

PRODUCT CATALOGUE

ABB AS, Electrification Products division

Gas-insulated ring main unit SafeRing and compact switchgear SafePlus 12-24kV



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1 Introduction

SafeRing and SafePlus switchgears for secondary distribution were developed by ABB in Skien and introduced to the markets in 2000, replacing the previous SF₆-insulated products RGC and CTC. The installed base of SafeRing / SafePlus is more than 150 000 switchgears in more than 100 countries all over the world.

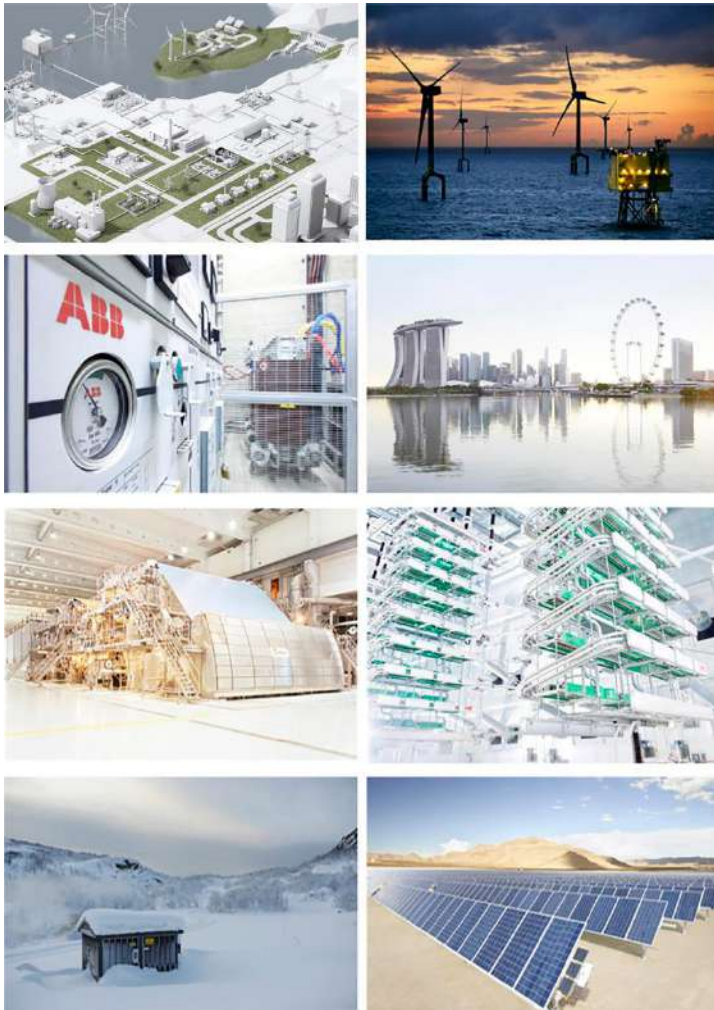
The switchgear portfolio is constantly under development to adjust to new market requirements and customers' needs.

SafeRing is available in standard configurations based on a high-volume production. These standardized RMUs, which are the most required configurations within a distribution network, can be extendable upon request. SafePlus is the switchgear version of SafeRing with flexibility, modularity and higher ratings.

Customer benefits

- A wide range of functional units, easy to extend and upgrade
- Up to five modules in one common gas tank
- No live parts exposed
- Fully sealed for lifetime
- Climatically independent
- Designed and tested according to IEC
- High reliability and safety
- Compact dimensions
- Safe and easy for operators in both maintenance and operating conditions
- All operations are carried out from the front of the switchgear





Applicable standards

SafeRing / SafePlus is tested according to the following IEC-standards:

- IEC 62271-1: Specifications High-voltage switchgear
- IEC 62271-100: Alternating-current circuit-breakers
- IEC 62271-102: Alternating current disconnectors earthing switches
- IEC 62271-103: High-voltage switches
- IEC 62271-105: Switch-fuse co-operation
- IEC 62271-200: Arc fault and switchgear
- IEC 60529: Degrees of protection provided by enclosures

SafeRing / SafePlus is also tested together with a CSS (Compact Secondary Substations) according to IEC 62271-202. Tests have been performed on CSS from various manufacturers.

Normal operation conditions

The rated characteristics of the switchgear are valid under the following ambient conditions:

- minimum ambient temperature: $-25\text{ }^{\circ}\text{C}$
- maximum ambient temperature: $+40\text{ }^{\circ}\text{C}$

For different temperature ranges, please contact your ABB sales representative.

Industry

- Pulp and Paper
- Cement
- Textiles
- Chemicals
- Food
- Automotive
- Petrochemical
- Quarrying
- Oil and gas pipelines
- Rolling mills
- Mines

Utilities and Power Plants

- Power generation stations
- Transformer stations and metering
- Main and auxiliary switchgear

Transport

- Airports
- Ports
- Railways
- Underground transport

Infrastructure

- Hotels
- Shopping centers
- Hospitals
- Large infrastructure and civil works

Renewables

- Wind
- Solar/PV

Ambient humidity:

- maximum 24 h average of relative humidity 95%
- maximum 24 h average of water vapour pressure 2.2 kPa
- maximum monthly average of relative humidity 90% RH
- maximum monthly average of water vapour pressure 1.8 kPa

The normal operational altitude is up to 1,500 m above sea level. For higher altitude applications, please contact your ABB sales representative. The switchgear is designed for operation in a normal, non-corrosive and uncontaminated atmosphere.

General

SafeRing is a SF₆-insulated ring main unit for the secondary distribution network. SafeRing can be supplied in 10 different configurations suitable for most switching applications in 12/24 kV distribution networks. As an option, SafeRing can be delivered as an extendable ring main unit.

SafePlus is ABB's flexible, extendable compact switchgear. Together, SafeRing and SafePlus represent a complete solution for 12/24 kV secondary distribution networks. SafeRing and SafePlus have identical user interfaces.

SafeRing / SafePlus is a completely sealed system with a stainless steel tank containing all the live parts and switching functions. A sealed steel tank with constant atmospheric conditions ensures a high level of reliability as well as personnel safety and a virtually maintenance-free system.

The SafeRing concept offers a choice of either a switch fuse combination or circuit breaker with relay for protection of the transformer. SafeRing can be supplied with an integrated remote control and monitoring unit.

Modularity and external busbars

All standard modules are only 325 mm wide. The width of non-standard modules, for example the metering module, are provided in the following pages.

SafePlus can be configured with a maximum of five modules in one SF₆ tank with an internal busbar. To configure switchgears with more than five modules as many tanks as needed can be joined together by use of an external busbar. Alternatively, the whole switchgear can be configured as fully modular with the use of the external busbar between all modules. The external busbar is fully insulated and screened in order to maintain climatic independence and a maintenance-free solution. All modules can be delivered prepared for future extension.

Transformer protection

SafePlus offers a choice between a switch fuse combination and circuit breaker with relay for transformer protection. The switch fuse combination offers optimal protection against short-circuits, while the circuit breaker with relay option offers better protection against low over-currents. Circuit breaker with relay is always recommended for larger transformers.



2 Design philosophy

SafeRing / SafePlus – ABB switchgears for secondary distribution

Secondary distribution switchgears have been the subject of significant development the past decades, resulting in increased functionality and smaller dimensions.

The traditional switching cells are substituted with complete switchgear systems. Specific functions such as grounding, disconnecting, cable connections, busbar extension, protection and switching have become integrated features in compact functional units.

Compact switchgear systems meet customers' MV application needs. ABB has always been a part of this development. The current ABB SafePlus range satisfies the most complex system specifications.

The most unique specialization is the development of the cable ring switchgear. The numerous public distribution substations requested a unified switching functionality which evolved into the ring main unit concept. ABB SafeRing range is one major contributor to this specialization.

Two Products – One range

ABB SafeRing is adapted to the needs of the immense utility distribution network. ABB SafePlus offers more in terms of flexibility and electrical capacity. Both switchgears offer the same customer interface.

Customers' involvement

The applied functionality in ABB SafeRing and SafePlus is the result of input from customers all over the world. Key customers are continuously involved with ABB design staff to ensure optimized switchgear operation. The functionality will always find its background from customer demands.

Personnel – safety and service

Safety is not only a specification and rating issue, but also a real life experience. Standards and associated testing will disclose weakness at the time of testing. ABB takes this further to be an objective related to durability and repetitive manufacturing quality.

All products are manufactured in accordance with ISO 9001. The latest edition of relevant IEC standards will always apply to our continuous product development and test program. "Integrated functionality" is a key objective to reduce the number of moving components, further reducing the risk of any mechanical defect.

We are responsible for the environment

The location for manufacturing SafeRing and SafePlus is Norway. Norway's green policy contributes to the focus on environmental factors in manufacturing as well as over the switchgear's lifespan.

All products are manufactured in accordance with our ISO 14001 certification. Recycling is confirmed at a 97% level. To simplify this process, we will continuously work with our partners to develop routines for handling end of life. Plastic parts are individually marked to simplify the recycling process. Solutions for elimination of gas emission in the rare event of a fault can be supplied.

Modern – development and manufacturing

Numerical simulations together with long experience ensure a compact and robust design. Dielectric simulations ensure that compactness will not influence the dielectric capability.

The combination of design techniques, experience and the most modern production technology guarantees state of the art products and durability.

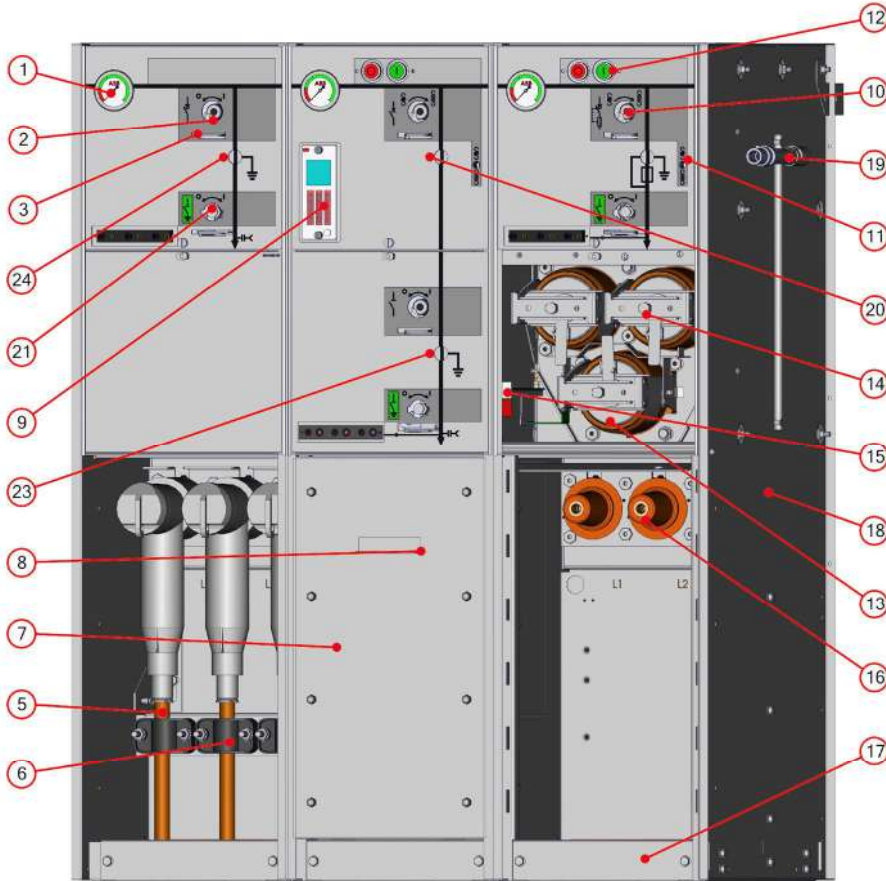
Complete solutions – one supplier

Complex applications involving different standard remote levels, such as monitoring, control and measurement and protection can now be supplied from one supplier.

This makes large scale implementation feasible and will simplify engineering and procurement. The control and monitoring unit available for SafeRing is located behind the front cover. This option is also readily available for retrofit since such demands normally evolve after the switchgear is in service.

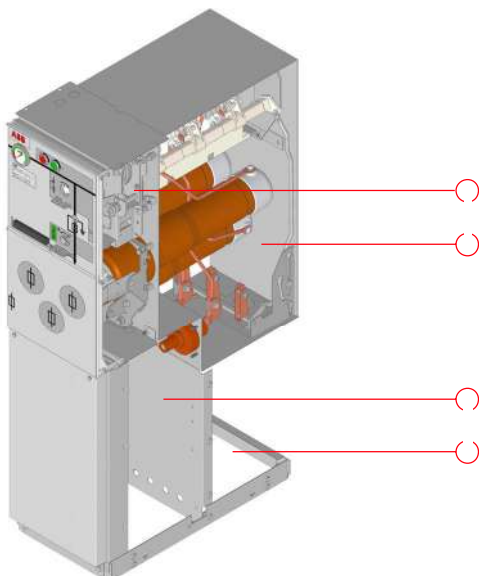
3 Arrangement

External



Description	ID
Manometer	1
Operating shaft disconnecter	2
Padlock hole	3
Cable	5
Cable clamp	6
Arc proof cable compartment	7
Door handle	8
Self-supplied protection relay	9
Operating shaft spring	10
Charged spring indicator	11
Push buttons	12
Fuse canister	13
Fuse operating handle	14
Fuse blown indicator	15
Cable bushings	16
Bottom list	17
Side panel	18
Operating handle	19
Disconnecter position indicator	20
Operating shaft earthing switch	21
Earthing switch position indicator	23
Disconnecter/earthing switch position indicator	24

Internal



Description	ID
Mechanism compartment	1
SF ₆ gas tank	2
Cable compartment	3
Pressure relief area	4

4 Manufacturing

4.1 Completely sealed system

Exterior

Upper and lower front covers are made of 3 mm aluminium covered with a polycarbonate foil. These foils contain the mimic diagram of the main circuit integrated with the position indicators for the switching devices. Background colour for these foils is light grey (RAL 7035). The upper front cover is removable. The lower front cover can be opened.

There are four different cable compartment covers: standard, with inspection window, arc proof and with extra depth for parallel cables. These covers are manufactured from 1.5 mm aluzink (except the arc proof cover) and are powder painted with colour RAL 7035.

All cable compartment covers are removable. Each module has a separate cable compartment which is divided from the others by means of partition walls. These partition walls can easily be removed, allowing comfortable access for connection of cables.

A vertical partition wall is fitted to divide the cable compartment(s) from the rear side of the switchgear / ring main unit.

In case of an arc fault inside the SF₆ tank, followed by an opening of the pressure relief valve in the bottom of the tank, this partition wall will prevent the hot gases blowing out from the pressure relief to enter the cable compartments. Side covers are made of 2 millimeter hot rolled steel and powder painted with colour RAL 7035.

Enclosure

SafeRing and SafePlus use SF₆ gas (sulphur hexafluoride) as insulation and quenching medium. The SF₆ gas is contained in a welded stainless steel tank, which is sealed for life.

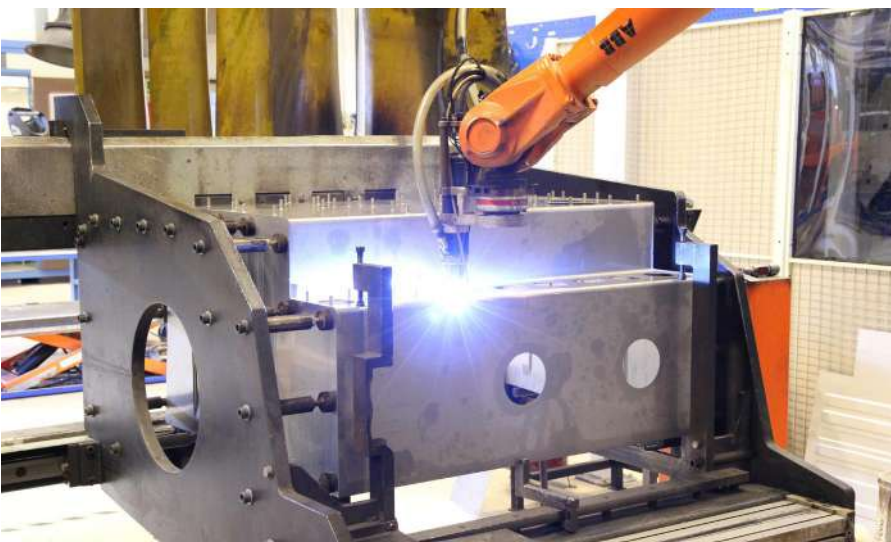
The pressure system is defined as a sealed for life system with an operating lifetime exceeding 30 years. The leakage rate is less than 0,1% per year.

In order to ensure a reliable and tight welding, all welding work is carried out by computer controlled robots. Electrical and mechanical bushings penetrating the tank are clamped and sealed to the tank by high quality O-rings.

The mechanical bushing has in addition a rotating shaft which connects the shaft of the switch to the corresponding shaft of the mechanism. The rotating shaft is sealed by a double set of gas seals.

All SF₆ Tanks have to pass a leakage test before gas filling. Leakage test and gas filling are done inside a vacuum chamber. The first step in the leakage test is to evacuate all air inside both the SF₆ tank and vacuum chamber simultaneously. Then the SF₆ tank is filled with helium. Due to the characteristics of helium this test will detect all possible leakages. If the SF₆ tank passes this test the helium will be evacuated and replaced by SF₆.

The SF₆ tank has a degree of protection of IP67 and can be immersed into water and still maintain all functions in a satisfactory way.



4.2 Factory routine tested

ABB has set a high quality automated system for production and quality control which assures sustainability of factory output. Part of the assurance is standard routine testing procedures according to IEC62271-200 performed on every manufactured switchgear.

IEC factory routine tests:

- Visual inspection and check
- Mechanical operations check
- Check of secondary wiring
- Electrical sequence operations
- Power frequency withstand voltage test
- Partial discharge measurement
- Measurement of resistance of the main circuits
- Secondary insulation test
- Control of the gas tightness

State of the art

For the routine testing, ABB uses the latest technologies and systems, such as:

- Fully automated high voltage testing cabin
- Temperature compensated gas filling system
- Automated connection counting system
- Automated screw torque control
- Computer aided mechanical characteristics control



5 Safety

5.1 Internal Arc Classification (IAC)

01 Arc duration and damage caused

During development of all ABB products, focus is on personnel safety. The SafeRing / SafePlus portfolio was designed and tested to withstand a variety of internal arc scenarios at the same current level as the maximum short circuit current. The tests show that the metal enclosure of SafeRing / SafePlus is able to protect personnel standing close to the switchgear during internal arc fault.

Causes and effects of internal arcs

Although an internal arc fault is highly unlikely it can theoretically be caused by various factors, such as:

- Insulation defects due to quality deterioration of the components. The reasons can be adverse environmental conditions and a highly polluted atmosphere.
- Inadequate training of the personnel in charge of the installation leading to incorrect installation of the cables.
- Broken or modified safety interlocks.
- Overheating of the contact area, e.g. when the connections are not sufficiently tightened.
- Short circuits caused by small animals that have entered into the cable compartment (i.e. through cable entrance).

The energy produced by the internal arc causes the following phenomena:

- Increase of the internal pressure.
- Increase of the temperature.
- Visual and acoustic effects.
- Mechanical stresses on the switchgear structure.
- Melting, decomposing and evaporation of materials.

Tested according to IEC standard 62271-200

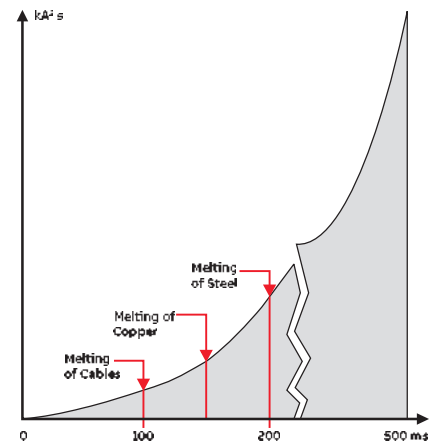
The capability of SafeRing / SafePlus switchgear to withstand internal arc is proven by type tests performed according to internal arc classification (IAC) as described in the standard IEC 62271-200 as follows:

Accessibility: A and B (switchgear)

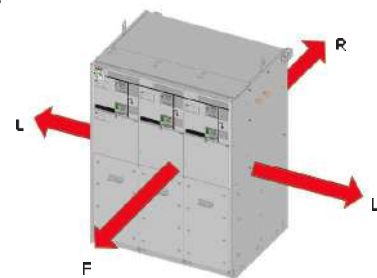
A=Accessible to authorized personnel only
300 mm safety distance on accessible sides of the switchgear (also distance to sensors during testing)

B=public access

100 mm safety distance on accessible sides of the switchgear (also distance to sensors during testing)



01



F-Front = Access from the front

L-Lateral = Access from sides

R-Rear = Access from the rear

Accessible sides of switchgear = Area that personnel can enter freely. For accessibility A this means a 300 mm safety distance + 500 mm or more in safe moving area.

Non-accessible side of switchgear = Area that is physically blocked or clearly marked as not safe for personnel.

All test specimens passed the following test criteria according to the standards:

1. Correctly secured doors and covers do not open
2. No fragmentation of the enclosure occurs within the time specified for the test. Projection of small parts up to an individual mass of 60 g are accepted
3. Arcing does not cause holes in the enclosure of the switchgear up to a height of 2 m
4. Indicators do not ignite due to the effect of hot gases
5. The enclosure remains connected to its earthing point

5.1 Internal Arc Classification (IAC)

01 *290 mm base frame available as an option. Note: The height of the exhaust channel must always be 2002 mm in order to comply with the requirements in IEC standards. When the base frame is 290 mm, the exhaust channel is extended to reach 2002 mm height

02 1100 mm version available as an option

SafeRing / SafePlus is available for a wide range of installations and applications in order to secure the highest safety for operators. Switchgears are designed and type-tested for internal arc classification according to the following configurations:

5.1.1 IAC AFLR - with ventilation upwards through an exhaust channel

With this setup, hot gasses and pressure are evacuated into the safe area of the switchgear room above the switchgear through the gas exhaust channel. In this setup the switchgear can be installed as free standing. This solution is not available for M-module. With this solution, a base frame of 450 mm (optional 290 mm) is included as standard.

Basic parameters of setup:

- IAC AFLR up to 25 kA / 1s
- Minimum height of ceiling: 2600 mm
- Minimum distance from backwall:
 - 800 mm with accessible rear side
 - 100 mm with non-accessible rear side
- Switchgear needs to be installed and fixed to the floor in accordance with "SafeRing / SafePlus 12-24kV Installation and operating instructions"

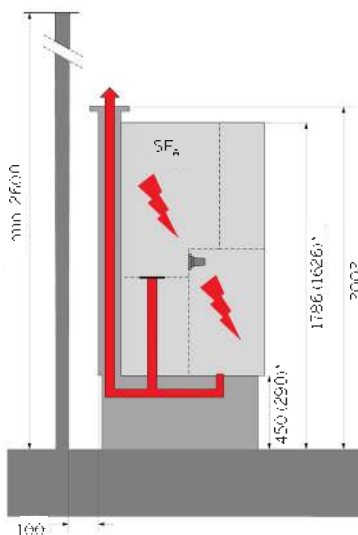
For number of modules, availability, heights and specifications, see table no. 5.1.1.

5.1.2 IAC AFLR or AFL - downwards ventilation With ventilation down to the cable trench.

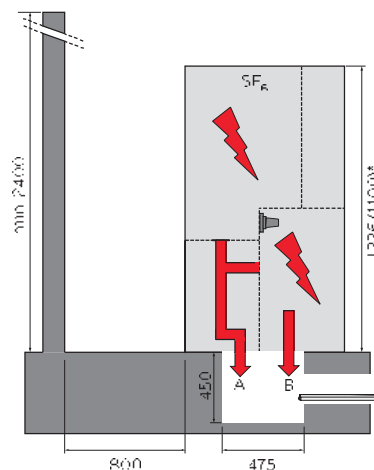
With this setup, hot gases and pressure are evacuated downwards in the cavity in the floor beneath the switchgear. Hot gases are led to the cable trench by means of a back plate installed on the rear side of the switchgear, forcing the hot gases down during an arc fault. The switchgear must be arranged as instructed according to the basic parameters below.

Basic parameters of set-up:

- IAC AFLR or AFL up to 20 kA / 1s
 - Minimum height of ceiling: 2000 mm
 - Recommended distance to back wall:
 - 800 mm with accessible rear side
 - 100 mm recommended for non-accessible rear side (possible down to 20mm)
 - Back plate installed on the switchgear
 - Requires a minimum opening between switchgear and cable trench in the "pressure relief area" for each module shown as opening "A" in illustration "02".
 - Opening "A" in a 1-way module: 250 x 205 mm
 - Opening "A" in 2-5 way modules: 150 x 205 mm
- It is optional to cover opening "B" between the switchgear cable compartment and the cable trench with a gland plate. This is not an allowed option for low version switchgears.
- Minimum width of cable trench: 475 mm
 - Minimum depth of cable trench: 450 mm
 - A pressure relief channel to a safe area is required and it must have a free opening area of 0,1m²
 - Switchgear needs to be installed and fixed to the floor in accordance with "SafeRing / SafePlus 12-24kV Installation and operating instructions".



01



02

—
 01 If the distance from the side wall is greater than 20 mm, arc shields on both sides are required. Marked area is restricted, but installation is allowed if mounting of arc shield is feasible.

—
 02 Arc shield He of arc shield for M-module is 1317 mm.

—
 03 Arc shield with base frame.

—
 04 1100 mm version available as option.

5.1.3 IAC AFL – Backwards ventilation
 With ventilation behind the switchgear.

With this setup, hot gases and pressure are evacuated behind the switchgear. Hot gases are led to the safe areas of the switchgear room by means of arc shields installed on accessible lateral sides of the switchgear or as a combined solution with additional ventilation down into a cable trench.

Basic parameters of set-up:

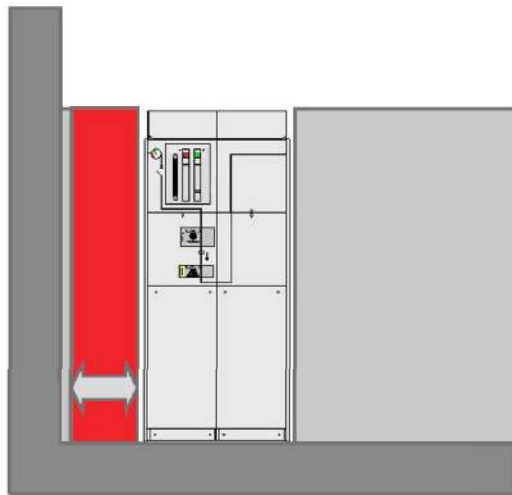
- IAC AFL up to 20 kA / 1s
- Minimum height of ceiling: 2400 mm
- Arc shields need to be installed if the distance between the switchgear and respective sidewall(s) is more than 20 mm to maintain its AFL classification. If both sides of the switchgear are more than 20 mm from any sidewalls then arc shields are required on both sides.

- Arc shields are 100 mm
- Minimum distance to back wall: 100 mm
- Larger distances can be accepted if the area between the switchgear and back wall is non-accessible.
- Switchgear needs to be installed and fixed to the floor in accordance with "SafeRing / SafePlus 12-24kV Installation and operating instructions"

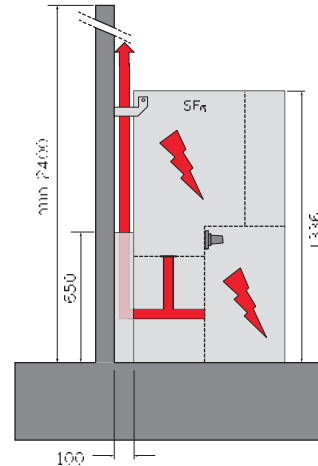
For number of modules, availability, heights and specifications, see table no. 5.1.1.

5.2.4 Non-arc proof version

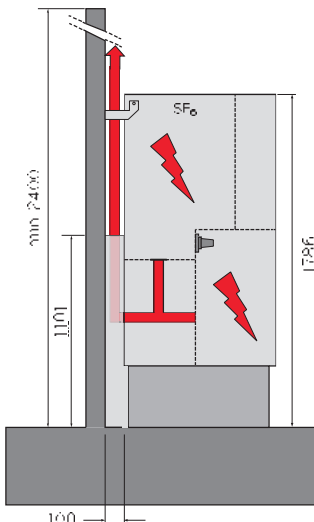
The non-arc proof version of the switchgear is not verified for any of the IAC-classes. In the highly unlikely event of an internal arc fault in the switchgear, hot gases and pressure could evacuate randomly in any direction at any place of enclosure.



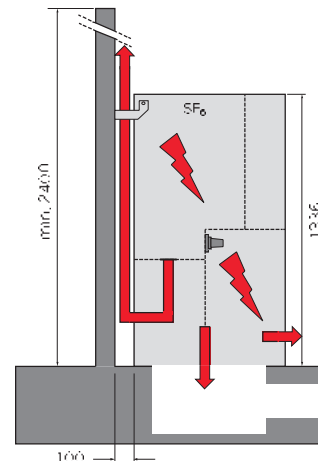
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 02



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 02



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 03



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 04

Table 5.1.1

ISC (kA/1s)	IAC class	Ventilation	Height of switchgear (mm)	Roof height (mm)	Base frame	Max sets of current transformers
16	AFL	Backwards	1336 (standard) 1100 (low)	2400 (standard) 2400 (low)	Optional (290/450 mm)	2 ²⁾
	AFL	Downwards ³⁾	1336 (standard) 1100 (low) ⁶⁾	2000 (standard) 2000 (low)	Optional (290/450 mm)	2 ²⁾
	AFLR	Downwards ³⁾	1336 (standard) 1100 (low) ⁶⁾	2000 (standard) 2000 (low)	Optional (290/450 mm)	2 ²⁾
	AFLR	Upwards ⁴⁾	2002 ¹⁾	2600	Mandatory ⁵⁾ (290/450 mm)	2 ²⁾
20	AFL	Backwards	1336 (standard) 1100 (low)	2400 (standard) 2400 (low)	Optional (290/450 mm)	2 ²⁾
	AFL	Downwards ³⁾	1336 (standard) 1100 (low) ⁶⁾	2000 (standard) 2000 (low)	Optional (290/450 mm)	2 ²⁾
	AFLR	Downwards ³⁾	1336 (standard) 1100 (low) ⁶⁾	2000 (standard) 2000 (low)	Optional (290/450 mm)	2 ²⁾
	AFLR	Upwards ⁴⁾	2002 ¹⁾	2600	Mandatory ⁵⁾ (290/450 mm)	2 ²⁾
25	AFLR	Upwards ⁴⁾	2002 ¹⁾	2600	Mandatory ⁵⁾ (450 mm)	2 ²⁾

1) Height of exhaust channel is always 2002 mm. This dimension is independent of the height of the base frame and switchgear.

2) In case two sets of CT's are required, additional base frame is mandatory and it is not allowed with gland plate as second set of CT's will be installed in base frame.

3) IAC classification is unavailable in case of installation deviating from basic parameter set-up described in "downwards ventilation" section on previous pages.

4) Upwards ventilation solution requires a base frame for attaching the gas exhaust channel. Only available from 2-way to 5-way switchgears.

5) Not allowed with gland plate between switchgear and base frame, gland plate can be installed below base frame.

6) Not allowed with gland plate on low version for this ventilation direction

5.2 Arc suppressor

—
01 Arc suppressor
inside the tank

Arc suppressor – active device for increased safety

The arc suppressor is an optimal quick-make short circuit device with a mechanical pressure detector which can be installed in each incoming feeder inside the sealed SF₆ tank of SafeRing and SafePlus switchgear.

If an arc fault should occur inside the SF₆ tank the pressure device of the arc suppressor will automatically trip and short circuit the incoming feeder(s) within milliseconds, thereby extinguishing the arc and preventing a gas blowout. The arc is extinguished without any emission of hot gases and the bolted short circuit will be interrupted by the upstream circuit-breaker.

No links or release mechanisms are installed outside the tank. Corrosion and any environmental influences are therefore prevented, giving optimum reliability.

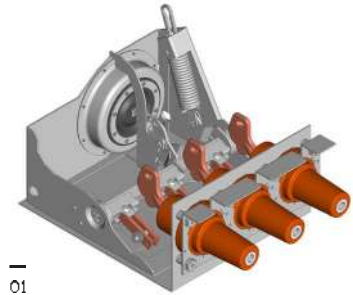
The pressure detector is insensitive to pressure changes due to variation in atmospheric temperature or pressure, as well as external phenomena such as vibrations or shocks.

The arc suppressor is tested for short-circuit currents in the range of 1kArms to 21kArms and it will reduce the generated arc energy to less than 5% of the arc energy released during an arcing time of 1 second.

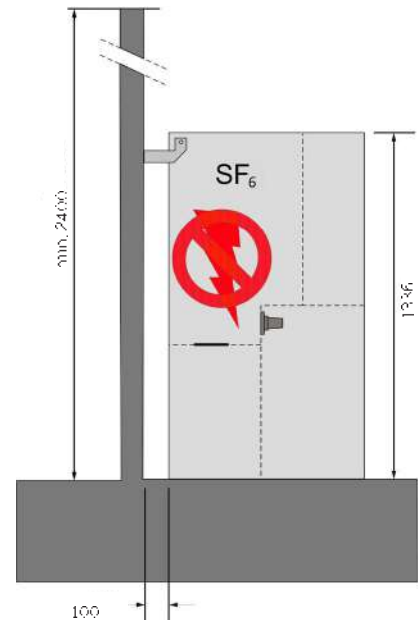
Since the system is self-contained, an internal arc fault in the tank will have no impact on the surroundings, so there will be no cleaning work required. No arc fault tests have to be repeated in combination with channel release systems or transformer stations.

Arc protection in IED (Intelligent Electronic Device)

Protection relays REF615 and REF620 IED can optionally be fitted with a fast and selective arc flash protection. It offers a two- or three-channel arc-fault protection system for arc flash supervision of different cable compartments of switchgear modules. Total tripping time is less than 100 ms.



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01



5.3 Interlocking and locking

Interlocks

The safety mechanical interlocks between switches are standard and detailed information is described for each module. They are set out by the IEC standards and are necessary to guarantee the correct operation sequence.

ABB safety interlocks enable the highest level of reliability, even in the case of an accidental error, and ensure operator safety.

Keys

The use of key interlocks is very important in realizing the interlocking logics between panels of the same switchgear or of other medium, low and high voltage switchgear. The logics are realized by means of distributors or by ringing the keys. The earthing switch closing and opening operations can be locked by means of keys. For a more detailed description, see dedicated interlocking pages for each module and chapter 28 "Key interlocks".

Padlocks

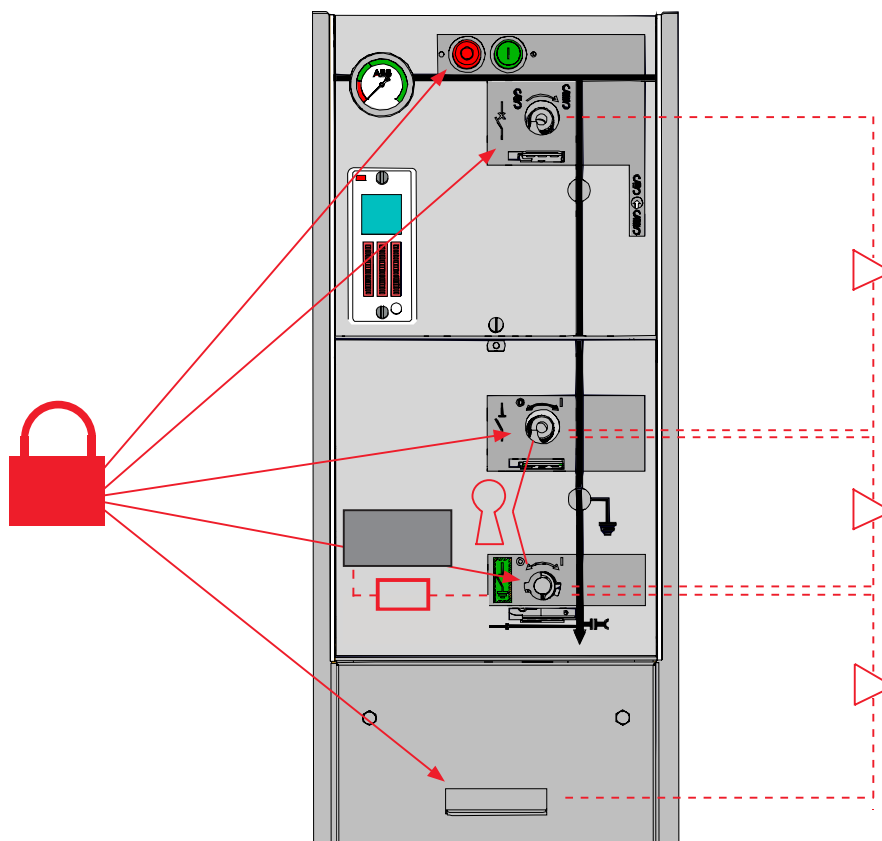
The cable compartment doors can be locked in the closed position by means of padlocks. The padlock can also be applied to the switches to avoid improper operation of the switchgear. For a more detailed description, see dedicated interlocking pages for each module. Padlocks from 4 to 8 mm diameter can be accommodated.

Blocking coil/electrical interlocking

The earthing switch closing/opening operations can be electrically interlocked by use of electrical blocking coils. Voltage presence system with signalling contact is required. For a more detailed description, see dedicated interlocking pages for each module.

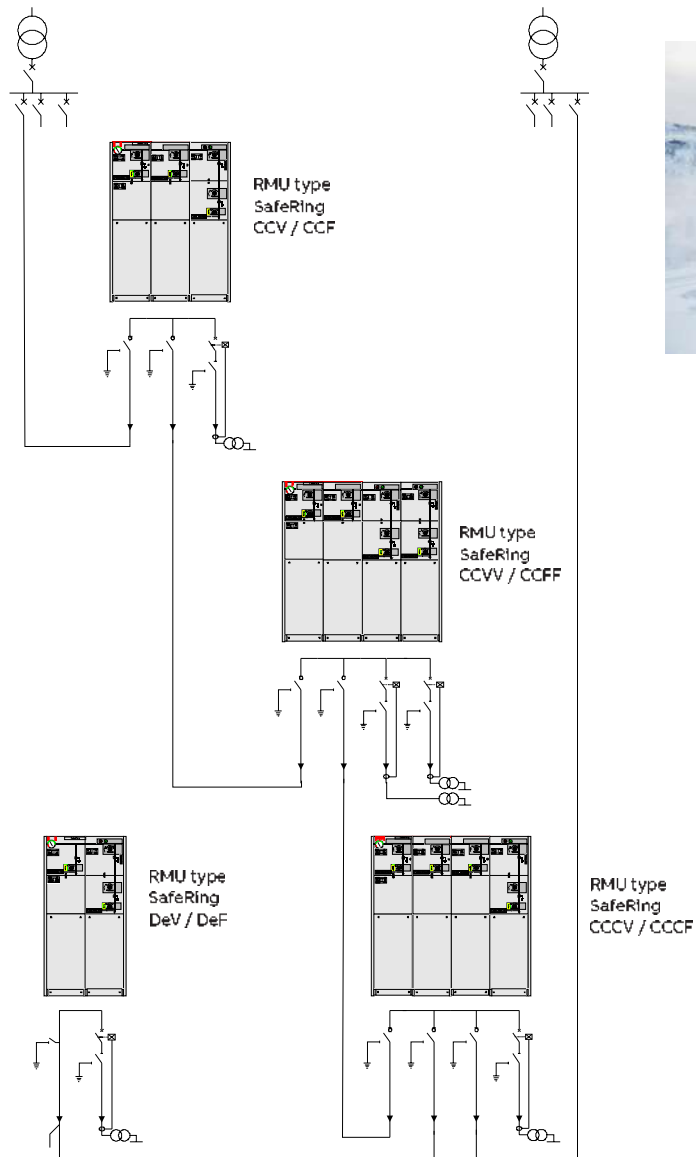
Undervoltage release

This release opens the circuit-breaker when there is a sharp reduction or cut in the power supply voltage. This is an optional feature.

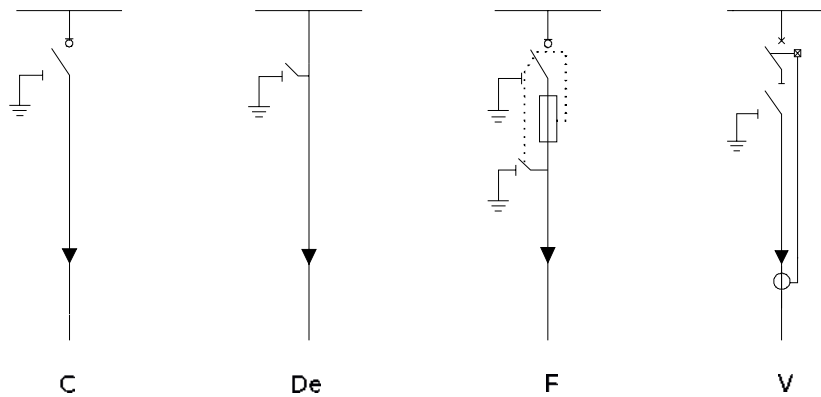


6 SafeRing

SafeRing installed in Compact Secondary Substations



6.1 Applications SafeRing



SafeRing is designed for use in the following applications:

- Compact secondary substations
- Small industries
- Wind power plants
- Solar/PV plants
- Hotels, shopping centers, office buildings, business centers etc.
- Light mining applications, airports, hospitals, tunnels and underground railways

Available modules:

- C Cable switch
- De Direct cable connection with earthing switch
- F Switch-fuse disconnector
- V Vacuum circuit-breaker

6.2 SafeRing configurations



General

SafeRing is a ring main unit for the secondary distribution network. SafeRing can be supplied in 10 different configurations suitable for most switching applications in 12/24 kV distribution networks. As an option, SafeRing can be delivered as an extendable ring main unit.

SafeRing is a completely sealed system with a stainless steel tank containing all the live parts and switching functions. A sealed steel tank with constant atmospheric conditions ensures a high level of reliability as well as personnel safety and a virtually maintenance-free system.

The SafeRing concept offers a choice of either a switch fuse combination or circuit breaker with relay for protection of the transformer. SafeRing can be supplied with an integrated remote control and monitoring unit and additional equipment which makes the switchgear more intelligent.

SafeRing is supplied with the following standard equipment

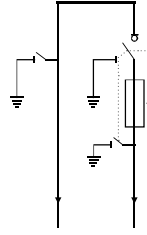
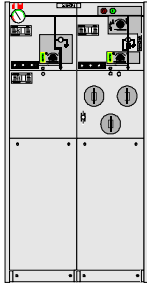
- Earthing switches
- Operating mechanisms with integrated mechanical interlocking
- Operating handle
- Facilities for padlocks on all switching functions
- Bushings for cable connection in front with cable covers
- Lifting lugs for easy handling
- All 3- and 4-way units are designed for the subsequent fitting of an integrated remote control and monitoring unit
- Cable compartment cover allowing surge arrester or double cable connection
- Busbar, 630A
- Earthing bar
- Capacitive voltage indication

Optional features

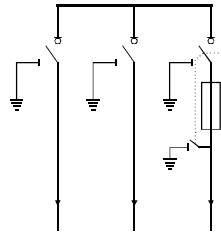
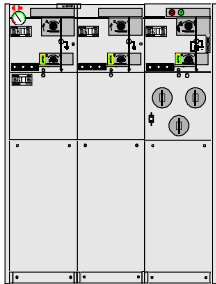
- Bushings for connection of external busbar on top of the ring main unit
- Bushings (inner cone type) for side connection (400A) (C-, F- and De-modules only)
- Bushings for cable testing, including earthing device (C- and De- modules only)
- Interlocking of compartment for cable test bushings
- Arc suppressor with signal (1NO) wired to terminals (only on incoming feeders)
- Arc proof and interlocked cable covers
- Signal (1NO) from internal pressure indicator wired to terminals (only one each SF₆ tank)
- Latched single spring mechanism for ring cable switch

Optional features also available as retrofit

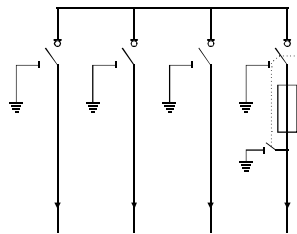
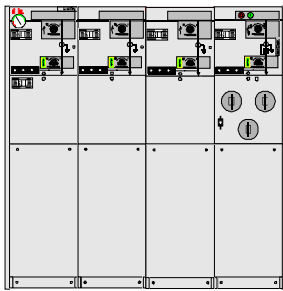
- Manometer for SF₆ pressure monitoring (temperature compensated)
- Integrated control and monitoring unit (ICMU)
- Integrated battery and charger
- Motor operation
- Trip coil open
- Trip coil open and close
- Auxiliary switch for load break switch position 2NO + 2NC
- Aux. switch for vacuum circuit breaker position 2NO + 2NC
- Aux. switch for disconnecter position 2NO + 2NC
- Aux. switch for earth switch position 2NO + 2NC
- Aux. switch for fuse blown 1NO
- Vacuum circuit breaker tripped signal 1NO
- Extra base frame (h=450 mm or 290 mm)
- Top entry box
- Relays and RTU (Remote Terminal Unit)
- Different key interlocking systems
- External current and voltage sensors for monitoring
- Fault passage indicators
- Cable compartment cover with inspection window
- Arc proof cable cover with inspection window
- Deep cable cover for double connection
- Cable support bars, non-magnetic or adjustable
- Earthing bar for surge arrester



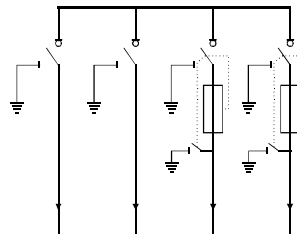
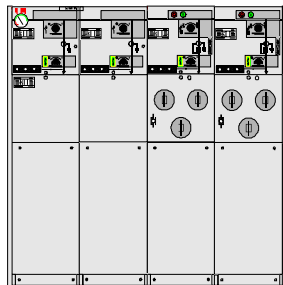
DeF
 Depth: 751mm
 Width: 696 mm
 Height: 1336/1100* mm



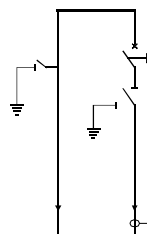
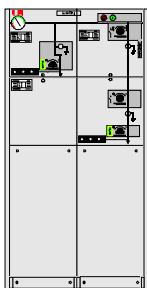
CCF
 Depth: 751 mm
 Width: 1020 mm
 Height: 1336/1100* mm



CCCF
 Depth: 751 mm
 Width: 1346 mm
 Height: 1336/1100* mm

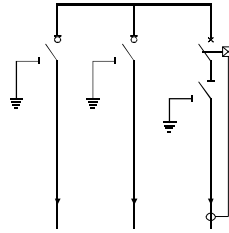
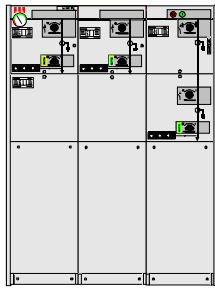


CCFF
 Depth: 751 mm
 Width: 1346 mm
 Height: 1336/1100* mm

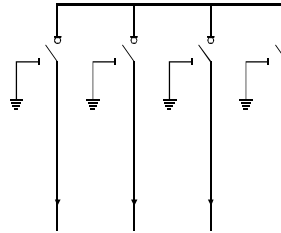
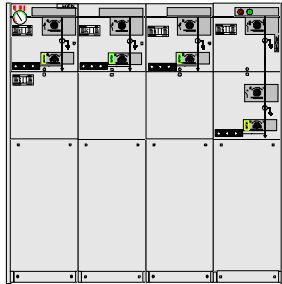


DeV
 Depth: 751 mm
 Width: 696 mm
 Height: 1336/1100* mm

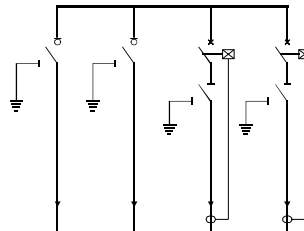
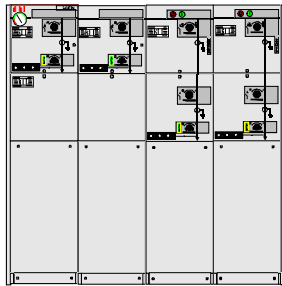
* 1100 mm version as optional solution



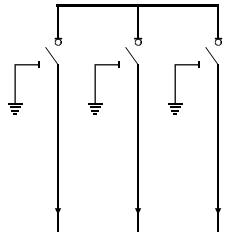
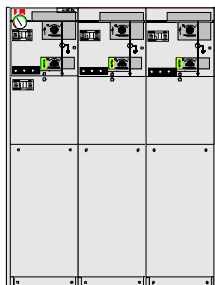
CCV
 Depth: 751 mm
 Width: 1020 mm
 Height: 1336/1100* mm



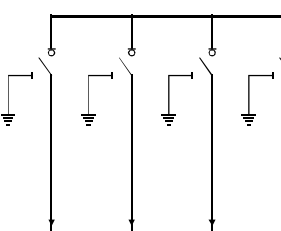
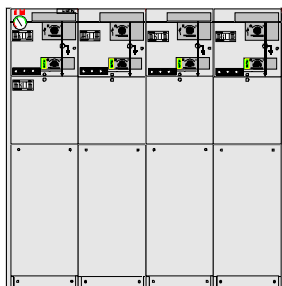
CCCV
 Depth: 751mm
 Width: 1346 mm
 Height: 1336/1100* mm



CCVV
 Depth: 751 mm
 Width: 1346 mm
 Height: 1336/1100* mm



CCC
 Depth: 751 mm
 Width: 1020 mm
 Height: 1336/1100* mm



CCCC
 Depth: 751 mm
 Width: 1346 mm
 Height: 1336/1100* mm

* 1100 mm version as optional solution

6.3 Technical data SafeRing

SafeRing	C-module		F-module		V-module		
	Switch disconnecter	Earthing switch	Switch-fuse disconnecter suppressor	Downstream earthing switch	Vacuum circuit-breaker	Earthing switch/disconnector	
Rated voltage	kV	12/17,5/24	12/17,5/24	12/17,5/24	12/17,5/24	12/17,5/24	12/17,5/24
Rated frequency ⁵⁾	Hz	50/50/50	50/50/50	50/50/50	50/50/50	50/50/50	50/50/50
Power frequency withstand voltage	kV	28 ⁴⁾ /38/50	28 ⁴⁾ /38/50	28 ⁴⁾ /38/50	28 ⁴⁾ /38/50	28 ⁴⁾ /38/50	28 ⁴⁾ /38/50
Lightning impulse withstand voltage	kV	95/95/125	95/95/125	95/95/125	95/95/125	95/95/125	95/95/125
Rated normal current	A	630/630/630		200 ¹⁾	200/200/200		
Breaking capacities:							
- active load	A	630/630/630					
- closed loop	A	650/650/650					
- off load cable charging	A	140/140/140					
- off load transformer	A			20/20/20			
- earth-fault	A	205/160/160					
- earth-fault cable charging	A	117/91/91					
- short-circuit breaking current	kA			see ²⁾		16/16/16	
Making capacity	kA	52,5/40/40	52,5/40/40	see ²⁾	12,5/12,5/12,5	40/40/40	40/40/40
Short time current 3 sec. ³⁾	kA	21/16/16	21/16/16			16/16/16	16/16/16

1) Depending on the current rating of the fuse-link

2) Limited by high voltage fuse-links

3) Maximum rating for bushings Interface C (400 series bolted)

4) GOST version is available with 42kV power frequency withstand voltage

5) For rated frequency 60Hz de-rating of current parameters needs to be applied