service)

Table 4-5 , FortsetzungDP Master (Class 2) Jobs That Can be Sent to the DP Master (Class 1)

Function	Explanation/Comment
DDLM_Act_Param	The DP master (class 2) activates or deactivates the DP slave. The following parameters can be transferred: • Area Code: 1..125 (= PROFIBUS address of the DP slave) • Activate : - 00H DP master (class 1) is not processing this DP slave cyclically. - 01H DP master (class 2) reads the input data of this DP slave cyclically. - 02H DP master (class 2) reads the output data of this DP slave cyclically. - 80H DP master (class 1) exchanges data cyclically with this DP slave.
	The DP master (class 2) sets the mode of the DP master (class 1). The following parameters can be transferred: • Area Code: 128 Current mode 200 Mode for CPU stop 201 Mode for CP stop • Mode: 00H Offline 40H Stop 80H Clear C0H Run (= operate)

4.10 Reading Input/Output Data as DP Master (Class 2)

A DP Master (Class 2) Can only “Read”

The PROFIBUS CP acting as a DP master class 2, can read the input and output data of any DP slave not assigned to it.

This function, for example, allows a process signal to be acquired by several DP masters and can save sensors in the field (shared input/shared output).

Programming devices, diagnostic or management devices typically operate in the role of DP master (class 2).

Reading Input/Output Data Cyclically or Acyclically

The input/output data of a DP slave assigned to another master can be read:

- Acyclically

  An acyclic call is possible with the DP_DIAG block. The data that are read are then available in the received data area of the FC.

- Cyclically

  It is possible to trigger cyclic reading of the inputs/outputs using the DP_CTRL block. The data are read with a DP_RECV call.

  The DP slave must be configured with input data in the PROFIBUS CP of the DP master (class 2). The length of the configured input data must be at least the data length to be read (input or output data area of the DP slaves). The receive data area is read out with DP_RECV.

Changing the Master Function

A DP slave can only be controlled either by one DP master (class 1) or one DP master (class 2) at any one time in cyclic operation.

It is, however, possible to change the modes during operation. This means that a DP master (class 1) can relinquish its functions and these can be taken up by a different device. In this case, the previous DP master (class 1) device that controlled the process input and output can then continue to read the DP slave (process input and output) as a monitoring device (DP master (class 2)).

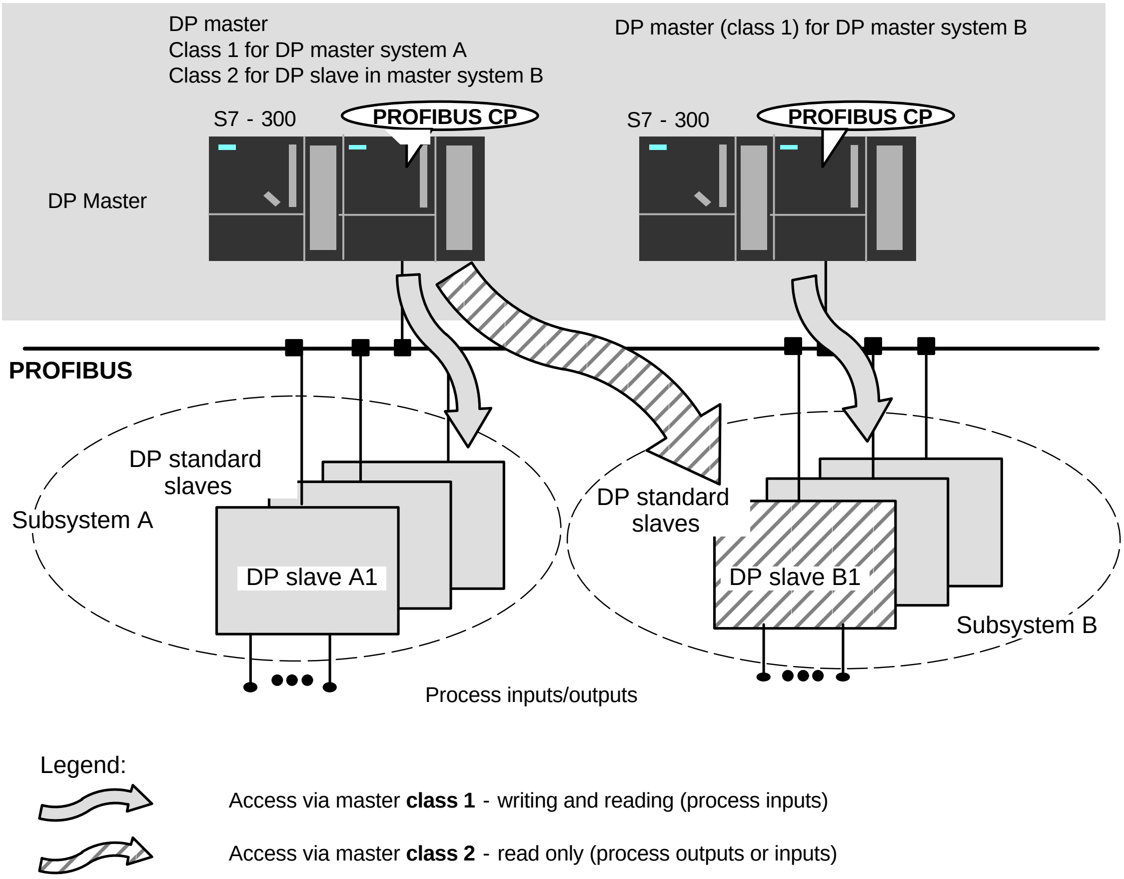


Figure 4-9 Example of Class 1 and Class 2 Master Access at One Point in Time

Using FC DP-CTRL

The master function is switched over by triggering a DP-CTRL job once (CTYPE 7 and 8; see Section 8.3.4).

Tip:

For more information on this topic, refer to the samples and explanations on the SIMATIC NET CD-ROM “Quick Start”.

4.11 Activating/Deactivating DP Slaves

Application and Uses

To be able to activate or deactivate individual DP slaves on PROFIBUS DP during operation, there are suitable job types available in the DP-CTRL FC.

This means that all the DP slaves that might be used can already be included in the configuration of the system. DP slaves that have been configured, but do not yet exist, can be deactivated. This reduces the numbers of frames on the network.

If configured slaves are physically added later, they simply need to be activated.

This function can also be extremely useful in applications in which mobile DP slaves dock on or off on PROFIBUS DP (for example in transport systems)).

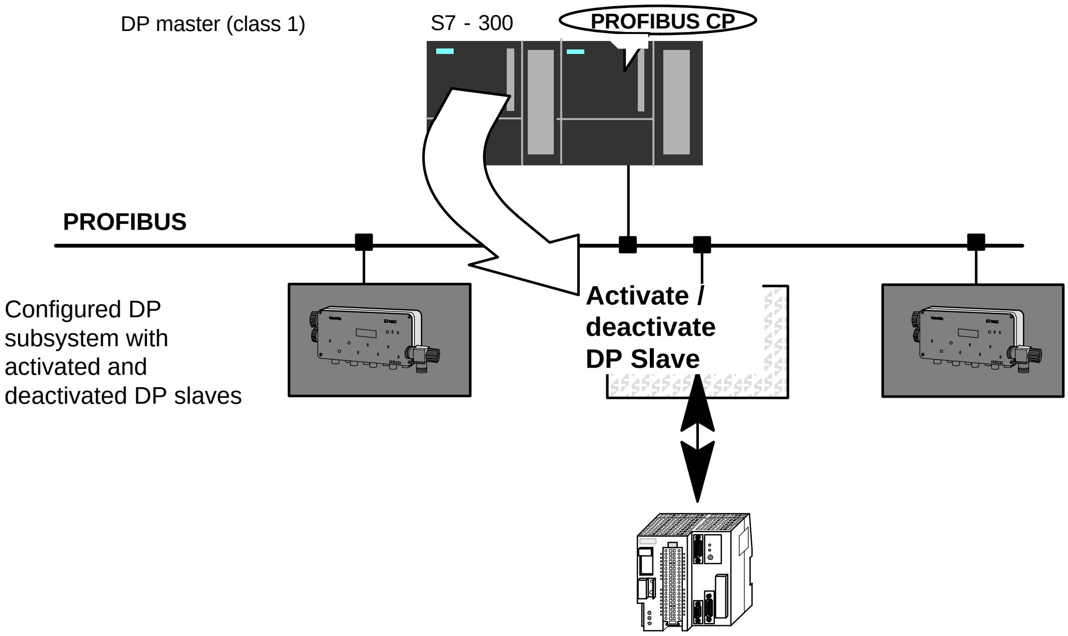


Figure 4-10 Example of a DP Master System with Activated and Deactivated DP Slaves

Using FC DP-CTRL

You activate or deactivate a DP slave by triggering a DP-CTRL job once (CTYPE 9 and 10; see Section 8.3.4).

Tip:

For more information on this topic, refer to the samples and explanations on the SIMATIC NET CD-ROM “Quick Start”. ❑

5 DP Diagnostics in the User Program of a SIMATIC S7-300 Station

The DP diagnostics described in this chapter are programmed in the user program. Diagnostics are intended primarily to increase the operating reliability of a DP master system by detecting the statuses of the DP slaves.

DP diagnostics is a powerful aid to troubleshooting during installation and operation of DP stations on PROFIBUS.

Note

The **user program interface** for DP diagnostics described here is only available for the SIMATIC S7 DP master with PROFIBUS CP.

5.1 DP Diagnostic Options

Diagnostic Aims

The main aim of the diagnostic functions is to check that the connected DP slaves are ready for operation and to obtain information about the causes of any problems that may occur.

Diagnostic Functions

The DP diagnostic functions allow you to determine the following aspects:

- Which of the connected DP slave stations is not responding on PROFIBUS?
- Which of the connected DP slave stations has diagnostic data available?
- Which problems are affecting specific stations?

In addition to these functions, there are further functions that depend on the diagnostic path and diagnostic tool such as status queries started by the user program.

Diagnostic Options and Tools

The diagnostic functions can be operated in the following ways with the following tools:

- In conjunction with the user program in the CPU
- With the diagnostic tool on the PG (dealt with in Chapter 9);
- By activating diagnostic functions on masters (class 2).

Application

The functions are designed so that the different diagnostic strategies can be combined and tailored to your needs. It is also possible to use the individual functions completely separately from each other.

5.2 Calling Diagnostic Functions in the User Program

Overview

By including diagnostic functions in the user program, you can achieve continuous monitoring of the DP slaves and their modules.

Integration in the User Program

Diagnostic functions are started in the user program by calling the DP_DIAG function. The actual diagnostics is achieved by evaluating the diagnostic values transferred to the diagnostic lists by the FC.

You can make the DP_DIAG call and the evaluation of the diagnostic lists dependent on status bits in the DPSTATUS status byte of the DP_RECV function (FC).

Diagnostic Sequence

The following diagram illustrates the decisions you can make when implementing diagnostic functions.

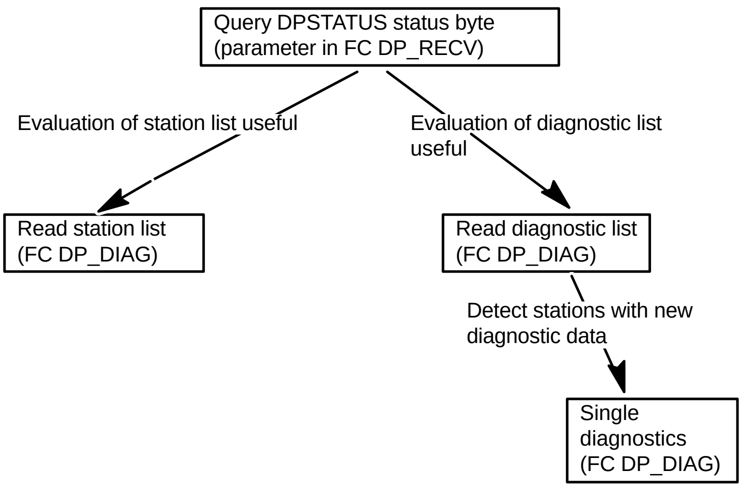


Figure 5-1 Decision Paths for Conditional Diagnostics

Integration in the CPU Cycle

One possible method of integrating the FCs in the CPU cycle for diagnostic purposes using organization and function blocks of the user program is shown below:

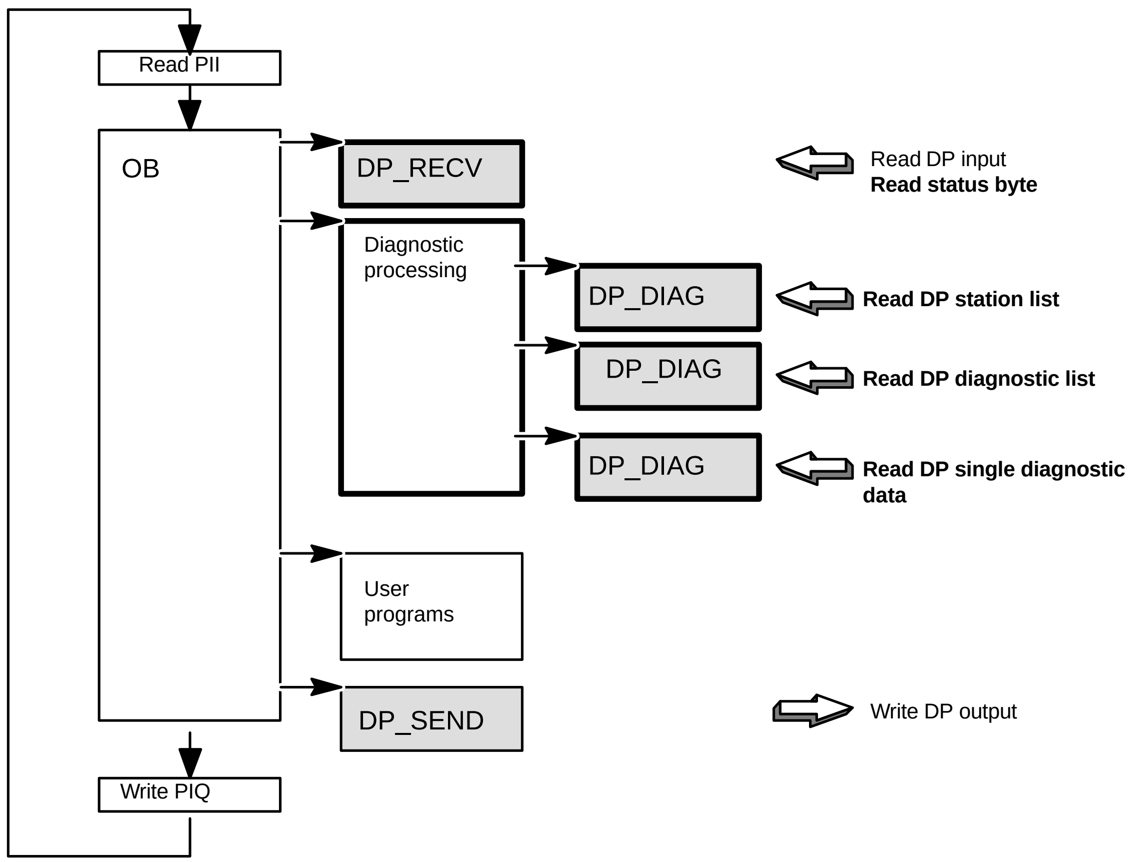


Figure 5-2 Typical Sequence of DP Function Block Calls in the CPU Cycle with Diagnostic Processing

Structure of the Status Byte (see also Section 8.3.2)

The DPSTATUS status byte transferred to the DP_RECV function for a conditional diagnostic data query has the following structure:

7	6	5	4	3	**2**	**1**	0
							0

Table 5-1 Meaning of the DPSTATUS Bits Relevant for Diagnostics (extract from Table 5-1 in Section 8.3.2)

Bit	Meaning
2	0: no new diagnostic data exist 1: evaluation of DP diagnostic list useful; at least one station has new diagnostic data
1	0: all DP slaves in the data transfer phase 1: evaluation of the DP station list useful

5.3 The DP Station List

The DP station list provides information about the status and availability of all the DP slaves assigned to the DP master during the configuration phase.

The station list is kept on the PROFIBUS CP and updated continuously in the CP polling cycle. The list is enabled once the DP_RECV function has been run through without an error occurring. After it has been read out, the station list is then disabled again.

5.3.1 Structure of the Station List

Relationship Between DP_RECV and DP_DIAG

The station list read in always matches the last input data read with DP_RECV, **regardless** of the number of polling cycles run through between the DP_RECV call and the DP_DIAG call.

Format of the Station List

The DP station list has a length of 16 bytes or 128 bits. Each bit of the DP station list corresponds to a PROFIBUS address and therefore to a potential DP slave station.

Byte	0	1	2-14	15
Status bit	7 6 5 4 3 2 1 0	7 6 5 4 3 2 1 0		7 6 5 4 3 2 1 0
Station address*)	0 1 2 3 4 5 6 7	8 9 10 11 12 13 14 15		120 127

*) The bit for the station address 127 is irrelevant since the permitted range for DP slave addresses on the PROFIBUS bus is between 0 and 126.

Meaning of the Status Bits

The coding of the status bits has the following meaning:

Table 5-2 Coding of the DP Station List

Bit Coding	Meaning
0	The following meanings are possible: • The configured slave station is in the cyclic data transfer phase. or • The station was configured with input/output data length “0”, in other words, the station is **not** processed cyclically by the DP master. or • The station address is not used.
1	The station is **not** in the cyclic data transfer phase. The following reasons are possible: • The configured slave station does not exist on the bus or is not responding on the bus. • The configured slave station is incorrectly configured. • The configured slave station is not ready for data transfer with the DP master (still in the startup phase).

5.3.2 Read out DP Station List

Evaluating the Status Byte

With the group message “DP station list evaluation useful” the DPSTATUS status byte indicates that at least one of the configured DP slave stations is not in the data transfer phase. To identify such stations, the DP station list must be requested and evaluated.

application program

The DP_DIAG function is used to read out the DP station list. The necessary parameters are explained in the description of the block. DP_DIAG is described in Section 8.3.3.

The DP station list can be read out once after each successfully completed DP-RECV call regardless of the status byte.

Saving the Station List

The station list can be read into a data block or a bit memory area on the CPU. The address must be specified in the DP-DIAG block call.

5.4 DP Single Diagnostics

Purpose of Single Diagnostics

DP single diagnostics allows diagnostic data to be fetched from specific slaves. These diagnostic data are encoded according to the DP standard with supplementary information in the third status byte (see Table 5-6).

Overview

DP single diagnostics is generally triggered depending on the result of the diagnostic list evaluation. It is, however, possible to start a single diagnostic job regardless of other statuses.

5.4.1 The DP Diagnostic List

Purpose

The DP diagnostic list provides information about the DP slaves with changed diagnostic data. The diagnostic data themselves must be fetched with the single diagnostics function.

The diagnostic list is kept on the PROFIBUS CP and constantly updated in the DP polling cycle. The updating is achieved by high-priority messages from the DP slaves as soon as the diagnostic information has changed on one of the slaves. Entries can also be made by the DP master.

After the user program has read out the diagnostic list once, the diagnostic list is disabled. The diagnostic list can only be enabled again when at least **one new** entry exists. Reading single diagnostics is possible at any time.

Format of the Diagnostic List

The DP diagnostic list has a length of 16 bytes or 128 bits. Each bit in the DP diagnostic list corresponds to a PROFIBUS address and therefore to a possible DP slave station.

Byte	0								1								2-14	15							
Diagnostic bit	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0		7	6	5	4	3	2	1	0
Station address*	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		120							127

*) The bit for the station address 127 is irrelevant since the permitted range for DP slave addresses on the PROFIBUS bus is between 0 and 126.

Meaning of the Diagnostic Bits

Table 5-3 Coding of the DP Diagnostic List

Bit Coding	Meaning
0	The following meanings are possible (one excludes the other): • The configured DP slave station has no new diagnostic data, or... The station was configured with input/output data length “0”, in other words, the station is **not** processed cyclically by the DP master. or... • The station address is not used.
1	The configured DP slave station has new diagnostic data. These can be fetched with the single diagnostics function.

Initialization Phase

During the initialization phase of the master (parameter assignment, configuration), the diagnostic messages in the diagnostic list are ignored (the diagnostic bits are initialized with 0). If an error occurs during the initialization phase of a DP slave, the diagnostic bit of this station is set to 1.

5.4.2 Reading out the DP Diagnostic List

Evaluating the Status Byte

With the group message “DP station list evaluation useful” the status byte indicates that diagnostic data have changed on at least one of the configured DP slave stations. To identify such stations, the DP station list must be requested and evaluated.

User program

The DP_DIAG function is used to read out the DP station list. The necessary parameters are explained in the description of the block. DP_DIAG is described in Section 8.3.3.

The DP diagnostic list can only be read out when there are new diagnostic data for at least one station.

Saving the Diagnostic List

The station list can be read into a data block or a bit memory area on the CPU. The address must be specified in the DP-DIAG block call.

Note: Reading into the process image (PI) is possible but achieves nothing.

Response

Note the following response during execution and on the interface to your user program:

- The status “Evaluation of DP diagnostic list useful” in DPSTATUS is reset by reading the diagnostic list.
- The station-related bits in the diagnostic list stored on the CP are reset after reading out the relevant single diagnostics information.

Note

If the single diagnostics information is read before the diagnostic list is evaluated, neither the bits in DPSTATUS nor the bits in the diagnostic list will be reset!

5.4.3 Reading out DP Single Diagnostics

Application Program

The DP_DIAG function is used to read out the DP single diagnostic data. The necessary parameters are explained in the description of the block. DP_DIAG is described in Section 8.3.3.

Saving the Diagnostic Data

The DP diagnostic data can be read into a data block or a bit memory area on the CPU. The address must be specified in the DP-DIAG block call.

Structure of the Diagnostic Data

The following diagram provides an overview of the structure. A more detailed representation of the diagnostic information with the extended DP slave diagnostics can be found in Table 5-4.

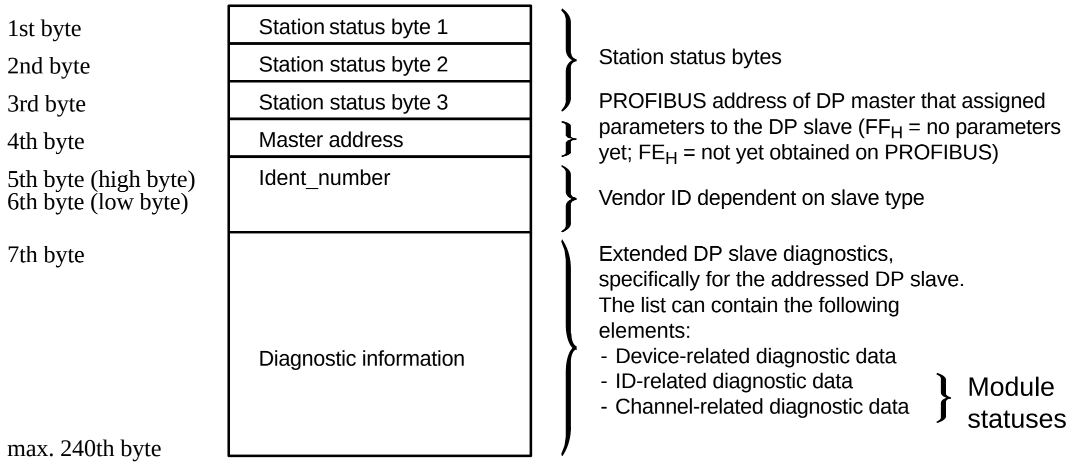


Figure 5-3 Basic Structure of the Single Diagnostic Data

Note

The total length of the data record is 4 bytes shorter than the length in the DP standard. Instead of the maximum possible 244 bytes, only 240 bytes are permitted for operation with the PROFIBUS CP in a SIMATIC S7-300.

Structure of the Station Status Bytes

The coding of the station status bytes is explained in the following tables.

Table 5-4 Structure of the Station Status Bytes - Station Status Byte 1

Bit No.	Meaning	Explanation
7	MasterLock	The DP slave has been assigned parameters by a different DP master, in other words, the DP slave can only be read by the local DP master. This bit is set by the CP (DP master), when the master address is not FF_H and is different from the CP bus address.
6	ParameterFault	The last parameter assignment frame received was incorrect or not permitted. Remedy: Check the parameter assignment for illegal parameters.

Table 5-4 Structure of the Station Status Bytes - Station Status Byte 1

Bit No.	Meaning	Explanation
5	InvalidSlaveResponse	This bit is set by the CP (DP master) when no plausible response has been received from the DP slave. (Various causes possible).
4	ServiceNotSupported	The requested functions (for example, SYNC mode, FREEZE mode) are not supported by the DP slave. Remedy: For example, switch off the SYNC/FREEZE check or do not send any SYNC/FREEZE jobs.
3	ExtDiagMessage ExtStatusMessage	Bit = 1 (Ext_Diag) means: Important slave-specific diagnostic data exist. The module statuses/device-related diagnostics should be evaluated. Bit = 0 (Ext_Status_Message) means: Information or a message may exist. The additional information (module statuses/device-related diagnostics) can be evaluated.
2	SlaveConfigCheckFault	Configuration data received from the DP master are rejected by the DP slave. Cause/remedy: For example, incorrect module configuration -> check the diagnostic buffer in NCM S7 for PROFIBUS.
1	StationNotReady	The DP slave is not yet ready for parameter assignment and data exchange. Remedy: Temporary status, this cannot be influenced by the DP master.
0	StationNonExistent	The DP slave is not responding on the bus. This bit is set by the CP (DP master 1).

Table 5-5 Structure of the Station Status Bytes - Station Status Byte 2

Bit No.	Meaning	Explanation
7	Deactivated	The DP slave is not being polled by its own DP master 1. Cyclic reading is possible.
6	Reserved	-
5	SyncMode	The DP slave is in the SYNC mode
4	FreezeMode	The DP slave is in the FREEZE mode
3	WatchdogOn	The watchdog is activated on the DP slave.
2	StatusFromSlave	Bit = 1: the diagnostic data is from a DP slave. Bit = 0: the diagnostic data is from DP master 1

Table 5-5 Structure of the Station Status Bytes - Station Status Byte 2

Bit No.	Meaning	Explanation
1	StaticDiag	Static diagnostics The DP slave cannot transfer data at present.If this bit is set, the DP master must fetch diagnostic data from the DP slave until the bit is reset by the DP slave.
0	ParameterRequest	This bit is set by the DP slave when it requires a new parameter assignment or must be configured.

Table 5-6 Structure of the Station Status Bytes - Station Status Byte 3

Bit No.	Meaning	Explanation
7	ExtDataOverflow	If this bit is set, there is more diagnostic information available than can be displayed in the extended diagnostic data. You cannot, however, display this data.
6 - 5	DP_Station_State	Status of the DP master 00 RUN 01 CLEAR 10 STOP 11 OFFLINE
4	Polling_By_Master	The DP slave is polled by its own DP master.
3	More_Ext_Dia_Data_Exist	During the data transfer phase, the DP slaves send more diagnostic data than the DP master class 1 (= parameter assignment master) can evaluate. This diagnostic frame is then ignored by the DP master class 1 but can be read by the CPU acting as DP master class 2. The maximum diagnostic data length that can be evaluated in the DP master class 1 (in bytes) For number of slaves / with number of FDL connections 0 / 16 --- 24 / 242 / 242 32 / 242 / 218 48 / 194 / 138 64 / 130 / 34 80 / 74 / 18 96 / 58 / 10 112 / 42 / 10 125 / 34 / 0 --- From the table, you can see that with up to 24 DP slaves, the maximum data length of 242 bytes is permitted regardless of the number of FDL connections.
2	Master_Not_In_Ring	The DP master is not on the bus.

Table 5-6 Structure of the Station Status Bytes - Station Status Byte 3

Bit No.	Meaning	Explanation
1	MasterConfigCheckFault	The DP master rejects the configured slave module list as incorrect. Cause / Remedy: For example, incorrect module configuration (number, order) -> check the diagnostic buffer in NCM S7.
0	Actual_Diagnose	The diagnostic data are up-to-date (1) or are older stored diagnostic data (0). (Older, stored diagnostic data are read out according to the principle last in first out -> see Section 8.3.3.)

5.5 Diagnostic Query with DP Master (class 2)

Note

The following section refers to the **responder functions** of the DP master class 1.

Overview

The PROFIBUS CP supports DP standard diagnostic queries from a DP master (class 2) on PROFIBUS. To allow this, the CP provides the DP standard service DDLM_Get_Master_Diag with the CP acting as responder.

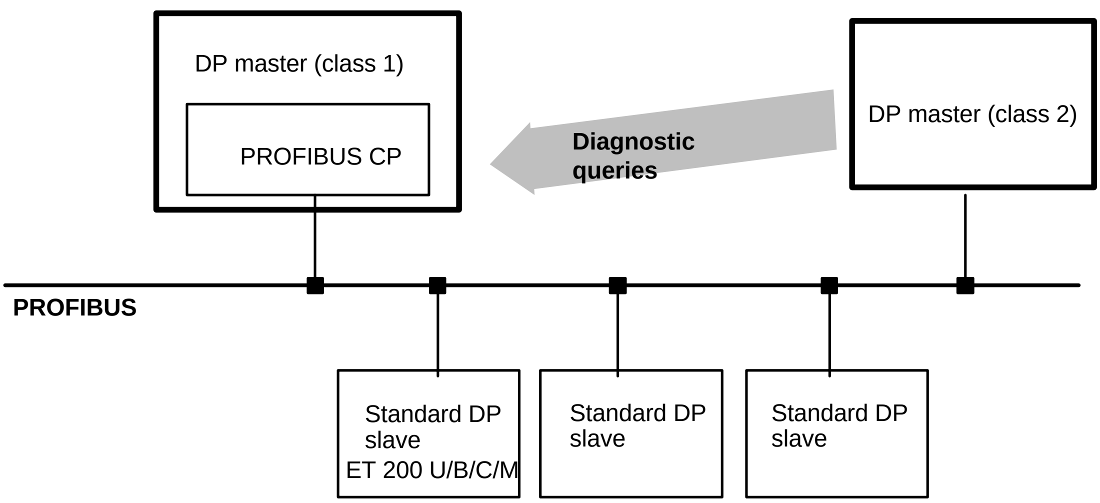


Figure 5-4 Single Master Bus Configuration with DP Master (Class 2)

Diagnostic Functions

Analogous to the diagnostic functions for the user program on the CPU, the DP master (class 2) has the following functions available:

- Read DP slave list
  This is a group status query about all the DP slave stations configured on the addressed DP master class 1.
- Read DP system diagnostic data
  This is a group diagnostic job about all the DP slave stations configured on the addressed DP master class 1.
- DP single diagnostics
  This requests diagnostic data from a specific station.
- Read DP master status
  For details, see DP standard /12/

Note

The DP slave and the DP system diagnostic functions conform to the DP standard. The bit coding and list processing are slightly different from the station list and diagnostic list for the user program.

Sequence of a Diagnostic Query

A DP single diagnostic request instructs the DP master class 1 to prepare the diagnostic data for fetching. From the moment that the diagnostic data are prepared, the DP master class 1 monitors the fetching of the diagnostic data. The monitoring time is fixed in the CP system data.

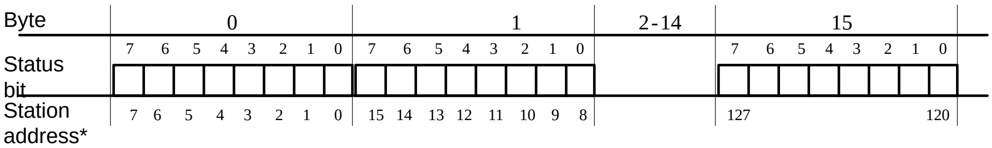
5.5.1 The DP Slave List for a DP Master (class 2)

Sequence of a Diagnostic Query

A diagnostic query of the DP slave list is acknowledged immediately when the list has been prepared.

Structure of the DP Slave List

The DP slave list has a length of 16 bytes or 128 bits. Each bit of the DP slave list corresponds to a PROFIBUS address and therefore to a possible DP slave station.



*) The bit for the station address 127 is irrelevant since the permitted range for DP slave addresses on the PROFIBUS bus is between 0 and 126.

Meaning of the Status Bits

Table 5-7 Coding of the DP Slave List

Bit Coding	Meaning
0	The following meanings are possible: • The configured DP slave station does not exist or is no longer responding. or • The station address is not used. or • The configured DP slave is not in cyclic data transfer with its own DP master.
1	• The configured DP slave station is in the cyclic data transfer phase.

Note

The bit coding differs from the DP station list (see Section 5.3). The reason for this is that the DP station list indicates the stations that are functioning incorrectly without any additional evaluation.
Moreover, this DP slave list is updated at a fixed interval T, whereas the DP station list is updated in every polling cycle.

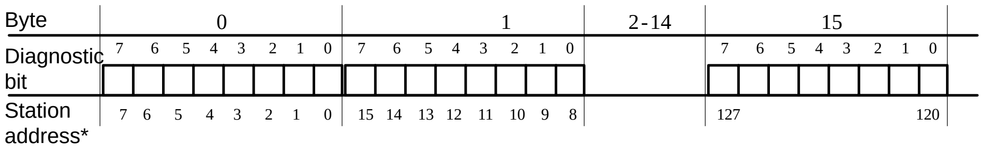
5.5.2 DP System Diagnostics for a DP Master (class 2)

Sequence of a Diagnostic Query

A DP system diagnostic request is acknowledged immediately when the DP system diagnostic list has been prepared.

Structure of the DP System Diagnostic List

The DP system diagnostic list has a length of 16 bytes or 128 bits. Each bit of the DP system diagnostic list corresponds to a PROFIBUS address and therefore to a possible DP slave station.



*) The bit for the station address 127 is irrelevant since the permitted range for DP slave addresses on the PROFIBUS bus is between 0 and 126.

Meaning of the Diagnostic Bits

Table 5-8 Coding of the DP System Diagnostic List

Bit Coding	Meaning
0	The following meanings are possible: • The configured slave station has no new diagnostic data. or • The station address is not used.
1	The configured slave station has new diagnostic data. These can be fetched with the single diagnostics function.

Note

In contrast to the DP diagnostic list (see Section 5.4.1) the bits are only updated as a result of changes reported by the DP slaves.

5.5.3 DP Single Diagnostics for a DP Master (class 2)

DP Single Diagnostics

DP single diagnostics is normally started as a result of the evaluation of the DP slave list (group diagnostics).

Structure of the Diagnostic Data

The diagnostic data obtained are identical to the single diagnostic data described in the section describing DP single diagnostics in the user program; however a **maximum of 124 bytes** are transferred.

Table 5-9 Structure of the Station Status Bytes - Station Status Byte 3

Bit No.	Meaning	Explanation
7	Ext_Diag_Data_Overflow	If this bit is set, there is more diagnostic information available than can be displayed in the extended diagnostic data.
6-0	reserved	-

❑

6 Configuring and Programming the DP Slave Mode with an S7-300 System

A SIMATIC S7 PLC with a PROFIBUS CP in the DP slave mode is suitable for applications in which intelligent preprocessing of process signals is required locally.

This chapter explains the following:

- Which data areas in the CPU are addressed as DP data areas by the CPU user program.
- What you need to do to trigger and monitor communication.
- What you need to program in the user program and what you need to configure with NCM S7 for PROFIBUS.

Please check the documentation /2/ accompanying your CP to find out whether your PROFIBUS CP supports the DP slave mode.

Further information is available from the following sources:

- For other topics involving the DP slave mode with the PROFIBUS CP, such as:
  - integrating the PROFIBUS CP in PROFIBUS
  - programming functions (FCs) for DP
  - DP diagnostics
  - the use of the NCM S7 for PROFIBUS configuration software
  - configuring the PROFIBUS CP as DP master in an S7-300

  refer to the other chapters in this manual.
- For configuring and programming DP masters (for example SIMATIC S5 PLC with CP 5430/5431, PC with CP 5613/5614 or IM 308-B/C) read the relevant user manual.

6.1 Procedure

Steps

The following steps are necessary to allow you to operate a DP master system with a SIMATIC S7 PLC acting as the DP slave:

Configuring

Configure the PROFIBUS CP as a DP slave for data exchange using PROFIBUS DP.
See Section 6.3

Programming

Write the user program for the SIMATIC S7 DP Slave and download the program to the SIMATIC S7 CPU. See Section 6.4

Commissioning

Start up and test the DP slave and DP master during operation on the PROFIBUS

If errors occur in the DP communication, use diagnostic functions.

Configuring

The PROFIBUS CP must be supplied the following as a PROFIBUS node:

- A PROFIBUS address
- Bus parameters

This information is configured and downloaded to the PROFIBUS CP.
Configuring the bus parameters is described in Chapter 3.

Programming

By programming, you specify the sequence of the user program and access to the I/O data. The following must be programmed on the CPU:

1. Writing or reading process data in the DP data buffer.
2. The DP communication in the CPU program. Here, you use the FCs (DP_SEND or DP_RECV).

How you use the functions (FCs) for the DP slave mode in your user program is described in the following sections of this chapter. The exact syntax of the FCs and the meaning of the block parameters is described in Chapter 8.

Note

If you are familiar with the functions of the PROFIBUS CP/DP slaves, you can skip the next section and continue at Section 6.3.

6.2 How the SIMATIC S7 PLC Operates in the DP Slave Mode with the PROFIBUS CP

Characteristics

The following features characterize the way in which the PROFIBUS CP transfers data in the DP slave mode.

- The PROFIBUS-DP interface of the PROFIBUS CP operates in compliance with PROFIBUS DP, EN 50170 Vol. 2.
- The DP slave mode allows process data that were preprocessed in the user program of the DP slave to be transferred to the DP master. In the other direction it allows data to be received from the DP master, further processed in the user program of the DP slave and output to the process.
- The PROFIBUS CP operating as a DP slave **cannot** be activated as a DP master **at the same time**.

Tasks of the PROFIBUS CP

The PROFIBUS CP performs the following tasks when handling the DP data exchange with the DP master (see also Figure 6-1):

1. Receiving frames from the DP master
   - used for parameter assignment and configuration
   - that contain process output data and passing on the data to the CPU
   - that set the PROFIBUS address and the mode (DP master, DP slave active, DP slave passive, no DP mode, see Section 4.6);
2. Receiving input data from the DP data area of the CPU and preparing the data for the DP master.
3. Preparing diagnostic data that can be fetched and evaluated by the DP master.
4. Preparing input and output data to be read by masters of class 2 (master class 2 services supported: “read input data RD_Inp” and “read output data RD_Outp”).

Addressing an S7-300 as a DP Slave

A SIMATIC S7-300 operating with a PROFIBUS CP in the DP slave role, can be addressed by the DP master as a compact or modular device. When configuring on the DP master, device database and type files (for COM ET200 V4.0 and V5.x) are available.

Area of Consistency

The area of consistency is always the entire input and output data area of the DP slave. This applies regardless of whether the DP master addresses the DP slave as a compact or modular device.

Note

Please note any differences as explained in the documentation /2/ of the CP type your are using!

Active or Passive Station in the DP Slave Mode

The PLC operated with an PROFIBUS CP is normally also operated on the PROFIBUS in the active DP slave mode. This makes it possible to use other communications services such as FDL connections, S7 communication, or PG functions in addition to the slave functions.

It is also possible, to configure the DP slave exclusively as a passive station on the bus. This is necessary in system configurations in which only the DP master can be an active station on the bus or when the number of active stations must be limited. Remember that PG functions and other communication services are not possible via a CP configured as passive.

PROFIBUS Address and Bus Parameters

The transmission rate and PROFIBUS address must be identical to those set on the DP master.

The transmission rate, the PROFIBUS address and the mode (DP master, DP slave active, DP slave passive, no DP mode, see Section 4.6) are set solely by configuring in STEP 7 (see Chapter 3).

The PROFIBUS CP adopts these settings after the configured data have been downloaded.

It is not possible to set these parameters using parameter assignment frames.

The PROFIBUS address and the mode (DP master, DP slave active, DP slave passive, no DP mode, see Section 4.6) can be set as follows:

- By configuring;

  The CP adopts this setting after the configured data have been downloaded. This variant is described for setting the mode in this chapter. This is the standard situation for a fixed setting.

- Using a job in the user program;

  For an example, refer to Section 3.4

- Using a DP master (class 2) job.

  For more detailed information, refer to Section 6.3.2.

The minimum station delay (MinTsdr) is adopted from the parameter assignment frame of the master.

6.2.1 Principle of Data Exchange

Cyclic Data Exchange between DP Master and DP Slave

Data exchange between the DP master and DP slave is cyclic (DP polling cycle) and uses send and receive buffers on the PROFIBUS CP (DP data buffers). The data exchange is started by the DP master that sends output data and fetches input data.

Data Exchange between CPU and PROFIBUS CP

The data exchange between the CPU and PROFIBUS CP depends on the calls for the DP_RECV and DP_SEND blocks (FCs) within the CPU cycle.

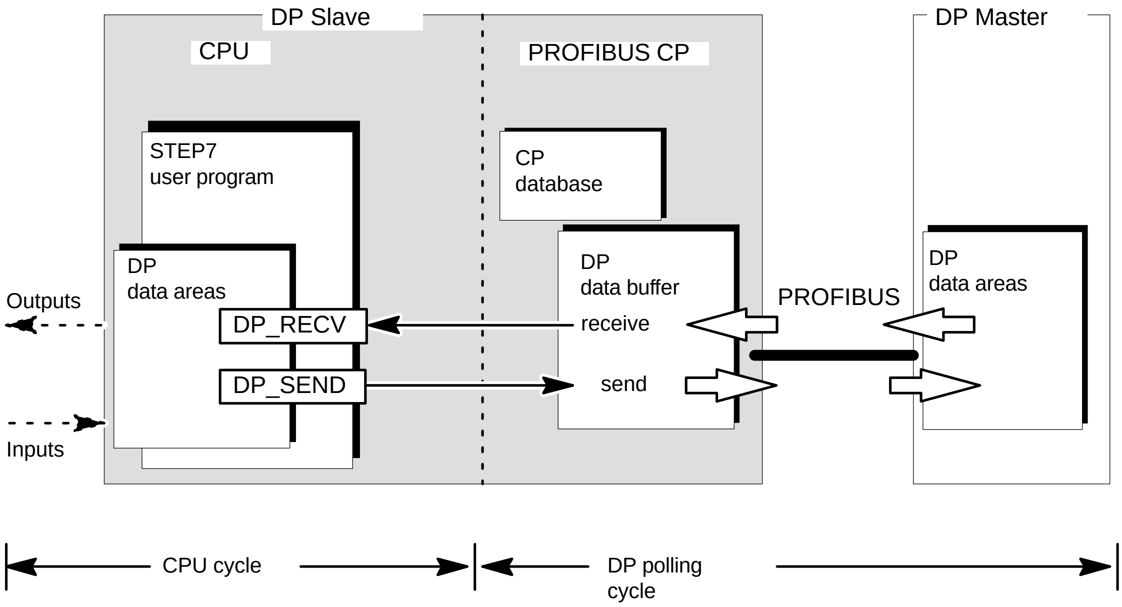


Figure 6-1 Interaction between the CPU and PROFIBUS CP in the DP Slave Mode

Functions (FCs)

For the data exchange using the STEP 7 user program, two FCs are available:

- DP_RECV
  This function takes the DP data transferred by the DP master from the receive buffer of the PROFIBUS CP and enters them in a specified DP data area on the CPU.
- DP_SEND
  This function transfers the data of a specified DP data area on the CPU to the send buffer of the PROFIBUS CP for transmission to the DP master.

CPU Cycle and DP Polling Cycle

The CPU cycle and the DP cycle are independent of each other. The CPU-CP interface that can be addressed by the user program with the functions DP_SEND and DP_RECV is designed so that complete data transfer is ensured when handled correctly.

Handling correctly means that the data transfer with DP_SEND and the reception with DP_RECV requires evaluation of the block status bits in the user program.

For a detailed description of the data exchange with flow charts, refer to the description of the FCs in Chapter 8.

Area of Consistency

The entire DP input or output data area of the DP slave is included and consistency during transmission is guaranteed. Here, it does not matter whether the DP master addresses the DP data area in its entirety or divided into modules.

Note

Please note any differences as explained in the documentation of the CP type your are using!

6.2.2 DP Data Area on the CPU

DP Data Areas on the CPU

On the CPU, various data areas can be used for communication with the DP master. Which data area you use depends on the type of PLC and the task in hand. The following areas are available:

- Process image
  This assumed that a continuous input or output area can be reserved for distributed I/Os in the process image of the CPU. This can, however, be restricted by the size of the process image and the number of signal modules installed centrally.
- Bit memory address area
  Just like the process image, this area is also suitable for global storage of DP signals. The bit memory address area can, for example, be used when the space left free by central signal modules in the process image is too small.
- Data block (DB)
  Data blocks can also be used to store DP signals.This location is preferable when the DP data area is processed by **one** program block.

Note

The DP data area for input and output data is always transferred as the **entire area** to or from the data areas on the CPU.

The following diagram illustrates the mapping of the DP data buffer of the PROFIBUS CP on the alternative data areas in the CPU.

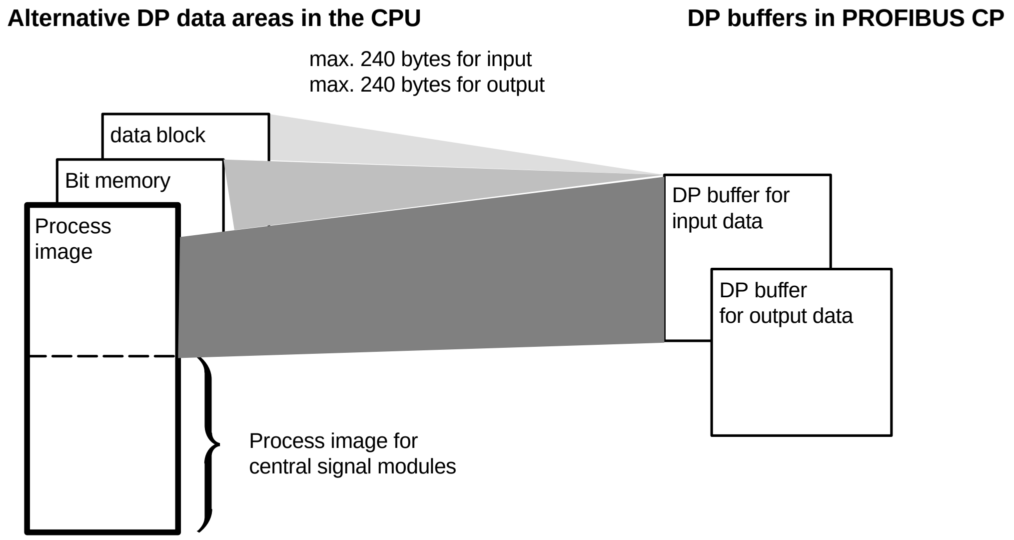


Figure 6-2 Assignment of the DP Process Image to the CPU Data Areas

6.2.3 Initialization and Data Transfer on PROFIBUS

Initialization

Initializing the DP slave mode involves the following:

- Parameter assignment
  The parameter assignment specifies how the DP slave operates.
- Configuration
  The configuration specifies the structure of the DP slave.

Parameter Assignment

The DP slave is assigned parameters by the DP master by configuring the bus parameters and by the parameter assignment frame.

Configuration

As DP slave, the PROFIBUS CP requires the following information for the configuration:

- Length of the input data
- Length of the output data

The DP slave is configured using the FC calls on the user program interface on the CPU. The DP slave checks whether the total length contained in the configuration frame of the DP master is identical to the lengths specified in the FCs. If the lengths specified for input/output data are not identical, the slave does **not** change to the data transfer phase.

Note

Remember that successful parameter assignment and configuration by the DP master is only possible **after** local initialization by the DP_RECV FC call for the output data and the DP_SEND FC call for the input data.

Reasons for a Re-initialization

In the following situations, the PROFIBUS CP requests reassignment of parameters/reconfiguration from the DP master:

- The length information about the DP data area transferred in the FCs does not match the information saved on the PROFIBUS CP. A change in length in the FC calls means a change in configuration. If the PROFIBUS CP is in the data transfer phase, it changes to the parameter assignment phase. It only changes back to the data transfer phase when the DP master sends a new parameter assignment/configuration frame that matches the saved information.
- During the data transfer phase, an incorrect parameter assignment frame is sent.
- The CPU or the PROFIBUS CP change to the STOP mode.
- The watchdog is exceeded (see below).
- The PROFIBUS CP receives a control frame with an unsupported service (for example SYNC, FREEZE).

Note

Check the entries in the diagnostic buffer of the DP slave.

Watchdog

If the watchdog expires, the DP slave assumes that communication with the DP master has broken down. If no frame is received from the DP master during the watchdog time, the PROFIBUS CP reacts by resetting and starting up again.

6.2.4 Diagnostic Data

Preparing Diagnostic Data

The PROFIBUS CP as DP slave prepares diagnostic data for the DP master.

Structure of the Diagnostic Data

The PROFIBUS CP provides the following diagnostic data in response to a diagnostic request:

- Obligatory data are **always** transferred in response to a diagnostic request on the DP master.
- Device-specific diagnostic data are transferred depending on the mode.

Table 6-1 Structure and Meaning of the Diagnostic Data

Byte **)	Meaning		Explanation / Value	Default
1	Obligatory data (DP standard)	Station status bytes	Content according to the DP standard (see Chapter 5 Diagnostics).	
2				
3				
4		Master address	PROFIBUS address of the master that configured/assigned parameters to the slave.	0xFF
5		Vendor ID	Vendor identifier for the PROFIBUS CP as DP slave	see Documentation /2/
6				

Table 6-1 Structure and Meaning of the Diagnostic Data, continued

Byte **)	Meaning		Explanation / Value	Default
7	Device-specific diagnostic data	Header byte	Specifies the length of the device-specific diagnostic data	0x02 or 0x04*)
8		Message	0x01 **Configuration phase** The slave is in the configuration phase and is not yet polled by the master. The send and receive length indicate the lengths taken from the blocks. If both lengths are 0, there has not yet been a block call. 0x02 **Configuration change** The block lengths have changed during the data transfer phase. The send and receive length indicate the new values. 0x04 **CPU in the STOP state** 0x08 **Min. TSDR not changed** The minimum TSDR transferred by the master is longer than the maximum TSDR set in the bus parameters. Remedy: Adapt bus parameters. 0x10 **LSAP cannot be activated** At least one SAP for the DP slave mode cannot be activated. Remedy: Power OFF -> ON on the CP.	0x00
9 *)		Send length	Specifies the current configuration: length of the DP_SEND block.	0x00
10 *)		Receive	Specifies the current configuration: length of the DP_RECV block.	0x00

*) Valid for the messages “configuration phase” and “configuration change”

**) Bytes 7-10 differ depending on the particular CP; please check the information in the documentation /2/.

6.2.5 Global Control Jobs

Meaning

Using a global control frame, the DP master can send global commands to the DP slave.

The following are defined:

- **CLEAR**
  Control command to change the data output to a safe, defined state.
- **SYNC** [1)]
  Control command for synchronizing data output.
- **FREEZE**[1)]
  Control command to freeze data input.

CLEAR

The DP master can reset the outputs in the DP slave using the global control job CLEAR.

The sequence in the DP slave is as follows:

The CLEAR command causes the DP master to set the outputs in the DP data buffer area to 0 continuously. Data inputs continue to be read. The next time DP_RECV is run through on the DP slave, the reset DP output byte is transferred to the DP data area of the CPU. The user program receives a message in the status byte of the FC.

Synchronization SYNC / FREEZE [1)]

To find out whether the PROFIBUS CP supports the global control frames SYNC and FREEZE, please refer to the CP documentation /2/.

[1)] The information in the documentation of the PROFIBUS CP /2/ applies.

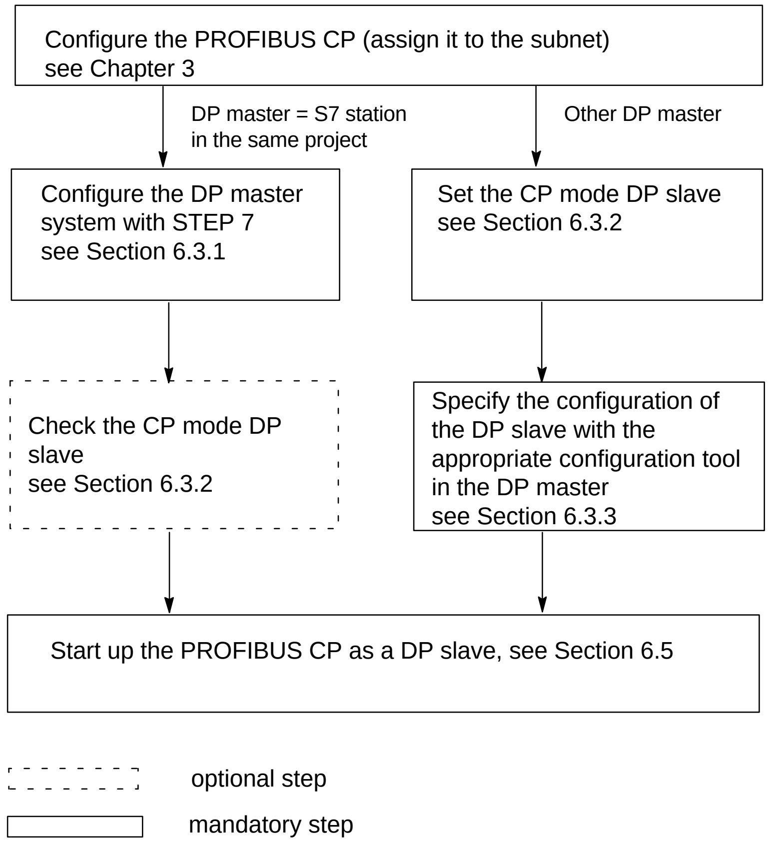
6.3 Configuring and Starting the DP Slave Mode

Procedure

Enter the PROFIBUS CP of the DP slave in the hardware configuration and assign the CP to the subnet as described in Chapter 3.

The rest of the procedure depends on the type of device and the configuration of the DP master, as follows:

- The DP master is a SIMATIC S7 station configured in the same project as the DP slave
- The DP master is any other type of device



6.3.1 Assigning the “Intelligent” DP Slave to the DP Master System

Requirements

The procedure of assigning S7 stations with PROFIBUS CPs as intelligent DP slaves to a DP master system, as described here, assumes the following:

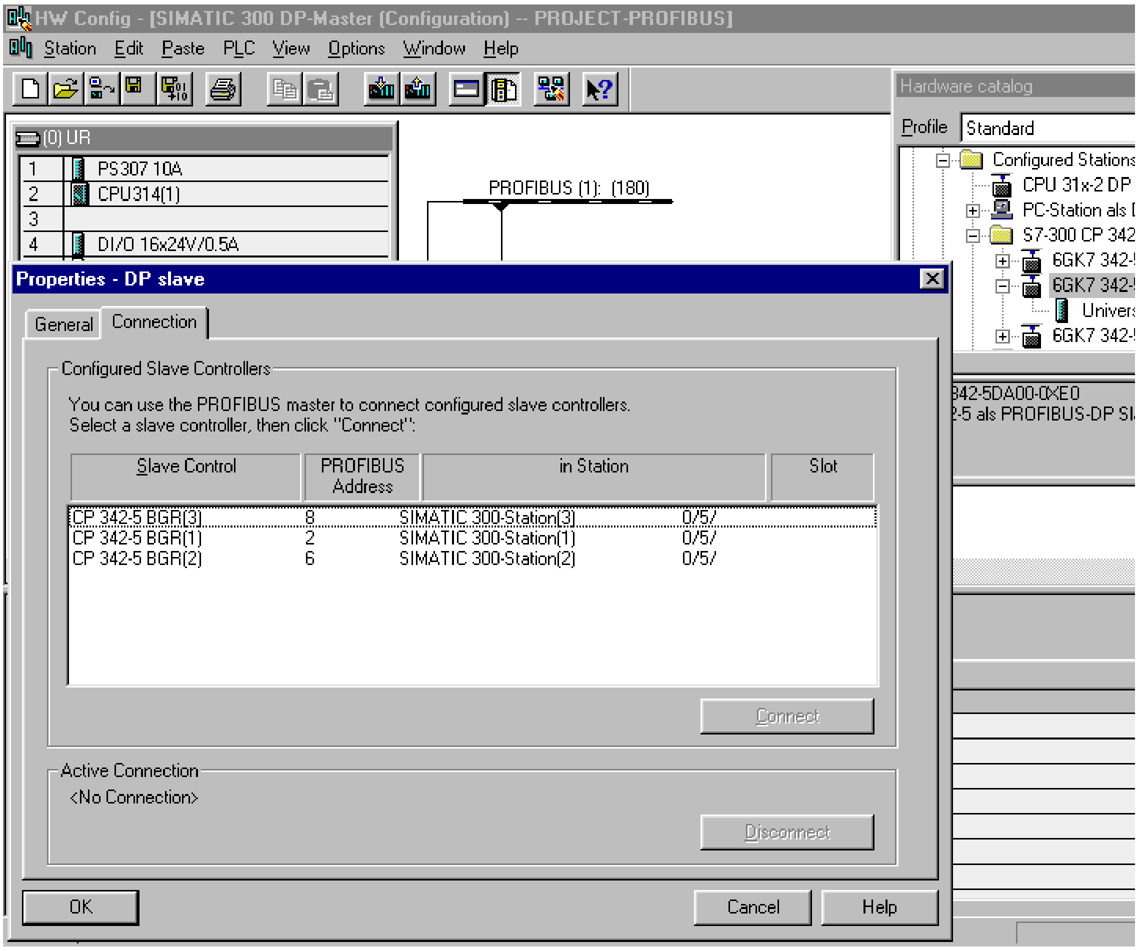
- The DP master is a SIMATIC S7 station that was configured in the same project as the DP slave.
- The PROFIBUS CP of the DP slave has been entered in the hardware configuration and networked. This means that when the DP master system is then configured, the PROFIBUS CP is configured automatically for the DP slave mode.

Entering the DP Slave in the Configuration Table

Configure a DP subsystem (DP master system) as follows:

1. Open the hardware configuration of the S7 station that will act as DP master.
2. **Result:** The connection symbol for the DP master system appears beside the DP master module.
3. Open the hardware catalog and select the entry “PROFIBUS DP/already configured stations“ for the DP slave with a PROFIBUS CP and drag the entry “6GK...” to the connection symbol.

   Result: If stations are configured in the project that can act as intelligent DP slaves, a dialog “Properties DP Slave” is displayed.



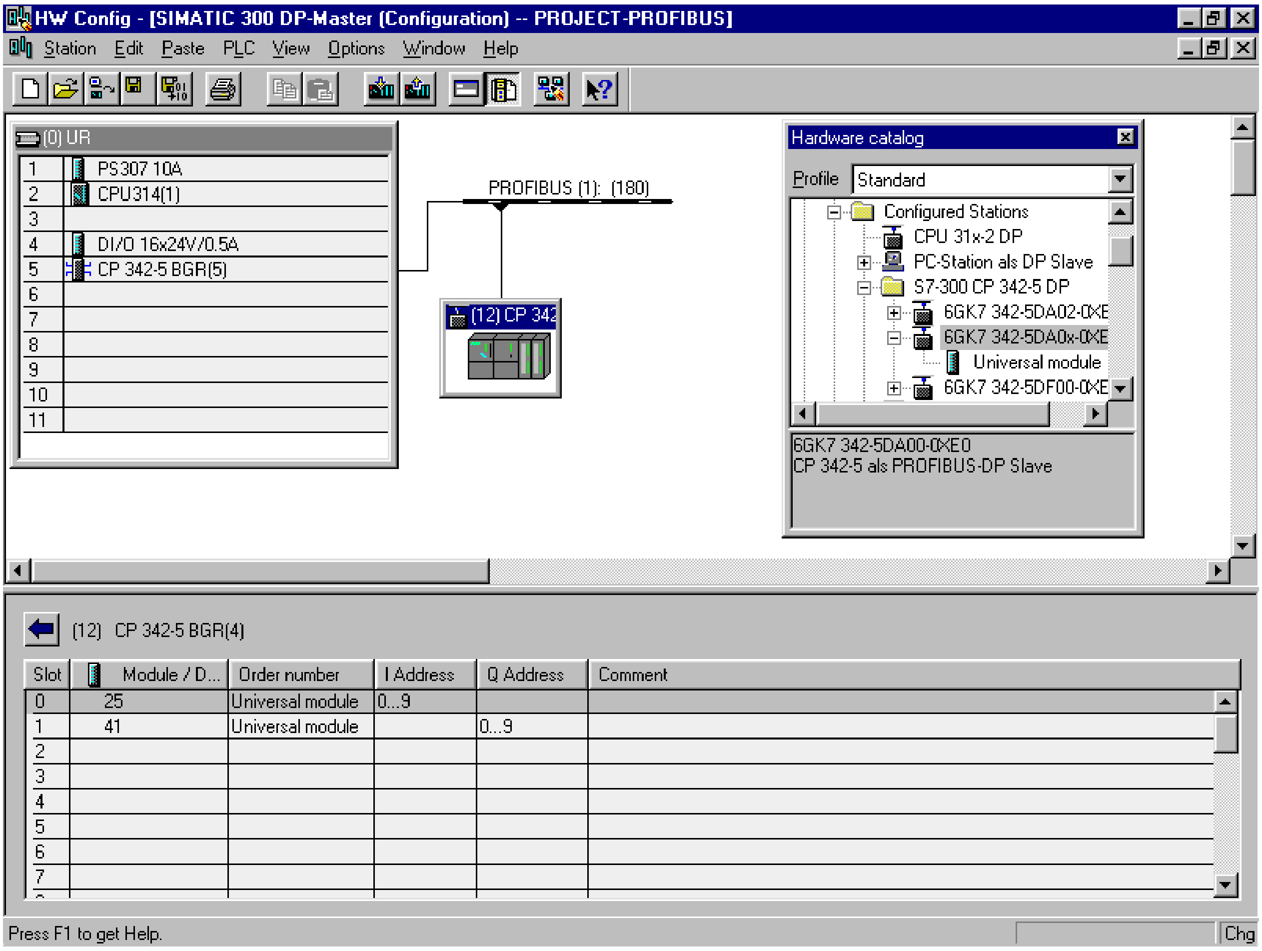
4. Select the DP slave in question and confirm your selection with OK.

   Result:
   With this selection, the PROFIBUS CP of the DP slave is automatically configured for the “DP Slave Active” mode.

5. As the next step, select one or more universal modules from the hardware catalog and position it/them in the configuration table. This configures the data areas of the DP slaves.

6. You must now specify the module or modules in terms of its data types (input/output) data length and address assignment. You can enter values directly in the table or select the module and open the object properties.

The following figure shows the “Master System Configuration Table” (detailed view) with one SIMATIC S7 PLC with a PROFIBUS CP as the DP slave. The standard module was configured with two universal modules; the DP master is a SIMATIC S7-300 station.



6.3.2 Checking or Setting the CP Mode DP Slave

DP Slave Mode in the Properties Dialog

The PROFIBUS CP operates as a DP slave when this mode is set in the "Operating Mode" tab of the properties dialog.

Automatic Recognition of the CP Mode

The DP slave mode to be set for the PROFIBUS CP is detected automatically from the hardware configuration of the DP master system providing the PROFIBUS CP is located in the same project and in the same subnet as the DP master.

This situation was described in Section 6.3.1. The properties dialog then indicates that the DP slave mode has already been selected.

Note

PG functions and test functions via MPI are always possible regardless of the selected mode.

PG functions and test functions via PROFIBUS are always possible regardless of the selected mode (exception: DP slave **passive**).

Procedure

Follow the steps outlined below to check or modify the setting:

1. Select the PROFIBUS CP in the configuration table.
2. Select **Edit▸Object Properties**. The following dialog is displayed:

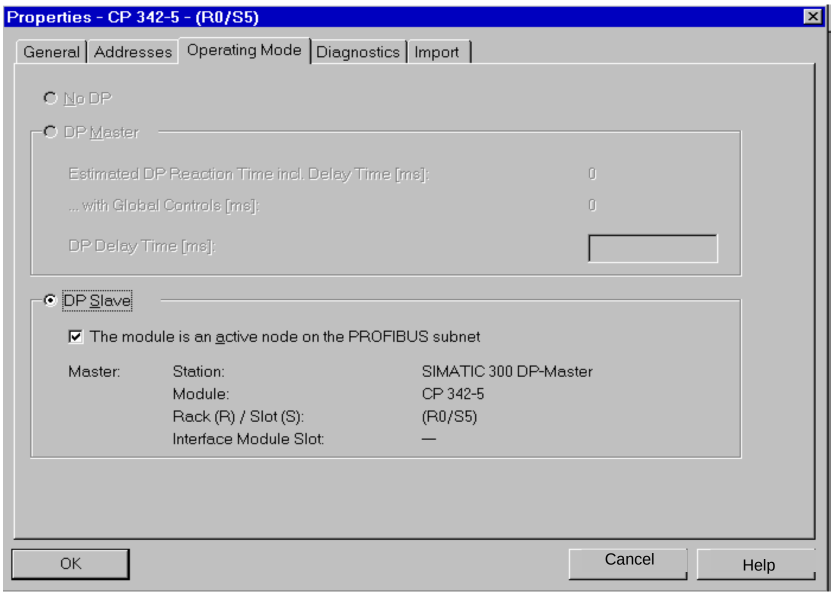


Figure 6-3 Example of the Properties Dialog for a PROFIBUS CP with the DP Slave Function

3. If the mode is not already set as a result of the automatic detection function, click the DP Slave field.
4. If required, select the option “The module is a passive node on PROFIBUS”
   - DP slave active (Default)

     The PROFIBUS CP is an active node, in other words it can be used for further communication services such as FDL connections, PG functions or S7 Functions (passive).
   - DP slave passive

     The PROFIBUS CP operates exclusively as a DP slave. PG functions and other protocols using PROFIBUS are not possible.

- Using a job in the user program of the local CPU;

  Using the job in the user program, the PROFIBUS address can be adapted dynamically to the situation in your plant.

  This could, for example, be used in redundant systems, one station taking over the tasks of another, failed station. The PROFIBUS address of the redundant station is then changed to the address of the previously active station.

  For an example, refer to Section 3.4
- using the DP service (DDLM_Set_Slave_Add see /12/) of the DP master (class 2) via PROFIBUS

  This involves setting the address via the bus and also allows the PROFIBUS address to be adapted dynamically to the situation in your plant.

  See Section 4.9

6.3.3 Notes on Configuring on the DP Master

Basic Data of the DP Slave

From the point of view of the DP master, the following basic data of the PROFIBUS CP in the role of DP slave must be taken into consideration:

- Standard device database file (GSD file)
  The device master data are available in the GSD file for configuring and assigning parameters.

  These contain the following information

  - Vendor ID
  - Configuration of the DP data area
  - Minimum slave interval
  - SYNC / FREEZE;
  - User-specific data

or

- Type file (for COM PB V3.3 and COMWIN ET 200).

Obtaining the GSD and Type File

The GSD and type file are supplied with the STEP 7 standard package.

6.4 Programming the DP Slave Mode

Principle of Job and Data Transfer

The DP data area in the CPU is addressed by the user program in the slave CPU using normal STEP 7 instructions.

In the user program, the transfer of the DP data areas is triggered and successful execution is monitored. The connected PROFIBUS CP is informed about the location of the DP data area by address parameters when the FCs are called.

Programming the DP Slave Mode

Use the two FCs on the interface on the user program as follows:

- DP_RECV to receive the DP data from the DP master
- DP_SEND to send the DP data to the DP master.

Purpose of the FC

The FC call has the following effects:

- The first time the block is called, the slave configuration is activated.
- The DP data area is transferred to the PROFIBUS CP (DP_SEND) or received from the PROFIBUS CP (DP_RECV).
- The execution of the job is confirmed either positively or negatively in a status message.

Note

The data area information (SEND parameter for DP_SEND and RECV parameter for DP_RECV) must match the lengths configured on the DP master and transferred as a configuration frame.

Evaluate the Code Bits

Evaluate the following bits in the FC blocks:

- in DP_SEND:
  the parameters DONE, ERROR and STATUS
- in DP_RECV:
  the parameters NDR, ERROR, STATUS and DPSTATUS

Refer to the block description and sample call in Section 8.3.

Structure of DPSTATUS

You can see the structure and meaning of the bits in DPSTATUS in Section 8.3.2.

Calling FCs in the CPU Cycle

One possible sequence in which the DP functions can be used in conjunction with organization and program blocks in the CPU cycle is shown below.

The example illustrates the situation where data transferred by the DP master are read in at the start of each CPU cycle and the output data generated are output for transmission to the DP master when the user programs are completed. Whether or not both FCs are called, depends on the data areas used (inputs / outputs).

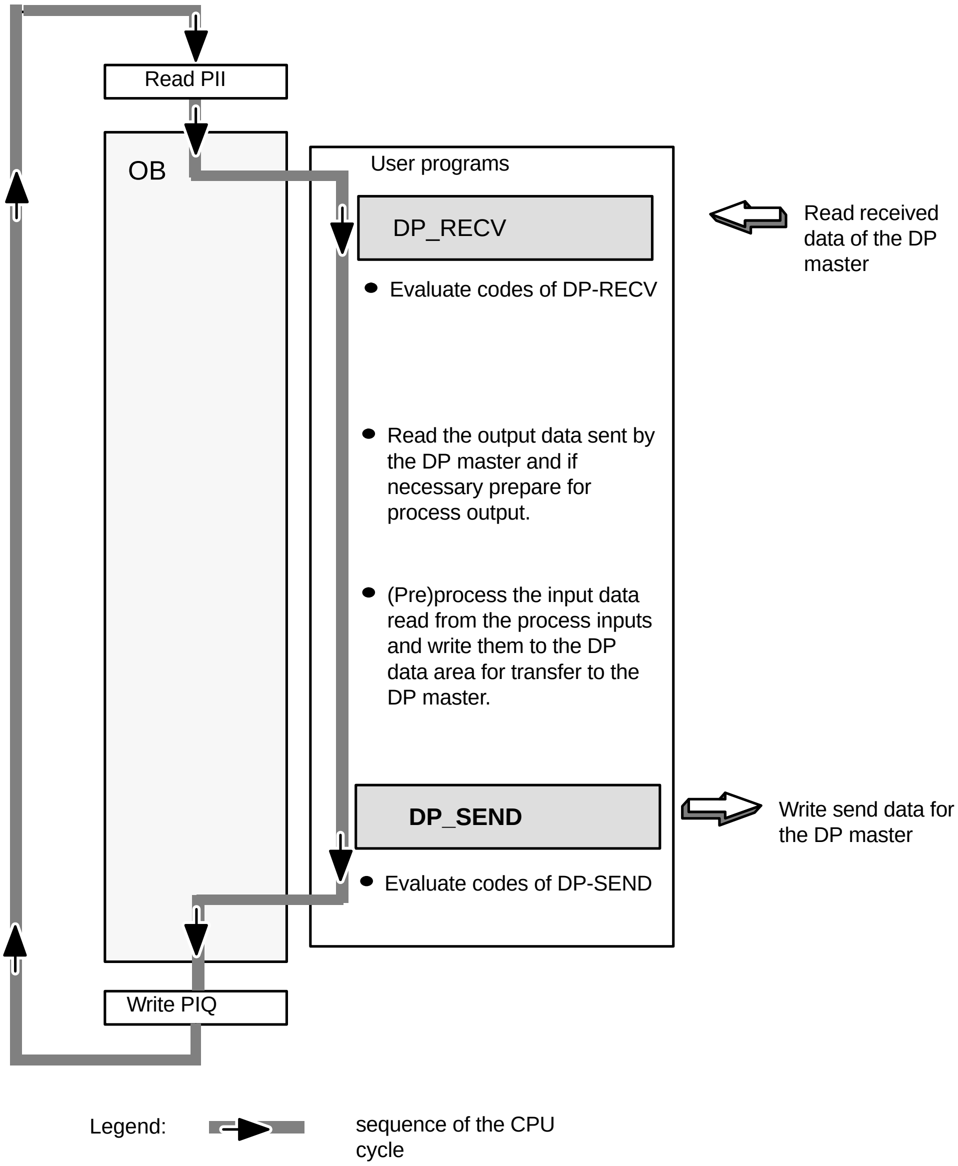


Figure 6-4 Typical Sequence of DP Function Calls in the CPU Cycle

6.5 Starting Up a DP Slave

Steps for Startup

The following steps are necessary before a DP slave is ready to exchange data with the DP master:

1. Download the configuration data to the PROFIBUS CP.
2. Download the user program to the CPU.
3. Start the CPU or make sure that the FCs are executed free of errors.

Result:

The DP slave is ready to be configured and have parameters assigned by the DP master.

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7 Configuring FDL Connections / Programming the SEND/RECEIVE Interface

FDL connections with the PROFIBUS CP allow program-controlled communication on PROFIBUS between SIMATIC S7 PLCs and the following:

- SIMATIC S7 PLC with PROFIBUS CP
- SIMATIC S5 with PROFIBUS CP (for example 5430/31)
- SIMATIC S5-95 U with PROFIBUS interface
- PC/PG with PROFIBUS CP (CP 5613)
- Devices capable of the SDA and SDN service complying with EN 50170, Vol. 2

This chapter explains the following:

- The characteristics of an FDL connection.
- Which data areas can be used on the S7 CPU.
- How to program the SEND/RECEIVE interface in the user program.

You will find further information in the following sources:

- You will find detailed explanations of how to configure connections in STEP 7: **Help ▸ Contents.**
- The FCs for programming FDL connections are described in Section 8.4
- In the PROJECT_PROFIBUS sample project that you can start after installing NCM S7; you will find a description of this in the primer “Getting Started” /4/.
- For programming and configuring stations for FDL connections (for example a SIMATIC S5 PLC with the CP 5430/31, SIMATIC S5-95U with a PROFIBUS interface, PCs with a CP CP 5613), please refer to the appropriate manuals.

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

You can order this directly on the Internet at:
http://www.ad.siemens.de/csi/net

7.1 Procedure

Steps

The following steps are necessary to operate FDL connections in the SIMATIC S7 with the PROFIBUS CP:

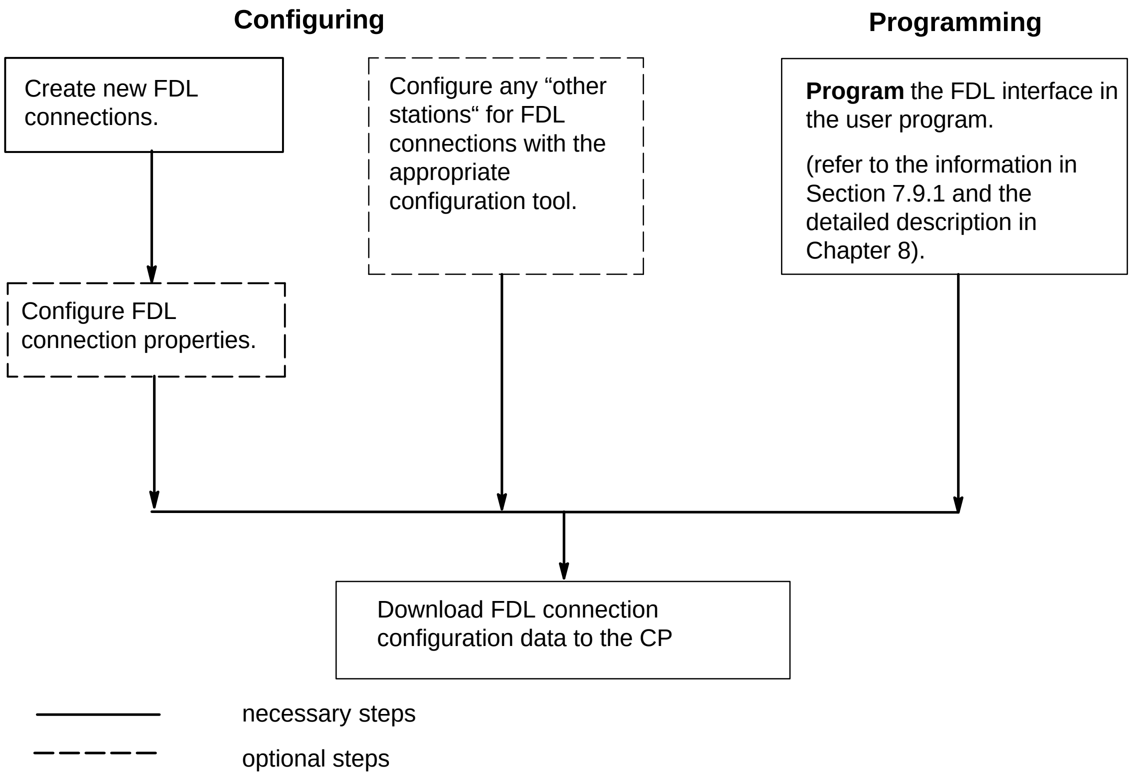


Figure 7-1 Operating FDL Connections with a PROFIBUS CP

7.2 Possible Connection Configurations

Connections between Stations Inside and Outside the Project

Communication connections are possible between the communication partners shown in the diagram below.

The communication partners can be in the same project or distributed in the subprojects of a multiproject.

Connections to communication partners outside a project are configured using the STEP 7 object “Partner in other project” or using substitute objects such as “Other stations” or SIMATIC S5.

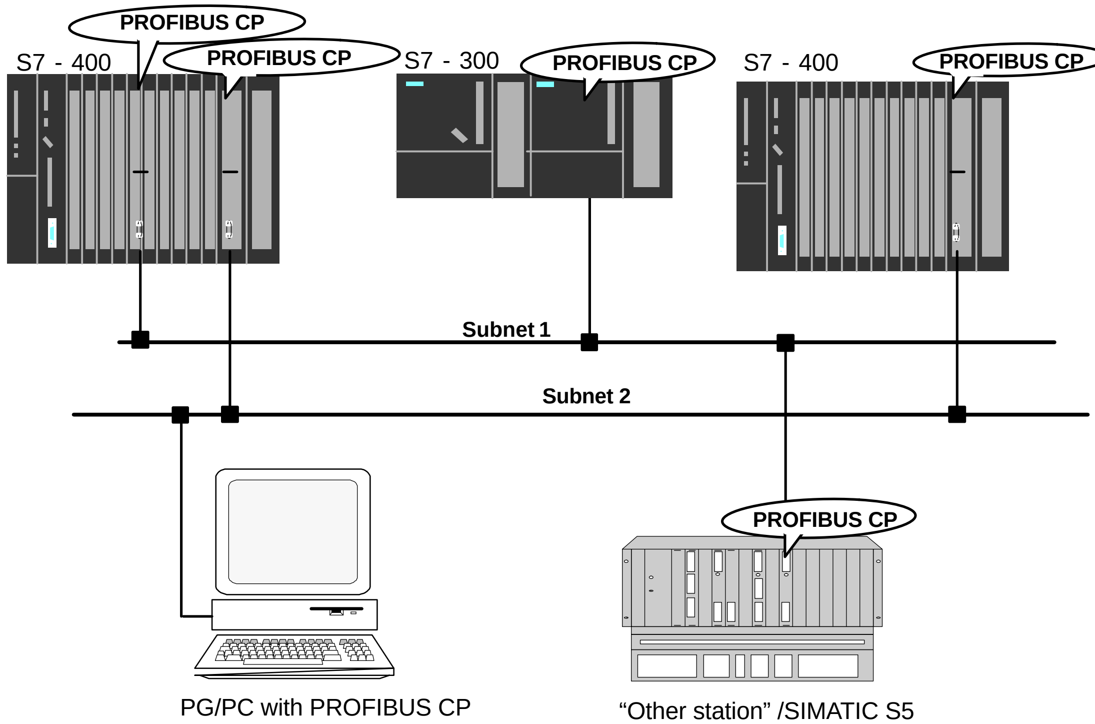


Figure 7-2 Possible Connections

More than One Subnet

If you want to operate several subnets, then use the appropriate number of PROFIBUS CPs within a station.

Organization in a Multiproject

If interproject subnets are configured, you can also configure connections over such subnets using STEP 7 V5.2. The endpoints of these connections can be located in different projects.

STEP 7 supports you both when creating interproject connections within a multiproject as well as when synchronizing connections that were configured without a multiproject context.

7.3 SIMATIC S7 PLC with FDL Connections

Application

Data transmission on a configured FDL connection is suitable for the transmission of related blocks of data between two or more PROFIBUS stations.

The following must be distinguished:

- **Specified FDL connection**

  The communications nodes are specified uniquely by configuring connections.

  The connection partner can be within or outside the STEP 7 project.

- **Unspecified FDL connection (free layer 2 access)**

  The address of the connection partner is not specified during configuration. The communications nodes are identified by address information in the communication job of the user program. This means that up to 126 nodes can be reached via one configured unspecified FDL connection providing they support FDL connections.

  The connection partner can be within or outside the STEP 7 project.

- **FDL connection with broadcast**

  All the nodes ready to receive broadcast messages can be reached on PROFIBUS.

- **FDL connection with multicast**

  All the nodes belonging to the multicast group can be reached on PROFIBUS.

Tasks of the PROFIBUS CP

The PROFIBUS CP handles the following tasks for data transfer on an FDL connection:

- On specified connections
  - When receiving

    Receives data from the PROFIBUS and passes them on the user data area in the CPU.

  - When sending

    Receives the data from the user data area of the CPU and sends them via PROFIBUS.

- Additional functions on unspecified connections
  - When receiving

    Enters the sender and the FDL service in the job header.
  - When sending

    Evaluates the job header and addresses the partner, executes the selected FDL service,

Requirement for Configuration

The PROFIBUS CP of the local and remote station were entered in the hardware configuration and networked with the subnet.

Notice

If you want to use FDL connections, the CP mode of the PROFIBUS CP must **not** be set to **DP slave passive**!

All stations outside the project must be configured with substitute objects (for example “S5” or “other station”).

Priority of the Frames

Remember that the PROFIBUS CPs for SIMATIC S7 send frames with “LOW” priority.

Partner stations (SIMATIC S5 or non-SIMATIC stations) must also use the LOW priority otherwise no connection can be established.

7.3.1 Specified FDL Connection

Characteristics

A specified FDL connection allows program-controlled communication between two stations on PROFIBUS with the following characteristics:

- The data transfer is bi-directional, in other words, it is possible to transmit and receive on the FDL connection simultaneously.
- Both stations have the same rights, in other words, each station can trigger the send and receive procedures in response to events.
- Sending and receiving data uses the SDA service (SendDataAcknowledge) complying with EN 50170, Vol 2.

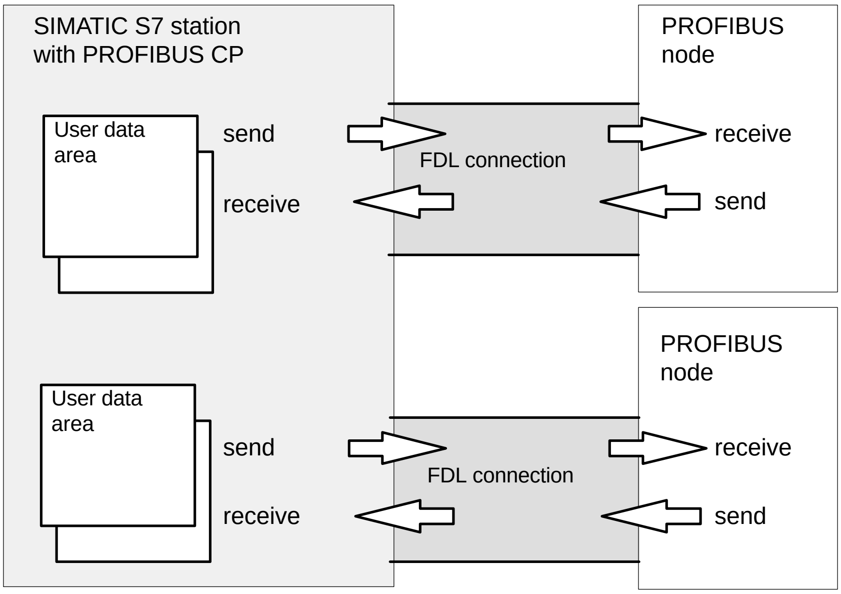


Figure 7-3 Sending and Receiving on **One** Specified FDL Connection - Configured Destination Address

Amounts of Data

Refer to the product information accompanying the PROFIBUS CP for the number of FDL connections supported by the PROFIBUS CP /2/. The number of connections per station can be increased by adding more CPs.

The maximum amount of data that can be sent or received by the PROFIBUS CP on a specified FDL connection is as follows:

- 240 bytes sending
- 240 bytes receiving

7.3.2 Unspecified FDL Connection (Free Layer 2 Access)

Characteristics

An unspecified FDL connection with open layer 2 access allows program-controlled addressing of the communication partner and communication between nodes on PROFIBUS has the following characteristics:

- The data transfer is bi-directional, in other words, it is possible to transmit and receive on the FDL connection simultaneously.
- The local node is specified in the configuration. The remote node is entered in the job header of the job buffer by the user program when it calls AG_SEND. This means that every node on the PROFIBUS (PROFIBUS addresses 0 to 126) can be reached.
- The PB address, the LSAP and the service of the sender can be read from the job header of AG_RECV.

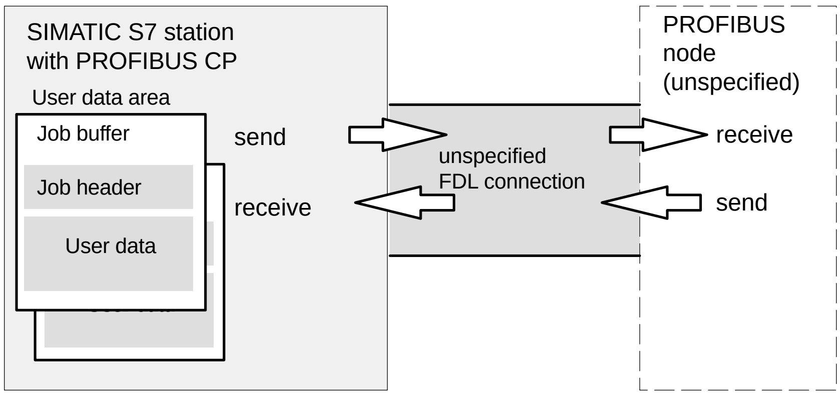


Figure 7-4 Sending and Receiving via an unspecified FDL Connection - Programmed Addressing

Amounts of Data

For the number of FDL connections supported by the particular PROFIBUS CP, please refer to the product information shipped with the PROFIBUS CP /2/. The number of connections per station can be increased by adding more CPs.

Up to 236 bytes of user data can be transferred per job buffer. The job header occupies an additional 4 bytes.

7.3.3 FDL Connection with Broadcast

Characteristics

A broadcast connection allows a message to be sent to more than one receiver with **one** job. This means that messages can be received on a broadcast connection that are also received by other nodes on PROFIBUS at the same time.

The characteristics can be summarized as follows:

- Data transfer is bi-directional, in other words it is possible to send and receive at the same time on the broadcast connection.
- Data is sent and received using the FDL service SDN (Send Data with No Acknowledge).
- When sending, a job buffer must be specified with the AG_SEND call. The area for the job header must be reserved; the content is, however, not relevant.
- The PB address, the LSAP and the service of the broadcast sender can be read from the job header of AG_RECV.
- When sending, the LSAP range from 1 to 56 is used. For receiving, LSAP 63 is reserved for all broadcast nodes.

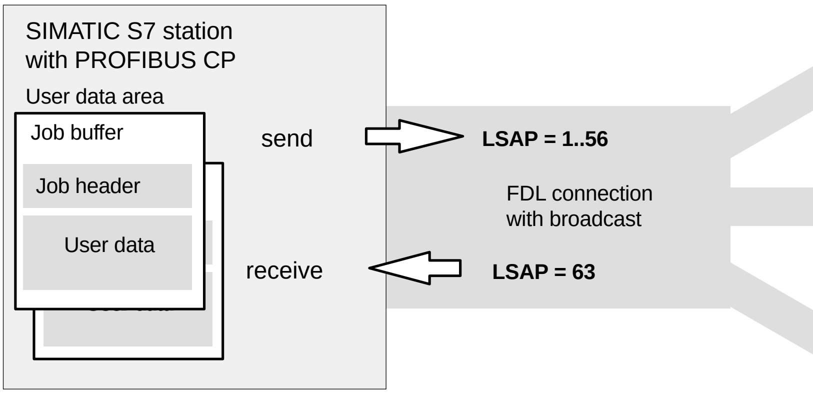


Figure 7-5 Sending and Receiving via an FDL Connection with Programmed Broadcast Addressing

Configuring an FDL Connection with Broadcast

When you create the FDL connection, select “All broadcast nodes” as the connection partner/station.

Amounts of Data

The PROFIBUS CP supports **one** broadcast connection.

Up to 236 bytes of user data can be transferred per job buffer. The job header occupies an additional 4 bytes.

Notice

If you use an FDL connection with broadcast, you cannot receive messages on any further broadcast connection on this CP, including FMS connections with broadcast.
Reason:
The receive LSAP for broadcast (63) is occupied by the broadcast connection.

7.3.4 FDL Connection with Multicast

Characteristics

An FDL connection with multicast allows the sending of a message to several receivers belonging to a multicast group with one job.

The characteristics can be summarized as follows:

- Data transfer is bi-directional, in other words it is possible to send and receive at the same time on the FDL connection with multicast.
- Data is sent and received using the FDL service SDN (Send Data with No Acknowledge).
- A uniform LSAP is used to send to the multicast group (range 1 to 56).
- When sending, a job buffer must be specified with the AG_SEND call. The area for the job header must be reserved; the content is, however, not relevant.
- The PB address, the LSAP and the service of the multicast sender can be read from the job header of AG_RECV.

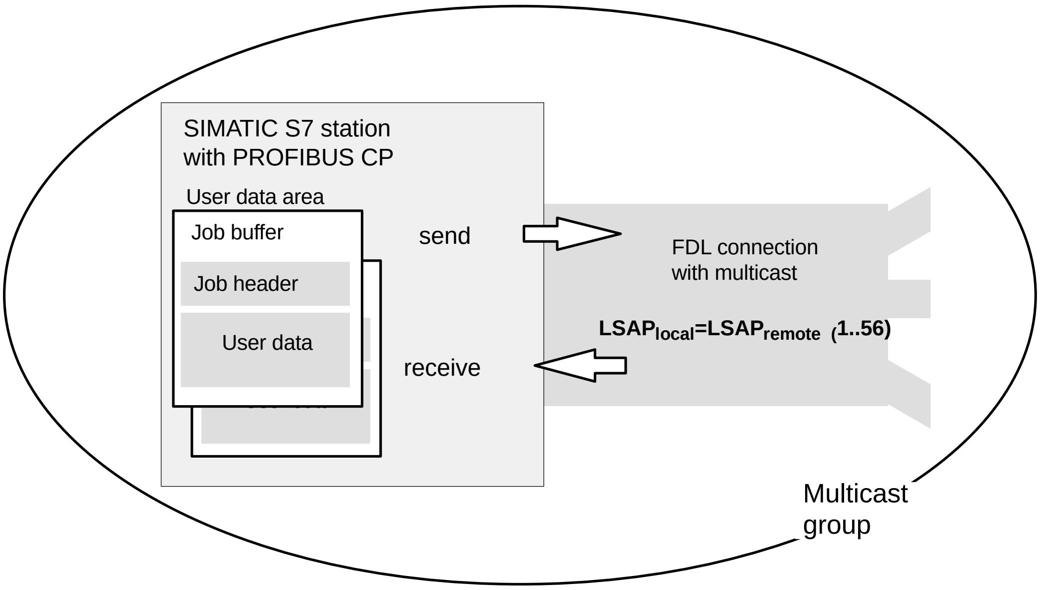


Figure 7-6 Sending and Receiving via an FDL Connection with Programmed Multicast Addressing

Configuring an FDL Connection with Multicast

When you create the FDL connection, select “All multicast nodes” as the connection partner/station.

Amounts of Data

For the number of FDL connections supported by the particular PROFIBUS CP, please refer to the product information shipped with the PROFIBUS CP /2/. The number of connections per station can be increased by adding more CPs.

Up to 236 bytes of user data can be transferred per job buffer. The job header occupies an additional 4 bytes.

7.4 Creating a New FDL Connection

Connections

When you create new connections, you start from entered and networked stations. A connection is then configured starting from a station in the current S7 project and then selecting a second station.

Due to the networking, the PROFIBUS address of the local station is already decided. On a specified FDL connection, this also applies to the selected destination station. The local and remote LSAPs (Link Service Access Point) at both ends of the connection are automatically assigned default values.

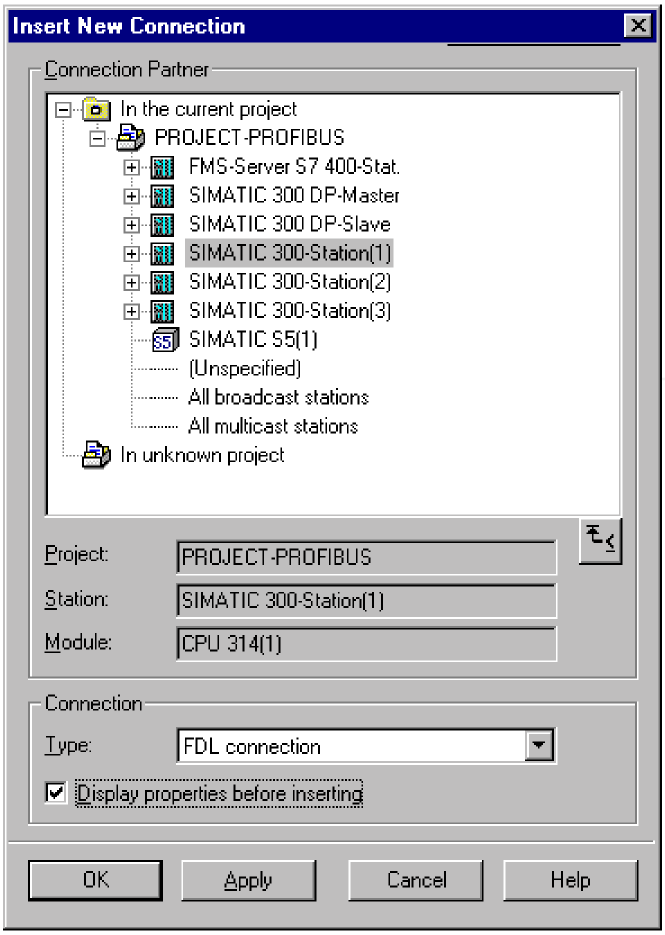
The endpoint of the connection to a SIMATIC S7 station is always a CPU. A separate connection table is created for each CPU and displays the connection partner and types of connections.

New Connection

To configure a new connection, the stations and their CPs must be configured and networked in the S7 project. To create a new connection, follow the steps below starting in NetPro:

1. In NetPro, select the CPU in the station from which you want to establish the connection.
2. Select the menu command **Insert ▸ New Connections** (also available with the right mouse button!)**.**

Result: The following dialog appears on the screen.



3. Select the partner station to which you want to establish a connection (if several CPUs exist, please select the required CPU).
4. Select the connection type you want to use (for example FDL connection) in the “Type” box

If you confirm your entries with **Add**, the new connection is created and the ”New Connection” remains open. This allows you to create further connections without needing to reopen the dialog box. At the same time, the connection list is updated.

When you click **OK**, the connection is entered in the list, the dialog is terminated and the display in the main dialog is updated.

If you click **Cancel**, the dialog is terminated and the connection is not entered in the list.

Notice

The number of connections possible per PROFIBUS CP can be found in the product information /2/supplied with the CP. If several CPs are installed in one station, the next CP is automatically selected if the limit is exceeded. You can rearrange connections in the properties dialog.

Connections to “Other Stations” are generated as “incompletely specified connections”, in other words the remote LSAP is empty. These connections must be checked in the properties dialog and acknowledged with “OK”. To specify the connection, the remote LSAP must be entered.

Connections to Non-S7 Stations using Substitute Objects

If you want to configure connections to devices or stations that are not S7 stations, select a station of the type “SIMATIC S5”, “PC/PG” or “Other Station” as the destination station.

By creating these stations in NetPro and networking them, you have already specified the PROFIBUS address of the local station and the remote station. The local LSAP (Link Service Access Point) is automatically assigned a default value. The remote LSAP remains empty and must be specified in the Properties dialog in the “Addresses” tab.

7.5 Connections to Partners in Other Projects

There are two ways of creating connections to partners configured in other STEP 7 projects or with other tools outside the current STEP 7 project:

- Connections using substitute objects such as “SIMATIC S5”, “PC/PG” , “SIMATIC PC Station” or “Other Station”.

  This method is described in the section above.

- Unspecified connections

  Connections to an as yet unknown device (for example a diagnostic unit) are configured as “unspecified” connections. Unspecified FDL connections can be used in two ways:

  - Free layer 2 access (see also Section 7.3.2)

    The communications partner is addressed by the user program.

  - Connection to an unconfigured partner

    You address an unconfigured communications partner in the current STEP 7 project in the Properties dialog of the connection.

  You can create an unspecified connection simply by selecting station “unspecified” for the connection partner when you create the connection.

- STEP 7 Object “Partner in unknown project” (multiproject)

  With this method, a connection is reserved in both subprojects that can be synchronized later by the system when the partner project is included in the multiproject.

  In both projects, the same connection name must be configured in the properties of the connection. The connection name is used as a textual reference when the projects are merged. Based on the connection name, it is possible to assign the connection partner and synchronize the connection properties.

  The connection configuration can be downloaded to the S7 station only after the subprojects and therefore also the connections have been merged since neither the partner address nor the remote LSAP is known prior to this.

7.6 Configuring FDL Connection Properties

Introduction

As well as the entry in the connection table, you can also modify special properties for each configured connection.
Here, you can change specific connection parameters that were entered as defaults during the new connection dialog.

Opening the Dialog

To call the dialog for special connection properties, follow the steps outlined below:

1. Select the required connection in the connection table.
2. Select the menu option **Edit ▸ Object Properties**.

Result: The “Properties FDL Connection” dialog appears.

Tabs

The properties dialog takes the form of tabs containing groups of different types of parameter.

The following tabs are available for FDL connections:

- **General**

  Displays the global parameters of the connection and the local name of the FDL connection.

- **Addresses**

  Displays the local and remote address information.

- **Overview**

  This is an overview of all the configured FDL connections of the selected S7 station with their parameters (local and remote LSAPs).

- **Status Information**

  This tab displays the current status information for the connection (valid at the time the dialog is opened). This information corresponds to that displayed by NCM diagnostics.

7.6.1 Specifying the FDL Connection Partner

General Tab

This tab in the properties dialog displays global parameters for the connection and the local connection name of the FDL connection. The local ID is identical to the ID in the connection list and is shown here to illustrate the assignment.

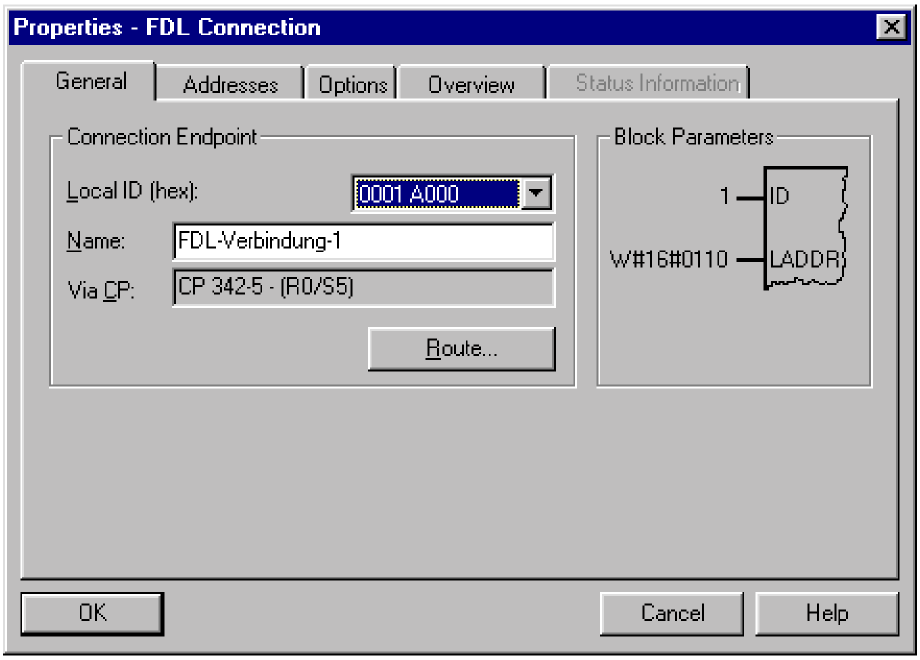


Table 7-1

Local Endpoint	
Attributes	**Description**
Local ID	Identical to the value from the connection list
Name	Proposed name that can be changed by the user
Via CP	If the station contains more than one CP of the same type connected to the same subnet, you can select the connection route. -> “Route” button. If no CP is assigned (for example because the CP was previously deleted) “none” is displayed here. If there is only one CP plugged into the station, no selection is possible.
Block Parameters	
ID	This value must be entered as a block call parameter ID in the user program to identify the connection.
LADDR	This decimal value must be entered as a block call parameter LADDR in the user program to identify the CP (display in hexadecimal, 200_H -> 512_D).

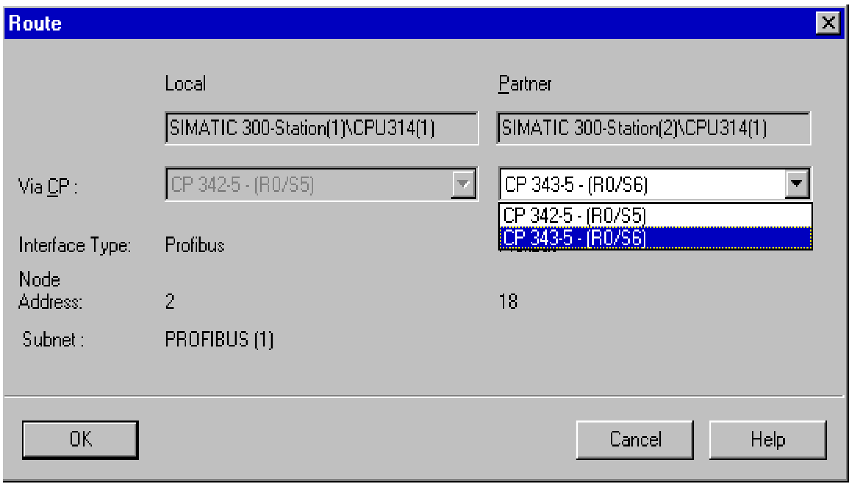
Connection Name (Reference) - only in a multiproject

If you create a connection to a partner in another project, that has not yet been merged with the current multiproject, you must enter a connection name as reference. Interproject connections can then be joined up based on this reference. As soon as the connections have been brought together, the connection name (reference) can no longer be entered.

Routing to Distribute Load

If two or more CPs of the same type exist in a station and are connected to the same subnet, you can select the route.

Click the “Route” button in the “General” tab to display the route dialog:



If you have configured load distribution at the local or remote end on two or more PROFIBUS CPs, you can assign the connection to the required route via the CPs.

7.6.2 Specifying Address Parameters

Address Parameters of an FDL Connection

A connection is specified by the local and remote connection endpoint: These include:

- PROFIBUS address of the station to be contacted.
- Local LSAP (Link Service Access Point) :
  The local LSAP controls the reception of data on the PROFIBUS CP. Receive resources are made available for the LSAP on the PROFIBUS CP for receiving data on the FDL connection
- Remote LSAP (Link Service Access Point):
  The remote LSAP controls the sending of data on the PROFIBUS CP. The PROFIBUS CP sends data to the station on the FDL connection using the LSAP. The destination station must be ready to receive for this SAP.

Addresses Tab - Specified FDL Connection

For a specified FDL connection, the addresses tab displays the relevant local and remote address information as proposed values. If necessary, you can set the LSAP addresses individually.

The way in which the connection partners are shown in the Properties dialog is illustrated in the following example of node A and its connection to node B.

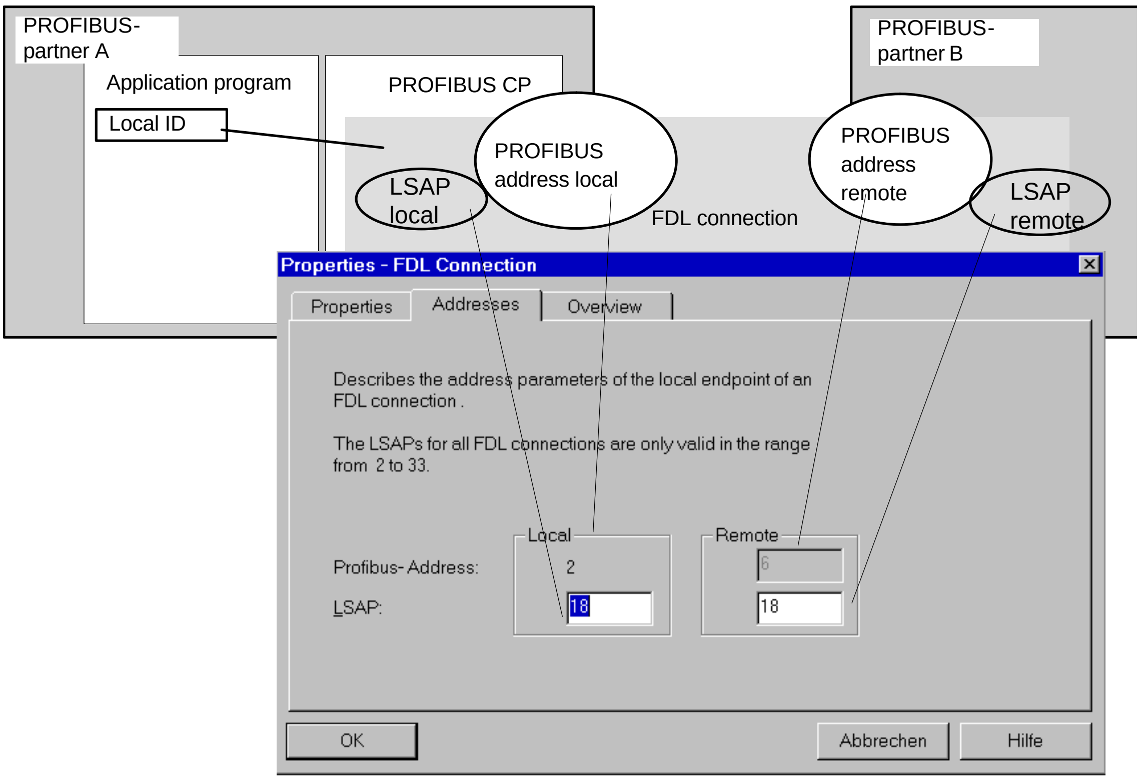


Figure 7-7 Correlation between the Information in the “Addresses” Tab and the Endpoints of the FDL Connection

Addresses Tab - Unspecified FDL Connection

An unspecified FDL connection can be used in two ways:

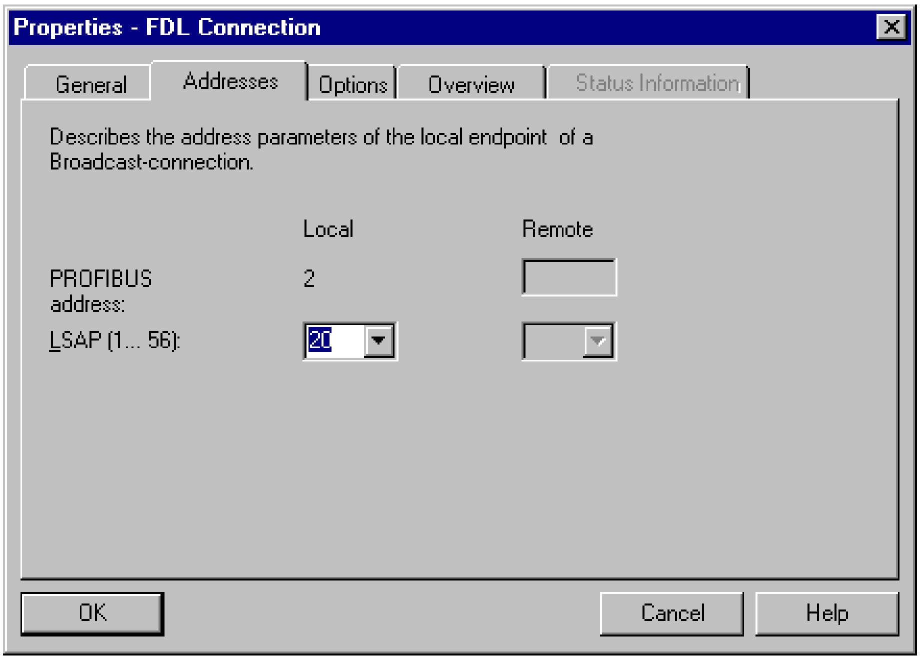
- Connection to a remote station in a different project

  You can specify the remote PROFIBUS address and the LSAP for any destination station. The destination station can be within or outside the current STEP 7 project.

  As long as the remote address is unspecified, no communication is possible on the FDL connection.

- Free layer 2 access

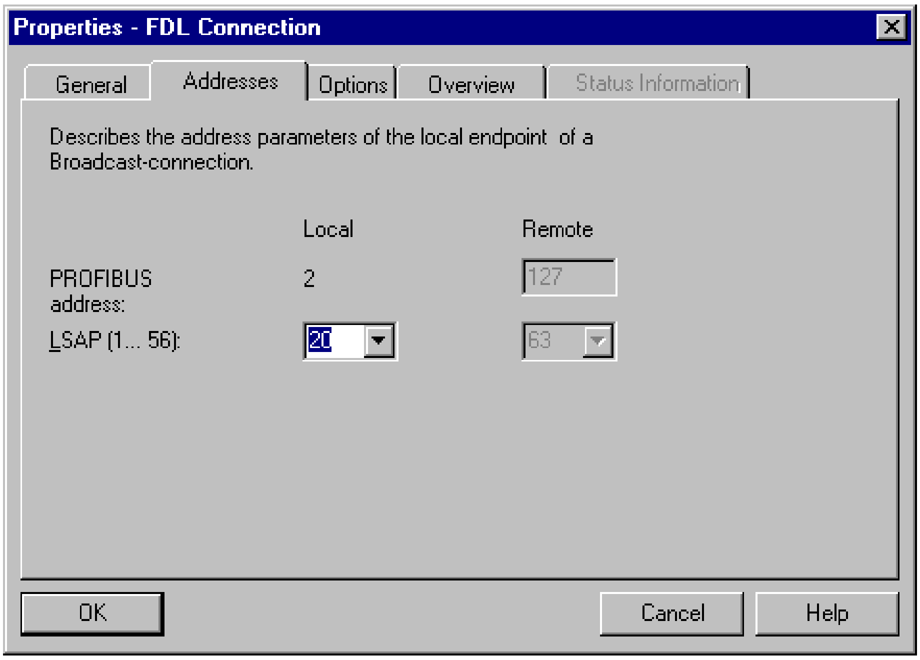
  To configure a free layer 2 access, click the appropriate button. The input boxes for the remote PROFIBUS address and the remote LSAP can then no longer be written to, since the destination addresses are now specified by the user program.



Addresses Tab - FDL Connection with Broadcast

For an FDL connection with broadcast, the remote address parameters are fixed. All broadcast stations can be reached using the PROFIBUS address 127. Receive data are accepted by all broadcast stations via LSAP 63.

The local address parameters are entered in the job header of the message for sending and sent to the receiver. The user program on the remote partner can therefore find out the sender of the broadcast frame.



Notice

If you use an FDL connection with broadcast, you cannot use any other broadcast connection, not even an FMS connection with broadcast.

Caution

Please note the following information about activating cyclic distribution of the bus parameters:

If you have activated this option in the ”Properties PROFIBUS” dialog in the ”Network Settings” tab, the bus parameters are sent cyclically during operation as broadcast frames. To avoid conflicts handling frames in the user program that receives the broadcast frames, you must either:

ignore all frames sent with an LSAP >56 or

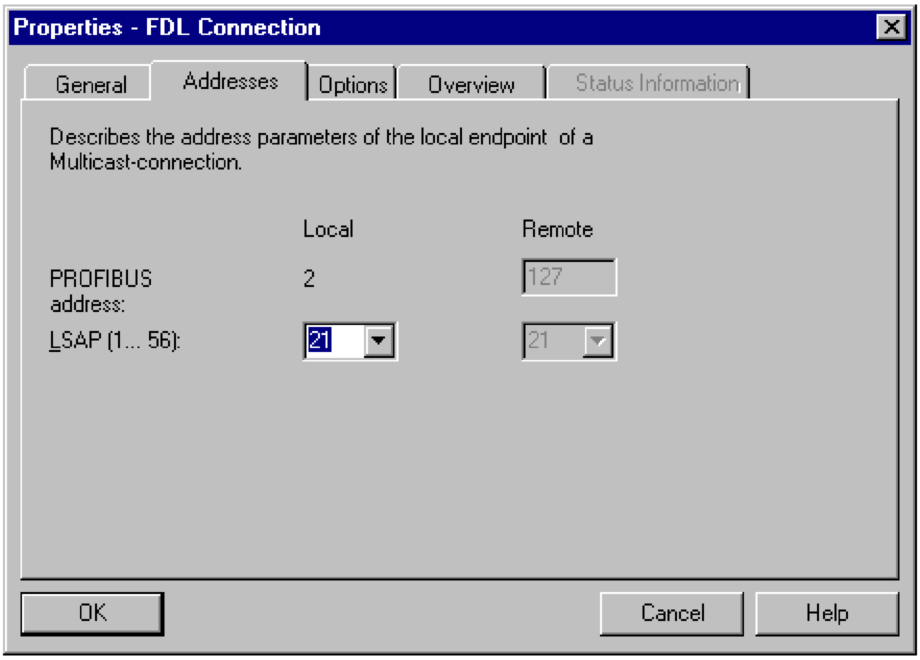
or

deactivate the function in the ”Network Settings” tab.

Addresses - FDL Connection with Multicast Tab

For an FDL connection with multicast, the remote address parameters are fixed. All multicast stations can be reached via the PROFIBUS address 127. Data is sent and received by all stations in the multicast group using the same LSAP (range 1 to 56). The value of the LSAP can therefore only be selected locally and is adopted automatically as the remote LSAP.

The local address parameters are entered in the job header of the message for sending and sent to the receiver. The user program on the remote partner can therefore find out the sender of the multicast message.



7.6.3 Checking the Configuration of the FDL Connections

Overview Tab

The overview tab displays all the previously configured FDL connections and their parameters for this station (this is only for information and cannot be modified). You can set the column width in the table individually.

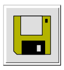
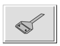
Parameter	Description
Local ID	This is the connection ID of the FDL connection
Name (loc. endpoint)	Entered connection name. This identifies the FDL connection.
CPU / Applications	If you display all the FDL connections being operated in this station in the multiprocessor mode (with PC stations: multiple applications), the CPU/application that is the endpoint of the particular connection is specified here.
R/S or via CP	With S7-CPs: Rack/slot of the local CP via which the connection is established. With PC stations: Display of the CP over which the connection is maintained.
Remote address	Specifies the remote PROFIBUS address of the partner.
Local LSAP	Local link service access point.
Remote LSAP	Remote link service access point.
Status	The status displays the current configuration status of the connection. “Connections without assignment” are indicated by “**No local CP/No remote CP**” in the status column and a “**!**” character at the end of the“Local ID” (for example: 0002 A000!). Connections to “Other Stations” are generated as “incompletely specified connections”, in other words the remote LSAP is empty. The user must check these connections in the properties dialog. If you exit the properties dialog with “OK”, the changes are entered and the identifier of the local ID (!) and the status “Incomplete” are acknowledged.

7.7 Further Functions in Connection Configuration

Toolbar

In the toolbar of the connection configuration dialog the following functions are available:

Table 7-2 Important Functions for Configuring Connections

Save 	To save the configured connection, select the Save function or click the save button (diskette icon).
Print 	You can print the entire connection table or individual sections of it by selecting the Print function or clicking the print button (printer icon). The following print options are available: • Overview of all connections (complete connection table) • Overview of the selected connections (selected area) • Detailed printout of all connections (details of all connections) • Detailed printout of the selected connections (details of the selected area)
Change Connection Partners 	You assign a new partner station to the selected connection. Important! Remember that this also changes the partner ID on connections of the SEND/RECEIVE interface.
Insert Connection 	You create a new entry in the connection table.
Download 	You download the connection table to the PLC. For more detailed information call up the integrated help function.
Help 	If you require help or more information, select the Help function or click the help button (? icon). The help button provides you with context-sensitive help. Using the help function you call a help dialog familiar from other Windows applications.

Print Function in the “Overview” Tab

An additional function for printing the configured connections and configuration status is available in the “Overview” tab.

7.8 Editing Connections without an Assignment

Overview

This section explains the actions that can lead to a configured connection losing its assignment to the CP or being deleted.

Notice

Remember that in contrast to the S7 homogeneous connections, the connections of the SEND/RECEIVE interface are assigned a CP-dependent ID. The actions below may require the ID to be modified so that the interface information in the user program must also be adapted.

Table 7-3 Actions That Can Cause Changes to Configured Connections

Action	Consequences for the Connections	How to Establish the Connection Again
The CP (module) is moved to a different location in the hardware configuration	The connections are retained. The connection IDs are automatically updated.	1. Adapt the module start address LADDR in the user program. 2. Download the connection configuration to the CP again.
The CP (module) is deleted in the hardware configuration. You receive the message “CP has n connections; the assignment will be lost in the connection table”.	The connections remain **without assignment to a CP** in the connection table. In the “Overview” tab of the Properties dialog, the connections are identified with “!”.	Once you have placed a CP in the hardware configuration and networked it: 1. Assign the CP in the connection properties dialog in the “Address” tab. **or** Reassign the connection using the **Edit ▸ Connection Partner.....** menu command. 2. Adapt the connection ID in the user program. 3. Download the connection configuration to the CP again.
Deleting the SIMATIC S7 station.	All the connections to this station are deleted within the project.	Reconfigure the station and connections.

Table 7-3 Actions That Can Cause Changes to Configured Connections, continued

Action	Consequences for the Connections	How to Establish the Connection Again
Deleting a remote station.	The connections of the stations in the project to remote stations remain **without assignment** in the connection table. In the “Overview” tab of the Properties dialog, the connections are identified with “!”.	Reassign a remote station (or even a local station) to the connection using the function **Edit ▸ Connection Partner...**
Changing the subnet assignment of the CP.	The connections that were assigned via the CP remain without an assignment in the connection table. In the “Overview” tab of the Properties dialog, the connections are identified with “!”.	Reassign the connections using the **Edit ▸ Connection Partner...** menu command or in the “Address” tab of the properties dialog for the connection.

Display

The status of the connection is displayed in the “Properties FDL Connection” dialog in the “Overview” tab.

Vorsicht

If a CP is replaced by a different CP, this must provide at least the same services and must be at least the same version.

7.9 SEND/RECEIVE Interface in the User Program on the CPU

Functions (FCs)

The following two blocks (FCs) are available for handling communication on FDL connections:

- AG_SEND
  This block takes the user data from the specified user data area and transfers it to the PROFIBUS CP.
- AG_RECV
  This block transfers received user data to the user data area specified in the call.

The diagram below illustrates the situation. Using the FCs AG_SEND and AG_RECV, the user program instructs the PROFIBUS CP to send or receive data on the configured FDL connection.

With the connection types unspecified with free layer 2 access, broadcast and multicast, the job buffer includes a further job header in the user data area for address and service parameters.

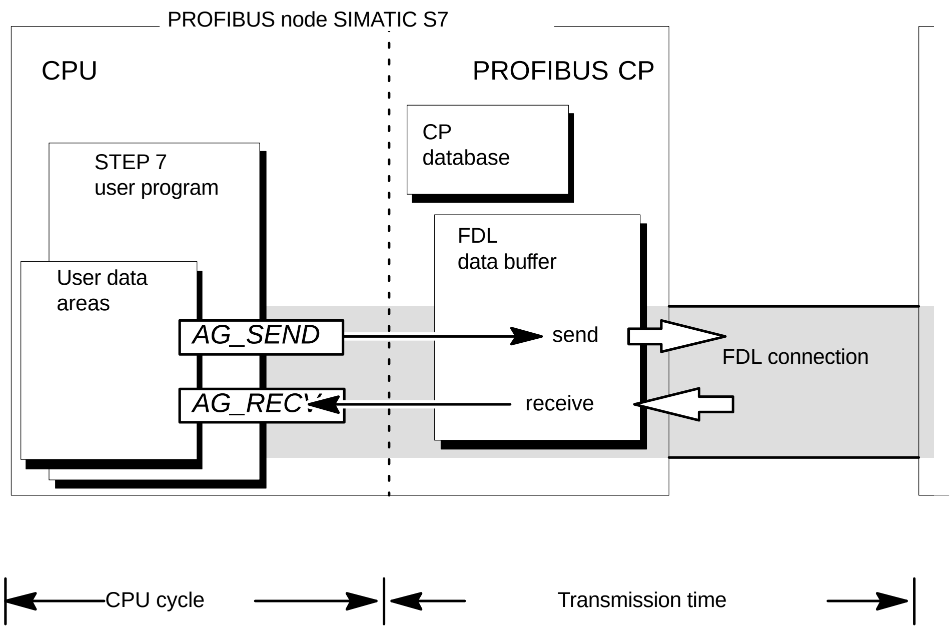


Figure 7-8 Interaction of the CPU and PROFIBUS CP when Using FDL Connections

7.9.1 Writing the User Program for FDL Connections

Principle of Job and Data Transfer

With the FC calls, the CPU program triggers the transmission of the user data areas and monitors successful execution.
Among others, the following parameters are transferred when the FCs are called:

- The number of the FDL connection (ID)
- The module address
- The location of the user data area in the CPU

For detailed information on the call interface, refer to Chapter 8.

Function of the FCs (Functions)

Calling the function blocks has the following effects:

- The user data area is transferred to the PROFIBUS CP or received from the PROFIBUS CP.
- The execution of the job is confirmed positively or negatively in a status message.

Programming FDL Connections

Program the SEND/RECEIVE interface in the user program as follows:

1. Use the following functions (FCs) for data transmission on FDL connections:
   - AG_SEND for transferring the user data area to the PROFIBUS CP
   - AG_RECV for entering data received from the PROFIBUS CP in the user data area
2. Evaluate the following bits in the FCs:
   - for AG_SEND the parameters DONE, ERROR, STATUS
   - for AG_RECV the parameters NDR, ERROR, STATUS

Calling FCs in the CPU Program

One possible sequence for FCs in conjunction with the organization and program blocks in the CPU cycle is illustrated in the following diagram.

Notice

The blocks can be called more than once in a cycle for <u>one</u> communication connection.

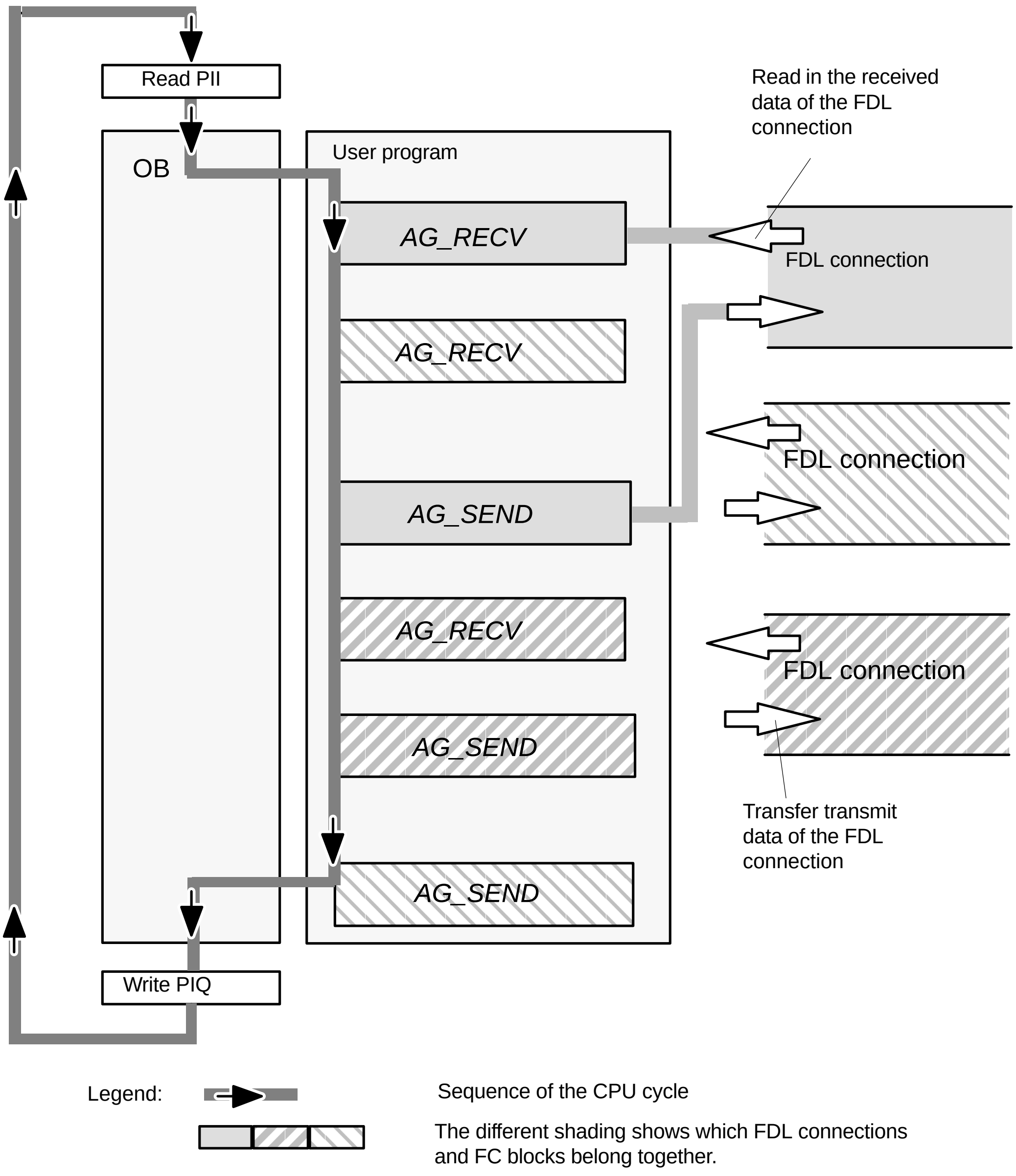


Figure 7-9 Typical Sequence of FDL Function Calls in the CPU Cycle

The following points are illustrated by the diagram:

- The user program consisting of any number of blocks (OBs, FBs or FCs) accesses several FDL connections. (Figure 7-9 illustrates three connections).
- At various points (event and program-controlled) the user program sends data

on an FDL connection using the AG-SEND call.

- At various points in the CPU cycle, the user program accepts the data received on the FDL connection using an AG-RECV call.

7.9.2 Data transfer S7 CPU <-> PROFIBUS CP

Principle

The PROFIBUS CP processes the send and receive jobs independent of the CPU cycle and requires one FDL transmission time. The interface to the user program with the FCs is synchronized by an acknowledgment. Two situations must be distinguished:

- The CPU cycle is faster than the transmission time.
- The CPU cycle is slower than the transmission time.

Note

Please refer to the sequence charts for the FCs in Section 8.3. These charts show how to handle the SEND/RECEIVE interface in the user program for problem-free data exchange.

Remember the points below about the CPU cycle and transmission time.

CPU Cycle Faster than the Transmission Time

If a block is called before data were transferred or received, the procedure is as follows on the interface of the FCs:

- AG-SEND:
  No further job is accepted until the transmission of the data on the FDL connection has been acknowledged by the PROFIBUS station. During this time, the user program receives the message “job active” until the PROFIBUS CP can accept the next job on the same FDL connection (the acknowledgment is in one of the subsequent cycles).

- AG-RECV:
  - On an S7-300:
    The job is acknowledged with the message “Job active” if there are no received data on the PROFIBUS CP. The user program receives this message in the CPU cycle until the PROFIBUS CP has received data again on the same FDL connection.
  - On an S7-400:
    The job is acknowledged with the message “no data available yet” if there are no received data on the PROFIBUS CP. The user program must then start a new job to receive data.

CPU Cycle Slower than the Transmission Time

If a block is called again before the data were transferred or received, the procedure is as follows on the interface of the FC blocks:

- AG-SEND:
  The job is positively acknowledged. The PROFIBUS CP is ready to receive a new send job (at the earliest however with the next call).
- AG-RECV:
  The job is acknowledged with “new data received” if there are new data in the user data area. Following this, you can transfer the data to the user program and call AG-RECV again to be ready to receive data.

  Until the PROFIBUS CP is ready to receive again, it sends a negative acknowledgment to the other PROFIBUS nodes (senders) on the PROFIBUS.

Notice

Remember that resource shortages can occur if the processing speeds on the sender and receiver are not the same (sender faster than receiver).

If this occurs, the sender receives a message from the FCs and must repeat the send job at a later time. (“No resources on the destination station” see Section 8.3).

❑

8 Programming FCs (Functions) for S7 PROFIBUS CPs

Off-the-shelf blocks form the interface to some of the communications services available with the PROFIBUS CPs. This chapter includes a detailed description of the following:

- FCs (functions) for the DP mode with the S7-300
- FCs (functions) for FDL connections (SEND/RECEIVE interface)

The description of each FC includes the following sections that may be extended by specific information:

- Meaning
- Call Interface
- How the Block Works
- Explanation of the Formal Parameters
- Condition Codes

This chapter provides you with information over and above the general information available in the online help for the FCs when programming in STEP 7.

You will find further information in the following sources:

- The communication FBs (BSEND, BRCV, PUT, GET, USEND, URCV) and FC C_CNTRL for programming S7 communication for the S7-300 are described in the STEP 7 Documentation /9/.
- In the PROJECT_PROFIBUS sample project that you can start after installing NCM S7, you will find **sample programs**. There are descriptions of these in the Primer /4/.
- For programming and configuring stations for FDL connections (for example a SIMATIC S5 PLC with the CP 5430/31, SIMATIC S5-95U with a PROFIBUS interface, PCs with a CP CP 5613), please refer to the appropriate manuals.

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

You can order this directly on the Internet at:
http://www.ad.siemens.de/net/html_00/online_zugreifen.htm

8.1 General information on the FCs / FBs for PROFIBUS CPs

Block Library

The functions (blocks of the type FC) described here are supplied with the standard STEP 7 package.

The following list shows the numbers of the FCs as they are supplied with the configuration tool. You can change these numbers. You will also find the following information on the block library in the SIMATIC Manager:

- Standard Library

  These blocks are available after installing the standard package.

- SIMATIC_NET_CP

  These blocks are available when you install the NCM S7 for PROFIBUS option (default setting in STEP 7 Setup). Please note that you must use different FCs for the S7-300 and S7-400 (separate libraries).

Communication Service	Block type [1)]		SIMATIC Manager Library			Described in
			Standard Library	SIMATIC_NET_CP		
			Communication Blocks	CP 300	CP 400	
PROFIBUS DP	FC1	DP_SEND	x	x		Section 8.3
	FC2	DP_RECV	x	x		
	FC3	DP_DIAG	x	x		
	FC4	DP_CTRL	x	x		
SEND/RECEIVE (S5-compatible communication)	FC5	AG_SEND		x	x	Section 8.4
	FC6	AG_RECV		x	x	
	FC50	AG_LSEND			x	
	FC60	AG_LRECV			x	
S7 communication	FB12	BSEND		x		STEP 7 Documentation /9/
	FB13	BRCV		x		
	FB15	PUT		x		
	FB14	GET		x		
	FB8	USEND		x		
	FB9	URCV		x		
	FC62	C_CNTRL		x		

Communication Service	Block type [1)]		SIMATIC Manager Library			Described in
			Standard Library	SIMATIC_NET_CP		
			Communication Blocks	CP 300	CP 400	
PROFIBUS-FMS	FB2	IDENTIFY		x	x	NCM S7 for PROFIBUS Manual Volume 2 /3/
	FB3	READ		x	x	
	FB4	REPORT		x	x	
	FB5	STATUS		x	x	
	FB6	WRITE		x	x	

[1)] Note:
The following descriptions also include information on differences between the various block versions. Please take note of the version identifiers of the blocks you are using.

The SIMATIC Manager block libraries installed with STEP 7 / NCM S7 contain the block versions that were current at the time of the STEP 7 release.

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://www4.ad.siemens.de/view/cs/de/8797900

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

Notice

At various points in this chapter, you will find information on the different CP versions. These passages are highlighted with the following symbol:

Newer CP types are CPs / module types with the following versions or higher:

CP 342-5
6GK7342-5DA02-0XE0 version 1 or higher / firmware version V4.0 or higher

CP 342-5 FO
6GK7342-5DF00-0XE0 version 1 or higher / firmware version V4.0 or higher

CP 343-5 (not relevant for FCs for DP functionality)
6GK7343-5FA01-0XE0 version 1 or higher / firmware version V4.0 or higher

FCs / FBs and Module Replacement (Spares)

Module replacement in this sense means the replacement of a module with another module that may be a more recent version.

Notice

Please remember that if you replace a module, you must only use the blocks permitted for the configured CP type in the user program.

This means:

- If you replace the module without adapting the configuration data to the possibly newer module type, you do not need to make any changes to the blocks used.
- If you replace the module and you do adapt the configuration data to the newer module type, you must use the block versions approved for this module type.

We recommend that you always use the latest block versions for all module types. With the older module types, this recommendation assumes that you are using the latest firmware for the particular block type.

You will find more information on replacing blocks in our Customer Support on the Internet at:

http://www4.ad.siemens.de/view/cs/de/7806643

The manuals /2/ contain information on the compatibility of the S7-CPs and the corresponding blocks (FCs / FBs).

8.2 Setting Parameters for Block / Function Calls

Before describing the blocks / FCs in detail, a few general comments on calling and setting parameters for FCs will be useful in this point.

It is possible to make the following general statements about the following parameter groups that occur in all FCs / FBs:

- Parameters for CP and connection assignment (input parameters)
- Parameters for specifying a CPU data area (input parameters)
- Status information (output parameters)

Calling Communication Blocks for an S7-300

Notice

The communication blocks for S7-300 (SIMATIC NET block libraries for S7-300 in STEP 7) must not be called in more than one priority class! If, for example, you call a communication block in OB1 and in OB35, block execution could be interrupted by the higher-priority OB.

If you call blocks in more than one OB, you must write your program so that a communication block that is currently executing cannot be interrupted by another communication block (for example by disabling/enabling SFC interrupts).

8.2.1 Parameters for CP and Connection Assignment (input parameters)

When you call an FC, you transfer the module start address of the PROFIBUS CP in the CPLADDR or LADDR parameter. The module start address of the PROFIBUS CP can be found in the properties dialog of the CP in the ”Address/Input” tab (can be selected in the SIMATIC Manager or in HW Config).

With connection-oriented jobs, you must also reference the connection to be used by its connection ID. You will find this in the properties dialog of the connection under “Block parameters” (refer to the information in NetPro).

Setting Block Parameters Automatically[1)]

To ensure correct parameter settings for the block calls, The LAD/STL/FBD editor in STEP 7 provides you with the option of accepting all the relevant parameters from the hardware configuration (HW Config) and from the connection configuration (NetPro).

When assigning the parameters for the block in the user program, follow the steps outlined below:

1. Select the block call and its block parameters;
2. Right-click and select the menu command **"Connections..."**.
3. Depending on the block type, you can now select the connection and/or module intended for the block from a list.
4. Confirm your selection; as far as possible, the available parameter values are entered in the block call.

Response to Incorrect Addresses

If the S7-CPU cannot communicate with the PROFIBUS CP using the specified module start address or cannot identify it as a CP, the errors described below result.

Cause	Reaction / Code
No module can be addressed or identified at the specified CP address.	The CPU remains in the stop with system error state; in this case, evaluate the diagnostic buffer of the CPU.
The CP address points to a different module type.	Possible error code in the STATUS parameter of the communication block: 8184H System error 80B0H The module does not recognize the data record. 80C0H The data record cannot be read. 80C3H Resources occupied (memory). 80D2H Logical base address wrong.

Notice

If you inadvertently address not a CP but another module type, errors occur that cannot be indicated by the error messages of the FCs themselves.

1). This function is possible only with the block library ..V5.0 SP3 or later.

8.2.2 Parameters for Specifying a CPU Data Area (input parameters)

Specifying the Data Area on the CPU

When you call an FC, you transfer the address and length of the data area on the CPU in which the user data are available or will be stored or which can contain further parameter information.

The ANY pointer data type is used to address this area. For more detailed information on this data type, refer to the STEP 7 online help under the topic ”Format of the Parameter Type ANY”. You will also find a detailed description of the ANY point in /9/.

8.2.3 Status Information (output parameters)

For status evaluation, the following parameters must be evaluated in the user program:

- DONE or NDR

  These parameters (DONE with send jobs and NDR with receive jobs) signal (successful) completion of the job.
- ERROR

  This indicates that the job could not be executed error-free.
- STATUS

  This parameter supplies detailed information about the execution of the job. Status codes can be returned during execution of the job (DONE=0 and ERROR=0).

Evaluating Status Codes

Remember that the status codes DONE, NDR, ERROR, STATUS are updated at each block call.

Status Codes during CP Startup

With a complete restart or restart of the PROFIBUS CP (after activating a switch on the module), the output parameters of the FC are reset as follows:

- DONE = 0
- NDR = 0
- ERROR = 0
- STATUS = 8180_H or 8181_H

8.3 FCs for the DP Mode with the S7-300

Overview

The following FCs are available for the DP master and DP slave modes with an S7-300:

FC	FC can be used with:		Meaning
	DP Master	DP Slave	
DP_SEND (FC1)	X	X	for sending data
DP_RECV (FC2)	X	X	for receiving data
DP_DIAG (FC3)	X	-	for diagnostic functions initiated by the DP master
DP_CTRL (FC4)	X	-	for control functions

Application

The following diagram illustrates the use of the DP_SEND and DP_RECV FCs on the DP master and DP slave.

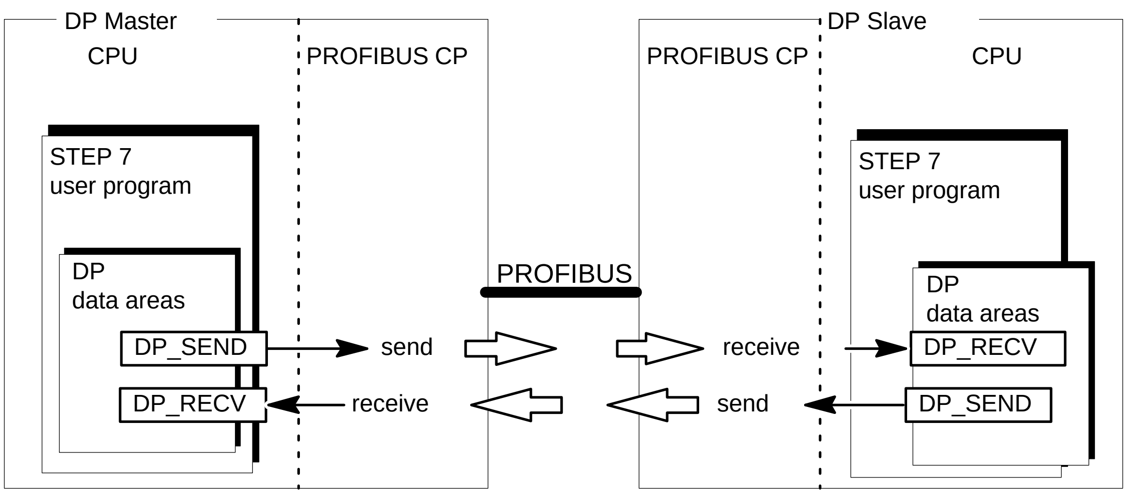


Figure 8-1 Using the FCs DP_SEND and DP_RECV With DP Master and DP Slave

8.3.1 FC1 DP_SEND

Meaning

FC DP_SEND transfers data to the PROFIBUS CP. Depending on the mode of the PROFIBUS CP, DP_SEND has the following significance:

- On the DP master
  The block transfers the data of a specified DP output area to the PROFIBUS CP for output to the distributed I/O system.
- When used in the DP slave:
  The block transfers the input data of the DP slave to the PROFIBUS CP for transfer to the DP master.

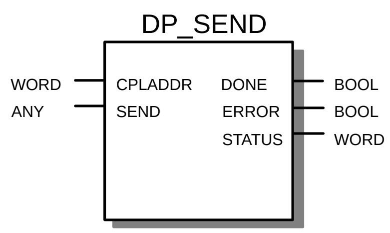
The selected data area can be a process image area, a memory bit area or a data block area.

Correct execution is signaled when the entire DP data area could be accepted by the PROFIBUS CP.

Remember *), that the DP_SEND function must always be called at least once on the DP master and on the DP slave in the user program.

*) Note: This does **not** apply to newer CP types! FC DP_SEND must then be called successfully at least once for the DP slave in the user program if inputs were configured for this slave. Please read the information in the manual.

Call Interface



Example of a call in STL representation

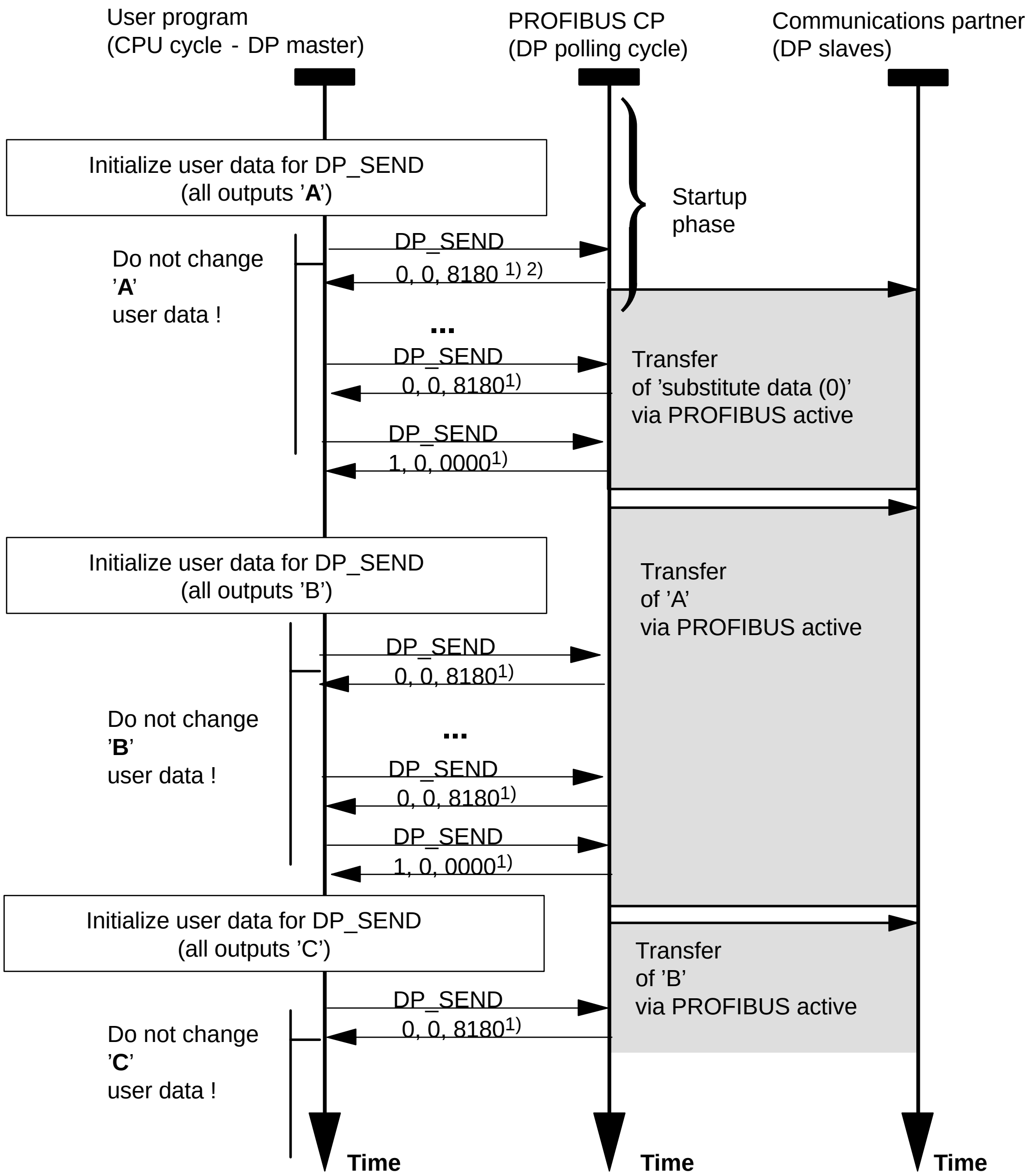
STL		Explanation
call fc 1		//DP_SEND function call
CPLADDR:=	W#16#0120	
SEND :=	P#db17.dbx0.0 byte 103	
DONE :=	M 99.1	
ERROR :=	M 99.0	
STATUS :=	MW 104	

FC1 DP_SEND - continued

How the Block Works

The following flow diagram illustrates the normal sequence of data transfer triggered with DP_SEND in the user program.

Each DP_SEND job in the user program is acknowledged by the PROFIBUS CP setting values in the DONE, ERROR and STATUS output parameters.



Legend:
1) Parameter transfer DONE, ERROR, STATUS
2) With older CP types, the code 8183_H is possible during startup

FC1 DP_SEND - continued

Guarantee of Data Transfer

The diagram also shows that with the confirmation DONE=1, ERROR=0 and STATUS=0000, data transfer to the communications partner is functioning correctly.

The latest transmitted data transferred to the PROFIBUS CP are always passed on to the communications partner. For this reason, new user data must only be entered in the send buffer following a positive acknowledgment (DONE=1, ERROR=0, STATUS=0000).

Explanation of the Formal Parameters

The following table explains all the formal parameters for the DP_SEND function:

Parameter	Declaration	Type	Possible Values	Remarks
CPLADDR	INPUT	WORD		Module base address When you configure the CP with STEP 7 hardware configuration, the module start address is displayed in the configuration table. Specify this address here.
SEND	INPUT	ANY (as VARTYPE only BYTE, with FC1 V3 and higher: BYTE with FC1 up to V2.x: BYTE, WORD and DWORD)		Specifies the address and length. The address of the DP data area refers to one of the following: - Process image area - Bit memory - Data block area The length must be set for - DP master: 1 to 240 - DP slave: 1 to 86  The following applies to new modules (see CP manual): - DP master: 1...2160 - DP slave: 1..240
DONE	OUTPUT	BOOL	0: - 1: new data	This parameter indicates whether or not the job was executed without errors. For the meaning of this parameter in conjunction with the ERROR and STATUS parameters, refer to the following table.
ERROR	OUTPUT	BOOL	0: - 1: error	For the meaning of this parameter in conjunction with the DONE and STATUS parameters, refer to the follow table.
STATUS	OUTPUT	WORD	see following table	Status code For the meaning of this parameter in conjunction with the DONE and ERROR parameters, refer to the following table 8-1.

FC1 DP_SEND - continued

Condition Codes

The following table shows the condition codes formed by the DONE, ERROR and STATUS parameters that must be evaluated by the user program.

Note

For entries coded with $8Fxx_H$ in STATUS, refer to the information in the STEP 7 Standard and System Functions reference manual. The chapter describing error evaluation with the RET_VAL output parameter contains detailed information.

To find out which SFCs are used and are relevant for error evaluation, display the properties dialog of the FC described here in the “Calls” tab.

Table 8-1 DP_SEND Codes

DONE	ERROR	STATUS	Meaning
0	0	8180_H	Startup: The DP service was started but data acceptance is not yet possible. Normal operation: Data transfer active.  With newer CP types, the following meaning is possible (see /2/): DP has not been started due to CP STOP or “no parameter assignment” (occurs here instead of code 0,1,8183_H!).
1	0	0000_H	New data transferred without error.
0	1	8183_H	No configuration or the DP service has not yet started on the PROFIBUS CP.
0	1	8184_H	System error or bad parameter type.
0	1	$8F22_H$	Area length error reading a parameter (e.g. DB too short).
0	1	$8F23_H$	Area length error writing a parameter (e.g. DB too short).
0	1	$8F24_H$	Area error reading a parameter.
0	1	$8F25_H$	Area error writing a parameter.
0	1	$8F28_H$	Alignment error reading a parameter.
0	1	$8F29_H$	Alignment error writing a parameter.
0	1	$8F30_H$	Parameter is in the write-protected 1st act. data block.
0	1	$8F31_H$	Parameter is in the write-protected 2nd act. data block.
0	1	$8F32_H$	Parameter contains a DB number that is too high.
0	1	$8F33_H$	DB number error.
0	1	$8F3A_H$	Destination area not loaded (DB).
0	1	$8F42_H$	Timeout reading a parameter from the I/O area.
0	1	$8F43_H$	Timeout writing a parameter to the I/O area.

FC1 DP_SEND - continued

Table 8-1 DP_SEND Codes, continued

DONE	ERROR	STATUS	Meaning
0	1	8F44$_H$	Address of the parameter to be read is disabled in the access track.
0	1	8F45$_H$	Address of the parameter to be written is disabled in the access track.
0	1	8F7F$_H$	Internal error, e.g. illegal ANY reference.
0	1	8090$_H$	No module with this address exists.
0	1	8091$_H$	Logical base address not at a double word boundary.
0	1	80A1$_H$	Negative acknowledgment writing to the module.
0	1	80B0$_H$	The module does not recognize the data record.
0	1	80B1$_H$	The specified data record length is incorrect. Master mode: The length of the source area in the SEND parameter is greater than the length configured on the PROFIBUS CP for output data. Slave mode: The length of the source area specified in the SEND parameter is greater than the maximum length specified in the product information bulletin / manual /2/ .  With newer CP types, the following applies to the DP master and DP slave modes (see /2/): The number of data to be sent exceeds the upper limit for this service.
0	1	80C0$_H$	The data record cannot be read.
0	1	80C1$_H$	The specified data record is currently being processed.
0	1	80C2$_H$	There are too many jobs pending.
0	1	80C3$_H$	Resources occupied (memory).
0	1	80C4$_H$	Communication error (occurs temporarily, it is usually best to repeat the job in the user program).
0	1	80D2$_H$	Logical base address incorrect.

8.3.2 FC2 DP_RECV

Meaning

The DP_RECV function (FC) receives data on PROFIBUS. DP_RECV has the following significance depending on the mode of the PROFIBUS CP:

- On the DP master
  DP_RECV receives the process data from the distributed I/Os and status information and enters them in a specified DP input area.
- When used on the DP slave
  DP_RECV accepts the output data transferred by the DP master in the DP data area specified in the block.

The data area specified for the receive data can be a process image area, a bit address area or a data block area.

Error-free execution of the function is signaled when the entire DP data input area could be transferred by the PROFIBUS CP.

Remember *) that the DP_RECV function must always be called at least once on the DP master and on the DP slave in the user program. On the DP master it then only needs to be called to receive data.

*) Note: This does **not** apply to newer CP types! With new types, the FC DP_RECV must be called successfully at least once for the DP slave the user program if output data were configured for this DP slave. Please read the information in the manual.

Additional Task: Entering the Status Byte

The DP_RECV function has the following additional task:

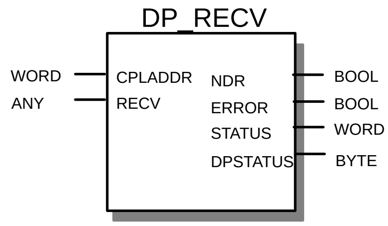
- Updating the DP status byte DPSTATUS. Here DP_RECV takes over tasks for DP_Diagnostics.

  If no receive data are configured, DP_RECV must be called with a length of 255 to update the DPSTATUS status byte (this only applies to DP masters; with DP slaves, the status byte cannot be read without data).

  Note: With newer modules (please refer to the information in the manual), it is adequate to specify the length 1. Remember that the entire area specified by the RECV parameter is always overwritten when the job is processed.
- Enabling the station list (see DP_DIAG Section 8.3.3).

FC2 DP_RECV - continued

Call Interface



Example in STL representation

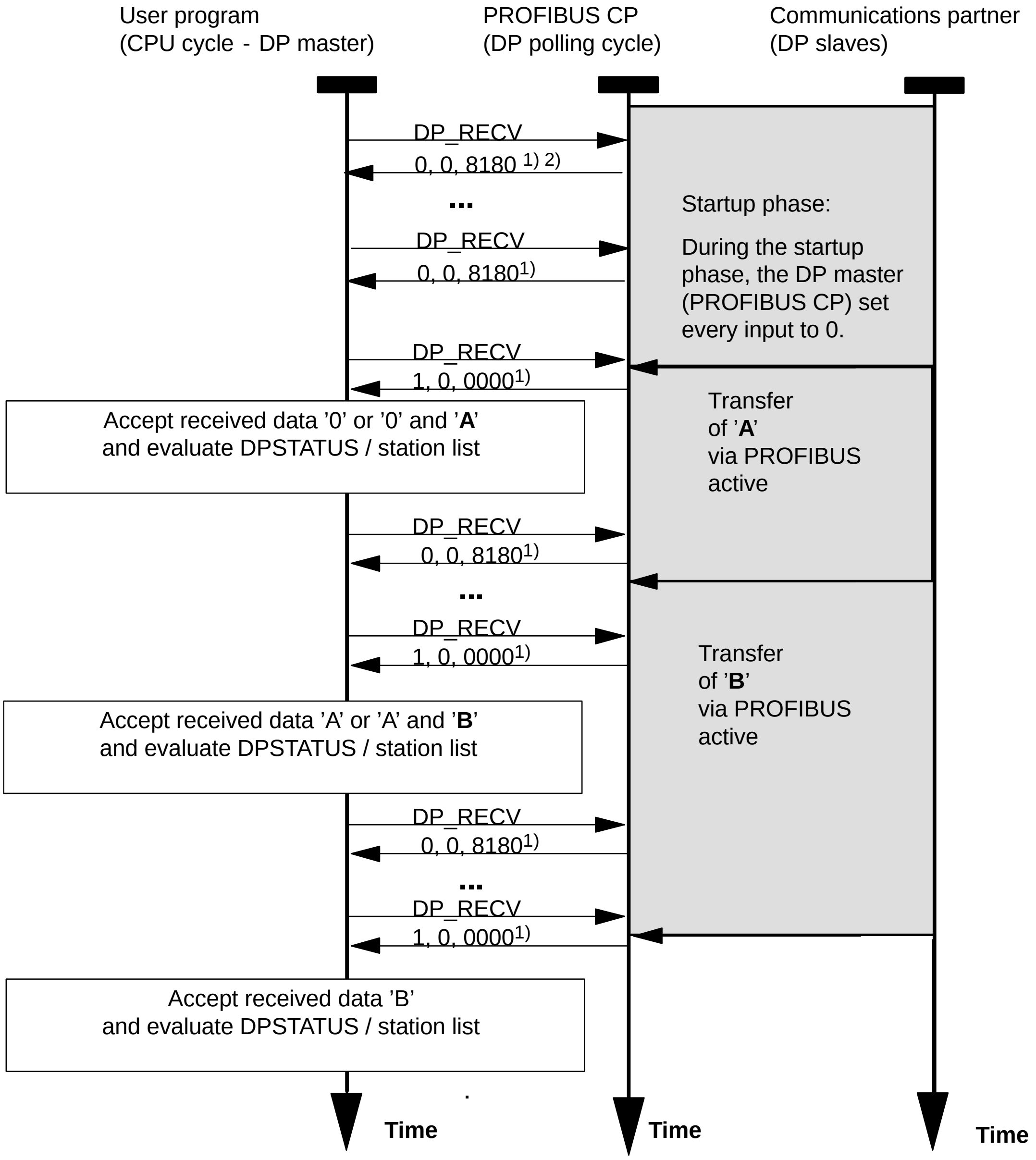
STL		Explanation
call fc 2		//DP_RECV function call
CPLADDR:=	W#16#0120	
RECV :=	P#db17.dbx240.0 byte 103	
NDR :=	M 99.1	
ERROR :=	M 99.0	
STATUS :=	MW 104	
DPSTATUS:=	MB 0	

How the Block Works

The following flow diagram illustrates the normal sequence of data transfer triggered with DP_RECV in the user program.

Each DP_RECV job in the user program is acknowledged by the PROFIBUS CP setting values in the NDR, ERROR and STATUS output parameters.

FC2 DP_RECV - continued



Legend:
1) Parameter transfer DONE, ERROR, STATUS
2) With older CP types, the code 8183_H is possible during startup

FC2 DP_RECV - continued

Guarantee of Data Acceptance

The diagram also shows that the confirmation NDR=1, ERROR=0 and STATUS=0000 indicates reliable data reception. Condition: The DP master and the DP slaves are in the data transfer phase.

Note the following points:

- In the DP master mode:

  If a DB slave is not in the data transfer phase, the corresponding received data are set to 0.

  If the DP master is neither in the RUN nor CLEAR state (bits 4 and 5 in DPSTATUS), all the received data are set to 0.

  If data have been received from the DP slave several times since the last DP_RECV function call, only the last received data is fetched with the next DP_RECV.

- In the DP slave mode:

  If the DP slave is not in the data transfer phase (bit 1 in DPSTATUS) or the DP master is in the CLEAR state (bit 2 in DPSTATUS), the received data are set to 0.

  If data have been received from the DP master several times since the last DP_RECV function call, only the last received data is fetched with the next DP_RECV.

Explanation of the Formal Parameters

The following table explains all the formal parameters for the function DP_RECV:.

Parameter	Declaration	Type	Possible Values	Remarks
CPLADDR	INPUT	WORD		Module base address When you configure the CP with STEP 7 hardware configuration, the module start address is displayed in the configuration table. Specify this address here.

FC2 DP_RECV - continued

Parameter	Declaration	Type	Possible Values	Remarks
RECV	INPUT	ANY (as VARTYPE only BYTE, with FC1 V3 and higher: BYTE with FC1 up to V2.x: BYTE, WORD and DWORD)		Specifies the address and length. The address of the DP data area refers to one of the following: - Process image area - Bit memory - Data block area The length must be set for - DP master: 1 to 240 - DP slave: 1 to 86 - DP master; only read status byte : 255  The following applies to new modules (see CP manual): - DP master: 1...2160 - DP slave: 1 to 240 - DP master; only read status byte : 1
NDR	OUTPUT	BOOL	0: - 1: new data accepted	This parameter shows if new data were accepted.Status code For the meaning of this parameter in conjunction with the DONE and ERROR parameters, refer to the following table 8-2.
ERROR	OUTPUT	BOOL	0: - 1: error	Error code For the meaning of this parameter in conjunction with the NDR and STATUS parameters, refer to the following table 8-2.
STATUS	OUTPUT	WORD	see following table	Status code For the meaning of this parameter in conjunction with the NDR and ERROR parameters, refer to the following table 8-2.
DPSTATUS	OUTPUT	Byte	For coding, see below under DPSTATUS (Table 8-3)	DP status code

FC2 DP_RECV - continued

Condition Codes

The following table shows the codes formed by the DONE, ERROR and STATUS parameters that must be evaluated by the user program.

Note

For entries coded with $8Fxx_H$ in STATUS, refer to the information in the STEP 7 Standard and System Functions reference manual. The chapter describing error evaluation with the RET_VAL output parameter contains detailed information.

To find out which SFCs are used and are relevant for error evaluation, display the properties dialog of the FC described here in the “Calls” tab.

Table 8-2 DP_RECV Codes

NDR	ERROR	STATUS	MEANING
0	0	8180_H	Startup: The DP service was started but data acceptance is not yet possible. Normal operation: Data acceptance active.  With newer CP types, the following meaning is possible (see /2/): DP has not been started due to CP STOP or “no parameter assignment” (occurs here instead of code $0,1,8183_H$!).
1	0	0000_H	New data accepted without error.
0	1	8183_H	No configuration or the DP service has not yet started on the PROFIBUS CP.
0	1	8184_H	System error or bad parameter type.
0	1	$8F22_H$	Area length error reading a parameter (e.g. DB too short).
0	1	$8F23_H$	Area length error writing a parameter (e.g. DB too short).
0	1	$8F24_H$	Area error reading a parameter.
0	1	$8F25_H$	Area error writing a parameter.
0	1	$8F28_H$	Alignment error reading a parameter.
0	1	$8F29_H$	Alignment error writing a parameter.
0	1	$8F30_H$	Parameter is in the write-protected 1st act. data block.
0	1	$8F31_H$	Parameter is in the write-protected 2nd act. data block.
0	1	$8F32_H$	Parameter contains a DB number that is too high.
0	1	$8F33_H$	DB number error.
0	1	$8F3A_H$	Destination area not loaded (DB).
0	1	$8F42_H$	Timeout reading a parameter from the I/O area.
0	1	$8F43_H$	Timeout writing a parameter to the I/O area.

FC2 DP_RECV - continued

Table 8-2 DP_RECV Codes, continued

NDR	ERROR	STATUS	MEANING
0	1	$8F44_H$	Address of the parameter to be read is disabled in the access track.
0	1	$8F45_H$	Address of the parameter to be read is disabled in the access track.
0	1	$8F7F_H$	Internal error, e.g. illegal ANY reference.
0	1	8090_H	No module with this address exists.
0	1	8091_H	Logical base address not at a double word boundary.
0	1	$80A0_H$	Negative acknowledgment writing to the module.
0	1	$80B0_H$	The module does not recognize the data record.
0	1	$80B1_H$	The specified data record length is incorrect. Slave mode: The length of the destination area specified in the RECV parameter is greater than the maximum length specified in the CP product information bulletin / manual /2/ . Master mode:The length of the destination area specified in the RECV parameter is greater than the length of the input data configured on the PROFIBUS CP.  With newer CP types, the following applies to the DP master and DP slave modes (see /2/): The number of data to be received exceeds the upper limit for this service.
0	1	$80C0_H$	The data record cannot be read.
0	1	$80C1_H$	The specified data record is currently being processed.
0	1	$80C2_H$	There are too many jobs pending.
0	1	$80C3_H$	Resources occupied (memory).
0	1	$80C4_H$	Communication error (occurs temporarily, it is usually best to repeat the job in the user program).
0	1	$80D2_H$	Logical base address incorrect.

FC2 DP_RECV - continued

DPSTATUS

The coding of the DPSTATUS output parameter is different for the DP master mode and DP slave mode:

- DP master mode:

7	6	5	4	3	2	1	0
							0

Table 8-3 Meaning of the Bits in DPSTATUS - DP master mode

Bit	Meaning
7	not used
6	1: received data overflow The received data were accepted by the DP slave faster than they could be fetched by the DP master with the block call in the CPU. The received data read out are always the last data received by the DP slave.  Note: With newer models (please refer to the information in the manual), this bit is no longer set.
5,4	Values for DP STATUS of the DP master: 00 RUN 01 CLEAR 10 STOP 11 OFFLINE  Note: With newer modules (refer to the information in the manual), the STOP mode is now the OFFLINE mode.
3	1:Cyclic synchronization is active.
2	0: no new diagnostic data exist 1: evaluation of diagnostic list useful; at least one station has new diagnostic data
1	0: all DP slaves in the data transfer phase 1: evaluation of the station list useful
0	DP Mode 0: DP master mode The other bits only have the specified meaning when this bit is not set.

FC2 DP_RECV - continued

- DP slave mode:

7	6	5	4	3	2	1	0
							1

Table 8-4 Meaning of the Bits in DPSTATUS - DP slave mode

Bit	Meaning
7-5	not used
4	1: input data overflow The input data were updated by the DP master faster than they could be fetched by the DP slave with the block call in the CPU. The input data read out are always the last input data received from the DP master.  Note: With newer models (please refer to the information in the manual), this bit is no longer set.
3	1: The DP slave has not received a frame from the DP master within the watchdog time. If this bit is set, **bit 1 is also set**.  Note: With newer models (please refer to the information in the manual), this bit is no longer set.
2	1: DP master 1 is in the CLEAR state. The DP slave receives the value 0 in the DP data intended for the outputs. This has the effect on the send data.
1	1: The configuration/parameter assignment is not yet completed.
0	DP mode 1: DP slave mode. **The other bits only have the specified meaning when this bit is set.**

Notice

Please note, that DPSTATUS must not be evaluated until the return parameter NDR=1 is set.

8.3.3 FC3 DP_DIAG

Meaning of the Block

The FC DP_DIAG is used to request diagnostic information. The following types of job are possible:

- Request DP station list
- Request DP diagnostic list
- Request DP single status;
- Read input/output data of a DP slave acyclically
- Read older DP single diagnostic information
- Read DP status.
- Read DP mode for PLC/CP stop
- Read current status of the DP slave.

Diagnostic data can also be requested for a specific slave by specifying a station address.

To transfer the diagnostic data to the CPU, you should reserve a memory area in the CPU and specify this area in the call. This memory area can be a data block area or a bit memory area. The maximum length of the available memory area must also be specified in the job.

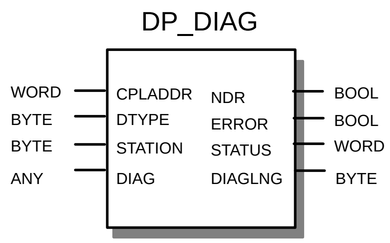
Note

FC DP_DIAG is only of practical use in the DP master mode.

No New Job Data

As long as this block is running, it must not be supplied with new job data. Exception: Requesting the DP station list or DP diagnostic list.

Call Interface



FC3 DP_DIAG - continued

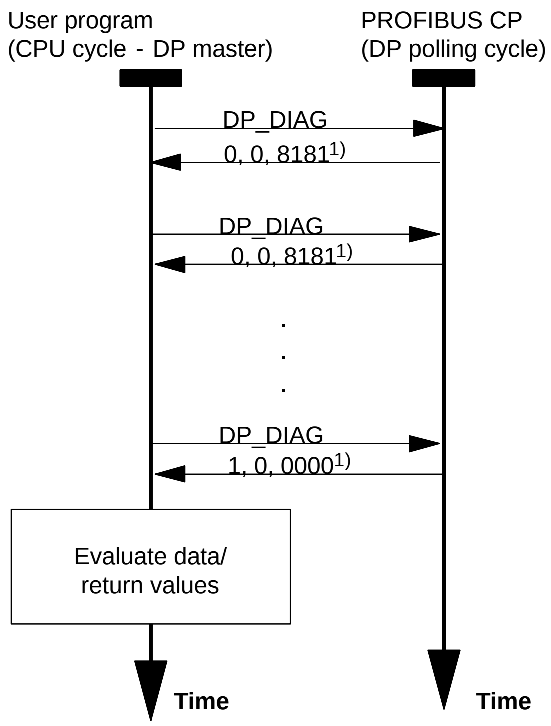
Example in STL representation

STL		Explanation
call fc 3		//DP_DIAG function call
CPLADDR:=	W#16#0120	
DTYPE :=	B#16#00	
STATION:=	B#16#03	
DIAG :=	P#db18.dbx0.0 byte 16	
NDR :=	M 70.0	
ERROR :=	M 70.1	
STATUS :=	MW 72	
DIAGLNG:=	MB 20	

Sequence/Handling the Call Interface

The DP_DIAG function call is processed during cyclic execution of the user program as follows:

The job is triggered with the first call. Diagnostic data are only returned in the acknowledgment of one of the subsequent calls.



Legend:
1) Parameter transfer NDR, ERROR, STATUS

FC3 DP_DIAG - continued

Note

Please note the following special feature of the job types read_DP_station_list and read_DP_diagnostic_list (see Table 8-5):

The diagnostic job supplies the diagnostic data available at the time of the last DP-RECV call. Reading a list prevents the data from being read out again (return value 0x8182).

The lists are released again following a new diagnostic event followed by a DP-RECV call.

After calling DP_DIAG, you obtain information indicating one of the situations below:

- **NDR=0, ERROR=0, STATUS=8181**

  As long as the values NDR=0, ERROR=0 and STATUS=8181 are set, the job parameters must not be modified.

- **NDR=1**

  The parameter value NDR=1 indicates that valid diagnostic data are available. Additional information is possible in the STATUS parameter.

- **NDR=0, ERROR=1**

  An error has occurred. The diagnostic data are invalid. The error message is located in STATUS.

FC3 DP_DIAG - continued

Explanation of the Formal Parameters

The following table explains all the formal parameters for the function DP_DIAG:.

Parameter	Declaration	Type	Possible Values	Remarks
CPLADDR	INPUT	WORD		Module base address When you configure the CP with STEP 7 hardware configuration, the module start address is displayed in the configuration table. Specify this address here.
DTYPE	INPUT	BYTE	0: Station list 1: Diagnostic list 2: Current diagnostic information 3: Older diagnostic information 4: Read status 5: Read status for CPU STOP 6: Read status for CP STOP 7: Read input data (acyclic) 8: Read output data (acyclic) 10: Read current status of the DP slave	Diagnostic type
STATION	INPUT	BYTE		Station address of the DP slave
DIAG	INPUT	ANY (as VARTYPE only BYTE, WORD and DWORD are permitted)	The length must be set from 1 to 240	Specifies the address and length. Address of the data area. Identifies either - Process image area - Bit memory or - Data block area Note: If more diagnostic data exist than can be entered in the DIAG area, only as much data as specified in the DIAG length will be transferred. The actual length is indicated in DIAGLNG.
NDR	OUTPUT	BOOL	0: - 1: new data	This parameter indicates whether or not new data were accepted. For the meaning of this parameter in conjunction with the ERROR and STATUS parameters, refer to the following table.

FC3 DP_DIAG - continued

Parameter	Declaration	Type	Possible Values	Remarks
ERROR	OUTPUT	BOOL	0: - 1: error	Error code For the meaning of this parameter in conjunction with the NDR and STATUS parameters, refer to the following table.
STATUS	OUTPUT	WORD	see list	Status code For the meaning of this parameter in conjunction with the NDR and ERROR parameters, refer to the following table.
DIAGLNG	OUTPUT	BYTE	see list	This contains the actual length (in bytes) of the data made available by the PROFIBUS CP, regardless of the buffer size specified in the DIAG parameter.

FC3 DP_DIAG - continued

Job Types

The following overview of the specifications for DTYPE, STATION and DIAGLNG shows the permitted or useful entries.

Table 8-5 Job Types for DP_DIAG

DTYPE	Corresponds to Job	Parameter STATION	DIAGLNG	Acknowledgment Code (contained in the STATUS parameter) shown in Table 8-6)
0	Read DP station list	- - -	- ignored -	Module base address When you configure the CP with STEP 7 hardware configuration, the module start address is displayed in the configuration table. Specify this address here.
1	Read DP diagnostic list	- - -	- ignored -	The DP diagnostic list informs the CPU program about the DP slaves with new diagnostic data (see Section 5.4.1, 5.4.2)
2	Read current DP single diagnostic data	1...126	>=6	The current DP single diagnostics informs the CPU program of the current diagnostic data of a DP slave. (see Section 5.4.3)
3	Read older DP single diagnostic data	1...126	>=6	The older DP single diagnostic data supplies the older diagnostic data of a DP slave to the CP program (see Section 5.4.3). This data is stored on the PROFIBUS CP and read according to the ”last in - first out” principle in the ring buffer. The structure of the ring buffer is explained below. If changes occur quickly in the DP slave diagnostic data, this function allows the diagnostic data of a DP slave to be acquired and evaluated in the CPU program of the DP master.
4	Read the requested operating mode with the DP-CTRL job (CYTPE=4).		>=0	With this job, you can read the DP status. The following statuses are possible - RUN - CLEAR - STOP - OFFLINE (see Section 4.10)  Note: With newer modules (refer to the information in the manual), the STOP mode is now the OFFLINE mode.

FC3 DP_DIAG - continued

Table 8-5 Job Types for DP_DIAG

DTYPE	Corresponds to Job	Parameter STATION	DIAGLNG	Acknowledgment Code (contained in the STATUS parameter) shown in Table 8-6)
5	Read DP status for CPU STOP		>=0	With this job you can find out the DP status to which the PROFIBUS CP changes if the CPU changes to STOP: - RUN - CLEAR - STOP - OFFLINE As default, the PROFIBUS CP changes to the DP status CLEAR if the CPU changes to STOP. (see Section 4.10) Note: With newer modules (refer to the information in the manual), the STOP mode is now the OFFLINE mode.
6	Read DP status for CP STOP		>=0	With this job you can find out the DP status to which the PROFIBUS CP changes if the CP changes to STOP: - STOP - OFFLINE As default, the PROFIBUS CP changes to the DP status OFFLINE if the CPU changes to STOP. (see Section 4.10) Note: With newer modules (refer to the information in the manual), the STOP mode is now the OFFLINE mode.
7	Read input data	1...126	>=1	With this job, the DP master (class 2) reads the input data of the DP slave. This function is also known as shared input.
8	Read output data	1...126	>=1	With this job, the DP master (class 2) reads the output data of a DP slave. This function is also known as shared output.
10	Read current DP slave status	1...126	>=0	With this job, you can read out the current status of the DP slave. The following statuses are possible : • The DP master exchanges data with the DP slave cyclically. • The DP master reads the input data of the DP slave cyclically. • The DP master reads the output data of the DP slaves cyclically. • The DP master is not currently processing this DP slave cyclically.

FC3 DP_DIAG - continued

Ring Buffer for Diagnostic Data

The following diagram illustrates how diagnostic data are read using the “read older DP single diagnostic data” function. The first access reads the **most recent of the older diagnostic data**.

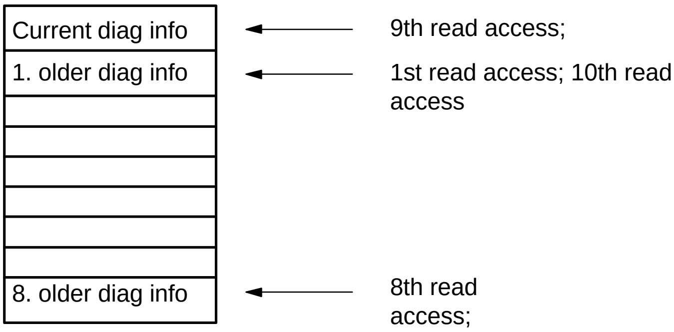


Figure 8-2 Ring Buffer for Diagnostic Data

When the current diagnostic data is read out, the read pointer is reset to the first older diagnostic data.

Condition Codes

The following table shows the codes formed by the DONE, ERROR and STATUS parameters that must be evaluated by the user program.

Note

For entries coded with $8Fxx_H$ in STATUS, refer to the information in the STEP 7 Standard and System Functions reference manual. The chapter describing error evaluation with the RET_VAL output parameter contains detailed information.

To find out which SFCs are used and are relevant for error evaluation, display the properties dialog of the FC described here in the “Calls” tab.

Table 8-6 DP_DIAG Codes

NDR	ERROR	STATUS	Possible with DTYPE	Meaning
0	0	8181_H	2-10	• Job active.  With newer CP types, the following meaning is possible (see /2/): The DP master has not been started due to CP STOP or “no parameter assignment” (occurs here instead of code 0,1,8183_H!).

FC3 DP_DIAG - continued

Table 8-6 DP_DIAG Codes , continued

NDR	ERROR	STATUS	Possible with DTYPE	Meaning
0	0	8182$_H$	0	• Triggering job pointless. With newer CP types, the following meaning is possible (see /2/): The DP master has not been started due to CP STOP or “no parameter assignment” (occurs here instead of code 0,1,8183$_H$!).
0	0	8182$_H$	1	• No new diagnostic data exist. With newer CP types, the following meaning is possible (see /2/): The DP master has not been started due to CP STOP or “no parameter assignment” (occurs here instead of code 0,1,8183$_H$!).
1	0	0000$_H$	0-10	Job completed without error.
1	0	8222$_H$	7,8	**Job completed without error**. The length of the DP slave data that were read is not the same as the data length expected by the DP master based on the module list of the DP slave in the CP database.
1	0	8227$_H$	7,8	**Job completed without error.** Message : no data exist.
1	0	8231$_H$	4,5,6	**Job completed without error**. Message : the DP status is already “RUN”
1	0	8232$_H$	4,5,6	**Job completed without error.** Message : the DP status is already “CLEAR”
1	0	8233$_H$	4,5,6	**Job completed without error.** Message : the DP status is already “STOP” Note: With newer modules (refer to the information in the manual /2/) the STOP mode is now the OFFLINE mode (here, code 8234H).
1	0	8234$_H$	4,5,6	**Job completed without error.** Message : the DP status is already “OFFLINE”
1	0	823A$_H$	2,3,7,8	**Job completed without error.** Message : 241 or 242 bytes of data were read. 240 bytes of data are available.
1	0	8241$_H$	2,3,10	**Job completed without error.** Message: the specified DP slave was not configured.
1	0	8243$_H$	2,3,10	**Job completed without error.** Message : the module list of the DP slave in the CP database only contains empty modules.

FC3 DP_DIAG - continued

Table 8-6 DP_DIAG Codes , continued

NDR	ERROR	STATUS	Possible with DTYPE	Meaning
1	0	8245_H	2,3,10	**Job completed without error.** Message : the DP slave is in the “read input data cyclically” status.
1	0	8246_H	2,3,10	**Job completed without error.** Message : the DP slave is in the “read output data cyclically” status.
1	0	8248_H	2,3,10	**Job completed without error.** Message : the module list of the DP slave in the CP database contains input, output or I/O modules.
1	0	8249_H	2,3,10	**Job completed without error.** Message : the DP slave is deactivated due to a DP mode change (e.g. CP mode selector set to STOP).
1	0	$824A_H$	2,3,10	**Job completed without error.** Message : the DP slave is deactivated due to a DP_CTRL job in the CPU program.
0	1	8090_H	0-10	Logical base address of the module is invalid.
0	1	$80B0_H$	0-10	The module does not recognize the data record or is changing from RUN --> STOP.
0	1	$80B1_H$	0-10	Specified data record length incorrect.
0	1	$80C0_H$	0-10	Data record cannot be read.
0	1	$80C1_H$	0-10	The specified data record is being processed.
0	1	$80C2_H$	0-10	Too many jobs pending.
0	1	$80C3_H$	0-8	Resources (memory) occupied.
0	1	$80C4_H$	0-10	Communication error
0	1	$80D2_H$	0-10	Logical base address wrong.
0	1	8183_H	0-10	DP master not configured.
0	1	8184_H	0-8	System error or bad parameter type.
0	1	8311_H	2-10	DTYPE parameter outside range of values.
0	1	8313_H	2,3,7,8, 10	STATION parameter outside range of values.
0	1	8321_H	2-10	The DP slave is not providing any valid data.
0	1	8326_H	7,8	The DP slave has more than 242 bytes of data available. The PROFIBUS CP supports a maximum of 242 bytes.
0	1	8335_H	7,8	The PROFIBUS CP is in the PROFIBUS status: station not in ring.
0	1	8341_H	2,3,7,8,10	The specified slave was not configured
0	1	8342_H	7,8	The DP slave with the PROFIBUS address specified in the STATION parameter is not obtainable.
0	1	8349_H	7,8	The DP master is in the OFFLINE mode.

FC3 DP_DIAG - continued

Table 8-6 DP_DIAG Codes , continued

NDR	ERROR	STATUS	Possible with DTYPE	Meaning
0	1	$8F22_H$	0-10	Area length error reading a parameter (e.g. DB too short).
0	1	$8F23_H$	0-10	Area length error writing a parameter (e.g. DB too short).
0	1	$8F24_H$	0-10	Area error reading a parameter.
0	1	$8F25_H$	0-10	Area error writing a parameter.
0	1	$8F28_H$	0-10	Alignment error reading a parameter.
0	1	$8F29_H$	0-10	Alignment error writing a parameter.
0	1	$8F30_H$	0-10	Parameter is in the write-protected 1st act. data block.
0	1	$8F31_H$	0-10	Parameter is in the write-protected 2nd act. data block.
0	1	$8F32_H$	0-10	The DB number in the parameter is too high.
0	1	$8F33_H$	0-10	DB number error
0	1	$8F3A_H$	0-10	Area not loaded (DB)
0	1	$8F42_H$	0-10	Timeout reading a parameter from the I/O area
0	1	$8F43_H$	0-10	Timeout writing a parameter to the I/O area
0	1	$8F44_H$	0-10	Address of the parameter to be read locked in the access track
0	1	$8F45_H$	0-10	Address of the parameter to be written locked in the access track
0	1	$8F7F_H$	0-10	Internal error, for example, bad ANY reference

8.3.4 FC4 DP_CTRL

Meaning of the Block

FC DP_CTRL transfers control jobs to the PROFIBUS CP. You specify a job field (CONTROL parameter) to specify the control job in greater detail.

The following types of job are possible:

- Global control acyclic/cyclic
- Delete older diagnostic data
- Set current DP mode
- Set DP mode for PLC/CP stop
- Read input/output data cyclically
- Set the operating mode of the DP slave.

With newer modules (refer to the information in the manual /2/), there are restrictions regarding the job types listed here.

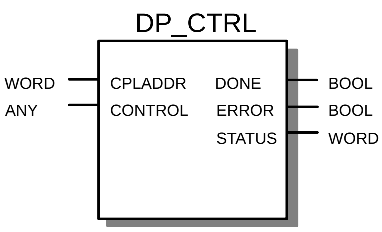
Note

FC DP_CTRL is only of practical use in the DP master mode.

No New Job Data

As long as this block is running, it must not be supplied with new job data.

Call Interface



FC4 DP-CTRL - continued

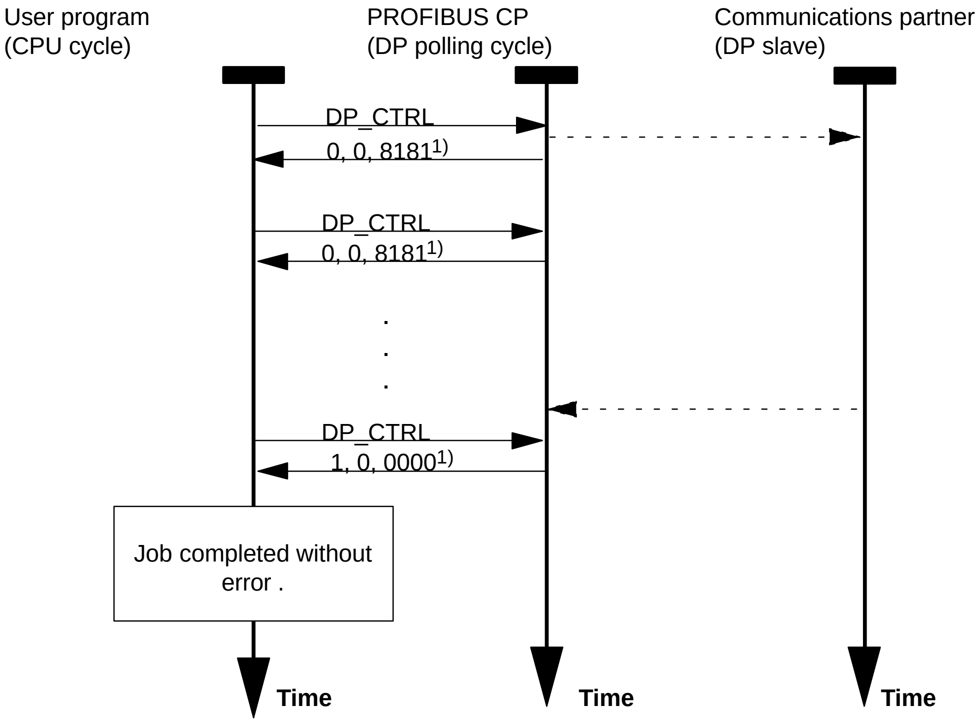
Example in STL representation

STL		Explanation
call fc 4		//DP_CTRL function call
CPLADDR:=	W#16#0120	
CONTROL:=	P#db14.dbx0.0 byte 30	// The buffer for the control job // occupies the first 30 bytes in DB 14.
DONE :=	M 70.0	
ERROR :=	M 70.1	
STATUS :=	MW 72	

Sequence/Handling the Call Interface

The DP_CTRL function call is processed within the cyclic execution of the user program as shown below:

The job is triggered with the first call. Diagnostic data are only returned in the acknowledgment of one of the subsequent calls.



Legend:
1) parameter transfer DONE, ERROR, STATUS

After calling DP_CTRL, you obtain information indicating one of the situations below:

FC4 DP-CTRL - continued

- **DONE=0, ERROR=0, STATUS=8181**

  As long as the values NDR=0, ERROR=0 and STATUS=8181 are set, the job parameters must not be modified.

- **DONE=1**

  The parameter value DONE=1 indicates that the job was executed. Additional information is possible in the STATUS parameter.

- **DONE=0, ERROR=1**

  An error has occurred. The error message is located in STATUS.

Explanation of the Formal Parameters

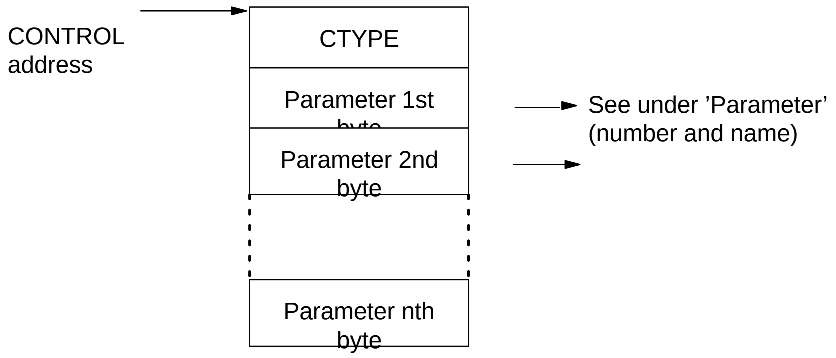
The following table explains all the formal parameters for the DP_CTRL function.

Parameter	Declaration	Type	Possible Values	Remarks
CPLADDR	INPUT	WORD		Module base address When you configure the CP with STEP 7 hardware configuration, the module start address is displayed in the configuration table. Specify this address here.
CONTROL	INPUT	ANY (as VARTYPE only BYTE, WORD and DWORD are permitted)	The length must be set from 1 to 240	Specifies the address and length of the CONTROL job field. Address of the data area. Identifies either - Process image area - Bit memory or - Data block area The length must be at least as long as the number of parameters.
DONE	OUTPUT	BOOL	0: - 1: Job executed without error.	Indicates whether the job was sent and completed without errors. For the meaning of this parameter in conjunction with the ERROR and STATUS parameters, refer to the following table 8-8.
ERROR	OUTPUT	BOOL	0: - 1: error	Error code For the meaning of this parameter in conjunction with the DONE and STATUS parameters, refer to the following table 8-8.
STATUS	OUTPUT	WORD	see following table 'Return Codes' (Table 8-8)	Status code For the meaning of this parameter in conjunction with the DONE and ERROR parameters, refer to the following table 8-8.

FC4 DP-CTRL - continued

Structure of the CONTROL Job Field

The control job has the following structure:



Example of the Job Field

With a job field as shown below, a cyclic global control job SYNC and UNFREEZE is sent for Group 4 and Group 5 without the autoclear option.

DB 14

Byte 0	01_H	CTYPE
Byte 1	24_H	Command Mode
Byte 2	18_H	Group Select
Byte 3	00_H	Autoclear

The length in the ANY pointer must be at least 4 (in the example, 30 has been selected).

Job Types

Permitted or feasible specifications for the job are shown in the following overview based on the specification for CTYPE and the information in the job field.

FC4 DP-CTRL - continued

Table 8-7 Job Types for DP_CTRL

CTYPE	Corresponds to Job	Parameters in the Job Field Name	No.	Meaning
0	Trigger global control	1st byte: command mode 2nd byte: group select (See section following this table.)	2	A single global control job is sent to the DP slaves selected with group select (see Section 4.2). The command mode parameter specifies the following global control jobs: - SYNC - UNSYNC - FREEZE - UNFREEZE - CLEAR It is possible to specify more than one job in the command mode parameter. Note: With newer modules (refer to the information in the manual), the Global Control job CLEAR is not supported.
1	Trigger cyclic global control	1st byte: command mode 2nd byte: group select 3rd byte: autoclear (See section following this table.)	3	The sending of cyclic global control jobs to the DP slaves selected with group select is triggered on the PROFIBUS CP (see Section 4.2). The autoclear parameter is only evaluated with the SYNC global control job. If at least one DP slave in the selected group is not in the data transfer phase and autoclear=1 is set, the CLEAR mode is activated and the output data of the DP slaves are set to “0”. The following global jobs can be activated in the command mode parameter: - SYNC - FREEZE - CLEAR (CLEAR bit = 1) or deactivated: - UNSYNC - UNFREEZE - UNCLEAR (CLEAR bit = 0) It is possible to specify more than one job in the command mode parameter. An active cyclic control job can only be terminated by a further global control job (cyclic or acyclic). To terminate the job set in the command mode, the job must be canceled. For example, the SYNC job is canceled by an UNSYNC job. Note: With newer modules (refer to the information in the manual), the Global Control job CLEAR is not supported.

FC4 DP-CTRL - continued

Table 8-7 Job Types for DP_CTRL, continued

CTYPE	Corresponds to Job	Parameters in the Job Field Name	No.	Meaning
3	Delete older DP single diagnostic data	1st byte: Slave address 1 to 126 127 = all slaves	1	The older diagnostic data stored on the PROFIBUS CP are deleted for one or all slaves.
4	Set current DP mode	1st byte: RUN =00H CLEAR =01H STOP =02H OFFLINE =03H RUN with AUTOCLEAR =04H RUN without AUTOCLEAR=05H	1	The DP mode can be set with this job as follows: - RUN - CLEAR - STOP - OFFLINE (See also Section 4.10) The AUTOCLEAR parameter means that the DP master class 1 automatically changes to the CLEAR state, when at least one of the DP slaves with which it wants to exchange data is not in the data transfer phase. AUTOCLEAR is reset by the RUN parameter without AUTOCLEAR. Note: With newer modules (refer to the information in the manual), the STOP mode is now the OFFLINE mode.
5	Set DP mode for CPU stop	1st byte: RUN =00H CLEAR =01H STOP =02H OFFLINE=03H	1	This job specifies which DP mode the PROFIBUS CP changes to if the CPU changes to stop. - RUN - CLEAR - STOP - OFFLINE As default, the PROFIBUS CP changes to the DP status CLEAR if the CPU changes to STOP. This mode remains set during a CP mode change from RUN --> STOP --> RUN. (See also Section 4.10) Note: With newer modules (refer to the information in the manual), the STOP mode is now the OFFLINE mode.

FC4 DP-CTRL - continued

Table 8-7 Job Types for DP_CTRL, continued

CTYPE	**Corresponds to Job**	**Parameters in the Job Field** Name	No.	**Meaning**
6	Set DP mode for CP stop	1st byte: STOP =02H OFFLINE=03H	1	This job specifies which DP mode the PROFIBUS CP changes to if the CP changes to stop. - STOP - OFFLINE As default, the PROFIBUS CP changes to the DP status OFFLINE if the CPU changes to STOP. This mode remains set during a CP mode change from RUN --> STOP --> RUN. (See also Section 4.10) Note: With newer modules (refer to the information in the manual), the STOP mode is now the OFFLINE mode.
7	Read input data cyclically (DP master class 2)	1st byte: slave address 1 to 125	1	This job triggers the cyclic reading of the input data of the addressed DP slave on the PROFIBUS CP acting as DP master (class 2). Normally, the DP slave is assigned to another DP master (class 1). The data are stored in the configured DP slave received data area and are fetched in the user program by the DP_RECV function. **This function is known as shared input.** Note: With newer models (please refer to the information in the manual), this job is not supported.
8	Read output data cyclically (DP master class 2)	1st byte: slave address 1 to 125	1	This job triggers the cyclic reading of the output data of the addressed DP slave on the PROFIBUS CP acting as DP master (class 2). Normally, the DP slave is assigned to another DP master (class 1). The data are stored in the configured DP slave received data area and are fetched in the user program by the DP_RECV function. **This function is known as shared output.** Note: With newer models (please refer to the information in the manual), this job is not supported.

FC4 DP-CTRL - continued

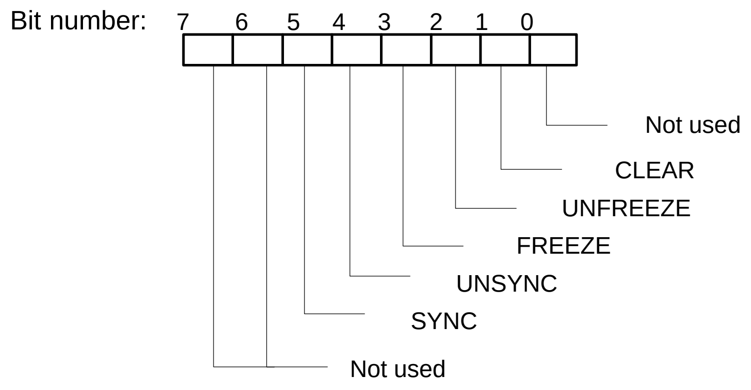
Table 8-7 Job Types for DP_CTRL, continued

CTYPE	**Corresponds to Job**	**Parameters in the Job Field** Name	No.	**Meaning**
9	Terminate cyclic processing of the DP slave by the DP master (class 1, class 2)	1st byte: slave address 1 to 125	1	This job terminates the cyclic reading of the input data or output data of the addressed DP slave or the data transfer (DP master class 1). The DP slave is then no longer processed by the PROFIBUS CP acting as DP master (class 2). **This deactivates the DP slave.**
10	Start cyclic processing as DP master (class 1)	1st byte: slave address 1 to 125	1	The PROFIBUS CP acting as the DP master (class 1) then assigns parameters to the addressed DP slave and starts cyclic data transfer (writing outputs/reading inputs). **This activates the DP slave.**

Structure of the Command Mode

In the command mode parameter, you specify the modes for input and output data for the cyclic and acyclic global control jobs.

The meaning is as follows:
1 = activated
0 = not activated



FC4 DP-CTRL - continued

Structure of Group Select

In the group select parameter, you specify the group to be addressed by the control job specified in the command mode parameter. The group select parameter occupies the second byte in the control job. Each bit defines a possible DP slave group.

Legend:
1 = assigned
0 = not assigned

Bit number:	7	6	5	4	3	2	1	0
Group:	7	6	5	4	3	2	1	8

Condition Codes

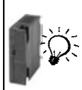
The following table shows the return codes formed by the DONE, ERROR and STATUS parameters that must be evaluated by the user program.

Note

For entries coded with $8Fxx_H$ in STATUS, refer to the information in the STEP 7 Standard and System Functions reference manual. The chapter describing error evaluation with the RET_VAL output parameter contains detailed information.

To find out which SFCs are used and are relevant for error evaluation, display the properties dialog of the FC described here in the “Calls” tab.

Table 8-8 DP_CTRL Codes

DONE	ERROR	STATUS	Possible with CTYPE	Meaning
0	0	8181_H	0 to 10	• Job active.  With newer CP types, the following meaning is possible (see /2/): The DP master has not been started due to CP STOP or “no parameter assignment” (occurs here instead of code 0,1,8183_H!).
1	0	0000_H	0 to 10	Job completed without error.
1	0	8214_H	0,1	**Job completed without error.** Message : cyclic global control job is sent as acyclic global control job

FC4 DP-CTRL - continued

Table 8-8 DP_CTRL Codes, continued

DONE	ERROR	STATUS	Possible with CTYPE	Meaning
1	0	8215_H	0,1	**Job completed without error.** The slaves addressed in the selected group are all deactivated.
1	0	8219_H	0,1	**Job completed without error.** An attempt was made to send an already active cyclic global control again. The global control continues unchanged.
1	0	8228_H	0,1	**Job completed without error.** Message : the DP slaves addressed in the selected groups do not have any input modules.
1	0	8229_H	0,1	**Job completed without error.** Message : the DP slaves addressed in the selected groups do not have any output modules.
1	0	8231_H	4,5,6	**Job completed without error**. Message : the DP status is already “RUN”
1	0	8232_H	4,5,6	**Job completed without error.** Message : the DP status is already “CLEAR”
1	0	8233_H	4,5,6	**Job completed without error.** Message : the DP status is already “STOP”
1	0	8234_H	4,5,6	**Job completed without error.** Message : the DP mode is already “OFFLINE”
1	0	8235_H	4	**Job completed without error.** Message : the DP status is already “RUN” with activated AUTOCLEAR
1	0	8236_H	4	**Job completed without error.** Message : the DP status is already “RUN” with deactivated AUTOCLEAR
1	0	8241_H	7-10	**Job completed without error.** Message: The specified DP slave was not configured.
1	0	8243_H	7-10	**Job completed without error.** Message : the DP slave is already deactivated since the module list of the DP slave in the CP database only contains empty modules.
1	0	8245_H	7-10	**Job completed without error.** Message : the DP slave is already in the “read input data cyclically” mode
1	0	8246_H	7-10	**Job completed without error.** Message : the DP slave is already in the “read output data cyclically” mode

FC4 DP-CTRL - continued

Table 8-8 DP_CTRL Codes, continued

DONE	ERROR	STATUS	Possible with CTYPE	Meaning
1	0	8248_H	7-10	**Job completed without error.** Message: the module list of the DP slave in the CP database contains input, output, or input/output modules.
1	0	8249_H	7-10	**Job completed without error.** Message: This slave is deactivated due to a change in the DP mode.
1	0	$824A_H$	7-10	**Job completed without error.** Message : the DP slave is already deactivate due to a DP_CTRL job in the CPU program
0	1	8090_H	0 to 10	No module with this address exists.
0	1	8091_H	0 to 10	Logical base address not at a double word boundary.
0	1	$80B0_H$	0 to 10	The module does not recognize the data record.
0	1	$80B1_H$	0 to 10	The specified data record length is incorrect.
0	1	$80C0_H$	0 to 10	The data record cannot be read.
0	1	$80C1_H$	0 to 10	The specified data record is currently being processed.
0	1	$80C2_H$	0 to 10	There are too many jobs pending.
0	1	$80C3_H$		Resources occupied (memory).
0	1	8183_H	0 to 10	The DP master is not configured.
0	1	8184_H		System error or bad parameter type.
0	1	8311_H	0 to 10	CTYPE parameter outside the range of values.
0	1	8312_H	0 to 10	The length of the area in the CONTROL parameter is too short.
0	1	8313_H	3,7,8,10	The slave address parameter is outside the range of values.
0	1	8315_H	0,1	All DP slaves of the group specified in the global control are deactivated (always occurs with an empty group).
0	1	8317_H	8	The length of the configured output data is greater than the configured receive area of the DP slave. Activating the slave mode “Read output data” is not possible.
0	1	8318_H	0,1,4,5,6	The parameter 1st byte of the job data field is outside the range of values. With GLOBAL CONTROL, CLEAR was used with SYNC or a GLOBAL CONTROL with CLEAR set was sent to group 0.
0	1	$831A_H$	0,1	At least one DP slave cannot handle FREEZE.
0	1	$831B_H$	0,1	At least one DP slave cannot handle SYNC.

FC4 DP-CTRL - continued

Table 8-8 DP_CTRL Codes, continued

DONE	ERROR	STATUS	Possible with CTYPE	Meaning
0	1	8333_H	0,1	This job is not permitted in the STOP mode.
0	1	8334_H	0,1	This job is not permitted in the OFFLINE mode.
0	1	8335_H	0,1	The PROFIBUS CP is in the PROFIBUS status: station not in ring.
0	1	8339_H	0,1	At least one DP slave in the selected group is not in the data transfer phase.
0	1	$833C_H$	1	Cyclic global control must not be used in the “PLC <-> CP free running” mode. This error does not occur on the CP 3425 because this mode is not possible with this CP (PBUS data records are always used for data transfer).
0	1	8341_H	7-10	The specified DP slave was not configured.
0	1	8183_H	0 to 10	DP master not configured.
0	1	8184_H	-	System error or bad parameter type.
0	1	$8F22_H$	0 to 10	Area length error reading a parameter (e.g. DB too short).
0	1	$8F23_H$	0 to 10	Area length error writing a parameter.
0	1	$8F24_H$	0 to 10	Area error reading a parameter.
0	1	$8F25_H$	0 to 10	Area error writing a parameter.
0	1	$8F28_H$	0 to 10	Alignment error reading a parameter.
0	1	$8F29_H$	0 to 10	Alignment error writing a parameter.
0	1	$8F30_H$	0 to 10	The parameter is in the write-protected first current data block.
0	1	$8F31_H$	0 to 10	The parameter is in the write-protected second current data block.
0	1	$8F32_H$	0 to 10	Parameter contains a DB number that is too high.
0	1	$8F33_H$	0 to 10	DB number error.
0	1	$8F3A_H$	0 to 10	Area not loaded (DB).
0	1	$8F42_H$	0 to 10	Timeout reading a parameter from the I/O area.
0	1	$8F43_H$	0 to 10	Timeout writing the parameter to the I/O area.
0	1	$8F44_H$	0 to 10	Access to a parameter to be read during block execution is prevented.
0	1	8F45H	0 to 10	Access to a parameter to be written during block execution is prevented.
0	1	$8F7F_H$	0 to 10	Internal error, e.g. illegal ANY reference.

FC4 DP-CTRL - continued

Table 8-8 DP_CTRL Codes, continued

DONE	ERROR	STATUS	Possible with CTYPE	Meaning
0	1	$80C4_H$	0 to 10	Communication error (occurs temporarily, it is usually best to repeat the job in the user program).
0	1	$80D2_H$	0 to 10	Logical base address incorrect.

8.4 FCs for FDL Connections (SEND/RECEIVE Interface)

Overview

The following FCs are available for the SEND/RECEIVE interface for transferring data on configured FDL connections:

FC	Can be used with [1)]		Meaning
	S7 - 300	S7 - 400	
AG_SEND (FC5)	x	x	for sending data
AG_RECV (FC6)	x	x	for receiving data
AG_LSEND (FC50)		x	for sending data
AG_LRECV (FC60)		x	for receiving data

[1)] Notes on the FCs in FCs for an S7-300 and S7-400

To ensure the compatibility of PROFIBUS and Ind. Ethernet at the interface in the user program, you can use the FCs AG_LSEND and AG_LRECV on PROFIBUS as alternatives to AG_SEND and AG_RECV. There is no difference in the interface or the way they function. On PROFIBUS, however, you can only transfer data up to a maximum of 240 bytes even with these FCs although they are intended for longer data records on Industrial Ethernet.

This is only possible if the block type and block version are permitted for the CP type you are using.

With newer versions of the S7 CPs for S7-300 for S7-300, only the FCs AG_SEND and AG_RECV are used; on Industrial Ethernet also for the transfer of longer data records.

The manuals /2/ contain information on the compatibility of the S7-CPs and the corresponding blocks (FCs / FBs). You will find an overview of the versions of the FCs/FBs in the documentation and block history.

Application

The following diagram illustrates the use of the FCs AG_SEND / AG_LSEND and AG_RECV / AG_LRECV for bi-directional data transfer on **one** configured FDL connection.
With certain connection types, a job header should be included in the user data area.

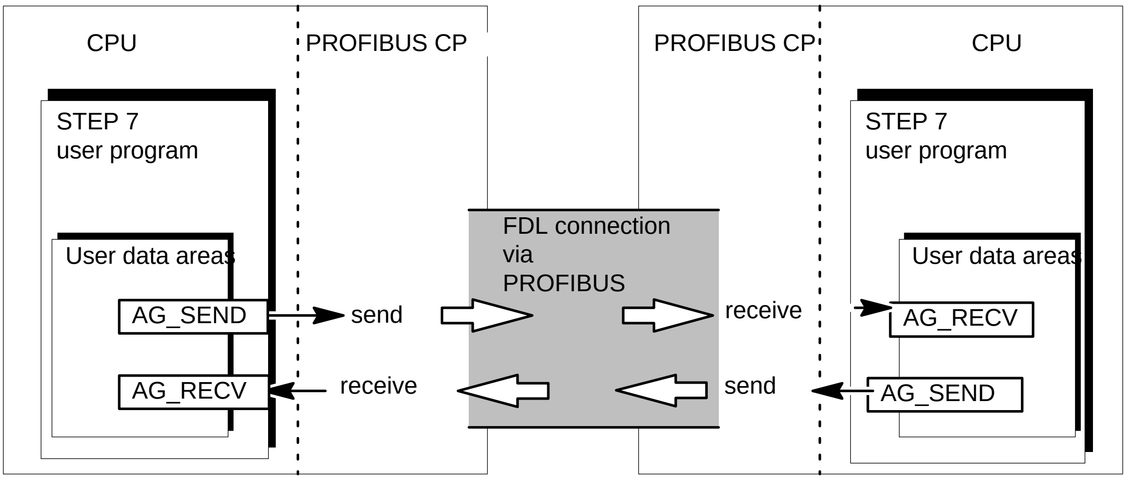


Figure 8-3 Using AG_SEND and AG_RECV on both Communications Partners

Application without Job Header

With a specified FDL connection, the address and job parameters are specified by the configuration of the connection. The user program only provides the user data in the FDL data area when sending with AG_SEND / AG_LSEND or receives the data with AG_RECV / AG_LRECV.
Up to 240 bytes of user data can be transferred. This applies to PROFIBUS for both the AG_SEND or AG_LSEND functions.

Working with the Job Header

The following connection types require a job header in the FDL (user) data area:

- Unspecified FDL connection with free layer 2 access
- FDL connection with broadcast
- FDL connection with multicast

The following schematic illustrates the structure of the job buffer and the meaning and location of the parameters in the job header.

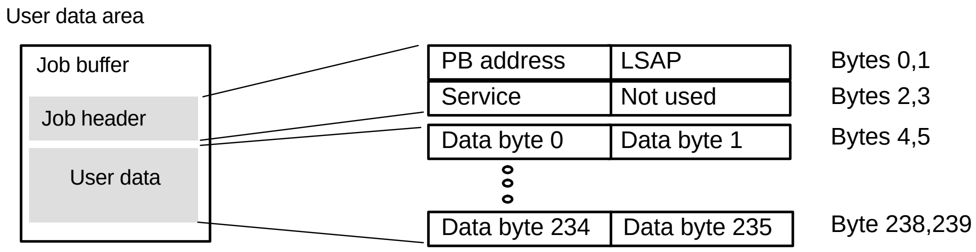


Figure 8-4 Sending and Receiving via an FDL Connection with Programmed Broadcast Addressing

The user data area can be up to 240 bytes. Up to 236 bytes of user data can be transferred. 4 bytes are reserved for the job header.

Please note that the data length specified in the block call (LEN parameter) must include the header and the user data!

8.4.1 FC5 AG_SEND / FC50 AG_LSEND

Meaning of the Block

FC AG_SEND / AG_LSEND transfers data to the PROFIBUS CP for transmission on a configured FDL connection.

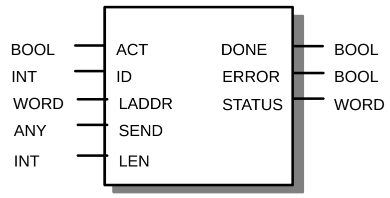
The selected data area can be a process image area, a memory bit area or a data block area.

Error free execution of the function is indicated when the entire FDL data area could be sent on PROFIBUS.

Note:
Unless otherwise stated, all the following information applies to both the FCs AG_SEND and AG_LSEND.

Call Interface

AG_SEND / AG_LSEND



Example in STL representation

STL			Explanation
call fc 5			//AG_SEND / AG_LSEND block call
ACT	:=	M 20.0	//Job triggered by memory bit
ID	:=	MW 22	//Connection ID acc. to configuration
LADDR	:=	W#16#0100	//=LADDR 256 dec. in hardware configuration
SEND	:=	P#db99.dbx10.0 byte 240	//Buffer with send data
LEN	:=	MW 24	//Length for send data
DONE	:=	M 20.1	//Execution code
ERROR	:=	M 20.2	//Error code
STATUS	:=	MW 26	//Status code

FC5 AG_SEND / FC50 AG_LSEND - continued

Calls with Job Header

The following table shows the connection types and job types for which parameters must be supplied in the job header.

The job header is located in the FDL (user) data area. It occupies the first 4 bytes and must be added to the length specified in the LEN parameter. The maximum user data length is therefore reduced for jobs with a job header to 236 bytes.

Table 8-9 Supplying the Job Header in the User Data Area

Parameter	FDL connection type		
	Unspecified free layer 2 2)	**Broadcast**	**Multicast**
PB address	Address of the destination station Values: 0 to 126 depending on node / 127 for broadcast/multicast	For AG_SEND no relevance; but area must be reserved.	For AG_SEND no relevance; but area must be reserved.
LSAP	LSAP of the destination station Values: 0 to 62 depending on node / 63 for broadcast	No significance but area must be reserved.	No significance but area must be reserved.
Service 1)	SDA (Send Data with Acknowledge): Value: 00_H SDN (Send Data with No Acknowledge): Value: 01_H	No significance but area must be reserved.	No significance but area must be reserved.

1) For broadcast and multicast, only the SDN service is possible.
2) The information on broadcast and multicast in this column is relevant only when an unspecified FDL connection is used for broadcast or multicast. On a configured FDL connection (recommended application) with broadcast or multicast as the connection partner, the address parameters are assigned automatically according to the configuration.

FC5 AG_SEND / FC50 AG_LSEND - continued

How the Block Works

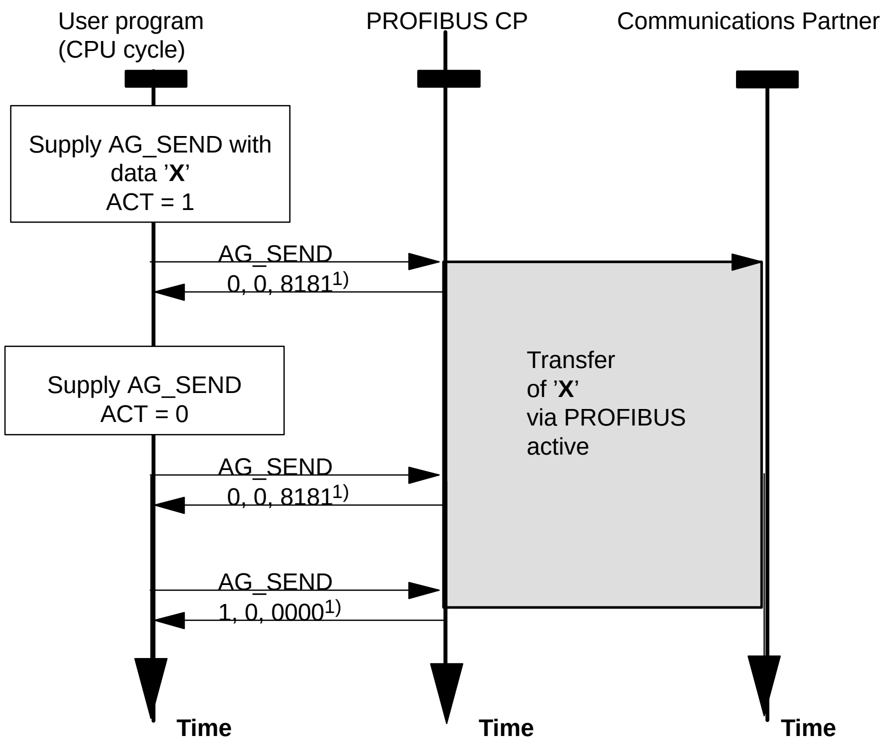
The following diagram illustrates the normal sequence of data transmission triggered in the user program using AG_SEND.

The send job in executed as soon as the parameter ACT = 1 is passed.

Following this, the parameter ACT = 0 must be passed in at least one further call.

The status code in the output parameters DONE, ERROR and STATUS is updated in each block call and can be evaluated. To update the status code without starting a new send job, start a new block call with the parameter ACT = 0.

Refer to the sample program at the end of Section 8.4.1.



Legend:
1) parameter transfer DONE, ERROR, STATUS

Explanation of the Formal Parameters

The following table explains all the formal parameters for the AG_SEND function.

FC5 AG_SEND / FC50 AG_LSEND - continued

Parameter	Declaration	Type	Possible Values	Remarks
ACT	INPUT	BOOL	0,1	If ACT=1, LEN bytes are sent from the FDL data area specified with the SEND parameter. If ACT=0, the status codes DONE, ERROR and STATUS are updated.
ID	INPUT	INT	1,2 to 16 (S7-300) 1,2 to 32 (S7-400)	The connection number of the FDL connection is specified in the ID parameter (see Configuration Chapter 7).
LADDR	INPUT	WORD		Module base address When you configure the CP with STEP 7 hardware configuration, the module start address is displayed in the configuration table. Specify this address here.
SEND	INPUT	ANY (as VARTYPE only BYTE, WORD and DWORD are permitted)		Specifies the address and length. The address of the FDL data area references either: - Process image area - Bit memory - Data block area With a call with job header, the FDL data area contains the job header **and** the user data.
LEN	INPUT	INT	1,2, to 240 (or up to “length specified for SEND parameter”)	Number of bytes to be sent from the FDL data area with this job. The possible values range from 1 to length specified for the SEND parameter. In a call, with job header, the length information is made up of the job header (4 bytes) + user data (1 to 236 bytes). Therefore LEN >= 4 !
DONE	OUTPUT	BOOL	0: - 1: new data	This parameter indicates whether or not the job was completed without errors. For the meaning of this parameter in conjunction with the ERROR and STATUS parameters, refer to the following table.
ERROR	OUTPUT	BOOL	0: - 1: error	Error code For the meaning of this parameter in conjunction with the DONE and STATUS parameters, refer to the following table.
STATUS	OUTPUT	WORD	see following table	Status code For the meaning of this parameter in conjunction with the DONE and ERROR parameters, refer to the following table.

FC5 AG_SEND / FC50 AG_LSEND - continued

Condition Codes

The following table shows the condition codes formed by the DONE, ERROR and STATUS parameters that must be evaluated by the user program.

Note

For entries coded with 8Fxx$_H$ in STATUS, refer to the information in the STEP 7 Standard and System Functions reference manual. The chapter describing error evaluation with the RET_VAL output parameter contains detailed information.

To find out which SFCs are used and are relevant for error evaluation, display the properties dialog of the FC described here in the "Calls" tab.

Table 8-10 AG_SEND Codes

DONE	ERROR	STATUS	Meaning
1	0	0000$_H$	Job completed without error.
0	0	0000$_H$	No job being executed.
0	0	8181$_H$	Job active.
0	1	7000$_H$	This code is only possible with an S7-400; the FC was called with ACT=0; the job is however not processed.
0	1	8183$_H$	No configuration or the FDL service has not yet started on the PROFIBUS CP.
0	1	8184$_H$	• Illegal data type specified for the SEND parameter. • FDL connection **without** job buffer: system error. • FDL connection **with** job buffer: parameter LEN<4 or illegal parameter in job header (with free layer 2 access).
0	1	8185$_H$	LEN parameter longer than SEND source area.
0	1	8186$_H$	ID parameter invalid. ID!=1,2 to 15,16.
0	1	8301$_H$	SAP not activated on destination station.
0	1	8302$_H$	No receive resources on the destination station; the receiving station cannot process received data quickly enough or has not prepared any receive resources.
0	1	8303$_H$	The PROFIBUS service (SDA **S**end **D**ata with **A**cknowledge) is not supported on this SAP of the destination station. This display can also occur temporarily when connections or gateways are downloaded in "RUN".
0	1	8304$_H$	The FDL connection is not established.
0	1	8311$_H$	The destination station is not obtainable at the specified PROFIBUS address or the service is not possible for the specified PROFIBUS address.
0	1	8312$_H$	PROFIBUS error on the CP; for example bus short circuit, local station not in the ring.

FC5 AG_SEND / FC50 AG_LSEND - continued

Table 8-10 AG_SEND Codes, continued

DONE	ERROR	STATUS	Meaning
0	1	8315_H	Internal parameter error on an FDL connection with job header: Parameter LEN<4 or illegal parameter in the job header (with free layer 2 access).
0	1	$8F22_H$	Source area invalid, for example: Area does not exist in the DB LEN parameter < 0
0	1	$8F24_H$	Area error reading a parameter.
0	1	$8F28_H$	Alignment error reading a parameter.
0	1	$8F32_H$	Parameter contains a DB number that is too high.
0	1	$8F33_H$	DB number error.
0	1	$8F3A_H$	Area not loaded (DB).
0	1	$8F42_H$	Timeout reading a parameter from the I/O area.
0	1	$8F44_H$	Address of the parameter to be read is disabled in the access track.
0	1	$8F7F_H$	Internal error, e.g. illegal ANY reference. e.g. parameter LEN=0
0	1	8090_H	• No module with this base address exists. • The FC being used does not match the system family being used (remember to use different FC for S7-300 and S7-400).
0	1	8091_H	Logical base address not at a double word boundary.
0	1	8092_H	In the ANY reference, a type other than BYTE is specified. (S7-400 only)
0	1	$80A4_H$	The communication bus connection between the CPU and CP is not established. (with newer CPU versions). This can, for example, be caused by the following: • No connection configuration; • The maximum number of CPs that can be operated at one time has been exceeded (for further information, refer to the CP manual /2/).
0	1	$80B0_H$	The module does not recognize the data record.
0	1	$80B1_H$	• Destination area invalid. for example, destination area > 240 bytes.  With newer the CP types, the following meaning is possible (refer to the CP manual /2/): The number of data to be sent exceeds the upper limit for this service.
0	1	$80B2_H$	The communication bus connection between the CPU and CP is not established.(with older CPU versions; otherwise $80A4_H$; ; for further information, refer to this code)
0	1	$80C0_H$	The data record cannot be read.
0	1	$80C1_H$	The specified data record is currently being processed.

FC5 AG_SEND / FC50 AG_LSEND - continued

Table 8-10 AG_SEND Codes, continued

DONE	ERROR	STATUS	Meaning
0	1	$80C2_H$	There are too many jobs pending.
0	1	$80C3_H$	Resources occupied (memory).
0	1	$80C4_H$	Communication error (occurs temporarily, it is usually best to repeat the job in the user program).
0	1	$80D2_H$	Module base address incorrect.

Example of AG_SEND

Below you will find an executable example of an FC5 (AG_SEND) call and parameter evaluation.

The OB100 listed below belongs to the FC100 selected here in which the send call takes place; OB100 sets the ACT bit correctly when the CPU starts up.

To function correctly, a DB100 with a size of at least 240 bytes must be loaded.

The program requires a CP at address 256 and a configured connection of the type ISO Transport / ISO-on-TCP / TCP or FDL with ID=1 (please adapt your configuration where necessary !).

```
//------------------------------------------------------------------

FUNCTION FC 100: VOID
TITLE = SENDE_DEMO
AUTHOR : Tester
FAMILY : S7300
NAME : FC5_Demo
VERSION : 1.0

//------------------------------------------------------------------

BEGIN
      CALL FC 5 (
      ACT          := M100.0,
      ID                 := 1,
      LADDR        := W#16#100,
      SEND         := P#DB100.dbx0.0 BYTE 240,
      LEN          := 240,
      DONE         := M100.1,
      ERROR := M100.2,
      STATUS       := MW102 );

//-------------------------------------------------------------------
```

FC5 AG_SEND / FC50 AG_LSEND - continued

```
      R M100.0;       //  Reset Parameter ACT for all further FC 5 calls
      SET;            //
      A M100.1;       //  Test for DONE = TRUE
      JC done;        //
      SET;            //
      A M100.2;       //  Test for ERROR = TRUE
      JC err;         //

//---------------------------------------------------------------------

      BEU;            //  Neither DONE nor ERROR is set, the job is
                      //  still running.

//---------------------------------------------------------------------

done  S M100.0;       //  Job completed without error. Set ACT = TRUE so
      BEU;            //  that the following call can trigger the new
                          job.

//--------------------------------------------------------------------

err:  NOP 1;          // An error occurred. The status word can be eva-
      NOP 1;          // luated here. Set ACT to TRUE in any case, so
      S M100.0;       // that a new send job can be triggered if the
      BEU;            // error disappears.

//--------------------------------------------------------------------

END_FUNCTION


ORGANIZATION_BLOCK OB100
TITLE       = Init_for_FC100
FAMILY:           S7300
NAME: SENDE_DEMO_INIT
VERSION:    1.0

VAR_TEMP

OB1_System: array [1..20] of byte;

END_VAR


BEGIN                    //
      SET                //
      S M100.0           //    Initialize ACT parameter
END_ORGANIZATION_BLOCK
```

8.4.2 FC6 AG_RECV / FC60 AG_LRECV

Meaning of the Block

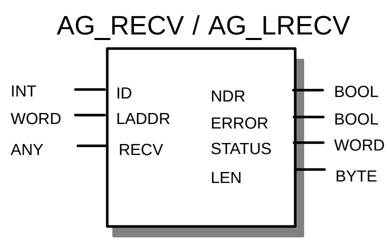
The AG_RECV / AG_LRECV function receives the data transferred on a configured FDL connection from the PROFIBUS CP.

The data area specified for the receive data can be a process image area, a bit address area or a data block area.

Error-free execution is indicated when the data could be received from the PROFIBUS CP.

Note:
Unless otherwise stated, all the following information applies to both the FCs AG_SEND and AG_LSEND.

Call Interface



Example in STL representation

STL			Explanation
call fc 6			//AG_RECV / AG_LRECV block call
ID	:=	MW 30	//Connection ID acc. to configuration
LADDR	:=	W#16#0100	//=LADDR 256 dec. in hardware configuration
RECV	:=	P#M 10.0 BYTE 100	//Buffer for received data
NDR	:=	DB 100.DBX 0.6	//Receive code
ERROR	:=	DB 100.DBX 0.7	//Execution code
STATUS	:=	DB 100.DBW 2	//Error code
LEN	:=	DB 100.DBW 4	//Status code

FC6 AG_RECV / FC60 AG_LRECV - continued

Calls with Job Header

The following table shows the connection types and job types for which parameters must be supplied in the job header.

The job header is located in the FDL (user) data area. It occupies the first 4 bytes and must be added to the length specified in the LEN parameter. The maximum user data length is therefore reduced for jobs with a job header to 236 bytes.

Table 8-11 Return Parameters in the Job Header in the FDL (User) Data Area

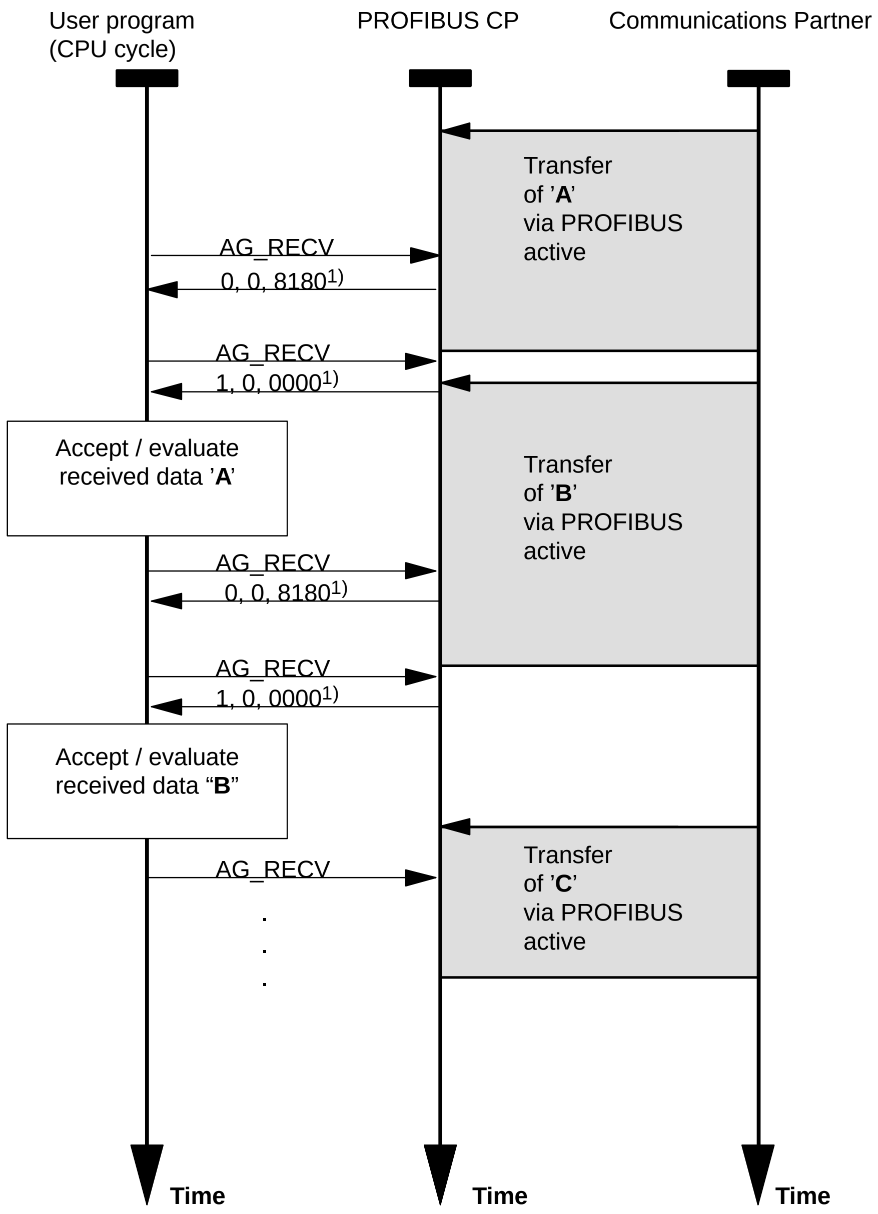
Parameter	FDL connection type		
	Unspecified free layer 2	**Broadcast**	**Multicast**
PB address	Address of the sender Values: 0 to 126 depending on node		
LSAP	LSAP of the sender Values: 0 to 63 depending on node		
Service	SDN indication (Send Data with No Acknowledge - Indication): Value: 01_H or SDA indication (Send Data with Acknowledge - Indication): Value: 00_H	SDN indication (Send Data with No Acknowledge - Indication): Value: $7F_H$	SDN indication (Send Data with No Acknowledge - Indication): Value: $7F_H$

FC6 AG_RECV / FC60 AG_LRECV - continued

How the Block Works

The following diagram illustrates the normal sequence of data acceptance triggered by an AG_RECV in the user program.

Each AG_RECV job in the user program is acknowledged by an entry in the output parameters NDR, ERROR and STATUS.



Legend:
1) parameter transfer DONE, ERROR, STATUS

FC6 AG_RECV / FC60 AG_LRECV - continued

Explanation of the Formal Parameters

The following table explains all the formal parameters for the function AG_RECV:.

Parameter	Declaration	Type	Possible Values	Remarks
ID	INPUT	INT	1,2 to 16 (S7-300) 1,2 to 32 (S7-400)	The connection number of the FDL connection is specified in the ID parameter (see Configuration Chapter 7).
LADDR	INPUT	WORD		Module base address When you configure the CP with STEP 7 hardware configuration, the module start address is displayed in the configuration table. Specify this address here.
RECV	INPUT	ANY (as VARTYPE only BYTE, WORD and DWORD are permitted)		Specifies the address and length. The address of the FDL data area references either: - Process image area - Bit memory - Data block area With a call with job header, the FDL data area contains the job header **and** the user data.
LEN	OUTPUT	INT	1,2, to 240	Specifies the number of bytes to be received in the FDL data area from the PROFIBUS CP. In a call, with job header, the length information is made up of the job header (4 bytes) + user data (1 to 236 bytes). Therefore LEN >= 4 !
NDR	OUTPUT	BOOL	0: - 1: new data	This parameter indicates whether new data were received. For the meaning of this parameter in conjunction with the ERROR and STATUS parameters, refer to the following table.
ERROR	OUTPUT	BOOL	0: - 1: error	Error code For the meaning of this parameter in conjunction with the NDR and STATUS parameters, refer to the following table.
STATUS	OUTPUT	WORD	see following table	Status code For the meaning of this parameter in conjunction with the NDR and ERROR parameters, refer to the following table.

Condition Codes

The following table shows the codes formed by the DONE, ERROR and STATUS parameters that must be evaluated by the user program.

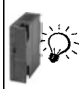
FC6 AG_RECV / FC60 AG_LRECV - continued

Note

For entries coded with 8Fxx$_H$ in STATUS, refer to the information in the STEP 7 Standard and System Functions reference manual. The chapter describing error evaluation with the RET_VAL output parameter contains detailed information.

To find out which SFCs are used and are relevant for error evaluation, display the properties dialog of the FC described here in the “Calls” tab.

Table 8-12 AG_RECV Codes

NDR	ERROR	STATUS	Meaning
1	0	0000$_H$	New data accepted.
0	0	8180$_H$	• There are not yet any data available.  With newer the CP types, the following meaning is possible (refer to the CP manual /2/): No configuration or the FDL service has not yet started on the PROFIBUS CP. (occurs here instead of the code 0,1,8183H !)
0	0	8181$_H$	Job active.
0	1	8183$_H$	No configuration or the FDL service has not yet started on the PROFIBUS CP.
0	1	8184$_H$	• Illegal data type specified for the RECV parameter. • System error.
0	1	8185$_H$	Destination buffer (RECV) is too short.
0	1	8186$_H$	ID parameter invalid. ID!=1,2 to 15,16.
0	1	8303$_H$	The PROFIBUS service (SDA-SendDatawithAcknowledge) is not supported on this SAP. This display can also occur temporarily when connections or gateways are downloaded in ”RUN”.
0	1	8304$_H$	The FDL connection is not established.
0	1	8F23$_H$	Source area invalid, for example: Area does note exist in the DB.
0	1	8F25$_H$	Area error writing a parameter.
0	1	8F29$_H$	Alignment error writing a parameter.
0	1	8F30$_H$	Parameter is in the write-protected 1st act. data block.
0	1	8F31$_H$	Parameter is in the write-protected 2nd act. data block.
0	1	8F32$_H$	Parameter contains a DB number that is too high.
0	1	8F33$_H$	DB number error.
0	1	8F3A$_H$	Destination area not loaded (DB).
0	1	8F43$_H$	Timeout writing a parameter to the I/O area.

FC6 AG_RECV / FC60 AG_LRECV - continued

Table 8-12 AG_RECV Codes, continued

NDR	ERROR	STATUS	Meaning
0	1	8F45$_H$	Address of the parameter to be read is disabled in the access track.
0	1	8F7F$_H$	Internal error, e.g. illegal ANY reference.
0	1	8090$_H$	• No module with this base address exists. • The FC being used does not match the system family being used (remember to use different FC for S7-300 and S7-400).
0	1	8091$_H$	Logical base address not at a double word boundary.
0	1	8092$_H$	In the ANY reference, a type other than BYTE is specified. (S7-400 only)
0	1	80A0$_H$	Negative acknowledgment reading from the module.
0	1	80A4$_H$	The communication bus connection between the CPU and CP is not established. (with newer CPU versions). This can, for example, be caused by the following: • No connection configuration; • The maximum number of CPs that can be operated at one time has been exceeded (for further information, refer to the CP manual /2/).
0	1	80B0$_H$	The module does not recognize the data record.
0	1	80B1$_H$	• Destination area invalid.  With newer the CP types, the following meaning is possible (refer to the CP manual /2/): The destination area is too short.
0	1	80B2$_H$	The communication bus connection between the CPU and CP is not established.
0	1	80C0$_H$	The data record cannot be read.
0	1	80C1$_H$	The specified data record is currently being processed.
0	1	80C2$_H$	There are too many jobs pending.
0	1	80C3$_H$	Resources occupied (memory).
0	1	80C4$_H$	Communication error (occurs temporarily, it is usually best to repeat the job in the user program).
0	1	80D2$_H$	Module base address incorrect.

8.5 Numeric Data / Resource Requirements of the FCs

Notice

Please note the version information of the blocks. Blocks with other versions have different resource requirements.

Table 8-13 Information for FCs with an S7-400

NAME	Version	FC no.	Load Memory Bytes	Work Memory Bytes	MC7 Bytes	Local data Bytes
AG_SEND	1.1	5	732	576	540	20
AG_RECV	1.1	6	656	522	486	20
AG_LSEND	3.0	50	1044	846	810	52
AG_LRECV	3.0	60	1190	992	956	58

Table 8-14 Information for FCs with an S7-300

NAME	Version	FC no.	Load Memory Bytes	Work Memory Bytes	MC7 Bytes	Local data Bytes
DP_SEND	3.0	1	1066	886	850	42
DP_RECV	3.0	2	1144	950	914	46
DP_DIAG	3.0	3	1956	1638	1602	58
DP_CTRL	3.0	4	1532	1292	1256	52
AG_SEND	4.1	5	1916	1610	1574	50
AG_RECV	4.5	6	1408	1174	1138	40

❑

9 NCM S7 Diagnostics

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

This chapter provides a general overview of the individual diagnostic functions.

The following checklist will help you to recognize several typical problems and their possible causes and shows how you can use the NCM S7 diagnostics tool to remedy the situation.

You will find further information in the following sources:

- When you are working with the diagnostic tool, the integrated help system provides you with context-related support.
- You will find detailed information on working with STEP 7 programs in the Help on STEP 7, which includes the topic “Diagnosing Hardware”.

9.1 Overview

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:

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

  Hardware diagnostics provides dynamic information on the operating mode 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. Diagnostic 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 diagnostic icon in the quick view or the diagnostic view.

- **Communication Diagnostics with NCM S7 Diagnostics**

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

- **HW Config Provides Static Information**

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

What You Should Already Know

You should be familiar with the basic information from Chapter 2 about handling NCM S7. This means that you know how to connect the CP to the PG and how to control the module using the PG.

9.2 Functions of NCM S7 Diagnostics

Functions

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 CP 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

Mode-Dependent 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 is not possible for a passive DP slave via PROFIBUS.

- Diagnostics of FDL Connections
- Diagnostics of FMS connections; for detailed information, refer to Volume 2 of this manual.

9.2.1 Installing and Starting NCM S7 Diagnostics

Installation

Die NCM S7 Diagnostics is an integrated part of the STEP 7 NCM S7 option.

There are several ways in which you can start the diagnostic tool, for example:

- Aus dem Standard-Startmenü von Windows 95/NT über die Programmgruppe SIMATIC.

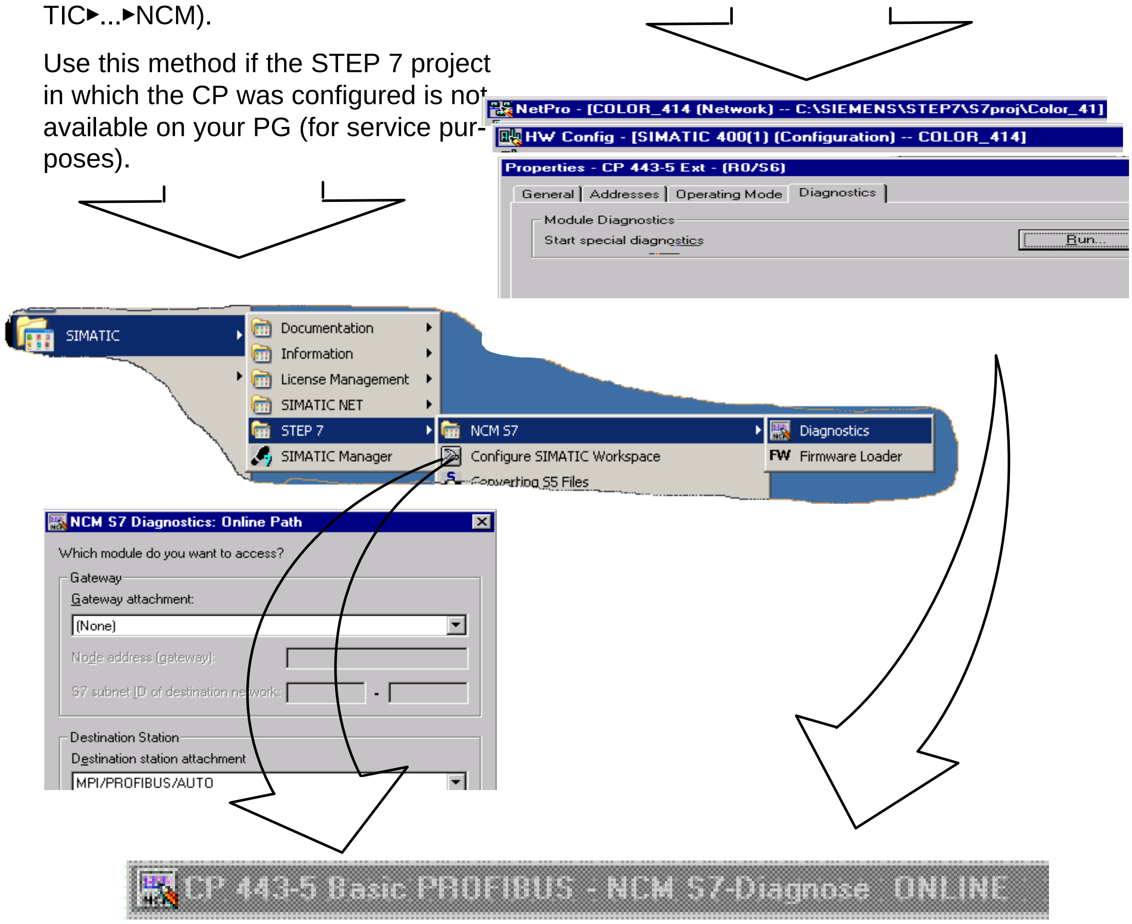
  Wählen Sie diese Möglichkeit, wenn Sie das STEP 7-Projekt, in dem der CP konfiguriert wurde, auf Ihrem PG nicht verfügbar ist (Servicezwecke).

- Aus dem Eigenschaftendialog des jeweiligen CP von Ihrem STEP 7-Projekt aus.

- From the standard Start menu of Windows (program group SIMATIC▸...▸NCM).

  Use this method if the STEP 7 project in which the CP was configured is not available on your PG (for service purposes).

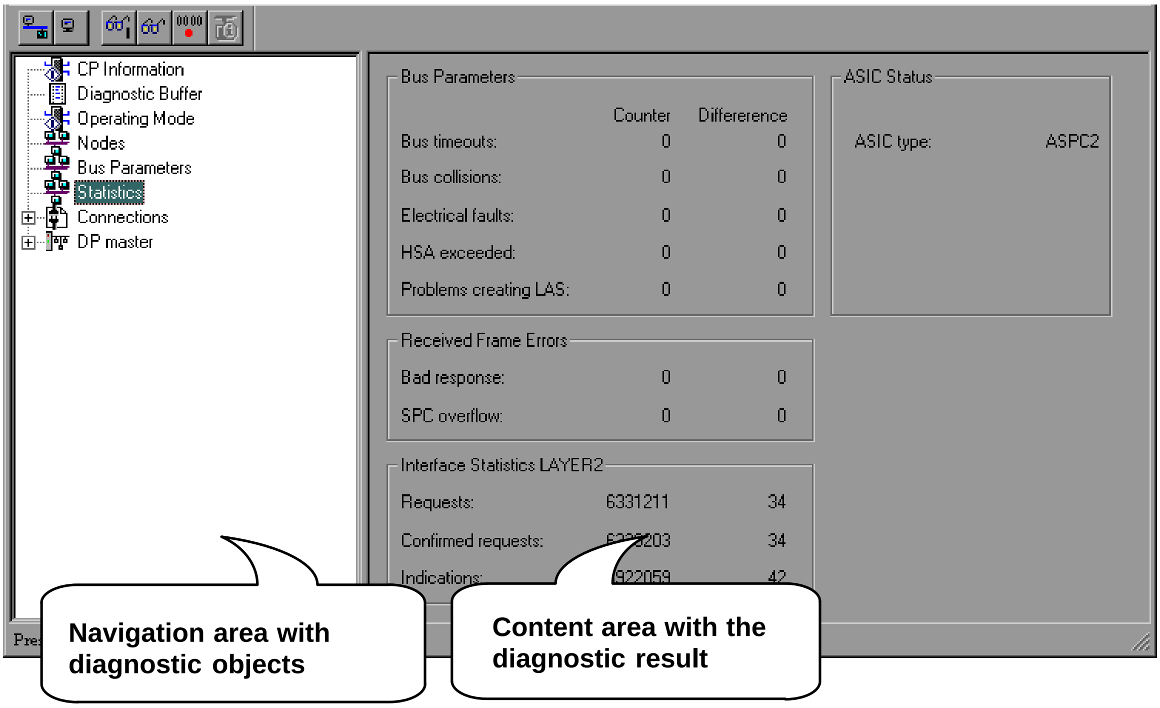
- From the Properties dialog of the CP within your STEP 7 project.



For further information on the Startup options, refer to Section 9.3.

Structure

In the same way, for example, as the SIMATIC Manager, NCM S7 Diagnostics appears as a separate two-part application window with a menu and toolbar:



- In the **navigation area** on the left-hand side, you will find the hierarchically arranged diagnostic objects.

  You have an overview of the available diagnostic functions at all times. The object structure displayed in the navigation area is adapted to the type of CP you are currently checking and the functions and connections configured for the CP.
- In the **content area**, on the right-hand side, you will see the result of the diagnostic function you selected in the navigation area.

Operation

- By selecting a diagnostic object in the navigation area with the mouse, you execute the diagnostic function.
- Using the **menu bar and toolbar**, you control the sequence of the diagnostics with context-sensitive menu commands.

9.2.2 General Menu Commands

Overview

When running diagnostic functions, the following menu commands have general significance. Depending on the context, other functions may be available; for more detailed information refer to the online help for NCM Diagnostics.

Table 9-1 Meaning of the Menu Commands

Menu	Meaning
Diagnostics▶ Open Online Connection... Diagnostics▶ Close Online Connection...	With this menu command, you can establish a connection to a different CP you want to check without having to quit and restart the diagnostic tool. The current diagnostic connection is closed. If you want to use more than one diagnostic connection at the same time, you can start NCM S7 diagnostics more than once.
Operating Mode▶	You can control the CP as follows:
Stop CP	Stops the CP.
Start CP	Starts the CP if the RUN/STOP switch is set to RUN.
Reset CP	With certain CP types, for example the CP 443-5 Basic, you can reset the CP memory. This function must be confirmed before it is executed.
View▶Update	Each time you activate this menu command, the displayed diagnostic and status information is updated once.
View▶ Update Cyclically	Using this menu command, you activate and deactivate the automatic (cyclic) updating of the displayed diagnostic and status information. You can set the interval between update points with the menu command **Options▶Customize**.
Options▶Customize	With this menu command, you set the general parameters for the diagnostic session.
Help▶	You display a help topic relating to the current diagnostic function As an alternative, you can also press the F1 key. Remember that you can also call up context-related help for some of the diagnostic functions. To obtain help, position the cursor on the output field and press the F1 key.

Note

If the connection to the CP is terminated during the diagnostic session, the following message is displayed: “The online connection was terminated”.

You can reestablish the connection to the CP with the corresponding acknowledgment in the dialog. The connection is then automatically reestablished whenever possible.

9.3 Starting Diagnostics

9.3.1 Establishing a Connection to the PROFIBUS CP

Initial Situation

Establish the physical connection between the PG and the SIMATIC S7 Station. There are two ways of doing this:

- MPI
- Industrial Ethernet (ISO protocol)
- Industrial Ethernet TCP/IP (IP protocol)
- PROFIBUS

Ways of Starting Diagnostics

You can start NCM Diagnostics from the following STEP 7 functions or dialogs:

- CP properties dialog
- Windows Start menu
- Connections properties dialog (NetPro)
- Hardware configuration HW Config

These possibilities are described below.

9.3.2 Starting Diagnostics from the CP Properties Dialog

If the project data are available on your PG/PC, follow the steps outlined below:

1. Select the S7 station in the project and open the hardware configuration (HW Config).
2. Select the CP and open the Properties dialog.
3. Select the “Diagnostics” dialog.
4. Select the “Run” button.

Result:
NCM S7 Diagnostics is opened. The path is set automatically to match the current connection in STEP 7.

9.3.3 Starting Diagnostics from the Windows Start Menu

If there are no configuration data on your PG/PC, follow the steps outlined below to start diagnostics with a connected CP:

1. Open the Windows Start menu and select the command **SIMATIC ▸ STEP 7 ▸ Diagnostics**

   NCM S7 Diagnostics is started with the message “No online connection to the CP” in the contents area.

2. In the displayed dialog “NCM S7 Diagnostics”, select the interface to match your hardware configuration.

   Depending on the type of network attachment you have, you will be prompted to specify an address:

Table 9-2 Possible Settings for the Online Paths - without Parameters for Internetworking

Attachment on Destination Station	Node Address	Location of the Module Rack / Slot
MPI	MPI address of the CP if this has its own MPI address. Otherwise specify the MPI address of the CPU.	Rack/slot no. of the CP to be checked. If you specify the MPI address of the CP, you can simply use the default setting “0/0”. With this setting, the CP whose address was specified as the node address is accessed.
PROFIBUS	PROFIBUS address of the PROFIBUS CP via which the S7 station is reached.	Rack/slot no. of the CP to be checked.
Industrial Ethernet	MAC address of the Ethernet CP via which the S7 station is reached. Entered in hexadecimal.	Rack/slot no. of the CP to be checked. If you specify “0/0”, the CP specified with the node address is accessed directly.
Industrial Ethernet TCP/IP	IP address of the Industrial Ethernet CP via which the S7 station is reached. Entered in decimal. Example: IP address decimal 142.120.9.134	Rack/slot no. of the CP to be checked. If you specify “0/0”, the CP specified with the node address is accessed directly.

Examples of an Online Path without Gateway

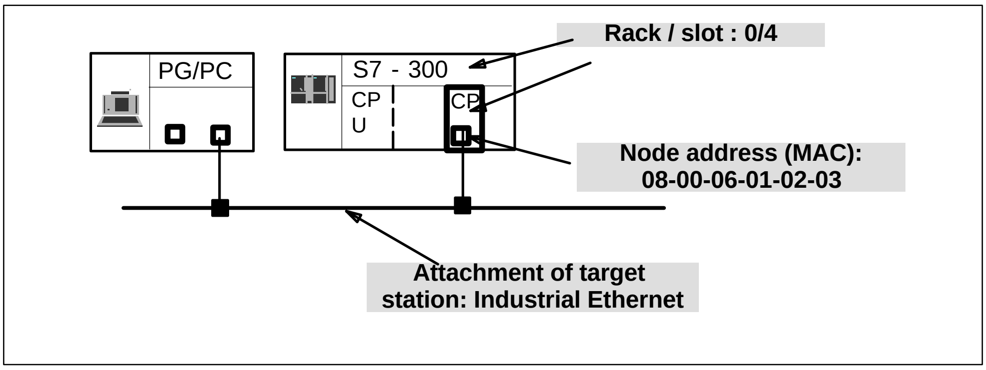


Figure 9-1 CP requiring diagnostics can be reached directly

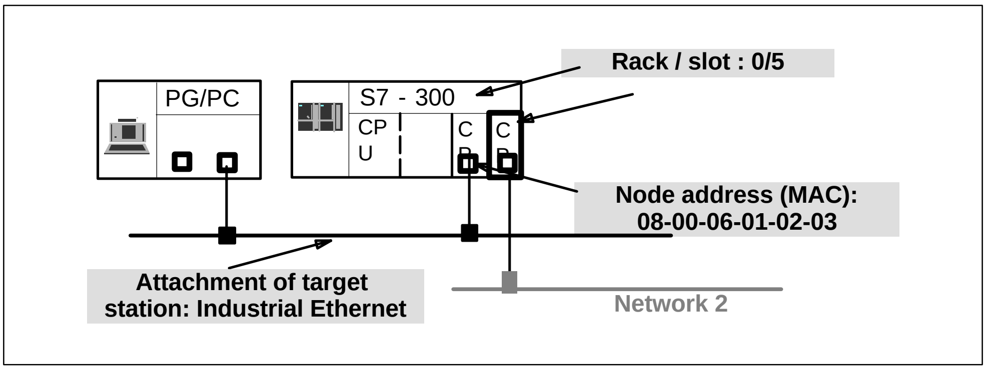


Figure 9-2 The CP requiring diagnostics is accessible indirectly over another CP

9.3.4 Using a Gateway

Case a: One gateway

If the CP you want to check with diagnostic functions can only be reached via a gateway, you must select the device and specify its node address in the local network.

You must also specify the S7 subnet ID of the destination network:

The subnet ID consists of two numbers separated by a dash:

- One number for the project
- One number for the subnet

You will find the subnet ID in the object properties of the subnet in the STEP 7 project. The subnet ID is also printed out with the network configuration.

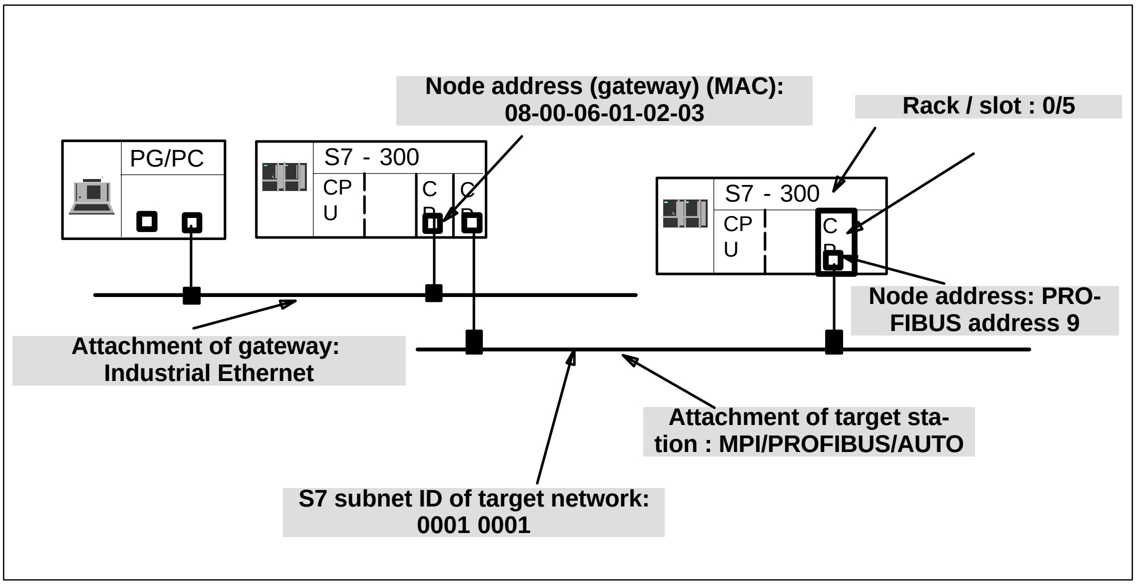


Figure 9-3 Example of the Parameter Settings for the Online Path with one Gateway

Case b: Several Gateways

If the CP requiring diagnostics can only be reached over several gateways, you only specify the first gateway.

Routing over the other gateways is done automatically.

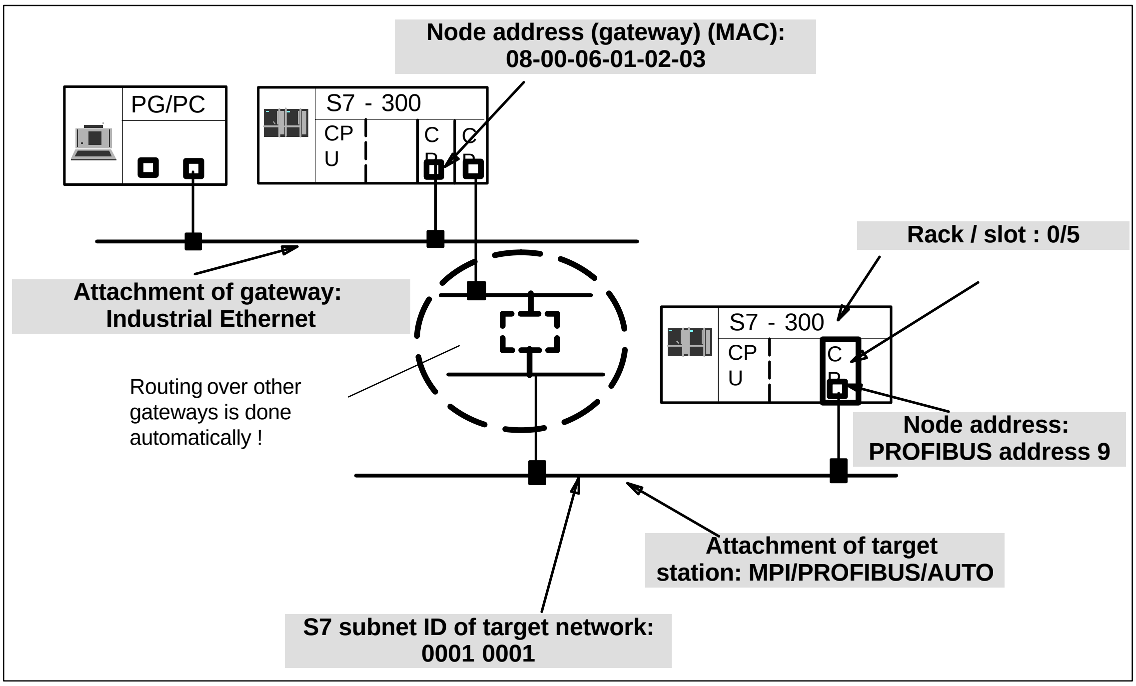


Figure 9-4 Example of the Parameter Settings for the Online Path with Several Gateways

9.3.5 Using the PC Station - Setting a Gateway with “PC internal”

There is a special situation when you use your PC/PG as a PC station and have therefore set the interface to PC internal (local) in “Setting the PG/PC Interface”. You must them set parameter values for the gateway, even when you do not need to go through any other gateway to reach the target station.

Select the following settings:

- Gateway attachment: MPI/PROFIBUS/AUTO
- Node address (gateway)

  Enter the index of the module here.

  The index is the virtual slot address of the component (can be displayed using the Station Configuration Editor). The index is identical to the slot number selected during configuration of the PC station in STEP 7 HW Config!
- S7 subnet ID of destination network:

  Follow the same steps as described for setting the gateway.

Tip:

You do not need to make these settings for the gateway if you select one of the following options:

- Start NCM Diagnostics from the Properties dialog of the CP.
- When setting up your module, do **not** select the interface as PC internal (local) in “Set PG/PC Interface”.

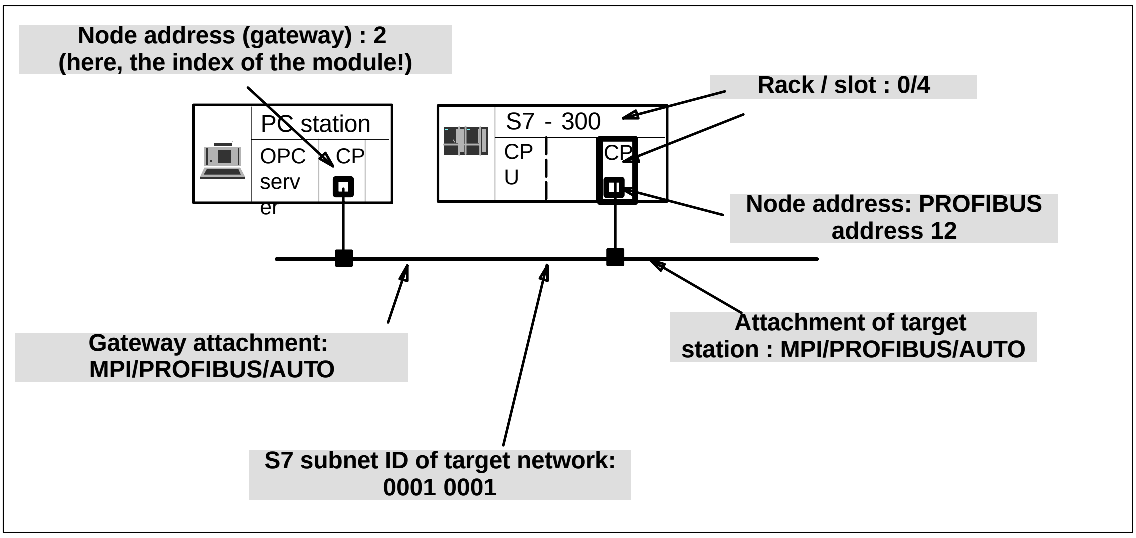


Figure 9-5 Example of Settings with “PC internal”

9.3.6 Other Ways of Starting Diagnostics

Starting in the properties dialog of the connections:

1. Select the **PLC▸Activate Connection Status** menu command to activate online access.
2. Select the “Special Diagnostics” button in the “Status Information” tab.

Starting in the hardware configuration tool HW Config:

1. With the S7 station online, select the **PLC▸Module Status** menu command;
2. Select the “Special Diagnostics” button in the dialog that is opened.

Note

To operate several diagnostic connections at the same time, you can start NCM S7 Diagnostics more than once.

You can also start NCM S7 Diagnostics twice with an online connection to the same CP; this can, for example, be useful if you want to monitor the diagnostic buffer at the same time as running diagnostic functions on a connection.

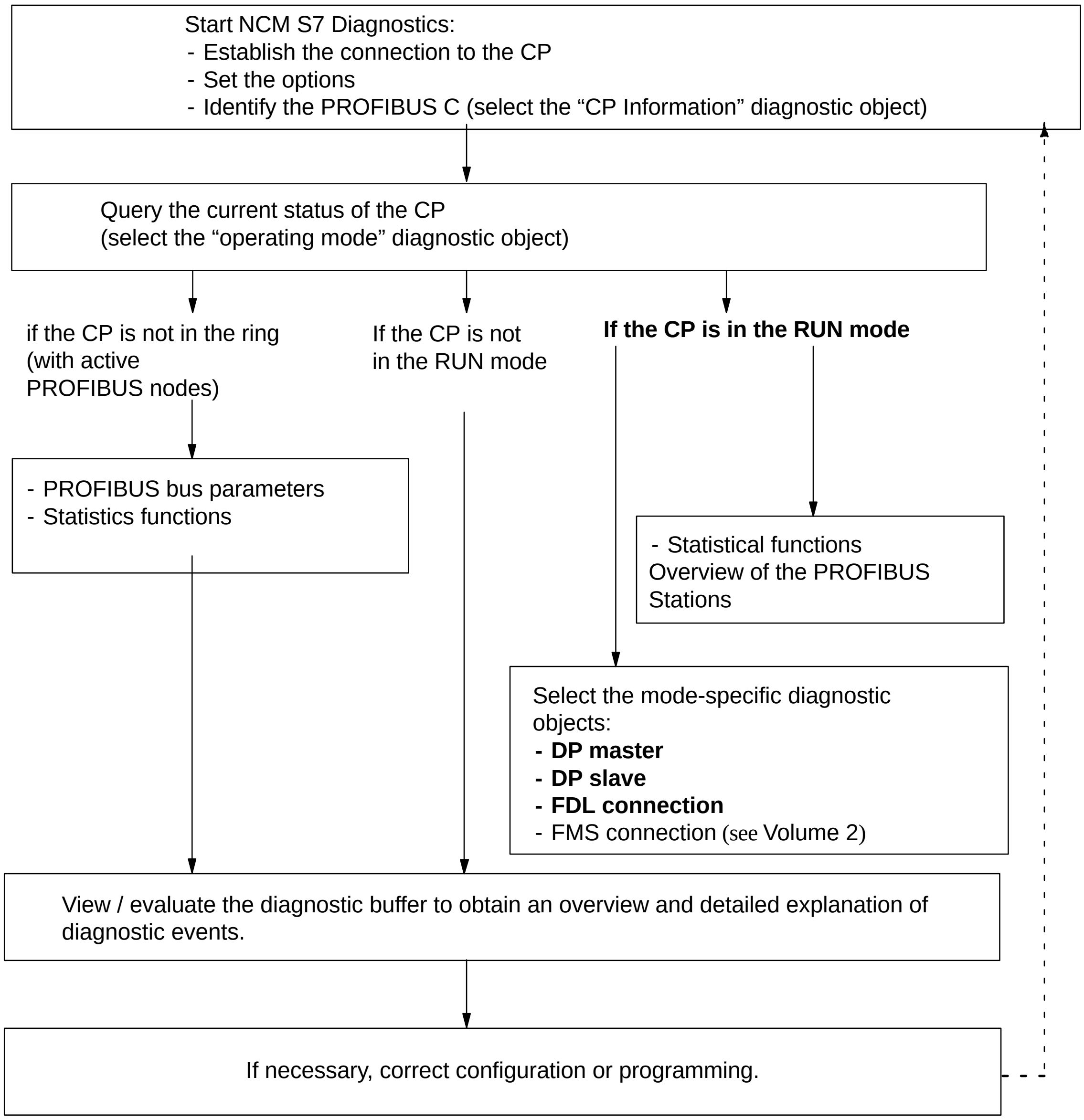
Requirement: You have an online connection available via the LAN (ISO or TCP/IP) on the one hand and an online connection via the communication (K) bus on the other (alternatively via the CPU or via PG channel routing via a further CP).

9.4 Steps in Diagnostics

Procedure

To use diagnostics efficiently, particularly when working with the diagnostic tool for the first time, the following procedure can be recommended.

1. Use the sequence shown below as a basis for using diagnostics:



2. Locate the problem, for example, based on the checklist in Section 9.6 the diagnostic function you require based on the recommendation in the list.

9.5 Calling Specific Diagnostic Functions

The following table shows the diagnostic options that exist in the available functions.

Table 9-3 General Diagnostic and Statistical Functions

Diagnostic Functions / Diagnostic Object	Diagnostic Aims	Special Features
CP information	The aim is to identify the CP to which NCM S7 Diagnostics is connected and to find out the current mode.	
Mode	Here, the aim is to find out the current operating mode of the PROFIBUS CP as a module in the S7-300/400 and as a node on PROFIBUS and, if necessary, to modify the mode (menu command **Operating Mode ▸ Stop CP/Start CP**).	
Device-Related Diagnostics	To display and decode device (vendor-specific) diagnostic data.	
Diagnostic buffer	General Error Diagnostics Using Diagnostic Buffers: To display and decode event messages recorded on the CP in detail. The diagnostic buffer provides you with detailed information about all the communication services of the CP.	Event messages are recorded on the CP in a ring buffer. The ring buffer can contain up to 50 entries. In NCM S7, on the other hand, up to 500 messages can be saved! All the CP functions can generate event messages. When you call the diagnostic object, the messages are read out and displayed. The latest message is displayed in the top line with the highest consecutive number. If you double-click a previously selected event message, you display a help text explaining the message in greater detail.
Stations	Overview of the Stations on PROFIBUS To clarify which active and passive stations exist on a PROFIBUS subnet and are detected in the logical ring.	

Table 9-3 General Diagnostic and Statistical Functions, continued

Diagnostic Functions / Diagnostic Object	Diagnostic Aims	Special Features
Bus Parameters	To display and check all the currently set bus parameters.	
Statistics	Station-Related Statistics: To evaluate information on how communication is handled by the addressed PROFIBUS CP on PROFIBUS.	Along with the status information the number of events (counter) since the last time the PROFIBUS CP was reset and the number of events detected since the last update job (difference) are also displayed.

Table 9-4 Mode-Dependent Functions

Diagnostic Functions / Diagnostic Object	Diagnostic Aims	Special Features
DP Master	DP master diagnostics provides the following functions: • Display of the status of the PROFIBUS CP configured as the DP master. • An overview of the DP slaves attached to the DP master system. • Slave diagnostics for one of the attached DP slaves.	You can display DP master diagnostics by selecting the diagnostic object “DP Master” in the navigation area.
Select the “DP Slave Adr. xx” diagnostic object:	The DP slave diagnostics function is used to display DP slave diagnostic data. Depending on the operating mode of the addressed PROFIBUS CP, this involves the following: • In the DP master mode, diagnostic data of the attached DP slaves. • In the DP slave mode, diagnostic data of the local PROFIBUS CP. Regardless of the mode, the DP master belonging to the DP slave provides additional diagnostic information that can be used for more detailed diagnostics.	The DP slave is displayed as follows depending on the CP mode: • In the DP slave mode: As a separate diagnostic object at the first hierarchy level. • In the DP master mode: As a nested diagnostic object of the DP master.
Module Diagnostics.	Query the module states: To decode the module error statuses in detail.	Module diagnostics can only be called when a module of the DP slave has failed! If there is no module diagnostics, the entry in the navigation area is shown in light gray.

Table 9-4 Mode-Dependent Functions, continued

Diagnostic Functions / Diagnostic Object	Diagnostic Aims	Special Features
To display and monitor FDL communication connections. You obtain an overview or detailed information in the contents area depending on the diagnostic object you select.		
Connections	• Overview of All Connection Types Used	By double-clicking the objects in the contents area, you can display detailed information.
Connections ▶ Type	• Overview of all the communication connections of a particular type, for example all FDL connections; • Information on the connection status	
Connections ▶ Type ▶ Type-connection-n	• Detailed information about the status of a communication connection.	

9.6 Checklist for ‘Typical Problems‘ in a System

Meaning

The following lists contain several typical problems and their possible causes and how you can use the NCM S7 diagnostics tool to remedy the situation.

The checklists deal with the following topics:

1. Checklist for General CP Functions
2. Checklist for DP Master Mode
3. Checklist for DP Slave Mode
4. Checklist for FDL Connections

You will find a similar checklist for FMS connections in Volume 2 of this manual.

Note

In the column “Identifying the Cause and Remedy”, you will see the diagnostic function recommended for dealing with the problem shown in bold face.

9.6.1 Checklist for General CP Functions

Table 9-5 Checklist for Typical Problems When Operating a CP in a System

Problem	Possible Cause	Identifying the Cause and Remedy
The PROFIBUS CP does not change to the RUN mode.	Invalid configuration loaded on the PROFIBUS CP.	**Yellow STOP LED and red SF LED lit continuously.** **Call up the diagnostic buffer in NCM S7 PROFIBUS Diagnostics.** Example of an entry Configure DP input data offset (offset=xxx, yy. module) is not permitted (PROFIBUS address zz). Further entry: CP STOP due to invalid CP parameter assignment What to do: Correct the configuration of the PROFIBUS CP.
	There is an active station with a different transmission rate or with different bus parameters before the PROFIBUS CP on the bus.	**STOP LED lit continuously, green RUN LED flashing.** **Query the operating mode in NCM S7 PROFIBUS diagnostics.** Operating mode: Startup, PROFIBUS status: Station not in the ring. What to do: Correct the transmission rate.
	A timeout has occurred in an NCM online function.	**Yellow STOP LED lit continuously. Green RUN LED flashing.** The PBUS identification run with the S7 CPU has not been made. The PROFIBUS CP waits for transfer of the correct MPI parameters by the S7 CPU.
	Physical bus fault, for example bus short circuit.	**Query the operating mode in NCM S7 PROFIBUS diagnostics.** PROFIBUS status: Station not in ring, Cause: Bus fault What to do: Eliminate the bus fault.
	Switch set to STOP on the PROFIBUS CP.	**Query the operating mode in NCM S7 PROFIBUS diagnostics.** Operating mode: STOP, cause: Switch set to STOP What to do: Change the switch to RUN on the PROFIBUS CP

9.6.2 Checklist for DP Master Mode

Table 9-6 Checklist for Typical Problems when Operating a DP Master in a System

Problem	Possible Cause	Identifying the Cause and Remedy
The CP does not change to the DP master mode (for example bus fault LED on some or all stations)	The DP master is not configured.	**Query the operating mode in detail in NCM S7 PROFIBUS diagnostics.** Status information/DP master mode -> Status: STOP, cause: Not configured What to do: Configure the DP master mode.
	Wrong length specified in the DP SEND call.	**Call up DP master diagnostics in NCM S7 PROFIBUS diagnostics.** DP status: STOP, cause of DP status: Incorrect send length in data transfer from PLC. **Call up the diagnostic buffer in NCM S7 PROFIBUS Diagnostics.** Entry “Output data length in the CPU (= xxx bytes) is less than the total output data length expected by the DP master (= yyy bytes) What to do: The correct length corresponds to the above parameter yyy -> correct the S7 program.
	The CPU is still in the STOP mode or the blocks DP-SEND/DP-RECV were not yet run.	**Call up DP master diagnostics in NCM S7 PROFIBUS diagnostics.** DP status STOP, cause of DP status no data transfer from PLC (->no polling mode) What to do: Change the CPU to RUN.
	DP mode STOP is requested using the DP-CTRL block.	**Call up DP master diagnostics in NCM S7 PROFIBUS diagnostics.** DP status STOP, cause of DP status no polling mode, status requested by user. What to do: Request RUN DP mode using the DP CTRL function (FC).
	DP mode offline requested using the DP-CTRL function (FC).	**Call up DP master diagnostics in NCM S7 PROFIBUS diagnostics.** DP status Offline, cause of DP status no polling mode, status requested by user. What to do: Request RUN DP mode using the DP CTRL function (FC).

Table 9-6 Checklist for Typical Problems when Operating a DP Master in a System

Problem	Possible Cause	Identifying the Cause and Remedy
	Slave stations are in the STOP mode (for example switch setting on the ET200U-DP).	**Call up DP master diagnostics in NCM S7 PROFIBUS diagnostics.** DP status RUN, cause of DP status normal polling mode (with CPU user data). Select the corresponding slaves in the slave list. Data transfer: No **Call up DP slave diagnostics for the corresponding slaves in the slave list.** Slave station diagnostics: StationNonExistent What to do: Set the DP slave switches to the RUN mode.
	PROFIBUS CP is acting as master class 2 and reads the input/output data of the slave stations cyclically.	**Call up DP master diagnostics in NCM S7 PROFIBUS diagnostics.** DP status RUN, cause of DP status normal polling mode (with CPU user data). Select the corresponding slave in the slave list Data transfer: No **Call up DP slave diagnostics for the corresponding slaves in the slave list.** Slave station diagnostics: StationNotReady, ExtStatusMessage, ParameterRequest, SlaveDeactivated, StatusFromSlave What to do: Switch off the read service and switch on the normal data transfer; In other words, change to master 1 mode.
Outputs of the DP slaves are zero although the user program requires output data not equal to zero.	Error reaction AUTOCLEAR has been configured and at least one configured DP slave is not in the data transfer phase.	**Call up DP master diagnostics in NCM S7 PROFIBUS diagnostics.** DP status Clear, cause of DP status at least one (act.) slave not in the data transfer phase. Search for the slave(s) in the slave list with data transfer: No **Call up DP slave diagnostics for the corresponding slaves in the slave list.** Analyze the DP slave diagnostics. What to do: Change the slave that is not in the data transfer phase to the data transfer phase, for example by correcting the configuration, RUN switch, physical connection to the bus etc.

Table 9-6 Checklist for Typical Problems when Operating a DP Master in a System

Problem	Possible Cause	Identifying the Cause and Remedy
	DP mode CLEAR is requested with the DP-CTRL block.	**Call up DP master diagnostics in NCM S7 PROFIBUS diagnostics.** DP status Clear, cause of DP status polling mode (data=0), status requested by user. What to do: Request RUN DP mode using the DP CTRL function (FC).
Input data are not arriving at the required area in the CPU. The wrong output data are output.	The wrong ANY pointer area was specified for DP-SEND or DP-RECV.	What to do: Configure the ANY pointer area according to the ANY pointer offset.
Although cyclic global control jobs (SYNC and FREEZE) were triggered, only the last job is processed.	Two separate global control jobs were sent.	What to do: Send the global control jobs SYNC and FREEZE with **one** global control job.

9.6.3 Checklist for DP Slave Mode

Table 9-7 Checklist for Typical Problems in the DP Slave Mode

Problem	Possible Cause	Identifying the Cause and Remedy
No DP data are arriving at the slave PROFIBUS CP from the DP master or the DP master is not receiving data from the slave PROFIBUS CP.	The DP master is not yet in the data transfer phase	**Call up DP slave diagnostics in NCM S7 PROFIBUS Diagnostics.** PROFIBUS address of the DP parameter assignment master: None Slave station diagnostics: StationNotReady ExtDiagMessage ParameterRequest StatusFromSlave Plain language message “Slave waits for parameters and configuration from master”. What to do: Change the DP master to the data transfer phase
	DP slave mode not configured on the PROFIBUS CP.	**Query the operating mode in detail in NCM S7 PROFIBUS diagnostics.** Status Information DP slave mode->Status: STOP Cause: not configured What to do: Correct the configuration of the PROFIBUS CP, set mode DP slave active or DP slave passive.
	The DP-RECV or DP-SEND blocks for the PROFIBUS CP as DP slave have not yet been run.	**Call up DP slave diagnostics in NCM S7 PROFIBUS Diagnostics.** PROFIBUS address of the DP parameter assignment master: None Slave station diagnostics: StationNotReady ExtDiagMessage ParameterRequest StatusFromSlave Plain language message “Slave determined own I/O data length (configuration), At least one DP block in the CPU is not run through” What to do: Call the DP-SEND and DP-RECV blocks in the CPU for the PROFIBUS CP as DP slave.

Table 9-7 Checklist for Typical Problems in the DP Slave Mode

Problem	Possible Cause	Identifying the Cause and Remedy
No DP data are arriving at the slave PROFIBUS CP from the DP master or the DP master is not receiving data from the slave PROFIBUS CP.	The I/O length specified in the slave when DP-SEND or DP-RECV is called does not match the I/O length configured on the master.	**Call up DP slave diagnostics in NCM S7 PROFIBUS Diagnostics.** PROFIBUS address of the DP parameter assignment master: None Slave station diagnostics: StationNotReady ExtDiagMessage ParameterRequest SlaveConfigCheckFault StatusFromSlave Plain language message “Slave waits for parameters and configuration from master, Data length changed. **Call up device-related diagnostics entry 02 XX YY** The entry 02 describes a configuration change (see also Table 6-1 on page A-146). The entry XX indicates the currently specified length (hexadecimal) of the DP-SEND for the PROFIBUS CP as DP slave (corresponds to the input data length to be configured for this slave on the DP master). The entry YY indicates the currently specified length (hexadecimal) of the DP-RECV for the PROFIBUS CP as DP slave (corresponds to the output data length to be configured for this slave on the DP master). There is also a corresponding entry in the diagnostic buffer: “Configuration accepted. Receive length: aaa, Send length: bbb” where aaa and bbb correspond to the parameters xx and yy above in hexadecimal. What to do: Correct the configuration on the DP master or length for DP-SEND or DP-RECV of the PROFIBUS CP acting as DP slave.
	The DP master is in the CLEAR status or The error reaction AUTOCLEAR is configured on the DP master and at least one of the DP slaves configured on the DP master is not in the data transfer phase.	**Call up DP slave diagnostics in NCM S7 PROFIBUS Diagnostics.** PROFIBUS address of the DP parameter assignment master: XXX Slave station diagnostics: StatusFromSlave Plain language message “DP master 1 is in the CLEAR mode”. What to do: Change the DP master to the RUN mode and eliminate the CLEAR mode.

Table 9-7 Checklist for Typical Problems in the DP Slave Mode

Problem	Possible Cause	Identifying the Cause and Remedy
No DP data are arriving at the slave PROFIBUS CP from the DP master or the DP master is not receiving data from the slave PROFIBUS CP.	The DP master is no longer polling the PROFIBUS CP as DP slave -> the watchdog has expired.	**Call up the diagnostic buffer in NCM S7 PROFIBUS Diagnostics.** The following entry is made in the diagnostic buffer: “Timeout occurred. Watchdog time set on slave: xxx * 10 msec” The Factor XXX is configured on the DP master and when multiplied by 10 msec produces the watchdog time in ms. What to do: Change the DP master back to RUN or correct the watchdog time in the configuration of the DP master.
	The DP master has released the PROFIBUS CP for other masters (for example change to the OFFLINE mode).	**Call up the diagnostic buffer in NCM S7 PROFIBUS Diagnostics.** The following entry is made in the diagnostic buffer: “Master (addr XXX) releases the slave for other masters. Status byte of the parameter assignment frame: YYY” The entry XXX corresponds to the address of the DP master that released the PROFIBUS CP as DP slave. The entry YYY corresponds to the first byte of the parameter assignment frame (for example 64 dec. means UNLOCK) What to do: Change the DP master back to the RUN mode or start data transfer with a different master.

Table 9-7 Checklist for Typical Problems in the DP Slave Mode

<table>
<tr><th>Problem</th><th>Possible Cause</th><th>Identifying the Cause and Remedy</th></tr>
<tr><td rowspan="2">No DP data are arriving at the slave PROFIBUS CP from the DP master or the DP master is not receiving data from the slave PROFIBUS CP.</td><td>The CPU is still in the STOP mode, the blocks DP-SEND / DP-RECV have not yet been run.</td><td>Call up DP slave diagnostics in NCM S7 PROFIBUS Diagnostics.
PROFIBUS address of the DP parameter assignment master: None
Slave station diagnostics:
StationNotReady
ExtStatusMessage
ParameterRequest
StatusFromSlave
Plain language message “Slave determined own I/O data length (configuration), CPU is in the STOP mode”
Call up device-related diagnostics entry 04
The entry 04 indicates that the CPU is in the STOP mode (see also Table 6-1 on page A-146).
What to do:
Change the CPU to the RUN mode.</td></tr>
<tr><td>The PROFIBUS CP as DP slave is in the “switch stop” status.
or
The PROFIBUS CP as DP slave was stopped by NCM S7 PROFIBUS or NCM S7 PROFIBUS Diagnostics.</td><td>Call up operating mode in NCM S7 PROFIBUS Diagnostics.
Operating mode: STOP
Cause: switch set to STOP
or
Cause: PG command STOP
What to do:
Change the PROFIBUS CP to the RUN mode with the switch, or in NCM S7 PROFIBUS or NCM S7 PROFIBUS Diagnostics.</td></tr>
</table>

9.6.4 Checklist for FDL Connections

Table 9-8 Checklist for Typical Problems with FDL Connections

Problem	Possible Cause	Identifying the Cause and Remedy
No data transfer on an FDL connection or only in one direction.	AG-SEND and AG-RECV are not called in the user program. or Receive or send buffer too small or incorrect.	**Check the user program.** **Evaluate status bytes in AG-SEND and AG-RECV.** What to do: If necessary, configure FC blocks. If necessary, correct ANY pointer.
	The LSAP assignment is wrong.	Evaluate status bytes of the FC blocks or evaluate diagnostic buffer. What to do: Change the SAPs according to the diagnostic buffer entries.
	PROFIBUS destination address not obtainable.	**Select PROFIBUS station overview.** Evaluate diagnostic buffer and check the PROFIBUS addresses of the PROFIBUS stations. What to do: Enter the correct destination address.
	Jobs with a job header: error in the job header of AG_SEND.	The interface of AG_SEND signals “System error” The diagnostic buffer signals “Invalid parameter” What to do: Check and correct the parameter in the job header.
Data transfer too slow	Receiving device too slow	**Evaluate diagnostic buffer.** Entry: “No receive resources on destination station XX”. What to do: Delay the send trigger or check the destination station and optimize reception.
The complete data field is not sent on an FDL connection.	LEN parameter for AG-SEND is set to the wrong value.	What to do: Set the LEN parameter to the required size. For jobs with a job header, the parameter LEN must include the job header **and** the user data.
The complete data field is not sent on an FDL connection.	The buffer specified with the ANY pointer is too small.	What to do: Correct the LEN parameter and the ANY pointer. ❑

10 Firmware Loader

This chapter will familiarize you with the uses and handling of the Firmware Loader.

The firmware loader allows you to download more recent firmware versions to the SIMATIC NET modules.

10.1 Application

Firmware

Here, firmware means the system programs in the SIMATIC NET modules.

Uses of the Firmware Loader

The firmware loader allows you to download more recent firmware versions to the SIMATIC NET modules. It is used on the following:

- PROFIBUS modules
- Industrial Ethernet modules
- Modules for Gateways (for example, IE/PB Link)

Installation

The firmware loader is available when you have installed NCM S7 on your PG/PC.

Load Files

The firmware loader supports the following file types:

- <file>.FWL

  A file form that contains information that can be displayed in the dialogs of the firmware loader in addition to the LAD file form.
- <file>.LAD

  A file format containing only the system program that can be downloaded to the module.

For detailed information, read the documentation, for example, the README file shipped with the load file.

This information is displayed even after reading in the FWL file into the firmware loader.

Working with the Firmware Loader

Depending on the module type, the downloading is prepared and executed in three or four steps.

For more detailed information, refer to the next section and the dialog boxes themselves.

Diese Informationen werden auch nach dem Einlesen der FWL-Datei in den Firmware-Lader angezeigt.

10.2 Loading Firmware

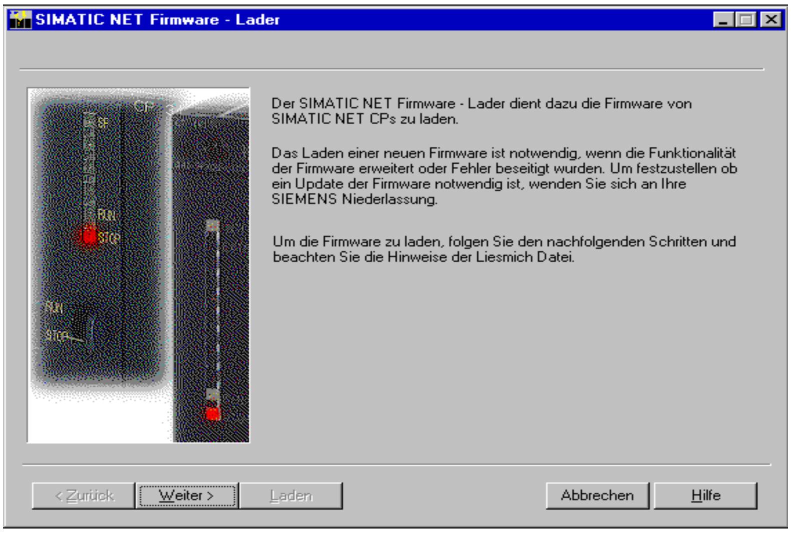
Loadable Firmware

The PROFIBUS CP supports updating of the firmware by the firmware loader. To allow this, the CP remains in the ”waiting for firmware update” state for 10 seconds following power up when you keep the mode selector held on STOP at the same time.

Following a firmware update, the rack must be turned off and on again before normal operation is possible!

Starting the Download

Open the Windows Start menu and select the menu command **SIMATIC ▸ STEP 7 ▸ NCM S7 Industrial Ethernet ▸ Firmware Loader.**



Select the **Next** button and follow the instructions displayed in the dialog.

Caution

Make sure that the load file you are using is intended as an update for the version of the firmware contained on your module. If you are in any doubt, contact your local Siemens advisor.

Caution

Remember that interrupting the download can lead to an inconsistent state on the module!

For more detailed information on the various load options, refer to the integrated help.

❑

A Pinout

Pinout - 9-Pin Sub-D Female Connector (PROFIBUS)

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	-	-	-

B Standards, certificates and approvals of SIMATIC NET S7-CPs

Product description:

- 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

Note

You can find the current valid certificates and approvals on the type plate of the respective product.

IEC 61131–2

The SIMATIC NET S7-CPs mentioned above fulfill the requirements and critieria of IEC 61131–2 (programmable logic controllers, Part 2: equipment requirements and tests).

CE Mark of Conformity

The SIMATIC NET S7-CPs mentioned above meet the requirements and protection objectives of the following EC directives and comply with the harmonized European Standards (EN) for programmable logic controllers published in the Official Gazettes of the European Community:

- 89/336/EEC “Electromagnetic Compatability“ (EMC Directive)
- 94/9/EG „Equipment and protective systems intended for use in potentially explosive atmospheres“ (Guidelines for Explosion Protection)

In accordance with EC directives the EC declarations of conformity are kept available for the responsible authorities at the following address:

- Siemens Aktiengesellschaft
  A&D Department
  Industrial Communication SIMATIC NET
  Postbox 4848
  D-90327 Nuremberg

EMC Directive

The SIMATIC NET S7-CPs mentioned above are designed for use in industrial areas.

Area of application	Requirement for	
	Emitted interference	Interference immunity
Industry	EN 61000–6–4 : 2001	EN 61000–6–2 : 2001

Guidelines for Explosion Protection

In accordance with EN 50021 (Electrical apparatus for potentially explosive atmospheres; Type of protection „n“)

II 3 G EEx nA II T3..T6

Note

During the installation of SIMATIC NET products in potentially explosive atmospheres zone 2, attention must be paid to the particular conditions involved.

You can find these conditions in the following:

- on the SIMATIC NET Manual Collection CD
- on the Internet under the address

  http://www4.ad.siemens.de/WW/news/de/13702947

Machinery Directive

The product continues to be a component according to article 4(2) of the EC Machinery Directive 89/392/EEC.

In accordance with the Machinery Directive, we are obliged to indicate that the described product is intended exclusively for installation in a machine. Before the finished product is commissioned, it is important to ensure that it conforms with the Directive 89/392EEC.

Adherance to Assembly Directives

The product meets the requirements if the assembly directives contained in this technical manual and in the documentation /1/ are adhered to during installation and operation.

Warning

Personal injury and material damage may be incurred.

The installation of expansions, which are not approved for SIMATIC S7-CPs or their target systems, can violate the requirements and regulations for safety and electromagnetic compatability.

Only use expansions that are approved for the system.

Note for Australia

The SIMATIC NET S7-CPs mentioned above fulfill the requirements of AS/NZS 2064 (Class A).

Note for Canada

This digital device Class A fulfills the requirements of the Canadian standard, ICES-003.

AVIS CANADIEN

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

UL and CSA Recognition

Note

You can find which of the following UL/CSA or cULus approvals was accorded to your product from the inscriptions on the type plate.

UL Recognition

UL-Recognition-Mark Underwriters Laboratories (UL) in accordance with UL 508:

- Report E 85972

CSA Certification

CSA-Certification-MarkCanadian Standard Association (CSA) in accordance with C 22.2 No. 142:

- Certification Record 063533–C-000

cULus Approval, Hazardous Location

HAZ. LOC.

CULUS Listed 7RA9 IND. CONT. EQ. FOR HAZ. LOC.

Underwriters Laboratories Inc. in accordance with

- UL 508 (Industrial Control Equipment)
- CSA C22.2 No. 142 (Process Control Equipment)
- UL 1604 (Hazardous Location)
- CSA–213 (Hazardous Location)

APPROVED for use in

- Class 1, Division 2, Group A, B, C, D T4A
- Class 1, Zone 2, Group IIC T4
- Class 1, Zone 2, AEx nC IIC T4

Please note the following:

Note

The system must be installed in accordance with the specifications of the NEC (National Electrical Code).

If you use the SIMATIC NET S7-CPs in environments that correspond to Class I, Division 2 (see above), they must be installed in a housing that corresponds at least to IP54 in accordance with EN 60529.

FM Approval

Factory Mutual Approval Standard Class Number 3611, Class I, Division 2, Group A, B, C, D.

Warning

Personal injury and material damage may be incurred.

In potentially explosive atmospheres personal injury and material damage may be incurred if an electrical circuit is connected or disconnected during operation of a SIMATIC NET S7-CP (e.g. in the case of plug connections, fuses, switches).

Do not connect or disconnect live current circuits, unless it is certain that danger of explosion has been excluded.

If you use SIMATIC NET S7-CPs under FM conditions, they must be installed in a housing that corresponds at least to IP54 in accordance with EN 60529.

C References and Literature

Manuals and Further Information

The following sources contain information on project engineering and operation:

/1/ For installation and commissioning of the CP

SIMATIC S7
S7-300 Programmable Controller
Hardware and Installation
Installation manual
Siemens AG

and

SIMATIC S7
S7-400, M7-400 Programmable Controller
Hardware and Installation
Installation manual
Siemens AG

/2/ For using and configuring the CP
Manual
S7-CPs for PROFIBUS - Configuring and Commissioning
Part of
- the manual package NCM S7 for SIMATIC NET CPs
- the online documentation in STEP 7 - Option NCM S7 for PROFIBUS
Siemens AG

/3/ For using and configuring the CP
Manual SIMATIC NET NCM S7 for PROFIBUS,
Volume 2
Part of
- - the manual package NCM S7 for SIMATIC NET CPs
- the online documentation in STEP 7 - Option NCM S7 for PROFIBUS
Siemens AG

/4/ For using and configuring the CP
NCM S7 for SIMATIC NET CPs “Primer”
Part of
- the manual package NCM S7 for PROFIBUS
- the online documentation in STEP 7 - Option NCM S7 for PROFIBUS
Siemens AG

/5/ SIMATIC NET , Instructions
Commissioning PC Stations
Part of
- the manual package NCM S7 for Industrial Ethernet
- the online documentation in STEP 7 / option NCM S7 for Industrial Ethernet
Siemens AG

/6/ For installing and operating a SIMATIC NET PROFIBUS network
Industrial Communications Networks PROFIBUS Networks Manual
Siemens AG

/7/ 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

/8/ 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

/9/ SIMATIC STEP 7 reference manuals with manuals for
- LAD / CSF / STL
- System software for S7-300/400 System and Standard Functions
Part of the online documentation in STEP 7
Siemens AG

/10/ On the topic of PROFIBUS:
SIMATIC NET Manual for PROFIBUS Networks
Release 02
Siemens AG

/11/ On the topic of PROFIBUS:
Decentralizing with PROFIBUS-DP
Structure, configuration and use of PROFIBUS DP with SIMATIC S7
Weigmann, J.; Kilian, G. / Publicis-MCD-Verlag

/12/ PROFIBUS Standard EN 50170, Vol 2
Beuth Verlag, Berlin

/13/ On the topic of PROFIBUS:
PROFIBUS-DP/DPV1
The new rapid way to Profibus DP
Popp, M.

/14/ On the topic of CiR:
Function Manual
SIMATIC Modifying the System during Operation via CiR
Siemens AG

/15/ On the topic of programming:
Automation with STEP 7 in STL and SCL
User Manual, Programming Manual
Berger, H. / Publicis-MCD-Verlag, 2001

/16/ On project engineering of PROFInet components and systems:

Basic help in the SIMATIC iMap engineering tool
Siemens AG

/17/ On project engineering of PROFInet components and systems:

Component based Automation - Configuring Plants with SIMATIC iMap
Manual
Siemens AG

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 Controllers SIMATIC S7 / M7 / C7”.

You can obtain these catalogs, further information you require and offers for courses from your local SIEMENS office or national head office.

D Glossary

D.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.
As an alternative, asynchronous updates according to the configuration (process image partition) or according to the programming using SFC 26/27 are possible.

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.

D.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, ACT, DEACT.

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

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

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.

E Document History

This section provides an overview of the previous releases of this manual and the functional expansions in STEP 7 and NCM S7.

New in release 05 / as of STEP7 V5.2 (C79000-G8976-C127-05)

Note

This is the last release before the two manuals “NCM S7 for PROFIBUS” and “Device Manual S7-CPs for PROFIBUS” were merged into this manual.

This version of the manual includes information relating to new functions in STEP 7 and NCM S7 as of V5.2.

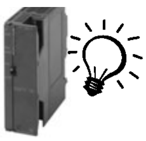
In the main, this involves the following topics:

- S7 communication over routers (single-ended client and server functionality) via an IE/PB Link or CP (see Section 1.4)
- Multiprojects

  With the new multiproject functionality, projects can be split up and distributed for engineering and then merged again.

New in Release 04 / valid up to STEP 7 V5.1

The changes mainly involved the DP functionality of the PROFIBUS CPs.



Since this functionality differs in some aspects from CP to CP, alternative features of newer modules were highlighted by this symbol throughout this release of the manual. Where this symbol appears, you should check the manual of your specific PROFIBUS CP for further information (the symbol is also used there). You will also find the symbol in the online help of STEP 7.

New in Release 03 / valid up to STEP 7 V5.0 SP3

- NCM S7 Diagnostics has a completely revised user interface. See Chapter 9

  The description of NCM S7 Diagnostics has been restructured. While this manual provides you with an overview and checklists, the online help provides you with detailed information on the diagnostic events.
- There is additional information on the DP master mode in Section 4.10 Reading Input/Output Data as a DP Master (Class 2) and in Section 4.11 Activating/Deactivating DP Slaves.

SIEMENS

SIMATIC NET

S7-CPs for PROFIBUS

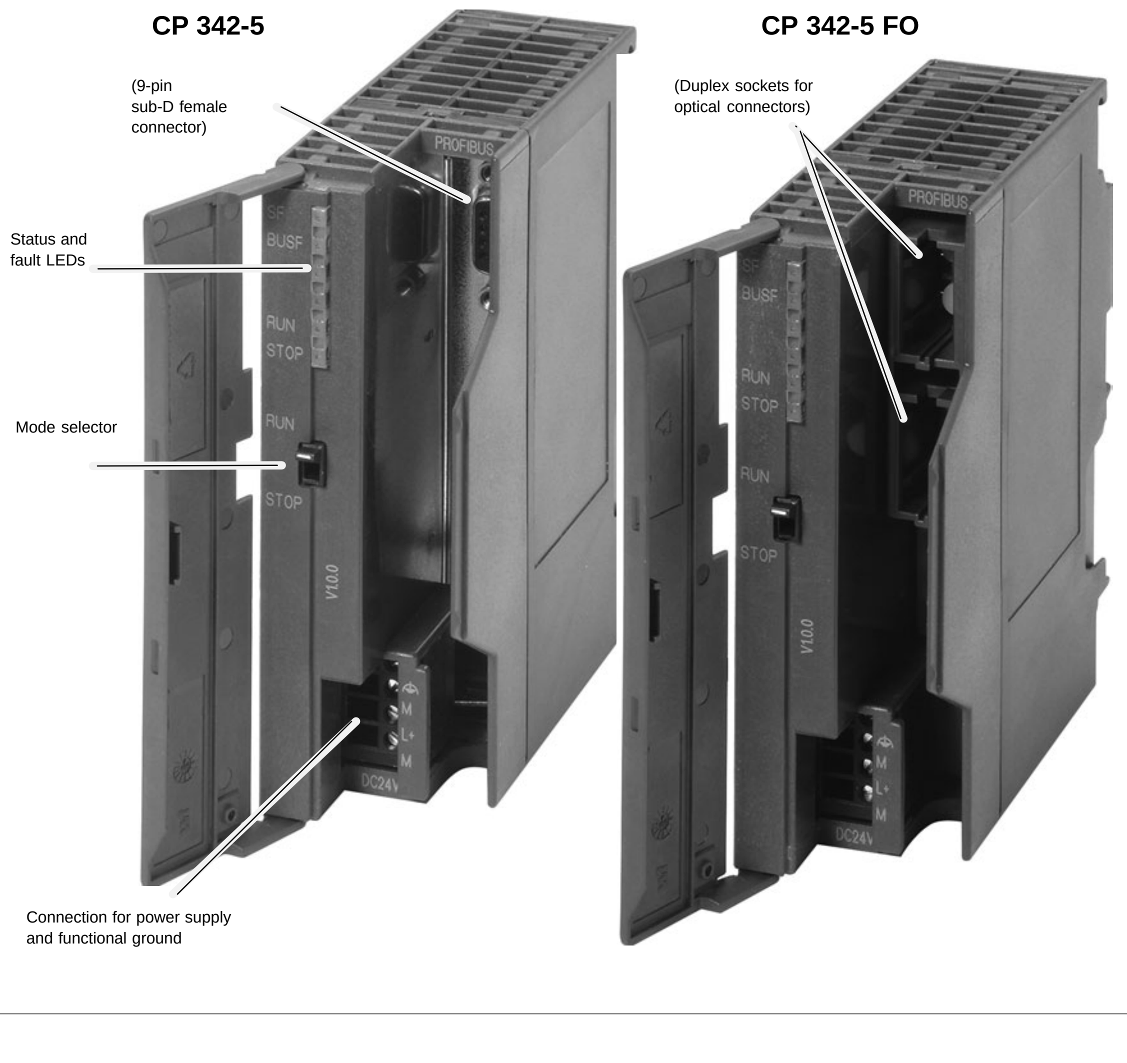
Manual Part B1

CP 342-5 / CP 342-5 FO

6GK7 342-5DA02-0XEO version 2 and higher (firmware version V5.4 and higher)

6GK7 342-5DF00-0XE0 version 2 and higher (firmware version V5.4 and higher)

for SIMATIC S7-300 / C7-300



Notes on the Product

Note

All instructions in the **product information bulletin** supplied with this product are valid and must be adhered to.

Compatibility with the Previous Version

Note

Due to the **enhanced functionality and restrictions**, pay particular attention to the notes in Chapter 5 of this manual.

Warning

Do not look directly into the opening of the optical transmitting diode or the optical fiber. The emitted light can cause injury to your eyes.

Contents

Contents - Part A

Note

Please remember that Part A of the manual also belongs to the description of the CPs. Among other things, this includes an explanation of the safety related notices and other information that applies to all S7 CPs for Industrial Ethernet.

Part A of the manual: Release 2/2003 or higher.

You can also obtain this general section from the Internet:

http://www4.ad.siemens.de/view/cs/de/8774037

Contents - Part B1

1 Features / Services

Application

The CP 342-5/342-5 FO communications processor is designed for operation in a SIMATIC S7-300 / C7-300 programmable logic controller. It allows the S7-300 / C7-300 to be attached to a PROFIBUS fieldbus system.

Services

The current version of the CP 342-5/342-5 FO supports the following communication services:

- PROFIBUS-DP
  - as DP master class 1 and class 2 (PROFIBUS-DP complying with EN 50170, DP master)
  - as DP slave (PROFIBUS-DP complying with EN 50170, DP slave)

Note

Note that the CP 342-5/342-5 FO can be operated as DP master or DP slave but not both at the same time. The DP mode can also be completely deselected.

- S7 communication and PG/OP communication
  - PG functions with upload / download of FM modules, configuration / diagnostics and routing
  - Operator control and monitoring functions (HMI)
    multiplexing TD/OP connections

    When multiplexing OP connections, the following acyclic services are supported:
    - single read
    - single write
    - read system status list

- Client and server for data exchange over communication blocks [4]) on S7 connections configured at both ends

  (Notes: Partner station can be an S7-300, S7-400 or PG/PC application with SIMATIC NET OPC server; raw data variables using BSEND/BRECV to WinCC are not supported.)

- Server for data exchange on connections configured at one end without communication blocks in the S7-300/C7-300 station

• S5-compatible communication (SEND/RECEIVE interface) over FDL connections of the following type:
  - Specified FDL connections
  - Free layer 2 connections (SDA, SDN)
  - Broadcast
  - Multicast

The CP 342-5/342-5 FO services mentioned above can be used at the same time independent of each another.

Configuration

To configure the module, STEP 7 version V5.1 or higher is required; for FDL connections and diagnostic functions, the NCM for PROFIBUS optional package shipped with STEP 7 must be installed.

The module can be configured via MPI or LAN/PROFIBUS.

Note

If you change the bus parameters in the configuration data, you can only download the configuration data to the CP via the MPI.

---

1) Blocks for S7 communication (see also STEP 7 online help or the “System Software for S7-300/400 System and Standard Functions” manual):

BSEND	FB 12
BRCV	FB 13
PUT	FB 14
GET	FB 15
USEND	FB 8
URCV	FB 9
C_CNTRL	FC 62

Notice

If you only have STEP 7 version V5.0 SP3 available and you want to continue using this version, read the special notes on the use of the CP 342-5 / 342-5 FO carefully. You will find these notes in Customer Support on the Internet under the following entry:

http://www4.ad.siemens.de/view/cs/en/2354644

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 of the General Part of this manual.

Programming - Using the CP as DP Master or DP Slave

DP slave mode:

To trigger a job execution, the FCs DP_SEND **and** DP_RECV must be activated at least once.

DP master mode:

To trigger the reception of data, FC DP_RECV must be activated at least once.

To allow diagnostics and control functions, you have the option of using the (FC) DP_DIAG and DP_CTRL functions.

You will find a detailed description of these blocks in the NCM S7 for PROFIBUS manuals.

Replacing a Module without a Programming Device

The CP supports the option of storing the configuration data of the CP on the CPU. If you use this option, you can replace the module without having to reload the configuration data from the programming device.

The configuration data is then stored in the load memory of the CPU. The stored configuration data are protected from power outage by battery backup or by plugging an EPROM card into the CPU.

2 Installation and Commissioning

Warning

Do not look directly into the opening of the optical transmitting diode or the optical fiber. The emitted light can cause injury to your eyes.

Procedure / Steps

Table 2-1

<table>
<tr><th>Step</th><th>Comments</th></tr>
<tr><td>1. Install the CP on the S7 standard rail.
2. Establish the connection to the backplane bus using the enclosed bus connector.</td><td>You can use slots 4 to 11 in racks 0 to 3 for the CP (connected by IM 360/361).
Proceed as explained in the sections on installation and wiring, described in detail in /1/.</td></tr>
<tr><td colspan="2">Note
The CP cannot be used in an expansion rack connected by an IM 365! Reason: The IM 365 does not connect the required communication bus through to the expansion rack.</td></tr>
<tr><td>3. Connect the CP to the power supply.</td><td>To wire up the power supply and CPU, follow the detailed instructions in /1/.</td></tr>
<tr><td colspan="2">Notes
• The CPU, CP and IM (if used) must be connected to the same power supply.
• Only wire up the S7-300 / C7-300 with the power switched off!
• When shipped, the CP has a jumper inserted between the M terminals and the functional ground. If you want to ground the reference potential, do not remove the jumper between the M terminals and functional ground (see also /1/ particularly the sections on installing an S7-300 with a grounded reference potential and installing an S7-300 with an ungrounded reference potential).</td></tr>
<tr><td>4. Connect the CP to PROFIBUS.</td><td></td></tr>
<tr><td>5. Commissioning is completed by downloading the configuration data.</td><td>For further details, especially regarding node initialization, please refer General Part A of the manual.</td></tr>
</table>

3 Displays and Mode Selector

LEDs Displaying the Status of the CP

The different combinations of the four LEDs on the front panel indicate the status of the CP:

Table 3-1

SF (red)	BUSF (red)	RUN (green)	STOP (yellow)	CP Operating Mode
○	○	☼	●	Starting up (STOP->RUN)
○	○	●	○	Running (RUN)
○	○	●	☼	Stopping (RUN->STOP)
○	○	○	●	Stopped (STOP)
●	○	○	●	Stopped (STOP) with errors
○	●	●	○	Running (RUN) with disturbances on PROFIBUS
○	☼	●	○	Running (RUN) with DP slave error(s)
○	○	○	☼	Ready to begin firmware download (mode active for 10 seconds)
○	○	☼	○	Downloading firmware
●	●	○	○	Invalid firmware downloaded
●	●	○	☼	Waiting for firmware update (CP contains incomplete firmware)
☼	☼	☼	☼	Module fault / system error

Key: ● on ○ off ☼ flashing

Note

Read the explanations of the modes of operation in the NCM S7 for PROFIBUS Manual /2/.

Controlling the Operating Mode

There are different ways in which you can control the mode of the CP 342-5/342-5 FO , as follows:

- Mode selector
- NCM S7 for PROFIBUS configuration software
- SIMATIC Manager in STEP 7

To control the mode from STEP 7 / NCM S7 for PROFIBUS, the mode selector must be set to RUN.

Mode Selector

With the mode selector, you can set the following modes:

- Switch from STOP to RUN:

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

- Switch from RUN to STOP:

  The CP changes to the STOP mode. Established connections (FDL and S7 connections) are closed.

  The following applies to the DP mode:

  - DP slave mode: the CP is no longer involved in data transfer
  - DP master mode: the mode is “OFFLINE”

  In the STOP mode, configuring and performing diagnostics on the CP 342-5/342-5 FO are possible.

Note

Refer to the explanations in the manual /2/ on the topic of loading the database on the CP.

---

4 Performance Data

4.1 Supported Transmission Rates

The transmission rate is set with the SIMATIC STEP 7 configuration software. The following values are permitted:

Table 4-1

Transmission Rate	CP 342-5	CP 342-5 FO
9.6 Kbps	✓	✓
19.2 Kbps	✓	✓
45.45 Kbps	✓	✓
93.75 Kbps	✓	✓
187.5 Kbps	✓	✓
500 Kbps	✓	✓
1.5 Mbps	✓	✓
3 Mbps	✓	-
6 Mbps	✓	-
12 Mbps	✓	✓

4.2 Characteristics of the DP Interface / DP Master

General Data

When operating the CP 342-5/342-5 FO as DP master, the following limits are important:

Table 4-2

Characteristics:	Explanation / Values
Number of DP slaves that can be operated	124 max.
Total number of slots that can be operated	1024 max.
Size of the DP data areas (total): - DP input area - DP output area	 2160 bytes max. 2160 bytes max.
Size of the DP data areas (per DP slave): - DP input area - DP output area	 244 bytes max. 244 bytes max.
Size of the DP diagnostic data:	240 bytes per DP slave

Notice

The maximum number of connectable DP slaves as shown in Table 4-2 can reduce if the DP slaves require extensive configuration and parameter assignment data.

In this case, the project memory on the CP is not adequate and you will receive a message in the diagnostic buffer of the CP indicating a lack of resources when you load the configuration data.

Extended DP Master Functions

The CP 342-5/342-5 FO supports

- SYNC/FREEZE (acyclic)
- Shared input/output (acyclic)
- Activate / deactivate DP slaves
- Modifiable during run time
  - local PROFIBUS address
  - change DP mode (no DP, DP master, DP slave active/passive)
- Hardware interrupts / diagnostic interrupts

  Hardware and diagnostic interrupts do not need to be evaluated in the user program. Hardware and diagnostic interrupts are acknowledged automatically by the CP.

  You can use single diagnostics to obtain interrupt information.

Execution Times of the FCs for PROFIBUS DP

The CPU cycle times (OB1) in the DP master mode are largely dependent on the time required to execute the FCs (FC DP_SEND, FC DP_RECV) required for DP on the S7-300 / C7-300 CPU.

Table 4-3

Component	Explanation / Approximate Values	
Execution time on the CPU 314C-2DP (6ES7 314-6CF00-0AB0)	per DP_SEND block call: • <3.0 ms at 8 bytes • <5.0 ms at 2160 bytes 1)	per block call DP_RECV: • <3.3 ms at 8 bytes • <5.8 ms at 2160 bytes 1)
Execution time on the CPU 317-2PN/DP (6ES7 317-2EJ10-0AB0)	per DP_SEND block call: • <1.5 ms at 8 bytes • <2.3 ms at 2160 bytes 1)	per block call DP_RECV: • <1.7 ms at 8 bytes • <2.8 ms at 2160 bytes 1)

1) with data lengths > 240 bytes, the data is transferred segmented. This then requires several block calls.

Note

The times specified for the DP master mode should only be considered as approximate values and apply only for a mono master configuration when no other services (for example PG functions) are processed on the CP.

Note

You will find important information on using and configuring (importing the GSD file) S7 slaves (ET200) when operating the CP as DP master at the following Internet address:

http://www4.ad.siemens.de/view/cs/en/2615831

4.3 Characteristics of the DP Interface / DP Slave

From the perspective of the DP master, the following information is important for successful transfer to the DP slave:

Table 4-4

Characteristics:	Explanation / Values
Device database (GSD)	Filename: CP 342-5: SIEM80D6.GSD CP 342-5 FO: SIEM80D7.GSD You can obtain the GSD files from: • The mailbox of the Interface Center Fürth Tel. 0911-737972 (outside Germany: +49-911-737972 • Internet http: http://www4.ad.siemens.de/view/cs/en/113652
Vendor ID	CP 342-5: $80D6_H$ CP 342-5 FO: $80D7_H$
Size of the DP data areas: - DP input area - DP output area	 240 bytes max. 240 bytes max.
Minimum slave interval	0.6 ms
SYNC / FREEZE	not supported
User parameter assignment data	3 bytes; value: 40 00 00 (fixed)
User diagnostic data	0 bytes

Note

For fail-safe operation, you must have the GSD file 80D6 (electrical variant) or 80D7 (FO variant).

http://www4.ad.siemens.de/view/cs/en/113652

Execution Times of the FCs for PROFIBUS DP

The CPU cycle times (OB1) in the DP slave mode are largely dependent on the time required to execute the FCs (FC DP_SEND, FC DP_RECV) required for DP on the S7-300 / C7-300 CPU.

Table 4-5

Component	Explanation / Values	
Execution time on the CPU 314C-2DP (6ES7 314-6CF00-0AB0)	per DP_SEND block call: • <3.0 ms at 8 bytes • <5.0 ms at 240 bytes	per block call DP_RECV: • <3.3 ms at 8 bytes • <5.8 ms at 240 bytes
Execution time on the CPU 317-2PN/DP (6ES7 317-2EJ10-0AB0)	per DP_SEND block call: • <1.5 ms at 8 bytes • <2.3 ms at 240 bytes	per block call DP_RECV: • <1.7 ms at 8 bytes • <2,8 ms at 240 bytes

Note

The reaction times specified for the DP slave mode should only be considered as approximate values and apply only when no other services (for example PG functions) are processed on the CP.

4.4 Data of S5-compatible Communication (SEND/RECEIVE Interface) on FDL Connections

The following information is important when operating FDL connections (specified, free layer 2 (SDA and SDN), broadcast, multicast):

Table 4-6

Characteristics:	Explanation / Values
Total number of FDL connections that can be operated	16 maximum
Size of the transferable data area on FDL connections	1-240 bytes maximum per specified FDL connection (for sending and receiving) Free layer 2, broadcast and multicast: 1 to 236 bytes of user data can be transferred per job. The job header requires an additional 4 bytes.

Execution times of the FCs AG_SEND / AG_RECV

The CPU cycle times (OB1) for FDL connections are largely dependent on the time required to execute the FCs (FC AG_SEND, FC AG_RECV) required on the S7-300 / C7-300 CPU.

Table 4-7

Component	Explanation / Values	
Execution time on the CPU 314C-2DP (6ES7 314-6CF00-0AB0)	per AG_SEND block call: • <5.1 ms at <=240 bytes	per block call AG_RECV: • <5.7 ms at <=240 bytes
Execution time on the CPU 317-2PN/DP (6ES7 317-2EJ10-0AB0)	per AG_SEND block call: • <2.4 ms at <=240 bytes	per block call AG_RECV: • <2.8 ms at <=240 bytes

Performance of FDL Connections

Refer to the following table for transmission rates with FDL connections dependent on the following parameters:

- Frame length (number of bytes)
- CPU type

The values were measured while sending or receiving successively (at a transmission rate of 1.5 Mbps; bus profile standard; 9 nodes).

Table 4-8 Number of FDL Frames per Second for CPU 317

Frame Length	Number of FDL Frames per Second
8 bytes	140 / s
128 bytes	138 / s
240 bytes	135 / s

4.5 Data of S7 Communication

The following information is important when operating S7 connections:

Table 4-9

Characteristics:	Explanation / Values
Number of S7 connections that can be operated (single/double ended configuration; including PG and TD/OP connections)	Max. 16 [1]

1) The actual possible number of S7 connections that can be operated depends on the type of CPU being used. Further restrictions result from mixed operation; refer to the notes in Section 4.7.

2) If the CP is configured as a DP slave, the following restrictions apply:
- No S7 connections can be used;
- OP multiplex mode cannot be used.

Execution Times of the FBs for S7 Connections

The CPU cycle times (OB1) for S7 connections are largely dependent on the time required to execute the function blocks (FBs PUT, GET, USEND, URCV, BSEND, BRCV) on the S7-300 / C7-300 CPU.

Table 4-10

	Execution time on the CPU per block call					
Block type	**PUT**	**GET**	**USEND**	**URCV**	**BSEND**	**BRCV**
Data length	**<=160 bytes**				**<=16 K bytes**	
CPU 314C-2DP (6ES7 314-6CF00-0AB0)	<5.6 ms	<5.8 ms	<6.0 ms	<5.6 ms	<5.7 ms	<5.8 ms
CPU 317-2PN/DP (6ES7 317-2EJ10-0AB0)	<2.1 m	<2.5 ms	<2.0 ms	<2.4 ms	<2.1 ms	<2.7 ms

Performance of S7 Connections

Refer to the following table for transmission rates with S7 connections dependent on the following parameters:

- Frame length (number of bytes)
- Job type
- CPU type

The values were measured while sending or receiving successively (at a transmission rate of 1.5 Mbps; bus profile standard; 9 nodes).

Table 4-11 Number of S7 Frames per Second for CPU 317

Job type	Frame length	Number of S7 Frames per Second
PUT	<= 160 bytes	29 / s
GET	<= 160 bytes	26 / s
USEND/URCV	<= 160 bytes	35 / s
BSEND/BRCV	<= 160 bytes	25 / s
	<= 400 bytes	14 / s
	<= 800 bytes	8 / s

4.6 Characteristics of Multiplexing OP Connections

The following information is important for operating HMI (TD/OP) connections:

Table 4-12

Characteristics:	Explanation / Values
Number of HMI connections	16 maximum

When multiplexing OP connections, the following acyclic services are supported:
- single read
- single write
- read system status list

If cyclic services or ProAgent interfacing (ALARM_S message block) are required, please continue to use the rack/slot addressing of the remote S7-300 CPU.

Notice

PG connections and connections to WinCC are not operated over the multiplexer; When operating a PG, a connection resource is always occupied.

4.7 Parallel Use of Communications Services (Multiprotocol Operation)

Performance

Using the various available communication services at the same time affects communication performance.

Note

Recommendation: In mixed operation - DP + FDL + S7 functions / TD/OP connections - you should select a delay time of 2-5 ms.

Overall Operational Limits

When using communication connections/services at the same time, it is not possible to achieve the maximum values as when using the communication connections/service alone.

The following limit values apply:

Table 4-13

Characteristics:	Explanation / Values
Number of connections in total • When operating with PROFIBUS DP (DP master with up to 15 DP slaves 1))	44 maximum Of these, up to 16 FDL connections and 12 S7 connections and 16 OP connections in multiplex mode.
• When operating without PROFIBUS DP	48 maximum

1) The number of S7 connections that can be operated when using the module as DP master depends on the number and configuration of the assigned DP slaves (see Table 4-14).

Influence of the Data Length in S7 Communication

In S7 communication, the data length of the jobs and in DP mode, the number of DP slaves and the length of the I/O data mean the following restrictions:

- Number of S7 connections
- Number of jobs that can be started at one time

The job with the longest data is decisive. The information applies to S7 job types BSEND/BRCV, PUT/GET, and USEND/URCV.

Table 4-14

Data length in bytes	Number of S7 connections or number of S7 jobs		
	S7 communication only	With DP master and 32 DP slaves ET200B (1 byte I and 1 byte O data)	With DP master and 32 DP slaves ET200M (32 bytes I and 32 bytes O data)
<=1000	16	10	8
2000	16	8	6
4000	16	6	5
8000	8	4	4
16000	4	2	2
32000	2	1	1

1) A maximum of 32 Kbytes can be transmitted with one BSEND/BRCV block, with PUT/GET/USEND/URCV a maximum of 160 bytes in each case.

5 Compatibility with the Previous Product

5.1 Extended Functionality Compared with Previous Product

The CP 342-5 (6GK7 342-5DA02-0XE0) described here can be used as a substitute for the following previous products:

- CP 342-5 6GK7 342-5DA00-0XE0
- CP 342-5 6GK7 342-5DA01-0XE0

The CP 342-5 and CP 342-5 FO described here are functionally compatible.

The CP 342-5 described here also supports transmission rates > 1.5 Mbps.

Number of attachable slaves and I/O capacity:

	I/O Capacity	Connectable Slaves
DP Master		
6GK7 342-5DA**01**-0XE0	240 bytes	64
6GK7 342-5DA**02**-0XE0	2160 bytes	124
6GK7 342-5DF**00**-0XE0	2160 bytes	124
DP Slave		
6GK7 342-5DA**01**-0XE0	86 bytes	
6GK7 342-5DA**02**-0XE0	240 bytes	
6GK7 342-5DF**00**-0XE0	240 bytes	

5.2 Replacing Older Modules / Replacing Defective Modules

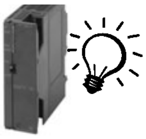
Replacing Modules

Use the following procedure when replacing an older module with one of those described here:

Table 5-1

Module Used Until Now	Configuration Procedure
6GK7 342-5DA00-0XE0	Supply the new module with the adapted configuration as follows: 1. Replace the previously configured CP 342-5 with the new module in STEP 7 / HW Config. You will find the new module in the hardware catalog. 2. Save, compile, and download the configuration data to the CPU or the CP.
6GK7 342-5DA01-0XE0	Situation a: configuration unchanged If you do not require any extended functionality compared with the functions provided by the old CP (for example number of connections), no changes to the configuration are necessary. During commissioning, simply remember the following distinction: • If you selected the option of storing the configuration data of the old CP on the CPU, this configuration data will be downloaded to the CP automatically during start up. • Otherwise download the configuration data to the CP again from your PG/PC. Situation b: configuration changed If you want to use the extra possibilities provided by the new CP, follow the steps below: 1. Use the new FCs in your user program (version 3.0 or higher; see also page B1-28). Note: You should check whether or not there are changes to the data format of the ANY pointers on the FC interface; for more detailed information, refer to the online help for the blocks. 2. Replace the previously configured CP 342-5 with the new module in STEP 7 / HW Config. You will find the new module in the hardware catalog. 3. Complete your configuration according to your requirements, for example in the connection configuration. 4. Save, compile, and download the configuration data to the CPU or the CP.

Information in the Online Help and the Documentation for NCM S7 for PROFIBUS



The additional information “for newer modules” in both the online help of STEP 7 / NCM S7 and in the NCM S7 for PROFIBUS manual apply to the CP described here. Look for the symbol shown here.

Note

If you cannot fill the slot left empty after replacing the module by moving the other modules back one slot, remember to insert a dummy module (6ES7 370-0AA01-0AA0).

In this case, the address switch on the back of the module must be set to “Non-Address-Mode” (NA).

Compatibility

Compared with the previous modules, the CP 342-5/342-5 FO reacts differently. Make sure you are aware of the effects in your user program. The following table provides you with an overview.

Table 5-2 Changed Reaction

Situation		Until Now	Now
1.	Output parameter DPSTATUS in FC DP_RECV		
	DP master mode:	Bit 6: indicates “overflow of received data”	Bit 6: is no longer set
	DP slave mode:	Bit 3: indicates “no frame from the DP master within the watchdog time”	Bit 3: is no longer set
		Bit 4: indicates “DP data overflow”	Bit 4: is no longer set
2.	DP Modes	A distinction is made between the STOP and OFFLINE modes.	The STOP mode is modeled on the OFFLINE mode.
3.	Set current DP mode	- is supported	In the version of the CP 342-5 described here, the following job parameters are not supported with FC DP_CTRL and CTYPE 4: • RUN with AUTOCLEAR • RUN without AUTOCLEAR

Table 5-2 Changed Reaction, continued

Situation		Until Now	Now
4.	Cyclic reading of the input/output data using FC DP_CTRL [1)]	- is supported	In the version of the CP 342-5 described here, the following services of FC DP_CTRL are not supported: CTYPE = 7 CTYPE = 8 These job types are rejected with code 8311_H.
5.	Triggering cyclic global control using FC DP_CTRL [1)]	- is supported	The following applies to the DP master mode: In the version of the CP 342-5 described here, the following services of FC DP_CTRL are not supported: CTYPE = 1 These job types are rejected with code 8311_H.
6.	Triggering acyclic global control with the CLEAR job using FC DP_CTRL [1)]	- is supported	The following applies to the DP master mode: In the version of the CP 342-5 described here, the following services of FC DP_CTRL are not supported: CTYPE = 0 Command Mode = CLEAR These job types are rejected with code 8318_H.
7.	Triggering acyclic global control for group 0 using FC DP_CTRL [1)]	- is supported	The following applies to the DP master mode: In the version of the CP 342-5 described here, the following services of FC DP_CTRL are not supported: CTYPE = 0 Group select = 0 These job types are rejected with code 8318_H.
8.	Consistency of data transfer between the CP and user program	The maximum DP data area is as follows: • 240 bytes in the DP master mode • 86 bytes in the DP slave mode	The maximum DP data area is as follows: • 2160 bytes in the DP master mode • 240 bytes in the DP slave mode
• Please read the additional notes on consistency at the end of this table.			

Table 5-2 Changed Reaction, continued

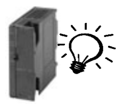
Situation		Until Now	Now
9.	FCs for DP operation and for S5-compatible communication		Depending on your configuration, it may be possible to use the older FC types alongside the new FC versions. Note the version identifiers for the STEP 7 block library.
• Please read the additional notes on the FCs at the end of this table.			
10.	FCs: Evaluating general properties and codes Description in the online help or in the NCM S7 for PROFIBUS manual		The additional information for ”newer modules” applies to the CP described here. These are highlighted with the following symbol: 
11.	Determined sending / receiving of data - coordination between CPU and CP/PROFIBUS	In the cyclic DP mode, the job confirmation on the FC interface contains the confirmation of transfer on PROFIBUS.	In the cyclic DP mode, the processing cycle on the CPU is separate from the cycle on the CP. Sending data: the confirmation of the job contains no confirmation of the earlier transfer on PROFIBUS. Receiving data: it is possible that the same data is received more than once.
12.	Jobs with DP_SEND and DP_RECV [1)]	DP slave mode: To trigger a job execution, the FCs DP_SEND **and** DP_RECV must be activated at least once. DP master mode: To trigger the reception of data, FC DP_RECV must be activated at least once.	To trigger child execution, only FC DP_SEND **or** DP_RECV needs to be activated depending on the application. In the DP master mode, at least one of the two FCs **must** be activated once.
13.	Receive buffer for AG_RECV is too small	If the receive buffer is too small, data are received up to the buffer size. The call is acknowledged with error message 8185_H.	If the receive buffer is too small, **no** data are received. The call is acknowledged with error message $80B1_H$.

Table 5-2 Changed Reaction, continued

Situation		Until Now	Now
14.	Responder functionality of the DP master (class 1); DP master (class 2) issues jobs to DP master (class 1) Functions • "DDLM_GET_Master_Diag" • "DDLM_Act_Param"	- is supported by DP master as responder -	- DP master **without** responder functionality -

1) see also STEP 7 online help on the FCs;

Note on 8. : Consistency when transferring data between the CP and user program

Depending on the user program, you can consider various areas as consistent data areas on the transfer interface between the CP and user program.

Note

Referred to the information on programming FCs in the online help on the FCs and in the manual General Application.

- Variant 1: NDR bit is evaluated on the FC interface

  You can assume consistency over the entire DP used.
- Variant 2: NDR bit is not evaluated on the FC interface

  You can assume data consistency in a 32-byte non-overlapping area.

  ("non-overlapping" means: 32-byte areas can be counted starting at initial address "0" of the DP data area of interest.)

Table 5-3 Range of Consistency in the DP Master Mode

Access Method in the User Program	Maximum Area with Data Consistency
Variant 1	2160 bytes
Variant 2	32 bytes

Table 5-4 Range of Consistency in the DP Slave Mode

Access Method in the User Program	Maximum Area with Data Consistency
Variant 1	240 bytes
Variant 2	32 bytes

Note on 9. :FCs for the DP mode

New FCs when shipped with STEP 7 V5.1 for the CP 342-5 / CP 342-5 FO described here. The following table indicates how you can use these new FC versions as well as the older FC versions for the available modules:

Table 5-5

FC Type (version)	Can be used with module type CP 342-5 with the order no.			
	6GK7 342-5DA00-0XE0	6GK7 342-5DA01-0XE0	6GK7 342-5DA02-0XE0 **configured as ..DA00 or ..DA01**	6GK7 342-5DA02-0XE0 / 342-5DF00-0XE0
< V3.0	✓	✓	✓	-
>= V3.0	✓	✓	✓	✓

Notice

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

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6 Technical Specifications

General Technical Specifications

Table 6-1

Technical Specifications	Value
Interfaces Attachment to PROFIBUS Maximum current consumption on the PROFIBUS interface with network components attached (for example, optical network components)	 9-pin sub-D female connector 100 mA at 5V
Power supply	24 V DC
Current consumption - from 24 V: - from S7-300 / C7-300 backplane bus	 0.25 A typical 150 mA typical
Cable cross section for 24V	0.25...2.5 mm^2
Power loss	6 W
• Permissible ambient temperature according to /1/, the following temperature ranges must not be exceeded in S7-300 / C7-300 tiers - horizontal installation - vertical installation • Transportation/storage temperature • Relative humidity max. • Altitude	 0 to 60°C 0 to 40°C -40 °C to +70 °C 95% at +25 °C up to 2000 m above sea level
Dimensions W x H x D (mm)	40 x 125 x 120
Weight	approx. 300 g

All the information in /1/ in the section “General Technical Data” regarding the following topics also applies to the CP 342-5/342-5 FO.

- Electromagnetic compatibility
- Transportation and storage conditions
- Mechanical and climatic ambient conditions
- Specifications for insulation tests, protection class, and protection level

SIEMENS

SIMATIC NET

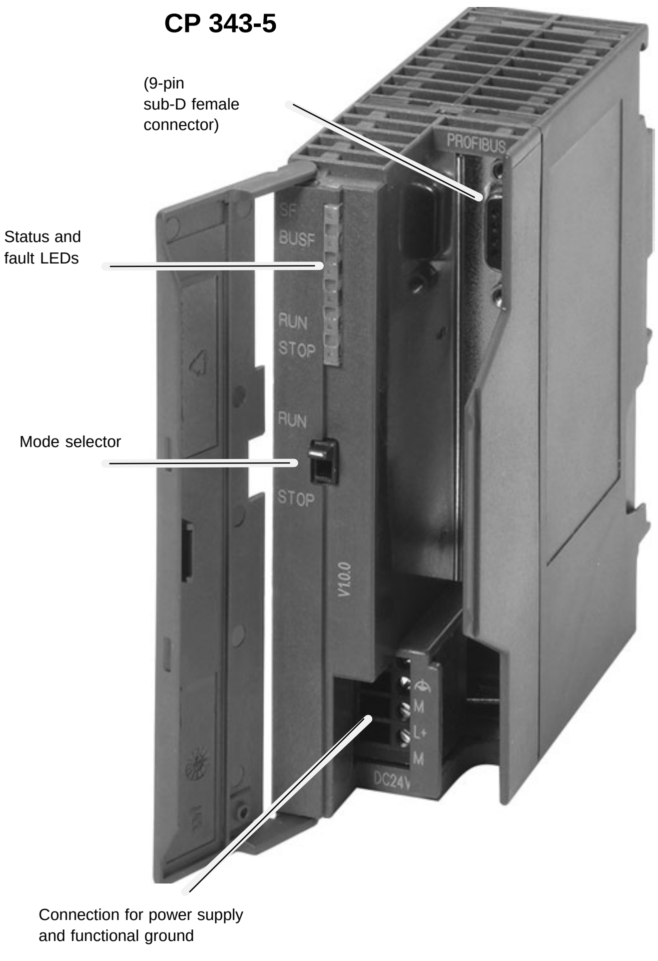
S7-CPs for PROFIBUS

Manual Part B2

CP 343-5

6GK7 343-5FA01-0XE0 version 2 and higher (firmware version V4.1 and higher)

for SIMATIC S7-300 / C7-300



Notes on the Product

Note

All instructions in the **product information bulletin** supplied with this product are valid and must be adhered to.

Compatibility with the Previous Version

Note

Due to the **enhanced functionality and restrictions**, pay particular attention to the notes in Chapter 5 of this manual.

Contents

Contents - Part A

Note

Please remember that Part A of the manual also belongs to the description of the CPs. Among other things, this includes an explanation of the safety, related notices and other information that applies to all S7 CPs for Industrial Ethernet.

You can also obtain this general section from the Internet:

http://www4.ad.siemens.de/view/cs/de/8774037

Contents - Part B2

1 Features / Services

Application

The CP 343-5 communications processor is designed for operation in a SIMATIC S7-300 / C7-300 programmable logic controller. It allows the S7-300 / C7-300 to be attached to a PROFIBUS fieldbus system.

Services

The current version of the CP 343-5 supports the following communication services:

- PROFIBUS-FMS (complying with EN 50170, FMS client and server functionality)

  as FMS master for the following types of connection:

  - 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
- S7 communication and PG/OP communication
  - PG functions with upload / download of FM modules, configuration / diagnostics and routing
  - operator control and monitoring functions (HMI)
  - server for data exchange on one-sided configured connections without communication blocks in the S7 station
- S5-compatible communication (SEND/RECEIVE interface) over FDL connections of the following type:
  - specified FDL connections
  - Free layer 2 connections (SDA, SDN)
  - Broadcast
  - Multicast

The CP 343-5 services mentioned above can be used at the same time independently from one another.

Configuring

STEP 7 from version V5.1 SP3 and higher, and the installation of the NCM for PROFIBUS optional package, delivered with STEP 7, are necessary for configuration.

The module can be configured via the MPI or LAN/PROFIBUS.

Note

If you change the bus parameters in the configuration data, you can only download these configuration data to the CP via the MPI.

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 of the General Part of this manual.

Replacing a Module without a Programming Device

The CP supports the option of storing the configuration data of the CP in the CPU. If you use this option, you can replace the module without having to reload the configuration data from the programming device.

The configuration data are then stored in the load memory of the CPU. The stored configuration data are protected from power outage by battery backup or by plugging an EPROM card into the CPU.

2 Installation and Commissioning

Procedure / Steps

Table 2-1

<table>
<tr><th>Step</th><th>Comments</th></tr>
<tr><td>1. Install the CP on the S7 standard rail.
2. Establish the connection to the backplane bus using the enclosed bus connector.</td><td>You can use slots 4 to 11 in racks 0 to 3 for the CP (connected by IM 360/361).
Proceed as explained in the sections on installation and wiring, described in detail in /1/ .</td></tr>
<tr><td colspan="2">Note
The CP cannot be used in an expansion rack connected by an IM 365! Reason: The IM 365 does not connect the required communication bus through to the expansion rack.</td></tr>
<tr><td>3. Connect the CP to the power supply.</td><td>To wire up the power supply and CPU, follow the detailed instructions in /1/.</td></tr>
<tr><td colspan="2">Notes
• The CPU, CP and IM (if used) must be connected to the same power supply.
• Only wire up the S7-300 / C7-300 with the power switched off!
• When shipped, the CP has a jumper inserted between the M terminals and the functional ground. If you want to ground the reference potential, do not remove the jumper between the M terminals and functional ground (see also /1/ particularly the sections on installing an S7-300 with a grounded reference potential and installing an S7-300 with an ungrounded reference potential).</td></tr>
<tr><td>4. Connect the CP to PROFIBUS.</td><td></td></tr>
<tr><td>5. Commissioning is completed by downloading the configuration data.</td><td>For further details, especially regarding node initialization, please refer General Part A of the manual.</td></tr>
</table>

3 Displays and Mode Selector

LEDs Displaying the Status of the CP

The different combinations of the four LEDs on the front panel indicate the status of the CP:

Table 3-1

SF (red)	BUSF (red)	RUN (green)	STOP (yellow)	CP Operating Mode
○	○	☼	●	Starting up (STOP->RUN)
○	○	●	○	Running (RUN)
○	○	●	☼	Stopping (RUN->STOP)
○	○	○	●	Stopped (STOP)
●	○	○	●	Stopped (STOP) with errors
○	●	●	○	Running (RUN) with disturbances on PROFIBUS
○	○	○	☼	Ready to begin firmware download (mode active for 10 seconds)
○	○	☼	○	Downloading firmware
●	●	○	○	Invalid firmware downloaded
●	●	○	☼	Waiting for firmware update (CP contains incomplete firmware)
☼	☼	☼	☼	Module fault / system error

Key: ● on ○ off ☼ flashing

Note

Read the explanations of the modes of operation in the NCM S7 for PROFIBUS Manual /2/, General Part A.

Controlling the Operating Mode

There are different ways in which you can control the mode of the CP 343-5, as follows:

- Mode selector
- NCM S7 for PROFIBUS configuration software
- SIMATIC Manager in STEP 7

To control the mode from STEP 7 / NCM S7 for PROFIBUS, the mode selector must be set to RUN.

Mode Selector

With the mode selector, you can set the following modes:

- Switch from STOP to RUN:

  The CP reads the configured and/or modified data into the work memory and then changes to the RUN mode.
- Switch from RUN to STOP:

  The CP changes to the STOP mode. Established connections (FDL, FMS and S7 connections) are closed.

  In the STOP mode, configuring and performing diagnostics on the CP 343-5 are possible.

Note

Refer to the information on downloading the database to the CP in the Manual /2/, General Part A.

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4 Performance Data

4.1 Supported Transmission Rates

The transmission rate is set with the SIMATIC STEP 7 configuration software. For permitted values, see Table 6-1 in Section 6.

4.2 Characteristics of FMS Connections

The following data are important for operating FMS connections:

Table 4-1

Component	Explanation / Values
Number of FMS connections	Maximum of 16
User data length	237 bytes for READ 233 bytes for WRITE and REPORT
Configurable variables	256 server variables and 256 variable descriptions that can be loaded from the partner. These can be distributed as required on the maximum number of configurable FMS connections. The value applies to elementary data types or arrays of elementary data types. This value does not apply to complex data types (STRUCT)! Note the information in the manual /3/ about using complex data types (STRUCT).

Cycle Load Caused by FMS Connections

When calculating the reaction times with FMS connections, the run time of the function blocks (FBs) in the S7-300 CPU (314-1 see Table 4-2) is the decisive factor.

The table below shows the cycle load resulting from the available FCs in ms. The values were obtained using a data length of 230 bytes (array).

Table 4-2

Component / FB	FB Number	Job Trigger in ms (first call)	Job Active in ms (next call)	Job Complete without Errors in ms (last call)
IDENT	FB 2	1.8	0.2	5.5
READ	FB 3	2.2	0.2	7.6

Table 4-2 , Fortsetzung

Component / FB	FB Number	Job Trigger in ms (first call)	Job Active in ms (next call)	Job Complete without Errors in ms (last call)
REPORT	FB 4	8.0	0.2	1.8
STATUS	FB 5	1.8	0.2	2.2
WRITE	FB 6	7.6	0.2	2.0

Further Notes on FMS

Please note the following:

In FMS server mode, the CP occupies an unconfigured communication bus connection on the S7 CPU.

Note that the S7 CPU 314 supports a maximum of 4 (newer CPU types a maximum of 12) unconfigured K bus connections! If, for example, you operate a PG and an OP with the S7 CPU, two unconfigured K bus connections are still free.

Note

To allow module replacement without a PG, settings on the CPU must be modified. Open the Properties dialog of the CPU in HW Config; in the “Monitoring time for...” box in the “Startup” tab, check and, if necessary, increase the following values:

- “Transfer of parameters to modules”

Depending on your system (station configuration), you may need to increase the following parameter:

- “Ready message from modules”

4.3 Characteristics of S5-compatible Communication (SEND/RECEIVE Interface) on FDL Connections

The following information is important for operating FDL connections (specified, free layer 2 (SDA and SDN), broadcast, multicast):

Table 4-3

Characteristics:	Explanation / Values
Total number of FDL connections that can be operated	Maximum of 16
Size of the transferable data area on FDL connections	1-240 bytes maximum per specified FDL connection (for sending and receiving) Free layer 2, broadcast and multicast: 1 to 236 bytes of user data can be transferred per job. The job header requires an additional 4 bytes.

Reaction Times for FDL Connections

The reaction times for FDL connections are largely dependent on the time required to execute the function blocks (AG-SEND, AG-RECV) on the S7-300 / C7-300 CPU.

Table 4-4

Component	Explanation / Values	
Run time on the CPU 314-1 (6ES7 314-1AE04-0AB0)	per AG_SEND block call: • 6.0 ms with 240 bytes	per block call AG_RECV: • 7.5 ms with 240 bytes

Performance of the FDL Connections

Refer to the following table for transmission rates with FDL connections dependent on

- frame length (number of bytes)
- the type of CPU

The values were measured while sending frames successively (at a transmission rate of 1.5 Mbps; bus profile standard; 9 nodes).

Table 4-5 Number of FDL Frames per Second

CPU Type / Transmission rate **Frame length**	**CPU 314 / 1.5 Mbps**
8 bytes	129 / s
128 bytes	130 / s
240 bytes	122 / s

4.4 Characteristics of S7 Communication

The following data are important for operating S7 connections:

Table 4-6

Characteristics:	**Explanation / Values**
Number of S7 connections	Max.16 1)

1) The actual possible number of S7 connections that can be operated depends on the type of CPU being used.

4.5 Parallel Use of Communication Services (Multiprotocol Mode)

Performance

Using the various available communication services at the same time affects communication performance:

- With a large number of connections (16 FMS connections) and more than eight S7 connections, FMS performance may drop.
- With cyclic NCM diagnostics, the update time should be set to 3 seconds, otherwise communication performance can drop.

5 Compatibility with the Previous Product

5.1 Extended functionality Compared with Previous Product

The CP 343-5 Basic (6GK7 343-5FA01-0XE0) described here can be used as a replacement for the previous product CP 343-5 Basic (6GK7 343-5FA00-0XE0).

Extended Functions with 6GK7 343-5FA01-0XE0

The CP 343-5 described here also supports transmission rates > 1.5 Mbps.

5.2 Replacing Older Modules / Replacing Defective Modules

Replacing a Module

Use the following procedure when replacing an older module with one of those described here:

Table 5-1

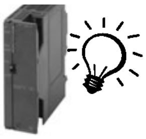
Module Used Until Now	Configuration Procedure
6GK7 343-5FA00-0XE0	**Configuration unchanged (replacing a defective module)** If you do not require any extended functionality compared with the functions provided by the old CP (for example transmission rate), no changes to the configuration are necessary. During commissioning, simply remember the following distinction: • If you selected the option of storing the configuration data of the old CP on the CPU, this configuration data will be downloaded to the CP automatically during start up. • Otherwise download the configuration data to the CP again from your PG/PC. **Extending the Configuration (using new functions)** If you want to use the extra possibilities provided by the new CP, follow the steps below: 1. Replace the previously configured CP 343-5 with the new module with order number 6GK7 343-5FA01-0XE0 in STEP 7 / HW Config. You will find the new module in the hardware catalog. 2. Complete your configuration according to your requirements, for example using the Properties dialog of the PROFIBUS subnet. 3. Use the FBs (V1.5 or higher) shipped with STEP 7 V5.1 or higher for FMS and regenerate the instance data blocks. 4. Save, compile, and download the configuration data and blocks to the CPU or CP again.

Note

If you cannot fill the slot left empty after replacing the module by moving the other modules back one slot, remember to insert a dummy module (6ES7 370-0AA01-0AA0).

In this case, the address switch on the back of the module must be set to “Non-Address-Mode” (NA).

Information in the Online Help and the Documentation for NCM S7 for PROFIBUS



The additional information “for newer modules” in both the online help of STEP 7 / NCM S7 and in the NCM S7 for PROFIBUS manual apply to the CP described here. Look for the symbol shown here.

Compatibility

The CP 343-5 functions differently compared with the previous module. Make sure you are aware of the effects in your user program. The following table provides you with an overview.

Table 5-2   Changed Reaction

Situation	Until Now	Now
Receive buffer for AG_RECV is too small	If the receive buffer is too small, data are received up to the buffer size. The call is acknowledged with error message 8185_H.	If the receive buffer is too small, **no** data are received. The call is acknowledged with error message $80B1_H$.

Notice

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/de/8797900

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6 Technical Specifications

General Technical Specifications

Table 6-1

Technical Specifications	Value
Supported Transmission Rates	9.6 Kbps, 19.2 Kbps, 45.45 Kbps 93.75 Kbps, 187.5 Kbps, 500 Kbps 1.5 Mbps, 3 Mbps, 6 Mbps, 12 Mbps
Interfaces Attachment to PROFIBUS Maximum current consumption on the PROFIBUS interface with network components attached (for example, optical network components)	 9-pin sub-D female connector 100 mA at 5V
Power supply	24 V DC
Current consumption - from 24 V: - from S7-300 / C7-300 backplane bus	 0.25 A typical 150 mA typical
Cable cross section for 24V	0.25...2.5 mm^2
Power loss	6 W
• Permissible ambient temperature according to /1/, the following temperature ranges must not be exceeded in S7-300 / C7-300 tiers - horizontal installation - vertical installation • Transportation/storage temperature • Relative humidity max. • Altitude	 0 to 60°C 0 to 40°C -40 °C to +70 °C 95% at +25 °C up to 2000 m above sea level
Dimensions W x H x D (mm)	40 x 125 x 120
Weight	approx. 300 g

All the information in the Section “General Technical Specifications” in /1/ on the following topics also applies to the CP 343-5

- Electromagnetic compatibility
- Transportation and storage conditions
- Mechanical and climatic ambient conditions
- Specifications for insulation tests, protection class, and protection level

SIEMENS

SIMATIC NET

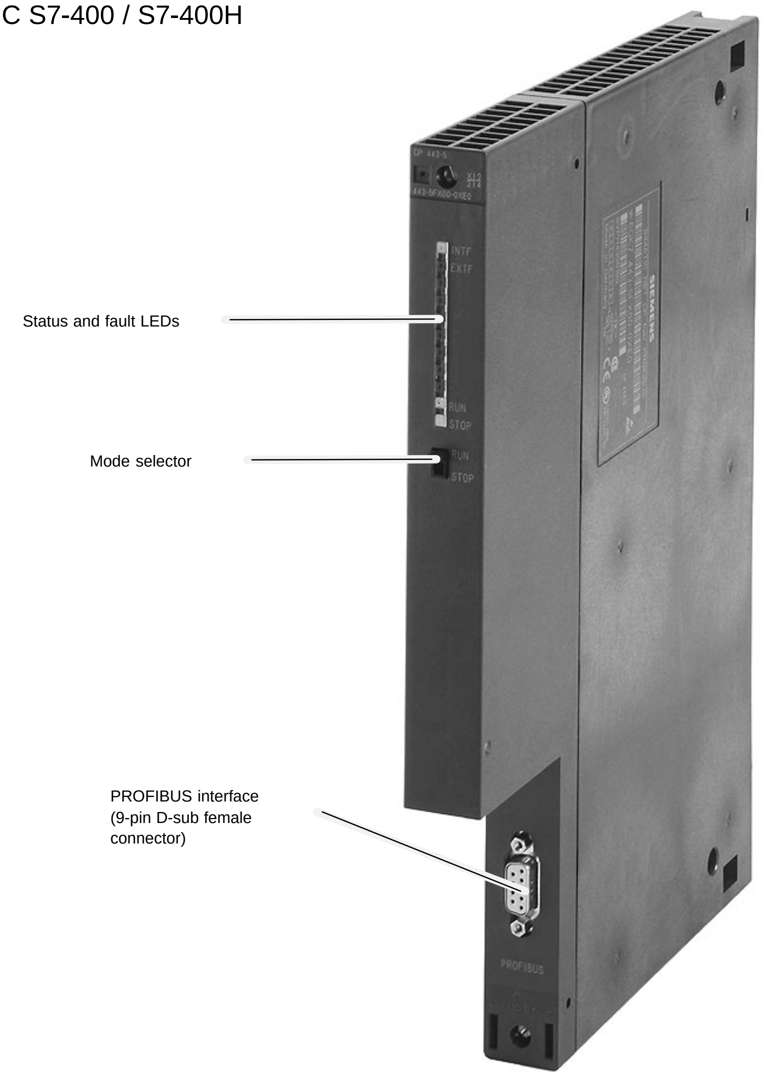
S7-CPs for PROFIBUS

Manual Part B3

CP 443-5 Basic

6GK7 443-5FX02-0XE0 Version 1 and higher (firmware version V4.0 and higher)

for SIMATIC S7-400 / S7-400H



Notes on the Product

Note

All notes in the **product information bulletin**, which is supplied with this product, are valid and must be observed.

Compatibility with the Previous Version

Note

Make sure that you read the information regarding **extended functionality and restrictions** in Chapter 6 of this manual!

Contents

Contents - Part A

Note

Please remember that Part A of the manual also belongs to the description of the CP. Among other things, it contains explanations of the safety notices, references, and general information that applies to all S7 CPs for PROFIBUS.

You can also download this general part from the Internet:

http://www4.ad.siemens.de/view/cs/de/8774037

Contents - Part B3

1 Properties / Services

Application

The CP 443-5 Basic communications processor is designed for use in a SIMATIC S7-400 (standard) and S7-400H (fault-tolerant system) programmable controller. It allows the S7-400 / S7-400H to be connected to a PROFIBUS fieldbus system.

Services

The current version of the CP 443-5 Basic supports the following communication services in the standard and H systems:

- **PROFIBUS FMS** (complying with EN 50170, FMS client and server function)

  as FMS master for the following types of connection:
  - 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
- **S7 communication and PG/OP communication**
  - PG functions with upload / download of FM modules, configuration / diagnostics and routing, user programs

    Note on routing: Dynamic switchover to alternative paths (for example if there is a problem on one of the possible transmission paths) is not supported.
  - Operator control and monitoring functions (HMI)
  - Data exchange using communication function blocks on S7 connections (fault-tolerant S7 connections also possible) [1])

1) Blocks for S7 communication (see also STEP 7 online help or "System Software for S7-300/400 System and Standard Functions" manual):

BSEND	SFB 12
BRCV	SFB 13
PUT	SFB 14
GET	SFB 15
USEND	SFB 8
URCV	SFB 9
START	SFB 19
STOP	SFB 20
RESUME	SFB 21
STATUS	SFB 22
USTATUS	SFB 23
CONTROL	SFC 62

- **S5-compatible communication (SEND/RECEIVE Interface) over FDL connections of the following types:**
  - specified FDL connections
  - free layer 2 connections
  - broadcast
  - multicast
- **Time-of-day synchronization over PROFIBUS**
  - The CP forwards time-of-day synchronization frames from the LAN to the station (CPU = time slave) or from the station to the LAN (CPU= time master) or this station is synchronized via a different LAN and the time-of-day synchronization frame must be forwarded over PROFIBUS for the synchronization of further stations.
  - Time-of-day status value, standard/daylight saving time switchover, synchronization status

The services of the CP 443-5 Basic module listed above can be used at the same time.

Configuration

When configuring, you must use STEP 7 version V5.2 SP1 or higher; for FDL connections and diagnostic functions, the NCM S7 for PROFIBUS optional package supplied with STEP 7 must be installed.

If the functionality of the predecessor module is adequate for your purposes, configuration and diagnostics are also possible with earlier STEP 7 versions.

It is possible to configure over the MPI or LAN/PROFIBUS.

System modifications are possible during operation (H system).

Note

For more detailed information on configuring PROFIBUS CP with STEP 7 / NCM S7, refer to the manual NCM S7 for PROFIBUS and the online help of STEP 7.

Programming - Using Blocks

For some communication services, there are “off-the-peg” blocks (FCs/FBs) available that implement the interface in your STEP 7 user program. 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 of the General Part of this manual.

Module Replacement without PG

Depending on the setting in the project configuration, the configuration data can also be stored in the load memory of the CPU. This makes it possible to replace modules without having to download the configuration data from the PG.

The stored configuration data is protected from power outage by battery backup or by plugging an EPROM card into the CPU.

2 Requirements for Use

The CP 443-5 Basic described here is supported by all the CPU operating systems listed in the table below.

The chapter also contains the following information:

- The number of CPs that can be operated with one CPU.
- The number of AG-SEND or AG-RECV calls on the SEND/RECEIVE interface that can be active at the same time (data exchange on FDL connections over PROFIBUS and corresponding connections over Industrial Ethernet).

2.1 Use with the Current CPU Types

When operating the CP 443-5 Basic with the CPU types listed here in the table, the following functionality is supported without exception:

- Number of operable CPs: 14
- Multicomputing (except for H systems)

Table 2-1 Use with the Current CPU Types

CPU	Order number	Firmware version	
			Number of AG-SEND or AG-RECV calls at same time
CPU 412	6ES7 412-1XF03-0AB0	As of V3.0	24 / 24
CPU 412-2	6ES7 412-2XG00-0AB0	As of V3.0	
CPU414-2 128 KB	6ES7 414-2XG03-0AB0	As of V3.0	
CPU414-3 384 KB	6ES7 414-3XJ00-0AB0	As of V3.0	
CPU 414-4H	6ES7 414-4HJ00-0AB0	As of V3.0	
CPU416-2 0.8 MB	6ES7 416-2XK02-0AB0	As of V3.0	64 / 64
CPU416-3 1.6 MB	6ES7 416-3XL00-0AB0	As of V3.0	
CPU 417-4	6ES7 417-4XL00-0AB0	As of V3.0	
CPU 417-4H	6ES7 417-4HL00-0AB0	As of V2.1	
	6ES7 417-4HL01-0AB0	As of V3.0	
CPU416F-2 1.6 MB	6ES7 416-2FK02-0AB0	As of V3.1	64 / 64

2.2 Converting older Systems

The discontinued CPUs listed here in Table 2-2 support the following functionality in conjunction with the CP 443-5 Basic:

- Number of operable CPs: 8
- Multicomputing

Table 2-2 Use with Discontinued CPU Types

CPU	Order number	Version	
			Number of AG-SEND or AG-RECV calls at same time
CPU 412	6ES7 412-1XF01-0AB0	2 or higher	12 / 12
	6ES7 412-1XF02-0AB0	2 or higher	
CPU 413	6ES7 413-1XG01-0AB0	2 or higher	
	6ES7 413-1XG02-0AB0	1 or higher	
CPU 413-2	6ES7 413-2XG01-0AB0	2 or higher	
	6ES7 413-2XG02-0AB0	1 or higher	
CPU414-1	6ES7 414-1XG01-0AB0	2 or higher	
	6ES7 414-1XG02-0AB0	2 or higher	
CPU414-2 128 KB	6ES7 414-2XG01-0AB0	2 or higher	
	6ES7 414-2XG02-0AB0	2 or higher	
CPU414-2 384 KB	6ES7 414-2XJ00-0AB0	4 or higher	
	6ES7 414-2XJ01-0AB0	2 or higher	
CPU416-1	6ES7 416-1XJ01-0AB0	2 or higher	32 / 32
	6ES7 416-1XJ02-0AB0	1 or higher	
CPU416-2 0.8 MB	6ES7 416-2XK00-0AB0	4 or higher	
	6ES7 416-1XK01-0AB0	1 or higher	
CPU416-2 1.6 MB	6ES7 416-2XL00-0AB0	4 or higher	
	6ES7 416-2XL01-0AB0	1 or higher	

3 Installation and Commissioning

Procedure / Steps

Table 3-1

<table>
<tr><th>Step</th><th>Explanation / Meaning</th></tr>
<tr><td>1. Insert the CP 443-5 Basic</td><td>The CP 443-5 Basic can be inserted in all racks with slots for P and K bus attachment:
• Central rack CR2
• Universal rack UR1, UR2 or UR2H
as central rack
as expansion rack with rack no. 1-6</td></tr>
<tr><td colspan="2">Note
When using the universal rack as an extension rack, you require an IM with a communication bus link!</td></tr>
<tr><td></td><td>The CP 443-5 Basic cannot be operated in an ER1 or ER2 expansion rack (no K bus link possible).
Suitable slots in the rack:
With the exception of the slots reserved for the power supply and IM-R, the CP 443-5 Basic can be inserted in all slots with a P and K bus interface (in the central or in an expansion rack no. 1-6).</td></tr>
<tr><td>2. Attachment to PROFIBUS</td><td>Note the information in the General section of this manual.</td></tr>
<tr><td colspan="2">Note
When using the CR2 rack, the CPU and CP must be plugged into the same segment if you want to use FDL/FMS connections.</td></tr>
<tr><td>3. Configuration</td><td>Depending on the communication services being used, configuration involves the following steps:
• Node initialization
This is necessary in all situations. This assigns a PROFIBUS address and bus parameters to the PROFIBUS CP. For details, refer to /2/
• Configuring connections:
This is necessary when using the communication services, S7 functions and FDL connections (SEND/RECEIVE interface). For details, refer to General Part A of the manual /2/.</td></tr>
<tr><td>4. PG/PC Attachment for Configuration</td><td>You can connect the PG when configuring the CP as follows:
• via MPI
• via LAN / PROFIBUS
The CP 443-5 Basic must already have a PROFIBUS address (for details of node initialization, refer to /2/).</td></tr>
</table>

4 Displays and Mode Selector

LEDs Displaying the Status of the CP

The 5 LED indicators on the front panel provide information on the status of the CP as shown in the table below:

Table 4-1

INTF (red)	EXTF (red)	BUSF (red)	RUN (green)	STOP (yellow)	CP-Betriebszustand
○	○	○	☼	●	Starting up (STOP->RUN)
○	○	○	●	○	Running (RUN)
○	○	○	●	☼	Stopping (RUN->STOP)
○	○	○	○	●	Stopped (STOP)
●	○	○	○	●	STOP due to internal error (for example CP not configured)
●	○	○	●	○	• Loading active in RUN. • RUN with internal error (e.g. bad configurattion data)
○	○	○	○	☼	Waiting for firmware update (duration 10 seconds after power on)
●	●	○	○	☼	Waiting for firmware update (CP currently has an incomplete firmware version).
○	○	●	●	○	RUN and PROFIBUS bus errors
☼	☼	☼	☼	☼	Module fault / system error

Key ● on ○ off ☼ flashing

Controlling the Operating Status

There are different ways of controlling the mode of the CP 443-5 Basic, as follows:

- Mode Selector
- NCM S7 for PROFIBUS configuration software
- SIMATIC Manager in STEP 7

To control the mode from STEP 7 / NCM S7 for PROFIBUS, the mode selector must be set to RUN.

Mode Selector

With the mode selector, you can set the following operating statuses:

- Switch from STOP to RUN:

  The CP reads the configuration data into the work memory and then changes to the RUN mode.

- Switch from RUN to STOP:

  The CP changes to STOP with the following results:

  - Established connections (FDL, FMS connections, configured, and unconfigured S7 connections) are terminated

  In the STOP mode

  - Configuration and diagnostics are possible
  - The time of day is distributed

5 Performance Data

5.1 Supported Transmission Rates

The transmission rate is set with the SIMATIC STEP 7 configuration software. For the permitted rates, refer to Table 7-1 in Chapter 7

5.2 Characteristics of S5-compatible Communication (SEND/RECEIVE Interface) on FDL Connections

The following characteristics are important when operating FDL connections (specified, free layer 2 (SDA and SDN), broadcast, multicast):

Table 5-1

Characteristic	Explanation / Values
Total number of FDL connections that can be operated.	32 maximum
Size of the transferable data area on FDL connections	240 bytes maximum per specified FDL connection (for sending and receiving) Free layer 2, broadcast and multicast: Per job up to 236 bytes of user data can be transferred. The job header requires an additional 4 bytes.

Cycle Load Caused by FDL Connections

The cycle load time for FDL connections is largely dependent on the time required to execute the function blocks (AG-SEND, AG-RECV) on the S7-400 CPU.

The following table lists the cycle load times of the available FCs in milliseconds. A distinction is made between the statuses “job completed” and ”job active”. The entries relate to the run time in the CPU 417-4 (see Table 5-2).

Table 5-2

Status	Job Completed		Job Active	
Component / FC	min.	max.	min.	max.
AG-SEND	0.12 ms	0.27 ms	0.11 ms	0.29 ms
AG-RECV	0.15 ms	0.37 ms	0.10 ms	0.26 ms

5.3 Data of FMS Connections

The following information is important for operating FMS connections:

Table 5-3

Component	Explanation / Values
Maximum number of operable FMS connections	48
User data length	237 bytes for READ 233 bytes for WRITE and REPORT
Configurable variables	512 server variables and 2640 variable descriptions that can be loaded from the partner (maximum values). These can be distributed as required on the maximum number of configurable FMS connections. The value applies to elementary data types or arrays of elementary data types. This value does not apply to complex data types (STRUCT)! Note the information in the manual /2/ about using complex data types (STRUCT).

Cycle Load Caused by FMS Connections

When calculating the reaction times with FMS connections, the run time of the function blocks (FBs) in the S7-400 CPU (416-1 see Table 5-4) is the decisive factor.

The table below shows the cycle load resulting from the available FCs in ms. A distinction is made between the statuses “job completed” and ”job active”.

Table 5-4

Status	**Job Completed**		**Job Active**	
Component / FB	**min**	**max**	**min**	**max**
READ	1.2 ms	1.6 ms	1.0 ms	2.3 ms
WRITE	1.2 ms	1.6 ms	1.0 ms	2.7 ms
STATUS	1.0 ms	1.5 ms	1.0 ms	2.8 ms
REPORT	1.7 ms	3.1 ms	1.3 ms	4.8 ms
IDENTIFY	1.7 ms	3.1 ms	1.3 ms	4.8 ms

Note

To allow module replacement without a PG, settings on the CPU must be modified. Open the Properties dialog of the CPU in HW Config; in the “Monitoring time for” box in the “Startup” tab, check and, if necessary, modify the following values:

- “Transfer of parameters to modules” (recommended value = 600 *100 ms)

Depending on your system (station configuration), you may need to increase the following parameter:

- “Ready message from modules”

For more detailed information about supported services and parameters, refer to the PICS tables (PICS: Protocol Implementation Conformance Statements) in the manual /6/.

5.4 Characteristics of S7 Communication

The following data is important for operating S7 connections:

Table 5-5

Characteristic	Explanation / Values
Number of S7 connections that can be operated via PROFIBUS	Maximum 48 (The value depends on the S7-400 CPU being used.)

5.5 Maximum Number of Connections in Total

In total (FDL , FMS , and S7 connections) a maximum of 59 connections can be operated

As an example, the following multiprotocol configuration was tested:

28 FMS client connections to S7-400/300 with SCC=RCC=1
+ 1 FMS server connection to S7-400 with SCC=RCC=4
+ 1 FMS server connection to S7-300 with SCC=RCC=1
+ 16 FDL connections to S7-400/300
+ 8 configured S7 connections to S7-400/300
+ 4 unconfigured HMI connections
+ Time-of-day forwarding
+ Diagnostics

Note

If PG or HMI functions are used, a suitable number of S7 connections must be reserved during configuration!

5.6 Time-of-day Synchronization

The CP 443-5 forwards time-of-day synchronization frames in the following directions:

1. From the CPU via the CP to PROFIBUS if the local CPU is the time master or this station is synchronized via a different LAN and the time-of-day synchronization frame is forwarded via PROFIBUS for the synchronization of further stations.
2. From PROFIBUS over the CP to the CPU if a remote station is time master, for example:
   - a remote CPU 41x with PROFIBUS interface (for example, CP 443-5)
   - a remote PC with CP 5412 / 5613 / 5614

All stations on a PROFIBUS subnet are synchronized with an accuracy of 10 ms.

Note

With transmission rates of < 1.5 Mbps, we recommend that you configure a synchronization interval of at least 10 s.

5.7 Use in Fault-tolerant Systems

With the CP 443-5 Basic, you can operate fault-tolerant S7 connections in an H system.

You will find more detailed information about the possible operating and structural options in the “SIMATIC S7-400H Programmable Controller Manual, Fault-tolerant Systems”.

If the CP 443-5 Basic is used in a fault-tolerant S7-400H system, the following communications services can also be used on single (non-redundant) connections:

- S7 connection for PG functions and PG routing
- S5-compatible communication (SEND/RECEIVE interface) on FDL connections
- FMS connections
- Time-of-day distribution

Note

Please note the CPU types in Table 4-4

5.8 Other Characteristics

Memory Reset of the CP

Warning

Please note that when you reset the CP memory using NCM Diagnostics or the SIMATIC Manager, the configuration data on the CPU must also be deleted otherwise the data will become inconsistent.

When using the S7-400H, do not use the memory reset function on the CP!

FMS Operation - Disabling and Enabling Interrupts and Asynchronous Events

Communication using the FMS blocks in the user program can break down if interrupts take too long to service (interrupt-driven programs such as hardware and diagnostic interrupts). You should check the codes in the CP diagnostic buffer.

It is advisable to disable interrupts before calling the FMS blocks and to enable them again after the FMS block call.

Note

Please read the additional information and notes. These are available in our Customer Support on the Internet:

http://www4.ad.siemens.de/view/cs/de/4557726

FMS Mode - Triggering a CP STOP from the PG

If you trigger a CP STOP using a PG function on a CP when using large numbers of connections, it is possible that you may have to repeat the job.

FMS Mode - Startup Behavior of the CPU after POWER ON

In the Properties dialog of the CPU, set “Startup after POWER UP” only to “Warm restart” or “Cold restart”.

6 Compatibility with the Previous Product

6.1 Extended Functionality Compared with Previous Product:

The CP 443-5 Basic (6GK7 443-5FX02-0XE0) described here can be used as a replacement for the previous products CP 443-5 Basic (6GK7 443-5FX01-0XE0 and 6GK7 443-5FX00-0XE0).

Please note the following information on the **extended functionality**.

Extended Functions as of 6GK7 443-5FX02-0XE0

The CP 443-5 Basic (6GK7 443-5FX02-0XE0) is functionally identical to the predecessor CP 443-5 Basic (6GK7 443-5FX01-0XE0).

The new CP 443-5 Basic provides better performance compared with the predecessor by a factor of up to 3

Extended Functions as of 6GK7 443-5FX01-0XE0

- PG bus functions in multiple subnets

  If you want to use the PG bus functions in multiple subnets, you must install the STEP 7 software version V5.0 or higher on the PG/PC.

  Note: Dynamic switchover to alternative paths (for example if there is a problem on one of the possible transmission paths) is, however, not supported.
- Time-of-day synchronization
- Use in SIMATIC S7-400H (fault-tolerant PLC)

6.2 Replacing Older Modules / Replacing Defective Modules

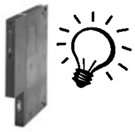
Replacing Modules

Please follow the procedure outlined below when replacing an older module with one of those described here:

Table 6-1

<table>
<tr><th>Module used until now</th><th>Configuration Procedure</th></tr>
<tr><td>6GK7 443-5FX00-0XE0</td><td>Configuration unchanged (replacing a defective module)
If you have no extra requirements for the CP compared with the old one, no changes to the configuration are necessary.
You then only need to remember the following difference when using the CP:
• Download the configuration data from your PG/PC to the CP again.
Note the following when forwarding the time of day:
When you have replaced a CP as described, the new CP assumes the following fixed direction for forwarding the time of day:
From LAN to S7 station (can be modified by configuration of the new module type, see below)
Extending the Configuration (using new functions)
If you want to use the extended functions of the new CP, follow the steps outlined below (see also Chapter 3):
1. In STEP 7 / HW Config, replace the already configured CP 443-5 Basic with the new module; you will find this in the Hardware Catalog.
2. Modify your configuration according to your requirements, for example in the Properties dialog for the PROFIBUS subnet.
3. Save, compile, and download the configuration data to the CPU or the CP.</td></tr>
<tr><td>6GK7 443-5FX01-0XE0</td><td>Configuration unchanged (replacing a defective module)
If you do not require any extra performance compared with the previously used CP, you do not need to make any changes in the configuration
• Download the configuration data from the PG/PC again if the data is stored on the CP and not on the CPU.</td></tr>
</table>

Information in the NCM S7 for PROFIBUS Online Help and Documentation



The information “for new modules” contained in both the STEP 7 / NCM S7 online help and the NCM S7 for PROFIBUS manual is also relevant for the CP described here. Look out for this symbol.

7 Technical Specifications

General Technical Data

Table 7-1

Technical Specifications	Value
Supported Transmission Rates	9.6 Kbps, 19.2 Kbps, 45.45 Kbps 93.75 Kbps, 187.5 Kbps, 500 Kbps 1.5 Mbps, 3 Mbps, 6 Mbps, 12 Mbps
Interfaces Attachment to PROFIBUS Maximum current consumption on the PROFIBUS interface with network components attached (for example, optical network components)	 9-pin sub-D female connector 100 mA at 5V
Power supply	5 V DC
Current consumption - from S7-400 backplane bus	 1.0 A typical at 5V
Power loss	5.5 W
Permitted ambient 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 1500 m above sea level
Design Dimensions W x H x D (mm)	 25 x 292 x 200
Weight	approx. 800 g

All the information in /1/ in the Section “General Technical Specifications” regarding the following topics also applies to the CP 443-5 Basic

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

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SIMATIC NET

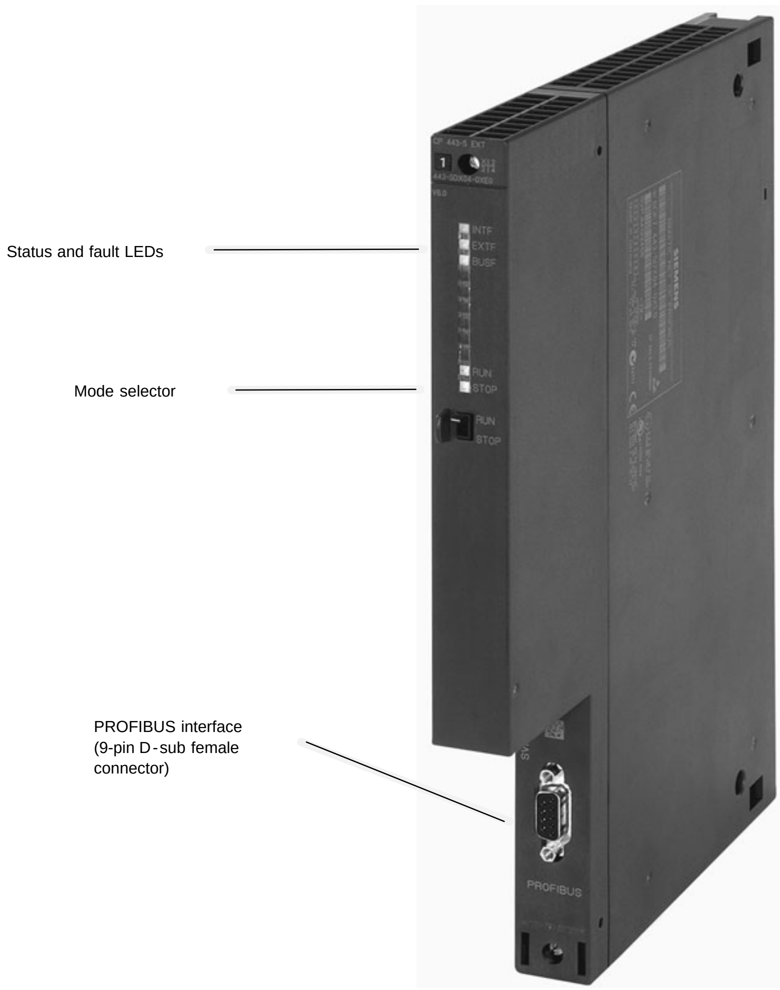
S7-CPs for PROFIBUS

Manual Part B4

CP 443-5 Extended for PROFIBUS

6GK7 443-5DX04-0XE0 Version 1 or higher (Firmware Version V6.1 or higher)

for SIMATIC S7-400 / S7-400H



Notes on the Product

Note

All notes in the **product information bulletin** that is supplied with this product are valid and must be observed.

Compatibility with the Previous Version

Note

Make sure that you read the information regarding **extended functionality and restrictions** in Chapter 6 of this manual!

Contents

Contents - Part A

Note

Please remember that Part A of the manual also belongs to the description of the CP. Among other things, it contains explanations of the safety notices, the references to literature, and general information that applies to all S7 CPs for PROFIBUS.

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

http://www4.ad.siemens.de/view/cs/de/1158693

Contents - Part B4

1 Properties / Services

Application

The CP 443-5 Extended communications processor is designed for use in a SIMATIC S7-400 (standard) and S7-400H (fault-tolerant system) programmable controller. It allows the S7-400 / S7-400H to be connected to a PROFIBUS fieldbus system.

You can use the CP as a router for data records intended for field devices (for example PA slaves).

Services

The current version of the CP 443-5 Extended supports the following communication services in the standard and H systems:

- **PROFIBUS-DP with the following characteristics:**
  - DP master (class 1) (redundant operation in fault-tolerant system also possible)
  - Direct data exchange (DP slave to DP slave)

    As a DP master, the CP 443-5 Extended is capable of enabling direct data exchange for “its” DP slaves.
  - SYNC /FREEZE (please refer to Tables 2-1 and 2-2)

    The outputs or inputs can be synchronized from the within the user program using system function SFC11.
  - Constant bus cycle time (only in the standard system)

    The ability to set a constant bus cycle time means that the DP master always starts the DP bus cycle after the same interval.
  - Selectable DP modes:

DPV1 functionality (default in STEP 7)	S7-compatible
DP master mode for: • DP slaves complying with the PROFIBUS DP-V0 and DPV1 standard • Siemens DP slaves (Refer to the information in Tables 2-1 and 2-2 on the required CPU)	DP master mode for: • DP Slaves complying with the PROFIBUS DP-V0 standard (DP slaves complying with the DPV1 standard can only be used with restricted functionality) • Siemens DP slaves

(For more information on the topic of DPV1, refer to the STEP 7 / Hardware Configuration online help)

- CiR (Configuration in RUN) - in the standard system

  By making a change to the configuration with CiR (Configuration in RUN), it is possible to put a DP slave / DP slot extension into operation or take it out of operation when necessary while the system is running.

  In other words, you can configure and activate additional DP slaves or DP slots while the S7 station is in RUN.

- Activate/deactivate DP slaves in the standard system

  DP slaves can be activated and deactivated from the within the user program using system function SFC12.

- Diagnostic Requests

  As a DP master class 1, the CP 443-5 supports diagnostic requests of a DP master class 2.

- Identifying the bus topology in a DP master system

  As a DP master, the CP 443-5 Extended supports the measurement of the PROFIBUS bus topology in a DP master system using a diagnostic repeater (DP slave).

  System function SFC103 in the user program can instruct diagnostic repeaters to measure the PROFIBUS BUS topology in a DP master system. When completed, the results of the measurements made by the diagnostic data can then be read in and processed by the user program.

• **S5-compatible communication (SEND/RECEIVE interface) on FDL connections of the following types:**

  - specified FDL connections
  - free layer 2 connections
  - broadcast
  - multicast

- **S7 communication and PG/OP communication**
  - PG functions with upload / download of FM modules, configuration / diagnostics and routing

    Note on routing: Dynamic switchover to alternative paths (for example if there is a problem on one of the possible transmission paths) is not supported.
  - Operator control and monitoring functions (HMI)
  - Client and server for data exchange on S7 connections via communications function blocks (fault-tolerant S7 connections also possible)[1)]
  - Download S7 connections and gateways in RUN.
- **Time-of-day synchronization via PROFIBUS**
  - The CP forwards time-of-day synchronization frames from the LAN to the station (CPU = time slave) or from the station to the LAN (CPU= time master) or this station is synchronized via a different LAN and the time-of-day synchronization frame must be forwarded over PROFIBUS for the synchronization of further stations.
  - The CP supports time stamping of distributed process signals in conjunction with the IM 153.
  - Time-of-day status value (standard/daylight saving time switchover, synchronization status)
- **Data record routing**

  You can use the CP as a router for data records intended for field devices (for example PA slaves). One tool that creates such data records for assigning parameters to field devices is SIMATIC PDM (Process Device Manager; see also SIMATIC PDM documentation...).

The services of the CP 443-5 Extended module listed above can be used at the same time.

1) Blocks for S7 communication (see also STEP 7 online help or "System Software for S7-300/400 System and Standard Functions" manual):

BSEND	SFB 12
BRCV	SFB 13
PUT	SFB 14
GET	SFB 15
USEND	SFB 8
URCV	SFB 9
START	SFB 19
STOP	SFB 20
RESUME	SFB 21
STATUS	SFB 22
USTATUS	SFB 23
CONTROL	SFC 62

Project engineering

To configure and use any functions, you require **STEP 7 as of V5.3**.

It is possible to configure over the MPI or LAN/PROFIBUS.

Programming - Using Blocks

For some communication services, there are "off-the-peg" blocks (FCs/FBs) available that implement the interface in your STEP 7 user program. 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 of the General Part of this manual.

Replacing Modules without a Programming Device

When installing the CP 443-5 Extended, the configuration data of the CP are always stored in the CPU. Therefore replacing modules is possible without having to download the configuration data from the PG.

The stored configuration data is protected from power outage by battery backup or by plugging a flash memory card into the CPU.

2 Requirements for Use

The CP 443-5 Extended V 6.1 described here is supported by all CPU operating systems in the versions listed in Tables 2-1 and 2-2.

2.1 Use with the Current CPU Types

Limits and Conditions

To use the CP type described here, the following limits and constraints apply within a rack:

- Number of operable CPs: 14
- Max. number of external DP chains (CP as DP master) : 10

Notice

The number CPs that can be operated as DP masters depends on the number of CP 443-1 Advanced modules operated as PROFINET IO controllers in the S7-400 station. In total, 10 CPs can be operated as

- PROFINET IO controllers (CP 443-1 Advanced) - maximum 4
- DP masters (CP 443-5 Extended) - maximum 10

- Multicomputing is supported (except with CiR and H systems)

System Environment

The CP 443-5 Extended is supported by the S7-400 CPUs and CPU operating systems with the order numbers and versions listed in the table below.

From the table, you can see which functionality is supported when you use the CP 443-5 Extended V 6.1 with the various CPU types: The following characteristics are listed:

- CPU type, order number and version
- Option of multicomputing
- The number of CPs that can be operated with one CPU
- The maximum number of external DP chains of an S7 station;
- The number of AG-SEND or AG-RECV calls on the SEND/RECEIVE interface that can be active at the same time (data exchange on FDL connections over PROFIBUS and corresponding connections over Industrial Ethernet).
- Whether the CPU supports SYNC/FREEZE functionality (SFC11) via the CP.
- Whether the CPU supports the activate / deactivate (SFC12) DP functionality via the CP.

- Whether the CPU supports the functionality for identifying the bus topology in a DP master system (SFC103) via the CP.
- DPV1 functionality
- CiR functionality (DP slave / DP slot, configurable extension)

Notice

ET 200M devices that were assigned to SYNC/FREEZE groups with STEP 7, **must not** have modules of the type FM or CP inserted.

Table 2-1 Use with the Current CPU Types

CPU	Order Number of the CPU: 6ES7...	Firmware version	Number of AG-SEND or AG-RECV calls at same time	SYNC/FREEZE functionality	DP-V1 functionality	CiR / HCiR functionality 1)	Activate / deactivate DP slave	Identify bus topology
CPU 412	..412-1XF04-0AB0	As of V4.	24 /24	+	+	+	+	-
		As of V4.1	24 /24	+	+	+	+	+
CPU 412-2	..412-2XG04-0AB0	As of V4.	24 / 24	+	+	+	+	-
		As of V4.1	24 / 24	+	+	+	+	+
CPU 414-2	..414-2XG04-0AB0	As of V4.	24 / 24	+	+	+	+	-
		As of V4.1	24 / 24	+	+	+	+	+
CPU 414-3	..414-3XJ04-0AB0	As of V4.	24 / 24	+	+	+	+	-
		As of V4.1	24 / 24	+	+	+	+	+
CPU414-4H	..414-4HJ04-0AB0	As of V4.	24 / 24	-	+	+	-	-
		As of V4.0.5	24 / 24	-	+	+	-	+
CPU 416-2	..416-2XK04-0AB0	As of V4.	64 / 64	+	+	+	+	-
		As of V4.1	64 / 64	+	+	+	+	+
CPU 416-3	..416-3XL04-0AB0	As of V4.	64 / 64	+	+	+	+	-
		As of V4.1	64 / 64	+	+	+	+	+
CPU 416F-2	..416-2FK04-0AB0	As of V4.	64 / 64	+	+	+	+	-
		As of V4.1	64 / 64	+	+	+	+	+

Table 2-1 Use with the Current CPU Types, continued

CPU	**Order Number of the CPU: 6ES7...**	**Firmware version**	**Number of AG-SEND or AG-RECV calls at same time**	**SYNC/FREEZE functionality**	**DP-V1 functionality**	**CiR / HCiR functionality** [1)]	**Activate / deactivate DP slave**	**Identify bus topology**
CPU417-4	..417-4XL04-0AB0	As of V4.	64 / 64	+	+	+	+	-
		As of V4.1	64 / 64	+	+	+	+	+
CPU417-4H	..417-4HL04-0AB0	As of V4.	64 / 64	-	+	+	-	-
		As of V4.0.5	64 / 64	-	+	+	-	+

Legend:

\+ => The characteristic is supported / the listed mode is possible

\- => The characteristic is **not** supported / the listed mode is **not** possible

1) All CPUs are CiR capable (the H-CPUs HCiR).

2.2 Converting older Systems

The discontinued CPUs listed in Table 2-2 support the following functionality in conjunction with the CP 443-5 Extended V 6.1:

- **No** DPV1 functionality
- **No** CiR functionality (DP slave, configurable expansion)
- **No** identification of the bus topology by the user program
- Maximum number of external DP chains per station: 4
- Number of operable CPs: 8
- Multicomputing

Table 2-2 Use with no longer available CPU Types - Part 1

CPU	Order number	Version	Number of AG-SEND or AG-RECV calls at same time	SYNC/FREEZE
CPU 412	6ES7 412-1XF01-0AB0	2 or higher	12 / 12	-
	6ES7 412-1XF02-0AB0	2 or higher	12 / 12	+
CPU 413	6ES7 413-1XG01-0AB0	2 or higher	12 / 12	-
	6ES7 413-1XG02-0AB0	1 or higher	12 / 12	+
CPU 413-2	6ES7 413-2XG01-0AB0	2 or higher	12 / 12	-
	6ES7 413-2XG02-0AB0	1 or higher	12 / 12	+
CPU 414-1	6ES7 414-1XG01-0AB0	2 or higher	12 / 12	-
	6ES7 414-1XG02-0AB0	2 or higher	12 / 12	+
CPU 414-2 128 KB	6ES7 414-2XG01-0AB0	2 or higher	12 / 12	-
	6ES7 414-2XG02-0AB0	2 or higher	12 / 12	+
CPU 414-2 384 KB	6ES7 414-2XJ00-0AB0	4 or higher	12 / 12	-
	6ES7 414-2XJ01-0AB0	2 or higher	12 / 12	+
CPU 416-1	6ES7 416-1XJ01-0AB0	2 or higher	32 / 32	-
	6ES7 416-1XJ02-0AB0	1 or higher	32 / 32	+
CPU 416-2 0.8 MB	6ES7 416-2XK00-0AB0	4 or higher	32 / 32	-
	6ES7 416-2XK01-0AB0	1 or higher	32 / 32	+
CPU 416-2 1.6 MB	6ES7 416-2XL00-0AB0	4 or higher	32 / 32	-
	6ES7 416-2XL01-0AB0	1 or higher	32 / 32	+

Legend:
\+ => The characteristic is supported / the listed mode is possible
\- => The characteristic is **not** supported / the listed mode is **not** possible

Table 2-3 Use with no longer available CPU Types - Part 2

CPU	Order Number of the CPU: 6ES7...	Firmware version	Number of AG-SEND or AG-RECV calls at same time	SYNC/FREEZE functionality	DP-V1 functionality	CiR / HCiR functionality 1)	Activate / deactivate DP slave	Identify bus topology
CPU 412	..412-1XF03-0AB0	As of V3.1	24 / 24	+	+	+	+	-
CPU 412-2	..412-2XG00-0AB0	As of V3.1	24 / 24	+	+	+	+	-
CPU 414-2	..414-2XG03-0AB0	As of V3.1	24 / 24	+	+	+	+	-
CPU 414-3	..414-3XJ00-0AB0	As of V3.1	24 / 24	+	+	+	+	-
CPU414-4H	..414-4HJ00-0AB0	As of V3.1	24 / 24	-	+	+	-	-
CPU 416-2	..416-2XK02-0AB0	As of V3.1	64 / 64	+	+	+	+	-
CPU 416-3	..416-3XL00-0AB0	As of V3.1	64 / 64	+	+	+	+	-
CPU 416F-2	..416-2FK02-0AB0	As of V4.	64 / 64	+	+	+	+	-
CPU417-4	..417-4XL00-0AB0	As of V3.1	64 / 64	+	+	+	+	-
CPU417-4H	..417-4HL00-0AB0	As of V2.1	64 / 64	-	-	+	-	-
	..417-4HL01-0AB0	As of V3.1	64 / 64	-	+	+	-	-

Legend:
+ => The characteristic is supported / the listed mode is possible
- => The characteristic is **not** supported / the listed mode is **not** possible

1) All CPUs are CiR capable (the H-CPUs HCiR).

3 Installation and Commissioning

Caution

The CP 443-5 Extended must not be plugged in or removed when the power is connected.

If you do remove or insert the CP while it is powered on, the CPU changes to STOP; this does not cause damage to the CP. Afterwards, you must turn the power for the central rack off and on again.

Procedure / Steps

Step	Explanation / Meaning
1. Insert the CP 443-5 Extended	The CP 443-5 Extended can be operated in the following racks: • Central rack CR2, CR3 • Universal rack UR1 UR2 or UR2H as the central or expansion rack with rack no. 1-6 (only possible if there is no DP operation). The CP 443-5 Extended cannot be used in an ER1 or ER2 expansion rack. Suitable slots in the rack: With the exception of the slots reserved for the power supply and IM-R, the CP 443-5 Extended can be inserted in all slots with a P and K bus interface (in the central or in an expansion rack no. 1-6).

Notice

When you are using PROFIBUS-DP, the module must only be operated in the central rack!

When using the universal rack as an extension rack, you require an IM with a communication bus link!

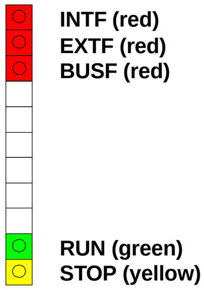
Step	Explanation / Meaning
2. Attachment to PROFIBUS	Note the information in the General part of this manual.

Step	Explanation / Meaning
3. Configuration	Depending on the communication services being used, configuration involves the following steps: • Node initialization This is necessary in all situations. This assigns a PROFIBUS address and bus parameters to the PROFIBUS CP. • Configuring connections: This is necessary when using the communication services, S7 functions and FDL connections (SEND/RECEIVE interface). • DP configuration This is necessary when the DP mode is used. For details, see /2/, General Part.
4. PG/PC Attachment for Configuration	You can connect the PG when configuring the CP as follows: • via MPI • via LAN / PROFIBUS The CP 443-5 Extended must already have a PROFIBUS address. For details, see /2/, General Part.

4 Displays and Mode Selector

LED Display of the Operating Status of the CP

Front panel:



The different combinations of the five LEDs on the front panel indicate the status of the CP:

Table 4-1

INTF LED	EXTF LED	BUSF LED	RUN LED	STOP LED	CP Operating Status
			☀	●	Starting up (STOP->RUN)
			●	○	Running (RUN)
			●	☀	Stopping (RUN->STOP)
			○	●	Stopped (STOP)
●			○	●	STOP with internal error or memory reset.
○	○	○	○	☀	Waiting for firmware update (duration 10 seconds after power on)
●	●	○	○	☀	Waiting for firmware update (CP currently has an incomplete firmware version).
●			●	○	• Download in RUN active / CiR • RUN with internal error (for example, bad configuration data)
		●			PROFIBUS bus errors
	●	☀	●	○	RUN; however problems on DP chain (DP slave not in data transfer or not accessible)
	●	○	●	○	RUN; however problems on DP chain (faulty module in DP slave).
☀	☀	☀	☀	☀	Module fault / system error

Legend: ● on ○ off ☀ flashing Field gray: undefined / any

Controlling the Operating Status

There are different ways in which you can control the status of the CP 443-5 Extended, as follows:

- Mode selector
- Configuration software NCM S7 Diagnostics
- SIMATIC Manager in STEP 7

To control the status from STEP 7 / NCM S7, the mode selector must be set to RUN.

Mode Selector

With the mode selector, you can set the following operating statuses:

- Switch from STOP to RUN:

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

- Switch from RUN to STOP:

  The CP changes to STOP with the following results:

  - Established connections (FDL connections, configured, and unconfigured S7 connections) are terminated
  - DP slaves are taken out of data transfer
  - Data record routing is deactivated

  In the STOP mode

  - Configuration and diagnostics are possible
  - The time of day is distributed

5 Performance Data

5.1 Supported Transmission Rates

The transmission rate is set with the SIMATIC STEP 7 configuration software. For the permitted rates, refer to Table 7-1 in Section 7

5.2 Characteristics of the DP Interface

No special FBs or FCs are necessary for the DP mode. The interfacing to the distributed peripheral I/O is by direct I/O access or using SFCs/SFBs of the CPU (see /11/).

Table 5-1

Characteristic	Explanation / Values
Number of DP slaves that can be operated	125
Max. size of the input area of all DP slaves	4 Kbytes
Max. size of the output area of all DP slaves	4 Kbytes
Maximum number of inputs per DP slave	244 bytes
Maximum number of outputs per DP slave	244 bytes
Max. size of the consistent area for a module	128 bytes

Diagnostic Requests

As a DP master class 1, the CP 443-5 supports diagnostic requests of a DP master class 2.

Note

In some situations, it is necessary to increase the default value for the startup parameter ”Monitoring time for transfer of parameters to modules” in the Properties dialog of the CPU:

- When there is a large number of modules (DP slaves) configured that can be assigned parameters;
- When a high value is configured for the constant bus cycle time in the network properties of the PROFIBUS DP chain.

CiR Functionality (see also function manual “Modifying the System during Operation via CiR” Siemens AG /14/)

The numbers of connections etc. shown in Table 5-1 also apply in the case of a configured DP slave expansion (CiR functionality) to the entire DP master system.

If you specify the properties of a CiR object in the DP master system of the CP 443-5 Extended in STEP 7, these values are included in checks performed by STEP 7.

The configurable properties relate to:

- The number of DP slaves and modules you can insert in a DP slave
- The number of input and output bytes that can still be configured in RUN.

5.3 Characteristics of S5-compatible Communication (SEND/RECEIVE Interface) over FDL Connections

The following information is important for operating FDL connections (specified, free layer 2 (SDA and SDN), broadcast, multicast):

Table 5-2

Characteristic	Explanation / Values
Total number of FDL connections that can be operated.	32 maximum
Size of the transferable data area on FDL connections	1-240 bytes maximum per specified FDL connection (for sending and receiving) Free layer 2, broadcast and multicast: Per job up to 236 bytes of user data can be transferred. The job header requires an additional 4 bytes.

Cycle Load Time due to FDL Connections

The cycle load time for FDL connections is largely dependent on the time required to execute the function blocks (AG-SEND, AG-RECV) on the S7-400 CPU.

The following table lists the cycle load times of the available FCs in milliseconds. A distinction is made between the statuses “job completed” and “job active”. The entries relate to the run time in the CPU 417 (6ES7 417-4XL04-0AB0 - see Table 2-1).

Table 5-3

Status	Job Completed		Job Active	
Component / FC	min.	max.	min.	max.
AG-SEND	0.10 ms	0.11 ms	0.14 ms	0.16 ms
AG-RECV	0.13 ms	0.14 ms	0.12 ms	0.13 ms

5.4 Characteristics of S7 Communication

The following data are important for operating S7 connections:

Table 5-4

Characteristic	Explanation / Values
Number of S7 connections that can be operated via PROFIBUS	Maximum 48 (The value depends on the S7-400 CPU being used.)

5.5 Parallel Use of Communications Services (Multiprotocol Operation)

If you use the available communication services at the same time, certain restrictions result in terms of the communications performance.

To illustrate the relationship between the connection types, the DP mode, and configured connections, the following values apply to the **typical** configurations.

Table 5-5

Connection Type	Number of Connections	With the DP Configuration
FDL connections	32	No DP
	32	with DP mode
S7 connections	48	No DP
	48	with DP mode
FDL and S7 connections 1)	59	No DP
	54	with DP mode

1) one additional 1 S7 connection can be set up online (for example for routing)

Note

If PG or HMI functions or data record routing are used, a suitable number of S7 connections must be reserved during configuration!

Help Provided by STEP 7

The number of connections on PROFIBUS shown in Table 5-5 can vary due to other influencing factors. The STEP 7 configuration tool displays warnings and help messages as soon as limit values are exceeded.

Scaling Services in the “Mixed Mode”

The DP delay time is used to scale cyclic DP communication and the other services (FDL and S7 connections). A DP delay time of 0 seconds guarantees the fastest possible DP update. By increasing the DP delay time, you create extra time on the CP for handling other services.

Note

Recommendation: In the mixed mode - PROFIBUS DP along with communications functions - a delay should be selected (recommended: 1 ms at transmission rates > 1.5 Mbps).

Notice

For the SFCs 11, 12, 13, 51, 55, 56, 57, 58, 59 and 103 and for SFBs 52 and 53, several calls are necessary. The duration of job processing depends on the load, bus round trip time and the transmission rate. If these SFCs are called in a loop within one cycle, the cycle time could be exceeded.

Exceptions:

- SFC51 requires only one call if it is used for reading the diagnostic data in a diagnostic interrupt (SFC51 with parameter ’partial system status list’ 0xB1 and 0xB2).
- Only one call is necessary for SFB54 (receive alarm with SFB54 ”RALRM”).

Blocks for DPV1 (according to the PNO standard) [1)]:

- SFB52 RDREC ”Read data record from a DP slave” corresponds to SFC59
- SFB53 WRREC ”Write data record to a DP slave” corresponds to SFC58
- SFB54 ALARM ”Read alarm information from a DP slave”

---

1) PNO: PROFIBUS Users Organization

5.6 Time-of-day Synchronization

The CP 443-5 forwards time-of-day synchronization frames in the following directions:

1. From the CPU via the CP to PROFIBUS if the local CPU is the time master or this station is synchronized via a different LAN and the time-of-day synchronization frame is forwarded via PROFIBUS for the synchronization of further stations.
2. From PROFIBUS over the CP to the CPU if a remote station is time master, for example:
   - a remote CPU 41x with PROFIBUS interface (for example, CP 443-5)
   - a remote PC with CP 5412 / 5613 / 5614

Note

With transmission rates of < 1.5 Mbps, we recommend that you configure a synchronization interval of at least 10 s.

5.7 Data Record Routing

A maximum of 11 connections can be established simultaneously to PA field devices at any one time.

PDM can, however, use several connections to one PA field device (for more information, refer to the manual “PDM - The Process Device Manager”).

5.8 Use in Fault-tolerant Systems [1)]

With a CP 443-5 Extended, you have the following options in a fault-tolerant (H) system:

- Operating fault-tolerant S7 connections with communication services configured on one partner

  or

- You can implement redundant and single peripheral structures (mixed mode is also possible).

You will find more detailed information about the possible operating and structural options in the “SIMATIC S7-400H Programmable Controller Manual, Fault-tolerant Systems”.

If the CP 443-5 Extended is used in a fault-tolerant S7-400H system, the following communications services can also be used on single (non-redundant) connections:

- S7 connection (including PG functions and PG routing)
- S5-compatible communication (SEND/RECEIVE interface) on FDL connections
- Time-of-day distribution

Note

[1)] Please note the CPU types in Table 2-1/2-2/2-3

5.9 Other Characteristics

Note on DP:
The connected DP slaves can only be assigned to and serviced by one CPU.

Notice

If you use the CiR functionality, multicomputing is not possible.

Memory Reset on the CP

Warning

Please note that when you reset the CP memory using NCM Diagnostics or the SIMATIC Manager, the configuration data on the CPU must also be deleted otherwise the data will become inconsistent.

Special feature of the DP mode:
If the CPU is in the RUN mode, the memory reset is rejected by the CP.

DP Diagnostic Frames when the CPU is in STOP

All diagnostic frames from DPV0 standard slaves and all DP alarm frames from DP-S7/DP-V1 standard slaves arriving when the CPU is in STOP mode are handled as follows:

- In “S7-compatible” mode

  The problems that still exist at the transition from CPU STOP to CPU RUN are passed on the user program.

- In DP-V1 mode

  The diagnostic/alarm frames are forwarded even when the CPU is in STOP mode, however, they must be evaluated by a suitable user program when the module starts up.

6 Compatibility with the Previous Product

6.1 Extended Functionality Compared with Previous Product:

Compared with previous products, the CP 443-5 Extended (6GK7 443-5DX04-0XE0) with firmware version V6.0 or higher has significantly improved performance in all services, in particular when they are operated parallel to each other.

The CP443-5 Extended described here (6GK7 443-5DX04-0XE0) with firmware version V6.1 or higher can be used as a replacement for the following predecessors of the CP 443-5 Extended:

- 6GK7 443-5DX00-0XE0
- 6GK7 443-5DX01-0XE0
- 6GK7 443-5DX02-0XE0
- 6GK7 443-5DX03-0XE0
- 6GK7 443-5DX04-0XE0, V6.0

Version History / Predecessor Products

The document "Version History/Current Downloads for the SIMATIC NET S7 CPs" contains information on the all the previously supplied PROFIBUS CPs for SIMATIC S7. You will find the latest version of this document at:

http://www4.ad.siemens.de/view/cs/de/9836605

6.2 Replacing Older Modules / Replacing Defective Modules

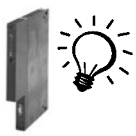
Replacing Modules

Please follow the following procedure when replacing an older module with one of those described here:

Table 6-1

Module used until now	Configuration Procedure
6GK7 443-5DX00-0XE0 6GK7 443-5DX01-0XE0 6GK7 443-5DX02-0XE0 6GK7 443-5DX03-0XE0 6GK7 443-5DX04-0XE0	Configuration unchanged (replacing a defective module) If you have no extra requirements for the CP compared with the old one, no changes to the configuration are necessary. All you need to do is replace the hardware with the power supply turned off. Extending the Configuration (using new functions) If you want to use options that you had not used with the previous CP, follow the steps below (see also Chapter 3): 1. In STEP 7 / HW Config replace the already configured CP 443-5 Extended with the new module; you will find this in the Hardware Catalog. 2. Modify your configuration according to your requirements, for example in the Properties dialog for the PROFIBUS subnet. 3. Save, compile, and download the configuration data to the CPU or the CP.

Information in the Online Help and Documentation on S7 CPs for PROFIBUS



The information “for new modules” contained in both the STEP 7 / NCM S7 online help and the S7 CPs for PROFIBUS manual is also relevant for the CP described here. Look out for this symbol.

7 Technical Specifications

General Technical Data

Table 7-1

Technical Data	Value
Supported Transmission Rates	9.6 Kbps, 19.2 Kbps, 45.45 Kbps 93.75 Kbps, 187.5 Kbps, 500 Kbps 1.5 Mbps, 3 Mbps, 6 Mbps, 12 Mbps
Interfaces Attachment to PROFIBUS Maximum current consumption on the PROFIBUS interface with network components attached (for example, optical network components)	 9-pin D-sub female connector 100 mA at 5V
Power supply	5 V DC
Current consumption - from S7-400 backplane bus	 1.0 A typical at 5V
Power loss	5.5 W
Permitted ambient conditions • Operating temperature • Transportation/storage temperature • Relative humidity • Altitude	 0 °C to +60 °C -40 °C to +70 °C max. 95% at +25 °C up to 2000 m above sea level
Design Dimensions W x H x D (mm)	 25 x 292 x 200
Weight	approx. 800 g

All the information in /1/ in the Section "General Technical Data" regarding the following topics also applies to the CP 443-5 Extended

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