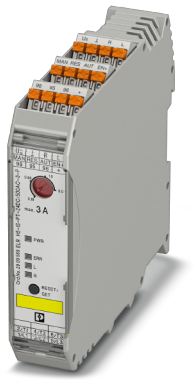
COMPLETE line

ELR H5-IS-xx- 24DC/500AC-x-P

Hybrid motor starter (CONTACTRON)



Data sheet
108037_en_04

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1 Description

The modular 3-phase hybrid motor starter with reversing function and current monitoring provides the following functions.

- Forward running for single- and three-phase motors
- Reverse running for three-phase motors
- Motor overload protection
- Emergency stop to performance level PLe (TÜV certified)

Using the DIN rail connector (Item No. 2908702) provides additional advantages:

- Emergency stop of the enable signal is also possible via the DIN rail connector, e. g. via a safety relay (PSR-MC38...) or safe controller
- Power can also be supplied via the DIN rail connector by a system power supply (e.g., QUINT4-SYS-PS/1AC/24DC/2.5/SC, item no. 2904614) or an IMC 1,5/5-ST-3,81 PCB connector (item no. 1857919)
- Use of contact extensions on the right side of the hybrid motor starter via an optional relay module (e. g. EM-2RSC/21AU-R/L-P, Item No.: 2908701) that supplies additional status information

The amount of cabling required is reduced to a minimum by the internal locking circuit and the load wiring.

Make sure you always use the latest documentation.
It can be downloaded from the product at phoenixcontact.com/products.

This document is valid for the products listed in the “Ordering data” chapter.

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3 Ordering data

Description	Type	Item no.	Pcs./Pkt.
Hybrid motor starter as an alternative to a conventional reversing contactor. Reverses 3~ AC motors up to 3 A, provides motor protection and emergency stop up to SIL 3/PL e. Group shut-down, supply, and relay extension possible via DIN rail connector.	ELR H5-IS-PT- 24DC/500AC-3-P	2909569	1
Hybrid motor starter as an alternative to a conventional reversing contactor. Reverses 3~ AC motors up to 9 A, provides motor protection and emergency stop up to SIL 3/PL e. Group shut-down, supply, and relay extension possible via DIN rail connector.	ELR H5-IS-PT- 24DC/500AC-9-P	2909567	1
Pseudoknoten für Neuheitenbroschüre, wenn in einer Spalte kein Produkt angezeigt werden soll	-	-	
Hybrid motor starter as an alternative to a conventional reversing contactor. Reverses 3~ AC motors up to 3 A, provides motor protection and emergency stop up to SIL 3/PL e. Group shut-down, supply, and relay extension possible via DIN rail connector.	ELR H5-IS-SC- 24DC/500AC-3-P	2908699	1
Hybrid motor starter as an alternative to a conventional reversing contactor. Reverses 3~ AC motors up to 9 A, provides motor protection and emergency stop up to SIL 3 / PL e. Group shut-down, supply, and relay extension possible via DIN rail connector.	ELR H5-IS-SC- 24DC/500AC-9-P	2908697	1

Accessories	Type	Item no.	Pcs./Pkt.
Plastic label, Card, white, unlabeled, can be labeled with: BLUEMARK ID COLOR, BLUEMARK ID, THERMOMARK PRIME, THERMOMARK CARD 2.0, THERMOMARK CARD, mounting type: adhesive, lettering field size: 15 x 5 mm, Number of individual labels: 189	US-EMLP (15X5)	0828790	10
Plastic label, Sheet, white, unlabeled, can be labeled with: BLUEMARK ID COLOR, BLUEMARK ID, BLUEMARK CLED, PLOTMARK, CMS-P1-PLOTTER, mounting type: adhesive, lettering field size: 15 x 5 mm, Number of individual labels: 10	UC-EMLP (15X5)	0819301	10
3-phase loop bridge for 1 CONTACTRON module, with Push-in connection and 22.5 mm housing width, connecting cable: 3 m	BRIDGE-PT 1	1161777	1
3-phase loop bridge for 2 CONTACTRON modules, with Push-in connection and 22.5 mm housing width, connecting cable: 3 m	BRIDGE-PT 2	2904490	1
3-phase loop bridge for 3 CONTACTRON modules, with Push-in connection and 22.5 mm housing width, connecting cable: 3 m	BRIDGE-PT 3	2904491	1

Accessories	Type	Item no.	Pcs./Pkt.
3-phase loop bridge for 4 CONTACTRON modules, with Push-in connection and 22.5 mm housing width, connecting cable: 3 m	BRIDGE-PT 4	2904492	1
3-phase loop bridge for 5 CONTACTRON modules, with Push-in connection and 22.5 mm housing width, connecting cable: 3 m	BRIDGE-PT 5	2904493	1
3-phase loop bridge for 6 CONTACTRON modules, with Push-in connection and 22.5 mm housing width, connecting cable: 3 m	BRIDGE-PT 6	2904494	1
3-phase loop bridge for 7 CONTACTRON modules, with Push-in connection and 22.5 mm housing width, connecting cable: 3 m	BRIDGE-PT 7	2904495	1
3-phase loop bridge for 8 CONTACTRON modules, with Push-in connection and 22.5 mm housing width, connecting cable: 3 m	BRIDGE-PT 8	2904496	1
3-phase loop bridge for 9 CONTACTRON modules, with Push-in connection and 22.5 mm housing width, connecting cable: 3 m	BRIDGE-PT 9	2904497	1
3-phase loop bridge for 10 CONTACTRON modules, with Push-in connection and 22.5 mm housing width, connecting cable: 3 m	BRIDGE-PT 10	2904498	1
3-phase loop bridge for 1 CONTACTRON module, with Push-in connection and 22.5 mm housing width, connecting cable: 1 m	BRIDGE-PT 1-1M	1161778	1
3-phase loop bridge for 2 CONTACTRON modules, with Push-in connection and 22.5 mm housing width, connecting cable: 1 m	BRIDGE-PT-2-1M	1049407	1
3-phase loop bridge for 3 CONTACTRON modules, with Push-in connection and 22.5 mm housing width, connecting cable: 1 m	BRIDGE-PT-3-1M	1049408	1
3-phase loop bridge for 4 CONTACTRON modules, with Push-in connection and 22.5 mm housing width, connecting cable: 1 m	BRIDGE-PT-4-1M	1049409	1
3-phase loop bridge for 5 CONTACTRON modules, with Push-in connection and 22.5 mm housing width, connecting cable: 1 m	BRIDGE-PT-5-1M	1049413	1
3-phase loop bridge for 2 CONTACTRON modules, with Push-in connection and 22.5 mm housing width, cable length between the modules: 0.3 m, connecting cable: 2 m	BRIDGE-PT-2-2M/0,3M	1107649	1
3-phase loop bridge for 3 CONTACTRON modules, with Push-in connection and 22.5 mm housing width, cable length between the modules: 0.3 m, connecting cable: 2 m	BRIDGE-PT-3-2M/0,3M	1107650	1
3-phase loop bridge for 4 CONTACTRON modules, with Push-in connection and 22.5 mm housing width, cable length between the modules: 0.3 m, connecting cable: 2 m	BRIDGE-PT-4-2M/0,3M	1107644	1

Accessories	Type	Item no.	Pcs./Pkt.
3-phase loop bridge for CONTACTRON modules, with screw connection and 22.5 mm housing width, connecting cable: 0.3 m, with ferrules.	BRIDGE- 2	2900746	1
3-phase loop bridge for 3 CONTACTRON modules, with screw connection and 22.5 mm housing width, connecting cable: 0.3 m, with ferrules.	BRIDGE- 3	2900747	1
3-phase loop bridge for 4 CONTACTRON modules, with screw connection and 22.5 mm housing width, connecting cable: 0.3 m, with ferrules.	BRIDGE- 4	2900748	1
3-phase loop bridge for 5 CONTACTRON modules, with screw connection and 22.5 mm housing width, connecting cable: 0.3 m, with ferrules.	BRIDGE- 5	2900749	1
3-phase loop bridge for 6 CONTACTRON modules, with screw connection and 22.5 mm housing width, connecting cable: 0.3 m, with ferrules.	BRIDGE- 6	2900750	1
3-phase loop bridge for 7 CONTACTRON modules, with screw connection and 22.5 mm housing width, connecting cable: 0.3 m, with ferrules.	BRIDGE- 7	2900751	1
3-phase loop bridge for 8 CONTACTRON modules, with screw connection and 22.5 mm housing width, connecting cable: 0.3 m, with ferrules.	BRIDGE- 8	2900752	1
3-phase loop bridge for 9 CONTACTRON modules, with screw connection and 22.5 mm housing width, connecting cable: 0.3 m, with ferrules.	BRIDGE- 9	2900753	1
3-phase loop bridge for 10 CONTACTRON modules, with screw connection and 22.5 mm housing width, connecting cable: 0.3 m, with ferrules.	BRIDGE-10	2900754	1
3-phase loop bridge for 2 CONTACTRON modules, with screw connection and 22.5 mm housing width, connecting cable: 1 m	BRIDGE- 2-1M	2901542	1
3-phase loop bridge for 3 CONTACTRON modules, with screw connection and 22.5 mm housing width, connecting cable: 1 m	BRIDGE- 3-1M	2901655	1
3-phase loop bridge for 4 CONTACTRON modules, with screw connection and 22.5 mm housing width, connecting cable: 1 m	BRIDGE- 4-1M	2901658	1
3-phase loop bridge for 5 CONTACTRON modules, with screw connection and 22.5 mm housing width, connecting cable: 1 m	BRIDGE- 5-1M	2901544	1
3-phase loop bridge for 6 CONTACTRON modules, with screw connection and 22.5 mm housing width, connecting cable: 1 m	BRIDGE- 6-1M	2901649	1
3-phase loop bridge for 2 CONTACTRON modules, with screw connection and 22.5 mm housing width, connecting cable: 3 m	BRIDGE- 2-3M	2901543	1
3-phase loop bridge for 3 CONTACTRON modules, with screw connection and 22.5 mm housing width, connecting cable: 3 m	BRIDGE- 3-3M	2901656	1

Accessories	Type	Item no.	Pcs./Pkt.
3-phase loop bridge for 4 CONTACTRON modules, with screw connection and 22.5 mm housing width, connecting cable: 3 m	BRIDGE- 4-3M	2901659	1
3-phase loop bridge for 5 CONTACTRON modules, with screw connection and 22.5 mm housing width, connecting cable: 3 m	BRIDGE- 5-3M	2901545	1
3-phase loop bridge for 6 CONTACTRON modules, with screw connection and 22.5 mm housing width, connecting cable: 3 m	BRIDGE- 6-3M	2901697	1
3-phase loop bridge for 7 CONTACTRON modules, with screw connection and 22.5 mm housing width, connecting cable: 3 m	BRIDGE- 7-3M	2901698	1
3-phase loop bridge for 8 CONTACTRON modules, with screw connection and 22.5 mm housing width, connecting cable: 3 m	BRIDGE- 8-3M	2901700	1
3-phase loop bridge for 9 CONTACTRON modules, with screw connection and 22.5 mm housing width, connecting cable: 3 m	BRIDGE- 9-3M	2901701	1
3-phase loop bridge for 10 CONTACTRON modules, with screw connection and 22.5 mm housing width, connecting cable: 3 m	BRIDGE-10-3M	2901702	1
3-phase loop bridge for 2 CONTACTRON modules, with screw connection and 22.5 mm housing width, cable length between the modules: 0.3 m, connecting cable: 2 m	BRIDGE- 2- 2M/0,3M	2909897	1
3-phase loop bridge for 3 CONTACTRON modules, with screw connection and 22.5 mm housing width, cable length between the modules: 0.3 m, connecting cable: 2 m	BRIDGE- 3- 2M/0,3M	2909898	1
3-phase loop bridge for 4 CONTACTRON modules, with screw connection and 22.5 mm housing width, cable length between the modules: 0.3 m, connecting cable: 2 m	BRIDGE- 4- 2M/0,3M	2909899	1
Primary-switched power supply, QUINT POWER, screw connection, DIN rail mounting, supply of devices possible via the TBUS DIN rail connector, protective coating, input: single-phase, output: 24 V DC/2.5 A	QUINT4-SYS-PS/1AC/24DC/ 2.5/SC	2904614	1
DIN rail connector for DIN rail mounting. Universal for TBUS housing. Gold-plated contacts, 5-pos.	ME 17,5 TBUS 1,5/ 5-ST-3,81 GN	2709561	10
Relay extension module for ELR-...-P hybrid motor starters, feedback of forward and reverse running when control signal is present, screw connection, DIN rail connector included	EM-2RSC/21AU-R/L-P	2908701	1
Relay extension module for ELR-...-P hybrid motor starters, feedback of forward and reverse running when control signal is present, Push-in connection, DIN rail connector included	EM-2RPT/21AU-R/L-P	2909573	1

Accessories	Type	Item no.	Pcs./Pkt.
Special DIN rail connector only suitable for CONTACTRON pro modular hybrid motor starters (ELR H...-P and EM-...-P). Pack contains 10 DIN rail connectors.	ELR-TBUS-22,5-P	2908702	10
Safety relay for emergency stop, safety doors and light grids up to SIL 3, Cat. 4, PL e, 1- or 2-channel operation, automatic or manual, monitored start, 2 enabling current paths, 1 signal output, TBUS interface, U_S = 24 V DC, pluggable screw terminal block	PSR-MC38-2NO-1DO-24DC-SC	1009831	1
Safety relay for emergency stop, safety doors and light grids up to SIL 3, Cat. 4, PL e, 1- or 2-channel operation, automatic or manual, monitored start, 2 enabling current paths, 1 signal output, TBUS interface, U_S = 24 V DC, pluggable push-in terminal	PSR-MC38-2NO-1DO-24DC-PI	1009832	1
DIN rail connector for safety switching devices, for supplying/controlling/monitoring (depending on the module)	PSR-TBUS	2890425	50
DIN rail connector for safety switching devices, for supplying/controlling/monitoring (depending on the module)	PSR-TBUS - 1PCS	1326060	1
PCB connector, nominal cross section: 1.5 mm², color: green, nominal current: 8 A, rated voltage (III/2): 160 V, contact surface: Tin, contact connection type: Socket, number of potentials: 5, number of rows: 1, number of positions: 5, number of connections: 5, product range: MC 1,5/..-ST, pitch: 3.81 mm, connection method: Screw connection with tension sleeve, screw head form: L Slotted, conductor/PCB connection direction: 0 °, plug-in system: COMBICON MC 1,5, locking: without, mounting: without, type of packaging: packed in cardboard	MC 1,5/ 5-ST-3,81	1803604	250
PCB connector, nominal cross section: 1.5 mm², color: green, nominal current: 8 A, rated voltage (III/2): 160 V, contact surface: Tin, contact connection type: Pin, number of potentials: 5, number of rows: 1, number of positions: 5, number of connections: 5, product range: IMC 1,5/..-ST, pitch: 3.81 mm, connection method: Screw connection with tension sleeve, screw head form: L Slotted, conductor/PCB connection direction: 0 °, plug-in system: COMBICON MC 1,5, locking: without, mounting: without, type of packaging: packed in cardboard	IMC 1,5/ 5-ST-3,81	1857919	50

4 Technical data

Device supply	
Rated control circuit supply voltage U_S	24 V DC
Control supply voltage range	19.2 V DC ... 30 V DC
Rated control supply current I_S	60 mA
Protective circuit	Surge protection Reverse polarity protection
Control input: right/left and enable input	
Rated actuating voltage U_C	24 V DC
Rated actuating current I_C	7 mA
Switching threshold	9.6 V (“0” signal) 19.2 V (“1” signal)
Switching level	< 5 V DC (For EMERGENCY STOP)
Typical turn-off time	< 30 ms
Protective circuit	Reverse polarity protection
AC output	
Rated operating voltage U_e	500 V AC (50/60 Hz)
Operating voltage range	42 V AC ... 550 V AC
Load current range	180 mA ... 3 A / 1.5 A ... 9 A
Trigger characteristic in acc. with IEC 60947-4-2	Class 10 / Class 10 (≤ 3 A) , Class 10A (> 3 A)
Cooling time	20 min. (for auto reset)
Rated operating current I_e AC-51	3 A / 9 A
Rated operating current I_e AC-53a	3 A / 7 A
Leakage current	0 mA / 0 mA
Protective circuit	Surge protection Varistor
Acknowledge output	
Confirmation: floating change-over contact, signal contact	
Switching capacity in accordance with IEC 60947-5-1	2 A (24 V, DC13)
Status and diagnostics indicators	
Status display	Yellow LED
Error indication	Red LED
Operating voltage display	Green LED
General data	
Mounting position	vertical (horizontal DIN rail, motor output below)
Mounting	alignable, for spacing see derating
Operating mode	100% operating factor
Degree of protection	IP20
Power dissipation min./max.	0.88 W / 4.1 W ; 0.88 W / 7 W
Dimensions W/H/D	22.5 mm / 107.5 mm / 114 mm

Connection data	Push-in connection	Screw connection
Connection name	**Control circuits**	**Control circuits**
Conductor cross section, rigid	0.2 mm² ... 2.5 mm²	0.2 mm² ... 2.5 mm²
Conductor cross section, flexible	0.2 mm² ... 2.5 mm²	0.2 mm² ... 2.5 mm²
Conductor cross section [AWG]	24 ... 14	24 ... 14
Tightening torque		0.5 Nm ... 0.6 Nm / 5 lb_f-in. ... 7 lb_f-in.
Connection name	**Load circuit**	**Load circuit**
Conductor cross section, rigid	0.2 mm² ... 2.5 mm²	0.2 mm² ... 2.5 mm²
Conductor cross section, flexible	0.2 mm² ... 2.5 mm²	0.2 mm² ... 2.5 mm²
Conductor cross section [AWG]	24 ... 14	24 ... 14
Tightening torque		0.5 Nm ... 0.6 Nm / 5 lb_f-in. ... 7 lb_f-in.
Stripping length	10 mm	8 mm

Ambient conditions	
Ambient temperature (operation)	-25 °C ... 70 °C (observe derating)
Ambient temperature (storage/transport)	-40 °C ... 80 °C
Altitude	≤ 2000 m

Standards/regulations	
Standards	EN 60947-1 EN 60947-4-2 EN ISO 13849 IEC 62061 IEC 61508

Insulation characteristics	
Rated insulation voltage	550 V
Rated surge voltage / insulation	6 kV
Insulation characteristics between the control input and control supply voltage, and auxiliary circuit to the main circuit	Safe isolation (IEC 60947-1)
Isolation characteristics between the control input and control supply voltage to auxiliary circuit	Safe isolation (IEC 60947-1) in the auxiliary circuit ≤ 300 V AC
Degree of pollution	2
Overvoltage category	III

Conformance/approvals	
UL approval NLDX.E228652	
Safety Integrity Level (SIL, IEC 61508) Safe shutdown	≤ 3
Safety Integrity Level (SIL, IEC 61508) Motor protection	2
Performance Level (ISO 13849) Safe shutdown	≤ e
Category (ISO 13849) Safe shutdown	≤ 3

5 Safety regulations and installation notes

- When working on the device, observe the national safety and accident prevention regulations.
- Disregarding these safety regulations may result in death, serious personal injury or damage to equipment.
- Startup, mounting, modifications, and upgrades should only be carried out by a skilled electrical engineer!
- Disconnect the power to the module.
- For emergency stop applications, the machine must be prevented from restarting automatically by a higher-level control system.
- During operation, parts of electrical switching devices carry hazardous voltages.
- During operation, the protective covers must not be removed from the electric switchgear.
- Keep the product documentation in a safe place.
- The device is an associated item of equipment. Do not install the device in potentially explosive areas. When installing and operating associated equipment, the applicable safety directives must be observed.
- If you use the "Automatic RESET" operating mode, the drive is switched on again after the cooling time has ended if a control signal is still present. The cooling time is 20 minutes.
- The device may not be exposed to mechanical or thermal influences that exceed the limits as described in the operating instructions. In order to provide protection against mechanical or electrical damage, install the device in an appropriate housing with a suitable degree of protection (at least IP54) in accordance with IEC 60529/EN 60529.
- Install the device according to the instructions in the installation instructions. Access to circuits within the device is not permitted.
- The device must not be opened or modified. Do not repair the device yourself, replace it with an equivalent device. Repairs may only be carried out by the manufacturer. The manufacturer is not liable for damage resulting from violation.
- You will find the safety-relevant data in this documentation and the certificates.
- The device performs diagnostics on the functions when the drive is switched on or has been switched off. When operating three-phase drives, an electrically skilled person or another skilled worker who is familiar with the relevant standards can also carry out the “Motor protection” function test. For this test, the drive must be operated with reverse or forward running, and the current flow in one conductor must be interrupted (e.g., by removing the fuse in the L1 or L3 phase). Next, the hybrid motor starter switches off the drive within 1.5 s ... 2 s. The LEDs for reverse or forward running go out, the ERR LED lights up, and the reply output is set. When operating single-phase motors, this test cannot be run because the phase failure detection and symmetry monitoring functions are disabled.
- Secure the device during safety-related applications with an access protection.
- Only use power supply units with safe isolation with SELV / PELV voltage in accordance with EN 60950-1 / EN 60204 (SELV / PELV). They prevent short circuits between primary and secondary sides.
- Observe the minimum permissible load current in safety-related applications:
  ELR H5-.../500AC-3-P: ≥ 180 mA
  ELR H5-.../500AC-9-P: ≥ 1.5 A

Area of application

- In circuits in potentially dust-explosive areas of zones 21 and 22, it must be guaranteed that the equipment connected to this circuit complies with category 2D or 3D or is certified as such.
- This is a product for environment A (industry). The device can cause unwanted radio interference if used in Class B environments (household). In this case, the user may be obligated to take the necessary precautionary measures.

5.1 UL note

WARNING: Risk of electric shock and fire

The opening of the branch-circuit protective device may be an indication that a fault current has been interrupted.

To reduce the risk of fire or electric shock, current-carrying parts and the other components of the controller should be examined and replaced if damaged.

Failure to follow instructions can result in death, serious injury, or equipment damage.

NOTE

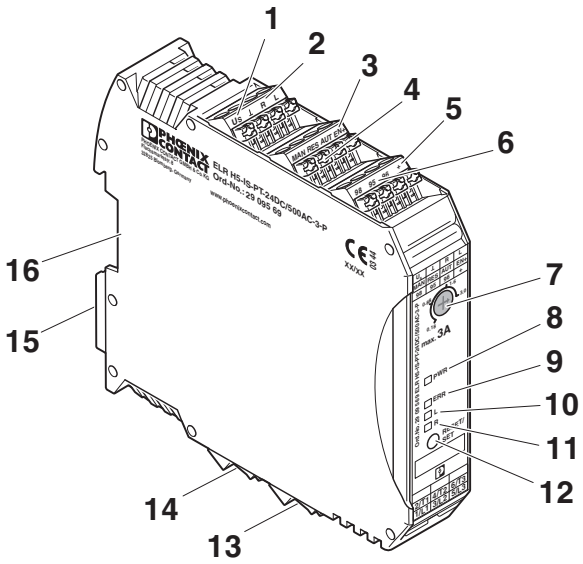
Use copper cables approved for at least 75 °C.

The device is designed for use with a "low voltage, limited energy, isolated power supply".

SCCR (single and group installation)	
Suitable for use on a circuit with a maximum of 5 kA rms symmetrical amperes and ≤ 480 V, with 20 A fuses rated RK5 (coordination type 1).	
Suitable for use on a circuit with a maximum of 100 kA rms symmetrical amperes and ≤ 480 V, with 30 A fuses rated J or rated CC (coordination type 1).	
FLA/LRA	3 A/20 A (480 V AC), 7,6 A/46 A (480 V AC)

6 Operating and indication elements

Figure 1 Operating and indication elements



1 Input: Control supply voltage
2 Control input: Forward/reverse running
3 EN+: Enable safety-related input
4 Acknowledgment inputs MAN, RES, AUT
5 +: Enable supply voltage
6 Feedback
7 Potentiometer for nominal current parameterization
8 LED PWR: Control supply voltage
9 LED ERR: Message/error
10 LED L: Reverse running
11 LED R: Forward running
12 Reset/set button
13 Motor output
14 Mains input
15 Metal lock for fixing to DIN rail
16 Connection option for DIN rail connector

7 Connection notes

WARNING: Danger to life by electric shock!

Never perform work on the device when voltage is present.

7.1 Mains connection and line protection

- When connecting the 3-phase network, it is essential to observe the terminal identification.
- The following specifications apply for the fuses used.

16 A gG / 50 kA / 500 V	Coordination type 1
16 A gR / 10 kA / 500 V	Coordination type 2
20 A gR / 5 kA / 400 V	Coordination type 2
FAZ-B16/3 2.5 kA / 400 V	Coordination type 1
PKM0-4 50 kA / 415 V	Coordination type 1
PKM0-6,3 15 kA / 415 V	Coordination type 1

- The control supply voltage inputs and the control voltage inputs must be operated with power supply modules in accordance with IEC 61131-2 (max. 5% residual ripple).
- In order to avoid inductive or capacitive coupling of noise emissions where long control wires are used, we recommend the use of shielded conductors.

NOTE: Electrical safety

Screw connection:

Only connect conductors with the same conductor cross section to a terminal point.

Push-in connection:

Only connect a conductor to a terminal point or use conductors with the same conductor cross section ferrules.

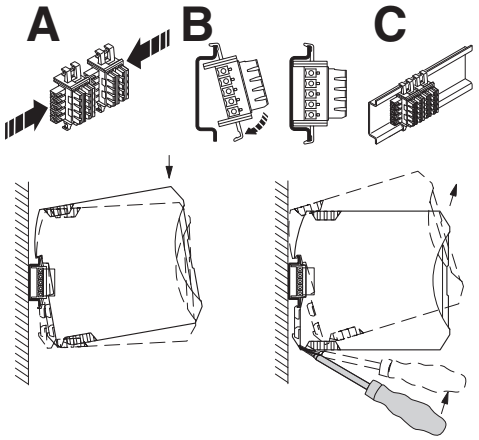
7.2 Mounting

NOTE: Risk of damage to equipment

For these modules, only use the DIN rail connector with Item No.: 2908702.

Use the DIN rail connector only to supply 24 V DC modules with power.

Figure 2 Mounting



- Plug the required number of DIN rail connectors together and push them onto the DIN rail.
- When placing the module onto the DIN rail, make sure that it is aligned correctly with the DIN rail connector.
- Feed the supply voltage at the module (a maximum of 5 modules) or at the DIN rail connector (a maximum of 30 modules).

NOTE: Risk of damage to equipment

Observe the permissible current carrying capacity.

24 V DC, 6 A (144 VA) at a maximum ambient temperature of 50 °C

24 V DC, 3.75 A (90 VA) at a maximum ambient temperature of 65 °C

NOTE: Risk of damage to equipment

If you use multiple hybrid motor starters with corresponding relay modules on a DIN rail connector section and remove a hybrid motor starter, the associated relay modules of the hybrid motor starter to the left of it can overload.

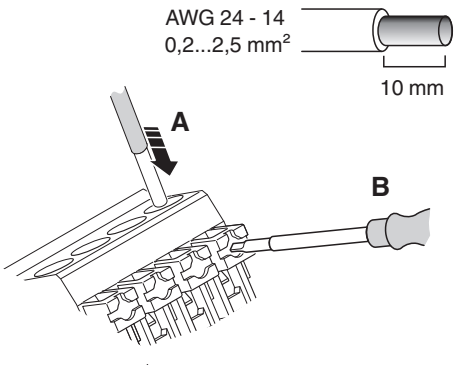
This must be avoided without fail.

Installation/removal of the devices on/from the TBUS DIN rail connector may only be performed when no voltage is applied.

7.3 Connecting cables

Push-in connection:

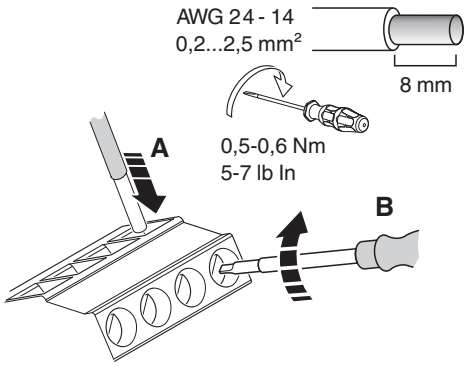
Figure 3 Push-in connection



Insert solid or stranded conductors with ferrules directly in the clamping space (A). Reliable contact can be made with stranded conductors without ferrules by opening the spring beforehand using the pushbutton (B). Press the pushbutton (B) also to release the conductor.

Screw connection:

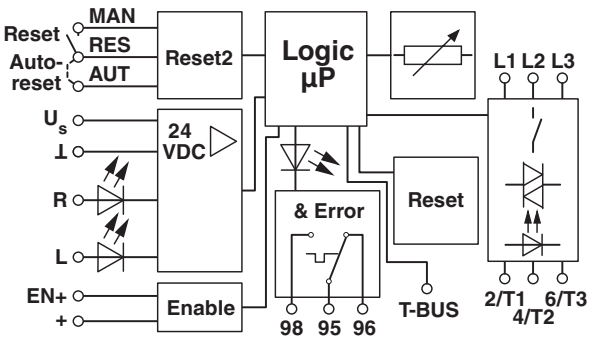
Figure 4 Screw connection



- Strip off each individual wire to 8 mm.
- Insert the wire into the corresponding connection terminal block.
- Use a screwdriver to tighten the screw in the opening above the connection terminal block.

7.4 Block diagram

Figure 5 Block diagram



7.5 Enable input

In order to make the motor connected to the device operational, you must issue the enable signal to the device via the Enable input (EN+) at the terminal or at the DIN rail connector.

As soon as a valid signal is present at an Enable input, the device receives control commands.

With non-safety-related applications, you can also issue the enable signal by bridging terminals (EN+) and (+).

Voltage interruptions (blanking) ≤ 3 ms or voltage pulse (unblanking) ≤ 4 ms are filtered.

8 Function

8.1 Status and diagnostics indicators

The device visualizes the operating statuses with a total of four LEDs.

LED PWR	Green	Device status
LED L	Yellow	Reverse running
LED R	Yellow	Forward running
LED ERR	Red	Internal or external error
		Process errors: Overcurrent, asymmetry (three-phase motor), phase failure (three-phase motor)

After applying the control supply voltage, all LEDs light up once as an LED test.

8.2 Diagnostic function

Various diagnostic functions enable the hybrid motor starter to detect many internal errors and also external errors (I/O errors).

If an error is detected, the device is switched to the safe shutdown state.

You cannot acknowledge internal errors. They are stored in the device. Afterwards the device cannot be started up again.

In case of external errors, an error acknowledgment is required to exit the safe shutdown state.

In case of a message, the power path remains switched on; an acknowledgement is not required.

The flashing PWR LED indicates a message.

After control supply voltage U_S has been switched on, the device determines whether an AC motor or a three-phase motor is connected. The setting is stored until the control supply voltage is switched off.

Explanation: A = LED switched off, Aut = automatic, B = LED flashes, B_r = LED flashes red, B_{ye} = LED flashes yellow, E = LED shines continuously, E_{ye} = LED shines yellow, E_r = LED shines red, Man = manual, Ne = not required, Nm = not possible, X = arbitrary state

Status	Description	PWR	ERR	L	R	Error acknowledgment
		Green	Red	Yellow		
Off	Supply voltage not present	A	A	A	A	-
Ready to operate, enable = 0	Supply voltage present, release has not been issued	B	X	X	X	Ne
Ready to operate, enable = 1	Supply voltage present, release has been issued	E	X	X	X	Ne
Drive switched on	Reverse running (L)	E	A	E	A	-
	Forward running (R)	E	A	A	E	-
Internal error	**Internal error** - device defective. Replace the device!	B	E	B	B	Nm
External error in controller or I/O devices (maintenance requirement)	**Motor protection function**: The motor current is higher than the motor nominal current specification: Cooling time elapsing (20 minutes)					
	Error during reverse running	E / B	B	E	A	Aut
	Error during forward running	E / B	B	A	E	Aut
	After 2 minutes, “L” or “R” flashes: manual reset is possible					
	Error during reverse running	E / B	B	B	A	Man
	Error during forward running	E / B	B	A	B	Man
	Error when restoring the system state: Manual acknowledgment possible after 2 min.	E / B	B	B	B	Man
	Symmetry (three-phase motor): The two motor currents deviate from each other by more than 33%.	E / B	B	A	A	Man
	Phase failure (three-phase motor): One of the motor currents is zero.	E / B	B	A	A	Man

Error acknowledgment

The following options are available for error acknowledgment.

Manual (reset/set button)

Press the reset/set button on the front of the device (≥0.5 s and ≤2 s).

If you press the reset/set button for more than 2 s (approximately), the device will return to the error state.

If you press the reset/set button for more than 6 s, the device switches to "Parameterization" mode.

Manual (remote acknowledgment point)

Connect a button (N/O contact) between the MAN and RES terminals.

Alternatively, acknowledgement can be provided directly via a 24 V DC PLC output.

An acknowledgement is triggered as soon as a positive edge is detected at the MAN input. If no negative edge is detected after approx. 2 s, the device adopts an error state since manipulation or an error in the acknowledgment circuit may have occurred.

Automatic

Establish an electrical connection between the RES and AUT terminals.

Following triggering of motor protection monitoring and subsequent cooling, the device performs an automatic acknowledgment.

The RES terminal provides the voltage for the reset.

In variants with a rated control supply voltage of 24 V DC, this is 24 V DC.

NOTE: device damage

Only connect conductors to the terminals MAN, RES and AUT which are a maximum of 30 m long.

Feedback

As soon as the device detects an error or indicates a message, the reply relay is switched, i.e. the N/O contact is closed or the N/C contact is opened. This behavior matches that of a motor protection switch or motor protection relay.

The feedback is for signaling purposes only and is not part of the safety chain. It is therefore not included in the safety considerations.

8.3 Parameterization - Nominal current setting

- Press the reset/set button for more than 6 s to switch to "Parameterization" mode. The green PWR flashes once.

In the Parameterization mode, the LEDs are switched off every 2 s for 0.3 s to distinguish this mode from other operating modes.

- Set the nominal drive current with the 240° potentiometer. The nominal current is specified in 16 stages. The four LEDs show the set current.

Code				Nominal current [mA]	
PWR	ERR	L	R	3 A	9 A
0	0	0	0	180	1500
0	0	0	1	300	2000
0	0	1	0	440	2500
0	0	1	1	600	3000
0	1	0	0	680	3500
0	1	0	1	880	4000
0	1	1	0	1000	4500
0	1	1	1	1100	5000
1	0	0	0	1200	5500
1	0	0	1	1500	6000
1	0	1	0	1600	6500
1	0	1	1	1900	7000
1	1	0	0	2100	7500
1	1	0	1	2400	8000
1	1	1	0	2700	8500
1	1	1	1	3000	9000

- Store the value by pressing the reset/set button again (non-volatile area of the data storage).
- Press the reset/set button for more than 2 s (and less than 6 s) to display the set current for 3 s. This function is only possible if 1) the device is not activated, and 2) there is no error at the device.

9 Application examples

In the following examples, the ENABLE signal of the hybrid motor starter is switched off on just one channel in some cases.

This type of installation acc. to SIL 3 (Cat. 3, Cat. 4) and PL e is only permitted if error prevention for cross-circuits is permitted.

This is the case, for example, if the hybrid motor starter and the safety relay are installed in the same control cabinet.

If such error prevention is not permitted, the disconnection must be made via two channels or two positions.

After control supply voltage U_S has been switched on, the device determines whether an AC motor or a three-phase motor is connected. The setting is stored until the control supply voltage is switched off.

For this, the respective motor must be connected correctly to the device as shown in the following examples.

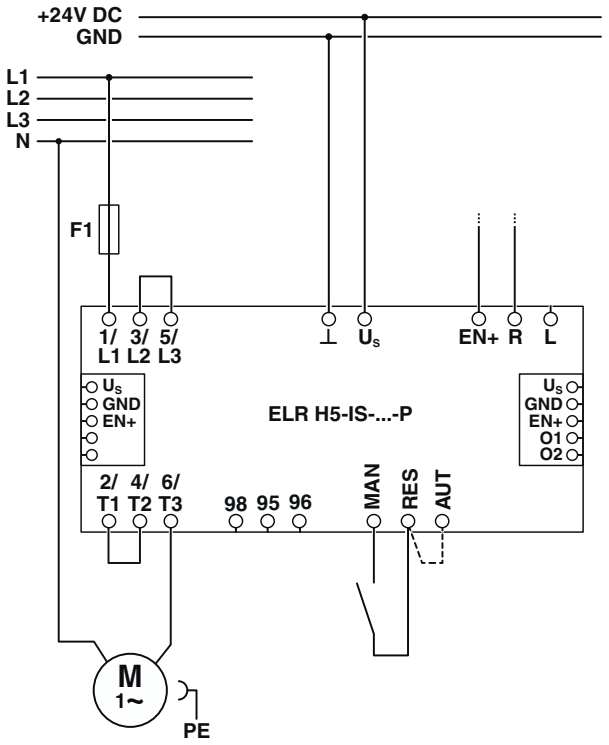
The symmetry monitoring and phase failure monitoring functions are disabled in the operating mode for single-phase AC motors.

Only the control input for forward running may be used.

The safety-relevant data applies for three-phase and AC current motors.

The following application examples illustrate the wiring for safe shutdown.

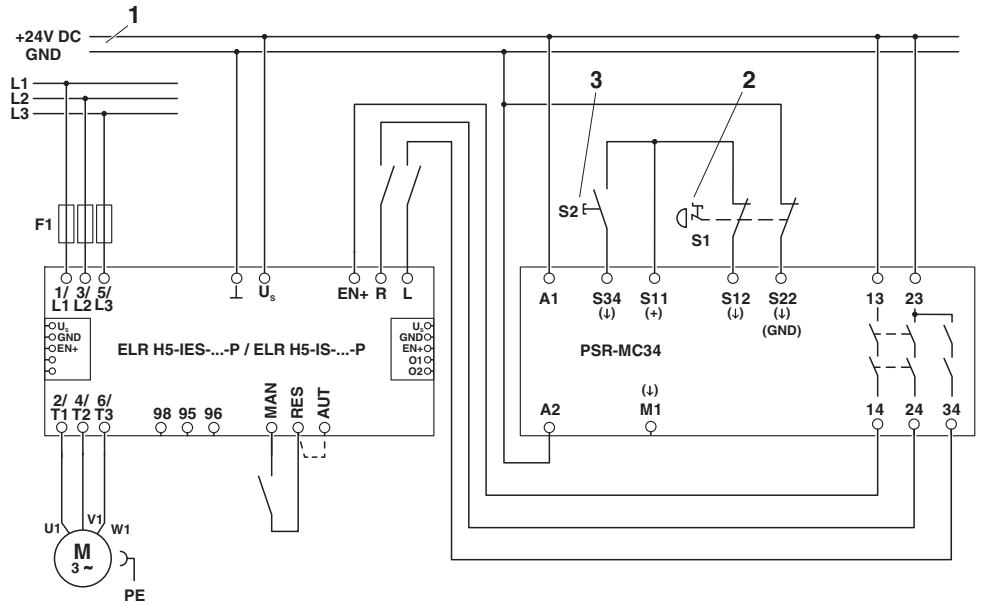
Figure 6 AC motor



9.1 Safety door / two-hand / emergency stop application (two-channel)

In accordance with Cat. 3, SIL 3, PL e:
ELR H5-.../500AC-...-P with higher-level safety relay combination

Figure 7 Safety door / two-hand / emergency stop application (two-channel)



1 Supply 1

2 Emergency stop

3 Reset/set button

The enable input and the control supply voltage are switched off via a safety relay as soon as the emergency stop button is actuated.

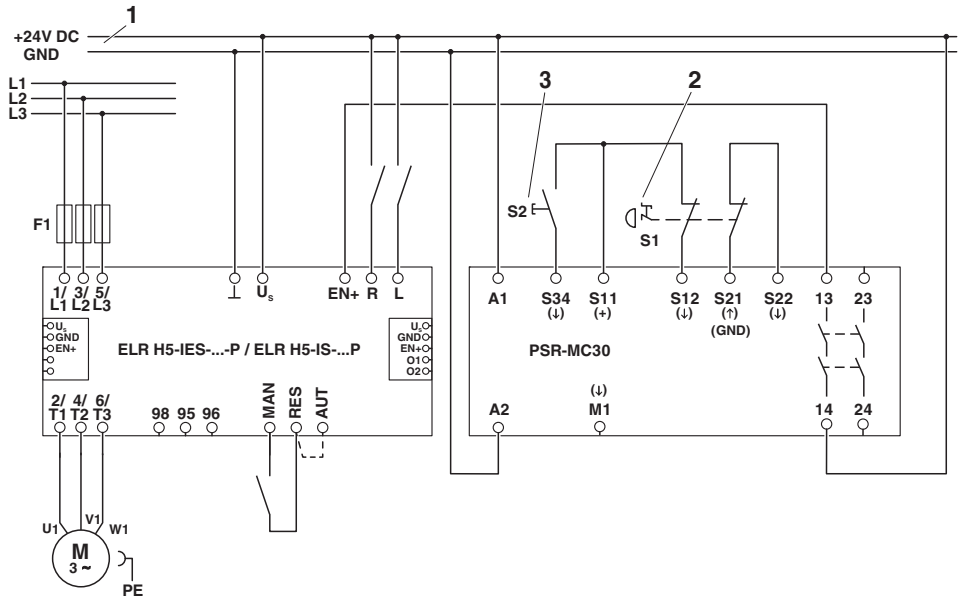
If shutdown is performed, e.g., from a “safe controller” with semiconductor outputs, the residual voltage must be < 5 V DC.

Voltage interruptions (blanking) ≤ 3 ms or voltage pulse (unblanking) ≤ 4 ms are filtered.

9.2 Safety door / two-hand / emergency stop application (single-channel) with error prevention

In accordance with Cat. 3, SIL 3, PL e:
ELR H5-.../500AC-...-P with higher-level safety relay combination within a closed control cabinet

Figure 8 Safety door / two-hand / emergency stop application (single-channel) with error prevention



1 Supply 1

2 Emergency stop

3 Reset/set button

The enable input is switched off via a safety relay as soon as the emergency stop button is actuated.

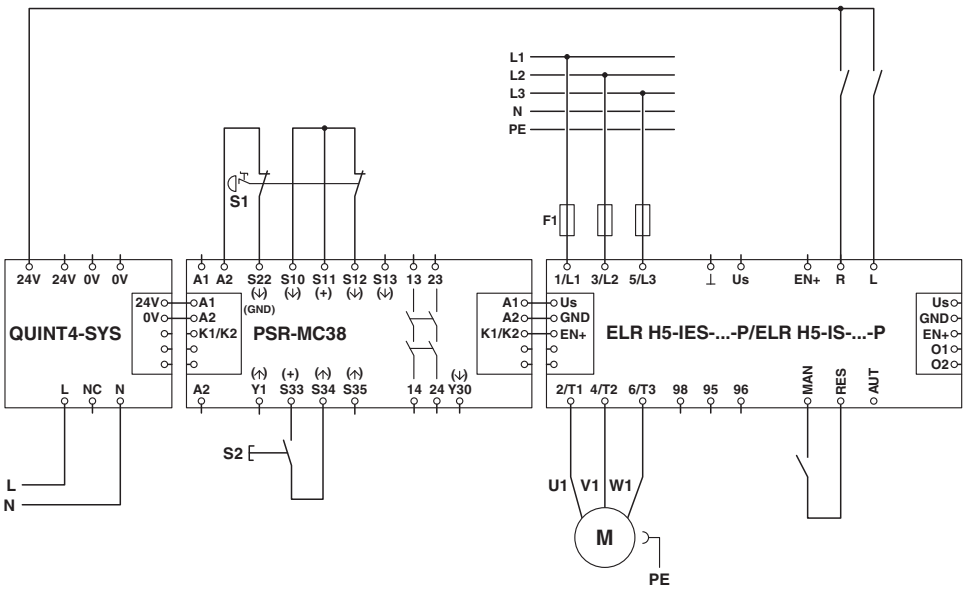
If shutdown is performed, e.g., from a “safe controller” with semiconductor outputs, the residual voltage must be < 5 V DC.

Voltage interruptions (blanking) ≤ 3 ms or voltage pulse (unblanking) ≤ 4 ms are filtered.

9.3 Safety door / two-hand / emergency stop application (single-channel via DIN rail connector) with error prevention

In accordance with Cat. 3, SIL 3, PL e:
ELR H5-.../500AC-...-P with higher-level safety relay combination within a closed control cabinet

Figure 9 Safety door / two-hand / emergency stop application (single-channel via DIN rail connector) with error prevention



The enable input (DIN rail connector) is switched off via a safety relay as soon as the emergency stop button is actuated.

If you use a suitable DIN rail connector, error prevention for the enable signal (K1/K2-EN+) is ensured.

CAUTION

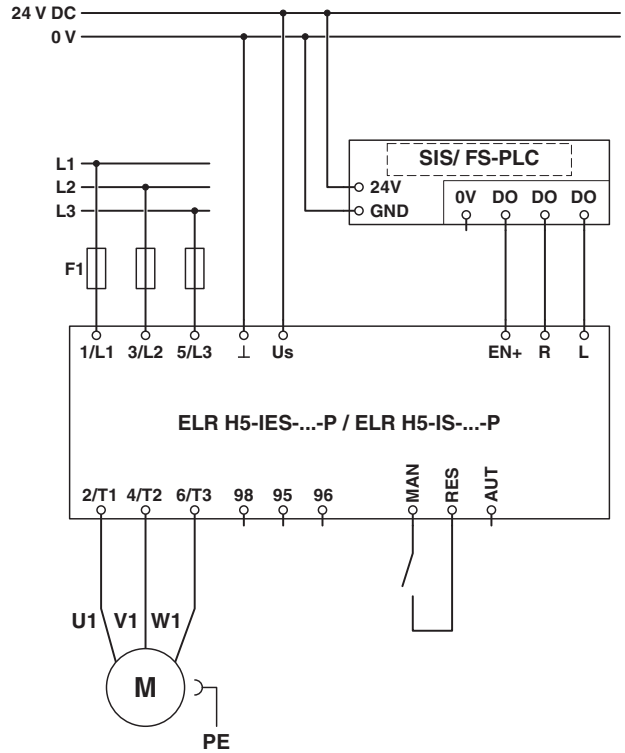
Do not use the PSR-TBUS dummy plug.

The connection must be terminated via the terminal points on the safety relay.

9.4 Safety door / two-hand / emergency stop application (two-channel)

In accordance with Cat. 3, SIL 3, PL e:
ELR H5-.../500AC-...-P with higher-level failsafe controller

Figure 10 Safety door / two-hand / emergency stop application (two-channel)



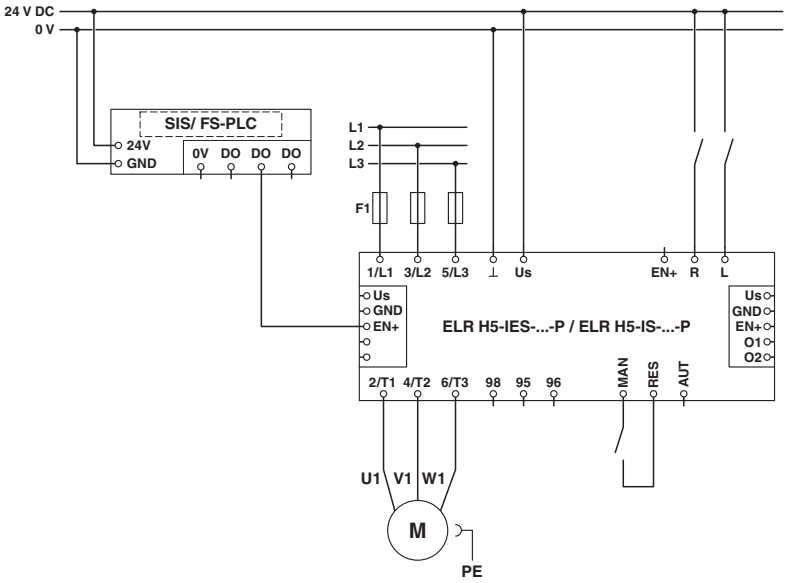
The enable input is switched off via a failsafe controller as soon as the emergency stop button is actuated.

Voltage interruptions (blanking) ≤ 3 ms or voltage pulse (unblanking) ≤ 4 ms are filtered.

9.5 Light grid / emergency stop application (single-channel via DIN rail connector) with error prevention

In accordance with Cat. 3, SIL 3, PL e:
ELR H5-.../500AC-...-P with higher-level failsafe controller within a closed control cabinet

Figure 11 Light grid / emergency stop application (single-channel via DIN rail connector) with error prevention



The enable input (DIN rail connector) is switched off via a failsafe controller as soon as the emergency stop button is actuated.

Voltage interruptions (blanking) ≤ 3 ms or voltage pulse (unblanking) ≤ 4 ms are filtered.

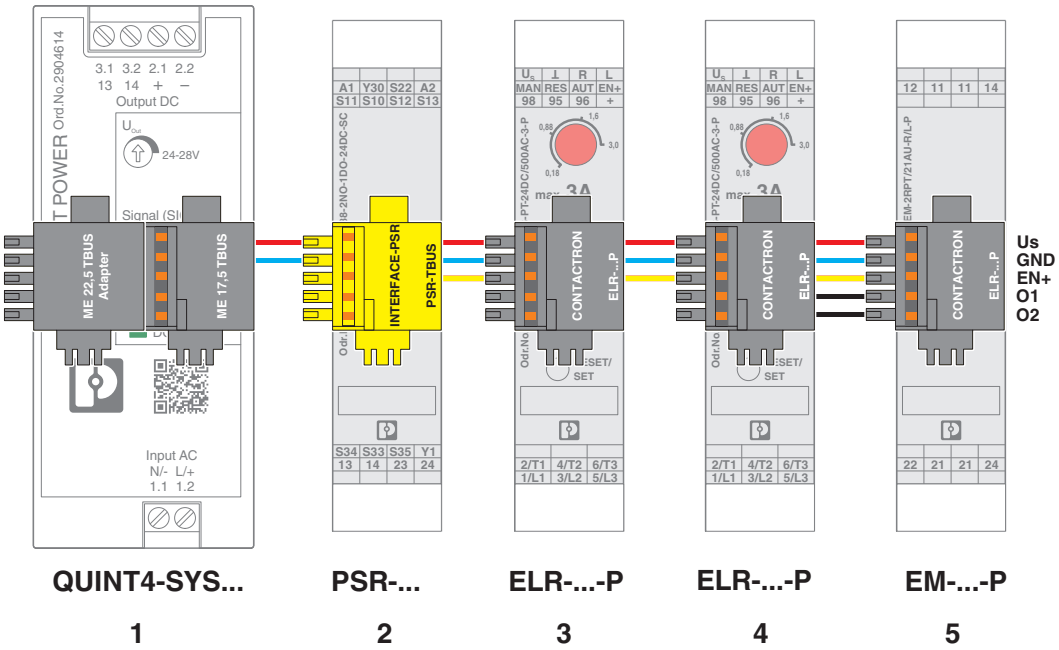
9.6 Sample assemblies

The DIN rail connectors are used for cross-wiring between the modules.

The O1 and O2 signals on the DIN rail connector are only transmitted to the right of an ELR…-P module and are only received by the EM-2R…-P extension module right beside it.

9.6.1 With DIN rail connector

Figure 12 Structure with DIN rail connector



1 QUINT4-SYS ... power supply
2 PSR-MC38... safety relay
3 Hybrid motor starter ELR ...-P
4 Hybrid motor starter ELR ...-P
5 Relay module EM-2R...-P

The control supply voltage (U_s/GND) and the enable signal (EN+) are supplied via the DIN rail connector.

A maximum of 20 modules are possible with this variant.

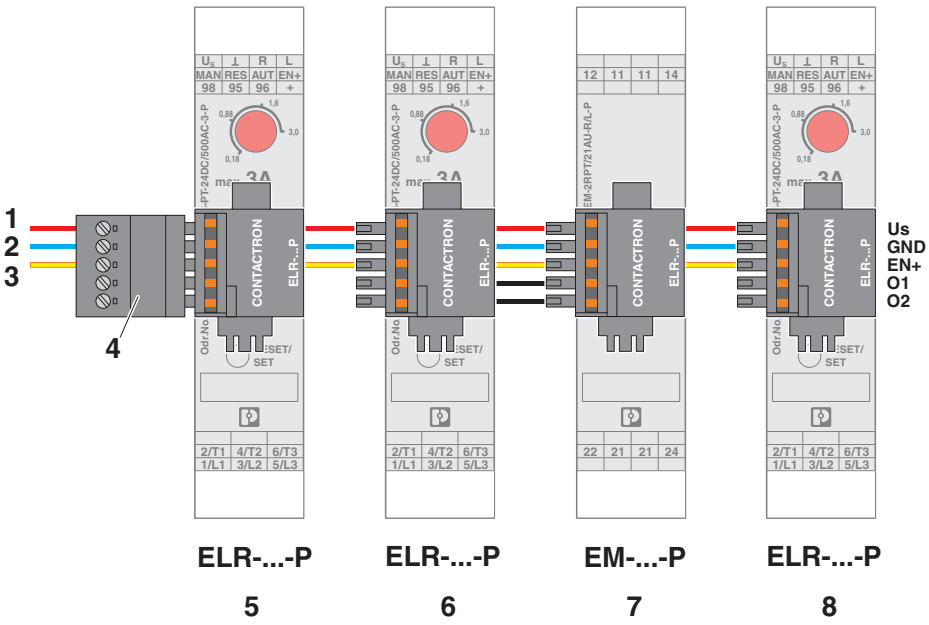
CAUTION

Do not use the PSR-TBUS dummy plug.

The connection must be terminated via the terminal points on the safety relay.

9.6.2 With DIN rail connector and PCB connector

Figure 13 Structure with DIN rail connector and PCB connector



1 Supply voltage from external power supply

2 GND for external power supply

3 ENABLE signal (EN+) from a safe controller or emergency stop switching device

4 PCB connectors IMC 1.5/ 5-ST-3.81 (Item No.: 1857919)

5 Hybrid motor starter ELR ...-P

6 Hybrid motor starter ELR ...-P

7 Relay module EM-2R...-P

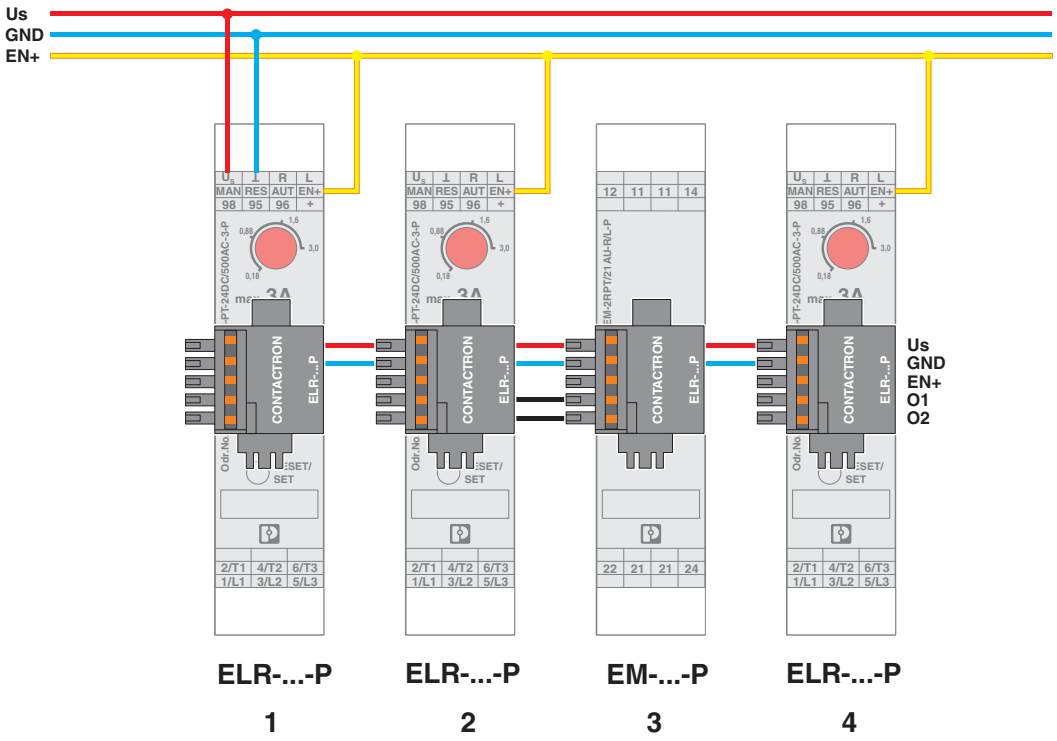
8 Hybrid motor starter ELR ...-P

The control supply voltage (U_S/GND) and the enable signal (EN+) are supplied via the PCB connector.

A maximum of 30 modules are possible with this variant.

9.6.3 With DIN rail connector and module terminal blocks

Figure 14 Structure with DIN rail connector and module terminal blocks



1 Hybrid motor starter ELR ...-P

2 Hybrid motor starter ELR ...-P

3 Relay module EM-2R...-P

4 Hybrid motor starter ELR ...-P

The control supply voltage (U_S/GND) and the enable signal (EN+) are supplied via the module terminal blocks.

A maximum of 5 modules are possible with this variant.

The ENABLE signal (EN+) may come from a safe controller or from an emergency stop switching device.

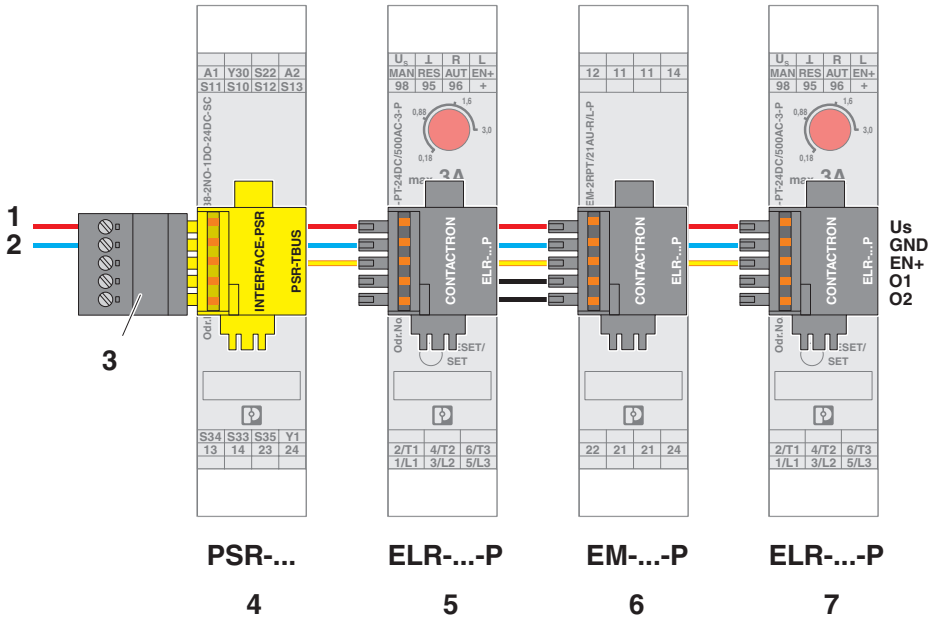
CAUTION

The terminals EN+ und EN+ on the DIN rail connector are decoupled from one another.

In this configuration, you must enable each respective ENABLE (EN+) terminal at the hybrid motor starters.

9.6.4 With DIN rail connector and PCB connector

Figure 15 Structure with DIN rail connector and PCB connector



1 Supply voltage from external power supply

2 GND for external power supply

3 PCB connectors IMC 1.5/ 5-ST-3.81 (Item No.: 1857919)

4 PSR-MC38... safety relay

5 Hybrid motor starter ELR ...-P

6 Hybrid motor starter ELR ...-P

7 Hybrid motor starter ELR ...-P

The control supply voltage (U_S/GND) and the enable signal (EN+) are supplied via the module terminal blocks.

A maximum of 20 modules are possible with this variant.

The ENABLE signal (EN+) may come from a safe controller or from an emergency stop switching device.

CAUTION

The terminals EN+ und EN+ on the DIN rail connector are decoupled from one another.

In this configuration, you must enable each respective ENABLE (EN+) terminal at the hybrid motor starters.

9.7 Motor protection

All safety-related functions are implemented by the hybrid motor starter without external influences. Special circuit technology is not required.

If the motor currents deviate by ≥ 33%, the device shuts the motor down within 2 minutes.

If the motor currents deviate by ≥ 67% (e.g. phase failure), the device shuts the motor down within 2 seconds.

The deviation can be calculated using the following formulas.

Value (I_{max}) > I_{nom} ⇒ (I_{max} - I_{min})/I_{max}

Value (I_{max}) < I_{nom} ⇒ (I_{max} - I_{min})/I_{nom}

In the event of high clock rates, the motor protection function may trip due to the increased switch-on currents

If you de-energize the rated control supply voltage (U_s), the energy storage of the motor protection function pauses at the last value and the cooling time stops at this point.

When you supply the module again, the cooling time resumes and prompt motor startup can trigger the motor protection function.

9.8 Motor with brake

If a motor with brake (connection in the motor terminal board) is connected, the 400 V AC brake must be linked to the 2/T1 and 6/T3 terminals. A 230 V AC brake must be connected to the 4/T2 terminals and the star point of the motor.

NOTE

Increase motor current monitoring to the nominal brake current. This should be set accordingly on the hybrid motor starter.

9.9 Auxiliary relay connection

You can connect a contact extension (e. g., EM-2RSC/21AU-R/L-P, Item No.: 2908701) to the right of the hybrid motor starter via the DIN rail connector (Item No.: 2908702).

The contact extension can, for example, by used to control external brakes or issue acknowledgements to the PLC.

Alternatively, you can use an auxiliary relay (e. g. PLC RSC 230UC/21, Item No.: 2966207) on connections 4T2 and N of the system.

10 Safety functions

System conditions	
Database for failure rates	SN 29500
System type (consisting of subsystems)	Type B
Standard used	IEC 61508
Beta factor	2 %
MTTF [years] (mean time to failure at ambient temperature of 40°C)	63

10.1 Safe shutdown

HFT (hardware fault tolerance)	1
Ambient temperature	40 °C
$MTTF_D$ [years] - mean time to dangerous failure	173
Shutdown time [ms]	200
λsu [FIT] - safe, undetectable	1149
λdd [FIT] - dangerous, detectable	656
λdu [FIT] - dangerous, undetectable	4.3
SFF [%] - safe failure fraction	99,8
DC [%] - diagnostic coverage	99,4
PFH_D [FIT] probability of a dangerous failure per hour	4.3
PFD_{avg} (6 months/36 months) Average Probability of Failure on Demand	$1,4 * 10^{-5}$ / $8,77 * 10^{-5}$
Safety level according to	IEC/CEI 61508-1: up to SIL 3
	ISO 13849-1: up to category 3 PL e

10.2 Motor protection

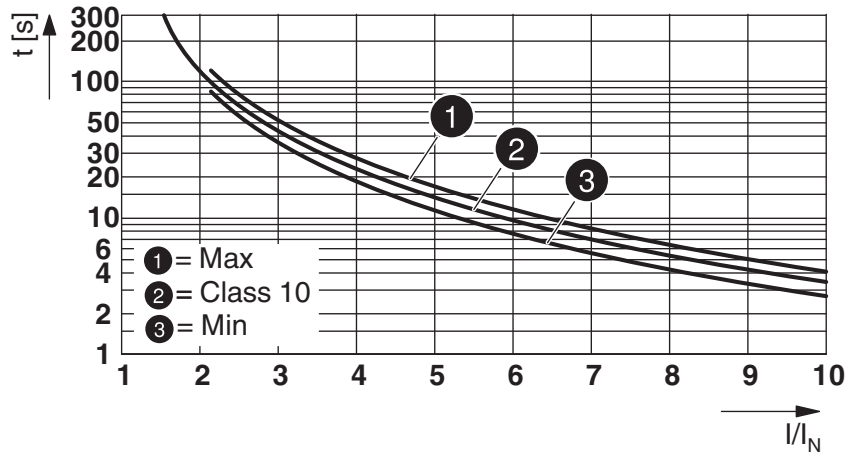
HFT (hardware fault tolerance)	0
Ambient temperature	40 °C
$MTTF_D$ [years] - mean time to dangerous failure	166
Shutdown time [ms]	According to Class 10/10A, IEC/CEI 60947
λsu [FIT] - safe, undetectable	1048
λdd [FIT] - dangerous, detectable	684
λdu [FIT] - dangerous, undetectable	5.5
SFF [%] - safe failure fraction	99,7
DC [%] - diagnostic coverage	99,2
PFD_{avg} (6 months/36 months) Average Probability of Failure on Demand	$2,0 * 10^{-5}$ / $0,12 * 10^{-5}$
Safety level according to	IEC/CEI 61508-1: up to SIL 2

Additional safety data is available on request.

11 Trigger characteristic

Applies to 3 A modules and 9 A modules for nominal motor currents up to ≤3 A

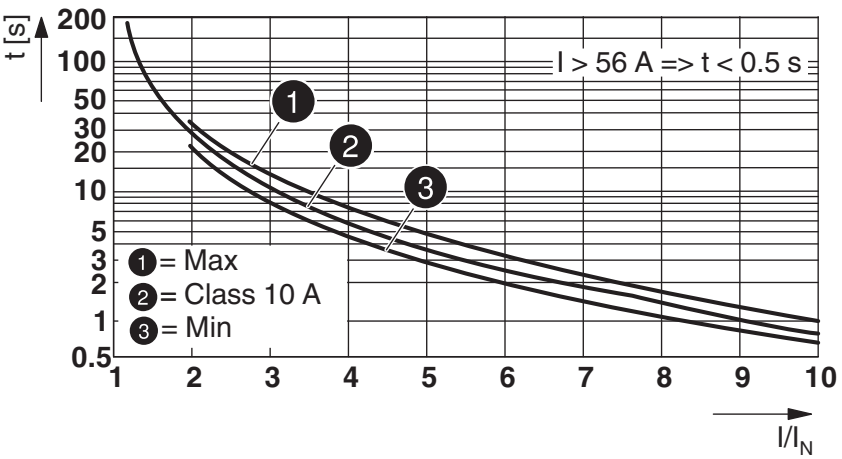
Figure 16 Trigger characteristic



t [s]	Release time in seconds
I/I_N	Overcurrent factor: the ratio between the actual current and the parameterized nominal current

Applies to 9 A modules for nominal motor currents >3 A

Figure 17 Trigger characteristic



t [s]	Release time in seconds
I/I_N	Overcurrent factor: the ratio between the actual current and the parameterized nominal current

12 Derating at 100% operating time

Additional data is available on request.

Ambient temperature [°C]	24	40	50	60	70
3 A/9 A modules					
Max. load current [A], stand-alone device	3 / 9	3 / 9	3 / 9	3 / 6,8	3 / 4,9
Max. load current [A], aligned with 20 mm spacing	3 / 9	3 / 9	3 / 7,6	3 / 6,5	3 / 3,9
Max. load current [A], aligned without spacing	3 / 6,5	3 / 6,5	3 / 5,2	3 / 3,4	-

The adjustment factors described here refer to hybrid motor starters with a maximum load current of 9 A. You can determine the maximum permissible rated current of the motor using the load current, the overcurrent factor (see data sheet of the relevant motor), and the derating table.

Derating table										
Overcurrent factor I_A/I_N	1	2	3	4	5	6	7	8	9	10
Adjustment factor K	1	1	1	1	1	1	0.88	0.77	0.69	0.62

Example 1	
Motor with overcurrent factor I_A/I_N (from motor data sheet)	8
Adjustment factor K	0.77
Max. permissible load current I_L at 40°C, aligned (from derating table)	6.5 A
Max. permissible rated current I_N of the motor	5 A

Example 2	
Motor with overcurrent factor I_A/I_N (from motor data sheet)	5
Adjustment factor K	1
Max. permissible load current I_L at 45°C, aligned (from derating table)	6.1 A
Max. permissible rated current I_N of the motor	6.1 A