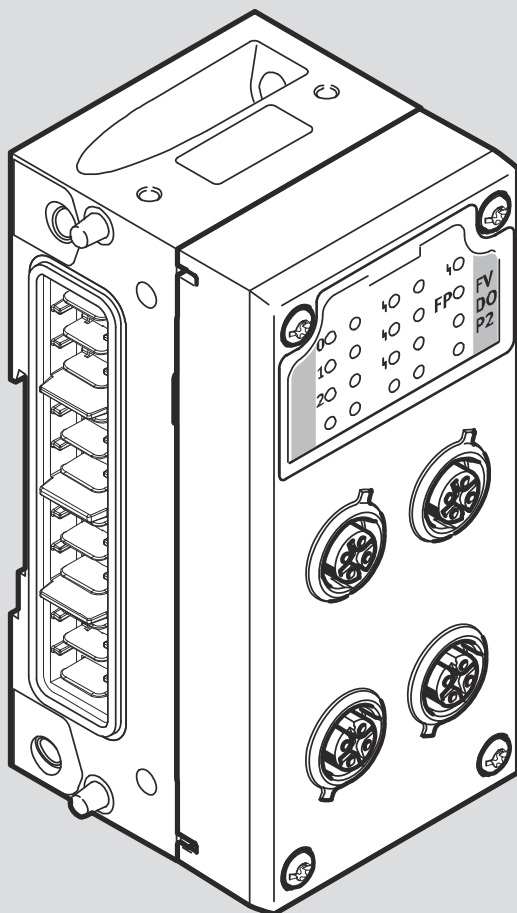


CPX-FVDA-P2

Output module

FESTO

Manual



8022607

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[8195574]

Translation of the original instructions

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Table of contents

1	Safety	5
1.1	Important user information	5
1.1.1	Danger categories	5
1.1.2	Marking of special information	5
1.2	General safety instructions	6
1.3	Intended use	6
1.4	Rules for product configuration	8
1.5	Foreseeable misuse	9
1.6	Attainable safety level	10
1.7	Failures due to a common cause (Common Cause Failure – CCF)	10
1.8	Requirements for use of the product	11
1.8.1	Technical prerequisites	11
1.8.2	Training of qualified personnel	11
1.8.3	Product conformity	12
1.8.4	UL/CSA certification	12
1.9	Transport and storage conditions	12
1.10	Service	12
1.11	Product identification	12
1.11.1	Revision version	13
1.12	Information regarding this description	14
1.13	Product-specific terms and abbreviations	14
2	System overview CPX-FVDA-P2	19
2.1	CPX terminal with output module CPX-FVDA-P2	19
2.1.1	Design of the output module CPX-FVDA-P2	23
2.1.2	Components	25
2.1.3	Supported product versions	28
2.1.4	Required bus topology (control chain)	30
2.2	PROFIsafe	31
2.2.1	PROFIsafe safety profile	31
2.2.2	Process image	32
2.2.3	Bit pattern of the output and input data (F-user data)	33
2.3	Mode of operation of the output module	36
2.3.1	Possible applications	37
2.3.2	Application examples	40
2.4	Actuator requirements (CH0 ... CH2)	53
2.4.1	Electrical requirements	53
2.4.2	Safety-related requirements	54
3	Installation	55
3.1	General information about installation	55
3.1.1	Module-related rules for configuration	55

3.2	Connecting the cables and plugs to the manifold block.	56
3.3	Electrical connection and display elements.	57
3.3.1	Pin allocation with M12 manifold block.	59
3.3.2	Pin allocation with TS manifold block.	60
3.3.3	Pin allocation with pneumatic interface VABA-S6-1-X...-F2-CB.	61
3.4	Setting the PROFIsafe address.	61
3.5	Disassembling and assembling the electronics module.	63
3.5.1	Disassembling the electronics module.	63
3.5.2	Installing the electronics module.	64
4	Commissioning.	65
4.1	General information.	65
4.1.1	Device master file (GSD/GSDML).	65
4.2	Preparing for commissioning.	66
4.3	Commissioning steps.	66
4.4	Setting the PROFIsafe parameters.	67
4.5	Setting the CPX module parameters.	69
4.5.1	CPX module parameters for CPX-FVDA-P2 in detail.	70
4.5.2	Parameterisation and signal display with the operator unit CPX-MMI-1.	73
4.6	Configuration with Siemens STEP 7 (example).	75
4.6.1	Addressing example.	77
5	Operation.	79
5.1	LED status indication.	79
5.1.1	Behaviour during the switch-on phase (start-up phase).	80
5.1.2	Normal operating status.	80
6	Diagnostics and error handling.	80
6.1	Overview of diagnostics options.	80
6.2	Possible error messages of the output module CPX-FVDA-P2.	81
6.3	Diagnostics using LEDs.	83
6.3.1	Error handling and parameterisation.	85
6.3.2	Behaviour in case of error.	88
6.4	Diagnostics via the CPX bus node.	88
6.4.1	Diagnostics with the operator unit CPX-MMI.	89
7	Service, repair, disposal.	89
7.1	Service.	89
7.2	Repair.	89
7.3	Disposal.	90
8	Technical appendix.	90
8.1	Technical data of the output module CPX-FVDA-P2.	90
8.2	Technical data of the manifold blocks.	95
8.3	Technical data of the interlinking block.	96
8.4	Technical data of the pneumatic interface.	97

1 Safety

1.1 Important user information

1.1.1 Danger categories

This description includes information on the possible dangers that can occur if the product is used incorrectly. The danger warnings are marked with a signal word (warning, caution etc.) with grey background and additionally identified with a pictogram. The following types of danger warnings are defined:

WARNING

Dangers which could lead to death or serious injuries.

CAUTION

Dangers which could lead to minor injuries or to serious material damage.

NOTICE

Material damage or loss of function.

1.1.2 Marking of special information

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

Pictograms

Information:

Recommendations, tips and references to other sources of information.

Accessories:

Information about necessary or useful accessories for the Festo product.

ENVIRONMENT

Environment:

Information about the environmentally friendly use of Festo products.

Text symbols and markers

1. Ordinal numbers denote activities ...
 2. ... that must be carried out in the order specified.
- Indents denote general lists and activities that can be carried out in any order.
 - In warnings, general lists and activities that can be carried out in any order are denoted by bullet points.

1.2 General safety instructions

WARNING

Non-observance of safety instructions can result in death, serious injuries or major material damage.

- The safety instructions must be observed.

NOTICE

Electronics modules include electrostatically sensitive devices.

Incorrect handling can cause damage to the electronics modules.

- Observe the handling specifications for electrostatically sensitive devices.
- Discharge static electricity from your body before assembling or disassembling modules to protect the modules.

NOTICE

To ensure compliance with the intended use:

- Every output channel that is in use must be switched at least once a week.
- If test pulses are switched off:
Every output that is in use must be switched at least once a day.

NOTICE

To ensure compliance with the safety level:

- Specify that every output channel in use must be switched on for more than 1 minute at a time for every 8 hours of operation.
The operating time begins when the output module is first switched on.

NOTICE

- Use a maximum of 2 output channels in a common safety pilot circuit.



Observe the regulations for electrical power supply (Protective Extra-Low Voltage, PELV) to CPX terminals in the system description CPX-SYS-... → www.festo.com/sp.

1.3 Intended use

The output module CPX-FVDA-P2 is intended for use as a shut-off module for the safe shutdown of connected consumers (safety function) if the following condition is met:

- The connected consumers are switched to a safe state when the safety shutdown takes place.

Product versions

The output module CPX-FVDA-P2 is available in three versions

→ Tab. 4 Permissible components:

- Version 1
in combination with certain manifold and interlinking blocks of the CPX terminal
- Version 2
as part of the pneumatic interface VABA-S6-1-X...-F1-CB of the valve terminal VTSA-F-CB
- Version 3

as part of the pneumatic interface VABA-S6-1-X...-F2-CB of the valve terminal VTSA-F-CB

Safety function

The safety function is achieved through dual-channel, P- and M-side disconnection of the load voltage supply for U_{VAL} valves:

- Version 1
 - Disconnection of the load voltage supply for U_{VAL} valves of the CPX terminal: output channel CH0 of the module.
Output channel CH0 is used to supply valve terminal pneumatic modules in the CPX terminal fitted on the right-hand side.
 - Disconnection of the two outputs provided through the connection technology of the module: output channel CH1 and CH2 of the module, also supplied via the load voltage supply for U_{VAL} valves.

In addition, the unswitched load voltage supply U_{VAL} is made available through the connection technology of the module as operating voltage for the external components (24 V DC auxiliary supply).

- Version 2
 - Disconnection of the three internal safe voltage zones: CH0, CH1, CH2.
- Version 3
 - Disconnection of the two internal safe voltage zones: CH0, CH1.
 - Disconnection of the safe output provided through the connection technology of the pneumatic interface: CH2.

The voltage zones can be disconnected independently of each other in an electrically safe manner. The output channels of the output module CPX-FVDA-P2 each form a safety circuit with their connected consumers.



Information about the power supply for the CPX terminal → System description CPX-SYS-...

Range of application

The output module CPX-FVDA-P2 is a product with safety-related functions, intended for mounting in machines or automation systems and is to be used as follows:

- in excellent technical condition
- in its original condition, without unauthorised modifications
- exclusively in the configurations stated here → 2.3.2 Application examples
- within the limits of the product defined by the technical data
 - 8.1 Technical data of the output module CPX-FVDA-P2
- in an industrial environment

NOTICE

Note that the safety limits of the output module are also its physical limits.

1.4 Rules for product configuration

- The output module CPX-FVDA-P2 may only be operated in Festo CPX terminals of the variant CPX-M-... or in pneumatic interfaces for the valve terminal VTSA-F-CB-....
- Comply with all technical operating limits → 8 Technical appendix.
Otherwise, malfunctions can occur.
- All parts of a CPX terminal or valve terminal that can be switched off by the output module are treated like an external load.
- Operation of the CPX-FVDA-P2 is permissible only in combination with the following PROFIsafe-compatible CPX bus nodes → Bus node rating plate:

Bus node	From revision	Network protocol
CPX-FB13 ¹⁾	30	PROFIBUS
CPX-FB33 ²⁾	21	PROFINET IO
CPX-M-FB34 ²⁾	21	PROFINET IO
CPX-M-FB35 ²⁾	21	PROFINET IO
CPX-FB43 ²⁾	50	PROFINET IO
CPX-M-FB44 ²⁾	50	PROFINET IO
CPX-M-FB45 ²⁾	50	PROFINET IO

1) → Description of CPX-FB13...

2) → Operating instructions for CPX-(M)-FB33/34/35/43/44/45

Tab. 1: Permissible PROFIsafe-compatible CPX bus nodes

- Operation of the CPX-FVDA-P2 within valve terminals is only permissible with the following valve types:

Valve terminal	Type	Valve types
MPA-S-FB-VI	32	MPA1, MPA2 on VMPA...-FB-EMG-... ¹⁾
MPA-F-FB-VI	33	MPAF1, MPAF2 on VMPA...-FB-EMG-... ¹⁾
MPA-L-FB-VI	34	All ¹⁾
VTSA-FB-VI	44	All up to width of 52 mm ¹⁾
VTSA-F-FB-VI	45	All up to width of 52 mm ¹⁾
VTSA-F-CB-VI	46	All ¹⁾

1) Malfunctions may occur if the resultant current is exceeded.

Tab. 2: Permissible valve types

- Operation of switch-off groups within valve terminals is permitted only in conjunction with permissible pneumatics → Description of the respective valveterminal.

- Operation of switch-off groups in CPX terminals in the Remote I/O mode of operation is only allowed with the following approved output modules:

Output module
CPX-4DA ¹⁾
CPX-8DA ¹⁾
CPX-8DA-H ¹⁾
CPX-8DI-8DO ¹⁾

1) Malfunctions may occur if the total current is exceeded.

Tab. 3: Permissible output modules

Output modules on the right side of the CPX-FVDA-P2, which are switched off via CH1 or CH2, may only be supplied via the additional supply CPX-M-GE-EV-Z.

The use of a voltage relay on the right of CPX-M-GE-EV-FVO is not permitted.

- Only the following components are permitted when assembling the CPX-FVDA-P2:

Version		Component	Type
1	CPX-FVDA-P2 in combination with certain manifold and interlinking blocks of the CPX terminal	Interlinking block	CPX-M-GE-EV-FVO
		Manifold block	CPX-M-AB-4-M12X2-5POL
			CPX-AB-8-KL-4POL
2	CPX-FVDA-P2 ¹⁾ as part of the pneumatic interface of the valve terminal VTSA-F-CB	Pneumatic interface	VABA-S6-1-X...-F1-CB
3		Pneumatic interface	VABA-S6-1-X...-F2-CB

1) Revision R04 (or a higher revision) of the output module required → Rating plate of the electronics module CPX-FVDA-P2

Tab. 4: Permissible components



Further information about the supported product variants can be found in section

→ 2.1.3 Supported product versions and the description of the VTSA-F-CB valve terminal.

Detailed information about the product, the supported product versions and required software versions as well as the permissible components of the CPX terminal can be found in the system description CPX-SYS-... → www.festo.com/sp.

Information about permissible configurations of the CPX terminal in combination with the output module can be found in the catalogue → www.festo.com/catalogue.

1.5 Foreseeable misuse

The following are examples of foreseeable misuse and are not approved as intended use:

- outdoor operation
- use in non-industrial areas
- use outside the limits of the product defined in the technical data

- unauthorised modifications
- use in combination with consumers where switching off can result in hazardous movements or conditions

NOTICE

The use of manifold blocks, interlinking blocks and pneumatic interfaces that are not specified is **not permissible**.

NOTICE

In the following cases, the use of the output module CPX-FVDA-P2 for formation of safety circuits is **not permissible**:

- in a CPX terminal equipped with CPX-FEC or CPX-CEC
- in a CPX terminal with shut-off groups containing output modules other than those permitted
- in a CPX terminal of variant P
- in a CPX terminal with a connected valve terminal which is equipped with valve types other than the following: VTSA, MPA-S, MPA-F → Tab. 2 Permissible valve types
- in a CPX terminal with a connected valve terminal where a proportional-pressure regulator VPPM is located in switching groups with a safety shutdown function
- in impermissible switching configurations → 2.3.2 Application examples

NOTICE

The output module does not contain any wearing parts. Repairs are not allowed on the output module CPX-FVDA-P2. This invalidates the certification of the output module. Professional replacement of the electronics module by the user is permissible.

NOTICE

If the product is damaged by unauthorised manipulation or use other than the intended use, the guarantee will be invalidated and the manufacturer will not be liable for damages.

1.6 Attainable safety level

With the CPX-FVDA-P2, safety functions can be implemented up to:

- Safety integrity level SIL 3 in accordance with IEC 61508
- Performance level e, Cat. 3 in accordance with EN ISO 13849-1
- Maximum SIL 3 in accordance with EN IEC 62061.

The attainable safety level of the overall safety device depends on the other components used to implement the safety function.

To maintain the safety level:

- Test the functionality of the safety device at adequate intervals.

1.7 Failures due to a common cause (Common Cause Failure – CCF)

Common cause failures cause the loss of the safety function, since both channels (P and M) in a dual-channel system fail simultaneously.

The following measures ensure that common cause failures are avoided:

- Comply with operating voltage limits
- Comply with temperature range

→ Tab. 48 Further characteristic values

→ Fig. 40

- Use a maximum of 2 output channels in a common safety pilot circuit

Additional measures for avoidance of common cause failures may result from the application.

1.8 Requirements for use of the product

- Make this description available to the design engineer, installation technician and personnel responsible for commissioning the machine or system in which this product is used.
- Keep this description in a safe place throughout the entire product lifecycle.
- Make sure that the specifications in the documentation are observed at all times. Also comply with the documentation for the other components and modules (e.g. bus nodes, pneumatics etc.).
- Take into consideration the legal regulations applicable for the location as well as:
 - instructions and standards
 - regulations of the testing organisations and insurers
 - national specifications
- Remove all packaging, such as foils, caps and cardboard. The material used in the packaging has been specifically chosen for its recyclability (exception: oiled paper = residual waste).
- Assembly must be performed in a professionally correct manner. To maintain the IP degree of protection:
 - screw the manifold block on tight
 - assemble cable entries and seals in a professionally correct manner
 - seal unused connections with cover caps
- If the system had to be shut down for safety reasons such as an EMERGENCY STOP, make sure the safety controller monitors/controls all system restarts as intended.

1.8.1 Technical prerequisites

General conditions for the correct and safe use of the product, which must be observed at all times:

- Comply with the technical operating limits → 8 Technical appendix.
Only then is operation of the product ensured in accordance with the relevant safety regulations.
- When connecting standard auxiliary components, also observe the specified critical limits for temperatures, electrical data and torques.

1.8.2 Training of qualified personnel

The device may only be commissioned by trained, qualified control and automation technology technicians, who are familiar with:



- the installation and operation of control systems
- the applicable regulations for operating safety-related systems
- the applicable regulations for accident prevention and occupational safety
- the documentation for the product

NOTICE

Work on safety engineering systems may only be carried out by qualified personnel trained in safety engineering.

1.8.3 Product conformity

The product-relevant directives are listed in the declaration of conformity → www.festo.com/sp.

Product conformity	
	in accordance with EU EMC Directive in accordance with EU Machinery Directive in accordance with EU RoHS Directive
	to UK EMC Regulations to UK Supply of Machinery Regulations to UK RoHS Regulations

Tab. 5: Product conformity

1.8.4 UL/CSA certification

Certain configurations of the product have been certified by Underwriters Laboratories Inc. (UL) for the USA and Canada.

These configurations bear the following mark:



UL Recognized Component Mark for Canada and the United States

Only for connection to an NEC Class 2 supply.

Raccorder Uniquement a un circuit de Classe 2.

Observe the following if your application must be in compliance with the UL requirements:

- Regulations for compliance with the UL certification can be found in the separate UL-specific special documentation.
The relevant technical data in that documentation also takes priority if it does not influence the safety engineering values in an impermissible manner.
- The technical data in this documentation may show values deviating from this.

1.9 Transport and storage conditions

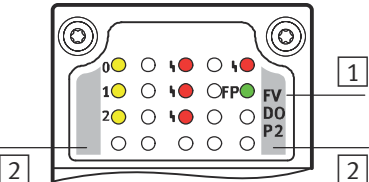
- Protect the product during transport and storage from excessive stress factors, such as:
 - Mechanical loads
 - Impermissible temperatures
 - Moisture
 - Aggressive atmospheres
- Store and transport the product in its original packaging.
The original packaging offers sufficient protection from typical stresses.

1.10 Service

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

1.11 Product identification

The module identifier and product rating plate identify the product. The module identifier can be seen through the transparent covering on the manifold block.

Module identifier	Meaning
	<ul style="list-style-type: none"> Module identifier 1: FVDOP2 (F=Safety; V=Valves; D=Digital; O=Outputs; P=PROFIsafe; 2=Variant) yellow background 2 for identification of the safety function

Tab. 6: Module identifier of the output module CPX-FVDA-P2

The product labelling is for identification of the product and shows the following information:

Product labelling (example)	Meaning
CPX-FVDA-P2	Order reference
1971599	Part number
MM-YYYY:XX Rev XX	MM = manufacturing month YYYY = manufacturing year XX = plant number Rev XX = revision code
CE, UKCA and DataMatrix code	Identification
12345678901234	14-character serial number
Festo SE & Co. KG	Manufacturer's address
DE-73734 Esslingen	

Tab. 7: Product labelling (example)



Further information can be found in the CPX-SYS-... system description. ➔ www.festo.com/sp.

1.11.1 Revision version

- Determine the revision of a CPX module:
 - with the operator unit CPX-MMI-1 ➔ [Module data][Revision]
 - with appropriate configuration software ➔ Module data, revision code.
 - from the rating plate of the relevant module
(in the dismantled state, ➔ Tab. 7 Product labelling (example)).
- Before replacing a module, check whether the revision code of the bus node corresponds to the requirements of the module ➔ Tab. 26 Required versions.
- Use only an electronics module with revision R04 (or higher) for the pneumatic interface VABA-S6-1-X...-F1/F2-CB ➔ Tab. 4 Permissible components.

1.12 Information regarding this description

This description contains general basic information about operating, assembling and installing the output module CPX-FVDA-P2 in combination with the CPX terminal and refers exclusively to the following revisions of the output module:

Type	Part number	Revision
CPX-FVDA-P2	1971599	R0x ¹⁾

1) x stands for a single digit from 1 to 9

Tab. 8: This description applies to the following product

General basic information about operating, assembling, installing and commissioning CPX terminals can be found in the CPX system description.
Special information about commissioning, parameterisation and performing diagnostics on a CPX terminal with the bus node you are using can be found in the corresponding description for your bus node. Information about additional CPX modules can be found in the description for the specific module.
Information about the pneumatics can be found in the corresponding pneumatics descriptions.

i
An overview of the user documentation structure for the CPX terminal can be found in the CPX-SYS-... system description.

Conventions

The special parameters of the module appear on the operator unit CPX-MMI-1 in English. The data and parameters in the text displayed in English on the operator unit are shown in square brackets in this description, e.g. [Debounce time]. This is followed by the translation:
Debounce time [Debounce time].

1.13 Product-specific terms and abbreviations

Term/abbreviation	Meaning
Switch-off group	Group of loads that can be controlled independently of each other and switched off together for safety reasons with the same output channel. A switch-off group is also known as a load group. In valve terminals, a switch-off group forms a separate, safe voltage zone.
Output channel	An independently switchable output that is switched via two redundant switching elements in the outward and return path of the circuit. CH0, CH1 and CH2 are independent output channels that are switched internally via a 2-channel principle.
CRC signature	Test value in the PROFIsafe security telegram to check the integrity of telegram data (cyclic redundancy check).
Depassivation	➔ Reintegration or passivation (the opposite)

Term/abbreviation	Meaning
Wire break detection	Function that detects and reports connection errors such as loads without contact and wire break. For CPX-FVDA-P2, this function can be activated or deactivated by parameterisation. If using the output module in the pneumatic interface – without external voltage zones – deactivate the wire break detection function.
I/O image	→ Process image
Replacement value	Preset safe value that replaces the real process value or the programmed value in the event of a malfunction or when booting safety-related systems. For CPX-FVDA-P2 (digital outputs), this is the output value 0.
F-Device	Collective term for safety-related devices
F-Host	Safety controller for controlling safety-related devices
F-System	Safety-related system that restores a safe state in the event of dangerous system and device errors.
GSDML/GSD	Device master data file in XML format
iParameters	Technology-specific individual parameters for a particular F-Device
Channel	→ Output channel
Channel-based passivation	A type of passivation during which only the defective output channel is passivated. The module remains integrated. It is acknowledged in CPX-FVDA-P2 via the process image → 2.2.3 Bit pattern of the output and input data (F-user data).
Short circuit	Connection of switching points with normally different electrical potentials, e.g. of 0 V and 24 V of one voltage source.
M-switch (low-side switch)	Switch in the 0 V current path of an output channel. Further information → P-switch

Term/abbreviation	Meaning
Passivation	<p>Safety function during which the output module CPX-FVDA-P2 switches off all output channels or only the defective output channels (channel-wise passivation), depending on the relevant error. Instead of the programmed values, the so-called replacement values (0) are then effective.</p> <p>Module passivation is automatic, e.g.:</p> <ul style="list-style-type: none"> – with safety-related communication errors (PROFIsafe) – in the case of self-test errors – with channel errors, but only if the “channel-wise passivation” function is switched off → channel-wise passivation. <p>Once the module has been passivated, regular reintegration is required (standard PROFIsafe acknowledgment process).</p> <p>If channel-wise passivation is switched on, in case of a channel error only the affected output channel is passivated. An acknowledgment signal is required via the process image to depassivate the output channel → 2.2.3 Bit pattern of the output and input data (F-user data).</p>
Performance Level (PL..., cat...)	<p>Discrete level that specifies the capability of a controller's safety-related parts to perform a safety function under defined conditions. Categories and 5 performance levels (PL a to PL e) are defined in DIN EN ISO 13849-1.</p> <ul style="list-style-type: none"> – Category (cat.) is the classification of a safety-related part of a controller with respect to its resistance to errors and its subsequent behaviour in the error condition, which is achieved by the structural arrangement of the parts, error detection and by their reliability. – PL a is the lowest and PL e the highest level.
PROFIBUS	<p>Standard for fieldbus communication between controllers (PLC/IPC) and devices in automation technology (PROcess Field BUS → www.profibus.com).</p>
PROFINET IO	<p>Fieldbus standard based on industrial Ethernet for communication between controllers (PLC/IPC) and devices → www.profibus.com/pn, www.profibus.de.</p>

Term/abbreviation	Meaning
PROFIsafe	<p>Safety-related bus profile for PROFIBUS and PROFINET that, in conjunction with PROFIsafe-compliant devices (F-Host and F-Device), facilitates correct and reliable transmission of safety messages.</p> <p>Mechanisms for safe transmission and error detection:</p> <ul style="list-style-type: none"> – CRC signatures (data integrity test) – consecutive numbering of the safety messages, – address checking → PROFIsafe address – time monitoring. <p>In the event of errors, the F-Device can automatically trigger predefined safety measures. The consecutive numbering enables the recipient to check that all messages are received in the right order.</p> <p>For this purpose, the F-Host and the F-Device are equipped with their own state machines, which are synchronised using a control and status byte. Correct synchronisation is monitored by including counter values in the CRC signature calculation.</p>
PROFIsafe address	<p>In order to identify the addressee of a message, every PROFIsafe-enabled device or module has its own unique PROFIsafe address. The PROFIsafe address is specified in the configuration program and set via the DIL switch on the PROFIsafe-enabled device or module. Configuration errors are automatically detected by comparing the target and actual configuration.</p>
PROFI-safe monitoring time	<p>Monitoring time for safety-related communication between F-Host and F-Device</p>
Process image	<p>The process image is part of a controller's system memory. At the start of the cyclical program, the signal states of the input modules are transferred to the process image for the inputs. At the end of the cyclical program, the process image for the outputs are transferred to the output modules as the signal state.</p>
P-switch (high-side switch)	<p>Switch in the 24 V current path of an output channel.</p> <p>Each output channel has a 24 V and a 0 V current path between which the load is switched. With the CPX-FVDA-P2, these current paths are switched together and at the same time, although independently of each other.</p> <p>The P-switch switches the 24 V current path and the M-switch switches the 0 V current path of the output channel. Both switches (P-switch and M-switch) must be closed in order for voltage to be applied to the load.</p> <p>For the CPX-FVDA-P2, the P-switch and M-switch of an output channel are controlled by different micro controllers for safety reasons.</p>

Term/abbreviation	Meaning
Cross circuit	Accidental bypasses in circuits, e.g. between 0 V and FE. For example, they can be triggered by pinched cables and can cause impermissible currents in circuits. If, for example, 0 V and FE are connected to each other in the system power supply, a cross circuit between the 0 V current path and FE downstream of the M-switch results in the switch being bypassed. The switch is rendered ineffective. In a similar way, a cross circuit can also result in the P-switch being bypassed.
Cross-circuit monitoring	Function that detects possible cross currents in the device's own circuits and switches the device or the output channel into a safe state. This prevents accidental switching of the load due to impermissible cross currents.
Acknowledgement	Signal or procedure for depassivation. By acknowledging, the user confirms that the module can be reintegrated, or the output channel can be depassivated without any risk. If the complete module has been passivated, acknowledgment is carried out via regular reintegration (standard PROFIsafe process). If an output channel has been passivated (channel-wise passivation), it is acknowledged via an acknowledgement signal from the process image ➔ 2.2.3 Bit pattern of the output and input data (F-user data).
Black channel (Black Channel)	The transmission channels of PROFIBUS and PROFINET IO are not influenced by PROFIsafe. They do not need to be considered in more detail with regard to PROFIsafe and are therefore called black channels.
Safe state	State in which the system is safe.
Safety-related communication	Exchange of safety-related messages between the F-Host and F-Device (e.g. via PROFIsafe)
Safety integrity	Effectiveness of safety functions in a safety-related system under requirement-based conditions.
Safety integrity level	Safety integrity level for safety-related systems in acc. with IEC 61508. There are 4 levels (SIL 1 to SIL 4). SIL 1 is the lowest level and SIL 4 is the highest level of safety integrity. The higher the level, the less probable it is that the system will fail in a dangerous manner.
Safety circuit	Output module CPX-FVDA-P2 with all the connected consumers. A safety circuit is formed when the load to be operated safely is supplied from an output (CHO, CH1, CH2) of the CPX-FVDA-P2. A switched-on (supplied) load can either be safely switched off upon request (via PROFIsafe) or the module automatically switches off the load safely if it detects a safety-related error.
Safety pilot circuit	Safety circuit including safety-related control by the controller.
Safety program	Safety-related user program in the F-Host

Term/abbreviation	Meaning
Safety control unit	A safety controller is generally a programmable logic controller with specific design elements for processing safe input information into safe output information. It is used in safety-critical systems in order to guarantee the required safety integrity level.
SIL	→ Safety integrity level
SIL CL	Claim limit for subsystems of a safety-related electrical control system.
Test pulse	Fast switching pulse for monitoring switching capability and detecting cross circuits → Forced switch on/off.
Reintegration	Switching from replacement values to programmed values or process values (depassivation) → Passivation. Reintegration is a standard PROFIsafe process to depassivate a passivated module → PROFIsafe standard.
Forced switch on/off	Functional test procedure to determine the switching capability of a device. The P-switch and M-switch of the output module CPX-FVDA-P2 are checked cyclically for effective functionality.

Tab. 9: Product-specific terms and abbreviations

2 System overview CPX-FVDA-P2

2.1 CPX terminal with output module CPX-FVDA-P2

Only the variant CPX-M-... of the CPX terminal or the valve terminal VTSA-F-CB can be equipped with the output module CPX-FVDA-P2 → 1.4 Rules for product configuration.

Product versions

The module has 3 digital output channels (CH0 ... CH2), which enable the load voltage supplies for valves U_{VAL} to be switched off safely in two channels on the P-side and M-side:

- Version 1
 - Switches off the load voltage supply for valves U_{VAL} of the CPX terminal: output channel CH0 of the module.
The valve terminal pneumatics modules of the CPX terminal fitted on the right-hand side are supplied via output channel CH0.
 - Switches off the two outputs provided through the connection technology of the module: output channel CH1 and CH2 of the module, also supplied via the load voltage supply for valves U_{VAL} .
In addition, the unswitched load voltage supply U_{VAL} is made available via the connection technology of the module as operating voltage for the external components (24 V DC auxiliary supply).
- Version 2
 - Switches off the three internal safe voltage zones: CH0, CH1, CH2.

- Version 3
 - Switches off the two internal safe voltage zones: CH0, CH1.
 - Switches off the safe output provided through the connection technology of the pneumatic interface: CH2.

In addition, the unswitched load voltage supply U_{VAL} is made available via the connection technology of the module as operating voltage for the external components (24 V DC auxiliary supply).

The voltage zones can be safely switched off electrically independently of one other.

The output channels of the output module CPX-FVDA-P2 each form a safety circuit with their connected consumers.



Output channels CH0, CH1 and CH2 can be used to safely switch off up to 3 switch-off groups (load groups) or voltage zones independently of each other → Examples.

From the perspective of the output module CPX-FVDA-P2, the output channels (CH0 ... CH2) are channel pairs. The channel pairs can be switched together and at the same time, although independently of each other. One channel forms the positive (P) path and another forms the negative (M) path for a potential-free load voltage supply.

All P-switches and M-switches of the module output channels are controlled by different processors that continuously monitor one other (safety concept).

Output channels 1 and 2 (CH1, CH2) in version 1 and output channel 2 in version 3 are suitable, for example, for the load voltage supply of external components that must be switched off safely when required and that fulfil the relevant requirements

→ 2.4 Actuator requirements (CH0 ... CH2) and → 8 Technical appendix.

Examples

- Soft start/quick exhaust valves for external components or the internal valve terminal pneumatics (version 1, 2 and 3).
- Valve groups within the CPX terminal that are supplied separately via electrical supply plates (version 1 and 3).
- Output signal groups that are supplied via additional electrical supplies.
These output signal groups can be arranged in both their own and a separate valve terminal (version 1 and 3).
- Integrated power supply of another valve terminal. The operating voltage for electronics and sensors $U_{EL/SEN}$ is supplied from the unswitched auxiliary power supply and the load voltage U_{VAL}/U_{OUT} from an output channel (CH1 or CH2). If required (during operation), the load of the other valve terminal is then switched off without influencing the communication and input functions (version 1 and 3).

NOTICE

- Use a maximum of 2 output channels in a common safety pilot circuit.



Information on the power supply concept of the CPX terminal can be found in the system description CPX-SYS-...

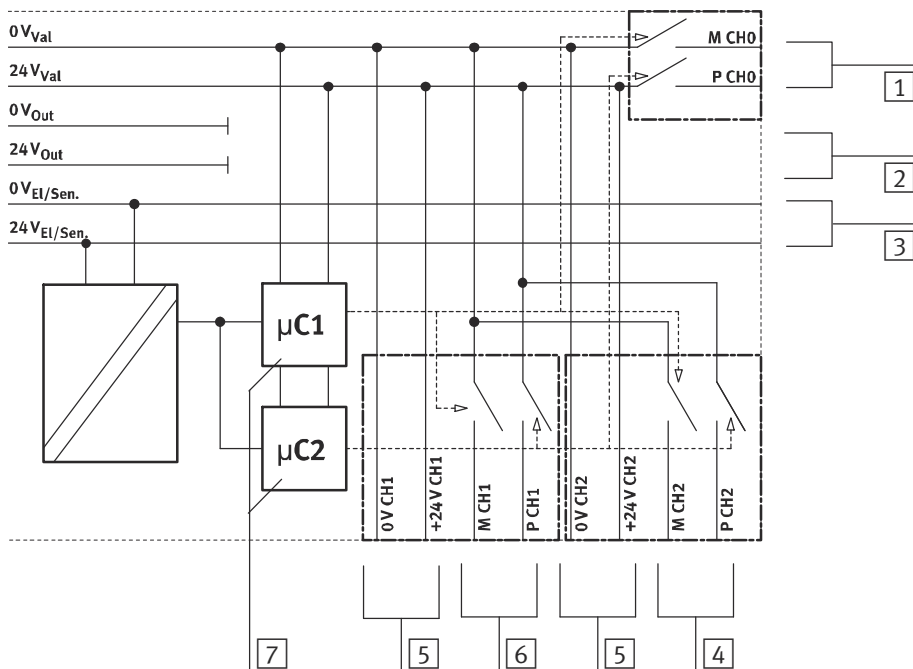


Fig. 1: Basic representation of the power supply concept for the CPX terminal with output module CPX-FVDA-P2 (version 1)

- | | |
|---|--|
| <p>1 CH0: output supplied by 24 V_{VAL} and 0 V_{VAL} for pneumatics modules fitted on the right-hand side</p> <p>2 Load voltage 24 V_{OUT} and 0 V_{OUT} is no longer available on the right-hand side</p> <p>3 Operating voltage for electronics and sensors (24 V_{EL/SEN} and 0 V_{EL/SEN}) for pneumatics modules fitted on the right-hand side</p> <p>4 CH2: output supplied by 24 V_{VAL} and 0 V_{VAL}; available through the connection technology of the module CPX-FVDA-P2</p> | <p>5 Unswitched voltage U_{VAL} for the supply of intelligent load systems (auxiliary supply)</p> <p>6 CH1: output supplied by 24 V_{VAL} and 0 V_{VAL}; available through the connection technology of the module CPX-FVDA-P2</p> <p>7 Processors for controlling and monitoring the P-switch and M-switch</p> |
|---|--|

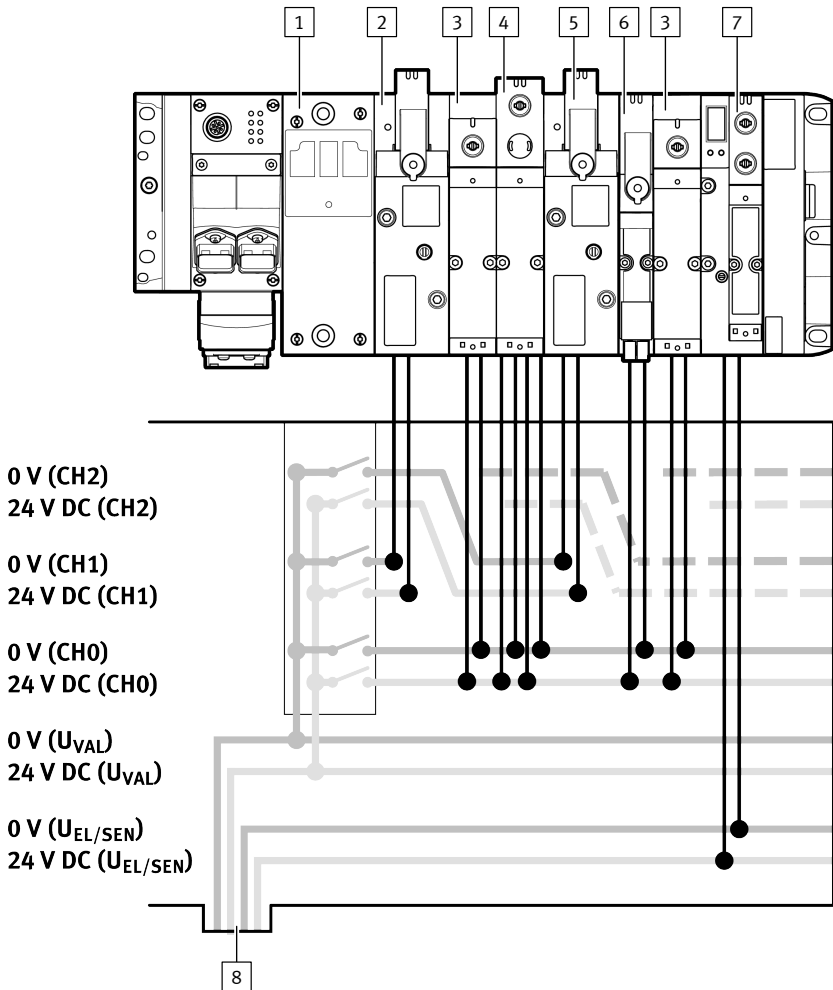


Fig. 2: Example: pneumatic interface with integrated output module CPX-FVDA-P2

- | | |
|-----------------------------------|---|
| 1 Pneumatic interface (version 2) | 6 Pilot air valve |
| 2 Soft-start valve 1 | 7 Vacuum generator |
| 3 Monostable valve | 8 Supply CPX-(M)-GE-EV-S... (7/8" or push-pull) |
| 4 Bistable valve | |
| 5 Soft-start valve 2 | |

2.1.1 Design of the output module CPX-FVDA-P2

2.1.1.1 Design in a CPX terminal

The output module CPX-FVDA-P2 features a modular design and consists of the following components – in a CPX terminal –:

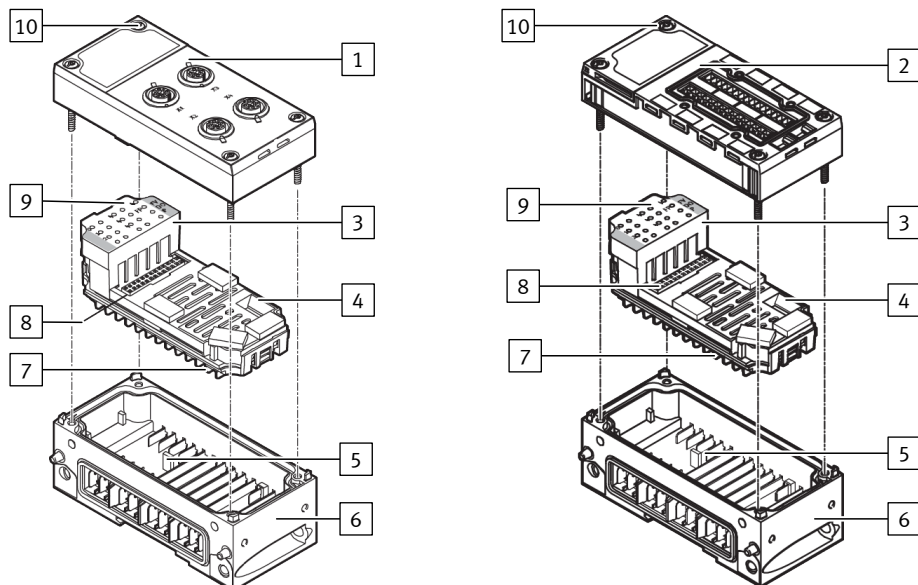


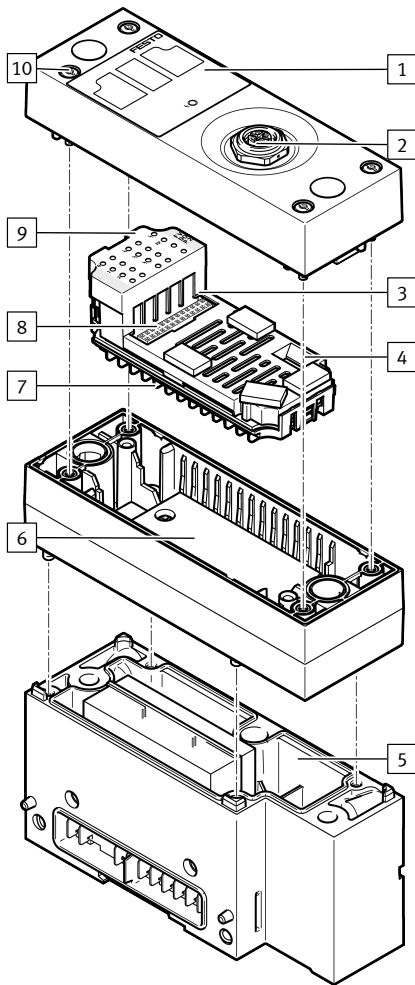
Fig. 3: Output module CPX-FVDA-P2 in a CPX terminal

- | | | | |
|---|---|----|---|
| 1 | Manifold block CPX-M-AB-4-M12X2-5POL | 7 | Rating plate (underneath) |
| 2 | Manifold block CPX-AB-8-KL-4POL | 8 | Electrical plug connector between electronics module and manifold block |
| 3 | Electronics module CPX-FVDA-P2 | 9 | LEDs of the electronics module |
| 4 | 10-way DIL switch for PROFI-safe address | 10 | Screws |
| 5 | Mechanical coding | | |
| 6 | Interlinking block with busbars CPX-M-GE-EV-FVO | | |

To avoid errors in assembly, both the interlinking block CPX-M-GE-EV-FVO and the electronics module CPX-FVDA-P2 are mechanically coded. The coding prevents a different module from being plugged into the interlinking block or the electronics module from being plugged into an incorrect interlinking block.

2.1.1.2 Design in a valve terminal VTSA-F-CB

The output module CPX-FVDA-P2 features a modular design and consists of the following components – in a valve terminal VTSA-F-CB or the associated pneumatic interface VABA-S6-1-X...-F1/F2-CB –:



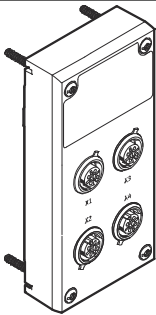
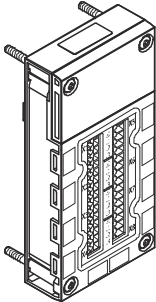
- 1 Cover (in this case, VABA-S6-1-X2-F2-CB)
- 2 M12 bushing (version 3 only, VABA-S6-1-X2-F2-CB)
- 3 Electronics module CPX-FVDA-P2
- 4 10-way DIL switch for PROFI-safe address
- 5 Pneumatic interface
- 6 Housing with bus bars for electronics module
- 7 Rating plate (underneath)
- 8 Electrical plug connector between electronics module and cover with M12 bushing
- 9 LEDs of the electronics module
- 10 Screws

Fig. 4: Output module CPX-FVDA-P2 in a pneumatic interface VABA-S6-1-X...-F1/F2-CB of the valve terminal VTSA-F-CB


2.1.2 Components

Manifold block

The manifold block provides the output module's electrical connection technology.
The following manifold blocks can be used for CPX-FVDA-P2:

Manifold block	Type	Description
	CPX-M-AB-4-M12X2-5POL	M12 metal connection technology <ul style="list-style-type: none">– 4 M12 bushings with metal thread, 5-pin– Degree of protection IP65/IP67 when using cover caps for unused connections– One functional earth connection for each bushing– Possibility of shielding through metal thread– enables the use of M12 and SPEEDCON SPEEDCON plug connectors
	CPX-AB-8-KL-4POL	Terminal strip connection technology <ul style="list-style-type: none">– 2 terminal strips, 16-pin (4 x 4-pin)– Degree of protection IP20– Degree of protection IP65/IP67 with cover AK-8KL and fittings kit VG-K-M9– All cores can be placed individually in a spring-loaded terminal– Connections combined in groups of 4 with one functional earth connection for each group

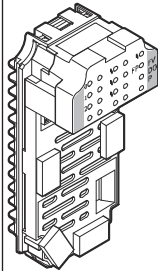
Tab. 10: Permissible manifold block

 Manifold blocks are not mechanically coded. The use of a manifold block other than those specified here is not permitted.

Electronics module

The electronics module includes the electronic components of the output module. It is connected to the interlinking block and the manifold block with electrical plug connectors. The PROFIsafe address can be set directly on the electronics module with a DIL switch

➔ 3.4 Setting the PROFIsafe address.

Electronics module	Type	Description
	CPX-FVDA-P2	<ul style="list-style-type: none">- A digital output channel CH0 for switching off the load voltage supply U_{VAL} in the linkage of the CPX terminal¹⁾- Two digital output channels CH1 and CH2²⁾- Control of the digital output channels with safety-related PLC via PROFIsafe- Status and error display per output channel- Module error display- Max. load current at CH0, CH1 and CH2 ➔ 8 Technical appendix.- Electronic fuse as short-circuit protection- A mechanical coding prevents the electronics module from being plugged into impermissible interlinking blocks.

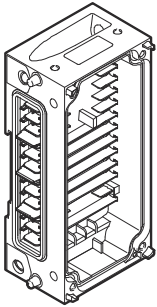
1) All the modules supplied via the load voltage supply U_{VAL} of the CPX terminal are switched off in two channels by means of P- and M-switching.

2) The connected external consumers are switched off in two channels by means of P- and M-switching. Output channels 1 and 2 (CH1, CH2) are supplied from U_{VAL} .

Tab. 11: Electronics module

Interlinking block

The interlinking block CPX-M-GE-EV-FVO provides the mechanical and electrical linkage to the CPX terminal.

Interlinking block	Type	Description
	CPX-M-GE-EV-FVO	<p>Special metal interlinking block for CPX-FVDA-P2 (without supply)</p> <ul style="list-style-type: none">– Interrupts all busbars for load voltage supplies (U_{VAL} and U_{OUT})– The busbars for the load voltage supply U_{VAL} are closed or interrupted via the output module– Busbars for U_{OUT} are not interrupted¹⁾– Mechanical coding prevents you from plugging in impermissible modules

1) A U_{OUT} is no longer available to the right of the output module via the busbars.

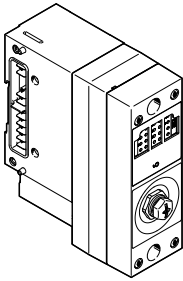
Tab. 12: Interlinking block



The use of different interlinking blocks for CPX-FVDA-P2 is not permitted.

Pneumatic interface

The pneumatic interface VABA-S6-1-X...-F1/F2-CB provides the mechanical and electrical linkage to the valve terminal VTSA-F-CB.

Interlinking block	Type	Description
	VABA-S6-1-X...-F1-CB VABA-S6-1-X...-F2-CB ¹⁾	<p>Special pneumatic interface for CPX-FVDA-P2 (without supply)</p> <ul style="list-style-type: none">– Interrupts all circuits for the load voltage supply (U_{VAL})– The circuits for the load voltage supply U_{VAL} are closed or interrupted via the CPX-FVDA-P2

1) Fig. shows the design

Tab. 13: Pneumatic interface



It is not permitted to use different pneumatic interfaces for CPX-FVDA-P2.

2.1.3 Supported product versions

To control the output module CPX-FVDA-P2, a PROFIBUS or PROFINET-capable bus node is required. The CPX terminal must be equipped with one of the following bus nodes → bus node rating plate:

Bus node	From revision	Network protocol
CPX-FB13	30	PROFIBUS
CPX-FB33	21	PROFINET IO
CPX-M-FB34	21	PROFINET IO
CPX-M-FB35	21	PROFINET IO
CPX-FB43	50	PROFINET IO
CPX-M-FB44	50	PROFINET IO
CPX-M-FB45	50	PROFINET IO

Tab. 14: Bus node for controlling the output module CPX-FVDA-P2

The following product versions of the CPX terminal and valve terminals support operation of the output module CPX-FVDA-P2 in combination with the bus nodes named above:

Product version	Description
Electrical terminal CPX-M	Modular electrical terminal CPX (without pneumatic modules)
Valve terminal, type 32	Valve terminal MPA-S with modular electrical peripheral equipment CPX
Valve terminal, type 33 – MPA-F-FB-VI	Valve terminal MPA-F with modular electrical peripheral equipment CPX
Valve terminal, type 44 – VTSA-FB-VI – VTSA-FB-NPT-VI	Valve terminal VTSA with modular electrical peripheral equipment CPX
Valve terminal, type 45 – VTSA-F-FB-VI – VTSA-F-FB-NPT-VI	Valve terminal VTSA-F with modular electrical peripheral equipment CPX
Valve terminal, type 46 – VTSA-F-CB-VI	Valve terminal VTSA-F-CB with modular electrical peripheral equipment CPX

Tab. 15: Supported product versions in combination with the bus nodes named above

Product versions		
Valve terminal	Type	Valve types
MPA-S-FB-VI	32	MPA1, MPA2 on VMPA...-FB-EMG-... ¹⁾
MPA-F-FB-VI	33	MPAF1, MPAF2 on VMPA...-FB-EMG-... ¹⁾
MPA-L-FB-VI	34	All ¹⁾
VTSA-FB-VI	44	All up to width of 52 mm ¹⁾
VTSA-F-FB-VI	45	All up to width of 52 mm ¹⁾
VTSA-F-CB-VI	46	All ¹⁾

1) Malfunctions may occur if the resultant current is exceeded.

Tab. 16: Supported product versions of the valve terminals named above

Other product versions are not supported by the output module CPX-FVDA-P2 at output channel CH0. Operation of switch-off groups within valve terminals is permitted only in conjunction with permissible pneumatics → Description of the respective valve terminal.

Only the following components are permitted when assembling the CPX-FVDA-P2 in a CPX terminal or the pneumatic interface of a valve terminal VTSA-F-CB:

Version		Component	Type
1	CPX-FVDA-P2 in combination with specific manifold and interlinking blocks of the CPX terminal	Interlinking block	CPX-M-GE-EV-FVO
		Manifold block	CPX-M-AB-4-M12X2-5POL
			CPX-AB-8-KL-4POL
2	CPX-FVDA-P2 ¹⁾ as part of the pneumatic interface of the VTSA-F-CB valve terminal	Pneumatic interface	VABA-S6-1-X...-F1-CB
3			VABA-S6-1-X...-F2-CB

1) Revision R04 (or higher) of the output module required → Rating plate of the electronic module CPX-FVDA-P2

Tab. 17: Permissible components

NOTICE

When using the CPX-FVDA-P2 in a pneumatic interface, the module's self-monitoring function can trigger false diagnoses in certain cases.

- Deactivate the wire break detection function for output channels CH0, CH1 and CH2 in the "Wire break monitoring" parameter of the pneumatic interface.

NOTICE

When using individual pneumatic modules of types VMPA... or VTSA..., the "Wire break" diagnostic message may be triggered because the detection limit is undershot.

- In this case, deactivate the "Wire break" diagnostic message for the specific output channel.

- Operation of switch-off groups in CPX terminals in the Remote I/O mode of operation is only allowed with the following approved output modules:


Output module
CPX-4DA ¹⁾
CPX-8DA ¹⁾
CPX-8DA-H ¹⁾
CPX-8DI-8DO ¹⁾

1) Malfunctions may occur if the resultant current is exceeded.

Tab. 18: Permissible output modules

Output modules on the right side of the CPX-FVDA-P2, which are switched off via CH1 or CH2, may only be supplied via the additional supply CPX-M-GE-EV-Z.

The use of a voltage relay on the right of CPX-M-GE-EV-FVO is not permitted.



Further information about the supported product versions can be found in the description of the valve terminal VTSA-F-CB.

Detailed information about the product, the supported product versions and required software versions as well as the permissible components of the CPX terminal can be found in the system description CPX-SYS-... ➔ www.festo.com/sp.

Information on further configurations of the CPX terminal can be found in the catalogue ➔ www.festo.com/catalogue.

2.1.4 Required bus topology (control chain)

Hardware and software components are required to set up safety-related systems. For example, a safety controller (F-Host) with corresponding planning and programming tools is required.

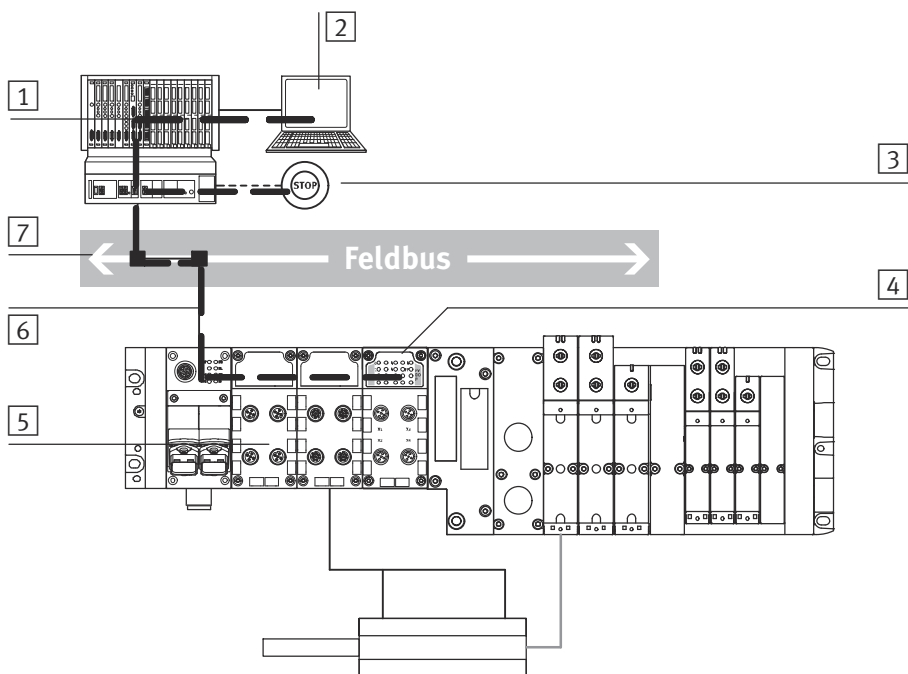


Fig. 5: Communication between safety controller and safety module via PROFIsafe

- | | |
|---|--|
| 1 Safety controller (F-Host) | 5 CPX terminal with bus node for PROFIBUS or PROFINET IO |
| 2 Safety Configuration Tool (for safety controller) | 6 Embedded PROFIsafe data (black channel) |
| 3 Emergency stop pushbutton (example) | 7 PROFIBUS or PROFINET IO |
| 4 Output module CPX-FVDA-P2 | |

2.2 PROFIsafe

The data exchange between the output module and the safety controller via the safety-related PROFIsafe bus profile from PROFIBUS or PROFINET.

2.2.1 PROFIsafe safety profile

The PROFIsafe telegrams are embedded in standard telegrams and transmitted via the black channel from the safety PLC to the output module. The black channel extends from the fieldbus connection on the safety controller via the CPX bus node to the output module CPX-FVDA-P2 (→ Fig. 5). The PROFIsafe telegrams are processed there by the output module.

In addition to process data, the PROFIsafe telegrams also transmit safety information. Therefore, the output module CPX-FVDA-P2 occupies 6 bytes each in the process image of the CPX terminal (→ Fig. 6; [3], [4], [5]).

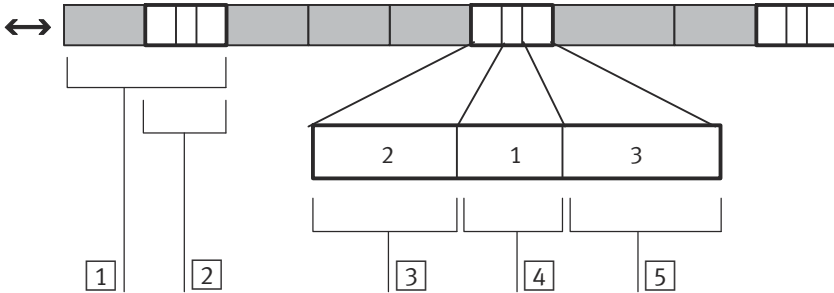


Fig. 6: Telegram structure of the output module CPX-FVDA-P2

- | | |
|---|--|
| <div style="border: 1px solid black; padding: 2px; display: inline-block; margin-bottom: 5px;">1</div> Standard telegram with embedded PROFIsafe data | <div style="border: 1px solid black; padding: 2px; display: inline-block; margin-bottom: 5px;">4</div> 1 byte status or control byte |
| <div style="border: 1px solid black; padding: 2px; display: inline-block; margin-bottom: 5px;">2</div> Embedded PROFIsafe telegram | <div style="border: 1px solid black; padding: 2px; display: inline-block; margin-bottom: 5px;">5</div> 3 bytes CRC signature (CRC2) |
| <div style="border: 1px solid black; padding: 2px; display: inline-block; margin-bottom: 5px;">3</div> 2 bytes for the module's F-user data | |

Data is transmitted on the same physical basis as the transfer of process data to a standard module. There is a distinction to be made between the kind of data and the interpretation of that data by the F-Device (PROFIsafe slave).

For PROFIsafe communication in combination with the output module CPX-FVDA-P2, the following apply:

- The module supports the PROFIsafe bus profile in the V2 mode
- Parameterisation on V1 mode is rejected

2.2.2 Process image

Due to the PROFIsafe safety mechanisms, the output module CPX-FVDA-P2 occupies 6 bytes for inputs and 6 bytes for outputs in the process image of the CPX terminal. Of these, 4 bytes of each type are used exclusively for PROFIsafe communication.

The 6 bytes for outputs are made up as follows:

- 2 bytes output data
(F-user data, ➔ Tab. 19 Bit pattern of the output data (F-user data, byte 0 and byte 1))
- 1 status byte (for PROFIsafe communication)
- 3 CRC bytes (for PROFIsafe communication)

The 6 bytes for inputs are made up as follows:

- 2 bytes input data
(F-user data, ➔ Tab. 20 Bit pattern of the input data (F-user data, byte 0 and byte 1))
- 1 control byte (for PROFIsafe communication)
- 3 CRC bytes (for PROFIsafe communication)

2.2.3 Bit pattern of the output and input data (F-user data)

Bit pattern of the output data: byte 0 and byte 1								
Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 0	reserved	Test pulses activated		reserved		Target status		
		CH2	CH1			CH2	CH1	CH0
	0	0 = Activate 1 = Deactivate		0		0 = Off 1 = On		
Byte 1	Channel-based passivation	reserved		Data direction	reserved	Acknowledgement		
						CH2	CH1	CH0
	0 = Off 1 = on	0		0 = Device to Host (fixed value)	0	– Low → High change = user acknowledgment or – permanent 1 = auto acknowledgment		

Tab. 19: Bit pattern of the output data (F-user data, byte 0 and byte 1)

– Make sure that all the output data bits are set according to their definition.

Bits 0 ... 2 control the switches at output channels 0 ... 2.

– Make sure that the controlled switching frequency is not exceeded.

Switching commands are only executed by an integrated (depassivated) module. Failsafe values are output if the module or channel is passivated.

Cross-circuit monitoring

The test pulses of the relevant output channel can be deactivated in a targeted manner via bit 5 and bit 6 of byte 0. This reduces the interference potential for the connected load. The other diagnostics measures remain active. The switch-off paths are checked cyclically during active monitoring. The function of the electronic switches and lack of cross-circuiting of the lines are checked. The cyclical check results in a momentary potential shift of the output voltage, which takes place on the P-side and M-side simultaneously. As a result, the output voltage remains largely unchanged. Potential-free consumers are not affected by this test.

The actual status of the mode of operation is returned at the same position in the input data.

NOTICE

The safety engineering characteristic values change if the cross-circuit monitoring test pulses are deactivated → Tab. 45 Safety characteristics.

NOTICE

The cross-circuit monitoring function only monitors the device's own circuits.

- Ensure that cross-circuiting to other circuits is not possible using appropriate installation measures.

Channel-based passivation

Channel-wise passivation can be switched on or off via bit 7 of byte 1.

As long as the function is inactive (0 = Off), the output module safely switches off all output channels, even in the case of an individual channel error, in accordance with the PROFIsafe specification and signals this error to the F-Host via the “FV_activated” and “Device Fault” flags. The F-Host then passivates the output channels of the module (F-Slave), isolates the module and sets the “Activate_FV” control bit.

CAUTION

If the module determines that the cause of an error is no longer present, it will withdraw the “Device_Fault” flag. The F-Host must evaluate this and can only withdraw the “Activate_FV” control bit when a safe restart is possible, or the hazard can be contained by other measures. The technical options can be found in the documentation of the relevant F-Host.

If a channel error occurs when the function is active (1 = On), the output module only safely switches off the output channel in which the error occurred. Unaffected output channels remain uninfluenced and the module remains integrated.

In addition to the current status, the module signals the channel error status to the controller via the input image (➔ Tab. 20 Bit pattern of the input data (F-user data, byte 0 and byte 1), channel error status).

Input data

In byte 0, the output module returns the logical actual statuses as well as the statuses of the monitoring flags to the F-Host as input data ➔ Tab. 20 Bit pattern of the input data (F-user data, byte 0 and byte 1). This makes it possible to check the status of the monitoring flags.

The setting of the “Channel-wise passivation” parameter is returned in byte 1. If channel-wise passivation is switched on through the bits “Channel error status of channel ...”, the errors detected by the module are signaled. These errors can be evaluated by the F-Host.

Bit pattern of the input data: byte 0 and byte 1								
Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 0	reserved	Test pulses activated		reserved		logical actual status ¹⁾		
		CH2	CH1			CH2	CH1	CH0
	0	0 = Activate 1 = Deactivate		0		0 = Off 1 = On		
Byte 1	Channel-based passivation	reserved		Data direction	reserved	Channel error status		
						CH2	CH1	CH0
	0 = Off 1 = on	0		0 = Device to Host (fixed value)	0	0 = No error 1 = error		

1) These bits reflect the logical current states. The statuses are not determined through measurements. No external voltages are evaluated at passivated or switched-off outputs. If the complete module is passivated, these bits deliver 0 signals. If an output channel is passivated, the corresponding bit delivers a 0 signal.

Tab. 20: Bit pattern of the input data (F-user data, byte 0 and byte 1)

Acknowledgment sequence

If channel-wise passivation is used, acknowledgement must be ensured via the user program.

The following sequence description shows the relevant bits for channel-wise passivation in the input and output images of the module

(→ Tab. 20 Bit pattern of the input data (F-user data, byte 0 and byte 1),

→ Tab. 19 Bit pattern of the output data (F-user data, byte 0 and byte 1)).

No.	Sequence	channel-based passivation ¹⁾	Target status of the output channel ¹⁾	Actual status of the output channel ²⁾	Channel error status ²⁾	Acknowledgment of channel error ¹⁾
1	Module is not passivated	1 (active)	X	X	0	0
	Channel error occurs					
2	Module has detected the error	1 (active)	X	0 ³⁾	1 ³⁾	0
	F-Host detects the error in the module					
3	F-Host passivates the output	1 (active)	0 ³⁾	0	1	0

No.	Sequence	channel-based passivation ¹⁾	Target status of the output channel ¹⁾	Actual status of the output channel ²⁾	Channel error status ²⁾	Acknowledgment of channel error ¹⁾
3	Error is rectified					
	User acknowledges the error (at least 1 F-I/O cycle)	1 (active)	0	0	1	1 ³⁾
4	Channel is no longer passivated	1 (active)	X ³⁾	X ³⁾	0 ³⁾	0 ³⁾
X = signal irrelevant; 1 = logic 1; 0 = logic 0						

1) Bit in the output image
2) Bit in the input image
3) Bit relevant for the table row.

Tab. 21: Sequence description of channel error acknowledgment – example

The detection of a short circuit is not possible in the passivated status. Therefore, the short circuit is reported until it is acknowledged.

Automatic acknowledgment is possible by holding the acknowledgment bit permanently at “1”. Reintegration is delayed in the event of a short circuit.

In case of acknowledgment despite the presence of an error, the output channel is automatically passivated again within the detection time. If automatic acknowledgment is not desired, the user program must ensure that the F-Host cancels the acknowledgment.

Data direction

In the supported version, the PROFIsafe protocol does not have a sufficient indication of the transmission direction of a telegram. As a result, it is possible that a telegram from the F-Host will be sent back to it and misinterpreted.

This is extremely rare and occurs only if an unsafe device malfunctions in the black channel.

To safely avoid this exception:

- Make sure that bit 4 of byte 1 (in the F-Host) of the F-user data’s input image is regularly checked for “1”.
- Also ensure that when a “0” is read in, the relevant module is immediately passivated in the controller.

2.3 Mode of operation of the output module

The switches of the output channels are each controlled by different processors in accordance with the safety concept. For this purpose, the output module is equipped with 2 processors that monitor each other constantly and check the switching capability. In addition, they can monitor the output channels for short circuits and cross circuits ➔ Fig. 1.

Each high-side path (P, 24 V current path) of an output channel is coupled with a current measurement device. This is able to measure current from about 50 mA and detect load and short-circuit current.

The entire module is designed to ensure that the output channels are also switched off in case of an error, e.g.:

- overvoltage, undervoltage, overload, short circuit and cross circuit
- communication failure or malfunction PROFIsafe
- failure or defect of individual safety-determining components of the module.

NOTICE

When operating a load with constant high momentum (e.g. fast-switching valves), the diagnostic function cannot be executed in full. In this case, the output channel is switched off safely.

- Ensure that a load with sufficiently reduced momentum is operated at the relevant output channel.

2.3.1 Possible applications

The module can only be used in machines and systems with increased safety requirements if a safe state is achieved by switching off circuits. The following table lists possible applications:

Case	Safe shutdown ...	Output channel used	Safe function
1	... of the load voltage supply for the internal valves of the valve terminal with galvanic isolation	<ul style="list-style-type: none"> – CH0 (version 1) – CH0, CH1, CH2 (version 2) – CH0, CH1 (version 3) 	Safe switch-off of the load voltage with cyclical checking of the switch-off paths for function and cross circuit
2	... potential-free individual consumers, e.g. valves, contactors, relays	<ul style="list-style-type: none"> – CH1 + CH2 (version 1) – CH2 (version 3) 	
3	... the load voltage of external electronic consumers with safe galvanic isolation of the load voltage		

Tab. 22: Possible applications for the output module CPX-FVDA-P2

Case 1

Safely switching off the load voltage supply for the internal valves of the valve terminal with galvanic isolation via CH0.

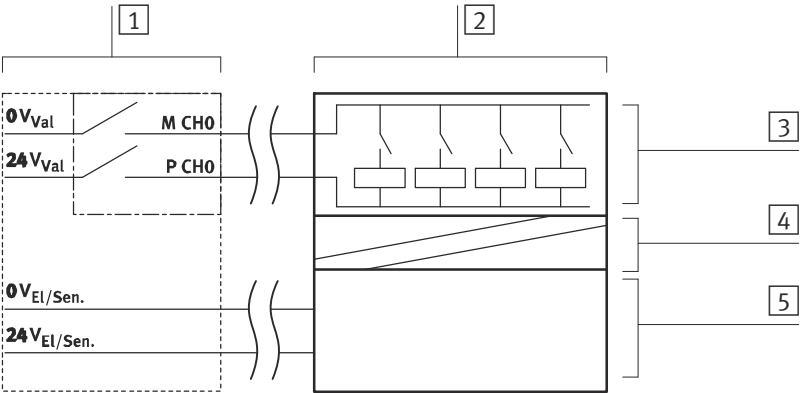


Fig. 7: Switching off the load voltage supply of CPX-internal solenoid coils

- 1 Output module CPX-FVDA-P2 with interlinking block CPX-M-GE-EV-FVO
- 2 Valve terminal MPA or VTSA
- 3 Solenoid coils of the internal pneumatics
- 4 Galvanic isolation
- 5 Electronics side

Case 2

Safely switching off potential-free individual consumers via CH1 or CH2, e.g. valves, contactors, relays. For example, an internal or external valve group can be exhausted via an external venting valve.

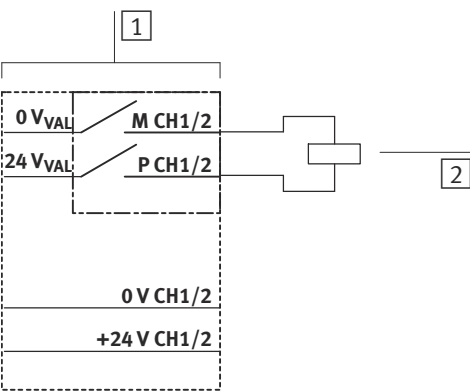


Fig. 8: Safely switching off potential-free individual consumers

- 1 Output module CPX-FVDA-P2
- 2 Potential-free passive load

Case 3

Safely switching off the load voltage of external electronic consumers with safe galvanic isolation of the load voltage via CH1 or CH2.

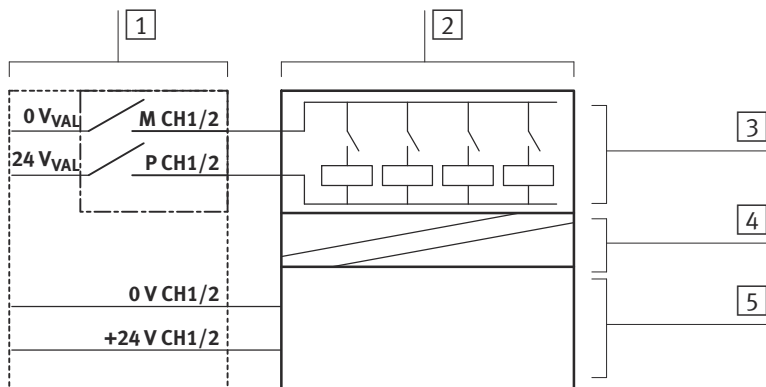


Fig. 9: Safely switching off the load voltage of external electronic consumers with safe galvanic isolation of the load voltage

- | | |
|--|--|
| <p>1 Output module CPX-FVDA-P2</p> <p>2 External consumer, e.g. valve terminal, switch-off group of the CPX terminal or switch-off group of a valve terminal</p> <p>3 Load side of the consumer, galvanically isolated</p> | <p>4 Galvanic isolation</p> <p>5 Electronics side of the consumer, can optionally be connected to the 24 V supply provided by the module</p> |
|--|--|

Case 4

Safe switch-off of the load voltage of external electronic consumers with safe galvanic isolation of the load voltage via CH1 or CH2.

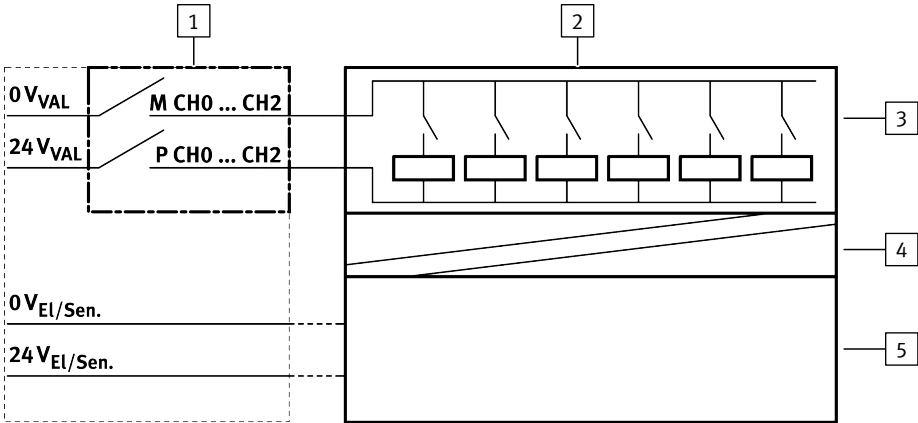


Fig. 10: Safe switch-off of the voltage zones (switch-off groups) in a valve terminal VTSA-F-CB with safe galvanic isolation of the load voltage

- | | |
|---|--|
| <p>1 Output module CPX-FVDA-P2 in valve terminal VTSA-F-CB</p> <p>2 Consumer, in this case switch-off groups (voltage zones) of the valve terminal VTSA-F-CB</p> <p>3 Load side of the consumer, galvanically isolated</p> | <p>4 Galvanic isolation</p> <p>5 Electronics side of the consumer, connected to the 24 V supply provided by the module</p> |
|---|--|

2.3.2 Application examples

A safety function is created by safely switching off connected consumers. The following application examples show you the different potential options for the intended use of the CPX-FVDA-P2.

NOTICE

The output channels of the CPX-FVDA-P2 do not provide isolated potentials, which may be used independently from a safety perspective. For this reason, the P and M-connections of an output channel must always be used together.

- Make sure that the current path is always routed from P to M of **the same** output channel.

The following pages contain various application examples that illustrate the switching of permissible and impermissible safety circuits.

CAUTION

- Make sure that the application examples which are designated as impermissible are not used under any circumstances.
They merely represent an example of foreseeable misuse.

Example 1 – permissible use of the CPX-FVDA-P2

Internally connecting the CPX valve terminal, which is mounted on the CPX terminal, to CH0.

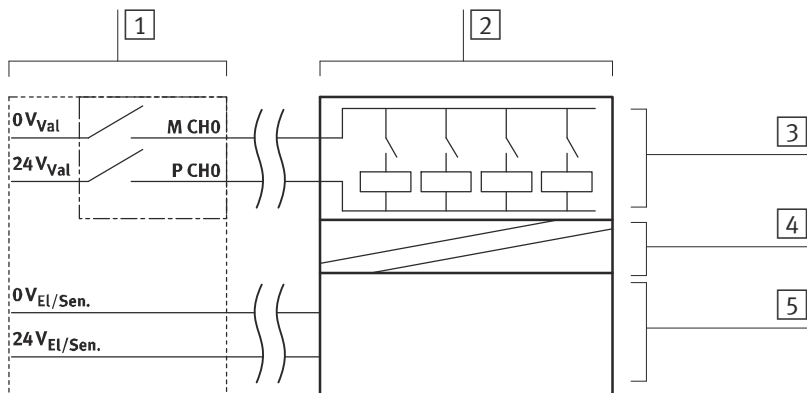


Fig. 11: Connecting the load voltage supply of CPX-internal solenoid coils

- | | | | |
|---|--|---|--------------------|
| 1 | Output module CPX-FVDA-P2 with inter-linking block CPX-M-GE-EV-FVO | 4 | Galvanic isolation |
| 2 | CPX valve terminal MPA or VTSA | 5 | Electronics side |
| 3 | Solenoid coils of the internal pneumatics | | |

Example 2 – permissible use of the CPX-FVDA-P2

Connecting potential-free passive loads to one of the two output channels CH1 or CH2.

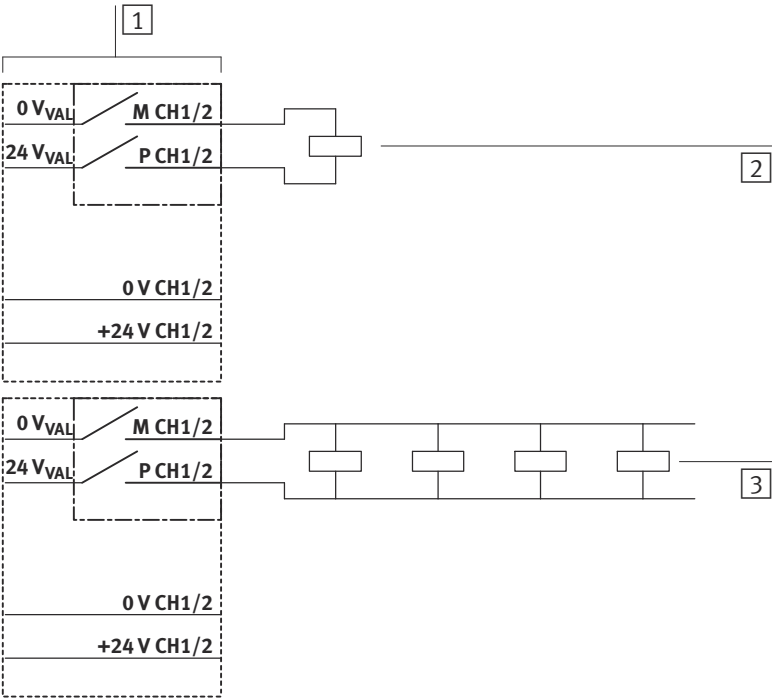


Fig. 12: Safely connecting potential-free individual consumers

- 1 Output module CPX-FVDA-P2
- 2 Potential-free passive load
- 3 Potential-free parallel passive load

Example 3 – permissible use of the CPX-FVDA-P2

Connecting safety relays to one of the two output channels CH1 or CH2.

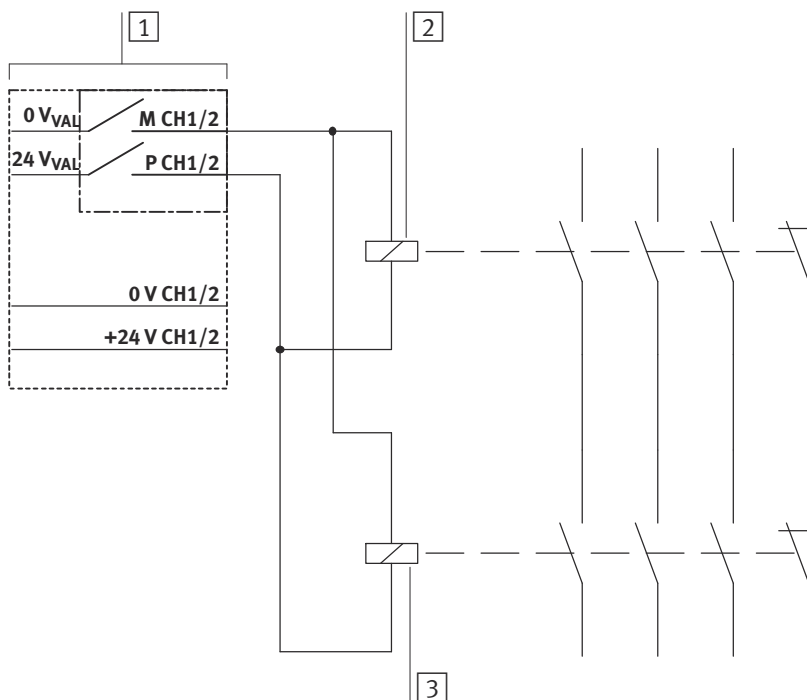


Fig. 13: Safely connecting safety relays

- 1 Output channel CH1 or CH2 of output module CPX-FVDA-P2
- 2 Safety relay 1 with forcibly actuated acknowledgment contact
- 3 Safety relay 2 with forcibly actuated acknowledgment contact

Example 4 – impermissible use of the CPX-FVDA-P2

CAUTION

This connection of potential-free loads **must not be used** to create a safety circuit.

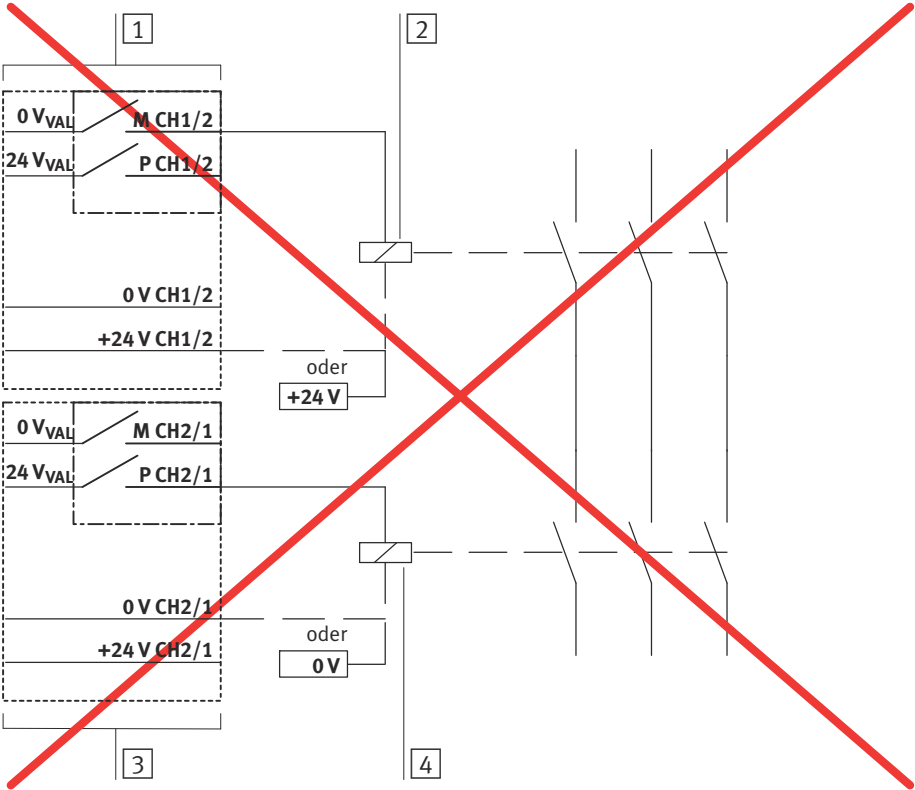


Fig. 14: Impermissible connection of potential-free individual consumers, using safety relays as an example

- | | |
|---|---|
| <div>1</div> Output channel CH1 or CH2 of output module CPX-FVDA-P2 | <div>3</div> Output channel CH2 or CH1 of output module CPX-FVDA-P2 |
| <div>2</div> Safety relay 1 | <div>4</div> Safety relay 2 |

Example 5 – permissible use of the CPX-FVDA-P2

Connecting general active loads to one of the two output channels CH1 or CH2.

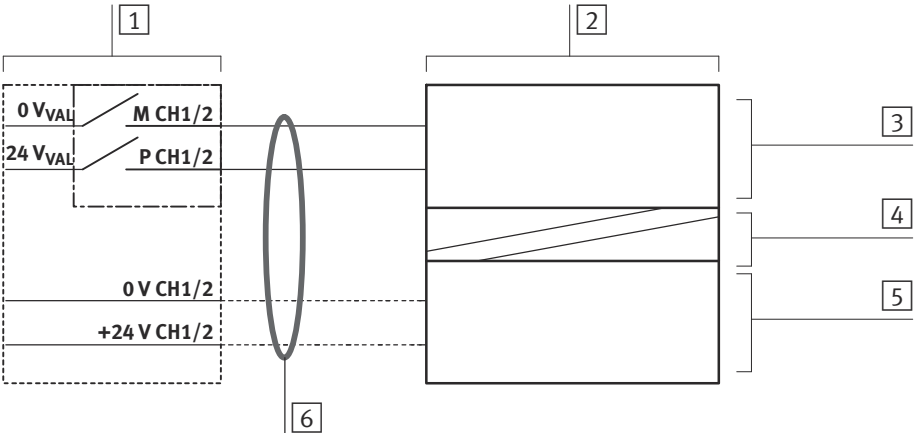


Fig. 15: Connecting general active loads

- | | | | |
|--------------|---------------------------|--------------|---|
| <div>1</div> | Output module CPX-FVDA-P2 | <div>5</div> | Supply of the general active load |
| <div>2</div> | General active load | <div>6</div> | The signals may be routed together via the same cable |
| <div>3</div> | Safety load circuit | | |
| <div>4</div> | Galvanic isolation | | |



If the supply comes from the output module, a functional galvanic isolation is sufficient.

Example 6 – permissible use of the CPX-FVDA-P2

Connecting an MS6-SV-...E-10V24-... via NECA-S1G9-P9-MP5 to one of the two output channels CH1 or CH2.

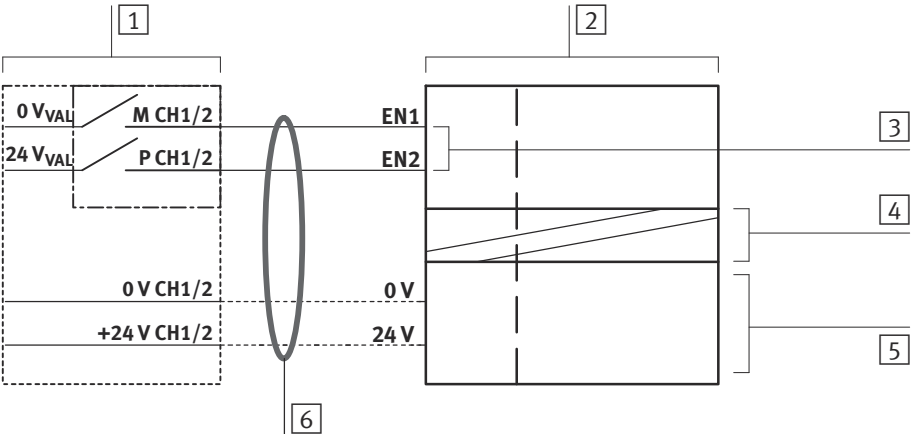


Fig. 16: Connecting an MS6-SV-...E-10V24-... via NECA-S1G9-P9-MP5

- 1 Output module CPX-FVDA-P2
- 2 NECA-S1G9-P9-MP5 with MS6-SV-...E-10V24-...
- 3 Antivalent control inputs EN1, EN2
- 4 Galvanic isolation
- 5 Supply of the MS6-SV-...E-10V24-... via NECA-S1G9-P9-MP5
- 6 The signals may be routed together via the same cable

Example 7 – permissible use of the CPX-FVDA-P2

Connecting an MS6-SV-...E-10V24-... to both output channels CH1 and CH2.

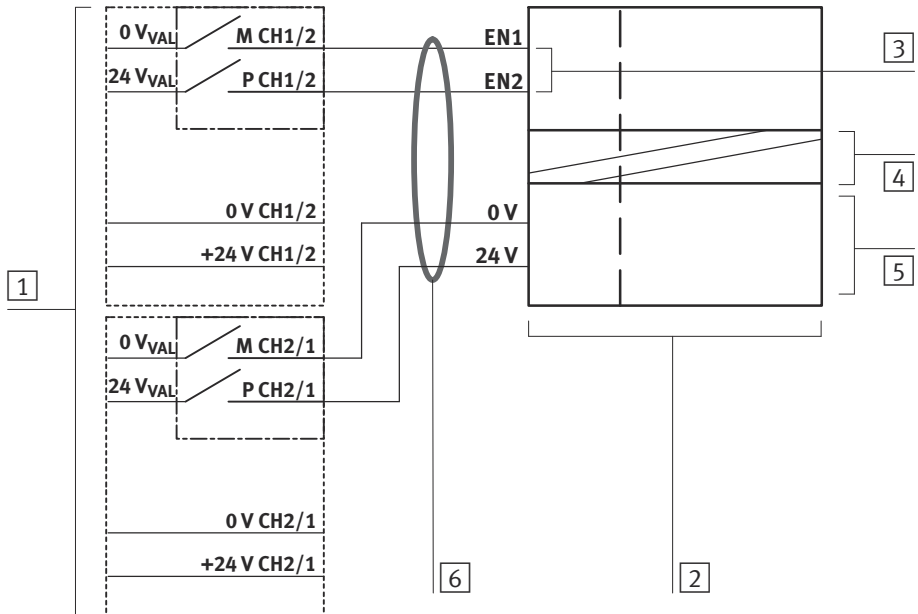


Fig. 17: Connecting an MS6-SV-...-E-10V24-... via NECA-S1G9-P9-MP5 to both output channels CH1 and CH2.

- | | | | |
|---|---|---|--|
| 1 | 2x output module CPX-FVDA-P2 with inter-linking block CPX-M-GE-EV-FVO | 4 | Galvanic isolation |
| 2 | NECA-S1G9-P9-MP5 with MS6-SV...-E-10V24-... | 5 | Supply of the MS6-SV...-E-10V24-... via NECA-S1G9-P9-MP5 |
| 3 | Antivalent control inputs EN1, EN2 | 6 | The signals may be routed together via the same cable (with a Y-distributor if required) |



The second output channel can be used to briefly switch off the supply to MS6, which triggers a reset and the acknowledgment of an internal MS6 error shutdown.

Example 8 – impermissible use of the CPX-FVDA-P2

CAUTION

This connection of an MS6-SV...-E-10V24-... **must not be used** to create a safety circuit.

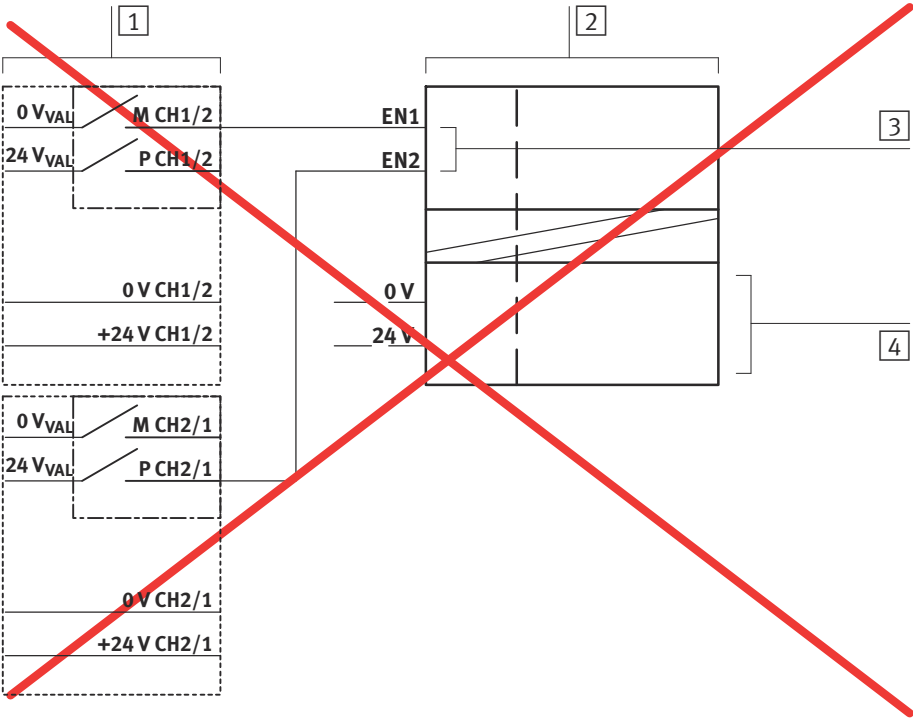


Fig. 18: Impermissible connection of an MS6-SV...-E-10V24-...

- | | |
|---|--|
| <div>1</div> <div>2x output module CPX-FVDA-P2</div> | <div>3</div> <div>Antivalent control inputs EN1, EN2</div> |
| <div>2</div> <div>NECA-S1G9-P9-MP5 with MS6-SV...-E-10V24-...</div> | <div>4</div> <div>Supply of the MS6-SV...-E-10V24-... via NECA-S1G9-P9-MP5</div> |

Example 9 – permissible use of the CPX-FVDA-P2

Connecting a separate safety circuit of a valve terminal via an additional supply to one of the two output channels CH1 or CH2.

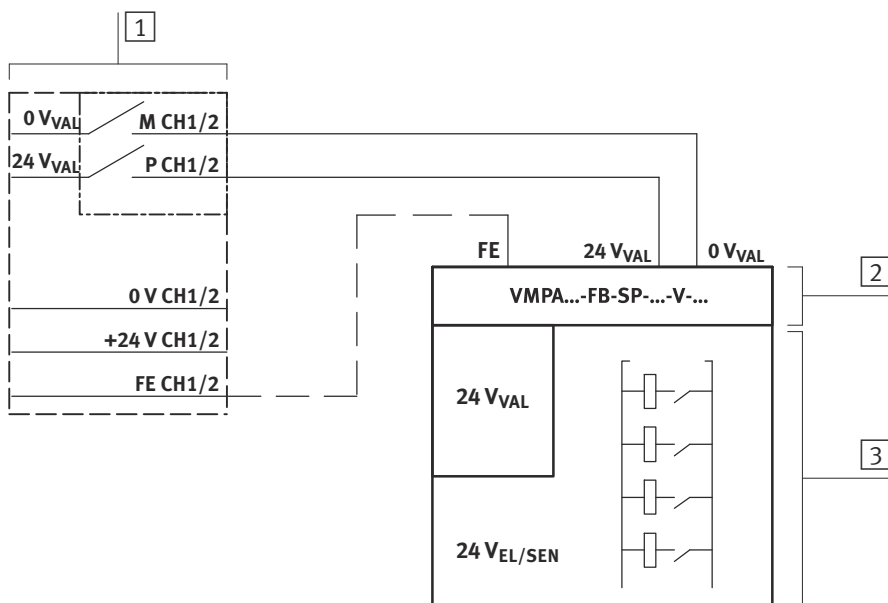


Fig. 19: Connecting a valve terminal via an additional supply

- 1 Output channel CH1 or CH2 of output module CPX-FVDA-P2
- 2 Additional supply VMPA...-FB-SP-...-V-...
- 3 Part of the valve terminal with the valves that must be switched off for safety

Example 10 – permissible use of the CPX-FVDA-P2

Connecting output modules of a separate supply circuit via an additional supply to one of the two output channels CH1 or CH2.

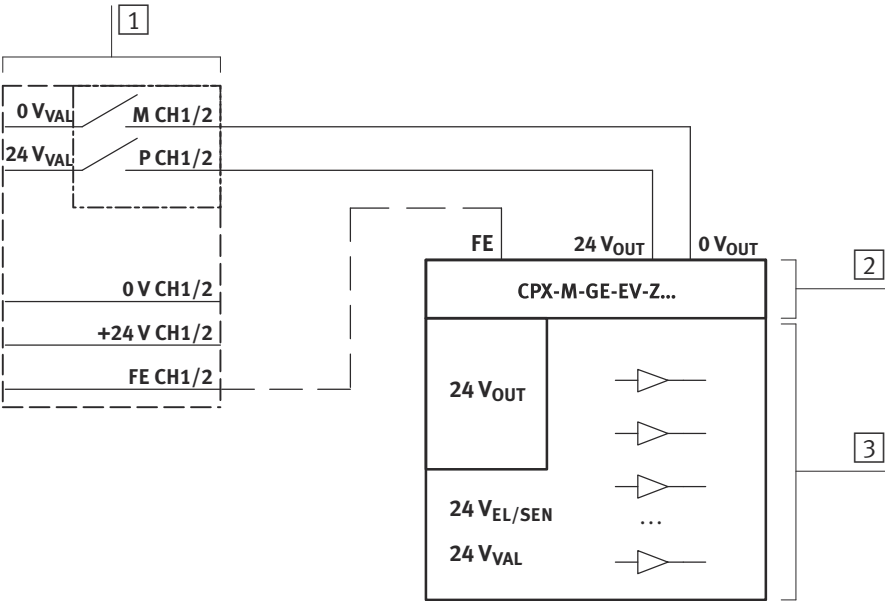


Fig. 20: Connecting a separate supply circuit via an additional supply

- 1

Output channel CH1 or CH2 of output module CPX-FVDA-P2
- 2

Additional supply CPX-M-GE-EV-Z...
- 3

Part of the CPX terminal with the output modules that must be switched off for safety engineering

NOTICE

- Only use the released output modules in the safety circuit.
- Observe the specifications for connecting loads to an output module in the safety circuit
 - ➔ 2.4.2 Safety-related requirements and
 - ➔ Example 12 – permissible use of the CPX-FVDA-P2.

Example 11 – permissible use of the CPX-FVDA-P2

Connecting an external valve terminal via the system supply to one of the two output channels CH1 or CH2. Outputs and valves are operated in the same safety circuit.

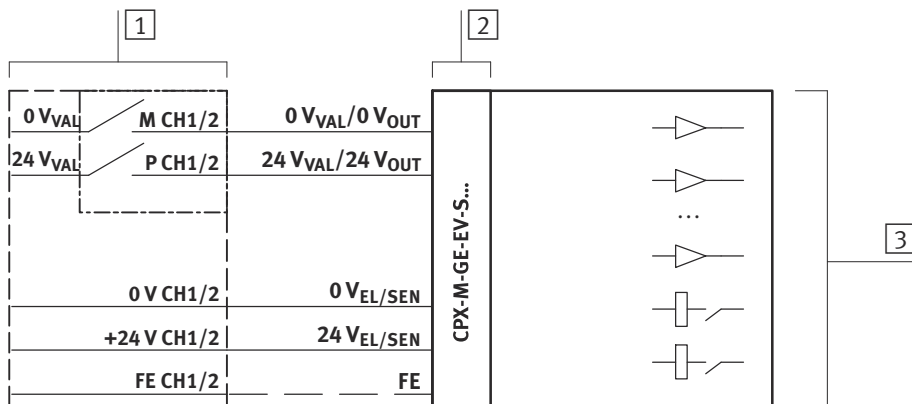


Fig. 21: Connecting an external valve terminal via the system supply

- | | |
|---|--|
| <p>1 Output channel CH1 or CH2 of output module CPX-FVDA-P2</p> <p>2 System supply CPX-M-GE-EV-S...</p> | <p>3 CPX valve terminal with the output modules and valves that must be switched off for safety engineering</p> |
|---|--|

NOTICE

- Only use one of the following system supplies:
 - CPX-M-GE-EVS-7/8-5POL
 - CPX-M-GE-EV-S-PP-5POL
 - CPX-M-GE-EV-S-7/8-CIP-4POL
- Only use the released output modules and valve terminals in the safety circuit.
- Observe the specifications for connecting loads to an output module in the safety circuit
 - ➔ 2.4.2 Safety-related requirements and
 - ➔ Example 12 – permissible use of the CPX-FVDA-P2.

Example 12 – permissible use of the CPX-FVDA-P2

Connecting further loads to an output module in the safety circuit.

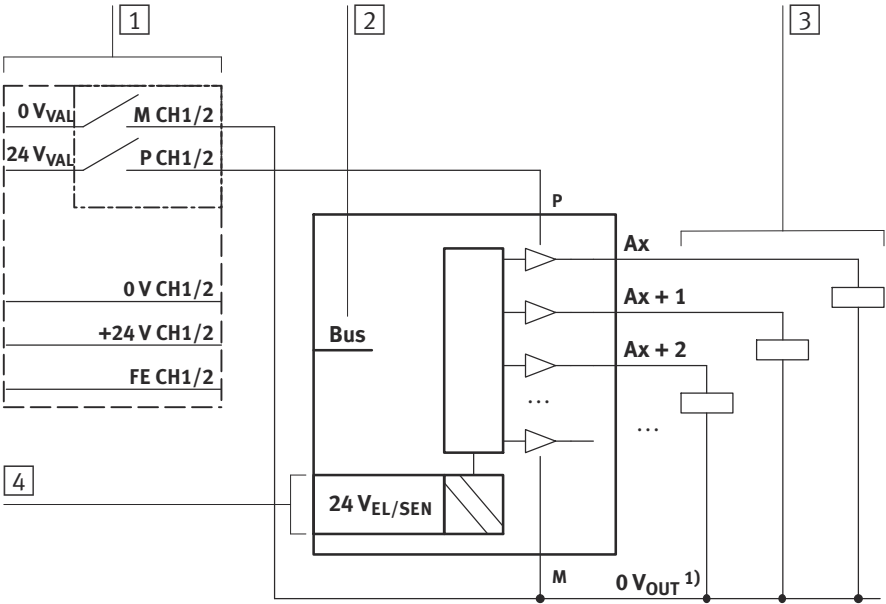


Fig. 22: Connecting further loads via an output module

- | | | | |
|---|---|---|---|
| 1 | Output channel CH1 or CH2 of output module CPX-FVDA-P2 | 3 | Functionally switched loads that can be switched off for safety |
| 2 | Internal system bus for functional control of the loads | 4 | Operating voltage supply, galvanically isolatedSignal names from P.BE-CPX-EA... |

NOTICE

- Use only the existing connections for supplying the additional loads.
- Connect the additional loads in a potential-free manner (not related to FE or PE).

Example 13 – impermissible use of the CPX-FVDA-P2

CAUTION

This connection of loads via a 0-potential without connection to the M-channel **must not be used** to create a safety circuit.

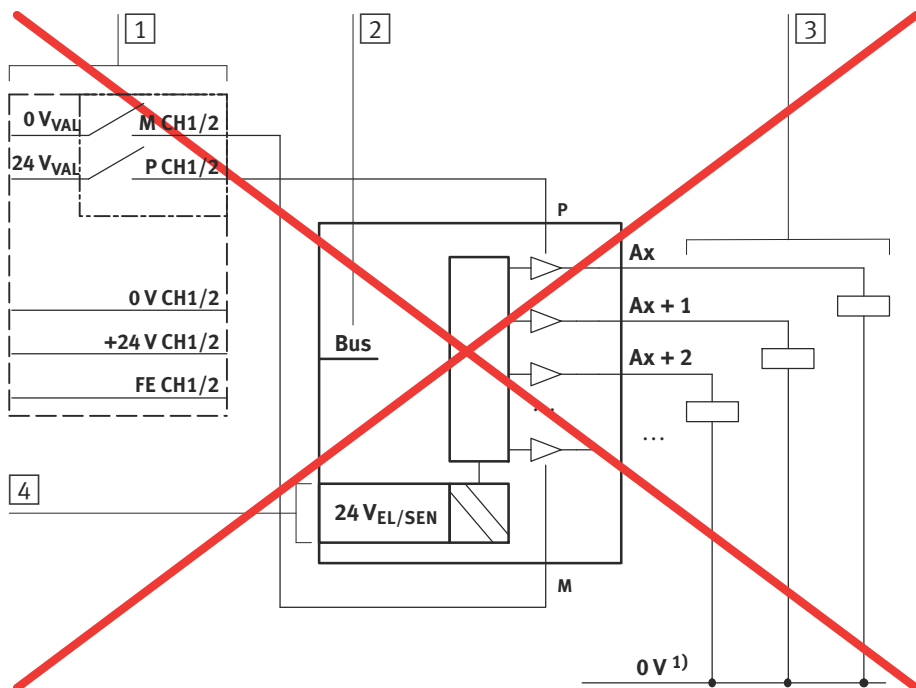


Fig. 23: Impermissible use of the CPX-FVDA-P2

- | | |
|--|---|
| <p>1 Output channel CH1 or CH2 of output module CPX-FVDA-P2</p> <p>2 Internal system bus for functional control of the loads</p> | <p>3 Functionally switched loads that can be switched off for safety</p> <p>4 Operating voltage supply, galvanically isolated 0 V potential not originating from M, e.g. VSEN</p> |
|--|---|

2.4 Actuator requirements (CH0 ... CH2)

Observe the following information when using the output module CPX-FVDA-P2 for safety purposes

➔ 8.1 Technical data of the output module CPX-FVDA-P2:

2.4.1 Electrical requirements

All output channels ensure that loads are switched off safely. The number of loads to be switched off is limited by the maximum current load.

If the max. load current is exceeded, the output module sends an “Overload” diagnostic message for the relevant output channel and reacts with a channel or module orientation in a safety-oriented manner corresponding to the mode of operation.

- Make sure that the loads used in the safety circuit are insensitive to test pulses of the cross-circuit monitoring function.

If necessary, it may be helpful to deactivate the test pulses of the cross-circuit monitoring function.

In this regard, please note the deviating safety characteristic values

➔ Tab. 45 Safety characteristics.

- Only use externally supplied loads if their supply voltage:
 - from safe galvanically isolated safety extra-low voltage (PELV)
 - from the load voltage supply for valves (U_{VAL}).

NOTICE

If electronic loads are connected to CH1 and CH2, a cross circuit may be detected incorrectly under certain unfavourable operating conditions.

- Pay particular attention to the maximum values for the following characteristics

➔ 8.1 Technical data of the output module CPX-FVDA-P2.

- Line length for external loads
- Permanent current (load current) per output channel
- Permanent current of the unswitched load voltage U_{VAL} (auxiliary supply) per output channel

Auxiliary supply connections (0 V, +24 V) are available via the manifold blocks (for CH1 and CH2) or via the output of the pneumatic interface (for CH2).



Additional technical data ➔ 8.1 Technical data of the output module CPX-FVDA-P2.

Maximum permissible load inductivity at output channels CH1 and CH2 ➔ Fig. 37.

NOTICE

When additional valves are added to a valve terminal, the load current at CH0 increases ... CH2.

- When operating the valve terminal, make sure that the maximum permissible load current is **not** exceeded.

To this end, limit the number of valves that are switched on at the same time.

Otherwise, the relevant safety circuit will be switched off for safety reasons.

NOTICE

When operating the CPX-FVDA-P2 in a pneumatic interface, please note that the maximum total current depends on the ambient temperature ➔ Fig. 40.

2.4.2 Safety-related requirements

When connecting loads:

- Observe the requirements of the safety standards that apply to the respective load and system type. This applies in particular to loads that have another power supply or storage option in addition to the electrical connection to the P and M-channels.
- Make sure that the safe state of the loads is maintained under each of the following conditions:
 - Switching off the P-channel and M-channel (normal operation).
 - Switching off only the P-channel or the M-channel (error).

When controlling loads connected to additional voltage sources:

- Make sure that one of the following options applies:
 - The additional voltages come from the same source as the load voltage supply U_{VAL} .
 - The loads are galvanically isolated from the potential of the output channels of the CPX-FVDA-P2 in accordance with the required safety level.

When operating loads that are switched via another output module

➔ Tab. 3 Permissible output modules:

- Take measures to prevent or detect cross circuits between the other output module and the load.
- Operate the load potential-free.
- Make sure that the power supplies used are from the same source to guarantee the cross-circuit detection function.
- Always connect the load to the corresponding 0 V connection on the output module.

NOTICE

- Make sure that CH1 and CH2 are not connected electrically in parallel.

NOTICE

- Make sure that all voltages in the system (for CPX and its loads that are switched for safety purposes) are based on the same functional earth (FE).

3 Installation

3.1 General information about installation

WARNING

- For the electrical power supply, use only PELV circuits in accordance with EN 60204-1 (protective extra-low voltage, PELV).
Also take into account the general requirements for PELV circuits in accordance with EN 60204-1.
- Only use power sources which guarantee reliable electrical isolation of the operating voltage from the mains in accordance with EN 60204-1.

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

Compliance with the input voltage limits of the module is also ensured.

3.1.1 Module-related rules for configuration

- Only plug the output module CPX-FVDA-P2 into the interlinking block CPX-M-GE-EV-FVO or the pneumatic interface VABA-S6-1-X...-F1/F2-CB.



A mechanical coding prevents the output module from being plugged into an incorrect interlinking block.

- Note that the manifold blocks and the pneumatic interface are not mechanically coded.
- Only operate the output module with manifold blocks CPX-M-AB-4-M12X2-5POL or CPX-AB-8-KL-4POL or the pneumatic interface VABA-S6-1-X...-F1/F2-CB.
- When placing the output module, ensure that the voltage 24 V_{VAL}/0 V_{VAL} is switched to the right of it via output channel CH0 and that the voltage 24 V_{OUT}/0 V_{OUT} is no longer available.
- Use the output module only in combination with permissible product versions of the CPX terminal or the valve terminal VTSA-F-CB → 2.1.3 Supported product versions.

NOTICE

The power supply U_{OUT} is no longer available on the right side of interlinking block CPX-M-GE-EV-FVO.

- If required, use an intermediate supply (additional supply) with the aid of a CPX-M-GE-EV-Z.
- Output modules on the right side of the CPX-FVDA-P2, which are switched off via CH1 or CH2, may only be supplied via the additional supply CPX-M-GE-EV-Z.
- The use of a voltage relay on the right of CPX-M-GE-EV-FVO is not permitted.

NOTICE

The safety function of output channel CH0 is disabled when the intermediate supply CPX-M-GE-EV-Z is assembled on the right side of interlinking block CPX-M-GE-EV-FVO.

3.2 Connecting the cables and plugs to the manifold block

NOTICE

Incorrect handling can cause damage to the electronics modules.

- Switch off the supply voltages before assembly or installation.
- Only switch on the electrical power supplies when the product has been fully assembled and all installation work is complete.
- Ensure that defective cables are replaced immediately.

Actuators are connected to the manifold block. This means that the plugs and cables can remain on the manifold block when, for example, the electronics module is replaced.



The degree of protection of the module depends on the manifold block as well as on the plugs and cover caps used. Information can be found on the following pages and in the appendix

→ 8.2 Technical data of the manifold blocks.



Use plugs from the Festo product ranger → www.festo.com/catalogue.

The max. permitted line length is 200 m.

NOTICE

In order for output modules with manifold block CPX-M-AB-4-M12X2-5POL to comply with degree of protection IP65/IP67:

- Use the specified plugs from the accessories → www.festo.com/catalogue to connect the actuators.
- Tighten the union nuts of the plugs by hand.
- Use cover caps ISK-M12 (accessories) to seal unused bushings.

NOTICE

In order for output modules with manifold block CPX-AB-8-KL-4POL to comply with degree of protection IP65/IP67:

- Use the specified covering from the accessories → www.festo.com/catalogue for sealing.

NOTICE

The cross-circuit monitoring function only monitors the device's own circuits.

- Ensure that cross-circuiting to other circuits is not possible using appropriate installation measures.

3.3 Electrical connection and display elements

The LEDs and the module identifier can be seen through the transparent covering on the manifold block (example → Fig. 24).

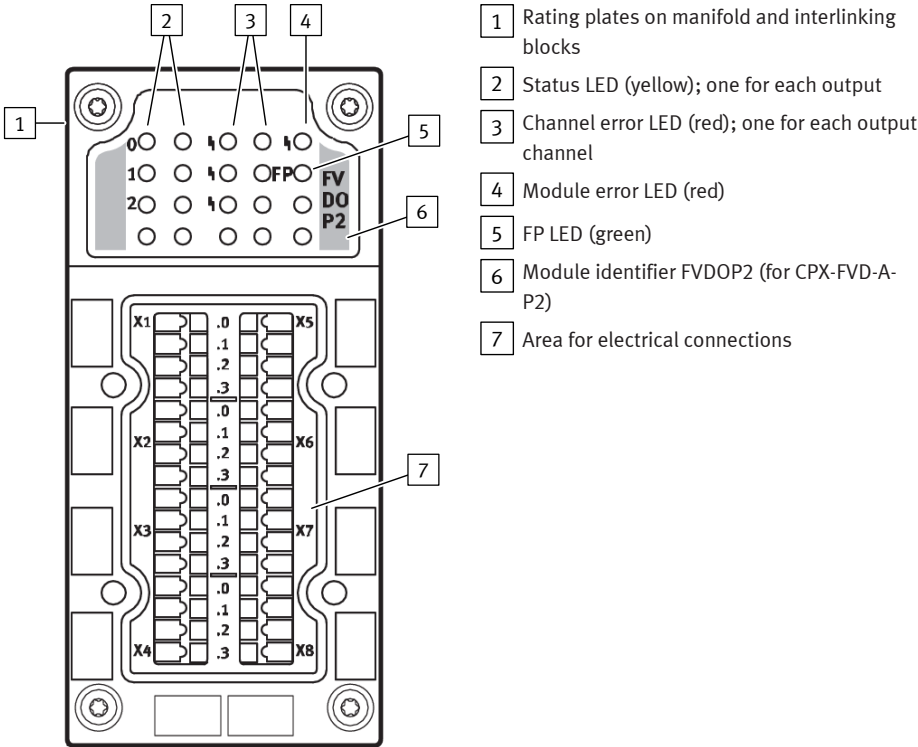


Fig. 24: Display and connecting elements CPX-FVDA-P2

i

Detailed information about the LEDS → 6.3 Diagnostics using LEDs.

3.3.1 Pin allocation with M12 manifold block

NOTICE

Bushings X1 to X4 on the manifold block are labelled accordingly. The numbering of the bushings here corresponds to the output addresses.

CPX-FVDA-P2 with manifold block CPX-M-AB-4-M12X2-5POL

Manifold block	Pin allocation X1, X2	Pin allocation X3, X4
	<p>Bushing X1</p> <p>1: 0 V CH1¹⁾ 2: +24 V CH1¹⁾ 3: F-DO(M) CH1²⁾ 4: F-DO(P) CH1²⁾ 5: FE</p>	<p>Bushing X3</p> <p>1: n.c. 2: n.c. 3: n.c. 4: n.c. 5: FE</p>
	<p>Bushing X2</p> <p>1: 0 V CH2¹⁾ 2: +24 V CH2¹⁾ 3: F-DO(M) CH2²⁾ 4: F-DO(P) CH2²⁾ 5: FE</p>	<p>Bushing X4</p> <p>1: n.c. 2: n.c. 3: n.c. 4: n.c. 5: FE</p>

FE = functional earth
n.c. = unassigned (not connected)

1) Unswitched voltage UVAL can be used to supply intelligent load systems (auxiliary supply)

2) All output voltages are likewise derived from the internal contact rail UVAL

Tab. 23: Pin allocation with M12 manifold block



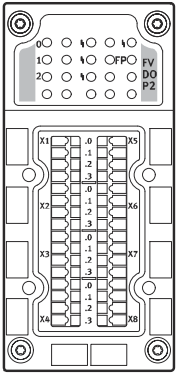
The metal thread of the manifold block CPX-M-AB-4-M12x2-5POL is connected internally with pin 5 (functional earth FE).

3.3.2 Pin allocation with TS manifold block

NOTICE

The terminal strips on the manifold block are labelled accordingly. The numbering of the terminals here corresponds to the output addresses.

CPX-FVDA-P2 with manifold block CPX-AB-8-KL-4POL

Manifold block	Left terminal strip allocation		Right terminal strip allocation	
	X1	.0 .1 .2 .3 .0 .1 .2 .3 .0 .1 .2 .3 .0 .1 .2 .3	X5	X5 0: n.c. 1: n.c. 2: n.c. 3: FE
	X2	.0 .1 .2 .3 .0 .1 .2 .3 .0 .1 .2 .3 .0 .1 .2 .3	X6	X6 0: n.c. 1: n.c. 2: n.c. 3: FE
	X3	.0 .1 .2 .3 .0 .1 .2 .3 .0 .1 .2 .3 .0 .1 .2 .3	X7	X7 0: n.c. 1: n.c. 2: n.c. 3: FE
	X4	.0 .1 .2 .3 .0 .1 .2 .3 .0 .1 .2 .3 .0 .1 .2 .3	X8	X8 0: n.c. 1: n.c. 2: n.c. 3: FE

FE = functional earth

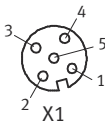
n.c. = unassigned (not connected)

1) Unswitched voltage UVAL can be used to supply intelligent load systems (auxiliary supply)

2) All output voltages are likewise derived from the internal contact rail UVAL

Tab. 24: Pin allocation with TS manifold block

3.3.3 Pin allocation with pneumatic interface VABA-S6-1-X...-F2-CB

CPX-FVDA-P2 in pneumatic interface VABA-S6-1-X...-F2-CB	
Pin allocation external channel CH2 on M12 bushing	
	M12 bushing 1: 0 V CH2 ¹⁾ 2: +24 V CH2 ¹⁾ 3: F-DO(M) CH2 ²⁾ 4: F-DO(P) CH2 ²⁾ 5: FE
FE = functional earth	

1) Unswitched voltage UVAL usable for supply of intelligent load systems (auxiliary supply)

2) All output voltages are likewise derived from the internal contact rail UVAL.

Tab. 25: CPX-FVDA-P2 in pneumatic interface VABA-S6-1-X...-F2-CB

3.4 Setting the PROFIsafe address

The output module is controlled by an F-Host via PROFIsafe and needs a PROFIsafe address for unique identification. The PROFIsafe address is defined via configuration software and is set directly at the output module using binary coding with the 10-way DIL switch. Both settings must match.

The 10-way DIL switch is located directly on the electronics module and can be set while the manifold block or the pneumatic interface is not assembled

➔ 2.1.1 Design of the output module CPX-FVDA-P2.

PROFIsafe addresses in the range from 1 to 1023 are permissible.

The DIL switch setting is evaluated during the run-up phase of the firmware. For that reason, the output module must be restarted by switching on the load voltage U_{VAL} again in order to accept the changed address. Information about address allocation via configuration software can be found in the relevant software documentation.

NOTICE

Incorrect handling can cause damage to the electronics modules.

- Never pull/push the electronics module from/into the interlinking block when the power is switched on.

Electronics modules include electrostatically sensitive devices.

- Observe the handling specifications for electrostatically sensitive devices.
- Discharge static electricity from your body before assembling or disassembling modules to protect the modules.

NOTICE

The DIL switch is a mechanically sensitive component due to its size.

- To set it, use an appropriate, small, blunt tool (e.g. watchmaker's screwdriver) and proceed very carefully.

NOTICE

This PROFIsafe module accepts every PROFIsafe host address and thus fulfils the requirements for PROFIsafe address type 1.

The factory preset is PROFIsafe address 0. The following image → Fig. 25 shows the 10-way DIL switch with an example of an address.

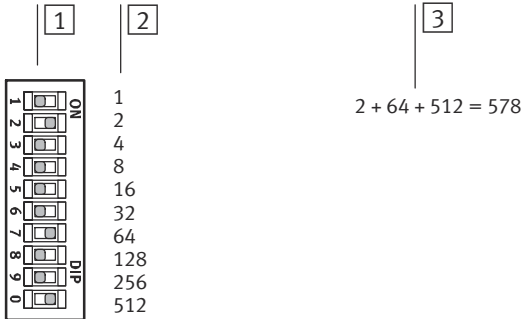


Fig. 25: 10-way DIL switch for setting the PROFIsafe address – binary coded

- 1 Addressing example – PROFIsafe address 578
- 2 Decimal value when set to ON
- 3 Calculation example – DIL switch element 2, 7 and 0 (10) set to ON

NOTICE

Before commissioning the automated system, ensure that the PROFIsafe address has been set according to the installation planning.

To set the PROFIsafe address on the DIL switch:

NOTICE

Incorrect handling can cause damage to the electronics modules.

- Switch off the supply voltages before assembly or installation.
- Do not switch on the electrical power supplies before the product has been fully assembled and all installation work is complete.

1. Switch off the power supplies of the CPX terminal.
2. Remove the assembled manifold block → 3.5.1 Disassembling the electronics module.
3. Carefully set the desired PROFIsafe address on the DIL switch by using a suitable tool, e.g. a small watchmaker's screwdriver.



During assembly, observe the information in → 3.5 Disassembling and assembling the electronics module (fitting without distortion, clean connection surfaces, etc.).

4. Reassemble the manifold block. Tightening torque → 3.5.2 Installing the electronics module.

3.5 Disassembling and assembling the electronics module

NOTICE

Incorrect handling can damage the electronics module.

- Never pull or push the electronics module from or into the interlinking block or pneumatic interface when the power is switched on.

Electronics modules include electrostatically sensitive devices.

- Observe the handling specifications for electrostatically sensitive devices.
- Discharge static electricity from your body before assembling or disassembling modules to protect the modules.

-
- Switch off the supply voltages before assembly or installation.
 - Do not switch on the electrical supply voltages before all assembly and installation work is complete.
-



To avoid errors in assembly, both the interlinking block CPX-M-GE-EV-FVO and the electronics module CPX-FVDA-P2 are mechanically coded. The coding prevents a different module from being plugged into the interlinking block or the module from being plugged into an incorrect interlinking block.

The plugs connected to the manifold block on the CPX-M-AB-4-M12X2-5POL or cables on the CPX-AB-8-KL-4POL can remain attached while disassembling the manifold block.



Before a CPX terminal can be extended or converted, it must first be unscrewed and disassembled. Information can be found in the CPX system description.

CPX terminals are supplied from the factory completely assembled.

It may be necessary to disassemble and assemble the manifold blocks for the following reasons:






- Replacing the connection equipment

It may be necessary to disassemble and assemble the electronics module for the following reasons:

- Changing the DIL switch setting (PROFIsafe address)
- Replacing a defective electronics module

3.5.1 Disassembling the electronics module

To disassemble the electronics module → 2.1.1 Design of the output module CPX-FVDA-P2:

1. Switch off the operating and load voltage supplies.
2. Unscrew the screws  and carefully lift off the manifold block  or  (→ Fig. 3) or the cover of the pneumatic interface  (→ Fig. 4).
3. If necessary: pull the electronics module  carefully off the busbars or contacts in the pneumatic interface or out of the manifold block.

3.5.2 Installing the electronics module

NOTICE

Incorrect handling can damage the electronics module.

- Never push the electronics module into the interlinking block or the pneumatic interface when powered.

NOTICE

- Ensure that the interlinking block (➔ Fig. 3) or the housing of the pneumatic interface (➔ Fig. 4) is clean and free of foreign matter, especially on and near the contacts and busbars.
- Check the seals for damage in order to comply with the degree of protection IP65/IP67.
- Make sure connecting surfaces are clean in order to optimise the sealing effect and prevent contact errors.

NOTICE

- Use only the supplied screws with metric threads for the metal interlinking block CPX-M-GE-EV-FVO.
- Use only the supplied self-tapping screws for the pneumatic interface.
- To avoid damaging the threads, ensure the screws are inserted precisely and use existing threads.
- Tighten the screws using a hand-held screwdriver only.
- Make sure threaded fittings are free of any distortion or mechanical tension.
- Observe the specified tightening torques.
- Observe the assembly instructions in the documentation that comes with the products for modules and components ordered at a later date.

Prior to mounting, make sure the PROFIsafe address on the electronics module is set correctly ➔ 3.4 Setting the PROFIsafe address.

For mounting the electronics module and manifold block ➔ 3.4 Setting the PROFIsafe address:

1. Switch off the operating and load voltage supplies.
2. Align the electronics module [3] correctly and press it carefully into the interlinking block [6] (➔ Fig. 3) or into the housing [6] (➔ Fig. 4).
3. Check the seal and the sealing surfaces, align the manifold block [1] or [2] or the cover of the pneumatic interface and place it on the electronics module [3].
4. Set the screws [10] so that the existing threads can be used. Tighten the screws crosswise by hand. Tightening torque: 0.9 ... 1.1 Nm.

4 Commissioning

4.1 General information

The following software versions as well as a CPX bus node with a corresponding revision code are required to operate the output module:

Device master file	Bus node Revision code ¹⁾	Control software (PLC software version)
<ul style="list-style-type: none"> – PROFIBUS: from CPX_059E.gsd 2013-02-04 – PROFINET: from GSDML-V2.25- Festo-CPX-20121203.xml 2012-12-03 	<ul style="list-style-type: none"> – CPX-FB13 from rev. 30 – CPX-FB33 from rev. 21 – CPX-M-FB34 from rev. 21 – CPX-M-FB35 from rev. 21 – CPX-FB43 from rev. 50 – CPX-M-FB44 from rev. 50 – CPX-M-FB45 from rev. 50 	Manufacturer: Siemens <ul style="list-style-type: none"> – STEP 7: from version 5.4 with service pack SP5 or higher – S7 Distributed Safety: from version 5.4 with service pack SP4 or higher
		Manufacturer: Phoenix Contact <ul style="list-style-type: none"> – AUTOMATIONWORX Software Suite 2009 with service pack SP3 or higher – SafetyProg 2.4 (build 356) or higher

1) Revision code → bus node rating plate

Tab. 26: Required versions



The output module can only be clearly displayed in a pneumatic interface (e.g. in the TIA Portal) in conjunction with the bus node CPX-FB33 or CPX-M-FB34/35 revision 35 or higher.

The configuration depends on the control system. The basic approach and required configuration data are presented in the following pages.

4.1.1 Device master file (GSD/GSDML)

In combination with the output module CPX-FVDA-P2, you need a current device master file GSD/GSDML for configuration and programming.

Reference source

Current versions of the GSDML/GSD files for CPX terminals can be found on the Festo websites

→ www.festo.com/sp.

Import the GSDML/GSD file into the project of the configuration program. After import, you can select the CPX terminal with the output module CPX-FVDA-P2 in the configuration program and edit it (e.g. set F-parameter).



Configuration, parameterisation and commissioning of the CPX terminal with CPX-FVDA-P2 depend on the control system.

Detailed information can be found in the documentation of the control system and in the online help of the configuration software.

Module identifier

Every module has a separate identifier (module identifier).

Add the module identifiers – from left to right, corresponding to the physical order as installed in the CPX terminal – to your configuration program.

Module (order code)	Module identifier ¹⁾	Assigned I/O bytes ²⁾
CPX-FVDA-P2	FVDO-P2	6 O bytes + 6 I bytes

1) Module identifier in the operator unit or in the hardware configuration of the programming software

2) 4 bytes each are used exclusively for PROFI-safe communication

Tab. 27: Module identifier of the output module CPX-FVDA-P2

4.2 Preparing for commissioning

1. Ensure that the CPX terminal is assembled correctly → CPX system description.
2. Check the wiring (connecting cables, contact assignment)
→ 3.3.1 Pin allocation with M12 manifold block.
3. Disassemble the manifold block of the output module or the cover of the pneumatic interface
→ 3.5.1 Disassembling the electronics module.
4. Check that the module functions perfectly.
5. Set the PROFI-safe address with the DIL switch on the module and assemble the manifold block
→ 3.5.2 Installing the electronics module.

4.3 Commissioning steps

NOTICE

Detailed information about configuring, programming and commissioning in combination with the relevant F-Host can be found in the F-Host manufacturer's documentation.

Information about configuring and commissioning the CPX terminal can be found in the description of the CPX bus node.

1. Integrate the GSDML/GSD file into the configuration software of the F-Host
→ CPX bus node description.

2. Configure and parameterise the output module with the F-Host configuration software.
 - Add the CPX terminal to the configuration
 - ➔ Description of the corresponding CPX bus node
 - Add the output module to the CPX configuration
 - Set the start address for the inputs and outputs
 - Set the PROFIsafe parameters of the output module
 - ➔ 4.4 Setting the PROFIsafe parameters
 - If required, set the default parameters of the output module
 - ➔ 4.5 Setting the CPX module parameters and
 - ➔ 4.5.1 CPX module parameters for CPX-FVDA-P2 in detail
3. Create and load the safety program.
4. Commission the CPX terminal on the fieldbus (PROFIBUS or PROFINET I/O) and test the characteristics in a trial run.

4.4 Setting the PROFIsafe parameters

PROFIsafe-specific parameters can be viewed or set with the configuration device of the F-Host (e.g. HW Config). They are marked in accordance with the PROFIsafe profile in the GSDML/GSD file. They can only be accessed by entering the password in the F-Host.

PROFIsafe parameters	General description	Applies to CPX-FVDA-P2:	Value
F_CHECK_IPAR	Determines whether the individual device parameters (CPX module parameters) are to be taken into account when checking the consistency (CRC calculation) of the F-user data telegram.	CPX-FVDA-P2 does not make individual device parameters available.	No check (cannot be changed)
F_CHECK_SEQNR	Determines whether the sequence number is to be taken into account when checking the consistency (CRC calculation) of the F-user data telegram.	CPX-FVDA-P2 supports only the V2 mode. The sequence number is always included in the CRC2 test in the V2 mode.	Check (cannot be altered)
F_SIL	The expected safety integrity level (SIL) of the module.	CPX-FVDA-P2 supports requirements up to SIL 3.	– SIL 1 – SIL 2 – SIL 3
F_CRC_LENGTH	Communicates the expected length of CRC2 key to the F-Host in the safety telegram.	This parameter cannot be changed with CPX-FVDA-P2 since the CRC2 key always occupies 3 bytes.	3 CRC bytes (cannot be changed)

PROFIsafe parameters	General description	Applies to CPX-FVDA-P2:	Value
F_BLOCK_ID	Shows if the data record for the F_iPar_CRC value has been extended by 4 bytes. The parameter F_Block_ID has a value of 1 if the parameter F_iPar_CRC is present, otherwise it has a value of 0.	CPX-FVDA-P2 does not make individual device parameters available.	0 (cannot be changed)
F_PAR_VERSION	Displays the PROFIsafe mode of operation of the device. The setting 1 corresponds to PROFIsafe V2 MODE.	CPX-FVDA-P2 works exclusively in PROFIsafe V2 MODE.	1 (cannot be changed)
F_SOURCE_ADD (PROFIsafe source address)	Unique PROFIsafe source address of the F-Host.	Unique PROFIsafe source address of the F-Host.	Specified by the F-Host
F_DEST-ADD (PROFIsafe target address)	Unique PROFIsafe target address of the F-Device within the PROFIsafe network. The address set via the configuration software must match the PROFIsafe address set on the output module with the DIL switch.	CPX-FVDA-P2 compares both settings in order to check the authenticity of the connection → 3.4 Setting the PROFIsafe address	1 ... 1023 (0 is not permitted)
F_WD_Time	Time period (watchdog time) within which a valid current safety telegram must arrive from the F-Host. Otherwise the F-Device switches into a safe state.	The time period must be short enough that the system can react fast enough to communication failures or malfunctions. On the other hand, the time period must be long enough to tolerate typical delays in transmission. The cycle time for calling the safety program must be shorter than the time period set here.	50 ... 65535 [ms]
F_iPAR_CRC	CRC via the individual device parameters (iParameters).	CPX-FVDA-P2 does not make individual device parameters available.	0 (cannot be changed)

Tab. 28: PROFIsafe parameters

4.5 Setting the CPX module parameters

The characteristics of the output module CPX-FVDA-P2 can be parameterised. Parameters that influence diagnostic or error messages refer only to the diagnostic system of CPX and not to the diagnostic channels of the safety protocol.



Further information on parameterisation can be found in the CPX system description for CPX-SYS-... or the description of the bus node.

The following table provides an overview of the existing CPX module parameters of the output module.

Overview of module parameters for CPX-FVDA-P2			
Function number ¹⁾	Bit	Module parameters	Default
4828 + m * 64 + 0	0, 1	reserved	–
	2	Supply voltage monitoring U _{VAL}	active
	3 ... 7	reserved	–
4828 + m * 64 + 1 ... 5	0 ... 7	reserved	–
4828 + m * 64 + 6	0	General diagnostics – output channel 0	active
	1	General diagnostics – output channel 1	active
	2	General diagnostics – output channel 2	active
	3	reserved	–
	4	General diagnostics – module	active
	5	General diagnostics – fail-safe mode protocol	active
	6, 7	reserved	–
4828 + m * 64 + 7	0	Wire break monitoring – output channel 0	inactive
	1	Wire break monitoring – output channel 1	inactive
	2	Wire break monitoring – output channel 2	inactive
	3 ... 7	reserved	–
4828 + m * 64 + 8 ... 21	0 ... 7	reserved for PROFIsafe	–
4828 + m * 64 + 22	0 ... 7	Setting of the DIL switch 0 ... 7	0 ¹⁾
4828 + m * 64 + 23	0, 1	Setting of the DIL switch 8, 9	

1) Parameters read-only via operator unit and command interpreter (CI).

Tab. 29: Overview - module parameters for CPX-FVDA-P2

4.5.1 CPX module parameters for CPX-FVDA-P2 in detail

Module parameter: supply voltage monitoring U _{VAL}		Operator unit
Function no.	4828 + m * 64 + 0 m = module number (0 ... 47)	
Description	This parameter influences the diagnostic behaviour of the module when detecting undervoltage and overvoltage on U _{VAL} (➔ 8.1 Technical data of the output module CPX-FVDA-P2, supply voltage monitoring). The parameter is used to activate or deactivate the diagnostic message when undervoltage or overvoltage is detected. Active diagnostic message when undervoltage and overvoltage is detected at U _{VAL} causes the following. The error is: <ul style="list-style-type: none">– Sent to the CPX bus node– Displayed via the module error LED.	
Bit	Diagnostic message – supply voltage monitoring Bit 0, 1 Reserved Bit 2 Supply voltage monitoring U _{VAL} Bit 3 ... 7 Reserved	[Monitor Vout/Vval]
Values	0 = inactive 1 = active (default)	[Inactive] [Active]
Comment	The monitoring function itself is not affected and is always active. It makes sense to switch off the diagnostics in the case of undervoltage detection U _{VAL} if another module that is connected to the switched voltage (e.g. a pneumatic interface) features its own undervoltage detection function and can issue a corresponding error message.	

Tab. 30: Supply voltage monitoring U_{VAL}

Module parameter: general diagnostics		Operator unit
Function no.	$4828 + m * 64 + 6$ $m = \text{module number (0 ... 47)}$	
Description	<p>This parameter influences the module's general diagnostic behaviour. It determines whether channel, module or protocol-specific error messages are to be suppressed or reported.</p> <p>Active diagnostics cause the following. The relevant error is:</p> <ul style="list-style-type: none"> – Sent to the CPX bus node – Displayed via the module error LED. Note the exceptions specified under Comment. 	
Bit	<p>General diagnostics</p> <p>Bit 0: Output channel 0</p> <p>Bit 1: Output channel 1</p> <p>Bit 2: Output channel 2</p> <p>Bit 3: Reserved</p> <p>Bit 4: Module</p> <p>Bit 5: Failsafe protocol</p> <p>Bit 6, 7: Reserved</p>	<p>[General diagnosis]</p> <p>[Channel 0]</p> <p>[Channel 1]</p> <p>[Channel 2]</p> <p>[Module]</p> <p>[Failsafe protocol]</p>
Values	<p>0 = inactive – suppress error message</p> <p>1 = active – report error (default)</p>	<p>[Inactive]</p> <p>[Active]</p>
Comment	<p>Exceptions:</p> <ul style="list-style-type: none"> – Error messages regarding wire breaks cannot be influenced with this parameter. However, the wire break monitoring function can be activated or deactivated with the wire break monitoring parameter (➔ Tab. 32 Wire break monitoring (channel-specific)). – In the case of module-specific error messages, diagnostic messages from the failsafe protocol are not suppressed. 	

Tab. 31: General diagnostics

Module parameter: wire break monitoring		Operator unit
Function no.	$4828 + m * 64 + 7$ m = module number (0 ... 47)	
Description	Determines whether the respective output channel should be monitored for wire break. It is necessary to deactivate the wire break monitoring function if: <ul style="list-style-type: none"> – A load smaller than the specified minimum load is to be switched or – The electrical signal is guided additionally through external relays which themselves disconnect the circuit 	
Bit	Monitoring of wire break Bit 0 Output channel 0 Bit 1 Output channel 1 Bit 2 Output channel 2 Bit 3 ... 7 Reserved	[Monitor wire fracture] [Channel 0] [Channel 1] [Channel 2]
Values	0 = inactive 1 = active Defaults: – Output channel 0: inactive – Output channel 1: inactive – Output channel 2: inactive	[Inactive] [Active]
Comment	Wire break monitoring is only possible when the output channel is switched on. If there is a wire break during active monitoring, the error LED of the respective output channel flashes. Any pending diagnostic messages are reset if the monitoring function is switched off. A wire break diagnosis does not switch off the output channel.	

Tab. 32: Wire break monitoring (channel-specific)

Module parameter: DIL switch setting								Operator unit	
Function no.	4828 + m * 64 + 22 4828 + m * 64 + 23 m = module number (0 ... 47)								
Description	Indicates the setting of the PROFIsafe address selector switch on the module. In addition to the PROFIsafe parameter F_DEST_ADD (➔ 4.4 Setting the PROFIsafe parameters), the setting of the address selector switch can be read out via CPX parameters for diagnostic purposes – e.g. with the operator unit (read only).								
Bit	Low byte (4828 + m * 64 + 22) Bit 0: SW 0 Bit 1: SW 1 ... Bit 7: SW 7 High byte 4828 + m * 64 + 23) Bit 0: SW 8 Bit 1: SW 9 Bit 2 ... 7: reserved or 0							[PROFIsafe addr.]	
Values	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	
	SW 7	SW 6	SW 5	SW 4	SW 3	SW 2	SW 1	SW 0	Low byte
	0	0	0	0	0	0	SW 9	SW 8	High byte
	0: switch element is set to OFF 1: switch element is set to ON							[0] [1]	
Comment	This parameter can only be changed by changing the DIL switch setting (read only).								

Tab. 33: DIL switch setting

4.5.2 Parameterisation and signal display with the operator unit CPX-MMI-1

The universal operator unit CPX-MMI-1 offers convenient functions that support you during the commissioning process. The operator unit enables you to view the CPX module parameters and change them if necessary. The PROFIsafe parameters of the module cannot be influenced using the operator unit. This is for technical safety reasons.



General information on the operator unit and on commissioning the CPX terminal using the operator unit can be found in the description P.BE-CPX-MMI-1...

The following section requires knowledge of the basic functions of the operator unit.

The output module name [FVDO-P2 Output Module Safety] is displayed in the main menu of the operator unit. The short text [FVDO-P2] is displayed in the header of the operator unit. An example is shown in the diagram below:

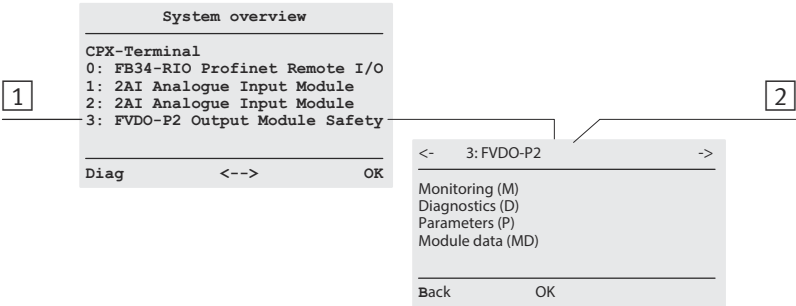


Fig. 26: Module identifier of the output module CPX-FVDA-P2 on the operator unit

- 1 Module identifier in the main menu (here as module 3)
- 2 Module identifier in the header of the system submenu for a module

The following image shows an example of the special displays for the output module CPX-FVDA-P2.



Note that the [Forcing], [Fail safe] and [Idle mode] menus are not supported for the output module CPX-FVDA-P2.

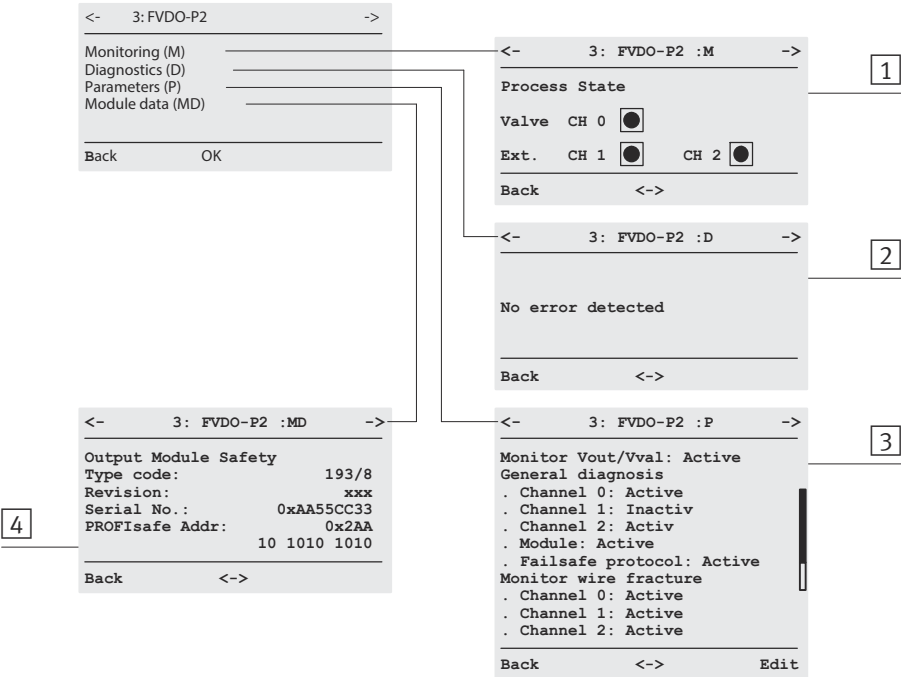


Fig. 27: Special displays for CPX-FVDA-P2 on the operator unit

- | | |
|--------------------------|--|
| 1 Monitoring (M) | 3 Parameters (P) – basic representation |
| 2 Diagnostics (D) | 4 Module data (MD) |

When the [Monitoring/Forcing (M)] command is called up, the statuses of the 3 output channels are displayed.

4.6 Configuration with Siemens STEP 7 (example)

The configuration examples shown in this chapter are based on the use of a Siemens PLC and the Siemens STEP_7 version 5.4 configuration and programming software with Distributed Safety version 5.4. PROFINET is used as a bus system. The following section requires familiarity with the operation of the STEP 7 software.



Please first read the description of your CPX bus node to learn the basic procedure for configuring a CPX terminal. The information in the following sections refers exclusively to the output module CPX-FVDA-P2.

After you have installed the GSDML/GSD file and added the CPX terminal to the project's network using the configuration software (HW Config), you can add the output module to the configuration table of the CPX terminal ➔ CPX bus node description.

You can then set the start addresses for inputs and outputs as well as the PROFIsafe parameters and the standard module parameters.

- In the configuration table, double-click the row of the output module CPX-FVDA-P2. The “Properties – FVDA-P2” dialogue window is displayed.
- Now set the desired start addresses of the inputs and outputs in the [Addresses] tab of the dialogue window → Fig. 28.

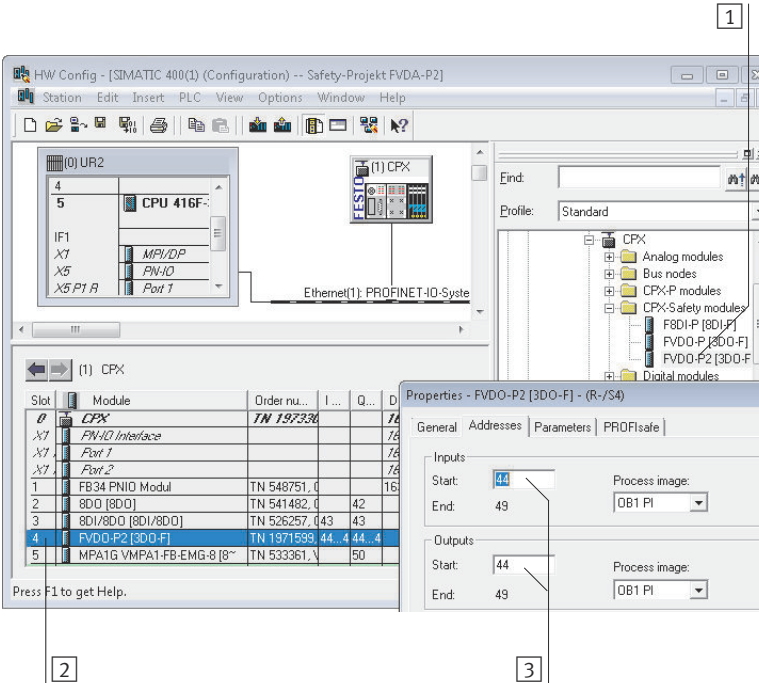


Fig. 28: CPX terminal configuration with Siemens STEP 7 – HW Config

- 1 Output module CPX-FVDA-P2 in the hardware catalogue
- 2 Output module CPX-FVDA-P2 in the configuration table of the CPX terminal
- 3 Start addresses of the output module for inputs and outputs (in this case, 44)

The third tab of the “Properties – FVDA-P2” dialogue window offers access to the standard parameters of the output module.

i Please note that not all of the PROFIsafe parameters that are represented here are relevant for the output module. You can find detailed information about the individual parameters in → 4.5.1 CPX module parameters for CPX-FVDA-P2 in detail.

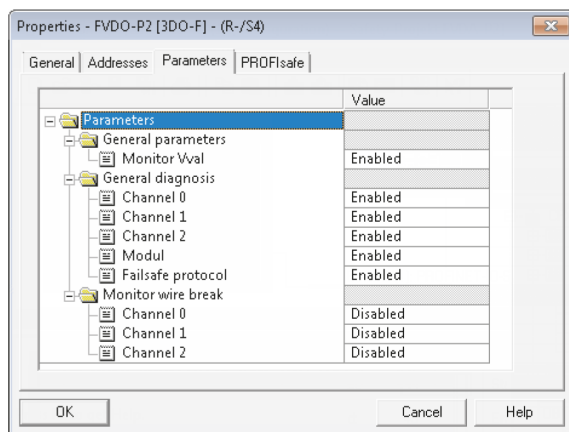


Fig. 29: Default parameters of the output module CPX-FVDA-P2

The fourth tab of the “Properties – FVDA-P2” dialogue window offers access to the PROFIsafe parameters of the output module.

- Set the correct PROFIsafe target address under [F_Dest_Add] (➔ Fig. 30). The setting must match the DIL switch setting on the module (➔ Fig. 25).



You can find detailed information about the individual parameters in
➔ 4.4 Setting the PROFIsafe parameters.

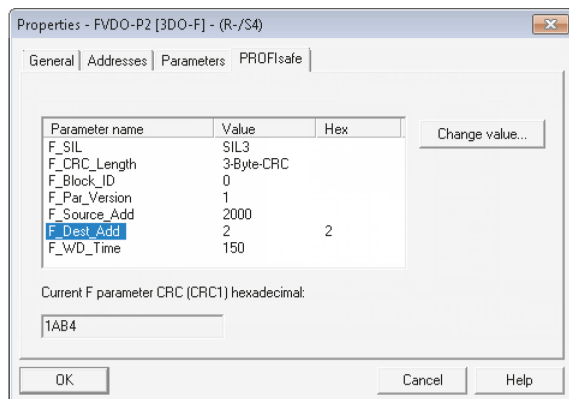


Fig. 30: PROFIsafe parameters

4.6.1 Addressing example

Addressing example: CPX terminal with VTSA pneumatics

Addresses used as of input/output byte 42:

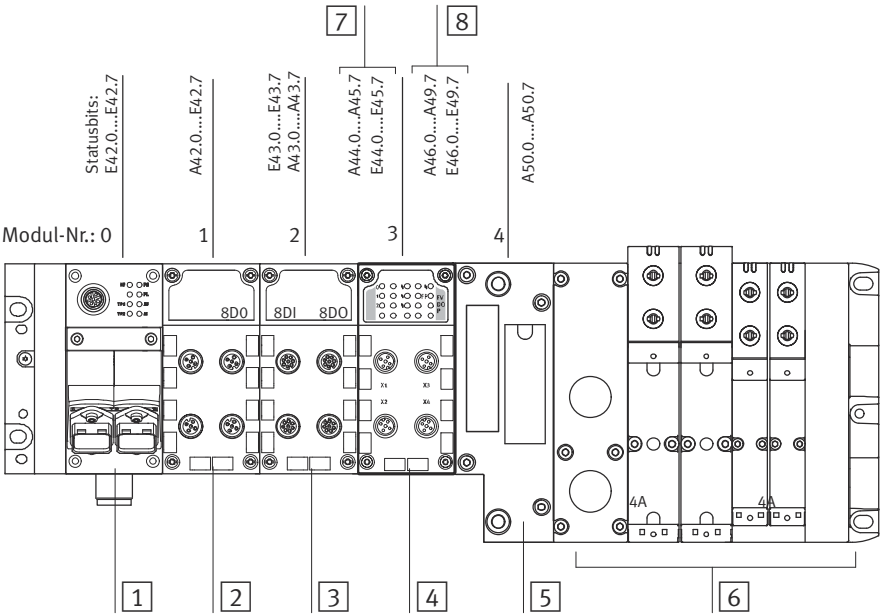


Fig. 31: Addressing example

- | | |
|--|---|
| 1 Bus node CPX-M-FB34 | 6 VTSA pneumatics |
| 2 Output module with 8 digital outputs | 7 F-user data (2 bytes for inputs and 2 bytes for outputs) |
| 3 Input/output module with 8 digital inputs and 8 digital outputs | 8 Unusable range (1 byte each for status/control and 3 bytes for CRC) |
| 4 Output module CPX-FVDA-P2 (6 bytes for inputs and 6 bytes for outputs) | |
| 5 Pneumatic interface (DIL switch set to 8 digital outputs) | |

Module no.	Module	I address	O address
0	Bus node CPX-M-FB34 CPX-M-FB34 PNIO module [status]	42	–
1	Digital output module CPX-8DA [8DO]	–	42
2	Digital input/output module CPX-8DE-8DA [8DI/8DO]	43	43
3	Output module CPX-FVDA-P2 CPX-FVDA-P2	44 ... 49	44 ... 49

Module no.	Module	I address	O address
4	VTSA: pneumatic interface ¹⁾ VABA-S6-1-X2 [8DO]	–	50
–	VTSA: pneumatics module VABV-S4-1-T2...	–	–
–	VTSA: pneumatics module VABV-S4-2-T2...	–	–

1) The number of allocated output addresses is specified using the DIL switch (in this case, 8DO)

Tab. 34: Input and output addresses for the example (➔ Fig. 31)

5 Operation

5.1 LED status indication

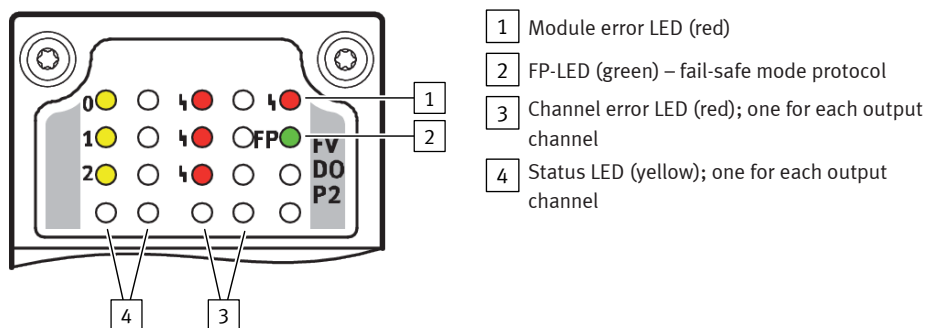


Fig. 32: LED indicators of the output module
CPX-FVDA-P2

The following LEDs are on in the normal operating status:

- FP LED –fail-safe mode protocol (green)
- Status LED (yellow) of the active output channels

The status LEDs of inactive output channels and the module and channel error LEDs are not on.

NOTICE

The LED display of the module was not designed for safety purposes.













- Please note that these LEDs should not be used for evaluation during safety-related activities.



Detailed information on error characteristics can be found in

- ➔ 6.2 Possible error messages of the output module CPX-FVDA-P2 and
- ➔ 6.3.2 Behaviour in case of error.









5.1.1 Behaviour during the switch-on phase (start-up phase)

No.	Status LED	FP LED	Channel error LED	Module error LED	I/O image	Event/status
1a ¹⁾				 500 ms	0 ¹⁾	Start-up – switching on the operating voltage supply $U_{EL/SEN}$
1b ¹⁾			 500 ms		0 ¹⁾	Start-up – switching on the load voltage supply for valves U_{VAL}
2					0	Waiting for safety parameters

1) The sequence depends on the order in which the operating and load voltage supply are switched on. If both power supplies are switched on simultaneously, 1a and 1b occur together.

Tab. 35: Behaviour during the switch-on phase

5.1.2 Normal operating status

No.	Status LED	FP LED	Channel error LED	Module error LED	I/O image	Event/status
3					1 ¹⁾	Output channel is switched on
4 ¹⁾					0 ¹⁾	Output channel is switched off

1) Refers to the output channel to which the respective status LED is assigned.

Tab. 36: Normal operating status

6 Diagnostics and error handling

6.1 Overview of diagnostics options

The CPX terminal offers extensive options for diagnostics and error handling. The output module supports the following options for diagnostics and error handling:

Diagnostics option		Brief description	Reference
On-site diagnostics	LED	The module LEDs display output channel and module errors.	➔ 6.3 Diagnostics using LEDs
	Operator unit (MMI)	Diagnostic information from the module can be displayed on the operator unit in a convenient and menu-driven manner.	➔ 6.4.1 Diagnostics with the operator unit CPX-MMI and operator unit description

Diagnostics option		Brief description	Reference
Diagnostics via bus node	System status query (status bit query)	8 status bits of the CPX terminal display common diagnostics messages (global error messages).	➔ 6.2 Possible error messages of the output module CPX-FVDA-P2 as well as CPX system description and description for the CPX bus node
	I/O diagnostics interface	CPX-FVDA-P2 reports specific malfunctions as error numbers to the CPX bus node. This data can be read via the I/O diagnostics interface.	➔ CPX system description
	Fieldbus-specific diagnostics	Depends on the bus node (e.g. DPV1)	➔ CPX bus node description

Tab. 37: Diagnostics options

Specific errors of the output module CPX-FVDA-P2 are reported or suppressed dependent on the module parameterisation. Reported errors can be evaluated, depending on the bus protocol used. The errors are indicated on-site via the error LEDs and, if necessary, can be evaluated with the operator unit.



Information about the diagnostics options for the complete CPX terminal or all modules can be found in the CPX system description or in the description of the CPX bus node employed.

6.2 Possible error messages of the output module CPX-FVDA-P2

Error no.	Display on the operator unit	Description	Error handling
2 ¹⁾	[Short circuit]	Short circuit/overload at output.	<ul style="list-style-type: none"> – Eliminate short circuit. – Acknowledge and reintegrate the module or output channel.
3 ²⁾	[Wire fracture/idling current I/O]	Wire break.	<ul style="list-style-type: none"> – Check and, if required, replace the cables and connected actuators.
5 ³⁾	[Undervoltage in power supply]	Undervoltage in supply voltage U_{VAL} .	<ul style="list-style-type: none"> – Eliminate undervoltage. – Acknowledge and reintegrate the module.
61 ³⁾	[Overvoltage in power supply]	Overvoltage in supply voltage U_{VAL} .	<ul style="list-style-type: none"> – Eliminate overvoltage. – Acknowledge and reintegrate the module.

Error no.	Display on the operator unit	Description	Error handling
64; 65 ³⁾	[F_DEST_ADD mismatch]	The PROFIsafe address set by the DIL switch does not correlate with the setting on the PROFIsafe master (F_DEST_ADD).	<ul style="list-style-type: none"> – Check the set address or F_DEST_ADD parameter. Correct address or send new parameters.
66 ³⁾	[F-Communication fault]	Error in safe communication.	<ul style="list-style-type: none"> – Check F-Host. – Acknowledge and reintegrate the module.
67 ³⁾	[F-Communication timeout]	Timeout during PROFIsafe transmission. The chronological sequence of the PROFIsafe communication is malfunctioning.	<ul style="list-style-type: none"> – Check program in F-Host. – Check communication paths. – Check timeout (parameter F_WD_Time). – Acknowledge and reintegrate the module.
68 ¹⁾	[Leakage current]	Cross-circuit error (shunt error) at output.	<ul style="list-style-type: none"> – Eliminate cross circuit. – Acknowledge and reintegrate the module or output channel.
69; 72 ³⁾	[F-Parameter fault]	Error in safe parameterisation (safety parameterisation invalid). PROFIsafe communication cannot be established.	<ul style="list-style-type: none"> – Check PROFIsafe parameters. – Send corrected parameters.
80	[Function failure]	Switching frequency is too high.	<ul style="list-style-type: none"> – Reduce the switching frequency.
145 ³⁾	[Built-in self test failed]	Self-test error; module has detected an error during the self-test.	<ul style="list-style-type: none"> – Switch on the supply voltage U_{VAL} again. This restarts the module. – Connect and earth professionally in accordance with EN 60204-1 and EN 50310.

1) If "channel-wise passivation" is active, only the affected output channel is passivated. Otherwise, footnote 3) applies.

2) Does not lead to a safety switch-off.

3) All output channels of the module are passivated (CH0 ... CH2 are switched off).

Tab. 38: Possible error messages



When using PROFIBUS, all error messages without a standardised error type are mapped to error type 9.

When using PROFINET, error message 69 is transmitted as diagnostic message 72 and error message 65 is transmitted as diagnostic message 64.

6.3 Diagnostics using LEDs

The following LEDs for on-site diagnostics are located under the transparent covering of the module:

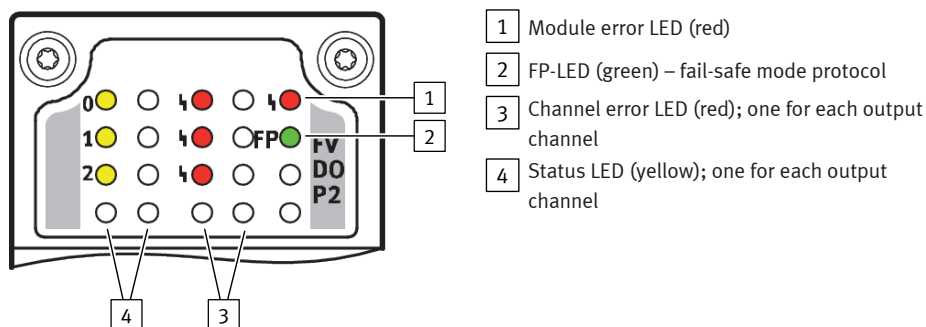


Fig. 33: LED indicators of the output module
CPX-FVDA-P2



In the run-up phase, error LEDs **1** and **3** are on for approx. 500 ms.

The following LEDs are on in the normal operating status:





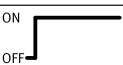
- FP LED –failsafe protocol (green) **2**
- Status LED (yellow) **4** of the active output channels

The status LEDs of inactive output channels and the module **1** and channel **3** error LEDs are not on.

NOTICE






The LED display of the module was not designed for safety purposes.

- Please note that these LEDs should not be used for evaluation during safety-related activities.





Module error LED			
LED (red)	Sequence	Status	Significance/error handling
 LED not on	ON  OFF	error-free operation	none
 LED flashes	error-specific	Self-test error or internal communication problem	To delete the error, switch the operating voltage off and on again (Power Off/ On). ¹⁾
 LED on	ON  OFF	Module error (e.g. module supply undervoltage, missing safety parameterisation or error in safe communication)	Eliminate undervoltage or correct parameterisation.

1) If self-test errors persist, replace the module!









Tab. 39: Module error LED

Channel error LED			
LED (red)	Sequence	Status	Significance/error handling
 LED not on	ON  OFF	error-free operation	none
 LED flashes	error-specific	Wire break	Replace the affected cable
 LED on	ON  OFF	Cross circuit at output or short circuit/overload error at output (depends on error number)	Eliminate the cause

Tab. 40: Channel error LED

Status LED			
LED (yellow)	Sequence	Status	Significance/error handling
 LED not on	ON  OFF	Output channel inactive (logic 0)	The respective load voltage supply is switched off.
 LED on	ON  OFF	Output channel active (logic 1)	The respective load voltage supply is switched on.

Tab. 41: Status LED

FP LED (FP for fail-safe mode protocol)			
LED (green)	Sequence	Status	Significance/error handling
 LED flashes twice	ON  OFF	– Waiting for safety parameters	– Module waits for parameterisation by the F-Host
 LED flashes slowly	ON  OFF	– PROFIsafe address error or – CRC error PROFIsafe parameter	– The set PROFIsafe address does not correlate with safety parameterisation. – Safety parameterisation invalid. PROFIsafe communication cannot be established.
 LED flashes quickly	ON  OFF	– Operator acknowledge possible	– PROFIsafe: OA req
 LED on	ON  OFF	– Fail-safe mode protocol active	– Module communicates with an F-Host via a PROFIsafe protocol.

Tab. 42: FP LED

6.3.1 Error handling and parameterisation

The following diagram illustrates the error handling process for the output module. Using the appropriate module parameters (which are represented in the diagram as switches), you can suppress the further reporting and display of the errors as required (description of the parameters → 4.5.1 CPX module parameters for CPX-FVDA-P2 in detail).

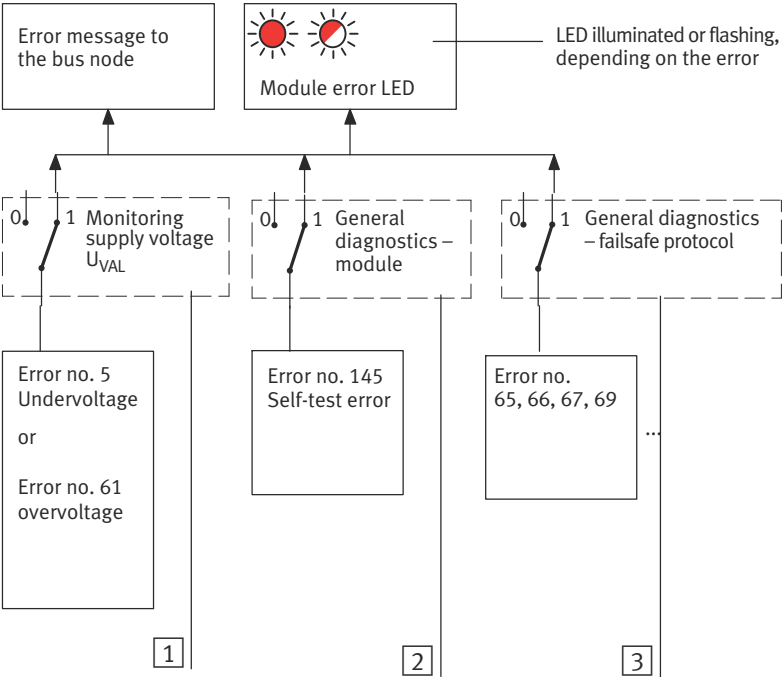


Fig. 34: Principle of error handling and parameterisation – part 1

- 1

“Monitoring undervoltage – valves” parameter
- 2

“General diagnostics – module” parameter
- 3

“General diagnostics – failsafe protocol” parameter

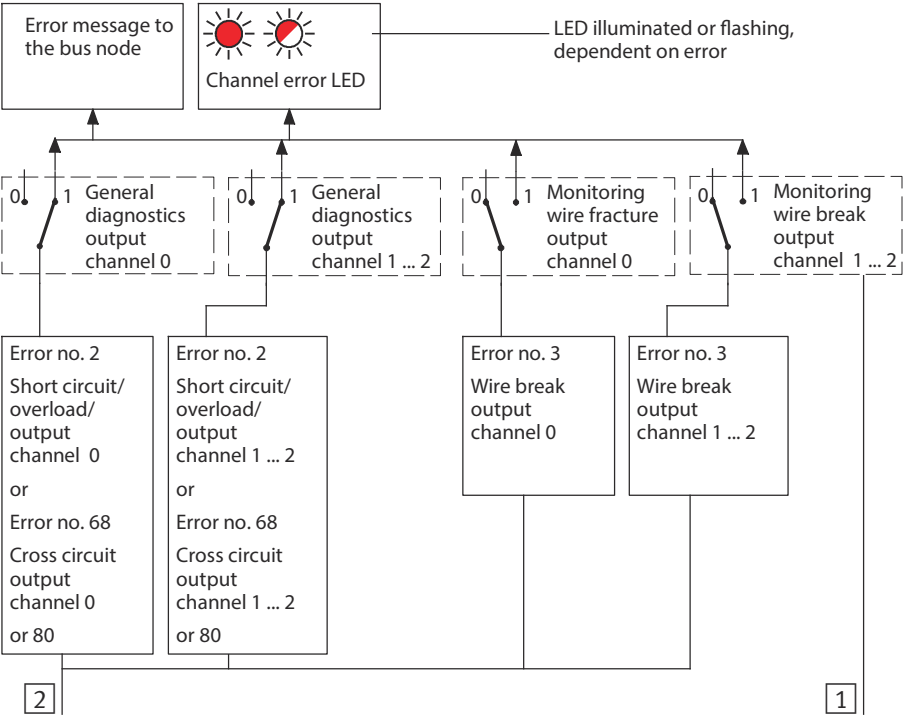
















Fig. 35: Principle of error handling and parameterisation – part 2

- 1 Module parameters (switch setting shown = default setting)
- 2 Channel-specific errors

6.3.2 Behaviour in case of error

Status LED	FP LED	Channel error LED	Module error LED	Error no.	Event/state	
				2 ¹⁾	Short circuit/overload at output	Error elimination ➔ 6.2 Possible error messages of the output module CPX-FVDA-P2
				3 ²⁾	Wire break	
				5 ³⁾	Undervoltage in supply voltage	
				61 ³⁾	Overvoltage in supply voltage	
				65 ³⁾	The PROFIsafe address set on the DIL switch does not correlate with the setting on the PROFIsafe master (F_DEST_ADD).	
				66 ³⁾	Error in safe communication.	
				67 ³⁾	Timeout during PROFIsafe transmission.	
				68 ¹⁾	Cross-circuit error (shunt error) at output.	
				69 ³⁾	Error in safe parameterisation (safety parameterisation invalid). PROFIsafe communication cannot be established.	
		4)		145 ³⁾	Module has detected an error during the self-test.	

1) If “channel-wise passivation” is active, only the affected output channel is passivated. Otherwise 3).
2) Does not lead to a safety switch-off.
3) All output channels of the module are passivated (CH0 ... CH2 are switched off).
4) In many cases, the channel error LEDs are also illuminated.

Tab. 43: Behaviour in case of error

6.4 Diagnostics via the CPX bus node

i

Information about diagnostics via the relevant CPX bus node can be found in the description of the corresponding bus node.

6.4.1 Diagnostics with the operator unit CPX-MMI

The operator unit displays current error messages of the output module in plain text.

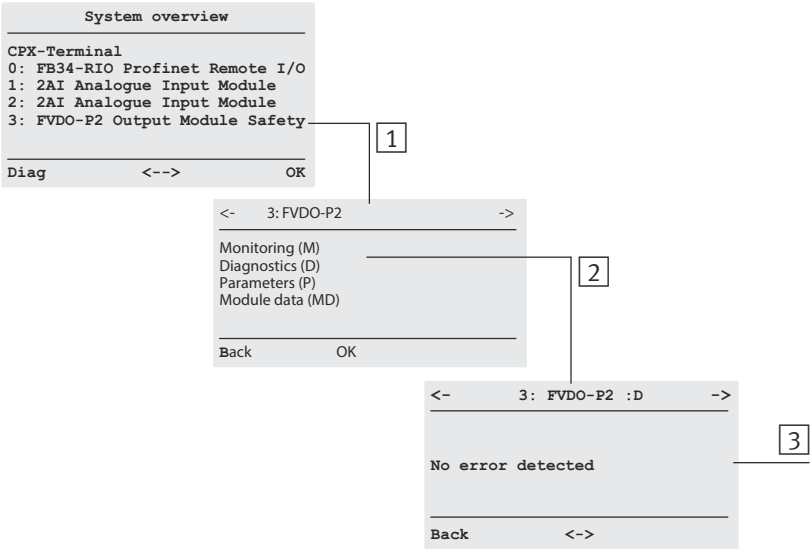


Fig. 36: Module identifier of the output module CPX-FVDA-P2 on the operator unit

- 1 Select module in the main menu (in this case, module 3)
- 2 Select “Diagnostics” menu
- 3 Current module errors (in this case, none)

Furthermore, the operator unit offers access to the diagnostic memory (➔ description of CPX-MMI-1...).

7 Service, repair, disposal

7.1 Service

The output module does not contain any components requiring servicing.

7.2 Repair

NOTICE

The module does not contain any wearing parts. Repairs are not allowed.
This invalidates the certification of the output module.
A professional replacement of the electronics module is permissible.

NOTICE

- Always replace the output module in case of an internal defect.
- Send the unmodified defective output module, including a description of the error and the application, back to Festo for analysis.

Please contact your technical consultant to clarify the modalities of the return. When making your complaint, you should mention that the module is a safety device.



To disassemble and assemble the electronics module → 3.5 Disassembling and assembling the electronics module

7.3 Disposal

The material used in the packaging has been specifically chosen for its recyclability.
For final disposal of the output module, please contact a certified waste management company for electronic waste.

8 Technical appendix

8.1 Technical data of the output module CPX-FVDA-P2



General technical data of the CPX terminal → CPX-SYS-... system description

Approval information	
CE	
Type-examination	The functional safety engineering of the product has been certified by an independent testing body, see EC-type examination certificate → www.festo.com/sp
Certificate issuing authority	TÜV Rheinland, Certification Body of Machinery, NB 0035
Certificate no.	01/205/5294.02/23
UKCA	
Type-examination	The functional safety engineering of the product has been certified by an independent body, see UK-type examination certificate → www.festo.com/sp
Certificate issuing authority	TÜV Rheinland UK Ltd, UK Approved Body No. 2571
Certificate no.	01/205U/5294.01/23

Tab. 44: Approval information

Safety characteristics ¹⁾		CPX-FVDA-P2
Switch off diagram per output channel		P- and M-switching
Internal reaction time to switch-off command [ms] (T_{WCDT}) on output channel CH0		< 23
Internal reaction time to switch-off command (T_{WCDT}) on output channels CH1 and CH2 depending on minimum load		Load diagrams → Fig. 38 → Fig. 39
PROFIsafe watchdog time	[ms]	F_WD_TIME
Max. response time of safety function	[ms]	F_WD_TIME + T_{WCDT}
Max. cyclical request rate	[rpm]	1
Mean time to dangerous failure (MTTF _d)	[years]	> 750
Probability of failure per hour (PFH _b)	[1/h]	< 1.0×10^{-9}
Max. useful life	[years]	20
Min. request rate for each output channel (CH0, CH1, CH2)		
– With test pulses switched on	[1/week]	1
– With test pulses switched off	[1/day]	1
Measures to avoid common cause failures (CCF)		<ul style="list-style-type: none"> – Comply with operating voltage limits – Comply with temperature range → Tab. 48 Further characteristic values → Fig. 40 – Combine a maximum of 2 output channels in a common safety pilot circuit
Safety protocol		PROFIsafe Profile version 2.4 ²⁾
Safe shutdown of the output channels		Level of safety function
IEC 61508		SIL 3
EN ISO 13849		Cat. 3, PL e
EN IEC 62061		Maximum SIL 3

1) In order to guarantee the safety level, a minimum switch-on period of 1 minute must be ensured every 8 operating hours for every output channel used.

2) Profile for Safety Technology on PROFIBUS DP and PROFINET IO; Version 2.4, March 2007

Tab. 45: Safety characteristics



Please note that compliance with the named standards is limited to the output module CPX-FVDA-P2. From the perspective of the output module, all disconnectable parts of a CPX terminal and/or valve terminal are treated as an external load.

Electrical characteristic values		CPX-FVDA-P2
Nominal operating voltage	[V DC]	24
Permissible voltage fluctuations	[%]	−15 ... +20
Operating voltage when tapping busbar 24 V _{VAL} and 0 V _{VAL} (integrated reverse polarity protection)	[V DC]	20.4 ... 28.8
Residual ripple (within tol.)	[V _{ss}]	2
Voltage drop bypass time U _{VAL}	[ms]	2
Intrinsic current consumption at nominal operating voltage	[mA]	typ. 65 for valves (from U _{VAL}) typ. 25 for electronics (from U _{EL/SEN})
Undervoltage monitoring U _{VAL}	[V]	< 19.5 for t>250 ms
Overvoltage monitoring U _{VAL}	[V]	> 29.5 for t>250 ms
Electrical isolation between V _{EL/SEN} (or 5 V CBUS) and V _{VAL}	[V rms]	min. 500
Electrical isolation between output channel (CH0, CH1, CH2) – and internal bus		Yes, with intermediate supply
Electrical isolation between output channel – output channel		no
Potential reference of the output channels		U _{VAL}
Max. power supply CH0, CH1, CH2 (load current per output channel)	[A]	1.5 → Fig. 40
Max. load current per unswitched voltage U _{VAL} (auxiliary supply)	[A]	2.5
Max. peak current per output channel	[A]	5 for t < 30 ms
Max. total current per module	[A]	5
Max. switching frequency of the output channels	[Hz]	1
Max. voltage drop per output channel under continuous load	[V]	0.6
Wire break detection (CH0, CH1, CH2)		can be parameterised, detection point I _L approx. 50 mA ¹⁾
Max. cable length (CH1, CH2)	[m]	200
Max. load capacity against FE	[nF]	400
Max. load capacity P-M	[μF]	22
Max. load inductivity	[mH]	1000 at 150 mA, 100 at 600 mA; Characteristic curve → Fig. 37

Electrical characteristic values	CPX-FVDA-P2
Fuse protection (short circuit)	Integrated electronic fuse
Max. test pulse duration [μs]	300
Max. voltage drop during test pulse [V]	6

1) When using the output module in the pneumatic interface - without external voltage zones - deactivate the wire break detection function.

Tab. 46: Electrical characteristic values

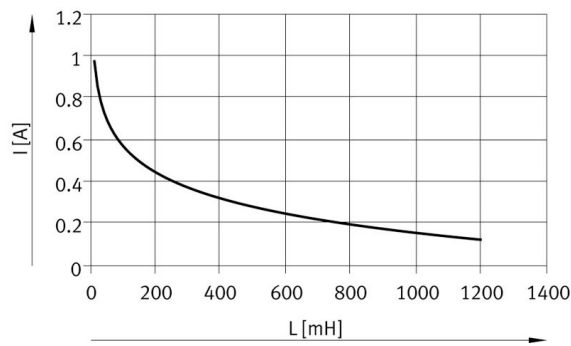


Fig. 37: Maximum permissible load inductivity at the output channels

Functional characteristic values	CPX-FVDA-P2
Module code	193d (C1h)
Sub-module code	8d (08h)
Compatible with fast start-up (FSU)	Yes
Start-up time until module ready [s]	< 2
Diagnostics of external channel fault	Periodic inspection – for function – for external supply – for cross circuit
Response time for external channel errors [min]	< 1
Response time to switch off command (typ.) [ms]	< 10
Internal PROFIsafe processing time (T_{DAT}) [ms]	< 50

Tab. 47: Functional characteristic values

NOTICE

- Use the following diagram if the load current is known.

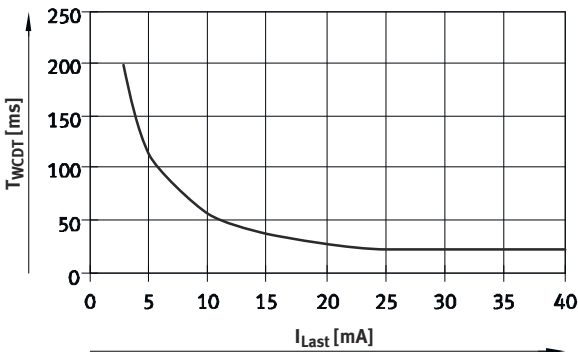


Fig. 38: Internal reaction time as a function of the minimum load current

NOTICE

- Use the following diagram if the load resistance is known.

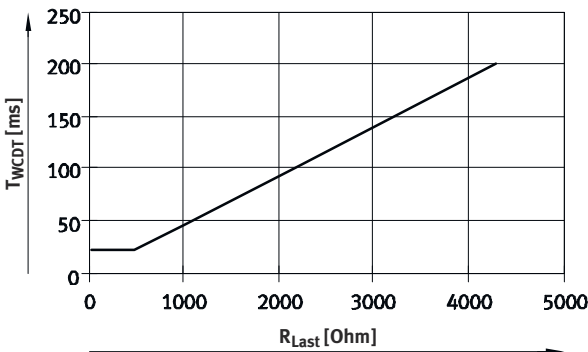


Fig. 39: Internal reaction time as a function of the resistive minimum load

Further characteristic values		
Ambient temperature in storage	[°C]	– 20 ... + 70
Ambient operating temperature		
– in interlinking block CPX-M-GE-EV-FVO	[°C]	– 5 ... + 50
with resultant current of 4.5 A for all 3 outputs		
– in pneumatic interface VABA-S6-1-X...-F1/F2-CB	[°C]	– 5 ... + 30
with resultant current of 4.5 A for all 3 outputs		
– in pneumatic interface VABA-S6-1-X...-F1/F2-CB	[°C]	– 5 ... + 40
with resultant current of 3 A for all 3 outputs		
– in pneumatic interface VABA-S6-1-X...-F1/F2-CB	[°C]	– 5 ... + 50
with resultant current of 1.5 A for all 3 outputs		
Relative humidity (non-condensing)	[%]	5 ... 90
Degree of protection to EN 60529		depending on the manifold block or the pneumatic interface ¹⁾
UL certification		c UL us – Recognized (OL)

1) ➔ Description of CPX-FVDA-P2-... “Technical data of the manifold blocks” or description of the valve terminal VTSA-F-CB

Tab. 48: Further characteristic values

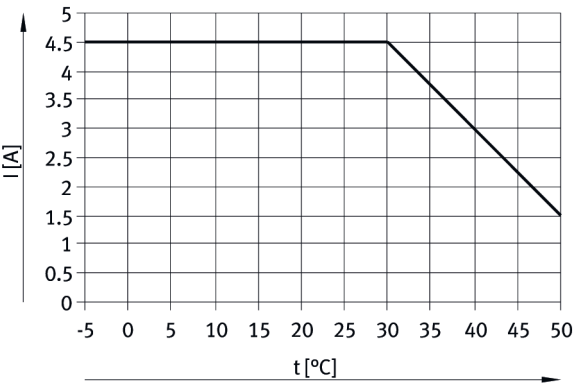


Fig. 40: Dependence of the maximum output current on the ambient temperature (during operation) when using the output module in the pneumatic interface VABA-S6-1-X...-F1/F2-CB

8.2 Technical data of the manifold blocks

Technical data	CPX-M-AB-4-M12X2-5POL
Degree of protection in accordance with EN 60529 ¹⁾	IP65/67, completely mounted, plug inserted or provided with cover cap ISK-M12
Information about housing materials	Die-cast aluminium

Technical data	CPX-M-AB-4-M12X2-5POL
Connections	
Version	4 M12 bushings, metal thread, 5-pin
Contact load [A]	4

1) Degree of protection is determined by the combination of interlinking block and manifold block

Tab. 49: Technical data – manifold block CPX-M-AB-4-M12X2-5POL

Technical data	CPX-AB-8-KL-4POL
Degree of protection in accordance with EN 60529 ¹⁾	IP20, completely mounted, cable connected to terminal strip
Information about housing materials	Reinforced polyamide, polycarbonate
Connections	
Version	2 terminal strips
Contact load [A]	4

1) Degree of protection is determined by the combination of interlinking block and manifold block

Tab. 50: Technical data – manifold block CPX-AB-8-KL-4POL

8.3 Technical data of the interlinking block

Technical data	CPX-M-GE-EV-FVO
Type of mounting	Angled fitting
Information about housing materials	Die-cast aluminium
Function	Interrupts the contact rails for load voltage supplies (U_{VAL} switchable, U_{OUT} permanent)
Special feature	Mechanical coding prevents you from plugging in impermissible electronics modules

Tab. 51: Technical data – interlinking block CPX-M-GE-EV-FVO

8.4 Technical data of the pneumatic interface

Technical data	VABA-S6-1-X2-F1-CB
Degree of protection in accordance with EN 60529 ¹⁾	IP65
Information about sub-base materials	Die-cast aluminium
Information about cover materials	Polyamide

1) Degree of protection is determined by the combination of interlinking block and manifold block

Tab. 52: Technical data – pneumatic interface VABA-S6-1-X2-F1-CB

Technical data	VABA-S6-1-X2-F2-CB
Degree of protection in accordance with EN 60529 ¹⁾	IP65
Information about sub-base materials	Die-cast aluminium
Information about cover materials	Polyamide
Connection	
Function	Safe digital output
Version	Socket, M12x1 A-coded, 5-pin

1) Degree of protection is determined by the combination of interlinking block and manifold block

Tab. 53: Technical data – pneumatic interface VABA-S6-1-X2-F2-CB

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