ENGINEERING TECHNOLOGY

User Manual *ControlPlex®*
CPC20EN Controller

EtherNet/IP™

1 Table of contents

2 General information

2.1 Safety instructions

This manual points out possible danger for your personal safety and gives instruction how to avoid property damage. The following safety symbols are used to draw the reader's attention to the safety instructions included in this manual.

Danger!

Danger to life and limb unless the following safety precautions are taken.

Warning

Danger to machinery, materials or the environment unless the following safety precautions are taken.

Note

Information is provided to allow a better understanding.

Caution

Electrostatically sensitive devices (ESD). Devices must exclusively be opened by the manufacturer.

Disposal guidelines

Packaging can be recycled and should generally be brought to re-use.

2.2 Qualified personnel

This user manual must exclusively be used by qualified personnel, who are able – based on their training and experience – to realise arising problems when handling the product and to avoid related hazards. These persons have to ensure that the use of the product described here meets the safety requirements as well as the requirements of the presently valid directives, standards and laws.

2.3 Use

The product is part of a continuous enhancement process. Therefore there might be deviations between the product in hand and this documentation. These deviations will be remedied by a regular review and resulting corrections in future editions. The right to make changes without notice is reserved. Error and omissions excepted.

2.4 Delivery state

The product is supplied with a defined hardware and software configuration. Any changes in excess of the documented options are not permitted and lead to liability exclusion.

3 General description

Requirements regarding transparency and flexibility are constantly growing in industrial applications. Modern automation technology meets these requirements with cross-linked components and their communication capabilities in a range of business levels and sectors. Control and computer-aided solutions are no longer the sole focus, but monitoring of individual components and processes becomes more and more important. This is exactly the target application area of the intelligent and bus-capable power distribution system ***ControlPlex®***. It serves for the protection of industrial applications as well for monitoring and control. The CPC20 bus controller is the centre piece of the system. It analyses measuring data, indicates error and transmits the information to the superordinate control systems by means of standard bus systems. Its OPC* UA interface offers the option of direct communication with a company's IT infrastructure.

The CPC20 has been designed as a system in connection with module 18plus. It consists of a supply module for supply of max. 80 A. Up to 16 connection modules can be connected, each of them accommodating one double-channel electronic circuit protector. In the end the user has max. 32 channels for his protection system. When using a transfer module, the number of channels can even be doubled once more. Thus the CPC20 offers a maximum number of 64 channels. Communication options comprise transmission of the operating condition, of measuring values and device information regarding the connected components, but also changes of the product-specific parameters such as current ratings and execution of actions, e.g. ON and OFF operation.

Information can be transmitted in a cyclical or non-cyclical mode to the superordinate control system, the Ethernet interface or via an available service interface to the connected service computer. If no connection is available to a superordinate control unit, this will have no effect on the behaviour of the connected circuit protectors. The bus controller is able to ensure their functionality even without a connection to a superordinate control unit. The saved parameters will be used for this purpose.

The ***ControlPlex®*** intelligent power distribution system offers the well-known E-T-A quality and reliability with regard to overcurrent protection in combination with the innovative functionalities on the score of automation technology.

**** under preparation. Can be retrofitted via firmware update when available.***

3.1 Design of the entire system

The CPC20 bus controller is the centre piece of the ***ControlPlex®*** system. It allows consistent communication between the ESX60D electronic circuit protectors and the superordinate control level, connected HMIs and even into the Cloud.

The EtherNet/IP™ interface to the superordinate control unit is implemented as two RJ45 connectors. It allows connection of the required control unit with the ***ControlPlex®*** system, This enables display, analysis as well as diagnosis of the individual measuring values. In addition, it allows control of the individual electronic circuit protectors. An additional Ethernet interface enables direct access of the integral web server of the bus controller. Service staff can thus directly access the system on site. Moreover, access via the connected infrastructure of the company is enables and thus global access. OPC UA* and MQTT* allow transmission of all measuring values and status information e.g. to a superordinate cloud application, independently of the control system.

Revised measuring values of all electronic circuit protectors are also forwarded to the automation system. This enables the user to have unrestricted access to the safety-relevant functions even in the event of an interruption. Any occurring failures will be detected quickly and can be remedied without delay. The ***ControlPlex®*** system effectively reduces system downtimes and significantly increases the productivity.

16 power distribution modules with up to 16 2-channel ESX60D electronic circuit protectors can be directly connected to the CPC20 bus controller. This number can be doubled with the transfer module. Thus the bus controller operates up to 64 channels. This is done in a cycle time of 520 ms.

**** under preparation. Can be retrofitted via firmware update when available.***

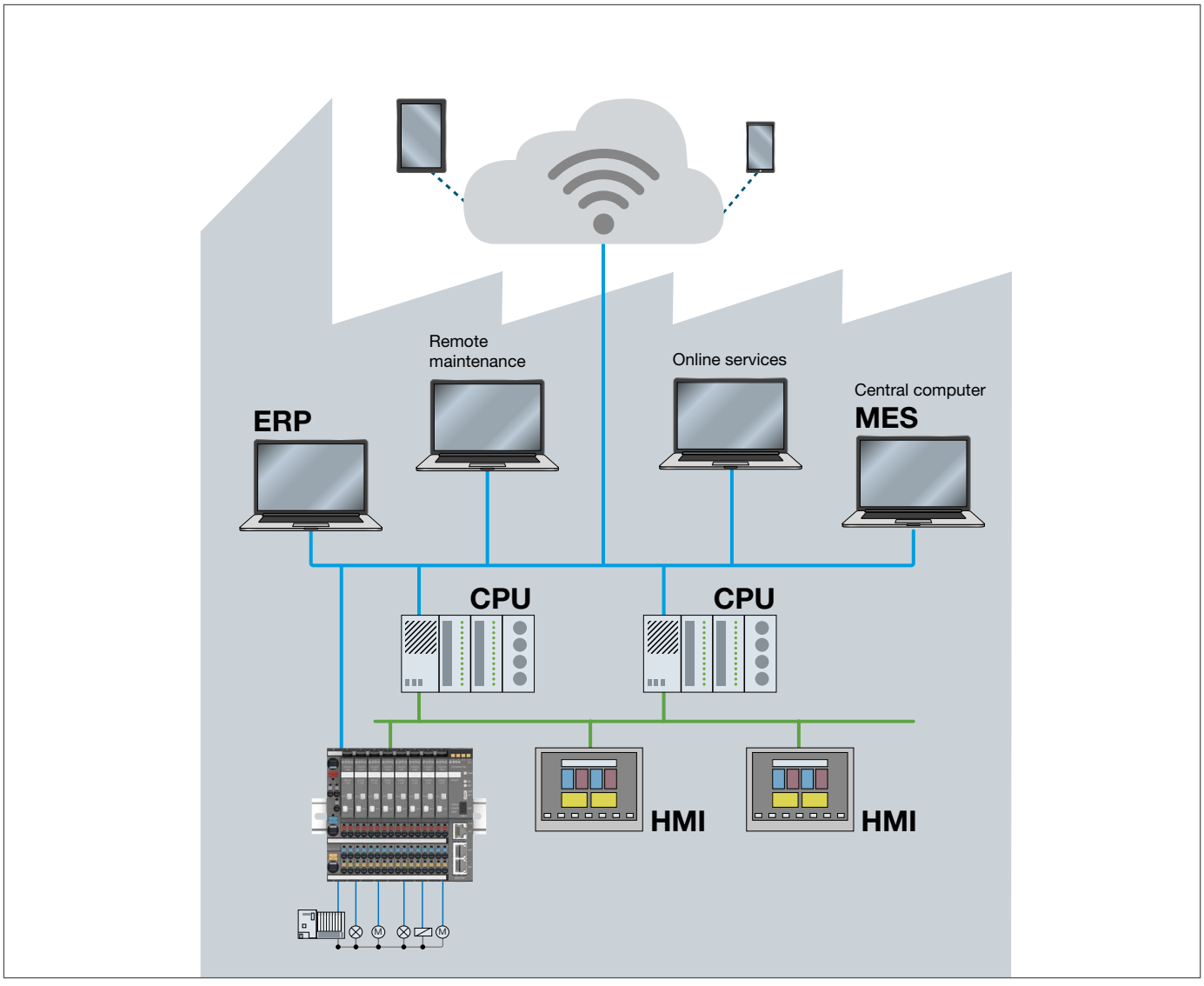

fig. 1: System overview

3.2 Dimensions CPC20

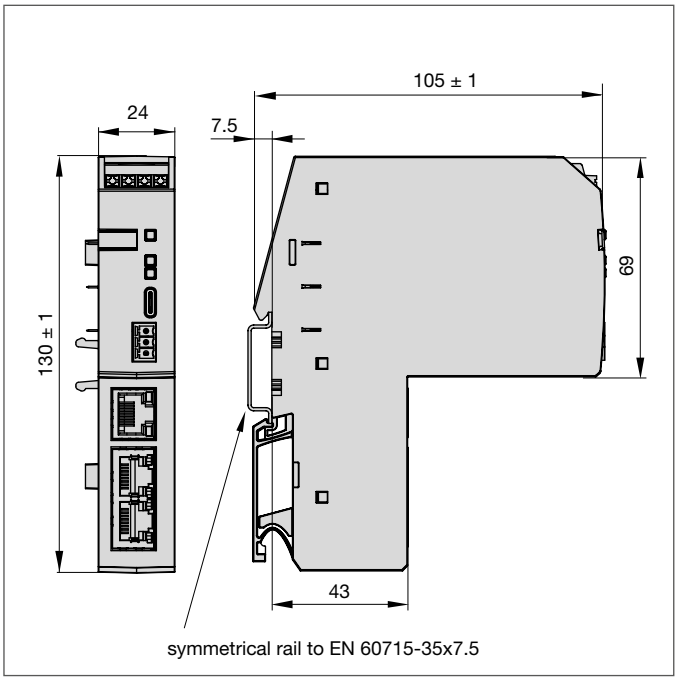

fig. 2: Dimensions CPC20

3.3 Dimensions 18plus-EM03 supply module

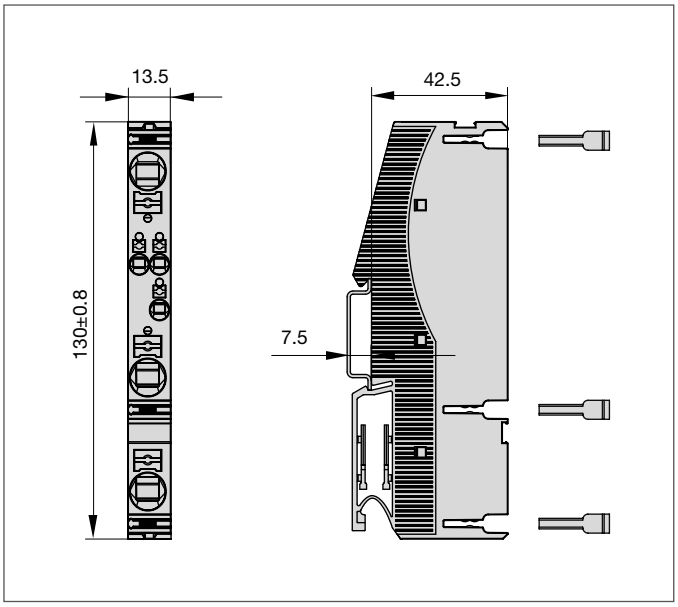

fig. 3: Dimensions of 18plus-EM03 supply module

3.4 Dimensions 18plus- AM03 connection module

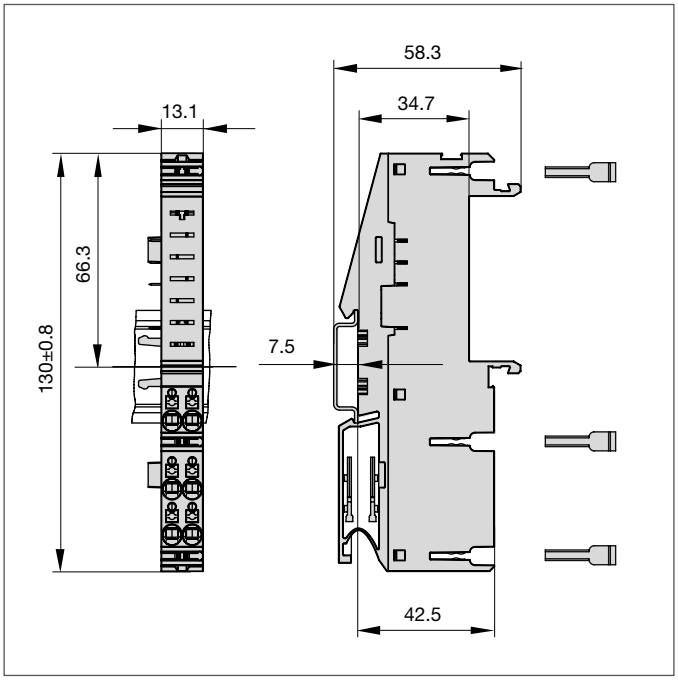

fig. 4: Dimensions of 18plus-AM03 connection module

3.5 Dimensions 18plus-TM03 transfer module

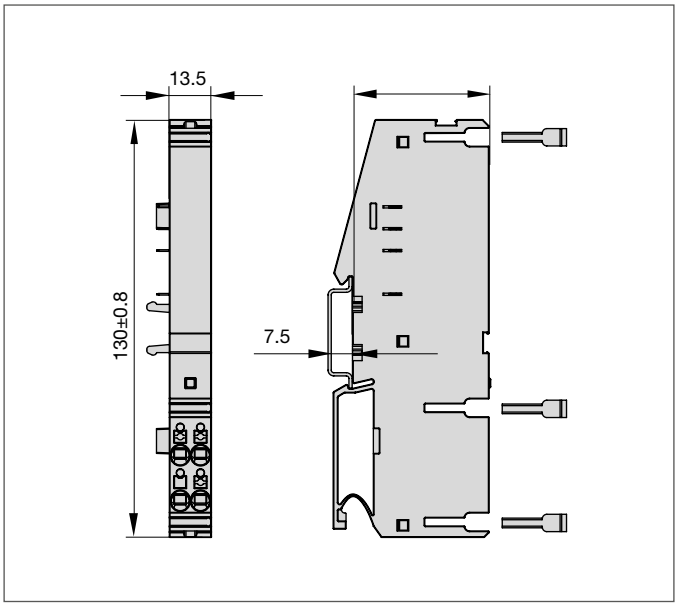

fig. 5: Dimensions of 18plus-TM03 transfer module

3.6 Dimensions of 18plus-AM03 connection module with ESX60D

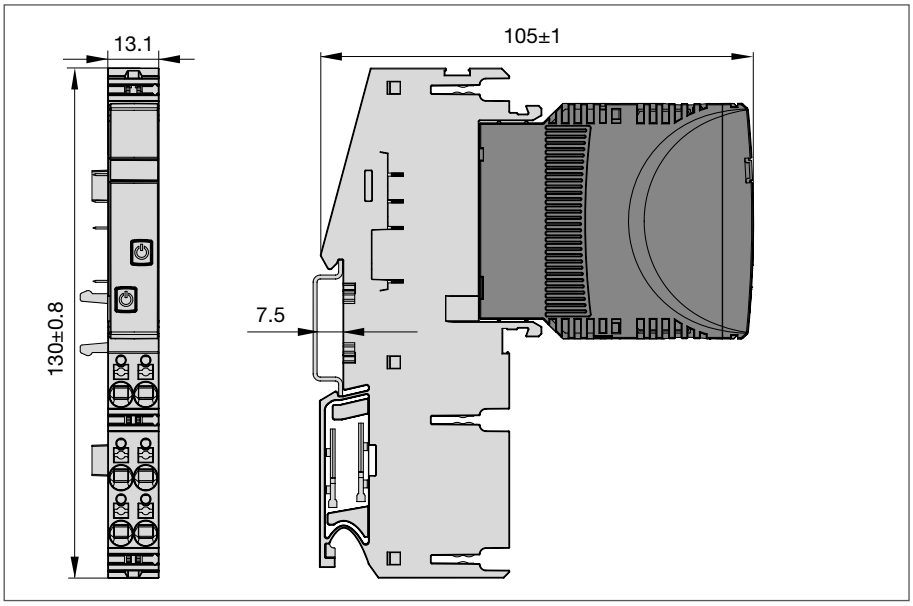

fig. 6: Dimensions of 18plus-AM03 connection module fitted with ESX60D

3.7 Status indication and terminals

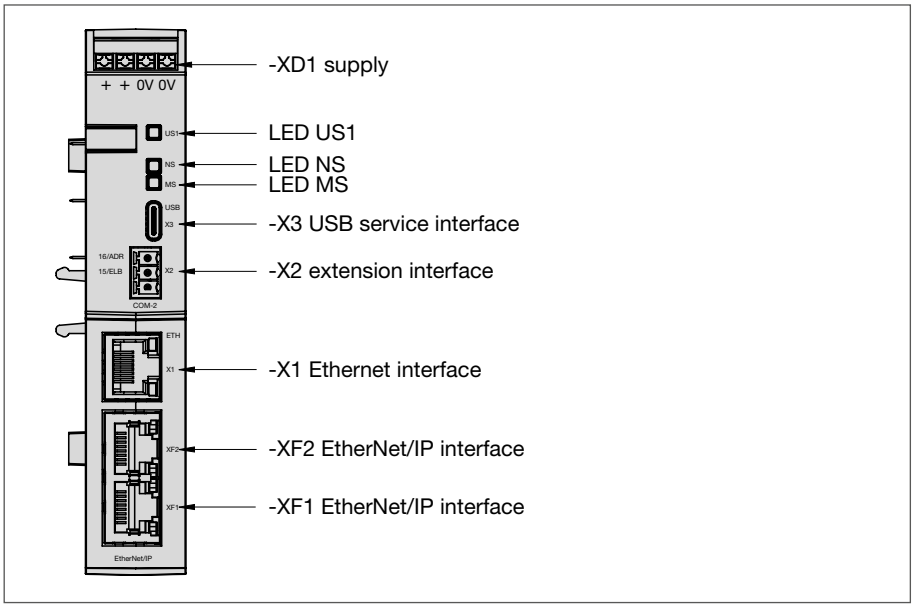

fig. 7: Status indication and terminals CPC20

3.7.1 Terminals for voltage supply

supply XD1

Voltage ratings:	DC 24 V (± 10 % → 18 … 30 V)	
Rated current:	typically 160 mA	
Terminal design:	4 x push-in terminals (+/+/0V/0V)	
	Max. cable cross section rigid	0.2 – 2.5 mm²
	flexible with wire end ferrule (with plastic sleeve)	0.2 – 2.5 mm²
	flexible with wire end ferrule (without plastic sleeve)	0.2 – 2.5 mm²
	stripping length	11 mm

Using a supply voltage outside the indicated operating range can cause malfunctions or destruction of the device.

The CPC20 has a direct and fixed connection between the housing shield of the RJ45 connectors (XF1, XF2 and X1) and the 0V of X41.

3.7.2 Connector for the additional ELBus®

X2 Direct connection with 18plus (no wiring required)

X52COM-2: Connection for the second power distribution system 18plus
Cable length max. 3 m
typically H07V-K 1.5 mm²
15: Data line **ELBus®** COM
16: Addressing

Use of the terminals for applications not provided for in the operation manual or improper connection can lead to malfunction or destruction of the device.

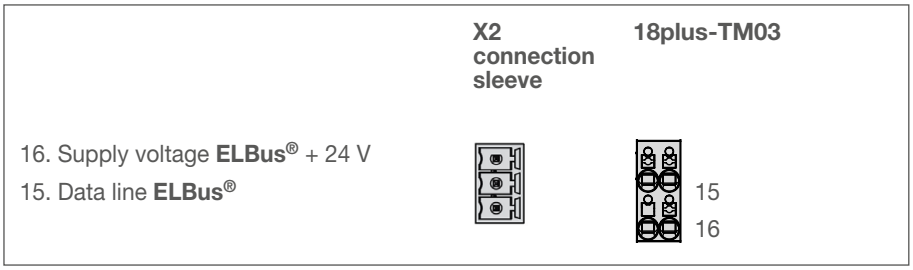

fig. 8: ELBus® connection

3.7.3 USB service and maintenance interface, terminal X3

The USB interface serves for connection of the service computer. The available user software ***ControlPlex®* Views** provides the option to carry out firmware updates.

3.7.4 EtherNet/IP™ interfaces with integral switch, connection sleeve XF1, XF2

XF1 Connection to bus system EtherNet/IP™
Type: RJ45

When wiring and connecting to the bus system EtherNet/IP™, the installation and wiring regulations of the EtherNet/IP™ Specification have to be observed.

XF2 Connection to bus system EtherNet/IP™
Type: RJ45

When wiring and connecting to the bus system EtherNet/IP™, the installation and wiring regulations of the EtherNet/IP™ Specification have to be observed.

3.7.5 ETHERNET interface, connection sleeve X1

X1 connection with bus controller CPC20
Type: RJ45

3.7.6 LED status indication

LED	Color	Description
US1	green	Normal duty, MS or NS possible.
	orange	The breaker is in the start-up phase.
	red blinking	Firmware update is presently carried out.
MS	orange	The breaker is in the start-up phase.
	green	Controlled by a Scanner in Run state
	green blinking	Not configured or Scanner in Idle state
	red	Major fault
	red blinking	Firmware update is presently carried out or recoverable fault(s)
NS	orange	The breaker is in the start-up phase.
	green	Online, one or more connections established
	green blinking	Online, no connections established
	red	Duplicate IP address
	red blinking	Firmware update is presently carried out or one or more connections timed out
LNK/ACT	OFF	No link, no activity
	green	Link established
	blinking green	Activity available

fig. 9: LED status indication

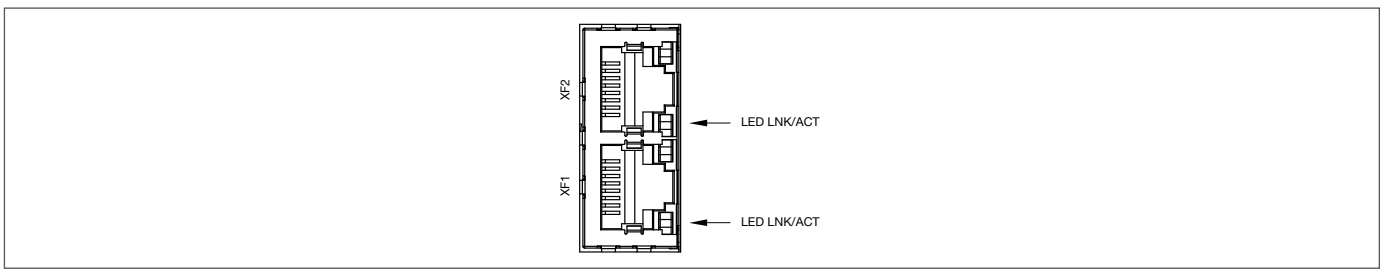

fig. 10: Signaling RJ45 connectors

4 Mounting and installation

4.1 Mounting of the system

The preferred mounting position of the ***ControlPlex®*** system is horizontal.

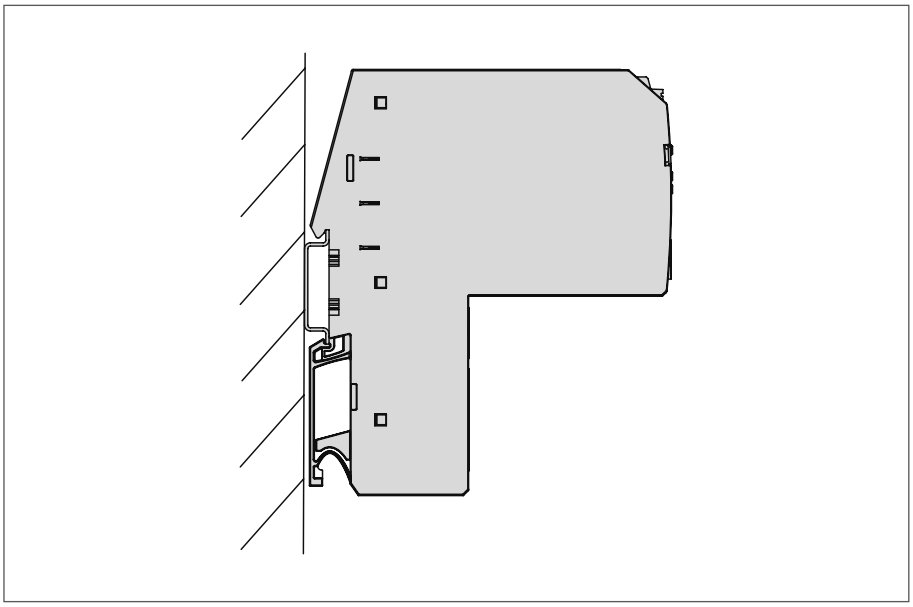

fig. 11: Installation drawing

4.2 System installation

Connection of CPC20 bus controller with 18plus-TM03 transfer module for extension of the number of circuit protectors to be connected to 32 devices.

The connection between CPC20 and the 18plus-TM03 has to be realised manually.

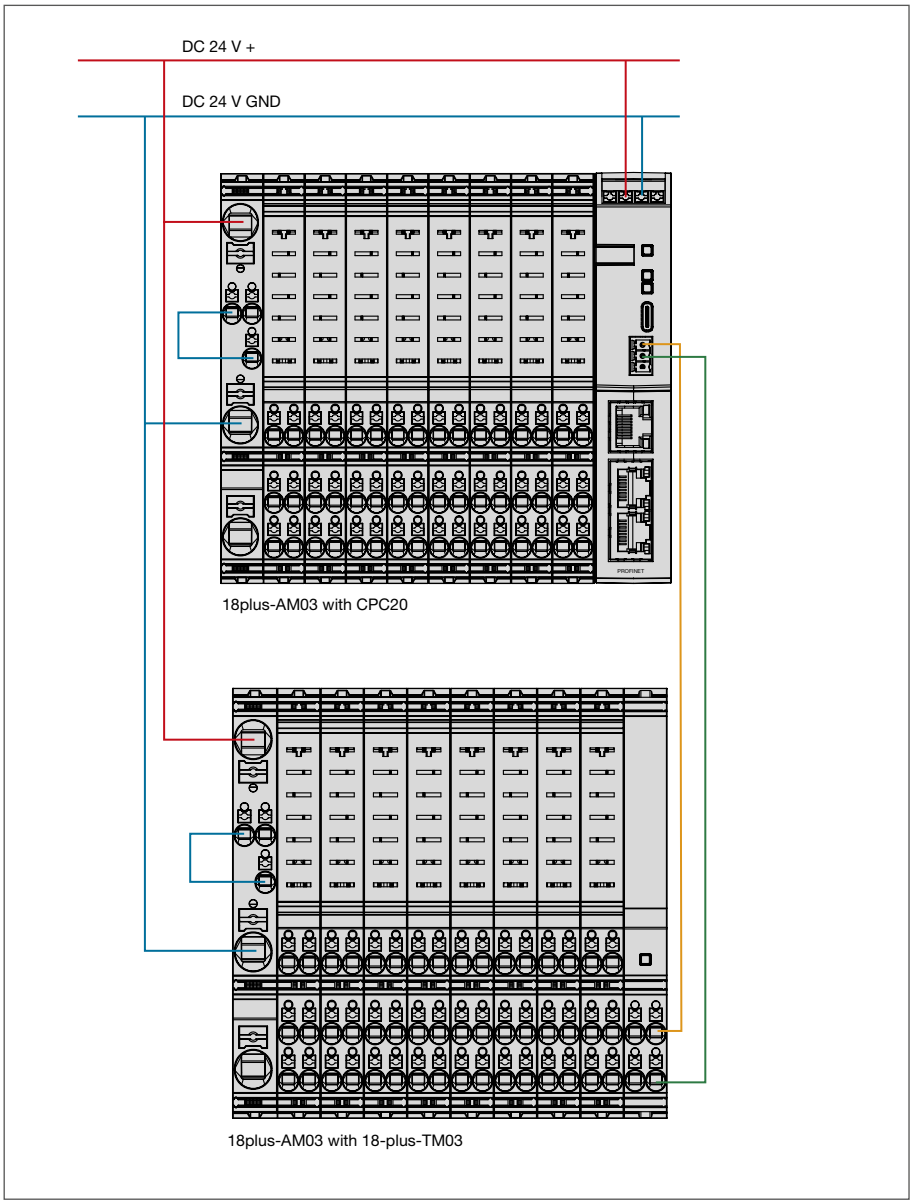

fig. 12: System installation

5 Operating modes of the CPC20 bus controller

5.1 Operating mode: Start-up mode

The CPC20 bus controller is initialized by applying the supply voltage. The device will carry out implemented program memory tests and self test routines. During this time a communication via the interfaces is not possible.

5.2 Operating mode: System error mode

If a failure is detected during the self test routines, the bus controller will change into operating mode System Error. This operating mode can only be discontinued by way of re-starting the device and it prevents the data exchange via the interfaces. If the bus controller is in this operating mode, it is unable to control the electronic circuit protectors and these will stay in the stand-alone mode (overcurrent protection).

5.3 Operating mode: Configuration error mode

If there are no valid or invalid configuration data available in the bus controller, it will change into this operating mode. This operating mode only allows non-cyclical data exchange. Cyclical data exchange is prevented. Leave this operating mode upon receipt of the correct slot parameters and configuration data.

5.4 Operating mode: stand-alone mode

In normal duty there is a connection between the bus controller and the superordinate control unit. Thus the control of the electronic circuit protectors and the change of their parameters is executed by the superordinate control unit. Should the communication between both participants fail, this has no influence on the protective function of the circuit protectors. In this case the CPC20 bus controller will automatically adopt the control and parameterisation of the electronic circuit protectors, because all required data sets are saved within the CPC20. By means of the web server, the electronic circuit protectors, their status and parameters can be accessed via the Ethernet interface interface. It is thus possible to change e.g. parameter data of the various electronic circuit protectors. If the failure on the communication level is remedied, this operating mode will be left and the superordinate control unit will take over control again as master. If during this time a parameter was changed while there was no communication, this will be signaled to the superordinate control unit. In this case the user can correspondingly define the control behaviour and it can be programmed in the programmable logic controller. This allows the user to select a reaction meeting his requirements.

5.5 Operating mode: Slave mode

In this operating mode the CPC20 is connected to a EtherNet/IP™ system. Communication to the CPC20 bus controller works faultlessly and the controller can be addressed and controlled by the superordinate control unit.

The behaviour of the bus controller with simultaneous use of a field bus interface and of the web server or the USB service and maintenance interface can be determined by means of the configuration of the device in the superordinate control unit. It can be pre-selected there that Ethernet and/or the USB service and maintenance interface are granted either only reader access or reader and editor access. In the event of editor access, changes of the parameterisation of the electronic circuit protectors can be carried out in parallel to the field bus system. These parameter changes will then be advised to the superordinate control system and can be adopted by it or also overwritten. The user can select the behaviour accordingly.

5.6 Operating mode: Firmware Update Mode

The devices are supplied with a software programmed according to their functionality. If the functions of the devices are extended, this will be carried out in the firmware. It is therefore necessary to carry out a firmware update if the new functionality shall be used.

6 Basic functionalities of the entire system

6.1 Internal cycle times

The cycle time of the system depends on the number of data to be transmitted between the CPC20 bus controller and the projected slots for the ESX60D electronic circuit protectors.

It is possible to choose the data quantity for the communication of the superordinate control unit. This can be achieved by using the different data models. It is therefore possible to transmit either the status, the measuring values for the load current and the output voltage of the electronic circuit protector or to only send the circuit protector status to the superordinate control unit. The choice between the various data models is made available to the user in the GSDML file of the control system. These are configuration data which are transmitted to the programmable logic controller by means of the hardware configuration of the CPC20.

The cycle time per bus with 16 18plus-AM03 modules is approx. 520 ms for the cyclical data. A window of 70 ms is kept free for non-cyclical data. In total, this is a max. cycle time of 590 ms.

The ESX60D electronic circuit protectors can be plugged into the 18plus-AM03 power distribution module at any time. After plugging in a circuit protector, it will automatically be parameterised if parameters are available for the slot in question.

6.2 Hot swap of circuit protectors

Transmission of the parameters will be without interruption of the cyclical data exchange between the CPC20 and the ESX60D electronic circuit protector.

6.3 Communication via the USB service interface

The maintenance and service interface allows direct access to the CPC20 bus controller. Firmware updates for the CPC20 are possible via this interface.

6.4 About the additional Ethernet interface

The additional Ethernet interface extends the functional scope of the bus controller. The following functionalities are provided via this interface.

6.4.1 Web Server

The web server offers the entire scope of measuring data, status information, parameterisation options an d control function of the CPC20 bus controller. The parameterisation of the interface is described separately.

6.4.1.1 Default IP address -X91

The default IP address of the CPC20 is: 192.168.1.1 The web server can be reached via this IP address.

6.4.1.2 User name and password

In order to be able to carry out configurations, the user has to have the required access authorisation. It is defined in user administration.

The default settings are:

User	admin
Password:	admin

We urgently recommend to individually adjust these settings upon startup of the device.

7 Communication via EtherNet/IP™

EtherNet/IP™ is a network adaption of the Common Industrial Protocol (CIP™) developed by the ODVA organization. CIP uses abstract object modeling to describe the available communication services and data provided by a product. Objects and their components are addressed by an addressing scheme consisting of Node Address (IP-Address), Class Identifier (Class ID), Instance Identifier (Instance ID), Attribute Identifier (Attribute ID) and a Service Code. Assembly objects are used for I/O messages by combining several I/O data into one block.

The IP-Address is typically assigned by a DHCP-server within the network.

7.1 *ControlPlex*® device model

Up to two power distribution systems can be connected to the CPC20 controller. They consist of the 18plus-EM-03 supply, the 18plus-AM03 connection modules and for the external system, communication is run via the 18plus-TM03 transfer module. These blocks are purely passive. Up to 16 18plus-AM03 connection modules can be configured per power distribution system.

The power distribution system ***ControlPlex***® uses the following EtherNet/IP™ model:

EtherNet/IP™	CPC20EN
Class 0x01, 0x06, 0x47, 0xF5, 0xF6	The EtherNet/IP™ interface requires several mandatory objects. These are the identity object (0x01), the connection manager object (0x06), the device level ring object (DLR, 0x47), the TCP/IP interface object (0xF5) and the Ethernet link object (0xF6).
Class 100	Class 100 represents the CPC20EN controller. All system wide information and settings can be accessed through this class. Details are described in Chapter 9. The I/O data of the CPC20EN are described in chapter 8.1.
Class 101	Class 101 represents the circuit protectors connected to the CPC20EN on the first power distribution system. All circuit breaker specific information and settings can be accessed through this class. Details are described in Chapter 9. The I/O data of each circuit protector contain the control byte, the status byte and measuring values. The process data image of the PLC holds 10 input bytes and 2 output bytes for each circuit protector. Details are described in chapter 8.2. The quantity of cyclically exchanged process data is adjustable. If fewer circuit protectors are connected than configured, the status of the missing circuit protectors is marked as »not available«. If more circuit protectors than configured are connected, these cannot be accessed by the PLC.
Class 102	Class 102 represents the circuit protectors connected to the CPC20EN on the second power distribution system. All circuit breaker specific information and settings can be accessed through this class. Details are described in Chapter 9. The I/O data of each circuit protector contain the control byte, the status byte and measuring values. The process data image of the PLC holds 10 input bytes and 2 output bytes for each circuit protector. Details are described in chapter 8.2. The quantity of cyclically exchanged process data is adjustable. If fewer circuit protectors are connected than configured, the status of the missing circuit protectors is marked as »not available«. If more circuit protectors than configured are connected, these cannot be accessed by the PLC.

fig. 13: Device model

7.2 EDS file

The EDS file is provided in the download area of the E-T-A website and can be downloaded there.

7.3 Identity Object (Class ID: 0x01)

The identity object supports only instance 1.

Service codes Get_Attributes_All (1) and Get_Attribute_Single (14) are supported.

Further details are provided by the EtherNet/IP™ Specification

Name	Attribute ID	Data Type	Description
Vendor ID	1	UINT	Vendor identification
Device Type	2	UINT	General type of product
Product Code	3	UINT	Product code of vendor
Revision	4	USINT, USINT	Revision of the item
Status	5	WORD	Summary status of device
Serial Number	6	UDINT	Serial number of device
Product Name	7	SHORT_ STRING	Profile ID
Active Language	11	STRUCT of: USINT USINT USINT	Active language
Supported Language List	12	ARRAY of: STRUCT of: USINT USINT UISNT	List of all supported languages

fig. 14: Identity Object Attributes

7.4 TCP/IP Interface Object (Class ID: 0xF5)

The TCP/IP interface object supports only instance 1.

Service codes Get_Attributes_All (1), Get_Attribute_Single (14) and Set_Attribute_Single (16) are supported.

Further details are provided by the EtherNet/IP™ Specification.

Name	Attribute ID	Data Type	Description
Status	1	DWORD	Interface status
Configuration Capability	2	DWORD	Interface capability flags
Configuration Control	3	DWORD	0 = Statically-assigned IP configuration 1 = IP-configuration via BOOTP 2 = IP-configuration via DHCP
Physical Link Object	4	STRUCT	Path to physical link object
Interface Configuration: IP Address, Network Mask, Gateway Address, Name Server, Name Server 2, Domain Name	5	STRUCT of: UDINT, UDINT, UDINT, UDINT, UDINT, STRING	IP-configuration
Host Name	6	STRING	Host name
TTL Value	8	USINT	TTL Value for EtherNet/IP multicast packets
Mcast Config	9	STRUCT of: USINT USINT UINT UDINT	IP multicast configuration
Encapsulation inactivity timeout	13	UINT	Number of seconds of inactivity before a TCP connection is closed. 0: Disabled

fig. 15: TCP/IP Interface Object Attributes

8 Cyclical I/O data

EtherNet/IP™ provides the exchange of cyclical process data from an originator (e.g. PLC) to the target (CPC20EN) O→T and vice versa T→O. The number of exchanged I/O data bytes can be varied.
The Forward_Open request to the connection manager initiates the I/O communication and determines the requested packet interval (RPI), the priority, the data size and the connection path. Valid RPI range for the CPC20EN is between 1 ms and 1000 ms. One exclusive owner, one listen only and one input only connection is supported simultaneously.The O→T connection includes a Run/Idle Header which account for the first 4 bytes.
The O→T assembly (100) data size is adjustable between 0 and 64 bytes.
The T→O assembly (101) data size is adjustable between 0 and 326 bytes.
The connection path must be set to 0x20 04 24 00 2C 64 2C 65 because no configuration assembly is used.

If you plan to not use the maximum configuration, the system will always start to cut off last bytes. That means that 32nd channel of the second ELBus-Board will always be the first one to be cut off. So it is impossible to receive data of the second ELBus-Board without receiving all data of the first ELBus-Board.

8.1 I/O data input: CPC20 controller

Originator→Target bytes 0 … 1
The 2 input bytes contain the following global error and diagnostic messages.

	Byte	Type	Range	Description
status controller	0 HighByte 1 LowByte	Word	0xFFFF	bit 0 = no configuration data available bit 1 = invalid configuration data bit 2 = reserve bit 3 = reserve bit 4 = command buffer overflow bit 5 = reserve bit 6 = reserve bit 7 = no communication with at least one PWR board bit 8 = reserve bit 9 = CPC temporary error bit 10 = CPC hardware error bit 11 = reserve bit 12 = reserve bit 13 = reserve bit 14 = reserve bit 15 = reserve

fig. 16: Cyclical diagnostic data CPC20

8.2 I/O data input: total current

Originator→Target bytes 2 … 3 (ELBus Board 1)
Originator→Target bytes 164 … 165 (ELBus Board 2)
The total current supplies a standardized 16-bit value with the calculated total current of all circuit protectors (2 byte input data).

The measuring value is indicated as follows:

	Byte	Type	Range	Description
Total current	0 HighByte 1 LowByte	UInt16	0 … 65535	A standardised 16-bit-value with a resolution of 10 mA is made available. Example for calculation of the measuring value: value (1320)/ 100 ≙ 13.20 Amps

fig. 17: Total Current

8.3 I/O data input: circuit protectors

Originator→Target bytes 4 … 163 (ELBus Board 1)

Originator→Target bytes 166 … 325 (ELBus Board 2)

Each circuit protector has up to two channels. The input and output data are always transmitted for both possible channels.

10 bytes input data are exchanged for each circuit breaker containing the status of the channel, the load current and the load voltage.

Design of the input bytes per circuit protector is as follows:

	Byte	Type	Range	Description
Status channel	0	byte	0 … 255	0xFF (255) ≙ no device available or wrong configuration bit 0 = load output ON bit 1 = short circuit bit 2 = overload bit 3 = low voltage bit 4 = reserve bit 5 = reserve bit 6 = limit value current bit 7 = event / or button pressed »True« means the status is active.
Load current channel 1	1 HighByte 2 LowByte	UInt16	0 … 65535	A standardised 16-bit-value with a resolution of 10 mA is made available. Example for calculation of the measuring value: value (150)/100 ≙ 1.50 Amps
Load voltage way 1	3 HighByte 4 LowByte	UInt16	0 … 65535	A standardised 16-bit-value with a resolution of 10 mV is made available. Example for calculation of the measuring value: value (2512)/100 ≙ 25.12 Volt
Status channel 2	5	byte	0 … 255	0xFF (255) ≙ no device available, wrong configuration or 1-channel device used bit 0 = load output ON bit 1 = short circuit bit 2 = overload bit 3 = low voltage bit 4 = reserve bit 5 = reserve bit 6 = limit value current bit 7 = event / or button pressed »True« means the status is active.
Load current channel 2	6 HighByte 7 LowByte	UInt16	0 … 65535	A standardised 16-bit-value with a resolution of 10 mA is made available. Example for calculation of the measuring value: value (150)/100 ≙ 1.50 Amps
Load voltage way 2	8 HighByte 9 LowByte	UInt16	0 … 65535	A standardised 16-bit-value with a resolution of 10 mV is made available. Example for calculation of the measuring value: value (2512)/100 ≙ 25.12 Volt

fig. 18: Input data circuit protector

8.4 Output data circuit protectors:

Target→Originator bytes 0 … 31 (ELBus Board 1)
Target→Originator bytes 32 … 63 (ELBus Board 2)
2 bytes output data are exchanged controlling the circuit protector.

Design of the output byte per circuit protector slot is as follows (control circuit protector):

	Byte	Type	Range	Description
Control channel 1	0	byte	0 … 255	bit 0 = load output ON/OFF bit 1 = reset load output (only responds to rising edge 0 -> 1) bit 2 = reserve bit 3 = reserve bit 4 = reserve bit 5 = reserve bit 6 = reserve bit 7 = reserve »True« means the status is active.
Control channel 2	1	byte	0 … 255	bit 0 = load output ON/OFF bit 1 = reset load output (only responds to rising edge 0 -> 1) bit 2 = reserve bit 3 = reserve bit 4 = reserve bit 5 = reserve bit 6 = reserve bit 7 = reserve »True« means the status is active.

fig. 19: Output data circuit protector

Sample configuration:

1)
Eight 18plus-AM03 connection modules are connected directly to the CPC20EN, this results in 16 channels connected to the first ELBus-Board.
The O→T data size can be configured to 84 input bytes and 16 bytes T→O data is provided.

Addressing of the output data is corresponding to the ESX sequence.
circuit protector 1, ELBus-Board 1: channel 1.1 control input byte address[0]
circuit protector 1, ELBus-Board 1: channel 1.2 control input byte address[1]
circuit protector 2, ELBus-Board 1: channel 2.1 control input byte address[2]
circuit protector 2, ELBus-Board 1: channel 2.2 control input byte address[3]
circuit protector 3, ELBus-Board 1: channel 3.1 control input byte address[4]
……

Addressing of the input data is corresponding to the ESX sequence.
Status controller: address [0..1],
total current ELBus-Board 1: address[2..3]
circuit prot. 1, ELBus-B. 1: channel 1.1 status: address [4], load current: address [5..6], load voltage: address [7..8]
circuit prot. 1, ELBus-B. 1: channel 1.2 status: address [9], load current: address [10..11], load voltage: address [12..13]
circuit prot. 2, ELBus-B. 1: channel 2.1 status: address [14], load current: address [15..16], load voltage: address [17..18]
circuit prot. 2, ELBus-B. 1: channel 2.2 status: address [15], load current: address [19..20], load voltage: address [21..22]
……

2)

Eight 18plus-AM03 connection modules are connected directly to the CPC20EN, this results in 16 channels connected to the first ELBus-Board. Eight 18plus-AM03 connection modules are connected to the second ELBus-Port of the CPC20EN, this results in 16 channels connected to the second ELBus-Board.
The O→T data size can be configured to 244 input bytes and 48 bytes T→O data is provided.

Addressing of the output data is corresponding to the ESX sequence.
circuit protector 1, ELBus-Board 1: channel 1.1 control input byte address[0]
circuit protector 1, ELBus-Board 1: channel 1.2 control input byte address[1]
circuit protector 2, ELBus-Board 1: channel 2.1 control input byte address[2]
……
circuit protector 16, ELBus-Board 1: channel 32.2 control input byte address[31]
circuit protector 1, ELBus-Board 2: channel 1.1 control input byte address[32]
circuit protector 1, ELBus-Board 2: channel 1.2 control input byte address[33]
……
circuit protector 8, ELBus-Board 2: channel 8.2 control input byte address[47]

Addressing of the input data is corresponding to the ESX sequence.
Status controller: address [0..1],
total current: address[2..3]
circuit prot. 1, ELBus-B. 1: channel 1.1 status: address [4], load current: address [5..6], load voltage: address [7..8]
circuit prot. 1, ELBus-B. 1: channel 1.2 status: address [9], load current: address [10..11], load voltage: address [12..13]
circuit prot. 2, ELBus-B. 1: channel 2.1 status: address [14], load current: address [15..16], load voltage: address [17..18]
……
circuit prot. 16, ELBus-B. 1: channel 32.2 status: address [159], load current: address [160..161], load voltage: address [162..163]
total current ELBus-Board 2: address[164..165]
circuit prot. 1, ELBus-B. 2: channel 1.1 status: address [166], load current: address [167..168], load voltage: address [169..170]
circuit prot. 1, ELBus-B. 2: channel 1.2 status: address [171], load current: address [172..173], load voltage: address [174..175]
…….
circuit prot. 8, ELBus-B. 2: channel 8.2 status: address [201], load current: address [202..203], load voltage: address [204..205]

9 Non-cyclical data

Explicit EtherNet/IP™ messages services allow exchange of further data with the CPC20 controller and the circuit protectors. EtherNet/IP™ Class, Instance and Attribute are required. For reading and editing controller data, Class 100 is used. Class 101 is used for reading and editing the data of the circuit protectors on the first ELBus-Board. Class 102 is used for reading and editing the data of the circuit protectors on the extension board.

The index is set up as follows:

Class ID	Instance ID	Attribute ID	Number of data bytes	Reading (R) writing (W)	Description
100	1	1	19	R	Device information of CPC20 controller (see chapter 9.1.1).
100	1	3	9	R/W	Configuration data of CPC20 controller (see chapter 9.1.2).
100	1	4	1	W	Action commands for all channels and the CPC20 controller (see chapter 9.1.3).
100	1	2	4	R	Dynamic information of CPC20 controller (see chapter 9.1.4).

fig. 20: CPC20 Object Attributes

The non-cyclical access to the data of circuit protectors and/or channels is divided as follows:

Class ID	Instance ID	Attribute ID	Number of data bytes	Reading (R) writing (W)	Description
101..102	01 … 32	3	8	R/W	Device parameters of a channel (see chapter 9.2.1).
101..102	01 … 32	1	19	R	Device information of a channel (see chapter 9.2.2).
101..102	01 … 32	6	2	R/W	Configuration data of a channel (see chapter 9.2.3).
101..102	01 … 32	5	1	R	Event message of a channel (see chapter 9.2.4).
101..102	01 … 32	4	1	W	Action commands for a channel (see chapter 9.2.5).
101..102	01 … 32	2	22	R	Diagnosis data of a channel (see chapter 9.2.6).
101..102	01 … 32	7	800	R	History data of a channel (see chapter 9.2.7)

fig. 21: Channel Object Attributes

9.1 CPC20 controller

The non-cyclical parameters of the controller are described in the following chapters.

9.1.1 »Device information« CPC20 Controller

The device information of the controller consists of 19 bytes.

Class ID = 100, Instance ID = 1 and Attribute ID = 1

Service Code: Get_Attribute_Single (14)

All device information with possible conditions are described in the following table.

	Byte	Type	Range	Description
Device Type	0 HighByte 1 LowByte	UInt16	0 … 65535	16406 = CPC20PN-T2 16438 = CPC20EC-T2 16470 = CPC20EN-T2 16502 = CPC20CC-T2 This list may be extended by future controllers.
Hardware version	2 HighByte 3 LowByte	UInt16	0 … 65535	holds the hardware version of the installed product
Internal assembly order numbers	4 HwHb 5 HwLB 6 LwHB 7 LwLB	UInt32	0 … 4294967295	holds the assembly order no. of the installed product
Internal order number	8 HighByte 9 LowByte	UInt16	0 … 65535	holds the internal order number of the installed product
Production facilities number	10 HighByte 11 LowByte	UInt16	0 … 65535	holds the production facilities number of the installed product
Serial number	12 HwHb 13 HwLB 14 LwHB 15 LwLB	UInt32	0 … 4294967295	holds the serial number of the installed product
Software version (major.x.x)	16	byte	0 … 255	holds the major software version of the installed product
Software version (x.minor.x)	17	byte	0 … 255	holds the major software version of the installed product
Software version (x.x.build)	18	byte	0 … 255	holds the build software version of the installed product

fig. 22: Device information CPC

9.1.2 »Configuration« configuration data of CPC20 Controller

The device configuration data for the controller consists of 17 bytes.

Class ID = 100, Instance ID = 1 and Attribute ID = 3

Service Code: Get_Attribute_Single (14), Set_Attribute_Single (16)

All parameters with possible conditions are described in the following table.

	Byte	Type	Range	Description
Configuration data CPC	0	byte	0 … 255	bit 0 = writing via USB or web server. Allows changing of parameters via the interfaces even when the bus connection is active. bit 1 True: In the event of a bus interruption, the status of the load outputs is maintained. False: In the event a bus interruption, all load outputs will be set to the status OFF. bit 2 = saving mode, the LEDs will be dimmed for power reduction. bit 3 = reserve bit 4 = reserve bit 5 = reserve bit 6 = reserve bit 7 = reserve
Control commands lock **ELBus®** 1 on CPC channel 1 … 16	1 HighByte 2 LowByte	UInt16	0 … 65535	Each bit represents a channel. (bit 0 = channel 1; bit1 = channel 2 …) If the bit is set, this means that the channel is not switched on or off via the control unit or the web server.
Control commands lock **ELBus®** 1 on CPC channel 17 … 32	3 HighByte 4 LowByte	UInt16	0 … 65535	Each bit represents a channel. (bit 0 = channel 17; bit1 = channel 18 …) If the bit is set, this means that the channel is not switched on or off via the control unit or the web server.
Control commands lock **ELBus®** 2 extension. channel 1 … 16	5 HighByte 6 LowByte	UInt16	0 … 65535	Each bit represents a channel. (bit 0 = channel 1; bit1 = channel 2 …) If the bit is set, this means that the channel is not switched on or off via the control unit or the web server.
Control commands lock **ELBus®** extension. channel 17 … 32	7 HighByte 8 LowByte	UInt16	0 … 65535	Each bit represents a channel. (bit 0 = channel 17; bit1 = channel 18 …) If the bit is set, this means that the channel is not switched on or off via the control unit or the web server.
Control commands lock **ELBus®** 3 extension. channel 1 … 16 reserve	9 HighByte 10 LowByte	UInt16	0 … 65535	Each bit represents a channel. (bit 0 = channel 1; bit1 = channel 2 …) If the bit is set, this means that the channel is not switched on or off via the control unit or the web server.
Control commands lock **ELBus®** 3 extension. channel 17 … 32 reserve	11 HighByte 12 LowByte	UInt16	0 … 65535	Each bit represents a channel. (bit 0 = channel 17; bit1 = channel 18 …) If the bit is set, this means that the channel is not switched on or off via the control unit or the web server.
Control commands lock **ELBus®** 4 extension channel 1 … 16 reserve	13 HighByte 14 LowByte	UInt16	0 … 65535	Each bit represents a channel. (bit 0 = channel 1; bit1 = channel 2 …) If the bit is set, this means that the channel is not switched on or off via the control unit or the web server.
Control commands lock **ELBus®** 4 extension channel 17 … 32 reserve	15 HighByte 16 LowByte	UInt16	0 … 65535	Each bit represents a channel. (bit 0 = channel 1; bit1 = channel 2 …) If the bit is set, this means that the channel is not switched on or off via the control unit or the web server.

fig. 23: Configuration data CPC

9.1.3 »System commands« system commands CPC20 Controller

The action commands of the controller consist of 1 byte. All action commands being sent to the CPC20 carry out the action for all channels.

Class ID = 100, Instance ID = 1 and Attribute ID = 4

Service Code: Set_Attribute_Single (16)

All parameters with possible conditions are described in the following table.

	Byte	Type	Range	Description
Action commands	0	byte	0 … 255	115 = reset error memory 118 = reset device parameters to factory settings including CPC20 192 = reset statistics minimum values 196 = reset statistics maximum values 204 = reset device parameters to factory settings 212 = switch off load output 216 = reset load output 200 = reset trip counter 220 = reset statistics mean value Other values will not be accepted.

fig. 24: System commands CPC

9.1.4 »Dynamic information« Dynamic information CPC20 Controller

The dynamic information for the controller consists of 4 bytes.

Class ID = 100, Instance ID = 1 and Attribute ID = 2

Service Code: Get_Attribute_Single (14)

	Byte	Type	Range	Description
cycle time **ELBus®** 1	0 HighByte 1 LowByte	UInt16	0 … 65535	Holds the internal cycle time of the **ELBus®** in milliseconds [ms].
cycle time **ELBus®** 2	2 HighByte 3 LowByte	UInt16	0 … 65535	Holds the internal cycle time of the **ELBus®** in milliseconds [ms].

fig. 25: Dynamic information CPC

9.2 Circuit protectors/channels

The parameters of the circuit protectors are described in the following chapters. The parameters are organized in channels.

9.2.1 »Parameter channel« device parameters for a channel

The device parameters for one channel consist of 8 bytes.

Class ID = 101, Instance ID = 1 … 32 and Attribute ID = 3

Service Code: Get_Attribute_Single (14), Set_Attribute_Single (16)

All parameters with possible conditions are described in the following table.

	Byte	Type	Range	Description
Rated current	0	byte	161 … 170	Holds the current rating of the channel. With adjustable devices, you can set a new current rating here and transmit with a write command. 161 = 1 A current rating (default value) 162 = 2 A current rating 163 = 3 A current rating 164 = 4 A current rating 165 = 5 A current rating 166 = 6 A current rating 167 = 7 A current rating 168 = 8 A current rating 169 = 9 A current rating 170 = 10 A current rating
Switch-on behaviour	1	byte	161 … 163	Defines behaviour when connecting the supply voltage 161 = condition before power off (default value) 162 = off 163 = on
Disconnection after overload	2	byte	105 … 135	Here it is determined at what percentage of rated current of the channel overload shall be signalled. The default value is 120 %.
Trip time at overload	3	byte	0 … 255	Here it is determined after which period of time in the overload range the load output shall be disconnected. The range is from 50 ms up to 10,000 ms. It is calculated with the factor 50. Example for 3000 ms: Trip time at overload (60) * 50 = 3000 ms The default value is 3000 ms.
Trip time under short-circuit conditions	4	byte	0 … 255	Here it is determined after which period of time in the overload range the load output shall be disconnected. The range is from 50 ms up to 1,000 ms. It is calculated with the factor 10. Example for 100 ms: Trip time at overload (10) * 10 = 100 ms The default value is 400 ms
ON delay	5	byte	0 … 255	Here it is determined after which period of time in the overload range the load output shall be disconnected. The range is from 50 ms up to 2,500 ms. It is calculated with the factor 10. Example for 50 ms: Trip time at overload (5) * 10 = 50 ms The default value is 100 ms
limit value load current	6	byte	50 … 100	Determines at which percentage of the current rating of a channel the message »limit value exceeded« (bit in status of cyclical data) is signalled. The range is from 80 % to 100 %. The default value is 80 %.
Hysteresis for the limit value load current.	7	byte	0 … 255	This parameter determines the hysteresis of the limit value current. The range is from 5 % to 20 %. The default value is 5 %.

fig. 26: Device parameters channel

9.2.2 »Device information« device information for one channel

The device information for one channel consists of 19 bytes.

Class ID = 101 … 102, Instance ID = 1 … 32 and Attribute ID = 1

Service Code: Get_Attribute_Single (14)

All parameters with possible conditions are described in the following table.

	Byte	Type	Range	Description
Circuit breaker p/n	0 HighByte 1 LowByte	UInt16		36894 = ESX60D This list may be extended by future controllers.
Hardware version	2 HighByte 3 LowByte	UInt16	0 … 65535	holds the hardware version of the installed product
Internal assembly order no.	4 HwHb 5 HwLB 6 LwHB 7 LwLB	UInt16	0 … 4294967295	holds the assembly order no. of the installed product
Production facilities number	8 HwHb 9 HwLB 10 LwHB 11 LwLB	UInt32	0 … 4294967295	holds the assembly order no. of the installed product
Serial number	12 HwHb 13 HwLB 14 LwHB 15 LwLB	UInt32	0 … 4294967295	holds the serial number of the installed product
Software version (major.x.x)	16	byte	0 … 255	holds the major software version of the installed product
Software version (x.minor.x)	17	byte	0 … 255	holds the major software version of the installed product
Software version (x.x.build)	18	byte	0 … 255	holds the build software version of the installed product

fig. 27: Device information channel

9.2.3 »Device type config« configuration data of for one channel

The configuration data for one channel consist of 2 bytes.

Class ID = 101 … 102, Instance ID = 1 … 32 and Attribute ID = 6

Service Code: Get_Attribute_Single (14), Set_Attribute_Single (16)

All parameters with possible conditions are described in the following table.

	Byte	Type	Range	Description
Circuit breaker p/n	0 HighByte 1 LowByte	UInt16	0 … 65535	36894 = ESX60D This list may be extended by future circuit protectors.

fig. 28: Configuration data channel

9.2.4 »Event« event message for one channel

The event messages for one channel consist of 1 byte.

Class ID = 101 … 102, Instance ID = 1 … 32 and Attribute ID = 5

Service Code: Get_Attribute_Single (14)

All parameters with possible conditions are described in the following table.

	Byte	Type	Range	Description
Event	0	byte	0 … 255	bit 0 = waiting for parameterisation bit 1 = bar chart available bit 2 = new current rating available bit 3 = channel off via momentary switch/switch bit 4 = reserve bit 5 = reserve bit 6 = reserve bit 7 = device error detected »True« means the status is active.

fig. 29: Event messages

9.2.5 »Action commands« action commands for one channel

The action commands for one channel consist of 1 byte.

Class ID = 101 … 102, Instance ID = 1 … 32 and Attribute ID = 4

Service Code: Set_Attribute_Single (16)

All parameters with possible conditions are described in the following table.

	Byte	Type	Range	Description
Action commands	0	byte	0 … 255	117 = delete bar chart 192 = reset minimum values 196 = reset maximum values 200 = reset trip counter 204 = reset parameters to factory setting 208 = switch on load output 212 = switch off load output 216 = reset load output 220 = reset mean values Other values will not be accepted

fig. 30: Action commands channel

9.2.6 »Dynamic Info« dynamic information for one channel

The dynamic information for one channel consist of 22 bytes.

Class ID = 101 … 102, Instance ID = 1 … 32 and Attribute ID = 2

Service Code: Get_Attribute_Single (14)

All parameters with possible conditions are described in the following table.

	Byte	Type	Range	Description
Error memory	0 HighByte 1 LowByte	UInt16	0 … 65535	bit 0 = no parameters available bit 1 = error parameter memory bit 2 = error program memory bit 3 = error data memory bit 4 = error control unit bit 5 = reset through watchdog bit 6 = reserve bit 7 = reserve bit 8 = error current sensor bit 9 = error fail-safe element bit 10 = reserve bit 11 = reserve bit 12 = reserve bit 13 = reserve bit 14 = reserve bit 15 = reserve »True« means the status is active.
Trip counter	2 HighByte 3 LowByte	UInt16	0 … 65535	The number of trippings since the last reset is shown here.
Reason for trip	4	byte	0 … 255	0 = no trip 1 = short circuit 2 = overload 3 = device temperature too high 4 = internal device failure
Min. load voltage	5 HighByte 6 LowByte	UInt16	0 … 65535	Contains the highest measured voltage of the channel since the last reset. A standardised 16-bit-value with a resolution of 10 mV is made available. Example for calculation of the measuring value: Value (2512): 100 = 25.12 Volt
Max. load voltage	7 HighByte 8 LowByte	UInt16	0 … 65535	Contains the highest measured voltage of the channel since the last reset. A standardised 16-bit-value with a resolution of 10 mV is made available. Example for calculation of the measuring value: Value (2512): 100 = 25.12 Volt
Medium value load voltage	9 HighByte 10 LowByte	UInt16	0 … 65535	Contains the mean voltage value of the channel since the last reset. A standardised 16-bit-value with a resolution of 10 mV is made available. Example for calculation of the measuring value: Value (2512): 100 = 25.12 Volt
Min. load current	11 HighByte 12 LowByte	UInt16	0 … 65535	Contains the lowest measured current of the channel since the last reset. A standardised 16-bit-value with a resolution of 10 mA is made available. Example for calculation of the measuring value: Value (150): 100 = 1.50 Ampere

	Byte	Type	Range	Description
Max. load current	13 HighByte 14 LowByte	UInt16	0 … 65535	Contains the highest measured current of the channel since the last reset. A standardised 16-bit-value with a resolution of 10 mA is made available. Example for calculation of the measuring value: Value (150): 100 = 1.50 Ampere
Medium value load current	15 HighByte 16 LowByte	UInt16	0 … 65535	Contains the mean current value of the channel since the last reset. A standardised 16-bit-value with a resolution of 10 mA is made available. Example for calculation of the measuring value: Value (150): 100 = 1.50 Ampere
Supply voltage	17 HighByte 18 LowByte	UInt16	0 … 65535	shows the operating voltage of the channel A standardised 16-bit-value with a resolution of 10 mV is made available. Example for calculation of the measuring value: Value (2512): 100 = 25.12 Volt
Temperature	19 HighByte 20 LowByte	UInt16	0 … 65535	The device temperature is shown directly. Example: 25 corresponds to 25 °C
Diagnostic information of channel	21	byte	0 … 255	0 = OK 1 = available device type does not match the configured type 2 = no device detected 144 = device parameters not plausible 145 = no bar chart 146 = slide switch is in OFF position 147 = detected undervoltage 148 = detected excess temperature 149 = reset command required 150 = command was processed correctly 151 = parameterisation required 152 = Internal failure detected 153 = unknown command 154 = set length error 155 = rated current available, check sum error 156 = current rating selector switch was actuated

fig. 31: Dynamic information

9.2.7 »History« bar chart of circuit protector

The bar chart of a circuit protector contains 400 data sets with the measuring values of load voltage (Uload) and load current (Iload). The measuring values are saved as 8 bit values, i.e. a total of 800 data bytes.

The measuring values are permanently saved in the circuit protector with a frequency of 100 Hz. Recording is stopped with disconnection of the load through short circuit, overload or excess temperature (trip). The bar chart will then contain the measuring values of the last 4 seconds. If for example the trip time at overload is parameterised to be 3 seconds, the measuring values will be saved 1 second before and 3 seconds after overload detection of the circuit protector.

All parameters with possible conditions are described in the following table.
Class ID = 101 … 102, Instance ID = 1 … 32 and Attribute ID = 7 … 10
Service Code: Get_Attribute_Single (14)

Measuring values 1..200 are picked up with attribute 7, the measuring values 201 … 400 with attribute 8, the measuring values 401..600 with attribute 9 and the measuring values 601..800 with attribute 10.
All parameters with possible conditions are described in the following table.

	Byte	Type	Range	Description
load voltage 1	0	byte	0 … 255	The load voltage is calculated as follows: value (148) * 0.2 = 24.864 Volt
load current 1	1	byte	0 … 255	The load current is calculated as follows: (value (151) – 128) * 0.155 = 3.565 Amps
load voltage 2	2	byte	0 … 255	The load voltage is calculated as follows: value (148) * 0.2 = 24.864 Volt
load current 2	3	byte	0 … 255	The load current is calculated as follows: (value (151) – 128) * 0.155 = 3.565 Amps
…	4 … 797	byte	0 … 255	
load voltage 800	798	byte	0 … 255	The load voltage is calculated as follows: value (148) * 0.2 = 24.864 Volt
load current 800	799	byte	0 … 255	The load current is calculated as follows: (value (151) – 128) * 0.155 = 3.565 Amps

fig. 32: Bar chart

10 Appendix

10.1 List of pictures

10.2 Technical data

For the technical data of CPC20 please see relevant data sheet.

Notes

Notes

Notes

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