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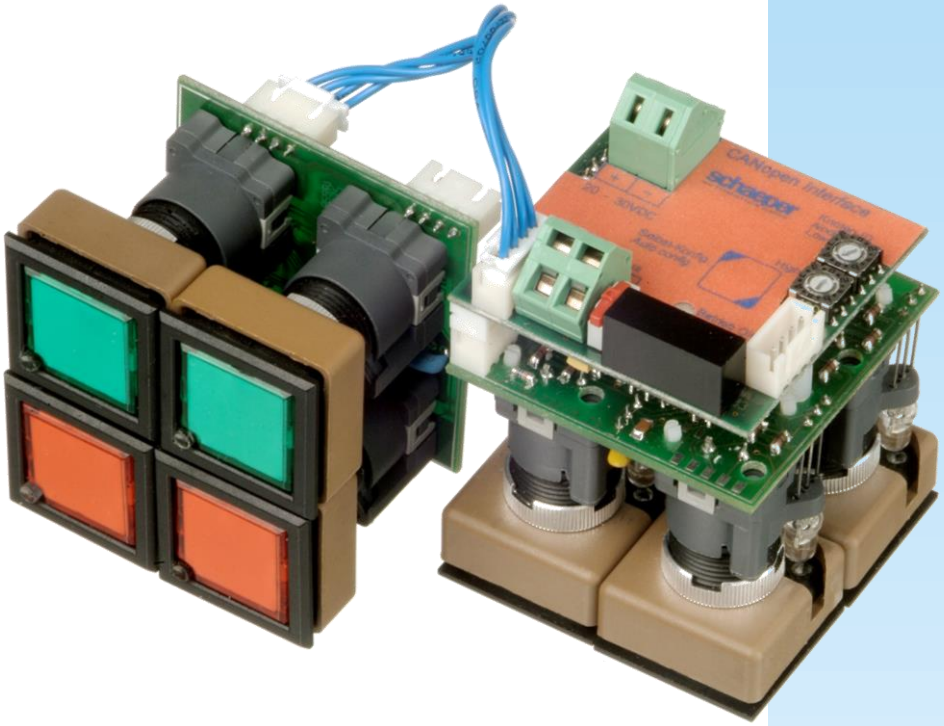
ES-MBF

Modular Control Panel



1 Important notes

Warning

All *modular control panels* have open, exposed PCBs.

Anyone handling such devices or operating the configuration elements must ensure adequate earthing before doing so in order to prevent damage through electrostatic discharge (ESD).

The devices must be installed in mechanically correctly fitting front panels together with designated pushbutton attachments and the PCBs must be suitably enclosed in order to avoid contaminants such as dust, moisture, liquids or aggressive gases that may impair the function from reaching the PCBs!

After correct installation, as described above, the pushbutton panels offer IP65 and ESD protection.

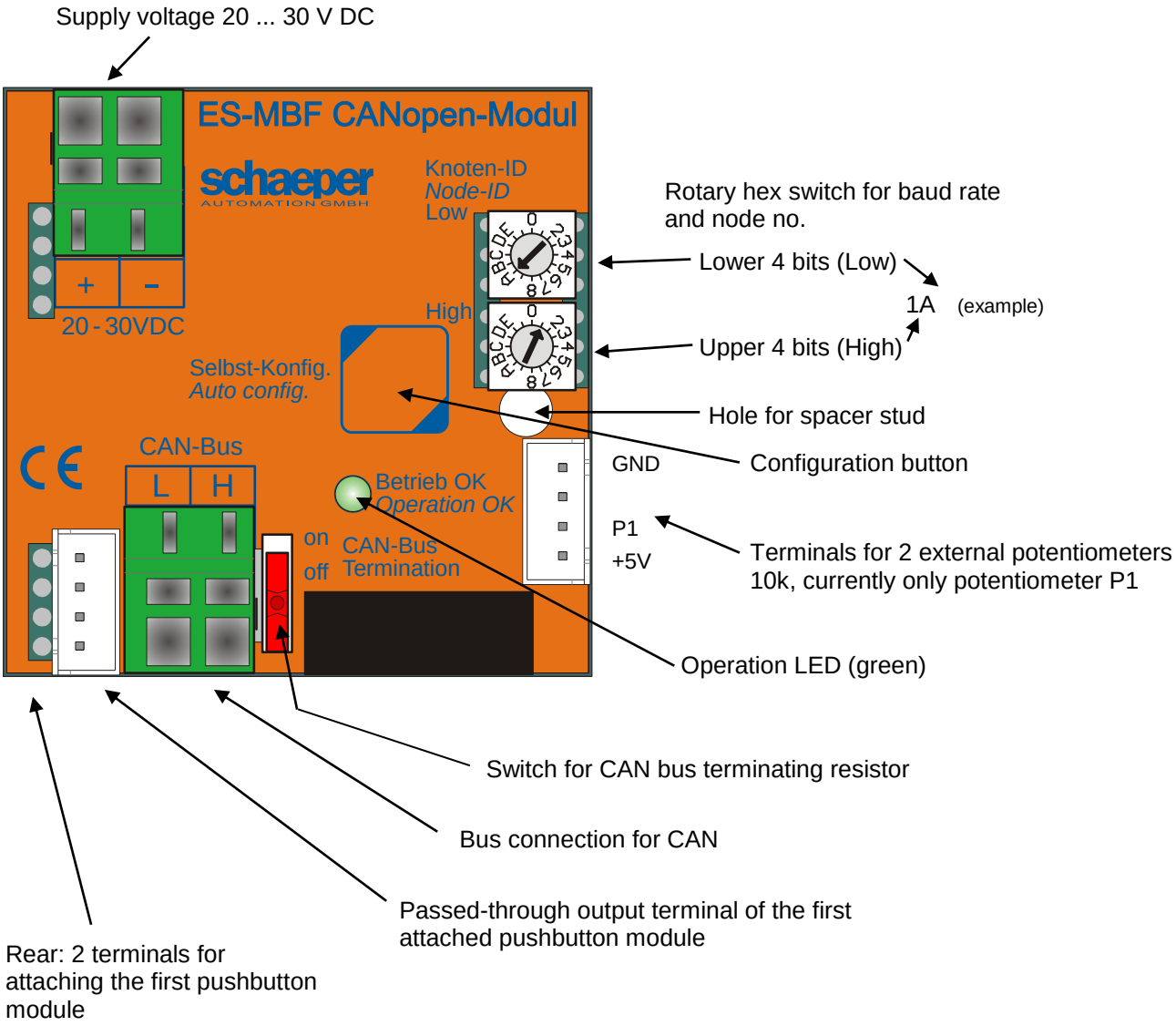
CAN

Users of the CANopen modules are expected to have adequate knowledge of the CAN bus and the CANopen protocol. The bus system features mentioned in this description are not explained here!

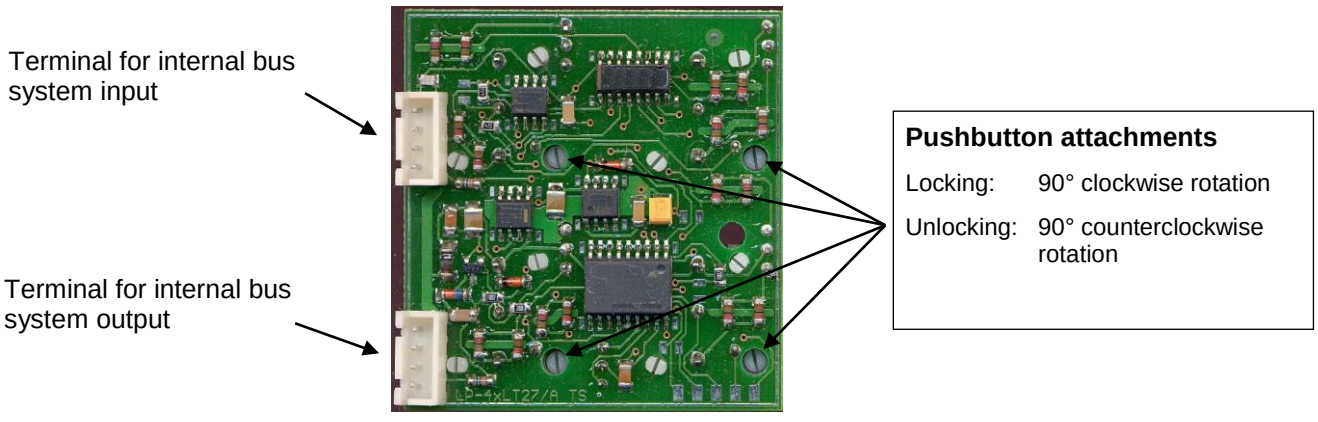
Detailed information can be found in numerous sources and the CANopen standards (available from the CiA organisation, www.can-cia.org).

2 Operation and connections

2.1 CANopen module



2.2 Pushbutton module



Rear view

3 Configuration

3.1 CAN interface

The CAN parameters, i.e. baud rate and node no., can be set if both rotary hex switches are set to zero when the supply voltage is switched on. The following table illustrates the procedure.

No.	Hex switch	Operation LED	Task
1	0 (Low) 0 (High)	Flashing (8 Hz)	Switch on supply voltage.
2	Index (Low) 0 (High)	Flashing (8 Hz)	Set index for baud rate: 0: 1000 kbaud/s 1: 800 kbaud/s 2: 500 kbaud/s 3: 250 kbaud/s 4: 125 kbaud/s (default) 5: 100 kbaud/s 6: 50 kbaud/s 7: 20 kbaud/s 8: 10 kbaud/s
3	Index (Low) 0 (High)	Flashing (3 Hz)	Press configuration button (min. 0.5 s): The set baud rate is stored in the non-volatile memory. If an index greater than 8 is set, the preset baud rate of 125 kbaud/s (index 4) is stored!
4	Node no. (Low) Node no. (High)	Flashing (3 Hz)	Set node no.: Valid values 1 ... 127 (decimal) or 1 ... 7F (hexadecimal) High Low Node nos. greater than 127 (or 7F) stop the function of the CANopen module (Operation LED flashes with 8 Hz). To restore the function, set a correct node no. and switch the supply voltage off and back on again.
5	Node no. (Low) Node no. (High)	Continuous lighting or Flashing (1 Hz) or Flashing (8 Hz)	Press configuration button (min. 0.5 s): CANopen module is ready for operation: **Continuous lighting:** Communication with CAN bus is OK **Flashing (1 Hz):** Communication with CAN bus is faulty CANopen module has detected a fault: **Flashing (8 Hz):** At least one pushbutton module is faulty, or the stored pushbutton module configuration does not match the currently connected module.

After this configuration the current setting of the rotary hex switches is used as node no. whenever the supply voltage is switched on. Node nos. greater than 127 (or 7F) stop the function of the CANopen module (Operation LED flashes with 8 Hz).

If both rotary hex switches are not in the zero position but set to a valid node no. when a brand-new CANopen module is switched on for the first time, the module operates with the default baud rate of 125 kbaud/s (index 4).

3.2 Connected pushbutton modules

The CANopen module must also be configured for the connected pushbutton modules in order to enable correct reading of the pushbuttons or control of the LED. At the same time the configuration data enable the CANopen module to check whether all pushbutton modules are accessible via the internal bus. This ensures that faulty modules are detected and reported quickly.

Starting the configuration

The pushbutton modules can be configured if at least one of the rotary hex switches is **not** set zero when the supply voltage is switched on (this is the initial configuration state fir the CANopen interface).

The Operation LED must be lit continuously (Operation OK) or flash slowly (waiting for CAN bus). The configuration can now be started by pressing the configuration button (at least 0.5 seconds). The CANopen module now reads the characteristic data of the connected pushbutton modules, transfers parameters required for internal communication to each pushbutton module, and reads them back for verification once they have been stored in the EEPROM of the pushbutton modules.

The Operation LED remains switched off during the configuration process, which takes between 0.1 and 2 seconds. If the configuration is successful the Operation LED switches back to the same state as before. Once the configuration is complete all LEDs of the successfully configured pushbutton modules are switched on for approx. 1 second.

Brand-new CANopen modules and modules that were previously configured without attached pushbutton modules are automatically configured when the supply voltage is switched on. If both rotary hex switch switches are set to zero when the supply voltage is switched on, CAN configuration mode will be activated after completion of the automatic configuration. This is indicated through rapid flashing (approx. 8 Hz) of the Operation LED.

Error during configuration

A fault during configuration is indicated through rapid flashing (approx. 8 Hz) of the Operation LED. Once the configuration is complete all LEDs of the successfully configured pushbutton modules are switched on for approx. 1 second.

If a significant fault is detected in a pushbutton module during configuration that prevents communication with the CANopen module, the configuration is terminated as successful with the last functioning pushbutton module. Successful configuration of the connected pushbutton modules can be verified by means of the LEDs as described above. Alternatively, the number of detected pushbuttons and LEDs can be determined by analysing the *Byte 1: pushbuttons* Byte 2: LED (see p. 8).

Failure of a pushbutton module during normal operation is indicated by rapid flashing (approx. 8 Hz) of the Operation LED.

Completing the configuration

Once the configuration is complete, the total number of detected pushbuttons for all modules is written to the first byte and the total number of LEDs to the second byte of the Manufacturer Status Register (two-colour LEDs count as two LEDs). The correct number of pushbuttons and LEDs in the system can therefore be verified by querying the Manufacturer Status Register.

4 Flashing of Operation LEDs

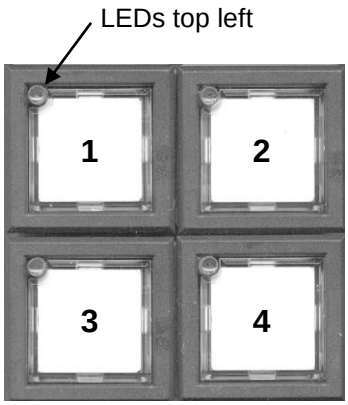
The control panel status is indicated by flashing of the LEDs with different frequency.

Operation LED	Meaning
Continuous lighting	The control panel is ready for operation
Flashing (1 Hz)	The CANopen module is waiting for correct connection of the CAN bus
Flashing (3 Hz)	The baud rate was stored during configuration of the CAN interface. The module is now waiting for the node no. to be set.
Flashing (8 Hz)	General error message; faulty pushbutton module, or two or more pushbutton modules have the same internal address (see section 8, p. 8) or **If both rotary hex switches are in zero position:** start of CAN interface configuration

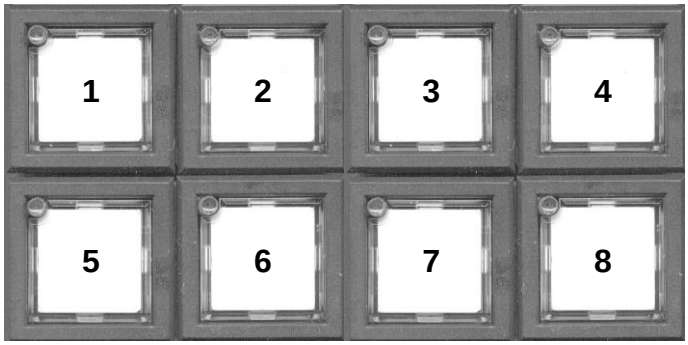
5 Data structure

The button modules are connected via the internal 4-core bus cable. In the same order the pushbutton states and the control signals for the LEDs are written to the bits of two internal data fields or read from there. Sets of 4 bytes of these data fields are mapped to a Transmit PDO (TPDO) or a Receive PDO (RPDO).

The allocation of the individual pushbuttons and LEDs to the bits in the PDOs is illustrated in the following diagrams. These allocations apply if the LEDs are in the left upper corner of the pushbuttons when the front pushbuttons are viewed from the front. In addition, numbers of the illuminated pushbuttons are printed at the back of the PCBs of the pushbutton modules, i.e. LT1, LT2 etc.



Pushbutton module **I**



Pushbutton module **II**

Mapping of the pushbutton states onto the 1st TPDO is illustrated below, based on the example above using two pushbutton modules :

Bit no.	7	6	5	4	3	2	1	0
1st byte	II,4	II,3	II,2	II,1	I,4	I,3	I,2	I,1
2nd byte	0	0	0	0	II,8	II,7	II,6	II,5
3rd byte	0	0	0	0	0	0	0	0
4th byte	0	0	0	0	0	0	0	0

Mapping of the control signals for the red/green two-colour LED from the above example for the 1st RPDO:

For pushbutton modules with central illumination the LEDs are mapped to the green fields.

Bit no.	7	6	5	4	3	2	1	0
1st byte	I,4	I,4	I,3	I,3	I,2	I,2	I,1	I,1
2nd byte	II,4	II,4	II,3	II,3	II,2	II,2	II,1	II,1
3rd byte	II,8	II,8	II,7	II,7	II,6	II,6	II,5	II,5
4th byte	0	0	0	0	0	0	0	0

Meaning of the bit values

Bit = 1: pushbutton pressed / LED lit

Bit = 0: pushbutton not pressed / LED not lit

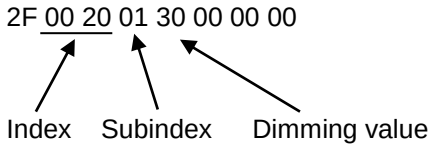
The TPDOs are not sent cyclically but event-driven (i.e. when a pushbutton is pressed or released).

6 LED dimming

The LEDs of all connected button modules can be dimmed via an SDO telegram sent over the CAN bus. By default the brightness level of all LEDs is set to 100%. The brightness is set via a 1-byte value in the *manufacturer specific object* with index 2000h, subindex 01h; FFh means full brightness. When night illumination is deactivated the minimum brightness value is set to 02h with the module in order to prevent dimming of the LEDs down to zero/off.

When night illumination is activated the minimum brightness of an active LED is set to 4 times the value of night illumination, with a minimum of 20h. If, for example, the night illumination value is set to 03h, the minimum brightness for indicating a message would be calculated as 4 x 03h = 0Ch, but increased to the minimum value of 20h. If a CAN telegram is sent for setting the night illumination level to 20h, the actual night illumination value in the pushbutton modules is limited to 10h and the minimum brightness of a message is set to 4 x 10h = 40h.

Example for an SDO dimming command:



6.1 Dimming via CAN telegram or analog input

The brightness value for dimming the LEDs can be set via a CAN telegram, if the *manufacturer specific object* with index 2000h, subindex 02h is set to a value greater than 0h. If this value is set to 0h, the brightness value can be set via a potentiometer at analog input 1, for example (see section 2.1, p. 3).

6.2 Night illumination

Night illumination for the LEDs of all connected pushbutton modules can be activated and set with an SDO telegram over the CAN bus. Night illumination is switched off by default. The brightness is set via a 1-byte value in the *manufacturer specific object* with index 2000h, subindex 03h: a value of 0h means switched off, the maximum value is 10h, and higher values are limited to 10h.

7 CANopen services & objects

The CANopen module provides functions for a slave with static PDO mapping. The EDS file *EXCAN_B.eds* is available for module description data within a CAN network.

The following table shows the available services and send or receive objects for operating the module.

Service / Object	ID	Note
8 RPDOs	200 h + <node no.> 300 h + <node no.> 400 h + <node no.> 500 h + <node no.>	Receiving of LED control signals (32 bits per PDO), of which the last 4 for are preset to inactive (disabled)
4 TPDOs	180 h + <node no.> 280 h + <node no.> 380 h + <node no.> 480 h + <node no.>	Sending of pushbutton states (32 bits per PDO)
1 SSDO	600 h + <node no.>	Server SDO for parameterisation and parameter queries
Node guard	700 h + <node no.>	Server SDO for querying the operating state

The following table shows the available objects for operating the module.

Object	Index/Subindex	Default	Note
Heartbeat Time	1017h / 0h	0h	For monitoring the CANopen module
Guard Time	100Ch / 0h	0h	Not evaluated
Life Time Factor	100Dh / 0h	0h	Not evaluated
Error Register	1001h		Internal errors
Manufacturer Status Register	1002h / 0h		No. of configured pushbuttons and LED (hex format) Byte 1: pushbuttons Byte 2: LED
Emergency Object	1003h		Fault notification
Store Object	1010h / 01h		Storing all current parameters
Restore Object	1011h / 01h		Restoring all default parameters
Identity Object	1018h		Product version nos. and vendor ID
Dimming Object	2000h / 01h	FFh	Dimming value for LED (byte 1)
Dimming Object	2000h / 02h	1h	Switching of dimming value via CAN telegram (byte 1 = 1h) or analog input (byte 1 = 0h)
Dimming Object	2000h / 03h	0h	Night illumination value for LED (byte 1)

The CANopen module processes 11-bit IDs and tolerates 29-bit IDs (CAN Specification 2.0 B).

8 Error messages via the CAN bus

Any faults detected during normal operation or during the configuration phase of the pushbutton modules are communicated via the Emergency Object. After termination of a fault state an *Error Reset* byte is sent. During a fault state the Operation LED flashes with 8 Hz. In addition to faulty pushbutton modules the fault state is also set if two or more pushbutton modules have the same internal address. Pressing the configuration button on the CANopen module allocates a unique address for each pushbutton module and terminates the fault state.

Meaning of the error bytes: Byte 3 contains the number of the first faulty pushbutton module. The following bytes 4 to 6 refer to this pushbutton module. Further faulty pushbutton modules may be present. The next fault is reported when the first faulty pushbutton module is removed.

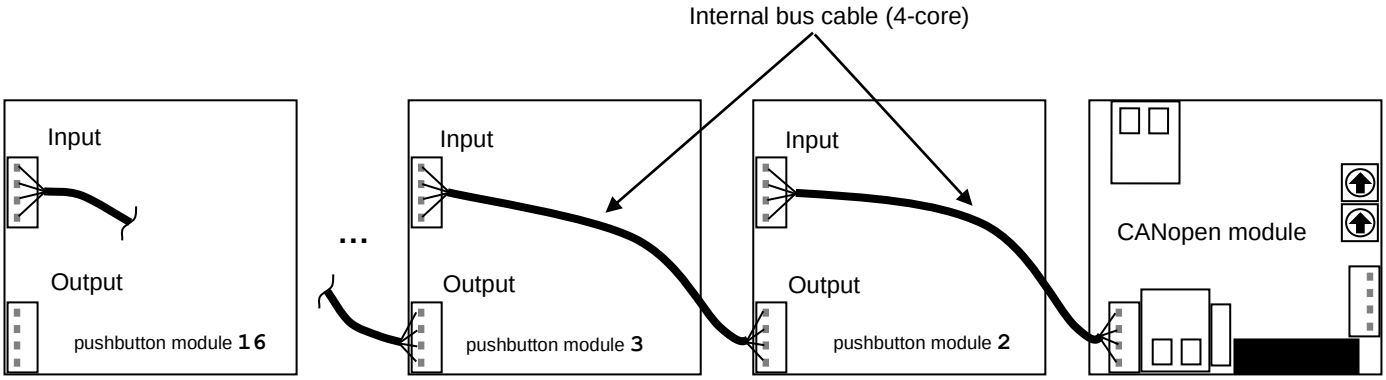
Byte	Meaning
0 1	Error code: 0000h error reset or no error FF00h error during normal operation FF11h error during configuration
2	Error Register
	Manufacturer-specific error field:
3	No. of faulty pushbutton module (1 to 16, hex format), see p. 9 section *Control panel configuration*
4	Error code for internal bus
5	Status/error code for CANopen module
6	Error code for CANopen module
7	Reserved (always zero)

9 Control panel configuration

The required number of pushbutton modules is assembled based on the number of required pushbutton and display functions. The fieldbus module is attached directly to the first pushbutton module and secured with the plastic spacer stud by latching it into the (opposite) holes in each PCB. To separate the two PCBs lightly squeeze the head of the spacer stud with flat-nose pliers and lift the PCB.

The other pushbutton modules are each connected via a 4-core cable.

The following diagram shows the correct connection positions for the internal bus cables.



last pushbutton module

pushbutton module **1**
attached at the rear

View: rear of PCBs

10 Ordering information

The pushbutton modules are available in different versions, including custom versions.

Item no.	Description
E4LT27/B	Module with 4 contactors, each including a 2-coloured corner LED
E4LT27/B1	Module with 4 contactors, each with central socket for monochrome LED
E4LT27/B2	Module with 4 contactors, (1, 3, 4) with central socket, (2) without socket
EXCAN/B	CANopen module, max. 1 MBd, U_{vers} = 20...30 VDC, for max. 16 pushbutton modules
EXZU-IBL/90	Connection cable between pushbutton modules, 90 mm long, packing unit: 10 pieces

11 Technical data

11.1 Pushbutton module

Supply Via fieldbus module

Switching element Schlegel Type CTLP(L) for attachments 24 x 24 mm² or 27 x 27 mm²

Indicator lamps Soldered-in, two-colour LED or pluggable LED incl. pre-resistor (T5.5 k) for CTLPL socket, max. current per LED colour 20 mA

Pushbutton grid 27mm x 27mm

Temperature 0 to +55 °C (operation)

Internal Bus	4-core for data and power supply connection, 1 connector for bus input, 1 connector for bus output, locking plug connectors, protected against polarity reversal
Depth	approx. 55 mm without attached CANopen module approx. 70 mm with attached CANopen module
Dimensions	L x W x D: 54 x 54 x 52 mm^3 (incl. Schlegel Quartron pushbutton attachment)
Weight	32 g (without pushbutton attachment)

11.2 CANopen module

Supply	20 to 30 V DC, incl. residual ripple total current input incl. pushbutton modules max. 2A, protected through pluggable fuse F2.5A, connection via 2-pole spring-loaded terminal (0.2 to 1.5 mm^2 flexible)
Analog inputs	1 or 2 potentiometers 10k, resolution 8 bit (in this version only 1 potentiometer for LED dimming)
CAN bus	galv. isolated (Uisol = 500 V DC), max. data rate 1 Mbps switchable termination resistor 120Ω, baud rate and node no. are set via two rotary hex switches, connection via 2-pole spring-loaded terminal (0.2 to 1.5 mm^2 flexible)
Telegram rate	CAN receive PDOs with ID for CANopen module: max. 50/s
EDS file	EXCAN_B.eds, version 3
Conformity	passed *CANopen conformance test, version 2.0.02* (CiA)
Temperature	0 to +55 °C (operation)
Internal display	LED for *Operation OK* (green)
Internal button	for starting auto-configuration of the connected pushbutton modules
Internal Bus	4-core for data and power supply connection, 1 connector for bus input, 1 connector for bus output, locking plug connector, protected against polarity reversal
Fitting	attachable to the <u>first</u> pushbutton module
Removal	pull off the 4-pole bus connectors, <u>lightly</u> squeeze the head of the plastic bracket with flat-nose pliers (for unlatching), and lift off the PCB
Connectable pushbutton modules	max. 16 total number of all buttons on all pushbutton modules: max. 128 total number of all LED on all pushbutton modules: max. 256 (**note max. current input of 2 A!**)
Dimensions	L x W x D: 50 x 50 x 25 mm^3 attached to pushbutton module, overall size L x W x D: 54 x 54 x 72 mm^3 (incl. Schlegel Quartron pushbutton attachment)
Weight	25g