MOELLER

Hardware and Engineering

LE 4-622-CX1
Local Expansion Module for Incremental Encoders

LE 4-633-CX1
Local Expansion Module for Absolute Encoders

03/98 AWB 2700-1324 GB

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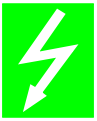
Author: Werner Albrecht
Editor: Thomas Kracht
Translator: Terence Osborn



Warning!

Dangerous electrical voltage!

Before commencing the installation

- Disconnect the power supply of the device.
- Ensure that devices cannot be accidentally restarted.
- Verify isolation from the supply.
- Earth and short circuit.
- Cover or enclose neighbouring units that are live.
- Follow the engineering instructions (AWA) of the device concerned.
- Only suitably qualified personnel in accordance with EN 50 110-1/-2 (VDE 0105 Part 100) may work on this device/system.
- Before installation and before touching the device ensure that you are free of electrostatic charge.
- The functional earth (FE) must be connected to the protective earth (PE) or to the potential equalisation. The system installer is responsible for implementing this connection.
- Connecting cables and signal lines should be installed so that inductive or capacitive interference do not impair the automation functions.
- Install automation devices and related operating elements in such a way that they are well protected against unintentional operation.
- Suitable safety hardware and software measures should be implemented for the I/O interface so that a line or wire breakage on the signal side does not result in undefined states in the automation devices.
- Ensure a reliable electrical isolation of the low voltage for the 24 volt supply. Only use power supply units complying with IEC 60 364-4-41 (VDE 0100 Part 410) or HD 384.4.41 S2.
- Deviations of the mains voltage from the rated value must not exceed the tolerance limits given in the specifications, otherwise this may cause malfunction and dangerous operation.
- Emergency stop devices complying with IEC/EN 60 204-1 must be effective in all operating modes of the automation devices. Unlatching the emergency-stop devices must not cause restart.
- Devices that are designed for mounting in housings or control cabinets must only be operated and controlled after they have been installed with the housing closed. Desktop or portable units must only be operated and controlled in enclosed housings.
- Measures should be taken to ensure the proper restart of programs interrupted after a voltage dip or failure. This should not cause dangerous operating states even for a short time. If necessary, emergency-stop devices should be implemented.
- Wherever faults in the automation system may cause damage to persons or property, external measures must be implemented to ensure a safe operating state in the event of a fault or malfunction (for example, by means of separate limit switches, mechanical interlocks etc.).

Contents

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About This Manual

Other manuals

The LE 4-622-CX1 and LE 4-633-CX1 local expansion modules are used in conjunction with the PS 4-200 and PS 4-400 locally expandible compact PLCs.

Consequently, some of the topics covered in this manual are closely or directly linked to the PS 4. More detailed information is given in the corresponding manuals:

Hardware and Engineering for the PS 4-200, AWB 27-1184-GB

Hardware and Engineering for the PS 4-400, AWB 27-1240-GB

Symbols

Two symbols are used throughout this manual and have the following meanings:

▶ Indicates handling instructions

Draws your attention to interesting tips and additional information

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1 About The Local Expansion Modules

LE 4-622-CX1

Task

The LE 4-622-CX1 is used to position, detect the position of and count fast pulses.

Special features

Table 1: Special features of the LE 4-622-CX1

Number of channels (counter)	2
Counter range	24 bits: 0 to FF FFFF hex 0 to 16,777,215 decimal
Mode (set individually for each channel)	1: Positioning system for 5 V incremental encoders 2: Positioning system for 24 V incremental encoders 3: Fast counter for 24 V signals
Counter frequency	Max. 300 kHz (5 V inputs) Max. 30 kHz (24 V inputs)
Preferred applications	Position detection for positioning tasks
Power supply to the encoder	External via ZB 4-122-KL1 twin-level terminal block

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Setup

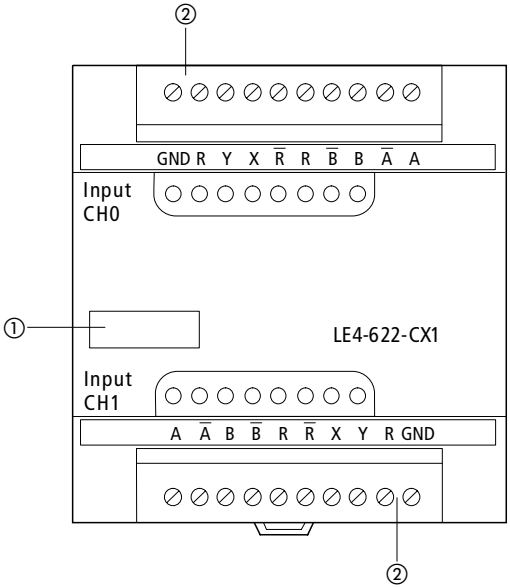

Figure 1: Structure of the LE 4-622-CX1

① Plug-in screw terminal for the data cables

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LE 4-633-CX1

Task

The LE 4-633-CX1 is used to position or to accurately determine the absolute position of drive shafts. The absolute position values are transferred by serial synchronous transmission.

Special features

Table 2: Special features of the LE 4-633-CX1

Number of SSI channels	3
Transmission speed	125 kHz or 250 kHz
Preferred applications	Positioning tasks
Data code	Binary or Gray
Data format	25-bit (single and multi-turn)
Wire break detection on signal line D+ and D-	Yes
Power supply to the absolute encoder	External via ZB 4-122-KL1 twin-level terminal block

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Setup

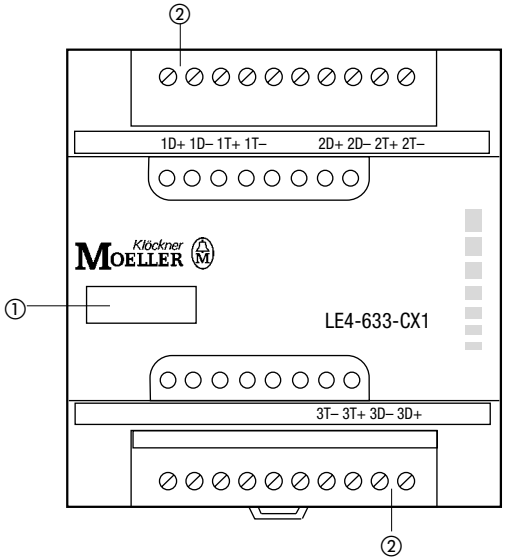

Figure 2: Setup of the LE 4-633-CX1

① Plug-in screw terminal for the clock and data cables

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2 Engineering

Electromagnetic compatibility (EMC)

Please read the engineering notes in the “EMC Engineering Guidelines for Automation Systems” manual (AWB 27-1287-GB).

German EMC law

To ensure that you conform to the requirements of the EMC law, please note the following points (see also Figure 3):

- ▶ Lay the screened data cable on the left or right of the module by the shortest route and produce a low impedance connection between the screen braid and the reference potential over a large contact area ①. The accessories you will need are listed in the Appendix.
- ▶ Use the ZB 4-122-KL1 twin-level terminal block ② for the power supply to the encoder.
- ▶ Follow the manufacturer’s instructions for the power supply unit ③ for the encoder (absolute encoder, incremental encoder, etc).
- ▶ Insulate the end of the screen braid as closely as possible to point at which the signal line ④ enters the module.

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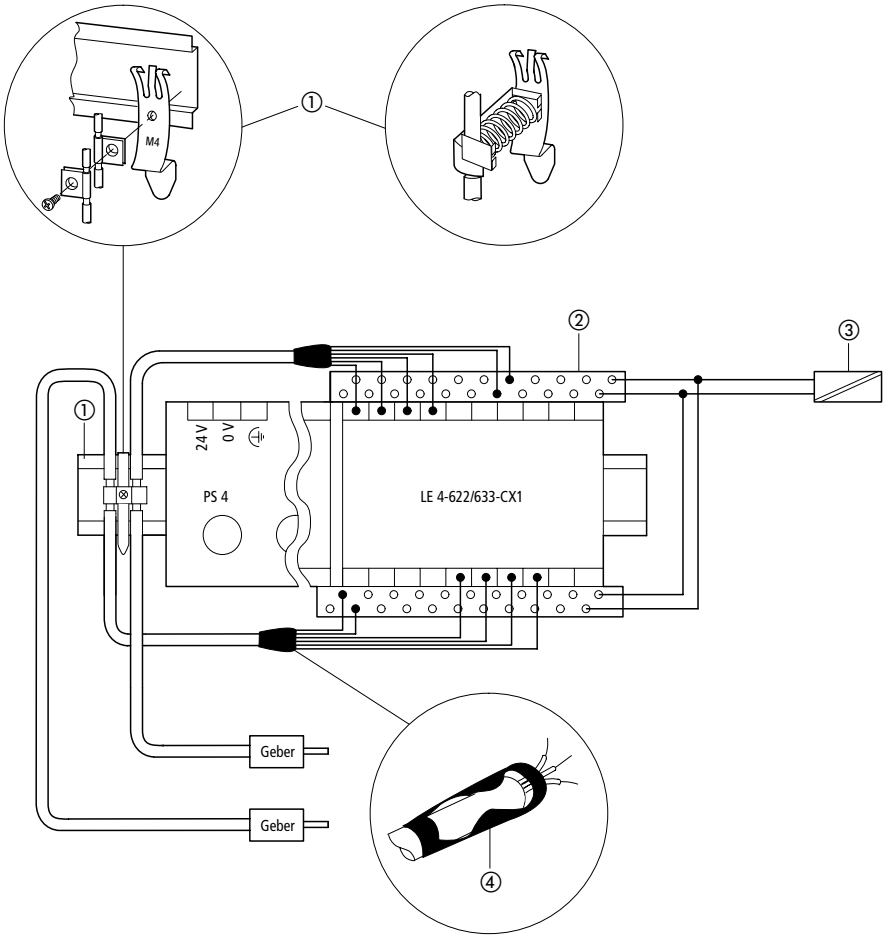

Figure 3: EMC measures

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Overview of the terminals

LE 4-622-CX1

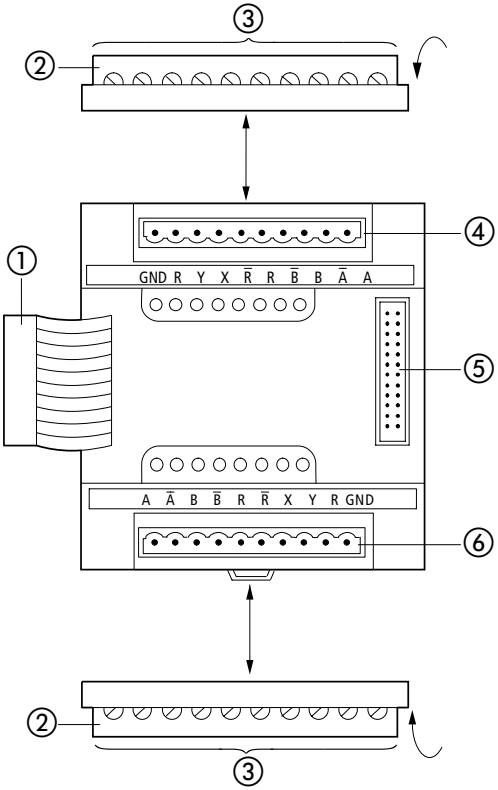

Figure 4: Overview of the terminals on the LE 4-622-CX1

① Plug connector for the LE bus
② Plug-in screw terminals
③ Conductor cross-sections:
flexible with ferrule 0.22 mm² to 1.5 mm²
solid 0.22 mm² to 2.5 mm²
④ Terminal for channel 0
⑤ Plug connector for LE bus
⑥ Terminal for channel 1

LE 4-633-CX1

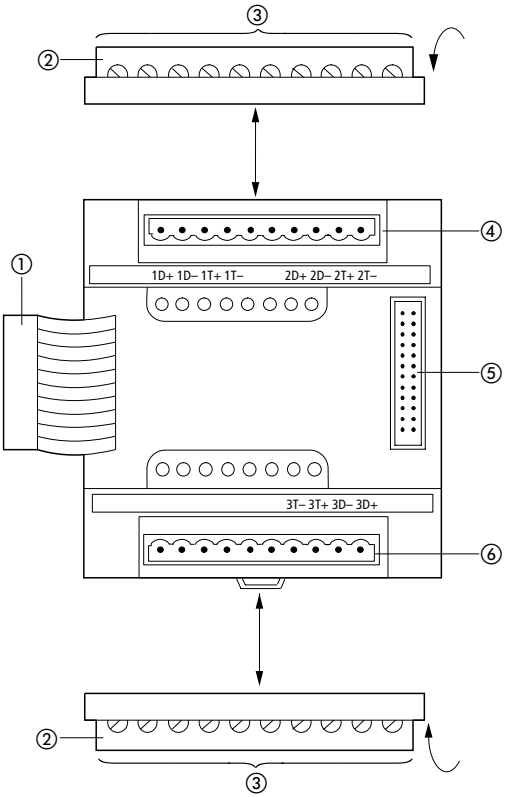

Figure 5: Overview of the terminals on the LE 4-633-CX1

① Plug connector for LE bus
② Plug-in screw terminals
③ Conductor cross-sections:
flexible with ferrule 0.22 mm² to 1.5 mm²
solid 0.22 mm² to 2.5 mm²
④ Terminal for channel 1 and channel 2
⑤ Plug connector for LE bus
⑥ Terminal for channel 3

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Terminal assignment on the data cable

LE 4-622-CX1

Three different modes or connection types can be used for each counter channel to suit various applications:

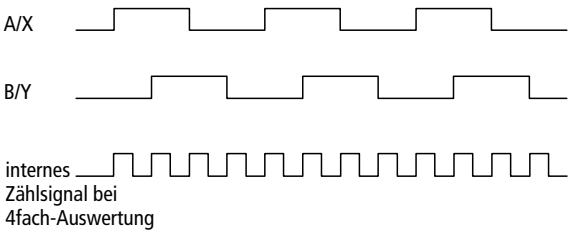
Mode 1:
Positioning system for 5 V incremental encoders

Mode 2:
Positioning system for 24 V incremental encoders

Mode 3:
Fast counter for 24 V pulse generators

Use the Parameter Editor of the Sucosoft S 30-S4 or S 40 software to select the mode. The mode is adopted when the program starts up and cannot be changed while the program is running. The mode can only be changed in the Parameter Editor.

In modes 1 and 2, the signal is quadrupled internally. This means that the rising and falling signal edges are evaluated at inputs A and B or X and Y.



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Positioning system for 5 V incremental encoders

With this type of connection, the 5 V pulses of an incremental encoder are counted. The incremental encoder should be connected to LE 4-622-CX1 as shown in Figure 6 below:

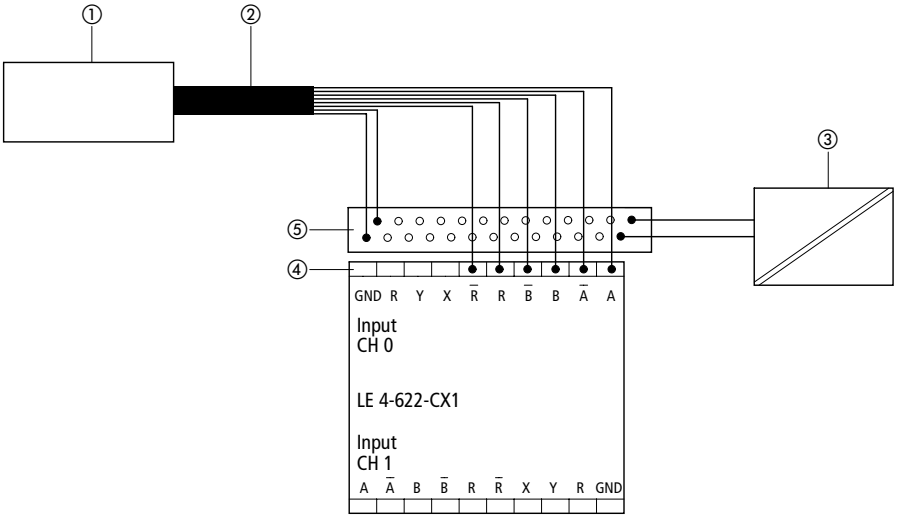

Figure 6: Connection of a 5 V incremental encoder

① Incremental encoder
② Screened data cable
③ Power supply unit for the incremental encoder (follow the manufacturer's instructions)
④ Plug-in screw terminal for connecting the data cable
⑤ ZB 4-122-KL1 twin-level terminal block for connecting the power supply

In this mode, the LE 4 needs antivalent signals in order to operate.

The incremental encoder sends the following 5 V signals:

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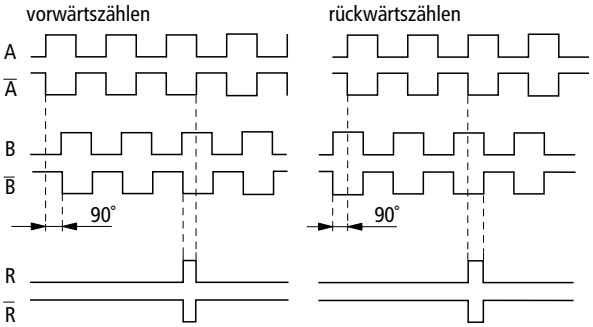

Figure 7: Signals from a 5 V incremental encoder

The signals at inputs A/B and $\overline{A}$/$\overline{B}$ are offset by 90° so that the direction can be detected. $\overline{A}$ and $\overline{B}$ are the antivalent signals of A and B. R or $\overline{R}$ (antivalent signal) is the reference signal which the encoder sends once every revolution, for example.

If a wire break occurs on one of these cables, an error message is signalled at the “Error” output of the function block.

Select the “Incremental encoder 5 V DC (mode 1)” setting in the Parameter Editor.

Positioning system for 24 V incremental encoders

With this type of connection, the 24 V pulses of an incremental encoder are counted. The incremental encoder should be connected to LE 4-622-CX1 as shown in Figure 8 below.

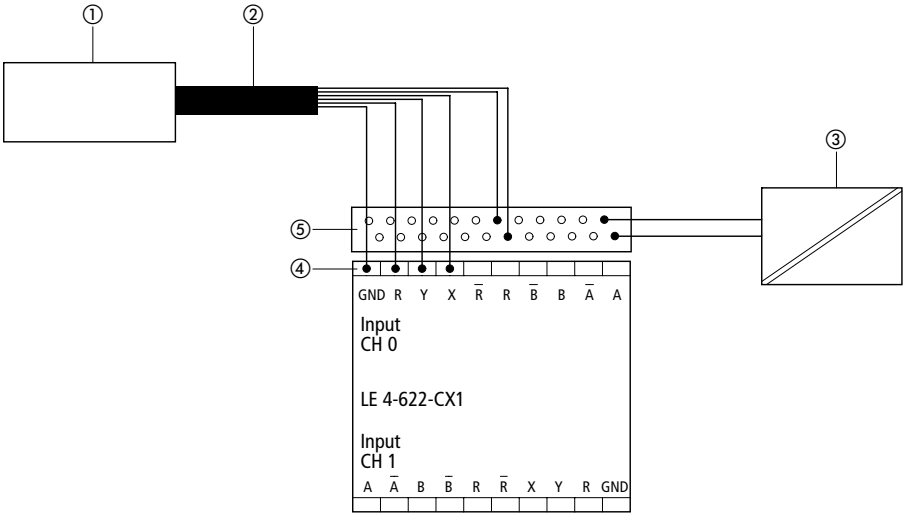

Figure 8: Connection of a 24 V incremental encoder

① Incremental encoder
② Screened data cable
③ Power supply unit for the incremental encoder (follow the manufacturer's instructions)
④ Plug-in screw terminal for connecting the data cable
⑤ ZB 4-122-KL1 twin-level terminal block for connecting the power supply

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The incremental encoder sends the following 24 V signals

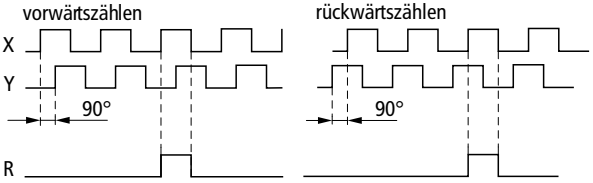

Figure 9: Signals from a 24 V incremental encoder

The signals at LE inputs X/Y are offset by 90° so that the direction can be detected. R is the reference signal which the encoder sends once every revolution, for example.

Select the “Incremental encoder 24 V DC (mode 2)” setting in the Parameter Editor.

Fast counter for 24 V pulse generators

With this type of connection, the 24 V pulses from a pulse generator are counted. The pulse generator,

such as an initiator, should be connected to the LE 4-622-CX1 as shown in Figure 10 below.

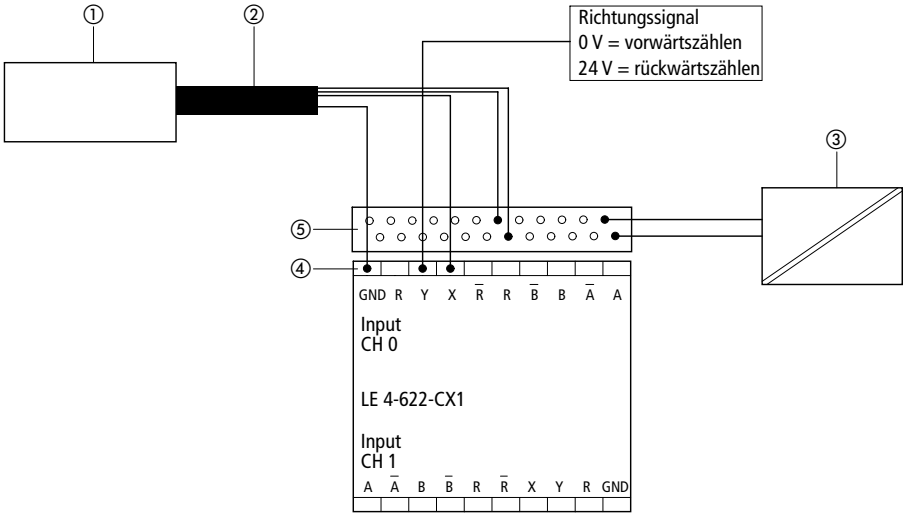

Figure 10: Connection of a 24 V pulse generator

① Pulse generator
② Screened data cable
③ Power supply unit for the incremental encoder (follow the manufacturer's instructions)
④ Plug-in screw terminal for connecting the data cable
⑤ ZB 4-122-KL1 twin-level terminal block for connecting the power supply

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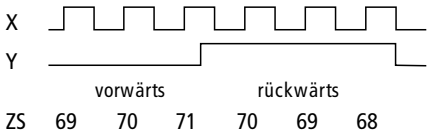
The pulse generator sends 24 V counter pulses to LE input X. The counter level changes in response to a positive edge. The counting direction can be changed using an external switch which acts on LE input Y:

Up counting = 0 V at input Y
Down counting = 24 V at input Y



X = LE input for counter pulses
Y = LE input for displaying the direction
ZS = Counter level

Select the “Pulse generator 24 V DC (mode 3)” setting in the Parameter Editor.

Terminal assignment for the SSI data cable on the LE 4-633-CX1

The following terminal assignment diagram shows how to connect an absolute encoder an with SSI interface
(SSI = **S**ynchronous **S**erial **I**nterface) to the LE 4-633-CX1. This local expansion module has three SSI channels.

Absolute encoders using either Gray and/or binary code may be connected.

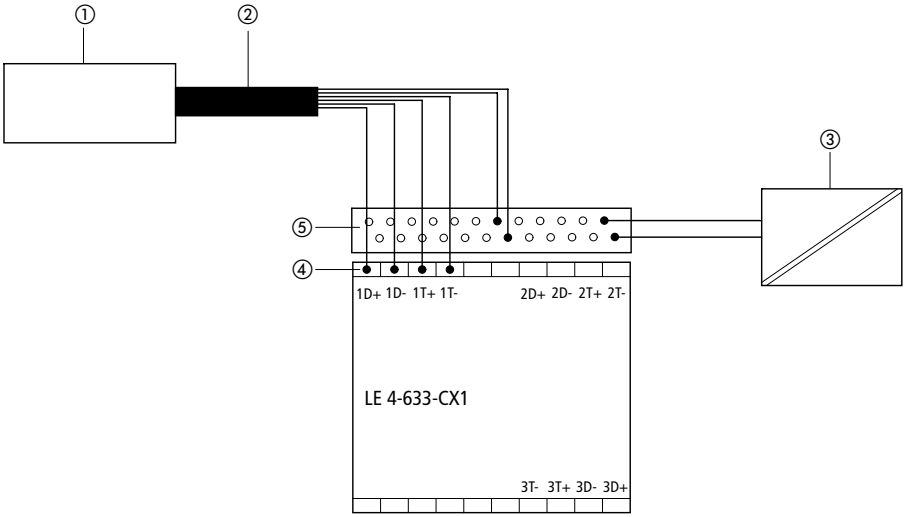


Figure 11: Connection of an absolute encoder with SSI interface

① Absolute encoder with SSI interface
② Screened data cable
③ Power supply unit for the absolute encoder (follow the manufacturer's instructions)
④ Plug-in screw terminal for connecting the data cable
⑤ ZB 4-122-KL1 twin-level terminal block for connecting the power supply

Wire the D+ cable of the absolute encoders to the D+ input on the LE 4-633-CX1. Repeat accordingly for D–, T+ and T–.
Incorrect timing diagrams may be obtained if these data cables are swapped over, which can cause a wire break message to appear on the PS 4.

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In contrast to incremental encoders, absolute encoders can record the precise (absolute) position, even after a power failure. Either single-turn or multi-turn absolute encoders can be used, depending on the distance or angle to be resolved and the required resolution accuracy. Given the need to detect either distances or angles, we generally differentiate between translational (linear motion) and rotational (rotary motion) position determination.

The following diagrams show how the data from the absolute encoder appears as a bit pattern on the PS 4 (bit 31 to bit 0). The differences between 25-bit multi-turn (Figure 12), 21-bit multi-turn (Figure 13) and 13-bit single-turn (Figure 14) should be noted since the LE 4-633-CX1 analyses the data in 25-bit multi-turn format.

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Figure 12 shows the graphical structure of the 25-bit multi-turn data format in relation to the resolution per revolution and the number of revolutions.

Bits 6 to 0 always contain pulse value “0”

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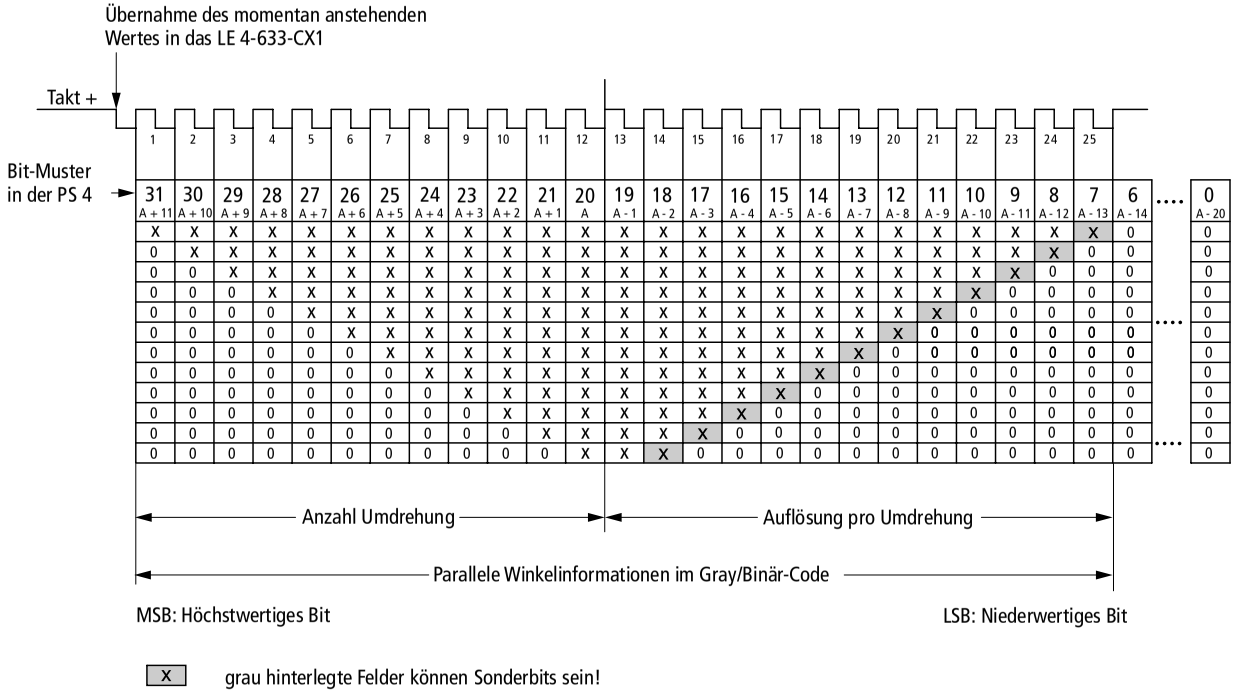

Figure 12: Multi-turn data format (25-bit) for synchronous serial data transmission with bit pattern in the PS 4

Figure 13 shows the graphical structure of the 21-bit multi-turn data format in relation to the resolution per revolution and the number of revolutions.

Only the first 21 bits (bit 31 to bit 11) have to be evaluated in the PS 4 since the LE 4-633-CX1 reads the data from the absolute encoder in 25-bit multi-turn data format. Bits 10 to 7, which have a “?”, do not have to be evaluated. Bits 6 to 0 always contain pulse value “0”

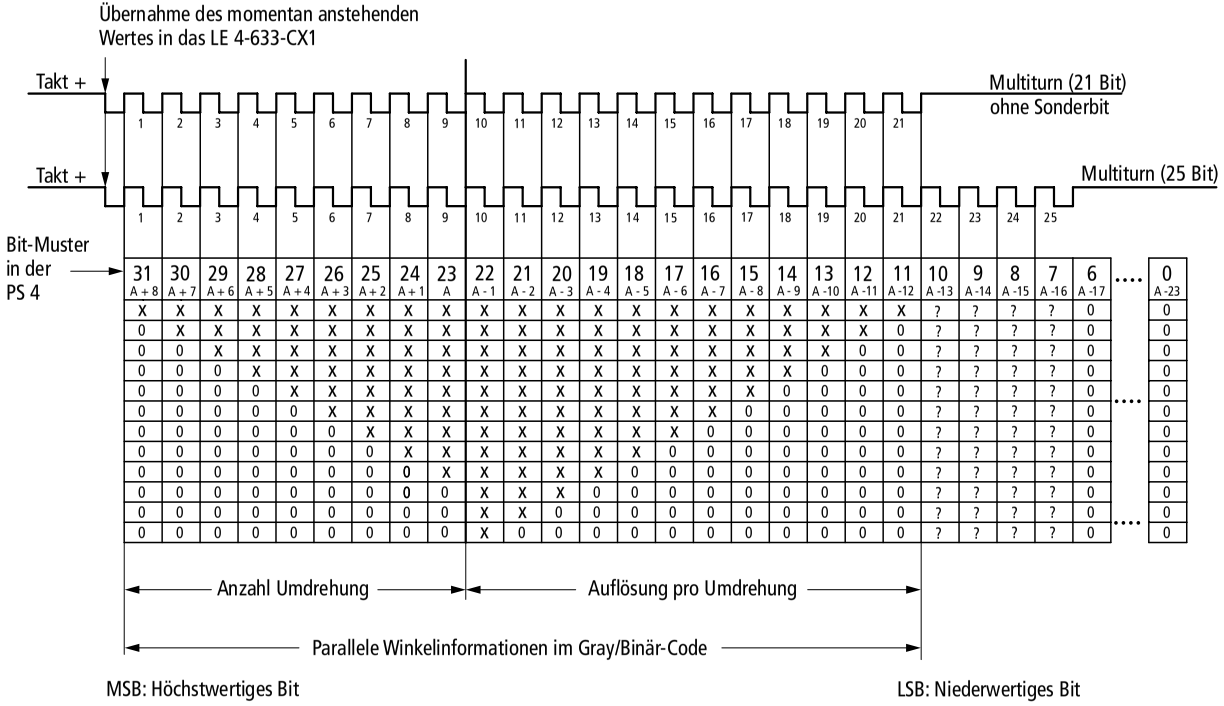

Figure 13: Multi-turn data format (21-bit) for synchronous serial data transmission with bit pattern in the PS 4

Figure 14 shows the graphical structure of the 13-bit single-turn data format in relation to the resolution for one revolution.

Since the LE 4-633-CX1 reads the data from the absolute encoder in 25-bit multi-turn data format, only the first 13 bits (bit 31 to bit 19) may be evaluated in the PS 4. Bits 18 to 7, which have a “?”, must not be evaluated. Bits 6 to 0 always contain pulse value "0".

Please also note the data format information provided by the absolute encoder manufacturer.

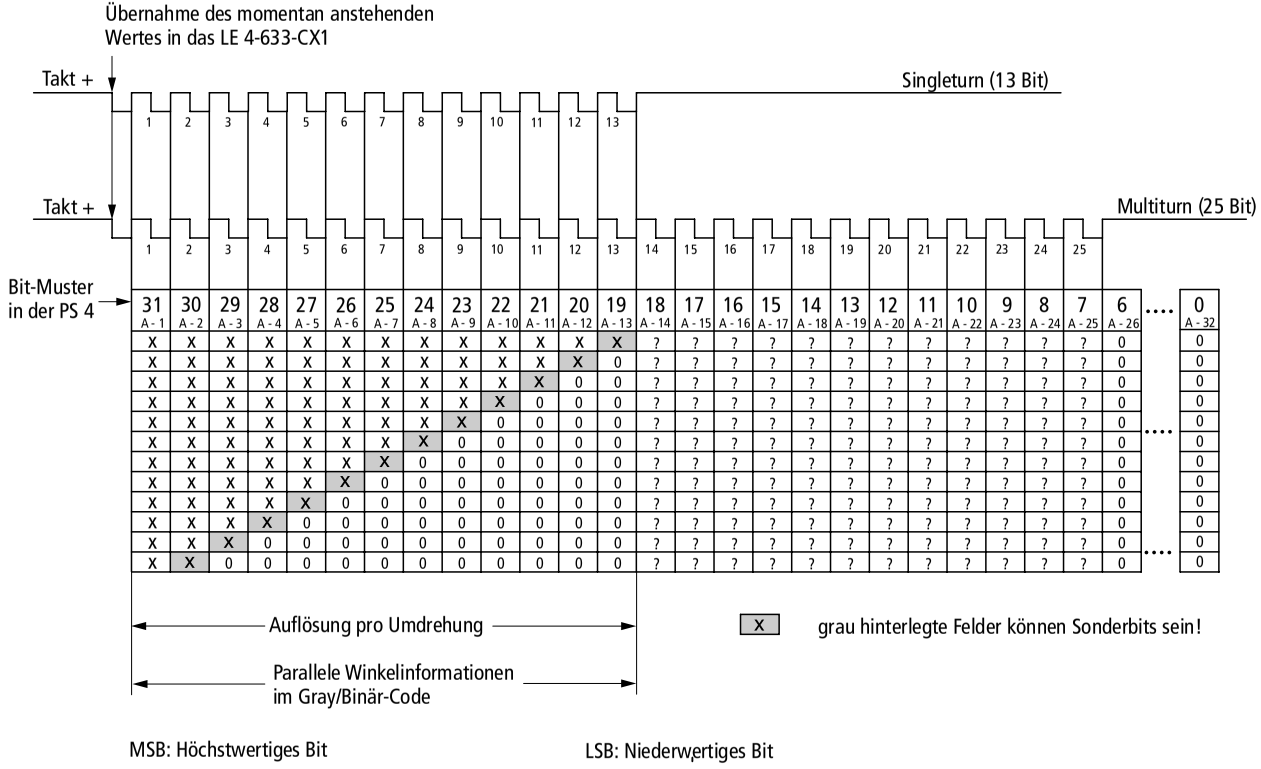

Figure 14: Single-turn data format (13-bit) for synchronous serial data transmission with bit pattern in the PS 4

Number of LEs per PS 4

Two such LEs may be connected to each PS 4. The LEs must be located at position 1 or 2, immediately beside the PS 4, although either LE may be placed in each position.

Connection to the PS 4

Connect the LE 4 directly to the PS 4 using the plug connector.

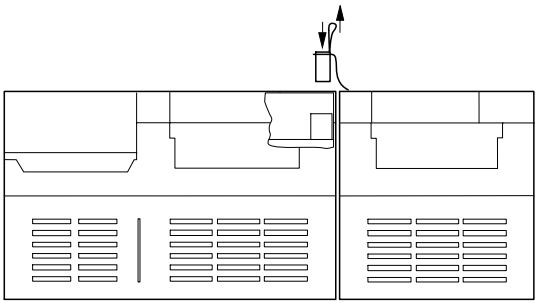

Figure 15: Connection to the PS 4

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3 Mounting

Local expansion modules can be mounted either on the top-hat rail or on fixing feet.

Snap the LE 4 onto the top-hat rail or fix it to the mounting plate before connecting it to the PS 4.

Mounting on the top-hat rail

- ▶ Insert one side of the module into the top-hat rail ①.
- ▶ Use the screwdriver to push the slide bar out of the module ②.
- ▶ Swivel the module onto the top-hat rail ③.
- ▶ Remove the screwdriver. The slide bar will engage on the top-hat rail and lock the module in place ④. Check that the module is fixed securely.

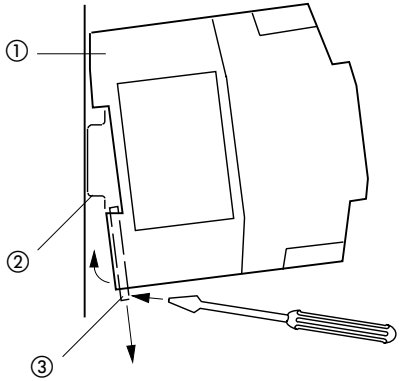

Figure 16: Mounting on the top-hat rail

Mounting on fixing feet

- ▶ Push the fixing foot in until it latches into position ①.
- ▶ Check that it is seated firmly. The latching lug must engage in the hole ②.
- ▶ Use an M4 screw to fix the fixing feet to the mounting plate ③.

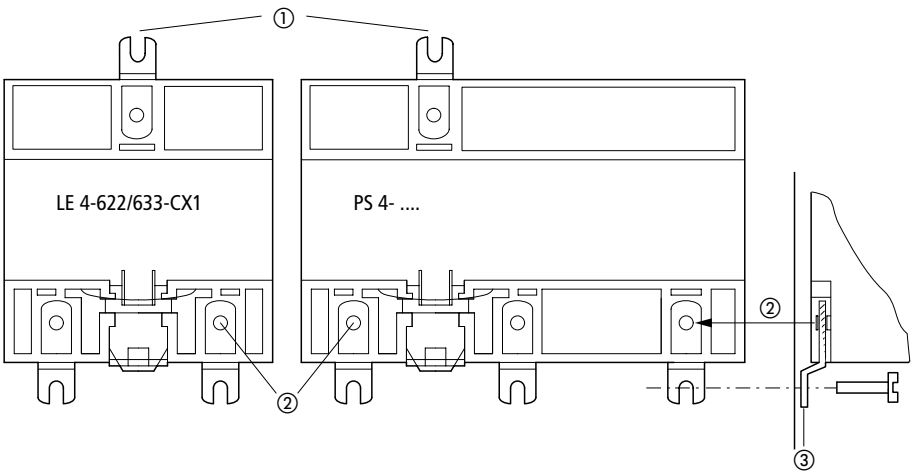

Figure 17: Mounting on fixing feet

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Mounting in the switch cabinet

The following conditions must be fulfilled:

- ▶ Fix the PS 4 with its local expansion modules horizontally in the switch cabinet.
- ▶ Ensure that it is at least 50 mm away from the cable duct.
- ▶ Keep the control and power circuits separate.

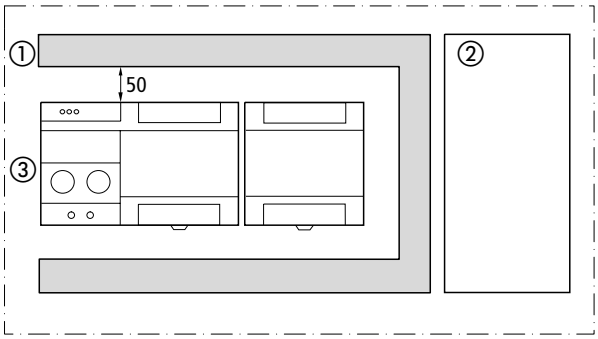

Figure 18: Horizontal arrangement of the modules in the switch cabinet

① At least 50 mm
② Power circuit
③ Cable duct

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Appendix

Dimensions

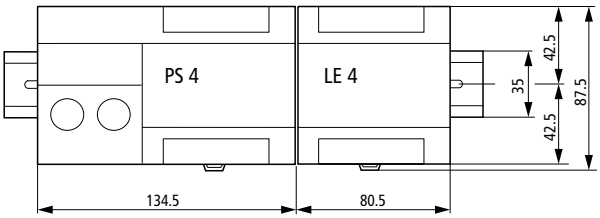

Figure 19: Front view of the PS 4, LE 4

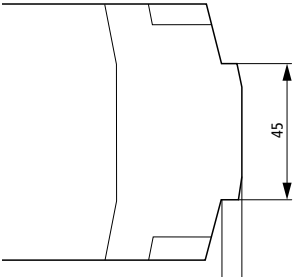

Figure 20: Side view of the PS 4, LE 4

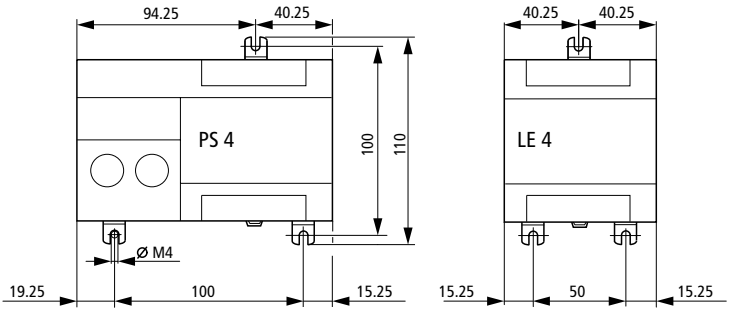

Figure 21: PS 4, LE 4 with fixing feet

Accessories

Fixing foot	Klöckner-Moeller	ZB 4-101-GF1	Fixing foot for screwing the LE or PS 4 onto a mounting plate
Plug-in screw terminal	Klöckner-Moeller	ZB 4-110-KL1	Screw terminal for the input/output level
Twin-level terminal block	Klöckner-Moeller	ZB 4-122-KL1	Snap-fit 2 x 11-pole potential terminal
Contact clamps for fixing the screening	Klöckner-Moeller	ZB 4-102-KS1	Contact clamps for connecting the screen of the data cable to the earth potential
Terminal clamp for snap-on mounting	e.g. Weidmüller	KLBü 3-8 SC	Order no.: 169226
Snap-on mounting for the top-hat rail	e.g. Weidmüller	FM 4/TS 35	Order no.: 068790
Lightning protection module	Module e.g. from Dehn	–	–

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Technical data

General

Applicable standards		EN 61131-2, EN 50178	
Ambient temperature		0 to 55°C	
Storage temperature		–25°C to 70°C	
Shock		2 shocks with sinusoidal half-wave 11 ms duration, 15 g peak value	
Surge withstand capability		15 g, 11 ms	
Vibration		Constant 1 g, f = 10 – 150 Hz	
EMC			
Emissions		EN 55011/22 class A	
Immunity to interference			
ESD	EN 61 000-4-2	Contact discharge	4 kV
		Air discharge	8 kV
RFI	EN 61 000-4-3	AM/PM	10 V/m
Burst	EN 61 000-4-4	Mains/digital I/O	2 kV
		analog I/O, field bus	1 kV
Surge	ENV 50 142	Digital I/O, assym.	0.5 kV
		Mains DC, assym.	1 kV
		Mains DC, sym.	0.5 kV
		Mains AC, assym.	2 kV
		Mains AC, sym.	1 kV
Line-conducted interference	ENV 50 141	AM	10 V
Degree of protection		IP 20	
Humidity class		RH 1	
Insulation voltage		600 V AC	
Weight		270 g	
Connections		Plug-in screw terminals	
Conductor cross-sections flexible with ferrule: solid:		 0.22 to 1.5 mm^2 0.22 to 2.5 mm^2	
Power supply to the encoder		Separate via ZB 4-122-KL1 twin-level terminal block	
Data cable to encoder		As per encoder manufacturer's specifications (but normally screened cable)	

LE 4-622-CX1

Phase shift deviation (mode 1+2; 5 V and 24 V incremental encoder)	Max. ± 50 %
Minimum pulse-width (mode 3; 24 V pulse generator)	16 µs
Counter inputs 5 V	
Level	Conforming to RS 422
Differential input voltage	U_{max} = 5.25 V U_{min} = 2 V
Input current	I_{max} = 20 mA at U < 5.25 V I_{min} = 2.5 mA at U > 2 V
Maximum counter frequency	300 kHz
Pulse quadrupling	Yes
90° offset signals	Yes
Antivalent signals	Yes
Counter range	24 bits
Electrical isolation	Yes
Counter inputs 24 V	
Input voltage	U_{max} = 30 V U_{min} = 18 V
Input current	I_{min} = 2.5 mA at U = 18 V
Maximum counter frequency	30 kHz
Pulse quadrupling	Yes (for incremental encoder)
90° offset signals	Yes (for incremental encoder)
Counter range	24 bits
Electrical isolation	Yes

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Number of SSI interfaces	3
Data code	Gray or binary (conversion must be carried out in PS 4)
Data format	Multi-turn 25 bits (13 bits must be evaluated for single-turn or 21 bit for multi-turn)
Electrical isolation - LE bus to SSI interfaces - Between SSI interfaces	 Yes No
Clock output of SSI interface	RS422 electrically isolated, T+, T–
Data input of SSI interface	RS422 electrically isolated, D+, D–
Wire break detection	Yes (RS 422, data input D+, D– only)
Data transmission speed	125 kHz or 250 kHz for all 3 SSI interfaces
Maximum cable length to absolute encoder	Depends on the data transmission speed of the absolute encoder and is specified by the manufacturer in the technical data. It is limited, however: Baud rate: cable length: 250 kHz: <150 m 125 kHz: <350 m

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