Multi-channel electronic device circuit breaker with IO-Link interface

User manual

PHOENIX CONTACT
INSPIRING INNOVATIONS

User manual

Multi-channel electronic device circuit breaker with IO-Link interface

UM EN CBMC E4 ... IOL, revision 00 2017-08-31

This user manual is valid for:

Designation	Order No.
CBMC E4 24DC/1-4A+ IOL	2910410
CBMC E4 24DC/1-10A IOL	2910411

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1 For your safety

Read this user manual carefully and keep it for future reference.

1.1 Labeling of warning notes

This symbol indicates hazards that could lead to personal injury.
There are three signal words indicating the severity of a potential injury.

DANGER
Indicates a hazard with a high risk level. If this hazardous situation is not avoided, it will result in death or serious injury.

WARNING
Indicates a hazard with a medium risk level. If this hazardous situation is not avoided, it could result in death or serious injury.

CAUTION
Indicates a hazard with a low risk level. If this hazardous situation is not avoided, it could result in minor or moderate injury.

This symbol together with the **NOTE** signal word alerts the reader to a situation which may cause property damage or a malfunction.

Here you will find additional information or detailed sources of information.

1.2 Qualification of users

The use of products described in this user manual is oriented exclusively to:

- Electrically skilled persons or persons instructed by them. The users must be familiar with the relevant safety concepts of automation technology as well as applicable standards and other regulations.
- Qualified application programmers and software engineers. The users must be familiar with the relevant safety concepts of automation technology as well as applicable standards and other regulations.

2 About this document

2.1 Aim of this document

This user manual helps you to start up and operate the following products:

– CBMC E4 24DC/1-4A+ IOL
– CBMC E4 24DC/1-10A IOL

2.2 Hardware requirements

Table 2-1 Hardware requirements

Hardware	Description
CBMC E4 ... IOL	Multi-channel electronic device circuit breaker with IO-Link interface for protecting four consumers at 24 V DC in the event of overload and short circuit. For order data, see Section "Ordering data" on page 35
IO-Link master	For order data, see Section "Ordering data" on page 35
IO-Link connecting cable	For order data, see Section "Ordering data" on page 35

3 Description of the CBMC E4 24DC/1-4A+ IOL and CBMC E4 24DC/1-10A IOL

The CBMC Circuit Breaker Multichannel Compact CBMC E4 24DC/1-4A+ IOL and CBMC E4 24DC/1-10A IOL are identical in appearance. They only differ with regard to a function. In the following, the term device circuit breaker or CBMC E4 ... IOL is therefore generally used. Any differences are indicated in the corresponding sections of the text, if necessary.

The device circuit breaker CBMC E4 24DC/1-4A+ IOL is approved for use in NEC Class 2 circuits and adjustable to 4 A.

All the latest approvals can be found on the Internet at phoenixcontact.net/products

3.1 General description of the device circuit breaker

The CBMC E4 ... IOL is a multi-channel device circuit breaker with the possibility of setting the nominal current. It is used to protect downstream consumers against overload and short circuit. Using the integrated IO-Link interface also makes possible comprehensive diagnosis and control of the device.

Figure 3-1 CBMC E4 ... IOL

24 V DC power terminal

For the device circuit breaker, observe the correct connection cross section and the maximum feeding current with regard to the ambient temperature. A corresponding temperature derating can be found in Section "Technical data" under "Derating" on page 34.

IO-Link connection

The integrated IO-Link connection according to IO-Link standard 1.1 ensures the connection to the IO-Link master. With the help of the IO-Link protocol, it is possible to receive and send the cyclic and acyclic data of the device circuit breaker (see Section 5 "Process data and status information").

Delivery state

On delivery, the product has a defined default setting. All channels are switched off and set to 4A at the factory. The user-interface locks are all deactivated and the read only memory of the device is used for securing the device settings. You can find more standard values of the device circuit breaker in Section 5.2 on page 20.

3.2 Possible fields of application of the device circuit breaker

The CBMC E4 ... IOL as overload and short-circuit protection

The main function of the device circuit breaker is to protect the consumers and cables connected on the output side against overload and short circuit. Up to 4 load current circuits can be secured at the device circuit breaker.

In order to be able to fully operate the CBMC E4 ... IOL, a power supply and an IO-Link master with upstream control are required.

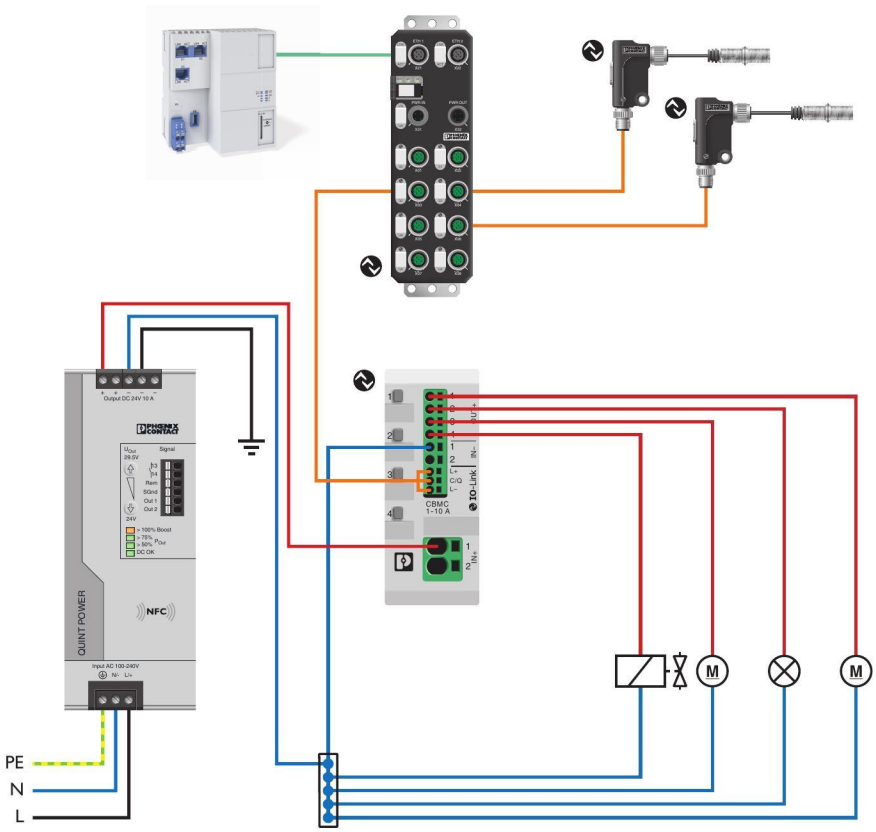

Figure 3-2 IO-Link with CBMC topology

3.3 Connection and operating elements

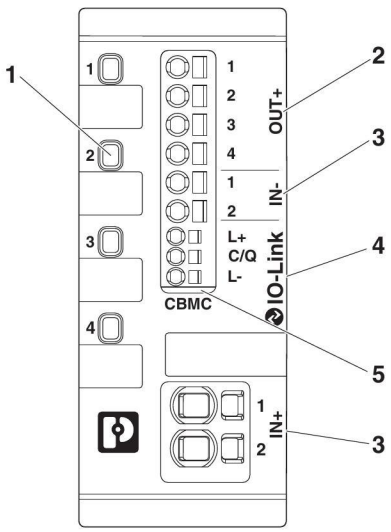

Figure 3-3 CBMC E4 ... IOL operating elements

1. Channel LED button
2. Protected outputs
3. 24 V DC supply
4. IO-Link interface
5. IO-Link LED

3.3.1 Channel LED button

The channel LED button of the CBMC E4 ... IOL is a multi-functional button. The channel state can be completely influenced with it.

Table 3-1 Channel LED button

Function	Description
On / Off	Actuate the button briefly (<2 seconds) to switch the channel on and off.
Programming mode	– The respective channel of the programming mode is activated by actuating the channel LED button for a longer time (>2 seconds). This is signaled by a channel LED flashing yellow. – Now the currently set nominal current can be read out via the flashing sequence displayed on the LED. – Furthermore, it is possible to enter a new nominal current by briefly actuating the LED button repeatedly For example, 4x actuation for 4 amps. – Afterwards, the desired nominal current can be controlled via the LED flashing sequence. – By actuating for a longer time (> 2 seconds) the new nominal current for the channel is taken on.

- After 60 seconds without activity the programming mode automatically switches off. Possible changes are discarded and the channel takes on its previous state again.
- The programming of channels can also be done while in operation. The channels do not need to be switched off.
- Initial programming:
  After the channel has been switched on, it may occur that the channel shuts off and the LED blinks red. Check the currents that have been set.

3.3.2 Diagnostics and status indicators

Designation	State	Color	Description
Channel LED button	On	Green	Channel is switched on and ready.
		Yellow	The flowing channel current is >80% of the set nominal current.
		Red	The channel has triggered due to overload or short circuit, and is in the 5-second cooldown phase. In the case of constant illumination for more than 5 seconds, there is a defect in the power path of the CBMC E4 … IOL. The device has to be replaced in the event of such an error pattern.
	1-4 on	Red	The initial voltage is outside the prescribed range of 18 ... 30 V DC.
	Flashing	Yellow	Channel is in manual programming mode. The currently set/entered nominal current is output by the flashing.
		Red	Cooling phase after short circuit or overload release ended. Restart possible.
	Off	---	Channel switched off
IO-Link LED	Flashing	Green	IO-Link communication exists (preoperate/operate)
	Off	---	There is no connection to the IO-Link master.

The IO-Link LED under the terminal lock of the device is used for visual communication confirmation. The LED flashes in the case of an active IO-Link connection with data exchange between master and device. If you do not get any visual feedback via the LED, check the IO-Link connection and the IO-Link master configuration.

3.4 Operating modes

3.4.1 Independent operation

The device can be operated without an IO-Link. For this, only the supply voltage and ground need to be connected. The channel states and the nominal currents can be adjusted via the buttons.

For safety reasons, the device access locks retain their state even after a voltage reset (see Section "Device access locks" on page 29). If the device should be operable without IO-Link by means of buttons, previously activated device access locks should be deactivated per IO-Link beforehand.

After a voltage reset, the last parameters written acyclically per IO-Link /programmed by button are loaded from the read only memory.

If the channels should first be switched off after start-up, until they are switched by buttons, for example, this can be configure beforehand via Index 3328_{dec} (see Section "State of the channels after voltage reset" on page 23).

3.4.2 IO-Link operation

For operation with IO-link, the three IO-Link conductors (L+, C/Q, L-) must be connected with the master and the port configured in the IO-Link master. If desired, the device can also be pre-configured without supply voltage at IN+ by means of acyclic access. The output channels can only be physically switched on, however, when the voltage at the "IN+" connection is in the range of the permitted operating voltage.

The device is automatically in IO-Link operation when it is connected to a configured master port. An existing connection is signaled by the flashing of the green IO-Link LED (under the "L-" connection at the terminal lock, see Figure 3-3). Parameterization is then performed by means of acyclic and cyclic access (see Sections "Cyclic process data" on page 17 and "Acyclic data" on page 20). If the data storage mechanism in the master is active, the checksums in the device and in the master are compared and the parameters exchanged correspondingly.

After a voltage reset, the device circuit breaker behaves identically in IO-Link operation as in independent operation.

4 Mounting and power supply

4.1 Mounting the device circuit breaker

Mounting location

The CBMC E4 ... IOL meets the IP20 degree of protection. The compact design means that the device circuit breaker can be installed in standard terminal boxes.

Mounting/DIN rail

The device circuit breaker can be mounted tool-free on the DIN rail.

Removal

A standard tool (e.g., a bladed screwdriver with a blade width of 2.5 mm) can be used to remove the device circuit breaker.

Mounting position

Mount the device horizontally. The ventilation slots should be oriented upward or downward. Maintain a minimum distance of 30 mm on the top and bottom to ensure convection cooling (see Figure 4-1 "Convection cooling"and Figure 4-2 "Minimum distance").

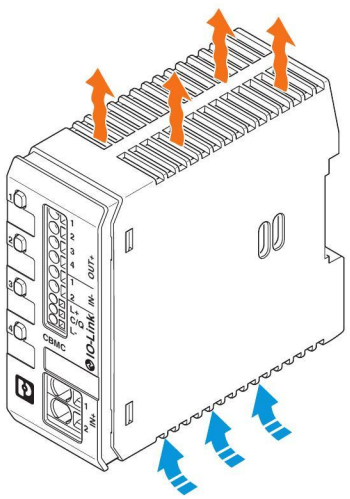

Figure 4-1 Convection cooling

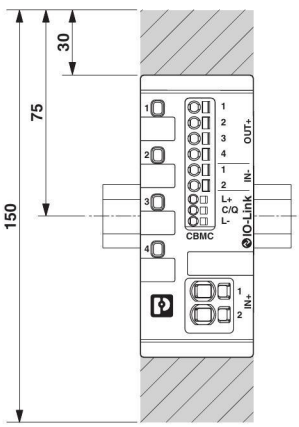

Figure 4-2 Minimum distance

4.2 Power supply connection

Select a power supply unit that covers the power needs of your downstream devices. The selection depends on the resulting maximum currents.

- In order to comply with UL approval, use copper cables that are designed for operating temperatures ≥ 75 °C.
- Ensure cables are correctly sized for the maximum input and output current.
- It is imperative to connect the negative pole to the IN- terminal to ensure self-supply.

4.3 Connecting the IO-Link connection

Pay attention to the correct assignment of the cables when connecting the IO-Link connection.

Table 4-1 IO-Link connection

Connection	Function	Color	Wire no.
L+	Positive supply voltage of IO-Link communication.	Brown	1
C/Q	Data channel.	Black	4
L-	0-Volt power supply of IO-Link communication.	Blue	3

4.4 IODD file

The current IODD file for IO-Link device integration can be found in the download area of the product under configuration file at www.phoenixcontact.net.

In order to build up IO-Link communication, the vendor and device ID must be entered for some IO-Link masters. You can find these in the table below.

Table 4-2 Vendor and device ID

ID	Decimal	Hexadecimal
Vendor ID (Phoenix Contact)	176	00 B0
Device ID (CBMC E4 24DC/1-4A+ IOL)	393520	06 01 30
Device ID (CBMC E4 24DC/1-10A IOL)	393504	06 01 20

5 Process data and status information

5.1 Cyclic process data

Data from IO-Link master to CBMC IO-Link (PDout)

The channels can be switched on and off and the nominal currents changed through the cyclic process output data (PDout) of the master to CBMC E4 ... IOL. The data is transmitted in three bytes (see Table 5-1). Settings by means of PDout are not saved in the read only memory of the CBMC E4 ... IOL, in contrast to acyclic data or button entries. This means it is possible to frequently switch the outputs cyclically without influencing the service life of the internal read only memory.

Table 5-1 Bit-assignment of the PDout data type

Byte 0	PDout	Valid Flag	Reserved			Switch channel 4	Switch channel 3	Switch channel 2	Switch channel 1
	Bit	23	22	21	20	19	18	17	16
Byte 1	PDout	Nominal current channel 1				Nominal current channel 2			
	Bit	15	14	13	12	11	10	9	8
Byte 2	PDout	Nominal current channel 3				Nominal current channel 4			
	Bit	7	6	5	4	3	2	1	0

Example:

PDout = 8F AA AA_{hex} (PDout valid, switch all channels on, and all four nominal currents to 10 A)

The CBMC E4 ... IOL can also be operated in the case of cyclic communication on the user interface using buttons, insofar as this function is not blocked by device access locks (see Section "Device access locks" on page 29. Button entries effect the change into "independent operation" in which the device receives, but ignores, the cyclic data coming from the master, until this changes again in at least one bit.

A change of the nominal current via PDout also effects a change back to IO-Link operation, so that channels can be switched on and off in this way.

Validity PDout (Valid Flag)

In order for the device to perceive the PDout of the master as valid, it is necessary that the MSB is set from Byte [0] to 1. In the case of a 0 in the MSB, the received PDout is ignored.

Switch channel

For switching on, a 1 must be written into the bit of the respective channel. Correspondingly, a 0 must be written at the desired bit position for switching off. When several channels are switched on concurrently, these are switched on sequentially with 100 ms difference.

If an error in the power path is detected on a channel (see Section "Diagnostics and status indicators" on page 12), it is not possible to switch on the channel, either by button or via IO-Link.

Nominal current

The nominal current for each channel is transmitted in four bits. The valid value range for a nominal current is limited to entries of 1 … 4 or 1 … 10 depending on the device variants.

Data from BMC IO-Link to the master

The CBMC E4 ... IOL provides the master with its current process data. This contains the channel status, error status, present load current, and the input voltage of the CBMC E4 ... IOL. The data is encoded as follows in 8 Byte process input data:

Table 5-2 Bit assignment of data type "CBMC IO-Link to master"

Byte 0	PDin	Status channel 1	Status channel 2	Status channel 3	Status channel 4	Error channel 1	Error channel 2	Error channel 3	Error channel 4
	Bit	63	62	61	60	59	58	57	56
	Subindex	1	2	3	4	5	6	7	8

Byte 1	PDin	Nominal current channel 1				Nominal current channel 2			
	Bit	55	54	53	52	51	50	49	48
	Subindex	9				10			

Byte 2	PDin	Nominal current channel 3				Nominal current channel 4			
	Bit	47	46	45	44	43	42	41	40
	Subindex	11				12			

Byte 3	PDin	Load current channel 1							
	Bit	39	38	37	36	35	34	33	32
	Subindex	13							

Byte 4	PDin	Load current channel 2							
	Bit	31	30	29	28	27	26	25	24
	Subindex	14							

Byte 5	PDin	Load current channel 3							
	Bit	23	22	21	20	19	18	17	16
	Subindex	15							

Byte 6	PDin	Load current channel 4							
	Bit	15	14	13	12	11	10	9	8
	Subindex	16							

Byte 7	PDin	Input voltage							
	Bit	7	6	5	4	3	2	1	0
	Subindex	17							

Channel status

The channel status is transmitted in a bit and corresponds to the current status of the respective channel. A 1 corresponds to the "on" state; a 0 corresponds to the "off" state.

Error status

The error status is transmitted in a bit and corresponds to the current error status of the respective channel. A 1 means that the corresponding channel was switched off after an error. A 0 means that no error exists. Switching on a channel that was switched off by an error resets its error status to 0.

Load current channel

The load current at a channel is encoded in one byte. The value range 0 ... 255 corresponds with a gradient of 0.1 to the value range of 0.0 A ... 25.5 A.

Input voltage

The input voltage of the CBMC E4 ... IOL is encoded in one byte. The value range of 0 ... 255 corresponds with an offset of 10 V and a gradient of 0.1 to a representable voltage range of 10.0 V ... 35.5 V.

The process data is also available via acyclic access (see Section "Acyclic data" on page 20)

5.2 Acyclic data

Table 5-3 Acyclic data

Index	Subindex	Name	Description	Length	Access right	Value range	Default value	Gradient	Offset
2_{dec} 02_{hex}	0	System command	Upload parameters in data memory	1 byte	wo	5_{dec} 5_{hex}	-	-	-
			Restart device			128_{dec} 80_{hex}			
			Restore default state			130_{dec} 82_{hex}			
12_{dec} $0C_{hex}$	0	Device access lock	Reserved	2 bytes	rw	Bit 0: 0	0	-	-
			Data memory lock			Bit 1: 0;1	0		
			Local parameterization lock			Bit 2: 0;1	0		
			Local user interface lock			Bit 3: 0;1	0		
			Reserved			Bit 4-15: 0	0		
16_{dec} 10_{hex}	0	Manufacturer	-	15 bytes	ro	-	-	-	-
17_{dec} 11_{hex}	0	Manufacturer text	Manufacturer URL	22 bytes	ro	-	-	-	-
18_{dec} 12_{hex}	0	Product name	-	22 bytes	ro	-	-	-	-
19_{dec} 13_{hex}	0	Product ID	Order number	7 bytes	ro	-	-	-	-
20_{dec} 14_{hex}	0	Product text	-	52 bytes	ro	-	-	-	-
21_{dec} 15_{hex}	0	Serial number	-	10 bytes	ro	-	-	-	-
22_{dec} 16_{hex}	0	Hardware version	-	4 bytes	ro	-	-	-	-
23_{dec} 17_{hex}	0	Firmware version	-	4 bytes	ro	-	-	-	-

Table 5-3 Acyclic data

Index	Subindex	Name	Description	Length	Access right	Value range	Default value	Gradient	Offset
40_{dec} 28_{hex}	0	Process data input	PDin	8 bytes	ro	-	-	-	-
	1		Switching state OUT1	1 bit		0; 1			
	2		Switching state OUT2						
	3		Switching state OUT3						
	4		Switching state OUT4						
	5		Error OUT1	1 bit		0; 1	-		
	6		Error OUT2						
	7		Error OUT3						
	8		Error OUT4						
	9		Nominal current OUT1	4 bits		1 – 4 A/ 1 - 10 A	-		
	10		Nominal current OUT2						
	11		Nominal current OUT3						
	12		Nominal current OUT4						
	13		Load current OUT1	1 byte		0 - 25.5 A	-	0.1	
	14		Load current OUT2						
	15		Load current OUT3						
	16		Load current OUT4						
	17		Input voltage	1 byte		10 - 35.5 V	-	0.1	10
41_{dec} 29_{hex}	0	Process data output	PDout	3 bytes	ro	-	-	-	-
64_{dec} 40_{hex}	0	Product range	-	58 bytes	ro	-	-	-	-
3328_{dec} $0D00_{hex}$	0	Channel state after voltage reset	Load state from read only memory/ all channels out	1 byte	rw	0; 1	0	-	-
3329_{dec} $0D01_{hex}$	0	Switching state	OUT1-4	4 bytes	rw	0; 1	0	-	-
	1		OUT1	1 byte		0; 1			
	2		OUT2	1 byte		0; 1			
	3		OUT3	1 byte		0; 1			
	4		OUT4	1 byte		0; 1			

Table 5-3 Acyclic data

Index	Subindex	Name	Description	Length	Access right	Value range	Default value	Gradient	Offset
3330_{dec} $0D02_{hex}$	0	Local programming lock	OUT1-4	4 bytes	rw	0; 1	0	-	-
	1		OUT1	1 byte		0; 1			
	2		OUT2	1 byte		0; 1			
	3		OUT3	1 byte		0; 1			
	4		OUT4	1 byte		0; 1			
3331_{dec} $0D03_{hex}$	0	Nominal current	OUT1-4	4 bytes	rw	1 – 4 A/ 1 - 10 A	4	-	-
	1		OUT1	1 byte					
	2		OUT2	1 byte					
	3		OUT3	1 byte					
	4		OUT4	1 byte					
3332_{dec} $0D04_{hex}$	0	Error memory	Error history (FIFO)	15 bytes	ro	-	-	-	-
3333_{dec} $0D05_{hex}$	0	Output voltages	OUT1-4	8 bytes	ro	0 - 30 V	-	0.1	-
	1		OUT 1	2 bytes					
	2		OUT 2	2 bytes					
	3		OUT 3	2 bytes					
	4		OUT 4	2 bytes					

5.2.1 IO-Link specific parameters

System commands

System command 5_{dec}

The device supports the possibility of uploading parameters that are changed in the data memory of the IO-Link master. The parameters that are uploaded when the system command ("ParamDownloadStore") is called up, are:

– Channel state after voltage reset
– Nominal currents
– Programming locks

Changing a nominal current by button on the device also triggers uploading of the parameters in the data memory of the IO-Link master, insofar as the data memory function in the master is activated, and the device access lock of the data memory is inactive.

System command 128_{dec}

The system command allows the controller of the CCBMC E4 ... IOL to be restarted.

System command 130_{dec}

The system command resets the device to its default settings.

With it:

- All channels are disabled
- Errors are acknowledged
- Nominal currents are set to delivery value
- Device access locks are deactivated
- Programming locks are deactivated
- Setting of the channel state after voltage reset to "load channel states from read only memory"
- Error memory emptied (FIFO)
- Error in power path deleted

Serial number

The serial number of the device is located under Index 21_{dec} and is stored as CHAR.

Hardware version

The hardware version of the device is located under Index 22_{dec} and is stored as CHAR.

Firmware version

The firmware version of the device is located under Index 23_{dec} and is stored as CHAR.

Process data from the device to master (PDin)

The device allows index/subindex access to the process data. The 8 byte PDin is returned under Index 40_{dec} with Subindex 0. The assignment according to the subindex is described in Section "Cyclic process data" on page 17.

Process data from the master to device (PDout)

The process data from the master to device can be retrieved via Index 41_{dec}. In the case of read access, 3 bytes are returned.

Product range

The product range is located under Index 64_{dec} and stored as CHAR.

5.2.2 Device-specific parameters

State of the channels after voltage reset

The setting for the last channel states from the read only memory or the channels should always be off after a voltage reset, is read- and writable under Index 3328_{dec}.

Bit [0]:

0: channels after start-up are at last state that was acyclically written or set by button (standard value)

1: channels after start-up are off; waiting for cyclic/acyclic or button entry.

Table 5-4 Bit-assignment of data type, "State of the channels after voltage reset"

Byte 0	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
	0	0	0	0	0	0	0	1/0

Channel state

The channels of the device can be switched on and off via Index 3329_{dec}. By accessing Subindex 0, all four channel states can be read or written (if several channels are switched on via Subindex 0 access, the actual switching-on always happens sequentially with 100 ms delay).

If an error in the power path is detected on a channel (see Section"Diagnostics and status indicators" on page 12), it is not possible to switch on the channel, either per button or via IO-Link. Acyclic access that should switch on the channels is acknowledged with an error event.

Table 5-5 Bit-assignment of data type "Channel state"

Switching state channel 1								
Byte 0	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
	0	0	0	0	0	0	0	1/0

Switching state channel 2								
Byte 1	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
	0	0	0	0	0	0	0	1/0

Switching state channel 3								
Byte 2	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
	0	0	0	0	0	0	0	1/0

Switching state channel 4								
Byte 3	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
	0	0	0	0	0	0	0	1/0

The value range for this index consists of two values for channel on and for channel off.

Example:

Subindex 0 read access returns the byte sequence 01 00 00 00_{hex}. From this, it can be read that only channel 1 is currently switched on.

The individual channel states of channels 1-4 are read- and writable under Subindex 1-4.

Local programming lock

Bit [0]:

0: Programming mode permitted (standard value)

1: Programming mode blocked for respective channel

Table 5-6 Bit-assignment of data type "Local programming lock"

Programming lock active/inactive channel 1								
Byte 0	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
	0	0	0	0	0	0	0	1/0

Programming lock active/inactive channel 2								
Byte 1	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
	0	0	0	0	0	0	0	1/0

Programming lock active/inactive channel 3								
Byte 2	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
	0	0	0	0	0	0	0	1/0

Programming lock active/inactive channel 4								
Byte 3	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
	0	0	0	0	0	0	0	1/0

If the nominal current should not be programmable by button on all channels, the device access lock "Local parameterization lock" can also be used for this.

Nominal current

The nominal current setting can be found under Index 3331. The nominal currents of all channels can be retrieved under Subindex 0 for read and write access, and the respective nominal current of a channel is encoded in Bit [0] to Bit [3].

Table 5-7 Bit-assignment of data type "Nominal current"

Nominal current channel 1								
Byte 0	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
	0	0	0	0	1/0	1/0	1/0	1/0

Nominal current channel 2								
Byte 1	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
	0	0	0	0	1/0	1/0	1/0	1/0

Nominal current channel 3								
Byte 2	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
	0	0	0	0	1/0	1/0	1/0	1/0

Nominal current channel 4								
Byte 3	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
	0	0	0	0	1/0	1/0	1/0	1/0

Example:

Byte [0] = 03_{hex} corresponds to a set nominal current of 3 A on channel 1. In the case of write access, whole-number nominal currents from 1 to 4 A or 1 to 10 A are accepted, depending on the device variant.

The individual nominal currents of channel 1-4 are read- and writable under Subindex 1-4.

Error memory

The device offers the possibility of retrieving an error history via Index 3332_{dec}. The last 15 errors are encoded in 15 bytes. The latest errors are located in Byte [0] and the oldest in Byte [14]. If a new error is recorded, the oldest error is deleted in parallel (FIFO principle).

The values in FIFO have the following meaning:

Table 5-8 Error memory

$Value_{dec}$	**Indicates**
0	FIFO slot empty (e.g. after "Reset to the factory settings" command)
1	Short circuit channel 1
2	Short circuit channel 2
3	Short circuit channel 3
4	Short circuit channel 4
5	Overload channel 1
6	Overload channel 2
7	Overload channel 3
8	Overload channel 4
9	Undervoltage
10	Surge voltage
11	Error power path (MOSFET / Fail-safe element defective) channel 1
12	Error power path (MOSFET / Fail-safe element defective) channel 2
13	Error power path (MOSFET / Fail-safe element defective) channel 3
14	Error power path (MOSFET / Fail-safe element defective) channel 4

Output voltages

The output voltages of the channels can be retrieved via Index 3333_{dec}. The voltages of all channels together are stored under Subindex 0 and are returned in 8 bytes. Each channel's output voltage is encoded in 2 bytes.

Table 5-9 Bit-assignment of data type "output voltages"

Output voltage channel 1								
Byte 0	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8
(high)	1/0	1/0	1/0	1/0	1/0	1/0	1/0	1/0
Byte 1	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
(low)	1/0	1/0	1/0	1/0	1/0	1/0	1/0	1/0

Output voltage channel 2								
Byte 2	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8
(high)	1/0	1/0	1/0	1/0	1/0	1/0	1/0	1/0
Byte 3	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
(low)	1/0	1/0	1/0	1/0	1/0	1/0	1/0	1/0

Output voltage channel 3								
Byte 4	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8
(high)	1/0	1/0	1/0	1/0	1/0	1/0	1/0	1/0
Byte 5	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
(low)	1/0	1/0	1/0	1/0	1/0	1/0	1/0	1/0

Output voltage channel 4								
Byte 6	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8
(high)	1/0	1/0	1/0	1/0	1/0	1/0	1/0	1/0
Byte 7	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
(low)	1/0	1/0	1/0	1/0	1/0	1/0	1/0	1/0

Example:

With Byte [0] = 01_{hex} and Byte [1] = $2B_{hex}$, the result is the 16 bit value 01 $2B_{hex}$. This corresponds to the value 299_{dec}. The voltage value comes from multiplying the 16-bit value by a gradient of 0.1. This results in an output voltage of 29.9 V.

The individual voltages of the channels are reached under Subindex 1-4.

5.3 Events

The device supports the following events:

Table 5-10 Events

Event code	Designation	Type	Mode	Description
36000_{dec} $8CA0_{hex}$	HW error (power path) OUT1	Error	Single event	Fuse or MOSFET in power path OUT1 defective
36001_{dec} $8CA1_{hex}$	HW error (power path) OUT2	Error	Single event	Fuse or MOSFET in power path OUT2 defective
36002_{dec} $8CA2_{hex}$	HW error (power path) OUT3	Error	Single event	Fuse or MOSFET in power path OUT3 defective
36003_{dec} $8CA3_{hex}$	HW error (power path) OUT4	Error	Single event	Fuse or MOSFET in power path OUT4 defective
36016_{dec} $8CB0_{hex}$	Short circuit switch-off OUT1	Warning	Single event	OUT1 switched off because of short circuit
36017_{dec} $8CB1_{hex}$	Short circuit switch-off OUT2	Warning	Single event	OUT2 switched off because of short circuit
36018_{dec} $8CB2_{hex}$	Short circuit switch-off OUT3	Warning	Single event	OUT3 switched off because of short circuit
36019_{dec} $8CB3_{hex}$	Short circuit switch-off OUT4	Warning	Single event	OUT4 switched off because of short circuit
36032_{dec} $8CC0_{hex}$	Overload shutdown OUT1	Warning	Single event	OUT1 switched off because of overload
36033_{dec} $8CC1_{hex}$	Overload shutdown OUT2	Warning	Single event	OUT2 switched off because of overload
36034_{dec} $8CC2_{hex}$	Overload shutdown OUT3	Warning	Single event	OUT3 switched off because of overload
36035_{dec} $8CC3_{hex}$	Overload shutdown OUT4	Warning	Single event	OUT4 switched off because of overload
36048_{dec} $8CD0_{hex}$	Undervoltage shutdown IN+	Warning	Coming/Going	Permitted minimum voltage not reached
36049_{dec} $8CD1_{hex}$	Surge voltage shutdown IN+	Warning	Coming/Going	Permitted maximum voltage exceeded
36056_{dec} $8CD8_{hex}$	Total current switch off OUT1	Warning	Single event	Total current switch off trigger: OUT1 carried maximum current

Table 5-10 Events

Event code	Designation	Type	Mode	Description
36057_{dec} $8CD9_{hex}$	Total current switch off OUT2	Warning	Single event	Total current switch off trigger: OUT2 carried maximum current
36058_{dec} $8CDA_{hex}$	Total current switch off OUT3	Warning	Single event	Total current switch off trigger: OUT3 carried maximum current
36059_{dec} $8CDB_{hex}$	Total current switch off OUT4	Warning	Single event	Total current switch off trigger: OUT4 carried maximum current

5.4 Device access locks

The device supports three different device access locks. All device access locks are inactive in delivery state and after the "Reset default settings" system command is carried out.

Table 5-11 Device access locks

Device access lock	Effect
Data storage lock	Parameter changes are not uploaded in the data storage of the IO-Link master.
Local parameterization lock	The nominal currents of the channels can no longer be programmed via the buttons on the device. Display of the nominal current is still possible by pressing the button for a long time. The channels can still be switched on and off with the buttons.
Local user interface lock	All button functions are deactivated.

5.5 Data storage (IO-Link data storage)

The device supports the data storage function of IO-Link standard 1.1. The data storage objects include the nominal currents, the setting of channels after voltage reset, and the programming locks for the channels.

The channel states are not data memory objects and can be changed either acyclically per index access or by means of process data outputs (PDout).

A Technical appendix

A 1 Technical data

Dimensions (nominal sizes in mm)	

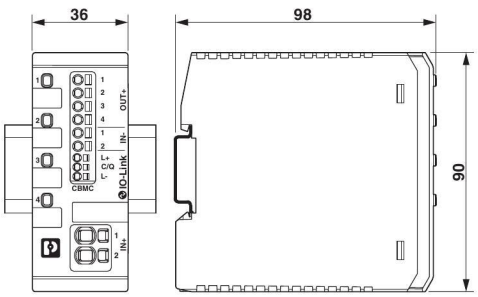

Figure A-1 Dimensions

Height	90 mm
Width	36 mm
Depth	98 mm

Ambient conditions	
Ambient temperature (operating)	-25 °C ... 60 °C
Ambient temperature (storage/transport)	-40°C…70°C
Humidity test	96 h, 95% RH, 40°C
Altitude	2000 m
Degree of protection	IP20

General	
Flammability rating according to UL 94	V-0
Mounting type	DIN rail: 35 mm
Color	Light gray RAL 7035
Protection class	III
Pollution degree	2
Design	DIN rail module, one-piece

Electrical data	
Fuse type	Electronic
Rated surge voltage	0.5 kV
Operating voltage	18 V DC ... 30 V DC
Rated voltage	24 V DC
Rated current IN	Max. 40 A DC Max. 40 A DC (per terminal position when bridging additional devices via IN+) 1 / 2 / 3 / 4 / 5 / 6 / 7 / 8 / 9 / 10 A DC (settable per output channel)
Measuring tolerance I	15 % typ.
Rated insulation voltage Ui	30 V (load circuit)
Feedback resistance	35 V DC max.
Switch-on delay	0.1 s (cascaded per output channel)
Required backup fuse	Not required, integrated failsafe element
Internal output fuse	15 A DC (per output channel)
Status indicator	LED (green, yellow, red)
Efficiency	> 99 %
Closed circuit current I0	33 mA, typ.
Power dissipation	0.8 W typ. (no-load operation)
	9 W (nominal operation)
Module initialization time	1.6 s
Waiting time after switch off of a channel	5 s (in the event of overload / short circuit)
Temperature derating	24 A DC (at 60 °C) 28 A DC (at 54 °C) 32 A DC (at 47 °C) 36 A DC (at 41 °C) 40 A DC (at 35 °C)
Electric strength	35 V DC max. (load circuit)
Contact type	Without electrical isolation
MTBF (IEC 61709, SN 29500)	8403361 h (at 25°C with 21 % load) 3067484 h (at 40 °C with 34.25 % load) 534188 h (at 60 °C with 100 % load)
Shutdown time load circuit	≤ 10 ms (for short circuit > 2.0 x IN)
Undervoltage shutdown load circuit	1 s (1.2 ... 2.0 x IN) ≤ 17.8 V DC (active) ≥ 18.8 V DC (inactive)
Surge voltage shutdown load circuit	≥ 30.5 V DC (active)
Max. capacitive load load circuit	≤ 29.5 V DC (inactive) 45000 µF (depending on the current setting and the short-circuit current available)
Vibration resistance, frequency	10 Hz ... 150 Hz (transmission frequency 58 Hz)
Vibration resistance, acceleration	49 m/s^2
Vibration resistance test duration	150 min. (per axis and direction)

Connection data main circuit IN+	
Connection method	Push-in connection
Stripping length	15 mm
Conductor cross section solid	0.2 mm² ... 10 mm²
AWG conductor cross section	15 ... 8
Conductor cross section flexible, with ferrule, with plastic sleeve	0.25 mm² ... 4 mm²
Conductor cross section flexible, with ferrule, w/o plastic sleeve	0.25 mm² ... 6 mm²

Main circuit IN-	
Connection method	Push-in connection
Stripping length	10 mm
Conductor cross section solid	0.2 mm² ... 2.5 mm²
AWG conductor cross section	24 ... 12
Conductor cross section flexible, with ferrule, with plastic sleeve	0.25 mm² ... 1.5 mm²
Conductor cross section flexible, with ferrule, w/o plastic sleeve	0.25 mm² ... 2.5 mm²

Main circuit OUT	
Connection method	Push-in connection
Stripping length	10 mm
Conductor cross section solid	0.2 mm² ... 2.5 mm²
AWG conductor cross section	24 ... 12
Conductor cross section flexible, with ferrule, with plastic sleeve	0.25 mm² ... 1.5 mm²
Conductor cross section flexible, with ferrule, w/o plastic sleeve	0.25 mm² ... 2.5 mm²

Remote indication contact	
Connection method	Push-in connection
Switching function	N/O contact
Stripping length	10 mm
Conductor cross section solid	0.2 mm² ... 2.5 mm²
AWG conductor cross section	24 ... 12
Conductor cross section flexible, with ferrule, with plastic sleeve	0.25 mm² ... 1.5 mm²
Conductor cross section flexible, with ferrule, w/o plastic sleeve	0.25 mm² ... 2.5 mm²
DC operating voltage	0 V DC ... 30 V DC
DC operating current	100 mA DC

IO-Link connection	
Connection method	Push-in connection
Stripping length	10 mm
Conductor cross section solid	0.2 mm² ... 1.5 mm²
AWG conductor cross section	24 ... 16
Conductor cross section flexible, with ferrule, with plastic sleeve	0.2 mm² ... 0.75 mm²
Conductor cross section flexible, with ferrule, w/o plastic sleeve	0.25 mm² ... 1.5 mm²

A 1.1 Derating

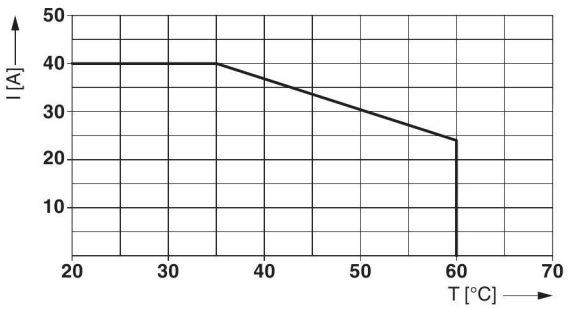

Figure A-2 Derating

A 1.2 Tripping characteristics

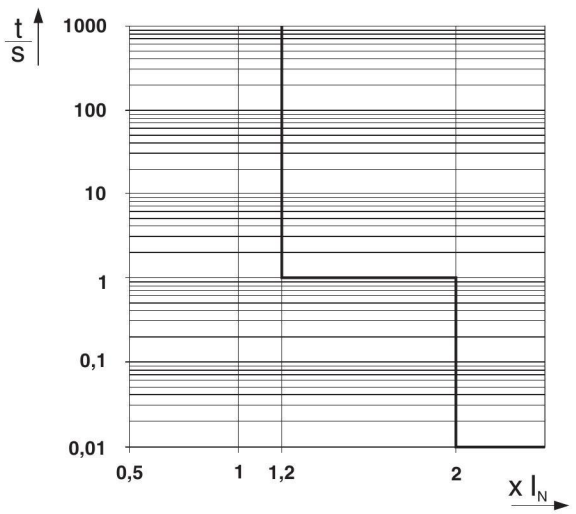

Figure A-3 Tripping characteristics

A 2 Ordering data

Products			
Description	**Type**	**Order No.**	**Pcs./Pkt.**
Multi-channel electronic circuit breaker with IO-Link interface for protecting four consumers at 24 V DC in the event of overload and short circuit. With electronic locking of the set nominal currents. For installation on DIN rails.			
– Adjustable from 1 A to 4 A	CBMC E4 24DC/1-4A+ IOL	2910410	1
– Adjustable from 1 A to 10 A	CBMC E4 24DC/1-10A IOL	2910411	1

Accessories			
Description	**Type**	**Order No.**	**Pcs./Pkt.**
Customer-specifically programmed version of the primary-switched QUINT POWER power supply for DIN rail mounting with free choice of output characteristic curve and SFB (Selective Fuse Breaking) Technology, input: 1-phase, output: 24 V DC/10 A	QUINT4-PS/1AC/24DC/10/...	2907867	1
Primary-switched TRIO POWER power supply with push-in connection for DIN rail mounting, input: single phase, output: 24 V DC/10 A	TRIO-PS-2G/1AC/24DC/10	2903149	1
Label, roll, white, unmarked, can be marked with: THERMOMARK ROLL, THERMOMARK ROLL X1, THERMOMARK ROLLMASTER 300/600, THERMOMARK X1.2, THERMOMARK S1.1, mounting type: adhered, lettering field size: 10 x 7 mm	EML (10X7)R	0816663	1
Equipment marking, roll, white, unmarked, can be marked with: THERMOMARK ROLL, THERMOMARK ROLL X1, THERMOMARK ROLLMASTER 300/600, THERMOMARK X1.2, THERMOMARK S1.1, mounting type: adhered, lettering field size: 20 x 7 mm	EML-ESD (20 X 7)R	0830567	1
Axioline E, Ethernet device in a plastic housing with 8 IO-Link ports and 4digital inputs, 24 V DC, M12 fast connection technology	AXL E ETH IOL8 DI4 M12 6P	2701536	1
Axioline E, PROFINET device in a plastic housing with 8 IO-Link ports and 4 digital inputs, 24 V DC, M12 fast connection technology	AXL E PN IOL8 DI4 M12 6P	2701513	1
Network cable, Ethernet, CAT5 (100 Mbps), 4-pos., PUR, RAL 5021 (water blue), shielded, straight M12 SPEEDCON/IP67 plug (D-coding) to free cable end, cable length: 1 m	NBC-MSD/ 1,0-93E SCO	1407356	1

B Appendixes

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