CATALOG

SafeRing / SafePlus 36

Gas-insulated medium-voltage switchgear

- Personal safety
- Compact dimensions
- Sealed system for lifetime

—

At ABB, we believe in a world in which nature and technology go hand in hand. A world in which powering your operations also means powering positive change – for your business and our planet. We strive to create products and solutions that make a difference. Our philosophy is that greener is smarter. And smarter is greener. That's the thinking behind our medium-voltage, secondary gas-insulated switchgear (GIS): SafeRing/SafePlus 36.

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Introduction

SafeRing and SafePlus switchgears for secondary distribution were developed by ABB in Skien, Norway and introduced to the markets in 2000, replacing the previous SF_6 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 Ring Main Units (RMU), which are the most required configurations within a distribution network, can be extensible 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
- 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

SafeRing and SafePlus provide complete, flexible and compact switchgear solutions. The completely sealed systems with a stainless steel tank, which contains all live parts and switching functions, ensure a high level of reliability, personnel safety and a virtually maintenance-free system. For fast delivery, SafeRing is available with pre-defined configurations for transformer and switching stations, or as consumer switchgear with connection to the DSO (Distribution System Operator) network. SafePlus offers flexible customized switchgear to cover all distribution needs, including advanced grid automation (smart RMUs).

Personnel Safety
Our design is able to protect personnel standing close to the switchgear during an internal arc fault. High safety with touch-proof design and no access to MV parts. To make maintenance and installation as safe as possible, we have included features such as padlockable handles, cover interlocks and gas pressure relief functions to our products. The system's features and design enable an outstanding level of safety and protection.

Compact dimesions
Specific functions such as earthing, disconnecting, cable connections, busbar extension, protection and switching are integrated functions in compact functional units.

Sealed for lifetime
The pressure system is defined as a sealed for life system with an operating lifetime better than 30 years. Very low maintenace requirement due to a sealed gas tank.

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

- IEC 62271–1: Common specifications for high-voltage switchgear and controlgear standards
- IEC 62271-100; Part 100: Alternating current circuit-breakers
- IEC 62271-102; Part 102: Alternating current disconnectors and earthing switches
- IEC 62271-103; Part 103: Switches for rated voltages above 1 kV up to and including 52 kV
- IEC 62271-105; Part 105: Alternating current switch-fuse combinations for rated voltages above 1 kV up to and including 52 kV
- IEC 62271-200; Part 200: AC metal-enclosed switchgear and control gear for rated voltages above 1 kV and up to and including 52 kV
- IEC 60529: Degrees of protection provided by enclosures (IP code)

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

Industries
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, Wind turbines, Solar/PV, Hydro power plants

Transport
Airports, Ports, Railways, Underground transport

Infrastructure
Hotels, Shopping centers, Hospitals, Commercial buildings, Large infrastructure and civil works

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

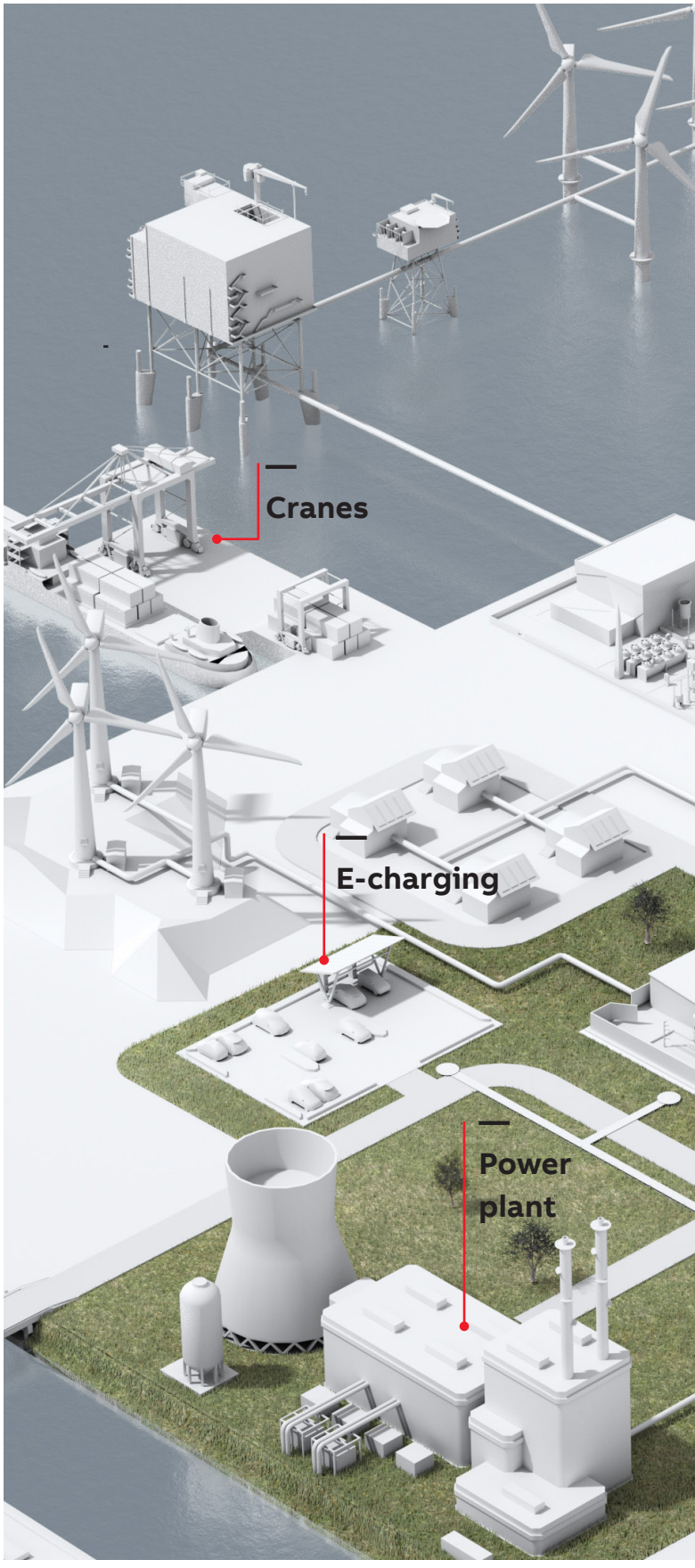
- minimum ambient temperature: - 25°C
- maximum ambient temperature: + 40°C

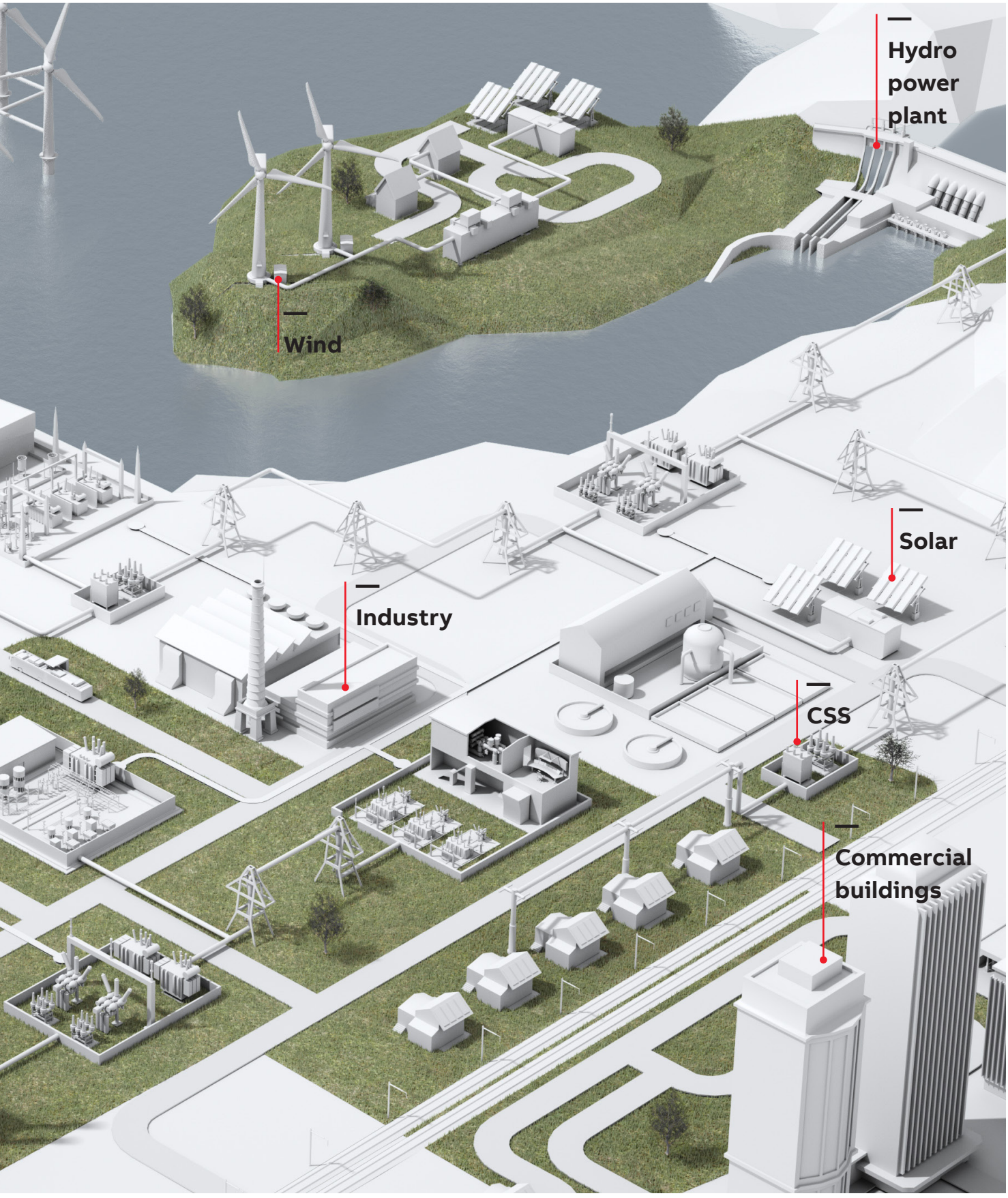
Ambient humidity

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

The normal operational altitude is up to 1500 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.




Hydro power plant
Wind
Solar
Industry
CSS
Commercial buildings

Introduction
Design Philosophy

SafeRing/SafePlus – ABB switchgears for secondary distribution
Secondary distribution switchgears have been the subject of significant development the past twenty years.

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 requirements. ABB has always been an part of this development.

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

Two products – One range
ABB SafeRing is adapted to the needs in the utility distribution networks. ABB SafePlus offers more flexibility and electrical capacity. Both switchgear's offer the same user 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 optimised switchgear operation. The functionality will always find its background from customer requirements.

Personnel – safety operation
All products are designed and manufactured in compliance with ISO 888,51, ISO 14001 and ISO 18001. The latest edition of relevant IEC standards will always apply to our continuous test programme. Safety is not only a specification and rating issue, but also a real life experience.
All units are factory routine tested according to international standards. ABB takes this further to be an objective related to durability and repetitive manufacturing quality. Features for further enhancing personnel safety are available. “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
SafeRing and SafePlus are manufactured in Norway. Green policy assures 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. Materials are carefully selected to ensure reuse at end of life. Recycling capability is 88,8% (for details see chapter "Environmental certification").
To facitilitate the recycling process we continuously work with our partners to improve end of life handling.

Modern - development and manufacturing
Numerical simulations together with long experience ensure a safe, reliable, compact and robust design.

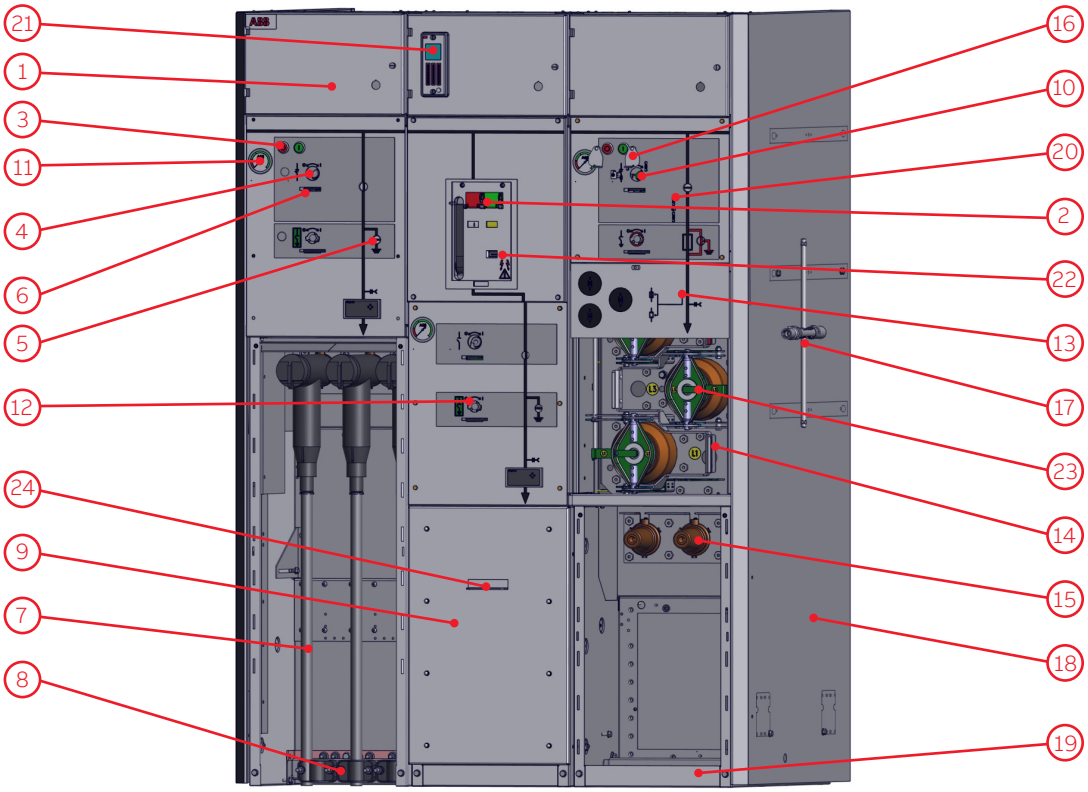
Dielectric simulations ensure that compactness does not influence the dielectrical capability.

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 remote control and monitoring can be supplied from ABB.

This makes large scale implementation feasible and simplifies engineering and procurement.

Introduction
Arrangement



1	Low voltage compartment	13	Fuse blown indicator
2	Operating mechanism for vac-uum circuit-breaker	14	Fuse canister
3	Push buttons	15	Cable bushing
4	Operating shaft load break switch	16	Lockable push buttons
5	Earthing switch position indicator	17	Operating handle
6	Padlock device	18	Side cover
7	Cable	19	Bottom list
8	Cable clamps	20	Charged spring indicator
9	Arc proof cable compartment	21	Self-powered protection relay
10	Operating shaft load break switch	22	Counter
11	Manometer	23	Fuse operating handle
12	Operating shaft earthing switch	24	Cable compartment handle

Introduction
Completely sealed system

Exteriour
Upper and lower front covers are made of 1,5mm aluzink and covered with a polycarbonate foil. These foils contain the mimic diagram of the main circuit with the position indicators for the switching devices. Background color for these foils is grey RAL 7035, which makes the black single line diagram stand out for easy reading of position indicators. Both the upper and lower front covers are removable.

Low voltage compartments are available in three different versions: integrated with front cover, integrated with hinged door and high with hinged door. For the high version, total height of the switchgear will be 2180 mm (2280 mm for metering module).

There are three different cable compartment covers: standard, arc proof and one with extra depth for parallel cables. All cable compartment covers are removable. Each module has a separate cable compartment which is divided from the others by means of partition walls.
A vertical partition wall is fitted to divide the cable compartment(s) from the rear side of the switchgear / ring main unit. In the event of an internal arc in a switchgear with arc proof classification IAC AFL the pressure relief disc in the bottom of the tank will open. This vertical partition wall will prevent the hot gases from entering the cable compartments. With arc proof classification IAC AFLR hot gases may enter the cable compartment.

Side covers are made of 1,25 millimeter hot rolled steel and powder painted in color RAL 7035.

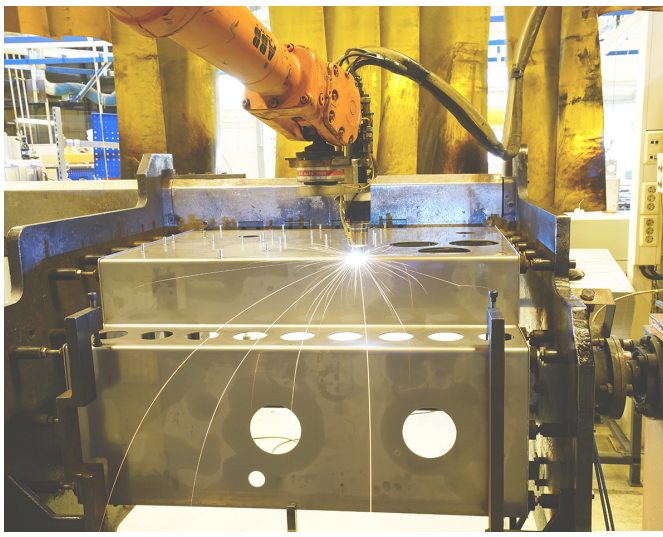
Enclosure
SafeRing/SafePlus 36 uses SF_6 gas (Sulfur hexafluoride) as insulation and quenching medium. The SF_6 is contained in a welded stainless steel enclosure.

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

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

All SF_6 enclosures are tested with helium to ensure there are no leakages before being filled with SF_6. Due to the characteristics of Helium, this test will detect any leakage. Leakage testing and gas filling are performed inside a vacuum chamber.

The SF_6 enclosure has a degree of protection of IP67. This means the SF_6 enclosure can be immersed into water and still maintain all functions in a satisfactory way.



Introduction
Factory routine tested

ABB utilizes 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.

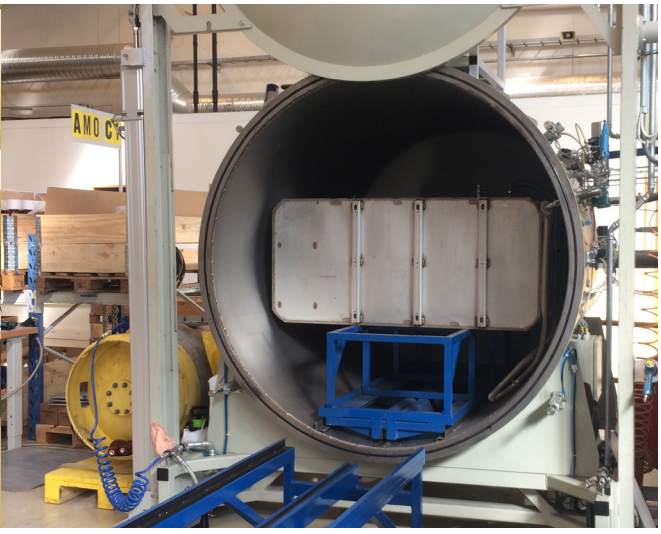
IEC factory routine tests:

- Visual inspection and check
- Mechanical sequence operations
- 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

ABB uses the latest technologies and systems for routine testing, for example:

- Fully automated high voltage testing cabin
- Temperature compensated gas filling system



Safety
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:

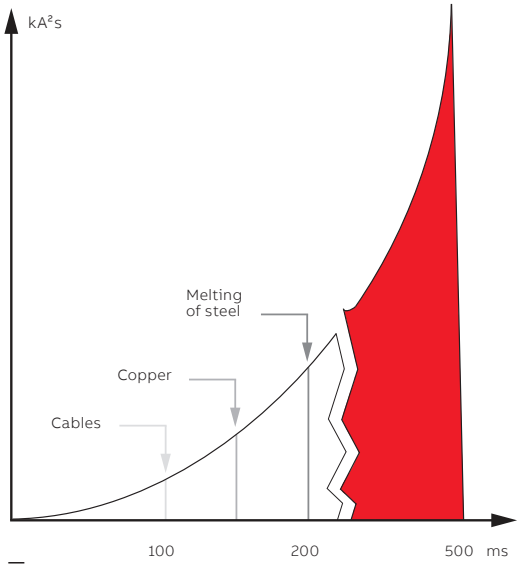
- Increase of the internal pressure.
- Increase of the temperature.
- Visual and acoustic effects.
- Mechanical stresses on the switchgear structure.
- Melting, decomposing and evaporation of materials.

Tested according to IEC standard 62271-200

The capability of SafeRing/SafePlus switchgear to withstand an 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)

F-Front = Access from the front
L-Lateral = Access from sides
R-Rear = Access from the rear



— 01

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 60g 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

Safety
Internal Arc Classification (IAC)

—
01 IAC AFL - with ventilation to the cable trench
—
02 IAC AFL - with ventilation behind the switchgear

SafeRing/SafePlus is avalible 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:

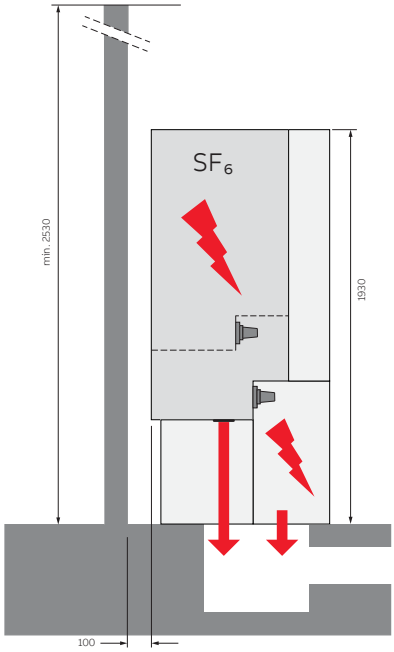
IAC AFL - with ventilation to the cable trench
With this setup, hot gasses and pressure are evacuated downwards in the cavity in the floor. The cable trench should to be at least two meters long, with an opening of minimum 0.5 m². Hot gasses are led to the cable trench by means of a back plate installed on the rear side of the cable compartment.

Basic parameters of setup:
IAC AFL up to 25 kA / 1 s
- Height of ceiling (switchgear height 1930 mm): min. 2530 mm
- Height of ceiling (switchgear height 1700 mm): min. 2300 mm
- Distance to backwall: min. 100 mm
- Distance to sidewall: min. 100 mm

IAC AFL - With ventilation behind the switchgear
With this setup, hot gasses and pressure are evacuated behind the switchgear, either if the arc fault occurs inside the SF6-tank or in the cable compartment. Hot gasses are led to the safe areas of the switchgear room.

Basic parameters of setup:
- IAC AFL up to 25 kA / 1 s
- Height of ceiling (switchgear height 1930 mm): min. 2530 mm
- Distance from backwall*: mon. 100 mm
- Distance from sidewall: min. 100 mm

*non-accesible rear side



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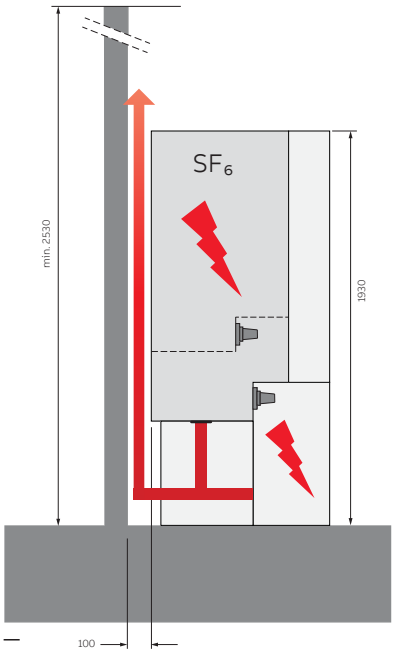

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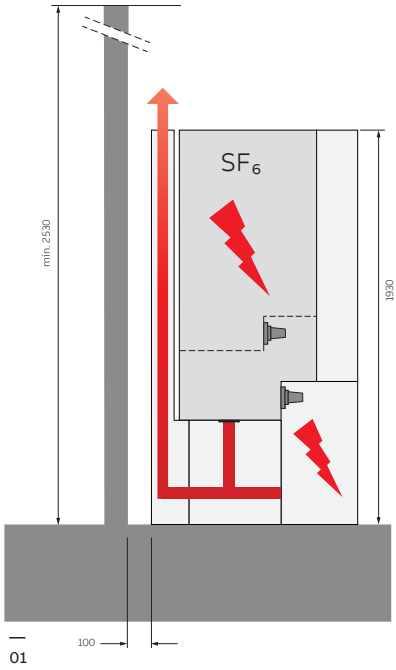
Safety
Internal Arc Classification (IAC)

—
01 IAC AFLr - with ventilation upwards through an exhaust channel
—
02 Non-arc proof version

IAC AFLR - with ventilation upwards through an exhaust channel
With this setup, hot gases and pressure are evacuated into the safe area of the switchgear room above the switchgear through the gas exhaust channel.

Basic parameters of setup:
- IAC AFLR (switchgear height 1930 mm) up to 25 kA / 1s
- Height of ceiling (switchgear height 1930 mm): min. 2530 mm
- Minimum distance from backwall:
  - min. 800 mm (with accessable rear side)
  - min. 100 mm (with non accessible rear side)
- Minimum distance from sidewall: min. 100 mm

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 gasses and pressure could evacuate randomly in any direction at any place of the enclosure.



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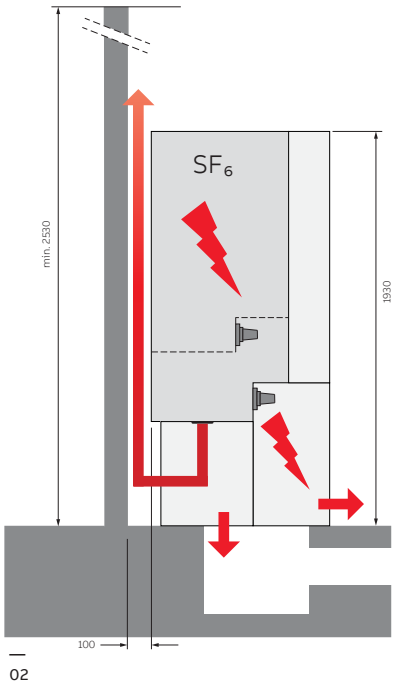

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ISC (kA)	IAC-class	Ventilation	Height of switchgear (mm)	Roof height (mm)	Arc suppressor	Base frame	Max sets of CTs
20	AFL	Downwards	1930/1700	2530/2300	optional	optional	2/1**
20	AFL	Backwards	1930	2530	optional	optional	2/1**
20	AFLR	Upwardswards	1930	2530	optional	optional	1
25	AFL	Backwards	1930	2530	optional	optional	1**
25	AFLR	Upwardswards	1930	2530	optional	optional	1

** In case two sets of CT's are required, open ventilation downwards to cable trench is mandatory

Safety
Arc suppressor

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01 Arc suppressor inside the tank
—
02 with Arc suppressor

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

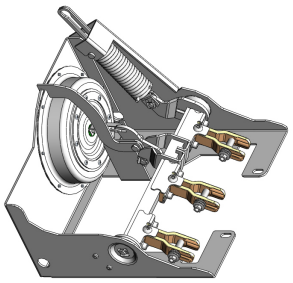
The pressure detector is insensitive to pressure changes due to variation in atmospheric temperature or pressure as well as external phenomena such as vibrations or shocks.

The arc suppressor will operate for short-circuit currents in the range of 5kArm s to 25kArms and it will reduce the generated arc energy to less than 5% of the arc energy released during an arcing time of 1 sec.

An optional signalling device (1NO) will provide local and/or remote indication that one or more arc suppressors has tripped.

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

The costs of the cleaning work required after an internal arc fault during which the release flap has opened are reduced to zero.



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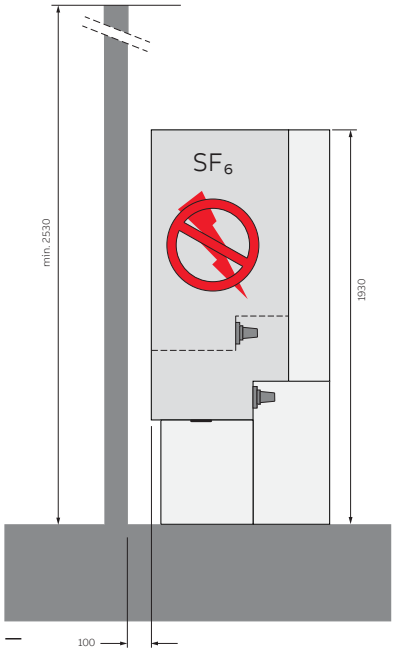

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02

Mechanisms

All operating mechanisms are situated outside the SF_6 enclosure behind the removable front covers with a degree of protection of IP2X. This allows for easy access to all operating mechanisms if retrofit or service should be required. The speed of operation of these mechanisms is independent of the operator.

As an option, all units can be equipped with interlocked cable covers. This will prevent access to the cable compartment before the earthing switch is in closed position. It will also be impossible to operate the switch disconnector to closed position before the cable compartment cover is put back in place.

Each mechanism is equipped with a padlocking device. When adding a padlock to this device, access to operate the mechanism will be impossible. This device has three holes; the diameter of suitable padlocks is 4 - 8 mm.

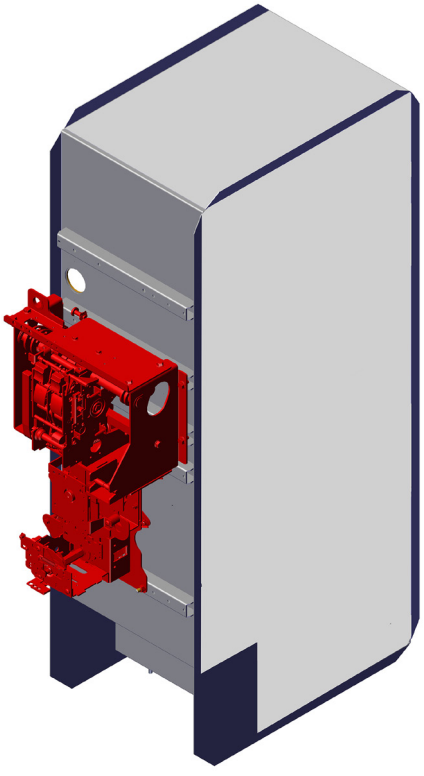
All operating mechanisms are equipped with true position indicators for all switches. In order to safeguard true indication, indicators are directly connected to the operating shafts of the switches inside the SF_6 tank.

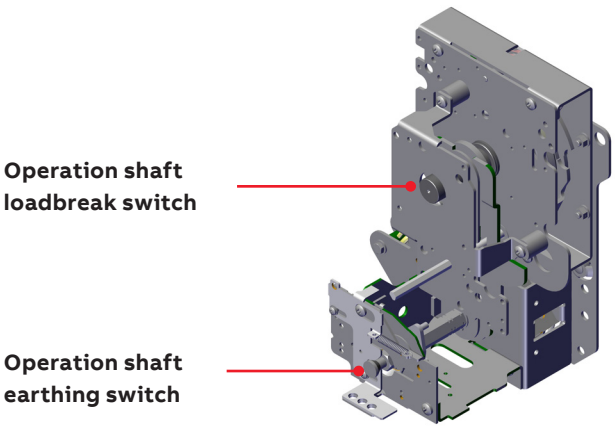
The operating handle has an anti-reflex system which prevents an immediate re-operation of the switch.
All steel parts have been electroplated with zinc and passivated against corrosion.

Cable switch module (C)
The mechanism (3PKE) has two operating shafts: the upper one for the load break switch and the lower one for the earthing switch.

Both shafts are single spring operated and they are directly connected to the switches inside the SF_6 enclosure. When both load break switch and earthing switch are in open position the switch satisfies the specifications of disconnector.

Due to the mechanical interlock between the upper and lower operating shafts, it is impossible to operate the load break switch when the earthing switch is in earthed position or operate the earthing switch when the load break switch is in closed position.





3PKE

Switch-fuse module (F)
The mechanism (3PAE) has two operating shafts: the upper one for the load break switch and the lower one for the earthing switch. The upper one operates two springs: one for closing and one for opening. Both springs are charged simultaneously. By means of mechanical push buttons it is then possible to close and open the load break switch.

The opening spring is always charged when the load break switch is in closed position and will then be ready to open the load break switch immediately if one of the HV fuses has tripped.

The lower shaft is single spring operated and operates the earthing switch inside the SF_6 enclosure.

The blown fuse(s) has/have to be replaced before the operator will be able to close the load break switch again. According to IEC 60282-1, all three fuse-links should be replaced, even if only one or two fuses have tripped.

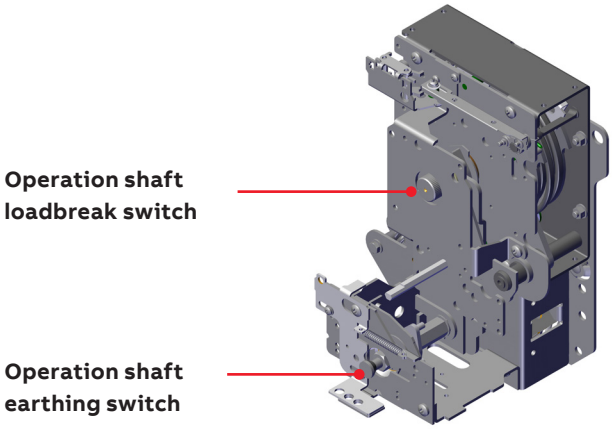
Due to the mechanical interlock between the upper and lower operating shafts, it is impossible to operate the load break switch when the earthing switch is in earthed position or operate the earthing switch when the load break switch is in closed position. It will also be impossible to access the fuse compartment before the earthing switch is in closed position.

Vacuum circuit-breaker (V)
This module has two mechanisms: the upper one (EL3) is for the circuit-breaker and the lower one (3PKE) with two operating shafts is for the disconnector and earthing switches. The vacuum circuit-breaker has the possibility of rapid auto-reclosing. By means of mechanical push buttons it is possible to close and open the circuit-breaker. The opening spring is always charged when the circuit-breaker is in closed position and will be ready to open immediately if the protection relay gives a trip signal. If the mechanism is recharged after closing, it is possible to perform an open - close - open sequence.

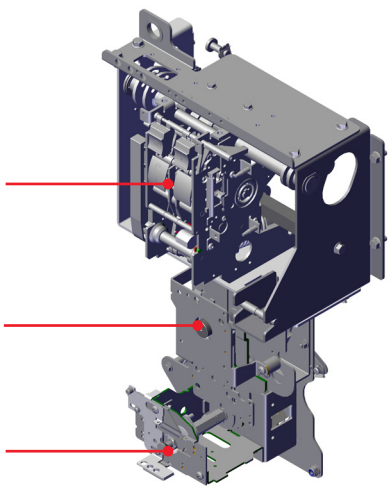
The lower mechanism is identical to the one described above for the cable switch module.

There is a mechanical interlock between these two mechanisms which prevents operating the disconnector when the circuit-breaker is in closed position.

When the earthing switch is in closed position it will be impossible to operate the disconnector, but the circuit-breaker can be closed for testing.



3PAE



EL3 (EL3S) + 3PKE

Interlocks
Interlocking and locking

—
01 Under voltage coil MU

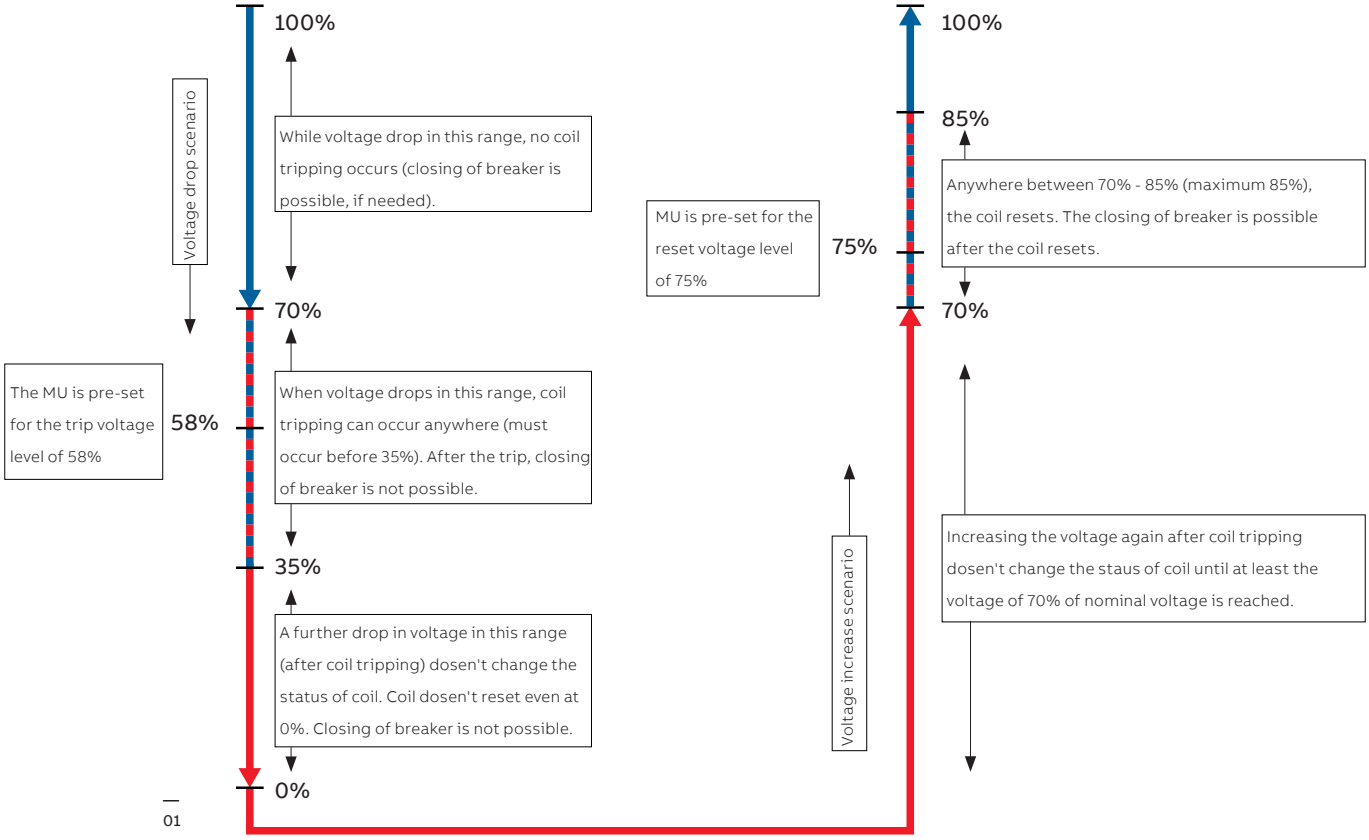
Interlocks
The safety mechanical interlocks between switches are standard; detailed information is provided for each module. They are set out by IEC standards and are necessary to guarantee the correct operation sequence. ABB safety interlocks enable the highest level of reliability, even in the case 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 with 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 the chapter “Key interlocks”.

Padlocks
As an option, the cable compartment doors of arc-proof switchgears 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 an electrical blocking coil. Vacuum circuit-breaker (VCB) closing can be blocked by use of electrical blocking coil. 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.



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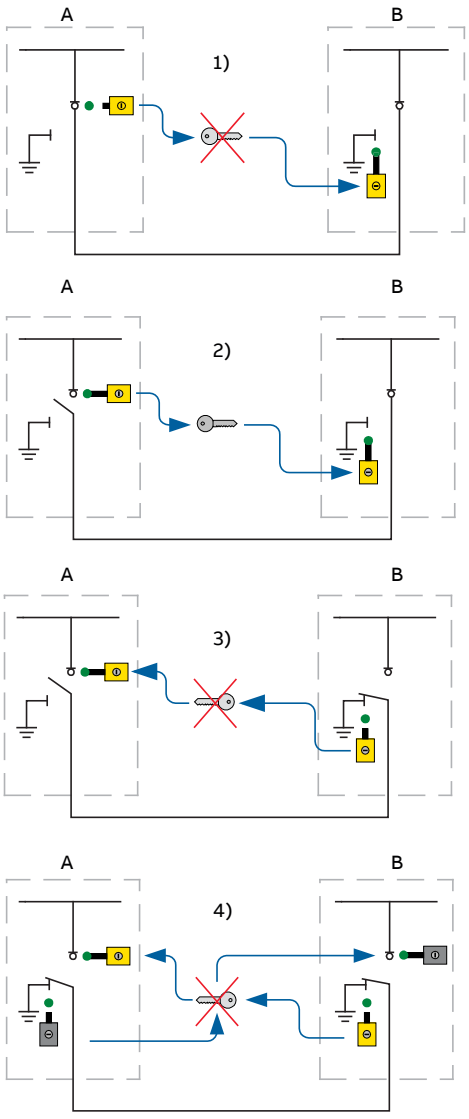
Interlocks
Key interlock

Key interlocks offer sequential control of SafeRing/SafePlus through that transfer of keys that are either trapped or released in a predetermined order. Bolt lock is default and recommended by ABB. For features, see table on the next page.

All load break switches, earthing switches and disconnectors can be equipped with any single key interlock. For double key interlock Ronis is the only type of key that fits ABB's switchgears. Fuse-switch and vacuum circuit-breaker switches cannot be equipped with a key interlock.



Example for single key interlock
Key interlocks can be used as follows:
Two switchgears A and B are connected to each other by cables. The purpose of interlocks is to prevent closing of the earthing switch unless the load break switch in the other switchgear is locked in open position.

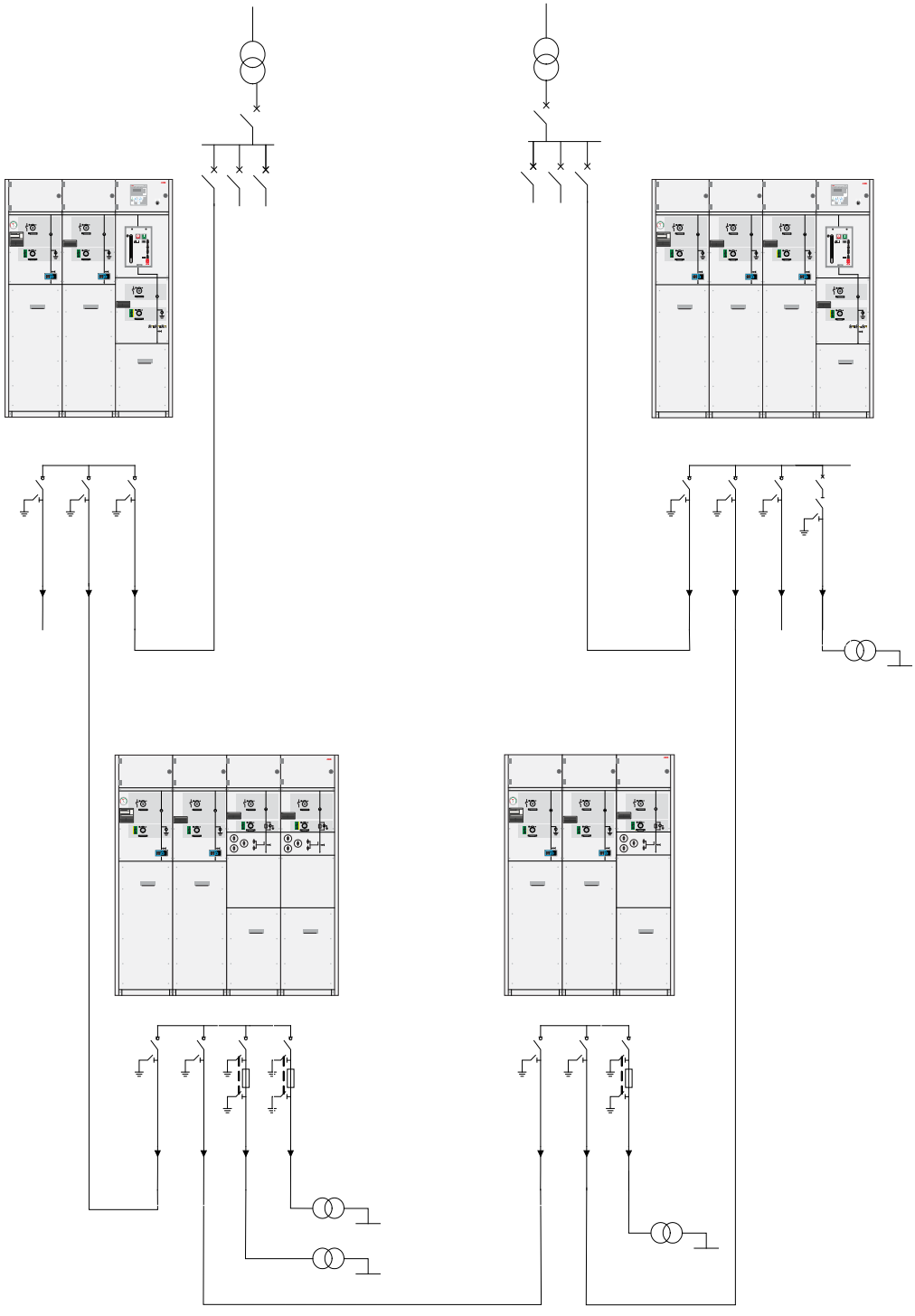
1. One key interlock will be mounted close to the operating shaft of the load break switch in switchgear A. An identical key interlock will be mounted close to the operating shaft of the earthing switch in switchgear B. As long as the load break switch in switchgear A is in closed position, it will be impossible to remove or operate the key in the key interlock.
2. First you have to operate the load break switch in switchgear A to open position. Then it will be possible to operate the key interlock and turn the key which extends the locking bolt. This will prevent access to the operating shaft of the load break switch. Then withdraw the key and insert it into the identical key interlock on the earthing switch of switchgear B.
3. When the key is inserted, you will be able to operate the key interlock and turn the key which will withdraw the extended locking bolt. Then there will be access to operate the earthing switch to closed position. As long as the earthing switch is in closed position, the key will be captured and make it impossible to close the load break switch in switchgear A.
4. If the load break switch in switchgear B and earthing switch in switchgear A are equipped with another identical key interlock which has a different key combination than described above, it will be impossible to make an earth connection of an incoming energized cable from either switchgear A nor B.

Another example for use of key interlocks is to prevent access to the distribution transformer before the primary side of the transformer is connected to earth. This can be solved by means of two identical key interlocks: one mounted on the earthing switch for the distribution transformer feeder and the other one on the door in front of the transformer.

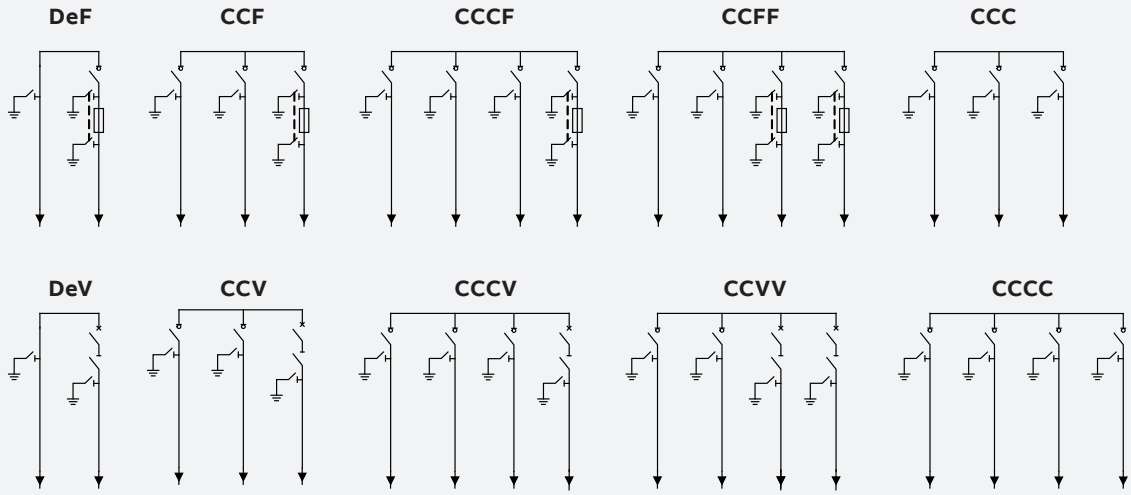
Interlocks
Key interlock

Types and features of locks							
C-module							
Type	**LBS off**	**LBS on**	**LBS on/off**	**ES off single key**	**ES on**	**ES on/off**	**Doorlock**
Bolt lock (Ronis type)	•	•	•	•	•	•	N/A
Castell	•	•	N/A	•	•	N/A	N/A
Kirk	•	•	N/A	•	•	N/A	N/A
F-module							
Type							
Bolt lock (Ronis type)	N/A	N/A	N/A	•	•	•	N/A
Castell	N/A	N/A	N/A	•	•	N/A	N/A
Kirk	N/A	N/A	N/A	•	•	N/A	N/A
V -module							
Type	**DS off**	**DS on**	**DS on/off double**				
Bolt lock (Ronis type)	•	•	N/A	•	•	•	N/A
Castell	•	•	N/A	•	•	N/A	N/A
Kirk	•	•	N/A	•	•	N/A	N/A
De-module							
Type							
Bolt lock (Ronis type)	N/A	N/A	N/A	•	•	•	N/A
Castell	N/A	N/A	N/A	•	•	N/A	N/A
Kirk	N/A	N/A	N/A	•	•	N/A	N/A
M-module *)							
Type							
Bolt lock (Ronis type)	N/A	N/A	N/A	N/A	N/A	N/A	•
Castell	N/A	N/A	N/A	N/A	N/A	N/A	•
Kirk	N/A	N/A	N/A	N/A	N/A	N/A	•

SafeRing
Applications



SafeRing
Applications



SafeRing is a ring main unit for the secondary distribution network. SafeRing is available in 10 different configurations suitable for most switching applications in 36 and 40,5 kV distribution networks. SafeRing is extendible and can be combined with SafePlus.

SafePlus is ABB's flexible compact switchgear. Together they represent a complete solution for 36 kV secondary distribution networks. SafeRing and SafePlus have identical user interfaces.

SafeRing is a completely sealed system with a stainless steel tank containing all live parts and switching functions. A hermetically sealed stainless 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 between switch-fuse combination or circuit-breaker in combination with relay for protection of the transformer. SafeRing can be supplied with an integrated remote control and monitoring unit.

SafeRing is designed for use in the following applications:

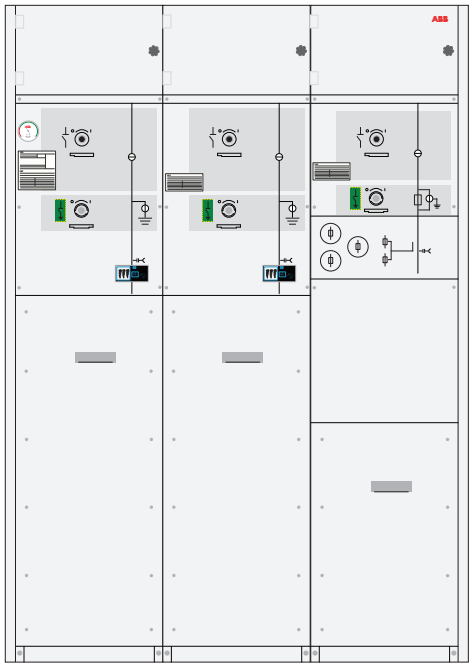
- Compact secondary substations
- Small industries
- Hotels, shopping centres, office buildings, business centers etc.

Available modules:

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

SafeRing
Configurations

01 SafeRing CCF



SafeRing is supplied with the following standard equipment

- Vacuum circuit-breaker (only for V-panels)
- Two-position load break puffer switch
- Earthing switch with single spring operating mechanism
- Switch position indication for load break switches and earthing switches
- Single spring operating mechanism on cable switches
- Two-position mechanism with auto-reclosing duty for vacuum circuit-breaker
- Double spring operating mechanism on switch-fuse-disconnectors
- Front-facing, horizontal 400 series bolted cable bushings with integrated voltage divider for voltage indication
- Busbars, 630A
- Earthing bar
- Operating handle
- Lifting lugs for easy handling
- Manometer for SF6 pressure
- Sidewalls - painted

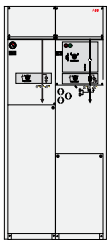
Factory assembled options

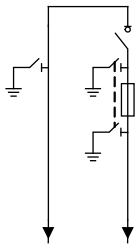
- Integrated control and monitoring unit (ICMU)
- Bushings for extension busbar
- Interlocking
- Cable compartment front cover interlocked with earthing switch
- Signal (1NO/1NC) from internal pressure indicator wired to terminals (one each SF_6 enclosure)

Additional equipment also available as retrofit

- Motor operation
- Trip coil open
- Trip coil open and close
- Auxiliary switch for load break switch 2NO + 2NC
- Auxiliary switch for earth switch 2NO + 2NC
- Auxiliary switch for fuse blown 1NO
- Auxiliary switch for vacuum circuit-breaker 2NO+2NC
- Capacitive voltage indication
- Short circuit indicator
- Cable cover for parallel cables
- Adjustable cable support bars
- Key interlocking system, EL 11 AP
- Current measuring

SafeRing
Configurations





DeF
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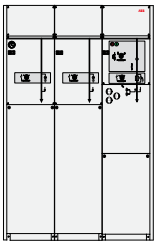
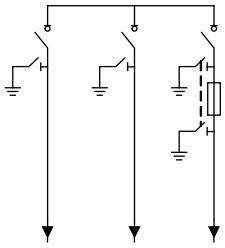
Height: 1930 mm





CCF
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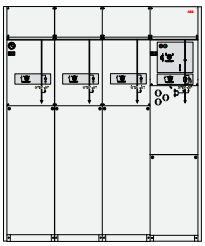
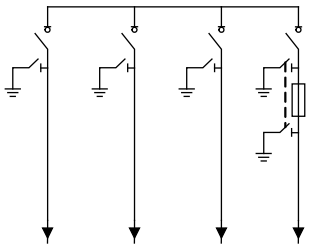
Height: 1930 mm





CCCF
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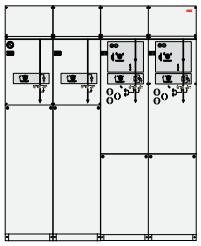

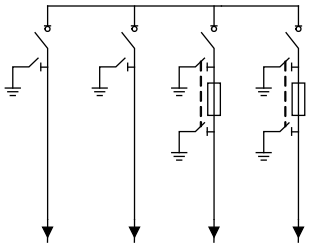

CCFF
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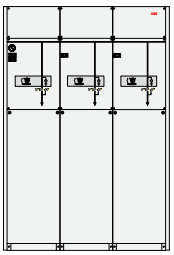
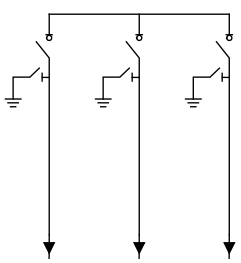
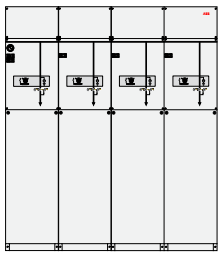
Height: 1930 mm

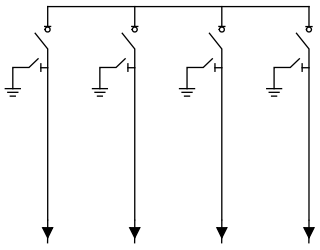




CCC
Depth: 888,5 mm
Width: 1330 mm
Height: 1930 mm

SafeRing
Configurations





CCCC
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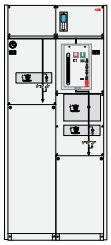

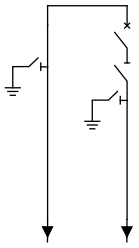

DeV
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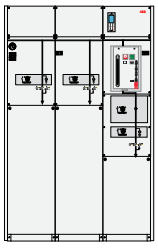
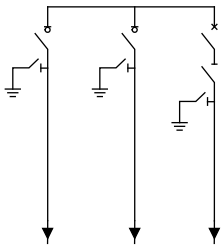
Height: 1930 mm





CCV
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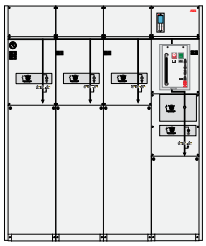
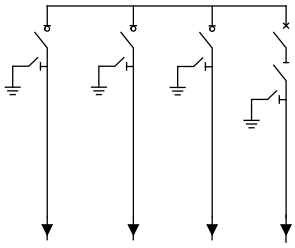
Height: 1930 mm





CCCV
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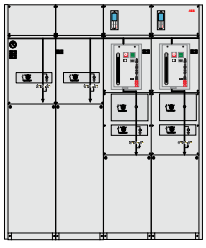
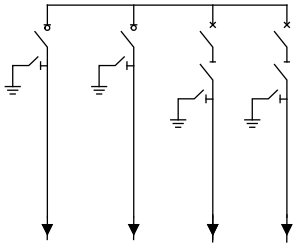
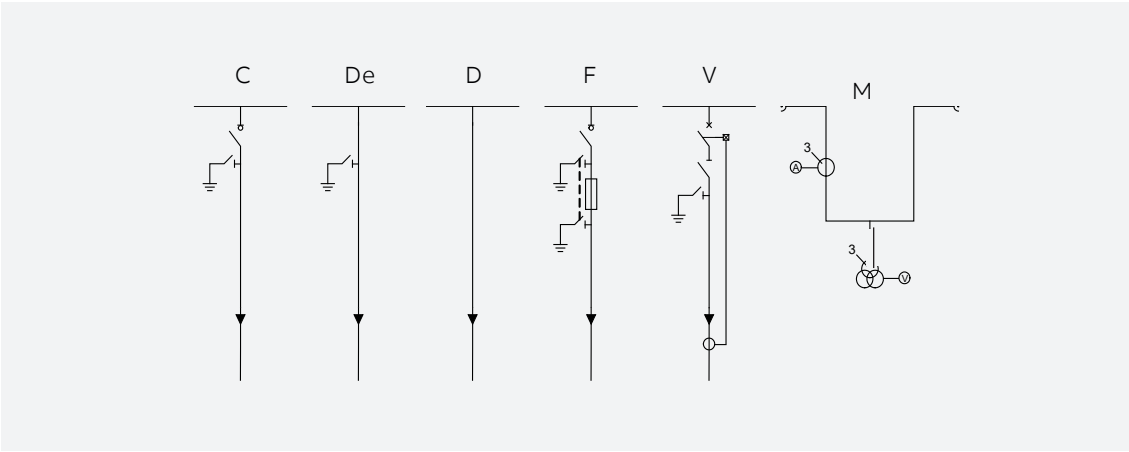
Height: 1930 mm





CCVV
Depth: 888,5 mm
Width: 1750 mm
Height: 1930 mm

SafePlus
Applications



SafePlus is designed for customised application of switchgear in:

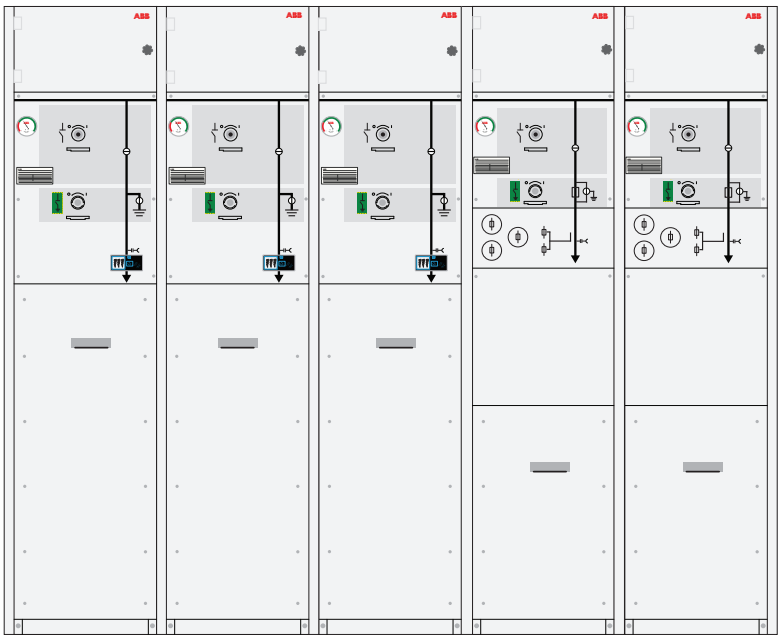
- Compact secondary substations
- Small industries
- Wind power plants
- Hotels, shopping centres, office buildings, business centers etc.

Available modules:

C	Cable switch
De	Direct cable connection with earthing
D	Direct cable connection
F	Switch-fuse-disconnector
V	Vacuum circuit-breaker
M	Metering module (air-insulated)

SafePlus compact switchgear in fully modular design, typical configuration:

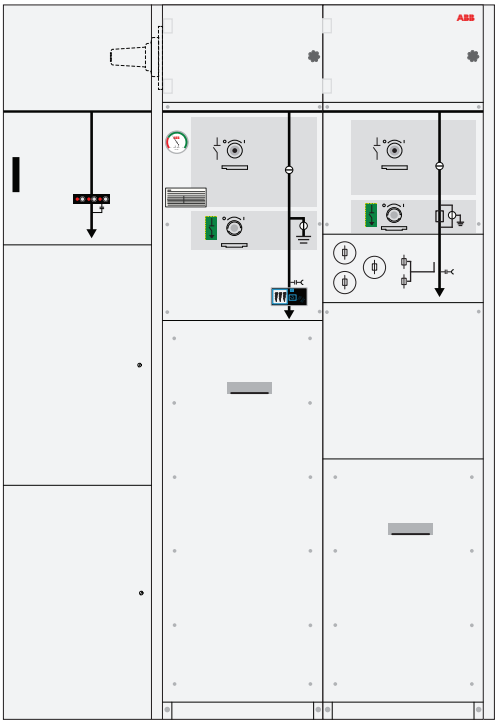
- 3 fully modular cable switch panels
- 2 fully modular switch-fuse-disconnector panels



SafePlus
Applications

SafePlus compact switchgear, typical configuration:

- 3-function switchgear consisting of 3 switch-fuse-disconnector panels in a compact SF_6 tank
- Extendible with 1- or 2-way units



SafePlus compact switchgear, typical wind turbine configuration:

- 2-function switchgear consisting of 1 cable switch and 1 vacuum circuit-breaker
- 1 set of cable bushings on left hand side for direct cable connection

SafePlus
Modules

—
01 SafePlus CCV

—
01

General
SafePlus is a metal enclosed compact switchgear system for up to 40,5 kV distribution applications. The switchgear has a unique flexibility due to its extendibility and the possible combination of fully modular and semi-modular configurations.

SafePlus is a completely sealed system with a stainless steel tank containing all the live parts and switching functions.

The sealed steel tank with constant atmospheric conditions ensures a high level of reliability, personnel safety and a virtually maintenance-free system. As an option, SafePlus can be equipped with a set of busbar connections on the left and/or right side to allow for extension or full modularity.

The panels of modular or extended switchgears must be connected on site using an external busbar kit.

The SafePlus system offers a choice between switch-fuse combination or circuit-breaker in combination with relay for protection of the transformer.

SafePlus can also be supplied with or retrofitted with remote control and monitoring equipment.

SafePlus is supplied with the following standard equipment:
- Operating handle
- Lifting lugs for easy handling
- Busbars, 630 A
- Earthing bar
- Manometer for SF_6 pressure
- Sidewalls - painted

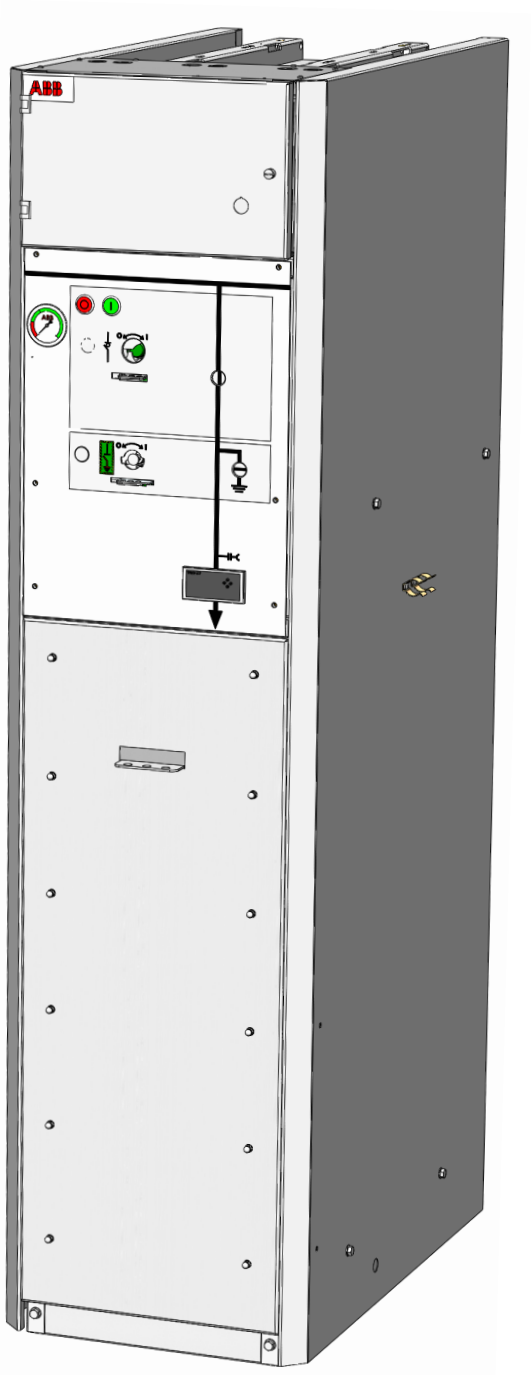
Factory assembled options
- Bushings for extension busbar
- Signal (1NO/1NC) from internal pressure indicator wired to terminals (one for each SF_6 enclosure)

Additional equipment also available as retrofit
- Integrated control and monitoring unit (ICMU)
- Adjustable cable support bars

SafePlus
C - Cable switch

The cable switch (C-Module) is a two position switch-disconnector using SF_6 gas as an arc quenching medium with a separate earthing switch.

The switch positions are close and open. In the open position the switch satisfies the disconnector requirements.

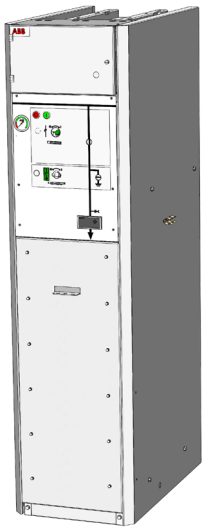


SafePlus
C - Cable switch - features

Standard features
- Two-position load break puffer switch and separate earthing switch
- Two-position single spring operating mechanisms with two separate operating shafts for load break function and earthing function
- Switch position indication for load break switch and earthing switch
- Front-facing, horizontal 400 series bolted cable bushings with integrated voltage divider for voltage indication
- Cable compartment cover allowing double cable connection cable adapters
- Busbars, 630A
- Earthing bar

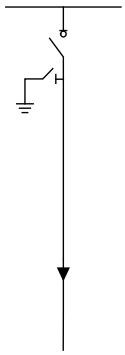
Factory assembled options
- Interlocking Cable compartment front cover interlocked with earthing switch

Additional equipment also available as retrofit
- Motor operation for load break switch
- Auxiliary switches
  - Load break switch position 2NO+2NC
  - Earthing switch position 2NO+2NC
- Capacitive voltage indicator
  - VPIS with integrated indicator lamps (LED)
  - HR- module (VDS)
- Short circuit and earth fault indicator
- External current transformers (CT)
- Key interlock



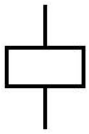
Depth:	888,5 mm
Width:	420 mm
Height:	1930 mm *)

*) Height with high LV-compartment: 2180 mm



SafePlus
C - Cable switch - interlocking

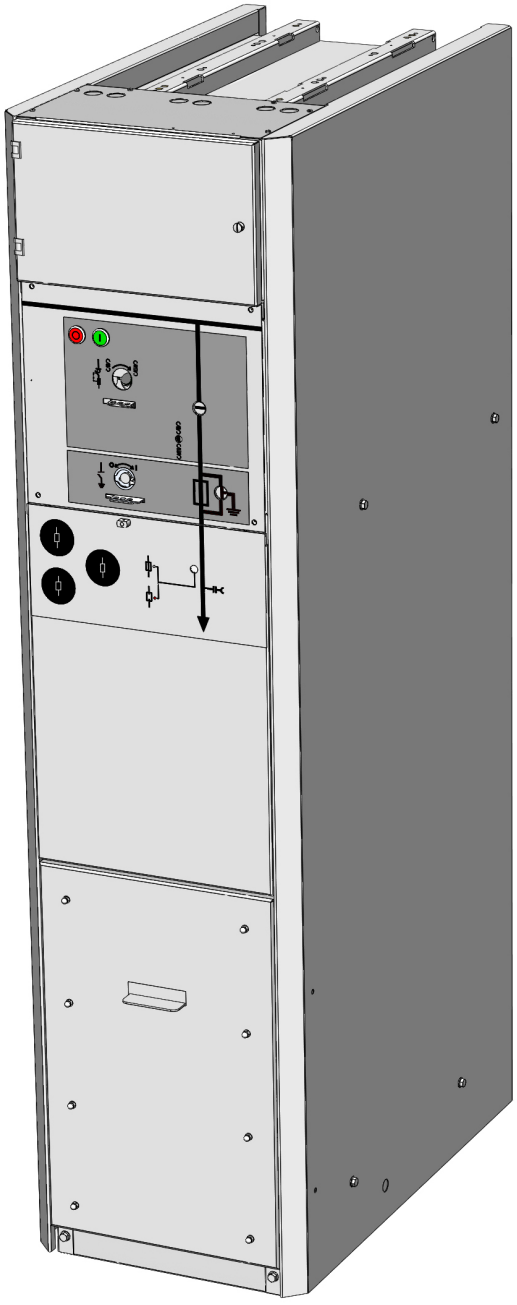
Abbreviations	
LBS	Load break switch
ES	Earthing switch
CB	Circuit breaker
DC	Disconnector
SF	Switch-fuse

Interlock type	Operation	Condition	Comment
Mechanical interlock C-module 	Closing LBS	ES is open, cable compartment cover is on	Cable compartment interlock is optional
	Opening LBS	ES is open, cable compartment cover is on	Cable compartment interlock is optional
	Closing ES	LBS is open	Standard
	Opening ES	LBS is open	Standard
	Opening cable compartment	ES is closed	Cable compartment interlock is optional
	Closing cable compartment	ES is closed	Cable compartment interlock is optional
Electrical interlock C-module 	Remote operation of LBS	Gas pressure in tank is under treshold	Optional feature. Manometer with signalling contact, contact can be used only for signalling purposes
	Closing ES	Incoming cable is without voltage	Optional feature. Voltage presence System with signalling contact is required.
Padlocks C-module Padlocks to be provided by customer 	Lock on LBS	None	Standard feature (Diameter of padlock: 8 mm)
	Lock on ES	None	Standard feature (Diameter of padlock: 8 mm)
	Lock cable compartment cover in closed position	None	Optional feature for arc proof cable compartment. Not possible for non-arc proof cable compartment. (Diameter of padlock: 8 mm)
	Lock cable compartment cover in open position	None	Optional feature for arc proof cable compartment. Not possible for non-arc proof cable compartment. (Diameter of padlock: 8 mm)
	Lock on local push buttons	None	Optional feature (Diameter of padlock: 8 mm)
Key interlock C-module 	Key lock on LBS	See details in chapter Interlocks “Key interlocks”	Optional feature
	Key lock on ES	See details in chapter Interlocks “Key interlocks”	Optional feature

SafePlus
F - Switch-fuse disconnector

The switch-fuse combination (F-Module) is a two position switch diconnector with a separate earthing switch. By means of the fuse tripping device it operates as a switch-fuse combination. There is a double earthing switch which in the earthed position connects earth to both sides of the fuses simultaneously. Both earthing switches are operated in one operation.

The switch-fuse and earthing switch is mechanically interlocked to prevent hazardous access to the fuses. The lower cover which gives access to the fuses is also mechanically interlocked with the earthing switch.

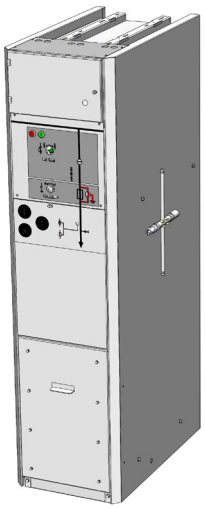


SafePlus
F - Switch-fuse disconnector - features

Standard features
- Fuse/transformer rating: 36 kV, max 63 A fuse-links
- Switch position indication for switch-fuse-disconnector and earthing switches
- Double spring mechanism for switch-fuse-disconnector with two separate operating shafts for load break function and earthing function
- Fuse canisters for DIN type fuse-links. Only accessible when earthing switch is closed
- Fuse tripping arrangement
- Optical fuse trip indication
- Cable bushings horizontal in front, 400 series bolted with integrated voltage divider for voltage indication
- Cable compartment allowing double cable connection
- Main busbars, 630 A
- Earthing bar

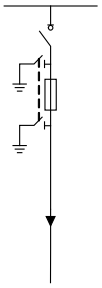
Factory assembled options
Cable compartment front cover interlocked with earthing switch

Additional equipment also available as retrofit
- Motor operation for switch-fuse-disconnector
- Trip coil open
- Trip coil open and close
- Auxiliary switches :
  - Switch-fuse-disconnector position 2NO+2NC
  - Earthing switch position 2NO+2NC
  - Fuse blown 1 NO
- Capacitive voltage indicator
  - VPIS with integrated indicator lamp (LED)
  - HR- module (VDS)
  - Key interlock on earthing switch



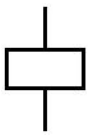
Depth:	888,5 mm
Width:	420 mm
Height:	1930 mm *)

*) Height with high LV-compartment: 2180 mm



SafePlus
F - Switch-fuse disconnector - interlocking

Abbreviations	
LBS	Load break switch
ES	Earthing switch
CB	Circuit breaker
DC	Disconnector
SF	Switch-fuse

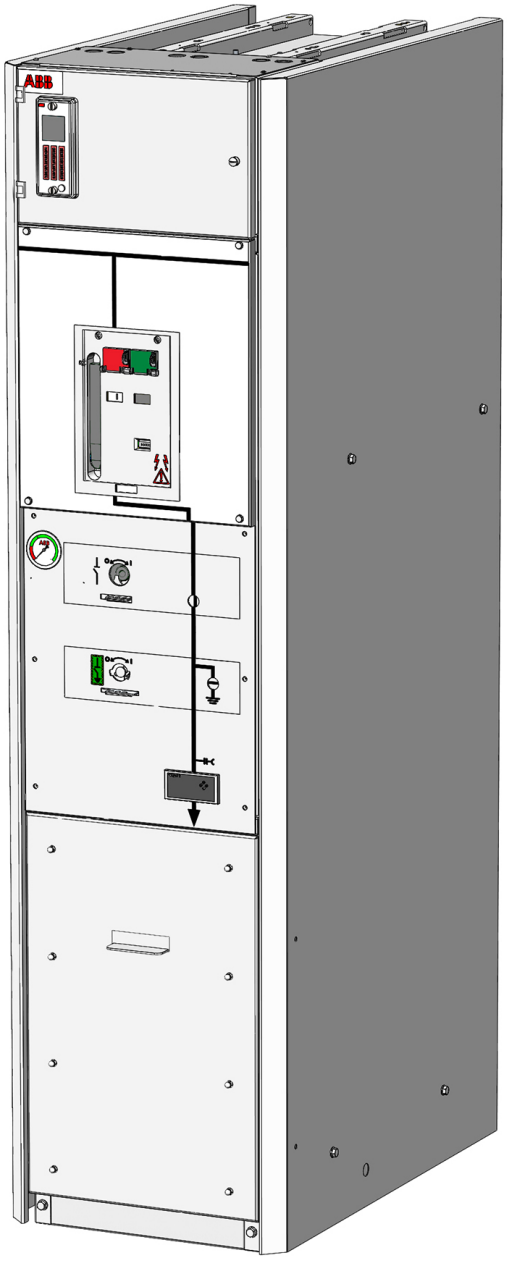
Interlock type	Operation	Condition	Comment
Mechanical interlock C-module 	Closing SF	ES is open, fuse striker pin has not triggered, cable compartment cover is on	Cable compartment interlock is optional
	Opening SF	ES is open	Standard
	Closing ES	SF is open, fuse door panel is closed	Standard
	Opening ES	SF is open, fuse door panel is closed	Standard
	Opening fuse door panel	ES is closed	Standard
	Closing fuse door panel	ES is closed	Standard
	Opening cable compartment	ES is closed	Optional feature
	Closing cable compartment	ES is closed	Optional feature
Electrical interlock F-module 	Closing ES	Incoming cable is without voltage	Optional feature. Voltage presence System with signalling contact is required.
Padlocks F-module Padlocks to be provided by customer 	Lock on SF	None	Standard feature (Diameter of padlock: 8 mm)
	Lock on ES	None	Standard feature (Diameter of padlock: 8 mm)
	Lock cable compartment cover in closed position	None	Optional feature (Diameter of padlock: 8 mm)
	Lock cable compartment cover in open position	None	Optional feature (Diameter of padlock: 8 mm)
	Lock on push buttons	None	Optional feature (Diameter of padlock: 8 mm)
Key interlock F-module 	Lock on SF		
	Key lock on ES	See details in chapter Interlocks “Key interlocks”	Optional feature

SafePlus
V - Vacuum circuit-breaker (VCB Mk1)

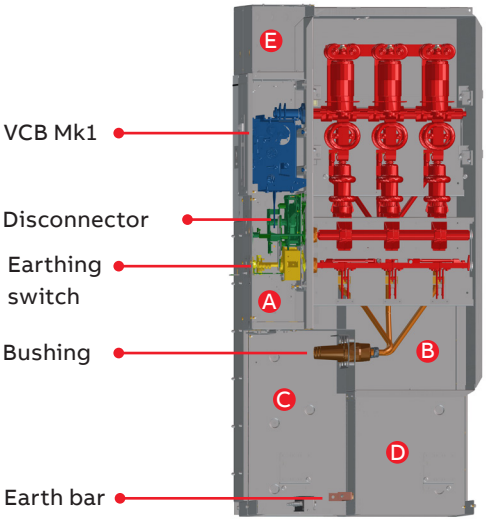
The vacuum circuit-breaker (V-module MK1) has vacuum interrupters for short-circuit current interruption.

A two-position disconnector is connected in series with the circuit-breaker. After the disconnector has been opened the integrated down-stream earthing switch can be closed.

The operation between vacuum circuit-breaker and disconnector as well as between disconnector and earthing switch are mechanically interlocked.



Modular structure V-module
The vacuum switch panel consists of the circuit-breaker, disconnector and earthing switch in compartment A, busbar compartments B, the cable termination compartment C, the pressure relief duct D for the busbar compartment and for the cable termination compartment and the low-voltage compartment E.

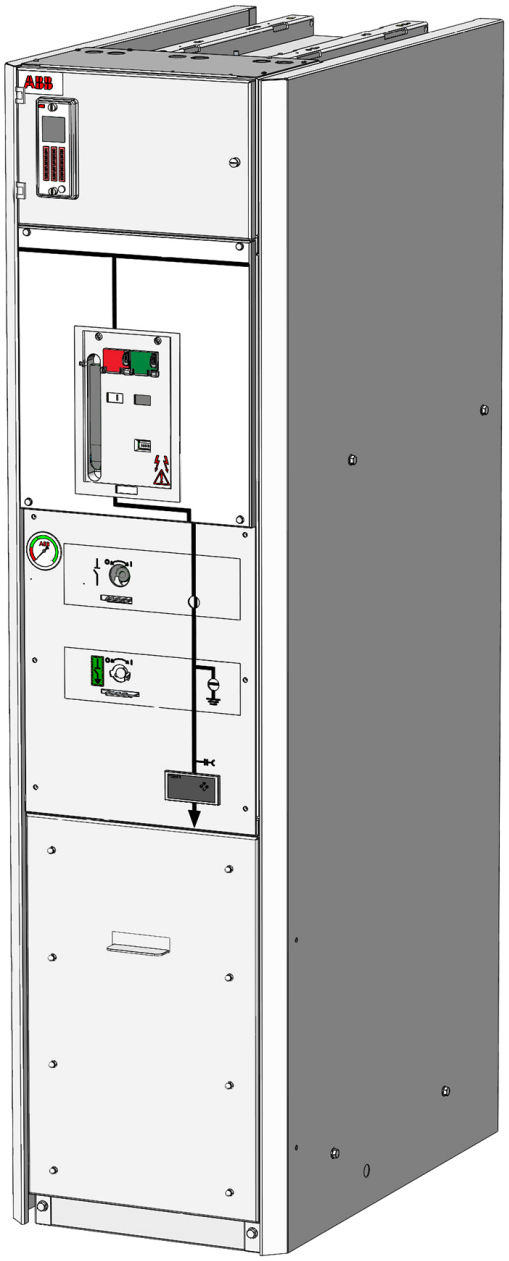


SafePlus
V - Vacuum circuit-breaker (VCB Mk2)

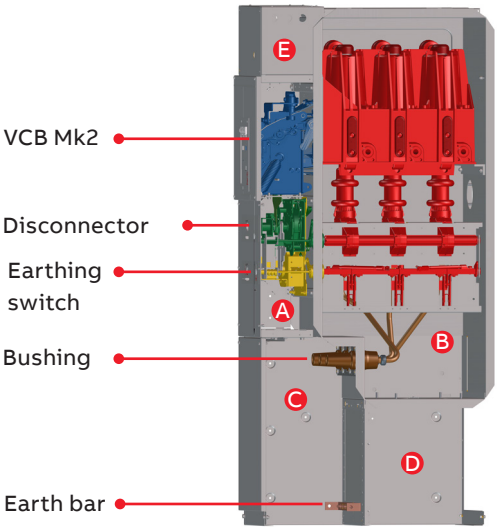
The vacuum circuit-breaker (VCB Mk2) fulfil M2 mechanical endurance class and has vacuum interrupters for short-circuit current interruption.

A two-position disconnector is connected in series with the circuit-breaker. After the disconnector has been opened the integrated down-stream earthing switch can be closed.

The operation between vacuum circuit-breaker and disconnector as well as between disconnector and earthing switch are mechanically interlocked.



Modular structure V-module
The vacuum switch panel consists of the circuit-breaker, disconnector and earthing switch in compartment A, busbar compartments B, the cable termination compartment C, the pressure relief duct D for the busbar compartment and for the cable termination compartment and the low-voltage compartment E.

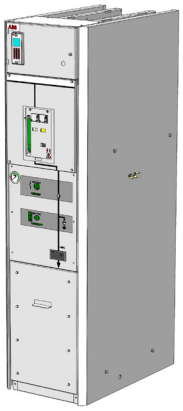


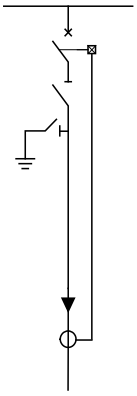
SafePlus
V - Vacuum circuit-breaker - features

Standard features
- 630A vacuum circuit-breaker
- Two position mechanism with auto-reclosing for vacuum circuit breaker
- Two position operating mechanisms for the downstream disconnector and earthing switches
- Interlocking between vacuum circuit-breaker and disconnector
- Switch position indication for vacuum circuit-breaker, disconnector and earthing switch
- Self powered electronic protection relay ABB type REJ603 with ring core CTs on cables
- Trip coil (for relay tripping)
- Cable bushings horizontal in front, 400 series bolted with integrated voltage divider for voltage indication
- Cable compartment cover allowing double cable connection
- Main busbar, 630A
- Earthing bar

Factory assembled options
- Bushings for connection of external busbars or cable on
  - Interface 2 (inside cone)
  - Interface C (400 series bolted)
- Interlocking
- Cable compartment front cover interlocked with earthing switch
- Signal (1NO/1NC) from internal pressure indicator wired to terminals (only one each SF_6 tank)

Additional equipment also available as retrofit
- Motor operation for vacuum circuit-breaker
- High LV-compartment with hinged door
- Short circuit indicator
- Auxiliary switches
  - vacuum circuit-breaker position 2NO+2NC
  - disconnector position 2NO+2NC
  - earthing switch position 2NO+2NC
  - vacuum circuit-breaker tripped signal 1NO
- Capacitive voltage indicating systems
  - HR-module (Voltage Detecting System VDS)
  - VPIS (Voltage Presence Indicating System), with integrated indicator lamps
- Indicator lamp for HR-module, 1-phase VIM-1
- Indicator lamp for HR-module, 3-phase VIM-3
- Trip coil open
- Trip coil open and close
- Undervoltage release (optional electronic time delay device)
- Cable compartment cover
  - with extra depth (surge arrestor)
  - arc proof (if existing modules have interlocked covers)
- Key interlock on disconnector/earthing switch





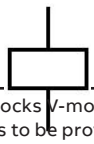
Depth: 888,5 mm
Width: 420 mm
Height: 1930 mm *)

*) Height with high LV-compartment: 2180 mm

SafePlus

V - Vacuum circuit-breaker - interlocking

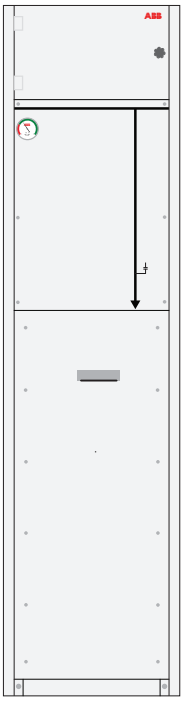
Abbreviations	
LBS	Load break switch
ES	Earthing switch
CB	Circuit breaker
DC	Disconnector
SF	Switch-fuse

Interlock type	Operation	Condition	Comment
Mechanical interlock V-module 	Closing CB	None	
	Opening CB	None	
	Closing DC	CB is open, ES is open, cable compartment cover is on	Cable compartment interlock is optional
	Opening DC	CB is open, ES is open, cable compartment cover is on	Cable compartment interlock is optional
	Closing ES	DC is open	Standard
	Opening ES	DC is open	Standard
	Opening cable compartment	ES is closed	Cable compartment interlock is optional
	Closing cable compartment	ES is closed	Cable compartment interlock is optional
Electrical interlock V-module 	Closing ES	Incoming cable is without voltage	Optional feature. Voltage presence System with signalling contact is required.
Padlocks V-module Padlocks to be provided by customer	Lock on ES	None	Standard feature (Diameter of padlock: 8 mm)
	Lock on DC	None	Standard feature (Diameter of padlock: 8 mm)
	Lock on push buttons CB	None	Optional feature (Diameter of padlock: 4 mm) 3 options: 1. each push button can be locked separately 2. both push buttons can be locked with one padlock 3. each push button can be locked separately and with open button locked with opening signal acitve
	Lock cable compartment cover in closed position	None	Optional feature for arc proof cable compartment. Not possible for non-arc proof cable compartment.
	Lock cable compartment cover in open position	None	Optional feature for arc proof cable compartment. Not possible for non-arc proof cable compartment.
Key interlock V-module 	Key lock on DC	See details in chapter Interlocks “Key interlocks”	Optional feature
	Key lock on ES	See details in chapter Interlocks “Key interlocks”	Optional feature

SafePlus
D - Direct cable connection

Depth: 888,5 mm
Width: 420 mm
Height: 1930 mm *)

*) Height with high LV-compartment: 2180 mm



The D-module are a module without load break- or earthing switch for direct cable connection.

Standard features
- Cable bushings horizontal in front, 400 series bolted with integrated voltage divider for voltage indication
- Busbar, 630 A
- Earthing bar

Factory assembled options
- Bushings for connection of external busbars on either side of the unit
- Signal (1NO) from internal pressure indicator wired to terminals (only one each SF_6-tank)

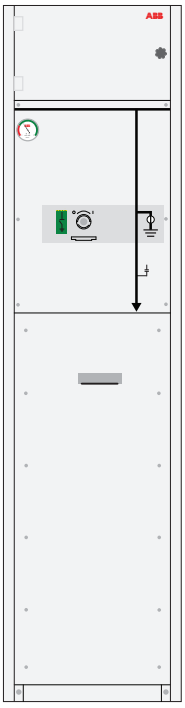
Optional features also available as retrofit
- Capacitive voltage indicating systems
  - HR-module (Voltage Detecting System, VDS)
  - VPIS (Voltage Presence Indicating System), with integrated indicator lamps
- Indicator lamp for HR-module, 1-phase VIM-1
- Indicator lamps for HR-module, 3-phase VIM-3
- Short circuit and earth fault indicators
- External current sensors (CT) for monitoring
- Cable compartment cover
  - with extra depth (double cable, surge arresters)
  - arc proof

SafePlus

De - Direct cable connection w/earthing switch

Depth: 888,5 mm
Width: 420 mm
Height: 1930 mm *)

*) Height with high LV-compartment: 2180 mm



The De-module are a module with earthing switch for direct cable connection.

Standard features

- Earthing switch
- Two-position single spring mechanism
- Switch position indication
- Cable bushings horizontal in front, 400 series bolted with integrated voltage divider for voltage indication
- Busbar, 630 A
- Earthing bar

Factory assembled options

- Bushings for connection of external busbars on either side of the unit
- Interlocking of cable compartment front cover with earthing switch
- Signal (1NO) from internal pressure indicator wired to terminals (only one each SF_6 tank)

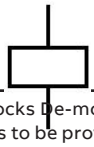
Optional features also available as retrofit

- Capacitive voltage indicating systems
  - HR-module (Voltage Detecting System, VDS)
  - VPIS (Voltage Presence Indicating System, with integrated indicator lamp for HR-module, 1-phase VIM-1
- Indicator lamps for HR-module, 3-phase VIM-3
- Short circuit and earth fault indicator
- External current sensors (CT) for monitoring
- Cable compartment cover with extra depth (double cable, surge arrester. Arc proof (if existing modules have interlocked cable compartment)
- Auxiliary switches
- Earthing switch position 2NO+2NC

SafePlus

De - Direct cable connection w/earthing switch - interlocking

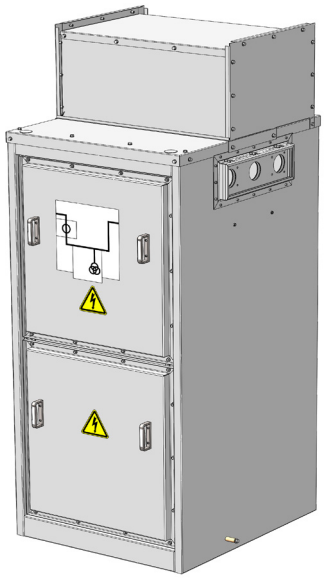
Abbreviations	
LBS	Load break switch
ES	Earthing switch
CB	Circuit breaker
DC	Disconnector
SF	Switch-fuse

Interlock type	Operation	Condition	Comment
Mechanical interlock De-module 	Closing ES	None	
	Opening ES	None	
	Opening cable compartment	ES is closed	Cable compartment interlock is optional
	Closing cable compartment	ES is closed	Cable compartment interlock is optional
Electrical interlock De-module 	Closing ES	Incoming cable is without voltage	Optional feature. Voltage presence System with signalling contact is required.
Padlocks De-module Padlocks to be provided by customer 	Lock on ES	None	Standard feature (Diameter of padlock: 8 mm)
	Lock cable compartment cover in closed position	None	Optional feature for arc proof cable compartment. Not possible for non-arc proof cable compartment.
	Lock cable compartment cover in open position	None	Optional feature for arc proof cable compartment. Not possible for non-arc proof cable compartment.
Key interlock De-module 	Key lock on ES	See details in chapter Interlocks “Key interlocks”	Optional feature

SafePlus
M - Metering module

Depth: 1033 mm
Width: 880 mm
Height: 1934 mm *)

*) Height with high LV-compartment: 2280 mm



Right side top connection to SafePlus modules, bottom cable in

Technical data Metering module

Rated voltage	U_r	kV	36	38,5
Power frequency withstand voltage	U_d	kV	70	80
Impulse withstand voltage	U_p	kV	170	180
Rated normal current	I_r	A	630	630
Short time current 1 sec.	I_k	kA	20	20

The M-module is a factory assembled type-tested air insulated metering cubicle with conventional Current Transformers (CT) and Voltage Transformers (VT).

The M-module is designed for CTs and VTs with dimensions according to DIN 42600 Narrow Type and for installation of transformers locally.

The M-module is manufactured and tested according to IEC 62271-200. It is available in four (4) versions:

- Bottom cable in/out
- Left side top connection to SafePlus modules, bottom cable in
- Right side top connection to SafePlus modules, bottom cable in
- Left and right side connection to SafePlus modules (non arc-proof)

Standard features

- Three (3) pcs DIN 42600 Narrow Type current transformers with ribs
- Three (3) pcs DIN Narrow Type single pole voltage transformers
- Padlock interlocking to prevent access to live parts
- MV cable connection to SafePlus cubicle
- MV cable connection inside M-module by conventional cable lugs

Voltage transformers

- Single pole insulated with measuring and earth fault windings
- Primary voltage and frequency (50 or 60 Hz) have to be specified
- Secondary windings -- / 110:√3 / 110:3 V or -- / 100:√3 / 100:3 V have to be specified
- Note: VTs can also be delivered without open Delta Earth fault windings
- Burden / class has to be specified

Current transformers

- Single-core or double-core design
- Secondary side reconnectable possible
- Primary current max 600 Amp has to be specified
- Secondary current 5 Amp or 1 Amp has to be specified

Low voltage compartment

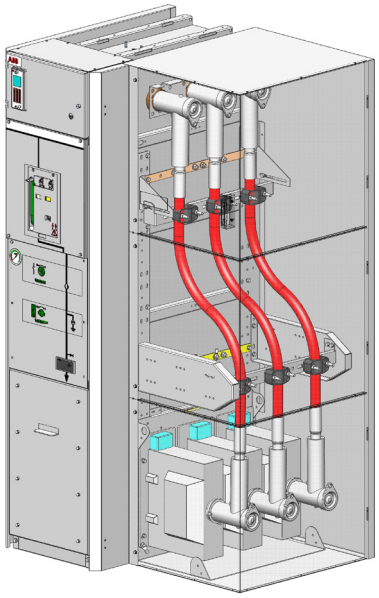
- Terminals for voltage transformers secondary connection
- 3-pole MCB for measuring voltage
- 1-pole MCB for earth fault voltage
- Damping resistor for voltage transformers open delta earth fault windings to avoid ferroresonance
- Separating terminals for current transformers secondary windings
- Space for electronic kWh-meter

Optional features

- Voltmeter with selector switch, 6 positions +0
- A-meter with selector switch, 3 positions +0

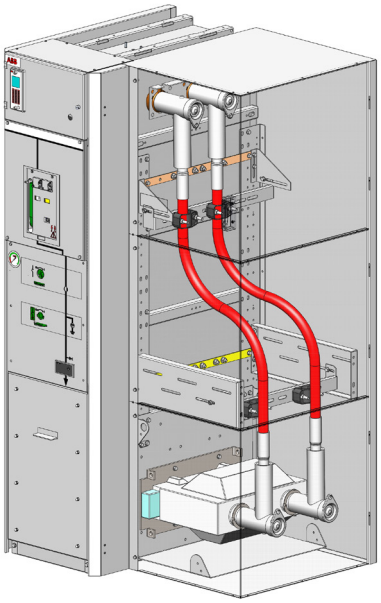
SafePlus
Side metering

- Non-arc proof only
- 1 to 4-panel switchgear
- Additional width: 588 mm
- Cover required to maintain touch proofing
- Right and left cable connection are available for all solutions



Auxiliary voltage
Available solutions:
2 VTs double pole
1 VT double pole (shown in picture)

- Non-arc proof only
- 1 to 4-panel switchgear
- Additional width: 588 mm
- Cover required to maintain touch proofing
- Right and left cable connection is available for all solutions



Transformers and sensors
Current transformers

—
01
KOKM 072
for RMU
—
02
KOLMA
—
03
KOLA

Toroidal current transformers
Toroidal transformers are insulated either in epoxy-resin or encapsulated in a plastic housing. They are used either for power measuring devices or protection relays.

These transformers can be ring-core or split-core type. They can be used both for measuring phase current and for detecting earth-fault current. They conform to standard IEC 61869-1.

KOKM 072 xA 10 – These indoor ring-core current transformers supply metering and protection devices at a maximum nominal voltage of 0.72 kV and nominal frequency of 50 or 60 Hz.

Secondary circuits can be mounted using copper wires with a cross-section up to 4 mm² (strand) or up to 6 mm² (solid conductor).

CTs with secondary current 0,075A are specially designed and applicable for self-powered relays.

KOLA and KOLMA are used for measurement of residual current.

—
01

—
02

—
03

Transformers and sensors
Measuring transformers

—
01
TPU 7x.xx
up to 40,5 kV
—
02
TJC 7x.xx
up to 40,5 kV

Current transformers to DIN standards
The DIN current transformers are insulated in resin and are used for powering measuring devices and protection relays. These transformers can have a wound core with one or more cores and come with performance and precision classes that suit the requirements of the installation.

These devices conform to standard IEC 61869-2.

Their dimensions normally comply with standard DIN 42600 Narrow Type.

The current transformers can also be supplied with a capacitive socket for connection to voltage signalling devices.

The ABB range of current transformers is called TPU.

Voltage transformers
The voltage transformers are insulated in epoxy resin and are used for powering measuring devices and protections. In this case, the transformers can be equipped with a medium voltage protection fuse.

These devices conform to standard IEC 61869-3.

Their dimensions comply with standard DIN 42600 Narrow Type.

These transformers can have one or two poles and possess performance and precision classes that suit the functional requirements of the instruments to which they are connected.

The ABB range of voltage transformers is called TJC, TDC, TJP.

—
01

—
02

Transformers and sensors
Smart sensors

KECA 80 C85 Indoor current sensor
KECA 80 C85 sensors are able to reach measuring class 0.5 for continuous measurement from 5% of the rated primary current (Ipr) up to the rated continuos thermal current (Icth). This is beyond 120% of Ipr that is common for conventional CTs.

For dynamic current measurement (protection purposes), ABB KECA 80 C85 sensors fulfil requirements of protection class 5P up to an impressive value reaching the rated short-time thermal current Ith. That provides the possibility to designate the corresponding accuracy class as 5P630, proving excellent linearity and accuracy measurements.

Sensor applications
KECA 80 C85 sensors are intended for use in current measurement in low voltage or medium voltage switchgear. In case of medium voltage switchgear the current sensor shall be installed over a bushing insulator, insulated cable, insulated and shielded cable connectors or any other type of insulated conductor. The current sensor is equipped with a clamping system which provides easy and fast installation and therefore makes the sensor suitable for retrofit purposes.

Secondary cables
The sensor is equipped with a cable for connection with the Intelligent Electronic Device (IED). The cable connector is type RJ-45. The sensor accuracy classes are verified up to the RJ-45 connector, i.e. considering also its secondary cable. These cables are intended to be connected directly to the IED, and subsequently neither burden calculation nor secondary wiring is needed. Every sensor is therefore accuracy tested when equipped with its own cable and connector.

Parameters for application	
Rated primary current of application	Up to 2500 A
Sensor parameters	
Highest voltage for equipment, U_m	0,72 kV
Rated power frequency withstand voltage	3 kV
Rated primary current, I_{pr}	80 A
Rated continuous thermal current I_{cth}	2500 A
Rated transformation ratio, K_{ra}	80A / 150 mV at 50 Hz 180 mV aat 60 Hz
Current accuracy class	0,5/5P630
Length of cable	2,2/3,4/3,6 m

The design of the sensor is optimized to be easily assembled on the shielded cable connectors used with bushings designed according to the standard EN 50181, Interface C.

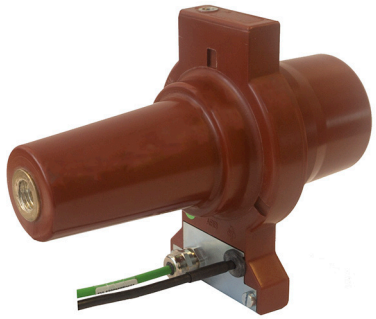
Correction factors
The amplitude and phase error of a current sensor is, in practice, constant and independent of the primary current. Due to this fact it is an inherent and constant property of each sensor and it is not considered as an unpredictable and influenced error. Hence, it can be easily corrected in the IED by using appropriate correction factors, stated separately for every sensor.

Values of the correction factors for the amplitude and phase error of a current sensor are mentioned on the label and should be uploaded into the IED without any modification before the sensors are put into operation. Please refer to the current sensor instructions and IED manual for more information.

KEVA 24 C Indoor voltage sensor
KEVA 24 voltage sensors are intended for use in voltage measurement in gas insulated medium voltage switchgear.

The voltage sensors are designed to easily replace the insulating plugs originally used in the cable T-connectors. Due to their compact size and optimized design, sensors can be used for retrofit purposes as well as in new installations.

Transformers and sensors
Combisensor



Sensor variants
KEVCY Combisensors are ABB's electronic instrument transformers (Sensors) offering current and voltage measurements for the protection and monitoring of medium voltage power systems up to 40.5 kV, 630 A.

Linearity
Due to the absence of a ferromagnetic core the sensor has a linear response over a very wide primary current range, far exceeding the typical CT range.

Current sensor
Current measurement in KEVCY xx RE1 sensors is based on the Rogowski coil principle. A Rogowski coil is a toroidal coil, without an iron core, placed around the primary conductor in the same way as the secondary winding in a current transformer.

Voltage sensor
Voltage measurement in KEVCY xx RE1 sensors is based on the capacitive divider principle.

Sensor application
KEVCY xx RE1 is a compact and very small bushing type sensors designed to be used in SF_6-gas insulated switchgear type SafeRing and SafePlus. The external cone type of the sensor is designed according to the standard EN 50181, Interface C (400 series 630 A, M16 bolt), and therefore enables connection of all compatible cable connectors.

Secondary cables
The sensor is equipped with two cables:
- Cable for coupling electrode with BNC connector
- Current and voltage signal cable with RJ-45 connector for connection with the IED

The cable connector for connection with the IED is type RJ-45. The sensor accuracy classes are verified up to the RJ-45 connector, i.e. considering also its secondary cable. This cable is intended to be connected directly to the IED, and subsequently neither burden calculation nor secondary wiring is needed. Every sensor is therefore accuracy tested when equipped with its own cable and connector.

Standard cable length for connection with an IED is 2.2 meters. Standard cable length for connection with a coupling electrode is 0.45 meters.

Technical data. general		
Rated primary current of application		up to 630 A
Rated primary voltage of application		up to 40,5 kV
Highest voltage for equipment, U_m	KEVCY 36 RE1	36 kV
	KEVCY 40,5 RE1	40,5kV
Rated power frequency withstand voltage	KEVCY 36 RE1	70 kV
	KEVCY 40,5 RE1	95 kV
Rated lighting impulse withstand voltage	KEVCY 36 RE1	170 kV
	KEVCY 40,5 RE1	185 kV

Technical data, voltage sensor	
Rated primary voltage, U_{pr}	KEVCY 36 RE1 33/√3 kV KEVCY 40,5 RE1 35/√3 kV
Maximum rated primary voltage, U_{primax}	KEVCY 36 RE1 36/√3 kV KEVCY 40,5 RE1 40,5/√3 kV
Rated frequency, f_n	50/60 Hz
Accuracy class	0.5/3P
Rated burden, R_{br}	10 MOhm
Rated transformation ratio, K_n	10 000 : 1
Rated voltage factor, k_u	1.9/8h
Technical data, current sensor	
Rated primary current, I_{pr}	80 A
Rated transformation ratio, K_{ra}	80A /0.150 V at 50 Hz 80 A/0.180 V at 60 Hz
Rated secondary output, U_{sr}	3mV/Hz i.e 150 mV at 50 Hz or 180 mV at 60 Hz
Rated continuous thermal current, I_{cth}	630 A
Rated short-time thermal current, I_{th}	25 kA / 3 s
Rated dynamic current, I_{dyn}	63 kA
Rated frequency, f_r	50/60 Hz
Rated extended primary current factor, K_{pcr}	7.875
Accuracy limit factor, K_{alf}	100
Rated burden, R_{br}	10 MOhm
Cables	
Current and voltage sensing: Length Connector	 2.2 m RJ-45 (CAT-6)
Coupling electrode: Length Connector	 0.45 m BNC

Terminations
Cable bushings

—
01
400 series
Interface C
—
02
IEEE bushing
Interface C

—
01

—
02

The connection of the HV-cable is made by cable bushings. The bushings are made of cast resin epoxy with moulded-in conductors. In addition, a screen is moulded in to control the electrical field and is also used as the main capacitor supplying the voltage indicators.

Up-to-date production facilities and highly advanced robots and test equipment ensure the high quality required for each single device.

A very high number of units have been installed worldwide in distribution networks, power stations and industrial complexes.

Used together with fully screened connectors, these bushings present an ideal solution for areas with humidity or condensation problems. The bushings are designed according to CENELEC EN 50181, EDF HN 52-S-61 and IEC 60137.

Cable bushings available:

- Interface C
  400 series with M16 bolted contact (I_n=630A)
- Interface C
  IEEE bushing with M16 bolted contact

The bushings fulfil the requirements of DIN47636T1.

Standard on all modules and for side connection.

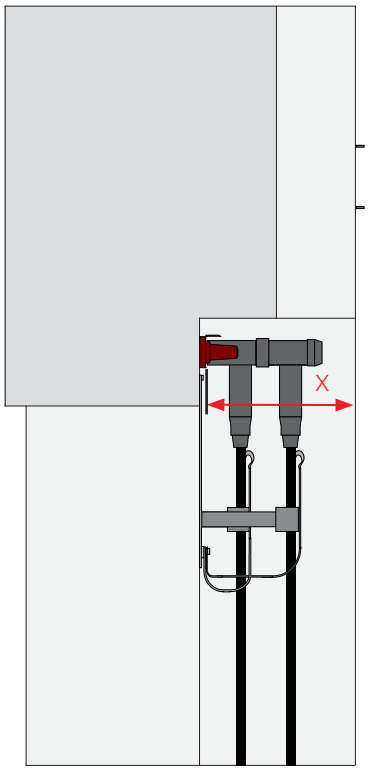
Important: Where cables are not connected, the earthing switch must be locked in closed position or the bushings must be fitted with dead end receptacles before the unit is energized.

Terminations
Cable terminations

—
01
Standard cable cover
—
02
Arc proof cable cover
—
03
Expanded cable cover

All bushings are protected by cable compartment covers.
The drawings below show typical arrangements with cable connectors.

The table below the drawings shows the distance X in millimeters from cable bushing to the inner part of cable compartment cover.



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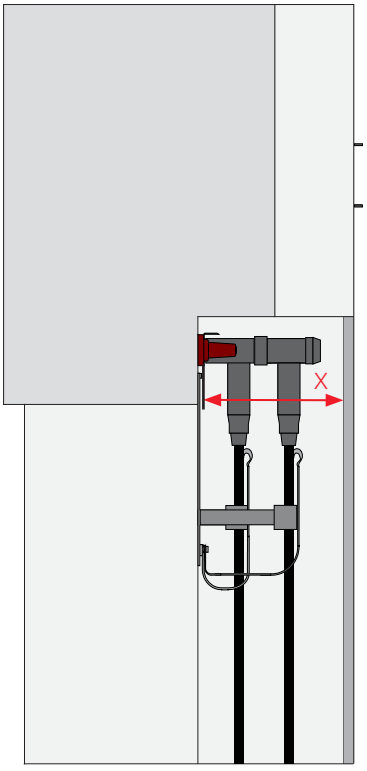
01



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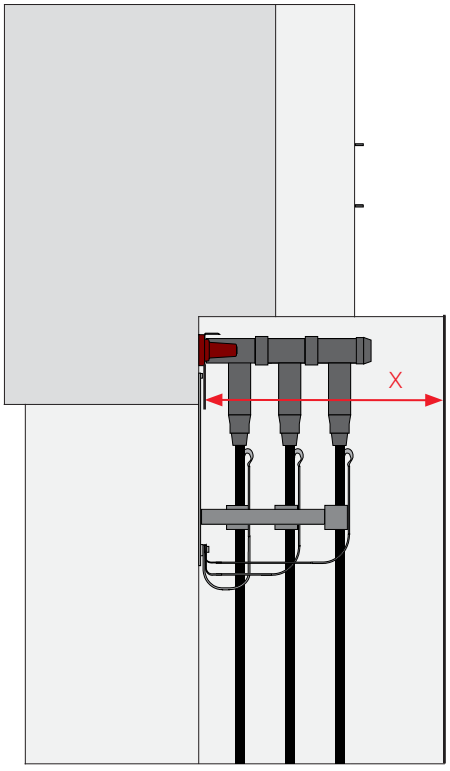
02



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03

	Distance X
Standard cable cover	360 mm
Arc proof cable cover	343 mm
Expanded cable covers	580 mm

The following manufacturers of cable terminations are recommended:

- Cellpack
- Euromold
- NKT cables
- Südkabel
- Tyco Electronics

Terminations
Cable terminations

Application area
Premolded screened separable connectors for XLPE insulated 1- or 3-core cables with aluminum or copper conductors for 12–42 kV. Can be installed both indoors and outdoors.

Fits standard bushings of outer cone type according to EN 50181. Connectors with rated current 630 A, interface type C with bolt M16.

Standard
Meets the requirements of:
- CENELEC, HD 629.1 S2

Design
Premolded and manufactured in rubber with three layers: a conductive inner layer, an insulation layer and a conductive outer layer, that are vulcanized together for the best possible interface between the layers.

The cable connectors include both a capacitive test point with protection and an integrated earthing wire.

Delivered in 3-phase kits, complete with cable lugs, bolt connection and stress grading adapter, designed to ensure a reliable installation.

Note:
For 3-core cable with common Cu-screen wires, a screen separation kit must be used.

36 kV: Separable connectors interface C with earthing shield, I_r = 630 A						**Cable compartment**						
						Single cable + surge arrester		**Dual cables**		**Dual cables + surge arrester**		
Manufacturer	**Connector type**	**Conductor [mm2]**	**XLPE / EPR Ø [mm]**	**Additional equipment for dual cable arrangement**	**Surge Arrester**	Standard X = 360 mm	Arc proof X = 343 mm	Standard X = 360 mm	Arc proof X = 343 mm	Standard X = 360 mm	Arc proof X = 343 mm	Expanded X =580 mm
Cellpack	CTS 630A 36kV	35-400	22.0-31.5	CTKS 630A	CTKSA	•	•	•	•			•
Euromold	M484TB/G	35-630	16.0-56.0	M800PB	800SA	•	•	•	•			•
Euromold	P484TB/G	35-630	16.0-37.5	P800PB	800SA	•	•	•	•			•
NKT cables	CB 36-630	25-300	17.0-40.0	CC 36-630	CSA 36	•	•	•	•			•
NKT cables	CB 36-630 (1250)	400-630	34.0-44.0	CC 36-630(1250)	CSA 36	•	•	•	•			•
Südkabel	SAT 36	300-1000	35.0-59.4	SEHDK 36	MUT 33	•	•	•	•			•
Südkabel	SEHDT 33	35-500	22.0-45.6	SEHDK 36	MUT 33	•	•	•	•			•
Tyco Electronics	RSTI-68	35-300	22.4-42.0	RSTI-CC-68	RSTI-68-SA	•	•	•	•			•
Tyco Electronics	RSTI-x95	400-1000	28.9-59.0	RSTI-CC-x95	None	•	•	•	•			

Separable connectors without earthing shield are not recommended.

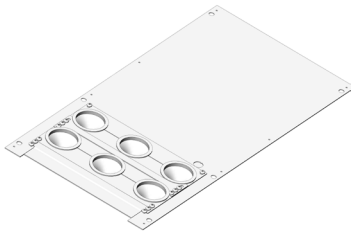
For dynamic and thermal short-circuit currents, please compare the values expected in your network with the rated values of the connector from the different suppliers.

Terminations
Additional equipment

—
01
Standard cable support bar for single cable connection.
—
02
Adjustable cable support bar for single cable connection.
—
03
Adjustable cable support bar for double cable connection.
—
04
Adjustable cable support bar for single cable connection with earthing bar for surge arrester.

Gland plates
Gland plates may be placed either at the bottom of the switchgear or at the bottom of the base frame. They prevent access of reptiles and small animals into the cable compartment.

Gland plates are available for double and single sets of cables.



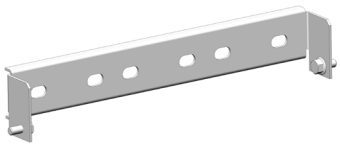
Cable clamps
Cable clamps are used to support the cable and the cable connection. They are available in three different sizes (Outer cable diameter):

- 24-38 mm
- 25-54 mm
- 66-90 mm (available on request)

Not supporting the cables may put an unacceptable strain on the bushings and ultimately result in gas leakage or other damage.

Cable support bars

—
01



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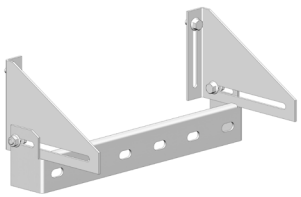

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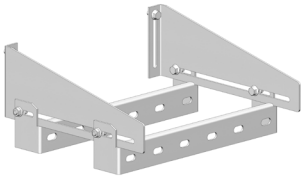

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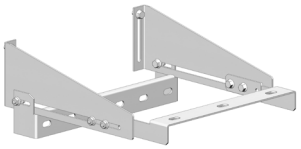
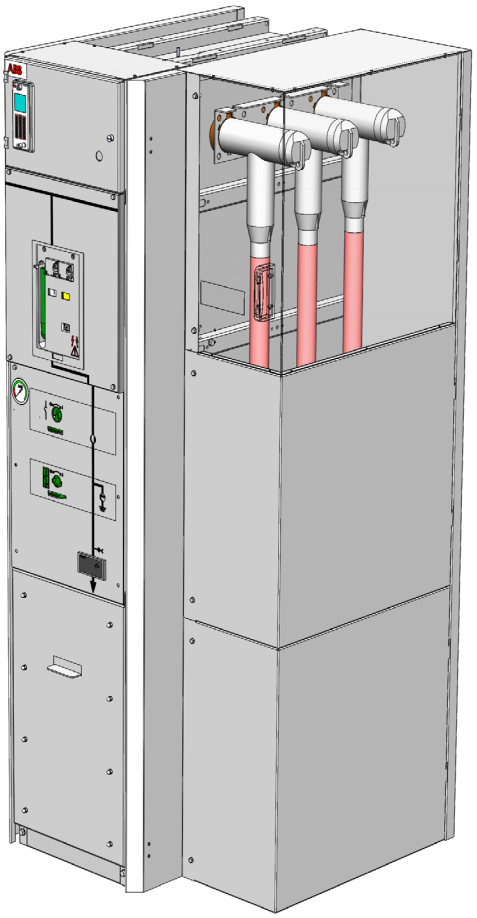
04



Terminations
Side connection

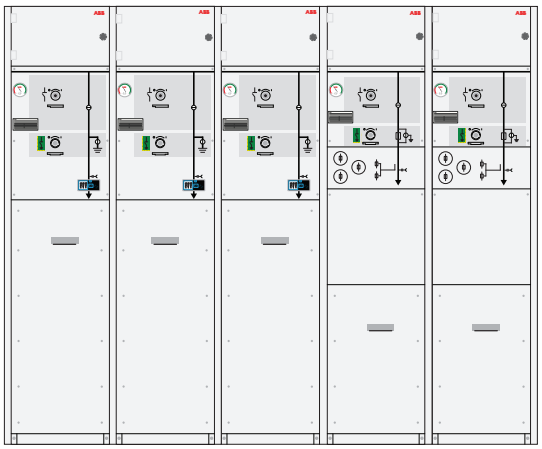
Basic parameters of setup:

- Right and left hand side connection
- Up to triple cable connection
- Non-arc proof is standard
- IAC AFL 25 kA 1s is available:
  - Distance from backwall: 100 mm
  - May be placed on base frame



Terminations
Side extension

—
01
SafePlus 36 with a fully modular design.
—
02
SafePlus 36 consisting of three sections (FFF+C+C) connected to each other by means of side extension kit.
—
03
The installation of the external busbars has to be done on site, see separate installation instructions, 1VDD006146 GB.



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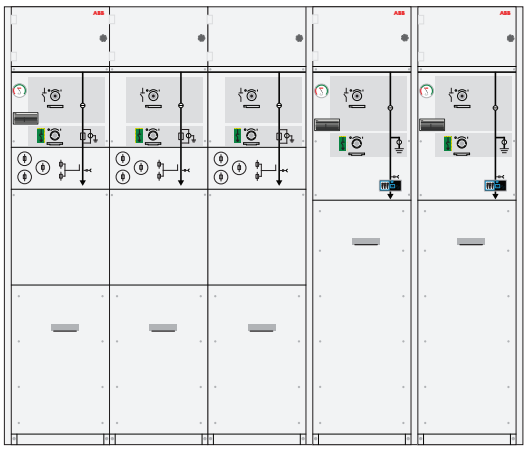
01

As an option, SafeRing/SafePlus 36 can be provided with bushings for side extention on one or both sides.

For a SafePlus 36 switchgear consisting of only one module, bushings on both sides are necessary if future extention is required.

Since a maximum of four panels can be included in a single, common SF6-tank, the side extension and busbar kit are required for configurations that require additional panels.

For practical handling of modules on site, the switchgear can be extended by 1- or 2-way units.



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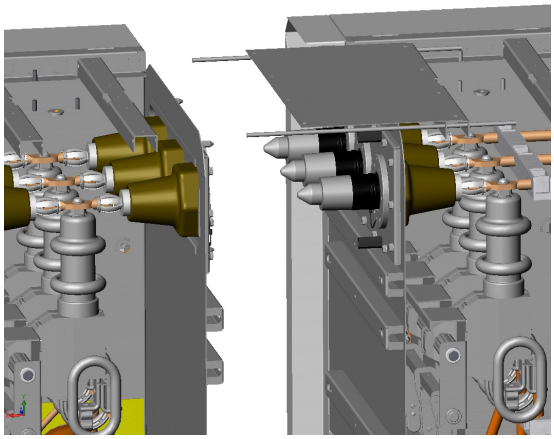

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03

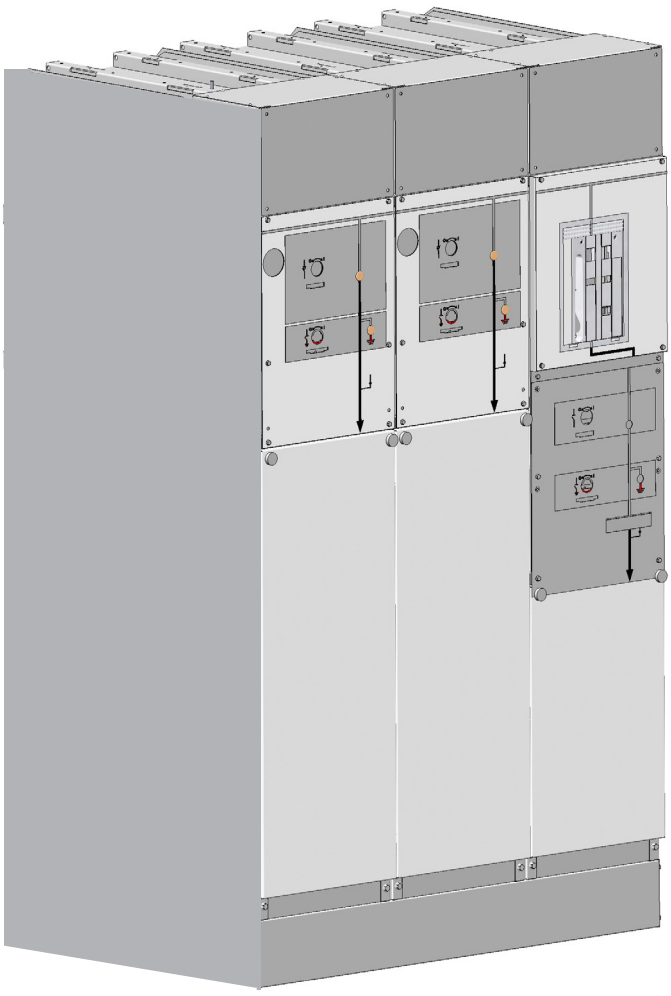
Optional equipment
Base frame

—
01
SafePlus 36 CCV.
—
02
The baseframe as seen from the rear

When SafeRing or SafePlus are placed directly on a floor, the height from the floor to the centre of the cable bushings is 615 mm (F-and V-module), or 1034mm (C-,D-and De-module).

If there is no cable trench, this height might not be sufficient for proper installation of cables. It is then possible to place the switchgear on an additional base frame. Base frame are available in three different heights: 160, 350 and 495 mm. The 160mm base frame has openings for cable entrance from the bottom, rear, right hand side.

The 350mm and 495mm base frame have openings for cable entrance from the bottom and rear side.



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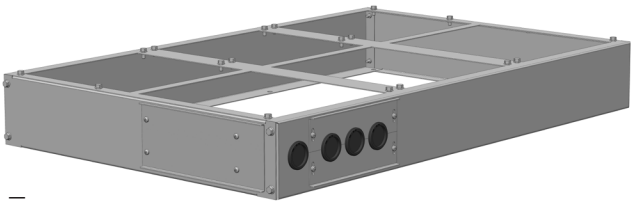
01



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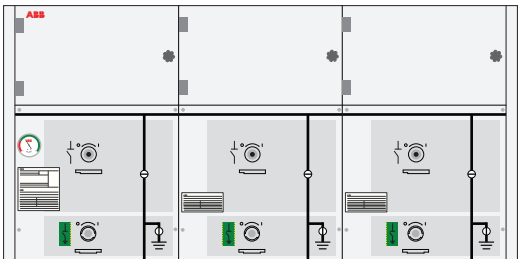
02

Optional equipment
Low voltage compartment

—
01
LVC 284 mm
—
02
LVC 534 mm



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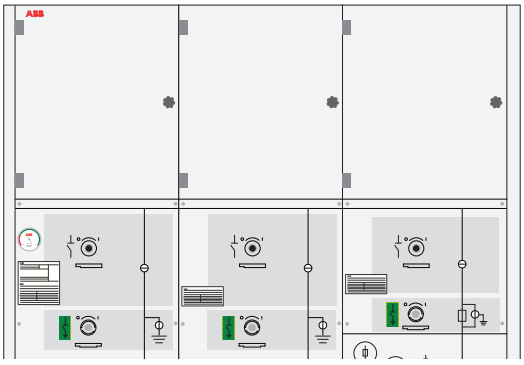
01

When motor operation, coils, auxiliary switches or other relevant components are mounted on a SafeRing/SafePlus 36 module, the auxiliary relays, MCB / fuses and terminals are located in the low voltage compartment on the top of the switchgear.

The low voltage compartment allows entrance of the customer`s low voltage cables on either side or on the top left or top right of the switchgear. Also, the low voltage compartment allows for the installation of intstruments etc..

As an option, the standard LV-compartment can be delivered with a hinged door.

Height of standard version: 284 mm



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02

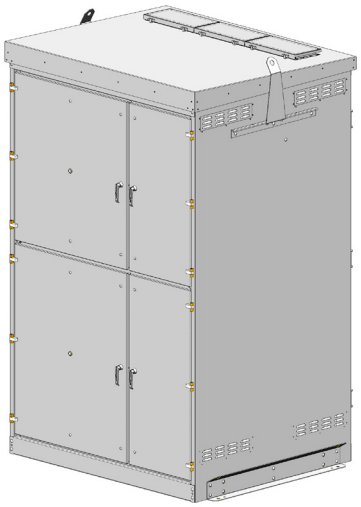
Additionally, all SafePlus switchgears can be supplied with a high low voltage compartment.

This compartment can be equipped with protection relays, meters, terminal blocks etc.

This compartment also allows entrance of low voltage cable from the rear side.

Height of high version: 534 mm

Optional equipment
Outdoor enclosure



Arc proof version
An outdoor enclosure is a water-resistant cabinet which protects the switchgear from outdoor conditions. Note that the outdoor enclosure may be installed in restricted areas only. Every offer needs to be discussed with an ABB sales representative.

Basic parameters for setup:
- Available for 2-4 way units
- IAC AFLR 25kA 1s
- IP 54
- If there is a roof above the enclosure the minimum distance to the roof is 600 mm
- Minimum distance to sidewall: 100 mm
- Minimum distance to backwall: 800 mm

Non-arc proof version
Basic parameters for setup:
- Available for 2-4 way units
- IP 54

Motor operation and coils

Closing and opening of load-break switches and charging mechanism springs for switch-fuse and vacuum circuit breaker mechanisms can all be performed by motor operation.

All motor devices require DC voltage. If control voltage is either 110 or 220 VAC, a rectifier is integrated in the control unit.

The operating cycle for motor operation for C- and F-module is CO - 3 min (i.e. it can be operated with a frequency of up to one close and one open operation every third minute). The operating perating sequence for Vaccum circuit-breaker is O-0,3s-CO-3min-CO.

Test voltage for tables below is + 10/ - 15% for motor operations and closing coils and +10/ -30% for trip coils and opening coils. Motors and coils can easily be mounted on the mechanisms after delivery (retrofit).

Characterstics of motor operation for C-module

Rated voltage	Power consumption	Operating times		Peak start current	Fuse
(V)	[W] or [VA]	Closing time (s)	Opening time (s)	(A)	
24	130	6-10	6-10	19	F 6,3 A
48	150	4 - 7	4 - 7	13	F 4 A
60	90	6 - 9	6 - 9	7	F 4 A
110	90	6 - 9	6 - 9	3	F 2 A
220	90	6 - 9	6 - 9	1,7	F 1 A

Characterstics of motor operation for F-module

Rated voltage	Power consumption	Operating times		Peak start current	Fuse
(V)	[W] or [VA]	Charge / Closing time (s)	Opening time (ms)	(A)	
24	180	8 - 15	40 - 60	19	F 6,3 A
48	200	5 - 9	40 - 60	13	F 4 A
60	140	8 - 13	40 - 60	7	F 4 A
110	140	8 - 13	40 - 60	3	F 2 A
220	140	8 - 13	40 - 60	1,7	F 1 A

Characterstics of motor operation for V-module

Rated voltage	Power consumption	Charge time	Current	Peak start current	Fuse
(V)	[W] or [VA]	(s)	(A)	(A)	
24	350	7-15	15	38	F 10 A
48	350	7-15	7	19	F 6,3 A
60	350	7-15	6	15	F 6,3 A
110	350	7-15	3	8	F 4 A
220	350	7-15	1,5	4	F 2 A

Motor operation and coils

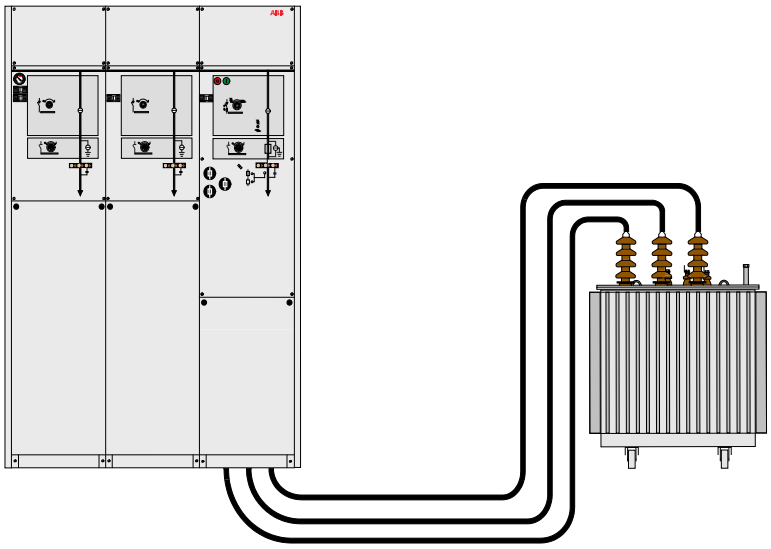
Characterstics of shunt trip-, closing- and opening coils*)				
Rated voltage	Power consumption - Launch	Power consumption - Hold	Operating times	
(V)	[W] or [VA]	[W] or [VA]	Closing time (ms)	Opening time (ms)
24 V DC	100	1,5	50 - 90	40 - 80
48 V DC	100	1,5	50 - 90	40 - 80
60 V DC	100	1,5	50 - 90	40 - 80
110 V DC	100	1,5	50 - 90	40 - 80
220 V DC	100	1,5	50 - 90	40 - 80
110 V AC	100	1,5	50 - 90	40 - 80
220 V AC	100	1,5	50 - 90	40 - 80

*) Smart Coil

Auxiliary equipment like motor drives, operation coils and auxiliary swithes are all located behind the upper front covers.

Electrical control units for motor operation and the internal wiring in general are terminated to the terminals located in the low voltage compartments.

Transformer protection



SafeRing/SafePlus offers a choice between switch-fuse combination or circuit-breaker in combination with relay for transformer protection.

The switch-fuse combination offers optimal protection against short-circuit currents, while the circuit-breaker with relay offers better protection against low over-currents.

Circuit-breaker with relay is always recommended for higher rated transformers.

SafeRing/SafePlus V-modules are delivered with 630A rating. Both for SafeRing and SafePlus the relay is self-powered utilizing the energy from the current transformers under a fault situation for energizing the trip coil.

The self-powered relay can also be used for cable protection. More details on the different relays can be found in the chapter "Relays".

Important features V-module:

- Relay in low voltage box (for the self-powered relays used for transformer protection)

Typical for vacuum circuit-breaker protection:

- Protection against short-circuits
- Very good for protection of over-currents
- Small fault currents are detected in an early stage

Fuse-link selection

By selection of fuse-links for the protection of a transformer it is important that requirements in IEC 62271-105 and in IEC 60787 are fulfilled.

Correct selection of fuse-links for the protection of the transformer will give:

- Optimal protection of the transformer
- No damage on the fuse-link's fuse-elements due to the magnetizing inrush current of the transformer
- No overheating of the fuse-links, the switch-fuse combination or the switchgear due to the full load current or the permissible periodic overload current of the transformer
- A transfer current of the combination which is as low as possible, and less than the rated transfer current of the switch-fuse combination
- A situation where the fuse-links alone will deal with the condition of a short-circuit on the transformer secondary terminals
- Fuse-links that discriminate with the low-voltage fuse-links in the event of phase-to-phase faults occurring downstream of the low-voltage fuse-links

By carefully checking that these rules are followed, fuse-links from any manufacturer can be used in combination with SafeRing/SafePlus as long as the fuse-links are in accordance with the requirements described on the following pages.

Fuses

SafeRing/SafePlus 36 is designed and tested for HRC-fuses according to IEC 60282-1

The dimensions of the fuse-links that can be used in SafeRing/SafePlus must be in accordance with IEC 60282-1, Annex D. The fuse-links have to be type I with terminal diameter (Ø A) equal to 45 mm and body length (D) equal to 537 mm.

The dimensions of the fuse-links can also be in accordance with DIN 43 625. The length of the fuse canister is based on the use of fuse-links with length 537 mm.

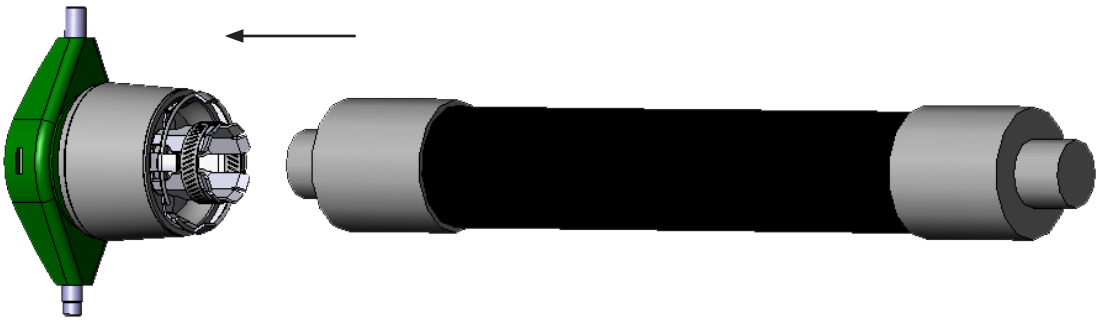
SafeRing/SafePlus is designed for fuse-links with striker in accordance with IEC 60282-1. The striker must be type “Medium” with an energy of 1 J and a travel of minimum 20 mm. The start force of the striker should be minimum 60 N.

Please note: When inserting the fuse link into the canister, the striker-pin must always face outwards against the fuse holder.

2100 kVA is the maximum size distribution transformer which can be fed from a SafeRing/SafePlus fuse switch module.

The tables on the next pages show recommended types of fuse links for use in SafeRing/SafePlus.

In order to find the correct fuse size compared to the transformer rating in kVA, please see the selection tables on the next pages.



Fuses
Selection table - CEF

SafeRing 36 SafePlus 36 F-panel 100% load		Rated voltage: Operating voltage: $I_{transfer}$ at 36 kV: T_o:	36 kV 30 kV 840 A 40 ms	
Transformer rating (kVA)	**u_k (%)**	**Transformer rated current (A)**	**ABB Catalogue no.**	**Fuse link rated current (A)**
100	4	1,9	1YMB531006M0001	6
125	4	2,4	1YMB531006M0002	10
160	4	3,1	1YMB531006M0002	10
200	4	3,8	1YMB531006M0003	16
250	4	4,8	1YMB531006M0003	16
315	4	6,1	1YMB531006M0003	16
400	4	7,7	1YMB531006M0003	16
500	4	9,6	1YMB531006M0004	25
630	4	12,1	1YMB531006M0004	25
800	5	15,4	1YMB531006M0004	25
1000	6	19,2	1YMB531006M0005	40
1250	6	24,1	1YMB531006M0005	40

SafeRing 36 SafePlus 36 F-panel 120% load		Rated voltage: Operating voltage: $I_{transfer}$ at 36 kV: T_o:	36 kV 30 kV 840 A 40 ms	
Transformer rating (kVA)	**u_k (%)**	**Transformer rated current (A)**	**ABB Catalogue no.**	**Fuse link rated current (A)**
100	4	1,9	1YMB531006M0001	6
125	4	2,4	1YMB531006M0002	10
160	4	3,1	1YMB531006M0002	10
200	4	3,8	1YMB531006M0003	16
250	4	4,8	1YMB531006M0003	16
315	4	6,1	1YMB531006M0003	16
400	4	7,7	1YMB531006M0003	16
500	4	9,6	1YMB531006M0004	25
630	4	12,1	1YMB531006M0004	25
800	5	15,4	1YMB531006M0005	40
1000	6	19,2	1YMB531006M0005	40
1250	6	24,1	1YMB531006M0005	40

- Both tables above are based on using ABB CEF high-voltage current-limiting back-up fuse-links
- Normal operating conditions with no overlaod of transformer (table 1) and with 20% overlaod of transformer (table 2)
- Ambient air temperature -25°C to +40°C

Fuses
Selection table - CEF-S

SafeRing 36 SafePlus 36 F-panel 100% load			Rated voltage: Operating voltage: $I_{transfer}$ at 36 kV: T_o :	36 kV 30 kV 840 A 40 ms		Rated voltage: Operating voltage: $I_{transfer}$ at 40,5 kV: T_o :	40,5 kV 35 kV 750 A 40 ms
Transformer rating (kVA)	**u_k (%)**	**Transformer rated current (A)**	**ABB Catalogue no.**	**Fuse link rated current (A)**	**Transformer rated current (A)**	**ABB Catalogue no.**	**Fuse link rated current (A)**
100	4	1,9	1YMB744014M5611	6,3	1,6	1YMB744014M5611	6,3
125	4	2,4	1YMB744016M5611	10	2,1	1YMB744014M5611	6,3
160	4	3,1	1YMB744016M5611	10	2,6	1YMB744016M5611	10
200	4	3,8	1YMB744016M5611	10	3,3	1YMB744016M5611	10
250	4	4,8	1YMB744018M5611	16	4,1	1YMB744016M5611	10
315	4	6,1	1YMB744018M5611	16	5,2	1YMB744018M5611	16
400	4	7,7	1YMB744019M5611	20	6,6	1YMB744018M5611	16
500	4	9,6	1YMB744021M5611	25	8,2	1YMB744019M5611	20
630	4	12,1	1YMB744024M5611	31,5	10,4	1YMB744019M5611	20
800	5	15,4	1YMB744024M5611	31,5	13,2	1YMB744021M5611	25
1000	6	19,2	1YMB744025M5811	40	16,5	1YMB744024M5611	31,5
1250	6	24,1	1YMB744025M5811	40	20,6	1YMB744025M5811	40
1600	6	30,8	1YMB744029M5811	63	26,4	1YMB744027M5811	50
2000	6	38,5	1YMB744029M5811	63	33,0	1YMB744029M5811	63

SafeRing 36 SafePlus 36 F-panel 120% load			Rated voltage: Operating voltage: $I_{transfer}$ at 36 kV: T_o :	36 kV 30 kV 840 A 40 ms		Rated voltage: Operating voltage: $I_{transfer}$ at 40,5 kV: T_o :	40,5 kV 35 kV 750 A 40 ms
Transformer rating (kVA)	**u_k (%)**	**Transformer rated current (A)**	**ABB Catalogue no.**	**Fuse link rated current (A)**	**Transformer rated current (A)**	**ABB Catalogue no.**	**Fuse link rated current (A)**
100	4	1,9	1YMB744014M5611	6,3	1,6	1YMB744014M5611	6,3
125	4	2,4	1YMB744016M5611	10	2,1	1YMB744014M5611	6,3
160	4	3,1	1YMB744016M5611	10	2,6	1YMB744016M5611	10
200	4	3,8	1YMB744018M5611	16	3,3	1YMB744016M5611	10
250	4	4,8	1YMB744018M5611	16	4,1	1YMB744016M5611	10
315	4	6,1	1YMB744019M5611	20	5,2	1YMB744018M5611	16
400	4	7,7	1YMB744021M5611	25	6,6	1YMB744018M5611	16
500	4	9,6	1YMB744021M5611	25	8,2	1YMB744019M5611	20
630	4	12,1	1YMB744024M5611	31,5	10,4	1YMB744021M5611	25
800	5	15,4	1YMB744024M5611	31,5	13,2	1YMB744021M5611	25
1000	6	19,2	1YMB744025M5811	40	16,5	1YMB744025M5811	40
1250	6	24,1	1YMB744027M5811	50	20,6	1YMB744027M5811	50
1600	6	30,8	1YMB744029M5811	63	26,4	1YMB744029M5811	63

- Both tables above are based on using ABB CEF-S high-voltage current-limiting back-up fuse-links
- Normal operating conditions with no overlaod of transformer (table 1) and with 20% overlaod of transformer (table 2)
- Ambient air temperature -25°C to +40°C

Fuses
Selection table - SIBA

SafeRing 36 SafePlus 36 F-panel 100% load		Rated voltage: Operating voltage: $I_{transfer}$ at 36 kV: T_o:	36 kV 30 kV 840 A 40 ms	Rated voltage: Operating voltage: $I_{transfer}$ at 40,5 kV: T_o:	40,5 kV 35 kV 750 A 40 ms		
Transformer rating (kVA)	**u_k (%)**	**Transformer rated current (A)**	**SIBA article no.**	**Fuse link rated current (A)**	**Transformer rated current (A)**	**SIBA article no.**	**Fuse link rated current (A)**
100	4	1,9	30 008 13	6,3	1,6	30 340 13	6,3
125	4	2,4	30 008 13	10	2,1	30 340 13	6,3
160	4	3,1	30 008 13	10	2,6	30 340 13	10
200	4	3,8	30 008 13	10	3,3	30 340 13	10
250	4	4,8	30 008 13	16	4,1	30 340 13	10
315	4	6,1	30 008 13	16	5,2	30 340 13	16
400	4	7,7	30 008 13	20	6,6	30 340 13	16
500	4	9,6	30 008 13	25	8,2	30 340 13	20
630	4	12,1	30 016 13	31,5	10,4	30 340 13	20
800	5	15,4	30 016 13	31,5	13,2	30 341 13	25
1000	6	19,2	30 016 13	40	16,5	30 341 13	31,5
1250	6	24,1	30 016 13	40	20,6	30 341 13	40
1600	6	30,8	30 024 43	63	26,4	30 342 13	50
2000	6	38,5	30 024 43	63	33,0	30 342 13	63

SafeRing 36 SafePlus 36 F-panel 120% load		Rated voltage: Operating voltage: $I_{transfer}$ at 36 kV: T_o:	36 kV 30 kV 840 A 40 ms	Rated voltage: Operating voltage: $I_{transfer}$ at 40,5 kV: T_o:	40,5 kV 35 kV 750 A 40 ms		
Transformer rating (kVA)	**u_k (%)**	**Transformer rated current (A)**	**SIBA article no.**	**Fuse link rated current (A)**	**Transformer rated current (A)**	**SIBA article no.**	**Fuse link rated current (A)**
100	4	1,9	30 008 13	6,3	1,6	30 340 13	6,3
125	4	2,4	30 008 13	10	2,1	30 340 13	6,3
160	4	3,1	30 008 13	10	2,6	30 340 13	10
200	4	3,8	30 008 13	16	3,3	30 340 13	10
250	4	4,8	30 008 13	16	4,1	30 340 13	10
315	4	6,1	30 008 13	20	5,2	30 340 13	16
400	4	7,7	30 008 13	25	6,6	30 340 13	16
500	4	9,6	30 008 13	25	8,2	30 340 13	20
630	4	12,1	30 016 13	31,5	10,4	30 341 13	25
800	5	15,4	30 016 13	31,5	13,2	30 341 13	25
1000	6	19,2	30 016 13	40	16,5	30 341 13	40
1250	6	24,1	30 024 13	50	20,6	30 342 13	50
1600	6	30,8	30 024 43	63	26,4	30 342 13	63

- Both tables above are based on using SIBA HV-back-up fuse-links
- Normal operating conditions with no overlaod of transformer (table 1) and with 20% overlaod of transformer (table 2)
- Ambient air temperature -25°C to +40°C
- Fuse-links with rated current 63A are SSK type (for 36 kV)

Protections relays and control products

The V-module for SafePlus 36kV includes a 630A vacuum circuit-breaker. This chapter describes the different choices of protection relays and feeder terminals that can be used in SafePlus. Standard test procedure includes functional testing of protection relay trip circuits.

All customer settings must be done on site. ABB feeder terminals are configured according to customer specification for protection functions. Special control requirements can be delivered on request. The V-module can also be delivered prepared for protection relays.

This is defined in two types:

- Trip coil and auxiliary contact.
- Cut out in LV-compartment, trip coil, aux contact, wiring and drawings.

This is applicable for relays delivered complete from our factory or if we have received necessary documentation on the relay. Other types of relays are available on request.

There are three main groups of relays delivered:

- ABB feeder protection relays
- Self-powered relays
- ABB feeder terminals

A. ABB feeder protection relays
ABB offers a wide range of feeder protection relays. After many years on the market these relays have an excellent reputation for reliability and secure operation. These relays have either 18-80VDC or 80-265VAC/DC auxiliary supplies and are connected to conventional CTs and VTs.

B. Self-powered relays
Self-powered relays are suitable for rough conditions and places without possibility of auxiliary supply. SafeRing and SafePlus can be delivered with ABB REJ603 to fulfil all relevant needs in a distribution network.

C. ABB feeder terminals
ABB feeder terminals provide cost-effective solutions for different protection, monitoring and control applications. SafePlus can be delivered with REF630.

Feeder protection
The power protection applications can be roughly divided into two categories, namely standard applications (utilizing basic current-based protection) and high requirement applications (utilizing current- and voltage-based protection) and also the combination of the two.

The selected power protection scheme or system has to fulfil the application-specific requirements regarding sensitivity, selectivity and operating speed of the power protection. The power protection requirements are mainly determined by the physical structure of the power network or system and in most cases the requirements can be fulfilled with nondirectional/directional over-current protection IEDs.

In power networks or systems with a more complex structure more advanced power protection functions like distance protection or line differential protection may have to be introduced.

The purpose of the over- and undervoltage power protection system is to monitor the voltage level of the network. If the voltage level deviates from the target value by more than the permitted margin for a set time period, the voltage protection system is activated and it initiates actions to limit the duration of this abnormal condition and the resulting stresses caused to the power system or its components.

To prevent major outages due to frequency disturbances, the substations are usually equipped with under-frequency protection IEDs, which in turn control various power loadshedding schemes. These are just a few examples of the major power protection for power feeders.

Relays
Auxilliary powered relays

605 series
The Relion 605 series protection relays feature basic devices that fulfill the essential protection needs in medium-voltage networks. The series is best suited for secondary distribution applications. These relays are well-known for their straight forward approach to protection.

615 series
The Relion 615 series protection relays can be defined as a compact and versatile solution for power distribution in utility and industrial applications. The 615 series provides standard configurations, which allows you to easily adapt and set-up your applications, still allowing you to adapt the configuration according to application specific needs. The protection relays are delivered with a standard configuration for easier and faster relay engineering and shorter time-to-operation. The 615 series combines compactness and powerful features in one smart package.

620 series
The Relion 620 series offers flexibility and performance for demanding power distribution in utility and industrial applications. The series offers wider application coverage in one product compared to the 615 series, which enables wider standardization of the product type in your application. The 620 series protection relays are delivered with an example configuration, which helps adaptation to user specific requirements.

630 series
The Relion 630 series protection relays feature flexible and scalable functionality to adapt to different needs in power distribution networks and industrial applications. The relays contain pre-configured application configurations, which can be tailored to meet the specific requirements for also the most demanding distribution applications.

640
REX640 makes protecting all assets in advanced power generation and distribution applications easy. The fully modular design allows unequaled customization and modification flexibility, and easy adaptation to changing protection requirements throughout the relay life cycle.

Relays
Self-powered

REJ603 v.3.0


REJ603 v.1.5

REJ603
REJ603 is designed for selective short-circuit and earth-fault protection of feeders in secondary distribution networks and for protection of small transformers in utilities and industries. REJ603 is a current-transformer-powered numerical feeder protection relay designed for applications where auxiliary power is not available or cannot be guaranteed, thereby making it an ideal choice for installation in remote locations. The relay is primarily used in ring main units and secondary distribution switchgear within distribution networks.
REJ603 v.1.5: Functions are easy to set up by using the dip-switches.
REJ603 v.3.0: Contains LCD display, LED indicators and navigation keys. Measurement, events and settings can be viewed in the display.

WIB1

WIB1
All available versions of the WIB1 relay offer high-tech and cost-optimized protection for medium voltage switchgears. Specifically in compact switchgears, the WIB12PE and WIB12FE protection system in combination with a circuit-breaker can replace the combination of load break switch with HV fuses, thereby improving the overload protection of the attached unit. When power distribution networks are extended more and more high powered transformers are used and here HV fuses are unacceptable. For such applications the WIB1 protection system is an optimal replacement.

WIC1

WIC1
All available versions of the WIC1 relay offer high-tech and cost-optimized protection for medium voltage switchgears. Specifically in compact switchgears, the WIC1 protection system in combination with a circuit breaker can replace the combination of load break switch with HV fuses, thereby improving the overload protection of the attached unit. When power distribution networks are extended more and more high powered transformers are used and here HV fuses are inadmissible. For such applications the WIC1 protection system is an optimal replacement.

Indicators
Capacitive voltage indicators

VPIS

WEGA 1.2C (VDS)

Capdis (VDS)

HR-module (VDS)

VIM 3


VIM 1

PCM

SafeRing/SafePlus switchgears are equipped with voltage indicators in accordance with IEC 62271-213 standard for voltage detecting and indication system.

Voltage indicators VPIS
VPIS indicators indicate only presence of the medium-voltage. Absence of the voltage needs to be confirmed by use of voltage detection equipment.

Phase comparison and testing of VPIS
Each phase of the integrated voltage presence indicating system has a connection point on the front panel, which can be used to perform phase comparison and to test the voltage presence
indicator.

Voltage indicators VDS
VDS is used to detect the presence or absence of medium voltage according to IEC 61243-5. The VDS system delivered by ABB can be either based on the LRM or the HR-system.

Voltage indicators VDS LRM
With the VDS LRM system, the following can be indicated:
- Overvoltage
- Nominal voltage presence
- Isolation problems
- No voltage
- Broken lead indication (Optional feature)
  Indication is done visually on the display.

Voltage indicators VDS HR
SafeRing/SafePlus can be delivered with a Voltage Detection System, VDS HR. The indicator itself consists of two parts:
- Fixed part assembled on the switchgear
- Pportable indicator lamps, type VIM-1 and VIM-3, which can be connected to the coupling system interface.

Phase comparator
Phase comparator is used for controlling the phase sequence when connecting two voltage systems
together, e.g. during the switching from one source of power supply to another. Phase comparison can be done by any phase comparator according to IEC 62271-215.

Indicators
Short-circuit indicators

Compass B

IKI-50

The increasing demand for reliability and effectiveness of distribution networks requires more flexibility and automation in ring main units. As one of the biggest manufacturers in the medium voltage distribution segment, ABB replies to this demand by installation of grid automation devices. One of the basic devices is the fault passage indicator.

Fault passage indicators
A fault passage indicator makes it possible to detect any faults, including short circuits and earth faults, as well as short circuit current direction. It also makes it easier to locate faults. Fault passage indicators may be delivered as an option to the SafeRing/SafePlus switchgear. The indicator is usually placed in the front panel of the switchgear.

A fault passage indicator offers different functionalities either short-circuit indication, which is designed to detect, display and remotely indicate short-circuits in medium voltage distribution networks, or earth fault indication, which is designed to detect, locally indicate and remotely report earth-fault currents in medium voltage distribution networks.

Both functionalities can be combined in one device.

Indicators
Manometers / pressure indicators

—
01
Manometer with flexible tube
—
02
Manometer with Arc suppressor indication, one contact NO/NC and flexible tube

SafeRing/SafePlus switchgears are sealed systems, designed and tested according to IEC 62271-200 as a maintenance free switchgear for lifetime (30 years). The switchgear does not require any gas handling.

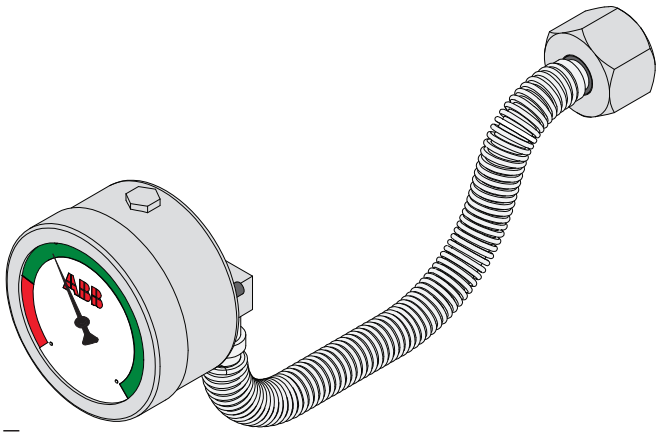
ABB applies state of the art technology for gas tightness providing the equipment with an expected leakage rate lower than 0.1 % per annum, referring to the filling-pressure of 1.4 bar*. The switchgear will maintain gas-tightness and a gas-pressure better than 1.35 bar* throughout its designed lifespan. This pressure value is still within a good margin from the pressure used during the type tests, which is 1.3 bar*.

*) at 20°C.

For increasing the safety under operation of the switchgear, manometers may be used for each tank.

In case of need of remote indication, manometers can be equipped with signalling contacts. Detailed description of manometer functions are described in the table on next page.

Altitude
Maximum height above sea level for installation without reducing gas pressure is 1500 meters. For installation above 1500 meters, please contact ABB for instructions.



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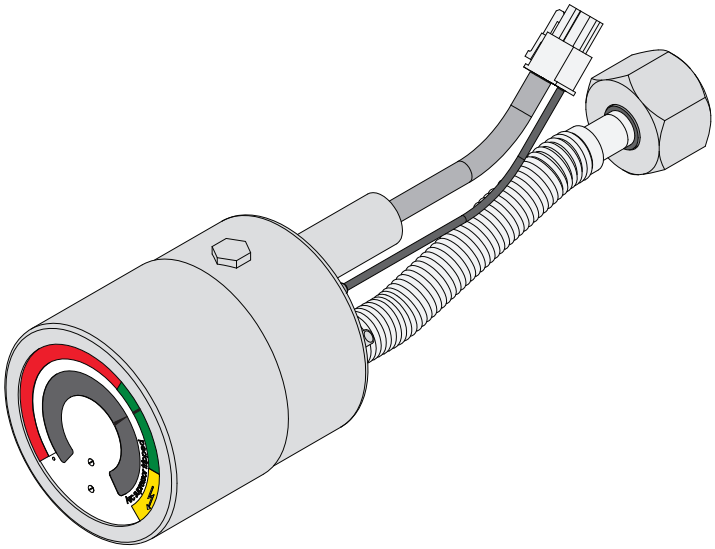
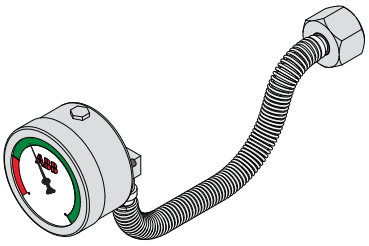
01



—
02

Model	Insulation medium	Temp. comp.	Accuracy	Scale range (Absolute)	Appearance (Absolute)	Marking of scale (Absolute)	Over-pressure ind.	Signalling contact	Treshold pressure	Connection to the tank
2RAA039247P0001	SF_6	X	+/- 1% (20°C) +/- 2.5% (-20–+60°C)	1 - 2 bar	red zone 1.0 – 1.2 bar green zone 1.2 – 2.0 bar	mark at 1.4 bar	-	-	-	flexible
2RAA039249P0001	SF_6	X	+/- 1% (20°C)	1 - 2 bar	red zone 1 – 1.2 bar green zone 1.2 – 2.0 bar	mark at 1.2 bar	-	1x NO/NC	1.2 bar	flexible
2RAA039248P0001	SF_6	X	+/- 1% (20°C) +/- 2.5% (-20–+60°C)	1 - 2 bar	red zone 1.0 – 1.2 bar green zone 1.2 – 1.7 bar yellow zone 1.7 – 2.0 bar	mark at 1.4 bar	X (yellow indication)	-	-	flexible
2RAA045613P0001	SF_6	X	+/- 1% (20°C) +/- 2.5% (-20–+60°C)	0 - 2 bar	red zone 0 – 1.2 bar green zone 1.2 – 1.7 bar yellow zone 1.7 – 2.0 bar	mark at 1.4 bar	X (yellow indication)	1x NO/NC	1.2 bar	flexible
Density switch GMD1	SF_6	X	+/- 2% (-25–+70°C)	-	-	-	-	1x NC	1.15/1.25 bar	solid



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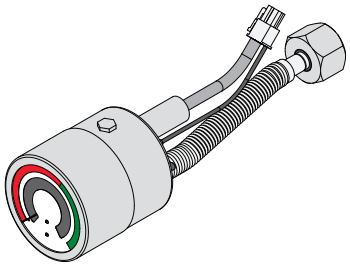

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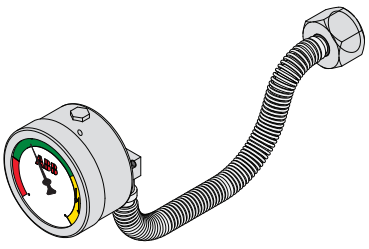

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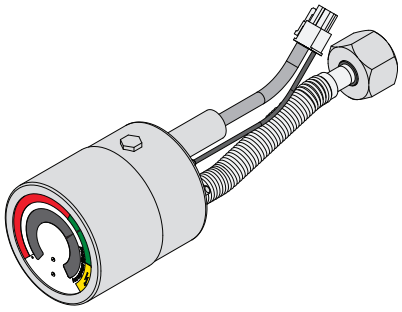


2RAA045613P0001

GMD1

Remote control

—
01
Pendant control without indication lamps
—
02
Pendant control with indication lamps

Pendant control
It is possible to increase the safety of the personnel operating the switchgear by using pendant control for switching operations. With this pendant control it is possible to operate the switchgear up to a distance of 15 meters away.

Additional safety is added by connecting the on/off buttons through an enable button. The enable button must be pressed and held prior to operating the on or off buttons thus reducing the risk of accidental switch operation.

The cable is connected to the switchgear's terminal blocks in the low voltage compartment.

Basic features
Cable length: 15 meters (other lengths on request)
Cable connection to low voltage compartment via:
- Plug (as shown in picture)
- Direct connection to terminal blocks

—
01

—
02

SafeRing/SafePlus can be supplied with remote control and monitoring equipment. The switchgear can be fitted with different types of ABB remote terminal units: ARC600, REC615, RTU 540.

Being responsible for a whole network puts you in the situation where some devices might be brand new while others have been working fora very long time. As a gateway between IEDs and network control system (communication protocols and station bus) it is able to interpret information from all standard protocols.

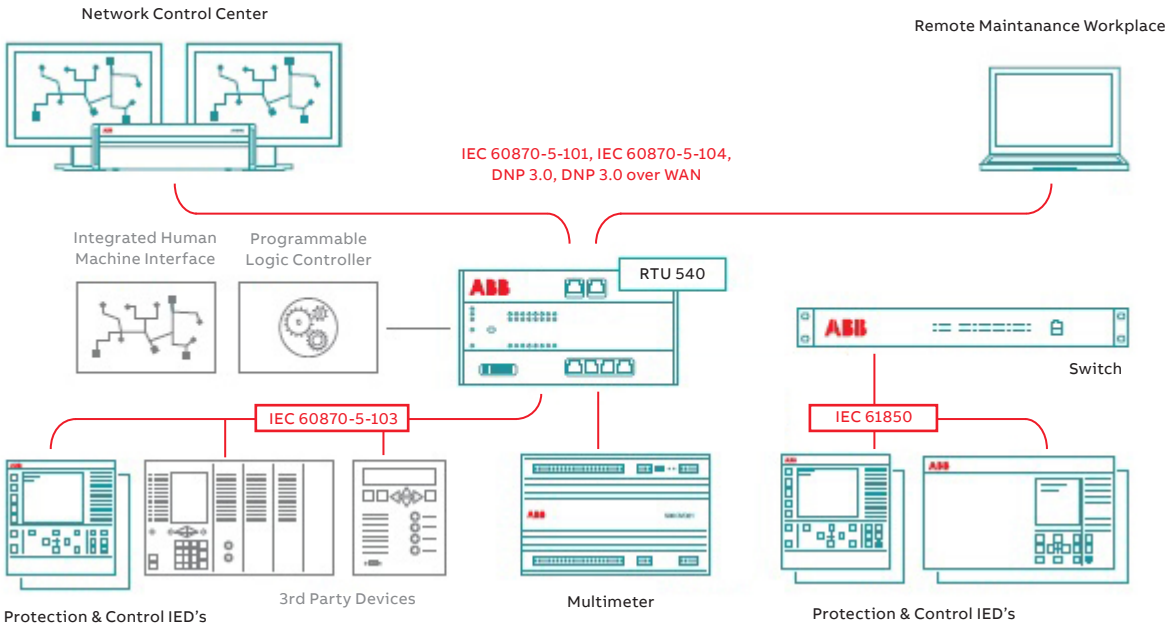
Benefits

- Powerful protocol gateway to bridge old and new technologies in one system
- Intelligent device for automated load and voltage control
- Robust and compact housing for fan-less operation enables you to handle a complex network due to distributed intelligence
- Agile functionality allows easy adaption of automation based on changing system requirements
- Selective interpretation allows fast decision making in the network control center and saves primary equipment
- Communication redundancy for peace of mind and confidence in the network

Application areas

- Gateway between IEDs and Network control system
- Interfacing of station level I/Os into station bus
- Integration of serial IEDs into station bus
- Transformer monitoring and control
- Voltage control

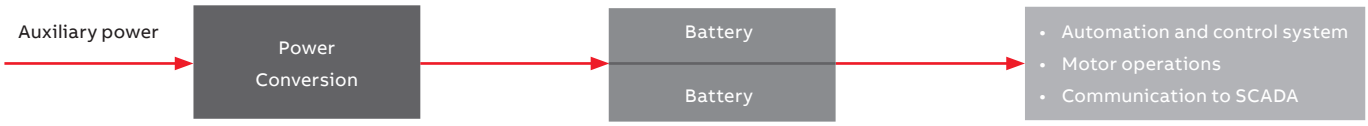
Remote control terminal RTU 540	
Auxiliary power	24 - 110V DC or 110 / 220V AC
Charger	60 watt
Battery	2 x 12V (24V), 20 Ah



Battery back-up solutions

In the event of disruption to the auxiliary power supply, included batteries ensure uninterrupted operation of system critical components like protection relays. While on battery power, information can still be sent to central SCADA including switch states and remote operation of compatible switches remains available so that network reconfiguration can be achieved remotely.

Operating times when using battery-backup is often between 24-48 hours. This standby time is affected by the number of connected devices and derating from storage in extreme cold climatic conditions.



26Ah Battery back-up solution
The 26Ah battery back-up solution is a 24 VDC with 26Ah output solution comprised by 2x 12 VDC, 26Ah Haze GEL batteries and a Power Conversion setup where we use an ADC 5000 Series battery charger.
This 26Ah battery back-up solution can be placed inside the lower mechanism compartment of a C-, D- or De- module.

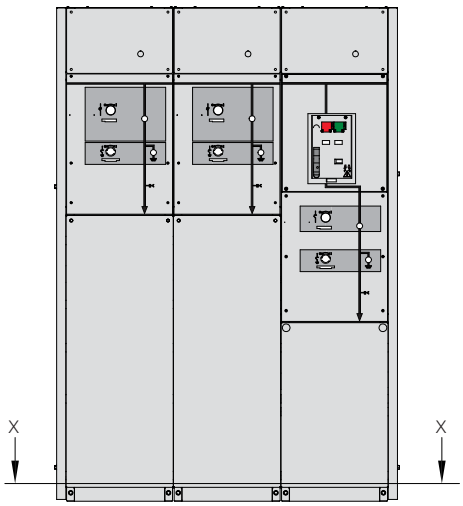
HZY-EV12-26

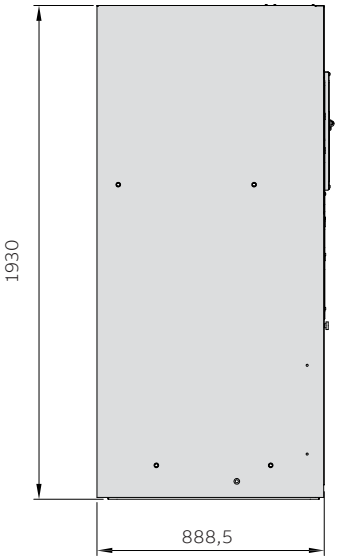
Power Conversion
Battery charger:

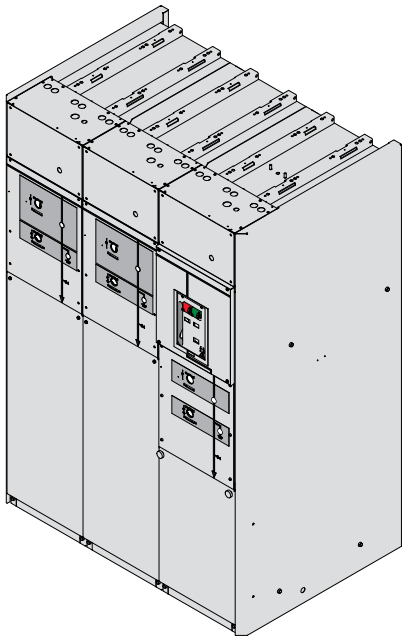
- ADC 5000 Series
- 60 watt (Usually used for SmartGrid solutions)
  125 watt (standard)
- Input voltage: 90...264 VAC
- Frequency: 45...65 Hz
- Output voltage: 24 VDC
- Operating temp without power loss: -40...55°C

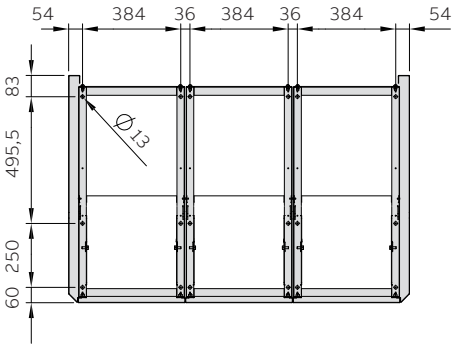
ADC 5000 series

Dimensions
Standard switchgear









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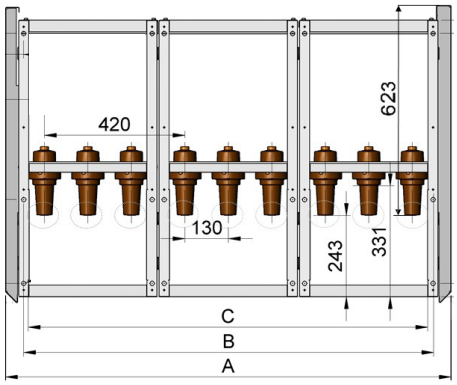
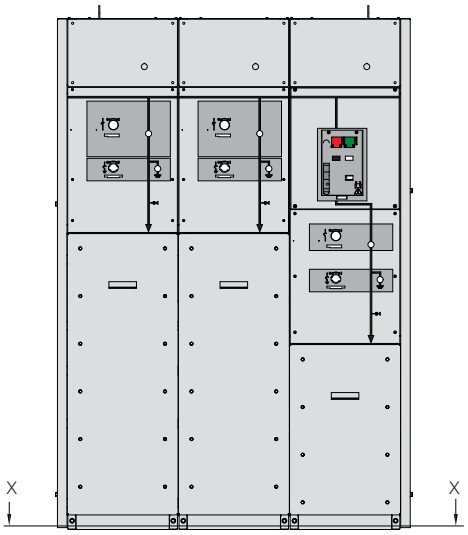
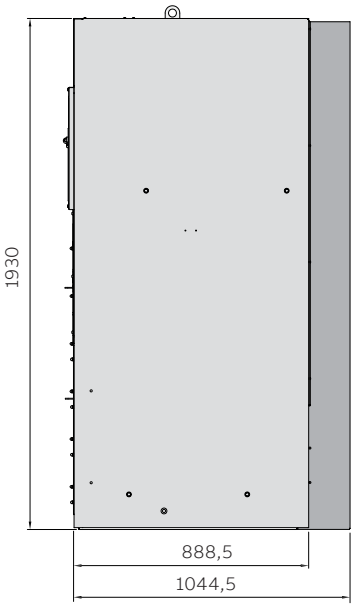
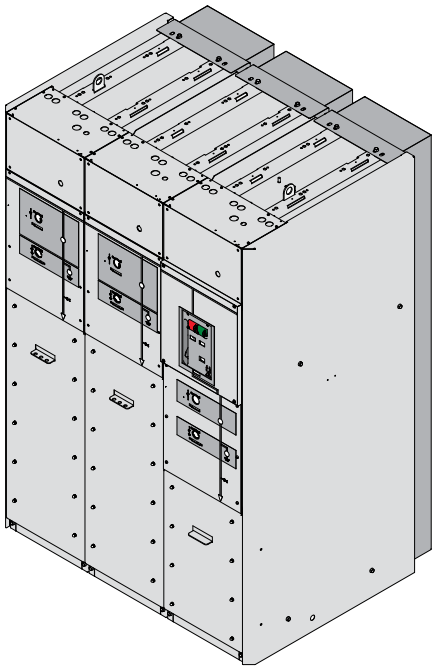


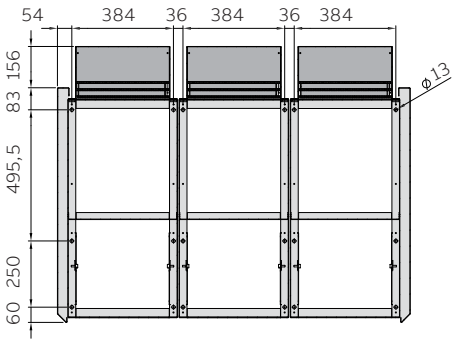
Module	A (mm)	B (mm)	C (mm)
2-way	912	804	786
3-way	1332	1224	1188
4-way	1752	1644	1608

Dimensions
Arc proof switchgear









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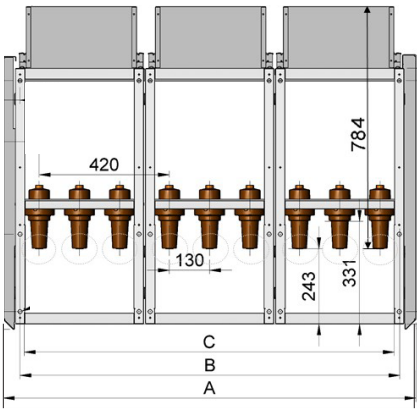
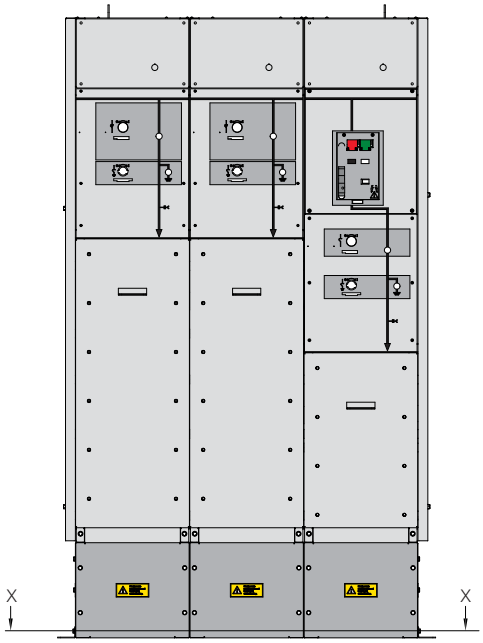
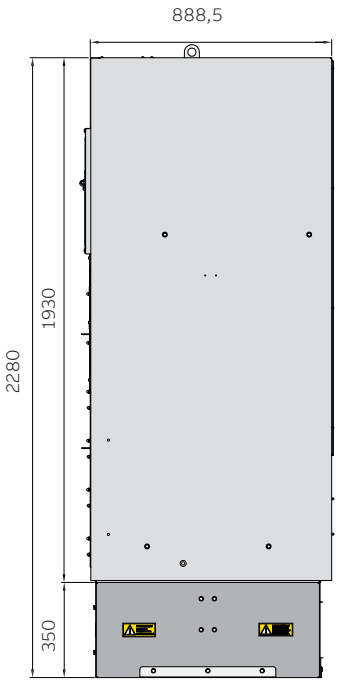
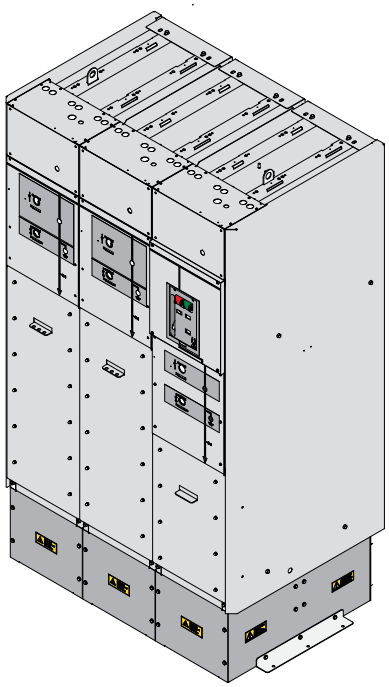


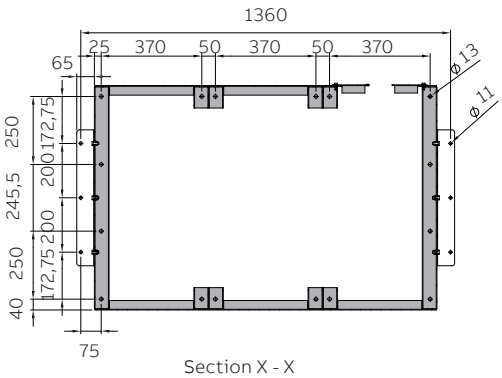
Module	A (mm)	B (mm)	C (mm)
2-way	912	804	786
3-way	1332	1224	1188
4-way	1752	1644	1608

Dimensions
Switchgear with baseframe

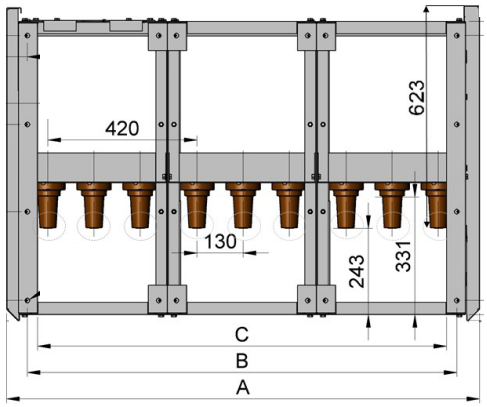








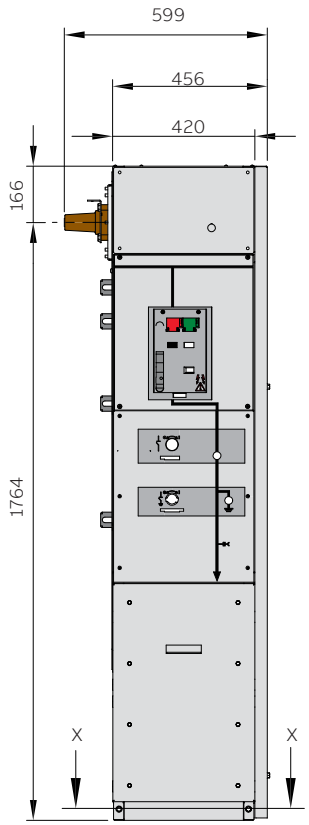
Section X - X

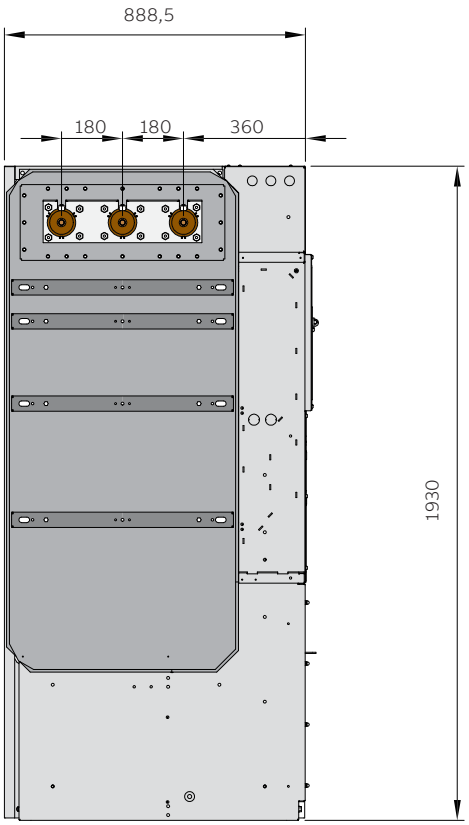


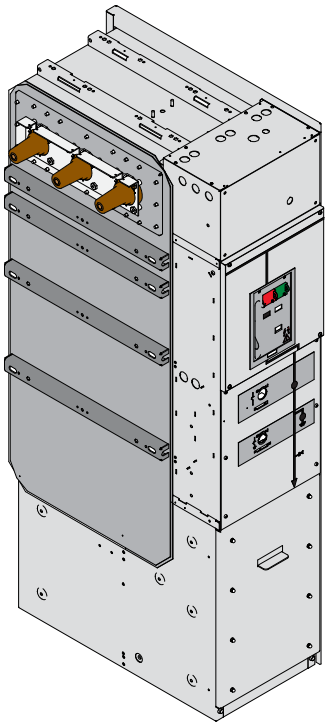
Module	A (mm)	B (mm)	C (mm)
2-way	912	790	740
3-way	1332	1210	1160
4-way	1752	1630	1580

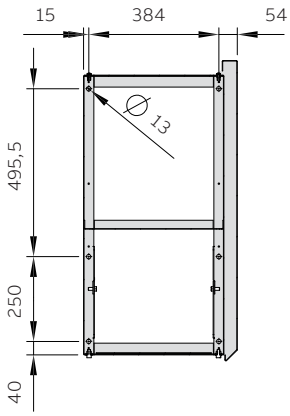
Dimensions

1-way with side connection





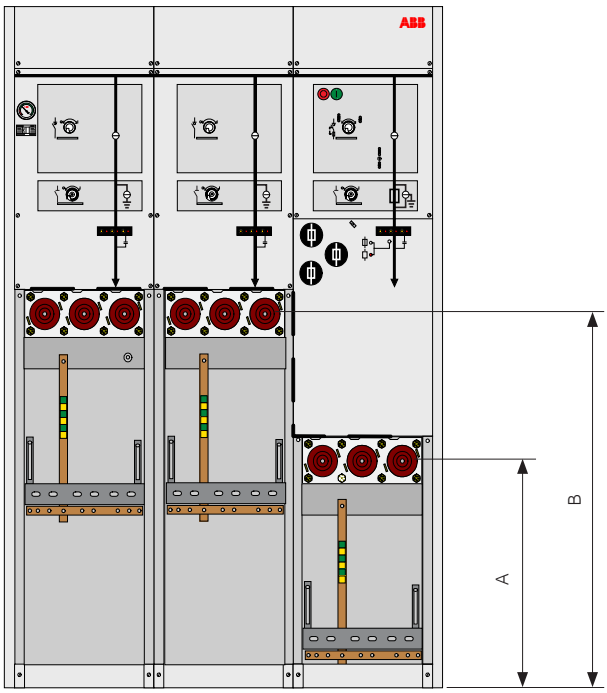




Section X - X

Dimensions
Cable connection

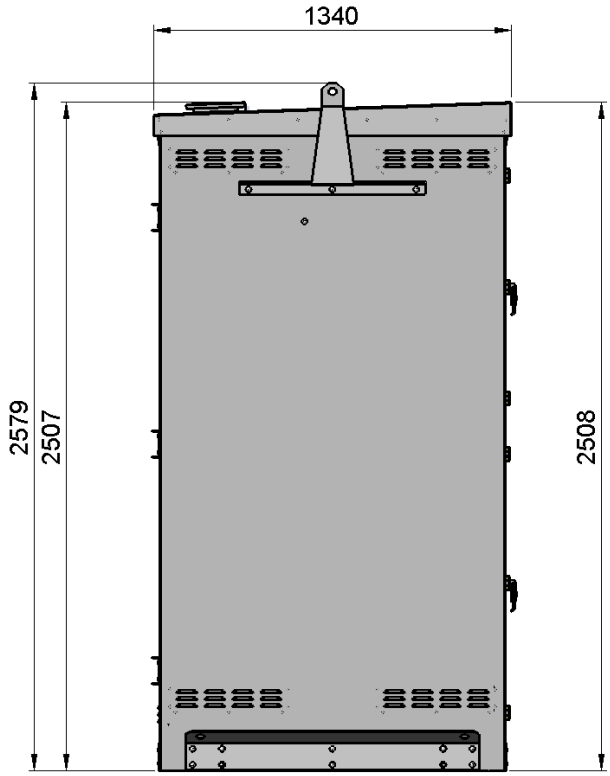
3-way unit CCF with removed cable compartment covers

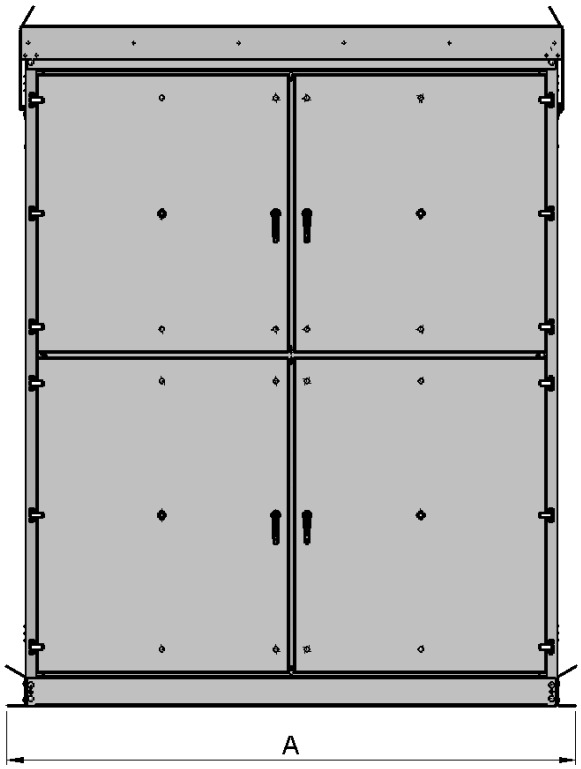


A = 615 mm (for F- and V-modules)

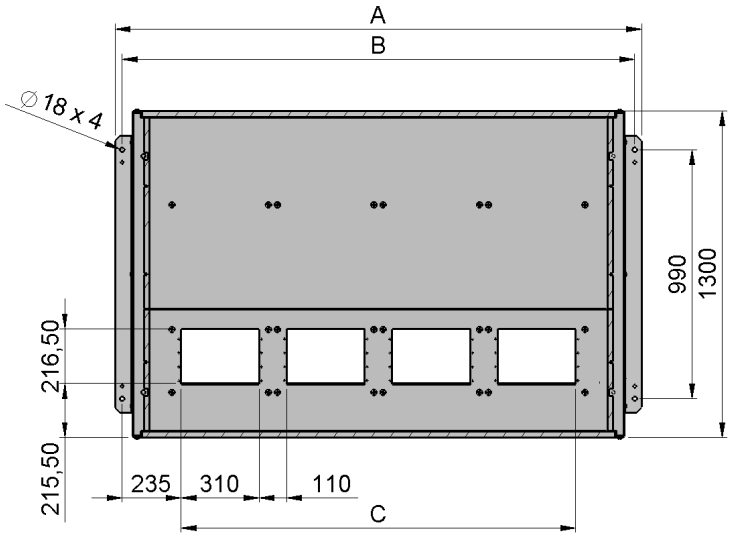
B = 1034 mm (for C-, D- and De-modules)

Dimensions
Outdoor enclosure





Footprint outdoor enclosure



Type of unit	A mm	B mm	C mm	Depth with open doors mm
2-way	1256	1200	774	1861
3-way	1676	1620	1150	2274
4-way	2096	2040	1570	2313

Technical data
Standards

IEC 62271-1	Common specifications for high-voltage switchgear and controlgear standards
IEC 62271-100	High-voltage switchgear and controlgear - Part 100: Alternating current circuit-breakers
IEC 62271-102	High-voltage switchgear and controlgear - Part 102: Alternating current disconnectors and earthing switches
IEC 62271-103	High-voltage switchgear and controlgear - Part 1: Switches for rated voltages above 1 kV up to and including 52 kV
IEC 62271-105	High-voltage switchgear and controlgear - Part 105: Alternating current switch-fuse combinations for rated voltages above 1 kV up to and including 52 kV
IEC 62271-200	High-voltage switchgear and controlgear - Part 200: AC metal-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV
IEC 60529	Degrees of protection provided by enclosures (IP code)

Voltage detection and Indication systems	IEC 62271-213
Bushings	IEC 60137, CENELEC EN 50181, EDF HN 52-S-61
Electronic protection relays	IEC 60255
Instrument transformers	IEC 61869-1; Part 1: General requirements
Instrument transformers	IEC 61869-2; Part 2: Additional requirements for current transformers
Instrument transformers	IEC 61869-3; Part 3: Additional requirements for inductive voltage transformers
Current sensors	IEC 61869-11; Part 8: Electronic current transformers
Voltage sensors	IEC 61869-11; Part 7; Electronic voltage transformers
Combined bushings sensors	IEC 61869-11, CENELEC EN 50181
High-voltage fuses	IEC 60282-1; Part 1: Current-limiting fuses
Cable connection	IEC 60137, CENELEC EN 50181

Technical data
SafeRing

Ring Main Unit, electrical data

1	Rated voltage	U_r	kV	36	36	38	38,5	40,5
2	Rated power frequency withstand voltage	U_d	kV	70	70	80	80	95
	- across disconnector		kV	80	80	95	95	110
3	Rated lightning impulse withstand voltage	U_p	kV	170	170	180	180	185
	- across disconnector		kV	195	195	210	210	215
4	Rated frequency	f_r	Hz	50	60	60	50	50
5	Rated normal current (busbars)	I_r	A	630	600	600	630	630
6	Rated short-time withstand current	I_k	kA	16	16	16	16	16
7	Rated duration of short-circuit	t_k	s	3	3	3	3	3
8	Rated peak withstand current	I_p	kA	40	41,6	41,6	40	40
9	Internal arc classification IAC AFL	I_a/t_a	kA/s	20/1	20/1	20/1	20/1	20/1
10	Internal arc classification IAC AFLR	I_a/t_a	kA/s	25/1	25/1	25/1	25/1	25/1
11	Loss of service continuity			LSC2-PM (for C-, D-, De- and V-module), LSC2A-PI (for F-module)				

Making and breaking capacities C-module with switch-disconnector and earthing switch

12	Rated normal current	I_r	A	630	600	600	630	630
13	Rated mainly active load breaking current	I_{load}	A	630	600	600	630	630
14	Number of operations for mainly active load breaking	n		100	100	10	30	30
15	Rated distribution line closed-loop breaking current	I_{loop}	A	630	600	600	630	630
16	Rated cable-charging breaking current	I_{cc}	A	20			21	21
17	Rated line-charging breaking current	I_{lc}	A	2			2.1	2.1
18	Rated earth-fault breaking current	I_{ef1}	A	60	-	-	63	63
19	Rated cable- and line-charging breaking current under earth-fault conditions	I_{ef2}	A	35	-	-	36	36
20	Rated short-circuit making current	I_{ma}	kA	40	41,6	41, 6	40	40
21	Rated mechanical endurance class (earthing switch)			M0	M0	M0	M0	M0
22	Rated short-circuit making capability class (earthing switch)			E2	E2	E2	E2	E2
23	Electrical and mechanical classes (switch-disconnector) [1]			E3, C2, M1	M1	M1	E2, C2, M1	E2, C2, M1

Making and breaking capacities F-module with switch-fuse disconnector and earthing switch

24	Rated normal current [2]	I_r	A	200	-	-	200	200
25	Rated short-circuit breaking current [3]	I_{sc}	kA	16	-	-	16	16
26	Rated making capacity (downstream earthing switch)	I_{ma}	kA	2,5	-	-	2,5	2,5
27	Rated short-time current (downstream earthing switch)	I_k	kA	1	-	-	1	1
28	Rated duration of short-circuit (downstream earthing switch)	t_k	s	1	-	-	1	1
29	Rated peak withstand current (downstream earthing switch)	I_p	kA	2.5			2.5	2.5
30	Rated transfer current	$I_{transfer}$		840	-	-	750	750
31	Rated mainly active load breaking current	I_{load}		200	-	-	200	200
32	Rated distribution line closed-loop breaking current	I_{loop}		200	-	-	200	200
33	Electrical and mechanical classes (downstream earthing switch)			E2, M0	-	-	E2, M0	E2, M0

[1] For 60Hz making tests with 3 making operations at 65kA and making and breaking tests at 600A (TD_{load} and TD_{loop}), each with 10 CO, have been performed.
[2] Depending on the current rating of the fuse-link.
[3] Limited by high voltage fuse-links.

Making and breaking capacities V-module with vacuum circuit-breaker, downstream disconnector and earthing switch

	Rated voltage			36	36	38	38,5	40,5
34	Rated short-circuit breaking current	I_{sc}	kA	16	16	16	16	16
35	DC time constant of the rated short-circuit breaking current	t	ms	45	45	45	45	45
36	DC component	p_{cs}	%	41	30	25	33	33
37	Rated first-pole-to-clear factor	k_{pp}		1.5	1.5	1.5	1.5	1.5
38	Rated short-circuit making current (circuit-breaker)		kA	40	41.6	41.6	40	40
39	Rated operating sequence [1]			0 - 0,3s - CO - 3min - CO				
40	Rated cable-charging breaking current	I_c	A	50	-	-	-	-
41	Rated line-charging breaking current	I_{lc}	A	10	-	-	-	-
42	Electrical and mechanical classes (circuit-breaker) [2]			E1, C2, M1, S2	E1, M1 S1	E1, M1 S1	E1, M1 S1	E1, M1 S1
43	Rated out-of-phase breaking current	I_d	kA	5	-	-	-	-
44	First-pole-to-clear factor for out-of-phase conditions (system with effectively and non-effectively earthed neutral)			2.5	-	-	-	-
45	Rated short-circuit making current (earthing switch)	I_{ma}	kA	16	16	16	16	16
46	Rated short-circuit making capability class (earthing switch)			E2	E2	E2	E2	E2
47	Rated mechanical endurance class (earthing switch)			M0	M0	M0	M0	M0
48	Rated mechanical endurance class (disconnector)			M0	M0	M0	M0	M0
Making and breaking capacities De-module								
49	Rated short-circuit making current (earthing switch)	I_{ma}	kA	40	41.6	41.6	40	40
50	Rated short-circuit making capability class (earthing switch)			E2	E2	E2	E2	E2
51	Rated mechanical endurance class (earthing switch)			M0	M0	M0	M0	M0

[1] Rated operating sequence O-3s-CO-15s-CO is applicable for circuit-breakers rated 16kA at 50Hz.
[2] Class E2 is applicable for rated operating sequence O-3min-CO-3min-CO.

Technical data
SafePlus

Compact switchgear, electrical data (overview does not show rated values applicable for Metering modules)

1	Rated voltage	U_r	kV	36		36		38		38,5		40,5	
2	Rated power frequency withstand voltage	U_d	kV	70		70		80		80		95	
	- across disconnector		kV	80		80		95		95		110	
3	Rated lightning impulse withstand voltage	U_p	kV	170		170		180		180		185	
	- across disconnector		kV	195		195		210		210		215	
4	Rated frequency	f_r	Hz	50		60		60		50		50	
5	Rated normal current (busbars)	I_r	A	630		600		600		630		630	
6	Rated short-time withstand current	I_k	kA	20	25	20	25	20	25	20	25	20	25
7	Rated duration of short-circuit	t_k	s	3	1	3	1	3	1	3	1	3	1
8	Rated peak withstand current	I_p	kA	50	62,5	52	65	52	65	50	62,5	50	62,5
9	Internal arc classification IAC AFL	I_a/t_a	kA/s	20/1	25/1	20/1	25/1	20/1	25/1	20/1	25/1	20/1	25/1
10	Internal arc classification IAC AFLR	I_a/t_a	kA/s	20/1	25/1	20/1	25/1	20/1	25/1	20/1	25/1	20/1	25/1
11	Loss of service continuity			LSC2-PM (for C-, D-, De- and V-module), LSC2A-PI (for F-module)									

Making and breaking capacities C-module with switch-disconnector and earthing switch

12	Rated normal current	I_r	A	630		600		600		630		630	
13	Rated mainly active load breaking current	I_{load}	A	630		600		600		630		630	
14	Number of operations for mainly active load breaking	n		100		100		10		30		30	
15	Rated distribution line closed-loop breaking current	I_{loop}	A	630		600		600		630		630	
16	Rated cable-charging breaking current	I_{cc}	A	20		-		-		21		21	
17	Rated line-charging breaking current	I_{lc}	A	2		-		-		2.1		2.1	
18	Rated earth-fault breaking current	I_{ef1}	A	60		-		-		63		63	
19	Rated cable- and line-charging breaking current under earth-fault conditions	I_{ef2}	A	35		-		-		36		36	
20	Rated short-circuit making current	I_{ma}	kA	50	62,5	52	65	52	65	50	62,5	50	62,5
21	Rated mechanical endurance class (earthing switch)			M0		M0		M0		M0		M0	
22	Rated short-circuit making capability class (earthing switch)			E2	E2	E2	E1	E2	E1	E2	E2	E2	E2
23	Electrical and mechanical classes (switch-disconnector) [1]			E3, C2, M1		M1		M1		E2, C2, M1		E2, C2, M1	

Making and breaking capacities F-module with switch-fuse disconnector and earthing switch

24	Rated normal current [2]	I_r	A	200	-	-	200	200
25	Rated short-circuit breaking current [3]	I_{sc}	kA	20	-	-	20	20
26	Rated making capacity (downstream earthing switch)	I_{ma}	kA	2,5	-	-	2,5	2,5
27	Rated short-time current (downstream earthing switch)	I_k	kA	1	-	-	1	1
28	Rated duration of short-circuit (downstream earthing switch)	t_k	s	1	-	-	1	1
29	Rated peak withstand current (downstream earthing switch)	I_p	kA	2,5	-	-	2,5	2,5
30	Rated transfer current	$I_{transfer}$		840	-	-	750	750
31	Rated mainly active load breaking current	I_{load}		200	-	-	200	200
32	Rated distribution line closed-loop breaking current	I_{loop}		200	-	-	200	200
33	Electrical and mechanical classes (downstream earthing switch)			E2, M0	-	-	E2, M0	E2, M0

[1] For 60Hz making tests with 3 making operations at 65kA and making and breaking tests at 600A (TD_{load} and TD_{loop}), each with 10 CO, have been performed
[2] Depending on the current rating of the fuse-link
[3] Limited by high voltage fuse-links

VCB Mk1; Making and breaking capacities V-module with vacuum circuit-breaker, downstream disconnector and earthing switch

	Rated voltage			36		36		38		38,5		40,5			
	Rated current			**630**		**600**		**600**		**630**		**630**			
	Rated frequency			50		60		60		50		50			
34	Rated short-circuit breaking current	I_{sc}	kA	20	25	20		20		20	25	20	25		
35	DC time constant of the rated short-circuit breaking current	t	ms	45		45		45		45		45			
36	DC component	p_{cs}	%	41	29	30	-	30	-	33	29	33	29		
37	Rated first-pole-to-clear factor	k_{pp}		1,5		1,5		1,5		1,5		1,5			
38	Rated short-circuit making current (circuit-breaker)		kA	50	62,5	52	65	52	65	50	62,5	50	62,5		
39	Rated operating sequence [1]			O - 0,3s - CO - 3min - CO											
40	Rated cable-charging breaking current	I_c	A	50		-		-		-		-			
41	Rated line-charging breaking current	I_{lc}	A	10		-		-		-		-			
42	Electrical and mechanical classes (circuit-breaker)			E1[2], C2[3], M1, S2[4]		E1[2], M1, S1		E1[2], M1, S1		E1[2], M1, S1		E1[2], M1, S1			
43	Rated out-of-phase breaking current	I_d	kA	5		-		-		-		-			
44	First-pole-to-clear factor for out-of-phase conditions (system with effectively and non-effectively earthed neutral)			2,5		-		-		-		-			
45	Rated short-circuit making current (earthing switch)	I_{ma}	kA	50	62,5	52	65	52	65	50	62,5	50	62,5		
46	Rated short-circuit making capability class (earthing switch)			E2	E2	E2	E1	E2	E1	E2	E2	E2	E2		
47	Rated mechanical endurance class (earthing switch)			M0		M0		M0		M0		M0			
48	Rated mechanical endurance class (disconnector)			M0		M0		M0		M0		M0			

VCB Mk2; Making and breaking capacities V-module with vacuum circuit-breaker, downstream disconnector and earthing switch

	Rated voltage			36		36		38		38,5		40,5			
	Rated current			**630**		**600**		**630**		**630**		**630**			
	Rated frequency			50		60		50/60		50/60		50/60			
50	Rated short-circuit breaking current	I_{sc}	kA	20	25	20	25	20	25	20	25	20	25		
51	DC time constant of the rated short-circuit breaking current	t	ms	45		45		45		45		45			
52	DC component	p_{cs}	%	41		41		41		41		41			
53	Rated first-pole-to-clear factor	k_{pp}		1,5 and 1,3		1,5 and 1,3		1,5 and 1,3		1,5 and 1,3		1,5 and 1,3			
54	Rated short-circuit making current (circuit-breaker)		kA	50	62,5	52	65	52	65	52	65	52	65		
55	Rated operating sequence			O - 0,3s - CO - 15s - CO											
56	Rated cable-charging breaking current	I_c	A	50		50		50		50		50			
57	Rated line-charging breaking current	I_l	A	10		10		10		10		10			
58	Electrical and mechanical classes (circuit-breaker)			E2, C2, M2, S2		E2, C2, M2, S2		E2, C2, M2, S2		E2, C2, M2, S2		E2, C2, M2, S2			
59	Rated out-of-phase breaking current	I_d	kA	6,25		6,25		6,25		6,25		6,25			
60	First-pole-to-clear factor for out-of-phase conditions (system with effectively and non-effectively earthed neutral)			2,5		2,5		2,5		2,5		2,5			
61	Rated short-circuit making current (earthing switch)	I_{ma}	kA	50	62,5	52	62,5/65	52	62,5/65	52	62,5/65	52	62,5		
62	Rated short-circuit making capability class (earthing switch)			E2	E2	E2	E2/E1	E2	E2/E1	E2	E2/E1	E2	E2		
63	Rated mechanical endurance class (earthing switch)			M1		M1		M1		M1		M1			
64	Rated mechanical endurance class (disconnector)			M1		M1		M1		M1		M1			

Making and breaking capacities De-module with earthing switch

	Rated frequency			50		60		50/60		50/60		50/60			
61	Rated short-circuit making current (earthing switch)	I_{ma}	kA	50	62,5	52	62,5/65	52	62,5/65	52	62,5/65	52	62,5		
62	Rated short-circuit making capability class (earthing switch)			E2	E2	E2	E2/E1	E2	E2/E1	E2	E2/E1	E2	E2		
67	Rated mechanical endurance class (earthing switch)			M0		M0		M0		M0		M0			

Making and breaking capacities D-module

68	Making and breaking capabilities not applicable as the D-module has no switching devices. Rated values are listed in lines 1-11														

[1] Rated operating sequence O-0,3s-CO-15s-CO is applicable for circuit-breakers rated 20kA at 50Hz
[2] Class E2 is applicable for rated operating sequence O-3min-CO-3min-CO
[3] Class C1 is applicable for I_{sc} = 25kA
[4] Class S1 is applicable for I_{sc} = 25kA

Technical data
General

General data	
Type of Ring Main Unit	Metal enclosed
Number of phases	3
Whether RMU is type tested	Yes
Pressure test on equipment tank or containers	Until pressure relief device opens
Whether facility is provided with pressure relief device	Yes
Insulating gas	SF_6
Nominal operating gas pressure	1,4 bar abs. at 20°C
Gas diffusion rate	less than 0,1 % p.a.
Expected operating lifetime	30 years
Whether facilities are provided for gas monitoring	Yes, temperature compensated manometer can be delivered
Material used in tank construction	Stainless steel sheet, 2 mm
Busbars	300 mm^2 Cu
Earth bar (external)	120 mm^2 Cu
Earth bar bolt dimension	M10
Operations	
Means of switch-disconnector operation	Separate handle
Means of fuse-switch-disconnector operation	Separate handle and push-buttons and/or opening and closing trip coils
Means of circuit-breaker operation	Integrated handle and push-buttons and/or opening and closing trip coils
Total opening time of circuit-breaker	approx. 40 - 80 ms
Closing time of circuit-breaker	approx. 50 - 90 ms
Mechanical operations of switch-disconnector	1000 CO (Class M1)
Mechanical operations of earthing switch	1000 CO
Mechanical operations of circuit-breaker	2000 CO (Class M1)
Principle switch-disconnector	2 position puffer switch
Principle earthing switch	2 position earthing switch with downstream earthing switch in F-modules
Principle circuit-breaker	Vacuum interrupter with axial magnetic field contacts
Switch-disconnector	
Rated making operations on short circuit current (class E3)	5
Rated making operations on short circuit current (class E2)	**3**
Rated operations mainly active load (class E3)	100
Rated operations mainly active load (class E2)	**30**
Fuse-links	
Length, D, of fuse-links to be used in fuse canister	537 mm
Contact diameter, ØA, of fuse-links to be used in fuse canister	45 mm
Maximum diameter, ØC, of fuse-links to be used in fuse canister	88 mm
Standard dimensions	According to IEC60282-1 type 1/DIN 43625
Maximum fuse-link rated current	63 A

Normal service conditions - indoor according to IEC 62271-1:2017 subclause 4.1.2	
Maximum ambient air temperature	+ 40°C [1)]
Maximum ambient air temperature - average value measured over a period of 24 hours	+ 35°C [1)]
Minimum ambient air temperature ambient air temperature	- 25°C [2)]
Altitude for erection above sea level	...1500 m [3)]
Maximum relative humidity - average value measured over a period of 24 hours	95%
Weight table	
Maximum weights for SafeRing 36	
2-way DeV/DeF	550 kg
3-way CCV/CCF	800 kg
4-way CCCV/CCCF	1050 kg
4-way CCVV/CCFF	1100 kg
3-way CCC	750 kg
4-way CCCC	1000 kg
Maximum weights for SafePlus 36	
1-way (C-, D-, De-module)	250 kg
1-way (F-, V-module)	300 kg
2-, 3- and 4-way	as for SafeRing
M – metering module	600 kg
Degree of protection	
High voltage live parts, SF_6 tank	IP 67
Front covers / operating mechanisms	IP 2X
Cable covers	IP 3X
Fuse canisters	IP 67
Colors	
Front covers	RAL 7035
Side and cable covers	RAL 7035
Switch area	Medium Grey Pantone 429C

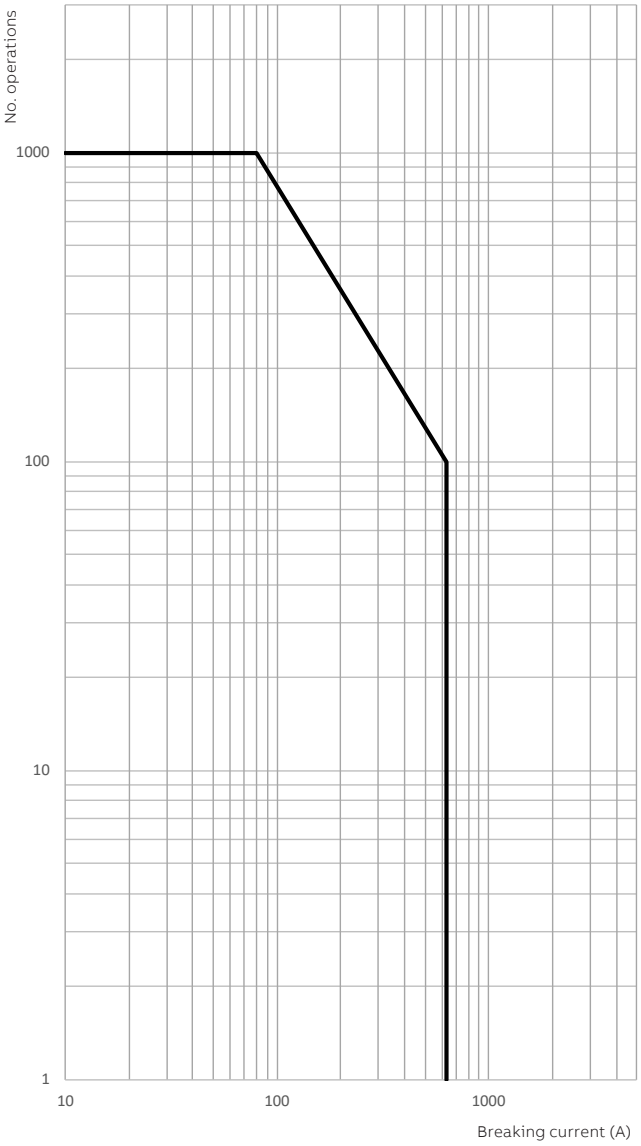
[1)] Derating allows for higher maximum temperatures.
[2)] For lower minimum air temperature, please contact ABB.
[3)] For higher altidude, please contact ABB.

“ABB wishes to highlight that values of dimensions and weights provided herein are preliminary and may change after final design preparation, based on final scope of supply and installation details of the switchgear. As a consequence, provided values of dimensions and weights are NOT to be considered as final but only for standard reference purposes.

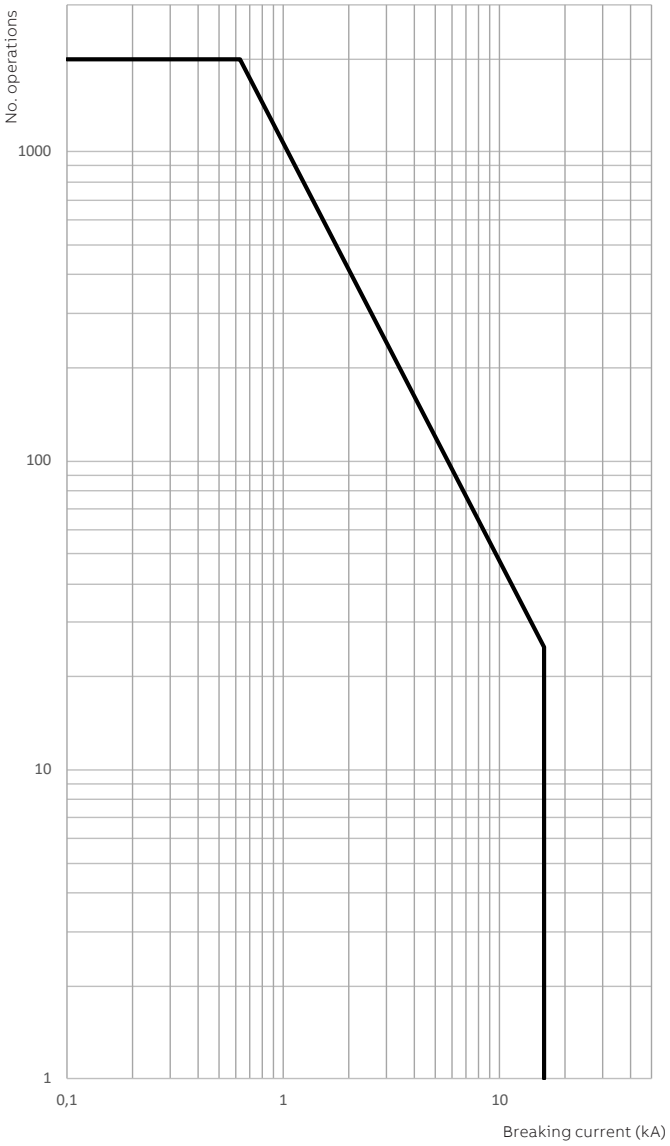
ACCORDINGLY, YOU EXPRESSLY ACKNOWLEDGE AND AGREE THAT VALUES OF DIMENSIONS AND WEIGHTS PROVIDED HEREIN ARE NEITHER FINAL NOR BINDING AND THAT THE RESULT OF THEIR USE IS NEITHER FEASIBLE NOR ACCURATE NOR ERROR FREE”.

Technical data
Number of operations

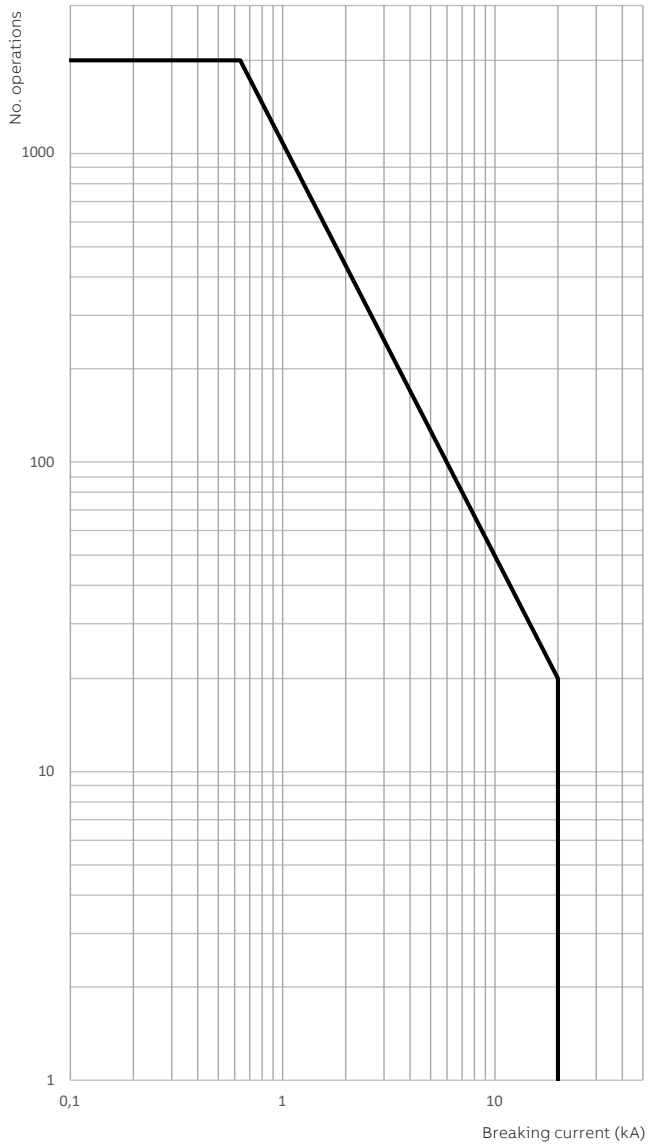
SafeRing /SafePlus C-module 36, 38,5 and 40,5kV



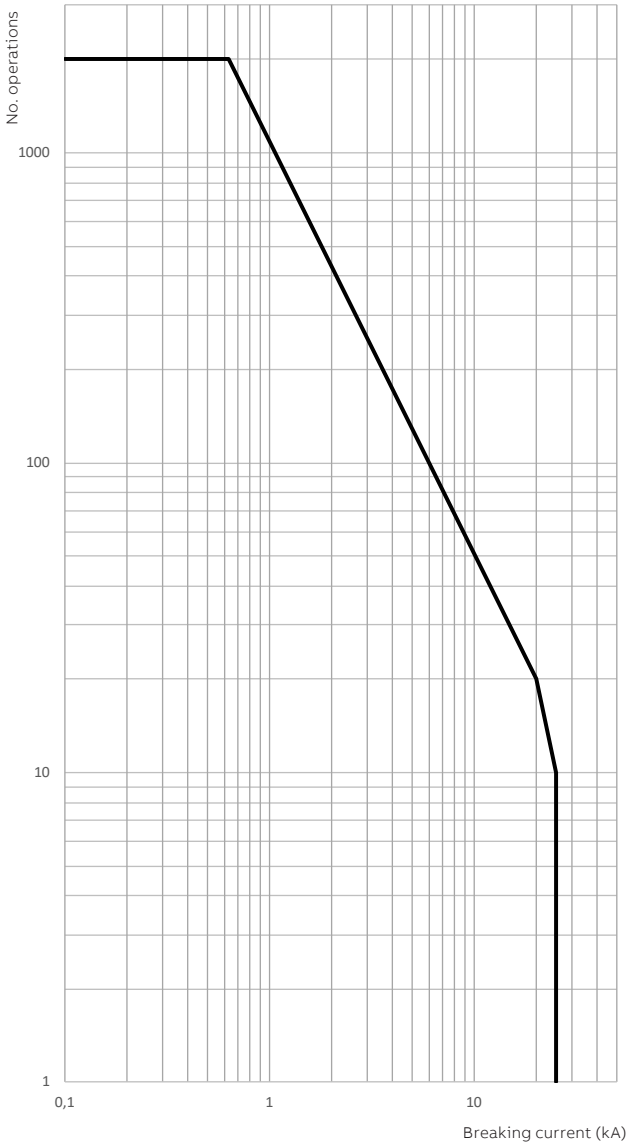
SafeRing VCB Mk1, 16kA, 36, 38,5 and 40,5kV



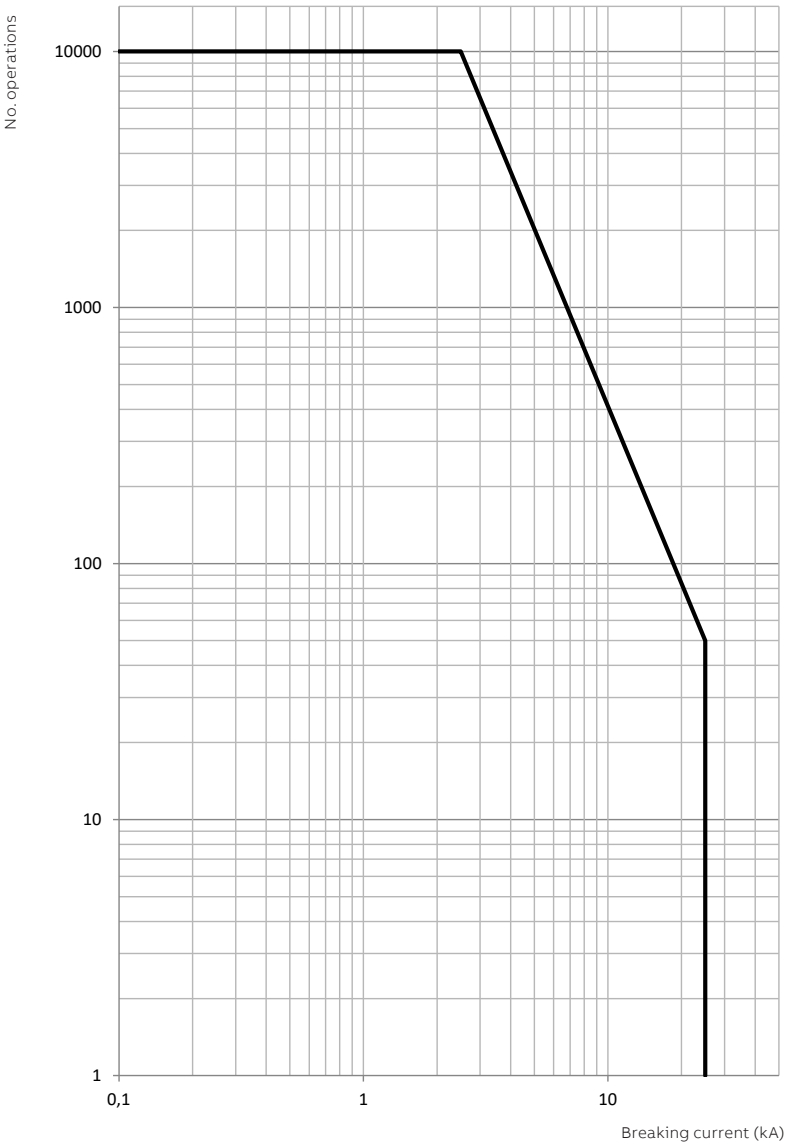
SafePlus VCB Mk1, 20kA, 36, 38,5 and 40,5kV



SafePlus VCB Mk1, 25kA, 36, 38,5 and 40,5kV



SafePlus VCB Mk2, 25kA, 36, 38,5 and 40,5kV, 50/60Hz



Environmental certification for gas-insulated SafeRing/SafePlus

Life expectancy of product
The product is developed in compliance with the requirements denoted by IEC 62271-200. The design incorporates a lifespan 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 at 20°C throughout its designed life span.

Recycling capability				
Raw Material	**Weight (kg)**	**% of total weight**	**Recycle**	**Environmental effects & recycle/reuse processes**
Iron	139,9	31,4	Yes	Separate, utilize in favour of new source (ore)
Stainless steel	130,8	29,3	Yes	Separate, utilize in favour of new source (ore)
Copper	71,9	16,1	Yes	Separate, utilize in favour of new source (ore)
Brass	3,0	0,7	Yes	Separate, utilize in favour of new source (ore)
Aluminium	1,0	0,2	Yes	Separate, utilize in favour of new source (ore)
Zinc	5,1	1,1	Yes	Separate, utilize in favour of new source (ore)
Silver	0,075	0,017	Yes	Electrolysis, utilize in favour of new source
PBT	2,3	0,5	Yes	Make granulate, re-use or apply as energy
PA6-6	5,3	1,2	Yes	
PC	0,8	0,2	Yes	
Other thermoplastic	0,1	0,0	Yes	
Packing foil	0,3	0,1	Yes	High-grade energy additive in refuse incineration
SF6 gas	7,14	1,6	Yes	ABB AS in Skien reclaims used SF_6 gas
Dielectric oil	0,3	0,1	Yes	Collect / reclaim / regenerate
Wooden pallet	27,8	6,2	Yes	Re-use
Total recycleables	395,8	88,8		
Rubber	1,9	0,4	No	Incinerate energy in rubber
Epoxy compounds	46,5	10,4	No	Contains 60 % quartz sand, incinerate energy in epoxy
Unspecified	1,5	0,3	No	Stickers, film foils, powder coating, lubricates
Total non-recycleables	49,9	11,2		
Total weight *)	445,7	100 %		

*) All figures are collected from CCF 3-way unit with fuse canisters.

End-of-life
ABB Electrification Products Division is committed to the protection of the environment and follows the ISO 14001 standard. It is our obligation to assure environmentally clean processes, high recyclablity and facilitate end-of-life recycling for our products. The switchgear contains SF_6 gas with a high global warming potential and the gas must not be released to the atmosphere. The switchgear is marked with a SF_6 Global Warming label.

ABB's handling and recycling services are in accordance with IEC 62271-4 for end of life of SF_6 filled equipment.

ABB Electrification, Distribution Solutions unit in Skien is equipped for the recovery of SF_6 gas from discarded switchgears.

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new.abb.com/medium-voltage/switchgear/gas-insulated-switchgear

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