COMPLETE **line**

# ELR H5-IES-xx- 24DC/500AC-xx

## Hybrid motor starter (CONTACTRON)

Data sheet
105517_en_04    © PHOENIX CONTACT  2022-09-19

## 1    Description

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

– Forward running
– Reverse running
– Motor overload protection
– EMERGENCY STOP to performance level PLe

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

[i]    Make sure you always use the latest documentation.
It can be downloaded from the product at phoenixcontact.net/products.

[i]    This document is valid for the products listed in the "Ordering data".

**PHŒNIX CONTACT**
INSPIRING INNOVATIONS

## 2    Table of contents

# 3    Ordering data

| Description | Type | Item no. | Pcs./Pkt. |
|---|---|---|---|
| Hybrid motor starter for reversing 3~ AC motors up to 500 V AC and 0.6 A output current, with 24 V DC control voltage, adjustable overload shutdown and emergency stop function to SIL 3/PL e and push-in connection | ELR H5-IES-PT- 24DC/ 500AC-0,6 | 2903902 | 1 |
| Hybrid motor starter for reversing 3~ AC motors up to 500 V AC and 2.4 A output current, with 24 V DC control voltage, adjustable overload shutdown and emergency stop function to SIL 3/PL e and push-in connection | ELR H5-IES-PT- 24DC/ 500AC-2 | 2903904 | 1 |
| Hybrid motor starter for reversing 3~ AC motors up to 500 V AC and 9 A output current, with 24 V DC control voltage, adjustable overload shutdown and emergency stop function to SIL 3/PL e and push-in connection | ELR H5-IES-PT- 24DC/ 500AC-9 | 2903906 | 1 |
| Hybrid motor starter for reversing 3~ AC motors up to 500 V AC and 0.6 A output current, with 24 V DC control voltage, adjustable overload shutdown, emergency stop function to SIL 3/PL e, and screw connection. | ELR H5-IES-SC- 24DC/ 500AC-0,6 | 2900582 | 1 |
| Hybrid motor starter for reversing 3~ AC motors up to 500 V AC and 2.4 A output current, with 24 V DC control voltage, adjustable overload shutdown and emergency stop function to SIL 3 / PL e and screw connection | ELR H5-IES-SC- 24DC/ 500AC-2 | 2900414 | 1 |
| Hybrid motor starter for reversing 3~ AC motors up to 500 V AC and 9 A output current, with 24 V DC control voltage, adjustable overload shutdown, emergency stop function to SIL 3/PL e, and screw connection. | ELR H5-IES-SC- 24DC/ 500AC-9 | 2900421 | 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 |
| Modular power distribution board with CrossLink® interface, 125 A, 3-pos., touch-proof and protection against polarity reversal, width: 225 mm | EM-CPS-225 | 1002634 | 1 |
| Modular power distribution board with CrossLink® interface, 125 A, 3-pos., touch-proof and protection against polarity reversal, width: 405 mm | EM-CPS-405 | 1002635 | 1 |
| Connection module with integrated spring-loaded terminals for cables from 1.5 to 16 mm², 3-pos., maximum 63 A | EM-CPS-TB3/63A | 1002633 | 4 |

| Accessories | Type | Item no. | Pcs./Pkt. |
|---|---|---|---|
| Device adapter with fuse holder for 16 A fuse (10x38/Class CC), CrossLink® interface and fixed DIN rail | EM-CPS-DA-22,5F/16A | 1002668 | 1 |
| 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 |
| 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 |

| Accessories | Type | Item no. | Pcs./Pkt. |
|---|---|---|---|
| 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 |
| 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 |

| Accessories | Type | Item no. | Pcs./Pkt. |
| --- | --- | --- | --- |
| 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 |
| 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 |
| The BRIDGE COVER covering hood is used to cover unused plugs on the CONTACTRON bridge that may subsequently be used to extend the system. The hood can be used with the screw and Push-in version of the bridge. | BRIDGE COVER | 2906240 | 10 |

# 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 $I_S$ | 40 mA |
| Protective circuit | Surge protection<br>Reverse polarity protection |

| Control input right/left | |
| --- | --- |
| Rated actuating voltage $U_C$ | 24 V DC |
| Rated actuating current $I_C$ | 5 mA (Input type 1) |
| Switching threshold | 9.6 V ("0" signal)<br>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 see to derating | 75 mA ... 600 mA / 180 mA ... 2.4 A / 1.5 A ... 9 A |
| Trigger characteristic in acc. with IEC 60947-4-2 | Class 10A / Class 10A / Class 10A |
| Cooling time | 20 min. (for auto reset) |
| Rated operating current $I_e$ AC-51 | 0.6 A / 2.4 A / 9 A |
| Rated operating current $I_e$ AC-53a | 0.6 A / 2.4 A / 6.5 A |
| Leakage current | 0 mA / 0 mA / 0 mA |
| Protective circuit | Surge protection |

| Acknowledge output | |
| --- | --- |
| Confirmation: floating change-over contact, signal contact | |
| Switching capacity according to IEC 60947-5-1 | 3 A (230 V, AC15)<br>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. | 1.1 W / 1.5 W ; 1.1 W / 3.3 W ; 1.1 W / 14.6 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 |

| Standards/regulations | |
|---|---|
| Standards | IEC 60947-1<br>IEC 60947-4-2<br>IEC 61508<br>ISO 13849 |

| Insulation characteristics | |
|---|---|
| Rated insulation voltage | 500 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) at operating voltage ≤ 300 V AC<br>Basic insulation (IEC 60947-1) at operating voltage 300 V AC ... 500 V AC |
| 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 | |
|---|---|
| UKCA<br>UKCA-compliant | |
| ATEX<br>PTB 07 ATEX 3145 | ⟨Ex⟩ II (2) G [Ex e] [Ex d] [Ex px]<br>⟨Ex⟩ II (2) D [Ex t] [Ex p] |
| UL approval<br>NLDX.E228652 | |
| Safety Integrity Level (SIL, IEC 61508)<br>Safe shutdown | ≤ 3 |
| Safety Integrity Level (SIL, IEC 61508)<br>Motor protection | 2 |
| Performance Level (ISO 13849)<br>Safe shutdown | ≤ e |
| Category (ISO 13849)<br>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.
- Observe the safety regulations that are applicable when motors are used in the Ex area (ATEX directive 2014/34/EU).
- If you use the "Automatic RESET" mode, the drive is switched on again after the cooling time has expired - if a control signal is still present. The cooling time is 20 minutes. For applications in the Ex-protection area, automatic restart is not permitted.
- The device may not be exposed to mechanical or thermal influences that exceed the limits as described in the operating instructions. To protect 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. Where dust is present, the device must be installed in suitable housing (at least IP64) in accordance with EN 60079-14.
- Install the device according to the instructions in the installation instructions. Access to circuits within the device is not permitted.
- The operating equipment cannot be repaired by the user and must be replaced by an equivalent device. Repairs may only be carried out by the manufacturer.
- Observe the safety information, conditions, and limits of use specified in the product documentation. Comply with them.
- The device performs diagnostics on the functions when the drive is switched on or has been switched off. In addition, an electrically skilled person or another skilled worker who is familiar with the relevant standards can carry out the "motor protection" safety function test. For this test, the drive must be operated in reverse or

forward running, and the current flow in a conductor must be interrupted (e.g., by removing a fuse in phase L1 or L3). The hybrid motor starter then switches off the drive within 1.5 s ... 2 s. The LEDs for reverse or forward running go out, and the ERR LED and feedback output are set.
- 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-06: ≥ 75 mA
  ELR H5-.../500AC-2: ≥ 180 mA
  ELR H5-.../500AC-9: ≥ 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 capable of delivering not more than 5 kA rms symmetrical amperes, 500 Volts maximum when protected by a 20 A class RK5 fuse (coordination type 1). | |
| Suitable for use on a circuit capable of delivering not more than 100 kA rms symmetrical amperes, 500 Volts maximum when protected by a 30 A class J or class CC fuse (coordination type 1). | |
| FLA | 0.6 A (500 V AC) / 2.4 A (500 V AC) / 6.5 A (500 V AC) |

# 6 Operating and indication elements

Figure 1    Operating and indication elements
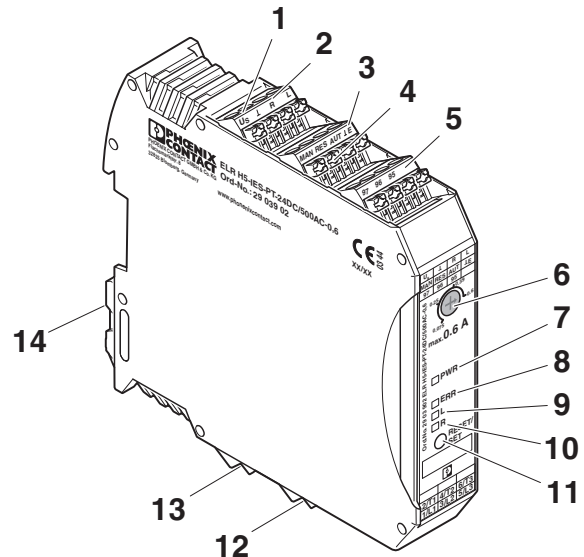


**1** Input: Control supply voltage

**2** Control input: Forward/reverse running

**3** ⊥ E: Benchmark forward/reverse running

**4** Acknowledgment inputs MAN, RES, AUT

**5** Feedback

**6** Potentiometer for nominal current parameterization

**7** LED PWR: Control supply voltage

**8** LED ERR: Message/error

**9** LED L: Reverse running

**10** LED R: Forward running

**11** Reset button

**12** 3-phase output voltage

**13** 3-phase input voltage

**14** Metal lock for fixing to DIN rail

# 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.

| | |
|---|---|
| 25 A gG / 10 kA / 500 V | Coordination type 1 |
| 16 A B-circuit breaker / 1.5 kA / 400 V | Coordination type 1 |
| 30 A CC / 30 kA / 500 V | Coordination type 1 |
| 3RV2021-4AA20 / 10 kA / 420 V / ≤45°C | Coordination type 1 |
| FAZ-C16/3 / 10 kA / 420 V / ≤45°C | Coordination type 1 |
| PKZM0-6,3 / 30 kA / 420 V / ≤45°C | Coordination type 1 |
| PKZM0-4 / 100 kA / 420 V / ≤45°C | Coordination type 1 |
| 16 A FA (6.3 x 32 mm) / 1.5 kA / 500 V | Coordination type 2 |
| 16 A FF / gR (10 x 38 mm) / 10 kA / 500 V | Coordination type 2 |

• The control supply voltage and control voltage inputs must be operated with power supply modules according to 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.
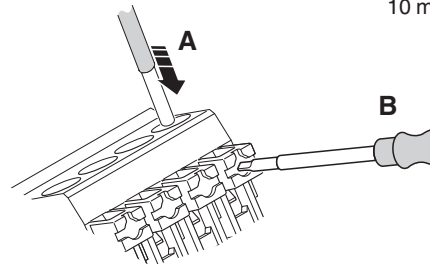
Push-in connection:

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

## 7.2    Connecting cables

**Push-in connection:**
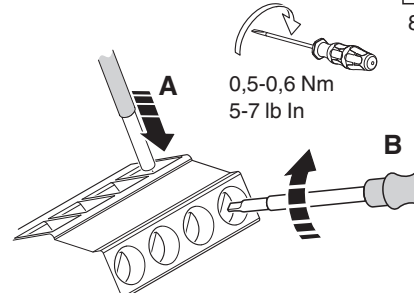
Figure 2    Push-in connection



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:**
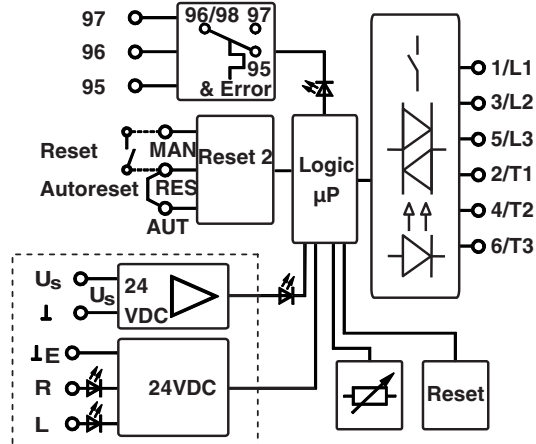
Figure 3    Screw connection



• 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.

## 7.3 Block diagram

Figure 4     Block diagram



## 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, phase failure |

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.

The flashing PWR LED indicates a message.

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

Explanation: A = LED switched off / E = LED lights continuously / B = LED flashes ca. 2 Hz (50:50) / Aut = Automatic / Man = Manual / Nm = Not possible / Ne = Not required

| Status | Description | PWR Green | ERR Red | L Yellow | R | Error acknowledgment |
|---|---|---|---|---|---|---|
| Off | Supply voltage not present | A | A | A | A | - |
| Ready to operate | Supply voltage present | E | A | A | A | - |
| Drive switched on | Reverse running (L) | E | A | E | A | - |
| | Forward running (R) | E | A | A | E | - |
| Internal error | Internal device error - **device replacement required** | E | E | A | A | 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 | E | A | Aut |
| | Error during forward running | E | B | A | E | Aut |
| | After 2 minutes, "L" or "R" flashes: manual reset is possible | | | | | |
| | Error during reverse running | E | B | B | A | Man |
| | Error during forward running | E | B | A | B | Man |
| | **Error when restoring the system state**: Manual acknowledgment possible after 2 min. | E | B | B | B | Man |
| | **Symmetry**: The two motor currents deviate from each other by more than 33 %. | E | B | A | A | Man |
| | **Blocking**: The max. measurable motor current is exceeded for more than 2 s. | | | | | |
| | Error during reverse running | E | B | B | A | Man |
| | Error during forward running | E | B | A | B | Man |
| Message (power path remains switched on) | **Message with pending control signal**:<br>- 2 or more phases are missing<br>- No motor connected<br>- Motor current in at least two phases > 2 s below the minimum current value that can be set | | | | | |
| | Message during reverse running | B | B | E | A | Ne |
| | Message during forward running | B | B | A | E | Ne |

## Error acknowledgment

The following options are available for error acknowledgment.

**Manual** (reset button)

Press the reset button on the front of the device.

When pressing the reset button for more than 2 s (approximately), the device returns to the error state.

Pressing the reset button for more than 6 s changes the device to the "Parameterization" mode.

**Manual** (remote acknowledgment point)

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

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.

> **i** 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.

> **i** 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 button for more than 6 s to change to the "Parameterization" mode. The green PWR LED 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 | 0.6 A | 2 A | 9 A |
| 0 | 0 | 0 | 0 | 75 | 180 | 1500 |
| 0 | 0 | 0 | 1 | 110 | 250 | 2000 |
| 0 | 0 | 1 | 0 | 145 | 410 | 2500 |
| 0 | 0 | 1 | 1 | 180 | 560 | 3000 |
| 0 | 1 | 0 | 0 | 215 | 710 | 3500 |
| 0 | 1 | 0 | 1 | 250 | 870 | 4000 |
| 0 | 1 | 1 | 0 | 285 | 1020 | 4500 |
| 0 | 1 | 1 | 1 | 320 | 1170 | 5000 |
| 1 | 0 | 0 | 0 | 355 | 1330 | 5500 |
| 1 | 0 | 0 | 1 | 390 | 1480 | 6000 |
| 1 | 0 | 1 | 0 | 425 | 1630 | 6500 |
| 1 | 0 | 1 | 1 | 460 | 1790 | 7000 |
| 1 | 1 | 0 | 0 | 495 | 1940 | 7500 |
| 1 | 1 | 0 | 1 | 530 | 2090 | 8000 |
| 1 | 1 | 1 | 0 | 565 | 2250 | 8500 |
| 1 | 1 | 1 | 1 | 600 | 2400 | 9000 |

- Store the value by pressing the reset button again (non-volatile area of the data storage).

- Press the reset 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

> **NOTE**
> Switching off the control voltage supply with a
> controlled motor always results in wear in the
> hybrid motor starter.

> Further application examples can be downloaded
> via the product at phoenixcontact.net/products.

## 9.1    Safety door (emergency stop)

In applications where safety shutdown is a normal operating
state, e.g., for safety door or two-hand applications, it is the
control circuit that is switched and not the control supply
voltage.

Figure 5      Safety door (emergency stop)
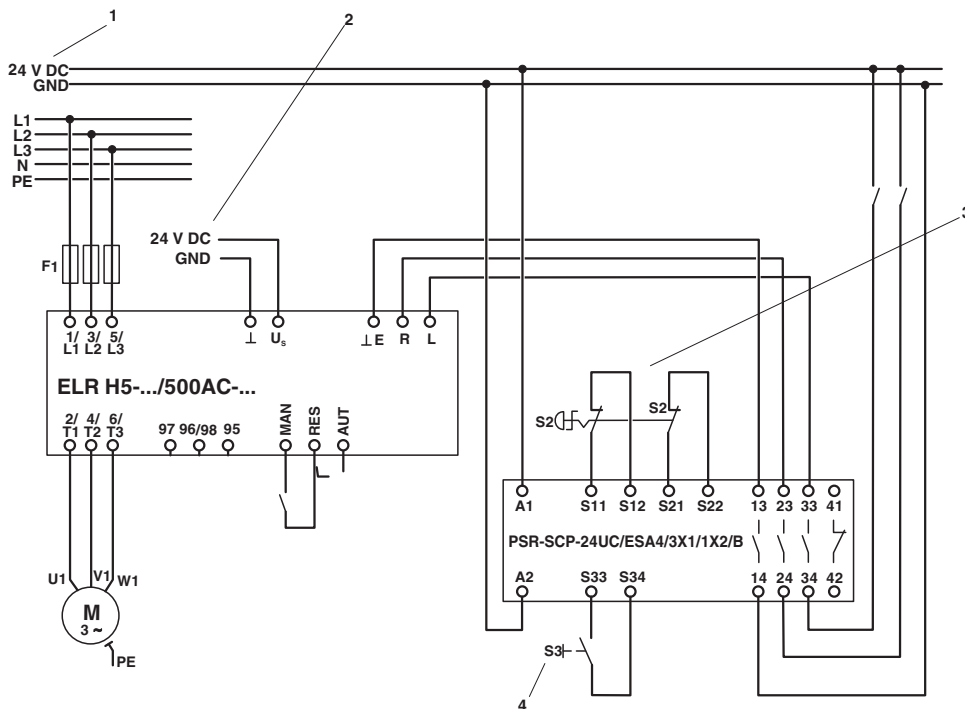


**1**    Supply 1
**2**    Supply 2
**3**    Emergency stop
**4**    Reset button

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

Interruptions ≤ 3 ms are filtered.

## 9.2     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 $\geq 33\%$, the device shuts the motor down within 2 minutes.

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

The deviation can be calculated using the following formulas.

Value $(I_{max}) > I_{nom} \Rightarrow (I_{max} - I_{min})/I_{max}$

Value $(I_{max}) < I_{nom} \Rightarrow (I_{max} - I_{min})/I_{nom}$

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

## 9.3     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.

## 9.4     Auxiliary relay connection

Auxiliary relay (e. g. PLC RSC 230UC/21, Item No.: 2966207) for activating external brakes or acknowledgements, e. g. to the PLC, must be connected to the 4T2 and N connections 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 | 1 % |
| MTTF [years] (mean time to failure at ambient temperature of 40°C) | 39.3 |

## 10.1   Safe shutdown

| | |
|---|---|
| HFT (hardware fault tolerance) | 1 |
| Ambient temperature | 40 °C |
| $MTTF_D$ [years] - mean time to dangerous failure | 517 |
| Shutdown time [ms] | 80 |
| $\lambda sd$ [FIT] - safe, detectable | 664 |
| $\lambda su$ [FIT] - safe, undetectable | 968 |
| $\lambda dd$ [FIT] - dangerous, detectable | 218 |
| $\lambda du$ [FIT] - dangerous, undetectable | 2.67 |
| SFF [%] - safe failure fraction | 99 |
| DCS [%] - diagnostic coverage safe | 40.7 |
| DC [%] - diagnostic coverage | 98 |
| $PFH_D$ [FIT] probability of a dangerous failure per hour | 2.67 |
| $PFD_{avg}$ (6 months/36 months) Average Probability of Failure on Demand | $0.4 * 10^{-5}$ / $2.4 * 10^{-5}$ |
| 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 | 447 |
| Shutdown time [ms] | According to Class 10A, IEC/CEI 60947 |
| $\lambda sd$ [FIT] - safe, detectable | 637 |
| $\lambda su$ [FIT] - safe, undetectable | 870 |
| $\lambda dd$ [FIT] - dangerous, detectable | 239 |
| $\lambda du$ [FIT] - dangerous, undetectable | 17 |
| SFF [%] - safe failure fraction | 99 |
| DCS [%] - diagnostic coverage safe | 42.3 |
| DC [%] - diagnostic coverage | 93 |
| $PFD_{avg}$ (6 months/36 months) Average Probability of Failure on Demand | $0.04 * 10^{-3}$ / $0.24 * 10^{-3}$ |
| Safety level according to | IEC/CEI 61508-1: up to SIL 2 |

**i**   Additional safety data is available on request.

## 11    Trigger characteristic

Figure 6    Trigger characteristic
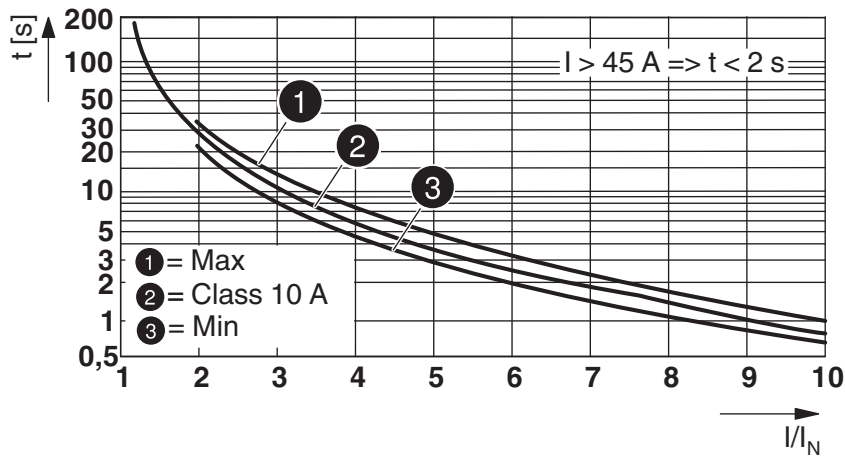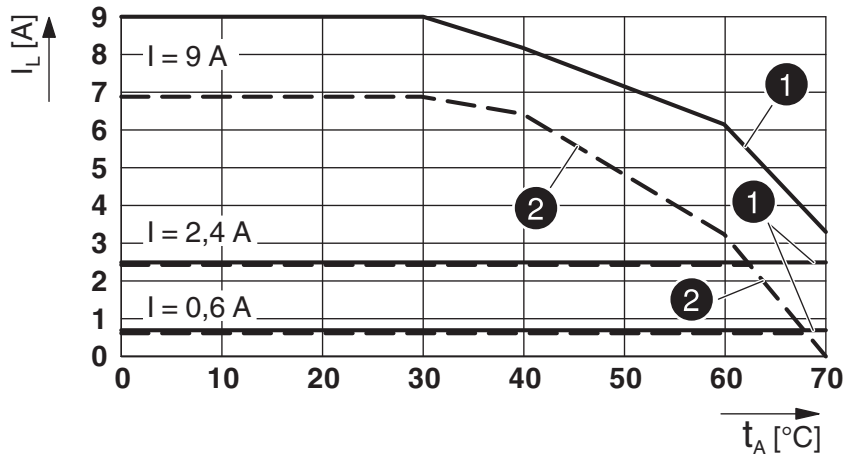


t [s]        Release time in seconds

$I/I_N$      Overcurrent factor: the ratio between the actual
             current and the parameterized nominal current

## 12 Derating curves for 100 % operating time

Additional data is available on request.

Figure 7 Derating curve



$I_L$ = Load current [A]
$t_A$ = Ambient temperature [°C]
$I_A$ = Starting current [A]
❶ = Aligned with 20 mm spacing
❷ = Aligned without spacing

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 9 A derating curve.

| 9 A derating curve | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Overcurrent factor $I_A/I_N$ | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Adjustment factor K | 1 | 1 | 1 | 1 | 1 | 0.96 | 0.83 | 0.72 | 0.64 | 0.58 |

| Example 1 | |
|---|---|
| Motor with overcurrent factor $I_A/I_N$ (from motor data sheet) | 8 |
| Adjustment factor K | 0.72 |
| Max. permissible load current $I_L$ at 30°C, not aligned (from derating curve) | 9 A |
| Max. permissible rated current $I_N$ of the motor | 6.5 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 60°C, aligned (from derating curve) | 3.2 A |
| Max. permissible rated current $I_N$ of the motor | 3.2 A |