Motor-protective circuit-breakers

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Motor-protective circuit-breakers
Overview

Definition

Motor-protective circuit-breakers are circuit-breakers used for switching, protection and isolation of circuits primarily associated with motor loads. At the same time, they protect these motors against destruction from locked-motor starting, overload, short-circuit and phase-failure in three-phase power supplies. They have a thermal release for protection of the motor winding (overload protection) and an electromagnetic release (short-circuit protection).

The following accessories can be fitted to motor-protective circuit-breakers:

- undervoltage releases,
- Shunt release,
- Auxiliary contact,
- Trip-indicating auxiliary contact.

Moeller motor-protective circuit-breakers

PKZM01
The motor-protective circuit-breaker PKZM01 reintroduces the pushbutton actuation up to 16 A which was very popular with customers. The mushroom actuator for Emergency-Stop operation on simple machines is also being reintroduced. The PKZM01 is preferably installed in surface-mount or flush-mount enclosures. Many accessory parts from the PKZM0 can be used.

Major system module: motor-protective circuit-breaker

PKZM4
The PKZM4 system is a modular and efficient system for switching and protecting motor loads up to 63 A. It is the “big brother” of the PKZM0 and can be used with almost all PKZM0 accessory parts.

Major system modules: motor-protective circuit-breakers

PKZM0
The PKZM0 motor-protective circuit-breaker is a modular and efficient system for switching and protecting motor loads up to 32 A and transformers up to 25 A.

The major system modules are:

- Motor-protective circuit-breakers
- Transformer-protective circuit-breaker
- (High-capacity) contact modules

Description → section "The motor-protective circuit-breakers PKZM01, PKZM0 and PKZM4", page 6-4.

PKZ2
PKZ2 for motor and distribution circuit protection

The PKZ2 is a modular and efficient system for protecting, switching, signalling and remote operation of motors and systems in low-voltage switchgear systems up to 40 A.

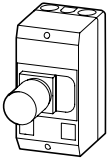
The major system modules are:

- Motor-protective circuit-breakers
- System-protective circuit-breakers
- (High-capacity) contact modules

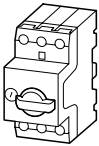
Description → section "Motor and system protection", page 6-12.

Motor-protective circuit-breakers
Overview

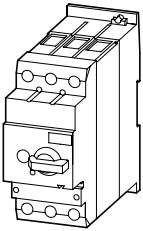
PKZM01
Circuit-breaker
in surface mounting
enclosure



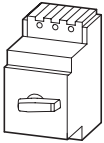
PKZM0
Circuit-breaker



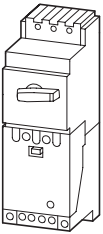
PKZM4
Circuit-breaker



PKZ2
Circuit-breaker

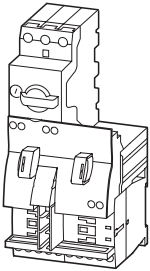


PKZ2
Compact starter



MSC-D
DOL Starters

MSC-R
Reversing starters



Motor-protective circuit-breakers
PKZM01, PKZM0 and PKZM4

The motor-protective circuit-breakers PKZM01, PKZM0 and PKZM4

PKZM01, PKZM0 and PKZM4 use bimetallic releases which are delayed depending on the magnitude of the current to offer a proven, technical solution for motor protection. The releases are sensitive to phase failure and are temperature-compensated. The rated current with the PKZM0 up to 32 A is split into 15 ranges, for the PKZM01 it is split into 12 ranges and for the PKZM4 up to 63 A into 7 ranges. The installation (motor) and the supply cable are reliably protected by short-circuit releases, permanently set to 14 × I_u. The motor start is also guaranteed in every operational situation. The phase-failure sensitivity of PKZM0 and PKZM4 can be used to protect EEx e motors. An ATEX certificate has been awarded. The motor-protective circuit-breakers are set to the rated motor current in order to protect the motors.

The following accessories complement the motor-protective circuit-breaker for the various secondary functions:

- Undervoltage release U,
- Shunt release A,
- Standard auxiliary contact NHI,
- Trip-indicating auxiliary contact AGM.

Motor starter combinations

The motor-starter combinations MSC are available up to 32 A. Motor starters up to 16 A consist of a motor-protective circuit-breaker PKZM0 and a contactor DILM. Both can be mechanically connected without the use of tools. Furthermore, a plug-in electrical connector is used to establish the connection with the main circuit wiring. The motor-protective circuit-breaker PKZM0 and the contactor DILM up to 16 A feature the respective interfaces for this purpose.

The motor-starter combination MSC from 16 A consists of a motor-protective circuit-breaker PKZM0 and a contactor DILM. Both are fitted to a top-hat rail and mechanically and electrically interconnected by a connector element.

The MSC is available as direct-on-line starter MSC-D and as reversing starter MSC-R.

The compact starters and high-capacity compact starters with the PKZ2 (up to 18.5 kW/400 V) are available for motor ratings of more than 5.5 kW/400 V or the combination of PKZM4 with the proven contactor DILM.

Motor-protective circuit-breakers
PKZM01, PKZM0 and PKZM4

Motor-protective circuit-breakers for starter combinations

PKM0

The PKM0 motor-protective circuit-breaker is a protective switch for starter combinations or for use as a basic unit in a short-circuit protective switch in the range 0.16 A to 32 A. The basic unit is without overload release, but equipped with short-circuit release. This circuit-breaker is used for protection of resistive loads where no overloading is to be expected.

These protective switches are also used in motor-starter combinations with and without automatic reset, where an overload relay or a thermistor overload relay is used as well.

Transformer-protective circuit-breakers and current limiters

PKZM0-T

The transformer-protective circuit-breaker is designed for protecting transformer primaries. The short-circuit releases in the types from 0.16 A to 25 A are permanently set to 20 × I_u. The response ranges of the short-circuit releases are higher here than with motor-protective circuit-breakers in order to cope with the even higher inrush currents of idling transformers without tripping. The overload release in the PKZM0-T is set to the rated current of the transformer primary. All the PKZM0 system accessories can be combined with the PKZM0-T.

PKZM0-...-C

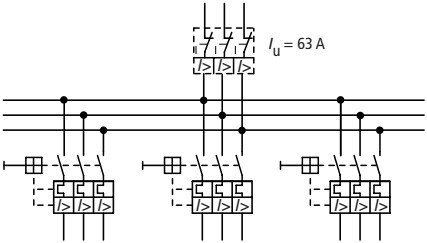
The PKZM0 features a version with springloaded terminals. A version with springloaded terminals on both sides, and a combined version which features springloaded terminals on the outgoer side only can be chosen. The conductors can be connected here without ferrules. The connections are maintenance-free.

CL-PKZ0

The current limiter module CL-PKZ0 is a short-circuit protective device specially developed for the PKZM0 and PKZM4 for non-intrinsically-safe areas. The CL module has the same base area and uses the same terminations as the PKZM0. When they are mounted on a top-hat rail alongside one another, it is possible to connect them using B3...-PKZ0 three-phase commoning links. The switching capacity of the series connected PKZM0 or PKZM4 + CL is 100 kA at 400 V. In the event of a short-circuit, the contacts of the motor-protective circuit-breaker and CL will open. While the current limiter returns for the closed rest position, the motor protective-circuit breaker trips via the instantaneous release and produces a permanent isolating gap. The system is ready to operate again, once any defect has been rectified. The current limiter can conduct an uninterrupted current of 63 A. The module may be used for individual or group protection. Any feed direction may be used.

Motor-protective circuit-breakers
PKZM01, PKZM0 and PKZM4

Individual and group protection with CL-PKZ0



Use the BK25/3-PKZ0 for terminals > 6/4 mm²

For grouped connection with three-phase commoning link B3...PKZ0.
Note utilization factors to IEC/EN 0660 500.

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Examples:

PKZM0-16, PKZM4-16 or	PKZM0-16/20, PKZM4-16/20 or	PKZM0-20, PKZM4-20 or	PKZM0-25, PKZM4-25
4 × 16 A × 0.8 = 51.2 A	2 × (16 A + 20 A) × 0.8 = 57.6 A	3 × 20 A × 0.8 = 50 A	3 × 25 A × 0.8 = 60 A

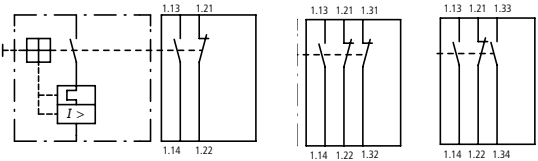
Motor-protective circuit-breakers

PKZM01, PKZM0 and PKZM4 – auxiliary contacts

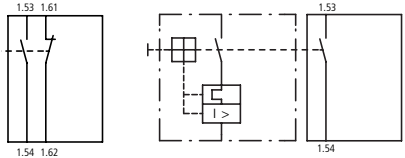
Auxiliary switches and standard auxiliary contacts NHI for PKZM01, PKZM0 and PKZM4

They switch at the same time as the main contacts. They are used for remote indication of the operating state, and interlocking of switches against one another. They are available with screw terminals or springloaded terminals.

Side mounted:

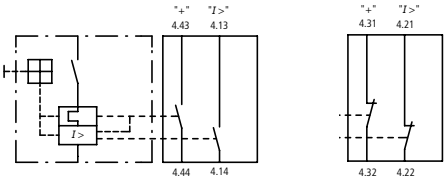


Integrated:



Trip-indicating auxiliary contacts AGM for PKZM01, PKZM0 and PKZM4

These provide information about the reason for the circuit-breaker having tripped. In the event of a voltage/overload release (contact 4.43-4.44 or 4.31-4.32) or short-circuit release (contact 4.13-4.14 or 4.21-4.22) two potential-free contacts are actuated independently of one another. It is thus possible to indicate the difference between short-circuit and overload.



Motor-protective circuit-breakers
PKZM01, PKZM0 and PKZM4 – releases

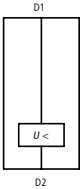
Voltage releases

These operate according to the electromagnetic principle and act on the switch mechanism of the circuit-breaker.

Undervoltage releases

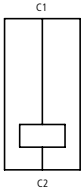
These switch the circuit-breaker off when no voltage is present. They are used for safety tasks. The undervoltage release U-PKZ20, which is connected to voltage via the early-make auxiliary contacts VHI20-PKZ0 or VHI20-PKZ01, allows the circuit-breaker to be switched on. In the event of power failure, the undervoltage release switches the circuit-breaker off via the switch mechanism. Uncontrolled restarting of machines is thus reliably prevented. The safety circuits are proof against wire breaks.

The VHI-PKZ0 can be used together with the PKZM4!



Shunt releases

These switch the circuit-breaker off when they are connected to voltage. Shunt releases can be provided in interlock circuits or for remote releases where voltage dips or interruptions are not to lead to unintentional switch off.

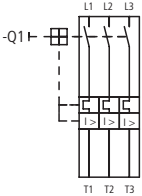


Motor-protective circuit-breakers

PKZM01, PKZM0 and PKZM4 – operating principle schematics

Motor-protective circuit-breakers PKZM01, PKZM0 and PKZM4

Manually operated motor-starter

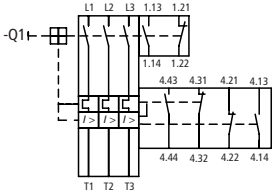


Motor-protective circuit-breakers

PKZM01, PKZM0 and PKZM4 – operating principle schematics

Motor-protective circuit-breakers with auxiliary switches and trip-indicating auxiliary contacts

PKZM01(PKZM0-...)(PKZM4...) + NHI11-PKZ0 + AGM2-10-PKZ0



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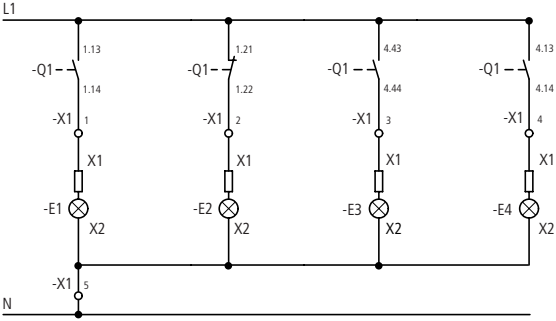
For differential fault message

(Overload or short-circuit)



E1: circuit-breaker ON
E2: circuit-breaker OFF
E3: general fault, overload release
E4: short-circuit release

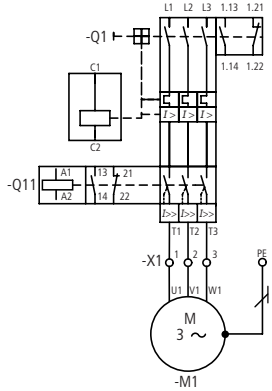
Motor-protective circuit-breakers

PKZM01, PKZM0 and PKZM4 – operating principle schematics

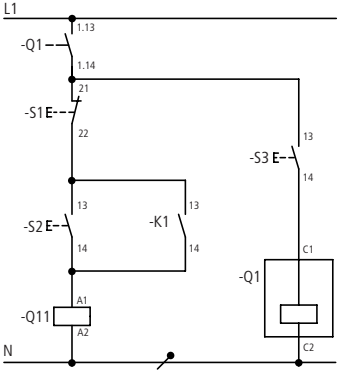
Remote switch off via shunt release

High-capacity compact starter with auxiliary contact and shunt release

PKZM0-.../S00-.. + A-PKZ0



Q11: Contact module



S1: Off

S2: On

S3: Circuit-breaker On

Motor-protective circuit-breakers
PKZ2 – overview

Motor and system protection

The PKZ2 achieves its modularity by combining the motor or system-protective circuit-breaker with various accessories. This results in numerous application options and adaptation to widely differing requirements.

The circuit-breaker

The circuit-breaker PKZ2/ZM... consists of:

- Basic device,
- Plug-in trip block.

There is a choice of trip blocks:

- Motor-protective trip blocks (11 versions for the range from 0.6 to 40 A)
- System-protective trip blocks (5 versions for the range from 10 to 40 A)

All trip blocks are equipped with adjustable overload and short-circuit releases.

Overload from ... to...:

- Motor-protective trip blocks: 8.5 to 14 $\times I_e$
- Motor-protective trip blocks: 5 to 8.5 $\times I_e$

Standards

The PKZ2 motor-protective circuit-breaker complies with the IEC 947, EN 60947 and EN 60947 standards. The circuit-breaker has a switching capacity of 30 kA/400 V. It is inherently short-circuit proof up to a rated operational current of 16 A. The PKZ2 also complies with the requirements stipulated in EN 60204 for disconnectors and main switches.

Special motor-protective trip block ZMR-...-PKZ2

This trip block features an overload relay function which allows the following interesting application:

In the event of an overload, the circuit-breaker does not trip. Instead, a normally closed contact (95–96) is actuated which switches off the contactor in the control circuit (contactors up to 18.5 kW, AC-3). At the same time, a normally open contact (97–98) is actuated, which ensures remote indication. The normally closed contact and normally open contact are suitable for carrying two different potentials.

The trip block has a manual and an automatic position:

- Automatic position: The normally closed contact and normally open contact automatically return to the original position after the bimetallic strips have cooled down. The contact can be actuated again by actuation, for example, of a pushbutton.
- Manual position: An acknowledgement locally, at the unit, moves the contacts back to the original position after tripping.

Important note!

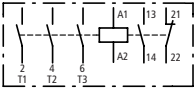
For an EEx e application, the normally closed contact 95–96 must be used to shed the contact module or contactor, to achieve disconnection.

Motor-protective circuit-breakers
PKZ2 – overview

(High-capacity) contact module S-...-PKZ2

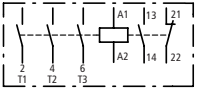
A compact starter combination is produced by combining a contact module S-...-PKZ2 (contactor) featuring the same contours with the PKZ2:

- Switch + standard contact module SE1A-...-PKZ2. The contact module features the same functions and properties of a standard contactor. It can be used for operational switching of 1 × 10^6 AC-3 operations.



- Switch + S-PKZ2... high-capacity contact module. A high-capacity compact starter is obtained by using a motor-protective circuit-breaker (PKZ2/ZM...) as the switch, and a combination circuit-breaker is produced by using a circuit-breaker (PKZ2/ZM-...-8) as the switch.

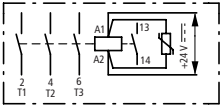
The high-capacity contact module increases the switching capacity of the combination to 100 kA/400 V, and is suitable for 1 × 10^6 AC-3 operations.



(High-capacity) contact module for 24 V DC control voltage

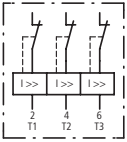
An actuating voltage of 1 V DC can be used with the contact module SE2A-G-PKZ24 (2 V DC) and the high-capacity contact module S-G-PKZ24 (24 V DC). It is necessary to take account of:

- Pick-up capacity: 150 VA,
- Pick-up current 6.3 A (16 – 22 ms)
- Holding power: 2.7 W,
- Holding current: 113 mA.



Current limiters CL-PKZ2

A specially developed current-limiter module which can be attached and featuring the same contours is available to increase the switching capacity of the circuit-breaker to 100 kA/400 V. In the event of a short-circuit the contacts of the PKZ2 and CL-PKZ2 will open. The PKZ2 trips via the magnetic release and remains in this position. The CL-PKZ2 returns to the rest position after the short-circuit. Both units are ready for operation again after the fault.



Motor-protective circuit-breakers
PKZ2 – remote operator

The remote operator allows the PKZ2 to be switched on and off remotely during operation. After tripping, it can be reset to 0 by the remote operator.

The PKZ2 system has two remote operators:

- In the RE-PKZ2 – the electronic remote operator for standard applications – both CONTROL and LINE are separate inputs, but with the same reference potential. This allows actuation using low current units, e.g. control circuit devices.
- The electronic remote operator RS-PKZ2 can be actuated directly, without any coupling elements, from the semiconductor outputs of a PLC (24 V DC).
  Electrical isolation between the CONTROL and LINE allows it to take power for the switching process from a separate power supply (e.g. 230 V 50 Hz).

Both remote operators must be supplied with the mains supply of 72 W/VA for 74 ms at the terminals 700–30 during the switching operation (On/Off/Reset). Twelve voltage versions are available per remote operator. These cover a wide application range. The remote operators can optionally be set for manual or automatic operation.

- Manual position: remote switching on is reliably electrically interlocked.
- Automatic position: remote switching is possible.

An integrated normally open contact (33–34) when closed indicates the automatic position of the remote operator.

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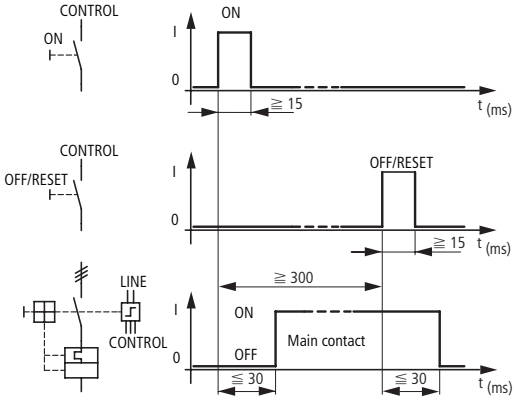
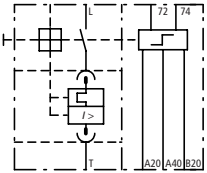
Minimum command time for the remote operators RE-PKZ2 and RS-PKZ2



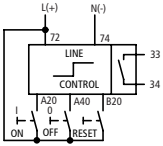
Motor-protective circuit-breakers

PKZ2 – remote operator

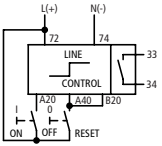
Remote operator RE-PKZ2



Off and Reset separate

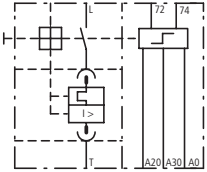


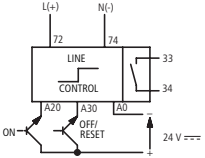
Off equals Reset

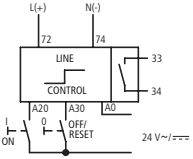


Remote operator RS-PKZ2

Off equals Reset







6

Motor-protective circuit-breakers
PKZ2 – release

Voltage releases

Undervoltage release U

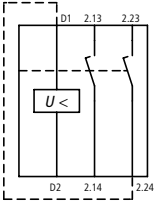
Undervoltage releases trip the circuit-breaker in the event of a power failure and prevent restarting when the power returns. Three versions are available:

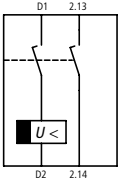
- Non-delayed,
- With/without early-make auxiliary contact,
- With 200 ms dropout delay.

Undervoltage releases which switch off without delay are suitable for Emergency-Stop circuits.

The undervoltage release can be energized early by an additional link (see circuit diagram).

Undervoltage release with a 200 ms dropout delay.

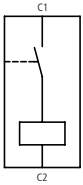




Shunt release A

Shunt releases trip the circuit-breaker when a voltage is applied. These are an economic option for switching off remotely.

Shunt releases are suitable for AC and DC, and one version covers a wide voltage range.



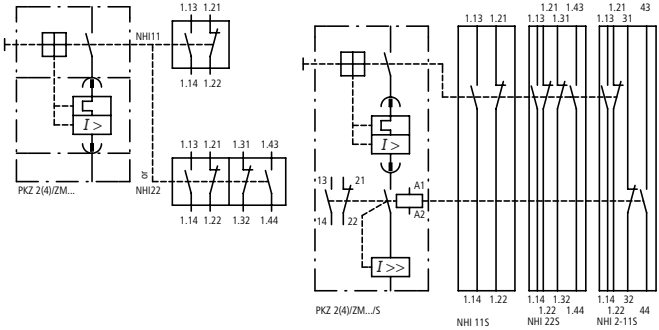
Motor-protective circuit-breakers

PKZ2 – auxiliary switches, trip-indicating auxiliary contacts

NHI standard auxiliary contacts

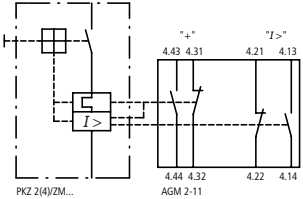
The NHI is available in two versions.
NHI for circuit-breakers, fitted and featuring the same contours, for indicating the position of the main contacts of the switch.

NHI ... S for the starter combination, featuring the same contours, for indication of the position of the main contacts of the contactor and/or those of the circuit-breaker.



Trip-indicating auxiliary contact AGM

The trip-indicating auxiliary contact is of particular importance. Two separate contact pairs signal that the circuit-breaker is in the tripped position. One contact pair (normally open & normally closed) signals general tripping and one pair signals tripping in the event of a short circuit. If the normally open contact 4.43/4.44 and the normally closed contact 4.21/4.22 are connected in series, then it is also possible to indicate overload tripping differentially.

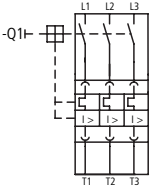


Motor-protective circuit-breakers

PKZ2 – operating principle schematics

Motor-protective circuit-breaker consisting of:

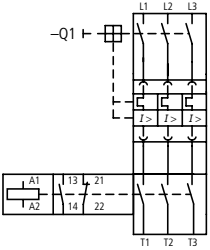
- PKZ2 basic unit
- Plug-in trip block Z



6

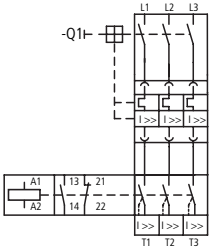
Compact starter, consisting of:

- Basic device
- Trip block
- Contact module SE1A...-PKZ2, which can be attached and has the same contours, for operational switching

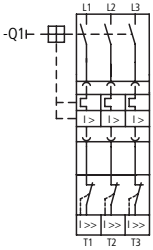


High-capacity compact starter, consisting of:

- Basic device
- Trip block
- High-capacity contact module fitted with same contour profile



Circuit-breaker with current limiter fitted



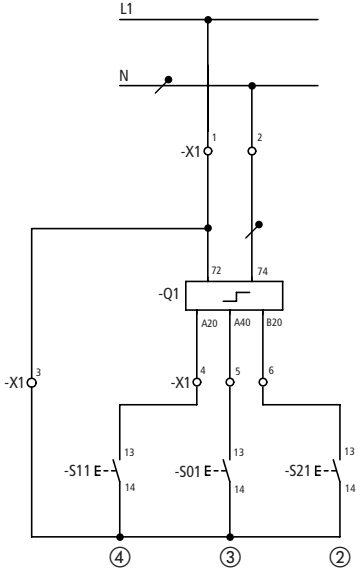
Motor-protective circuit-breakers
PKZ2 – operating principle schematics

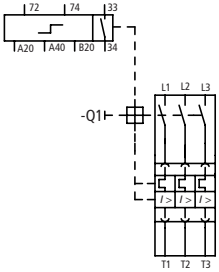
On-off switching with remote operator

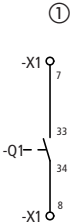
Separate actuation of OFF and RESET

Circuit-breaker with remote operator, standard version.

Example 1: PKZ2/ZM-.../RE(...)







① Separate actuation of OFF and Reset
② Reset
③ OFF
④ ON

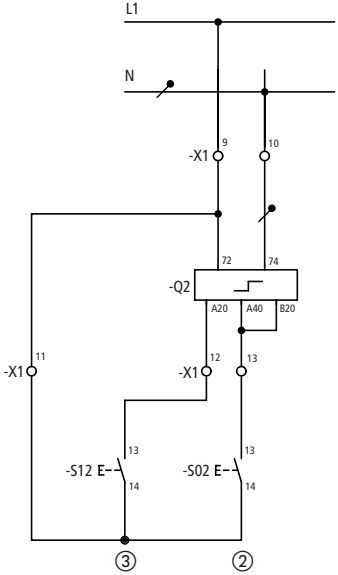
Actuation by control circuit devices (for example pushbuttons NHI, AGM, VS3, EK...SPS with floating contacts).

Auxiliary switch for signalling the manual/automatic position of the remote operator. Indicates the automatic position when closed.

Motor-protective circuit-breakers
PKZ2 – operating principle schematics

Common actuation of OFF and RESET

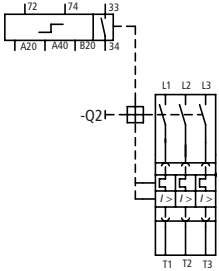
Circuit-breaker with remote operator, standard version.



① Off = Reset
② Off/Reset
③ ON

Actuation by control circuit devices (for example pushbuttons NHI, AGM, VS3, EK...SPS with floating contacts).

Example 2: PKZ2/ZM-.../RS(...)

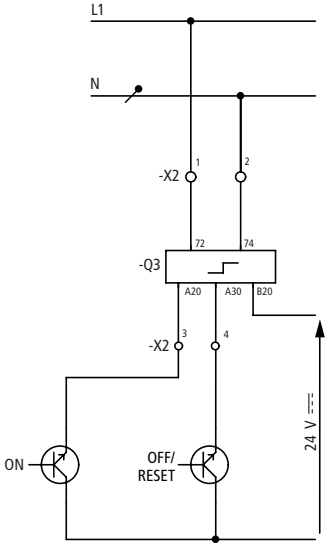


Auxiliary switch for signalling the manual/automatic position of the remote operator. Indicates the automatic position when closed.

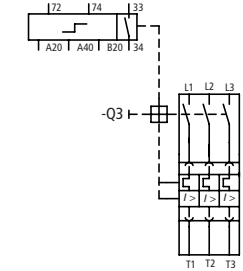
Motor-protective circuit-breakers
PKZ2 – operating principle schematics

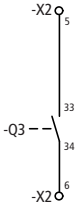
Circuit-breaker with remote operator, 24 V DC version with electronic outputs

For direct actuation by a programmable logic controller (PLC).



Example 3: PKZ2/ZM-.../RS(...)





Actuation by PLC with 24 V DC electronic outputs.
Auxiliary switch for signalling the manual/automatic position of the remote operator.

Indicates the automatic position when closed.

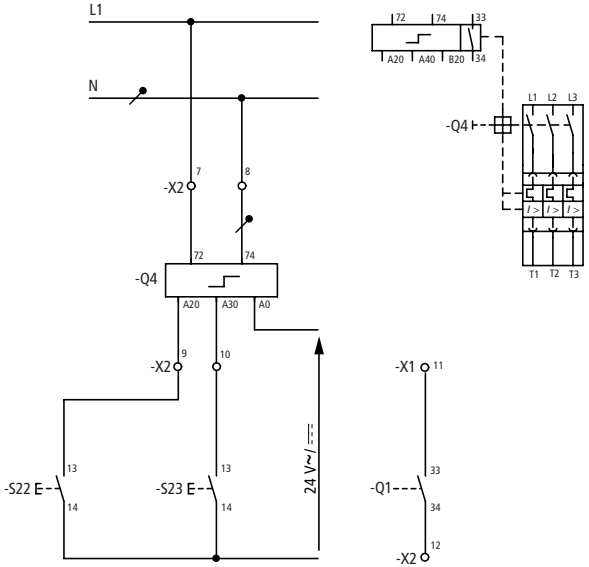
6

Motor-protective circuit-breakers
PKZ2 – operating principle schematics

Circuit-breaker with remote operator

Actuation by control circuit devices.

Example 4: PKZ2/ZM-.../RS(...)



S22: On
S23: Off/Reset

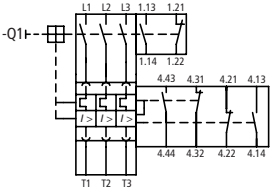
Actuation by control circuit devices via 24 V AC/DC.
Auxiliary switch for signalling the manual/automatic position of the remote operator. Indicates the automatic position when closed.

Motor-protective circuit-breakers
PKZ2 – operating principle schematics

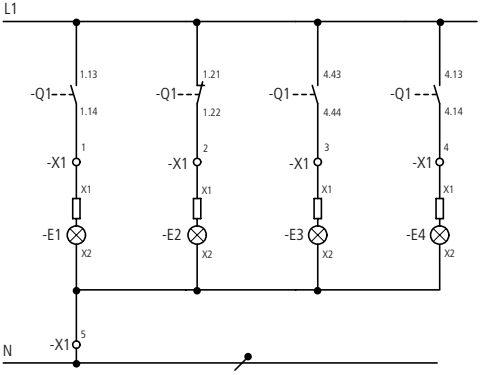
Indication by auxiliary switches

Circuit-breaker with auxiliary contact and trip-indicating auxiliary contact.

Example: PKZ2/ZM-... + NHI11-PKZ2 + AGM2-11-PKZ2



For differential fault indication.



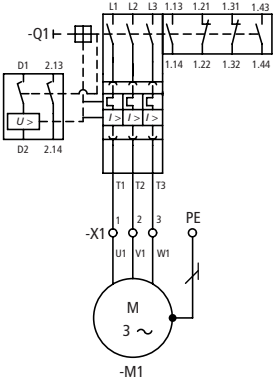
E1: Circuit-breaker On
E2: Circuit-breaker Off
E3: General fault, Overload tripping
E4: Short-circuit tripping

Motor-protective circuit-breakers

PKZ2 – operating principle schematics

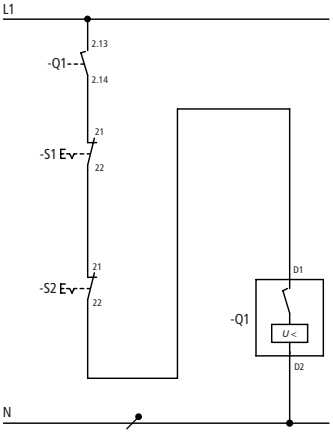
Use of the undervoltage release in the Emergency-Stop circuit

Motor-protective circuit-breaker with auxiliary contact and undervoltage release.



Example: PKZ2/ZM... + NHI22-PKZ2 + UHI-PKZ2

All poles of the Emergency-Stop circuit are isolated from the mains supply in the event of a power failure.



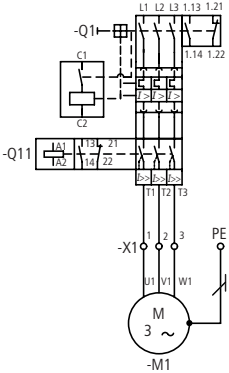
S1: Emergency-Stop
S2: Emergency-Stop

Motor-protective circuit-breakers
PKZ2 – operating principle schematics

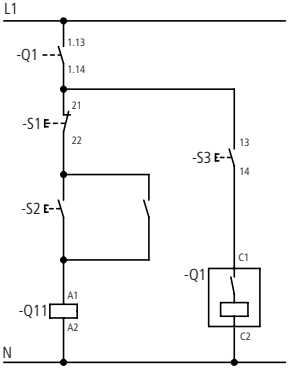
Remote switch off via shunt release

High-capacity compact starter with auxiliary contact and shunt release

Example: PKZ2/ZM-.../S-PKZ2 + A-PKZ2



Q11: High-capacity contact module



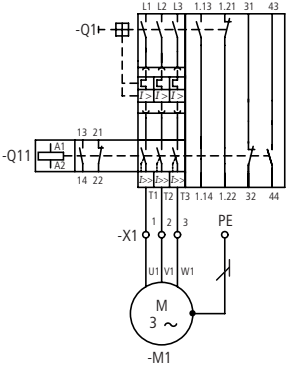
S1: Off
S2: On
S3: Circuit-breaker Off

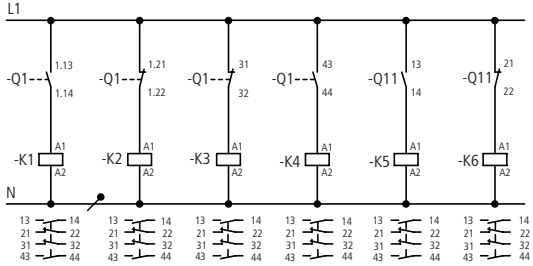
Motor-protective circuit-breakers

PKZ2 – operating principle schematics

High-capacity compact starter with maximum number of auxiliary contacts fitted

Example: PKZ2/ZM.../S-PKZ2 + NHI2-11S-PKZ2





K1: Circuit-breaker On
K2: Circuit-breaker Off
K3: Contact module Off
K4: Contact module On
K5: Contact module On
K6: Contact module Off

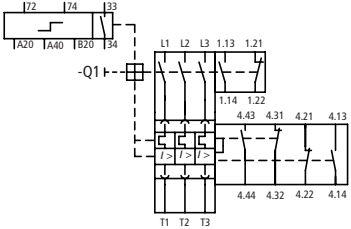
Motor-protective circuit-breakers

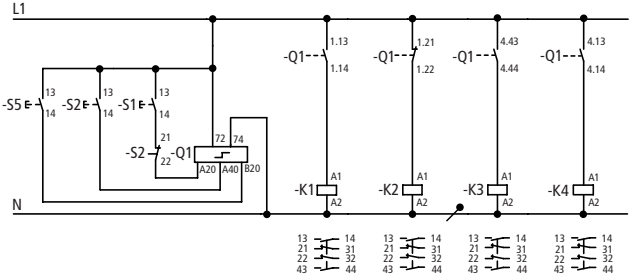
PKZ2 – operating principle schematics

Remotely actuated circuit-breaker with switch status indication

Motor-protective circuit-breaker with remote operator + auxiliary contact (1 NO, 1 NC) + trip indicating auxiliary contact

Example: PKZ2/ZM.../RE + NHI11-PKZ2 + AGM2-11-PKZ2



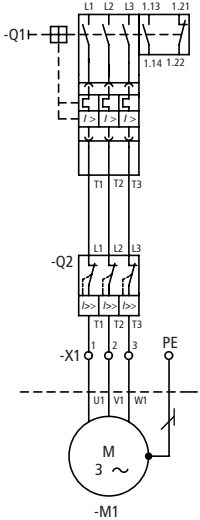


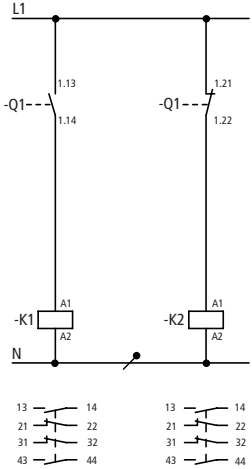
S1: On
S2: Off
S5: Reset
Q1: Auxiliary contact, indication: manual-auto
K1: Circuit-breaker On
K2: Circuit-breaker Off
K3: Overload indication
K4: Short-circuit indication

Motor-protective circuit-breakers
PKZ2 – operating principle schematics

Circuit-breaker with current limiter in separate mounting

Example: PKZ2/ZM... + NHI11-PKZ2 with CL/EZ-PKZ2





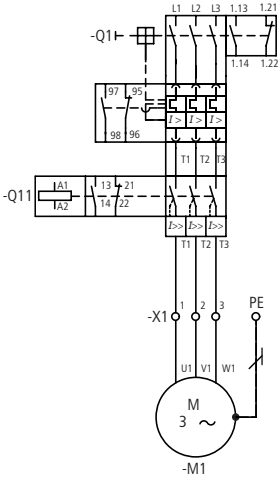
K1: Circuit-breaker On
K2: Circuit-breaker Off

Q2: Current limiter, separate mounting

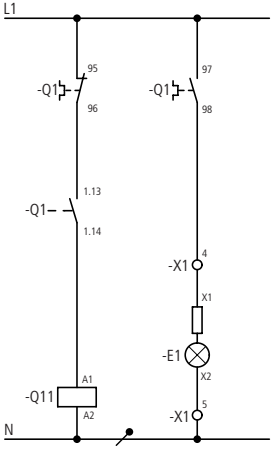
Motor-protective circuit-breakers
PKZ2 – operating principle schematics

ZMR-...-PKZ2 special trip block with overload relay function

For switching off a contactor in the control circuit in the event of an overload by means of a trip block ZMR-...PKZ2 with an overload relay function and with simultaneous indication. The circuit-breaker thumb-grip remains in the "On" position. Circuit-breaker with trip block ZMR, high-capacity contact module S and NHI11-PKZ2.



Q11: High-capacity contact module



Q11: Shutdown
E1: Overload indication

Notes