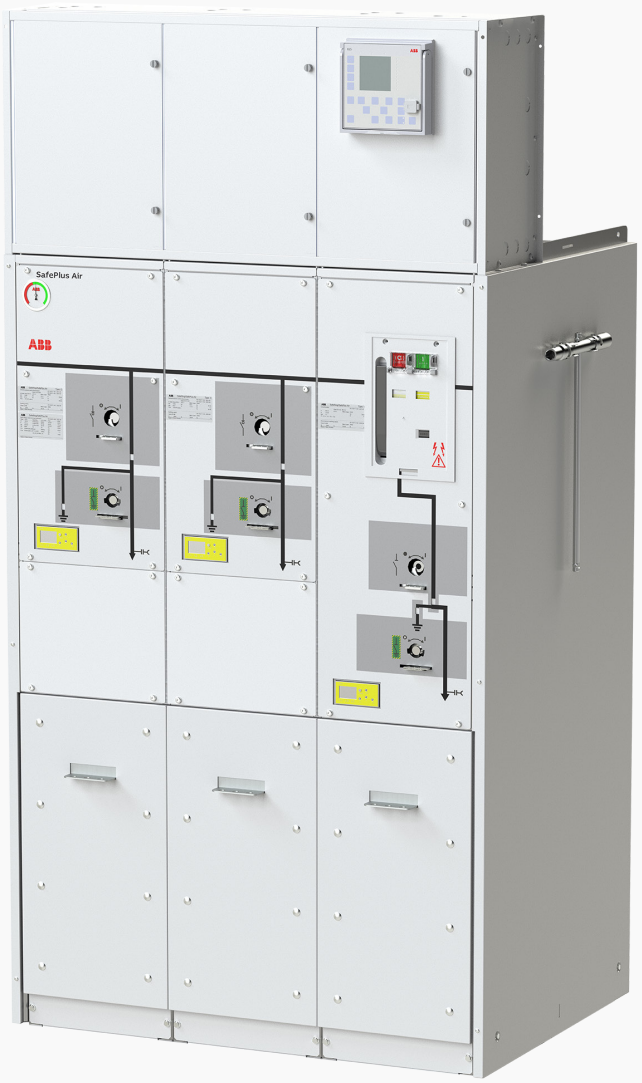
CATALOG

SafeRing / SafePlus Air 24kV



Engineered to outrun

- Same interface, footprint, and operations as SafeRing and SafePlus - no additional training required

- Global warming potential (GWP) = 0

- Puffer-type load break switch (LBS) specifically for SF6-free applications. The LBS effectively interrupts load currents in dry air and is a well proven technology in SafeRing/SafePlus SF6-free application for many years

- Modified gas enclosure design to withstand high filling pressure

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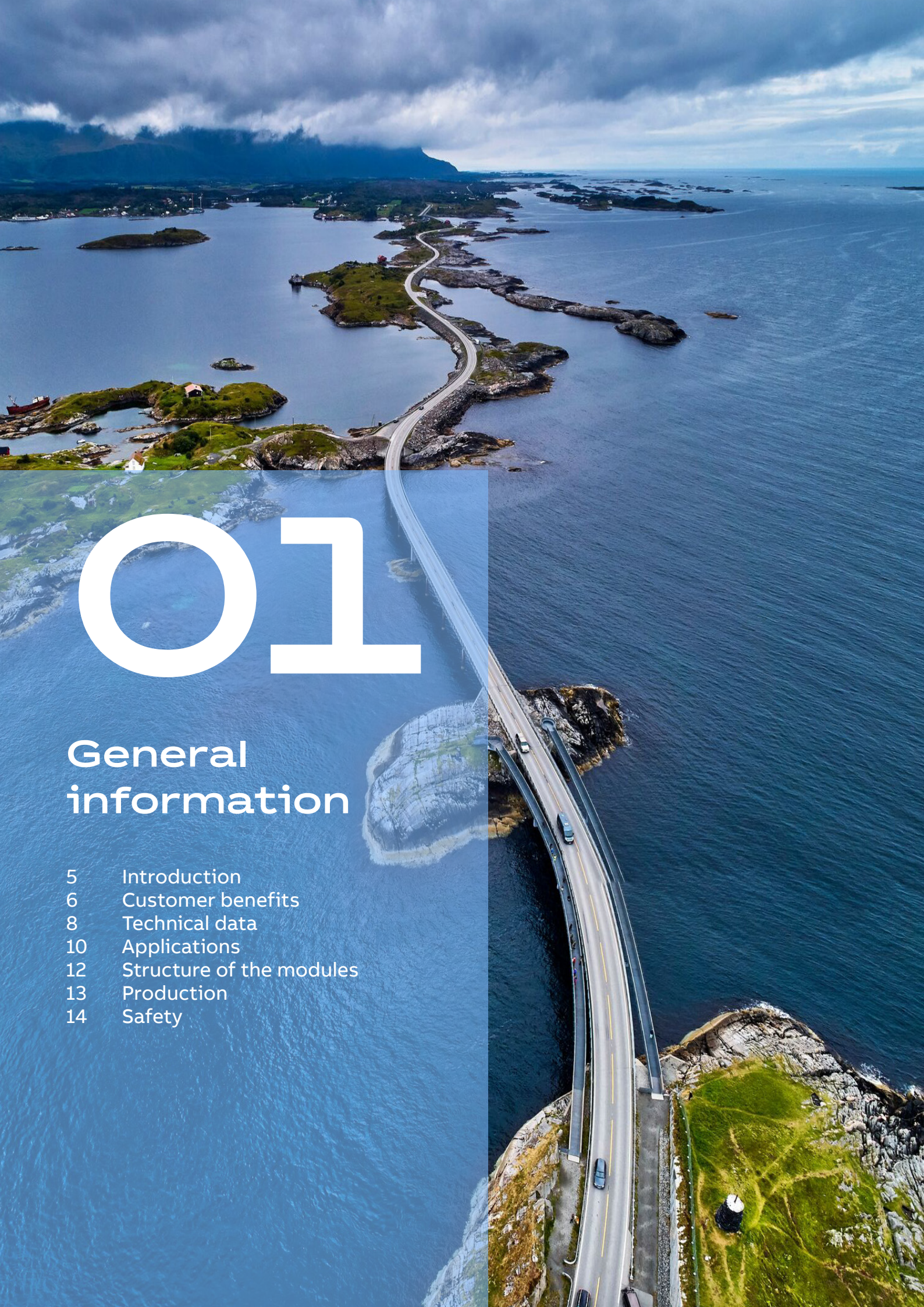


01

General information

Introduction

ABB offers a comprehensive range of alternatives to SF6 for medium-voltage switchgear applications. Dry Air solutions are available in 3-way units in standard configurations, with additional equipment tailored to customer specifications.

SafeRing / SafePlus Air are fully sealed systems with a stainless steel tank housing all live components and switching functions.

All units undergo routine testing before dispatch, and no special tools are required for installation.

Available Functional Units:

- C = Load break switch with disconnector and earthing switch
- F = Fuse-switch disconnector
- V = Vacuum circuit-breaker with disconnector and earthing switch

Units are delivered directly from the factory, ready for on-site installation.

General Information:
SafeRing Air is a ring main unit designed for secondary distribution networks. Suitable for most switching applications up to 24kV distribution networks.

SafePlus Air is a metal-enclosed compact switchgear system for up to 24kV distribution applications. The switchgear offers unique flexibility due to the possible combination of semi-modular configurations.

A sealed steel tank with constant atmospheric conditions ensures high reliability, personnel safety, and a maintenance free medium voltage system.

The switchgear portfolio is continuously developed to meet new market requirements and customer needs. Both SafeRing Air and SafePlus Air modules are harmonized with the existing SafeRing / SafePlus portfolio.

Insulation Gas:
Dry Air insulation gas has a global warming potential (GWP) of 0, making medium voltage (MV) gas-insulated switchgear (GIS) both efficient and compact. Concerns about the high GWP of SF6 have driven ABB to develop next-generation retrofittable power distribution products. From an environmental perspective, Dry Air is the ideal choice for customers seeking a climate-friendly alternative.

Global Warming Potential (GWP):
Dry Air is environmentally ideal with a GWP of zero, meaning it does not contribute to global warming.

Modularity:
All modules are only 325 mm wide, the same width as SafeRing / SafePlus current portfoiio.

Application:

SafeRing / SafePlus Air are the most compact solutions on the market, making them ideal for utility, CSS, light industry, buildings, and infrastructure applications.

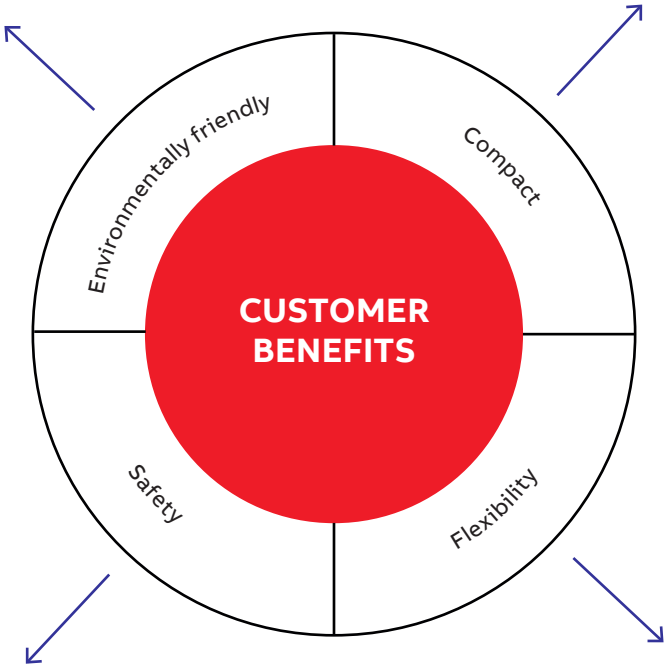
Customer benefits

Environmentally friendly

- Alternative technologies with low environment impact and high level of recyclability
- Global warming potential GWP = 0
- Low climate impact
- Avoid regulations for the use of SF_6

Compact

- Compact design, all modules only 325 mm wide
- Less material, used in a more efficient way
- Compact design with small footprint
- Lower thermal losses



Safety

- Reliable current breaking capability
- Maintenance free medium-voltage solution
- Safe switching in case of gas leaking
- Virtually maintenance-free switchgear minimizes operations, reduces danger to operators
- Mechanical interlocks prevent unsafe operations
- Key interlocks available for additional safety
- Robust internal arc protections
- Loss of service continuity – IEC 62271-200 describes the extent to which a switchgear's high-voltage compartments and/or functional units may remain energized when a main circuit compartment of this functional unit is opened.

Flexibility

- High degree of recycle capability
- Can be fitted with motor operation, AC or DC
- Can be fitted with wide a range of indicators

Sealed system

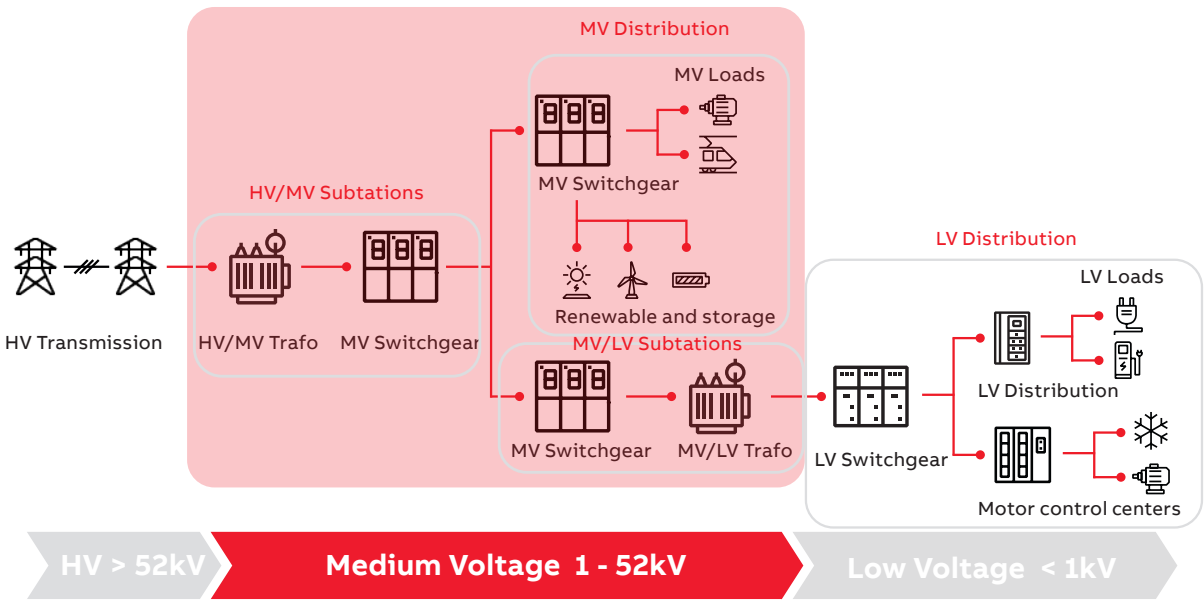
- Climatically independent as all live components and switching functions are contained within a stainless-steel tank protecting them from soiling, humidity, foreign bodies, and other environmental influences. Capable of operating in industrial polluted, high corrosive environments and flood-risk areas
- Normal operational altitude is up to 1500 m above sea level. Beyond this, the system can also be installed at altitudes exceeding 1500 m with the provision of adjusting the internal pressure to ensure optimal performance

Compact and reliable

- Very low maintenance requirement due to a sealed for lifetime gas tank
- All panel variants can stay in service up to the point of repair, even in the unlikely event of a leak. Contact ABB for further details
- Compact design with small footprint
- As an alternative to traditional transformers, these units can be outfitted with sensor technology for current and voltage measurement. They also feature advanced automation and control with the IEC 61850 communication protocol
- Additionally, they offer condition monitoring and diagnostics, providing secure access to condition and operational data. This supports optimal switchgear operations and helps to reduce maintenance costs
- Puffer-breaking technology is a proven method used in SF6 breaking in high voltage and medium voltage applications and has been in use for more than 50 years. ABB has adopted this technology and introduced it in its SF6-free secondary switchgear portfolio.

Safe

- Internal arc certified design offers a high level of operator safety with front, rear and lateral arc protection, certified with accessibility A FLR 20 kA 1 s according to IEC 62271-200.
- Both switchgear solutions are operator friendly with a copy of the switchgear diagram on the front of the panel so there is no need to open the doors for manual operations.
- Wide range of monitoring and diagnostic features for safe and reliable operations



Technical data

IEC standards

The Air portfolio is manufactured and tested in accordance with the latest version of the below IEC regulations.

Code	Description
IEC 62271-1	High-voltage switchgear and controlgear - Part 1: Common specifications
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 103: Switches combination for rated voltages above 1 kV up to and including 52 kV
IEC 62271-105	High-voltage switchgear and controlgear- Part 105: Switche-fuse combination for rated voltages above 1 kV up to and including 52 kV
IEC 62271-200	High-voltage switchgear and controlgear - Part 200: A.C. metal-enclosed switchgear and controlgear for rated voltages above 1 kV up to and including 52 kV
IEC 62271-213	Voltage detecting and indication system
IEC 62271-4	High-voltage switchgear and controlgear - Part 4: Handling procedures for gases for insulation and/or switching
IEC 60529	Degrees of protection provided by enclosures (IP code)
IEC 60255	Electronic protection relays
IEC 61869-1	Instrument transformers - general requirements
IEC 61869-2	Current instrument transformers
IEC 61869-3	Voltage instrument transformers
IEC 61869-10	Low-power passive current transformers
IEC 61869-11	Low-power passive voltage transformers
IEC 60137, CENELEC EN 50181	Bushings
IEC 61869-11, IEC 61869-10	Combined bushings sensors
IEC 60502-4	Cable connection

Rating	Unit	Value
Rated voltage	kV	24
Rated frequency	Hz	50
Rated conitnuous current	A	630
Rated short-time withstand current	kA	20
Rated peak withstand current	kA	50
Rated duration of short-circuit	s	3
Rated short-time phase-to-earth withstand current	kA	20
Rated peak phase-to-earth withstand current	kA	50
Rated duration of phase-to-earth short-circuit	s	1
Filling level for insulation and/or switching (abs.)	kPa	250
Minimum functional level for insulation and/or switching (abs.)	kPa	230
Rated short-duration power-frequency withstand voltage	kV	50
Rated lightning impulse withstand voltage	kV	125
Rated DC cable test voltage	kV	60
Rated duration for DC cable test	min.	60
C - module		
Rated cable charging current	A	60
Rated line charging current	A	1,5
Rated earth-fault breaking current	A	180
Rated cable- and line-charging breaking current under earth-fault	A	104
Rated short-circuit making current, switch and earthing switch	kA	50
Electrical and mechanical endurance class, earthing switch		E2, M0
Electrical and mechanical endurance class, load-break switch		E3, C2, M1
F - module		
Rated mainly active load breaking current	A	200
Rated distribution line closed-loop breaking current	A	200
Rated cable charging current	A	16
Rated line charging current	A	1,5
Rated earth-fault breaking current	A	48
Rated cable- and line-charging breaking current under earth-fault	A	28
Rated short-circuit breaking current	kA	20
Mechanical endurance class, load-break switch		M1
Rated short-time withstand current, downstream earthing switch	kA	2,5
Rated peak withstand current, downstream earthing switch	kA	6,3
Rated duration of short-circuit, downstream earthing switch	s	1
Electrical and mechanical endurance class, earthing switch		E2, M0
V - module		
Rated short-circuit breaking current	kA	20
Rated duration of short-circuit	s	3
Rated operating sequence		O-0.3s-CO-15s-CO
Rated Line-charging breaking curreny	A	10
Rated cable-charging breaking current	A	31,5
Rated first pole-to-clear factor, Kpp:		1,3 and 1,5
Electrical and mechanical endurance class,		E2, C2, S1, M2
Rated short-time withstand current, earthing switch	kA	20
Rated duration of short-circuit, earthing switch	s	3
Rated short-time withstand current, single phase, earthing switch	kA	20
Rated duration of short-circuit, single phase, earthing switch	s	1
Electrical and mechanical endurance class, earthing switch		E2, M1

Application

1

Renewable Energy

- Green Power energy (Wind, Solar, Hydro)

2

Utilities Distribution

- Transformer stations
- SMART GRID solutions
- Metering

3

Industry

- Pulp and Paper
- Mines and Minerals
- Textiles
- Chemicals
- Food and Beverage
- Automotive
- Petrochemical
- Oil and gas pipelines

4

Data Centers

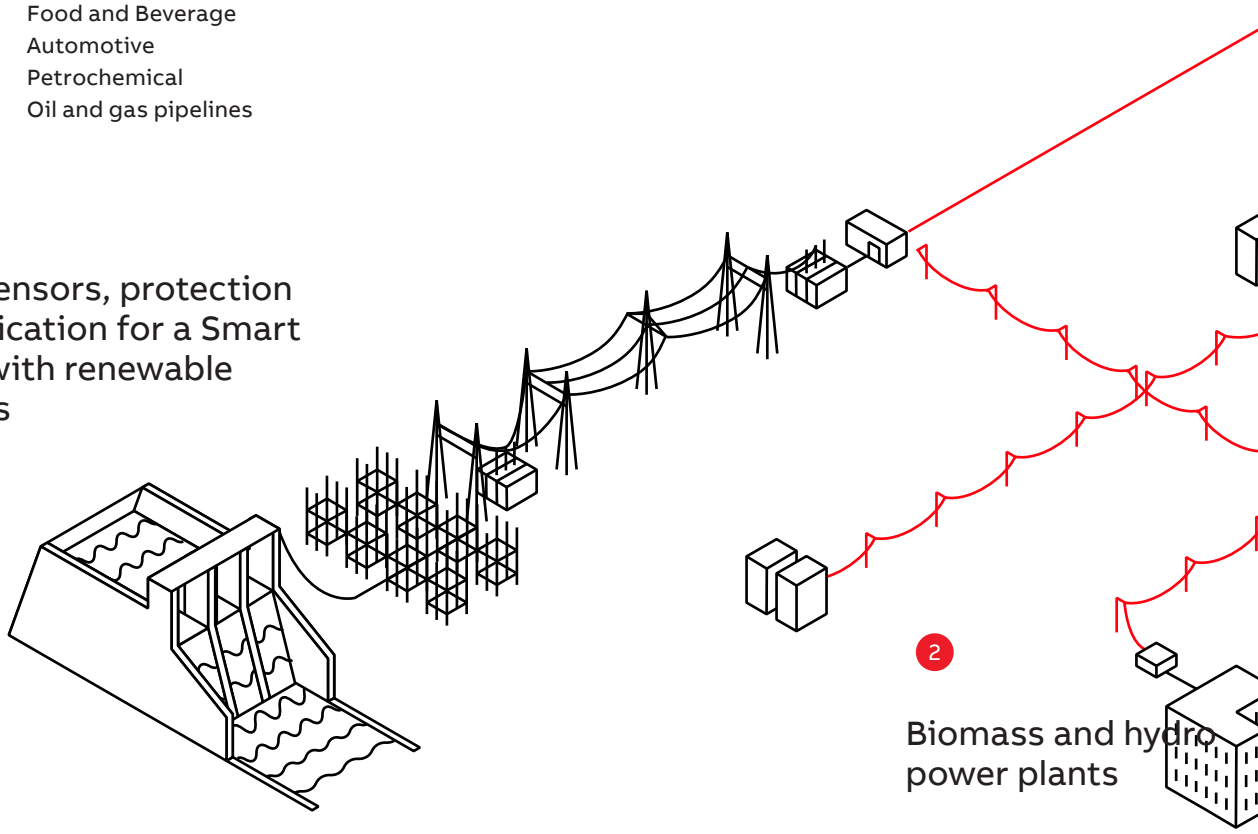
- Hyperscale
- Colocation

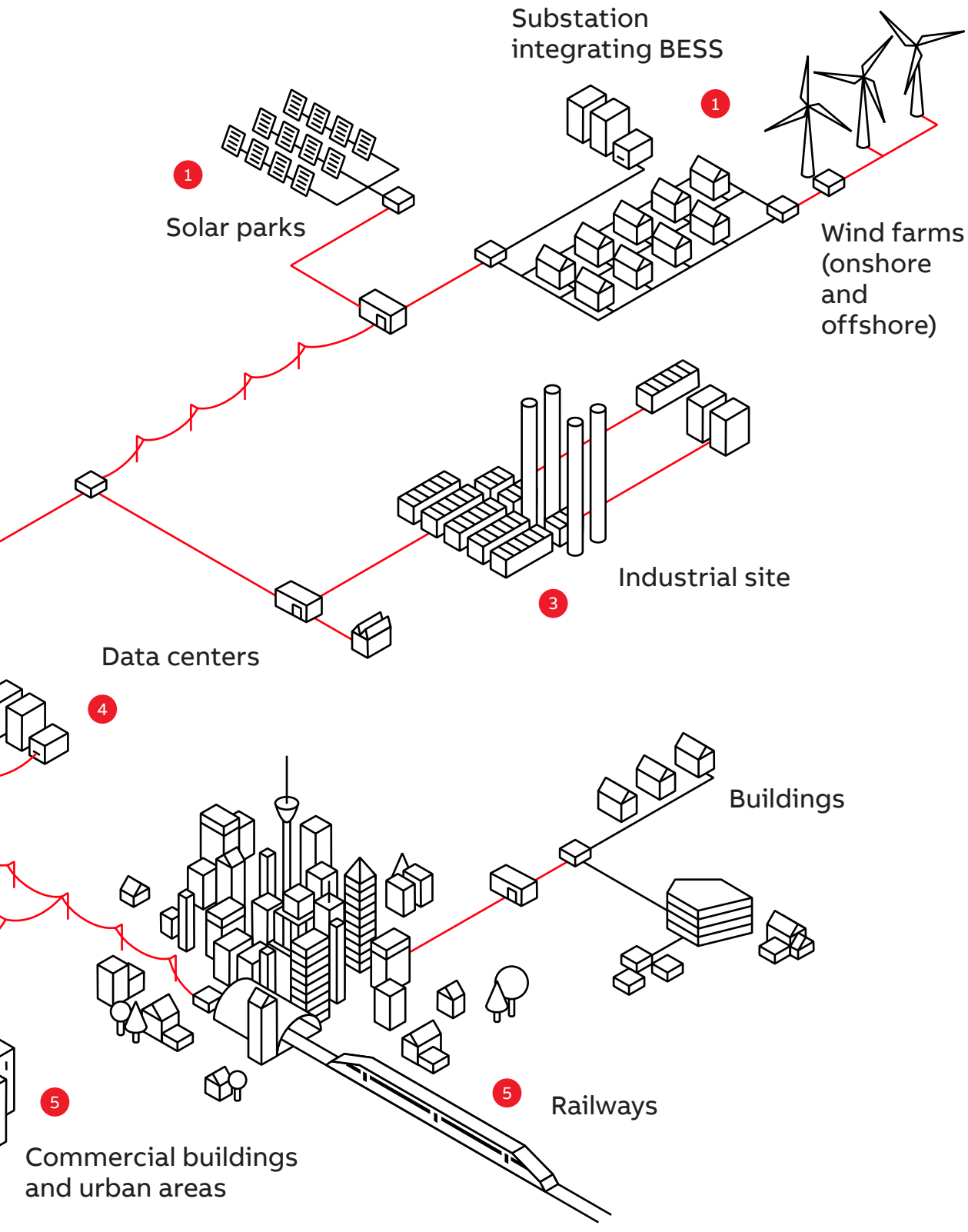
5

Building & Infrastructure/ Transportation

- Hotels/Residential
- Shopping malls
- Hospitals
- Large infrastructure and civil works
- Airports
- Railways
- Ports and Marine
- EV Charging

We provide sensors, protection and communication for a Smart Grid coping with renewable enrgy sources

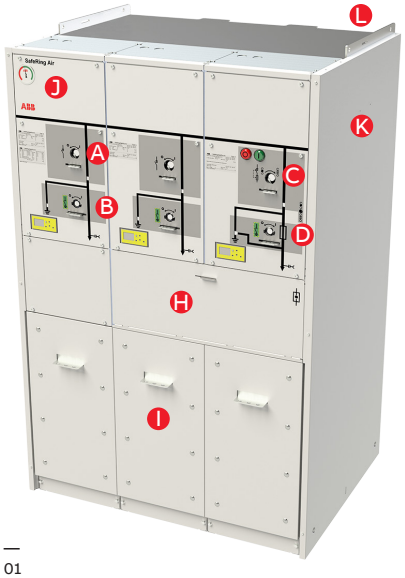



Substation
integrating BESS
1
1
Solar parks
Wind farms
(onshore
and
offshore)
Industrial site
3
Data centers
4
Buildings
5
Railways
5
Commercial buildings
and urban areas

STRUCTURE OF THE MODULES

Modular structure CCF-module

The feeder panel consists of the load break switch A and earthing switch B, fuse-switch disconnector C and earthing switch D, fuse-link compartment H, cable compartment I manometer J, side panel K, lifting brackets L



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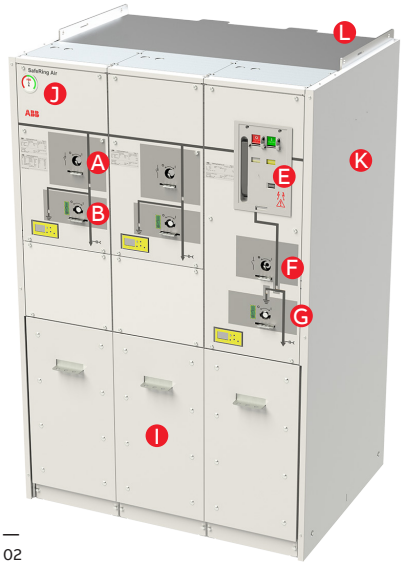
01 CCF-module feeder panel with Load Break Switch, Fuse-switch disconnector and earthing switches

—
02 CCV-module with Load Break Switch, earthing switch and vacuum circuit-breaker, switch disconnector and earthing switch

Modular structure CCV-module

The vacuum switch panel consists of the load break switch A and earthing switch B, vacuum circuit-breaker E, switch disconnector F and earthing switch G, cable compartment I manometer J, side panel K, lifting brackets L



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02

PRODUCTION

Exterior design

The new generation of gas-insulated switchgear features a redesigned front panel. This panel is made from a single steel plate covered with polycarbonate foil, giving it a fresh look. The entire front panel can be removed for easy access to the low-voltage compartment for inspections. The foils display the main circuit diagram and position indicators for the switches, with a light grey background (RAL 7035).

There are two types of cable compartment covers: standard and arc-proof. All covers are removable. Each module has its own cable compartment, separated by partition walls that can be easily removed for cable connections.

A vertical partition wall separates the cable compartments from the rear of the switchgear. In case of an arc fault, this wall prevents hot gases from entering the cable compartments. The side panel has been redesigned for a smooth surface without screws or components, using hot-rolled steel in RAL 7035.

Enclosure

SafeRing and SafePlus use Dry Air as an insulation medium, contained in a welded stainless steel tank that is sealed for life. The pressure system is designed to last over 30 years with a leakage rate of less than 0.1% per year. Welding is done by computer-controlled robots to ensure reliability. Electrical and mechanical bushings are sealed to the tank with high-quality O-rings.

The mechanical bushing has a rotating shaft that connects to the switch mechanism, sealed by double gas seals. All GIS tanks undergo a leakage test before being filled with gas. The test uses Helium to detect leaks, and if passed, the Helium is replaced with Dry Air.

The SafeRing and SafePlus gas compartments have an IP67 protection rating, meaning they can be submerged in water and still function properly.

ABB has established a high-quality automated system for production and quality control, ensuring the sustainability of factory output. Part of this assurance involves standard routine testing procedures according to IEC62271-200, performed on every manufactured switchgear.

IEC Factory Routine Tests:

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

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

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

SAFETY

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

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

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

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

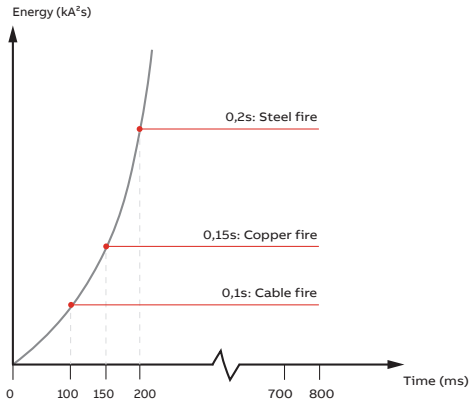
- Increase of the internal pressure
- Increase of the temperature
- Visual and acoustic effects
- Mechanical stresses on the switchgear structure
- Melting, decomposing and evaporation of materials

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

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

B = public access, 100 mm safety distance on accessible sides of the switchgear (also distance to sensors during testing)

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



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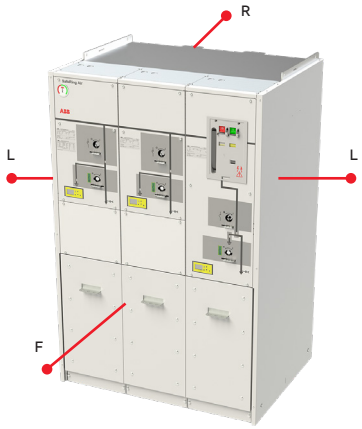


Accessible sides of switchgear = Area that personnel can enter freely. For accessibility A this means a 300 mm safety distance + 500 mm or more in safe moving area.
Non-accessible side of switchgear = Area that is physically blocked or clearly marked as not safe for personnel.

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

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

Internal arc classification (IAC)

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

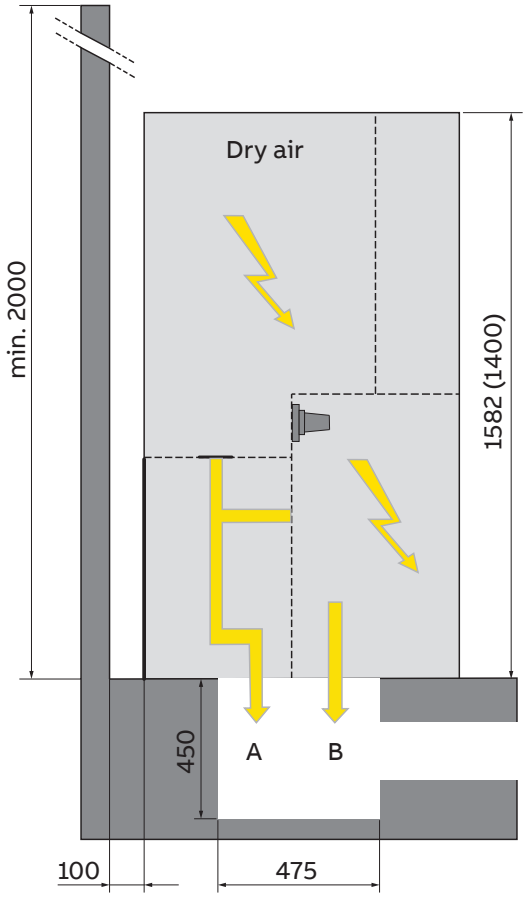
IAC AFLR or AFL - downwards ventilation.
With ventilation down to the cable trench.

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

Basic parameters of set-up:

- IAC AFLR or AFL up to 20 kA / 1s
- Minimum height of ceiling: 2000 mm
- Recommended distance to back wall:
  - 800 mm with accessible rear side
  - 100 mm recommended for non-accessible rear side (possible down to 20mm)
- Back plate installed on the switchgear
- Requires a minimum opening between switchgear and cable trench in the “pressure relief area” for each module.
  - Opening “A” in a 3-way module: 150x205mm
  - It is optional to cover opening “B” between the switchgear cable compartment and the cable trench with a gland plate. This is not an allowed option for low version switchgears
- Minimum width of cable trench: 475 mm
- Minimum depth of cable trench: 450 mm
- A pressure relief channel to a safe area is required and it must have a free opening area of 0,1m²
- Switchgear needs to be installed and fixed to the floor in accordance with “SafeRing / SafePlus Air 24kV Installation and operating instructions"

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



Arc suppressor – active device for increased safety

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

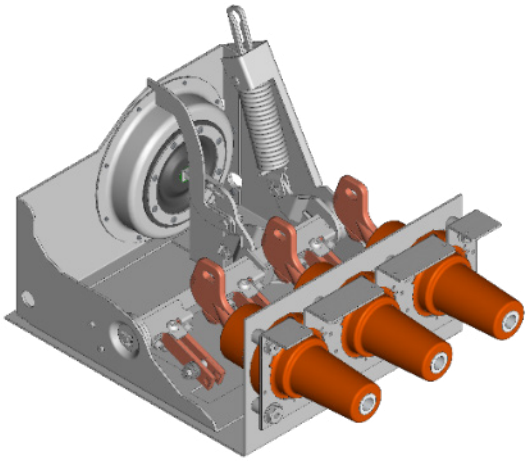
If an arc fault should occur inside the tank the pressure device of the arc suppressor will automatically trip and short circuit the incoming feeder(s) within milliseconds, thereby extinguishing the arc and preventing a gas blowout.
The arc is extinguished without any emission of hot gases and the bolted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

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

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

The arc suppressor is tested for short-circuit currents in the range of 1kArms to 20kArms and it will reduce the generated arc energy to less than 5% of the arc energy released during an arcing time of 1 second.

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



Arc protection in IED (Intelligent Electronic Device)

Protection relays REX615 can optionally be fitted with a fast and selective arc flash protection.
It offers a two- or three channel arc-fault protection system for arc flash supervision of different cable compartments of switchgear modules. Total tripping time is less than 100 ms.

02

configurations

SafeRing Air 24kV

General
SafeRing Air is a ring main unit for the secondary distribution network. It can be supplied suitable for most switching applications in distribution networks.

The SafeRing Air concept offers a choice of circuit breaker with relay for protection of the transformer.

SafeRing Air is supplied with the following standard equipment
- Load break switch
- Earthing switches
- Operating mechanisms with integral mechanical interlocking
- Operating handle
- Facilities for padlocks on all switching functions
- Bushings for cable connection in front with cable covers
- Lifting lugs for easy handling
- Busbar, 630A
- Earthing bar
- Capacitive voltage detection system (VDIS)

Additional equipment
- Arc suppressor for SafeRing Air
- Interlocked cable covers
- Arc proof cable covers complete incl. interlocking
- Trip coil open
- Trip coil open and close
- Motor operation
- Auxiliary switches for all switching functions
- Prepared for relay test equipment
- Capacitive voltage indication (VDS)
- Short circuit indicator
- VCB - tripped signal
- Current metering
- LV compartment
- Ronis key interlock
- Self Powered Relays for V-module

SafePlus Air 24kV

General
SafePlus Air is a metal enclosed compact switchgear system for up to 24kV distribution applications. The switchgear has a unique flexibility due to the possible combination of fully modular and semi-modular configurations.

SafePlus Air, which is ABBs standard ring main unit, represent a complete solution for up to 24kV distribution networks.

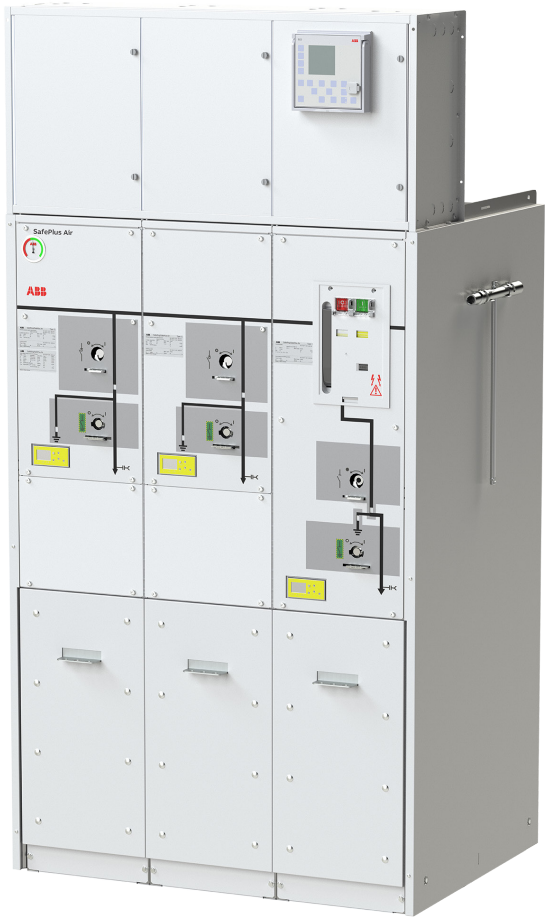
SafePlus Air have identical user interfaces, operation procedures, spare parts and components. SafePlus Air is a completely sealed system with a stainless steel tank containing all live parts and switching functions.

A sealed steel tank with constant gas conditions ensures a high level of reliability as well as personnel safety and a virtu ally maintenance-free system.

The SafePlus Air system offers a choice of a circuit-breaker with relay for protection of the transformer.

SafePlus Air accommodates a wide selection of protection relays for most applications.

SafePlus Air can also be supplied with remote control and monitoring equipment which makes the switchgear more intelligent (Low-voltage compartment is required).

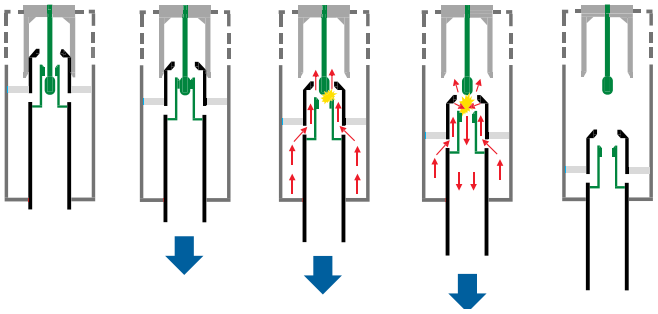


CCF - Cable switch and Switch-fuse module

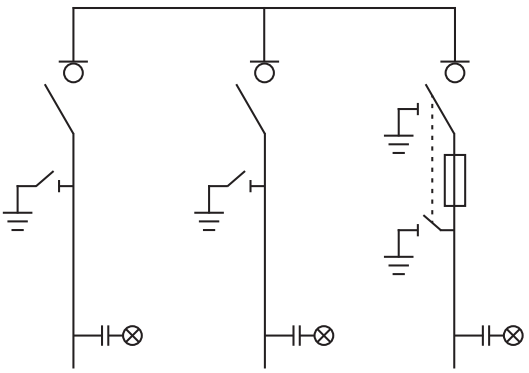
In the new C-panel, the load switching operation is performed with a linear switch disconnector based on the puffer principle. Due to the linear motion of the contacts inside a small interruption chamber, the insulating gas is compressed and forced directly onto the current arc, cooling it down and interrupting the current flow. The principle is well known from high voltage circuit breakers and high-duty medium voltage applications. However, through years of innovation and fundamental research, ABB can utilize the same principle in a scaled down version as a cost effective and robust alternative to vacuum interrupters.

The puffer principle allows several advantages over alternative switching technologies. During interruption, the linear contacts are separated to a safe disconnecting gap, not requiring a separate device for disconnector as with vacuum interrupter-based devices. Further, the arc quenching power is provided directly by the forced cooling of compressed gas, as generated by the motion of the external mechanical drive. No vacuum gap, metal vapor or ablation effects are required, offering a robust performance at all current levels. The natural disconnector gap and replacement of hot- with cold gas during the switching operation quickly re-establish the insulation level, allowing the robust interruption of loads with high transient voltages, such capacitive duties and switch-fuse transfer currents. The switch-disconnector is fitted with a two-position earthing switch. The combination of these devices offers a simplified operation sequence and single-line diagram of the C-module, similar to the present SafeRing/ SafePlus solutions from ABB with SF6.

Puffer interrupter technology



Depth: 797 mm
Width: 1029 mm
Height: 1558 mm (1400 mm)



Common features
All modules share many common features. These are described in the chapter “SafeRing Air configurations”.

Standard features - C
- 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
- Interlocking between load break switch and earthing switch
- Switch position indication for load break switch and earthing switch
- Cable bushings horizontal in front, Interface C with integrated voltage divider for voltage indication

Optional features
- Arc suppressor with signal (1NO) wired to low voltage terminals
- Signal (1NO) from internal pressure indicator wired to terminals (only one each air tank)
- Auxiliary switches
  - Switch position 2NO+2NC
  - Earthing switch position 2NO+2NC

Optional features also available as retrofit
- Motor operation for load break switch
- Auxiliary switches for load break switch position, earthing switch position and fuse blown
- Trip coil open
- Trip coil open and close

Standard features - F
- Two position switch-fuse-disconnector with upstream earthing switch mechanically linked with downstream earthing switch
- Switch position indication for switch-fuse-disconnector and earthing switches
- Operating mechanism with double spring for switch-fuse-disconnector function
- Common mechanism for earthing functions
- Fuse canisters for DIN type fuse. Only accessible when earthing switches are closed
- Fuse-link / transformer rating:
  - 24 kV, max 63 A CEF fuses
- Fuse tripping arrangement
- Optical fuse trip indication
- Cable bushings, Interface A, 200A (200 plug-in)

Optional features
- Cable bushings:
  - Interface C, 630A (400 bolted)
  - Interface C, 630A (400 bolted) combisensor with integrated screen for voltage indication and sensors for current and voltage monitoring
- Signal (1NO) from internal pressure indicator wired to terminals
- Arc proof solution

Optional features also available as retrofit
- Motor operation for switch-fuse-disconnector
- Auxiliary switches for load break switch position, earthing switch position and fuse blown
- Trip coil open
- Trip coil open and close

CCV - Cable switch and Vacuum circuit-breaker module

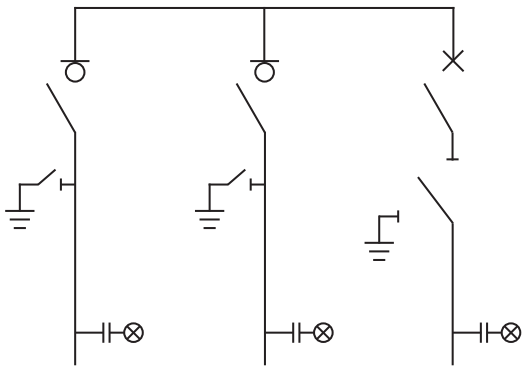
The vacuum circuit-breaker (V-Module) has vacuum bottles as interrupters of the current.
A three-position disconnector/earthing switch is connected in series with the circuit-breaker main circuit.
The operation between vacuum circuit-breaker and disconnector/earthing switch is mechanically interlocked.

Depth: 797 mm
Width: 1029 mm
Height: 1582 mm (1400 mm)

Common features
All modules share many common features. These are described in the chapter “SafeRing Air configurations”.

Standard features - C
See the description for the CCF module

Standard features - V
- 630A vacuum circuit-breaker for feeder protection
- Two position double spring mechanism for vacuum circuit-breaker
- Downstream three position disconnector/ earthing switch from vacuum circuit-breaker
- Three positioning single spring mechanism for disconnector/ earthing switch
- Interlocking between vacuum circuit-breaker and disconnector/earthing switch
- Switch positioning indication for vacuum circuit-breaker and disconnector/earthing switch
- Interface C, 630A (400 bolted)
- Trip coil (for relay tripping)
- Capacitive voltage indication



Optional features
- Arc suppressor with signal (1NO) wired to terminals
- Signal (1NO) from internal pressure indicator wired to terminals

Optional features also available as retrofit
- Motor operation for vacuum circuit-breaker
- Auxiliary switches; Vacuum circuit breaker position 2NO+2NC, disconnector position 2NO+2NC, earthing switch position 2NO+2NC and vacuum circuit-breaker tripped signal 1NO
- Blocking coil
- Undervoltage release coil with/without time delay

03

components

Current transformers

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

Some of these transformers can be closed or split-core type. They can all 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.

The transformers can be mounted inside the ring main unit / switchgear. Secondary circuits should be mounted using copper wires with a cross-section up to 4 mm^2 (strand) or up to 6 mm^2 (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.

KOKM 072

KOLMA

KOLA

Ring core current transformers and earth-fault transformers

Protection relay standard CT's typical	Ring core current transformer type	Ratio - burden
Transformer type: class 10P10	KOKM 072 or SVA 100-100-45	50-100-200/1A 1,5/3/6VA
Transformer type: class 5P10	KOKM 072 or SVA 100-100-45	150/1A 4VA
Transformer type: class 5P10	KOKM 072 or SVA 100-100-45	100-200/1A 4 - 7VA
Transformer type: class 5P10	KOKM 072 or SVA 100-100-45	300-600/1A 4 - 7VA
Transformer type: class 5P10	KOKM 072 or SVA 100-100-45	400-600/1A 4 - 7VA
Earth-fault transformer		
Earth-fault transformer, class 10P10, burden 0,5 - 15VA dependent on selected ratio	KOLMA 06A1 (90 mm)	Multi-tap secondary: 50-150/1A or 50-750/5A
Earth-fault transformer, class 10P10, burden 0,5 - 15VA dependent on selected ratio	KOLMA 06D1 (180 mm)	Multi-tap secondary: 50-150/1A or 50-750/5A
Earth-fault transformer, 0,5 - 20VA	KOLA 100 mm ring type	50 - 1600A
Earth-fault transformer, 0,5 - 20VA	KOLA 180 mm ring type	50 - 1800A

Current transformers for self-powered relays, see chapter "Relays".

Measuring transformers

Current transformers to DIN standards
The DIN current transformers are insulated in resin and are used for powering measuring and protection devices. 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 signaling devices. The ABB range of current transformers is called TPU.

TPU 4x.xx up to 12 kV
TPU 5x.xx up to 17.5 kV
TPU 6x.xx up to 24 kV

Voltage transformers
The voltage transformers are insulated in epoxy resin and are used for powering measuring and protection devices. They are available for fixed assembly or on a plug-in plate for panels with withdrawable circuit-breakers. In this case, the transformers can be equipped with a medium voltage protection fuse. They 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.

TJC 4x.xx up to 12 kV
TJC 5x.xx up to 17.5 kV
TJC 6x.xx up to 24 kV

Sensors

Sensor variants
Two versions are available: one providing voltage measurement together with voltage indication capability or a second one providing both of these plus the possibility of current measurement (KEVCY 24 RE1).

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 24 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 24 RE1 and KEVCY 24 RF1 sensors is based on the capacitive divider principle.

Sensor application
KEVCY 24 RE1 & RF1 are compact and very small bushing type sensors designed to be used in air insulated switchgear type SafeRing Air/SafePlus Air.
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 plugs.

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 IED: 2.2 m
Standard cable length for connection with coupling electrode: 0.45 m

Technical data, general	
Rated primary current of application	up to 630A
Rated primary voltage of application	up to 24kV
Rated power frequency withstand voltage	50kV
Rated lighting impulse withstand voltage	125kV
Technical data, voltage sensor	Value
Rated primary voltage, U_{pr}	22/√3kV
Maximum rated primary voltage, U_{primax}	22/√3kV
Rated frequency, f_n	50/60Hz
Accuracy class	0.5/3P
Rated burden, R_{br}	10MOhm
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}	80A
Rated transformation ratio, K_{ra}	80A /0.150V, 50Hz 80A/0.180V, 60Hz
Rated secondary output, U_{sr}	3mV/Hz i.e 150mV at 50Hz or 180mV at 60Hz
Rated continuous thermal current, I_{cth}	630A
Rated short-time thermal current, I_{th}	25kA / 3s
Rated dynamic current, I_{dyn}	63kA
Rated frequency, f_r	50/60Hz
Rated extended primary current factor, K_{pcr}	7.875
Accuracy limit factor, K_{alf}	100
Rated burden, R_{br}	10MOhm
Cables	
Current and voltage sensing:	
Length	2.2m
Connector	RJ-45 (CAT-6)
Coupling electrode:	
Length	0.45m
Connector	BNC

KECA 80 C85 Indoor current sensor
With KECA 80 C85 sensors measuring class 0.5 is reached for continuous current measurement in the extended accuracy range from 5% of the rated primary current Ipr not only up to 120%of Ipr (as being common for conventional current transformers), but even up to the rated continuous thermal current Icth.

For dynamic current measurement (protection purposes) the ABB sensors KECA 80 C85 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
The current sensors type KECA 80 C85 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 & 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 IED. The cable connector is type RJ-45. The sensor accuracy classes are verified up to the RJ-45 connector, i.e. consider- ing 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 sen- sor is therefore accuracy tested when equipped with its own cable and connector.

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

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

Correction factors
The amplitude and phase error of a current sensor is, in prac- tice, 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 sensor label (for more information please refer to Instructions for installa- tion, use and maintenance) and should be uploaded without any modification into the IED before the sensors are put into operation. To achieve required accuracy classes it is recommended to use all correction factors (Cfs): amplitude correction factor (aI) and phase error correction factor (pI) of a current sensor.

KEVA 24 C Indoor voltage sensor.
The voltage sensors type KEVA 24 are intended for use in voltage measurement in gas insulated medium voltage switchgear.
The voltage sensors are designed as easy replacement of originally used insulating plugs 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.

Correction factors
The amplitude and phase error of a voltage sensor is, in practice, constant and independent of the primary voltage. Due to this fact, it is an inherent and constant property of each sensor and 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 voltage sensor are mentioned on the sensor label (for more information please refer to Instructions for installa- tion, use and maintenance) and should be uploaded without any modifications into the IED before the sensors are put into operation (please check available correction in the IED manual). To achieve required accuracy classes it is recom- mended to use both correction factors (Cfs): amplitude cor- rection factor (aU) and phase error correction factor (pU) of a voltage sensor.

Parameters for application	
Rated primary voltage of application	up to 24kV
Sensor parameters	
Rated primary voltage, U_{pn}	22/√3
Highest voltage for equipment, U_m	24kV
Rated power frequency withstand voltage	50kV
Rated lightning impulse withstand voltage	125kV
Rated continuous thermal current I_{cth}	2500A
Rated transformation ratio, K_{ra} for voltage measurement	10000 : 1
Voltage accuracy class	0,5/3P
Length of cable	2,2m

Sensor variants and use in cable connectors

Sensor type designation	Manufacturer	Type
KEVA 24 C10	Nexans (Euromold)	400 TB/G
		440 TB/G
		K400 TB/G
		K440 TB/G
		400PB-xSA
KEVA 24 C21	Kabeldon	CSE-A 12630
		CSEP-A 12630
		CSE-A 24630
		CSEP-A 24630
		SOC 630 - 1/2
KEVA 24 C23	Raychem	RSTI 58xx/39xx
		RSTI CC 58xx/39xx
		RSTI LCxx/LAxx (older)
	NKT	CB 12-630
		CC 12-630
		CB 24-630
		CC 24-630
KEVA 24 C24	Nexans (Euromold)	430 TB/G
		300 PBM/G-630A
		300SA-10-xN
	Prysmian	MSCEA/EC-630-C

Bushing

The connection of the MV-cables is made by cable bushings. The bushings are made of epoxy resin 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 indicating systems.

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

Used together with full-screened connectors an ideal solution for areas with humidity or condensation problems is achieved.

The bushings are designed according to CENELEC EN 50181 and IEC 60137.

There are different cable bushings:

- Interface A (400 series with plug-in connection, In=200A)
- Interface C (400 series with M16 bolted contact, In=630A)
- Interface C (400 series with M16 bolted contact) and integrated voltage and current sensors (In=630A) (See combisensors)

Due to compability with insulating gas SafeRing/SafePlus Air uses interfaces bushings made of different epoxy mixture.

The installation instructions from the manufacturer of cable terminations must be followed. Be sure to lubricate the bushings thoroughly with the silicone supplied.

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.

Cable termination

All bushings are situated at the same height from the floor and are protected by a cable compartment cover.

Interface A - Elbow connector

Interface C - Elbow asymmetrical connector

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

Cable compartment	Interface A (plug-in)	Interface C (bolted)
Standard cable cover	400	360
Arc proof cable cover with/without window	377	337
Expanded cable cover	595	555

The following manufacturers of cable terminations are recommended:

- Elastimold (ABB)
- 3M
- Nexans (Euromold)
- NKT cables (Kabeldon)
- Südkabel
- TE

Table 12-24kV Separable connectors interface A, I_r = 250 A

Manufacturer	Designation	Conductor (mm^2)	•LP/EPR (Ø mm)	Earthing Shield Yes/No
Elastimold	ESE25	25-150	13.46-29.97	Y
3M	93-EE 895-2	25-150	14.7-29.5	Y
Nexans	K200LR	120-150	21.5-28.5	Y
NKT	CSE-A 2450	10-95	13.0-25.5	Y
TE	RSES-VD	25-150	17.9-28.5	Y
Südkabel	SEW 24	35-95	17.3-25.0	Y

Table 24kV Separable connectors interface C, I_r = 630 A

Manufacturer	Designation	Conductor (mm^2)	•LP/EPR (Ø mm)	Earthing Shield Yes/No	Dual cable arr.	Surge arrestor
Elastimold	ESA6	16-400	13.46-45.21	Y	ESC6	N.A.
3M	93-EE 995-6	95-240	22.0-32.6	Y	N.A.	N.A.
Nexans	K480TB/G	16-300	12.0-37.5	Y	800PB	800SA
NKT	CB-A 24-630	25-300	17.0-44.0	Y	CC-24-630	CSA
TE	RSTI58	25-300	12.7-34.6	Y	RSTI-CC-58	RSTI-68SA
Südkabel	SAT 24	95-240	15.0-32.6	Y	SAK 24	MUT 23

- For dual cable + surge arrester, deeper cable compartment is required.
- 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

Fuses

Fuse-links type CEF are designed to protect distribution transformers, cables, overhead lines and other apparatus against thermal and dynamic effects of short-circuit currents.

Lower power losses by average level of 20 % comparing to previous design, generating additional savings during product life-cycle

Continuous protection and reliable operation guaranteed by robust design and compliance with newest IEC standards

Key features:
- Rated voltages 3/7.2 kV – 20/36 kV with rated currents of 6.3 A – 200 A
- For indoor and outdoor applications
- Designed and type tested acc. to IEC 602821, VDE 0670-T4 and VDE 0670-T402
- Top level fault current limitation and interruption performance up to 63kA RMS
- Striker 80 N (medium type)
- Equipped with Temperature Control Unit enabling the additional protection against thermal stresses in small enclosures

SafeRing/SafePlus is designed and tested for fuse-links produced according to IEC 60282-1. The dimensions of the fuse-links have to be in accordance with IEC 60282-1, Annex D. The fuse-links have to be type I with terminal diameter equal to 45 +1 mm and body length (e) equal to 442 mm.

The dimensions of the fuse-links can also be in accordance with DIN 43625 and the length of the fuse canister is based on the use of fuse-links with length 442 mm. For installation of shorter fuses, (<24kV) a fuse adapter will be needed. Please note: When inserting the fuse-link into the canister, the striker-pin must always face outwards against the fuse holder. The fuse adapter has to be fixed to the fuse-link contact that faces inward in the fuse canister. The maximum size of distribution transformer which can be fed from a SafeRing/ SafePlus switch-fuse module is 1600 kVA. For higher rated transformers, we recommend our vacuum circuit-breaker module with CT's and protection relay.

The following table shows CEF fuse-links for use in SafeRing/SafePlus. To find the correct fuse-link compared to the transformer rating in kVA, please see the selection tables 21.1.1, 21.1.2 and 21.2.1.

For more technical data, refer to ABB Poland catalogue 2401PL1613-W1-en.

Fuse selection table - CEF

Table 1

100%	Transformer rating (kVA)																Fuse-link rated voltage
U_n (kV)	25	50	75	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	
3	10	20	25	31.5	40	50	50	63	100	125	160	160					
3.3	10	20	25	25	31.5	40	50	63	80	100	160	160	160				
4.15	10	16	20	25	25	31.5	40	50	63	80	100	160	160				
5	10	16	20	20	25	31.5	315	50	50	63	100	100	125	160	160		7.2 kV
5.5	6.3	10	16	20	25	25	31.5	40	50	63	80	100	100	160	160		
6	6.3	10	16	25	25	25	40	40	50	50	80	100	125	160	160		
6.6	6.3	10	16	20	20	25	25	31.5	40	50	63	80	100	100	160		
10	4[2]	10	10	16	16	20	20	25	31.5	31.5	50	50	50	63	100	125	
11	2.5[2]	6.3	10	10	16	20	20	25	25	31.5	40	50	50	63	80	100	12 kV
12	2.5[2]	6.3	10	10	16	16	20	20	25	31.5	40	50	50	63	80	100	
13.8	2.5[2]	6.3	10	10	10	16	20	20	25	25	31.5	40	40	50	63	80	
15	2.5[2]	6.3	10	10	10	16	16	20	20	25	31.5	40	40	50	63	80	17.5 kV
17.5	2[1,2]	5[2]	6.3	10	10	10	16	16	20	25	25	31.5	31.5	40	50	63	
20	2[1,2]	4[2]	6.3	10	10	10	16	16	20	20	25	31.5	31.5	40	50	63	
22	2[1,2]	2.5[2]	6.3	6.3	10	10	10	16	20	20	25	25	25	31.5	40	50	24 kV
24	2[1,2]	2.5[2]	6.3	6.3	10	10	10	16	16	20	20	25	25	31.5	40	50	

- The table is based on using fuses type ABB CEF
- Normal operating conditions with no overload
- Ambient temperature -25˚C - +40˚C
- [1] Fuse is not able to clear independently transformers secondary side terminals short-circuit current
- [2] CEF-VT

Table 2

120%	Transformer rating (kVA)																Fuse-link rated voltage
U_n (kV)	25	50	75	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	
3	10	20	25	31.5	40	50	50	63	100	125	160	160					
3.3	10	20	25	25	31.5	40	50	63	80	100	160	160					
4.15	10	16	20	25	31.5	31.5	40	50	63	80	100	160	160				
5	10	16	20	20	25	31.5	31.5	50	50	63	100	100	125	160			7.2 kV
5.5	6.3	10	16	20	25	25	31.5	40	50	63	80	100	125	160			
6	6.3	10	16	20	20	25	31.5	40	50	50	63	100	125	160	160		
6.6	6.3	10	16	20	20	25	25	31.5	40	50	63	80	100	125	160		
10	4[2]	10	10	16	16	20	20	25	31.5	31.5	50	50	63	80	100	125	
11	2.5[2]	6.3	10	10	16	20	20	25	25	31.5	40	50	63	80	100	125	12 kV
12	2.5[2]	6.3	10	10	16	16	20	20	25	31.5	40	50	50	63	80	100	
13.8	2.5[2]	6.3	10	10	10	16	20	20	25	25	31.5	40	50	63	80	100	
15	2.5[2]	6.3	10	10	10	16	16	20	20	25	31.5	40	40	50	63	80	17.5 kV
17.5	2[1,2]	5[2]	6.3	10	10	10	16	16	20	25	25	31.5	40	50	63	80	
20	2[1,2]	4[2]	6.3	10	10	10	16	16	20	20	25	31.5	31.5	40	50	63	
22	2[1,2]	2.5[2]	6.3	6.3	10	10	10	16	20	20	25	25	31.5	40	50	63	24 kV
24	2[1,2]	2.5[2]	6.3	6.3	10	10	10	16	16	20	20	25	40	31.5	40	50	

- The table is based on using fuses type ABB CEF
- Normal operating conditions with 20% overload
- Ambient temperature -25˚C - +40˚C
- [1] Fuse is not able to clear independently transformers secondary side terminals short-circuit current
- [2] CEF-VT

Fuse selection table - CEF-S

Table 3

Transformer rated voltage (kV)	Transformer rating (kVA)														Fuse-link rated voltage (kV)	Fuse-link length „e“ (mm)	Catalog No. CEF-S
	25	50	75	100	125	160	200	250	315	400	500	630	800	1000			
	Fuse-link rating In (A)																
6	10	16	20	25	40	40	50	63	63						6/12	292	10A: 1YMB741216M2611
6.6	10*	16	20	25	40	40	50	50									16A: 1YMB741218M2611
10	10*	10	16	20	20	25	40	40	50	63	63						20A: 1YMB741219M2611
11	10*	10	16	20	20	25	40	40	40	50	63						25A: 1YMB741221M2611
12		10	16	16	20	20	25	40	40	50	63	63					40A: 1YMB741225M2611
																	50A: 1YMB741227M2611
																	63A: 1YMB741229M2611
13.8		10*	16	16	20	20	25	40	40	40	50				10/24	442	10A: 1YMB742416M4611
15		10*	10	16	16	20	20	25	40	40	50	50					16A: 1YMB742418M4611
17.5		10*	10	16	16	20	20	20	40	40	40	50	50				20A: 1YMB742419M4611
20		10*	10*	10	16	16	20	20	25	40	40	50	50				25A: 1YMB742421M4611
22		10*	10*	10	16	16	20	20	20	40	40	40	50	50			40A: 1YMB742425M4611
24			10*	10	16	16	16	20	20	25	40	40	50	50			50A: 1YMB742427M4611
Max.gG fuse-link at LV side (A)	40	80	125	160	160	200	250	250	300	400	400	800					

The table was calculated according to standards IEC 60787 and IEC 62271-105. The following transformer and switchgear operating conditions were assumed:

- Maximum long-lasting transformer overload - 120%,
- Magnetizing inrush current for transformers up to and including 630kVA - 12 x In during 100ms
- Magnetizing inrush current for transformers above 630kVA - 10 x In during 100ms
- Standard ambient working conditions for SafeRing/ SafePlus switchgear (most important: ambient temperature -25 °C to +40 °C)

For ratings marked with “*” fuse is notable to clear independently transformers secondary side terminals short-circuit current.

The table above details the rated current of a particular fuse-link for a given line voltage and transformer rating.
For different criteria, the fuse selection must be recalculated.

Manometer

SafeRing/SafePlus Air are sealed systems, designed and tested according to IEC 62271-200 as maintenance free switchgear for lifetime (30 years).

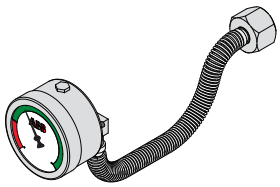
ABB applies state of the art technology for gas tightness
providing the equipment with an expected leakage rate lower than 0.1 % per annum, referring to the filling-pressure of 250kPa*. The switchgear will maintain air-tightness and an airpressure better than 230kPa* throughout its designed life-span. This pressure value is still within a good margin from pressure used during the type tests, which is 230kPa*.

*) at 20°C.

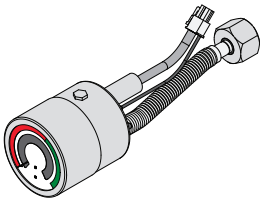
For increased safety under operation of the switchgear, manometers may be used for each tank.

In case remote indication is needed, manometers can be equipped with signalling contacts. Detailed descriptions of manometer functions are found in the table below.

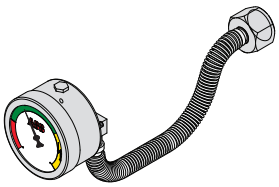
Altitude
Max height above sea level for installation without reducing gas pressure is 1500 meters. In the interval from 1500 to 2000 meters, gas pressure has to be reduced. For installation above 2000 meters, please contact ABB for instructions.



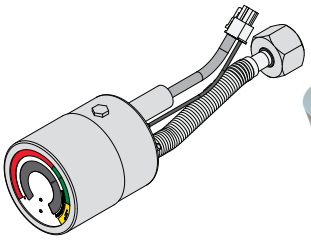
Standard



With signal contact



With yellow area



With yellow area and signal contact

Dencity switch (GMD1)

Motor operation

Closing and opening operations of load-break switches and charging of the springs of the mechanisms for the circuit-breaker and the switch-fuse combination may be performed by motor operation. The disconnector in the V-module and all earthing switches do not have this possibility. All motor devices require DC voltage. If the control voltage is either 110 or 220 VAC, a rectifier is integrated in the control unit.

The operating cycle for motor operation is CO - 3 min (i.e. it may be operated with a frequency of up to one close and one open operation every third minute). Test voltage for tables below is +10/-15 % for motor operations and closing coils and +10/-30% for trip coils and opening coils. The motor and coils can easily be mounted to the mechanisms after delivery (retrofit).

Characteristics of motor operation for C-module

Rated voltage (V)	Power consumption (W) or (VA)	Operation times		Peak start current (A)	Fuse
		Closing time (s)	Opening time (s)		
24	90	5 - 7	5 - 7	19	F 6.3 A
48	90	5 - 7	5 - 7	13	F 4 A
60	90	6 - 8	6 - 8	10	F 4 A
110	90	6 - 8	6 - 8	6	F 2 A
220	90	6 - 8	6 - 8	3	F 1 A

Characteristics of motor operation for F-module

Rated voltage (V)	Power consumption (W) or (VA)	Operation times		Peak start current (A)	Fuse
		Charge/Closing time (s)	Opening time (ms)		
24	90	5 - 7	40-60	19	F 6.3 A
48	90	5 - 9	40-60	13	F 4 A
60	90	8 - 13	40-60	10	F 4 A
110	90	8 - 13	40-60	6	F 2 A
220	90	8 - 13	40-60	3	F 1 A

Characteristics of motor operation for V-module

Rated voltage (V)	Power consumption (W) or (VA)	Operation times		Peak start current (A)	Fuse
		Charge/Closing time (s)	Opening time (ms)		
24	120	10 - 17	40-60	14	F 6.3 A
48	100	5 - 9	40-60	13	F 4 A
60	100	9 - 13	40-60	7	F 4 A
110	100	9 - 13	40-60	3	F 2 A
220	100	9 - 14	40-60	1.7	F 1 A

Characteristics of shunt trip coils, closing coils and opening coils for F-and V-module

Rated voltage (V)	Power consumption (W) or (VA)	Operation times		Peak start current (A)	Fuse for closing coil Y2 (Opening coil Y1 is unfused)
		Closing time (ms)	Opening time (ms)		
24 V DC	150	40-60	40-60	6	F 6.3 A
48 V DC	200	40-60	40-60	4	F 4 A
60 V DC	200	40-60	40-60	3	F 4 A
110 V DC	200	40-60	40-60	2	F 2 A
220 V DC	200	40-60	40-60	1	F 1 A
110 V AC	200	40-60	40-60	2	F 2 A
230 V AC	200	40-60	40-60	1	F 1 A

Relays

SafePlus Air can be delivered with a V-module with 630A vacuum circuit-breaker. This chapter describes the different choices of protection relays and feeder terminals that can be used in SafePlus Air. These relays require an additional low-voltage compartment.

Standard test procedure is functional test of trip circuit of the relays. All customer settings must be done on site.

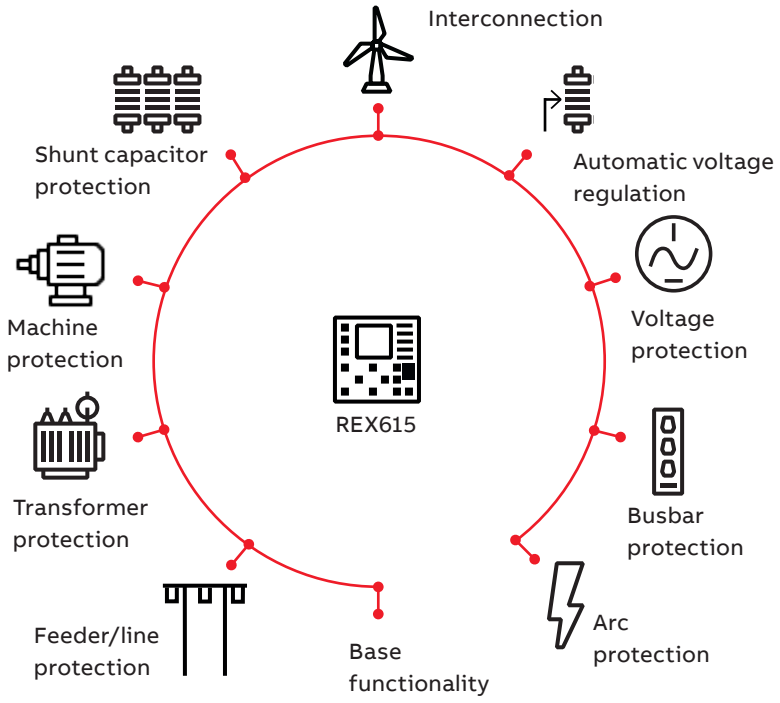
REF type feeder terminals are configured according to customer specification for protection functions. Special control requirements on request only.

There are two main groups of relays delivered:

A. Auxilliary powered relays
B. Self-powered relays

A. ABB offers a wide range of feeder protection relays. These relays have been sold for a long time and have an excellent reputation for reliability and safe 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 are suitable for rough conditions and places without the possibility of auxiliary supply. SafeRing Air and SafePlus Air can be delivered with different types to fulfill all relevant needs in a distribution network.



Auxilliary powered relays

REX615

The REX615 relay offers comprehensive protection for power generation and distribution applications. It provides wide application coverage with a freely configurable device, allowing for flexible and cost-effective tailoring to specific requirements. Ready-made application packages ensure convenient and smooth ordering. The relay's modular hardware and software enable easy adaptation to changing protection and communication needs. Its intuitive human-machine interface (HMI) features a large graphical display for customizable single-line diagrams (SLD). The unique earth-fault protection portfolio ensures optimal selectivity, sensitivity, and reliability, regardless of the network type or fault.

The REX615 relay also promotes optimal cyber security to safeguard today's networks and supports secure connectivity. Its withdrawable plug-in unit design allows for swift installation, maintenance, and testing. As the world's first truly IEC 61850-based protection relay, it is designed to support the increasing digitalization of substations. With over one million 615 and 620 series relays installed worldwide, the REX615 demonstrates reliability and commitment to continuous evolution. Extensive life cycle services provide full support from start to finish, ensuring the relay is modular and flexible for future-proof protection and control.

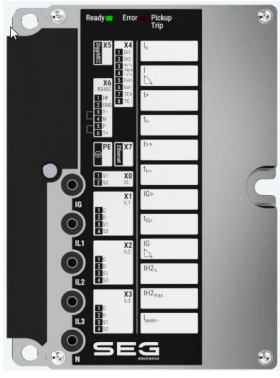
All-in-one protection for power generation and distribution applications. REX615 is a freely configurable all-in-one protection and control relay for power generation and distribution applications, representing the next step for ABB’s 615 and 620 series relays. Multiapplication coverage combined with a fully modular and scalable hardware and software ensures maximum flexibility and optimal cost-effectivity throughout the relay life cycle – and supports sustainability.

Self-powered relays

REJ603 v.3.0

REJ603 v.1.5

IKI-35



WIC1-g2

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.

IKI-30/IKI-35
The transformer protection relay IKI-30 is applicable for transformers with nominal power between 160 and 12 500 kVA; as overcurrent, short-circuit or earth-fault protection relay in combination with a circuit- breaker and as overcurrent protection in combination with load-break switch and switch-fuse devices. IKI-35 is a self-powered overcurrent protection relay with self test function and event recorder. For transformer or feeder protection with a wide range of CT's.

WIC1 g2
All available versions of the WIC1 relay are a high-tech and cost-optimized protection for MV switchgears. Specifically in compact switchboards, the WIC1 protection system in combination with a circuit-breaker can replace the combination of load-break-switch with HV fuses. The overload protection for the attached unit is clearly improved. When power distribution networks are extended more and more high powered transformers are used and HV fuses are inadmissible. For such applications the WIB1/WIC1 protection system is an optimal replacement.

Indicators

Voltage indication

Capdis

Wega

Vois+

SafePlus switchgears are equipped with Voltage Detecting and Indicating Systems (VDIS) in accordance with IEC 62271-213. The voltage detecting systems are capacitively coupled to live parts. It is designed to verify the absence of voltage in medium voltage switchgear. Here are some key features:

- Three-Phase Continuous Indication: It provides continuous monitoring of all three phases to ensure accurate voltage detection.
- No Battery Required: The system operates without the need for batteries or auxiliary power.
- Integrated Measuring Point: It includes a three-phase measuring point for tasks like phase comparison and rotating field direction measurement.

This system enhances safety by ensuring that the equipment is de-energized before maintenance or inspection.

Fault indicators

Sigma

Sigma F+E

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.

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.

Sigma is a combined short-circuit and earth fault indicator. It is designed to detect, display and remotely indicate phase selective short-circuits and earth faults in medium voltage distribution networks. It is designed for operation in radial or open ring networks. Besides the device can be operated in ring networks with double-sided feeds either with automatic or manual reclosure. Due to the measuring principle the earth fault indication is suitable for networks with low-impedance or solidly earthed neutral systems. Even in isolated radial networks limited earth fault indication is possible.

The ComPass is a combined short-circuit direction and earth fault direction indicator for medium voltage networks.
The Compass is suitable for operation in radial, ring and mesh networks. It can be used in networks with a solidly earthed, low impedance, compensated or isolated neutral point. A load-break switch or circuit-breaker can be controlled with the variant ComPass BS 2.0 (1250 A).
In addition, freely programmable functions can be defined with the logic module.

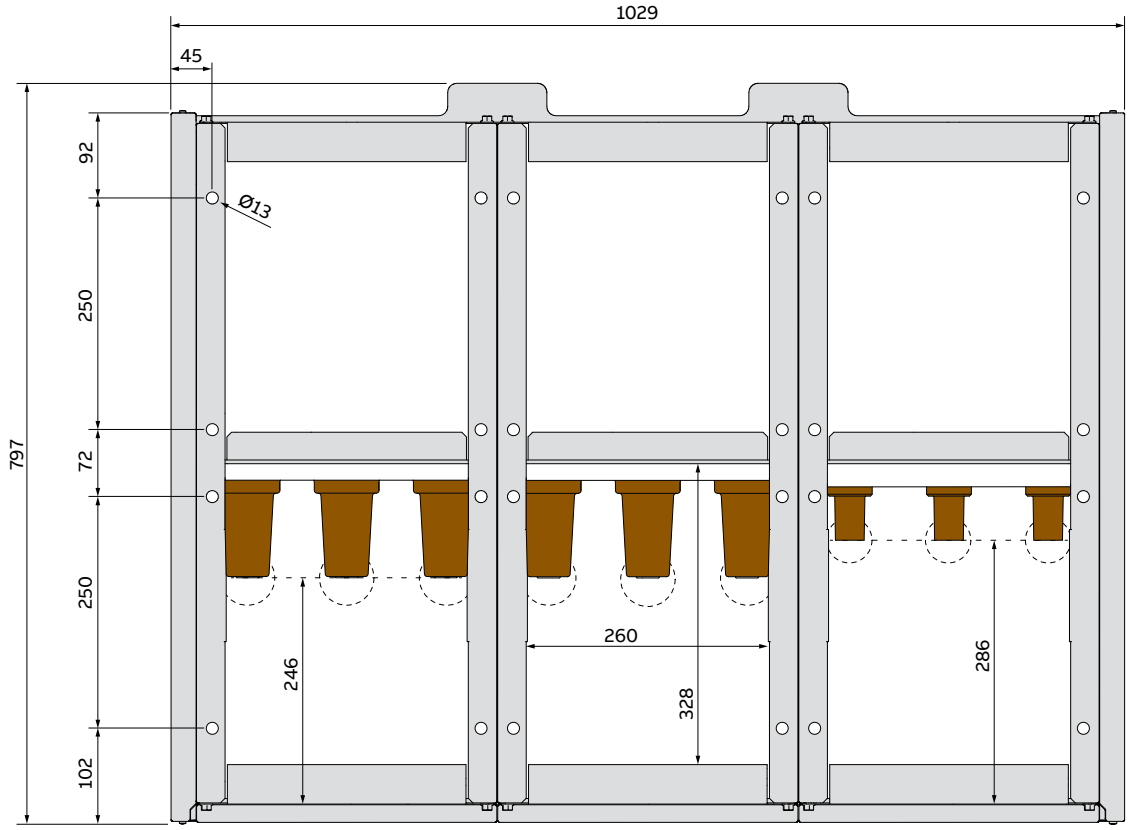
04

Dimension

Dimension

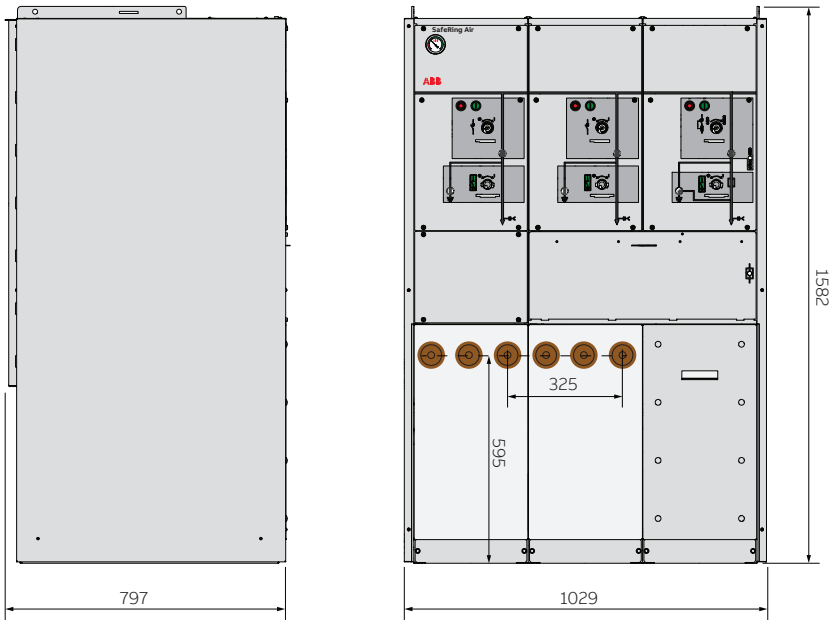
Dimensional drawings for installation. Note that the floor must be well levelled and the unit must be fixed by means of anchor bolts in accordance with the dimensional drawing for the number of modules as appropriate. The tolerance of the eveness is maximum 1mm per meter.

Footprint

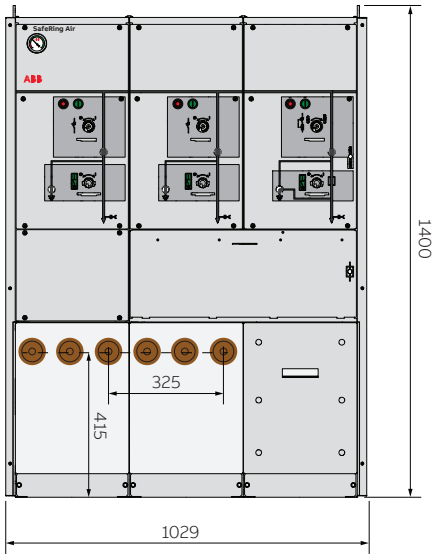


CCF

Standard cable compartment

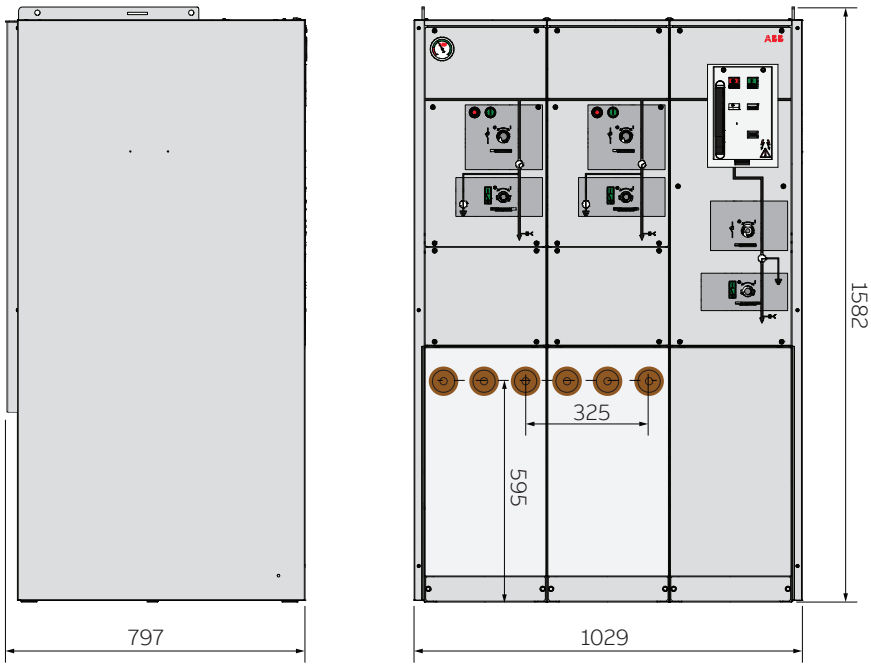


Low cable compartment

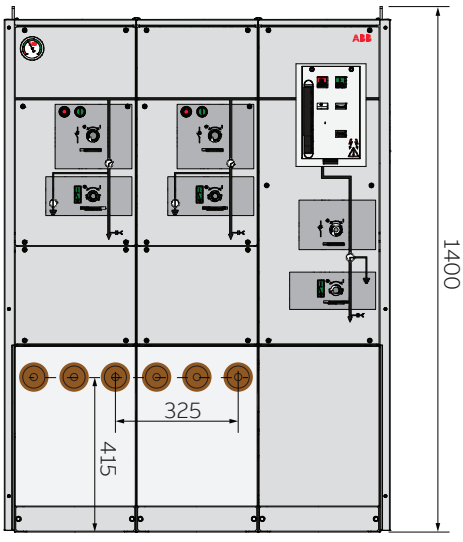


CCV

Standard cable compartment



Low cable compartment



Environmental certification

Life expectancy

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

SafeRing Air and SafePlus Air are sealed gas insulated switchgears filled with clean compressed air taken from the atmosphere. Air insulating gas may be released directly to the atmoshphere.

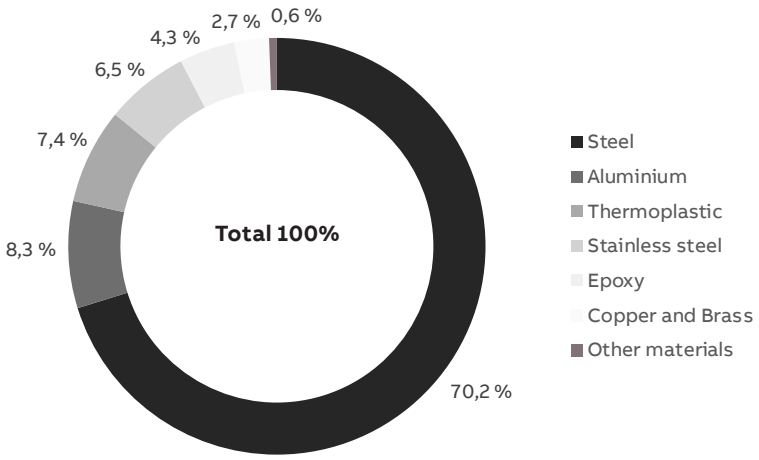
SafeRing Air and SafePlus Air are manufactured in Norway and the manufacturing site is certified according to ISO 9001:2015, ISO 14001:2015, and ISO 45001:2018.

The switchgears are gas-tight with an expected diffusion rate of less that 0,1% per annum. With a rated filling pressure of 250 kPa (2,5 bar) absolute at 20°C, the switchgear will maintain gas-tightness and a gas-pressure better than the minimum functional pressure of 230 kPa (2,3 bar) absolute at 20°C throughout its designed life span.

Recycling capability

Constituents of a CCV switchgear:

Material	% of total weight	Recycle
Steel	70,2	Yes
Aluminium	8,3	Yes
Thermoplastic	7,4	Yes
Stainless steel	6,5	Yes
Epoxy	4,3	Yes
Copper and Brass	2,7	Yes
Other metals	0,6	Yes
Total recyclables	100 %	
Total weight (kg)	≈520	



End-of-life

ABB continuously strive to replace hazardous substances. The Air portifolio does not contain any substances listed in ABB List of prohibited and restricted substances. The portifolio is designed to facilitate disassembling and recycling.

The thermoplastics are marked to facilitate sorting and they do not contain any halogenated flame retardants.
There exist no explicit requirements for how to handle discarded switchgears at end-of-life. No special action is required, non-recoverable parts can be recovered and reused normally according to local regulations.

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

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https://new.abb.com/medium-voltage/Switchgear/gas-insulated/iec-gis-rmu-for-secondary-distribution/safering-safeplus

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