

MEDIUM-VOLTAGE SWITCHGEAR

8DJH

Gas-Insulated, up to 24 kV

Installation and Operating Instructions

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SIEMENS

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About these instructions

For reasons of clarity, these instructions do not purport to cover all details or variations in the equipment. They do also not provide for every possible contingency to be met in connection with installation or operation. For details about technical design and equipment like for example technical data, secondary equipment, circuit diagrams, please refer to the configuration documents.

The product is subject to continuous technical development within the scope of technical progress. If not stated otherwise on the individual pages of these instructions, we reserve the right to modify the specified values and drawings. Should further information be desired or should particular problems arise which are not covered sufficiently by these instructions, contact the Siemens Service Hotline.

The contents of these instructions are not part of or do not modify any prior or existing agreement, commitment or relationship. The Sales Contract contains the entire obligations of Siemens. The warranty contained in the contract between the parties is the sole warranty of Siemens. Any statements contained herein do not create new warranties or modify the existing warranty.

⇨ To avoid personal injury, the personnel must read these instructions before starting to work.

⇨ The personnel must observe all safety instructions and warnings in these instructions, and follow the handling instructions.

⇨ Store these instructions carefully, and so that they are accessible to the personnel at any time.

⇨ These instructions are a part of the product. When the switchgear is transferred, supply these instructions as well.

All dimensions are given in mm.

The illustrations included in this manual are simplified and serve to create a general understanding. The illustrations may therefore deviate from the actual product.

Symbols used

☒	Precondition symbol: Identifies a necessary precondition for an operation.
1.	Numbered operation instruction: Identifies an operation step. Asks the operator to perform an operation.
✓	Result symbol: Identifies the result of an operation or the intermediate result after an operation step.
⇨	Measures symbol: Identifies measures to avoid hazards, or important information and facilitations of work.
►	Cross-reference symbol: Identifies a reference to a chapter, an illustration or a table.

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1 Safety instructions

To avoid possible personal injury and switchgear damages, the personnel shall read and observe the following safety instructions.

1.1 Qualified personnel

All activities described in this manual must be performed by qualified personnel. Qualified personnel in the sense of these instructions is somebody who, due to his professional education, knowledge and experience as well as knowledge of the applicable standards, is able to judge the work he is in charge of and can therefore recognize possible dangers. These include, for example:

⇨ Transporting, assembling, maintaining and commissioning the product.
⇨ Switching on, switching off, earthing and identifying circuits and equipment/systems as per the relevant safety standards.

1.2 Personal protective equipment (PPE)

The personal protective equipment must be determined by the switchgear operator depending on the work to be performed at the switchgear and on the internal arc classification of the switchgear. To select the personal protective equipment, the local laws and regulations, among others, must be complied with.

If covers are opened or removed from an operating switchgear, the internal arc classification according to IEC 62271-200 is no longer fulfilled. The switchgear operator must take this into account when selecting the personal protective equipment. In case of internal arc, full personal protection is not provided then, even if the personal protective equipment is worn.

1.3 Safety instructions across the entire product life cycle

Five Safety Rules

Touching energized components can lead to a life-endangering electric shock. Non-observance of the Five Safety Rules can cause an internal arc. **Observe the Five Safety Rules of electrical engineering during all activities undertaken at the switchgear:**

⇨ Isolate.
⇨ Secure against reclosing.
⇨ Verify safe isolation from supply.
⇨ Earth and short-circuit.
⇨ Cover or barrier adjacent live parts.

Internal arc

The internal arc classification determines the tested areas around the switchgear. An internal arc in a switchgear with internal arc classification may result in the development of very loud noise and smoke.

In the case of switchgear **without** or with an **impaired internal arc classification,** an internal arc can cause life-threatening injury.

⇨ Determine the internal arc classification of the switchgear on the nameplate.

Removing components

Arbitrary removal of components can deactivate safety equipment, impair the stability of the switchgear, or impair the internal arc classification.

⇨ Only remove components if requested to do so in the instructions or after consultation with Siemens Service.

Operating accessories

Using incorrect operating accessories can damage the safety equipment of the switchgear and cause injury.

⇨ Only use the original Siemens accessories belonging to the switchgear.

Insulating gas SF_6

SF_6 is colorless, odorless, heavier than air, and collects at ground level. A high concentration of SF_6 in the air can cause suffocation. Larger amounts of SF_6 in the atmosphere can cause environmental damage.

⇨ When working on the switchgear, make sure that no insulating gas SF_6 can escape.
⇨ Do not drill into the gas compartment.
⇨ SF_6 has to be reclaimed.
⇨ SF_6 must not be released into the atmosphere.
⇨ Use and handling of SF_6 must comply with IEC 62271-4 and the locally applicable regulations.

Sharp-edged sheets

If covers are removed from the switchgear, sharp-edged sheets inside the switchgear can cause cuts.

⇨ Wear personal protective equipment (e.g. cut-resistant gloves and arm sleeves).
⇨ Cover sharp-edged spots.

Battery screwdriver

Using a battery screwdriver may damage bolted joints. Bolted joints can be tightened with an incorrect torque.

⇨ Avoid battery screwdrivers.
⇨ Screw the bolts in hand-tight. Then tighten them using a torque wrench.
⇨ Deactivate the impact wrench function of the battery screwdriver.

Manufacturer documentation of supplied parts

⇨ Observe the manufacturer documentation of supplied parts, e.g. for cable plugs, voltage transformers, current transformers.

1.4 Transport

Transport unit

Transport units are switchgear or accessories, which are screwed to a transport pallet. The transport units can be packed, for example, as a seaworthy crate or in film. During transport, the transport units can slip off the hoisting tackle or tip over and cause life-threatening injury.

⇨ The hoisting tackle used must meet the requirements as regards dimensions and load-bearing capacity.
⇨ Observe the dimensions and weights of the transport unit (delivery note).
⇨ Secure the transport unit against slipping off the hoisting tackle or transport gear. For example, use crane hooks with safety lug.
⇨ Observe the center of gravity of the transport units.
⇨ The center of gravity of the transport units is not always located under the lashing point. Transport only panel groups with a max. width of 2000 mm or max. height of 2600 mm.
⇨ Do not step on the transport unit.
⇨ Do not stack the transport units.
⇨ After lifting, let the switchgear swing into the center of gravity.
⇨ Carry out transport with lifting truck or fork-lift truck exclusively with the transport unit on the transport pallet.
⇨ With the fork of the truck, go fully underneath the transport pallet.
⇨ There must be no persons standing in the swinging or tipping area of the transport unit.

Floor openings

Panels that have to be moved over floor openings may only have a small standing surface on the base frame. The panel can tip over when crossing floor openings and cause life-threatening injury.

⇨ Use bridges when crossing floor openings.
⇨ Dimension the bridge according to the weights and dimensions of the panel so that the standing surface and load-bearing capacity is sufficient. For example, use adjustable supports.
⇨ Wedge the bridge against displacement.

Accessories

The accessories are placed in the connection compartment of the switchgear upon delivery. If the switchgear is lifted without transport pallet, the accessories can fall out of the switchgear at the bottom. During transport without connection compartment cover, the accessories can fall out of the switchgear at the front. Accessories falling out can cause injury.

⇨ Before transporting without transport pallet, remove the accessories from the switchgear.
⇨ Only transport the transport unit with the connection compartment covers hooked in.

1.5 Storage

Desiccant bags

Desiccant bags lose their effectiveness after 6 months. Depleted desiccant bags can lead to the corrosion of switchgear parts and accessories.

⇨ Have the desiccant bags replaced by a specialist every 6 months.

1.6 Installation

To perform installation work, these instructions assume a switchgear that is not connected to the power grid and is in de-energized condition. Any exceptions will be pointed out in the text.

Gas compartment

The gas compartment of the switchgear is under pressure. Damage to the gas compartment impairs the internal arc classification.

⇨ Do not drill into or damage the switchgear.

Covers

In certain panel types, the cable compartment cover is additionally bolted together with the panel. The front cover is always bolted on. If the cable compartment cover or the front cover are not bolted on, the panels lose their internal arc classification.

If an internal arc occurs during operation, unbolted covers may fly off. This can cause serious injury or death.

⇨ Do not put switchgear with missing covers into operation.
⇨ After hooking in, fasten bolted cable compartment covers to the panel again with all bolts.
⇨ Always fasten the front cover to the panel with all bolts.

Voltage transformers

Voltage on the secondary side of the voltage transformer leads to high voltage on the primary side of the voltage transformer. Touching energized components can lead to a life-endangering electric shock.

⇨ Separate the secondary wires of the voltage transformers from any voltage sources before executing the installation work.

A voltage transformer short-circuited on the secondary side can explode during operation and cause life-threatening injury.

⇨ Check the secondary wiring of the voltage transformers before commissioning.

The metal coating on the outside of voltage transformers is connected to earth potential. A damaged metal coating can lead to the voltage transformer not functioning correctly. Touching can lead to a life-endangering electric shock.

⇨ Verify intact condition of the metal coating before assembly. Do not put voltage transformers with damaged metal coating into operation. Contact the Siemens Service Hotline.
⇨ Do not damage the metal coating. Watch out for pointed or sharp-edged objects.

Current sensors

The use of current sensors on unscreened cable connection systems can cause an internal arc during operation.

⇨ Use current sensors exclusively with screened cable connection systems.

Protective caps

Protective caps are only used to provide protection against damage to the bushings. Using protective caps as surge-proof covers can lead to a life-threatening electric shock and an internal arc during operation.

⇨ Do not use protective caps as surge-proof covers.

Damaged or polluted components

Components with contact surfaces, silicone surfaces, or cast-resin components can be damaged during installation due to sharp-edged objects or high forces. Pollution or damage leads to insufficient electrical contact, disruptive discharges or flashovers, and can cause an internal arc during operation.

⇨ Do not unpack components until right before assembly.
⇨ Verify intact condition of the components.
⇨ Do not damage components. Watch out for pointed or sharp-edged objects.
⇨ Do not install damaged components.
⇨ Clean polluted components with suitable means prior to installation.
⇨ Do not mount plug sets in a bent or twisted manner.

Welded seams

Panels can be welded onto the foundation rails. Brittle welded seams can result in the switchgear not being sufficiently fastened to the floor.

⇨ Protect welded seams against corrosion.

Heavy components

Components such as voltage transformers, current transformers, pressure relief ducts, and low-voltage compartments are very heavy. When heavy components are lifted or tip over, this can cause serious injuries.

⇨ Lift the heavy components with several persons or with suitable means.
⇨ Secure the heavy components against falling down.

Copper bars

Components from copper, such as earthing bars or connection bars, can cause an internal arc during operation due to insufficient contact.

⇨ Clean the oxidized contact points before installation.
⇨ Do not damage contact surfaces.
⇨ Bolt the copper bars together without distortions and gaps.

Air inclusions

If screw-type cones or voltage transformers are inserted in an inside cone, air inclusions may develop. Air inclusions can impair insulation and cause an internal arc during operation.

⇨ While inserting the inside cone, let excess air out with a plastic cable strap or nylon thread.
⇨ With cable straps, make the smooth surface face the more sensitive material.
⇨ After pulling out, check the cable strap for damage.

High speed moving components

Components behind the front cover can automatically move quickly and cause serious injury. Do not remove the front cover of the operating mechanism until the following switching operations have been performed:

⇨ If applicable, switch off electrical control circuits for motor operating mechanisms and operating coils.
⇨ Discharge the spring energy store in the operating mechanism.
⇨ If the spring is still charged, contact the Siemens Service Hotline.
⇨ Switch the three-position switch to READY-TO-EARTH position.
⇨ To avoid impermissible switching operations, switch off auxiliary voltage, e.g.:
  – Switch off the auxiliary voltage supply of the motor.
  – Trip the MCB.
  – Disconnect the control cables.
⇨ Close the circuit-breaker (the closing spring is not charged, the opening spring is charged).
⇨ Fit and secure the "feeder earthed" locking device.
⇨ Check if the "spring charged" indicator shows "spring not charged". If the spring is still charged, contact the Siemens Service Hotline.
⇨ Do not reach into the circuit-breaker operating mechanism.

Cross member

A removed cross member impairs the stability of the panel. The panel may be distorted by movement.

⇨ If the cross member is removed, do not move the panel.

Pollution of the inside

Pollution of the inside of the switchgear can cause malfunctions during operation.

⇨ Observe extreme cleanliness during installation.
⇨ To avoid rust layers, remove metal cuttings, dust or liquids on the gas compartment after installation.
⇨ No smoking.

1.7 Electrical connections

High-voltage cables

Incompatible combinations of cable plug types, surge arresters, and surge limiters can cause an internal arc during operation.

⇨ Use the same, compatible makes for combining plug types, surge arresters, and surge limiters.
⇨ The maximum tightening torque of the cable plugs (80 Nm) must not be exceeded.
⇨ Do not violate the minimum bending radius of the high-voltage cables.
⇨ Do not mount high-voltage cables and plug sets in a bent or twisted manner.

Secondary wires

Damage to secondary wires may cause malfunctions.

⇨ Do not lay the secondary wires in close proximity of sharp-edged sheets.

1.8 Tests

Cable testing

Cable testing with connected cables represents a special stress for the isolating distance.

If the busbar of the switchgear under test or of the opposite substation are live with operating voltage, no overvoltages may occur. Overvoltages can cause life-endangering injury due to an internal arc.

⇨ Overvoltages must be avoided by suitable measures taken by the switchgear operator.

To carry out a cable test, the switchgear must be live with open covers. High test voltages can lead to a fault during the cable test, causing life-endangering injury due to an internal arc. Insufficient distance or contact with live parts will cause life-threatening injury due to an electric shock.

⇨ During the cable test, keep a safety distance (min. 3 m) from the switchgear.
⇨ Install barriers.
⇨ Switch on warnings.
⇨ When the cable test is completed, earth the test cables.

1.9 Operation

Voltage detecting and indicating systems (VDIS)

Always verify safe isolation from supply without any doubt using a VDIS. Humidity can impair the function of the voltage indicator. Incorrect use can impair the function of the voltage indicator. Touching live parts leads to a life-endangering electric shock.

⇨ Rule out possible sources of failure:
  – Defective voltage indicator (or device for function testing of the coupling section)
  – Maloperation of the voltage indicator (or device for function testing of the coupling section)
  – In case of rain or fog, do not use the voltage indicator outdoors.
  – Dry a humid voltage indicator before use.
  – Always use the voltage indicator in accordance with the permissible nominal voltage and nominal frequency.
  – Do not damage the voltage indicator.
⇨ Perform the functional test of the voltage indicator and the coupling section according to the locally applicable regulations:
  – On a live panel
  – With a test unit according to IEC 62271-213
  – On all phases
  – If the voltage indicator does not indicate any voltage, perform the operation test again.
⇨ Use only voltage indicators or devices to test the function of the coupling section according to IEC 62271-213.
⇨ Perform repeat test of interface conditions at the capacitive interfaces, as well as on the indicators according to the customer's specifications or locally applicable regulations.
⇨ Do not use short-circuiting jumpers as separate plugs. The operation of the surge arrester installed is not ensured if short-circuiting jumpers are used.

Ready-for-service indicator

The ready-for-service indicator is an indicator for the filling level with insulating gas and thus the service readiness of the panel. Switching without service readiness can cause an internal arc.

⇨ Check service readiness of the switchgear before performing any switching operation. The pointer of the ready-for-service indicator must be in the **green** area.
⇨ **If the pointer is in the red area:**
  – Do not operate the switchgear.
  – Contact the Siemens Service Hotline.

Operating levers

When the operating lever is inserted in the actuating opening, it can slip off and cause injury. The tensioning force of the operating spring can turn the inserted operating lever back and cause injury.

⇨ Insert the operating lever carefully in the actuating opening.
⇨ Hold the operating lever at both handles while switching.
⇨ After switching, remove the operating lever from the actuating opening.

Actuating openings

Components behind an open actuating opening may suddenly move quickly and cause cuts or bruises.

⇨ Do not reach into actuating openings.

HV HRC fuse-links

When a HV HRC fuse-link has tripped, the HV HRC fuse-links in the other phases may also have been stressed.

⇨ Always replace HV HRC fuse-links in all phases.
⇨ Always insert HV HRC fuse-links in all phases, even if there are individual phases without connected operational equipment.

1.10 Changes to the product

Modifications or alterations to the product can cause the expiration of warranty claims, and cause danger to life, limb and other legally protected interests. The fulfillment of the type tests may not be ensured anymore. Any changes to the product must be coordinated with Siemens in advance.

After coordination with Siemens, please comply with the following points when making changes to the product:

⇨ Use Siemens original parts.
⇨ Use qualified personnel.
⇨ Install or adjust parts properly.
⇨ Perform settings in accordance with Siemens specifications.
⇨ After installation and setting, have a final check performed by a service technician approved by Siemens, including documentation of the test results.
⇨ Perform maintenance according to the installation and operating instructions of the product.

1.11 Operator commitment

⇨ Regardless of the specifications in these instructions, the operator must know and comply with local legal regulations for safe transport, storage, installation and operation of the switchgear. These comprise the standards as well as, for example, laws, ordinances, guidelines and standards for industrial safety, health protection, and environmental protection that are applicable to the switchgear.
⇨ The switchgear operator must keep the technical documents supplied with the switchgear throughout the entire service life, and keep them up to date in case of modifications of the switchgear.

Accessibility to the switchgear room

Optionally, the switchgear has an internal arc classification, which means that tested areas are specified as indicated on the nameplate. Uncontrolled access to hazardous areas will cause life-endangering injury in case of internal arc.

⇨ Observe the switchgear design and determine the internal arc classification of the switchgear by means of the data on the nameplate.
⇨ The switchgear operator must establish the accessibility to the switchgear room in accordance with the spatial conditions and the equipment installed in there.

Customer-specific indicators and control elements

Apart from the indicators and control elements shown in these instructions, the switchgear can be equipped with additional customer-specific equipment (e.g. for local or remote switching operations).

⇨ The operator must instruct the operating personnel regarding the correct operation of this customer-specific equipment.

1.12 IT security

The software of Siemens protection devices is regularly checked for safety. If weak points are identified in the process, which may allow third parties to access protection devices, information thereto is distributed through the **SIPROTEC and SICAM Security Update Report Newsletter**.

The Newsletter can be subscribed to at the following website:

www.siemens.com/gridsecurity

Before commissioning the switchgear, it must be verified that the current firmware version is installed on the protection devices. The latest version of firmware can be obtained from the following website:

https://support.industry.siemens.com/cs/products?mfn=ps&pnid=24236&lc=en-WW

For information on updates for other makes of protection devices, please contact the respective manufacturer.

1.13 Hazardous substances

If hazardous substances are required to perform the work, the relevant safety data sheets and operating instructions must be observed.

2 Description

2.1 Due application

The factory-assembled, type-tested and metal-enclosed 8DJH switchgear for indoor installation is used for power distribution in secondary distribution systems, e.g. in transformer substations, transfer substations or industrial distribution systems.

The switchgear is designed for application under normal service conditions according to IEC 62271-1. It can be used under special service conditions as defined individually between the operator and the manufacturer of the switchgear.

The rated values for use of the switchgear can be found on the nameplate [► Page 26, "Nameplates"] and in the technical data [► Page 18, "Technical data"].

2.2 Panel types

Panel type	Description
R	Ring-main panel
K	Cable panel
K(E)	Cable panel with make-proof earthing switch
T	Transformer panel
L	Circuit-breaker panel
S	Bus sectionalizer panel with three-position switch-disconnector
H	Bus sectionalizer panel with switch-fuse combination
V	Bus sectionalizer panel with circuit-breaker
E	Busbar earthing panel
M(SS)	Billing metering panel, air-insulated ▪ M(SS): Busbar-busbar connection ▪ M(SK): Busbar-cable connection ▪ M(KS): Cable-busbar connection ▪ M(KK): Cable-cable connection
M(SK)	
M(KS)	
M(KK)	
M(430)	Busbar voltage metering panel with primary fuse protection

2.3 Features of the switchgear

- Type-tested and 3-pole metal-enclosed
- Designed as individual panel or panel block
- Individual panels can be lined up in any sequence
- Single-busbar system
- Climate-independent and maintenance-free
- Welded gas compartment without seals, made of stainless steel, with welded-in bushings for electrical connections and mechanical components
- Insulating gas SF_6
- The vacuum circuit-breaker consists of a vacuum interrupter unit with integrated three-position disconnector located in the gas compartment, and the associated operating mechanisms
- Three-position switch-disconnector with load-break function and make-proof earthing function
- Pressure relief downwards, optionally to the rear or upwards via pressure absorber systems
- All actuating openings are functionally interlocked against each other, and are lockable
- Logical mechanical interlocks and locking devices prevent impermissible and undesired operations on the switching devices
- Cable connection with outside-cone plug-in system
- HV HRC fuse assembly in switch-fuse combination, fuse replacement possible without tools
- Voltage detection with voltage detecting and indicating systems (VDIS)
- Busbar interconnection between panels via lateral busbar couplings

2.4 Panel design

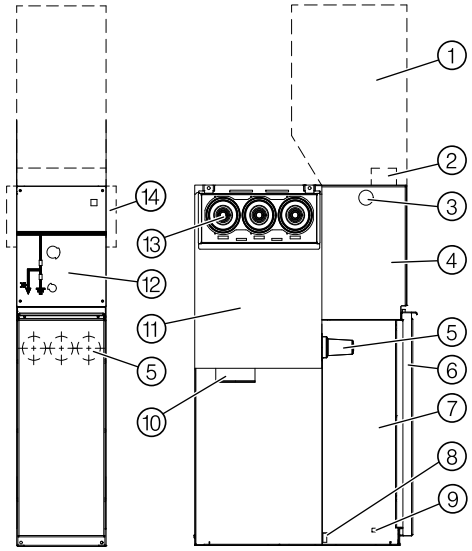


Fig. 1: Ring-main panel type R

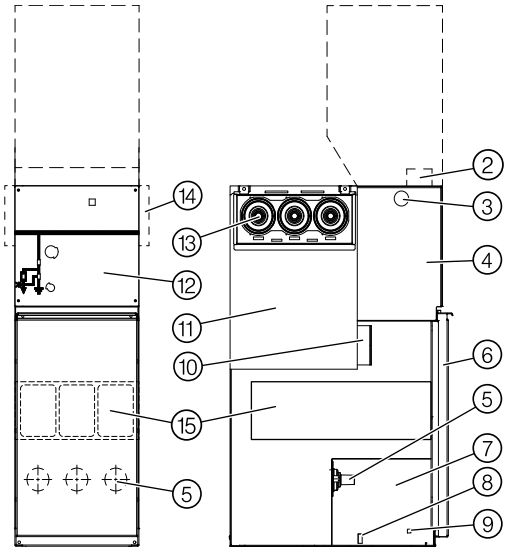


Fig. 2: Transformer panel type T

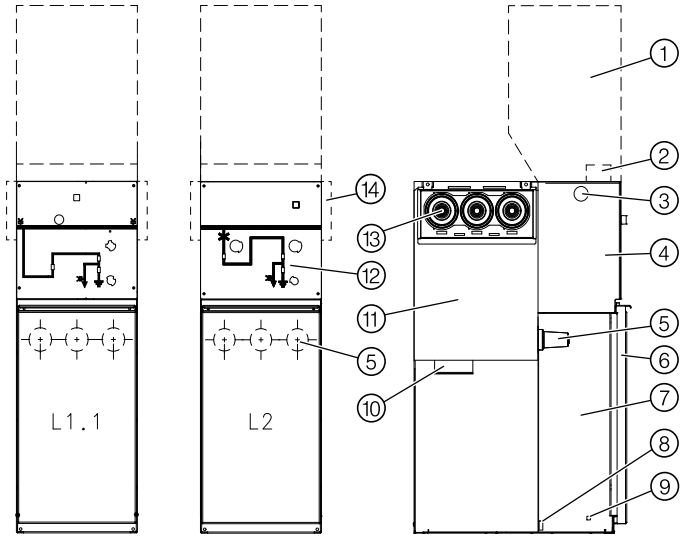


Fig. 3: Circuit-breaker type L (type 1.1 and type 2)

① Low-voltage compartment (option)
② Wiring duct (option)
③ Opening for secondary wires
④ Operating mechanism of switching device
⑤ Bushing for cable plug
⑥ Cable compartment cover
⑦ Earthing busbar
⑧ Cable compartment
⑨ Earthing point
⑩ Pressure relief device
⑪ Gas compartment (gas-filled compartment) with switching device
⑫ Control board
⑬ Bushing for busbar
⑭ Busbar termination cover (end panel only)
⑮ HV HRC fuse assembly

2.5 Cable connection

2.5.1 Options for cable connection

The bushings for connecting the feeder cables correspond to EN 50181 / DIN EN 50181. The following cable plug types can be used at the cable feeders:

- Cable plugs with bolted contact M16, outside-cone connection type C (cable feeders of all panel types)
- Cable plugs with plug-in contact, outside-cone connection type A (option, transformer feeder only)

The recommended cable plug sets and possible connection cross-sections are given in the tables on the following pages [► Page 12, "Recommended cable plugs"]. The installation of other makes and types is possible on request.

Connection option for ring-main feeder (example):

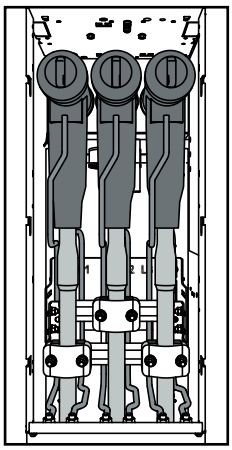


Fig. 4: Cable connection for ring-main feeder (interface type C)

Transformer feeder connection options (examples):

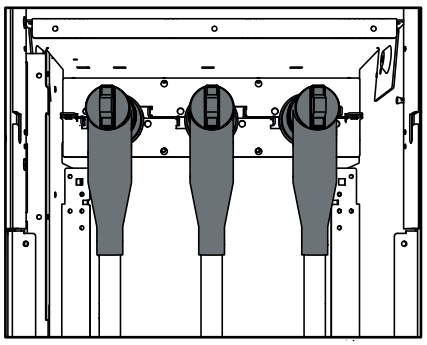


Fig. 5: Cable feeder downwards with elbow plugs (interface type A)

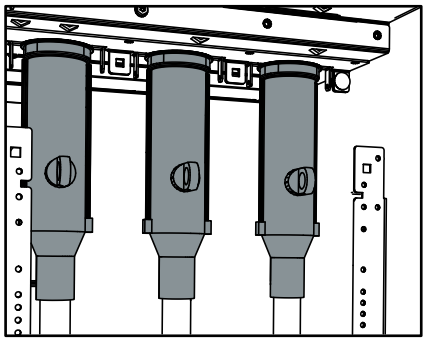


Fig. 6: Cable feeder downwards with straight plugs (interface type A)

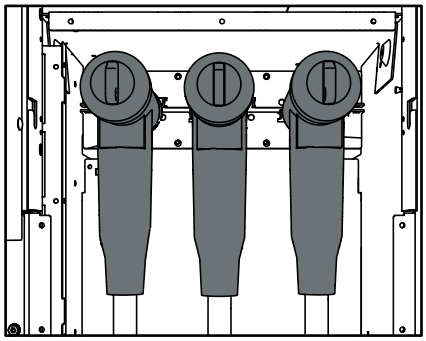


Fig. 7: Cable feeder to the front with elbow plugs or T-plugs (interface type C)

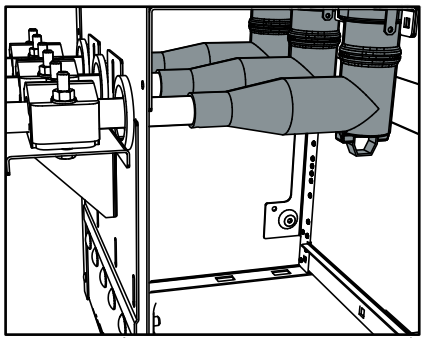


Fig. 8: Cable feeder backwards with elbow plugs (interface type A)

2.5.2 Recommended cable plugs

Tab. 1: Cable plugs for single cable connection (interface type C)

Cable type	Cable plug					
	Make		Type	T/W[1),2)]	Conductor cross-section [mm²]	Design[2)]
Thermoplastic-insulated cables ≤ 12 kV according to IEC 60502-2 / VDE 0276-620						
1-core or 3-core cable, PE and XLPE-insulated N2YSY (Cu) and N2XSY (Cu) or NA2YSY (Al) and NA2XSY (Al)	Nexans Euromold		400TB/G, 430TB/G, 480TB/G	T	35...300	screened
			400LB/G	W	35...300	screened
			484TB/G	T	70...630	screened
			440TB/G	T	185...630	screened
	nkt cables		CB 24-630	T	25...300	screened
			AB 24-630	T	25...300	insulated
			CB 36-630 (1250)	T	300...630	screened
	Südkabel		SET 12	T	50...300	screened
			SEHDT 13	T	185...500	screened
	Prysmian Kabel und Systeme (Pirelli Elektrik)		FMCTs-400	T	25...300	screened
	3M Germany		93-EE 705-6 / -95	T	50...95	screened
			93-EE 705-6 / -240	T	95...240	screened
	TE Connectivity		RICS 51 ... with IXSU[3)]	T	25...300	insulated
			RICS 31 ... with IXSU[3)]	T	25...300	insulated
			RSTI-39xx	T	400...800	screened
	Cellpack		CTS 630 A 24 kV	T	25...400	screened
			CTS 630 A 36 kV	T	35...400	screened
Thermoplastic-insulated cables 15 / 17.5 / 24 kV according to IEC 60502-2 / VDE 0276-620						
1-core or 3-core cable, PE and XLPE-insulated N2YSY (Cu) and N2XSY (Cu) or NA2YSY (Al) and NA2XSY (Al)	Nexans Euromold		K400TB/G, 430TB/G, 480TB/G	T	35...300	screened
			K400LB/G	W	35...300	screened
			484TB/G	T	70...630	screened
			K440TB/G	T	185...630	screened
	nkt cables		CB 24-630	T	25...300	screened
			AB 24-630	T	25...300	insulated
			CB 36-630 (1250)	T	300...630	screened
	Südkabel		SET 24	T	50...240	screened
			SEHDT 23.1	T	300	screened
			SEHDT 23	T	185...630	screened
	Prysmian Kabel und Systeme (Pirelli Elektrik)		FMCTs-400	T	25...240	screened
	3M Germany		93-EE 705-6 / -95	T	25...95	screened
			93-EE 705-6 / -240	T	95...240	screened
	TE Connectivity	for 1-core cables	RICS 51 ... with IXSU[3)]	T	25...300	insulated
			RSTI-58xx	T	25...300	screened
			RSTI-59xx	T	400...800	screened
		for 3-core cables	RICS 51 ... with IXSU[3)]	T	25...300	insulated
			RSTI-58xx + RSTI-TRFxx	T	25...300	screened
	Cellpack		CTS 630 A 24 kV	T	25...400	screened
			CTS 630 A 36 kV	T	35...400	screened
Paper-insulated mass-impregnated cables ≤ 12 kV according to IEC / EN 60055-2 / VDE 0276-621						
3-core cable, paper-insulated N(A)KLEY, N(A)KBA, N(A)KBY	TE Connectivity		RICS 51... with UHGK / EPKT	T	95...300	insulated
3-core cable, paper-insulated N(A)EKBA, N(A)KLEY			RICS 51 ... with IDST 51[3)]	T	50...300	insulated
Paper-insulated mass-impregnated cables 15 / 17.5 / 24 kV according to IEC / EN 60055-2 / VDE 0276-621						
1-core or 3-core cable, paper-insulated N(A)EKBA, N(A)KLEY	TE Connectivity		RICS 51 ... with IDST 51[3)]	T	35...240	insulated

1) T = cable T-plug, E= cable elbow plug

2) Use of current transformers and current sensors in combination with insulated systems is possible on request.

3) Discontinued by the manufacturer

Tab. 2: Cable plugs for single cable connection (interface type A)

Cable type	Cable plug				
	Make	Type	G/W[1)]	Conductor cross-section [mm²]	Design
Thermoplastic-insulated cables ≤ 12 kV according to IEC 60502-2 / VDE 0276-620					
1-core cable, PE- and XLPE-insulated N2YSY (Cu) and N2XSY (Cu) or NA2YSY (Al) and NA2XSY (Al)	Nexans Euromold	158LR	W	16...120	screened; with capacitive measuring point
		152SR	G	95...120	screened; with capacitive measuring point
		200LR	W	25...95	screened; with capacitive measuring point
		K200LR-12	W	25...95	screened
		K200SR-12	G	25...95	screened
	nkt cables	EASW 10 / 250, size 2	W	25...95	screened; option: with metal housing or capacitive measuring point
		EASG 10 / 250, size 2	G	25...95	screened; option: with capacitive measuring point
		CE 24 – 250	W	95...120	screened; option: with metal housing or capacitive measuring point
	Südkabel	SEHDG 11.1	G	25...120	screened; option: with metal housing
		SEW 12	W	25...120	screened; option: with metal housing
	Cooper Power Systems	DE 250 – R-C	W	16...120	screened
		DS 250 – R-C	G	16...120	screened
	Prysmian Kabel und Systeme (Pirelli Elektrik)	FMCE-250	W	25...120	screened
	3M Germany	93-EE 605-2 / -95	W	25...95	screened; option: with metal housing
		93-EE 600-2 / xx	G	25...150	screened; option: with metal housing
	TE Connectivity	RSSS 52xx	G	25...95	screened; with capacitive measuring point
		RSES 52xx-R	W	25...120	screened; with capacitive measuring point
	Cellpack	CWS 250 A 24 kV	W	16...150	screened
Thermoplastic-insulated cables 15 / 17.5 / 24 kV according to IEC 60502-2 / VDE 0276-620					
1-core cable, PE- and XLPE-insulated N2YSY (Cu) and N2XSY (Cu) or NA2YSY (Al) and NA2XSY (Al)	Nexans Euromold	K158LR	W	16...120	screened; with capacitive measuring point
		K152SR	G	25...120	screened; with capacitive measuring point
		200LR	W	25...95	screened; with capacitive measuring point
		K200LR-16	W	25...95	screened
		K200SR-16	G	25...95	screened
	nkt cables	EASG 20 / 250	G	25...95	screened; option: with metal housing
		CE 24 – 250	W	25...95	screened; option: with metal housing or capacitive measuring point
	Südkabel	SEHDG 21.1	G	25...70	screened; option: with metal housing
		SEW 24	W	25...95	screened; option: with metal housing
	Cooper Power Systems	DE 250 – R-C	W	16...120	screened
		DS 250 – R-C	G	16...120	screened
	Prysmian Kabel und Systeme (Pirelli Elektrik)	FMCE-250	W	25...120	screened
	3M Germany	93-EE 605-2 / -95	W	25...95	screened; option: with metal housing
		93-EE 600-2 / xx	G	25...150	screened; option: with metal housing
	TE Connectivity	RSSS 52xx	G	16...70	screened; with capacitive measuring point
		RSES 52xx-R	W	16...120	screened; with capacitive measuring point
	Cellpack	CWS 250 A 24 kV	W	16...150	screened

1) S = straight cable plug, E = cable elbow plug

2.5.3 Single cable connection with voltage transformer 4MT8 (interface type C)

The voltage transformer 4MT8 can be installed in ring-main feeders and circuit-breaker feeders with a panel width of 500 mm. A deep cable compartment cover is not necessary.

For connection, symmetrical cable T-plugs (see table) are required. Before performing a voltage test at the cables (on site with max. 80 % U_d), the voltage transformers must be removed.

Tab. 3: Symmetrical cable T-plugs

Make	Type	Design
Nexans	(K)400TB/G	screened
	(K)440TB/G	screened
Prysmian	FMCTs-400	screened
Südkabel	SEHDT (13/23)	screened

2.5.4 Deep cable compartment cover

For the following panel types, the connection of up to 2 feeder cables per phase (double cable connection) is possible.

- Cable panel (type K)
- Ring-main panel (type R)
- Circuit-breaker panel (type L)

Depending on the panel type, plug make, or surge arrester make, a deep cable compartment cover can be selected to obtain a larger mounting depth of the cable compartment. The double cable connection is also possible in connection with surge arresters or surge limiters.

Further information [▶ Page 14, Tab. 4: "Cable plugs for double cable connection (interface type C)"] and [▶ Page 15, Tab. 5: "Cable plugs for single cable connection and double cable connection with surge arresters (interface type C)"].

Cable connection with deep cable compartment cover

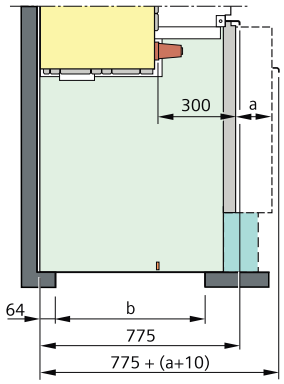


Fig. 9: Mounting depth at the cable connection for panel types R, K and L

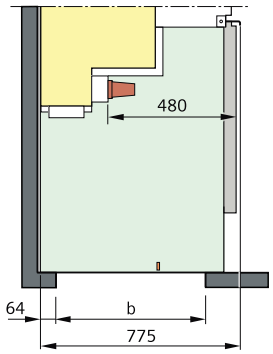


Fig. 10: Mounting depth at the cable connection for panel types R(500) and L(500)

Tab. 4: Cable plugs for double cable connection (interface type C)

Cable plug		Connection combination			Cable compartment cover[1]	
Make	Type	Design[2]	Arrangement[3]	Mounting depth [mm]	Deeper by a [mm]	Depth of floor opening b [mm]
Nexans	(K)430TB/G + (K)300PB/G (K)480TB/G + (K)800PB/G (K)484TB/G + (K)804PB/G	screened	K + K	290	–	610
	2x (K)400TB/G with coupling insert (K)400CP	screened	K + K	505	250[4]	860
	(K)400TB/G + (K)400LB/G with coupling insert (K)400CP-LB	screened	K + K	455	250	860
	(K)400TB/G + (K)430TB/G with coupling insert (K)400CP	screened	K + K	403	250	860
	2x (K)440TB/G with coupling insert (K)440CP	screened	K + K	505	250[4]	860
Südkabel	SET (12/24) + SEHDK (13.1/23.1)	screened	K + K	290	–	610
	SEHDT 23.1 + SEHDK 23.1	screened	K + K	290	–	610
	2x SEHDT 23.1 with coupling unit KU 23.2/23	screened	K + K	363	250	860
	SEHDT (13/23) + SET (12/24) with coupling unit KU 23 or KU 33	screened	K + K	451	250	860
	2x SET (12/24) with coupling unit KU 23.2/23	screened	K + K	363	105	715
nkt cables	CB 24-630 + CC 24-630	screened	K + K	290	–	610
	2x CB 24-630 with coupling unit CP 630C	screened	K + K	370	250 105[5]	860 715
	AB 24-630 + AC 24-630	insulated	K + K	290	105[5]	715
	2x AB 24-630 with coupling unit CP 630A	insulated	K + K	370	250 105[5]	860 715
	CB 36-630 (1250) + CC 36-630 (1250)	screened	K + K	300	–	610

Cable plug		Connection combination			Cable compartment cover[1]	
Make	Type	Design[2]	Arrangement[3]	Mounting depth [mm]	Deeper by a [mm]	Depth of floor opening b [mm]
TE Connectivity	RSTI-58xx + RSTI-CC-58xx	screened	K + K	285	–	610
	RSTI-x9xx + RSTI-CC-x9xx	screened	K + K	315	105	715
3M Deutschland	2x 93-EE705-6/xxx with coupling unit KU 23.2	screened	K + K	363	105	715

1) Only for 310 mm and 430 mm wide panels. For 500 mm wide panels without disconnectable voltage transformers at the feeder, no deep cable compartment cover and floor opening are required.
2) Use of current transformers and current sensors in combination with insulated systems is possible on request.
3) C = cable plug, S = surge arrester
4) For a 500 mm wide panel without disconnectable voltage transformers at the feeder, a 105 mm deep cable compartment cover is required.
5) On request

Tab. 5: Cable plugs for single cable connection and double cable connection with surge arresters (interface type C)

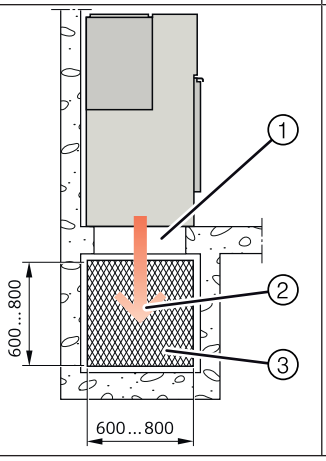
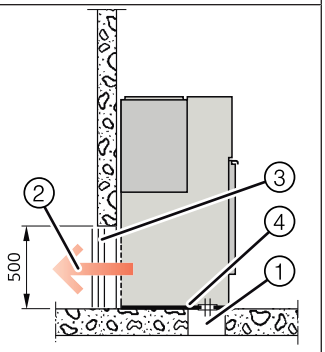
Cable plugs / surge arresters		Connection combination			Cable compartment cover[1] deeper by a[2] [mm]
Make	Type	Design[3]	Arrangement[4]	Mounting depth [mm]	
Nexans	(K)430TB/G + 300SA (K)480TB/G + 800SA (K)484TB/G + 800SA	screened	K + Ü	290	–
	(K)430TB/G + (K)300PB/G + 300SA	screened	K + K + Ü	395	105[5]
	(K)480TB/G + (K)800PB/G + 800SA (K)484TB/G + (K)804PB/G + 800SA	screened	K + K + Ü	400	250
Südkabel	SET (12 / 24) + MUT (13 / 23)	screened	K + Ü	302	105
	SEHDT 23.1 + MUT 23	screened	K + Ü	302	105[5]
	2x SET (12 / 24) + MUT (13/23) with coupling unit KU 23.2/23	screened	K + K + Ü	476	250
	2x SEHDT 23.1 + MUT 23 with coupling unit KU 23.2/23	screened	K + K + Ü	476	250
	SEHDT (13 / 23) + MUT 33	screened	K + Ü	540	250
nkt cables	CB 24-630 + CSA 24...	screened	K + Ü	290	–
	AB 24-630 + ASA 24...	insulated	K + Ü	290	105
	CB 36-630 (1250) + CSA...	screened	K + Ü	290	–
TE Connectivity	RICS 5139 + RDA...	insulated	K + Ü	275	–
	RSTI-58xx + RSTI-CC-58SAxx	screened	K + Ü	285	–
	RSTI-58xx + RSTI-CC-68SAxx	screened	K + Ü	292	–
	RSTI-x9xx + RSTI-CC-58SAxx	screened	K + Ü	295	–
	RSTI-x9xx + RSTI-CC-68SAxx	screened	K + Ü	302	105
3M Deutschland	2x 93-EE705-6/xxx + MUT 23 with coupling unit KU 23.2	screened	K + K + Ü	476	250

1) Only for 310 mm and 430 mm wide panels. For 500 mm wide panels without disconnectable voltage transformers at the feeder, no deep cable compartment cover and floor opening are required.
2) Drawing [▶ Page 14, "Deep cable compartment cover"]
3) Use of current transformers and current sensors in combination with insulated systems is possible on request.
4) C = cable plug, S = surge arrester
5) For a 500 mm wide panel without disconnectable voltage transformers at the feeder, a 105 mm deep cable compartment cover is required.

2.6 Pressure relief

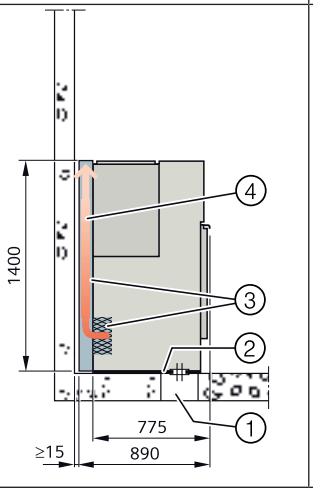
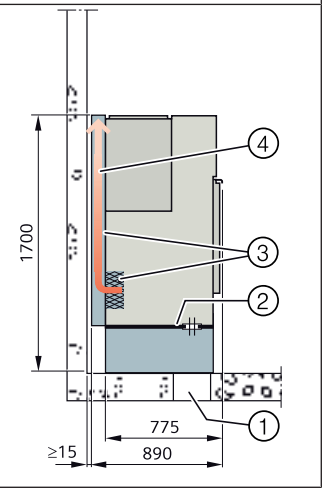
The switchgear is equipped with one of the following pressure relief methods.

Pressure relief without pressure absorber system

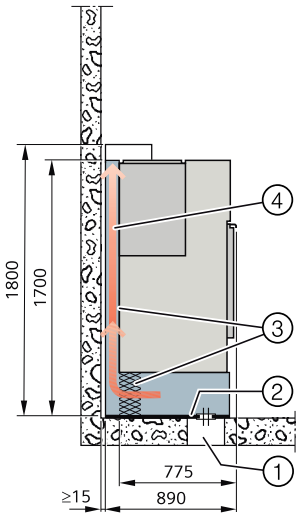
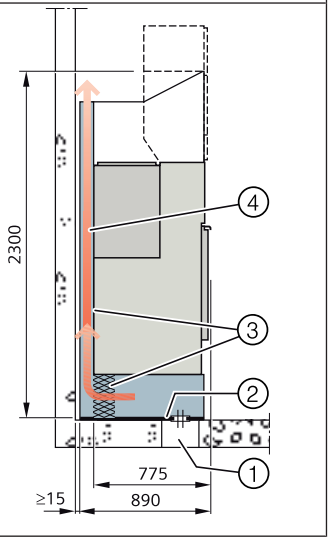
Pressure relief downwards (standard)	Pressure relief to the rear (option)
Individual panels and panel blocks with IAC A FL or FLR up to 21 kA/1s	Panel blocks with IAC A FL up to 21 kA/1s
	
Features of the exhaust opening with expanded metal (provided by the site): ▪ Mesh breadth and width of the expanded metal < 2.5 mm ▪ Effective exhaust cross-section min. 0.35 m²	

① Floor opening
② Direction of pressure relief
③ Exhaust opening with expanded metal
④ Floor plate

Pressure relief with pressure absorber system

Pressure relief upwards	
Panel blocks with IAC A FL or FLR up to 16 kA/1s	
Panel height 1400 mm	Panel height 1700 mm (with base frame)
	

① Floor opening
② Floor plate
③ Pressure absorber system
④ Direction of pressure relief

Pressure relief upwards	
Individual panels or panel blocks with IAC A FL or FLR up to 21 kA/1s	
Panels in wall-standing arrangement (except billing metering panel)	▪ Panels in free-standing arrangement ▪ Billing metering panel in wall-standing arrangement or free-standing arrangement
	

① Floor opening
② Floor plate
③ Pressure absorber system
④ Direction of pressure relief

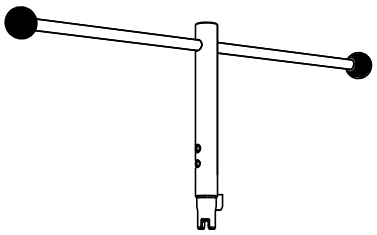
2.7 Accessories

Storage location of the accessories upon delivery of the switchgear:

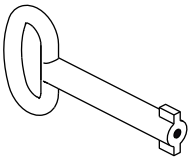
- **Individual panel:** In the cable compartment of the panel
- **Panel block:** In the cable compartment of the left-hand panel
- **With comprehensive accessories:** In a separate transport box

The accessories depend on the respective purchase order. The supplied accessories are listed in the order documentation.

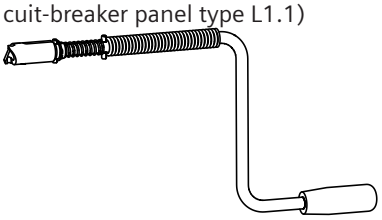
- Operating and installation instructions
- Operating levers for operation of switching devices (different designs)



- Double-bit key (option, key with a diameter of 3 mm or 5 mm)



- Hand crank for charging the spring energy store (only circuit-breaker panel type L1.1)



Other accessories (examples):

- Surge arresters
- Cable plugs
- HV HRC fuse-links
- Test fuses with extension tube (suitable for reference dimension e of fuse-link)
- Voltage indicators
- Units to test the capacitive interface and the voltage indicators
- Unit to test the plug-in voltage indicators
- Phase comparison test units

3 Technical data

The technical data of the switchgear specified in this chapter are general values. The rated values of the supplied switchgear are provided on the respective nameplate [► Page 26, "Nameplates"].

3.1 Complete switchgear

Tab. 6: General technical data

Rated voltage U_r			**kV**	**7.2**	**12**	**15**	**17.5**	**24**
Rated insulation level		Rated short-duration power-frequency withstand voltage U_d						
		- phase-to-phase, phase-to-earth, open contact gap	kV	20	28/42[1)]	36	38	50
		- across the isolating distance	kV	23	32/48[1)]	39	45	60
		Rated lightning impulse withstand voltage U_p						
		- phase-to-phase, phase-to-earth, open contact gap	kV	60	75	95	95	125
		- across the isolating distance	kV	70	85	110	110	145
		Rated frequency f_r	Hz	50/60				
Rated continuous current I_r[2)]		Busbar	A	630				
		Ring-main feeder	A	400 or 630				
		Circuit-breaker feeder	A	250 or 630				
		Transformer feeder	A	Depending on HV HRC fuse-link				
50 Hz	Rated short-time withstand current I_k	Switchgear with t_k = 1 s	kA	≤ 25				≤ 20/21[1)]
		Switchgear with t_k = 3 s (design option)	kA	≤ 20/21[1)]				
	Rated peak withstand current I_p		kA	≤ 63				≤ 50/52.5[1)]
	Rated short-circuit making current I_{ma}	Ring-main feeder	kA	≤ 63				
		Circuit-breaker feeder	kA	≤ 63				
		Transformer feeder	kA	≤ 63				
60 Hz	Rated short-time withstand current I_k	Switchgear with t_k = 1 s	kA	≤ 25				≤ 20/21[1)]
		Switchgear with t_k = 3 s[1)]	kA	≤ 20/21[1)]				
	Rated peak withstand current I_p		kA	≤ 65				≤ 52/55[1)]
	Rated short-circuit making current I_{ma}	Ring-main feeder	kA	≤ 65				≤ 52/55[1)]
		Circuit-breaker feeder	kA	≤ 65				≤ 52/55[1)]
		Transformer feeder	kA	≤ 65				≤ 52/55[1)]
Filling level (pressure values at 20 °C)		Rated filling level p_{re} (absolute)	kPa	150				
		Minimum functional level p_{me} (absolute)	kPa	130				
Ambient air temperature T		Operation without secondary equipment	°C	-25/-40[1)] to +55/+70[1)]				
		Operation with secondary equipment[3)]	°C	-25/-40[1)] to +55/+70[1)]				
		Storage and transport including secondary equipment[3)]	°C	-25 to +70				
			°C	-40 to +70 (option)				
Degree of protection		Gas compartment		IP65				
		Switchgear enclosure		IP2X / IP3X[1)]				
		Low-voltage compartment		IP3X / IP4X[1)]				

1) Design option

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

3) Depending on the secondary equipment used

Tab. 7: Max. permissible operating voltages

Rated voltage	Highest operating voltage with tolerance	Max. permissible operating voltage
kV	kV	kV
7.2	6.9 ±10 %	7.59
12	11.6 ±10 %	12.76
15	14.4 ±10 %	15.84
17.5	16 ±10 %	17.6
24	23 ±10 %	25.3

3.2 Three-position switch-disconnector

Tab. 8: Switching capacity of switch-disconnector

Rated voltage U_r		kV	7.2	12	15	17.5	24
Rated mainly active load-breaking current I_{load}	100 switching operations at I_{load}	A	630				
	20 switching operations at 0.05 x I_{load}	A	31.5				
Rated closed-loop breaking current I_{loop}		A	630				
Rated cable-charging breaking current I_{cc}		A	68				
Rated line-charging breaking current I_{lc}		A	68				
Rated short-circuit making current I_{ma}	50 Hz	kA	≤ 63				≤ 50
							≤ 52.5[1]
	60 Hz	kA	≤ 65				≤ 52
							≤ 55[1]
Rated earth-fault breaking current I_{ef1}		A	200				
Rated cable-charging breaking current and rated line-charging breaking current under earth-fault conditions I_{ef2}		A	115				
Number of mechanical operating cycles / Classification		n	1000 / M1				
Number of electrical operating cycles with I_{load} / Classification		n	100 / E3				
Number of short-circuit making operations with I_{ma} / Classification		n	5 / E3				
Test of capacitive switching capability			C2				

1) Design option

Tab. 9: Switching capacity of make-proof earthing switch

Rated voltage U_r		kV	7.2	12	15	17.5	24
Rated short-circuit making current I_{ma}	50 Hz	kA	≤ 63				≤ 50
							≤ 52.5[1]
	60 Hz	kA	≤ 65				≤ 52
							≤ 55[1]
Number of mechanical operating cycles / Classification		n	1000 / M0				
Number of short-circuit making operations / Classification		n	5 / E2				

1) Design option

Tab. 10: Switching capacity of switch-fuse combination

Rated voltage U_r	kV	7.2	12	15	17.5	24
Rated mainly active load-breaking current I_{load}	A	200				
Rated transfer current $I_{transfer}$	A	1500		1300		
Maximum transformer rating	kVA	[▶ Page 27, Tab. 35: "Transformer protection table"]				
Tripping time for striker operation	ms	≥ 50 ms				
Tripping time for release operation	ms	≥ 130 ms				
Setting time for delay at the protection device	ms	≥ 100 ms				

Tab. 11: Switching capacity of make-proof earthing switches (with HV HRC fuse-links on feeder side)

Rated voltage U_r		kV	7.2	12	15	17.5	24
Rated short-circuit making current I_{ma}	50 Hz	kA	≤ 6.3				
	60 Hz	kA	≤ 6.5				
Rated short-time withstand current I_k with t_k = 1 s		kA	≤ 2.5				

Motor operating mechanism

Tab. 12: Rated current for the motor operating mechanism protection equipment

Rated supply voltage [V]		Recommended rated current for the protection equipment[1] [A]
DC	24	4
	48	2
	60	1.6
	110	1.0
	120/125	1.0
	220	1.0
AC	110 (50/60 Hz)	1.0
	230 (50/60 Hz)	0.5

1) Protection equipment with tripping characteristic type C

The control voltage (including releases) is protected with 8 A.

Releases

Releases trip the switch-fuse combination. Depending on the operating mechanism used, up to 2 releases can be used.

- **Shunt release (-Y1, -Y3)**
  The opening command is executed by application of an auxiliary voltage (AC or DC, depending on the design option).
  After opening the switch-fuse combination, the release is de-energized internally.

Tab. 13: Power consumption of the operating coils

Operating coil	Power consumption [W/VA]
	Switch-fuse combination
Shunt release (-Y1, -Y3)	≤ 370

3.3 Three-position disconnector

Tab. 14: Switching capacity of disconnector

Rated voltage U_r	kV	7.2	12	15	17.5	24
Rated continuous current I_r	A	250, 630				
Number of mechanical operating cycles / Classification	n	1000 / M0				

Tab. 15: Switching capacity of make-proof earthing switch

Rated voltage U_r		kV	7.2	12	15	17.5	24
Rated short-circuit making current I_{ma}	50 Hz	kA	≤ 63				≤ 50
							≤ 52.5[1]
	60 Hz	kA	≤ 65				≤ 52
							≤ 55[1]
Number of short-circuit making operations / Classification		n	5 / E2				

1) Design option

Tab. 16: Power consumption of the interlocking solenoids

Rated supply voltage		Power consumption
DC	24 / 48 / 60 / 110 / 120 / 125 / 220 V	9.2 W
AC	110 / 230 V	9.2 VA

3.4 Vacuum circuit-breaker

Tab. 17: Switching capacity of vacuum circuit-breaker type 1.1 with three-position disconnector

Rated voltage U_r				kV	7.2	12	15	17.5	24
Rated continuous current of the feeders I_r				A	630				
50 Hz	Rated short-time withstand current I_k	Switchgear with t_k = 1 s	I_k ($_{th}$)	kA	≤ 25[1]				≤ 20/21[2]
		Switchgear with t_k = 3 s	I_k ($_{th}$)	kA	≤ 20/21[2]				
	Rated peak withstand current I_p			kA	≤ 63				≤ 50/52.5[2]
	Rated short-circuit breaking current I_{sc}			kA	≤ 25				≤ 20/21[2]
	Rated short-circuit making current I_{ma}			kA	≤ 63				≤ 50/52.5[2]
60 Hz	Rated short-time withstand current I_k	Switchgear with t_k = 1 s	I_k ($_{th}$)	kA	≤ 25				≤ 20/21[2]
		Switchgear with t_k = 3 s	I_k ($_{th}$)	kA	≤ 20/21[2]				
	Rated peak withstand current I_p			kA	≤ 65				≤ 52/55[2]
	Rated short-circuit breaking current I_{sc}			kA	≤ 25				≤ 20/21[2]
	Rated short-circuit making current I_{ma}			kA	≤ 65				≤ 52/55[2]
Number of operating cycles for disconnector, mechanical					1000				
Number of operating cycles for earthing switch, mechanical					1000				
Number of operating cycles for circuit-breaker, mechanical					10000 (2000[3])				
Classification of circuit-breaker					M1[3], M2, E2, C2, S1				
Classification of disconnector					M0				
Classification of make-proof earthing switch					E2				
Rated operating sequence					O - 0.3 s - CO - 3 min - CO				
					O - 0.3 s - CO - 15 s - CO on request				
Number of short-circuit breaking operations				n	50				

1) Depending on the secondary equipment used
2) Design option
3) Charging the spring energy store manually

Tab. 18: Switching capacity of vacuum circuit-breaker type 2 with three-position disconnector

Rated voltage U_r				**kV**	**7.2**	**12**	**15**	**17.5**	**24**
Rated continuous current of the feeders I_r				A	250 or 630				
50 Hz	Rated short-time withstand current I_k	Switchgear with t_k = 1 s	I_k ($_{th}$)	kA	≤ 25				≤ 20/21[1]
		Switchgear with t_k = 3 s	I_k ($_{th}$)	kA	≤ 20/21[1]				
	Rated peak withstand current I_p			kA	≤ 63				≤ 50/52.5[1]
	Rated short-circuit breaking current I_{sc}			kA	≤ 25				≤ 20/21[1]
	Rated short-circuit making current I_{ma}			kA	≤ 63				≤ 50/52.5[1]
60 Hz	Rated short-time withstand current I_k	Switchgear with t_k = 1 s	I_k ($_{th}$)	kA	≤ 25				≤ 20/21[1]
		Switchgear with t_k = 3 s	I_k ($_{th}$)	kA	≤ 20/21[1]				
	Rated peak withstand current I_p			kA	≤ 65				≤ 52/55[1]
	Rated short-circuit breaking current I_{sc}			kA	≤ 25				≤ 20/21[1]
	Rated short-circuit making current I_{ma}			kA	≤ 65				≤ 52/55[1]
Number of operating cycles for disconnector, mechanical					1000				
Number of operating cycles for earthing switch, mechanical					1000				
Number of operating cycles for circuit-breaker, mechanical					2000				
Classification of circuit-breaker					M1, E2, C1, S1				
Classification of disconnector					M0				
Classification of make-proof earthing switch					E2				
Rated operating sequence					O - 3 min - CO - 3 min - CO				
Number of short-circuit breaking operations				n	20				

[1] Design option

Operating times, contacts

The time indications in the following table refer to the application of the switchgear in accordance with IEC 60721-3-3 Class 3K22. If the switchgear is operated beyond this range, the indicated times may deviate.

Tab. 19: Operating times

Component (item designation)		**Time**	
		Type 1.1	**Type 2**
Closing time			
Closing solenoid	(-Y9)	< 60 ms	< 45 ms
Opening time			
1st shunt release	(-Y1)	< 30 ms	< 45 ms
2nd shunt release	(-Y2)	< 30 ms	—
	(-Y3)	—	< 45 ms
C.t.-operated release	(-Y4)	< 45 ms	—
	(-Y6)	—	< 45 ms
Undervoltage release	(-Y7)	< 45 ms	< 45 ms
Low-energy release	(-Y6)	—	< 45 ms
Break time			
1st shunt release	(-Y1)	< 45 ms	< 60 ms
2nd shunt release	(-Y2)	< 45 ms	—
	(-Y3)	—	< 60 ms
C.t.-operated release	(-Y4)	< 60 ms	—
	(-Y6)	—	< 60 ms
Undervoltage release	(-Y7)	< 60 ms	< 60 ms
Low-energy release	(-Y6)	—	< 60 ms
Close-open time			
1st shunt release	(-Y1)	< 80 ms	< 65 ms
2nd shunt release	(-Y2)	< 20 ms	—
	(-Y3)	—	< 65 ms
Component (item designation)		**Time**	
		Type 1.1	**Type 2**
C.t.-operated release	(-Y4)	< 60 ms	—
	(-Y6)	—	< 65 ms
Undervoltage release	(-Y7)	< 60 ms	< 65 ms
Low-energy release	(-Y6)	—	< 65 ms
Minimum command duration CLOSE[1]			
Closing solenoid	(-Y9)	45 ms	40 ms
Minimum command duration OPEN[1]			
1st shunt release	(-Y1)	< 40 ms	< 40 ms
2nd shunt release	(-Y2)	< 20 ms	—
	(-Y3)	—	< 40 ms
C.t.-operated release	(-Y4)	< 20 ms	—
	(-Y6)	—	< 20 ms
Undervoltage release	(-Y7)	< 20 ms	< 20 ms
Low-energy release	(-Y6)	—	< 20 ms
Arcing time		< 15 ms	< 15 ms
Charging time (motor)		< 15 s	< 15 s
Dead time		0,3 s	180 s

[1] For operation of the switchgear beyond the range defined by IEC 60721-3-3 Class 3K22, a minimum command duration of 100 ms is recommended.

Closing time: The interval of time between the initiation (command) of the closing operation and the instant when the contacts touch in all poles.

Opening time: The interval of time between the initiation (command) of the opening operation and the instant when the contacts separate in all poles.

Arcing time: The interval of time from the first initiation of an arc and the instant of final arc extinction in all poles.

Break time: The interval of time between the initiation (command) of the opening operation and the instant of final arc

extinction in the last-pole-to-clear (= opening time and arcing time).

Close-open time: The interval of time - in a make-break operating cycle - between the instant when the contacts touch in the first pole in the closing process, and the instant when the contacts separate in all poles in the subsequent opening process.

Tab. 20: Power consumption of circuit-breaker motor operating mechanism

Circuit-breaker	Max. power consumption	
	DC	AC
Type 2	approx. 80 W	approx. 80 VA
Type 1.1	approx. 170 W	approx. 230 VA

Tab. 21: Rated current for the motor operating mechanism protection equipment

Rated supply voltage[1]		Recommended rated current for the protection equipment[2]	
		Circuit-breaker type 1.1	Circuit-breaker type 2
DC	24 V	8 A[3]	8 A
	48 V	4 A	6 A
	60 V	4 A	4 A
	110 V	2 A	2 A
	220 V	1.6 A	1.6 A
AC	110 V (50/60 Hz)	3 A	2 A
	230 V (50/60 Hz)	2 A	1.6 A

1) The supply voltage may deviate from the rated supply voltage by max. -20 % to +10 %.
2) M.c.b. with C-characteristic
3) Double bus wire

Tab. 22: Breaking capacity of auxiliary switch 3SV92

Operational voltage [V]		Operational current [A]	
40 Hz to 60 Hz AC	up to 230	10	
		Resistive load	Inductive load
DC	24	10	10
	48	10	9
	60	9	7
	110	5	4
	220	2.5	2

Closing solenoid (-Y9)

The closing solenoid closes the circuit-breaker electrically. The closing command is executed by application of an auxiliary voltage (AC or DC, depending on the design option).

After closing, the closing solenoid is de-energized internally.

Releases

Releases trip the circuit-breaker. Depending on the operating mechanism used, up to 2 releases can be used.

- **Shunt release (-Y1)**
  The opening command is executed by application of an auxiliary voltage (AC or DC, depending on the design option). After opening the circuit-breaker, the release is de-energized internally.
- **Shunt release (-Y2)**
  The shunt release (-Y2) can be operated as an additional release besides the shunt release (-Y1), and works in the same way.
- **Undervoltage release (-Y7)**
  During normal operation, the shunt releases are supplied with a closed-circuit current from an auxiliary voltage source (AC or DC, depending on the design option). When the auxiliary voltage falls below a specific value, or when it is interrupted, the opening operation takes place.
- **C.t.-operated release (-Y4)**
  The c.t.-operated release **3AX1102** is used for protection devices with a relay output, which are supplied with c.t. current. The tripping circuit is supplied via auxiliary instrument transformers for tripping. When the required tripping current (0.5 A or 1 A, depending on the design option) flows in the tripping circuit, the opening operation takes place.
- **C.t.-operated release (-Y6)**
  The low-energy c.t.-operated release **3AX1104** is used for protection devices with a pulse output, which are supplied with c.t. current. The tripping circuit is supplied as well through the protection core of the current transformer. When a pulse of 0.1 Ws runs through the tripping circuit, the opening operation takes place.
- **Low-energy release (-Y6)**
  The low-energy release is provided for use in combination with the transformer monitor IKI-30 (make Kries) or the protection device 7SJ45 (make Siemens) supplied with c.t. current. The tripping circuit is supplied through the current sensor or current transformer. When a pulse of 0.02 Ws runs through the tripping circuit, the opening operation takes place. The low-energy release is available for the vacuum circuit-breaker type 2.

Circuit-breaker tripping signal

When the circuit-breaker is tripped by a release (e.g. by protection tripping), there is a signal through the NO contact -S6.

If the circuit-breaker is tripped deliberately with the mechanical pushbutton, this signal is suppressed by the NC contact -S7.

Tab. 23: Power consumption of the releases

Releases	Power consumption [W/VA]	
	Circuit-breaker	
	Type 1.1	Type 2
Closing solenoid (-Y9)	≤ 440	≤ 370
Shunt release (-Y1)	≤ 440	≤ 370
Shunt release (-Y2)	≤ 60 W	—
	≤ 100 VA	
C.t.-operated release (-Y4)	≤ 20	—
C.t.-operated release (-Y6)	≤ 20	≤ 30
Low-energy release (-Y6)	—	≤ 10
Undervoltage release (-Y7)	≤ 30	≤ 30

3.5 Current transformers and voltage transformers

The technical data of the current transformers and the voltage transformers is given in the configuration documents of the supplied switchgear.

3.6 SIBushing

Type		SIBushing
Cable connection		Outside cone type C according to EN 50181, welded into in den switchgear vessel
Voltage detecting and indicating systems		Connection for capacitive voltage detecting and indicating systems according to IEC 62271-213
Current measurement	Standard	IEC 61869-10
	Sensor principle	Rogowski coil
	Output signal	22.5 mV (at 50 A/50 Hz) and 27.0 mV (at 50 A/60 Hz)
	Class	0.5
Voltage measurement	Standard	IEC 61869-11
	Sensor principle	Capacitor voltage divider
	Ratio	10000/1
	Class	0.5 with temperature compensation
Temperature measurement	Sensor principle	Measuring shunt
	Resistor type	Pt100

Tab. 24: Contact assignment

RJ45 connector	Contact							
	1	2	3	4	5	6	7	8
LPCT	-S1	S2	—	—	—	—	—	—
LPVT	—	—	—	—	—	—	a	n
Temperature	—	—	—	Pt100	Pt100	—	—	—

3.7 Classification of the switchgear

The switchgear is classified according to IEC/EN 62271-200.

Partition class: PM (metal partition - with metal partition walls)

Tab. 25: Loss of service continuity category

Panel type	Loss of service continuity category
Panel with connection compartment	
Ring-main panel	LSC 2
Transformer panel	
Circuit-breaker panel	
Cable panel	LSC 1
Cable panel with make-proof earthing switch	
Billing metering panel ▪ Cable-cable connection ▪ Busbar-cable connection ▪ Cable-busbar connection	
Panel without connection compartment	
Bus sectionalizer panel with three-position switch-disconnector	No LSC assigned[1]
Bus sectionalizer panel with switch-fuse combination	
Bus sectionalizer panel with circuit-breaker	
Busbar earthing panel	
Busbar voltage metering panel with primary fuse protection	
Billing metering panel ▪ Busbar-busbar connection	

1) The IEC 62271-200 does not provide an LSC classification for panels without cable compartment.

Tab. 26: Accessibility to high-voltage compartments

Compartment[1]		Accessibility
Gas compartment (busbar and switching-device compartment)		Non-accessible
Connection compartment at	Panel with earthing switch	Interlock-controlled
	Cable panel (K)	Tool-based
	Billing metering panel type M, air-insulated	Tool-based

1) The low-voltage compartment and the operating mechanism compartment are not high-voltage compartments according to the standard.

Tab. 27: Internal arc classification IAC (option)

Type of installation of the switchgear	IAC class
Wall-standing arrangement	IAC A FL 21 kA 1 s
Free-standing arrangement	IAC A FLR 21 kA 1 s

IAC	Internal Arc Classification
A	Type of accessibility: Switchgear in closed electrical service location, access "for authorized personnel only"
F	Front
L	Lateral
R	Rear
[kA]	Test current
[s]	Test duration

3.8 Standards, directives and laws

The switchgear complies with the following standards, directives and laws applicable at the time of delivery:

		IEC/EN
Switchgear		62271-1
		62271-200
Switching devices	Circuit-breakers	62271-100
	Disconnectors	62271-102
	Earthing switches	
	Switch-disconnectors	62271-103
	Switch-fuse combination	62271-105
Voltage detecting and indicating systems		62271-213
HV HRC fuses		60282-1
Surge arresters		60099
Surge limiters		
Degree of protection		60529
		62262
Insulation		60071
Instrument transformers	General requirements	61869-1
	Current transformers	61869-2
	Inductive voltage transformers	61869-3
	Low-power current transformers	61869-6 61869-10
	Low-power voltage transformers	61869-6 61869-11
Insulating gas SF_6		60376
Installation		61936-1 EN 50522
Environmental conditions		60721-3-3
Operation		EN 50110

Type approval of vacuum interrupter

The vacuum interrupters fitted in the switching devices are type-approved in accordance with § 45 of the Radiation Protection Act (StrlSchG) of the Federal Republic of Germany as interference radiators, and they meet the requirements for interference radiators according to § 23 of the latest Radiation Protection Ordinance (StrlSchV) up to the rated voltage specified in the approval document.

Vacuum interrupters featuring type approval may be operated by the owner of the switchgear without explicit authorization. The approval document is available on request specifying the switchgear type and factory reference number.

Transport regulations

The gas compartment of the switchgear fulfills the preconditions according to section 2.2.2.3 of the "UN Recommendations on the Transport of Dangerous Goods", as implemented in the dangerous goods regulations of the different carriers. For this reason, the switchgear does not qualify as dangerous goods due to the insulating gas.

If dangerous goods are installed in the low-voltage part, this must be considered accordingly.

3.9 Panel types, dimensions and weights

The switchgear weight depends on the switchgear design and the degree to which it is equipped. The transport weight results from the switchgear weight and the packing weight.

The tables show mean values. The exact weights can be found on the nameplate.

Tab. 28: Depth

Switchgear design	Depth [mm]
Standard panels or panel blocks	775 mm
with pressure relief duct	+115 mm
with deep cable compartment cover 105 mm	+105 mm
with cable compartment cover deeper by 250 mm	+250 mm

Tab. 29: Weight of individual panels

Panel type	Width	Switchgear height [mm]		
	[mm]	1200	1400	1700
		Gross weight approx. [kg]		
R	310	100	110	120
R(500)	500	140	150	170
K	310	100	110	120
K(E)	430	130	140	160
T	430	135	145	160
L	430	130	140	155
L (type L1.1) without 4MT3	500	210	220	240
L (type L2)	500	160	170	190
M(SK/SS/KS)	840	–	370	400
M(KK)	840	–	270	300
M(430)	430	245	255	270
M(500) incl. 3x4MT3	500	230	240	260
S	430	130	140	160
S(500)	500	150	160	180
S(620)	620	200	220	240
H	430	135	145	160
V	500	240	250	270
E	310	100	110	120
E(500)	500	140	150	170

Tab. 30: Weight of low-voltage compartment

Panel type	Low-voltage compartment Height 600 mm
	approx. [kg]
R	40
R(500)	60
K	40
K(E)	50
T	50
L	50
L (type L1.1) without 4MT3	60
L (type L2)	60
M(SK/SS/KS)	70
M(KK)	70
M(430)	60
M(500) incl. 3x4MT3	60
S	50
S(500)	60
S(620)	45
H	50
V	60
E	40
E(500)	60

Tab. 31: Weight of panel blocks

Panel block	Width	Gross weight for a switchgear height of[1]		
	[mm]	1200 mm	1400 mm	1700 mm
		approx. [kg]		
Block of 2 panels				
KT, TK	740	230	250	280
K(E)T	860	240	260	290
KL[2], LK	740	230	250	280
K(E)L[2]	860	250	270	300
RK, KR	620	200	220	240
RT, TR	740	230	250	280
RL[2], LR	740	230	250	280
TT	860	270	290	320
RR	620	200	220	240
LL[2]	860	260	280	310
RS	740	230	250	280
RH	740	230	250	280
Block of 3 panels				
RRT, TRR, RTR	1050	330	360	400
LRR, RRL[2]	1050	320	350	390
RLR	1050	320	350	390
RRR	930	300	330	360
TTT	1290	410	440	490
LLL[2]	1290	400	430	480
RRS	1050	320	350	390
RRH	1050	330	360	400
RTT, TRT, TTR	1170	370	400	440
RLL, LLR	1170	360	390	430
Block of 4 panels				
RRRT, RRTR, RTRR, TRRR	1360	430	470	520
RLRR, LRRR, RRRL[2]	1360	430	470	520
RRRR	1240	400	440	480
TRRT, RTTR, TTRR, RRTT	1480	470	510	560
LRRL, RLLR, RRLL, RLRL	1480	460	500	550
TTTT	1720	540	580	640
LLLL[2]	1720	520	560	620
RRRS	1360	420	460	510
RRRH	1360	430	470	520
RTTT,	1600	505	545	595
LLLR, LLRL, RLLL	1600	500	540	590

1) Without low-voltage compartment

2) Applies to design with circuit-breaker type 2

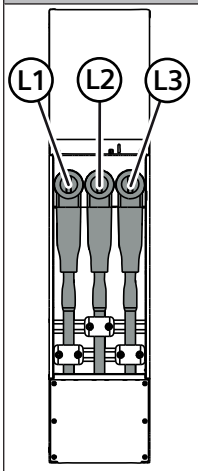
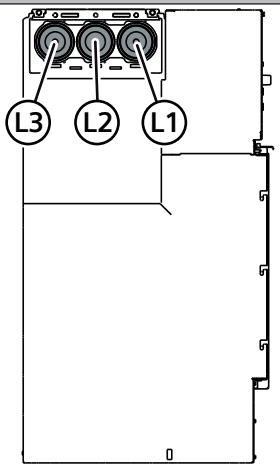
Tab. 32: Packing weights

Maximum width of switchgear assembly	Packing weight (depending on the type of transport)	
	Truck / rail / container	Seaworthy crate / air-freight
[mm]	approx. [kg]	approx. [kg]
850	30	90
1200	40	120
1550	50	150
1800	60	180
2000	75	225

3.10 Phase sequence

The phases L1, L2 and L3 of all panel types are at the following positions:

Tab. 33: Phase sequence

Cable compartment	Busbar
 (View from the front)	 (View from the left)

3.11 Insulating gas

The sealed pressure system of the switchgear contains the insulating gas SF_6 (fluorinated greenhouse gas, GWP 22,800).

Example for a typical amount of SF_6 gas:
Panel block 8DJH RRT with 2.2 kg SF_6 (CO_2e = 50 t)

The respective amount of gas included is indicated on the nameplates of the switchgear.

Gas leakage rate

The gas leakage rate is < 0.1 % per year (referred to the absolute gas pressure).

3.12 Nameplates

The nameplates are provided at the switchgear front and in the operating mechanism compartment.

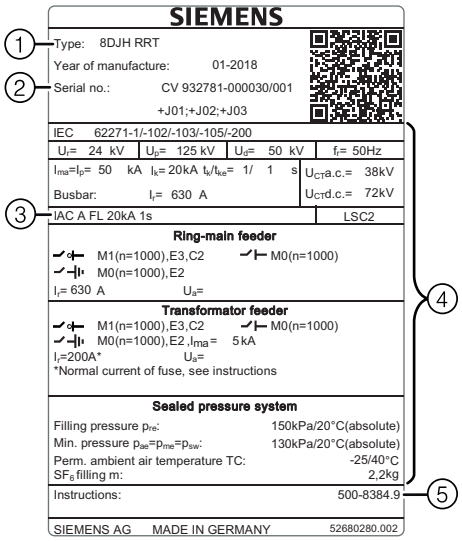


Fig. 11: Nameplate (example)

① Switchgear type and year of manufacture
② Serial number
③ Internal arc classification (option)
④ Technical data
⑤ Number of the operating instructions

3.13 Dielectric strength and site altitude

The switchgear can be installed up to an altitude of 3500 m (above sea level).

For site altitudes of more than 1000 m (above sea level), the reduction of the dielectric strength must be considered. Depending on the panel type or panel equipment, a higher insulation level may have to be selected. The higher insulation level results from the multiplication of the rated insulation level with the altitude correction factor K_a.

Tab. 34: Reduction of the dielectric strength

Site altitude H (above sea level)	Reduction of the dielectric strength for panel type or panel equipment
≤ 1000 m	No restriction
< 1000 m ≤ 3500 m	▪ Panel with HV HRC fuses ▪ Billing metering panel type M ▪ Panel **without** screened cable plugs at the cable connection

Altitude correction factor K_a

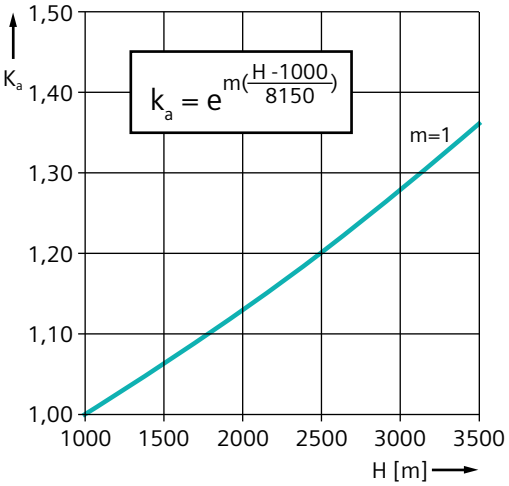


Fig. 12: Altitude correction factor K_a depending on the site altitude

Calculation example
▪ Site altitude 3000 m: K_a = **1.28** ▪ Rated voltage of the power grid: **17.5 kV**
Rated lightning impulse withstand voltage from the table [▶ Page 18, Tab. 6: "General technical data"] at a rated voltage of 17.5 kV: U_p = **95 kV** $U_p \times K_a$ = necessary rated lightning impulse withstand voltage: 95 kV × 1.28 = **122 kV**
Result: According to the table [▶ Page 18, Tab. 6: "General technical data"], a switchgear for a rated voltage of **24 kV** with a rated lightning impulse withstand voltage of **125 kV** is to be selected.

3.14 Selection of HV HRC fuse-links

According to IEC 60282-1, the breaking capacity of HV HRC fuse-links 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-link 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.

To be observed during configuration of switching devices and selection of HV HRC fuse-links:

- Use only fuse-links satisfying the stated operating conditions.
- Use only fuse-links whose breaking capacity was tested at least with the maximum system voltage.

In case of doubt, select a suitable HV HRC fuse-link together with the manufacturer.

Allocation of HV HRC fuses and transformers

The three-position switch-disconnector in the transformer feeder (transformer switch) was combined with HV HRC fuse-links and tested in accordance with IEC 62271-105.

The following protection table shows HV HRC fuse-links tested by Siemens, which are recommended for transformer protection.

The **protection tables** are valid for:

- Maximum ambient air temperature in the switchgear room of 40 °C considering the influences of the switchgear enclosure. The 24-hour mean value is max. 35 °C (both values according to IEC 62271-1).

- Requirements according to IEC 62271-105
- Protection of distribution transformers according to IEC/ TR 62655/VDE 0670-402
- Rated power of the transformer (no overload operation)

Please contact the Siemens Service Hotline if you want to use HV HRC fuse-links from other manufacturers.

Legend:

U_n	System operating voltage
S_r	Rated power of transformer
u_k	Relative impedance voltage of transformer
I_r	Rated current of transformer / fuse-link
U_r	Operating voltage / rated voltage of fuse-link
e	Reference dimension of fuse-link

Tab. 35: Transformer protection table

Transformer			HV HRC fuse-link				
S_r [kVA]	u_k [%]	I_r [A]	I_r [A]	U_r [kV]	e [mm]	Order number	
						Make SIBA	Make Mersen
▼ System operating voltage U_n 3.3 – 3.6 kV ▼							
20	4	3.5	6.3	3–7.2	292	3009813.6.3	–
			10			3009813.10	–
30	4	5.25	10	3–7.2	292	3009813.10	–
			16			3009813.16	–
50	4	8.75	16	3–7.2	292	3009813.16	–
			20			3009813.20	–
75	4	13.1	20	3–7.2	292	3009813.20	–
			25			3009813.25	–
100	4	17.5	31.5	3–7.2	292	3009813.31.5	–
			40			3009813.40	–
125	4	21.87	31.5	3–7.2	292	3009813.31.5	–
			40			3009813.40	–
160	4	28	40	3–7.2	292	3009813.40	–
			50			3009813.50	–
200	4	35	50	3–7.2	292	3009813.50	–
			63			3009913.63	–
250	4	43.74	63	3–7.2	292	3009913.63	–
			80			3009913.80	–
▼ System operating voltage U_n 4.16 – 4.8 kV ▼							
20	4	2.78	6.3	3–7.2	292	3009813.6.3	–
30	4	4.16	10	3–7.2	292	3009813.10	–
50	4	6.93	16	3–7.2	292	3009813.16	–
75	4	10.4	16	3–7.2	292	3009813.16	–
			20			3009813.20	–
100	4	13.87	20	3–7.2	292	3009813.20	–
			25			3009813.25	–
125	4	17.35	25	3–7.2	292	3009813.25	–
			31.5			3009813.31.5	–
160	4	22.2	31.5	3–7.2	292	3009813.31.5	–
			40			3009813.40	–
200	4	27.75	40	3–7.2	292	3009813.40	–
			50			3009813.50	–
250	4	34.7	50	3–7.2	292	3009813.50	–
			63			3009913.63	–
315	4	43.7	63	3–7.2	292	3009913.63	–
			80			3009913.80	–
▼ System operating voltage U_n 5.0 – 5.5 kV ▼							
20	4	2.3	6.3	3–7.2	292	3009813.6.3	–
30	4	3.4	6.3	3–7.2	292	3009813.6.3	–
			10			3009813.10	–
50	4	5.7	10	3–7.2	292	3009813.10	–
			16			3009813.16	–
75	4	8.6	16	3–7.2	292	3009813.16	–
			20			3009813.20	–
100	4	11.5	16	3–7.2	292	3009813.16	–
			20			3009813.20	–
125	4	14.4	20	3–7.2	292	3009813.20	–
			25			3009813.25	–
160	4	18.4	31.5	3–7.2	292	3009813.31.5	–
			40			3009813.40	–
200	4	23	40	3–7.2	292	3009813.40	–
			50			3009813.50	–
250	4	28.8	40	3–7.2	292	3009813.40	–
			50			3009813.50	–
315	4	36.3	50	3–7.2	292	3009813.50	–
			63			3009913.63	–
400	4	46.1	63	3–7.2	292	3009913.63	–
			80			3009913.80	–
▼ System operating voltage U_n 6 – 7.2 kV ▼							
20	4	1.9	6.3	6–12	292	3000413.6.3	–
				3–7.2		3009813.6.3	–
				6–12	442	3010113.6.3	–
50	4	4.8	10	3–7.2	292	3009813.10	–
				6–12		3000413.10	–
					442	3010113.10	–
			16	3–7.2	292	3009813.16	–
				6–12		3000413.16	45DB120V16PTD
					442	3010113.16	–
75	4	7.2	16	3–7.2	292	3009813.16	–
				6–12		3000413.16	45DB120V16PTD
					442	3010113.16	–
100	4	9.6	16	3–7.2	292	3009813.16	–
				6–12		3000413.16	–
					442	3010113.16	–
			20	3–7.2	292	3009813.20	–
				6–12		3000413.20	–
					442	3010113.20	–
			25		292	–	45DB120V25PTD
125	4	12	20	3–7.2	292	3009813.20	–
				6–12		3000413.20	–
					442	3010113.20	–
			25	3–7.2	292	3009813.25	–
				6–12		3000413.25	45DB120V25PTD
					442	3010113.25	–
160	4	15.4	31.5	3–7.2	292	3009813.31.5	–
				6–12		3000413.31.5	45DB120V32PTD
					442	3010113.31.5	–

Transformer			HV HRC fuse-link				
S_r [kVA]	u_k [%]	I_r [A]	I_r [A]	U_r [kV]	e [mm]	Order number	
						Make SIBA	Make Mersen
200	4	19.2	31.5	3–7.2	292	3009813.31.5	–
				6–12		3000413.31.5	–
					442	3010113.31.5	–
			40	3–7.2	292	3009813.40	–
				6–12		3000413.40	45DB120V40PTD
					442	3010113.40	–
250	4	24	40	3–7.2	292	3009813.40	–
				6–12		3000413.40	–
					442	3010113.40	–
			50	3–7.2	292	3009813.50	–
				6–12		3000413.50	–
					442	3010113.50	–
			63		292	3001243.63	45DB120V63PTS2
315	4	30.3	50	3–7.2	292	3009813.50	–
				6–12		3000413.50	45DB120V50PTD
					442	3010113.50	–
			63		292	3001243.63	45DB120V63PTS2
			80			–	45DB120V80PTS2
400	4	38.4	63	6–12	292	3001243.63	–
			80			3001243.80	45DB120V80PTS2
					442	3010243.80	–
			63	3–7.2	292	3009913.63	–
				6–12		3001213.63	–
					442	3010213.63	–
			100		292	–	45DB120V100PTS2
500	4	48	80	6–12	292	3001243.80	–
					442	3010243.80	–
				3–7.2	292	3009913.80	–
				6–12		3001213.80	–
					442	3010213.80	–
			100		292	3001243.100	45DB120V100PTS2
					442	3010243.100	45DB120V100PTS3
630	4	61	100	6–12	442	3010243.100	–
			125		292	3002043.125	45DB120V125PTS2
					442	3010343.125	–
800	4	77	160	6–12	442	–	45DB120V160PTS3
▼ System operating voltage U_n 10 – 12 kV ▼							
20	4	1.15	4	6–12	292	3000413.4	–
50	4	2.9	10	6–12	292	3000413.10	45DB120V10PTD
					442	3010113.10	–
				10–17.5	292	3025513.10	–
					442	3023113.10	–
				10–24		3000613.10	45DB240V10PTD
75	4	4.3	10	6–12	292	3000413.10	45DB120V10PTD
					442	3010113.10	–
				10–17.5	292	3025513.10	–
					442	3023113.10	–
				10–24		3000613.10	45DB240V10PTD
100	4	5.8	16	6–12	292	3000413.16	–
					442	3010113.16	–
				10–17.5	292	3025513.16	–
					442	3023113.16	–
				10–24		3000613.16	45DB240V16PTD

Transformer			HV HRC fuse-link				
S_r [kVA]	u_k [%]	I_r [A]	I_r [A]	U_r [kV]	e [mm]	Order number	
						Make SIBA	Make Mersen
125	4	7.2	16	6–12	292	3000413.16	45DB120V16PTD
					442	3010113.16	–
				10–17.5	292	3025513.16	–
					442	3023113.16	–
				10–24		3000613.16	45DB240V16PTD
			20			–	45DB240V20PTD
160	4	9.3	20	6–12	292	3000413.20	45DB120V20PTD
					442	3010113.20	–
				10–17.5	292	3022113.20	–
					442	3023113.20	–
				10–24		3000613.20	45DB240V20PTD
200	4	11.5	25	6–12	292	3000413.25	45DB120V25PTD
					442	3010113.25	–
				10–17.5	292	3022113.25	–
					442	3023113.25	–
				10–24		3000613.25	45DB240V25PTD
250	4	14.5	25	6–12	292	3000413.25	45DB120V25PTD
					442	3010113.25	–
				10–17.5	292	3022113.25	–
					442	3023113.25	–
				10–24		3000613.25	45DB240V25PTD
			31.5	6–12	292	3000413.31.5	–
					442	3010113.31.5	–
				10–17.5	292	3022113.31.5	–
					442	3023113.31.5	–
				10–24		3000613.31.5	45DB240V32PTD
315	4	18.3	31.5	6–12	292	3000413.31.5	45DB120V32PTD
					442	3010113.31.5	–
				10–17.5	292	3022113.31.5	–
					442	3023113.31.5	–
				10–24		3000613.31.5	45DB240V32PTD
			40	6–12	292	3000413.40	–
					442	3010113.40	–
				10–17.5	292	3022113.40	–
					442	3023113.40	–
				10–24		3000613.40	45DB240V40PTD
400	4	23.1	40	6–12	292	3000413.40	45DB120V40PTD
					442	3010113.40	–
				10–17.5	292	3022113.40	–
					442	3023113.40	–
				10–24		3000613.40	45DB240V40PTD
			50	6–12	292	3000413.50	–
					442	3010113.50	–
				10–17.5	292	3022113.50	–
					442	3023213.50	–
				10–24		3001413.50	45DB240V50PTS
500	4	29	50	6–12	292	3000413.50	45DB120V50PTD
					442	3010113.50	–
				10–17.5	292	3022113.50	–
					442	3023213.50	–
				10–24		3001413.50	45DB240V50PTD
			63	6–12	292	3001243.63	45DB120V63PTS2
				10–24	442	3001443.63	45DB240V63PTD

Transformer			HV HRC fuse-link				
S_r [kVA]	u_k [%]	I_r [A]	I_r [A]	U_r [kV]	e [mm]	Order number	
						Make SIBA	Make Mersen
630	4	36.4	63	6–12	292	3001243.63	–
			80	10–24	442	3001443.80	45DB240V80PTS
			63	6–12	292	3001213.63	45DB120V63PTD
					442	3010213.63	–
				10–17.5		3023213.63	–
			80	6–12	292	3001243.80	45DB120V80PTS2
					442	3010243.80	–
800	5–6	46.2	63	6–12	292	3001213.63	–
			80			3001243.80	45DB120V80PTS2
					442	3010243.80	–
				10–24		–	45DB240V80PTS
1000	5–6	58	100	6–12	292	–	45DB120V100PTS2
					442	3010243.100	45DB120V100PTS3
				10–24		–	45DB240V100PTS
1250	5–6	72.2	125	6–12	292	–	45DB120V125PTS2
					442	3010343.125	45DB120V125PTS3
▼ System operating voltage U_n 13.8 kV ▼							
20	4	0.8	3.15	10–24	442	3000613.3,15	–
50	4	2.1	6.3	10–17.5	442	3023113.6,3	–
				10–24		3000613.6,3	–
			10			–	45DB240V10PTD
75	4	3.2	6.3	10–17.5	442	3023113.6,3	–
			10			3023113.10	–
				10–24		3000613.10	45DB240V10PTD
100	4	4.2	10	10–17.5	442	3023113.10	–
			16			3023113.16	–
				10–24		3000613.16	45DB240V16PTD
125	4	5.3	10	10–17.5	442	3023113.10	–
			16			3023113.16	–
				10–24		3000613.16	45DB240V16PTD
160	4	6.7	16	10–17.5	442	3023113.16	–
				10–24		–	45DB240V16PTD
200	4	8.4	16	10–17.5	442	3023113.16	–
			20			3023113.20	–
				10–24		3000613.20	45DB240V20PTD
250	4	10.5	20	10–17.5	442	3023113.20	–
			25			3023113.25	–
				10–24		3000613.25	45DB240V25PTD
315	4	13.2	25	10–17.5	442	3023113.25	–
				10–24		–	45DB240V25PTD
			31.5	10–17.5		3023113.31,5	–
				10–24		3000613.31,5	45DB240V32PTD
400	4	16.8	31.5	10–17.5	442	3023113.31,5	–
				10–24		3000613.31,5	45DB240V32PTD
			40			–	45DB240V40PTD
500	4	21	40	10–17.5	442	3023113.40	–
				10–24		3000613.40	45DB240V40PTD
			50			–	45DB240V50PTD
630	4	26.4	50	10–17.5	442	3023213.50	–
				10–24		3001413.50	45DB240V50PTD
			63			–	45DB240V63PTD
			80			–	45DB240V80PTS

Transformer			HV HRC fuse-link				
S_r [kVA]	u_k [%]	I_r [A]	I_r [A]	U_r [kV]	e [mm]	Order number	
						Make SIBA	Make Mersen
800	5–6	33.5	63	10–24	442	3001443.63	45DB240V63PTD
			80			–	45DB240V80PTS
1000	5–6	41.9	80	10–24	442	3001443.80	45DB240V80PTD
1250	5–6	52.3	100	10–24	442	–	45DB240V100PTS
▼ System operating voltage U_n 15 – 17.5 kV ▼							
20	4	0.77	3.15	10–24	442	3000613.3,15	–
50	4	1.9	6.3	10–17.5	442	3023113.6,3	–
				10–24		3000613.6,3	–
75	4	2.9	6.3	10–17.5	442	3023113.6,3	–
			10	10–24		–	45DB240V10PTD
100	4	3.9	10	10–17.5	442	3023113.10	–
				10–24		–	45DB240V10PTD
125	4	4.8	16	10–17.5	442	3023113.16	–
				10–24		3000613.16	45DB240V16PTD
160	4	6.2	16	10–17.5	442	3023113.16	–
				10–24		–	45DB240V16PTD
200	4	7.7	16	10–24	442	–	45DB240V16PTD
			20	10–17.5		3023113.20	–
				10–24		3000613.20	–
250	4	9.7	25	10–17.5	442	3023113.25	–
				10–24		3000613.25	45DB240V25PTD
315	4	12.2	25	10–24	442	–	45DB240V25PTD
			31.5	10–17.5		3023113.31,5	–
				10–24		3000613.31,5	–
400	4	15.5	31.5	10–17.5	442	3023113.31,5	–
				10–24		3000613.31,5	45DB240V32PTD
500	4	19.3	31.5	10–17.5	442	3023113.31,5	–
				10–24		3000613.31,5	–
			40	10–17.5		3023113.40	–
				10–24		3000613.40	45DB240V40PTD
630	4	24.3	40	10–17.5	442	3023113.40	–
				10–24		3000613.40	–
			50	10–17.5		3023213.50	–
				10–24		3001413.50	45DB240V50PTD
			63			3001443.63	–
800	5–6	30.9	63	10–24	442	3001443.63	–
1000	5–6	38.5	80	10–24	442	3001443.80	–
1250	5–6	48.2	100	10–24	442	3002243.100	–
▼ System operating voltage U_n 20 – 24 kV ▼							
20	4	0.75	3.15	10–24	442	3000613.3,15	–
50	4	1.5	6.3	10–24	442	3000613.6,3	–
75	4	2.2	6.3	10–24	442	3000613.6,3	–
100	4	2.9	6.3	10–24	442	3000613.6,3	–
			10			–	45DB240V10PTD
125	4	3.6	10	10–24	442	3000613.10	45DB240V10PTD
160	4	4.7	10	10–24	442	3000613.10	–
200	4	5.8	16	10–24	442	3000613.16	45DB240V16PTD
250	4	7.3	16	10–24	442	3000613.16	45DB240V16PTD
315	4	9.2	16	10–24	442	3000613.16	–
			20			3000613.20	–
			25			–	45DB240V25PTD
400	4	11.6	20	10–24	442	3000613.20	–
			25			3000613.25	45DB240V25PTD

Transformer			HV HRC fuse-link				
S_r [kVA]	u_k [%]	I_r [A]	I_r [A]	U_r [kV]	e [mm]	Order number	
						Make SIBA	Make Mersen
500	4	14.5	25	10–24	442	3000613.25	45DB240V25PTD
			31.5			3000613.31,5	45DB240V32PTD
630	4	18.2	31.5	10–24	442	3000613.31,5	45DB240V32PTD
			40			3000613.40	45DB240V40PTD
800	5–6	23.1	31.5	10–24	442	3000613.31,5	–
			40			3000613.40	45DB240V40PTD
1000	5–6	29	50	10–24	442	3001413.50	45DB240V50PTS
			63			3001443.63	–
1250	5–6	36	50	10–24	442	–	45DB240V50PTS
			80			3001443.80	–
1600	5–6	46.5	100	10–24	442	3002243.100	–
2000	5–6	57.8	140	10–24	442	3002243.140	–

4 Transport

4.1 Transport unit

A transport unit consists of an individually packed panel or panel block on a transport pallet.

Storage of switchgear accessories upon delivery

- **Individual panel**: in cable compartment
- **Panel block**: in left-hand cable compartment
- **In case of many accessories:** in a separate transport unit

Specifications on weights and transport dimensions [► Page 24, "Panel types, dimensions and weights"].

4.2 Unloading and transporting the switchgear

1. Attach ropes far away on the hoisting tackle. The ropes must not exert any force on the panel walls under load.
2. Sling the ropes around the ends of the transport pallets.
3. During transport to the place of installation or storage place, leave the panels on their transport pallet for as long as possible.
4. Remove the packing not before start of assembly.
5. Observe the transport information provided on the switchgear:
   – The angle between the crane chains at the lifting facility must be less than 90°.
   – The distance between the transport eyes and the lifting facility must be at least half the switchgear width.

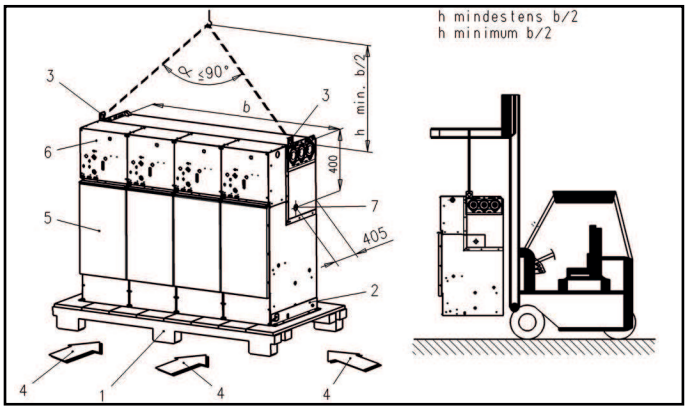


Fig. 13: Adhesive label with transport information (example)

Center of gravity

The center of gravity of a panel depends on the degree to which the panel is equipped. The position of the center of gravity is marked with a symbol on both sides of the panel.



Fig. 14: Symbol for the center of gravity

Transport eyes

The transport eyes are pre-assembled at the factory. For delivery without low-voltage compartment and without pressure absorber, the transport eyes must be turned before transporting the switchgear.

1. Undo the bolt ② of the transport eyes ① and turn the transport eyes upwards by 180°.
2. Re-fasten the bolt-and-washer assembly ②.

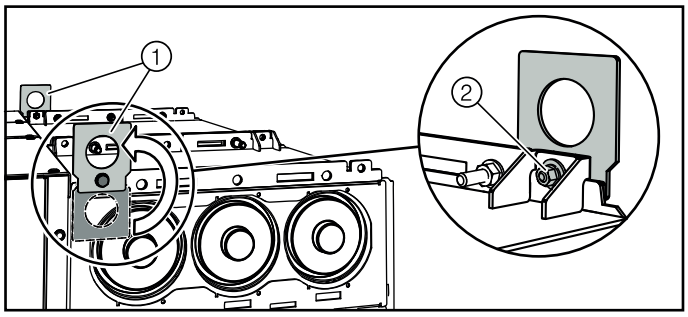
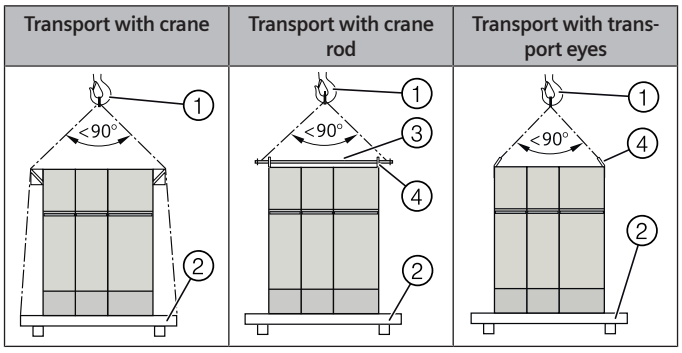
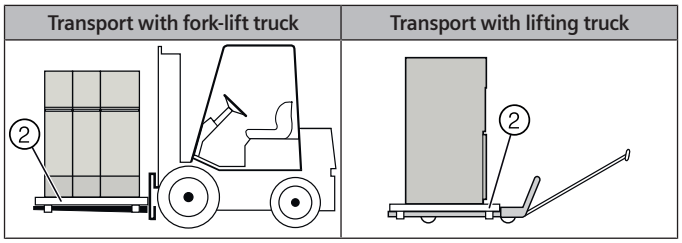


Fig. 15: Turning the transport eyes

Further transport facilities





① Crane hook
② Transport pallet
③ Crane rod (Ø 40 mm, observe switchgear weight)
④ Transport eye

4.3 Checking the delivery

1. Temporarily open the packing in a weatherproof place. In order to prevent pollution of the switchgear, do not remove the PE film completely until reaching the final mounting position.
2. Check whether the delivery is complete using the delivery notes and packing lists.
3. Compare the serial number of the switchgear printed on the delivery note with the serial number on the packing and the serial number on the nameplate.
4. Check whether all operating and installation instructions specified on the nameplate are available.
5. Check whether the switchgear accessories are complete.
6. Check the switchgear for defects and transport damage. Inform the forwarding agent about determined defects or transport damages and document them, e.g. on the freight documents. Document major defects or transport damages photographically and prepare a damage report. If required, refuse to accept the delivery.

INFORMATION

Due to fluctuations in the production process, minor optical anomalies may be visible on the gas vessel:
- Welding splatters
- Discoloration, due to welding deposits, for example
- Irregular edges at the rear side
- Corrections, e.g. manual welding seams

These optical anomalies do not affect the long service life, the tightness or the corrosion protection of the switchgear.

7. Check service readiness [► Page 81, "Ready-for-service indicator"].
8. To repair transport damages or defects, contact the Siemens Service Hotline.
9. Refit the packing at the best.

4.4 Setting down the switchgear at the place of installation

Transport the switchgear together with its transport pallet as close as possible to the mounting position.

1. Remove the packing of the switchgear. Dispose of packings and consumables in an environmentally compatible way, or recycle them.
2. If required, remove the cable compartment cover and take out the accessories. Hook the cable compartment cover in again.

If the switchgear can be lifted directly from the transport pallet onto its mounting position:

1. Remove the transport angles.
2. Lower the switchgear slowly on the mounting position.

If the switchgear cannot be lifted directly from the transport pallet onto its mounting position:

1. Remove the transport angles from the transport pallet. Do **not** remove the transport angles from the switchgear.
2. Lower the switchgear by means of the transport angles onto roller pads (reinforced rollers) or tubes.
3. Lift the switchgear at the side edges with roller crowbars and slowly lower it onto the mounting position.
4. Remove the transport angles from the switchgear.

Removing the transport angles

The transport angles are fixed to the switchgear at the sides.

1. Remove the fixing bolts of the transport pallet.

2. Remove the fixing bolts of the transport angles. Remove the transport angles.

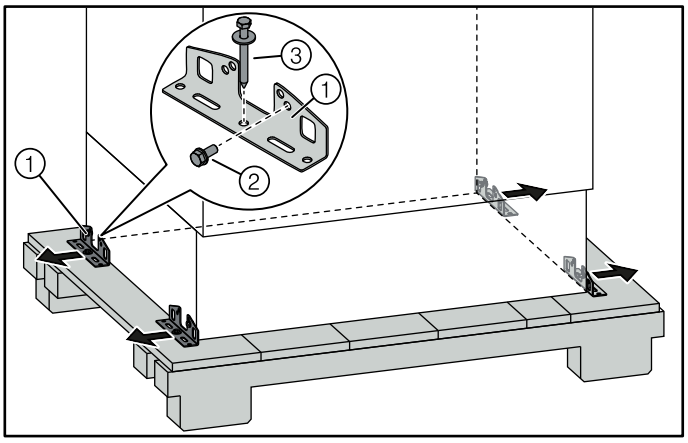


Fig. 16: Removing the transport angles

① Transport angle
② Fixing bolt of the switchgear
③ Fixing bolt of the transport pallet

3. Screw the fixing bolts of the transport angles in again at the same place on **both sides** of the switchgear.

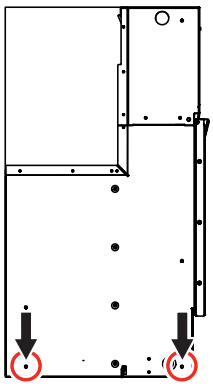


Fig. 17: Fixing points for transport angles (on both sides)

5 Storage

1. Observe the information provided on the switchgear packing concerning transport and storage.

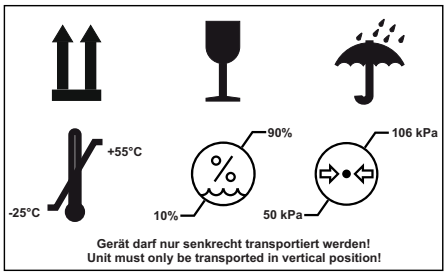


Fig. 18: Storage and transport information (example)

Ambient air temperatures

Permissible ambient air temperatures for storage of the switchgear [▶ Page 18, Tab. 6: "General technical data"].

Storage in closed rooms

- Storage is possible in the undamaged original packing including transport base (all packing types)

Outdoor storage

- Storage is possible in the undamaged original packing including transport base, executed as seaworthy crate, for a maximum of 6 months
- Longer storage time is possible; to do this, contact the Siemens Service Hotline. Have the desiccant bags replaced by a specialist every 6 months

Requirements on the storage place

- Ground with adequate load-bearing capacity, solid, even and dry
- Ambient air temperatures always within the limit values for the switchgear
- Protected against mechanical damages, e.g. collision with vehicles, falling objects, tilting, falling over, vandalism
- Protected against humidity, e.g. rain, flooding, melting water, foam, persistent high air humidity, floor humidity
- Protected against fire
- Protected against direct solar radiation
- Protected against corrosive, dusty or arenaceous pollution
- Protected against the wind
- Protected against vermin (e.g. rats, mice, insects), and vegetation overgrowth

Instructions for storage

- Do not unpack small parts (to prevent corrosion and loss)
- Check packing for ingress of humidity (condensation) every 4 weeks

6 Installation

In the instructions given in the following chapters it is assumed that a new switchgear is being installed which is not connected to the mains, and is not live.

6.1 Extending existing switchgear or replacing components

Before extending or replacing parts of an existing switchgear, perform the following operations:

Switching off high voltage

1. Isolate the switchgear and secure it against reclosing.
2. Ensure safe isolation from supply for the switchgear.
3. Earth all feeders.

Switching off auxiliary voltage

1. Switch off the auxiliary voltage, and secure it against reclosing.
2. Verify safe isolation from supply.

Discharging the spring energy store

1. Discharge all spring energy stores in the panels. The "spring charged" indicator must show "spring not charged".

6.2 Tools and auxiliary means

- Standard tools such as torque wrenches (6...50 Nm), various screwdrivers (slot, Philips and Torx), various wrenches
- Battery screwdriver
- Shims to compensate for floor unevenness (thickness: 0.5...1 mm)

6.3 Cleaning agents

Activity	Cleaning agents
Cleaning the front covers, voltage transformers and current transformers	Mild, customary household cleaner for general degreasing work and cleaning work **(solvent-free)**
Cleaning electrostatically stressed cast-resin insulators or cast-resin components	Dry wiping cloths; plastic cleaner containing alcohol if there is a lot of dirt
Applying and wiping off liquid cleaning agent (for single use)	Lint-free cleaning paper
Removing dust	Brush
Damp cleaning, drying	Lint-free wiping cloths
Suction of drilling chips, construction waste or dust	Vacuum cleaner with plastic tip for sensitive components

6.4 Mounting paste

Use mounting paste only according to the installation instructions.

Use only the supplied or released mounting paste.

6.5 Tightening torques

If not stated otherwise, the following tightening torques apply to the switchgear:

Material / material	Thread	Tightening torque
Metal joints		
Sheet steel / sheet steel e.g.: front covers, roof plates, etc.	M5	7 Nm
	M6[1)]	12 Nm
	M8	30 Nm
Earthing busbar		
Sheet steel / copper	M8	20 Nm
Copper / copper	M8	20 Nm
Earthing the switchgear		
Sheet steel / cable lug	M12	50 Nm[2)]
Cable shield earthing	M10	30 Nm[2)]
Cable connection		
Cable plug / bushing	M16	max. 80 Nm[2)]

[1)] Self-tapping

[2)] The tightening torque depends on:
- Material of cable lug
- Information of cable and sealing end manufacturer

6.6 Comments on electromagnetic compatibility

To achieve appropriate electromagnetic compatibility (EMC), some basic requirements must be observed while erecting the switchgear. This applies especially to the installation and connection of external cables and wires.

The switchgear assemblies of this type series fulfill the basic protection requirements of the EMC Directive. Basic measures for ensuring EMC are already taken during design and assembly of the switchgear. Among other things, these measures include:

- The low-voltage compartment is an integral part of the panel, which means that the protection and control devices with the internal wiring are metal-enclosed.
- Reliable earth connections of the frame parts via toothed contact washers or locking washers.
- Lay EMC-relevant wires in metal ducts within the panel (e.g. copper wires without metal shields).
- Spatial separation of sensitive signal wires from wires with high interference voltage levels.
- Limitation of switching overvoltages of inductive loads (e.g. relay or contactor coils, motors) by means of protective circuits with diode, varistor or RC element.
- Within the low-voltage compartment, the secondary devices are mounted in defined zones.
- Shortest possible connection between corresponding modules in subracks.
- Consideration of the magnetic leakage fields of conductor bars and cables.
- Protection of subracks and wiring backplanes against interference by perforated shielding plates.
- Large surface bonding between all modules and devices as well as bonding to the earthing conductor of the switchgear assembly.

These measures basically enable proper operation of the switchgear. The planner or operator of the complete switchgear must decide whether additional measures are required depending on the electromagnetic environment where the switchgear is installed. Such measures must be implemented by the installation company in charge.

In an environment with heavy electromagnetic interference it may be necessary to use shielded cables and wires for the external connections. This makes it possible to avoid interferences in the low-voltage compartment and thus, undesired influences on

the electronic protection and control or other automation devices.

Cable shields must be electrically bonded to be able to carry high frequencies, and contacted concentrically at the cable ends.

Connect and earth the cable shields and wires in the low-voltage compartment.

Connect the cable shields to earth potential – with high electrical conductivity and all around as far as possible. Protect the contact surfaces from corrosion in case of humidity (regular condensation).

When laying cables into the switchgear assembly, separate the control, signaling and data cables, and other lines with different signal and voltage levels, e.g. by laying them on separate racks or riser cable routes.

Corresponding to the different shield designs, there is a number of methods to perform connection. The planning department or site management determines which of the methods will be used, taking EMC requirements into account. The preceding points should always be taken into account.

Connect the shield to cables or wires with clamps contacting all around. If low demands are placed on EMC, it is also possible to connect the cable shield directly to earth potential (combine or twist the shield wires) or via short cable connections. Use cable lugs or wire-end ferrules at the connecting points.

Always keep the connecting leads of the shields as short as possible (< 100 mm).

If cable shields are used as protective earth conductors at the same time, the connected plastic-insulated single-core wire must be marked green/yellow over its entire length. Non-insulated connections are inadmissible.

6.7 Switchgear room

Requirements on switchgear room and cable basement

- When planning and dimensioning the switchgear room, observe the dimensions and weights of the switchgear. Observe the specified minimum distances.
- Depending on the pressure relief method, floor openings and pressure relief rooms must be provided for. The dimensions must be according to the dimension drawing in the switchgear documentation.
- The switchgear room including the cable basement must be able to withstand the pressure stress caused by an internal arc, and must be equipped with pressure relief outlets to the outside.
- The cable basement must allow adequate space for connecting and laying the high-voltage cables.

Further information:

- [► Page 43, "Floor openings and fixing points"]
- [► Page 24, "Panel types, dimensions and weights"]
- [► Page 16, "Pressure relief"]

Room dimensions and minimum distances

The room dimensions result from the total width of the switchgear and the required wall distances.

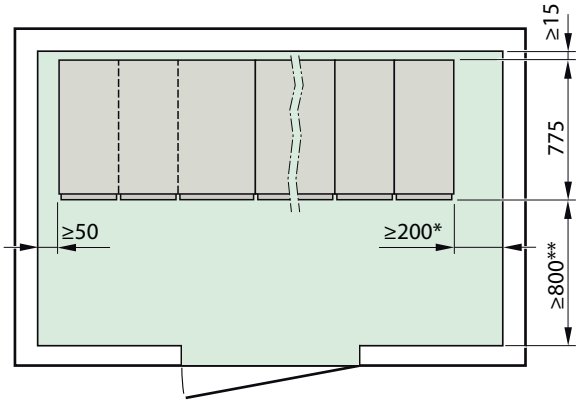


Fig. 19: Pressure relief downwards (standard)

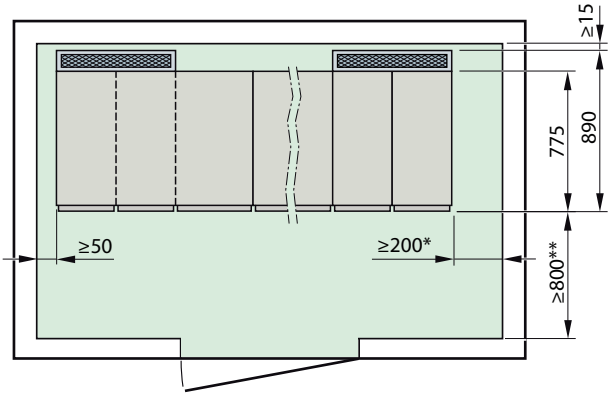


Fig. 20: Pressure relief with pressure relief duct at the rear

* For lined up panels

** Depending on the locally applicable regulations. For extension or panel replacement, a control aisle of at least 1000 mm is recommended.

When a pressure absorber system is used, the room heights tested for internal arc classification that are given in the following table are decisive:

Switchgear height [mm]	Room height [mm]
1400	≥ 2000
1700, 1800	≥ 2200
2300	≥ 2400
2600	≥ 2600

6.8 Preparing the foundation

- A suitable foundation can be a false floor, a double floor or a reinforced-concrete foundation. The reinforced-concrete floor must be equipped with foundation rails for supporting the panels.
- As for design and construction of the foundation, the relevant standards DIN 43661 "Fundamentschienen in Innenanlagen der Elektrotechnik" (Foundation rails in electrical indoor installations) and DIN 18202 "Maßtoleranzen im Hochbau" (Blatt 3) (Measuring tolerances in structural engineering) apply.
- The dimensions of the floor opening and the fixing points of the switchgear are given in the switchgear documentation.

1. Determine level differences between the mounting surfaces of the panels using a measuring sheet, and compensate with shims.

Stipulations for evenness and straightness

Evenness/straightness tolerance according to DIN 43661:

1 mm per 1 m switchgear width and 2 mm for the total switchgear width.

6.9 Checking service readiness

The gas compartment is filled with insulating gas and is under pressure. Before starting installation, the gas pressure must be checked by means of the ready-for-service indicator.

1. Read the ready-for-service indicator ([▶ Page 81, "Ready-for-service indicator"]).

✓ If the pointer of the ready-for service indicator is in the green area, the gas pressure is in order.

If the pointer of the ready-for-service indicator is in the red area:

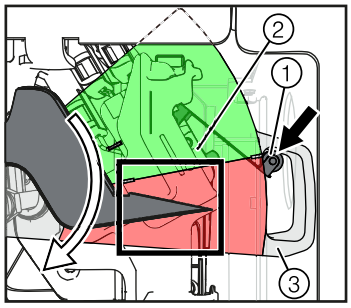
2. Check the signaling switch of the ready-for-service indicator.

Checking the signaling switch

During transport, the signaling switch of the ready-for-service indicator can latch tight in the red area due to vibrations.

1. Remove the front cover [▶ Page 63, "Removing and mounting the front cover"].
2. Carefully push the roller lever ① in the direction of the signaling switch ②.

✓ The sector disc ③ must return automatically until the pointer of the ready-for-service indicator is in the green area again. If not, please stop the installation and contact the Siemens Service Hotline.



① Roller lever
② Signaling switch
③ Sector disk

Fig. 21: Roller lever and sector disk

6.10 Removing the transport eyes and transport blocks

On panels with pre-assembled low-voltage compartments, transport blocks are mounted. The transport blocks can be removed before installation work is started. The transport eyes must be removed before installation work is started.

1. Unscrew the bolted joint and remove the transport eyes and/or transport blocks.

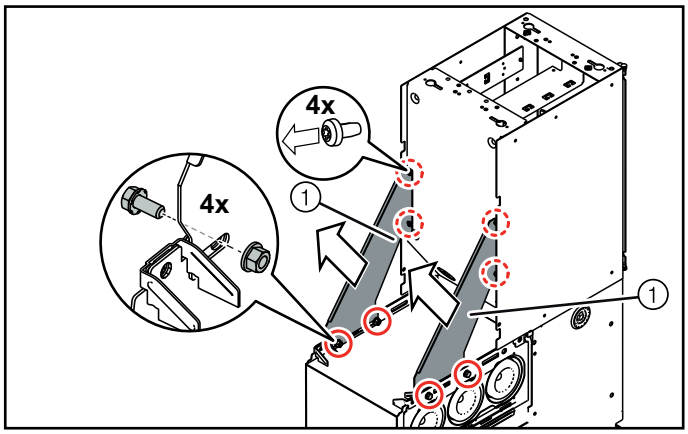


Fig. 22: Removing transport blocks

① Transport block

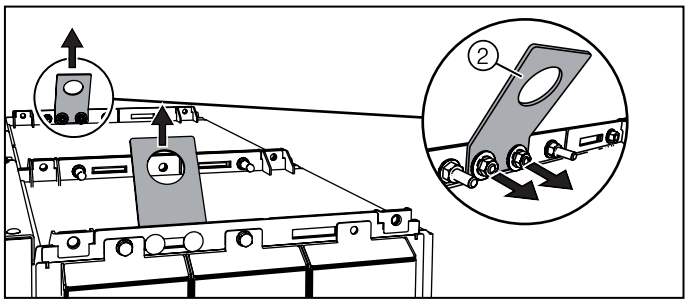
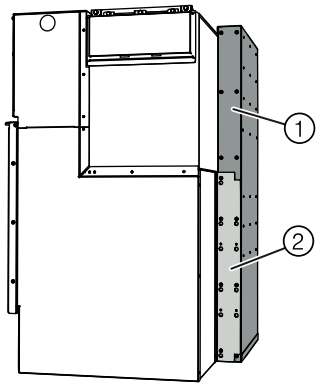


Fig. 23: Removing transport eyes

② Transport eye

6.11 Installing the pressure relief duct for the pressure absorber system (IAC up to 16 kA)



① Pressure relief duct
② Fixing bracket

Fig. 24: Mounted pressure relief duct

1. Fasten 2 fixing brackets ② for the pressure relief duct of the switchgear to the rear wall of the frame using 6 self-tapping screws M6 each.

2. Fasten the pressure relief duct ① to the 2 fixing brackets on both sides using 6 self-tapping screws M6 each.
CAUTION Heavy component; use suitable lifting equipment or lift together with several persons.

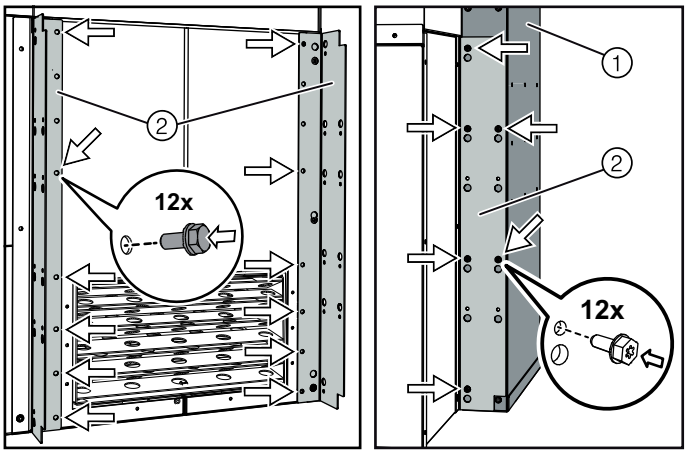
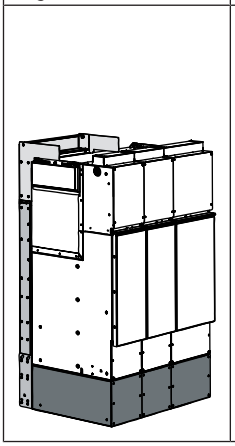
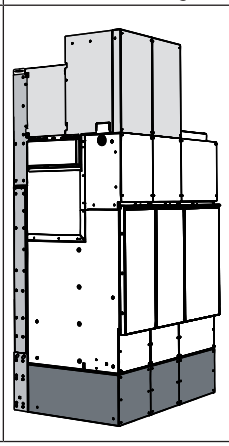
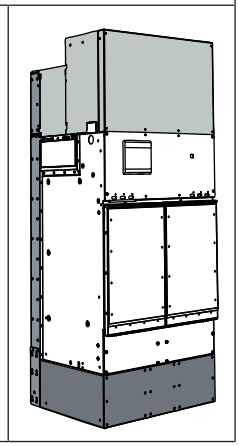


Fig. 25: Mounting the fixing brackets and the pressure relief duct

6.12 Installing the base and the pressure relief duct for the pressure absorber system (IAC up to 21 kA)

IAC A FL up to 21 kA/1s	IAC A FLR up to 21 kA/1s	
Panel in wall-standing arrangement (except billing metering panel)	Panel in free-standing arrangement (except billing metering panel)	Billing metering panel in wall-standing arrangement or free-standing arrangement
Height 1800 mm	Height ≥ 2300 mm	
		

1. Bolt the pressure relief duct together with the fixing brackets on both sides of the base frame using 6 self-tapping screws M6 each.
CAUTION Heavy component; use suitable lifting equipment or lift together with several persons.

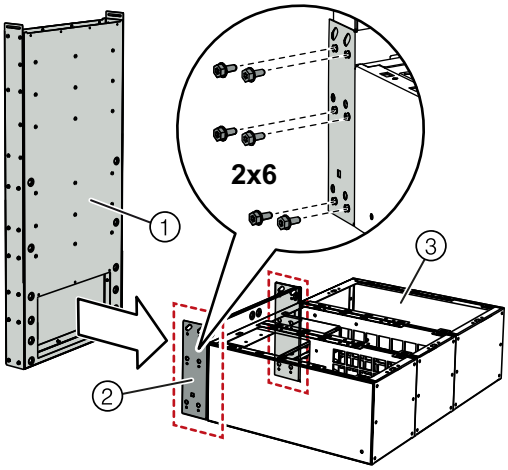


Fig. 26: Mounting the pressure relief duct

① Pressure relief duct
② Fixing bracket
③ Base frame

2. **Billing metering panels or panels in free-standing arrangement:** Fasten the top unit to the pressure relief duct using 8 self-tapping screws M6.
CAUTION Heavy component; use suitable lifting equipment or lift together with several persons.

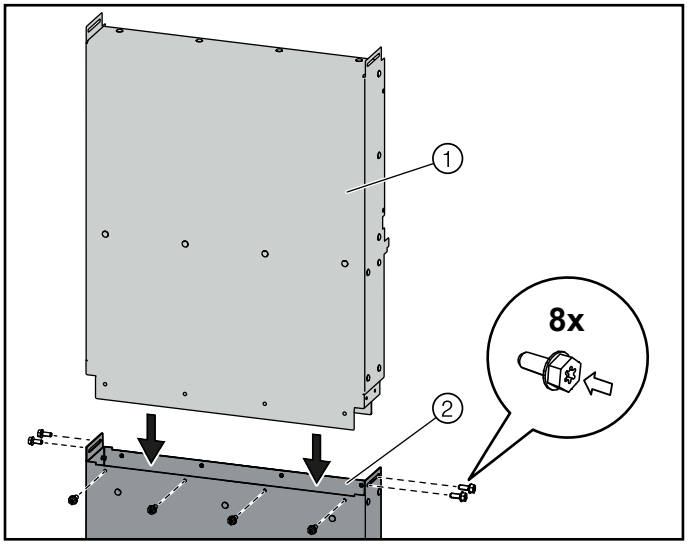


Fig. 27: Mounting the top unit (view from the rear)

① Top unit
② Pressure relief duct

3. Align the base frames of all panels next to each other at their installation position.

4. Bolt the base frames together using 2 bolts M8x20 and nut-and-washer assemblies M8 each.

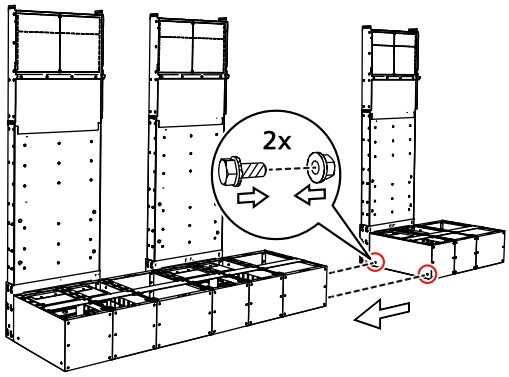


Fig. 28: Bolting the base frames together (example)

5. Fasten the base frames to the foundation using at least 4 bolts M8 per panel. In the case of base frames for billing metering panels, all available fixing points must be used [▶ Page 42, "Fastening the switchgear to the foundation"].

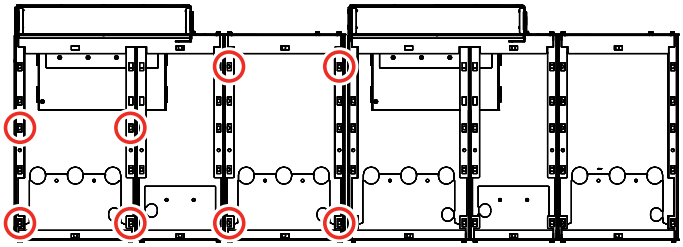


Fig. 29: Fixing points of the base frame on the foundation (example)

6. Close unused fixing points with silicone or adhesive tape.

The fixing points of the pressure relief duct and the switchgear are described in the dimensional drawings of the switchgear documentation.

Mounting the panels onto the base frames

1. Lift the panel onto the base frame. Push it into position. If required, remove the cable brackets.

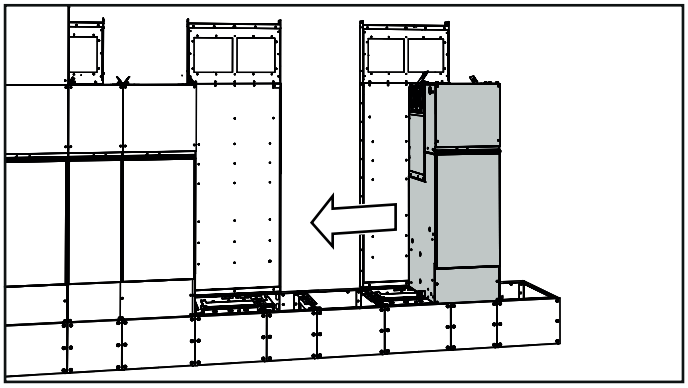


Fig. 30: Positioning the panel

2. Align panel and base frame. In doing so, observe that the bolted joints between the base frame and the panel frame are in line.

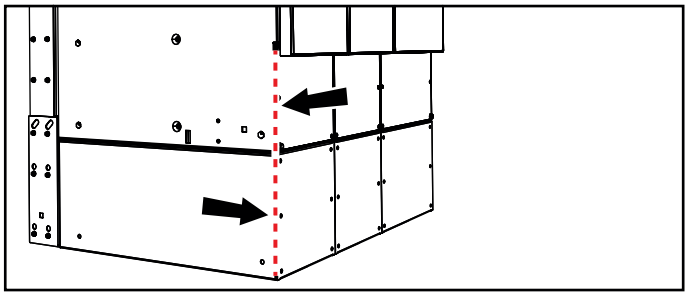


Fig. 31: Aligning the panel flush

3. Interconnect the panels [▶ Page 46, "Joining panels"].

Joining the base frame and the panel

1. Join the panel frame and the base frame at the front using 2 fixing clips. Mount the fixing clips with bolts M8.

If the cooler of the pressure absorber system is mounted in the base frame, the two rear fixing clips cannot be mounted. In this case, mount the fixing clips at fixing points located more to the front.

2. Join the panel frame and the base frame at the rear using at least 4 fixing clips.

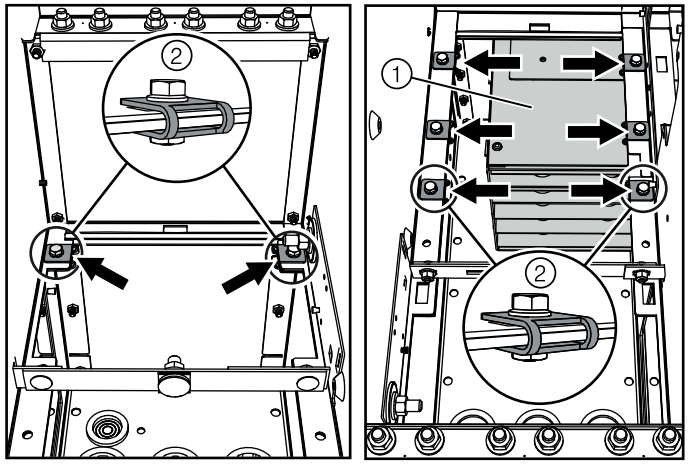


Fig. 32: Positions for fixing clips at the front (left) and rear (right)

① Cooler
② Fixing clip

3. Fasten the base frame at the front to the cross member and at the rear to the rear wall.

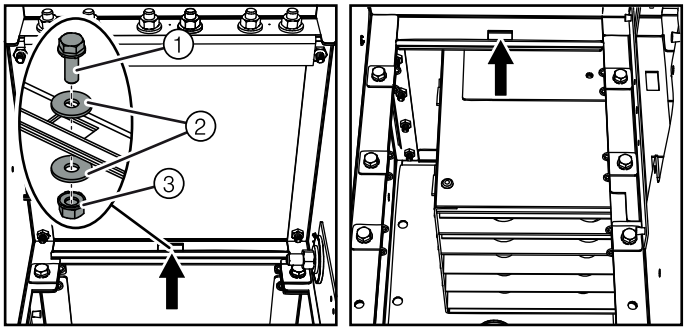


Fig. 33: Fastening the base frame at the front (left) and at the rear (right)

① Bolt-and-washer assembly M8x25
② Conical spring washer (2x)
③ Nut-and-washer assembly M8

4. Mount the tension brace on the base frame using 4 bolts M8.

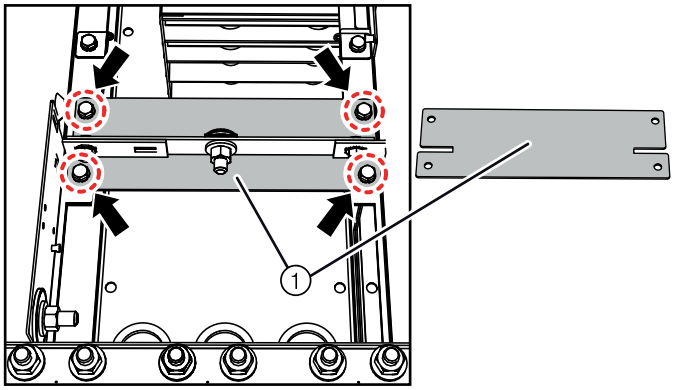


Fig. 34: Mounting the tension brace

① Tension brace

5. **Only for panels in wall-standing arrangement (except billing metering panels):** Fasten the top unit for the pressure relief duct using 8 bolt-and-washer assemblies.

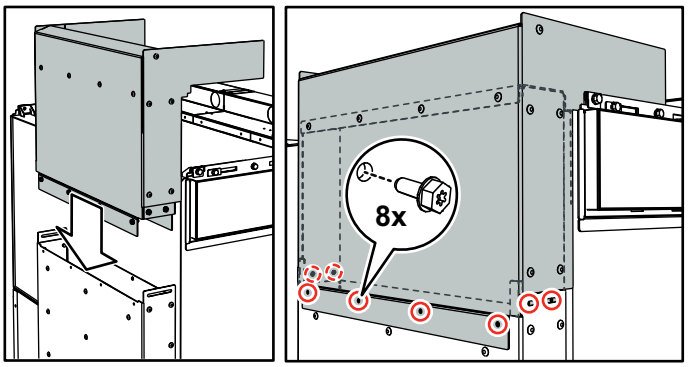


Fig. 35: Mounting the top unit

6. Bolt the cable bracket ① together with the adjustment rail and the cable clamps. Use 4 self-tapping screws M6 (tightening torque: 12 Nm).

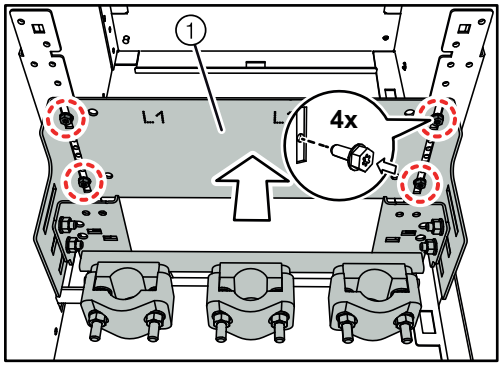


Fig. 36: Mounting the cable bracket

7. Mount the cross member [▶ Page 63, "Removing and mounting the cross member"].
8. Hook the cable compartment cover in [▶ Page 62, "Removing and mounting the cable compartment cover"].
9. Seal the joint between the switchgear and the base frame with silicone.

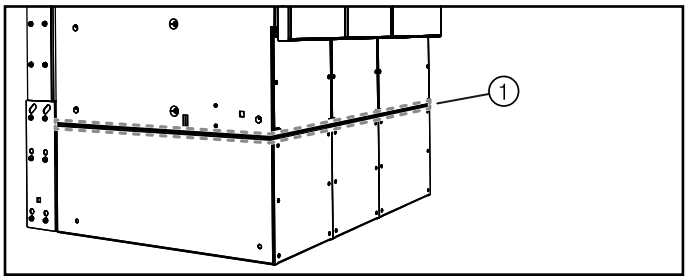
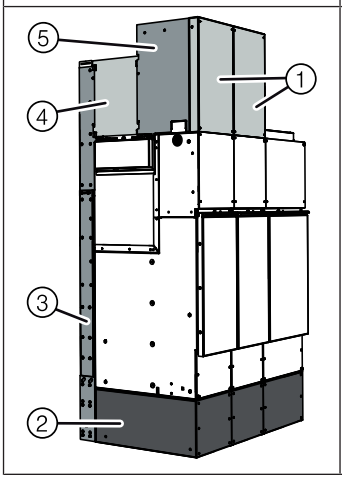
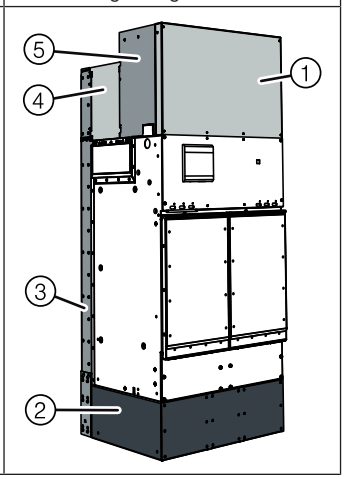


Fig. 37: Sealing the joint

① Joint

6.13 Installing the pressure absorber top unit (IAC up to 21 kA)

Tab. 36: Versions of pressure absorber top units

Pressure absorber top unit	Pressure absorber top unit for metering panel
Panels in free-standing arrangement	Metering panels in wall-standing and free-standing arrangement
	

① Front cover
② Base frame with pressure absorber
③ Pressure relief duct
④ Absorber collar
⑤ Lateral part

1. Remove the transport eyes and transport blocks [▶ Page 35, "Removing the transport eyes and transport blocks"].

Pressure absorber top unit with low-voltage compartment

In the case of a panel with low-voltage compartment, only the absorber collar and front cover need to be mounted to the low-voltage compartment. It is not necessary to mount the front cover, lateral part and retaining bracket.

1. If required, mount the low-voltage compartment [▶ Page 53, "Installing the low-voltage compartment"].

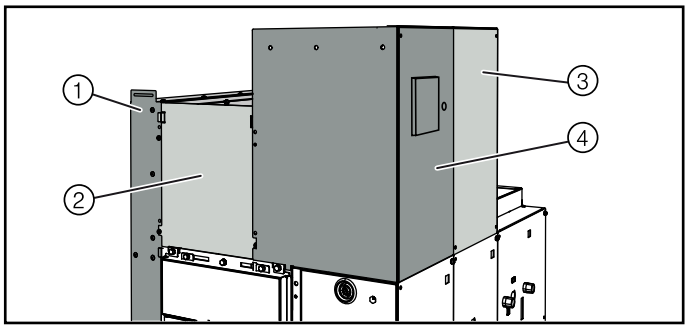


Fig. 38: Pressure absorber top unit with low-voltage compartment (example)

① Pressure relief duct
② Absorber collar
③ Front cover
④ Low-voltage compartment

Mounting retaining brackets

1. **Billing metering panel:** Fasten both fixing points using 2 bolts M5.
   Other panel types: Fasten only the interior fixing point using 1 bolt M5 each.

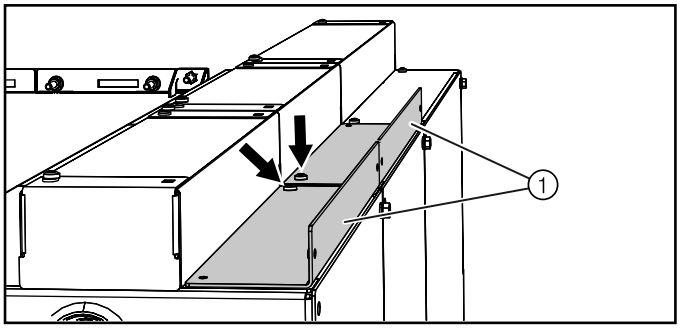


Fig. 39: Mounting retaining brackets

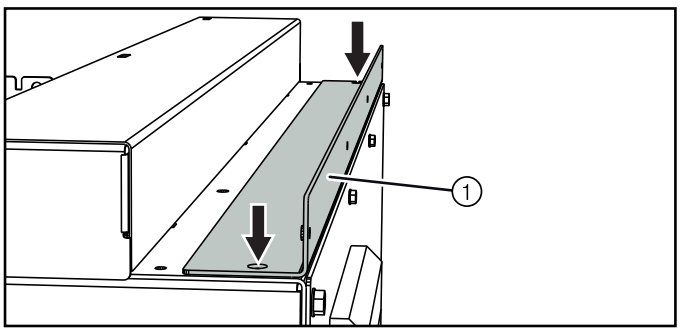


Fig. 40: Mounting the retaining bracket (billing metering panel)

① Retaining bracket

Mounting front covers

For mounting the front covers, various options are possible:

- Front cover mounted on panel without low-voltage compartment
- Front cover mounted on panel with low-voltage compartment in the adjacent panel
- Front cover on billing metering panel

1. Fasten the front cover ① and the support ③ using one bolt M8, plain washer and hexagon nut. Do not mount a support at the billing metering panel.

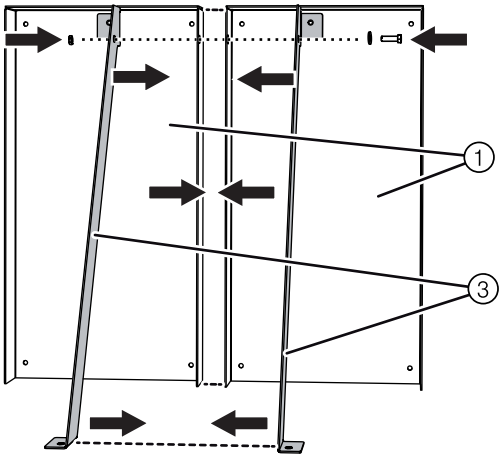


Fig. 41: Fastening supports and front covers

2. Bolt the front covers together with the retaining brackets ②. To do this, use self-tapping screws M6 with plastic washer.
3. Fasten the supports ③ at the roof plate using one bolt M5 each.

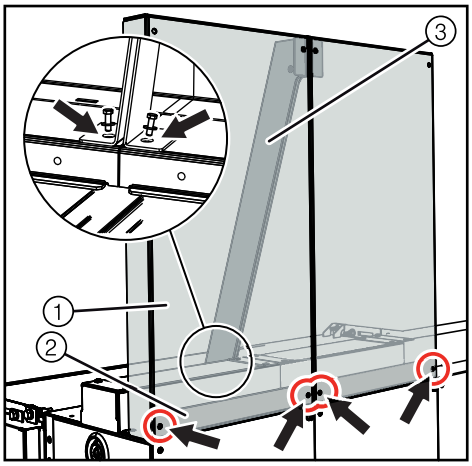


Fig. 42: Mounting front covers

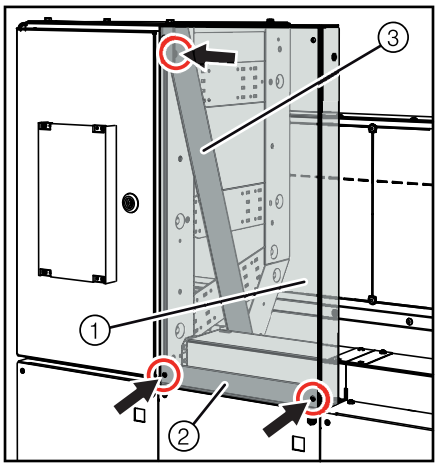


Fig. 43: Mounting a front cover next to a panel with low-voltage compartment

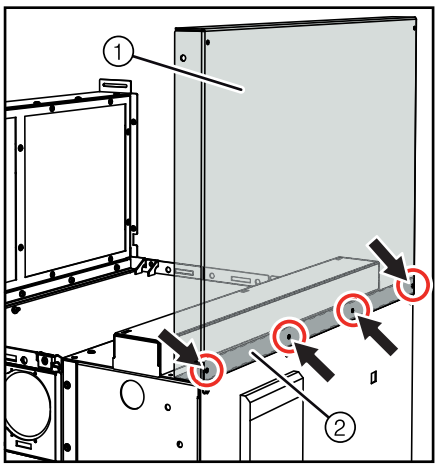


Fig. 44: Mounting the front cover (billing metering panel)

① Front cover
② Retaining bracket
③ Support

Mounting lateral parts

1. Fasten the lateral parts at the left and right upper edge of the switchgear roof plate using 2 bolts M5 each. Bolt together with the front cover using one bolt M8.

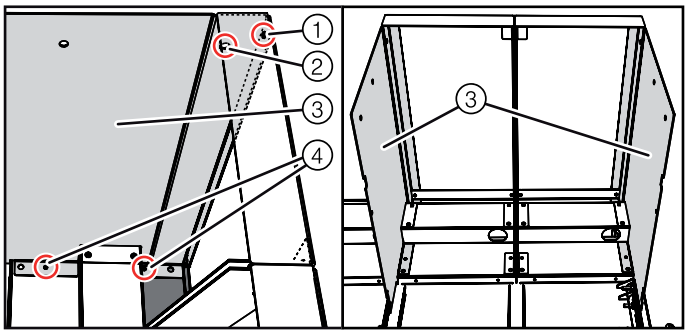


Fig. 45: Mounting lateral parts

① M6 bolt with plastic washer
② Bolt M8
③ Lateral part
④ Bolt M5 (2x)

Mounting the absorber collar

1. Insert the absorber collar on both sides between the pressure relief duct and the front lateral parts, and fasten with 4 bolts M6 each.
   – If there are voltage transformers mounted on the busbar, the right-hand absorber collar cannot be mounted.
   – If a panel group consisting of 2 panels is wider than 620 mm, there will be a gap on the right side between the absorber collar and the lateral part. To close the gap, mount offset plates between the right-hand absorber collar and the lateral part [▶ Page 41, "Mounting offset plates"].

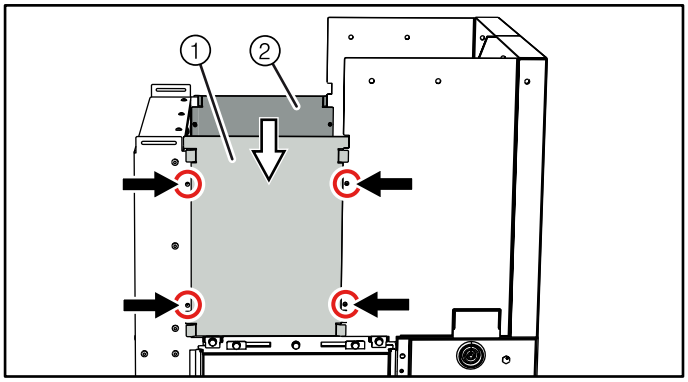


Fig. 46: Mounting the absorber collar

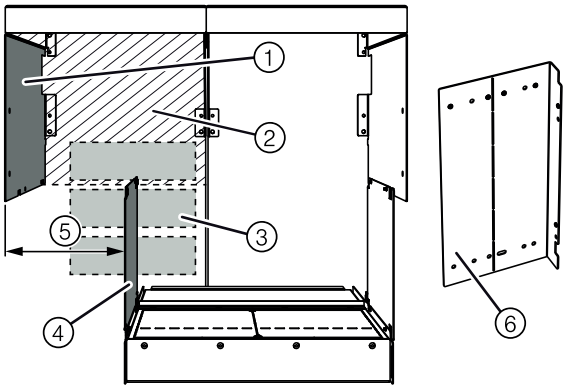
① Left-hand absorber collar
② Right-hand absorber collar

6.13.1 Mounting offset plates

The offset plates close the gap between the absorber collar and the lateral part. 2 offset plates must always be mounted.

Do not mount the offset plates:

- If a low-voltage compartment is mounted.
- If voltage transformers are mounted at the busbar.



① Front lateral part
② Position of low-voltage compartment
③ Position of voltage transformer
④ Absorber collar
⑤ Installation dimension of offset plates
⑥ Offset plate

1. Measure the installation dimension ⑤.
2. **If offset plates with an installation dimension between 120 mm and 190 mm are required:** Shorten both offset plates at the notches with a side cutter.

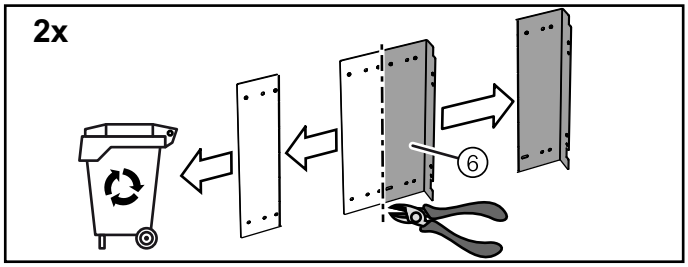


Fig. 47: Shortening the offset plates

3. Fasten the offset plates between the absorber collar ④ and the lateral part ① using 4 self-tapping screws M6.
4. Bolt the offset plates together using 2 self-tapping screws M6.

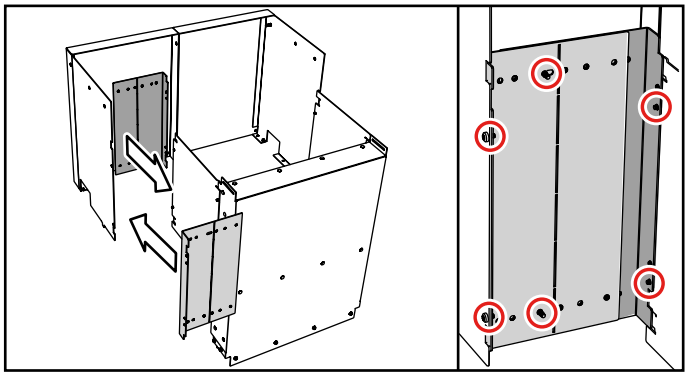


Fig. 48: Installation of offset plate, installation dimension ≥ 190 mm

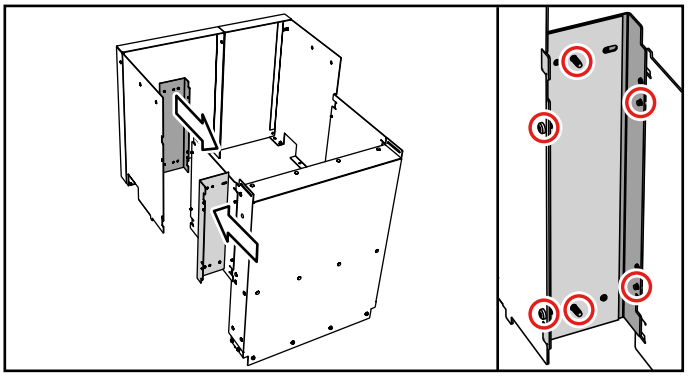


Fig. 49: Installation of offset plate, installation dimension 120...190 mm

6.14 Fastening the switchgear to the foundation

The switchgear must be firmly fastened to the foundation of the switchgear room. The fastening and the foundation must absorb the stress arising from vibrations and faults such as a short circuit in the grid or internal arcing. The switchgear must not detach from the foundation as a result of such stress.

Possible fixing options:

- Bolting onto the foundation rails or the concrete foundation
- Welding onto the foundation rails

Fastening the switchgear with bolts

The panel frames have cutouts for fastening the switchgear [▶ Page 43, "Floor openings and fixing points"].

1. Bring the switchgear into position.
2. Remove the cable compartment cover [▶ Page 62, "Removing and mounting the cable compartment cover"].
3. If required, remove the cross member [▶ Page 63, "Removing and mounting the cross member"].
4. The switchgear must rest flush on the floor; if necessary, lay shims underneath.
5. Fasten the panels at the following fixing points using bolts M8 (see example illustration):
   - Fasten end panels at least at 4 fixing points; once at the front, once at the rear, and twice laterally.
   - Fasten intermediate panels at least at 2 fixing points; once at the front and once at the rear.
   - Fasten air-insulated billing metering panels at **all available fixing points**.
   - Fasten panels with floor covers at **all available fixing points**.

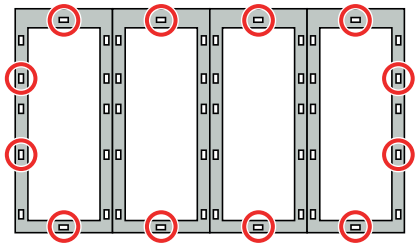


Fig. 50: Fixing points (example, top view)

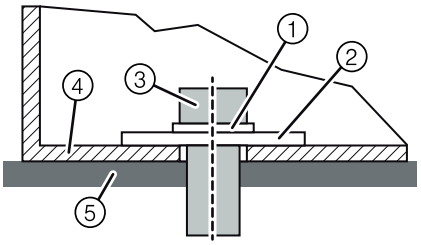


Fig. 51: Fastening the panel to the foundation

① Conical spring washer M8 (DIN 6796)
② 3D washer M10 (DIN EN ISO 7093)
③ Bolt M8
④ Panel frame
⑤ Foundation or foundation rail

Welding the switchgear onto foundation rails

1. Weld the switchgear onto the foundation rails.
2. Protect welded seams against corrosion.
3. Remove dirt.

6.14.1 Floor openings and fixing points

The following overviews show the floor openings and fixing points for the different panel types and pressure relief methods.

Panels with a width of 310 mm have two recesses in the panel frame for reasons of space. These recesses must be observed for planning the foundation.

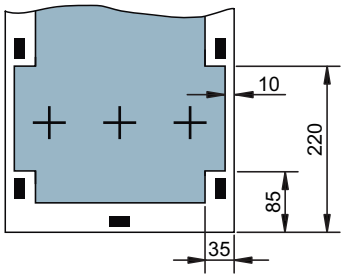
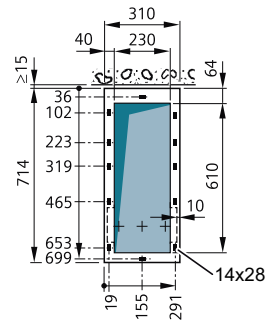


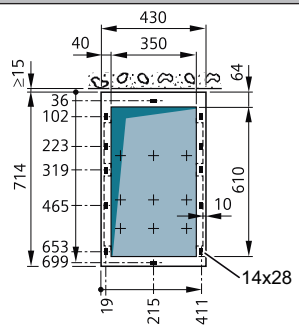
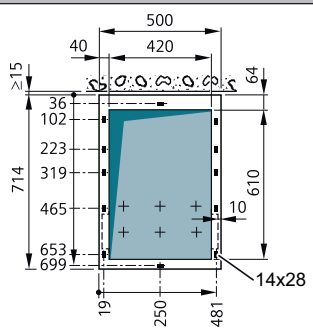
Fig. 52: Recess in the panel frame

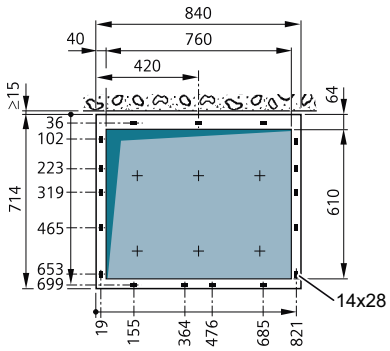
INFORMATION

Dimensional drawings for other versions can be ordered via the Siemens Service Hotline.

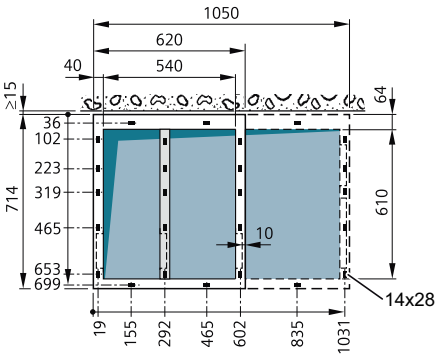
Standard individual panels

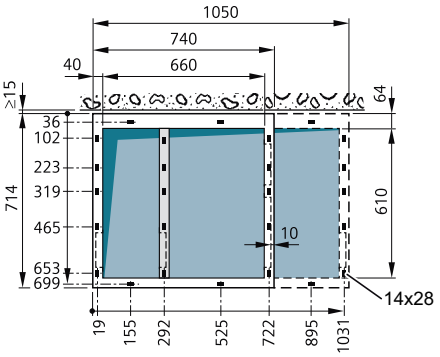
Panel width 310 mm	
	▪ Type R ▪ Type K ▪ Type E

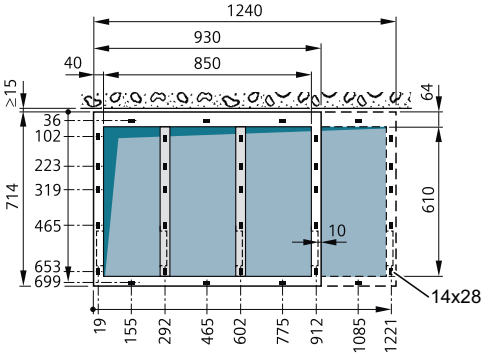
Panel width 430 mm	Panel width 500 mm
	
▪ Type K(E) ▪ Type L ▪ Type T ▪ Type S ▪ Type H ▪ Type M(430)	▪ Type R(500) ▪ Type L(500) ▪ Type E(500) ▪ Type S(500) ▪ Type V ▪ Type M(500)

Panel width 840 mm	
	▪ Type M

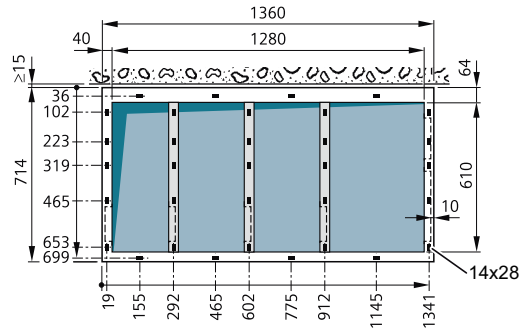
Panel blocks (selection)

Panel block		Width [mm]
	▪ RR ▪ RK ▪ KR	620
	▪ RRT ▪ RRL ▪ RRS ▪ RRH	1050

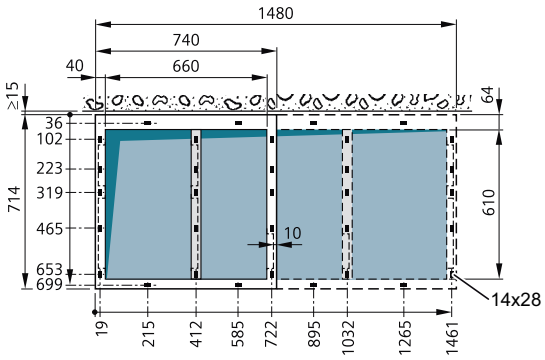
Panel block		Width [mm]
	▪ RT ▪ RL ▪ KT ▪ KL	740
	▪ RTR ▪ RLR	1050

Panel block	Width [mm]
▪ RRR	930
▪ RRRR	1240
	

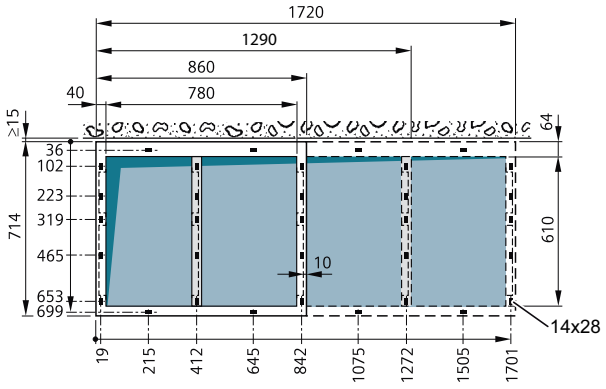
Panel block	Width [mm]
▪ RRRT ▪ RRRL ▪ RRRS	1360



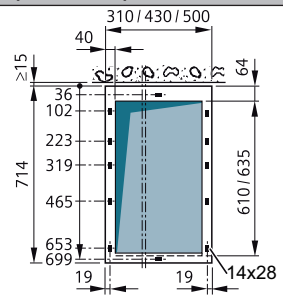
Panel block	Width [mm]
▪ TRRT ▪ LRRL	1290
▪ TK ▪ LK ▪ TR ▪ LR	1480

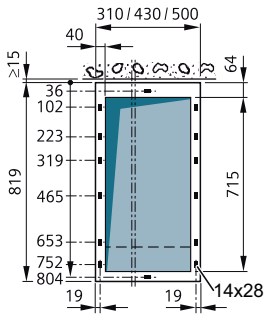
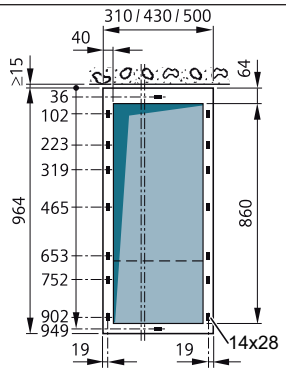


Panel block	Width [mm]
▪ K(E)T ▪ K(E)L ▪ TT ▪ LL	860
▪ TTT ▪ LLL	1290
▪ TTTT ▪ LLLL	1720

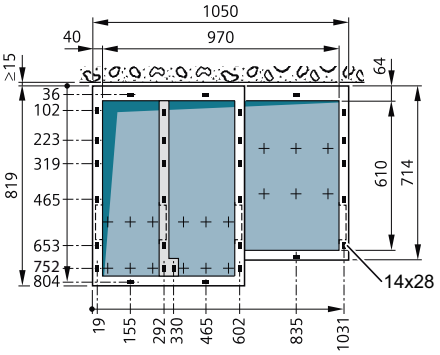


Versions with deep cable compartment covers (e.g. for double cable connections)

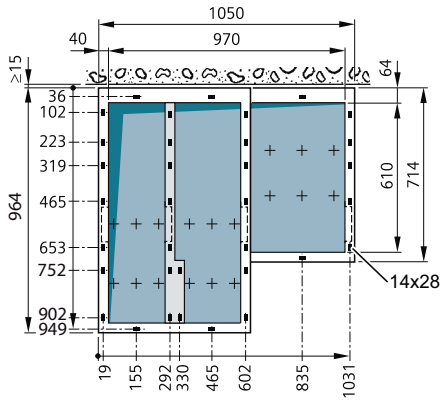
Deep cable compartment cover without base frame extension	
	Panel width 310 / 430 / 500 mm

Deep cable compartment cover with base frame extension	
Panel width 310 / 430 / 500 mm	
Deeper by 105 mm	Deeper by 250 mm
	
Floor opening depending on the selected cable connection / arrester	

Example: Floor openings and fixing points for double cable connection in panel blocks

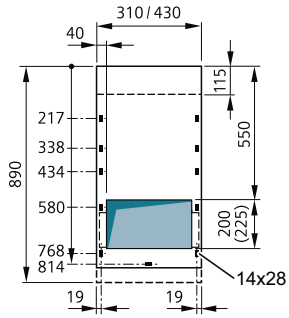
Panel block RRT deeper by 105 mm


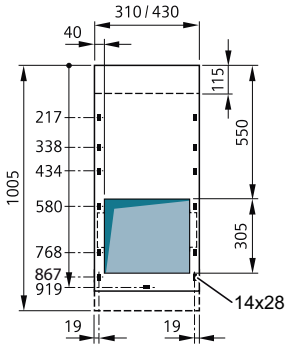
Panel block RRT deeper by 250 mm



Versions for panels with pressure absorbers and deep cable compartment covers

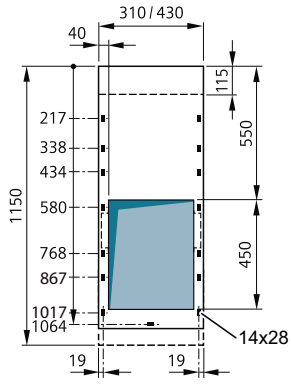
Panel width 310 / 430 mm





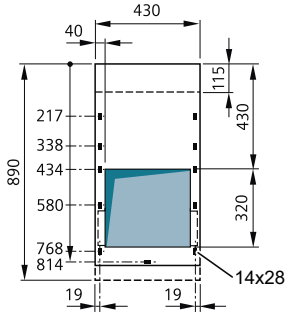
- Type R
- Type K
- Type K(E)
- Type L

Panel width 310 / 430 mm



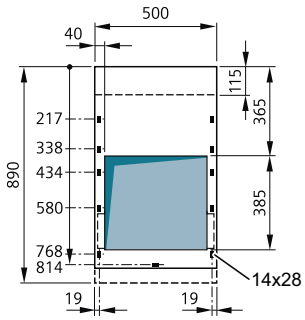
- Type R
- Type K
- Type K(E)
- Type L

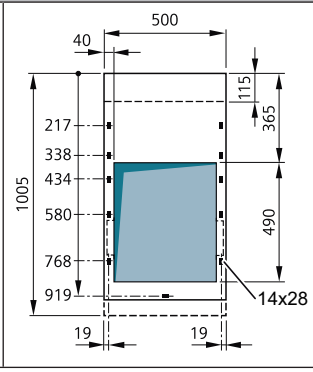
Panel width 430 mm



- Type T

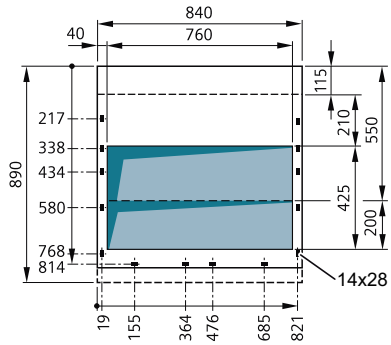
Panel width 500 mm





- Type R(500)
- Type L(500)

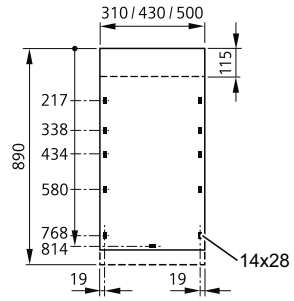
Panel width 840 mm



- Type M

Tab. 37: Fixing points for panels without outgoing cable feeder

Panel width 310 / 430 / 500 mm



- Type S
- Type H
- Type V
- Type M(430) / (500)
- Type E / E(500)

6.15 Joining panels

Preparing the side wall of the existing switchgear

1. Remove the busbar termination cover ①.
2. Remove 3 clamping covers for dummy plugs ② and silicone dummy plugs ③.

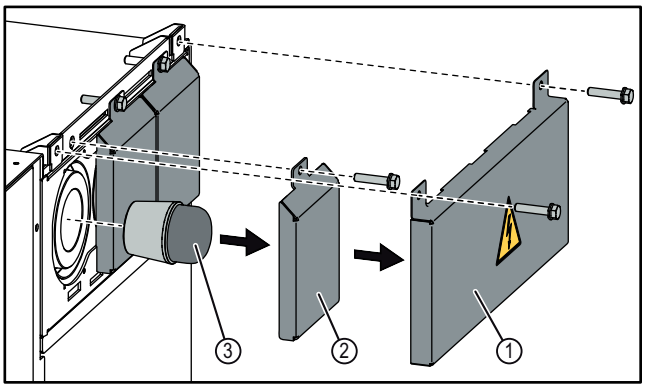
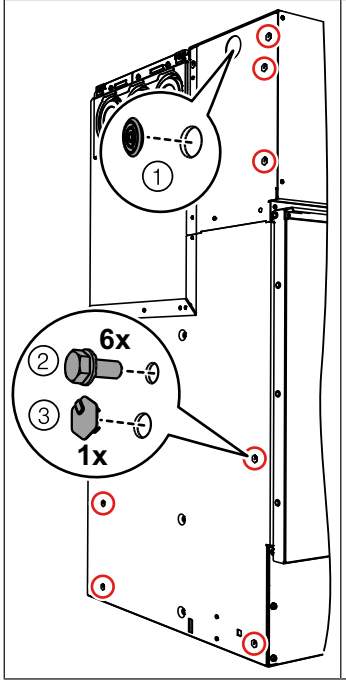
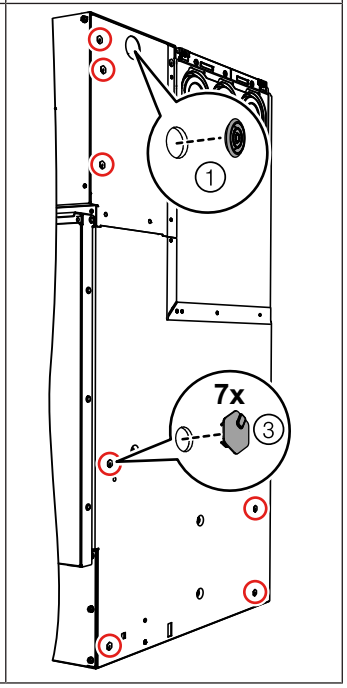


Fig. 53: Removing the busbar termination

3. Remove cap ①, sealing stopper ③ or bolt-and-washer assemblies ② from the side wall.
   ATTENTION Do not reuse removed sealing stoppers.

Left end panel	Right end panel
▪ Undo 7 bolt-and-washer assemblies. ▪ Remove the sealing stopper. ▪ Remove the cap.	▪ Remove 7 sealing stoppers. ▪ Remove the cap.
	

① Cap
② Bolt-and-washer assembly
③ Sealing stopper

Preparations for lining up

☒ Floor unevenness under the panel is compensated with shims [▶ Page 34, "Preparing the foundation"].
☒ The panel to be lined up must comply with the required wall distance [▶ Page 34, "Switchgear room"].
☒ The first panel to be lined up is on its mounting position and the others are placed at a small distance.
☒ Transport blocks and transport eyes are removed.
☒ All panels must be in vertical position and at the same level.

1. Align the panel to be lined up laterally.

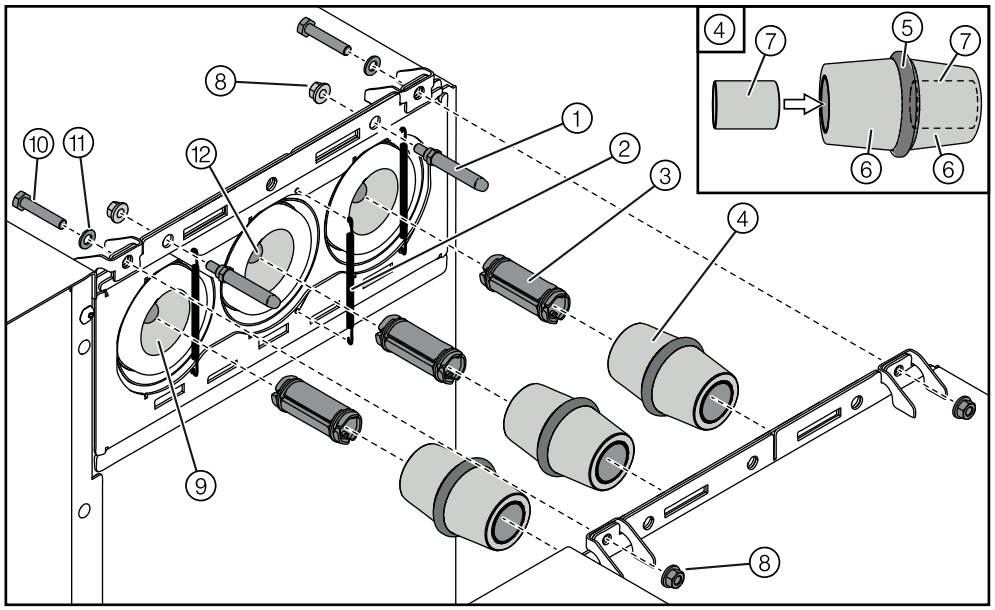
INFORMATION

In panels with busbar coupling, continue with the installation in the next chapter. Installation of panels **without** busbar coupling [▶ Page 48, "Connecting panels without busbar coupling"].

6.15.1 Interconnecting panels with busbar coupling

Mounting the busbar coupling

Panel interconnection is done via busbar couplings which compensate tolerances between adjacent panels by means of spherical fixed contacts and movable contact couplings.



① Guiding tension bolts (2x)
② Tension spring for earthing (3x)
③ Contact coupling (3x)
④ Silicone coupling (3x)
⑤ Conductive area
⑥ Push-on surface
⑦ Insertable sleeve (6x)
⑧ Nut-and-washer assembly M8 (4x)
⑨ Busbar bushing
⑩ Panel connecting bolt M8x45 (2x)
⑪ Conical spring washer 8 (2x)
⑫ Contact stud

Fig. 54: Principle of installation for busbar coupling

⚠ WARNING

Insufficient electrical contact

A damaged busbar coupling can cause an internal arc during operation.

⇨ Do not damage the busbar bushings with pointed or sharp-edged objects.

⇨ Check the contact surfaces and the silicone surfaces for damages before assembly.

Protective caps may have been mounted on the busbar bushings as a transport protection.

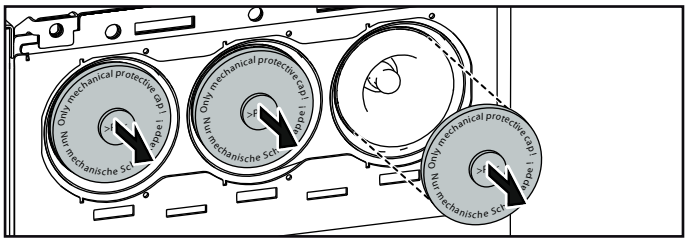


Fig. 55: Removing protective caps

1. If required, remove the protective caps from the busbar bushings by hand.
2. If they have not been pre-assembled at the factory, hook the 3 tension springs for earthing ② into the clamping plate in the left-hand panel (use an appropriate tool, e.g. flat pliers).
3. Insert both guiding tension bolts ① into the two openings in the clamping plate, and tighten with nut-and-washer assembly ⑧ (tightening torque: 20 Nm).
4. Clean the busbar bushings ⑨ carefully inside with a lint-free wiping cloth. Use the supplied mounting paste as cleaning agent.
5. Clean the contact stud ⑫ with a lint-free wiping cloth **(without mounting paste)**.
6. Evenly and centrally push the contact couplings ③ onto the contact studs ⑫ in all phases as far as they will go.
7. Clean the grease and pollution off the insertable sleeve ⑦ and push-on surface ⑥ of the silicone coupling.
8. Apply a uniformly thin film of mounting paste all around the push-on surface ⑥ on one side of the silicone coupling. Do not apply mounting paste to the conductive area ⑤.
9. Fit the silicone coupling – with the side previously coated with mounting paste – onto the contact couplings ③ and into the busbar bushing ⑨ as far as it will go.
   NOTE: Turn the silicone coupling slightly while inserting. In order not to pollute the tension spring for earthing with mounting paste, push the tension spring for earthing to the side while inserting the silicone coupling.

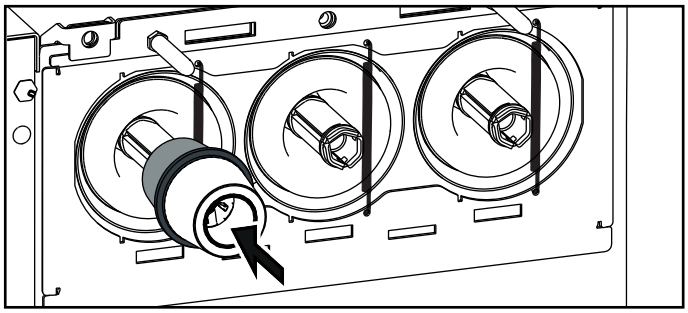


Fig. 56: Inserting the silicone coupling

✓ After inserting the silicone coupling, the tension spring for earthing must be situated **behind** the conductive area (visual check).

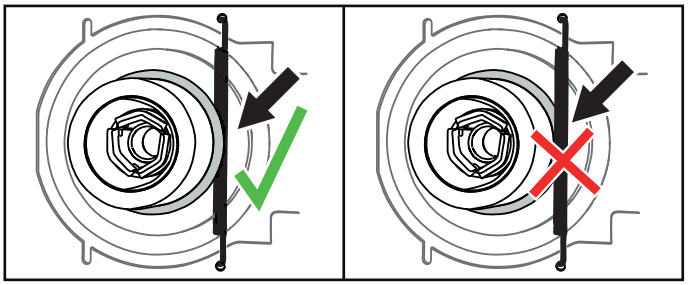


Fig. 57: Position of the tension spring for earthing

10. Apply mounting paste to another 2 silicone couplings. Insert them into the busbar bushings in the same way.
11. Carefully clean the busbar bushings ⑨ of the **panel to be lined up**. Use the supplied mounting paste as cleaning agent.
12. Clean the contact studs of the panel to be lined up with a lint-free wiping cloth **(without mounting paste)**.
13. Clean the grease and pollution off the insertable sleeves ⑦ and push-on surfaces ⑥ of the silicone couplings.
14. Apply the supplied mounting paste to the push-on surfaces ⑥ of the silicone couplings evenly, thinly and all around. Do not apply mounting paste to the conductive area ⑤.
15. Push the panel to be lined up to the fixed-mounted panel. Thread the guiding tension bolts ① into the clamping plate in the panel to be lined up, until the distance between the two panels is approx. 30 mm.

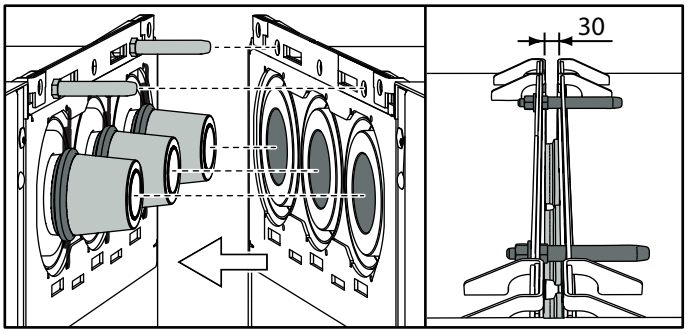


Fig. 58: Lining up the panel

16. Interconnect the two panels with 2 panel connecting bolts ⑩, conical spring washers ⑪ and nut-and-washer assemblies ⑧ each at the top of the clamping plate, but **do not bolt tight**.

INFORMATION

Further installation of panels **with** busbar coupling [▶ Page 48, "Bolting panels together"].

6.15.2 Connecting panels without busbar coupling

For panels without busbar coupling, a gap between the side walls of the gas compartments results during the interconnection. To compensate this gap, vessel adapters must be inserted between the panels.

The extension kit contains 2 vessel adapters.

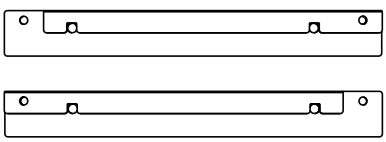


Fig. 59: Vessel adapter

☒ **Mounting position of the vessel adapter:** The folded edge of the vessel adapter must point towards the gas compartment.

1. If **one** of the panels is equipped with a gas compartment, insert **one** vessel adapter between the panels.
2. If **both** of the panels are equipped with a gas compartment, insert **both** vessel adapters between the panels.
3. Push the panel to be lined up to the fixed-mounted panel.

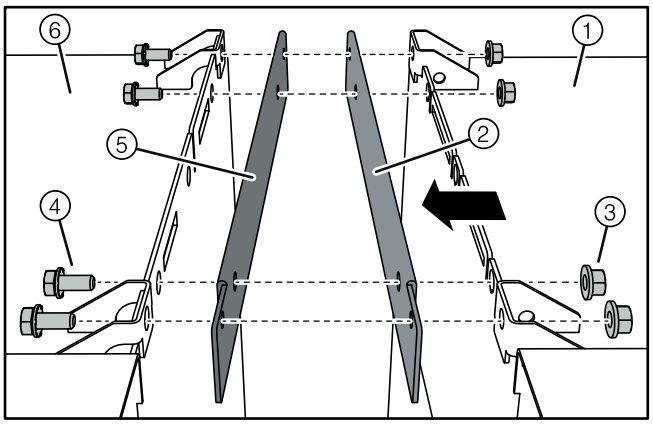


Fig. 60: Lining up the panel

① Right-hand panel
② Vessel adapter for right-hand panel (option)
③ Nut-and-washer assembly M8 (4x)
④ Bolt-and-washer assembly M8x45 (4x)
⑤ Vessel adapter for left-hand panel (option)
⑥ Left-hand panel

4. Interconnect the panels with 4 panel connecting bolts (bolt-and-washer assemblies M8x40) at the upper panel connection, **but do not bolt tight yet**.
5. If required, bolt the vessel adapter tight between the two panels.
6. Bolt the panels together [▶ Page 48, "Bolting panels together"].

6.15.3 Bolting panels together

1. Remove the cable compartment cover [▶ Page 62, "Removing and mounting the cable compartment cover"].
2. If required, remove the cross member [▶ Page 63, "Removing and mounting the cross member"].
3. Remove the front cover [▶ Page 63, "Removing and mounting the front cover"].

INFORMATION

Setnuts may be fastened at the bolted joints in the left-hand panel.

⇨ Remove the setnuts before bolting the panels together.

4. Tighten the bolt-and-washer assemblies ① uniformly together with the bolt-and-washer assemblies at the clamping plate ② until both panels are joined without any gaps (tightening torque: 30 Nm).
   – Screw each of the bolt-and-washer assemblies from the left-hand panel to the right-hand panel into the setnuts provided for this purpose.
   – Make sure that there is a uniform distance between the panels.

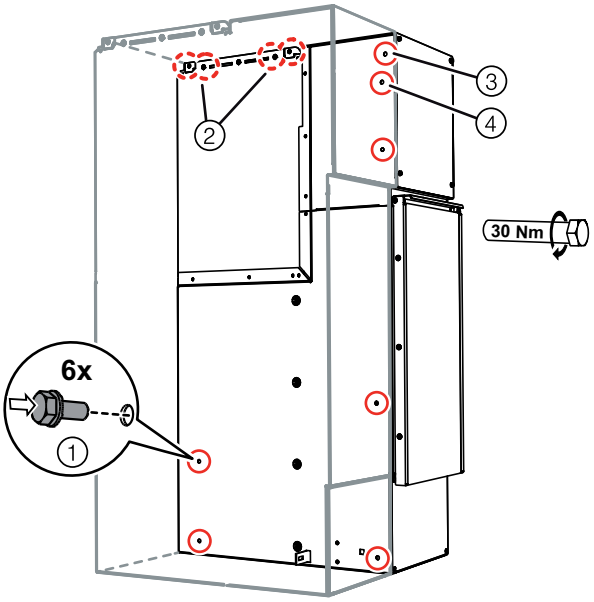


Fig. 61: Bolted joints for the panel interconnection

① Bolt-and-washer assemblies M8x20 (6x)
② Bolt-and-washer assemblies M8x45 at the clamping plate (2x or 4x)
③ Only bolt together in case of circuit-breaker panel type L1.1
④ Bolt together in all panel types except for circuit-breaker panel type L1.1
○ Bolted joint

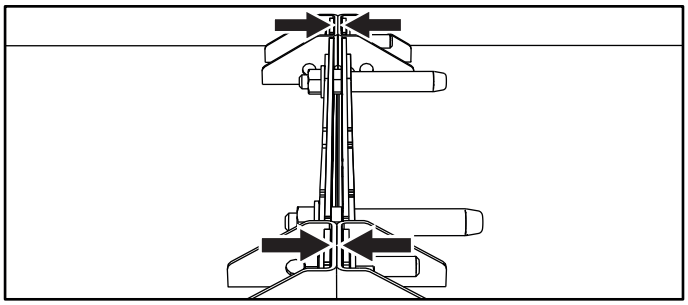
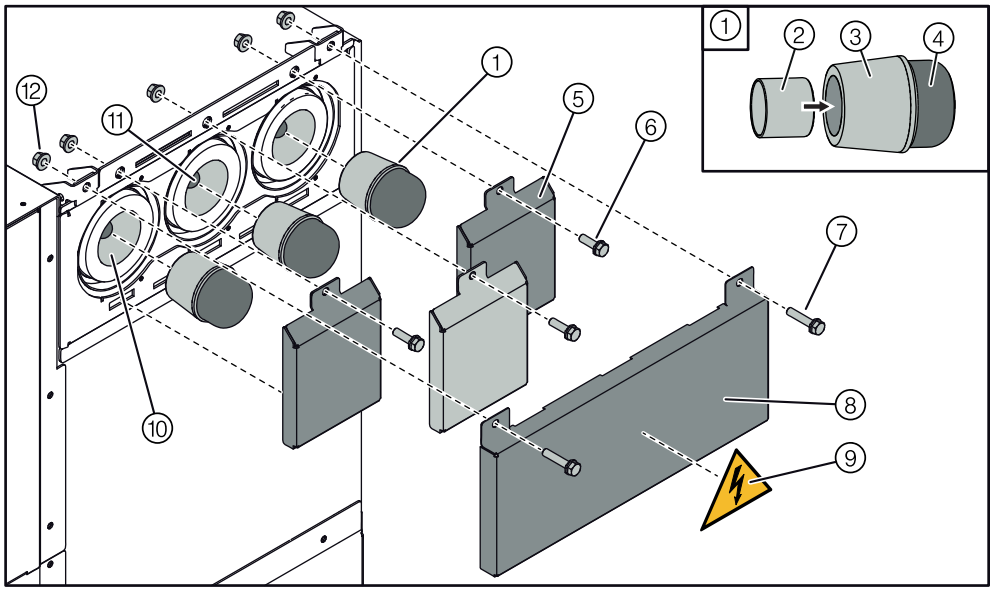


Fig. 62: Panels bolted together without a gap

5. Mount the front cover [▶ Page 63, "Removing and mounting the front cover"].
6. Bolt the lined up panel to the foundation or the base frame [▶ Page 42, "Fastening the switchgear to the foundation"].
7. Interconnect the earthing busbars of the panels [▶ Page 52, "Interconnecting the earthing busbars"].
8. If required, mount the cross member [▶ Page 63, "Removing and mounting the cross member"].
9. Hook the cable compartment cover in [▶ Page 62, "Removing and mounting the cable compartment cover"].
10. Interconnect all other panels in the same way.

6.16 Mounting the busbar termination

On free busbar ends, screened silicone dummy plugs are inserted and pressed on through a clamping cover for dummy plugs. A busbar termination cover is mounted over all three dummy plugs.



① Silicone dummy plug (3x)
② Insertable sleeve (3x)
③ Push-on surface
④ Conductive area
⑤ Clamping cover for dummy plugs (3x)
⑥ Bolt-and-washer assembly M8x20 (3x)
⑦ Bolt-and-washer assembly M8x30 (2x)
⑧ Busbar termination cover (1x)
⑨ Warning sign (1x)
⑩ Busbar bushing
⑪ Contact stud
⑫ Nut-and-washer assembly M8 (5x)

Fig. 63: Principle of installation for busbar termination

⚠ WARNING

Insufficient electrical contact

A damaged busbar termination can cause an internal arc during operation.

⇨ Do not damage the busbar bushings with pointed or sharp-edged objects.

⇨ Check the contact surfaces and the silicone surfaces for damages before assembly.

Protective caps may have been mounted on the busbar bushings at the factory as a transport protection.

1. If required, remove the protective caps from the busbar bushings by hand.

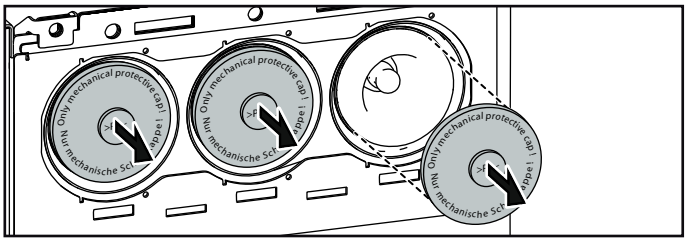


Fig. 64: Removing protective caps

2. The clamping plate may be equipped with tension springs for earthing. Remove the tension springs for earthing on all 3 phases (use a suitable tool, e.g. flat nose pliers).

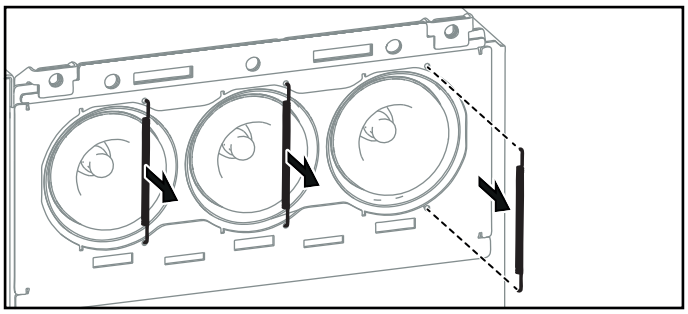


Fig. 65: Removing the tension springs for earthing

3. Clean the busbar bushings ⑩ carefully inside with a lint-free wiping cloth. Use the supplied mounting paste as cleaning agent.
4. Clean the contact stud ⑪ with a lint-free wiping cloth **without** mounting paste.
5. Clean the push-on surface of the silicone dummy plug ③ and the insertable sleeve ② carefully.
6. Apply the **supplied** mounting paste uniformly to the push-on surface ③ of the silicone dummy plug. Do **not apply mounting paste** to the conductive area ④ and the insertable sleeve ②.
7. Insert the silicone dummy plug ① into the busbar bushing ⑩ with a slight rotary movement, and hold it.

8. Hook the lower part of the clamping cover for dummy plugs ⑤ into the clamping plate, and press the upper part onto the clamping plate. Fasten the clamping cover for dummy plugs to the clamping plate using a nut-and-washer assembly ⑫ and a bolt-and-washer assembly ⑥ (tightening torque: 30 Nm).

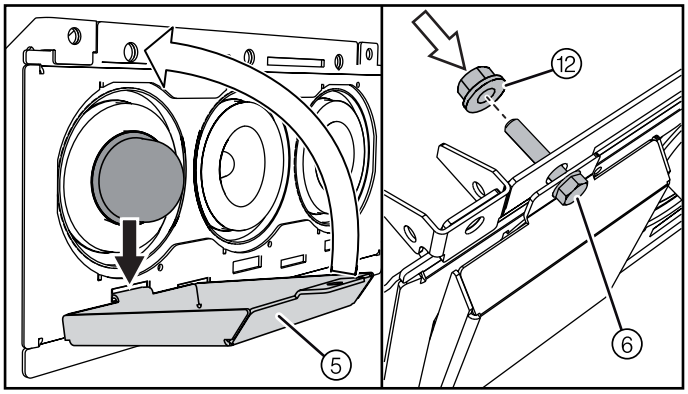


Fig. 66: Mounting the clamping cover for the dummy plugs

9. Mount the dummy plugs and the clamping covers for dummy plugs on the other two phases.
10. Hook the busbar termination cover ⑧ in and fasten it to the clamping plate with 2 bolt-and-washer assemblies ⑦ and nut-and-washer assemblies ⑫ (tightening torque: 30 Nm).

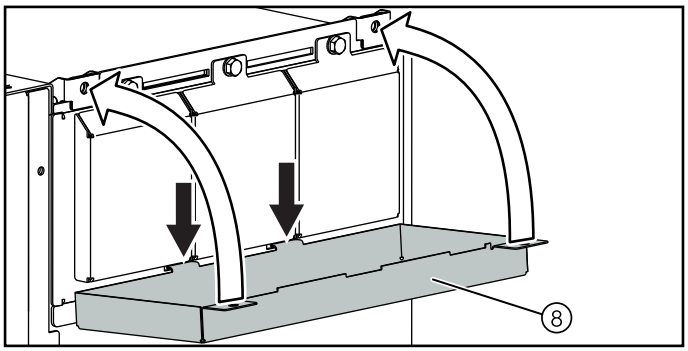


Fig. 67: Hooking the busbar termination cover in

11. Affix the warning label.

Closing openings in the left end panel

1. Insert the cap ① into the side wall.
2. Screw 6 bolt-and washer assemblies M8x20 ③ into the side wall (tightening torque: 30 Nm).
   ATTENTION For circuit-breaker panel type L1.1, mount the upper bolt-and-washer assembly and the sealing stopper inversely.
3. Insert a sealing stopper ② into the side wall.

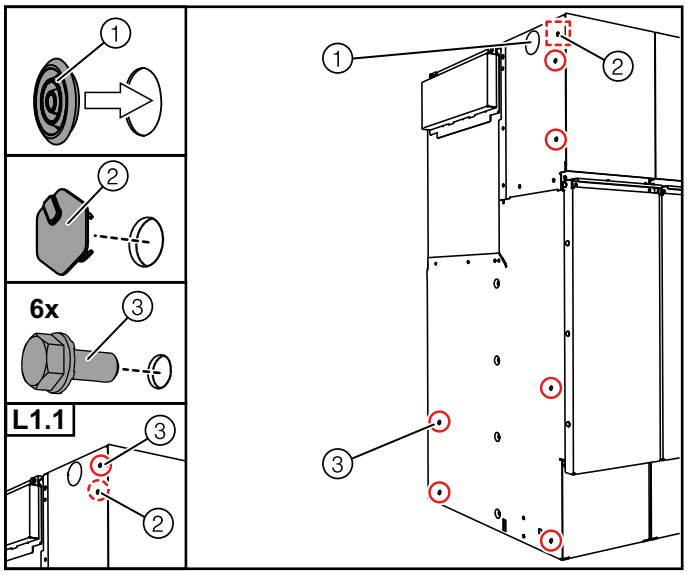


Fig. 68: Closing openings in the left end panel

Closing openings in the right end panel

1. Insert the cap ① into the side wall.
2. Insert 7 sealing stoppers ② into the side wall.

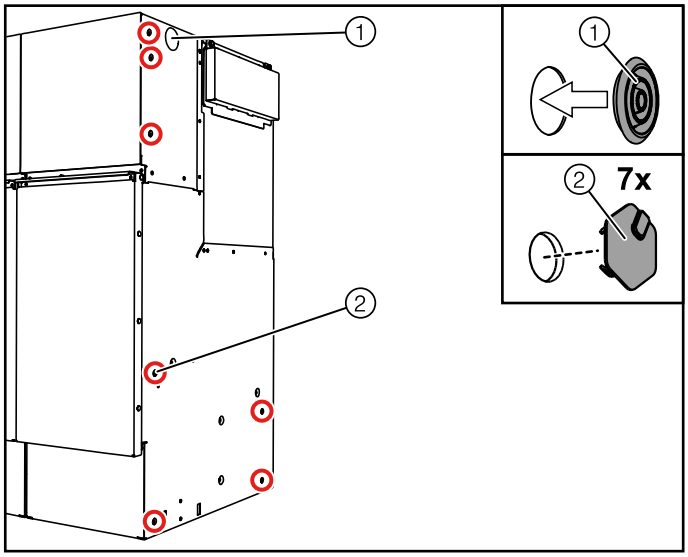


Fig. 69: Closing openings in the right end panel

Mounting the closure plate

If the panel was originally not supplied as an end panel, a closure plate must be mounted on the side walls in the cable compartment. It may be necessary to re-assemble the closure plate from the existing end panel into the new end panel.

1. **If an earthing point is mounted on the side wall:** Remove the earthing point ③.
2. Fasten the closure plate ① to the side wall using 2 blind rivets ②. **Observe the mounting position of the closure plate.**

3. Mount the removed earthing point ③ again at the same position on the closure plate.

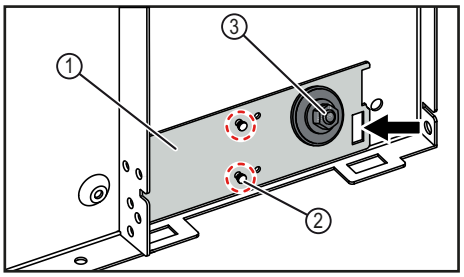


Fig. 70: Closure plate with earthing point

① Closure plate
② Blind rivet M5x12
③ Earthing point

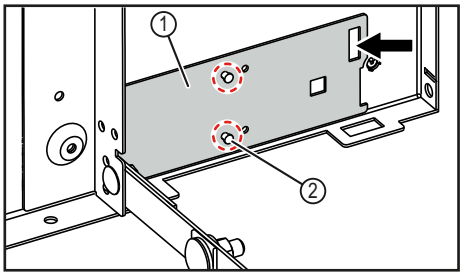


Fig. 71: Closure plate at the panel with earthing busbar

① Closure plate
② Blind rivet M5x12

6.17 Earthing the switchgear

6.17.1 Interconnecting the earthing busbars

The earthing busbars must be interconnected at the joints between the panels. The earthing busbars are interconnected with a link. The link is pre-assembled on the earthing busbar as standard.

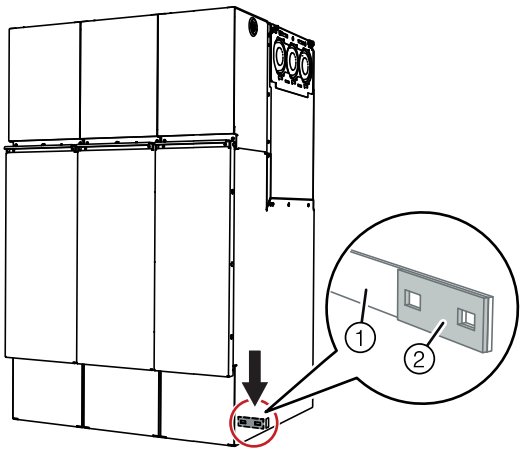


Fig. 72: Position of the earthing busbar

① Earthing busbar
② Link

1. Remove the cable compartment cover in both adjacent panels [▶ Page 62, "Removing and mounting the cable compartment cover"].
2. If required, remove the cross member [▶ Page 63, "Removing and mounting the cross member"].
3. Undo the bolted joints ③ of the link ② from the earthing busbar ①.
4. Brush the oxidized copper surfaces of the earthing busbars ① and ④, and apply a thin film of the supplied mounting paste.
5. Push the link ② through the opening in the side wall, and bolt it together with the two earthing busbars.

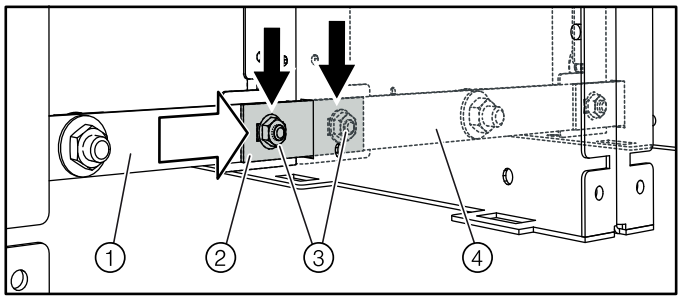


Fig. 73: Interconnected earthing busbars

① Left-hand earthing busbar
② Link
③ Bolted joint of the link
④ Right-hand earthing busbar

6. Refit the cable bracket and cross member.
7. Bolt together all other earthing busbars in all panels in the same way.

6.17.2 Earthing extendable switchgear

Extendable switchgear assemblies are earthed via one of the earthing connection points at the earthing busbar.

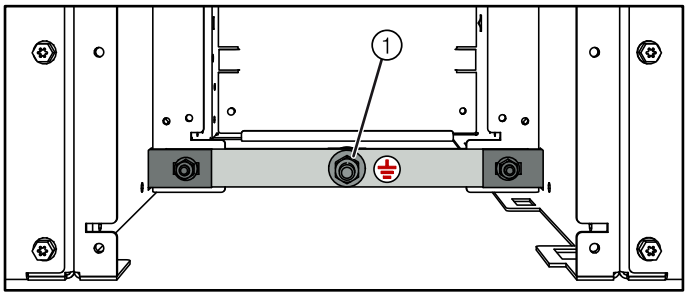


Fig. 74: Earthing connection point at the earthing busbar

① Earthing connection point (earthing bolt M12)

- Connect each panel block or panel group of max. 4 panels once with the substation earth.
- In panel groups comprising more than 4 panels, connect every fifth panel with the substation earth.

1. Remove the cable compartment cover [▶ Page 62, "Removing and mounting the cable compartment cover"].
2. Connect the earthing connection point ① to the substation earth.
3. Interconnect the earthing busbars throughout the complete panel group [▶ Page 52, "Interconnecting the earthing busbars"].

4. Hook the cable compartment cover in again.

6.17.3 Earthing non-extendable switchgear

For non-extendable switchgear, the earthing connection point is located on the side wall behind the cable compartment cover.

1. Remove the cable compartment cover [▶ Page 62, "Removing and mounting the cable compartment cover"].
2. Connect the earthing connection point ① to the substation earth.
3. Hook the cable compartment cover in again.

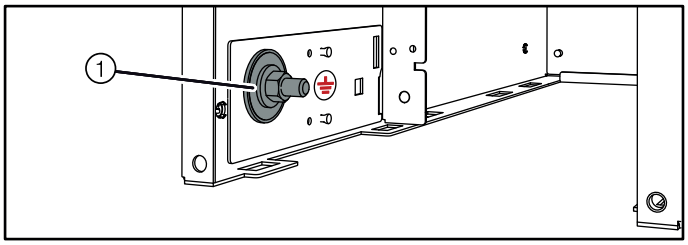


Fig. 75: Earthing connection point

① Earthing connection point (earthing bolt M12)

6.18 Installing the low-voltage compartment

As standard, the low-voltage compartment is pre-assembled on the associated panel. Depending on the design of the respective panel, the low-voltage compartment can also be delivered separately.

1. Before setting down the low-voltage compartment, lead the low-voltage cables upwards out of the panel.
2. Place the low-voltage compartment onto the roof of the associated panel.
   CAUTION Heavy component; use suitable lifting equipment or lift together with several persons.
   ATTENTION Do not damage the low-voltage cables.
3. Bolt the low-voltage compartment onto the roof plate of the panel using 4 bolt-and-washer assemblies M8.

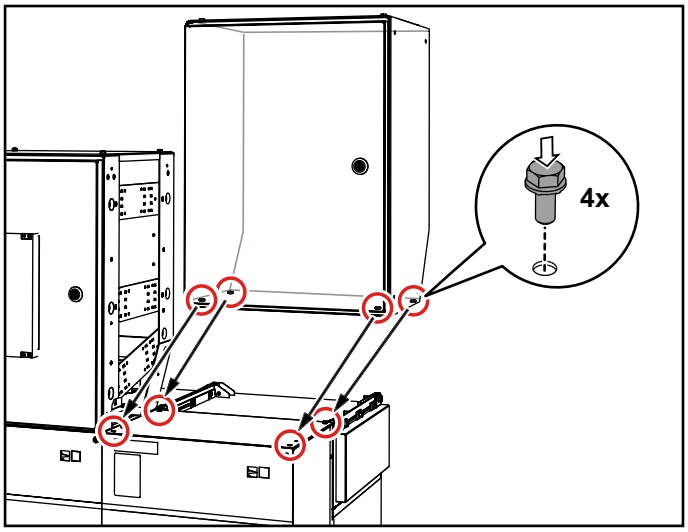


Fig. 76: Bolting the low-voltage compartment together with the panel

4. Open the door of the adjacent, left-hand low-voltage compartment.
5. Screw 3 bolt-and-washer assemblies M8 through the right side wall of the left-hand low-voltage compartment into the setnuts of the right-hand low-voltage compartment.

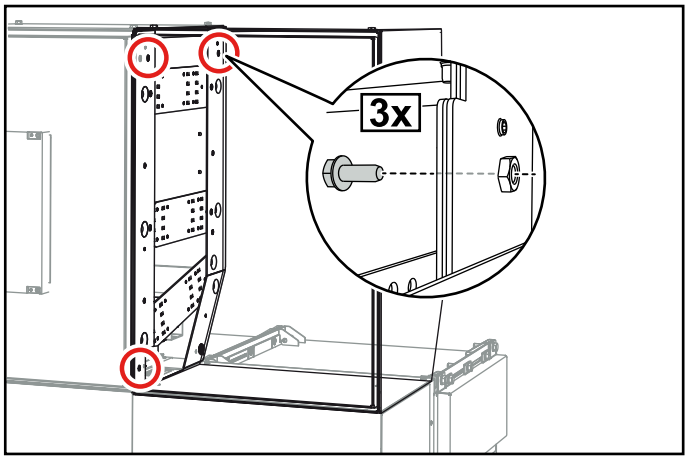


Fig. 77: Bolting the low-voltage compartments together

6.19 Installing the billing metering panel type M

Overview of the mounting positions of the current transformers and voltage transformers in the billing metering panel type M, depending on the connection type of the busbars and high-voltage cables.

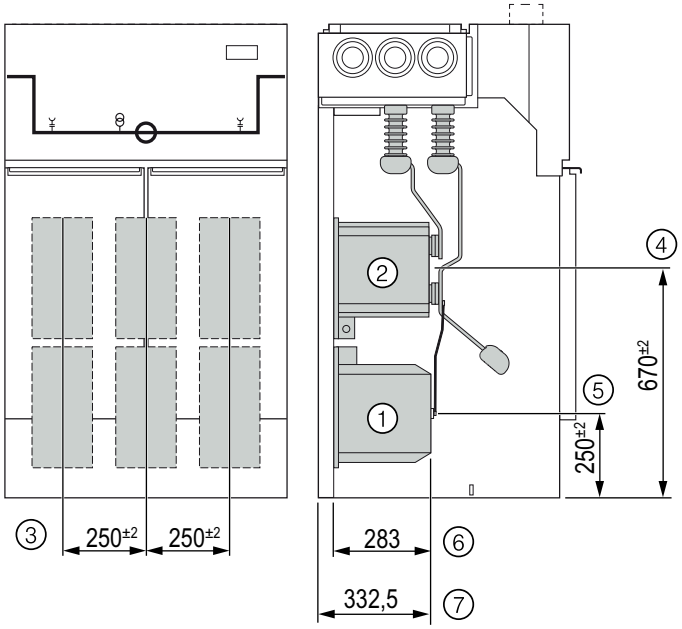


Fig. 78: Busbar-busbar connection

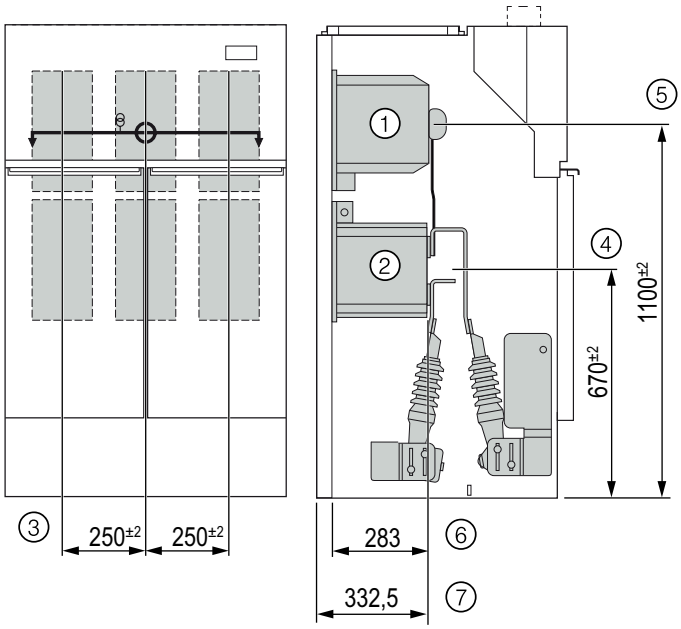


Fig. 79: Cable-cable connection

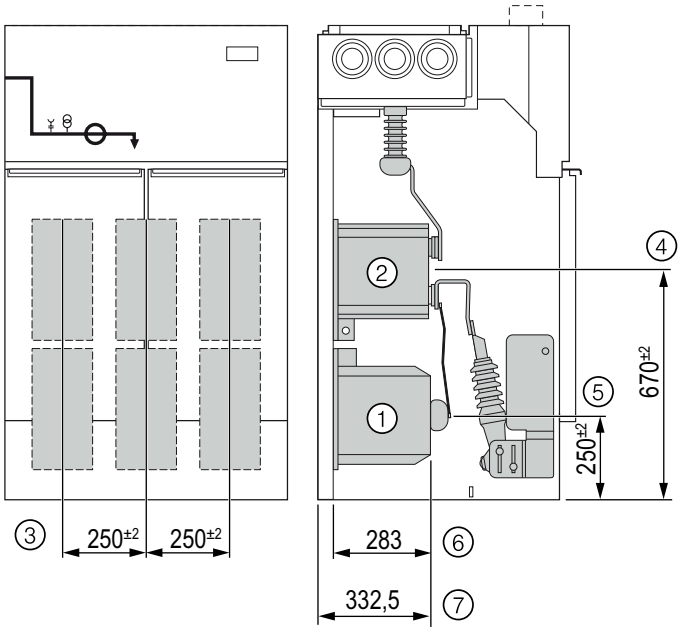


Fig. 80: Busbar-cable connection

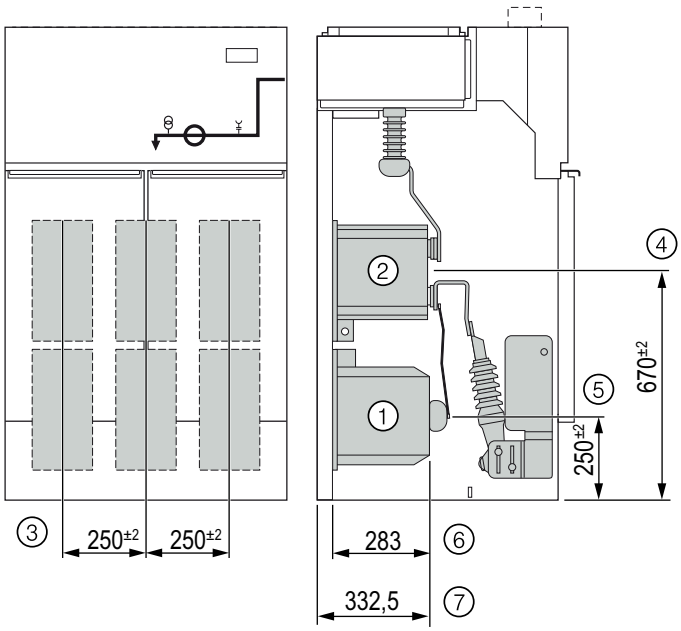


Fig. 81: Cable-busbar connection

① Voltage transformer
② Current transformer
③ Instrument transformer distance (centrally)
④ Mounting height of current transformer
⑤ Mounting height of voltage transformer
⑥ Mounting depth of instrument transformer
⑦ Distance from instrument transformer to switchgear rear wall

6.19.1 Routing of currents and bars

The direction of the current flow is from the left to the right side of the billing metering panel. The voltage transformers can be connected upstream or downstream from the current transformers.

Top view into the open gas compartment with the bushings and the busbars:

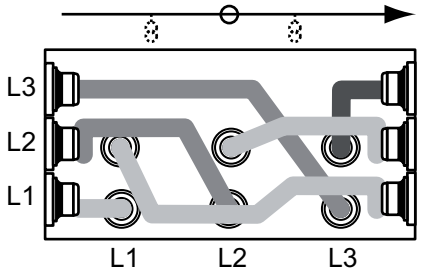


Fig. 82: Busbar-busbar connection

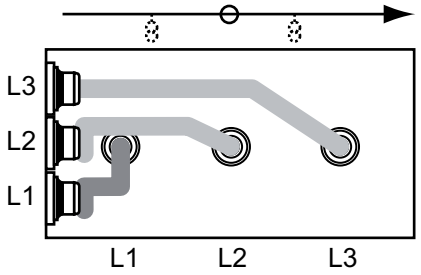


Fig. 83: Busbar-cable connection

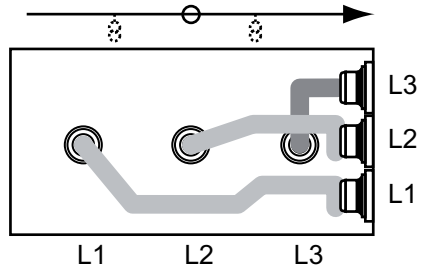


Fig. 84: Cable-busbar connection

6.19.2 Installing current transformers and voltage transformers

Mount only current transformers and voltage transformers which have been released by Siemens and correspond to the following standards:

- Dimensions according to DIN 42600-8 for current transformers 4MA7
- Dimensions according to DIN 42600-9 for voltage transformers 4MR

1. Remove the cable compartment covers [▶ Page 62, "Removing and mounting the cable compartment cover"]. Observe the instructions specified there.
2. Remove the cross member [▶ Page 63, "Removing and mounting the cross member"].

Mounting the C-rail

1. Bolt 2 holders to each C-rail at the sides. The mounting position of the holders depends on the rated voltage of the switchgear:
   U_r ≤ 12 kV: Mount the holder turned to the front ①.
   U_r > 12 kV: Mount the holder turned to the rear ②.

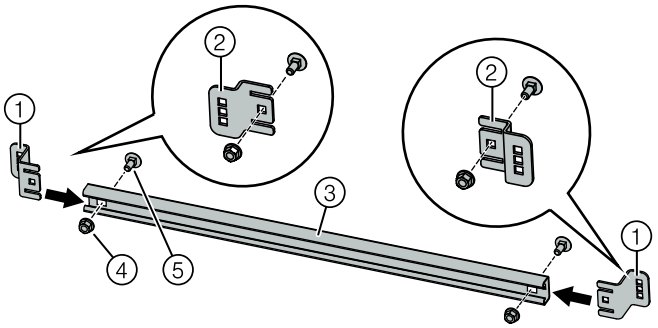


Fig. 85: Mounting position of the C-rail

① Mounting position of holder for 12 kV
② Mounting position of holder for 24 kV
③ C-rail
④ Nut-and-washer assembly M8
⑤ Cup head bolt M8x20

2. Fasten the 4 C-rails to the rear wall at the sides using holders. The position of the C-rail is marked by means of a prick-punch point ②.
   NOTE: The prick-punch point only applies to small current transformers and voltage transformers according to DIN 42600-8 and DIN 42600-9. For other instrument transformer types, the specified dimensions and mounting positions must be observed.

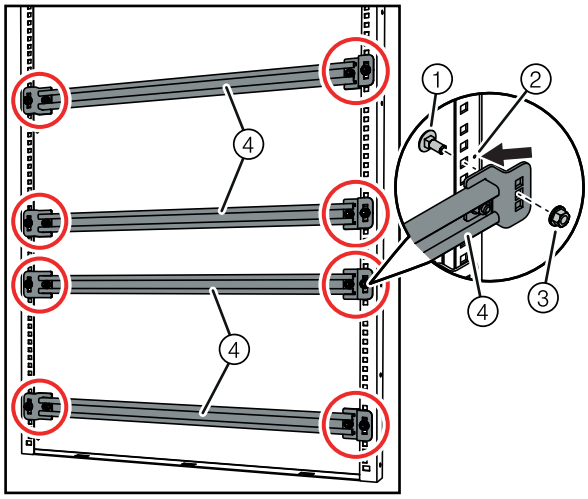


Fig. 86: Mounting C-rails

① Cup head square neck bolt M8
② Prick-punch point
③ Nut-and-washer assembly M8
④ C-rail with holder

Mounting the current transformers and voltage transformers on the C-rails

Order of assembly: First, fasten the current transformer and voltage transformer for phase L2 in the center of the C-rails. Then, fasten the current transformers and voltage transformers for phases L1 and L3 on the left and right at a distance of $250^{\pm 2}$ mm.

1. For each current transformer and voltage transformer, insert 4 sliding nuts with setscrew into the upper and lower C-rail. Insert the sliding nuts in upright position.

2. Fasten each current transformer and each voltage transformer to the C-rails at the 4 fixing points.
   CAUTION Heavy component; use suitable lifting equipment or lift together with several persons.

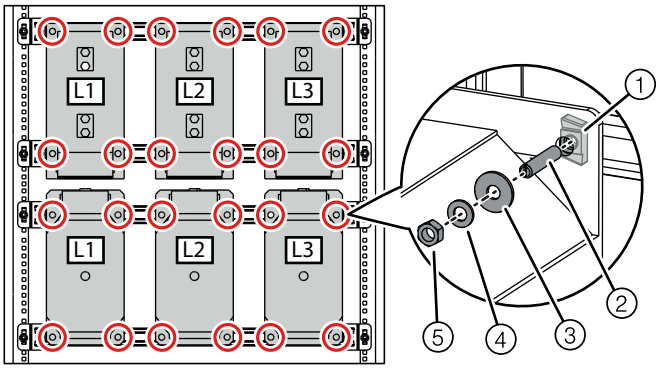


Fig. 87: Installing current transformers and voltage transformers

① Sliding nut
② Setscrew M10x60
③ Plain washer (3D washer)
④ Conical spring washer
⑤ Hexagon nut M10

6.19.3 Connecting current transformers

Mounting the connection bars

1. Clean oxidized contact points of the connection bars.
2. Mount the spacers and connection bars on the current transformer without distortions and gaps (tightening torque: 40 Nm).
   WARNING Damaged contact surfaces can cause an internal arc during operation. Do not damage contact surfaces.

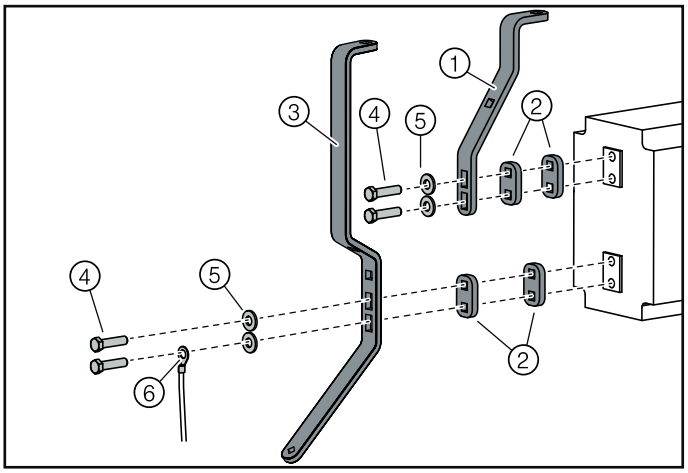


Fig. 88: Busbar-busbar connection

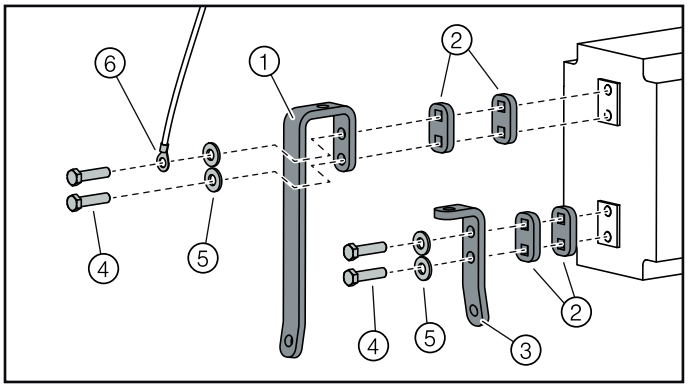


Fig. 89: Cable-cable connection

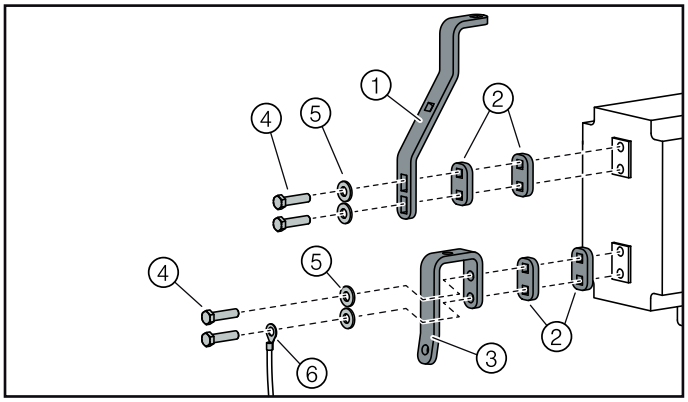


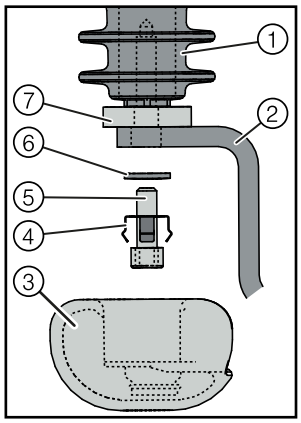
Fig. 90: Busbar-cable and cable-busbar connection

① Connection bar at the top
② Spacer[1] (4x)
③ Connection bar at the bottom
④ Hexagon head bolt M12 (4×)
⑤ Conical spring washer (2x)
⑥ Connecting cable with cable lug

Fastening the connection bars to the busbar

1. Clean the bushing of the busbar ① with cleaning agent and a lint-free wiping cloth, and rub dry.
2. Install the spacer ⑦ between the bushing and the connection bar ②.
3. Push the retaining clip ④ and the conical spring washer ⑥ onto the cheese head bolt ⑤.
4. Bolt the connection bar and the spacer together with the cheese head bolt to the bushing of the busbar (tightening torque: 40 Nm).
5. Put the control cap ③ on the retaining clip.
   WARNING Insufficient distance can cause an internal arc. The distance between the mounted control cap and earthed parts must be at least 65 mm.
   WARNING A damaged control cap insulation can cause an internal arc. The control cap must not be damaged.
6. Verify firm seat of control cap.
7. Perform the installation for the other two phases in the same way.

[1] Depending on the current transformer used



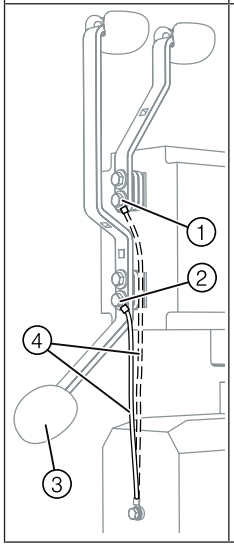
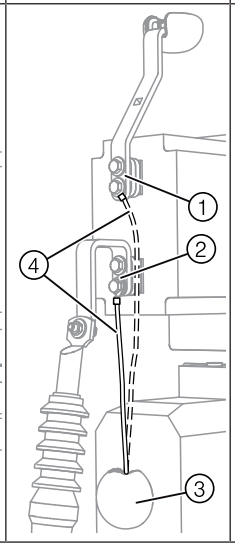
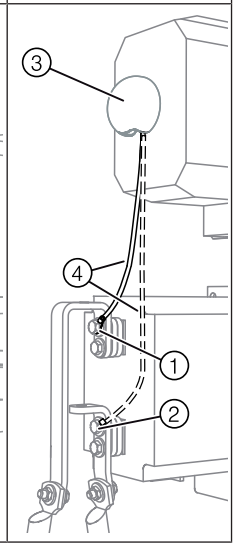
① Bushing
② Connection bar
③ Control cap
④ Retaining clip
⑤ Hexagon socket head cap bolt M10
⑥ Conical spring washer
⑦ Spacer

Fig. 91: Fastening the connection bar

6.19.4 Connecting voltage transformers

Connect the voltage transformers with the connecting cables either at the lower or upper terminals of the current transformers (see circuit diagrams). The connecting cables are pre-assembled or supplied with the accessories.

Tab. 38: Connection options for the connecting cable

Connection		
Busbar-busbar	Busbar-cable Cable-busbar	Cable-cable
		

① Upper current transformer connection
② Lower current transformer connection
③ Control cap
④ Connecting cable

1. Undo the hexagon head bolt and conical spring washer at the voltage transformer.
2. Mount the control cap holder.

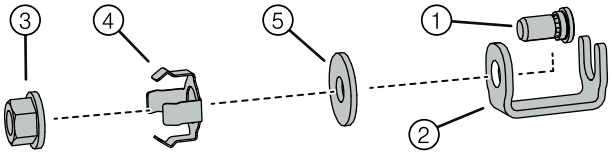


Fig. 92: Mounting the control cap holder

① Threaded stud M8
② Fixing bracket
③ Nut-and-washer assembly M8
④ Retaining clip
⑤ Plain washer

3. Mount the control cap together with the connecting cable onto the voltage transformer (tightening torque: 20 Nm). **Panel with busbar-busbar connection:** Fasten the connecting cable together with the hexagon head bolt and the conical spring washer **without** control cap and holder.

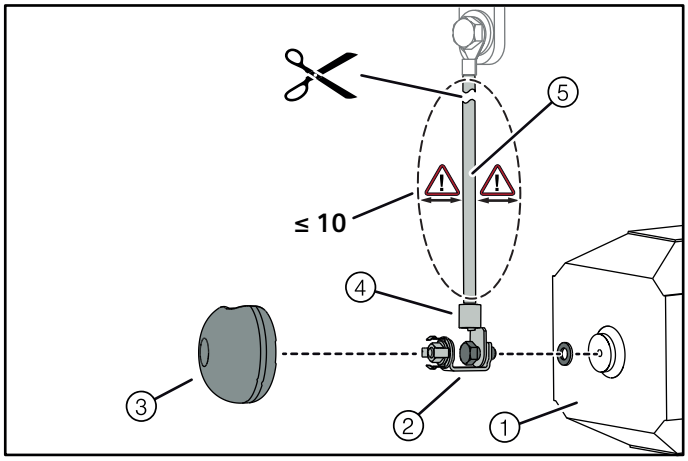
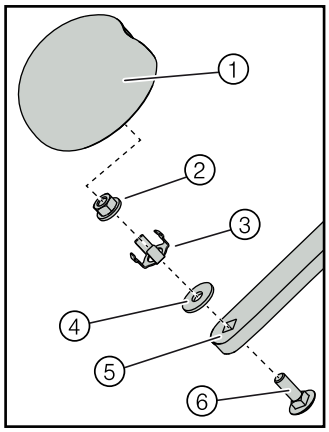


Fig. 93: Mounting the control cap

① Voltage transformer
② Control cap holder
③ Control cap
④ Cable lug
⑤ Connecting cable

4. Cut the connecting cable to suit the distance between the current transformer and voltage transformer terminals. **WARNING** Too much deflection can cause an internal arc. Maintain minimum distance from live parts. The deflection of the connecting cable must not be more than 10 mm.
5. Strip the insulation of the connecting cable and press the cable lug on.
6. Connect the connecting cable to the current transformer and voltage transformer according to the circuit documentation. It is permissible for the connecting cable to touch parts of the same phase.

7. **Panel with busbar-busbar connection:** Mount the control cap at the bottom of the connection bar.



① Control cap
② Nut-and-washer assembly M8
③ Retaining clip for control cap
④ Plain washer size 8
⑤ Connection bar
⑥ Cup head bolt M8x25

Fig. 94: Mounting the control cap at the connection bar

2-pole voltage transformer

1. Cut the connecting cable between the 2-pole voltage transformer and the current transformer to the same length and connect.

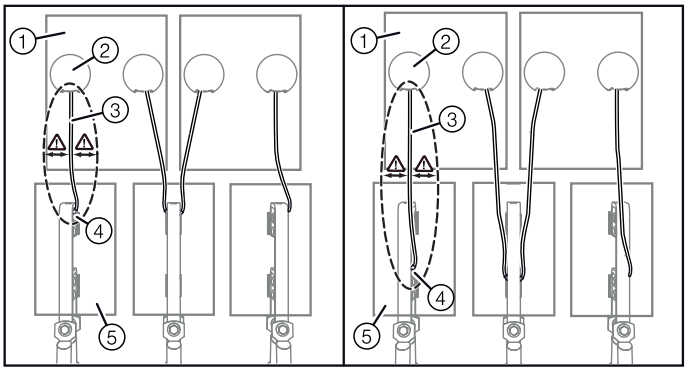


Fig. 95: Connecting cables for 2-pole voltage transformer

① 2-pole voltage transformer
② Control cap
③ Connecting cable
④ Cable lug
⑤ Current transformer

6.19.5 Connecting high-voltage cables

Floor plates with cutouts for the high-voltage cables may be pre-assembled in the billing metering panel. The floor plates can be removed before installation of the high-voltage cables.

☒ Maximum permissible cable cross-section: 300 mm².

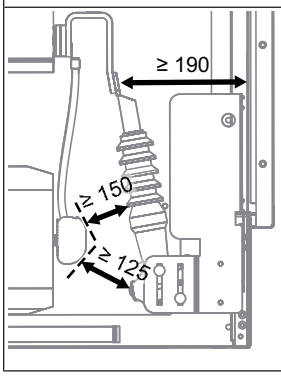
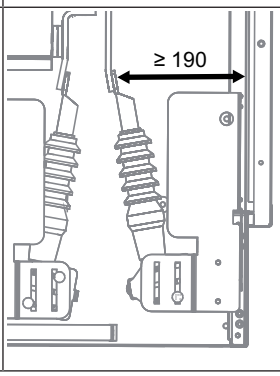
1. Re-install the floor plates step by step during installation of the high-voltage cables [► Page 60, "Mounting floor plates"].
2. Mount the cable termination according to the manufacturer stipulations.
3. Depending on the connection type, fasten the high-voltage cables ② at the connection bars ④ of the current transformers.

   ATTENTION If lower manufacturer stipulations do not exist for tightening torques, tighten the bolted joints to max. 50 Nm.

   WARNING Too small distances can cause an internal arc. Maintain the minimum distance between high-voltage cables and energized or earthed components according to IEC 61936.

   Minimum distance:
   – **U_r ≤ 12 kV:** 120 mm
   – **U_r > 12 kV:** 220 mm
   – If the minimum distances are too small, a dielectric test must be carried out. The test must prove that there is no risk of flashover.

Tab. 39: Verified minimum distances

Connection	
Cable-busbar Busbar-cable	Cable-cable
	

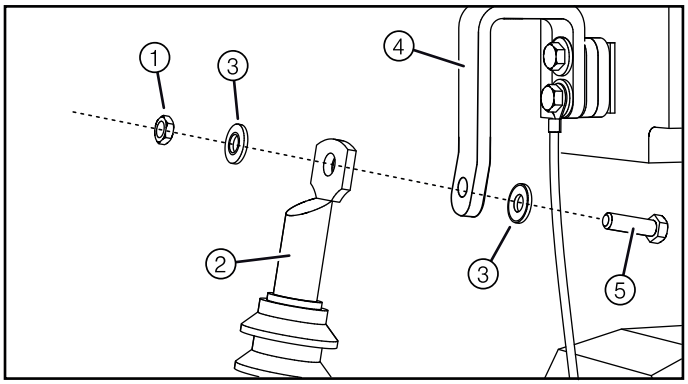


Fig. 96: Cable-busbar connection (busbar-cable)

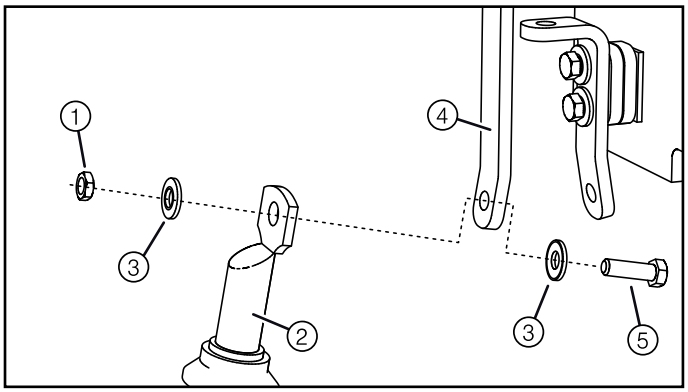


Fig. 97: Cable-cable connection (upper current transformer connection)

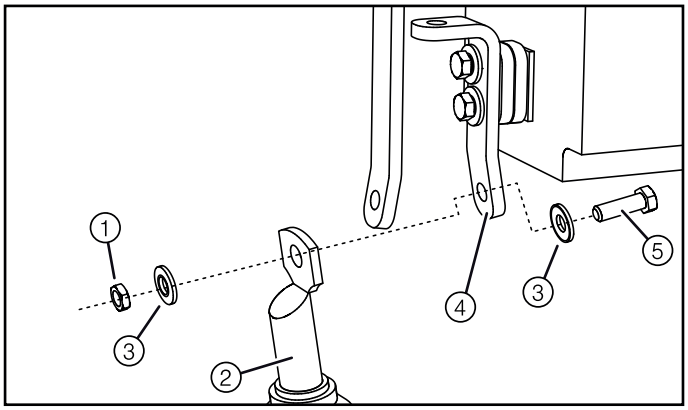


Fig. 98: Cable-cable connection (lower current transformer connection)

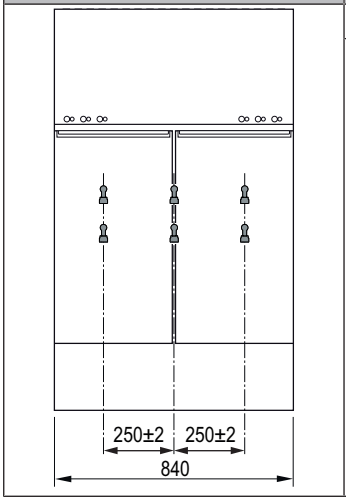
① Hexagon nut M12
② High-voltage cable
③ Conical spring washer M12
④ Connection bar of current transformer
⑤ Hexagon head bolt M12x40

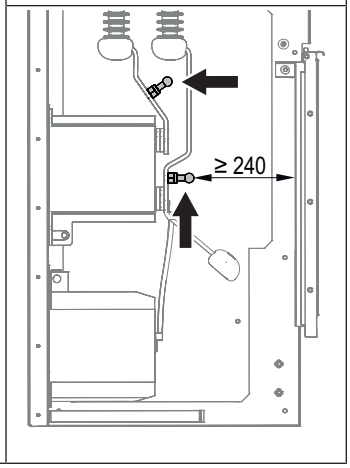
6.19.6 Mounting spherical connection bolts

To earth the busbars or the high-voltage cables when the current transformers are removed, spherical connection bolts must be mounted on the connection bars. The spherical connection bolts are available as accessories.

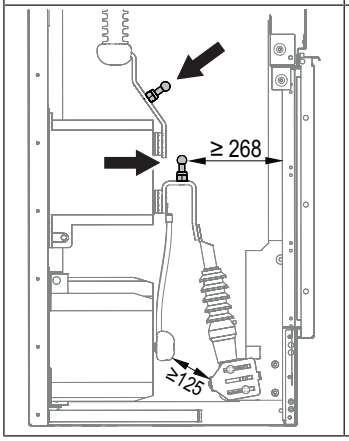
Mounting positions and tested minimum distances of the spherical connection bolts

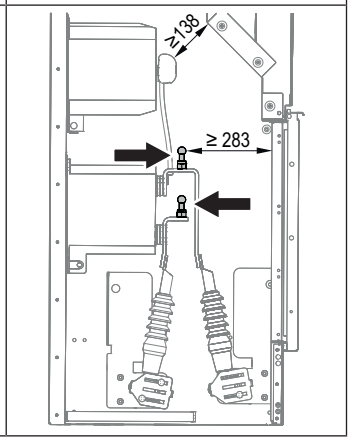
Front	Connection
	Busbar-busbar



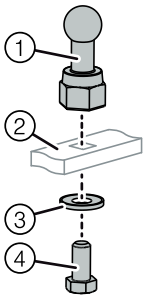


Connection	
Busbar-cable	Cable-cable
Cable-busbar	





1. Mount the spherical connection bolts on the connection bars (tightening torque: 40 Nm).
   WARNING Insufficient distance can cause an internal arc. Maintain the minimum distance between the spherical connection bolts and earthed components according to IEC 61936.
   Minimum distance:
   – **U_r ≤ 12 kV:** 120 mm
   – **U_r > 12 kV:** 220 mm



① Spherical connection bolt
② Connection bar
③ Conical spring washer M12
④ Hexagon head bolt M12x25

Fig. 99: Mounting spherical connection bolts

6.19.7 Laying wires of secondary equipment

The secondary wires of the current and voltage transformers are combined in a flexible steel tube and led into the billing metering panel.

1. Fasten the flexible steel tube at the lateral plastic plate using cable straps. Holes for the cable straps are prepared in the plastic plate.
   WARNING Insufficient distance from secondary wires to primary energized components can cause an internal arc. Maintain the minimum distance (≥ 190 mm).

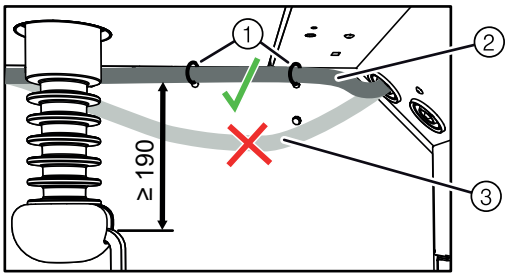


Fig. 100: Minimum distance for secondary wires

① Cable strap
② Flexible steel tube laid correctly
③ Flexible steel tube laid incorrectly:
Minimum distance not observed

6.19.8 Mounting floor plates

In billing metering panels, floor plates made of expanded metal can be installed as protection against small animals.

1. Install the floor plate with the screwed-on bracket ① towards the switchgear front.
2. Elongated holes are provided in the floor plates for fastening to the foundation. Bolt the floor plates to the foundation together with the panel frame.

Mounting positions and fixing points of the floor plates:

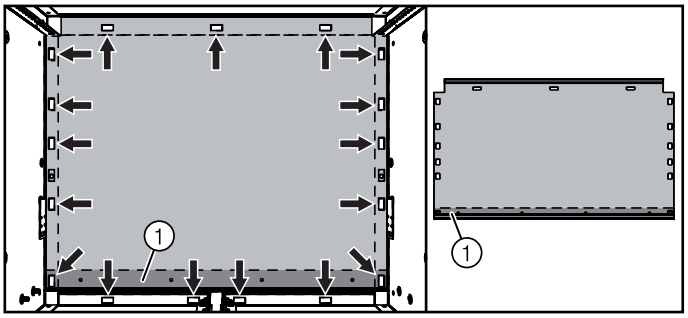


Fig. 101: Busbar-busbar connection

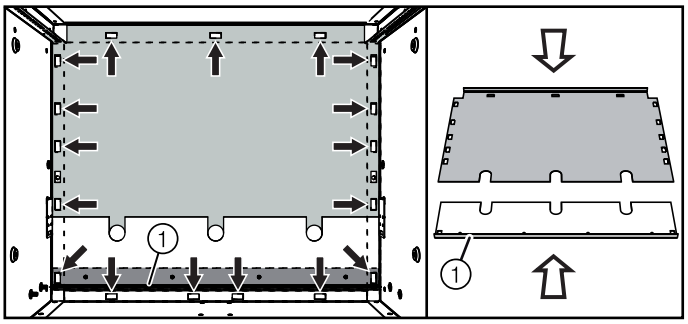


Fig. 102: Busbar-cable (cable-busbar) connection

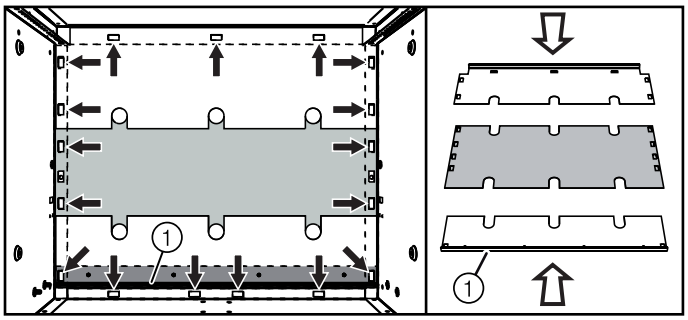


Fig. 103: Cable-cable connection

6.19.9 Final assembly work

1. Mount the cross member [▶ Page 63, "Removing and mounting the cross member"].
2. Mounting the cable compartment covers [▶ Page 62, "Removing and mounting the cable compartment cover"].

INFORMATION

Bolts for cable compartment covers

In as-delivered condition, the cable compartment covers of the billing metering panel are not fastened with all necessary bolts. After completion of installation, the cable compartment covers of the billing metering panel must be fastened at **all** bolted joints [▶ Page 62, "Removing and mounting the cable compartment cover"]. The additional bolts required for this purpose are enclosed with the switchgear accessories.

6.19.10 Mounting earthing accessories in the billing metering panel

⚠ DANGER

Inappropriate earthing accessories

Using inappropriate earthing accessories when the cable compartment cover is removed can cause serious injury or death due to an internal arc.

⇨ The earthing accessories must be designed for the short-circuit currents of the respective grid configuration.

⇨ The connections of the earthing accessories must be suitable for mounting at the switchgear [▶ Page 61, Tab. 40: "Suitable earthing accessories (selection)"].

The earthing accessories are always fastened between the earthing connection point for the earthing accessories and the spherical connection bolts.

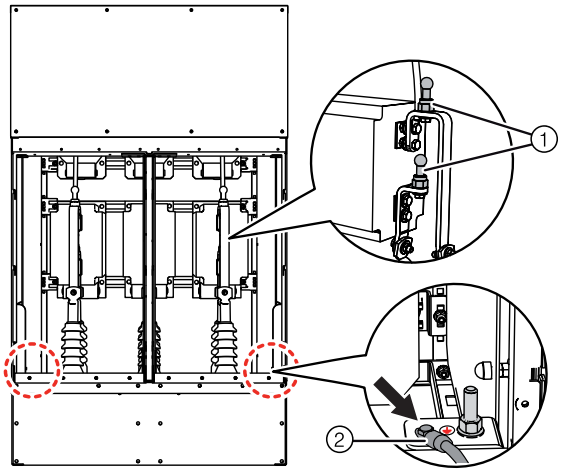


Fig. 104: Fixing points of the earthing accessories

① Spherical connection bolt
② Earthing connection point (on the left and right in the panel)

The earthing connection point offers different fixing options for the earthing accessories.

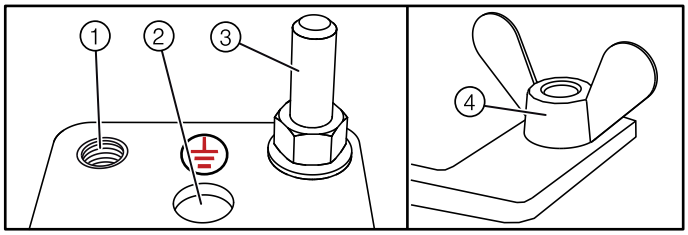


Fig. 105: Fixing options at the earthing connection point

① Threaded stud M12
② Through stud (max. Ø 16.3 mm)
③ Bolt with nut M12
④ Earthing accessories with wing nut

1. Mount the earthing accessories **first** at the earthing connection point for the earthing accessories. Observe the manufacturer information.
   DANGER Insufficient current-carrying capacity of the earthing can cause an internal arc. All connecting parts of the earthing accessories must be flush on the earthing connection point.
2. Earthing accessories with wing nuts ④ can be fastened to the earthing connection point at the position ③. To do this, remove the nut M12 and the conical spring washer before.
3. Then, mount the earthing accessories at the spherical connection bolts ([► Page 59, "Mounting spherical connection bolts"]) on all 3 phases.

Tab. 40: Suitable earthing accessories (selection)

No.	Maximum short-circuit current/duration	Type	Description	
1	13.8 kA / 1 s for straight spherical connection bolt with a sphere diameter of 20/25 mm **Version number: VK6ESW9**[1)]	EKV3+1 70R	3-pole earthing and short-circuiting device according to IEC 61230	▪ Cross-section of rope: 70 mm² / 35 mm² ▪ Length of rope, phase side: 600 mm ▪ Length of rope, earthing side: 1800 mm
		UK 25 SK	Universal terminal (art. no. 773 034)	▪ For straight spherical connection bolt ▪ Sphere diameter: 20/25 mm ▪ Spindle with hexagon
		EAS EK FM 12	Earthing connection unit M12 (art. no. 775 621)	With wing bolt
	Accessories	ES SK 1500	Earthing rod (art. no. 761 015)	▪ Length: 1500 mm ▪ Spindle with hexagon (size 19)
2	18.7 kA / 1 s for straight spherical connection bolt with a sphere diameter of 20 mm **Version number: V5DYR2W**[1)]	EKV3+1 95R	3-pole earthing and short-circuiting device according to IEC 61230	▪ Cross-section of rope: 95 mm² / 35 mm² ▪ Length of rope, phase side: 600 mm ▪ Length of rope, earthing side: 1800 mm
		KKH 20 D SK	Universal terminal (art. no. 772 330)	▪ For straight spherical connection bolt ▪ Sphere diameter: 20 mm ▪ Spindle with hexagon
		EAS EK FS 12	Earthing connection unit M12 (art. no. 775 626)	With wing bolt
	Accessories	ES SK 1000	Earthing rod (art. no. 761 010)	▪ Length: 1000 mm ▪ Spindle with hexagon (size 19)
3	18.7 kA / 1 s for straight spherical connection bolt with a sphere diameter of 25/30 mm **Version number: VSU7LDJ**[1)]	EKV3+1 95R	3-pole earthing and short-circuiting device according to IEC 61230	▪ Cross-section of rope: 95 mm² / 35 mm² ▪ Length of rope, phase side: 600 mm ▪ Length of rope, earthing side: 1800 mm
		UK 30 SK	Universal terminal (art. no. 773 130)	▪ For straight spherical connection bolt ▪ Sphere diameter: 25/30 mm ▪ Spindle with hexagon
		EAS EK FS 12	Earthing connection unit M12 (art. no. 775 626)	With wing bolt
	Accessories	ES SK 1500	Earthing rod (art. no. 761 015)	▪ Length: 1500 mm ▪ Spindle with hexagon (size 19)

No.	Maximum short-circuit current/duration	Type	Description	
4	23.7 kA / 1 s for straight spherical connection bolt with a sphere diameter of 25/30 mm **Version number: VE6X4KZ**[1)]	EKV3+1 120R	3-pole earthing and short-circuiting device according to IEC 61230	▪ Cross-section of rope: 120 mm² / 50 mm² ▪ Length of rope, phase side: 600 mm ▪ Length of rope, earthing side: 1800 mm
		UK 30 SQ	Universal terminal (art. no. 773 330)	▪ For straight spherical connection bolt ▪ Sphere diameter: 25/30 mm ▪ Spindle with cross-pin
		EAS EK FS 12	Earthing connection unit M12 (art. no. 775 626)	With wing bolt
	Accessories	ES SQ 1500	Earthing rod (art. no. 761 016)	▪ Length: 1500 mm ▪ Spindle with cross-pin

1) Manufacturer: DEHN + SÖHNE GmbH + Co. KG, Hans Dehn-Str. 1., Postfach 1640, D-92306 Neumarkt, Germany, www.dehn.de

6.20 Recurring activities

6.20.1 Removing and mounting the cable compartment cover

The cable compartment cover can additionally be bolted on in certain panel types.

WARNING An unbolted cable compartment cover can cause life-endangering injury in case of internal arc.

In the following panel types, the cable compartment cover **must** be bolted to the panel during operation:

- Billing metering panel type M
- Cable panel type K
- All panels with pressure absorber system (IAC up to 21 kA)

Removing the cable compartment cover

1. Earth the feeder.
2. **For cable panels or panels with a pressure absorber system (IAC up to 21 kA)**: Remove 2 self-tapping screws ② at the top of the cable compartment cover.
   For billing metering panels: Undo 4 bolts ② as well as 11 bolts ③ and 1 bolt ④ at both cable compartment covers.
3. Lift the cable compartment cover ① and remove it to the front.

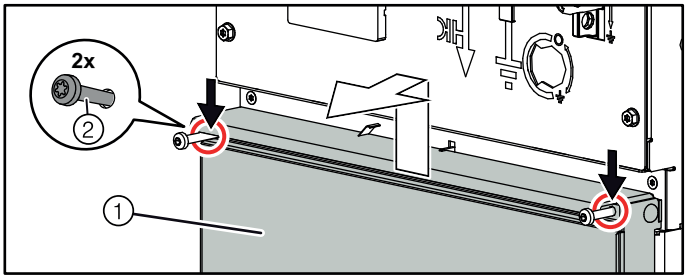


Fig. 106: Cable compartment cover, all panel types (without billing metering panel)

① Cable compartment cover

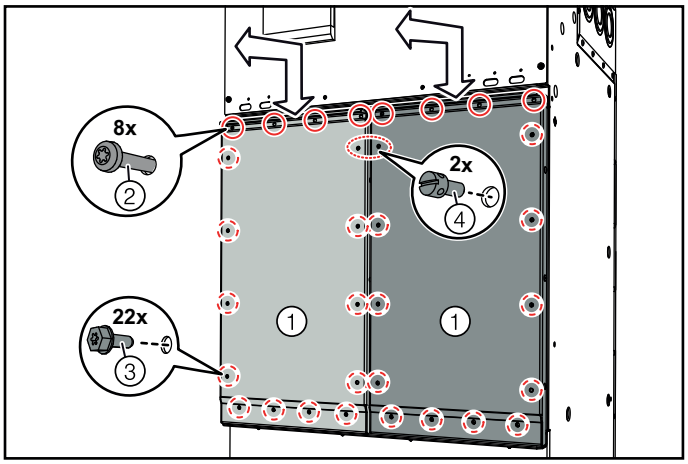


Fig. 107: Cable compartment cover, billing metering panel

① Cable compartment cover
② Self-tapping screw M6x50
③ Hexagon head bolt with hexalobular socket and small flange M6x16
④ Bolt M6x12 (sealable)

Hooking the cable compartment cover in

1. Hook the cable compartment cover in.
2. **If the cable compartment cover was bolted on:** Fasten the cable compartment cover again at the panel using the bolts removed previously.

6.20.2 Removing and mounting the cross member

Removing the cross member

1. Remove the cable compartment cover [▶ Page 62, "Removing and mounting the cable compartment cover"].
2. **Panel height 1200 mm:** Undo 4 bolts ② at the cross member ①.
3. **Panel height 1400 mm:** Undo 6 bolts ② at the cross member ①.
4. **Billing metering panel:** Undo 10 bolts ④ at the cross member ①.
5. Undo the floor fixing bolt ③ if the panel was already fastened to the foundation.
6. Remove the cross member ①.
   ATTENTION Do not move the panel with removed cross member.

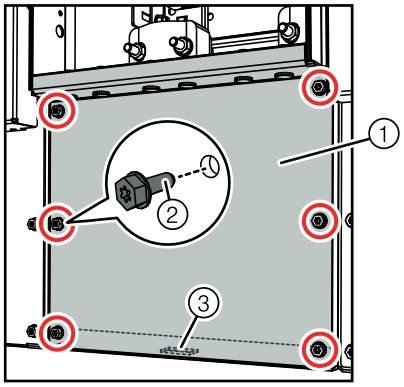


Fig. 108: Cross member (example)

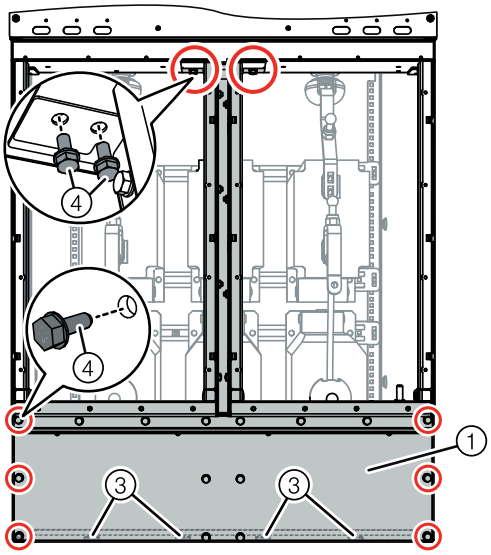


Fig. 109: Cross member (billing metering panel)

① Cross member
② Hexagon head bolt with hexalobular socket M6x16
③ Floor fixing bolt
④ Bolt-and-washer assembly M8x16

Mounting the cross member

1. Fasten the cross member ① again at the panel using the bolts removed previously.
2. If applicable, fasten the cross member to the foundation again using the floor fixing bolt ③.

6.20.3 Removing and mounting the front cover

WARNING Components behind the front cover can automatically move quickly. Before removing the front cover, deactivate electrical control circuits and discharge the spring energy store.

If applicable, deactivate electrical control circuits:

1. Switch off the auxiliary voltage supply of the motor.
2. Open the MCB.
3. Disconnect the control cables.

If available, discharge the spring energy store in the operating mechanism:

4. Actuate the OFF pushbutton.
5. Actuate the ON pushbutton.
6. Actuate the OFF pushbutton again.

✓ The "spring charged" indicator shows "spring not charged".

Removing the front cover

1. Remove 4 bolts from the front cover (billing metering panel: 8 bolts), and store them.
2. Carefully remove the front cover to the front. Store the front cover safely.

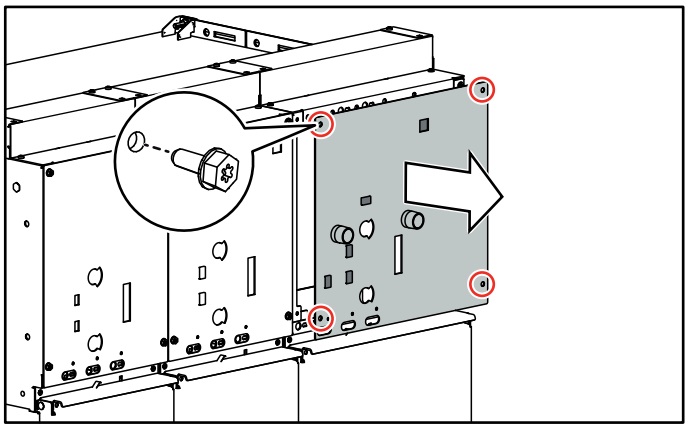


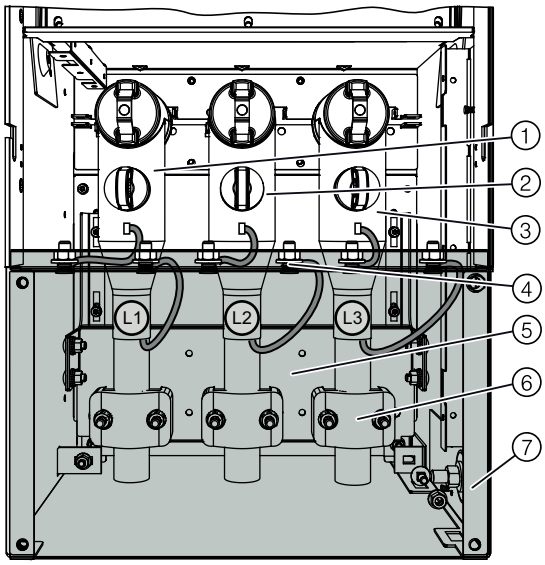
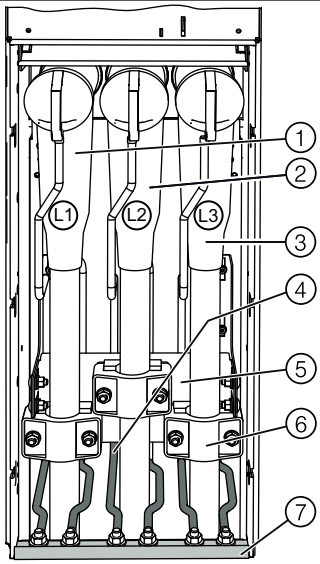
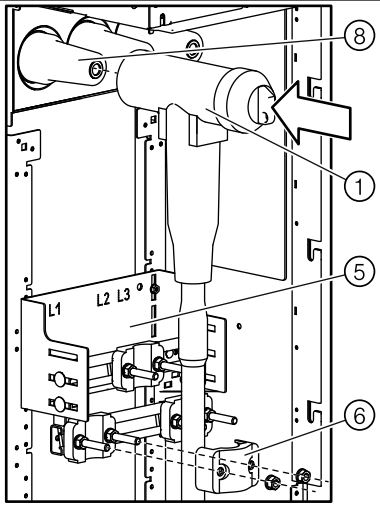
Fig. 110: Removing the front cover (example)

Mounting the front cover

1. Fasten the front cover again at the panel using the bolts removed previously.
2. Put the panel back into operation.

7 Electrical connections

7.1 Connecting high-voltage cables

Cable connection type A	Cable connection type C	Example
		

① Cable T-plug (phase L1)
② Cable T-plug (phase L2)
③ Cable T-plug (phase L3)
④ Earthing cable for plug housing and cable shield
⑤ Cable bracket
⑥ Cable clamp
⑦ Cross member (removable)
⑧ Bushing

Common features and suitable cable plugs [► Page 11, "Cable connection"].

NOTICE

Removing the protection ring

A white plastic protection ring may be assembled on the outside-cone bushing type C. The protection ring serves as a stop for the plug. Removing the protection ring can damage the connection of the voltage detecting and indicating system.

⇨ Do not remove the protection ring.

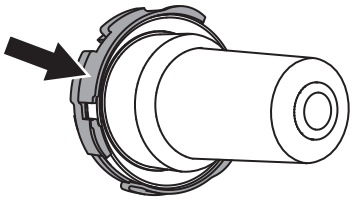


Fig. 111: Protection ring at the bushing

1. Earth and isolate the switchgear.
2. Remove the cable compartment cover [► Page 62, "Removing and mounting the cable compartment cover"].
3. The cross member ⑦ can be removed to swing in the cables [► Page 63, "Removing and mounting the cross member"].
4. **Panel with pressure absorber (IAC up to 16 kA and 21 kA):** Remove the floor plate [► Page 65, "Cable installation in switchgear with pressure absorber (IAC up to 16 kA and 21 kA)"].
5. Remove the upper part of the cable clamps ⑥.
6. Pre-adjust the cable bracket ⑤ and the lower part of the cable clamps.
7. Removing the protective caps from the bushings.

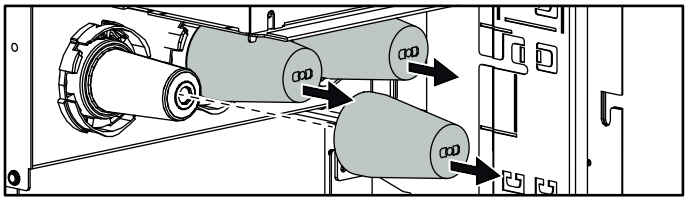


Fig. 112: Removing the protective caps

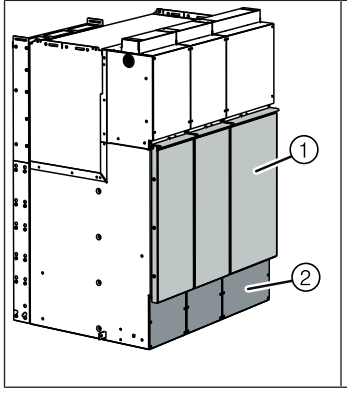
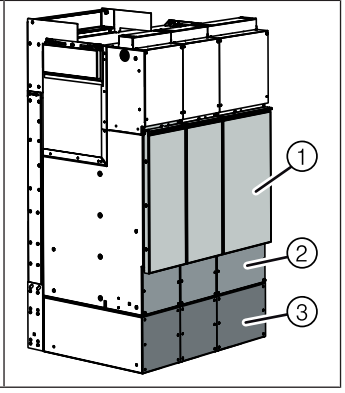
8. **Optionally:** Mount the cable-type current transformers ([► Page 66, "Mounting cable-type current transformers"]).
9. Fit the cable plugs on the conductor ends according to the manufacturer's instructions.
10. **Optionally:** Mount the ring-core current sensors [► Page 68, "Installing ring-core current sensors at the cable connection"].
11. **Optionally:** Mount the voltage sensors [► Page 69, "Installing voltage sensors"].

12. Carefully coat the push-on surfaces of the cable plugs and the bushings with mounting paste. Use the mounting paste stipulated by the cable plug manufacturer.
13. Mount the cable plugs onto the bushings of phases L1 to L3 straight and without distortion. Observe the correct phase sequence and manufacturer information.
    WARNING Damage to the bushings can cause an internal arc. Do not allow high-quality joints of the bushings to be damaged by the threaded studs of the cable plugs.
    WARNING Damage to the bushings can cause an internal arc. The maximum tightening torque of the cable plugs (80 Nm) must not be exceeded.
14. Mount the upper part of the cable clamps ⑥.
15. Align and fasten the cable bracket ⑤.
16. Refit the floor plate.
17. Refit the cross member [► Page 63, "Removing and mounting the cross member"].
18. Connect the earthing cables of the plug housings and the cable shielding at the cross member ⑦. **Note:** Take hexagon nuts and conical spring washers for the earthing connection points from the accessories.
19. Hook the cable compartment cover in again [► Page 62, "Removing and mounting the cable compartment cover"].

7.2 Cable installation in switchgear with pressure absorber (IAC up to 16 kA and 21 kA)

In switchgear with pressure absorber (IAC up to 16 kA and 21 kA), the high-voltage cables must be led into the cable compartment or base frame through a floor plate.

The floor plate can be mounted with the recess for the control cables on the left side or on the right side.

Switchgear with pressure absorber	
IAC up to 16 kA (example)	IAC up to 21 kA (example)
	

① Cable compartment cover
② Cross member
③ Front plate of base frame

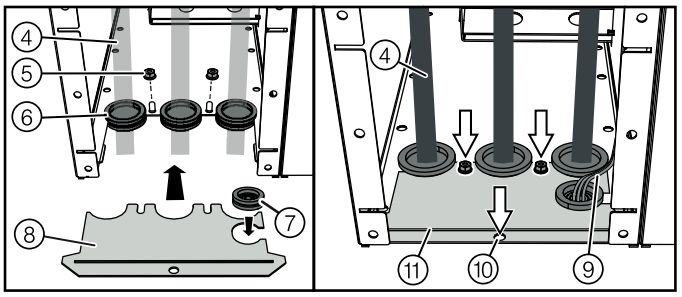


Fig. 113: Mounting the floor plate (example: IAC up to 21 kA)

④ High-voltage cable (max. Ø 52 mm)
⑤ Nut-and-washer assembly M8 (2x)
⑥ Rubber sleeve (Ø 70 mm)
⑦ Rubber sleeve (Ø 56 mm)
⑧ Floor plate
⑨ Control cables (max. Ø 38 mm)
⑩ Fixing point of foundation
⑪ Slot

☒ Cable compartment cover removed
☒ Cross member removed

1. **Switchgear with pressure absorber (IAC up to 21 kA):** Remove the front plate ③ of the base frame. To do this, undo the 6 self-tapping screws M6x16.
2. Undo the 2 nut-and-washer assemblies M8 ⑤ and the bolted joint at the fixing point ⑩.
3. Take the floor plate ⑧ out of the panel.
4. Lead the high-voltage cable ④ into the cable compartment.
5. With a knife, cut an opening into the rubber sleeves ⑥ and ⑦ that fits the diameter of the cable, or for the control cables.
6. Push the rubber sleeves ⑥ onto the high-voltage cables.
7. Lead the control cables through the rubber sleeve ⑦.
8. Insert the rubber sleeves ⑥ and ⑦ into the recesses of the floor plate.
9. Install the high-voltage cables and the cable plugs [► Page 64, "Connecting high-voltage cables"].

Mounting the floor plate after cable installation

1. Insert the floor plate ⑧ and fasten it with 2 nut-and-washer assemblies M8 ⑤. The floor plate must penetrate into the grooves s of the rubber sleeves ⑥.
2. Fasten the floor plate at the fixing point ⑩ of the foundation.
3. **Switchgear with pressure absorber (IAC up to 21 kA):** Mount the front plate of the base frame ③ using 6 self-tapping screws M6x16.
4. Mount the cross member ② [► Page 63, "Removing and mounting the cross member"].
   Switchgear with pressure absorber (IAC up to 16 kA): The lug of the cross member must penetrate into the slot ⑪ of the front floor plate.
5. Hook the cable compartment cover ① in [► Page 62, "Removing and mounting the cable compartment cover"].

7.3 Installing cable plugs type Raychem RICS5xxx with RDA

Observe the minimum distances according to the manufacturer information while connecting non-screened cable plugs or surge arresters.
The use of RICS5xxx cable plugs with RDA in panels with a width of 310 mm is allowed under normal ambient conditions despite the reduced distance.

1. Remove the cable compartment cover [▶ Page 62, "Removing and mounting the cable compartment cover"].
2. Remove the upper cross member ① at the panel. For this purpose, undo 4 self-tapping screws M6 ②.

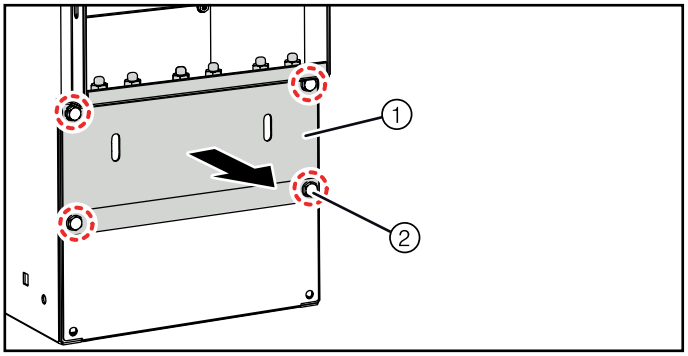


Fig. 114: Removing the upper cross member

3. Mount cable plug type Raychem RICS5xxx with surge arrester RDA ③. Observe the installation instructions of the cable plug and surge arrester manufacturer.
4. Push the surge arrester plate ⑤ between the hexagon nuts M12 ④ and a conical spring washer ⑥ each, and tighten.

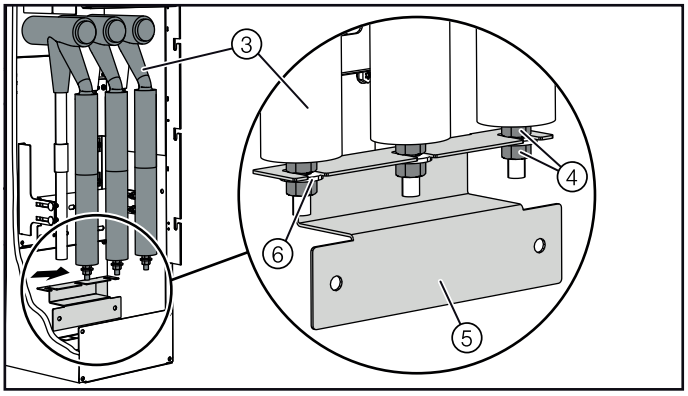


Fig. 115: Mounting the surge arrester plate

5. Fasten the upper cross member ① with 4 self-tapping screws M6 ②.
6. Fasten the surge arrester plate to the upper cross member using 2 hexagon head bolts M8x16 ⑦ and plain washers ⑥.

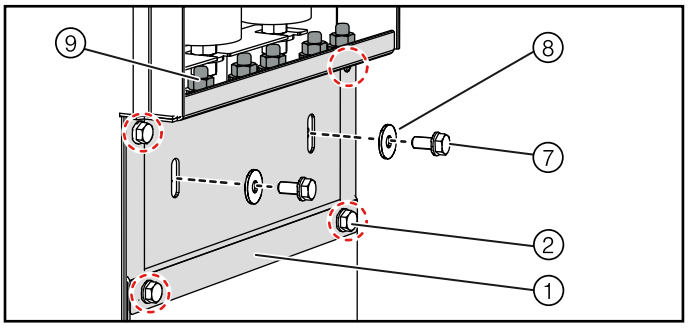


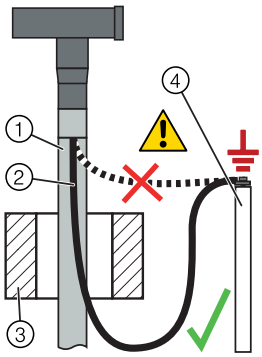
Fig. 116: Fastening the upper cross member and the surge arrester plate

7. Connect the cable shields with cable lugs and earthing bolts M10 at the earthing connection points ⑨. **Note:** Take hexagon nuts and conical spring washers for the earthing connection points from the accessories.
8. Hook the cable compartment cover in and bolt together, if required.

7.4 Mounting cable-type current transformers

The cable-type current transformers are supplied in the cable compartment and must be mounted on the high-voltage cables on site. The current transformer mounting plates are pre-assembled on the cable bracket at the factory.

1. Remove the cable compartment cover [▶ Page 62, "Removing and mounting the cable compartment cover"].
2. Remove the cross member, if required [▶ Page 63, "Removing and mounting the cross member"].
3. Take the supplied current transformers out of the cable compartment.
4. Push the current transformers onto the high-voltage cables.
5. Mount the cable plugs according to the manufacturer's stipulations.
6. Adjust the position of the current transformer mounting plates at the cable bracket according to the current transformer type. There must be enough space available for the mounted current transformers (observe the following overviews of mounting positions).



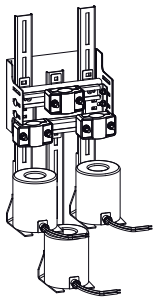
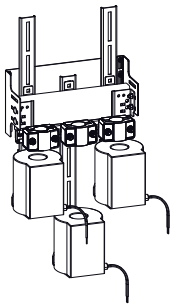
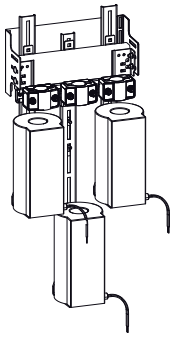
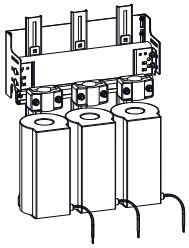
① High-voltage cable
② Cable shield
③ Current transformer
④ Cross member

Fig. 117: Connecting the cable shield

7. Swing the high-voltage cables in together with the cable-type current transformers, and connect the cable plugs at the bushings [▶ Page 64, "Connecting high-voltage cables"].

8. If they have not been pre-assembled at the factory, lead the connection wires of the current transformers upwards into the operating mechanism compartment or the low-voltage compartment. Connect the connection wires according to the circuit diagram.
9. Mount the cross member [► Page 63, "Removing and mounting the cross member"].
10. Hook the cable compartment cover in [► Page 62, "Removing and mounting the cable compartment cover"].

Tab. 41: Mounting positions of cable-type current transformers 4MC7032 and 4MC7033

Current transformer			Width of panel
Type	Height	Mounting position	
4MC7032	▪ 80 mm ▪ 150 mm		310 mm
4MC7033	▪ 65 mm ▪ 110 mm ▪ 170 mm		430 mm
	285 mm		430 mm
	285 mm		500 mm

- To provide enough space for the current transformer wires, place the current transformers slightly turned on the current transformer mounting plate.
- Due to their height, mounted current transformers can reach into the cable basement.

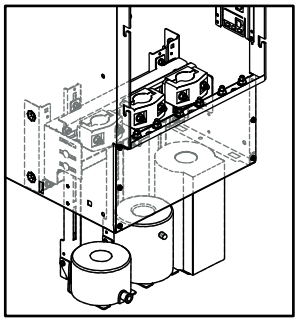


Fig. 118: Current transformers reach into the current basement (example)

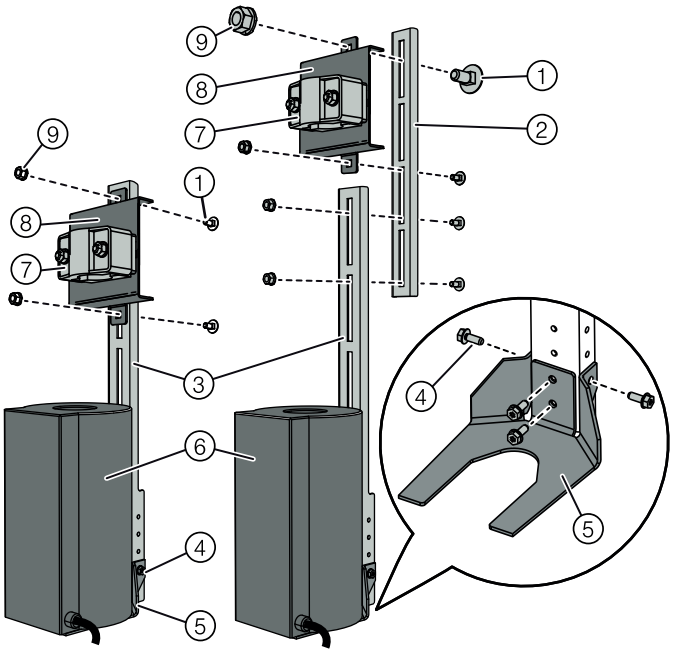
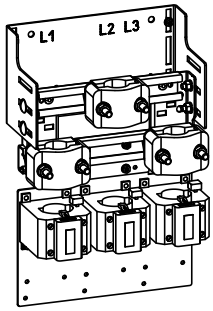
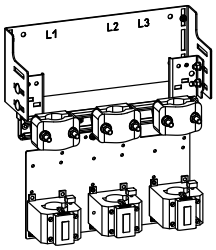
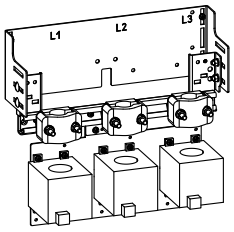


Fig. 119: Principle of installation for 4MC7033

① Cup head bolt M8x20
② Extension of adjustment rail (optional)
③ Adjustment rail
④ Self-tapping Torx screw M6x16
⑤ Current transformer mounting plate
⑥ Current transformer
⑦ Cable clamp
⑧ Cable bracket
⑨ Nut-and-washer assembly M8

Tab. 42: Mounting positions of cable-type current transformers 4MC7031 and WIC1

Current transformer			Width of panel
Type	Height	Mounting position	
4MC7031	89 mm		310 mm
			▪ 430 mm ▪ 500 mm
WIC1	130 mm		▪ 430 mm ▪ 500 mm

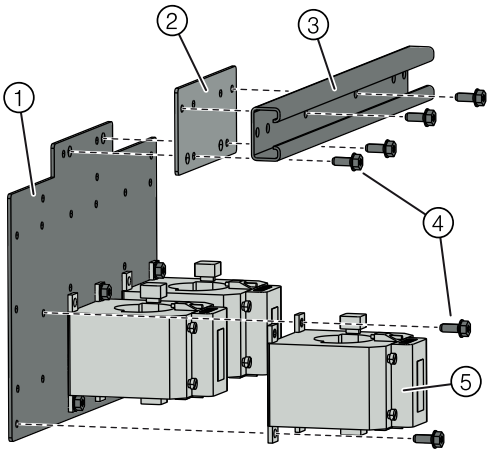


Fig. 120: Principle of installation for 4MC7031 current transformers

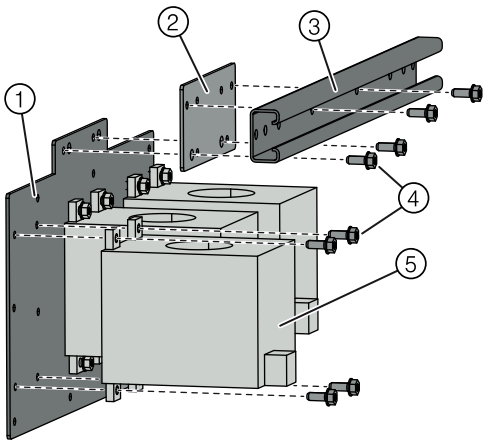


Fig. 121: Principle of installation for WIC1 current transformers

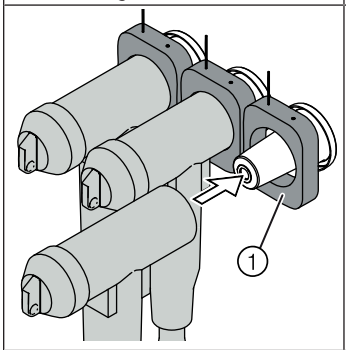
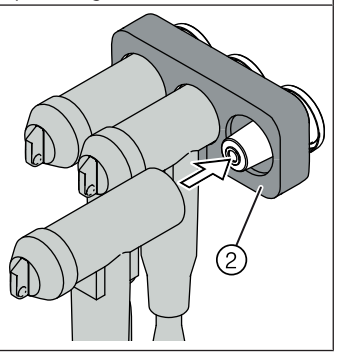
① Current transformer mounting plate
② Holder for current transformer mounting plate
③ C-rail
④ Self-tapping Torx screw M6x16
⑤ Current transformer

7.5 Installing ring-core current sensors at the cable connection

Preconditions:

- Use current sensors and transformer monitoring systems exclusively **with screened cable connection systems**.
  WARNING The use of unscreened cable connection systems can cause an internal arc during operation. **Exceptions:** Make Horstmann with the article numbers 49-6025-6xx for devices of the SIGMA 2.0 and ComPass series.
- For the ring-core current sensors, the maximum permissible outside diameter for the connection cables or cable sets is given in the corresponding configuration documentation of the switchgear. Compare the stipulations before start of installation with the maximum permissible outside diameters of the connection material.

Ring-core current sensors are mounted on the cable plug during installation of the high-voltage cables. The following current sensors can be mounted:

Individual ring-core current sensors ①	3-phase ring-core current sensor ②
	

1. Earth and lock the cable feeder.
2. Remove the cable compartment cover [▶ Page 62, "Removing and mounting the cable compartment cover"].
3. Push the ring-core current sensors onto the bushings and mount the cable plugs.

INFORMATION

In panels with a width of 310 mm, there is not sufficient space for 3 individual ring-core current sensors next to each other.

⇨ Mount the cable plugs together with the ring-core current sensors on phases L1 and L3.

⇨ Push the ring-core current sensor on phase L2 further onto the cable plug, and position it **in front of** the two other ring-core current sensors.

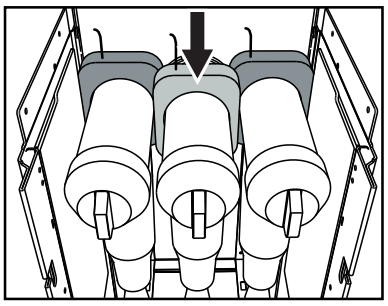
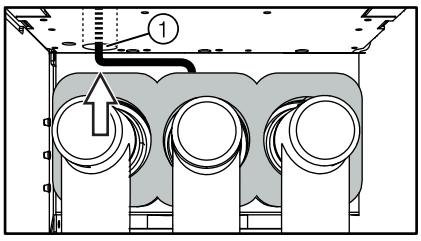


Fig. 122: Ring-core current sensors (panel width 310 mm)

Connecting ring-core current sensors

1. If they have not been pre-assembled at the factory, lead the connection wires of the ring-core current sensors through the cable tube ① upwards into the low-voltage compartment or the operating mechanism compartment. Connect the connection wires according to the circuit diagram.



① Cable tube

7.6 Installing voltage sensors

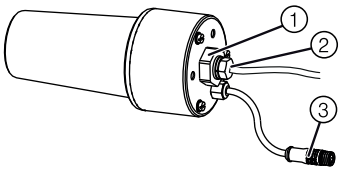


Fig. 123: Voltage sensor (example)

① Cast-resin hexagon (key size 24)

② Connection of earthing cable (conductor cross-section: min. 6 mm²)

③ Plug connection of the measuring lead

Voltage sensors are mounted on the cable plug instead of the locking cap.

☒ Use the cable plugs released by the manufacturer of the voltage sensors [▶ Page 70, Tab. 43: "Voltage sensors and cable plugs for use"].
ATTENTION The use of unsuitable cable plugs can damage the switchgear.

1. Mount the cable plugs according to the manufacturer's instructions. Do **not** mount the locking cap of the cable plugs.
2. Clean the cone of the voltage sensor and the cable plug with a lint-free wiping cloth.
3. Coat the cone of the voltage sensor with the mounting paste recommended by the plug manufacturer.
4. Screw the voltage sensor into the cable plug at the cast-resin hexagon ① (tightening torque: max. 30 Nm).

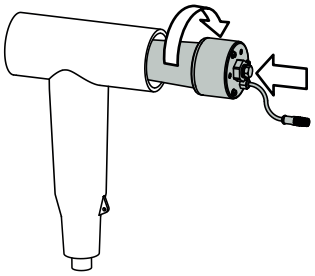
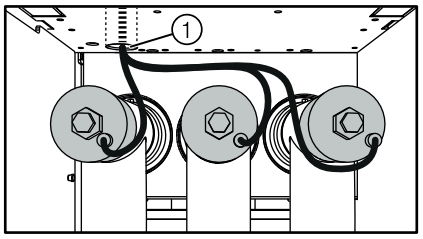


Fig. 124: Mounting the voltage sensor (example)

5. Mount the earthing cable at the earthing connection point ② (tightening torque: 10 Nm). Connect the earthing cable to the cross member. **Note:** Take hexagon nuts and conical spring washers for the earthing connection points from the accessories.
6. Connect the measuring lead ③ with the connection wires.
7. If they have not been pre-assembled at the factory, lead the connection wires of the voltage sensors through the cable tube upwards into the low-voltage compartment or the operating mechanism compartment. Connect the connection wires according to the circuit diagram.



① Cable tube

Tab. 43: Voltage sensors and cable plugs for use

Voltage sensor				Cable plug		
Description	Insulation level[1)] U [kV]	Make	Type	Make	Type	Description
Voltage sensor for cone according to EN 50180	24/50/125	Zelisko	SMVS-UW1001	Nexans	(K) (M) 440TB	Cone according to EN 50180
				Cellpack	CTS-S 630 A 24 kV	
				Südkabel	SEHDT 13	
					SEHDT 23	
Voltage sensor with shortened cone for asymmetrical cable T-plugs	24/50/125		SMVS-UW1002-0	nkt cables	CB-24	Shortened cone
					CC-24	
				TE Connectivity	RSTI-58xx	
					RSTI-CC58xx	
			SMVS-UW1002-1	Nexans	(K)430TB/G	
			SMVS-UW1002-2	Cellpack	CTS 630 A 24 kV	
			SMVS-UW1002-3	Nexans	(K)480TB/G	

1) Rated voltage / rated power-frequency withstand voltage / rated lightning impulse withstand voltage

7.7 Connecting SIBushing

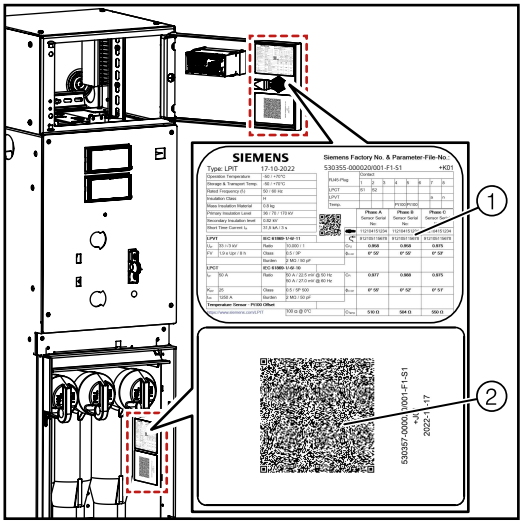
The following chapter describes connecting the SIBushing to the device on site. For example, if the low-voltage compartment was not mounted at the factory or the device is subsequently installed or replaced. The connection for devices is explained on a device-specific basis.

The sensor cable is a special connection cable. The sensor cable must not be replaced with any other connection cables.

7.7.1 Connecting SIBushing for all devices

☒ Configuration software exists.

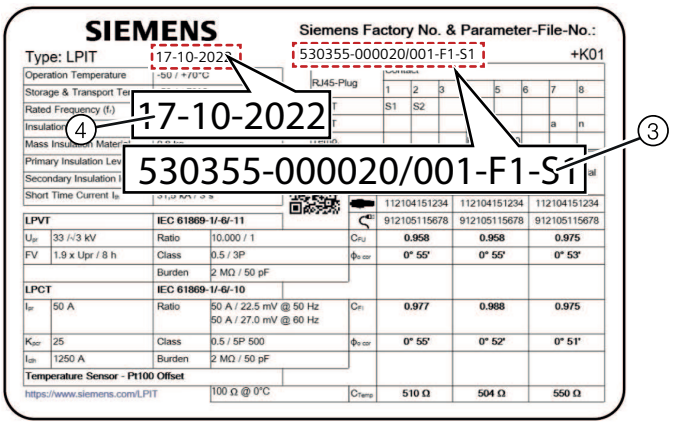
1. Connect the pre-assembled sensor cables at the device according to the circuit diagram and the color markings (L1 = brown, L2 = black, L3 = gray).
2. Identify the nameplate of the SIBushing ① in the cable compartment or the door of the low-voltage compartment.



① Nameplate of the SIBushing

② QR code of the SIBushing

3. Scan the associated QR code of the SIBushing ②.
4. Transfer the content of the scanned QR code to a text file, e.g. by means of an e-mail.
5. Save the text file with the switchgear serial number as the filename, and the file format `.JSON`, e.g. `530355-000020-001-F1-S1.JSON`. Replace the "**/**" in the serial number with a "**-**".



③ Switchgear serial number

④ Year of manufacture of the switchgear

6. Continue with the chapters for the specific device.
   [▶ Page 70, "Configuring SICAM FCM PLUS, IKI55, and COMPASS BS 2.0 for SIBushing"]
   [▶ Page 70, "Configuring EOR 3DS for SIBushing"]
   [▶ Page 71, "Configuring SIPROTEC 5 for SIBushing"]

7.7.2 Configuring SICAM FCM PLUS, IKI55, and COMPASS BS 2.0 for SIBushing

1. Establish the connection to the device using a USB connection cable.
2. With the configuration software, transfer the saved file according to the information of the device manufacturer.

✓ The SIBushing is connected completely.

7.7.3 Configuring EOR 3DS for SIBushing

1. Take the SD card out of the card slot on the rear side of the device.
2. Insert the SD card in a reader. Access the SD card.

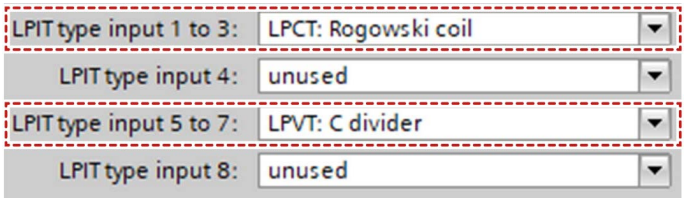
3. Save the file with the prefix `PIDU_Parameter_SIBushing_` e.g. `PIDU_Parameter_SIBushing_530355-000020-001-F1-S1.JSON` in the `sensor_config` folder of the SD card.
4. Take the SD card out of the reader. Re-insert it into the device.
5. Restart the device.

✓ The SIBushing is connected completely.

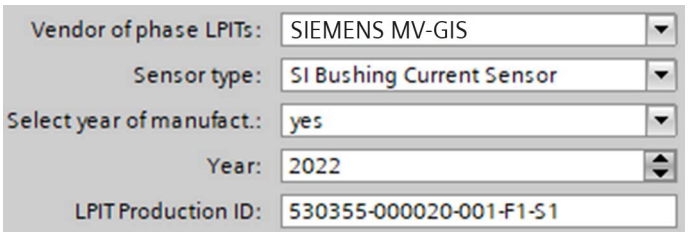
7.7.4 Configuring SIPROTEC 5 for SIBushing

☒ The configuration software is up to date.

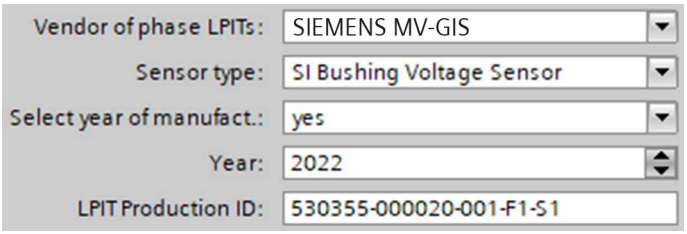
1. Start the `DIGSI` configuration software.
2. Call the device.
3. For `LPIT General`, select the following settings.



4. For the `Rogowski coil` current sensor, select the following settings. Find the serial number and year of manufacture on the nameplate. Replace the "**/**" in the serial number with a "-".



5. For the `C divider` voltage sensor, select the following settings. Find the serial number and year of manufacture on the nameplate. Replace the "**/**" in the serial number with a "-".



6. Establish the connection to the protection device and transfer the settings according to the manufacturer instructions.

✓ The SIBushing is connected completely.

7.8 Installing voltage transformers 4MT8 at the cable feeder

The voltage transformers may already be pre-assembled in the panel when delivered. To install the voltage transformers together with the connection cables, the voltage transformers must first be removed.

☒ Necessary cable T-plugs for installation with voltage transformers 4MT8 [▶ Page 13, "Single cable connection with voltage transformer 4MT8 (interface type C)"].

1. Isolate and earth the cable feeder.
2. Remove the cable compartment cover [▶ Page 62, "Removing and mounting the cable compartment cover"].

If the voltage transformers are pre-assembled in the panel when delivered:

3. Undo the transport fixing of the voltage transformer connection wires.
4. Remove 3 hexagon head bolts (①,②) and contact washers ③ at one of the voltage transformers.
5. Lift the voltage transformer ④ together with the holder carefully out of the panel.
   CAUTION Heavy component; use suitable lifting equipment or lift together with several persons.
6. Take all the voltage transformers out of the panel in the same way.

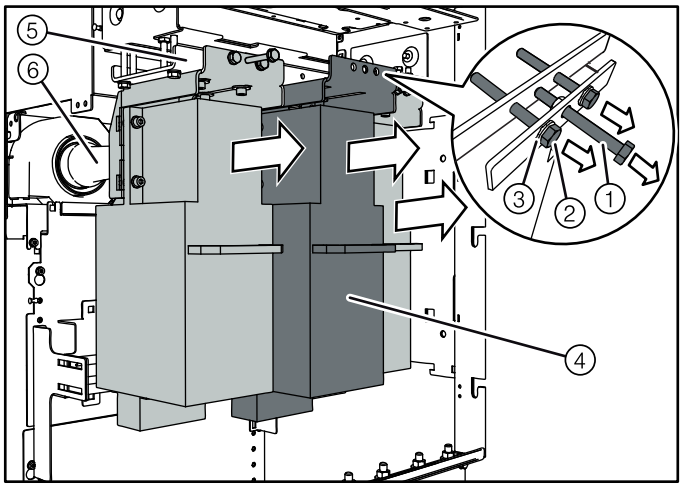


Fig. 125: Removing voltage transformers

① Hexagon socket head bolt M8x40
② Hexagon head bolt M8x70 (2x)
③ Contact washer (2x)
④ Voltage transformer 4MT8 (3x)
⑤ Voltage transformer mounting plate
⑥ Bushing

7. Remove the protective caps of the bushings ⑥ (if available).

Checking and correcting the voltage transformer alignment

1. Screw the centering bolt ⑦ into the right-hand bushing ⑥. The centering bolt is an adjustment aid for correct positioning of the voltage transformers.

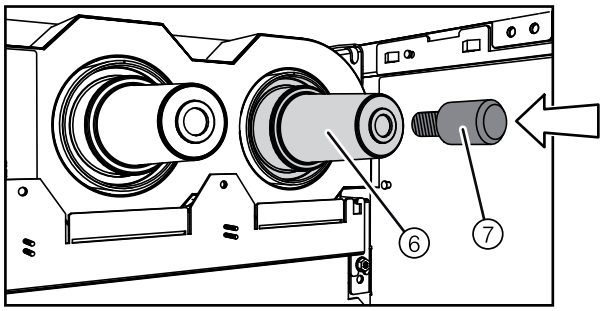


Fig. 126: Screwing the centering bolt into the bushing

2. Push the voltage transformer ④ together with the voltage transformer slide ⑧ carefully onto the voltage transformer mounting plate ⑤.
   CAUTION Heavy component; use suitable lifting equipment or lift together with several persons.
   – Do not damage the voltage transformer. Avoid touching the cable bracket or the cable clamps. If necessary, correct the position of the cable bracket.
   – It must be easy to push the voltage transformer bushing onto the centering bolt ⑦.

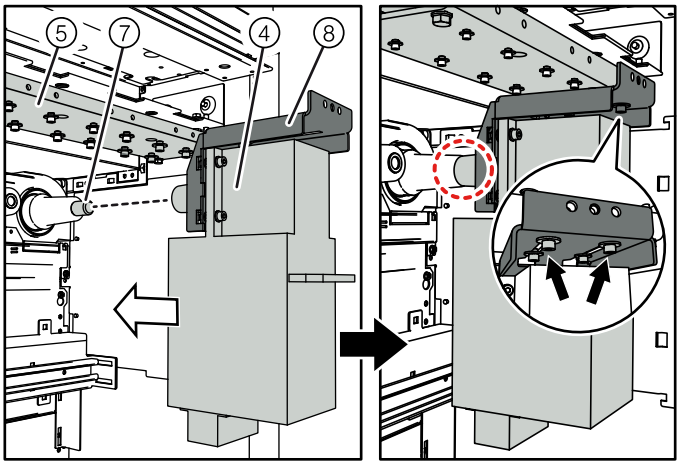


Fig. 127: Pushing the voltage transformer onto the centering bolt

If the voltage transformer cannot be pushed onto the centering bolt, correct the voltage transformer alignment on the voltage transformer slide.

3. Undo the 4 hexagon socket head bolts ⑨ at the voltage transformer ④.

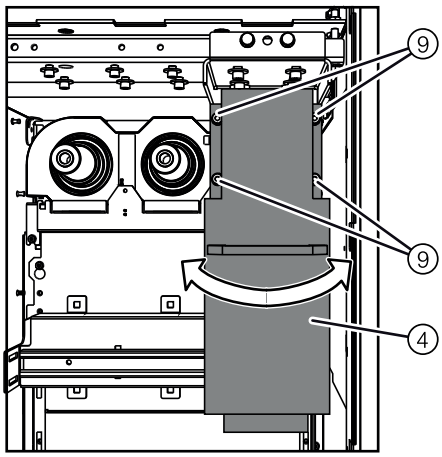


Fig. 128: Correcting the voltage transformer alignment

4. Correct the voltage transformer alignment. Push the voltage transformer again onto the centering bolt.
5. Bolt the voltage transformer on.

Adjusting the voltage transformer mounting plate

To establish the correct position of the voltage transformer, correct the position of the voltage transformer mounting plate.

1. Undo the 2 hexagon head bolts ⑪ located inside.
2. Change the position of the voltage transformer mounting plate ⑤ by readjusting the front and rear bolted joint ⑩.
3. Refasten the voltage transformer mounting plate with the 2 hexagon head bolts ⑪ located inside.

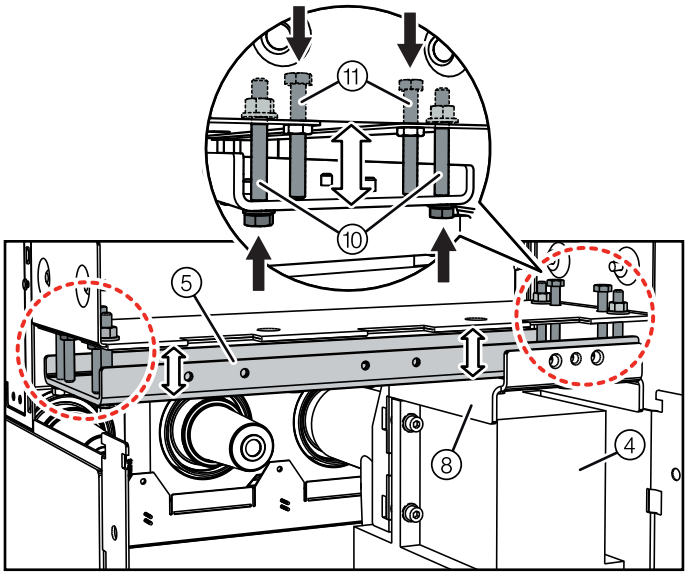


Fig. 129: Correcting the position of the voltage transformer mounting plate

4. Remove the voltage transformer ④ together with the voltage transformer slide ⑧ again.
5. Screw the centering bolt ⑦ into the left-hand bushing. Perform adjustment in the same way.
6. Screw the centering bolt ⑦ into the center bushing. Perform adjustment in the same way.
7. Remove the centering bolt ⑦.

✓ The voltage transformer fixing is adjusted and installation is prepared. The feeder cables can be connected to the bushings.

Connecting voltage transformers

If a power-frequency voltage test is planned after switchgear installation, do not mount the voltage transformers yet [► Page 98, "Preparing the power-frequency voltage test"].

1. Mount feeder cables and cable plugs ⑫ on the bushings [► Page 64, "Connecting high-voltage cables"].
2. Remove the sealing stoppers of the cable plugs.
3. Re-insert the voltage transformer with the voltage transformer slide. Push the voltage transformer cone into the cable plug.

4. The voltage transformer cone must be inserted in the cable plug.

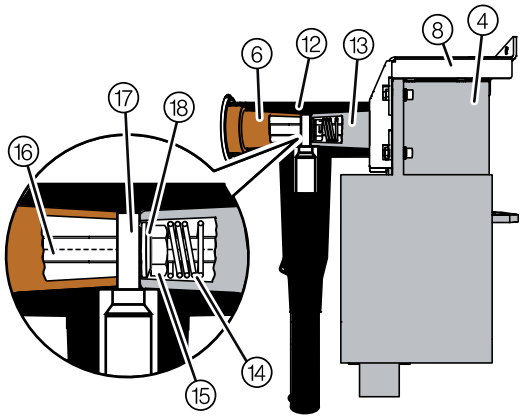


Fig. 130: Installing the voltage transformer at the cable plug

④ Voltage transformer
⑥ Bushing
⑧ Voltage transformer slide
⑫ Cable plug
⑬ Voltage transformer cone
⑭ Contact spring
⑮ Hexagon nut
⑯ Bolt M16
⑰ Feeder cable
⑱ Contact washer

Aligning and fastening the voltage transformer

Bolt the voltage transformer slide ⑧ together with the voltage transformer mounting plate ⑤.

1. First bolt both exterior hexagon head bolts ① tight, until the voltage transformer begins to incline. Then, turn the bolts back slightly.
2. Counter the bolted joint with the central hexagon head bolt ①.
3. Check the vertical alignment of the voltage transformer with a spirit level ⑲.
4. If required, readjust with the hexagon head bolts on the voltage transformer slide:
   – Undo the outer hexagon head bolts .
   – Adjust the central hexagon head bolt .
   – Re-tighten the outer hexagon head bolts.

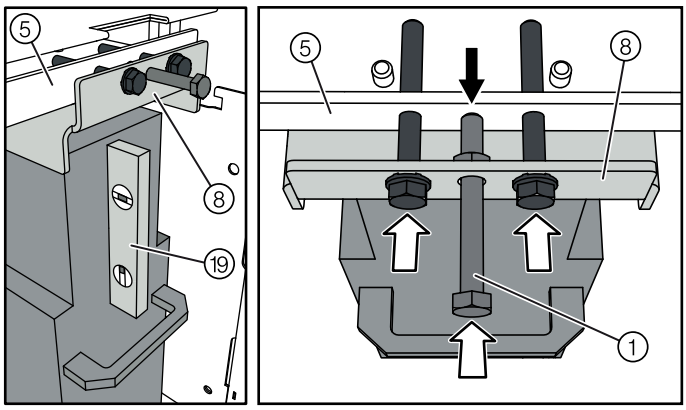


Fig. 131: Aligning and fastening the voltage transformer

① Hexagon head bolt M8x70 (3x)
⑤ Voltage transformer mounting plate
⑧ Voltage transformer slide
⑲ Spirit level

5. **Installing further voltage transformers:** First, install the central voltage transformer in the same way.

Final work

1. Connect the secondary wires of the voltage transformers according to the circuit diagram.
2. Hook the cable compartment cover in [► Page 62, "Removing and mounting the cable compartment cover"].

7.9 Installing or replacing voltage transformers 4MT3 at the cable feeder

The installation or replacement of voltage transformers type 4MT3 at the cable connection must exclusively be done by instructed Siemens personnel.

For further information, please contact the Siemens Service Hotline.

7.10 Removing voltage transformers from the busbar

If a power-frequency voltage test is performed before commissioning [▶ Page 98, "Preparing the power-frequency voltage test"], the voltage transformers must be removed.

⚠ DANGER

Live parts

Touching the busbar leads to a life-endangering electric shock.

⇨ Earth the busbar with suitable measures. Observe the Five Safety Rules.

⚠ DANGER

High voltage on the primary side of the voltage transformer

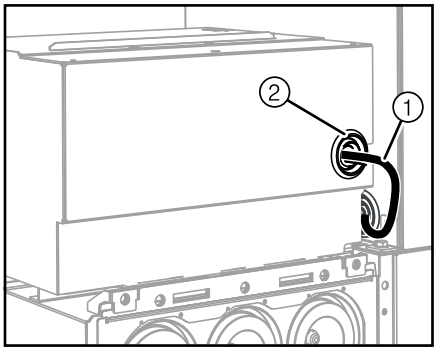
Voltage on the secondary side of the voltage transformer leads to high voltage on the primary side of the voltage transformer. Touching live parts can lead to a life-endangering electric shock.

⇨ Separate the secondary leads of the voltage transformers from any voltage sources before executing the installation work.

Preparation

☒ The panel must be accessible from the rear or from above.

1. Earth the busbar and secure it against reclosing.
2. Separate the secondary wires ① of the voltage transformers from any voltage sources.
3. If a cover is mounted: Remove the cap ②.



① Secondary wire
① Cap

Fig. 132: Cover (option)

Removing the cover (option)

1. Remove 2 bolts M8 from the voltage transformer cover (option).
2. Open the right side of the cover. Push backwards and remove from the side.

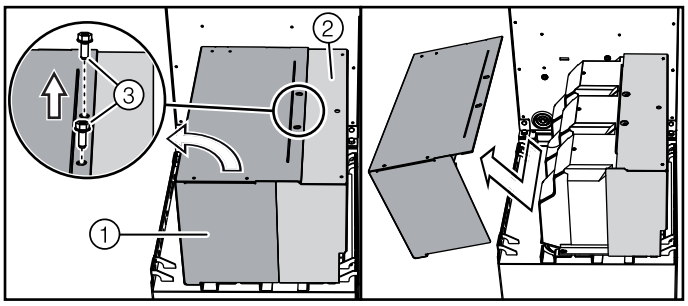


Fig. 133: Removing the cover (right side)

① Cover (right side)
② Cover (left side)
③ Bolt M8 (2x)

3. Push the cover (left side) backwards and remove it upwards.

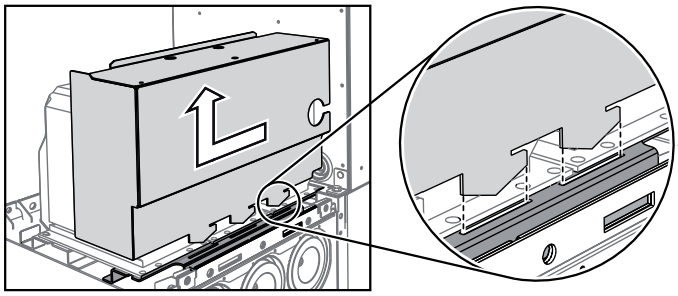


Fig. 134: Removing the cover (left side, view from the rear)

Removing voltage transformers

☒ Necessary tools: Socket wrench (size 10) with extension and magnetic insert

1. Mount the handles on the voltage transformers.
2. Undo the bolts of the voltage transformers using the socket wrench [▶ Page 75, Fig. 137: "Fixing points of the voltage transformers"].
3. Lift the voltage transformers upwards by the handles.
   CAUTION Heavy component; use suitable lifting equipment or lift together with several persons.
4. Mount surge-proof caps on the bushings.
   WARNING Do not use the protective caps of the bushings as surge-proof caps.
5. If required, refit the cover.

7.11 Installing voltage transformers at the busbar

⚠ DANGER

Energized components

Touching the busbar leads to a life-endangering electric shock.

⇨ Earth the busbar with suitable measures. Observe the Five Safety Rules.

Preparation

☒ The panel must be accessible from the rear or from above.

1. Earth the busbar. Secure against reclosing.
2. Take the surge-proof caps off the busbar bushings.
3. Clean the bushing carefully with a lint-free wiping cloth.
4. Apply a thin film of mounting paste to the bushing uniformly and all around.
5. Apply a thin film of mounting paste to the voltage transformer inside cone uniformly and all around.
6. Push the voltage transformer inside cone onto the bushing.

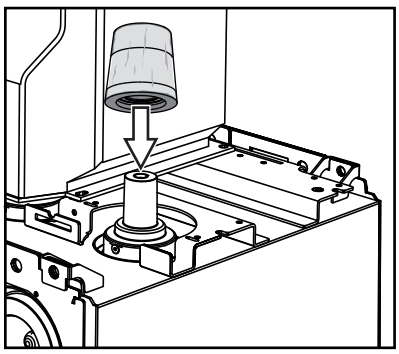


Fig. 135: Pushing the voltage transformer inside cone onto the bushing

Installing voltage transformers

☒ Necessary tools: Socket wrench (size 10) with extension and magnetic insert

1. Remove the nameplate from the handle and store in a safe place. Fasten the handle onto the voltage transformer.
2. To let excess air out, apply a cable strap ① or nylon thread to the bushing.

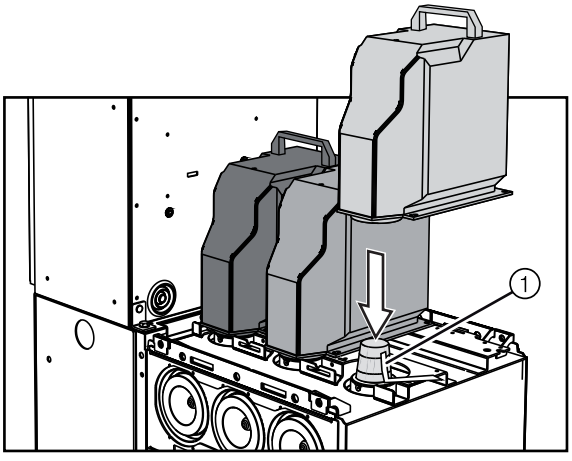


Fig. 136: Setting the voltage transformer down on the bushing

3. Take the voltage transformer by the handle. Set it onto the bushing from above. Take care that the cable strap does not get out of place.
   CAUTION Heavy component; use suitable lifting equipment or lift together with several persons.
4. While setting down the voltage transformer, pull out the cable strap carefully.

✓ Verify intact condition of the cable strap. If the cable strap was damaged when it was pulled out, remove the voltage transformer again and eliminate the residues of the cable strap.

5. Fasten the voltage transformer with 4 bolts (tightening torque: 12 Nm).

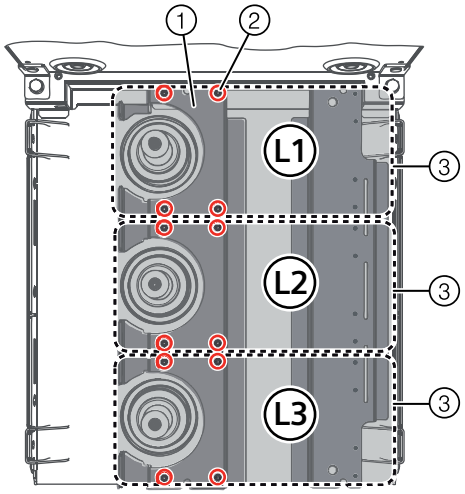


Fig. 137: Fixing points of the voltage transformers

① Voltage transformer mounting plate
② Fixing point
③ Position of voltage transformer

6. Remove the handle of the voltage transformer. Keep the handle for later use.
7. Install further voltage transformers in the same way.

Mounting the cover (option)

1. Fit the cover (left side). Push it to the front.

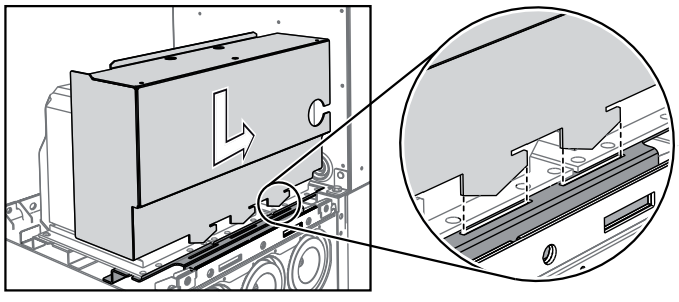


Fig. 138: Mounting the cover (left side)

2. Lead the secondary wires of the voltage transformers ① out of the cover ②. Lead them through the cover into the low-voltage compartment.

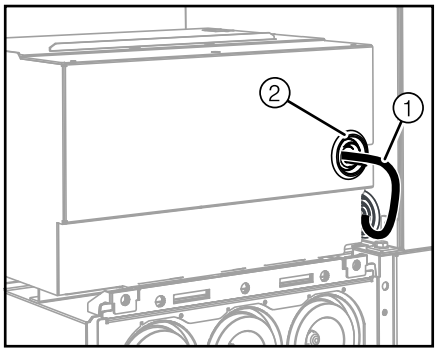


Fig. 139: Leading the low-voltage plug connections out

3. Fit the cover (right side). Push to the front and close.
4. Fasten the cover with 2 bolts M8.

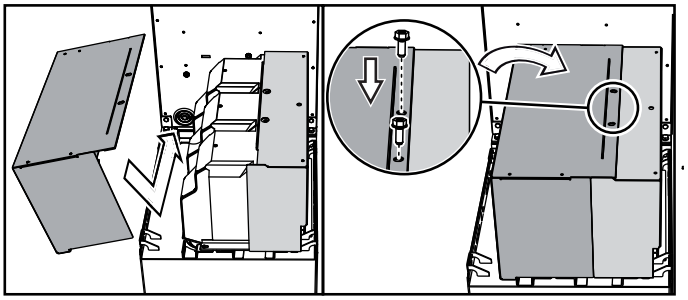


Fig. 140: Mounting the cover (right side)

Final work

1. Connect the secondary wires of the voltage transformers according to the circuit diagram.
2. Fix loosened DIN rail again, if required.

7.12 Connecting the secondary equipment

Wires for secondary equipment can be laid in different directions.

- To the side
  - through the wiring duct (option)
  - through the protective cover in the operating mechanism compartment
- To the rear through the wiring duct (option)
- Downwards through the cable compartment

For panel blocks, wire routing across panels is possible through the wiring duct (option) located on the operating mechanism box. For extendable switchgear, wire routing through the wiring ducts is recommended.

⚠ WARNING

Unscreened cable plugs

When secondary wires are laid through the cable compartment, unscreened cable plugs on the high-voltage cables can lead to an internal arc.

⇨ Use screened cable plugs for connecting the high-voltage cables.

Tab. 44: Availability of lateral wiring ducts in the cable compartment

Panel type	Wiring duct	Panel	
		without current transformer	with current transformer
R, K, K(E)	left	on request	on request
	right	on request	partially occupied
T	left	partially occupied	
	right	yes	partially occupied
L	left	yes	
	right	yes	partially occupied

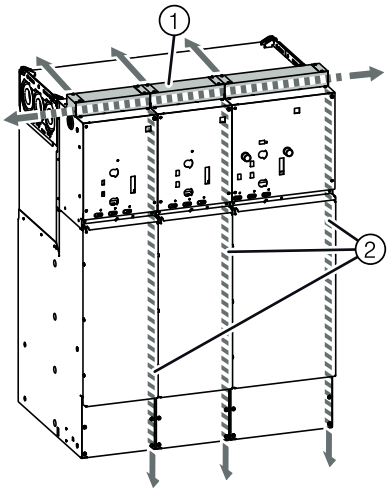


Fig. 141: Wire routing with wiring duct on the operating mechanism box

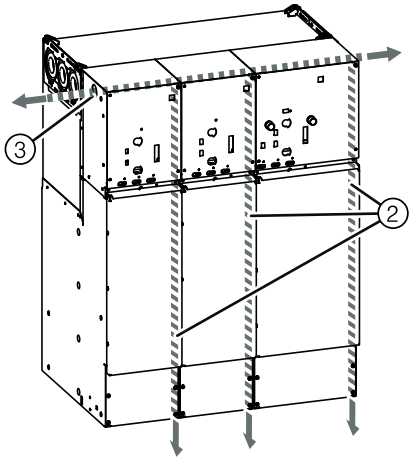


Fig. 142: Wire routing through the operating mechanism box

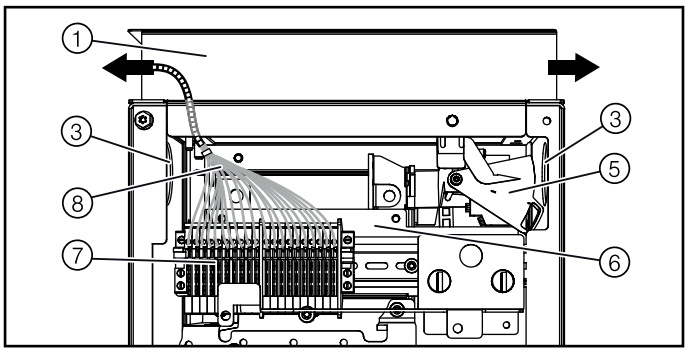


Fig. 143: Wire routing in the operating mechanism box

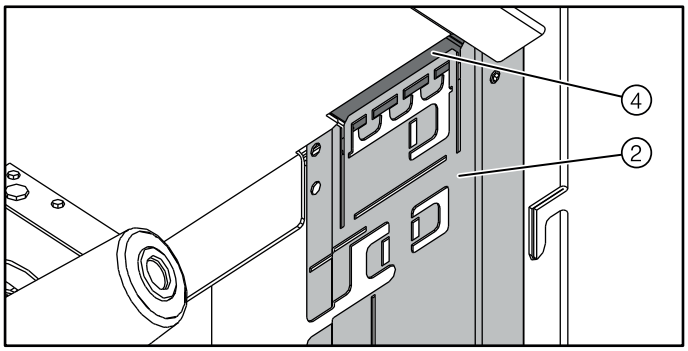


Fig. 144: Lateral wiring duct

① Wiring duct on the operating mechanism box (option)
② Lateral wiring duct
③ Cap
④ Cutout for secondary wires
⑤ Ready-for-service indicator
⑥ Fixing duct
⑦ Terminal strip
⑧ Customer-side wiring

The terminal strips of the secondary equipment supplied are assigned to the associated operating mechanisms or feeders. For information about the external connection, see the supplied circuit diagrams.

1. Switch off auxiliary voltage.
2. Discharge the spring energy store, remove the front cover [► Page 63, "Removing and mounting the front cover"], and observe the instructions specified there.
3. Connect the customer-side secondary wires to the terminal strip or directly to the terminals of the secondary devices according to the circuit diagrams.
   ATTENTION Secondary wires must not get in contact with movable parts or heat sources.
4. To lead the secondary wires through the lateral wiring ducts into the operating mechanism compartment, break the cutout above the wiring ducts.
5. If available, use the wiring ducts for wire routing.
6. Lead the secondary wires of the current transformers and voltage transformers through steel mesh tubes or steel tubes in a shielded way into a lateral wiring duct.
7. Earth the steel mesh tubes or steel tubes with metal cable straps.
8. Avoid extra-long secondary wires or lay them in the wiring ducts or the fixing duct in a meandering pattern.
9. Wire routing to the side is possible through the cut out cap.

Do not switch on auxiliary voltage yet. The auxiliary voltage is switched on during commissioning of the switchgear.

8 Commissioning

8.1 Final measures after installation

Clean-up and visual inspection

1. Remove dirt from the area of the switchgear. Remove metal cuttings, cement dust or liquids on the gas compartment in order to avoid rust layers.
2. Store any instruction labels and documents that are no longer required for switchgear operation.
3. Touch up scratches and impacts in the surface painting with a paint pen.
4. Remove any tools and materials that are no longer required from the area of switchgear.
5. Check switchgear fixing.
6. Check connection to substation earth.
7. Check connection of all earth connections.
8. Check all switchgear parts that have been assembled during the installation work in order to verify correct assembly and completeness.
9. Check service readiness [► Page 81, "Ready-for-service indicator"].
10. Check the data on the nameplate and the auxiliary voltage of the control and end devices against the requirements.

Checking high-voltage connections

1. Check earthing of cable terminations on all connected high-voltage cables.
2. If intended by the customer, perform cable test [► Page 96, "Cable testing"].
3. Perform one of the following measures in all cable feeders without connected high-voltage cables:
   – Switch the feeder to EARTHED position and lock it.
   – Fit surge-proof caps at the bushings.

Checking secondary wire connections

1. Check the wiring of auxiliary and control circuits according to the circuit diagrams.
2. Check clamping and plug connections at random (tightening torques, perfect contact, labels, etc.).

Testing voltage transformers

1. If intended by the customer, test the installed voltage transformers.

Closing covers

1. Fit all covers.
2. Put covers on the capacitive measuring points of the VDIS.

Checking protection devices

1. Check the version of the firmware installed on the protection devices, and update if required [► Page 9, "IT security"].

8.2 Test operation and mechanical operation test

☒ Operating voltage is not switched on.

☒ **Circuit-breaker type 1.1:** Auxiliary voltage is switched on.

1. On circuit-breakers and switch-fuse combinations, do not perform any no-load switching operations, i.e. opening commands without closing before.
2. Switch all switching devices several times manually to all switching positions [► Page 80, "Operation"] and check the position indicators.
3. Check mechanical interlocks [► Page 83, "Interlocks"] with normal force. Verify smooth operation of locking device.
4. Check proper operation of the key-operated interlock (option). If the master key is used, protect it against unauthorized access after the test.
5. Check the fuse tripping functionality with a test fuse.
6. Fit HV HRC fuse-links [► Page 95, "Replacing HV HRC fuse-links"]. Insert HV HRC fuse-links in all phases, even if there are individual phases without connected operational equipment.
7. **Circuit-breaker type 2:** Set undervoltage release to "reset" position [► Page 78, "Changing the setting of the undervoltage release"].

8.2.1 Changing the setting of the undervoltage release

The undervoltage release is located in the operating mechanism compartment behind the front cover. By changing the position of the retaining bolt, the function of the undervoltage release can be blocked.

- On circuit-breakers type 2, the undervoltage release is delivered by the factory in position A "Trip blocked".
- On circuit-breakers type 1.1, the undervoltage release is delivered by the factory in position B "Trip reset".

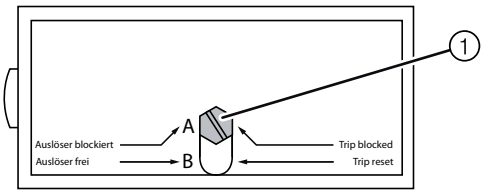


Fig. 145: Undervoltage release

① Retaining bolt

Position of retaining bolt	Function
A	Undervoltage release blocked
B	Undervoltage release reset

1. Remove the front cover [► Page 63, "Removing and mounting the front cover"] and observe the instructions specified there.
2. Undo the retaining bolt of the striker at the undervoltage release and insert it again in the desired position.
3. Refit the front cover.

8.3 Electrical operation test

☒ **Circuit-breaker type 2:** While charging the spring energy store and in ready-to-close state, auxiliary voltage must be applied without interruption at the undervoltage release (option).

☒ **Circuit-breaker type 2:** Undervoltage release is set to "reset" position [► Page 78, "Changing the setting of the undervoltage release"].

1. Switch all three-position disconnectors or three-position switch-disconnectors to OPEN position.
2. Switch on auxiliary voltage and check polarity.

3. Switch switching devices with electrical operation to all switch positions (electrically and manually). Check position indicators and electrical interlocking conditions.
   If the auxiliary voltage fails during the electrical operation test [► Page 82, "Failure of auxiliary voltage"].
4. Check electrical indications and trippings.

8.4 Instructing the operating personnel

1. Instruct the operating personnel in theory and practice of switchgear operation.

8.5 Applying operating voltage

Do not apply the operating voltage before the following measures have been performed successfully:

- [► Page 78, "Final measures after installation"]
- [► Page 78, "Test operation and mechanical operation test"]
- [► Page 78, "Electrical operation test"]

Preconditions

1. Switch all circuit-breakers in all panels to OPEN position.
2. Switch all three-position disconnectors and three-position switch-disconnectors in all panels to OPEN position.
3. Ensure consistent phase sequence in the entire switchgear assembly. Check the phase sequence in all incoming and outgoing feeders assembly before connecting them to the busbar.
4. Earth feeders without connected connection cables. Close all bushings in a surge-proof way.
5. Switch off all feeders.
6. Short-circuit unused current transformers on the secondary side.
7. Operate unused voltage transformers open on the secondary side.

Energizing incoming feeders

1. Energize all incoming feeders in the respective opposite substation.
2. Verify correct terminal-phase connections using a phase comparison test unit according to IEC 62271-215.

Applying voltage to the busbar

If the phase sequence of all incoming feeders is correct, the incoming feeders can be connected to the busbar:

1. Switch the three-position switch-disconnector, three-position disconnector and circuit-breaker to CLOSED position.

✓ The busbar of the switchgear is live.

Energizing outgoing feeders

1. One after the other, energize all outgoing feeders that are connected to consumers.

✓ When all outgoing feeders are energized, the switchgear is completely in operation.

9 Operation

9.1 Indicators and control elements

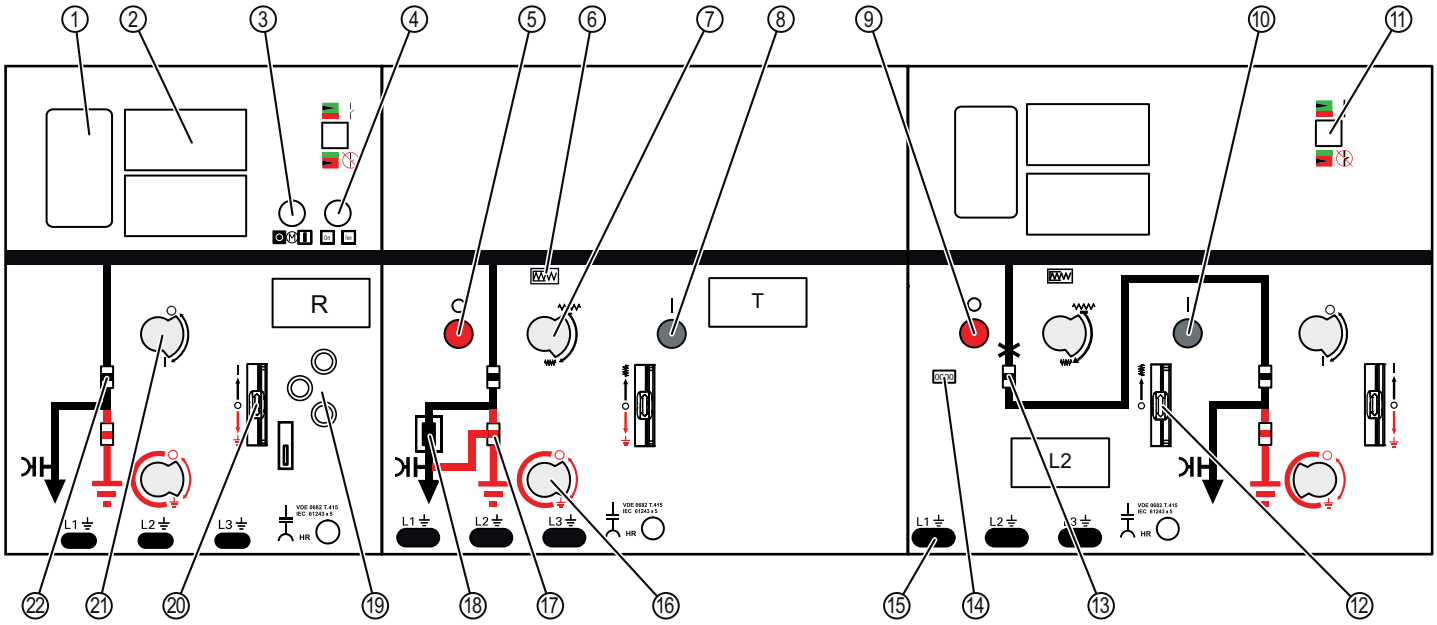


Fig. 146: Panel group R-T-L (example)

① Nameplate
② Secondary devices (option)[2]
③ Momentary-contact rotary control switch for motor operating mechanism (option)
④ Local-remote switch for motor operating mechanism (option)
⑤ OFF pushbutton for switch-disconnector
⑥ "Spring charged" indicator
⑦ Actuating opening for "spring charging"
⑧ ON pushbutton for switch-disconnector
⑨ ON pushbutton for circuit-breaker
⑩ OFF pushbutton for circuit-breaker
⑪ Ready-for-service indicator
⑫ Locking device for circuit-breaker
⑬ Position indicator for circuit-breaker
⑭ Operation counter
⑮ Sockets for capacitive voltage detecting system
⑯ Actuating opening for earthing switch
⑰ Position indicator for earthing switch
⑱ "Fuse tripped" indicator
⑲ Key-operated interlock (option)
⑳ Three-position switch locking device
㉑ Actuating opening for disconnector
㉒ Position indicator for disconnector

9.1.1 Position indicators

Switching device	Switch position		
	CLOSED	OPEN	EARTHED
Disconnector			—
Switch-disconnector			
Earthing switch	—		
Circuit-breaker			—

9.1.2 "Spring charged" indicator

Panel	Spring not charged	Spring charged
Transformer panel		
Circuit-breaker panel type L2		
Circuit-breaker panel type L1.1		

9.1.3 "Fuse tripped" indicator

Fuse	
not tripped	tripped
	

[2] For example, short-circuit indicator, earth-fault indicator, voltage detecting and indicating system

Further information [▶ Page 90, "Operation after the tripping of a HV HRC fuse-link"].

9.1.4 Ready-for-service indicator

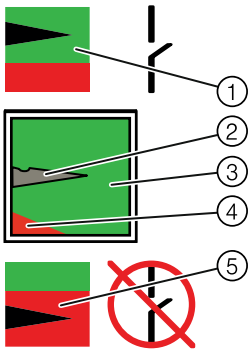
The ready-for-service indicator shows if the gas density in the gas compartment is in order.

Check service readiness of the switchgear before performing any switching operation.

Green area below the pointer: Switchgear ready for service.

Red area below the pointer: Switchgear not ready for service:

1. Do not switch!
2. Contact the Siemens Service Hotline.



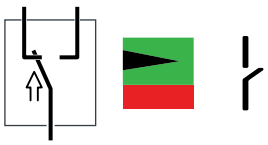
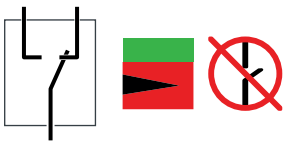
① Indication "Ready for service"
② Pointer
③ Green area
④ Red area
⑤ Indication "Not ready for service"/"Do not operate"

Fig. 147: Ready-for-service indicator

Signaling switch

If the ready-for-service indicator changes from the green area to the red area, the signaling switch (option) for remote electrical indication changes its switching state.

Tab. 45: Functional principle of the signaling switch

State of the ready-for-service indicator in the green area	State of the ready-for-service indicator in the red area
Changeover contact operated: 	Changeover contact not operated: 

9.1.5 Operation counter

The operation counter indicates the number of operating cycles. An operating cycle corresponds to a closing operation and an opening operation of the circuit-breaker.

9.1.6 Operating levers

Operating levers are available in different designs.

Universal operating lever with black handles

The universal operating lever is marked with the following symbol:



- Operation of switch-disconnectors, disconnectors and earthing switches
- Charging of operating mechanisms of circuit-breakers type 2 and switch-fuse combinations

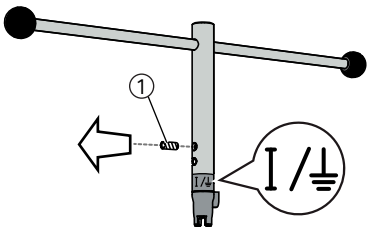


Fig. 148: Universal operating lever, short

① Setscrew

Retrofitting to an anti-reflex lever: With anti-reflex levers, a direct inversion of the operating direction during a switching operation is prevented. Each operating lever can be retrofitted to an anti-reflex lever:

1. Remove the setscrew ① from the standard operating lever.

Separate operating levers

- Operating lever with black handles:
  - Operation of switch-disconnectors and disconnectors
  - Charging of operating mechanisms of circuit-breakers type 2 and switch-fuse combinations
- Operating lever with red handles:
  - Operation of earthing switches

Long operating levers

All operating levers are also available with a **long** design. Use of long operating levers:

- Switchgear in compact substations
- Switchgear with deep cable compartment cover

9.1.7 Hand crank

In panels with circuit-breaker type 1.1, the spring energy store can be charged manually with the hand crank.

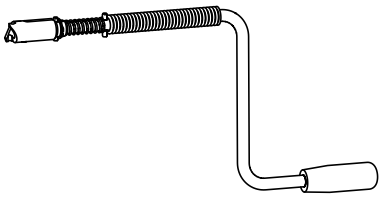


Fig. 149: Hand crank

9.1.8 Double-bit key

Depending on its design (Ø d), the double-bit key is suitable for different activities.

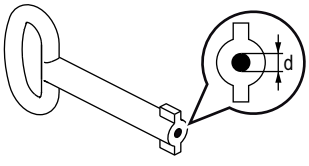


Fig. 150: Double-bit key

Tab. 46: Double-bit key designs

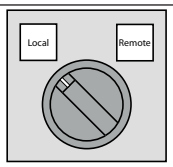
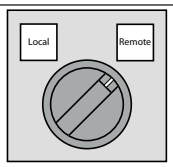
d [mm]	Activity
3	Opening and closing the door of the low-voltage compartment
5	▪ Opening and closing the door of the low-voltage compartment ▪ Operating the voltage transformer earthing device

9.1.9 Motor operating mechanism

The panels can be equipped with a motor operating mechanism for electrical switching operations. Manual switching operations are also possible with motor operating mechanism.

9.1.9.1 Local-remote switch (option)

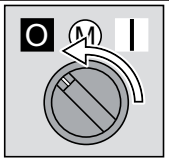
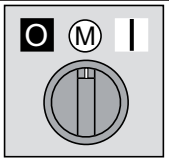
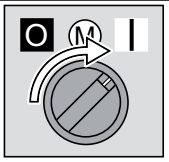
The local-remote switch determines the location for motor operation.

"Local" position	"Remote" position
Local operation by motor	Remote operation by motor from the control room or monitoring station
	

9.1.9.2 Momentary-contact rotary control switch for motor operating mechanism (option)

Motorized switching operations can be carried out with the momentary-contact rotary control switch.

Precondition: The local-remote switch (option) is in **Local** position.

Opening	Central position	Closing
		

9.1.9.3 Failure of auxiliary voltage

The following table describes the behavior of the different operating mechanisms if the auxiliary voltage fails during the **spring charging process** or the **switching process**. In addition, it describes how to bring the panel back into a normal operating state.

Tab. 47: Failure of auxiliary voltage

Switching device and panel types	Behavior of operating mechanism if the auxiliary voltage fails	Behavior of operating mechanism when the auxiliary voltage returns
		Necessary activity
Circuit-breaker type 2 Types L, V	The spring charging process is interrupted and the operating spring returns to its initial state. The original, defined switch position is not abandoned. For manual operation [▶ Page 86, "Operating circuit-breaker type 2"].	The spring charging process is restarted automatically.
Circuit-breaker type 1.1 Types L, V	The spring charging process is interrupted. The operating spring stops in its current state. The original, defined switch position is not abandoned. The spring charging process can be continued manually. For manual operation [▶ Page 85, "Operating circuit-breaker type 1.1"].	The spring charging process is restarted automatically.
Switch-fuse combination Types T, H, M(430)	The spring charging process is interrupted. Depending on the instant of voltage interruption, the following cases can occur: ▪ The operating spring is not charged completely. In this case, the operating spring returns to its initial state. The "spring charged" indicator shows "spring not charged". For manual operation [▶ Page 89, "Operating the switch-fuse combination"]. ▪ The operating spring is charged completely, but closing has not yet been performed. The "spring charged" indicator shows "spring charged". ***ATTENTION*** Do not perform any manual switching operation. In both cases, the original defined switch position is not abandoned.	The started switching operation is not continued. 1. Perform the CLOSE operation with the motor operating mechanism.
Three-position disconnector or three-position switch-disconnector Types R, S, E, L, V	The switching process is interrupted and the operating spring returns to its initial state. The original defined switch position is not abandoned. For manual operation [▶ Page 87, "Operating the three-position switch"].	The started switching operation is not continued. 1. Perform the motorized switching operation again.

9.1.10 Interlocks

Mechanical interlocks

- **Separate actuating openings for DISCONNECTING, EARTHING and spring charging:**
  Switching straight from CLOSED to EARTHED position and from EARTHED to CLOSED position is not possible, as the operating lever must be re-inserted in the OPEN position.
  The manual charging of the operating mechanisms of switch-fuse combinations and circuit-breakers is performed in a separate actuating opening.
- **Cable compartment interlock:**
  The cable compartment cover cannot be removed until the three-position switch is in EARTHED position.
- **Locking device:**
  [▶ Page 84, "Locking device"]
- **Closing lockout:**
  When the cable compartment cover is removed, the three-position switch cannot be switched to CLOSED position. Switching from EARTHED to OPEN position is possible, e.g. to test the cables without removing the cable plugs.
- **De-earthing lockout:**
  When the cable compartment cover is removed, the three-position switch cannot be switched from EARTHED to OPEN position.
- **Operating lever inserted:**
  As long as the actuating opening for charging the operating mechanism of the switch-fuse combination or the circuit-breaker is open, the ON and OFF pushbuttons are blocked.
- **Locking device for pushbutton** [▶ Page 84, "Locking device for pushbuttons"]
- **Key-operated interlock** [▶ Page 84, "Key-operated interlock"]
- **Interlock between circuit-breaker and three-position disconnector:**
  – Circuit-breaker in OPEN position:
    The three-position disconnector can be closed, opened or earthed. As soon as one of the actuating openings of the three-position disconnector is opened, the circuit-breaker cannot be operated anymore.
  – Circuit-breaker in CLOSED position:
    No switching operations are possible with the three-position disconnector.

Electrical interlocking

- **Locking device:**
  If the control gate of the locking device is operated, electrical switching commands to the corresponding switching device are suppressed.

On the customer's request, different electrical interlocks can be installed. Further information is given in the corresponding configuration documentation of the delivered switchgear.

Tab. 48: Availability of the mechanical interlocks

Mechanical interlocking	Panel type										
	R	T	L	K	K(E)/E	M(430)	M(500)	M(840)	S	H	V
Separate actuating openings	X	X	X	–	–	X	X	–	X	X	X
Cable compartment interlock	X	X	X	–	X	X	X	–	X	X	X
Three-position switch locking device	X	X	X	–	O	X	O	–	X	X	X
Closing lockout	O	–	O	–	–	–	O	–	X	–	O
De-earthing lockout	–	X	O	–	O	X	–	–	–	X	O
Operating lever inserted	–	X	X	–	–	X	–	–	–	X	X
Interlock between circuit-breaker and three-position disconnector	–	–	X	–	–	–	–	–	–	–	X
Locking device for pushbutton	–	A	O	–	–	–	–	–	–	–	O
Key-operated interlock	O	O	O	–	O	O	O	–	O	O	O

X Standard **O** Option **–** Not available **A** On request

9.1.10.1 Locking device

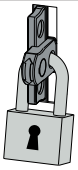
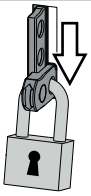
With the locking device, access to the actuating openings of the switching devices can be prevented. The control gate of the locking device can be padlocked in any position.

If the control gate of the locking device is operated, electrical switching commands to the corresponding switching device are suppressed.

☒ Shackle diameter of padlock: 6...12 mm

1. Move the control gate into the required position [▶ Page 84, Tab. 49: "Mode of operation of locking device"].
2. If necessary, refit the padlock at the locking device, and lock it.

Tab. 49: Mode of operation of locking device

Position of the control gate		
Top	Center	Bottom
		
Possible switching operations		
Three-position disconnector and three-position switch-disconnector		
Disconnector CLOSED / OPEN	None	Earthing switch EARTHED / OPEN
Switch-fuse combination		
Spring charging	None	Earthing switch EARTHED / OPEN
Circuit-breaker		
Spring charging	None	Not possible
Make-proof earthing switch (panel type K(E))		
Not possible	None	Earthing switch EARTHED / OPEN
Make-proof earthing switch (panel type E)		
Earthing switch EARTHED / OPEN	None	Not possible

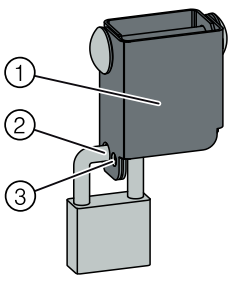
9.1.10.2 Locking device for pushbuttons

The pushbuttons can be equipped with a device for padlocking or for sealing.

- Shackle diameter of padlock: 3...6 mm.

Locking the pushbutton

1. Close the flap at the pushbutton.
2. Hook the padlock in and lock it, or fit the sealing.



① Flap at the pushbutton
② Hole for padlock
③ Hole for sealing

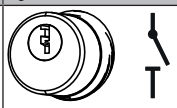
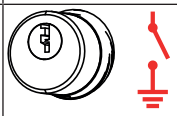
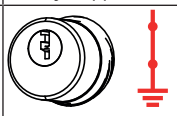
Fig. 151: Locking the pushbutton

9.1.10.3 Key-operated interlock

With a key-operated interlock, panel-overlapping interlocks can be implemented. The operator must determine the interlocking conditions and document them in a interlocking scheme.

The three-position switches can be equipped with the following interlocking options:

Tab. 50: Interlocking options of the key-operated interlock

Interlocking stipulation	Cylinder lock
Switch-disconnector or disconnector Interlocking the switching operation from OPEN to CLOSED position (KF 1)	 ▪ Key free in OPEN position ▪ Key trapped in CLOSED position
Earthing switch Interlocking the switching operation from OPEN to EARTHED position (KF 2):	 ▪ Key free in OPEN position ▪ Key trapped in EARTHED position
Earthing switch Interlocking the switching operation from EARTHED to OPEN position (KF 3)	 ▪ Key free in EARTHED position ▪ Key trapped in OPEN position

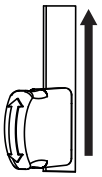


Fig. 152: Control gate of the key-operated interlock

Interlocking the switch position

1. Switch the panel to the switch position to be interlocked.
2. Push the control gate upwards.
3. Turn the key in the corresponding cylinder lock according to the interlocking stipulation, and remove it.
4. Push the control gate downwards.

9.2 Operating panel types (overview)

In the following overview, the corresponding operation chapters are assigned to the panel types.

Panel type	Operation
L, V with circuit-breaker type 1.1	[▶ Page 85, "Operating circuit-breaker type 1.1"]
L, V with circuit-breaker type 2	[▶ Page 86, "Operating circuit-breaker type 2"]
R	[▶ Page 87, "Operating the three-position switch"]
S	
T	[▶ Page 89, "Operating the switch-fuse combination"]
H	
M(430)	

9.3 Operating circuit-breaker type 1.1

This chapter describes the manual operation of a panel with circuit-breaker type 1.1 (panel types L and V).

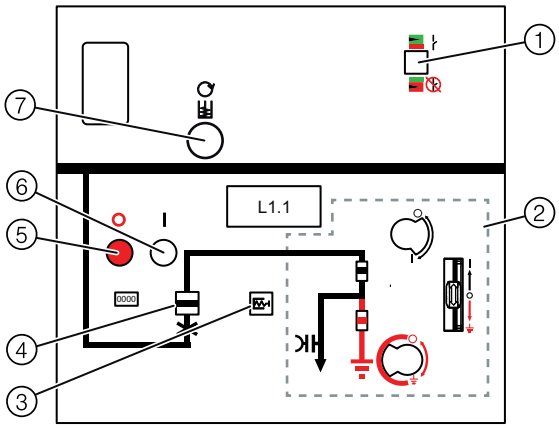


Fig. 153: Control board for circuit-breaker panel type 1.1 (example)

① Ready-for-service indicator
② Control elements, three-position disconnector
③ "Spring charged" indicator
④ Position indicator for circuit-breaker
⑤ OFF pushbutton for circuit-breaker
⑥ ON pushbutton for circuit-breaker
⑦ Actuating opening for "spring charging"

Panel with motor operating mechanism

If the panel is equipped with a motor operating mechanism, the spring energy store is automatically charged again a few seconds after operating the circuit-breaker. Then, the "spring charged" indicator shows "spring charged".

General procedure for switching:

1. If required, charge the spring energy store.
2. Close the circuit-breaker.

Operating the three-position disconnector:

3. Open the circuit-breaker.
4. Perform the desired switching operation with the three-position disconnector [▶ Page 87, "Operating the three-position switch"].
5. Close the circuit-breaker.

Rapid auto-reclosing

The circuit-breaker supports the rapid auto-reclosing provided this has been set in the protection device. To charge the operating mechanism manually, the following sequence of operations is required:

1. Charge the spring energy store.
2. Close the circuit-breaker.
3. Recharge the spring energy store.

✓ The circuit-breaker can carry out of the operating sequence O - 0.3 s - CO.

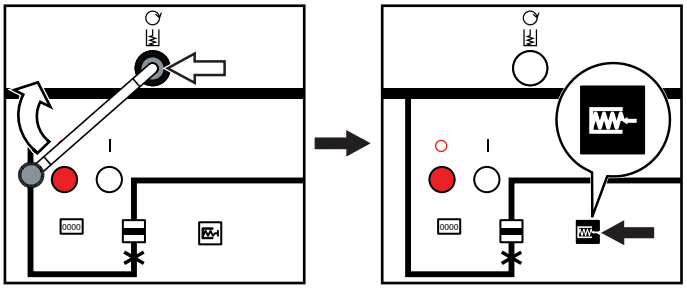
9.3.1 Charging the spring energy store in circuit-breaker type 1.1

Before switching operations can be carried out with the circuit-breaker, the spring energy store must be charged. In the following cases, the spring energy store must be charged manually:

- Circuit-breaker without motor operating mechanism
- Failure of auxiliary voltage supply

☒ Circuit-breaker in OPEN position
☒ The "spring charged" indicator shows "spring not charged".

1. Remove the protective cap of the actuating opening for "spring charging".
2. Insert the hand crank into the actuating opening and turn clockwise until the "spring charged" indicator shows "spring charged".



✓ The "spring charged" indicator shows "spring charged".

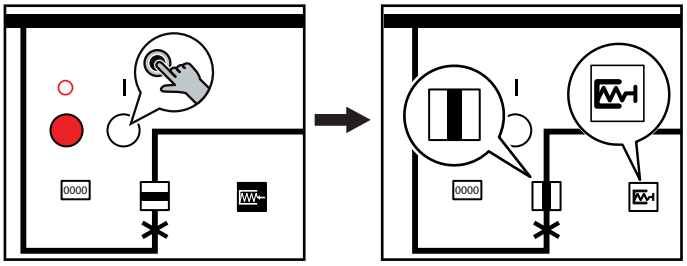
3. Remove the hand crank.
4. Refit the protective cap.

✓ The circuit-breaker can now be closed and opened again (operating sequence CO).

9.3.2 Closing circuit-breaker type 1.1

☒ The ready-for-service indicator shows "ready for service".
☒ The "spring charged" indicator shows "spring charged".

1. Actuate the ON pushbutton.

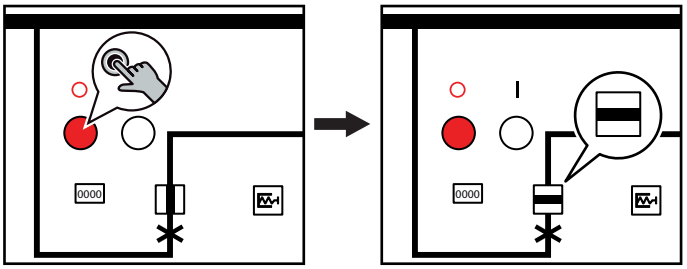


✓ The position indicator of the circuit-breaker shows the CLOSED position.

9.3.3 Opening circuit-breaker type 1.1

☒ The ready-for-service indicator shows "ready for service".

1. Actuate the OFF pushbutton.



✓ The position indicator of the circuit-breaker shows the OPEN position.

9.4 Operating circuit-breaker type 2

This chapter describes the manual operation of a panel with circuit-breaker type 2 (panel types L and V).

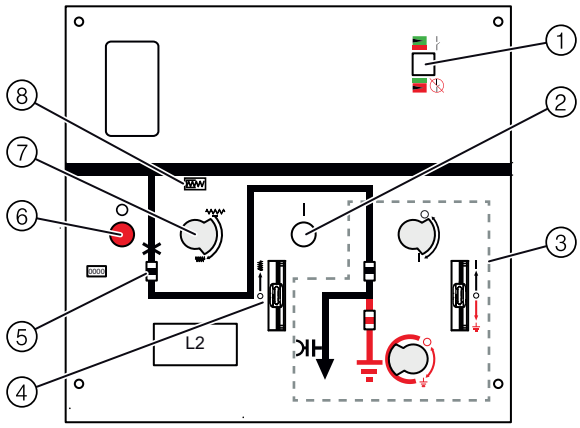


Fig. 154: Control board for circuit-breaker panel type 2 (example)

① Ready-for-service indicator
② ON pushbutton for circuit-breaker
③ Control elements, three-position disconnector
④ Locking device for circuit-breaker
⑤ Position indicator for circuit-breaker
⑥ OFF pushbutton for circuit-breaker
⑦ Actuating opening for "spring charging"
⑧ "Spring charged" indicator

Panel with motor operating mechanism

If the panel is equipped with a motor operating mechanism, the spring energy store is automatically charged again a few seconds after operating the circuit-breaker. Then, the "spring charged" indicator shows "spring charged".

General procedure for switching:

1. If required, charge the spring energy store.
2. Close the circuit-breaker.

Operating the three-position disconnector:

3. Open the circuit-breaker.
4. Perform the desired switching operation with the three-position disconnector [▶ Page 87, "Operating the three-position switch"].
5. Close the circuit-breaker.

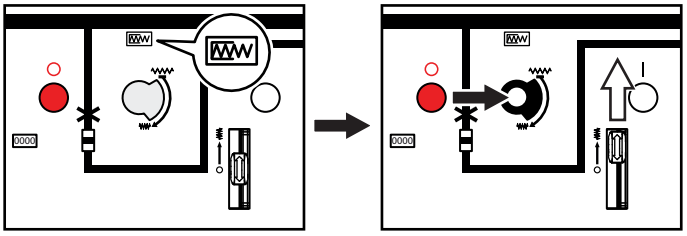
9.4.1 Charging the spring energy store in circuit-breaker type 2

Before switching operations can be carried out with the circuit-breaker, the spring energy store must be charged. In the following cases, the spring energy store must be charged manually:

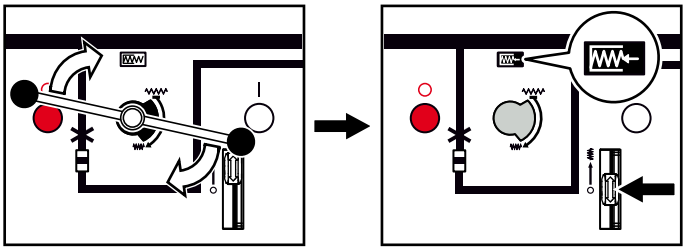
- Circuit-breaker without motor operating mechanism
- Failure of auxiliary voltage supply

☒ The "spring charged" indicator shows "spring not charged".

1. Push the locking device of the circuit-breaker upwards, and hold it.



2. Insert the operating lever into the actuating opening for "spring charging" and turn clockwise as far as it will go. To insert the operating lever, a spring resistance must be overcome.



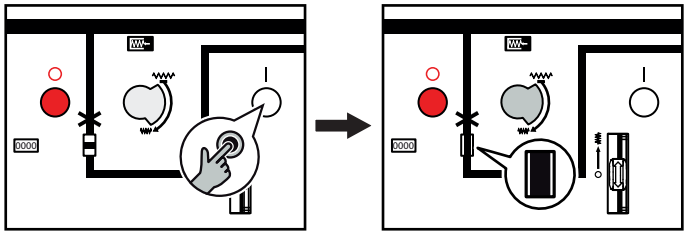
3. Remove the operating lever.

✓ The "spring charged" indicator shows "spring charged".

✓ The circuit-breaker can now be closed and opened again (operating sequence CO).

9.4.2 Closing circuit-breaker type 2

☒ The ready-for-service indicator shows "ready for service".
☒ The "spring charged" indicator shows "spring charged".
1. Actuate the ON pushbutton.



✓ The position indicator of the circuit-breaker shows the CLOSED position.
✓ The "spring charged" indicator still shows "spring charged".

9.4.3 Opening circuit-breaker type 2

NOTICE

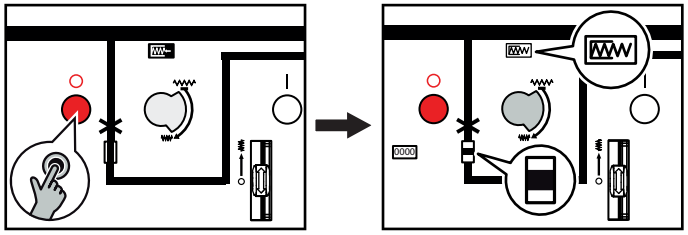
Opening with charged closing spring

Operating the OFF pushbutton directly after charging the closing spring can damage the switching device.

⇨ After charging the closing spring, always close the switching device first.

⇨ After closing, the OFF pushbutton can be operated.

☒ The ready-for-service indicator shows "ready for service".
☒ The "spring charged" indicator shows "spring charged".
1. Actuate the OFF pushbutton.



✓ The position indicator of the circuit-breaker shows the OPEN position.
✓ The "spring charged" indicator shows "spring not charged".

9.5 Operating the three-position switch

This chapter describes the manual operation of the following panel types:

- Panels with three-position switch-disconnector (panel types R and S)
- Panels with three-position disconnector (panel types L and V)
- Panels of the panel type M(500)

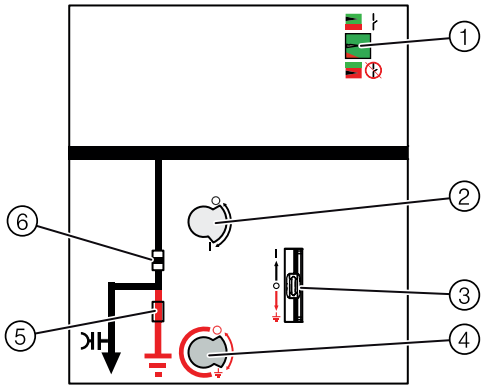


Fig. 155: Control board for ring-main panel (example)

① Ready-for-service indicator
② Actuating opening for DISCONNECTING
③ Locking device
④ Actuating opening for EARTHING
⑤ Position indicator for earthing switch
⑥ Position indicator for disconnector/switch-disconnector

INFORMATION

In a panel with circuit-breaker, the three-position disconnector can only be operated if the circuit-breaker is in OPEN position.

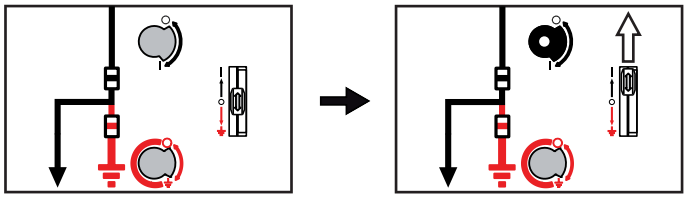
The actuating opening for EARTHING is different for the three-position switch-disconnector and the three-position switch-disconnector. The operating level must be inserted turned by 180°, the operation is the same.

Three-position disconnector	Three-position switch-disconnector
	

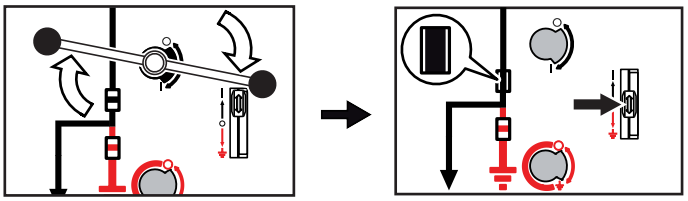
9.5.1 Switching the three-position switch from OPEN to CLOSED

☒ The ready-for-service indicator shows "ready for service".

1. Push the locking device upwards, and hold it.



2. Insert the operating lever into the actuating opening for DISCONNECTING and turn clockwise as far as it will go.



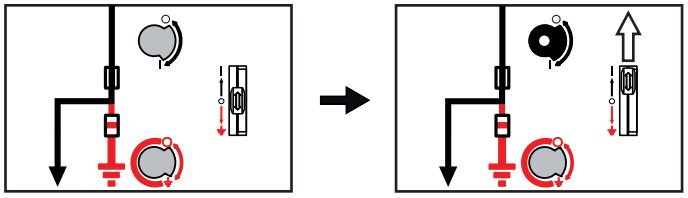
3. Remove the operating lever.

✓ The position indicator of the disconnector shows the CLOSED position.

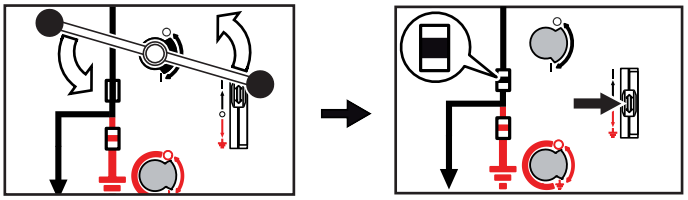
9.5.2 Switching the three-position switch from CLOSED to OPEN

☒ The ready-for-service indicator shows "ready for service".

1. Push the locking device upwards, and hold it.



2. Insert the operating lever into the actuating opening for DISCONNECTING and turn counter-clockwise as far as it will go.



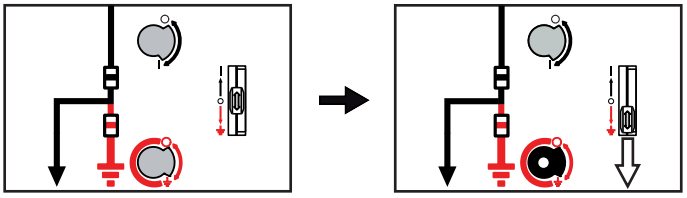
3. Remove the operating lever.

✓ The position indicator of the disconnector shows the OPEN position.

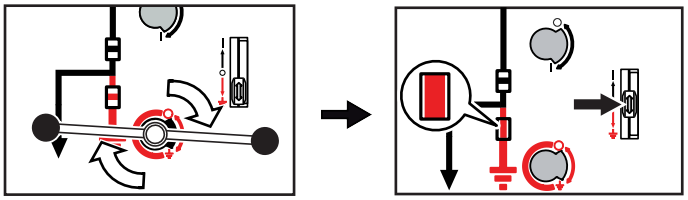
9.5.3 Switching the three-position switch from OPEN to EARTHED

☒ The ready-for-service indicator shows "ready for service".

1. Verify safe isolation from supply of the feeder [▶ Page 90, "Verification of safe isolation from supply"].
2. Push the locking device downwards, and hold it.



3. Insert the operating lever into the actuating opening for EARTHING and turn clockwise as far as it will go.



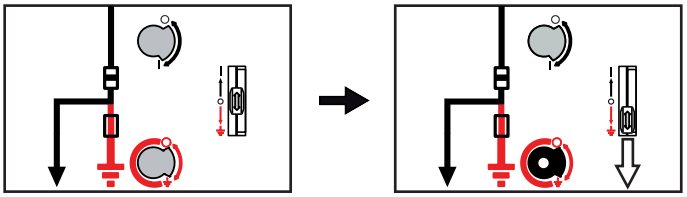
4. Remove the operating lever.

✓ The position indicator of the earthing switch shows the EARTHED position.

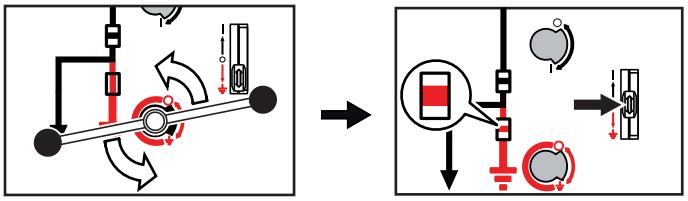
9.5.4 Switching the three-position switch from EARTHED to OPEN

☒ The ready-for-service indicator shows "ready for service".

1. Push the locking device downwards, and hold it.



2. Insert the operating lever into the actuating opening for EARTHING and turn counter-clockwise as far as it will go.



3. Remove the operating lever.

✓ The position indicator of the earthing switch shows the OPEN position.

9.6 Operating the switch-fuse combination

This chapter describes the manual operation of the following panel types:

- Panels with switch-fuse combination (panel types T and H)
- Panels with disconnector and HV HRC fuses (panel type M(430))

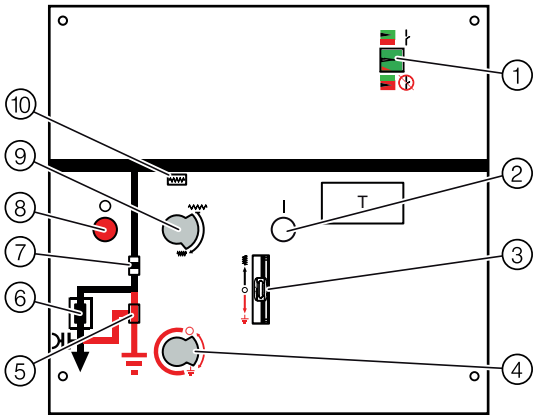


Fig. 156: Control board for transformer panel (example)

① Ready-for-service indicator
② ON pushbutton
③ Locking device
④ Actuating opening for EARTHING
⑤ Position indicator for earthing switch
⑥ "Fuse tripped" indicator
⑦ Position indicator for disconnector/switch-disconnector
⑧ OFF pushbutton
⑨ Actuating opening for "spring charging"
⑩ "Spring charged" indicator

9.6.1 Charging the spring energy store of the switch-fuse combination

NOTICE

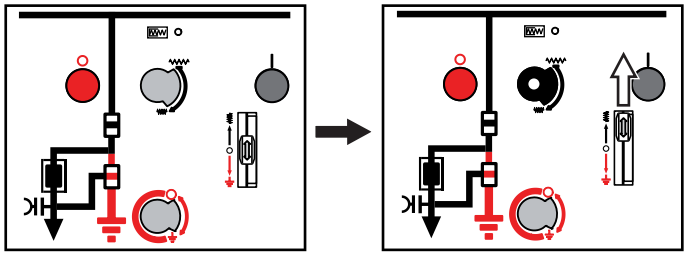
Opening with charged closing spring

Operating the OFF pushbutton directly after charging the closing spring can damage the switching device.

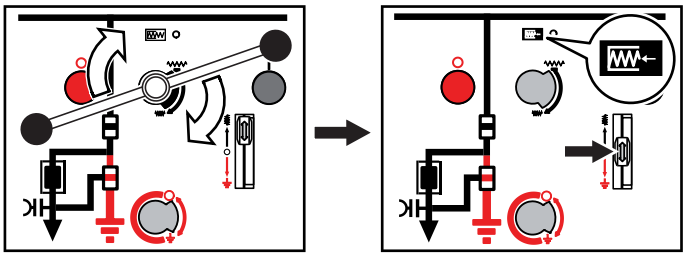
⇨ After charging the closing spring, always close the switching device first.

⇨ After closing, the OFF pushbutton can be operated.

1. Push the locking device upwards, and hold it.



2. Insert the operating lever into the actuating opening for "spring charging" and turn clockwise as far as it will go. To insert the operating lever, a spring resistance must be overcome.



3. Remove the operating lever.

✓ The "spring charged" indicator shows "spring charged".

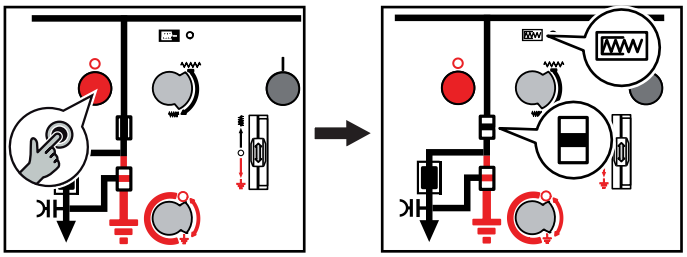
✓ The switch-fuse combination can now be closed and opened again (operating sequence CO).

9.6.2 Switching the switch-fuse combination from CLOSED to OPEN position

☒ The ready-for-service indicator shows "ready for service".

☒ The "spring charged" indicator shows "spring charged".

1. Actuate the OFF pushbutton.



✓ The "spring charged" indicator shows "spring not charged".

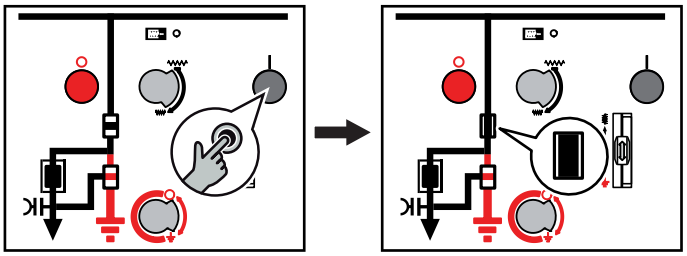
✓ The position indicator of the disconnector shows the OPEN position.

9.6.3 Switching the switch-fuse combination from OPEN to CLOSED position

☒ The ready-for-service indicator shows "ready for service".

☒ The "spring charged" indicator shows "spring charged".

1. Actuate the ON pushbutton.



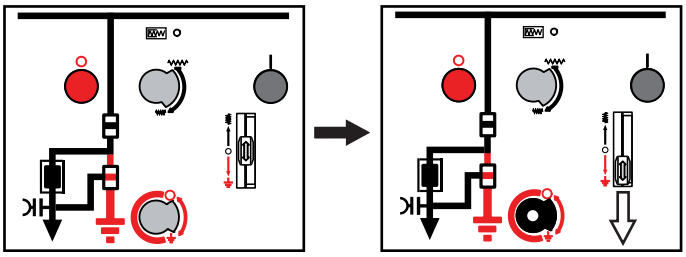
✓ The position indicator of the disconnector shows the CLOSED position.

✓ The "spring charged" indicator still shows "spring charged".

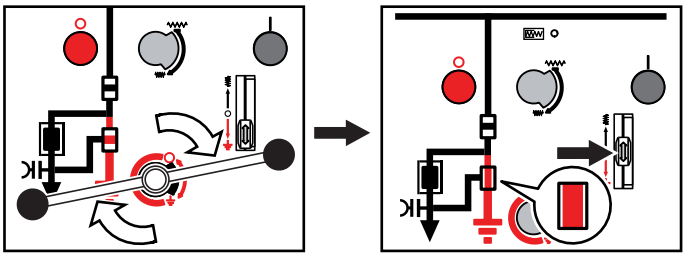
9.6.4 Switching the switch-fuse combination from OPEN to EARTHED position

☒ The ready-for-service indicator shows "ready for service".

1. Verify safe isolation from supply of the feeder.
2. Push the locking device downwards, and hold it.



3. Insert the operating lever into the actuating opening for EARTHING and turn clockwise as far as it will go.



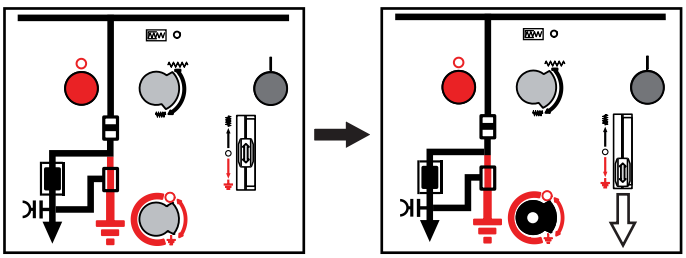
4. Remove the operating lever.

✓ The position indicator of the earthing switch shows the EARTHED position.

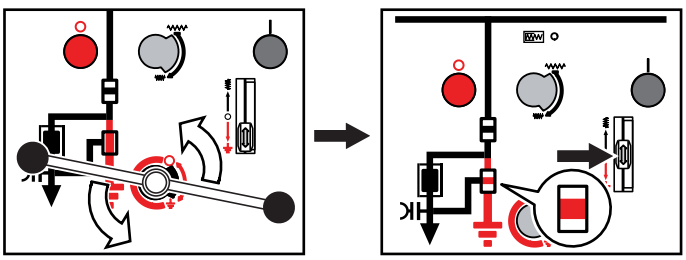
9.6.5 Switching the switch-fuse combination from EARTHED to OPEN position

☒ The ready-for-service indicator shows "ready for service".

1. Push the locking device downwards, and hold it.



2. Insert the operating lever into the actuating opening for EARTHING and turn counter-clockwise as far as it will go.



3. Remove the operating lever.

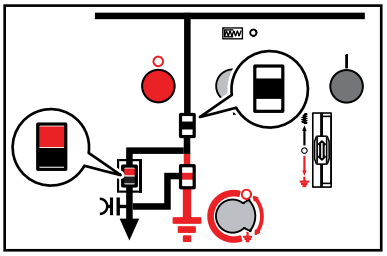
✓ The position indicator of the earthing switch shows the OPEN position.

9.6.6 Operation after the tripping of a HV HRC fuse-link

☒ The "fuse tripped" indicator shows "fuse tripped".

☒ The position indicator of the disconnector/switch-disconnector shows the OPEN position.

☒ The ready-for-service indicator shows "ready for service".



1. Earth the feeder.
2. Replace HV HRC fuse-links [▶ Page 95, "Replacing HV HRC fuse-links"].
3. De-earth the feeder.

If the feeder is to be reconnected to the busbar:

4. Charge the spring energy store.
5. Close the feeder.

9.7 Verification of safe isolation from supply

Safe isolation from supply is verified by means of a voltage detecting and indicating system (VDIS). VDIS can be designed as pluggable or integrated systems. Both systems are used to indicate the presence or absence of operating voltage at interfaces according to IEC 62271-213 and EN 50110-1.

A VDIS cannot distinguish between the state of absence of voltage (<0,1*U_n) and the state of safe isolation from supply (0,0*U_n). The state of safe isolation from supply (U = 0 V) can only be reached by switching to EARTHED position.

The unambiguous "voltage present" indication is ensured within its nominal voltage and nominal frequency according to IEC 62271-213.

he "verification of safe isolation from supply" according to these instructions means the verification of absence of operating voltage (<0,1* U_n).

9.7.1 Pluggable voltage detecting and indicating system

In a pluggable VDIS, all components are fixed-mounted, except for the voltage indicator. The voltage indicator is a mobile indicating device.

Use

- VDIS can be used indoors and outdoors according to IEC 62271-213.
- The "voltage present" indication is ensured within the specified operating temperature in the voltage range of the interface according to IEC 62271-213.
- Incorrect use can impair the operation of the VDIS. Always use the VDIS according to the permitted nominal voltage and nominal frequency.

- In case of fog or humidity, do not use the voltage indicator outdoors.
- Under unfavorable light conditions, shadow or additionally illuminate the display.

General maintenance

VDIS do not contain any components replaceable by the user, and they are maintenance-free.

Operating elements VDIS

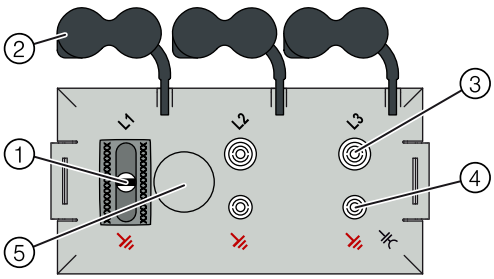
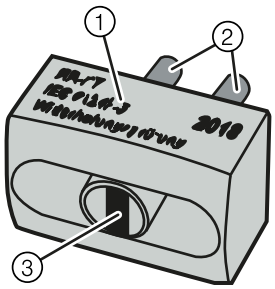


Fig. 157: Coupling section of the VDIS with voltage indicator

① Voltage indicator
② Cover for measuring points
③ Measuring point (socket)
④ Earth socket
⑤ Designation: Repeat test of interface condition



① Technical data and test symbol
② Plug
③ Indication

Fig. 158: Voltage indicator

Tab. 51: Indication of voltage indicator

Indication	Meaning for	
	Functional test	Voltage detection
Flashes (frequency ≥1 Hz)	Voltage indicator ready for service	Phase not isolated from supply
Off	Voltage indicator defective, **do not use**	Phase isolated from supply

Tab. 52: Technical data of voltage indicator and coupling section

	VDIS voltage indicator
Nominal voltage (rated pickup voltage of the interface)	4...5 V
Nominal frequency	16.7...50 Hz
Input impedance	2.0...2.4 MΩ
Flashing frequency (at pickup voltage)	≥ 1 Hz
Power supply	Power is supplied through the voltage to be tested when the voltage indicator is inserted.
Degree of protection	IP54 (only valid with fitted protective cap for the interface and with sealing plugs for the unused connections at the rear side)

Functional test

The VDIS , but also the voltage indicator, do not have a self-test function. Therefore, a functional test must be performed before indicating the voltage.

- Make sure that the voltage indicator operates properly for the functional test of the VDIS. The indication must flash.
- Perform the functional test of the VDIS according to the locally applicable regulations:
  – On a live panel
  – With a test unit according to IEC 62271-213
  – On all phases
- Do not use short-circuiting jumpers as separate plugs. The operation of the surge arrester installed is not en- sured if short-circuiting jumpers are used.
- Perform repeat test of interface conditions at the capacitive interfaces and on the indicators according to the customer's specifications and locally applicable regulations.

Performing the functional test

☒ On an energized VDIS interface
☒ On a voltage source with known voltage in the range of the pickup values according to IEC 62271-213
☒ With a VDIS function test unit

1. Insert the voltage indicator in a test unit and read the indication.

Checking safe isolation from supply

☒ The voltage indicator is dry and clean.
☒ The functional test has been completed successfully.
☒ Operating errors during the functional test are excluded.

1. Remove the covers from the measuring points of the phases.
2. Insert the voltage indicator into the socket of the measuring point.
3. Read the indication.
4. Remove the voltage indicator.
5. Repeat the test for the other phases.

✓ If the voltage indicator does not flash in any of the phases, voltage is not present at any phase (<0,1*U_n). The panel can be earthed.

6. Refit the covers on the measuring points.

9.7.2 Integrated voltage detecting and indicating system

In an integrated VDIS, all components are fixed-mounted. The integrated VDIS is adjusted to the overall system of the switchgear.

Use

- The "voltage present" indication is ensured within the specified operating temperature in the voltage range of the interface according to IEC 62271-213.
- Incorrect use can impair the operation of the VDIS. Always use the VDIS according to the permitted nominal voltage and nominal frequency.
- The integrated VDIS features a 3-phase measuring point (sockets), e.g. for phase comparison.
- Under unfavorable light conditions, shadow or additionally illuminate the display.

Maintenance

VDIS do not contain any components replaceable by the user, and they are maintenance-free.

Operating elements CAPDIS

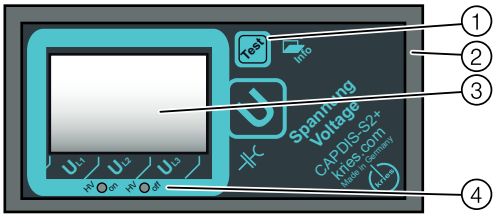


Fig. 159: CAPDIS-S2+: Cover closed

① "Test" button
② Cover
③ LC display
④ LEDs red and green (state of the relay contacts)

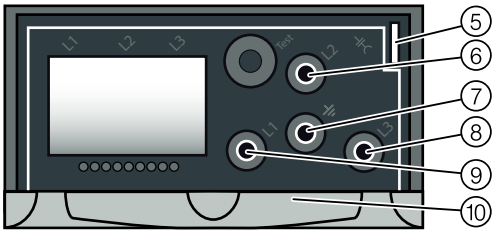


Fig. 160: CAPDIS-S2+: Cover open

⑤ Duct for signaling cables CAPDIS-M
⑥ Test socket L2
⑦ Earth socket
⑧ Test socket L3
⑨ Test socket L1
⑩ Short instructions

Operating elements VOIS+

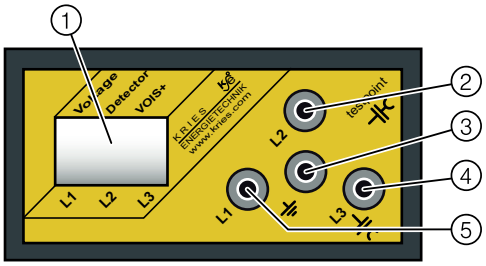


Fig. 161: VOIS+: Cover open

① LC display
② Test socket L2
③ Earth socket
④ Test socket L3
⑤ Test socket L1

Operating elements WEGA

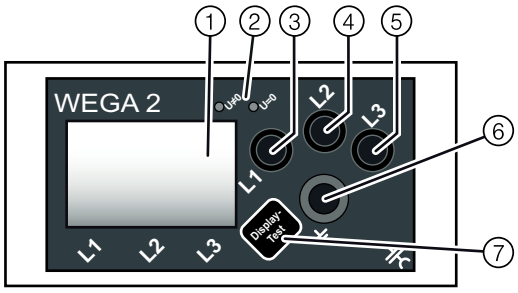


Fig. 162: Operating elements WEGA

① Display (illuminated for WEGA 2 if auxiliary voltage is available)
② LEDs green and red
(state of the relay contacts)
③ Test socket L1
④ Test socket L2
⑤ Test socket L3
⑥ Earth socket
⑦ "Display Test" button

Performing the functional test

1. **On CAPDIS S1+/S2+ or WEGA 1/2:** Push the "Test" or "Display Test" button.

✓ "Test" passed indication lights up shortly.

2. **On VOIS+:** Perform the functional test of the integrated VDIS according to the locally applicable regulations:
   – On a live panel
   – With a test unit according to IEC 62271-213
   – On all phases
3. Perform repeat test of interface conditions at the capacitive interfaces and on the indicators according to the customer's specifications and locally applicable regulations.

Checking safe isolation from supply

⚠ WARNING

Incorrect indication of safe isolation from supply

A phase comparison test unit or interface test unit plugged into the measuring points (sockets) of the VDIS can cause an incorrect indication of safe isolation from supply. Touching live parts leads to electric shock.

⇨ Do not plug any devices into the measuring points (sockets) during the verification of safe isolation from supply.

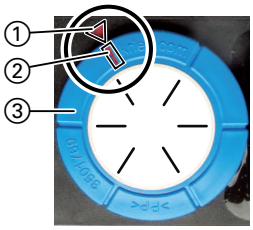
☒ The functional test has been completed.

1. Read the indication on the display [▶ Page 93, "Indications of the voltage detecting and indicating systems"].

✓ If the display does not indicate voltage in any of the phases, the phases are not energized (< 0.1*U_n). The panel can be earthed.

Factory setting on the C2 module (CAPDIS-S1+/S2+)

The C2 module ③ is set to the operating voltage of the switchgear. The setting is recognizable from the correspondence of the arrow ① and the marking ②.



① Arrow
② Marking
③ C2 module

Fig. 163: Marking of the factory setting on the C2 module (example)

⚠ WARNING

Mortal danger due to electric shock

Changing the factory setting on the C2 module in the voltage detecting indication system can cause a functional failure of the voltage detecting indication system. Safe isolation from supply can then no longer be verified without any doubt.

⇨ The factory setting of the C2 module can only be changed with the approval of Siemens.

If the setting of the C2 module was modified, re-establish the factory setting as follows:

1. Pull out the C2 module at the rear side of VDIS.
2. Plug the C2 module into VDIS so that the arrow ① on the housing points to the marking ② on the C2 module.

9.7.2.1 Indications of the voltage detecting and indicating systems

Tab. 53: Indications of the integrated voltage detecting and indicating systems CAPDIS and VOIS

Indication	VOIS+, VOIS R+			CAPDIS-S1+			CAPDIS-S2+			State of the relay contacts[1]		Description
	L1	L2	L3	L1	L2	L3	L1	L2	L3	Red	Green	
A0							000			U ≠ 0 ○	U = 0 ●	Operating voltage not present.
A1	ϟ	ϟ	ϟ	ϟ	ϟ	ϟ	ϟ	ϟ	ϟ	U ≠ 0 ●	U = 0 ○	Operating voltage present.
A2										U ≠ 0 ○	U = 0 ○	Operating voltage not present. Auxiliary voltage not available (only CAPDIS-S2+).
A3			ϟ			ϟ			ϟ	U ≠ 0 ●	U = 0 ●	Failure of the operating voltage at phase L1, operating voltage present at phases L2 and L3 (for CAPDIS-Sx+ also indication: earth fault).
A4	—			ϟ	ϟ	ϟ	ϟ	ϟ	ϟ	U ≠ 0 ●	U = 0 ○	Voltage (**not** operating voltage) present.
A5	—			ϟ	ϟ	ϟ	ϟ	ϟ	ϟ	U ≠ 0 ○	U = 0 ○	Indication: "Test" passed (lights up shortly).
A6	—			ϟ ERROR	ϟ	ϟ	ϟ ERROR	ϟ	ϟ	U ≠ 0 ○	U = 0 ○	Indication: "Test" not passed (lights up shortly).
A7	—			ϟ	ϟ	ϟ	ϟ	ϟ	ϟ	U ≠ 0 ●	U = 0 ●	Overvoltage present (lights up permanently).
A8	—			—			ϟ ERROR	ϟ	ϟ	U ≠ 0 ○	U = 0 ○	Indication: "ERROR" e.g. in case of missing auxiliary voltage.

[1] LED does not light up: ○○; LED lights up: ●●

Tab. 54: Indications of the integrated voltage detecting and indicating system WEGA

Indication	WEGA 1			WEGA 2			State of the relay contacts[1]		Description
	L1	L2	L3	L1	L2	L3	Red	Green	
A0	—						U ≠ 0 ○	U = 0 ●	Operating voltage not present.
A1	ϟ	ϟ	ϟ	ϟ	ϟ	ϟ	U ≠ 0 ●	U = 0 ○	Operating voltage present. Integrated repeat test passed.
A2							U ≠ 0 ○	U = 0 ○	Operating voltage not present. Only WEGA 2: Auxiliary power not present, display not illuminated
A3		ϟ	ϟ		ϟ	ϟ	U ≠ 0 ●	U = 0 ●	Failure of the operating voltage at phase L1, operating voltage present at phases L2 and L3. Integrated repeat test passed (L2 and L3).
A4	ϟ	ϟ	ϟ	ϟ	ϟ	ϟ	U ≠ 0 ●	U = 0 ○	Voltage present, current monitoring of coupling section below limit value.
A5	ϟ	ϟ	ϟ	ϟ	ϟ	ϟ	U ≠ 0 ●	U = 0 ○	If the "Display Test" button is pressed: Display test passed.
A6	ϟ	ϟ	ϟ	ϟ	ϟ	ϟ	U ≠ 0 ○	U = 0 ●	In operation: Voltage present and integrated repeat test passed. Voltage signal too high.
A7	—			ϟ	ϟ	ϟ	U ≠ 0 ○	U = 0 ○	Auxiliary voltage missing.

[1] LED does not light up: ○○; LED lights up: ●●

9.8 Operating the voltage transformer earthing device

The voltage transformer earthing device is used to bring feeder voltage transformers to earth potential.

⚠ DANGER

Internal arc resulting from operating the voltage transformer earthing device

When a panel is live, operating the voltage transformer earthing device will cause serious injury or death due to an internal arc.

⇨ Operate the voltage transformer earthing device only when the feeder is earthed.

INFORMATION

Due to the system, mechanical vibrations can cause short-time oscillation of the voltage transformer earthing device during operation as a result of mechanical vibrations, which can cause minor voltage fluctuations.

⇨ Adjust a stabilization time of 200 ms for the relevant protection settings.

For operating the voltage transformer earthing device, the double-bit key (for a diameter of 5 mm) is required.

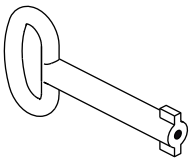


Fig. 164: Double-bit key

1. Earth the feeder.
2. Remove the cable compartment cover [▶ Page 62, "Removing and mounting the cable compartment cover"].

Bringing feeder voltage transformers to earth potential

1. Remove the padlock from the voltage transformer earthing device.
2. Insert the double-bit key in the actuating opening of the voltage transformer earthing device and turn 180° **counter-clockwise**.
3. Remove the double-bit key.

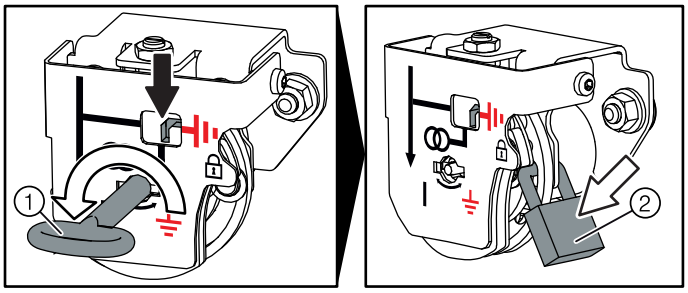


Fig. 165: Bringing feeder voltage transformers to earth potential

4. Refit the padlock ②.

✓ The voltage transformers are disconnected from the feeder, earthed, and secured in this position.

Reconnecting the feeder voltage transformers to the feeder

1. Remove the padlock from the voltage transformer earthing device.
2. Insert the double-bit key in the actuating opening of the voltage transformer earthing device and turn 180° **clockwise**.
3. Remove the double-bit key.

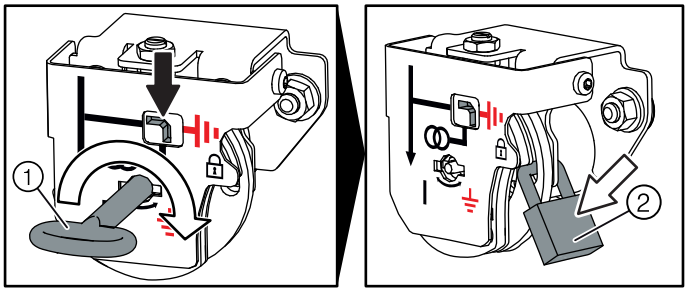


Fig. 166: Reconnecting the feeder voltage transformers to the feeder

4. Refit the padlock ②.

✓ The voltage transformers are reconnected to the feeder and secured in this position.

Final activities

1. Hook the cable compartment cover in [▶ Page 62, "Removing and mounting the cable compartment cover"].

9.9 Replacing HV HRC fuse-links

Requirements placed on fuse-links:

- HV HRC fuse-links according to DIN 43625 (main dimensions) with striker in "medium" version according to IEC/EN 60282-1 [▶ Page 26, "Selection of HV HRC fuse-links"].
- Use exclusively the fuse-links from the protection table that have been tested by Siemens [▶ Page 27, Tab. 35: "Transformer protection table"]. Any use of other fuse-links must be checked by Siemens in advance. Contact the Siemens Service Hotline.
- Observe the design of the fuse slide supplied (reference dimension e=292 mm, optionally e=442 mm).
- Do **not** use HV HRC fuse-links with different characteristics for nominally equal rated current.
- **Not** approved fuse-links for switchgear with a rated voltage of up to 12 kV:
  - 7.2 kV fuse-links with reference dimension 192 mm
  - 24 kV fuse-links with reference dimension 292 mm

Tab. 55: Reference dimension

Rated voltage U_r [kV]	Dimension e [mm][1)]
≤ 12	292 (option: 442)
> 12	442

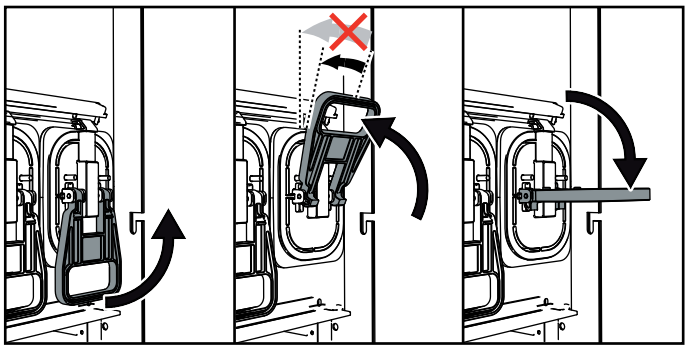
1) Observe the design of the fuse slide supplied.

The replacement of fuse-links in the transformer panel is described hereafter. For the panel types H and M(430), the procedure is identical.

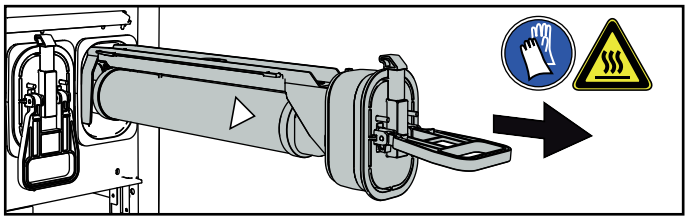
☒ **Replace HV HRC fuse-links in all phases.** When a HV HRC fuse-link has tripped, the HV HRC fuse-links in the other phases may also have been stressed.

☒ Insert HV HRC fuse-links in all phases, even if there are individual phases without connected operational equipment.

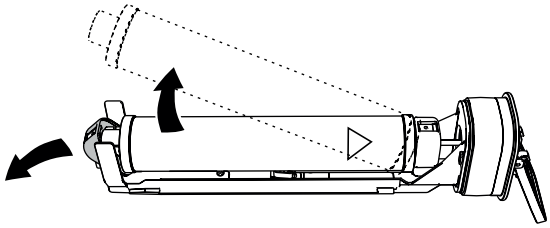
1. Isolate and earth the feeder.
2. Remove the cable compartment cover [▶ Page 62, "Removing and mounting the cable compartment cover"].
3. Push the handle of the fuse slide **slightly** upwards towards the stop in order to detach the gasket.



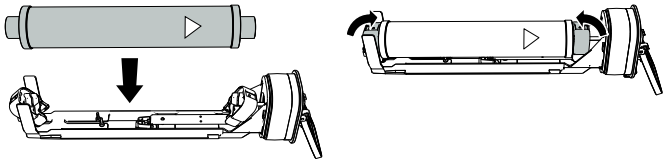
4. Withdraw the fuse slide with the HV HRC fuse-link.
   CAUTION Fuse-link may be hot, wear gloves.



5. Lay the fuse slide on a flat, clean and firm underground.
6. Push the cover of the HV HRC fuse-link (on the opposite side of the housing cover) aside, and pull the HV HRC fuse-link out of the fuse slide.

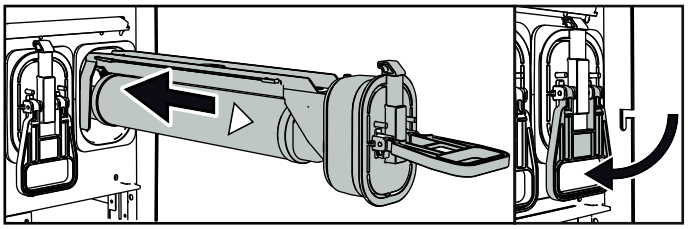


7. Fit the new HV HRC fuse-link into the contact springs and observe the striker position in the process. The arrow on the HV HRC fuse-link must point towards the box cover.



8. Verify correct seating of the covers and the HV HRC fuse-link.
9. Push the fuse slide into the guide slot of the fuse box.

10. Push the fuse slide into the fuse box as far as it will go. The fuse slide cover must rest fully on the cast-resin frame of the fuse box.



11. Push the handle of the fuse slide down until it latches tight.
12. Replace HV HRC fuse-links in the remaining phases.
13. Hook the cable compartment cover in [▶ Page 62, "Removing and mounting the cable compartment cover"]. The cable compartment cover can only be hooked in correctly if the fuse slides are properly latched in.

10 Tests

10.1 Cable testing

10.1.1 Cable testing via cable plugs

⚠ DANGER

Non-interlocked three-position switch

In panels without closing lockout (option), the three-position switch is not interlocked if the cable compartment cover is removed. Switching to CLOSED position can cause an internal arc or an electric shock.

⇨ Observe the Five Safety Rules.

⇨ Fit switching prohibition signs.

⇨ Padlock the locking device (option).

⚠ WARNING

Mortal danger due to overvoltages

Cable testing with connected cables represents a special stress for the isolating distance. If the busbar of the switchgear under test or of the opposite substation are live with operating voltage, no overvoltages may occur.

⇨ Overvoltages must be avoided by suitable measures taken by the switchgear operator.

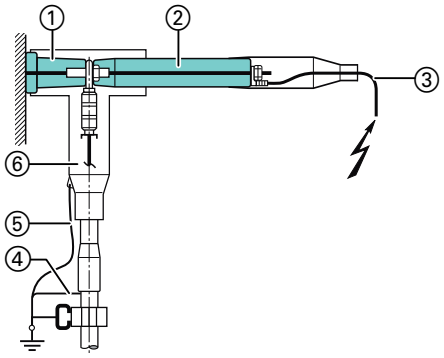


Fig. 167: Cable testing (basic scheme)

① Bushing
② Measuring bolt (cable test element)
③ Test lead
④ Earthing connection of cable shield
⑤ Earthing connection of cable plug
⑥ Cable T-plug

Tab. 56: Test voltages

Rated voltage of switchgear	Test voltage				AC test voltage VLF[1] 0.1 Hz				
	AC		DC		Rectangle		Sinus		Test duration
	U_{ct}	Test duration	U_{ct}	Test duration	R.m.s. value	Maximum value	R.m.s. value	Maximum value	
[kV]	[kV]	[min]	[kV]	[min]	[kV]	[kV]	[kV]	[kV]	[min]
7.2	11	1	22	15	22	22	15.6	22	60
12	19	1	38	15	38	38	26.8	38	60
15	28	1	52	15	52	52	36.8	52	60
17.5	28	1	52	15	52	52	36.8	52	60
24	38	1	72	15	72	72	51	72	60

1) Very low frequency

☒ Observe the manufacturer information (maximum test values) of connection cables, cable plugs, or voltage detecting and indicating systems.

1. Disconnect the feeder under test.
2. Make sure that the feeder in the opposite substation has also been isolated and secured against reclosing.
3. Verify safe isolation from supply.
4. Earth the feeder.
5. Remove the cable compartment cover [▶ Page 62, "Removing and mounting the cable compartment cover"].
6. If voltage transformers are mounted at the cable feeder in the panel, bring the voltage transformers to earth potential [▶ Page 94, "Operating the voltage transformer earthing device"].
7. Remove the voltage transformers on the testing section and close the bushings in a surge-proof way.
8. Short-circuit the current transformers at the secondary terminals.
9. Earth the capacitive test sockets.
10. Undo the screw-type cone at the cable T-plug or at the adapter.
11. Fit cable test elements (e.g. measuring bolts) according to the operating instructions of the plug manufacturers. Use only cable test elements of the cable plug manufacturer.
12. Barrier the test area.
13. De-earth.
14. Perform the test according to the recommendations of the cable manufacturers or the customers' specifications. Observe the test voltages [▶ Page 97, Tab. 56: "Test voltages"].

After the test

1. Earth the feeder under test.
2. Remove cable test elements.
3. Clean the screw-type cone and apply the supplied mounting paste.
4. Mount the screw-type cone on the cable T-plug according to the manufacturer information.
5. Connect the voltage transformers at the cable feeder [▶ Page 94, "Operating the voltage transformer earthing device"].
6. Re-install the removed voltage transformers.
7. Fit the cable compartment cover [▶ Page 62, "Removing and mounting the cable compartment cover"].
8. De-earth the panel and the opposite substation, and re-energize the feeder.

10.1.2 Cable sheath test

⚠ DANGER

Non-interlocked three-position switch

In panels without closing lockout (option) or de-earthing lockout (option), the three-position switch is not interlocked when the cable compartment cover is removed. Switching to CLOSED position can cause an internal arc or an electric shock.

⇨ Observe the 5 Safety Rules.

⇨ Fit switching prohibition signs.

⇨ Padlock the locking device (option).

1. Isolate and earth the feeder under test.
2. Earth the capacitive measuring points at the VDIS.
3. Remove the cable compartment cover [▶ Page 62, "Removing and mounting the cable compartment cover"].
4. Undo the cable shield earthing at the cross member of the panel frame as well as in the opposite substation.
5. Perform cable sheath test following the recommendations of the cable manufacturers or the customer's stipulation.
6. Mount the cable shield earthing again at the cross member of the panel frame as well as in the opposite substation.
7. Refit and lock the cable compartment cover [▶ Page 62, "Removing and mounting the cable compartment cover"].
8. De-earth the capacitive measuring points at the VDIS.
9. De-earth the panel and the opposite substation, and re-energize the feeder.

10.2 Preparing the power-frequency voltage test

A power-frequency voltage test can be performed at the readily installed switchgear.

1. Remove surge arresters.
2. Remove surge limiters.
3. **For switchgear with voltage transformer earthing device:** Bring the feeder voltage transformers to earth potential [► Page 94, "Operating the voltage transformer earthing device"].
   For switchgear without voltage transformer earthing device: Remove the feeder voltage transformers.
4. Remove the voltage transformer from the busbar.
5. Cover bushings of voltage transformers, surge arresters and surge limiters in a surge-proof way with suitable sealing caps.
6. Short-circuit the current transformers at the secondary terminals.
7. Earth the capacitive test sockets.

✓ The power-frequency voltage test can now be performed.

11 Service information

11.1 General maintenance

The switchgear does not require maintenance under normal service conditions.

The gas compartment of the switchgear represents a hermetically sealed pressure system according to IEC 62271-1.

Secondary equipment

Inspection/testing of the secondary equipment, such as the voltage detecting and indicating system, is done within the scope of locally applicable specifications and customer-specific regulations.

Test operation

An operation test of the switching devices is required only at the time of commissioning, modification or retrofit at the panel.

If any information regarding special service conditions is required, contact the Siemens Service Hotline:

11.2 Replacement of components

Due to the fact that all parts of this switchgear have been optimized to last the normal service life, it is not possible to recommend particular spare parts.

Information required for spare part orders of single components and devices:

- Type and serial number of the switchgear [► Page 26, "Nameplates"]
- Description or identification of the device or part on the basis of a sketch, a photo or a circuit diagram

12 End of life

Insulating gas

The equipment contains the fluorinated greenhouse gas SF_6 with a global warming potential (GWP) of 22.800[3].

Before recycling the materials, evacuate the SF_6 gas professionally and prepare it for further use. For further information, please contact the Siemens Service Hotline.

Recycling

The switchgear is an environmentally compatible product. The components of the switchgear can be recycled in an environmentally compatible way by dismantling into sorted scrap and residual mixed scrap. After evacuating the insulating gas, the switchgear mainly consists of the following materials:

- Steel (enclosure and operating mechanisms)
- Stainless steel (gas compartment)
- Copper (conductor bars)
- Silver (contacts)
- Cast-resin based on epoxy resin (bushings and post insulators)
- Plastic materials (switchgear and fuse tripping)
- Silicone rubber

The switchgear can be recycled in ecological manner in compliance with existing legislation. Auxiliary devices such as short-circuit indicators, voltage detecting and indicating systems, or voltage indicators have to be recycled as electronic scrap. Any existing batteries have to be recycled professionally.

As delivered by Siemens, the switchgear does not contain hazardous substances as per the Ordinance on Hazardous Substances applicable in the Federal Republic of Germany. For operation in other countries, the locally applicable regulations must be observed.

For further information regarding declarable or restricted substances in this product, please contact the following e-mail address:
materialcompliance.ms.ehs@siemens.com

Measures after an internal arc

For suitable measures after an internal arc on the switchgear, observe IEC 62271-4 and the locally applicable regulations.

13 Annex

13.1 MCU (Motor Control Unit)

13.1.1 Extract from the Technical Description

The switchgear can be equipped with different versions of the electrical motor control unit (MCU, Motor Control Unit). The following sections are an extract from the Technical Description of the electrical motor control unit.

The complete Technical Description of the different versions is available under the following order numbers:

MCU version	Order number
MCU-RI	953-0091.9
MCU-RI V2	953-6012.0
MCU-MH	953-0071.9
MCU-MH-MOD	953-0081.9

13.1.2 Safety instructions

1. Before performing a dielectric test, remove the connecting plug from the MCU.
2. To activate the SWITCH POSITION signaling switch, do not use any external switching contacts that are equipped with capacitors > 4.7 nF connected in parallel with the contact.
3. The voltage quality of the voltages used for auxiliary and load circuits must correspond to applicable standards.
4. If an AC control voltage or AC load voltage is used, which is generated directly from single-phase inverters, earth $U_{N2\sim}$.

[3] Source: "Regulation (EU) No. 517/2014 of the European Parliament and of the Council of 16 April 2014 on fluorinated greenhouse gases and repealing Regulation (EC) No. 842/2006"

13.1.3 Design

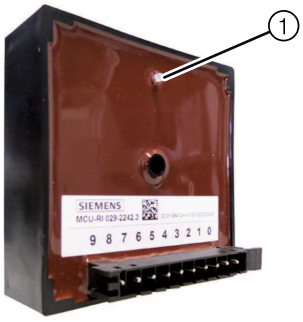


Fig. 168: MCU-RI

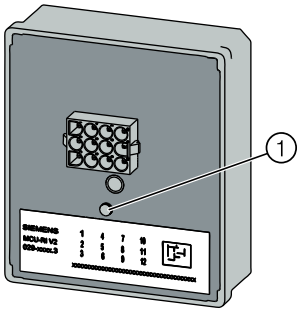


Fig. 169: MCU-RI V2

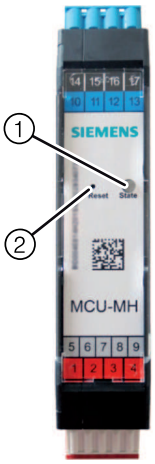


Fig. 170: MCU-MH

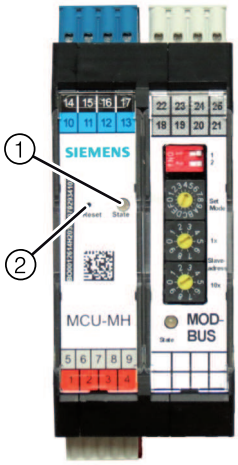


Fig. 171: MCU-MH-MOD

① LED status indicator
② Reset pushbutton

13.1.4 Fault signals

Fault signals at the unit are displayed via a red flashing LED status indicator.

Clearing the fault mode

Options for clearing the fault mode after the cause for the fault mode was eliminated:

- **Only MCU-MH and MCU-MH-MOD:** Via the reset pushbutton at the unit (operation of the reset pushbutton: Insert a thin, pointed object through the opening on the front).
- Switch the control voltage off and on again.

The following table shows the fault coding of the flashing codes for all versions of the MCU.

Tab. 57: Fault coding MCU-MH and MCU-MH-MOD

Type of fault	LED status indicator	Interlocking to circuit-breaker[1)]	Cause	Measure
Incorrect sense of rotation of motor	Lights up permanently red	Off	Motor polarity interchanged	▪ Check motor connecting leads ▪ Carry out a reset of the MCU
Relay on MCU clocks on command input (approx. 1x per sec.)	No indication	Off	No load voltage available	▪ Check the load voltage supply
Relay on MCU clocks very quickly on command input (approx. 5x per sec.)	No indication	Off	No control voltage available	▪ Check the control voltage supply
H-bridge is not isolated from supply	Flashes 2x red	On	N[2)] not earthed (IT system)	▪ Earth N. ▪ Carry out a reset of the MCU
			Load voltage relay of MCU defective	▪ Replace MCU
No feedback of disconnector contact after disconnector CLOSED command	Flashes 3x red	On	Disconnector could not be CLOSED within the maximum permissible runtime. Mechanical defect or defect at the gear motor	▪ Check operating mechanism and gear motor ▪ Switch the operating mechanism manually to an end position and perform reset
No feedback of opening contact after disconnector OPEN command	Flashes 4x red	On	Disconnector could not be OPENED within the maximum permissible runtime. Mechanical defect or defect at the gear motor	▪ Check operating mechanism and gear motor ▪ Switch the operating mechanism manually to an end position and perform reset
No feedback of earthing switch contact after earthing switch CLOSED command	Flashes 5x red	On	Earthing switch could not be CLOSED within the maximum permissible runtime. Mechanical defect or defect at the gear motor	▪ Check operating mechanism and gear motor ▪ Switch the operating mechanism manually to an end position and perform reset

Type of fault	LED status indicator	Interlocking to circuit-breaker[1)]	Cause	Measure
No feedback of opening contact after earthing switch OPEN command	Flashes 6x red	On	Earthing switch could not be OPENED within the maximum permissible runtime. Mechanical defect or defect at the gear motor	▪ Check operating mechanism and gear motor ▪ Switch the operating mechanism manually to an end position and perform reset
No standby mode after end of command	Flashes 8x red	On	Circuit for automatic shutdown of MCU defective	▪ Replace MCU
Impermissibly long switching command	Flashes 8x red	On	Switching command is applied for more than 5 min	▪ Shorten command output ▪ Carry out a reset of the MCU

1) Off = circuit-breaker can be switched, On = circuit-breaker cannot be switched

2) Neutral conductor

Tab. 58: Fault coding MCU-RI and MCU-RI V2

Type of fault	LED status indicator	Cause	Measure
Incorrect sense of rotation of the motor	Lights up permanently red	Motor polarity interchanged	▪ Check motor connecting leads ▪ Carry out a reset of the MCU
Relay of MCU clocks on command input (approx. 1x per sec.)	No indication	No load voltage available	▪ Check the load voltage supply
Relay of MCU clocks very quickly on command input (approx. 5x per sec.)	No indication	No control voltage available	▪ Check the control voltage supply
No feedback of disconnector contact after disconnector CLOSED command	Flashes 3x red	Disconnector could not be CLOSED within the maximum permissible runtime. ▪ Mechanical defect or defect at the gear motor	▪ Check operating mechanism and gear motor ▪ Carry out a reset of the MCU
No feedback of opening contact after disconnector OPEN command	Flashes 4x red	Disconnector could not be switched to OPEN position within the maximum permissible runtime. ▪ Mechanical defect or defect at the gear motor	▪ Check operating mechanism and gear motor ▪ Carry out a reset of the MCU
Command and feedback of disconnector do not coincide.	Flashes 6x red	The MCU gets an incorrect feedback from the disconnector. ▪ Mechanical defect or defect at the gear motor ▪ Wiring error	▪ Check wiring of MCU and position of disconnector ▪ Carry out a reset of the MCU
Relay of MCU does not switch off the motor.	Flashes 7x red	The processor gets an incorrect feedback from the internal relay. ▪ Electrical defect on the printed circuit board ▪ Creepage currents between the contacts	▪ Replace MCU
Impermissibly long switching command	Flashes 8x red	Switching command is applied for more than 5 min	▪ Shorten command output ▪ Carry out a reset of the MCU
No standby mode after end of command	Flashes 9x red	Circuit for automatic shutdown of MCU defective	▪ Replace MCU

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