Circuit-breakers

Circuit-breakers
Overview

NZM circuit-breakers

Circuit-breakers are mechanical switching devices that switch currents in the circuit on or off and control them under normal operating conditions. These circuit-breakers protect electrical equipment from thermal overloads and in the event of a short-circuit.

The NZM circuit-breakers cover the rated current range from 20 to 1600 A.

Depending on the version, they have additional protective functions such as residual current device, earth-fault protection or the capability for energy management by detecting load peaks, and selective load shedding. NZM circuit-breakers stand on account of their compact shape and their current-limiting characteristics.

Switch-disconnectors without overload or tripping units are available in the same sizes as the circuit-breakers and can be fitted with additional shunt or undervoltage release to suit the versions concerned.

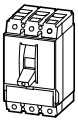
NZM circuit-breakers and switch-disconnectors are built and tested to the specifications in standard IEC/EN 60947.

They feature isolating characteristics. In conjunction with a locking facility, they are suitable for use as main switches to IEC/EN 60204/VDE 0113, part 1.

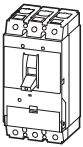
The electronic release of frame sizes NZM2, NZM3 and NZM4 feature communication capabilities. The actual states of the circuit-breakers can be visualized locally via a Data Management Interface (DMI) or converted to digital output signals. Additionally, the circuit-breakers can be connected to a network, e.g. PROFIBUS-DP.

NZM1

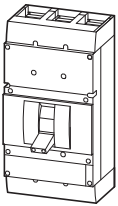
NZM2



NZM3



NZM4



Notes

The NZM7, NZM10 and NZM14 circuit-breakers are no longer contained in the Eaton range. They have been replaced by a new generation of devices. Information on the above devices is provided in this chapter.

Circuit-breakers
Overview

IZMX circuit-breakers

The IZMX circuit-breakers are designed for use in the high rated current range from 630 A.
IZMX circuit-breakers and INX switch-disconnectors provide the main switch isolation functions required by the IEC/EN 60204-1 standard as they are lockable in the OFF position. They can therefore be used as mains switches. IZM circuit-breakers are built and tested in accordance with IEC/EN 60947.

Depending on the type of equipment protected, the following main areas of application are possible with different settings to the release electronics:

- System protection,
- Motor protection,
- Transformer protection,
- Generator protection.

IZMX circuit-breakers offer different electronic units from simple system protection with overload and short-circuit release right through to the digital release with graphical display and the possibility to create time selective networks.

They can be adapted to a wide range of requirements with a comprehensive range of mounted accessories such as auxiliary contacts, trip-indicating auxiliary contacts, motor operators or voltage release, fixed-mounted or withdrawable units.

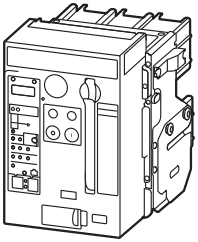
With their communication capability, the IZMX circuit-breakers open up new possibilities in power distribution. Important information can be passed on, collected and evaluated, also for preventative maintenance. For example, by enabling rapid intervention in processes, system downtimes can be reduced or even prevented.

Selection criteria of an IZM circuit-breaker are:

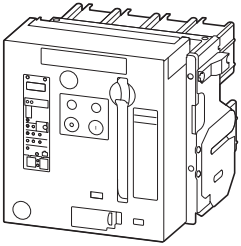
- Max. short-circuit current I_{kmax},
- Rated operating current I_n,
- Ambient temperature,
- 3 or 4-pole design,
- Fixed mounting or withdrawable units,
- Protective function,
- Min. short-circuit current.

Detailed information on the circuit-breakers is provided in chapter 18 of the Eaton Industrial Switchgear Catalog 2010.

IZMX16

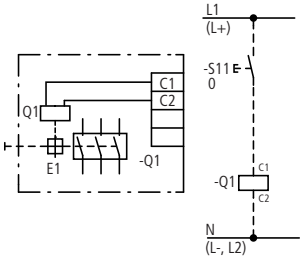


IZMX40



Circuit-breakers
Shunt release

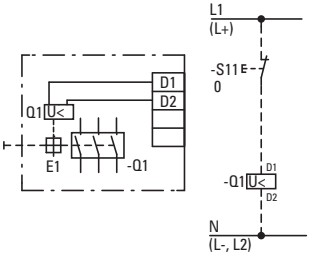
Shunt release A



Module (Q1, solenoid) of a circuit-breaker or motor-protective circuit-breaker that actuates a release mechanism when voltage is applied. When de-energized, the system is in the rest position.
A normally open contact actuates the system. If the shunt release is rated for intermittent duty (overexcited shunt release with 5 % DF), the intermittent operation must be ensured by connecting an appropriate auxiliary contact of the circuit-breaker upstream. This measure is not required when using a shunt release with 100 % DF.
Shunt releases are used for remote tripping when an interruption in the voltage is not intended to lead to automatic disconnection. Tripping does not occur in the event of wire breakage, loose contacts or undervoltage.

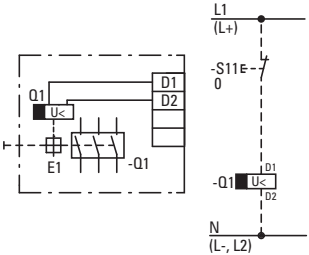
Circuit-breakers
Undervoltage releases

Undervoltage release U



A passive electromagnetic relay (Q1) which actuates a release mechanism when the supply voltage drops or is interrupted, in order, for example, to prevent the automatic restarting of motors. Undervoltage releases are also suitable for very reliable interlocking and remote off switching since disconnection always occurs in the event of a fault (e.g. wire breakage in the control circuit). The circuit-breakers cannot be reclosed when the undervoltage releases are de-energized.
The system is in the rest position when energized. Actuation is produced by a normally closed contact. Undervoltage releases are always designed for uninterrupted operation. These are the ideal tripping elements for totally reliable interlocking tasks (e.g. emergency offswitching).

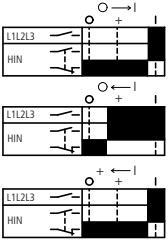
Off-delayed undervoltage release UV



The off-delayed undervoltage release (Q1) is a combination of a separate delay unit (UVU) and the respective release. This release is used to prevent brief interruptions in power leading to disconnection of the circuit-breaker. The delay time can be set between 0.06 and 16 s.

Circuit-breakers
Contact diagrams of the auxiliary contacts

Auxiliary contact – standard HIN

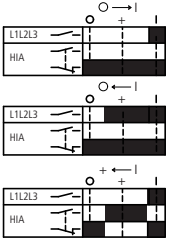


Auxiliary contacts are used to provide command or signal outputs from processes which are governed by the position of the contacts. They can be used for interlocking with other switches, and for the remote indication of the switching state. Auxiliary contacts have the following properties:

- Standard auxiliary contacts behave like main switch contacts
- Switch position indication
- Interlocking
- Disconnection of the shunt release

7

Auxiliary contact – trip-indicating HIA



0 → I
Switch on
0 ← I
Switch off
+← I
Trip
■ Contact closed
□ Contact open

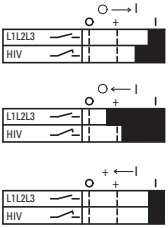
Used to provide command and signal output relating to electrical tripping of the circuit-breaker (trip position +) as is required, for example, for mesh network circuit-breakers. No pulse is produced when the switch is opened or closed manually or by a motor operator.

- Indication that the switch is in the tripped position
- Switch position indication only if tripping is caused by, for example, overcurrent, short-circuit, test or voltage release. No fleeting contact when switched on or off manually or switched off with the motor (exception: manual switch off with motor operator NZM2, NZM3, NZM4).

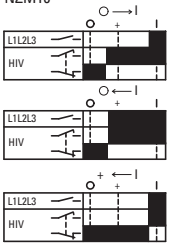
Circuit-breakers
Contact diagrams of the auxiliary contacts

Auxiliary contact – early make HIV

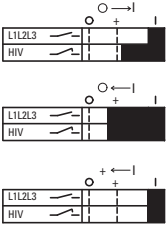
NZM1, NZM2, NZM3, NZM7



NZM10



NZM4



Early-make auxiliary contacts are used to provide command or signal outputs for processes which are initiated before the closure or opening of the main contact system. Because they close early, they can be used for interlocks with other switches. Furthermore, they allow a switch position indication.
With the circuit-breaker in the Tripped position, the HIV is in the same position as it is at OFF. Because of its early-make characteristics, it can be used to apply voltage to the undervoltage release.
→ Section "Undervoltage releases", page 7-5,
→ Section "Remote switch-off with voltage release", page 7-11,
→ Section "Applications of the undervoltage release", page 7-13.

0 → I
Switch on
0 ← I
Switch off
+← I
Trip
■ Contact closed
□ Contact open

Circuit-breakers
Internal circuit diagrams NZM

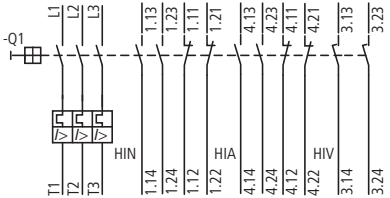
Maximum configuration

	NZM...			
	1	**2**	**3**	**4**
HIN: 1 NO, 1 NC, 2 NO, 2 NC or 1NO/1NC	1	2	3	3
HIA: 1 NO, 1 NC, 2 NO, 2 NC or 1NO/1NC	1	1	1	2
HIV: 2 S	1	1	1	1

If a motor operator is used at the same time, a configuration with 2 NO, 2 NC or 1 NO/1NC (double auxiliary contact) is restricted on the NZM3 circuit-breaker.

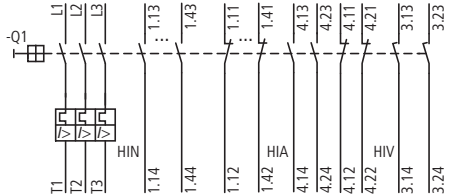
For this observe the latest installation instructions.

NZM1



Contact elements M22-K10 (K01, K20, K02, K11) from the RMQ-Titan range from Eaton are used for the auxiliary contacts. Two early-make auxiliary contacts (2 NO) are also available.

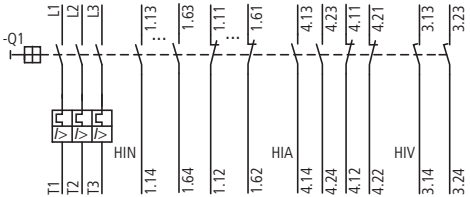
NZM2



Information on the auxiliary contacts
→ Section "Maximum configuration", page 7-8

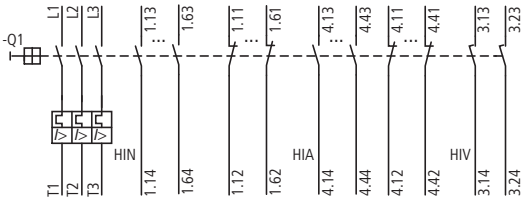
Circuit-breakers
Internal circuit diagrams NZM

NZM3



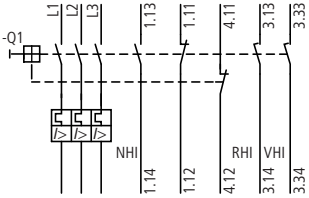
Details about the auxiliary contacts
→ Section "Maximum configuration", page 7-8

NZM4



Details about the auxiliary contacts
→ Section "Maximum configuration", page 7-8

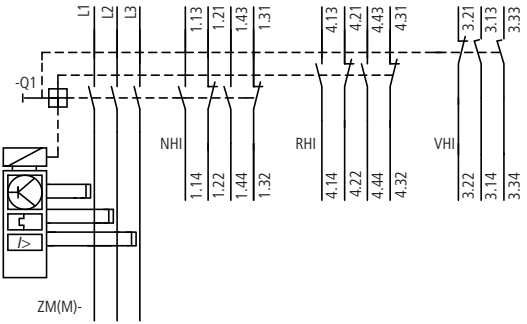
NZM7



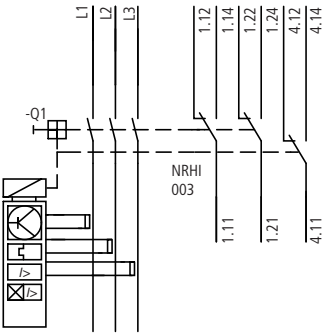
In the NZM7 circuit-breaker two auxiliary contact modules can be fitted as NHI (NC or NO) as well as a trip-indicating auxiliary contact RHI (NC or NO). Contact elements EK01/EK10 are used from the Eaton RMQ range of pilot devices. Early-make auxiliary contacts (2 NO) are also available.

Circuit-breakers
Internal circuit diagrams NZM

NZM10



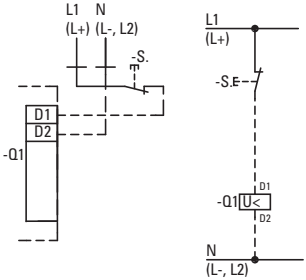
NZM14



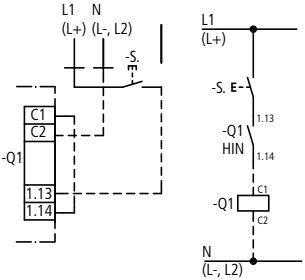
Circuit-breakers

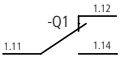
Remote switch-off with voltage release

Remote switch-off with undervoltage releases



Remote switch-off with shunt release





Terminal marking for NZM14

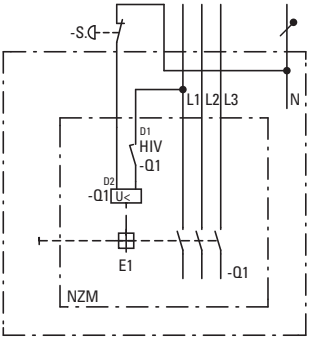
When the switch is in the Off position, the entire control circuit is live.

In order to de-energize the entire actuating circuit when using a shunt release, the control voltage must be connected downstream of the switch terminals.

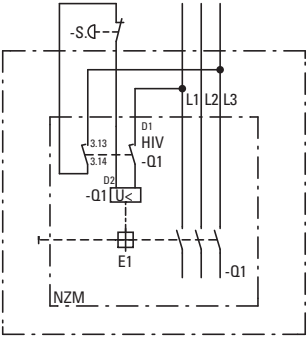
Circuit-breakers

Remote switch-off with voltage release

Main switch application in processing machines with Emergency-Stop function conform to the IEC/EN 60204-1, VDE 0113 part 1

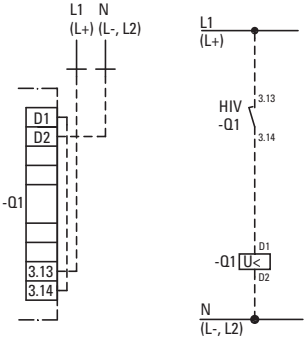


In the OFF position of the main switch all control elements and control cables which exit the control panel are de-energized. The only live components are the control-voltage tap-offs with the control lines to the early-make auxiliary contacts.



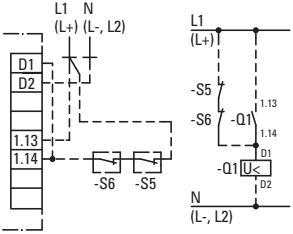
Circuit-breakers
Applications of the undervoltage release

Switch off of the undervoltage release



The early-make auxiliary contact HIV (Q1) can – as shown above – disconnect the undervoltage release from the control voltage when the circuit-breaker is in the Off position. If the undervoltage release is to be disconnected in 2 poles, then a further normally open contact of Q1 must be connected between terminals D2 and N. The early-make auxiliary contact HIV (Q1) will always apply voltage to the undervoltage release in time to permit closure.

Starting interlock of the undervoltage release

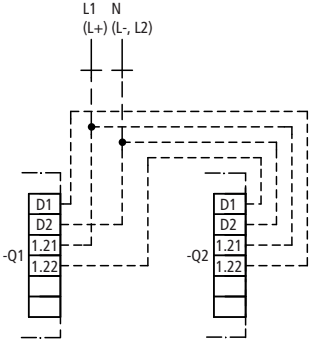


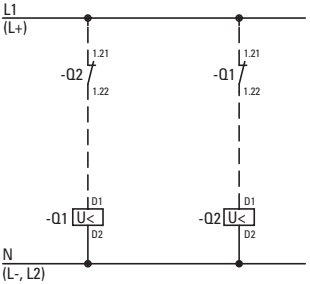
Circuit-breakers with an undervoltage release produce a positive Off position in conjunction with an interlocking auxiliary contact on the starter (S5), ancillary devices on the motor (e.g. brush lifting, S6) or on all switches in multi-motor drives.

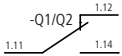
The circuit-breaker can only be closed if the starter or switch is in the zero or OFF position.

Circuit-breakers
Switch off of the undervoltage release

Interlocking of several circuit-breakers using an undervoltage release





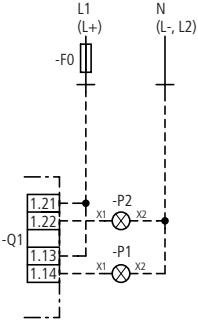


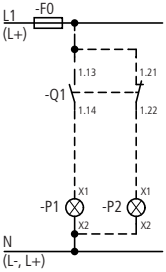
Terminal marking for NZM14

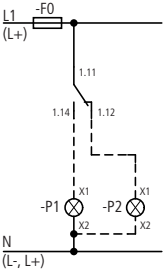
When interlocking 3 or more circuit-breakers, each circuit-breaker must be interlocked with the series-connected normally closed contacts of the auxiliary contacts on the other circuit-breakers using one contactor relay – for contact duplication – per auxiliary contact. If one of the circuit-breakers is closed, the others cannot be closed.

Circuit-breakers
Indication of the contactor state

ON and OFF indication with auxiliary contact – standard HIN (Q1)



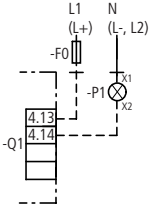


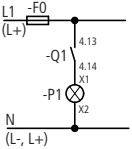


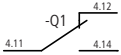
P1: On
P2: Off

Tripped indication using trip-indicating auxiliary contact HIA (Q1)

Trip-indicating auxiliary contacts for mesh network circuit-breaker







Terminal marking for NZM14

P1: Tripped

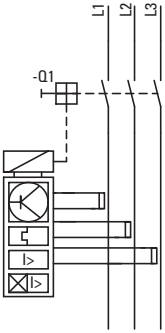
Circuit-breakers

Short-time delayed circuit-breaker – internal circuit diagrams

Time-discriminating network topology

Short-time delayed circuit-breakers NZM2(3)(4)/VE, NZM10/ZMV and NZM14 enable a time-discriminating network design with variable stagger times.

Where the prospective short-circuit currents are extremely high, additional installation protection is achieved by instantaneous releases, which respond without any delay.



NZM2(3)(4)…-VE…
Trip block VE

Adjustable short-time delay:

0, 20, 60, 100, 200, 300, 500, 750, 1000 ms

NZM10../ZMV..
ZMV trip block only for circuit-breaker types:

NZM10-...N

NZM10…S

Adjustable short-time delay:

0, 10, 50, 100, 150, 200, 300, 500, 750, 1000 ms

NZM14-... S(H)
Standard circuit-breakers

NZM14-...S

NZM14-...H

Adjustable short-time delay:

100, 150, 200, 250, 300 ms

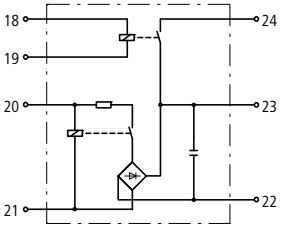
Circuit-breakers
Mesh network circuit-breakers

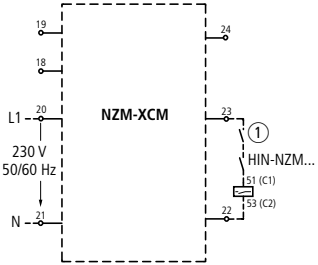
NZM1, NZM2, NZM3, NZM4, NZM7, NZM10, NZM14

Circuit with capacitor unit and shunt release 230 V, 50 Hz.

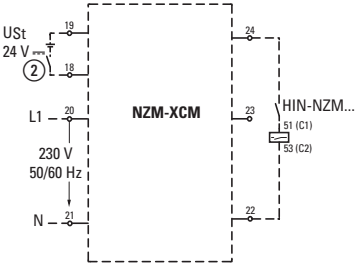
The configuration of the capacitor unit which provides the energy for the shunt release of the mesh network circuit-breaker can be undertaken independently of the circuit-breaker.

Connect NZM-XCM to the supply side!





① Mesh network relay



② Mesh network relay with low power contacts

Circuit-breakers

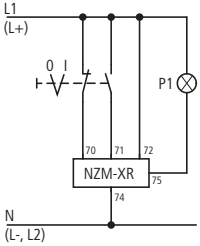
Remote operation with motor operator

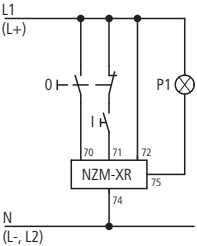
Two-wire control (continuous contact)

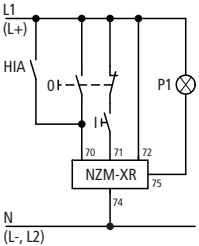
Three-wire control (pulse contact)

Three-wire control with automatic return to the Off position after tripping

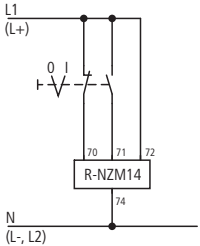
NZM2, NZM3, NZM4, NZM7, NZM10

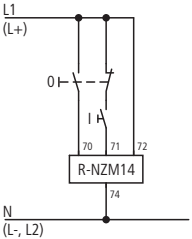


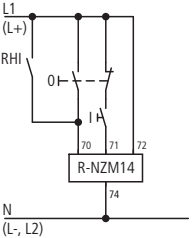




NZM14







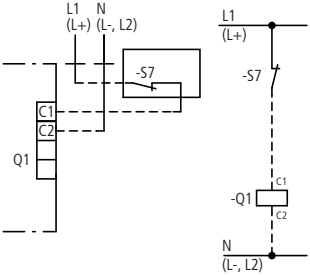
Circuit-breakers

Circuit-breaker as transfomer switch

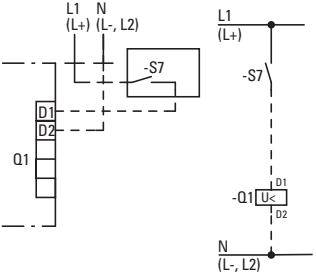
Faults upstream of the low-voltage circuit-breaker, e.g. in the transformer itself, are disconnected by suitable protective devices (e.g. a Buchholz relay) on the high-voltage side. The S7 auxiliary contact of the high-voltage circuit-breaker trips out the NZM transformer switch on the low-voltage side in order to prevent feedback to the high-voltage network. S7 thus isolates the transformer from the network on both sides. This interlocking with the high-voltage circuit-breaker must always be provided when transformers are being operated in parallel.

If only one normally open contact is available as the auxiliary contact, an undervoltage release must be used instead of the shunt release. At the same time, this provides protection against undervoltage.

Circuit-breakers with shunt release (Q1) (



Circuit-breakers with undervoltage release (Q1)



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Circuit-breakers

Circuit-breaker with residual current device

Residual current releases combined with circuit-breakers are used for protection against the effects of fault currents. These device combinations fulfill the following tasks:

- Overload protection,
- Short-circuit protection,
- Fault-current protection.

Depending on type the earth-fault releases protect the following:

- Persons against direct contact (basic protection),
- Persons against indirect contact (fault protection),
- Dangers of an earth fault (fire etc.)

These kinds of earth-fault releases can be attached to the NZM1 and NZM2 circuit-breakers. No auxiliary voltage is required. In the event of a fault, the earth-fault release trips the circuit-breaker, i.e. the main contacts are opened. The circuit-breaker and the earth-fault release must be reset to restore the supply.

Part no.	Rated current range A	Rated operational voltage U_e V	Response value of earth fault release $I_{\Delta n}$ A	Delay time t_v ms	Sensitivity
NZM1(-4)-XFI30(R)(U)	15 – 125	200 – 415	0.03	–	Pulsating current
NZM1(-4)-XFI300(R)(U)	15 – 125	200 – 415	0.3	–	
NZM1(-4)-XFI(R)(U)	15 – 125	200 – 415	0.03; 0.1; 0.3 0.5; 1; 3	10; 60; 150; 300; 450	
NZM2-4-XFI30[1)]	15 – 250	280 – 690	0.03	–	
NZM2-4-XFI[1)]	15 – 250	280 – 690	0.1; 0.3; 1; 3	60; 150; 300; 450	
NZM2-4-XFI30A[1)]	15 – 250	50 – 400	0.03	–	AC/DC
NZM2-4-XFIA[1)]	15 – 250	50 – 400	0.1; 0.3; 1	60; 150; 300; 450	

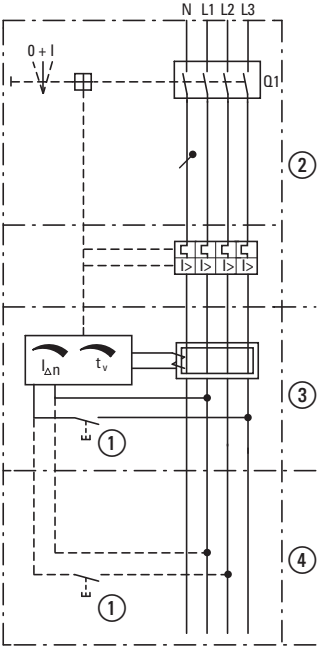
[1)] Devices are not dependent on the supply voltage.

Circuit-breakers

Circuit-breaker with residual current device

Circuit-breakers can be used together with residual current releases in three-phase and single-phase systems.

With 2-pole operation it must be ensured that voltage is applied to both terminals required for test functions.



① Test button (T)
② NZM1-(4)…, NZM2-4…
③ +NZM2-4-XFI
④ NZM1-(4)-XFI

Trip indication is implemented via auxiliary contacts. Circuit-breaker NZM2-4 -XFI… has fixed contacts. The NZM1(-4)-XFI… allows two M22-K… contact elements from the Eaton RMQ-Titan range to be clipped in.

Contact representation for "not released"
NZM1(-4)-XFI…

NZM2-4-XFI…

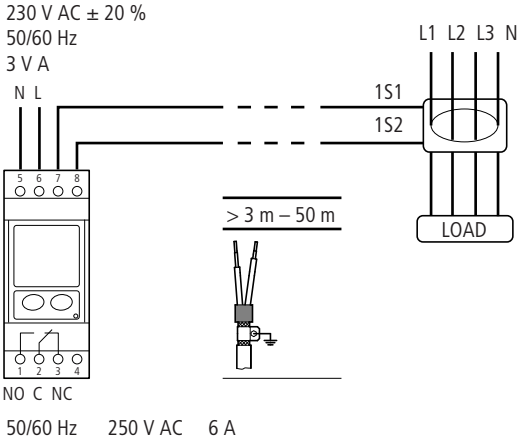
Circuit-breakers
Circuit-breaker with residual current device

Residual-current relays PFR with ring-type transformers

The area of application for the relay/transformer combination ranges – depending on the standards involved – from personnel protection to fire prevention to general protection of systems for 1 to 4-pole electrical power networks.
There are three different relay types and seven different transformer types available. They cover operating currents ranging from 1 to 1800 A.
The three relay types have the following features:

- Rated fault current 30 mA, permanently set,
- Rated fault current 300 mA, permanently set,
- Rated fault current from 30 mA to 5 A and a delay time from 20 ms to 5 s which is variable in stages.

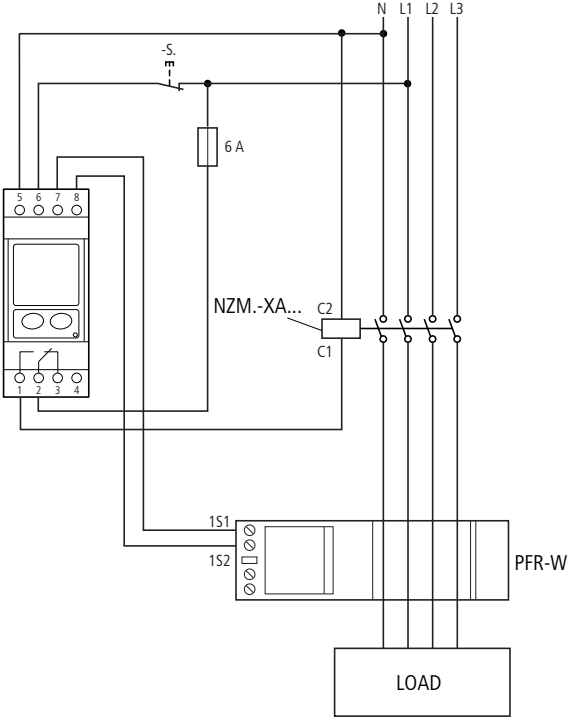
The residual current relay indicates when a fault current has exceeded the predefined fault current by using a changeover contact. The contact signal can be processed further as a signal in programmable logic controllers or can initiate a trip via the undervoltage release of a circuit-breaker/switch-disconnector. The compact ring-type transformer is placed without any particular space requirement at a suitable position in the power chain.



Circuit-breakers

Circuit-breaker with residual current device

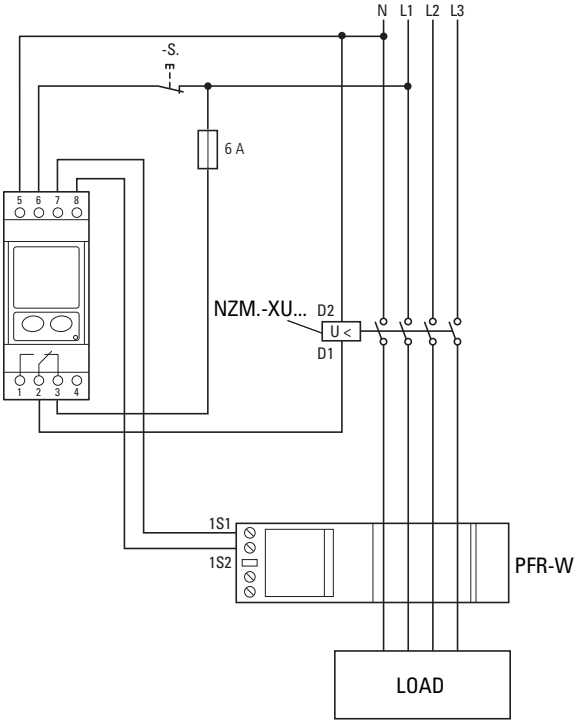
Trip of circuit-breakers with shunt release and possible external reset of the relay by a pushbutton (NC contact)



Circuit-breakers

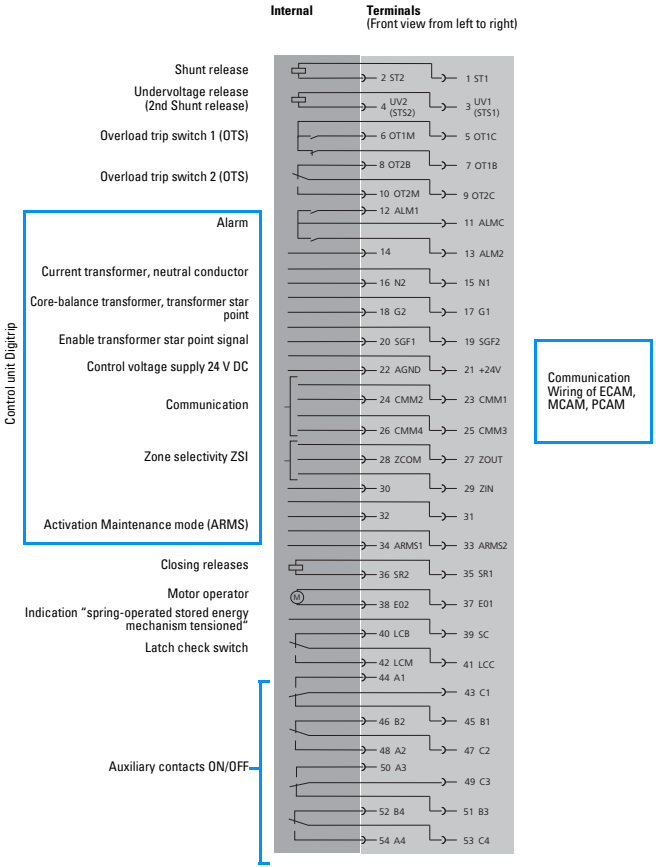
Circuit-breaker with residual current device

Trip of circuit-breakers with undervoltage release and possible external reset of the relay by a pushbutton (NC contact)



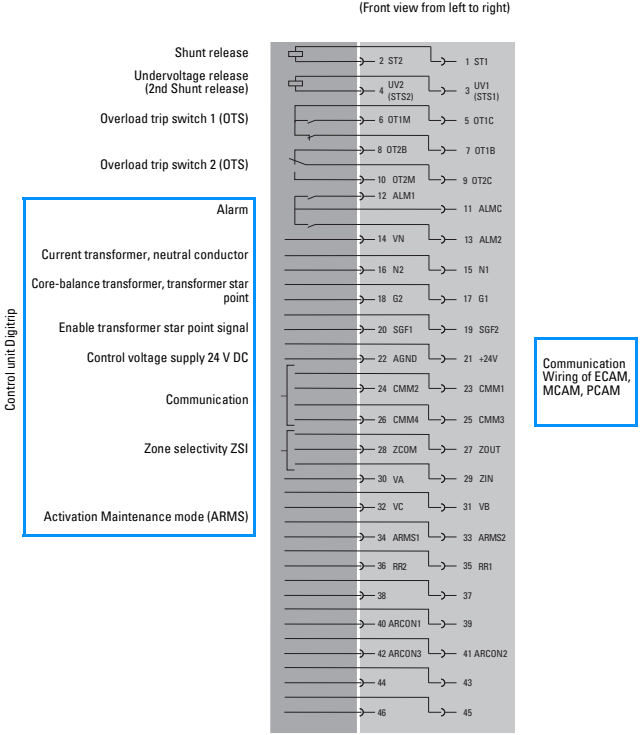
Circuit-breakers
Terminal assignments of IZMX circuit-breakers

Terminal assignment IZMX16



Circuit-breakers
Terminal assignments of IZMX circuit-breakers

Terminal assignment IZMX40



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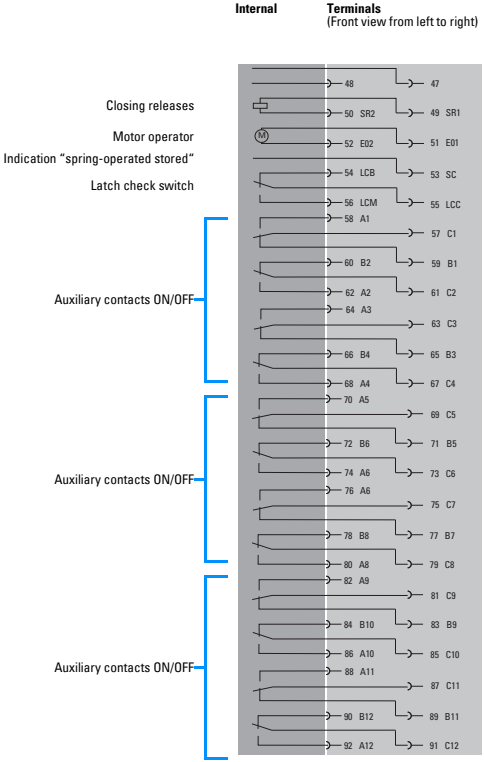
Circuit-breakers
Terminal assignments of IZMX circuit-breakers

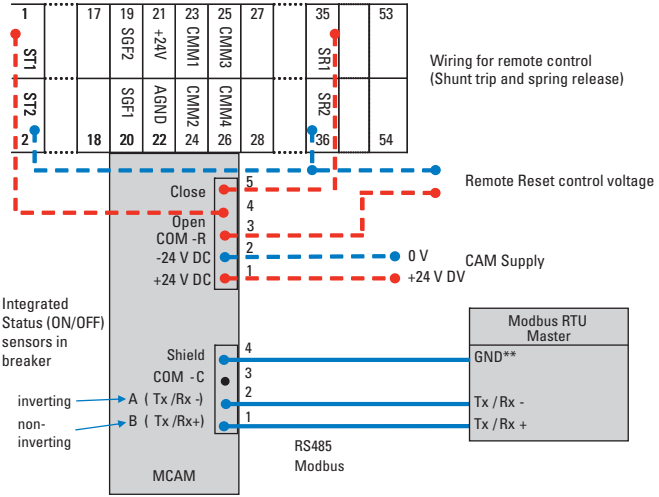
Terminal assignment IZMX40



Circuit-breakers
Terminal assignments of IZMX circuit-breakers

Plan view of a mounted MCAM on IZMX...

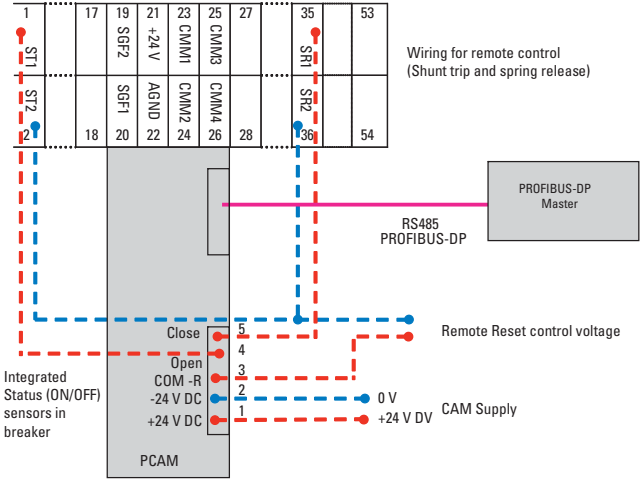
Terminal diagram Modbus



Circuit-breakers
Terminal assignments of IZMX circuit-breakers

Plan view of a mounted PCAM on IZMX...

Terminal diagram PROFIBUS DP



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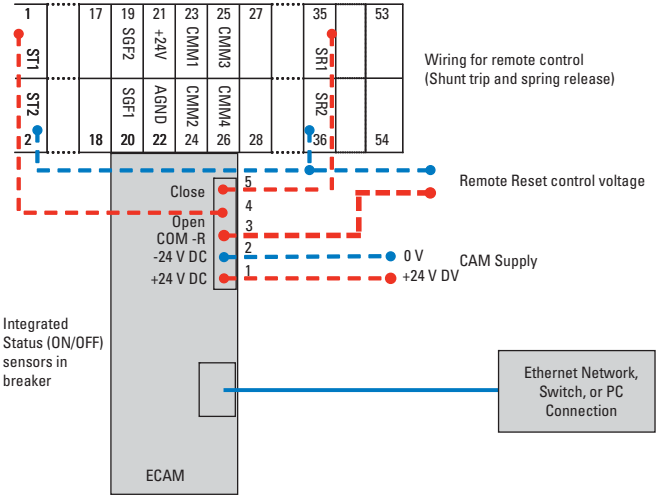
Circuit-breakers
Terminal assignments of IZMX circuit-breakers

Plan view of a mounted ECAM on IZMX...

Terminal diagram Ethernet



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