Universal bus node
CTEU-PB

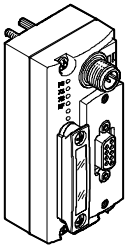
FESTO

Electronics description

Bus nodes

Type CTEU-PB

Fieldbus protocol
PROFIBUS-DP



Description
575393
en 1208NH
[758863]

Original ..... de

Edition ..... en 1208NH

Designation ..... P.BE-CTEU-PB-OP+MAINT-EN

Order no. 575393

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Intended use

The bus node CTEU-PB documented in this description has been designed exclusively for use as a station (slave) on the PROFIBUS-DP fieldbus.

The bus node may only be used as follows:

- as intended
- in original condition, without unauthorised modifications. Only the conversions or modifications described in the documentation supplied with the product are permitted.
- in excellent technical condition.
  The limit values specified for pressures, temperatures, electrical data, torques etc. must be complied with.

Observe the regulations of the trade associations, German Technical Control Board (TÜV), VDE stipulations or corresponding national laws and regulations.

Range of application and certifications

The product fulfils the requirements of EU directives and is marked with the CE marking.

CE

Standards and test values which the product complies with and fulfils can be found in the Technical appendix. The product-relevant EC directives can be found in the declaration of conformity.

Certificates and declarations of conformity for this product can be found at www.festo.com.

Target group

This description is intended exclusively for technicians trained in control and automation technology who have experience in installing, commissioning, programming and diagnosing programmable logic controllers (PLCs) and participants on the PROFIBUS-DP fieldbus.

Service

Please consult your local Festo Service if you have any technical problems.

Instructions on this description

This description includes specific information about the configuration, parameterisation, commissioning, programming and diagnostics of the bus node with the PROFIBUS-DP fieldbus protocol.

Information for mounting the bus node on the CAPC-... electrical connection box can be found in the assembly instructions supplied with the electrical connection box.
Information about other bus nodes and components of the CTEU... product family can be found in the product documentation for the respective product.

Important user instructions

Danger categories

This description includes instructions on the possible dangers which can occur if the product is used incorrectly. These instructions are marked with a signal word (Warning, Caution, etc.), printed on a shaded background and marked additionally with a pictogram.
A distinction is made between the following danger warnings:

Warning
... means that failure to observe this instruction may result in serious personal injury or material damage.

Caution
... means that failure to observe this instruction may result in personal injury or material damage.

Note
... means that failure to observe this instruction may result in material damage.

In addition, the following pictogram marks passages in the text which describe activities with electrostatically sensitive devices:

Electrostatically sensitive devices: Incorrect handling may cause damage to devices.

Marking special information

The following pictograms mark passages in the text which contain special information.

Pictograms

Information:
Recommendations, tips and references to other information sources.

Accessories:
Specifications on necessary or useful accessories for the Festo product.

Environment:
Information on the environmentally friendly use of Festo products.

Text designations

- Bullet points denote activities that may be carried out in any sequence.

1. Numerals denote activities that must be carried out in the sequence specified.

– Arrowheads indicate general lists.

The following product and fieldbus-specific terms and abbreviations are used in this description:

Term/abbreviation	Significance
Bus nodes	create the connection to certain fieldbuses/networks, pass on control signals to the connected devices/modules and monitor their functioning.
CLEAR_DATA	This command, sent by the master, resets all outputs of the addressed slave.
DI, DO, DX	Digital inputs (DI) or outputs (DO) or digital inputs and outputs (DX)
DIL switches	Dual-In-Line switches usually comprise several switch elements that can be used to make hardware settings.
DP	PROFIBUS protocol for decentralised peripheral equipment, such as sensors and actuators, and their cyclical communication functions (data exchange and diagnostic messages) through DPV0-protocol or acyclic, need-dependent data exchange and alarm handling through DPV1-protocol.
$F0_h$	Hexadecimal numbers are marked by a low-set “h”.
Fail state	This is a function which can automatically activate the “Hold last state” in the event of connection errors (program abort or timeout of the fieldbus connection) and is also designated “fail safe” in some cases.
FREEZE	This command, sent by the master, freezes all inputs of the slave. The slave now sends a constant image of all inputs, independent of their further change in status. The input image is updated with each further transmission of the FREEZE command. A FREEZE command is cancelled with UNFREEZE.
GSD	General Station Description (or Gerätestammdatei - device master file) stands for the individual electronic data sheet of the device type. It is made available by the device manufacturer.
Hold last state	defines the status which outputs/valves are to assume after fieldbus and/or communication errors
I & M	stands for ‘Identification and Maintenance’ and represents the electronic name plate of the bus node.
Load voltage	includes the power supply for connected devices and (digital) outputs, e.g. solenoid coils of valves

Term/abbreviation	Significance
Master	The master/DP master is an active device that determines the data traffic in the fieldbus system PROFIBUS-DP and may send messages/commands without external request if there is a transmission authorisation. The DP master can be an individual device or part of a programmable logic controller (PLC).
O, I	Digital output, digital input
OB	Output byte
Operating voltage	also designated signal voltage : includes the power supply for electronics and sensors
PLC	Programmable Logic Controller (German: Speicherprogrammierbare Steuerung (SPS))
Power supply	Heading term for operating and load voltage supplies
PROFIBUS DP	is the PROFIBUS variant for speed-optimised, serial data exchange with decentralised stations and is performed cyclically with the protocol DPV0.
Slave	The slave/DP slave is a passive peripheral device that receives messages/ commands of the master, implements and acknowledges them or re-sponds with a message on request of a master.
Station address	Address of the fieldbus station, also designated PROFIBUS address or station number
Status bits	Internal inputs, which supply coded common diagnostic messages
PLC/IPC	programmable logic controller/industrial PC, also designated system controller or controller (German: SPS)
SYNC	A SYNC command causes all slaves addressed by the master to freeze their own output data and buffer the data transferred from the master, which will be switched through to the physical outputs at the next SYNC command. A SYNC command is cancelled with UNSYNC.

Tab. 0/1: Terms and abbreviations

Installation

Chapter 1

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1.1 General instructions on installation

Warning
Danger of injury through uncontrolled movements of connected equipment.

Make sure that electrical and pneumatic equipment are in a de-energised and pressureless status.

Before working on the pneumatics:

- Switch off the compressed air supply
- Vent the valve terminal

Before working on the electrical components, e.g. before installation or maintenance work:

- Switch off power supply

In this way, you can avoid:

– uncontrolled movements of loose tubing
– accidental and uncontrolled movements of the connected actuators
– undefined switching states of the electronics

Caution
The bus node includes electrostatically sensitive devices.

- Do not touch any electronic components.
- Observe the handling specifications for electrostatically sensitive devices.

They will help you avoid damage to the electronics.

Note
Use protective caps or blanking plugs to seal unused connections. You will then achieve protection class IP65.

1.2 Mounting

The bus node can be directly mounted on appropriate equipment (e.g. valve terminals with I-Port connection) from Festo or decentralised on the electrical connection box.

Note
Information on mounting the bus node on the decentralised electrical connection box type CAPC-... can be found in the assembly instructions that accompany the connection box.

Mounting on valve terminal

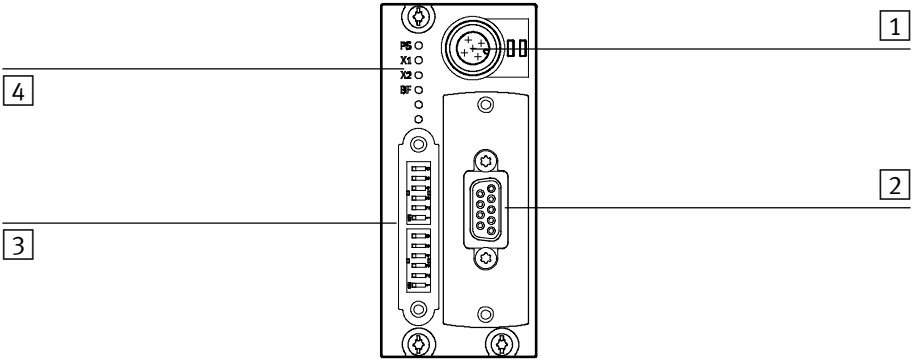
For mounting the bus node, a valve terminal from Festo with I-port connection is required.

Proceed as follows:

1. Inspect the seals and sealing surfaces on bus node and valve terminal.
2. Plug the bus node onto the valve terminal in the right position and without tilting.
3. First, lightly screw in the three self-tapping screws with a Torx screwdriver (size T10). Use existing threads, if available.
4. Tighten the screws with 1.0 Nm.

1.2.1 Connection and display components

The following electrical connection and display components can be found on the bus node (see Fig. 1/1):



1 Power supply connection for bus node and connected devices, if applicable (e.g. valve terminal)

2 Fieldbus connection (D-sub plug)

3 DIL switch group 1 and 2

4 Status LEDs (status display/diagnostics ➔ chap. 3.2)

Fig. 1/1: Connection and display components on the bus node

1.3 Power supply

The bus node has separate operating and load voltage supplies. The bus node also supplies voltage to equipment connected via the I-port interface.

Warning

- For the electrical power supply, use only PELV **circuits** in accordance with IEC/EN 60204-1 (Protective Extra-Low Voltage, PELV).
  Also take into account the general requirements for PELV circuits in accordance with IEC/EN 60204-1.
- Only use power **sources** which guarantee reliable electrical isolation of the operating voltage in accordance with IEC/EN 60204-1.

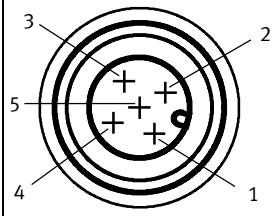
Through the use of PELV circuits, protection from electric shock (protection from direct and indirect contact) in accordance with IEC/EN 60204-1 is ensured (Electrical equipment of machines. General requirements).

1.3.1 Power supply connection

Interface specifications

The bus node is equipped with a power supply connection in accordance with IEC 61076-2-101:

- Round plug connector M12
- Plug (male)
- A coded
- 5-pin

M12 connection, A-coded	Pin	Allocation		Function
	1	24 $V_{EL/SEN}$	(PS)	Operating voltage supply
	2	24 $V_{VAL/OUT}$	(PL)	Load voltage supply
	3	0 $V_{EL/SEN}$	(PS)	Operating voltage supply
	4	0 $V_{VAL/OUT}$	(PL)	Load voltage supply
	5	FU [1)]		Functional earth
1) The connection to functional earth must also be ensured via the connected device or electrical connection box CAPC-....				

Tab. 1/1: Pin allocation of the power supply

For the connection to power supply units or the power supply, use cables with M12 coupling (socket plug connector), A-coded, in accordance with IEC 61076-2 (➔ Accessories ➔ www.festo.com/catalogue).

1.4 Setting the DIL switches

Parameters

With the DIL switches, you set the following parameters for the bus node (incl./excl. connected equipment):

- Operating mode
- PROFIBUS station address
- Diagnostics mode

1.4.1 Removal and mounting of the DIL switch cover

To set the bus node, the cover of the DIL switches must be removed.

Caution
The bus node includes electrostatically sensitive devices.
- Do not touch any electronic components.
- Observe the handling specifications for electrostatically sensitive devices.

They will help you avoid damage to the electronics.

Proceed as follows:

Dismounting

1. Switch off the power supply.
2. Unscrew the two mounting screws of the transparent cover.
3. Lift off the cover.

Mounting

1. Place the cover carefully on the bus node.

Note
- Make sure that the seal is seated correctly!

2. Tighten the two mounting screws at first hand-tight and then with a max. torque of 0.4 Nm.

1.4.2 Setting the DIL switches

Proceed as follows:

1. Switch off the power supply.
2. Remove the DIL switch cover (chap. 1.4.1).
3. Assign a still unused station address to the bus node.
4. Activate/deactivate the diagnostics mode.
5. Set the Fail state characteristics.
6. Mount the DIL switch cover (chap. 1.4.1).

[1] DIL switches 1 ... 7: station address

[2] DIL switches 8 ... 10: reserved (standard setting: OFF)

[3] DIL switch 11: diagnostics mode

[4] DIL switch 12: Fail state mode

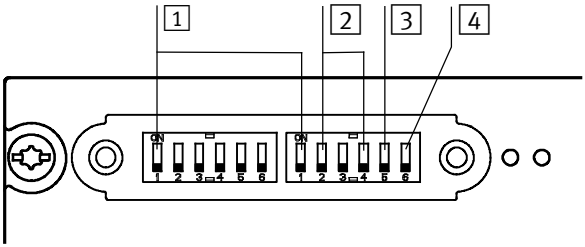


Fig. 1/2: DIL switch groups in the bus node

Setting the station address with DIL switches

Set the station address of the bus node binary coded using the switch elements 1 ... 7 (Fig. 1/2, item 1) of the DIL switch. The following station addresses are permissible:

Protocol	Address designation	Permissible station addresses
PROFIBUS DP	PROFIBUS station address	1 ... 125

Note
- Station addresses may only be assigned once per higher-level master.
- Assign the station addresses in ascending order.
- Assign the station addresses to suit the machine structure of your system.

Station address examples

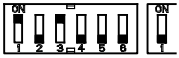
Station address “5”							
DIL switch setting at the bus node							
	ON	OFF	**ON**	OFF	OFF	OFF	OFF
Binary notation	2^0	2^1	2^2	2^3	2^4	2^5	2^6
Binary number	1	0	1	0	0	0	0
Decimal number	1	0	4	0	0	0	0
	$2^0 + 2^2 = 1 + 4 = 5$						

Fig. 1/3: Station address coding, example 1

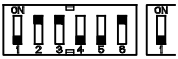
Station address “38”							
DIL switch setting at the bus node							
	OFF	**ON**	**ON**	OFF	OFF	**ON**	OFF
Binary notation	2^0	2^1	2^2	2^3	2^4	2^5	2^6
Binary number	0	1	1	0	0	1	0
Decimal number	0	2	4	0	0	32	0
	$2^1 + 2^2 + 2^5 = 2 + 4 + 32 = 38$						

Fig. 1/4: Station address coding, example 2

Reserved DIL switches

Leave the DIL switches 8 ... 10 (Fig. 1/2, item 2) on OFF (standard setting) so that no undesired actions are triggered in the case of a later extension of function.

Setting the diagnostics mode with DIL switches

You set the device-related diagnostics of the PROFIBUS-DP with the switch element 11 (Fig. 1/2, item 3) of the DIL switch groups.
If the device-specific diagnostics are activated (ON), device-specific diagnostic information of the bus node will be sent to the higher-order master, e.g. short circuit of the outputs or undervoltage of the valves.

Setting the Fail state mode with DIL switches

You set the Fail state behaviour of the bus node with the switch element 12 (Fig. 1/2, item 4) of the DIL switch groups. Constellations of Fail state behaviour can be found in chap. 2.8.

1.5 Connecting the fieldbus

1.5.1 Fieldbus cable

Note
Faulty installation and high transmission rates may cause data transmission errors as a result of signal reflections and attenuations.

- Always use a bus terminal on both ends of the fieldbus segment (see chap. 1.5.6)
- Connect the screening continuously to all fieldbus cables and earth the screening only once to avoid ground loops.
- Observe the specifications in the product documentation of your control system regarding cable type, usable T-adapters and max. length of branch lines.
- In calculating the max. permissible length of the fieldbus cable dependent on the baud rate used, also consider the sum of the length of the branch lines.

Note
If the bus node is installed on a movable mounting in a machine, the fieldbus cable must be provided with strain relief on the moving part of the machine. Also observe the corresponding regulations in EN 60204 Part 1.

1.5.2 Cable specifications

For fieldbus communication, use a twisted, screened two-wire cable in accordance with the PROFIBUS specification (EN 50170, cable type A):

Surge impedance:	135 ... 165 ohms (3 ... 20 MHz)
Capacity per unit length:	‹ 30 nF/km
Loop resistance:	‹ 110 ohms/km
Wire diameter:	› 0.64 mm
Wire cross section:	≥ 0.34 mm^2

Fieldbus segment length

Precise specifications on the fieldbus segment length can be found in chap. 1.5.3 and in the product documentation of your control system.

1.5.3 Fieldbus baud rate and fieldbus length

Note
The maximum permissible fieldbus segment lengths (cable length without repeater) are dependent on the baud rate used.

- Observe the maximum permissible segment length if you connect the bus node to a fieldbus segment.
- Avoid branch lines.

The baud rate is specified by the master. It limits the usable cable lengths (see Tab. 1/2).

Cable length (approximate values) dependent on the data rate (baud rate)

Baud rate [1]	Segment length [2]	Branch line length [3] (total)
9.6 kBaud	Max. 1200 m	Max. 500 m
19.2 kBaud	Max. 1200 m	Max. 500 m
93.75 kBaud	Max. 1200 m	Max. 100 m
187.5 kBaud	Max. 1000 m	Max. 33.3 m
500 kBaud	Max. 400 m	Max. 20 m

Cable length (approximate values) dependent on the data rate (baud rate)		
Baud rate [1]	**Segment length [2]**	**Branch line length [3] (total)**
1.5 MBaud	Max. 200 m	Max. 6.6 m
3 ... 12 MBaud	Max. 100 m	–

[1] The baud rates named here are approximate values and are not supported by all masters.
[2] Trunk line
[3] Drop line

Tab. 1/2: Maximum cable lengths (approximate values)

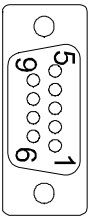
1.5.4 Fieldbus interface at the bus node

There is a 9-pin sub-D socket on the bus node for connection to the fieldbus.
This connection is used for the supply line and continuation of the fieldbus cable. Connect the bus node with the fieldbus plug from Festo type FBS-SUB-9-GS-DP-B.

➔

Note
Before connecting the sub-D plugs of other manufacturers:

- Replace the two flat screws with bolts (type UNC 4-40/M3x5) from Festo accessories (➔ Accessories ➔ www.festo.com/catalogue).

D-sub socket	Pin	Fieldbus plug from Festo[1)]	Signal connection	Designation
	1	-	Screening	Connection to functional earth
	2	-	n.c.	not connected
	3	B	**RxD/TxD-P**	**Reception/transmitted data P**
	4	-	CNTR-P [2)]	Repeater control signal [2)]
	5	-	DGND	Data reference potential (M5V)
	6	-	VP	Supply voltage plus (P5V)
	7	-	n.c.	not connected
	8	A	**RxD/TxD-N**	**Reception/transmitted data N**
	9	-	n.c.	not connected
	Housing	Clamp strap	Screening	Connection to functional earth

[1)] Type FBS-SUB-9-GS-DP-B, part no. 532216, IP65
[2)] The repeater control signal CNTR-P is a TTL signal.

Tab. 1/3: Pin allocation of the fieldbus interface of the bus node

1.5.5 Connection technology for fieldbus interface

Note
Use protective caps or blanking plugs to seal unused connections. You will then achieve protection class IP65.

Connection with fieldbus plugs from Festo

With a fieldbus plug, you connect the bus node conveniently to the fieldbus without the use of pre-made cable.

Use the fieldbus plug, type FBS-SUB-9-GS-DP-B from the Festo accessories (➔ Accessories ➔ www.festo.com/catalogue).

T-TAP function

You can disconnect this fieldbus plug from the bus node without interrupting the fieldbus cable (T-TAP function).

DIL switches

With the DIL switch in the fieldbus plug, you can switch the following:

DIL switch setting	Bus terminal	Continuation of the fieldbus line
OFF	Disabled	Enabled
ON	Enabled	Disabled

Note
The fieldbus plug, type FBS-SUB-9-GS-DP-B, switches the continuing fieldbus line off if the bus terminal is activated.

1 Folding cover with inspection window

2 Blanking plug if connection unused

3 Clamp strap for screened connection

4 Fieldbus incoming (IN)

5 Switch for bus terminal and continuing fieldbus

6 Fieldbus continued (OUT)

7 Only capacitively connected

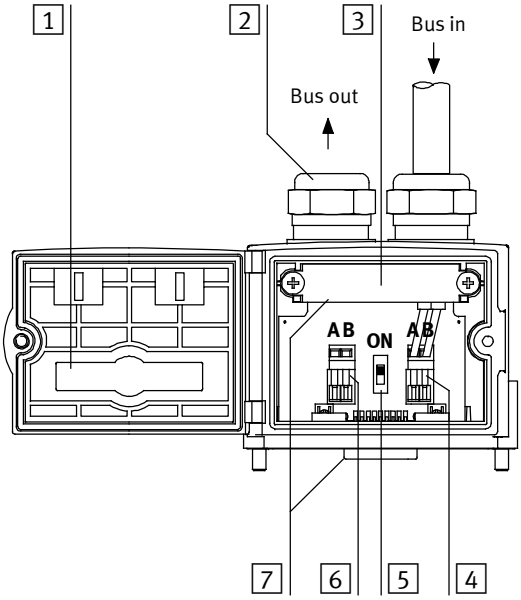


Fig. 1/5: Fieldbus plug from Festo, type FBS-SUB-9-GS-DP-B

Note
The clamp strap in the fieldbus plug from Festo is connected internally only capacitively with the metal housing of the Sub-D plug. This is to prevent compensating currents flowing through the screening of the fieldbus line.

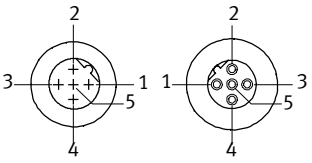
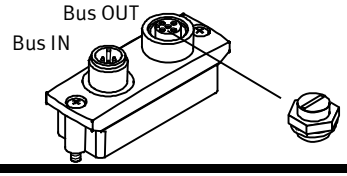
Note
Observe the assembly instructions for the fieldbus plug. Tighten the two mounting screws with max. torque of 0.4 Nm!

Connection with M12 adapter (reverse key coded)

With the M12 adapter, you connect the bus node conveniently to the fieldbus with the use of pre-made cable. You can disconnect the M12 adapter from the bus node without interrupting the bus line (T-TAP function).

Connection to the fieldbus is made with a 5-pin M12 plug with PG 9 fitting. Use the second socket for continuation of the fieldbus.

Use M12 adapters, type FBA-2-M12-5POL-RK from the Festo accessories (➔ Accessories ➔ www.festo.com/catalogue).

M12 adapter **Reverse key, B-coded**	**Pin no.** **Bus IN**	**Pin no.** **Bus OUT**
	1. n.c. 2. **RxD/TxD-N** 3. n.c. 4. **RxD/TxD-P** 5. FE M12 thread: functional earth FU, screening	1. VP (P5V) 2. **RxD/TxD-N** 3. DGND (M5V) 4. **RxD/TxD-P** 5. FE M12 thread: functional earth FU, screening
FBA-2-M12-5POL-RK 		

Tab. 1/4: Pin allocation of the M12 adapters for the fieldbus interface

Connection with fibre-optic cables (FOC)

The PROFIBUS-DP interface of the bus node corresponds to the specification EN 50170-2 and supports the control of network components for fibre-optic cables.

Use fibre-optic cables for transmission in environments subject to heavy interference as well as for extending the working range at high transmission rates.

Examples for fibre-optic cable network components:

- Siemens Optical Link Module (OLM) for PROFIBUS plus
- Siemens Optical Link Plug (OLP) for PROFIBUS (IP 20)
- Harting Han-InduNet® media converter IP 65 (optical data transmission in the DESINA installation concept)

1.5.6 Bus terminal

Note
Each fieldbus segment must be terminated at the start and end to minimise data transmission errors due to signal reflections and attenuations.

- To terminate, use a bus terminal network on both ends of the fieldbus segment (see Fig. 1/6).
- Never use more than two activated bus terminals within a fieldbus segment.

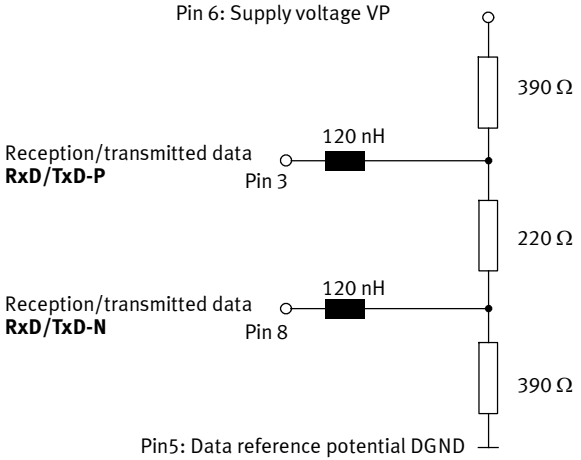


Fig. 1/6: Circuit diagram of a bus terminal network in accordance with EN 50170

Recommendation:
Use the fieldbus plugs from Festo for the bus terminal (see Fig. 1/5). A bus terminal network that can be connected and disconnected is integrated in the housing of this plug.

1.5.7 Functional test

Check the operating status of the bus node using the status LEDs:

– The LED **PS** is illuminated green when the power supply is present at both circuits.

– The LEDs **X1** and/or **X2** illuminate green when a device is connected.

Check for error-free communication between bus node and master using the status LEDs:

– The LED **BF** is not illuminated in the normal operating status.

See also chap. 2.9.4, Normal operating status.

Commissioning

Chapter 2

Table of contents

2.1 General remarks on the fieldbus protocol PROFIBUS-DP

The CTEU-... product family enables the creation of a decentralised automation system in a PROFIBUS-DP fieldbus network.

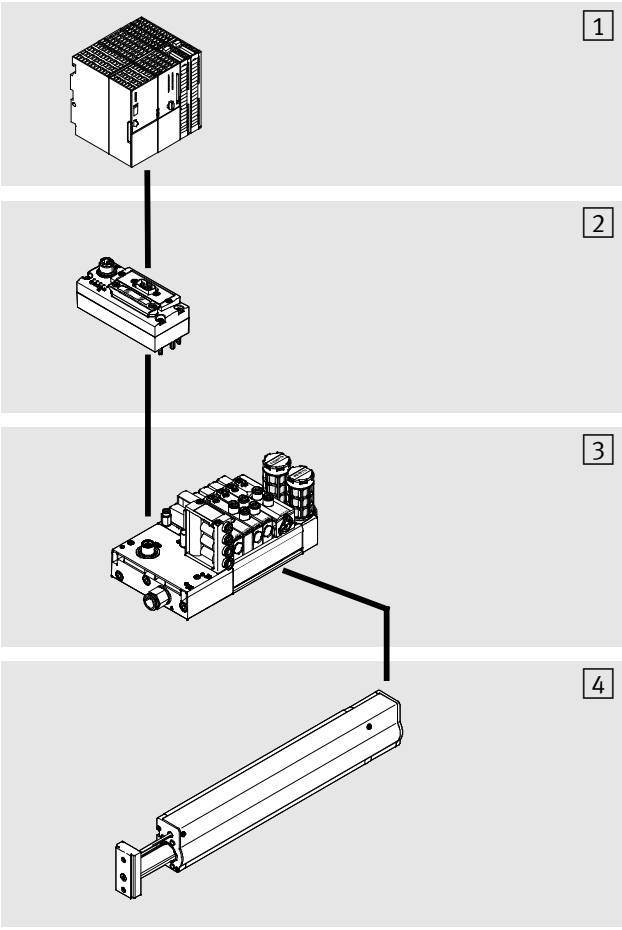
2.1.1 Components

1 Higher-order controller (DP master): e.g. from SIEMENS

2 Fieldbus level: bus node CTEU

3 Device level: e.g. valve terminal VTUB-12

4 Drive level: e.g. Linear module HME



2.1.2 Data exchange with the PROFIBUS-DP fieldbus protocol

The fieldbus protocol PROFIBUS-DP uses a communication profile to regulate how data is exchanged among the fieldbus stations. Cyclical and acyclic data exchange are differentiated thereby.

2.1.3 Brief overview of the function range

- General communication and diagnostic messages about cyclical/synchronous data exchange (DPV0)
- Acyclic/asynchronous data exchange (DPV1)
- Diagnostics
- Process Data

2.1.4 Control commands

The operating modes FREEZE, SYNC and CLEAR_DATA are supported by the bus node in accordance with the PROFIBUS-DP standard.

The method of accessing these commands depends on the controller used. Corresponding information can be found in your controller's documentation.
Information on DPV1 commands can be found in chap. A.2 in Appendix A.

Caution
The operating mode FREEZE or SYNC is reset automatically:
– when the bus node is switched on or off
– when the fieldbus interface stops

The operating mode FREEZE is also reset automatically when:
– the bus connection to the bus node is interrupted (with activated response monitoring in the controller)

FREEZE command

Set	All input signals of the bus node are “frozen”. The bus node now sends a constant image of all inputs to the master. With each further FREEZE command, the input image is updated and sent again to the master.
Reset	Return to normal operation: UNFREEZE command

SYNC command

Set	All output signals of the bus node are “frozen”. The bus node now no longer reacts to modifications to the output image in the master. With each further SYNC command, the updated output image is transmitted.
Reset	Return to normal operation: UNSYNC command

CLEAR_DATA command

All output signals of the bus node are reset.

2.2 Preparing the bus node for configuration

A maximum of three modules can be configured: the bus node itself as well as up to two connected I-Port devices (e.g. valve terminals).

2.2.1 Addressing the bus node

The bus node has an address space of up to 16 bytes inputs and 16 bytes outputs:
Max_Data_Len = 32 (20_h)

The counting mode is module-oriented for inputs and outputs, starting with the device at I-Port connection 1, followed by the device at I-Port connection 2

2.2.2 Modules/devices at I-Port connection 1 and 2

Enter the identifiers corresponding to the physical sequence of the modules in your configuration program, starting with the device at I-Port connection 1, followed by the device at I-Port connection 2.

Electric modules	Module indicator [1)]	Identifier		Allocated address space	
Designation		EN50170	Siemens	Inputs	Outputs
Bus node CTEU for PROFIBUS-DP	CTEU-PB	0x00	0	–	–
Valve terminal CPV10-GE-PT-8 16 valves with I-Port connection	CPV10-8	0x21	16DO	0	2 bytes / 16 O
Valve terminal CPV14-GE-PT-8 16 valves with I-Port connection	CPV14-8	0x21	16DO	0	2 bytes / 16 O
Input module CTSL M12	CTSL M12	0x11	16DI	2 bytes / 16 I	0
Input module CTSL M8	CTSL M8	0x11	16DI	2 bytes / 16 I	0
Valve terminal VTUG-1-16 valves with I-Port connection	VAEM-L1-S-8-PT	0x21	16DO	0	2 bytes / 16 O
Valve terminal VTUG-17-32 valves with I-Port connection	VAEM-L1-S-16-PT	0x23	32DO	0	4 bytes / 32 O
Valve terminal VTUG-33-48 valves with I-Port connection	VAEM-L1-S-24-PT	0x25	37	0	6 bytes / 48 O
Valve terminal VTOC-Interlock / VTUG-Interlock 1-16 valves with I-Port connection	VAEM-L2-S_ PTL-16	0x13, 0x21	32DI 16DO	4 bytes / (18 used I)	2 bytes/16 O
Valve terminal VTOC-Interlock / VTUG-Interlock 17-32 valves with I-Port connection	VAEM-L2-S_ PTL-32	0x33	32DX	4 bytes / (18 used I)	4 bytes/32 O

Electric modules	Module indicator [1]	Identifier		Allocated address space	
Designation		EN50170	Siemens	Inputs	Outputs
Valve terminal VTOC-Interlock / VTUG-Interlock 33-48 valves with I-Port connection	VAEM-L2-S_ PTL-48	0x13, 0x25	32DI 37	4 bytes / (18 used I)	6 bytes/48 O
Valve terminal MPA-L with I-Port connection with 32 valves	VMPAL-EPL-IP032	0x23	32DO	0	4 bytes / 32 O
Valve terminal VTUB with I-Port connection 3-8 valves	VTUB-12-8	0x20	8DO	0	1 byte/8 O
Valve terminal VTUB with I-Port connection 9-16 valves	VTUB-12-16	0x21	16DO	0	2 bytes/16 O
Valve terminal VTUB with I-Port connection 17-24 valves	VTUB-12-24	0x23	32DO	0	4 bytes/32 O
Valve terminal VTUB with I-Port connection 24-35 valves	VTUB-12-35	0x25	37	0	6 bytes/48 O
Universal module with 64 inputs and outputs	Universal module 64DIO	0x37	55	8 bytes / 64 I	8 bytes / 64 O
Universal module with 64 inputs	Universal module 64DI	0x17	23	8 bytes / 64 I	0
Universal module with 64 outputs	Universal module 64DO	0x27	39	0	8 bytes / 64 O

[1] Module identifier in the hardware configuration of the programming software

Tab. 2/1: Module overview and address allocation: bus nodes and examples for digital input and output modules

2.3 Installation on a higher-level controller

2.3.1 Device master file (GSD) and symbol files

A device master file (GSD) is needed for configuration and programming of the bus node with a programming unit or PC. The GSD includes all required information for adjustment of the bus node using configuration and programming software, e.g. Siemens SIMATIC STEP 7.

Procurement source

Current GSD and symbol files can be found on the Festo website at ➔ www.festo.com ➔ Support/Downloads ➔ Search “GSD”.

GSD files

You will require one of the following files for the bus node:

– FEST0D67.GSD (German version)

– FEST0D67.GSE (International version)

For some older controllers, the GSD file can be too large for the available memory capacity. In this case, contact Festo's Technical Hotline.
Contact data can be found on the Festo website at ➔ www.festo.com ➔ Contact.

Symbol files

Use the following symbol files to represent the bus node and its statuses in your configuration software:

Normal operating status	**Diagnostic case**	**Special operating status**
		
File: CTEU_PB.dib	File: CTEU_PBD.dib	File: CTEU_PBS.dib

Tab. 2/2: Symbol files for configuration software

Publication date	Supports
July 2012	Initial version

Tab. 2/3: History of the GSD files

Note
GSD files are downward compatible. Always use the latest GSD file to ensure support of all functions of the bus node.

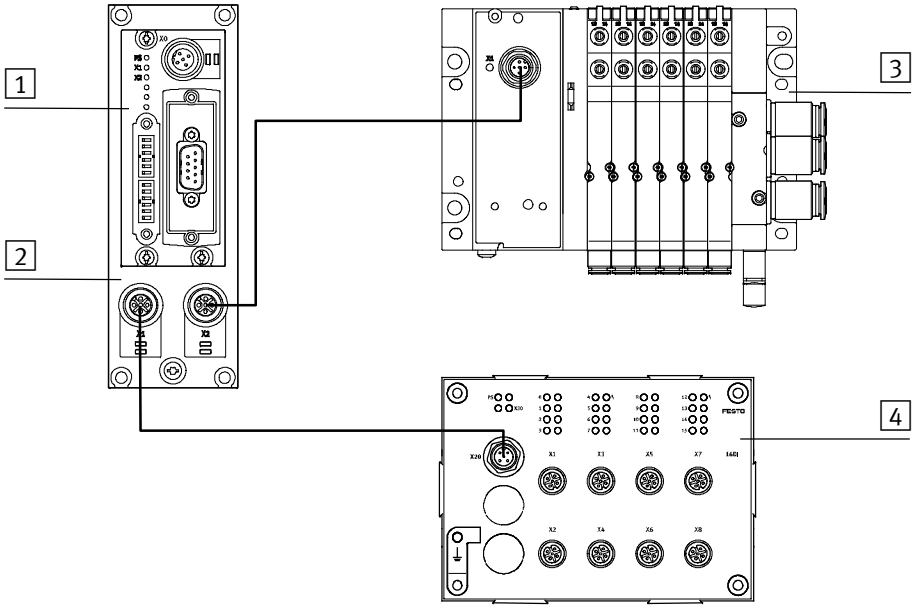
Installation

Install the files by using the configuration software of your master controller. Please refer to the product documentation of your software for detailed procedures.

2.4 Configuration by using process data

2.4.1 Configuration examples

Example 1: Bus node on adapter CAPC-... with valve terminal MPA-L and input module CTSL-...



1 Bus node CTEU-PB

2 Electrical connection box CAPC-...

3 Valve terminal MPA-L with I-Port connection

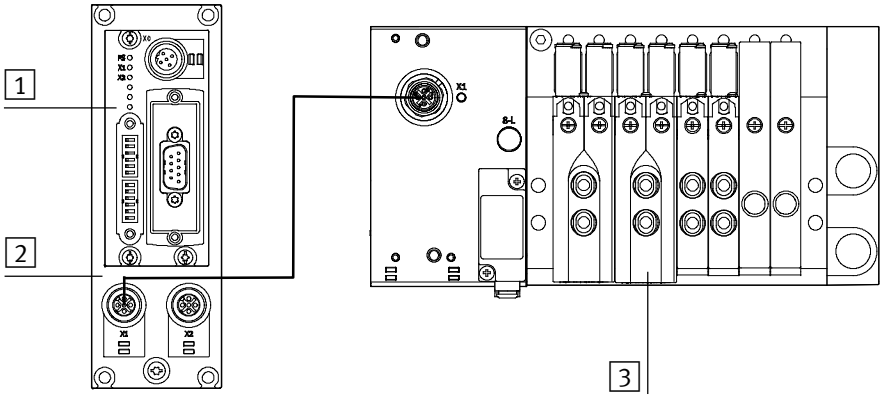
4 Input module CTSL-...

Fig. 2/1: Configuration example 1:
Bus node with devices at I-Port connection 1 and 2

Modules		Identifier			Allocated address space	
Designation	**No.**	**Characteristic** [1]	**EN 50170**	**Siemens**	**Inputs**	**Outputs**
Bus node CTEU-PB for PROFIBUS-DP	0	CTEU-PB	00_h	0	–	–
Valve terminal MPA-L	1	VMPAL-EPL-IPO32	0x23	32DO	0	4 bytes / 32 O
Input module CTSL-...	2	CTSL-D-16E-M12-5	0x11	16DI	2 bytes / 16 I	0
[1] Module identifier in the hardware configuration of the programming software						

Tab. 2/4: Configuration for example 1

Example 2: Bus node on adapter CAPC-... with valve terminal VTUB-12



1 Bus node CTEU-PB

2 Electrical connection box CAPC-...

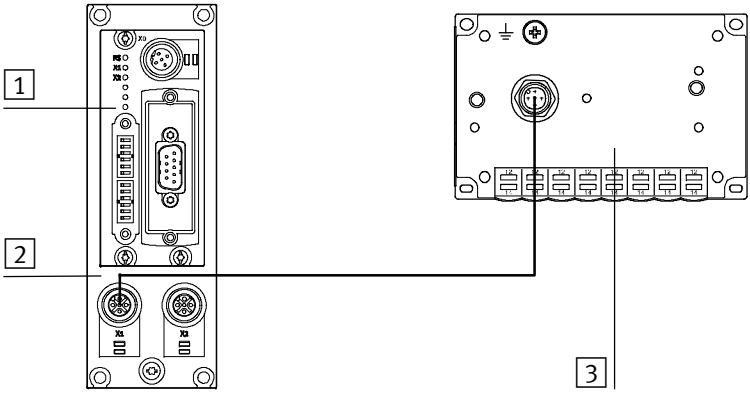
3 Valve terminal VTUB-12 with I-Port connection

Fig. 2/2: Configuration example 2:
Bus node with device at I-Port connection 2

Modules		**Identifier**			**Allocated address space**	
Designation	**No.**	**Charac-teristic [1)]**	**EN 50170**	**Siemens**	**Inputs**	**Outputs**
Bus node CTEU for PROFIBUS-DP	0	CTEU-PB	00_h	0	–	–
Valve terminal VTUB-12	1	VTUB-12-8	0x20	8DO	0	1 byte / 8 O
[1)] Module identifier in the hardware configuration of the programming software						

Tab. 2/5: Configuration for example 2

Example 3: Bus node on adapter CAPC-... with valve terminal CPV



1 Bus node CTEU-PB

2 Electrical connection box CAPC-...

3 Valve terminal CPV with I-Port connection

Fig. 2/3: Configuration example 3:
Bus node with device at I-Port connection 2

Modules		**Identifier**			**Allocated address space**	
Designation	**No.**	**Characteristic** [1]	**EN 50170**	**Siemens**	**Inputs**	**Outputs**
Bus node CTEU-PB for PROFIBUS-DP	0	CTEU-PB	00_h	0	–	–
valve terminal CPV	1	CPV10-8	0x21	16DO	0	2 bytes / 16 O
[1] Module identifier in the hardware configuration of the programming software						

Tab. 2/6: Configuration for example 3

2.4.2 Configuration of a DP master

The bus node can be controlled by commercially available programmable logic controllers (PLC) aw well as PCs and industrial PCs with a PROFIBUS-DP interface in accordance with EN 50170. The corresponding programming and commissioning software of your PLC manufacturer is required for commissioning.

Configuration of the bus node with a PLC from Siemens is described in chap. 2.4.4.

2.4.3 Bus start-up

In order to commission the mounted and connected bus node, the master must carry out the following functions in the corresponding sequence:

1. Request diagnostic information
2. Send parameterisation data (Set_Prm)
   For the start parameterisation, the parameter set is loaded by the master into the bus node. The bus node distributes the parameters to the connected equipment.
3. Check configuration data (Chk_Cfg)
4. Transfer input and output data (cyclical data exchange, Data_Exchange)
5. Read diagnostic information (Slave_Diag)

The structure and contents of the individual telegrams are described in the appendix.

Note
After each interruption of fieldbus communication, the parameter set is resent to the bus node by the master.

2.4.4 Configuration using a DP master from Siemens as an example

The configuration examples shown in this chapter are based on the use of a programmable logic controller (PLC) Siemens SIMATIC S7-300 and the configuration and programming software Siemens Step 7, Version 5.5 + SP2. Operation of the STEP 7 software is assumed to be known in the following.

Note
These instructions refer to the **German** language version of the Siemens SIMATIC controller and STEP 7 configuration and programming software.

Other language versions usually use other designations for the program and function calls and menu items mentioned here.

Preparations

Caution
Danger of malfunctions, damage or injuries to people

- Before commissioning, ensure that the connected elements (e.g. actuators) do not perform any accidental or uncontrollable movements.
- If necessary, disconnect the load voltage supply and compressed air supply.

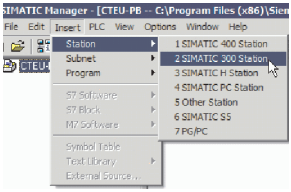
See also chap. 2.9.2, Checklist before switching on.

Setting up automation project

1. Start the Siemens SIMATIC Manager of your Siemens SIMATIC controller.
2. Create a new project in the SIMATIC Manager: [File] - [New...].

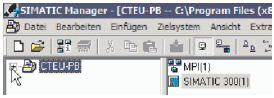
3. Enter a project name (e.g. “CTEU-PB”) in the input field “Name” of the “New” dialogue window and confirm the input with “OK”.
   The new automation project is now set up.

Setting up the controller system (PLC/Master)



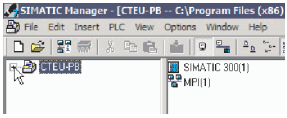
4. Select the newly set-up automation project in the left part of the dialogue window and click on [Insert] - [Station] to select the hardware type of your controller (e.g. “SIMATIC 300 Station”).

   The selected hardware now appears in the right part of the dialogue window.

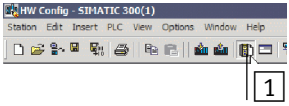


5. Open the automation project by clicking on the Plus symbol in the left part of the dialogue window.

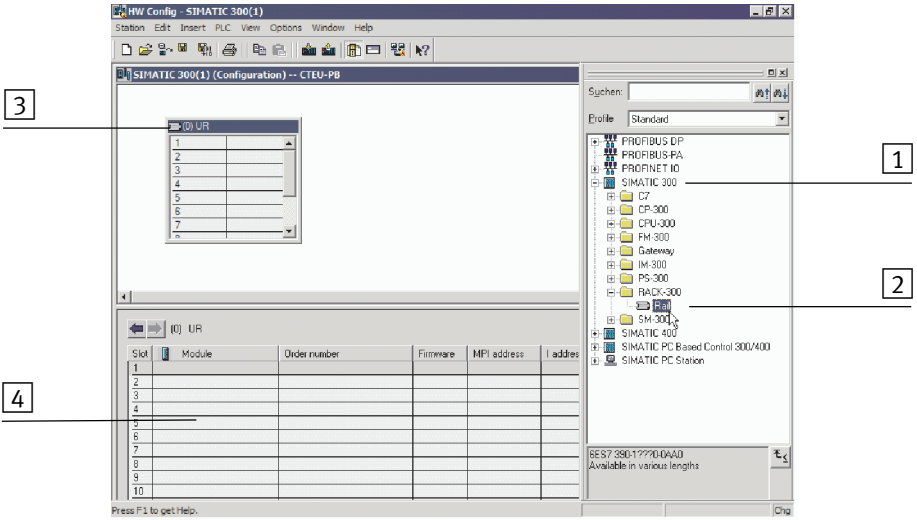
Equip control system (PLC/DP Master)



6. Click on the Station symbol (which is located to the left of the station name) and double-click on the Hardware symbol under “Object name” in the right part of the dialogue window.
   The “HW Config” hardware configuration window opens.



7. Open the Hardware Catalogue (1) via the toolbar.



1 Select control system

2 Insert rack rail

3 Set up control system in the rack rail window

Fig. 2/4: Set up control system (PLC/DP Master) - insert rack rail (Rail)

8. Select your control system (PLC/DP Master) in the Hardware Catalogue (e.g. “SIMATIC 300”, 1 in Fig. 2/4): Click on the Plus symbol to expand the selection.

9. Open the rack folder (e.g. “RACK-300”, 2 in Fig. 2/4) for selection of a rack rail.

10. Double click on the rack rail symbol (e.g. “Rail”, 2 in Fig. 2/4).
A sub-window (with rack rail symbol in the header) opens in the left area of the HW Config window (3 and 4 in Fig. 2/4).

    The sub-window symbolises the rack rail (profile rail) of your control system. You compile the individual elements in this sub-window and thus form the basis for your PROFIBUS automation system.

11. Select your CPU from the Hardware Catalogue (precise comparison with your hardware required!) and drag the corresponding element (symbol) into a line of the rack rail window (3 or 4 in Fig. 2/4).
    Note: Slot 1 is reserved and cannot be used for the configuration.
    The dialogue window “Properties - PROFIBUS interface DP” opens automatically (see Fig. 2/5).

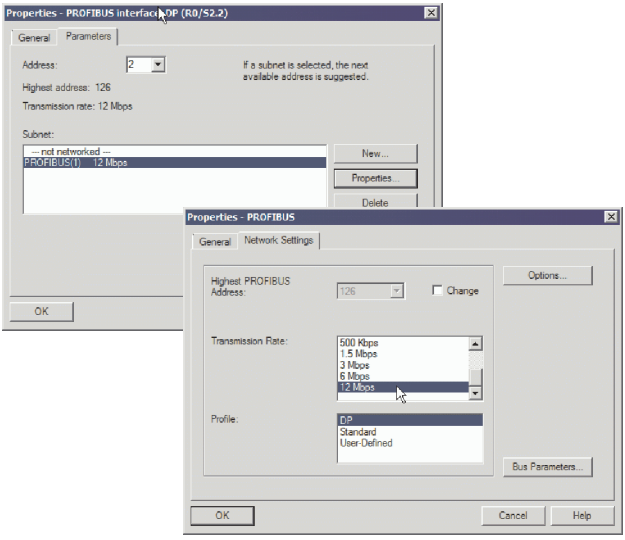


Fig. 2/5: Edit the sub-network properties

12. Select the tab “Parameters” or “Network Settings” and there the station address that you set at the bus node using DIL switches (see chap. 1.4.2)

Set up sub-network

13. Click on “New...” in the “Properties” dialogue windowto set up a PROFIBUS sub-network (see Fig. 2/5).

14. Edit, if necessary, the “Transmission rate” und “Profile” entries in the “Parameters” tab (see Fig. 2/5).

15. Click on “OK” in the two “Properties” dialogue windows in succession to complete the setting of the PROFIBUS sub-network.

Install GSD and symbol files

Install the GSD and symbol files in the next steps: These must be reachable via your PC. Source and notes for the selection, see chap. 2.3.1.

1. Start the installation function via the HW Config menu: [Options] - [Install GSD File ...].

2. Update the hardware catalogue through the menu commands [Options] - [Update Catalog].
   The slaves installed through the GSD file are read into the hardware catalogue.

3. Open in the hardware catalogue the path PROFIBUS-DP › Additional Field Devices › Valves › Festo SE und Co. KG › CTEU-PB.
   All modules that can be connected to the CTEU-PB bus node now appear.

Install bus node as slave

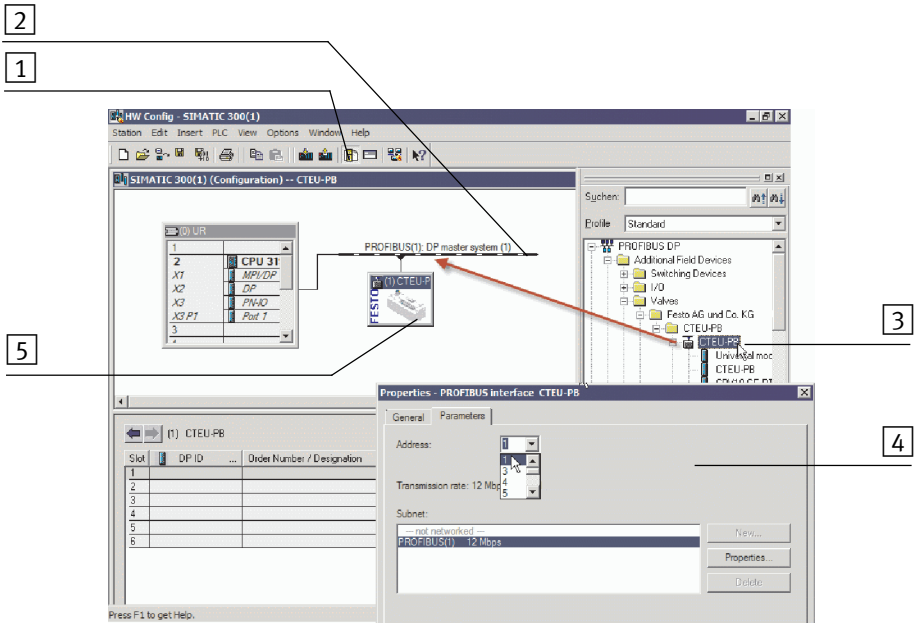
1. Mark the line view of the PROFIBUS sub-network in the main window (2, see Fig. 2/6).

2. Open in the hardware catalogue the path PROFIBUS-DP › Additional Field Devices › Valves › Festo SE und Co. KG › CTEU-PB.

3. Select the module “CTEU-PB”.
   The dialogue window “Properties - PROFIBUS interface” opens automatically (3, see Fig. 2/6).

4. Select the tab “Parameters” and there the station address that you set at the bus node using DIL switches (see chap. 1.4.2)

5. Click on “OK” in the “Properties” dialogue window to complete the setting of the PROFIBUS sub-network.
   A graphic symbol of the bus node is linked in the main window with the line view of the PROFIBUS sub-network (5, see Fig. 2/6).



1 Hardware catalogue call

2 Line view of the PROFIBUS sub-network

3 Module selection in the hardware catalogue

4 “Properties” dialogue window

5 With the bus node linked to the PROFIBUS sub-network

Fig. 2/6: Station selection with STEP 7 - HW Config

Configuration of the modular part with STEP 7

Create configuration

Fill the configuration table with the device or devices connected to your bus node (see Fig. 2/7):

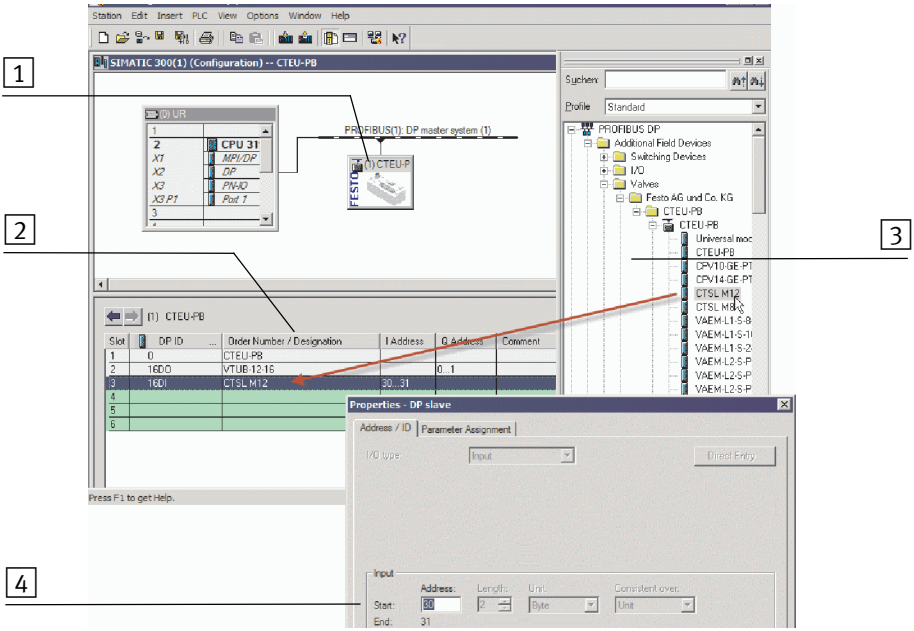
1. Click on the symbol of the valve terminal to be configured in HW Config [1]. The configuration table [2] will be displayed under the rack.
2. Open in the hardware catalogue [3] the module “CTEU-PB” via the path PROFIBUS-DP › Additional Field Devices › Valves › Festo SE und Co. KG › CTEU-PB.
3. Pull a bus node into slot 1 of the configuration table.
4. Pull the device connected to I-Port connection 1 into slot 2 of the configuration table and assign the start add-ress of the inputs or outputs in the “Properties - PROFIBUS interface” dialogue window [4].
5. Repeat this step, if necessary, with the second I-Port device connected to the bus node.

Note
Always pull the device connected to I-Port connection 1 as a module without gaps into the configuration table first and only after that do the same with the device connected to I-Port connection 2.

Modifying the address

1. Double-click on the corresponding line in the configuration table [2].
2. Modify the starting address of the inputs/outputs in the “Properties - DP Slave” dialogue window [4].

Note
SIEMENS S7-400 controllers reserve up to 4 bytes of addresses for each DP identifier, depending on the version status.



1 HW Config

2 Configuration table

3 Hardware catalogue

4 “Properties – DP-Slave” dialogue window

Fig. 2/7: Configuration with STEP7 – Hardware catalogue

This concludes the station selection and configuration.

2.5 Identification and maintenance

The I&M function (Identification and Maintenance function) serves as an electronic name plate of the bus node and offers uniform, non-proprietary access to device-specific online information via the internet.

2.5.1 Overview of the I&M data structures

Address/ structure,	**Designation, size**	**Description**	**Use** ***obligatory/ optional***
I&M0 (65000)	Device-specific basic information	The manufacturer and the device with its hardware and software versions is uniquely identified.	Obligatory in all DP-V1 slaves
I&M1 (65001)	Information on the system (32 bytes)	The user can specify system identifiers here	Optional
	Information on the location (22 bytes)	The user can specify the installation site here	Optional
I&M2 (65002)	Information on the time (16 bytes)	The user can, for example, specify the installation/mounting date here	Optional
I&M3 (65003)	Additional information (54 bytes)	Here the user can specify additional information	Optional
I&M4 (65004)	Reserved	Support through CTEU-PB: no	Optional
I&M5 ... I&M017 (65005 ... 65017)	Reserved for futher I&M Functions	Support through CTEU-PB: no	Optional

Address/ structure,	**Designation, size**	**Description**	**Use** ***obligatory/ optional***
I&M18 ... I&M098 (65018 ... 65098)	Profile-specific I&M functions	Support through CTEU-PB: no	Optional
I&M100 ... I&M199 (65100 ... 65199)	Manufacturer-specific I&M functions	Support through CTEU-PB: no	Optional

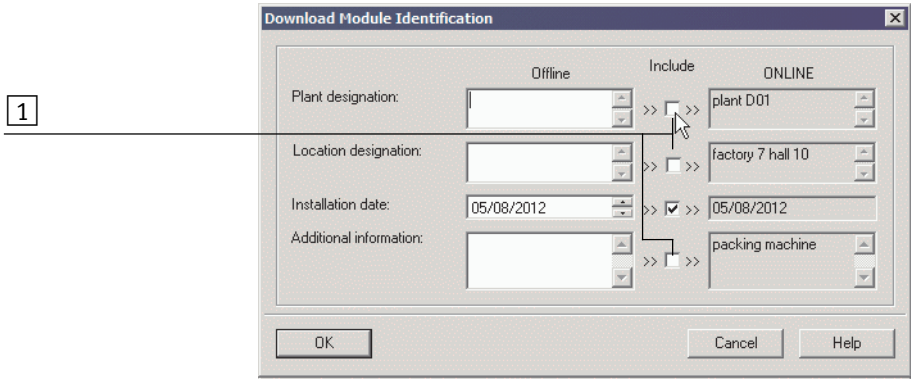
Tab. 2/7: I&M data structures (data records)

- Module-related I&M data are not supported.
- Every data structure always comprises 64 bytes.
- The I&M data structures are read with the “call service” from the bus node or written into the device.

2.5.2 Load identification properties into the bus node using Step 7

1. Mark the bus node in HW Config.
2. Click on [Download Module Identification...] in the [PLC] menu.
   The corresponding dialogue window is displayed (see Fig. 2/8).
3. Enter your identification properties into the data fields under “Offline” (example, see Fig. 2/8).
4. Activate the checks under “Include” only for the data fields for which you wish to load data into the bus node. Deactivate checks for the already correctly filled-out data fields in the “ONLINE” field, or they will be overwritten!

5. Confirm with “OK”.



1 Deactivate checks so that ONLINE fields that have already been filled out are not overwritten.

Fig. 2/8: Load identification data into the bus node

2.5.3 Check identification properties using Step 7

1. Mark the bus node in HW Config.
2. Click on [Module Information...] in the [PLC] menu. The corresponding dialogue window is displayed (see Fig. 2/9).

“General” — In the “General” tab, you will find the hardware and software/ firmware status of the bus node (see Fig. 2/9) as well as the specifications entered in the fields “Plant designation” and “Location designation” (Fig. 2/8).

“DP-Slave Diagnostics” — In the “DP-Slave Diagnostics” tab, you will find, if applicable, diagnostic information about the bus node (see Fig. 2/10, status: error).

“Identification” — In the “Identification” tab, you will find further information, such as manufacturer's specifications (see Fig. 2/10) as well as the specifications entered in the fields “Installation date” and “Additional information” (Fig. 2/8).

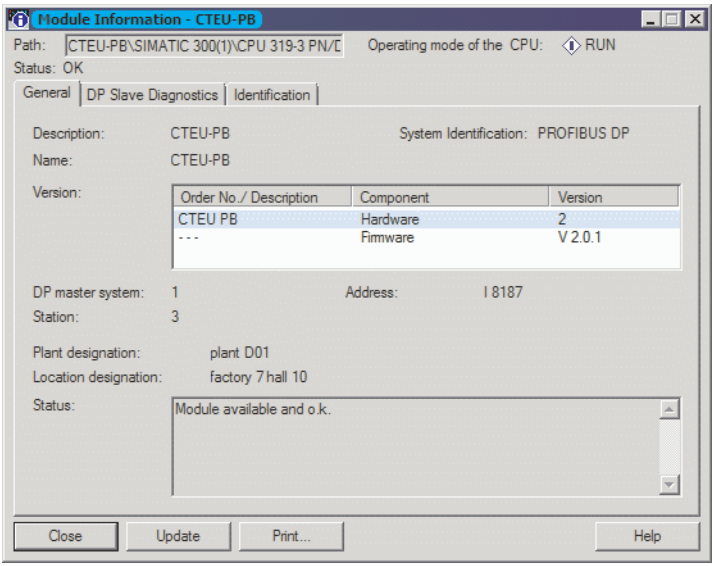
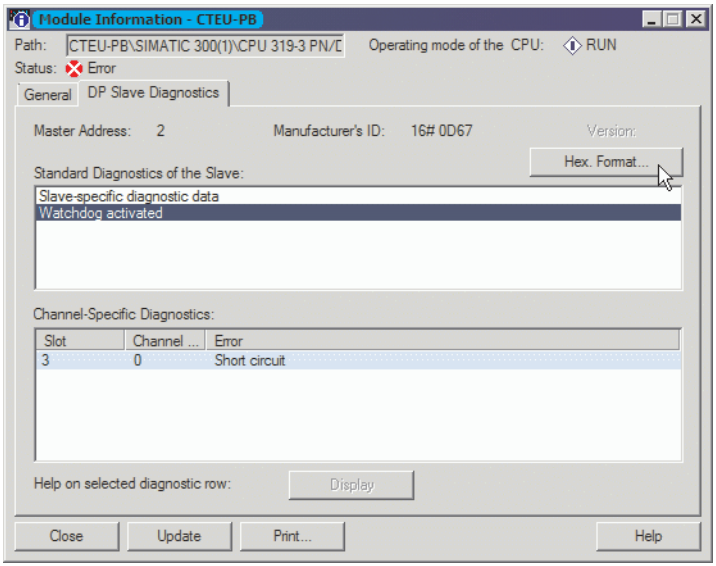


Fig. 2/9: Identification data, “General” tab



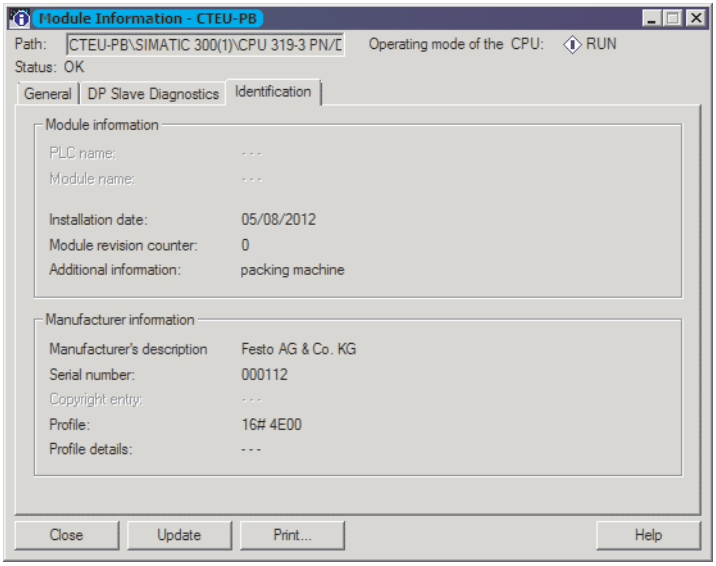


Fig. 2/10: Identification data, “DP-Slave Diagnostics” and “Identification” tabs

2.6 Parameterisation (DP)

You can set the characteristics of the bus node individually by parameterisation. A distinction is made between the following types of parameters:

Types of parameters	Parameters	Description
System parameters	Fail state	Defines the status which digital output signals (outputs and valves) are to assume in the event of fieldbus communication errors.
Bus node parameters	Tool change	See chap. 2.6.4
Equipment parameters	Device-specific	Influence the characteristics of a specific module, e.g. monitoring, settings in the case of error
	Channel-specific	Influence the behaviour of a specific input or output channel, e.g. settings of the inputs' debounce times
Diagnostic memory parameters		Influence the operating method of the internal diagnostic memory

Tab. 2/8: Types of parameters

Parameter descriptions for I-Port devices can be found in the product documentation for the respective product if it supports parameterisation.

2.6.1 Parameterisationwhen being switched on (start behaviour)

1 Master loads parameter set into the bus node

2 Bus node distributes parameter set

3 I-Port devices 1 and 2 receive parameter set

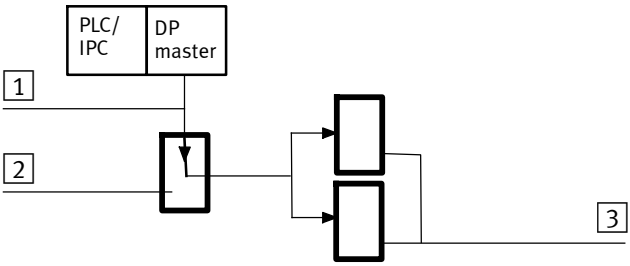


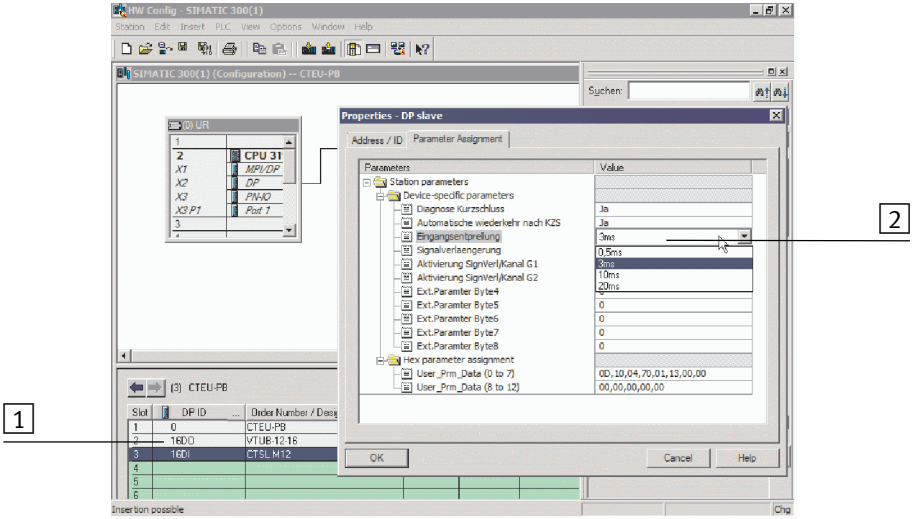
Fig. 2/11: Sequence of the start parameterisation

When the fieldbus system is switched on, the bus node is parameterised as “Start parameterisation” through the parameter set stored in the DP master. The bus node then distributes the parameters in a module-oriented manner to the connected equipment.

2.6.2 Equipment parameters

Proceed as follows:

1. Double click in the configuration table on the line of the module which you wish to parameterise [1].
   The corresponding dialogue window is displayed (see Fig. 2/12).
2. Click on the parameter value which you wish to modify.
   A list field with the possible values is opened [4].
3. Modify the value by clicking on and selecting it and confirm the entry with “OK”.



1 Connected device

2 List field with available values

Fig. 2/12: Parameterisation of bus nodes and connected I-Port devices

Note
Module parameters can refer to:
- properties of a complete I-Port device
- properties of an individual channel of an I-Port device.

2.6.3 Parameterisation of the bus node

- Diagnostics (DIL switch element 11, see chap. 1.4.2)
- Fail state (DIL switch element 12, see chap. 1.4.2)
- Tool change mode (software parameters, see chap. 2.6.4)

2.6.4 Bus node parameters tool change

The tool change mode (GSD: “Tool Change Mode”) offers the option to integrate or replace I-Port devices flexibly. Merely a universal data range is created, which a device can occupy. Which equipment is then actually connected is not defined. As a result, a flexible replacement of different equipment is possible. In this case, any I-Port devices are recognised without an error message as long as their real process data size does not exceed the configured size.

Through a universal module (see Tab. 2/1), a fixed maximum I/O data length is assigned to each I-Port connection on the respective module or slot position (Siemens). This ensures that the right module configuration, i.e. sufficient data length, is also queried after every switch-on.

In the parameters of the bus node, the tool change mode can be activated for each I-Port connection individually.

The following cases of the tool change mode can be differentiated:

Case	Tool change mode off	Tool change mode on
Connect/remove or link/separate device in ongoing operation	If a device is separated from the I-Port connection during operation, the “Device disconnected” diagnosis becomes active. This error is automatically reset as soon as the connection to the device is restored. If a device is connected to an I-Port connection during operation, the bus node issues an error (“Device wrongly connected”). This error is automatically reset as soon as the connection to the device is separated again. If a device was already found at the I-Port connection during switch-on, the “Device disconnected” diagnosis is active as long as the connection to the device is/becomes separated during operation. This error is automatically reset (diagnosis “Device reconnected”) as soon as the connection to the device is restored.	A fixed address space is reserved in the image table for both I-Port devices. As soon as a device is detected at one of the I-Port connections, its I/O data are mapped into the image table. Diagnostic messages are not generated when there is no connection to the device nor in case of configuration errors (e.g. I/O length of the device is larger than I/O length of the tool change mode). If a device is connected to an I-Port connection during operation, the device is recognised but no error message is generated.

Case	Tool change mode off	Tool change mode on
Switching on without a connected I-Port device and subsequent connection.	If no device is connected to the relevant I-Port connection at switch-on, no I/O data are mapped into the image table. As a result, the “Device configuration failed” diagnosis is output. The second I-Port connection then is/becomes inactive as well and can no longer be used. This error can only be eliminated by adjusting the configuration or connecting an I-Port device to the bus node and restarting the system.	A fixed address space is reserved in the image table for each I-Port device. As soon as a device is detected at an I-Port connection, its I/O data are mapped into the image table. The “Device disconnected” diagnosis is active as long as the connection to the device is separated during operation. This error is automatically reset as soon as the connection to the device is restored.
The I-Port connection is not configured at the DP master The I-port connection is deactivated und cannot be used.	If a device is recognised at the I-Port connection when the system is switched on, the diagnosis “Device wrongly connected” is reported. The second I-Port connection is then inactive as well and can no longer be used. This error can only be eliminated by adjusting the configuration or connecting an I-Port device to the bus node and restarting the system.	If a device is detected at this unconfigured I-Port connection, the second I-Port connection remains active and effective.

2.6.5 Application example for the parameterisation

In the application example (Fig. 2/13), packages are transported on a fast-moving conveyor belt.

1 Input for 1st sensor

2 Parameterised input for 2nd sensor

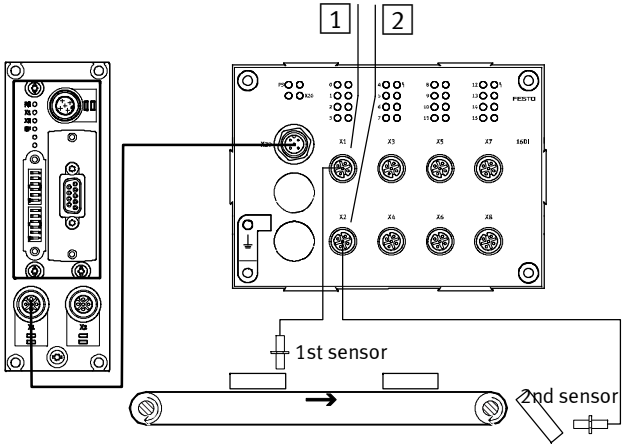


Fig. 2/13: Application example for parameterisation of input debounce time and signal extension time on the 2nd sensor

For improvement of the signal detection and processing, the input for the 2nd sensor is parameterised as follows:

– Reduction of the input debounce time from 3 ms (factory setting) to 0.1 ms: detection of shorter signals is possible. This parameter is set for the total module.

– Signal extension time set for 50 ms: Secure detection of the signals through the controller.
The value of this parameter is set for the complete module, but must be activated / deactivated separately for each input channel.

2.7 Communication

After the fieldbus stations are switched on, they all assume the “waitParam” status and wait for instructions from the higher-level DP master.

2.7.1 Statuses when communication is established

waitParam	In this status, the bus node waits for parameters of the DP master.
waitConfig	In this status, the bus node waits for the set configuration of the DP master.
DataEx	In this status, the bus node is exchanging data (DataEx-change) with the DP master. User data and diagnostic inform-ation can be transmitted thereby.

2.7.2 Status transitions

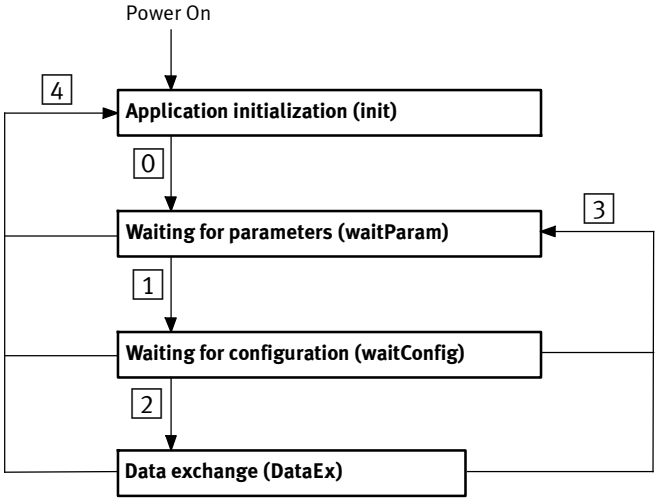


Fig. 2/14: Status transitions (for description see Tab. 2/9)

Description of the status transitions

Status	Designation	Function
0	–	Initialisation was successful.
1	Check Param OK	Checking of the parameters was successful.
2	Check Config OK	Checking of the configuration was successful (comparison of the configuration set at the DP master with the actually existing configuration in the bus node).
3	Reset communication	After timeout or malfunction at the fieldbus or reset of communication, fieldbus communication is restarted, e.g. after the fieldbus cable is unplugged and plugged back in or the DP master is restarted.
4	Hardware reset	After the bus node is restarted, initialization of the bus node is started anew.

Tab. 2/9: Status transitions – descriptions at Fig. 2/14

2.8 Fail state behaviour

Fail state regulates the behaviour of the bus node and the connected equipment in the event of communication malfunctions.

Parameterisation

The behaviour of the bus node is dependent on the DIL switch setting (see chap. 1.4) and the configured behaviour of the master in the case of:

– telegram failure

– interruption of the fieldbus line

Depending on the parameterisation, the outputs (valves and electric outputs) will be switched off (factory setting), switched on or retain their status (see Tab. 2/10).

Warning
An incorrect status of the valves and outputs can lead to dangerous situations!

- Ensure that valves and outputs are put into a safe status if the stated malfunctions occur.

Note
Please observe the following if the outputs are reset in the event of fieldbus interruptions or malfunctions:

– Monostable valves move to the basic position

– Bistable valves remain in the current position

– Mid-position valves go into mid-position (pressurized, exhausted or closed, depending on valve type).

Behaviour		DIL switch:	Device:	Diagnostics
of the fieldbus	**of the connected device**	**Fail state switching position**	**signals applied by the bus node**	
OK	Timeout	Off	are reset	Master controller reports a connection error. The “X1” and/or X2”-LED on the bus node illuminate red. “BF”-LED on the bus node is off.
		On	remain set (“Hold last state”)	
Timeout	OK	Off	are reset	The “X1” and/or X2”-LED on the bus node illuminate green. “BF”-LED on the bus node flashes red.
		On	remain set (“Hold last state”)	
	Timeout	Off	are reset	The “X1” and/or X2”-LED on the bus node illuminate red. “BF”-LED on the bus node flashes red.
		On	remain set (“Hold last state”)	

Tab. 2/10: Constellations of Fail state behaviour

2.9 Switching on

This chapter includes fundamental instructions for commissioning the bus node.

Detailed instructions and further information can be found in the documentation or online help for the controller or control program that you use.

2.9.1 Information concerning the switch-on behaviour of the bus node

Warning
Danger of injury through uncontrolled movements of connected equipment.

Make sure that electrical and pneumatic equipment are in a de-energised and pressureless status.

Before working on the pneumatics:

- Switch off the compressed air supply
- Vent the valve terminal

Before working on the electrical components, e.g. before installation or maintenance work:

- Switch off power supply

In this way, you can avoid:

– uncontrolled movements of loose tubing
– accidental and uncontrolled movements of the connected actuators
– undefined switching states of the electronics

Note
The configuration set at the master must agree with the equipment actually connected at the bus node.
If there are deviations in the configuration, no data exchange takes place between master and bus node (BF-LED flashes red slowly).

Observe the following instructions about switch-on behaviour:

- Disconnect the operating voltage from the bus node before replacing equipment, as the configuration is retransmitted from the master at the restart.
- Equipment must already be connected to the bus node before switch-on, or an error message will result and no process data will be exchanged.
- Special case, tool change mode (chap. 2.6.4):
  In this case, any I-Port device is recognised without an error message as long as the real process data size does not exceed the configured size.

2.9.2 Checklist before switching on

The following conditions must be fulfilled:

– DIL switch settings have been made (see chap. 1.4).

– Fieldbus connecting cables are connected (see chap. 1.5).

– Installation and configuration have been performed completely (see chap. 2.3 and 2.4).

2.9.3 Switching on the power supply

Note
Observe the general commissioning instructions in the product documentation of your controller.

From the perspective of the bus node, any sequence can be used to switch on the voltage supply within the fieldbus system.

2.9.4 Normal operating status

After the switch on procedure, the status LEDs indicate the operating status and correct function of the bus node and the fieldbus communication.

LED display	Status
	PS illuminates green when the voltage supply is established.
	X1/X2 illuminates green if the device has been connected correctly and is in the RUN mode.
	BF is not illuminated in the normal operating status.

Tab. 2/11: Status LEDs after switch-on

Information about diagnostics using the Status LEDs can be found in chap. 3.2.

Diagnostics

Chapter 3

Table of contents

3.1 Summary of diagnostics options

The following possibilities for diagnostics and error handling are available, depending on the configuration of the bus node:

Diagnostics option	Brief description	Benefits	Detailed description
LED display	The status LEDs display directly configuration errors, hardware errors, bus errors, etc.	Fast “on-site” recognition of errors	Chap. 3.2
Diagnostics via PROFIBUS-DP	Diagnostics in accordance with the PROFIBUS DP standard	Detailed module-related and channel-related error detection in the online mode of the programming/configuration software and in the PLC user program.	Chap. 3.3

Tab. 3/1: Diagnostics options

1 DIL switch settings:
Off = no diagnostic messages (default)
On = diagnostics are sent

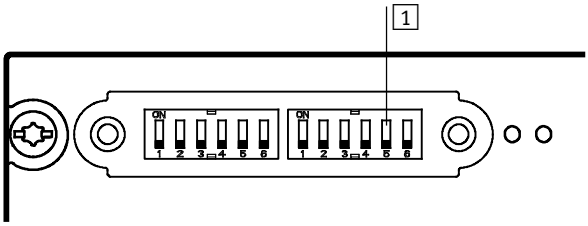


Fig. 3/1: DIL switches for diagnostic messages:
Switch element 11 of 12 (counted from the left over both switch groups)

3.2 Diagnostics via LED display

Status LEDs are available on the bus node for diagnosing the bus node and any connected devices (see Fig. 3/2).

The LEDs can assume the following statuses (sometimes in different colours):

illuminated flashing off

3.2.1 Normal operating status display

1 CTEU-specific LEDs

2 Fieldbus-specific LEDs

3 Reserved

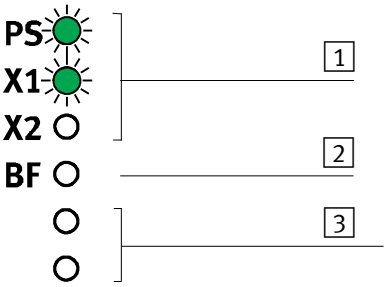
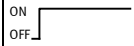
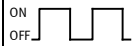


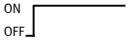
Fig. 3/2: Status LEDs of the bus node

3.2.2 PS-LED status display

PS (Power System) – power supply			
LED	**Process**	**Status**	**Meaning/error elimination**
 LED illuminated green		Normal operating status: Operating and load voltage present and in the permissible range [1]	–
 LED flashing green		Undervoltage in operating or load voltage supply	• Bus node reports undervoltage in the operating voltage supply • Connected device reports undervoltage [1] in the load voltage supply at bus nodes
 LED is off		Operating voltage is not present or not in the permissible range.	• Check operating voltage supply (pin 1 and 3)
1) Requirement: the connected device uses and monitors the load voltage			

Tab. 3/2: Status displays of the device-specific “PS” LED

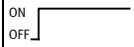
3.2.3 Status display X1-/X2-LEDs

X1 or X2 [1] - Internal communication between bus node and device 1 or 2 [1]			
LED	**Process**	**Status**	**Meaning/error elimination**
 LED illuminated green		Normal operating status	Device is connected correctly to the bus node.
 LED flashing green		Device diagnostics are running and/or diagnostic data are on hand.	Data connection between bus node and device is built up. • Device diagnostics can be read via fieldbus communication (if activated via DIL switches on the bus node)
 LED illuminated red		Device is connected correctly to the bus node, but internal communication is faulty. A connected device was removed after commissioning	• Check I-Port connection: cables, plug connectors, signal transmission (error counter overrun) • Restart the bus node (by switching the power off -› on)
 LED flashing red		Incorrect device connected: – Device detected that is not I-Port compatible – Non-configured device detected If X1 and X2 are flashing red simultaneously: – No device connected to the bus node – Configuration error	• Use an I-Port-compatible device (e.g. appropriate valve terminal) from Festo • Connect at least one device • Restart the bus node (by switching the power off -› on)

LED	Process	Status	Meaning/error elimination
○ LED is off	ON OFF	Connection is being established. No I-Port device is connected to the corresponding I-Port connection.	–
1) Electrical connection box CAPC with two interfaces for connecting a second device is required.			

Tab. 3/3: Status displays of the device-specific “X1” LED if device 1 is connected and “X2” if device 2 is connected

3.2.4 Status display BF-LED

BF (bus fault)			
LED	**Process**	**Status**	**Meaning/error elimination**
 LED illuminated red		– Hardware error at the bus node – Fieldbus communication is not available or has failed. – Voltage supply at the master or the controller has failed.	• Replace the bus node. • Contact Festo Service
 LED flashing red		– Correct the incorrect station number on the bus node or the controller	• Check station address assignment
		– Fieldbus communication is interrupted and automatically restored.	• Ready status has been stopped.
 LED is off		Normal operating status	Fieldbus communication is built up. Diagnostics are possible.

Tab. 3/4: Status displays of the fieldbus-specific “BF” LED

3.3 Diagnostics via fieldbus

The bus node supports the following diagnostic possibilities via PROFIBUS-DP in accordance with EN 50170:

- Module-/channel-related diagnostics:
  One bit is reserved per module (bus node or connected device) for displaying a diagnosis.
- Channel-related diagnostics (see chap. 3.3.4):
  - Module number
  - Module type
  - Type of diagnostics (error number)

3.3.1 Diagnostic steps

Fig. 3/3 shows you the steps necessary for diagnostics of the bus node and of connected equipment.

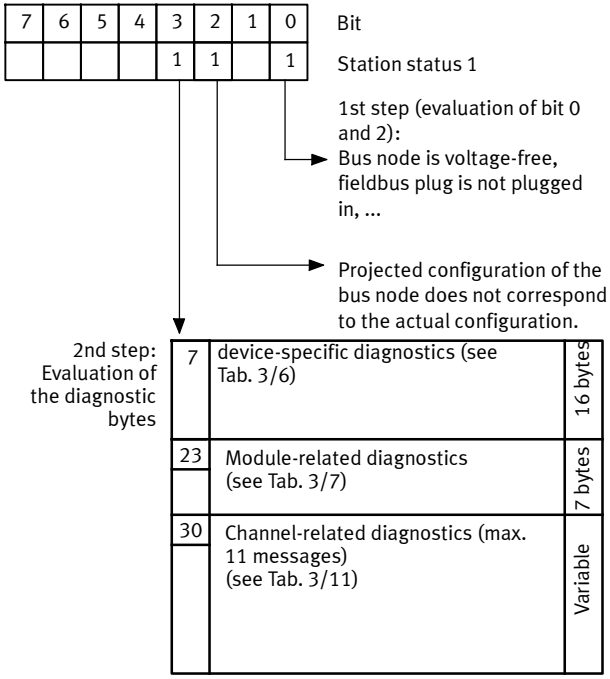


Fig. 3/3: Diagnostic steps

Note

The device-specific diagnostic information are only sent to the master if transmission is activated.

- In order to do this, set switch element 11 of the DIL switch group to “ON” (see chap. 1.4.2).

In order to commission your fieldbus system, it may be useful in some cases to switch off the device-specific diagnostics.

3.3.2 Overview of diagnostic bytes

In the following the diagnostic bytes are represented in four tables.

Standard diagnostic information		
Byte	**Contents**	**Explanation**
1	**Station status 1**	See Tab. 3/8
2	**Station status 2**	See Tab. 3/9
3	**Station status 3**	See Tab. 3/10
4	Diag.Master_add	Master address: The address of the master that parameterised the bus node is entered in this byte.
5	Ident_number high byte	Manufacturer identifier high byte ($0d_h$)
6	Ident_number low byte	Manufacturer identifier low byte (67_h)
7	External diagnostic data	Data block of the channel-related diagnostics

Tab. 3/5: Overview of diagnostic bytes: standard diagnostic information

Device-specific diagnostics (16 bytes), (module status DPV1)		
Byte	**Contents**	**Explanation**
7	Header	For the bus node fixed 04h
8	Type	For the bus node fixed 81h
9	Slot	For the bus node fixed 0_h
10	Slot	For the bus node fixed 0_h
11	Module 0 (bit 1 and 2) ... Module 3 (bit 6 and 7)	2 bits per module: 00 = no error (valid user data) 01 = module error (invalid user data) 10 = incorrect module (invalid user data) 11 = module failed or is not on hand (invalid user data)
12	Module 4...7	like byte 11
13	Module 8...10 (bits 6 and 7 are reserved)	like byte 11
14...22	Reserved	–

Tab. 3/6: Diagnostic bytes 7 ... 22: device-specific diagnostics (fixed at a length of 16 bytes)

Module-related diagnostics (variable length)		
Byte	**Contents**	**Explanation**
1	Header	For the bus node fixed 42_h
2	Module-related diagnostics	Specifies the module number with diagnostics.

Tab. 3/7: Module-related diagnostics

3.3.3 Details for standard diagnostic information

The following diagnostic information can be requested by the DP master from the bus node system via the function **Slave_Diag**. The procedure when reading out this diagnostic information using the example of a SIMATIC S7 system is described in chap. 3.4.1.

Station status_1		
Bit	**Significance**	**Explanation**
0	**Diag.Station_Non_Existent**	Bus node is no longer/not yet addressable. Possible causes: – Operating voltage not applied – Data transmission line interrupted – Malfunction in data transmission line
1	**Diag.Station_Not_Ready**	Bus node is not yet ready for data exchange.
2	**Diag.Cfg_Fault**	The configuration data received from the master are not the same as those determined by the bus node.
3	**Diag.Ext_Diag**	Extended diagnostics are present (see chap. 3.3.4 and 3.3.5).
4	Diag.Not_Supported	Bit = 1: Bus node does not support the function requested
5	Diag.Invalid_Slave_Response	Bit = 0 (set by the bus node)
6	Diag.Prm_Fault	Last parameter telegram was defective, e.g. incorrect length or Ident Number
7	Diag.Master_Lock	Bit = 0 (set by the bus node)
bold = bus-node-related bits		

Tab. 3/8: Diagnostic bits Station status_1

Station status_2		
Bit	**Significance**	**Explanation**
0	**Diag.Prm_Req**	Bit = 1: Master must configure the bus node again

Bit	Significance	Explanation
1	Diag.Stat_Diag	Bit = 1: Master must fetch diagnostic data until this bit is set to 0
2	–	Bit = 1: Bus node does not support the function requested
3	**Diag.WD_On**	Bit = 1: Response monitoring/watchdog activated
4	Diag.Freeze_Mode	Bit = 1: Freeze activated
5	Diag.Sync_Mode	Bit = 1: SYNC activated
6	–	Reserved
7	Diag.Deactivated	Bit = 0 (set by the bus node)
bold = bus-node-related bits		

Tab. 3/9: Diagnostic bits station status_2

Station status_3		
Bit	**Significance**	**Explanation**
0 ... 6	–	Reserved
7	Diag.Ext_Diag_Overflow	Bit = 1: Bus node has more diagnostic messages than can be buffered or master includes more diagnostic messages than it can buffer.

Tab. 3/10: Diagnostic bits Station status_3

3.3.4 Details of the channel-related diagnostics

Through the channel-related diagnostics, detailed diagnostic information is transferred by port. For each channel, 3 bytes of diagnostic data are available (see Fig. 3/4):

– Byte 1: module number

– Byte 2: module type

– Byte 3: type of diagnostics

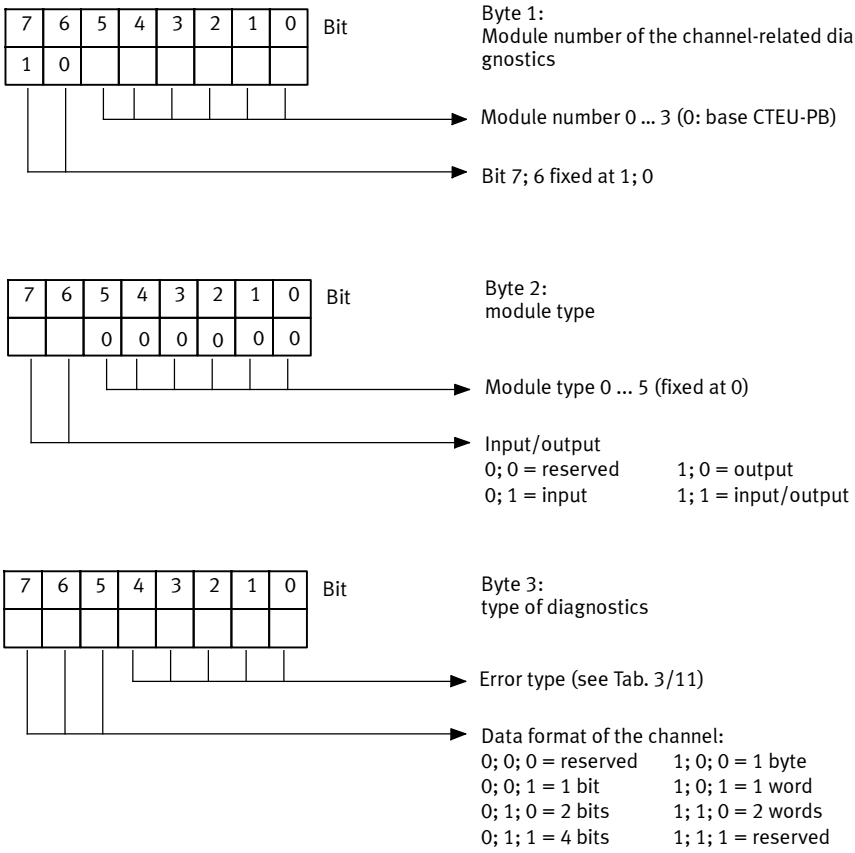


Fig. 3/4: Channel-related diagnostics: byte 1 ... 3

Value	Error type (standard)	Value	Error type (Festo)
0	Reserved	16	Reserved
1	**Short circuit**	17	Reserved
2	**Undervoltage**	18	Reserved
3	Overvoltage	19	I-Port diagnostics
4	**Overload**	**20**	**Peripheral error, tool change configuration**
5	Overtemperature	**21**	Reserved
6	**Cable break**	**22**	Reserved
7	**Upper limit value exceeded**	**23**	Reserved
8	**Lower limit fallen below**	**24**	Reserved
9	Reserved	**25**	Reserved
10	Reserved	**26**	Reserved
11	Reserved	**27**	Hardware error
12	Reserved	**28**	Reserved
13	Reserved	**29**	**Short circuit in I-Port connecting cable**
14	Reserved	**30**	Reserved
15	Reserved	**31**	Reserved
bold = relevant for the bus node			

Tab. 3/11: Error types (byte 3 of the channel-related diagnostics)

3.3.5 Channel-related and extended diagnostic data

Byte	Type	Description
1	Channel-related header and module no.	Module no. = I-Port connection
2	Channel no. and device types	Channel no. not used, always 0 Device types: Input, output, input and output
3	Value and diagnostics type	See chap. 3.3.4
4	Header	Length of the external diagnostics
5	I-Port no.	Specifies the connected device from which the diagnostics originate
6	IPort Diag Byte0 (event code low)	Event codes are diagnostic messages of the equipment connected to the bus node. You may be able to find corresponding information in the product documentation for the respective device.
7	IPort Diag Byte1 (event code high)	

3.3.6 Event codes of connected equipment

Malfunctions and statuses from connected I-Port devices are transmitted in the form of event codes through the bus node to the master and output there and stored, if necessary.

Event codes of connected I-Port devices can be found in the respective product documentation of the I-Port device, since they are independent of the respective device function.

3.4 Diagnostics via controller or DP master

3.4.1 Diagnostics for DP masters, general

The diagnostic behaviour is dependent on the type and scope of the respective master. Observe the information in the product documentation of your controller or DP master.

3.4.2 Diagnostics with Siemens SIMATIC S7

With controllers from Siemens and other manufacturers, you have the ability to specify the behaviour of the bus node in case of malfunctions (for details see product documentation on the respective controller).

You can set one of the two types of diagnostic behaviour:

– Hard characteristics in case of malfunction: The controller switches to the operating mode “STOP” when an error occurs

– Smooth characteristics in case of malfunction: The controller remains in the operating mode “RUN” when an error occurs

Control system	Module	Significance	STOP	RUN
SIMATIC S7/M7	OB82	Reaction to a device-specific diagnosis	default	OB is programmed
	OB86	Reaction to failure of a DP slave	default	OB is programmed
OB: Organisation module (building block)				

Tab. 3/12: Diagnostic behaviour “STOP” and “RUN” with SIMATIC S7

Almost all configuration programs also offer the function “Response monitoring” to take into account switch-off time of the valves and electric outputs.

Further details on error handling and response monitoring can be found in the product documentation for the respective controller

Possibilities for reading out the diagnostics

The diagnostics for PROFIBUS-DP are supported by function blocks. These download the slave diagnostics and write them into a data range of the user program.

Control system	Function block	See ...
SIMATIC S7/M7	SFC13 “DP NRM_DG”	“System and Standard Functions” reference manual
SIMATIC S7/M7	FB125	Siemens download in Internet

Tab. 3/13: Possibilities for reading out the diagnostics for SIMATIC S7

Example for a STEP 7 user program:

STL	Explanation
`CALL SFC 13`	
`REQ:=TRUE`	Read request
`LADDR:=W#16#03FE`	Pointer at diagnostic address, e.g. $1022_d = 03FE_h$ (see “DP slave properties” mask in HW Config)
`RET_VAL:=MW100`	If errors occur, output of error code
`RECORD:=P#M110.0 BYTE 64`	Pointer at start of data range for diagnostics and maximum length of the diagnostic data
`BUSY:=M10.0`	Read procedure finished

Fig. 3/5: Programming example in STL

3.5 Online diagnostics with STEP 7

Direct diagnostic events in relationship with the bus node can be:

– Decentralised peripherals: Station failure
  - Communication between bus node and master interrupted

– Module (bus node or DP master) faulty (see device-specific diagnosticsTab. 3/6)

– Change of operating status from STARTING UP to RUN (nominal/actual difference exists)
  - Configuration data of the bus node do not agree with the peripherals
  - Bus node has incorrect DIL setting

3.5.1 Read out diagnostic buffer with STEP 7 (up to V 5.5)

Requirement

HW Config is called up.

Proceed as follows (Fig. 3/6):

1. Switch from offline to online [1].
2. Click with the right mouse button on the CPU in rack [2].
3. Click on [Module information...] in the displayed context menu.
   The corresponding dialogue window is displayed (see Fig. 3/6, [3]).
4. Click on the tab “Diagnostic buffer” [4].
5. Click on the event and read the details [5]. They provide you with more precise information on the further procedure, and are dependent on the S7 controller used.

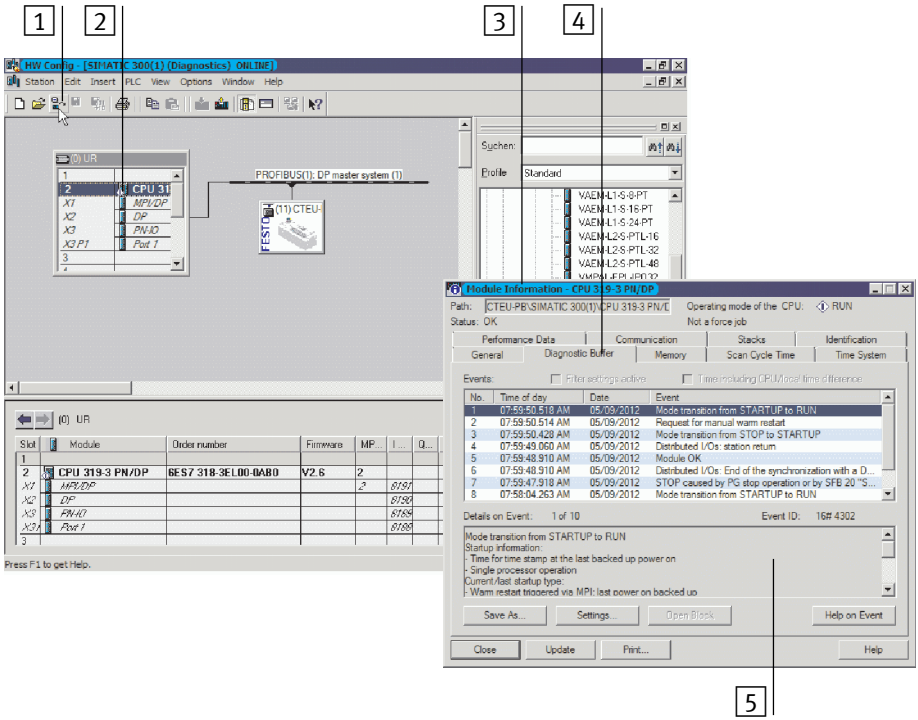


Fig. 3/6: Online diagnostics via the diagnostic buffer (explanation see text)

3.5.2 Device-specific diagnostics with STEP 7 (up to V 5.5)

You can display error messages of the device-specific diagnostics with HW Config if you mark the bus node instead of the CPU.

Requirement

HW Config is called up.

Proceed as follows (see Fig. 3/7):

1. Switch from offline to online [1].
2. Click with the right mouse button on the icon of the bus node [2].
3. Click on [Module information...] in the displayed context menu.
   The corresponding dialogue window is displayed (see Fig. 3/7, [3]).
4. Click on the “DP Slave diagnostics” tab [4].
5. Read the diagnostic information [5].

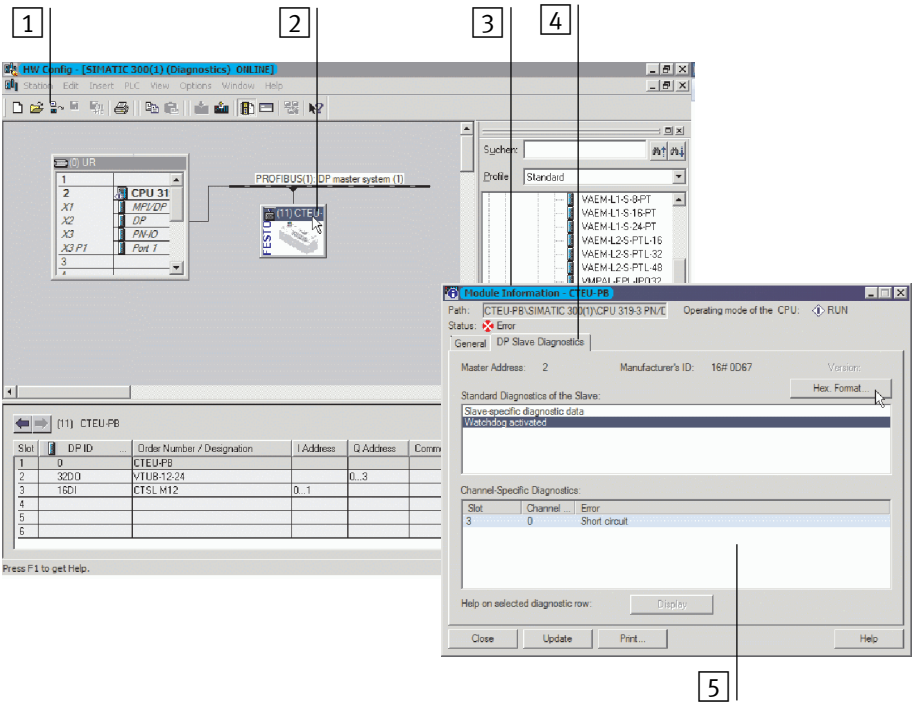


Fig. 3/7: Device-specific diagnostics (for explanation, see text)

Error handling

Chapter 4

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4.1 Fault finding and error elimination

This section is meant as a checklist to help you review your installation and commissioning steps if an error occurs.

Exclude potential sources of error by working through the following sections completely and in the specified sequence.

4.1.1 Check installation

- Check the correct installation of the bus node on the device or the CAPC-... electrical connection box and the correct earthing of all of the components involved.
- Make sure that all of the necessary cables are mounted correctly.

Information on installation of the bus node can be found in chap. 1.
Information for mounting the bus node on the CAPC-... electrical connection box can be found in the assembly instructions supplied with the electrical connection box.

4.1.2 Check the power supply

Warning

- Only use PELV **circuits** in accordance with IEC/EN 60204-1 (protective extra-low voltage, PELV) for the electrical power supply.
  Also observe the general requirements for PELV circuits in accordance with IEC/EN 60204-1.
- Only use power **sources** which guarantee reliable electrical isolation of the operating voltage in accordance with IEC/EN60204-1.

- Check to make sure **both** power supplies for the operating and load voltage are connected.
- Check the pin assignment even of pre-assembled cables.

Normal status LED

PS-LED illuminated green and X1- and/or X2-LED are illuminated green.

Error status 1

The operating voltage supply at the bus node exhibits undervoltage:

– PS-LED flashing green

Error status 2

The load voltage supply for the connected device or devices is missing or exhibits undervoltage:

– PS-LED flashing green and

– X1- and/or X2-LED are flashing green

Requirement: The connected device(s) must support this diagnostic function (see device description).

4.1.3 Restart communication between the bus node and the device

Problem description:

X1 and X2 flash red simultaneously despite the checked mechanical connection between the bus node and the device (dismounting -› mounting)

Remedy

Proceed as follows:

1. Disconnect the operating voltage.
2. Check the assembly and/or re-establish the cable connection between the bus node and connected devices.
3. Restart voltage.

LED normal status

X1 and/or X2 are illuminated or flashing green.

4.1.4 Check fieldbus communication

- Compare the desired station address with the station address set on the bus node (DIL switch setting).

Information on installation of the bus node can be found in chap. 1.

- Compare your selected cable lengths with the technical data in the appendix and the recommendations in chap. 1.5.1.
- Check the installation of the bus terminals at both ends of the fieldbus.

LED normal status: BF LED is off (in DataEx mode).

4.1.5 Check PROFIBUS-DP configuration

Problem description: Process data are defective.

Remedy: Proceed as follows:

1. Check at the controller the set process data ranges for consistency (not too small/large, without overlapping, unused ranges, ...)
2. Check whether the force/control data are correct or if manually set statuses have to be reset.
3. Check at your master whether the configuration or parameter data are correct, since otherwise no process data exchange will take place.

Problem description: Outputs do not switch to the desired status if fieldbus communication is disrupted.

Remedy: Proceed as follows:

1. Check whether Freeze or Sync mode is set (see chap. 2.1.4)
2. Check whether Fail State is activated on the bus node (DIL switch position, see chap. 1.4).

4.1.6 Read out diagnostic messages via controller

The diagnostic messages of the bus node are dependent on the controller used and its configuration and parameterisation. Further information can be found in chap.3.4 and chap. 3.5 as well as in the documentation for your controller.

Technical appendix

Appendix A

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A.1 Technical data

General	
Temperature range – Operation – Storage/transport	 -5 ... +50 °C -20 ...+70 °C
Relative air humidity in accordance with IEC 60770	93 % at 40 °C
Protection class in accordance with EN 60529, bus node mounted completely, plug connector inserted or provided with protective cap	IP65/67 1) with corresponding cable from Festo accessories
Protection against electric shock (protection against direct and indirect contact in accordance with IEC/DIN 60204-1)	by means of PELV circuit (Protected Extra Low Voltage)
Electromagnetic compatibility (EMC) 2) – Emitted interference – Resistance to interference	 See declaration of conformity ➔ www.festo.com
Vibration and shock 3) Tested in accordance with DIN/IEC 68 / EN 60068 – Vibration (part 2 - 6) – Shock (part 2 - 27) – Continuous shock (part 2 - 29)	Severity level (SL) for assembly on ... Wall: SL 2, H-rail: SL 1 Wall: SL 2, H-rail: SL 1 Wall and H-rail: SL 1
Dimensions – Width – Length – Height	 40 mm 91 mm 50 mm
Weight (bus node without cable and without CAPC-... or I-Port device)	90 g

1) Observe that connected devices may only satisfy a lower protection class, a smaller temperature range, etc.
2) The bus node is intended for use in an industrial environment. Measures for interference suppression may need to be implemented in residential areas.
3) Explanation of the severity level ➔ following table “Explanation on vibration and shock – severity level”

General	
Materials – Housing – Fibre-optic cable, DIL switch cover – Threaded sleeve M12 – Threaded bush M3 – Seals – Screws	RoHS-compliant PA, reinforced PC Brass, galvanically nickel-plated Brass Nitrile rubber Galvanised steel
Corrosion protection	CRC 2 Medium protection against moderate corrosion through contact with typical industrial atmosphere (e.g. water vapour condensation, coolant and lubricants).

Explanation on vibration and shock – severity level	
Severity level 1 (SL 1, in accordance with EN 60068, part 2 – 29)	Vibration: 0.15 mm path at 10 ... 58 Hz; 2 g acceleration at 58 ... 150 Hz
	Shock: ±15 g at 11 ms duration; 5 shocks per direction
	Continuous shock: ± 15 g at 6 ms duration; 1000 shocks per direction
Severity level 2 (SL 2, in accordance with EN 60068, part 2 – 27)	Vibration: 0.35 mm path at 10 ... 60 Hz; 5 g acceleration at 60 ... 150 Hz
	Shock: ±30 g at 11 ms duration; 5 shocks per direction
	Continuous shock: n. a.

Power supply	
Operating voltage [1] **bus node** – Nominal value – Tolerance	 DC 24 V DC 18 ... 30 V
Load voltage [1] **of connected devices** – Area	 DC 18 ... 30 V [2]
Intrinsic current consumption of bus node at DC 24 V	Max. 100 mA
Load capacity of the operating and load voltage supply – Bus node on a connected device (e.g. valve terminal) – Bus node on electrical connection box, type CAPC-...	 Max. 4 A Max. 2 A
Mains buffering time	10 ms
Isolation of fieldbus interface at $V_{EL/SEN}$	Galvanically isolated
1) Separate, external fuses are required for operating and load voltage supply. 2) Dependent on the connected device (e.g. valve terminal)	

Fieldbus	
PROFIBUS chip	VPC3+S
Design	RS 485, floating
Type of transmission	Serial asynchronous, half duplex
Protocol	PROFIBUS DP
Baud rate	9.6 ... 12000 kBaud, automatic baud rate identification
Cable type	Dependent on the cable length and the set fieldbus baud rate: see product documentation for your controller

I-Port signal transmission	
– Internal cycle time	Typically 4 ms for 2 bytes of user data

Baud rate [1]	Max. cable lengths		Reaction times	
	Segment length [2]	Branch line length [3] (total)	Max. T_{SDR} (T_{Bit})	Min. T_{SDR} (T_{Bit})
9.6 kBaud	Max. 1200 m	Max. 500 m	60	11
19.2 kBaud	Max. 1200 m	Max. 500 m		
93.75 kBaud	Max. 1200 m	Max. 100 m		
187.5 kBaud	Max. 1000 m	Max. 33.3 m		
500 kBaud	Max. 400 m	Max. 20 m	100	
1.5 MBaud	Max. 200 m	Max. 6.6 m	150	
3 ... 12 MBaud	Max. 100 m	–	250 ... 800	

[1] The baud rates named here are approximate values and are not supported by all DP masters.
[2] Trunk line
[3] Drop line

A.2 Access to the bus node via DPV1

By means of DPV1 commands, you can access all parameter information which the bus node provides:

You can conveniently access the parameter information via the PROFIBUS configuration software.

A.2.1 Reading and writing data records

Various function blocks are available for reading and writing data. The following table provides an overview:

Function	**Function block in accordance with DP standard**	**Function block Siemens S7, formerly**	**Function block Siemens S7, new**
Read data	DP_RDREC	SFC 59 RD_REC	SFB 52 RDREC
Write data	DP_WRREC	SFC 58 WR_REC	SFB 53 WRREC
DPV1 compatibility*)	“conforms to standard” EN50170	“S7 compatible”	“S7 compatible” IEC 61131-3
*) Parameterisation of the bus node as described in the following.			

Tab. A/1: Overview of function blocks for reading and writing data records

You can still use the function blocks SFC 58 and SFC 59 in your existing S7 projects.
Recommendation: When creating new projects, use the new function blocks SFB 52 and SFB 53 in order to make use of the full DPV1 functionality. Before accessing the data, set the DPV1 compatibility to “S7-compatible” as follows:

Siemens S7 - SFC 59 and 58

Function module SFC 59 in STL for reading a data record:

STL	**Explanation**
`CALL SFC 59“RD_REC”`	
`REQ :=TRUE`	Request to read
`IOID :=B#16#54`	Identifier of the address range (here always 54)
`LADDR :=W#16#6`	Logical address of the bus node (see mask “DP-slave properties” in HW Config)
`RECNUM :=B#16#14`	Data record number 20 (see Fig. 2/9)
`RET_VAL :=MW100`	If errors occur, output of error code
`RECORD :=P#M110.0 BYTE 8`	Target range for the read-in record and data record length
`BUSY :=M10.0`	Reading in process

Fig. A/1: Example program for reading out the diagnostic memory status

Function block SFC 58 in STL for writing a data record:

STL	Explanation
`CALL SFC 58“WR_REC”`	
`REQ :=TRUE`	Request to write
`IOID :=B#16#54`	Identifier of the address range (here always 54)
`LADDR :=W#16#6`	Logical address of the bus node (see mask “DP-slave properties” in HW Config)
`RECNUM :=B#16#14`	Data record number 20 (see Fig. 2/9)
`RECORD :=P#M130.0 BYTE 8`	Pointer at start of data range for diagnostics and length of the diagnostic data
`RET_VAL :=MW102`	If errors occur, output of error code
`BUSY :=M10.1`	Reading in process

Fig. A/2: Example program for transmitting the diagnostic memory status

Siemens S7 - SFB 52 and 53

New function block SFB 52 in STL for writing a data record:

STL	Explanation
`CALL “RDREC” , DB100`	
`REQ :=TRUE`	Request to read
`ID :=B#16#256`	Logical address of the bus node (see mask “DP-slave properties” in HW Config)
`INDEX :=19`	Data record number
`MLEN :=4`	max. Length of the data record information to be read in byte
`VALID :=M200.0`	1 = New data record received and valid
`BUSY :=M200.1`	1 = Reading in process
`ERROR :=M200.2`	1 = Error in reading
`STATUS :=MD202`	Access identifier or error code
`LEN :=MW220`	Length of the read data record information
`RECORD :=P#M230.0 BYTE 4`	Target range for the read data record and max. Data record length

Fig. A/3: Example program for reading out the Device ID from device 1

New function block SFB 53 in STL for writing a data record:

STL	Explanation
`CALL "WRREC" , DB101`	
`REQ :=TRUE`	Request to write
`ID :=B#16#256`	Logical address of the bus node (see mask "DP-slave properties" in HW Config)
`INDEX :=32`	Data record number
`LEN :=8`	Max. length of the data record information to be transferred in bytes
`DONE :=M200.0`	1 = Data record has been transferred
`BUSY :=M200.4`	1 = Writing in process
`ERROR :=M200.5`	1 = Error in writing
`STATUS :=MD206`	Access identifier or error code
`RECORD :=P#M230.0 BYTE 10`	Source range for the data record and max. Data record length

Fig. A/4: Example program for transfer of the parameters for device 1

A.2.2 Data records for DP-master controls, general

Access to the parameters and data through DPV1 is made via a slot and index number (see Tab. A/2 to Tab. A/4).

The slot number for the module-related data results from:
slot number = module number + 100.
That is, the bus node can be reached via the slot number 100, a connected device at I-Port connection 1 can be reached via the slot number 101 and a device at I-Port connection 2 can be reached via the slot number 102.

Slot 100: bus nodes				
Index	**Name**	**Length [byte]**	**Access 2)**	**Data record number 3)**
0	Last I-Port event code 1)	4	r	16
1) See chap. 3.3.5 2) r = read, rw = read and write 3) Specifically for Siemens S7 controllers				

Tab. A/2: Acyclic DPV1 master data access to the bus node

Slot 101: Device at I-Port connection 1				
Index	**Name**	**Length [byte]**	**Access 1)**	**Data record number 2)**
0	Process data inputs in bytes	1	r	30
1	Process data outputs in bytes	1	r	31
2	Vendor ID	2	r	32
3	Device ID	4	r	33
4	Function ID	2	r	34
5	Manufacturer name	64	r	35
6	Manufacturer URL	64	r	36
7	Product name	64	r	37
8	Part no.	64	r	38
9	Product text	64	r	39
10	Serial no.	64	r	40
11	HW revision	64	r	41
12	SW revision	64	r	42
13	Slave attribute (I-Port)	1	rw	43
14	Extended parameters	1	r	44
15	Diagnostics types	2	r	45
16	Parameter device 1	8	rw	46
1) r = read, rw = read and write 2) Specifically for Siemens S7 controllers				

Tab. A/3: Acyclic DPV1 master data access, I-Port connection 1

Slot 102: Device at I-Port connection 2				
Index	**Name**	**Length [byte]**	**Access 1)**	**Data record number 2)**
0	Process data inputs in bytes	1	r	60
1	Process data outputs in bytes	1	r	61
2	Vendor ID	2	r	62
3	Device ID	4	r	63
4	Function ID	2	r	64
5	Manufacturer name	64	r	65
6	Manufacturer URL	64	r	66
7	Product name	64	r	67
8	Part no.	64	r	68
9	Product text	64	r	69
10	Serial no.	64	r	70
11	HW revision	64	r	71
12	SW revision	64	r	72
13	Slave attribute (I-Port)	1	rw	73
14	Extended parameters	1	r	74
15	Diagnostics types	2	r	75
16	Parameter device 2	8	rw	76
1) r = read, rw = read and write 2) Specifically for Siemens S7 controllers				

Tab. A/4: Acyclic DPV1 master data access, I-Port connection 2

A.3 Operation with the general DP master

A.3.1 Sending parameterisation data

Set_Prm — The parameterisation data is transferred from the DP master to the bus node with the function Set_Prm.

Octet 1: Station status

Bit	Significance	Explanation		
0	—	Reserved		
1	—			
2	—			
3	WD_On	Response monitoring of the bus node on/off: 0 = off 1 = on		
4	Freeze_Req	0 = FREEZE mode not required by the master 1 = FREEZE mode set by the master		
5	Sync_Req	0 = SYNC mode not required by the master 1 = SYNC mode set by the master		
6	Unlock_Req	**Bit 7**	**Bit 6**	**Explanation**
7	Lock_Req	0	0	Min. T_{SDR} + slave parameters may be overwritten
		0	1	Bus node is approved for other masters
		1	0	Bus node is blocked for other masters
		1	1	Bus node is approved for other masters

Tab. A/5: Octet 1: Station status

Further octets

Octet	Designation	Explanation
2 and 3	WD_Fact_1 WD_Fact_2	Range 1...255: The response monitoring time of the bus node is transferred with these two octets: TWD [s] = 10ms x WD_Fact_1 x WD_Fact_2
4	Minimum Station Delay Responder (min T_{SDR})	The minimum time the bus node must wait, before the reply telegram may be sent to the DP master.
5 and 6	Ident_number	Transmits the manufacturer identifier (= $059E_h$) of the bus node; parameterisation telegrams to bus nodes are only accepted if the transmitted and the programmed Ident. Numbers match.
7	Group_Ident	Not supported by bus nodes
8	DPV1 parameter status 1	Watchdog, fail safe mode and MS1 channel
9	DPV1 parameter status 2	DPV1 alarms on/off
10	DPV1 parameter status 3	DPV1 alarm types, other
11	Bus nodes	Bit 1: tool change mode I-Port connection 1 Bit 2: tool change mode I-Port connection 2
12 ... 23	I-Port connection 1	Module code (3 bytes device ID and 1 byte type ID), 8 bytes device-specific parameters
24 ... 35	I-Port connection 2	Module code (3 bytes device ID and 1 byte type ID), 8 bytes device-specific parameters
38 ... 198	User_Prm_Data	Reserved

Tab. A/6: Octets 2 ... 198

A.3.2 Checking the configuration data

Chk_Cfg	The configuration data are transferred from the DP master to the bus node with the function Chk_Cfg. A maximum of 3 modules (bus node and max. 2 connectable devices) can be configured at the DP master.
Permissible identifiers	Identifiers in accordance with EN 50170 and the assigned address space of the connectable equipment can be found in the tables in chap. 2.2.2 and several configuration examples in chap. 2.4.

A.3.3 Transferring input and output data

Data_Exchange

Cyclic data exchange is accomplished with the function Data_Exchange.

With this function, the output data of the bus node are transmitted as an octet string of length x. The octet string length depends on the number of identifier bytes.

Note
With the function Data_Exchange, the bus node expects the **output data** for the valves and electric outputs.

The **input data** are sent to the master as a reply telegram.

Overview of the user data (Data_Exchange) for example 1 from chap. 2.4.1 (bus node with MPA-L and CTSL):

Output data (Outp_Data)	**Input data (Inp_Data)**
Octet 1: O-data byte_0*) (MPA-L output data byte 1) Bit 0: output x.0 Bit 1: output x.1 ... Bit 6: output x.6 Bit 7: output x.7	**Octet 1: I data byte_0** (CTSL input data byte 1) Bit 0: input t.0 Bit 1: input t.1 ... Bit 6: input t.6 Bit 7: input t.7
Octet 2: O-data byte_1 (MPA-L output data byte 2) Bit 0: output y.0 Bit 1: output y.1 ... Bit 6: output y.6 Bit 7: output y.7	**Octet 2: I data byte_1** (CTSL input data byte 2) Bit 0: input t.0 Bit 1: input t.1 ... Bit 6: input t.6 Bit 7: input t.7

Tab. A/7: Cyclical data exchange for example 1 from chap. 2.4.1

A.3.4 Reading diagnostic information

Slave_Diag

The diagnostic data are requested by the bus node with the function Slave_Diag (see chap. 3.3.3).

Set_Prm

With the function Set_Prm you can determine the watchdog time (WD_Fact_1, Octet 2, WD_Fact_2, Octet 3).
The behaviour of the bus node in case of error (e.g. bus failure) depends on the parameterisation (see chap. 2.8).

A.3.5 Implemented functions and service access points (SAP)

Function	**Available**	**Destination SAP (DSAP)**
Data_Exchange	Yes	NIL
RD_Inp	Yes	56
RD_Outp	Yes	57
Slave_Diag	Yes	60
Set_Prm*)	Yes	61
Chk_Cfg	Yes	62
Get_Cfg	Yes	59
Global_Control	Yes	58
Set_Slave_Add	No	55
MSAC_C1	Yes	50, 51
MSAC_C2	No	–
*) The bus node parameters are also sent with Set_Prm during the initialisation phase.		

Tab. A/8: Overview of functions and service access points

DPV1	You can access the DPV1 services with the following functions: – MSAC_C1: For masters of class 1 (e.g. PLC), fixed service access points. – MSAC_C2 is not supported.

A.3.6 Transmission times at the master

Note
Observe the cycle time of your controller and the update time of the DP-master.

Delay time	The delay time that arises through the internal cycle time of the I-Port communication can be found in chap. A.1.
Reaction time	The minimum and maximum reaction times T_{SDR} dependent on the baud rate can also be found in chap. A.1.
Total transmission time	Please take the calculation of the total transmission time from the product documentation of your controller or DP master.

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Appendix B

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