SIEMENS

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Switchgear Type SIMOSEC, up to 24 kV, Air-Insulated, Extendable

Medium-Voltage Switchgear

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Application

Typical uses

R-HA40-111.tif

R-HA41-115.tif

Example
Transfer switchgear with integrated low-voltage niche

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R-HA41-135.tif

Utilities transfer substation for industrial plants

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Medium-Voltage Switchgear

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siemens.com/medium-voltage-switchgear
siemens.com/SIMOSEC

The products and systems described in this catalog are manufactured and sold according to a certified management system (acc. to ISO 9001, ISO 14001 and BS OHSAS 18001).

Application, Requirements

Features

SIMOSEC switchgear is a factory-assembled, type-tested, three-phase, metal-enclosed, indoor switchgear according to IEC 62271-200 *) and GB 3906 *) for single busbars.

Typical uses

SIMOSEC switchgear is used for power distribution in distribution systems with busbar currents up to 1250 A.

The modular, space saving design enables application in

- Substations, customer transfer substations, distribution substations and switching substations of power supply and public utilities
- Public buildings, such as high-rise buildings, railway stations, hospitals
- Industrial plants.

Typical applications

- Wind power stations
- High-rise buildings
- Airports
- Underground railway stations
- Sewage treatment plants
- Port facilities
- Traction power supply systems
- Automobile industry
- Petroleum industry
- Chemical industry
- Unit-type heating power stations
- Textile, paper and food industries
- Emergency power supply installations
- Shopping centers and data centers.

Modular design

- Individual panels, for free combination and extension
- Option: Low-voltage compartments can be supplied in two overall heights
- Circuit-breaker panels for various applications.

Reliability

- Type and routine-tested *)
- No cross insulation between phases
- Standardized and manufactured using numerically controlled machines
- Quality management system according to DIN EN ISO 9001
- More than 100,000 switchgear components in operation worldwide for many years.

Personal safety

- All switching operations can be performed with closed panel front
- Metal-enclosed LSC 2 panels
- HV HRC fuses and cable sealing ends are only accessible when the outgoing feeders are earthed
- Logical mechanical interlocking
- Capacitive voltage detecting system for verification of safe isolation from supply
- Earthing of outgoing feeders by means of make-proof earthing switches
- Partition class: **PM** (metallic partition).

Compact design

Thanks to the use of gas-insulated switching-device vessel compact dimensions are possible.
Thus:

- Existing switchgear rooms can be used effectively
- New constructions cost little
- Costly city-area space is saved.

Security of operation

- Components, e.g. operating mechanisms, three-position switches, vacuum circuit-breakers proven for years
- LSC 2 panels:
  - Panels with metallic partition (metal-clad) between busbar and switching device and between switching device and cable compartment (R, T, L)
  - Panels with metallic partition between switching device and busbar compartment
- Metal-enclosed switching-device vessel with three-position switch, gas-insulated
  - Welded sealed-for-life switching-device vessel
  - No cross insulation between phases
  - With welded-in rotary bushings for operation
  - Three-position switch-disconnector with gas-insulated switching functions
  - Three-position disconnector, gas-insulated
  - Switching functions CLOSE-OPEN-EARTH
- Operating mechanisms of switching devices accessible outside the switching-device vessel
- Maintenance-free operating mechanism parts (IEC 62271-1/VDE 0671-1 *) and GB 11022 *))
- Mechanical position indication integrated in mimic diagram
- Switchgear interlocking system with logical mechanical interlocks
- Partition class: **PM** (metallic partition).

Reavailability

- Three-position switch-disconnector with gas-insulated, maintenance-free quenching principle
- Metallic partition between busbar compartment, switching devices and cable compartment
- Separate pressure relief for each compartment
- Cable testing without the need to isolate the busbar
- Mounting location of three-phase current transformer for selective disconnection of circuit-breaker feeders.

*) For standards, see page 72

Cost-efficiency

Low "lifecycle costs" and high availability throughout the entire product service lifecycle as a result of:

- Minimum space requirement
- Easy switchgear extension, without gas work
- Maintenance-free gas-insulated switching functions of the three-position switch (gas-insulated quenching principle)
- Vacuum circuit-breaker
- Modular product range and design, e.g. circuit-breaker panels
- Low maintenance
- Option: Numerical multifunction protection relay (SIPROTEC protection device family, optionally external makes).

Quality and environment

- Quality and environmental management system according to DIN EN ISO 9001 and DIN EN ISO 14001
- Easy switchgear extension, without gas work on site
- Minimum space requirements.

Service life

Under normal operating conditions, the expected service life of air-insulated switchgear SIMOSEC is at least 35 years, probably 40 to 50 years, taking the tightness of the hermetically welded switching-device vessel into account. The service life is limited by the maximum number of operating cycles of the switchgear devices installed:

- For circuit-breakers, according to the endurance class defined in IEC 62271-100
- For three-position disconnectors and earthing switches, according to the endurance class defined in IEC 62271-102
- For three-position switch-disconnectors, according to the endurance class defined in IEC 62271-103.

Technology

- Air-insulated indoor switchgear
- Gas-insulated, maintenance-free switching functions for the three-position switch as switch-disconnector
- Partition class: **PM** (metallic partition)
- Three-pole primary enclosure
- Phases arranged one behind the other
- No cross insulation between phases
- Busbar system at the top
- Air-insulated busbar and cable connection system
- Three-position switch, metal-enclosed, with air-insulated primary terminals and gas-insulated switching functions
- Vacuum circuit-breaker, metal-enclosed, up to 1250 A, fixed-mounted in gas-insulated switching-device vessel
- Option: Vacuum circuit-breaker (type 3A_), air-insulated, up to 1250 A, removable design: Easy to remove after loosening the fixing bolts
- Hermetically-sealed by welded, stainless-steel switching-device vessel
  - For switching devices
  - With insulating gas SF_6 (fluorinated greenhouse gas).

Insulating system

- Switching-device vessel filled with SF_6 gas
- Features of SF_6 gas:
  - Non-toxic
  - Odorless and colorless
  - Non-inflammable
  - Chemically neutral
  - Heavier than air
  - Electronegative (high-quality insulator)
  - Global Warming Potential GWP = 22,800
- Pressure of SF_6 gas in the switching-device vessel (absolute values at 20 °C):
  - Rated filling level: 140 kPa
  - Design pressure: 180 kPa
  - Design temperature of the SF_6 gas: 80 °C
  - Operating pressure of bursting disc: ≥ 270 kPa
  - Bursting pressure: ≥ 550 kPa
  - Gas leakage rate: < 0.1 % per year.

Panel design

- Factory-assembled, type-tested
- Metal-enclosed, with metallic partitions
- LSC 2 panels, LSC 1 panels (without isolating distance)
- Pressure relief
  - To the rear and upwards
  - Separately for each compartment
- Air-insulated cable connection system for conventional cable sealing ends
- Option: Three-phase current transformer, factory-assembled on the feeder bushings
- Integrated low-voltage niche (standard) for installation of, e.g.
  - Terminals, MCBs, pushbuttons
  - Protection devices
- Option: Top-mounted low-voltage compartment
- Option: Panel heating for severe ambient conditions, e.g. condensation.

Standards (see page 72)

Application, Requirements

Features, classification

Electrical features

- Rated voltages up to 24 kV
- Rated short-time withstand current up to 25 kA
- Rated normal current of feeders
  – Up to 800 A, e.g. for ring-main, metering panels
  – Up to 1250 A, for circuit-breaker panels
  – Up to 1250 A, for bus sectionalizer panels
- Rated normal current of busbar up to 1250 A.

SIMOSEC switchgear is a factory-assembled, type-tested, metal-enclosed switchgear for indoor installation.
SIMOSEC switchgear is classified according to IEC 62271-200 / VDE 0671-200.

Design and construction

Partition class	PM (metallic partition)
Loss of service continuity category Panels – With HV HRC fuses [T, M(VT-F), ...] – Without HV HRC fuses (R, L, D, ...) – Metering panels type M or H1 or bus riser panel type H	 LSC 2 LSC 2 LSC 1
Accessibility to compartments (enclosure) – Busbar compartment – Switching-device compartment – Switching-device compartment with removable circuit-breaker – Low-voltage compartment (Option) – Cable compartment for panels: – Without HV HRC fuses (R, L, ...) – With HV HRC fuses (T, ...) – Cable feeder (K) – Metering panel (air-insulated) (M, ...H)	 – Tool-based – Non-accessible – Interlock-controlled – Tool-based – Interlock-controlled – Interlock-controlled – Tool-based – Tool-based

Internal arc classification (option)

The following internal arc classifications are fulfilled: IAC A FL(R), I_{SC}, t	
IAC	= Internal arc classification
IAC class for – Wall-standing arrangement – Free-standing arrangement	Rated voltage 7.2 kV to 24 kV: IAC A FL, I_{SC}, t IAC A FLR, I_{SC}, t
Type of accessibility: A – F – L – R	Switchgear in closed electrical service location, access "for authorized personnel only" (according to IEC 62271-200) Front Lateral Rear (for free-standing arrangement)
Arc test current I_{SC}	Up to 21 kA
Test duration t	1 s

Common electrical data

Rated insulation level		Rated voltage U_r	kV	**7.2**		**12**		**17.5**		**24**		
		Rated short-dur. power-frequency withstand voltage U_d										
		– phase-to-phase, phase-to-earth, open contact gap	kV	20		28, 42 *)		38		50		
		– across the isolating distance	kV	23		32, 48 *)		45		60		
		Rated lightning impulse withstand voltage U_p										
		– phase-to-phase, phase-to-earth, open contact gap	kV	60		75		95		125		
		– across the isolating distance	kV	70		85		110		145		
Rated frequency f_r			Hz	50 / 60 →								
Rated normal current I_r **) for busbar		Standard	A	630 →								
		Option	A	800, 1250 →								
50 Hz	Rated short-time withstand current I_k	for rated duration of short-circuit t_k = 1 s, 2 s *)	up to kA	21	25	21	25	21	25	16	20	25
		for rated duration of short-circuit t_k = 3 s (20 kA/4 s *))	up to kA	21	–	21	–	21	–	16	20	–
	Rated peak withstand current I_p		up to kA	52.5	63	52.5	63	52.5	63	40	50	63
60 Hz	Rated short-time withstand current I_k	for rated duration of short-circuit t_k = 1 s, 2 s *)	up to kA	21	25	21	25	21	25	16	20	25
		for rated duration of short-circuit t_k = 3 s	up to kA	21	–	21	–	21	–	16	20	–
	Rated peak withstand current I_p		up to kA	55	65	55	65	55	65	42	52	65

Pressure values, temperature

Pressure in gas-insulated switching-device vessel for SF_6 gas-insulated switching devices (pressure values at 20 °C)	Rated filling level for insulation p_{re} (absolute)		kPa	140 →
	Minimum functional level for insulation p_{me} (absolute)		kPa	120 →
	Signal of filling level for insulation p_{ae} (absolute)		kPa	120 →
	Minimum functional level for switching p_{sw} (absolute)		kPa	120 →
Ambient air temperature T (minimum/maximum air temperature depends on the secondary equipment used)	Operation:	Standard	°C	–5 to +55 [1] →
		Option	°C	–25 [1] △) →
	Storage/transport	Standard	°C	–5 to +55 [1] →
		Option	°C	–25, +70 [1] →
		Option *)	°C	–40 →
Degree of protection	for gas-filled switching-device vessel			IP65 →
	for switchgear enclosure			IP2X/IP3X *) →
	for low-voltage compartment			IP3X/IP4X *) →

*) As design option, according to some national requirements (e.g.: GOST, GB, ...)
**) The rated normal currents apply to ambient air temperatures of max. 40 °C.
The 24-hour mean value is max. 35 °C (according to IEC 62271-1 / VDE 0671-1)
1) Depending on the secondary equipment used
△) If panel heating available

Technical Data

Electrical data of the switchgear

Common electrical data of the switchgear panels

Rated insulation level		Rated voltage U_r	kV	7.2		12		17.5		24		
Ring-main panel types R, R1, R(T), R1(T), cable panel types K and K1 3)												
Rated normal current I_r **)		Standard	A	630 →								
		Option	A	800, 1250 for type K1 →								
50 Hz	Rated short-time withstand current I_k	for rated duration of short-circuit t_k = 1 s, 2 s *)	up to kA	21	25	21	25	21	25	16	20	25
		for rated duration of short-circuit t_k = 3 s (4 s *))	up to kA	21	–	21	–	21	–	16	20	–
	Rated peak withstand current I_p		up to kA	52.5	63	52.5	63	52.5	63	40	50	63
	Rated short-circuit making current I_{ma}	for ring-main feeders	up to kA	52.5	63	52.5	63	52.5	63	40	50	63
60 Hz	Rated short-time withstand current I_k	for rated duration of short-circuit t_k = 1 s, 2 s *)	up to kA	21	25	21	25	21	25	16	20	25
		for rated duration of short-circuit t_k = 3 s	up to kA	21	–	21	–	21	–	16	20	–
	Rated peak withstand current I_p		up to kA	55	65	55	65	55	65	42	52	65
	Rated short-circuit making current I_{ma}	for ring-main feeders	up to kA	55	65	55	65	55	65	42	52	65
Transformer panel types T, T1, T(T) as switch-fuse combination according to IEC 62271-105												
Rated normal current I_r **)1)		Standard	A	200 →								
50 Hz	Rated short-time withstand current I_k 1) 4)	for rated duration of short-circuit t_k = 1 s, 2 s *)	up to kA	21	25	21	25	21	25	16	20	25
		for rated duration of short-circuit t_k = 3 s (4 s *))	up to kA	21	–	21	–	21	–	16	20	–
	Rated peak withstand current I_p 1)	for transformer feeders 1)	up to kA	52.5	63	52.5	63	52.5	63	40	50	63
	Rated short-circuit making current I_{ma} 1)	for transformer feeders 1)	up to kA	52.5	63	52.5	63	52.5	63	40	50	63
60 Hz	Rated short-time withstand current I_k 1) 4)	for rated duration of short-circuit t_k = 1 s, 2 s *)	up to kA	21	25	21	25	21	25	16	20	25
		for rated duration of short-circuit t_k = 3 s	up to kA	21	–	21	–	21	–	16	20	–
	Rated peak withstand current I_p 1)	for transformer feeders 1)	up to kA	55	65	55	65	55	65	42	52	65
	Rated short-circuit making current I_{ma} 1)	for transformer feeders 1)	up to kA	55	65	55	65	55	65	42	52	65
	Dimension e of HV HRC fuse-link		e = 292 mm	•		•		•		–		
			e = 442 mm	•		•		•		•		
Disconnector panel types D1, D1(T)												
Rated normal current I_r **)		Standard	A	1250 →								
		On request	A	630 →								
50 Hz	Rated short-time withstand current I_k	for rated duration of short-circuit t_k = 1 s, 2 s *)	up to kA	21	25	21	25	21	25	16	20	25
		for rated duration of short-circuit t_k = 3 s (4 s *))	up to kA	21	–	21	–	21	–	16	20	–
	Rated peak withstand current I_p		up to kA	52.5	63	52.5	63	52.5	63	40	50	63
60 Hz	Rated short-time withstand current I_k	for rated duration of short-circuit t_k = 1 s, 2 s *)	up to kA	21	25	21	25	21	25	16	20	25
		for rated duration of short-circuit t_k = 3 s	up to kA	21	–	21	–	21	–	16	20	–
	Rated peak withstand current I_p		up to kA	55	65	55	65	55	65	42	52	65

• possible
– not possible

*) As design option, on request according to some national requirements (e.g.: GOST, GB, ...)
**) The rated normal currents apply to ambient air temperatures of max. 40 °C.
The 24-hour mean value is max. 35 °C (according to IEC 62271-1/VDE 0671-1)

1) Depending on HV HRC fuse-link (depending on the let-through current of the HV HRC fuse-link), earthing switch at the feeder: see page 11
3) On request: Panel types K and K1, each with make-proof earthing switch
4) Busbar

Common electrical data of the switchgear panels

Rated insulation level		Rated voltage U_r	kV	7.2		12		17.5		24		
Circuit-breaker panel [2] types L, L1, L(T), L1(T)												
Rated normal current I_r **)		Standard: L, L(T), L1, L1(T)	A	630 →								
		Option: L1, L1(T)	A	1250 A △) →								
50 Hz	Rated short-time withstand current I_k	for rated duration of short-circuit t_k = 1 s, 2 s *)	up to kA	21	25	21	25	21	25	16	20	25
		for rated duration of short-circuit t_k = 3 s (4 s *))	up to kA	21	–	21	–	21	–	16	20	–
	Rated peak withstand current I_p		up to kA	52.5	63	52.5	63	52.5	63	40	50	63
	Rated short-circuit making current I_{ma}		up to kA	52.5	63	52.5	63	52.5	63	40	50	63
	Rated short-circuit breaking current I_{sc}		up to kA	21	25	21	25	21	25	16	20	25
60 Hz	Rated short-time withstand current I_k	for rated duration of short-circuit t_k = 1 s, 2 s *)	up to kA	21	25	21	25	21	25	16	20	25
		for rated duration of short-circuit t_k = 3 s	up to kA	21	–	21	–	21	–	16	20	–
	Rated peak withstand current I_p		up to kA	55	65	55	65	55	65	42	52	65
	Rated short-circuit making current I_{ma}		up to kA	55	65	55	65	55	65	42	52	65
	Rated short-circuit breaking current I_{sc}		up to kA	21	25	21	25	21	25	16	20	25
Metering panel types M, bus riser panel types H, H1												
Rated normal current I_r **) for:												
M, M(-K), M(-B), M(-BK), H, M(KK), H1		Standard	A	630 →								
M, M(-K), M(-B), M(-BK), H, H1		Option	A	800, 1250 →								
50 Hz	Rated short-time withstand current I_k	for rated duration of short-circuit t_k = 1 s, 2 s *)	up to kA	21	25	21	25	21	25	16	20	25
		for rated duration of short-circuit t_k = 3 s (4 s *))	up to kA	21	–	21	–	21	–	16	20	–
	Rated peak withstand current I_p		up to kA	52.5	63	52.5	63	52.5	63	40	50	63
60 Hz	Rated short-time withstand current I_k	for rated duration of short-circuit t_k = 1 s, 2 s *)	up to kA	21	25	21	25	21	25	16	20	25
		for rated duration of short-circuit t_k = 3 s	up to kA	21	–	21	–	21	–	16	20	–
	Rated peak withstand current I_p		up to kA	55	65	55	65	55	65	42	52	65
Circuit-breaker panel types L1(r), L2(r), L1(r, T), L2(r, T)												
Rated normal current I_r **)		Standard: L1(r), L1(r, T)	A	630 →								
		Option: L2(r), L2(r, T)	A	1250 →								
50 Hz	Rated short-time withstand current I_k	for rated duration of short-circuit t_k = 1 s, 2 s *)	up to kA	21	25	21	25	21	25	16	20	25
		for rated duration of short-circuit t_k = 3 s	up to kA	21	–	21	–	21	–	16	20	–
	Rated peak withstand current I_p		up to kA	52.5	63	52.5	63	52.5	63	40	50	63
	Rated short-circuit making current I_{ma}		up to kA	52.5	63	52.5	63	52.5	63	40	50	63
	Rated short-circuit breaking current I_{sc}		up to kA	21	25	21	25	21	25	16	20	25
60 Hz	Rated short-time withstand current I_k	for rated duration of short-circuit t_k = 1 s, 2 s *)	up to kA	21	25	21	25	21	25	16	20	25
		for rated duration of short-circuit t_k = 3 s	up to kA	21	–	21	–	21	–	–	20	–
	Rated peak withstand current I_p		up to kA	55	65	55	65	55	65	42	52	65
	Rated short-circuit making current I_{ma}		up to kA	55	65	55	65	55	65	42	52	65
	Rated short-circuit breaking current I_{sc}		up to kA	21	25	21	25	21	25	16	20	25

• possible
– not possible

*) As design option, on request according to some national requirements (e.g.: GOST, GB, ...)
**) The rated normal currents apply to ambient air temperatures of max. 40 °C.
The 24-hour mean value is max. 35 °C (according to IEC 62271-1/VDE 0671-1)

2) With vacuum circuit-breaker in gas-filled switching-device vessel (maintenance-free under normal ambient conditions according to IEC 62271-1)
△) 1250 A in preparation

Technical Data

Electrical data of the switchgear

Common electrical data of the switchgear panels

Rated insulation level		Rated voltage U_r	kV	7.2		12		17.5		24		
Busbar voltage metering panel types M(VT-F), M1(VT-F)												
Rated normal current I_r **)[1]		Standard	A	200 →								
50 Hz	Rated short-time withstand current I_k [2]	for rated duration of short-circuit t_k = 1 s, 2 s*)	up to kA	21	25	21	25	21	25	16	20	25
		for rated duration of short-circuit t_k = 3 s (4 s*))	up to kA	21	–	21	–	21	–	16	20	–
	Rated peak withstand current I_p [1)2)]		up to kA	52.5	63	52.5	63	52.5	63	40	50	63
60 Hz	Rated short-time withstand current I_k [2]	for rated duration of short-circuit t_k = 1 s, 2 s*)	up to kA	21	25	21	25	21	25	16	20	25
		for rated duration of short-circuit t_k = 3 s	up to kA	21	–	21	–	21	–	16	20	–
	Rated peak withstand current I_p [1)2)]		up to kA	55	65	55	65	55	65	42	52	65
	Dimension of HV HRC fuse-link	Standard: For HV HRC fuse-link		application of fuses for voltage transformer protection →								
		On request: Option: For HV HRC fuse-link according to IEC / EN 60282-1 / VDE 0670-4 and DIN 43625	e = 292 mm	•		•		•		•		
			e = 442 mm	–		–		–		–		
Busbar voltage metering panel types M(VT), M1(VT)												
Rated normal current I_r **) [1]		Standard	A	200 →								
50 Hz	Rated short-time withstand current I_k [2]	for rated duration of short-circuit t_k = 1 s, 2 s*)	up to kA	21	25	21	25	21	25	16	20	25
		for rated duration of short-circuit t_k = 3 s (4 s*))	up to kA	21	–	21	–	21	–	16	20	–
	Rated peak withstand current I_p [2]		up to kA	52.5	63	52.5	63	52.5	63	40	50	63
60 Hz	Rated short-time withstand current I_k [2]	for rated duration of short-circuit t_k = 1 s, 2 s*)	up to kA	21	25	21	25	21	25	16	20	25
		for rated duration of short-circuit t_k = 3 s	up to kA	21	–	21	–	21	–	16	20	–
	Rated peak withstand current I_p [2]		up to kA	55	65	55	65	55	65	42	52	65
Busbar earthing panel type E												
50 Hz	Rated short-time withstand current I_k	for rated duration of short-circuit t_k = 1 s, 2 s*)	up to kA	21	25	21	25	21	25	16	20	25
		for rated duration of short-circuit t_k = 3 s (4 s*))	up to kA	21	–	21	–	21	–	16	20	–
	Rated peak withstand current I_p		up to kA	52.5	63	52.5	63	52.5	63	40	50	63
	Rated short-circuit making current I_{ma}		up to kA	52.5	63	52.5	63	52.5	63	40	50	63
60 Hz	Rated short-time withstand current I_k	for rated duration of short-circuit t_k = 1 s, 2 s*)	up to kA	21	25	21	25	21	25	16	20	25
		for rated duration of short-circuit t_k = 3 s	up to kA	21	–	21	–	21	–	16	20	–
	Rated peak withstand current I_p		up to kA	55	65	55	65	55	65	42	52	65
	Rated short-circuit making current I_{ma}		up to kA	55	65	55	65	55	65	42	52	65

• possible
– not possible

Footnotes: for page 10

*) As design option, on request according to some national requirements (e.g.: GOST, GB, ...)
**) The rated normal currents apply to ambient air temperatures of max. 40 °C.
1) Depending on HV HRC fuse-link (depending on the let-through current of the HV HRC fuse-link)
2) Busbar

Footnotes: for page 11

*) As design option, on request according to some national requirements (e.g.: GOST, GB, I_{load} = 800 A, ...)
**) The rated normal currents apply to ambient air temperatures of max. 40 °C.
The 24-hour mean value is max. 35 °C (according to IEC 62271-1/VDE 0671-1)
1) Depending on HV HRC fuse-link (depending on the let-through current of the HV HRC fuse-link)
2) The following values apply to 60 Hz: 2 resp. E1

Three-position switch-disconnector

Rated insulation level		Rated voltage U_r	kV	**7.2**		**12**		**17.5**		**24**		
		Rated short-duration power-frequency withstand voltage U_d										
		– phase-to-phase, phase-to-earth, open contact gap	kV	20		28, 42 *)		38		50		
		– across the isolating distance	kV	23		32, 48 *)		45		60		
		Rated lightning impulse withstand voltage U_p										
		– phase-to-phase, phase-to-earth, open contact gap	kV	60		75		95		125		
		– across the isolating distance	kV	70		85		110		145		
Rated frequency f_r			Hz	50 / 60 →								
Rated normal current I_r**)		Standard:	A	630 →								
		Option:	A	800 →								
50 Hz	Rated short-time withstand current I_k	for rated duration of short-circuit t_k = 1 s, 2 *)	up to kA	21	25	21	25	21	25	16	20	25
		for rated duration of short-circuit t_k = 3 s (4 s *))	up to kA	21	–	21	–	21	–	16	20	–
	Rated peak withstand current I_p		up to kA	52.5	63	52.5	63	52.5	63	40	50	63
	Rated short-circuit making current I_{ma}		up to kA	52.5	63	52.5	63	52.5	63	40	50	63
60 Hz	Rated short-time withstand current I_k	for rated duration of short-circuit t_k = 1 s, 2 *)	up to kA	21	25	21	25	21	25	16	20	25
		for rated duration of short-circuit t_k = 3 s	up to kA	21	–	21	–	21	–	16	20	–
	Rated peak withstand current I_p		up to kA	55	65	55	65	55	65	42	52	65
	Rated short-circuit making current I_{ma}		up to kA	55	65	55	65	55	65	42	52	65

Switching capacity for general-purpose switches according to IEC/EN 62271-103

Test duty TD_{load}	Rated mainly active load-breaking current I_{load}	100 operations I_{load} [I_1] *)	A	630 →								
		20 operations 0.05 I_{load} [I_1]	A	31.5 →								
Test duty TD_{loop}	Rated closed-loop breaking current I_{loop} [I_{2a}]		A	630 →								
Test duty TD_{cc}	Rated cable-charging breaking current I_{cc} [I_{4a}]		A	68 →								
Test duty TD_{lc}	Rated line-charging breaking current I_{lc} [I_{4b}]		A	68 →								
Test duty TD_{ma}	Rated short-circuit making current I_{ma}	50 Hz	up to kA	52.5	63	52.5	63	52.5	63	40	50	63
		60 Hz	up to kA	55	65	55	65	55	65	42	52	65
Test duty TD_{ef1}	Rated earth-fault breaking current I_{ef1} [I_{6a}]		A	200 →								
Test duty TD_{ef2}	Rated cable-charging breaking current and line-charging breaking current under earth-fault conditions I_{ef2}		A	115 →								
Number of mechanical operating cycles / M-classification			n	1000 / M1; 2000 *) / M1 →								
Number of electrical operating cycles with I_{load} / Classification			n	100 / E3 →								
Number of short-circuit making operations with I_{ma}			n	5	5	5	5	5	5	5	5	5
Classification				E3	E3	E3	E3	E3	E3	E3	E3	E3
C-classification	for general-purpose switch (no restrikes, TD: I_{cc}, I_{lc})			C2	C2	C2	C2	C2	C2	C2	C2	C2

Classification for disconnectors according to IEC/EN 62271-102/VDE 0671-102

Number of mechanical operating cycles	n	1000 (2000 *)) →
M-classification		M0 (M1 *)) →

Technical data and switching capacity for earthing switch according to IEC/EN 62271-102/VDE 0671-102

Rated short-time withstand current I_k	50 Hz	up to kA	21	25	21	25	21	25	16	20	25
Rated short-circuit making current I_{ma}	50 Hz	up to kA	52.5	63	52.5	63	52.5	63	40	50	63
Rated short-time withstand current I_k	60 Hz	up to kA	21	25	21	25	21	25	16	20	25
Rated short-circuit making current I_{ma}	60 Hz	up to kA	55	65	55	65	55	65	42	52	65
Number of mechanical operating cycles / M-classification		n	1000 / M0 →								
Number of short-circuit making operations with I_{ma}		n	5	5	5	5	5	5	5	5	5 / 2 [2)]
Classification			E2	E2	E2	E2	E2	E2	E2	E2	E2/E1 [2)]

Switch-disconnector/fuse combination according to IEC/EN 62271-105/VDE 0671-105

Rated voltage U_r	kV	**7.2**	**12**	**17.5**	**24**
Rated normal current I_r **)	A	200 [1)] →			
Rated transfer current $I_{transfer}$	A	1750	1750	1500	1400
Maximum transformer rating	kVA	800	1600	1600	2500

Switching capacity for make-proof earthing switch, arranged on feeder side, downstream from HV HRC fuse, for typical: T, T1, M(VT-F)

Rated short-time withstand current t_k = 1 s		kA	2 →	
Rated short-circuit making current I_{ma}	50 Hz	kA	5 →	
	60 Hz	kA	5.2 →	
Number of short-circuit making operations with I_{ma} / E-classification		n	5 / E2	5 / E2	5 / E2	5 / E2
Number of mechanical operating cycles / M-classification		n	1000 / M0 →			

For footnotes, see page 10

Technical Data

Technical data, switching capacity and classification of switching devices

Three-position disconnector, with the functions: Disconnecting CLOSE / OPEN-EARTH,

[e.g. for disconnector panel types D1, D1(T), for circuit-breaker panel types L1(r), L2(r), L1(r,T), L2(r,T)]

Technical data and classification for disconnectors according to IEC / EN 62271-102 / VDE 0671-102

					7.2		12		17.5		24		
Rated voltage U_r				kV	7.2		12		17.5		24		
Rated frequency f_r				Hz	50 / 60 →								
Rated normal current I_r **)			Types L1(r), L1(r,T)	A	630 (on request: 800) →								
for panel types:			Types L2(r), L2(r,T), D1, D1(T)	A	1250 →								
50 Hz	Rated short-time withstand current I_k	for rated duration of short-circuit t_k = 1 s, 2 s *)		up to kA	21	25	21	25	21	25	16	20	25
		for rated duration of short-circuit t_k = 3 s (4 s *))		up to kA	21	–	21	–	21	–	16	20	–
	Rated peak withstand current I_p			up to kA	52.5	63	52.5	63	52.5	63	40	50	63
60 Hz	Rated short-time withstand current I_k	for rated duration of short-circuit t_k = 1 s, 2 s *)		up to kA	21	25	21	25	21	25	16	20	25
		for rated duration of short-circuit t_k = 3 s		up to kA	21	–	21	–	21	–	16	20	–
	Rated peak withstand current I_p			up to kA	55	65	55	65	55	65	42	52	65
Number of mechanical operating cycles				n	1000 (2000 *)) →								
M-classification					M0 (M1 *)) →								

Classification for earthing switch according to IEC / EN 62271-102 / VDE 0671-102 [for panel types D1, D1(T)]

Number of mechanical operating cycles / M-classification				n	1000 / M0								
Number of short-circuit making operations with I_{ma}				n	5	5	5	5	5	5	5	5	5
Classification					E2	E2	E2	E2	E2	E2	E2	E2	E2

Make-proof earthing switch

Technical data and switching capacity for earthing switch according to IEC / EN 62271-102 / VDE 0671-102 (for panel types: R, D, E)

					7.2		12		17.5		24		
Rated voltage U_r				kV	7.2		12		17.5		24		
50 Hz	Rated short-time withstand current I_k	for rated duration of short-circuit t_k = 1 s, 2 s *)		up to kA	21	25	21	25	21	25	16	20	25
		for rated duration of short-circuit t_k = 3 s (4 s *))		up to kA	21	–	21	–	21	–	16	20	–
	Rated short-circuit making current I_{ma}			up to kA	52.5	63	52.5	63	52.5	63	40	50	63
60 Hz	Rated short-time withstand current I_k	for rated duration of short-circuit t_k = 1 s, 2 s *)		up to kA	21	25	21	25	21	25	16	20	25
		for rated duration of short-circuit t_k = 3 s		up to kA	21	–	21	–	21	–	–	20	–
	Rated short-circuit making current I_{ma}			up to kA	55	65	55	65	55	65	42	52	65
Number of mechanical operating cycles / M-classification				n	1000 / M0 →								
Number of short-circuit making operations with I_{ma}				n	5	5	5	5	5	5	5	5	5
Classification					E2	E2	E2	E2	E2	E2	E2	E2	E2

Make-proof earthing switch (air-insulated, arranged at cable feeder)

[e.g. for circuit-breaker panel types L1(r), L2(r)]

Technical data and switching capacity for earthing switch according to IEC/EN 62271-102/VDE 0671-102

					7.2		12		17.5		24	
Rated voltage U_r				kV	7.2		12		17.5		24	
50 Hz	Rated short-time withstand current I_k	for rated duration of short-circuit t_k = 1 s		up to kA	20	25	20	25	20	25	16	20
		for rated duration of short-circuit t_k = 3 s		up to kA	20	–	20	–	20	–	16	20
	Rated short-circuit making current I_{ma}			up to kA	50	63	50	63	50	63	40	50
	Rated peak withstand current I_p			up to kA	50	63	50	63	50	63	40	50
60 Hz	Rated short-time withstand current I_k	for rated duration of short-circuit t_k = 1 s		up to kA	20	25	20	25	20	25	16	20
		for rated duration of short-circuit t_k = 3 s		up to kA	20	–	20	–	20	–	–	20
	Rated short-circuit making current I_{ma}			up to kA	52	65	52	65	52	65	42	52
	Rated peak withstand current I_p			up to kA	52	65	52	65	52	65	42	52
Number of mechanical operating cycles / M-classification				n	1000 / M0 →							
Number of short-circuit making operations with I_{ma}				n	2	2	2	2	2	2	2	2
Classification					E1	E1	E1	E1	E1	E1	E1	E1

*) As design option, on request according to some national requirements (e.g.: GOST, GB, ...)

**) The rated normal currents apply to ambient air temperatures of max. 40 °C.
The 24-hour mean value is max. 35 °C (according to IEC 62271-1/VDE 0671-1)

Vacuum circuit-breaker

Switching capacity according to IEC/EN 62271-100/VDE 0671-100
Type CB-f [1) 4)], combined with three-position disconnector, in gas-insulated switching-device vessel [4)]
Type CB-r / SION L (3AE6) [1)]

					7.2		12		17.5		24		
Rated voltage U_r				kV	7.2		12		17.5		24		
Rated normal current I_r **) for circuit-breaker type		CB-f, CB-r (SION L)		A	630 →								
				A	on request: 800 →								
		CB-r (SION L)		A	1250 →								
Rated frequency f_r				Hz	50/60 →								
50 Hz	Rated short-time withstand current I_k	for rated duration of short-circuit t_k = 1 s, 2 s *)	up to kA		21	25	21	25	21	25	16	20	25
		for rated duration of short-circuit t_k = 3 s (4 s *) □))	up to kA		21	–	21	–	21	–	16	20	–
	Rated peak withstand current I_p		up to kA		52.5	63	52.5	63	52.5	63	40	50	63
	Rated short-circuit breaking current I_{sc}		up to kA		21	25	21	25	21	25	16	20	25
	Rated short-circuit making current I_{ma}		up to kA		52.5	63	52.5	63	52.5	63	40	50	63
60 Hz	Rated short-time withstand current I_k	for rated duration of short-circuit t_k = 1 s, 2 s *)	up to kA		21	25	21	25	21	25	16	20	25
		for rated duration of short-circuit t_k = 3 s	up to kA		21	–	21	–	21	–	16	20	–
	Rated peak withstand current I_p		up to kA		55	65	55	65	55	65	42	52	65
	Rated short-circuit breaking current I_{sc}		up to kA		21	25	21	25	21	25	16	20	25
	Rated short-circuit making current I_{ma}		up to kA		55	65	55	65	55	65	42	52	65

Classification and number of operating cycles for circuit-breaker according to IEC/EN 62271-100/VDE 0671-100
Circuit-breaker: CB-f NAR [3)]

Mechanical	Number of operating cycles		2000 →
	Class		M1 →
Electrical	Number of operating cycles with I_r: 2000		Class E2 →
	Breaking of capacitive currents		Class C1 →
	Number of short-circuit breaking operations with I_{sc}	n	20 →
			Class S1 →
Rated operating sequence	CB-f NAR		O – 3 min – CO – 3 min – CO →

Circuit-breaker: CB-f AR [1)]; CB-r AR [1) 3)]

Mechanical	Number of operating cycles	n	10 000 →
	Class		M2 →
Electrical	Number of operating cycles with I_r: 10,000		Class E2 →
	Breaking of capacitive currents		Class C2 →
	Number of short-circuit breaking operations with I_{sc} for CB-f AR	n	30 or 50 →
	Number of short-circuit breaking operations with I_{sc} for CB-r AR	n	30 →
			Class S2 →
Rated operating sequence	CB-f		O – 0.3 s – CO – 3 min – CO →
	CB-f		O – 0.3 s – CO – 30 s – CO →
	CB-r (SION L)		O – 0.3 s – CO – 15 s – CO →

Classification for disconnector according to IEC/EN 62271-102/VDE 0671-102 (for panel types L, L1, ...)

Number of mechanical operating cycles	n	1000 (2000 *)) →
M-classification		M0 (M1 *)) →

Classification for earthing switch according to IEC/EN 62271-102/VDE 0671-102 (for panel types L, L1, ...)

Number of mechanical operating cycles / M-classification	n	1000 / M0 →										
Number of short-circuit making operations with I_{ma}	n	5	5	5	5	5	5	5	5	5	5	5
Classification		E2	E2	E2	E2	E2	E2	E2	E2	E2	E2	E2

*) As design option, on request according to some national requirements (e.g.: GOST, GB, ...)

**) The rated normal currents apply to ambient air temperatures of max. 40 °C.
The 24-hour mean value is max. 35 °C (acc. to IEC 62271-1 / VDE 0671-1)

□) Only for CB-f

1)

Definition of the different types of vacuum circuit-breakers (= VCB):			*VCB version:*	without AR [3)]	with AR [3)]
Panel type	VCB type	Vacuum circuit-breaker – Design:		CB-...NAR	CB-...AR
L, L1	CB-f	**f**ixed-mounted in gas-insulated switching-device vessel, combined with three-position disconnector		CB-f NAR	CB-f AR
L1(r), L2(r)	CB-r (SION L)	air-insulated, **r**emovable, separate three-position disconnector			CB-r AR

3) AR = Automatic reclosing; NAR = Non-automatic reclosing

4) VCB in switching-device vessel (maintenance-free under normal ambient conditions according to IEC 62271-1)

Product Range

Product range overview

Standard panels (examples)

Ring-main panel, type R

Transformer panel, type T

Circuit-breaker panel

Circuit-breaker panel, type L
with CB type "CB-f NAR" [2]
(500 mm)

Application as:	Panel designation	Panel type	Panel width mm	Rated current	
Column No.					
Cable feeder panels	Ring-main panel [1]	R	375	630 A, 800 A	
		R1	500	630 A, 800 A	
	Transformer panel [1]	T	375	200 A	
		T1	500	200 A	
	Cable panel	K	375	630 A	
		K1	500	630 A, 1250 A	
	Circuit-breaker panel (fixed-mounted CB, gas-insul.) [1] (with CB type "CB-f" [2])	L	500	630 A	
		L1	750	630 A, 1250 A △)	
	Circuit-breaker panel (removable CB) type "CB-r"	L1(r)	750	630 A	
		L2(r)	875	1250 A	
	Disconnector panel [1]	D1 △)	500	1250 A △)	
Transfer panels	Ring-main transfer panel [1]	R(T)	375	630 A, 800 A	
	Ring-main transfer panel [1]	R1(T)	500	630 A	
	Circuit-breaker transfer panel [1]	L(T)	500	630 A	
	Circuit-breaker transfer panel [1]	L1(T)	750	630 A, 1250 A	
	Circuit-breaker transfer panel (removable CB)	L1(r, T)	750	630 A	
		L2(r, T)	875	1250 A	
	Disconnector transfer panel [1]	D1(T)	500	1250 A	
Metering panels and other panel versions	Metering panel as billing metering panel	M	750	630 A, 800 A, 1250 A	
	Metering panel with cable connection	M(-K)	750	630 A, 800 A, 1250 A	
	Metering panel with busbar connection	M(-B)	750	630 A, 800 A, 1250 A	
	Metering panel with busbar and cable connection	M(-BK)	750	630 A, 800 A, 1250 A	
	Metering panel with cable connection: Individual panel	M(KK)	750	630 A, 800 A	
	Busbar voltage metering panel	M(VT)	375	200 A	
	Busbar voltage metering panel	M1(VT)	500	200 A	
	Busbar voltage metering panel with fuse	M(VT-F)	375	200 A	
	Busbar voltage metering panel with fuse	M1(VT-F)	500	200 A	
	Bus riser panel	H	375	630 A, 800 A, 1250 A	
	Metering panel / bus riser panel	H1	500	630 A, 1250 A	
Busbar earthing panel	Busbar earthing panel	E	375	–	

● Available
○ Optionally available
– Not applicable

1 Three-phase CT	2 CT as cast-resin CT (e.g. type 4MA)	3 CT as cable-type CT	4 VT (1-pole) as cast-resin VT	5 VT (2-pole) as cast-resin VT	6 2nd cable	7 3rd cable	8 Surge arrester instead of 2nd cable (3rd cable)	9 LSC category (Loss of service continuity category)	10 Rated voltage	Panel type
●	–	●	–	–	○ (up to 17.5 kV)	–	○ (up to 17.5 kV)	LSC 2	24 kV	R
●	●	●	○	–	○	–	○		24 kV	R1
–	–	●	–	–	–	–	–	LSC 2	24 kV	T
–	–	●	–	–	–	–	–		24 kV	T1
–	–	●			○ (up to 17.5 kV)	–	○ (up to 17.5 kV)	LSC 1	24 kV	K
–	●	●	○		○	–	○		24 kV	K1
●	●	●	○		○		○	LSC 2	24 kV	L
●	●	●	○		○	○	○		24 kV	L1
●	●	●	○		○	–	○	LSC 2	24 kV	L1(r)
●	●	●	○		○	○	○		24 kV	L2(r)
●	●	●	○		○	–	○	LSC 2	24 kV	D1 △)
–		–			–	–	–	LSC 2	24 kV	R(T)
–		–			–	–	–	LSC 2	24 kV	R1(T)
●	●	–	○	–	–	–	–	LSC 2	24 kV	L(T)
●	●	–	○	–	–	–	–	LSC 2	24 kV	L1(T)
●	●	–	○	–	–	–	–	LSC 2	24 kV	L1(r, T)
●	●	–	○	–	–	–	–		24 kV	L2(r, T)
–		–			–	–	–	LSC 2	24 kV	D1(T)
–	●	–	○	○	–	–	–	LSC 1	24 kV	M
–	●		○	○	○	–	○		24 kV	M(-K)
–	●	–	○	○	–	–	–		24 kV	M(-B)
–	●		○	○	○	–	○		24 kV	M(-BK)
–	●		○	○	○	–	○		24 kV	M(KK)
–	–	–	○		–	–	–	LSC 2	17.5 kV	M(VT)
–	–	–	○		–	–	–		24 kV	M1(VT)
–	–	–	○		–	–	–		17.5 kV	M(VT-F)
–	–	–	○		–	–	–		24 kV	M1(VT-F)
–	○	–	○	–	–	–	–	LSC 1	24 kV	H
–	○	–	○	○	–	–	–	LSC 1	24 kV	H1
–	–	–	–	–	–	–	–	LSC 2	24 kV	E

△) In preparation

1) Panel type: Metal-clad
2) Type designation of vacuum circuit-breaker

Product Range

Product range overview

Standard panels (examples)

Cable panel
type K

Billing metering panel
type M

Bus riser panel
type H

Circuit-breaker panel, type L1
with CB type "CB-f" [2]
(750 mm)

Panel designation		Panel type	Panel width mm	
Column No.				
Ring-main panel [1]	as feeder	R R1	375 500	
	as transfer	R(T) R1(T)	375 500	
Transformer panel [1]	as feeder	T T1	375 500	
Cable panel	as feeder	K K1	375 500	
Circuit-breaker panel [1] with CB type "CB-f" [2]	as feeder	L L1	500 750	
	as transfer	L(T) L1(T)	500 750	
Circuit-breaker panel [1] with CB type 3AE [2]	as feeder	L1(r) L2(r)	750 875	
	as transfer	L1(r, T) L2(r, T)	750 875	
Metering panels (as billing metering panel)	standard	M M(-B)	750 750	
	as end panel	M(-K) M(-BK)	750 750	
Metering panel	as individual panel	M(KK)	750	
Busbar voltage metering panel [1]		M(VT)	375	
		M1(VT)	500	
		M(VT-F)	375	
		M1(VT-F)	500	
Bus riser panel		H	375	
Metering panel / bus riser panel		H1	500	
Disconnector panel [1]	as feeder	D1 △)	500	
	as transfer	D1(T)	500	
Busbar earthing panel		E	375	

△) In preparation
1) Panel type: Metal-clad
2) Type designation of vacuum circuit-breaker

● Basic equipment
○ Additional equipment (option), further additional equipment on request
– Not available

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	Panel type
●[1]	●	–	●	●	–	●	○	○	○	○	–	–	○	–	○	○	–	–	○	○	○	○	○	○	–	R R1
●	●	–	–	●	–	●	○	○	○	○	–	–	○	–	–	○	–	–	○	–	○	○	○	–	–	R(T) R1(T)
●	●	–	●[8]	●	○	●	○	○	○	○	–	●	○	○	●	○	–	–	○	–	○	○	○	○	–	T T1
–	–	●	●	●	–	–	–	–	–	–	–	–	–	–	○	○	–	–	–	○	○	○	○	○	–	K K1
●[2]	●	–	●	●	○	●	○	○	○	○	●	–	○	–	○	○	○	○	○	○	○	○	○	○	–	L L1
●[2]	●	–	–	●	○	●	○	○	○	○	●	–	○	–	–	○	○	○	○	–	○	○	○	–	–	L(T) L1(T)
●[2]	●	–	●	●	○	●	○	○	○	○	●	–	○	–	○[6]	○	○	○	○	○	○	○	○	○	○	L1(r) L2(r)
●[2]	●	–	–	●	○	●	○	○	○	○	●	–	○	–	–	○	○	○	○	–	○	○	○	–	○	L1(r, T) L2(r, T)
–	–	●	–	●	–	–	–	–	–	–	–	–	–	–	○	○	–	–	–	–	○	○	○	–	–	M M(-B)
–	–	●	●	●	–	–	–	–	–	–	–	–	–	–	○	○	–	–	–	–	○	○	○	○	–	M(-K) M(-BK)
–	–	●	●	●	–	–	–	–	–	–	–	–	–	–	○	○	–	–	–	–	○	○	○	○	–	M(KK)
●[1]	●	–	–	●	–	●	○	○	○	○	–	–	–	○	–	○	–	–	○	–	○	○	○	–	–	M(VT)
●[1]	●	–	–	●	–	●	○	○	○	○	–	–	–	○	–	○	–	–	○	–	○	○	○	–	–	M1(VT)
●[1]	●	–	–	●	–	●	○	○	○	○	–	–	–	○	○	○	–	–	○	–	○	○	○	–	–	M(VT-F)
●[1]	●	–	–	●	–	●	○	○	○	○	–	–	–	○	○	○	–	–	○	–	○	○	○	–	–	M1(VT-F)
–	–	●	–	●	–	–	–	–	–	–	–	–	–	–	–	○	–	–	–	–	○	○	○	–	–	H
–	–	●	–	●	–	–	–	–	–	–	–	–	–	–	–	○	–	–	–	–	○	○	○	–	–	H1
●	●	–	●	●	–	●	○	○	○	○	–	–	○	–	○	○	–	–	○	○	○	○	○	○	–	D1 △)
●	●	–	–	●	–	●	○	○	○	○	–	–	○	–	–	○	–	–	○	–	○	○	○	–	–	D1(T) △)
●	–	●	–	●	–	●	○	○	–	–	–	–	–	–	○	○	–	–	○	–	○	○	○	–	–	E
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	Panel type

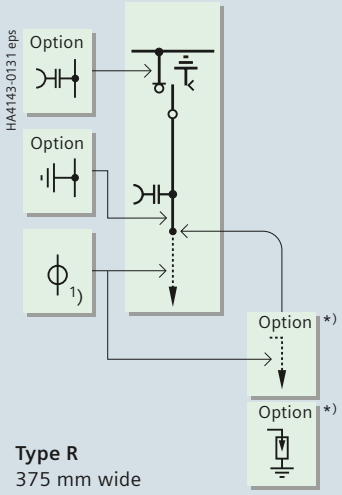
△) In preparation

1) Three-position switch as three-position switch-disconnector
2) Three-position switch as three-position disconnector
4) In special cases, deeper floor cover for panels with cable feeder required. Design of floor cover: Depending of direction of pressure relief
5) Not to be applied for versions with separate feeder earthing switch in panel types L1(r), L2(r)
6) Inspection window is a standard equipment in panel types L1(r), L2(r) for versions with separate earthing switch at the cable feeder
7) Or for earthing switch in panel type E
8) For panel type T with a rated voltage of 24 kV: Deeper cable fixing located underneath the panel

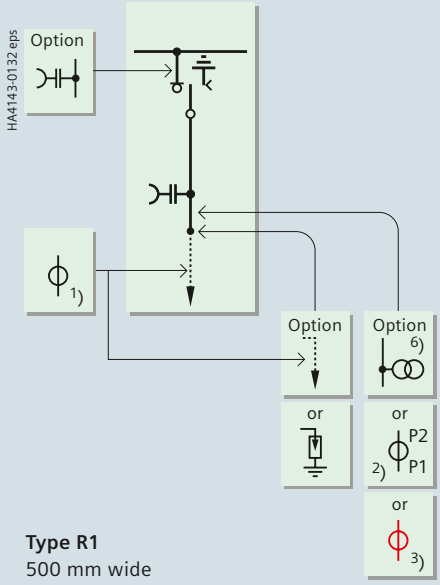
Product Range

Ring-main panels, cable panels, busbar earthing panels

Ring-main panels
as feeder panels

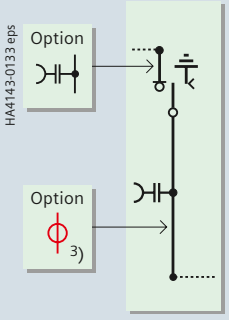


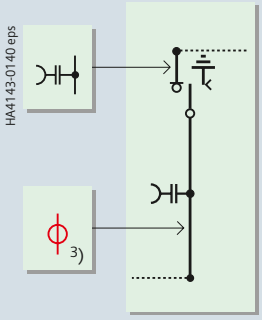
Type R
375 mm wide



Type R1
500 mm wide

Ring-main panel
as transfer panel for attachment to panel
types M, M(-K), H types L1(r, T)

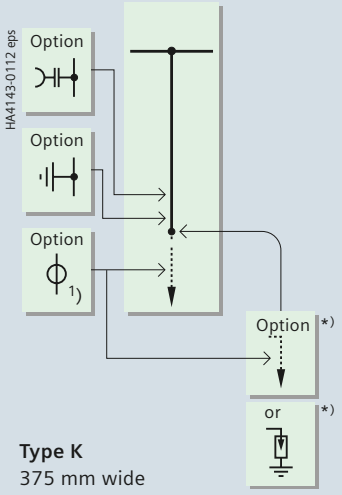




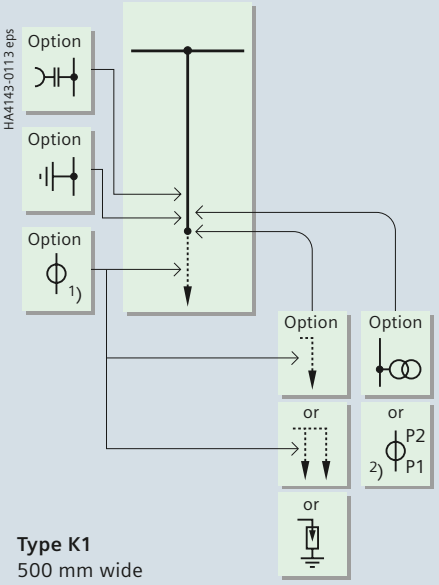
Type R(T)
375 mm wide

Type R1(T)
500 mm wide

Cable panels
as feeder panels, 630 A

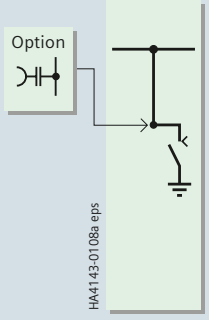


Type K
375 mm wide



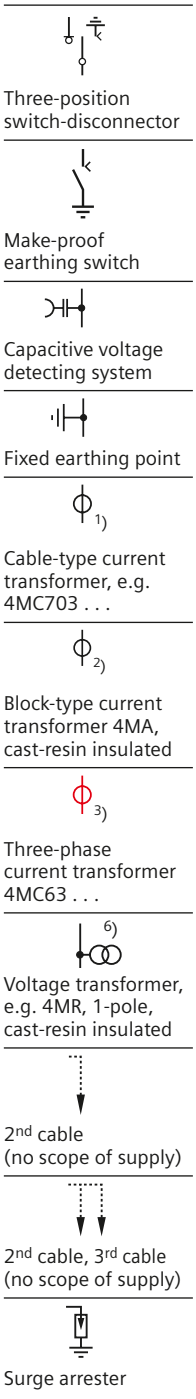
Type K1
500 mm wide

Busbar earthing panel



Type E
375 mm wide

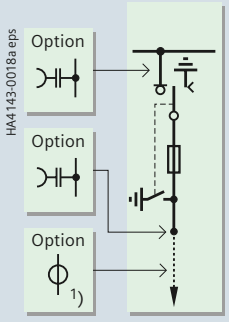
Panel equipment with devices and current and voltage transformers depends on the rated voltage and the panel type (e.g. L1, R) as well as on the panel combination [e.g. R(T)]



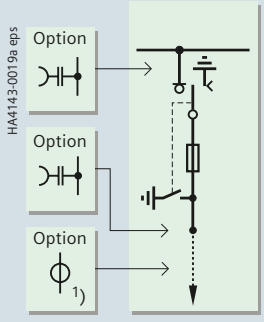
*) Option: Up to U_r=17.5 kV

2) P1 and P2 are terminal designations of the current transformer

Transformer panels
as feeder panels

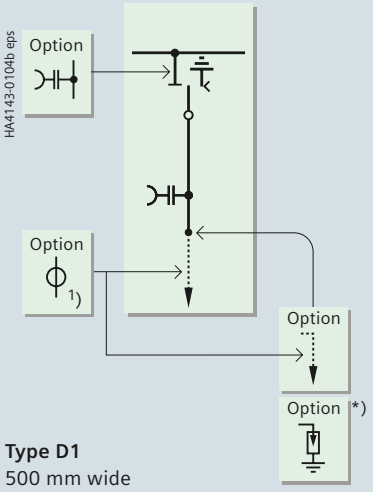


Type T
375 mm wide

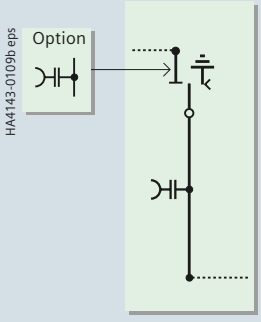


Type T1
500 mm wide

Disconnector panels
as feeder panels △)



Type D1
500 mm wide



Type D1(T)
500 mm wide

Panel equipment with devices and current and voltage transformers depends on the rated voltage and the panel type (e.g. L1, R) as well as on the panel combination [e.g. R(T)]

Three-position switch-disconnector

Three-position disconnector

Discharge switch

HV HRC fuse

Capacitive voltage detecting system

Cable-type current transformer, e.g. 4MC703 . . .

On request:
Three-phase current transformer 4MC63 . . .

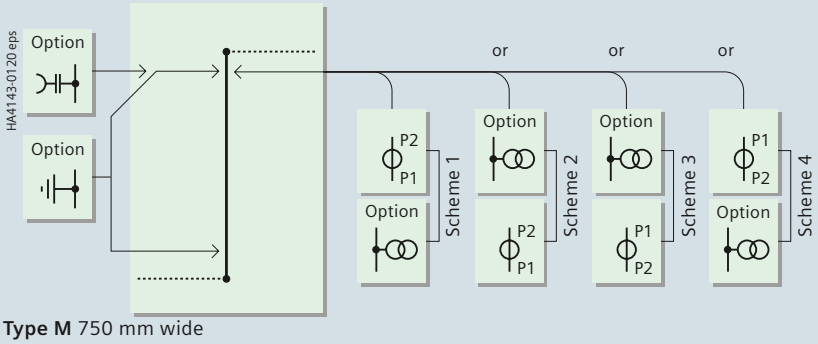
Cable
(not included in the scope of supply)

2nd cable
(not included in the scope of supply)

Surge arrester

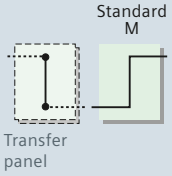
*) On request
△) In preparation

Billing metering panels 630 A, 800 A, 1250 A
Standard



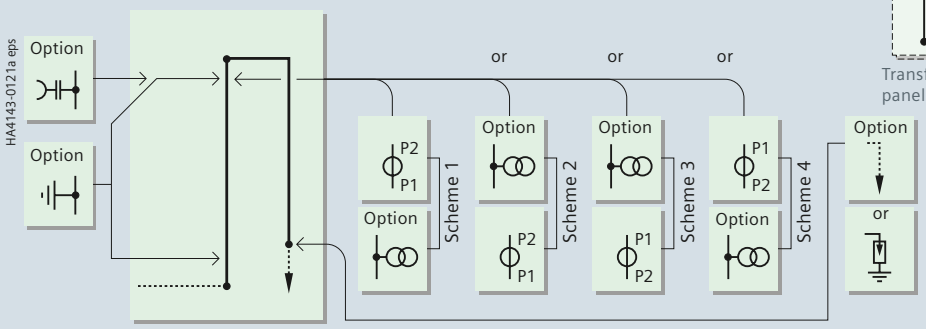
Type M 750 mm wide

Panel design of M



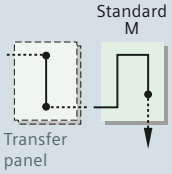
Standard:
For transfer to the right

Billing metering panels 630 A, 800 A, 1250 A
for cable connection



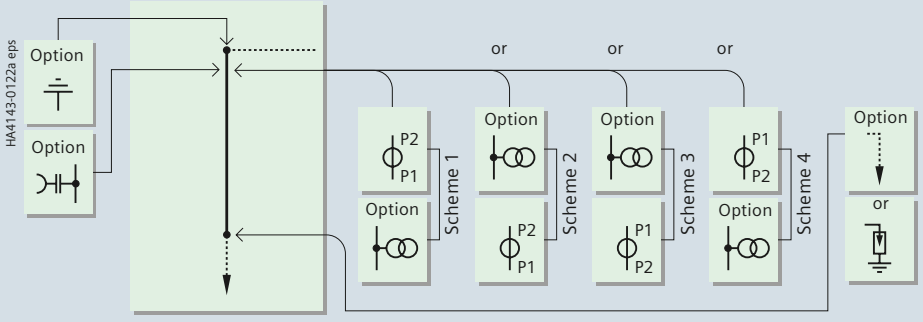
Type M(-K) 750 mm wide

Panel design of M(K)



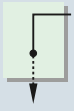
Standard:
For transfer to the right

Billing metering panels 630 A, 800 A, 1250 A
for busbar connection

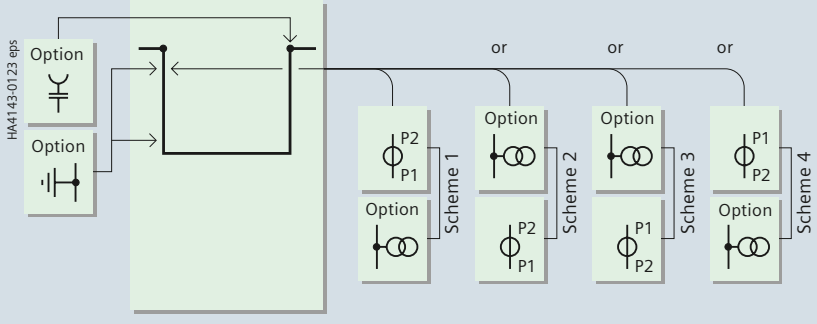


Type M(-BK) 750 mm wide

Panel design of M(-BK)



Billing metering panels 630 A, 800 A, 1250 A
for busbar connection



Type M(-B) 750 mm wide

Panel design of M(-B)

Panel equipment with devices and current and voltage transformers depends on the rated voltage and the panel type (e.g. L1, R) as well as on the panel combination [e.g. R(T)]

Capacitive voltage detecting system

Fixed earthing point

Block-type current transformer 4MA, cast-resin insulated

Voltage transformer, e.g. 4MR, 1-pole, cast-resin insulated

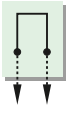
Fixed earthing point for busbar earthing

Cable
(not included in the scope of supply)

2nd cable
(not included in the scope of supply)

Surge arrester

Option

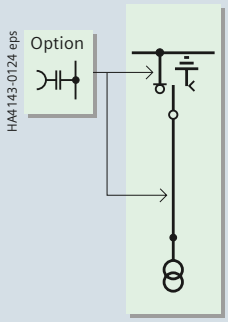


Individual metering panel type M(KK)

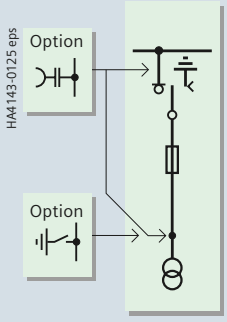
[2]) P1 and P2 are terminal designations of the current transformer

Busbar voltage metering panels

up to 17.5 kV

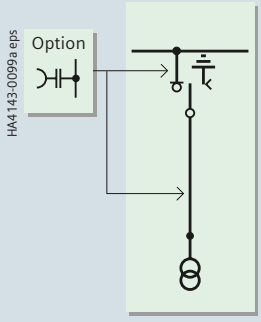


Type M(VT)
375 mm wide

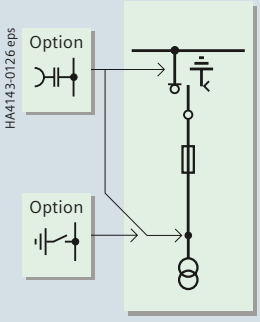


Type M(VT-F)
375 mm wide

up to 24 kV

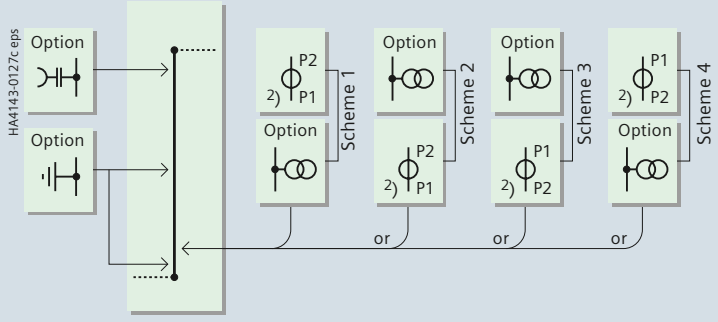


Type M1(VT)
500 mm wide



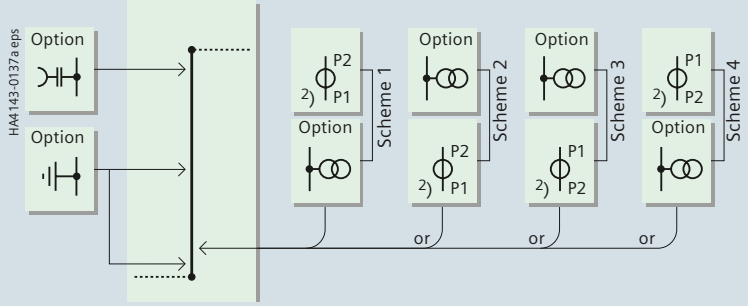
Type M1(VT-F)
500 mm wide

Metering panel and/or bus riser panels



Type H, 630 A, 800 A, 1250 A
375 mm wide

Schemes 1 to 4 depend on:
– Rated voltage U_r
– Panel combinations (TC-xx) with the adjacent panel types



Type H1, 630 A, 1250 A
500 mm wide

Panel equipment with devices and current and voltage transformers depends on the rated voltage and the panel type (e.g. L1, R) as well as on the panel combination [e.g. R(T)]

Three-position switch-disconnector

Capacitive voltage detecting system

Fixed earthing point

HV HRC fuse

Voltage transformer, e.g. 4MR, 1-pole, cast-resin insulated

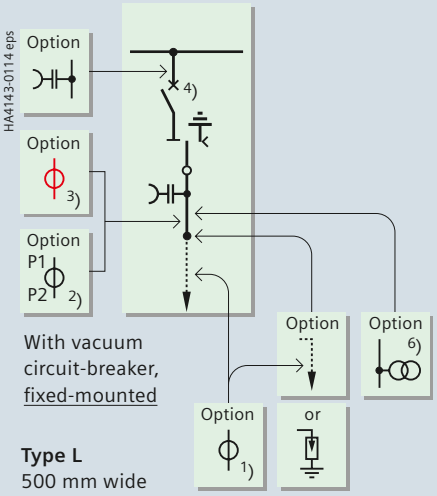
Discharge switch

Block-type current transformer 4MA, cast-resin insulated

Voltage transformer, e.g. 4MR, 1-pole, cast-resin insulated

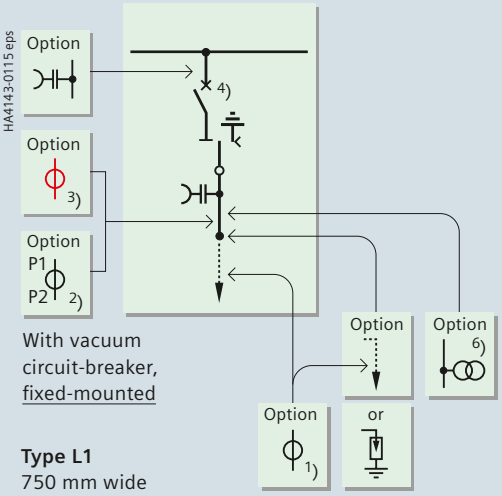
2) P1 and P2 are terminal designations of the current transformer

Circuit-breaker panels 630 A
as feeder panels



With vacuum circuit-breaker, fixed-mounted

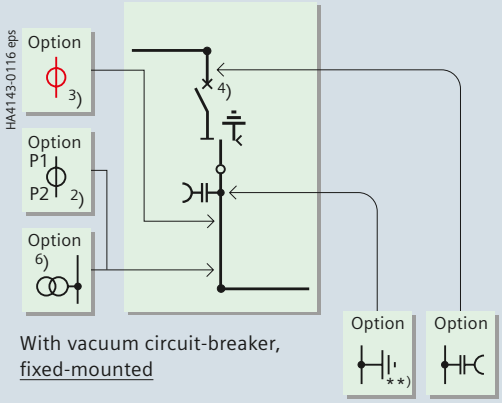
Type L
500 mm wide



With vacuum circuit-breaker, fixed-mounted

Type L1
750 mm wide

as transfer panel for attachment
to panel types M or H or R(T), D1(T)

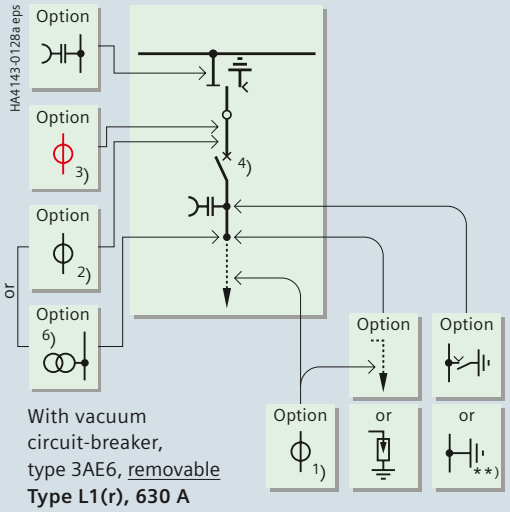


With vacuum circuit-breaker, fixed-mounted

Type L1(T)
750 mm wide

Type L(T):
500 mm wide

Circuit-breaker panels 630 A, 1250 A
as feeder panels

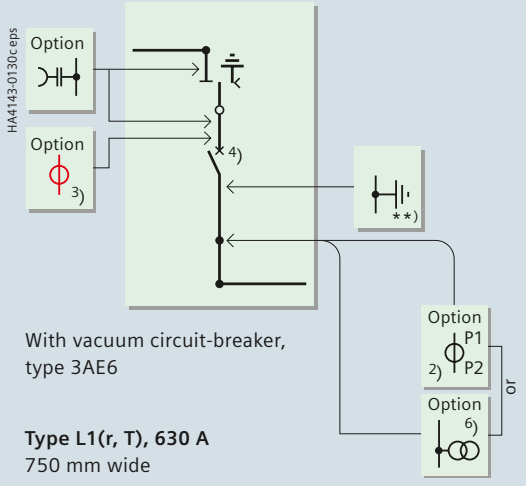


With vacuum circuit-breaker, type 3AE6, removable

Type L1(r), 630 A
750 mm wide

Type L2(r), 1250 A
875 mm wide

as transfer panel for attachment
to panel types, see table below



With vacuum circuit-breaker, type 3AE6

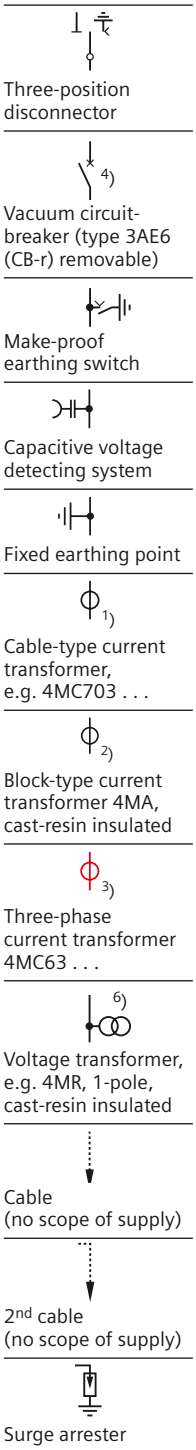
Type L1(r, T), 630 A
750 mm wide

Type L2(r, T), 1250 A
875 mm wide

**) Standard: Feeder earthing via the vacuum circuit-breaker type 3AE6 (with interlocks, without earthing switch)

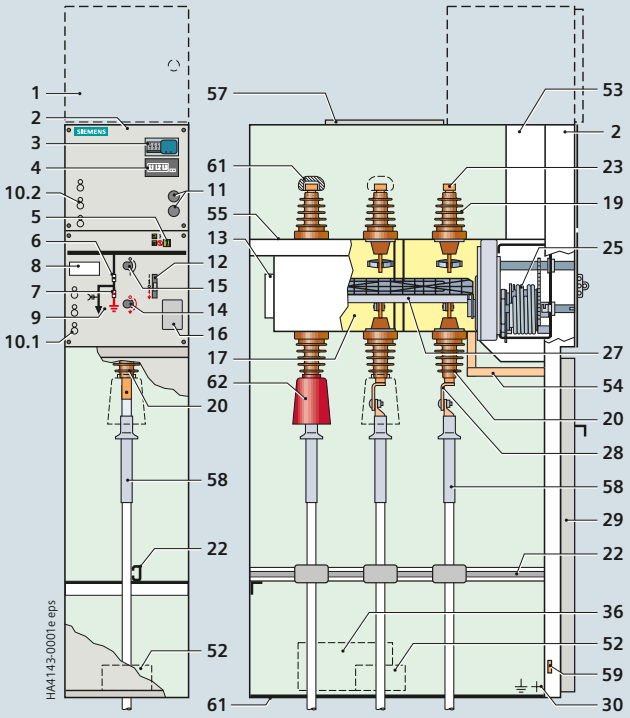
Panel combinations	Design	Rated current
L1(r, T) + H1	Standard	630 A
L1(r, T) + R1(T)	Standard	630 A
L2(r, T) + D1(T)	Standard	1250 A
L2(r, T) + H1	Standard	1250 A

Panel equipment with devices and current and voltage transformers depends on the rated voltage and the panel type (e.g. L1, R) as well as on the panel combination [e.g. R(T)]



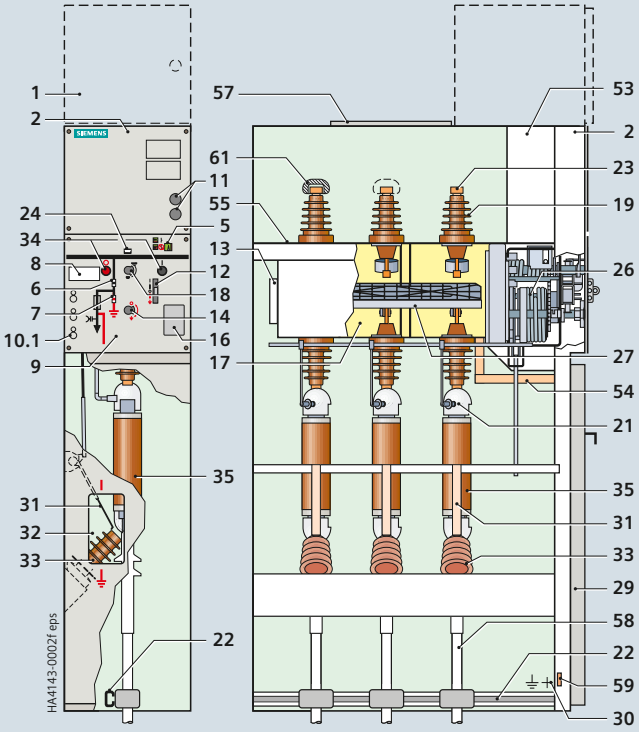
2) P1 and P2 are terminal designations of the current transformer

Ring-main panel as feeder



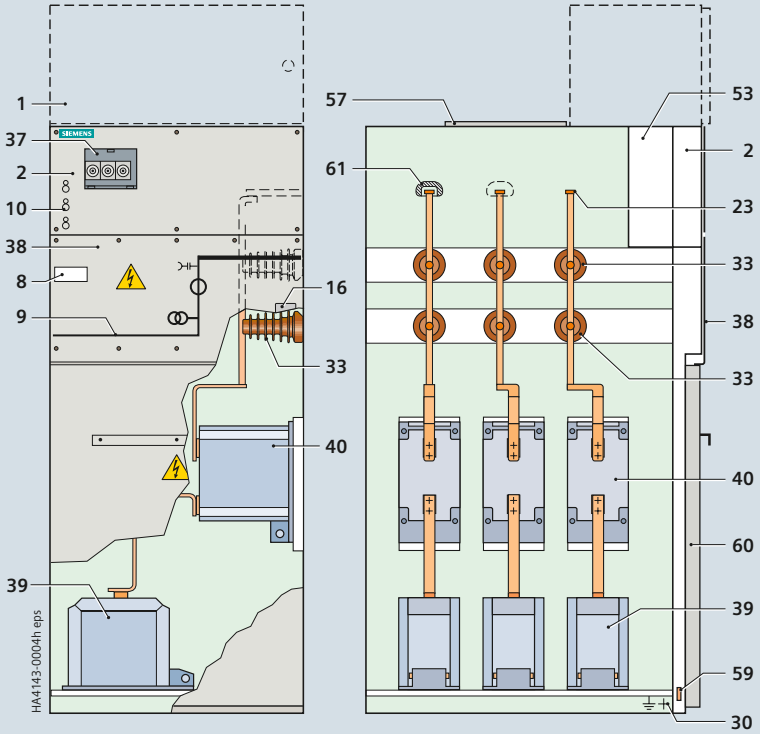
Type R Section

Transformer panel as feeder



Type T Section

Billing metering panel

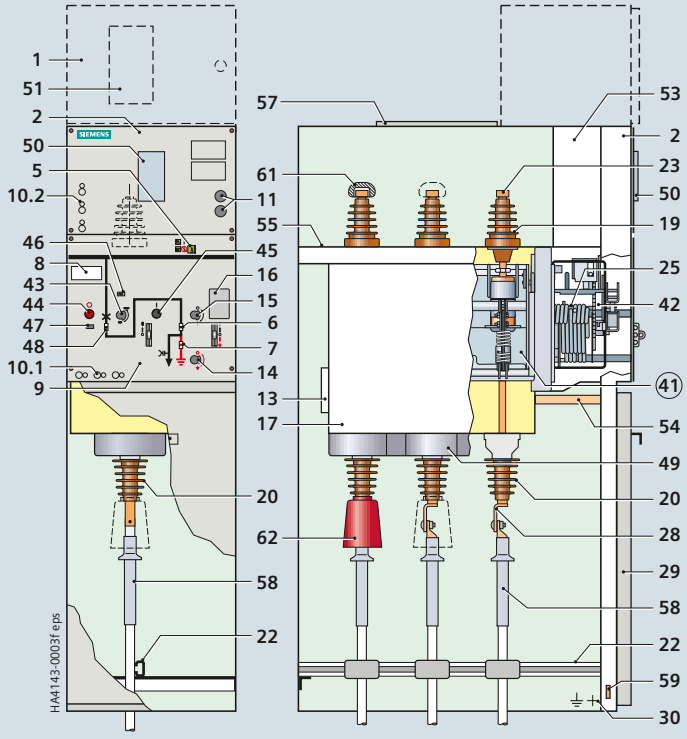


Type M Section

Legend for pages 23 and 24 (contin. on page 24)

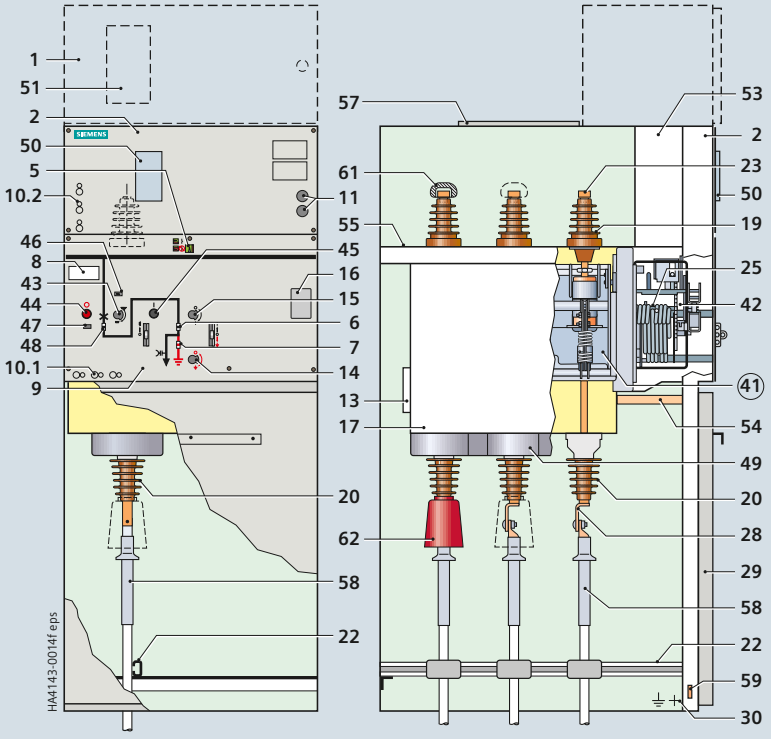
1 Option: Low-voltage compartment
2 Niche for optional low-voltage equipment, cover can be unscrewed
3 Option: CAPDIS-Sx voltage detecting system
4 Option: Short-circuit/earth-fault indicator
5 Option: Ready-for-service indicator for switching device
6 Position indication for load-break function "CLOSED – OPEN"
7 Position indication for earthing function "OPEN – EARTHED"
8 Feeder designation label
9 Mimic diagram
10 Option: Sockets for capacitive voltage detecting system (depending on arrangement)
10.1 for feeder
10.2 for busbar
11 Option: Momentary-contact rotary control switch "CLOSED – OPEN" for motor operating mechanism with local-remote switch for three-position switch-disconnector
12 Option: Locking device for three-position switch-disconnector
13 Pressure relief device for switching device
14 Manual operation for the mechanism of the earthing function
15 Manual operation for the mechanism of the load-break or disconnecting function in L panels
16 Rating and type plate
17 Gas-insulated vessel for switching device (contains fluorinated greenhouse gas SF_6)
18 Manual operation for mechanism "spring charging"
19 Bushing-type insulator for busbar

Circuit-breaker panel (with vacuum circuit-breaker type CB-f NAR)



Type L (500 mm) **Section**

Circuit-breaker panel (with vacuum circuit-breaker type CB-f NAR)



Type L1 (750 mm) **Section**

Legend for pages 23 and 24

20 Bushing-type insulator for feeder
21 Terminal for HV HRC fuse assembly (with tripping)
22 Cable bracket with cable clamps (option) for fastening cables
23 Busbar
24 "Spring charged" indicator for stored-energy "OPEN"
25 Spring-operated mechanism for three-position switch-disconnector
26 Spring-operated / stored-energy mechanism for three-position switch-disconnector
27 Three-position switch-disconnector
28 Cable connection
29 Cable compartment cover
30 Earthing connection (for location, see dimension drawings)
31 Earthing switch for cable connection
32 Inspection window
33 Post insulator
34 Operation for stored-energy mechanism
– stored-energy "OPEN" (red)
– stored-energy "CLOSED" (black)
35 Option: HV HRC fuse-link (e = 292 mm or 442 mm)
36 Option: Heating in the panel
37 Option: Secondary protection for voltage transformer
38 Cover, screwed on
39 4MR voltage transformer
40 4MA7 block-type current transformer

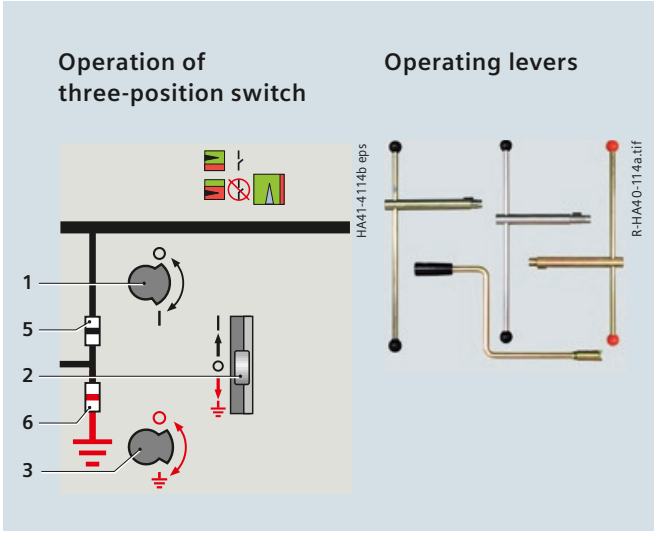
Vacuum circuit-breaker:

41 Vacuum circuit-breaker, (VCB) fixed-mounted
42 Operating mechanism box
43 Manual operation for "spring charging"
– for closing with manual operating mechanism
– for emergency operation with motor operating mechanism
44 Mechanical "OFF" pushbutton
45 Mechanical "ON" pushbutton (not supplied with spring-operated mechanism)
46 "Spring charged" indicator
47 Operations counter (option for VCB type: CB-f NAR)
48 Position indicator

49 Option: Three-phase current transformer 4MC63
50 Option: Overcurrent-time protection relay (type 7SR45 or similar)
51 Option: Multifunction protection relay SIPROTEC 5 7SJ82
52 Cable-type current transformer
53 Niche applicable for control cables and / or bus wires
54 Option: Additional earthing busbar for switching-device vessel
55 Metallic partition of busbar compartment
57 Busbar compartment cover for panel extension
58 Cable sealing end (not included in scope of supply)
59 Earthing busbar
60 Cover for transformer connection compartment
61 Insulating cap on the busbar (for $U_r > 17.5$ kV)
62 Insulating cap for cable connection (for $U_r > 17.5$ kV)

Control board

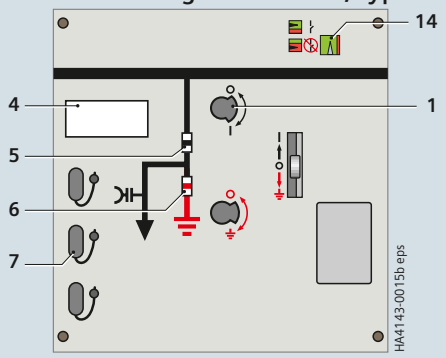
The control boards are function-related. They integrate operation, mimic diagram and position indication. Furthermore, the respective indicating, measuring and monitoring equipment as well as locking devices and control elements (e.g. local-remote switch) are arranged there according to the panel type and version. The ready-for-service indicator and rating plates are also located at the operating front. Operation is identical for transformer and circuit-breaker feeders. First, the operating mechanism must be charged; then, closing / opening is done through separate pushbuttons. The condition of the energy store is indicated.
All actuating openings are functionally interlocked against each other, and are optionally lockable. The operating lever carries two plug inserts, separately for the disconnecting and earthing function.



1 Manual operation of load-break function (R, T) or disconnecting function (L)
2 Locking function (option for ring-main feeders)
3 Manual operation of earthing function
4 Panel designation label
5 Position indicator for switch-disconnector
6 Position indicator for earthing switch
7 Sockets of capacitive voltage detecting system
8 "Fuse tripped" indicator
9 ON pushbutton for transformer or circuit-breaker function
10 OFF pushbutton for transformer or circuit-breaker function
11 Manual operation for "spring charging"
12 "Spring charged" indicator
13 Position indicator for circuit-breaker
14 Ready-for-service indicator
15 Operations counter
16 Preselection for manual charging of circuit-breaker panels

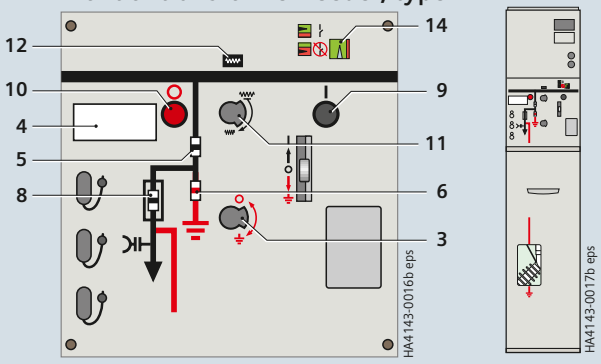
*) AR = Automatic reclosing
NAR = Non automatic reclosing

Front of ring-main feeder, type R



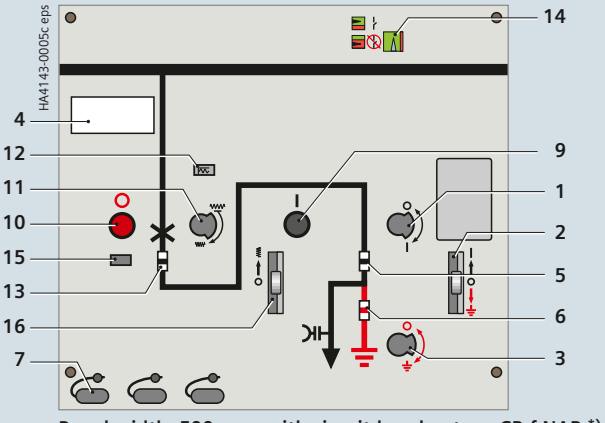
Panel width: 375 mm

Front of transformer feeder, type T

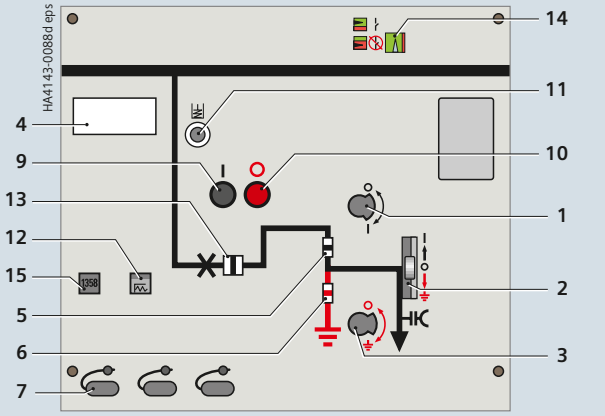


Panel width: 375 mm

Front of circuit-breaker feeder, type L



Panel width: 500 mm, with circuit-breaker type CB-f NAR *)



Panel width: 500 mm, with circuit-breaker type CB-f AR *)

Features

- Switch positions:
  CLOSED – OPEN – EARTHED
- Switching functions as general-purpose switch-disconnector (class E3) according to
  – IEC / EN 62271-103 / VDE 0671-103 *)
  – IEC / EN 62271-102 / VDE 0671-102 *)
- Designed as a three-position switch with the functions
  – Switch-disconnector and
  – Make-proof earthing switch
- Operation via rotary bushing welded gas-tight into the front of the switching-device vessel
- Climate-independent contact in the gas-filled switching-device vessel
- Maintenance-free according to IEC / EN 62271-1 / VDE 0671-1
- Individual secondary equipment
- No cross insulation between phases.

Mode of operation

The operating shaft forms one unit together with the three contact blades. Due to the arrangement of the fixed contacts (earth – busbar), it is not necessary to interlock the CLOSE and EARTHING functions.

Closing operation

During the closing operation, the operating shaft with the moving contact blades changes from the "OPEN" to the "CLOSED" position.
The force of the spring-operated mechanism ensures a high closing speed and a reliable connection of the main circuit.

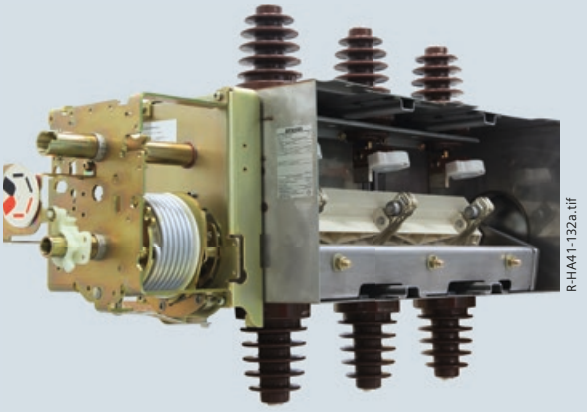
Opening operation

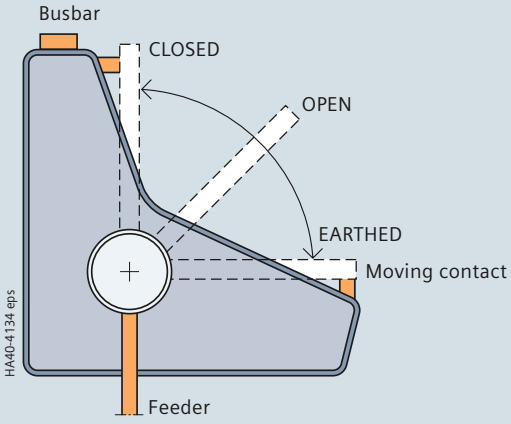
During the opening operation, the arc is caused to rotate by the arc-suppression system. This rotation movement prevents the development of a fixed root.
The isolating distance in gas established after breaking fulfills the conditions applicable to isolating distances in accordance with
– IEC / EN 62271-102 / VDE 0671-102 *)
and
– IEC / EN 62271-1 / VDE 0671-1 *).
Due to the arc rotation caused by the arc-suppression system, both load currents and minor no-load currents are safely interrupted.

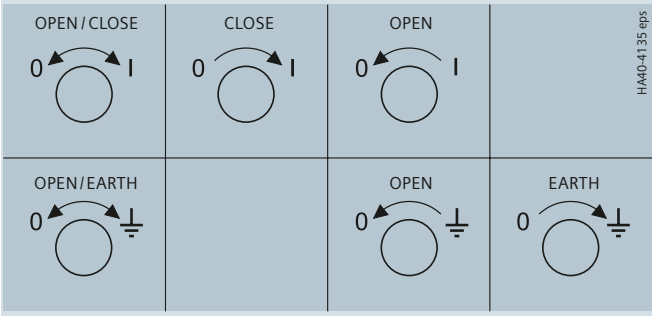
Earthing operation

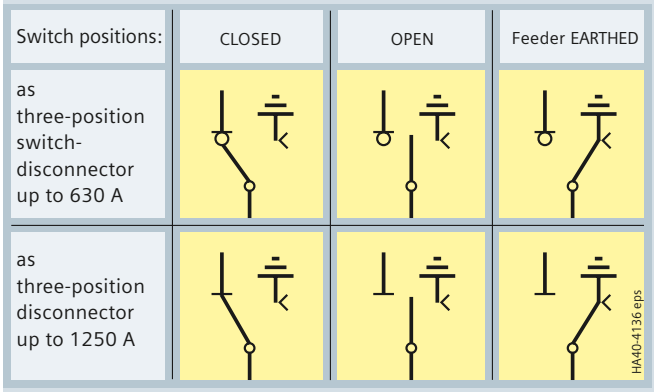
The EARTHING operation is implemented by changing from the "OPEN" to the "EARTHED" position.

Three-position switch-disconnector









*) For standards, see page 72

Features

- Mechanical endurance of more than 1000 operating cycles
- Parts subjected to mechanical stress are highly corrosion-proof
- Manual operation with the help of a slip-on operating lever
- Option: Motor operation
- Control board with accordingly cut-out switching gate prevents the three-position switch-disconnector from being switched directly from the "CLOSED" via the "OPEN" to the "EARTHED" position
- Two separate actuating openings are provided for unambiguous selection of the DISCONNECTING and EARTHING functions
- Operation via rotary movement, operating direction according to IEC / EN 60447 / VDE 0196 (recommendation of FNN *)).

Spring-operated mechanism

The switching movements are performed independently of the operating speed.

Spring-operated / stored-energy mechanism

The switching movements are performed independently of the operating speed.
During the charging process, the closing and opening springs are charged. This ensures that the switch-disconnector / fuse combination can switch off all types of faults reliably even during closing.
Closing and opening is done via pushbuttons, and is therefore identical with the operation of circuit-breaker operating mechanisms.
An energy store is available for tripping by means of an operating HV HRC fuse or via a shunt release (f-release). After tripping, a red bar appears on the position indicator.

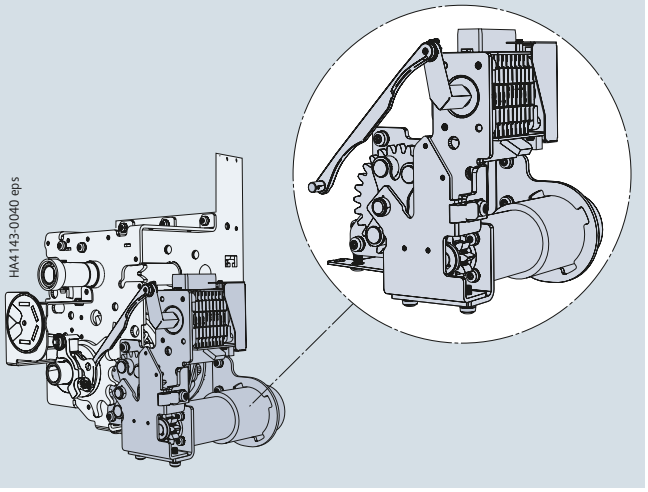
- **Motor operating mechanism** (option)

The manual operating mechanisms of SIMOSEC switchgear can be equipped with motor operating mechanisms for the three-position switch-disconnector. Retrofitting is possible.
Operating voltages for motor operating mechanisms:
– 24, 48, 60, 110, 220 V DC
– 110 and 230 V AC, 50 / 60 Hz.

Operation:

- Local operation by momentary-contact rotary control switch (option)
- Remote operation (standard) applied to terminal.

Motor unit with auxiliary switch block



Shunt release (option)
(f-release)

Spring-operated / stored-energy mechanisms can be equipped with a shunt release. Remote electrical tripping of the three-position switch-disconnector is possible via the magnet coil of the shunt release, e.g. transformer overtemperature tripping. To avoid thermal overloading of the shunt release in the event of a continuous signal that may be applied, the shunt release is switched off via an auxiliary switch which is mechanically coupled with the three-position switch-disconnector.

Assignment of operating mechanism type of three-position switch to panel types

Panel type	R, L, D1, L(r)	E	T, M(VT-F), M(VT)	
Function	Switch-disconnector (R) Disconnector (L, D) Disconnector [L1(r), L2(r)]	Earthing switch	Switch-disconnector (T, T1) Disconnector [M(VT), M(VT-F)]	Earthing switch
Type of operating mechanism	Spring-operated	Spring-operated	Stored-energy	Spring-operated
Operation	Manual Motor (option)	Manual	Manual Motor (option)	Manual

Legend
D = Disconnector feeder
E = Earthing panel
L = Circuit-breaker feeder
R = Ring-main feeder
T = Transformer feeder
M(VT), M(VT-F) = Busbar voltage metering panel
*) FNN: Forum network technology / network operation of the VDE (FNN)

Auxiliary switch (option)

Each operating mechanism of the three-position switch-disconnector (or three-position disconnector) can be optionally equipped with an auxiliary switch for the position indication:

– Switch-disconnector function: **)
  CLOSED and OPEN: 1 NO + 1 NC + 2 changeover (manually operated)
– Earthing switch function:
  CLOSED and OPEN: 1 NO + 1 NC + 2 changeover
– Switch-disconnector function in T typicals: **)
  CLOSED and OPEN: 2 changeover (manually operated, motor-operated)
– Earthing switch function:
  CLOSED and OPEN: 1 NO + 1 NC + 2 changeover.

Technical data of the auxiliary switch
Breaking capacity

AC operation at 40 Hz up to 60 Hz		DC operation		
Operating voltage	Normal current	Operating voltage	Normal current Resistive	Inductive, T = 20 ms
V	A	V	A	A
up to 230	10	24	10	10
		48	10	9
		60	9	7
		110	5	4
		240	2.5	2

Rated switching capacity

Rated insulation level	250 V AC / DC
Insulation group	C according to VDE 0110
Continuous current	10 A
Making capacity	50 A

Panel type R:
Operating mechanism for three-position switch, and low-voltage niche with terminals and MCB's (options)

Panel type L:
Motor operating mechanism for three-position switch, and circuit-breaker type "CB-f NAR"

Abbreviations:
NO = Normally open contact
NC = Normally closed contact
**) Depending on the secondary equipment of the three-position switch

Features

- According to IEC/EN 62271-100/VDE 0671-100/GB 1984 *)
- Application in hermetically welded switching-device vessel in conformity with the system
- Climate-independent vacuum interrupter poles in the gas-filled switching-device vessel
- Operating mechanism located outside the switching-device vessel in the front operating mechanism box
- Maintenance-free for indoor installation according to IEC/EN 62271-1/VDE 0671-1 *)
- Individual secondary equipment.

Operating mechanism functions

The closing spring is charged by means of the operating lever or the hand crank supplied, or by the motor (option), until the latching of the closing spring is indicated ("spring charged" indicator). Then, the vacuum circuit-breaker can be closed manually or electrically.
In operating mechanisms provided for automatic reclosing (AR), the closing spring can be recharged manually or automatically in case of motor operating mechanism. Thus, the "closing option" is available again.

Operating mechanism

The operating mechanism assigned to a circuit-breaker feeder consists of the following components:

- Operating mechanism for circuit-breaker
- Operating mechanism for three-position disconnector
- Motor operating mechanism (optional)
- Position indicators
- Pushbuttons for CLOSING and OPENING the circuit-breaker
- Operations counter (optional)
- Interlocking between circuit-breaker and disconnector.

Assignment of operating mechanism type

Panel type	L, L1, L(T), L1(T), L1(r), L2(r)		
Function	Circuit-breaker	Three-position disconnector	
		Disconnector	Earthing switch
Type of operating mechanism	Stored-energy	Spring-operated	Spring-operated
Operation	Manual/motor	Manual/motor	Manual

Trip-free mechanism

The vacuum circuit-breaker is fitted with a trip-free mechanism according to IEC/EN 62271-100/VDE 0671-100 *).
In the event of an opening command being given after a closing operation has been initiated, the moving contacts return to the open position and remain there even if the closing command is sustained. This means that the contacts are momentarily in the closed position, which is permissible according to the mentioned standard.

*) For standards, see page 72

Technical data of the vacuum circuit-breaker

Vacuum circuit-breaker Type		CB-f AR *)	CB-f NAR *)	CB-r 3AE6 △)
Short-circuit breaking current		up to 25 kA	up to 25 kA	up to 25 kA
Rated operating sequence:				
– O – 0.3 s – CO – 3 min – CO		•	–	–
– O – 0.3 s – CO – 15 s – CO		on request	–	•
– O – 0.3 s – CO – 30 s – CO		•	–	–
– O – 3 min – CO – 3 min – CO		–	•	–
Number of breaking operations I_r		10000	2000	10000
Number of short-circuit breaking operations I_{SC}		30 Option: 50	20	30
Individual panel type L ...:	500 mm	L	L	–
Individual panel type L1...:	750 mm	L1	L1	L1(r)
	875 mm	–	–	L2(r)

Explanations:
• Design option
– Not available
*) AR = Automatic reclosing; NAR = Non automatic reclosing
△) In preparation; circuit-breaker design: • CB-r: removable

Vacuum circuit-breaker type CB-f

The vacuum circuit-breaker consists of a vacuum interrupter unit with integrated three-position disconnector located in the switching-device vessel, and the associated operating mechanisms.

Circuit-breaker secondary equipment

Circuit-breaker	Type CB-f AR	Type CB-f NAR	Type CB-r AR
Motor operating mechanism	○	○	○
Closing solenoid	●	○	●
Shunt release	○	○	○
C.t.-operated release	○	○	○
Low-energy magnetic release	–	○	–
Undervoltage release	○	○	○
Anti-pumping	●	o.r.	●
Circuit-breaker tripping signal	●	○	●
Varistor module	for ≥ 60 V DC	for ≥ 60 V DC	for ≥ 60 V DC
Auxiliary switch			
6 NO + 6 NC	●	●	●
free contacts thereof 1)	1 NO + 2 NC + 2 changeover	1 NO + 1 NC + 2 changeover	2 NO + 2 NC + 2 changeover
11 NO + 11 NC	○	–	○
free contacts thereof 1)	6 NO + 7 NC + 2 changeover	–	7 NO + 7 NC + 2 changeover
Position switch	●	●	●
Mechanical interlocking	●	●	●
Operations counter	●	○	●

● = Standard
○ = Option
o.r. = on request

Abbreviations:
NO = Normally open contact
NC = Normally closed contact

1) Depending on the selected secondary components

Motor operating mechanism (option)

Operating voltages for motor operating mechanisms:
- 24, 48, 60, 110, 220 V DC
- 110 and 230 V AC, 50/60 Hz.

Further values on request.
Motor rating for circuit-breaker operating mechanism at:

CB-f AR: *)
– Maximum 500 W
– Maximum 650 VA

CB-f NAR: *)
– Maximum 80 W
– Maximum 80 VA.

Secondary components

The scope of the secondary equipment of the vacuum circuit-breaker depends on the type of application and offers a wide range of possible variations, allowing almost every requirement to be satisfied.

Closing solenoid
- For electrical closing.

Shunt release
- Standard: Magnet coil
- Option: Magnet coil with energy store
- Tripping by protection relay or electrical actuation.

C.t.-operated release
- For tripping pulse 0.1 Ws in conjunction with suitable protection systems, e.g. protection system 7SJ45, make Woodward/SEG type WIC; other designs on request
- Used if external auxiliary voltage is missing, tripping via protection relay.

Low-energy magnetic release (for CB-f NAR)
- For tripping pulse 0.02 Ws, tripping via transformer monitor (IKI-30).

Undervoltage release
- Comprising:
– Energy store and unlatching mechanism
– Electromagnetic system, which is permanently connected to voltage while the vacuum circuit-breaker is closed; tripping is initiated when this voltage drops
- Connection to voltage transformers possible.

Anti-pumping (standard for CB-f AR) *)
(mechanical and electrical)

Function: If constant CLOSE and OPEN commands are present at the vacuum circuit-breaker at the same time, the vacuum circuit-breaker will return to the open position after closing. It remains in this position until a new CLOSE command is given. In this manner, continuous closing and opening (= pumping) is avoided.

Circuit-breaker tripping signal
- For electrical signaling (as pulse > 10 ms), e.g. to remote control systems, in the case of automatic tripping (e.g. protection)
- Via limit switch and cutout switch.

Varistor module
- To limit overvoltages to approx. 500 V for protection devices (when inductive components are mounted in the vacuum circuit-breaker)
- For auxiliary voltages ≥ 60 V DC.

Auxiliary switch
- For electrical position indication.

Position switch
- For signaling “closing spring charged”.

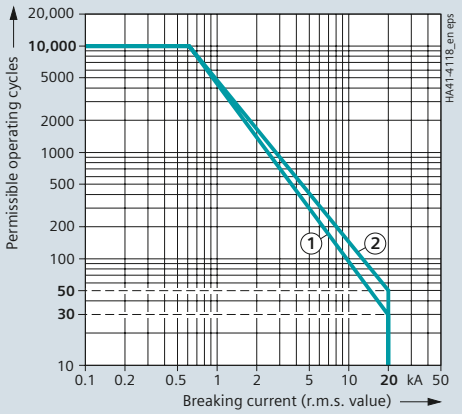
Mechanical interlocking
- Dependent on the type of operating mechanism
- Logical mechanical interlock between the three-position disconnector and the circuit-breaker (option: Closing lock-out for the three-position disconnector in circuit-breaker panels)
- Option: Operating mechanism with mechanical interlocking as
– Spring-operated mechanism: Opening for operating crank is blocked
– Stored-energy mechanism with closing solenoid and pushbutton: The pushbutton operated by the mechanical interlock prevents a continuous command to the closing solenoid
- During operation of the three-position disconnector from CLOSED to OPEN, the vacuum circuit-breaker cannot be in CLOSED position.

Operations counter
- As numeric indicator, 5 digits, mechanical.

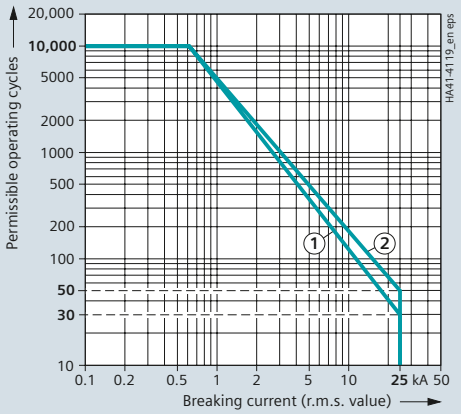
*) AR = Automatic reclosing
NAR = Non automatic reclosing

Electrical service life

Vacuum circuit-breaker type CB-f AR *)



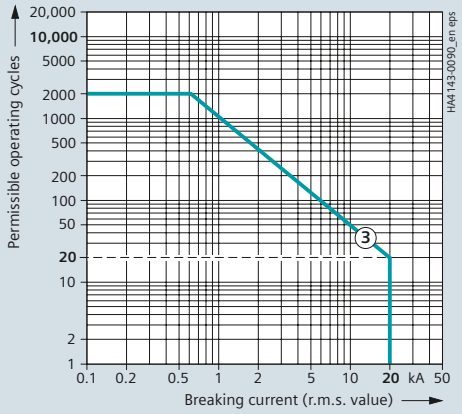
Rated short-circuit breaking current 20 kA



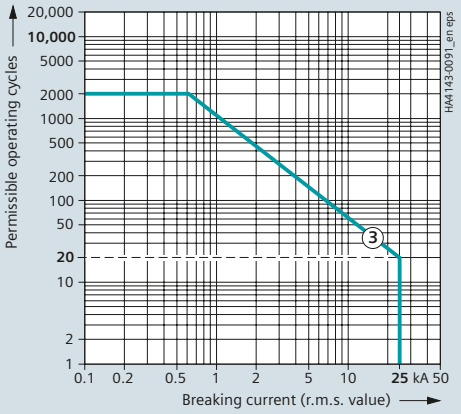
Rated short-circuit breaking current 25 kA

Max. number of short-circuit breaking operations: ① n = 30, ② n = 50

Vacuum circuit-breaker type CB-f NAR *)



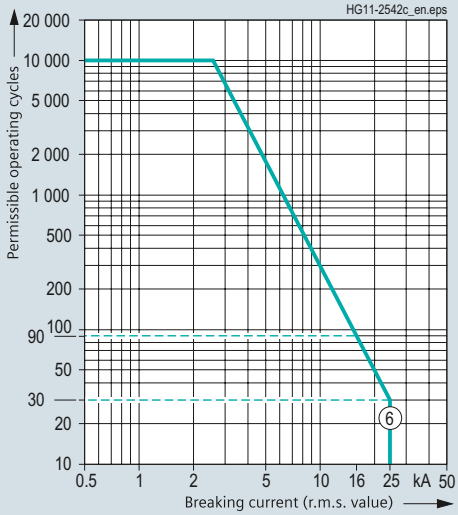
Rated short-circuit breaking current 20 kA



Rated short-circuit breaking current 25 kA

Max. number of short-circuit breaking operations: ③ n = 20

Vacuum circuit-breaker type 3AE6, for switchgear type SIMOSEC as CB-r AR *)

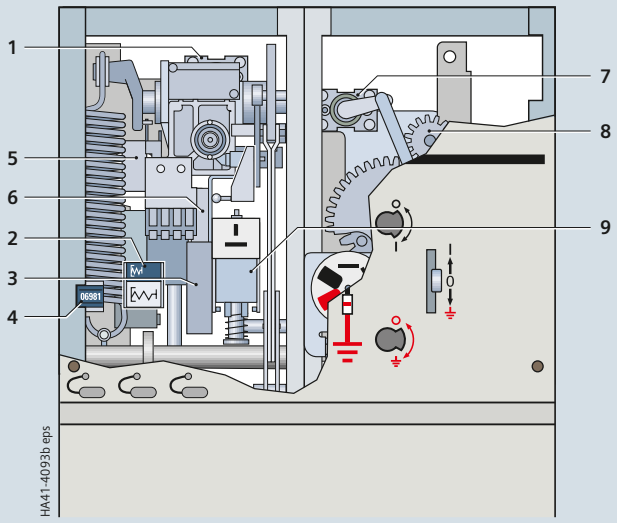


Rated short-circuit breaking current 25 kA

Max. number of short-circuit breaking operations: ⑥ n = 30

*) AR = Automatic reclosing
NAR = Non automatic reclosing

Vacuum circuit-breaker type CB-f AR *)



Maximum secondary equipment

1 Auxiliary switch at the circuit-breaker
2 Position switch "spring charged"
3 2nd release
4 Operations counter
5 1st release
6 Motor operating mechanism, circuit-breaker
7 Auxiliary switch at the three-position disconnector
8 Motor operating mechanism, three-position disconnector
9 Closing solenoid, circuit-breaker

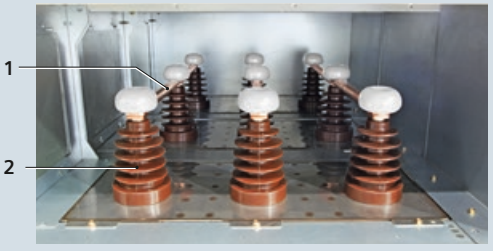
Busbars

- Safe-to-touch due to metallic enclosure
- Metal-clad busbar compartment
- Three-pole design, bolted from panel to panel
- Easy switchgear extension
- Made of copper: Round E-Cu.

Busbars

1 Busbar
2 Bushing-type insulator for busbar

Busbar compartment extending over 3 panels (example ≤ 17.5 kV)
Side view



1 Busbar
2 Bushing-type insulator for busbar

Busbar compartment extending over 3 panels (example 24 kV)
Side view

*) AR: Automatic reclosing

General features

- Connecting lugs for sealing ends arranged one behind the other
- Uniform cable connection height for the respective panel types
- With cable bracket, e.g. type C40 according to DIN EN 50024
- Access to the cable compartment only if feeder has been isolated and earthed.

Special features

– In cable panels (type K)

– In ring-main panels (type R)

– In circuit-breaker panels (type L)

- For thermoplastic-insulated cables
- For paper-insulated mass-impregnated cables with adapter systems
- For connection cross-sections up to 300 mm²
- Cable routing downwards.

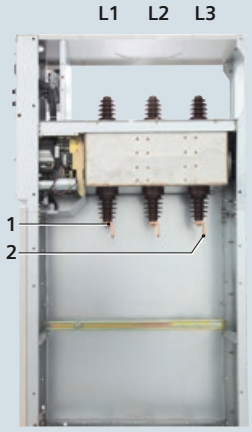
– In transformer panels (type T)

- For thermoplastic-insulated cables
- For connection cross-sections up to 120 mm²: Cable lug max. 32 mm wide
- For rated normal currents of 200 A.

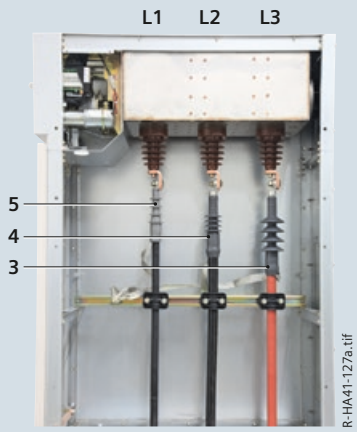
Note:
– Cable sealing ends and cable clamps are not included in the scope of supply

For options, see figures:
1) Only with ring-main panel
2) Cable clamps in transformer panels type T... partly mounted underneath the panel in the cable basement (for 24 kV = standard)
3) Make Siemens, type 3EK, other makes on request

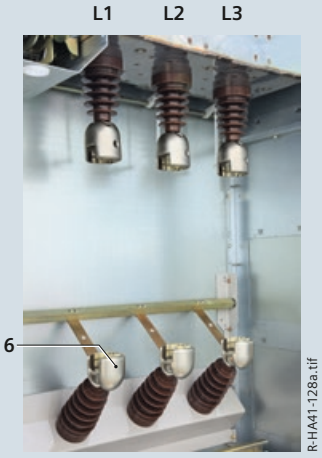
Cable connection (examples)



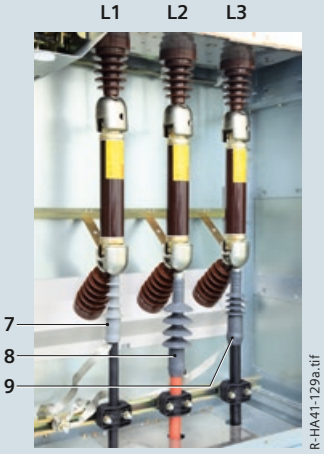
Ring-main panel type R
Cable compartment as delivered



Cable compartment with cable sealing ends (options: A, B, C [1] and D [1], see below)



Transformer panel type T
Cable compartment as delivered



Cable compartment with cable sealing ends (option: A [2], see below)

Options

- **A** Mounted cable clamps [2]
- **B** Short-circuit / earth-fault indicator
- **C** Double cable connection
- **D** Suitable for connection of surge arresters [3]

Cable sealing ends (examples)

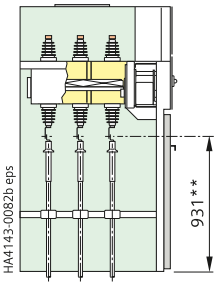
1 As-delivered condition
2 Connection for cable
3 Phase L1:
Make Lovink-Enertech, type IAEM 20, 240 mm² (20 kV)
4 Phase L2:
Make Prysmian Kabel und Systeme (Pirelli Elektrik) type ELTI mb-1C-2h-C-T3, 240 mm² (24 kV)
5 Phase L3:
Make Tyco Electronics Raychem, type EPKT 24 C / 1X, 185 mm² (24 kV), as shrink-on sealing end, for severe ambient conditions
6 As-delivered condition, prepared for cable sealing end
7 Phase L1:
Make Lovink-Enertech, type IAEM 20, 95 mm² (20 kV)
8 Phase L2:
Make Tyco Electronics Raychem, type TFTI / 5131, 95 mm² (24 kV), as push-on sealing end
9 Phase L3:
Make Euromold, type ITK, 95 mm² (24 kV)

Components

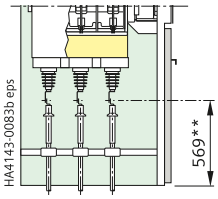
Selection data for various cable sealing ends [1)]

Cable sealing end, e.g. for panel types R..., K..., D..., M(-K), M(-BK), L... and T...[2)] (for connection heights of cables, see opposite dimension drawings)		
Make	Type	Cross-section in mm²
Single-core thermoplastic-insulated cables for ≤ 12 kV (6/10 kV); acc. to IEC standard [2)]		
Euromold	AIN 10, AFN 10	25–300 (500 *)
	AIS, AIP	150–300; 50–300
	12 MONOi	25–300 (500 *)
	ITK-212 •)	50–300 (400 *)
Prysmian Kabel und Systeme	ELTI mb-1C-12	35–240
	ELTI-1C-12	25–300
TE Connectivity	IXSU-F	16–300 (500 *)
	MVTI-31xx-	25–240 (300 *)
	EPKT	16–300
Lovink-Enertech	IAEM 10	25–300
	IAES 10	25–300 (500 *)
3M	92-EB 6x-1	35–300 (400 *)
Südkabel	SEHDI 10.2	35–300 (500 *)
nkt cables	TI 12	25–240
	TO 12	25–300 (500 *)
Three-core thermoplastic-insulated cables for ≤ 12 kV (6/10 kV); acc. to IEC standard [2)]		
Euromold	AIN 10, AFN 10 •)	25–300 (500 *)
	12 MONOi	35–300 (500 *)
Prysmian Kabel und Systeme	ELTI-3C-12	25–300
TE Connectivity	IXSU-F33xx	16–300 (500 *)
Lovink-Enertech	IAES 10	25–300
	GHKI	16–300 (400 *)
Single-core thermoplastic-insulated cables for > 12 kV to ≤ 24 kV (12/20 kV) •) [2)]		
Euromold	AIN 20, AFN 20	25–300 (630 *)
	AIS, AIP	70–300; 25–300
	24 MONOi	25–300 (500 *)
	36 MSC [3)]	95–300 (500 *)
	36 MSC (Option [4)])	95–300 (500 *)
	ITK-224	25–240
Prysmian Kabel und Systeme	ELTI mb-1C-24	35–240
	ELTI-1C-24	25–300
TE Connectivity	IXSU-F	25–300 (500 *)
	MVTI-51xx-	25–300
	EPKT	16–300 (500 *)
Lovink-Enertech	IAEM 20	25–300
	IAES 20	25–300 (500 *)
3M	93-EB 6x-1	50–300 (400 *)
Südkabel	SEHDI 20.2	35–300 (500 *)
	SEI 24	25–240
nkt cables	TI 24	25–240
	TO 24	25–300 (500 *)
Three-core thermoplastic-insulated cables for > 12 kV to ≤ 24 kV (12/20 kV) •) [2)]		
Euromold	24 MONOi	35–300 (500 *)
	AFN 20, AIN 20	35–300
Lovink-Enertech	GHKI	25–300 (500 *)
TE Connectivity	on request IXSU-F53xx	on request

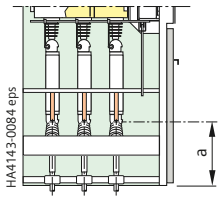
Connection height **) of cables above floor or above lower edge of panel:



Panel type R ...



Panel type L ...



Panel type T ...

Dimension a
~ 384 mm:
For fuses with e = 442 mm (standard for 24 kV)
~ 534 mm:
For fuses with e = 292 mm

Note:
Depending on make and type, the termination of the cable sealing end (= shield earth) for the 3-core thermoplastic-insulated cable and the fitted cable clamp (option) may be located underneath the panel in the cable basement. This must be taken into account in panels with floor cover (option).

*) On request: Max. connection cross-section of cable sealing end types

**) Due to the installation of 4MA cast-resin insulated block-type current transformers, the connection height of the cables is reduced in the corresponding panel types [e.g.: L, L1, M (-K), ...]

1) Note:
For cable connections, the manufacturer information about the sealing end and the design of the cable must be taken into account (e.g., operating voltage, rated power-frequency withstand voltage, cable type, core material)

2) Transformer panels type T...:
- Lower edge of sealing end partly underneath the panel (depending on type of sealing end)
- Cable lugs of sealing ends up to 32 mm width
- Owing to the various lengths of the sealing ends, mounted cable clamps are partly underneath the panel

3) Circuit-breaker panel types L...:
Lower edge of sealing end below panel

4) Cable sealing end type with insulation shields

•) Remark concerning applications with requirements according to the GB standard (China): Type suitable for rated short-duration power-frequency withstand voltage U_d = 42 kV according to IEC 62271-1 and U_m = 42 kV according to EN/HD 629

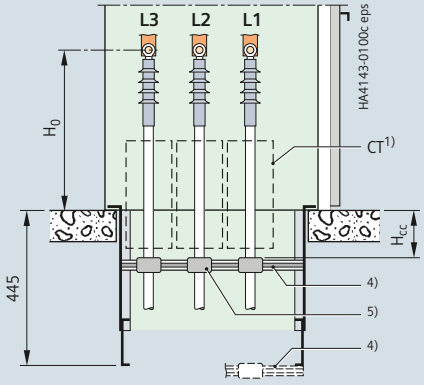
Cable cross-sections

Panel type	Panel width	Version	Connected cables x connection cross-section number x mm² for rated voltage			Transformer combination in the connection compartment Current transformer		
			12 kV	17.5 kV	24 kV	4MC70	4MA	4MR
K	375	Standard	1 x 300	1 x 300	1 x 300	○		
		On request	2 x 300	2 x 300	2 x 300			
K1	500	Standard	1 x 300	1 x 300	1 x 300	○		
		Option	2 x 400	2 x 300	2 x 300			
R	375	Standard	1 x 300	1 x 300	1 x 300	○		
		On request	2 x 300	2 x 300	2 x 300			
R1, D1	500	Standard	1 x 300	1 x 300	1 x 300	○		
		Option	2 x 300	2 x 300	2 x 300			
L	500	Standard	1 x 300	1 x 300	1 x 300	○		
		Option	2 x 240	2 x 240	2 x 240		–	–
L1	750	Standard	1 x 300	1 x 300	1 x 300	○		
		Option	2 x 300	2 x 300	2 x 300		○	○
M(-K), M(-BK)	750	Standard	1 x 400	1 x 300	1 x 300		○	○
		Option	3 x 400	3 x 300	3 x 300		○	○
M(KK)	750	Standard	1 x 400	1 x 300	1 x 300		○	○
		Option	2 x 300	2 x 300	2 x 300		○	○
L1(r)	750	Standard	1 x 300	1 x 300	1 x 300	○	○	–
		Option	2 x 300	2 x 300	2 x 300	○		–
L2(r)	875	Standard	2 × 300	2 × 300	2 × 300	○	○	
		Option	3 × 300	3 × 300	3 × 300		○	

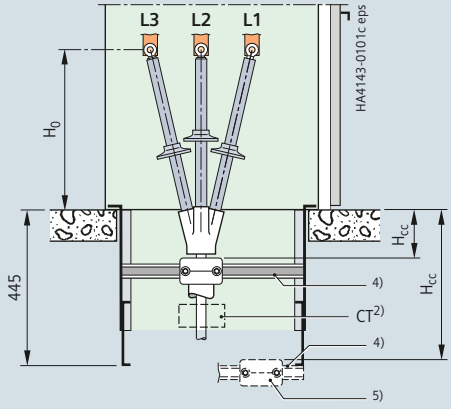
○ possible – not possible

Cable fixing: Depending on the cable type (1-core cable, 3-core cable) or the associated panel type △) and its components, the cable may also be fixed in the cable basement (for local installation):

1-core cable



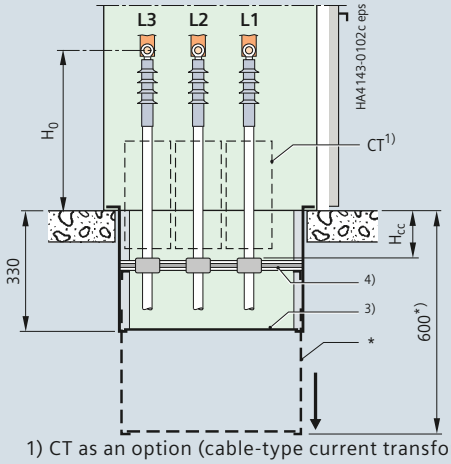
3-core cable

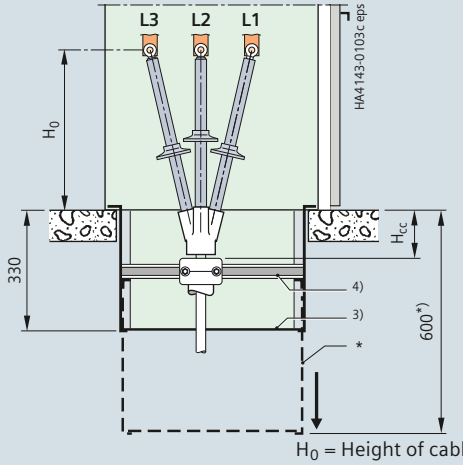


Max. dimensions H_{cc} in mm	Cable version 1-core	3-core
Standard	435	425
Option: With additional floor cover	469	459
5) Height of cable clamp (= Option)	60	77

H_{cc} = Available height for cable connection: From the mounted cable clamp 5)

Optionally, a deep floor cover is also possible:





1) CT as an option (cable-type current transformer)
2) CT as an option (zero-sequence current transformer for earth-fault detection)
3) Deep floor cover
4) Cable fixing bar, additionally movable downwards
5) Option: Cable clamp

H_0 = Height of cable connection in the panel
*) Extendable up to 600 mm
△) For panel types T and T1 with a rated voltage of 24 kV: Deeper cable fixing located underneath the panel

HV HRC fuse assembly

Features

- Application for
– Transformer panel types T (375 mm) and T1 (500 mm)
– Busbar voltage metering panel type M(VT-F), M1(VT-F)
- HV HRC fuse-links acc. to DIN 43625 (main dimensions) with striker version "medium" acc. to IEC 60282 / VDE 0670-4 *)
– As short-circuit protection before transformers
– With selectivity (depending on correct selection) to upstream and downstream connected equipment
- Requirements according IEC 62271-105 fulfilled as HV alternating current switch-fuse combination
- Selection of HV HRC fuses for transformers
- Fuse replacement possible only when feeder is earthed
- Option: Shunt release on operating mechanism of three-position switch-disconnector
- Option: "Tripped indication" of three-position switch-disconnector in transformer feeder (transformer switch) for remote electrical indication with one normally-open contact (1 NO).

Mode of operation

"HV HRC fuse tripped"

Following the tripping of an HV HRC fuse-link, the mechanism for charging the spring must be set to the "OPEN" position.
Subsequently, earthing can be implemented by means of the three-position switch-disconnector and e.g. the fuse can be replaced.

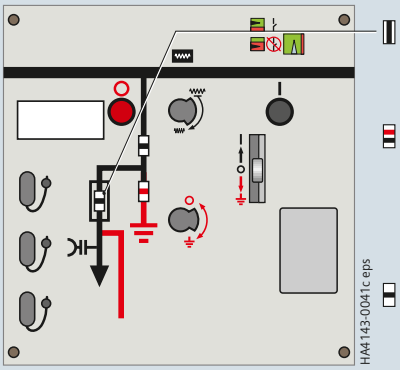
Replacement of HV HRC fuse-links (without any tools)

- Isolating and earthing of the transformer feeder
- Opening the connection compartment cover
- Subsequent manual replacement of the HV HRC fuse-link.

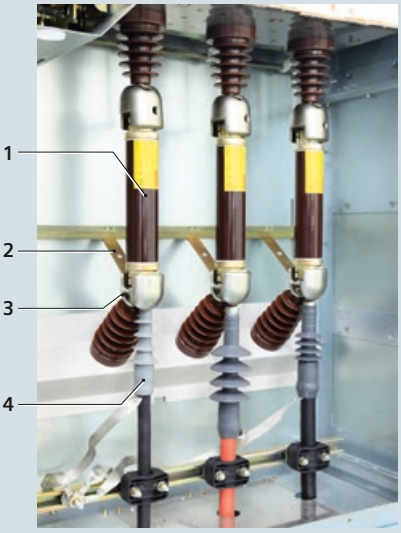
Note to HV HRC fuse-links

According to IEC 60282-1 (2009) Clause 6.6, the breaking capacity of HV HRC fuses is tested within the scope of the type test at 87 % of their rated voltage.
In three-phase systems with resonance-earthed or isolated neutral, under double earth fault and other conditions, the full phase-to-phase voltage may be available at the HV HRC fuse during breaking. Depending on the size of the operating voltage of such a system, this applied voltage may then exceed 87 % of the rated voltage.
It must therefore already be ensured during configuration of the switching devices and selection of the HV HRC fuse that only such fuse-links are used, which either satisfy the above operating conditions, or whose breaking capacity was tested at least with the maximum system voltage. In case of doubt, a suitable HV HRC fuse must be selected together with the fuse manufacturer.

HV HRC fuse assembly



Control board of a transformer feeder



1 HV HRC fuse (not included in the scope of supply)
2 Earthing switch for cable connection
3 Cover for bolted cable lug connection (e.g. for rated voltage U_r = 24 kV)
4 Cable sealing end (not included in the scope of supply)

HV HRC fuses in transformer panel type T
Side view

*) For standards, see page 72

Fuse protection table

The following table shows the recommended HV HRC fuse-links make SIBA (electrical data valid for ambient air temperatures of up to 40 °C) for fuse protection of transformers. The three-position switch-disconnector in the transformer feeder in panel type "T" was combined and tested according to IEC 62271-103.

Standards

HV HRC fuse-links "medium" version with striker and for tripping energy 1 ± 0.5 Joule according to

- IEC / EN 60282-1 / VDE 0670-4
- IEC / EN 60787 / VDE 0670-402
- DIN 43625 main dimensions.

MV system	Transformer			HV HRC fuse-link				
Operating voltage U_n	Rated power S_r	Relative impedance voltage u_k	Rated current I_r	Rated current I_r	Min. operating / rated voltage U_r	Dimension e	Outside diameter d	Order No. Make SIBA
kV	kVA	%	A	A	kV	mm		
3.3 to 3.6	20	4	3.5	6.3	3 to 7.2	292	53	**30 098 13.6,3**
				10	3 to 7.2	292	53	**30 098 13.10**
	50	4	8.75	16	3 to 7.2	292	53	**30 098 13.16**
				20	3 to 7.2	292	53	**30 098 13.20**
	75	4	13.1	20	3 to 7.2	292	53	**30 098 13.20**
				25	3 to 7.2	292	53	**30 098 13.25**
	100	4	17.5	31.5	3 to 7.2	292	53	**30 098 13.31,5**
				40	3 to 7.2	292	53	**30 098 13.40**
	125	4	21.87	31.5	3 to 7.2	292	53	**30 098 13.31,5**
				40	3 to 7.2	292	53	**30 098 13.40**
	160	4	28	40	3 to 7.2	292	53	**30 098 13.40**
				50	3 to 7.2	292	53	**30 098 13.50**
	200	4	35	50	3 to 7.2	292	53	**30 098 13.50**
				63	3 to 7.2	292	67	**30 099 13.63**
	250	4	43.74	63	3 to 7.2	292	67	**30 099 13.63**
				80	3 to 7.2	292	67	**30 099 13.80**
	315	4	55.1	80	3 to 7.2	292	67	**30 099 13.80**
				100	3 to 7.2	292	67	**30 099 13.100**
	400	4	70	100	3 to 7.2	292	67	**30 099 13.100**
4.16 to 4.8	20	4	2.78	6.3	3 to 7.2	292	53	**30 098 13.6,3**
	30	4	4.2	10	3 to 7.2	292	53	**30 098 13.10**
	50	4	6.93	16	3 to 7.2	292	53	**30 098 13.16**
	75	4	10.4	16	3 to 7.2	292	53	**30 098 13.16**
				20	3 to 7.2	292	53	**30 098 13.20**
	100	4	13.87	20	3 to 7.2	292	53	**30 098 13.20**
				25	3 to 7.2	292	53	**30 098 13.25**
	125	4	17.35	25	3 to 7.2	292	53	**30 098 13.25**
				31.5	3 to 7.2	292	53	**30 098 13.31,5**
	160	4	22.2	31.5	3 to 7.2	292	53	**30 098 13.31,5**
				40	3 to 7.2	292	53	**30 098 13.40**
	200	4	27.75	40	3 to 7.2	292	53	**30 098 13.40**
				50	3 to 7.2	292	53	**30 098 13.50**
	250	4	34.7	50	3 to 7.2	292	53	**30 098 13.50**
				63	3 to 7.2	292	67	**30 099 13.63**
	315	4	43.7	63	3 to 7.2	292	67	**30 099 13.63**
	400	4	55.5	80	3 to 7.2	292	67	**30 099 13.80**
	500	4	69.4	100	3 to 7.2	292	67	**30 099 13.100**
5 to 5.5	20	4	2.3	6.3	3 to 7.2	292	53	**30 098 13.6,3**
	30	4	3.2	6.3	3 to 7.2	292	53	**30 098 13.6,3**
				10	3 to 7.2	292	53	**30 098 13.10**
	50	4	5.7	10	3 to 7.2	292	53	**30 098 13.10**
				16	3 to 7.2	292	53	**30 098 13.16**
	75	4	8.6	16	3 to 7.2	292	53	**30 098 13.16**
				20	3 to 7.2	292	53	**30 098 13.20**
	100	4	11.5	16	3 to 7.2	292	53	**30 098 13.16**
				20	3 to 7.2	292	53	**30 098 13.20**
	125	4	14.4	20	3 to 7.2	292	53	**30 098 13.20**
				25	3 to 7.2	292	53	**30 098 13.25**
	160	4	18.4	31.5	3 to 7.2	292	53	**30 098 13.31,5**
				40	3 to 7.2	292	53	**30 098 13.40**
	200	4	23	40	3 to 7.2	292	53	**30 098 13.40**
				50	3 to 7.2	292	53	**30 098 13.50**
	250	4	28.8	40	3 to 7.2	292	53	**30 098 13.40**
				50	3 to 7.2	292	53	**30 098 13.50**
	315	4	36.3	50	3 to 7.2	292	53	**30 098 13.50**
				63	3 to 7.2	292	67	**30 099 13.63**
	400	4	46.1	63	3 to 7.2	292	67	**30 099 13.63**
				80	3 to 7.2	292	67	**30 099 13.80**
	500	4	52.5	80	3 to 7.2	292	67	**30 099 13.80**
				100	3 to 7.2	292	67	**30 099 13.100**
	630	4	72.7	100	3 to 7.2	292	67	**30 099 13.100**
				125	3 to 7.2	292	67	**30 099 13.125**

Components

Allocation of HV HRC fuses and transformers

Recommended HV HRC fuses for switchgear type SIMOSEC

MV system	Transformer			HV HRC fuse-link				
Operating voltage U_n	Rated power S_r	Relative impedance voltage u_k	Rated current I_r	Rated current I_r	Min. operating / rated voltage U_r	Dimension e	Outside diameter d	Order No. Make SIBA
kV	kVA	%	A	A	kV	mm		
6 to 7.2	20	4	1.9	6.3	6 to 12	292	53	**30 004 13.6,3**
				6.3	6 to 12	442	53	**30 101 13.6,3**
	30	4	2.9	6.3	6 to 12	292	53	**30 004 13.6,3**
				6.3	6 to 12	292	53	**30 101 13.6,3**
	50	4	4.8	10	6 to 12	292	53	**30 004 13.10**
				10	6 to 12	442	53	**30 101 13.10**
	75	4	7.2	16	6 to 12	292	53	**30 004 13.16**
				16	6 to 12	442	53	**30 101 13.16**
	100	4	9.6	16	6 to 12	292	53	**30 004 13.16**
				16	6 to 12	442	53	**30 101 13.16**
				20	6 to 12	292	53	**30 004 13.20**
				20	6 to 12	442	53	**30 101 13.20**
	125	4	12	20	6 to 12	292	53	**30 004 13.20**
				20	6 to 12	442	53	**30 101 13.20**
				25	6 to 12	292	53	**30 004 13.25**
				25	6 to 12	442	53	**30 101 13.25**
	160	4	15.4	31.5	6 to 12	292	53	**30 004 13.31,5**
				31.5	6 to 12	442	53	**30 101 13.31,5**
	200	4	19.2	31.5	6 to 12	292	53	**30 004 13.31,5**
				31.5	6 to 12	442	53	**30 101 13.31,5**
				40	6 to 12	292	53	**30 004 13.40**
				40	6 to 12	442	53	**30 101 13.40**
	250	4	24	40	6 to 12	292	53	**30 004 13.40**
				40	6 to 12	442	53	**30 101 13.40**
				50	6 to 12	442	53	**30 101 13.50**
	315	4	30.3	50	6 to 12	292	53	**30 004 13.50**
				50	6 to 12	442	53	**30 101 13.50**
				63	6 to 12	292	67	**30 012 43.63**
	400	4	38.4	63	6 to 12	292	67	**30 012 43.63**
				80	6 to 12	292	67	**30 012 43.80**
				80	6 to 12	442	67	**30 102 43.80**
				63	6 to 12	292	67	**30 012 13.63**
				63	6 to 12	442	67	**30 102 13.63**
	500	4	48	80	6 to 12	292	67	**30 012 43.80**
				80	6 to 12	442	67	**30 102 43.80**
				80	6 to 12	442	67	**30 102 13.80**
				100	6 to 12	292	67	**30 012 43.100**
				100	6 to 12	442	67	**30 102 43.100**
	630	4	61	100	6 to 12	442	67	**30 102 43.100**
				125	6 to 12	442	85	**30 103 43.125**
				125	6 to 12	292	85	**30 020 43.125**
	800	5 (5.5)	77	125	6 to 12	292	85	**30 020 43.125**
				125	6 to 12	442	85	**30 103 43.125**
10 to 12	20	4	1.15	4	6 to 12	292		**on request**
	50	4	2.9	10	6 to 12	292	53	**30 004 13.10**
				10	6 to 12	442	53	**30 101 13.10**
				10	10 to 17.5	292	53	**30 255 13.10**
				10	10 to 17.5	442	53	**30 231 13.10**
				10	10 to 24	442	53	**30 006 13.10**
	75	4	4.3	10	6 to 12	292	53	**30 004 13.10**
				10	6 to 12	442	53	**30 101 13.10**
				10	10 to 17.5	292	53	**30 255 13.10**
				10	10 to 17.5	442	53	**30 231 13.10**
				10	10 to 24	442	53	**30 006 13.10**
	100	4	5.8	16	6 to 12	292	53	**30 004 13.16**
				16	6 to 12	442	53	**30 101 13.16**
				16	10 to 17.5	292	53	**30 255 13.16**
				16	10 to 17.5	442	53	**30 231 13.16**
				16	10 to 24	442	53	**30 006 13.16**
	125	4	7.2	16	6 to 12	292	53	**30 004 13.16**
				16	6 to 12	442	53	**30 101 13.16**
				16	10 to 17.5	292	53	**30 255 13.16**
				16	10 to 17.5	442	53	**30 231 13.16**
				16	10 to 24	442	53	**30 006 13.16**
	160	4	9.3	20	6 to 12	292	53	**30 004 13.20**
				20	6 to 12	442	53	**30 101 13.20**
				20	10 to 17.5	292	67	**30 221 13.20**
				20	10 to 17.5	442	53	**30 231 13.20**
				20	10 to 24	442	53	**30 006 13.20**

MV system	Transformer			HV HRC fuse-link				
Operating voltage U_n	Rated power S_r	Relative impedance voltage u_k	Rated current I_r	Rated current I_r	Min. operating / rated voltage U_r	Dimension e	Outside diameter d	Order No. Make SIBA
kV	kVA	%	A	A	kV	mm		
10 to 12	200	4	11.5	25	6 to 12	292	53	**30 004 13.25**
				25	6 to 12	442	53	**30 101 13.25**
				25	10 to 17.5	292	67	**30 221 13.25**
				25	10 to 17.5	442	53	**30 231 13.25**
				25	10 to 24	442	53	**30 006 13.25**
	250	4	14.5	25	6 to 12	292	53	**30 004 13.25**
				25	6 to 12	442	53	**30 101 13.25**
				25	10 to 17.5	292	67	**30 221 13.25**
				25	10 to 17.5	442	53	**30 231 13.25**
				25	10 to 24	442	53	**30 006 13.25**
				31.5	6 to 12	292	53	**30 004 13.31,5**
				31.5	6 to 12	442	53	**30 101 13.31,5**
				31.5	10 to 17.5	292	67	**30 221 13.31,5**
				31.5	10 to 24	442	53	**30 006 13.31,5**
	315	4	18.3	31.5	6 to 12	292	53	**30 004 13.31,5**
				31.5	6 to 12	442	53	**30 101 13.31,5**
				31.5	10 to 17.5	292	67	**30 221 13.31,5**
				31.5	10 to 17.5	442	53	**30 231 13.31,5**
				31.5	10 to 24	442	53	**30 006 13.31,5**
				40	6 to 12	442	53	**30 101 13.40**
	400	4	23.1	40	6 to 12	292	53	**30 004 13.40**
				40	6 to 12	442	53	**30 101 13.40**
				40	10 to 17.5	292	67	**30 221 13.40**
				40	10 to 17.5	442	53	**30 231 13.40**
				40	10 to 24	442	53	**30 006 13.40**
	500	4	29	50	6 to 12	292	53	**30 004 13.50**
				50	6 to 12	442	53	**30 101 13.50**
				50	10 to 17.5	292	67	**30 221 13.50**
				50	10 to 17.5	442	67	**30 232 13.50**
				50	10 to 24	442	67	**30 014 13.50**
				63	6 to 12	292	67	**30 012 43.63**
				63	10 to 24	442	67	**30 014 43.63**
	630	4	36.4	63	6 to 12	292	67	**30 012 43.63**
				63	6 to 12	292	67	**30 012 13.63**
				63	6 to 12	442	67	**30 102 13.63**
				63	10 to 17.5	442	67	**30 232 13.63**
				63	10 to 17.5	292	85	**30 221 13.63**
				63	10 to 24	442	67	**30 014 13.63**
				63	10 to 24	442	67	**30 014 43.63**
				80	10 to 24	442	67	**30 014 43.80**
				80	6 to 12	292	85	**30 012 43.80**
				80	6 to 12	442	67	**30 102 43.80**
	800	5 (5.5)	46.2	63	6 to 12	292	67	**30 012 13.63**
				80	6 to 12	292	67	**30 012 43.80**
				80	6 to 12	442	67	**30 102 43.80**
	1000	5 (5.5)	58	100	6 to 12	442	67	**30 012 43.100**
				100	10 to 24	442	85	**30 022 43.100**
	1250	5 (5.5)	72.2	125	10 to 24	442	85	**30 022 43.125**
	1600	5 (to 5.7)	92.3	160	6 to 12	442	85	**30 103 43.160**
13.8	20	4	0.8	3.15	10 to 24	442	53	**30 006 13.3,15**
	50	4	2.1	6.3	10 to 17.5	442	53	**30 231 13.6,3**
				6.3	10 to 17.5	292	53	**30 255 13.6,3**
				6.3	10 to 24	442	53	**30 006 13.6,3**
	75	4	3.2	6.3	10 to 17.5	442	53	**30 231 13.6,3**
				10	10 to 17.5	292	53	**30 255 13.10**
				10	10 to 17.5	442	53	**30 231 13.10**
				10	10 to 24	442	53	**30 006 13.10**
	100	4	4.2	10	10 to 17.5	442	53	**30 231 13.10**
	125	4	5.3	10	10 to 17.5	442	53	**30 231 13.10**
				16	10 to 17.5	442	53	**30 231 13.16**
				16	10 to 17.5	292	53	**30 255 13.16**
				16	10 to 24	442	53	**30 006 13.16**
	160	4	6.7	16	10 to 17.5	442	53	**30 231 13.16**
	200	4	8.4	16	10 to 17.5	442	53	**30 231 13.16**
				20	10 to 17.5	442	53	**30 231 13.20**
				20	10 to 17.5	292	53	**30 221 13.20**
				20	10 to 24	442	53	**30 006 13.20**
	250	4	10.5	20	10 to 17.5	442	53	**30 231 13.20**
				25	10 to 17.5	292	67	**30 221 13.25**
				25	10 to 17.5	442	53	**30 231 13.25**
				25	10 to 24	442	53	**30 006 13.25**

Components

Allocation of HV HRC fuses and transformers

Recommended HV HRC fuses for switchgear type SIMOSEC

MV system	Transformer			HV HRC fuse-link				
Operating voltage U_n	Rated power S_r	Relative impedance voltage u_k	Rated current I_r	Rated current I_r	Min. operating / rated voltage U_r	Dimension e	Outside diameter d	Order No. Make SIBA
kV	kVA	%	A	A	kV	mm		
13.8	315	4	13.2	25	10 to 17.5	442	53	**30 231 13.25**
				31.5	10 to 17.5	292	67	**30 221 13.31,5**
				31.5	10 to 17.5	442	53	**30 231 13.31,5**
				31.5	10 to 24	442	53	**30 006 13.31,5**
	400	4	16.8	31.5	10 to 17.5	442	53	**30 231 13.31,5**
				31.5	10 to 17.5	292	67	**30 221 13.31,5**
				31.5	10 to 24	442	53	**30 006 13.31,5**
	500	4	21	40	10 to 17.5	442	53	**30 231 13.40**
				40	10 to 17.5	292	67	**30 221 13.40**
				40	10 to 24	442	53	**30 006 13.40**
	630	4	26.4	50	10 to 17.5	442	67	**30 232 13.50**
				50	10 to 17.5	292	67	**30 221 13.50**
				50	10 to 24	442	67	**30 014 13.50**
	800	5 to 6	33.5	63	10 to 24	442	67	**30 014 43.63**
	1000	5 to 6	41.9	80	10 to 24	442	67	**30 014 43.80**
	1250	5 to 6	52.3	100	10 to 24	442	85	**30 022 43.100**
	1600	5 to 6	66.9	125	10 to 24	442	85	**30 022 43.125**
15 to 17.5	20	4	0.77	3.15	10 to 24	442	53	**30 006 13.3,15**
	50	4	1.9	6.3	10 to 17.5	442	53	**30 231 13.6,3**
				6.3	10 to 17.5	292	53	**30 255 13.6,3**
				6.3	10 to 24	442	53	**30 006 13.6,3**
	75	4	2.9	6.3	10 to 17.5	442	53	**30 231 13.6,3**
	100	4	3.9	10	10 to 17.5	442	53	**30 231 13.10**
	125	3 (3.5)	4.8	16	10 to 17.5	442	53	**30 231 13.16**
				16	10 to 24	442	53	**30 006 13.16**
	160	4	6.2	16	10 to 17.5	442	53	**30 231 13.16**
	200	3 (3.5)	7.7	20	10 to 17.5	442	53	**30 231 13.20**
				20	10 to 17.5	292	67	**30 221 13.20**
				20	10 to 24	442	53	**30 006 13.20**
	250	3 (3.5)	9.7	25	10 to 17.5	292	67	**30 221 13.25**
	315	3 (3.5)	12.2	31.5	10 to 17.5	292	67	**30 221 13.31,5**
				31.5	10 to 24	442	53	**30 006 13.31,5**
	400	4	15.5	31.5	10 to 17.5	442	53	**30 231 13.31,5**
				31.5	10 to 17.5	292	67	**30 221 13.31,5**
				31.5	10 to 24	442	53	**30 006 13.31,5**
	500	4	19.3	31.5	10 to 17.5	442	53	**30 231 13.31,5**
				31.5	10 to 24	442	53	**30 006 13.31,5**
				31.5	10 to 17.5	292	67	**30 221 13.31,5**
				40	10 to 17.5	442	53	**30 231 13.40**
				40	10 to 24	442	53	**30 006 13.40**
				40	10 to 17.5	292	67	**30 221 13.40**
	630	4	24.3	40	10 to 17.5	442	53	**30 231 13.40**
				40	10 to 17.5	292	67	**30 221 13.40**
				40	10 to 24	442	53	**30 006 13.40**
				50	10 to 17.5	292	67	**30 221 13.50**
				50	10 to 17.5	442	67	**30 232 13.50**
				50	10 to 24	442	67	**30 014 13.50**
	800	5 (5.1)	30.9	63	10 to 24	442	67	**30 014 43.63**
	1000	5 to 6	38.5	63	10 to 24	442	67	**30 014 43.63**
	1250	5 to 6	48.2	100	10 to 24	442	85	**on request**
	1600	5 to 6	61.6	125	10 to 24	442	85	**on request**
20 to 24	20	4	0.57	3.15	10 to 24	442	53	**30 006 13.3,15**
	50	4	1.5	6.3	10 to 24	442	53	**30 006 13.6,3**
	75	4	2.2	6.3	10 to 24	442	53	**30 006 13.6,3**
	100	4	2.9	6.3	10 to 24	442	53	**30 006 13.6,3**
	125	4	3.6	10	10 to 24	442	53	**30 006 13.10**
	160	4	4.7	10	10 to 24	442	53	**30 006 13.10**
	200	4	5.8	16	10 to 24	442	53	**30 006 13.16**
	250	4	7.3	16	10 to 24	442	53	**30 006 13.16**
	315	4	9.2	16	10 to 24	442	53	**30 006 13.16**
				20	10 to 24	442	53	**30 006 13.20**
	400	4	11.6	20	10 to 24	442	53	**30 006 13.20**
	500	4	14.5	25	10 to 24	442	53	**30 006 13.25**
				31.5	10 to 24	442	53	**30 006 13.31,5**
	630	4	18.2	31.5	10 to 24	442	53	**30 006 13.31,5**
	800	5 to 6	23.1	31.5	10 to 24	442	53	**30 006 13.31,5**
				40	10 to 24	442	53	**30 006 13.40**
	1000	5 to 6	29	40	10 to 24	442	53	**30 006 13.40**
	1250	5 (to 5.9)	36	50	10 to 24	442	67	**30 014 13.50**
	1600	5 (to 5.5)	46.5	80	10 to 24	442	67	**30 014 43.80**
	2000	5 to 6	57.8	100	10 to 24	442	85	**30 022 43.100**
	2500	5 (to 5.7)	72.2	140	10 to 24	442	85	**30 022 43.140**

Features

- According to IEC 61869-2 / DIN EN 61869-2 *)
- Designed as a three-pole ring-core current transformer
- Free of dielectrically stressed cast-resin parts (due to design)
- Insulation class E
- Inductive type
- Climate-independent
- Secondary connection by means of a terminal strip in the panel.

Installation

- Arranged outside the switching-device vessel on the bushings
- Factory-assembled
- Mounting location:
  – For circuit-breaker panels type L...
  – For bus sectionalizer panels type L(T)
  – Option: On request for ring-main-panels type R...

Other designs
(option)

For protection equipment based on the current-transformer operation principle: Three-phase current transformer type 4MC63 60 for

- Protection relay 7SR45 (7SJ46) as definite-time overcurrent protection
- Definite-time overcurrent protection relay, make Woodward / SEG, type WIP-1.

Three-phase current transformer 4MC63 64 for

- Definite-time overcurrent protection relay, make Woodward / SEG, type WIC.

*) For standards, see page 72

Three-phase current transformer 4MC63 ...

installed on bushing-type insulators

Technical data	Three-phase current transformer 4MC63 60 (standard type) 1)											
	for $I_N \leq 150$ A for $I_D = 630$ A				for $I_N \leq 400$ A for $I_D = 630$ A				for $I_N \leq 1000$ A for $I_D = 1250$ A			
Primary data												
Highest voltage for equipment U_m	0.72 kV				0.72 kV				0.72 kV			
Rated current I_N A	150	100	75	50	400	300	200		1000	750	600	500
Rated short-duration power-frequency withstand voltage (winding test)	3 kV				3 kV				3 kV			
Rated short-time thermal current I_{th}	25 kA / 1 s, 2 s 1) or 20 kA / 3 s				25 kA / 1 s, 2 s 1) or 20 kA / 3 s				25 kA / 1 s, 2 s 1) or 20 kA / 3 s			
Rated continuous thermal current I_D	630 A				630 A				1250 A			
Transient overload current	1.5 x I_D / 1 h				2 x I_D / 0.5 h				1.5 x I_D / 1 h			
Rated dynamic current I_{dyn}	2.5 x I_{th}				2.5 x I_{th}				unlimited			
Secondary data												
Rated current A	1	0.67	0.5	0.33	1	0.75	0.5		1	0.75	0.6	0.5
Rating VA	5	3.33	2.5	1.67	5	3.75	2.5		5	3.75	3	2.5
Rated current (option)	5 A				5 A				5 A			
Current at I_D	4.2 A				1.575 A				1.25 A			
Protection core – Class	10 P				10 P				10 P			
Protection core – Overcurrent factor	10				10				10			

1) Other values on request, e.g. as additional type 4MC63 63 (complementary types)

Features

- According to IEC 61869-2 / DIN EN 61869-2 *)
- Designed as a single-pole ring-core current transformer
- Climate-independent
- Free of dielectrically stressed cast-resin parts (due to design)
- Insulation class E
- Inductive type
- Secondary connection by means of a terminal strip inside the panel.

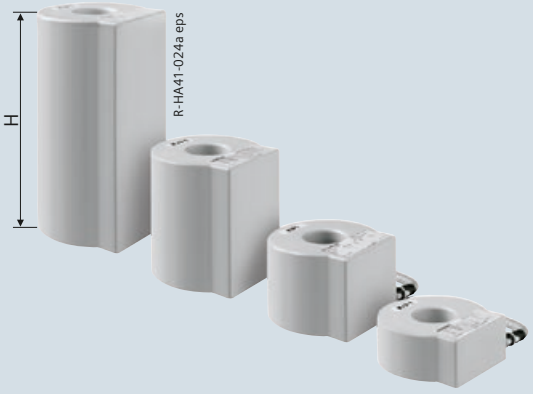
Application

- For circuit-breaker panels type L...
- For ring-main panels type R...
- For transformer panels type T...

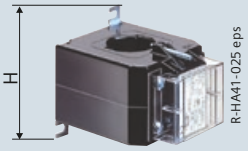
Installation

- Cable-type current transformer 4MC70 33 for panel types: R..., K..., L...
- Cable-type current transformer 4MC70 31: E.g. for panel types R..., K... and T...
- Arranged on the cable at the panel connection
- For shielded cables
- Transformers mounted on a supporting plate at our factory; final assembly on the cables on site.

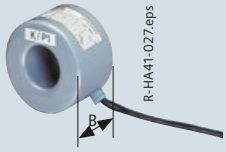
Cable-type current transformer 4MC70 33, 4 overall heights



Cable-type current transformer 4MC70 31



On request: Cable-type current transformer



Technical data	Cable-type current transformer 4MC70 33	Cable-type current transformer 4MC70 31
Primary data		
Highest voltage for equipment U_m	0.72 kV	0.72 kV
Rated current I_N	20 A to 600 A	50 A to 600 A
Rated short-duration power-frequency withstand voltage (winding test)	3 kV	3 kV
Rated short-time thermal current I_{th}	up to 25 kA / 1 s or 25 kA / 3 s or 20 kA / 3 s	25 kA / 1 s, or 14.5 kA / 3 s
Rated continuous thermal current I_D	1.0 x I_N option: 1.2 x I_N	1.0 x I_N option: 1.2 x I_N
Transient overload current	1.5 x I_D / 1 h or 2 x I_D / 0.5 h	1.5 x I_D / 1 h or 2 x I_D / 0.5 h
Rated dynamic current I_{dyn}	2.5 x I_{th}	2.5 x I_{th}
Secondary data		
Rated current	1 A or 5 A	1 A or 5 A
Measuring core – Class	0.2 / 0.5 / 1	1
Measuring core – Overcurrent factor	without / FS5 / FS10	FS5 (option: FS10)
Measuring core – Rating	2.5 VA to 30 VA	2.5 VA to 10 VA
Protection core – Class	10 P / 5 P	–
Protection core – Overcurrent factor	10 / 10	–
Protection core – Rating	2.5 VA to 10 VA	–
Option: Secondary tap	1 : 2 (e.g. 150 A – 300 A)	1 : 2
Dimensions		
Overall height H [2] mm	65 [1] / 110 [1] / 170 [1] / 285 [1]	89
Outside diameter	150 mm	85 mm x 114 mm
Inside diameter	55 mm	40 mm
For cable diameter	50 mm	36 mm

Other values on request

*) For standards, see page 72

1) Depending on the core data

2) Available installation space for cable-type current transformers inside the panels depends on make, type and cross-section of sealing end.
Example: Panel type R or K: Installation space approx. 285 mm

Features

Current transformer 4MA7

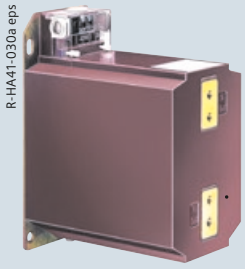
- According to IEC 61869-2 / DIN EN 61869-2 *)
- Dimensions according to DIN 42600-8
- Designed as a single-pole indoor block-type current transformer
- Cast-resin insulated
- Insulation class E
- Secondary connection by means of screw-type terminals.

Voltage transformer 4MR

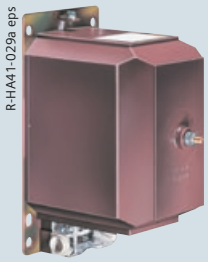
- According to IEC 61869-3 / DIN EN 61869-3 *)
- Dimensions according to DIN 42600-9 (small model)
- Designed as an indoor voltage transformer:
  - Type 4MR, single-pole
  - Option: Type 4MR, two-pole
- Cast-resin insulated
- Insulation class E
- Secondary connection by means of screw-type terminals.

Application

- For panel types:
  - Metering panel type M...as billing metering panel (750 mm wide)
  - Metering panel / bus riser panel type H and H1
  - Busbar voltage transformer panel types M(VT), M(VT-F), L ...
- For mounting at the feeder.



Current transformer 4MA7, single-pole



Voltage transformer 4MR14, single-pole

Technical data

Current transformer 4MA7, single-pole (other values on request)

Primary data

Highest voltage for equipment U_m		kV	**3.6**	**7.2**	**12**	**12**	**17.5**	**24**
Rated short-duration power-frequency withstand voltage U_d		kV	10	20	28	42	38	50
Rated lightning impulse withstand voltage U_p		kV	20	60	75	75	95	125
Rated current I_N		A	20 to 1200 →					
Rated short-time thermal current I_{th}		kA	up to 20 kA / 3 s, or up to 25 kA / 1 s →					
Rated continuous thermal current I_D			up to 1.0 × I_n (option: 1.2 × I_n) →					
Rated dynamic current I_{dyn}			max. 2.5 × I_{th} →					

Secondary data

Rated current		A	1 or 5 →		
Measuring core	Class		0.2	0.5	1 →
	Overcurrent factor		without	FS5	FS10 →
	Rating	VA	2.5 to 30 →		
Protection core	Class		5 P or 10 P →		
	Overcurrent factor		10 →		
	Rating	VA	2.5 to 30 →		

Voltage transformer 4MR, single-pole (other values on request)

Primary data

Highest voltage for equipment U_m (= 1.2 x U_N)	kV	**3.6**	**7.2**	**12**	**12**	**17.5**	**24**
Rated short-duration power-frequency withstand voltage U_d	kV	10	20	28	42	38	50
Rated lightning impulse withstand voltage U_p	kV	20	60	75	75	95	125
Rated voltage U_N	kV	3.3 / √3	3.6 / √3 4.2 / √3 4.8 / √3 5.0 / √3 6.0 / √3 6.3 / √3 6.6 / √3	7.2 / √3 10.0 / √3 11.0 / √3 11.6 / √3	10.0 / √3 11.0 / √3	12.8 / √3 13.2 / √3 13.8 / √3 15.0 / √3 16.0 / √3	17.5 / √3 20.0 / √3 22.0 / √3 23.0 / √3
Rated voltage factor (8 h)		1.9 × U_N →					

Secondary data

Rated voltage	V	100 / √3 →			
		110 / √3 (option) →			
		120 / √3 (option) →			
Rated voltage for auxiliary winding (option)	V	100 / 3 →			
		110 / 3 (option) →			
		120 / 3 (option) →			
Rating	VA	20	50	100 →	
Class		0.2	0.5	1.0 →	

*) For standards, see page 72

Ready-for-service indicator

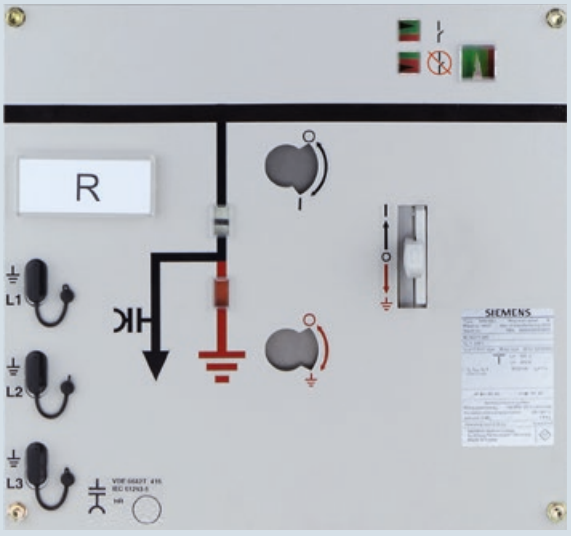
Features

- Self-monitoring; easy to read
- Independent of temperature and pressure variations
- Independent of the site altitude
- Only responds to changes in gas density
- Option: Alarm switch "1 NO" for remote electrical indication.

Mode of operation

For the ready-for-service indicator, a gas-tight measurement box is installed inside the switching-device vessel. A coupling magnet, which is fitted to the bottom end of the measurement box, transmits its position to an outside armature through the non-magnetizable stainless-steel switching-device vessel. This armature moves the ready-for-service indicator of the switchgear.
While changes in the gas density during the loss of gas, which are decisive for the dielectric strength, are displayed, temperature-dependent changes in the gas pressure are not. The gas in the measurement box has the same temperature as that in the switching-device vessel. The temperature effect is compensated via the same pressure change in both gas volumes.

Ready-for-service indicator



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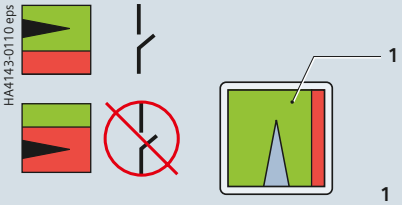
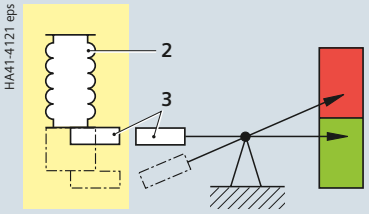
Gas monitoring



1 Green indication: Ready for service (red indication: Not ready for service)



Stainless-steel vessel filled with SF_6 gas

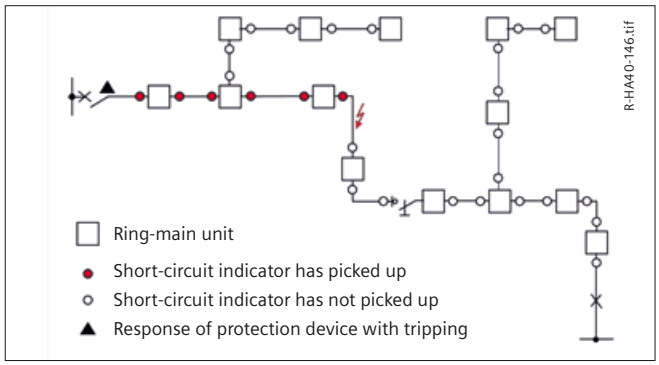
Ready-for-service indicator

Principle of operation of gas monitoring with ready-for-service indicator

2 Measurement box
3 Magnetic coupling

Short-circuit/earth-fault indicators make Horstmann

Short-circuit/earth-fault indicator (option)
Ring-main, cable and circuit-breaker feeders can optionally be equipped with short-circuit or earth-fault indicators in different designs. The equipment features are shown in the table on page 46.
Short-circuit and earth-fault indicators reduce the downtimes of a power system by delimiting the fault locations in medium-voltage systems.



Short-circuit/earth-fault indicators can be used in all kinds of power systems. In impedance-earthed and solidly earthed systems, as well as in isolated and compensated (resonant-earthed) systems, earth-fault detection is also possible.

SIGMA 2.0 with basic functions

- Adjustable pickup values
- Phase-selective fault indication
- Reset of the fault indication: manually, automatically, from remote
- Earth-fault detection in impedance-earthed or solidly earthed systems
- Remote indication with relay contacts.

SIGMA D++ with directional function

- Directional short-circuit indication
- Directional earth-fault indication for all types of neutral treatment
- Unambiguous indication of the fault direction
- Monitoring with “SIGMA Explorer” software.

ComPass B 2.0 with monitoring

- Voltage detection via WEGA voltage detecting system and resistive sensor system for up to 4 devices
- High-precision current and voltage measurement up to 0.5 %
- Monitoring of the values: U, I, f, P, Q, S, E, cos φ, load flow direction, power meter with direction
- Temperature measurement with PT100
- Limit value recording for U, I, P, Q, T
- Transfer of measured values, fault indications and events via RS485/MODBUS.

ComPass Bs 2.0 with control function

- Remote control of a switch-disconnector or circuit-breaker
- Freely programmable logic to define the switching conditions
- 6 binary inputs for recording relevant state information from the switchgear/substation.

EARTH ZERO

ALPHA E

SIGMA 2.0

SIGMA D++

ComPass B 2.0

All indicators (except ALPHA) use the same phase current sensors.

Components

Indicating and measuring equipment

Short-circuit/ earth-fault indicators from Horstmann	ALPHA M ALPHA E	SIGMA 2.0 SIGMA 2.0 AC/DC	SIGMA F+E 2.0 SIGMA F+E 2.0 AC/DC	SIGMA F+E 3 2.0 SIGMA F+E 3 2.0 AC/DC	SIGMA D	SIGMA D+	SIGMA D++	ComPass A 2.0	ComPass B 2.0	ComPass Bs 2.0	Earth Zero-EarthZeroFlag
Function											
Short circuit / earth fault	■/■	■/■	■/■	■/■	■/■	■/■	■/■	■/■	■/■	■/■	–/■
Direction indication	–	–	–	–	■	■	■	–	■	■	–
Monitoring: U, I, f, P, Q, S, E, cos φ, load flow direction	–	–	–	–	–	–	–	■	■	■	–
Control of a CB or SD	–	–	–	–	–	–	–	–	–	■	–
Logic	–	–	–	–	–	–	–	–	–	■	–
Applicable for the following neutral treatments											
Impedance earthed	■	■	■	■	■	■	■	■	■	■	■
Solidly earthed	■	■	■	■	■	■	■	■	■	■	■
Isolated	■	■	■	■	■	■	■	■	■	■	–
Compensated	■	■	■	■	■	■	■	■	■	■	–
Short-circuit pickup values											
I>> Short-circuit current	400, 600, 800, 1000 A	200, 300, 400, 600, 800, 1000, 2000 A, self-adjustment			DIP: 200, 300, 400, 600, 800, 2000 A, self-adjustment Software (SW): 50 – 2000 A			20 – 2000 A			–
tI>> Pickup delay	100 ms	40, 80 ms		40, 80, 200, 300 ms	DIP: 40, 80 ms, Software (SW): 40 ms – 60 s			40 ms – 60 s			–
Earth-fault pickup values											
IES> Short-circuit-to-earth current	–	–	20, 40, 60, 80, 100, 120 or 160 A		DIP: off, 20, 40, 60, 80, 100, 120, 160 A, Software (SW): 20 – 1000 A			20 – 1000 A			25, 50, 75, 100 A
IET> Transient earth fault	–	–	–	–	–	10 – 100 A	10 – 500 A	–	10 – 500 A		–
IEP> Active residual current cos φ	–	–	–	–	–	5 – 200 A	5 – 200 A	–	1 – 200 A		–
IEQ> Reactive current sin ϕ	–	–	–	–	–	5 – 200 A	5 – 200 A	–	1 – 200 A		–
UNE> Permanent earth fault	–	–	–	–	–	–	–	–	1 – 100 %		–
ΔIE> Pulse location (pulse amplitude)	–	–	–	■	–	1 – 100 A	1 – 100 A	1 – 200 A			–
Pickup delay	–	–	80, 200 ms	60, 80, 200, 300 ms	DIP: 80, 160 ms, Software (SW): 40 ms – 60 s			40 ms – 60 s			80, 160 ms
Reset											
Manually / from remote	■ / – (M) ■/■ (E)	■/■	■/■	■/■	■/■	■/■	■/■	■/■	■/■	■/■	■/–
Auto. time reset	■ (E)	■	■	■	■	■	■	■	■	■	■
Current/voltage recovery	–	–	–	■/–	■/■	■/■	■/■	■/–	■/■	■/■	–/■
Test											
Manually / from remote	■/–	■/■	■/■	■/■	■/■	■/■	■/■	■/■	■	■	■/–
Communication											
Relay contact	1	1	2	3	4	4	4	4	4	4	1
Maintained / passing contact	adjustable	adjustable			adjustable			adjustable			adjustable
RS485 / MODBUS-RTU	–	–	–	–	–	–	–	■	■	■	–
USB connection	–	–		–	■	■	■	■	■	■	–
Parameterizing											
Manually / from remote	■/–	■/–	■/–	■/–	■/–	■/–	■/–	■/■	■/■	■/■	■/–
Supply											
Lithium cell, ≥ 20 years	■ (E)	■/Capacitor (AC/DC)			■	■	■	■	■	■	■
Current-transformer operated	■	■	■	■	■	■	■ (not IET>)	–	–	–	■
External auxiliary voltage	–	24 – 230 V AC / DC (only AC / DC versions)		24 – 230 V AC / DC (SIGMA F+E3 2.0 optional)	–	24 V AC, 24 – 60 V DC (possible)	24 – 230 V AC / DC (for IET>)	24 – 230 V AC / DC			–
Binary inputs											
Number	2	2	2	2	2	2	2	2	2	6	–
Number of phase current / summation current sensors											
Short circuit / earth fault	3/0	3/0	3/0	3/0	3/0	3/0 or 3/1 for IET>	3/0 or 3/1	3/0	3/0 (opt. 3/1 or 2/1)		0/1
Voltage coupling											
Capacitive	–	–	–	–	■	■	■	–	■	■	–
Resistive	–	–	–	–	–	–	–	–	■	■	–

Short-circuit / short-circuit-to-earth and earth-fault indicators, make Kries

Ring-main, cable and circuit-breaker feeders can optionally be equipped with short-circuit or earth-fault indicators in different designs. The equipment features are shown in the table on page 48.
The three most common types of faults in medium-voltage systems are earth faults in cables and switchgear, faults and overloads of distribution transformers, as well as short circuits in cables and switchgear. For fast fault location and minimization of downtimes, electronic fault indicators are used:

- Selective fault detection, and thus minimization of downtimes
- Reliable fault detection through electronic measured-value acquisition
- Remote indication of fault events and measured values.

1. Short-circuit and short-circuit-to-earth indicator IKI-20
- Universally adjustable
- Current-transformer supported battery version or auxiliary voltage versions available
- Extended commissioning and testing functions.

2. Short-circuit and earth-fault indicator IKI-20PULS
- Short-circuit detection same as IKI-20
- Earth-fault detection via pulse location in compensated systems.

3. Short-circuit and earth-fault indicator IKI-20C(PULS)
- Current-transformer operated (No battery, no auxiliary voltage)
- Optionally with pulse location for earth-fault detection in compensated systems.

4. Directional short-circuit and earth-fault indicator IKI-22
- Directional fault detection for all system types
- Directional detection combined with the voltage detecting system CAPDIS-Sx+.

5. Grid-Inspector IKI-50
- Directional measured-value acquisition
- Monitoring of values U, I, f, P, Q, S, E, cos φ, power factor, load flow direction (momentary value, mean value and min/max value, directional)
- Directional fault detection for all system types
- Switchgear control or automation through an integrated, programmable logic component
- Directional detection combined with the voltage detecting system CAPDIS-Sx+.

Options:
- One device controls two cable panels and the load flow total
- Directional detection combined with resistor dividers (accuracy 1.0 %)
- Early fault detection and detection of intermittent earth faults
- Telecontrol interface according to IEC 60870-5-104.

6. Short-circuit-to-earth indicator IKI-10light
- Earth-fault detection in systems with impedance-earthed neutral or temporarily impedance-earthed neutral
- Adjustable.

R-HA41-IKI-20.tif

IKI-20

R-HA41-IKI-20CPULS.tif

IKI-20CPULS

R-HA41-IKI-22.tif

IKI-22

R-HA41-IKI-50.tif

IKI-50

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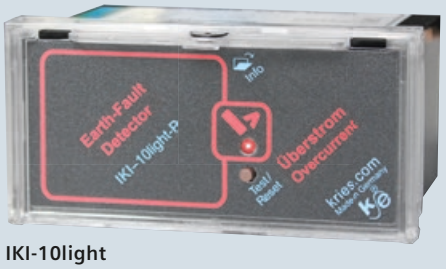


IKI-10light

Components

Indicating and measuring equipment

Short-circuit/ earth-fault indicators from Kries	IKI-20B	IKI-20T	IKI-20U	IKI-20PULS	IKI-20C	IKI-20CPULS	IKI-22	IKI-50_1F	IKI-50_1F_EW_PULS	IKI-50_2F	IKI-50_2F_EW_PULS	IKI-10-light-P
Function												
Short-circuit indication	■	■	■	■	■	■	■	■	■	■	■	
Earth-fault indication				■		■	■	■	■	■	■	
Short-circuit-to-earth indication [5]	■	■	■		■		■	■	■	■	■	■
Direction indication							■	■	■	■	■	
Applicable for the following neutral earthing options												
Impedance	■	■	■		■		■	■	■	■	■	■
Solid	■	■	■		■		■	■	■	■	■	■
Isolated	■	■	■		■	■	■	■	■	■	■	
Compensated	■	■	■	■	■		■	■	■	■	■	
Pickup current												
Short-circuit current	100, 200, 400, 600, 800, 1000, 2000 A				400, 600, 800, 1000 A		100, 200, 300, 400, 600, 800, 1000, 2000 A	100 ... 1000 A (steps of 100 A)				
Earth-fault current							Transient fault detection	4 ... 30 A (steps of 1 A)				
Short-circuit-to-earth current [5]	40, 80, 100, 150 A						40, 80, 100, 200 A	40 ... 200 A (steps of 10 A)				20, 40, 60, 80 A
Pulse location				■		■			■		■	
Pickup time												
Short-circuit current	60, 80, 150, 200 ms				100 ms		60, 80, 150, 200 ms	60 – 1600 ms				
Short-circuit-to-earth current [5]	60, 80, 150, 200 ms				100 ms		60, 80, 150, 200 ms	60 – 1600 ms				70, 250 ms
Earth-fault current				Pulse location		Pulse location	Transient fault detection	400 – 3000 ms				
Reset												
Manual	■	■	■	■	■	■	■	■	■	■	■	■
Automatic	■	■	■	■	■	■	■	■	■	■	■	■
From remote	■	■	■	■			■	■	■	■	■	■
Remote indication												
Passing contact	adjustable				■	■	■	adjustable				
Maintained contact	adjustable							adjustable				
Interface												
RS485/MODBUS								■	■	■	■	
IEC 60870-5-104 (option)								■	■	■	■	
Power supply												
Lithium battery	■						■					■
External auxiliary voltage		■	■	■			Only for transient fault detection	Buffered for 6 h by internal capacitor				■
Current inputs												
Phase current	3	3	3	3	3	3	3	3	3	6	6	–
Summation current	1	1	1	1		1		1 [1]	0 [2]	0 [2]	0 [2]	1
Voltage inputs												
Via CAPDIS							3	3	3	6	6	–
Via resistor divider (option)								3	3	6	6	–
Release outputs												
Potential-free	1 – 3	1 – 3	1 – 3	1 – 3	2	2	4	4	4	4	4	1
Supplied by internal capacitor (option)								2 [3]	2 [3]	2 [3]	2 [3]	
Binary inputs												
Number	2 (test + reset)						2 (test + reset)	4	4	4	4	–

1) Optional for wattmetric detection of earth-fault direction
2) Creation of sum signal via 3 transformers mounted around the conductor
3) 0.1 Ws, 24 V DC
4) Momentary value, mean value and min/max value, directional
5) Short-circuit to earth = Earth fault in impedance-earthed system

Short-circuit/earth-fault indicator from Siemens	SICAM FCM	SICAM FPI
Function		
Short-circuit indication	■	■
Earth-fault indication	■	■
Earth-fault function (impedance-earthed system)	■	■
Indication of direction, short-circuit/earth-fault	■	–
Undervoltage and overvoltage indication	■	–
Applicable for the following neutral earthing options		
Impedance	■	■
Solid	■	■
Isolated	■	■
Compensated	■	■
Pickup current		
Short-circuit current	50 ... 2000 A (steps of 1 A)	Type 1: 200 – 1200 A, type 2: 200 – 800 A (in 7 steps each)
Earth-fault current	1 ... 1000 A (steps of 1 A)	Type 1: 10 – 100 A, type 2: 40 – 300 A (in 7 steps each)
Pulse location	–	–
Pickup time		
Short-circuit current	40 ms < *t* < 60 s	< 500 ms adjustable
Earth-fault current	40 ms < *t* < 60 s	< 500 ms adjustable
Reset		
Manual	■	■
Automatic	■	■
From remote	■	■
Remote indication		
Passing contact	adjustable	–
Maintained contact	adjustable	2 binary outputs
Interface		
RS485/MODBUS	■	–
Power supply		
Lithium battery	■	■
External auxiliary voltage	■	–
Current inputs		
Phase current	3 (2) [1]	3 optical
Summation current	0 (1) [1]	1 optical
Voltage inputs		
Via resistor divider	3	–
Via integrated capacitive voltage indicator (optional)	3	–
Relay outputs		
Potential-free	2 [2]	2
Binary inputs		
Number	1	–

SICAM FCM

1. SICAM FCM

The short-circuit and earth-fault indicator SICAM FCM (Feeder Condition Monitor) with direction indication enables fast and precise fault location, thus reducing the downtimes in the power system. The possibility to determine and telecommunicate the values U, I, f, P, Q, S, E, cos φ and load flow direction supports efficient operational management and network planning.

- Usable in earthed, isolated and resonance-earthed systems
- Directional short-circuit and earth-fault detection
- Selective fault information with direction indication as a basis for "self-healing" applications
- Usable with current and voltage sensors according to IEC 60044 for precise measurement without calibration and adjustment to the primary values
- Alternatively usable with an integrated capacitive voltage detecting system
- Flexible earth-current detection as from 0.4 A
- Integrated MODBUS-RTU interface:
- Remote parameterization via SICAM A8000 and MODBUS
- Self-test function of the communication connection.

2. SICAM FPI (Fault Passage Indicator)

- Detection of short circuits and earth faults
- Indication of phase and earth faults via 4 separate LEDs
- Enhanced diagnostics, self and sensor cable diagnostics is supported
- Configurable binary outputs, for remote indication to SCADA via RTU for faults and for diagnostics.

SICAM FPI

1) Measuring sensor 3+0 (summation current is calculated), measuring sensor 2+1 (phase L2 is calculated)
2) Optional

For circuit-breaker panels (type L, L1 ...)

Protection of distribution transformers with ratings that cannot or should not be protected with HV HRC fuses:

- Tripping of the circuit-breaker in case of overload (delayed)
- Tripping of the circuit-breaker when the short-circuit current arises.

On request: Application with switch-fuse combination (panel type T...)

Monitoring of the overload range of distribution transformers with

- Tripping of the switch in case of overload (current smaller than the rated current of the switch)
- Blocking of the tripping function in the short-circuit range (here, the fuse takes over the disconnecting function).

Features

- Current-transformer operated (cable-type transformer), alternatively auxiliary voltage 24 ... 230 V AC/DC
- Instrument transformer
  – Special cable-type current transformer
  – No direction-dependent installation required
  – No earthing of a transformer pole required
  – No short-circuit terminals required for maintenance
- Low-energy magnetic release (0.02 Ws)
- Mounting location
  – In the low-voltage niche of the feeder panel
  – In the low-voltage compartment (option) of the circuit-breaker feeder
- Response performance
  – Definite-time overcurrent characteristic
  – Definite-time overcurrent characteristic for earth-fault protection (additional sensor required)
  – Inverse-time overcurrent characteristic
    – extremely inverse
    – normal inverse
  – Externally undelayed instantaneous tripping
- Self-test function
  – Display test LED (red)
  – Battery test (under load) LED (green)
  – Primary current test with tripping and with primary current injection into the transformers
- Indication
  – LED indication for tripping (single flash: Starting, double flash: Tripping)
  – Reset after 2 h, 4 h or automatically (after return of power) or manually with reset pushbutton

Transformer monitor IKI-30

Example for selection of transformer protection

Operating voltage (kV)	Transformer rating (kVA) Make and type of the device		
	Siemens	Woodward/SEG	Kries
	7SJ45/7SJ46	WIC 1-2P	IKI-30
5	≥ 160	≥ 160	≥ 160
6	≥ 160	≥ 160	≥ 160
6.6	≥ 160	≥ 160	≥ 160
10	≥ 200	≥ 250	≥ 160
11	≥ 200	≥ 250	≥ 160
13.8	≥ 250	≥ 400	≥ 160
15	≥ 315	≥ 400	≥ 160
20	≥ 400	≥ 500	≥ 250

- Outputs
  – Tripping signal: 1 floating relay output (NC contact) for telecommunication as passing contact
  – Starting signal: 1 floating relay output (NC contact)
    – is activated as long as the starting criterion is reached, e.g. to block an upstream primary protection
  – 1 watchdog (relay)
  – 1 external tripping output for control of an existing release, e.g. via capacitor
  – Tripping output designed as impulse output for direct control of the low-energy release
- Input
  – Remote tripping signal, control via floating external contact
  – Instantaneous tripping.

Voltage detecting systems according to IEC 61243-5 or VDE 0682-415

- For verification of safe isolation from supply
- HR or LRM detecting systems with plug-in indicator
- LRM detecting systems with integrated indicator type VOIS+, VOIS R+, CAPDIS-S1+, CAPDIS-S2+, WEGA 1.2 C, WEGA 2.2 C or WEGA 3.

Plug-in voltage indicator

- Verification of safe isolation from supply phase by phase
- Indicator suitable for continuous operation
- Measuring system and voltage indicator can be tested, repeat test according to local specifications and standards
- Voltage indicator flashes if high voltage is present.

VOIS+, VOIS R+

- Without auxiliary power
- Display indication "A1" to "A3" (see legend)
- Repeat test according to local specifications and standards
- With integrated 3-phase LRM test socket for phase comparison
- With integrated signaling relay (only VOIS R+).

Common features of CAPDIS-Sx+

- Without auxiliary power
- Integrated repeat test of the interfaces (self-monitoring)
- With integrated function test (without auxiliary power) by pressing the "Test" button
- Adjustable for different operating voltages (adjustable capacitance C2)
- With integrated 3-phase LRM test socket for phase comparison
- With connectable signal-lead test
- With overvoltage monitoring and signaling (1.2 times operating voltage).

CAPDIS-S1+

- Without auxiliary power
- Display indication "A1" to "A7" (see legend)
- Without ready-for-service monitoring
- Without signaling relay (without auxiliary contacts).

CAPDIS-S2+

- Display indication "A0" to "A8" (see legend)
- Only by pressing the "Test" pushbutton: "ERROR" indication (A8), e.g. in case of missing auxiliary voltage
- With ready-for-service monitoring (auxiliary power required)
- With integrated signaling relay for signals (auxiliary power required).

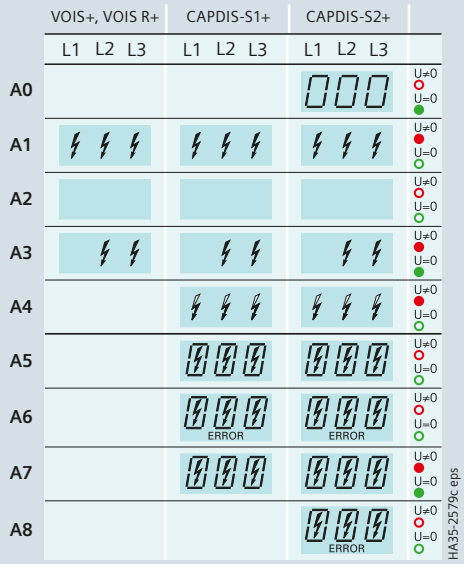
Indicators and detecting systems

Plug-in voltage indicator
per phase at the panel front

Integrated voltage indicator VOIS+, VOIS R+

Integrated voltage detecting system CAPDIS-S1+, -S2+

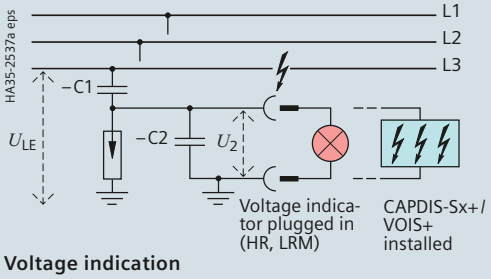
Symbols shown



CAPDIS S2+: The red and green LEDs show the state of the relay contacts

- ○○ LED doesn't light up
- ●● LED lights up
- U = Operating voltage

A0 CAPDIS-S2+: Operating voltage not present
A1 Operating voltage present
A2 – Operating voltage not present
– For CAPDIS-S2+: Auxiliary power not present
A3 Failure in phase L1, operating voltage at L2 and L3 (for CAPDIS-Sx+ also earth-fault indication)
A4 Voltage (not operating voltage) present
A5 Indication "Test" passed (lights up shortly)
A6 Indication "Test" not passed (lights up shortly)
A7 Overvoltage present (lights up permanently)
A8 "ERROR" indication, e.g. in case of missing auxiliary voltage



Voltage indication
via capacitive voltage divider (principle)

– C1 Capacitance integrated into bushing
– C2 Capacitance of the connection leads and the voltage indicator to earth
$U_{LE} = U_N/\sqrt{3}$ during rated operation in the three-phase system
$U_2 = U_A$ = Voltage at the capacitive interface of the switchgear or at the voltage indicator

WEGA 3
- Display indication “A1” to “A5”
- Integrated repeat test of the interface (self-monitoring)
- With integrated 3-phase LRM test socket for phase comparison.

WEGA 1.2 C
- Display indication “A1” to “A6” (see legend)
- Integrated repeat test of the interface (self-monitoring)
- With integrated function test (without auxiliary power) by pressing the “Display Test” button
- With integrated 3-phase LRM test socket for phase comparison.

WEGA 2.2 C
- Display indication “A0” to “A7” (see legend)
- Integrated repeat test of the interface (self-monitoring)
- With integrated function test (without auxiliary power) by pressing the “Display Test” button
- With integrated 3-phase LRM test socket for phase comparison
- With two integrated signaling relays (auxiliary power required *)).

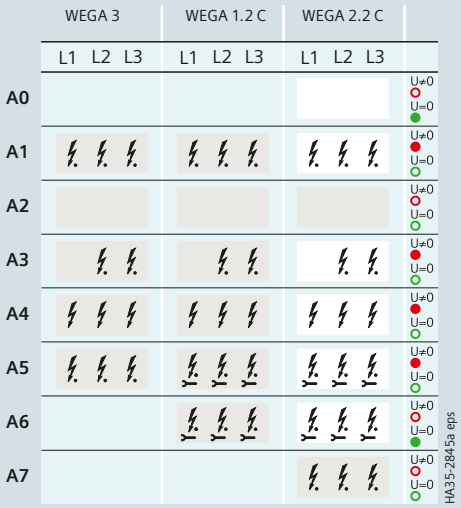
*) Shows the function of the relay via the LED indications (U=0, U≠0)

Integrated voltage indicator WEGA 3

Integrated voltage indicator WEGA 1.2 C

Integrated voltage indicator WEGA 2.2 C

Symbols shown



LC display gray: not illuminated

LC display white: illuminated

WEGA 2.2 C: The red and green LEDs show the state of the relay contacts

○○ LED doesn´t light up

●● LED lights up

U = Operating voltage

A0 For WEGA 2.2 C:
Operating voltage not present, auxiliary power present, LCD illuminated

A1 Operating voltage present
For WEGA 2.2 C: Auxiliary power present, LCD illuminated

A2 Operating voltage not present
For WEGA 2.2 C: Auxiliary power not present, LCD not illuminated

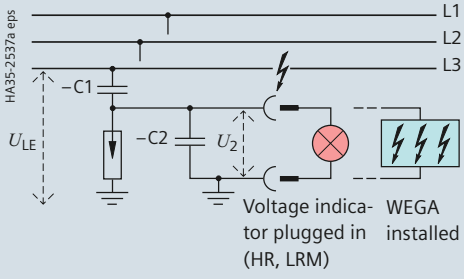
A3 Failure in phase L1, operating voltage at L2 and L3
For WEGA 2.2 C: Auxiliary power present, LCD illuminated

A4 Voltage present, current monitoring of coupling section below limit value
For WEGA 2.2 C: Auxiliary power present, LCD illuminated

A5 Indication “Display-Test” passed
For WEGA 2.2 C: Auxiliary power present, LCD illuminated

A6 Indication “Display Test” passed
For WEGA 2.2 C:
Auxiliary power present

A7 For WEGA 2.2 C: LCD for missing auxiliary voltage is not illuminated



Voltage indication
via capacitive voltage divider (principle)

– C1 Capacitance integrated into bushing
– C2 Capacitance of the connection leads and the voltage indicator to earth
$U_{LE} = U_N/\sqrt{3}$ during rated operation in the three-phase system
$U_2 = U_A$ = Voltage at the capacitive interface of the switchgear or at the voltage indicator

Verification of correct terminal-phase connections

- Verification of correct terminal-phase connections possible by means of a phase comparison test unit (can be ordered separately)
- Safe-to-touch handling of the phase comparison test unit by inserting it into the capacitive taps (socket pairs) of the switchgear.

Phase comparison test units according to IEC 61243-5 or VDE 0682-415

R-HA41-EPV.eps

Phase comparison test unit make Pfisterer, type EPV
as combined test unit (HR and LRM) for:
– Voltage detection
– Phase comparison
– Interface test
– Integrated self-test
– Indication via LED.

R-HA41-ORION-3-1.tif

Phase comparison test unit make Horstmann, type ORION 3.1
as combined test unit (HR and LRM) for:
– Phase comparison
– Interface testing at the switchgear
– Voltage detection
– Integrated self-test
– Indication via LED and acoustic alarm
– Phase sequence indication.

R-HA41-CAP-Phase.eps

Phase comparison test unit make Kries, type CAP-Phase
as combined test unit (HR and LRM) for:
– Voltage detection
– Repeat test
– Phase comparison
– Phase sequence test
– Self-test.
The unit does not require a battery.

R-HA41-ORION-M-1.tif

Phase comparison test unit make Horstmann, type ORION M1
as combined test unit (HR and LRM) for:
– Voltage detection
– Phase comparison
– Interface testing at the switchgear
– Integrated self-test
– Indication via display and acoustic alarm
– Phase sequence indication and status LED
– Measurement of interface current up to 25 µA
– Measurement of phase angle from –180° to +180°
– Measurement of harmonics up to 40th harmonic
– Securing the measured values via PC software (ORION explorer) and USB.

Simple protection systems

As a simple protection for distribution transformers and circuit-breaker feeders, standard protection systems are available, consisting of:

- Current-transformer operated protection device with c.t.-operated release (low-energy 0.1 Ws)
  - Siemens Reyrolle 7SR45
  - Woodward / SEG WIC 1-2P, WIC 1-3P, WIP-1
- Protection device with auxiliary voltage supply with shunt release (f)
  - Siemens Reyrolle 7SR10 (Siemens SIPROTEC 7SJ46)
- Instrument transformer as
  - Cable-type current transformer (standard)
  - Three-phase current transformer as option for SIMOSEC switchgear panels type L .....

Mounting location

- In 350 mm high low-voltage compartment (option) of the circuit-breaker feeder, or in the low-voltage niche.

Application of simple protection systems

Operating voltage (kV)	Transformer rating (kVA)	
	7SJ45 / 7SJ46	WIC 1-2P
6	≥ 160	≥ 160
10	≥ 200	≥ 250
13.8	≥ 250	≥ 400
15	≥ 315	≥ 400
20	≥ 400	≥ 500

Multifunction protection (selection)

SIPROTEC Compact series
Overcurrent protection SIPROTEC 7SJ80

- 9 programmable function keys
- 6-line display
- USB port at the front
- 2 additional communication ports
- IEC 61850 with integrated redundancy (electrical or optical).

SIPROTEC 5 series, overcurrent protection SIPROTEC 7SJ82

- Directional and non-directional time-overcurrent protection with additional functions
- Time optimization of the tripping times by direction comparison and protection data communication
- Frequency protection and rate-of-frequency change protection for load shedding applications
- Overvoltage and undervoltage protection in all required variations
- Power protection, configurable as active or reactive power protection
- Control, synchrocheck and switchgear interlocking system
- Firmly integrated, electrical Ethernet port J for DIGSI
- Complete IEC 61850 (Reporting and GOOSE) via integrated port J
- Two optional, pluggable communication modules usable for different and redundant protocols (IEC 61850, IEC 60870-5-103, DNP3 (serial+TCP), MODBUS RTU Slave, protection data communication).

Reyrolle 7SR45

SIPROTEC 7SJ80

SIPROTEC 7SJ82

Other types and makes on request

Mounting location

- In the 350 mm or 550 mm high low-voltage compartment (option) of the circuit-breaker feeder.

Features of low-voltage compartment (option)

- Overall heights
  – 350 mm
  – 550 mm
- Partitioned safe-to-touch from the high-voltage part of the panel
- Installation on the panel:
  Possible per feeder
- Customer-specific equipment
  For accommodation of protection, control, measuring and metering equipment
- Overall height depends on the panel-specific configuration of primary and secondary equipment
- Door with hinge on the left
  (standard for heights of 350 and 550 mm)
  Option: Door with hinge on the right.

Low-voltage cables

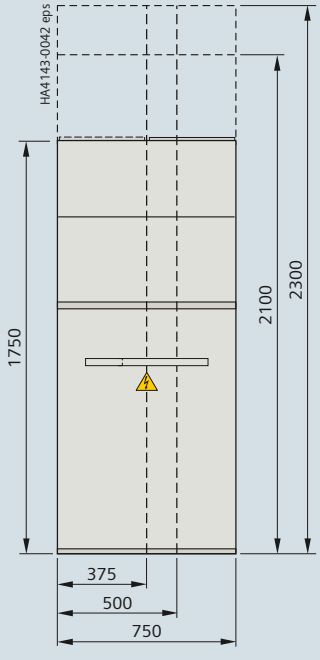
- Control cables of the panel to the low-voltage compartment via multi-pole, coded module plug connectors
- Option: Plug-in bus wires from panel to panel inside the low-voltage niche, or optionally in the separate wiring duct on the panel.

Low-voltage compartment (option)

SIPROTEC 5
7SJ82:
1 LED indications
2 LCD
3 Navigation keys
4 Function keys

On circuit-breaker panel type L, L1, ...
for additional low-voltage equipment

Low-voltage compartment (example 750 x 350 mm)



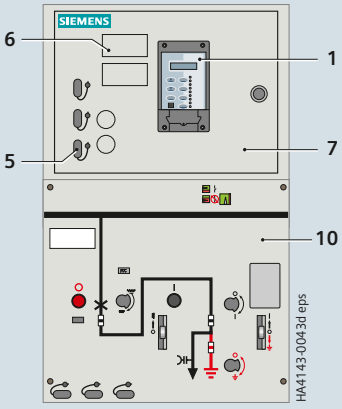
Switchgear height
1750 mm

Low-voltage niche (standard)

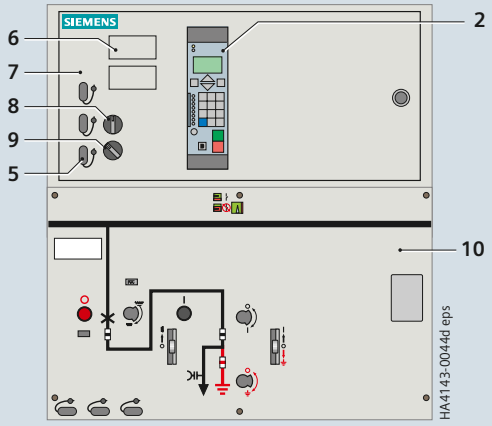
- Inside the panel
- Cover for low-voltage niche:
  – Standard: Screwed-on cover
  – With door (option)
- For accommodation of terminals and standard protection devices, e.g. in circuit-breaker panels combined with frame cover for panels
  – Protection relays (with max. 75 mm wide mounting frame), e.g.
    – Type 7SR45, 7SR10: For type L and L1
    – Make Woodward / SEG, type WIC1: For type L and L1

  On request:
    – 7SJ80
    – Make Woodward / SEG, WIP-1
- For bus wires and / or control cables; niche open at the side to the adjacent panel
- Safe-to-touch, separated from high-voltage part of the panel
- Degree of protection IP3X (standard).

Low-voltage niche (examples)



In circuit-breaker panel type L (500 mm) (with CB-f NAR*))



In circuit-breaker panel type L1 (750 mm)

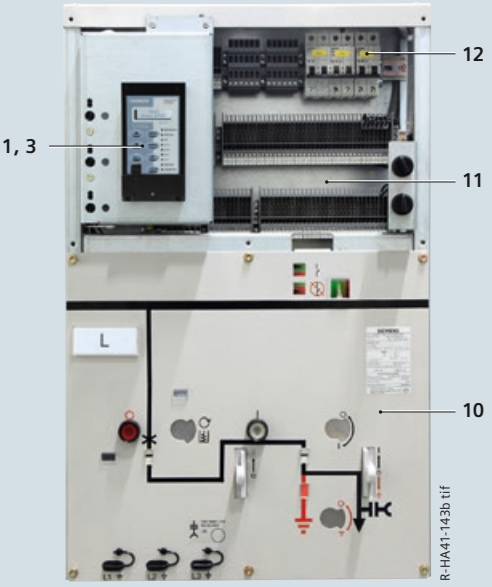
Protection relay as option:

1 Protection relay type 7SR45

2 On request: Protection relay type 7SJ80 in LV niche

3 Protection relay make Woodward (SEG), type WIC

4 On request: Multifunction protection relay SIPROTEC 4 type 7SJ61 on swing-out frame



In circuit-breaker panel type L (500 mm)

5 Option: Sockets for capacitive voltage detecting system for busbar

6 Short-circuit / earth-fault indicator

7 Frame cover of low-voltage niche (can be unscrewed)
Option: as door

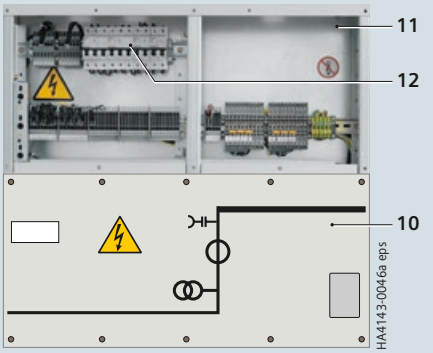
8 Option: Local-remote switch for three-position switch-disconnector

9 Option: Momentary-contact rotary control switch ON-OFF for motor operating mechanism of the three-position switch-disconnector

10 Panel front

11 Low-voltage niche open

12 Option:
Installed equipment



In metering panel type M (750 mm)
(low-voltage niche open)

*) AR = Automatic reclosing
NAR = Non automatic reclosing

Room planning

Switchgear installation

Wall-standing arrangement, free-standing arrangement
– 1 row
– 2 rows (for face-to-face arrangement).

Room dimensions

See opposite dimension drawings.

Door dimensions

The door dimensions depend on the
– Number of panels in a transport unit
– Design with or without low-voltage compartment.

Switchgear fastening

- For floor openings and fixing points of the switchgear, see pages 66 to 68
- Foundations:
– Steel girder construction
– Steel-reinforced concrete.

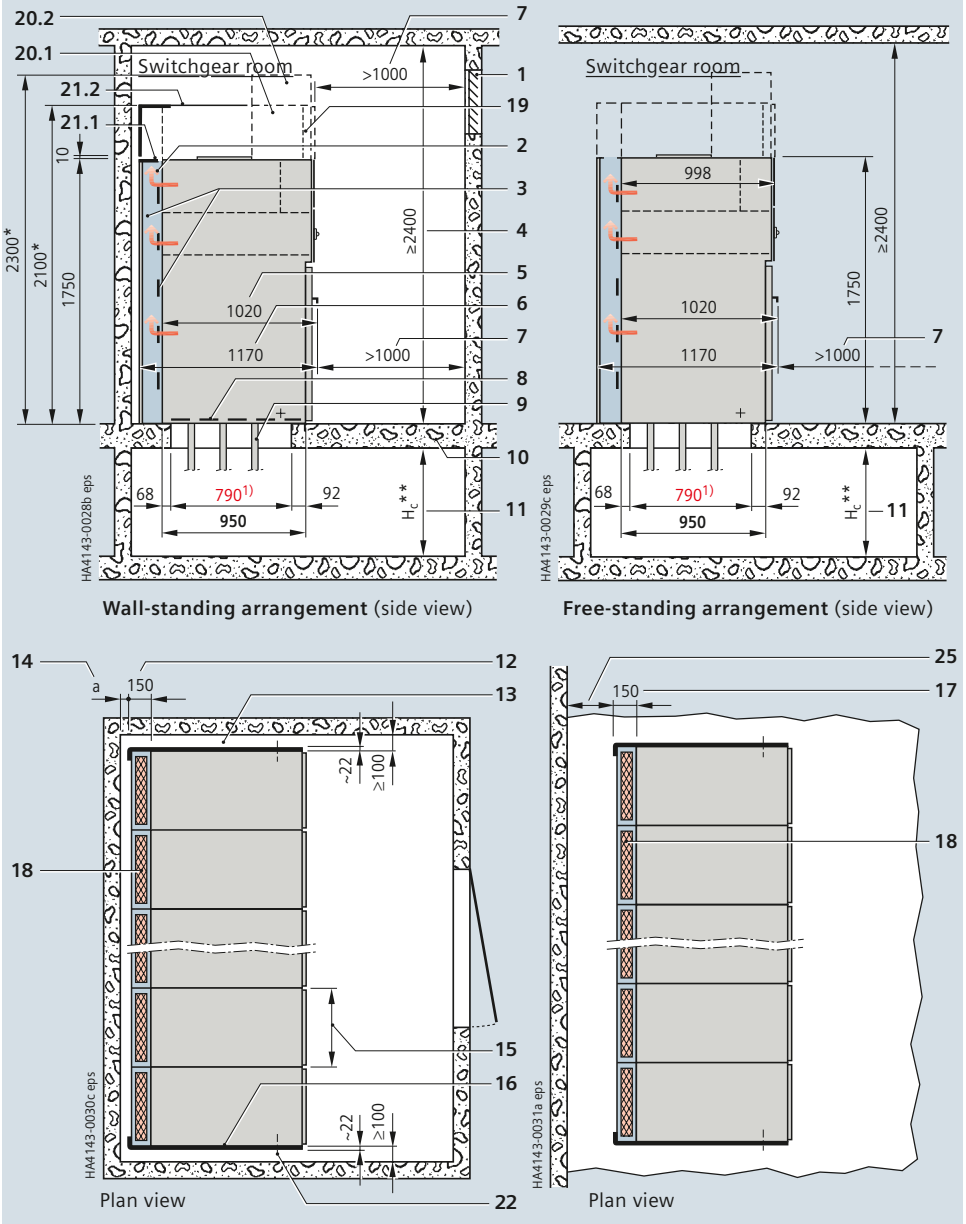
Panel dimensions

See pages 60 to 65

Weight

The weight of a panel depends on the extent to which it is equipped (e.g. with motor operating mechanism, voltage transformer). For details, please refer to page 69.

Room planning



Wall-standing arrangement (side view)

Free-standing arrangement (side view)

Plan view

Plan view

1 Relief opening
2 Direction of pressure relief
3 Pressure relief of switchgear
4 Room height
5 Individual panel depth △)
6 Panel depth including end wall △)
7 Depending on national requirements:
Control aisle ≥ 1000 mm recommended (in Germany ≥ 800 mm).
When extending or replacing panels, it might be necessary – depending on the room dimensions – to disassemble the respective adjacent panels.
8 Option: Floor cover (optionally deeper)
9 Cable
10 Foundation
11 Height of cable basement depending on (recommendation for $H_{c\ inside}$):
– Bending radius of cable
≥ 600 mm**... ≥ 1400 mm
– Cable fixing underneath the panel (in cable basement)
≥ 1400 mm
– Use of deep floor cover
≥ 1400 mm
12 Wall distance, dimension of pressure relief duct (= option)
13 Side wall distance
14 Wall distance a (see also page 59)
15 Panel width

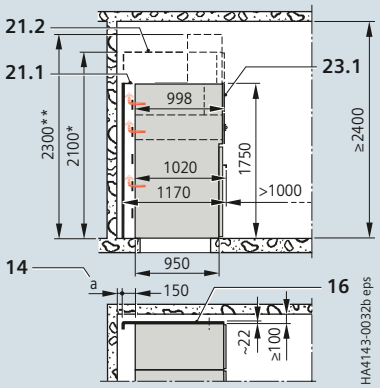
Continued on next page

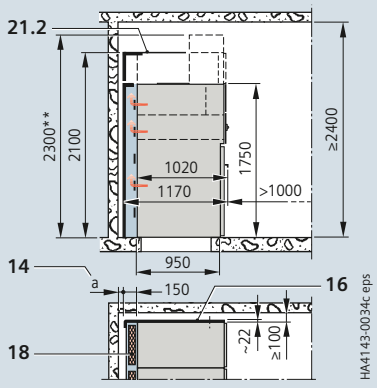
1) Floor opening
△) Panel type L, L1, L(1), L1(T) with VCB type 3AH569:
Panel depth: 1080 mm,
switchgear depth: 1230 mm
*) Switchgear height 2100 mm if height of low-voltage compartment 350 mm; switchgear height 2300 mm if height of low-voltage compartment 550 mm
**) Cable fixing in the panel,
– without deep floor cover (for version without current transformer on the cable)

Dimensions

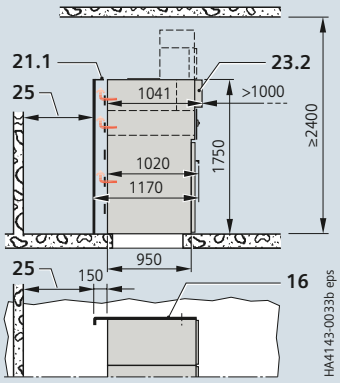
Switchgear installation

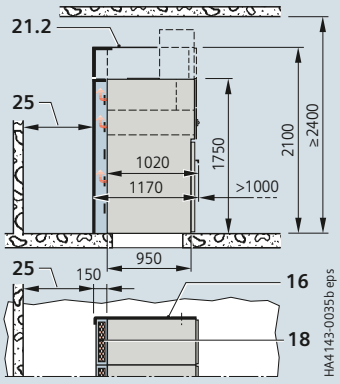
Wall-standing arrangement





Free-standing arrangement





Design of switchgear

Type of installation	IAC	Rear pressure relief duct	Switchgear height in mm	Recommended height for switchgear room
Wall-standing	–	–	1750	≥ 2400
Free-standing	–	– △)	1750	≥ 2400

Floor cover: Available as option

Wall-standing	IAC A FL 16 kA, 1 s	●	2100	≥ 2400
	IAC A FL 21 kA, 1 s	●	2100	≥ 2400
Free-standing	IAC A FLR 16 kA, 1 s	●	2100	≥ 2400
	IAC A FLR 21 kA, 1 s	●	2100	≥ 2400

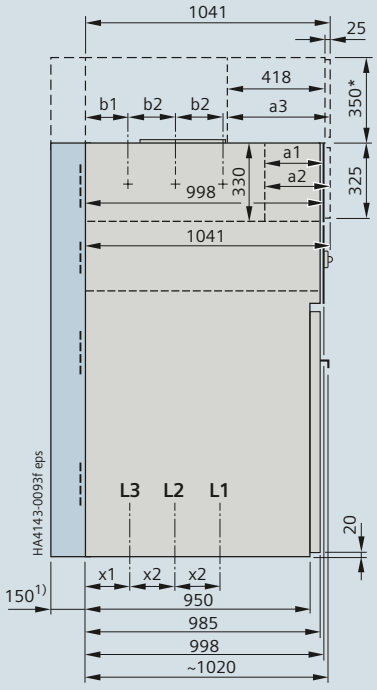
Floor cover: Available as option

Continued from page 57

16 End wall
17 Depth of pressure relief duct
18 Option: Pressure relief duct for each panel, for wall-standing or free-standing arrangement
19 Option: Front cover (panel without low-voltage compartment)
20.1 Option: Low-voltage compartment: 350 mm high
20.2 Option: Low-voltage compartment: 550 mm high
21.1 End wall: 1750 mm high
21.2 End wall: 2100 mm high (standard for IAC design, option without IAC = 2100 mm high)
22 Earthing terminal
23 Cover for low-voltage niche
23.1 Standard: Cover screwed-on (panel depth: 998 mm)
23.2 Option: Door (= 45 mm, panel depth: 1041 mm)
25 Distance to rear wall: ≥ 800 mm (for free-standing arrangement)

△) Option: Rear pressure relief duct
● As standard
*) Panel height: 2100 mm, height of low-voltage compartment: 350 mm
**) Option: Panel height: 2300 mm, height of low-voltage compartment : 550 mm

For standard dimensions and IAC design, see also page 59



Compartment	Dimensions for: "Available mounting depth for low-voltage equipment"	in mm approx.
LV niche – with front cover	a_1	201
LV niche – with door (option)	a_2	246
LV compartment (option)	a_3	443

*) Option: Low-voltage compartment or front cover available in two heights: 350 mm or 550 mm

1) Option: Pressure relief duct

Rated voltage U_r	Dimensions in mm	
Position of cables △)	x1 △)	x2 △)
Up to 17.5 kV	187	210
24 kV	187	210
Position of busbar	b1	b2
Up to 24 kV	187	210

△) The position of the cables in the panel depends on the panel type and the additional, optional built-in panel components (e.g. current and voltage transformers). Therefore, the dimensions x1 and x2 may be different.

Standard dimensions of switchgear

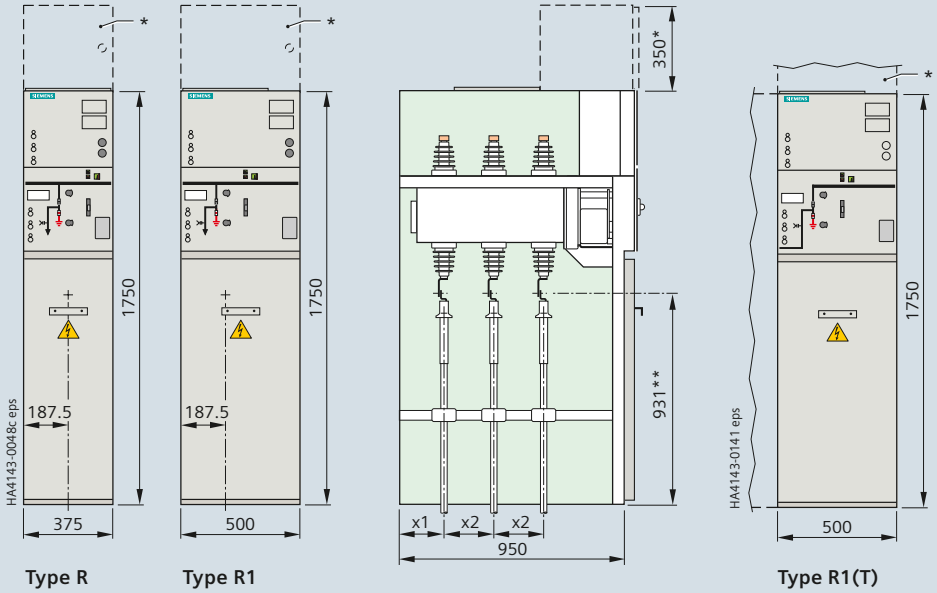
IAC – Design of switchgear	Pressure relief duct (add to panel depth)	Direction of pressure relief	Panel depth *)	Switchgear depth	Switchgear height	Switchgear arrangement	Distance "a" from switchgear to rear wall of switchgear room
	Depth: 150 mm		in mm	in mm	in mm		in mm
• without IAC (= standard)	without	to the rear/upwards	1020, 1041	1170	1750 **)	wall-standing	–
		to the rear				free-standing	–
	with	upwards	1020, 1041	1170	1750 **)	free-standing	approx. ≥ 35 mm
• IAC A FL or IAC A FLR	with (duct is standard)	upwards	1020, 1041	1170	≤ 16 kA: ≥ 2100 ≤ 21 kA: ≥ 2100 (incl. front cover or low-voltage compartment)	wall-standing	approx. ≥ 35 mm
						free-standing	approx. ≥ 800 mm

*) Panel depth depends on panel type and panel design:
– Low-voltage niche with door (= option) (instead of screwed front cover): 1041 mm
– Low-voltage niche with door: 1041 mm

**) In addition, a low-voltage compartment can be selected optionally. The switchgear height is changed respectively

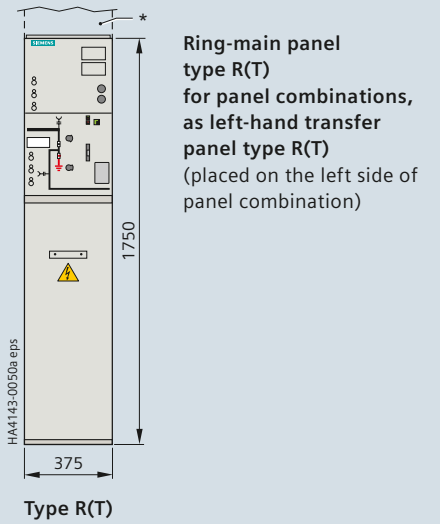
Dimensions

Ring-main panels, transformer panels



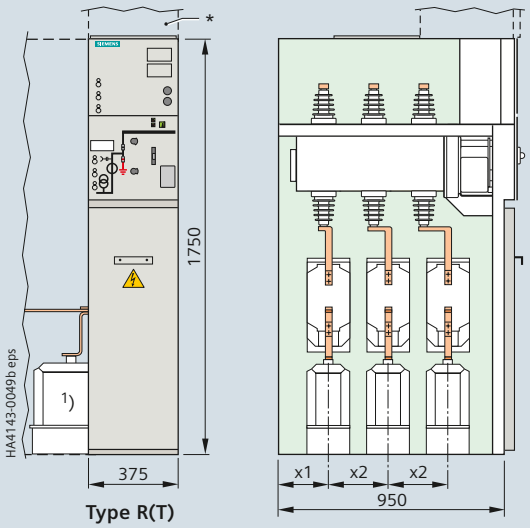
Type R **Type R1** **Type R1(T)**

Ring-main panels



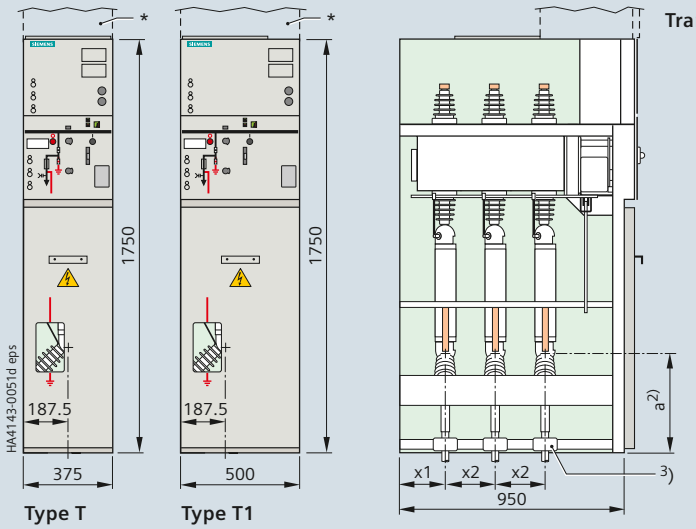
Type R(T)

Ring-main panel type R(T) for panel combinations, as left-hand transfer panel type R(T)
(placed on the left side of panel combination)



Type R(T)

Ring-main panel type R(T) for panel combinations, as right-hand transfer panel type R(T)
(placed on the right side of panel combination)



Type T **Type T1**

Transformer panels

*) Option:
Low-voltage compartment

** For panel design with 4MA block-type current transformer, the cable connection height is reduced

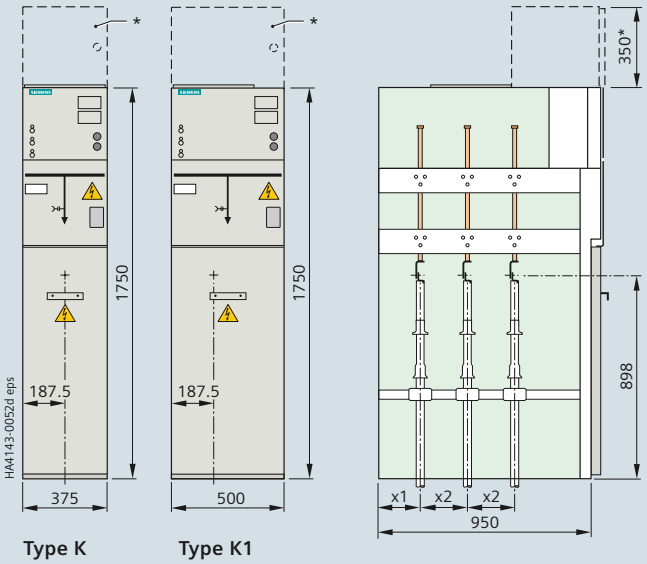
1) Location of voltage transformer in left-hand panel

Panel type T:

2) Dimension a
~ 384 mm: for fuses with e = 442 mm
~ 534 mm: for fuses with e = 292 mm

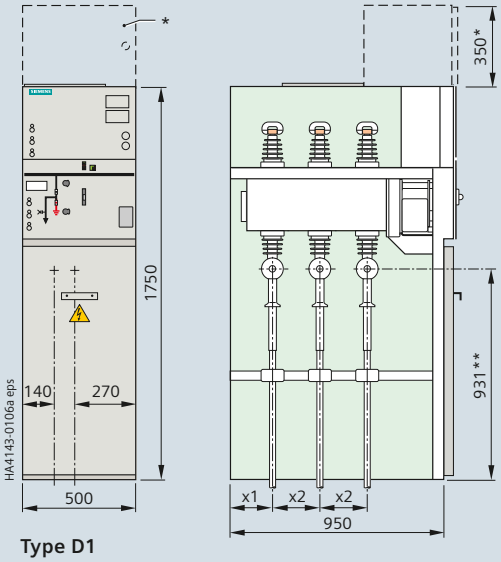
3) Panel types T and T1 with a rated voltage of 24 kV: deeper cable fixing underneath the panel

Dimensions x1 and x2:
See pages 59 and 66



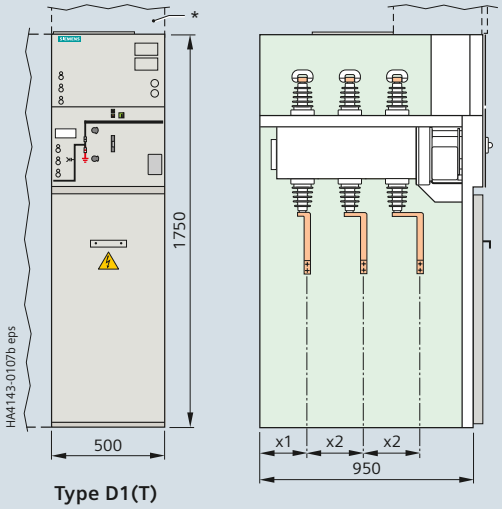
Type K **Type K1**

Cable panels



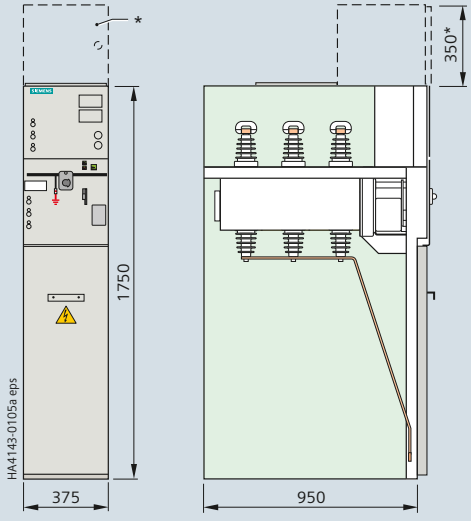
Type D1

Disconnector panel type D1 for cable connection



Type D1(T)

Disconnector panel type D1(T)
for panel combinations [e.g. metering panel type M or L1(T)]



Type E

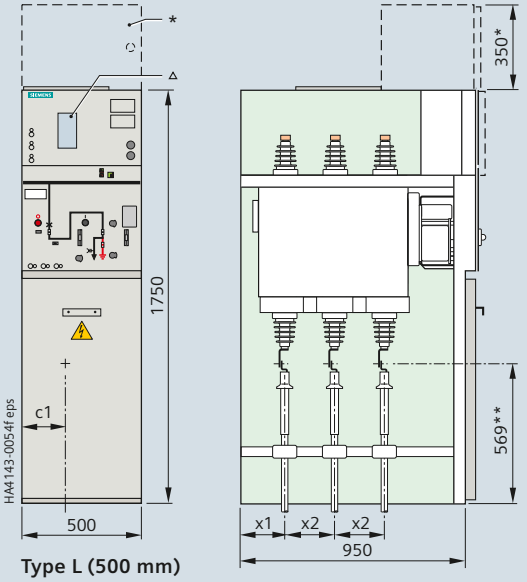
Earthing panel

*) Option:
Low-voltage compartment
**) For panel design with 4MA block-type current transformer, the cable connection height is reduced

Dimensions x1 and x2:
See pages 59 and 66

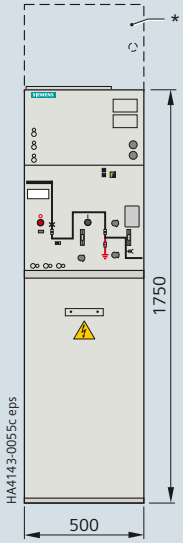
Dimensions

Circuit-breaker panels

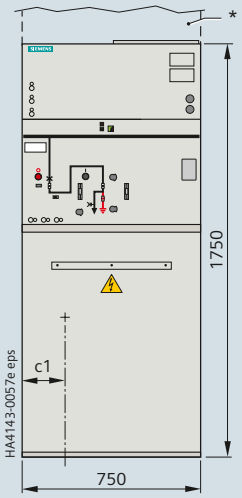


Type L (500 mm)

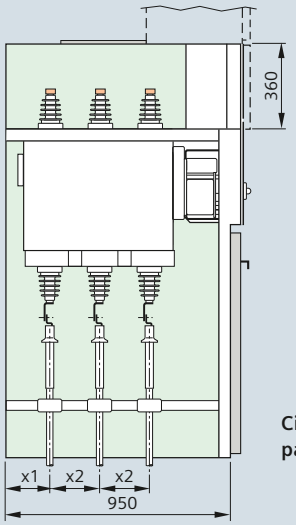
Circuit-breaker panel 630 A



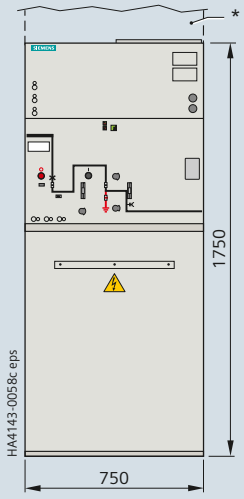
Type L(T)
as transfer panel to the right



Type L1 (750 mm)



Circuit-breaker panel 630 A, 1250 A



Type L1(T)
as transfer panel to the right

*) Option:
Low-voltage compartment

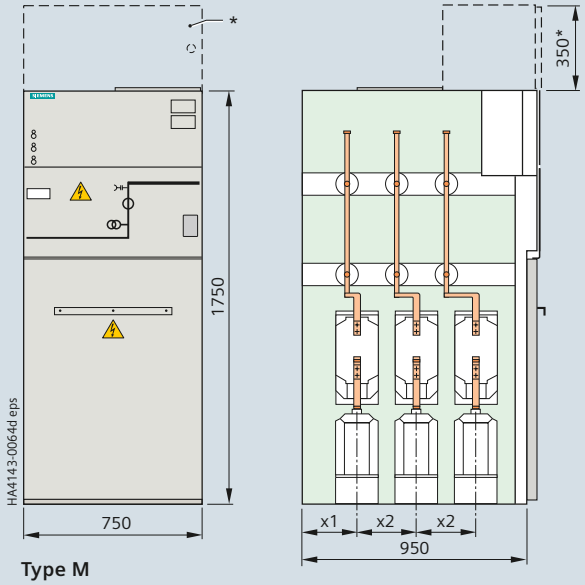
**) For panel design with 4MA block-type current transformer, the cable connection height is reduced

△) Option: Protection relay

Position of L1, L2 and L3: See page 59
Dimensions x1 and x2: See pages 59 and 66

Panel design

M

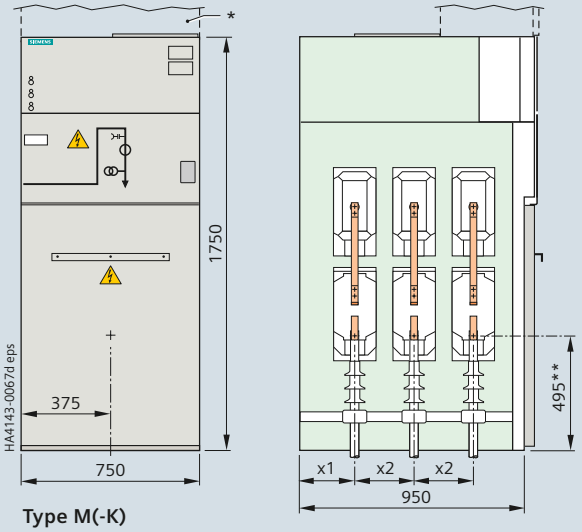


Type M

Metering panel type M (standard)

Panel design

M(-K)

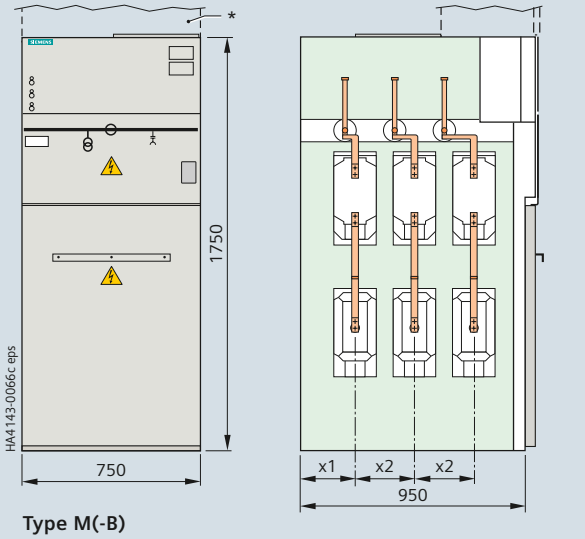


Type M(-K)

Metering panel type M(-K) (for cable connection)

Panel design

M(-B)

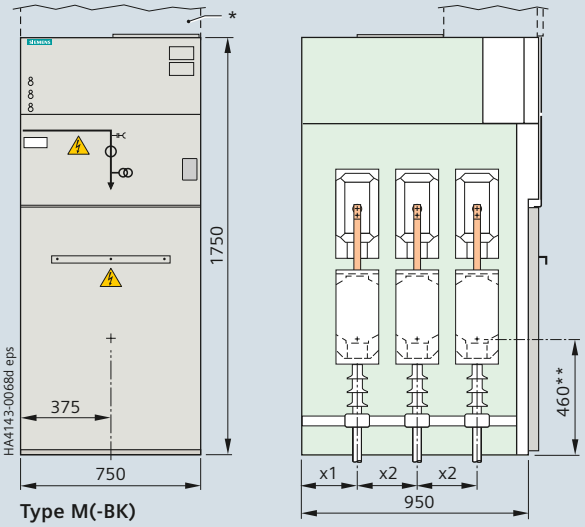


Type M(-B)

Metering panel type M(-B)
(for busbar connection)

Panel design

M(-BK) M(-BK)



Type M(-BK)

Metering panel type M(-BK)
(for cable connection)

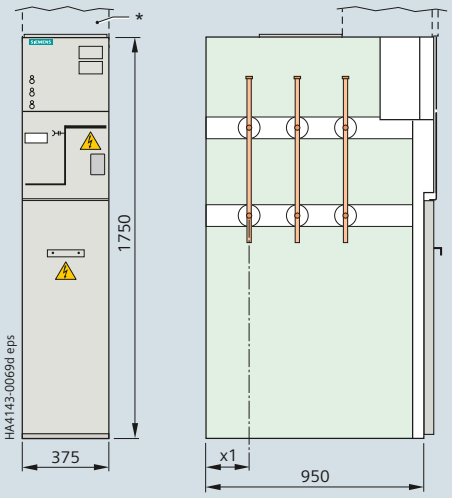
U_r	Dimensions in mm	
	x1	x2
Up to 17.5 kV	187	210
24 kV	215	250

Dimensions x1 and x2 for cable connection: See pages 66 and 67

*) Option:
Low-voltage compartment
**) The cable connection height depends on the rated voltage, the transformer design and the number of cable connections

Dimensions

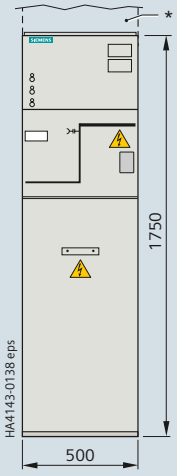
Metering/bus riser panels, busbar voltage metering panels



Type H,
for transfer to the right (without transformers)

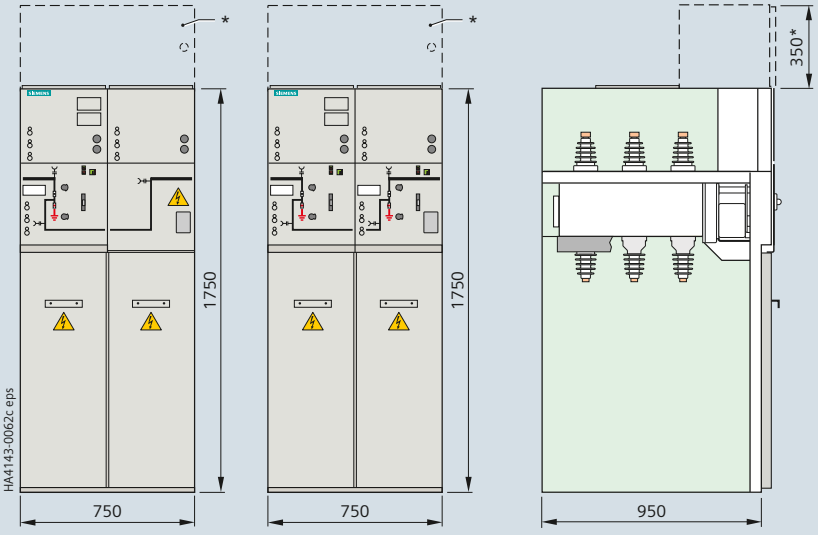
Bus riser panel

U_r	Dimensions in mm
	x1
Up to 17.5 kV	187
24 kV	187



Type H1,
for transfer to the right

Metering panel
and/or
bus riser panel



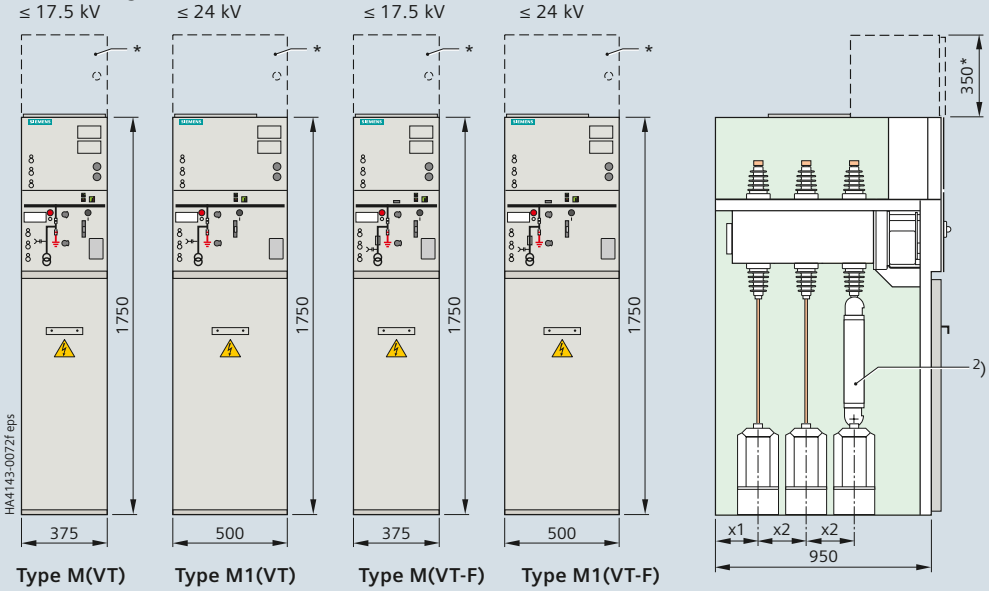
Type R(T) + H

Type 2x R(T)

Ring-main transfer panel type R(T)
and
bus riser panel type H
without transformers

Rated voltage U_r:

≤ 17.5 kV ≤ 24 kV ≤ 17.5 kV ≤ 24 kV



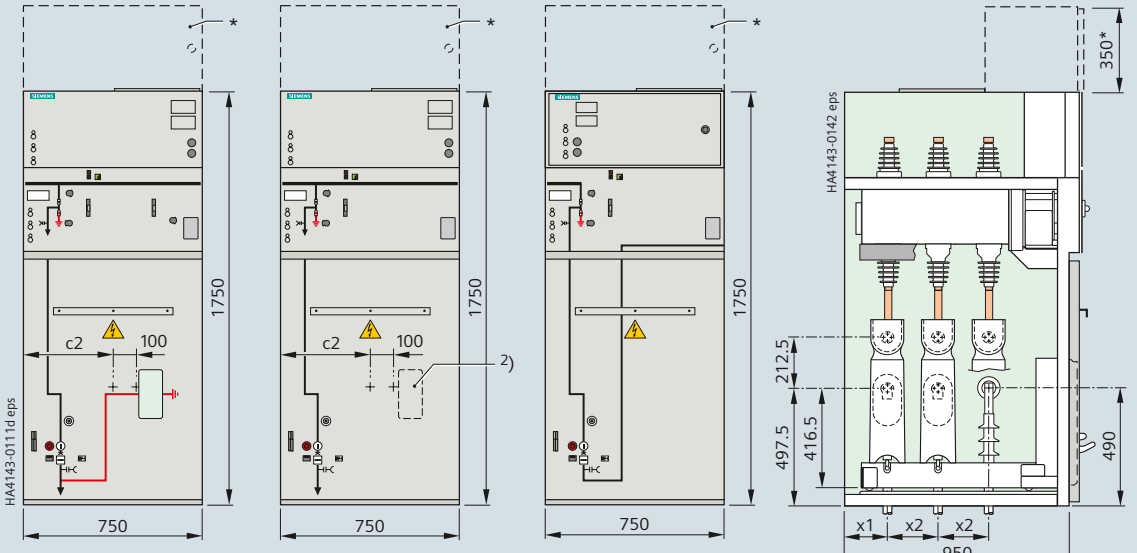
Type M(VT) **Type M1(VT)** **Type M(VT-F)** (with fuses) **Type M1(VT-F)** (with fuses)

Busbar voltage metering panels

U_r	Dimensions in mm	
	x1	x2
Up to 17.5 kV	187	210
24 kV	215	250

*) Option:
Low-voltage compartment

2) Option: Fuses

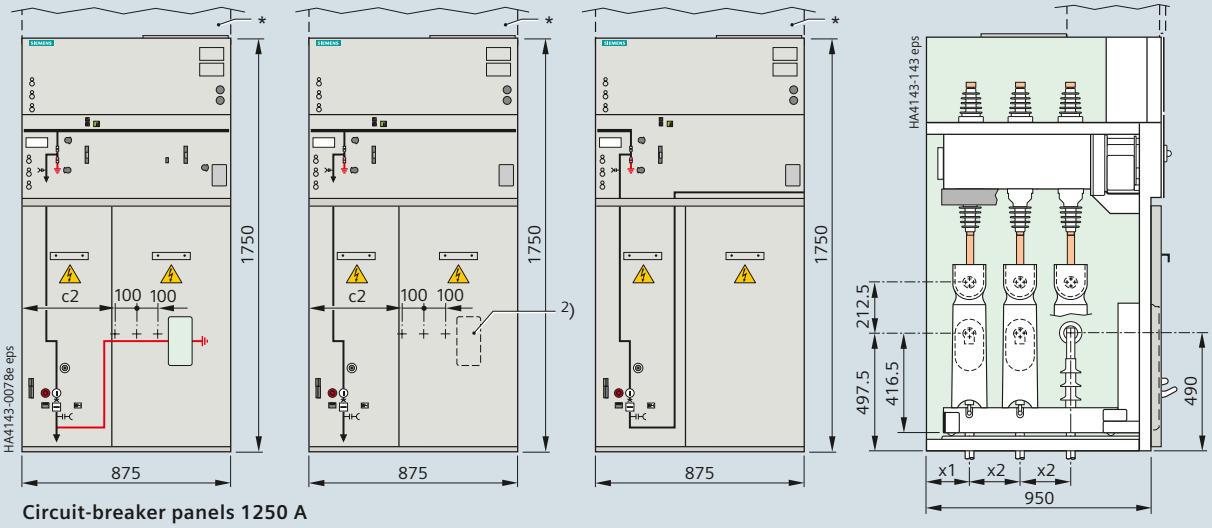


*) Option: Low-voltage compartment

2) Earthing of the feeder via the vacuum circuit-breaker
Option: Inspection window

Dimensions x1, x2 and c2 for cable connection:
See pages 66 and 67

Circuit-breaker panels 630 A
Type L1(r) | **Type L1(r)** | **Type L1(r, T) 2)** as transfer panel



Circuit-breaker panels 1250 A
Type L2(r) | **Type L2(r)** | **Type L2(r, T) 2)** as transfer panel

Panel combination *)	Rated normal current of TC	Total width of TC (in mm)	Serial no. of TC
R(T) - H	630 A, 800 A	750	TC-1
H - R(T)	630 A	750	TC-2
R(T) - R(T)	630 A, 800 A	750	TC-3
R(T) - M	630 A, 800 A	1125	TC-4
R(T) - M(-K)	630 A, 800 A	1125	TC-6
L(T) - H	630 A	875	TC-11
L(T) - M	630 A	1250	TC-13
L(T) - M(-K)	630 A	1250	TC-15
L(T) - R(T)	630 A	875	TC-17
L1(T) - H	630 A	1125	TC-21

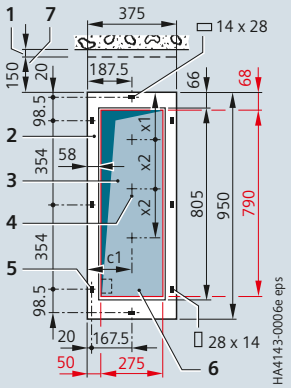
Panel combination *)	Rated normal current of TC	Total width of TC (in mm)	Serial no. of TC
L1(T) - M	630 A	1500	TC-23
L1(T) - M(-K)	630 A	1500	TC-25
L1(T) - R(T)	630 A	1125	TC-27
D1(T) - H	1250 A	875	TC-45
L1(r,T) - H1	630 A	1250	TC-61
L1(r,T) - R1(T)	630 A	1250	TC-62
L2(r,T) - H1	1250 A	1375	TC-63
L2(r,T) - D1(T)	1250 A	1375	TC-64
R(TM) - L(TM)	630 A	1500	TC-57
R(TM) - L1(TM)	630 A	1750	TC-58

*) Current and voltage transformer installation in the "TC": Depending on the type of "TC" and the rated voltage (not possible everywhere)
TC = Typical combination

Dimensions

Floor openings (dimensions in red) and fixing points

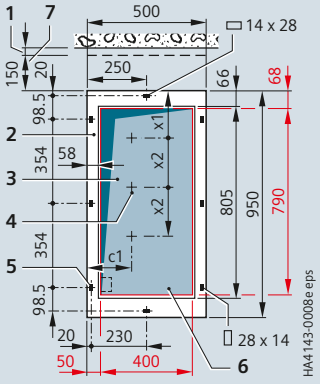
For panel width 375 mm



With cable connection

For panel type	Position of cables [1]					
	Dimensions in mm					
	x1	x1	x2		c1	
	17.5 kV	24 kV	17.5 kV	24 kV	17.5 kV	24 kV
R	187	187	210	210	187.5	187.5
K	187	187	210	210	187.5	187.5
T	187	187	210	210	187.5	187.5

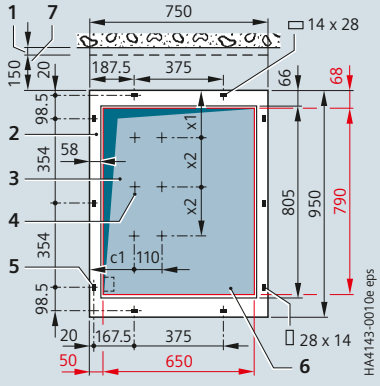
For panel width 500 mm



With cable connection

For panel type	Position of cables [1]					
	Dimensions in mm					
	x1	x1	x2		c1	
	17.5 kV	24 kV	17.5 kV	24 kV	17.5 kV	24 kV
R1, D1	187	187	210	210	187.5	187.5
K1	187	187	210	210	187.5	187.5
T1	187	187	210	210	187.5	187.5
L	187	187	210	210	187.5	187.5
L with CTs, VTs	187	235	210	230	250	300

For panel width 750 mm



With cable connection

For panel type	Position of cables [1]						
	Dimensions in mm						
	Number of cables	x1	x1	x2		c1	c1
		17.5 kV	24 kV	17.5 kV	24 kV	17.5 kV	24 kV
L1	1	187	187	210	210	187.5	187.5
	2	187	187	210	210	172.5	172.5
L1 with CTs, VTs	1	187	215	210	250	235	335
	2	187	215	210	250	235	335

1 Wall distance (see page 59)

2 Fixing frame (base) of an individual panel or panel block

3 Floor opening for high-voltage cables and, where applicable, control cables

4 Position of the led-in cables for the feeder [1]

5 Fixing points

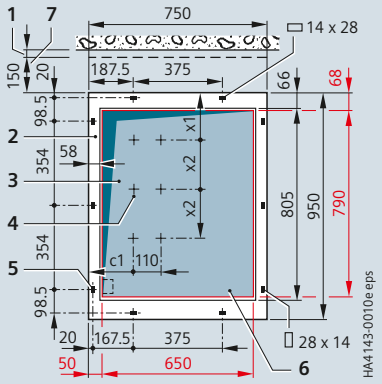
6 Floor opening if required for panels without cable connection

7 Option: Pressure relief duct

Note:
Connection of double cables: Depending on the panel type and version of the sealing end, the cable distance is approx. 110 mm.

1) The position of the cables in the panel depends on the additional built-in panel components, e.g. current and voltage transformers. Therefore, the dimensions x1, x2, c1, c2 may be different.

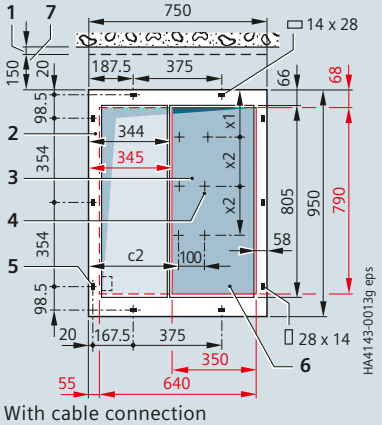
Metering panels: Panel width 750 mm



With cable connection

For panel type	Position of cables [1]						
	Dimensions in mm						
	Number of cables	x1	x1	x2		c1	c1
		17.5 kV	24 kV	17.5 kV	24 kV	17.5 kV	24 kV
M(-K)	1	187	215	210	250	375	375
M(-BK)	1	187	215	210	250	375	375

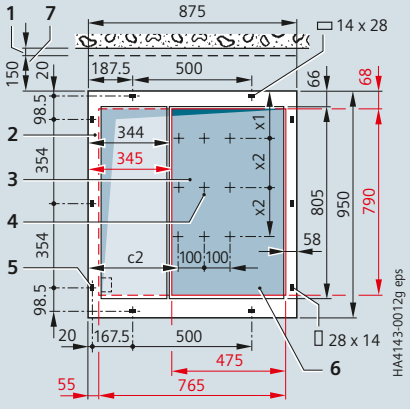
For panel type L1(r), width 750 mm



With cable connection

For panel type	Position of cables [1]						
	Dimensions in mm						
	Number of cables	x1	x1	x2		c2	c2
		17.5 kV	24 kV	17.5 kV	24 kV	17.5 kV	24 kV
L1(r)	1	187	235	210	230	377	377
	2	187	235	210	230	377	377

For panel type L2(r), width 875 mm



With cable connection (up to 3 cables)

For panel type	Position of cables [1]						
	Dimensions in mm						
	Number of cables	x1	x1	x2		c2	c2
		17.5 kV	24 kV	17.5 kV	24 kV	17.5 kV	24 kV
L2(r)	1	187	235	210	230	377	377
	2	187	235	210	230	377	377
	3	187	235	210	230	377	377

1 Wall distance (see page 59)
2 Fixing frame (base) of an individual panel or panel block
3 Floor opening for high-voltage cables and, where applicable, control cables
4 Position of the led-in cables for the feeder [1]
5 Fixing points
6 Floor opening if required for panels without cable connection
7 Option: Pressure relief duct

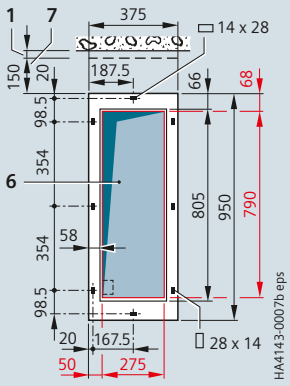
Note:
Connection of double cables: Depending on the panel type and version of the sealing end, the cable distance is approx. 110 mm, or 100 mm.

1) The position of the cables in the panel depends on the additional built-in panel components, e.g. current and voltage transformers. Therefore, the dimensions x1, x2, c1, c2 may be different.

Dimensions

Floor openings (dimensions in red) and fixing points

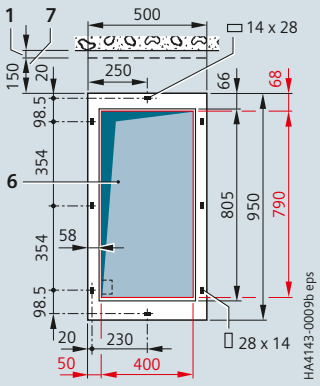
For panel width 375 mm



For panel type:
R(T)
M(VT), M(VT-F)
H, E

Without cable connection

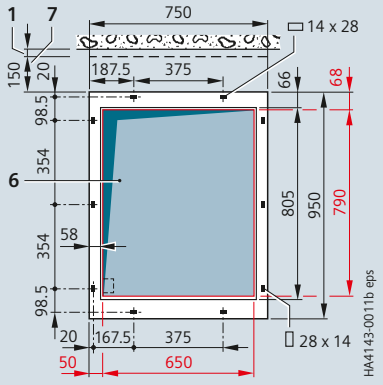
For panel width 500 mm



For panel type:
R1(T), E1
M1(VT), M1(VT-F)
L(T)
D1(T)
H1

Without cable connection

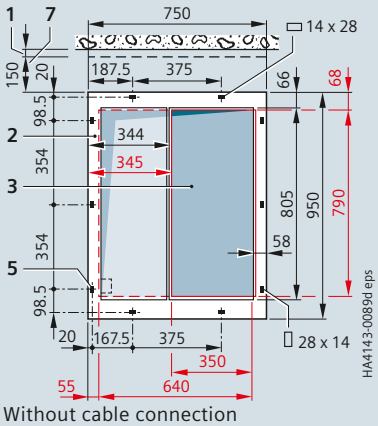
For panel width 750 mm



For panel type:
L1(T)
M, M(-B)

Without cable connection

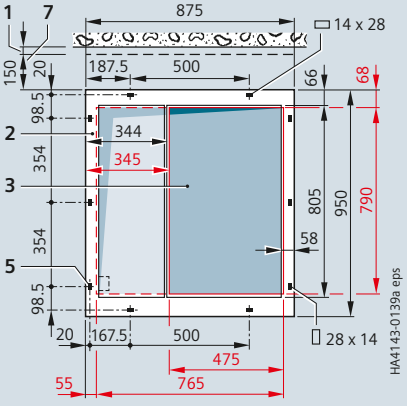
For panel width L1(r, T), width 750 mm



For panel type:
L1(r, T)

Without cable connection

For panel type L2(r, T), width 875 mm



For panel type:
L2(r, T)

1 Wall distance (see page 59)
2 Fixing frame (base) of an individual panel or panel block
3 Floor opening for high-voltage cables and, where applicable, control cables
4 Position of the led-in cables for the feeder [1)]
5 Fixing points
6 Floor opening if required for panels without cable connection
7 Option: Pressure relief duct

Note:
Connection of double cables: Depending on the panel type and version of the sealing end, the cable distance is approx. 110 mm.

1) The position of the cables in the panel depends on the additional built-in panel components, e.g. current and voltage transformers. Therefore, the dimensions x1, x2, c1, c2 may be different.

Individual panels or combinations thereof for standard switchgear	Panel type	Panel or panel combination		Transport unit "TU" (including packing) for standard panels (without / with pressure relief duct, option)				
		Width **B1** mm	Net weight [1] approx. kg without / with LV C*) / LV C*)	Width **B2** m	Height H △) of "TU" m without / with LV C*) / LV C*)	Depth **T2** m	Volume m³ without / with LV C*) / LV C*)	Gross weight [1)4)] approx. kg without / with LV C*) / LV C*)
Transport of individual panels ○)								
Ring-main panel	R R1	375 500	160 / 220 180 / 240	1.08 1.08	1.95 / 2.3	1.40	2.95 / 3.48	220 / 280 240 / 300
Ring-main transfer panel	R(T)	375	250 / 310	1.08				310 / 370
Transformer panel	T T1	375 500	180 / 240 200 / 260	1.08 1.08				240 / 300 260 / 320
Cable panel	K K1	375 500	140 / 200 150 / 210	1.08 1.08				200 / 260 210 / 270
Cable panel with make-proof earthing switch	K K1	375 500	150 / 210 170 / 220	1.08 1.08				210 / 270 230 / 330
Circuit-breaker panel (fixed-mounted circuit-breaker type "CB-f")	L L1	500 750	300 / 360 340 / 400	1.08 1.08				360 / 420 400 / 460
	L(T) L1(T)	500 750	300 / 360 340 / 400	1.08 1.08				360 / 420 400 / 460
Circuit-breaker panel (removable circuit-breaker)	L1(r) L2(r)	750 875	350 / 410 380 / 440	1.08 1.08				410 / 470 440 / 500
Disconnector panel	D1	500	180 / 240	1.08				240 / 300
Disconnector transfer panel	D1(T)	500	250 / 310	1.08				310 / 370
Metering panel	M; M(-K) M(-B); M(-BK)	750 750	270 / 330 270 / 330	1.08 1.08				340 / 390 340 / 390
Metering panel	M(KK)	750	270 / 330	1.08				340 / 390
Busbar voltage metering panel	M(VT) M(VT-F) M1(VT) M1(VT-F)	375 375 500 500	210 / 270 230 / 290 240 / 300 250 / 310	1.08 1.08 1.08 1.08				270 / 330 290 / 350 310 / 370 330 / 390
Bus riser panel	H H [3)]	375 375	170 / 230 280 / 340	1.08 1.08				230 / 290 340 / 400
Busbar earthing panel	E	375	180 / 240	1.08				240 / 300
Panel combinations					1.95 / 2.3	1.40	2.95 / 3.48	
Bus sectionalizer panel (with circuit-breaker)	L(T) + H	875	470 / 570	1.08				530 / 630
Bus sectionalizer panel (with circuit-breaker)	L(T) + R(T)	875	500 / 600	1.08				560 / 660
Bus sectionalizer panel (1 three-position switch-disconnector)	R(T) + H R(T) + H [3)]	750 750	250 / 350 350 / 450	1.08 1.08				310 / 410 410 / 510
Bus sectionalizer panel (2 three-position switch-disconnectors)	R(T) + R(T) R(T) + R(T) [3)]	750 750	310 / 410 420 / 520	1.08 1.08				370 / 470 480 / 580

For individual panel	Panel width mm	Additional weight per duct and per panel approx. kg
Pressure relief duct (option) for wall / free-standing arrangement of switchgear	375	30
	500	40
	750	60
	875	70

*) Low-voltage compartment, 350 mm high, weight approx. 60 kg depending on the panel type and on the extent to which it is equipped, or optionally 550 mm high

△) Other heights "H" of "TU" possible (depending on the equipment of the panel type and the packing type)

○) Depending on the delivering factory

1) The net weight and the gross weight depend on the extent to which the panel is equipped (e.g. current transformers, motor operating mechanisms) and are therefore given as mean value

3) Panel types including CTs and VTs: Weight per CT or VT as cast-resin design: Approx. 20 kg (example: 3 CTs and 3 VTs approx. additionally 120 kg per panel)

4) Add additional weight for pressure relief duct (according to table values)

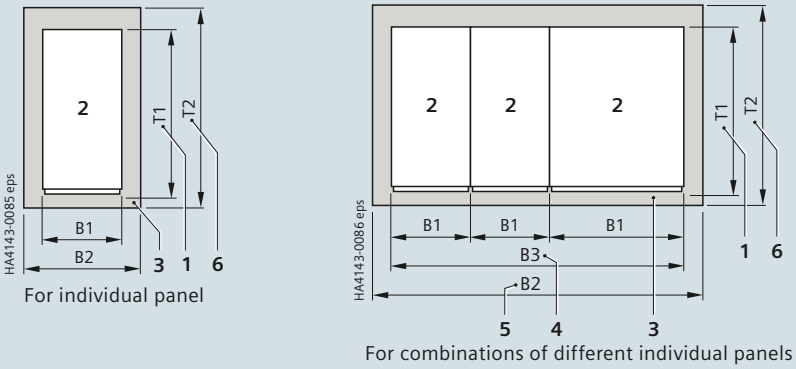
Individual panels or combinations thereof for standard switchgear	Panel type	Panel or panel combination		Transport unit "TU" (including packing) for standard panels (without / with pressure relief duct, option)				
		Width **B1** mm	Net weight [1] approx. kg without / with LV C*) / LV C*)	Width **B2** m	Height H △) of "TU" m without / with LV C*) / LV C*)	Depth **T2** m	Volume m³ without / with LV C*) / LV C*)	Gross weight [1] approx. kg without / with LV C*) / LV C*)

Transport dimensions ○) for combinations of different individual panels

Transport unit "TU":	Max. width of switchgear unit "B3"	B2		T2		
– Standard: As individual panels arranged side by side and not screwed together	On request	0.70	1.95/2.3	1.40	1.91/2.25	
– Option: As multi-panel transport unit, panels screwed together	≤ 875 mm	1.08	1.95/2.3	1.40	2.95/3.48	2) + 70 **)
Standard packing for:	≤ 1000 mm ***)	1.20	1.95/2.3	1.40	3.28/3.86	2) + 80 **)
– Truck	≤ 1500 mm	1.78	1.95/2.3	1.40	4.64/5.47	2) + 100 **)
– Sea transport, airfreight	≤ 2125 mm	2.33	1.95/2.3	1.40	6.36/7.50	2) + 120 **)
Container packing, standard	≤ 875 mm	1.10	1.95/2.3	1.40	3.00/3.50	2) + 80 **)
(other dimensions on request)	≤ 2000 mm	2.20	1.95/2.3	1.40	6.00/7.10	2) + 120 **)

Transport unit "TU" (CN):	Max. width of switchgear unit "B3"	B2		T2		
–Standard: As individual panels arranged side by side and not screwed together	On request	0.70	1.95/2.3	1.40	1.91/2.25	
– Option: As multi-panel transport unit, panels screwed together	≤ 875 mm	1.050	1.95/2.3	1.40	2.95/3.48	2) + 70 **)
Standard packing for:	≤ 1125 mm	1.290	1.95/2.3	1.40	3.08/3.70	2) + 80 **)
– Truck	≤ 1500 mm	1.680	1.95/2.3	1.40	4.64/5.47	2) + 100 **)
– Sea transport	≤ 2000 mm	2.200	1.95/2.3	1.40	6.00/7.10	2) + 120 **)
– Container transport (other packing on request)						

Transport units (= TU) for shipping (plan view)



1 T1 = Depth of individual panel
2 Individual panel dimension B1 x T1
3 Transport unit, dimension B2 x T2
4 B3 = Overall width of combination of different individual panels
5 B2 = Width of the transport unit
6 T2 = Depth of the transport unit

*) Low-voltage compartment, 350 mm high, weight approx. 60 kg depending on the panel type and on the extent to which it is equipped, or optionally 550 mm high

** Packing weight

*** On request: Max. panel width "B3" ≤ 1125 mm (e.g. for 3 x 375 mm)

Δ) Other heights "H" of "TU" possible (depending on the equipment of the panel type and the packing type)

○) Depending on the delivering factory (CN, PT)

1) The net weight and the gross weight depend on the extent to which the panel is equipped (e.g. current transformers, motor operating mechanisms) and are therefore given as mean value

2) Sum of the net weights of individual panels

Packing types (examples)

For size and weight of the transport units, see page 69.

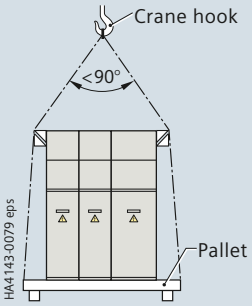
Place of destination and means of transport	Examples for packing ○)
China / Europe by rail and truck	Type: Open PE protective foil pulled over the switchgear, with wooden base
Overseas by seafreight	Type: Seaworthy crate (standard) Welded PE protective foil, with closed wooden crate, with desiccant bag
	Type: Open for container PE protective foil pulled over the switchgear, with wooden base
Overseas by airfreight	Type: Open PE protective foil pulled over the switchgear, with wooden base and lattice or cardboard cover

Transport

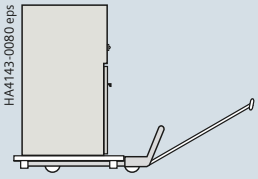
SIMOSEC switchgear is completely delivered in transport units. Please observe the following:

- Transport facilities on site
- Transport dimensions and weights
- Size of door openings in building
- Switchgear with low-voltage compartment: Please observe other transport dimensions and weights.

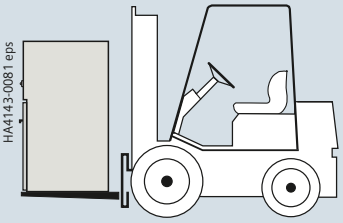
Types of transport (examples)



Crane transport with pallet



Transport with lifting truck
with or without pallet



Transport with fork-lift truck, standing

○) Depending on the delivering factory

Standards

Standards, specifications, guidelines

Standards

SIMOSEC switchgear complies with the relevant standards and specifications applicable at the time of type tests.
In accordance with the harmonization agreement reached by the countries of the European Union, their national specifications conform to the IEC standard.

Overview of standards (2018)

		IEC standard	VDE standard	EN standard	GB standard
Switchgear	SIMOSEC	IEC 62271-1	VDE 0671-1	EN 62271-1	GB/T 11022
		IEC 62271-200	VDE 0671-200	EN 62271-200	GB 3906
Devices	Circuit-breakers	IEC 62271-100	VDE 0671-100	EN 62271-100	GB 1984
	Disconnectors and earthing switches	IEC 62271-102	VDE 0671-102	EN 62271-102	GB 1985
	Switch-disconnectors	IEC 62271-103	VDE 0671-103	EN 62271-103	GB 3804
	Switch-disconnector/fuse combination	IEC 62271-105	VDE 0671-105	EN 62271-105	GB 16926
	HV HRC fuses	IEC 60282-1	VDE 0670-4	EN 60282-1	GB 15166.2
	Voltage detecting systems Voltage presence indicating systems	IEC 61243-5 IEC 62271-206	VDE 0682-415 VDE 0671-206	EN 61243-5 EN 62271-206	DL/T 538-2006 (acc. to IEC 61958-2008, similar to Chinese standard)
Degree of protection	IP code	IEC 60529	VDE 0470-1	EN 60529	GB 4208
	IK code	IEC 62262	VDE 0470-100	EN 50102	
Insulation	–	IEC 60071	VDE 0111	EN 60071	GB/T 311.2
Transformers	Instrument transformers: General requirements	IEC 61869-1	VDE 0414-9-1	EN 61869-1	
	Current transformers	IEC 61869-2	VDE 0414-9-2	EN 61869-2	GB 1208
	Voltage transformers	IEC 61869-3	VDE 0414-9-3	EN 61869-3	GB 1207
Power installations	Common rules Earthing of power installations	IEC 61936-1 –	VDE 0101-1 VDE 0101-2	EN 61936-1 EN 50522	– –
Insulating gas SF_6	Specification for sulfur hexafluoride (SF_6)	IEC 60376	VDE 0373-1	EN 60376	–

Type of service location

SIMOSEC switchgear can be used as an indoor installation in accordance with IEC 61936 (Power installations exceeding 1 kV AC) and VDE 0101:

- Outside lockable electrical service locations at places which are not accessible to the public. Enclosures of switchgear can only be removed with tools.
- Inside lockable electrical service locations. A lockable electrical service location is a place outdoors or indoors that is reserved exclusively for housing electrical equipment and which is kept under lock and key. Access is restricted to authorized personnel and persons who have been properly instructed in electrical engineering.
  Untrained or unskilled persons may only enter under the supervision of authorized personnel or properly instructed persons.

Dielectric strength

- The dielectric strength is verified by testing the switchgear with rated values of short duration power-frequency withstand voltage and lightning impulse withstand voltage according to IEC 62271-1 / VDE 0671-1 and GB 11022 (see table "Dielectric strength").
- The rated values are referred to sea level and to normal atmospheric conditions (1013 hPa, 20 °C, 11 g/m³ humidity in accordance with IEC 60071 and VDE 0111).
- The dielectric strength decreases with increasing altitude. For site altitudes above 1000 m (above sea level) the standards do not provide any guidelines for the insulation rating. Instead, special regulations apply to these altitudes.
- Site altitude
  – As the altitude increases, the dielectric strength of insulation in air decreases due to the decreasing air density. This reduction is permitted up to a site altitude of 1000 m according to IEC and VDE.
  – For site altitudes above 1000 m a higher insulation level must be selected. It results from the multiplication of the rated insulation level for 0 to 1000 m with the altitude correction factor K_a.

Table – Dielectric strength

Rated voltage (r.m.s. value)	kV	7.2	12		15	17.5	24
Rated short-duration power-frequency withstand voltage (r.m.s. value)							
– Across the isolating distances	kV	23	32	48 *)	39	45	60
– Between phases and to earth	kV	20	28	42 *)	36	38	50
Rated lightning impulse withstand voltage (peak value)							
– Across the isolating distances	kV	70	85		105	110	145
– Between phases and to earth	kV	60	75		95	95	125

Current carrying capacity

- According to IEC 62271-200 or IEC 62271-1, VDE 0671-200 or VDE 0671-1, the rated normal current refers to the following ambient air temperatures:
  – Maximum of 24-hour mean + 35 °C
  – Maximum + 40 °C
- The current carrying capacity of the panels and busbars depends on the ambient air temperature outside the enclosure.

Internal arc classification

- Protection of operating personnel by means of tests for verifying the internal arc classification
- Internal arcing tests must be performed in accordance with IEC 62271-200 or VDE 0671-200
- Definition of criteria:
  – Criterion 1:
  Correctly secured doors and covers do not open, limited deformations are accepted
  – Criterion 2:
  No fragmentation of the enclosure, no projection of small parts above 60 g
  – Criterion 3:
  No holes in accessible sides up to a height of 2 m
  – Criterion 4:
  No ignition of indicators due to hot gases
  – Criterion 5:
  The enclosure remains connected to its earthing point.

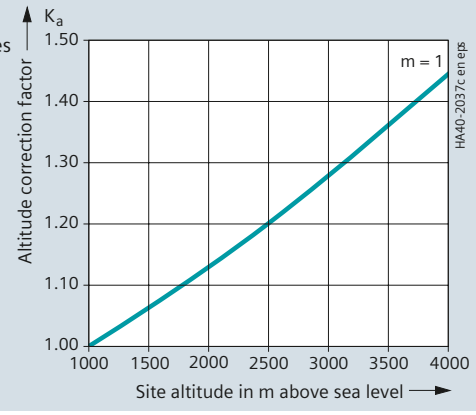
*) Value according to GB standard

Resistance to internal faults (option)

In SIMOSEC switchgear, the appearance of internal faults (internal arcs) is less compared with earlier designs due to:
– Use of gas-insulated switching-device vessels
– Use of metal-enclosed switching-device vessels
– The fact that maloperation is practically excluded due to logical arrangement of operating elements and use of logical mechanical interlocks
– Short-circuit-proof feeder earthing by means of the three-position switch (make-proof earthing switch) or the circuit-breaker.

Altitude correction factor K_a

For site altitudes above 1000 m, the altitude correction factor K_a is recommended, depending on the actual site altitude above sea level.



Rated short-duration power-frequency withstand voltage for site altitudes > 1000 m to be selected

≥ Rated short-duration power-freq. withstand volt. up to ≤ 1000 m · K_a

Rated lightning impulse withstand voltage for site altitudes > 1000 m to be selected

≥ Rated lightning impulse withstand voltage up to ≤ 1000 m · K_a

Example 1:
3000 m site altitude above sea level
17.5 kV switchgear rated voltage
95 kV rated lightning impulse withstand voltage
Rated lightning impulse withstand volt. to be selected 95 kV · 1.28 = 122 kV
Result:
According to the above table, a switchgear for a rated voltage of 24 kV with a rated lightning impulse withstand voltage of 125 kV is to be selected

Example 2:
2750 m site altitude above sea level
7.2 kV switchgear rated voltage
60 kV rated lightning impulse withstand voltage
Rated lightning impulse withstand volt. to be selected 60 kV · 1.25 = 75 kV
Result:
According to the above table, a switchgear for a rated voltage of 12 kV with a rated lightning impulse withstand voltage of 75 kV is to be selected.

Cable testing

- For circuit-breaker and switch-disconnector feeders
- DC voltage test
  Before the test:
  Remove or disconnect any voltage transformers at the cable connection in SIMOSEC switchgear
- SIMOSEC switchgear, e.g. for rated voltages up to 17.5 kV can be subjected to cable tests at a max. DC test voltage of 38 kV according to VDE. The voltage at the busbar may be 17.5 kV in this case
- SIMOSEC switchgear for rated voltages up to 24 kV can be subjected to cable tests at a max. DC test voltage of 72 kV or according to VDE at 70 kV, 15 min. The voltage at the busbar may be 24 kV in this case.
- For cable testing

– the installation and operating instructions of the switchgear
– the standards IEC 62271-200/VDE 0671-200 Clause 5.105 *)
– the information on manufacturer-dependent cable sealing ends
– the cable version (e.g. paper-insulated mass-impregnated cables, PVC cables or XLPE cables)

must be observed.

Test voltages:

Rated voltage	U_0 / U (U_m)	Max. test voltage applied to the connected cable		
		VLF [1], 0.1 Hz	acc. to IEC	VDE 0278
		3 x U_0 U_{LF}	U =	6 x U_0, 15 min max. U =
U_r (kV)	(kV)	AC (kV)	DC (kV)	DC (kV)
12	6/10 (12)	19	24	38 [2]
24	12/20 (24)	38	48	70

Color of the switchgear

Panel front:
RAL 7035 (light grey)
End walls:
Standard: Steel (sendzimir galvanized)
Option: Painted, color according to panel front.

Terms

"Make-proof earthing switches" are earthing switches with short-circuit making capacity according to
– IEC 62271-102 and
– VDE 0671-102.

Climate and environmental influences

Indoor installation:
The SIMOSEC switchgear is suitable for application in indoor installations under normal operating conditions as defined in the standard IEC 62271-1:

- Temperature: –5 °C up to +55 °C
  –25 °C up to +55 °C [3]
  (optional, with panel heating)
- Relative air humidity: Mean value over 24 h [3]: ≤ 95 %
  Mean value over 1 month: ≤ 90 %
- Condensation: Occasionally use a heater as anti-condensation protection (in the panel)
- Site altitude: Altitude correction to be considered (see page 73)

SIMOSEC switchgear is largely insensitive to climate and environmental influences by virtue of the following features:

- No cross insulation for isolating distances between phases
- Metal enclosure of switching devices (e.g. three-position switch) in gas-filled stainless-steel switching-device vessel
- Dry-type bearings in operating mechanism
- Essential parts of the operating mechanism made of corrosion-proof materials
- Use of climate-independent three-phase current transformers.

Climate classes:

– The climate classes are defined according to IEC 60721-3-3.
– The SIMOSEC switchgear has been subjected to a climatic test according to IEC 60932, Level 2, and is suitable for operating conditions according to "Design Class 1". This test also meets the requirements of IEC 62271-304 for "Design Class 1".

SIMOSEC switchgear may be used, subject to possible additional measures – e.g. panel heaters or floor covers – under the following environmental influences and climate classes:

- Environmental influences

– Natural foreign materials
– Chemically active pollutants
– Small animals

Recycling

The switchgear can be recycled in ecological manner in compliance with existing legislation. Auxiliary devices such as short-circuit indicators have to be recycled as electronic scrap. Batteries have to be recycled professionally. Insulating gas SF_6 has to be evacuated professionally as a reusable material and recycled (SF_6 must not be released into the environment).

*) For standards, see page 72
1) VLF = very low frequency
2) Referred to: U_0/U (U_m = 6.35/11 (12) kV)
3) Secondary devices (e.g. protection devices, meters, measuring transducers, etc.) must be suitable for the given operating conditions.

PM

Metallic partition according to IEC 62271-200 (3.109.1). Metallic partitions between open, accessible compartments and live parts.
The SIMOSEC switchgear is suitable for application in indoor installations under normal operating conditions as defined in the standard IEC 62271-1.

Protection against solid foreign objects, electric shock and water

SIMOSEC switchgear fulfills according to the standards *)

IEC 62271-1	EN 62271-1	VDE 0671-1
IEC 62271-200	EN 62271-200	VDE 0671-200
IEC 60529	EN 60529	VDE 0470-1
IEC 62262	EN 50102	VDE 0470-100

the following degrees of protection
(for explanations, see opposite table):

Degree of protection "IP"	Type of protection
IP2X (standard)	for switchgear enclosure
IP3X (option)	for switchgear enclosure (optional)
IP3XD (option on request)	for switchgear enclosure (on request)
IP65	for parts of the primary circuit of switching-device vessels under high voltage

Degree of protection IK	Type of protection
IK 07	for switchgear enclosure

For secondary devices in the low-voltage door, the stipulations of the IP degree of protection apply according to the definitions for the switchgear enclosure.

IEC / EN 60529:

Type of protection	Degree of protection

Standard: **IP 2X**

Protection against solid foreign objects
Protected against solid foreign objects of 12.5 mm diameter and greater (the object probe, sphere of 12.5 mm diameter, shall not fully penetrate)

Protection against access to hazardous parts
Protected against access to hazardous parts with a finger (the jointed test finger of 12 mm diameter, 80 mm length, shall have adequate clearance from hazardous parts)

Protection against water
No definition

Option: **IP 3X**

Protection against solid foreign objects
Protected against solid foreign objects of 2.5 mm diameter and greater (the object probe, sphere of 2.5 mm diameter, shall not penetrate at all)

Protection against access to hazardous parts
Protected against access to hazardous parts with a tool (the access probe of 2.5 mm diameter shall not penetrate)

Protection against water
No definition

Option on request: **IP 3XD**

Protection against solid foreign objects
Protected against solid foreign objects of 2.5 mm diameter and greater (the object probe, sphere of 2.5 mm diameter, shall not penetrate at all)

Protection against water
No definition

Protection against access to hazardous parts
Protected against access with a wire (the access probe of 1.0 mm diameter, 100 mm length, shall have adequate clearance from hazardous parts)

IP 65

Protection against solid foreign objects
Dust-tight (No ingress of dust)

Protection against access to hazardous parts
Protected against access to hazardous parts with a wire (the access probe of 1.0 mm diameter shall not penetrate)

Protection against water
Protected against water jets (water projected in jets against the enclosure from any direction shall have no harmful effects)

*) For standards, see page 72

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