Circuit-breakers

7

Circuit-breakers
Overview

NZM circuit-breakers

These circuit-breakers protect electrical equipment against thermal overloading and in the event of a short circuit. They cover the rated current range from 20 to 1600 A.

Depending on the version, they have additional protective functions such as fault-current protection, earth-fault protection or the capability for energy management by recognition of load peaks, and deliberate load shedding.

Circuit-breakers NZM are distinguished by their compact shape and their current-limiting characteristics.

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

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

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

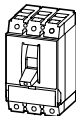The electronic releases of frame sizes NZM2, NZM3 and NZM4 feature communication capabilities.

The current states of the circuit-breaker onsite can be visualized via a **D**ata **M**anagement **I**nterface (DMI) or via digital output signals. Additionally, the circuit-breakers can be connected to a network, e.g. PROFIBUS-DP.
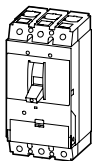
7

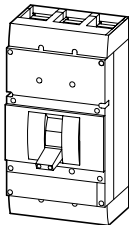NZM1   NZM2   NZM3   NZM4

Circuit-breakers
Overview, shunt releases

IZM circuit-breakers

These circuit-breakers protect electrical equipment in the rated current range from 630 to 6300 A. They have digital tripping electronics, which are available in four different versions.

The tripping units offer extensive protection and signalling functions, extending from standard short-circuit and overload protection to energy management with data transmission.

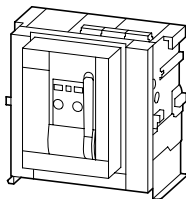Circuit-breakers IZM are built and tested to the specifications in IEC/EN 60947.

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

The circuit-breakers in the IZM range are also available as IN switch-disconnectors without tripping units.
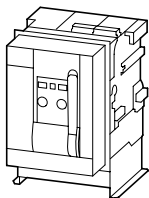
IZM1   **IZM2**   **IZM3**
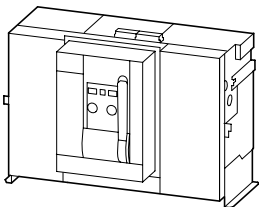
7

Shunt releases A (Q1)
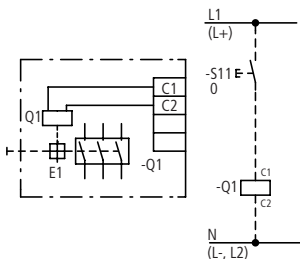
An electromagnet which, when a voltage is applied, actuates a tripping mechanism. When de-energized, the system is in the rest position. A normally open contact actuates the system. If the shunt release is rated for intermittent duty, the intermittent operation must be ensured by positioning appropriate auxiliary contacts (usually HIN/S1) upstream of the circuit-breaker.

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 (Q1)
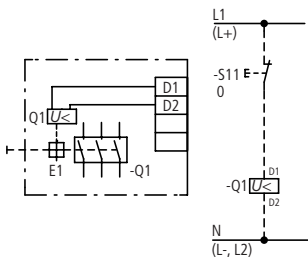
An electromagnet which actuates a tripping mechanism upon interruption of the voltage. The system is in the rest position when energized. Actuation is produced by a normally closed contact. Undervoltage releases are always designed for uninterrupted operation. These are the ideal tripping elements for totally reliable interlocking tasks (e.g. Emergency-Stop).

Undervoltage releases trip the circuit-breaker when the power fails in order, for example, to prevent motors from restarting automatically. They are also suitable for very reliable interlocking and remote switching off since disconnection always occurs in the event of a fault (e.g. wire breakage in the control circuit). The circuit-breakers cannot be closed when the undervoltage releases are de-energized.

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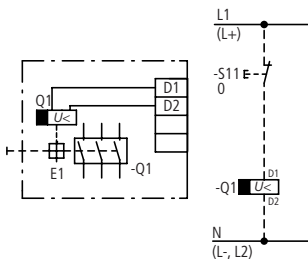
The off-delayed undervoltage release is a combination of a separate delay unit (UVU) and the respective release. This release is used to prevent brief interruptions in power leading to disconnection of the circuit-breaker. The delay time is adjustable between 0.06 and 16 s.

7

Circuit-breakers
Contact sequence of the auxiliary contacts

Standard auxiliary contact HIN
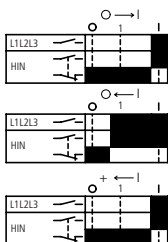
Used to provide command or signal outputs from processes which are governed by the position of the contacts. They can be used for interlocking with other switches, and for the remote indication of the switching state.

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

Trip-indicating auxiliary contact RHI, new designation: trip-indicating auxiliary contact HIA
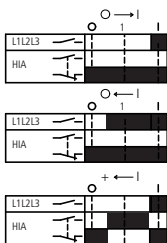
Used to provide command and signal output relating to electrical tripping of the circuit-breaker (trip position +) as is required, for example, for mesh network switches. No pulse is produced when the switch is opened or closed manually, or by a motor operator.

- 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, 3, 4).

0 → I

Switch on

0 ← I

Switch off

+ ← I

Trip

■ contacts closed

□ contacts opened

7

Circuit-breakers
Contact sequence of the auxiliary contacts

Early-make auxiliary contact HIV

NZM 1, 2, 3
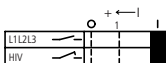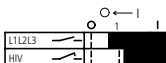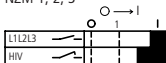
Used to provide command or signal outputs from processes which are initiated before the closure or opening of the main contact system. Because they close early, they can be used for interlocks with other switches. Furthermore, they allow a switch position indication.

The HIV has the same position in the tripped position of the circuit-breaker and the off position of the circuit-breaker. Because of their early-make feature, they can be used for energizing the undervoltage release (→ section "Undervoltage releases", page 7-4).

NZM 4
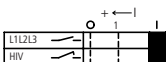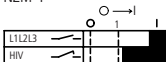
0 → I
Switched on
0 ← I
Switch off
+ ← I
Trip
■ contacts closed
□ contacts opened

7

Circuit-breakers
Internal circuit diagrams

NZM1
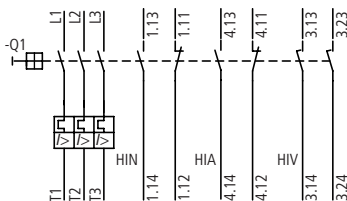
Contact elements M22-K10 (K01) from the RMQ-Titan range from Moeller are used for the auxiliary contacts. Two early-make auxiliary contacts (2 NO) are also available.

Maximum component fitting:

	NZM			
	1	**2**	**3**	**4**
HIN, 1 NO or 1 NC	1	2	3	3
HIA, 1 NO or 1 NC	1	1	1	2
HIV, 2 NO	1	1	1	1
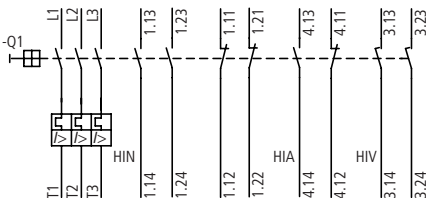
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NZM2

Details about the auxiliary contacts: → section "Maximum component fitting:", page 7-7

Circuit-breakers
Internal circuit diagrams

NZM3
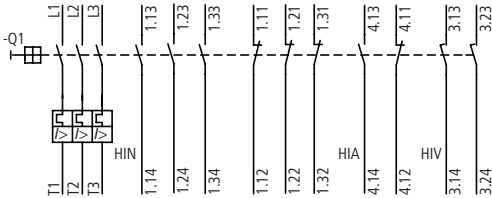
Details about the auxiliary contacts:
→ section "Maximum component fitting:", page 7-7

NZM4
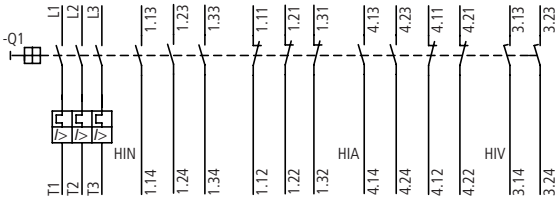
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Details about the auxiliary contacts:
→ section "Maximum component fitting:", page 7-7

Circuit-breakers
Remote switch-off with voltage releases

Remote switch-off with undervoltage releases
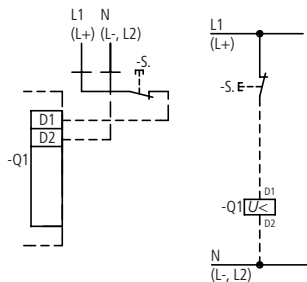
Remote switch-off with shunt release

7
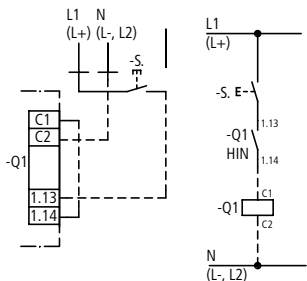
Circuit-breakers
Remote switch-off with voltage releases

Main switch application in processing machines with Emergency-Stop function conform to the IEC/EN 60204-1 standard
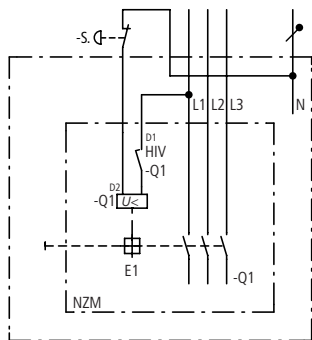
In the OFF position of the main switch all control elements and control cables which exit the control panel are voltage free. The only live components are the control-voltage tap-offs with the control lines to the early-make auxiliary contact.
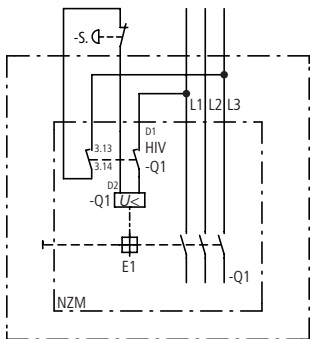
Circuit-breakers
Application of the undervoltage release

Shut off of the undervoltage release
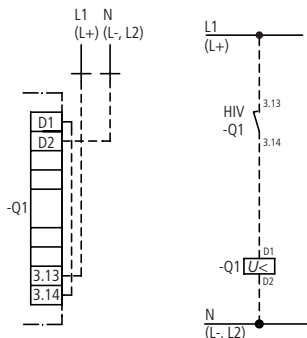
The early-make auxiliary contact HIV (Q1) can – as shown above – disconnect the undervoltage release from the control voltage when the circuit-breaker is in the Off position. If the undervoltage release is to be disconnected in 2 poles, then a further normally open contact of Q1 must be connected between 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
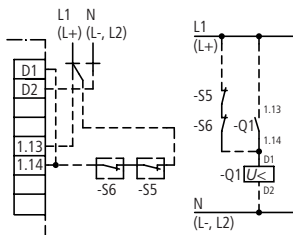
Circuit-breakers with undervoltage release produce a positive Off position in conjunction with interlocking auxiliary contacts on the starter (S5), ancillary devices on the motor (e.g. brush lifting, S6) or on all switches in multi-motor drives.

The circuit-breaker cannot be closed unless the starter or switch is in the zero or Off position.

7

Circuit-breakers
Shutdown of the undervoltage release

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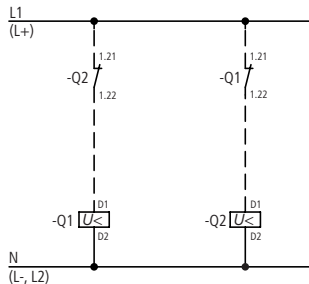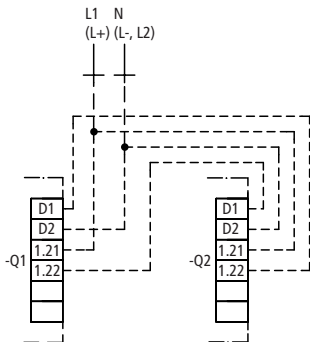
When interlocking 3 or more circuit-breakers, each circuit-breaker must be interlocked with the series-connected normally closed contacts of the auxiliary contacts on the other circuit-breakers using one contactor relay – for contact duplication – per auxiliary contact. If one of the circuit-breakers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

7

Circuit-breakers
Indication of the switch position

On and Off indication using standard auxiliary contacts HIN (Q1)

L1
(L+)

N
(L-, L2)

-F0

-Q1

1.21
1.22
1.13
1.14

-P2
X1 X2

-P1
X1 X2

L1
(L+)

-F0

-Q1

1.13   1.21
1.14   1.22

-P1
X1

-P2
X1
X2   X2

N
(L-, L+)

L1
(L+)

-F0

1.11

1.14 1.12

-P1
X1

-P2
X1
X2   X2

N
(L-, L+)
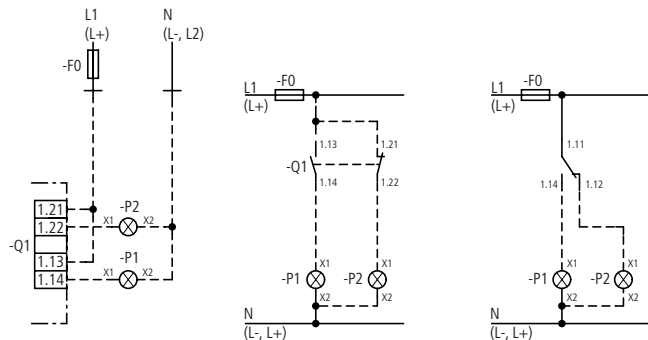
P1: On
P2: Off

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

Trip-indicating auxiliary contacts for mesh network
switches

L1
(L+)

N
(L-, L2)

-F0

-P1
X1
X2

-Q1

4.13
4.14

L1
(L+)

-F0

-Q1

4.13

4.14
X1

-P1
X2

N
(L-, L+)

P1: Tripped

7
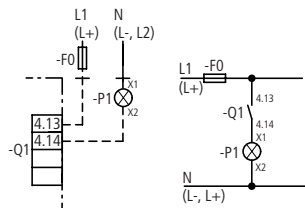
Circuit-breakers
Short-time delayed circuit-breaker – internal circuit diagrams

Time-discriminating network topology

Short-time delayed circuit-breakers
NZM2(3)(4)/VE 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

7
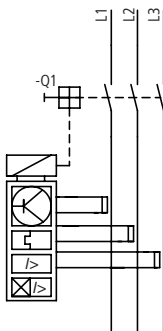
Circuit-breakers
Mesh network circuit-breaker

NZM1, NZM2, NZM3, NZM4

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 the NZM-XCM to the power feed side!
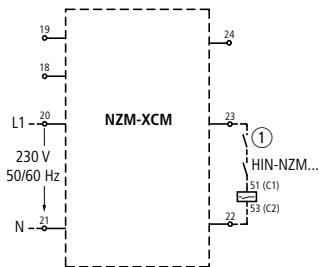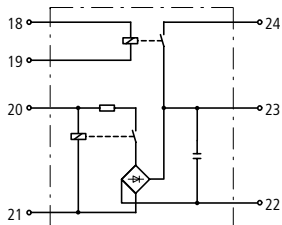
① Mesh network relay
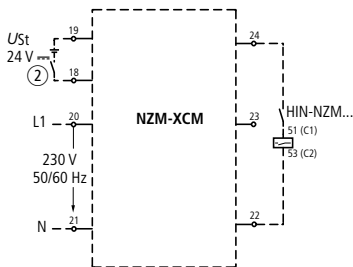
② Mesh network relay with low-capacity contacts

7

Circuit-breakers
Remote operation with motor operator

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

NZM2, 3, 4
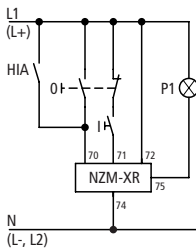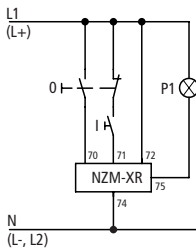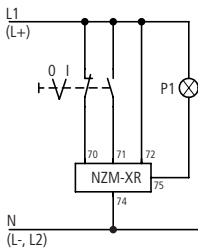
Circuit-breakers
as a transformer switch

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-breaker with shunt release Q1
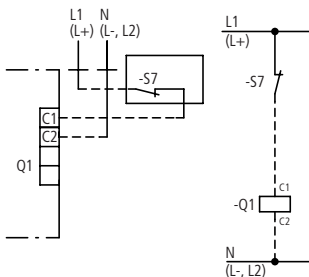
Circuit-breaker with undervoltage release Q1

7
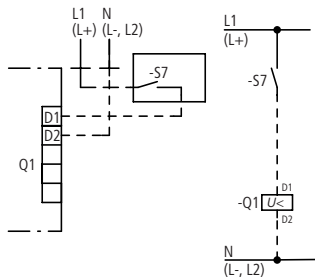
Circuit-breakers
with residual-current release

NZM2-4-XFI, XFI30

These circuit-breakers with integrated residual current protection offer:

- Overload protection
- Short-circuit protection
- Fault-current protection

In addition to the protective functions, this circuit-breaker can perform the functions of a main switch with isolating characteristics. Like RCCB's built conform to VDE 0664, the residual current release recognises AC and DC fault currents. The residual-current release NZM74-... and NZM2-4-FI(30) are "pulse current sensitive". The NZM2-4-FIA(30) is sensitive to AC and DC. In the event of a fault the circuit-breaker disconnects the fault circuitry. The residual-current protective switches for the NZM2-4 and NZM74 are built and tested to IEC/EN 60 947 and VDE 0664 Part 3.

The residual-current release requires no external auxiliary voltage for tripping. For the switch rated current range 30–250 A at rated voltages 200–690 V (NZM2-4) and 380 – 690 V (NZM74), rated fault currents $I_{\Delta n}$ = 0.1-0.5*-1-3 A and delay times t_v - 60-150-300-450 ms can be set in steps. The XFI30 or FIP30 trips at a rated fault current of 30 mA.

* 0.3 at NZM74
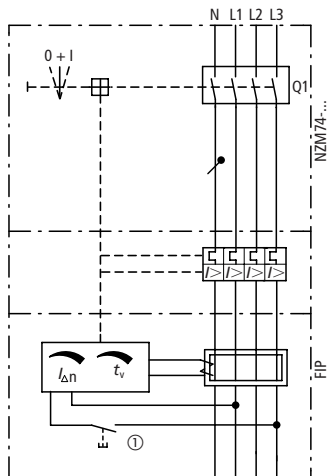
① Test button

Circuit-breakers
with residual-current release

Residual-current relay PFR with ring-type transformer

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 are:

• 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 fault 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.

230 V AC ± 20 %
50/60 Hz
3 V A
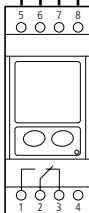
L1 L2 L3 N

N L

1S1
1S2

> 3 m – 50 m

LOAD

5 6 7 8

NO C NC
1 2 3 4

50/60 Hz   250 V AC   6 A

7
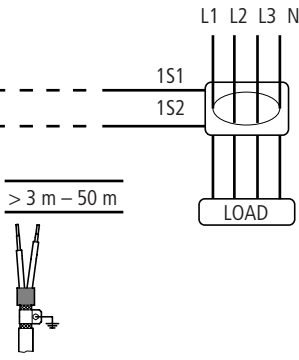
Circuit-breakers
with residual-current release

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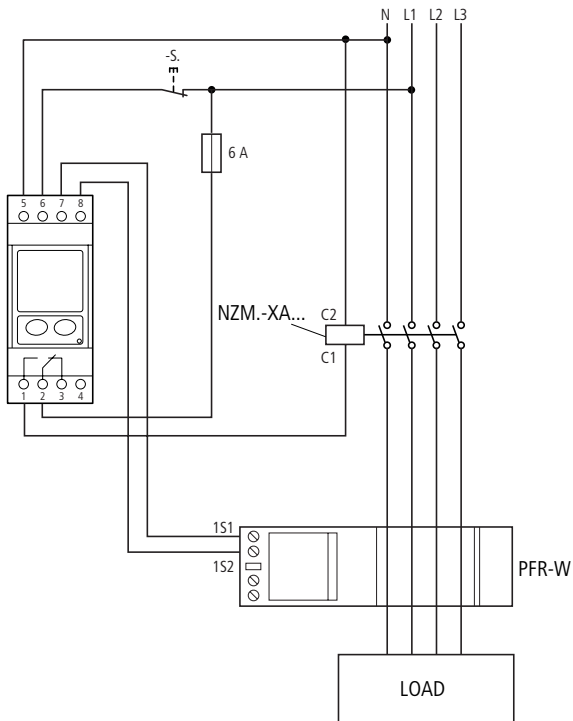
Circuit-breakers
with residual-current release

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

N L1 L2 L3

-S.

6 A

5 6 7 8

NZM.-XU... D2
$U <$
D1

1 2 3 4

1S1
1S2

PFR-W

LOAD

7

Terminal assignment of the control circuit plug
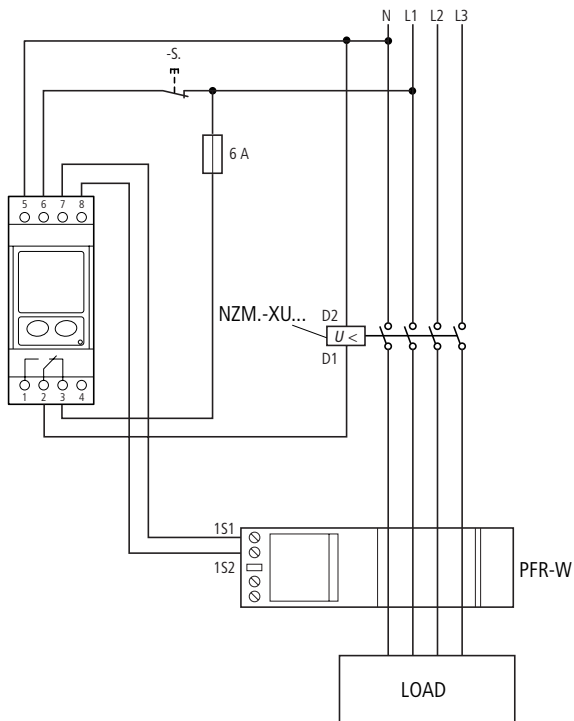
Control circuit plugs X8, X7, X6, X5 are identical

Internal	Terminals	External

X8: optional control circuit plug
(Connections X8:1 to X8:8 only with IZM...-U... and IZM...-D...)

① Electronic overload release

X8

Internal label	Terminal	External label
XFR remote reset	14	L/L+
	13	N/L- U_s
G-converter S2	12	e.g.[1]
G-converter S1	11	
IZM-XW(C) N-converter S2	10	Jumper with no
IZM-XW(C) N-converter S1	9	N-converter
External voltage transformer star	8	L1
External voltage transformer L3	7	L2
External voltage transformer L2	6	L3
External voltage transformer L1	5	N
0 V DC	4	24 V DC external
24 V DC	3	power supply
Internal system bus +	2	
Internal system bus –	1	Terminating resistor, if no external system bus module

X7: optional control circuit plug
Not available with communication function IZM-XCOM-DP.
At the position of X7 a communications module is located.

X7

Internal label	Terminal
Tripped signalling switch XHIA	14
	13
	12
Signal state	11
Spring-operated stored energy	10
XEE electrically "ON"	9
	8
	7
XHIS signalling switch on	6
first voltage release	5
	4
XHIS signalling switch on	3
second voltage release	2
	1

IZM-XCOM-DP

L/L+ U_s

1) Convertor in transformer star point or summation current convertor 1200 A/1 A

X6: standard control circuit plug

	X6	
XE/A first shunt release	14 13	L/L+ N/L- U_s
Standard auxiliary switch XHI: S1 "NO"	12 11	
Standard auxiliary switch XHI: S1 "NC"	10 9	
Closing release XE/A	8 7	N/L- L/L+ U_S
"Ready to close" auxiliary switch XHIB	6 5	
Standard auxiliary switch XHI: S2 "NO"	4 3	
Standard auxiliary switch XHI: S2 "NC"	2 1	
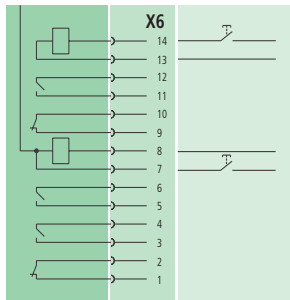
X5: optional control circuit plug

	X5	
Only XUV "non-delayed trip"	14 13	Emergency-stop or jumper
XA1, XU, XUV second voltage release	12 11	L/L+ N/L- U_S
Standard auxiliary contact XHI11/XHI22/XHI31: S3 "NO", XHI40: S7	10 9	
Standard auxiliary contact XHI11/XHI22/XHI31: S3 "NC", XHI40: S7	8 7	
Standard auxiliary contact XHI22: S4 "NO", XHI31/XHI40: S8 "NO"	6 5	
Standard auxiliary contact XHI22: S4 "NC", XHI31/XHI40: S8 "NO" Motor operators	4 3 2	L/L+ U_S
Optional motor cut-off switch XMS ① black-white, ② brown	1	N/L-

Circuit-breakers
IZM circuit-breakers

Control circuit isolator

7

XHI11(22)(31): S3, XHI22: S4 oder XHI40: S7, XHI40: S8
optionale Zusatz-Hilfsstromschalter
Optional auxiliary switches

XHI: S1, XHI: S2
Standard-Hilfsstromschalter
Standard auxiliary switches

Klemmen Terminals	Leitungsnummer Wire no.	Intern Internal	Leitungsnummer Wire no.	Klemmen Terminals
X5.6	X5-6	3 — S8 — 4	X5-5	X5.5
X5.4	X5-4	3 — 4	X5-3	X5.3
X5.10	X5-10	3 — S7 — 4	X5-9	X5.9
X5.8	X5-8	3 — 4	X5-7	X5.7
X5.6	X5-6	3 — S4 — 4	X5-5	X5.5
X5.4	X5-4	1 — 2	X5-3	X5.3
X5.10	X5-10	3 — S3 — 4	X5-9	X5.9
X5.8	X5-8	1 — 2	X5-7	X5.7
X6.4	X6-4	3 — S2 — 4	X6-3	X6.3
X6.2	X6-2	1 — 2	X6-1	X6.1
X6.12	X6-12	3 — S1 — 4	X6-11	X6.11
X6.10	X6-10	1 — 2	X6-9	X6.9

Circuit-breakers
IZM circuit-breakers

Signalling switch

Klemmen Terminals	Leitungsnummer Wire no.		Intern Internal		Leitungsnummer Wire no.	Klemmen Terminals

XHA — Ausgelöst-Melde-schalter / Bell switch alarm
Reset
X7.12 — NO — bl / blue — 4 — Trip — XHX — 1 — sw / blk — COM — X7.13
X7.14 — NC — bn or gr — 2

XHS1 — Meldeschalter zweiter Spannungsauslöser XA1, XU oder XUV / Signal 2nd voltage release XA1, XU or XUV energized
U < XU XUV XA1
X7.1 — NO — bl / blue — 4 — energized
XHS1 — 1 — sw / blk — COM — X7.2
X7.3 — NC — bn or gr — 2 — de-energized

XHS — Meldeschalter erster Spannungsauslöser XA / Signal 1st voltage release energized
XA
X7.4 — NO — bl / blue — 4 — energized
XHS — 1 — sw / blk — COM — X7.5
X7.6 — NC — bn or gr — 2 — de-energized

XHF — Speicher-zustands-meldung / "Spring charged" signal
X7.10 — X7.10 — XHF — 4 — 1 — X7.11 — X7.11

XHIB — Einschalt-bereitschafts-meldung / "Ready to close" signal
X6.6 — X6-6 — XHIB — 4 — 1 — X6-5 — X6.5

color

7

Circuit-breakers
IZM circuit-breakers

7

Voltage release/electrical manual reset

Optional: XA1 zweiter Arbeitsstromauslöser
XU Unterspannungsauslöser oder
XUV Unterspannungsauslöser, verzögert

Option: 2nd shunt release or
undervoltage release or
undervoltage release with delay

*) Emergency-stop or jumper

XA
erster Arbeitsstromauslöser

1 st shunt release

Klemmen
Terminals

Leitungsnummer
Wire no.

Intern
Internal

color

Leitungsnummer
Wire no.

Klemmen
Terminals

X5.12 – X5.12

X5.13 bn XUV

X5.14 bn XS.11 – XS.11

X5.12 XU XS.11 – XS.11

X5.12 XA1 X6.11

X6.14 XA X6.13

Circuit-breakers
IZM circuit-breakers

Closing release/electrical ON

XE
Einschaltmagnet
Closing release

XEE
Elektrisch "EIN"
Electrical "ON"

X6.7

X6.8

XE

X7.7

X7.9

X7.9

X6.7

4

3

XEE

X6.7

Klemmen
Terminals

Leitungsnummer
Wire no.

Intern
Internal

Leitungsnummer
Wire no.

Klemmen
Terminals

7

Circuit-breakers
IZM circuit-breakers

7

Motor operator, remote reset magnet

Klemmen Terminals	Leitungsnummer Wire no.	Intern Internal	Leitungsnummer Wire no.	Klemmen Terminals

XM Motorantrieb
Motor operator

X5.1 ← X5.1 — sw / blk — (M) — S11 — bn — X5.2 → X5.2

XM Motorantrieb
Optional: Motorabstellschalter XMS

Charging motor
optional: motor cut-off switch XMS

X5.1 ← X5.1 — sw / blk — 1 / F / 4 XMS — (M) — S11 — bn — X5.2 → X5.2

XFR Fern-Rücksetzmagnet
S13 Abstellschalter für Fern-Rücksetzung

XFR remote reset coil
S 13 cut-off switch for remote reset coil

X8.14 ← — XFR — S13 — X8.13 →

color

color

Protective circuits for overcurrent release with breaker status sensor and metering module

	Auslösemagnet für Überstromauslösung	Elektronischer Überstromauslöser		Messmodul		Interner Systembus	
	Trip magnet for overcurrent release	Overcurrent release	Breaker Status Sensor	Metering module		Internal system bus 1)	

Klemmen / Terminals: X8.12 X8.11 X8.10 X8.9 X8.5 X8.6 X8.7 X8.8 X8.1 X8.2 X8.3 X8.4 2)

- + 24V d.c. 0V d.c.

Intern / Internal

S2 S1
G-Wandler
G sensor

S2 S1
N-Wandler
N sensor

U L1 U L2 L3
Spannungswandler
Voltage transformer

Messmodul
Metering module

F5

XZM...

Interner Systembus
Internal system bus

- + 24V d.c. 0V d c

BSS-Modul
BSS module

S40 S41 S44

S43 S45

Protective circuits for overcurrent release, metering module only

Klemmen Terminals	Auslösemagnet für Überstromauslösung Trip magnet for overcurrent release	Elektronischer Überstromauslöser Overcurrent release	Messmodul Metering module	Interner Systembus Internal system bus 1)

X8.12 X8.11 X8.10 X8.9   X8.5 X8.6 X8.7 X8.8   X8.1 X8.2 X8.3 X8.4

24V d.c.   0V d.c.

Intern
Internal

F5

XZM...

S2 S1   S2 S1
G-Wandler   N-Wandler
G sensor   N sensor

U L1 U L2 U L3
Spannungswandler
Voltage transformer
Messmodul
Metering module

Interner Systembus
Internal system bus
+
24V d.c.
0V d.c.

Protective circuits for overcurrent release, breaker status sensor only

	Auslösemagnet für Überstromauslösung	Elektronischer Überstromauslöser			Breaker Status Sensor	Interner Systembus
	Trip magnet for overcurrent release	Overcurrent release			Breaker Status Sensor	Internal system bus 1)

Klemmen
Terminals

X8.12 X8.11   X8.10 X8.9

X8.1 X8.2 X8.3 X8.4

-    +   24V d.c.   0V d.c.

Intern
Internal

F5

S2 S1   S2 S1

G-Wandler   N-Wandler
G sensor   N sensor

XZM...

Interner Systembus
Internal system bus

-
+
24V d.c.
0V d.c.

BSS-Modul
BSS module

S40   S41   S44

S43   S45

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Notes

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