APPLICATION MANUAL

Logic relays

CL range

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 operating and installation instructions of the device concerned.
- Only suitably qualified personnel in accordance with EN 50110-1/-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 in such a way that inductive or capacitive interference does 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 60364-4-41 (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 60204-1 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.).

Table of Contents

About this manual

This manual describes the installation, commissioning and programming (circuit diagram generation) of the logic relays CL-LSR/CL-LST and CL-LMR/CL-LMT.

Specialist electrical training is needed for commissioning and creating circuit diagrams. When controlling active components such as motors or pressure cylinders, parts of the system can be damaged and persons put at risk if the logic relay is connected or programmed incorrectly.

Device designation

This manual uses the following abbreviated designations for different device models:

CL-LSR/CL-LST for
CL-LSR...12AC1, CL-LSR...12AC2, CL-LSR...12DC1, CL-LSR...12DC2 and CL-LST...12DC2

CL-LMR/CL-LMT for
CL-LMR...18AC1, CL-LMR...18AC2, CL-LMR...18DC1, CL-LMR...18DC2 and CL-LST...20DC2

CL-AC1 for
CL-LSR...12AC1
CL-LMR...18AC1

CL-AC2 for
CL-LSR...12AC2
CL-LER.18AC2 and CL-LMR...18AC2

CL-DC1 for
CL-LSR...12DC1
CL-LMR...18DC1

CL-DC2 for
CL-LSR...12DC2, CL-LST...12DC2
CL-LMR...18DC2, CL-LMT...20DC2,
CL-LER.18DC2 and CL-LET.20DC2

CL-LE... for
CL-LER.2O, CL-LEC.CI000, CL-LER.18AC2, CL-LER.18DC2 and CL-LER.20DC2

Reading conventions

Symbols used in this manual have the following meanings:

▶ indicates actions to be taken.

Attention!
Warns of the risk of material damage.

Caution!
Warns of the possibility of serious damage and slight injury.

Warning!
Indicates the risk of major damage to property, or serious or fatal injury.

→ Draws your attention to interesting tips and supplementary information.

For greater clarity, the name of the current chapter is shown in the header of the left-hand page and the name of the current section in the header of the right-hand page. This does not apply to pages at the start of a chapter and empty pages at the end of a chapter.

1 Logic relay

Intended users

The logic relay must only be installed and wired up by trained electricians or other persons familiar with the installation of electrical equipment.

Specialist electrical training is needed for commissioning and creating circuit diagrams. When controlling active components such as motors or pressure cylinders, parts of the system can be damaged and persons put at risk if the logic relay is connected or programmed incorrectly.

Proper use

The logic relay is a programmable switching and control device and is used as a replacement for relay and contactor control circuits. The logic relay must be properly installed before use.

- The logic relay is designed to be installed in an enclosure, switch cabinet or distribution board. Both the power feed and the signal terminals must be laid and covered so as to prevent accidental contact.
- The installation must comply with regulations for electromagnetic compatibility (EMC).
- The power up of the logic relay must not cause any hazards arising from activated devices, such as unexpected motor startups or power ups.

Improper use

The logic relay should not be used as a substitute for safety-related controls such as burner or crane controls, emergency-stop or two-hand safety controls.

Overview

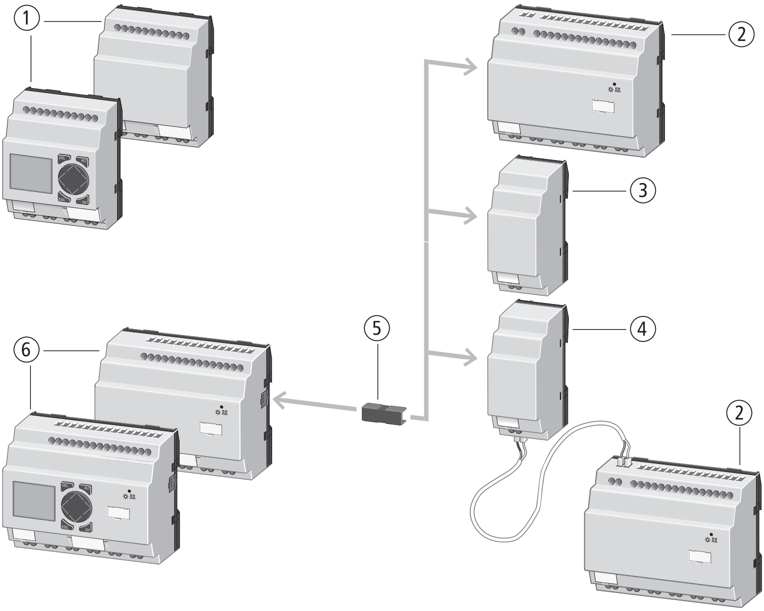


Figure 1: CL basic units and expansions

Legend for figure 1:

① CL-LSR/CL-LST logic relays
② CL-LER, CL-LET input/output expansion
③ CL-LER.2O output expansion
④ Coupler unit for CL-LEC.CI000 remote expansion
⑤ CL-LINK CL-LAS.TK011 data plug
⑥ CL-LMR/CL-LMT logic relays

The logic relay is an electronic control relay with logic functions, timer, counter and time switch functions. It is also a control and input device rolled into one. With the logic relay you can create solutions for domestic applications as well as for tasks in machine and plant construction.

Circuit diagrams are connected up using ladder diagrams, and each element is entered directly via the CL display.

For example, you can:

- Connect n/o and n/c contacts in series and in parallel
- Connect output relays and markers,
- Use outputs as relays, impulse relays or latching relays
- Use multi-function timing relays with different functions
- Use up and down counters
- Count high-speed counter pulses
- Measure frequencies
- Process analog inputs, CL-AC1, CL-DC1, CL-DC2, (CL-LSR/CL-LST: two analog inputs, CL-LMR/CL-LMT: four analog inputs)
- Display any texts with variables, enter setpoints
- Use year time switches, 7-day time switches CL-...C(X)...
- Count operating hours (four retentive operating hours counters integrated)
- Track the flow of current in the circuit diagram
- Load, save and password-protect circuit diagrams

To wire the logic relay via your PC use the CL-SOFT programming software. This software is used to create and test your circuit diagram on the PC. CL-SOFT enables you to print out your circuit diagram in DIN, ANSI or CL format.

Device overview

CL basic units at a glance

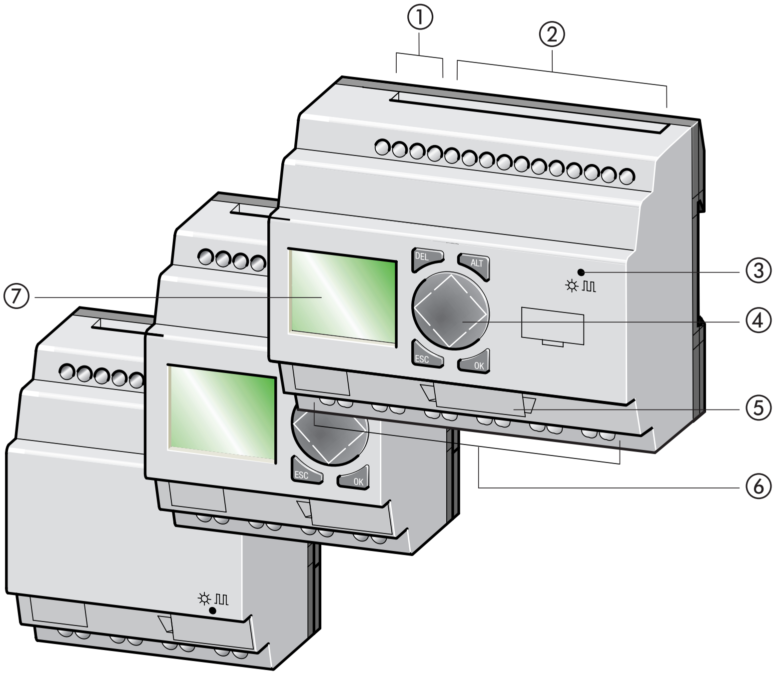


Figure 2: Device overview

① Supply voltage
② Inputs
③ Operating status LED
④ Keypad
⑤ Interface for memory module or PC connection
⑥ Outputs
⑦ Display

Logic relay with remote display CL-LDD..., CL-LDC.S...

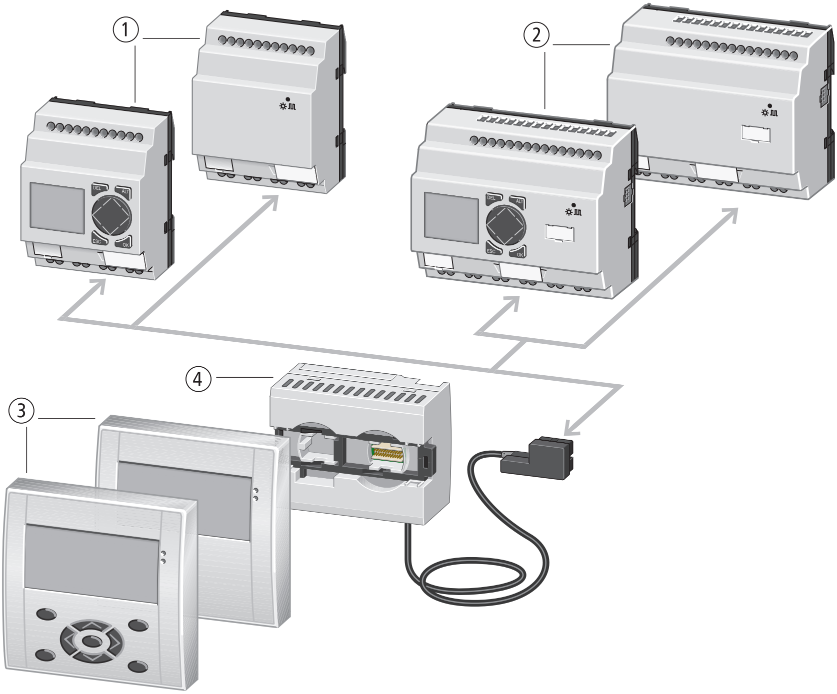
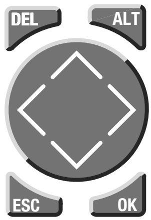


Figure 3: Device overview with remote display

① CL-LSR/CL-LST logic relays
② CL-LMR/CL-LMT logic relays
③ Display module CL-LDD...
④ Remote display connection module CL-LDC.S... with connection cable

CL operating principles

Keypad



DEL: Delete object in circuit diagram

ALT: Special functions in circuit diagram, status display

Cursor buttons ‹ › ˄ ˅:
Move cursor
Select menu items
Set contact numbers, contacts and values

OK: Next menu level, save your entry

ESC: Previous menu level, cancel

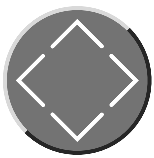
Selecting menus and entering values

 and 

Show system menu

Move to next menu level
Call menu item
Activate, change, store entries

Move to previous menu level
Cancel entries since last OK



˄ ˅	Change menu item Change value
‹ ›	Change place

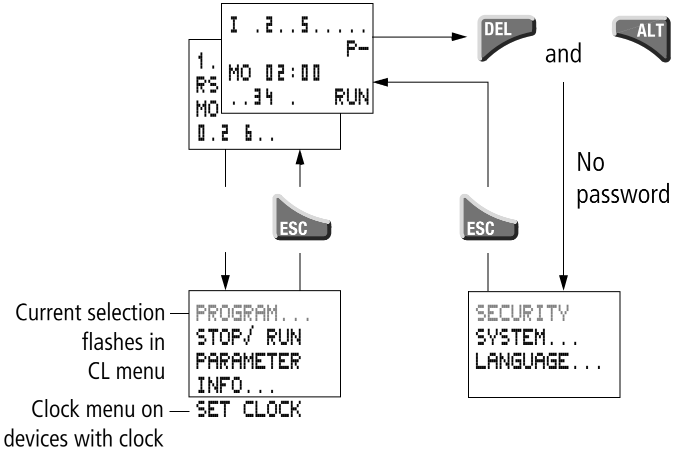
P buttons function:

‹	Input P1	˄	Input P2
›	Input P3	˅	Input P4

Selecting main and system menu

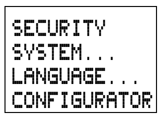
Status display

CL-LSR/CL-LST: 8 inputs, 4 outputs



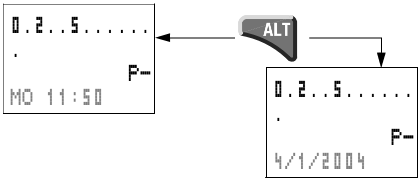
1st menu level
Main menu

1st menu level
System menu
CL-LSR/CL-LST or
CL-LMR/CL-LMT

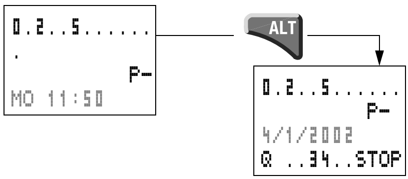


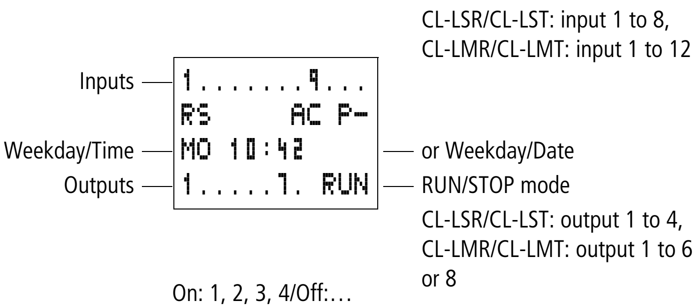
Toggling between weekday, time display and date display

(only on devices with clock)

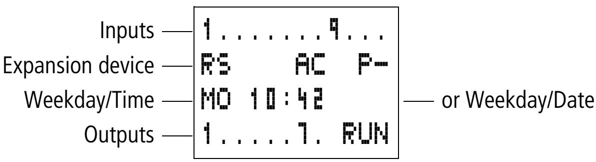


Status display logic relay





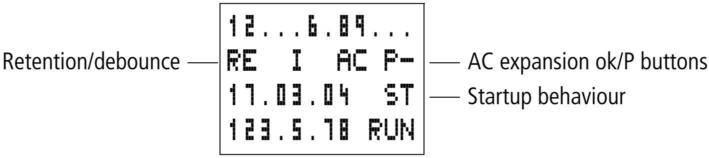
Status display for local expansion



On: 1, 2, 3, 4/Off:…

RS = Expansion functioning correctly

Advanced status display



RE : Retention switched on
I : Debounce switched on
AC : AC expansion functioning correctly
DC : DC expansion functioning correctly
GW : Bus coupling module detected
GW flashing: Only CL-LEC.CI000 detected. I/O expansion not detected.
17.03.04 Display of actual device date
ST : When the power supply is switched on, the logic relay switches to STOP mode

CL-LED display

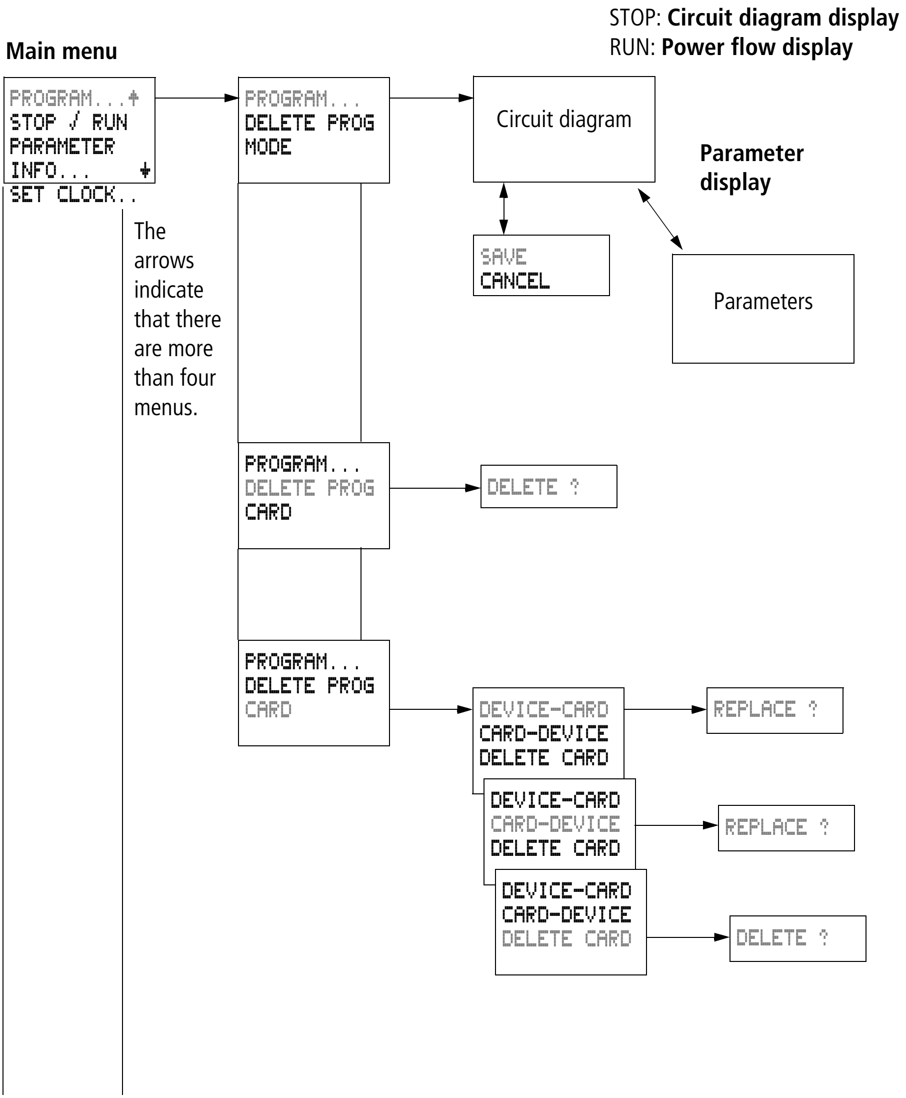
CL-LSR.CX..., CL-LST.CX..., CL-LMR/CL-LMT, CL-LER and CL-LET feature an LED on the front which indicates the status of the power supply as well as the RUN or STOP mode (→ figure 2, Page 14).

LED OFF	No power supply
LED continuously lit	Power supply present, STOP mode
LED flashing	Power supply present, RUN mode

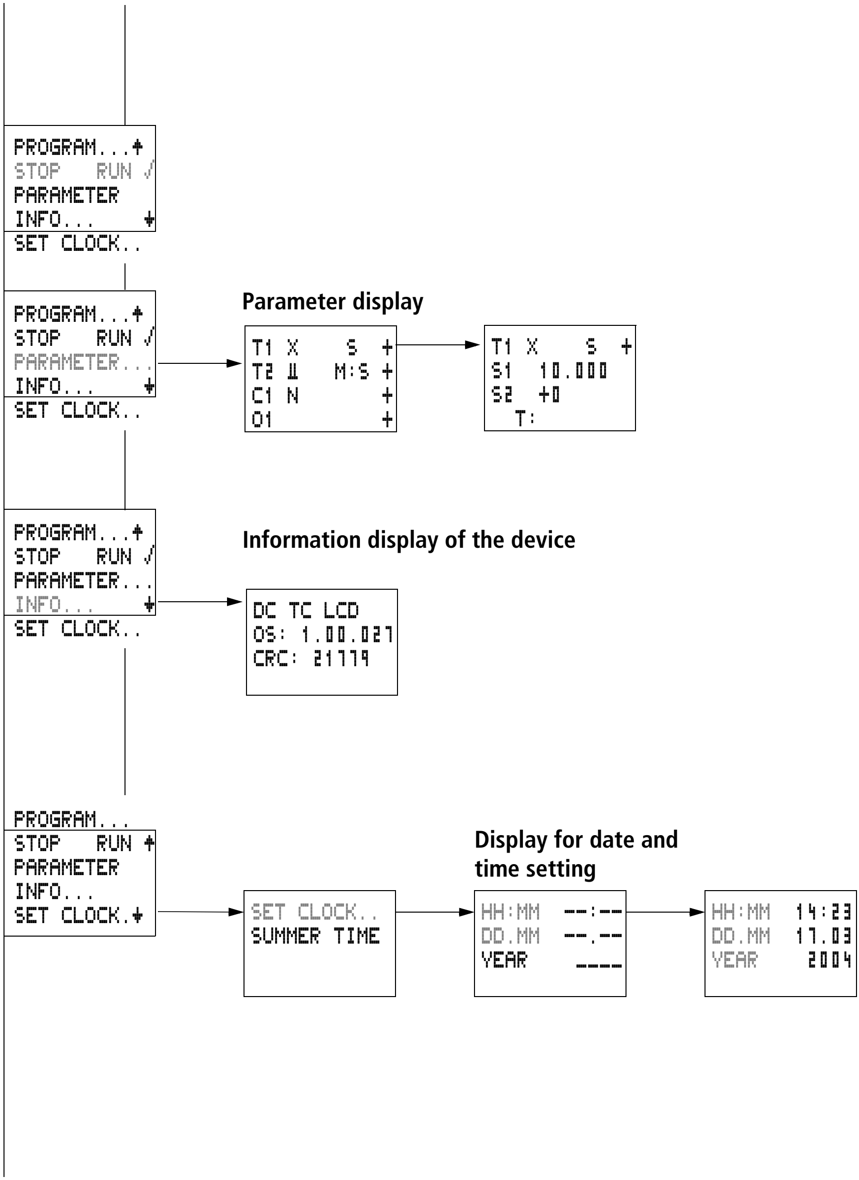
Menu structure

Main menu without password protection

▶ You access the main menu by pressing OK.

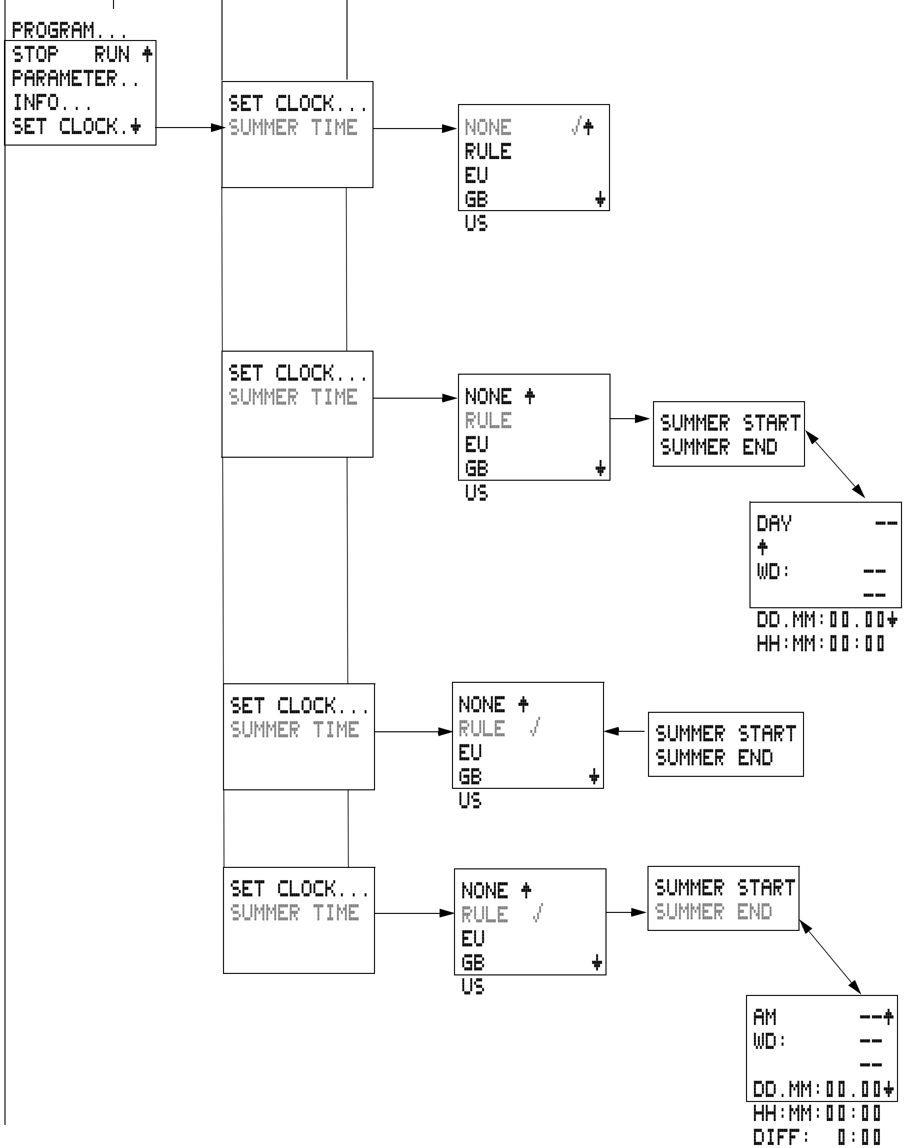


Main menu

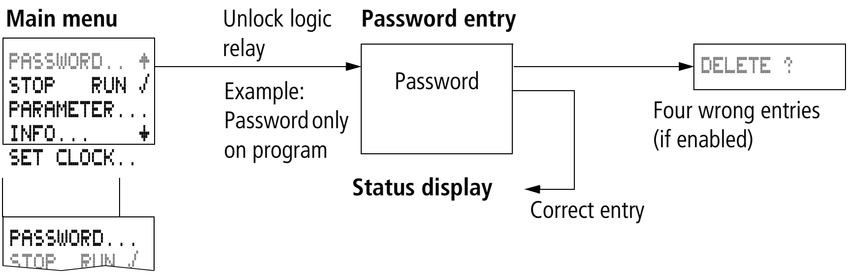

PROGRAM...
STOP RUN √
PARAMETER
INFO...
SET CLOCK..
Parameter display
T1 X S +
T2 ⫫ M:S +
C1 N +
O1 +
T1 X S +
S1 10.000
S2 +0
T:
Information display of the device
DC TC LCD
OS: 1.00.027
CRC: 21779
Display for date and time setting
SET CLOCK..
SUMMER TIME
HH:MM --:--
DD.MM --.--
YEAR ____
HH:MM 14:23
DD.MM 17.03
YEAR 2004

Main menu

Only one selection is possible.

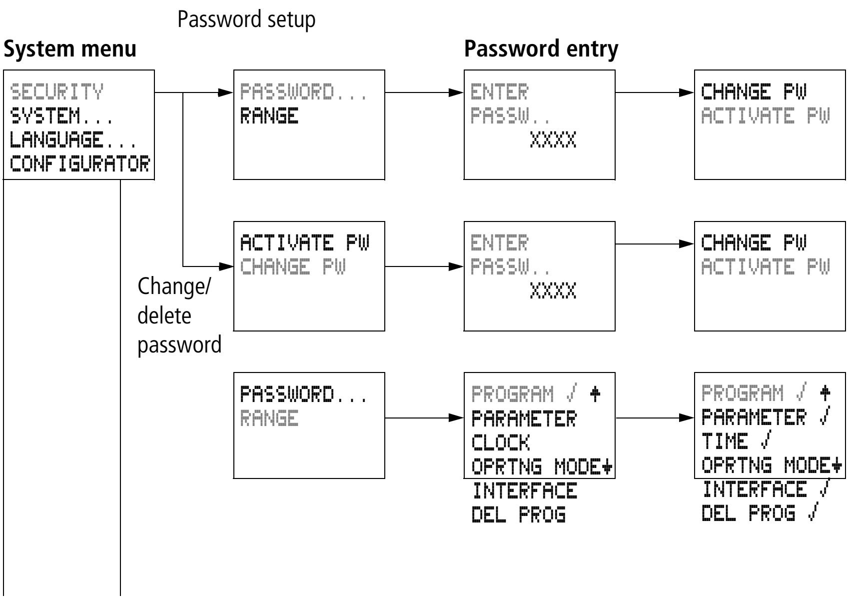


Main menu with password protection

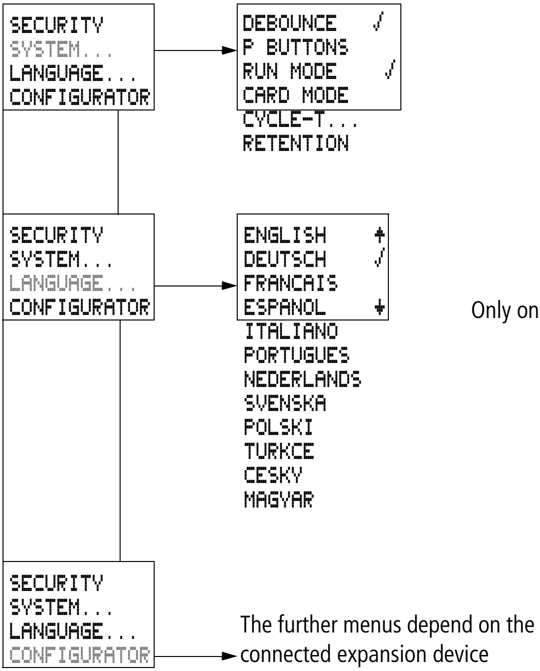


System menu CL

The system menu is accessed by simultaneously pressing **DEL** and **ALT**.

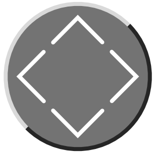


System menu



Only one selection is possible.

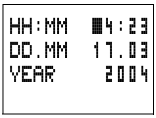
Selecting or toggling between menu items



Cursor ∧ ∨

Select or toggle

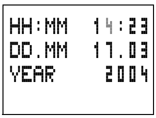
Cursor display



The cursor flashes.

Full cursor █/:

- Move cursor with < >,
- in circuit diagram also with ∧ ∨

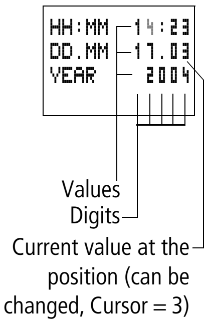


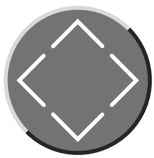
Value M/M

- Change position with < >
- Change values with ∧ ∨

Flashing values/menus are shown in grey in this manual.

Set value





Select value ∧ ∨

Select digit < >

Change value at digit ∧ ∨

Store entry

Retain previous value

2 Installation

The logic relay must only be installed and wired up by trained electricians or other persons familiar with the mounting of electrical equipment.

Danger of electric shock

Never carry out electrical work on the device while the power supply is switched on.

Always follow the safety rules:

- Switch off and isolate
- Secure against reclosing
- Ensure that the device is no longer live
- Cover adjacent live parts

The logic relay is installed in the following order:

- Assemble devices if necessary
- Mounting
- Wiring up the inputs
- Wiring up the outputs
- Connecting the power supply

Mounting

Install the logic relay in a control cabinet, service distribution board or in an enclosure so that the power feed and terminal connections cannot be touched accidentally during operation.

Fit the logic relay on a top-hat rail in accordance with DIN EN 50022 or fasten the logic relay with fixing brackets. The logic relay can be mounted either vertically or horizontally.

→ When using the logic relay with expansion units, connect the expansion concerned before mounting (→ page 30).

For ease of wiring, leave a gap of at least 30 mm between the terminals and the wall or adjacent devices.

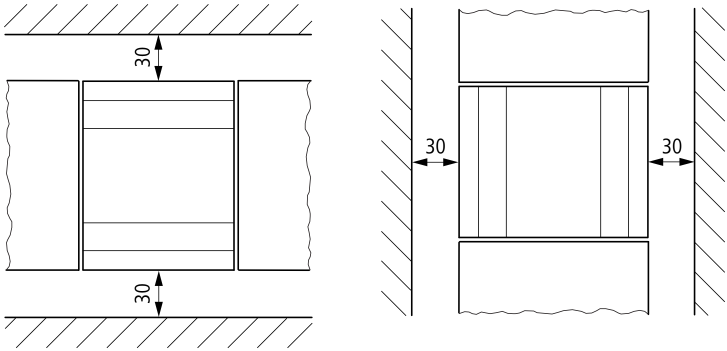
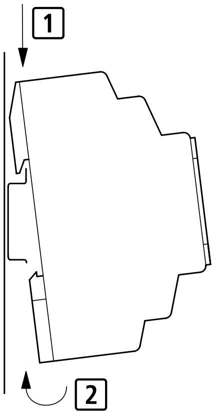


Figure 4: Clearances from the logic relay



Mounting on top-hat rail

▶ Place the logic relay diagonally on the upper lip of the top-hat rail. Slightly push the device down and against the top-hat rail until it also snaps onto the bottom lip of the rail.

The logic relay will clip into place and will be secured by the built-in spring mechanism.

▶ Check that the device is seated firmly.

The device is mounted vertically on a top-hat rail in the same way.

Screw mounting

Fixing brackets that can be inserted on the rear of the logic relay are required for screw mounting. The fixing brackets are available as an accessory.

CL-LMR/CL-LMT: Fasten each device with at least three fixing brackets.

CL-LEC.CI000: CL-LSR/CL-LST: CL-LMR/CL-LMT:

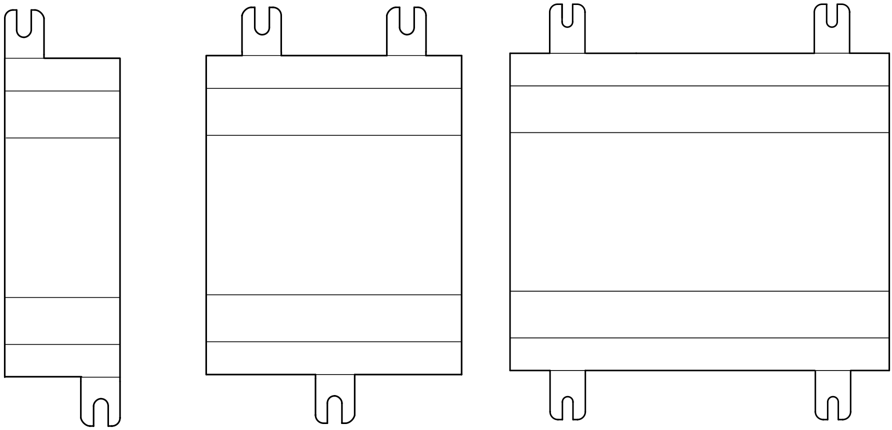


Figure 5: Screw mounting

Connecting the expansion device

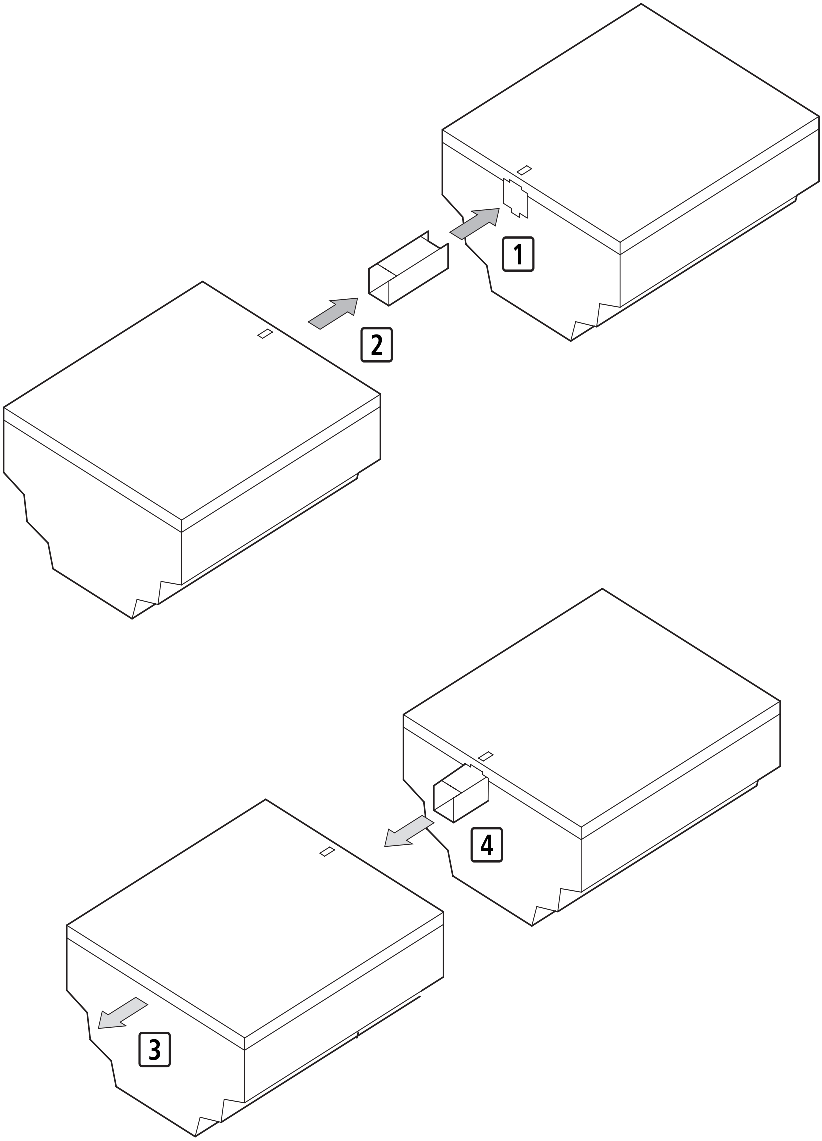


Figure 6: Connecting expansion units

- ▶ Open the CL-LINK connections on the side of both CL devices.
- ▶ Fit the CL-LINK data plug CL-LAS.TK011 in the opening provided on the expansion device.
- ▶ Plug the devices together.
- ▶ Proceed in the reverse order to dismantle the device.

Terminals

Tools

Slot-head screwdriver, width 3.5 mm, tightening torque 0.6 Nm.

Cable cross-sections

- Solid: 0.2 to 4 mm^2
- Flexible with ferrule: 0.2 to 2.5 mm2

Connecting the power supply

→ The required connection data for device types **CL-AC1** with the voltage 24 V AC**, CL-AC2** with the standard voltage of 100 V to 240 V AC, **CL-DC1** with the voltage 12 V DC and **CL-DC2** with 24 V DC is provided in section “Technical data”, Page 254.

The CL-LSR/CL-LST and CL-LMR/CL-LMT logic relays perform a two-second system test after the power supply voltage is applied. Either RUN or STOP mode will be activated after these two seconds, depending on the default setting.

Cable protection

The logic relay requires cable protection (F1) rated for at least 1 A (slow).

Supplying AC units

Supplying AC basic units

CL-LSR...12AC1,CL-LMR...18AC1,
CL-LSR...12AC2,CL-LMR...18AC2

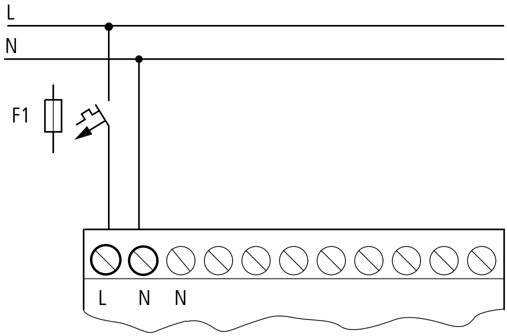


Figure 7: Supply voltage to AC basic unit

Supplying AC basic units

CL-LER.18AC2

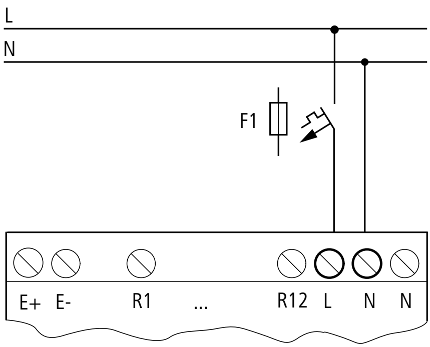


Figure 8: Supply voltage to AC basic unit

Applies to CL-AC devices with a power supply greater than 24 V AC:

- The voltage terminals for phase L and neutral conductor N have been reversed.
- This enables the CL interface (for memory module or PC connection) to have the full connection voltage of the phase conductor L (100 to 240 V AC).
- There is a danger of electric shock if the CL interface is not properly connected or if conductive objects are inserted into the socket.

Attention!
A short current surge will be produced when switching on for the first time. Do not switch on the logic relay with reed contacts because these could possibly burn or stick.

Supplying DC units

Supplying DC basic units

CL-LSR...12DC1, CL-LMR...18DC1, CL-LSR...12DC2, CL-LMR...18DC2

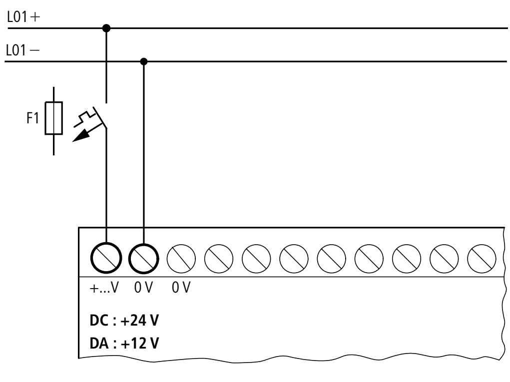


Figure 9: Supply voltage to DC basic unit

Supplying DC expansion devices CL-LER.18DC2, CL-LER.20DC2

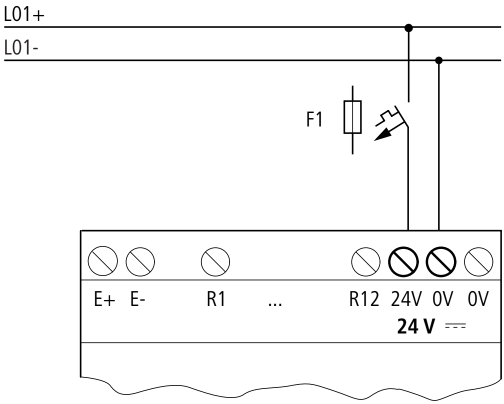


Figure 10: Supply voltage to DC expansion unit

→ CL-DC1 and CL-DC2 are protected against reverse polarity. Ensure the correct polarity of the terminals to ensure that the logic relay functions correctly.

Cable protection

The logic relay requires cable protection (F1) rated for at least 1 A (slow).

→ When the CL device is switched on for the first time, its power supply circuit behaves like a capacitor. Ensure that reed relay contacts or proximity switches are not used as the switching device for switching on the power supply.

Connecting the inputs

The inputs of the logic relay switch electronically. Once you have connected a contact via an input terminal, you can reuse it as a contact in your CL circuit diagram as often as you like.

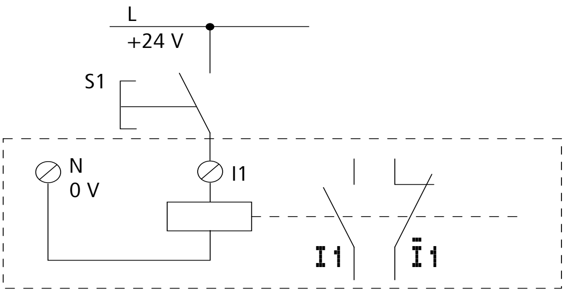


Figure 11: Connecting the inputs

Connect to the logic relay input terminals contacts such as pushbuttons, switches, relay or contactor contacts, proximity switches (three-wire).

Connect digital AC inputs

Caution!
Connect the inputs for AC devices in compliance with the safety regulations of the VDE, IEC, UL and CSA. The same phase conductor to which the device power supply is connected should be used for the supply of the inputs. The logic relay will otherwise not detect the switching level or may be destroyed by overvoltage.

Connect digital AC inputs to the basic unit

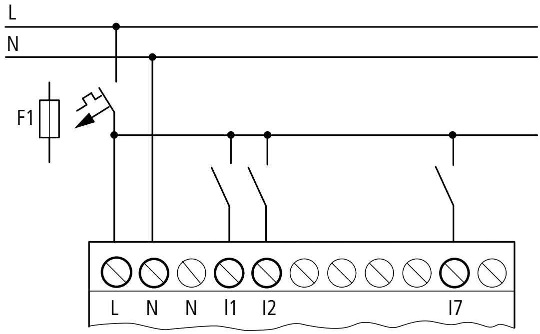


Figure 12: Connect digital inputs CL-AC1 and CL-AC2

Connect digital AC inputs to the expansion unit

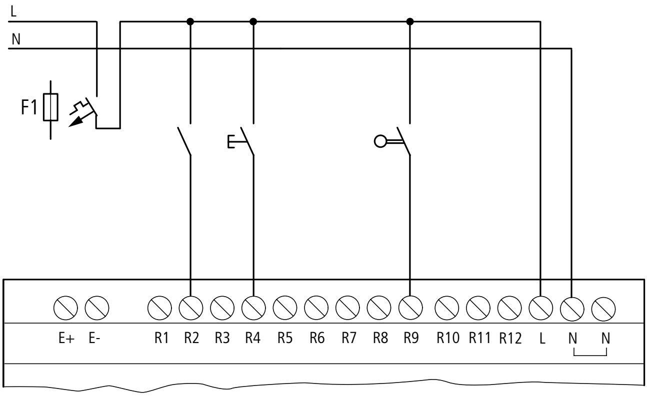


Figure 13: Connect digital inputs CL-LER.18AC2

Table 1: Input signal values CL-AC1

		Voltage range of the input signals		Input current
		OFF signal	ON signal	
CL-LSR/ CL-LMR	I1 to I6	0 to 6 V AC	14 to 26.4 V AC	4 mA at 24 V AC
	I7, I8		greater than 7 V AC or greater than 9.5 V DC	2 mA with 24 V AC and 24 V DC
CL-LMR	I9, I10		14 to 26.4 V AC	4 mA at 24 V AC
	I7, I8		greater than 7 V AC or greater than 9.5 V DC	2 mA with 24 V AC and 24 V DC

Table 2: Input signal values CL-AC2

		Voltage range of the input signals		Input current
		OFF signal	ON signal	
CL-LSR/ CL-LMR	I1 to I6	0 to 40 V	79 to 264 V	0.5 mA at 230 V AC/ 0.25 mA at 115 V AC
	I7, I8			6 mA at 230 V AC/4 mA at 115 V
CL-LMR	I1 to I6			0.5 mA at 230 V AC/ 0.25 mA at 115 V AC
CL-LER/ CL-LET	R1 to R12			

Cable lengths

Severe interference can cause a "1" signal on the inputs without a proper signal being applied. Observe therefore the following maximum cable lengths:

I1 to I6	40 m without additional circuit
I7, I8	100 m without additional circuit
I1 to I6	40 m without additional circuit
R1 to R12	

With longer cables you can, for example, connect a 1 A diode (e.g. 1N4007) with a blocking voltage of at least 1000 V in series with the CL input. Ensure that the diode is connected in relation to the input as shown in the circuit diagram, otherwise the logic relay will not detect the 1 signal.

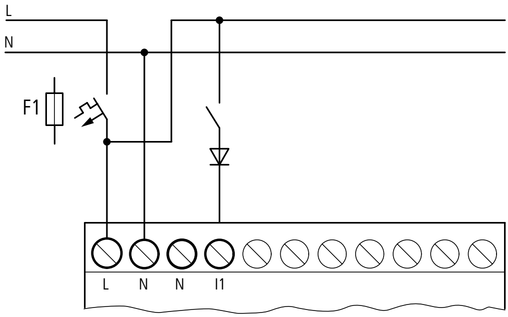


Figure 14: AC input with suppression diode for CL-AC1 and CL-AC2

CL-AC2:
Inputs I7 and I8 on the CL-AC2 have a high input current. Neon bulbs with a maximum residual current of 2 mA/1 mA at 230 V/115 V can be connected to I7 and I8.

→ Always use neon bulbs that are operated with a separate N connection.

Caution!
Do not use reed relay contacts at I7, I8. These may burn or melt due to the high inrush current of I7, I8.

Two-wire proximity switches have a residual current in the "0" state. If this residual current is too high, the logic relay input may only detect a "1" signal.

Use therefore the inputs I7, I8. An additional input circuit is required if more inputs are needed.

Increasing the input current

The following input circuit can be used in order to prevent interference and also when using two-wire proximity switches:

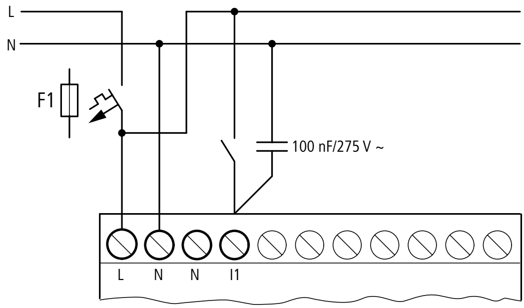


Figure 15: Increasing the input current

→ When using a 100 nF capacitor, the drop-out time of the input increases by 80 (66.6) ms at 50 (60) Hz.

A resistor can be connected in series with the circuit shown in order to restrict the inrush current.

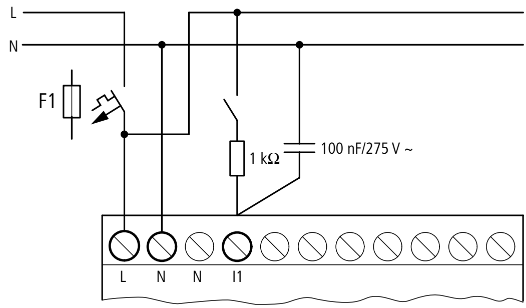


Figure 16: Limitation of the input current with a resistor

→ The increased capacitance increases the drop-off time by approx. 40 ms.

Connect digital DC inputs

Use input terminals I1 to I12 , R1 to R12 to connect pushbutton actuators, switches or 3 or 4-wire proximity switches. Given the high residual current, do not use 2-wire proximity switches.

Connect digital DC inputs to the basic unit

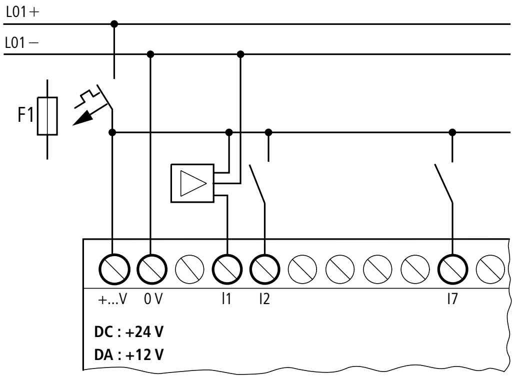
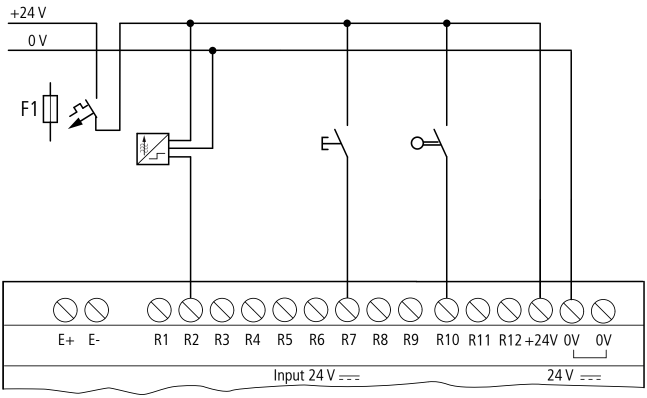


Figure 17: Connect digital inputs CL-DC1 and CL-DC2

Connect digital DC inputs to the expansion unit



CL-LE...DC2

Figure 18: Connect digital inputs CL-LER.18DC2, CL-LET.20DC

Table 3: Input signal values CL-DC2

		Voltage range of the input signals		Input current
		OFF signal	ON signal	
CL-LSR/ CL-LST/ CL-LMR/ CL-LMT	I1 to I6	0 to 5 V	15 to 28.8 V	3.3 mA at 24 V DC
	I7, I8		greater than 8 V DC	2.2 mA at 24 V
CL-LMR/ CL-LMT	I9, I10		15 to 28.8 V	3.3 mA at 24 V DC
	I7, I8		greater than 8 V DC	2.2 mA at 24 V
CL-LER/ CL-LET	R1 to R12		15 to 28.8 V	3.3 mA at 24 V DC

Table 4: Input signal values CL-DC1

		Voltage range of the input signals		Input current
		OFF signal	ON signal	
CL-LSR/ CL-LMR	I1 to I6	0 to 4 V DC	8 to 15.6 V DC	3.3 mA at 12 V
	I7, I8			1.1 mA at 12 V
CL-LMR	I9, I10			3.3 mA at 12 V
	I7, I8			1.1 mA at 12 V

Connect analog DC inputs

The CL-AC1, CL-AC2 and CL-DC2 basic units are provided with analog inputs. Inputs I7 and I8, and if present I11 and I12, can be used to connect analog voltages ranging from 0 V to 10 V. A simple additional circuit also allows the analog evaluation of currents from 0 to 20 mA. The analog input signals are converted to 10-bit digital signals.

The following signals apply:

- 0 V DC corresponds to a digital 0.
- 5 V DC corresponds to a digital value of 512.
- 10 V DC corresponds to a digital value of 1 023.

Caution!
Analog signals are more sensitive to interference than digital signals. Consequently, greater care must be taken when laying and connecting the signal lines.

Incorrect switching states may occur if they are not connected correctly.

Safety measures with analog signals

- ▶ Use shielded twisted pair cables to prevent interference with the analog signals.
- ▶ With short cable lengths, ground the shield at both ends using a large contact area. If the cable length is more than around 30 m, grounding at both ends can result in equalisation currents between the two grounding points and thus in the interference of analog signals. In this case, only ground the cable at one end.
- ▶ Do not lay signal cables parallel to power cables.
- ▶ Connect inductive loads to be switched via the logic relay outputs to a separate power feed, or use a suppressor circuit for motors and valves. If loads such as motors, solenoid valves or contactors are operated via the same power feed, switching may give rise to interference on the analog input signals.

The following four circuits contain examples of applications for analog value processing.

Caution!
Ensure that the reference potential is connected. Connect the 0 V of the power supply unit for the different setpoint potentiometers and sensors shown in the examples to the 0 V and neutral conductor terminal (CL-AC1) of the logic relay power feed. Otherwise incorrect switching states may occur if they are not connected correctly.

Power supply of CL-AC1 devices and analog inputs

With CL-AC1 devices that process analog signals, the device must be fed via a transformer so that the device is isolated from the mains supply. The neutral conductor and the reference potential of the DC power feed of analog sensors must be electrically connected.

→ Ensure that the common reference potential is grounded or monitored by a ground fault monitoring device. Observe the requirements of the relevant regulations.

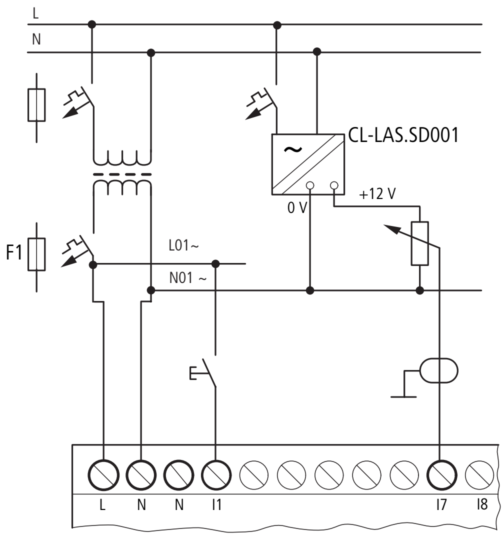


Figure 19: CL-AC1 analog input, connection of reference potentials

Analog setpoint potentiometer, CL-AC1,CL-DC1,CL-DC2

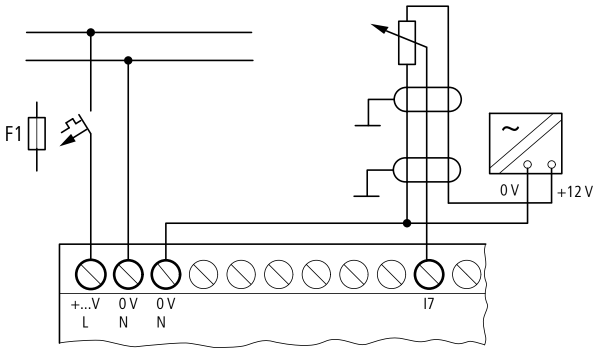


Figure 20: Analog setpoint potentiometer with own power feed

Use a potentiometer with a resistance of ≦ 1 kΩ, e. g. 1 kΩ, 0.25 W.

Analog setpoint potentiometer CL-DC2

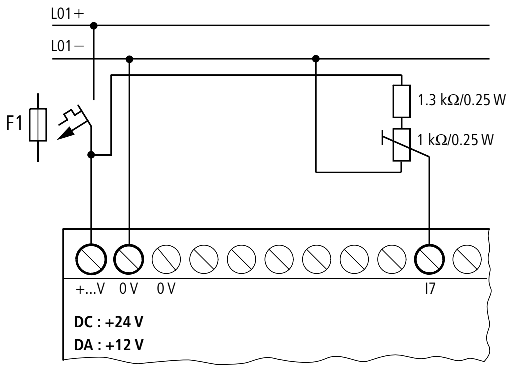


Figure 21: Analog setpoint potentiometer with 24 V DC power feed

Brightness sensor CL-AC1, CL-DC1, CL-DC2

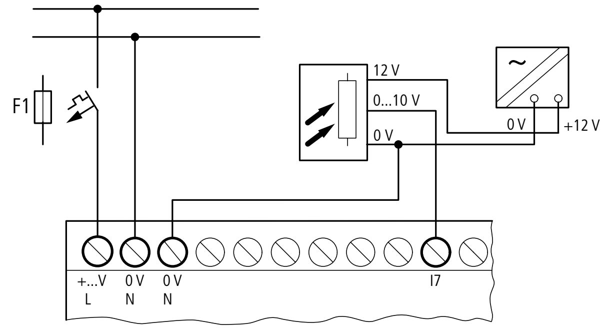


Figure 22: Connection of a brightness sensor, analog input

Temperature sensor, CL-DC1, CL-DC2

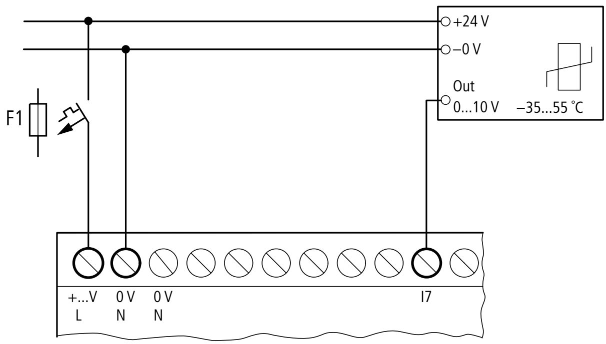


Figure 23: Connection of the temperature sensor, analog input

20 mA sensor

4 to 20 mA (0 to 20 mA) sensors can be connected easily without any problem using an external 500 V resistor.

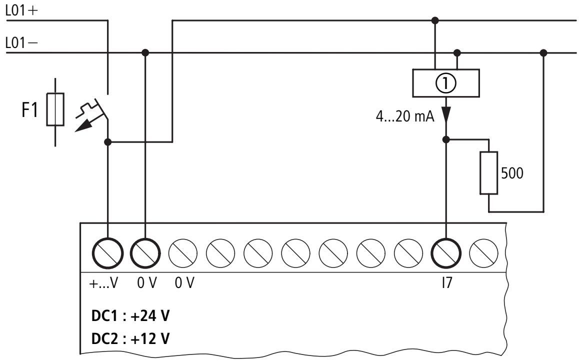


Figure 24: Connection 0 (4) to 20 mA sensor output, analog input

Analog sensor

The following values apply:

- 4 mA = 1.9 V
- 4 mA = 1.9 V
- 20 mA = 9.5 V

(Based on $U = R \times I = 478\ \Omega \times 10\ \text{mA} \sim 4.8\ \text{V}$).

Connecting high-speed counters and frequency generators

High-speed counter signals and frequencies on the CL-DC1 and CL-DC2 can be counted accurately on inputs I1 to I4 independently of the cycle time. These inputs are permanently assigned to counters.

The coils and contacts have the following meanings:

- I1 = C13 high-speed up/down counter
- I2 = C14 high-speed up/down counter
- I3 = C15 frequency counter
- I3 = C15 frequency counter

Pulse shape of count signals:
the logic relay processes square wave signals.

Mark-to-space ratio of count signals:
We recommend a mark-to-space ratio of 1:1.

If this is not the case:
The minimum pulse or pause duration is 0.5 ms.

$t_{min} = 0.5 \times (1/f_{max})$

t_{min} = minimum time of the pulse or pause duration

f_{max} = maximum count frequency (1 kHz)

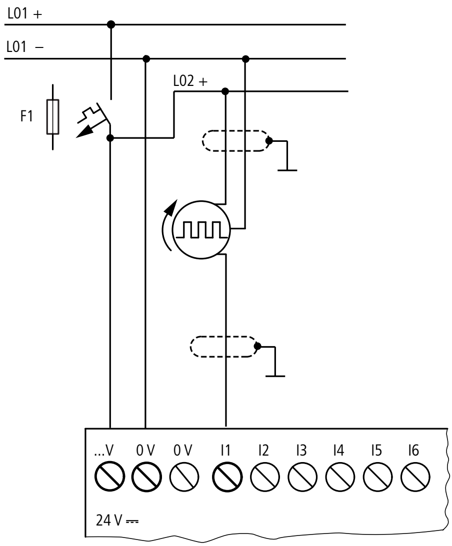


Figure 25: Connecting high-speed counters and frequency generators

→ Inputs that are used as high-speed counter inputs should not be used in the circuit diagram as contacts. If the counter frequency is high:

Not all the high-speed counter signals will be measured for processing in the circuit diagram. The logic relay will only process randomly detected signals in the circuit diagram.

Connecting outputs

The Q outputs operate inside the CL as isolated contacts.

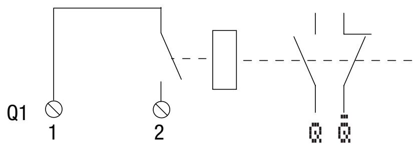


Figure 26: Output Q

The associated relay coils are controlled in the CL circuit diagram via the following outputs.

- Q1 to Q4 and Q1 to Q8 (Q6), basic units
- S1 to S8 (S6), expansion devices

The signal states of the outputs can be used in the CL circuit diagram as n/o or n/c contacts for other switching conditions.

The relay or transistor outputs are used to switch loads such as fluorescent tubes, filament bulbs, contactors, relays or motors. Prior to installation observe the technical limit values and data for the outputs (→ section "Technical data", Page 254).

Connect relay outputs

CL-LSR

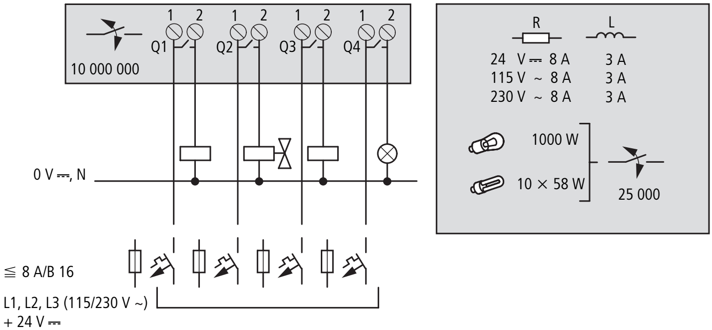
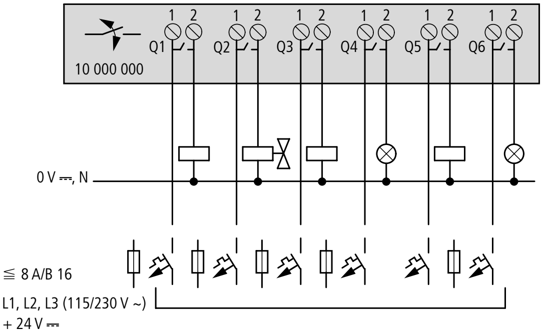


Figure 27: Relay outputs CL-LSR

CL-LMR and CL-LER.2O



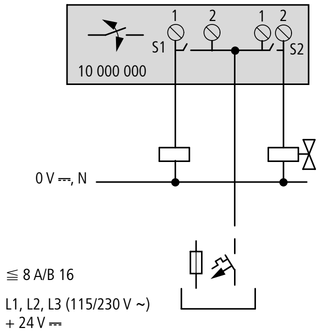


Figure 28: Relay outputs CL-LMR and CL-LER.2O

CL-LER.18AC2, CL-LER.18DC2

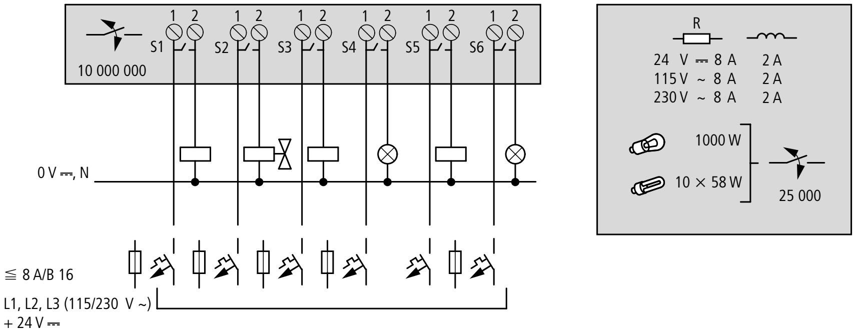
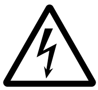


Figure 29: Relay outputs CL-LER.18AC2, CL-LER.18DC2

Unlike the inputs, the outputs can be connected to different phases.



Caution!
Do not exceed the maximum voltage of 250 V AC on a relay contact.

If the voltage exceeds this threshold, flashover may occur at the contact, resulting in damage to the device or a connected load.

Connecting transistor outputs

CL-LST

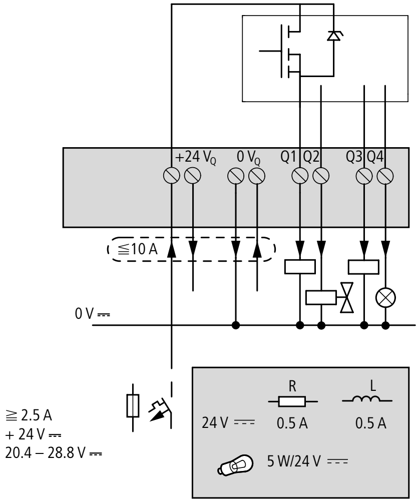


Figure 30: Transistor outputs CL-LST

CL-LMT

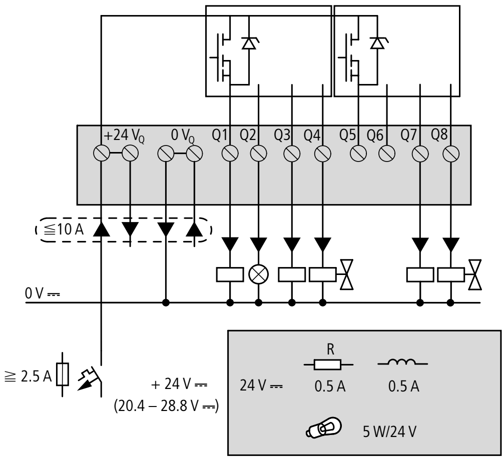


Figure 31: Transistor outputs CL-LMT

CL-LET.20DC2

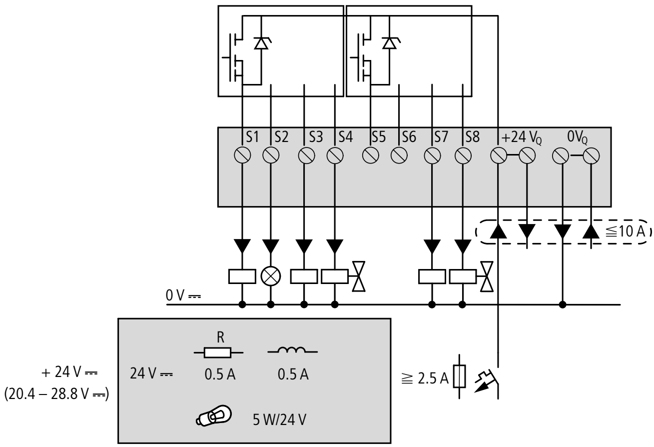


Figure 32: Transistor outputs CL-LET.20DC2

Parallel connection:
Up to four outputs can be connected in parallel in order to increase the output power. This enables a maximum output current of 2 A.

Caution!
Outputs within a group (Q1 to Q4 or Q5 to Q8, S1 to S4 or S5 to S8) can be switched in parallel; e.g. Q1 and Q3 or Q5, Q7 and Q8. Outputs switched in parallel must be activated at the same time.

Caution!
Please note the following when switching off inductive loads.

Suppressed inductive loads cause less interference in the entire electrical system. For optimum suppression the suppressor circuits are best connected directly to the inductive load.

If inductive loads are not suppressed, the following applies: Several inductive loads should not be switched off simultaneously to avoid overheating the driver blocks in the worst possible case. If in the event of an emergency stop the +24 V DC power supply is to be switched off by means of a contact, and if this would mean switching off more than one controlled output with an inductive load, then you must provide suppressor circuits for these loads (see the following diagrams).

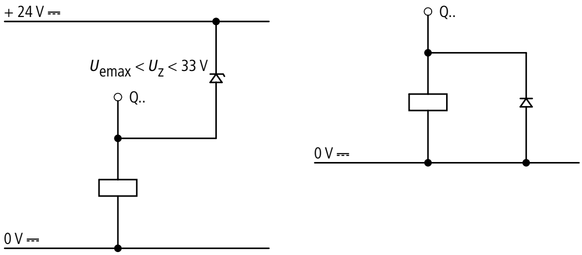


Figure 33: Inductive load with suppressor circuit

Behaviour with short-circuit/overload

A transistor output will switch off in the event of a short-circuit or overload. The output will switch back on up to the maximum temperature after a cooling time that depends on the ambient temperature and the current level. If the fault condition persists, the output will keep switching off and on until the fault is corrected or until the power supply is switched off (→ section "Monitoring of short-circuit/overload with CL-LST, CL-LMT and CL-LET", Page 234).

Expanding inputs/outputs

You can add expansion units to the following CL models in order to increase the number of inputs and outputs:

Expandable CL basic units	Expansion units	
CL-LMR/ CL-LMT	CL-LER.18...	115/230 V AC power supply • 12 AC inputs, • 6 relay outputs
		24 V DC power supply • 12 DC inputs, • 6 relay outputs
	CL-LET.20DC2	• 12 DC inputs, • 8 transistor outputs
	CL-LER.2O	2 relay outputs
	Special expansion units see current catalogue	

Local expansion

Local expansion units are connected directly next to the basic unit.

▶ Connect the CL expansion unit via the CL-LINK connection.

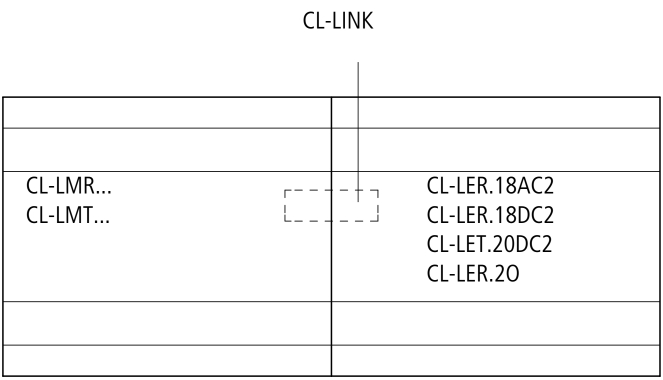


Figure 34: Connecting local expansion with CL basic unit

Warning!
The following electrical separation is implemented between the CL-LMR.C.../CL-LMT.C... basic unit and the expansion device (separation always in local connection of expansion unit)

- Basic isolation 400 V AC (+10 %)
- Safe isolation 240 V AC (+10 %)

Units may be destroyed if the value 400 V AC +10 % is exceeded, and may cause the malfunction of the entire system or machine!

→ The basic unit and expansion unit can be provided with different DC power supplies.

Remote expansion

Remote expansion units can be installed and run up to 30 m away from the basic unit.

Warning!
The two-wire or multi-core cable between units must have the necessary insulation voltage required for the installation environment concerned. In the event of a fault (ground leakage, short-circuit) serious damage or injury to persons may otherwise occur.

A cable such as NYM-0 with a rated operating voltage of U_e = 300/500 V AC is normally sufficient.

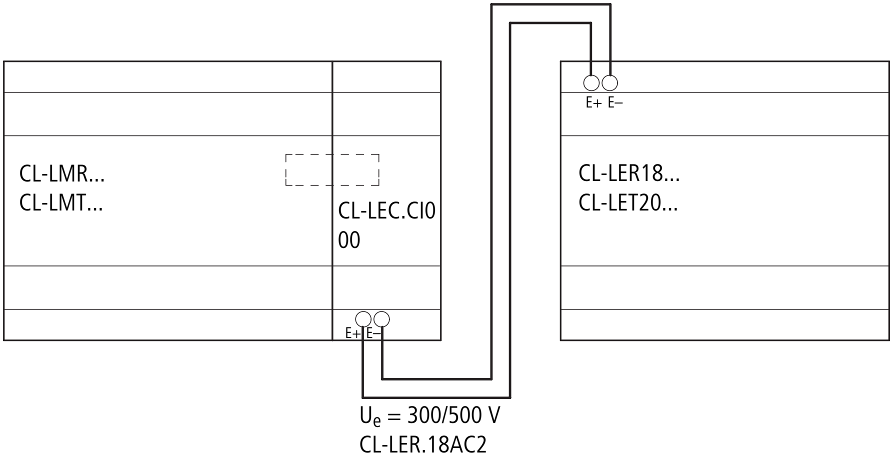


Figure 35: Connecting remote expansion units to CL basic unit

→ The terminals “E+” and “E-” of the CL-LEC.CI000 are protected against short-circuits and polarity reversal. Functionality is only ensured if “E+” is connected with “E+” and “E-” with “E-”.

3 Commissioning

Switching on

Before switching on, check that you have connected the power supply terminals and inputs correctly:

- 24 V AC version CL-AC1
  - Terminal L: Phase conductor L
  - Terminal N: Neutral conductor N
  - Terminals I1 to I12: Actuation via same phase conductor L
- 230 V AC version CL-AC2
  - Terminal L: Phase conductor L
  - Terminal N: Neutral conductor N
  - Terminals I1 to I12, R1 to R12: Actuation via phase conductor L
- 12 V DC version:
  - Terminal +12 V: voltage +12 V
  - Terminal 0 V: voltage 0 V
  - Terminals I1 to I12: Actuation via same +12V
- 24 V DC version:
  - Terminal +24 V: voltage +24 V
  - Terminal 0 V: voltage 0 V
  - Terminals I1 to I12, R1 to R12: Actuation via the same +24 V

If you have already integrated the logic relay into a system, secure any parts of the system connected to the working area to prevent access and ensure that no-one can be injured if, for example, motors start up unexpectedly.

Setting the menu language

```
ENGLISH       √
DEUTSCH
FRANCAIS
ESPANOL
```

When you switch on the logic relay for the first time, you will be asked to select the menu language.

▶ Use the cursor buttons ⋀ or ⋁ to select the language required.

- English
- German
- French
- Spanish
- Italian
- Portuguese
- Dutch
- Swedish
- Polish
- Turkish
- Czech
- Hungarian

▶ Press **OK** to confirm your choice and press **ESC** to exit the menu.

The logic relay will then switch to the status display.

→ You can change the language setting at a later date, (→ section "Changing the menu language", Page 201).

If you do not set the language, the logic relay will display this menu every time you switch on and wait for you to select a language.

CL operating modes

The logic relay has two operating modes – RUN and STOP.

In RUN mode the logic relay continuously processes a stored circuit diagram until you select STOP or disconnect the power. The circuit diagram, parameters and the CL settings are retained in the event of a power failure. All you will have to do is reset the real-time clock after the back-up time has elapsed. Circuit diagram entry is only possible in STOP mode.

Caution!
In RUN mode the logic relay will immediately run the saved circuit diagram in the unit when the power supply is switched on. This will happen unless STOP mode was set as startup mode. In RUN mode outputs are activated according to the switch logic of the circuit diagram.

When a memory module with a circuit diagram is fitted in a CL model with an LCD display, this circuit diagram will not start automatically if there is circuit diagram in the logic relay. You therefore have to transfer the circuit diagram from the memory module to the logic relay.

In RUN mode CL models without an LCD display load the circuit diagram on the memory module automatically and run it immediately.

Creating your first circuit diagram

The following single line diagram takes you step by step through wiring up your first CL circuit diagram. In this way you will learn all the rules, quickly enabling you to use the logic relay for your own projects.

As with conventional wiring, you use contacts and relays in the CL circuit diagram. With the logic relay, however, you no longer have to connect up components individually. At the push of a few buttons, the CL circuit diagram produces all the wiring required. All you have to do is then connect any switches, sensors, lamps or contactors you wish to use.

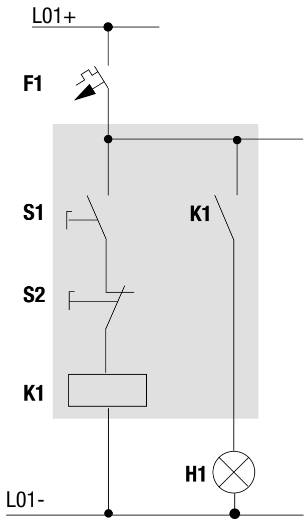


Figure 36: Lamp controller with relays

In the following example, the logic relay carries out all the wiring and performs the tasks of the circuit diagram shown below.

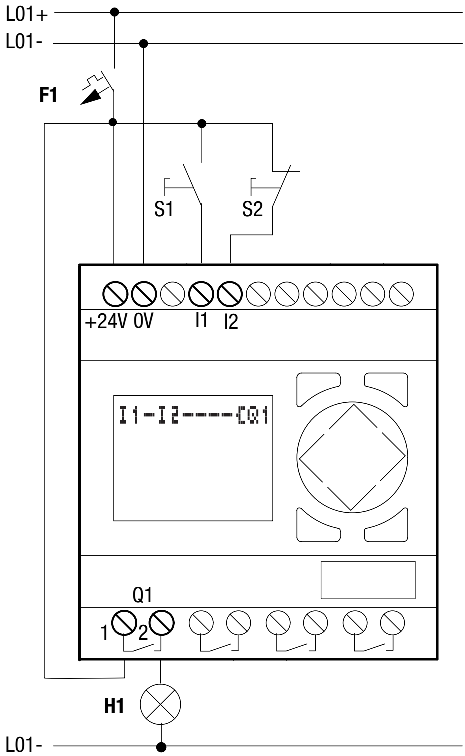
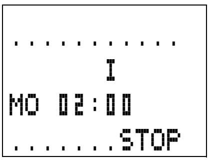


Figure 37: Lamp controller with logic relay

Starting point: the status display



The logic relay activates the status display after it is powered up. This shows the switching state of the inputs and outputs, and indicates whether the logic relay is already running a circuit diagram.

→ The examples were written without the use of expansion units. If an expansion unit is connected, the status display will first show the status of the basic unit and then the status of the expansion unit before showing the first selection menu.

```
PROGRAM...
STOP ✓ RUN
PARAMETER
INFO
```

▶ Press OK to switch to the main menu.

Press OK to switch to the next menu level, and press ESC to move one level back.

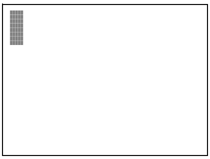
→ OK has two other functions:

- Press OK to save modified settings.
- In the circuit diagram, you can also press OK to insert and modify contacts and relay coils.

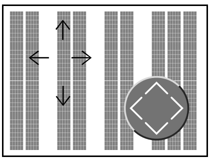
The logic relay is in STOP mode.

▶ Press **OK** 2 × to enter the circuit diagram display via menu items PROGRAM… → PROGRAM. This is where you will create the circuit diagram.

Circuit diagram display



The circuit diagram display is currently empty. The cursor flashes at the top left, which is where you will start to create your diagram. The logic relay automatically proposes the first contact input I1.



Use the ⋀ ⋁ < > cursor buttons to move the cursor over the invisible circuit diagram grid.

The first three double columns are the contact fields and the right-hand columns form the coil field. Each line is a circuit connection. The logic relay automatically connects the contact to the power supply.

▶ Now try to wire up the following CL circuit diagram.

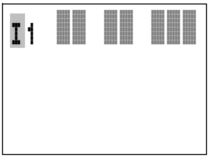
```
I1-I2----[Q1
```

The switches S1 and S2 are at the input whilst I1 and I2 are the contacts for the input terminals. Relay K1 is represented by the relay coil [Q1. The symbol [identifies the coil's function, in this case a relay coil acting as a contactor. Q1 is one of up to eight CL output relays in the basic unit.

From the first contact to the output coil

With the logic relay you work from the input to the output. The first input contact is I1.

▶ Press OK.



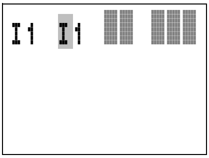
The logic relay proposes the first contact I1 at the cursor position.

▶ I flashes and can be changed, for example, to a P for a pushbutton input using the cursor buttons ∧ or ∨. However, nothing needs to be changed at this point.

▶ Press **OK** 2 x, to move the cursor across the 1 to the second contact field.

You could also move the cursor to the next contact field using the cursor button >.

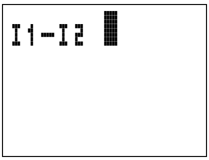
▶ Press OK.



Again, the CL inserts a contact I1 at the cursor position. Change the contact number to I2 so that n/c contact S2 can be connected to input terminal I2.

▶ Press **OK** so that the cursor jumps to the next position and use cursor buttons ∧ or ∨ to change the number 2.

→ Press **DEL** to delete a contact at the cursor position.



▶ Press **OK** to move the cursor to the third contact field.

You do not need a third relay contact, so you can now wire the contacts directly up to the coil field.

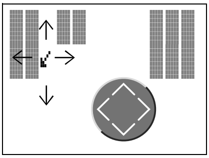
Wiring

The logic relay displays a small arrow in the circuit diagram when creating the wiring.

Press **ALT** to activate the arrow and press the cursor buttons ⌃⌄ ‹ › to move it.

→ ALT also has two other functions depending on the cursor position:

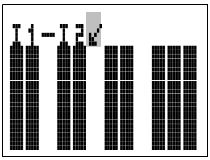
- From the left contact field, press **ALT** to insert a new, empty rung.
- The contact under the cursor can be changed between a n/o and n/c contact by pressing the **ALT** button.



The wiring arrow works between contacts and relays. When you move the arrow onto a contact or relay coil, it changes back to the cursor and can be reactivated if required.

→ The logic relay automatically wires adjacent contacts in a circuit connection up to the coil.

▶ Press ALT to wire the cursor from I2 through to the coil field.



The cursor changes into a flashing wiring arrow and automatically jumps to the next logical wiring position.

▶ Press the cursor button ›. Contact I2 will be connected up to the coil field.

→ You can use **DEL** to erase a connection at the cursor or arrow position. Where connections intersect, the vertical connections are deleted first, then, if you press **DEL** again, the horizontal connections are deleted.

▶ Press the cursor button › once more.

The cursor will move to the coil field.

```
I1-I2----[Q1
```

▶ Press **OK**.

The logic relay proposes the relay coil Q1. The specified coil function [and the output relay Q1 are correct and do not have to be changed.

```
I1-I2----[Q1
```

Your first working CL circuit diagram now looks like this:

Press **ESC** to leave the circuit diagram display.

```
SAVE
CANCEL
```

The adjacent menu will appear.

▶ Press OK.

The circuit diagram is now automatically saved. CANCEL exits the circuit diagram. Changes that have been made to the circuit diagram are not saved.

→ The logic relay saves all the necessary circuit diagram and program data retentively in the internal data memory.

Once you have connected pushbutton actuators S1 and S2, you can test your circuit diagram straight away.

Testing the circuit diagram

```
PROGRAM...↑
STOP √ RUN
PARAMETER..
INFO...   ↓
```

▶ Switch with ESC to the main menu and select the STOP √ RUN menu option.

With STOP RUN √ and STOP √ RUN you switch to the RUN or STOP operating modes.

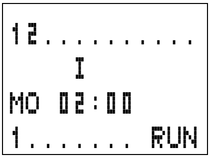
The CL is in RUN mode if the tick is present at the corresponding menu item, i.e. STOP RUN √.

→ The tick next to a menu item indicates which operating mode or function is currently active.

▶ Press OK.

The tick changes to “STOP RUN √”

The status display shows the current mode and the switching states of the inputs and outputs.

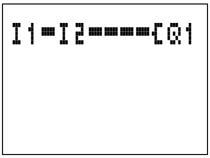


▶ Change to the status display by pressing **ESC** and press pushbutton actuator S1.

The contacts for inputs I1 and I2 are activated and relay Q1 picks up.

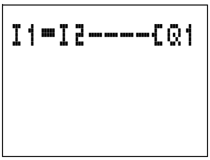
Power flow display

The logic relay allows you to check rungs in RUN mode. This means that you can check your circuit diagram via the built-in power flow display while it is being processed by the logic relay.



▶ Switch to the circuit diagram display (confirm PROGRAM menu with OK) and actuate pushbutton S1.

The relay picks up. The logic relay indicates the current flow.



▶ Press pushbutton actuator S2, that has been connected as a n/c contact.

The rung is interrupted and relay Q1 drops out.

Press **ESC** to return to the status display.

→ With the logic relay you can test parts of a circuit diagram before it is entirely completed.

The logic relay simply ignores any incomplete wiring that is not yet working and only runs the finished wiring.

Deleting the circuit diagram

▶ Switch the logic relay to the STOP mode.

The display shows STOP ✓ RUN.

→ The logic relay must be in STOP mode in order to extend, delete or modify the circuit diagram.

PROGRAM
DELETE PROG

▶ Use PROGRAM... to switch from the main menu to the next menu level.

▶ Select DELETE PROGRAM

The logic relay shows the query DELETE?.

▶ Press **OK** to delete the program or **ESC** to cancel.

Press **ESC** to return to the status display.

Fast circuit diagram entry

You can create a circuit diagram in several ways: The first option is to enter the elements in the circuit and then to wire all the elements together. The other option is to use the enhanced operator guidance of the CL and create the circuit diagram in one go, from the first contact through to the last coil.

If you use the first option, you will have to select some of the elements in order to create and connect up your circuit diagram.

The second, faster option is what you learned in the example. In this case you create the entire rung from left to right.

4 Wiring with the logic relay

By working through the example in chapter 3 you should now have gained an initial impression of just how simple it is to create a circuit diagram in the logic relay. This chapter describes the full range of logic relay functions and provides further examples of how to use the logic relay.

CL operation

Buttons for editing circuit diagrams and function relays

Delete rung, contact, relay or empty rung in the circuit diagram

Toggle between n/c and n/o contact
Connect contacts, relays and rungs
Add rungs,

^ ˅ Change value
Move cursor up/down

< > Change place
Cursor left/right

Cursor buttons set as P buttons:

<	Input P1,	^	Input P2
>	Input P3,	˅	Input P4

Undo setting from last **OK**
Leave current display, menu

Change, add new contact/relay,
Save setting

Operating principles

The cursor buttons in the circuit diagram perform three functions. The appearance of the flashing cursor indicates the current mode.

- Move
- Enter
- Connect

In Move mode you can use ʌ ∨ < > to move the cursor around the circuit diagram in order to select a circuit connection, contact or relay coil.

Use **OK** to switch to Entry mode so that you can enter or change a value at the current cursor position. If you press **ESC** in Entry mode, the logic relay will undo the most recent changes.

Press **ALT** to switch to Connect mode for wiring contacts and relays. Press **ALT** again to return to Move.

Press **ESC** to exit the circuit diagram and parameter display.

→ The logic relay performs many of these cursor movements automatically. For example, the logic relay switches the cursor to Move mode if no further entries or connections are possible at the selected cursor position.

Opening the parameter display for function relays with contacts or coils

If you specify the contact or coil of a function relay in Entry mode, the logic relay automatically switches from the contact number to the function relay parameter display when you press **OK**.

Press > to switch to the next contact or coil field without entering any parameters.

Program

A program is a sequence of commands which the logic relay executes cyclically in RUN mode. A CL program consists of the necessary settings for the device, password, system settings, a circuit diagram and/or function relays.

Circuit diagram
The circuit diagram is that part of the program where the contacts are connected together. In RUN mode a coil is switched on and off in accordance with the current flow and the coil function specified.

Function relay
Function relays are program elements with special functions. Example: timing relays, time switches, counters. Function relays are elements provided with or without contacts and coils as required. In RUN mode the function relays are processed according to the circuit diagram and the results are updated accordingly.

Examples:
Timing relay = function relay with contacts and coils
Time switch = function relay with contacts

Relays
Relays are switching devices which are electronically simulated in the logic relay. They actuate their contacts according to their designated function. A relay consists of at least a coil and a contact.

Contacts
You modify the current flow with the contacts in the CL circuit diagram. Contacts such as n/o contacts are set to 1 when they are closed and 0 when they are opened.
Every n/o or n/c contact in the CL circuit diagram can be defined as either a n/o contact or a n/c contact.

Coils

Coils are the actuating mechanisms of relays. In RUN mode, the results of the wiring are sent to the coils, which switch on or off accordingly. Coils can have seven different coil functions.

Table 5: Usable contacts

Contact	CL display
n/o contact, Open in the rest state	I, Q, M, N, A, Ö, Y, C, T, O, P, :, D, S, R, Z
n/c contact, Closed in the rest state	$\overline{I}$, $\overline{Q}$, $\overline{M}$, $\overline{N}$, $\overline{A}$, $\overline{Ö}$, $\overline{Y}$, $\overline{C}$, $\overline{T}$, $\overline{O}$, $\overline{P}$, $\overline{D}$, $\overline{S}$, $\overline{R}$, $\overline{Z}$

The logic relay works with different contacts, which can be used in any order in the contact fields of the circuit diagram.

→ In order to ensure compatibility with the AC010 devices, each CL-LSR/CL-LST and CL-LMR/CL-LMT logically supports all possible contacts. The switching state is always zero if contacts are not supported by the device, i.e. devices without a clock. The switching states of contacts (n/o) and time switches are always logically zero.

This feature enables the same circuit diagram to be used on all CL-AC1, CL-AC2, CL-DC1 and CL-DC2 devices.

Table 6: Contacts

Contact type	n/o	n/c	CL-LSR CL-LST	CL-LMR CL-LMT	Page
Analog value comparator function relay	A	$\overline{A}$	A1…A16	A1…A16	98
Counter function relay	C	$\overline{C}$	C1…C16	C1…C16	111
Text marker function relay	D	$\overline{D}$	D1…D16	D1…D16	131
7-day time switch function relay	Ö	$\overline{Ö}$	Ö1…Ö8	Ö1…Ö8	137
CL input terminal	I	$\overline{I}$	I1…I8	I1…I12	77
0 signal			I13	I13	
Expansion status			–	I14	236
Short-circuit/overload			I16	I15…I16	236
Markers, (auxiliary relay)	M	$\overline{M}$	M1…M16	M1…M16	85
Markers (auxiliary relay)	N	$\overline{N}$	N1…N16	N1…N16	85
Operating hours counter	O	$\overline{O}$	O1…O4	O1…O4	143
Cursor button	P	$\overline{P}$	P1…P4	P1…P4	82
CL output	Q	$\overline{Q}$	Q1…Q4	Q1…Q8	77
Input terminal for expansion unit	R	$\overline{R}$	–	R1…R12	77
Short-circuit/overload with expansion	R	$\overline{R}$	–	R15…R16	236
CL output (expansion or auxiliary marker S)	S	$\overline{S}$	S1…S8 (as marker)	S1…S8	85
Timer function relay	T	$\overline{T}$	T1…T16	T1…T16	148
Jump label	:	–	:1…:8	:1…:8	164
Year time switch	Y	$\overline{Y}$	Y1…Y8	Y1…Y8	167
Master reset, (central reset)	Z	$\overline{Z}$	Z1…Z3	Z1…Z3	174

Relays, function relays

The logic relay has different types of relay for wiring in a circuit diagram.

→ In order to ensure compatibility with the AC010 devices, each CL-LSR/CL-LST and CL-LMR/CL-LMT logically supports all relay types internally. If a relay type is not supported by the device, the switching state of the contacts is always set to zero. The switching states of contacts (n/o) and time switches are always logically zero.

This feature enables the same circuit diagram to be used on all CL-AC1, CL-AC2, CL-DC1 and CL-DC2 devices. Furthermore, you can use outputs that are not physically present as markers.

Relay	CL display	CL-LSR CL-LST	CL-LMR CL-LMT	Coil function	Parameters
Analog value comparator function relay	A	A1...A16	A1...A16	–	✓
Counter function relay	C	C1...C16	C1...C16	✓	✓
Text marker function relay	D	D1...D16	D1...D16	✓	✓
7-day time switch function relay	Ö	Ö1...Ö4	Ö1...Ö4	–	✓
Markers (auxiliary relay)	M	M1...M16	M1...M16	✓	–
Markers (auxiliary relay)	N	N1...N16	N1...N16	✓	–
Operating hours counter	O	O1...O4	O1...O4	✓	✓
CL output relay	Q	Q1...Q8	Q1...Q8	✓	–
CL output relay expansion, marker	S	S1...S8 (as marker)	S1...S8	✓	–
Timer function relay	T	T1...T16	T1...T16	✓	✓
Conditional jump	:	:1...:8	:1...:8	✓	–
Year time switch	Y	Y1...Y8	Y1...Y8	–	✓
Master reset, (central reset)	Z	Z1...Z3	Z1...Z3	✓	–

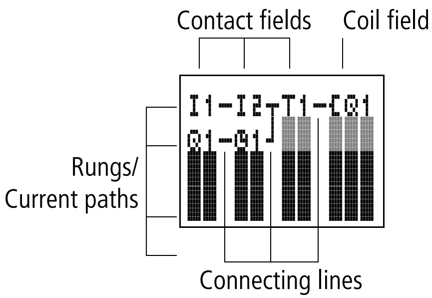
You can set the switching behaviour of these relays by means of the coil functions and parameters selected.

The options for setting output and marker relays are listed with the description of each coil function.

The coil functions and parameters are listed with the description of each function relay.

Circuit diagram display
In the logic relay circuit diagram, contacts and coils are connected up from left to right – from the contact to the coil. The circuit diagram is created on a hidden wiring grid containing contact fields, coil fields and rungs. It is then wired up with connections.

- You can add switching contacts in the three **contact fields**. The first contact field is automatically connected to the voltage.
- You add the relay coil to be controlled together with its function and designation in the **coil field**.
- Every line in the circuit diagram forms a **circuit connection or rung**. Up to 128 rungs can be wired in a circuit diagram.



- Connections are used to produce the electrical contact between switching contacts and the coils. They can be created across several rungs. Each point of intersection is a connection.

→ The circuit diagram display performs two functions:

- In STOP mode it is used to edit the circuit diagram.
- In RUN mode it is used to check the circuit diagram using the power flow display.

Saving and loading circuit diagrams

The logic relay provides you with two ways of saving circuit diagrams externally:

- Saving with the memory module
- Saving to a PC running CL-SOFT.

Once they have been saved, programs can be reloaded into the logic relay, edited and run.

All circuit diagram data is saved in the logic relay. In the event of a power failure the data will be retained until the next time it is overwritten or deleted.

Memory module

Each CL-LAS.MD003 memory module contains one circuit diagram and is inserted in the interface of the logic relay. The program is stored retentively on the memory module.

The way the memory module works and a description of how to transfer a program to the module is given in on section “Memory module”, Page 239.

→ MD001 memory modules of the AC010 devices can be read in CL-LSR/CL-LST. Memory modules MD001 and MD002 of AC010 devices can be read in the CL-LMR/ CL-LMT.

Only the CL-LAS.MD003 memory module can be write accessed by CL-LSR/CL-LST and CL-LMR/CL-LMT.

CL SOFT

CL-SOFT is a PC program with which you can create, store, test and manage CL circuit diagrams.

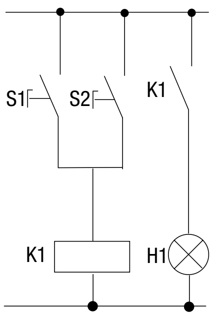
Completed circuit diagrams are transferred between your PC and the logic relay via the connecting cable. Once you have transferred a circuit diagram, simply run the logic relay straight from your PC.

Details on the program and transferring circuit diagrams are given in section “CL-SOFT”, Page 243.

Working with contacts and relays

In CL circuit diagrams, the switches, buttons and relays of conventional circuit diagrams are connected up using input contacts and relay coils.

Conventional circuit

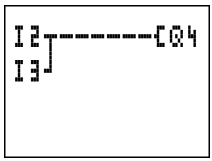


Wired with the logic relay

CL connection

Connect n/o contact S1 to input terminal I2
Connect n/o contact S2 to input terminal I3
Connect load H1 to the device output Q4
S1 or S2 switch on H1.

CL circuit diagram

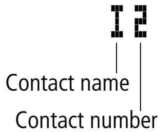


Input and output contacts

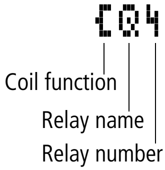
First specify which input and output terminals you wish to use in your circuit.

Depending on the type and configuration, the logic relay has 8, 12 or 24 input terminals and 4, 6, 8, 10 or 16 outputs. The signal states on the input terminals are detected in the circuit diagram with the input contacts I1 to I12. R1 to R12 are the input contacts of the expansion device. The outputs are switched in the circuit diagram with the output relays Q1 to Q8 or S1 to S8 (expansion).

Entering and changing contacts and relay coils



A switching contact is selected in the logic relay via the contact name and contact number.



A relay coil is defined by its coil function, name and number.

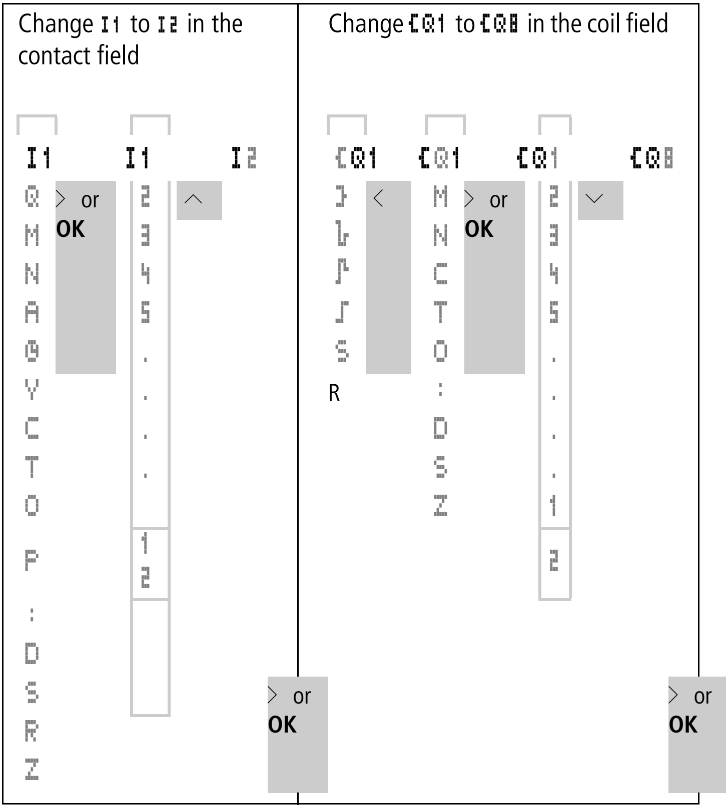
→ A full list of all the contacts and relays is given in the overview starting on Page 72.

I 1

Values for contacts and coil fields are changed in Entry mode. The value to be changed flashes.

→ If the field is empty, the logic relay will enter contact I1 or the coil CQ 1.

- ▶ Move the cursor using the buttons ‹ › ˄˅ to a contact or coil field.
- ▶ Press **OK** to switch to Entry mode.
- ▶ Use ‹ › to select the position you wish to change, or press **OK** to jump to the next position.
- ▶ Use ˄˅ to modify the value of the position.



The logic relay will leave Entry mode when you press < > or **OK** to leave a contact field or coil field.

Deleting contacts and relay coils

▶ Move the cursor using the buttons < > ^ v to a contact or coil field.

▶ Press **DEL**.

The contact or the relay coil will be deleted, together with any connections.

Changing n/o contacts to n/c contacts

Every switching contact in the CL circuit diagram can be defined as either a n/o contact or a n/c contact.

- ▶ Switch to Entry mode and move the cursor over the contact name.
- ▶ Press ALT. The n/o contact will change to a n/c contact.
- ▶ Press **OK** 2 × to confirm the change.

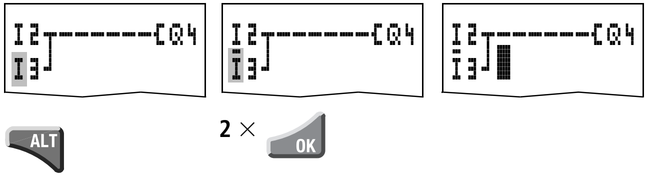


Figure 38: Changing contact I3 from n/o to n/c

Creating and modifying connections

Switching contacts and relay coils are connected with the wiring arrow in Connect mode. The logic relay displays the cursor in this mode as an arrow.

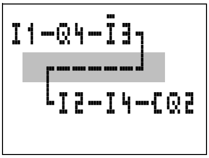
- ▶ Use < > ∧∨ to move the cursor onto the contact field or coil field from which you wish to create a connection.

→ Do not position the cursor on the first contact field. At this position the **ALT** button has a different function (Insert rung).

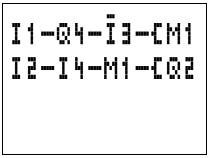
- ▶ Press **ALT** to switch to Connect mode.
- ▶ Use < > to move the diagonal arrow between the contact fields and coil fields and ∧∨ to move between rungs.
- ▶ Press **ALT** to leave Connect mode.

The logic relay will leave the mode automatically when you move the diagonal arrow onto a contact field or coil field which has already been assigned.

→ In a rung, the CL logic relay automatically connects switching contacts and the connection to the relay coil if there are no empty fields in-between.



Never work backwards. You will learn why wiring backwards does not work in section "Example: Do not wire backwards" Page 229.



When wiring more than three contacts in series, use an M or N marker.

Deleting connections

▶ Move the cursor onto the contact field or coil field to the right of the connection that you want to delete. Press **ALT** to switch to Connect mode.

▶ Press **DEL**.

The logic relay will delete a connection. Closed adjacent connections will be retained.

If several circuit connections are connected to one another, the logic relay first deletes the vertical connection. If you press **DEL** again, it will delete the horizontal connection as well.

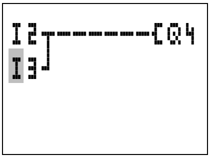
→ You cannot delete connections that the logic relay has created automatically.

Close the delete operation with **ALT** or by moving the cursor to a contact or coil field.

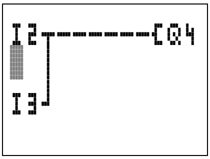
Inserting and deleting a rung

The CL circuit diagram shows four of the 128 rungs in the display at the same time. The logic relay automatically scrolls up or down the display to show hidden rungs – even empty ones – if you move the cursor past the top or bottom of the display.

A new rung is added below the last connection or inserted above the cursor position:



- ▶ Position the cursor on the **first** contact field of a circuit connection.
- ▶ Press **ALT**.



The existing rung with all its additional connections is "shifted" downwards. The cursor is then positioned directly in the new rung.

Deleting a rung

The logic relay only removes empty rungs (without contacts or coils).

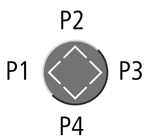
- ▶ Delete all the contacts and relay coils from the rung.
- ▶ Position the cursor on the first contact field of the empty rung.
- ▶ Press **DEL**.

The subsequent rung(s) will be "pulled up" and any existing links between rungs will be retained.

Switching with the cursor buttons

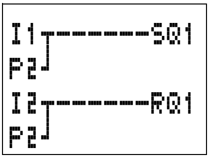
The logic relay also allows you to use the four cursor buttons as hardwired inputs in the circuit diagram.

The buttons are wired in the circuit diagram as contacts P1 to P4. The P buttons can be activated and deactivated in the system menu.



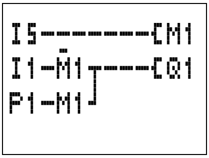
The P buttons can also be used for testing circuits or manual operation. These button functions are also useful for servicing and commissioning purposes.

Example 1:



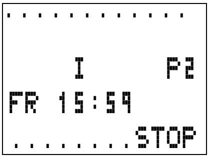
A lamp at output relay Q1 is switched on and off via inputs I1 and I2 or using cursor buttons ∧ ∨.

Example 2



Terminal I1 is used to control output relay Q1. Terminal I5 switches to Cursor button mode and deactivates rung I1 via M1.

→ The P buttons are only detected as switches in the status menu. The cursor buttons are used for other functions in the menus, the power flow display and in the text display.

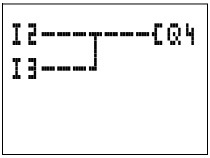


The status menu display shows whether the P buttons are used in the circuit diagram.

- P: button function wired and active.
- P2: button function wired, active and P2 button ∧ pressed
- P-: button function wired and not active.
- Empty field: P buttons not used.

Checking the circuit diagram

The logic relay contains a built-in measuring device enabling you to monitor the switching states of contacts and relay coils during operation.



▶ Complete the small parallel connection and switch the logic relay to RUN mode via the main menu.

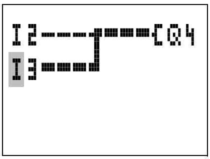
▶ Return to the circuit diagram display.

You are now unable to edit the circuit diagram.

→ If you switch to the circuit diagram display and are unable to modify a circuit diagram, first check whether the logic relay is in STOP mode.

The circuit diagram display performs two functions depending on the mode:

- STOP: Creation of the circuit diagram
- RUN: Power flow display



▶ Switch on I3.

In the power flow display, energized connections are thicker than non-energized connections.

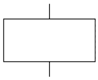
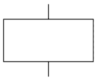
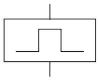
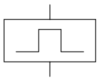
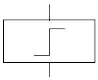
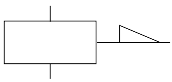
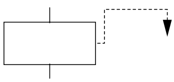
You can follow energized connections across all rungs by scrolling the display up and down.

→ The power flow display will not show signal fluctuations in the millisecond range.This is due to the inherent delay factor of LCD displays.

Coil functions

You can set the coil function to determine the switching behaviour of relay coils. The following coil functions are available for relays Q, M, S, D, “:”:

Table 7: Coil function

Circuit diagram display	CL display	Coil function	Example
	[	Contactor function	[Q1, [D2, [S4, [:1, [M7
	]	Contactor function with negated result	]Q1,]D2,]S4
	↓	Cycle pulse on falling edge	↓Q3, ↓M4, ↓D8, ↓S7
	↑	Cycle pulse on rising edge	↑Q4, ↑M5, ↑D7, ↑S3
	ʃ	Impulse relay function	ʃQ3, ʃM4, ʃD8, ʃS7
	S	Set (latching)	SQ8, SM2, SD3, SS4
	R	Reset (unlatching)	RQ4, RM5, RD7, RS3

Marker relays M and N are used as a flag. The S relay can be used as the output of an expansion unit or as a marker if no expansion unit is connected. The only difference between them and the output relay Q is that they have no output terminals.

→ The coil functions of the function relays are described in the descriptions for the appropriate relays.

→ The coil functions [,], ¬, ⌐, (contactor, contactor negated, cycle pulse falling, rising edge) must only be used once for each relay coil. The last coil in the circuit diagram determines the status of the relay.

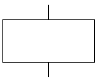
When controlling a contactor or relay, the control coil is only present once. Create parallel circuits or use Set, Reset as a coil function.

Rules for wiring relay coils

To ensure a clear overview of all relay states only assign the same coil function once to a relay (ä, S, R). However, retentive coil functions such as ä, S, R can be used several times if required by the circuit diagram logic.

Exception: When using jumps to structure a circuit diagram, this coil function can also be used effectively several times.

Relay with contactor function [



The output signal follows immediately after the input signal and the relay acts as a contactor.

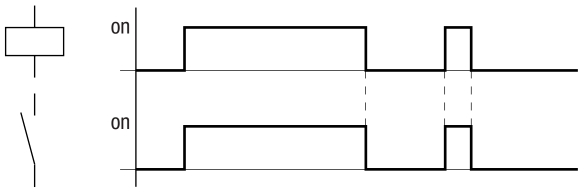
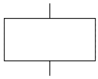


Figure 39: Signal diagram of contactor function

Display in the logic relay:

- Output relays Q: [Q1 to [Q8 (depending on type)
- Markers M, N: [M1 to [M16, [N1 to [N16
- Function relays (Text) D: [D1 to [D16
- Output relays S: [S1 to [S8
- Jumps: [:1 to [:8



Contactor function with negated result (inverse contactor function) Ɔ

The output signal is simply an inversion of the input signal; the relay operates like a contactor with contacts that have been negated. If the coil is triggered with the 1 state, the coil switches its n/o contacts to the 0 state.

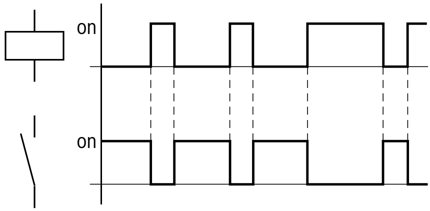
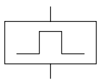


Figure 40: Signal diagram of inverse contactor function

Display in the logic relay:

- Output relays Q: ƆQ1 to ƆQ8 (depending on type)
- Markers M, N: ƆM1 to ƆM16, ƆN1 to ƆN16
- Function relays (Text) D: ƆD1 to ƆD16
- Output relays S: ƆS1 to ƆS8
- Jumps: Ɔ:1 to Ɔ:8



Falling edge evaluation (cycle pulse) Ƚ

This function is used if the coil is only meant to switch on a falling edge. With a change in the coil state from 1 to 0, the coil switches its n/o contacts to the 1 state for one cycle.

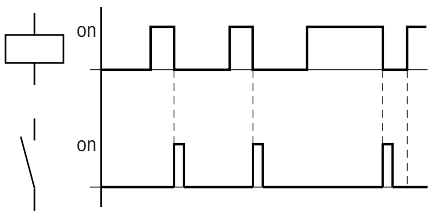


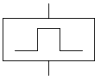
Figure 41: Signal diagram of cycle pulse with falling edge

Display in the logic relay:

- Markers M, N: ↓M1 to ↓M16, ↓N1 to ↓N16
- Jumps: ↓:1 to ↓:8

→ Physical outputs should not be used as a cycle pulse is generated.

Rising edge evaluation (cycle pulse) ↑



This function is used if the coil is only meant to switch on a rising edge. With a change in the coil state from 0 to 1, the coil switches its n/o contacts to the 1 state for one cycle.

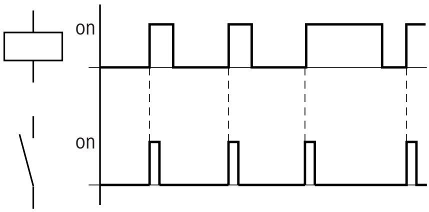


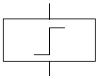
Figure 42: Signal diagram of cycle pulse with rising edge

Display in the logic relay:

- Markers M, N: ↑M1 to ↑M16, ↑N1 to ↑N16
- Jumps: ↑:1 to ↑:8

→ Physical outputs should not be used as a cycle pulse is generated.

Impulse relay



The relay coil switches whenever the input signal changes from 0 to 1. The relay behaves like an impulse relay.

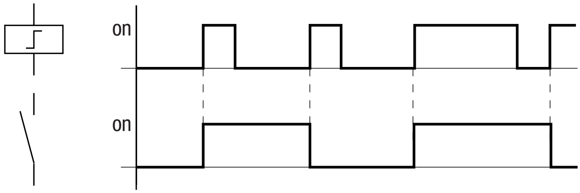
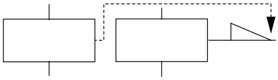


Figure 43: Signal diagram of impulse relay

Display in the logic relay:

- Output relay Q: Q1 to Q8 (depending on type)
- Markers M: M1 to M16
- Function relays (Text) D: D1 to D8
- Relays S: S1 to S8

→ A coil is automatically switched off if the power fails and if STOP mode is active. Exception: Retentive coils retain signal 1 (→ section "Retention (non-volatile data storage)", Page 221).



Latching relay

The "latch" and "unlatch" relay functions are used in pairs. The relay picks up when latched and remains in this state until it is reset by the "unlatch" function.

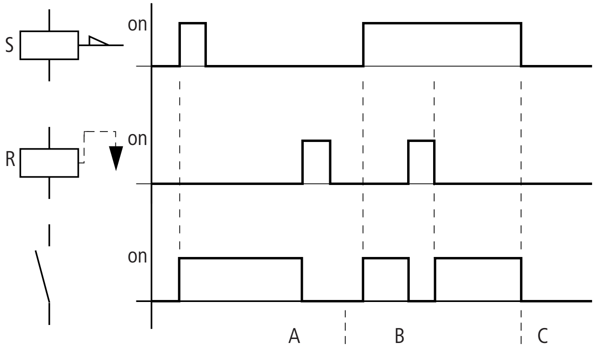


Figure 44: Latching relay signal diagram

- Range A: The set coil and the reset coil are triggered at different times
- Range B: Reset coil is triggered at the same time as the set coil
- Range C: Power supply switched off

Display in the logic relay:

- Q output relays: SQ1 to SQ8, RQ1 to RQ8 (depending on type)
- M markers: SM1 to SM16, RM1 to RM16
- (Text) D function relays: SD1 to SD8, RD1 to RD8
- S relays: SS1 to SS8, RS1 to RS8

```
I1-I2----SQ1

I2-------RQ1
```

Use each of the two relay functions S and R once only per relay. If both coils are triggered at the same time, priority is given to the coil further down in the circuit diagram.This is shown in the above signal diagram in section B.

→ A latched relay is automatically switched off if the power fails or if the device is in STOP mode. Exception: Retentive coils retain signal 1 (→ section "Retention (non-volatile data storage)", Page 221).

Function relays

Function relays allow you to simulate the functions of different conventional control engineering devices in your circuit diagram. The CL logic relay provides the following function relays:

Table 8: Function relays

CL circuit diagram display	Function relays
A1, A2	Analog value comparator, threshold value switch (only useful for devices with an analog input)
C1, CC1, DC1, RC1	Counter relay, up/down counter, high-speed counter, frequency counter
D2, {D2	Text, output user-defined texts, enter values
Ø1, Ø2	Time switch, weekday/time
O1, {O2	Operating hours counter with limit value entry
T1, TT1, RT1, HT1 X, ?X	Timing relay, on-delayed Timing relay, on-delayed with random switching
T1, TT1, RT1, HT1 ■, ?■	Timing relay, off-delayed Timing relay, off-delayed with random switching
T6, TT6, RT6, HT6 X■, ?X■	Timing relay, on- and off-delayed Timing relay, on- and off-delayed with random switching
T2, TT2, RT2, HT2 Л	Timing relay, single pulse
T3, TT3, RT3, HT3 ЛЛ	Timing relay, flashing

CL circuit diagram display	Function relays
:2, {:2	Jump
Y3	Year time switch, date
Z1, Z3	Master reset, central reset of outputs, markers

A function relay is started via its relay coil or by evaluating a parameter. It switches the contact of the function relay according to its function and the set parameters.

→ Current actual values are cleared if the power supply is switched off or if the logic relay is switched to STOP mode.

Exception: Retentive coils keep their logic state (→ section "Retention (non-volatile data storage)", Page 221).

Attention!
The following applies to RUN mode: The logic relay processes the function relays after a pass through the circuit diagram.The last state of the coils is used for this.

Only use the coil of a function relay once. Exception: When working with jumps, the same coil can be used several times.

Example function relay with timer and counter relay

A warning light flashes when the counter reaches 10. The example shows function relays C1 and T1. The S1 pushbutton actuator is used for the count signal. The S2 pushbutton actuator resets counter P1.

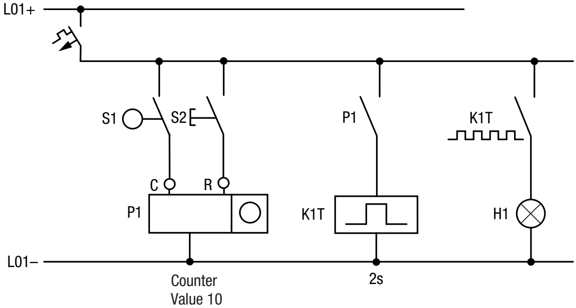
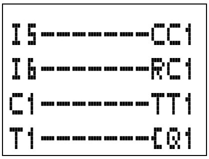


Figure 45: Hardwiring with relays

The wiring of the logic relay is as follows.



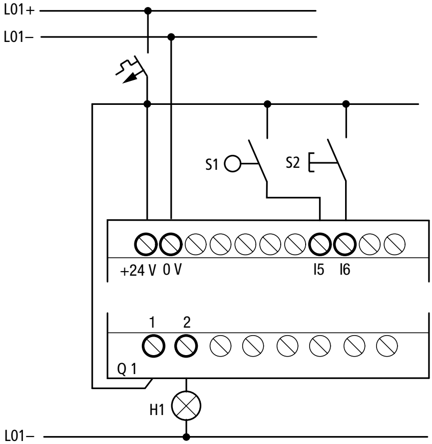
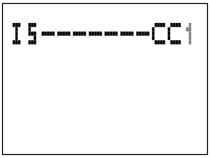


Figure 46: CL wiring and circuit diagram

The counter P1 is called C1 in the logic relay.

The timing relay K1T is called T1 in the logic relay.



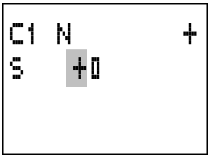
▶ Complete the circuit diagram up to CC1.

CC1 is the count coil of the counter 1 function relay.

→ Press **OK** to call up the logic relay parameter display.

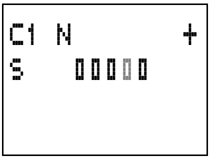
▶ Move the cursor onto the 1 of CC1 and press **OK**.

The parameter set for the counter is displayed.

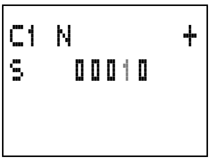


▶ Press the cursor button until the cursor is on the plus sign on the right of the S (setpoint).

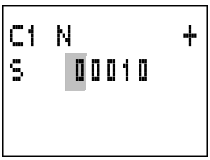
▶ Press the **OK** button.



▶ Press the > button.

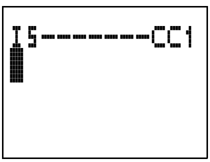


▶ Use > to move the cursor onto the tens digit.



▶ Use ︿ ﹀ to modify the value of the digit.

▶ Confirm the value input with **OK**.



▶ Press **ESC** to return to the circuit diagram, the setpoint 0010 will be stored.

→ The logic relay has specific parameter displays for function relays. The meaning of these parameters is explained under each relay type.

```
I5--------CC1
I6--------RC1
C1--------TT1
```

▶ Enter the circuit diagram up to coil TT1 of the timing relay. Set the parameter for T1 .

```
T1 X     S  +
I1    +0
I2    +0
  T:
```

The timing relay operates as a flash relay. The CL symbol for the flasher/blink relay is ǁ and is set at the top left of the parameter display. S means here the time base second.

```
T1 ǁ     S  +
I1    +0
I2    +0
  T:
```

▶ Select the ǁ symbol by pressing the ﹀ button.

```
T1 ǁ     S  +
I1    +0
I2    +0
  T:
```

▶ Use the 〉 to move to the first time setpoint I1 .

```
T1 ǁ     S  +
I1    00.000
I2    +0
  T:
```

▶ Press the **OK** button.

▶ Press the 〉 button.

```
T1 ǁ     S  +
I1    01.000
I2    +0
  T:
```

▶ Use the ︿ ﹀ 〈 〉 buttons to enter the value 01.000.

▶ Confirm with **OK**.

The time setpoint I1 for the pause time is 1 s

```
T1 ⊥⊥      S   +
I1    01.000
I2    00.500
  T:
```

▶ Use the ﹀ button to enter the value of the second setpoint I2.

▶ Set this value to 0.5 s.

This is the time value for the pulse time.

▶ Press **ESC** to leave the parameter entry.

The values are now stored.

▶ Complete the circuit diagram.

```
I5--------CC1
I6--------RC1
C1--------TT1
T1--------[Q1
```

```
SAVE
CANCEL
```

▶ Press the **ESC** button.

▶ Press **OK** to store the circuit diagram.

▶ Test the circuit diagram with the power flow display.

▶ Switch the logic relay to RUN mode and return to the circuit diagram.

Each parameter set can be displayed using the power flow display for the circuit diagram.

▶ Move the cursor onto C1 and press **OK**.

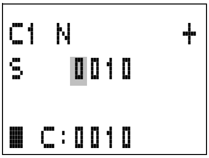
The parameter set for the counter is displayed with actual and setpoint values.

▶ Switch I5. The actual value changes.

```
C1  N          +
S    0010

□ C:0000
```

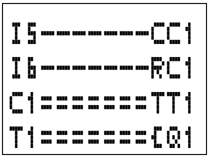
This is represented in the logic replay parameter display. In the last line C: 0007 the counter actual value is = 7.

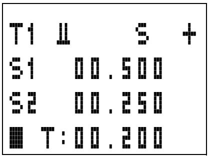
```
C1  N          +
S    0010

□ C:0007
```



If the actual value is greater than or equal to the setpoint (10), the left character on the bottom row will change to ■. The contact of counter C1 switches.

The counter contact triggers the timing relay. This causes the warning light to flash at output Q1.
Power flow of the circuit diagram





Doubling the flashing frequency:

▶ In the power flow display select T1 .

▶ Press **OK**.

▶ Change the set time I1 to 00.500 and I2 to 00.250 (0.5 and 0.25 s).

▶ The set time will be accepted as soon as you press **OK**.

The character on the left of the bottom row will indicate whether the contact has switched or not.

- □ Contact has not switched (n/o contact open).
- ■ Contact has switched (n/o contact closed).

You can also modify parameter settings via the PARAMETER menu option.

→ If you want to prevent other people from modifying the parameters, change the access enable symbol from + to – when creating the circuit diagram and setting parameters. You can then protect the circuit diagram with a password.

Analog value comparator/ threshold value switch

The logic relay provides 16 analog comparators A1 to A16 for use as required. These can also be used as threshold value switches or comparators.

An analog value comparator or threshold value switch enables you to compare analog input values with a setpoint, the actual value of another function relay or another analog input. This enables you to implement small controller tasks such as two-point controllers very easily.

All CL-AC1, CL-AC2 and CL-DC2 devices are provided with analog inputs.

- The analog inputs of the CL-LSR/CL-LST are I7 and I8.
- The analog inputs of the CL-LMR/CL-LMT are I7, I8, I11 and I12

→ Compatibility with AC010 devices

If you have loaded an existing AC010 circuit diagram, the previous comparator functions and values are retained. The analog comparator function relay operates in CL-LSR/ CL-LST and CL-LMR/CL-LMT as well as in AC010 devices. The setpoints are converted to the new resolution of the analog inputs. The setpoint 5.0 (AC010) produces the setpoint 512 (CL-LSR/CL-LST, CL-LMR/CL-LMT).

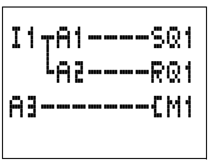
The following comparisons are possible:

Value at function relay input I1	Comparator functions	Mode selection at the function relay	Value at function relay value input I2
Analog input I7, I8, I11, I12			Analog input I7, I8, I11, I12
Setpoint 0000 to 9999			Setpoint 0000 to 9999
Actual value of counter relay C1 to C16			Actual value of counter relay C1 to C16

Value at function relay input I1	Comparator functions	Mode selection at the function relay	Value at function relay value input I2
Actual value of timing relay T1 to T16			Actual value of timing relay T1 to T16
	Less than	LT	
	Less than/equal to	LE	
	Equal to	EQ	
	Greater than/equal to	GE	
	Greater than	GT	

Table 9: Comparison examples:

A1 function relay Value input I1		A1 function relay Value input I1
I7	GE (greater than/equal to)	I8
I7	LE (less than/equal to)	I8
I7	GE (greater than/equal to)	Setpoint
I7	LE (less than/equal to)	Setpoint
I8	GE (greater than/equal to)	Setpoint
I8	LE (less than/equal to)	Setpoint



Circuit diagram display with analog value comparator

Analog value comparators are integrated as contacts in the circuit diagram.

In the circuit diagram above, I1 enables both analog value comparators. If a value goes below the set value, A1 switches output Q1. If another value exceeds the set value, A2 deactivates output Q1. A3 switches marker M1 on and off.

```
A1  EQ       +
I1   +0      +
F1   +0
I2   +0      +
F2   +0
OS   +0
HY   +0
```

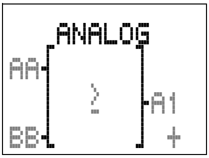
Table 10: Parameter display and parameter set for analog value comparator:

A1	Analog value comparator function relay 1
EQ	Equal mode The function relay has the following modes: • LT: less than • LE: less than/equal to • EQ: equal to • GE: greater than/equal to • GT:greater than
+	+ appears in the PARAMETER menu. – does not appear in the PARAMETER menu
I1	Comparison value 1 (positive value I7, I8, I11, I12, actual value T1 to T16, C1 to C16)
F1	Gain factor for I1 (I1 = F1 × actual value at I1); F1 = positive value from 0 to 9999
I2	Comparison value 2 (positive value I7, I8, I11, I12, actual value T1 to T16, C1 to C16)
F2	Gain factor for I2 (I2 = F2 × actual value at I2); F2 = positive value from 0 to 9999
OS	Offset for the value of I1 (I1 = OS + actual value at I1); OS = positive value from 0 to 9999
HY	Switching hysteresis for value I2 Value HY applies both to positive and negative hysteresis. • I2 = Actual value at I2 + HY; • I2 = Actual value at I2 - HY; • HY = Positive value from 0 to 9999

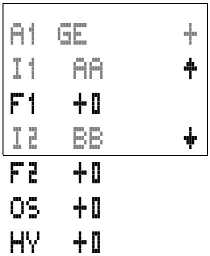
→ Work normally with analog inputs and setpoints as the parameters for the analog value comparator.

Compatibility of AC010 devices with logic relays

New functions were added to the parameter display of the CL-LSR/CL-LST and CL-LMR/CL-LMT. The AC010 parameters can be found at the following points.



AC010 parameter		Logic relay parameter
AA	=	I1 AA
BB	=	I2 BB
A1	=	A1
+	=	+
≥	=	GE



→ The analog comparator of the CL-LSR/CL-LST and CL-LMR/CL-LMT operates internally in the value range:

–2 147 483 648 to +2 147 483 647

This ensures that the correct value is always calculated. This is important for multiplying values (I1 × F1 or I2 × F2).

Example:

I1 = 9 999, F1 = 9 999

I1 × F1 = 99 980 001

The result is within the value range.

→ If no value is entered at F1 or F2, only the value at I1 and I2 is used (no multiplication).

→ If the value of a counter relay exceeds the value 9 999, the value of the counter is shown in the display of the analog value comparator minus 10 000.

Example: Counter actual value =10 233

Display of the analog value comparator: 233 (10 000 is displayed as 0).

Parameter display in RUN mode

Parameter display and parameter set for analog value comparator in RUN mode with the display of the actual values:

```
A1 EQ        +
I1   0249    +   — Actual value, e.g.: analog input
F1   0000        — Factor is not used
I2   0350    +   — Actual comparison value, e.g.: constant
F2   0000        — Factor is not used
OS   0000        — Offset is not used
HY   0025        — The switching hysteresis is +/– 25
```

Resolution of the analog inputs

The analog inputs I7, I8, and on the CL-LMR/CL-LMT I11, I12 have the following resolution.

The analog signal from 0 to 10 V DC is converted to a 10-bit digital value from 0 to 1 023. A digital value of 100 represents an analog value of 1.0 V (exactly 0.98 V).

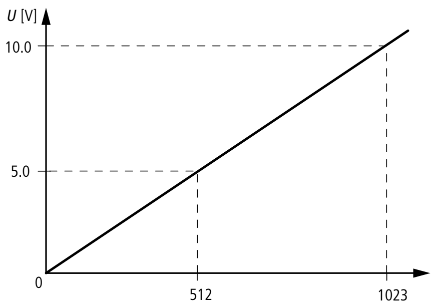


Figure 47: Resolution of the analog inputs

Function of the analog value comparator function relay

→ The GT, GE, LT, and LE comparison functions only differ in the fact that GE and LE also switch when the value is equal to the setpoint. To ensure that all analog value comparators of AC010 devices are compatible with the logic relays, the CL-LSR/CL-LST and the CL-LMR/CL-LMT have five comparison modes.

Caution!
Analog signals are more sensitive to interference than digital signals.Consequently, greater care must be taken when laying and connecting the signal lines.

Set the switching hysteresis to a value so that interference signals will not cause accidental switching. A value of 0.2 V (value 20 without gain) must be observed as a safety value.

Function of the Less than comparison

Parameter display and parameter set for Less than analog value comparator.

```
A1 LT       +
I1  I7      +
F1  +0
I2  0100    +
F2  +0
OS  +0
HY  0025
```

Circuit diagram with analog value comparator.

```
A1--------[Q1
```

→ The values F1 +0, F2 +0 and OS +0 were not defined. A gain is not used with any values. No offset is used.

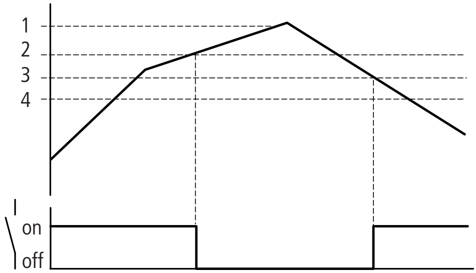


Figure 48: Signal diagram of analog value comparator in Less than mode

1: actual value at I7

2: setpoint plus hysteresis value

3: setpoint

4: setpoint minus hysteresis

The n/o contact switches off when the actual value at I7 exceeds the setpoint plus hysteresis. If the actual value at I7 falls below the setpoint, the n/o contact switches on.

Function of the Less than/equal to comparison

Parameter display and parameter set for Less than/equal to analog value comparator.

```
A2 LE        +
I1   I7      +
F1   +0
I2   0100    +
F2   +0
OS   +0
HY   0025
```

Circuit diagram with analog value comparator.

```
A2--------[Q1
```

→ The values F1 +0, F2 +0 and OS +0 were not defined. No values are used with a gain factor, and no offset is used.

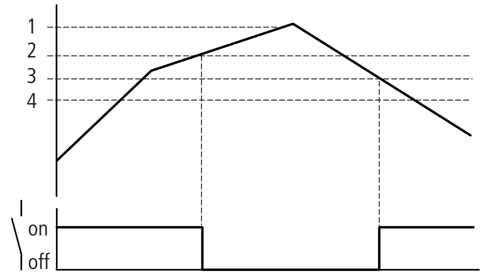


Figure 49: Signal diagram of analog value comparator in Less than/ equal to mode

1: actual value at I7

2: setpoint plus hysteresis value

3: setpoint

4: setpoint minus hysteresis

The n/o contact switches off when the actual value at I7 exceeds the setpoint plus hysteresis. If the actual value at I7 equals or falls below the setpoint, the n/o contact switches on.

Function of the Equal to comparison

Parameter display and parameter set for Equal to analog value comparator.

```
A8 EQ       +
I1  I8      +
F1  0010
I2  3000    +
F2  +0
OS  +0
HY  0250
```

Circuit diagram with analog value comparator.

```
A8--------[Q3
```

→ The values F2 +0 and OS +0 were not defined. No values are used with a gain factor, and no offset is used. A gain factor of 10 is used with the analog value at I8. The hysteresis is adjusted accordingly.

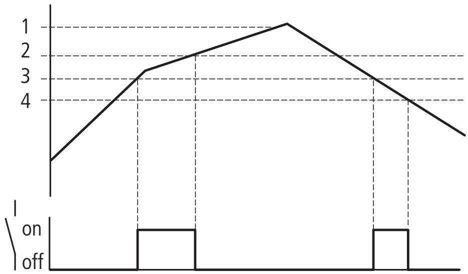


Figure 50: Signal diagram of analog value comparator in Equal to mode

1: actual value at I8, multiplied with gain factor F2

2: setpoint plus hysteresis value

3: setpoint

4: setpoint minus hysteresis

The n/o contact switches on if the actual value at I8 (multiplied by F1) reaches the configured setpoint. If the actual value exceeds the setpoint, the n/o contact switches off. The n/o contact switches on if the actual value at I8 (multiplied by F1) reaches the configured setpoint. If the actual value falls below the setpoint minus hysteresis, the n/o contact switches off.

Example: Function of the Greater than/equal to comparison

Parameter display and parameter set for Greater than/equal analog value comparator.

```
A5 GE      +
I1  I7     +
F1  +0
I2  0100   +
F2  +0
OS  +0
HY  0025
```

Circuit diagram with analog value comparator.

```
A5--------[Q1
```

→ The values `F1 +0`, `F2 +0` and `OS +0` were not defined. No values are used with a gain factor, and no offset is used.

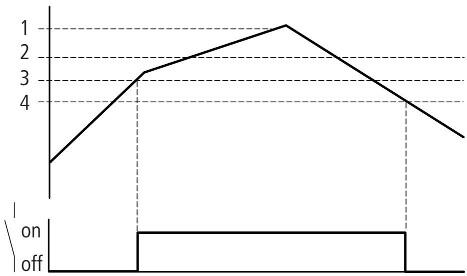


Figure 51: Signal diagram of analog value comparator in Greater than/equal to mode

1: actual value at I7

2: setpoint plus hysteresis value

3: setpoint

4: setpoint minus hysteresis

The n/o contact switches if the actual value at I7 is equal to the setpoint. The n/o contact switches off when the actual value at I7 falls below the setpoint minus hysteresis.

Example: Function of the Greater than comparison

Parameter display and parameter set for Greater than analog value comparator.

```
A4  GT        +
I1   I7       ÷
F1   +0
I2   0100     ÷
F2   +0
OS   +0
HY   0025
```

Circuit diagram with analog value comparator.

```
A4--------[Q1
```

→ The values F1 +0, F2 +0 and OS +0 were not defined. No values are used with a gain factor, and no offset is used.

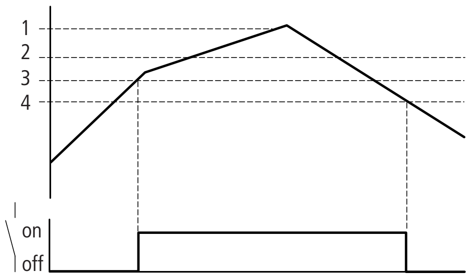


Figure 52: Signal diagram of analog value comparator in Greater than mode

1: actual value at I7

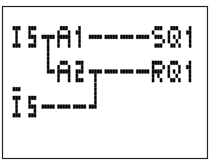
2: setpoint plus hysteresis value

3: setpoint

4: setpoint minus hysteresis

The n/o contact switches if the actual value at I7 reaches the setpoint. The n/o contact switches off when the actual value at I7 falls below the setpoint minus hysteresis.

Example: Analog value comparator as two-step controller



If, for example, the temperature goes below a value, A1 switches on the output Q1 with the enable input I5. If the temperature exceeds the set value, A2 will switch off. If there is no enable signal, output Q1 will always be switched off by I5.

Parameter settings of both analog value comparators:

Switching on

```
A1  LT       +
I1   I7      ÷
F1   +0
I2   0500    ÷
F2   +0
OS   +0
HY   +0
```

Switch off

```
A2  GT       +
I1   I7      ÷
F1   +0
I2   0550    ÷
F2   +0
OS   +0
HY   0015
```

```
I5┬A1-----SQ1
  └I7┬----RQ1
Ī5---┘
```

A simple circuit can be implemented if a switching point of the controller is assigned to the digital switching point of the analog input. This switching point is 8 V DC (CL-DC1, CL-DC2) and 9.5 V (CL-AC1).

Parameter settings:

Switching on

```
A1  LT       +
I1   I7      ÷
F1   +0
I2   0500    ÷
F2   +0
OS   +0
HY   +0
```

Switch off

The switch point is implemented via I7 (digital switching signal).

Example: Analog value comparator, detection of operating states

```
A6--------CN1
A7--------CN2
A8--------CN3
```

Several analog value comparators can be used to evaluate different operating states. In this case 3 different operating states are evaluated.

Parameter settings of three analog value comparators:

First operating state

```
A6  EQ        +
I1   I7       ↑
F1   +0
I2   0500     ↓
F2   +0
OS   +0
HY   0025
```

Second operating state

```
A7  EQ        +
I1   I7       ↑
F1   +0
I2   0700     ↓
F2   +0
OS   +0
HY   0025
```

Third operating state

```
A8  EQ        +
I1   I7       ↑
F1   +0
I2   0850     ↓
F2   +0
OS   +0
HY   0025
```

Example: Analog value comparator, comparison of two analog values

To compare two analog values, you can use the following circuit. In this case, the comparison determines whether I7 is less than I8.

```
A1--------[M9
```

Parameter settings of the analog value comparator.

```
A1  LT        +
I1   I7       ↑
F1   +0
I2   I8       ↓
F2   +0
OS   +0
HY   0025
```

Counters

The logic relay provides 16 up/down counters C1 to C16 for use as required. The counter relays allow you to count events. You can define an upper threshold value as a comparison value. The contact will switch according to the actual value.

High-speed counters, frequency counters up to 1 kHz counter frequency.
CL-DC1 and CL-DC2 feature four high-speed counters C13 to C16. The function is defined by the mode selected. The counter input is connected directly to a digital input. The high-speed digital inputs are I1 to I4.

Possible applications include the counting of components, lengths, events and frequency measurement.

→ The counters of CL-LSR/CL-LST and CL-LMR/CL-LMT function in the same way as the counters of the AC010 devices. If required, the same counters can also be used for retentive data.

Table 11: Counter modes

Counters	Operating mode	
C1 to C12	N	Up/down counter
C13, C14	N or H	Up/down counters or high-speed up counters (CL-DC1, CL-DC2)
C15, C16	N or F	Up/down counters or frequency counters (CL-DC1, CL-DC2)

Wiring of a counter

You integrate a counter into your circuit in the form of a contact and coil. The counter relay has different coils.

→ To prevent unpredictable switching states, use each coil of a relay once only in the circuit diagram.

Do not use the input of a high-speed counter as a contact in the circuit diagram. If the counter frequency is too high only a random input value will be used in the circuit diagram.

```
I5--------CC2
I6--------DC2
I7--------RC2
C2--------SM9
```

CL circuit diagram with counter relay

The coils and contacts have the following meanings:

Contact	Coil	
C1 to C12		The contact switches if the actual value is greater than or equal to the setpoint.
	CC1 to CC16	Counter input, rising edge counts
	DC1 to DC16	Counting direction • Coil not triggered: up counting. • Coil triggered: down counting.
	RC1 to RC16	Reset, coil triggered: actual value reset to 00000

Parameter display and parameter set for counter relays:

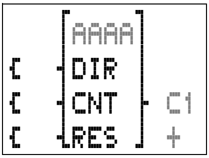
```
C2 N        +
S   00000
```

C2	Counter function relay number 2
N	• Mode N: up/down counter • Mode H: high-speed up/down counter • Mode F: frequency counter
+	• **+** appears in the PARAMETER menu. • **–** does not appear in the PARAMETER menu
S	Setpoint, constant from 00000 to 32000

In the parameter display of a counter relay you change the mode, the setpoint and the enable of the parameter display.

Compatibility of AC010 with CL-LSR/CL-LST and CL-LMR/CL-LMT: Counter parameter display

The CL-LSR/CL-LST and CL-LMR/CL-LMT parameter display has been provided with new functions. The AC010 parameters are at the following points.



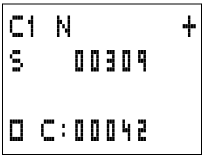
AC010 parameter		CL-LSR/CL-LST, CL-LMR/CL-LMT parameter
AAAA	=	S AAAAA
	=	
C1	=	C1
+	=	+

Value range

The counter relay counts between 0 and 32 000.

Behaviour when value range is reached

The CL logic relay is in RUN mode
If the value of 32 000 is reached, this value will be retained until the count direction is changed. If the value of 00000 is reached, this value will be retained until the count direction is changed.
Parameter display in RUN mode:



Current setpoint, constant (0309)

□ Contact has not switched.

■ Contact has switched.

Actual value (00042)

Retention

Counter relays can be operated with retentive actual values. You can select the retentive counter relays in the SYSTEM… → RETENTION… menu. C5 to C7, C8 and C13 to C16 can be selected.
If a counter relay is retentive, the actual value is retained when the operating mode changes from RUN to STOP as well as when the power supply is switched off.

If the logic relay is started in RUN mode, the counter relay operates with the retentively saved actual value.

Determining counter frequency

The maximum counter frequency depends on the length of the circuit diagram in the logic relay. The number of contacts, coils and rungs used determines the run time (cycle time) required to process the CL circuit diagram.

Example: When using CL-LST.C12DC2 with only three rungs for counting, resetting and outputting the result via the output, the counter frequency may be 100 Hz.

The maximum counter frequency depends on the maximum cycle time.

The following formula is used to determine the maximum counter frequency:

$$f_c = \frac{1}{2 \times t_c} \times 0.8$$

f_c = maximum counter frequency
t_c = maximum cycle time
0.8 = correction factor

Example

The maximum cycle time is t_c = 4000 µs (4 ms).

$$f_c = \frac{1}{2 \times 4\ \text{ms}} \times 0.8 = 100\ \text{Hz}$$

Function of the counter function relay

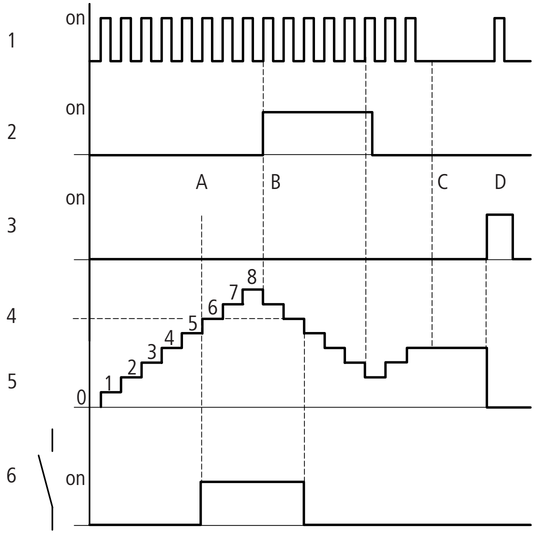


Figure 53: Signal diagram

1: Count pulses at the count coil CC…

2: Count direction, direction coil DC…

3: Reset signal at the reset coil RC…

4: Counter setpoint (the setpoint in the figure = 6)

5: actual value of the counter

6: contact of the counter, C

- Range A: The relay contact of counter C with setpoint value 6 switches when the actual value is 6.
- Range B: If the counting direction is reversed, the contact is reset when the actual value is 5.
- Range C: Without count pulses the current actual value is retained.
- Range D: The reset coil resets the counter to 0.

Example: Counters, counting unit quantities, manual counter value reset

The input I6 contains the necessary counter information and controls the count coil CC1 of counter 1. Q4 is activated if the setpoint is reached. Q4 remains switched on until I7 resets counter C1 to zero with the RC1 coil.

Circuit diagram display

```
I6--------CC1
C1--------[Q4
I7-Q4-----RC1
```

Parameter settings of the counter C1

```
C1 N       +
S    00100
```

Example: Counting unit quantities, automatic counter value reset

The input I6 contains the necessary counter information and controls the count coil CC2 of counter 2. M8 will be switched on for one program cycle if the setpoint is reached. The counter C2 is automatically set to zero by the reset coil RC2.

Circuit diagram display

```
I6--------CC2
C2-------┬[M8
         └RC2
```

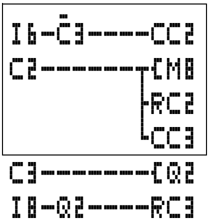
Parameter settings of the counter C2

```
C2 N       +
S    01000
```

Example of a two counter cascade

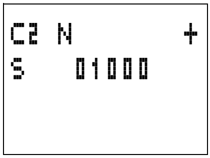
Another counter is added to the previous example. As the contact of counter C2 is only set to 1 for one program cycle, the carry of counter C2 is transferred to counter C3. The counter C3 prevents further counting when its setpoint is reached.

Circuit diagram display

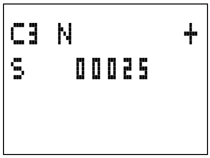


25 000 pulses are counted. 25 × 1 000 = 25 000

Parameter settings of the counter C2



Parameter settings of the counter C3



Example: Up/down counting with a scan for actual value = zero

The input I6 contains the necessary counter information and controls the count coil CC6 of counter 6. Marker N2 is set if the setpoint is reached. Marker N2 controls the direction coil DC6 of counter C6. If N2 is 1 (activated), counter C6 counts down. If the actual value of the counter is 00000, the analog value comparator A6 resets mark N2. The direction coil DC6 of counter C is switched off. Counter C6 only operates as an up counter.

Circuit diagram display

```
I6--------CC6
C6--------SN2
N2--------DC6
A6-N2-----RN2
```

Parameter settings of the counter C6

```
C6 N         +
S    01000
```

Parameter settings of the analog value comparator A6

```
A6 EQ        +
I1   C6      +
F1   +0
I2   0000    +
F2   +0
OS   +0
HY   +0
```

→ The above example scans the value zero. However, any permissible value within the range of the analog value comparator function block can be entered.

Example: Counter with retentive actual value

Select a retentive counter if you wish to retain the actual value of a counter, even after a power failure or a change from RUN to STOP.

▶ Select the required counter in the SYSTEM… → RETENTION… menu.

```
M 9 - M12   +
M13 - M16
N 9 - N16
C 5 - C 7 √+
C 20
C13 - C16
T 02
T 8
T13 - T16
D 1 - D 8
```

The example shows the counters C5 to C7 as retentive counters.

Circuit diagram display

```
I6--------CC5
C5--------[Q3
I8-Q3-----RC5
```

Parameter settings of the counter C5

```
C5 N       +
S   00565
```

The counter has the value 450 before the power supply is switched off.

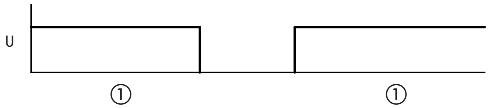


Figure 54: Retentive counter

① The numerical value 450 is retained even after a power outage.

U = Supply voltage of the device

High-speed counters, CL-DC1, CL-DC2

The logic relay provides various high-speed counter functions. These counter function blocks are coupled directly to digital inputs. The following functions are possible:

- Frequency counters: C15 and C16
- High-speed counters: C13 and C14.

Frequency counter

The logic relay provides two frequency counters C15 and C16 for use as required. The frequency counters can be used for measuring frequencies. The high-speed frequency counters are permanently connected to the digital inputs I3 and I4.

Applications such as speed monitoring, volume measurement using a volume counter, the monitoring of machine running can be implemented with the frequency counter.

The frequency counter allows you to enter an upper threshold value as a comparison value. The C15 and C16 frequency counters are not dependent on the cycle time.

Counter frequency and pulse shape

The maximum counter frequency is 1 kHz.

The minimum counter frequency is 4 Hz.

The signals must be square waves. We recommend a mark-to-space ratio of 1:1.

If this is not the case:

The minimum mark-to-space ratio is 0.5 ms.

$$t_{min} = 0.5 \times \frac{1}{f_{max}}$$

t_{min} = minimum time of the pulse or pause duration
f_{max} = maximum count frequency (1 kHz)

→ Frequency counters operate independently of the program cycle time. The result of the actual value setpoint comparison is only transferred once every program cycle for processing in the circuit diagram.

The reaction time in relation to the setpoint/actual value comparison can therefore be up to one cycle in length.

Measurement method

The pulses on the input are counted for one second irrespective of the cycle time, and the frequency is determined. The measurement result is provided as an actual value.

Wiring of a frequency counter

The digital inputs have the following assignment:

- I3 counter input for frequency counter C15.
- I4 counter input for frequency counter C16.

→ If you use C15 or C16 as frequency counters, coils DC15 or DC16 will have no function. The counter signals are transferred directly from the digital inputs I3 and I4 to the counters. A frequency counter measures the actual value and does not measure a direction.

```
---------CC15
C15-------SQ3
I8--------
RC15
```

You only integrate a frequency counter into your circuit in the form of a contact and enable coil. The coils and contacts have the following meanings:

Contact	Coil	
C15 to C16		The contact switches if the actual value is greater than or equal to the setpoint.
	CC15, CC16	Enable of the frequency counter on “1” state, coil activated
	RC15, RC16	Reset, coil triggered: actual value reset to 00000

→ The frequency counter can also be enabled specifically for a special operating state. This has the advantage that the cycle time of the device is only burdened with the frequency measurement when it is taking place. If the frequency counter is not enabled, the cycle time of the device is shorter.

```
C15 F      +
S   00200
```

Parameter display and parameter set for frequency counter:

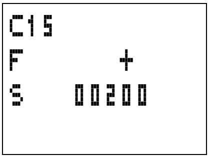
C15	Counter function relay number 15
F	Mode F: frequency counter
+	• + appears in the PARAMETER menu. • – does not appear in the PARAMETER menu
S	Setpoint, constant from 00000 to 01000 (32000 is a possible setting, the maximum frequency is 1 kHz)

In the parameter display of a counter relay you change the mode, the setpoint and the enable of the parameter display.

Value range

The counter relay counts between 4 and 1000 [Hz].

Parameter display in RUN mode:



— Current setpoint, constant (0309)

— □ Contact has not switched.

■ Contact has switched.

Actual value (0153)

Retention

Setting retention on the frequency counter serves no purpose since the frequency is continuously remeasured.

Function of the frequency counter

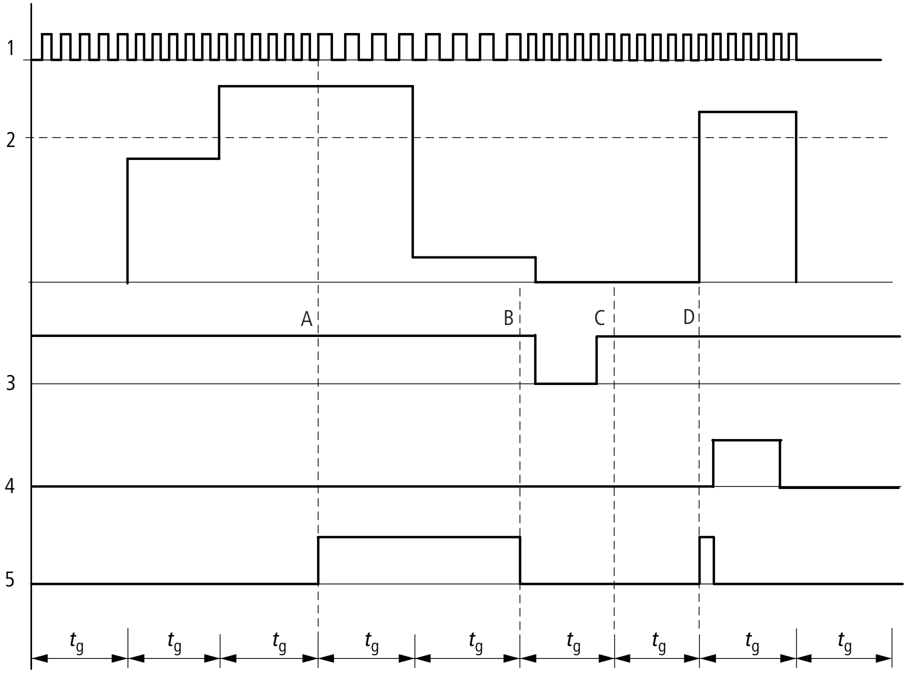


Figure 55: Signal diagram of frequency counter

1: counter input I3 or I4

2: upper setpoint

3: enable coil CC…

4: reset coil RC…

5: contact (n/o contact) C… upper setpoint value reached.

t_g: gate time for the frequency measurement

- Range A: The counter is enabled. After a frequency above the setpoint was measured for the first time, contact C15 (C16) switches.
- Range B: If the actual value falls below the setpoint, the contact is reset. The removal of the enable signal resets the actual value to zero.
- Range C: The counter is enabled. After a frequency above the setpoint was measured for the first time, contact C15 (C16) switches.
- Range D: The reset coil resets the actual value to zero.

Example: Frequency counter

Frequency counters with different switch points

The frequency measured at input I3 is to be classified in different value ranges. The analog value comparator is used as an additional comparison option.

The counter is enabled via the marker N3. The value 900 or higher is detected by frequency counter C15 as the upper limit value. This triggers the coil of marker N4.

If the frequency is higher than 600 Hz, analog value comparator A1 indicates this and triggers marker N5.

If the frequency is higher than 400 Hz, analog value comparator A2 indicates this and triggers marker N6.

Circuit diagram display

```
N3--------CC15
C15-------[N4
A1--------[N5
A2--------[N6
```

Parameter settings of the counter C15

```
C15 F       +
S    00900
```

Parameter settings of the analog value comparator A1

```
A1  GE      +
I1   C15    +
F1   +0
I2   0600   +
F2   +0
OS   +0
HY   +0
```

Parameter settings of the analog value comparator A2

```
A2  GE      +
I1   C15    +
F1   +0
I2   0400   +
F2   +0
OS   +0
HY   +0
```

High-speed counters

You can use the high-speed counters to count high frequency signals reliably.

The logic relay provides two high-speed up/down counters C13 and C14 for use as required. The high-speed counter inputs are permanently connected to the digital inputs I1 and I2. This counter relay allows you to count events independently of the cycle time.

The high-speed counters allow you to enter an upper threshold value as a comparison value. The C13 and C14 high-speed counters are not dependent on the cycle time.

Counter frequency and pulse shape

The maximum counter frequency is 1 kHz.

The signals must be square waves. We recommend a mark-to-space ratio of 1:1.

If this is not the case:

The minimum mark-to-space ratio is 0.5 ms.

$$t_{min} = 0.5 \times \frac{1}{f_{max}}$$

t_{min} = minimum time of the pulse or pause duration
f_{max} = maximum count frequency (1 kHz)

→ High-speed counters operate independently of the program cycle time. The result of the actual value setpoint comparison is only transferred once every program cycle for processing in the circuit diagram.

The reaction time in relation to the setpoint/actual value comparison can therefore be up to one cycle in length.

Wiring of a high-speed counter

The digital inputs have the following assignment:

- I1: high-speed counter input for counter C13.
- I2: high-speed counter input for counter C14.

→ If you use C13 or C14 as high-speed counters you must enable them with the coil CC13 or CC14 accordingly.

```
----------CC13
C13--------SN3
I6---------DC13
I8-C13-----RC13
```

You integrate a high-speed counter into your circuit in the form of a contact and coil.

The coils and contacts have the following meanings:

Contact	Coil	
C13 to C14		The contact switches if the actual value is greater than or equal to the setpoint.
	CC13, CC14	Enable of the high-speed counter on 1 signal coil activated
	DC13, DC14	Counting direction • Status 0, not activated, up counting. • Status 1, activated, down counting.
	RC13, RC14	Reset, coil triggered: actual value reset to 00000

→ The high-speed counter can also be enabled specifically for a special operating state. This has the advantage that the cycle time of the device is only burdened with the counting when it is taking place. If the high-speed counter is not enabled, the cycle time of the device is shorter.

```
C13 H       +
S    00950
```

Parameter display and parameter set for the high-speed counter:

C13	Counter function relay number 13
H	High-speed counter mode (H = high speed)
+	• + appears in the PARAMETER menu. • – does not appear in the PARAMETER menu
S	Setpoint, constant from 00000 to 32000

In the parameter display of a counter relay you change the mode, the setpoint and the enable of the parameter display.

Value range

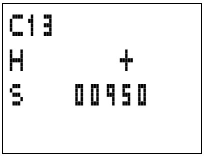
The counter relay counts between 0 and 32 000.

Behaviour when value range is reached

The logic relay is in RUN mode.

The value is retained if the counter reaches 32 000. If the counter counts down and reaches 0, this value is retained.

Parameter display in RUN mode:



Current setpoint, constant (1 250)

□ Contact has not switched.

■ Contact has switched.

Actual value (877)

Retention

The high-speed counter can be run with the retentive actual value. You can select the retentive counter relays in the SYSTEM… → RETENTION… menu. C5 to C7, C8 and C13 to C16 can be selected.

If a counter relay is retentive, the actual value is retained when the operating mode changes from RUN to STOP as well as when the power supply is switched off.

If the logic relay is started in RUN mode, the counter relay operates with the retentively saved actual value.

Function of the high-speed counter function block

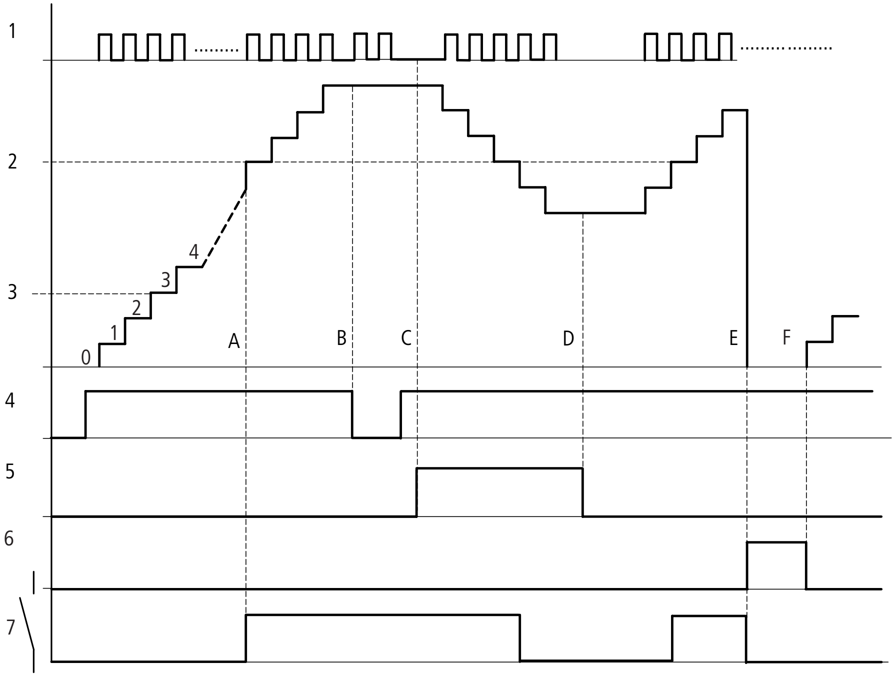


Figure 56: Signal diagram of high-speed counter

1: count pulses at counter input I1(I2)

2: setpoint of the counter

3: actual value of the counter

4: enable of the counter, CC13 (CC14)

5: count direction, direction coil DC13 (DC14)

6: reset coil of the counter RC13 (RC14)

7: contact of the counter, C13 (C14)

- Range A: The relay contact C13 (C14) of the counter with setpoint value 512 switches as soon as the actual value is 512.
- Range B: When new count pulses or the counter enable are not present, the actual value is retained.
- Range C: If the count direction is reversed DC13 (DC14), the contact is reset when the actual value is 511.
- Range D: The count direction is set to up counting
- Range E: The reset coil RC13 (RC14) resets the counter to 0. No pulses are counted.
- Range F: The reset coil is not active, pulses are counted.

→ In the examples it must be remembered that there may be a time difference of up to one program cycle between the setpoint/actual value comparison and the processing of the result. This may cause deviations in values.

Example: Counting measuring pulses and setting an output

Measuring pulses can represent lengths, rotations, angles or other values. These program sections are required for applications involving the filling of sacks, bags or the cutting of foil.

The count signals are continuously present at I1. The high-speed counter C13 counts these pulses. The counter is automatically set to zero if the actual value equals the setpoint. Contact C13 is then set for one program cycle. The output Q3 is set at the same time. This is then reset by input I8.

Circuit diagram display

```
N1--------CC13
C13-------SQ13
C13-------RC13
I8--------RQ13
```

Parameter settings of the counter C13

```
C13 H      +
S   1000
```

Example: Running motors or spindles in parallel

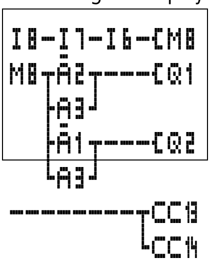
Applications may involve motion control with the parallel control of two drives. Only certain deviations are permissible so that the mechanical system does not jam.

These tasks can be implemented with the following solution.

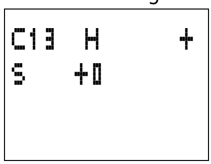
I8 starts the drives. I7 and I6 carry the feedback signals of the motor-protective circuit-breakers. The drives are stopped if a motor-protective circuit-breaker trips. The analog value comparators control the difference of the path distance. The appropriate drive is stopped temporarily if one path distance is outside of the set tolerance. The coils and contacts have the following meanings:

- M8 = enable for all drives
- Q1 = drive 1, counter drive 1 is connected with input I1 and this with high-speed counter C13.
- Q2 = drive 2, counter drive 2 is connected with input I2 and this with high-speed counter C14.
- A1 = comparison, if C13 is less than C14, drive 2 is too fast.
- A2 = comparison, if C14 is less than C13, drive 1 is too fast.
- A3 = comparison, if C13 and C14 are equal, both drives can be activated.
- The hysteresis value of A1, A2 and A3 depends on the resolution of the transducer and the mechanical system.

Circuit diagram display



Parameter settings of the counter C13



Parameter settings of the counter C14

```
C14 H       +
S    +0
```

Parameter setting of analog value comparators A1 and A2

```
A1  LT      +      A2  LT      +
I1   C13    ↑      I1   C14    ↑
F1   +0            F1   +0
I2   C14    ↓      I2   C13    ↓
F2   +0            F2   +0
OS   +0            OS   +0
HY   0015          HY   0015
```

Parameter settings A3

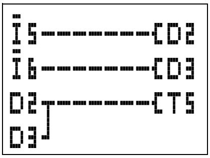
```
A1  EQ      +
I1   C13    ↑
F1   +0
I2   C14    ↓
F2   +0
OS   +0
HY   0020
```

Text display

CL-LSR/CL-LST and CL-LMR/CL-LMT are able to display 16 freely editable texts. These texts can be triggered by the actual values of function relays such as timing relays, counters, operating hours counters, analog value comparators, date, time or scaled analog values. The setpoints of timing relays, counters, operating hours counters, analog value comparators can be modified when the text is displayed. The text display can only be edited with CL-SOFT (from Version 6.xx). The texts are stored in the CL-SOFT file or on the CL-LAS.MD003 memory module for CL-LSR/CL-LST and CL-LMR/CL-LMT.

→ Compatibility with AC010

If you wish to load an existing AC010 circuit diagram, the available text display functions are retained. The text display operates in CL-LSR/CL-LST and CL-LMR/CL-LMT in the same way as in AC010.



Wiring a text display

You integrate a text display into your circuit in the form of a contact and coil.

The coils and contacts have the following meanings:

Contact	Coil	
D1 to D16		Coil of the corresponding text display is triggered
	[,], ↲, ↓, ↑, S, R D1 to D16	If a coil is triggered, the text is shown in the display.

The text display does not have a parameter display in the PARAMETER menu.

Retention

The texts D1 to D8 can be operated with retentive actual values (contacts).

If the text displays are retentive, the actual value is retained when the operating mode changes from RUN to STOP as well as when the power supply is switched off.

When the logic relay is restarted in RUN mode, the text displays D1 to D8 continue with the retentively stored actual value.

```
SWITCH,
CONTROL,
DISPLAYS,
MADE EASY!
```

Example of a text display:

The text display can display the following:

```
RUNTIME M:S
T1  :012:46
C1  :0355  ST
PRODUCED
```

— Line 1, 12 characters
— Line 2, 12 characters, a setpoint or actual value
— Line 3, 12 characters, a setpoint or actual value
— Line 4, 12 characters

Scaling

The values of the analog inputs can be scaled.

Range	Selectable display range	Example
10 to +10 V	0 to 9999	0000 to 0100
10 to +10 V	± 999	–025 to 050
10 to +10 V	± 9.9	–5.0 to 5.0

Function

The D text output function block (D = Display, tex t display) operates in the circuit diagram like a normal M marker. If a text is assigned to a marker, this is displayed in the CL display when the coil is set to 1. For this to take place, the logic relay must be in RUN mode and the status display must be activated before the text is displayed.

D2 to D16:
If several texts are present and are triggered, each text is automatically displayed in turn every 4 s. This process will be repeated until

- No other text display function block is set to 1.
- STOP mode is selected.

- The power supply of the logic relay is no longer present.
- The **OK** or **DEL** + **ALT** buttons are used to switch to a menu.
- A setpoint is entered.
- The text for D1 is displayed.

D1:
D1 is designed as an alarm text. If D1 is activated, the text assigned to it will be displayed until

- The coil D1 is reset to 0.
- STOP mode is selected.
- The power supply of the logic relay is no longer present.
- The **OK** or **DEL** + **ALT** buttons are used to switch to a menu.

Text entry

Text entry is only possible using CL–SOFT.

Character set

All ASCII characters in upper and lower case are permissible.

- A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
- a b c d e f g h i j k l m n o p q r s t u v w x y z

The following special characters are permissible:
! „" # $ % & ' () * + , – ./0 1 2 3 4 5 6 7 8 9

Counter with actual value	Analog input scaled as temperature value	D1 as error message on fuse failure
QUANTITY PCE:0042 !COUNTING!	TEMPERATURE OUT -010 DEG IN +018 DEG HEAT	FUSE FAULT HOUSE 1 FAILED!

Figure 57: Text output examples

Entering a setpoint in a display

A text can contain two values such as actual values and setpoints of function relays, analog input values and time and date. The position of setpoints and actual values is fixed to the centre of lines 2 and 3. The length depends on the value to be displayed. Setpoint entries in the text display are useful if the PARAMETER menu is not available for display or entry. Also when the operator is to be shown which setpoint is being modified.

```
RUNTIME M:S      — Line 1
T1  :012:46      — Line 2, setpoint can be edited
C1  :0355   ST   — Line 3, setpoint can be edited
PRODUCED         — Line 4
```

→ The appropriate text function block must be available in order to modify a setpoint. The setpoint must be a constant.

→ When values are being entered, the text is retained statically on the display. The actual values are updated.

The example shows the following.

The setpoint of timing relay T1 is to be changed from 12 minutes to 15 minutes.

- Line 2: setpoint of timing relay T1, can be edited.
- Line 3: actual value of timing relay T1.

The text is displayed.

```
STIR M:S
S : 012:00
ACT: 008:33
BREAD ROLLS
```

```
STIR M:S
S : 012:00
ACT: 008:33
```

▶ Pressing the **ALT** button will cause the cursor to jump to the first editable value.

In this operating mode, you can use the cursor buttons ˄˅ to move between different editable constants.

```
STIR M:S
S : 012:00
ACT: 008:33
BREAD ROLLS
```

▶ Press **the OK button**, the cursor will jump to the highest digit of the constant to be modified.

In this operating mode use the cursor buttons ˄˅ to modify the value. Use the cursor buttons ˂ ˃ to move between digits.
Use the **OK** button to accept the modified value. Use the **ESC** button to abort the entry and leave the previous value.

```
STIR M:S
S : 015:00
ACT:008:34
BREAD ROLLS
```

```
STIR M:S
S : 015:00
ACT:008:34
BREAD ROLLS
```

▶ Press **the OK button**, the cursor will move from constant to constant.

The modified value is accepted.

```
STIR M:S
S : 015:00
ACT:008:34
BREAD ROLLS
```

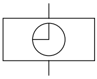
Press the **ESC** button to leave Entry mode.

7-day time switch

Types CL-LSR.C... /CL-LST.C... and CL-LMR.C.../CL-LMT.C... are provided with a real-time clock. The time switches can only be used properly in these devices.

→ The procedure for setting the time is described under section “Setting date and time” on Page 205.

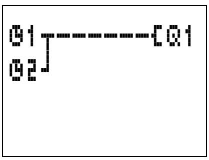
The logic relay offers eight 7-day time switches Ö1 to Ö8 for up to 32 switch times.
Each time switch has four channels which you can use to set four on and off times. The channels are set via the parameter display.



The timer has a back-up battery. This means that it will continue to run in the event of a power failure, although the time switch relays will not switch. When the logic relay is in a de-energized state, the timer contacts remain open. Information on the battery back-up time are provided on Page 256.

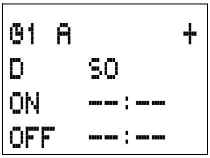
→ Compatibility with AC010

If you wish to load an existing AC010 circuit diagram, the existing 7-day time switch functions are retained. The 7-day time switches in the CL-LSR/CL-LST and CL-LMR/CL-LMT operate in the same way as in the AC010.



A 7-day time switch can be integrated into your circuit in the form of a contact.

Contact	Coil		
Ö1 to Ö8			Contact of the 7-day time switch

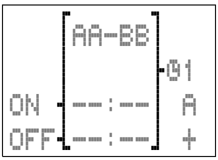


Parameter display and parameter set for 7-day time switch

Ø1	7-day time switch function relay 1
A, B, C, D	Time switch channels
+	• + appears in the PARAMETER menu, • – does not appear in the PARAMETER menu
D	Day setting, from -- to --
ON	On time
OFF	Off time

The parameter display for a 7-day time switch is used to modify the weekdays, the on time, the off time and to enable the parameter display.

Compatibility of AC010 with CL-LSR/CL-LST and CL-LMR/CL-LMT: 7-day time switch parameter display
The CL-LSR/CL-LST and CL-LMR/CL-LMT parameter display has been modified. The AC 010 parameters are at the following points.



AC010 parameter		CL-LSR/CL-LST, CL-LMR/CL-LMT parameter
Ø1	=	Ø1
AA-BB	=	AA-BB
A	=	A
ON --:--	=	ON --:--
OFF --:--	=	OFF --:--
+	=	+

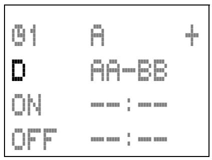


Table 12: On and off times

Parameters	Meaning	Meaningful values
Day of the week	Monday to Sunday	MO, TU, WE, TH, FR, SA, SU, --
On time	Hours: Minutes No time set at "--:--"	00:00 to 23:59, --:--
Off time	Hours: Minutes No time set at "--:--"	00:00 to 23:59, --:--

Parameter display in RUN mode:

```
Ö1  A  11:30  +   — Selected channel, current time (only in RUN)
D      MO-FR      — Weekday(s) from – to
ON     06:45      — On time
OFF    19:30  ■   — Off time
```

□ Contact has not switched.

■ Contact has switched.

Changing time switch channel

You can change time switch channel in either RUN or STOP mode by selecting the channel required with the cursor buttons ∧∨.
Example:

```
Ö1  A  11:30  +
D      MO-FR
ON     06:45
OFF    19:30  ■
```

The parameter display of the 7-day time switch is active. The cursor is flashing on channel A.

```
Ö1  B  11:30  +
D      SA
ON     06:45
OFF    15:00  ■
```

▶ Press the ∧ button to move the cursor to channel B.

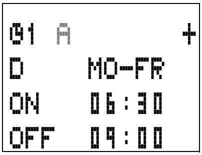
Press the › button to reach any value that can be edited.

Function of the 7-day time switch

The following examples illustrate the function of the 7-day time switch.

Work days example

The time switch Ö1 switches on Monday to Friday between 06:30 and 09:00 and between 17:00 and 22:30.



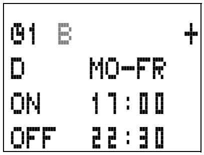
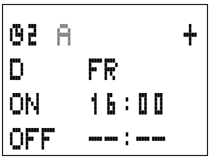
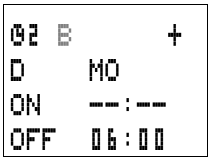


Figure 58: Work days signal diagram

Weekends example

Time switch Ö2 switches on at 16:00 on Friday and switches off at 06:00 on Monday.





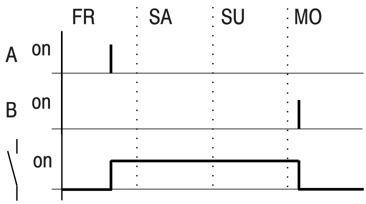


Figure 59: Signal diagram of “weekend”

Night switching example

Time switch Ø3 switches on at 22:00 on Monday and switches off at 06:00 on Tuesday.

```
Ø3 D        +
D     MO
ON    22:00
OFF   06:00
```

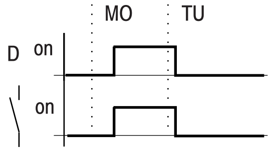


Figure 60: Night switching signal diagram

→ If the Off time is before the On time, the logic relay will switch off on the following day.

Time overlaps example

The time settings of a time switch overlap. The clock switches on at 16:00 on Monday, whereas on Tuesday and Wednesday it switches on at 10:00. On Monday to Wednesday the switching-off time is 22:00.

```
Ø4 A        +        Ø4 B        +
D     MO-MI          D     TU-WE
ON    16:00          ON    10:00
OFF   22:00          OFF   00:00
```

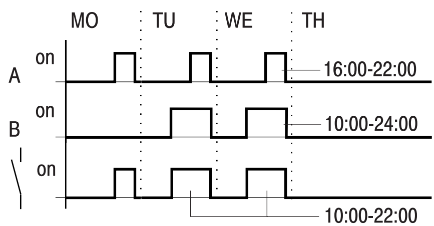
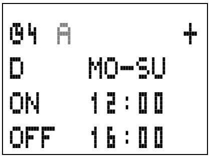


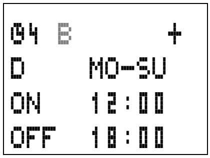
Figure 61: Time overlaps signal diagram

→ On and off times always follow the channel which switches first.

Power failure example

The power is removed between 15:00 and 17:00. The relay drops out and remains off, even after the power returns, since the first off time was at 16:00.

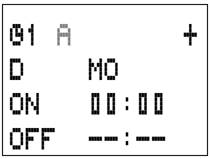


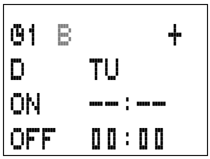


→ When switched on, the logic relay always updates the switching state on the basis of all the available switching time settings.

24 hour switching example

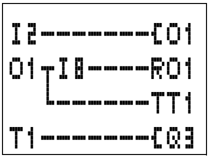
The time switch is to switch for 24 hours. Switch-on time at 00:00 on Monday and switch-off time at 00:00 on Tuesday.





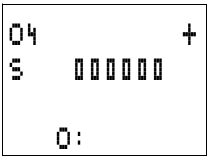
Operating hours counter

The logic relay provides 4 independent operating hours counters. These operating hours counters enables you to record the operating hours of systems, machines and machine parts. An adjustable setpoint can be selected within the value range. In this way, maintenance times can be logged and reported. The counter states are retained even when the device is switched off. As long as the count coil of the operating hours counter is active, the logic relay counts the hours in one second cycles.



You integrate an operating hours counter into your circuit in the form of a contact and coil.

Contact	Coil	
O1 to O4		
	CO1 to CO4	Count coil of the operating hours counter
	RO1 to RO4	reset coil of the operating hours counter

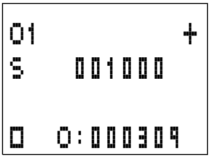


Parameter display and parameter set for the operating hours counter function block:

O4	Operating hours counter number 04
+	• **+** appears in the parameter display • **–** appears in the parameter display
S	Setpoint in hours
O:	Actual value of the operating hours counter [h]

In the parameter display of an operating hours counter you change the setpoint in hours and the enable of the parameter display.

Parameter display in RUN mode:



— Set time in hours

— Actual time in hours

□ Contact has not switched.

■ Contact has switched.

Value range of the operating hours counter

The operating hours counter counts in the range from 0 hours up to more than 100 years.

Accuracy of the operating hours counter

The operating hours counter counts in seconds. When the device is switched off, up to 999 ms can be lost.

Function of the operating hours counter function block

When the coil of the O operating hours counter is set to 1, the counter increments its actual value by 1 (basic pulse: 1 second).

If the actual value of the operating hours counter reaches the setpoint of S, the contact O… switches for as long as the actual value is greater than or equal to the setpoint.

The actual value is kept stored in the device until the reset coil RO… is triggered. The actual value is then set to zero.

→ Operating mode change RUN, STOP, power On, Off, delete program, change program, load new program. All these functions do not clear the actual value of the operating hours counter.

Example: Operating hours counter
Operating hours counter for the operating time of a machine. The time in which a machine (logic relay) is energized is to be measured.

Circuit diagram display

```
----------[O1
```

Parameter settings of operating hours counter O1

```
O1          +
S    000000
```

Example: Maintenance meter for different machine sections
Machine sections have to be maintained after different times have elapsed. Markers N1 and N2 are the On markers of two different machine sections. These markers control the associated operating hours counters. Output Q4 switches on a warning light if the setpoint of an operating hours counter has been reached. A keyswitch at input I8 resets the associated operating hours counter after maintenance has been completed.

Circuit diagram display

```
N1--------[O2
N2--------[O3
O2┬-------[Q4
O3┘
I8┬O2-----RO2
  └O3-----RO3
```

Parameter settings of operating hours counter O2

```
O2          +
S    000500
```

Parameter settings of operating hours counter O3

```
O3          +
S    000800
```

Example: Maintenance meter for different machine sections, with text output

The entire machine operating time is to be counted. Machine sections have to be maintained after different times have elapsed. Markers N1 and N2 are the On markers of two different machine areas. These markers control the associated operating hours counters. Output Q4 switches on a warning light if the setpoint of an operating hours counter has been reached. This should flash. A keyswitch at input I8 resets the associated operating hours counter after maintenance has been completed.

The entire machine operating time is to be displayed continuously. The run time of the machine sections should only be displayed once the maintenance interval has elapsed.

Circuit diagram display

```
---------ÄO1
O1-------ÄD4
N1-------ÄO2
N2-------ÄO3
O2┬-------TT4
O3┘
T4-------ÄQ4
O2┬I8----RO2
  └------ÄD2
O3┬I8----RO3
  └------ÄD3
```

Parameter settings of operating hours counter O1

```
O1         +
S   000000
```

Parameter settings of operating hours counter O2

```
O2         +
S   000500
```

Parameter settings of operating hours counter O3

```
O3         +
S   000800
```

Parameter setting of timing relay T1

```
T1 ⊥⊥    S  +
I1  02.000
I2  01.500
  T:
```

Text of text display D2

```
MAINTENANCE
REQUIRED
HRS:000501
MACHINE 01
```

Text of text display D3

```
MAINTENANCE
REQUIRED
HRS:000800
MACHINE 02
```

Text of text display D4

```
RUNTIME
MACHINE
HRS:001955
```

Timing relays

The logic relay provides 16 timing relays from T 1 to T 16.

A timing relay is used to change the switching duration and the make and break times of a switching contact. The delay times can be configured between 2 ms and 99 h 59 min. You can use positive values, values of analog inputs, actual values of counter relays and timing relays.

You can also use the logic relay as a multi-function relay in the application. The logic relay is more flexible than any hardwired timing relay since you can wire all the functions at the push of a button as well as program additional functions.

→ The timing relays of CL-LSR/CL-LST and CL-LMR/CL-LMT function in the same way as the timing relays of the AC010 devices.

Exception: The "flasher" function starts on the CL-LSR/CL-LST and CL-LMR/CL-LMT with the pulse. With the AC010, the "flasher" function starts with the pause. If required, the same timing relays can also be used for retentive data.

```
I1-I4-----TT1
T1--------[Q3
```

You integrate a timing relay into your circuit in the form of a contact and coil.

Contact	Coil	
T1 to T16		Contact of a timing relay
	TT1 to TT16	Enable, timing relay trigger
	RT1 to RT16	reset coil of the timing relay
	HT1 to HT16	stop coil of the timing relay (H = Stop , S means the set coil function)

→ To prevent unpredictable switching states, use each coil of a relay once only in the circuit diagram.

```
T1 X    S  +
I1  00.000
I2  00.000
  T:
```

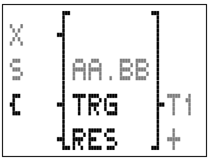
Parameter display and parameter set for a timing relay

T1	Timing relay number 1
X	On-delayed mode
S	Time range in seconds
+	• **+** appears in the PARAMETER menu. • **–** does not appear in the PARAMETER menu
I1	Time setpoint 1: • Positive value, I7, I8, I11, I12 • Actual value T1 to T16, C1 to C16
I2	Time setpoint 2 (with timing relay with 2 setpoints): • Positive value, I7, I8, I11, I12 • Actual value T1 to T16, C1 to C16
T:	Display of actual value in RUN mode

In the parameter display of a timing relay you can change the mode, the time base, the time setpoint 1, time setpoint 2 (if necessary) and the enable of the parameter display.

Compatibility of AC010 with CL-LSR/CL-LST and CL-LMR/CL-LMT: Timing relay parameter display

The CL-LSR/CL-LST and CL-LMR/CL-LMT parameter display has been provided with new functions. The AC010 parameters are at the following points.



AC010 parameter		CL-LSR/CL-LST-, CL-LMR/CL-LMT parameter
T1	=	T1
X	=	X
S	=	S
AA.BB	=	AA.BB
+	=	+

```
T1 X    S +
I1 AA.BB
I2
```

Parameter display in RUN mode:

Display	
T1 X S +	Mode, time base
I1 10.000	Time setpoint 1
I2 00.000	Time setpoint 2
□ T:03.305	Actual value of elapsed time

□ Contact has not switched.

■ Contact has switched.

Retention

Timing relays can be run with retentive actual values. Select the number of retentive timing relays in the SYSTEM… → RETENTION… menu.T7, T8, T13 to T16 can be used as retentive timing relays.

If a timing relay is retentive, the actual value is retained when the operating mode is changed from RUN to STOP and when the power supply is switched off.

If the logic relay is started in RUN mode, the timing relay operates with the retentively saved actual value.

→ When the device is restarted, the status of the trigger pulse must be the same as on disconnection.

Status 1 with all operating modes:

- on-delayed,
- single pulse,
- flashing.

Status 0 with all operating modes: off-delayed.

Status 1 or 0 (as with disconnection): on-delayed: on/off-delayed

Timing relay modes

Parameters	Switch function
X	Switch with on-delay
?X	Switch with on-delay and random time range
■	Switch with off-delay
?■	Switch with off-delay and random time range
X■	On- and off-delayed, two time setpoints
?X■	On- and off-delayed switching with random time, 2 time setpoints
Л	Single-pulse switching
Ш	Flash switching, mark-to-space ratio = 1:1, 2 time setpoints
Ш	Flash switching, mark-to-space ratio ≠ 1:1, 2 time setpoints

Time range

Parameters	Time range and setpoint time	Resolution
S 00.000	Seconds: 0.00 to 99.99 s	10 ms
M:S 00:00	Minutes: Seconds 00:00 to 99:59	1 s
H:M 00:00	Hours: Minutes, 00:00 to 99:59	1 min.

→ Minimum time setting:
If a time value is less than the logic relay's cycle time, the elapsed time will not be recognised until the next cycle. This may cause unforeseeable switching states.

Variable values as time setpoint (I7, I8, I11, I12, actual value T1 to T16, C1 to C16)

→ If the value of the variable is greater than the maximum permissible value of the configured time range, the maximum value of the time range will be used as the setpoint.

→ You can only use analog values as setpoints if the value of the analog input is stable. Fluctuating analog values reduce the reproducibility of the time value.

The following conversion rules apply if you are using variable values such as an analog input:

s time base

Equation: Time setpoint = (Value $\times$ 10) in [ms]

Value, e.g. Analog input	Time setpoint in [s]
0	00.00
100	01.00
300	03.00
500	05.00
1023	10.23

M:S time base

Rule:
Time setpoint = Value divided by 60,
integer result = Number of minutes, remainder is the number of seconds

Value, e.g. Analog input	Time setpoint in [M:S]
0	00:00
100	01:40
300	05:00
500	08:20
1023	17:03

Time base H:M

Rule:
Time setpoint = Value divided by 60,
integer result = Number of hours, remainder is the number of minutes

Value, e.g. Analog input	**Time setpoint in [H:M]**
0	00:00
100	01:40
300	05:00
606	10:06
1023	17:03

Function of the timing relay function block

Timing relay, on-delayed with and without random switching

Random switching: The contact of the timing relay switches randomly within the setpoint value range.

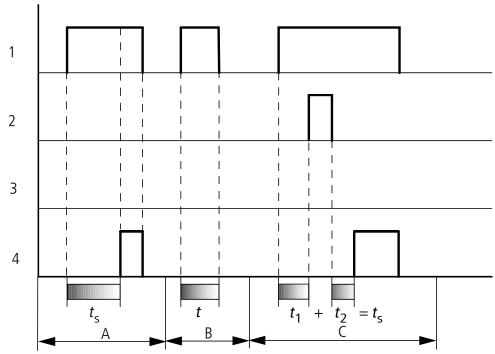


Figure 62: Signal diagram of timing relay, on-delayed (with and without random switching)

1: Trigger coil TTx

2: Stop coil HTx

3: Reset coil RTx

4: Switching contact (n/o contact) Tx

t_S: Setpoint time

- Range A: The set time elapses normally.
- Range B: The entered setpoint does not elapse normally because the trigger coil drops out prematurely.
- Range C: The stop coil stops the time from elapsing.

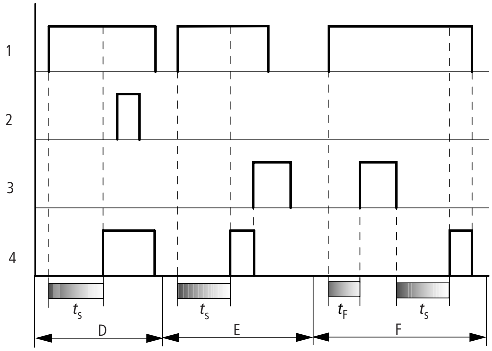


Figure 63: Signal diagram of timing relay, on-delayed (with and without random switching)

- Range D: The stop coil is inoperative after the time has elapsed.
- Range E: The reset coil resets the relay and the contact.
- Range F: The reset coil resets the time during the timeout sequence. After the reset coil drops out, the time elapses normally.

Timing relay, off-delayed with and without random switching

Random switching: The contact of the timing relay switches randomly within the setpoint value range.

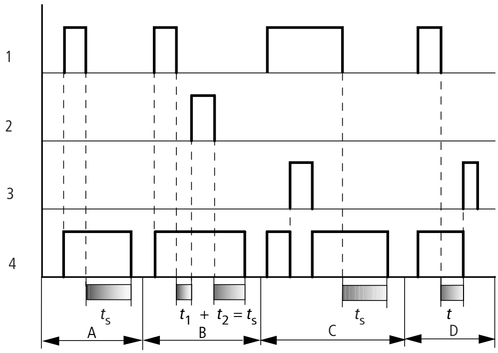


Figure 64: Signal diagram of timing relay, off-delayed (with and without random switching)

1: Trigger coil TTx

2: Stop coil HTx

3: Reset coil RTx

4: Switching contact (n/o contact) Tx

t_S: Setpoint time

- Range A: The time elapses after the trigger coil is deactivated.
- Range B: The stop coil stops the time from elapsing.
- Range C: The reset coil resets the relay and the contact. After the reset coil drops out, the relay continues to work normally.
- Range D: The reset coil resets the relay and the contact when the function block is timing out.

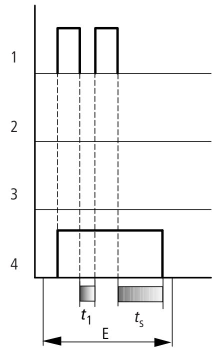


Figure 65: Signal diagram of timing relay, off-delayed (with/without random switching with retriggering)

Range E: The trigger coil drops out twice. The actual time t_1 is cleared and the set time ts elapses completely (retriggerable switch function).

Timing relay, on- and off-delayed with and without random switching

Time value I1: on-delay time
Time value I2: off-delay time

Random switching: The contact of the timing relay switches randomly within the setpoint value ranges.

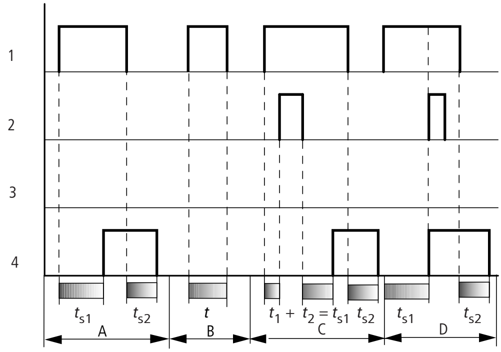


Figure 66: Signal diagram timing relay, on and off-delayed 1

1: Trigger coil TTx

2: Stop coil HTx

3: Reset coil RTx

4: Switching contact (n/o contact) Tx

t_{s1}: Pick-up time

t_{s2}: Drop-out time

- Range A: The relay processes the two times without any interruption.
- Range B: The trigger coil drops out before the on-delay is reached.
- Range C: The stop coil stops the timeout of the on-delay.
- Range D: The stop coil has no effect in this range.

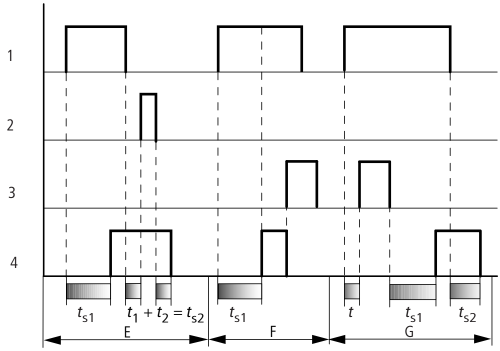


Figure 67: Signal diagram timing relay, on and off-delayed 2

- Range E: The stop coil stops the timeout of the off-delay.
- Range F: The reset coil resets the relay after the on-delay has elapsed
- Range G: The reset coil resets the relay and the contact whilst the on-delay is timing out. After the reset coil drops out, the time elapses normally.

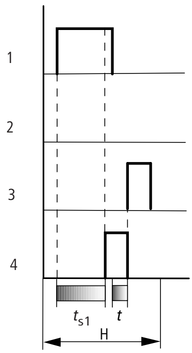


Figure 68: Signal diagram timing relay, on- and off-delayed 3

- Range H: The Reset signal interrupts the timing out of the set time.

Timing relay, single pulse

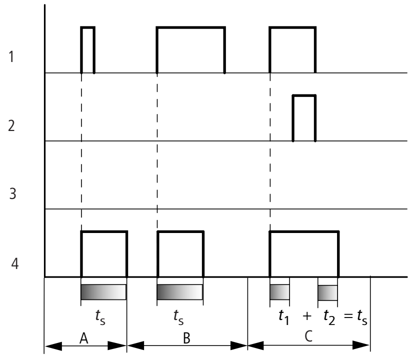


Figure 69: Signal diagram of timing relay, single pulse 1

1: Trigger coil TTx

2: Stop coil HTx

3: Reset coil RTx

4: Switching contact (n/o contact) Tx

- Range A: The trigger signal is short and is lengthened
- Range B: The trigger signal is longer than the set time.
- Range C: The stop coil interrupts the timing out of the set time.

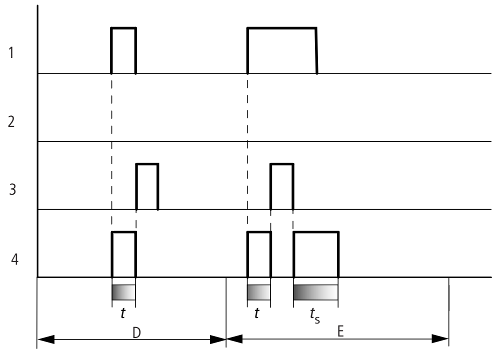


Figure 70: Signal diagram timing relay, pulse shaping 2

- Range D: The reset coil resets the timing relay.
- Range E: The reset coil resets the timing relay. The trigger coil is still activated after the reset coil has been deactivated and the time is still running.

Timing relay, flashing

You can set the mark-to-space ratio to 1:1 or ≠ 1:1.

Time value I1: mark time
Time value I2: space time

Mark-to-space ratio = 1:1 flashing: S1 equals S2.
Mark-to-space ratio ≠ 1:1 flashing: S1 not equal S2.

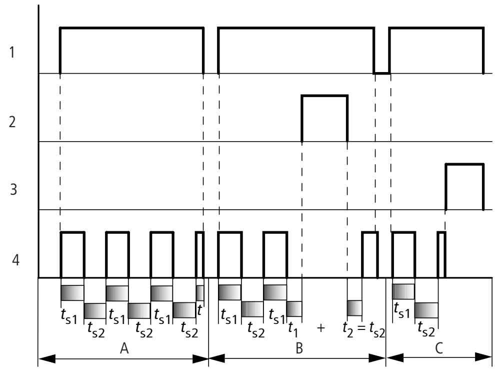


Figure 71: Timing relay signal diagram, flashing

1: Trigger coil TTx

2: Stop coil HTx

3: Reset coil RTx

4: Switching contact (n/o contact) Tx

- Range A: The relay flashes for as long as the trigger coil is activated.
- Range B: The stop coil interrupts the timing out of the set time.
- Range C: The reset coil resets the relay.

Examples timing relay

Example: Timing relay, on-delayed

In this example a conveyor starts 10 s after the system is powered up.

Circuit diagram display

```
I5--------TT1
T1--------[Q1
```

Parameter settings of timing relay T1

```
T1 X     S  +
I1  10.000
I2
```

Example: Timing relay, off-delayed

The off-delayed function is used to implement a rundown time on the conveyor if required.

Circuit diagram display

```
I6--------TT2
T2--------[Q2
```

Parameter settings of timing relay T2

```
T2 ■     S  +
I1  30.000
I2
```

Example: Timing relay, on- and off-delayed

The on/off-delayed function is used to implement the delay of both the startup and the disconnection if required.

Circuit diagram display

```
I6--------TT3
T3--------[Q3
```

Parameter settings of timing relay T3

```
T3 X■    S  +
I1  10.000
I2  30.000
```

Example: Timing relay, single pulse

The input pulses present may vary in length. These pulses must be normalised to the same length. The single pulse function can be used very simply to implement this.

Circuit diagram display

```
I1--------TT4
T4--------[Q4
```

Parameter settings of timing relay T4

```
T4 Л     S  +
I1  10.000
I2
```

Example: Timing relay, flashing

This example shows a continuous flash pulse function. Outputs Q3 or Q4 flash according to the marker states of M8 or M9.

Circuit diagram display

```
----------TT5
T5┬M8-----[Q3
  └M9-----[Q4
```

Parameter settings of timing relay T5

```
T5 Ш     S  +
I1  02.000
I2  01.000
```

Example: On-delayed timing relay with retentive actual value

Select a retentive timing relay if you wish to retain the actual value of a timing relay, even after a power failure or a change from RUN to STOP.

```
M 9 - M12 √+
M13 - M16
N 9 - N16
C 5 - C 7  +
C 20
C13 - C16
T 7        √
T 8        √
T13 - T16
D 1 - D 8
```

▶ Select the required timing relay in the SYSTEM… → RETENTION… menu.

The example shows the timing relays T7, T8 as retentive timing relays. Markers M9 to M12 were also selected as retentive.

Circuit diagram display

```
M9--------TT8
T8--------[Q1
```

Parameter settings of timing relay T8

```
T8 X   M:S +
I1  15:00
I2
```

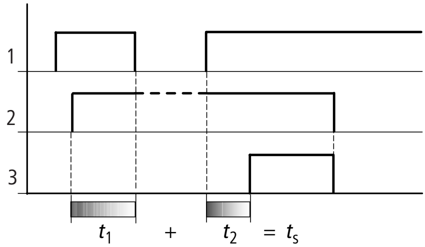


Figure 72: Function of the circuit

1: Power supply

2: Status of marker M9 and thus trigger signal T8

3: Status of n/o contact T8

Jumps

Jumps can be used to optimise the structure of a circuit diagram or to implement the function of a selector switch. Jumps can be used for example to select whether manual/ automatic operation or other machine programs are to be set.

```
I2--------[:1
----------[:2
:1
T1--------[Q3
```

You integrate ":1" jumps into your circuit in the form of a contact and coil. Jumps consist of a jump location and a jump label.

Contact	Coil
:1 to :8 (can only be used as first leftmost contact)	
	[:1 to [:8

Function

If the jump coil is triggered, the rungs after the jump coil are no longer processed. The states of the coils before the jump will be retained, unless they are overwritten in rungs that were not missed by the jump. Jumps are always made forwards, i.e. the jump ends on the first contact with the same number as that of the coil.

- Coil = Jump when 1
- Contact only at the first leftmost contact = Jump label

The jump label contact point is always set to **"1"**.

→ Backward jumps are not possible with the logic relay due to the way it operates.

If the jump label does not come after the jump coil, the jump will be made to the end of the circuit diagram. The last rung will also be skipped.

Multiple use of the same jump coil and jump contact is possible as long as this is implemented in pairs, i.e.: Coil [:1/jumped range/Contact:1,Coil [:1/jumped range/Contact :1 etc.

Attention!
If circuit connections are skipped, the states of the coils are retained. The time value of timing relays that have been started will continue to run.

Power flow display

Jumped sections are indicated by the coils in the power flow display.

All coils after the jump coil are shown with the symbol : of the jump coil.

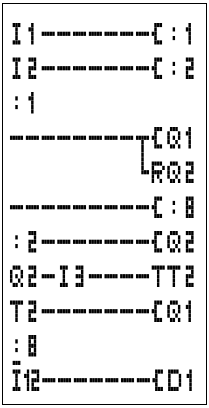
Example
A selector switch allows two different sequences to be set.

- Sequence 1: Switch on motor 1 immediately.
- Sequence 2: Switch on Guard 2, wait time, then switch on motor 1.

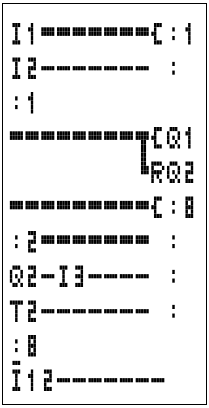
Contacts and relays used:

- I1 sequence 1
- I2 sequence 2
- I3 guard 2 moved out
- I12 motor-protective circuit-breaker switched on
- Q1 motor 1
- Q2 guard 2
- T1 wait time 30.00 s, on-delayed
- D1 text "Motor-protective circuit-breaker tripped"

Circuit diagram:



Power flow display: I1 selected:



Section from jump label 1 processed.

Jump to label 8.
Section to jump label 8 skipped.

Jump label 8, circuit diagram processed from this point on.

Year time switch

Types CL-LSR.C.../CL-LST.C... and CL-LMR.C.../CL-LMT.C... are provided with a real-time clock that can be used as a 7-day time switch and year time switch in the circuit diagram. If you have to implement special on and off switching functions on public holidays, vacations, company holidays, school holidays and special events, these can be implemented easily with the year time switch.

→ The procedure for setting the time is described under section "Setting date and time" on Page 205.

The logic relay offers eight year time switches Y1 to Y8 for up to 32 switch times.

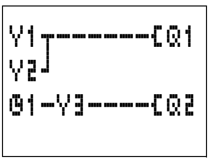
Each time switch has four channels which you can use to set four different on and off times. The channels are set via the parameter display.

The time and date are backed up in the event of a power supply failure and continue to run. This means that it will continue to run in the event of a power failure, although the time switch relays will not switch. When the device is in a de-energized state, the timer contacts remain open. Refer to section "Technical data", Page 256, for information on the buffer time.

→ The clock module integrated in the logic relay works within the date range 01.01.2000 to 31.12.2099.

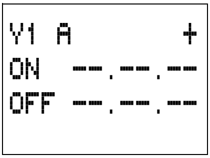
Wiring of a year time switch

A year time switch can be integrated into your circuit in the form of a contact.



The coils and contacts have the following meanings:

Contact	Coil	
Y1 to Y8		Contact of the year time switch



Parameter display and parameter set for year time switch

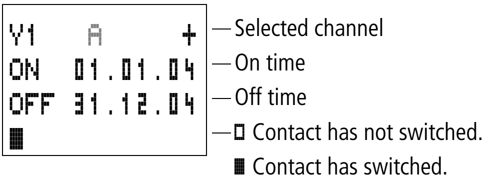
Y3	Year time switch function relay 1
A, B, C, D	Time switch channels
+	• **+** appears in the PARAMETER menu. • **–** does not appear in the PARAMETER menu
ON	On date: day, month, year (two-digit 2004 = 04)
OFF	Off date: day, month, year (two-digit 2004 = 04)

The parameter display for a year time switch is used to modify the on time, the off time and to enable the parameter display.

Table 13: On and off times

Parameters	Meaning	Meaningful values
xx.--.00	Date, day	01 to 31
--.**xx**.00	Month	01 to 12
--.-0.**00**	Year, two-digit	00 to 99

Parameter display in RUN mode:



Changing time switch channel

You can the change time switch channel in either RUN or STOP mode by selecting the channel required with the cursor buttons ʌv.

Example:

```
Y4 A         +
ON   01.01.04
OFF  31.03.04
█
```

The display on the left shows the parameter display of a year time switch.

```
Y4 B         +
ON   01.10.04
OFF  31.12.04
□
```

▶ Press the ʌ button to move the cursor to channel B.

Press the > button to reach any value that can be edited.

→ Important input rules.

The year time switch only operates properly by observing the following rules.

The on year must not be later than the off year.

ON and OFF times must have the same parameters.
Example: ON = Year, OFF = Year; ON = Year/Month, OFF = Year/Month

Entry rules

The following nine entry rules are possible.

Display format: XX = digit used

```
Y1    A      +
ON   XX.--.--
OFF  XX.--.--
```

Rule 1
ON: Day

OFF: Day

```
Y1    A      +
ON   --.XX.--
OFF  --.XX.--
```

Rule 2
ON: Month

OFF: Month

```
Y1    A      +
ON   --.--.XX
OFF  --.--.XX
```

Rule 3
ON: Year

OFF: Year

```
Y1    A      +
ON   XX.XX.--
OFF  XX.XX.--
```

Rule 4
ON: Day/month

OFF: Day/month

```
Y1    A      +
ON   --.XX.XX
OFF  --.XX.XX
```

Rule 5
ON: Month/year

OFF: Month/year

```
Y1    A      +
ON   XX.XX.XX
OFF  XX.XX.XX
```

Rule 6
ON: Day/month/year

OFF: Day/month/year

```
Y1    A      +
ON   XX.XX.--
OFF  --.--.--
```

Rule 7
Two-channel

Channel A ON: Day/month

```
Y1    B      +
ON   --.--.--
OFF  XX.XX.--
```

Channel B OFF: Day/month

```
Y1    B     +
ON   XX.XX.XX
OFF  --.--.XX
```

Rule 8
Two-channel

Channel ON: Day/month/year

```
Y1    D     +
ON   --.--.XX
OFF  XX.XX.XX
```

Channel D OFF: Day/month/year

With this rule, the same year number must be entered in each channel in the ON and OFF entry area.

Rule 9
Overlapping channels:

The first ON date switches on and the first OFF date switches off.

Function of the year time switch

The year time switch can switch ranges, individual days, months, years or combinations of all three.

Years
ON: 2002 to OFF: 2010 means: Switch on at 00:00 on 01.01.2002 and switch off at 00:00 on 01.01.2011.

Months
ON: 04 to OFF: 10 means:
Switch on at 00:00 on 1 April and switch off at 00:00 on 1 November

Days
ON: 02 to OFF: 25 means:
Switch on at 00:00 on day 2 and switch off at 00:00 day 26

→ Avoid incomplete entries. It hinders transparency and leads to unwanted functions.

Example: Selecting year range
The year time switch Y1 is required to switch on at 00:00 on January 1 2004 and stay on until 23:59 December 31 2005.

Circuit diagram display

```
Y1--------[Q1
```

Parameter settings of the year time switch Y1

```
Y1    A     +
ON  --.--.04
OFF --.--.05
```

Example: Selecting month ranges

The year time switch Y2 is required to switch on at 00:00 on March 1 and stay on until 23:59 September 30.

Circuit diagram display

```
Y2--------[Q1
```

Parameter settings of the year time switch Y2

```
Y2    A     +
ON  __.03.--
OFF --.09.--
```

Example: Selecting day ranges

The year time switch Y3 is required to switch on at 00:00 on day 1 of each month and switch off at 23:59 on day 28 of each month.

Circuit diagram display

```
Y3--------[Q1
```

Parameter settings of the year time switch Y3

```
Y3    A     +
ON  01.--.--
OFF 28.--.--
```

Example: Selecting public holidays

The year time switch Y4 is required to switch on at 00:00 on day 25.12 of each year and switch off at 23:59 on day 26.12 of each year. "Christmas program"

Circuit diagram display

```
Y4--------[Q1
```

Parameter settings of the year time switch Y4

```
Y4    A     +
ON   25.12.--
OFF  26.12.--
```

Example: Selecting a time range

The year time switch Y1 is required to switch on at 00:00 on day 02.05 of each year and switch off at 23:59 on day 31.10 of each year. "Open air season"

Circuit diagram display

```
Y1--------[Q1
```

Parameter settings of the year time switch Y1

```
Y1    A     +
ON   02.05.--
OFF  --.--.--
```

```
Y1    B     +
ON   --.--.--
OFF  31.10.--
```

Example: Overlapping ranges

The year time switch Y1 channel C switches on at 00:00 on day 3 of months 5, 6, 7, 8, 9, 10 and remains on until 23:59 on day 25 of these months.

The year time switch Y1 channel D switches on at 00:00 on day 2 of months 6, 7, 8, 9, 10, 11, 12 and remains on until 23:59 on day 17 of these months.

Circuit diagram display

```
Y1--------[Q1
```

Parameter settings of the year time switch Y1

```
Y1   C     +
ON  03.05.--
OFF 25.10.--
```

```
Y1   D     +
ON  02.06.--
OFF 17.12.--
```

Total number of channels and behaviour of the contact Y1:
The time switch will switch on at 00:00 from 3 May and off at 23:59 on 25 May.
In June, July, August, September, October, the time switch will switch on at 00:00 on day 2 of the month and switch off at 23:59 on day 17 .
In November and December, the time switch will switch on at 00:00 on day 2 of the month and switch off at 23:59 on day 17.

Master reset

The master reset function relay enables you to set with one command the status of the markers and all outputs to "0". Depending on the operating mode of this function relay, it is possible to reset the outputs only, or the markers only, or both. Three function blocks are available.

```
N8--------[Z1
Q3--------[Z2
I8--------[Z3
Z1-Z2-Z3-]Q2
```

Wiring of the master reset function relay

You integrate a master reset function relay into your circuit in the form of a contact and coil.

The coils and contacts have the following meanings:

Contact	Coil	
Z1 to Z3		Contact of the master reset
	[Z1 to [Z3	Coil of the master reset

Operating modes

The different coils of the master reset have different operating modes

- Z1: For Q outputs: controls outputs Q1 to Q8 and S1 to S8.
- Z2: For markers M, N: controls the marker range M1 to M16 and N1 to N16.
- Z3: for outputs and markers: controls Q1 to Q8, S1 to S8, M1 to M16 and N1 to N16.

Function of the master reset function relay

A rising edge or the 1 signal on the coil will reset the outputs or markers to 0, depending on the operating mode set. The location of the coil in the circuit diagram is of no importance. The master reset always has the highest priority.

The contacts Z1 to Z3 follow the status of their own coil.

```
I8--------↑Z1
I5--------[Q1
I2-M1-T1-SS3
M3┬C1----SQ3
M4┘
```

Example: Resetting outputs
All outputs that you have used can be reset to 0 with one command.

A rising edge at the coil of Z1 will cause all Q and S outputs to be reset.

```
I8--------↑Z2
I5--------[M1
I2-M1-T1-SN3
M3┬C1----SM8
M4┘
```

Example: Resetting markers
All markers that you have used can be reset to 0 with one command.

A rising edge at the coil of Z2 will cause all markers M and N to be reset.

```
I8--------ʃZ3
I5--------[Q1
I2-M1-T1-SS3
M3┬C1----SQ3
M4┘
I1--------[M1
I7-C2-T1-SN3
T3-A1----SM8
M4-A5----SN8
```

Example: Resetting outputs and markers

All outputs and markers that you have used can be reset to 0 with one command.

A rising edge at the coil of Z3 will cause all Q and S outputs and all M and N markers to be reset.

Basic circuits

The values in the logic table have the following meanings

For switching contacts:

- 0 = n/o contact open, n/c contact closed
- 1 = n/o contact closed, n/c contact open

For Q…: relay coils

- 0 = coil not energized
- 1 = coil energized

Negation (contact)

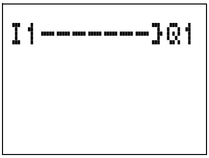
Negation means that the contact opens rather than closes when it is actuated (NOT circuit).
In the CL circuit diagram, press the **ALT** button to toggle contact I1 between n/c and n/o contact.

```
Ī1--------[Q1
```

Table 14: Negation

I1	Q1
1	0
0	1

Negation (coil)

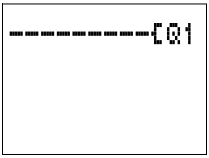


Negation means in this case that the coil opens when the n/o contact is actuated (NOT circuit).
In the CL circuit diagram example, you only change the coil function

Table 15: Negation

I1	Q1
1	0
0	1

Maintained contact

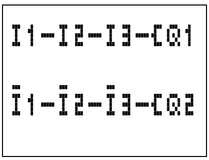


To energize a relay coil continuously, make a connection of all contact fields from the coil to the leftmost position.

Table 16: Maintained contact

---	Q1
…	1

Series circuit



Q1 is controlled by a series circuit consisting of three n/o contacts (AND circuit).

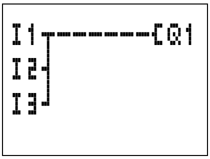
Q2 is controlled by a series circuit consisting of three n/c contacts (NOR circuit).

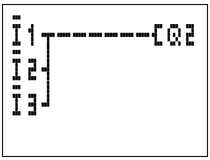
In the CL circuit diagram, you can connect up to three n/o or n/c contacts in series within a rung. Use M marker relays if you need to connect more than three n/o contacts in series.

Table 17: Series circuit

I1	I2	I3	Q1	Q2
0	0	0	0	1
0	0	1	0	0
0	1	0	0	0
0	1	1	0	0
1	0	0	0	0
1	0	1	0	0
1	1	0	0	0
1	1	1	1	0

Parallel circuit





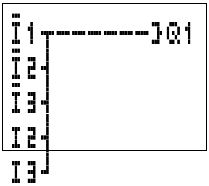
Q1 is controlled by a parallel circuit consisting of several n/o contacts (OR circuit).

A parallel circuit of n/c contacts controls Q2 (NAND circuit).

Table 18: Parallel circuit

I1	I2	I3	Q1	Q2
0	0	0	0	1
0	0	1	1	1
0	1	0	1	1
0	1	1	1	1
1	0	0	1	1
1	0	1	1	1
1	1	0	1	1
1	1	1	1	0

Parallel circuit operating like a series connection of n/o contacts



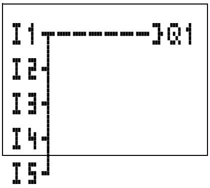
A series circuit with more than three contacts (n/o contacts) can be implemented with a parallel circuit of n/c contacts on a negated coil.

In the CL circuit diagram you can switch as many rungs in parallel as you have rungs available.

Table 19: Parallel connection of n/c contacts on a negated coil

I1	I2	I3	I4	I5	Q1
0	0	0	0	0	0
0	0	0	0	1	0
0	0	0	1	0	0
0	0	0	1	1	0
0	0	1	0	0	0
0	0	1	0	1	0
0	0	1	1	0	0
0	0	1	1	1	0
0	1	0	0	0	0
0	1	0	0	1	0
0	1	0	1	0	0
0	1	0	1	1	0
0	1	1	0	0	0
…	…	…	…	…	0
…	…	…	…	…	0
1	**1**	**1**	**1**	**1**	**1**

Parallel circuit operating like a series connection of n/c contacts



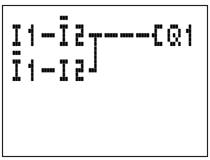
A series circuit with more than three contacts (n/c contacts) can be implemented with a parallel connection of n/o contacts on a negated coil.

In the CL circuit diagram you can switch as many rungs in parallel as you have rungs available.

Table 20: Parallel connection of n/o contacts on a negated coil

I1	I2	I3	I4	I5	Q1
0	**0**	**0**	**0**	**0**	**1**
0	0	0	0	1	0
0	0	0	1	0	0
0	0	0	1	1	0
0	0	1	0	0	0
0	0	1	0	1	0
0	0	1	1	0	0
0	0	1	1	1	0
0	1	0	0	0	0
0	1	0	0	1	0
…	…	…	…	…	0
…	…	…	…	…	0
1	1	1	1	1	0

Two-way circuit



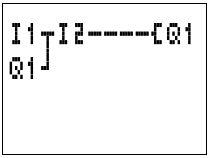
A two-way circuit is made in the logic relay using two series connections that are combined to form a parallel circuit (XOR).

An XOR circuit stands for an "E**x**clusive **Or**" circuit. The coil is only energized if one contact is activated.

Table 21: Two-way circuit (XOR)

I1	I2	Q1
0	0	0
0	1	1
1	0	1
1	1	0

Self-latching



S1 n/o contact at I1
S2 n/c contact at I2

A combination of a series and parallel connection is used to wire a latching circuit.

Latching is established by contact Q1 which is connected in parallel to I1. If I1 is actuated and reopened, the current flows via contact Q1 until I2 is actuated.

Table 22: Self-latching

I1	I2	Contact Q1	Coil Q1
0	0	0	0
0	1	0	0
1	0	0	0
1	1	0	1
0	0	1	0
0	1	1	1
1	0	1	0
1	1	1	1

Latching circuits are used to switch machines on and off. The machine is switched on at the input terminals via n/o contact S1 and is switched off via n/c contact S2.

S2 breaks the connection to the control voltage in order to switch off the machine. This ensures that the machine can be switched off, even in the event of a wire break. I2 is always closed when not actuated.

```
I1--------SQ1
Ī2--------RQ1
```

S1 n/o contact at I1
S2 n/c contact at I2

Alternatively the latching circuit can also be set up with the wire break function using the “Set” and “Reset” coil functions.

Coil Q1 latches if I1 is activated. I2 inverts the n/c contact signal of S2 and only switches if S2 is activated in order to disconnect the machine or in the event of a wire break.

Make sure that both coils are wired up in the correct order in the CL circuit diagram: first wire the S coil and then the R coil. This will ensure that the machine will be switched off when I2 is actuated, even if I1 is switched on.

Impulse relay

```
I1--------ʃQ1
```

S1 n/o contact at I1

An impulse relay is often used for controlling lighting, such as stairwell lighting.

Table 23: Impulse relay

I1	Status of Q1	Q1
0	0	0
0	1	1
1	0	1
1	1	0

Cycle pulse on rising edge

```
I1--------ʃ'Q1
```

S1 n/o contact at I1

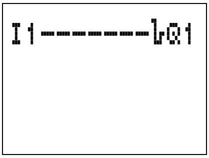
You can create a cycle pulse on a rising edge if you use the appropriate coil function.

This is very useful for count pulses, jump pulses.

Table 24: Cycle pulse on rising edge

I1	Status of Q1 cycle n	Status of Q1 cycle n + 1
0	0	0
1	1	0
0	0	0

Cycle pulse on falling edge



S1 n/o contact at I1

You can create a cycle pulse on a falling edge if you use the appropriate coil function.

This is very useful for count pulses, jump pulses.

Table 25: Cycle pulse on falling edge

I1	Status of Q1 cycle n	Status of Q1 cycle n + 1
1	0	0
0	1	0
1	0	0

Circuit examples

Star-delta starting

Two star-delta circuits can be obtained with the logic relay. The advantage of the logic relay is that you can select any changeover time between star and delta contactors and any wait time between switching off the star contactor and switching on the delta contactor.

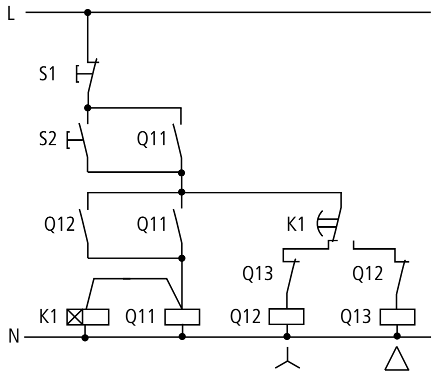


Figure 73: Star-delta circuit with conventional contactors

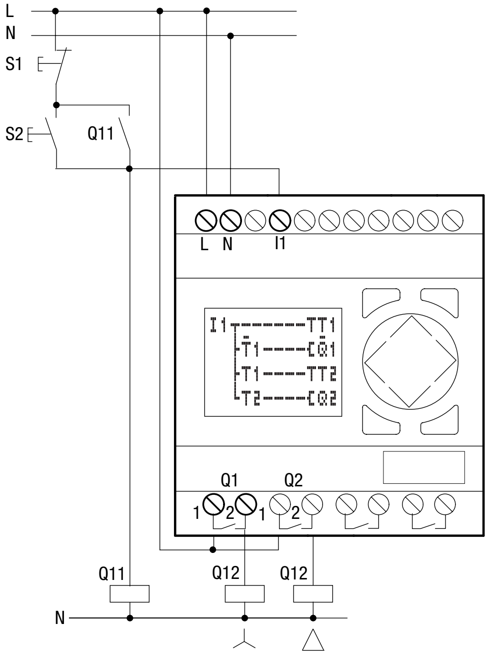
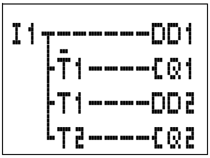


Figure 74: Star-delta circuit with the logic relay



Function of the CL circuit diagram:

Start/Stop of circuit with the external actuators S1 and S2. The mains contactor starts the timing relay in the logic relay.

- I1: Mains contactor switched on
- Q1: Star contactor ON
- Q2: Delta contactor ON
- T1: Star-delta changeover time (10 to 30 s, X)
- T2: Wait time between star off, delta on (30, 40, 50, 60 ms, X)

If your logic relay has an integral time switch, you can combine star-delta starting with the time switch function. In this case, use the logic relay to switch the mains contactor as well.

4x shift register

You can use a shift register for storing an item of information, such as for the sorting of parts into good and bad, for two, three or four transport steps further on.

A shift pulse and the value (0 or 1) to be shifted are needed for the shift register.

The shift register's reset input is used to clear any values that are no longer needed. The values in the shift register go through the register in the order: 1st, 2nd, 3rd, 4th storage location.

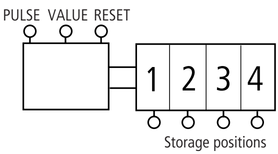


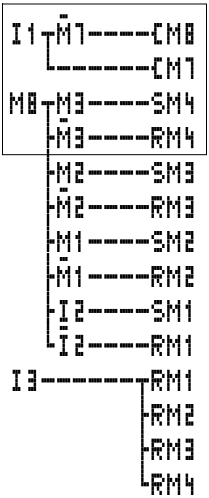
Figure 75: Block diagram of the 4x shift register

Table 26: Shift register

Pulse	Value	Storage position			
		1	2	3	4
1	1	1	0	0	0
2	0	0	1	0	0
3	0	0	0	1	0
4	1	1	0	0	1
5	0	0	1	0	0
Reset = 1		0	0	0	0

Assign the information “bad” to value 0. If the shift register is cleared accidentally, no bad parts are used further.

- I1: Shift pulse (PULSE)
- I2: Information (good/bad) to be shifted (VALUE)
- I3: Clear content of the shift register (RESET)
- M1: 1st storage location
- M2: 2nd storage location
- M3: 3rd storage location
- M4: 4th storage location
- M7: Marker relay for cycle pulse
- M8: Cyclical pulse for shift pulse



Generate shift pulse

Set 4th storage location
Clear 4th storage location
Set 3rd storage location
Clear 3rd storage location
Set 2nd storage location
Clear 2nd storage location
Set 1st storage location
Clear 1st storage location
Clear all storage locations

Figure 76: CL circuit diagram shift register

How does the shift register work?

The shift pulse is activated for exactly one cycle. To do this, the shift pulse is generated by evaluating the change from I1 OFF to I1 ON – the rising edge.

The cyclical processing of the logic relay is used to trigger the shift pulse.

When I1 is activated for the first time, the marker relay n/c contact M7 is closed during the first pass through the cycle. Thus, the series circuit consisting of I1, n/c contact M7 (closed) and M8 is activated. Although M7 is now also activated, this does not yet have any effect on contact M7.

The contact of M8 (n/o contact) was still open during the first cycle so a shift pulse cannot yet be generated. When the relay coil M8 is activated, the logic relay transfers the result to the contacts.

In the second cycle n/c contact M7 is open. The series circuit is opened. The contact M8 is activated from the result of the first cycle. Now, all the storage locations are either set or reset in accordance with the series circuit.

If the relay coils were activated, the logic relay transfers the result to the contacts. M8 is now open again. No new pulse can be formed until I1 has opened, since M7 is open for as long as I1 is closed.

How does the value reach the shift register?
When shift pulse M8 = ON, the state of I2 (VALUE) is transferred to storage location M1.

If I2 is activated, M1 is set. If I2 is deactivated, M1 is deactivated via n/c contact I2.

How is the result shifted?
The logic relay activates the coils in accordance with the rung and its result, from top to bottom. M4 assumes the value of M3 (value 0 or 1) before M3 assumes the value of M2. M3 assumes the value of M2, M2 the value of M1 and M1 the value of I2.

Why are the values not constantly overwritten?
In this example, the coils are controlled only by the S and R functions, i.e. the values are retained in on or off states even though the coil is not constantly activated. The state of the coil changes only if the rung up to the coil is activated. In this circuit, the marker relay is therefore either set or reset. The rungs of the coils (storage locations) are only activated via M8 for one cycle. The result of activating the coils is stored in the logic relay until a new pulse changes the state of the coils.

How are all the storage locations cleared?
When I3 is activated, all the R coils of storage locations M1 to M4 are reset, i.e. the coils are deactivated. Since the reset was entered at the end of the circuit diagram, the reset function has priority over the set function.

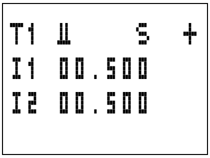
How can the value of a storage location be transferred?
Use the n/o or n/c contact of storage locations M1 to M4 and wire them to an output relay or in the circuit diagram according to the task required.

Running light

An automatic running light can be created by slightly modifying the shift register circuit.

One relay is always switched on. It starts at Q1, runs through to Q4 and then starts again at Q1.

The marker relays for storage locations M1 to M4 are replaced by relays Q1 to Q4.
The shift pulse I1 has been automated by the flasher relay T1. The cycle pulse M8 remains as it is.



On the first pass, the value is switched on once by n/c contact M9. If Q1 is set, M9 is switched on. Once Q4 (the last storage location) has been switched on, the value is passed back to Q1.

Change the times.

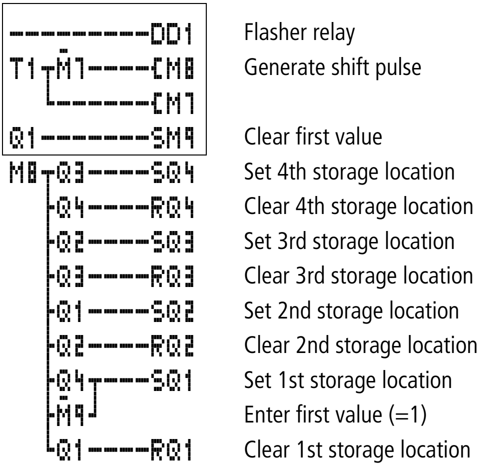


Figure 77: CL running light circuit diagram

Stairwell lighting

For a conventional circuit you would need at least five space units in the distribution board, i.e. one impulse relay, two timing relays and two auxiliary relays.

The logic relay requires only four space units. A fully functioning stairwell lighting system can be set up with five terminals and the CL circuit diagram.

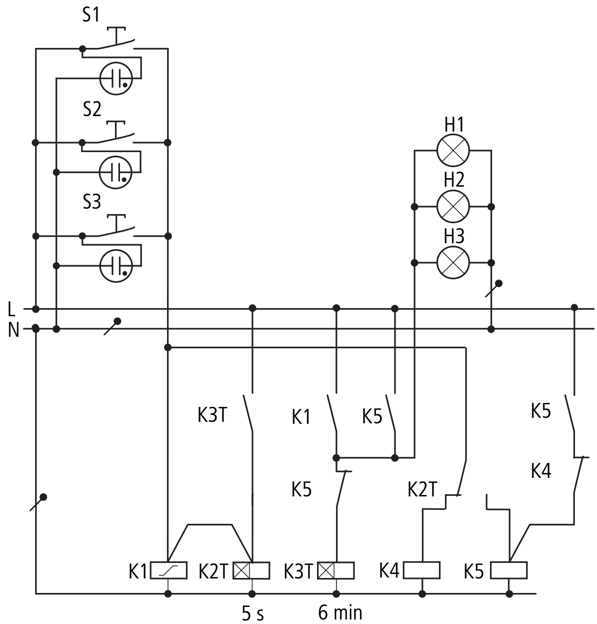


Figure 78: Conventional stairwell lighting

→ Up to twelve such stairwell circuits can be implemented with one CL device.

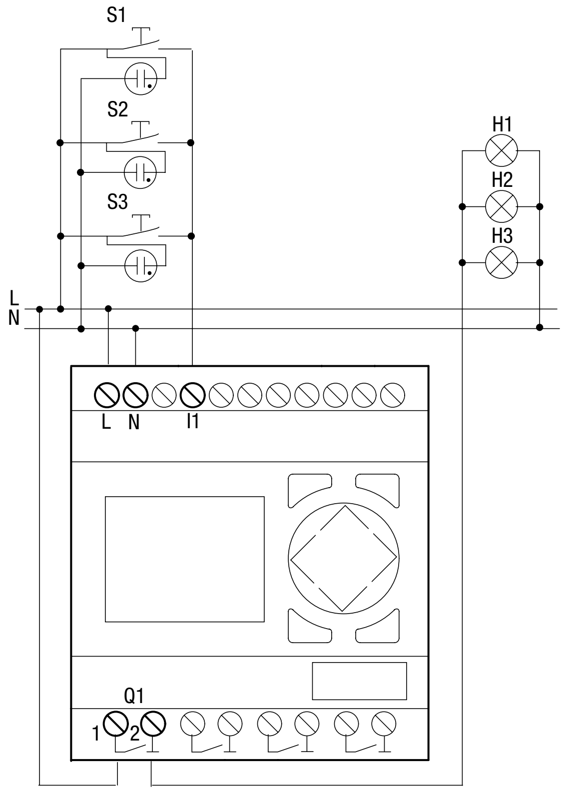


Figure 79: Stairwell lighting with the logic relay

Button pressed briefly	Light ON or OFF. The impulse relay function will even switch off continuous lighting.
	Light switches off automatically after 6 min.; with continuous lighting this function is not active.
Button pressed for more than 5 s	Continuous lighting

The CL circuit diagram for the above functions is as follows:

The enhanced CL circuit diagram: after four hours, the continuous lighting is also switched off.

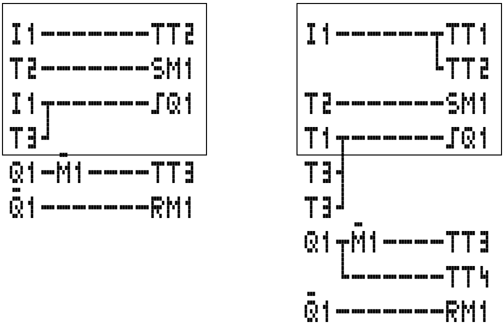


Figure 80: CL circuit diagram for stairwell lighting

Meaning of the contacts and relays used:

- I1: ON/OFF pushbutton
- Q1: Output relay for light ON/OFF
- M1: Marker relay. This is used to block the “switch off automatically after 6 minutes” function for continuous lighting.
- T1: Cycle pulse for switching Q1 on and off, (⎍, single-pulse with value 00.00 s)
- T2: Scan to determine how long the button was pressed. If pressed longer than 5 s, continuous lighting is switched on (X, on-delayed, value 5 s).
- T3: Switch off after a lighting time of 6 min. (X, on-delayed, value 06:00 min).
- T4: Switch off after 4 hours continuous lighting (X, on-delayed, value 04:00 h).

If you are using the logic relay with a time switch, you can define both the stairwell lighting and the continuous lighting periods via the time switch.

If you use the logic relay with analog inputs, you can optimise the stairwell lighting with a brightness sensor to suit the lighting conditions.

5 CL settings

All CL settings can only be carried out on models provided with keypad and LCD display.

CL-SOFT can be used to set all models via the software.

Password protection

The logic relay can be protected by a password against unauthorised access.

In this case the password consists of a value between 000001 and 999999. The number combination 000000 is used to delete a password.

→ Factory setting:

0000, no password present and none active, circuit diagram area selected.

Password protection inhibits access to selected areas. The system menu is always protected when a password is activated.

The password can protect the following entries and areas:

- Start or modification of the program
- Transfer of a circuit diagram to the memory module
- Change of the RUN or STOP mode.
- Calling and modification of function block parameters
- All settings of the real-time clock.
- Modifications of all system parameters.
- Communication with the individual device
- Disabling of the password delete function.

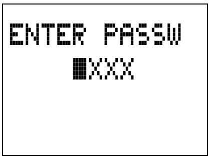
→ A password that has been entered in the logic relay is transferred to the memory module together with the circuit diagram, irrespective of whether it was activated or not.

If this CL circuit diagram is loaded back from the memory module, the password will also be transferred to the logic relay and is activated immediately.

Password setup

A password can be set up via the system menu in either RUN or STOP mode. You cannot change to the system menu if a password is already activated.

▶ Press **DEL** and **ALT** to call up the system menu.
▶ Select the menu option SECURITY… to enter the password.
▶ Press the **OK** button and move to the PASSWORD… menu.
▶ Press **OK** again to enter the Password entry mode.



If no password has been entered, the logic relay changes directly to the password display and displays four XXXX characters: No password present.

▶ Press **OK**, four zeros will appear
▶ Set the password using the cursor buttons:
– < > select position in the password,
– ∧∨ set a value between 0 to 9.

▶ Save the new password by pressing **OK**.

Use **OK** to exit the password display and proceed with **ESC** and ∨ to the RANGE… menu.

The scope of the password has not yet been defined. The password is now valid but not yet activated.

```
CIRCUIT DIAG.√ ↑
PARAMETER
CLOCK
OPRTNG MODE↓
INTERFACE
DELETE FUNCT
```

Selecting the scope of the password

▶ Press the **OK** button.

▶ Select the function or the menu to be protected.

▶ Press the **OK** button in order to protect the function or menu (tick = protected).

→ Standard protection encompasses the programs and circuit diagram.

At least one function or menu must be protected.

- CIRCUIT DIAG: The password is effective on the program with circuit diagram and non-enabled function relays.
- PARAMETER: The PARAMETER menu is protected.
- CLOCK: Date and time are protected with the password.
- OPERATING MODE: The toggling of the RUN or STOP operating mode is protected.
- INTERFACE: The interface is disabled for access with CL-SOFT.
- DELETE FUNCT: The question DELETE PROG? will appear on the device after four incorrect password entries have been made. This prompt is not displayed if selected. However, it is no longer possible to make changes in protected areas if you forget the password.

Activating the password

You can activate a valid password in three different ways:

- automatically when the logic relay is switched on again
- automatically after a protected circuit diagram is loaded
- via the password menu.

▶ Press **DEL** and **ALT** to call up the system menu.

▶ Open the password menu via the SECURITY… menu

The logic relay will only show this password menu if a password is present.

```
CHANGE PW
ACTIVATE
```

→ Make a note of your password before activating it. If the password is no longer known, the logic relay can be unlocked (DELETE FUNCT is not active), but the circuit diagram and data settings are lost. The interface must not be disabled.

Attention!
The following applies if the password is not known or is lost and the delete password function is disabled: The device can only be reset to the factory setting at the manufacturers. The program and all data will be lost.

▶ Select ACTIVATE PW and press **OK**.

The password is now active. The logic relay will automatically return to the status display.

You must unlock the logic relay with the password before you implement a protected function, enter a protected menu or the system menu.

Unlock logic relay

Unlocking the logic relay will deactivate the password. You can reactivate password protection later via the password menu or by switching the power supply off and on again.

▶ Press **OK** to switch to the main menu.

The PASSWORD… entry will flash.

```
PASSWORD...
STOP   RUN √
PASSWORD...
INFO
```

▶ Press **OK** to enter the password entry menu.

→ If the logic relay shows PROGRAM… in the main menu instead of PASSWORD…, this means that there is no password protection active.

The logic relay will display the password entry field.

```
ENTER PASSW
     XXXX
```

▶ Set the password using the cursor buttons:

▶ Confirm with **OK**.

If the password is correct, the logic relay will return automatically to the status display.
The PROGRAM… menu option is now accessible so that you can edit your circuit diagram.

```
PROGRAM...
STOP
PARAMETER
INFO
```

The system menu is also accessible.

Changing or deleting the password range

▶ Unlock the logic relay

▶ Press **DEL** and **ALT** to call up the system menu.

▶ Open the password menu via the menu option SECURITY → PASSWORD…

The CHANGE PW entry will flash.

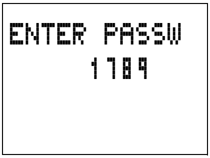
```
CHANGE PW
ACTIVATE PW
```

The logic relay will only show this menu if a password is present.

▶ Press **OK** to enter the password entry menu.

▶ Press **OK** to move to the 4-digit entry field.

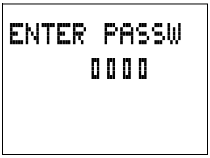
▶ Four zeros will be displayed



▶ Modify the four password digits using the cursor buttons.

▶ Confirm with **OK**.

Press **ESC** to exit the security area.



Delete

Use number combination 000000 to delete a password.

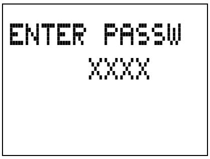
If a password has not been entered already, the logic relay will show four XXXX.

Password incorrect or no longer known

If you no longer know the exact password, you can try to re-enter the password several times.

→ The DELETE FUNCT function has not been deactivated.

Have you entered an incorrect password?



▶ Re-enter the password.

After the fourth entry attempt the logic relay will ask whether you wish to delete the circuit diagram and data.

▶ Press
- **ESC**: Circuit diagram, data or password are not deleted.
- **OK**: Circuit diagram, data and password are deleted.

The logic relay will return to the status display.

→ If you no longer know the exact password, you can press **OK** to unlock the protected logic relay. The saved circuit diagram and all function relay parameters will be lost.

Pressing **ESC** will retain the circuit diagram and data. You can then make another four attempts to enter the password.

Changing the menu language

CL-LSR/CL-LST and CL-LMR/CL-LMT provide twelve menu languages which are set as required via the system menu.

Language	**Display**
English	ENGLISH
German	DEUTSCH
French	FRANCAIS
Spanish	ESPANOL
Italian	ITALIANO
Portuguese	PORTUGUES
Dutch	NEDERLANDS
Swedish	SVENSKA
Polish	POLSKI
Turkish	TURKCE
Czech	CESKY
Hungarian	MAGYAR

→ Language selection is only possible if the logic relay is not password-protected.

▶ Press **DEL** and **ALT** to call up the system menu.

▶ Select LANGUAGE… to change the menu language.

```
ENGLISH     ↑
DEUTSCH    √
FRANCAIS
ESPANOL     ↓
ITALIANO
PORTUGUES
NEDERLANDS
SVENSKA
POLSKI
TURKCE
CESKY
MAGYAR
```

The language selection for the first entry ENGLISH is displayed.

▶ Use ⌃ or ⌄ to select the new menu language, e.g. Italian (ITALIANO).

▶ Confirm with OK. ITALIANO is assigned a tick.

▶ Exit the menu with ESC.

```
SICUREZZA
SISTEMA...
LINGUA MENU
CONFIGURA
```

The logic relay will now show the new menu language.

Press **ESC** to return to the status display.

Changing parameters

The logic relay allows you to change function relay parameters such as timing relay setpoint values and counter setpoints without having to call up the circuit diagram. This is possible regardless of whether the logic relay is running a program or is in STOP mode.

▶ Press **OK** to switch to the main menu.

▶ Start the parameter display by selecting PARAMETER.

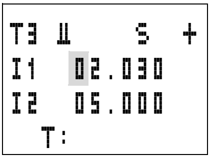
```
T3 Ш     S +
T8 X   M:S +
C4 N       +
O3         +
Ø2         +
A1 EQ      +
A3 LT      +
```

All function relays are displayed as a list.

The following preconditions must be fulfilled in order for a parameter set to be displayed:

- A function relay must have been included in the circuit diagram.
- The PARAMETER menu must be available.
- The parameter set must have been enabled for access, indicated by the + character at the bottom right of the display.

→ You can enable or disable parameter access using the “+” or “–” parameter set characters in the circuit diagram.



▶ Select the required function block with ∧ or ∨ .
▶ Press the **OK** button.
▶ Use the cursor buttons ∧ or ∨ to scroll through the parameters.
▶ Change the values for a parameter set:
- Press **OK** to enter the Entry mode,
- Press < > to change decimal place
- Press ∧∨ to change the value of a decimal place,
- Press **OK** to save constants or
- **ESC** Retain previous setting.

Press **ESC** to leave the parameter display.

Adjustable parameters for function relays

You can also modify the function relay parameters used in the circuit diagram in the PARAMETER menu.

Adjustable setpoint values are:

- With all function relays the setpoints
- On and off times with time switches.

In RUN mode the logic relay operates with a new setpoint as soon as it has been modified in the parameter display and saved with **OK**.

Example: Changing switch times for outdoor lighting
The outdoor lighting of a building is automatically switched on from 19:00 to 23:30 Mondays to Fridays in the CL circuit diagram.

```
Θ1  A  11:30  +
D      MO-FR
ON     19:00
OFF    23:30
```

The parameter set for the time switch function relay 1 is saved in channel A and looks like this.

From the following weekend, the outdoor lighting is now also required to switch on between 19:00 and 22:00 on Saturdays.

▶ Select PARAMETER from the main menu.

The first parameter set is displayed.

▶ Use ︿ or ﹀ to scroll through the parameter sets until channel A of time switch 1 is displayed.

```
Θ1  B  11:30  +
D      --
ON     00:00
OFF    00:00
```

▶ Press ︿ to select the next empty parameter set, in this case channel B of time switch 1.

The current time is 11:30.

▶ Change the value for the day interval from MO to SA:

```
Θ1  B  11:30  +
D      SA
ON     00:00
OFF    00:00
```

– 〈 〉 Move between the parameters
– ︿﹀ Change value.

▶ Press **OK** to acknowledge the value SA.

```
Θ1  B  11:30  +
D      SA
ON     19:00
OFF    00:00
```

▶ Change the ON value to 19:00.
▶ Move to the value of ON
▶ Press **OK.**
– 〈 〉 Move between the parameters
– ︿﹀ Change value.

▶ Press **OK** to acknowledge the value 19:00.

```
Θ1  B  11:30  +
D      SA
ON     19:00
OFF    22:00
```

▶ Set the switching off time to 22:00.
▶ Press **OK**.

The logic relay will save the new parameters. The cursor will remain in the contact field on channel identifier B.

Press **ESC** to leave the parameter display.

The time switch will now also switch on at 19:00 on Saturdays and switch off at 22:00.

Setting date and time

Some CL-LSR/CL-LST and CL-LMR/CL-LMT devices are provided with a real-time clock with date and time functions. Type designation CL-LSR.C.../CL-LST.C... and CL-LMR.C.../ CL-LMT.C... The time switch function relays can thus be used to implement time switch applications.

→ Factory setting:

„SA 0:01 01.05.2004“

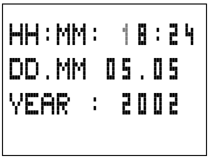
Setting the time

If the clock is not yet set or if the the logic relay is restarted after the backup time has elapsed, the clock will start with the setting “SA 0:01 01.05.2004”. The CL clock operates with date and time so that hour, minute, day, month and year have to be set.

▶ Select SET CLOCK… from the main menu.

This will open the menu for setting the time.

▶ Select SET CLOCK and confirm with **OK**.



▶ Set the values for time, day, month and year.

▶ Press the **OK** button to access the Entry mode.

- ‹ › Move between the parameters
- ˄˅ Change the value of a parameter
- **OK** Save day and time
- **ESC** Retain previous setting.

Press **ESC** to leave the time setting display.

Setting summer time start and end

Most CL models are fitted with a real-time clock. The clock has various possibilities for starting and ending the summer time (DST) setting. These are subject to different legal requirements in the EU, GB and USA.

→ Factory setting:

No automatic DST setting present

You can make the following settings:

- NONE: no DST setting rule.
- RULE: a user-defined date for the DST change.
- EU: date defined by the European Union; Start: last Sunday in March; End: last Sunday in October:
- GB: date defined in Great Britain; Start: last Sunday in March; End: fourth Sunday in October.
- US: date defined in the United States of America: Start: first Sunday in April; End: last Sunday in October.

The following applies to all legally stipulated DST settings:

Summer time start: On the day of time change, the clock moves forward one hour at 02:00 to 03:00.

Summer time end: On the day of time change, the clock moves back one hour at 03:00 to 02:00.

Select SET CLOCK… from the main menu.
This will open the menu for setting the time.

```
SET CLOCK
SUMMER TIME
```

▶ Select the SUMMER TIME menu option.

Selection of summer time start and end

The logic relay shows you the options for the DST change.

The standard setting is NONE for automatic DST changeover (Tick at NONE).

→ The start and end of summer time can only be set in STOP mode.

```
NONE      √↑
RULE...
EU
GB         ↓
US
```

▶ Select the required variant and press the **OK** button.

```
NONE       ↑
RULE...
EU         √
GB         ↓
US
```

The rule for the European Union (EU) has been selected.

Summer time start and end, setting the rule

If you wish to enter your own date, it is important to know what settings are possible.

The start and end of summer time is a complex calculation procedure throughout the world. For this reason, the standard rules for the EU, US, GB are provided in the logic relay.

The following rules normally apply:

Table 27: DST setting rule

When DAY	Weekday WD	How	Date
Rule 1: change on a special date			
--	--	--	→ Table 28
Rule 2: change on a defined day in the month			
• 1st (first) • 2nd (second) • 3rd (third) • 4th (fourth) • L. (last)	• SU (Sunday) • MO (Monday) • TU (Tuesday) • WE (Wednesday) • TH (Thursday) • FR (Friday) • SA (Saturday)	MONTH	→ Table 28 1)
Rule 3: change on a defined day after or before a date			
1st (first)	• SU (Sunday) • MO (Monday) • TU (Tuesday) • WE (Wednesday) • TH (Thursday) • FR (Friday) • SA (Saturday)	• AFTER THE • BEFORE THE	→ Table 28

1) Apart from day definitions

Table 28: Date parameters

Day DD.	Month MM	Hour HH:	Minute MM	Time difference H:M
• 1. • 2. • … • 31.	• 1 (January) • 2 (February) • … • 12 (December)	• 00 • 01 • 02 • 03 • … • 23	• 00 • 01 • 02 • 03 • 04 • … • 59	• + 03:00 • + 02:30 • + 02:00 • + 01:30 • + 01:00 • + 00:30 • – 00:30 • – 01:00 • – 01:30 • – 02:00 • – 02:30 • – 03:00

Example with EU (European Union)
End of summer time

Menu in SUMMER END:

The following rule applies:

The clock goes back one hour (-1:00) to 2:00 at 3:00 on the last Sunday in October.

Table 29: EU Summer time end

When	Weekday WD	How	Day DD.	Month MM	Hour HH:	Minute MM	Time difference H:M
DAY L. (last)	SU (Sunday)	MONTH	--	10 (October)	03	00	- 01:00

Start of summer time

Menu in logic relay SUMMER START:

The following rule applies:

The clock goes forward one hour (+1:00) to 3:00 at 2:00 on the last Sunday in March.

Table 30: EU Start of summer time

When	Weekday WD	How	Day DD.	Month MM	Hour HH:	Minute MM	Time difference H:M
DAY L. (last)	SU (Sunday)	MONTH	--	03 (March)	02	00	+ 01:00

The following start and times for summer time normally apply throughout the world (as at beginning of 2004):

Table 31: Summer time rules

Country/ Region	Summer time start	Summer time end	Start time[1)]	End time[2)]
Brazil, Rio de Janeiro	1st Sunday in November	1st Sunday after the 15th February	00:00	00:00
Chile, Santiago	1st Sunday after 8th October	1st Sunday after 8th March	00:00	00:00
USA/Antarctic, McMurdo	1st Sunday in October	1st Sunday after 15th March	02:00	02:00
Chatham Islands	1st Sunday in October	1st Sunday after 15th March	02:45	03:45
New Zealand	1st Sunday in October	1st Sunday after 15th March	02:00	03:00
Chile, Easter islands	1st Saturday after 8th October	1st Saturday after 8th March	22:00	22:00
USA/Antarctic, Palmer	1st Sunday after 9th October	1st Sunday after 9th March	00:00	00:00
Iran[3)]	1st day of Favardin	30th day of Shahrivar	00:00	00:00
Jordan	Last Thursday in March	Last Thursday in September	00:00	01:00
Israel	Special rules according to the Hebrew calendar		01:00	01:00
Australia, Howe Islands	Last Sunday in October	Last Sunday in March	02:04)	02:00
Australia	Last Sunday in October	Last Sunday in March	02:00	03:00

Country/ Region	Summer time start	Summer time end	Start time[1]	End time[2]
Georgia	Last Sunday in March	Last Sunday in October	00:00	00:00
Azerbaijan	Last Sunday in March	Last Sunday in October	01:00	01:00
Kirgistan	Last Sunday in March	Last Sunday in October	02:30	02:30
Syria	1st April	1st October	00:00	00:00
Iraq	1st April	1st October	03:00	04:00
Pakistan	1st Sunday after the 2nd April	1st Saturday in October	00:00	00:00
Namibia	1st Sunday in September	1st Sunday in April	02:00	02:00
Paraguay	1st Sunday in September	1st Sunday in April	02:00	00:00
Canada, Newfoundland	1st Sunday in April	Last Sunday in October	00:01	00:01

1) Relevant local time to which the clock should be set forward.
2) Relevant local time to which the clock should be set back.
3) Persian calendar
4) Summer time = standard time + 0.5 hours

```
NONE ↑
RULE...
EU
GB   ↓
US
```

▶ Select the RULE menu.
▶ Press the **OK** button.

```
SUMMER START
SUMMER END
```

The two SUMMER START (start of summer time) and SUMMER END (end of summer time) menus are shown.

SUMMER START: set the DST time for the start of summer.

SUMMER END: set the DST time for the end of summer.

→ If a standard rule has been selected, this will be accepted as the rule.

This menu appears for entering the required time settings:

```
DAY         L.↑
WD:         SU
          MONTH
DD.MM:--.03↓
HH:MM:00:00
DIFF: +1:00
```

- DAY – Rule for day, 1st, 2nd, 3rd, 4th, Lst.
- WD – Weekday
- MONTH – Rule 2 MONTH, AFTER, BEFORE
- DD.MM – Date, day, month
- HH:MM – Time, hour, minute
- DIFF – Time difference, summer time always + x:xx
  Time difference, winter time always - x:xx

```
SUMMER START
SUMMER END
```

Enter summer time start.

▶ Press **OK** to reach Entry mode for the summer time start rule.

The following menu appears:

```
DAY         L.↑
WD:         SU
          MONTH
DD.MM:--.03↓
HH:MM:00:00
DIFF: +1:00
```

This will open the menu for setting the time.

▶ Set the values for DST time change.

▶ Press the **OK** button to access the Entry mode.
– ⌃⌄ Select required value.
– ‹ › Move between the parameters
– ⌃⌄ Change the value of a parameter
– **OK** Save value.
– **ESC** Retain previous setting.

Press **ESC** to leave the DST setting display.

The above rule is the EU rule for the start of summer time.

→ The menu for the end of summer time has the same structure. The values are now entered accordingly.

→ The DIFF time difference value can be modified both for the summer time setting and the winter time setting. The value is always the same.

Summer time means a positive value + X:XX.

Winter time means a negative value – X:XX.

→ Behaviour on 29 February

If the time change is set for 29.02. at HH.MM, the switch time for years that are not leap years will occur on 01.03 at HH.MM.

The DST time minus the time difference should not go into 28.02. The following applies:

00:15 is put back by –30 min. New time: 28.02. 23:45

→ Behaviour for summer time end on 01.01.

If 01.01. is selected for the end of summer time, ensure the following:

The DST time minus the time difference should not go into 31.12. Otherwise the time will continue to run until the set time minus the time difference 0:00 on the 01.01. The time will then continue to run with 00:00.

→ Setting the time manually within the summer time end setting:

At 3:00 on summer time end the time is to be put back by one hour to 2:00.

The time is set to 3:05 at 1:30. The logic relay interprets this as 3:05 "Winter time". A time change will not be carried out.

Activating input delay (debounce)

Input signals are evaluated by the logic relay with an input delay. This enables, for example, the trouble-free evaluation of switches and pushbutton actuators subject to contact bounce.

→ Factory setting:

Debounce is activated.

High-speed counter functions are evaluated independently of the debounce function.

In many applications, however, very short input signals have to be monitored. In this case, the debounce function can be switched off.

▶ Press **DEL** and **ALT** to call up the system menu.
▶ Select the SYSTEM menu.

→ If the logic relay is password-protected you cannot open the system menu until you have "unlocked" it.

```
DEBOUNCE    ↑
P BUTTONS
RUN MODE
CARD MODE ↓
```

The input delay (debounce) is set with the DEBOUNCE menu item.

```
DEBOUNCE  √↑
P BUTTONS
RUN MODE
CARD MODE ↓
```

Activating debounce (input delay)

A tick √ next to DEBOUNCE indicates that this function is activated.

If this is not so, proceed as follows:

▶ Select DEBOUNCE and press **OK**.

Debounce mode will be activated and the display will show DEBOUNCE √.

Press **ESC** to return to the status display.

Deactivating debounce (input delay)

If the logic relay is showing DEBOUNCE in the display, this means that Debounce mode has already been deactivated.

▶ Otherwise select DEBOUNCE √ and press **OK**.

If Debounce mode is deactivated the display will show DEBOUNCE.

→ How the logic relay input and output signals are processed internally is explained in section "Delay times for inputs and outputs", from Page 230.

Activating and deactivating the P buttons

Even though the cursor buttons (P buttons) have been set as pushbutton actuator inputs in the circuit diagram, this function is not activated automatically. This prevents any unauthorised use of the cursor buttons. The P buttons can be activated in the system menu.

→ If the logic relay is password-protected you cannot open the system menu until you have "unlocked" it.

→ Factory setting:

The P buttons are not activated.

```
DEBOUNCE  √↑
P BUTTONS
RUN MODE
CARD MODE ↓
```

The P buttons are activated and deactivated via the P BUTTONS menu.

▶ Press **DEL** and **ALT** to call up the system menu.

▶ Select the SYSTEM menu.

▶ Move the cursor to the P BUTTONS menu.

```
DEBOUNCE  √↑
P BUTTONS  √
RUN MODE
CARD MODE ↓
```

Activating the P buttons

If the logic relay shows `P BUTTONS √` in the display, the P buttons are active.

▶ Otherwise select P BUTTONS and press **OK**.

The logic relay will then show `P BUTTONS √` and the P buttons will be activated.

▶ Press **ESC** to return to the status display.

Function of the P buttons

The P buttons are only active in the status display. In this display you can use the P buttons to activate inputs in your circuit diagram.

→ If a text is displayed, the P buttons only function if a value entry is not carried out.

Deactivating the P buttons

▶ Select `P BUTTONS √` and press **OK**.

The logic relay will then show `P BUTTONS` and the P buttons will be deactivated.

→ Deleting a circuit diagram in the logic relay will cause the P buttons to be deactivated automatically. If a circuit diagram is loaded from the memory module or from CL-SOFT, the status set there is also transferred.

Startup behaviour

The startup behaviour is an important aid during the commissioning phase. The circuit diagram which the logic relay contains is not yet fully wired up, or the system or machine is in a state which the logic relay is not permitted to control. It must not be possible to activate the outputs when the logic relay is connected to the power supply.

Setting the startup behaviour

→ The CL models without a display can only be started in RUN mode.

Requirement: the logic relay must contain a valid circuit diagram.

→ Factory setting:

RUN mode is activated.

Switch to the system menu.

→ If the logic relay is protected by a password, the system menu will not be available until is the logic relay "unlocked" (→ section "Unlock logic relay", from Page 199).

Specify the operating mode which the logic relay must use when the supply voltage is applied.

Activating RUN mode

If the logic relay displays `RUN MODE √`, this means that the logic relay will start in RUN mode when the supply voltage is applied.

▶ Otherwise select RUN MODE and press **OK**.

```
DEBOUNCE   √↑
P BUTTONS
RUN MODE    √
CARD MODE   ↓
```

RUN mode is activated.

▶ Press **ESC** to return to the status display.

```
DEBOUNCE  √↓
P BUTTONS
RUN MODE   √
CARD MODE  ↓
```

Deactivating RUN mode

▶ Select RUN MODE √ and press **OK**.

The RUN mode function is deactivated.

The default setting for the logic relay is for RUN MODE √ to be displayed. In other words, starts in RUN mode when the power is switched on.

Table 32: Startup behaviour

Startup behaviour	Menu displayed	Status of the logic relay after startup
The logic relay starts in STOP mode	RUN MODE	STOP mode
The logic relay starts in RUN mode	RUN MODE √	RUN mode

Behaviour when the circuit diagram is deleted

The startup mode setting is a CL device function. When the circuit diagram is deleted this does not result in the loss of the setting selected.

Behaviour during upload/download to memory module or PC

When a valid circuit diagram is transferred from the logic relay to a memory module or the PC or vice versa, the setting is still retained.

→ The CL models without a display can only be started in RUN mode.

Possible faults

The logic relay does not start in RUN mode:

- The logic relay does not have a program in it.
- You have selected STOP mode (RUN MODE menu).

Startup behaviour for memory module

The startup behaviour using a memory module is for applications where unskilled personnel have to change the memory module with the logic relay de-energized.

The logic relay will then only start in RUN mode if a memory module with a valid program is fitted.

If the program on the memory module is different to the program in the logic relay, the program on the module is loaded first and the logic relay starts in RUN mode.

→ Factory setting:

Card mode is not activated.

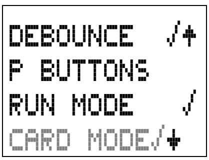
▶ Switch to the system menu.

→ If the logic relay is protected by a password, the system menu will not be available until the logic relay is "unlocked" (→ section "Unlock logic relay", from Page 199).

Activate memory module startup

If the logic relay shows RUN MODE √ in the display, it will only start up in RUN mode at power on if the memory module fitted contains a valid program.

▶ Otherwise select CARD MODE and press **OK**.



The logic relay will start up with the program on the module.

▶ Press **ESC** to return to the status display.

→ Card mode is only possible with the CL-LAS.MD003 memory module. Old MD001 or MD002 memory modules do not support this function.

```
DEBOUNCE  √+
P BUTTONS
RUN MODE   √
CARD MODE +
```

Deactivating card mode

▶ Select CARD MODE √ and press **OK**.

The Card mode function is deactivated.

The default setting for the logic relay is for CARD MODE to be displayed. In other words, the logic relay starts in RUN mode when the power is switched on.

Setting the cycle time

The logic relay allows you to fix the cycle time. To do this, move to the SYSTEM menu and from there to the CYCLE TIME… menu.

→ Factory setting:
The cycle time is set to 00 ms.

The cycle time can only be set in STOP mode.

```
P BUTTONS   +
RUN MODE    √
CARD MODE √
CYCLE-T.. .+
```

The logic relay is in STOP mode.

▶ Select CYCLE-T and press **OK**.

The following menu appears:

```
CYCLE TIME
      00 MS
```

▶ Press **OK**.

You can now enter the set cycle time.

- < > Move between the parameters
- ⋀⋁ Change value.

```
CYCLE TIME
      35 MS
```

▶ Press **OK** to acknowledge the value: e.g. 35 ms.

The set cycle time is at least 35 ms. The cycle time can be longer if the logic relay requires more time for processing the program.

→ The entry of a set cycle time is only useful in applications involving two-step controllers or similar functions.
With a cycle time setting of 00 ms, the logic relay will process the circuit diagram and the program at the fastest possible speed (see also Inside CL, cycle time).

Set cycle time value range:
between 00 and 60 ms.

Retention (non-volatile data storage)

It is a requirement of system and machine controllers for operating states or actual values to have retentive settings. What this means is that the values will be retained safely even after the supply voltage to a machine or system has been switched off and are also retained until the next time the actual value is overwritten.

→ Factory setting:

The retention function is not activated.

Permissible markers and function relays

It is possible to retentively store (non-volatile memory) the actual values (status) of markers, timing relays and up/down counters.

The following markers and function relays can be set to have retentive actual values:

- Markers: M9 to M12, M13 to M16, N9 to N16
- Up/down counters: C5 to C7, C8, C13 to C16
- Text function relays: D1 to D8
- Timing relays: T7, T8, T13 to T16

→ In order to ensure the full compatibility of CL-LSR/CL-LST and CL-LMR/CL-LMT devices with the AC010 devices, the settings for the retentive data were divided into the above areas.

Attention!
The retentive data is kept every time the power supply is switched off. Data security is assured for 1000000 write cycles.

Setting retentive behaviour

Requirement: the logic relay must be in STOP mode.

▶ Switch to the system menu.

→ If the logic relay is protected by a password, the system menu will not be available until the logic relay is "unlocked" (→ section "Unlock logic relay", from Page 199).

```
RUN MODE   √↓
CARD MODE
CYCLE-T...
RETENTION   ↓
```

▶ Switch to STOP mode.

▶ Switch to the system menu.

▶ Move to the SYSTEM menu and continue to the RETENTION… menu.

▶ Press the **OK** button.

The first screen display is the selection of the marker range.

```
M 9 - M12 √↓
M13 - M16
N 9 - N16
C 5 - C 7 √↓
C 8       √
C13 - C16
D 1 - D 8
T7
T8
T13 - T16
```

▶ ⌃⌄ Select a range.

▶ Press **OK** to select the marker, the function relay or the range that is to be retentive (tick on the line).

Press **ESC** to exit the input for the retentive ranges.

```
M 9 - M12 √↓
M13 - M16
N 9 - N16
C 5 - C 7 √↓
C 8       √
C13 - C16
D 1 - D 8
T 7       √
T 8       √
T13 - T16
```

Example:
M9 to M12, counters C5 to C7, C8 as well as timing relays T7 and T8 are retentive. Indicated by the tick on the line.

The default setting of the logic relay is selected so that no retentive data is selected. In this setting, the logic relay works without retentive actual values if a valid circuit diagram is present. When the logic relay is in STOP mode or has been switched to a de-energized state, all actual values are cleared.

Deleting retentive actual values

The retentive actual values are cleared if the following is fulfilled (applies only in STOP mode):

- The program's retentive actual values are reset to 0 when it is transferred to the logic relay from CL-SOFT or from the memory module. This also applies when there is no program on the memory module, in which case the old circuit diagram is retained in the logic relay.
- When the selected retentive markers, function relays or text display are deactivated.
- When the circuit diagram is deleted via the DELETE FUNCT menu.

The operating hours counters are always retentive. The actual values can only be reset by means of a special reset operation from the circuit diagram.

Transferring retentive behaviour

The setting for retentive behaviour is a circuit diagram setting; in other words, the retention setting is on the memory module and is transferred with the circuit diagram when uploading or downloading from the PC.

Changing the operating mode or the circuit diagram

When the operating mode is changed or the CL circuit diagram is modified, the retentive data is normally saved together with their actual values. The actual values of relays no longer being used are also retained.

Changing the operating mode
If you change from RUN to STOP and then back to RUN, the actual values of the retentive data will be retained.

Changing the CL circuit diagram
The actual values are retained if the CL circuit diagram is modified.

Attention!
Even if the markers and function relays that were selected as retentive are deleted from the circuit diagram, the retentive actual values are retained when switching from STOP to RUN or when switching the power supply off and on again. If these relays are used in the circuit diagram again, they will be assigned with the previous actual values.

Changing the startup behaviour in the SYSTEM menu

The retentive actual values in the logic relay are retained, irrespective of the RUN MODE or STOP MODE setting.

Displaying device information

The device information is provided for service tasks or in order to determine the performance level of the device.

This function is only available with devices featuring a display.

Exception: Terminal mode with the display system.

The logic relay allows you to show the following device information:

- Power supply AC1, AC2 or DC1, DC2,
- T (transistor output) or R (relay output)
- C (clock provided)
- LCD (display provided)
- OS: 1.10.204 (operating system version)
- CRC: 25825 (Checksum of the operating system is only displayed in STOP mode).
- Program name if this was assigned with CL- SOFT.

▶ Switch to the main menu.

→ The device information is always available. The password does not prevent access.

```
PROGRAM...  ↑
STOP √ RUN
PARAMETER...
INFO...     ↓
SET CLOCK..
```

▶ Select the main menu.

▶ Select the INFO.. menu with the cursor button ∨.

▶ Press the **OK** button.

```
DC TC LCD
OS: 1.00.027
CRC: 21779
PROGRAM_0815
```

This will display all device information.

Press **ESC** to exit the display.

6 Inside the logic relay

Logic relay circuit diagram cycle

In conventional control systems, a relay or contactor control processes all the rungs in parallel. The speed with which a contactor switches in this case depends on the components used, and ranges from 15 to 40 ms for relay pick-up and drop-out.

With the circuit diagram the logic relay is processed with a microprocessor that simulates the contacts and relays of the circuit concerned and thus processes all switching operations considerably faster. Depending on its size, the CL circuit diagram is processed cyclically every 2 to 40 ms.

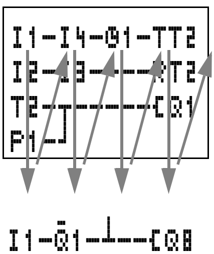
During this time, the logic relay passes through five segments in succession.

How the logic relay evaluates the circuit diagram:

Rungs Segment

1 2 3 4 5

1
2
3
4



…

In the first three segments the logic relay evaluates the contact fields in succession. The logic relay checks whether contacts are switched in parallel or in series and saves the switching states of all contact fields.

In the fourth segment, the logic relay assigns the new switching states to all the coils in one pass.

The fifth segment is outside of the circuit diagram. The logic relay uses this to contact the "outside world": output relays Q1 to Q… are switched and inputs I1 to "I…" are re-read. The logic relay also copies all new switch states to the status image.

The logic relay only uses this status image for one cycle. This ensures that each rung is evaluated with the same switching states for one cycle, even if the input signals at I1 to I12, for example, change their status several times within a cycle.

Evaluation in the circuit diagram and high-speed counter functions

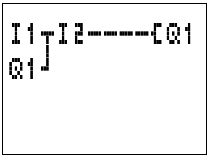
When using high-speed counter functions, the signal state is continuously counted or measured irrespective of the processing of the circuit diagram. (C13, C14 high-speed up/down counters, C15, C16 frequency counters)

CL operation and implications for circuit diagram creation

The logic relay evaluates the circuit diagram in these five segments in succession. You should therefore remember two points when you create your circuit diagrams:

- The changeover of a relay coil does not change the switching state of an associated contact until the next cycle starts.
- Always wire forwards, upwards or downwards. Never wire backwards.

Example: switching in the next cycle



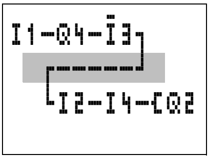
Start condition:

- I1, I2 switched on
- Q1 switched off.

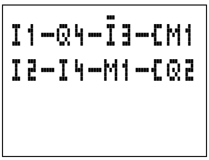
This is the circuit diagram of a self-latching circuit. If I1 and I2 are closed, the switching state of relay coil [Q1 is latched via contact Q1.

- **1st cycle**: Inputs I1 and I2 are switched on. Coil [Q1 picks up.
- Contact Q1 remains switched off since the logic relay evaluates from left to right.
- **2nd cycle**: The self-latching now becomes active. The logic relay has transferred the coil states at the end of the first cycle to contact Q1.

Example: Do not wire backwards



This example is shown in section "Creating and modifying connections". It was used there to illustrate how NOT to do it.



In the third circuit connection, the logic relay finds a connection to the second circuit connection in which the first contact field is empty. The output relay is not switched.
When wiring more than three contacts in series, use one of the marker relays.

Delay times for inputs and outputs

The time from reading the inputs and outputs to switching contacts in the circuit diagram can be set in the logic relay via the delay time.

This function is useful, for example, in order to ensure a clean switching signal despite contact bounce.

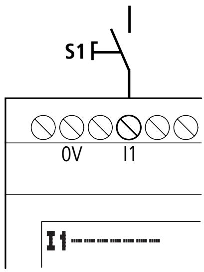


Figure 81: CL input assigned with a switch

CL-DC1, CL-DC2, CL-AC1 and CL-AC2 function with different input voltages and therefore also have different evaluation methods and delay times.

Delay times with CL-DC1 and CL-DC2 basic units

The delay time for DC signals is 20 ms.

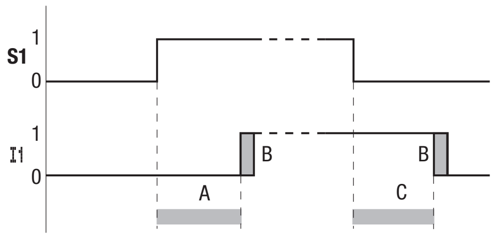


Figure 82: Delay times of CL-DC1 and CL-DC2 basic units

An input signal S1 must therefore be 15 V or 8 V (CL-DC1) for at least 20 ms on the input terminal before the switching contact will change from 0 to 1 (range A). If applicable, this time must also include the cycle time (range B) since the logic relay does not detect the signal until the start of a cycle.

The same time delay (range C) applies when the signal drops out from 1 to 0.

If the debounce is switched off, the logic relay responds to an input signal after just 0.25 ms.

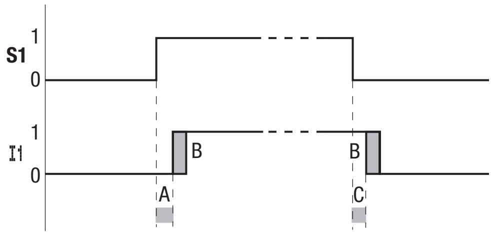


Figure 83: Switching behaviour with input debounce disabled

Typical delay times with the debounce delay switched off are:

- On-delay for I1 to I12:
  - 0.25 ms (CL-DC2),
  - 0.3 ms (CL-DC1)
- Off-delay for
  - I1 to I6 and I9 to I12: 0.4 ms (CL-DC2), 0.3 ms (CL-DC1)
  - I7 and I8: 0.2 ms (CL-DC2), 0.35 ms (CL-DC1)

→ Ensure that input signals are noise-free if the input debounce is disabled. The logic relay will even react to very short signals.

Delay time with CL-AC1 and CL-AC2 basic units

The input delay with AC voltage signals depends on the frequency. The appropriate values for 60 Hz are given in brackets.

- On-delay
  - 80 ms at 50 Hz,
  - 66 ms at 60 Hz
- Off-delay for
  - I1 to I6 and I9 to I12: 80 ms (66 ms)
  - I7 and I8: 160 ms (150 ms) with CL-AC1
  - I7 and I8: 80 ms (66 ms) with CL-AC2

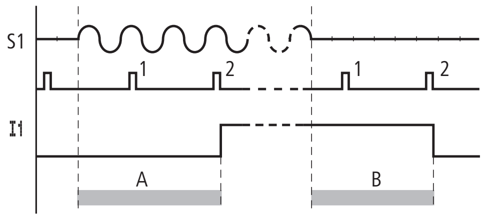


Figure 84: On-delay, CL-AC1 and CL-AC2

If the debounce delay is switched on, the logic relay checks at 40 ms (33 ms) intervals whether there is a half-wave present at an input terminal (1st and 2nd pulses in A). If the logic relay detects two pulses in succession, the device switches on the corresponding input internally.

If this is not the case, the input is switched off again as soon as the logic relay does not detect two successive half-waves (1st and 2nd pulses in B).

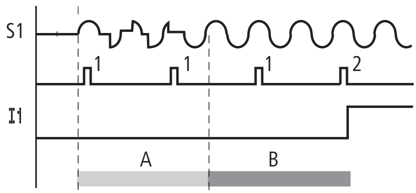


Figure 85: Pushbutton with bounce

If a button or switch bounces (A), the delay time may be extended by 40 ms (33 ms) (A).

If the debounce delay is switched off, the delay time is reduced.

- On-delay
  20 ms (16.6 ms)
- Off-delay for
  I1 to I6 and I9 to I12: 20 ms (16.6 ms)
- Off-delay for
  I7 and I8: 100 ms (100 ms) with CL-AC1, CL-AC2

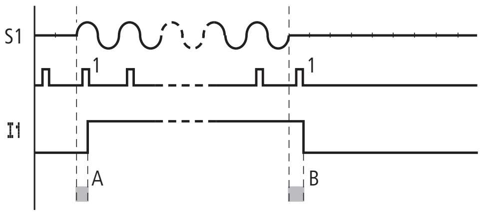


Figure 86: On- and Off-delays

The logic relay switches the contact as soon as it detects a pulse (A). If no pulse is detected, the logic relay switches off the contact (B).

→ The procedure for changing the delay times is described in section "Activating input delay (debounce)" on Page 214.

Delay times for the analog inputs CL-AC1, CL-DC1 and CL-DC2

The analog input values are read at 1 ms intervals. The values are continuously smoothed so that the analog values do not fluctuate excessively and remain clean. At the start of the circuit diagram cycle, the currently available analog values that have been smoothed are provided for processing in the circuit diagram.

Monitoring of short-circuit/ overload with CL-LST, CL-LMT and CL-LET

Depending on the CL type in use, it is possible to use the internal inputs I15 and I16, R15, R16 to monitor for short-circuits or overloads on an output.

- CL-LST:
  I16 = Group fault alarm for outputs Q1 to Q4.
- CL-LMT:
  - I16 = Group fault alarm for outputs Q1 to Q4.
  - I15 = Group fault alarm for outputs Q5 to Q8.
- CL-LET:
  - R16 = Group fault alarm for outputs S1 to S4.
  - R15 = Group fault alarm for outputs S5 to S8.

Table 33: Status of error outputs

State of outputs	Status I15 or I16, R15 or R16
No fault found	0 = switched off (n/o contact)
At least one output has a fault	1 = switched on (n/o contact)

The following examples are for I16 = Q1 to Q4. I15 indicates in the same way short-circuits and overloads on Q5 to Q8.

Example 1: Output with fault indication

```
I1-M16-----[Q1
I16--------SM16
```

The circuit diagram functions as follows:
If a transistor output reports a fault, M16 is set by I16. The n/c contact of M16 switches off output Q1. M16 can be cleared by resetting the CL power supply.

Example 2: Output of operating state

```
I1-M16----[Q1
I16------SM16
M16--------[Q4
```

The circuit functions as described in example 1. An additional feature is that when an overload is detected, the indicator light at Q4 is actuated. If Q4 has an overload, it would 'pulse'.

Example 3: Automatic reset of error signal

```
I1-M16----[Q1
I16------SM16
M16--------TT8
T8---------RM16
M16-------[Q4
```

The circuit diagram functions in the same way as example 2. In addition the marker M16 is reset every 60 seconds by timing relay T8 (on-delayed, 60 s). Should I16 remain at 1, M16 will continue to be set. Q1 is set briefly to 1 until I16 switches off again.

Expanding CL-LMR/CL-LMT

CL-LMR/CL-LMT can be expanded locally using the CL-LER.18AC2, CL-LER.18DC2, CL-LER.2O or CL-LET.20DC2 expansion modules, or remotely via the CL-LEC.CI000 coupler unit.

Install the units and connect the inputs and outputs as described (→ chapter "Installation", Page 27).

You process the inputs of the expansion devices as contacts in the CL circuit diagram in the same way as you process the inputs of the basic unit. The input contacts are assigned the operand identifiers R1 to R12.

R15 and R16 are the group fault alarms of the transistor expansion unit (→ section "Monitoring of short-circuit/ overload with CL-LST, CL-LMT and CL-LET", Page 234).

The outputs are processed as relay coils or contacts like the outputs in the basic unit. The output relays are S1 to S8.

→ CL-LER.18AC2 and CL-LER.18DC2 are provided with the outputs S1 to S6. The other outputs S7, S8 can be used as markers.

How is an expansion unit recognised?

The logic relay checks cyclically whether a device is sending data on CL-LINK.

Transfer behaviour

The input and output data of the expansion units is transferred serially in both directions. Take into account the modified reaction times of the inputs and outputs of the expansion units:

Input and output reaction times of expansion units

The debounce setting has no effect on the expansion unit.

Transfer times for input and output signals:

- **Central expansion**
  Time for inputs R1 to R12:
  30 ms + 1 cycle time
- Time for outputs S1 to S6 (S8):
  15 ms + 1 cycle
- **Remote expansion**
  Time for inputs R1 to R12:
  80 ms + 1 cycle time
- Time for outputs S1 to S6 (S8):
  40 ms + 1 cycle

Function monitoring of expansion units

If the power supply of the expansion unit is not present, no connection can be established between it and basic unit. The expansion inputs R1 to R12, R15, R16 are incorrectly processed in the basic unit and show status 0. It cannot be assured that the outputs S1 to S8 are transferred to the expansion unit.

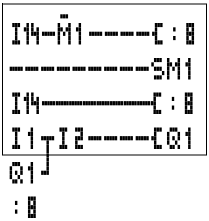
Warning!
Ensure the continuous monitoring of CL expansion devices in order to prevent switching faults in machines or systems.

The status of the internal input I14 of the basic unit indicates the status of the expansion unit:

- I14 = "0": expansion unit is functional
- I14 = "1": expansion unit is not functional

→ When the power supply is switched on, basic units and expansion devices may require different power up times to reach full functionality. If the basic unit is powered up faster, the internal monitoring input I14 will have status 1, indicating that an expansion device is not functional.

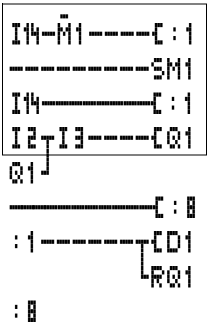
Example



The expansion unit may be powered up later than the basic unit. This means that the basic unit is switched to RUN when an expansion unit is missing. The following CL circuit diagram detects if the expansion unit is functional or not functional.

As long as I14 is 1, the remaining circuit diagram is skipped. If I14 is 0, the circuit diagram is processed. If the expansion unit drops out for any reason, the circuit diagram is skipped. M1 detects whether the circuit diagram was processed for at least one cycle after the power supply is switched on. If the circuit diagram is skipped, all the outputs retain their previous state. The next example should be used if this is not desired.

Example with LCD output and reset of the outputs



Saving and loading circuit diagrams

You can either use the logic relay interface to save circuit diagrams to a memory module or use CL-SOFT and a transmission cable to transfer them to a PC.

CL-LSR..X.../CL-LST..X..., CL-LMR..X.../CL-LMT..X...

CL models without a keypad can be loaded with a CL circuit diagram via CL-SOFT or automatically from the fitted memory module every time the power supply is switched on.

Interface

The logic relay interface is covered.

DANGER of electric shock with CL-AC units!
If the voltage terminals for phase (L) and neutral conductor (N) are reversed, the connected 230 V/115 V voltage will be present at the CL interface. There is a danger of electric shock if the plug is not properly connected or if conductive objects are inserted into the socket.

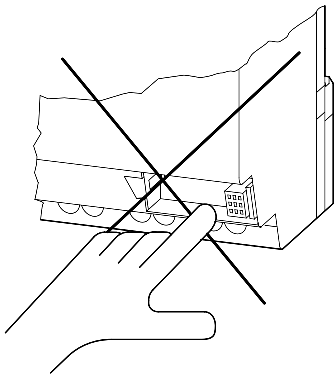


Figure 87: Do not touch the interface

▶ Carefully remove the cover with a screwdriver.

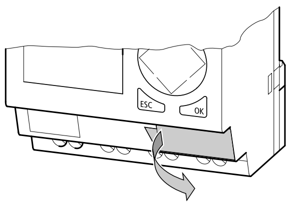


Figure 88: Remove the cover

To close the slot again, push the cover back onto the slot.

Memory module

The module is available as an accessory CL-LAS.MD003 for CL-LSR/CL-LST and CL-LMR/CL-LMT.

Compatibility of memory modules MD001 and MD002

Circuit diagrams with all the data can transferred to the CL-LSR/CL-LST and CL-LMR/CL-LMT from the MD001 and MD002 memory module. A transfer, however, in the other direction is not possible.

Each memory module saves **one** CL circuit diagram.

Information stored on the memory module is "non-volatile" and thus you can use the module to archive, transfer and copy circuit diagrams.

The memory module can be used for saving

- the circuit diagram
- all parameter sets of the function relays
- all display texts with functions
- the system settings,
  - Input delay
  - P buttons
  - Password
  - Retention on/off,
- card start
- summer time start/end time settings

▶ The memory module is fitted in the opened interface provided for it.

CL-LSR/CL-LST (CL-LAS.MD003): CL-LMR/CL-LMT (CL-LAS.MD003):

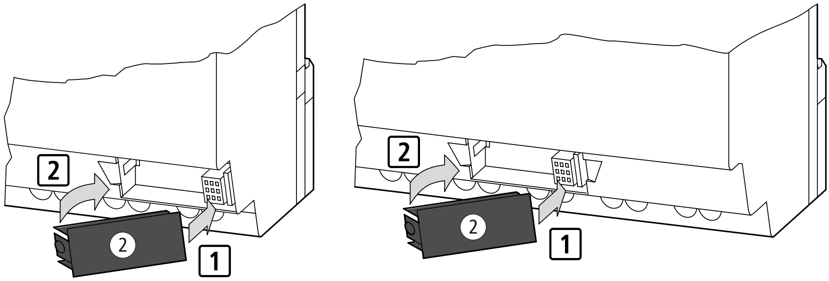


Figure 89: Insert memory module

→ With the logic relay you can insert and remove the memory module even if the power feed is switched on, without the risk of losing data.

Loading or saving circuit diagrams

You can only transfer circuit diagrams in STOP mode.

Behaviour of CL device without integrated keypad, display when loading the memory module
The CL modules without a keypad and LCD display transfer the circuit diagram from the inserted memory module to CL-LSR..X.../CL-LST..X... or CL-LMR..X.../CL-LMT..X.. when the power supply is switched on. The circuit diagram in the logic relay is retained if the circuit diagram on the memory module is invalid.

Behaviour of CL device with integrated keypad, display when memory module is inserted
If the logic relay does not contain a circuit diagram, the circuit diagram is loaded from the memory module automatically when the logic relay is switched on.

→ The memory module is detected when the module is inserted and you move from the main menu to the program menu.

As read access to MD001, MD002 and CL-LAS.MD003 modules are possible, the module can only be removed in the status display. This ensures that the correct module is always detected.

Only the CL-LAS.MD003 memory module can be written to.

▶ Switch to STOP mode.

```
PROGRAM
DELETE PROG
CARD
```

▶ Select PROGRAM… from the main menu.

▶ Select the CARD… menu option.

The CARD… menu option will only appear if you have inserted a functional memory module.
You can transfer a circuit diagram from the logic relay to the module and from the module to the CL memory or delete the content of the module.

```
DEVICE-CARD
CARD-DEVICE
DELETE CARD
```

→ If the operating voltage fails during communication with the module, repeat the last step since the logic relay may not have transferred or deleted all the data.

After transmission, remove the memory module and close the cover.

Saving a circuit diagram to the memory module

▶ Select CARD-DEVICE.

▶ Confirm the prompt with OK to delete the contents of the memory module and replace it with the CL circuit diagram.

```
REPLACE ?
```

Press ESC to cancel.

Loading a circuit diagram from the memory module

```
DEVICE-CARD
CARD-DEVICE
DELETE CARD
```

▶ Select the CARD → DEVICE menu option.

▶ Press OK to confirm the prompt if you want to delete the CL memory and replace it with the module content.

Press ESC to go back one menu.

Attention!
Once you have started the CARD → DEVICE transfer, the following operation is initiated:

- The RAM of the device is loaded from the module.
- The internal program memory is cleared.
- The data is written from the module to the internal retentive program memory.

This is carried out in blocks. A complete program is not transferred to the RAM for space reasons.

If an invalid program or an interruption occurs during the read or write operation, CL-LSR/CL-LST or CL-LMR/CL-LMT loses the program in the internal memory.

Deleting a circuit diagram on the memory module

▶ Select the DELETE CARD menu option.

```
DELETE ?
```

▶ Press **OK** to confirm the prompt and to delete the module content.

Press ESC to cancel.

CL-SOFT

CL-SOFT is a PC program with which you can create, store, test and manage CL circuit diagrams.

→ You should only transfer data between the PC and the logic relay using the special CL-PC connecting cable, which is available as an optional accessory CL-LAS.TK001.

DANGER of electric shock with CL-AC units!
Safe isolation of the interface voltage is only ensured by using the cable CL-LAS.TK001.

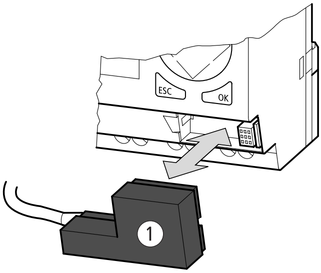


Figure 90: Inserting CL-LAS.TK001 ①

▶ Connect the PC cable to the serial PC interface.

▶ Insert the CL plug in the opened interface.

▶ Activate the status display on the logic relay.

→ The logic relay cannot exchange data with the PC while the circuit diagram display is on screen.

Use CL-SOFT to transfer circuit diagrams from your PC to the logic relay and vice versa. Switch the logic relay to RUN mode from the PC to test the program using the current wiring.

CL-SOFT provides extensive help on how to use the software.

▶ Start CL-SOFT and click on Help.

The help provides all the additional information about CL-SOFT that you will need.

INVALID PROG

If there are transmission problems, the logic relay will display the INVALID PROG message.

▶ Check whether the circuit diagram is suitable for the destination device.

→ If the operating voltage fails during communication with the PC, repeat the last step. It is possible that not all the data was transferred between the PC and the logic relay.

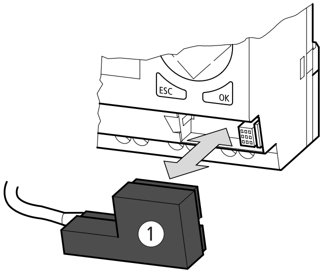


Figure 91: Pull CL-LAS.TK001 ①

▶ After transmission, remove the cable and close the cover.

Logic relay with separate display module

CL-LSR/CL-LST and CL-LMR/CL-LMT can be operated with a separate display module. In this configuration, all the display information is transferred via the CL interface.

This has the advantage that the logic relay can be operated remotely. The texts in the logic relay are backlit and displayed on the front of the operator or control panel in twice the size. The display module has the high degree of protection IP65.

When using a display module with a keypad, the logic relay can be programmed and assigned parameters “from outside”.

→ Card mode operation is not possible when using a stand-alone display module. The interface can only be used once.

The display modules CL-LDD.XK (IP65) and CL-LDD.K (IP65) with the CL-LDC.S... remote display connection modules are currently available for use as stand-alone display modules.

→ The remote display connection module CL-LDC.S... communicates continuously with the logic relay. This increases the cycle time of the logic relay and must be taken into account during engineering.

Device version

Every logic relay has the device version number printed on the left of the device housing. The device version is indicated by the first two digits of the device number.

DC 20,4 …28,8 V
3 W

01-900000042

Figure 92: Example of device version

This device is of device version 01.

The device version provides useful service information about the hardware version and the version of the operating system.The device version is important for selecting the correct logic relay for CL-SOFT.

7 What happens if …?

You may sometimes find that the logic relay does not do exactly what you expect. If this happens, read through the following notes which are intended to help you solve some of the problems you may encounter.

You can use the power flow display in the logic relay to check the logic operations in the CL circuit diagram with reference to the switching states of contacts and relays.

Only qualified persons should test the logic relay voltages while the device is in operation.

Messages from the CL system

Messages from the CL system on the LCD display	Explanation	Remedy
No display	Power supply interrupted	Switch on the power supply
	LCD is faulty	Replace logic relay
Continuous display		
TEST: AC	Self-test aborted	Replace logic relay
TEST: EEPROM		
TEST: DISPLAY		
TEST: CLOCK		
ERROR: I2C	Memory module removed or not inserted correctly before saving	Insert memory module
	Memory module is faulty	Change memory module
	Logic relay is faulty	Replace logic relay
ERROR: EEPROM	The memory for storing the retentive values or the CL circuit diagram memory is faulty.	Replace logic relay
ERROR: CLOCK	Clock error	Replace logic relay

Messages from the CL system on the LCD display	Explanation	Remedy
ERROR: LCD	LCD is faulty	Replace logic relay
ERROR: ACLOW	Incorrect AC voltage	Test the voltage
	Logic relay is faulty	Replace logic relay

Possible situations when creating circuit diagrams

Possible situations when creating circuit diagrams	Explanation	Remedy
Cannot enter contact or relay in circuit diagram	Logic relay is in RUN mode	Select STOP mode
Time switch switches at wrong times	Time or time switch parameters not correct	Check time and parameters
Message when using a memory module PROG INVALID	CL memory module without circuit diagram	Change CL type or change the circuit diagram in the memory module
	Circuit diagram on the memory module uses contacts/relays that the logic relay does not recognise	
Power flow display does not show changes to the rungs	Logic relay is in STOP mode	Select RUN mode
	Association/connection not fulfilled	Check and modify circuit diagram and parameter sets
	Relay does not activate coil	
	Incorrect parameter values/time	
	• Analog value comparison is incorrect • Time value of timing relay is incorrect • Function of timing relay is incorrect	
Relay Q or M does not energize	Relay coil has been wired up several times	Check coil field entries

Possible situations when creating circuit diagrams	Explanation	Remedy
Input not detected	Loose terminal contact	Check installation instructions, check external wiring
	No voltage to switch/button	
	Wire breakage	
	CL input is faulty	Replace logic relay
Relay output Q does not switch and activate the load	Logic relay in STOP mode	Select RUN mode
	No voltage at relay contact	Check installation instructions, check external wiring
	Logic relay power supply interrupted	
	CL circuit diagram does not activate relay output	
	Wire breakage	
	CL relay is faulty	Replace logic relay

Event

Event	Explanation	Remedy
The actual values are not being stored retentively.	Retention has not been switched on.	Switch on retention in the SYSTEM menu.
The RETENTION… menu is not displayed in the SYSTEM menu.	Logic relay is in RUN mode	Select STOP mode
The SYSTEM menu is not displayed.	This CL model does not have this menu.	Exchange logic relay if you need retention
Logic relay starts in STOP mode only	No circuit diagram in logic relay	Load, input circuit diagram
	Startup behaviour is set to the function “Startup in operating mode STOP”.	Set the startup behaviour in the SYSTEM menu.
LCD display showing nothing.	No power supply	Switch on the power supply
	Logic relay is faulty	Press the **OK** button. If no menu appears, replace the logic relay.
	Text displayed with too many spaces	Enter text or do not select
GW flashes on the status display	CL-LEC.CI000 coupler unit detected without I/O expansion.	Connect I/O expansion to external CL-LINK

Appendix

Dimensions

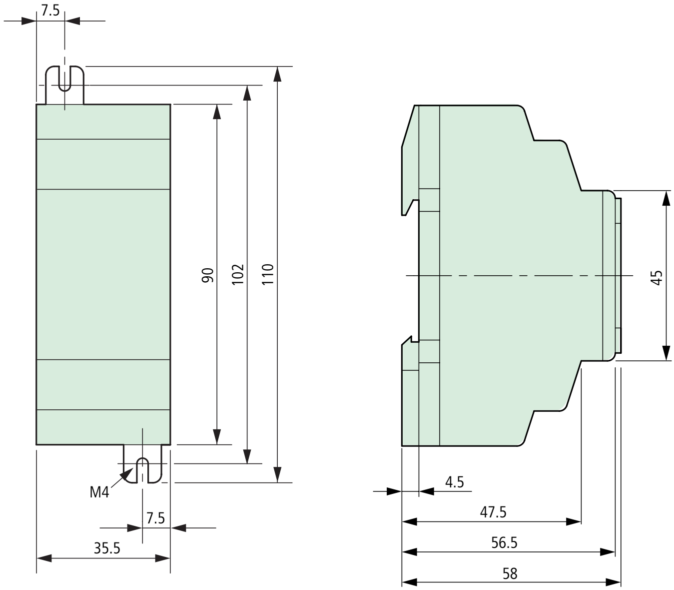


Figure 93: Dimensions CL-LEC.CI000 and CL-LER.2O in mm
(specifications in inches see table 34, page 253)

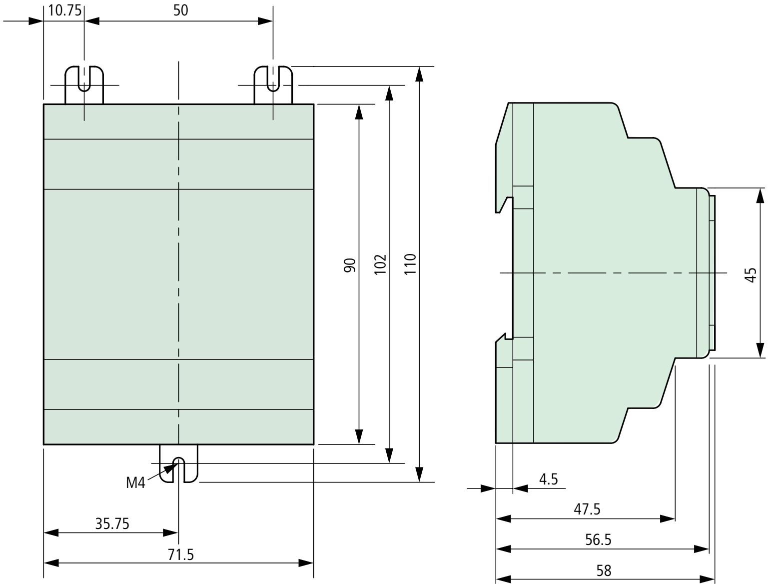


Figure 94: Dimensions CL-LSR/CL-LST in mm
(specifications in inches see table 34, page 253)

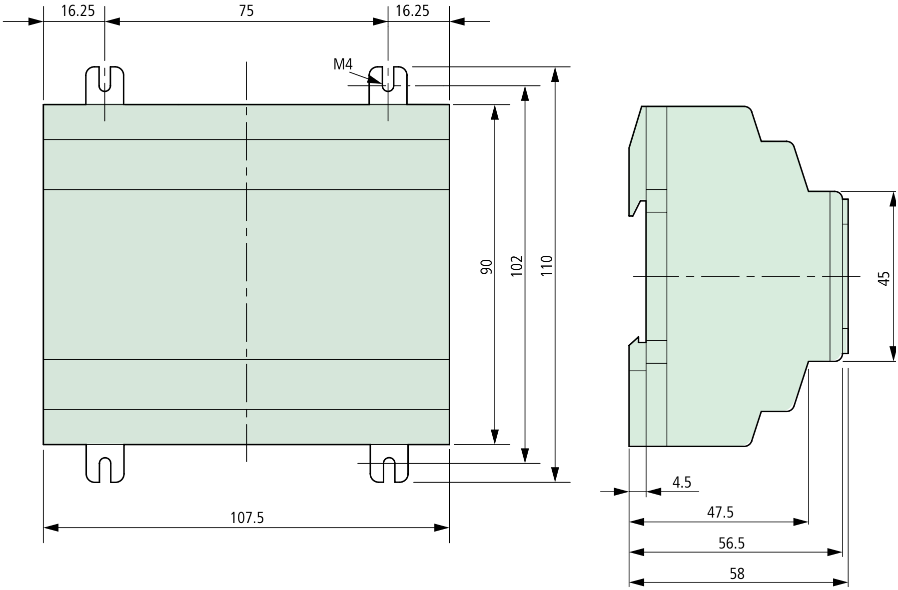


Figure 95: Dimensions CL-LMR/CL-LMT in mm (specifications in inches see table 34)

Table 34: Dimensions in inches

mm	inches	mm	inches
4.5	0.177	56.5	2.22
7.5	0.295	58	2.28
10.75	4.23	71.5	2.81
16.25	0.64	75	2.95
35.5	1.4	90	3.54
35.75	1.41	102	4.01
45	1.77	107.5	4.23
47.5	1.87	110	4.33
50	1.97		

Technical data

General

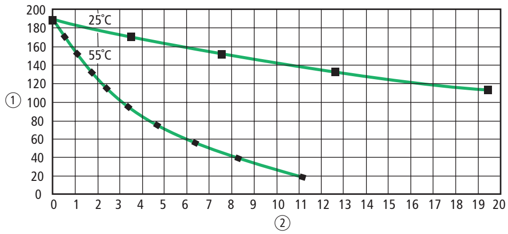
CL…

	CL-LEC.CI000 CL-LER.2O	CL-LSR, CL-LST	CL-LMR, CL-LMT
Dimensions W × H × D			
[mm]	35.5 × 90 × 56.5	71.5 × 90 × 56.5	107.5 × 90 × 56.5
[inches]	1.4 × 3.54 × 2.08	2.81 × 3.54 × 2.08	4.23 × 3.54 × 2.08
Space units (SU) width	2 SU (space units) wide	4 SU (space units) wide	6 SU (space units) wide
Weight			
[g]	70	200	300
[lb]	0.154	0.441	0.661
Mounting	Top-hat rail DIN 50022, 35 mm or screw mounting with 3 CL-LAS.FD001 fixing brackets (accessories); only 2 fixing brackets required for CL-LEC.CI000 and CL-LER.2O.		

Climatic environmental conditions (Cold to IEC 60068-2-1, Heat to IEC 60068-2-2)	
Ambient temperature during operation Installed horizontally/vertically	–25 to 55 °C, –13 to 131 °F
Condensation	Prevent condensation with suitable measures
LCD display (reliably legible)	0 to 55 °C, 32 to 131 °F
Storage/transport temperature	–40 to +70 °C, –40 to 158 °F
Relative humidity (IEC 60068-2-30)	5 to 95 %, non-condensing
Air pressure (operation)	795 to 1080 hPa
Corrosion resistance	
IEC 60068-2-42	SO_2 10 cm^3/m^3, 4 days
IEC 60068-2-43	H_2S 1 cm^3/m^3, 4 days
Inflammability class to UL 94	V 0
Ambient mechanical conditions	
Pollution degree	2
Degree of protection (EN 50178, IEC 60529, VBG4)	IP 20

Oscillations (IEC 60068-2-6)	10 to 57 Hz (constant amplitude 0.15 mm)
	57 to 150 Hz (constant acceleration 2 g)
Shock (IEC 60068-2-27)	18 shocks (semi-sinusoidal 15 g/11 ms)
Drop (IEC 60068-2-31)	Drop height 50 mm
Free fall, when packed (IEC 60068-2-32)	1 m
Electromagnetic compatibility (EMC)	
Electrostatic discharge (ESD), (IEC/EN 61 000-4-2, severity level 3)	8 kV air discharge, 6 kV contact discharge
Electromagnetic fields (RFI), (IEC/EN 61000-4-3)	Field strength 10 V/m
Emitted interference Interference immunity (EN 55011, EN 55022) IEC 61000-6-1,2,3,4	Class B
Fast transient burst (IEC/EN 61000-4-4, severity level 3)	2 kV power cables, 2 kV signal cables
High-energy pulses (surge) CL-AC (IEC/EN 61000-4-5)	2 kV power cable symmetrical
High-energy pulses (surge) CL-DC1, CL-DC2, CL-AC1 (IEC/EN 61000-4-5, severity level 2)	0.5 kV power cable symmetrical
Immunity to line-conducted interference to (IEC/EN 61000-4-6)	10 V
Insulation resistance	
Clearance and creepage distances	EN 50178, UL 508, CSA C22.2, No 142
Insulation resistance	EN 50178
Overvoltage category/degree of pollution	II/2
Tools and cable cross-sections	
solid core	min. 0.2 mm2, max. 4 mm2/AWG:22 – 12
Flexible with ferrule	min. 0.2 mm^2, max. 2.5 mm^2/ AWG: 22 – 12 Factory wiring: to AWG 30
Slot-head screwdriver, width	3.5 × 0.8 mm
Tightening torque	0.6 Nm

Backup/accuracy of real-time clock (only with CL-LSR..X.../CL-LST..X..., CL-LMR..X.../CL-LMT..X...)	
Clock battery back-up	



① = backup time in hours
② = service life in years

Accuracy of the real-time clock	Normally ± 5 s/day, ~ ±0,5 h/year
Repetition accuracy of timing relays	
Accuracy of timing relays	± 1 % of value
Resolution	
Range "s"	10 ms
Range "M:S"	1 s
Range "H:M"	1 min.
Retentive memory	
Write cycles of the retentive memory (at least)	1 000 000
Rungs (logic relay)	
CL-LSR/CL-LST, CL-LMR/CL-LMT	128

Special approvals

CSA

Hazardous Locations CLASS I Division 2 Groups A, B, C and D Temperature Code T3C –160 °C in 55 °C ambient.

Power supply

CL-LSR...AC1, CL-LMR...AC1, CL-LSR...AC2, CL-LMR...AC2

	CL-LSR...AC1, CL-LMR...AC1		**CL-LSR...AC2, CL-LMR...AC2**	
Rated value (sinusoidal)	24 V AC		100/110/115/120/230/240 V AC	
Operating range	+10/–15 % 20.4 to 26.4 V AC		+10/–15 % 85 to 264 V AC	
Frequency, rated value, tolerance	50/60 Hz, ± 5 %		50/60 Hz, ±5 %	
Input current consumption	CL-LSR...AC1	CL-LMR...AC1	CL-LSR...AC2	CL-LMR...AC2
at 115/120 V AC 60 Hz			Normally 40 mA	Normally 70 mA
at 230/240 V AC 50 Hz			Normally 20 mA	Normally 35 mA
at 24 V AC 50/60 Hz	Normally 200 mA	Normally 300 mA		
Voltage dips	20 ms, IEC/EN 61131-2		20 ms, IEC/EN 61131-2	
Power loss	CL-LSR...AC1	CL-LMR...AC1	CL-LSR...AC2	CL-LMR...AC2
at 115/120 V AC			Normally 5 VA	Normally 10 VA
at 230/240 V AC			Normally 5 VA	Normally 10 VA
at 24 V AC	Normally 5 VA	Normally 7 VA		

CL-LSR...DC1, CL-LMR...DC1, CL-LS...DC2, CL-LM...DC2

	CL-LSR...DC1, CL-LMR...DC1		**CL-LSR...DC2, CL-ST...DC2, CL-LMR...DC2, CL-LMT...-DC2**	
Rated voltage				
Nominal value	12 V DC, +30 %, –15 %		24 V DC, +20 %, –15 %	
Permissible range	10.2 to 15.6 V DC		20.4 to 28.8 V DC	
Residual ripple	≦ 5 %		≦ 5 %	
Input current at rated voltage	CL-LSR...DC1	CL-LMR...DC1	CL-LS...DC2	CL-LM...DC2
	Normally 140 mA	Normally 200 mA	Normally 80 mA	Normally 140 mA
Voltage dips	10 ms, IEC/EN 61 131-2		10 ms, IEC/EN 61 131-2	
Power loss	CL-LS...DC1	CL-LM...DC1	CL-LS...DC2	CL-LM...DC2
	Normally 2 W	Normally 3.5 W	Normally 2 W	Normally 3.5 W

Inputs

CL- LSR...AC1, CL-LMR...AC1

	CL- LSR...AC1	**CL-LMR...AC1**
Digital inputs 24 V AC		
Quantity	8	12
Status display	LCD (if provided)	LCD (if provided)
	2 inputs (I7, I8) usable as analog inputs	4 inputs (I7, I8, I11, I12) usable as analog inputs
Potential isolation		
To power supply	No	No
Between each other	No	No
To the outputs	Yes	Yes

	CL- LSR...AC1	CL-LMR...AC1
Rated voltage L (sinusoidal)	24 V AC	24 V AC
At state ″0″	0 to 6 V AC	0 to 6 V AC
At state ″1″	(I7, I8) > 8 V AC, > 11 V DC (I1 to I6, I9 to I12)14 to 26.4 V AC	(I7, I8, I11, I12) > 8 V AC, > 11 V DC (I1 to I6, I9, I10) 14 to 26.4 V AC
Rated frequency	50/60 Hz	50/60 Hz
Input current for state ″1″ I1 to I6 (CL-LMR also I9 to I10)	4 mA at 24 V AC 50 Hz	4 mA at 24 V AC 50 Hz
Input current for state ″1″ I7, I8 (CL-LMR also I11, I12)	2 mA at 24 V AC 50 Hz, 2 mA at 24 V DC	2 mA at 24 V AC 50 Hz, 2 mA at 24 V DC
Delay time for 0 to 1 and 1 to 0 for I1 to I8, CL-LMR also I9 to I12		
Debounce ON	80 ms (50 Hz), $66\frac{2}{3}$ ms (60 Hz)	80 ms (50 Hz), $66\frac{2}{3}$ ms (60 Hz)
Debounce OFF	20 ms (50 Hz), $16\frac{2}{3}$ ms (60 Hz)	20 ms (50 Hz), $16\frac{2}{3}$ ms (60 Hz)
Max. permissible cable length (per input)		
I1 to I8 (CL-LMR also I9 to I10)	Normally 40 m	Normally 40 m

CL-LSR...AC2, CL-LER.18AC2, CL-LMR...AC2

	CL-LSR...AC2	CL-LER.18AC2, CL-LMR...AC2
Digital inputs 115/230 V AC		
Quantity	8	12
Status display	LCD (if provided)	LCD (if provided)
Potential isolation		
To power supply	No	No
Between each other	No	No
To the outputs	Yes	Yes
Rated voltage L (sinusoidal)		
At signal ″0″	0 to 40 V AC	0 to 40 V AC
At signal ″1″	79 to 264 V AC	79 to 264 V AC
Rated frequency	50/60 Hz	50/60 Hz

	CL-LSR...AC2	CL-LER.18AC2, CL-LMR...AC2
Input current for state „1“ R1 to R12, I1 to I6 (CL-LMR also I9 to I12)	6 × 0.5 mA at 230 V AC 50 Hz 6 × 0.25 mA at 115 V AC 60 Hz	10 (12) × 0.5 mA at 230 V AC 50 Hz 10 (12) × 0.25 mA at 115 V AC 60 Hz
Input current for state “1” I7, I8	2 × 6 mA at 230 V AC 50 Hz, 2 × 4 mA at 115 V AC 60 Hz	2 × 6 mA at 230 V AC 50 Hz, 2 × 4 mA at 115 V AC 60 Hz
Delay time for 0 to 1 and 1 to 0 for I1 to I6, I9 to I12		
Debounce ON	80 ms (50 Hz), 66²/₃ ms (60 Hz)	80 ms (50 Hz), 66²/₃ ms (60 Hz)
Debounce OFF (also R1 to R12)	20 ms (50 Hz), 16²/₃ ms (60 Hz)	20 ms (50 Hz), 16²/₃ ms (60 Hz)
Delay time I7, I8 for 1 to 0		
Debounce ON	160 ms (50 Hz), 150 ms (60 Hz)	80 ms (50 Hz),66²/₃ ms (60 Hz)
Debounce OFF	100 ms (50 Hz/60 Hz)	20 ms (50 Hz), 16²/₃ ms (60 Hz)
Delay time I7, I8 for 0 to 1		
Debounce ON	80 ms (50 Hz), 66²/₃ ms (60 Hz)	80 ms (50 Hz), 66²/₃ ms (60 Hz)
Debounce OFF	20 ms (50 Hz), 16²/₃ ms (60 Hz)	20 ms (50 Hz), 16²/₃ ms (60 Hz)
Max. permissible cable length (per input)		
I1 to I6, R1 to R12 (CL-LMR also I9 to I12)	Normally 40 m	Normally 40 m
I7, I8	Normally 100 m	Normally 100 m

CL-LSR...DC1, CL-LMR...DC1

	CL-LSR...DC1	CL-LMR...DC1
Digital inputs		
Quantity	8	12
Inputs usable as analog inputs	I7, I8	I7, I8, I11, I12
Status display	LCD (if provided)	LCD (if provided)
Potential isolation		
To power supply	No	No
Between each other	No	No
To the outputs	Yes	Yes
Rated voltage		
Nominal value	12 V DC	12 V DC
At state "0"	4 V DC (I1 to I8)	4 V DC (I1 to I12)
At state "1"	8 V DC (I1 to I8)	8 V DC (I1 to I12)
Input current for state "1"	3.3 mA at 12 V DC (I1 to I6)	3.3 mA at 12 V DC (I1 to I6, I9 to I12)
I7, I8	1.1 mA at 12 V DC	1.1 mA at 12 V DC
Delay time for 0 to 1		
Debounce ON	20 ms	20 ms
Debounce OFF	Normally 0.3 ms (I1 to I16) Normally 0.35 ms (I7, I8)	Normally 0.3 ms (I1 to I6, I9, I10) Normally 0.35 ms (I7, I8, I11, I12)
Delay time from 1 to 0		
Debounce ON	20 ms	20 ms
Debounce OFF	Normally 0.3 ms (I1 to I16) Normally 0.15 ms (I7, I8)	Normally 0.4 ms (I1 to I6, I9 to I12) Normally 0.2 ms (I7, I8, I11, I12)
Cable length (unscreened)	100 m	100 m

CL-LS...DC2,CL-LE...DC2, CL-LM...DC2			
	CL-LSR...DC2, CL-LST...DC2	**CL-LER...DC2, CL-LET...DC2**	**CL-LMR...DC2, CL-LMT...DC2**
Digital inputs			
Quantity	8	12	12
Inputs usable as analog inputs	I7, I8		I7, I8, I11, I12
Status display	LCD (if provided)		
Potential isolation			
To power supply	No	No	No
Between each other	No	No	No
To the outputs	Yes	Yes	Yes
Rated voltage			
Nominal value	24 V DC	24 V DC	24 V DC
At state "0"	< 5 V DC (I1 to I8)	< 5 V DC (R1 to R12)	< 5 V DC (I1 to I12)
At state "1"	> 8 V DC (I7, I8)		> 8 V DC (I7, I8, I11, I12)
	> 15 V DC (I1 to I6)	> 15 V DC (R1 to R12)	> 15 V DC (I1 to I6, I9, I10)
Input current for state "1"	3.3 mA at 24 V DC (I1 to I6)	3.3 mA at 24 V DC (R1 to R12)	3.3 mA at 24 V DC (I1 to I6, I9, I10)
I7, I8 (CL-LM...DC2. also I11, I12)	2.2 mA at 24 V DC		2.2 mA at 24 V DC
Delay time for 0 to 1			
Debounce ON	20 ms	20 ms	20 ms
Debounce OFF CL-LS...DC2 I1 to I8 CL-LE...DC2 R1 to R12 CL-LM...DC2 I1 to I12	Normally 0.25 ms		

	CL-LSR...DC2, CL-LST...DC2	CL-LER...DC2, CL-LET...DC2	CL-LMR...DC2, CL-LMT...DC2
Delay time from 1 to 0			
Debounce ON	20 ms	20 ms	20 ms
Debounce OFF	• Normally 0.4 ms (I1 to I6) • Normally 0.2 ms (I7, I8)	Normally 0.4 ms (R1 to R12)	• Normally 0.4 ms (I1 to I6, I9, I10) • Normally 0.2 ms (I7, I8, I11, I12)
Cable length (unshielded)	100 m	100 m	100 m

High-speed counter inputs, I1 to I4		CL-LSR...DC1, CL-LSR...DC2, CL-LST...DC2, CL-LMR...DC1, CL-LMR...DC2, CL-LMT...DC2
Number		4
Cable length (shielded)	m	20
High-speed up and down counter		
Counting frequency	kHz	< 1
Pulse shape		Square
Pulse pause ratio		1:1
Frequency counter		
Counting frequency	kHz	< 1
Pulse shape		Square
Pulse pause ratio		1:1

	CL-LSR...AC1, CL-LSR...DC1, CL-LSR...DC2, CL-LST...DC2	CL-LMR...AC1, CL-LMR...DC1, CL-LMR...DC2, CL-LMT...DC2
Analog inputs I7, I8, I11, I12		
Quantity	2	4
Potential isolation		
To power supply	No	No
From the digital inputs	No	No
To the outputs	Yes	Yes
Input type	DC voltage	DC voltage
Signal range	0 to 10 V DC	0 to 10 V DC
Resolution analog	10 mV	10 mV
Resolution digital	0.01 (10-bit, 1 to 1023)	0.01 (10-bit, 0 to 1023)
Input impedance	11.2 kΩ	11.2 kΩ
Accuracy		
Two CL devices	± 3 % of actual value	± 3 % of actual value
Within a single device	± 2 % of actual value (I7, I8), ± 0,12 V	
Conversion time, analog/digital	Debounce ON: 20 ms Debounce OFF: every cycle	
Input current at 10 V DC	1 mA	1 mA
Cable length (shielded)	30 m	30 m

Relay outputs

CL-LSR, CL-LMR, CL-LER.18AC2, CL-LER.18DC2, CL-LER.2O

	CL-LSR	CL-LMR, CL-LER.18AC2, CL-LER.18DC2	CL-LER.2O
Quantity	4	6	2
Type of outputs	Relay		
In groups of	1	1	2
Parallel switching of outputs to increase performance	Not permissible		
Protection of an output relay	Miniature circuit-breaker B16 or 8 A fuse (slow)		
Potential isolation for mains current supply, inputs	Yes 300 V AC (safe isolation) 600 V AC (basic isolation)		
Mechanical lifespan (switching operations)	10×10^6		
Mains relays			
Conventional therm. current	8 A (10 A UL)		
Recommended for load	> 500 mA, 12 V AC/DC		
Short-circuit resistance $\cos \varphi = 1$	16 A characteristic B (B16) at 600 A		
Short-circuit resistance $\cos \varphi = 0.5$ to 0.7	16 A characteristic B (B16) at 900 A		
Rated impulse withstand voltage U_{imp} contact coil	4 kV		
Rated insulation voltage *Ui(t)*			
Rated operational voltage Ue	250 V AC		
Safe isolation to EN 50178 between coil and contact	300 V AC		
Safe isolation to EN 50178 between two contacts	300 V AC		
Making capacity			
AC-15 250 V AC, 3 A (600 Ops/h)	300000 operations		
DC-13 L/R ≦ 150 ms 24 V DC, 1 A (500 Ops/h)	200000 operations		

	CL-LSR	CL-LMR, CL-LER.18AC2, CL-LER.18DC2	CL-LER.2O
Breaking capacity			
AC-15 250 V AC, 3 A (600 Ops/h)	300 000 operations		
DC-13 L/R ≦ 150 ms 24 V DC, 1 A (500 Ops/h)	200 000 operations		
Filament bulb load	1 000 W at 230/240 V AC/25 000 operations 500 W at 115/120 V AC/25 000 operations		
Fluorescent tube with ballast	10 × 58 W at 230/240 V AC/25 000 operations		
Conventional fluorescent tube, compensated	1 × 58 W at 230/240 V AC/25 000 operations		
Fluorescent tube, uncompensated	10 × 58 W at 230/240 V AC/25 000 operations		
Operating frequency, relays			
Mechanical switching operations	10 million (1 × 10^7)		
Mechanical switching frequency	10 Hz		
Resistive lamp load	2 Hz		
Inductive load	0.5 Hz		

UL/CSA

Uninterrupted current at 240 V AC/24 V DC		10/8 A
AC	Control Circuit Rating Codes (Utilization category)	B300 Light Pilot Duty
	Max. rated operational voltage	300 V AC
	Max. uninterrupted thermal current cos φ = 1 at B 300	5 A
	Maximum make/break capacity cos φ ≠ 1 (Make/break) with B300	3600/360 VA
DC	Control Circuit Rating Codes (Utilization category)	R300 Light Pilot Duty
	Max. rated operational voltage	300 V DC
	Max. thermal uninterrupted current with R300	1 A
	Maximum apparent on/off power with R300	28/28 VA

Transistor outputs

CL-LST, CL-LMT, CL-LET.20DC2

	CL-LST	CL-LMT, CL-LET.20DC2
Number of outputs	4	8
Contacts	Semiconductors	Semiconductors
Rated voltage U_e	24 V DC	24 V DC
Permissible range	20.4 to 28.8 V DC	20.4 to 28.8 V DC
Residual ripple	≦ 5 %	≦ 5 %
Supply current		
At state "0"	Normally 9 mA, max. 16 mA	Normally 18 mA, max. 32 mA
At state "1"	Normally 12 mA, max. 22 mA	Normally 24 mA, max. 44 mA
Reverse polarity protection	Yes, Attention! If voltage is applied to the outputs when the polarity of the power supply is reversed, this will result in a short circuit.	
Potential isolation to mains supply, inputs	Yes	Yes
Rated current I_e on 1 signal	max. 0.5 A DC	max. 0.5 A DC
Lamp load	5 Watts without R_V	5 Watts without R_V
Residual current on 0 state per channel	< 0,1 mA	< 0,1 mA
Max. output voltage		
On 0 state with ext. load < 10 MΩ	2.5 V	2.5 V
On 1 state, Ie = 0.5 A	$U = U_e - 1$ V	$U = U_e - 1$ V
Short-circuit protection	Yes, thermal (analysis via diagnostics input I16, I15; R16, R15)	
Short-circuit tripping current for Ra ≦ 10 mΩ	0,7 A ≦ I_e ≦ 2 A per output	
Max. total short-circuit current	8 A	16 A
Peak short-circuit current	16 A	32 A
Thermal cutout	Yes	Yes

	CL-LST	CL-LMT, CL-LET.20DC2
Max. switching frequency with constant resistive load $R_L < 100\ k\Omega$: operations/hour	40000 (depends on program and load)	
Parallel connection of outputs with resistive load; inductive load with external suppression circuit (see page 53) Combination within a group	Group 1: Q1 to Q4	• Group 1: Q1 to Q4, S1 to S4 • Group 2: Q5 to Q8, S5 to S8
Number of outputs	max. 4	max. 4
Total maximum current	2.0 A, Attention! Outputs must be actuated simultaneously and for the same time duration.	
Status display of the outputs	LCD display (if provided)	

Inductive load (without external suppressor circuit)

General explanations:
$T_{0.95}$ = time in milliseconds until 95 % of the stationary current is reached.

$$T_{0,95} \approx 3 \times T_{0,65} = 3 \times \frac{L}{R}$$

Utilisation category in groups for:

- Q1 to Q4
- Q5 to Q8
- S1 to S4
- S5 to S8

$T_{0.95}$ = 1 ms R = 48 Ω L = 16 mH	Utilization factor		g = 0.25
	Relative duty factor	%	100
	Maximum switching frequency f = 0.5 Hz Maximum duty factor DF = 50 %	Operations/h	1 500
DC13 $T_{0.95}$ = 72 ms R = 48 Ω L = 1.15 H	Utilization factor		g = 0.25
	Relative duty factor	%	100
	Maximum switching frequency f = 0.5 Hz Maximum duty factor DF = 50 %	Operations/h	1 500
Other inductive loads:			
$T_{0.95}$ = 15 ms R = 48 Ω L = 0.24 H	Utilization factor		g = 0.25
	Relative duty factor	%	100
	Maximum switching frequency f = 0.5 Hz Maximum duty factor DF = 50 %	Operations/h	1 500
Inductive loading with external suppressor circuit for each load (→ section "Connecting transistor outputs", Page 51)			
	Utilization factor		g = 1
	Relative duty factor	%	100
	max. operating frequency Max. duty factor	Operations/h	Depending on the suppressor circuit

List of the function relays

Usable contacts

Contact type	n/o	n/c	CL-LSR/ CL-LST	CL-LMR/ CL-LMT	Page
Analog value comparator function relay	A	$\overline{A}$	A1…A16	A1…A16	98
Counter function relays	C	$\overline{C}$	C1…C16	C1…C16	111
Text display function relay	D	$\overline{D}$	D1…D16	D1…D16	131
Week time switch function relay	Ö	$\overline{Ö}$	Ö1…Ö8	Ö1…Ö8	137
CL input terminal	I	$\overline{I}$	I1…I8	I1…I12	77
0 signal			I13	I13	
Expansion status			–	I14	236
Short-circuit/overload			I16	I15…I16	234
Markers, (auxiliary relay)	M	$\overline{M}$	M1…M16	M1…M16	85
Markers (auxiliary relay)	N	$\overline{N}$	N1…N16	N1…N16	
Operating hours counter	O	$\overline{O}$	O1…O4	O1…O4	143
Cursor button	P	$\overline{P}$	P1…P4	P1…P4	82
CL output	Q	$\overline{Q}$	Q1…Q4	Q1…Q8	77
Input terminal for expansion unit	R	$\overline{R}$	–	R1…R12	77
Short-circuit/overload with expansion	R	$\overline{R}$	–	R15…R16	234
CL output (expansion or auxiliary marker S)	S	$\overline{S}$	S1…S8 (as marker)	S1…S8	85
Timer function relays	T	$\overline{T}$	T1…T16	T1…T16	148
Jump label	:	–	:1…:8	:1…:8	164
Year time switch	Y	$\overline{Y}$	Y1…Y8	Y1…Y8	167
Master reset, (central reset)	Z	$\overline{Z}$	Z1…Z3	Z1…Z3	174

Available function relays

Relay	CL display	CL-LSR/ CL-LST	CL-LMR/ CL-LMT	Coil function	Parameters
Analog value comparator function relay	A	A1...A16	A1...A16	–	✓
Counter function relays	C	C1...C16	C1...C16	✓	✓
Text marker function relay	D	D1...D16	D1...D16	✓	✓
Week time switch function relay	@	@1...@8	@1...@8	–	✓
Markers (auxiliary relay)	M	M1...M16	M1...M16	✓	–
Markers (auxiliary relay)	N	N1...N16	N1...N16	✓	–
Operating hours counter	O	O1...O4	O1...O4	✓	✓
CL output relay	Q	Q1...Q4	Q1...Q8	✓	–
CL output relay expansion, markers	S	S1...S8 (as marker)	S1...S8	✓	–
Timer function relays	T	T1...T16	T1...T16	✓	✓
Conditional jump	:	:1...:8	:1...:8	✓	–
Year time switch	Y	Y1...Y4	Y1...Y4	–	✓
Master reset (central reset)	Z	Z1...Z8	Z1...Z8	✓	–

Names of relays

Relay	Meaning of abbreviation	Function relay designation	Page
A	**A**nalog value comparator	Analog value comparator	98
C	**c**ounter	Counter	111
D	**d**isplay	Text display	131
@	(week, Software)	Week time switch	137
O	**o**perating time	Operating hours counter	143
T	**t**iming relays	Timing relay	148
Y	**y**ear	Year time switch	167
Z	**z**ero reset,	Master reset	174

Names of function relay

Function relay coil	Meaning of abbreviation	Description
C	**c**ount input	Counter input, counter
D	**d**irection input	Counter direction, counter
H	**hold, stop**	Stopping of timing relay, stop, timing relay
R	**re**set	Reset of actual value to zero, operating hours counters, counters, text displays, timing relays
T	**t**rigger	Timing coil, timing relay

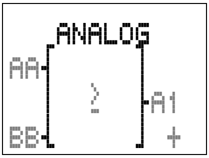
Name of function block inputs (constants, operands)

Input	Meaning of abbreviation	Description
F1	**F**actor **1**	Gain factor for I1 (I1 = F1 × Value)
F2	**F**actor **2**	Gain factor for I2 (I2 = F2 × Value)
HY	**Hy**steresis	Switching hysteresis for value I2 (Value HY applies to positive and negative hysteresis.)
D	**D**ay	Day
I1	**I**nput **1**	1st setpoint, comparison value
I2	**I**nput **2**	2nd setpoint, comparison value
S	**S**etpoint	Setpoint, limit value

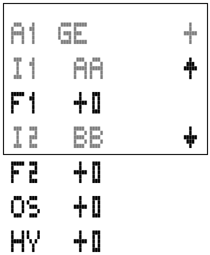
Compatibility of the function relay parameters

The functions of the CL-LSR/CL-LST and CL-LMR/CL-LMT units were extended to integrate the function relays of the AC010 units. The parameter displays were adapted for the additional functions.

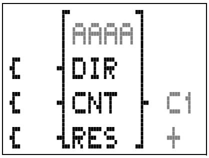
Parameter display of analog value comparator



AC010 parameter		CL-LSR/CL-LST-, CL-LMR/CL-LMT parameter
AA	=	I1 AA
BB	=	I2 BB
A1	=	A1
+	=	+
≥	=	GE

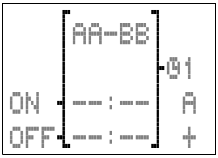


Parameter display of counters

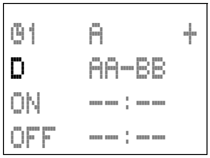


AC010 parameter		CL-LSR/CL-LST, CL-LMR/CL-LMT parameter
AAAA	=	S AAAAA
	=	
C1	=	C1
+	=	+

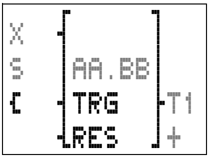
Parameter display 7-day time switch



AC010 parameter		CL-LSR/CL-LST, CL-LMR/CL-LMT parameter
B1	=	B1
AA-BB	=	AA-BB
A	=	A
ON --:--	=	ON --:--
OFF --:--	=	OFF --:--
+	=	+



Parameter display of timing relay



AC010 parameter		CL-LSR/CL-LST, CL-LMR/CL-LMT parameter
T1	=	T1
X	=	X
S	=	S
AA.BB	=	AA.BB
+	=	+

Compatibility of the memory module

Type of memory module	CL-LSR, CL-LST		CL-LMR, CL-LMT	
	Reading	Writing	Reading	Writing
MD001	✓	–	✓	–
MD002	–	–	✓	–
CL-LAS.MD003	✓	✓	✓	✓

Glossary

Analog input

The CL-AC1, CL-DC1 and CL-DC2 devices are provided with the two (CL-LSR/CL-LST) or four (CL-LMR/CL-LMT) analog inputs I7, I8 and I11, I12. The input voltages are between 0 V and 10 V. The measuring data is evaluated with the integrated function relays.

Circuit diagram elements

As in conventional wiring, the circuit diagram is made up of circuit elements. These include input, output and marker relays, plus function relays and P buttons.

Connect mode

Connect mode is used to wire up the circuit elements in your CL circuit diagram.

Contact behaviour

The contact behaviour of any circuit element can be defined as either a n/c contact or a n/o contact. n/c contact elements are identified by a line above the identifier (Exception: jump).

Decentralized expansion

I/O expansion with the expansion device (e.g. CL-LET.20DC2) is installed up to 30 m away from the basic unit. The CL-LEC.CI000 coupler is fitted centrally on the basic unit. A two-wire cable is used to exchange the input and output data between the expansion device and the basic unit.

Entry mode

Entry mode is used to input or modify values when creating circuit diagrams or setting parameters, for example.

Function relay

Function relays can be used for complex control tasks. The logic relay features the following function relays:

- Timing relay
- 7-day time switch
- Year time switch
- Counter, up/down, high-speed, frequency
- Analog value comparator/threshold value switch
- Operating hours counter
- Master reset
- Text marker relay

Impulse relay

An impulse relay is a relay which changes its switching state and retains its new state (latched) when a voltage is applied to the relay coil for a short time.

Input

The inputs are used to connect up external contacts. In the circuit diagram, inputs are evaluated via contacts I1 to I12 and R1 to R12.

CL-AC1, CL-DC1 and CL-DC2 can receive additional analog data via the inputs I7, I8 and I11, I 12.

Interface

The CL interface is used to exchange and save circuit diagrams to a memory module or PC.

A memory module stores a circuit diagram and the CL settings.

The CL-SOFT PC software allows you to control the logic relay from the PC. For this the PC and the logic relay are connected via the CL-LAS.TD001 cable.

Local expansion

I/O expansion with the expansion device (e.g. CL-LET.20DC2) is installed directly on the basic unit. The connector is always supplied with the expansion unit.

Memory module

The memory module is used to store your CL circuit diagram, together with its parameter and CL settings. The data on the memory module will be retained without an external power supply.

The memory module is fitted in the interface provided for it.

Non-volatile data

See Retention.

Operating buttons

The logic relay has eight operating buttons. These are used to select menu functions and create circuit diagrams. The large round button in the middle is used to move the cursor.

DEL, **ALT**, **ESC** and **OK** all perform additional functions.

Operating mode

The logic relay has two operating modes: RUN and STOP. RUN mode is used to process your CL circuit diagram (with the controller running continuously). In STOP mode you can create your circuit diagrams.

Output

You can connect various loads to the logic relay outputs, such as contactors, lamps or and motors. In the circuit diagram the outputs are controlled via the corresponding output relay coils Q1 to Q8 or S1 to S8.

Parameter

Parameters enable the user to set the behaviour of function relays. The relevant parameters apply for switch times or counter setpoints. They are set in the parameter display.

P buttons

The P buttons can be used to simulate four additional inputs which are controlled directly by the four cursor buttons, rather than via external contacts. The switching contacts of P buttons are connected up in the circuit diagram.

Power supply

CL-AC1 is powered by AC voltage at 24 V AC. The terminal designations are “L” and “N”.

CL-AC2 is powered by AC voltage at 85 to 264 V AC, 50/60 Hz. The terminals are labelled with “L” and “N”.

CL-DC1 is powered by DC voltage at 12 V DC. The terminals are labelled “+12 V” and “0 V”.

CL-DC2 is powered by DC voltage at 24 V DC. The terminals are labelled “+24 V” and “0 V”.

The terminals for the power feed are the first three terminals on the input side.

Retention

Data is retained even after the logic relay power supply is switched off. (retentive data)

The following data is retentive:

- CL circuit diagram
- Parameters, setpoint values
- Texts
- System settings
- Password
- Actual values of marker relays, timing relays, counters (selectable)

Rung

Each line in the circuit diagram is a rung. CL-LSR/CL-LST and CL-LMR/CL-LMT can take 128 rungs.

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ABB STOTZ-KONTAKT GmbH
Electrification Products Division
Low Voltage Products and Systems
Eppelheimer Strasse 82
69123 Heidelberg, Germany

abb.com/lowvoltage

1SVC 440 795 M0100 Rev. B (10/2018)