

PROFI[®] BUS



für PROFIBUS-DP

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0.1 Document history

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Version	Published	Modified	Comments
pEN1	2009-01-07	Completely	New edition, partly taken from HB 26-765
pEN1	2009-06-25	Completely	Revision
pEN01	2010-01-14	Completely	Chapter numbering
EN01	2013-06-26 2013-08-07	Ch. 2.5 Completely	- PCD7.T161 and PCD7.T162 added - Changed the Logo
ENG01	2019-01-31	Chapter A	New phone number (2015)

0.2 Trademarks

Saia PCD® is a registered trademark of Saia-Burgess Controls AG.

Technical changes are subject to the state of technology.

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1. Characteristics and fundamentals

PROFIBUS is the successful, open, industrial fieldbus standard for a broad application spectrum.

1.1 Characteristics

- **Open**

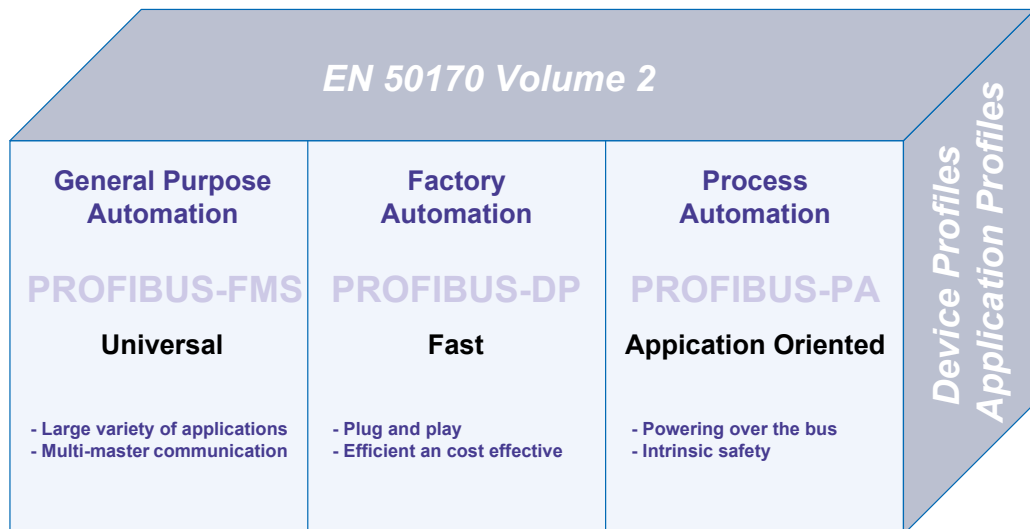
PROFIBUS enables the exchange of data between devices from different manufacturers, without special interface adjustments. PROFIBUS has been standardised under the stable German standard DIN 19245 and European standard pr EN 50 170.

- **Vendor-independent**

PROFIBUS devices are offered by many qualified manufacturers. This enables the user to select the most suitable device from a preferred manufacturer for the application in question.

- **Optimised for a wide field of use**

PROFIBUS comprises the following three application-specific versions:



PROFIBUS has been standardised under European standard EN 50170 and the earlier German standard DIN 19245 parts 1 - 4.

PROFIBUS-FMS (FMS = Fieldbus Message Specification)

This is the general purpose solution for communications tasks at the field and cell levels of the industrial communications hierarchy. Powerful FMS services open up a wide range of applications, provide great flexibility and enable comprehensive communication tasks to be managed with cyclic or acyclic data communication at medium speed.

PROFIBUS-DP (DP = Decentralised Peripherals)

Optimised for high speed, this PROFIBUS version has been especially tailored for communication between automation systems and local peripherals, enabling plug-and-play for field devices

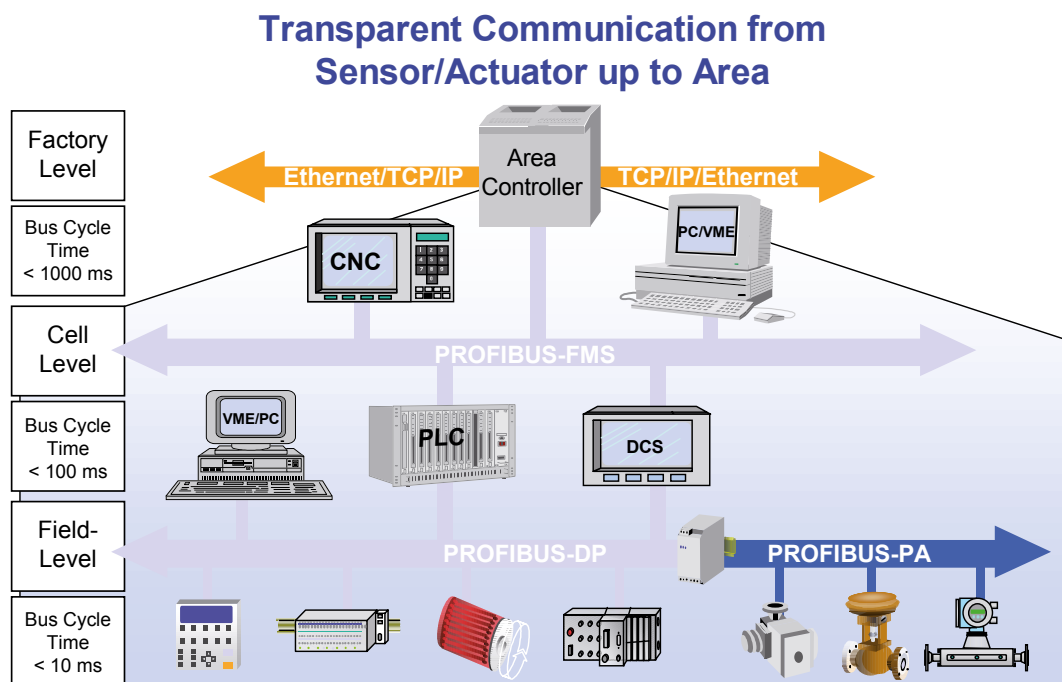
PROFIBUS-FMS and PROFIBUS-DP use the same transmission technology and the same bus access protocol. Both versions can therefore run simultaneously and in combination on a single cable.

PROFIBUS-PA (PA = Process Automation)

PROFIBUS-PA is the PROFIBUS version for process automation applications. PROFIBUS-PA uses the intrinsically safe transmission technology defined in IEC 1158-2 and enables the remote supply of stations through the bus.

The protocol functions of PROFIBUS-FMS, PROFIBUS-DP and PROFIBUS-PA are complemented by profiles which describe how PROFIBUS is used in special fields of application, such as process automation, building control technology or automated production.

Device profiles define device-specific functions. The device description language (DDL) and function blocks ensure that devices are fully interoperable.



- **Proven**

PROFIBUS is a complete, proven technology which has already stood the test of more than 100,000 applications in the fields of building automation, automated production, process automation and drive technology.

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- **Certificated**

Tests of conformity and interoperability performed in laboratories authorised by the PROFIBUS user organisation (PNO), combined with PNO device certification, give the user an assurance of guaranteed quality and functionality, even in multi-vendor installations.

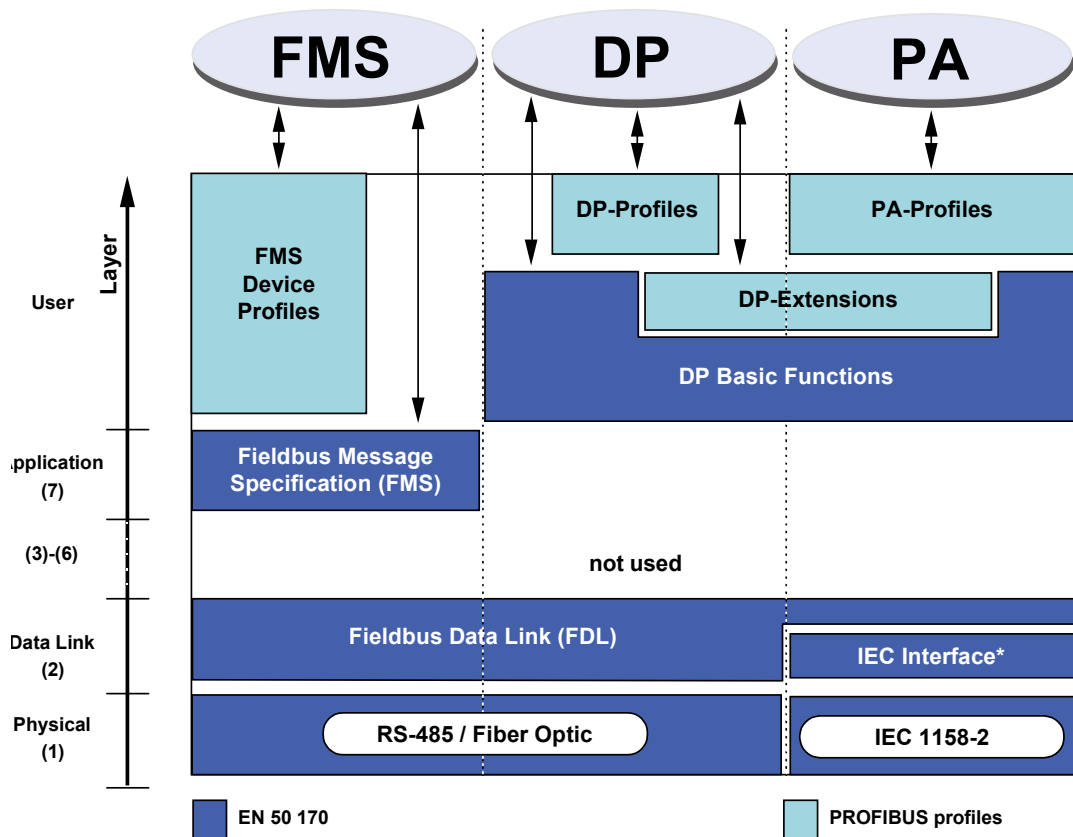
1.2 Basic principles

To construct a PROFIBUS network and exchange data over it, it is not imperative to read through and understand the following chapter in full. If you plan PROFIBUS communication with Saia PCD devices only, this in itself is a very simple undertaking and you can continue directly with chapter 2.

1

However, if you would also like to improve your knowledge and understanding of PROFIBUS theory, you will certainly find the following chapter useful.

1.2.1 ISO/OSI reference model



1.2.2 PROFIBUS layer 1 (physical layer)

PROFIBUS protocol architecture follows the ISO/OSI (Open System Interconnection) reference model, in line with international standard ISO 7498.

In this model each layer takes on precisely defined tasks. Layer 1 (physical layer) defines the physical transmission technology. Layer 2 (data link layer) defines the bus access procedure. Layer 7 (application layer) defines the user level.

A fieldbus system's field of use is essentially determined by the choice of transmission medium and the physical bus interface. Apart from the requirements of transmission security, expenditure on purchasing and installing the bus cable is crucially important. The PROFIBUS standard therefore provides for various forms of transmission technology, while retaining a uniform bus protocol.

Cable-based transmission: This version complies with US standard EIA RS-485 and was defined as the basic version for applications in the field of production engineering, building control technology and drive technology. It uses a shielded, twisted-pair copper cable.

Fibre-optic cable: For applications in very interference-prone environments, and to extend working range at high transmission speeds, the PNO has worked out a specification for fibre-optic based transmission technology.

Intrinsically safe transmission: PROFIBUS-PA enables the intrinsically safe transmission and supply of stations via the bus. The transmission technology is described in international standard IEC 1158-2.

1.2.3 PROFIBUS layer 2 (data link layer)

The second layer of the OSI reference model realises the functions of bus access control, data protection and the transaction of transmission protocols and telegrams. In PROFIBUS, layer 2 is called the fieldbus data link (FDL).

Bus access control (medium access control, MAC) defines the procedure for when a station on the bus can transmit data. The MAC must ensure that, at any one time, only one station ever has authorisation to transmit.

The PROFIBUS bus access method therefore includes a token passing procedure for communication between complex stations (masters) and an underlying master-slave procedure for the communication of complex stations with low-expense peripheral devices (slaves). This combined procedure is called a hybrid bus access procedure.

In PROFIBUS, the token-passing procedure only applies between complex stations (masters).

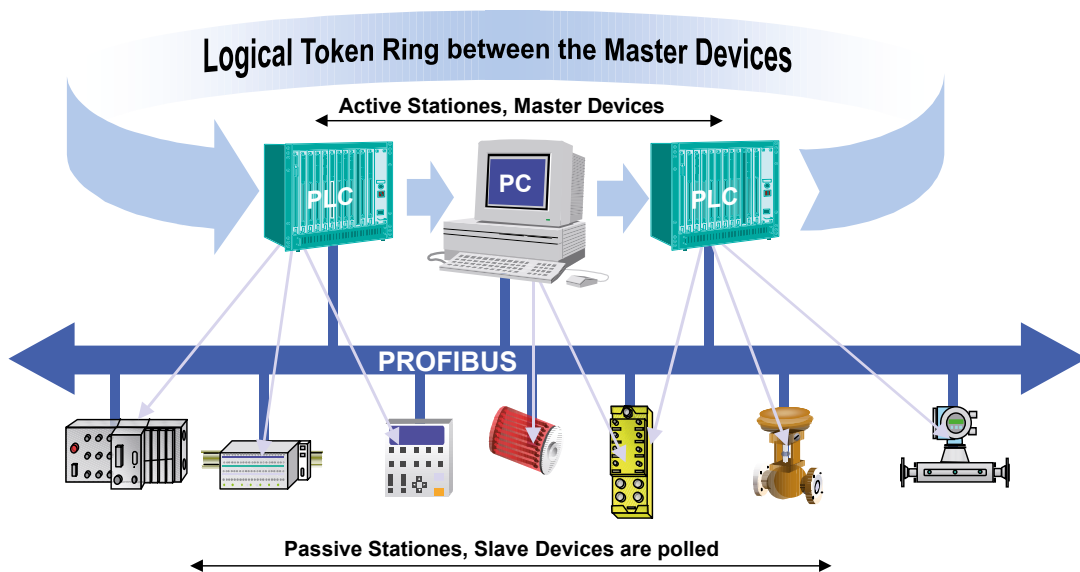
The master-slave procedure allows the master (active station) currently holding transmission authorisation to speak to its assigned slave devices (passive stations). This gives the master the opportunity of transmitting messages to the slaves or uploading messages from them.

With this hybrid access method for PROFIBUS, the following system configurations can be realised:

- Straight master-slave system
- Straight master-master system (token passing)
- A system combining both methods

The following figure shows a PROFIBUS structure with three active stations (masters) and seven passive stations (slaves). The three master devices form a logical token ring.

If an active station receives the token telegram, it can exercise for a certain time the function of master over the bus, communicating with all slave stations in a master-slave relationship and with all master stations in a master-master relationship.



1

The term «token ring» refers to the organisational stringing together of active stations which form a logical ring based on their bus addresses. In this ring, the token (bus access authorisation) is passed from one master to the next in a predefined order (ascending addresses).

The task of the bus access controller (MAC) of the active stations is to recognise this logical assignment in the bus system's «run-up phase» and establish the token ring. While operating in «run», any (active) station which is faulty or switched off is disconnected from the ring and any newly added active station is connected to it. These performance characteristics, together with the recognition of faults in the transmission medium, line receiver and errors relating to station addressing (e.g. multiple occupation) or token passing (e.g. multiple tokens or token loss), are typical features of PROFIBUS access control.

Another important task of layer 2 is data protection. The PROFIBUS layer 2 telegram formats enable high transmission security. All telegrams have a Hamming distance of $HD = 4$. This is achieved by application of the rules under international standard IEC 870-5-1, selecting special start and end characters for telegrams, slip-free synchronisation, parity bits and control bytes.

PROFIBUS-FMS and PROFIBUS-DP both use their own specific subset of layer 2 services (see table below). Services are called from higher-ranking layers via the service access points (SAPs) of level 2. With PROFIBUS-FMS these service access points are used for addressing the logical communication relationships. With PROFIBUS-DP a precisely defined function is assigned to each service access point used. For all active and passive stations, several service access points can be used in parallel. A difference is drawn between source (SSAP) and receiving service access points (RSAP).

Services of the PROFIBUS data protection layer (layer 2).

Service	Function	Used with
SDA	Send Data with Acknowledge	FMS
SRD	Send And Request Data With Acknowledge	FMS→DP
SDN	Send Data With No Acknowledge	FMS→DP
CSRD	Cyclic Send And Request Data With Acknowledge	FMS



The following SAPs are occupied by PROFIBUS-DP and cannot be used for FMS in a mixed FMS-DP network:

Function	SSAP	DSAP	Service
Data_Exchange	Default	Default	SRD
Chk_Cfg	62	62	SRD
Set_Prm	62	61	SRD
Slave_Diag	62	60	SRD
Get_Cfg	62	59	SRD
Global_Control	62	58	SDN
RD_Outp	62	57	SRD
RD_Inp	62	56	SRD
Set_Slave_Add	62	55	SRD
Reserved		54	
Reserved		53	
Reserved		52	
Reserved		51	

1.2.4 PROFIBUS-DP

PROFIBUS layer 7 (application layer)

Layer 7 of the ISO/OSI reference model is not used in PROFIBUS-DP.

1

PROFIBUS-DP characteristics

- Replaces costly parallel cabling between PLC/PC and I/Os
- Fast: transmits 1 kbyte of input and output data in less than 2 ms
- Powerful tools reduce engineering costs
- Supported by all main PLC manufacturers
- Great diversity of products available, e.g. PLCs/PCs, I/Os, drives, valves, encoders
- Cyclic and acyclic data transmission possible
- Monomaster and multimaster networks can be created
- Up to 246 bytes of input and output data possible per station

PROFIBUS-DP device types

PROFIBUS-DP defines three device types:

- **DP master class 1 (DPM1)**

Central control which exchanges data with the local I/Os (DP slaves) Several DPM1s are allowed, typical devices are PLCs, PCs, VMEs

- **DP master class 2 (DPM2)**

Project planning, monitoring or engineering tool which is used for commissioning or parameter setting/monitoring of DP slaves

- **DP slave**

Local device with direct interface to input/output signals; typical devices are I/Os, drives, valves, control units, etc.

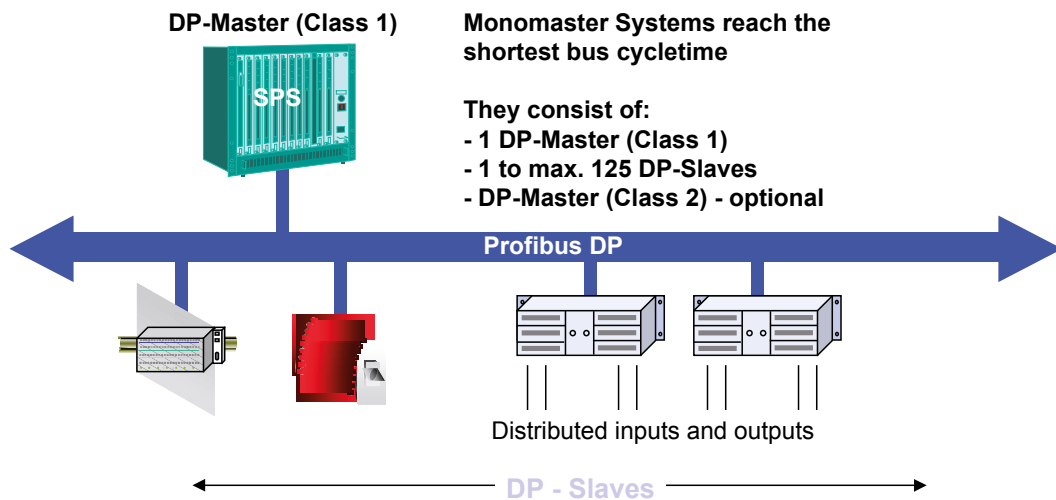
PROFIBUS-DP systems

PROFIBUS-DP can operate either as a monomaster or multimaster system:

- **Monomaster system**

1

PROFIBUS-DP Monomaster System



PROFIBUS-DP usually works as a monomaster system. This means that a master device, e.g. a PLC, is networked via PROFIBUS-DP with distributed peripheral devices, e.g. inputs and outputs. PROFIBUS-DP replaces the parallel cabling between the PLC and local peripherals.

A PROFIBUS-DP monomaster system consists of between 1 and 125 slaves, a class 1 master (i.e. the PLC) and an optional class 2 master (i.e. a configurator).

Monomaster systems achieve the shortest bus cycle times; they transmit 1 kbyte of input and output data in less than 2 ms.

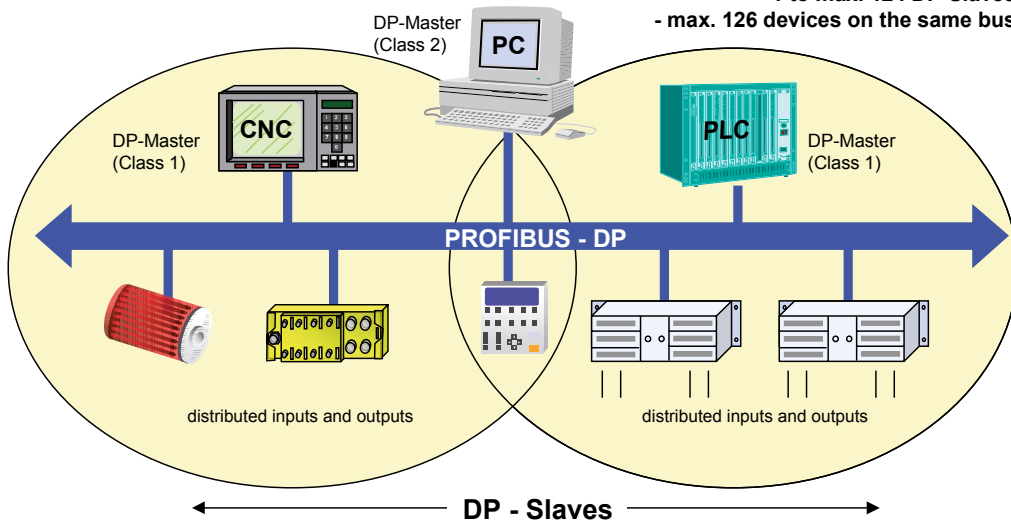
Multimaster system

PROFIBUS-DP Multimaster System

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Several DP-Masters may access a DP-Slave with read functions

PROFIBUS-DP Multi-Master systems consist of:
 - multiple Masters (Class 1 or 2)
 - 1 to max. 124 DP-Slaves
 - max. 126 devices on the same bus



PROFIBUS-DP can also be used in a multimaster configuration.

The figure shows two active devices, a PLC and a CNC. Each station has assigned input and output devices.

The advantage of PROFIBUS-DP is that active devices can access the data of jointly defined devices.

The DP class 2 master has the possibility of reading the diagnostic data of all devices on the bus.

PROFIBUS-DP communication functions

PROFIBUS-DP communication functions are differentiated according to the following communication relationships:

- Class 1 master and DP slaves
- Class 2 master and DP slaves
- Class 2 master and class 1 master

Possible communication relationships:

Function	DPM1DP slaves	DPM2 DP slaves	DPM1 DPM2
Parameter setting/configuration	•	•	-
Transmission of slave diagnostic data	•	•	-
Transmission of master diagnostic data	-	-	•
Cyclic data communications	•	•	-
Sync + freeze commands	•	•	-
Set slave address	-	•	-
Acyclic read of input/output images	-	•	-
Acyclic read/write of data	• ^{*)}	• ^{*)}	-
Alarm handling functions	• ^{*)}	• ^{*)}	-
Upload/download of master parameter records	-	-	•

^{*)} These extended PROFIBUS-DP functions are specified in technical instruction no. 2.082.

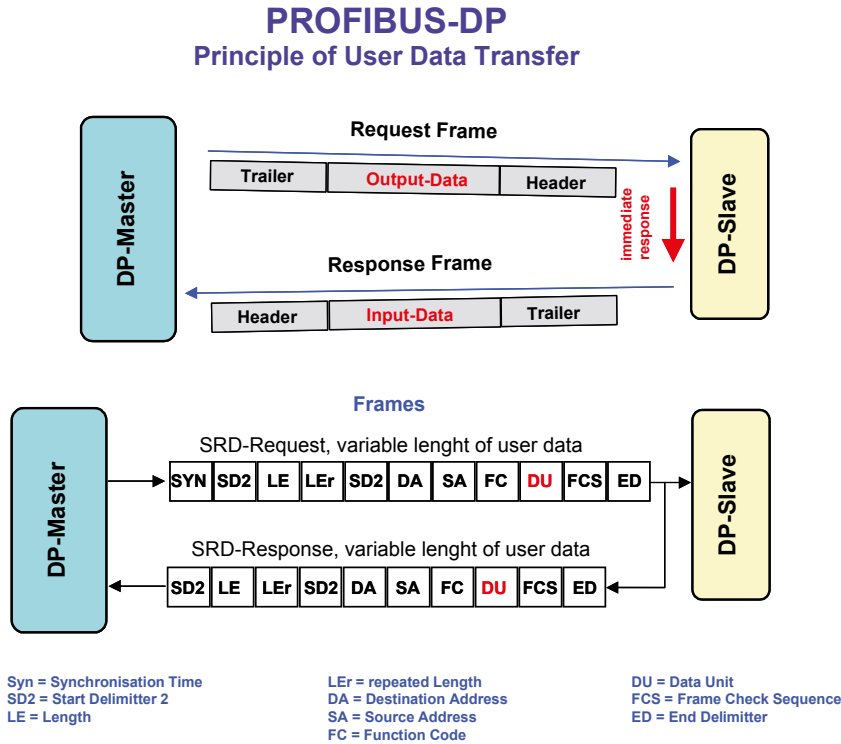
PROFIBUS-DP does not support communication between several DPM1s. If this functionality is required, PROFIBUS-FMS should be used in addition.

The extended DP functions are mainly used for intelligent slaves with many different parameters which have to be modified during operation. The new read and write functions were defined for this purpose.

It is important that the extended DP protocol is downward compatible with basic DP functions. That means that devices on which the new functions have been implemented are fully interoperable with devices lacking this extended functionality. The only restriction is that devices which lack the extended functions cannot execute the new functions.

PROFIBUS-DP data transmission

Data transmission with PROFIBUS-DP is based on a highly efficient telegram structure.



The input and output data of a device is transferred in a single bus cycle. The master sends a calling telegram which contains output data for the DP slave. In its reply telegram, the DP slave transmits its input data to the master. After receipt of the calling telegram, the DP slave answers directly. Each telegram can transmit up to 244 bytes of input or output data.

If the calling or reply telegrams have been corrupted by electromagnetic interference, the master immediately repeats the message cycle. The number of repetitions can be configured.

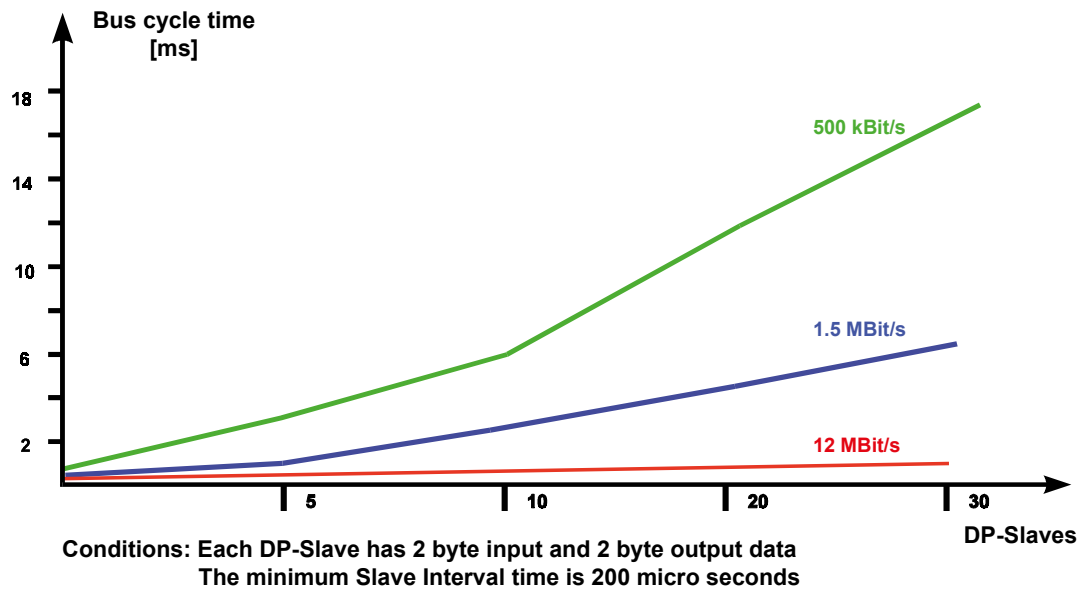
All PROFIBUS telegrams have high transmission security with a Hamming distance of HD = 4. The Hamming distance is a measure of a system’s error protection. This means that the higher the Hamming distance, the better the system security. HD = 4 meets the requirements for security-related applications.

PROFIBUS-DP bus cycle time

The bus cycle time of a PROFIBUS-DP system depends mainly on the baud rate used. A baud rate of between 9.6 kbit/s and 12 Mbit/s can be selected in increments.

1

Typical Bus Cycle Time of a PROFIBUS-DP Monomaster System



Example:

In a system configuration of 30 DP slaves working at 12 Mbit/s, and in which each slave has 2 bytes of input and output data, a bus cycle time of approx. 1 ms is achieved.

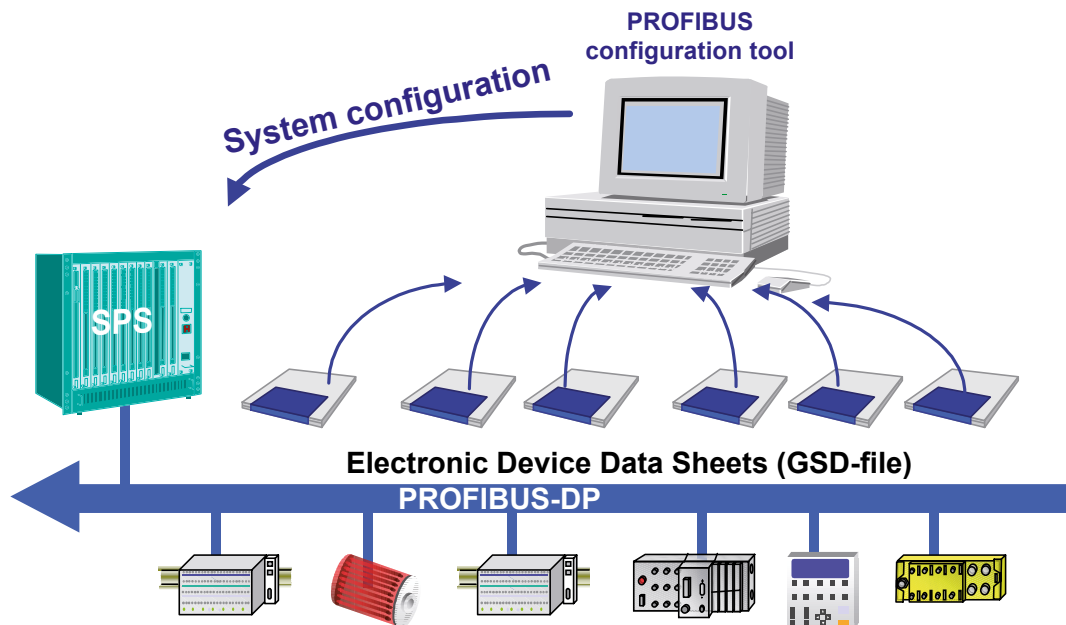
This shows that PROFIBUS-DP can be used even in very time-critical applications.

Project planning with PROFIBUS-DP bus cycle time

PROFIBUS not only describes the communication of devices with each other; it also provides a framework for open, vendor-independent project planning.

1

Open Configuration permits Plug and Play



Project planning tools, e.g. SNET, use electronic data sheets for the devices. These electronic data sheets are called device database files or GSD (General Station Description) files. These files are usually supplied on a diskette with the device. For many PROFIBUS devices, these files can also be downloaded from the PROFIBUS homepage <http://www.profibus.com>.

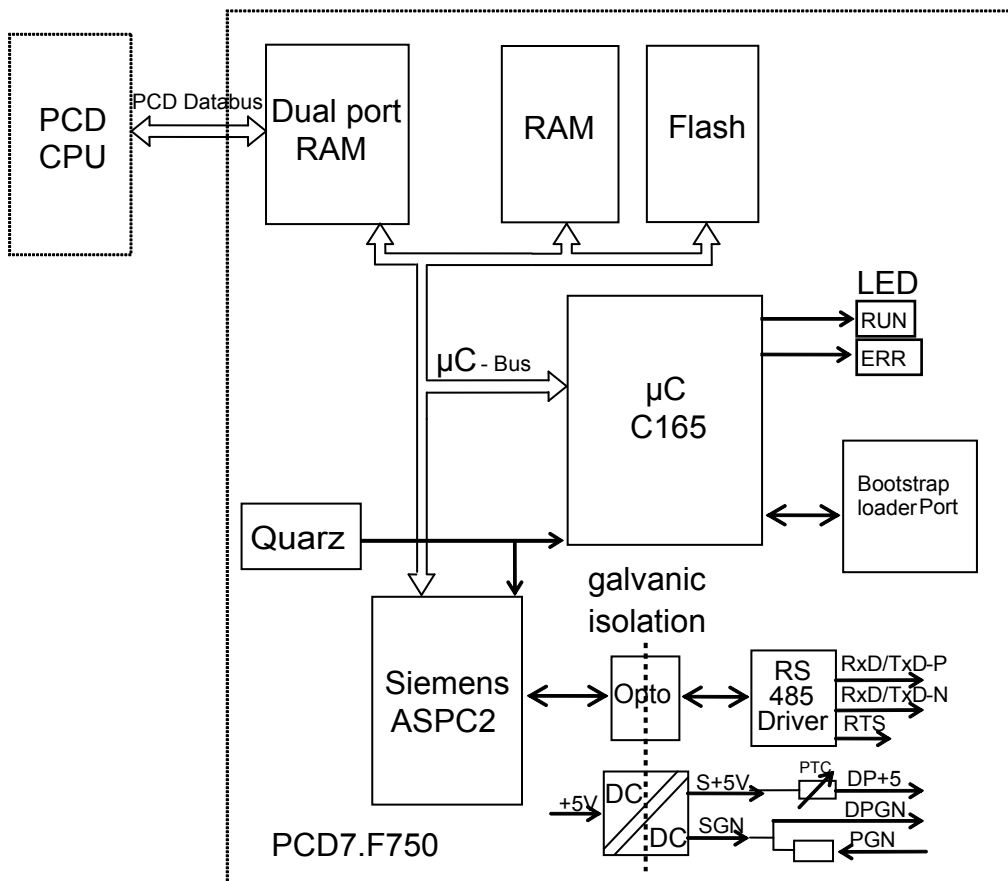
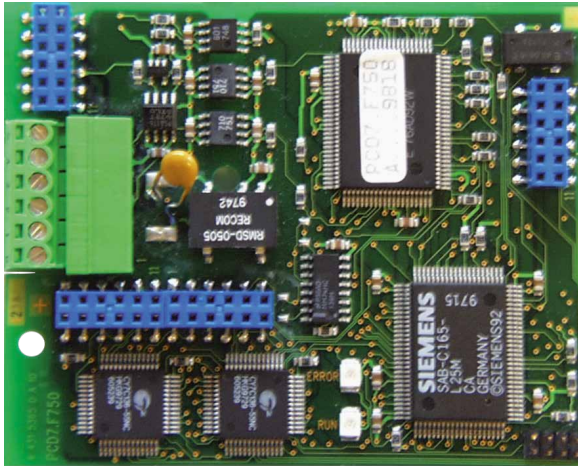
Manufacturers describe the functionality of their devices with the help of a GSD file. The format of GSD files has a fixed definition within the PROFIBUS standard. The project planning tool reads the GSD file into its internal database and takes into consideration all the characteristics of the device in question.

This simplifies project planning and can be carried out with a vendor-independent project planning tool. PROFIBUS-DP therefore permits genuine plug-and-play solutions and reduces engineering costs.

2. Modules for the PROFIBUS-DP network

2.1 PROFIBUS-DP master module for PCD1/2.Mxxx

PROFIBUS-DP PCD7.F750 master card



Block diagram of PCD7.F750

Technical data of PCD7.F750

Function	PROFIBUS-DP master class 1 E (DPM1 with extension)
Maximum number of stations	32 per segment/max. 126 per system (with repeaters)
PROFIBUS controller	ASPC2
Baud rate (kbit/s)	9.6...12,000
Internal current consumption from 5 V bus	Max. 400 mA
Current output DP+5 V	Max. 50 mA short-circuit protected with PTC
Electrical isolation	Between PCD-GND and PROFIBUS connection GND

Functions supported

Function	PROFIBUS-DP master class 1 E (DPM1 with extension)	
	Request	Response
Data_Exchange	x	
Slave_Diag	x	
Set_Prm	x	
Chk_Cfg	x	
Global Control	x	
Get_Master_Diag		x

Meaning of LEDs

The PCD7.F750 is equipped with a RUN LED and an ERROR LED. The LEDs on the PCD7.F750 card are switched in the following way:

Function	PCD7.F750 Run LED	PCD7.F750 Error LED
Power-up	1 sec. on	1 sec. on
then	flashing ~ 10 Hz	off
DP SASI instruction	flashing ~ 1 Hz	0.1 sec. on
then	flashing ~ 1 Hz –0.01 Hz	off
Program running normally	flashing ~ 1 Hz –0.01 Hz	off

Errors are indicated as follows:

PCD7.F750 Run LED	PCD7.F750 Error LED
flashing ~ 10 Hz	off
off	on
flashing ~ 1 Hz	flashing ~ 1 Hz

Possible causes of errors are:

- PCD7.F750 firmware does not match the firmware of the PCD1/2/6
- Wiring is incorrect (bad cable, wires transposed, no termination)
- Too many I/O bytes used
- Wrong configuration

Errors are stored in the PCD's history log. To discover the precise cause of an error, the history log must be displayed.

2.2 PROFIBUS-DP slave module for PCD1/2.Mxxx

The following PROFIBUS-DP slave modules are available:

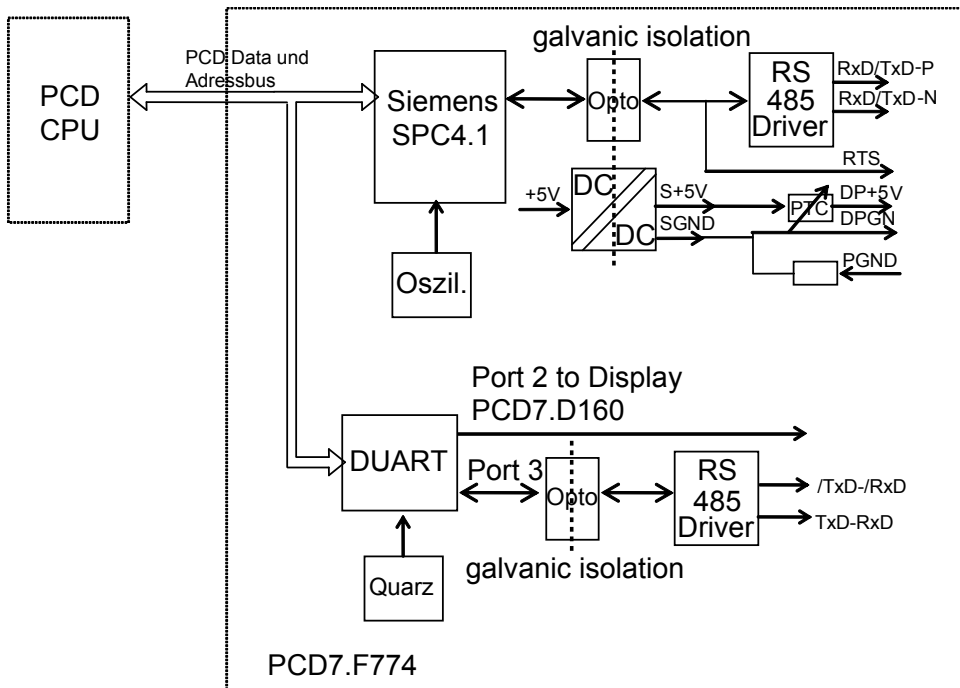
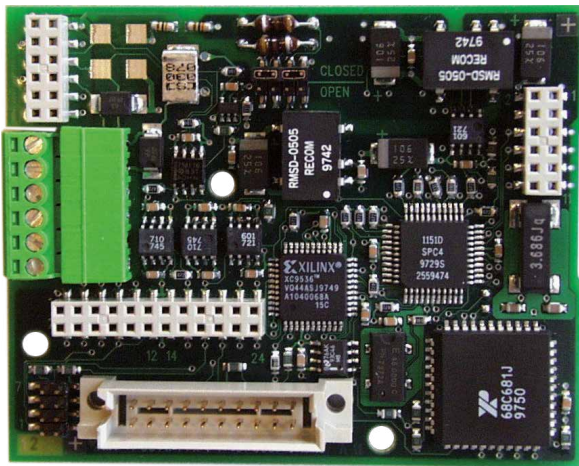
Module	Function
PCD7.F770	DP slave module for PCD1/2.M300
PCD7.F772	DP slave module for PCD2 with Port 3, RS-485
PCD7.F774 ¹⁾	DP slave module for PCD1/2 with Port 3, RS-485 and connection for PCD7.D160 terminal

¹⁾ Only available as PCD7.D164 terminal set.

This set includes a plug-on D160 terminal with the additional RS-485 communications ports (electrically isolated) on Port 3 and PROFIBUS-DP slave interface.

With the PCD1, Port 3 is not supported and, for the terminal, the housing cover with a recess (order number 4 104 7338 0) must also be used.

2.2.1 PROFIBUS-DP PCD7.F77x slave card



Block diagram of PCD7.F770/F772/F774

Technical data for PCD7.F770/F772/F774

Function	Profibus-DP slave E
Maximum number of stations	32 per segment/max. 126 per system (with repeaters)
PROFIBUS controller	SPC4.1
Baud rate (kbit/s)	9.6...12,000
Internal current consumption from 5 V bus	Max. 250 mA
Current output DP + 5 V	Max. 50 mA short-circuit protected with PTC
Electrical isolation	Between PCD-GND and PROFIBUS GND
Port 2	On PCD7.F774 for display D160 (TTL level)
Port 3	On PCD7.F772 and PCD7.F774, RS-485 electrically isolated from PCD-GND and PROFIBUS GND

Functions supported

Function	PROFIBUS-DP master class 1 E (DPM1 with extension)	
	Request	Response
Data_Exchange		x
RD_Inp		x
RD_Outp		x
Slave_Diag		x
Set_Prm		x
Chk_Cfg		x
Get_Cfg		x
Global Control		x

Supported PROFIBUS-DP diagnostics of PCD7.F77x slave modules

The PCD7.F77x slave modules support the 6 bytes of standard PROFIBUS-DP diagnostics. (Base+0 to Base+5)

In addition, byte 7 (Base+6) of the expanded PROFIBUS-DP diagnostics is sent in the following cases:

- CPU in STOP
- CPU in HALT

Here, byte 7 (Base+6) stores the following information:

CPU status	Transmission of byte 7 (Base+6)	ASCII character in byte 7
RUN	No	No character
STOP	Yes	'S'
HALT	Yes	'H'

GSD files for PROFIBUS-DP SBC slaves

2.3 Ports 2 and 3 of PCD7.F77x slave modules

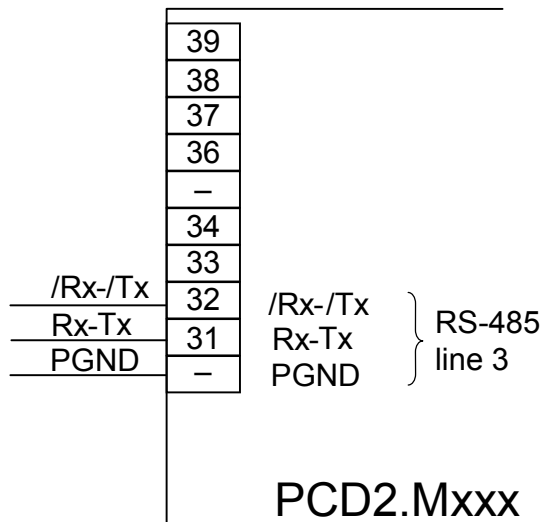
2.3.1 Port 2

Port 2 is connected directly to the PCD7.D160 plug-on terminal. Further information can be found in the PCD7.D160 manual (document number 26-753).

2

2.3.2 Port 3

Port 3 can be employed as a user-definable RS-485 communications port. This port can only be used on the PCD2. Connection is via the 10-pole connector:

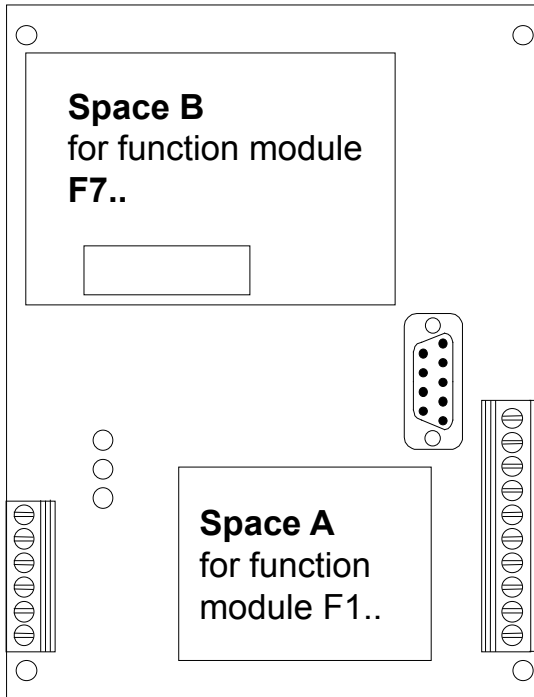


2.4 Connection of PROFIBUS-DP modules

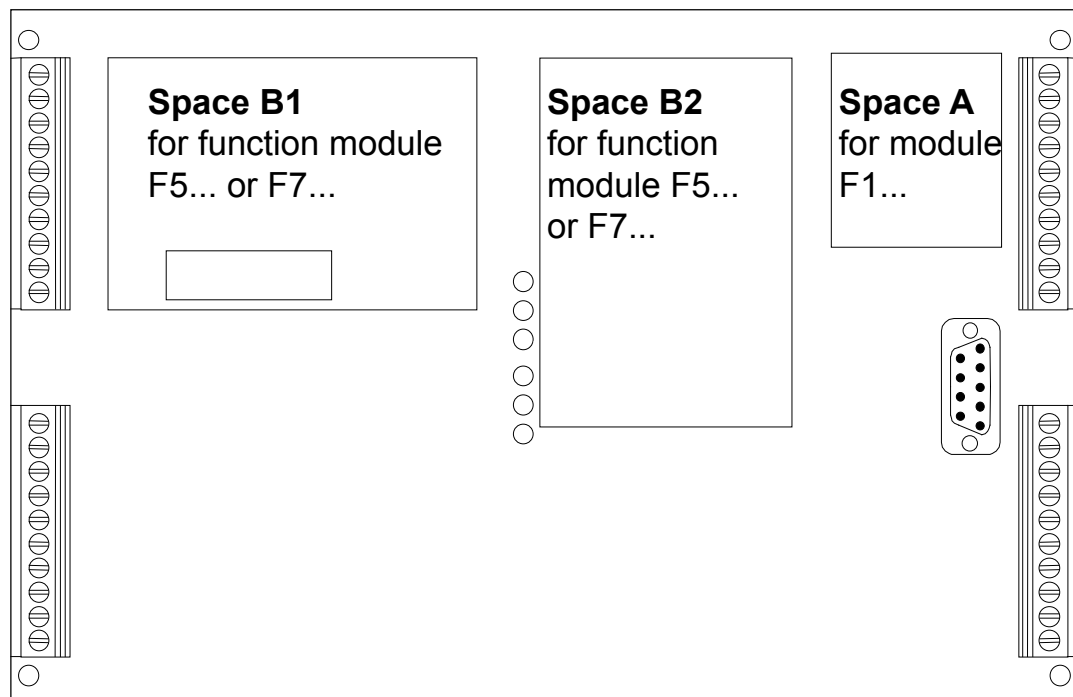
2.4.1 PCD7.F7XX module

Location of slot:

2



Slot B on PCD1.Mxxx:



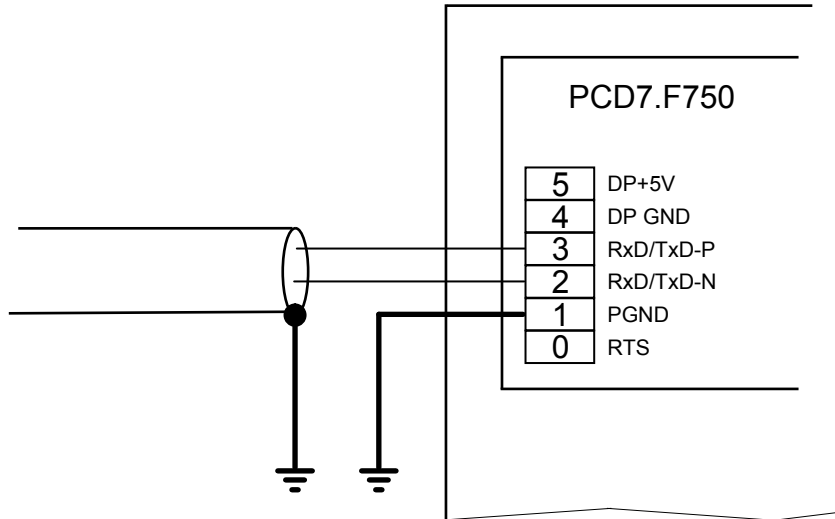
Slots B1 and B2 on PCD2.M170/480:

2.4.2 Meaning of connections:

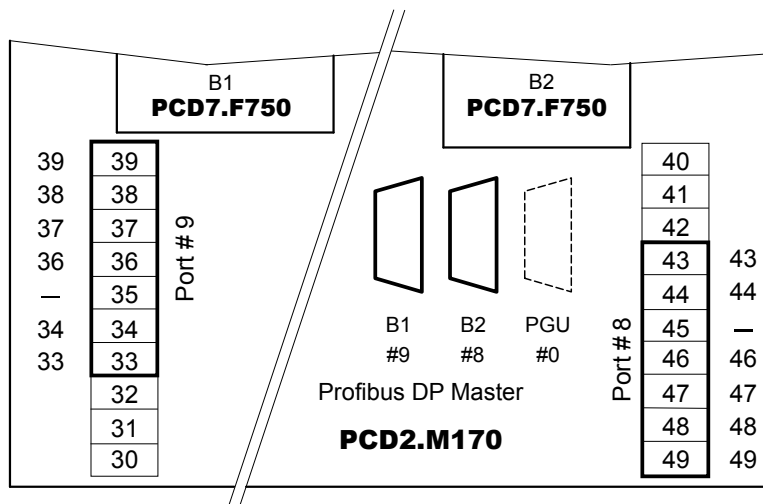
Signal	Meaning	PCD7.F7xx connector	Standard A-B connector	Standard cable green/red
CNTR-P/RTS	Control signal for repeater	0		
PGND	Shield/protective ground	1		
RxD/TxD-N	Receive/transmit data, minus	2	A	Green
RxD/TxD-P	Receive/transmit data, plus	3	B	Red
DP GND	Ground for DP +5 V	4		
DP +5 V	5 V supply for line termination resistors	5		
CNTR-N	Control signal for repeater			

2.4.3 PROFIBUS DP master, PCD7.F750 module

PCD1.M12x/M13x and PCD2.M120/M150 The PROFIBUS should be connected directly to the PCD7.F750 module.

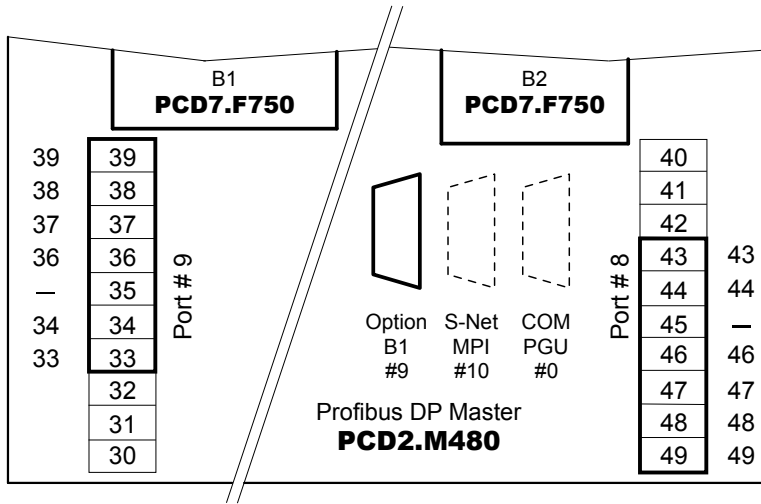


PCD2.M170 The PROFIBUS can be connected to the D-Sub connector. The pin configuration is as per the PROFIBUS standard. Alternatively, the PROFIBUS can be connected to the screw terminal block.



Slot	B1; Port#9		B2; Port#8	
	D-Sub 9-pole	Screw terminals 10-pole	D-Sub 9-pole	Screw terminals 10-pole
Signal	Pin no.	Terminal no.	Pin no.	Terminal no.
RTS/CNTR-P	4	33	4	43
PGND	1	35	1	45
RxD/TxD-N	8	36	8	46
RxD/TxD-P	3	37	3	47
DP GND	5	38	5	48
DP +5 V	6	39	6	49

PCD2.M480

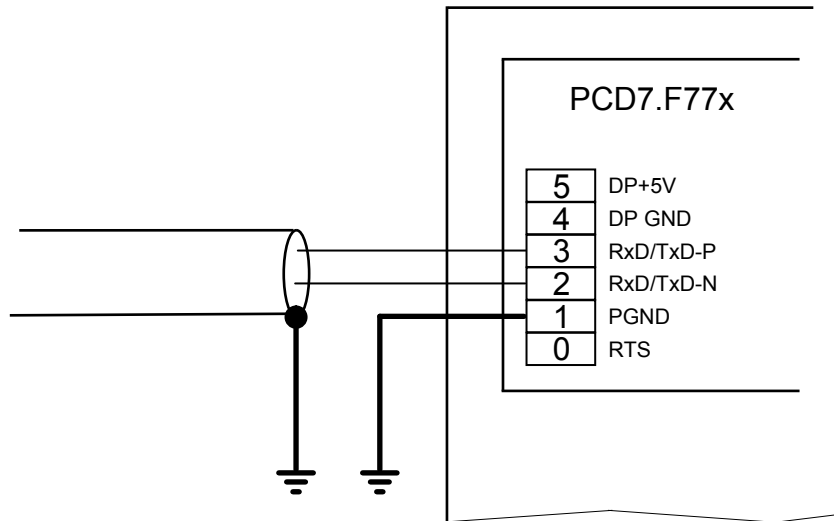


2

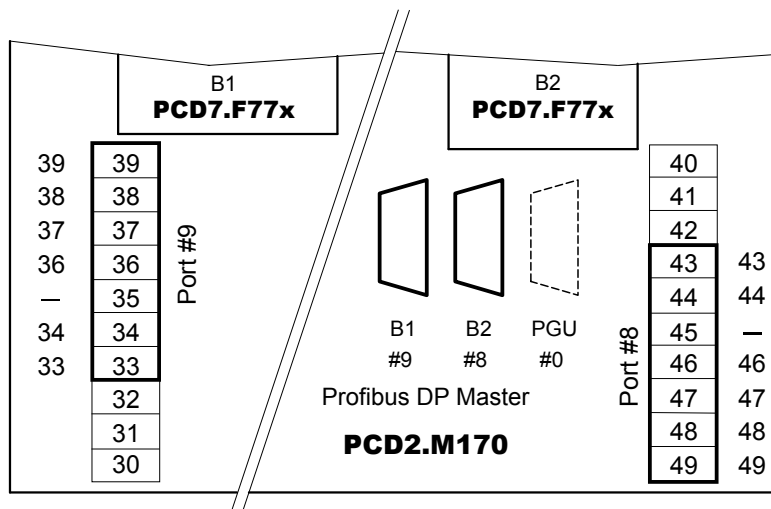
Slot	B1; Port#9		B2; Port#8
Connection type	D-Sub 9-pole	Screw terminals 10-pole	Screw terminals 10-pole
Signal	Pin no.	Terminal no.	Terminal no.
RTS/CNTR-P	4	33	43
PGND	1	35	45
RxD/TxD-N	8	36	46
RxD/TxD-P	3	37	47
DP GND	5	38	48
DP +5 V	6	39	49

2.4.4 PROFIBUS DP slave, PCD7.F77x module

PCD1.M12x/M13x and PCD2.M120/M150 The bus should be connected directly to the PCD7.F770 or PCD7.F772 module.



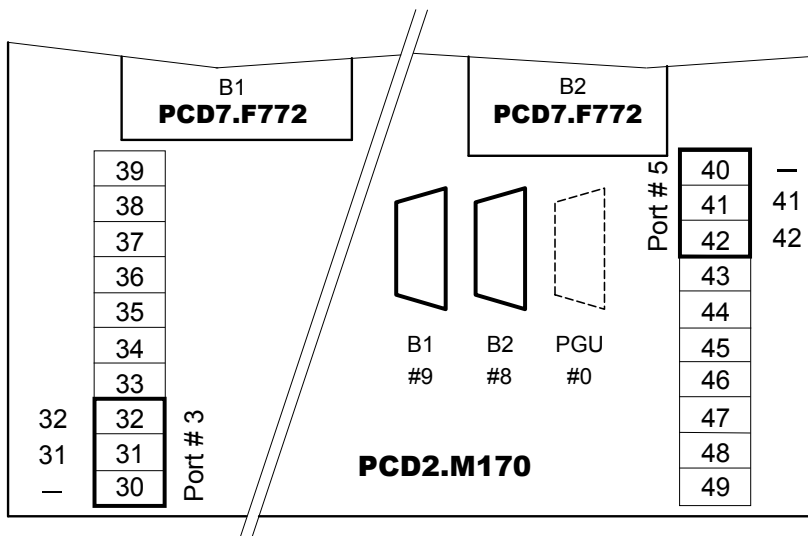
PCD7.F770 with PCD2.M170 The PROFIBUS can be connected to the D-Sub connector. The pin configuration is as per the PROFIBUS standard. Alternatively, the PROFIBUS can be connected to the screw terminal block.



Slot	B1; Port#9		B2; Port#8	
Connection type	D-Sub 9-pole	Screw terminals 10-pole	D-Sub 9-pole	Screw terminals 10-pole
Signal	Pin no.	Terminal no.	Pin no.	Terminal no.
RTS/CNTR-P	4	33	4	43
PGND	1	35	1	45
RxD/TxD-N	8	36	8	46
RxD/TxD-P	3	37	3	47
DP GND	5	38	5	48
DP +5 V	6	39	6	49

PCD7.F772 with PCD2.M170

Same as for PCD7.F770, but one serial RS-485 port per module in addition

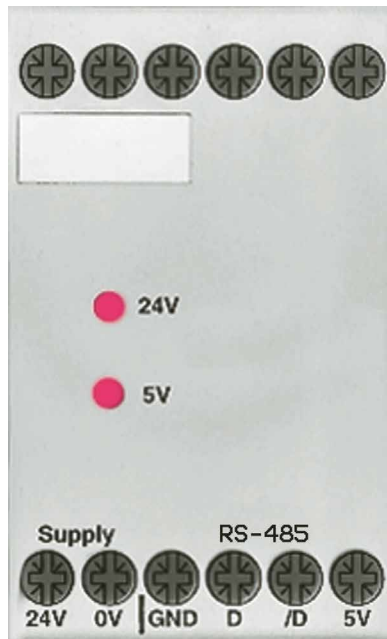


2

Slot	B1; Port#3	B2; Port#5
Connection type	Screw terminals	Screw terminals
Signal	Terminal no.	Terminal no.
/RX-/TX	32	42
RX-TX	31	41
PGND	30	40

2.5 PCD7.T160 termination box

(This product has been discontinued; please use PCD7.T161 or PCD7.T162)



For confidence and ease of maintenance when using an RS-485 network it is important to install the line termination resistors separately and accessibly. The termination box serves this purpose whereby, depending on the physical characteristics of the line, a suitable line termination resistor can be selected by means of 2 jumpers. Signal lines D and /D are biased at the required equilibrium rest potential with an electrically isolated supply.

The operating range of the PCD7.T160 termination box extends to a baud rate of 12 Mbaud.

Detailed information can be found in the manual: "Installation components for RS-485 networks" (document number 26-740).

2.5.1 Differences between the PCD7.T160, PCD7.T161 and PCD7.T162 devices

	PCD7.T160	PCD7.T161	PCD7.T162	Comments
Power supply	24 VDC	230 VAC	24 VAC/DC	
Housing	45 × 75 × 105 mm	17.5 × 85 × 64 mm	17.5 × 85 × 64 mm	PCD7.T161 and PCD7.T162 comply with the standards for switch cabinets
Line termination resistance	335, 224, 149 or 122 Ω selectable using DIL switch	Fixed 120 Ω	Fixed 120 Ω	The default value for PCD7.T160 is 122 Ω
Display	2 LEDs for 24 and 5 VDC	LED for 230 VAC	LED for 24 V	

*PCD7.T160 was phased out at the end of 2011

2.6 PCD7.T161 termination box

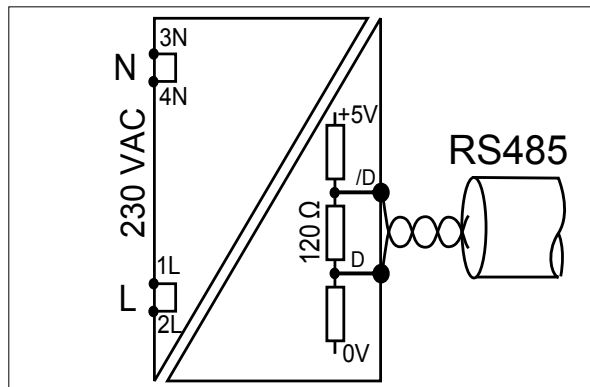
2.6.1 Functional description

For confidence and ease of maintenance when using an RS-485 network it is important to install the line termination resistors separately and accessibly. The RS-485 standard requires the bus to be terminated. The termination box serves this purpose.

Signal lines D and /D are biased at the required equilibrium rest potential with an electrically isolated supply.

The line termination resistance has a fixed value of 120 Ω , corresponding to the default value (factory setting) of the old PCD7.T160 device.

2.6.2 Block diagram/connection diagram



2.6.3 Technical data

17.5 mm housing (same as for ALD)

230 VAC +15 %/-20 %

Power consumption of 0.4 W

Electrically isolated power supply

Fixed line termination resistance of 120 Ω

LED operating indicator

2.7 PCD7.T162 termination box

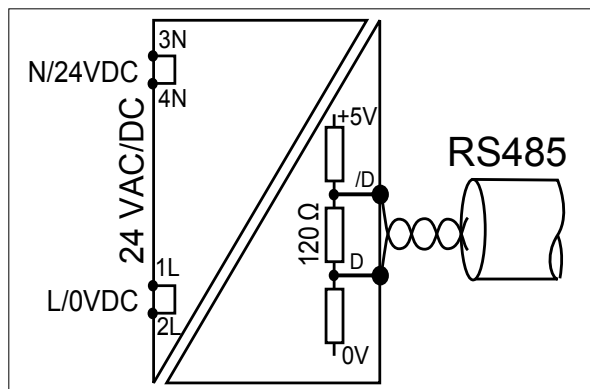
2.3.1 Functional description

For confidence and ease of maintenance when using an RS-485 network it is important to install the line termination resistors separately and accessibly. The RS-485 standard requires the bus to be terminated. The termination box serves this purpose.

Signal lines D and /D are biased at the required equilibrium rest potential with an electrically isolated supply.

The line termination resistance has a fixed value of $120\ \Omega$, corresponding to the default value (factory setting) of the old PCD7.T160 device.

2.7.2 Block diagram/connection diagram



2.7.3 Technical data

17.5 mm housing (same as for ALD)

24 VAC/DC $-15\%/+15\%$

Power consumption of 0.4 W

Electrically isolated power supply

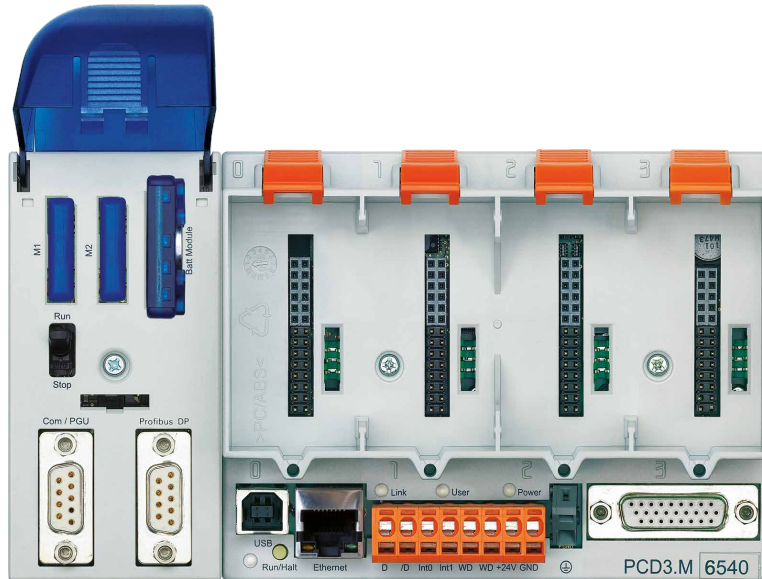
Fixed line termination resistance of $120\ \Omega$

LED operating indicator

2.8 PROFIBUS-DP for PCD3.Mxxxx


The PCD3 series comprises CPUs in which PROFIBUS is already integrated, the PCD3.M6440 and PCD3.M6540. No additional plug-in modules are required.

2



PCD3.M6440/M6540		PROFIBUS-DP master, port 10	
D-Sub pin	Signal	PROFIBUS-DP	
1			
2	GND ¹⁾	Protective earth	
3	B red RxD/ TxD-P	Receive/trans- mit-positive	
4	En		
5	GND_BUS	For line termina- tion resistors	
6	+5 V_BUS	For line termina- tion resistors	
7	24 V ¹⁾		
8	A green RxD/ TxD-N	Receive/trans- mit-negative	
Port 0	Port 10	9	

¹⁾ not electrically isolated

Terminal block for supply, watchdog, interrupt inputs and Port 2				PROFIBUS signal	PROFIBUS wiring		
	Pin	Signal	Explanation				
	1	D	Port # 2; RS-485 up to 115.2 kbit/s usable as free user port or Profi-S-Bus up to 187.5 kbits/s	RxD/TxD-N	A green		
	2	/D		RxD/TxD-P	B red		
	3	Int0	2 interrupt inputs 24 VDC or 1 rapid counter 24 VDC				
	4	Int1					
	5	WD	Watchdog				
	6	WD					
	7	+24 V	Supply voltage				
	8	GND					
RS-485 terminator switch							
Switch position	Designation	Explanation					
Left	O	Without termination resistors					
Right	C	With termination resistors					

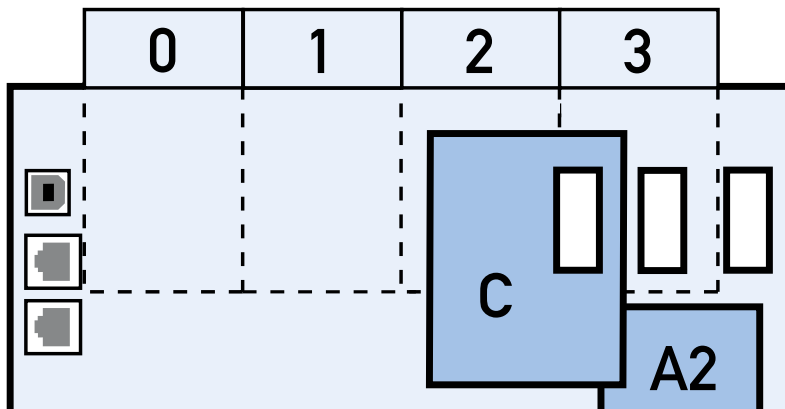
2

2.9 PROFIBUS-DP for PCD2.M5_

Slot C is intended to take the interface for PROFIBUS applications.

Slot input/output

2

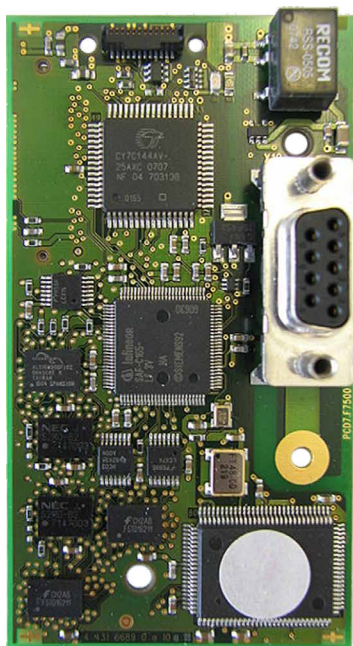


2.9.1 PROFIBUS DP master, PCD7.F7500 module for PCD2.M5xxx

The PROFIBUS should be connected directly to the PCD7.F7500 module.

PCD2.M5xxx

PCD7.F7500



PCD7.F7500 for connection as PROFIBUS-DP master (12 Mbit/s).

To avoid reflections, each segment must be terminated at the line ends. According to the PROFIBUS standard, this cannot be done on the device. The PCD7.T16x termination boxes or standard 9-pole PROFIBUS-DP D-Sub connectors are suitable for this.

Details can be found in manual 26-765 «PROFIBUS DP».

D-Sub 9-pole allocation

Space	C
Connection type	D-Sub 9-pole (female)
Signal	Pin no.
RTS/CNTR-P	4
PGND	Threaded bolts
RxD/TxD-N	8 A (green)
RxD/TxD-P	3 B (red)
DP GND	5
DP +5 V	6

3. Planning and installation of a PROFIBUS-DP network

Creating a PROFIBUS-DP network can be roughly divided into the following steps:

- a) Planning and installation of the network
- b) Network definition and configuration with the configurator
- c) Writing the user program
- d) Commissioning

3

This chapter does not describe any details. It is only intended as a guide and to provide ideas for the procedure to follow when planning and installing a PROFIBUS-DP network. Detailed technical information can be found in the manual «Installation components for RS-485 networks» (manual no. 26-740) and in the later chapters of this manual.

3.1 Planning and installation of the physical layer

- Construction of a layout diagram
- Defining max. network distance
- Defining max. segment distance
- Defining cable type
- Defining max. baud rate
- Possible provision of repeaters
- Defining the first and last stations
 - Provide PCD7.T161 or PCD7.T162 termination boxes
 - For the correct installation of PROFIBUS, the instructions in the manual «Installation components for RS-485 networks» (manual no. 26-740_ENG) should be strictly adhered to.

3.1.1 Line parameters

The PROFIBUS-DP bus line is specified in EN 50170 as line type A.

Parameter	Line A
Characteristic impedance (Ω)	135...165
Capacitance per unit length (pF/m)	< 30
Loop resistance (Ω /km)	110
Wire diameter (mm)	0.64
Wire cross section (mm ²)	> 0,34

Possible cable supplier:

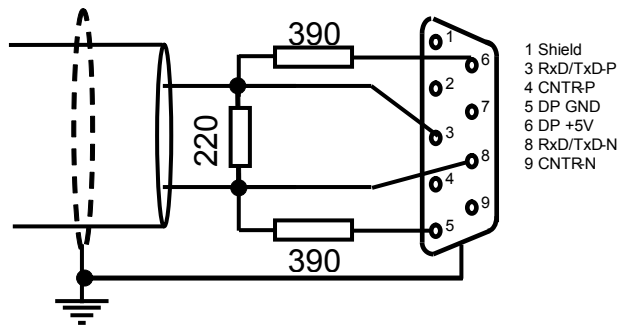
Volland AG, Rümlang, Switzerland, offering the following cable types:

- Cable for static installation: Unitronic bus L2/F.I.P.
Volland ref. 2170221
- Cable for highly flexible installation: Unitronic bus FD P L2/F.I.P.
Volland ref. 2170222

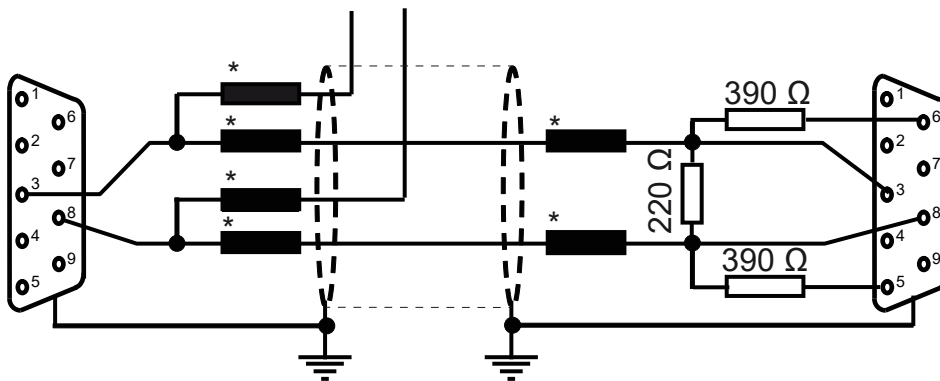
3.1.2 Connection of network stations

To prevent reflections at the ends of the line, each segment must be terminated at the physical extremities of its line. This means that lines are biased at the equilibrium rest potential. According to the PROFIBUS-DP standard, this must not be done directly on PROFIBUS-DP devices, but must be achieved by means of external components. Both the PCD7.T161, PCD7.T162 termination box and commercially available 9-pole PROFIBUS-DP D-Sub connectors are suitable for this purpose.

Network termination must therefore be done as shown below:



For baud rates > 1.5 Mbaud the following combination of plug connectors should be used at all stations in the network, because of their capacitive load:



* = Series inductance of 110 nH

Possible supplier for 9-pole PROFIBUS-DP D-Sub connectors to connect PCD controllers to the PROFIBUS-DP network:

ERNI Elektrotechnik AG, Brüttisellen, Switzerland:

- ERbic junction, horizontal grey: Erni ref. 103648
(junction equipped with series inductance of 110 nH)
- ERbic junction, horizontal grey: with PG connector:
Erni ref. 103663 (junction equipped with series inductance of 110 nH)
- ERbic termination, horizontal yellow: Erni ref. 103649
(junction equipped with series inductance of 110 nH plus termination resistors of 390 Ω and 220 Ω)

3

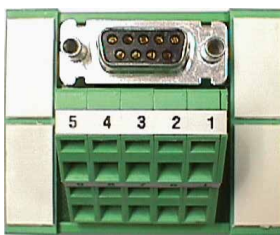


If a 9-pole D-Sub connector is to be used to connect the PCD1 or PCD2 to PROFIBUS-DP, the following adapter can be used (D-Sub 9-pole to terminals):

Possible supplier of D-Sub 9-pole to terminal adapter:

Phoenix Contact AG, 8317 Tagelswangen, Switzerland:

- VARIOFACE module with spring connection Phoenix Contact D-Sub, 9-pole, socket board: ref. 2293666



3.1.3 Stub cables

The stubs are those cables leading from the PROFIBUS-DP network cable to PROFIBUS-DP devices.

Meaning of the symbols in the following drawings:



PROFIBUS-DP device



Repeater with line termination resistors active left and right



Repeater with line termination resistor active on right and passive on left



Repeater with line termination resistor active on left and passive on right



Termination box PCD7.T161 or PCD7.T162

Admissible lengths for stub cable are described in the next section.

If a network in which stub cables are not allowed should, despite this fact, still require quite a long stub cable, repeaters must be used.

3.1.4 Network layout

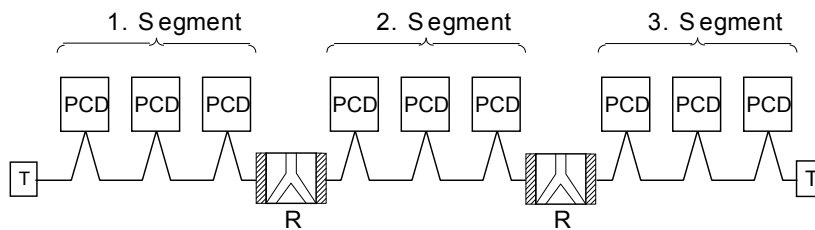
A maximum of 126 stations is allowed per network. A segment comprises a maximum of 32 stations. (Repeaters count as stations.)

The overall length of cable and overall stub cable length depend on the bit rate.

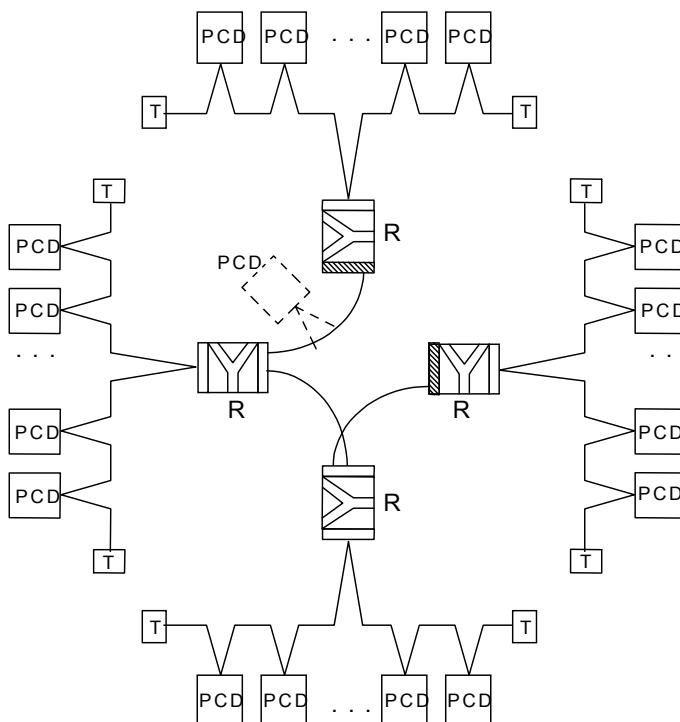
Transmission speed in kbit/s	Linear extent per segment in metres	Length of stub cable Total per segment in metres
9.6	1,200	6.6
19.2	1,200	6.6
93.75	1,200	6.6
187.5	1,000	6.6
500	400	6.6
1,500	200	6.6
3,000	100	0
6,000	100	0
12,000	100	0

Networks must not be branched without special measures. By using repeaters, the following network structures are possible:

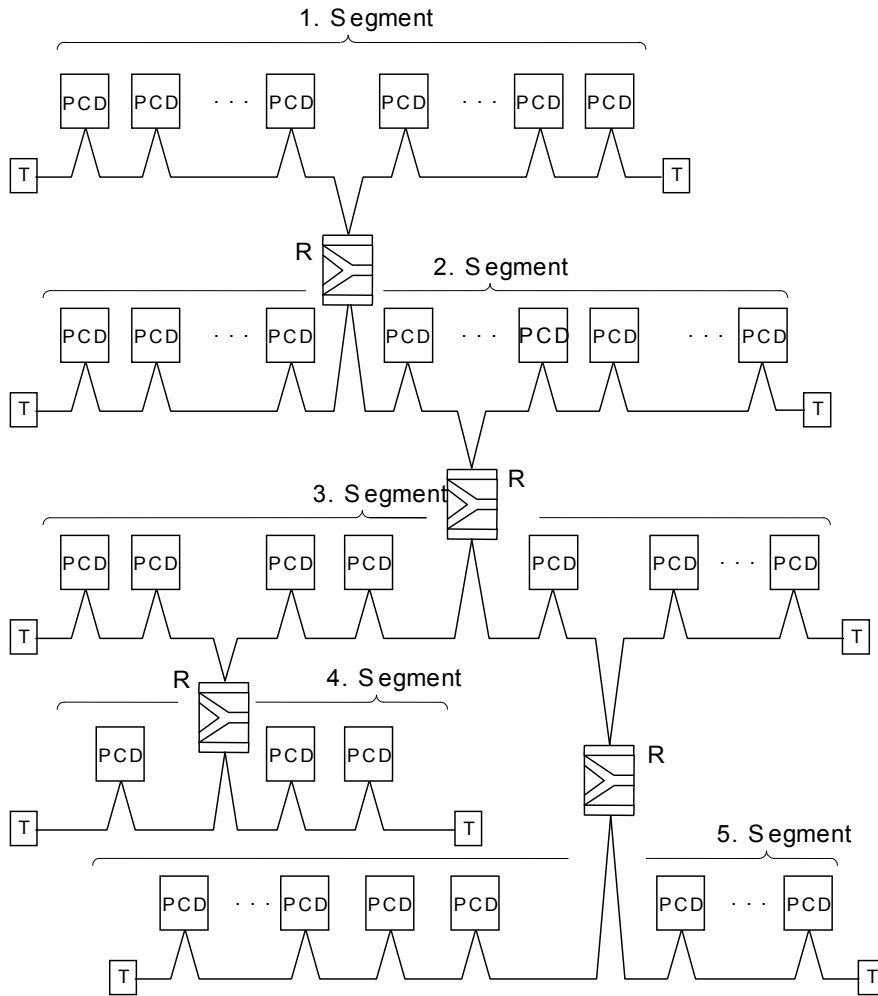
Linear structure



Star structure



Tree structure



3.2 Logical network structure

3.2.1 Definition of bus parameters

- Baud rate
- Possible formation of groups for Global Control Service functions

Important: Bus parameters must be identical for all stations on the bus
With mixed FMS/DP networks, the same baud rate must apply to both protocols.

3

3.2.2 Configuration of slaves

After describing its physical construction, slave controllers must now be integrated into the network and configured. Slave inputs and outputs must then be assigned to the master's media (mapping).

- Load GSD files from external systems into the configurator
- Definition of network with master and all slaves
- Configuration of slaves
- Mapping of slave I/Os to master media
- The maximum number of I/O bytes reserved in the master must not be exceeded

3.2.3 Checking and assessing the performance values required

- Definition of reaction time
- Definition of supply system loading

4. The PROFIBUS-DP configurator

The definition and configuration (bus parameters, network stations and variable definition) of a PROFIBUS-DP network can be very extensive, depending on the size of the project. This task is made significantly easier for the user by the PROFIBUS-DP configurator.

Files generated by the PROFIBUS-DP configurator can be used to configure SBC devices (masters or slaves).

4.1 General

The PROFIBUS-DP configurator consists of software that runs under MS-Windows 95/NT and higher. The operating system must have 32-bit data access. No special hardware is required. Windows technology is used throughout. This provides a good overview and makes parameter entry very user-friendly.

For ease of use only the most important parameters appear in the main windows. To reach the advanced parameters, most windows have an «advanced setup» button.

Default values are offered wherever the setting of parameters allows this. These default values can also be altered.

A value range is specified for each parameter.

The configurator ultimately creates an ASCII text file containing the definition texts for all PROFIBUS-DP connections in a station. This text file is used in the SASI command of the PROFIBUS channel.

As documentation, a list is generated containing all the parameters. It shows the precise configuration of the station in the PROFIBUS-DP network. It is also possible to derive a list of all slave elements assigned in the master from this summary.

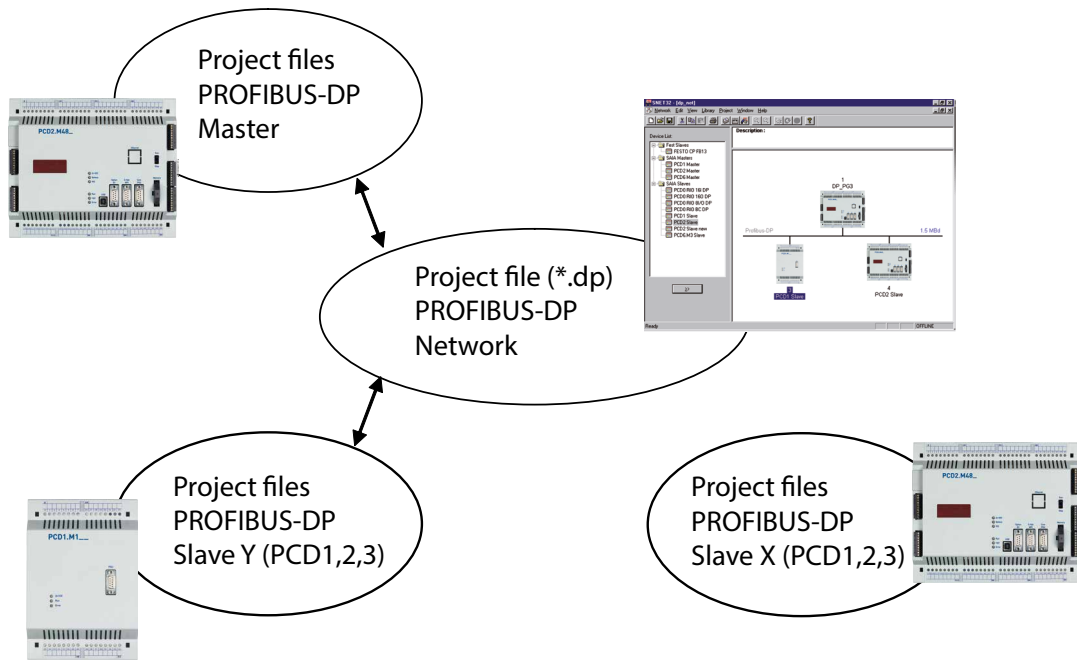
Data structure generated by the PROFIBUS-DP configurator

The PROFIBUS-DP configurator will set up a '*.def' and '*.src' file for each SBC master or SBC slave (applies only to PCD1, 2, 6) contained in the PROFIBUS-DP network.

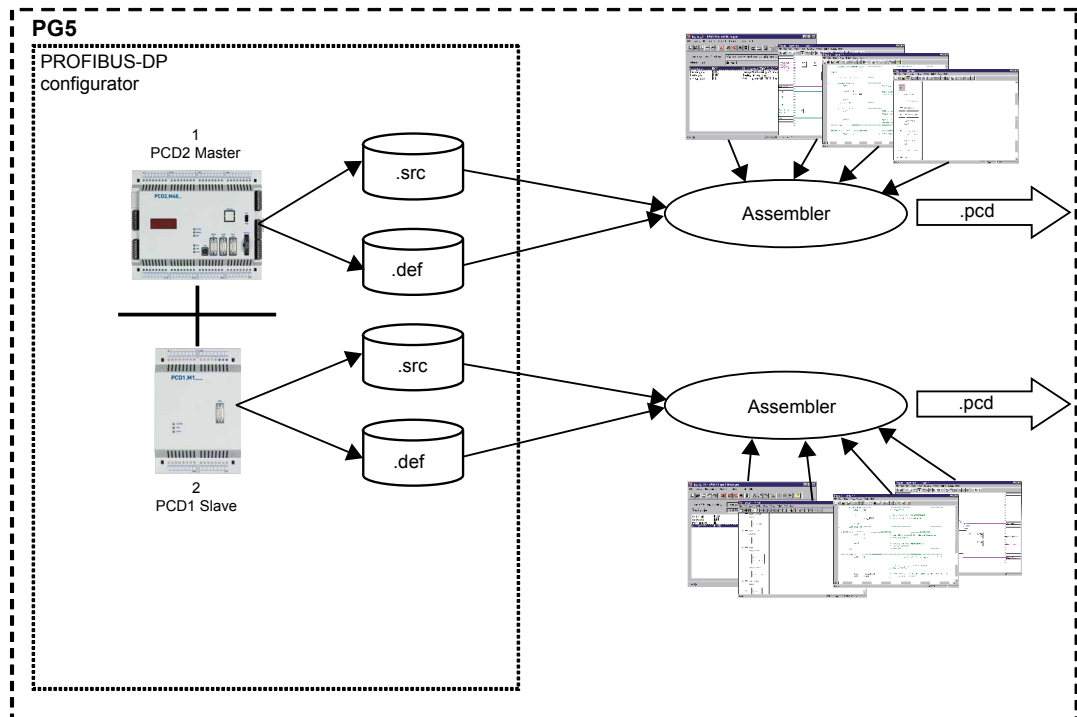
These files are then automatically linked to the user program by the PG5 programming software.

It is then possible to use any of the PG5 editors (IL, GRAFTEC, FUPLA or KOPLA) to access the media defined in the configurator. User programs written with earlier programming software can be imported into the PG5 project for further processing there.

Overview of the project structure:



Overview of files generated:



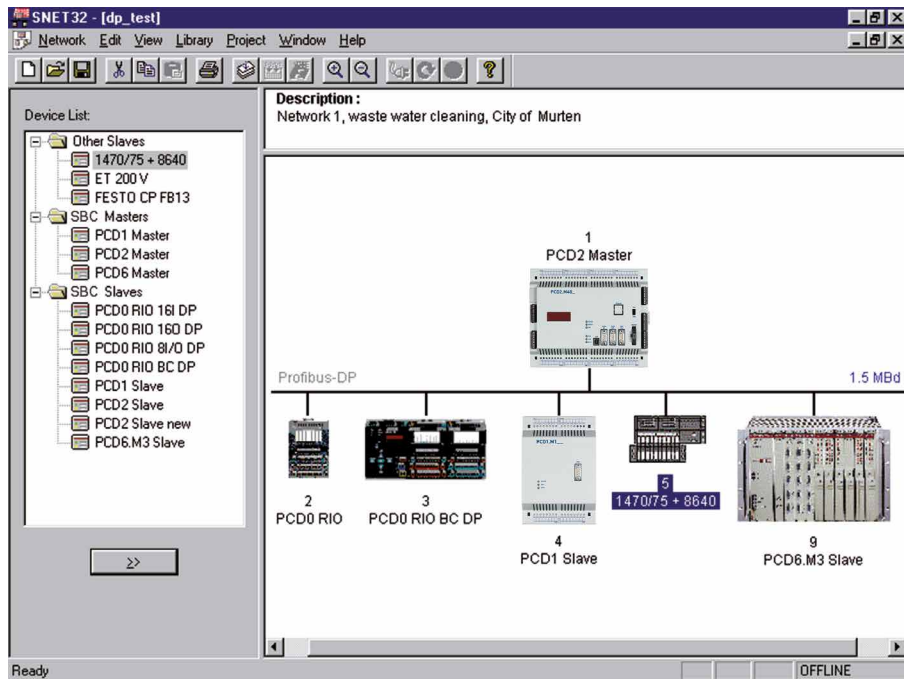
4.2 Procedure for PROFIBUS-DP configuration

The procedure can be divided into the following steps:

1. Start PG5
2. Open a PROFIBUS-DP project from the Project Manager
3. Configure the network
4. Define bus parameters
5. Define the slave hardware
6. Assign slave I/Os to master media
7. Save the configuration
8. Generate SASI texts for the PCD stations (Build Project)
9. Generate documentation

4.3 Description of the PROFIBUS-DP configurator menus

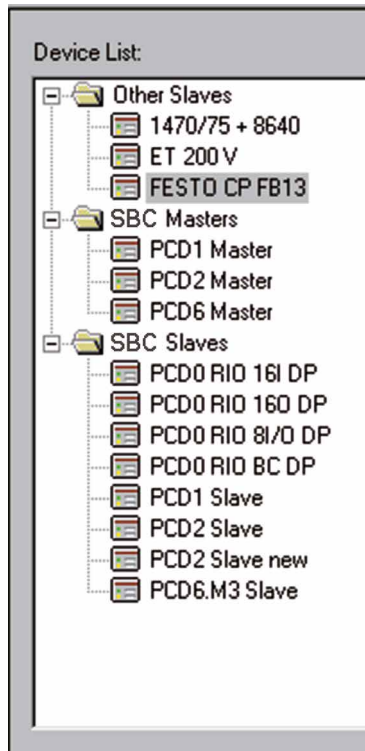
4.3.1 Main screen



4

Screen description:

On the left, the 'Device List' window shows PROFIBUS-DP devices that are present in the library.

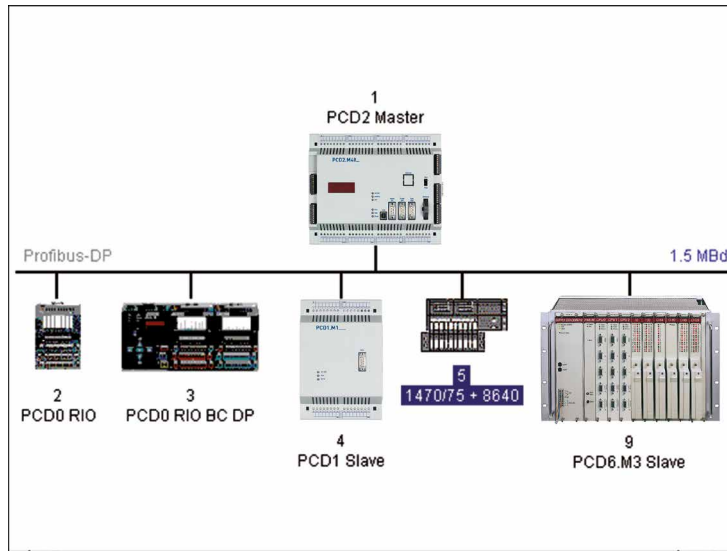


On the right, the 'Description:' window gives a description of the PROFIBUS-DP network.

Description :
Network 1, waste water cleaning, City of Murten

The PROFIBUS-DP network can be seen in the bottom right of the window. All PROFIBUS-DP devices present in the network have been inserted graphically in this window.

4



The following submenus can be selected in the top toolbar:



4.3.2 'Network' submenu

<u>N</u> ew	Ctrl+N
<u>O</u> pen...	Ctrl+O
<u>C</u> lose	
<u>S</u> ave	Ctrl+S
Save <u>A</u> s...	
<u>D</u> escription...	
<u>P</u> rint...	Ctrl+P
Print <u>P</u> review	
Print <u>S</u> etup...	
1 dp_test	
2 c:\program files\...\doc\test	
3 c:\program files\...\test	
4 c:\program files\...\dddd\ttt	
<u>E</u> xit	

4

New: Opens a new project. It is possible to choose here between a PROFIBUS-DP, SRIO or LON network.

Corresponds to this toolbar icon:



Open: Opens an existing project.

Corresponds to this toolbar icon:



Close: Closes the active project.

Save: Saves the active project under its current name.

Corresponds to this toolbar icon:



Save as...: Saves the active project under a new name.

Description...: Description of the project. This description can be seen on the main screen, top right window.

Print...: Prints the configuration parameters of the project. It is also possible to print the parameters in an ASCII file.

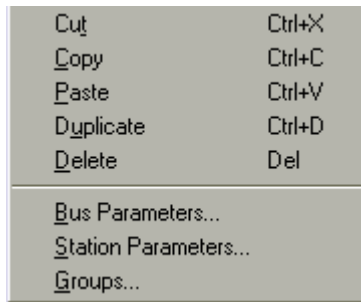
Print Preview: Creates an on-screen preview of the printout. This displays all devices used, their settings and the appropriate media.

Print Setup...: Settings for the printer type and paper format.

1 ... 4: Displays a list of the 4 most recently modified projects processed.

Exit: Exits SNET.

4.3.3 'Edit' submenu



4

Cut: Cuts out and saves a selected slave or master device to the clipboard. This copies the entire device configuration, i.e. installed modules and assigned media are also copied.

Corresponds to this toolbar icon:



Copy: Copies a selected slave or master device to the clipboard. This copies the entire device configuration, i.e. installed modules and assigned media are also copied.

Corresponds to this toolbar icon:



Paste: Inserts a slave or master device currently stored in the clipboard into the active project. This copies the entire device configuration, i.e. installed modules and assigned media are also copied.

Corresponds to this toolbar icon:

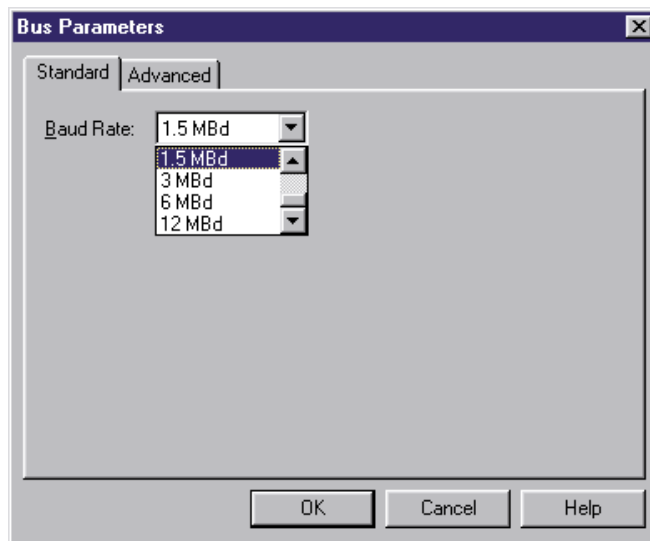


Duplicate: Creates a copy of a selected slave device. This copies the entire device configuration of the selected device, i.e. installed modules and assigned media are also copied.

Delete: Deletes a selected slave or master device.

Bus Parameters...:

Definition of network speed and bus timeout.

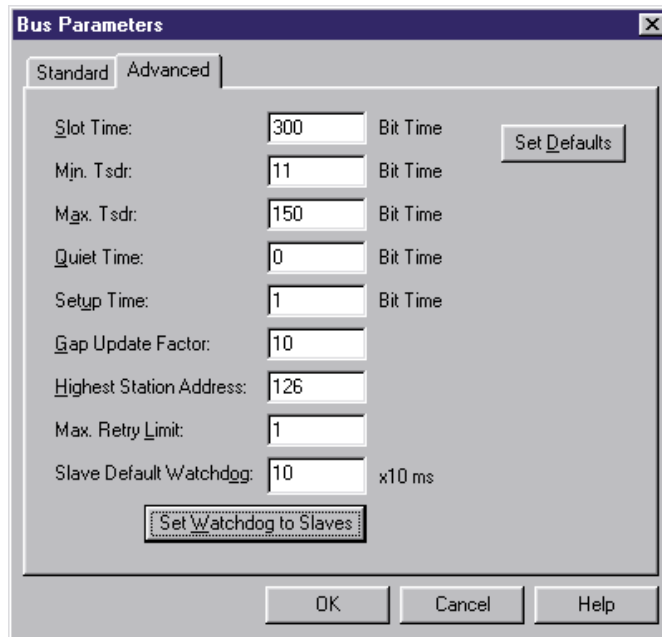


4

The following baud rates are possible:

9.6 kBd, 19.2 kBd, 93.75 kBd, 187.5 kBd, 500 kBd, 1.5 MBd, 3 MBd, 6 MBd or 12 MBd.

Note: If a speed is selected that is not available on all network devices, it is automatically changed to the highest possible speed supported by all devices.



Slot Time: Maximum period during which the transmitter of a data or token telegram awaits the response. The master waits for a calling telegram to be answered or acknowledged until the 'Slot Time' has run out. This parameter is purely a monitoring time and therefore does not affect data throughput.

Range of values: 52 ... 65535 bit periods

Min. Tsdr: Minimum waiting time for a slave between receiving a request telegram and sending the response to the master. This parameter is essentially determined by the processing speed of the connection (interpreting the call, putting together a response/acknowledgement) and the length of the telegram. This parameter can be used to delay transmission of the response/acknowledgement and depends on the slowest master (telegram initiator). Only after this time is the latter ready to receive an acknowledgement.

Range of values: 1 ... 65535 bit periods

Max. Tsdr: Maximum waiting time for a slave between receiving a request telegram and sending the response to the master. This parameter is essentially determined by the processing speed of the connection (interpreting the call, putting together a response/acknowledgement) and the length of the telegram.

Range of values: 1 ... 65535 bit periods

Quiet Time: Length of time a transmitter waits between sending the end of a telegram and switching on the receiver. This parameter can be used to take into account repeater transit times or modulator fade times.

Range of values: 0 ... 255 bit periods

- Setup Time:** This parameter defines the time that elapses between receipt of an event (e.g. last character of telegram sent) and execution of the required reaction (e.g. enabling the receiver).
Range of values: 0 ... 255 bit periods
- Gap Update** Number of token passages between two gap update cycles.
Range of values: 1 ... 100
- High. Station** Highest station address present in the network.Address:
Range of values: 2 ... 126
- Max. Retry** Number of times a telegram is repeated when no ACK Limit is received before NAK is registered. In very interference-prone environments, this parameter can be used to achieve safe operation.
Range of values: 1 ... 8
- Slave Default** Default watchdog time when a slave is integrated into the network.Watchdog:
Range of values: 0 ... 65025 × 10 ms
- Set Watchdog** Copies the time defined in the 'Slave Default Watchdog' to all slaves. This function serves to ensure that all slaves have the same watchdog time.
- Set Defaults:** Set baud rate-dependent default values.

Default values are as follows:

Baud rate	9.6	19.2	93.75	187.5	500	1500	3000	6000	12000
Slot Time	100	100	100	100	200	300	400	600	1000
Min. Tsd	11	11	11	11	11	11	11	11	11
Max. Tsd	60	60	60	60	100	150	250	450	800
Quiet Time	0	0	0	0	0	0	3	6	9
Setup Time	1	1	1	1	1	1	4	8	16
GAP	10	10	10	10	10	10	10	10	10
Highest Station	126	126	126	126	126	126	126	126	126
Max. Retry	1	1	1	1	1	1	2	3	4

Station Parameters:

For editing the station parameters of a chosen slave or master device. Different dialog boxes are shown according to the device.

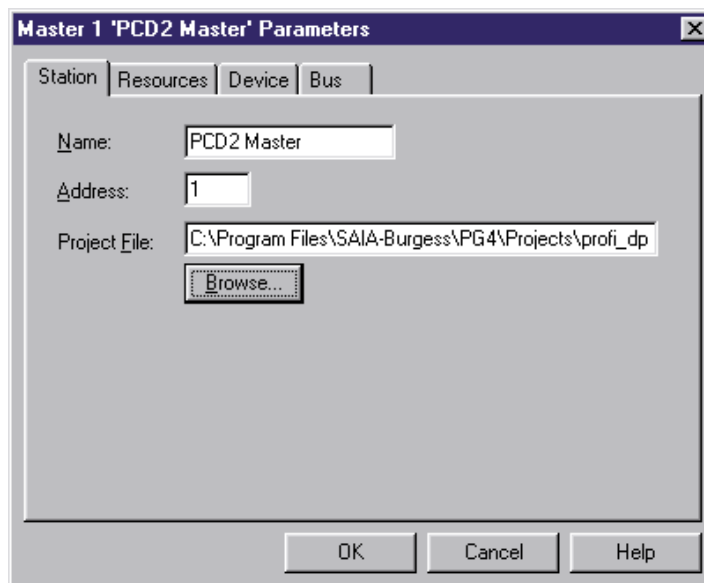
The following are possible:

- SBC master
- SBC slave
- Other slaves

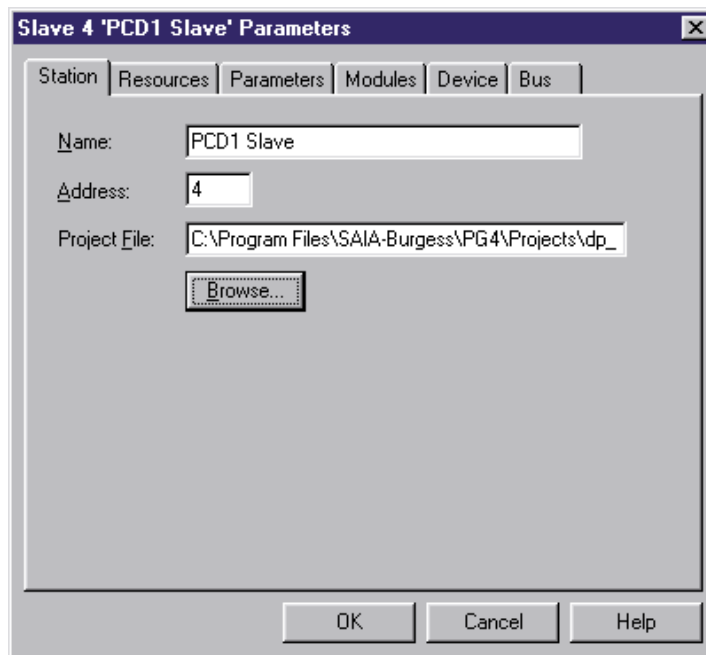
The following layouts are possible:

4

For SBC master devices:



For Saia PCD1, 2, 3 slave devices:



4

Name: Station name (max. 32 characters).

Address: Network address of device (range: 1-125).

Project File: Enter the PG5 project to which the device data generated by the PROFIBUS-DP configurator should be assigned. For SBC devices only.

Browse: Look for a PG5 project. For SBC devices only.

For non-SBC devices:

Explanation of individual menu items:

Station: Definition of device name and PROFIBUS-DP address

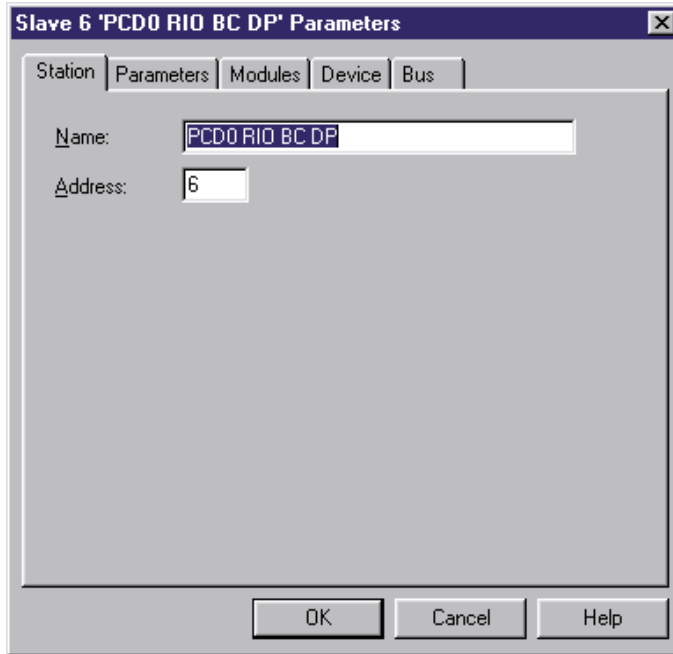
Name: Station name (max. 32 characters).

Address: Network address of device (range: 1 ... 125).

Project File: Enter the PG5 project to which the device data generated by the PROFIBUS-DP configurator should be assigned. For SBC devices only.

Browse: Look for a PG5 project. For SBC devices only.

Resources: Only selectable for SBC master or slave devices.

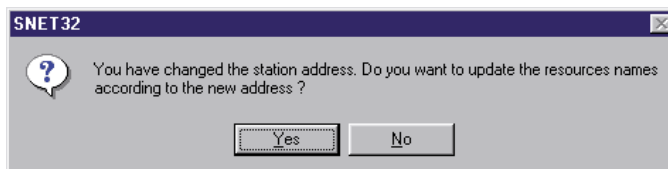


4

- First Diagn. Base address and/or symbolic name of the first diagnostic flag. 8 flags are reserved.

- First Diagn. Base address and/or symbolic name of the first diagnostic register. Up to 70 registers are reserved. This number depends on the extended diagnostics of the slave devices used.

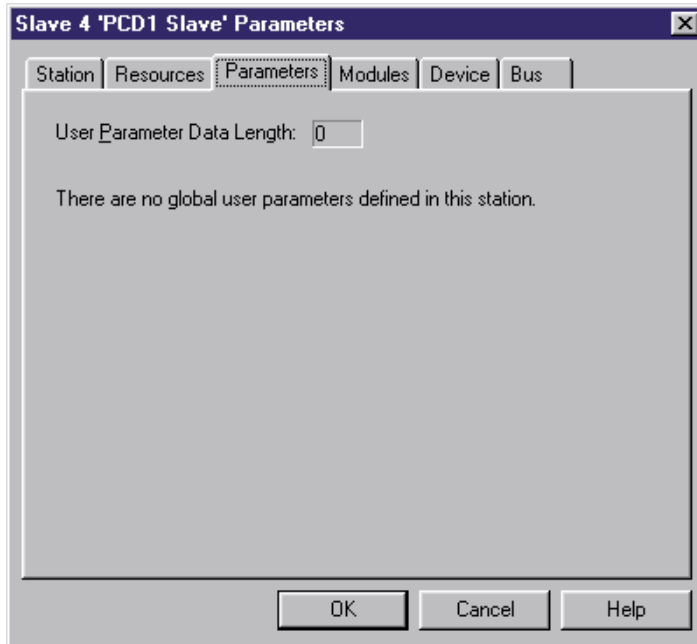
- SASI Text Text address and/or symbolic name of the SASI text Number. If the network address of an Saia PCD1, 2 or 3 device has been changed, the option to adapt symbolic names to the new station number is offered when exiting this window.



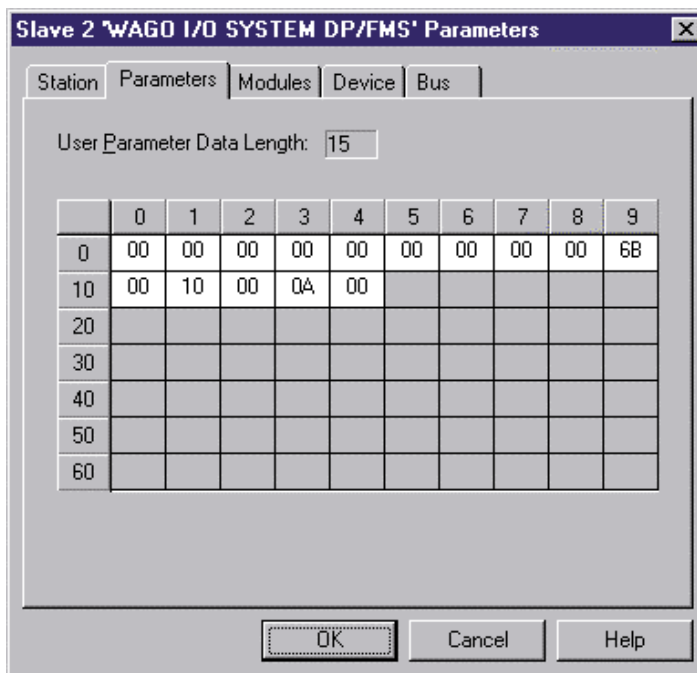
Parameters: Selectable with non-SBC slave devices. The user parameters of the device can be edited from this menu option. The user parameters are device-specific and have a different meaning for each device. The meaning of the user parameters should be taken from the device descriptions.

Depending on the PROFIBUS-DP device, user parameters can be represented in hexadecimal form or plain text. If no user parameters can be selected, the following frame appears:

4

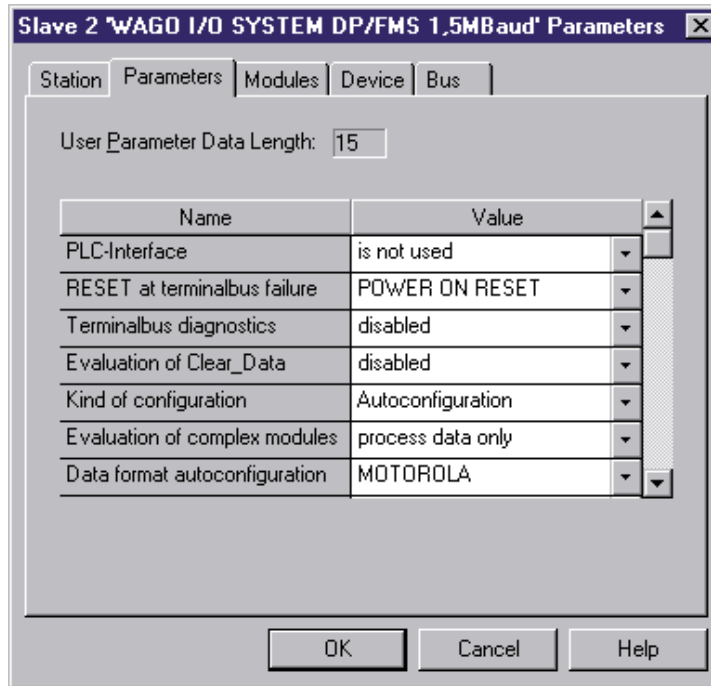


User parameters in hexadecimal form:



User parameters must be entered in the correct position and format. See device description.

User parameters in plain text form:

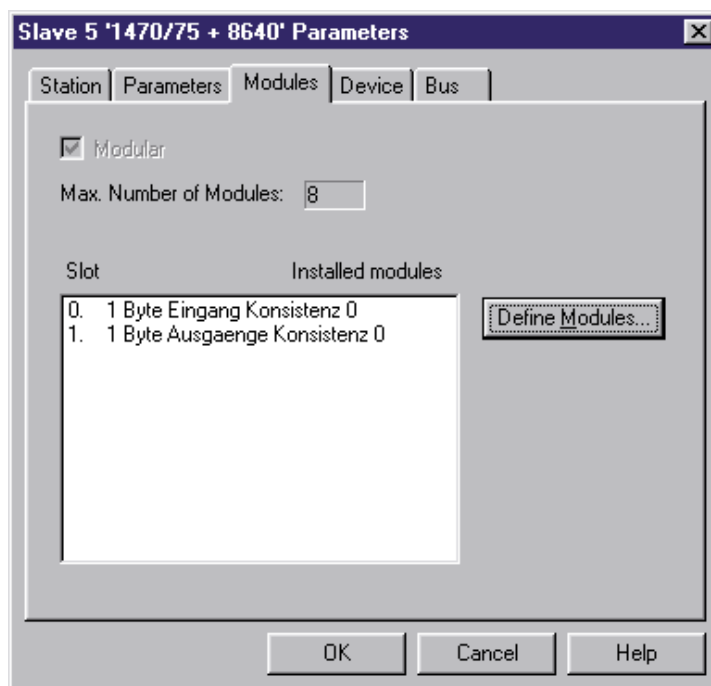


4

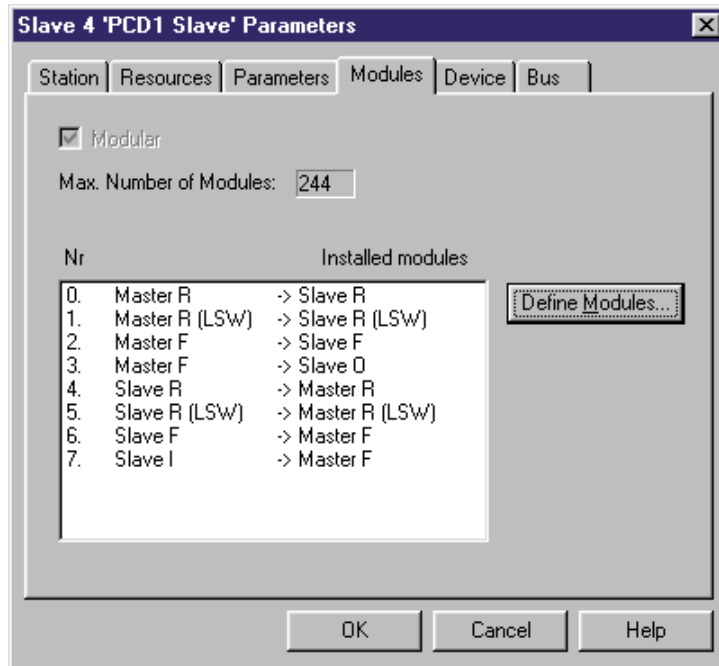
User parameters can be selected from a list of choices. The user does not have to worry about the position and correct entry.

Modules: Shows the modules possible for a device and allows these modules to be assigned and configured. For SBC slaves, the messages between an SBC master and an SBC slave are defined in this menu option.

Module definition for non-SBC slaves:



Module definition for SBC slaves:



4

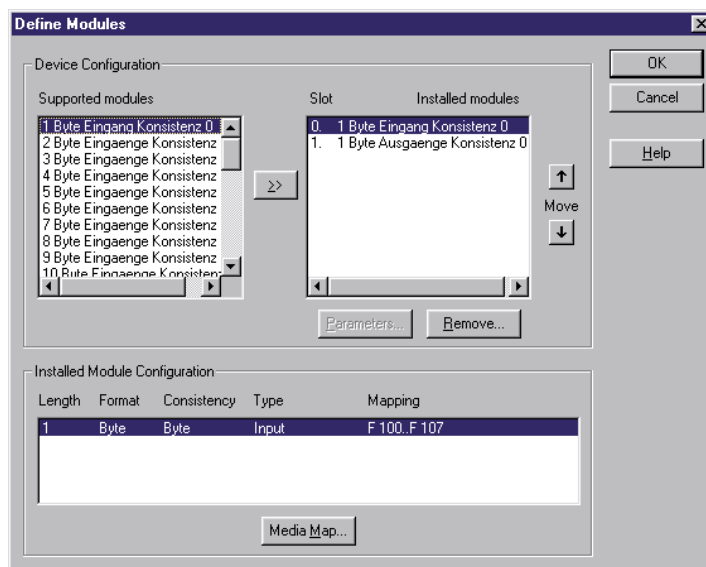
Modular: This indicates whether the device is a modular or compact unit. Modular devices can be expanded with modules. Compact devices cannot be expanded.

Max. Number This indicates the maximum number of modules of Modules: that the device supports.

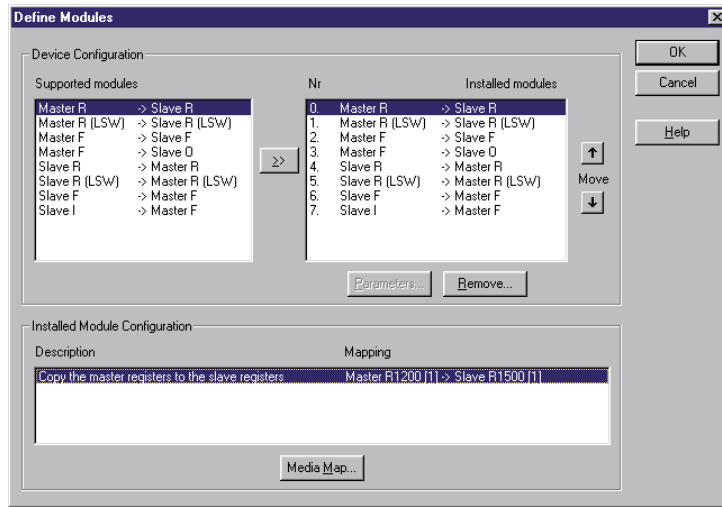
Installed List of modules installed in the device. modules:

Define Mod.: Inserts or deletes modules in the device. Definition of media in the master, which are assigned (mapped) to modules of the device.

Module definition for non-SBC slaves:

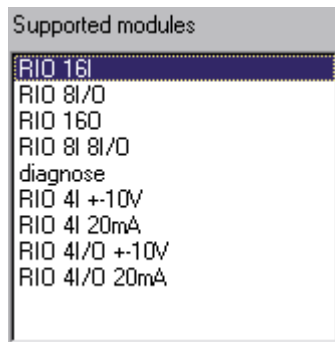


Module definition for Saia PCD1, 2, 3 slaves:



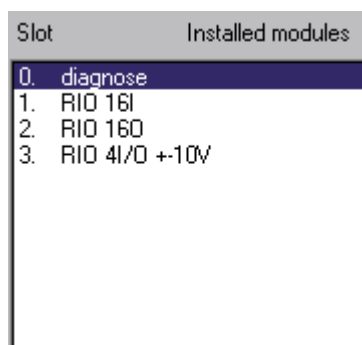
4

Supported List of all modules that are supported by the device. modules:



Inserts the selected module from the module list into the device configuration. Note: For each newly inserted module, configuration data must be mapped to the master media.

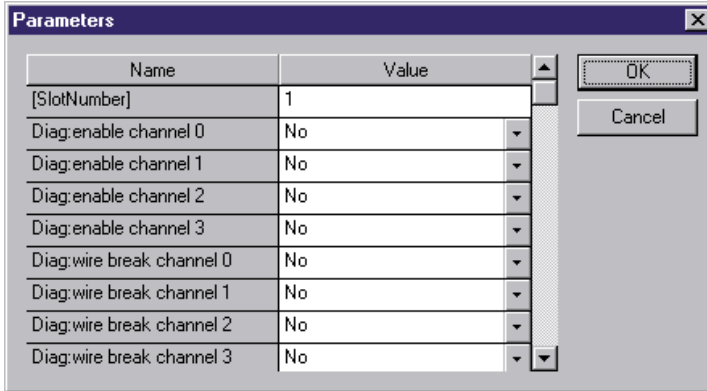
Installed List of modules already installed in the device. modules:



Shifts the selected module up or down in the sequence of installed modules.

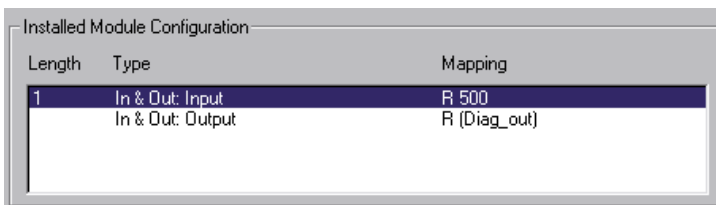
Remove: Removes the selected module from the list of installed modules.

Parameters: Definition of module parameters for the module selected from the list of installed modules.



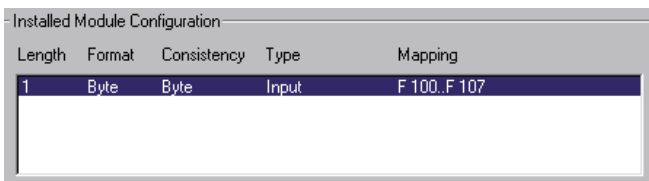
4

Installed Display of module configuration for slave devices. Module
This display is dependent upon the device type:Configuration:



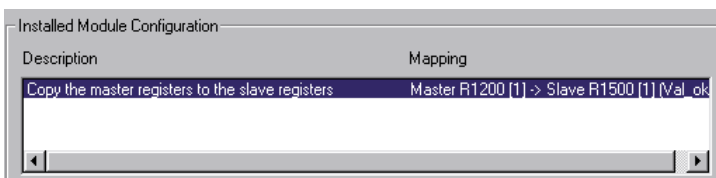
For all non-SBC slaves:

Length: Data length
Format: Byte or word
Consistency: Byte/word or over the entire data length
Type: Input, output or input/output
Mapping: Assignment to master PCD media



For Saia PCD1, 2, 3 slaves when an SBC master is configured:

Description: Description of data transfer
Mapping: Assignment to master PCD media



For Saia PCD1, 2, 3 slaves when no master is configured:

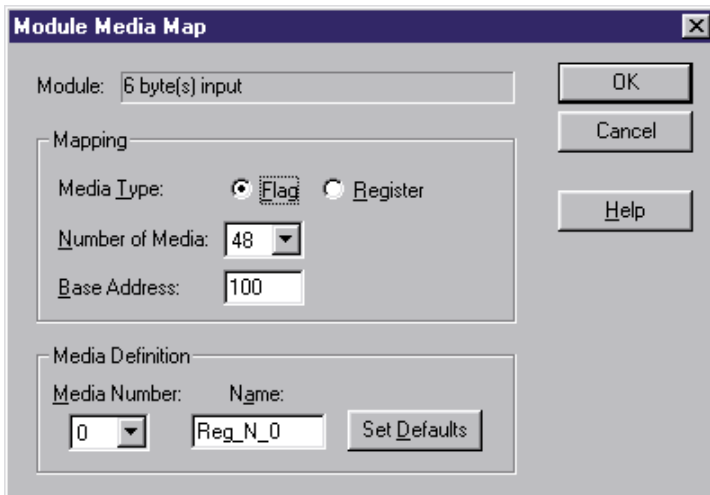
- Length: Data length
- Format: Byte or word
- Consistency: Byte/word or over the entire data length
- Type: Input, output or input/output
- Mapping: Assignment to master PCD media



4

Media Map: Assignment of selected modules to master PCD media. Mapping enables the user to access remote I/Os or the registers of remote devices via master PCD media (flags or registers). Depending on the slave device used, the media map frame is structured differently.

Media map for non-SBC slaves:



Module: Module description
Mapping: Definition of master PCD media with which this module is accessed.

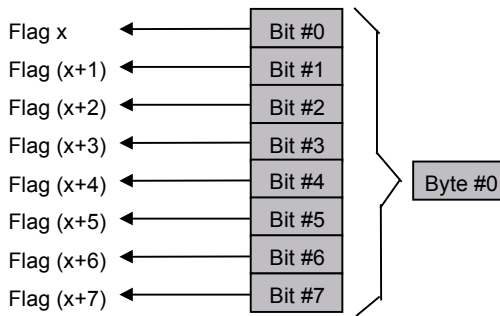
Media Type: Definition of master PCD media type (flag or register) with which the module is accessed.

Number of media Number of media to be used for accessing the module from the master.
 By default, bytes are mapped to flags and words to registers (2 words per register, if consistency is over the entire length; 1 word per register, if consistency is over one word). When required, the user can modify this default mapping in accordance with module specifications. For example, only one byte per register might be mapped (only using the register's LSB), or 4 bytes might be copied to one register, or 4 bytes might be stored

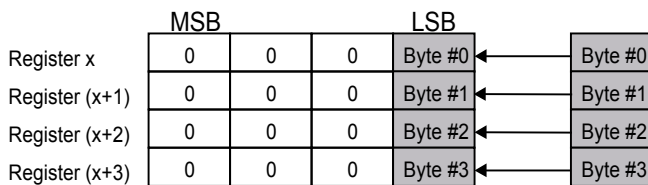
in two registers. If bytes are mapped to registers, by default 4 bytes per register are used when there is consistency over the entire length and 1 byte per register when there is consistency over one byte. All unused bytes are set to 0.

Example:

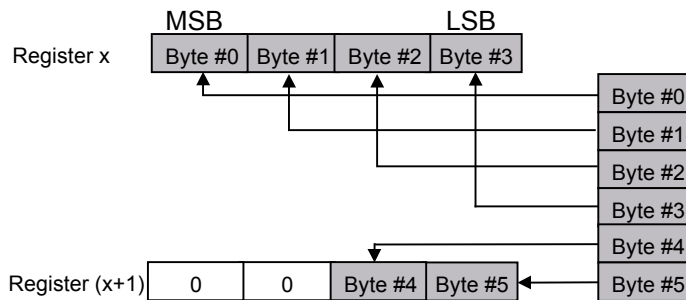
1 byte is mapped to 8 flags: (1 bit per flag)



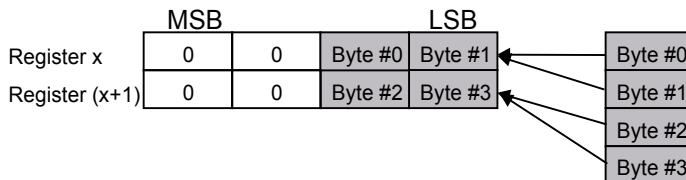
4 bytes are mapped to 4 registers (1 byte per register)



6 bytes are mapped to 2 registers (4 bytes per register)



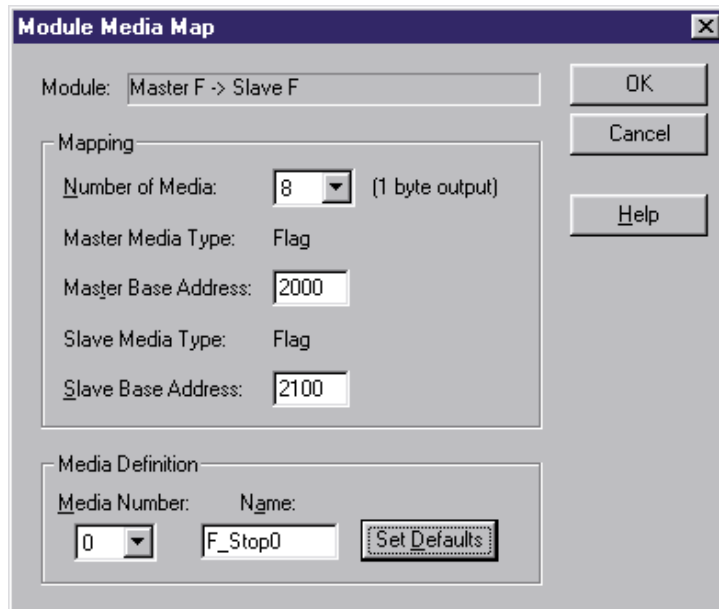
4 bytes are mapped to 2 registers (2 bytes per register)



Base Address: Base address for the medium. This entry is not compulsory in PG5, since media can be assigned with a symbolic name. If the base address is not entered, a symbolic name must be entered for each medium. Each medium will have a name that starts with the name specified in the base address and ends with a sequential number.

- Media Definition: Entry of symbolic media name.
- Media Number: Choice of media number
- Name: Name belonging to the appropriate media number. These names are then used in the master program.
- Set Defaults: This sets default values for all media names. When the last character of a default name is a number, this number is incremented for the next media. If the last character of the default name is not a number, a 0 is attached to the name and the names of subsequent media are incremented. Caution: To use the 'Set Defaults' button, the 'Media Number' must be set to 0.

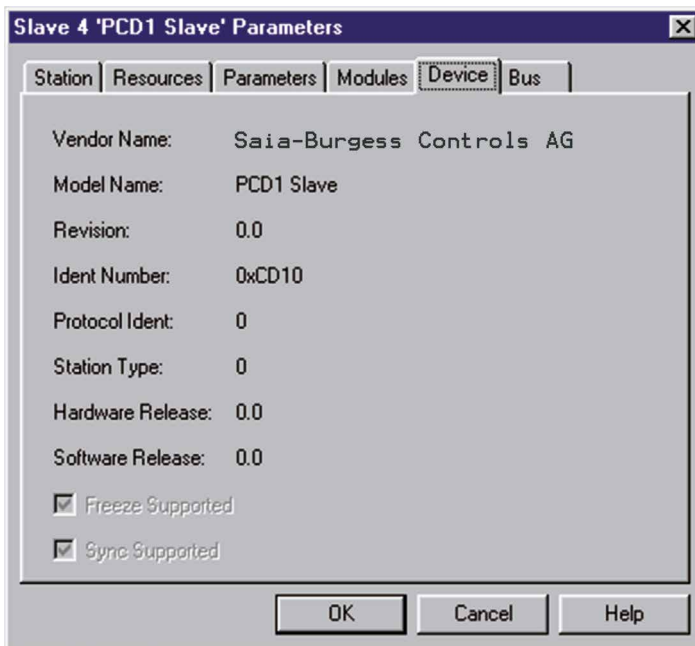
Media map for SBC slaves:



In contrast to non-SBC slaves, master and slave media are defined in this window.

- Module Description of module configuration.
- Mapping: Definition of master PCD media with which this module will be accessed.
- Number of Number of media to be used for accessing the module from the master.
(1, 2, 4 or 8 media for register transfer, 8 for flag transfer.)
- Master Media Type of medium used in master PCD to access the slave device media.
- Master Base Address: Base address for the medium.
This entry is not obligatory in PG5, since media can be mapped with a symbolic name. If the base address is not entered, a symbolic name must be entered for each medium in the media definition.

- Slave Media Type: Media type for slave PCD, by means of which the module configuration (flags, inputs, outputs or registers) of the actual slave is accessed.
- Slave Base Address: Slave base address for the first medium to be mapped. This entry is not obligatory in PG5, since media can be mapped with a symbolic name. If the base address is not entered, a symbolic name must be entered for each medium in the media definition.
- Media Definition: Entry of the symbolic media name. This name will be the same for master and slave media.
- Media Number: Choice of media number.
- Name: Name belonging to the related media number. These names are then used in the master and slave programs.
- Set Defaults: Sets default values for all media names. See description above.
- Device: Displays device-specific data. This data is downloaded from the GSD file and does not refer to PROFIBUS-DP devices actually installed. The parameters cannot be modified.



- Vendor Name: Name of the device manufacturer
- Model Name: Name of the device
- Revision: Last device update
- Ident Number: Unique PROFIBUS-DP number. This number is checked every time a connection is established between master and slave. If this number does not match the number present in the slave, no exchange of data takes place between the controllers.

Protocol Ident:

Station Type:

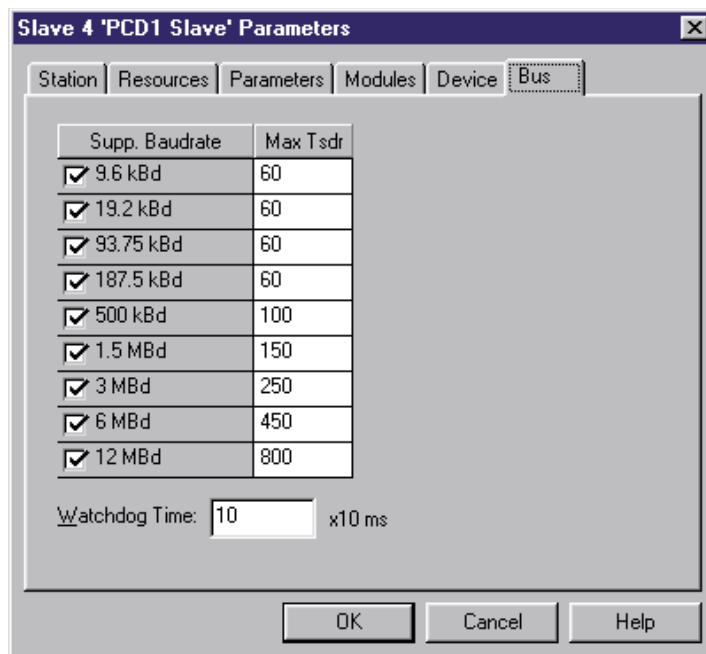
Hardware Hardware version of the device. Release:

Software Release: Software version of the device.

Freeze Supported: Indicates whether a PROFIBUS-DP device supports freeze mode.

Sync mode. Supported: Indicates whether a PROFIBUS-DP device supports sync

Bus: Displays device-specific bus data. This data is downloaded from the GSD file and does not refer to PROFIBUS-DP devices actually installed. The parameters cannot be modified.

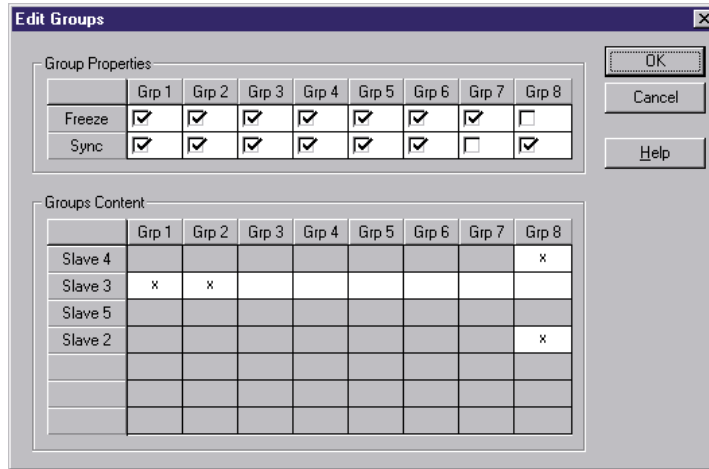


Supp. Baudrate Indicates the baud rates supported by a device.

Max TsdR: Indicates maximum 'TsdR Time' (in bit periods) for each baud rate supported by the module.

Watchdog Time: A watchdog time can be entered in this field. Each slave can have a different watchdog time. From the menu option 'Bus parameters, Advanced' it is possible to execute the option 'Set Watchdog to slaves', so that the time defined there will be written in this field. If the PROFIBUS-DP cable is removed during an active connection, the DATA_EXCH diagnostic flag will be set to «L» in the slave after the watchdog time expires.

Groups: Assignment of PROFIBUS-DP devices to the 8 groups defined in the standard. It is also possible to assign the supported «Global Control Services» to the groups.

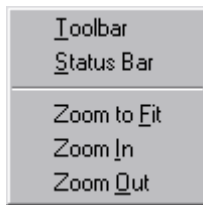




Group Definition of the 'Global Control Services' 'Sync' and 'Freeze'

Properties: for each group. Click on the 'Freeze' or 'Sync' fields to activate or deactivate the service.

Groups Content: Definition of which PROFIBUS-DP slave devices belong to which group. To insert a slave into a group, the slave must support the 'Global Control Services' of that group.

4.3.4 'View' submenu



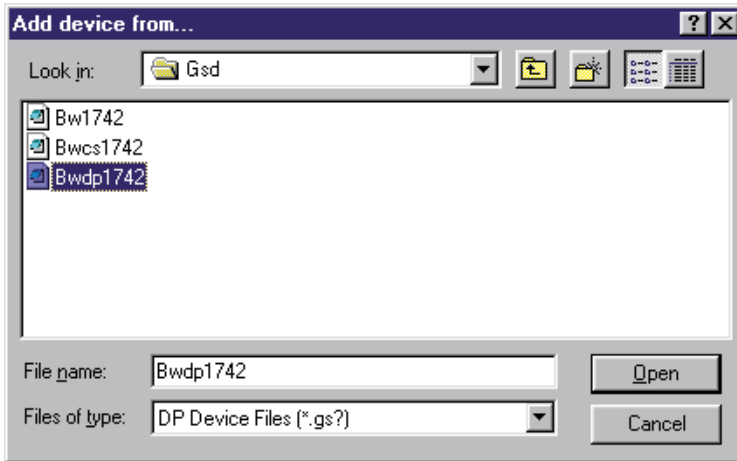
Toolbar:	Shows or hides the toolbar at the top of the screen.
Status Bar:	Shows or hides the status bar at the bottom of the screen.
Zoom to Fit:	With this option all devices in the network are displayed on the screen all the time.
Zoom In:	Magnification of network screen content. Corresponds to this toolbar icon: 
Zoom Out:	Reduces size of network screen content. Corresponds to this toolbar icon: 

4.3.5 'Library' submenu

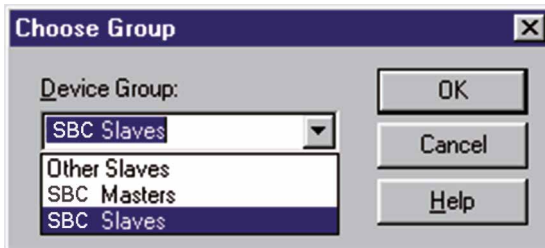


Add Device: Insert new PROFIBUS-DP devices. These devices must have a file with the extension '.gs?'.

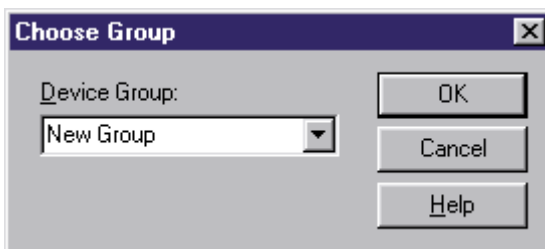
4



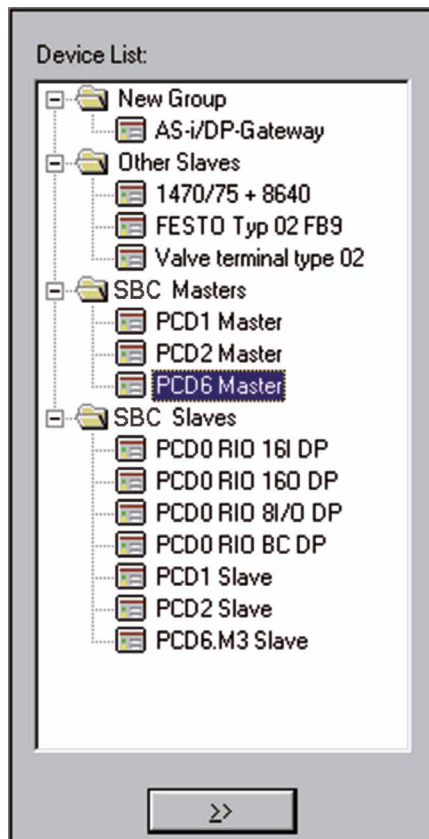
After the '.gs?' file is selected, the device can be assigned to a device group.



This can be done either by saving the device in an existing group, or in a new one. To define a new group, the new group name is simply entered in the entry field.



his new group is then automatically inserted in the device list:



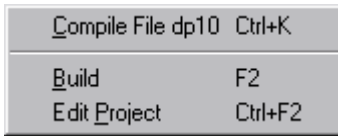
4

Remove Device: Deletes a PROFIBUS-DP device from the device list. A PROFIBUS-DP device can also be deleted from the device list by pressing the key.

Rename Group: Renames a device group. By clicking once on the device group text with the mouse button, the group name can also be edited.

Caution: If the PROFIBUS-DP device to be inserted has its own bitmap drawing, which should be displayed in the configurator when the device is called, this '*.bmp' file must be stored in the directory containing the configurator.

4.3.6 'Project' submenu



Compile File: The project selected is compiled, i.e. '.def' and '.src' files are created for all slave and master stations defined in the network.

Corresponds to this toolbar icon:

Build: The SBC device selected in the PROFIBUS-DP network is assembled and linked together with the compiled configurator files.

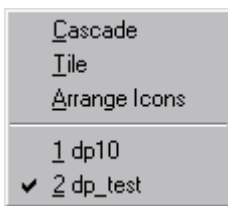
Corresponds to this toolbar icon:

Edit Project: This calls the PG5 Project Manager for the SBC device selected in the PROFIBUS-DP network.

Corresponds to this toolbar icon:

4

4.3.6 'Window' submenu



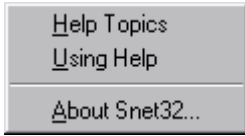
Cascade: All open projects are displayed on the screen. The display takes the form of an overlapping cascade, so that each project title is visible.

Tile: All open projects are displayed on the screen. The display takes the form of windows, without any overlapping of projects.

Arrange Icons: Ordered display of all minimised projects.

1...10 Selection list of all open projects.

4.3.8 'Help' submenu



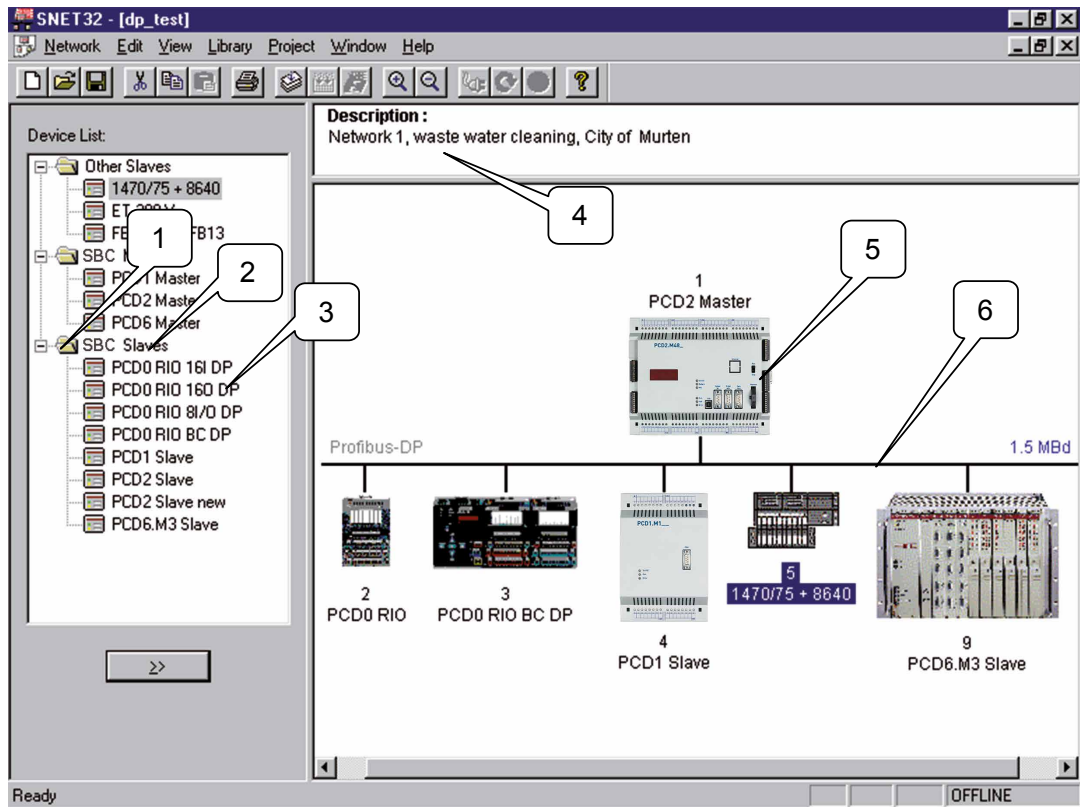
Help Topics: Summary of help topics.

Using Help: Description of how Help should be used.

About Snet32: Indicates the version number and the name of the licence holder.

Corresponds to this toolbar icon:

4.3.9 Mouse-sensitive elements in the configurator



This section only shows which elements of the PROFIBUS-DP configurator can also be edited with the mouse.

The meaning of individual items is described in the preceding chapters.

1

Left button: Double-click: Opens or closes the folder.

Right button: 

2


Left button: Edits the device group name.

Right button: 



3

Left button: Double-click: Inserts the selected device into the network.

Right button: 

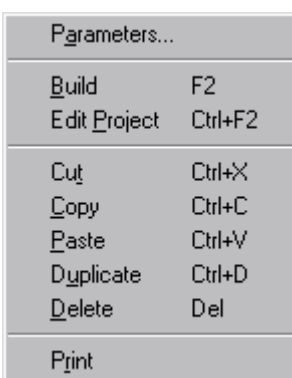
4

Left button: Double-click: Opens the editor for the network description

Right button: 

5

Left button: Drags and drops with the device selected.
Double-click: Opens the 'Parameter' entry window

Right button: 

6

Left button: Double-click: Opens the 'Bus Parameters' menu

Right button: 

5. Programming

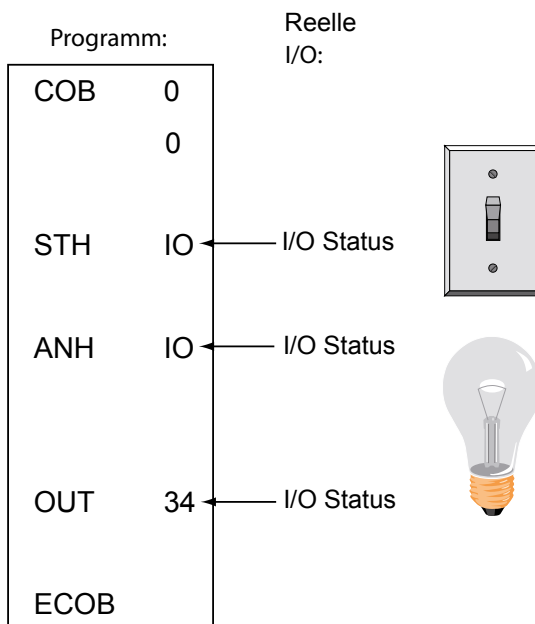
5.1 Access to slave I/Os and registers in a PCD user program with PROFIBUS-DP

When accessing PCD media, it is necessary to point out an important difference between a program running with PROFIBUS-DP and one which is running directly, i.e. without PROFIBUS-DP.

Program without PROFIBUS-DP:

If the input or output of a conventional user program without PROFIBUS-DP is read or written, the status of the actual input or output is instantaneously read or written.

5



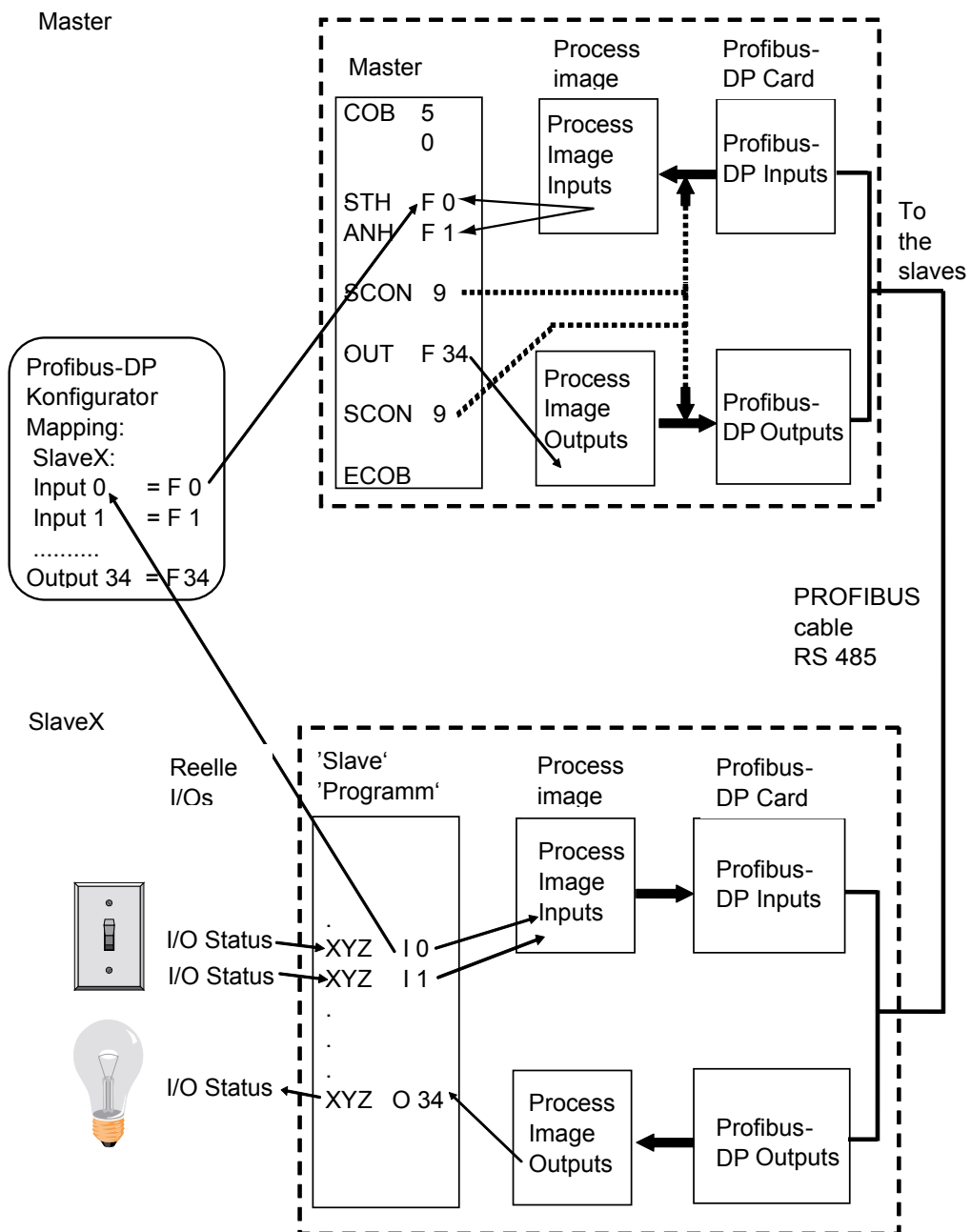
Program with PROFIBUS-DP slaves:

If the input or output of a PROFIBUS-DP slave is read or written in a user program with PROFIBUS-DP, the status of the actual input or output is not instantaneously read or written. Instead the status is modified in the process image memory of the PCD controller. Data from the process image memory of the PCD controller is then exchanged, either automatically or by the user program, between the PCD controller's process image memory and the memory of the PROFIBUS-DP card. This data exchange between the memory on the PROFIBUS-DP card and the slave subsequently takes place automatically in a cyclical sequence and cannot be influenced by the user program.

Process image memory of the PCD controller:

The PCD controller's process image memory stores all data (I/Os and registers) exchanged between the master and any slaves. This involves differentiating between an input and an output image memory. The PCD controller's input image memory stores all inputs and registers that are read by slaves. This data is then read in the master controller's user program. The PCD controller's output image memory stores all outputs and registers that are written to slaves. This data is described in the master controller's user program.

The assignment of I/Os and registers to slave devices in the PCD controller's image memory takes place via the «Mapping» menu in the PROFIBUS-DP configurator. This involves mapping the I/Os and registers of the slave devices to flags and registers in the master controller.



Data exchange between the PCD controller’s process image memory and the PROFIBUS-DP card

The data exchange between the PCD controller’s process image memory and the PROFIBUS-DP card’s memory can take place in two different ways.

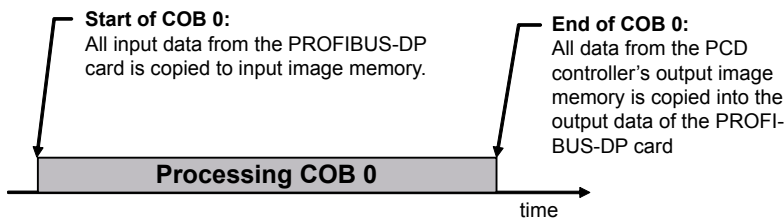
These are:

1. Default model:

The data exchange between the PCD controller’s process image memory and the PROFIBUS-DP card’s memory takes place automatically. This involves copying all input data from the PROFIBUS-DP card’s memory to the input image memory when the COB 0 command is processed.

At the end of COB 0, when the ECOB command is processed, all data from the output image memory is copied to the PROFIBUS-DP card’s output data memory.

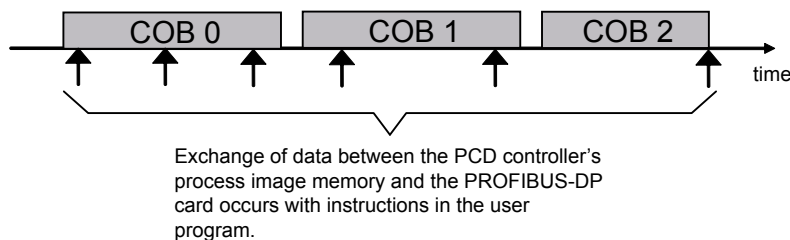
The data exchange between the PCD controller’s process image memory and the PROFIBUS-DP card’s memory only occurs as COB 0 is processed. No data exchange takes place if COB 0 is not processed in the user program.



2. Advanced model:

For this model, the data exchange between the PCD controller’s process image memory and the PROFIBUS-DP card’s memory takes place via commands in the user program.

This means that the data exchange between the PCD controller’s process image memory and the PROFIBUS-DP card’s memory can be forced at any time with special user program commands.



5.2 Description of the PCD commands (SASI, SCON)

The following commands are supported by PROFIBUS-DP:

SASI	Assign serial interface
SASII	Like SASI but indirect
SCON	Serial connect Command to force the data exchange
SCONI	Like SCON but indirect

5.2.1 SASI: Assigning a channel

Description: PROFIBUS-DP assignment takes place, as with most PCD communications modes, by the SASI command. SASI calls a text which contains the necessary information for initialising a PROFIBUS-DP channel. If communication is to take place across several PROFIBUS-DP channels, a separate SASI command should be edited for each channel. Channel no. 9 is used for PROFIBUS-DP. Channel 8 is already reserved for future PCDs, which may have two PROFIBUS-DP interfaces.

5

Structure:

SASI	channel
	text

Channel 9 (or 8)

Text Txt_DP Symbolic name of the text containing the assignment information. This text is generated by the PROFIBUS-DP configurator.

Example: SASI 9 ; Initialise channel 9

Txt_DP Definition text for PROFIBUS-DP

Flags: The error (E) flag is set if the definition text is missing or invalid, or if the FW does not support PROFIBUS-DP.

SASI text: The SASI text is generated by the PROFIBUS-DP configurator and has the following format:

Master:

“MODE:DPM;CONF:DBXxxxx;DIAG:Fyyyy,Rzzzz”

Slave:

“MODE:DPS;CONF:DBXxxxx;DIAG:Fyyyy,Rzzzz”

xxxx: Specific number of a DBX containing all PROFIBUS-DP information.

yyyy: Specific number of the first diagnostic flag or diagnostic output.

zzzz: Specific number of the first diagnostic register.

Diagnosis: Diagnosis of a PROFIBUS-DP communication takes place in the usual way for the PCD, i.e. for each communications channel, 8 flags are assigned for rough diagnosis and up to a maximum of 70 registers for detailed diagnosis. These diagnostic resources are defined in the configurator.

Diagnostic flags with PROFIBUS-DP

Address	Name	Description
xxxx	SLAVE_ERR	Slave error; Error in the slave
xxxx+1	GCS_BUSY	Global Control Service is processing
xxxx+2	SERV_BUSY	Service function is processing
xxxx+3	DATA_EXCH	Data exchange; Exchange of data between master and slave
xxxx+4		Not used
xxxx+5		Not used
xxxx+6	CONF_RCV	Configuration received; Slave has received a configuration telegram from the master
xxxx+7	CONF_STAT	Configuration status; Indicates whether configuration data is OK

5

Description of the diagnostic flags:

Slave_error (SLAVE_ERR)

Master: H = Error in one or more slaves L = No errors in the slaves

Slave: H = Error in the slave L = No error in the slave

Master:

The number of the slave that generated the error can be obtained from diagnostic registers +3 to +6. This flag is set to L when, after completion of a «Read slave diagnostic data» telegram, there are no longer any errors present.

Global Control Service (GCS_BUSY)

Master: H = Global Control Service is busy L = Global Control Service has finished

Slave: Not used

Global Control Services are:
Freeze, Unfreeze, Sync and Unsync.

Service (SERV_BUSY)

Master: H = Service function is busy L = Service function has finished

Slave: Not used.

Service functions are:

- Stop the data exchange between the PCD controller's process image memory and the PROFIBUS-DP's card memory
- Read the slave diagnostic data
- Activate or deactivate a slave.

Data Exchange (DATA_EXCH)

Master: H = Data exchange on the PROFIBUS-DP network is running. L = Data exchange on the PROFIBUS-DP network has stopped.

Slave: H = Connection with master is established (executing data exchange).

L = No data exchange connection with master. The flag does not become = L until the watchdog time defined in the slave has elapsed.

Configuration received (CONF_RCV)

Master: Not used.

Slave: H = Slave has received a configuration telegram from the master. L = Slave has not received a configuration telegram from the master.

Configuration status (CONF_STAT)

Master: Not used.

Slave: H = The configuration telegram from the master corresponds to the slave configuration. L = The configuration telegram from the master does not correspond to the slave configuration.

Diagnostic registers with PROFIBUS-DP

Diagnostic registers are grouped by the following areas:

- Service area
- Station area
- Standard PROFIBUS-DP diagnostic area
- Expanded PROFIBUS-DP diagnostic area

The maximum size of the diagnostic registers is defined by the 'Max_Diag_Data_Len' parameter from the slave device GSD file, since the slave diagnostic data is stored in the diagnostic registers. 'Max_Diag_Data_Len' can have a maximum size of 244 bytes. If there is more than one slave, the largest 'Max_Diag_Data_Len' parameter always applies. At present, the diagnostic registers are only used by the master.

Division of diagnostic registers:

Areas	Address	Description
Service area	Base +0	Result of Global Control Service GCS
	Base +1	Result of IL command SCON(I) fct. 0,1,8,9
	Base +2	Result of IL command SCON(I) function #7
Station area	Base +3	Error status stations 0...31
	Base +4	Error status stations 32...63
	Base +5	Error status stations 64...95
	Base +6	Error status stations 96...126
StandardPROFIB-US-DPdiagnostic	Base +7	Length of PROFIBUS-DP diagnostic (bytes 6...243)
	Base +8	Standard DP diagnostic (bytes 0 and 1)
	Base +9	Standard DP diagnostic (bytes 2 ... 5)
Expanded PROFIB-US-DP diagnostic	Base +10	Expanded DP diagnostic (bytes 6...9)
	Base +11	Expanded DP diagnostic (bytes 10...13)
	Base +12	Expanded DP diagnostic (bytes 14...17)
	Base +13	Expanded DP diagnostic (bytes 18...21)
	/	/
	/	/
	Base +69	Expanded DP diagnostic (bytes 242 and 243)

Description of diagnostic registers: **GCS result (Base + 0)**

The result of the «Global Control Service» is stored in this register. The «Global Control Service» is triggered by function codes 13...16 of the SCON command. The result codes are the same as described under: 'Result of IL command SCON(I) Fct. 0, 1, 8, 9 (Base + 1)'.

Result of IL command SCON(I) Fct. 0, 1, 8, 9 (Base + 1)

The result of the following functions is stored in this register:

- Run/stop data exchange; SCON with function code 0
- Read slave diagnostics; SCON with function code 1
- Activate or deactivate a slave. SCON with function code 8 or 9.

The following values are possible here:

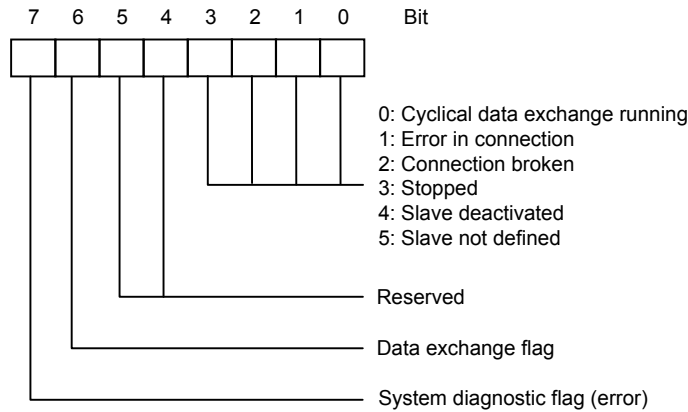
Value	Description
0	Command has been successfully completed
1	Incorrect parameter (contact your local SBC agent)
2	Not possible (contact your local SBC agent)
3	No local resources (contact your local SBC agent)
4	DP error (contact your local SBC agent)
5	Slave is not OK
6	Not defined
7	Status conflict (contact your local SBC agent)
8	Error in acyclic master-slave data exchange (contact your local SBC agent)
20	Timeout
21	Station number does not exist
22	Command executed more than once. (Diag flag Base+2 has not been checked)
23	Incorrect DP response
24	Incorrect parameter

Result of IL command SCON(I) Fct. 7 (Base + 2)

The result of the following function is stored in this register:

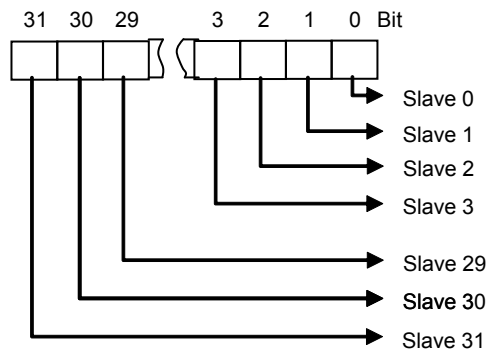
- Read station status. SCON with function code 7.

The register is coded here as follows:



Error status stations 0...31 (Base + 3)

Each bit in this register corresponds to the station number of a slave device. As soon as an error occurs in a slave device, the relevant bit is set to H. The bit is set to L when, after completion of a 'Read slave diagnostic data' telegram, there are no longer any errors present.



Error status stations 32...63 (Base + 4)

Same function as for diagnostic register (Base + 3) with errors for stations 32 to 63.

Error status stations 64...95 (Base + 5)

Same function as for diagnostic register (Base + 3) with errors for stations 64 to 95.

Error status stations 96...125 (Base + 6)

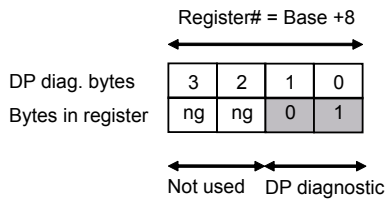
Same function as for diagnostic register (Base + 3) with errors for stations 96 to 125.

Length of PROFIBUS-DP diagnostic bytes 6...243 (Base +7)

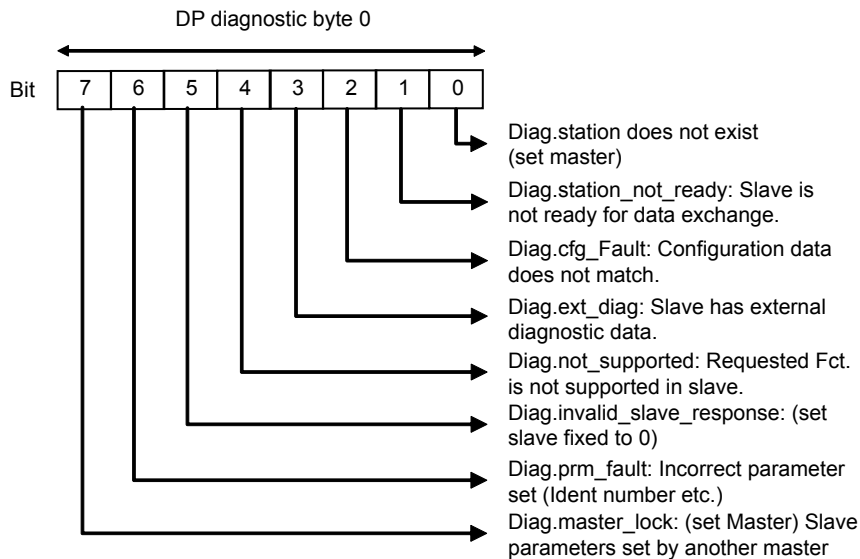
In this register, after an SCON command with function 1, the total length of diagnostic data (standard PROFIBUS-DP + external PROFIBUS-DP diagnostic) is stored in bytes. The length of diagnostic data differs in each slave device, amounting to no less than 6 bytes and no more than 244 bytes.

Standard DP diagnostic: Bytes 0 and 1 (Base +8)

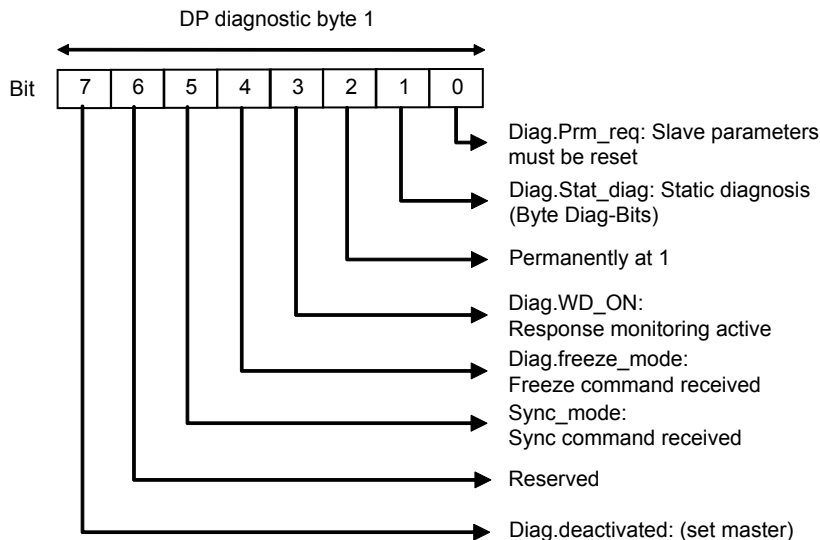
The first two bytes of standard PROFIBUS-DP diagnostic data are stored in this register. Division into diagnostic registers is as follows:



Meaning of PROFIBUS-DP diagnostic byte 0:



Meaning of PROFIBUS-DP diagnostic byte 1:



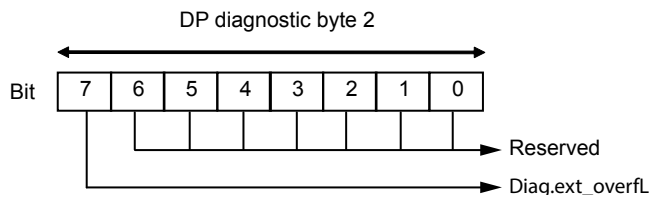
Standard DP diagnostic: Bytes 2 to 5 (Base +9)

Bytes 2 to 5 of the standard PROFIBUS-DP diagnostic data are stored in this register.

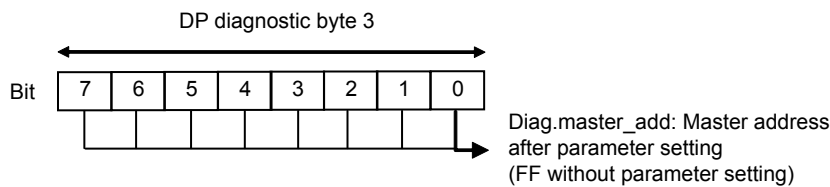
The division is as follows:



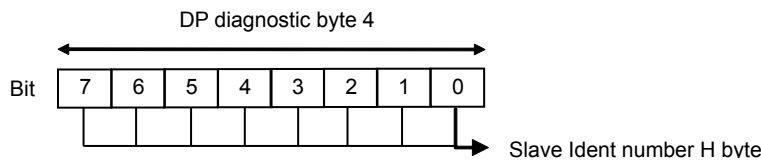
Meaning of PROFIBUS-DP diagnostic byte 2:



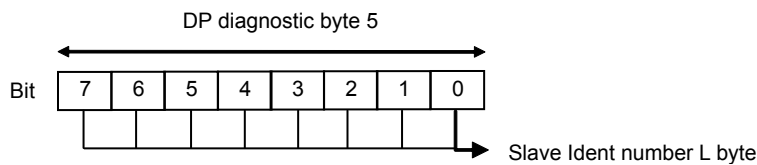
Meaning of PROFIBUS-DP diagnostic byte 3:



Meaning of PROFIBUS-DP diagnostic byte 4:



Meaning of PROFIBUS-DP diagnostic byte 5:

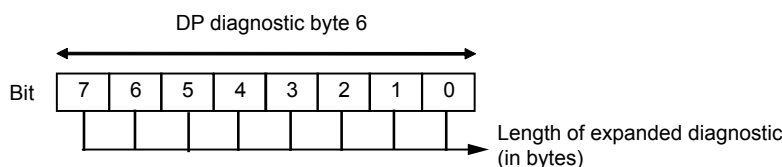


Expanded DP diagnostic: Bytes 6 to 9 (Base +10)

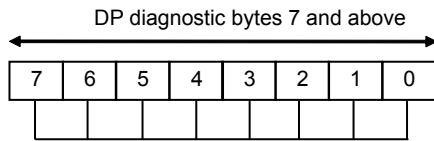
Bytes 6 to 9 of the expanded PROFIBUS-DP diagnostic data are stored in this register. The division is as follows:



Meaning of PROFIBUS-DP diagnostic byte 6:



Meaning of PROFIBUS-DP diagnostic byte 7 and above:



The meaning of individual bits must be obtained from slave descriptions.

Expanded DP diagnostic: bytes X0 to X3 (Base +Z)

The expanded diagnostic information is stored in these registers. The division is always as follows:



5.2.2 SCON commands to affect data exchange

Structure:

SCON	Channel
	Fct code
	Parameter

- Channel 9, 8
- Fct. code 0...16 Function code This function code triggers a specific function.
- Parameter 0...255 Parameters for the specific function.

Example: Request diagnostic data of slave 4

```

STH            SERV_BUSY        ; If diagnostic flag xxxx+2
JR            H    next           ; is not H, then SCON
SCON           9                 ; PROFIBUS-DP channel 9
              1                 ; Fct. code 1 = read slave
              4                 ; diagnostic data of slave 4

next:
```

Flags: The error flag is set if the channel is unassigned.

5.2.3 SCONI commands to affect data exchange

Structure:

SCONI	Channel
	Fct code
	Parameter

Channel	R 0...4095	Registers with channel numbers 9, 8
Fct. code	R 0...4095	Registers with function codes 0...16
Parameter	R 0...4095	Registers with the parameters for the specific function 0...255

Example: All data is to be exchanged between the PCD controller's process image memory and that of the PROFIBUS-DP card, controlled by the user program.

```
LD      R 2000      ; Load register 2000
          9          ; with channel 9
LD      R 2001      ; Load register 2001
          3          ; with fct. code 3 =
                   ; Force data exchange
LD      R 2002      ; Load register 2002
          0          ; with parameter 0 =
                   ; Input and output image
                   ; memory
SCONI   R 2000      ; SCONI command
          R 2001          R 2002
```

Flags: The error flag is set if the channel is unassigned.

Description of the function codes and parameters for the SCON(I) command

Fct. code		Parameter	Description	Diagnostic affected	
Master	Slave			Flag	Reg
0		0	Stop data exchange between master and slaves	2, 3	1
1		Slave no. 0...126	Read slave diagnostic data	0, 2	3...6, 0, 7, 8, 9, 10...69
2	2	012345	Start/stop default data exchange between image memory and PROFIBUS-DP card Stop default model data exchange for all slaves between the entire image memory and the PROFIBUS-DP card (COB 0; ECOB) Start default model data exchange for all slaves between the entire image memory and PROFIBUS-DP card (COB 0; ECOB) Stop data exchange for all slaves between input image memory and PROFIBUS-DP card (start of COB 0) Start data exchange for all slaves between input image memory and PROFIBUS-DP card (start of COB 0) Stop data exchange for all slaves between output image memory and PROFIBUS-DP card (end of COB 0) Start data exchange for all slaves between output image memory and PROFIBUS-DP card (end of COB 0)		
3	3	012	Force data exchange for all slaves between the entire image memory and the PROFIBUS-DP card Force data exchange for all slaves between the input image memory and the PROFIBUS-DP card Force data exchange for all slaves between the output image memory and the PROFIBUS-DP card		
4		Slave no. 0...126	Force data exchange for a slave device between the input image memory and the PROFIBUS-DP card		
5		Slave no. 0...126	Force data exchange for a slave device between the output image memory and the PROFIBUS-DP card		
6		Slave no. 0...126	Force data exchange for a slave device between the entire image memory and the PROFIBUS-DP card		
7		Slave no. 0...126	Read status of a slave		2
8		Slave no. 0...126	Deactivate slave	2	1
9		Slave no. 0...126	Activate slave	2	1
10		Group no. 0...255	Force data exchange for a group of slaves between the input image memory and the PROFIBUS-DP card		
11		Group no. 0...255	Force data exchange for a group of slaves between the output image memory and the PROFIBUS-DP card		
12		Group no. 0...255	Force data exchange for a group of slaves between the entire image memory and the PROFIBUS-DP card		
13		Group no. 0...255	FREEZE	1	0
14		Group no. 0...255	UNFREEZE	1	0
15		Group no. 0...255	SYNC	1	0
16		Group no. 0...255	UNSYNC	1	0

SCON(I) 1: Read slave diagnostic data

The diagnostic data of the slaves can be read with this command. Diagnostic data is mostly read when an error has been detected in the slaves. This is indicated by setting diagnostic flag +0. The user can then identify the faulty slave by means of diagnostic registers +3 to +6 and read the diagnostic data of that slave. As soon as this command is executed, diagnostic flag +2 is set to H and, when the command is finished, reset to L. When the command has been executed and the status of diagnostic flag +2 is L, the result of the operation is written to diagnostic register +1. A description of the response code is provided in the section 'Diagnostic registers with PROFIBUS-DP'. This command may only be executed when diagnostic flag +2 has the status L.

When the command is finished, the relevant bit for the slave to which the command was addressed is set to L in diagnostic registers +3 to +6 and the following values are stored in the diagnostic registers:

Diagnostic register +7: Length of expanded PROFIBUS-DP diagnostic
 Diagnostic register +8: Standard PROFIBUS-DP diagnostic, bytes 0 and 1
 Diagnostic register +9: Standard PROFIBUS-DP diagnostic, bytes 2 to 5
 Diagnostic register +10: Expanded PROFIBUS-DP diagnostic, bytes 6 to 9, etc.

A description of the response code is provided in the chapter 'Diagnostic registers with PROFIBUS-DP'.

Structure:

SCON	Channel
	Fct code
	Parameter

Channel 9, 8
 Fct. code 1
 Parameter 0...126 ; Station number

Flags: The error flag is set if the channel is unassigned or if the command is called when diagnostic flag +2 is not set to H.

Example: Read slave diagnostic data from slave 5:

```

STH        SLAVE_ERR        ; If diagnostic flag +0
JR        H NEXT            ; is not H, then SCON
SCON       9                ; PROFIBUS-DP channel 9
           1                ; Fct. code 1
           5                ; Slave no. 5

NEXT :
```

SCON(I) 2: Start/stop default data exchange between the image memory and the PROFIBUS-DP card

With this command, default data exchange between the image memory and the PROFIBUS-DP card can be started or stopped. Default data exchange refers to the data exchange that is executed automatically when COB 0 starts and when it ends. This data exchange can be changed to the following functions:

Parameters:

- 0 Stop default model data exchange for all slaves between the entire image memory and the PROFIBUS-DP card (COB 0; ECOB)
- 1 Start default model data exchange for all slaves between the entire image memory and the PROFIBUS-DP card (COB 0; ECOB)
- 2 Stop data exchange for all slaves between the input image memory and the PROFIBUS-DP card (start of COB 0)
- 3 Start data exchange for all slaves between the input image memory and the PROFIBUS-DP card (start of COB 0)
- 4 Stop data exchange for all slaves between the output image memory and the PROFIBUS-DP card (end of COB 0)
- 5 Start data exchange for all slaves between the output image memory and the PROFIBUS-DP card (end of COB 0)

5

Structure:

SCON	Channel
	Fct code
	Parameter

Channel 9, 8
 Fct. code 2
 Parameter 0...5 ; Parameter

Flags: The error flag is set if the channel is unassigned.

Example: Stop data exchange for all slaves between the input image memory and the PROFIBUS-DP card (start of COB 0)

```
SCON      9          ; PROFIBUS-DP channel 9
          2          ; Fct. code 2
          2          ; Parameter 2
```

SCON(I) 3: Force data exchange for all slaves between the image memory and the PROFIBUS-DP card

With this command, data exchange between the image memory of all slaves and the PROFIBUS-DP card can be forced in the user program at any time. This forcing can take place in the following ways:

Parameters:

- 0 Force data exchange for all slaves between the entire image memory and the PROFIBUS-DP card
- 1 Force data exchange for all slaves between the input image memory and the PROFIBUS-DP card
- 2 Force data exchange for all slaves between the output image memory and the PROFIBUS-DP card

5

Structure:

SCON	Channel
	Fct code
	Parameter

Channel 9, 8
 Fct. code 3
 Parameter 0...2 ; Parameter

Flags: The error flag is set if the channel is unassigned.

Example: Force data exchange for all slaves between the entire image memory and the PROFIBUS-DP card

```
SCON            9                    ; PROFIBUS-DP channel 9
                 3                    ; Fct. code 3
                 0                    ; Parameter 0 = input and
                                      ; output image memory
```

SCON(I) 4, 5, 6: Force data exchange for a slave between the image memory and the PROFIBUS-DP card

With these commands, data exchange between the image memory of a slave and the PROFIBUS-DP card can be forced in the user program at any time. This forcing can take place in the following way:

Fct. code:

- 4 Force data exchange for a slave between the input image memory and the PROFIBUS-DP card.
- 5 Force data exchange for a slave between the output image memory and the PROFIBUS-DP card.
- 6 Force data exchange for a slave between the entire image memory and the PROFIBUS-DP card

5

Structure:

SCON	Channel
	Fct code
	Parameter

Channel	9, 8	
Fct. code	4, 5, 6	; Fct. code
Parameter	0...126	; Slave number

Flags: The error flag is set if the channel is unassigned.

Example: Force data exchange for slave 12 between the output image memory and the PROFIBUS-DP card.

```
SCON      9           ; PROFIBUS-DP channel 9
          5           ; Fct. code 5
          12          ; Slave 12
```

SCON(I) 7: Read status of a slave

The status of a slave can be read with this command. After execution of the command, the slave's status is written to diagnostic register +2. A description of diagnostic register +2 is provided in section 5.1.1.2, 'Diagnostic registers with PROFIBUS-DP'.

Structure:

SCON	Channel
	Fct code
	Parameter

Channel	9, 8	
Fct. code	7	
Parameter	0...126	; Slave number

5

Flags: The error flag is set if the channel is unassigned.

Example: Read status of slave 34.

```
SCON      9      ; PROFIBUS-DP channel 9
          7      ; Fct. code 7
          34     ; Slave 34
```

SCON(I) 8, 9: Deactivate/activate slave

A slave can be activated or deactivated with this command. As soon as the command is executed, diagnostic flag +2 is set to H and when the command finishes, it is set to L. When the command has been executed and the status of diagnostic flag +2 is L, the result of the operation is written to diagnostic register +1. A description of the response code is provided in section 5.1.1.2, 'Diagnostic registers with PROFIBUS-DP'. This command may only be executed when diagnostic flag +2 has the status 0. The deactivation or activation of a slave is triggered by the following fct. codes:

Fct. code:

- 8 Deactivate slave
- 9 Activate slave



Structure:

SCON	Channel
	Fct code
	Parameter

Channel 9, 8
 Fct. code 8, 9 ; deactivate/activate slave
 Parameter 0...126 ; Slave number

Flags: The error flag is set if the channel is unassigned or if the command is called when diagnostic flag +2 is set to H.

Example: Deactivate slave 32.

```

    STH        SERV_BUSY        ; If diagnostic flag +2
    JR    H    NEXT             ; is not H, then SCON

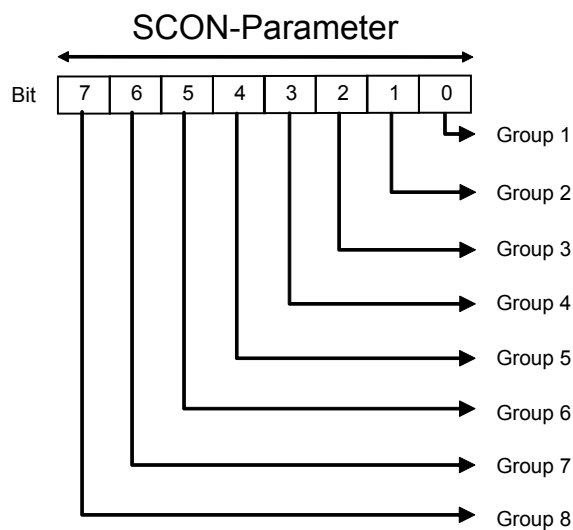
    SCON       9                 ; PROFIBUS-DP channel 9
               8                 ; Fct. code 8
               32                ; Slave 32

    NEXT:
```

SCON(I) 10, 11, 12: Force data exchange for a group of slaves between the image memory and the PROFIBUS-DP card

With this command, data exchange between the image memory of one or more groups of slaves and the PROFIBUS-DP card can be forced in the user program at any time. Assigning a slave to a group takes place with the PROFIBUS-DP configurator.

PROFIBUS-DP supports the formation of a maximum of 8 groups. These groups can be assigned as many slaves as required. The choice of group in the SCON parameter is bit-oriented according to the following pattern:



Forcing can be applied here to more than one group at a time. This forcing can take place in the following way:

Fct. code:

- 10 Force data exchange for a group of slaves between the input image memory and the PROFIBUS-DP card.
- 11 Force data exchange for a group of slaves between the output image memory and the PROFIBUS-DP card.
- 12 Force data exchange for a group of slaves between the entire image memory and the PROFIBUS-DP card.

Structure:

SCON	Channel
	Fct code
	Parameter

Channel 9, 8
Fct. code 10, 11, 12 ; Fct. code
Parameter 0...255 ; Group number

Flags: The error flag is set if the channel is unassigned.

Example: Force data exchange for groups 1 and 2 between the input image memory and the PROFIBUS-DP card.

5

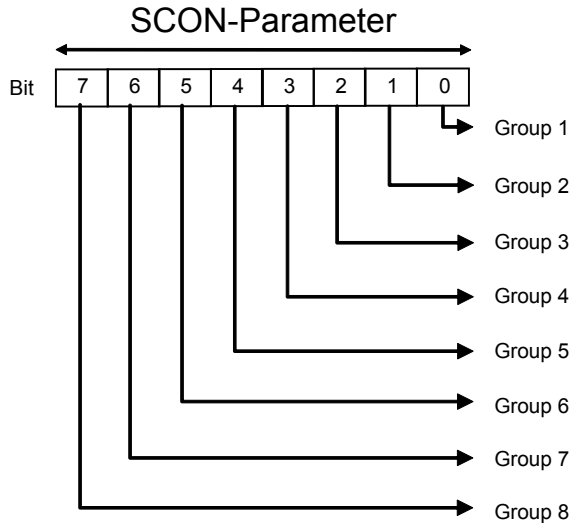
```
SCON        9             ; PROFIBUS-DP channel 9  
             10            ; Fct. code 10  
             3             ; Groups 1 and 2 (00000011)
```

SCON(I) 13, 14: 'Freeze', 'Unfreeze' Global Control Service

With these commands, the 'Freeze' and 'Unfreeze' commands can be triggered for one or more groups of slaves. The command is used for the purpose of input synchronisation. With the 'Freeze' command, the master causes a slave or group of slaves simultaneously to freeze inputs in their present state. The slaves addressed therefore stop their inputs at exactly the same time. In the next data cycle (Data_exch) the slaves transmit the frozen inputs to the master. Any changes at the inputs are not recognised by the slaves and are not passed on to the master either. After the conclusion of this action, the master sends an 'Unfreeze' command to the group. Input changes are now sent again from the slave to the master in the normal data cycle. It is permissible for the master, after one 'Freeze' command, to send further 'Freeze' commands to the slaves. In this case, the current status of inputs is frozen each time and sent to the master in the next data cycle.

Diagnostic flag +1 is set to H as soon as this command is executed. When the command is finished, the flag is set to L and the result of the operation is written to diagnostic register +0. A description of the response code in diagnostic register +0 is provided in section 5.1.1.2, 'Diagnostic registers with PROFIBUS-DP'.

This command may only be executed when diagnostic flag +1 has the status L. Assigning a slave to a group takes place with the PROFIBUS-DP configurator. PROFIBUS-DP supports the formation of a maximum of 8 groups. These groups can be assigned as many slaves as required. The choice of group in the SCON parameter is bit-oriented according to the following pattern:



A 'Freeze' or 'Unfreeze' command can be executed here on several groups simultaneously. Function code to trigger 'Freeze' or 'Unfreeze' commands:

13 Start 'Freeze' command 14 Start 'Unfreeze' command.

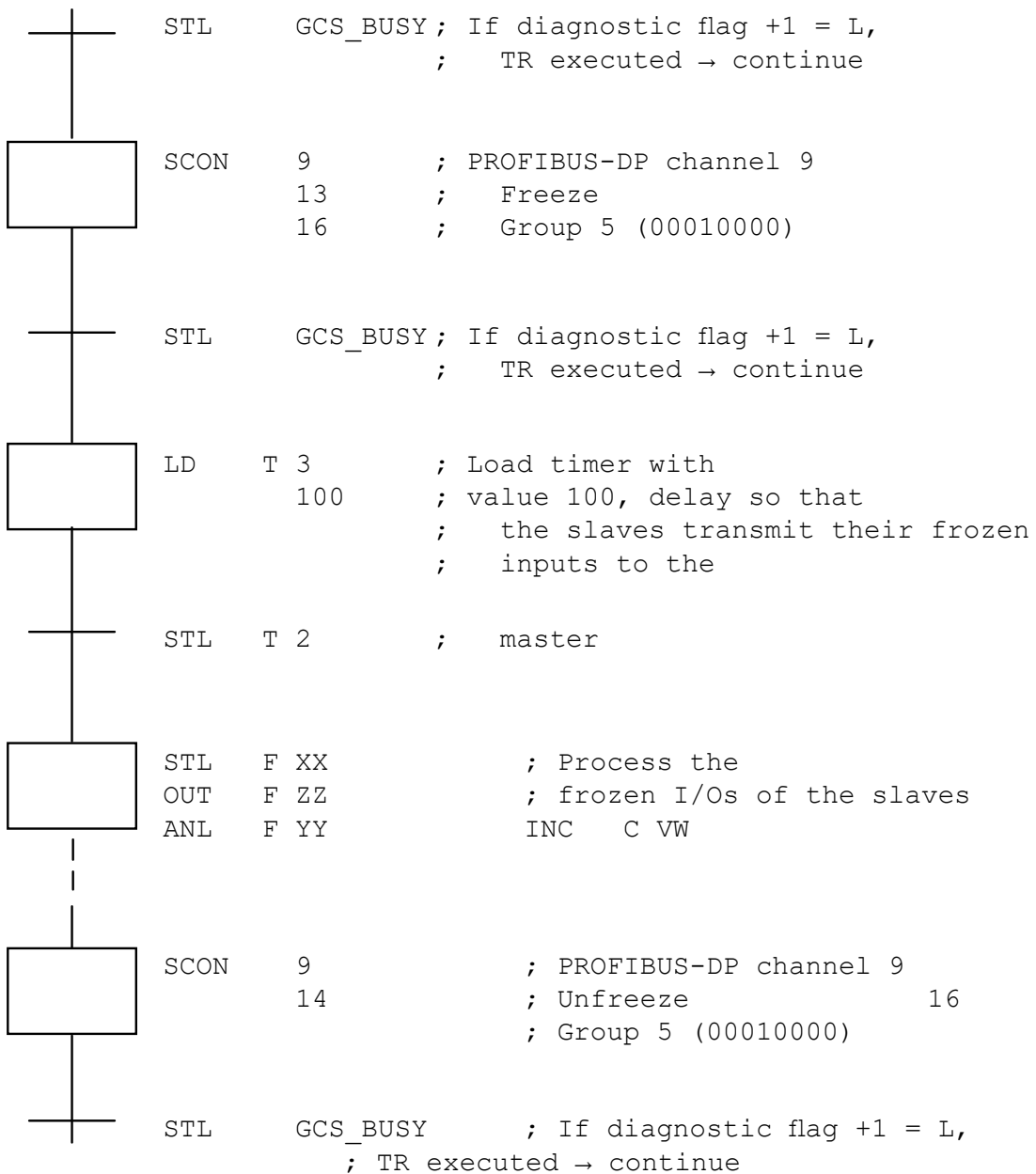
Structure:

SCON	Channel
	Fct code
	Parameter

Channel 9, 8
 Fct. code 13, 14 ; Fct. code
 Parameter 0...255 ; Group number

Flags: The error flag is set if the channel is unassigned or if the command is called when diagnostic flag +1 is set to H.

Example: Execute 'Freeze' and 'Unfreeze' sequence for the slaves of group 5.



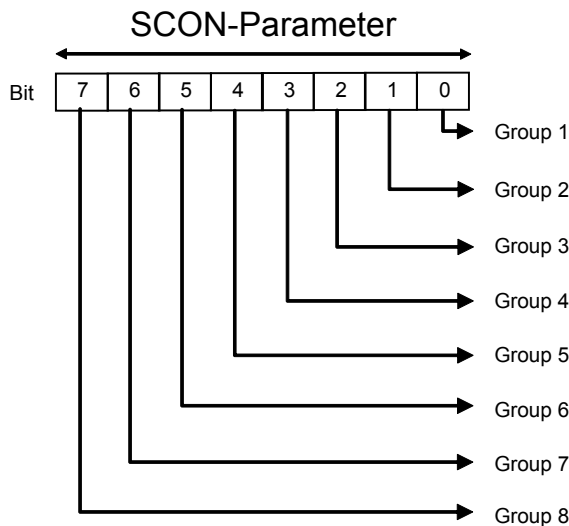
SCON(I) 15, 16: ‘Sync’, ‘Unsync’ Global Control Service

With these commands, the ‘Sync’ and ‘Unsync’ commands can be triggered for one or more groups of slaves. This command is used to synchronise the outputs.

With the ‘Sync’ command, the master causes a slave or group of slaves simultaneously to freeze outputs in their present state. In the next data cycle (Data_exch) the master transfers the output image to the slaves, without the slaves copying this image to their outputs. After the conclusion of this action, the master sends an ‘Unsync’ command to the group. All slave outputs are now switched on or off at precisely the same time and these outputs are again refreshed in the normal data cycle. It is permissible for the master, after one ‘Sync’ command, to send further ‘Sync’ commands to the slaves. In each case, the current output image is copied to the outputs at exactly the same time.

Diagnostic flag +1 is set to H as soon as this command is executed. When the command is finished, the flag is set to L and the result of the operation is written to diagnostic register +0. A description of the response code in diagnostic register +0 is provided in section 5.1.1.2, ‘Diagnostic registers with PROFIBUS-DP’. This command may only be executed when diagnostic flag +1 has the status L.

Assigning a slave to a group takes place with the PROFIBUS-DP configurator. PROFIBUS-DP supports the formation of a maximum of 8 groups. These groups can be assigned as many slaves as required. The choice of group in the SCON parameter is bit-oriented according to the following pattern:



A ‘Sync’ or ‘Unsync’ command can be executed here on several groups simultaneously.

Function code to trigger ‘Sync’ or ‘Unsync’ commands:

15 Start ‘Sync’ command 16 Start ‘Unsync’ command.

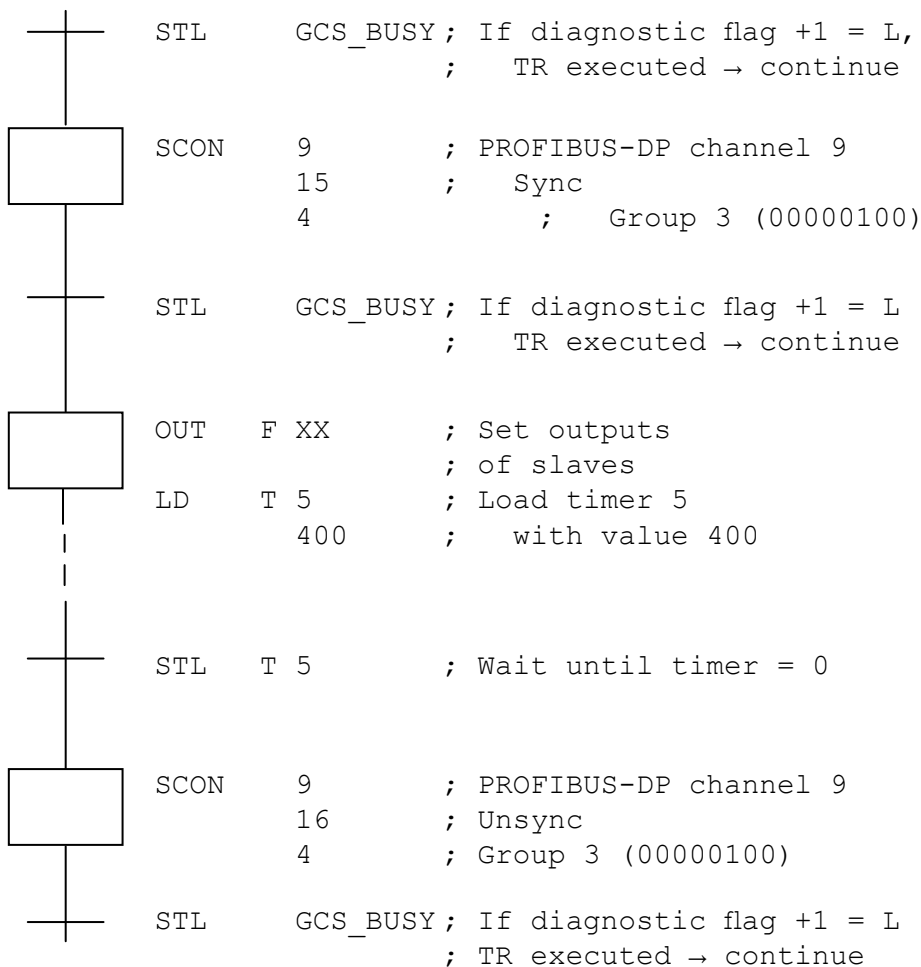
Structure:

SCON	Channel
	Fct code
	Parameter

Channel 9, 8
 Fct. code 15, 16 ; Fct. code
 Parameter 0...255 ; Group number

Flags: The error flag is set if the channel is unassigned or if the command is called when diagnostic flag +1 is set to H.

Example: Execute a 'Sync' and 'Unsync' sequence for the slaves of group 3.



5.2.4 History message log

In the event of problems with PROFIBUS-DP, the following error message is stored in the history log:

PROF DP FAIL xxx

ERR#	Description
0	Key word MODE: not found
0	Wrong mode specified
0	Key word CONF: not found
0	DBX key word not specified
0	DBX number error
0	DBX number too large
0	DBX does not exist
0	Key word DIAG: not found
0	Flag or output key word not specified in DIAG
0	Error in address of diag. flag or output
0	Range error diag. flag or output
0	Register key word not specified in DIAG
0	Range error diag. register
1	PROFIBUS-DP HW card not present
2	Error in command
3	DBX structure error
4	DBX type not for DP master (no PROFIBUS DBX)
5	FW-DBX version not compatible
6	No IN RING message after timeout on initialisation
7	Semaphore error for data exchange (info to PCD support)
8	DBX error: data transfer function not implemented
9	Incompatible PCD7.F75xx and PCD hardware

5.3 Rules for writing the user program

To begin with, here are the main rules for the PROFIBUS-DP user program once again:

- As usual with Saia PCDs, each communications interface must be initialised with a SASI command. This normally occurs in XOB 16.
- In the master PCD, media are reserved for all I/Os and registers of PROFIBUS-DP slaves. Access to these slave I/Os and registers takes place in the master program via these master media. The master media are grouped in the image memory. If slave I/Os are accessed in the master program, it is always this image memory that is accessed, not the actual I/Os.
- Data exchange between the image memory and the PROFIBUS-DP card (and the slaves) can be automatic or controlled by the user program. Only after data exchange has been executed between the image memory and the PROFIBUS-DP card (and the slaves) will slave I/Os be read or written.
- To enable automatic data exchange between the image memory and the PROFIBUS-DP card's memory (and the slaves), the beginning of COB 0 (COB 0) and end of COB 0 (ECOB) must be processed. At the beginning of COB 0, slave inputs are copied from the PROFIBUS-DP card's memory to the master PCD's input image memory. At the end of COB 0, the master PCD's output image memory is copied to the PROFIBUS-DP card's memory.
- By means of SCON commands, it is possible in the user program to force data exchange between the image memory and the PROFIBUS-DP card's memory.

5.4 Structure of the user program

5.4.1 Cold-start program in XOB 16

In XOB 16 the PROFIBUS-DP interface is initialised with the SASI command. The SASI texts generated by the PROFIBUS-DP configurator are used for this purpose.

Example:

```
XOB          16
SASI         9          ; Channel 9
            txt_1DP     ; Text from configurator

EXOB
```

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5.4.2 Main program in COB

To enable automatic data exchange between the image memory and the PROFIBUS-DP card's memory (and the slaves), the start of COB 0 (COB 0) and end of COB 0 (ECOB) must be processed. Data exchange between the image memory and the PROFIBUS-DP card's memory (and the slaves) can, if required, be controlled by the user program or forced. This is mainly used in large user programs when reactions are needed to time-critical I/O signals from slaves.

Example 1:

Automatic data exchange between the image memory and the PROFIBUS-DP card's memory in BLOC TEC structure.

```
COB          0          ; Copy slave inputs from
            0          ; PROFIBUS-DP card's memory to master PCD's
            ; input image memory.

STH          XX
ANL          YY          ; Code with which the slave media
OUT          ZZ          ; are accessed

ECOB          ; Data from output image memory
            ; is copied to the PROFIBUS-DP
            ; card's memory
```


Example 2:

Automatic data exchange and data exchanged forced by the user program between the image memory and the PROFIBUS-DP card's memory in a BLOCTEC structure.

```

COB      0      ; Copy slave inputs from the PROFIBUS-DP
          0      ; card's memory to the master PCD's
          ; input image memory.

STH      F XX
ANL      F YY ; Code with which the slave media
OUT      F BZ ; are accessed

CPB      2      ; Call PB with which the
          ; slave inputs from the PROFIBUS-DP
          ; card's memory are to be copied to the
          ; master PCD's input image memory

STH      F XX
ANL      F YY
          ; Code with which the slave media
OUT      F AZ ; are accessed

ECOB      ; Data from the output image memory
          ; is copied to the PROFIBUS-DP
          ; card's memory

PB       2      ; PB to refresh the inputs

SCON     9      ; Channel 9
          3      ; Fct. code 3 with parameter 1 =
          1      ; Force data exchange for all
          ; slaves between the input image memory
          ; and PROFIBUS-DP card

EPB

```

Example 3:

The slave I/Os must be coherent in a structured program with several COBs within a program cycle. In order to keep the same data status throughout the entire program, the I/Os are not accessed in COB 0.

```

COB      0      ; Copy slave inputs from PROFIBUS-DP
           0      ; card's memory to the master PCD's input
           ; image memory.
           ; COB 0 is only used for data exchange.
           ; The data provided is then processed
           ; by the other COBs.

ECOB

COB      1      ; Actual user program
           0      ; in which the slave media are accessed.

STH      F XX
ANL      F YY ; Code with which the slave media
OUT      F AZ ; are accessed

ECOB      ; End of COB 1

COB      2
           0

STH      F XX
ANL      F YY ; Code with which the slave media
ANL      F AZ ; are accessed OUT      F AY

ECOB      ; End of COB 2

```

6. Commissioning a PROFIBUS-DP network

Commissioning a PROFIBUS-DP network is completed in two steps:

- a) Checking and testing the hardware installation (physical layer)
- b) Checking and testing layer 7 (configuration and data exchange)

6.1 Checking and testing the hardware installation (physical layer)

Experience shows that the main causes of communications problems lie in inadequate or incorrect hardware installation. For this reason, great importance must be attached to this part of the commissioning process.

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The following checks and tests should be carried out scrupulously:

- Connection and laying of bus cable (terminals and connectors, shielding, stub cables, laying power cables, etc.)
- Check and adjust line termination resistors, repeaters, etc.
- Check the bus line for through transmission
- Check the electrical signal level, etc.

A detailed description of these checks and tests (also called static tests) can be found in the manual «Installation components for RS-485 networks» (doc. no. 26-740).

6.2 Checking and testing data exchange

These tests are to check data exchange between the master and slaves and the correct mapping of slave I/Os to master media.

6.2.1 Checking data exchange

1. Create the network with the PROFIBUS-DP configurator. For this, all stations present in the network must be defined with all I/Os. The correct baud rate must also be entered.

2. Write a basic program in PG5, which must contain the following program instructions:

```
XOB          16          ; Cold start routine
SASI         9          ; Start PROFIBUS-DP
              txt_1DP

EXOB

COB          0          ; Update inputs from PROFIBUS-DP
              0

ECOB          ; Update outputs from PROFIBUS-DP
```

3. Assemble and link the basic program and the PROFIBUS-DP configuration.
4. Load the program into the master controller.
5. Start the program
6. Check diagnostic flag DATA_EXCH.
This flag signals the operating status of data exchange on the PROFIBUS-DP network. 'H' means that data exchange is running on the PROFIBUS-DP network. 'L' means that data exchange is not running on the PROFIBUS-DP network.

Possible errors:

- No master in network
- No PROFIBUS-DP card plugged into PCD
- Incorrect FW or HW version
- No SASI instruction
- No COB 0, ECOB instruction.

7. Check diagnostic flag SLAVE_ERR.

If this flag = L, slave stations are addressed without error. If this flag = H, one or more slave stations has an error. To discover the faulty station, diagnostic registers 'base+3' to 'base+6' can be used. The diagnostic data of the faulty slave can then be read with the SCON command using function code 2.

Possible errors:

- Station number in slave does not match the station number in the PROFIBUS-DP configurator
- Several slaves have the same station number
- Wiring is incorrect.
(Short circuit between A and B, or A and B have been mixed up)
- Slave does not support the selected baud rate
- Slave has been incorrectly configured
- The slave's GSD file does not match the slave device.

6.2.2 Checking the mapped media

This test checks the correct addressing of slave I/Os. After data exchange between the master and the slaves has been checked according to section 6.2.1, the following test can be performed:

1. The program described in section 6.2.1 is loaded into the master controller.
2. Start the program
3. In PG5, the debugger is used to access individual media of the slave I/Os. For this purpose the slave inputs are displayed with a 'Display Flag' command and the slave outputs are described with a 'Write Flag' command.
4. Check that the right I/Os on the right slaves are read or switched on/off.

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Possible errors:

- Station number in slave does not match the station number in the PROFIBUS-DP configurator
- Several slaves have the same station number
- Several I/Os have been mapped to the same medium
- Slave has been incorrectly configured.
- The slave's GSD file does not match the slave device
- PROFIBUS-DP media are already used in the user program.

6.2.3 Use of bus monitors

If the checks and tests described in the previous sections do not produce the desired results, a bus monitor must be used for further tests and analyses.

A bus monitor is a testing tool for the commissioning, maintenance and diagnosis of PROFIBUS-DP networks. As a passive tool, it does not affect the bus in any way and does not require a station address, nor does it have to be considered during project planning.

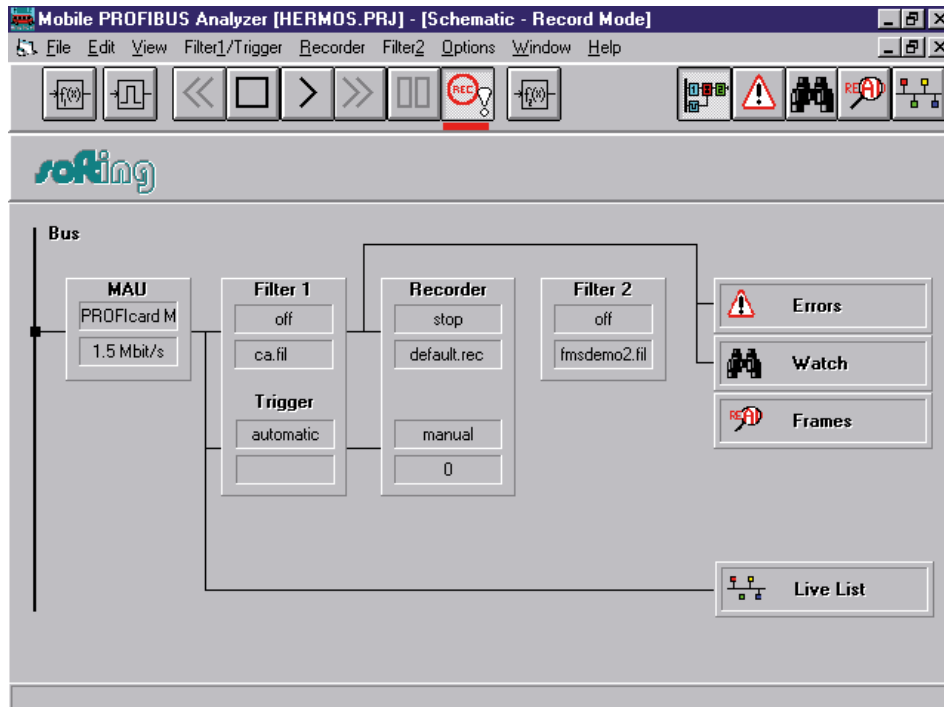
In online operation, the bus monitor traces telegram communications and displays either the «Live List» of stations connected to the bus, or certain bus characteristics. In offline operation, the data recorded can be assessed and a telegram analysis can be carried out on layer 2 or 7 of the communication model.

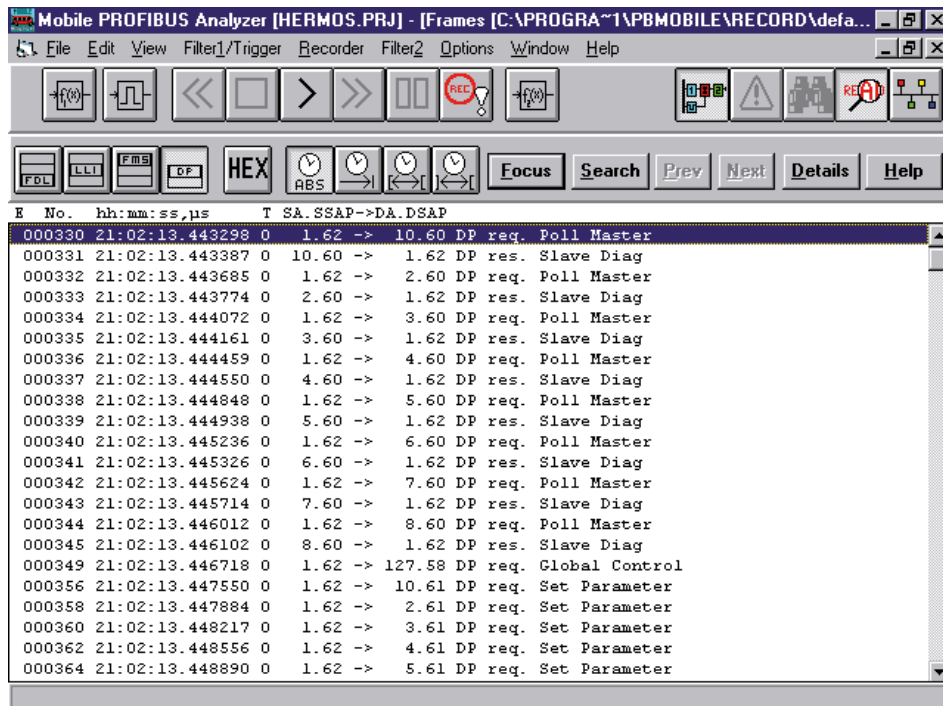
Bus monitor manufactured by Softing (Germany)

This bus monitor consists of MS-WINDOWS software, a PCMCIA card and a TAP (Terminal Access Point) adapter, which provides the physical connection between the PCMCIA card and the PROFIBUS.

This monitor can be used with a portable PC to trace and analyse FMS and DP telegrams with time stamping up to baud rates of 12 Mbps. Extensive adjustable filter functions allow detailed troubleshooting and error analysis.

More information and addresses can be found in the electronic PROFIBUS product catalogue (available from the PROFIBUS user organisation).








Working with the bus monitor

Unfortunately, use of a bus monitor still requires the user to have very extensive and thorough knowledge of PROFIBUS. The user must at least be in a position to interpret and understand the DP telegrams traced in order to carry out an analysis and troubleshooting. This means that the user must, for example, be able to interpret the coding of DP telegrams.

A Appendix

A.1 Icons

	In manuals, this symbol refers the reader to further information in this manual or other manuals or technical information documents. As a rule there is no direct link to such documents.
	This symbol warns the reader of the risk to components from electrostatic discharges caused by touch. Recommendation: Before coming into contact with electrical components, you should at least touch the negative pole of the system (cabinet or PGU connector). It is better to use a grounding wrist strap with its cable permanently attached to the negative pole of the system.
	This sign accompanies instructions that must always be followed.

A.2 Company address of Saia-Burgess Controls AG

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