

DISTRIBUTION SOLUTIONS

SafeRing XT/SafePlus XT

Gas-insulated ring main unit



- ⊕ Customer benefit list:
- Safe
 - Compact
 - Smart
 - Reliable

SafeRing XT/SafePlus XT is a SF₆-insulated switchgear which offers significant improvements to the customer by providing them with responses to the latest demanding requirements of rigid, most compact, modular & digital enabled switchgear solutions.

The design of ring main unit is based on an optimized integration of medium voltage components into the ring main unit combined with latest design of transformer protection relay, options of smart automation & control as well as monitoring & diagnostics features.

We strive to create products and solutions that make a difference.

Table of contents

07	1	Introduction
08	1.1	Field Application
11	1.2	Customer Benefits
12	1.3	Safe Digital
14	1.3.1	Smart automation & control
16	1.3.2	Monitoring & Diagnostics
17	1.3.3	ABB Ability™ Energy and Asset Manager
18	2	Design Philosophy
19	3	Arrangement
20	4	Features
21	5	Manufacturing
	5.1	Completely Sealed System
22	5.2	Factory routine tested
23	6	Safety
	6.1	Internal Arc Classification
25	6.2	Interlocking & Padlocking
26	7	SafeRing XT
27	7.1	Applications SafeRing XT

28	7.2	SafeRing XT Configurations
30	8	SafePlus XT
31	8.1	Applications SafePlus XT
31	8.2	SafePlus XT Configurations
32	9	Modules Description
32	9.1	C - Cable Switch Module
33	9.1.1	C - Cable Switch Module- Technical Data
35	9.2	V - Vacuum Circuit Breaker Module
36	9.2.1	V - Vacuum Circuit Breaker Module-Technical Data
38	9.3	D - Direct Cable Connection Module-Technical Data
39	9.4	M - Metering Module- Technical Data
40	10.	Current Transformers
41	11.	Voltage Transformers
42	12.	Sensors
45	13.	Mechanisms

48	14	Cable Bushing
49	15	Cable Terminations
55	16	Extension of Switchgear (Side extension)
56	17	Protection Relays & Control Products
57	17.1	Transformer protection & relay
60	17.2	Auxiliary Powered Relays
61	17.3	RTU & Control Products
63	18	Accessories
63	18.1	Motor Operation
63	18.1.1	Motorized version for Switch- disconnecter
65	18.2	Shunt Releases
66	18.3	Auxiliary/Signal Contacts
66	18.3.1	Vacuum Circuit Breaker auxiliary contacts
66	18.3.2	Switch Disconnecter/ Circuit Breaker Disconnecter auxiliary contacts

67	18.4	Capacitive Voltage Indicators
68	18.5	Short Circuit and/or Earth Fault Indicators
69	18.6	Manometer & Pressure Indicators
70	18.7	Operations Counter
71	18.8	Battery back-up Solutions
72	19	Safe Digital
72	19.1	Smart automation & control
74	19.2	Monitoring & Diagnostics Solutions
77	20	Dimensions
80	21	Technical Data
81	21.1	Technical Data – SafeRing XT/ SafePlus XT
82	21.2	Technical Data – General
84	21.3	Technical Data – Number of operations
85	22	Environmental Certification

1. Introduction

SafeRing XT/SafePlus XT switchgear for secondary distribution is developed by ABB in India based on design principles from SafeRing & SafePlus family which is introduced in the markets in 2000.



RTU 520 available under Safe Digital

The installed base of SafeRing/SafePlus is more than 250,000 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 XT is available in standard configurations based on a high-volume production. These standardized RMUs, which are the most required configurations within a distribution network, can be extendable upon request. SafePlus XT is the switchgear version which offers wide flexibility & modularity.

Advantages

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

1.1 Field Application

Industry

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

Utilities and power plants

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

Transport Airports Ports

- Railways
- Underground transport

Infrastructure

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

Renewables

- Wind
- Solar/PV





Applicable standards

SafeRing XT /SafePlus XT 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)

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

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

Ambient humidity:

- maximum 24 h average of relative humidity 95%
- maximum monthly average of relative humidity 90% RH

The normal operational altitude is up to 1000 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.

1.2 Customer Benefits

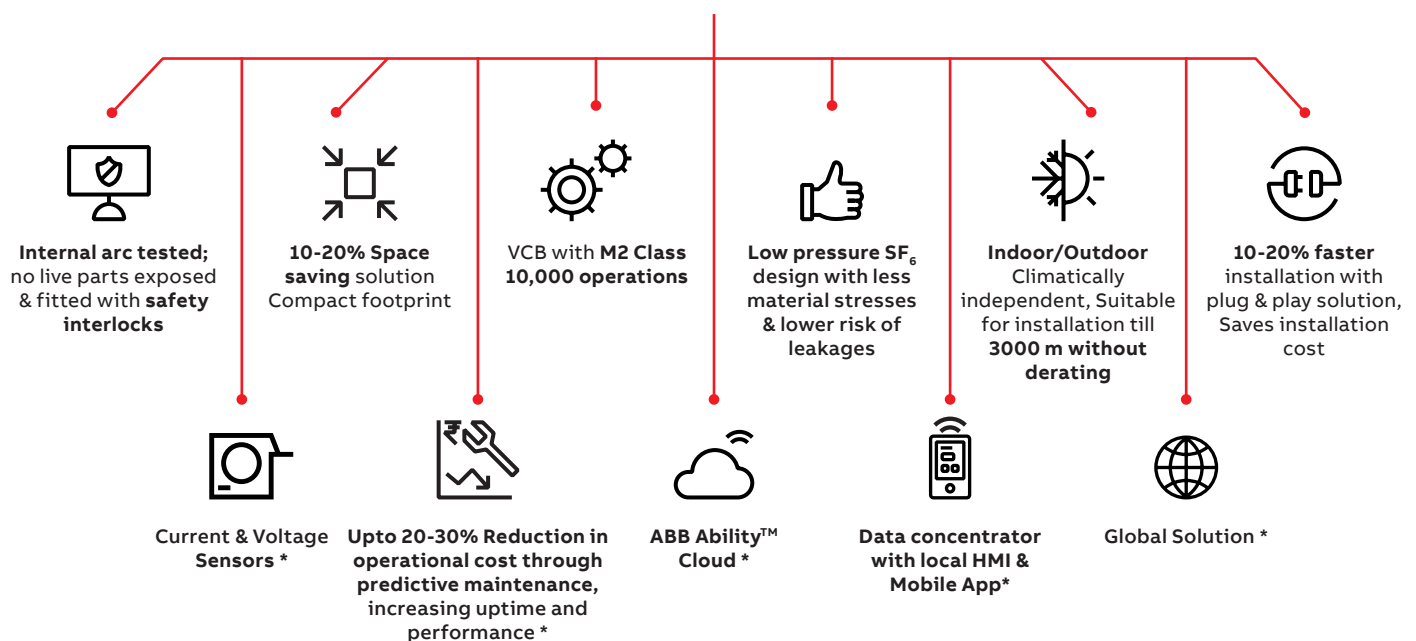
SafeRing XT/SafePlus XT represents advanced switchgear solution addressing important requirements of the future:

- Reliability & safety
- Digital enabled
- Compactness
- Extendibility & Flexibility
- Plug & play installations
- Lower cost of operation
- Maximized integration

SafeRing XT/SafePlus XT is a part of Safe Digital family which makes it easy to focus on applications and create reliable, efficient electrical network due to use of well proven components: current & voltage sensors, protection & control relays, smart automation & control and monitoring & diagnostics solution.

SafeRing XT and SafePlus XT is an Indoor/ Outdoor switchgear which provides 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 XT 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 XT offers flexible customized switchgear to cover all distribution needs, including smart automation & control as well as monitoring & diagnostics features. (Safe Digital)

Benefits



* Optional features & benefits with Safe Digital

1.3 Safe Digital

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01
Definition of ABB MV
Digital Switchgear

Improving efficiency with digital switchgear
Traditional switchgear often contains conventional instrument transformers and kilometers of wiring loops which require time and effort to plan and commission, and which increase operational cost over the switchgear lifetime. Digital switchgear, however, replaces hard-wired elements with a single supervised bus (IEC 61850), and modern current and voltage sensors flexibly adaptable to any rating and application – for lower losses, simple planning and easy alterations.

Traditional switchgear provides only little information on its health condition and maintenance needs, while digital switchgear, with a modern platform and robust monitoring and diagnostics sensors, makes data on the condition of gas tanks, cable connections and the

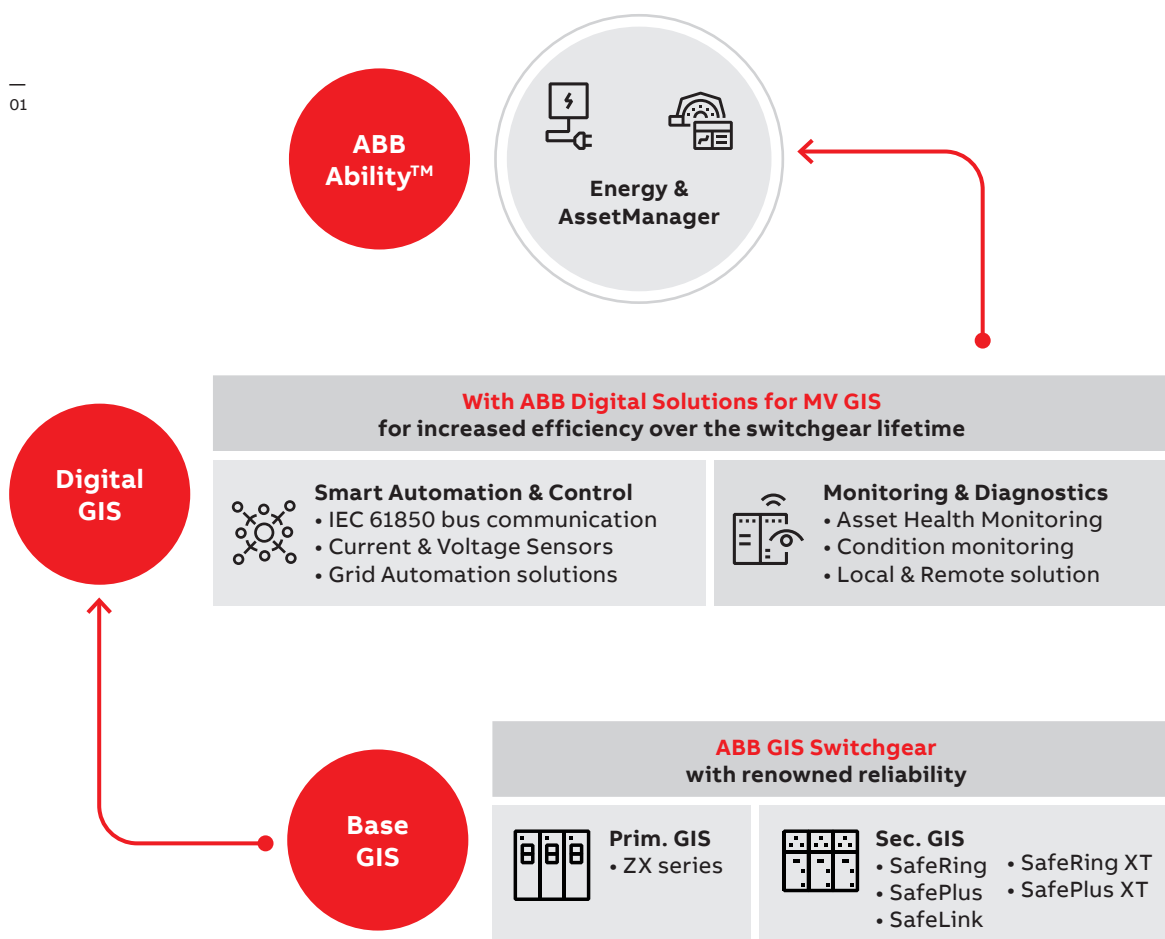
environment accessible at any time, from anywhere. This helps to optimize maintenance and reduce the risk of unplanned outages.

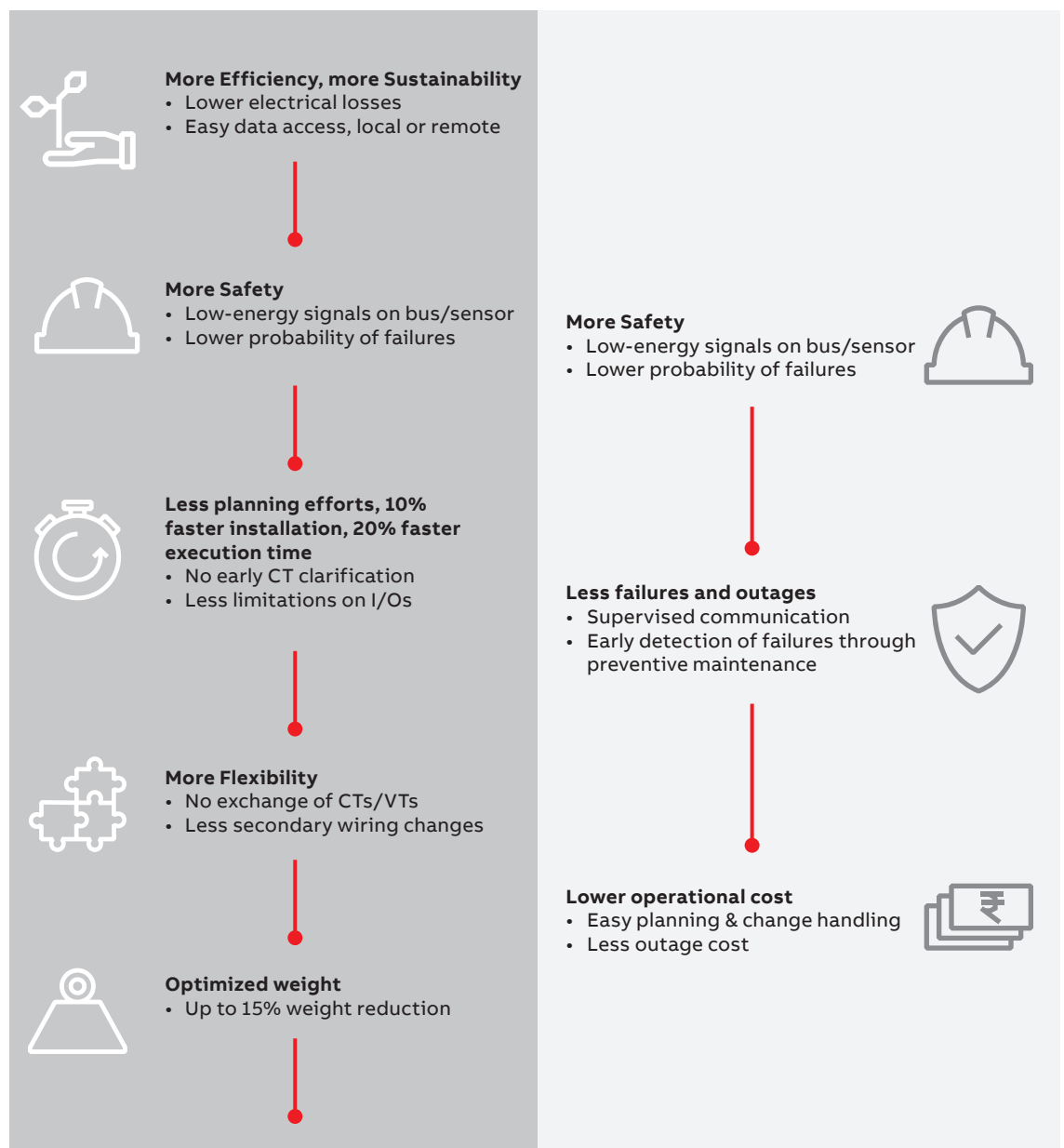
Following above reasoning, the definition of GIS Digital is based on two pillars:

- **Smart Automation & Control**
- **Monitoring & Diagnostics (M&D)**

As a part of the ABB Ability™ portfolio of connected solutions, and based on ABB's proven switchgear technologies, a Digital GIS enables smart electrical networks that deliver reliable and efficient power reliably. It enables easy plant system and operation integration to increase smart functionality, such as asset management, energy management, real-time diagnostics and remote monitoring and services.

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01





1.3.1 Smart automation & control

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03
Current sensor ABB
KECA 80 C85

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04
Voltage sensor KEVA C

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05
ABB Relion® REC615

ABB's digital switchgear solutions integrate innovative protection, control and sensing devices, where all measurements, status and commands are reliably transferred on a real-time Ethernet communication bus over the Modbus TCP, or IEC 61850 protocols, as applicable.

Through smart automation and control pro-active management of the medium-and low-voltage equipment is enabled throughout their entire life cycle by using well-proven components such as current and voltage sensors, Relion® protection relays and IEC 61850 digital communication or signal distribution within the switchgear.

Current sensors:

Current measurement with ABB KECA sensors is based on Rogowski coil principle. In Safe Digital the current sensor type KECA 80 C85 is used. It fulfils the requirements of protection class 5P up to an impressive value reaching the rated short- time thermal current I_{th} . That provides the possibility to designate the corresponding accuracy class as 5P630, proving excellent linearity and accuracy measurements. The current sensor shall be installed over a bushing insulator, insulated cable, insulated & shielded cable connectors or any other type of insulated conductor.

Voltage sensors:

Voltage measurement by ABB KEVA sensors is based on the resistive divider principle. Voltage sensors can optionally be installed in the switchgear's cable compartment for cable voltage measurement. The voltage sensors are designed as easy replacement of originally used insulating plugs in the cable T-connectors).

ABB Relion® REC615

The protection relay line provides protection and control for a complete range of applications including feeder, line differential, transformer, voltage, busbar, capacitor bank, motor, generator and interconnection protection as well as automatic voltage regulation for on-load tap changers. The 615 series offers a high functionality level in a compact format. Flexible engineering is enabled using the graphical application configuration functionality, and all relevant information including a single line diagram view is provided to the end user via the local graphical display. Relay include a wide range of communication protocols and interfaces ensuring seamless system level integration.

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03



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06
RTU520

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07
RIO 600

Field Remote Terminal Unit:

Various types of FRTU can be used in switchgear for observability and complete fault awareness in your power distribution network, RTU 520/530/540 series offers advanced fault and outage management, enabling the efficient detection and isolation of faults and restoration of power and service. With the fault and outage management functionality, outage times can be reduced by up to 81%, leading to an incredible economical advantage.



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Remote IO unit RIO600:

RIO600 Remote I/O unit is designed to expand the digital and analog I/O of ABB's Relion® protection relays, provide I/O for the station automation device COM600 and in Grid Automation applications. The unit allows maximum I/O flexibility and provides seamless IEC 61850 connectivity between the substation binary and analogue signals. Compared to a traditional fully hard-wired substation, a solution using RIO600 helps in simplifying and decreasing the wiring inside the substation by digitizing the hardwired signals. RIO600 enables accurate current and voltage measurements from the medium-voltage network utilizing ABB's light weight sensor technology.



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07

1.3.2 Monitoring & Diagnostics

08
Conditional
monitoring sensors in
SafeRing XT/SafePlus XT

ABB's GIS Digital series is based on ABB's existing condition monitoring platform, which includes data concentrator, LHMI, mobile APP, line-up HMI, and as an optional feature gateway and ABB Ability™ cloud.

Safe Digital includes following M&D functions:

- Gas pressure P20 real-time monitoring
- Cable connection temperature monitoring
- Environmental temperature and humidity monitoring

The gas density sensor remote unit is used for real-time monitoring of the gas pressure P20. The gas manometer's status is monitored by monitoring the gas P20 status and comparing its value to P20 threshold in order to diagnose whether it is in status of normal pressure, low pressure or over pressure. It will output a good, warning, alarm health status accordingly.

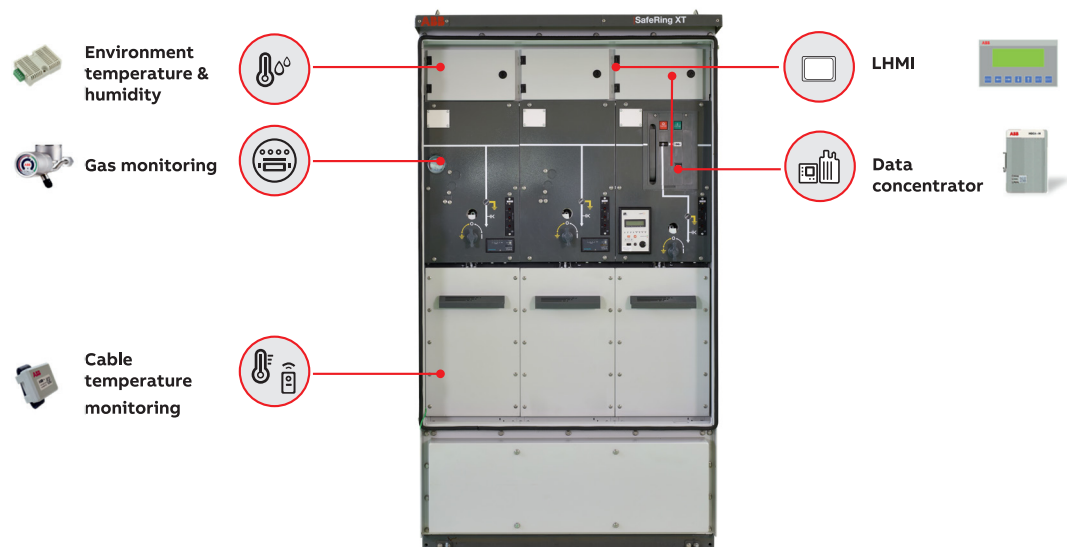
Cable connection temperature is monitored by using a non-intrusive temperature sensor to monitor the cable head temperature. It will indicate the temperature value and compare to a

threshold value to diagnose a health status of good, warn or alarm. To identify a cable connection fault in one of the phases, the three phase cable head temperature is compared to diagnose and output a good, warn or alarm health status.

For environmental temperature and humidity monitoring a temperature and humidity sensor THS01 is used in the switchgear room, low voltage compartment and cable compartment. Here, the temperature and relative humidity are compared with a threshold value to diagnose a health status of good, warn or alarm.

Local Human Machine Interface (LHMI) is mounted on the low voltage compartment (LVC) of the panel receiving data from the data concentrator. It contains a display, buttons, buzzer and a communication port and displays all readings of sensors. Depending on the application, related content will be shown accordingly.

Mobile Application can be installed via QR code download link below to view local M&D data and set related parameters.



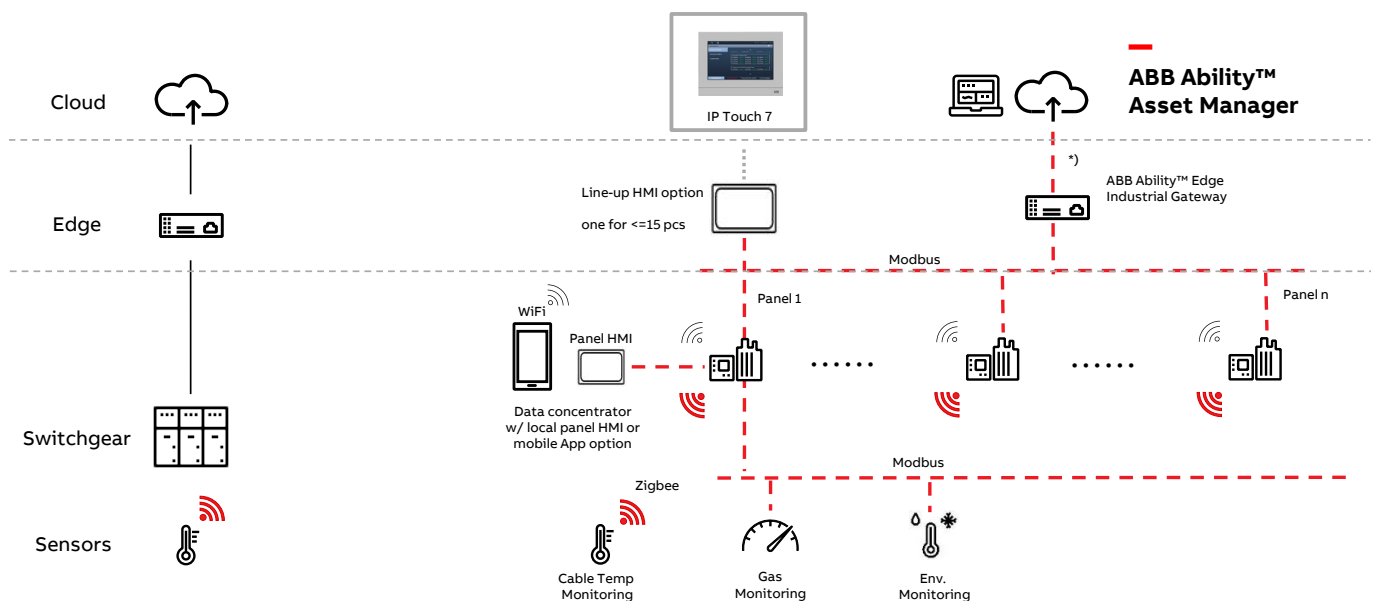
1.3.3 ABB Ability™ Energy and Asset Manager

Unlock your equipment's full potential, on edge or in-cloud



The all-new ABB Ability™ Edge Industrial Gateway uses IoT technology to simplify existing gateways. It is designed to collect all generated field device and parameter data, feeding it into one user-friendly dashboard.

This solution makes it possible to monitor all of your downstream low- and medium-voltage devices via the cloud or an on-premise system, with optional wi-fi and cellular connectivity.



It comes with below two options:

ABB Ability™ Industrial Edge Gateway - L (local view)

ABB Ability™ Industrial Edge Gateway - C (Cloud connected)

* Optional cloud connectivity

2. Design Philosophy

Evolution-more functionality, compact dimensions

Secondary distribution switchgears have been subject to a significant development in 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 fulfill customers MV application requirements. ABB has always taken an active part in this development. The numerous distribution substations requested a unified switching functionality that evolved into the Ring Main Unit concept. ABB's SafeRing XT/ SafePlus XT is adapted to the needs in the utility distribution networks.

Two products – One range

ABB SafeRing XT is adapted to the needs in the utility distribution networks. ABB SafePlus XT offers more flexibility and electrical capacity. Both switchgears offer the same user interface.

Customer's involvement

The applied functionality in SafeRing XT/ SafePlus XT is a result of input from customers all over the world. Key customers are continuously involved with ABB design staff to ensure optimised switchgear operation.

Personnel – safety operation

All products are designed and manufactured in compliance with ISO 9001, ISO 14001 and ISO 18001. The latest edition of relevant IEC standards will always apply to our continuous test program. 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

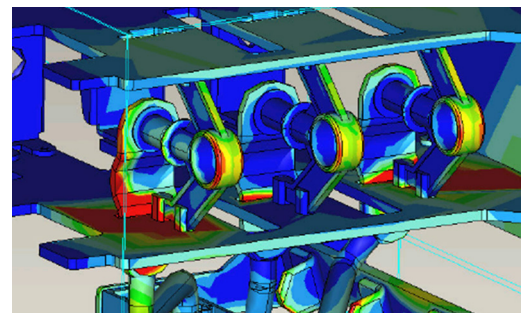
The location for manufacturing SafeRing/SafePlus XT is Nashik, India. Green policy assures focus on environmental factors in manufacturing as well as over the switchgear's life span. All products are manufactured in accordance with our ISO 14001 certification. Materials are carefully selected, to ensure reuse at end of life. Recycling capability is 95% (for details see chapter 10). To facilitate the recycling process we continuously work along with our partners to improve end of life handling.

Modern - development and manufacturing

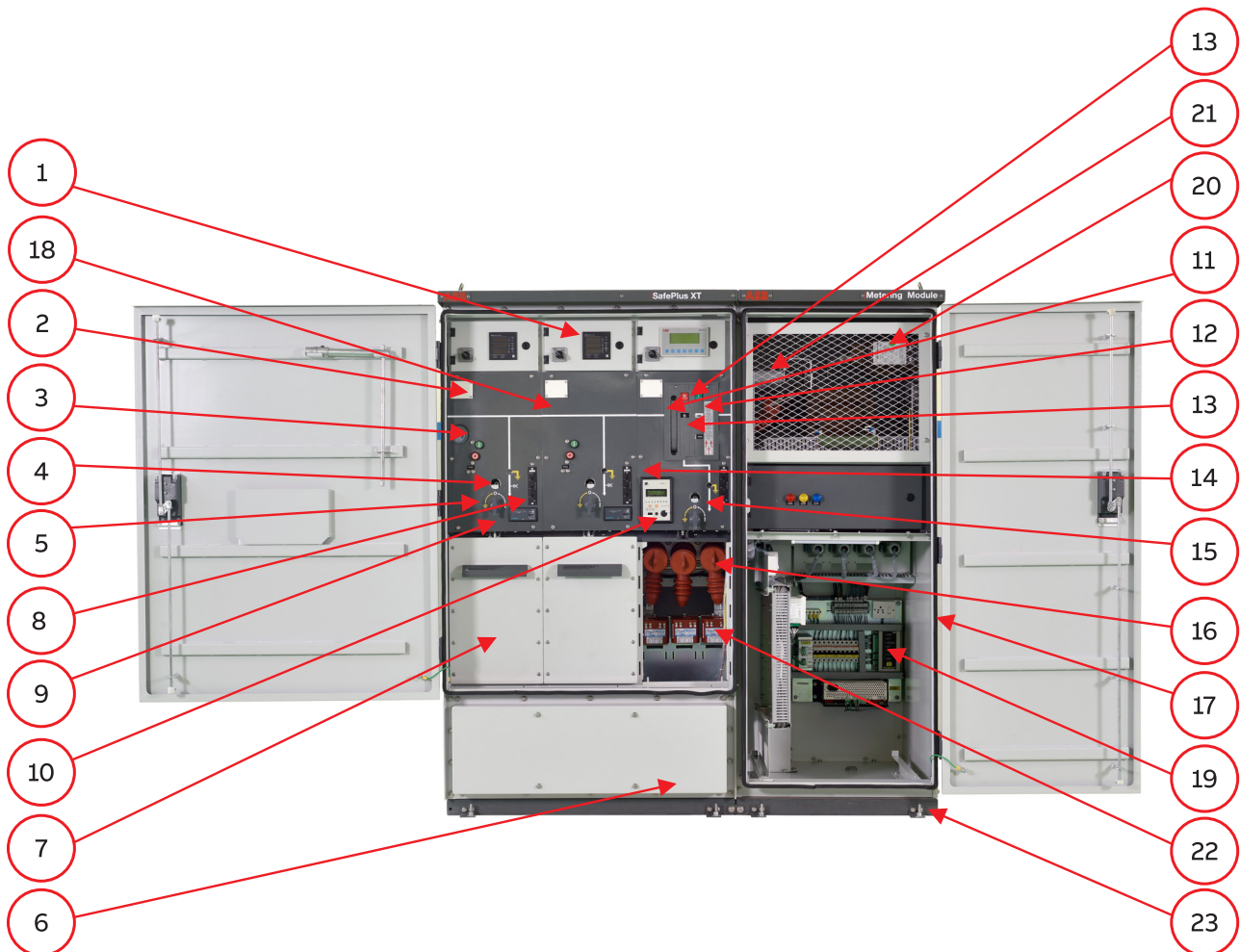
Numerical simulations together with long experience ensure reliable and safe, compact, and robust design. Dielectric simulations ensure that compactness does not influence the dielectric capability. The combination of design techniques; experience and the most modern production technology guarantee state of the art products and durability.

Complex solutions-one supplier

Complex applications involving different standard remote levels, such as monitoring, control and measurement and protection can now be supplied from one supplier. This makes large scale implementation feasible and simplifies engineering and procurement. The control and monitoring unit available for SafeRing XT is located behind the front cover. This option is also readily available for retrofit since such demands normally evolve after the switchgear is in service.



3. Arrangement



Description	
Integrated LV compartment	1
Feeder description plates	2
Gas pressure indicator	3
Operating shaft switch-disconnector	4
Padlock arrangement	5
Cable clamp	6
Arc proof cable compartment	7
Voltage presence indication system	8
Fault passage indicator	9
Self powered protection relay	10
Breaker mechanism	11
Spring Charge indicator	12
Push buttons VCB	13
Disconnecter with earthing switch	14
Cable bushings	15
Terminal Protectors	16
M-Metering Module	17
SLD With switch/VCB/Earthing switch indicators	18
Low voltage compartment for FRTU/digital components	19
Voltage transformer	20
Surge arrester	21
Cable mounted current transformers	22
Foundation fixing arrangements	23

4. Features



Standard features

- Integrated low-voltage compartment
- Earthing switches
- Operating mechanisms with integral mechanical interlocking
- Vacuum circuit breaker with high mechanical endurance of 10000 operations (M2 Class)
- 12kV, 630A, 21kA for 3 sec
- Robotically welded SS304 tank
- Metal enclosed switchgear & controlgear design with IP54 protection
- Arc proof cable covers fully interlocked
- Operating handle
- Facilities for padlocks on all switching functions
- Bushings for cable connection in front with cable covers
- Capacitive voltage indication
- Manometer for SF6 -pressure/density monitoring
- Lifting lug for easy handling
- All units are designed for the subsequent fitting of an integral remote control and monitoring unit

Additional Features

- ABB-Ability™ industrial edge gateway
- Field remote terminal unit
- Monitoring & diagnostics sensors
- Busbar extension LHS/RHS
- Inner cone plug-in busbar
- Metering
- Integrated control and monitoring
- Signal (1NO/1NC) from pressure indicator wired to terminals
- Open & close coil
- Motor operation
- Auxiliary switches for all switching functions
- Prepared for relay test equipment
- Short-circuit indicator
- Earth fault indicator
- Short-circuit and earth fault indicator

5. Manufacturing

5.1 Completely Sealed System

Exterior

Upper and lower front mimic are made of 1.6 mm painted steel with screen printing. These mimics contain the mimic diagram of the main circuit integrated with the position indicators for the switching devices. Background color for these mimics is light grey (RAL 7043). These mimics are removable.

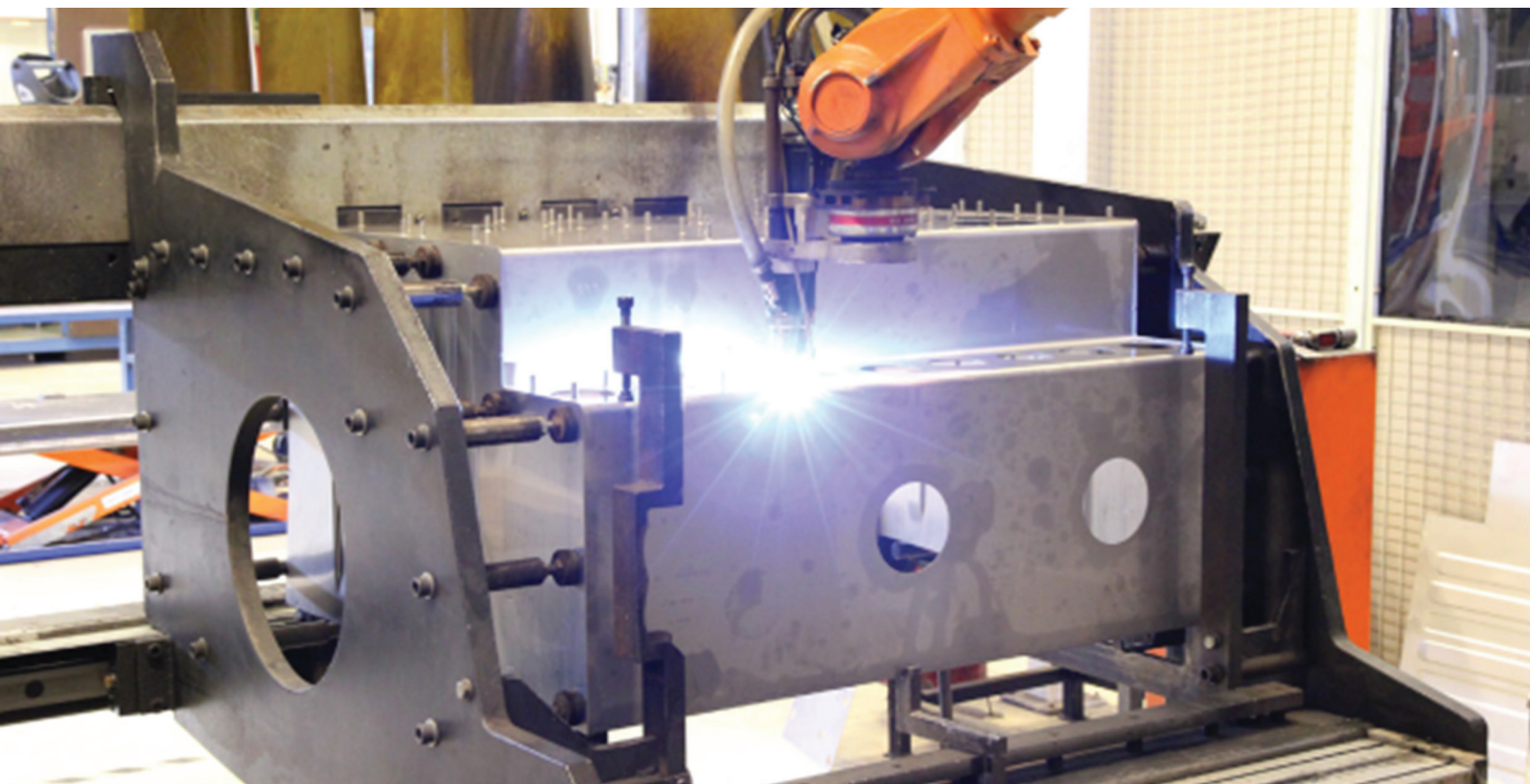
All cable compartment covers are arc proof & powder painted. All cable compartment covers are removable. Each module has a separate cable compartment. The removable cable covers allow comfortable access for connection of cables. These covers are mechanically interlocked with earthing switch of each module.

In case of an arc fault inside the SF₆ gas tank, followed by an opening of the pressure relief valve in the bottom of the tank, this partition wall will prevent the hot gases blowing out from the pressure relief to enter the cable compartments

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

The pressure system is defined as a sealed for life system with an operating lifetime exceeding 30 years. The leakage rate is less than 0,1% per year. In order to ensure a reliable and tight welding, all welding work is carried out by computer-controlled robots. Electrical and mechanical bushings penetrating the tank are clamped and sealed to the tank by high quality O-rings. The mechanical bushing has in addition a rotating shaft which connects the shaft of the switch to the corresponding shaft of the mechanism. The rotating shaft is sealed by a double set of gas seals.

All SF₆ Tanks have to pass a leakage test before gas filling. Leakage test and gas filling are done inside a vacuum chamber. The first step in the leakage test is to evacuate all air inside both the SF₆ tank and vacuum chamber simultaneously. Then the SF₆ tank is filled with helium. Due to the characteristics of helium this test will detect all possible leakages. If the SF₆ tank passes this test the helium will be evacuated and replaced by SF₆. The SF₆ tank has a degree of protection of IP67 and can be immersed into water and still maintain all functions in a satisfactory way.



5.2 Factory routine tested

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

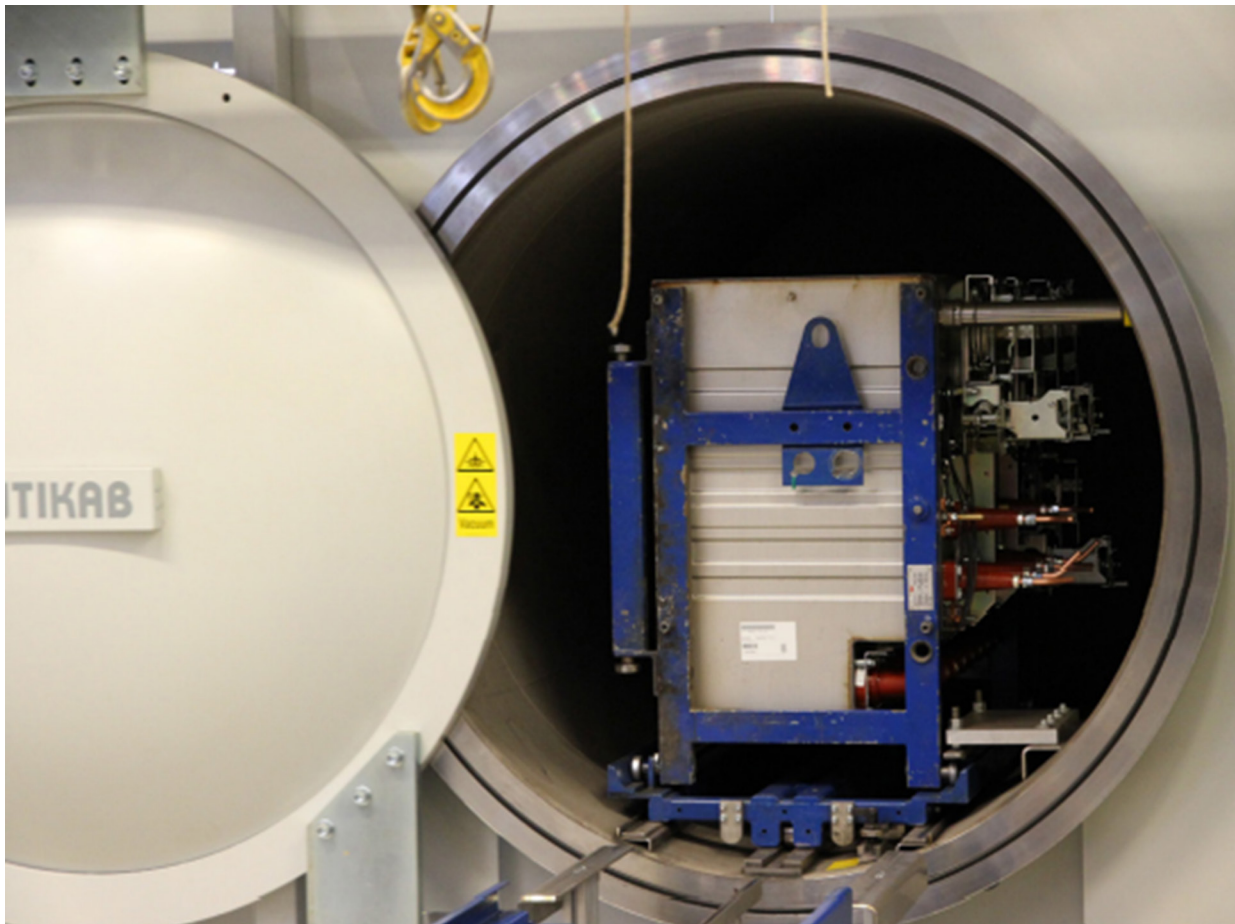
IEC factory routine tests:

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

State of the art

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

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



6. Safety

6.1 Internal Arc Classification

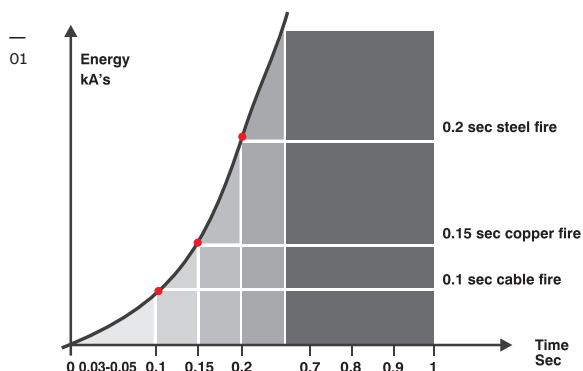
01
Arc duration and
damage caused

During development of all ABB products, focus is on personnel safety. The SafeRing XT/ SafePlus XT portfolio is designed and tested to withstand an internal arc IAC AFLR scenario at the same current level as the maximum short-circuit current. The tests show that the metal enclosure of the unit 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, decomposition and evaporation of material

Tested according to IEC standard 62271-200

The capability of SafeRing XT / SafePlus XT 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)

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



F (front) = Access from the front
L (lateral) = Access from sides
R (rear) = Access from the rear

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02
Plasma relief
arrangement (IAC AFLR)

Internal arc classification – 10kA 0.1s

With this configuration, for any internal arc inside SF6 gas tank, hot gases and pressure are evacuated towards switchgear bottom. For internal arc inside cable compartment, hot gases and pressure are also evacuated towards switchgear bottom. In this setup the switchgear can be installed as free standing.

Basic parameters of set-up

- IAC AFLR 10kA 0.1s (for cable compartment)
- IAC AFLR 21kA 1s (for SF6 gas tank)
- Switchgear needs to be installed and fixed to the floor in accordance with “SafeRing/ SafePlus XT installation and operating instructions”

Internal arc classification – 21kA 1s

With this configuration, for any internal arc inside SF6 gas tank, hot gases and pressure are evacuated towards switchgear bottom. For internal arc inside cable compartment, hot gases and pressure are also evacuated towards switchgear bottom. In this setup the switchgear can be installed as free standing.

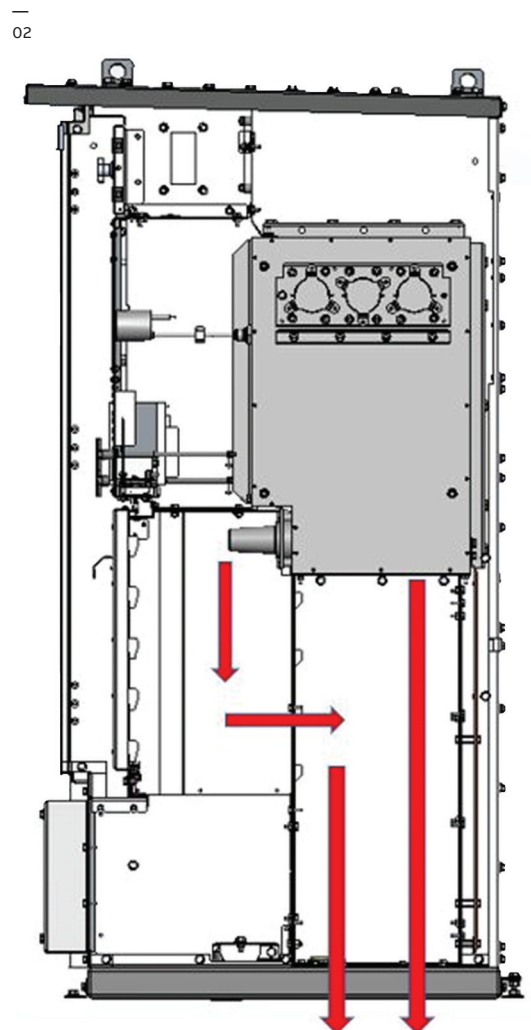
Basic parameters of set-up:

- IAC AFLR 21kA 1s (for cable compartment)
- IAC AFLR 21kA 1s (for SF6 gas tank)
- Switchgear needs to be installed and fixed to the floor in accordance with “SafeRing/ SafePlus XT installation and operating instructions”

IAC AFLR- 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 inbuilt path provided by the enclosure arrangement of the switchgear, forcing the hot gases down during an arc fault.

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



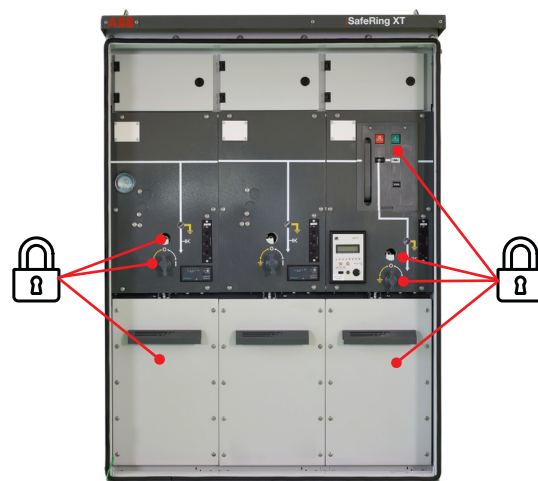
6.2 Interlocking & Padlocking

Interlocks

The safety mechanical interlocks between switches are standard and detailed information is described for each module. They are set out by the IEC standards and are necessary to guarantee the correct operation sequence. ABB safety interlocks enable the highest level of reliability, even in the case of an accidental error, and ensure operator safety.

Padlocks

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



Blocking coil/electrical interlocking (optional)

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

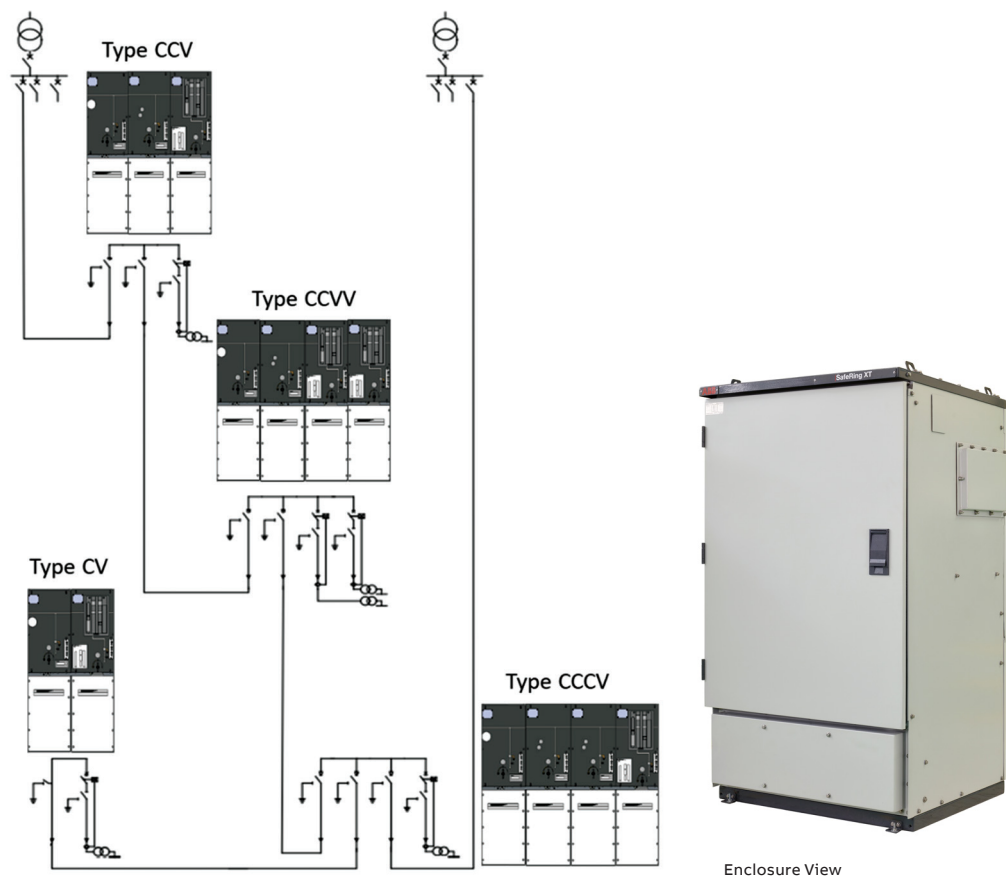
Undervoltage release

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

Interlock Type	Operation	Condition	Comment
Mechanical Interlock -C Module	Closing LBS	ES is open, Cable Door is closed	Standard interlock
Mechanical Interlock -C Module	Opening LBS	ES is open	Standard interlock
Mechanical Interlock -C, V Modules	Closing ES	LBS/Disconnecter is open, Cable door is closed	Standard interlock
Mechanical Interlock -C, V Modules	Opening ES	LBS/Disconnecter is open, Cable door is closed	Standard interlock
Mechanical Interlock -C, V Modules	Opening cable door	ES is closed	Standard interlock
Mechanical Interlock -V Module	Closing CB	No interlock	Standard interlock
Mechanical Interlock -V Module	Opening CB	No interlock	Standard interlock
Mechanical Interlock -V Module	Closing Disconnecter	CB is open, ES is open & Cable door is closed	Standard interlock
Mechanical Interlock -V Module	Opening Disconnecter	CB is open, ES is open & cable door is closed	Standard interlock
Electrical Interlock	Closing/Opening -LBS/VCB	As per customer request	Optional interlock
Padlock	Closing/Opening -LBS/DS/ES/VCB	Only provision	Optional interlock

7. SafeRing XT

SafeRing installed in Compact Secondary Substations



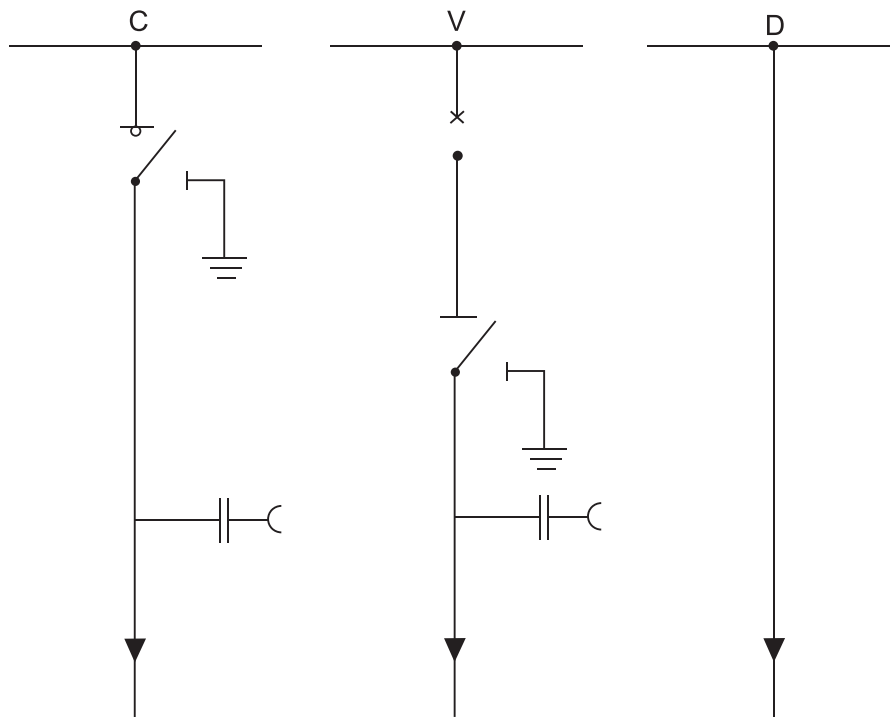
7.1 Applications SafeRing XT

SafeRing XT is designed for use in the following applications:

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

Available modules:

- C Cable switch
- V Vacuum circuit-breaker
- D Direct Cable Connection



7.2 SafeRing XT Configurations

General

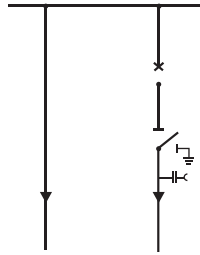
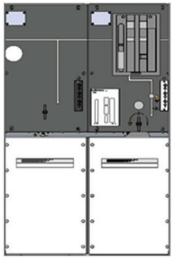
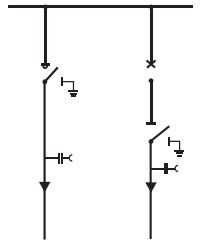
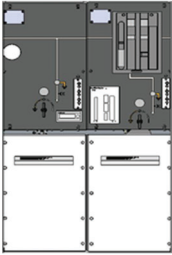
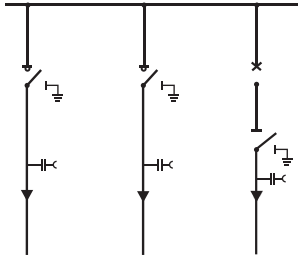
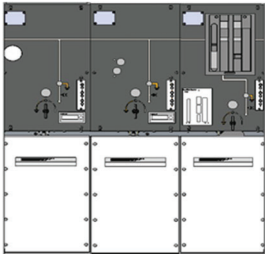
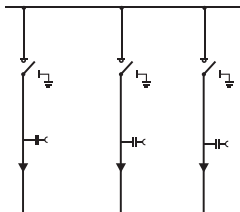
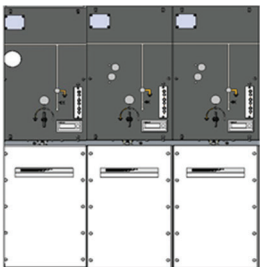
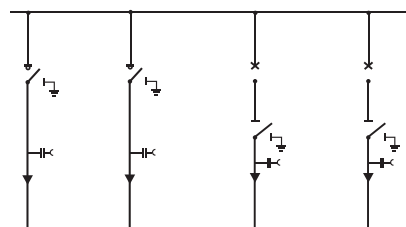
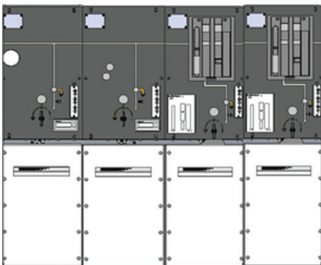
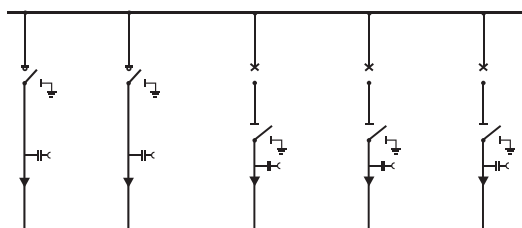
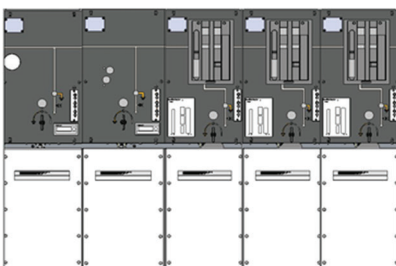
SafeRing XT is a ring main unit for the secondary distribution network. It can be supplied in various configurations suitable for most switching applications in 12 kV distribution networks. As an option, SafeRing XT can be delivered as an extendable ring main unit.

SafeRing XT is supplied with the following standard equipment

- Integrated low-voltage compartment
- Earthing switches
- Operating mechanisms with integral mechanical interlocking
- Vacuum circuit breaker with high mechanical endurance of 10000 operations (M2 Class)
- 12kV, 630A, 21kA for 3 sec
- Robotically welded SS304 tank
- Metal enclosed switchgear & controlgear with IP54 protection
- Arc proof cable covers fully interlocked
- Operating handle
- Facilities for padlocks on all switching functions
- Bushings for cable connection in front with cable covers
- Capacitive voltage indication
- Manometer for SF6 -pressure/density monitoring
- Lifting lug for easy handling
- All units are designed for the subsequent fitting of an integral remote control and monitoring unit

Additional equipment

- ABB- Ability™ industrial edge gateway
- Field remote terminal unit
- Monitoring & diagnostics sensors
- External current & voltage sensors
- Battery & Battery charger
- Busbar extension LHS/RHS
- Inner cone plug-in busbar
- Metering
- Integrated control and monitoring
- Signal (1NO/1NC) from pressure indicator wired to terminals
- Open & close coil
- Motor operation
- Auxiliary switches for all switching functions
- Prepared for relay test equipment
- Short-circuit indicator
- Earth fault indicator
- Short-circuit and earth fault indicator

**DV**Depth: **975 mm**Width: **740 mm**Height: **1840mm / 2080mm****CV**Depth: **975 mm**Width: **740 mm**Height: **1840 mm / 2080mm****CCV**Depth: **975 mm**Width: **1065 mm**Height: **1840 mm / 2080mm****CCC**Depth: **975 mm**Width: **1065 mm**Height: **1840 mm / 2080mm****CCVV**Depth: **975 mm**Width: **1390 mm**Height: **1840 mm / 2080mm****CCVVV**Depth: **975 mm**Width: **1715 mm**Height: **1840 mm / 2080mm**

8. SafePlus XT

—
01
For more configurations
& extensibility options,
please contact ABB
sales representative

—
SafePlus XT is a metal enclosed compact switchgear system for up to 12 kV distribution applications. The switchgear has a unique flexibility due to its extensibility and the possible combination of modular and semi-modular configurations.

SafePlus XT combined with SafeRing XT, which is ABB's standard ring main unit, represent a complete solution for 12 kV distribution networks. SafePlus XT and SafeRing XT have identical user interfaces, operation procedures, spare parts and components.

SafePlus XT 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 virtually maintenance-free system. As an option, extensible plug-in busbars can be provided to obtain full modularity.

The external plug-in busbar kit has to be mounted to the switchgears on site. It is fully insulated and screened to ensure reliability and climatic independence. The SafePlus XT system offers a choice of combination of switch and circuit-breaker with relay for protection of the transformer. SafePlus XT accommodates a wide selection of protection relays for most applications. SafePlus XT can also be supplied with:

- ABB-Ability™ industrial edge gateway
- Field remote terminal unit
- Monitoring & diagnostics sensors
- External current & voltage sensors

—
01



8.1 Applications SafePlus XT

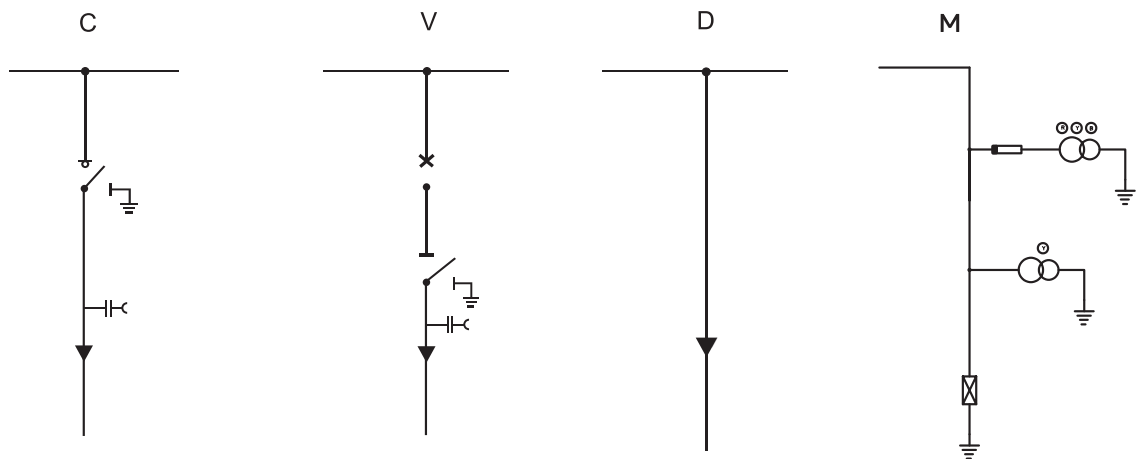
SafePlus XT is designed for use in the following applications:

- Small industries
- Solar/PV plants
- Data Centers
- Hotels, shopping centers, office buildings, business centers etc.
- Light mining applications, airports, hospitals, tunnels and underground railways

Available modules:

- C Cable switch module
- V Vacuum circuit-breaker module
- D Direct cable connection module
- M Air insulated metering module ¹⁾

¹⁾ Metering module with auxiliary voltage transformer & surge arrester optional



8.2 SafePlus XT Configurations

Various configurations comprising combination of load break switch and vacuum circuit breaker can be configured. Maximum five modules can be configured in a single SF6 filled gas tank.

Air insulated metering module can also be configured in a typical switchgear line up. For more configurations & extensibility options, please contact ABB sales representative.

9. Modules Description

9.1 C – Cable Switch Module

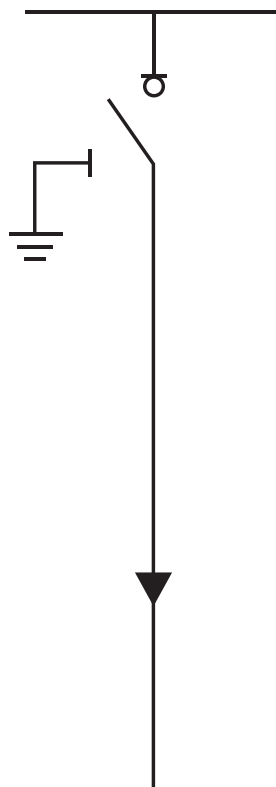
01
C- Cable switch Module

The cable switch (C-module) is a three-position switch-disconnector and earthing switch using SF₆ gas as an arc quenching medium. The switch positions are closed – opened – earthed. In the open position the switch satisfies the disconnector requirements.

01



9.1.1 C – Cable Switch Module-Technical Data



Depth: **975**
Width: **415**
Height: **1840mm / 2080mm**

Technical Data

Switch disconnector

Rated voltage	kV	12
Power frequency withstand voltage	KVrms	38
-across switch-disconnector	KVrms	45
Lightening Impulse withstand voltage	KVp	95
-across disconnector	kVp	110
Rated normal current	A	630
Rated frequency	Hz	50
Breaking capacities:		
-active load breaking current	A	630
-closed loop breaking current	A	630
-cable charging breaking current	A	63
-line charging breaking current	A	1
-earth fault breaking current	A	190
-cable and line charging breaking current under earth fault conditions	A	110
Rated short circuit making capacity	kAp	52.5
Short time current 3 sec	kA	21
Number of mechanical operations	1000 close / open manual	
Electrical & Mechanical Classes	E3, C2, M1	

Earthing Switch	kV	12
Power frequency withstand voltage	kVrms	38
Lightening Impulse withstand voltage	kVrms	95
Rated short circuit making capacity	kAp	52.5
Short time current 3 sec	KA	21
Number of mechanical operations	1000 close / open manual	
Electrical & Mechanical Classes	E2, M0	

Common features

All modules share many common features. These are described in the chapter “SafeRing XT / SafePlus XT configurations”

Standard features

- Three position load break switch with disconnecter and earthing switch (ON-OFF-EARTH)
- Single spring latched snap energy mechanism with common operating shaft for load break and earthing functions
- Switch position indication for load break switch and earthing switch
- Cable bushings horizontal in front, Interface C (400 series bolted) with integrated voltage divider for voltage indication
- Busbar 630A
- Arc proof cable covers (see chapter "Safety")
- Earthing switch interlocked with load break switch
- Cable compartment interlocked with respective Earthing Switch
- SF6 pressure manometer
- Padlock for all three positions of ON-OFF-EARTH
- End box for extensible bushings (if ordered as extensible)

Optional features:

- Extensible bushings for side extension (630A)
- Signal (1NO) from internal pressure indicator wired to terminals (only one each SF6 gas tank)
- Motorised operation for load break switch
- Aux. switch 2 NO+2 NC for switch disconnecter & 1NO+1NC for Earthing switch positions
- Short circuit indicator/ Earth fault indicator/ Short circuit-Earth fault indicator

Interlocking Feature (Standard)

The load break switch mechanism has one single operating shaft for the load break switch and for the earthing switch function. Shaft is operated by single spring. When both load break switch and earthing switch are in open position the switch satisfies the specifications of disconnecter. Due to selector switch interlock inside the mechanism, it is impossible to operate the load break switch when earthing switch is in earthed position or operate the earthing switch when the load break switch is in closed position.

Cable cover is locked in earth switch disconnected position & can also be opened in case of earth switch in closed position.

Padlocks of diameter 4-8 mm can be installed to secure positions of switch-disconnector & earth switch.

9.2 V – Vacuum Circuit Breaker Module

02
V- Vacuum circuit
breaker

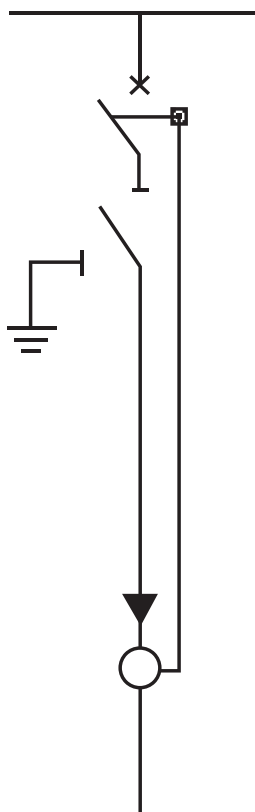
The Vacuum Circuit Breaker (V-module) has vacuum interrupters for short-circuit current interruption. A three-position switch-disconnector is connected downstream and in series with circuit-breaker.

The operation between Vacuum Circuit Breaker and switch-disconnector as well as between switch-disconnector and earthing switch are mechanically interlocked.

02



9.2.1 V – Vacuum Circuit Breaker Module-Technical Data



Depth: **975**
Width: **415**
Height: **1840mm / 2080mm**

Technical Data

Vacuum Circuit-breaker

Rated voltage	kV	12
Power frequency withstand voltage	KVrms	38
Lightening Impulse withstand voltage	KVp	95
Rated normal current	A	630
Rated frequency	Hz	50
Breaking capacities:		
-Short-circuit breaking current 3 sec.	kA	21
Rated short circuit making capacity	kAp	52.5
Number of mechanical operations	10,000 close / open manual	
Electrical & Mechanical Classes	E2 ¹⁾ , C2, S1, M2	
Operating sequence	0-0.3sec-CO-3 Min-CO	

Downstream disconnecter and earthing Switch

Rated voltage	kVrms	12
Power frequency withstand voltage	kVrms	38
-across switch-disconnector	kVrms	45
Lightening Impulse withstand voltage	kVp	95
-across switch-disconnector	kVp	110
Rated short circuit making capacity	kAp	52.5
Short time current 3 sec	KA	21
Number of mechanical operations	1000 close / open manual	
Electrical & Mechanical Classes	E2, M0	
1) E2 without auto-reclosing duty		

Common features

All modules share many common features. These are described in the chapter "SafeRing XT / SafePlus XT configurations"

Standard features

- 630 A vacuum circuit-breaker for feeder protection
- Two position EL2 trip free mechanism with auto reclosing facility for vacuum circuit breaker
- Mechanical signaling device for closing springs charged/ discharged
- Mechanical signaling device for circuit breaker open/ closed
- Lever for manually spring charging
- Closing & opening mechanical push button
- O-C-O operation possibility with closing spring in charged condition
- Interlocking between vacuum circuit breaker and disconnector
- Interlocking between disconnector and earthing switch
- Interlocking between cable compartment and earthing switch
- Three position disconnector/earthing switch downstream from circuit-breaker
- Position indication for disconnector and earthing switch
- Self-powered electronic protection relay with ring core CTs on cables
- Trip coil (for relay tripping)
- Cable bushings horizontal in front with integrated capacitor for voltage indication: Interface C (400 series bolted) for 630 A vacuum circuit-breaker
- Main busbar, 630A
- Arc proof cable compartment cover (see chapter "Safety")
- SF6 pressure manometer
- Padlock for all three positions of ON-OFF-EARTH

Optional features:

- Extensible bushings for side extension (630A)
- Signal (1NO) from internal pressure indicator wired to terminals (only one each SF6 gas tank)
- Motorized operation for VCB
- Vacuum circuit breaker position 3 NO+2 NC or 2 NO+3 NC
- Disconnector 2 NO+2 NC & Earthing switch 1 NO+1 NC
- Shunt opening and closing release/coil

- Operation counter for switch-disconnector & breaker ON-OFF operations
- Contact signaling closing spring charged/ discharge

Interlocking Feature

This module has two mechanisms; the upper one (EL2) is for Vacuum Circuit Breaker and the lower one is manually operated with single operating shaft for the three position Disconnector. The EL2 mechanism is provided with a lever for manually charging the closing spring. The Vacuum Circuit Breaker has the possibility of rapid auto-reclosing duty. By means for 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 in the event protection relay gives a trip signal. If the mechanism is recharged after closing, it is possible to perform Open - Close - Open sequence.

The EL mechanism is fitted with a mechanical anti-pumping device which prevents re-closing due to either electrical or mechanical commands. Should both the closing command and any one of the opening commands (local or remote) be active at the same time, there would be a continuous succession of opening and closing commands. The anti-pumping device avoids this situation, ensuring that each closing operation is only followed by an opening operation and that there is no other closing operation after this. To obtain a further closing operation, the closing command must be released and then re-launched. Furthermore, the anti-pumping device only allows circuit breaker closure if the following conditions are present at the same time.

- Operating mechanism spring fully charged
- Opening pushbutton and/or shunt opening release (-MO1/-MO2) not activated
- Circuit-breaker open

The lower mechanism is manually operated. It has 3 positions of OPEN, CLOSE and EARTH which can be padlocked after the selector switch is operated in specified position.

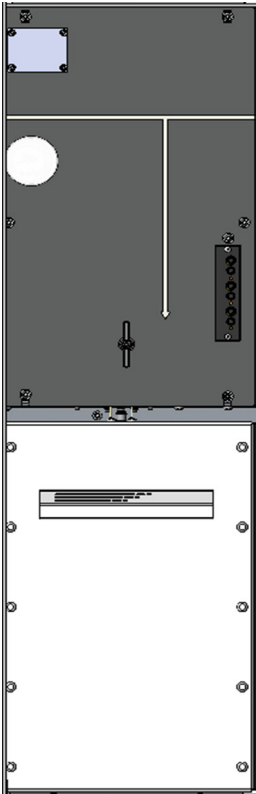
There is a mechanical interlock between these two mechanisms which prevents operating of the Disconnector and/or Earthing Switch when the circuit-breaker is in closed position.



9.3 D – Direct Cable Connection Module-Technical Data



The Direct Cable Connection (D-Module) is a direct cable module for incoming cable connection.



Common features

All modules share many common features. These are described in the chapter “SafeRing XT / SafePlus XT configurations”

Standard features

- Cable bushings horizontal on the sides, Interface C (400 series bolted) with integrated capacitor for voltage indication
- Busbars 630A
- Arc proof cable compartment cover (see chapter "Safety")

Optional features (also available as retrofit)

- Extensible bushing for connection of external busbars on side (630 A)
- Signal (1 NO) from internal pressure indicator wired to terminals (only one for each SF6 tank)

Depth: **975**
Width: **415**
Height: **1840mm / 2080mm**

Technical Data

Direct cable connection		
Rated voltage	kV	12
Power frequency withstand voltage	KVrms	38
Lightening Impulse withstand voltage	KVp	95
Rated normal current	A	630
Rated frequency	Hz	50
Short-circuit current 3 sec.	kA	21

—

9.4 M- Metering Module-Technical Data

—
03
Side connected
metering
(non-arc proof)

—
03



RMU with M-Module
Depth: 975 mm
Width: 1765 mm
Height: 1840 mm

M-Module
Depth: 975 mm
Width: 700 mm
Height: 1840 mm

Technical Data		
Metering Module		
Rated voltage	kV	12
Power frequency withstand voltage	kVrms	28
Lightening Impulse withstand voltage	kVp	75
Rated frequency	Hz	50

Standard features

- The side metering module is a factory assembled, type tested, air insulated metering cubicle with conventional VTs for busbar voltage metering.
- Cover to prevent access to live part

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 take care of ferro resonance effect.
- Separating terminals for current transformers secondary windings Space for electronic kWh-meter
- FRTU installation.

Optional features (also available as retrofit)

- 3 pcs of block type single phase voltage transformers
- 1 pc of block type single phase auxiliary voltage transformer
- Voltage indication system (VPIS)
- Voltmeter with selector switch, 6 positions +0 &/or A-meter with selector switch, 3 positions +0

10. Current Transformers

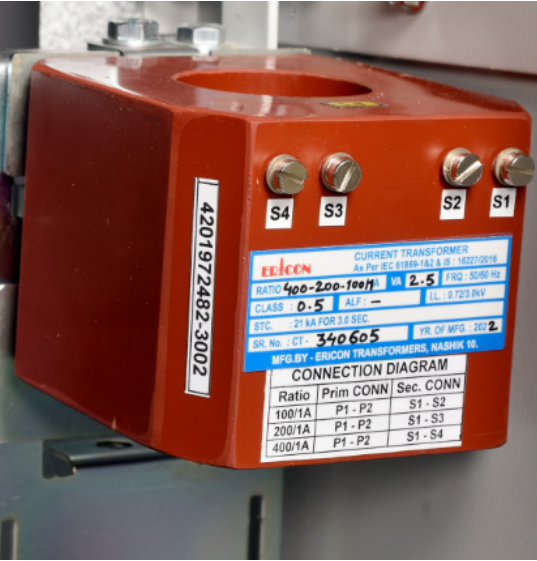
01
Protection/Metering
Current Transformers

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. They can be used for measuring phase currents and detecting earth-fault currents.

These indoor ring core current transformers supply metering and protection devices based on burden and accuracy class requirement. The transformers can be mounted over the power cables inside the RMU cable compartment. Secondary circuits can be connected using copper wires with a cross-section up to 2.5 mm². CTs with secondary current 0.075A are specially designed and applicable for use with ABB REJ series self-powered relays.

01



Typical ring core current transformers and earth-fault transformers

Protection relay standard CT's typical	Ring core current transformer ratio-burden type
Transformer Type: class 5P10	40-80/1 – 2.5VA
Transformer Type: class 5P10	50-100/1 – 2.5VA
Transformer Type: class 5P10	80-150/1 – 2.5VA
Transformer Type: class 5P10	100-200/1 – 2.5VA
Transformer Type: class 5P10	150-300/1 – 2.5VA
Transformer Type: class 5P10	300-600/1 – 2.5VA
Transformer Type: class 5P10	40-80/1 – 2.5VA
Transformer Type: class 5P10	40/1 – 2.5VA
Transformer Type: class 5P10	50/1 – 2.5VA
Transformer Type: class 5P10	80/1 – 2.5VA
Transformer Type: class 5P10	100/1 – 2.5VA
Transformer Type: class 5P10	150/1 – 2.5VA
Transformer Type: class 5P10	200/1 – 2.5VA
Transformer Type: class 5P10	250/1 – 2.5VA
Transformer Type: class 5P10	300/1 – 2.5VA
Transformer Type: class 5P10	600/1 – 2.5VA

Current transformers for self-powered relays, see chapter 17.2 “Self-powered relays”

Typical ring core current transformers

Metering standard CT's typical	Ring core current transformer ratio-burden type
Transformer Type: class 1.0/0.5	40-80/1 – 2.5VA
Transformer Type: class 1.0/0.5	50-100/1 – 2.5VA
Transformer Type: class 1.0/0.5	80-150/1 – 2.5VA
Transformer Type: class 1.0/0.5	100-200/1 – 2.5VA
Transformer Type: class 1.0/0.5	150-300/1 – 2.5VA
Transformer Type: class 1.0/0.5	300-600/1 – 2.5VA
Transformer Type: class 1.0/0.5	40-80/1 – 2.5VA
Transformer Type: class 1.0/0.5	40/1 – 2.5VA
Transformer Type: class 1.0/0.5	50/1 – 2.5VA
Transformer Type: class 1.0/0.5	80/1 – 2.5VA
Transformer Type: class 1.0/0.5	100/1 – 2.5VA
Transformer Type: class 1.0/0.5	150/1 – 2.5VA
Transformer Type: class 1.0/0.5	200/1 – 2.5VA
Transformer Type: class 1.0/0.5	250/1 – 2.5VA
Transformer Type: class 1.0/0.5	300/1 – 2.5VA
Transformer Type: class 1.0/0.5	600/1 – 2.5VA

11. Voltage Transformers

—
01
Single phase Voltage
transformer

—
The voltage transformers are insulated in epoxy resin and are used for powering measuring and protection devices. They are available for fixed assembly connections. In this case, the transformers can be equipped with a medium voltage protection fuse.

These transformers possess performance and precision classes that suit the functional requirements of the instruments to which they are connected.

These transformers are equipped with tertiary winding to connect with damping resistor in open delta connection.

Secondary windings -- / 110:√3 / 110:3 V or -- / 100:√3 / 100:3 V have to be specified
Burden / class has to be specified

—
01

Typical ratings of voltage transformers

Standard VT's typical ratios	Voltage transformer burden
11000V/R3/110V/R3/100V/3	25VA
11000V/R3/110V/R3/100V/3	50VA
11000V/R3/110V/R3/100V/3	100VA
11000V/R3/415V/R3	500VA
11000V/R3/415V/R3	1000VA



12. Sensors

KECA 80 C85 Indoor current sensor

Electronic Instrument Transformers (sensors) offer an alternative way of making the current measurement needed for the protection and monitoring of medium voltage power system. Sensors based on alternative principles have been introduced as successors to conventional instrument transformers in order to significantly reduce size, increase safety and to provide greater rating standardization and a wider functionality range. These well-known principles can only be fully utilized in combination with versatile electronic relays.

Sensor characteristics

KECA 80 C85 sensors can reach measuring class 0.5 for continuous measurement from 5% of the rated primary current (I_{pr}) up to the rated continuous thermal current (I_{cth}). This is beyond 120% of I_{pr} that is common for conventional CTs. For dynamic current measurement (protection purposes), ABB sensors KECA 80 C85 fulfill requirements of protection class 5P up to an impressive value reaching the rated short-time thermal current I_{th} . 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 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 an IED using cable connector 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.

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.



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}	80A
Rated continuous thermal current I_{eth}	2500 A
Rated transformation ratio, K_{ra}	80 A/ 150 mV at 50 Hz 180 mV at 70 Hz
Rated short-time thermal current, I_{th}	50 kA/3 s
Rated dynamic current, I_{dyn}	125 kA
Rated frequency, f_r	50/60 Hz
Rated extend primary current factor, K_{pcr}	31.25
Accuracy limit factor, K_{alf}	630
Accuracy class	0.5/5P630
Length burden, R_{br}	10 MOhm
Length of cable	2.2; 3.4; 3.6 m
Connector	RJ - 45 (CAT-6)
Weight	0.25 kg

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 to be an unpredictable and influenced error. Hence, it can be easily corrected in the IED by using appropriate correction factors, stated separately for every sensor.

KECA 80 D85 Indoor current sensor (split core type)

Electronic Instrument Transformers (sensors) offer an alternative way of making the current measurement needed for the protection and monitoring of medium voltage power system. Sensors based on alternative principles have been introduced as successors to conventional instrument transformers in order to significantly reduce size, increase safety and to provide greater rating standardization and a wider functionality range. These well-known principles can only be fully utilized in combination with versatile electronic relays.

Sensor characteristics

KECA 80 C85 sensors can reach measuring class 0.5 for continuous measurement from 5% of the rated primary current (I_{pr}) up to the rated continuous thermal current (I_{cth}). This is beyond 120% of I_{pr} that is common for conventional CTs. For dynamic current measurement (protection purposes), ABB KECA 80 C85 sensors fulfill requirements of protection class 5P up to an impressive value reaching the rated short-time thermal current I_{th} . That provides the possibility to designate the corresponding accuracy class as 5P630, proving excellent linearity and accuracy measurements.

Sensor applications

KECA 80 D85 sensors are intended for use in current measurement in medium voltage air and gas insulated switchgear. The current sensor is split core type equipped with a clamping system which provides easy and fast installation and therefore makes the sensor suitable for retrofit purposes. The current sensor shall be installed

over a bushing insulator, insulated cable, insulated & shielded cable connectors or any other type of insulated conductor.

Secondary cables

The sensor is equipped with a cable for connection with an IED using cable connector 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	
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}	4000A
Rated transformation ratio, k_{ra}	80A/ 150 mV at 50 Hz 180 mV at 60 Hz
Rated short-time thermal current, I_{th}	50 kA/3s
Rated dynamic current, I_{dym}	125 kA
Rated frequency, f	50/60Hz
Rated extend primary current factor, k_{pcr}	50
Accuracy limit factor, K_{aif}	630
Accuracy class	0.5/5P630
Rated burden, R	10 MOhm
Length of cable	2.2:5 m
Connector	RJ-45 (CAT-6)
Weight	0.25 kg

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.

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.

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 to be 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 relevant instructions and manuals for more information.

Parameters for application	
Rated primary voltage of application	up to 24 kV
Sensor parameters	
Rated primary voltage, U_{pn}	22/v3
Highest voltage for equipment, U_m	24 kV
Rated power frequency withstand voltage	50kV
Rated lightning impulse withstand voltage	125 kV
Rated continuous thermal current I_{cth}	2500 A
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 T-connectors

Cable T-connectors		
Sensor type	Manufacturer Type	Interface
KEVA 24 C10	Nezans-Euromold	400 TB/G
		440 TB/G
		K400 TB/G
		K400 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 C22	NKT	CB 12-630
		CC 12-630
		CB 24-630
		CC 24-630
	Raychem	RSTI L56xx
KEVA 24 C23	Raychem	RSTI-CC L56xx
		RSTI 58xx/39xx
	Raychem	RSTI CC
		58xx/39xx
	NKT	RSTI LCxx/LAxx(Older)
		CB 12-630
		CC 12-630
		CB 24-630
KEVA 24 C24	Nexans-Euromold	CC 24-630
		430 TB-630
		K430 TB-630
		300 PB-630
		K300 PB-630

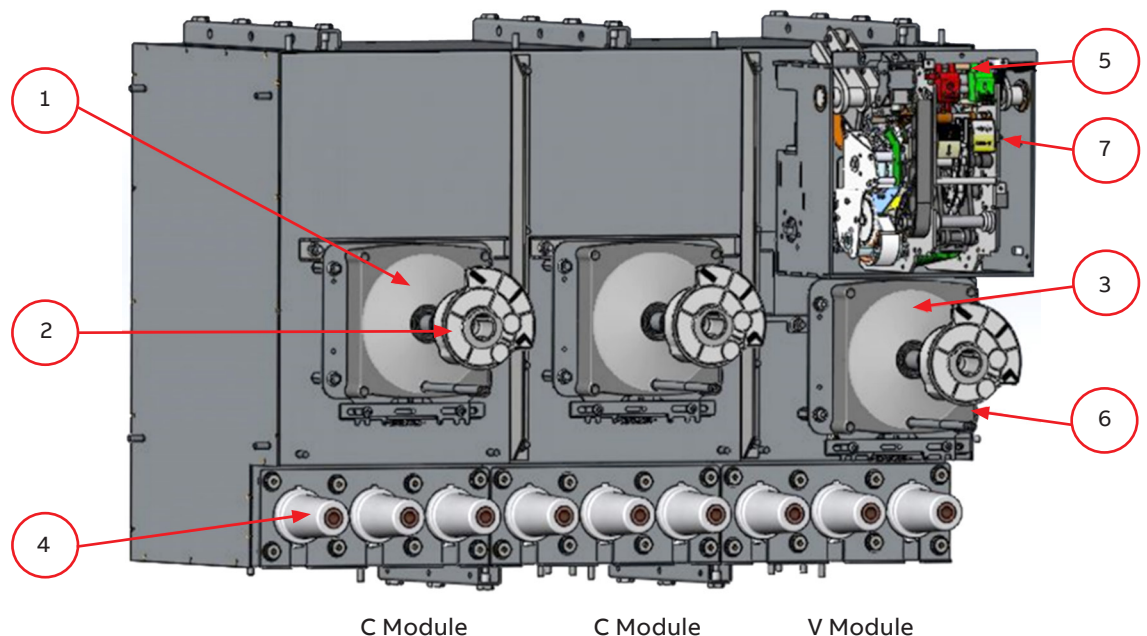
13. Mechanisms

All operating mechanisms are situated outside the SF₆ gas tank behind the front covers with 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. To prevent access to the cable compartment before the earthing switch is in closed position, all mechanisms are supplied with mechanical interlocks. These interlocks make it impossible to remove the cable compartment covers with the earthing switch in open position only. It will then also be impossible to operate the load break/disconnector switch to open position before the cable compartment cover is mounted properly.

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 hole; the diameter of suitable padlocks is 4 - 8 mm.

All operating mechanisms are equipped with position indicators for all switches. In order to achieve true indication, indicators are directly connected to the operating shafts of the switches inside the SF₆ gas tank.



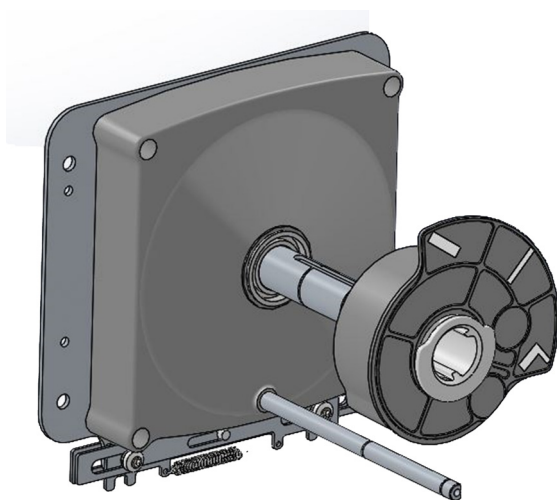
Description		
Switch-disconnector	1	
Position Indicator	2	
Disconnector	3	
Cable bushings	4	
VCB Push buttons	5	
VCB Earth switch	6	
VCB Spring charge indication	7	

—
01
Switch Mechanism

Load break switch

The switch mechanism 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 operate one common shaft which is directly connected to the three-position switch inside the SF6 gas tank. When both load break switch and earthing switch are in open position, the switch satisfies the specifications of disconnecter. Due to the mechanical interlock between the upper and lower operating shaft, it is impossible to operate the load break switch when the earthing switch is in closed position or to operate the earthing switch when the load break switch is in closed position.

—
01



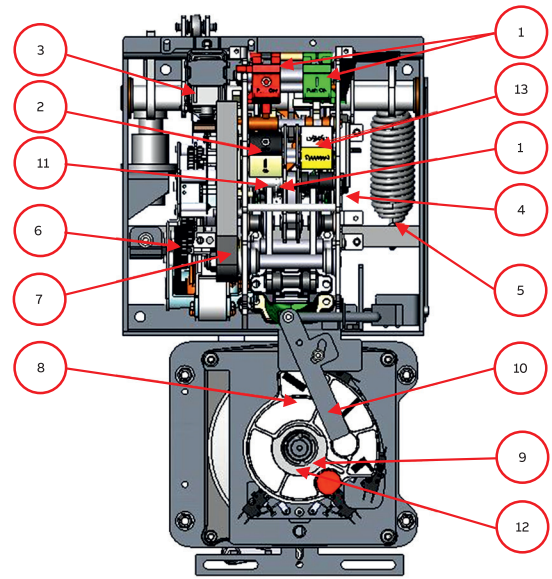
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02
Vacuum circuit
breaker mechanism

Vacuum circuit breaker

These two modules have two mechanisms; the upper one with one operating shaft is for the circuit-breaker and the lower one with two operating shafts is for the disconnecter and earthing switch. The upper mechanism has two operating springs: one for closing and one for opening. Both springs are charged in one operation. By means of mechanical push buttons it is then 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. However, a quick reclosing is not possible. If the mechanism is equipped with a motor operation, a reclosing will take approximately 10 seconds. The lower mechanism is therefore identical to the one described above for the cable switch module. There is a mechanical interlock between these two mechanisms which prevents operating of the disconnecter and earthing switch when the circuit-breaker is in closed position. When the earthing switch is in closed position it will be impossible to operate the disconnecter, but the circuit breaker can be closed for testing purpose.

Load break switch and disconnector mechanisms are equipped with padlocking facility with suitable holes which when used will restrict the access to operate the mechanism. All operating mechanisms are equipped with mechanical position indicators for ON-OFF-EARTH conditions. In addition, the circuit breaker mechanism also has indication to show spring charged/discharged condition. Operating handle is required only for the switch-disconnector mechanism.

—
02



Description	
VCB ON-OFF Push buttons	1
VCB position indicator	2
Series trip coil	3
Position for shunt close/open coils	4
VCB closing spring	5
Spring charge motor for EL2 mechanism	6
VCB manual spring charge handle	7
Disconnecter-earth switch position indicator	8
Disconnecter-earth switch	9
VCB-disconnector mechanical interlocking	10
EL2 mechanism	11
VCB Earth switch	12
VCB Spring charge indication	13

14. Cable Bushing

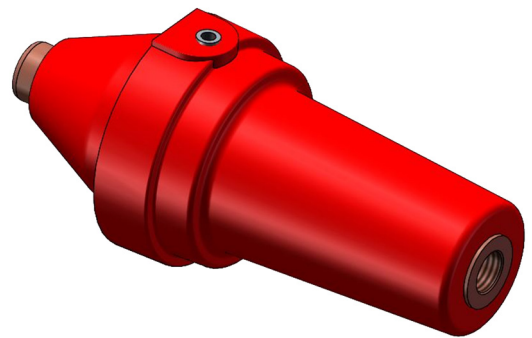
The connection of the HV-cables is made by cable bushings. The bushings are made of cast resin epoxy with molded in conductors. In addition, a screen is molded in, for controlling the electrical field. The screen is also used as the main capacitor supplying the voltage indicating systems.

ABB also has experience with bushings for SF₆ switchgears since 1985 with high performance and quality. A very large number has been installed worldwide in distribution networks, power stations and industrial complexes. Used together with fully screened connectors it is an ideal solution for areas with humidity or condensation problems.

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

The bushings are designed according to EN 50181 and are of type Interface C (400 series with M16 bolted contact, I_n = 630A).



15. Cable Terminations

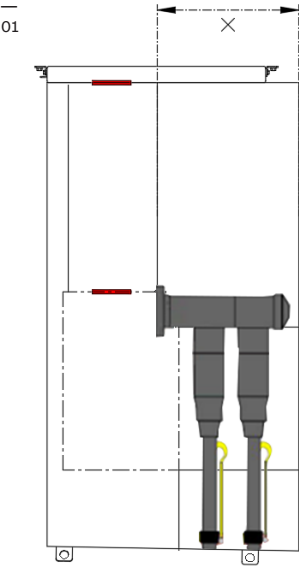
-
- 01
- Screened seperable
cable connectors
-
- 02
- Terminal Protector

—

All bushings are situated at the same height from the floor and are protected by a cable compartment cover. The two drawings below show typical arrangements with cable connectors for single and double cables.

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

Cable Compartment Type	Interface C (400 series bolted)
Arcproof cable compartment IAC AFLR 10kA 0.1 sec	305 mm
Arcproof cable compartment IAC AFLR 21kA 1 sec	298 mm



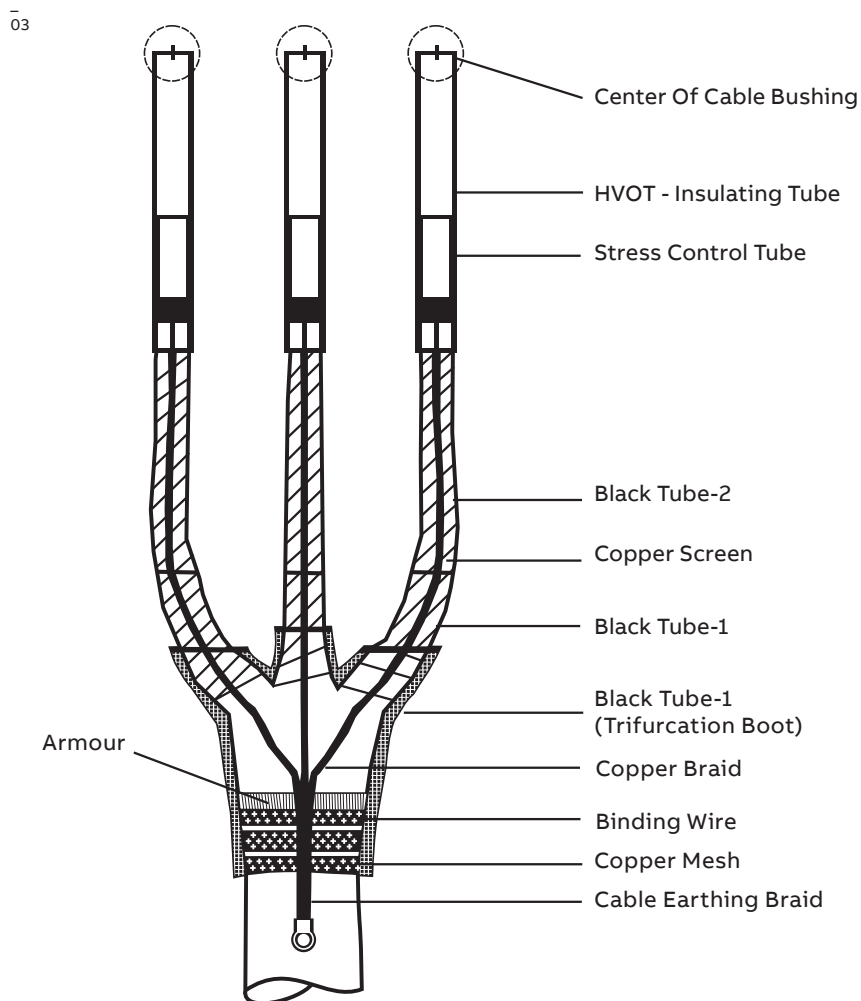
Cable cover with double
cable arrangement

Option 1
Heat shrink type cable termination using special insulated terminal protectors as shown in picture below.



03
Basic representation
cable termination

Basic representative cable termination for 12kV SafeRing XT/SafePlus XT from cable box gland plate to bushing center is shown below.



Warning

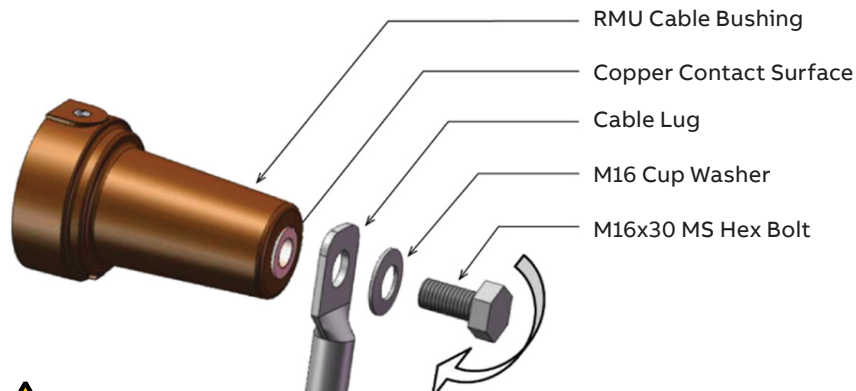
The installation instructions from the manufacturer of cable terminations must be followed. Be sure to lubricate the bushings thoroughly with the silicone grease supplied. Where cables are not connected, the Earthing Switch must be locked in closed position or the bushings must be fitted with dead end receptacles before the unit is energized.

—
04
Basic representation
cable termination

Following pictures shows the tightening torque and fasteners to be used for the bushing terminations.
Cable size of maximum 300 sq. mm can be used.

For cable Lug hole size = 16.2 mm

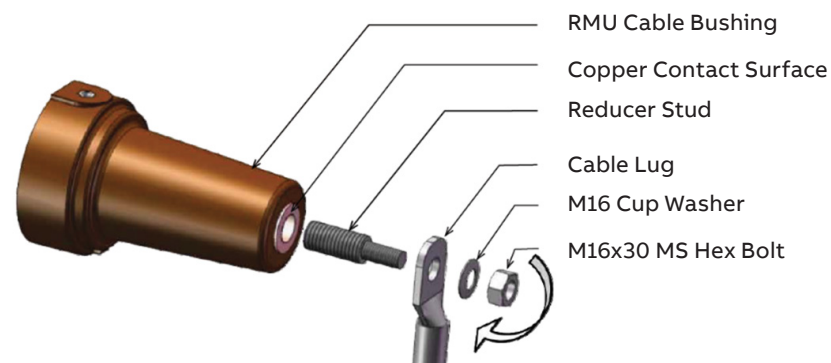
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04



Warning

Proper tightening torque of 50 N-m should be given to ensure good connection/contact of cable lug to bushing copper face.

For cable Lug hole size < 16.2mm

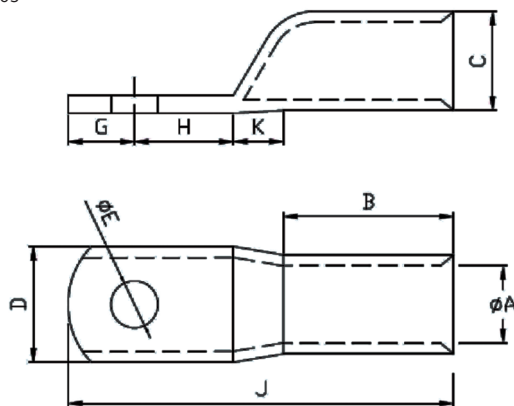


Warning

M16/M10 reducer stud should be inserted properly inside the bushing, such that lug touches the bushing copper face properly. Tightening torque of 30 N-m should be also properly ensured.

Note- For cable size above 300 sq. mm, special cable lug supplied by the factory must be used.

—
05



MGNS-301	E	A	C	D	B	G	H	K	J
PARAMETER	16.2	28	36	40-42	62	24	36	18	140
TOLERANCE	+0.2 -0.2	+0.2 -0.2	+0.2 -0.2	+1.0 -1.0	+0.5 -0.5	+0.5 -0.5	+0.5 -0.5	+0.5 -0.5	+1.0 -1.0

—
06
Screened seperable
cable connectors

—
06
Option 2 - Screened separable cable connectors as shown in picture below.



The following manufacturers of cable terminations are recommended:

1. 3M
2. Nexan Euromold
3. NKT cables
4. Prysmian
5. Südkabel
6. Tyco/Raychem
7. BBC CELLPACK
8. GCA

Application area

Pre-molded, screened, separable connectors for XLPE insulated 1- or 3-core cables with aluminum or copper conductors for 12 kV can be installed. 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

Screened separable connectors are premoulded 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.

Table 15.1

12 kV: Separable connectors interface C, Ir = 630 A							
Manufa cturer	Conductor [mm ²]	XLPE / EPR Ø [mm]	Single run arrang ement	Additional	Double run Applicable Module	Double run, Only Protection - CT ratios	Additional equipment for Surge Arrester
NKT	25-300	12.7-34.6	CB 24-630	CC 24-630	C Module	200-upto 630/1A 2.5VA 5P10	CSA M16- 630
					D Module	100/1A 2.5VA 5P10	
					V Module	80/1A 2.5VA 5P10	
						70/1A 2.5VA 10P10	
						60/1A 2.5VA 10P10	
						50/1A 2.5VA 10P10	
						40/1A 2.5VA 10P10	
	95-400	21.2-40.0	CB 24-1250	CC 24-1250	C Module	200-upto 630/1A 2.5VA 5P10	CSA M16-1250
					D Module	100/1A 2.5VA 5P10	
					V Module	80/1A 2.5VA 5P10	
						70/1A 2.5VA 10P10	
						60/1A 2.5VA 10P10	
Nexan Euromold	16-300	12.0-37.5	480 TB/G	-	-	-	-
	50-400	16.0-56.0	484 TB/G	-	-	-	-
Tyco/ Raychem	25-300	12.7-34.6	RSTI-58	RSTI-CC-58	C Module	200-upto 630/1A 2.5VA 5P10	RSTI-58SA
					D Module	100/1A 2.5VA 5P10	
					V Module	80/1A 2.5VA 5P10	
						70/1A 2.5VA 10P10	
						60/1A 2.5VA 10P10	
						50/1A 2.5VA 10P10	
						40/1A 2.5VA 10P10	
	400	17.5-42.0	RSTI-X95X	RSTI-CC- X95X	C Module	200-upto 630/1A 2.5VA 5P10	RSTI-58SA
					D Module	100/1A 2.5VA 5P10	
					V Module	80/1A 2.5VA 5P10	
						70/1A 2.5VA 10P10	
						60/1A 2.5VA 10P10	
3M	50-400	15.0-34.6	93-EE 705-6	-	-	-	-
	25-300	13.0-33.0	MSCEA-630	-	-	-	-
Prysmian	50-300	15.0-32.6	SET 24	-	-	-	-
	185-400	22.0-40.6	SEHDT 13	-	-	-	-
Sudkabel	25-240	14.7-22.0	CTS 630 24kV	CTKS 630 24kV	C Module	200-upto 630/1A 2.5VA 5P10	CTKSA 630 24kV
					D Module	100/1A 2.5VA 5P10	
					V Module	80/1A 2.5VA 5P10	
						70/1A 2.5VA 10P10	
						60/1A 2.5VA 10P10	
BBC Cellpack	25-240	14.7-22.0	CTS 630 24kV	CTKS 630 24kV		50/1A 2.5VA 10P10	
						40/1A 2.5VA 10P10	
GCA	35-400	22.0-31.5	CTS 630 36kV	-	-	-	-
	35-400	16.5-45.0	CJB20-630	-	-	-	-

Manufa cturer	Conductor [mm ²]	XLPE / EPR Ø [mm]	Single run arrang ement	Additional	Double run Applicable Module	Double run, Only Protection - CT ratios	Additional equipment for Surge Arrester
Raychem	25-300	13.5-30	ELBC-811 11kV-630A	ELBC-CC-811 11kV-630A	C Module	200-upto 630/ 1A 2.5VA 5P10	-
					D Module	100/1A 2.5VA 5P10	
					V Module	80/1A 2.5VA 5P10	
						70/1A 2.5VA 10P10	
						60/1A 2.5VA 10P10	
						50/1A 2.5VA 10P10	
						40/1A 2.5VA 10P10	

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.

16 Extension of Switchgear (Side extension)

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01
SafePlus XT connected to each other by means of side extension busbar kit

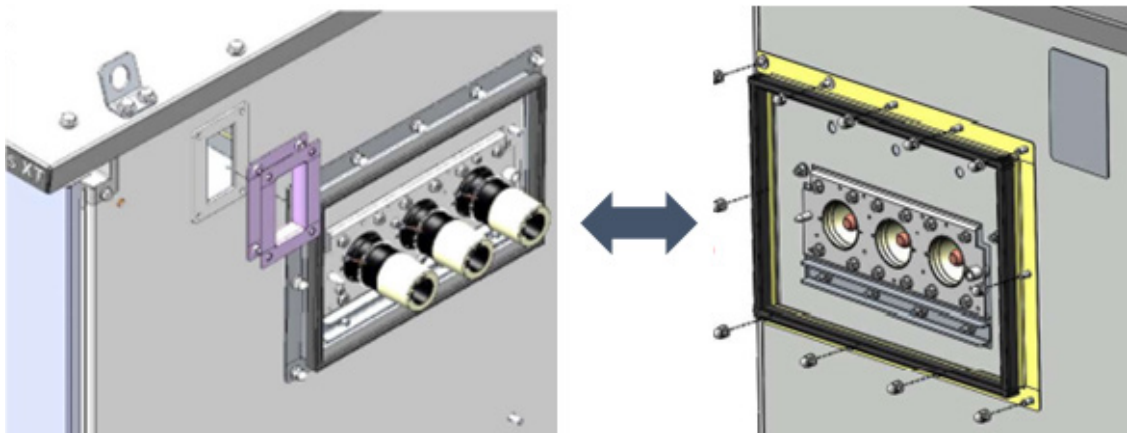
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02
The installation of the external busbars has to be done on site, see separate Operation & installation manual, 2REA063296

—
As an option, SafeRing XT / SafePlus XT can be provided with bushings for side extension on one or both sides. Maximum of five modules can be included in a single, common SF6-tank, the side extension and busbar kit are required for configurations that require additional modules. For practical handling of modules on site, the switchgear can be extended by 1- or 2-way units.

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01



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02



17 Protection Relays & Control Products

This chapter describes the different choices of protection relays, self-powered protection relays and RTU/control devices that can be used in SafePlus XT. Small or larger size of LV compartment can be selected to suit these protection relays and RTU/control devices based on the size and complexity.

We offer two types of device configuration for our ABB devices:

- Basic configuration
- Customized configurations

Basic configuration

This configuration option is intended for use where customer needs a premade setup. This setup covers the specific protection relay's base functionality installed in SafeRing XT/SafePlus XT switchgears. IED protection and control functionality is tested and documented acc. to basic setup.

Customized configuration

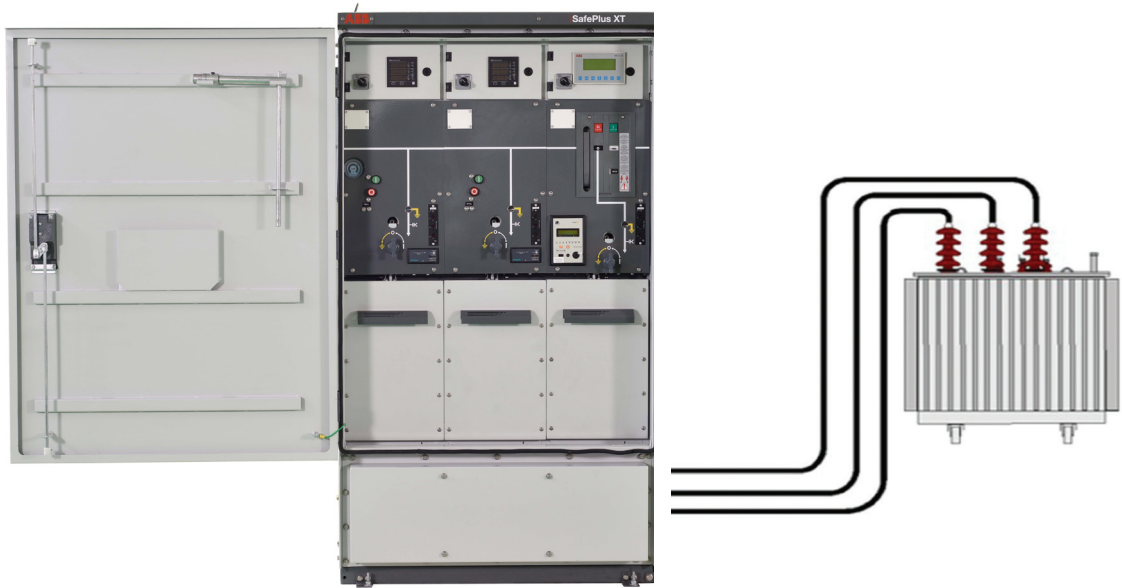
This configuration option is intended for use where customer needs a specific setup. IED's are tested and documented. Functional description and test reports will be delivered as part of the switchgear documentation.

For transformer protection with vacuum circuit-breaker see chapter 17.1, "Transformer protection & relay".



17 Protection Relays & Control Products

17.1 Transformer protection & relay



REJ603R 1.5

SafeRing XT/SafePlus XT offers a circuit breaker in combination with relay for transformer protection which has better protection against low over currents. Circuit breaker with relay is always recommended for higher rated transformers. RMU is delivered with 630 A rated V-module. Switchgear has a relay which is a self-powered protection relay that utilizes the energy from the CT's under a normal as well as fault situation, for energizing the trip coil. The CT's for the vacuum circuit breaker are mounted on the cable side of V-Module. The self-powered relay can also be used for cable protection and more details can be found in respective relay catalogues. Relay is mounted behind front door. Optionally, auxiliary powered relays can also be provided.

REJ603 3.0

Advantages of vacuum circuit breaker protection

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

Relay characteristics

- Economical
- Easy adjustment
- Perfect for large distribution transformers



REF601



Functionality				RELAYS		
Features	Description	ICE 60617	IEEE device No.	REJ603 v1.5	REJ603 v3.0	REF601
Protection Functions	Three-phase transformer inrush detector	312f>	6s	•	•	•
	Phase overcurrent (multi-characteristic)	31> (low set)	50/51	•	•	•
	Short-circuit protection	I>>	50/51	•	•	•
	Number of overcurrent elements		50/518	2	3	3
	Earth – fault current	IO>(low set)	50N/51N	•	•	•
	No of earth-fault elements			2	2	2
Characteristic curves	Overcurrent element			DEFT.NV1)	DEFT.NV1)	DEFT.NV1)
	Earth fault current			DEFT.NV1)	DEFT.NV1)	DEFT.NV1)
Additional functions	Trip Indication			•	•	•
	Electro-Impulse			1	1	1
	input remote trapping (voltage)					Auxiliary voltage
Measuring circuit	Rated secondary current			Wide range speciat CT	Wide range speciat CT	Wide range CT (1 / 5A)
	Measuring range, start current I> (A)			7.2	2	Auxiliary voltage
Climatic withstand	Storage temperature (°C)			--40..+85	--40..+85	--40..+85
	Operating temperature (°C)			--40..+85	--25..+55	--25..+55

- 1) Definite time overcurrent (DEFT), Inverse time overcurrent (INV), please contact us for further information
- 2) The relay's minimum powering current is 0.07 x In when currents in three phase and 0.18 x In when current in a single phase

17 Protection Relays & Control Products

17.1 Transformer protection & relay

REJ603 v.1.5 uan,sformer p,rotection and cable protection, ki,t (self-powered)	Riing core ourrent t ransformer type	Current range
Transformer type	CT1	8 - 28 A
Transformer type	CT2	16 - 56 A
Transformer type	CT3	3,2 - 112 A
Transformer type	CT4	64 - 224 A
Transformer type	CT5	128 - 448 A

REJ603 v.3 .. 0 transformer protection and cable protection ki,t	Ring core current transformer type	Current range
Transformer type	CT2 or WIC1-W,2	16 - 56 A
Transformer type	CT3 or WIC1-W3	32 - 112 A
Transformer type	CT4 or WIC1-W4	64 - 224 A
Transformer type	CT5 or WIC1-W5	128 - 448 A

17.2 Auxiliary Powered Relays



605 series

The relion 695 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 utility and industrial applications. The 615 series provides standard configuration, 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 unequalled customization and modification flexibility and easy adaptation to changing protection requirements throughout the relay life cycle.

17.3 RTU & Control Products

RTU520



RTU520

For enhanced observability and complete fault awareness in your power distribution network, RTU520 offers advanced fault and outage management, enabling the efficient detection and isolation of faults and restoration of power and service. With the fault and outage management functionality. Outage times can be reduced by up to 81%, leading to an incredible economical advantage.

RTU520 allows accurate energy measurements, based on advanced fault detection equipment. This detailed information are considered the basis for fault detection isolation and restoration (FDIR), and Fault Location Isolation and Service Restoration (FLISR) functionality. This solution enables a detailed power flow analysis with sensors and measurement devices in MV and LV applications, including smart meter integration. Improving your grid visibility gives you the control you need to take the right decisions at the right time to keep the power flowing.

RTU540



RTU540

Gateway product for distribution and sub-transmission. Bridges old and new technology and combines existing devices and new standards protocols (such as IEC 61850) in one substation automation system.

RTU540 incorporates advanced features like programmable logic control and a human machine interface allowing for instant insight into the status of the grid. The high-quality, compact metal housing includes input and output modules which lead to space savings in the control cabinet.

ARC600



ARC600

The Wireless Controller ARC600 integrates remote control, I/O interface, communications, battery charging and other necessary features for substation automation in the compact, all-in-one package.

ARC600 is optimized for controlling up to three primary switching devices such as sectionalizers, circuit breakers or reclosers. Status indication of the controllable switching devices and upto three earthing switches are also available. ARC600 enables the SCADA system to wirelessly monitor and control the field devices over the public communication infrastructure (cellular network)

Typically, the IEC-104 protocol is utilized for communication to the SCADA system but for the existing installations with a IEC-101 line or modern, Wireless Controller ARC600 supports also IEC-101 communication (including dial-up) to the SCADA system.

17.3 RTU & Control Products

—
ARG600



ARG600

The wireless gateway ARG600 provides wireless monitoring and control of field devices via cellular network from a central site or control center. The devices offer industrial quality connectivity for TCP / IP based protocols. Wireless Gateway ARG600 exhibits integrated communication capability and seamless integration to SCADA systems. With the Wireless Gateway ARG600 the Ethernet and serial devices can be attached to a TCP / IP based control system. DNP3.0 serial devices can be also attached to a DNP3.0 TCP SCADA system. In this case DNP3.0 protocol is transferred just over TCP / IP communication (transparent serial gateway mode).

—
ARR600



ARR600

Wireless I/O gateway ARR600 provides wireless monitoring and control of field devices via cellular network from a central site or control center. The devices offer industrial quality connectivity for the IEC60870 and Modbus based protocols. Field applications can be connected and controlled via built-in digital and analog I/Os. Wireless I/O Gateway ARR600 exhibits integrated communication capability and seamless integration to SCADA systems analog inputs and outputs. Remote applications, such as overhead sectionalizers, can be connected and controlled via the ARR600. The gateway also serves as a generic I/O interface. For example, substation alarms or temperature measurements can be transmitted to a central monitoring system.

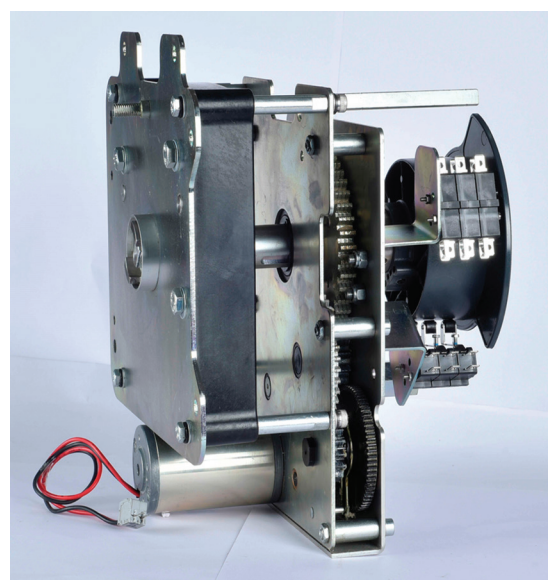
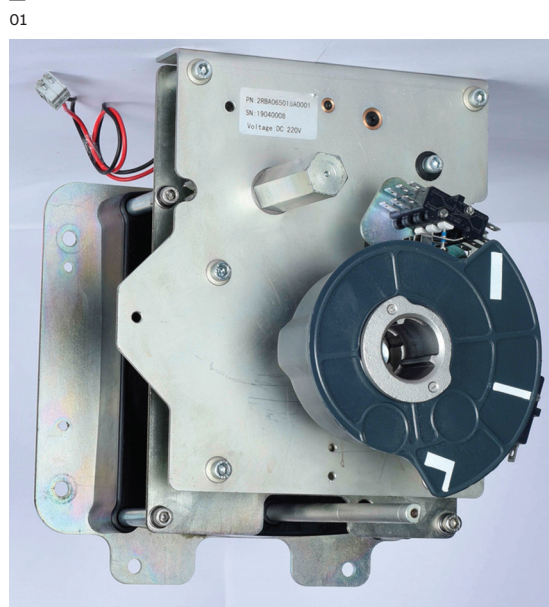
18 Accessories

18.1 Motor Operation

18.1.1 Motorized version for Switch-disconnector

01
Motor version
for C-module

Optionally, closing and opening operations of mechanism for Switch disconnector can also be performed with motorized operations.



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).

Motors can easily be mounted to the mechanisms after delivery (retrofit). Test

voltage for tables below is + 10/- 15 % for motor operations. The motor can be retrofitted after delivery.

Auxiliaries like motor drives and auxiliary switches are located behind the front mimic.

Characteristics	Specifications
Rated Voltages for Motor (Un)	24 VDC, 48 VDC, 60 VDC, 110 VDC, 220 VDC
Voltage variation	85-110% Un
Rated Power Consumption (max)	90 W, 90 VAC
Charging time	< 8 sec
Insulation voltage	2 kV 1 min (50 Hz)

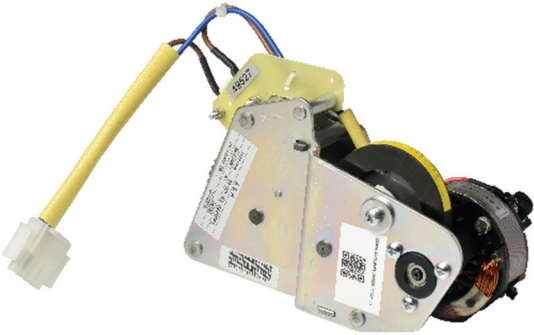
18.1.1 Motorized version for Switch-disconnector

Charging of the closing spring of the EL2 mechanism for the Vacuum Circuit Breaker can be performed with motorized operation.

However, disconnector & earthing switch of V module shall be still manually operated considering safety aspects.

—
02
Motor version
for V module

—
02



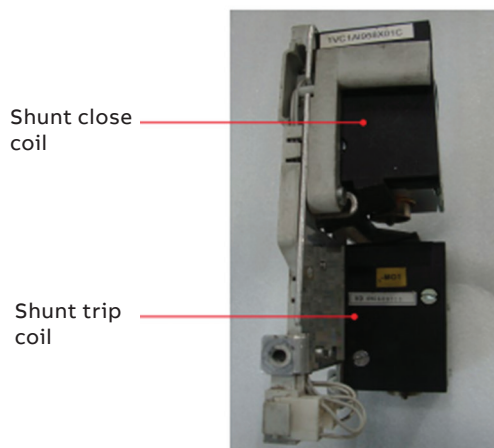
This carries out automatic charging of the circuit-breaker operating mechanism closing spring. After circuit-breaker closing, the geared motor immediately recharges the closing springs. In the case of a power cut or during

maintenance work, the closing spring can be charged manually in any case (by means of the crank handle incorporated in the operating mechanism).

Characteristics	Specifications
Rated Voltages for Motor (Un)	24 VDC, 48 VDC, 60 VDC, 110 VDC, 220 VDC, 110 VAC, 230 VAC
Voltage variation	85-110% Un
Inrush power (Ps)	600 W, 600 VAC
Rated power (Pn)	200 W, 200 VA
Charging time	< 10 sec
Inrush time	0.2 sec
Insulation voltage	2 kV 50 Hz for 1 min

Test voltage for tables below is
+ 10/- 15 % for motor operations and closing coils and +10/- 30% for opening coils. The motor and coils can also be retrofitted after delivery.

18.2 Shunt Releases



Shunt opening release (-MOI)

This allows remote opening control of the circuit breaker. The release can operate both in direct and alternating current. This release is suitable for both instantaneous and permanent service. In the case of instantaneous service, the minimum current impulse time must be 100 ms.

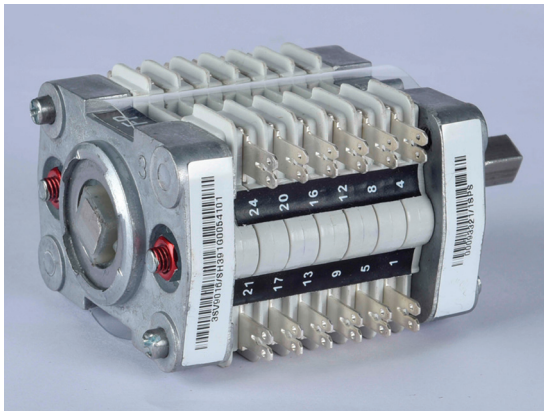
Shunt closing release (-MC)

This allows remote closing control of the circuit breaker. The release can operate both in direct and alternating current. This release is suitable both for instantaneous and permanent service. In the case of instantaneous service, the minimum current impulse time must be 100 ms. Use of the permanently supplied release is recommended to carry out the electrical anti-pumping function.

Characteristics	Specifications
Rated Voltages for Motor (Un)	24 VDC, 48 VDC, 60 VDC, 110 VDC, 220 VDC, 110 VAC, 230 VAC
Operating limits	70-110%Un
Inrush power (Ps) max	300 W, 300 VAC
Continuous Power (Pc)	5 W, 5 VA
#Closing time (ms) (with VCB)	40-70
#Opening time (ms) (with VCB)	40-80
Inrush duration (ms) approx	100
Insulation voltage	2 kV 50 Hz for 1 min

18.3 Auxiliary/Signal Contacts

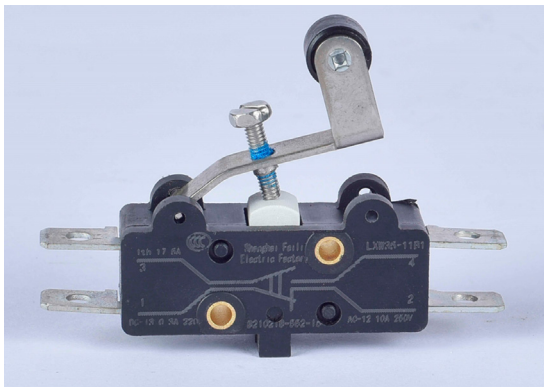
18.3.1 Vacuum Circuit Breaker auxiliary contacts



Electrical signaling of vacuum circuit-breaker open/close position can be provided with a group of 6 auxiliary contacts as

standard. These are with combination of break contacts (signaling circuit-breaker open) and make contacts (signaling circuit-breaker close position) i.e., 6NO+6NC. Optionally, 2nd set of such signaling contacts can be provided with 6NO+6NC. These auxiliary/signaling contacts are true contacts of auxiliary switch directly coupled to EL2 spring mechanism, which gives true indication of vacuum circuit breaker ON/OFF indication.

18.3.2 Switch Disconnecter/Circuit Breaker Disconnecter auxiliary contacts



Switch-disconnector, earthing Switch and disconnector can be provided with 1NO+1NC auxiliary contacts. In case of switch disconnector & CB disconnector, 2Nos. switch i.e. 2NO+2NC is an optional feature.

This consists of a micro switch which allows remote signaling of the state of the circuit-breaker operating mechanism closing spring. The following signals are possible: Contact open: signaling spring charged Contact closed: signaling spring discharged.

18.4 Capacitive Voltage Indicators

SafeRing XT / SafePlus XT switchgears are equipped with capacitive voltage indication called VPIS (Voltage Present Indicating System) in accordance with IEC 62271-206.

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.

This system has integrated LEDs. The LED starts to flicker when there is a system voltage between 10%-45% of line to ground voltage.



VPIS are available for: -

System voltage range 3.4 – 6.3 kV

System voltage range 6 – 13 kV

System voltage range 9 - 15 kV

Optionally, these voltage indicators can be supplied with SCADA contact of 1NO+1NC which will provide signal to SCADA on voltage present or not present.

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 61243-5

18.5 Short Circuit and/or Earth Fault Indicators

03
Earth Fault Indicator type EASI-ER

04
Earth Fault Indicator type EKL-1B

05
Short-circuit & Earth fault indicator type EKL-8000

06
Short-circuit & Earth fault indicator type EKL-8000

03



04



Earth fault and/or short circuit indicators according to the IEC standards can be provided for both the ring cable switches.

Shown above are panel mounted reading instruments. The reading instrument is equipped with a LED. The LED starts to blink, if the pre-adjusted operating current has been reached or exceeded. It can be reset manually or automatically after a certain defined delay. Test push button is provided and contact(s) for remote indication can be also provided. For different operating points/current settings, kindly check individual catalogues of different manufacturers.

Combined short circuit and earth fault can be also provided. The indicator set consists of one reading instrument, four sensors (one sensor on the 3 core cable and three for the individual 1 core cables) and four fibre optic/ standard copper cables. Earth fault and short circuit can

be indicated via one LED each or short circuit via one LED for each core, one LED for earth fault. Besides this a remote indication for earth fault and short circuit via one relay contact can also be provided.

05



06





18.6 Manometer & Pressure Indicators



SafeRing XT/XT Plus are sealed systems designed and tested according to IEC 62271-200 as 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

1.3 bar*. The switchgear will maintain gas-tightness and a gas-pressure better than 1.25 bar* throughout its designed lifespan. This pressure value is still within a good margin. From the pressure used during type testing, which is 1.2 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 signaling contacts. Detailed descriptions of manometer functions are described in the table on next page.

Altitude
For installation above 1000 meters, please contact ABB sales representative. Maximum height above sea level up to 3000m installation without reducing gas pressure is also available.

Model	Insulation medium	Temp. comp.	Accuracy	Scale range (Absolute)	Appearance (Absolute)	Making of scale (absolute)	Signalling contact	Threshold pressure	Connection to the tank
2REA051961P0002	5F ₆	X	+/-1% (20°C)	1 - 2 bar	red zone 0.1-1.2 bar green zone 1.2-2.0 bar	Mark at 1.2 bar	1x NC	1.2 bar	Solid
2REA051961P0001	5F ₆	X	+/-1% (20°C) +/- 2.5% (-20+60°C)	1 - 2 bar	red zone 0.1-1.2 bar green zone 1.2-2.0 bar	Mark at 1.3 bar	-	1.2 bar	Solid

2REA051961P0002



2REA051961P0001

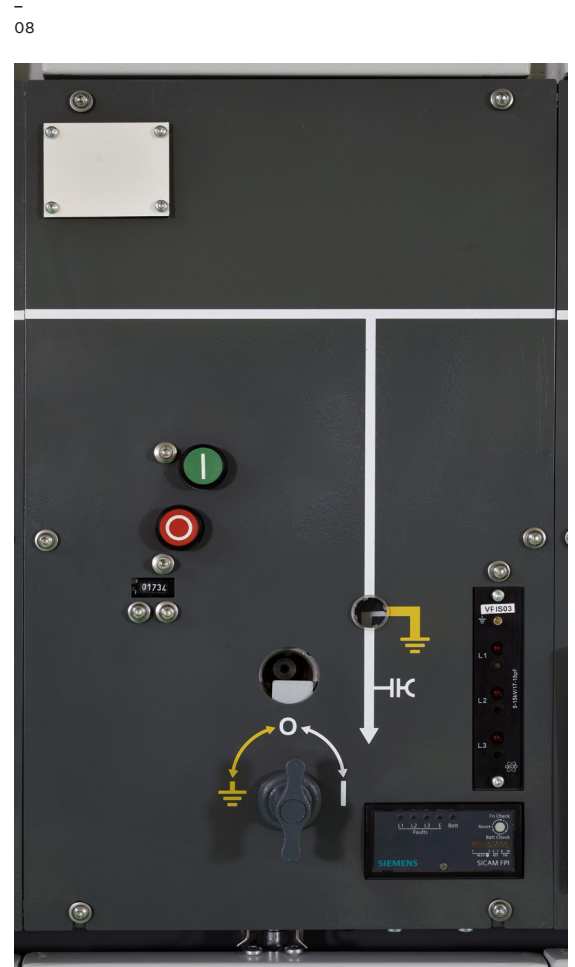
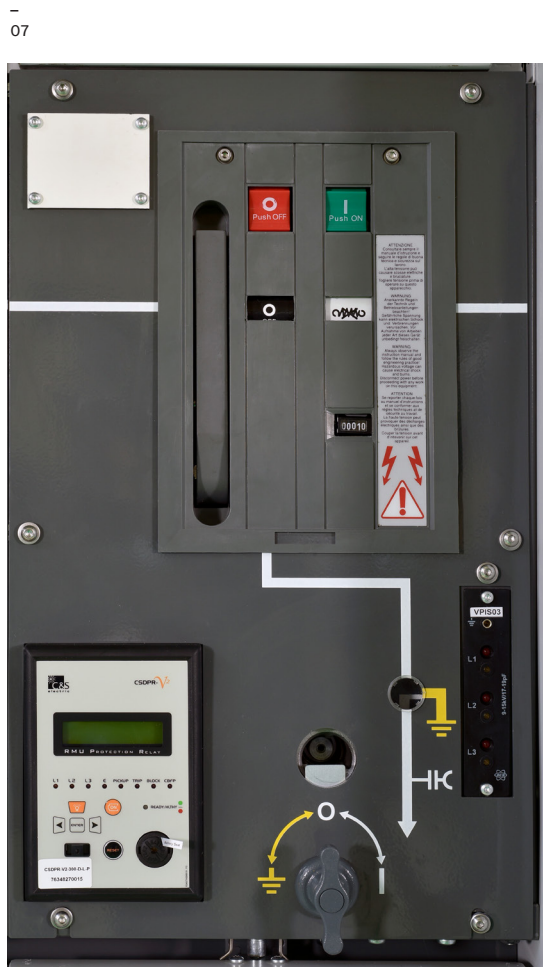


18.7 Operations Counter

07
VCB Operation Counter

08
Switch-disconnector

Optionally, for switch-disconnector & vacuum circuit breakers, mechanical operational counter is provided which will be visible from front mimic of VCB. This mechanical counter is mechanically connected to the respective mechanisms and hence gives the true count of number of operations performed in Vacuum circuit breakers.



18.8 Battery back-up Solutions

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09
Basic set up battery
with battery charger

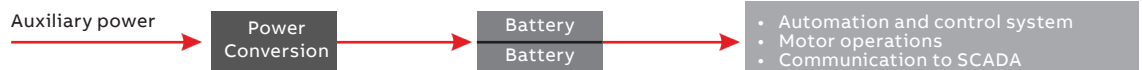
In the event of disruption to the auxiliary power supply, included batteries ensure uninterrupted operation of system critical components like protection relays. While on battery power, information can still be sent to central SCADA including switch states and remote operation of compatible switch-disconnectors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

The time the batteries will last depends on the components that are used in each configuration. This standby time is affected by the number of connected devices and derating from storage in extreme cold climatic conditions.

These batteries are controlled/charged by suitable battery charger which will convert the station supply of 230V AC to 24V DC and simultaneously charge the batteries on float/boost mode.

The standard battery charger is rated for 5 A & optionally 7.5 A or 10 A charger shall be provided depending on equipment load specified during project documentation.

Battery Ah calculation is done for each case and capacity is derived. Generally, 12Ah batteries will suffice the SafeRing/SafePlus XT load. In case of additional load of FRTU/Modem or any other equipments, optionally 20Ah, 26Ah, 42Ah batteries are provided.



For more details on power back-up solutions, please contact ABB sales representative.

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09



19 Safe Digital

19.1 Safe Digital

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01
RTU520

SafeRing XT / SafePlus XT can be supplied with remote terminal units (RTU). The switchgear can be fitted with different types of ABB remote terminal units: ARC600, REC615, RTU 520/530/540.

Being responsible for a whole network puts you in the situation where some devices might be

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01



brand new while others have been working for a 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.

Produktlinie 520 – Communication units



520CMD01
P. 36

Produktlinie 520 – Power supply units



520PSD01
P. 37

Produktlinie 520 – Input/Output modules



520AID01
P. 38



520AOD01
P. 38



520BID01
P. 39



520BOD01
P. 39



520CSD01
P. 40



520PTD01
P. 40

Produktlinie 520 – Input/Output adapters



520ADD01
P. 41



520ADD02
P. 41



520ADD03
P. 42

RTU520

For enhanced observability and complete fault awareness in your power distribution network, RTU520 offers advanced fault and outage management, enabling the efficient detection and isolation of faults and restoration of power and service. With the fault and outage management functionality, outage times can be reduced by up to 81%, leading to an incredible economical advantage. RTU520 allows accurate energy measurements, based on advanced fault

detection equipment. This detailed information are considered the basis for Fault Detection Isolation and Restoration (FDIR), and Fault Location Isolation and Service Restoration (FLISR) functionality. This solution enables a detailed power flow analysis with sensors and measurement devices in MV and LV applications, including smart meter integration. Improving your grid visibility gives you the control you need to take the right decisions at the right time to keep the power flowing.

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02
RTU 540

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03
PFC200

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04
Typical digital communication architecture

RTU540

Gateway product for distribution and sub-transmission. Bridges old and new technology and combines existing devices and new standards protocols (such as IEC 61850) in one substation automation system. RTU540 incorporates advanced features like programmable logic control and a human machine interface allowing for instant insight into the status of the grid. The high-quality, compact metal housing includes input and output modules which lead to space savings in the control cabinet.

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02



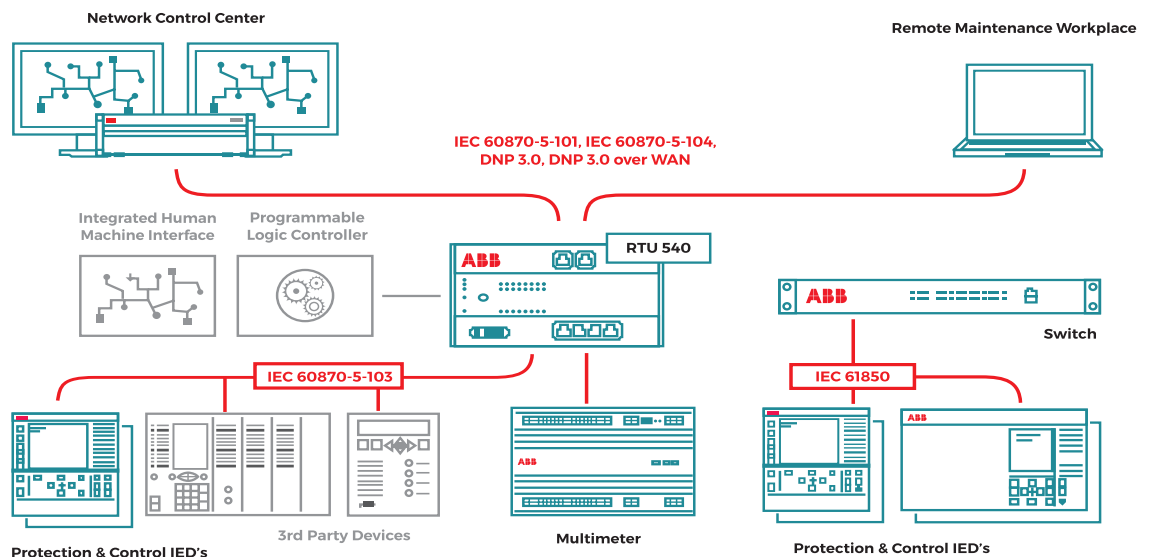
WAGO PFC200

The PFC200 Controller is a compact PLC for the modular WAGO-I/O-SYSTEM. Besides network and fieldbus interfaces, the controller supports all digital, analog and specialty modules found within the 750/753 Series. Two ETHERNET interfaces and an integrated switch enable line topology wiring. An integrated Webserver provides user configuration options, while displaying PFC200 status information.

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03



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04



19.2 Monitoring & Diagnostics Solutions

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05
Conditional monitoring
sensors in SafeRing
XT/SafePlus XT

ABB's GIS Digital series is based on ABB's existing condition monitoring platform, which includes data concentrator, LHMI, mobile APP, line-up HMI, and as an optional feature gateway and ABB Ability™ cloud.

SafeRing XT Digital includes following M&D functions:

- Gas pressure P20 real-time monitoring
- Cable connection temperature monitoring
- Environmental temperature and humidity monitoring

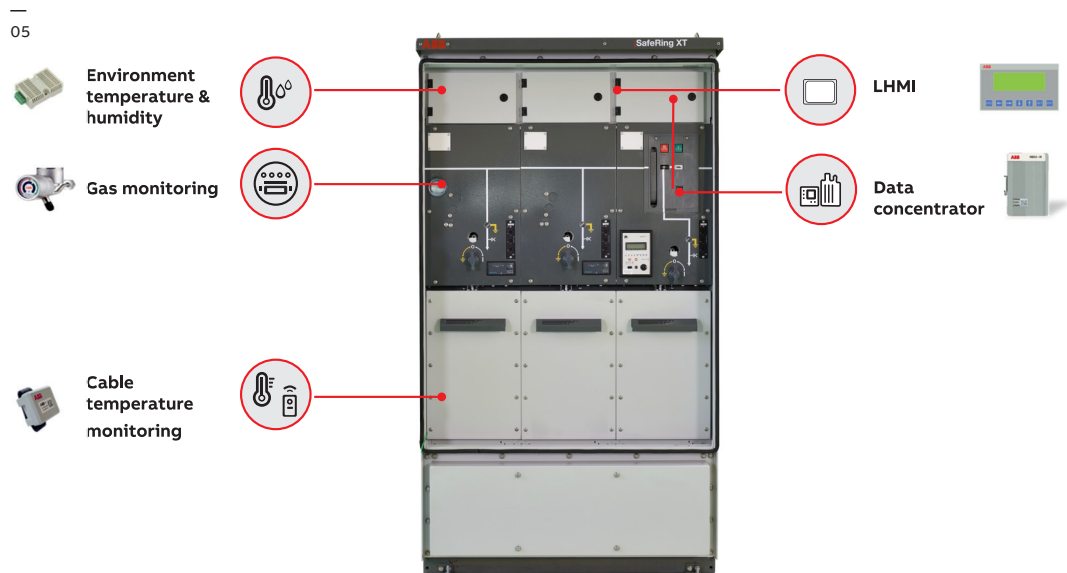


Table 1 Safe Digital SafeRing 12kV CCV components and Quantity

No.	Device name	Type No.	Pic.	Qty.	Location
1	Data concentrator	MDC4-M		1	LV compartment
2	Temperature sensor	STE202		9	Cable compartment
3	Gas manometer	DM06R		1	Outside of tank
4	Environment temp & humidity sensor	TH501		1	LV compartment
5	LHMI	OP320		1	LV panel

The gas density sensor remote unit

Device is used for real-time monitoring of the gas pressure P20. The gas manometer's status is monitored by monitoring the gas P20 status and comparing its value to P20 threshold in order to diagnose whether it is in status of normal pressure, low pressure or over pressure. It will output a good, warning, alarm health status accordingly.

Cable connection temperature sensor

This device is monitored by using a non-intrusive temperature sensor to monitor the cable head temperature. It will indicate the temperature value and compare to a threshold value to diagnose a health status of good, warn or alarm. To identify a cable connection fault in one of the phases, the three phase cable head temperature is compared to diagnose and output a good, warn or alarm health status. Note- For installation of cable temperature sensor screened separable elbow connectors must be used on power cables

Environmental temperature and humidity monitoring

Humidity sensor THS01 is used in the switchgear room, low voltage compartment and cable compartment. Here, the temperature and relative humidity are compared with a threshold value to diagnose a health status of good, warn or alarm.

Mobile Application

Users can install a special mobile application (download via QR code below) to view local M&D data and set related parameters.



Android and iOS App
download addresses

Local Human Machine Interface (LHMI)

The LHMI is mounted on the low voltage compartment (LVC) of the panel receiving data from the data concentrator. It contains a display, buttons, buzzer and a communication port and displays all readings of sensors. Following display and settings are provided:

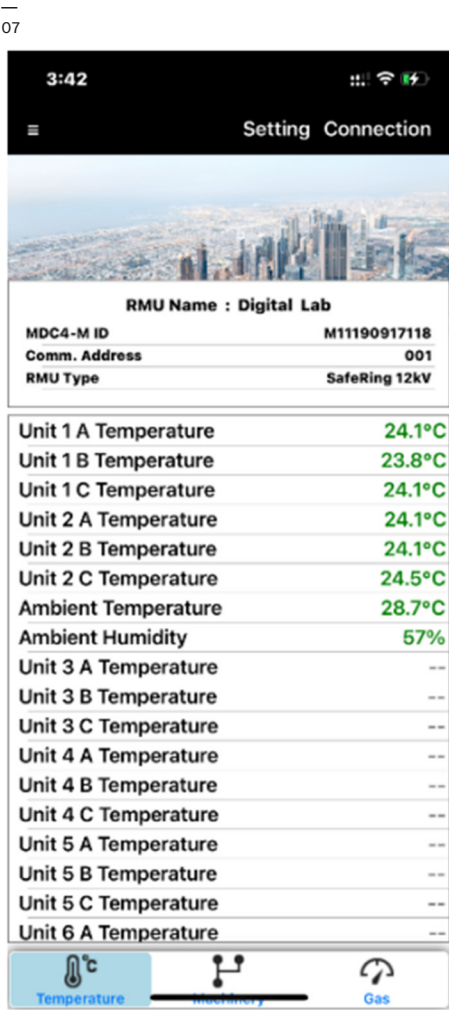
- Healthy diagnosis
- Temperature characteristic
- Electric characteristic
- System settings

Depending on the application, related content will be shown accordingly.



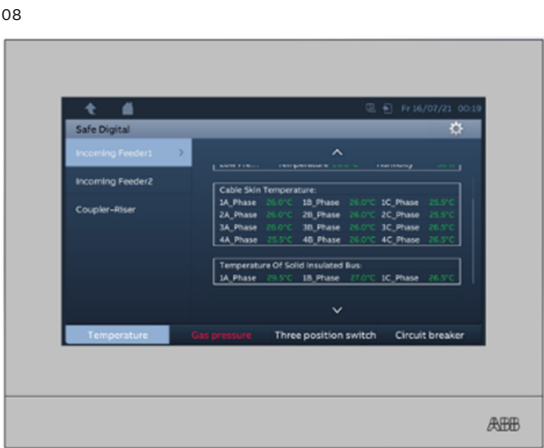
07
Temperature VISUAL-
IZATION IN MOBILE APP

08
LINE-UP HMI
(IP TOUCH 7)
HOME PAGE



Following M&D features can be visualized in the mobile APP:

- Gas pressure
- Cable non-intrusive temperature
- Temperature and humidity



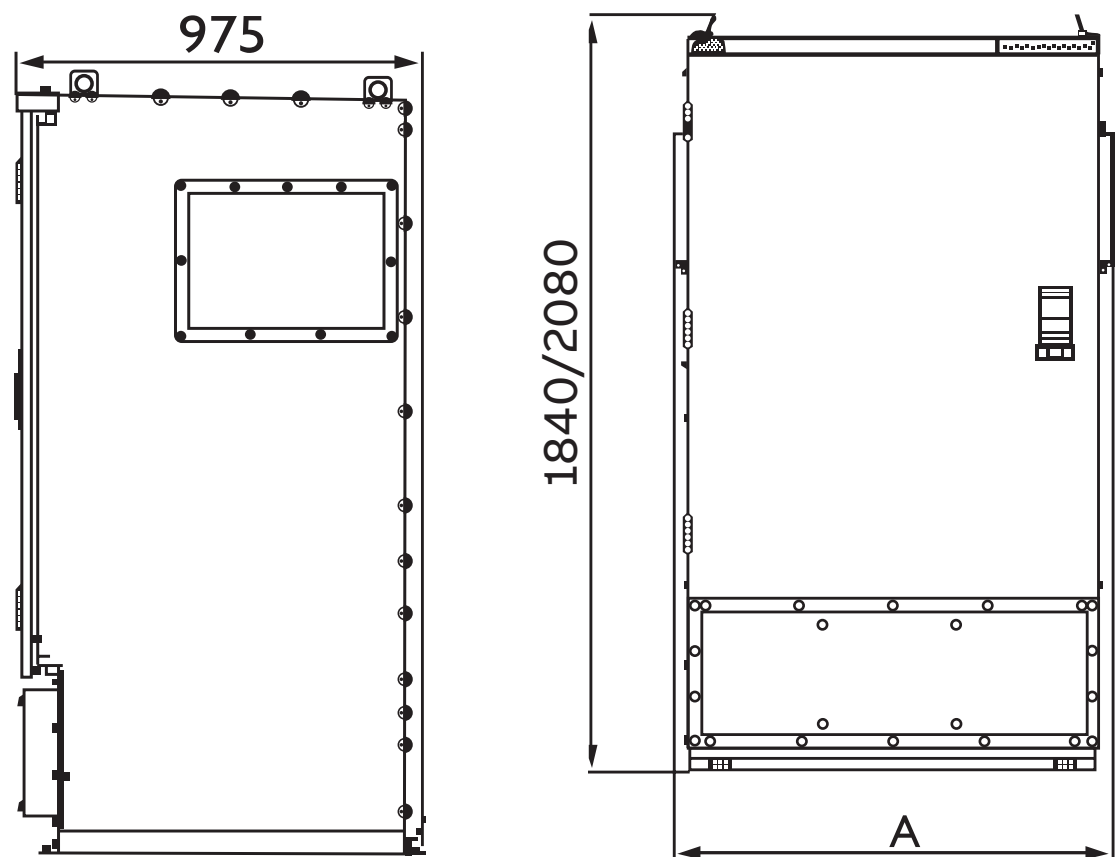
Line-up HMI

For ABB's GIS Digital series, a line-up HMI (mounted on the LVC of the panel) can be used to collect M&D data from several data concentrators. One line-up HMI can connect up to 30 data concentrators. It receives data from the data concentrator and displays all readings of sensors.

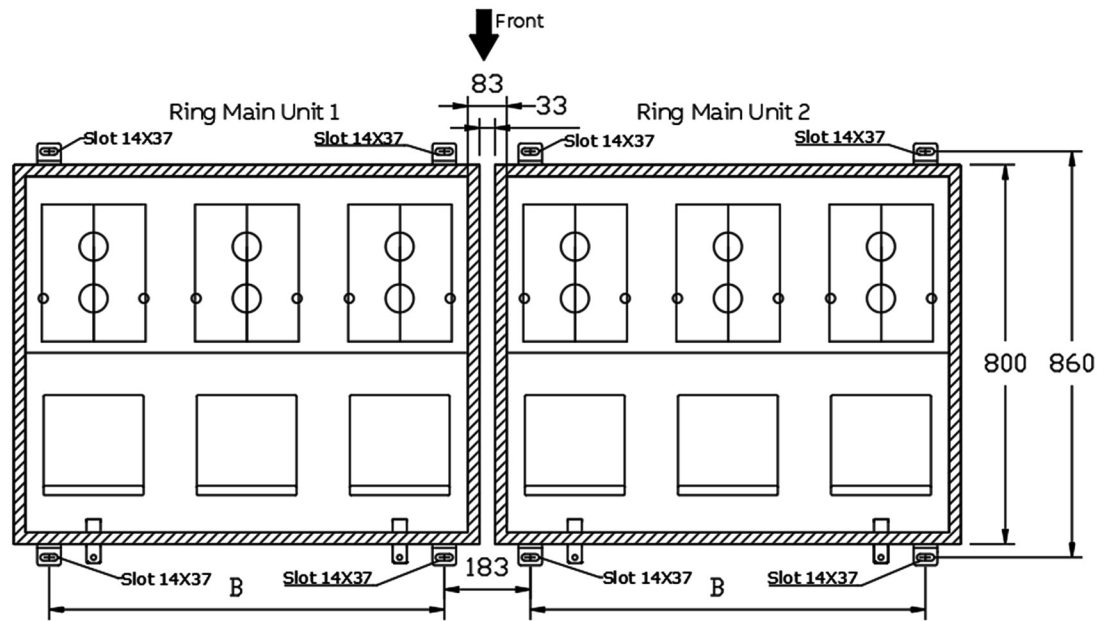
20 Dimensions

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01
3-way RMU dimensions

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01

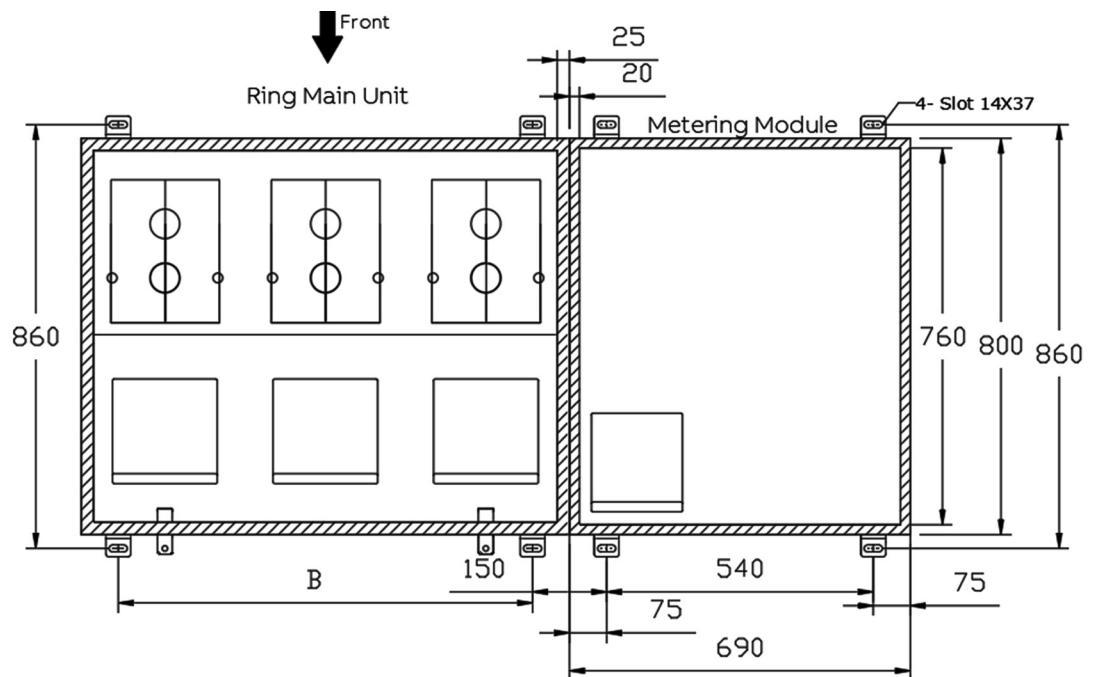


two options of integrated low voltage compartment.
Standard small / integrated LVC with height 1840 mm and large LVC with height 2080mm



Refer table above

Standard 3-Way Ring Main Unit + Metering Module



Refer table above

21 Technical Data

Codes and standards

SafeRing XT / SafePlus XT are manufactured and tested in accordance with the latest version of the below IEC regulations

IEC62271-1	Common specifications for high-voltage switchgear and controlgear standards
IEC62271-100	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 system (VOS)	IEC 61243-5
Voltage presence Indication systems (VPIS)	IEC 62271-206
Bushings	IEC 60137, CENELEC EN 50180 / EN 50181, EDF HN 52-5-61
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 60044-8; Part 8: Electronic current transformers
Voltage sensors	IEC 60044-7; Part 7: Electronic voltage transformers
Combined bushings sensors	IEC 60044-7, IEC 60044-8, CENELEC EN 50181, IEC 62271-206, IEC 61243-5
High-voltage fuses	IEC 60282-1; Part 1: Current-limiting fuses
Cable connection	IEC 60502-4, IEC 60137, CENELEC EN 50180, CENELEC EN 50181

21.1 Technical Data – SafeRing XT/SafePlus XT

1	Rated voltage	Ur	kV	12
2	Rated power frequency withstand voltage	Ud	(kVrms)	38
3	-across switch-disconnector			45
4	Rated lightening Impulse withstand voltage	Up	(kVp)	95
5	-across disconnector			110
6	Rated frequency	fr	Hz	50
7	Rated normal current (busbars)	Ir	A	630
8	Rated normal current (external plug-in busbars)	Ir	A	630
9	Rated normal current (cable switch)	Ir	A	630
10	Rated normal current (vacuum circuit breaker)	Ir	A	630
11	Rated short time withstand current	Ik	(kA)	21
12	Rated duration of short-circuit	tk	(Sec)	3
13	Rated peak withstand current	Ip	(kAp)	52.5
14	Internal arc classification IAC AFLR	Iac (kA/s)		10/0.1 & 21/1 both options
15	Loss of service continuity			
Making and breaking capacities C-module:				
16	Rated mainly active load breaking current	Iload	A	630A
17	Number of operations for mainly active load breaking	n		100
18	Rated distribution line closed-loop breaking current	Iloop	A	630
19	Rated earth-fault breaking current	Ief1	A	190
20	Rated cable- and line-charging breaking current under earth-fault conditions	Ief2	A	110
21	Rated short-circuit making current	Ima	kA	52.5
22	Cable charging breaking capacity	Icc2	A	63
23	Line charging breaking capacity	ILC	A	1
24	Electrical and mechanical classes		E3, C2, M1	
Making and breaking capacities V-module:				
25	Rated short-circuit breaking current	Isc	kA	21
26	Rated cable-charging breaking current	Ic	A	31.5 (Class C2)
27	Rated short-time current (earthing switch)	Ik	kA	21
28	Rated short-circuit making current (earthing switch)	Ima	kA	52.5
29	Electrical and mechanical classes		E2 ¹⁾ , C2, S1, M2	

1) E2 without auto-reclosing duty

21.2 Technical Data – General

Normal service conditions for indoor / Outdoor switchgear according to IEC 62271-200			
30	Ambient temperature 1)		
31	Maximum value	°C	+40 ¹⁾
32	Maximum value of 24 hours mean	°C	+35
33	Minimum value	°C	-25
34	Altitude for installation above sea level 2)	m	1000 ²⁾
35	Relative humidity max. 24 hour mean	%	95%

1) De-rating allows for higher maximum temperature

2) For installation above 1000 m, optional design available without reducing SF6 gas pressure

Special conditions

In accordance with IEC 62271-1, the manufacturer and end-user must agree about special operating conditions which deviate from operation under normal conditions. The manufacturer/supplier must be consulted in advance if especially difficult operating conditions are involved.

General data, enclosure and dimensions			
1	Type of Ring Main Unit & Compact Switchgear	Metal enclosed switchgear and control gear according to IEC 62271-200	
2	Number of poles	3	
3	Pressure test on gas filled tank	1.9bar abs (1 min withstand test)	
4	Facility provided with pressure relief	Yes	
5	Insulation gas	SF6	
6	Nominal operating gas pressure	1.3 bar abs at 20°C	
	Rated filling level for insulation Pre	1.3 bar	
7	Minimum functional gas pressure	1.2 bar	
8	Gas leakage rate / annum	< 0.1%	
9	Expected operating lifetime	30 years	
10	Facilities provided for gas monitoring 1)	Yes, temperature compensated manometer can be delivered	
11	Material used in tank construction	Stainless steel sheet, 2.0 /2.5 mm	
12	Busbar	200 mm ² Cu	
13	Earth bar (external)	120 mm ² Cu	
14	Earth bar bolt dimension	M10	
Overall dimensions of the fully assembled RMU		Small LV compartment	Large LV Compartment
15	1-way unit	975 x 415 x 1840 mm (D x W x H)	975 x 415 x 2080 mm (D x W x H)
16	2-way unit	975 x 740 x 1840 mm (D x W x H)	975 x 740 x 2080 mm (D x W x H)
17	3-way unit	975 x 1065 x 1840 mm (D x W x H)	975 x 1065 x 2080 mm (D x W x H)
18	4-way unit	975 x 1390 x 1840 mm (D x W x H)	975 x 1390 x 2080 mm (D x W x H)
19	5-way unit	975 x 1715 x 1840 mm (D x W x H)	975 x 1715 x 2080 mm (D x W x H)
20	3-way unit with metering module	975 x 1765 x 1840 mm (D x W x H)	
21	Distance between units when external extension is used	33 mm	

1) Manometer with 1NO-NC upon request

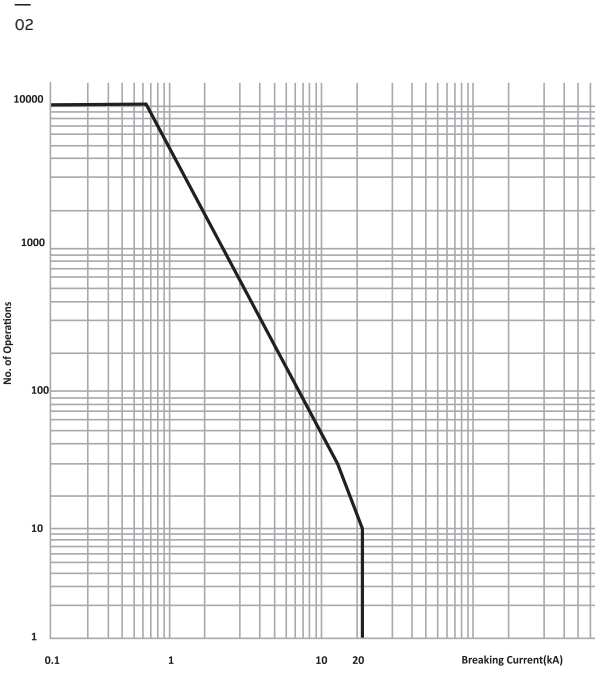
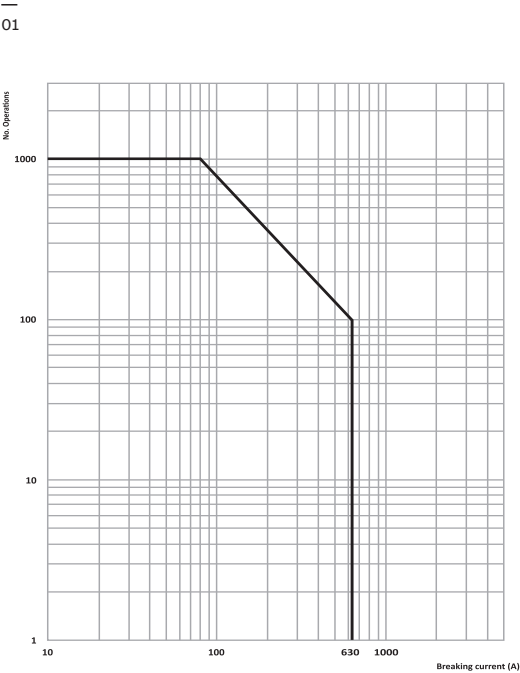
Weight table		
Module RMU		
1 way (C,D....etc)	250	350
1 Way (V....etc)	300	400
2 Way (DV, CV...etc)	450	550
3 way (CCV, CCC...etc)	650	750
4 Way (CCVV....etc)	850	975
5 Way (CCVVV...etc)	1050	1200
Metering Module	350	-
Maximum weight for SafePlus XT		
1-way V	300 kg	
1-way C,D	250 kg	
2/3/4-way	As for SafeRing XT	
5-way	1050 kg	
M- Metering module	350 kg	
Operations, degree of protection and colors		
1	Means of switch and disconnecter operation	separate handle
2	Means of circuit breaker operation	Inbuilt handle and push button
3	Rated operating sequence of circuit breaker	O - 0.3 sec - CO - 3 min - CO
4	Total opening time of circuit breaker	40-80 ms approx
5	Closing time of circuit breaker	40-80 ms approx
6	Mechanical operations of Switch-disconnector	1000 CO- Class M1
7	Mechanical operations of earthing Switches	1000 CO- Class M1
9	Mechanical operations of circuit breaker	10000 CO- Class M2
10	Principle switch-disconnector and earthing switch	3 position combined switch-disconnector and earthing switch
Degree of protection		
11	High voltage live parts, SF6 tank	IP 67
12	Front mimic and mechanism cover	IP 2X
13	Cable covers	IP 3X
14	Protection class for external structure and cable box	IP 54
15	Low voltage compartment	IP 3X
Colors		
16	Front mimic	RAL 7043
17	External structure and cable covers	RAL 7035
Cable compartment data		
18	Phase to phase center distance (C-Module)	107 mm
19	Phase to phase center distance (V-Module)	107 mm
20	Phase to phase clearance (min)	55 mm
21	Phase to earth clearance	50 mm
22	Phase to earth over insulator surface (creepage)	110 mm



21.3 Technical Data – Number of operations

01
SafeRing/SafePlus
XT C-module – 12kV

02
SafeRing /SafePlus XT
V-module - 12kV (VG5)



22 Environmental Certification

Life Expectancy of Product/Environment Declaration

The product is in compliance with the requirements denoted by IEC 62271-200. The design incorporates a life span under normal service conditions upto 30 years (IEC 62271-200 annex. GG) The switchgear is gas-tight an expected diffusion rate of less than 0.1 % per year. Referring to the filling pressure of 1.3 bar, the switchgear will maintain gas-tightness and a gas-pressure better than 1.2 bar*) throughout its operating life.*) at 20°C



Recycling capability				
CCV				
Raw Material	Weight (kg)	% of total weight	Recycle	Environmental effects & recycle/reuse processes
Iron	132.80	41.5	Yes	Separate, utilize in favour of new source (ore)
Stainless steel	83.20	26.0	Yes	Separate, utilize in favour of new source (ore)
Copper	43.98	13.7	Yes	Separate, utilize in favour of new source (ore)
Brass	2.30	0.7	Yes	Separate, utilize in favour of new source (ore)
Aluminium	8.55	2.7	Yes	Separate, utilize in favour of new source (ore)
Zinc	3.90	1.2	Yes	Separate, utilize in favour of new source (ore)
Silver	0.08	0.0	Yes	Electrolysis, utilize in favour of new source
Thermoplastic	5.07	1.6	Yes	Alternatively sort by sort, granulate, re-use or apply as energy additive in refuse incineration
Dielectric coil	0.21	0.1	Yes	Reclaim or use as high-grade energy additive in refuse incineration
SF6 gas	3.09	1.0	Yes	ABB in Nashik recovers used SF6 gas
Total recyclables	283.18	88.4		
Epoxy incl. 60% quartz	26.75	8.4	No	
Rubber	1.35	0.4	No	
Not specified *)	9.00	2.8		
Total weight **)	320.28	100%		
Packing foil	0.20		Yes	High-grade energy additive in refuse incineration
Wooden pallet	21.50		Yes	Re-use of use as energy additive in refuse incineration
*) Not specified amount represents: Stickers, film-foils, powder coating, screws, nuts, tiny components, grease, depending on configuration				
**) All figures are collected from 3-way module				

End-of-life

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

There exist no explicit requirements for how to handle discarded switchgears at end-of-life. ABB's recycling service is according to IEC 1634

edition 1995 section 6: «End of life of SF6 filled equipment» and in particular 6.5.2.a: «Low decomposition»: «No special action is required; non-recoverable parts can be disposed of normally according to local regulations.» ABB India Ltd, Electrification Products division in Nashik is equipped to reclaim SF₆ gas from discarded switchgears.



Contact us

If you have any further questions about this manual, our field service team will be pleased to help.

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