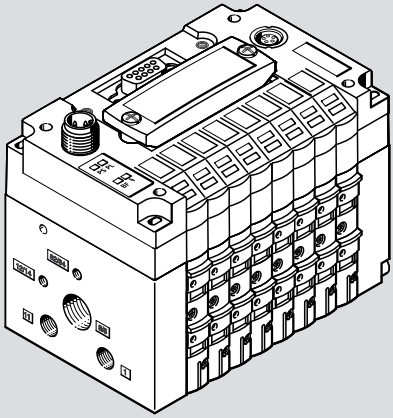
CPV10/14-GE-DI02-8

Electrical interface

FESTO



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Translation of the original instructions

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1 About this document

1.1 Applicable documents

All available documents for the product ➔ www.festo.com/sp.

1.2 Product version

This document refers to the following product versions:

Product	Version
Revision 10 (Rev 10)	
Software Version	From 1.4.15
Hardware version	From V0521

Tab. 1: Product version

- The CPV valve terminal ...-DI01 still operates like the previous DI01 version with version A of the CP protocol.
- The CPV valve terminal ...-DI02 still operates like the previous DI02 version with the extended CP(I) protocol version B.

The product version can be determined from the product labelling.

There may be an updated version of this document for this or later product versions
➔ www.festo.com/sp.

2 Safety

2.1 Safety instructions

– Only use the product in its original condition without unauthorised modifications.
– Only use the product if it is in perfect technical condition.
– Comply with specified critical limits.
– Comply with all applicable national and international instructions.
– Comply with the handling specifications for electrostatically sensitive devices.
– Take into account the ambient conditions at the location of use.
– Observe the identifications on the product.
– Before working on the product, switch off the power supply and secure it against being switched on again.

2.2 Intended use

The product is intended for interface with CPV valve terminals with a direct connection to the PROFIBUS DP and is intended for use in the industrial sector. Use the product exclusively in combination with modules and components that are certified for the specific product variant and have been tested and approved by Festo.

2.3 Training of qualified personnel

Work on the product may only be carried out by qualified personnel who can evaluate the work and detect dangers. The qualified personnel must be familiar with installation of electrical control systems. Qualified personnel have knowledge and experience in working with the PROFIBUS DP.

3 Additional information

- Contact the regional Festo contact if you have technical problems ➔ www.festo.com.
- Accessories ➔ www.festo.com/catalogue.

4 Product design

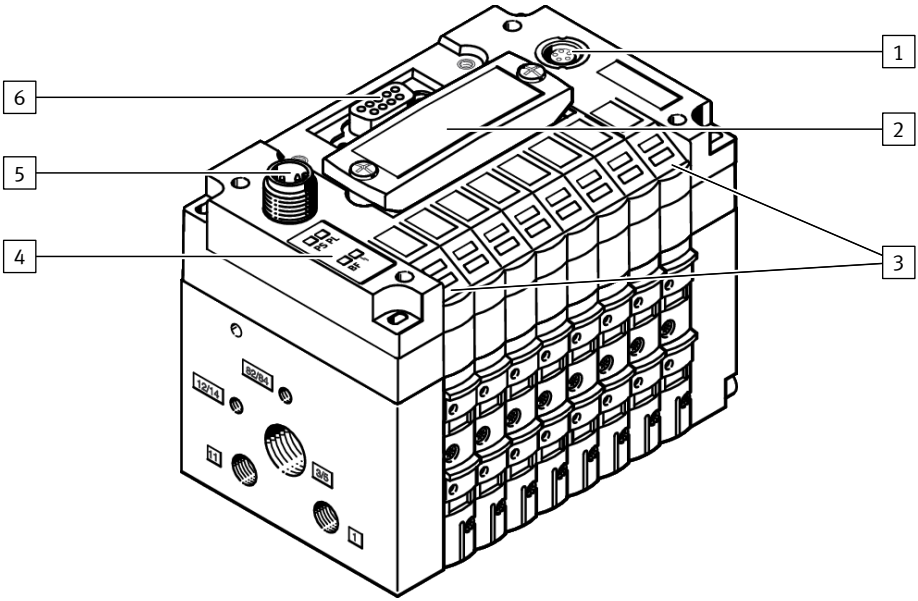


Fig. 1: Product design

1 CPI expansion port

2 Switch cover for DIL switch and SAVE button

3 Switching status indications of the CP valve coils

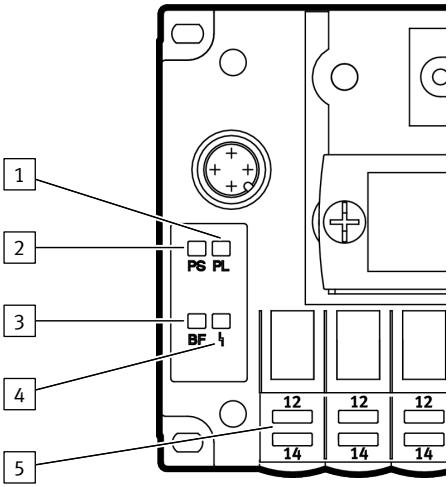
4 LED indicators PS, PL, BF and ϟ

5 Operating voltage and load voltage supply connection

6 PROFIBUS DP fieldbus interface

4.1 LED display elements

The LED display elements on the cover indicate the operating status.



1 LED display PL (Power Load)
2 LED display PS (Power System)
3 LED display BF (bus error)
4 LED display ↳ (other errors)
5 LED displays switching status of the CP valve coils

Fig. 2: LED display elements

4.2 Control elements

DIL switches

DIL switches	Function
	The PROFIBUS address is set in binary code via DIL switches 1 ... 7. Valid PROFIBUS address: 1 ... 125
	The device-based diagnostics are activated or deactivated with DIL switch 8 via PROFIBUS. ON = active (factory setting) OFF = inactive If the diagnostic mode is deactivated, no device-related diagnostic information of the valve terminal is sent to the master system.

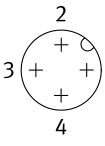
Tab. 2: DIL switches

SAVE button

CPI/CP modules connected to the CPI expansion connection are automatically recognised with the SAVE button ➔ 5.1.4 Detect CPI extension with SAVE button.

4.3 Connecting elements

4.3.1 Power supply

Plugs	Pin	Designation
	1	Operating voltage supply 24 V DC
	2	Load voltage supply 24 V DC
	3	Power supply 0 V DC
	4	Earth terminal

Tab. 3: Pin allocation of power supply connection

4.3.2 Fieldbus interface

The fieldbus is connected with a 9-pin Sub-D socket.
This connection is used for the supply line and continuing fieldbus cable.

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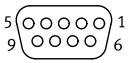
Only the Festo fieldbus plug will guarantee IP65.

- Before connecting fieldbus plugs from other manufacturers, replace the two flat screws with bolts.

Socket	Pin	Festo fieldbus connector IP65[1)]	PROFIBUS DP	Designation
	1		n.c.	not connected
	2		n.c.	not connected
	3	B	RxD/TxD-P	Receive/transmit 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	O	RxD/TxD-N	Receive/transmit data N
	9		n.c.	not connected
	Housing	Clamping clip	Shielding	Connection to functional earth

1) Type FBS-SUB-9-GS-DP-B
2) The repeater control signal CNTR-P is implemented as a TTL signal.

Tab. 4: Fieldbus interface pin allocation

4.3.3 CPI expansion port

The CPI expansion port is used to connect additional CPI/CP modules of the CPI system.

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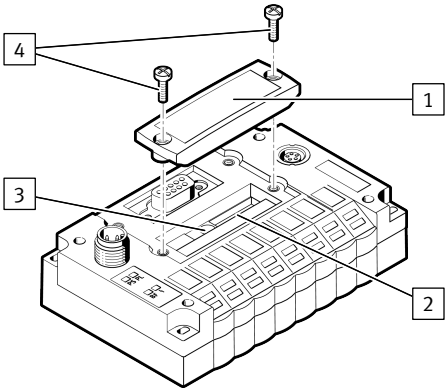
Detailed information on the CPI extension port ➔ 5.5 Extend CPV master.

5 Installation

5.1 Settings

5.1.1 Remove/install switch cover

The control elements (DIL switch and SAVE button) are located under the switch cover.



1 Switch cover
2 DIL switches
3 SAVE button
4 Screws

Fig. 3: Remove/install switch cover

1. Switch off the operating voltage.
2. Unscrew the switch cover screws and remove the switch cover.
3. Make the desired settings on the control elements.

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When CPI/CP modules are connected to the CPI expansion port ➔ 5.5 Extend CPV master.

4. Replace the switch cover and check that the seal is properly seated.
5. Hand-tighten the screws.

5.1.2 Setting the PROFIBUS address

The PROFIBUS address is entered in binary code with DIL switches 1 ... 7.
Valid PROFIBUS addresses: 1 ... 125

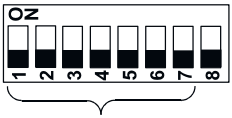

Fig. 4: Set PROFIBUS address

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The PROFIBUS address may only be assigned once per fieldbus line.

Set PROFIBUS address: 5	Set PROFIBUS address: 38
	
$2^0 + 2^2 = 1 + 4 = 5$	$2^1 + 2^2 + 2^5 = 2 + 4 + 32 = 38$

Tab. 5: Examples of set PROFIBUS addresses (binary coded)

5.1.3 Set diagnostic mode

If the device-related diagnosis is deactivated (switch element 8 to OFF), device-related diagnostic information of the valve terminal is not sent to the master system, e.g. short-circuit of the outputs or undervoltage of the valves ➔ 7.2.2 Diagnostic steps.

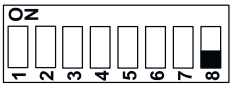

Fig. 5: Set diagnostic mode

5.1.4 Detect CPI extension with SAVE button

CPI/CP modules connected to the CPI expansion port are automatically detected by pressing the SAVE button.

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It is not necessary to press the SAVE button in the tool change configuration
➔ 6.4.2 Tool change configuration.

1. Prepare the connection to the power supply ➔ 5.4 Power supply.
2. Follow the description of the exact procedure.
   - ➔ 5.5 Extend CPV master
   - ➔ 5.6 Prepare CPI system for commissioning.

5.2 Connect fieldbus

5.2.1 Fieldbus cable

NOTICE

Data transmission errors due to signal reflections and signal attenuation due to incorrect installation and high transmission rates.

Transmission errors can be caused by:

- Missing or incorrect terminating resistor
- Missing shield connection
- Junctions
- Transmission over long distances
- Unsuitable cables.

Observe the cable specification. Cable type information ➔ Controller manual.

NOTICE

Property damage when the product is mounted in a machine so it can move.

- Install strain relief for the fieldbus cable on the moving part of the machine.
- Observe the regulations of IEC/DIN EN 60204-1.

- Use a twisted, shielded 2-wire line as the fieldbus cable.

Cable specification according to EN 50170 (cable type A)	
Surge impedance	135 ... 165 Ω (3 ... 30 MHz)
Capacitance per unit length	<30 nF/km
Loop resistance	<110 Ω/km
Core diameter	>0.64 mm
Wire cross section	>0.34 mm^2

Tab. 6: Cable specification according to EN 50170 (cable type A)

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Bus length

Information on the bus length ➔ 5.2.2 Fieldbus baud rate and fieldbus length and in the control system manuals.

5.2.2 Fieldbus baud rate and fieldbus length

NOTICE

Malfunctions due to impermissible fieldbus lengths.
The permissible fieldbus segment lengths depend on the baud rate used.
- Observe the maximum segment length (cable length without repeater) if the CPX terminal is connected to a fieldbus segment.
- Avoid branch lines.

The product automatically sets itself to one of the following baud rates:

Baud rate	Maximum segment length
9.6; 19.2; 93.75 kbaud	1200 m
187.5 kbaud	1000 m
500 kbaud	400 m
1500 kbaud	200 m
3000 ... 12000 kbaud	100 m

Tab. 7: Maximum fieldbus segment lengths depending on the baud rate

5.2.3 Connection options

Connection with Festo fieldbus plug

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Achieving IP65 degree of protection
- Seal unused ports with protective caps or blanking plugs.
- Observe the assembly instructions of the fieldbus plug.

The product is easily connected to the fieldbus with the Festo FBS-SUB-9-GS-DP-B fieldbus plug. The fieldbus plug can be disconnected from the product without interrupting the bus line (T-TAP function).

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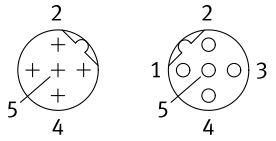
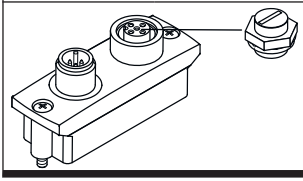
The clamping clip in the Festo fieldbus plug is internally only capacitively connected to the metal housing of the Sub-D connector. This prevents compensating currents from flowing through the shield of the fieldbus cable.

The following is switched with the switch in the fieldbus plug:
– OFF switch position:
  The bus connection is switched off and the continuing fieldbus line is switched on.
– ON switch position:
  The bus connection is switched and the continuing fieldbus line is switched off.

Connection with M12 adapter (reverse key coded)

When using the adapter FBA-2-M12-5POL-RK the product is connected to the fieldbus via M12 plugs. The plugs have an inverted mechanical coding (reverse key or B-coded), which prevents the incoming and outgoing connection from being confused. The adapter can be disconnected from the product without interrupting the bus line (T-TAP function). The connection to the fieldbus uses a 5-pin M12 plug with PG9 fitting. The second connector socket is used to continue the fieldbus.

M12 adapter (reverse key encoded)	Pin	Designation
	1	VP: supply voltage plus (P5V)
	2	RxD/TxD-N: receive/send data N
	3	DGND: data reference potential (M5V)
	4	RxD/TxD-P: receive/send data P
	5	FE: functional earth
	Housing	Shielding
	Protective cap or plug with bus terminating resistor if the connection is not used.	

Tab. 8: Pin allocation of the fieldbus interface with adapter for 5-pin M12 connection

Connection with fibre optics

The PROFIBUS DP interface conforms to the EN 50170-2 specification and supports the control of network components for fibre optics.

- Use fibre optic cables for transmission in environments with high levels of interference and to increase the range at high transmission speeds.

Example of fibre optic network components:

– SIEMENS Optical Link Module (OLM) for PROFIBUS plus
– SIEMENS Optical Link Plug (OLP) for PROFIBUS (IP20)
– Harting Han-InduNet® media converter IP65 in combination with adapter cable for Festo products (optical data transfer in the DESINA installation concept).

5.3 Bus terminal with terminating resistors

If the valve terminal is at the start or end of the fieldbus system, a bus termination is required.

- Use a bus termination at both ends of a bus segment.

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Recommendation

- Use the Festo prefabricated fieldbus plug for the bus termination. A suitable resistor network is integrated in the housing of this plug connector.

5.4 Power supply

5.4.1 Cables for the power supply

- Use a power supply cable with a sufficient cross-section.
- Avoid long distances between the fixed power supply and the CPV valve terminal. Long cables reduce the voltage supplied by the fixed power supply.
- If necessary, calculate the suitable cable cross-section and the maximum permissible cable length.

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- For the power supply connection, use plugs from the Festo catalogue to match the outside diameter of the cables used ➔ www.festo.com/catalogue.

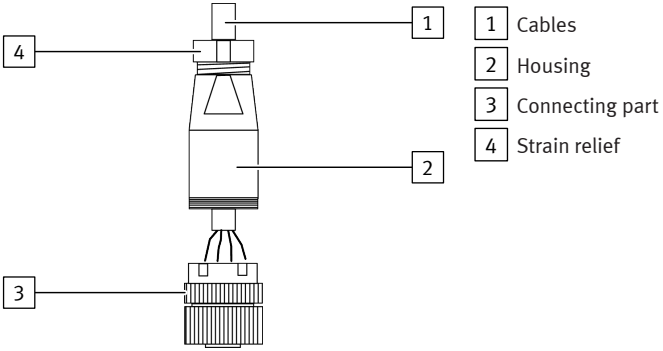

Fig. 6: Socket parts and cable access

Assembly

After selecting a suitable cable, connect it as follows:

1. Open the socket by loosening the middle knurled nut.
2. Open the strain relief on the rear part of the housing and feed the cable through.
3. Strip the ends of the conductors by 5 mm and fit wire end sleeves.
4. Connect the wire ends.
5. Put the connection part back on the housing of the socket and screw it in. Pull the cable back far enough so there are no cable loops in the housing.
6. Tighten the strain relief firmly.

5.4.2 Select power pack

⚠ WARNING

Risk of injury due to electric shock.

- For the electric power supply, use only PELV circuits that ensure a reliable electric disconnection from the mains network.
- Observe IEC 60204-1/EN 60204-1.

The use of PELV circuits ensures protection from electric shock (protection from direct and indirect contact) in accordance with IEC/EN 60204-1 (Electrical equipment of machines, General requirements).
The power requirement of a CP system depends on the number of CP modules and valve coils.
Recommendation:

- Use regulated power packs.
- When selecting the fixed power supplies, check that they supply sufficient power. To do this, calculate the total power requirement according to the following table.

Total power consumption

The table below shows the calculation of the total power consumption for a CP system. The values given are rounded up.

Power consumption f CP electronics (pin 1)		**Total**
CPV master	max. 100 mA	
CPV valve terminal	max. 40 mA	
CPA valve terminal	20 mA	
CP input module	max. 40 mA	
Sensors	see manufacturer's specifications	
CP output module	max. 40 mA	
Transfer		= _____ mA
Power consumption of valve power supply (pin 2)		
Power consumption of all valve coils energized at the same time[1)]	__ x ____mA	= _____ mA

1) Power consumption depends on the valve type ➔ Technical data of the valves in the corresponding pneumatics description.

Tab. 9: Calculate total power consumption

5.4.3 Connecting the power supply

NOTICE

Unexpected response of the valve terminal due to switch-on test pulses if the valve terminal is supplied with load voltage via an output of a "safety-related I/O module".

- Ensure that switch-on test pulses are safely suppressed or switched off.

NOTICE

As part of the emergency off design check what actions for the machine/system are required to set the system to a safe state in the case of an emergency off event:

- Switch off the load voltage of the valves and output modules in the secondary circuit of the power pack.
- Switch off the compressed air supply.

Energy stored in the input circuitry of valve terminals can cause the valves to switch off with a delay after the load voltage has been switched off:

- Detect the switch off of the load voltage using an input signal in the controller.
- Block the valve control signal by locking the output signal with the "load voltage" input signal.

The power supply is via the 4-pin M12 plug ➔ Fig. 1.
The power consumption depends on the type of valve terminal ➔ Tab. 9 Calculate total power consumption and "Pneumatics description, P.BE-CPV-...".

- When connecting the load voltage to pin 2, observe the tolerance 20.4 V DC ... 26.4 V DC. Check the load voltage of the valves during operation of the system.
- Protect the load voltage of the valve coils externally with a maximum 2 A fuse.

Equipotential bonding

NOTICE

Avoid malfunctions caused by electromagnetic interference.

- Connect the earth potential to pin 4 of the power supply connector.
- Connect the earth connection of the end plate to the earth potential with low impedance.
- Use low-impedance connections to ensure that the product housing and the earth connection at pin 4 have the same potential and that there are no compensating currents.

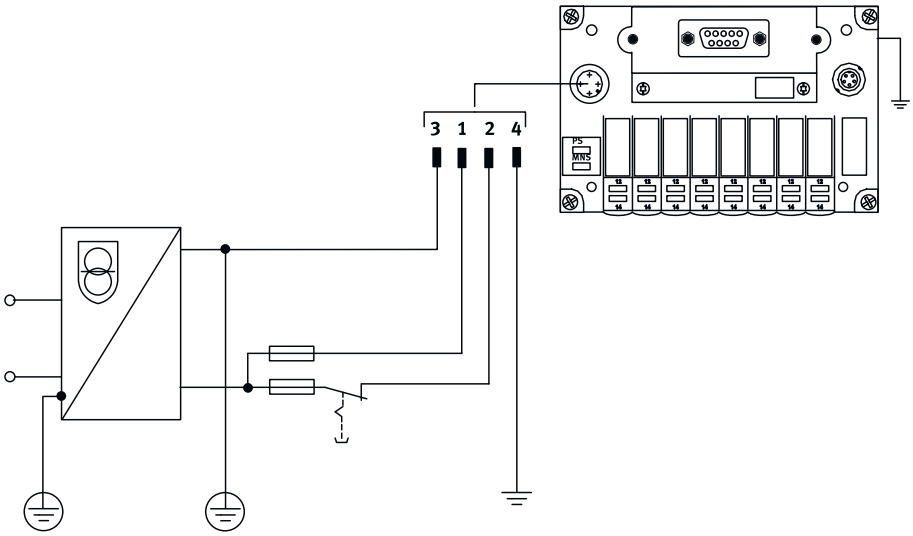

Fig. 7: Connection example with PELV fixed power supply and equipotential bonding

5.5 Extend CPV master

This section is only relevant if CPI/CP modules are to be connected to the CPI expansion connector.

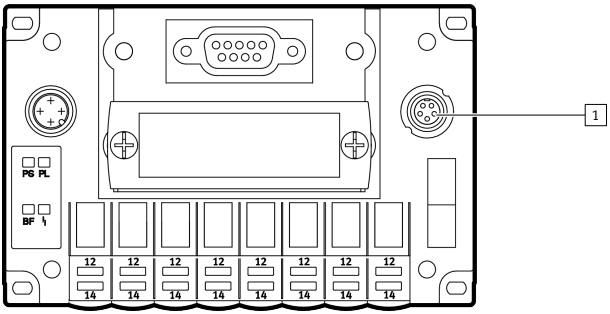

Fig. 8: CPI expansion port

1 CPI expansion port

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The rules for CPI systems apply to the expansion of the CPV master ➔ 5.5.1 Rules for extending the CPI system.

The following CPI/CP modules can be connected to the CPI expansion connection:
- CP input and output modules
- CPI input and output modules (with extended functionality)
- CPV-SC with CPI connection
- CPV/CPA valve terminals with and without extended functionality

NOTICE

Malfunctions due to impermissible cable lengths and cables.
The CP connecting cables must have special electrical properties.
- Use pre-assembled CP connection cables from Festo ➔ www.festo.com/catalogue.
- Comply with the maximum permissible cable length of 10 m between the CPV master and the last CPI/CP module.

To achieve degree of protection IP65, close the remaining free CP connections of the CP system with the sealing cap supplied.

5.5.1 Rules for extending the CPI system

Depending on the type of CP master and the connected CPI/CP modules, the CPI system supports a different number of modules per CP string.
The CPV master is a CPI master.
Modules can be divided into two groups:
– CPI modules (with extended functionality)
– CP modules (without extended functionality)

CPI type	Rules and properties
CPI system	– Max. 4 modules on the CP string – Max. 32 I and 32 O (per CP string) – Any order of the modules within the CP string
CPI master	A mixture of CPI/CP modules is possible on CPI masters: – Only one CP input module is possible at the end of a line – There is only one CP valve terminal per CP string[1] or one CP output module[1] possible – "Free" slots on the CP string can be "completed" with CPI modules[2] functionality.
CPI modules	Incoming and outgoing interface on all CPI modules (input modules, output modules) and valve terminals with CPI connection

1) without extended functionality
2) with extended

Tab. 10: Rules for expanding the CPI system

NOTICE

Malfunction due to exceeding the permitted number of CPI/CP modules.
A CP string may be expanded with a maximum of 2 CP valve terminals with CPI capability, as CP valve terminals always occupy 16 output addresses.
- Regardless of the type of CPI/CP module, do not connect more than 32 inputs and 32 outputs (total of all modules on a CP string).

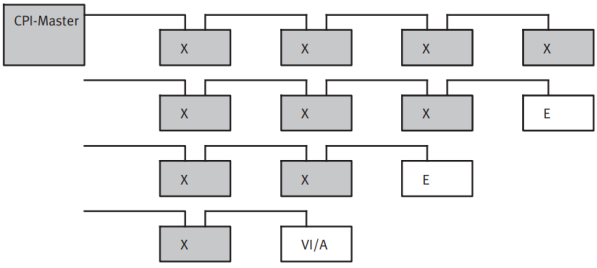

Fig. 9: Extension examples of a CPI system

- X: any CPI module or CP valve terminal with CPI capability (maximum 2 valve terminals possible)
- E: CP input module
- VI/A: CP valve terminal or CP output module
- Grey: CPI modules/valve terminals with extended functionality

CP string without CPI output module with a maximum of one CP valve terminal type	**Max. sensor power consumption of the CPI modules on the CP string[1)]**	**Maximum line length with CPI cable type KVI-CP-3-...**		
		U_{VAL} = 21.6 ... 24 V 16 valves[2)]	U_{VAL} = 20.4 V 8 valves[3)]	U_{VAL} = 20.4 V 16 valves[4)]
CPV10-.../ CPA10-...	0.5 O ... 1.5 O	10 m	10 m	10 m
CPV14-.../ CPA14-...	0.5 O ... 1.5 O	10 m	10 m	10 m
CPV18-...	0.5 O	10 m	10 m	10 m
	1.0 O	10 m	10 m	10 m[5)] 8 m[6)]
	1.5 O	10 m	10 m	10 m[5)] 5 m[6)]

1) Maximum drawn sensor supply current
2) Nominal voltage or undervoltage of –10%, 16 valve solenoid coils switched simultaneously (high-current phase)
3) Maximum undervoltage –15%, 8 valve solenoid coils switched simultaneously (high current phase)
4) Maximum undervoltage –15%, 16 valve solenoid coils switched simultaneously (high current phase)
5) Valve terminal installed at the start of the string
6) Valve terminal installed at the end of the string

Tab. 11: Permissible string lengths with CPI cables type KVI-CP-3- dependent on the CP valve terminal used and the sensor power consumption

CP string without CP valve terminal with a maximum of one CPI output module type	**Max. sensor power consumption of the CPI modules on the CP string[1)]**	**Maximum line length with CP cable type KVI-CP-3-...**
CP-A04-M12-CL	0.5 O	10 m
CP-A08...-M12-...	1.5 O	10 m

1) Maximum drawn sensor supply current

Tab. 12: Permissible string lengths with CP cables of type KVI-CP-3-... depending on the CPI output module used and the sensor current consumption

5.6 Prepare CPI system for commissioning

This section is only relevant if CPI/CP modules are connected to the CPI expansion port.

NOTICE

Addressing errors by changing address ranges during operation with different fieldbus systems.

- Do not connect a higher-order controller yet for preparation of commissioning the CPV master.

5.6.1 Check CP strings

Preparations

Before commissioning a CPV master with CPI extensions, every CPI system should first be separately prepared for commissioning.

Proceed as follows:

1. Check the pneumatic tubing of the valve terminals using the manual overrides ➔ Description of pneumatics.
2. Check all electrical wiring of the CPI system.
3. Save the current string assignment of the CPI system as target assignment ➔ 5.6.2 Save string assignment.

5.6.2 Save string assignment

NOTICE

Addressing errors with accidentally incorrectly installed CPI modules.

If the string assignment of the CPI system is subsequently changed:

- After saving the string assignment, check the address allocations of the CPI system before starting application programs.

String assignment

The CPV master saves the type and sequence of the connected CPI modules (string assignment) for the CP string. By saving the string assignment, the CPV master makes it possible to avoid connection errors and thus addressing errors. The CPV master automatically checks that the current string assignment matches the saved assignment.

A distinction is made between the following test phases:

– Check during the switch-on phase ➔ 5.7 Switch-on behaviour of the CPI system
– Check during operation ➔ 5.8 Behaviour of the CPI system in the event of malfunctions during operation

If the status LEDs on all CPI modules are on, the CPI system is ready for commissioning. The CPI system can now be put into operation.

Save string assignment

The desired string assignment is created and saved for commissioning. The corresponding addresses are assigned to the connected CPI modules.

Proceed as follows when saving the string assignment:

1. Leave the power supply of the CPV master switched off for the time being.
2. Check that the CPI cables are properly fixed with the union nut.
3. Switch on the power supply of the CPV master and, if applicable, the CPI/CP modules with load voltage connection. The error LED ϟ flashes on the CPV master if CPI/CP modules were connected there or the string assignment was changed.
4. Press and hold the SAVE button for at least 1 second, e.g. with a small screwdriver.
   This saves the current string assignment as the target string assignment in the CPV master.
   - The error LED ϟ stops flashing.
   - The status LEDs of all detected CPI/CP modules are on.
5. Switch off the CPV master and switch it on again.

5.7 Switch-on behaviour of the CPI system

After switching on the power supply, the CPV master automatically determines the current string assignment. This determines which CPI/CP modules are connected to the line extension.
If the current assignment matches the saved assignment, the CPV master switches to operational readiness. The LED displays PS and PL of the product and the status LEDs on the connected CPI/CP modules light up.
If the current assignment does not match the saved assignment, the error LED ↳ flashes on the CPV master. In this case, the CPI system is not operational.
Options for restoration of operational readiness:
– Eliminate assignment errors manually or replace individual CPI modules ➔ 5.8 Behaviour of the CPI system in the event of malfunctions during operation.
– Save current string assignment as target assignment ➔ 5.6.2 Save string assignment.

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Detailed information on diagnostics via the LED displays ➔ 7.1 Diagnostics via LED display elements.

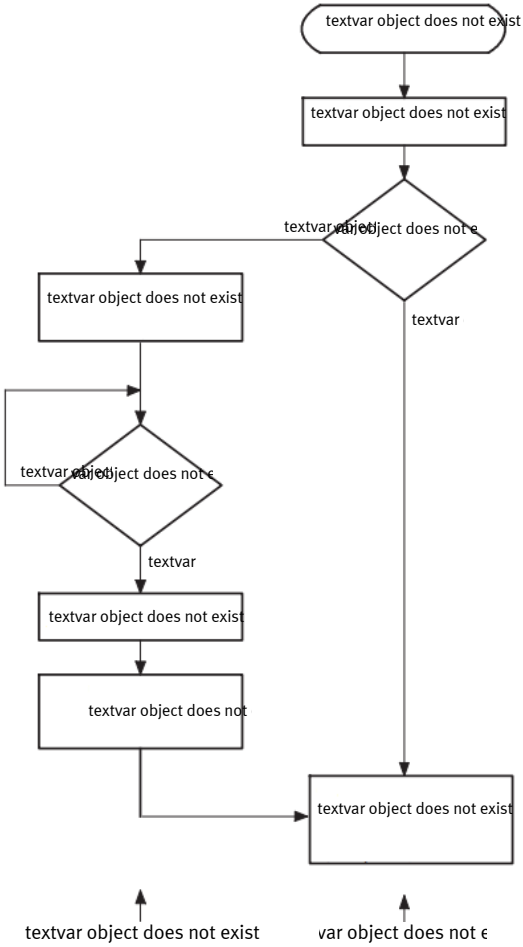

Fig. 10: Switch-on behaviour of the CPI system

5.8 Behaviour of the CPI system in the event of malfunctions during operation

If a malfunction occurs on the CP string during operation, e.g. due to a cable break, this is indicated on the CPV master by the diagnostics LED of the string extension (↳). The status LED on the relevant module goes out. All correctly working modules remain operational.
Incorrect state of the valves and outputs can lead to dangerous situations.

- Make sure that valves and outputs are set to a safe state when malfunctions occur.

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Detailed information on diagnostics via the LED displays ➔ 7.1 Diagnostics via LED display elements.

5.8.1 Eliminate assignment errors

Assignment or connection errors in the CPI system are eliminated as follows:

1. Switch off the power supply of the CPV master.
2. Restore the saved assignment by reconnecting the relevant CPI/CP modules to the CPV master.
3. Switch on the power supply of the CPV master again.

5.8.2 Replace CPI/CP modules

NOTICE

Loss of function due to replacement of CPI/CP modules.
After replacing a CPI/CP module with a CPI/CP module of a different type or after replacing several CPI/CP modules:

- Put the CPV master back into operation and save the string assignment again ➔ 5.6.2 Save string assignment.

Procedure for replacing a single module:

1. Switch off the power supply of the CPV master.
2. With CPI/CP output modules and valve terminals on the relevant CP string:
   Switch off the following energy sources:
   – Compressed air supply to the valve terminal
   – Operating voltage supply of the CPI/CP output module.
3. Disconnect all connection cables and hoses if necessary.
4. Connect all connection cables and, if necessary, tubing to the identical new module.
5. Now connect the identical new module to the same string.
6. For CPI/CP output modules and valve terminals: switch on the operating voltage supply or compressed air supply again.
7. Switch on the power supply of the CPV master again.
8. Check the addresses of the CPI system.

6 Commissioning

6.1 Preparations

6.1.1 Switching on the power supply

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Follow the switch-on instructions in the PLC controller manual.

When the controller is switched on, it automatically runs a comparison between the target and actual configuration. For this configuration run it is important that:
– the information on the fieldbus configuration is complete and correct.
– the power supply to the PLC and fieldbus stations is switched on either simultaneously or in the sequence specified below.

Observe the connection of the power supply:

Common power supply

- Feed in the common power supply for the control system and all fieldbus stations via a central fixed power supply or a central switch.

Separate power supply

If the control system and fieldbus stations have separate power supplies, switch them on in the following sequence:

1. Switch on the operating voltage supply for all fieldbus stations.
2. Switch on the operating voltage supply for the controller.

6.1.2 Address assignment for CPV master

The CPV master always has 16 output addresses, regardless of how many valve solenoid coils are installed. This enables later expansion without address shifting.
The figure below shows the addressing sequence of the individual CPV valve plates.

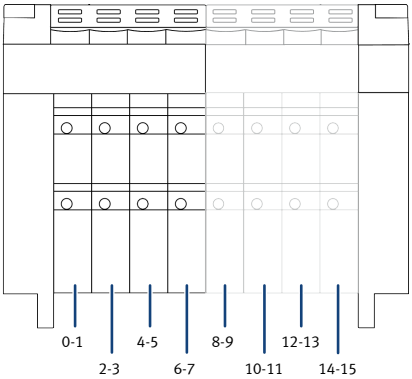

Fig. 11: Address assignment

- A valve position always occupies 2 addresses, even if it is equipped with a blanking plate or pressure separating plate. If a valve position is equipped with a bistable valve, the following assignment applies:
  - Pilot solenoid 14 occupies the low-order address
  - Pilot solenoid 12 the high-order address

  The higher-order address remains unused with monostable valves.
- The addresses are allocated from left to right and on the valve positions from front to back.

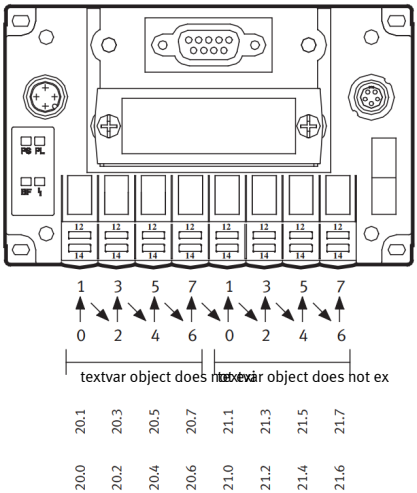

Fig. 12: Address assignment outputs example for output byte 20 and 21

6.1.3 Address assignment of CPI/CP modules

The table below shows an overview of the assigned addresses for various CPI/CP modules (status at the end of 2010).

CPI/CP modules		**Assigned I/Os on CPV-DI02-... CPI masters[1)]**	
Type	CPI capable[)]	I	O
CPI-/CP input modules			
CP-E08-M8-CL	yes	8 I	–
CP-E08-M12-CL	yes	8 I	–
CP-E16-KL-CL	yes	16 I	–
CP-E08-M12-EL	yes	16 I	–
CP-E16-M8-EL	yes	16 I	–
CP-E32-M8-EL	yes	32 I	–
CP-E16-M8	no	16 I	–
CP-E16N-M8	no	16 I	–
CP-E16-M8-Z	no	16 I	–
CP-E16-M12x2-5POL	no	16 I	–
CP-E16N-M12x2	no	16 I	–
CP-E16-KL-IP20-Z	no	16 I	–
CPI/CP output modules			
CP-A04-M12-CL	yes	–	8 O
CP-A08-M12-EL-Z	yes	–	8 O
CP-A08-M12-5POL	no	–	16 O
CP-A08N-M12	no	–	16 O
CPI-/CP valve terminals			
CPV...-CPI	yes	–	16 O
CPV-SC-CPI	yes		16 O
CPV...-GE-FB-4	no		16 O
CPV...-GE-FB-6	no		16 O
CPV...-GE-FB-8	no		16 O
CPA10/14-IFB-CP	no		16 O
Further CPI modules and CPI-capable valve islands in preparation.			

1) With extended functionality

Tab. 13: Assigned I/Os of CPI/CP modules

6.1.4 Information for commissioning

FREEZE and SYNC

The FREEZE and SYNC operating modes are supported by the CP system in accordance with EN 50170. Calling the FREEZE or SYNC commands depends on the controller. Information ➔ Documentation of the fieldbus connection.

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The FREEZE or SYNC operating mode is automatically reset when:

- CP system is switched on or off
- Fieldbus connection is stopped

Only the FREEZE operating mode is automatically reset when:

- Bus connection to the CP system interrupted (response monitoring active)

FREEZE command

All inputs of the CPI system are "frozen". The CPV master now sends a continuous image of all inputs to the master. The input image is refreshed and again continuously sent to the master at every subsequent FREEZE command.
Restore normal operation: UNFREEZE command

SYNC command

All outputs of the CPI system are "frozen". The CP system now no longer reacts to changes in the output image in the master. At every additional SYNC command the output image is imported in updated form.
Return to normal operation: UNSYNC command

Module consistency

The CP system supports the following variants of module consistency:

– about the selected format (word)

The table below shows an overview of the possible DP identifiers:

CPV and extension	DP identifier		Comment
	Siemens	EN 50170	
CPV master (without extension)	ID: 16DO	ID: $21_h/33_d$	16 digital outputs/valve coils of the CPV
Extension: 8 digital inputs	ID: 8DI	ID: $10_h/16_d$	e.g. CPI/CP input modules
Extension: 16 digital inputs	ID: 16DI	ID: $11_h/17_d$	
Extension: 24 digital inputs	ID: 24DI	ID: $12_h/18_d$	
Extension: 32 digital inputs	ID: 32DI	ID: $13_h/19_d$	
Extension: 8 digital outputs	ID: 8DO	ID: $20_h/32_d$	e.g. CPI/CP output modules, CP valve terminals
Extension: 16 digital outputs	ID: 16DO	ID: $21_h/33_d$	
Extension: 24 digital outputs	ID: 24DO	ID: $22_h/34_d$	
Extension: 32 digital outputs	ID: 32DO	ID: $23_h/35_d$	
Extension: tool change configuration (32 digital inputs and outputs)	ID: 32DX	ID: $33_h/51_d$	➔ 6.3.4 Tool change configuration

Tab. 14: Overview of DP identifiers for various extensions

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Enter the identifiers according to the physical order of the modules on the CP extension string, starting with CPV-DI02.

6.2 Device master file (GSD) and symbol files

A corresponding GSD file is required to configure the CPV master with a PG/PC. In addition to the slave-typical entries (ID number, revision, etc.), the GSD also contains a selection of identifiers.

Reference sources

Current GSD files are available on the Internet ➔ www.festo.com/sp.

GSD files

One of the following files is required for the CPV master:

– CPV_0A35.GSD (German version) or

– CPV_0A35.GSE (international version)

Icon files

Icon files are available to represent the valve terminal in the configuration software:

– Pbdicpin.dib (normal operating status)

– Pbdicpid.dib (diagnostic case)

– Pbdicpis.dib (special operating status)

6.3 Configuration with a Siemens master

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Various configuration programs are available in combination with a Siemens master.
- Observe the corresponding procedure of the configuration program used.

The following sections describe the essential configuration steps with the STEP 7 software as an example. The contents of the description of the STEP 7 software are assumed to be known in the following.
Information on operation with general DP masters ➔ 6.5 PROFIBUS DP: commissioning with a general DP master.

6.3.1 STEP 7 – HW Config (up to V 5.2) – preparations

1. Copy the GSD of the valve terminal to the directory...\STEP7\S7DATA\GSD of your PG/PC.
   File: CPV_0A35.GS*
   (Sources for the GSD ➔ 6.2 Device master file (GSD) and symbol files)
   The GSD can either:
   – manually copied to the above directory (e.g. via Windows Explorer) or
   – imported with the [Extras] – [Install new GSD] menu.

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   The hardware catalogue must be updated if the GSD is copied while working with STEP 7.
   - Menu in HW Config: [Options] [Update catalogue]

   As of STEP 7 V 4.02, GSDs are saved within the STEP 7 project (station GSD). This can mean that the update/import of new GSDs may appear to be faulty.
   - Observe the information on handling the station GSD in the STEP 7 help.
2. Edit the "Properties PROFIBUS" dialogue box
   – Transmission speed (baud rate)
   – Profile

Symbols

3. Copy the symbol files for the CPV master to the directory...\STEP7\S7DATA\NSBMP of your PG/PC.
   The icon files can either
   – be manually copied to the above directory or
   – imported via [Options] [Install new GSD] - file type "Bitmap Files" in HW Config.
4. Add a DP master system:
   – Right-click on "DP" under "CPU" in the rack
   – Click on [Add master system] in the context menu.

   ↳ The line of the DP master system is displayed.

6.3.2 Station selection with STEP 7

1. If the Hardware Catalogue has not been opened:
   Click on the catalogue icon.
   ↳ The hardware catalogue is displayed.
2. Open the "\PROFIBUS–DP\Additional Field Devices\Valves" folder in the hardware catalogue.
   ↳ The "Valves" folder is displayed when the GSD has been copied (see step 1 of the preparations).
3. Drag the "Festo CPV-DI02" station type to the line of the DP master system.
   ↳ The "Properties – PROFIBUS interface" dialogue window is displayed.
4. Select the PROFIBUS address identical to the selected setting of the DIL switch in the switch module (➔ 5.1.2 Setting the PROFIBUS address) and exit with OK.
   ↳ The valve terminal icon is displayed on the line of the DP master system.
5. If necessary, edit the "Properties – DP Slave" dialogue box: double-click the valve terminal icon.

6.3.3 Configuration with STEP 7

1. Click on the icon of the valve terminal to be configured in HW Config.
   ↳ The configuration table is displayed under the rack.
2. Open the "Festo CPV-DI02" module in the hardware catalogue (folder \PROFIBUS-DP\Other field devices\Valves\...).

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   Basic configuration
   The valve terminal always occupies 16 output addresses. First configure the basic device as follows:

3. Drag the "Base: 16DA" entry to the 1st line of the configuration table.
4. Drag the modules to the next free line in the configuration table according to the expansion of the CPV master.
5. Allocate the relevant start address in the "Properties – DP Slave" window.

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   Drag the modules into the configuration table according to the physical order of the extensions of the CPI system.

Change address

The addresses are assigned automatically.

- Double-click on the corresponding line in the configuration table and change the start address of the inputs or outputs in the "Properties – DP Slave" window.
  This completes the station selection and configuration.

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  Depending on the version, S7-400 controllers reserve up to 4 bytes addresses per DP identifier.

6.3.4 Tool change configuration

The tool change configuration enables modules to be put into operation on the CPI expansion connection without reconfiguration. It is not necessary to press the SAVE button in the tool change configuration.

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The tool change configuration makes sense if different CPI string extensions are connected to the product alternately during operation.

Procedure:

1. Perform the basic configuration.
2. Drag the "Tool w. A/E:32/32" item from the hardware catalogue to the 2nd line of the configuration table.

Addressing and function

The maximum possible 32 I and 32 O are occupied with the tool change configuration regardless of whether they are used or not. The addresses are assigned without gaps, module by module in ascending order.

NOTICE

Communication via PROFIBUS DP also starts even if the addresses are used incorrectly.
The system does not check which modules are actually connected with the tool change configuration.
After changing the string assignment, input signals may appear to be incorrectly evaluated if inputs are read that are no longer present in the new string assignment.

- After changing the string assignment, e.g. with fewer modules, ensure that only the addresses of the modules actually connected to the CP string are processed by the controller. The same applies to outputs.
  Example ➔ 6.4.2 Tool change configuration.

Only operate that part of the process image in the host system that is currently being used by the CPV valve terminal and the CPI extension.

Device	Occupied I/Os	Addressing
CPV basic device	16O	Output byte 0 ... 1
CPI extension	32I	Input byte 0 ... 3
	32O	Output byte 2 ... 5

Tab. 15: I/O assignment for tool change configuration

Configuration	Advantages	Disadvantages
Normal	– Good diagnostics options – Protection against swapping of the modules on the CP string	– Changes in the CP extension string must be reconfigured
Tool change	– Changes in the CP extension line possible without new configuration – Easily configurable	– Restricted diagnostic ➔ 7.2.5 Diagnostics for tool change configuration – Address assignment of the exchangeable configurations must be carried out with particular care

Tab. 16: Pros and cons of tool change configuration

6.4 Configuration examples

6.4.1 Normal configuration

The following table shows 3 examples for the configuration and addressing of expansions on the CPI expansion connection.

Normal configuration	DP identifiers	Addressing
CPV-DI02 + CP-**E08**-M12-CL	16DO[1)]	O20.0 ... O21.7
	8DI	I20.0 ... I20.7
CPV-DI02 + CP-**A04**-M12-CL + CP-**E08**-M12-CL	16DO[1)]	O20.0 ... O21.7
	8DO	O22.0 ... O22.7
	8DI	I20.0 ... I20.7
CPV-DI02 + 4x CP-**E08**-M12-CL	16DO[1)]	O20.0 ... O21.7
	8DI	I20.0 ... I20.7
	8DI	I21.0 ... I21.7
	8DI	I22.0 ... I22.7
	8DI	I23.0 ... I23.7

1) CPV-DI02 basic configuration

Tab. 17: Examples of normal configuration

6.4.2 Tool change configuration

The table below shows the same CPI extensions as ➔ Tab. 17 Examples of normal configuration, but this time with the tool change configuration. This allows extensions to be connected without reconfiguration.

Tool change configuration	DP identifiers	Occupied addresses
CPV-DI02 + CP-**E08**-M12-CL or CPV-DI02 + CP-**A04**-M12-CL + CP-**E08**-M12-CL or CPV-DI02 + 4x CP-**E08**-M12-CL	16DO[1)]	O20.0 ... O21.7
	32DX	I20.0 ... I23.7
		O22.0 ... O25.7

1) CPV-DI02 basic configuration

Tab. 18: Various extensions with tool change configuration,
compare with example from ➔ 6.4.1 Normal configuration

6.5 PROFIBUS DP: commissioning with a general DP master

The Festo CPI system can be controlled by any PLC, any PC or industrial PC with a PROFIBUS DP interface according to EN 50170.

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Observe the information on the following topics in the relevant sections:

- Module consistency, FREEZE and SYNC, identifiers ➔ 6.1.4 Information for commissioning
- GSD ➔ 6.2 Device master file (GSD) and symbol files

6.5.1 Bus start

In order to properly commission the CPI system, the DP master must perform the following functions in this order:

1. Send parameterisation data (Set_Prm)
2. Check configuration data (Chk_Cfg)
3. Transfer input and output data (cyclic data exchange, Data_Exchange)
4. Read diagnostic information (Slave_Diag)

The structure and content of the individual telegrams is described in the following sections.

6.5.2 Send parameterisation data

Set_Prm

The parameterisation data are transferred to the valve terminal by the DP master using the Set_Prm function.

Octet 1: station status				
Bit	Meaning	Explanation		
0 ... 2	–	Reserved		
3	WD_On	Response monitoring of the CPI system on/off: 0 = Off 1 = on		
4	Freeze_Req	0 = FREEZE mode not required by master 1 = FREEZE mode set by master		
5	Sync_Req	0 = SYNC mode not required by master 1 = SYNC mode set by master		
6	Unlock_Reqv	**Bit 7**	**Bit 6**	**Explanation**
7	Lock_Req	0	0	min T_{SDR} + slave parameters may be overwritten
		0	1	CPI system available for other masters
		1	0	CPI system blocked to other masters
		1	1	CPI system available for other masters

Tab. 19: Octet 1: station status

More octets

Octet	**Designation**	**Explanation**
2 and 3	WD_Fact_1 WD_Fact_2	Section 1 ... 255: the response monitoring time of the CPI system is transferred with these two octets: TWD [s] =10 ms xWD_Fact_1 x WD_Fact_2
4	Minimum Station Delay Responder (min T_{SDR})	Minimum time that the CPI system must wait before the response telegram can be sent to the DP master.
5 and 6	Ident_Number	Transfer of the manufacturer ID of the CPV master (= $0A35C_h$); parameterisation telegrams to the CPI system are only accepted if the transferred and programmed manufacturer ID match.
7	Group_Ident	Not supported by the CPI system
8 ... 32	User_Prm_Data	Not supported by the CPI system

Tab. 20: Octets 2 ... 32

6.5.3 Check configuration data

Chk_Cfg

The configuration data are transferred to the CPI system by the DP master with the Chk_Cfg function.
Parameter overview (Chk_Cfg):

- Octet 1–n:
  - DP identifier: permissible identifiers for the CPV master
    ➔ Tab. 14 Overview of DP identifiers for various extensions

CPV master and extensions	DP identifier		Comment
	decimal	hex	
CPV master (without extension = 16DA)	Octet 1: 33	Octet 1: 21_h	16 digital outputs/valve coils of the CPV-SC
Extension: 8 digital inputs	Octet: 16	Octet 1: 10_h	e.g. CPI/CP input modules
Extension: 16 digital inputs	Octet: 17	Octet: 11_h	
Extension: 24 digital inputs	Octet: 18	Octet: 12_h	
Extension: 32 digital inputs	Octet: 19	Octet: 13_h	
Extension: 8 digital outputs	Octet: 32	Octet: 20_h	e.g. CPI/CP output modules, CP valve terminals
Extension: 16 digital outputs	Octet: 33	Octet: 21_h	
Extension: 24 digital outputs	Octet: 34	Octet: 22_h	
Extension: 32 digital outputs	Octet: 35	Octet: 23_h	

Tab. 21: Overview of DP identifiers for various extensions of the CPV master

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Configuration examples ➔ 6.4 Configuration examples

6.5.4 Transfer input and output data

Data_Exchange

The cyclic data exchange is handled via the Data_Exchange function.
The function transfers the output data for CPI systems as an octet string of length x. The octet string length is aligned to the number of identifier bytes.

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The CPI system expects the output data for the valves and electrical outputs with the Data_Exchange function.
The input data are sent to the master as response telegram.

6.5.5 Read diagnostic information

Slave_Diag

The diagnostic data are requested from the CPI system with the Slave_Diag function ➔ 7.2.4 Details of standard diagnostic information.

Set_Prm
You can use the Set_Prm function to determine the watchdog time (WD_Fact_1, Octet 2, WD_Fact_2, Octet 3). In the event of an error, the CPI system switches off all valves and electrical outputs after the configured time, e.g. in the event of a bus failure.

6.5.6 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

Tab. 22: Overview of implemented functions and service access points

6.5.7 Bus parameters/reaction times

Baud rate (kbaud)	max T_{SDR} (T_{Bit})	min T_{SDR} (T_{Bit})
... 187.5	60	11
500	100	
1500	150	
3000	250	
6000	450	
12000	800	

Tab. 23: Bus parameters and reaction times

6.5.8 Transfer times at the PROFIBUS DP

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- Observe the cycle time of the PLC and the update time of the PROFIBUS DP.

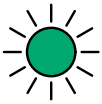
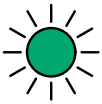
The delay time within the CP system depends on the amount of data and thus on the expansion of the CP system. It is: <2 ms.
Calculation of the total transfer time ➔ Controller manual.

7 Diagnostics

7.1 Diagnostics via LED display elements

7.1.1 Normal operating status

In the normal operating status only the green LED displays for the power supply and, depending on the switching status, the yellow LED displays for the pilot control solenoids are on.

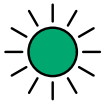
LED	Operating status	Error handling
PS  green light	Electronics/sensors power supply OK	–
PL  green light	Valves/outputs power supply OK	–
BF  off	No bus error	–
ϟ  off	No other errors	–

Tab. 24: Normal operating status

7.1.2 Error diagnostics with the LED displays

Error diagnostics with the LED display PS

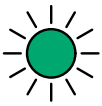
The green PS (Power System) LED display signals errors in the operating voltage supply.

LED PS (green)	Operating status	Error handling
 off	Electronics operating voltage not on	Check operating voltage supply (pin 1)
 flashes slowly	Electronics <18 V operating voltage	
 on	Electronics operating voltage is on	–

Tab. 25: Error diagnostics with the LED display PS

Error diagnostics with the LED display PL

The green PL (Power Load) LED display signals errors in the load voltage supply.

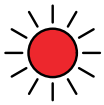
LED PL (green)	Operating status	Error handling
 off	Load voltage of valves/outputs is not on	Check load voltage supply (pin 2)
 flashes fast	CP valves <20.4 V load voltage	
 flashes slowly	Load voltage CP valves/outputs in the CPI extension <20.4 V	Check the load voltage supply of the CPI extension string (pin 2)
 on	Load voltage CP valves/outputs on	–

Tab. 26: Error diagnostics with the LED display PL

Load voltage errors are always displayed with the PL LED (regardless of the diagnostic mode set).
If device-related diagnostics are activated, errors will also be sent to the master PLC via the fieldbus.

Error diagnostics with the LED display BF

The red LED display BF (bus error) signals bus errors or the bus status.

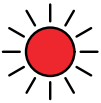
LED BF (red)	Operating status	Error handling
 off	Normal operating status	–
 flashes fast	PROFIBUS address not allowed	Correct address setting (1 … 125)
 flashes slowly[1)]	Fieldbus connection not OK Possible causes:	
	– PROFIBUS address incorrect (e.g. address assigned twice)	Check address setting
	– Fieldbus connection switched off or defective	Check fieldbus interface
	– Fieldbus connection interrupted, short-circuited or disturbed	Check fieldbus connection
	– PROFIBUS configuration error	Check the configuration of the master and the CPV Direct and, if necessary, perform a new detection ➔ 5.1.4 Detect CPI extension with SAVE button
 on	Hardware error	Service case

1) every second

Tab. 27: Error diagnostics with the LED display BF

Error diagnostics with the LED display ↳

The red LED display ↳ (other errors) signals CPI system errors or other errors.

LED ↳ (red)	Operating status	Error handling
 off	Normal operating status	–
 flashes fast	CP string error: – Deviation target state ≠ actual state of the CP configuration	Check CPI configuration and perform new detection if necessary ➔ 5.1.4 Detect CPI extension with SAVE button Alternatively: use tool change configuration
	– CP configuration not allowed	
 flashes slowly[1)]	I/O error in the CP string: – Module has diagnostics incident (short circuit, overload,...)	Check modules in the CP string for diagnostics ➔ 7.2 Diagnostics via PROFIBUS DP
 on	Module failure in the CP string: – Line interrupted or short circuit	Check CPI lines
	– If LEDs PS/PL off: hardware error	Service case

1) every second

Tab. 28: Error diagnostics with the LED display ↳

7.1.3 Status display of the valve solenoid coils

Every valve solenoid coil is associated with a yellow LED display ➔ Fig. 2. This LED display shows the switching status of the valve solenoid coil.

LED (yellow)	Valve solenoid coil switching position	Meaning
 off	Basic setting	Logic 0 (signal not pending)
 on	Switching position or Basic setting	Logic 1 (signal pending) Logic 1 but: – The load voltage of the valves is below the permissible tolerance range (DC <20.4 V) or – Compressed air supply not OK or – Pilot exhaust air blocked or – Service case

Tab. 29: Status display of the valve solenoid coils

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If there is no valve coil, the assigned LED does not indicate that the output is actuated.

7.2 Diagnostics via PROFIBUS DP

The CPI system supports diagnostic options via PROFIBUS DP according to EN 50170. Device-related diagnostics are supported.

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The identifier or channel-related diagnostics listed in EN 50170 are not supported.

7.2.1 Diagnostic words

The following error states of the CPI system are summarised in diagnostic words and sent to the DP master:

- Failure of the load voltage supply of the valves (pin 2)
- Sensor supply voltage short circuit
- Failure of the load voltage supply at the output modules
- Short circuit/overload at the output modules
- Interruption of the CPI connection at various CPI modules
- Undershoot of the voltage tolerance of the CP valves (<20.4 V).

7.2.2 Diagnostic steps

The CPI system offers extensive diagnostics options via PROFIBUS DP. The following figures show the necessary steps that are useful for diagnostics the CPI system. Only the diagnostic bits that require an additional diagnostic step are shown.

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The diagnostics information is only sent to the master system if the device-related diagnostics is activated (DIL switch element 8 to "ON") ➔ Tab. 2 DIL switches.

First diagnostic step

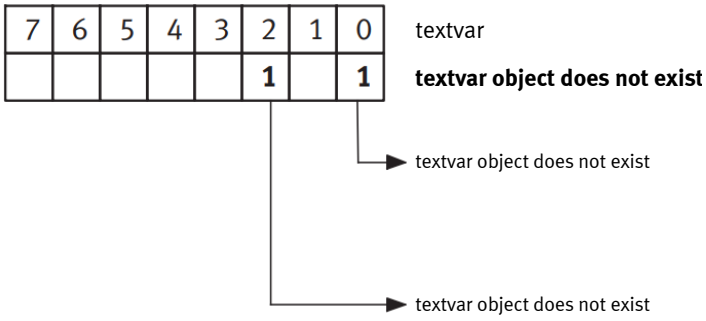

Fig. 13: First diagnostic step

Additional diagnostic steps

The diagnostic bits that require further diagnostic steps are shown below.

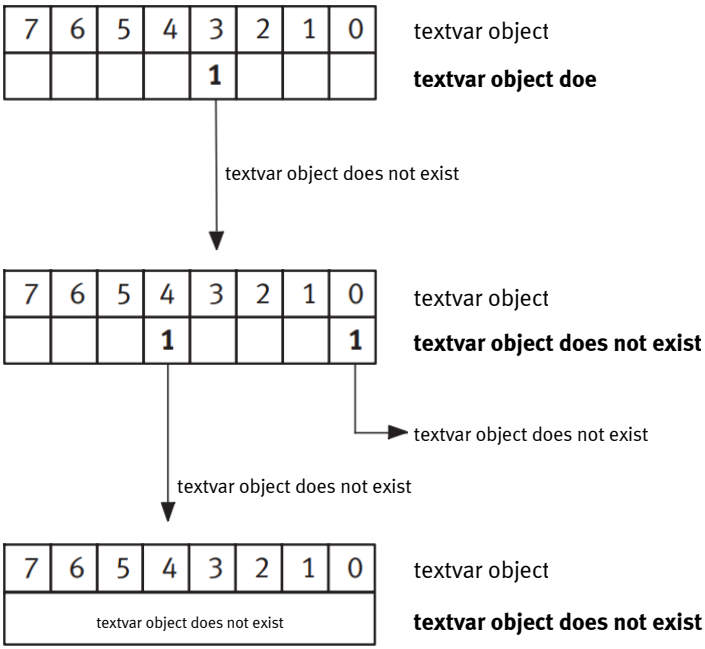

Fig. 14: Additional diagnostic steps

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For commissioning the system it can be helpful in some cases to first switch off the device-related diagnostics (DIL switch element 8 to "OFF") ➔ Tab. 2 DIL switches.

7.2.3 Overview of diagnostic bytes

Diagnostic words

Several diagnostic words are provided for each bus user. The following table shows the diagnostic words and their meaning for CPI systems from Festo:

Byte[1)]	Octet[2)]	Diagnostic address	Diagnostic address + 1	Octet[2)]	Byte[1)]
0	**1**	**Station status 1**	**Station status 2**	**2**	**1**
2	**3**	**Station status 3**	Master address (Diag.Master_Add)	4	3
4	5	Vendor ID Ident_number high byte $0A_h$	Vendor ID Ident_number low byte 35_h	6	5
6	7	Header	**Device-related diagnostics 1 (error overview)**	**8**	**7**
8	**9**	**Device-related diagnostics 2 (error byte CPV Direct)**	**Identification byte of the diagnostics**	10	9
bold = content is changed by the CPI system					

1) Siemens
2) EN 50170

Tab. 30: Overview of diagnostic bytes – Standard diagnostic information

7.2.4 Details of standard diagnostic information

The following diagnostic information can be requested by the DP master from the CPI system with the Slave_Diag function. The CPI system responds with an octet string of length 10.

i

Information on how to proceed when reading diagnostic information with a SIMATIC S5/S7 system
➔ 7.3.1 Siemens SIMATIC S7.

Diagnostic bits station status 1

Octet 1: station_status_1		
Bit	Meaning	Explanation
0	**Diag.Station_Non_Existent**	CPI system no longer/not yet responding. Possible causes: – Operating voltage not applied – Data connection interrupted – Malfunction on the data line
1	**Diag.Station_Not_Ready**	CPI system not yet ready for data exchange
2	**Diag.Cfg_Fault**	The configuration data received from the master do not match the data sent by the CPI system.
3	**Diag.Ext_Diag**	Device-related diagnostics present. Possible causes: – Wire break on input/output module – Short circuit/overload of electrical outputs or sensor supply inputs – U_{valves} <20.4V – $U_{outputs}$ <10 V – U_{sensor} <10 V
4	Diag.Not_Supported	1 = CPI system does not support the requested function
5	Diag.Invalid_Slave_Response	Always 0 (set by the CPI system)
6	Diag.Prm_Fault	Last parameterisation telegram has errors
7	Diag.Master_Lock	Always 0 (set by the CPI system)
bold = valve island-related bits		

Tab. 31: Diagnostic bits station status 1

Diagnostic bits station status 2

Octet 2: station_status_2		
Bit	Meaning	Explanation
0	**Diag.Prm_Req**	1 = master must reconfigure the CPI system
1	Diag.Stat_Diag	1 = master must request diagnostic data until this bit is set to 0
2	–	Always 1 (set by the CPI system)
3	**Diag.WD_On**	1 = response monitoring/watchdog activated
4	Diag.Freeze_Mode	1 = FREEZE enabled
5	Diag.Sync_Mode	1 = SYNC enabled
6	–	Reserved
7	Diag.Deactivated	Always 0 (set by the CPI system)
bold = valve island-related bits		

Tab. 32: Diagnostic bits station status 2

Diagnostic bits station status 3

Octet 3: station_status_3		
Bit	Meaning	Explanation
0 ... 6	–	Reserved
7	Diag.Ext_Diag_Overflow	Always 0 (set by the CPI system)

Tab. 33: Diagnostic bits station status 3

More octets

Octet 4 ... 7: Overview		
Octet	Designation	Explanation
4	Diag.Master_Add	Master address: The address of the master that parameterized the CPI system is entered in this octet.
5 ... 6	Ident_Number	Vendor ID: These octets contain the manufacturer ID: $0A35_h$ of the product.
7	Ext_Diag_Data (Device-related diagnostics)	Device-related diagnostics header. Length of the device-related diagnostics: 10 bytes

Tab. 34: Overview of octets 4 ... 7

Structure of device-related diagnostics

Octet 8: device-related diagnostics 1[1)]		
Bit	Meaning	Explanation
0	Group error CPI system	1 = at least one error is pending
1	–	Not used
2	–	Not used
3	–	Not used
4	Common error	1 = CP string/CP valve terminal error
5	–	Not used
6	–	Not used
7	No I/O data exchange	Actual configuration ≠ target configuration in the CP string (Perform detection with SAVE button➔ 5.1.4 Detect CPI extension with SAVE button)

1) Only sent to the master PLC if the device-related diagnostics is activated with the DIL switch.

Tab. 35: Diagnostic bits device-related diagnostics 1

Octet 9: device-related diagnostics 2		
Bit	Meaning	Explanation
0	$Error_{from}$	1 = CPI connection broken on output module
1	$Error_{an}$	1 = CPI connection broken on input module
2	Short circuit/overload	1 = short circuit/overload on output module
3	U_{Off}	1 = load voltage failure at output module
4	U_{Sen}	1 = sensor power supply short circuit/overload <10 V
5	U_{Ven}	1 = load voltage valve coils <20.4 V
6	U_{Last}	1 = load voltage valve coils <10 V
7	Ex	1 = other errors

Tab. 36: Diagnostic bits device-related diagnostics 2

Octet 10: device-related diagnostics 3		
Bit	Meaning	Explanation
0	CPV master diagnostics	1 = CPV master (basic device) reports diagnostics
1	Diagnostics in the CP string	1 = 1st module in the CP string reports diagnostics
2	Diagnostics in the CP string	1 = 2st module in the CP string reports diagnostics
3	Diagnostics in the CP string	1 = 3st module in the CP string reports diagnostics
4	Diagnostics in the CP string	1 = 4st module in the CP string reports diagnostics
5 ... 7	–	Reserved

Tab. 37: Diagnostic bits device-related diagnostics 3

Octet 11 ... 16: Overview		
Octet	Designation	Explanation
11	Error number	Error number CPV master basic device
12	Error number	Error number for 1st module in the CP string
13	Error number	Error number for 2nd module in the CP string
14	Error number	Error number for 3rd module in the CP string
15	Error number	Error number for 4th module in the CP string
16	–	Reserved

Tab. 38: Overview of octets 11 ... 16

Overview of the most important error numbers from ➔ Tab. 38 Overview of octets 11 ... 16		
No.	Operating status	Error elimination
0	No error	–
2	Short circuit/overload in sensor supply (SCS) or at output (SCO)	Rectify short circuit/overload
5	Undervoltage of the supply voltage (load supply outputs/valves, sensor supply input modules with additional supply)	Eliminate undervoltage of the corresponding supply voltage
11	Valve short circuit/overload	Check valve
12	Pilot valve function warning	Recommendation: replace valve
13	Wire break at valve (open load)	Check valve
14	Valve: switching cycle meter, limit value exceeded	Recommendation: replace valve
34	– String assignment error during operation detected (e.g. CPI module failure or CPI cable fault) – More than one module failure during operation - modules are no longer detected	– Check CP strings (CPI modules and CPI cables), if applicable replace CPI modules or CPI cables – Switch power supply off and on, check CPI cables and CPI modules if fault occurs repeatedly, replace if applicable
35	String assignment after switching on the power supply does not correspond to the stored string assignment or wrong module detected during operation	– Check CP strings (CPI modules and CPI cables), if applicable replace CPI modules or CPI cables – With correct string assignment: string assignment must be saved – Check string assignment, if applicable replace CPI module
36	Short circuit CP string ($24\ V_{el/sen}$ or $24\ V_{val}$) – Communication on CP string interrupted	– Check CP strings, if applicable replace CPI cables

Tab. 39: Overview of the most important error numbers

7.2.5 Diagnostics for tool change configuration

In the tool change configuration, only a simple diagnostic message is output for the CP string via the channel-related diagnostics.
Information on the tool change configuration ➔ 6.3.4 Tool change configuration.

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In the tool change configuration, the diagnostic information for all modules in the CP string is entered in the 2nd diagnostic byte. There is no information on which module is reporting the error.
- For precise localisation of the error check the module LEDs in the CP string.

Value	Error type (standard)	Value	Error type (Festo)
...	...	...	...
...	...	18	Peripheral error tool change configuration
...	...	...	...

Tab. 40: Diagnostics for tool change configuration

The diagnostic information of the CPV-DI02 basic device is normally entered in the tool change configuration in the 1st diagnostic byte.

7.3 Error handling

In the event of the following malfunctions, the behaviour of the CPI system depends on the configured behaviour of the master connection:
– Telegram failure
– Master stop
– Interruption of the bus line
Depending on the setting or configuration, all valves and electrical outputs are switched off or retain their status.
Incorrect state of the valves and outputs can lead to dangerous situations.
- Ensure that valves and outputs relating to the aforementioned malfunctions are placed in a safe state.

i

If the outputs are reset in the event of PLC stop, fieldbus interruption or fieldbus malfunction, note the following:
- Monostable valves move to the initial position.
- Bistable valves remain in the current position.
- Mid-position valves go into mid-position (pressurised, exhausted or closed, depending on valve type).

7.3.1 Siemens SIMATIC S7

These controllers enable the behaviour of the CPI system to be defined in the event of the malfunctions mentioned above.
Almost all configuration programs contain the "response monitoring" function. For the specified operating modes, the specified time corresponds to the fall time of the valves and electrical outputs.
Two types of error behaviour of the control system can be set:
– Hard error behaviour: if an error occurs the controller switches to the "STOP" operating mode.
– Soft error behaviour: if an error occurs the controller remains in the "RUN" operating mode.

Control system	Block	Meaning	STOP	RUN
SIMATIC S7/M7	OB82	Response to device-related diagnostics	Default	OB is programmed
	OB86	Response to the failure of a DP slave	Default	OB is programmed
OB: organisation block				

Tab. 41: STOP and RUN error behaviour with S7

i

Further details on response monitoring ➔ corresponding controller manuals.

Options for reading out the diagnostics for S7

The diagnostics for PROFIBUS DP are supported by function blocks in the various control systems. They read out the slave diagnostics and write it to a data area of the user program.

Control system	Function block	See...	Manufacturer
SIMATIC S5 with S5-95U/DP master	FB 230 "S_DIAG"	"ET 200 distributed I/O system" manual	Siemens
SIMATIC S7/M7	SFC 13 "DP NRM_DG"	"System and standard functions" reference manual	Siemens

Tab. 42: Options for reading out the diagnostics for S7

Example of a STEP 7 user program

IL	Explanation
`CALL SFC 13`	
`REQ:=TRUE`	Read request
`LADDR:=W#16#03FE`	Pointer to diagnostic address, e.g. $1022_d = 03FE_h$ (➔ "Properties – DP slave" window in HW Config)
`RET_VAL:=MW100`	If errors occur, output error code
`RECORD:=P#M110.0 WORD 5`	Pointer to the beginning of the data area for diagnostics and the length of the diagnostic data
`BUSY:=M10.0`	Read process finished

Tab. 43: Example

7.4 Online diagnostics with STEP 7

Direct diagnostic events in connection with the CP valve terminal can include:
- Distributed peripherals: station failure
  - Communication between slave and master interrupted.
- Module malfunction.
  - ➔ Tab. 35 Diagnostic bits device-related diagnostics 1
  - ➔ Tab. 36 Diagnostic bits device-related diagnostics 2
- Transition of the operating status from START-UP to RUN (target/actual difference)
  - Configuration data of the valve terminal do not match the peripherals.
  - Valve terminal has the wrong DIL setting.

7.4.1 Read diagnostic buffer with STEP 7 (up to V 5.2)

The diagnostics buffer of STEP 7 offers the option of displaying diagnostics events of the S7 system in the order in which they occurred.

Requirement:
- HW Config is called.

Procedure:
1. Switch from offline to online.
2. Right click on the CPU in the rack.
3. Click on [Module information...] in the displayed context menu.
   ↳ The "Module status" window opens.
4. Click on the "Diagnostics Buffer" tab.
5. Click on the desired event.
   ↳ The details of this event are displayed. These provide more detailed information on how to proceed and depend on the S7 controller used.

7.4.2 Device-related diagnostics with STEP 7 (up to V 5.2)

Error messages from the device-related diagnostics can be displayed via the "Module information" window.

1. Right-click on the valve terminal icon.
2. Click on [Module information...] in the displayed context menu.
   ↳ The "Module information" window opens.
3. Read the diagnostic information.

7.5 Short circuit/overload

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Detailed information about input and output modules ➔ Descriptions "CP modules electronics" and "CPI-CL modules, CPI-EL modules".

7.5.1 Output module

With short circuit or overload:
– all digital outputs of an output module are switched off.
– if present, the diagnostics LED on the output module is on, otherwise the green LED flashes.
– the short circuit/overload bit in octet 9 "device-related diagnostics 2" is set to 1.

i

The outputs can only be used again once the short circuit or overload has been eliminated and the error cleared.

Clear error

Errors are cleared by resetting all eight outputs.
The following options are available:

Options	Explanation
Set all outputs of the output module to logical "0" (RESET) or	Manually or automatically in the program
Briefly interrupt the CP connection on the CP output module or	Outputs on the output module are automatically reset
Briefly interrupt the operating voltage of the CPI system	All outputs of the CPI system are reset automatically

Tab. 44: Clear errors – options

The outputs can then be used again. If the short circuit/overload is still present, the outputs are switched off again.

7.5.2 Sensor power supply on an input module

In the case of sort circuit, overload or voltage error of the sensor power supply:
– sensor power supply of all inputs of the module is switched off,
– if present, the diagnostics LED on the input module is on, otherwise the green LED flashes
– the error bit U_{Sen} in octet 9 "device-related diagnostics 2" is set to 1.

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The inputs can only be used again once the short circuit or overload has been eliminated and the error cleared.

Clear error

The following options are available to clear the error:
– Briefly interrupt the CP connection on the CP input module
or
– Briefly interrupt the operating voltage of the CPI system on the CPV master.
The inputs can then be queried again. If the short circuit/overload is still present, the error is reported again.

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Module CP-E16-M8-Z:
The short circuit/overload is automatically reset and the voltage is switched on again.

8 Technical data

General technical data		
Operating temperature	[°C]	–50 ... +50
Storage and transport temperature	[°C]	–20 ... +70
Relative humidity (non-condensing)	[%]	95
Degree of protection in accordance with EN 60529		IP65 (if plugs are connected or fitted with protective cap)
Protection from electric shock (protection from direct or indirect contact in accordance with IEC 60204-1)		By the use of PELV circuits (Protective Extra-Low Voltage)
Electromagnetic compatibility		See declaration of conformity ➔ www.festo.com
Vibration resistance in accordance with DIN EN 60068-2-6		With wall mounting: 0.35 mm distance at 10 ... 60 Hz 5 g acceleration at 60 ... 150 Hz
Shock resistance in accordance with DIN EN 60068-2-27		With wall mounting: ±30 g at 11 ms duration; 15 cycles
Valves		➔ Pneumatic description type P.BE-CPV-...
The CP system is intended for industrial operation.		

Tab. 45: General technical data

Operating voltage bus interface and logic		
Power supply connection (pin 1)	[V DC]	24 + 10% /– 15% (reverse polarity protected)
Max. current consumption	[mA]	100
Residual ripple	[Vss]	4 (within tolerance)
Galvanic isolation of bus interface		By optocoupler

Tab. 46: Operating voltage bus interface and logic

Load voltage solenoid valves CPV valves		
Power supply connection (pin 2)	[V DC]	24 + 10% /– 15% (reverse polarity protected)
Current consumption		Sum of all activated CP solenoid valves ➔ Description "CPV pneumatics"
Residual ripple	[Vss]	4 (within tolerance)

Tab. 47: Load voltage solenoid valves CPV valves

CPI system		
Max. current consumption on the CP string	[A]	1.6 (at 24 V)
Short-circuit protection		Automatic voltage recovery
Design		
Number of CP strings		1
Max. cable length per CP string	[m]	10
Max. number of CPI/CP modules per CP string		4
Number of inputs/outputs per CP string		32 I/32 O
Support for the extended functionality of the CPI system		yes
Max. update time		
All CP strings exclusively occupied with modules with extended functionality	[ms]	2
Mixed string assignment	[ms]	4

Tab. 48: CPI system

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Technical data for pneumatics ➔ "Description of pneumatics P.BE-CPV-..."

PROFIBUS DP		
Protocol		PROFIBUS DP in accordance with EN 50170
Design		RS485, potential-free
Transmission type		Serial asynchronous, half duplex
Transmission rate	[kbaud]	9.6 ... 12000 (automatic detection)
Cable type		Depending on cable length and baud rate ➔ Controller manual

Tab. 49: PROFIBUS DP

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