Manual for installation and operation HB 600/05 en

ZX0 - block design
Gas-insulated medium voltage switchgear

Power and productivity
for a better world™

Your safety first - always!

That‘s why our instruction manual begins with these recommendations:

- Operate the switchgear as prescribed for its intended purpose.
- Ensure that the technical data on the name plate and in the specification are not exceeded during operation of the switchgear.
- Only install the switchgear in enclosed rooms suitable for electrical equipment.
- With the aim of a smooth installation sequence and ensuring a high quality standard, have installation at site performed by specially trained personnel or managed and supervised by the ABB Service Department.
- Ensure that installation, operation and maintenance are only performed by specialist electricians familiar with this manual.
- Comply in full with the legally recognized standards (IEC / DIN VDE), the connection conditions of the local electrical utility and the applicable safety at work regulations.
- Follow the instructions in the documentation when performing any work on switching devices and switchgear.
- Keep all documentation accessible to all persons concerned with installation, operation and maintenance.
- The user’s personnel bear unlimited responsibility in all matters affecting safety at work and the correct handling of the switchgear in accordance with EN 50110 and national regulations.
- Always observe the five safety rules set out in EN 50110 on establishing and securing the off-circuit condition at the place of work for the duration of work on the switchgear. Gas-insulated switchgear are notable for maximum safety, as the circuit-breaker performs the earthing switch function in conjunction with the three position disconnector. The sequence of safety rules therefore deviates from that proposed in the standard as follows:

Isolate,

Check the off-circuit condition,

Earth and short-circuit,

Secure to prevent reconnection,

Cover or guard off adjacent live parts.

If you have any further questions on this manual, the members of our field organization will be pleased to provide the required information.

Contents

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The relevant standards for switchgear over 1 kV and their switching devices		
	IEC	
Switchgear	62271-1	Common specifications for high-voltage switchgear and controlgear standards
Switchgear	62271-200	High-voltage switchgear and controlgear, Part 200: A.C. metal-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV
Circuit-breaker	62271-100	High-voltage switchgear and controlgear Part 100: High voltage alternating current circuit-breakers
Disconnector and earthing switch	62271-102	High-voltage switchgear and controlgear Part 102: Alternating current disconnectors and earthing switches
Switch disconnector	60265-1	High-voltage switches - Part 1: Switches for rated voltages above 1 kV and less than 52 kV
Switch disconnector – fuse combination	62271-105	High-voltage switchgear and controlgear Part 105: Alternating current switch-fuse combinations
HRC - fuses	60282	High-voltage fuses - Part 1: Current-limiting fuses

Take particular account of the relevant standards listed below. Observe the national technical specifications and the accident prevention regulations of the country in which the switchgear is operated.	
IEC 60364	Low-voltage electrical installations
IEC 61936	Power installations exceeding 1 kV a.c.
DIN EN 50110	Operation of electrical installations
National technical accident prevention regulations e.g. for electrical systems and equipment and SF_6 installations	

Fundamental notes on this manual:

Read the relevant sections of this manual through in full before performing work, so as to ensure correct handling.

Paragraphs in this manual are marked in accordance with their significance. The markings mean the following:

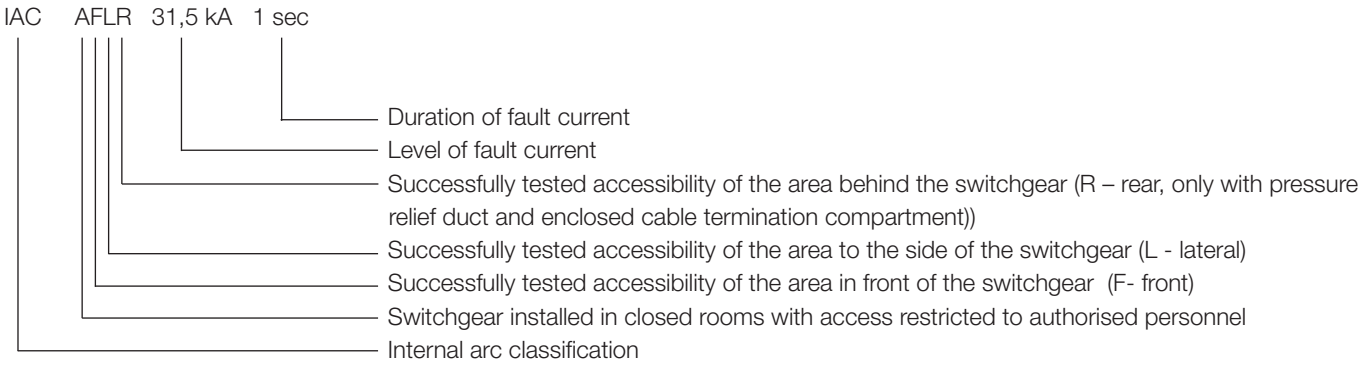
Hazard warning, meaning in this manual that death or serious injury and considerable damage may occur if the actions described are not performed.

Important note, meaning in this manual that injury and damage may occur if the actions described are not performed.

Attention is drawn to further documents.

Note on safety

The internal arc classification to IEC 62271-200 confirms a tested degree of operator protection. The information on accessibility of the switchgear as required by IEC 62271-200 can be found on the type plates of the panels. The coding is as follows (exemplary):



The operator of the switchgear must prevent access by personnel to non-arc classified areas, for instance by issuing instructions.

Within the ratings stated on the type plate, the switchgear is safe for operating personnel in accordance with IEC 62271-200 when all system components are completely and properly installed.

Commissioning, servicing and extension work require special attention with regard to safety (see also IEC 62271-200).

Operator safety in accordance with IEC 62271-200 assumes that the conditions stipulated by us are complied with (see also Technical Catalogue TK 500).

The IAC qualification relies on a system consisting of at least three panels. [1)]

[1)] At a room height of at least 2400 mm and a short-circuit current ≤ 21 kA (only possible with wall installation), the length of the switchgear system must be at least 1600 mm.

You have chosen a gas-insulated switchgear of series ZX0 in block design. This switchgear from the ZX range is notable for the following features:

- SF_6 gas-insulated with hermetically sealed pressure systems
- Rated voltages up to 24 kV
- Up to 1250 A and 25 kA
- Single busbar design
- Up to six panels grouped together in a block (one common gas compartment)
- Stainless steel enclosures, fabricated from laser cut sheet steel
- Modular structure
- Switchgear with a leakage rate of less than 0.1 % per year
- Integrated routine leakage testing of the panel blocks ex-works
- Indoor installation and free-standing installation
- Wall installation
- Panel widths 400 mm and 600 mm

Please observe further documents in addition to this manual. The documents relevant to your switchgear are part of the final documentation.

🕮 Installation checklist MC 600 E

🕮 Order documents

- Single line diagram
- Front view
- Construction data if compiled specifically for this order
- Circuit diagrams
- Earthing diagram – switchgear earth to station earth (not part of ABB supply)

🕮 Instruction manuals

- Use of SF_6 insulating gas HB 605 E
- Circuit-breaker VD4 X0 BA 440 E
- Snap-action mechanism for switch-disconnector BA 445 E
- Stored-energy spring mechanism for switch-disconnector with fuse BA 446 E
- Material supplement BA 509 E

🕮 Operating instructions and directions for components, e.g.

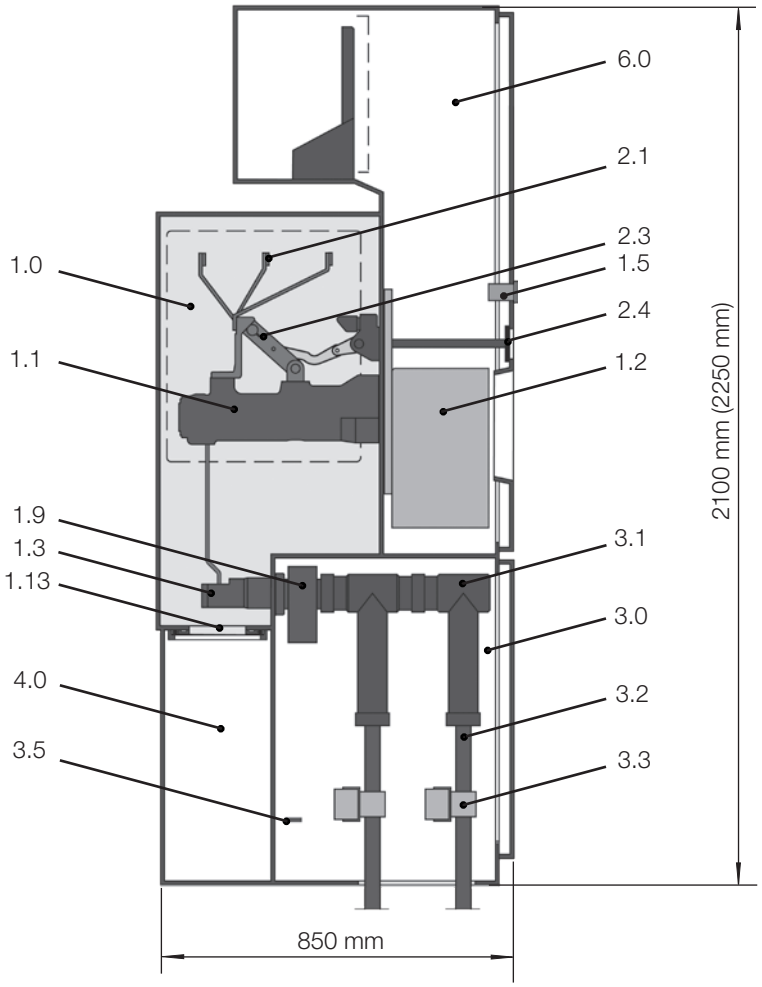
- Surge arresters
- Current and voltage transformers
- Current and voltage sensors
- Protection and control devices
- Capacitive indicators.

Do not use cleaning agent containing chlorine for cleaning the switchgear.

If you have technical questions, please contact our service staff

Power technology customer service Call number +49 180 6222-007

Fig. 1: Circuit-breaker panel, 800 A, panel width 400 mm, example configuration



1.0	Panel module
1.1	Circuit-breaker pole
1.2	Circuit-breaker operating mechanism
1.3	Outer cone
1.5	Sockets for capacitive voltage indicator system
1.9	Current transformer
1.13	Pressure relief disk
2.1	Busbar
2.3	Three position disconnector
2.4	Operating mechanism for three position disconnector
3.0	Cable termination compartment
3.1	Cable connector
3.2	High voltage cable
3.3	Cable clamp
3.5	Main earthing bar
4.0	Pressure relief compartment
6.0	Low voltage compartment

1. Despatch and storage

1.1 Condition on delivery

- The panels have been assembled into system blocks ready for operation.
- The panel blocks have been routine tested to IEC 62271-200.
- The busbar sockets are sealed with plastic film to protect them during transport.

The busbar sockets are not shockproof in this transport condition. Do not operate the switchgear with sealed busbar sockets (e.g. on extendable end panels). Close off unused busbar sockets with shockproof blanking plugs (see section 2.3.3).

- In normal cases, the gas compartments have been filled with sulphur hexafluoride (SF_6) insulating gas to the rated filling pressure. When airfreighted, however, the panel blocks are delivered with reduced pressure.
  - If delivered by airfreight, increase the pressure to the rated filling pressure before installing the panels (see instruction manual HB 605 E for the procedure to be adopted).
- The installation material and accessories and the documentation are packaged separately from the panel blocks.

1.2 Delivery

Check the consignment for completeness and freedom from damage. Document any transport damage found on the waybill and inform us of it immediately. Take photographs of the damage.

1.3 Packaging

The panel blocks have been prepared for transport by the agreed method and for the desired duration of any interim storage required. Details of the length of preservation and the storage location (indoors or outdoors) can be found in the order documents. If the panel blocks are packaged, they are mounted on a pallet and secured to prevent them from slipping.

The possible packaging methods are as follows:

- No packaging
- Packaged in plastic sheeting
- Packaged in plastic sheeting and surrounded by protective cardboard
- Heat sealed in plastic sheeting with drying agent enclosed
- Packaged in aluminium foil in transport crate with drying agent enclosed

1.4 Handling

- The transport units are the panel blocks.
- Always handle the panel blocks in the upright position.
- Take account of the weight of the transport units when selecting the handling equipment.

Due to the high centre of gravity of the panel blocks, there is a risk that the transport units may tip over! Take all precautions to protect personnel and the materials transported.

Only ever handle the panel blocks by

- fork lift truck,
- trolley jack,
- crane, or
- hydraulic lift trolley.

1.4.1 Handling by fork lift truck or trolley jack

The panel block must be standing on a pallet. The pallet must rest fully on the forks of the truck or jack. The high centre of gravity means there is a high risk of tipping. Avoid jerky motions.

1.4.2 Handling by crane

– The methods of handling by crane differ, depending on the width of the panel blocks. Up to a block width of 1 m, there are lugs on the top of the panel modules for fastening of the suspension ropes (figure 1.4.2.1), and from a width of 1.2 m upwards there are transport crossbeams with lugs for fastening of the suspension ropes located at the bottom (figure 1.4.2.2).

– Attach suspension ropes of a sufficient load bearing capacity (see section 10, Technical data, for the panel weights) to the lugs with shackles (figure 1.4.2.1). The ABB scope of supply does not include suspension ropes and shackles.

Fig. 1.4.2.1: Crane handling of a block with width up to 1 m

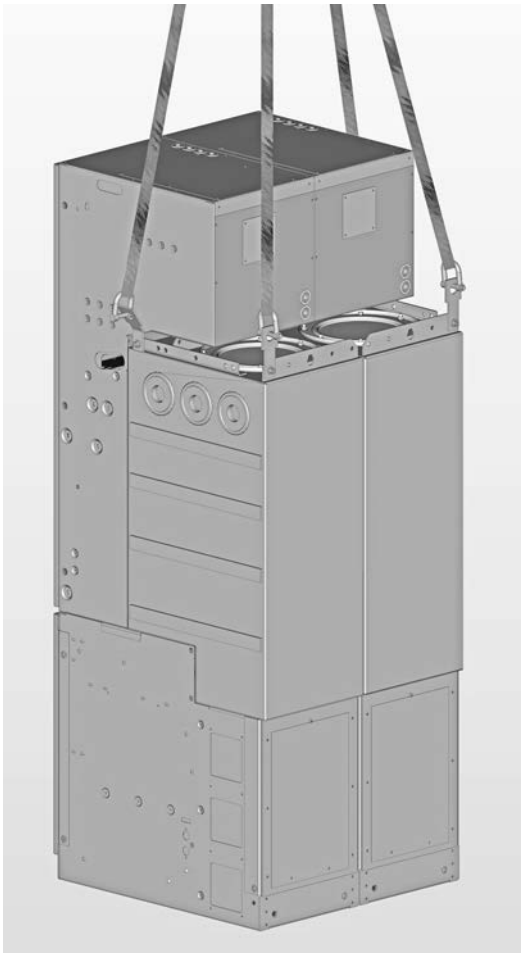
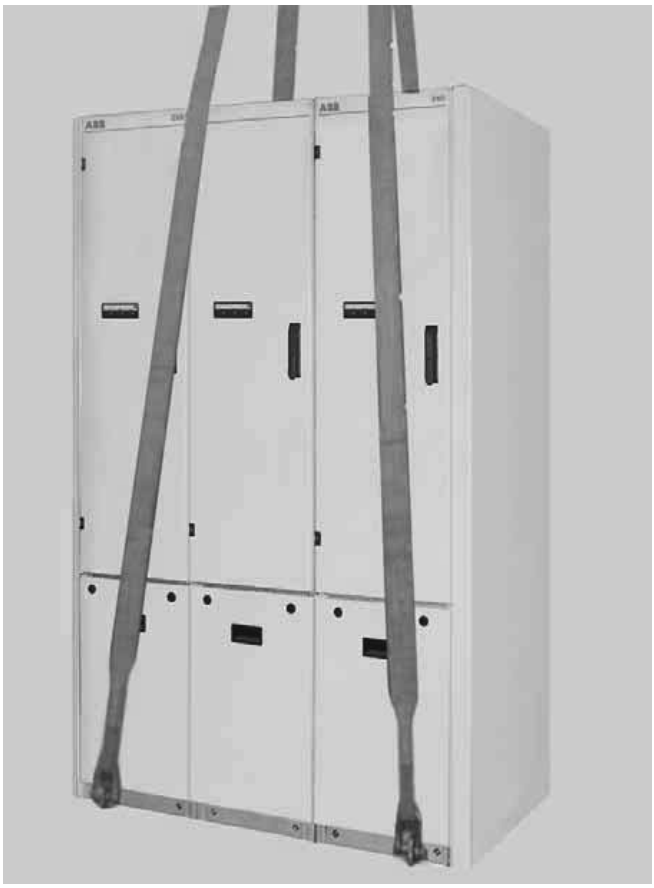


Fig. 1.4.2.2: Crane handling of a block with width of 1.2 m and more



1.4.3 Handling by hydraulic lift trolley

– Attach one hydraulic lift trolley (figure 1.4.3.1) of suitable load bearing capacity to each of the left and right sides of the panel block in accordance with the manufacturer's instructions.

The high centre of gravity means there is a high risk of tipping. Avoid jerky motions!

Fig. 1.4.3.1: Handling by hydraulic lift trolley

1.5 Intermediate storage

– Store the panel blocks in the upright position.

– Do not stack the panel blocks.

– Protect the transport units from damage.

The conditions for optimum intermediate storage without packaging or with basic packaging are as follows:

– The storeroom must comply with the normal operating conditions for a switchgear installation (see IEC 62271-1).

– Cover the unpackaged panel blocks with protective sheeting, remembering to preserve sufficient air circulation.

– cccc

The conditions for optimum intermediate storage with packaging and preservation are as follows:

– Check the packaging for damage.

– Store the transport units in a dry place protected from the weather.

– Contact us if

  – the storage life of the preservation is exceeded,

  – the packaging with preservation is damaged.

2. Installation of the switchgear at site

2.1 Fundamental notes on installation work

2.1.1 General site requirements

At the start of installation, the switchgear room at site must be complete and fitted with lighting and power for the installation work. It must also be lockable, dry, and with good ventilation facilities. All necessary provisions such as openings, ducts, etc. for laying of the power cables must already be in place. Compliance with the conditions for indoor switchgear to IEC 62271-1 must be ensured.

2.1.2 Tightening torques

Use DIN screws of tensile class 8.8. Use the tightening torques stated in table 2.1.2.1. The tightening torques apply to unlubricated screw connections.

Please consult the manufacturer's installation instructions for the tightening torques of cable connectors and surge arresters.

Table 2.1.2.1: Tightening torques

	M 8	M 10
Nut on studbolt	12,5	
Steel screw in pulling nut	18 - 24	
Screw in inner cone socket	20	
Other screws of tensile class 8.8	26	50

2.1.3 General information on treatment of plug-in connectors with silicone insulating parts

This section generally explains the procedure for treatment of silicone insulating parts in the busbar sockets, blanking plugs for the busbars, the silicone insulating parts on plug-in voltage transformers and blanking plugs for voltage transformer sockets. Only treat the silicone parts immediately before use. Section 2.3 indicates when the treated silicone parts are needed.

Please consult the documents from the cable connector manufacturer for details of the treatment procedure for silicone insulating parts on the cable connectors.

– Perform the following work to prepare silicone insulating parts for assembly:
  – Inspect the silicone insulating parts
  – Clean soiled silicone insulating parts
  – Grease the insulating parts
  – Clean the sockets, the contact tubes and the outer cone

Inspecting the silicone insulating parts

Only remove the relevant component from its protective packaging immediately before assembly.

Check the silicone insulating part for damage prior to installation.

If you note any damage on the silicone insulating part, only use the component after this has been agreed with our service department.

The silicone surface must be free of

– gas bubbles,
– scoring,
– damage,
– abrasions,
– foreign bodies.

Cleaning of soiled silicone insulating parts

– Perform cleaning work immediately before assembly of the relevant component as follows:
– Remove surplus or dirty grease from the silicone part with a soft, clean, non-fraying cloth.
– Clean the silicone insulating part when required with intensive cleaner M.X.T. 60 forte and a soft, non-fraying cloth.

Only use intensive cleaner M.X.T. 60 forte as the cleaning agent.

– Only moisten the cloth slightly with intensive cleaner. Apply only moderate pressure when cleaning the insulating parts of busbar connections. Do not wipe from the black areas towards the light insulating surfaces. By adopting this procedure you avoid transferring black, conductive material onto the light, insulating area.
– After cleaning with intensive cleaner M.X.T. 60 forte, wipe the silicone insulating part with a dry cloth.

As the cleaner causes the silicone to swell slightly, it then has to dry for approx. 15 minutes in the air.

Greasing the insulating parts

Grease the components immediately before use as follows:

Use the quantities of assembly paste listed in table 2.1.3.1.

– Silicone insulating parts on the busbar connection:
  Evenly grease the light, outer areas of the silicone part as shown in figure 2.1.3.1.
– Blanking plugs for the busbar connection:
  Evenly grease the light, outer areas of the silicone part as shown in figure 2.1.3.2.
– Silicone insulating parts of plug-in voltage transformers or test plugs:
  Evenly grease the silicone part as shown in figure 2.1.3.3.
– Silicone insulating parts of the blanking plugs for voltage transformers sockets:
  Evenly grease the silicone part as shown in figure 2.1.3.4.

Table 2.1.3.1: Quantities of assembly paste for silicone insulating parts

Component	Quantity of assembly paste to be used
Silicone insulating part on the busbar connection, both	Approx. 20 g each insulating part
Blanking plugs for the busbar bushing, silicone insulating parts of voltage transformers or blanking plugs for voltage transformer sockets	Approx. 10 g each part

Cleaning the sockets, the contact tubes and the outer cone

– Degrease and clean the mating piece for the silicone insulating part (the busbar socket or socket for the voltage transformer) with intensive cleaner M.X.T. 60 forte.

– Clean the outer cone on the cable connector with intensive cleaner M.X.T. 60 forte.

Assemble the components immediately to avoid soiling.

Fig. 2.1.3.1: Greasing the light, outer areas of the silicone insulating part on the busbar connection

Fig. 2.1.3.2: Greasing the light, outer area of the blanking plug for the busbar bushing in the area between the arrows

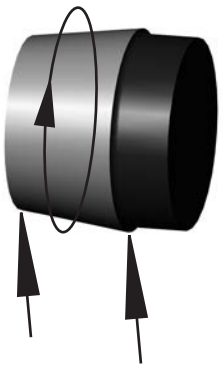


Fig. 2.1.3.3: Greasing the silicone insulating part of the voltage transformer in the area between the arrows

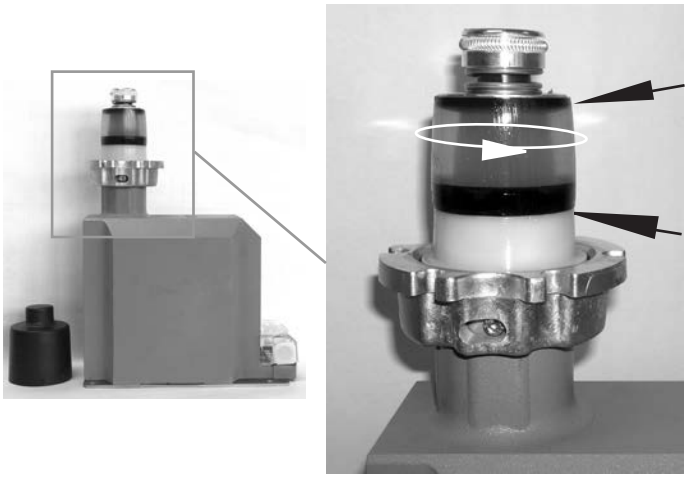
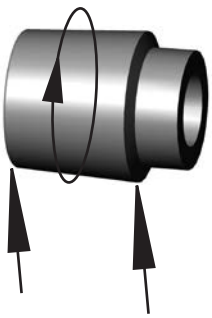


Fig. 2.1.3.4: Greasing the silicone insulating part of the blanking plug for voltage transformer sockets in the area between the arrows



2.1.4 Handling sulphur hexafluoride (SF_6)

As a rule, no gas work is required during installation.

We recommend that gas work should only be performed by personnel trained in the handling of SF_6. Gas may only be extracted by certified personnel. See manual HB 605 “Use of SF_6 insulating gas” for details on handling SF_6.

2.2 Foundation bars

– When a raised false floor is used, load-bearing sections of the floor frame serve as supports for the panel blocks. No additional foundation frame is necessary.

The slabs of the raised false floor must be fastened to the supporting frame.

– If there is a concrete floor and the switchgear consists of several panel blocks (with busbar connections), a foundation frame is required. Standard foundation frames supplied by ABB must be embedded in the floor topping.

Maintain the following evenness and straightness tolerances when installing the foundation frame or a raised false floor:

– Evenness tolerance: ± 1 mm / m

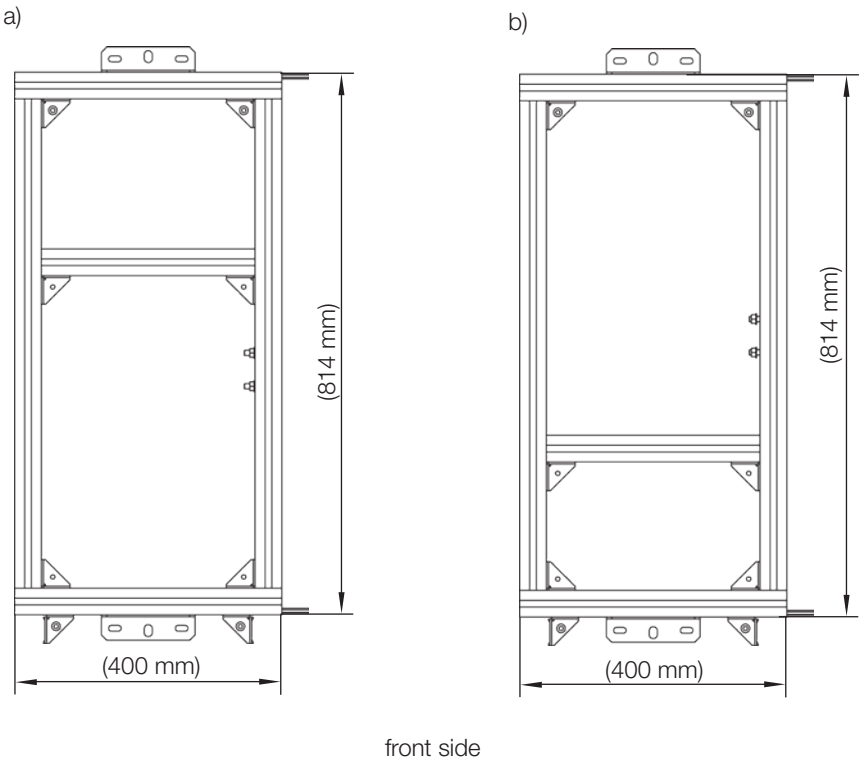
– Straightness tolerance: Max. 1 mm / m, but max. 2 mm for the entire length

Consult the order documents for the position of the foundation bars in the switchgear room.

If no standard ABB foundation frames are used, observe the relevant construction and laying drawings for the special frames.

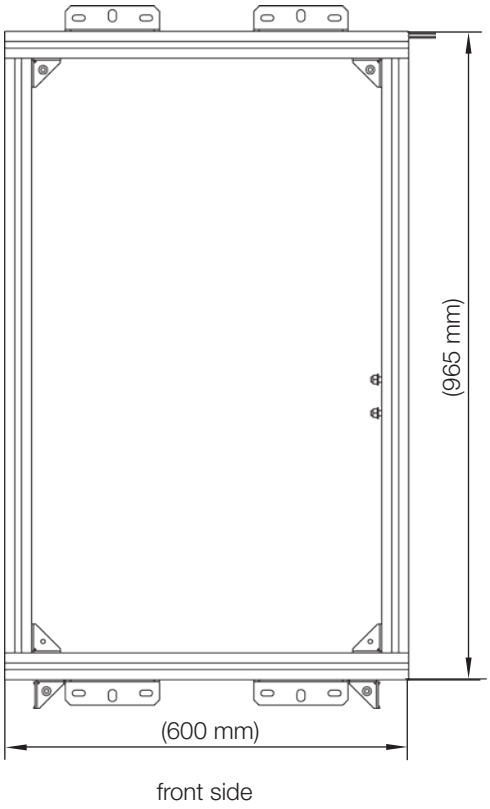
The standard foundation frames are shown in figure 2.2.1.

Fig. 2.2.1: Foundation frames, top view

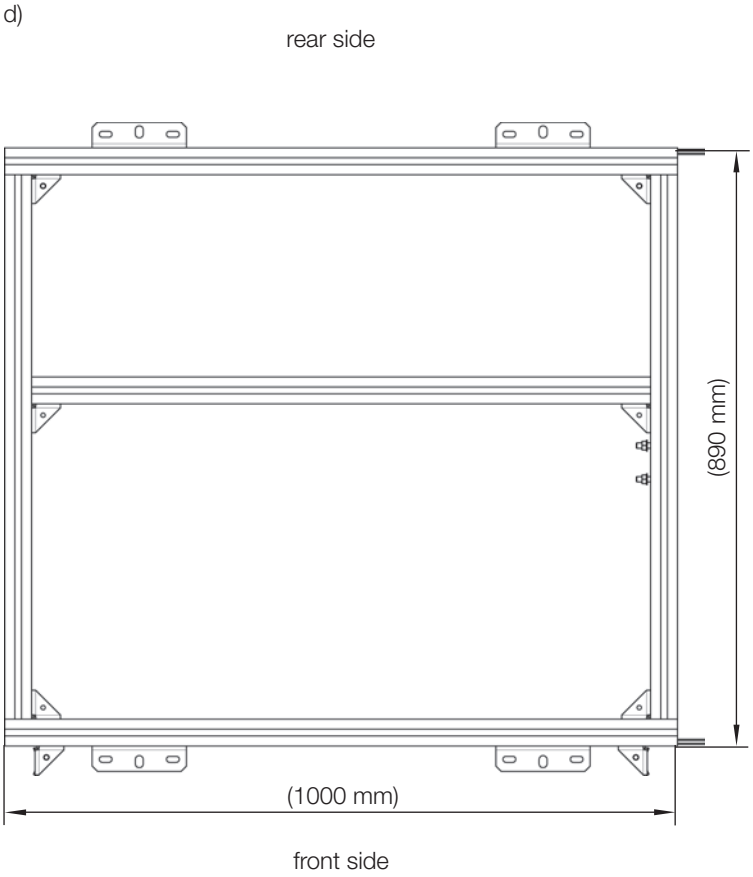


a) For feeder panels, width 400 mm
b) For metering, sectionalizer and riser panels, width 400 mm

c)



d)



c) For panels of 600 mm width
d) For air-insulated metering panels, width 1000 mm

2.2.1 Installation of the standard foundation frame

Standard foundation frames are delivered to site completely pre-assembled.

Installation principle:

The foundation frames are bolted together at the front and rear. Vertical alignment is effected by jacking screws. Brackets are used to fasten the frames to the floor. The foundation frames are finally embedded in the floor topping to provide their load bearing capacity.

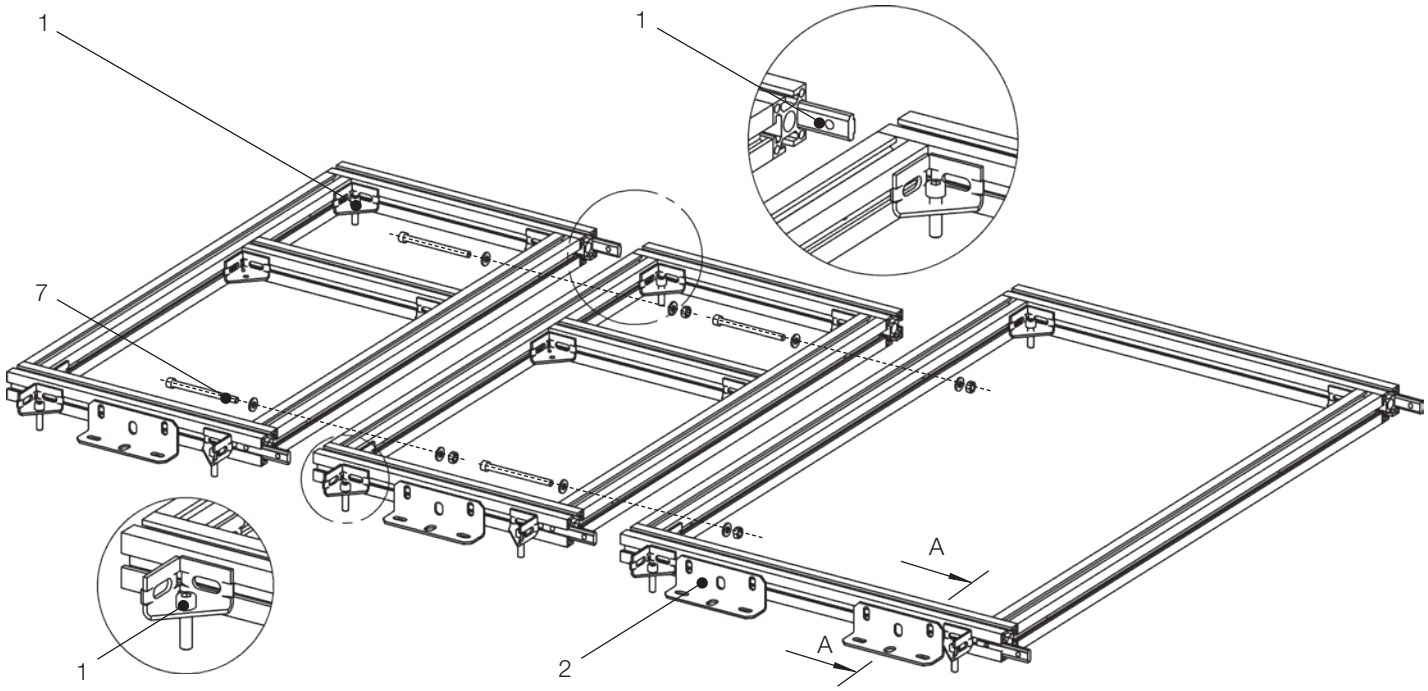
Detailed description of installation (Fig. 2.2.2.1)

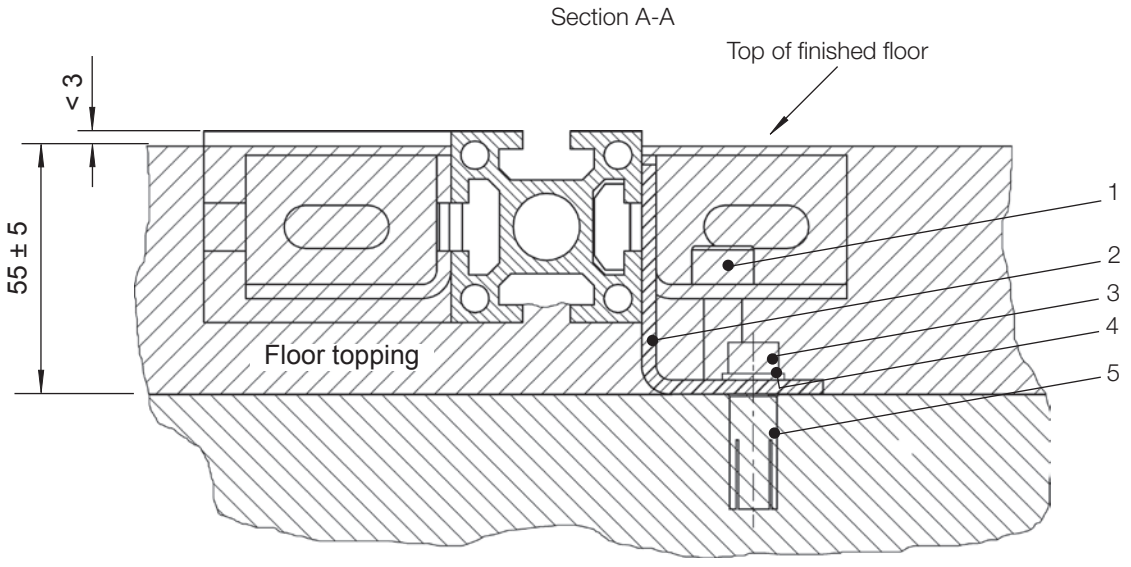
- Position the foundation frame sections in the correct locations on the concrete floor.
- Align the foundation frame vertically with the four screws (1), taking account of any deviation in floor level in the direction of the foundation frames which are still to be laid.
- Fasten the brackets (2) of the foundation frame to the floor, using one knock-in anchor (5) and one screw (3) with dished washer (4) for each bracket.
- Slide a slot rod (6) into the front slot of the front section and, if the rear sections of the two frames to be connected are aligned (i.e. have the same depth) a slot rod into the rear slot of the rear section. Tighten the grub screws in the slot rods.
- Place the following foundation frame in the correct position on the floor, allowing the inserted slot rods to slide into the sections of the frame to be installed. Bolt the foundation frames together with two M 8 x 100 cheese head screws (7) and nuts and washers. Tighten the grub screws in the slot rods.
- Align the foundation frame vertically as described above and fasten it to the floor.
- Install the following foundation frames in the same way.

- Earth the completely assembled frame. Further details on this can be found in the order documents.

When applying the floor topping, carefully fill under the foundation frame with topping material.

Fig. 2.2.1.1: Installation of the floor frame





2.3 Assembly of the switchgear

2.3.1 Preparatory work

2.3.1.1 Checking the SF_6 pressure in the gas compartments

Each panel block (= delivery unit) forms a gas compartment and is fitted with one filling connector. The filling connectors are located in the low voltage compartments and are accessible from the front when the low voltage compartment door is open.

– Check the gas pressure in each gas compartment with a temperature-compensated pressure gauge (see list of tools) before aligning and connecting the panel blocks, as follows:

– Remove the protective cap (2) from the filling connector (1) by turning it counter-clockwise.

Do not press the valve pin (3) in, as otherwise gas will flow out of the valve.

– While pulling the locking ring (4) outwards, press the coupling of the pressure gauge (5) into the filling connector.

– Check the reading on the scale of the pressure gauge.

The reading must be in the green area of the instrument's scale. If it is not, or if the site altitude is greater than 1000 m, please contact us.

– Remove the pressure gauge by pulling out the locking ring on the filling connector.

– Screw the protective cap onto the filling connector.

Fig. 2.3.1.1.1: Filling connector (1) with protective cap (2) in the low voltage compartment

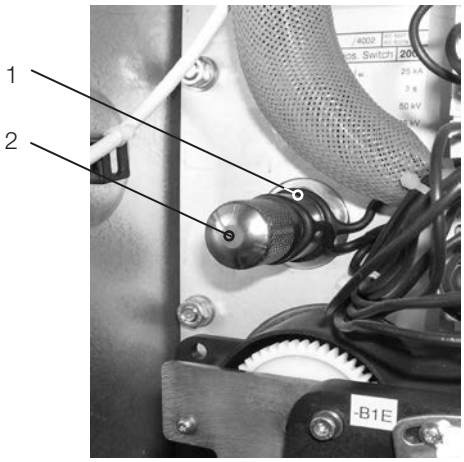


Fig. 2.3.1.1.2: Filling connector (1) with valve pin (3)

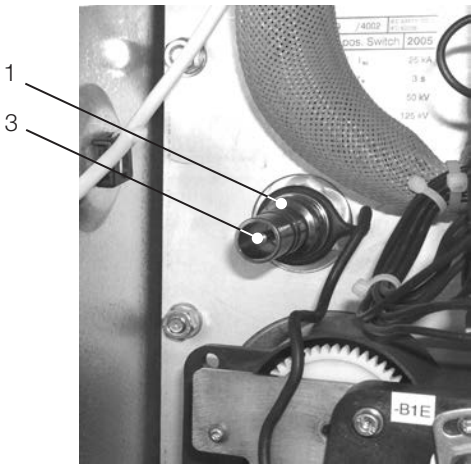
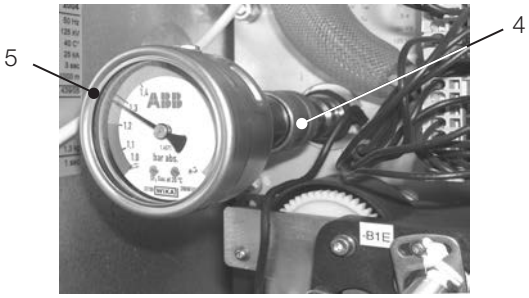


Fig. 2.3.1.1.3: Filling connector with pressure gauge (5) and locking ring (4)



2.3.1.2 Greasing the foundation bars

For standard foundation frames supplied by ABB, remove the protective film. Grease the top surfaces of the foundation frame or raised false floor beams. This facilitates erection and alignment of the panel blocks.

2.3.1.3 Preparing the panel blocks

– Remove the covers from the cable termination compartments on all panel blocks.

– Screw guide pins to the side of the panel block to be extended, using a threaded plate (see figure 2.3.1.3.1).

In the cases of sectionalizer, riser or metering panels, there is a second fastening bracket below the busbar bushings. Fit the guide pins to this fastening bracket using a threaded plate (figure 2.3.1.3.3).

Guide pins are only to be fitted to one of the panel block at the joint between two panel blocks. The guide pins remain in the relevant position after erection of the panel blocks and must not be removed.

– Lightly grease the guide pins for better sliding.

Fig. 2.3.1.3.1: Fitting the guide pins using a threaded plate

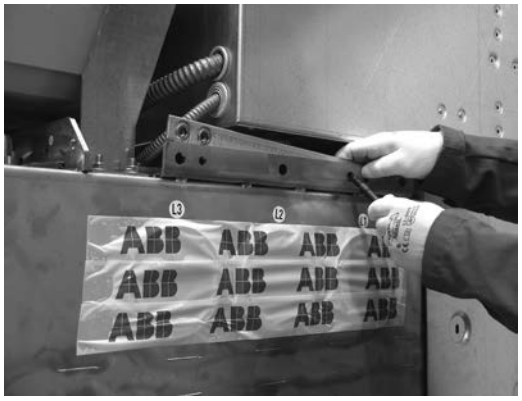


Fig. 2.3.1.3.2: Fitted guide pins

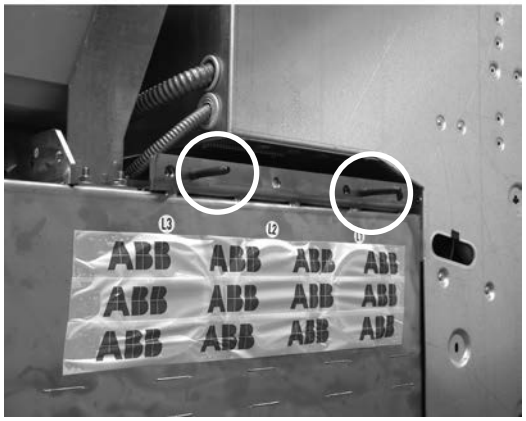
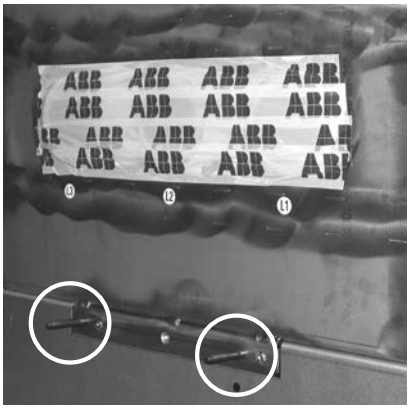


Fig. 2.3.1.3.3: Position of the guide pins in sectionalizer, riser and metering panels



2.3.2 Erection of the panel blocks

- Set up the furthest panel block precisely at the specified position.

When the standard foundation frame is used:

- Insert M 8 T-nuts through the holes in the floor plates into the slots in the foundation frame sections. Join the floor plates using washers (1 x washer 8.5 x 30 x 3 and 1 x dished washer 8) and M 8 x 16 cheese head screws to the previously positioned T-nuts (Fig. 2.3.2.1and Fig. 2.3.2.2).
- Each panel is fastened to the foundation frame with four screws (Fig. 2.3.2.1).

When a special foundation frame or raised false floor is used:

Fasten the panels in accordance with the instruction documents supplied.

Fig. 2.3.2.1: View of the fastening points for the panels

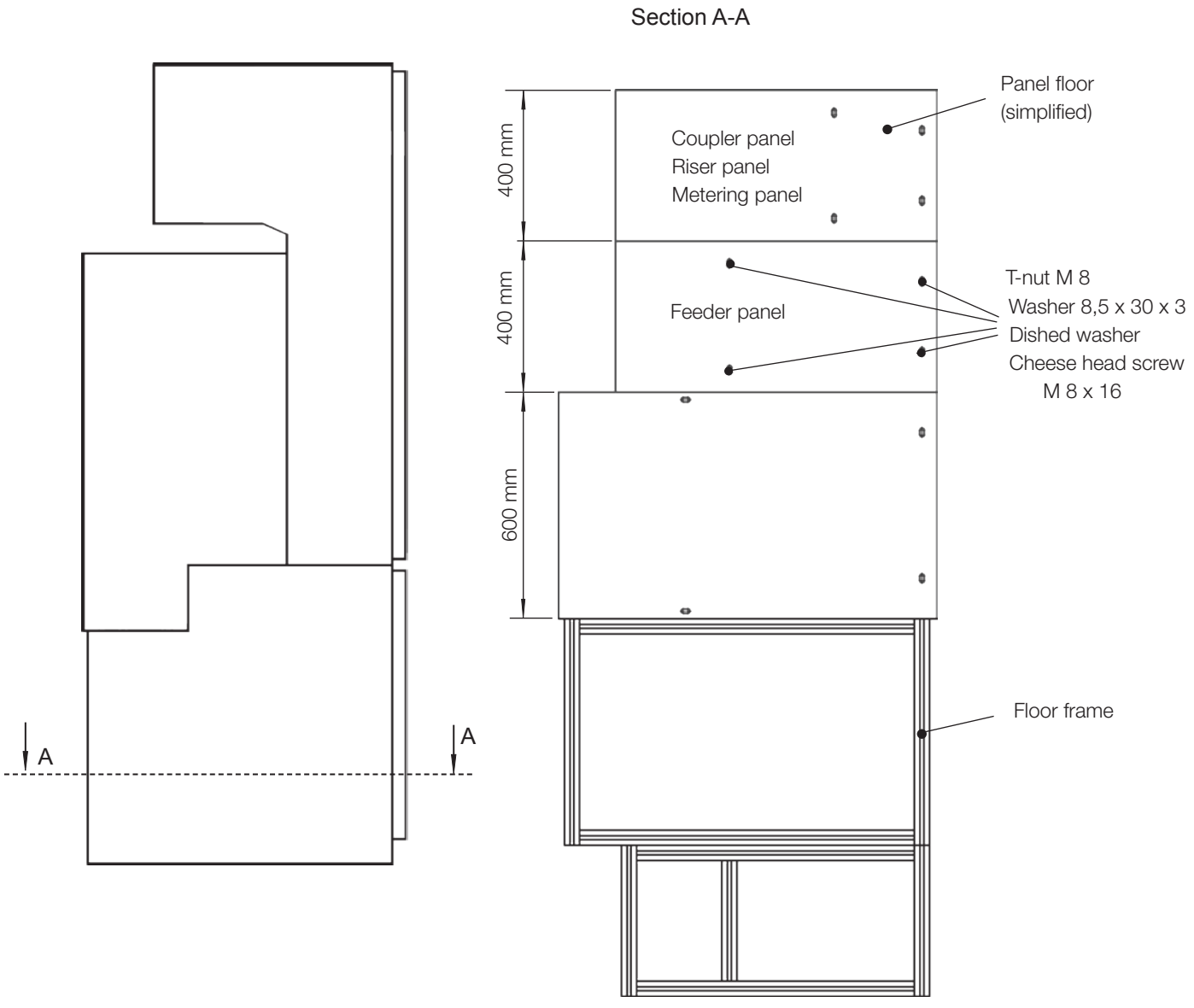
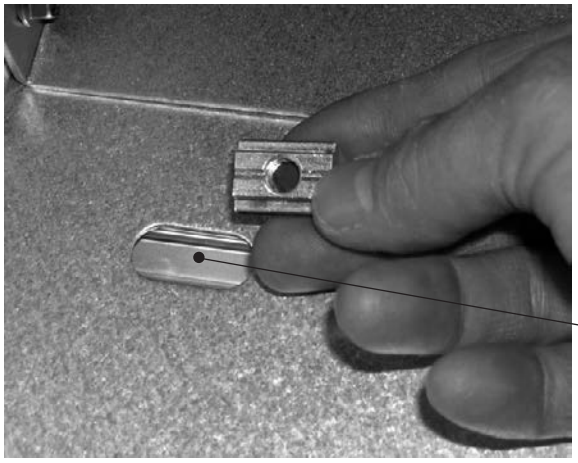
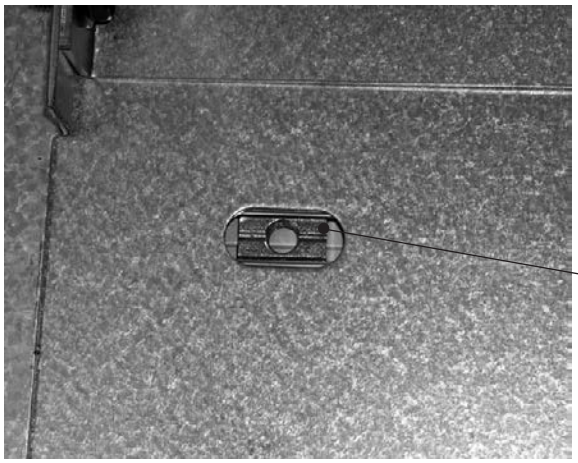


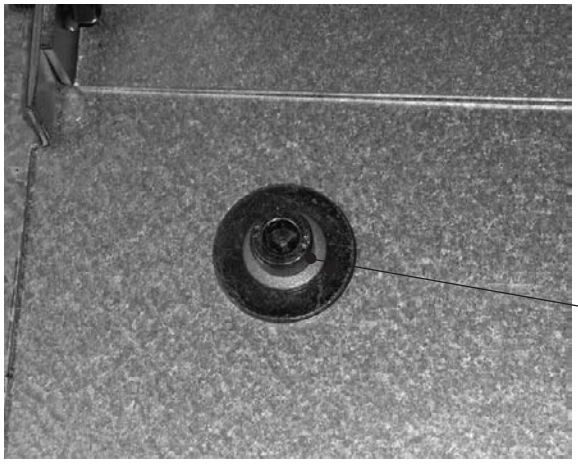
Fig.. 2.3.2.1: Fastening the panel to the foundation frame



Slot in the foundation frame section



T-nut, M 8



Fastening of the panel to the foundation frame

– Check the position of the panel block and align the panel block to the precise dimensions if necessary.

– Tighten the fastening screws in the panel block.

– Remove the protective film from the busbar sockets on the panel block which has been erected and the next panel block to be erected (figure 2.3.2.2).

– Prepare the silicone insulating parts, contact tubes and busbar sockets for the busbar connection between the two panel blocks as described in section 2.1.3.

– Insert the contact tubes into the busbar sockets of the panel which has been erected until they reach a tangible stop (figure 2.3.2.3).

Increased force is required to overcome the spring force of the spiral contact inside the busbar socket before the contact tube can be pressed into the socket up to the stop.

– Carefully insert the silicone insulating parts into the busbar sockets of the panel block which has already been erected. (figure 2.3.2.4).

Align the contact tubes horizontally.

Fig. 2.3.2.2: Protective film for busbar sockets

Fig. 2.3.2.3: Inserting a contact tube

Fig. 2.3.2.4: Fitted contact tubes and silicone insulating parts

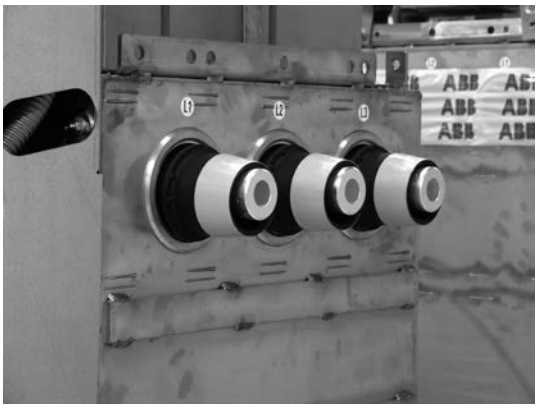
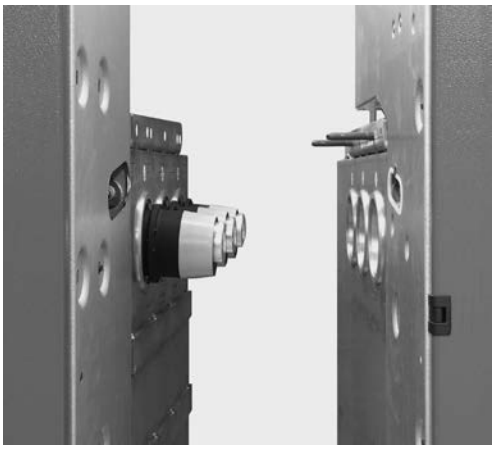


Fig. 2.3.2.5: Positioning of the panel block to be erected



– Slide the extension panel carefully against the existing system without tipping it, in such a way that the contact tubes slide into the busbar sockets and the guide pins into the corresponding bores in the fastening bracket.

Apply drawing or pressing tools to a large area on the panel blocks directly above the floor (for instance by using a wooden beam between the tool and the panel block) so as to avoid damage to the panel block.

– As soon as the distance between the two panel blocks is small enough, insert two M10 x 40 cheese head screws into the bores provided in the fastening bracket. Dismantling the lid in the rear wall of the low voltage compartment facilitates access to the front screw connection from inside the low voltage compartment (figure 2.3.2.6).

– The rear screw connection is located behind the low voltage compartment. Turn both the screws into the pulling nuts on the previously assembled threaded plate and tighten the screws alternately (figure 2.3.2.7).

– Connect the low voltage compartments and cable termination compartments of the two panel blocks at the specified locations (figure 2.3.2.8) with the aid of screws.

Fig. 2.3.2.6: Screw connections between the panel blocks: Accessibility of the front screw connection from the inside of the low voltage compartment

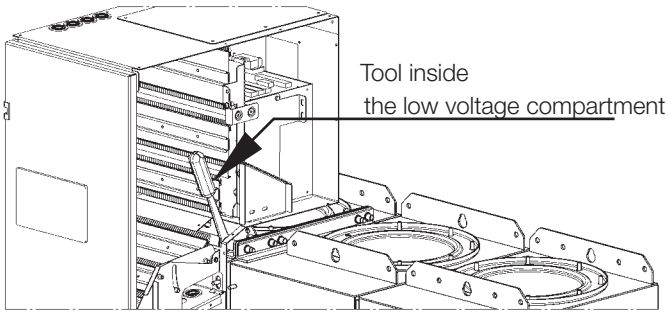


Fig. 2.3.2.7: Complete screw connections on the fastening brackets

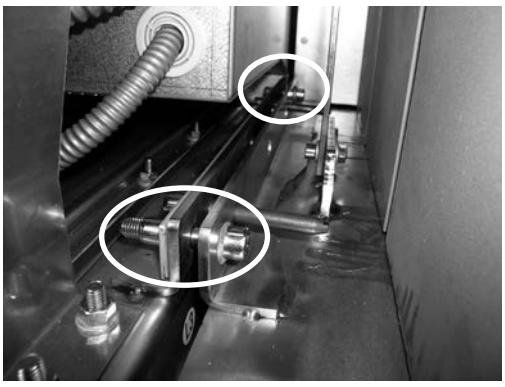


Fig. 2.3.2.8: Further fastening points on the panel blocks

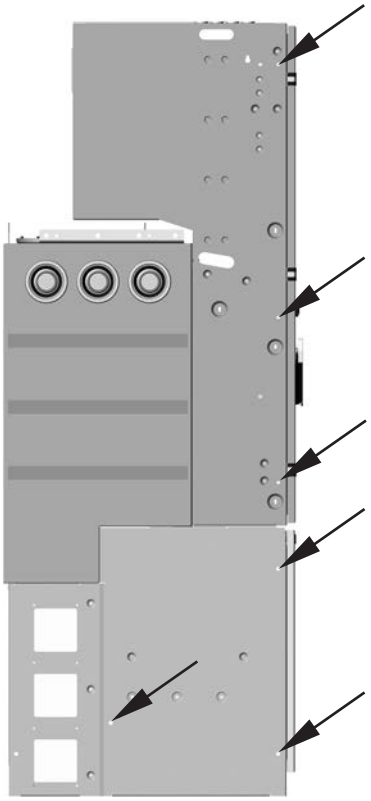


Fig. 2.3.2.9: Screwing the low voltage compartments together

– Check the position of the newly connected panel block, align it if necessary, and fasten it to the foundation frame with the panel fastening screws (figure 2.3.2.1).

– Lead the control wiring for the panel-panel connection through the opening in the adjacent panel.

– Connect the earthing bars of the panel blocks together.

– Assemble the further panel blocks in the manner described.

2.3.3 Closure of extendable busbar sockets

If your system is fitted with extendable end panels, the extendable busbar sockets on the outsides of the end panels are as a rule fitted ex-works with insulating blanking plugs (figures 2.3.3.1 a and b).

If extendable busbar sockets at the ends of the end panels are not closed off with insulating blanking plugs, the blanking plugs must be fitted at site in accordance with section 2.1.3 and with the aid of the assembly drawings provided.

Operation of the switchgear with open busbar sockets (including those in the course of the busbars, e.g. in sectionalizer panels, etc.) is not permissible!

Fig. 2.3.2.10: View into the cable termination compartment: Earthing bar

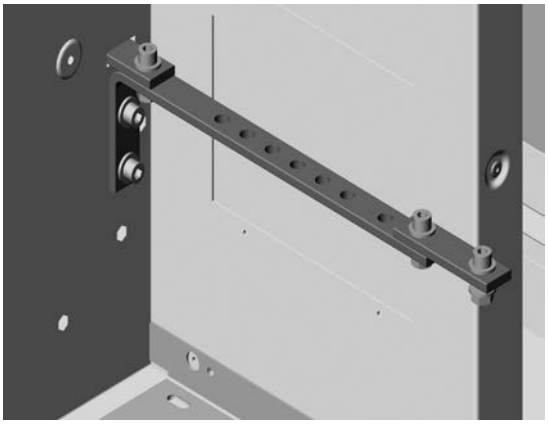


Fig. 2.3.3.1a: High dielectric strength blanking plugs in the busbar sockets – sectional view

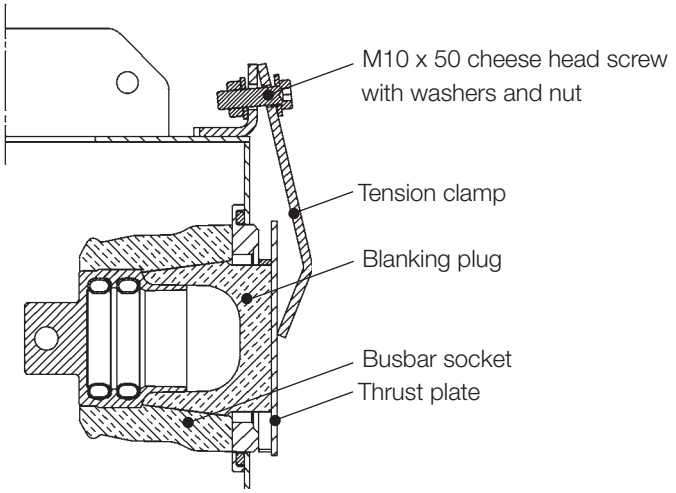


Fig. 2.3.3.1b: High dielectric strength blanking plugs in the busbar sockets

2.3.4 Assembling the end covers

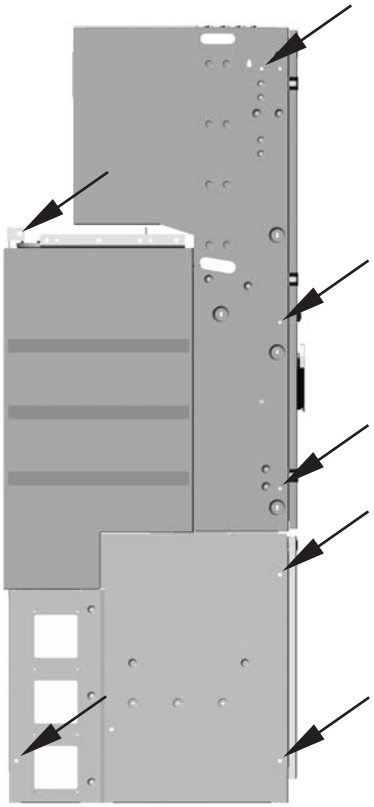
As a rule, the end covers are fitted at the works. In individual cases, end covers may also be supplied loose. Assemble the end covers as follows.

Screw the fastening bracket for the end cover onto the enclosure as shown in figure 2.3.4.1.

Fasten the end cover at the locations provided (figure 2.3.4.2) using screws. Finally, align the end cover.

Fig.. 2.3.4.1: Fastening bracket for the end cover

Fig. 2.3.4.2: Fastening points for the end cover



2.3.5 Handling of voltage transformers

As a rule, the panel blocks are supplied with voltage transformers installed. In individual cases, voltage transformers may also be supplied loose. Install the voltage transformers in accordance with the instructions in the section below.

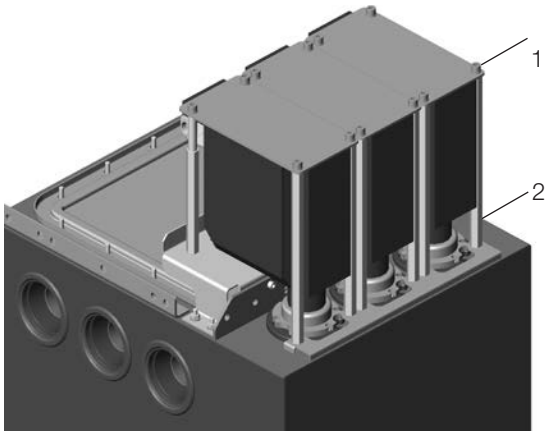
The weight of a voltage transformer can be over 30 kg. Use suitable lifting gear (e.g. a mobile gantry crane) to install the voltage transformers for integrated busbar measurement (type 3). We recommend having installation performed by two fitters. Observe the relevant accident prevention regulations in the country of installation.

2.3.5.1 Installation of plug-in voltage transformers

Isolate the relevant section of the system before installing plug-in voltage transformers.

- Comply with the safety regulations to EN 50110.
- Check the switchgear section for the off-circuit condition in accordance with section 5.1.
- Earth the switchgear section and secure the working area in accordance with section 4 and EN 50110 standard.
- Switch the mcbs [1] of the relevant operating mechanisms off so that the system section cannot be energized by remote control.
- Start installation with the middle transformer.
- Lay the transformer down, for example on the roof of the low voltage compartment.
- Wire the transformers as described in section 2.3.5.2.
- Remove the protective cap from the silicone part of the voltage transformer and store it for later use.
- Check the silicone part on the voltage transformer for damage. Observe the notes in section 2.1.3.
- Clean and grease the silicone part as described in section 2.1.3.
- Remove the plastic cover from the voltage transformer socket on the panel and store it for later use.
- Clean the voltage transformer socket as described in section 2.1.3.
- Slowly and carefully insert the transformer into the socket. Always ensure that the transformer is guided in vertically (do not tilt or tip it). The transformer cone must slide easily into the corresponding socket. Check the position of the silicone part in relation to the socket continuously and correct if necessary. A counter-pressure will become noticeable approx. 20 mm before the limit position is reached.
- Screw the base plate of the transformer with the threaded pins up to the mechanical stop with the aid of the screws supplied (1) (with dished washers), tightening them evenly across the diagonal (figure 2.3.5.1). Lock the relevant threaded pin with a spanner during this process so that there is no excessive strain on the welded-on studbolts.
- Where possible, wipe off any surplus grease which emerges.
- Install the other voltage transformers in the manner described.

Fig. 2.3.5.1: Installed voltage transformer



[1] mcb: miniature circuit-breaker

2.3.5.2 Wiring of the voltage transformers

The voltage transformers are fitted with terminal boards. The possible configurations of terminal boards can be found in figure 2.3.5.2.1 and table 2.3.5.2.1.

Fig. 2.3.5.2.1: Possible terminal board configurations

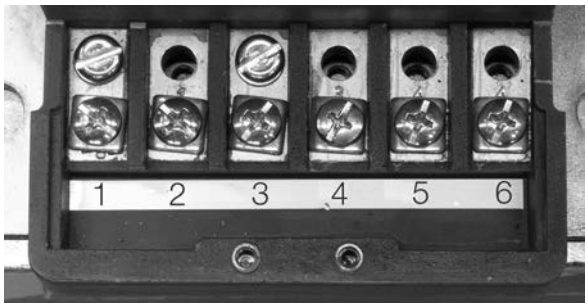


Table 2.3.5.2.1: Possible terminal board configurations

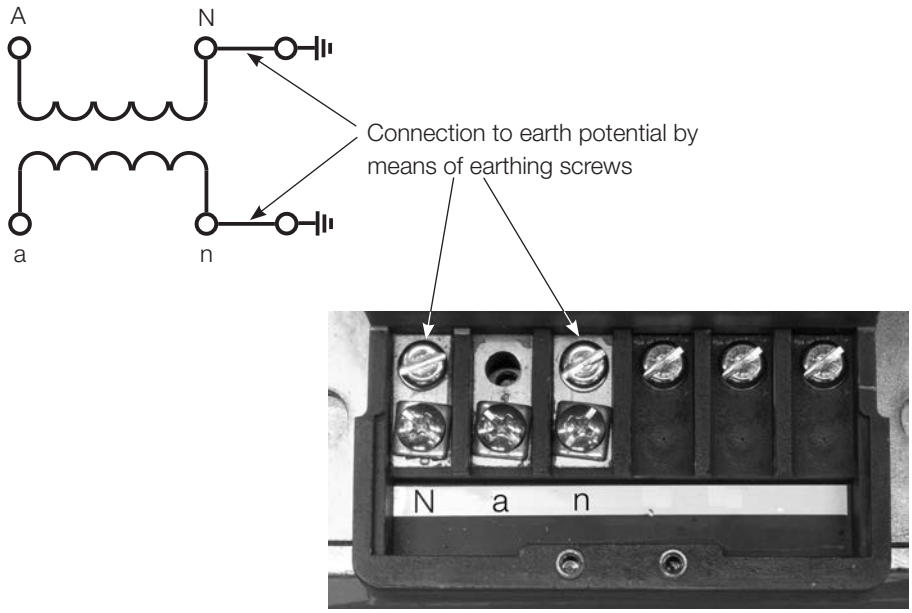
Windings			Terminal					
Number	Tap	e-n winding	1	2	3	4	5	6
1			N	a	n			
1		•	N	a	n	da	dn	
1	•		N	a1	a2	n		
1	•	•	N	a1	a2	n	da	dn
2			N	1a	1n	2a	2n	
2		•	1a	1n	2a	2n	da	dn
2	•		1a1	1a2	1n	2a1	2a2	2n

In a voltage transformer version with 2 windings plus tap or 2 windings plus e-n winding, "N" is implemented at the base plate of the voltage transformer.

Earthing of terminals on the voltage transformer terminal board using earthing screws

Connections to earth potential can be established by means of earthing screws on the terminals of the terminal board. Figure 2.3.5.2.2 illustrates this using the example of a voltage transformer with one secondary winding.

Fig. 2.3.5.2.2: Earthing of terminals using earthing screws



Wiring the voltage transformers

The cable harnesses for wiring of the transformers are prepared at the works and wired to the low voltage compartment. Wire the transformers as follows.

Wire the secondary terminals and the earthing of the voltage transformers in accordance with the circuit diagrams.

Check that all terminal screws including the earthing screws are tightly fastened.

Releasing the earthing screw on the 'N' terminal leads to potentially lethal high voltage at the terminal when the voltage transformer is in operation!

Releasing the earthing screw on the 'N' terminal is only permissible for test purposes on voltage transformers with de-energized primary!

Always use the original earthing screws!

Earthing of e-n windings

If the e-n windings of the voltage transformers are damped with a resistor, the windings connected in an open delta are to be earthed **at one point**. The circuit can be earthed

- in the low voltage compartment (figure 2.3.5.2.3) or

- on the terminal block of a voltage transformer (figure 2.3.5.2.4).

Perform measurements to ascertain which earthing method applies to your system.

Fig. 2.3.5.2.3: Earthing of the circuit in the low voltage compartment

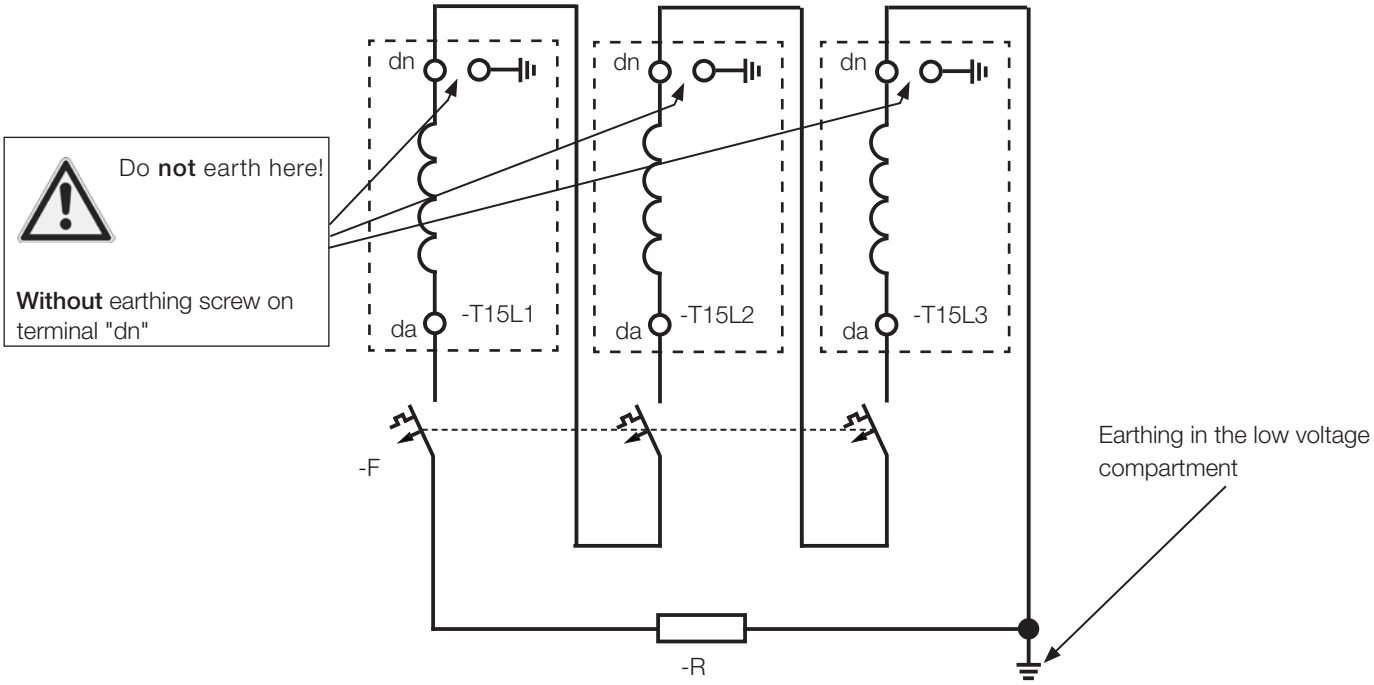
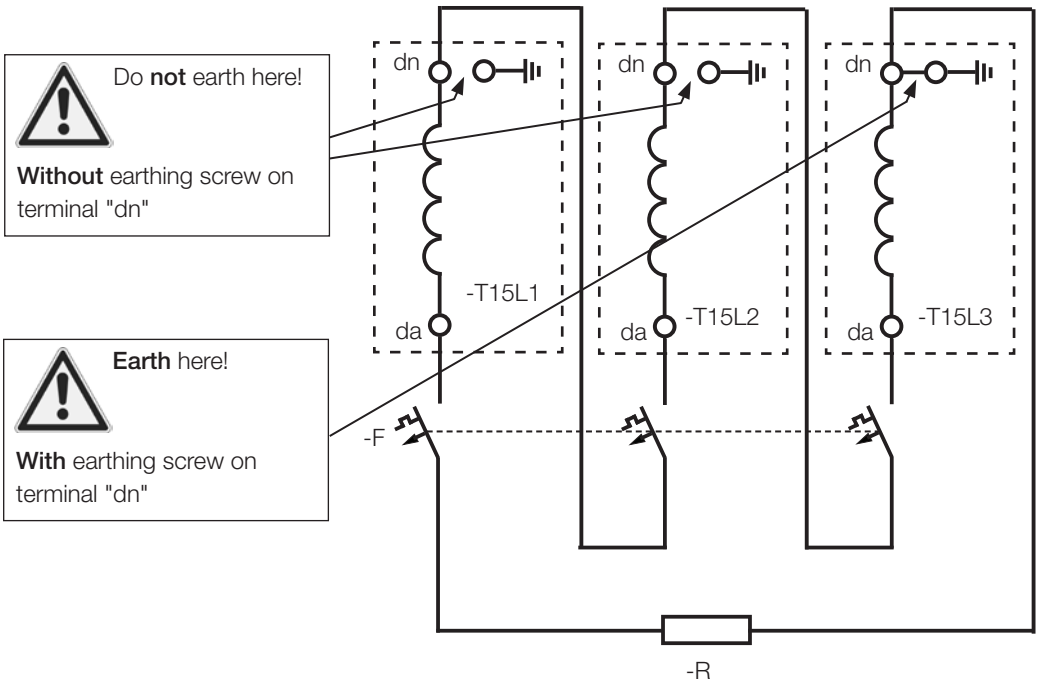


Fig. 2.3.5.2.4: Earthing the circuit on the terminal board of a transformer



Remove the earthing screws of the e-n windings from the terminal boards of the voltage transformers in accordance with the circuit diagrams (figure 2.3.5.2.5) or earth the e-n windings using the earthing screw (figure 2.3.5.2.6).

Earth the circuit at one point only.

Fig. 2.3.5.2.5: View of the terminal board of a voltage transformer with e-n winding: Earthing screw (arrow) in isolated position (no earthing)

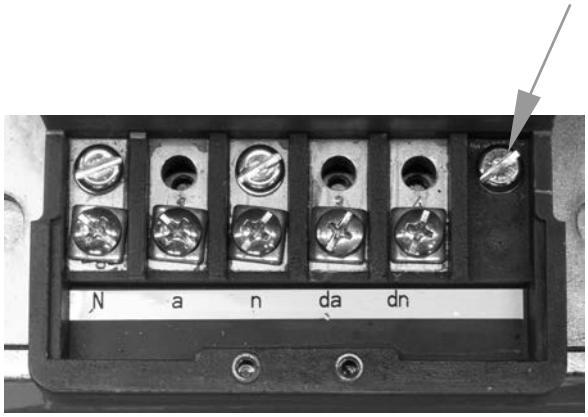
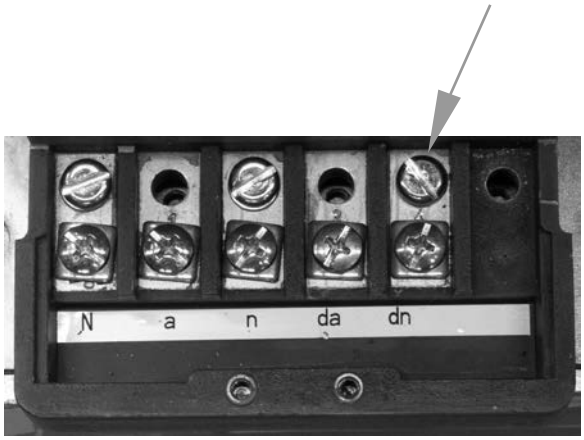


Fig. 2.3.5.2.6: View of the terminal board of a voltage transformer with e-n winding: Earthing screw (arrow) in earthing position (dn terminal earthed)



Checking the wiring

Finally, check the earthing system of the voltage transformer wiring in accordance with table 2.3.5.2.2.

Table 2.3.5.2.2: Earthing of terminals on the voltage transformer terminal board

Windings			Terminals					
Number	Tap	e-n winding						
1			N	a	n			
1		•	N	a	n	da	dn	
1	•		N	a1	a2	n		
1	•	•	N	a1	a2	n	da	dn
2			N	1a	1n	2a	2n	
2		•	1a	1n	2a	2n	da	dn
2	•		1a1	1a2	1n	2a1	2a2	2n

N — The terminal must be earthed via the earthing screw!

n — Earthing of the terminal in accordance with the circuit diagram!

dn — Earthing screw fitted in accordance with the circuit diagram and figure 2.3.5.2.3 or 2.3.5.2.4!

When 2 windings plus a tap or 2 windings plus e-n winding, are used, "N" is implemented by the works at the base plate of the voltage transformer.

2.3.5.3 Dismantling of plug-in voltage transformers

Isolate the relevant section of the system before dismantling plug-in voltage transformers.

- Comply with the safety regulations to EN 50110.
- Check the switchgear section for the off-circuit condition in accordance with section 5.1.
- Earth the switchgear section and secure the working area in accordance with section 4 and EN 50110 standard.
- Switch the mcbs [1] of the relevant operating mechanisms off so that the system section cannot be energized by remote control.

- Start dismantling with one of the outer transformers.
- Release the four fastening screws (1 in figure 2.3.5.1) of the transformer.
- Draw the transformer vertically (without tilting it) out of the socket.
- Lay the transformer down, for example on the roof of the low voltage compartment.
- Cover the silicone part of the transformer to protect it from soiling.
- Close off the voltage transformer socket in the panel with an insulating blanking plug (section 2.4.3).
- Dismantle the secondary wiring of the transformer.
- Remove the transformer from the roof of the low voltage compartment.
- Dismantle the other voltage transformers in the manner described.

2.4 Connection of cables and wiring

2.4.1 Control cables and wiring

- Establish the panel to panel connections of the control wiring. The panel to panel connections are of the plug-in type.
- The secondary cable entry for external control cables and wiring is located in the roof plate. Lead external control cables and wiring through the roof or floor plate using reducer rings, and connect these in accordance with the wiring diagram.

Earth the cable screen for the external control cables in accordance with the accepted EMC (electromagnetic compatibility) rules.

External control cables should be screened.

The lengths of the external control cables should not exceed 200 m. With greater lengths, use for example interposing relays or optical fibre cables.

[1] mcb: miniature circuit-breaker

2.4.2 High voltage cables

The high voltage cables are to be installed after high voltage testing.

– If fitted, dismantle the optional floor plates of the cable termination compartments. Remove the cable bushings from the floor plates.

– Lay the high voltage cables to the panels in accordance with the project planning.

Ensure that the phase positions of the cables are correct!

– If fitted, slide the cable bushings onto the cables.

– Connect the cable connectors to the cables in accordance with the manufacturer's instructions.

Checking the outer cones

Check the outer cones for damage. If there is damage to the outer cones, please contact our service department.

Cleaning the outer cones

Remove any surplus or dirty grease or soiling from the outer cones with a soft, clean, non-fraying cloth. Use intensive cleaner M.X.T. 60 forte for cleaning if necessary.

Fitting the cable connectors

– Connect the cable connectors to the relevant outer cones in accordance with the manufacturer's instructions.

– Connect the earthing conductors of the cable screens to the earthing bar in the panel.
If window-type current transformers are used, route the earthing conductors of the cable screen back through the current transformers and connect the earthing conductor to the earthing bar in the panel.

The earthing conductors of the cable screens should always be routed to the earthing bar in the shortest possible distance.

Observe the tightening torques for screw connections given in the cable connector manufacturer's instructions.

– Press the cable bushings into the openings provided in the floor plates (if fitted).

– Refit the floor plates and covers on the panels.

2.5 Fitting blanking plugs

Close off unused voltage transformer sockets with blanking plugs as follows:

– Treat the silicone insulating parts of the blanking plugs and the sockets for the voltage transformers as described in section 2.1.3.

– Insert the blanking plugs into the voltage transformer sockets and, without tilting them, fasten them in place by tightening the screws across the diagonal to the specified tightening torque (section 2.1.2).

2.6 Connecting the main earthing bar

– Connect the main earthing bar to the station earth.

Details of the cross section and the number of connections can be found in the earthing diagram (not included in ABB's scope of supply).

– Establish the earthing connections in accordance with IEC 61936 and IEC 62271-1 from the points of view of touch voltage, short-circuit capability and electromagnetic compatibility (EMC).

2.7 Concluding installation work

– Remove all tools and other foreign bodies from the switchgear.

– Refit any cladding, covers, cable ducts, etc. removed during the installation work.

Use only chlorine-free cleansers for cleaning of the switchgear.

– Clean the external surfaces of the enclosure and low voltage compartments where necessary.

– Touch up any damage to paintwork with a suitable paint.

– Check that the switchgear room is in proper condition for operation and establish that condition if necessary.

3 Commissioning

3.1 Conditions for commissioning of the switchgear

The conditions for commissioning of the switchgear are as follows:

- Supply voltage is available.
- There are no active SF_6 gas pressure alarms.
- Visual examination and sample checks on installation in accordance with this document have been performed.
- External control cables and wiring have been installed.
- Testing of the specified protection data of the secondary equipment has been successfully performed.
- Protection testing has been passed.
- Testing of all mechanical and electrical functions of the switching devices and corresponding operating mechanisms has been successfully performed.
- Testing of the panel and switchgear interlocks has been successfully performed.
- Several trial switching operations (without service voltage) on all switching devices have been successfully performed.
- Switch positions are correctly displayed on the panels and – if necessary – in the control room.
- If remote control systems are fitted, these have been successfully tested.
- Unused voltage transformer sockets and extendable busbar sockets have been closed off with insulating blanking plugs.
- Unused outer cones have been closed off and insulated.
- High voltage testing at 80 % of rated short-duration power-frequency withstand voltage U_d to IEC 62271 - 200 has been passed.
- High voltage cables have been installed (after performance of high voltage testing).
- All cladding and covers have been fitted.
- The following accessories have been handed over to the operators:
  - This manual
  - The corresponding documents and order documents
  - Double bit key or barrel lock key for opening and closing of the low voltage compartment doors
  - Levers and cranks for operation of the operating mechanisms (see list of accessories)
  - Earthing set (optional)
  - Plug-in indicator unit for capacitive indication – if necessary (see section 5.1)
  - Phase comparator in the case of more than one incoming feeder (optional)
- a work instruction for handling of SF_6 (an example can be found in instruction manual HB 605/E) is displayed in the switchgear room.
- The operators have been instructed in the theory and practice of operation of the switchgear and are familiar with all details of operation.

3.2 Energizing the system

– Please consult section 4 for procedures for operating the devices. Also observe section 3.1.

– Close all low voltage compartment doors.

– Switch all circuit-breakers off.

– Switch all three position disconnectors off.

– Switch all three position switch-disconnectors off.

Connecting the incoming feeder panels when these are circuit-breaker panels

– Switch the three position disconnector in the incoming feeder panel to the “Disconnector ON” position.

– Switch the circuit-breaker in the incoming feeder panel “ON”.

– The busbar is then at operating voltage.

Before connecting further incoming feeder panels, ensure that the phase angle of the panels is identical (section 5.2).

Connecting the incoming feeder panels when these are switch-disconnector panels

– Switch the switch-disconnector in the incoming feeder panel “ON”.

– The busbar is then at operating voltage.

Before connecting further incoming feeder panels, ensure that the phase angle of the panels is identical (section 5.2).

Connecting the outgoing feeder panels (loads) when these are circuit-breaker panels

– Switch the three position disconnector in the outgoing feeder panel to the “Disconnector ON” position.

– Switch the circuit-breaker in the outgoing feeder panel “ON”.

– The loads are then switched on.

Connecting the outgoing feeder panels (loads) when these are switch-disconnector panels

– Switch the three position switch-disconnector in the outgoing feeder panel to the “Switch-disconnector ON” position.

– The loads are then switched on.

Switch the further loads on as described.

The switchgear is in operation.

4. Operation

– All activities in connection with operation of the switchgear require compliance with EN 50110 standard or relevant national regulations regarding the operation of electrical installations (see also page 6).

– Always make sure that switching operations have been completed before performing the next switching operation.

4.1 Panels with circuit-breakers and three position disconnectors

The three switching positions of the three position disconnector, “connecting”, “disconnecting” and “preparing for earthing” are clearly defined by the mechanical structure of the switch. Connecting and disconnecting the operating current and earthing are performed exclusively by the circuit-breaker (figures 4.1.1 and 4.1.2). Figures 4.1.3 to 4.1.8 show the switching sequence for earthing of a busbar section using the sectionalizer and riser, on the basis of an example switchgear installation.
In order to avoid maloperation, the operating mechanisms are mechanically or electrically interlocked, and as an option also electrically interlocked between different panels.

– The three position disconnector (disconnector and earthing switch function) can only be operated when the circuit-breaker is open. The earthing switch can only be operated when the disconnector is open. The disconnector can only be operated when the earthing switch is open.

See the order documents for the conditions of optional panel to panel interlocks.

4.1.1 Notes on earthing of a feeder panel or system section

When the feeder panels or section of the system has been earthed by operating the earthing switch and circuit-breaker (figures 4.1.1, 4.1.2 and 4.1.5 to 4.1.9), secure it to prevent cancellation of earthing as follows:

Switch the mcbs for the circuit-breaker release circuit and for the motor-operated mechanism of the three position switch in the relevant panel off.
Lock the low voltage compartment door or where appropriate the mechanical OFF button for the circuit-breaker.
Affix a sign to the panel to indicate that earthing has been performed.

Fig. 4.1.1: Earthing a feeder and cancelling the earthing

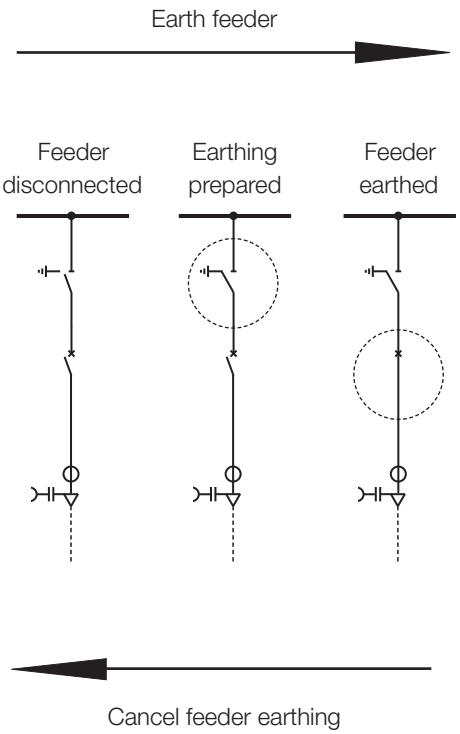


Fig. 4.1.2: Connecting and disconnecting a feeder panel

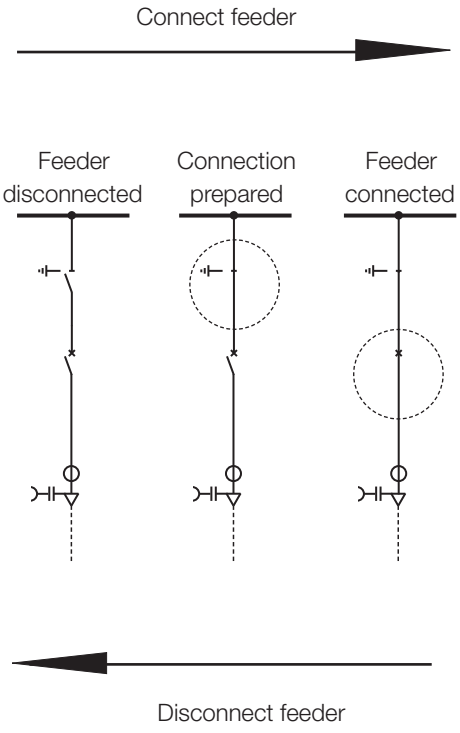


Fig. 4.1.3: Example switchgear, consisting of two busbar sections, in operation

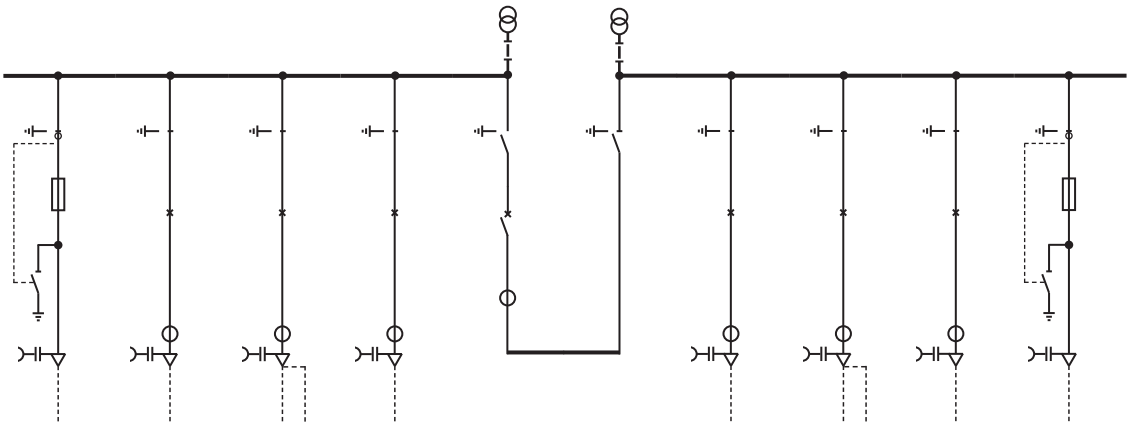


Fig. 4.1.4: Opening the circuit-breakers in the feeder panels in the area of the busbar section to be earthed

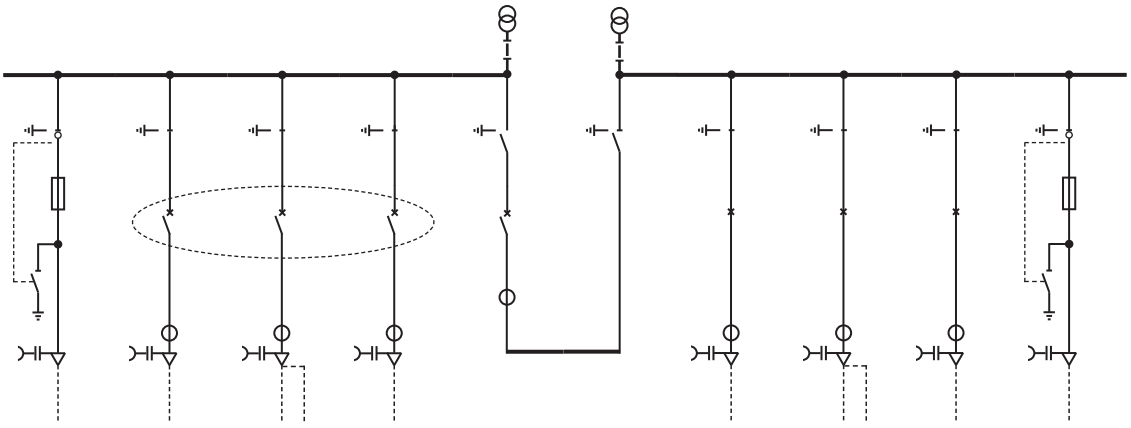


Fig. 4.1.5: Opening the disconnectors and switch-disconnectors in the feeder panels in the area of the busbar section to be earthed

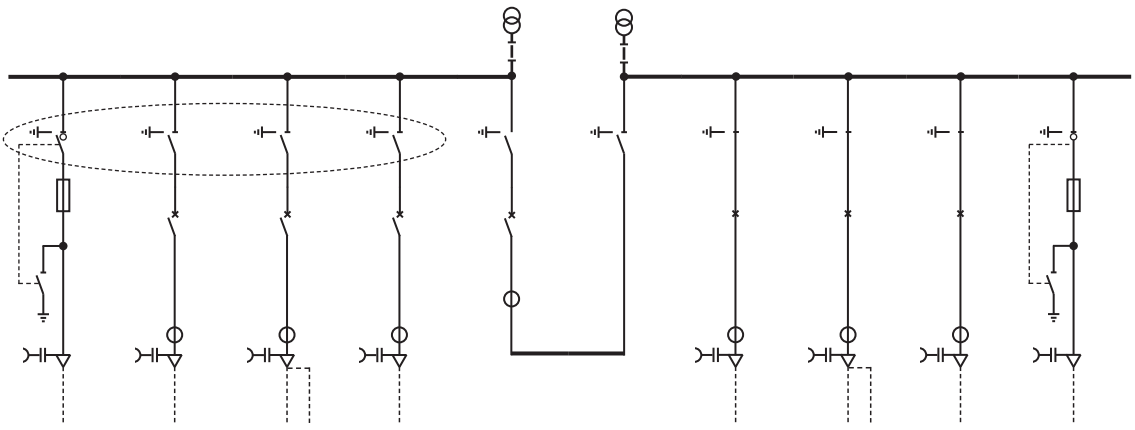


Fig. 4.1.6: Closing the disconnector in the sectionaliser

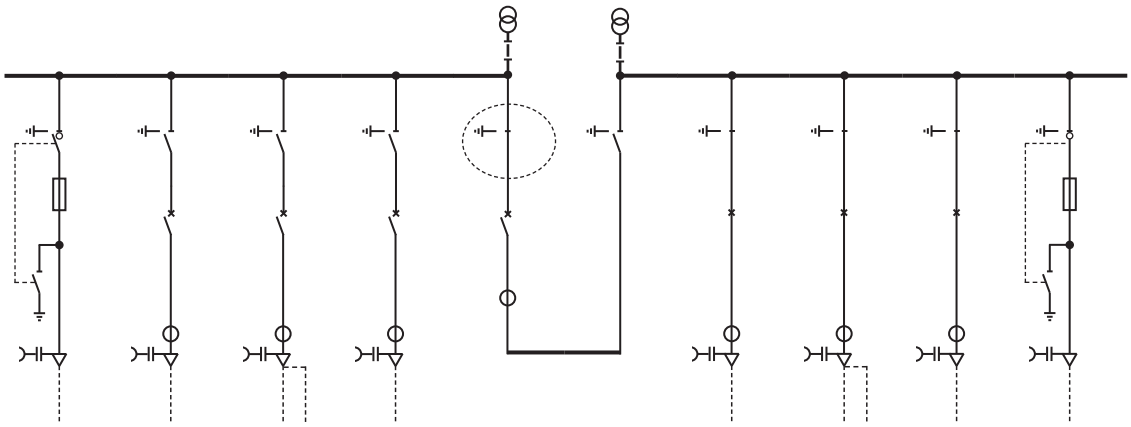


Fig. 4.1.7: Closing the earthing switch in the riser panel

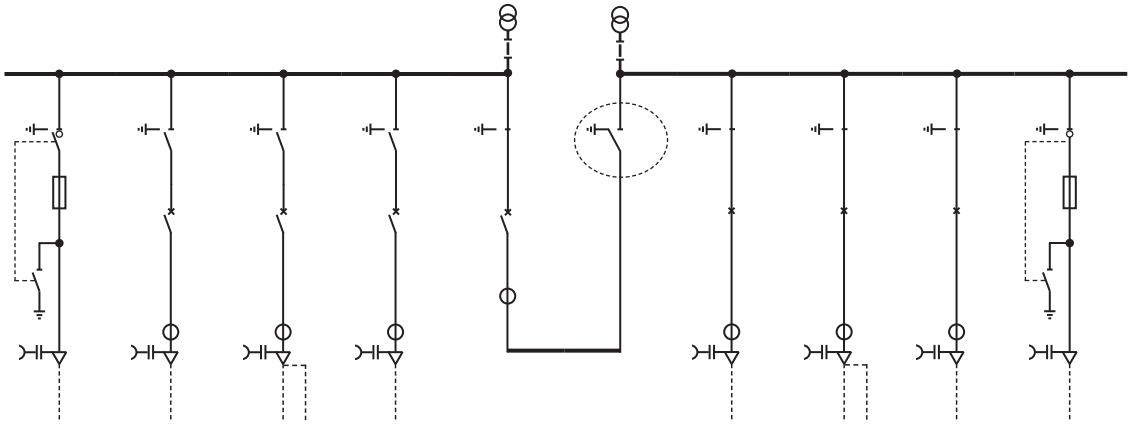
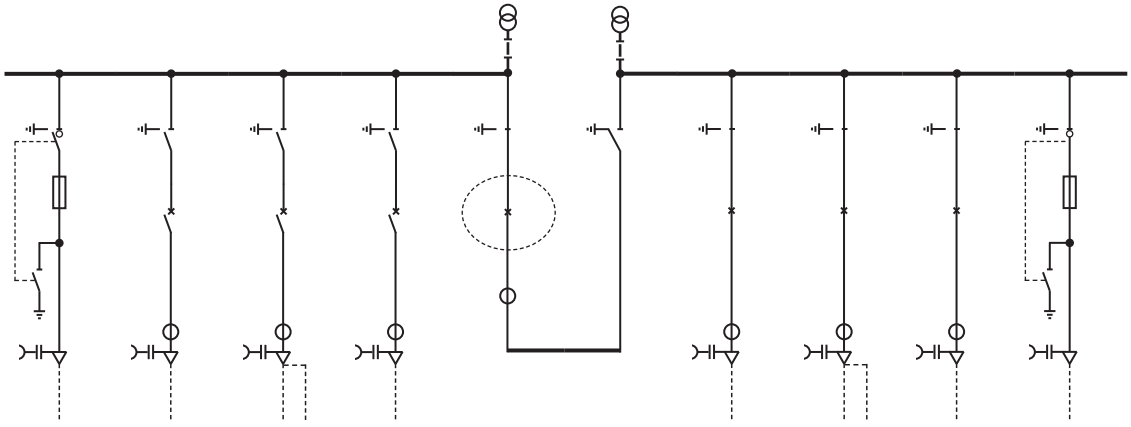


Fig. 4.1.8: Closing the circuit-breaker in the sectionalizer, left hand busbar earthed



4.1.2 Mechanism variants

Four different operating mechanisms for three position disconnectors are available: manual mechanisms 1 and 2, and motor-operated mechanisms 1 and 2. In the following sections you will find a detailed description of operation of these mechanisms and the corresponding circuit-breaker operating mechanisms.

See table 4.1.2.1 for assignment of the three position disconnector mechanisms.

The following applies to all switching operations:

With the exception of emergency manual operation, switching operations may only be performed with the low voltage compartment door closed.

4.1.2.1 Manual mechanism 1

Operation of manual mechanism 1 (figure 4.1.2.1.1) is purely manual, with the exception of the motorized or manual stored energy spring mechanism for the circuit-breaker. The three position disconnector is mechanically interlocked against the closed circuit-breaker. Operation of the earthing switch is only possible when the disconnector is open, and vice versa.

4.1.2.1.1 Operation of the circuit-breaker

– Mechanical switch position indication is effected by a graphical symbol (3) in the low voltage compartment door.

– In order to change the switching condition of the circuit-breaker, press the mechanical OFF button (1) or the mechanical ON button (2).

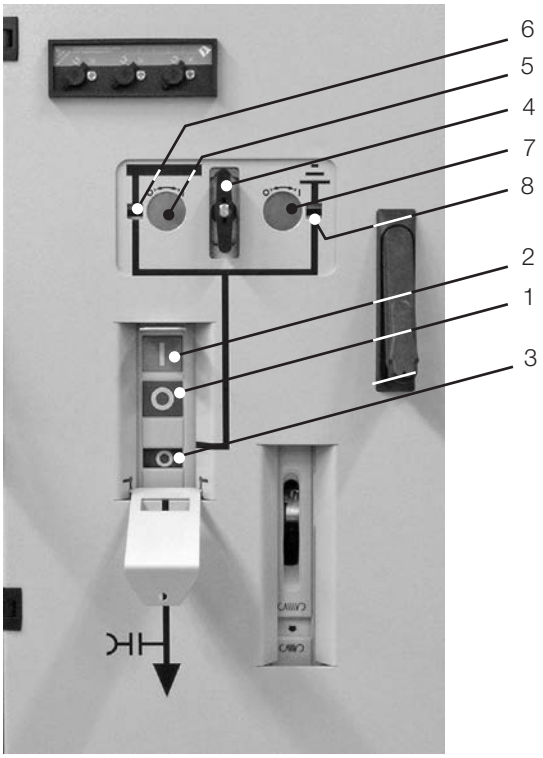
4.1.2.1.2 Operation of the three position disconnector

Turning of the selector lever (4) causes a slide to release the opening (5 or 7) for the operating lever of the disconnector or earthing switch. The selector lever can only be turned when the circuit-breaker is open. The selector lever can only be turned for earthing

Table 4.1.2.1: Assignment of the three position disconnector mechanisms to the panel widths

Three position disconnector mechanism	Panel width / mm	max. I_r / A
Manual mechanism 1	400	800
Manual mechanism 2	600	1250
Motor operated mechanism 1	400	800
	600	1250
Motor operated mechanism 2	600	1250

Fig. 4.1.2.1.1: Manual mechanism 1: Displays and controls



1 OFF button for circuit-breaker
2 ON button for circuit-breaker
3 Switch position indicator for circuit-breaker
4 Selector lever
5 Opening for disconnector operation
6 Switch position indicator for disconnector
7 Opening for earthing switch operation
8 Switch position indicator for earthing switch

switch operation when the disconnector is open, and for disconnector operation when the earthing switch is open.

– The selector lever can be blocked by a padlock.

– Mechanical switch position indication is effected by graphical symbols (6 and 8) in the low voltage compartment door.

Always perform all switching operations up to the stop.

Operation of the disconnector

– Turn the selector lever (4) clockwise and hold it fast.

– Plug the operating lever onto the hexagon through the released opening (5).

Disconnector OFF ⇨ ON

– Turn the operating lever approx. 75° clockwise until the stop is reached.

– Withdraw the operating lever.

Disconnector ON ⇨ OFF

– Turn the operating lever approx. 75° counter-clockwise until the stop is reached.

– Withdraw the operating lever.

Operation of the earthing switch

– Turn the selector lever (4) counter-clockwise and hold it fast.

– Plug the operating lever onto the hexagon through the released opening (7).

Earthing switch OFF ⇨ ON

– Turn the operating lever approx. 110° clockwise until the stop is reached.

– Withdraw the operating lever.

Earthing switch ON ⇨ OFF

– Turn the operating lever approx. 110° counter-clockwise until the stop is reached.

– Withdraw the operating lever.

Fig. 4.1.2.1.2.1: Operating lever for operation of manual mechanism 1

Fig. 4.1.2.1.2.2: Operation of the three position disconnector (in this case disconnector operation) with manual mechanism 1

4.1.2.1.3 Emergency manual operation

Circuit-breaker operating mechanism

- On failure of the supply voltage, the circuit-breaker can be opened at any time by pressing the mechanical OFF button. Closing of the circuit-breaker with the mechanical ON button is dependent on the stored-energy spring mechanism being charged. The condition of the stored-energy spring mechanism is displayed mechanically (10 in figure 4.1.2.1.3.1).
- On failure of the supply voltage or the stored-energy spring charging motor for the circuit-breaker operating mechanism, the charging process can be performed or completed manually.
  - To do this, insert the charging lever (11 in figure 4.1.2.1.3.1) into the receptacle and perform approximately 25 strokes until the charged condition is indicated.
  - When the charged condition is reached, the charging mechanism is disengaged, and no further movements of the charging lever can be made.

Circuit-breaker operating mechanism fitted with optional blocking magnet -RLE1

The blocking magnet -RLE1blocks the mechanical ON button of the circuit-breaker in certain situations. This interlock is active on failure of the supply voltage. Deblocking of the blocking magnet requires work inside the circuit-breaker operating mechanism, and may only be performed by qualified personnel. Contact the ABB Service Department if necessary.

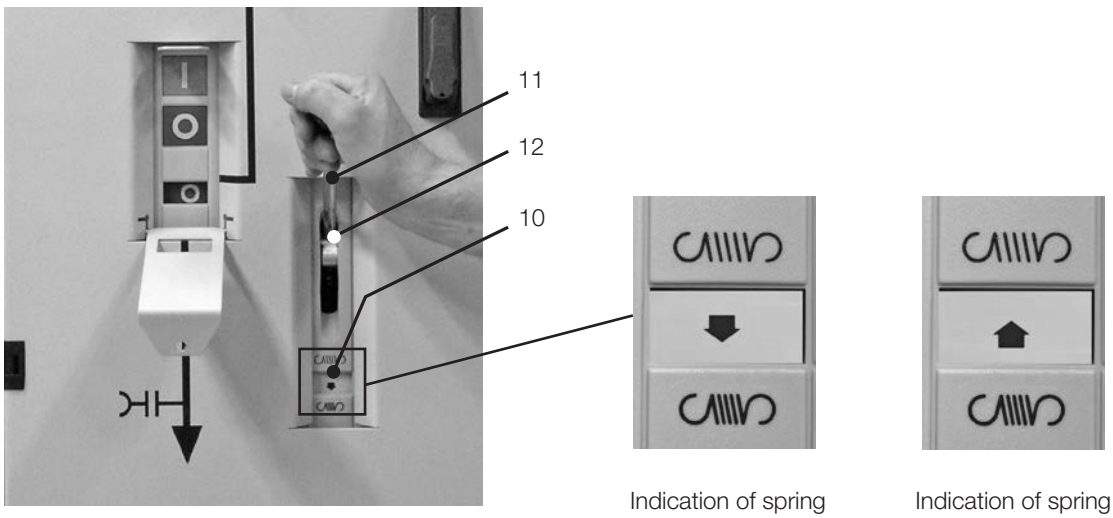
Three position disconnector mechanism

In this operating mechanism variant without a blocking magnet, the three position disconnector mechanism can also be operated without supply voltage as described in 4.1.2.1.2.

Three position disconnector mechanism fitted with optional blocking magnet -RLE1 and/or -RLE5

The blocking magnets -RLE3 and -RLE5 prevent turning of the selector lever for operation of the disconnector or earthing switch function of the switch in certain situations. This interlock is active on failure of the supply voltage. Deblocking of the blocking magnet requires work inside the three position disconnector operating mechanism, and may only be performed by qualified personnel. Contact the ABB Service Department if necessary.

Fig. 4.1.2.1.3.1: Manual charging of the stored-energy spring



10	Condition indicator for the stored energy spring
11	Charging lever
12	Receptacle for charging lever

4.1.2.2 Manual mechanism 2

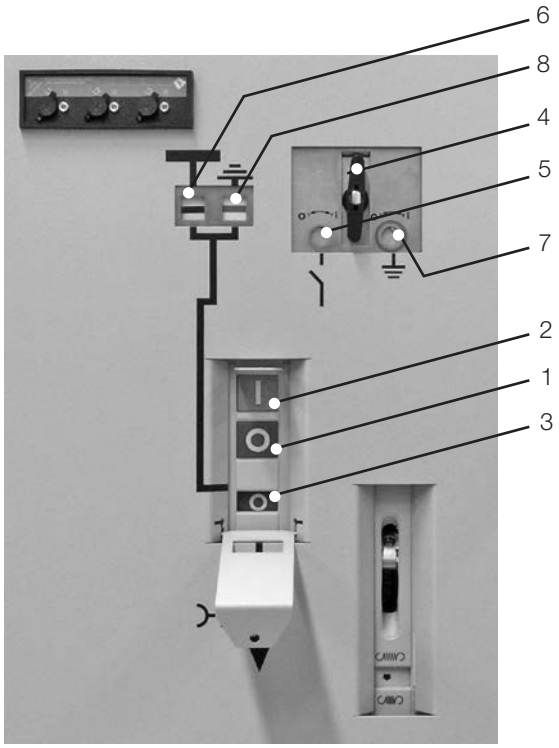
Operation of manual mechanism 2 (figure 4.1.2.2.1) is purely manual, with the exception of the motorized stored energy spring mechanism for the circuit-breaker. The three position disconnector is mechanically interlocked against the closed circuit-breaker. Operation of the earthing switch is only possible when the disconnector is open, and vice versa.

4.1.2.2.1 Operation of the circuit-breaker

– Mechanical switch position indication is effected by a graphical symbol (3) in the low voltage compartment door.

– In order to change the switching condition of the circuit-breaker, press the mechanical OFF button (1) or the mechanical ON button (2).

Fig. 4.1.2.2.1: Manual mechanism 2: Displays and controls



1	OFF button for circuit-breaker
2	ON button for circuit-breaker
3	Switch position indicator for circuit-breaker
4	Selector lever
5	Opening for disconnector operation
6	Switch position indicator for disconnector
7	Opening for earthing switch operation
8	Switch position indicator for earthing switch

4.1.2.2.2 Operation of the three position disconnector

Turning of the selector lever (4) causes a slide to release the opening (5 or 7) for the operating lever of the disconnector or earthing switch. The selector lever can only be turned when the circuit-breaker is open. The selector lever can only be turned for earthing switch operation when the disconnector is open, and for disconnector operation when the earthing switch is open.

– The selector lever can be blocked by a padlock.

– Mechanical switch position indication is effected by graphical symbols (6 and 8) in the low voltage compartment door.

– Two different cranks are required for operation of the earthing switch and the disconnector. The operating crank for the earthing switch is marked in red (figure 4.1.2.2.2.1).

Always perform all switching operations up to the stop.

Operation of the disconnector

– Turn the selector lever (4) counterclockwise and hold it fast.

– Plug the operating lever onto the hexagon through the released opening (5).

Disconnector OFF ⇨ ON

– Turn the operating crank clockwise through approx. 24 turns until the stop is reached.

– Withdraw the operating crank.

Disconnector ON ⇨ OFF

– Turn the operating crank counter-clockwise through approx. 24 turns until the stop is reached.

– Withdraw the operating crank.

Operation of the earthing switch

– Turn the selector lever (4) clockwise and hold it fast.

– Plug the operating crank onto the hexagon through the released opening (7).

Earthing switch OFF ⇨ ON

– Turn the operating crank clockwise through approx. 24 turns until the stop is reached.

– Withdraw the operating crank.

Earthing switch ON ⇨ OFF

– Turn the operating crank counter-clockwise through approx. 24 turns until the stop is reached.

– Withdraw the operating crank.

Fig. 4.1.2.2.2.2: Operation of the three position disconnector (in this case earthing switch operation) with manual mechanism 2

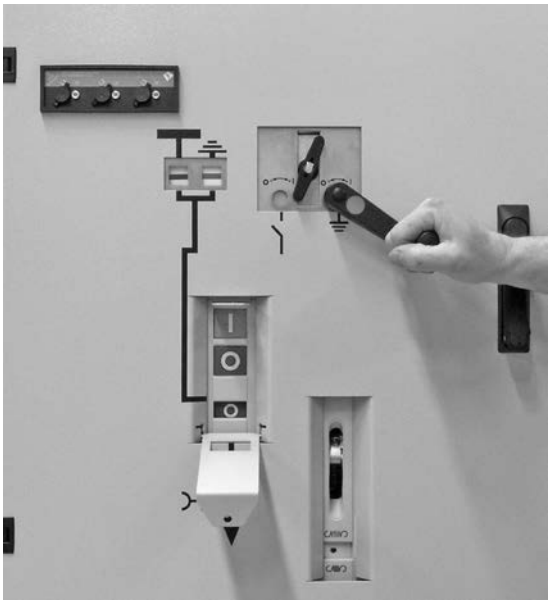
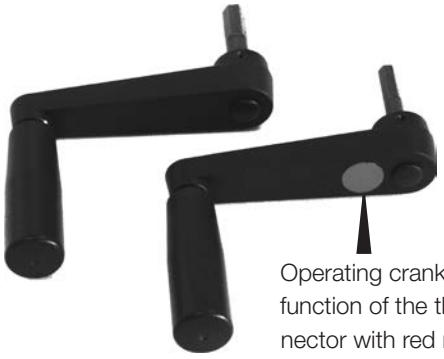


Fig. 4.1.2.2.2.1: Cranks for operation of the three position disconnector with manual mechanism 2



Operating crank for the earthing function of the three position disconnector with red marking

4.1.2.2.3 Emergency manual operation

Circuit-breaker operating mechanism

– On failure of the supply voltage, the circuit-breaker can be opened at any time by pressing the mechanical OFF button. Closing of the circuit-breaker with the mechanical ON button is dependent on the stored-energy spring mechanism being charged. The condition of the stored-energy spring mechanism is displayed mechanically (10 in figure 4.1.2.2.3.1).

– On failure of the supply voltage or the stored-energy spring charging motor for the circuit-breaker operating mechanism, the charging process can be performed or completed manually.

  – To do this, insert the charging lever (11 in figure 4.1.2.3.1) into the receptacle and perform approximately 25 strokes until the charged condition is indicated

Circuit-breaker operating mechanism fitted with optional blocking magnet -RLE1

The blocking magnet -RLE1 blocks the mechanical ON button of the circuit-breaker in certain situations. This interlock is active on failure of the supply voltage. Deblocking of the blocking magnet requires work inside the circuit-breaker operating mechanism, and may only be performed by qualified personnel. Contact the ABB Service Department if necessary.

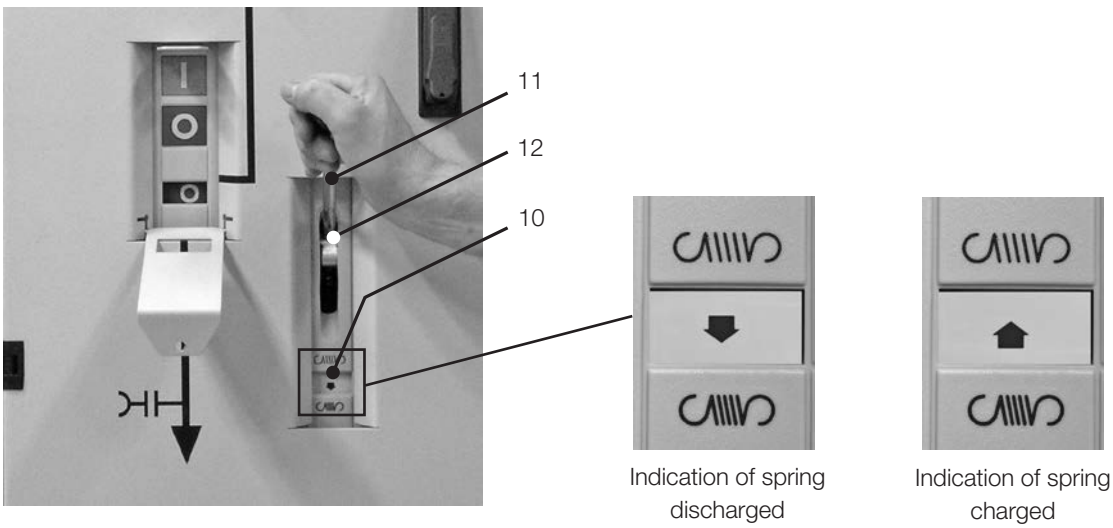
Three position disconnector mechanism

In this operating mechanism variant without a blocking magnet, the three position disconnector mechanism can also be operated without supply voltage as described in 4.1.2.2.2.

Three position disconnector mechanism fitted with optional blocking magnet -RLE3 and/or -RLE4

The blocking magnets -RLE3 and -RLE4 prevent turning of the selector lever for operation of the disconnector or earthing switch function of the switch in certain situations. This interlock is active on failure of the supply voltage. Deblocking of the blocking magnet requires work inside the three position disconnector operating mechanism, and may only be performed by qualified personnel. Contact the ABB Service Department if necessary.

Fig. 4.1.2.2.3.1: Manual charging of the stored-energy spring



10	Condition indicator for the stored energy spring
11	Charging lever
12	Receptacle for charging lever

4.1.2.3 Motor operated mechanism 1

When motor operated mechanism 1 (figure 4.1.2.3.1) is used, switching operations on the panel are performed by means of a control unit. The three position disconnector is electrically interlocked against the closed circuit-breaker. The earthing switch can only be operated when the disconnector is open, and vice versa. Switch position indication is effected by the display on the control unit used.

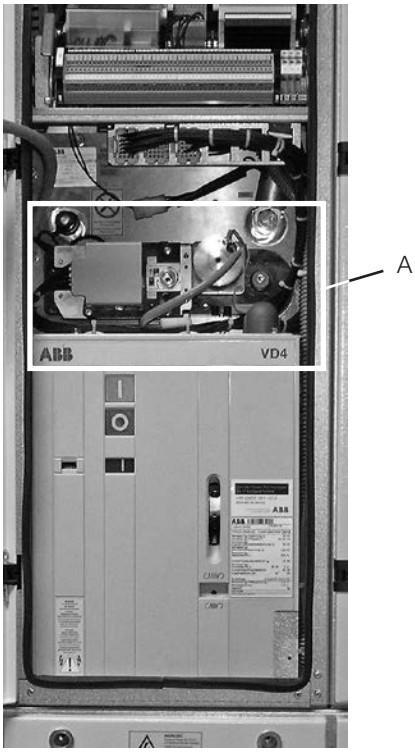
4.1.2.3.1 Emergency manual operation

– Open the low voltage compartment door for manual operation of the mechanisms.

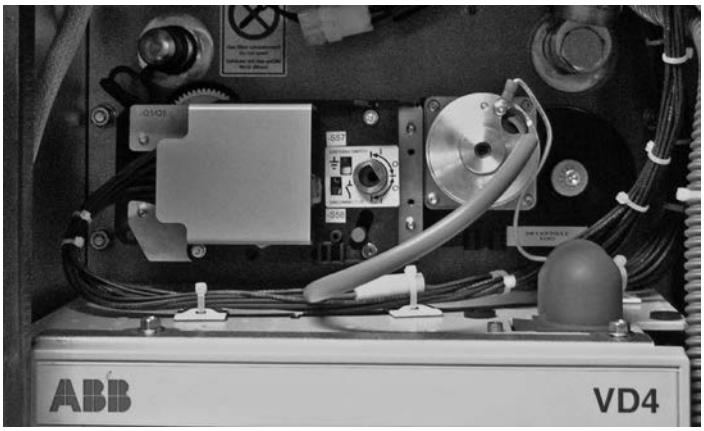
Opening of the low voltage compartment door constitutes intervention in the interlock system.

Protection against maloperation is cancelled.

Switch the mcbs [1] for the motor operated mechanism of the three position disconnector and for the circuit breaker mechanism (releases and charging motor) off.



Detail A



[1] mcb: miniature circuit-breaker

Circuit-breaker operating mechanism

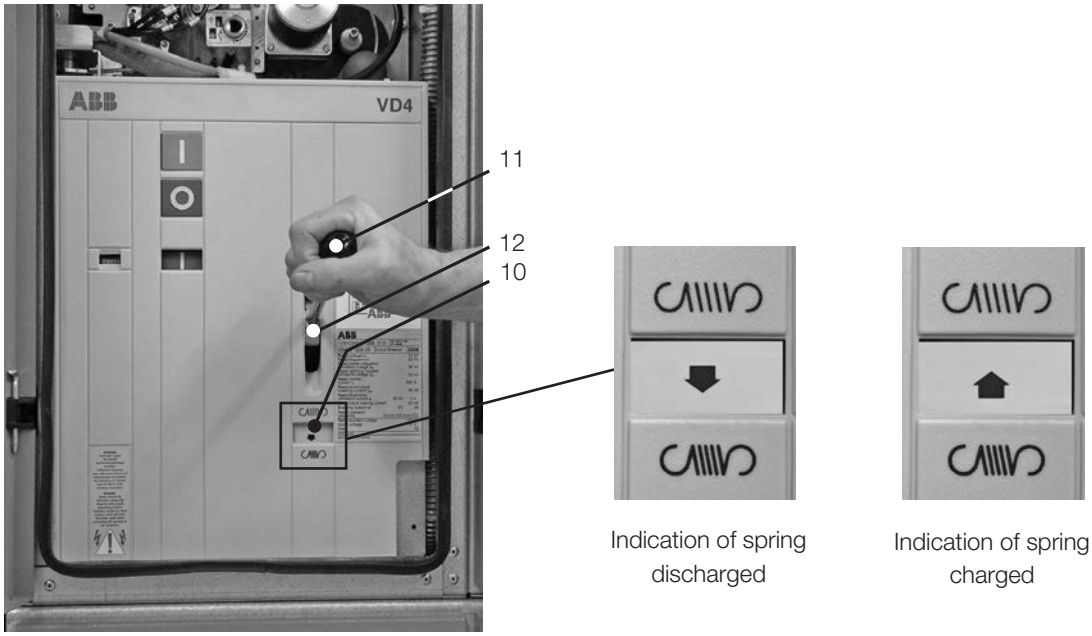
– On failure of the supply voltage, the circuit-breaker can be opened at any time by pressing the mechanical OFF button. Closing of the circuit-breaker with the mechanical ON button is dependent on the stored-energy spring mechanism being charged. The condition of the stored-energy spring mechanism is displayed mechanically (10 in figure 4.1.2.3.1.1).

– On failure of the supply voltage or the stored-energy spring charging motor for the circuit-breaker operating mechanism, the charging process can be performed or completed manually.

  – To do this, insert the charging lever (11 in figure 4.1.2.3.1.1) into the receptacle and perform approximately 25 strokes until the charged condition is indicated

  – When the charged condition is reached, the charging mechanism is disengaged, and no further movements of the charging lever can be made.

Fig. 4.1.2.3.1.1: Manual charging of the stored-energy spring



10	Condition indicator for the stored energy spring
11	Charging lever
12	Receptacle for charging lever

Three position disconnector mechanism

On emergency manual operation, the interlocks are ineffective.

The circuit-breaker must always be in the OFF position before the three position disconnector is operated.

Always perform all switching operations up to the stop.

The switch position of the three position disconnector is indicated mechanically (12 in figure 4.1.2.3.1.3).

– Plug the crank into the shaft of the three position disconnector mechanism (13 in figure 4.1.2.3.1.3).

Operation of the three position disconnector

When using the crank, ensure that pressure is continuously applied via the mushroom handle at the end of the crank throughout the complete switching operation.

In panel width 400 mm, approx. 17 turns of the crank are required from the OFF position of the three position disconnector to the ON position of the earthing switch or disconnector and vice versa, and in panel width 600 mm approx. 24 turns of the crank are required.

Earthing switch OFF ⇨ ON

– Turn the operating crank counter-clockwise until the stop is reached to switch the earthing switch on.

– Withdraw the operating crank.

Disconnector OFF ⇨ ON

– Turn the operating crank clockwise until the stop is reached to switch the disconnector on.

– Withdraw the operating crank.

Earthing switch ON ⇨ OFF ⇨ Disconnector ON

– Turn the operating crank clockwise until the stop is reached.

– The three position switch is then in the OFF position.

– Withdraw the operating crank and refit it. Turn the operating crank clockwise until the stop is reached.

– Withdraw the operating crank.

Disconnector ON ⇨ OFF ⇨ Earthing switch ON

– Turn the operating crank counter-clockwise until the stop is reached.

– The three position switch is then in the OFF position.

– Withdraw the operating crank and refit it. Turn the operating crank counter-clockwise until the stop is reached.

– Withdraw the operating crank.

Fig. 4.1.2.3.1.2: Crank for emergency manual operation of motor operated mechanism 1

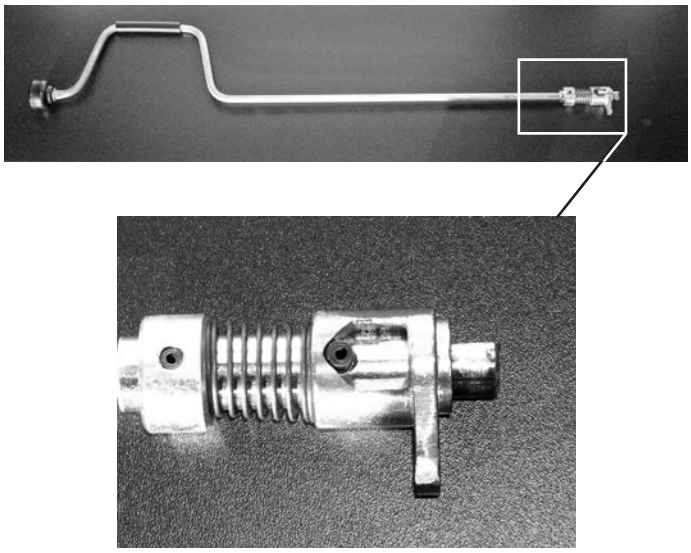
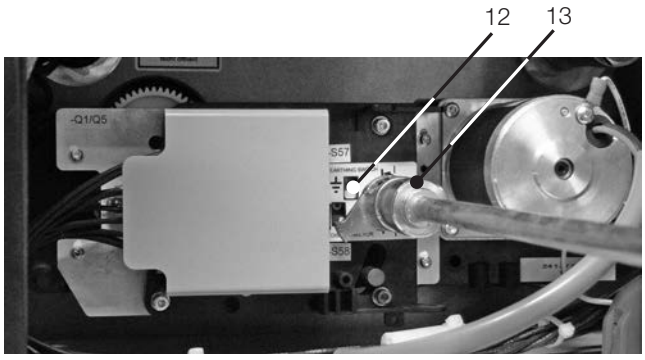


Fig. 4.1.2.3.1.3: Three position disconnector mechanism, motor operated mechanism 1, with crank for emergency manual operation fitted



12 Switch position indicator
13 Operating crank

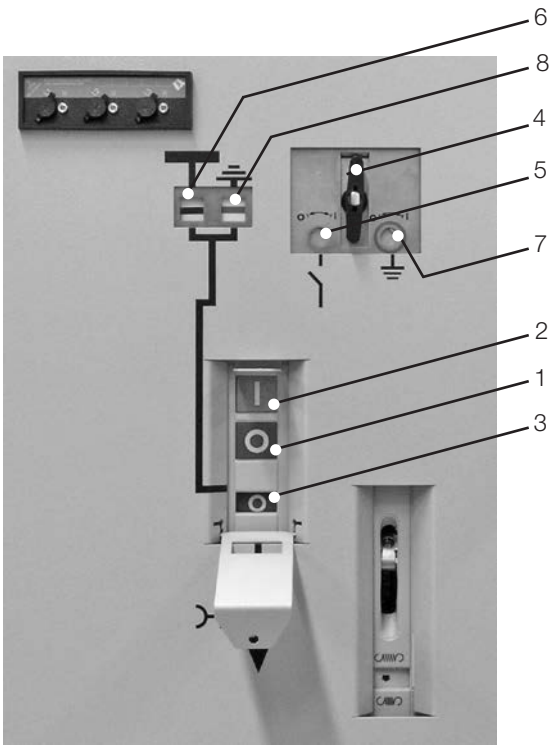
4.1.2.4 Motor operated mechanism 2

Motor operated mechanism 2 (figure 4.1.2.4.1) is in principle identical to manual mechanism 2. It does however have a motor for operation of the three position disconnector.

The circuit-breaker and three position disconnector are as a rule operated by remote control (from the control room). If electrical controls (e.g. the HMI of a control unit) are fitted on the panel, they can be operated electrically there. Manual operation of the three position disconnector is possible as an alternative.

The three position disconnector is mechanically interlocked against the closed circuit-breaker. The earthing switch can only be operated when the disconnector is open, and vice versa.

Fig. 4.1.2.4.1: Motor operated mechanism 2: Displays and controls



1	OFF button for circuit-breaker
2	ON button for circuit-breaker
3	Switch position indicator for circuit-breaker
4	Selector lever
5	Opening for disconnector operation
6	Switch position indicator for disconnector
7	Opening for earthing switch operation
8	Switch position indicator for earthing switch

4.1.2.4.1 Operation of the circuit-breaker

– Mechanical switch position indication is effected by a graphical symbol (3) in the low voltage compartment door.

– In order to change the switching condition of the circuit-breaker, press the mechanical OFF button (1) or the mechanical ON button (2).

4.1.2.4.2 Motorized operation of the three position disconnector

Motorized operation of the three position disconnector is possible at the panel when electrical controls (e.g. buttons in the door or control unit with integrated buttons) are fitted. Operate the appropriate controls to close and open the three position disconnector.

4.1.2.4.3 Manual operation of the three position disconnector

Turning of the selector lever (4) causes a slide to release the opening (5 or 7) for the operating lever of the disconnector or earthing switch. The selector lever can only be turned when the circuit-breaker is open. The selector lever can only be turned for earthing switch operation when the disconnector is open, and for disconnector operation when the earthing switch is open.

– The selector lever can be blocked by a padlock.

– Mechanical switch position indication is effected by graphical symbols (6 and 8) in the low voltage compartment door.

– Two different cranks are required for operation of the earthing switch and the disconnector. The operating crank for the earthing switch is marked in red (figure 4.1.2.4.3.1).

Always perform all switching operations up to the stop

Operation of the disconnector

– Turn the selector lever (4) counterclockwise and hold it fast.

– Plug the operating lever onto the hexagon through the released opening (5).

Disconnector OFF ⇨ ON

– Turn the operating crank clockwise through approx. 24 turns until the stop is reached.

– Withdraw the operating crank.

Disconnector ON ⇨ OFF

– Turn the operating crank counter-clockwise through approx. 24 turns until the stop is reached.

– Withdraw the operating crank.

Operation of the earthing switch

– Turn the selector lever (4) clockwise and hold it fast.

– Plug the operating crank onto the hexagon through the released opening (7).

Earthing switch OFF ⇨ ON

– Turn the operating crank clockwise through approx. 24 turns until the stop is reached.

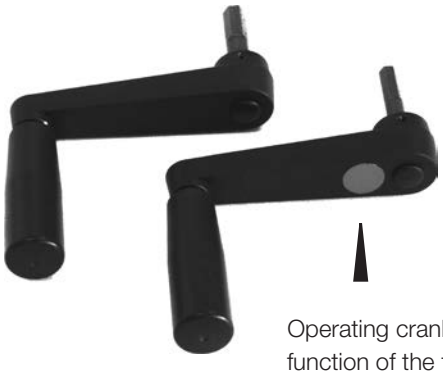
– Withdraw the operating crank.

Earthing switch ON ⇨ OFF

– Turn the operating crank counter-clockwise through approx. 24 turns until the stop is reached.

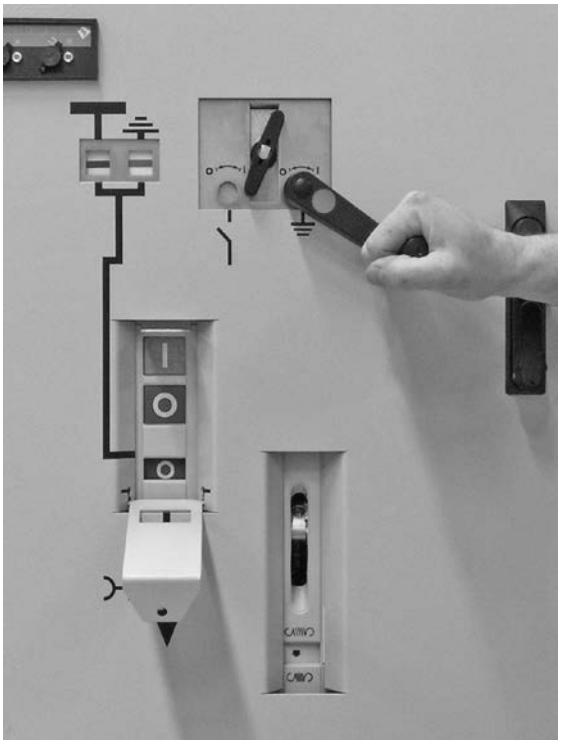
– Withdraw the operating crank.

Fig. 4.1.2.4.3.1: Cranks for operation of the three position disconnector with manual mechanism 2



Operating crank for the earthing function of the three position disconnector with red marking

Fig. 4.1.2.4.3.2: Operation of the three position disconnector (in this case disconnector operation) with motor operated mechanism 2



4.1.2.4.4 Emergency manual operation

Circuit-breaker operating mechanism

– On failure of the supply voltage, the circuit-breaker can be opened at any time by pressing the mechanical OFF button. Closing of the circuit-breaker with the mechanical ON button is dependent on the stored-energy spring mechanism being charged. The condition of the stored-energy spring mechanism is displayed mechanically (10 in figure 4.1.2.4.4.1).

– On failure of the supply voltage or the stored-energy spring charging motor for the circuit-breaker operating mechanism, the charging process can be performed or completed manually.

  – To do this, insert the charging lever (11 in figure 4.1.2.4.4.1) into the receptacle and perform approximately 25 strokes until the charged condition is indicated

  – When the charged condition is reached, the charging mechanism is disengaged, and no further movements of the charging lever can be made.

Circuit-breaker operating mechanism fitted with optional blocking magnet -RLE1

The blocking magnet -RLE1 blocks the mechanical ON button of the circuit-breaker in certain situations. This interlock is active on failure of the supply voltage. Deblocking of the blocking magnet requires work inside the circuit-breaker operating mechanism, and may only be performed by qualified personnel. Contact the ABB Service Department if necessary.

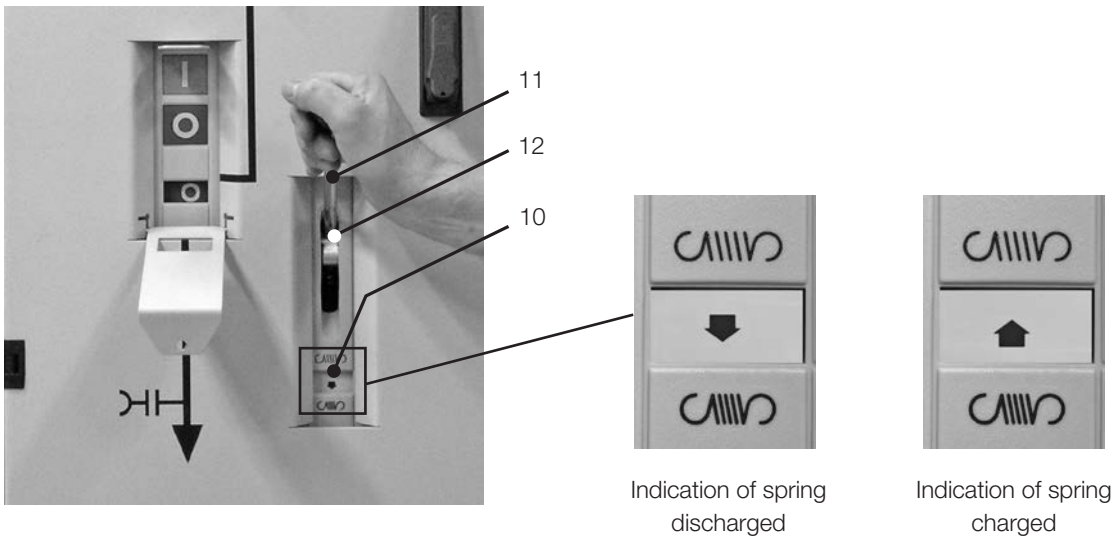
Three position disconnector mechanism

In this operating mechanism variant without a blocking magnet, the three position disconnector mechanism can also be operated without supply voltage as described in 4.1.2.4.3.

Three position disconnector mechanism fitted with optional blocking magnet -RLE3 and/or -RLE4

The blocking magnets -RLE3 and -RLE4 prevent turning of the selector lever for operation of the disconnector or earthing switch function of the switch in certain situations. This interlock is active on failure of the supply voltage. Deblocking of the blocking magnet requires work inside the three position disconnector operating mechanism, and may only be performed by qualified personnel. Contact the ABB Service Department if necessary.

Fig. 4.1.2.4.4.1: Manual charging of the stored-energy spring



10	Condition indicator for the stored energy spring
11	Charging lever
12	Receptacle for charging lever

4.2 Panels with three position switch-disconnectors

– The three switching positions of the three position switch-disconnector, “connecting”, “disconnecting” and “earthing” are clearly defined by the mechanical structure of the switch.

– The mechanism is operated with the low voltage compartment door closed (figure 4.2.1).

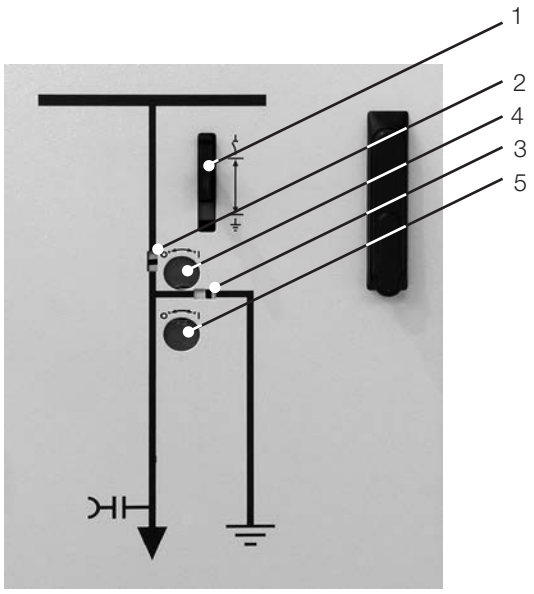
– The current switch position is indicated mechanically by graphical symbols (switch-disconnector position 2, earthing switch position 3) in the low voltage compartment door.

– The switch-disconnector function of the three position switch-disconnector can be manually or motor-operated. The earthing switch function of the three position switch-disconnector is always manually operated.

– The operating mechanism can be secured with a padlock on the selector slide (1).

– The selector slide can also be electrically interlocked as an option.

Fig. 4.2.1: Three position switch-disconnector operating mechanism: displays and controls



1 Selector slide
2 Switch position indicator for disconnector
3 Switch position indicator for earthing switch
4 Opening for disconnector operation
5 Opening for earthing switch operation

Consult the order documents for the conditions of any interlock.

– The lever required for operation (figure 4.2.2) can be fitted with a coding pin (figure 4.2.3). When the coded operating lever is used, the relevant actuating shaft must have a corresponding bore.

4.2.1 Notes on earthing of a feeder panel or system section

When the feeder panel or section of the system has been earthed, secure it to prevent cancellation of earthing as follows:

Secure the selector slide with a padlock.

Affix a sign to the panel to indicate that earthing has been performed.

Fig. 4.2.2: Lever for operation of the three position switch-disconnector

Fig. 4.2.3: Coded operating lever (right)

4.2.2 Manual mechanism

(see fig. 4.2.2.1)

Operation of the earthing switch

The earthing switch is always operated manually.

– Pull the selector slide (1) outwards, press it down towards the earthing switch symbol and hold it fast.

– Plug the operating lever onto the hexagon through the released opening (5) in the door.

Earthing switch OFF ⇨ ON

– Turn the operating lever approx. 90° clockwise.

– Withdraw the operating lever.

Earthing switch ON ⇨ OFF

– Turn the operating lever approx. 90° counter-clockwise.

– Withdraw the operating lever.

Operation of the switch-disconnector

– Pull the selector slide (1) outwards, press it up towards the switch-disconnector symbol and hold it fast.

– Plug the operating lever onto the hexagon through the released opening (4) in the door.

Switch-disconnector OFF ⇨ ON

– Turn the operating lever approx. 90° clockwise.

– Withdraw the operating lever.

Switch-disconnector ON ⇨ OFF

– Turn the operating lever approx. 90° counter-clockwise.

– Withdraw the operating lever.

4.2.3 Motor operated mechanism

Operation of the switch-disconnector

Closing and opening are performed at the panel by pressing the optional ON and OFF buttons in the low voltage compartment door, or manually.

4.2.4 Emergency manual operation of the motor operated mechanism

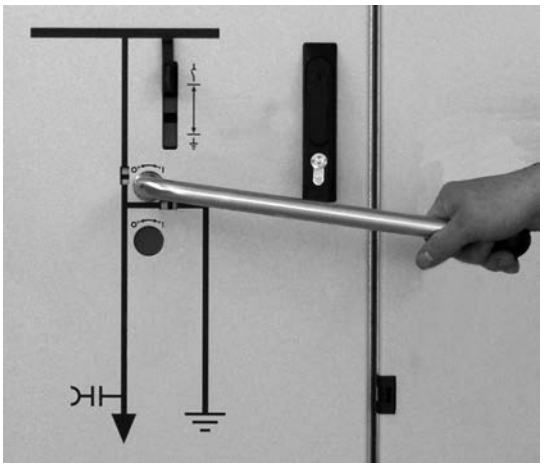
On failure of the supply voltage or on failure of the mechanism motor, the motor operated mechanism without blocking magnets can be operated in the same way as a manual mechanism (see section 4.2.1).

Switch the mcb [1] for the mechanism motor off before performing emergency manual operation.

Three position switch-disconnector mechanism fitted with optional blocking magnets –RLE3 and –RLE4

The blocking magnets –RLE3 and –RLE4 prevent movement of the selector slide in certain situations. This interlock is active on failure of the supply voltage. Deblocking of the blocking magnets requires work inside the three position switch-disconnector operating mechanism, and may only be performed by qualified personnel. Contact the ABB Service Department if necessary.

Fig. 4.2.2.1: Operation of the three position switch-disconnector (in this case disconnector operation)



[1] mcb: miniature circuit-breaker

4.3 Panels with three position switch-disconnectors with HRC fuses

– The three switching positions of the three position switch-disconnector, “connecting”, “disconnecting” and “earthing” are clearly defined by the mechanical structure of the switch.

– The mechanism is operated with the low voltage compartment door closed (figure 4.3.1).

– The current switch position is indicated mechanically by graphical symbols (switch-disconnector position 2, earthing switch position 3) in the low voltage compartment door.
– The switch-disconnector function of the three position switch-disconnector can be manually or motor-operated. The earthing switch function of the three position switch-disconnector is always manually operated. Operation of the cable earthing switch is triggered automatically by operation of the earthing switch in the three position switch-disconnector.

– Blowing of a fuse results in automatic tripping of the switch-disconnector.

– The operating mechanism can be secured with a padlock on the selector slide (1).

– The selector slide can also be electrically interlocked as an option.

Consult the order documents for the conditions of any interlock.

– The lever required for operation (figure 4.3.2) can be fitted with a coding pin (figure 4.3.3). When the coded operating lever is used, the relevant actuating shaft must have a corresponding bore.

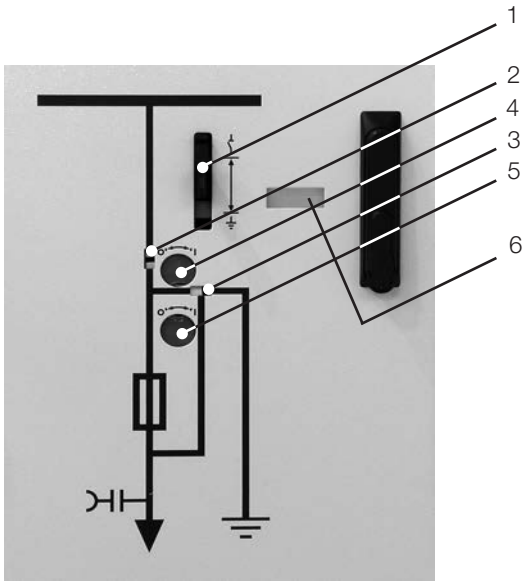
4.3.1 Notes on earthing of a feeder panel or system section

When the feeder panel or section of the system has been earthed, secure it to prevent cancellation of earthing as follows:

Secure the selector slide with a padlock.

Affix a sign to the panel to indicate that earthing has been performed.

Fig. 4.3.1: Three position switch-disconnector operating mechanism (with HRC fuse): displays and controls



1 Selector slide
2 Switch position indicator for disconnector
3 Switch position indicator for earthing switch
4 Opening for disconnector operation
5 Opening for earthing switch operation
6 “fuse blown” indicator

Fig. 4.3.2: Lever for operation of the three position switch-disconnector

Fig. 4.3.3: Coded operating lever (right)

4.3.2 Manual mechanism

(see fig. 4.3.2.1)

Operation of the earthing switch

The earthing switch is always operated manually.

– Pull the selector slide (1) outwards, press it down towards the earthing switch symbol and hold it fast.

– Plug the operating lever onto the hexagon through the released opening (5) in the door.

Earthing switch OFF ⇨ ON

– Turn the operating lever approx. 90° clockwise.

– Withdraw the operating lever.

Earthing switch ON ⇨ OFF

– Turn the operating lever approx. 90° counter-clockwise.

– Withdraw the operating lever.

Operation of the disconnector

– Pull the selector slide (1) outwards, press it up towards the switch-disconnector symbol and hold it fast.

– Plug the operating lever onto the hexagon through the released opening (4) in the door.

Switch-disconnector OFF ⇨ ON

– Turn the operating lever approx. 90° clockwise.

– Withdraw the operating lever.

Switch-disconnector ON ⇨ OFF

– Turn the operating lever approx. 90° counter-clockwise.

– Withdraw the operating lever.

4.3.3 Motor operated mechanism

Operation of the switch-disconnector

Closing and opening are performed by pressing the optional ON and OFF buttons in the low voltage compartment door, or manually.

4.3.4 Emergency manual operation of the motor operated mechanism

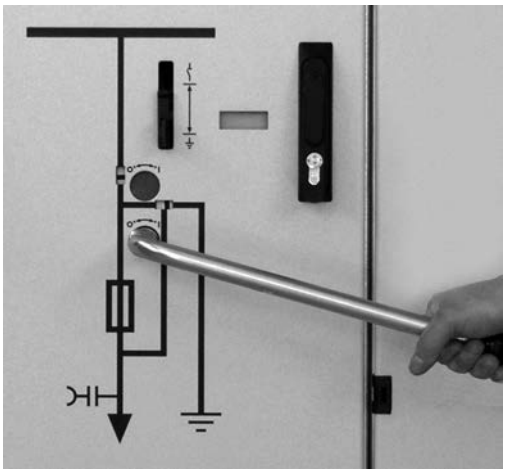
On failure of the supply voltage or on failure of the mechanism motor, the motor operated mechanism without blocking magnets can be operated in the same way as a manual mechanism (see section 4.3.2).

Switch the mcb [1] for the mechanism motor off before performing emergency manual operation.

Three position switch-disconnector mechanism fitted with optional blocking magnets -RLE3 and –RLE4

The blocking magnets -RLE3 and -RLE4 prevent movement of the selector slide in certain situations. This interlock is active on failure of the supply voltage. Deblocking of the blocking magnets requires work inside the three position switch-disconnector operating mechanism, and may only be performed by qualified personnel. Contact the ABB Service Department if necessary.

Fig. 4.3.2.1: Operation of the three position switch-disconnector (in this case earthing switch operation



[1] mcb: miniature circuit-breaker

4.3.5 Replacement of HRC fuses

Blowing of a fuse is indicated mechanically (figure 4.3.5.1).

Blowing of a fuse results in automatic tripping of the switch-disconnector. The switch position indicator (2) shows the OFF position of the switch-disconnector.

Conditions for replacement of a fuse:

After a fuse has blown, the actuating shaft of the switch-disconnector has to be returned to the OFF position manually.

– Pull the selector slide (1) outwards, press it up towards the switch-disconnector symbol and hold it fast.

– Plug the operating lever onto the hexagon through the released opening (4) in the door.

– Turn the operating lever approx. 90° counter-clockwise until the shaft engages.

Earth the outgoing feeder of the panel concerned as follows (figure 4.3.5.1):

– Comply with the safety regulations to EN 50110.

– Pull the selector slide (1) outwards, press it down towards the earthing switch symbol and hold it fast.

– Plug the operating lever onto the hexagon through the released opening (5) in the door.

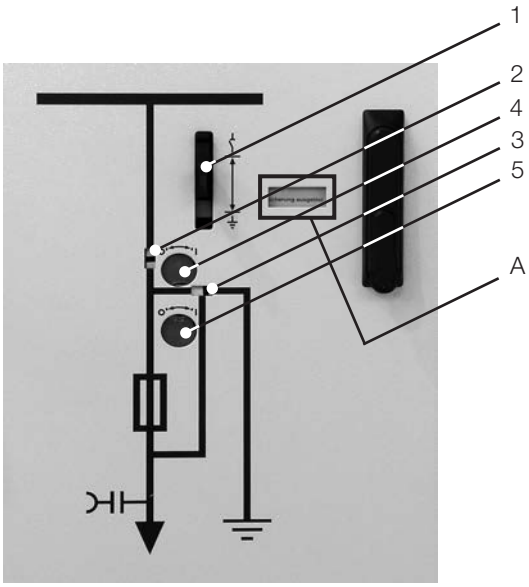
– Turn the operating lever approx. 90° clockwise – the outgoing feeder is then earthed.

– Secure the working area as described in section 4 and EN 50110 standard.

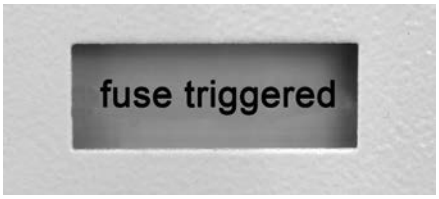
Always replace all three fuses in a panel, even if only one or two fuses have blown.

Use fuses from ABB or from the manufacturer Siba in accordance with tables 4.3.5.1 to 4.3.5.3. The fuse boxes are designed for a maximum fuse length of 442 mm and a maximum fuse diameter of 67 mm. Use adapters for smaller dimensions (see list of accessories).

Fig. 4.3.5.1: Fuse blown indication



Detail A



1	Selector slide
2	Switch position indicator for disconnector
3	Switch position indicator for earthing switch
4	Opening for disconnector operation
5	Opening for earthing switch operation

Replacing fuses

– Open the low voltage compartment door.

– Release the twist lock fastener (figure 4.3.5.3). The fuse flap then automatically swings out (figure 4.3.5.4).

– Draw the lid with the fuse to be replaced out of the box (figure 4.3.5.5). Turning and gently shaking the lid makes it easier to withdraw it.

– Remove the lid with the fitted fuse.

– Loosen the clamping band and remove the fuse from the lid.

– Clean the sealing collar (figure 4.3.5.6) on the lid with M.X.T. 60 forte intensive cleaner.

– Insert the new HRC fuse into the lid with the striker pin pointing towards the lid.

– Tighten the clamping band (figure 4.3.5.6). Ensure when doing so that the contact fingers of the ring contact are not deformed.
– Slide the fuse into the fuse box up to the stop.

– Replace the other fuses in the same manner.

– Swing the fuse flap upwards and fasten it with the twist lock fastener.

Fig. 4.3.5.2: Length adapter (1) and adapter for fuse diameter 53 mm (2)

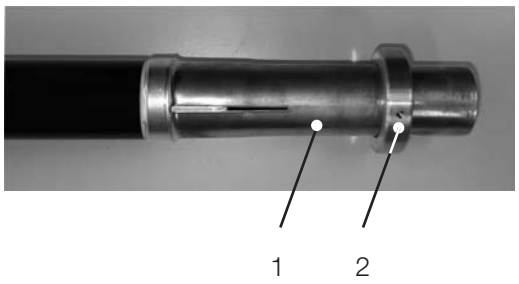


Fig. 4.3.5.3: Opening the fuse flap

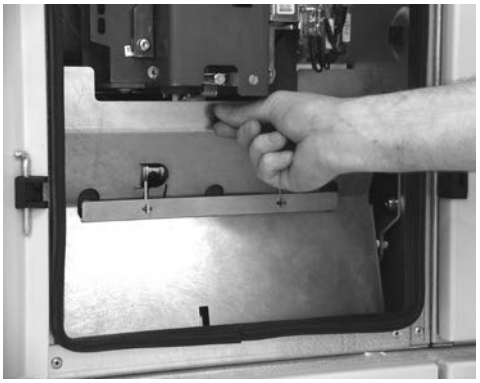


Fig. 4.3.5.4: Opening the fuse flap - 2

Fig. 4.3.5.5: Removing the lid with the fuse

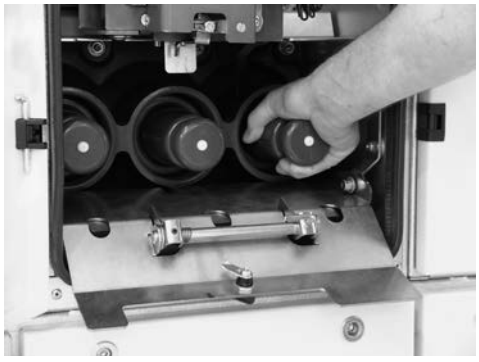


Fig. 4.3.5.6: Lid with fuse fitted

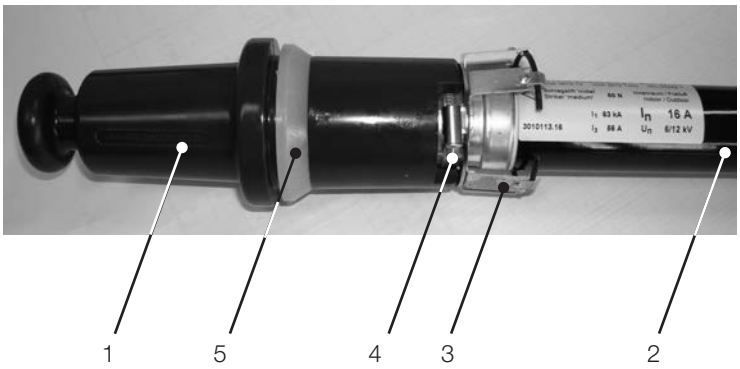


Fig. 4.3.5.7: Tightening the clamping band

1 Lid
2 Fuse
3 Ring contact
4 Clamping band screw
5 Sealing collar

Table 4.3.5.1: Selection table for HV HRC fuses, ABB type CEF

Operating voltage [kV]	Transformer Rating [kVA]	Relative impedance voltage u_K [%]	Rated transformer current [A]	Type	Rated current of the HV-fuse [A]
10 ... 12	100	4	5.8	CEF-TCU	16
	125	4	7.2		16
	160	4	9.2		20
	200	4	11.5		25
	250	4	14.4		31.5
	315	4	18.2		40
	400	4	23.1		40
	500	4	29.9		50
	630	4	36.4		63
	630	6	36.4		50
	800	6	46.2		63
20 ... 24	100	4	2.9		10
	125	4	3.6		10
	160	4	4.6		16
	200	4	5.8		16
	250	4	7.2		20
	315	4	9.1		20
	400	4	11.5		25
	500	4	14.4		31.5
	630	4	18.2		40
	630	6	18.2		31.5
	800	6	23.1		40

Table 4.3.5.2: Selection table for HV HRC fuses, Siba (U_r up to 12 kV)

Operating Voltage	Transformer Rating	Relative impedance voltage u_K	Rated transformer current	Rated current of the HV-fuse			
					min.		max.
[kV]	[kVA]	[%]	[A]	Type	[A]	Type	[A]
6 ... 7.2	50	4	4.8	HHD-B	16	HHD-B	16
	75	4	7.2		16		20
	100	4	9.6		20		25
	125	4	12		20		31.5
	160	4	15.4		31.5		40
	200	4	19.2		40		50
	250	4	24.1		40		63
	315	4	30.3		50		63
	400	4	38.5		63		63
	400	6	38.5		63	HHD-BSSK	80
10 ... 12	50	4	2.9		10	HHD-B	10
	75	4	4.3		10		10
	100	4	5.8		16		16
	125	4	7.2		16		20
	160	4	9.2		20		25
	200	4	11.5		20		31.5
	250	4	14.4		25		40
	315	4	18.2		31.5		50
	400	4	23.1		40		50
	400	6	23.1		40		40
	500	4	28.9		50		63
	500	6	28.9		50	HHD-BSSK	63
	630	4	36.4		63		80
	630	6	36.4		63		80
	800	6	46.2	HHD-BSSK	80		80

Table 4.3.5.3: Selection table for HV HRC fuses, Siba (U_r from 13.8 to 24 kV)

Operating Voltage	Transformer Rating	Relative impedance voltage u_K	Rated transformer current	Rated current of the HV-fuse			
				Type	min.	Type	max.
[kV]	[kVA]	[%]	[A]		[A]		[A]
13.8	75	4	3.1	HHD-B	10	HHD-B	10
	100	4	4.2		10		10
	125	4	5.2		16		16
	160	4	6.7		16		20
	200	4	8.4		20		20
	250	4	10.5		20		25
	315	4	13.2		25		31.5
	400	4	16.7		31.5		40
	400	6	16.7		31.5		31.5
	500	4	20.9		40		50
	500	6	20.9		40		40
	630	4	26.4		50		63
	630	6	26.4		50		50
	800	6	33.5	HHD-BSSK	63	HHD-BSSK	63
	1000	6	41.8		80		80
15 ... 17.5	75	4	2.9	HHD-B	10	HHD-B	10
	100	4	3.8		10		10
	125	4	4.8		16		16
	160	4	6.2		16		16
	200	4	7.7		20		20
	250	4	9.6		20		25
	315	4	12.1		20		31.5
	400	4	15.4		31.5		40
	400	6	15.4		31.5		31.5
	500	4	19.2		40		50
	500	6	19.2		40		40
	630	4	24.2		40		63
	630	6	24.2		40		40
	800	6	30.8		50	HHD-BSSK	63
	1000	6	38.5		63		80
24	100	4	2.9		10	HHD-B	10
	125	4	3.6		10		10
	160	4	4.6		10		16
	200	4	5.8		16		16
	250	4	7.2		16		20
	315	4	9.1		20		25
	400	4	11.5		20		31.5
	400	6	11.5		20		20
	500	4	14.4		25		40
	500	6	14.4		25		25
	630	4	18.2		31.5		50
	630	6	18.2		31.5		31.5
	800	6	23.1		40		40
	1000	6	28.9		50	HHD-BSSK	63

4.4 Observation of the display and monitoring facilities

The high voltage compartments must have a sufficient insulating gas pressure during operation (please see the table entitled “Technical data” for the pressures, chapter 10). The density of the SF_6 insulating gas is monitored during operation by a density sensor (temperature-compensated) or by a pressure gauge.

4.4.1 Gas monitoring with density sensors

The gas monitoring system with density sensor is used in systems with auxiliary power supply. If the gas pressure falls below the level for a warning signal, a signal is issued to indicate that the insulating gas should be topped up. In circuit-breaker systems the signal is indicated by a warning lamp or on a panel control unit. In switch-disconnector systems, the signal is indicated by a warning lamp.

When a switchgear is isolated for a relatively long period, the auxiliary power supply is to be maintained in order to monitor the insulating gas density.

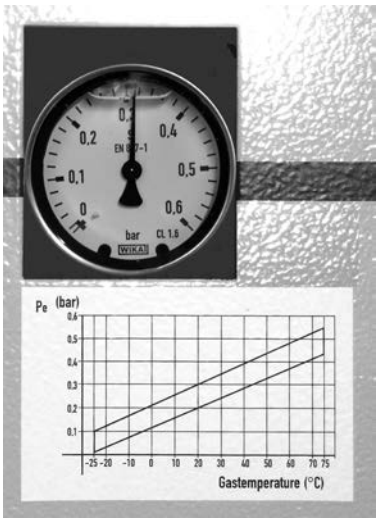
4.4.2 Gas monitoring with pressure gauge

The gas monitoring system with pressure gauge is used in systems without auxiliary power supply. The pressure gauge is located in the low voltage compartment of the relevant panel and can be read even when the low voltage compartment door is closed.

Check the insulating gas pressure at regular intervals. The insulating gas pressure must be within the limits shown on the operating pressure diagram (dependent on the temperature in the low voltage compartment).

The pressure gauge is not temperature-compensated. Remember that the temperatures in the low voltage compartment and the gas compartment are assumed to be equal. Temperature deviations can lead to faulty readings.

Fig. 4.4.2.1: Pressure gauge with operating pressure diagram



4.5 Operation of the isolating device for voltage transformers

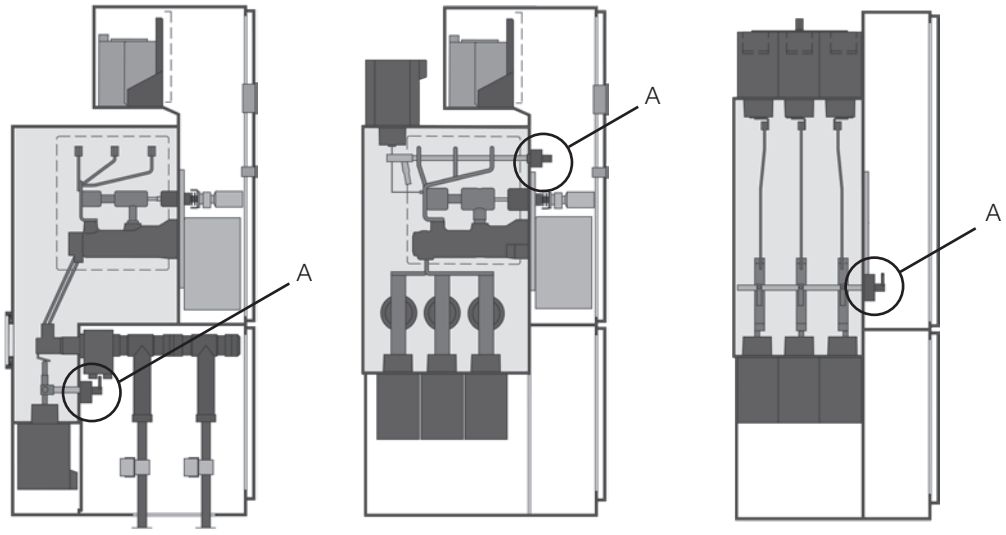
Isolate the relevant switchgear section before connecting or disconnecting voltage transformers.

- Comply with the safety regulations to EN 50110.
- Check the switchgear section for the off-circuit condition as described in section 5.1.
- Earth the switchgear section and secure the working area in accordance with section 4 and EN 50110 standard.
- Switch the mcbs [1] of the relevant operating mechanisms off in order to prevent the switchgear section being energized by remote control.

The device for operation of the voltage transformer isolating device may be located in the cable termination compartment or the low voltage compartment, depending on the position and function of the voltage transformers (figure 4.5.1).

If the isolating device is located in the cable termination compartment, dismantle the cover on the cable termination compartment. This is done by removing the two screws above the cover and drawing the cover upwards.

Fig. 4.5.1: A) Location of the controls for the voltage transformer isolating device (example configurations)



[1] mcb: miniature circuit-breaker

The controls and displays of the voltage transformer isolating device can be seen in figure 4.5.2. Observe the warning signs (6). Check the switch position indicator (5). The isolating device can be secured with a padlock (3). Remove the padlock prior to operation.

Isolating the voltage transformers

To isolate the voltage transformers, pull out the lock knob (2) and turn the operating lever (1) counter-clockwise as shown on the direction of rotation indicator (4). Release the lock knob. Turn the operating lever counter-clockwise until the lock knob engages in the limit position of the isolating device.

When the lock knob engages in the limit position, the dielectric strength of the isolating device is ensured.

Secure the isolating device with a padlock in the “OFF” position (8).

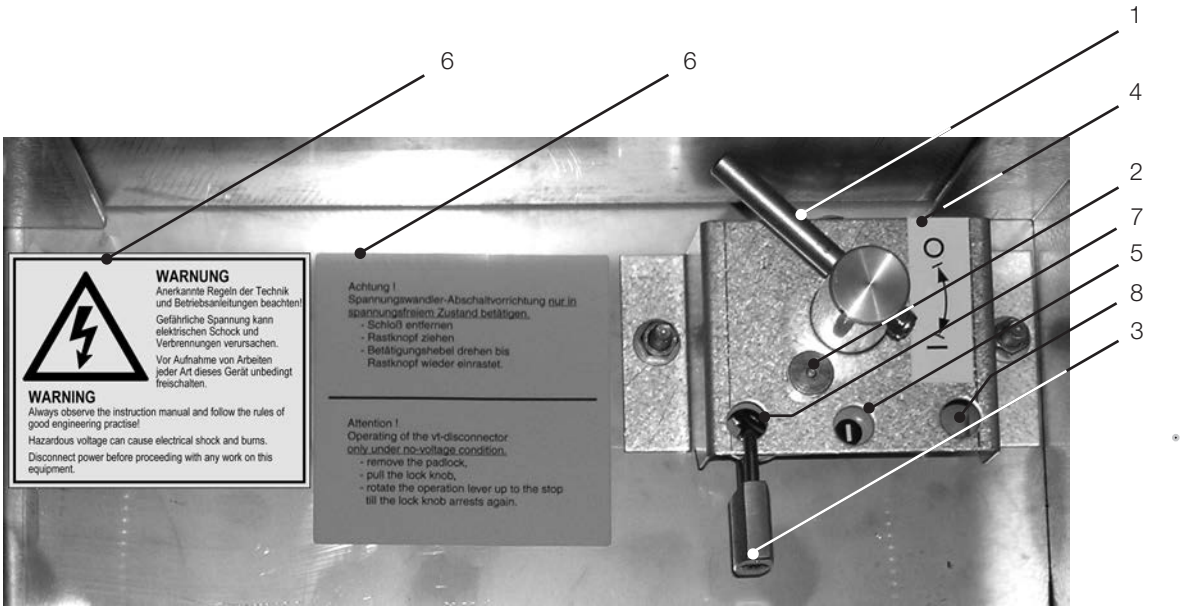
Connecting the voltage transformers

To connect the voltage transformers, pull out the lock knob (2) and turn the operating lever (1) clockwise as shown on the direction of rotation indicator (4). Release the lock knob. Turn the operating lever clockwise until the lock knob engages in the limit position of the isolating device.

When the lock knob engages in the limit position, the current carrying capacity of the isolating device is ensured.

Secure the isolating device with a padlock in the “ON” position (7).

Fig. 4.5.2: Controls and displays of the voltage transformer device



Achtung!
Spannungswandler-Abtrennvorrichtung nur in spannungsfreiem Zustand betätigen.
- Schloss entfernen
- Rastknopf ziehen
- Betätigungshebel drehen bis Rastknopf wieder einrastet

Attention!
Operating of the vt-isolating system only under no-voltage condition.
- remove the padlock
- pull the lock knob
- rotate the operation lever up to the stop till the lock knob arrests again.

1	Operating lever
2	Lock knob
3	Padlock (optional)
4	Direction of rotation indicator
5	Switch position indicator
6	Warning signs
7	Lock position for “ON” position
8	Lock position for “OFF” position

5 Test procedures

5.1 Testing for the off-circuit condition

The off-circuit condition on the cable side is tested by means of the capacitive voltage indicator (pick-off on the outer cone). Three systems can be used:

- LRM-system,
- KVDS-system, or
- CAVIN-system.

Observe the instruction manual for the system used.

- Check the function of the equipment immediately before use. The optical display must be clearly visible!
- The sockets of the capacitive indicator system must never be short-circuited, except during voltage testing on the switchgear.

5.1.1 LRM-system

Testing for the off-circuit condition is performed with a plug-in display unit (design to IEC 61243-5) at the three pairs of measuring sockets.

Perform repeat tests on the system in accordance with IEC 61243-5, for instance with interface tester KSP. Observe the instructions for the interface tester.

5.1.2 KVDS- and CAVIN-systems

Testing for the off-circuit condition is performed with the display on the unit. No separate display unit is required.

Fig. 5.1.1.1: LRM system with display unit

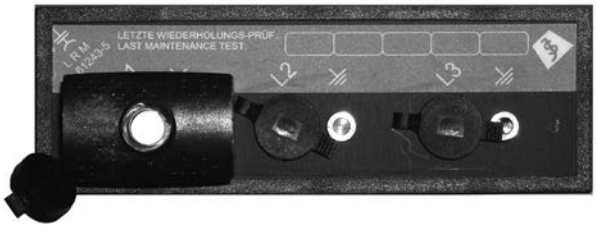


Fig. 5.1.2.1: KVDS-system

Fig. 5.1.2.2: CAVIN-system

5.2 Testing for the in-phase condition

Testing for the in-phase condition, e.g. when there is more than one incoming feeder, can be performed with a suitable phase comparator at the measuring sockets of the capacitive voltage indication system.

The phase comparator must comply with IEC 61243-5 and correspond to the technical design of the indicator system used.

Observe the instruction manual for the phase comparator.

5.3 High voltage tests

Direct access to the conductors via the fitted cable connectors is available for the performance of high voltage tests. The test voltage is applied through suitable test sets for the outer cone connector system used.

5.3.1 Cable tests with dc

Do not exceed the maximum test voltages and the maximum test duration as specified in IEC 60502-2.

Comply with the safety regulations to EN 50110.

- Isolate the switchgear section to be tested in accordance with section 4.
- Test the switchgear section for the off-circuit condition as described in section 5.1.
- Earth the switchgear section and secure the working area in accordance with section 4 and EN 50110 standard.
- Switch the mcbs [1] of the relevant operating mechanisms off in order to prevent the switchgear section being energized by remote control.
- Dismantle the cover on the relevant cable termination compartment.

Isolate all voltage transformers inside the switchgear section to be tested by operating the isolating device (see section 4.5).

Dismantle any surge arresters in the relevant outgoing feeder in accordance with section 4.5.

Short-circuit the sockets for the capacitive indicator system in the relevant switchgear section using the short-circuiting plug.

- Fit the high voltage testing set in accordance with the manufacturer's instructions.
- Establish the test circuit in accordance with the manufacturers directions for the test apparatus.
- De-earth the switchgear section to be tested before switching the test voltage on.
- Perform the cable test in accordance with the manufacturer´s directions for the test apparatus.
- Earth the switchgear section after completion of parts of the test and on conclusion of testing.
- Remove the high voltage testing set.
- Refit any dismantled surge arresters.
- Close off free outer cones with insulating blanking plugs in accordance with the manufacturers instructions.
- Remove the short-circuiting plugs from the capacitive indicator.
- Reconnect the voltage transformers by operating the isolating device (see section 4.5).
- Refit the cover on the cable termination compartment.

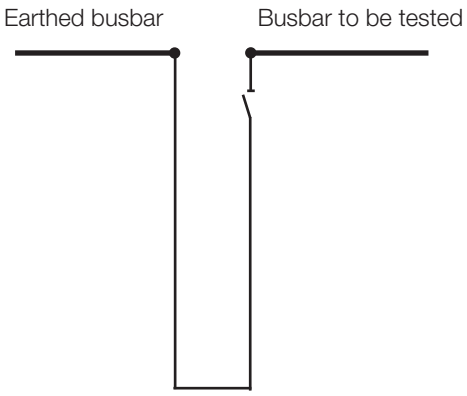
[1] mcb: miniature circuit-breaker

5.3.2 Voltage test of the main circuit

In the course of testing, the test voltage is applied in sequence to every conductor in the main circuit, with the other conductor earthed. Do not exceed the maximum test voltage (80 % of the rated short-duration power frequency withstand voltage (U_D) as stated on the type plate). Comply with the test conditions as set out in IEC 62271-200.

In the case of a sectionalizer (without circuit-breaker), application of the test voltage to the busbar in operation is not permissible. Earth the system section concerned for the duration of the test (figure 5.3.2.1).

Fig. 5.3.2.1: Voltage test in case of a sectionalizer (without circuit-breaker)



Comply with the safety regulations to EN 50110.

- Isolate the switchgear section to be tested in accordance with section 4.
- est the switchgear section for the off-circuit condition as described in section 5.1.
- Earth the switchgear section and secure the working area in accordance with section 4 and EN 50110 standard.
- Switch the mcbs [1] of the relevant operating mechanisms off in order to prevent the switchgear section being energized by remote control.
- Dismantle the cover on the relevant cable termination compartment.

Isolate all voltage transformers inside the switchgear section to be tested by operating the isolating device (see section 4.5).

Remove plugged-in voltage transformers inside the switchgear section to be tested as described in section 2.3.5.2

- Close off free inner cone sockets (for plugged-in voltage transformers) (Section 2.4.3).
- Remove any surge arresters fitted in accordance with the manufacturer's instructions.
- Close off free outer cones within the system section to be tested with blanking plugs in accordance with the manufacturers instructions.
- Short-circuit the secondary terminals of the block-type current transformers installed in the test circuit (in sectionalizers, risers and metering panels) and earth them.
- Short-circuit the sockets for the capacitive indicator system in the relevant switchgear section using the short-circuiting plug.
- Fit the high voltage testing set to the (outer cone) cable connector system of the panel to which the test voltage is to be applied, following the manufacturer's instructions.
- Connect the test transformer to the test plug or test cable and earth the other two phases of the test system.
- Connect the second terminal of the test transformer to system earth.
- Connect other sections of the switchgear to be tested by operating the relevant disconnectors and circuit-breakers.
- Cancel the earthing of the system section to be tested before applying the test voltage.
- Perform the high voltage test.
- Earth the system section on completion of individual tests and on conclusion of testing.
- Dismantle the test cables or test plugs.
- Fit any surge arresters and voltage transformers required.
- Close off any free test sockets and cable sockets with blanking plugs.
- Close off free outer cones with insulating blanking plugs in accordance with the manufacturer's instructions.
- Cancel any isolation of voltage transformers.
- Remove the short-circuiting plugs from the capacitive indicator.
- Refit the cover on the cable termination compartment.

[1] mcb: miniature circuit-breaker

5.4 Secondary protection testing

Comply with the safety regulations to EN 50110.

– Isolate the feeder panel to be tested in accordance with section 4.

– Test the switchgear section for the off-circuit condition as described in section 5.1

– Earth the outgoing feeder and secure the working area in accordance with section 4 and EN 50110 standard.

– Switch the mcbs [1] of the relevant operating mechanisms off in order to prevent the outgoing feeder being energized by remote control.

Voltage may only be applied to the OFF release coil of the circuit-breaker (shunt release OFF) for a period of 1000 ms. If this time is exceeded the coil will burn out. For this reason, the protection testing system must be shut down by the OFF command, or the shunt release OFF must be disconnected.

If the circuit-breaker is also to be tested, please note that earthing via the circuit-breaker is cancelled when the breaker is opened. Otherwise, disconnect the release coil before testing.

Note that when the voltage signals from the voltage transformers in the panel to be tested are used by other panels, the signals are not available during the work. This can lead to impairments of function in the other panels.

– Establish the test circuit in accordance with the protection tester manufacturer's directions and perform the test.

5.5 Protection testing by primary current injection

Direct access to the conductors for performance of protection tests by primary current injection is possible via the fitted cable connectors. The test current is applied via suitable testing sets for the cable connector system used.

Comply with the safety regulations to EN 50110.

– Isolate the relevant switchgear section in accordance with section 4.

– Test the switchgear section for the off-circuit condition as described in section 5.1.

– Earth the switchgear section and secure the working area in accordance with section 4 and EN 50110 standard.

– Switch the mcbs [1] of the relevant operating mechanisms off in order to prevent the switchgear section being energized by remote control.

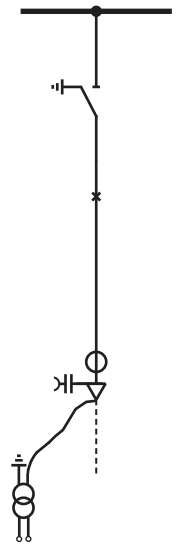
– Observe the example of primary side test circuits in figures 5.5.1.

If the circuit-breaker is also to be tested, please note that earthing via the circuit-breaker is cancelled when the breaker is opened. Otherwise, disconnect the release coil before testing.

Note that when the voltage signals from the voltage transformers in the panel to be tested are used by other panels, the signals are not available during the work. This can lead to impairments of function in the other panels.

Do not exceed the maximum values for the current testing plug (see the section on accessories).

Fig. 5.5.1: Test circuit



Test transformer

[1] mcb: miniature circuit-breaker

– Dismantle the cover on the cable termination compartment of the relevant panel.

– Fit the testing set in accordance with the manufacturer's instructions.

– Establish the test configuration in accordance with the manufacturer's instructions for the protection testing equipment and perform the protection test.

– Earth the switchgear section after completion of the test.

– Remove the testing set.

– Refit the insulating ends of the cable connectors in accordance with the manufacturer's instructions.

– Refit the cover on the cable termination compartment.

6 Service

6.1 Inspection and maintenance of the switchgear

– Check that the switchgear room and the switchgear are in proper condition for the intended use at regular intervals.

– Check primarily for dirt, corrosion and moisture.

If you find that the switchgear is not in the proper condition, take appropriate action, e.g. cleaning of the switchgear, removal of corrosion or rectification of the cause of the moisture.

6.2 Maintenance of the switching devices and their operating mechanisms

Please consult the relevant directions and instruction manuals for the actions and intervals required.

All parts in SF_6 are maintenance-free.

7 Actions at the end of the service life

ABB can be appointed to decommission and dismantle the switchgear. The switchgear is then professionally dismantled by ABB and the SF_6, which is normally reusable, removed before the switchgear is broken down into its remaining components.

Further notes on decommisioning at the end of the switchgear´s service life can be found in materials supplement BA 509.

8 List of tools

The tools required for assembly of the switchgear system are detailed in the list below. Tools are not part of the ABB scope of supply.
All the tools listed must comply with the safety regulations of the country concerned.

1	Temperature-compensated pressure gauge with coupling (ABB part number GCE0905091P0101) (figure 2.3.1.1.3)
1	Set of open-ended spanners, 8 to 19 mm AF
1	Set of ring spanners, 8 to 19 mm AF
1	Ratchet, 3/8", with extensions and 8 to 19 mm AF socket keys and 4 to 10 mm Allen key inserts
1	Ratchet, ½", with extensions and 10 to 19 mm AF socket keys and 4 to 10 mm Allen key inserts
1	Set of screwdrivers for slotted and cross-head screws, sizes 1 to 3
1	Set of electrician's pliers (end cutting nipper, pointed pliers, flat end pliers, stripping tongs)
1	Rubber mallet
1	Set of fitter's hammers
1	Leveller
1	Plumb bob
1	Guide string
1	Scribing iron
1	Punch
1	Tri-square
1	Tape measure
1	Calliper gauge
1	Continuity tester
1	Multimeter (voltage, current and resistance)
1	Torque wrench, 0 – 40 Nm, calibrated
1	Torque wrench, 15 – 100 Nm, calibrated
1	Extension cable, 230 V, 15 m long 1 Cable drum, 230 V / 16 A, 50 m
1	Angle grinder, small
1	Hand-held drill, chuck up to 13 mm
1	Hammer drill
1	Welding machine + accessories
1	Set of steel drill bits, 1 to 13 mm
1	Set of concrete drill bits, 6 to 12 mm
1	Steps, 8 rung
2	Trolley jacks (recommended capacity 2 t) or
2	Hydraulic lift trolleys (recommended capacity 3.5 t per pair)
4	Lifting ropes, 0.75 m, recommended capacity 1 t
4	Lifting ropes, 1.5 m, recommended capacity 1 t
4	Shackles, capacity 1 t
2	Pinch bars
5	Handling tubes
2	Chain hoists, 0.25 t including chain
1	Site lighting
1	Torch
1	Hand-held lamp
1	Vacuum cleaner
	Several wooden planks
	Several wooden beams
	Soft, non-fraying cleaning cloth
	Household cleaner, chlorine-*free

9 Working materials, auxiliary materials and accessories

Working materials, auxiliary materials and accessories are included in the scope of supply as contracted.

9.1 Working materials

	ABB part number
SF_6 insulating gas	
Pressure-liquefied gas in steel cylinders,	
Capacity: 5 kg	GCE0990258P0102
Capacity: 40 kg	GCE0990253P0102
Quality to IEC 60376	

Observe sample instruction manual included in manual HB 605 E

As a rule, the panel modules are filled with insulating gas at the works. For this reason, no gas cylinders are supplied with the switchgear. Gas cylinders are not normally part of the ABB scope of supply.
In the case of airfreight, the panel modules are filled at the works to a reduced insulating gas pressure, and therefore they have to be topped up with SF_6 at site. In this case SF_6 in cylinders is required. Further information on the handling of SF_6 can be found in instruction manual HB 605/E.
If extreme temperatures ≥ 50 °C during the storage, transport or temporary storage in the open air of the SF_6 cylinders with exposure to sunlight cannot be ruled out, please provide in your order for a reduced filling factor of 0.75 kg/l for safety reasons.

9.2 Auxiliary materials

Lubricant: Isoflex Topas NB 52,	
Capacity 1 kg	GCE0007249P0100
Assembly paste for silicone insulating parts,	
Capacity 40 g	1VB0000207P0100
Cleaning agent for silicone insulating parts, busbar sockets, outer cones and fuse sealing collars	
Intensive cleaner M.X.T. 60 forte, capacity 1 l	1VB0000240P0100
Paint, standard colour RAL 7035	
Can, capacity 1 kg	GCE9014060R0103

9.3 Accessories

	ABB part number
Accessories for operation of the three position disconnectors	
Manual mechanism 1	
Operating lever (figure 4.1.2.1.2.1)	GCE9401549R0103
Manual mechanism 2 and motor operated mechanism 2	
Crank for earthing function of the three-position disconnector (figures 4.1.2.2.2.1 and 4.1.2.4.3.1)	GCE7007715R0102
Crank for disconnector function of the three-position disconnector (figures 4.1.2.2.2.1 and 4.1.2.4.3.1)	GCE7007715R0101
Motor operated mechanism 1	
Crank for emergency manual operation (figure 4.1.2.3.1.2)	GCE7006002R0103
Accessories for operation of the three position switch-disconnector and three position switch-disconnector with fuse	
Operating lever (figures 4.2.2 and 4.3.2)	GCE9401549R0103
Operating lever with coding pin (figures 4.2.3 and 4.3.3)	GCE9016169R0101
Accessories for HRC fuses	
Length adapter for fuse length 292 mm and diameter 53 mm (figure 4.3.4.2)	GCE9015980R0101
Adapter for fuse diameter 53 mm (figure 4.3.4.2)	GCE9015982R0101
Fuse links (ABB type CEF or Siba): HRC fuse links for indoor switchgear with striker pin 80 N and temperature limiter, nominal dimension “e”: 442 mm (or 292 mm with adapter) nominal dimension “d”: 67 mm (or 53 mm with adapter)	On request, depending on rated voltage and rated current
Accessories for capacitive indicator, system LRM	
Display unit (figure 5.1.1.1)	GCE0931333P0101
Interface tester	GCE0900052P0102
Short-circuiting plug	GCE0909005P0101
Other accessories	
Double bit key for barrel lock in panel door	GCE0990108P0100
Wall mounting for accessories	GCE9016025P0101
Wall mounting for three HRC fuses	GCE9016382P0102
Adapter for DILO filling truck	1VB8000532R0101

10 Technical data

The technical data of the switchgear can be found on the name plate. The name plate of the panel is located at the top on the right-hand side wall of the opened low voltage compartment. Further name plates are located in the immediate vicinity of the devices they describe.

Table 10.1: Technical data of the panels

Electrical data					
Rated voltage / maximum operating voltage	U_r	kV	12	17,5	24
Rated power-frequency withstand voltage [1]	U_d	kV	28	38	50
Rated lightning impulse withstand voltage [1]	U_p	kV	75	95	125
Rated frequency [2]	f_r	Hz		50	
Rated normal current of busbars [3]	I_r	A		...1250	
Rated normal current [3]	I_r	A		...1250	
Rated short-time withstand current	I_k	kA		...25	
Rated peak withstand current	I_p	kA		...62.5	
Rated duration of short-circuit	t_k	s		...3	
Insulating gas system [4] [5]					
Alarm level for insulation	p_{ae}	kPa [6]		120	
Rated filling level for insulation	p_{re}	kPa		130	
Minimum functional level for operation [7]	p_{mm}	kPa		120	
Rated filling level for switch [7]	p_{sw}	kPa		130	
Further technical data					
Degree of protection for parts under high voltage				IP65	
Degree of protection of the low voltage compartment [8]				IP4X	

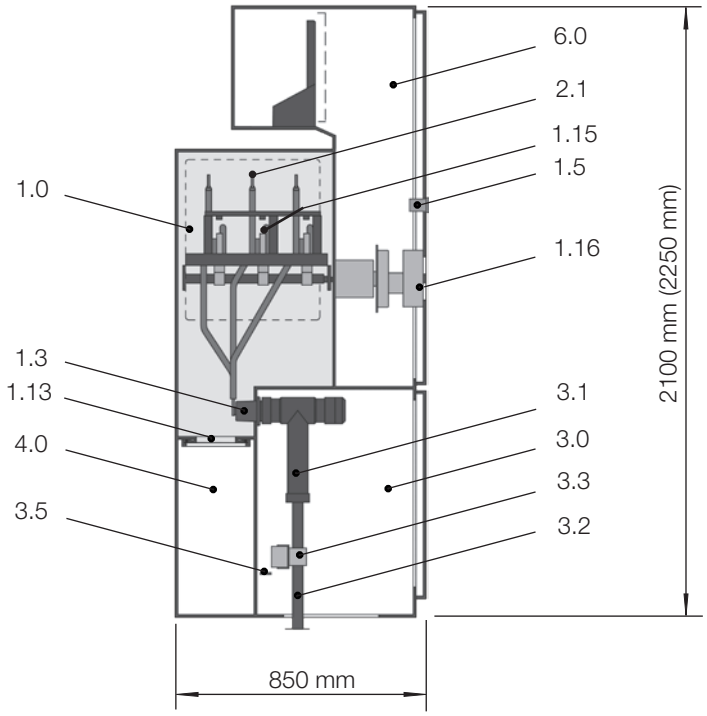
1) Higher levels to international standards on request
2) Rated current for 60 Hz on request
3) Higher rated currents on request
4) Insulating gas: SF_6 (sulphur hexafluoride)
5) All pressures stated are absolute values relative to 20 °C
6) 100 kPa = 1 bar
7) Applies to switch-disconnectors only
8) IP2X for panels with three position switch-disconnectors, IP3X for panels with circuit-breakers and mechanical controls, higher degrees of protection on request.

Table 10.2: Operating conditions		
Ambient temperature, maximum	°C	+40
Ambient temperature, maximum 24 h average [1]	°C	+35
Ambient temperature, minimum [2]	°C	-5
Site altitude [3]	m	...1000
Average humidity measured over 24 h [4]	%	≤ 95
Average relative humidity in one month [4]	%	≤ 90
Ambient air		Ambient air not significantly contaminated by dust, smoke, corrosive or flammable gases or salts.
Seismic withstand capability [5]		Tested to IEEE Std. 693 Draft 6,

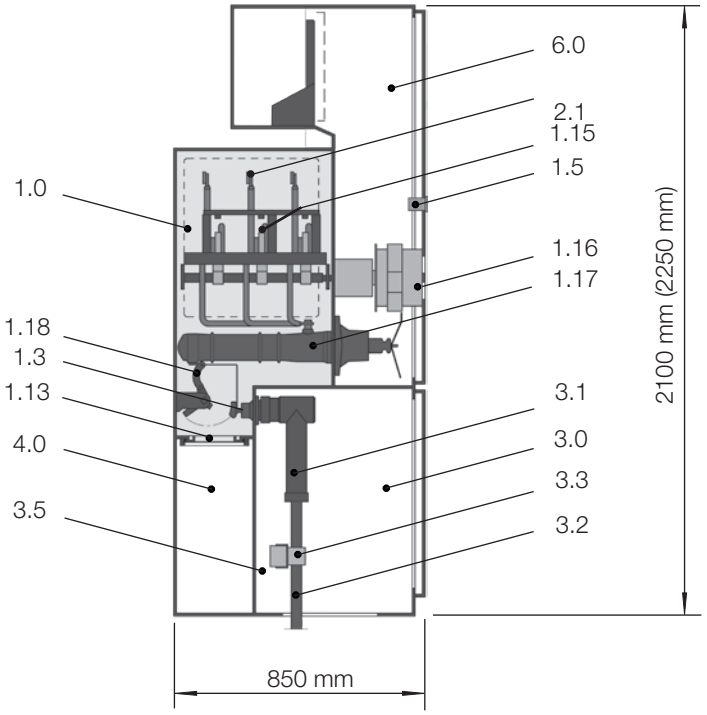
Table 10.3: Panel weights			
Panel type	Panel width [mm]	Rated current [A]	Weight, max. [kg]
Outgoing feeder panel with circuit-breaker	400	...800	300
	600	...1250	600
Outgoing feeder panel with three position switch-disconnector	400	...800	225
Outgoing feeder panel with three position switch-disconnector and fuse	400	...800	280
Sectionalizer panel	400	...800	390
	600	...1250	600
Riser panel	400	...800	335
	600	...1250	550
Metering panel	400		300
Busbar earthing panel	400		195

[1] Higher ambient temperature on request
[2] Panels without auxiliary power supply: -25 °C
[3] Greater site altitudes on request
[4] Take suitable action to prevent condensation in the low voltage compartment.
[5] Additional measures required (on request)

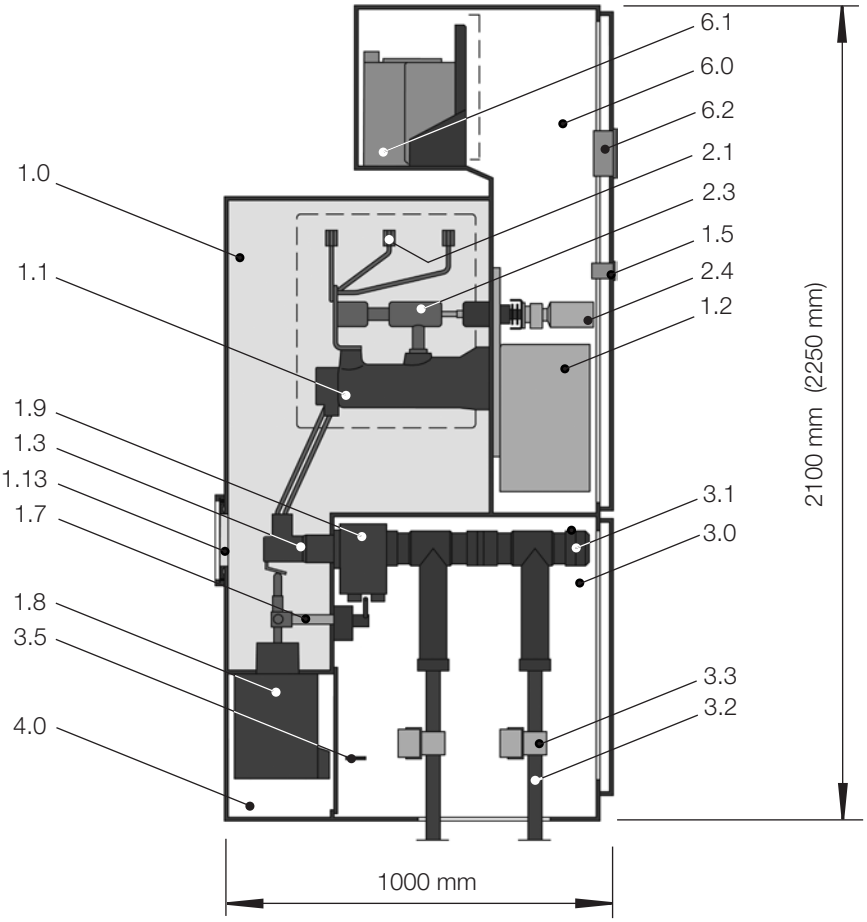
Feeder panel with switch disconnector 630 A, panel width 400 mm, example configuration



Feeder panel with switch disconnector and fuse, panel width 400 mm, example configuration



Feeder panel with circuit-breaker 1250 A, panel width 600 mm, example configuration



1.0	Panel module (enclosure)
1.1	Circuit-breaker pole
1.2	Circuit-breaker mechanism
1.3	Outer cone
1.5	Sockets for capacitive voltage system
1.7	Isolating system for voltage transformer
1.8	Voltage transformer, fixed mounted
1.9	Current transformer
1.13	Pressure relief disk
1.15	Three-position switch disconnector
1.16	Three-position switch disconnector operating mechanism
1.17	Fuse box
1.18	Earthing switch
2.1	Busbar system
2.3	Three-position disconnector
2.4	Three-position disconnector operating mechanism
3.0	Cable termination compartment
3.1	Cable connector
3.2	High voltage cable
3.3	Cable fastener
3.5	Main earthing bar
4.0	Pressure relief compartment
6.0	Low voltage compartment
6.1	Central unit of a combined protection and control device
6.2	Human-machine interface of a combined protection and control device

For your notes

Contact

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