SafeRing/SafePlus
SF$_6$ insulated Ring Main Unit and Compact Switchgear

- Safe and easy for operators
- Fully sealed for lifetime
- Virtually maintenance-free
Contents

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Your safety first - Always

That’s why our instruction manual begins with the following recommendations:

• Only install/operate switchgear in an environment suitable for the installation/operation of electrical equipment

• Ensure that installation, operation and maintenance are carried out by specialist electricians only

• Comply in full with the active standards (GB/IEC), the connection conditions of electrical utility and applicable safety at work regulations

• Observe the relevant regulations in the instruction manual for all actions involving switchgear

⚠️ Danger!
Pay special attention to the hazard notes in the instruction manual marked with this warning symbol.

• Make sure that the operating parameters of the switchgear are within the specified data

• Keep the instruction manual accessible to all persons concerned with installation, operation and maintenance

• The user’s personnel are to act responsibly in all operations affecting safety at work and the correct handling of the switchgear

If you have any further questions about this instruction manual, our technicians will be pleased to provide the required information.
1 General description

SafeRing is a SF₆ insulated ring main unit and SafePlus is a compact switchgear for applications in medium voltage distribution networks. SafeRing can be supplied as a 2, 3, 4 or 5 way standard configurations with additional equipment according to customer specification. DF, CCF, CCC, CCCF, CCFF, CV, FCC, FFF, CFC, FFCC, CCVV, CCCCC, CCFFF, CCCFC.

SafePlus has a unique flexibility due to its extendibility and the possible combination of fully modular and semi modular configurations. Be, SL, Sva, M - C - De - D - F - V - CB.

SafeRing and SafePlus offers a sealed stainless steel tank which contains all the live components and switching functions. The transformer is protected either by a switch fuse combination or a vacuum circuit-breaker.

The units/modules are delivered from the factory ready for installation.

Routine tests are carried out on all units/modules before dispatch.

No special tools are required for installing the equipment.

Available modules are:
C - Cable switch
F - Switch fuse disconnector
D - Direct cable connection
De - Direct cable connection with earthing
V - Vacuum circuit breaker
CB - Circuit Breaker module
SL - Busbar sectionalizer, load break switch
Sv - Busbar sectionalizer, vacuum circuit breaker
Be - Busbar earthing
M - Metering cubicle

SafeRing 3 - way unit CCV
1.1 Table of locations

Upper front cover
1. Manometer
2. Nameplate module
3. Short circuit indicator
4. Capacitive voltage indication
5. Load break/earthing switch position indicator
6. Push buttons close/open operation
7. Charged spring indicator
8. Self-powered protection relay
9. Vacuum circuit-breaker position
10. Operation shaft
11. Padlock device

Lower front cover
12. Nameplate switchgear
13. Fuse blown indicator
14. Disconnector/earthing switch position indicator
15. Capacitive voltage indication

Cable compartment cover
16. Cable compartment cover standard
17. Cable compartment cover with inspection window
18. Support bar (removable)

Side cover
19. Lifting lug
20. Operating handle (standard on right hand side)
1.2 Dimensional drawings

<table>
<thead>
<tr>
<th>Unit</th>
<th>A</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-way</td>
<td>371</td>
</tr>
<tr>
<td>2-way</td>
<td>696</td>
</tr>
<tr>
<td>3-way</td>
<td>1021</td>
</tr>
<tr>
<td>4-way</td>
<td>1346</td>
</tr>
<tr>
<td>5-way</td>
<td>1671</td>
</tr>
</tbody>
</table>

Top entry box - side view

Low voltage compartment-side view
2 Transport and handling

The units are delivered from the factory ready for installation.

<table>
<thead>
<tr>
<th>Weight table for standard</th>
<th>SafeRing</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 - way CF</td>
<td>270 kg</td>
</tr>
<tr>
<td>2 - way DF</td>
<td>260 kg</td>
</tr>
<tr>
<td>3 - way CFC</td>
<td>320 kg</td>
</tr>
<tr>
<td>3 - way CCF</td>
<td>320 kg</td>
</tr>
<tr>
<td>3 - way CCC</td>
<td>300 kg</td>
</tr>
<tr>
<td>3 - way FCC</td>
<td>320 kg</td>
</tr>
<tr>
<td>4 - way CCVV</td>
<td>411 kg</td>
</tr>
<tr>
<td>4 - way CCCCC</td>
<td>390 kg</td>
</tr>
<tr>
<td>4 - way CCFD</td>
<td>410 kg</td>
</tr>
<tr>
<td>4 - way CCFF</td>
<td>430 kg</td>
</tr>
<tr>
<td>4 - way CFFF</td>
<td>430 kg</td>
</tr>
<tr>
<td>4 - way CFFFF</td>
<td>480 kg</td>
</tr>
<tr>
<td>4 - way CCFF</td>
<td>540 kg</td>
</tr>
<tr>
<td>4 - way CCCFF</td>
<td>520 kg</td>
</tr>
<tr>
<td>5 - way CCCCC</td>
<td>500 kg</td>
</tr>
</tbody>
</table>

| SafePlus                  |
|---------------------------|---------|
| Standard 1-way            | 130 kg  |
| 2,3 and 4-way as for SafeRing | 480-660 kg |
| 5-way approx. between     |         |
| M-metering cubicle approx. | 250 kg  |

The weights is without additional equipment.

SafeRing/SafePlus is fitted with lifting lugs, but can also be moved on pallets with a forklift truck.

2.1 By receiving inspection

Upon receiving the SafeRing/SafePlus please check that the delivered equipment has not been damaged during transport. If any such damage has occurred, a claim must be submitted to the carrier immediately.

After unpacking, the following must be checked:
1. Operating handle 1 piece should be included.
2. Check that the pointer on the pressure indicator is in the green area.
3. Carry out a function test on the mechanical parts.

Any faults or omissions must be reported immediately to the supplier.

2.2 Storage

SafeRing/SafePlus must be stored under cover in a dry and well-ventilated area until it is installed and put into operation.
3 Installation

The base must be flat and fitted with anchor bolts in accordance with the dimensional drawing for the number of modules or units.
Planform of Foundation Channel Steel for Safe-Plus connected with 10 kV M or PT Cubicle

Bottom Assembling Drawing of 10 kV M or PT Cubicle

Foundation of SafePlus connected with 10 kV M or PT Cubicle
Installation 11

Bottom Assembling Drawing of 24 kV M Cubicle

Planform of Foundation Channel Steel for Safe-Plus connected with 24 kV M Cubicle

Foundation of SafePlus connected with 24 kV M Cubicle
Notice:
1. Four M12 expansion bolts should be provided and used by the customer.
2. The depth “H” must be larger than the cable bending radius and suitable to work. The materials under the first layer RC foundation should be also RC or bricks. Cable channel should be kept between the cable well, the cable channel and the foundation in order that the cable can be connected with the equipment in the outdoor.

<table>
<thead>
<tr>
<th></th>
<th>3 way safe</th>
<th>4 way safe</th>
<th>5 way safe</th>
<th>5 way+1 way safe</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1275</td>
<td>1625</td>
<td>1925</td>
<td>2225</td>
</tr>
<tr>
<td>B</td>
<td>1350</td>
<td>1700</td>
<td>2000</td>
<td>2300</td>
</tr>
</tbody>
</table>
3.1 Cable compartment
Removal of cable cover:

**NB!**
The cable cover can be supplied with interlocking to earthing switches. When interlocking is fitted, the cable cabinet can only be accessed when the earthing switch is in the closed position.

1. Loosen the screws on the cable cover, pull out and lift cover off.

2. Removal of front section.

3. Front section removed.

4. The panel can be removed by unscrewing A and B.
3.2 Cable connection

SafeRing/SafePlus is equipped with external bushings which comply with DIN47636T1 & T2/EDF HN 525-61 for termination of cables.

All bushings are situated in the same height from the floor and are protected by the cable cover.

Please see supplier documentation for details.

The manufacturer’s installation instructions must be followed. Be sure to lubricate the bushings thoroughly with the silicone supplied.

NB!
Where cables are not connected, the earthing switch must be locked in closed position or the bushings must be fitted with deadend recepticals before the unit is put into operation.
3.3 current transformers for relay protection

Installing current transformers. The cable shielding is led back through the centre hole and earthed.

A protection relay is installed in each vacuum circuit breaker module. The cables from the protection relay to the current transformers are placed in the cable compartment, ready for connection to the three current transformers supplied.

Before installation:
- Check that the three current transformers have been delivered and that they are all of the same type
- Check that the current transformers are of the correct type, with the correctly rated transformer ratio, for the distribution transformer’s rated current and for the adjustment range on the protection relay (see protection relay manual)

Each current transformer must be mounted onto its high voltage cable before the cable termination is fitted.

The earth shield on the cable must be led back through the centre hole in the current transformer (see figure on left) and earthed on the earthing bar in the cable compartment. A mounting plate for the current transformers is fitted in the cable compartment.

After the current transformers have been installed in the unit, the cables from the protection relay are connected. Consult the manual supplied with the protection relay for a description of the connections.

SafeRing with vacuum circuit breakers are prepared for protection relay: REJ603. It is designed so that there is no need for external auxiliary voltage for correct functioning.

Separate manuals have been prepared for each of these protection relay, with examples of adjustments.

It is essential for correct functioning that the current transformers are properly connected and that the protection relay is properly adjusted.
Refilling of SF₆ gas in SafeRing/SafePlus

Following equipment is needed: gas bottle with manometer and reduction valve adapter pressure measuring device.

1. Remove front cover and unscrew manometer as shown.
2. Screw (tightening the torque 45 Nm) the adapter to the valve.
3. Before connecting the hose from the gas bottle to the adapter, the air in the hose must be removed by running SF₆ gas through the hose.
4. When gas is flowing into the RMU/switchgear, the manometer on the gas bottle has to be observed. When it shows 0.4 bar at ambient temperature 20 °C (14 bar absolute) the gas filling must be stopped. See table for filling pressure above.
5. Remove the filling hose and connect the pressure device to check the pressure inside the RMU/switchgear.
6. When the correct pressure of 0.4 bar (14 bar absolute) is obtained, remove the adapter and screw with tightening torque 45 Nm the manometer to the RMU/switchgear as shown above. Observe that the sealing between the manometer and the valve is smooth and clean.

3.4 Gas pressure

SafeRing/SafePlus contains SF₆ gas with a nominal pressure of 1.4 bar at 20 °C.

SafeRing/SafePlus is sealed for life and is fitted with a temperature-compensated pressure indicator.

A temperature-compensated device that emits an electrical signal to indicate lower pressure can be supplied on request.

Pointer in green area - unit has correct pressure
Pointer in red area - pressure is too low.
4 Operation

4.1 Operating conditions

Normal ambient conditions
SafeRing/SafePlus is generally equipped for operation/service in normal indoor conditions in accordance with IEC 60694.

The following limitations apply:

Ambient temperature
- Max. temperature: +40°C
- Max. temperature (24-hour average): +35°C
- Min. temperature: -40°C

Humidity
- Max. average relative humidity measured over 24 hours: 95%
- Max. average relative humidity measured over 1 month: 90%

Max height above sea level for installation without reducing gas pressure: 1,500 metres

Special conditions
In accordance with IEC 60694, the manufacturer and end-user must agree about special operating conditions which deviate from operation under normal conditions.

The manufacturer/supplier must be consulted in advance if especially difficult operating conditions are involved. When electrical equipment is installed at more than 1,500 metres above sea level, for example, the atmospheric pressure will be lower and the overpressure in the tank will have to be reduced.

Airfreight
Units/modules delivered with reduced overpressure-see procedure for refilling.

4.2 Operation

All switches can be operated with the included operating handle.

Internal mechanical interlocking between the switch disconnector/circuit breaker and the associated earthing switches prevents incorrect operation. The operation of the switch disconnector/circuit breaker and earthing switches can be further interlocked by means of a padlock. The earthing switches are operated by a snap action mechanism, which ensures fast closing.

The earthing switch is closed by turning the operating handle clockwise. Turning the operating handle anti-clockwise opens the switch.

For closing the transformer switch the spring mechanism must be charged. Turning the operating handle clockwise does this. Then the green on button must be pressed to close the switch/breaker.

An anti-reflex system, standard on all operating handles, prevents the immediate re-operation of switches.
Switch disconnector:
Close: Turn the operating handle clockwise.
Open: Turn the operating handle anti-clockwise.

Earthing switch:
Close: Turn the operating handle clockwise.
Open: Turn the operating handle anti-clockwise.

Fuse switch disconnector.
Close: Turn the operating handle clockwise to charge the close/open spring. Then push the green button. (A)
Open: Push the red button. (B)
In circuit breaker configurations, the transformer circuit breaker can be tripped by the protection relay, while in switch fuse configurations fuse switch disconnector can be triggered by the fuse striker pin if an over current or short-circuit occurs.

Mechanical position indicators:
C: Transformer breaker open
D: Earthing switch closed
4.3 Installation and replacement of fuses
A red indicator below the fuse symbol on the lower front panel indicates a fuse trip. Fuses are replaced as shown in the sequence of illustrations. Switch fuse configurations are supplied without fuses installed.

When installing fuses for the first time, follow the sequence of illustrations 1-9.

1. Fuse trip indicator.

2. Close earthing switch by turning operating handle clockwise.

3. Unscrew fuse cover.

4. Tilt out the fusepanel to gain access to fuse canisters.

5. Applying the operating handle and turning anti-clockwise opens the fuse canisters.
6. Pull out the fuse handle. The fuses are firmly fixed in the fuse cover.

7. Fix the fuses to the fuse cover using the contact screw
   • The striker must point out from the fuse canister for the fuse to function properly.

8. Turn the handle on the fuse cover clockwise to close and seal the fuse canister. Use the operating handle.

9. Close the fuse panel.
   The switches are ready for operation.
5 Maintenance

All components in the SF₆ tank are maintenance-free for the declared life expectancy of the product. The tank is made of stainless steel.

If the panels sustain any scratches or damage, these must be repaired with paint to prevent corrosion.

Mechanical parts are positioned outside the tank and behind the front panel. This enables easy access and replacement if required.

Mechanical parts are surface-treated to prevent corrosion. Moving parts are lubricated at the factory for the product’s life expectancy. In extreme conditions (dust, sand and pollution), inspection and maintenance will be imperative, and in some cases replacements will be necessary. Check that the lubricant is not washed or wiped away from the mechanical moving parts.

5.1 Control and monitoring the gas
SafeRing/SafePlus is a pressure-sealed system that normally does not require special inspections. However the gas pressure on the manometer should always be checked prior to operation.
5.2 Environmental certification

1. Life expectancy of product

The product is developed in compliance with the requirements denoted by IEC 62271-200. The design incorporates a life span under indoor service conditions exceeding 30 years.

The switchgear is gas-tight with an expected diffusion rate of less than 0.1 % per annum. Referring to the reference-pressure of 1.4 bar, the switchgear will maintain gas-tightness and a gas-pressure better than 1.3 bar* throughout its designed life span.

*) at 20°C.

2. Recycling capability

<table>
<thead>
<tr>
<th>Raw Material</th>
<th>Amount</th>
<th>% of total weight</th>
<th>Re-cycle</th>
<th>Environmental effects &amp; recycle/reuse processes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iron</td>
<td>132.80 kg</td>
<td>42.53%</td>
<td>Yes</td>
<td>Separate, utilise in favour of new source (ore)</td>
</tr>
<tr>
<td>Stainless steel</td>
<td>83.20 kg</td>
<td>24.93%</td>
<td>Yes</td>
<td>Separate, utilise in favour of new source (ore)</td>
</tr>
<tr>
<td>Copper</td>
<td>43.98 kg</td>
<td>14.09%</td>
<td>Yes</td>
<td>Separate, utilise in favour of new source (ore)</td>
</tr>
<tr>
<td>Brass</td>
<td>2.30 kg</td>
<td>0.74%</td>
<td>Yes</td>
<td>Separate, utilise in favour of new source (ore)</td>
</tr>
<tr>
<td>Aluminium</td>
<td>6.55 kg</td>
<td>2.74%</td>
<td>Yes</td>
<td>Separate, utilise in favour of new source (ore)</td>
</tr>
<tr>
<td>Zinc</td>
<td>3.90 kg</td>
<td>1.25%</td>
<td>Yes</td>
<td>Separate, utilise in favour of new source (ore)</td>
</tr>
<tr>
<td>Silver</td>
<td>0.075 kg</td>
<td>0.024%</td>
<td>Yes</td>
<td>Electrolysis, utilise in favour of new source</td>
</tr>
<tr>
<td>Thermoplastic</td>
<td>5.07 kg</td>
<td>1.63%</td>
<td>Yes</td>
<td>Make granulate, re-use or apply as energy superior additive in refuse incineration</td>
</tr>
<tr>
<td>Epoxy incl. 60% quartz</td>
<td>26.75 kg</td>
<td>8.35%</td>
<td>Yes</td>
<td>Grind to powder and use as high-grade energy additive in cement mill</td>
</tr>
<tr>
<td>Rubber</td>
<td>1.35 kg</td>
<td>0.42%</td>
<td>Yes</td>
<td>High-grade energy additive in refuse incinerisation</td>
</tr>
<tr>
<td>Dielectric oil</td>
<td>0.21 kg</td>
<td>0.066%</td>
<td>Yes</td>
<td>Reclaim or use as High-grade energy additive in refuse incineration</td>
</tr>
<tr>
<td>SF₆ gas</td>
<td>3.24 kg</td>
<td>1.04%</td>
<td>Yes</td>
<td>Reclaim</td>
</tr>
<tr>
<td>Total for recycling</td>
<td>311.44 kg</td>
<td>97.25%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not specified *</td>
<td>9.00 kg</td>
<td></td>
<td></td>
<td>* Stickers, Film-foils, powder coating, screws, nuts, tiny components, grease.</td>
</tr>
<tr>
<td>Total weight **</td>
<td>320.00 kg</td>
<td>100%</td>
<td></td>
<td>High-grade energy additive in refuse incinerisation</td>
</tr>
<tr>
<td>Packing foil</td>
<td>0.2 kg</td>
<td></td>
<td>Yes</td>
<td>Re-use or use as energy additive in refuse incinerisation</td>
</tr>
<tr>
<td>Wooden pallet</td>
<td>21.5 kg</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**) All figures are collected from CCF 3-way unit with arc suppressor.

3. End-of-life

ABB Distribusjon is committed to the protection of the environment and adhere to ISO 14001 standards. It is our obligation to facilitate end-of-life recycling for our products.

There exist no explicit requirements for how to handle discarded switchgears at end-of-life. ABB’s recycling service is according to IEC 1634 edition 1995 section 6: End of life of SF₆ filled equipment and in particular 6.5.2.a: Low decomposition: No special action is required; nonrecoverable parts can be disposed of normally according to local regulations.

We also recommend ABB’s website: http://www.abb.com/sf6.