



Product catalogue

SF₆ insulated Compact Switchgear, type SafePlus and
SF₆ insulated Ring Main Unit, type SafeRing
12 / 24 kV

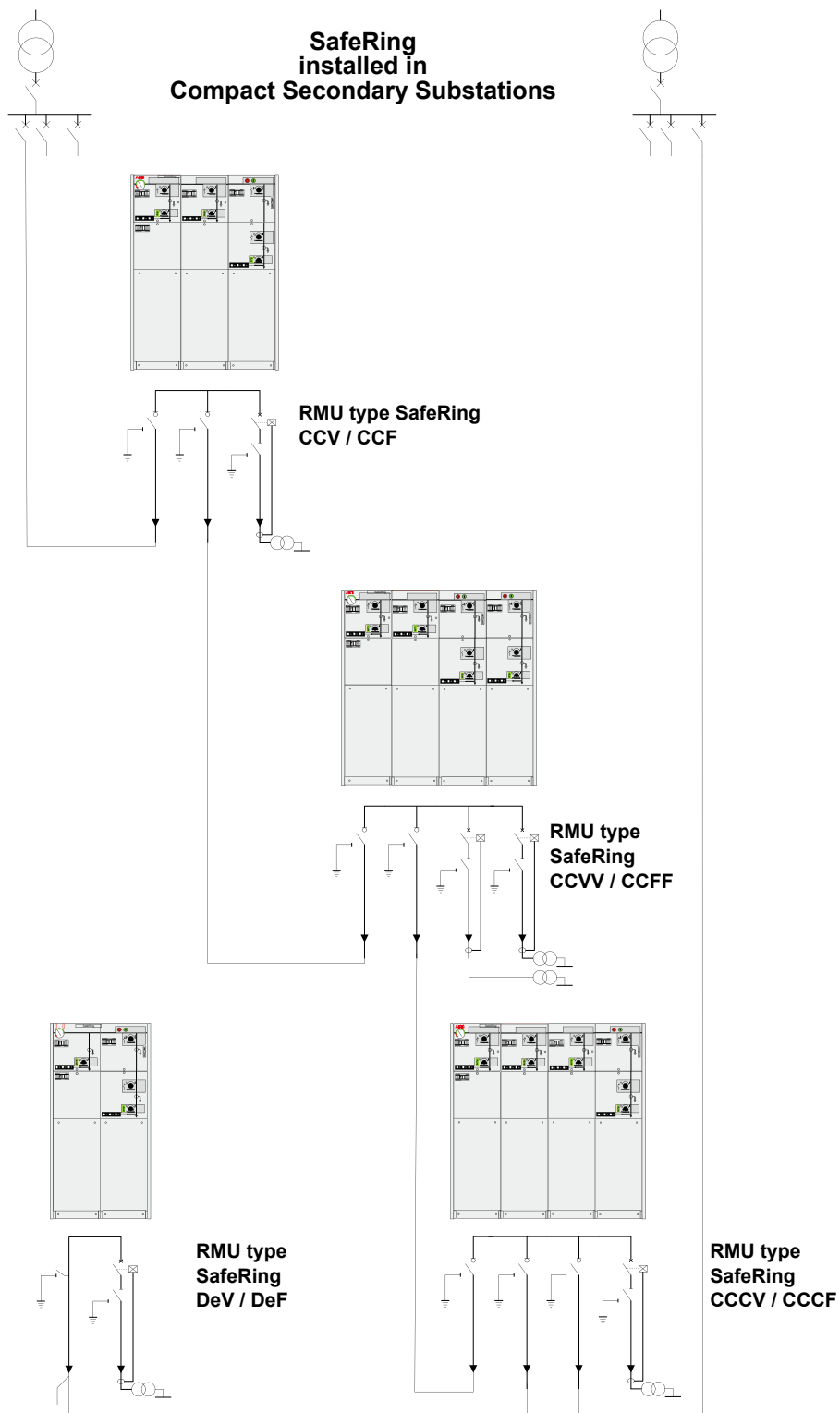
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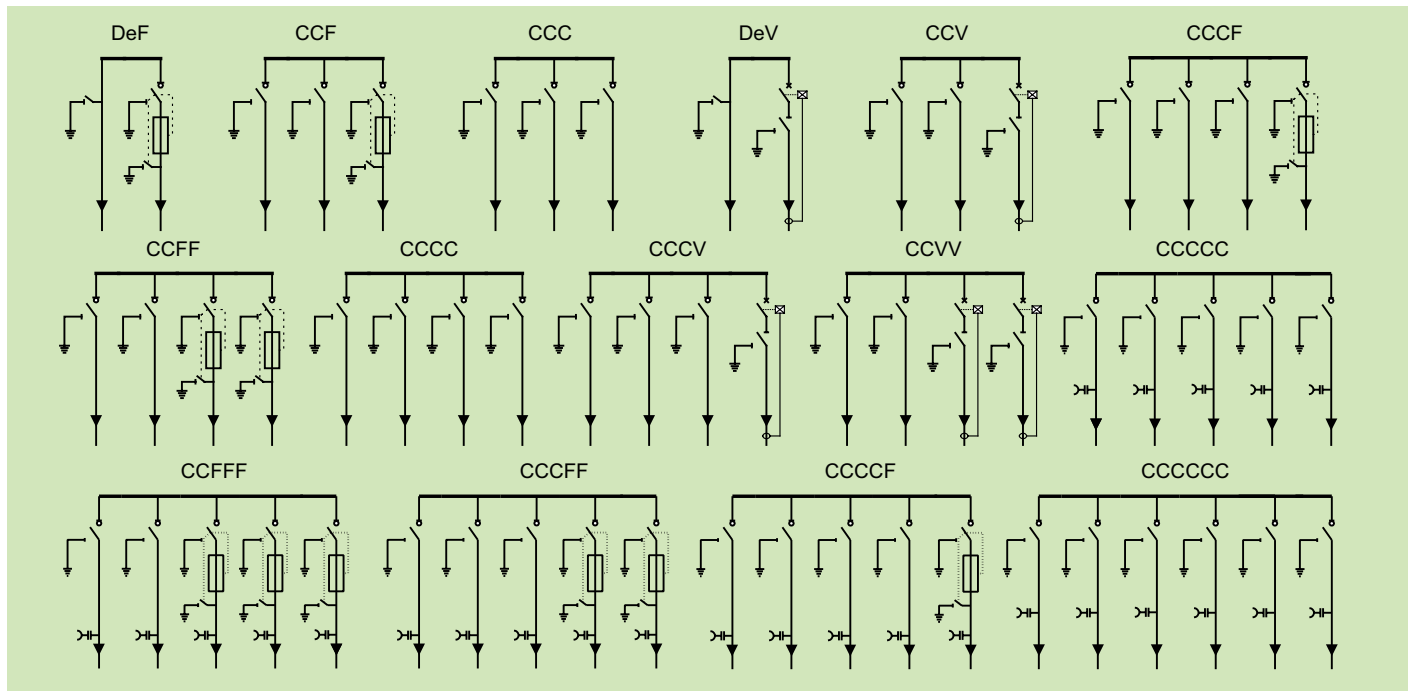
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1. Applications

1.1 SafeRing



1.1 SafeRing



SafeRing is a ring main unit for the secondary distribution network. SafeRing can be supplied in 15 different configurations suitable for most switching applications in 12/24 kV distribution networks. It is extendable and combined with the SafePlus concept, which is ABB's flexible, modular compact switchgear, they represent a complete solution for 12/24 kV secondary distribution networks. SafeRing and SafePlus have identical user interfaces.

SafeRing is designed for use in the following applications:

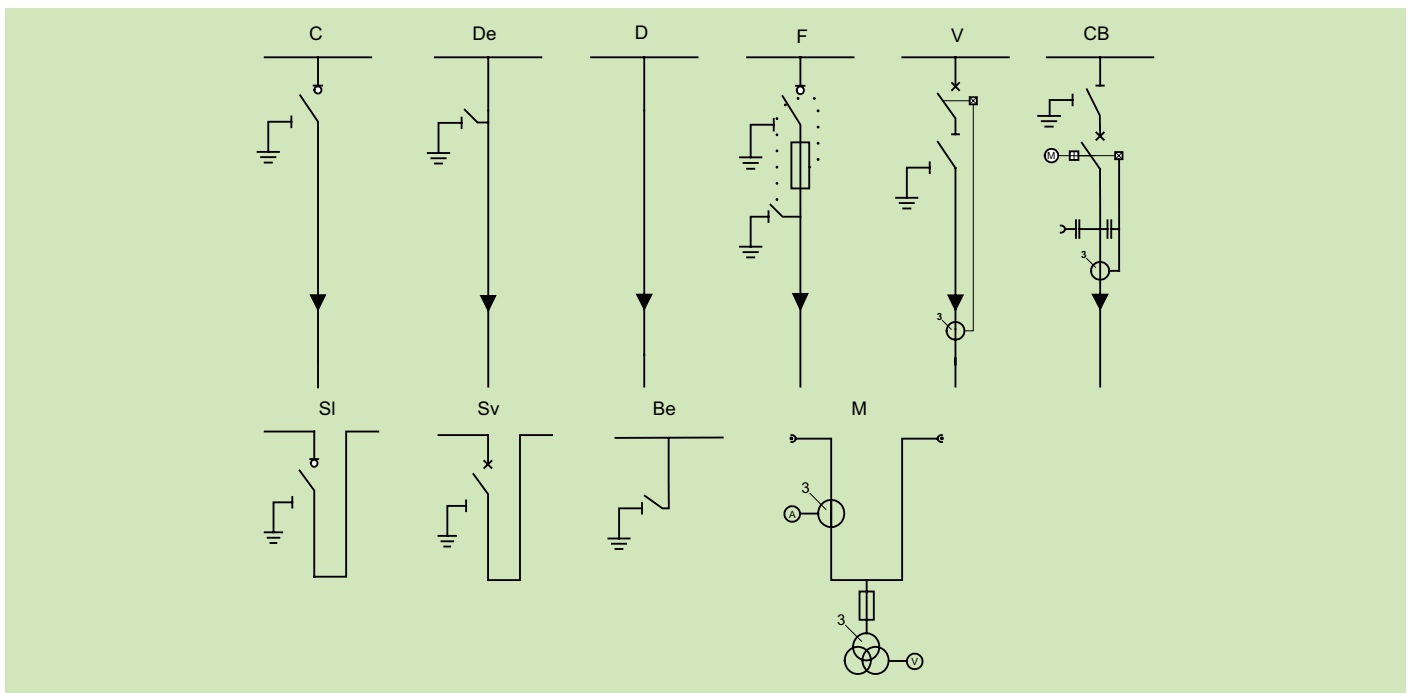
- Compact secondary substations
- Small industries
- Wind power plants
- Hotels, shopping centres, office buildings, business centres etc.
- Light mining applications, airports, hospitals, tunnels and underground railways

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

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

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

1.2 SafePlus

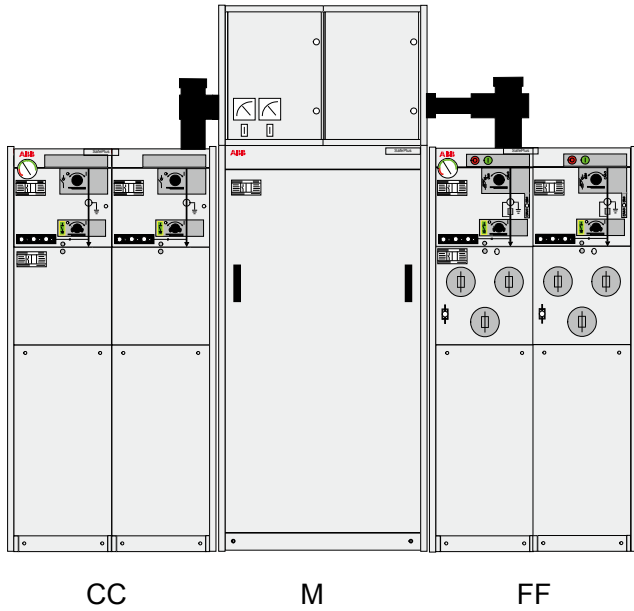


SafePlus is designed for use in the following applications:

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

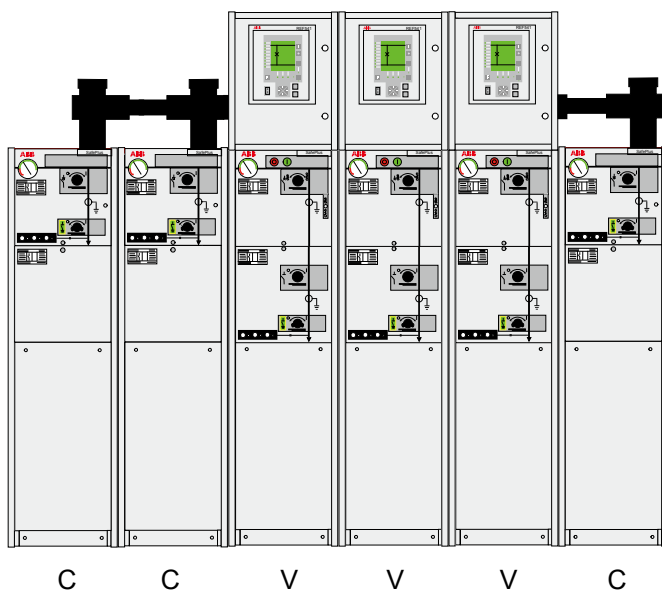
- C - Cable switch
- De - Direct cable connection with earthing
- D - Direct cable connection
- F - Switch-fuse-disconnector
- V - Vacuum circuit-breaker
- Be - Busbar earthing
- SI - Busbar sectionalizer, load break switch
- Sv - Busbar sectionalizer, vacuum circuit-breaker
- CB - Circuit-breaker module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

1.2 SafePlus



SafePlus compact switchgear consisting of:

- 2-way section with 2 modules of cable switches
- air-insulated metering module
- 2-way section with 2 modules of switch-fuses



SafePlus compact switchgear in fully modular design consisting of:

- 3 modules of cable switches
- 3 modules of vacuum circuit-breakers in combination with REF relays

2. Design philosophy



SafeRing and SafePlus – ABB switchgear for secondary distribution

Secondary distribution switchgear have been subject to a significant development over the past 20 years, resulting in increased functionality and smaller dimensions.

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

Compact switchgear systems meet customers MV application needs. ABB has always been a part of this development.

The current ABB SafePlus range satisfies the most complex system specifications.

The most unique specialisation is the development of the cable ring switchgear. The numerous public distribution substations requested a unified switching functionality which evolved into the Ring Main Unit concept.

ABB SafeRing range is one major contributor to this specialisation.

Two products – one range

ABB SafeRing is adapted to the needs in the immense utility distribution network.

ABB SafePlus offers more in terms of flexibility and electrical capacity.

Both switchgear offer the same customer interface.

Customers' involvement:

The applied functionality in ABB SafeRing and SafePlus is a result of input from customers all over the world.

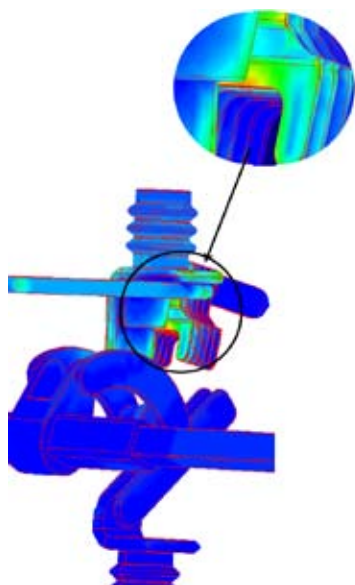
Key customers are continuously involved with ABB design staff to ensure optimised switchgear operation. *The functionality will always find its background from customer demands.*

Electrical and mechanical capability results from more than 100 years of ABB development.

Personnel – safety and service

Safety is not only a specification and rating issue, but also a real life experience.

Standards and associated testing will disclose weakness at time of testing. ABB takes this further to be an objective related to durability and repetitive manufacturing quality. All products are manufactured in accordance with ISO 9001. The latest edition of relevant IEC standards will always apply



2. Design philosophy



to our continuous product development and test programs.

“Integrated functionality” is a key objective to reduce the number of moving components, further reducing the risk of any mechanical defect.

We are responsible for the environment

The location for manufacturing SafeRing and SafePlus is Norway to China.

Our green policy contributes to focus on environmental factors in manufacturing as well as over the switchgear life span.

All products are manufactured in accordance with our ISO 14001 certification.

Recycling is confirmed at a 97% level.

To simplify this process we will continuously along with our partners improve routines for product handling at end of life. Plastic parts are individually marked to simplify the recycling process.

Solutions for elimination of gas emission in the rare event of a fault can be supplied.

Modern - development and manufacturing

Numerical simulations together with long experience will ensure compact and robust design.

Dielectric simulations will ensure that compactness will 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.

Complete solutions – one supplier

Complex applications involving remote control and monitoring can now be supplied from one supplier.

This makes large scale implementation feasible, and will simplify engineering and procurement.

The control and monitoring unit available for SafeRing is located behind the front cover. This option is also readily available for retrofit, while such demands normally evolve after the switchgear is in service.

3. SafeRing configurations

3.1 General



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

SafeRing combined with the SafePlus concept, which is ABB's flexible, modular compact switchgear represent a complete solution for 12/24 kV secondary distribution networks. SafeRing and SafePlus have identical user interfaces.

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

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

SafeRing is supplied with the following standard equipment

- Earthing switches
- Operating mechanisms with integral mechanical interlocking
- Operating handle
- Facilities for padlocks on all switching functions
- Bushings for cable connection in front with cable covers
- Lifting lugs for easy handling
- Interlocking
 - Cable compartment front cover interlocked with earthing switch
 - Interlocking of compartment for cable test bushings
- Manometer for SF₆ pressure monitoring (temperature compensated)
- Capacitive voltage indicating system

Optional features

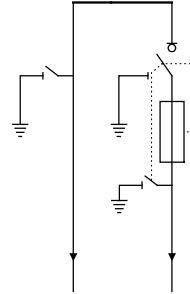
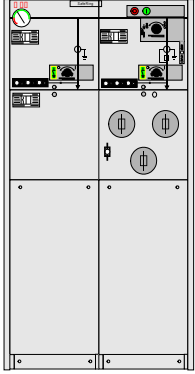
- Bushings for connection of external busbars on top of RMU
- Bushings for cable testing, incl. earthing device (C- and De-modules only)
- Cable bushings (Interface A, or C)
- Arc suppressor with signal (1NO) wired to terminals (only

- one each SF₆ tank)
- Signal (1NO) from internal pressure indicator wired to terminals (only one each SF₆ tank)

Optional features also available as retrofit

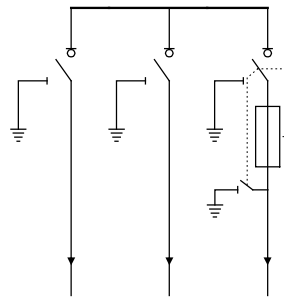
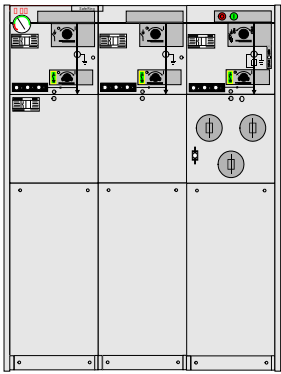
- Integrated control and monitoring unit (ICMU)
- Integrated battery and charger
- Motor operation
- Trip coil open
- Trip coil open and close
- Aux. switch for load break switch position 2NO + 2NC
- Aux. switch for vacuum circuit-breaker position 2NO + 2NC
- Aux. switch for disconnected position 2NO + 2NC
- Aux. switch for earth switch position 2NO + 2NC
- Aux. switch for fuse blown 1NO
- Vacuum circuit-breaker tripped signal 1NO
- Short circuit indicator
- Cable cover with window
- Cable cover for double cables
- Arc proof cable compartments
- Extra base frame (h=450 mm or 290 mm)
- Top entry box
- Cable support bars, non-magnetic or adjustable
- Ronis interlocking system, EL 11 AP
- Current measuring
- Prepared for relay test equipment
- All 3- and 4-way units are designed for the subsequent fitting of an integral remote control and monitoring unit

3.2 Configurations



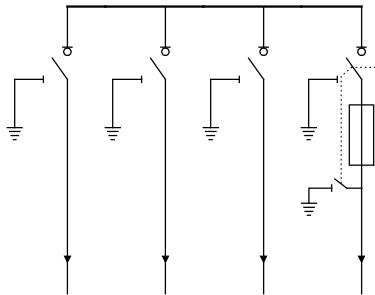
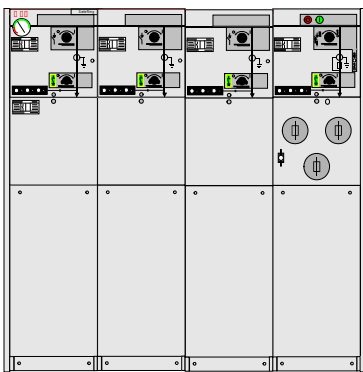
DeF

Depth: 765 mm
Width: 696 mm
Height: 1336 mm



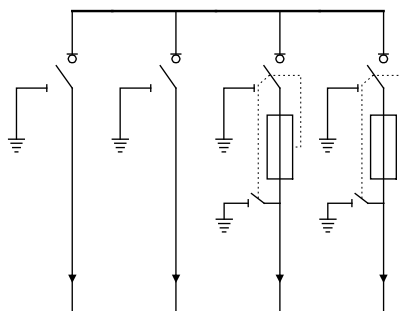
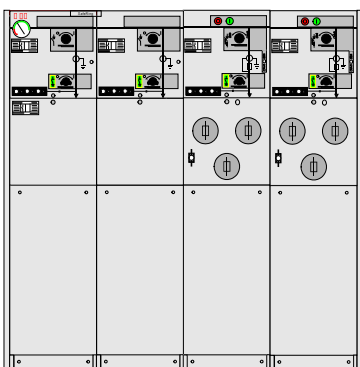
CCF

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Width: 1021 mm
Height: 1336 mm



CCCF

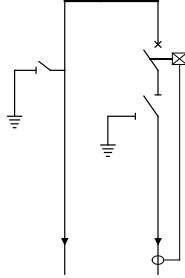
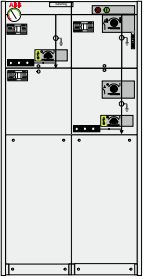
Depth: 765 mm
Width: 1346 mm
Height: 1336 mm



CCFF

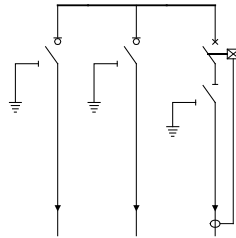
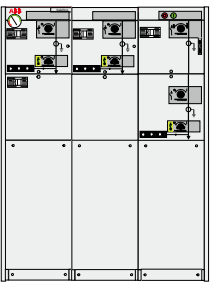
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3.2 Configurations



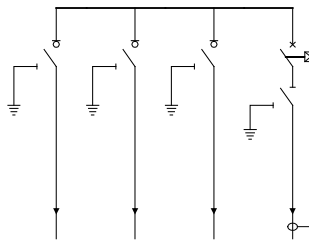
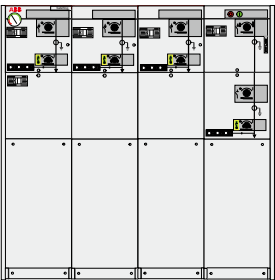
DeV

Depth: 765 mm
Width: 696 mm
Height: 1336 mm



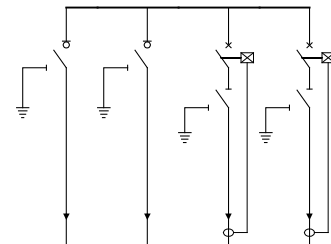
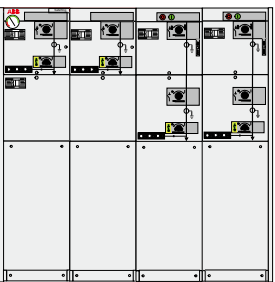
CCV

Depth: 765 mm
Width: 1021 mm
Height: 1336 mm



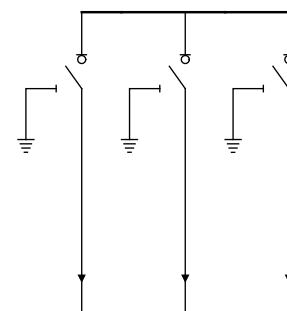
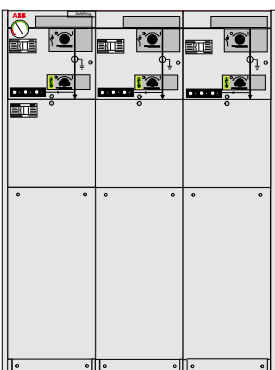
CCCV

Depth: 765 mm
Width: 1346 mm
Height: 1336 mm



CCWV

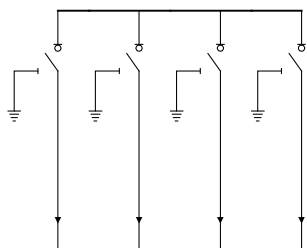
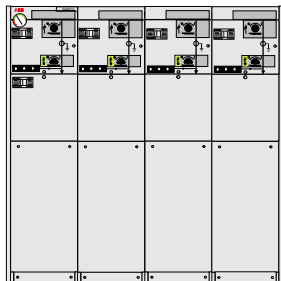
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Width: 1346 mm
Height: 1336 mm



CCC

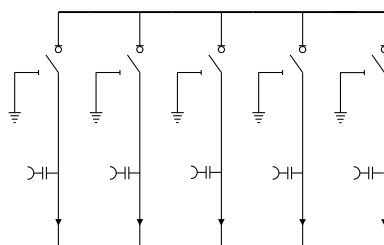
Depth: 765 mm
Width: 1021 mm
Height: 1336 mm

3.2 Configurations



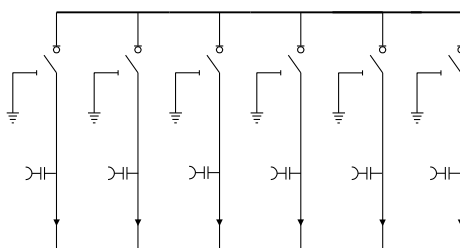
CCCC

Depth: 765 mm
Width: 1346 mm
Height: 1336 mm



CCCCC

Depth: 765 mm
Width: 1671 mm
Height: 1336 mm



CCCCCC

Depth: 765 mm
Width: 1996 mm
Height: 1336 mm

Technical data

SafeRing	C-module		F-module		V-module	
	Switch-disconnector	Earthing switch	Switchfuse combination	Downstream earthing switch	Vacuum circuit-breaker	Earthing switch
Rated voltage kV	12/15/17,5/24	12/15/17,5/24	12/17,5/24	12/17,5/24	12/15/17,5/24	12/15/17,5/24
Power frequency withstand voltage	kV 28/38/38/50	28/38/38/50	28/38/50	28/38/50	28/38/38/50	28/38/38/50
Impulse withstand voltage	kV 95/95/95/125	95/95/95/125	95/95/125	95/95/125	95/95/95/125	95/95/95/125
Rated current	A 630/630/630/630		see ¹⁾		200/200/200/200	
Breaking capacities:						
active load	A 630/630/630/630					
closed loop	A 630/630/630/630					
off load cable charging	A 135/135/135/135					
off load transformer			20/20/20			
earth fault	A 200/150/150/150					
earth fault cable charging	A 115/87/87/87					
short-circuit breaking current	kA		see ²⁾		16/16/16/16	
Making capacity	kA 52,5/52,5/40/40	52,5/52,5/40/40	see ²⁾	12,5/12,5/12,5	40/40/40/40	40/40/40/40
Short time current 0,5 sec ³⁾	kA				16/16/16/16	
Short time current 3 sec ⁴⁾	kA	21/21/16/16			16/16/16/16	16/16/16/16

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

²⁾ Limited by high voltage fuse-links

³⁾ Maximum rating for bushings Interface A (200 series plug-in)

⁴⁾ Maximum rating for bushings Interface C (400 series bolted)

SafeRing is tested according to IEC Publications IEC 60694, IEC 60265-1, IEC 62271-100, -102, -105, -200 and IEC 60529.

4. SafePlus modules

4.1 General



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

SafePlus combined with SafeRing, which is ABB's standard ring main unit, represent a complete solution for 12/24 kV distribution networks. SafePlus and SafeRing have identical user interfaces.

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

A sealed steel tank with constant atmospheric conditions ensures a high level of reliability as well as personnel safety and a virtually maintenance-free system. As an option external busbars can be provided to obtain full modularity.

The external busbar kit has to be mounted to the switchgear on site. It is fully insulated and screened to ensure reliability and climatic independence.

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

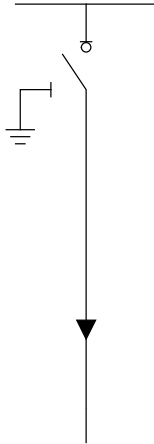
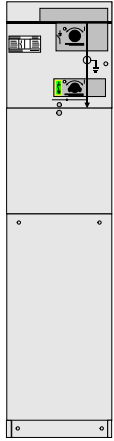
SafePlus accommodates a wide selection of protection relays for most applications.

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

SafePlus (except M- modules) is supplied with the following standard equipment:

- Earthing switches (not for D module)
- Operating mechanisms with integral mechanical interlocking
- Operating handle
- Facilities for padlocks on all switching functions
- Bushings for cable connection in front (not for SI-, Sv- and Bemodules)
- Cable compartment covers
- Manometer for SF₆ pressure monitoring (temperature compensated)
- Lifting lugs for easy handling

4.2 C- Cable switch



Depth: 765 mm
Width: 325 mm
Height: 1336 mm

Standard features

- Three position load break switch with disconnecter and earthing switch
- Operating mechanism with two separate operating shafts for load break function and earthing function
- Switch position indication for load break switch and earthing switch
- Cable bushings horizontal in front, Interface C (400 series bolted) with integrated capacitor for voltage indication
- Cable compartment cover allowing surge arrester
- Busbars, 630A
- Earthing bar
- Interlocking
 - Cable compartment front cover interlocked with earthing switch
 - Interlocking of compartment for cable test bushings
- Capacitive voltage indicating systems
 - VPIS (Voltage Presence Indicating System, acc. to IEC 61958) with integrated indicator lamps

Optional features

- Bushings for connection of external busbars on top of the unit
- Bushings for cable testing (incl. earthing device test points)
- Cable bushings
 - Interface C (400 series bolted) combisensors with integrated capacitor for voltage indication and sensors for current and voltage monitoring
- Arc proof and interlocked cable covers
- Arc suppressor with signal (1NO) wired to terminals (only one each SF₆ tank)
- Signal (1NO) from internal pressure indicator wired to terminals (only one each SF₆ tank)

Technical data

Rated voltage	kV	12	15	17,5	24
Power frequency withstand voltage	kV	28	38	38	50
Impulse withstand voltage	kV	95	95	95	125
Rated current	A	630	630	630	630
Breaking capacities:					
active load	A	630	630	630	630
closed loop	A	630	630	630	630
off load cable charging	A	135	135	135	135
earth fault	A	200	150	150	150
earth fault cable charging	A	115	87	87	87
Making capacity	kA	62,5	52,5	50	50
Short time current 1 sec	kA	25	-	-	-
Short time current 3 sec	kA	21	21	21	21
Number of mechanical operations	1000 CO manual				

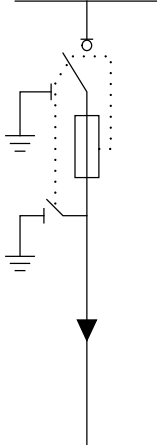
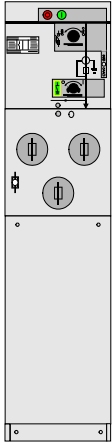
Earthing switch

Rated voltage	kV	12	15	17,5	24
Power frequency withstand voltage	kV	28	38	38	50
Impulse withstand voltage	kV	95	95	95	125
Rated current	A	630	630	630	630
Making capacity	kA	62,5	52,5	50	50
Short time current 1 sec	kA	25	-	-	-
Short time current 3 sec	kA	21	21	21	21
Number of mechanical operations	1000 CO manual				

Optional features also available as retrofit

- Motor operation for load break switch
- Low voltage compartment / top entry box
- Base frame (290 or 450 mm)
- Auxiliary switches
 - Load break switch position 2NO+2NC
 - Earthing switch position 2NO+2NC
- Short circuit and earth fault indicator
- Ronis key interlock
- External current sensors (CT) for monitoring
- Cable compartment covers
 - with window
 - with extra depth (double cables, surge arresters)
 - arc proof (if existing modules have interlocked cable covers)
- Cable support bars, non-magnetic or adjustable

4.3 F- Switch-fuse disconnecter



Depth: 765 mm
Width: 325 mm
Height: 1336 mm

Technical data

Rated voltage	kV	12	15	17,5	24
Power frequency withstand voltage	kV	28	38	38	50
Impulse withstand voltage	kV	95	95	95	125
Rated current	A	200	200	200	200
Breaking capacities:					
off load transformer	A	20	20	20	20
Making capacity	kA	¹⁾	¹⁾	¹⁾	¹⁾
Number of mechanical operations	1000 CO manual				

Earthing switch downstream

Rated voltage	kV	12	15	17,5	24
Power frequency withstand voltage	kV	28	38	38	50
Impulse withstand voltage	kV	95	95	95	125
Making capacity	kA	12,5	12,5	12,5	12,5
Short time current 1 sec	kA	5	5	5	5
Number of mechanical operations	1000 CO manual				

¹⁾ Limited by high voltage fuse-links

Standard features

- Three position switch-fuse-disconnector with upstream earthing switch mechanically linked with downstream earthing switch
- Switch position indication for switch-fuse-disconnector and earthing switches
- Operating mechanism with double spring for switch-fuse-disconnector function
- Common mechanism for earthing functions
- Fuse canisters for DIN type fuse-links. Only accessible when earthing switches are closed
- Fuse-link / transformer rating:
 - 12 kV, max 125 A, ABB type CEF fuse-links
 - 24 kV, max 63 A, ABB type CEF fuse-links
- Fuse tripping arrangement
- Optical fuse trip indication
- Cable bushings horizontal in front, Interface A (200 series plug-in) with integrated capacitor for voltage indication
- Cable compartment cover allowing surge arrester
- Busbars, 630 A
- Earthing bar
- Interlocking
 - Cable compartment front cover interlocked with earthing switch
- Capacitive voltage indicating systems
 - VPIS (Voltage Presence Indicating System, acc. to IEC 61958) with integrated indicator lamps

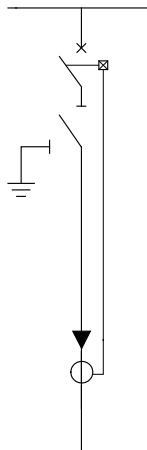
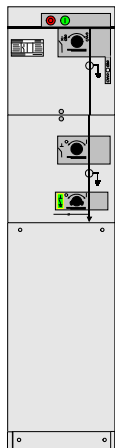
Optional features

- Bushings for connection of external busbars on top of the unit
- Cable bushings
 - Interface C (400 series bolted)
 - Interface C (400 series bolted) combisensors with integrated screen for voltage indication and sensors for current and voltage monitoring
- Signal (1NO) from internal pressure indicator wired to terminals (only one each SF₆ tank)

Optional features also available as retrofit

- Motor operation for switch-fuse-disconnector
- Low voltage compartment / top entry box
- Base frame (290 or 450 mm)
- Auxiliary switches:
 - Load break switch position 2NO+2NC
 - Earthing switch position 2NO+2NC
 - Fuse blown 1NO
- Trip coil open
- Trip coil open and close
- Cable compartment cover
 - with window
 - with extra depth (double cables, surge arresters)
 - arc proof (if existing modules have interlocked cable covers)
- Cable support bars, non-magnetic or adjustable
- Ronis key interlock on earthing switch

4.4 V- Vacuum circuit-breaker



Depth: 765 mm
Width: 325 mm
Height: 1336 mm

Technical data

Rated voltage	kV	12	15	17,5	24
Power frequency withstand voltage	kV	28	38	38	50
Impulse withstand voltage	kV	95	95	95	125
Rated current	A	630			
Breaking capacities:					
short-circuit breaking current	kA	21	21	16	16
Making capacity	kA	52,5	52,5	40	40
Short time current 3 sec	kA	21	21	16	16
Number of mechanical operations	2000 CO manual				

Earthing switch downstream

Rated voltage	kV	12	15	17,5	24
Power frequency withstand voltage	kV	28	38	38	50
Impulse withstand voltage	kV	95	95	95	125
Making capacity	kA	52,5	52,5	40	40
Short time current 3 sec	kA	21	21	16	16
Number of mechanical operations	1000 CO manual				

Standard features

- 630 A vacuum circuit-breaker for feeder protection
- Two position double spring mechanism for vacuum circuit-breaker
- Three position disconnector/earthing switch downstream vacuum circuit-breaker
- Three position single spring mechanism for disconnector/earthing switch
- Interlocking between vacuum circuit-breaker and disconnector/earthing switch
- Switch position indication for vacuum circuit-breaker and disconnector/earthing switch
- Self powered electronic protection relay with ring core CTs on cables
- Trip coil (for relay tripping)
- Cable bushings horizontal in front:
 - Interface C (400 series bolted) for 630 A vacuum circuitbreaker with integrated capacitor for voltage indication
- Cable compartment cover allowing surge arrester
- Busbars, 630 A
- Earthing bar
- Interlocking
 - Cable compartment front cover interlocked with earthing switch
- Capacitive voltage indicating systems
 - VPIS (Voltage Presence Indicating System, acc. to IEC 61958) with integrated indicator lamps

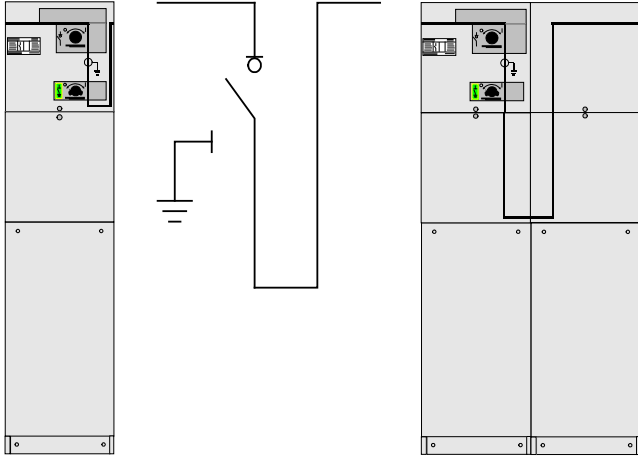
Optional features

- Bushings for connection of external busbars on top of the unit
- Cable bushings
 - Interface C (400 series bolted) combisensors with integrated capacitor for voltage indication and sensors for current and voltage monitoring
- Arc suppressor (for 630 A vacuum circuit-breaker only) with signal (1NO) wired to terminals (only one each SF₆ tank)
- Signal (1NO) from internal pressure indicator wired to terminals (only one each SF₆ tank)

Optional features also available as retrofit

- Motor operation for vacuum circuit-breaker
- Low voltage compartment / Top entry box
- Base frame (290 or 450 mm)
- Auxiliary switches
 - Vacuum circuit-breaker position 2NO+2NC
 - Disconnector position 2NO+2NC
 - Earthing switch position 2NO+2NC
 - Vacuum circuit-breaker tripped signal 1NO
- Trip coil open
- Trip coil open and close
- Cable compartment cover
 - with window
 - with extra depth (double cable, surge arrester) if combi-sensors are used
 - arc proof (if existing modules have interlocked cable covers)
- Cable support bars, non-magnetic
- Ronis key interlock on disconnector/earthing switch
- Advanced relays type SPAJ, REF and others.

4.5 SI- Busbar sectionaliser



Depth: 765 mm
Width: 325 mm
Height: 1336 mm

Depth: 765 mm
Width: 650 mm
Height: 1336 mm

Busriser is needed
when SI-module is
on right hand side of
SF₆-tank

Technical data

Rated voltage	kV	12	15	17,5	24
Power frequency withstand voltage	kV	28	38	38	50
Impulse withstand voltage	kV	95	95	95	125
Rated current	A	630	630	630	630
Breaking capacities:					
active load	A	630	630	630	630
closed loop	A	630	630	630	630
off load cable charging	A	135	135	135	135
earth fault	A	200	150	150	150
earth fault cable charging	A	115	87	87	87
Making capacity	kA	62,5	52,5	50	50
Short time current 1 sec	kA	25	-	-	-
Short time current 3 sec	kA	21	21	21	21
Number of mechanical operations	1000 CO manual				

Earthing switch

Rated voltage	kV	12	15	17,5	24
Power frequency withstand voltage	kV	28	38	38	50
Impulse withstand voltage	kV	95	95	95	125
Rated current	A	630	630	630	630
Making capacity	kA	62,5	52,5	50	50
Short time current 1 sec	kA	25	-	-	-
Short time current 3 sec	kA	21	21	21	21
Number of mechanical operations	1000 CO manual				

Standard features

- Three position load break switch with disconnecter and earthing switch
- Operating mechanism with two separate operating shafts for load break function and earthing function
- Switch position indication for load break switch and earthing switch
- Busbars, 630A
- Earthing bar

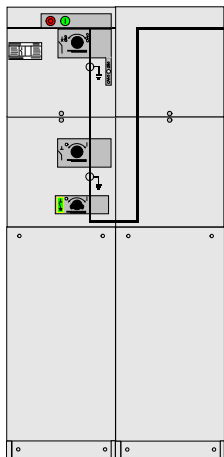
Optional features

- Bushings for connection of external busbars on top of the unit
- Signal (1 NO) from internal pressure indicator wired to terminals (only one each SF₆ tank)

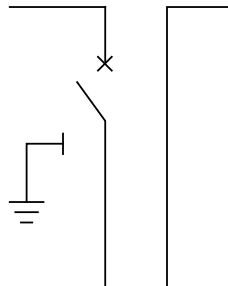
Optional features also available as retrofit

- Motor operation for load break switch
- Low voltage compartment / Top entry box
- Base frame (290 or 450 mm)
- Auxiliary switches
 - Load break switch position 2NO+2NC
 - Earthing switch position 2NO+2NC
- Ronis key interlock

4.6 Sv- Busbar sectionaliser



Depth: 765 mm
Width: 650 mm
Height: 1336 mm



Sv is always in combination with busrise module (Br)

Standard features

- 630 A vacuum circuit-breaker
- Two position double spring mechanism for vacuum circuit-breaker
- Three position disconnecter/earthing switch downstream vacuum circuit-breaker
- Three position single spring mechanism for disconnecter/earthing switch
- Interlocking between vacuum circuit-breaker and disconnecter/earthing switch
- Switch position indication for vacuum circuit-breaker and disconnecter/earthing switch
- Busbars, 630 A

Optional features

- Bushings for connection of external busbars
- Signal (1 NO) from internal pressure indicator wired to terminals (only one each SF₆ tank)

Technical data

Rated voltage	kV	12	15	17,5	24
Power frequency withstand voltage	kV	28	38	38	50
Impulse withstand voltage	kV	95	95	95	125
Rated current	A	630	630	630	630
Breaking capacities:					
short-circuit breaking current	kA	21	21	16	16
Making capacity	kA	52,5	52,5	40	40
Short time current 3 sec	kA	21	21	16	16
Number of mechanical operations	2000 CO manual				

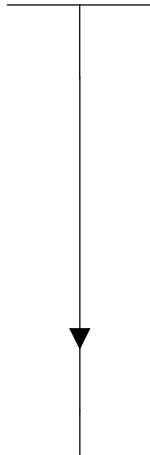
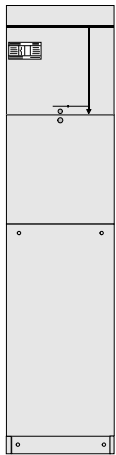
Earthing switch

Rated voltage	kV	12	15	17,5	24
Power frequency withstand voltage	kV	28	38	38	50
Impulse withstand voltage	kV	95	95	95	125
Making capacity	kA	52,5	52,5	40	40
Short time current 3 sec	kA	21	21	16	16
Number of mechanical operations	1000 CO manual				

Optional features also available as retrofit

- Motor operation for vacuum circuit-breaker
- Low voltage compartment / Top entry box
- Base frame (290 or 450 mm)
- Auxiliary switches
 - Vacuum circuit-breaker position 2NO+2NC
 - Disconnecter position 2NO+2NC
 - Earthing switch position 2NO+2NC
- Protection relay (metering module is required)
- Trip coil for relay trip
- Additional trip coil
- Ronis key interlock on disconnecter/earthing switch

4.7 D- Direct cable connection



Depth: 765 mm
Width: 325 mm
Height: 1336 mm

Technical data

Rated voltage	kV	12	15	17,5	24
Power frequency withstand voltage	kV	28	38	38	50
Impulse withstand voltage	kV	95	95	95	125
Rated current	A	630	630	630	630
Short time current 1 sec	kA	25	-	-	-
Short time current 3 sec	kA	21	21	21	21

Standard features

- Cable bushings horizontal in front, Interface C (400 series bolted) with integrated capacitor for voltage indication
- Cable compartment cover allowing surge arrester type Raychem RDA and double cable connection with ABB Kabeldon cable adapters
- Busbars, 630 A
- Earthing bar
- Capacitive voltage indicating systems
VPIS (Voltage Presence Indicating System, acc. to IEC 61958) with integrated indicator lamps

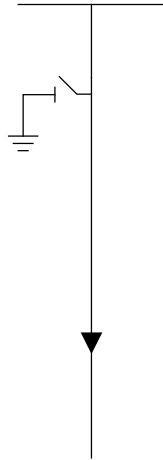
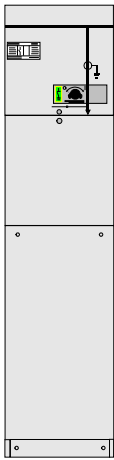
Optional features

- Bushings for connection of external busbars
- Cable bushings:
Interface C (400 series bolted) combisensors with integrated capacitor for voltage indication and sensors for current and voltage monitoring
- Arc suppressor with signal (1NO) wired to terminals (only one each SF₆ tank)
- Signal (1NO) from internal pressure indicator wired to terminals (only one each SF₆ tank)

Optional features also available as retrofit

- Low voltage compartment / top entry box
- Base frame (290 or 450 mm)
- Short circuit and earth fault indicators
- External current sensors (CT) for monitoring
- Cable compartment cover
with window
with extra depth (double cable, surge arresters)
arc proof (if existing modules have interlocked cable compartment)
- Cable support bars, non-magnetic or adjustable

4.8 De- Direct cable connection with earthing switch



Depth: 765 mm
Width: 325 mm
Height: 1336 mm

Standard features

- Earthing switch
- Two position single spring mechanism
- Switch position indication
- Cable bushings horizontal in front, Interface C (400 series bolted) with integrated capacitor for voltage indication
- Cable compartment cover allowing surge arrester type Raychem RDA and double cable connection with ABB Kabeldon cable adapters
- Busbars, 630 A
- Earthing bar
- Interlocking
 - Cable compartment front cover interlocked with earthing switch
 - Interlocking of compartment for cable test bushings
- Capacitive voltage indicating systems
 - VPIS (Voltage Presence Indicating System, acc. to IEC 61958 with integrated indicator lamps)

Optional features

- Bushings for connection of external busbars
- Bushings for cable testing, incl. earthing device
- Cable bushings:
 - Interface B (400 series plug-in) (In = 400 A)
 - Interface C (400 series bolted) with integrated voltage divider for voltage indication and integrated sensors for current and voltage monitoring
- Arc suppressor with signal (1NO) wired to terminals (only one each SF₆ tank)
- Signal (1NO) from internal pressure indicator wired to terminals (only one each SF₆ tank)

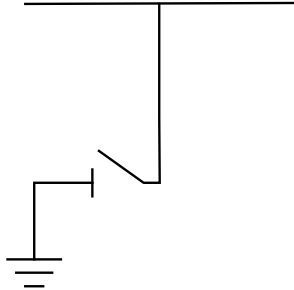
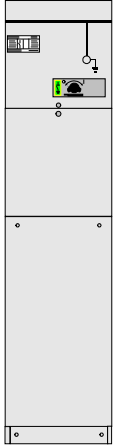
Technical data

Rated voltage	kV	12	15	17,5	24
Power frequency withstand voltage	kV	28	38	38	50
Impulse withstand voltage	kV	95	95	95	125
Rated current	A	630	630	630	630
Making capacity	kA	62,5	52,5	50	50
Short time current 1 sec	kA	25	-	-	-
Short time current 3 sec	kA	21	21	21	21
Number of mechanical operations	1000 CO manual				

Optional features also available as retrofit

- Low voltage compartment / Top entry box
- Base frame (290 or 450 mm)
- Indicator lamps for HR-module, 1-phase VIM-1
- Indicator lamps for HR-module, 3-phase VIM-3
- Short circuit and earth fault indicators
- External current sensors (CT) for monitoring
- Cable compartment cover
 - with window
 - with extra depth (double T, surge arresters)
 - arc proof (if existing module has interlocked cable compartment)
- Cable support bars, non-magnetic or adjustable
- Earth bar for surge arrester type Raychem RDA
- Auxiliary switches
 - Earthing switch position 2NO+2NC
- Ronis key interlock

4.9 Be- Busbar earthing



Depth: 765 mm
Width: 325 mm
Height: 1336 mm

Technical data

Rated voltage	kV	12	15	17,5	24
Power frequency withstand voltage	kV	28	38	38	50
Impulse withstand voltage	kV	95	95	95	125
Rated current	A	630	630	630	630
Making capacity	kA	62,5	52,5	50	50
Short time current 1 sec	kA	25	-	-	-
Short time current 3 sec	kA	21	21	21	21
Number of mechanical operations	1000 CO manual				

Standard features

- Earthing switch
- Two position single spring mechanism
- Switch position indication for earthing switch
- Busbars, 630 A
- Earthing bar

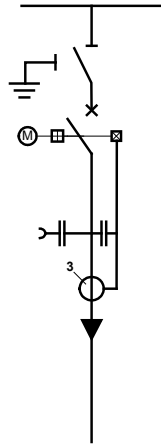
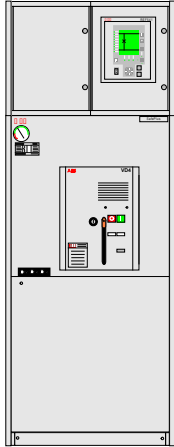
Optional features

- Bushings for connection of external busbars
- Signal (1NO) from internal pressure indicator wired to terminals (only one each SF₆-tank)

Optional features also available as retrofit

- Low voltage compartment / Top entry box
- Base frame (290 or 450 mm)
- Auxiliary switches
 - Earthing switch position 2NO+2NC
- Ronis key interlock

4.10 CB- Circuit-breaker module



Depth: 800 mm
Width: 696 mm
Height: 1336 mm

Standard features

- 630/1250A vacuum circuit-breaker
- Disconnector
- Earthing switch
- Bushings for connection of external busbars
- Motor operating mechanism, circuit-breaker
- Auto reclosing sequence
- Closing and tripping coil
- Combisensors with Interface C (400 series bolted)
- Low voltage compartment with REF541 or REF542plus

Optional features

- Signal (1NO) from internal pressure indicator wired to terminals

Optional features also available as retrofit

- Base frame (290 or 450 mm)

Technical data

Rated voltage	kV	12	24
Power frequency withstand voltage	kV	28	50
Impulse withstand voltage	kV	95	125
Rated current	A	630 / 1250	630 / 1250
Breaking capacities:			
Short-circuit breaking current	kA	25	20
Making capacity	kA	62,5	50
Short time current 1 sec	kA	25	20
Short time current 3 sec	kA	21	20
Number of mechanical operations		30000 CO	

A selection of configurable functions

Protection:

- non-directional overcurrent protection, 3 stages
- directional overcurrent protection, 3 stages
- non-directional earth-fault protection
- directional earth-fault protection
- residual overvoltage protection
- 3-phase thermal overload
- 3-phase overvoltage protection
- under- or overfrequency incl. rate of change, 5 stages

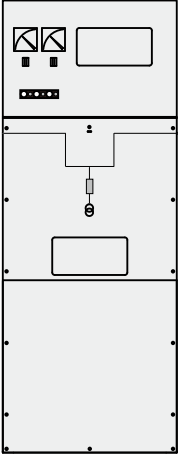
Measurement:

- 3-phase current
- neutral current
- 3-phase voltage
- residual voltage
- 3-phase power and energy incl. cos phi
- transient disturbance recorder

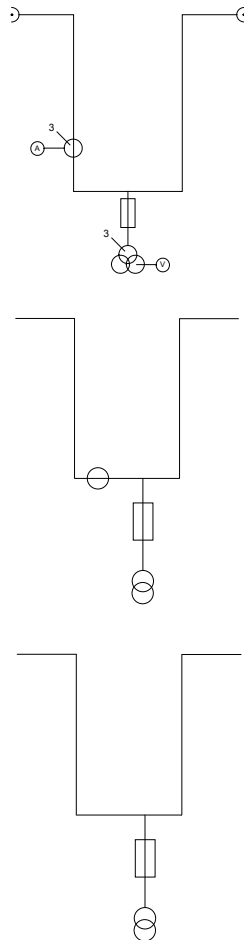
Optional functionality

- Capacitor bank protection
- Capacitor bank control
- Power quality
- Auto change-over

4.11 M- Metering module



Depth: 820 mm
Width: 696 mm
Height: 1806 mm



Technical data

Rated voltage	kV	12	15	17,5	24
Power frequency withstand voltage	kV	28	38	38	50
Impulse withstand voltage	kV	95	95	95	125
Rated current	A	630	630	630	630
Short time current 1 sec	kA	25	-	-	-
Short time current 3 sec	kA	21	21	21	21

The M-module is a factory assembled type tested air insulated metering cubicle with conventional CTs and VTs. The M-module is designed for CTs and VTs plenty air insulation distance. The M-module is also designed for tariff metering. And it can work as a VT-module to supply power and indicate voltage if without CTs.

Standard features

- 2 or 3 pcs (has to be specified) current transformers with ribs.
- 3 pcs single pole voltage transformers. or 2 pcs double pole VTs.
- 6 pcs bushings Interface C (400 series bolted) with connections and external busbars for SafePlus modules on left and right hand side.
- 3 pcs bushings Interface C (400 series bolted) only required if the M-module is left hand side or right hand side end module.
- Internal layout with CTs and VTs on left hand side or right hand side dependent of power direction (has to be specified).
- Padlock interlocking to prevent access to live parts.

Voltage transformers

- Single pole insulated with measuring and earth fault windings.
- Primary voltage and frequency (50 or 60 Hz) has to be specified.
- Secondary windings -- / $110:\sqrt{3}$ / $110:3$ V or -- / $100:\sqrt{3}$ / $100:3$ V has to be specified.

Note: VTs can also be delivered without open Delta Earthfault windings

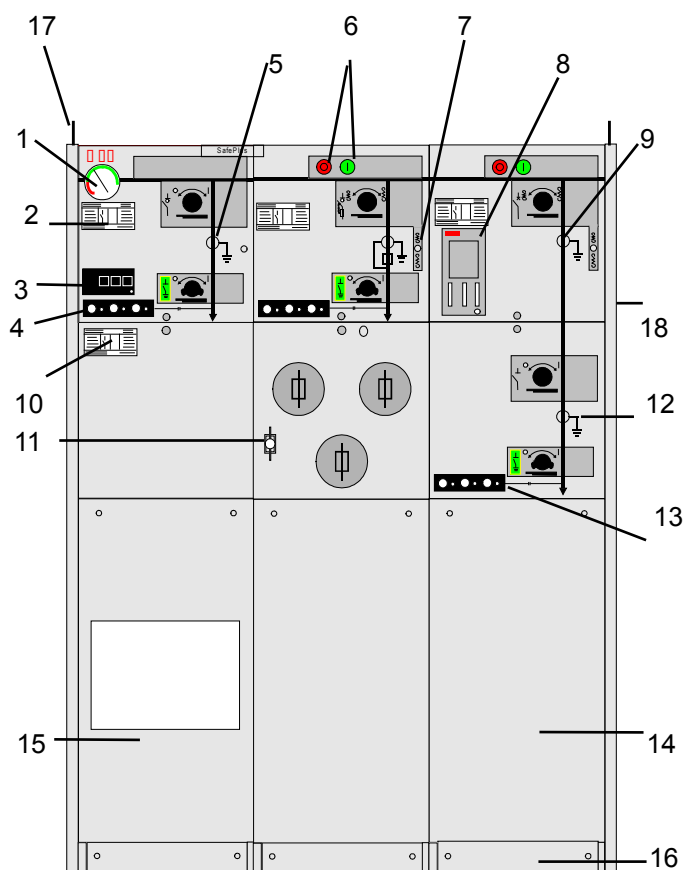
- Double pole voltage transformers for line voltage measure.
- Secondary windings- 100V
- Burden / class has to be specified.

Current transformers

- Single-core or double-core design.
- Secondary side reconnectable possible.
- Primary current max. 600 Amp., has to be specified.
- Secondary current 5 Amp or 1 Amp. has to be specified.
- Can be blank to work as VT-module / class has to be specified

5. Switchgear design

5.1 Outer assembly



3-way SafePlus configuration consisting of cable switch, fuse-switch and vacuum circuit-breaker

Upper front cover

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

Lower front cover

10. Nameplate switchgear
11. Fuse blown indicator
12. Disconnector / earthing switch position indicator
13. Capacitive voltage indication

Cable compartment cover

14. Cable compartment cover standard
15. Cable compartment cover with inspection window
16. Support bar (removable)

Side cover

17. Lifting lug
18. Operating handle (standard on right hand side)

Covers

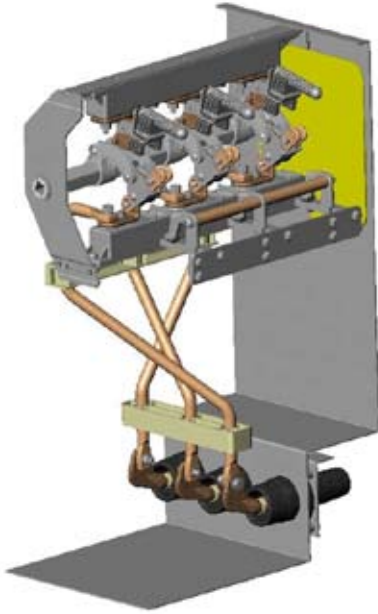
Upper and lower front cover have a thickness of 3 mm aluminium which is covered with a polycarbonate foil. These foils contain the mimic diagram of the main circuit with the position indicators for the switching devices. Background colour for these foils is light grey (RAL 7035). The upper front cover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

There are four different cable compartment covers; standard, with inspection window, arc proof, and with extra depth for parallel cables. These covers are manufactured from 1.25 mm aluzink (except the arc proof cover) and are powder painted with colour RAL 7035. All cable compartment covers are removable. Each module has a separate cable compartment which is divided from the others by means of partition walls. These partition walls can also easily be removed, allowing a comfortable access for connection of cables.

A vertical partition wall is fitted to divide the cable compartment(s) from the rear side of the switchgear / ring main unit. In case of an arc fault inside the SF₆ tank, followed by an opening of the pressure relief in the bottom of the tank, this partition wall will prevent the hot gases blowing out from the pressure relief to enter the cable compartments.

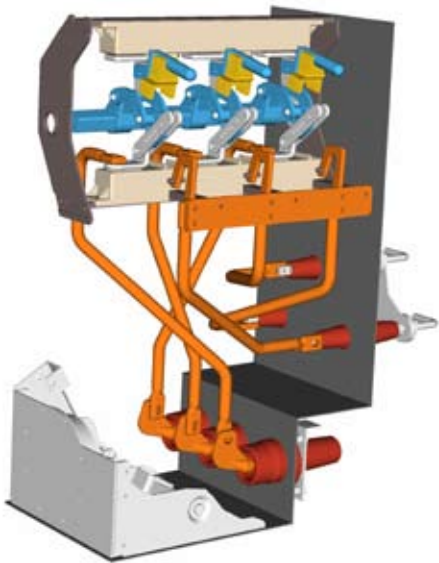
Side covers are made of 2 millimeter hot rolled steel and powder painted with colour RAL 7035.

5.2 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 position is close - open - earthed. In the open position the switch satisfies the disconnector requirements.



C-module equipped with arc suppressor (optional equipment) and cable test bushings (optional equipment).

5.3 Vacuum circuit-breaker module

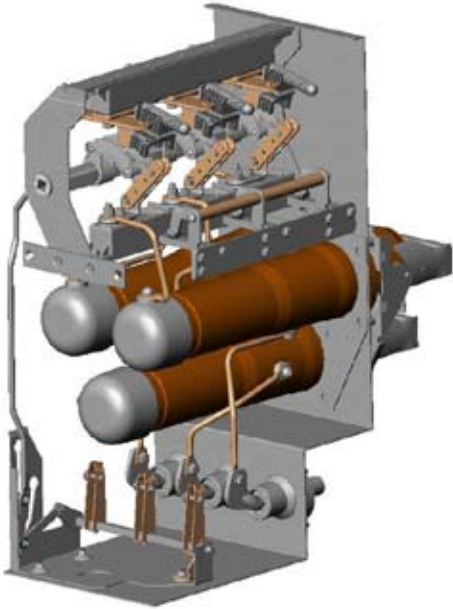


The vacuum circuit-breaker (V-module) has vacuum bottles as interrupters of the current.

In series with the circuit-breaker main circuit is connected a three-position disconnecter / earthing switch.

The operation between vacuum circuit-breaker and disconnecter/earthing switch is mechanically interlocked.

5.4 Switch-fuse module

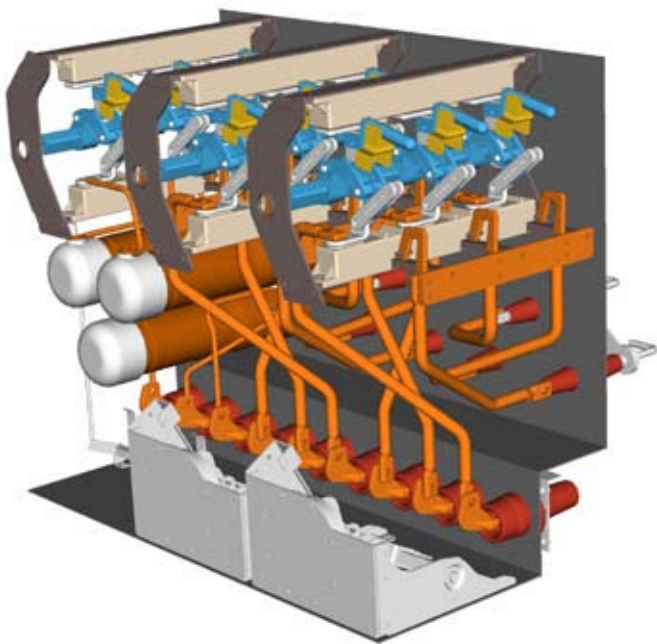


The switch-fuse (F-module) has a three position switch disconnect and earthing switch identical to the cable switch (C-module).

By means of the fuse tripping device it operates as a switch-fuse combination. There is a double earthing switch which in earthed position connects earth to both sides of the fuse-links simultaneously.

Both earthing switches are operated in one operation. The switch-fuse and earthing switch is mechanically interlocked to prevent hazardous access to the fuse-links.

The lower cover which gives access to the fuse-links is also mechanically interlocked with the earthing switch.



3-way unit consisting of two C-modules and one F-module. Both C-modules are equipped with arc suppressor (optional equipment) and cable test bushings (optional equipment)

5.5 Cable bushings



Interface C bushing (400 series bolted type) with terminal for capacitive voltage indication

The connection of the HV-cables is made by cable bushings. The bushings are made of cast resin with moulded-in conductors.

In addition, a screen is moulded in to control the electrical field and is also used as the main capacitor supplying the voltage indicating systems.

ABB has produced bushings for SF₆ switchgear since 1985. Up to date production facilities and highly advanced robots and test equipment ensure the high quality required for each single device.

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

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

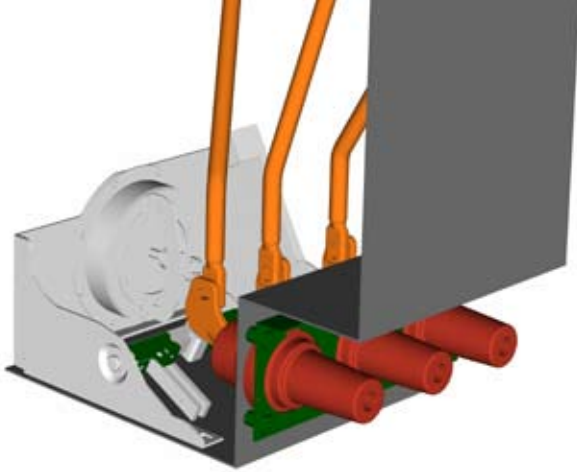
The bushings are designed according to Cenelec EN 50181, EDF HN 52-S-61 and IEC 60137.

There are 3 different cable bushings:

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

For more details, please see chapter 6.9

5.6 Arc suppressor



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

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

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

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

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

A signalling device (1NO) will indicate local or remote the tripping of one or more arc suppressors.

Since the system is self-contained, an internal arc fault will have no impact on the surroundings. No arc fault tests have to be repeated in combination with channel release systems or transformer stations. The costs of the cleaning work which has to be done after an internal arc fault when the release flap has opened, are reduced to zero.

5.7 Completely sealed system



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

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

In order to guarantee 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 SF₆-tank and vacuum chamber simultaneously. Then the SF₆-tank is filled with Helium.

Due to the characteristics of Helium this test will detect absolutely 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 high voltage functions in a satisfactory way.



5.8 Cable test bushings



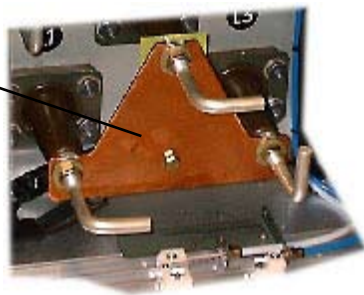
As an option, both C and De modules can be equipped with cable test bushings situated behind the lower front cover. This cover can be interlocked against the earthing switch to avoid access to the cable test compartment before earthing switch is in closed position.

When these bushings are mounted, cable insulation test can easily be done according to the following procedure:

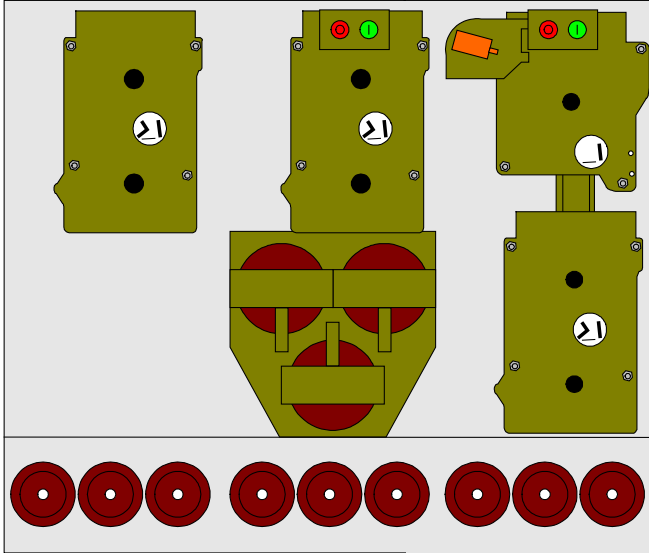
Principle sketch for testing:

1. Close the earthing switch after having checked the voltage indicators
2. Open compartment cover
3. Install the injection device onto the access terminals
4. Open the removable earthing bridge
5. Perform cable testing
6. Re-install the earthing bridge
7. Remove the injection device
8. Close compartment cover
9. Open the earthing switch

If the switchgear is not equipped with cable test bushings, cable testing is possible directly at the cable connectors if they are designed for this purpose, please follow the supplier's instruction.



5.9 Mechanisms and interlocks



Mechanisms front view.
SF₆ tank with operating mechanisms

All operating mechanisms are situated outside the SF₆-tank behind the front covers with degree of protection of IP2X.

This gives the opportunity of 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 cable compartment before earthing switch is in closed position, all mechanisms can as an option be supplied with mechanical interlocks which make it impossible to remove the cable compartment covers.

It will then also be impossible to operate load break / disconnect switch to open position before cable compartment cover is mounted properly.

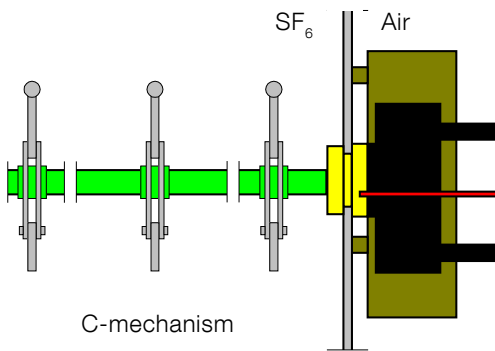
Each mechanism is equipped with a padlocking device. When adding a padlock to this device, the access to operate the mechanism will be impossible. This device has three holes with diameter 9 millimeter.

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-tank, please see shafts shown with red colour on next page.

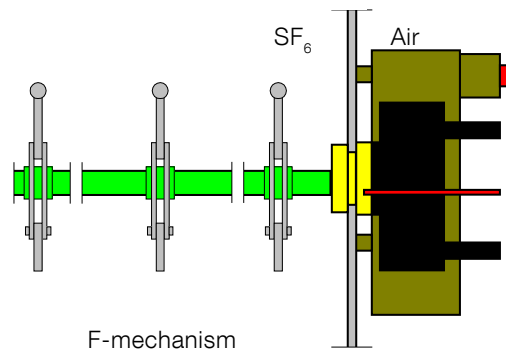
Operating handle has an anti-reflex system which prevents an immediate re-operation of the switch.

All steel parts have been electroplated with zinc and then olive chromated.

5.9 Mechanisms and interlocks



C-mechanism



F-mechanism

Cable switch module and busbar sectionalizer with load break switch (C-mechanism)

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

Both shafts are single spring operated and operate one common shaft which is directly connected to the three position switch (CFE-C) inside the SF₆-tank. When both load break switch and earthing switch are in open position, the switch satisfies the specifications of disconnector.

Due to the mechanical interlock between the upper and lower operating shaft, 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.

Switch-fuse module (F-mechanism)

The mechanism (3PAE) has two operating shafts; the upper one for the load break switch and the lower one for the earthing switch.

The upper one operates two springs; one for closing and one for opening. Both springs are charged in one operation. By means of mechanical push buttons it is then possible to close and open the load break switch.

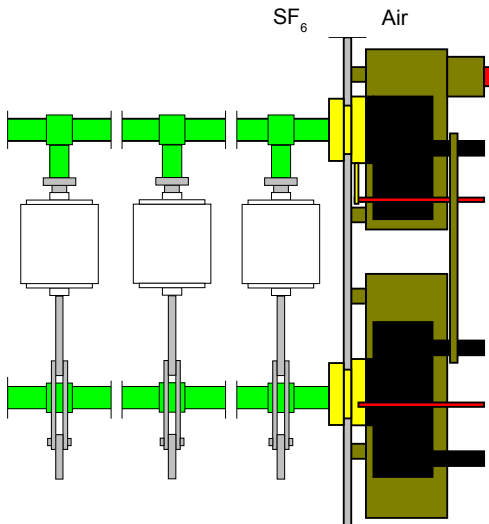
The opening spring is always charged when the load break switch is in closed position and will be ready to open the load break switch immediately if one of the HV-fuse-links blow. The blown fuse-link(s) has/have to be replaced before the operator will be able to close the load break switch again. According to IEC 60282-1, all three fuse links should be replaced, even if only one or two have operated.

The lower shaft is single spring operated. Both operating shafts operate one common shaft which is directly connected to the three position switch (CFE-F) inside the SF₆-tank.

Due to the mechanical interlock between the upper and lower operating shaft, 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.

It will also be impossible to get access to the fuse compartment before earthing switch is in closed position.

5.9 Mechanisms and interlocks



Vacuum circuit-breaker and busbar sectionalizer with circuit-breaker (V-mechanism)

These two modules have two mechanisms; the upper one (2PA) with one operating shaft is for circuit-breaker and the lower one (3PKE) with two operating shafts is for disconnect 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.

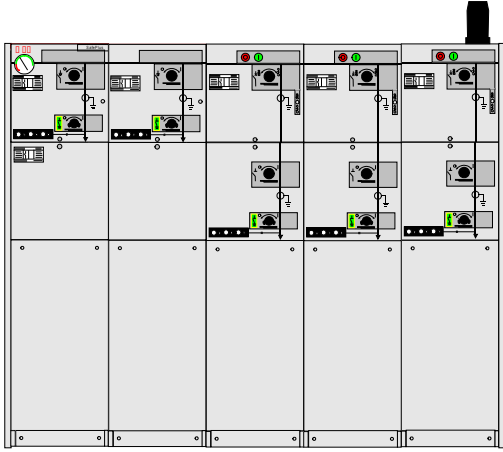
However a quick reclosing is not possible. If the mechanism is equipped with a motor operation a reclosing will take approx. 10 seconds.

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

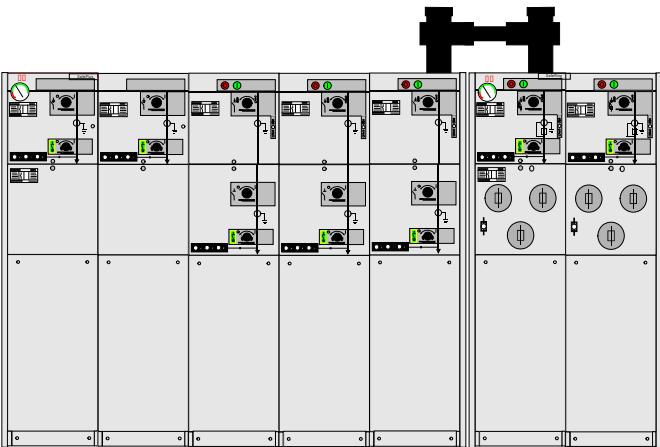
There is a mechanical interlock between these two mechanisms which prevents operating of the disconnect and earthing switch when the circuit-breaker is in closed position.

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

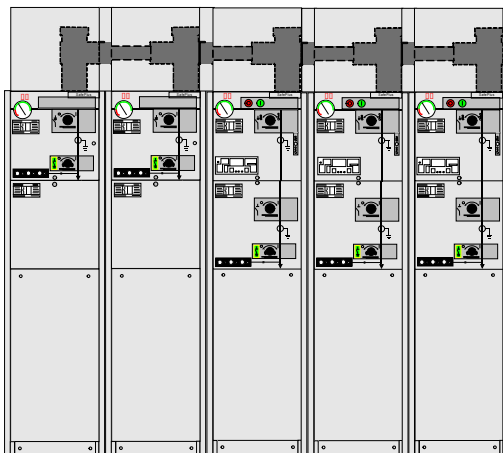
5.10 External busbars on topa



SafePlus prepared for future extension on right hand side



SafePlus consisting of two sections connected to each other by means of external busbar kit



SafePlus with external busbar cover

On the top of all SafeRing and SafePlus switchgear it is possible as an option to have bushings for connection of external busbars on the left and / or right side.

For a SafePlus switchgear consisting of only one module, only one set of bushings on the top is used.

When bushings are mounted on the top, you will have these possibilities:

1. When adding a dead end receptacle to each of these bushings, SafeRing/SafePlus will be prepared for future busbar extension.

2. With an external busbar kit, it is possible to connect two or more sections.

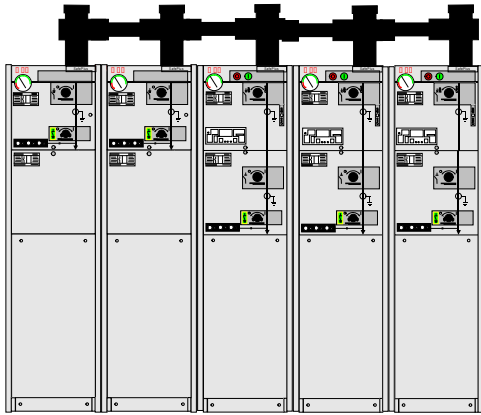
Normally, Since a 5-bays switchgear is the maximum size within one common SF₆-tank, the busbar kit allows a configuration with more than 5 modules.

Actually, the maximum size within one common SF₆-tank can content 6 modules in some definite configuration, like CCCCCC.

The installation of the external busbars has to be done on site, see separate manual for installation instructions, 1VDD006006 GB.

The complete extension kit and the dead end receptacles are fully screened, earthed and insulated with EPDM rubber. This makes a safe and reliable switchgear extension. In addition protection covers are available as an option.

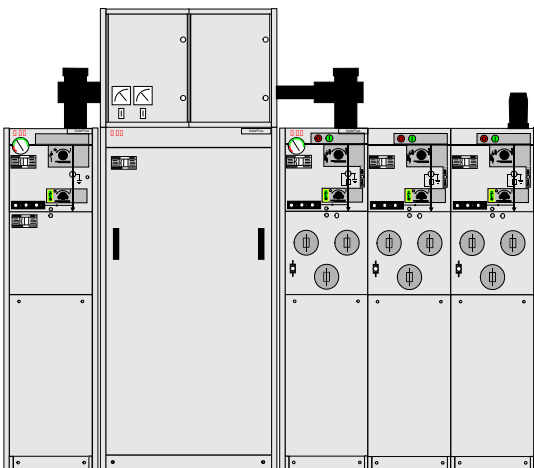
5.10 External busbars on top



SafePlus with a fully modular design

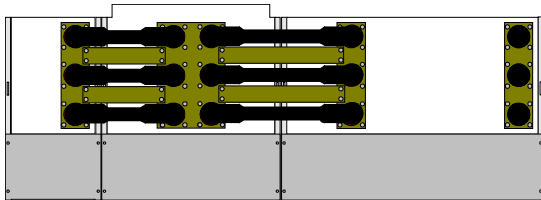
SafePlus switchgear can also be configured fully modular. This gives 1250 A busbar rating.

The busbars between the modules and the end adapters used on the left and right side are identical to the parts used in the previous example. For the three modules in the middle a special cross adapter is used.

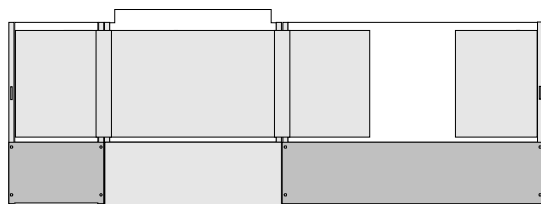


SafePlus with one in-circuit metering module (M-module), one Metering module (M-module) and three fused T-offs (F-modules), which are prepared for future extension.

The length of the external busbars are dependent of the type of modules to be connected.



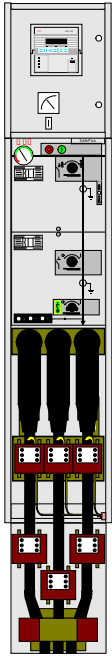
Top view



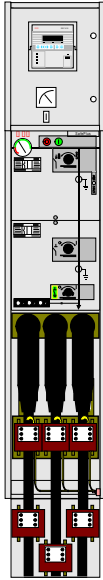
Top view with busbar cover mounted

6. Accessories

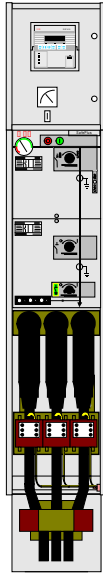
6.1 Base frame



Base frame
450 mm with
earth fault trans-
former and extra
set of current
transformers



Base frame
290 mm with
an extra set of
current trans-
formers



Base frame
290 mm with
earth fault
transformer

When SafeRing or SafePlus are placed directly on a floor, the height from the floor to the centre of the cable bushings is 595 millimeter.

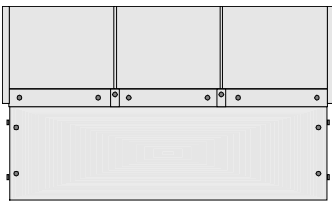
If there is no cable trench, this height might not be sufficient for proper installation of cables. It is then possible to install the switchgear on an additional base frame.

This base frame is available in two different heights; 290 and 450 millimeter.

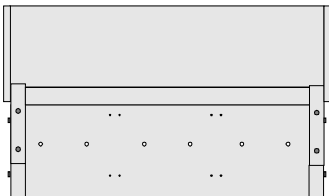
Inside the standard cable compartment for the vacuum circuit-breaker it will be enough space for three current transformers for protection relay.

If an earth fault transformer or an extra set of current transformers are required, an additional base frame is necessary, please see examples on left hand side.

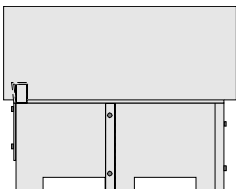
The base frame has openings for cable entrance from the bottom and from both sides. It is delivered as a kit and has to be assembled on site.



Front view

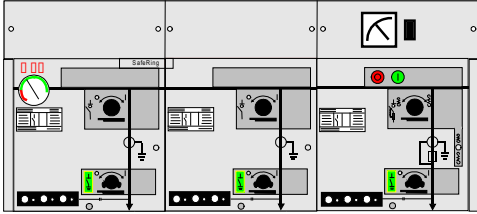


Rear view

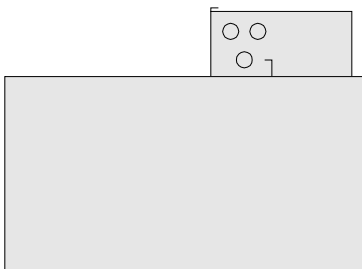


Side view

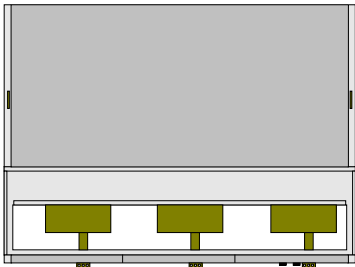
6.2 Low voltage compartment



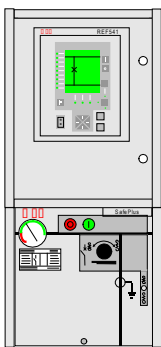
Top entry box with A-meter and selector switch



Side view



Top entry box seen from above when front / top cover has been removed



Low voltage compartment with REF 610 protection relay

If motor operation, coils, auxiliary switches, self powered protection relay etc. are mounted on a SafeRing or SafePlus module, the terminal blocks and the wiring are located behind the front covers.

However, an additional top entry box can be mounted on the top of all SafeRing and SafePlus switchgear. Since the top entry box is fixed to the side covers of the SF₆ tank, the total width of the switchgear must be covered.

The top entry box allows entrance of the customer's low voltage wiring from the rear side, left hand side and right hand side.

Furthermore the top entry box gives the opportunity to install ammeters with position switches, local/remote switch for motor operation etc.

Additionally all SafePlus switchgear can be supplied with low voltage compartment.

This compartment may be equipped with protection relays, meters, position switches, terminal blocks etc.

The compartment is fixed to the side covers of the SF₆ tank and must cover the total width of the switchgear. However, each module has a separate hinged door, but there are no partition walls between the modules.

The low voltage compartment has the possibility of cable entry from either left or right hand side.

6.3 Motor operation

Closing and opening operations of load-break switches and charging of the springs of the mechanisms for the circuit-breaker and the switchfusecombination may be performed with a motor operation. Disconnecter in the V-module and all earthing switches do not have this possibility.

All motors operate on DC voltage. If control voltage is either 110 or 220 VAC, a rectifier is integrated in the control unit. 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 and coils can easily be mounted to the mechanisms after delivery (retrofit).

Test voltage for tables below is +10/ -15 % for motor operations and closing coils and +10/ -30% for trip coils and opening coils.

The motor and coils can easily be mounted to the mechanisms after delivery (retro-fit).

Characteristics of motor operation for C-module

Rated voltage (V)	Power consumption (W) or (VA)	Operation times		Peak start current (A)	Fuse
		Closing time(s)	Opening time(s)		
24	9zzzz0	6 - 9	6 - 9	14	F 6,3 A
48	150	4 - 7	4 - 7	13	F 4 A
60	90	6 - 9	6 - 9	7	F 4 A
110	90	6 - 9	6 - 9	3	F 2 A
220	90	6 - 9	6 - 9	1,7	F 1 A

Characteristics of motor operation for F-module

Rated voltage (V)	Power consumption (W) or (VA)	Operation times		Peak start current (A)	Fuse
		Charge / Closing time(s)	Opening time (ms)		
24	160	9-14	40-60	14	F 6,3 A
48	200	5-9	40-60	13	F 4 A
60	140	8-13	40-60	7	F 4 A
110	140	8-13	40-60	3	F 2 A
220	140	8-13	40-60	1,7	F 1 A

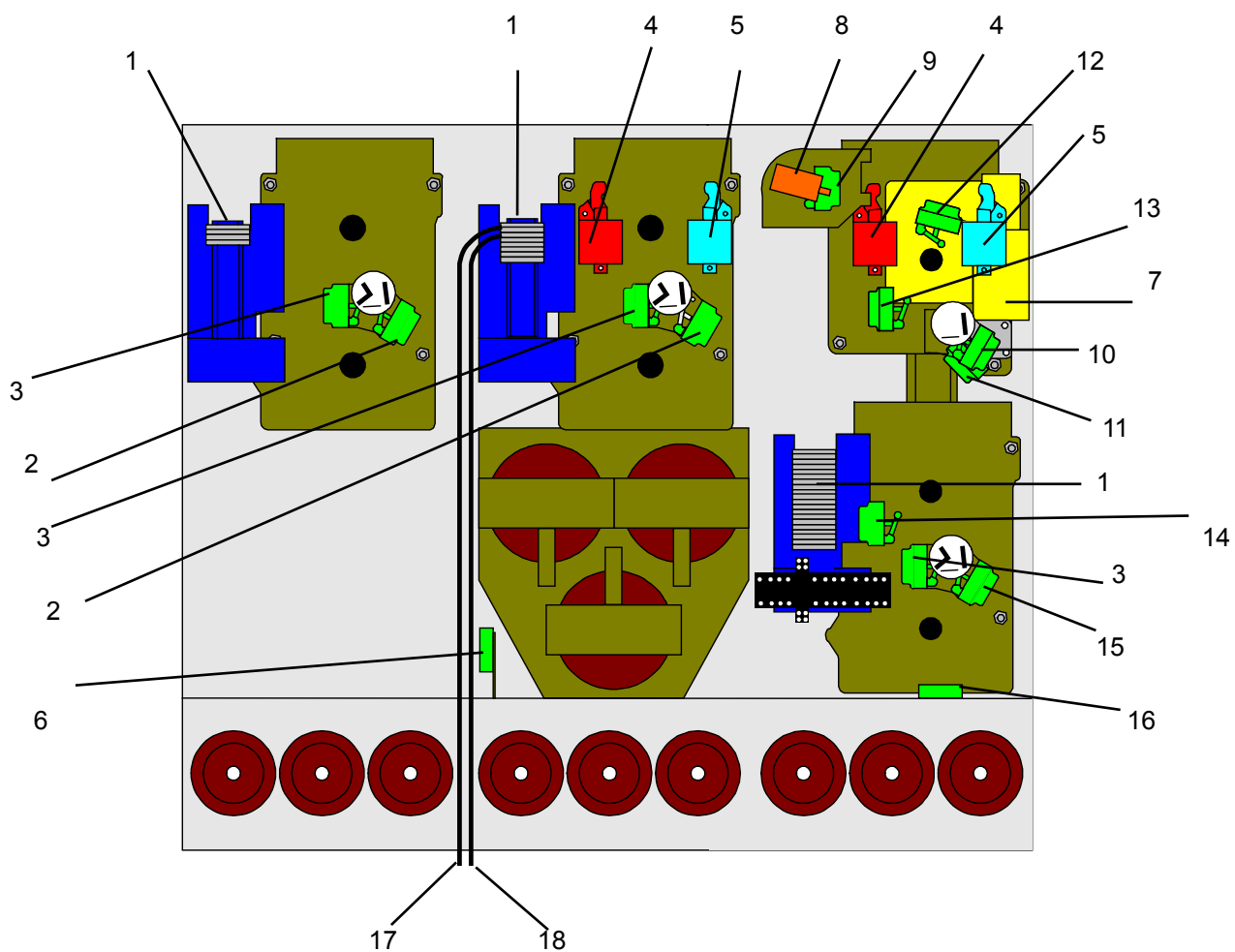
Characteristics of motor operation for V-module

Rated voltage (V)	Power consumption (W) or (VA)	Operation times		Peak start current (A)	Fuse
		Charge / Closing time(s)	Opening time (ms)		
24	180	10-17	40-60	14	F 6,3 A
48	220	5-9	40-60	13	F 4 A
60	150	8-13	40-60	7	F 4 A
110	170	8-13	40-60	3	F 2 A
220	150	8-13	40-60	1,7	F 1 A

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

Rated voltage (V)	Power consumption (W) or (VA)	Operation times		Peak start current (A)	Fuse for closing coil Y2 (Opening coil Y1 is unfused)
		Closing time (ms)	Opening time (ms)		
24 V DC	150	40-60	40-60	6	F 3,15 A
48 V DC	200	40-60	40-60	4	F 2 A
60 V DC	200	40-60	40-60	3	F 1,6 A
110 V DC	200	40-60	40-60	2	F 1 A
220 V DC	200	40-60	40-60	1	F 0,5 A
110 V AC	200	40-60	40-60	2	F 1 A
230 V AC	200	40-60	40-60	1	F 0,5 A

6.3 Motor operation

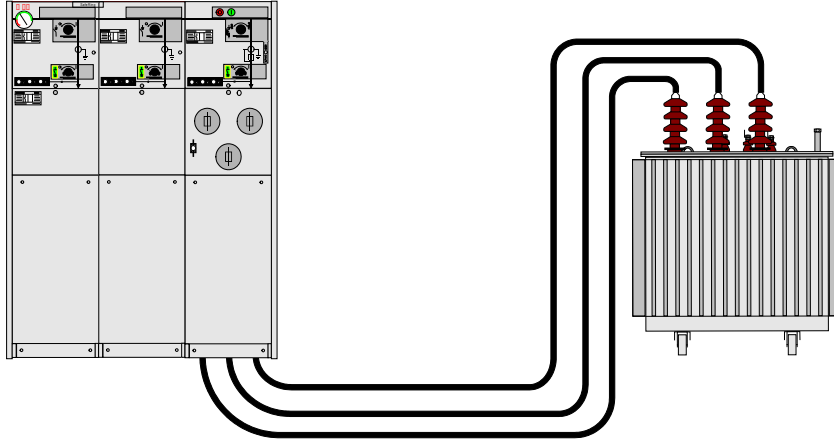


SafePlus CFV equipped with various auxiliary switches, coils and motor operation

- 1.Terminal blocks/control unit motor operation
- 2.Auxiliary switch S7, load break switch
- 3.Auxiliary switch S10, earthing switch
- 4.Opening coil Y1
- 5.Closing coil Y2
- 6.Auxiliary switch S9, fuse blown
- 7.Motor operation
- 8.Relay trip coil Y4 / Y5 /Y6*
- 9.Auxiliary switch S9, circuit-breaker tripped signal
- 10.Auxiliary switch S5, circuit-breaker
- 11.Auxiliary switch S6, mechanism latched
- 12.Auxiliary switch S8, spring charged
- 13.Auxiliary switch S14, operating handle, vacuum circuit-breaker
- 14.Auxiliary switch S15, operating handle, disconnector
- 15.Auxiliary switch S7, disconnector
- 16.Auxiliary switch S13, cable compartment cover
- 17.Auxiliary switch S20, arc suppressor
- 18.Auxiliary switch S19, SF₆ gas pressure

* Depending of the type of protection relay, the V module can only be delivered with one of the relay trip coils.

6.4 Transformer protection



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

The switch-fuse combination offers optimal protection against short-circuit currents, while the circuit-breaker with relay offers better protection against low over-currents. Circuit-breaker with relay is always recommended for higher rated transformers.

Both SafeRing and SafePlus V-module is delivered with a 630A rated current.

Both for SafeRing and SafePlus the relay is a self powered relay that utilizes the energy from the CTs under a fault situation, for energizing the trip coil.

The self powered relay can also be used for cable protection and more details on the different relays can be found in chapter 6.5.

Transformer protection with self powered relay.

Recommended types:

- ABB relay type REJ 603
- SACE PR512
- SEG WIC 1
- CIRCUTOR MPRB-06

Important features V-module:

- Relay behind cover. No need for additional low voltage box for these self powered relays used for transformer protection.

Typical for 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

SafeRing and SafePlus - Fuse-link selection

By selection of fuse-links for the protection of a transformer, it is important that requirements in IEC 62271-105 and in IEC 60787 are fulfilled. In particular Annex A in IEC 62271-105 gives a good example of the coordination of fuse-links, switch and transformer.

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

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

By carefully checking that these rules are followed, fuse-links from any manufacturer can be used in combination with SafeRing and SafePlus as long as the fuse-links are in accordance with the requirements described in chapter 6.5.

6.5 Fuse selection table

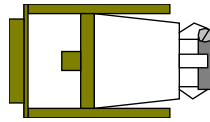
100%	Transformer rating (kVA)																CEF
Un (kV)	25	50	75	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	
3	16	25	25	40	40	50	50	80	100	125	160	160					7.2kV
3,3	16	25	25	40	40	50	50	63	80	100	125	160					
4,15	10	16	25	25	40	40	50	50	63	80	100	125	160				
5	10	16	25	25	25	40	40	50	50	63	80	100	160	160			
5,5	6	16	16	25	25	25	40	50	50	63	80	100	125	160			
6	6	16	16	25	25	25	40	40	50	50	80	100	125	160	160		
6,6	6	16	16	25	25	25	40	40	50	50	63	80	100	125	160		
10	6	10	10	16	16	25	25	25	40	40	50	50	80	80	125	125	12kV
11	6	6	10	16	16	25	25	25	25	40	50	50	63	80	100	125	
12	6	6	10	16	16	16	25	25	25	40	40	50	63	80	100	125	
13,8	6	6	10	10	16	16	25	25	25	25	40	50	50	63	80	100	17.5kV
15	6	6	10	10	16	16	16	25	25	25	40	40	50	63	80	100	
17,5	6	6	6	10	10	16	16	16	25	25	25	40	50	50	63	80	
20	6	6	6	10	10	16	16	16	25	25	25	40	40	50	63	63	24kV
22	6	6	6	6	10	10	16	16	16	25	25	25	40	50	50	63	
24	6	6	6	6	10	10	16	16	16	25	25	25	40	40	50	63	

- The table is based on using fuses type ABB CEF
- Normal operating conditions with no overload
- Ambient temperature -25°C - +40°C

120%	Transformer rating (kVA)																CEF
Un (kV)	25	50	75	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	
3	16	25	25	40	40	50	63	80	100	125	160						7.2kV
3,3	16	25	25	40	40	50	63	80	80	100	125						
4,15	10	16	25	25	40	40	50	63	80	80	100	125					
5	10	16	25	25	25	40	40	50	63	80	80	125	160				
5,5	6	16	16	25	25	25	40	50	50	80	80	100	125	160			
6	6	16	16	25	25	25	40	40	50	63	80	100	125	160			
6,6	6	16	16	25	25	25	40	40	50	63	80	80	100	125			
10	6	10	10	16	16	25	25	25	40	40	50	63	80	80	125		12kV
11	6	6	10	16	16	25	25	25	25	40	50	50	80	80	100	125	
12	6	6	10	16	16	16	25	25	25	40	40	50	63	80	100	125	
13,8	6	6	10	10	16	16	25	25	25	25	40	50	50	80	80	100	17.5kV
15	6	6	10	10	16	16	16	25	25	25	40	40	50	63	80	100	
17,5	6	6	6	10	10	16	16	16	25	25	25	40	50	50	63	80	
20	6	6	6	10	10	16	16	16	25	25	25	40	40	50	63	80	24kV
22	6	6	6	6	10	10	16	16	16	25	25	25	40	50	50	63	
24	6	6	6	6	10	10	16	16	16	25	25	25	40	40	50	63	

- The table is based on using fuses type ABB CEF
- Normal operating conditions with 20% overload
- Ambient temperature -25°C - +40°C

6.6 Fuse-links



Fuse holder



Fuse-link



Fuse adapter

SafeRing and SafePlus are designed and tested for fuse-links according to IEC 60282-1.

The dimensions of the fuse-links have to be in accordance with IEC 60282-1, Annex D. The fuse-links have to be type I with terminal diameter equal to + 45 mm and body length (D) equal to 442 mm.

The dimensions of the fuse-links can also be in accordance with DIN 43625 and the length of the fuse canister is based on the use of fuse-links with length 442 mm. For installation of shorter fuses, (<24kV) a fuse adapter will be needed. SafeRing and SafePlus are designed for fuse-links with striker in accordance with IEC 60282-1. The striker must be of type

“Medium” with an energy of 1 J and a travel of minimum 20 mm. The start force of the striker should be minimum 40 N.

Please note: When inserting the fuse-link into the canister, the striker-pin must always face outwards against the fuse holder. Fuse adapter has to be fixed to the fuse-link contact which faces inwards in the fuse canister.

1600 kVA is the maximum size of distribution transformer which can be fed from a SafeRing/ SafePlus switch-fuse module. For higher rated transformers, we recommend our vacuum circuit-breaker module with CT's and protection relay.

The below table shows CEF fuse-links for use in SafeRing/ SafePlus. For more technical data, please refer to separate catalogue for ABB CEF fuse-links.

In order to find the correct fuse-link compared to the transformer rating in kVA, please see the selection table on previous page.

Type	Rated voltage kV	Rated current A	e / D mm	Type	Rated voltage kV	Rated current A	e / D mm
CEF	3,6/7,2	6	192/65	CEF	17,5	6	292/65
CEF	3,6/7,2	10	192/65	CEF	17,5	10	292/65
CEF	3,6/7,2	16	192/65	CEF	17,5	16	292/65
CEF	3,6/7,2	25	192/65	CEF	17,5	25	292/65
CEF	3,6/7,2	40	192/65	CEF	17,5	40	292/87
CEF	3,6/7,2	50	192/65	CEF	17,5	50	292/87
CEF	3,6/7,2	63	192/65	CEF	17,5	63	292/87
CEF	3,6/7,2	80	192/87	CEF	17,5	80	442/87
CEF	3,6/7,2	100	192/87	CEF	17,5	100	442/87
CEF	3,6/7,2	125	292/87				
CEF	3,6/7,2	160	292/87				
CEF	12	6	292/65	CEF	24	6	442/65
CEF	12	10	292/65	CEF	24	10	442/65
CEF	12	16	292/65	CEF	24	16	442/65
CEF	12	25	292/65	CEF	24	25	442/65
CEF	12	40	292/65	CEF	24	40	442/65
CEF	12	50	292/65	CEF	24	50	442/87
CEF	12	63	292/65	CEF	24	63	442/87
CEF	12	80	292/87				
CEF	12	100	292/87				
CEF	12	125	442/87				

6.7 Relays



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

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

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

The V-module can also be delivered prepared for protection relays.

This is defined in two types:

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

This is applicable for relays delivered complete from our factory or if we have received necessary documentation on the relay.

Other types of relays on request.

There are three main groups of relays delivered:

A) ABB feeder protection relays

B) Self powered relays

C) ABB feeder terminals type REF 54x

A) ABB offers a wide range of feeder protection relays. These relays have been sold for a long period and have an excellent reputation for reliability and secure operation. These relays have either 18-80VDC or 80-265VAC/DC auxiliary supplies and are connected to conventional CTs and VTs.

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

C) ABB feeder terminals, type REF 54x provides cost-effective solutions for different protection, monitoring and control applications.

The terminals enable the use of accurate and reliable current and voltage sensors as well as conventional CTs and VTs.

6.7 Relays

Ring core current transformers and earth fault transformer

MPRB 06 transformer protection and cable protection kit (self powered)	Ring core current transformer type	Current range
Transformer type	CT1	15 - 112 A
	CT2	64 - 448 A
SEG WIC1 transformer protection and cable protection kit (self powered)	Ring core current transformer type	Current range
Transformer type	W2	16 - 56 A
(Thermal load capacity: permanently: 2,5 x highest rated current)	W3	32 - 112 A
	W4	64 - 224 A
	W5	128 - 448 A
PR512 transformer protection and cable protection kit (self powered)		Ratio
Transformer type		40/1 A
		80/1 A
		250/1 A
REJ603 transformer protection and cable protection kit (self powered)	Ring core current transformer type	Current range
Transformer type	CT1	8 - 28 A
	CT2	16 - 56 A
	CT3	32 - 112 A
	CT4	64 - 224 A
	CT5	128 - 448 A
Protection relay standard CT's typical	Ring core current transformer type	Ratio - burden
Transformer type: class 10P10	SVA100-100-45	50-100-200/1 A 1,5/3/6 VA
Transformer type: class 5P10	SVA100-100-45	150/1 A 4 VA
Transformer type: class 5P10	SVA100-100-45	100-200/1 A 4 - 7 VA
Transformer type: class 5P10	SVA100-100-45	300 - 600/1 A 4 - 7 VA
Transformer type: class 5P10	SVA100-100-45	400 - 600/1 A 4 - 7 VA
Earth fault transformer		
Earth fault transformer, class 10P10, burden 0,5 – 15VA dependent on selected ratio	KOLMA 06A1 (90 mm)	Multi-tap secondary: 50-150/1 A or 50-750/5A
Earth fault transformer, class 10P10, burden 0,5 – 15VA dependent on selected ratio	KOLMA 06D1 (180 mm)	Multi-tap secondary: 50-150/1 A or 50-750/5A

6.7 Relays

ABB feeder protection relays

Protection and measurement				Relay				
Type of faults	IEEE device no	IEC symbol	Protection function	SPAJ 140C	SPAA 341C	SPAA 120C	REF 610	REX 521 1)
Short circuits	51	3 I >	Non-directional overcurrent, low-set stage	X	X		X	X
	50/51/51B	3 I >>	Non-directional overcurrent, high-set stage	X	X		X	X
	50/51B	3 I >>>	Non-directional overcurrent instantaneous stage/blockable		X		X	X
	51	2 I >	Two-phase non-directional overcurrent, low-set stage			X		
	50/51	2 I >>	Two-phase non-directional overcurrent, high-set stage			X		
	51N	Io >	Non-directional earth fault, low-set stage	X	X		X	X
	51N	Io >/SEF	Non-directional earth fault, low-set stage sensitive					
Earth fault	50N/51N	Io >>/Io-o>	Non-directional earth fault, high-set stage	X	X		X	X
	67N	Io >>->/SEF	Directional earth fault, sensitive, In=1A and 5A		X	X		X
	67N	Io >>->/SEF	Directional earth fault, sensitive, In=0,2A and 1A					
	67N	Io >> ->	Directional earth fault, high-set stage		X	X		X
	59N	Uo >	Residual overvoltage (SPAA 341 also high-set/instantaneous)		X	X		X
Additional functions	46	Δ I >	Phase discontinuity		X			X
	62BF	CBFP	Circuit-breaker failure	X	X	X	X	X
Type of measurements		3I/2I	Three-phase / two-phase current	X	X	X	X	X
		Io	Neutral current	X	X	X	X	X
		Δ I	Degree of unbalance					
		Uo	Residual voltage		X	X		X
Auto-reclosing	79					X	X	X

¹⁾ Available protection functions dependant of version

Self powered relays

Functionality			Relay			
Features	Description	IEEE device no.	REJ 603	WIC1	MPRB-06	PR512/P
Protection FUNCTIONS	Phase overcurrent (multi-characteristic)	50/51	X	X	X	X
	Short-circuit protection	50/51	X	X	X	X
	Number of overcurrent elements	50/51B	2	2	2	2
	Earth fault current	50N/51N	X	X	X	X
	Number of earth fault elements		2	1	1	2
Characteristic curves	Overcurrent element		DEFT,INV 1)	DEFT,INV 1)	DEFT,INV 2)	DEFT,INV 2)
	Earth fault current		DEFT,INV 1)	DEFT	DEFT	DEFT,INV 2)
Additional functions	Trip indication		X	X (option)	X	X
	Electro-impulse		X	X	X	X
	input remote tripping (voltage)		X	115 VAC/230VAC	230 VAC	24VDC
Measuring circuit	Auxiliary power, voltage (option)				230 VAC	24 VDC
	Rated secondary current		wide range	wide range	wide range	40/80/250
			special CT	special CT	special CT	1A secondary
Climatic withstand	Measuring range, start current I> (A)		7,2	14,4	13,5	8
	Storage temperature (°C)		-40 ...+85	-40 ...+85	-40 ...+85	-40 ...+90
	Operating temperature (°C)		-40 ...+85	-40 ...+85	-40 ...+85	-5 ...+40

- ¹⁾ - Definite time overcurrent (DEFT)
 - Normal inverse time overcurrent (NINV)
 - Very inverse time overcurrent (VINV)
 - Extremely inverse time overcurrent (EINV)
 - Long time inverse time overcurrent (LINV)

- ¹⁾ - Resistance inverse timeovercurrent (RINV)
 - Characteristics of high voltage fuse-link (HV-FUSE)
 - Characteristics of full range fuse (FR-FUSE)
²⁾ - Definite time overcurrent
 - Inverse characteristics, please contact us for further information

6.7 Relays

ABB feeder terminals type REF 54x

SafePlus can be delivered with two different REF series feeder terminals:

REF 541 which is installed in the door of the low voltage compartment.

REF542plus with integrated web-interface is a leader in the development of feeder terminals. REF 542 plus has a separate display unit and does not need a build out frame.

Both REF units are configured according to customer specification for protection functions. Other configurations on request only.

Typical configuration of V-module:

Primary equipment, standard

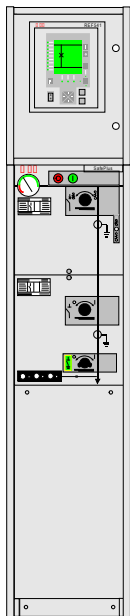
- 630A vacuum circuit-breaker
- Disconnecter
- Earthing switch

Additional equipment

- Trip coil (Y4)
- HR voltage indication
- Combisensors with 400 series interface
- Low voltage compartment
- REF 542 plus or REF 541
- Motor operation
- Earth fault transformer (sensitive earth fault)

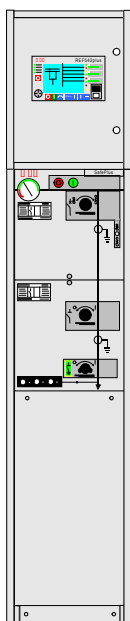


6.7 Relays



REF 541

Depth 765 mm
Width: 325 mm
Height: 1806 mm



REF 542plus

Depth 765 mm
Width: 325 mm
Height: 1806 mm

Technology summary REF 541 and REF542plus:
(configurable functions)

Protection:

- non-directional overcurrent protection, 3 stages
- directional overcurrent protection, 3 stages
- non-directional earth-fault protection
- directional earth-fault protection
- residual overvoltage protection
- 3-phase thermal overload
- 3-phase overvoltage protection
- 3-phase undervoltage protection
- Under- or overfrequency incl. rate of change, 5 stages

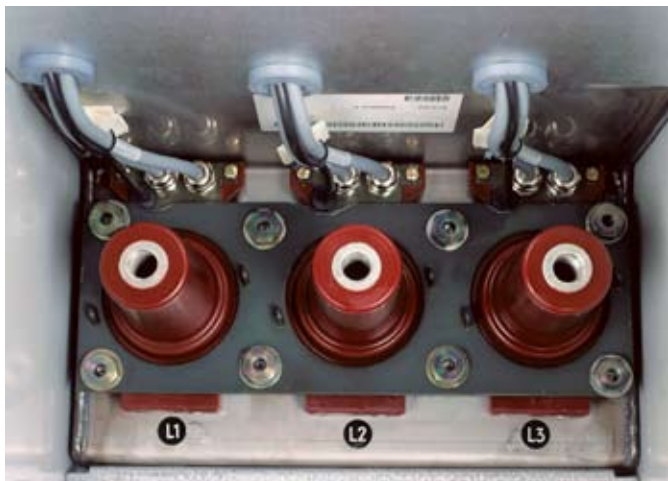
Optional functionality:

- Capacitor bank protection
- Capacitor bank control
- Power quality

Measurement:

- 3-phase current
- neutral current
- 3-phase voltage
- residual voltage
- 3-phase power and energy incl. $\cos \phi$
- transient disturbance recorder

6.8 Combisensor



The combi sensor is a Interface C bushing (400 series bolted) with three integrated sensors. It is installed instead of the normal bushing. The three sensors are one "ROGOWSKI" coil for current measurement and two capacitive voltage dividers for voltage measurement and indication.

Technical specification, general

Insulation level	24/50/125 kV
Rated short-time thermal current	25 kA 1s
Rated dynamic current (Idyn)	62,5 kA (peak)
Rated continuous thermal current	630 A
Cable length	2,2 m (supplied for the current and voltage sensors)
Cable terminal	Twin-BNC (TWB 1111K1-NP3G Goldflash)

Technical specification, current sensor

Principle	ROGOWSKI coil
Rated primary current (Ipr)	80 A
Accuracy limit factor	60
Rated primary current factor	10
Rated secondary voltage (U _{sr})	0,150 V (0,180 V at 60 Hz)
Rated burden	≥ 4 MΩ
Accuracy	Class 5 – using calibration factor Class 3 /10P60

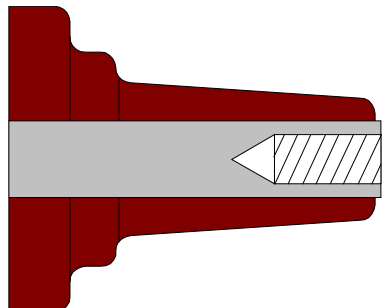
Technical specification, voltage sensor

Principle	Capacitive voltage divider
Rated primary voltage (U _{pr})	20;√3 kV
Rated secondary voltage (U _{sr})	2,0;√3 kV
Rated burden	≥ 4 MΩ
Division ratio	10 000:1
Accuracy class	Class 6P

Technical specification, voltage indication

Principle	Capacitive voltage divider
Capacitance C1	8 – 12 pF
Stray Capacitance C2	15 – 40 pF
Connection	Cable with BNC plug
Over-voltage protection	Surge arrester or additional parallel capacitor is excluded

6.9 Cable termination



Interface C
(Bolted type 400 series)

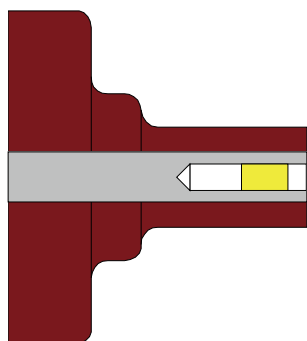
SafeRing/SafePlus are equipped with cable bushings which comply with Cenelec EN 50181*), EDF HN 52-S-61 and IEC 60137 for termination of cables.

The following cable bushings are available:

Interface C with M16 x 2 metric threads

400 series, $I_n = 630\text{ A}$

Standard on C, V ($I_n=630\text{A}$), D and De modules; and for top extension



Interface A
(Plug-in type 200 series)

Interface A with plug

200 series, $I_n = 200\text{ A}$

Standard on F and V modules ($I_n = 200\text{ A}$)

The yellow area indicates the silver coated contact spring.

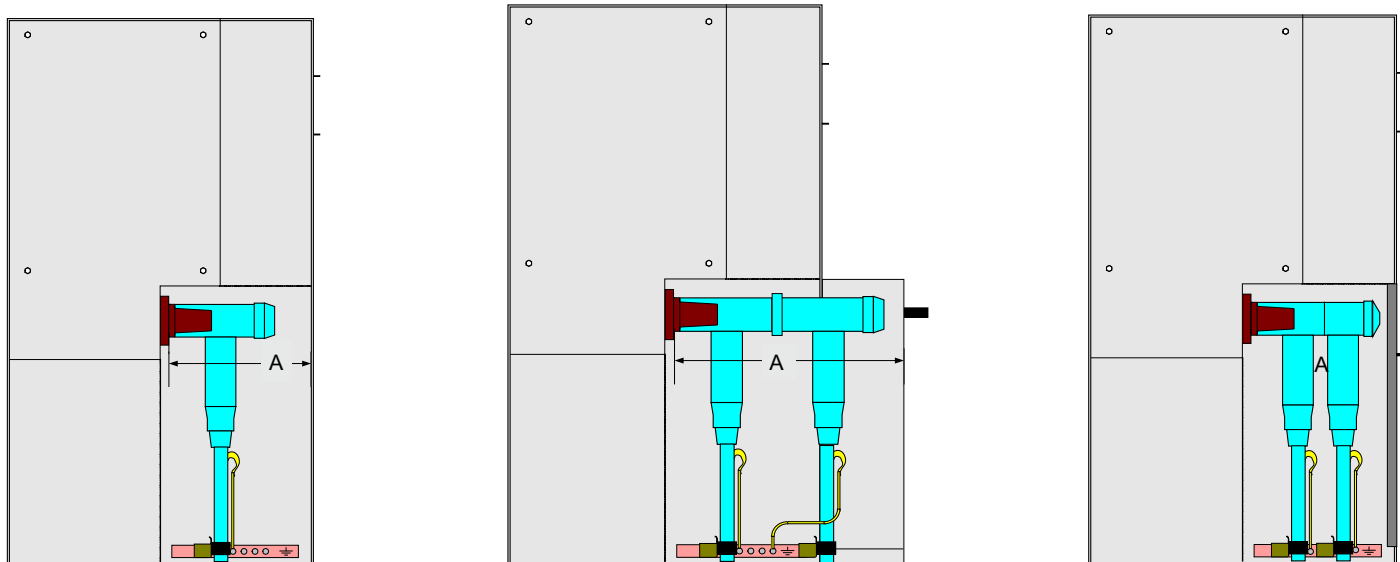
The installation instructions from the manufacturer of cable terminations must be followed. Be sure to lubricate the bushings thoroughly with the silicone supplied.

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

6.9 Cable termination

All bushings are situated in the same height from the floor and are protected by cable compartment cover. The three draw-

ings below show typical arrangements with cable connectors for single and double cables.



Arc proof cable compartment with double set of cables. Cable terminations from nkt cables or Elastimold.

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

	Interface A (200 series plug-in)	Interface B (400 series plug-in)	Interface C (400 series bolted)	Interface D (600 series bolted)
Standard	400	361	360	369
With window	392	354	353	362
Arc proof	377	338	337	346
Double cables	595	556	555	564

The following manufacturers of cable terminations are recommended:

- ABB Kabeldon
- Südkabel
- Euromold/Elastimold
- nkt cables
- Tyco Electronics
- Prysmian
- 3M

6.9 Cable termination



Kabeldon Screened Separable Connector from ABB

Benefits:

- No special tools
- Prefabricated for simple and safe installation
- Minimal cable stripping
- Active pressure
- Complete kits

Use:

Designed for XLPE-insulated 1- or 3-core cables with Al or Cu conductors for 12-24 kV.

Supplied in kits of three.

Fits standard bushings type outer cone in accordance with Cenelec EN 50180 and EN 50181.

Design:

The connector hood is made of rubber in three layers: inner conductive layer, insulating layer and outer conductive layer.

The connector meets the requirements for being touch-proof.

The 250 A connectors is equipped with a metallic part for capacitive voltage check.

Supplied complete with adapter for cable, screw cable lug and connection to the bushing.

Different accessories is also available like:

- Screen separation kit for 3-core cables
- Earthing kits for different type of cable screens
- Adaptor kits for small cables
- Capacitive test points for the 400 and 630 A series
- Parallell coupling of kits
- Equipment for safe-for-work

Designation	XLPE/EPR Ø mm ²	Conductor cross section mm ²	Rating	Bushing type	Picture type
SOC 250 TP	12.5 – 25.8	25 – 95	250 A	Plug-in Ø 7.9	a
SOC 400 – 1	15.0 – 26.8	50 – 120	400 A	Plug-in Ø 14	b
SOC 400 – 2	21.4 – 34.9	150 – 300	400 A	Plug-in Ø 14	b
SOC 630 – 1	15.0 – 26.8	50 – 120	630 A	Bolt M16	c
SOC 630 – 2	21.4 – 34.9	150 – 300	630 A	Bolt M16	c
SOC 630 – 3	31.5 – 42	400	630 A	Bolt M16	d
SOC 630 – 4	31.5 – 42	500	630 A	Bolt M16	d
SOC 630 – 5	40 – 46	630	630 A	Bolt M16	d

6.9 Cable termination

12 kV: Separable connectors interface A with earthing shield, $I_r = 250A$

Manufacturer	Designation	Conductor [mm ²]	XLPE / EPR Ø [mm]
3M	93-EE 605-2/-95	25-95	12.2-25.0
3M	92-EE 615-2/120	120	19.8-22.8
3M	92-EE 615-2/150	150	21.3-24.3
ABB	SOC 250 TP	25-95	12.9-25.8
Euromold	158LR/G	16-70	12.6-18.7
Euromold	158LR	70-95	18.4-26.4
nkt cables	EASW 10/250	25-95	12.7-19.2
nkt cables	CE 12-250	95-120	16.9-25.0
Prysmian	FMCE-250	16-95	10.0-21.3
Südkabel	SEW 12	25-150	12.2-25.0
Tyco Electronics	RSES	16-120	13.5-33.5

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

12 kV: Separable connectors interface C, $I_r = 630A$

Manufacturer	Designation	Conductor [mm ²]	XLPE / EPR Ø [mm]	Earthing shield Yes/No	Additional equipment for dual cable arrangement	Surge Arrester with	Cable compartment with								
							Single cable + surge arrester				Dual cables				
							Standard Distance A = 360 mm	with window Distance A = 353 mm	Arc proof Distance A = 337 mm	Double cables Distance A = 555 mm	Standard Distance A = 360 mm	with window Distance A = 353 mm	Arc proof Distance A = 337 mm	Double cables Distance A = 555 mm	
3M	93-EE 705-6/-95	50-95	15.0-23.5	Y	KU 23.1+93-EE 705-6/-95	MUT 23									
3M	93-EE 705-6/240	120-240	21.8-32.6	Y	93-EE 718-6/150-240	MUT 23									
ABB	KAP 300U	25-300	Flexible	N	None	None									
ABB	KAP 630	50-300	Flexible	N	KAP 630 P	KAP 630-S	X	X	X	X	X	X	X	X	X
ABB	SOC 630-1	50-120	15.0-26.8	Y	PC 630+SOC 630-1	Yes ¹⁾	X	X		X	X	X		X	
ABB	SOC 630-1	50-120	15.0-26.8	Y	PC 630+SOC 630-1	Yes ²⁾	X	X	X	X	X	X		X	
ABB	SOC 630-2	150-300	21.4-34.9	Y	PC 630+SOC 630-2	Yes ¹⁾	X	X		X	X	X		X	
ABB	SOC 630-2	150-300	21.4-34.9	Y	PC 630+SOC 630-2	Yes ²⁾	X	X	X	X	X	X		X	
Euromold	400TB/G	25-300	12.0-37.5	Y	400CP-SC+400TB/G	400PB-XSA				X					X
Euromold	400LB	25-300	12.0-37.5	Y	400CP-SC+400TB/G	400PB-XSA	X			X					X
Euromold	430TB-630	25-300	12.0-37.5	Y	300PB-630	300PB-10SA	X	X	X	X	X	X	X	X	X
Euromold	440TB/G	185-630	23.5-56.0	Y	440CP+ 440TB/G	400PB-XSA				X					X
nkt cables	CB 12-630	25-300	12.7-34.6	Y	CC 12-630	CSA 12	X	X	X	X	X	X	X	X	X
nkt cables	AB 12-630	25-300	12.7-34.6	N	AC 12-630	ASA 12	X	X	X	X	X	X	X	X	X
nkt cables	CB 24-630 (1250)	400-630	34.0-45.6	Y	CC 24-630 (1250) or CC 12-630	CSA 12	X	X	X	X	X	X	X	X	X
Prysmian	FMCTs-400	70-300	18.5-30.4	Y	FMPCs-400-12+FMCTs-400	Yes ²⁾				X					X
Prysmian	FMCTs-400/1250	70-630	18.5-42.0	Y	FMPCs-400-12+FMCTs-400/1250	Yes ²⁾				X					X
Südkabel	SET 12	50-300	15.0-32.6	Y	SEHDK 13.1	MUT 23	X	X	X	X	X	X	X	X	X
Südkabel	SET 12	50-300	15.0-32.6	Y	KU23.2/23+SET 12	MUT 23	X	X	X	X					X
Südkabel	SEHDT 13	400-500	31.6-36.4	Y	None	KU33 + MUT 33				X					
Tyco Electronics	RSTI-L	25-300	12.7-34.6	Y	RSTI-CC-L	RSTI-SA	X	X	X	X	X	X	X	X	X
Tyco Electronics	RICS	25-300	Flexible	N	None	RDA	X	X	X	X					
Tyco Electronics	RSTI-36Lxx	400-630	28.9-45.6	Y	RSTI-66CP-M16+RSTI-36Lxx	None				X					X

1) Combination with surge arrester possible with Euromold 156SA with Kabeldon parallel connector PC 630/250

2) Combination with surge arrester possible with Euromold 400PB-XSA

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

6.9 Cable termination

24 kV: Separable connectors interface A with earthing shield, $I_r = 250A$

Manufacturer	Designation	Conductor [mm ²]	XLPE / EPR Ø [mm]
3M	93-EE 605-2/-95	25-95	12.2-25.0
3M	93-EE 615-2/120	120	24.0-27.0
3M	93-EE 615-2/150	150	25.5-28.5
ABB	SOC 250 TP	25-95	12.9-25.8
Euromold	K158LR/G	16-25	12.6-18.7
Euromold	K158LR	25-95	18.4-26.4
nkt cables	EASW 20/250	25-95	17.0-25.0
nkt cables	CE 24-250	25-120	16.9-25.0
Prysmian	FMCE-250	35-95	18.6-26.0
Südkabel	SEW 24	25-95	17.3-25.0
Tyco Electronics	RSES	16-120	13.5-33.5

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 connectors from the different suppliers

24 kV: Separable connectors interface C with earthing shield, $I_r = 630A$

Manufacturer	Designation	Conductor [mm ²]	XLPE / EPR Ø [mm]	Additional equipment for dual cable arrangement	Surge Arrester with	Cable compartment with							
						Single cable + surge arrester				Dual cables			
						Standard Distance A = 360 mm	with window Distance A = 353 mm	Arc proof Distance A = 337 mm	Double cables Distance A = 655 mm	Standard Distance A = 360 mm	with window Distance A = 353 mm	Arc proof Distance A = 337 mm	Double cables Distance A = 655 mm
3M	93-EE 705-6/-95	50-95	15.0-23.5	KU 23.1+93-EE 705-6/-95	MUT 23	X	X	X	X				X
3M	93-EE 705-6/-240	95-240	21.8-32.6	93-EE 718-6/150-240	MUT 23	X	X	X	X	X	X	X	X
ABB	SOC 630-1	50-120	15.0-26.8	PC 630+SOC 630-1	Yes ¹⁾	X	X		X	X	X		X
ABB	SOC 630-1	50-120	15.0-26.8	PC 630+SOC 630-1	Yes ²⁾	X	X	X	X	X	X		X
ABB	SOC 630-2	150-300	21.4-34.9	PC 630+SOC 630-2	Yes ¹⁾	X	X		X	X	X		X
ABB	SOC 630-2	150-300	21.4-34.9	PC 630+SOC 630-2	Yes ²⁾	X	X	X	X	X	X		X
Euromold	K400TB/G	25-300	12.0-37.5	K400CP-SC+K400TB/G	400PB-XSA				X				X
Euromold	K400LB	25-300	12.0-37.5	K400CP-SC+K400TB/G	400PB-XSA	X			X				X
Euromold	K430TB-630	25-300	12.0-37.5	K300PB-630	300PB-10SA	X	X	X	X	X	X	X	X
Euromold	K440TB/G	185-630	23.5-56.0	K440CP+ K440TB/G	400PB-XSA				X				X
nkt cables	CB 24-630	25-300	12.7-34.6	CC 24-630	CSA 24	X	X	X	X	X	X	X	X
nkt cables	CB 24-630 (1250)	400-630	34.0-45.6	CC 24-630 (1250) or CC 24-630	CSA 24	X	X	X	X	X	X	X	X
Prysmian	FMCTs-400	35-300	18.5-35.3	FMPCs-400-24+FMCTs-400	Yes ²⁾				X				X
Prysmian	FMCTs-400/1250	35-630	18.5-47.1	FMPCs-400-24+FMCTs-400/1250	Yes ²⁾				X				X
Südkabel	SET 24	25-240	15.0-32.6	SEHDK 23.1	MUT 23	X	X	X	X	X	X	X	X
Südkabel	SET 24	25-240	15.0-32.6	KU23.2/23+SET 24	MUT 23	X	X	X	X				X
Südkabel	SEHDT 23.1	300	31.9-34.6	KU23.2/23+SEHDT 23.1	MUT 23	X	X	X	X				X
Südkabel	SEHDT 23	300-500	31.9-40.6	None	KU33 + MUT 33				X				
Tyco Electronics	RSTI-L	25-300	12.7-34.6	RSTI-CC-L	RSTI-SA	X	X	X	X	X	X	X	X
Tyco Electronics	RSTI-56Lxx	400-630	34.0-45.6	RSTI-66CP-M16+RSTI-56Lxx	None				X				X

1) Combination with surge arrester possible with Euromold 156SA with Kabeldon parallel connector PC 630/250

2) Combination with surge arrester possible with Euromold 400PB-XSA

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 connectors from the different suppliers

6.10 Capacitive voltage detection / indication



HR-module (VDS)



VPIS

Capacitive voltage indicating system

SafeRing / SafePlus can be supplied with two different types of capacitive voltage indication systems:

1. Voltage Detection System, type HR

SafeRing / SafePlus can be delivered with a voltage Detection System, (VDS) acc. to IEC 61243-5.

Portable voltage indicators, type VIM-1 and VIM-3 can be connected to the coupling system interface, see below for details. The VDS solution is designed and tested for reliable operation in heavily polluted and humid environments.

2. Voltage Presence Indicating System

SafeRing/SafePlus are normally delivered with a voltage Presence Indicating System (VPIS) acc. to IEC 61958.

The coupling system has integrated voltage indicators (LEDs). The VPIS solution is the recommended choice for normal indoor operating conditions.

Coupling system

VDS or VPIS are situated on the front of the switchgear, one for each functional unit.

The voltage condition for each cable terminal is shown by separable (VDS) or integrated (VPIS) voltage indicators. Identification of the phases is achieved by labels on the front of the coupling system /voltage indicator.

Phase balance check

The coupling systems of both solutions VDS and VPIS have connection points for phase balance checking.

If the VDS coupling systems have permanently connected indicators (VIM-3), these must be removed before phase balance checking can be done.

Phase balance checking should be done with a recommended phase comparator, type PCM, (for details see below). PCM can be used for phase balance checking between identical coupling systems (VDS or VPIS).

Particular care should be taken when phase balance checking is done between different coupling systems.

In this case a universal Phase Comparator (VPC acc. to IEC 61243-5) is recommended.

6.10 Capacitive voltage detection / indication



PCM



VIM-3



VIM-1

FF1 type PCM

The PCM-FF1 comparator indicates phasebalance /unbalance between two cubicles. To be used in capacitive Coupling systems, acc.to IEC 61243-5 and/or IEC 61958.

Special features:

No external power supply required.

Voltage indication by flashing LED.

Fully insulated system (IP 68) with cast resin.

Function test 230 V AC or test-equipment

“MAXTEST - S”

Technical data:

Rated frequency 50 / 60 Hz

Length of test lead 1,4 m

Operating temperature -25 -+55 °C

Dimensions, w x h x d

(excl. connectors) 43 x 22 x 20 mm

Enclosure protection IP 68

Weight 40 g

Voltage indicators VIM 1 and VIM 3 for HR-module

The voltage indicators VIM 1 and VIM 3 are used with capacitive outlets based on HR-system, to indicate high voltage in a switchgear. VIM 1 and VIM 3 fulfil the test requirements of IEC 61243-5. The indicators can be delivered in two versions:

VIM 1 for voltage indication in one phase at a time, mobile unit.

VIM 3 for voltage indication in three phases, prepared for permanent mounting in the switchgear.

Special features:

No external power supply required

Voltage indication by red flashing LED's.

Fully insulated system (IP 68) with cast resin and safety pin.

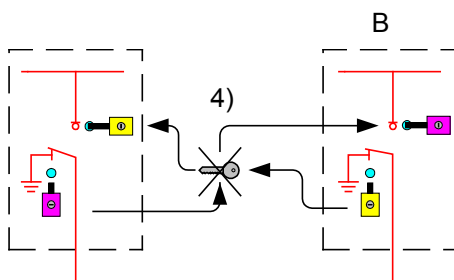
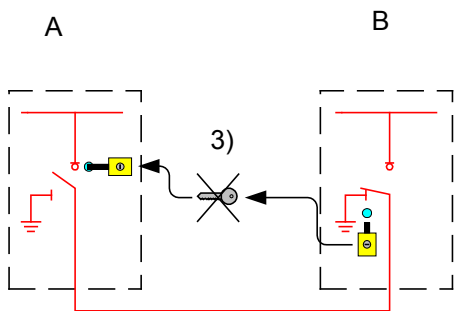
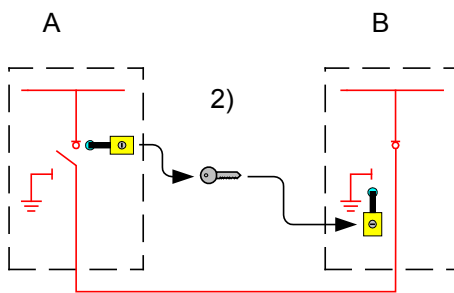
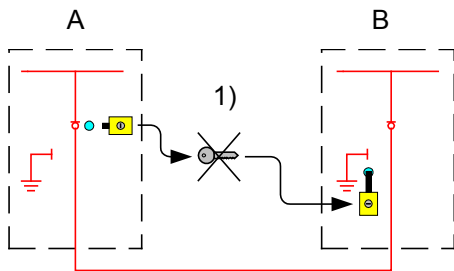
Function test: e.g. test equipment

“ MAXTEST - S”

Technical data VIM 1 and VIM 3	
Rated frequency	50 / 60 Hz
Threshold voltage U	70 – 90 V
Threshold current I	1,62 – 2,5 µA
Capacity to coupling system	74 – 88 pF
Input impedance of indicator	36 – 43,2 MΩ
Operating temperature	-25 - +55 °C
Enclosure protection	IP 68
Dimensions VIM 1, W x H x D (excl. connectors)	43 x 22 x 30 mm
Dimensions VIM 3, W x H x D (excl. connectors)	144 x 28 x 30 mm
Weight VIM 1	40 g
Weight VIM 3	110 g

6.11 Short-circuit indicator

Except for fuse-switch and vacuum breaker, all load break switches, earthing switches and disconnectors may be equipped with Ronis key interlock type EL11AP for one key or EL22 for 2 keys.



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

1) One Ronis key interlock will be mounted close to the operating shaft of the load break switch in switchgear A. An identical Ronis key interlock will be mounted close to the operating shaft of the earthing switch in switchgear B. As long as the load break switch in switchgear A is in closed position, it will be impossible to remove or operate the key in the key interlock.

2) First you have to operate this load break switch in switchgear A to open position.

Then it will be possible to operate this key interlock and turn the key which extends the locking bolt. This will prevent the access to the operating shaft of this load break switch.

Then withdraw the key and insert it into the identical key interlock on the earthing switch of switchgear B.

3) When the key is inserted, you will be able to operate the key interlock and turn the key which will withdraw the extended locking bolt.

Then there will be access to operate this earthing switch to closed position. As long as this earthing switch is in closed position, the key will be captured and make it impossible to close the load break switch in switchgear A.

4) If the load break switch in switchgear B and earthing switch in switchgear A are equipped with another identical Ronis key interlock which has a different key combination than described above, it will be impossible to make an earth connection of an incoming energized cable from neither switchgear A nor B.

Another example for use of Ronis key interlocks is to prevent access to the distribution transformer before the primary side of the transformer is connected to earth. This can be solved

by means of two identical Ronis key interlocks; one mounted on the earthing switch for the distribution transformer feeder and the other one on the door in front of the transformer.

7. Remote control



Equipped with RTU (remote termination unit), the SafeRing & SafePlus series switchgear can implement intelligent application. Connecting all the IRMUs by a communication network, it enable to monitor and control the switchgear remotely, locate and isolate fault automatically as well as the system recovery. This will dramatically reduce the affected area and duration of blackout, and realize the high reliability and excellent power quality.

The SafeRing & SafePlus series switchgear units works with ABB's IDS distribution grid automation systems featuring standard-based open architecture and consisting of substations and automation terminal modules. The automation terminals employs a distributed modular design, and feature high reliability. Meanwhile, the compact form factor allows for easy installation in a compact switchgear unit.

The automation system of IDS is available in two configurations, IDS-MMI and IDS-DAS.

The remote termination unit (RTU) of IDS is also available in two configurations, IDS-F86 and IDS-A814 are two kinds of IDS.

Integrated Control and Monitor Unit (ICMU)

The Safe series switchgear units may implement intelligent upgrading through the built-in IDS terminal modules (F86 and A814).

The RTU of IDS can be mounted in the RTU bay of Safe or in the low voltage cabinet on top of the Safe switchgear unit. Every RTU module includes a RS232 interface and a RS485 interface photoelectrically isolated to each other. The RS232 interface is provided for field testing and RS485 for remote communication. MODBUS or IEC60870-5-101 (DL/T634-1997) protocol may be leveraged in the communication with any remote site.

7. Remote control



IDS-F86

Standard feature set:

- Design for three-way switch unit
- MSP430F1612 hardware platform: high velocity, low work consumption, rich resource
- 16 binary input, 1500 VDC of isolation voltage
- 8 analog input, including 4 current values (5AAC), 4 voltage values (1*24VDC, 3*100VAC/220VAC)
- 6 binary output (remote control, for up to 3 switching actions), C-form relay, 250VAC8A/30VDC8A
- 1*RS485 interface for remote communication up to 1,200m
- 4 alternative baudrates: 9,600bps, 4,800bps, 1,200 bps and 600bps
- CAN main line communication with Hilon B stipulation velocity rate is 10, 20, 50, 100, 250, 500k bps
- 64 SOEs
- Operating temperature: -25~+70°C
- Operating voltage: 24VDC±20%, 5W

Optional:

- Energy counters
- 4 telemetry counters (digit adjustable)
- BCD code analyzer
- Double telemetry

7. Remote control



Intelligent substation IDS-DTU51

Standard functions:

- Designed for 5-way switchboard;
- Directly view and operate on interface plate;
- TMS320F2812 hardware platform, dual CPU system, quick response;
- Can be used for the power system of single bus with a sectional switch;
- 26 digital inputs, single remote signaling, isolation voltage 1500 VDC;
- Analog input: 3*5 currents (5AAC, 1AAC optional), 6 AC voltages (3*100VAC, 220VAC optional), class 0.5;
- 2 DC voltage inputs, 10-36, class 1.0;
- Each pair of 2 current and voltage inputs co-work to implement electricity vector calculation with precision being up to class 1.0;
- 13 digital outputs (time remain adjustable), C-type contact, 250VAC8A, 30VDC8A;
- 1 RS485 COM port for remote communication within a range of up to 1200m;
- 5 optional communication rates: 1200, 4800, 9600, 19200, 38400 bps
- Integrated CAN bus interface, Hilon B Protocol, rates: 10, 20, 50, 100, 250, 500k bps;
- Front RS232 interface for local debugging;
- 80 SOE sequential event records, 20 local SOEs;
- Temperature range: -15°C +70°C ;
- Two optional operation power supplies: 24VDC±20%, 12W; or 85_265V AC/DC,15VA.

Expanded function:

- 5 digital pulse counts, 65535 each;
- 4 remote signal shifting techniques: 65535 each;
- Relay output hold-up time adjustable: 0.2-99 s;
- Analogue limit alarm functionality.

Intelligent substation IDS-MMI

Features:

- PC104 busbar architecture
- 100MHz, 32-bit CPU
- VxWORKS real-time embedded OS
- Software and hardware watchdog
- 2*RS232 interfaces for communication with upper-level management system
- Implementing two communication plates for terminal communication, optional function combinations:

7. Remote control

Com- bination	Com- bination 1	Com- bination 2	Com- bination 3	Com- bination 4	Com- bination 5	Com- bination 6
Slot1	4 RS485s	1 Profi- bus DP	2CANs	4RS485s	4RS485s	1Profi- bus DP
Slot2	4RS485s	1Profi- bus DP	2CANs	1Profi- bus DP	2CANs	2CANs

- Communication protocol: DL/T451-91, IEC60870-5-101, MODBUS, SPA, IEC60870-5-104, Hilon B
- Real-time multi-task processing
- BIT at power-on
- Automatic fault location, isolation, and restructuring of 2 typical single rings
- 6.4-inch color LCD hard connected to PC
- LCD automatic/manual turn-on/off
- Keypad, mouse, floppy disk drive, etc.
- 5 alternative baudrates: 9,600bps, 4,800bps, 1,200 bps , 19,200 and 38,400bps
- Nonvolatile SOE
- Operating temperature: 0~+55°C
- Operating voltage: 24VDC±20%, 25W (excluding monitor)Intelligent substation IDS-MMI

Optional:

- LCD featuring wide temperature range: 50W, -25~+70°C
- No LCD: -25~+70°C
- SNMP trap (RTU cooperation needed)
- Other communication protocols
- 2*MMIs cascading
- Automation of 2 additional rings
- Inter-MMI ring control

Multi-function Substation IDS-DAS

Features:

- Standard industry processor
- Windows 2000 OS
- Software and hardware watchdog
- 2*RS232 interfaces for communication with upper-level management system
- 12*RS485 interfaces for communication with lower-level management system
- Communication protocols: DL/T451-91, IEC60870-5-101, MODBUS, SPA, IEC60870-5-104, Hilon B
- Real-time multi-task processing
- Automatic fault location, isolation, restructuring of 8 typical single rings
- 4 alternative baudrates: 9,600bps, 4,800bps, 1,200 bps and 600bps
- Nonvolatile SOE
- Operating temperature: 0~+40°C
- Operating voltage: 220VAC±10%, 200W

Optional:

- NMP trap (RTU cooperation needed)
- Other communication protocols
- Cascading of two substations

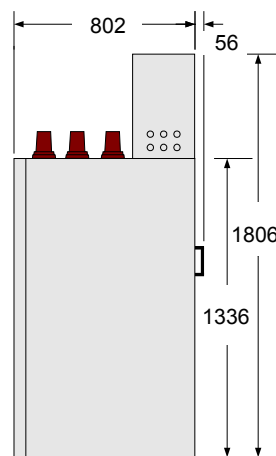
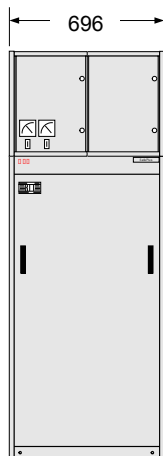
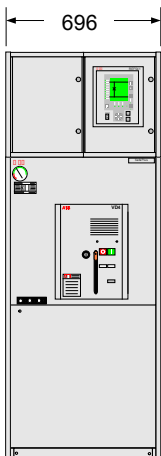
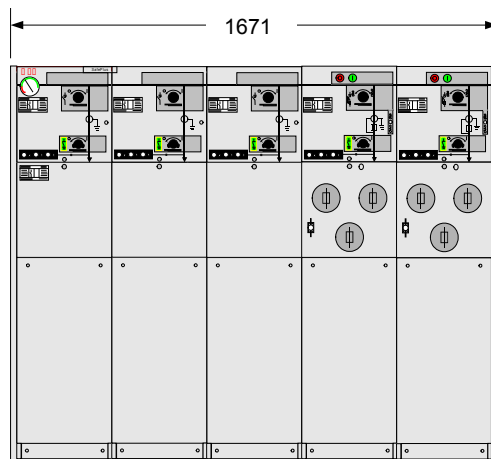
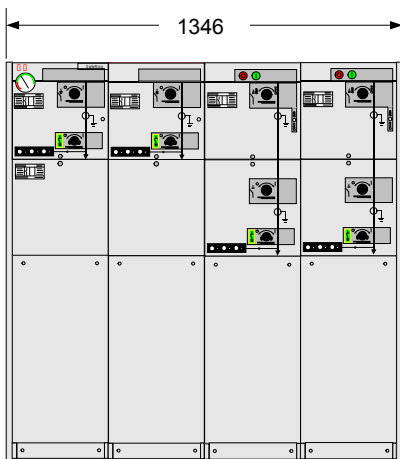
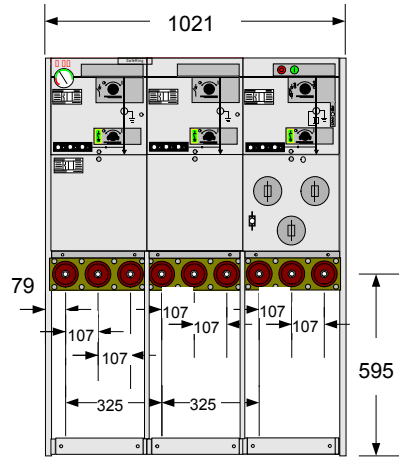
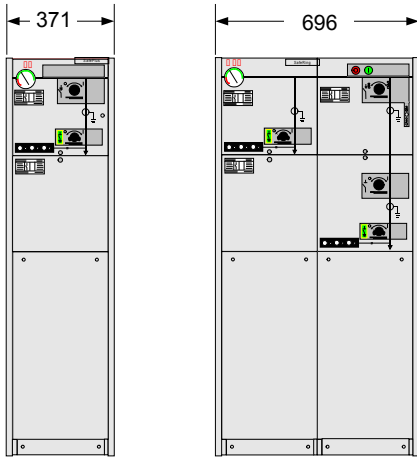
Other automation terminal module

IDS-A814,IDS-S/B8,IDS-C6/V6.

For more functions please refer to IDS Monitoring System catalogue published by ABB High Voltage Swithgear Co.,Ltd.,Beijing.

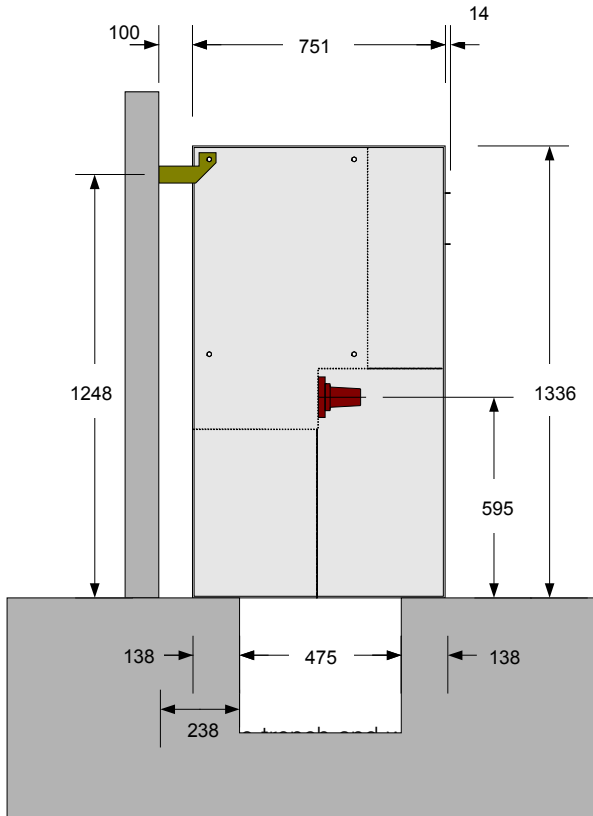
8. Dimensions

8.1 Standard units

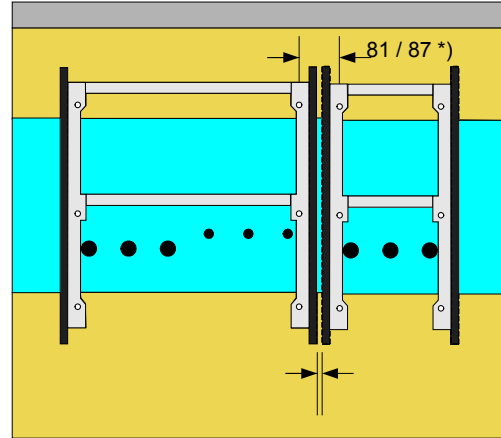


Metering module M, front view and side view right

8.2 Floor and wall fixing including cable entry



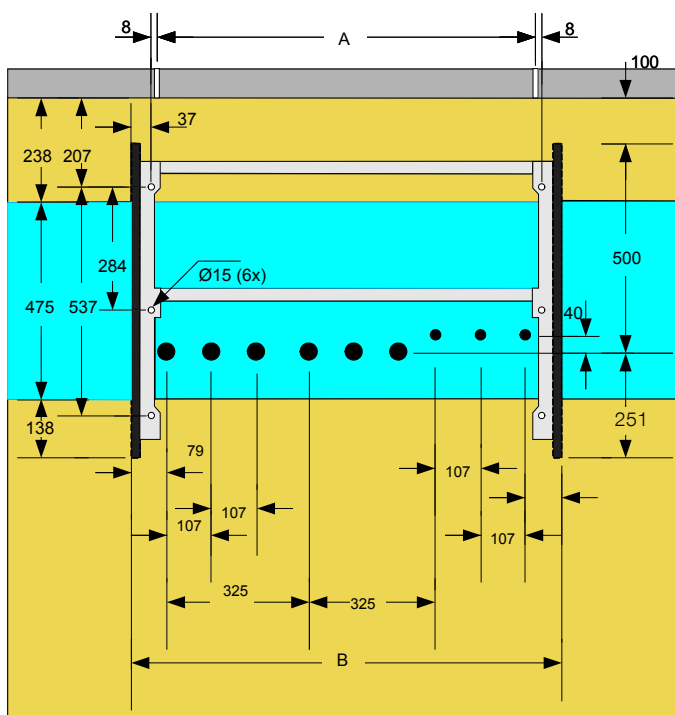
Cable trench and wall fixing



Distance between two units which are connected to each other by means of external busbars

● Indicates cable entry

*) Top extension - 8 mm / 81 mm
Side extension - 14 mm / 87 mm



Floor and wall fixing including cable entry

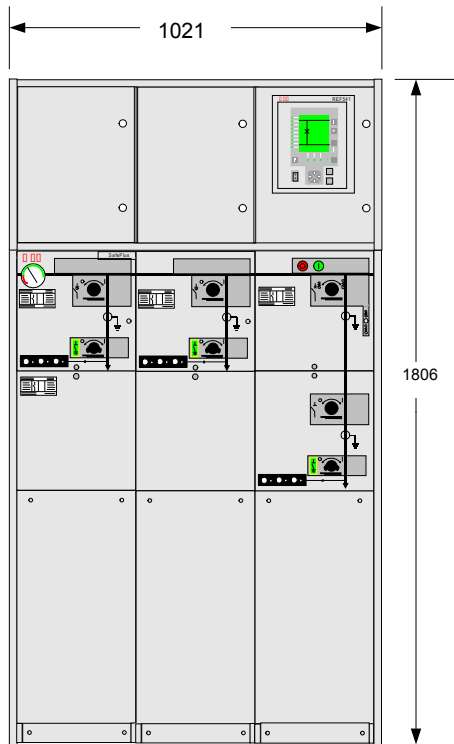
Unit	A	B
1-way	281	371
2-way	606	696
3-way	931	1021
4-way	1256	1346
5-way	1581	1671

3-way unit with cable bushings Interface C (400 series bolted) for module 1 and 2 and cable bushings Interface A (200 series plug-in) for module 3.

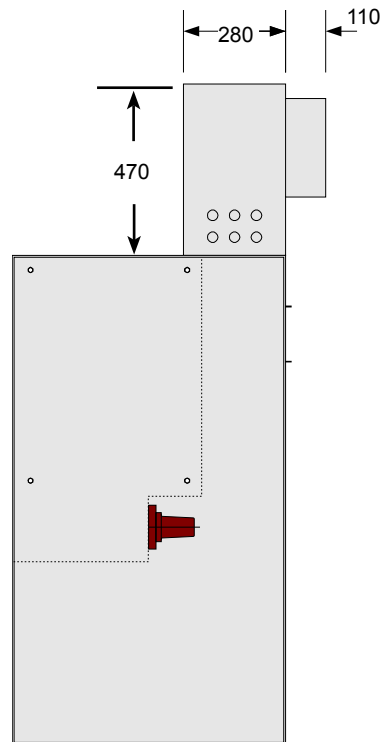
● Indicates cable entry

8.3 Low voltage compartment with relay

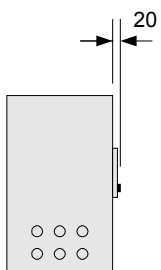
Low voltage compartment with relay



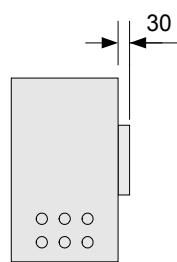
Low voltage compartment with REF 541



Low voltage compartment with REF 541



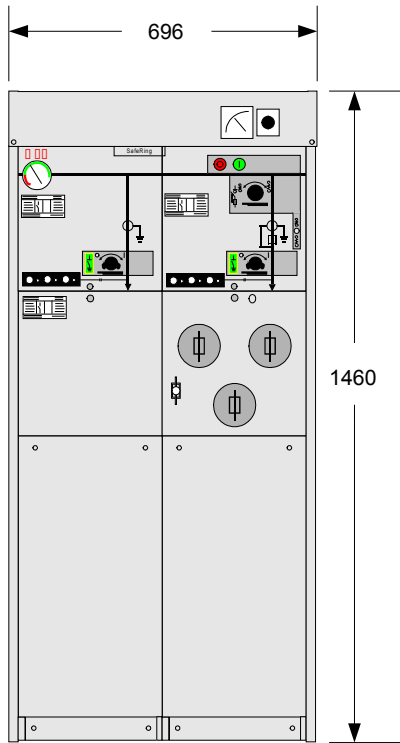
Low voltage compartment with REF 542plus



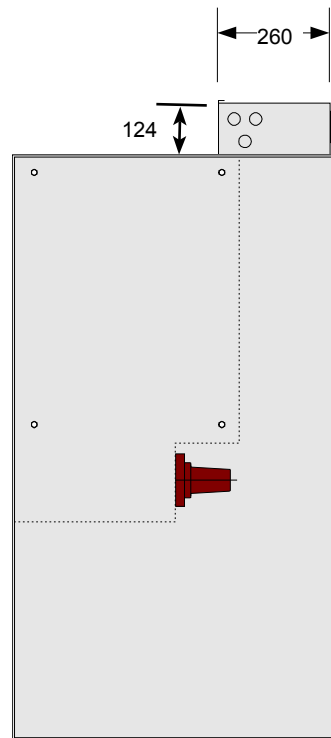
Low voltage compartment with REF 610

8.4 Floor and wall fixing including cable entry

Top entry box



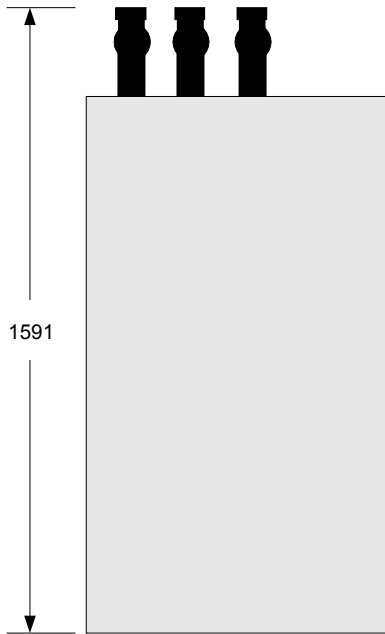
Top entry box with ammeter and position switch



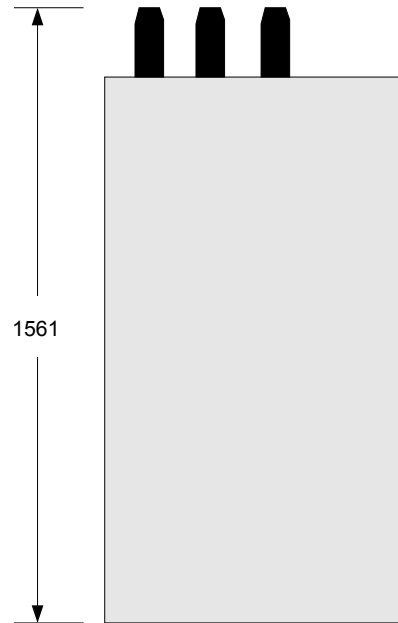
Top entry box - side view

8.5 Low voltage compartment with relay

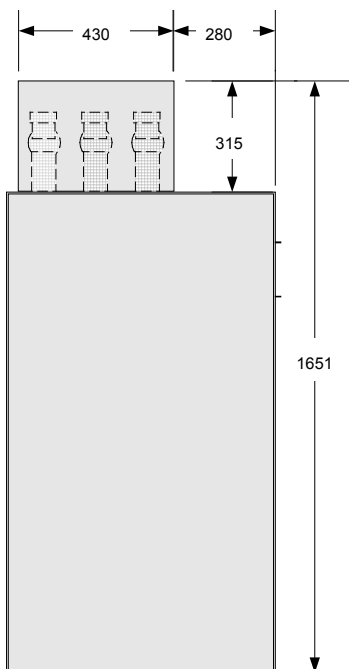
External busbars



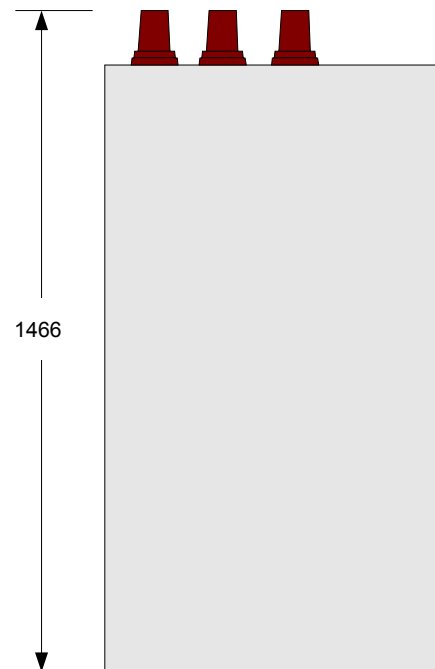
External busbars



Prepared for future extension with
dead end receptacles



Busbar cover

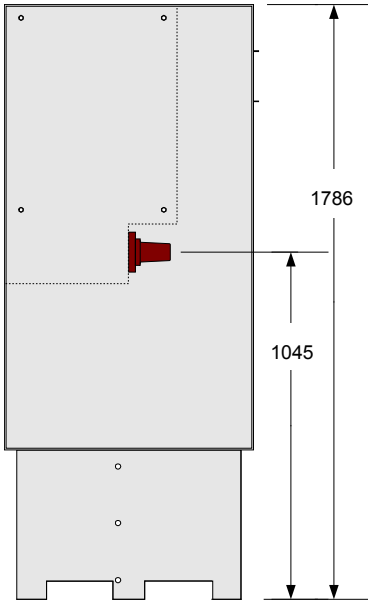


Product catalogue | Dimensions

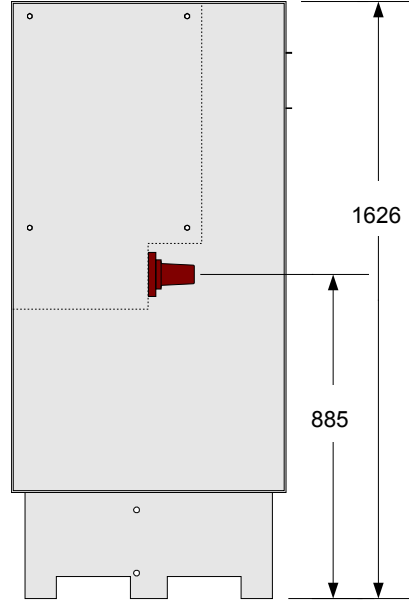
8.6 Base frames

8.7 Special cable compartment covers

Base frames

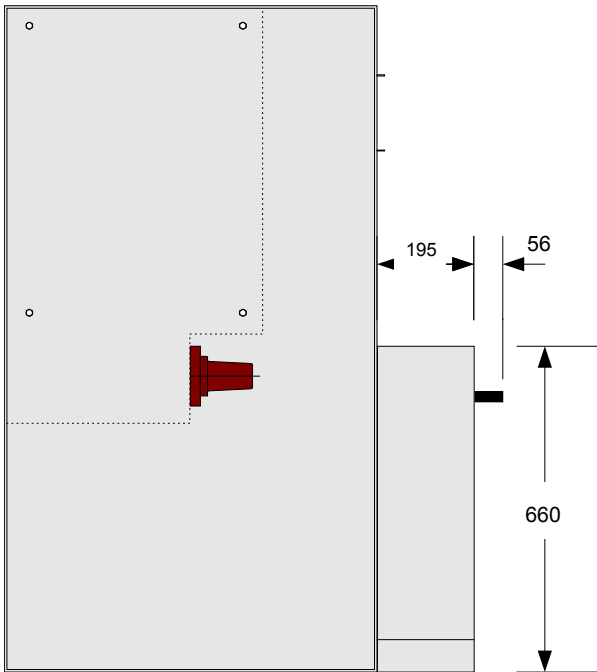


Base frame, height 450 mm

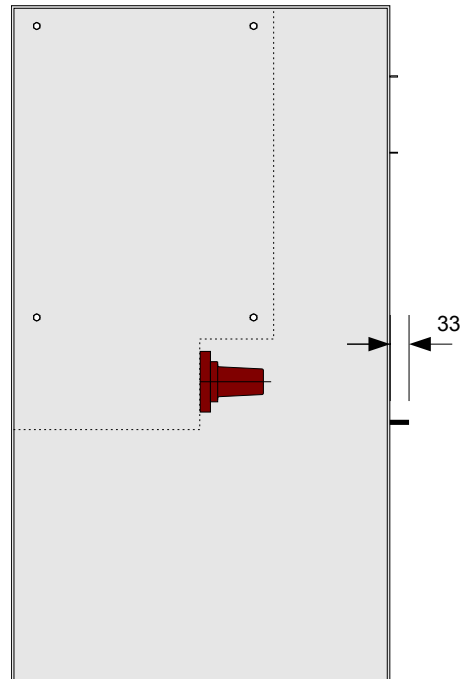


Base frame, height 290 mm

Special cable compartment covers



Cable compartment cover for parallel cables



Arc proof cable compartment cover

9. Low voltage compartment with relay

9.1 Codes and standards

Codes and standards

SafeRing and SafePlus are manufactured and tested in accordance with the latest version of:

IEC 60694	Common specifications for high-voltage switchgear and controlgear standards
IEC 62271-100	High-voltage switchgear and controlgear - Part 100: High-voltage alternating-current circuit-breakers
IEC 62271-102	High-voltage switchgear and controlgear - Part 102: Alternating current disconnectors and earthing switches
IEC 62271-105	High-voltage switchgear and controlgear - Part 105: Alternating current switch-fuse combinations
IEC 62271-200	High-voltage switchgear and controlgear - Part 200: A.C. metal-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV
IEC 60265-1	High-voltage switches- Part 1: Switches for rated voltages above 1 kV and less than 52 kV
IEC 60529	Degrees of protection provided by enclosures (IP code)

9.2 SafeRing, electrical data

SafeRing - Ring Main Unit, electrical data

Electrical data and service conditions							
1	Rated voltage	U_r	kV	12	15	17,5	24
2	Rated power frequency withstand voltage	U_d	kV	28	38	38	50
	- across disconnector		kV	32	45	45	60
3	Rated lightning impulse withstand voltage	U_p	kV	95	95	95	125
	- across disconnector		kV	110	110	110	145
4	Rated frequency	f_r	Hz	50/60	50/60	50/60	50/60
5	Rated normal current (busbars)	I_r	A	630	630	630	630
6	Rated normal current (cable switch)	I_r	A	630	630	630	630
7	Rated normal current (switch-fuse-disconnector)	I_r	A	200 ¹⁾	200 ¹⁾	200 ¹⁾	200 ¹⁾
8	Rated normal current (vacuum circuit-breaker)	I_r	A	200	200	200	200
9	Rated short-time withstand current	I_k	kA	21 ³⁾	21 ³⁾	16 ³⁾	16 ³⁾
10	Rated duration of short-circuit	t_k	s	3	3	3	3
11	Rated peak withstand current	I_p	kA	52,5	52,5	40	40
	<i>Making and breaking capacities C-module:</i>						
12	Rated mainly active load breaking current	I_1	A	630	630	630	630
13	Number of operations for mainly active load breaking	n		100	100	100	100
14	Rated distribution line closed-loop breaking current	I_{2a}	A	630	630	630	630
15	Rated no-load transformer breaking current	I_3	A	20	20	20	20
16	Rated single capacitor bank breaking current	I_{4c}	A	135	135	135	135
17	Rated earth fault breaking current	I_{6a}	A	200	150	150	150
18	Rated cable- and line-charging breaking current under earth fault conditions	I_{6b}	A	115	87	87	87
19	Rated short-circuit making current	I_{ma}	kA	52,5	52,5	40	40
	<i>Making and breaking capacities F-module:</i>						
20	Rated mainly active load breaking current	I_1	A	200	200	200	200
21	Number of operations for mainly active load breaking	n		100	100	100	100
22	Rated no-load transformer breaking current	I_3	A	20	20	20	20
23	Rated making capacity ²⁾	I_{sc}	kA	21	21	16	16
24	Rated making capacity (downstream earthing switch)	I_{ma}	kA	12,5	12,5	12,5	12,5
25	Rated short-time current (downstream earthing switch)	I_k	kA	5	5	5	5
26	Rated duration of short-circuit	t_k	s	1	1	1	1
	<i>Making and breaking capacities V-module:</i>						
27	Rated mainly active load breaking current	I_1	A	200	200	200	200
28	Rated short-circuit breaking current	I_{sc}	kA	16	16	16	16
29	Rated cable-charging breaking current	I_c	A	31,5	31,5	31,5	31,5
30	Rated short-time current (earthing switch)	I_k	kA	16	16	16	16
31	Rated short-circuit making current (earthing switch)	I_{ma}	kA	40	40	40	40
32	Rated filling level for insulation	P_{re}	MPa	0,04	0,04	0,04	0,04
	Service conditions for indoor equipment according to IEC 60694						
	Ambient temperature ⁴⁾						
33	Maximum value		°C	+40	+40	+40	+40
34	Maximum value of 24 hours mean		°C	+35	+35	+35	+35
35	Minimum value		°C	-25	-25	-25	-25
36	Altitude for installation above sea level ⁵⁾		m	1500	1500	1500	1500
37	Relative humidity			max 95%	max 95%	max 95%	max 95%

1) T-off fuse module: depending on the current rating of the fuse

2) T-off fuse module: limited by high voltage fuse-links

3) Valid with Interface C bushings (400 series bolted type) only

4) Derating allows for higher maximum temperature

5) For installation above 1500 m, reduced gas pressure is required

9.3 SafePlus, electrical data

SafePlus - Compact Switchgear, electrical data

Electrical data and service conditions							
1	Rated voltage	Ur	kV	12	15	17,5	24
2	Rated power frequency withstand voltage	Ud	kV	28	38	38	50
	- across disconnector		kV	32	45	45	60
3	Rated lightning impulse withstand voltage	Up	kV	95	95	95	125
	- across disconnector		kV	110	110	110	145
4	Rated frequency	fr	Hz	50/60	50/60	50/60	50/60
5	Rated normal current (busbars)	Ir	A	630	630	630	630
6	Rated normal current (external busbars)	Ir	A	1250	1250	1250	1250
7	Rated normal current (cable switch)	Ir	A	630	630	630	630
8	Rated normal current (switch-fuse-disconnector)	Ir	A	200 1)	200 1)	200 1)	200 1)
9	Rated normal current (vacuum circuit-breaker)	Ir	A	200 / 630	200 / 630	200 / 630	200 / 630
10	Rated short-time withstand current	Ik	kA	25 / 21 3)	21 3)	21 3)	21 3)
11	Rated duration of short-circuit	tk	s	1 / 3	3	3	3
12	Rated peak withstand current	Ip	kA	62,5 / 52,5	52,5	52,5	52,5
	Making and breaking capacities C-module:						
13	Rated mainly active load breaking current	I1	A	630	630	630	630
14	Number of operations for mainly active load breaking	n		100	100	100	100
15	Rated distribution line closed-loop breaking current	I2a	A	630	630	630	630
16	Rated no-load transformer breaking current	I3	A	20	20	20	20
17	Rated single capacitor bank breaking current	I4c	A	135	135	135	135
18	Rated earth fault breaking current	I6a	A	200	150	150	150
19	Rated cable- and line-charging breaking current under earth fault conditions	I6b	A	115	87	87	87
20	Rated short-circuit making current	I _{ma}	kA	62,5	52,5	50	50
	Making and breaking capacities F-module:						
21	Rated mainly active load breaking current	I1	A	200	200	200	200
22	Number of operations for mainly active load breaking	n		100	100	100	100
23	Rated no-load transformer breaking current	I3	A	20	20	20	20
24	Rated making capacity 2)	I _{sc}	kA	25	21	20	20
25	Rated making capacity (downstream earthing switch)	I _{ma}	kA	12,5	12,5	12,5	12,5
26	Rated short-time current (downstream earthing switch)	Ik	kA	5	5	5	5
27	Rated duration of short-circuit	tk	s	1	1	1	1
	Making and breaking capacities V-module:						
28	Rated mainly active load breaking current	I1	A	200 / 630	200 / 630	200 / 630	200 / 630
29	Rated short-circuit breaking current	I _{sc}	kA	21	21	16	16
30	Rated cable-charging breaking current	Ic	A	31,5	31,5	31,5	31,5
31	Rated short-time current (earthing switch)	Ik	kA	21	21	16	16
32	Rated short-circuit making current (earthing switch)	I _{ma}	kA	52,5	52,5	40	40
33	Rated filling level for insulation	Pre	MPa	0,04	0,04	0,04	0,04
	Service conditions for indoor equipment according to IEC 60694						
	Ambient temperature 4)						
34	Maximum value		°C	+40	+40	+40	+40
35	Maximum value of 24 hours mean		°C	+35	+35	+35	+35
36	Minimum value		°C	-25	-25	-25	-25
37	Altitude for installation above sea level 5)		m	1500	1500	1500	1500
38	Relative humidity			max 95%	max 95%	max 95%	max 95%

1) T-off fuse module: depending on the current rating of the fuse

2) T-off fuse module: limited by high voltage fuse-links

3) Valid with Interface C bushings (400 series bolted type) only

4) Derating allows for higher maximum temperature

5) For installation above 1500 m, reduced gas pressure is required

9.4 SafeRing and SafePlus, general data

General data, enclosure and dimensions

1	Type of ring main unit (RMU) and compact switchgear (CSG)	Metal-enclosed switchgear and controlgear according to IEC 62271-200		
2	Number of phases	3		
3	Type-tested RMU and CSG	Yes		
4	Pressure test on equipment tank or containers	2.64 bar abs		
5	Facility provided with pressure relief	Yes		
6	Insulating gas	SF ₆		
7	Nominal operating gas pressure	1.4 bar abs 20°C		
8	Gas leakage rate / annum	0,1%		
9	Expected operating lifetime	30 years		
10	Facilities provided for gas monitoring	Yes, temperature compensated manometer can be delivered		
11	Material used in tank construction	Stainless steel sheet, 3 mm		
12	Busbars	240 mm ² Cu		
13	Earth bar (external)	120 mm ² Cu		
14	Earth bar bolt dimension	M10		
	Overall dimensions of the fully assembled RMU	Height	Depth	Width
		mm	mm	mm
15	2-way unit	1336	765	696
16	3-way unit	1336	765	1021
17	4-way unit	1336	765	1346
	CSG (2, 3 and 4 way units as RMU) with additional height for optional low voltage compartment (470 mm)			
18	1-way unit	1336	765	371
19	5-way unit	1336	765	1671
20	Distance between units when external extension is used	8 mm		
21	Distance between units when side extension is used	14 mm		

9.5 SafeRing and SafePlus, general data

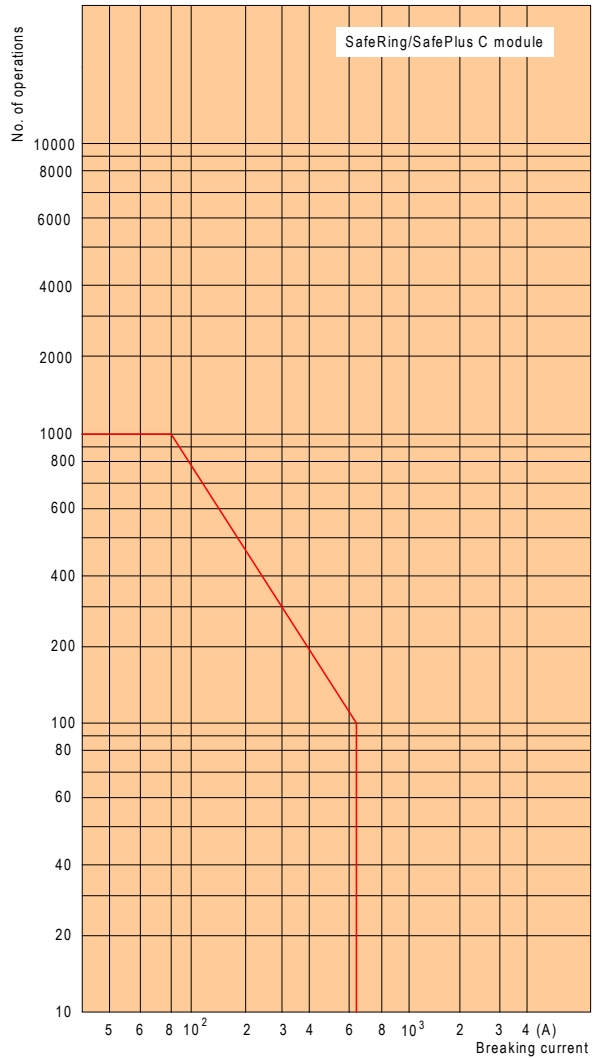
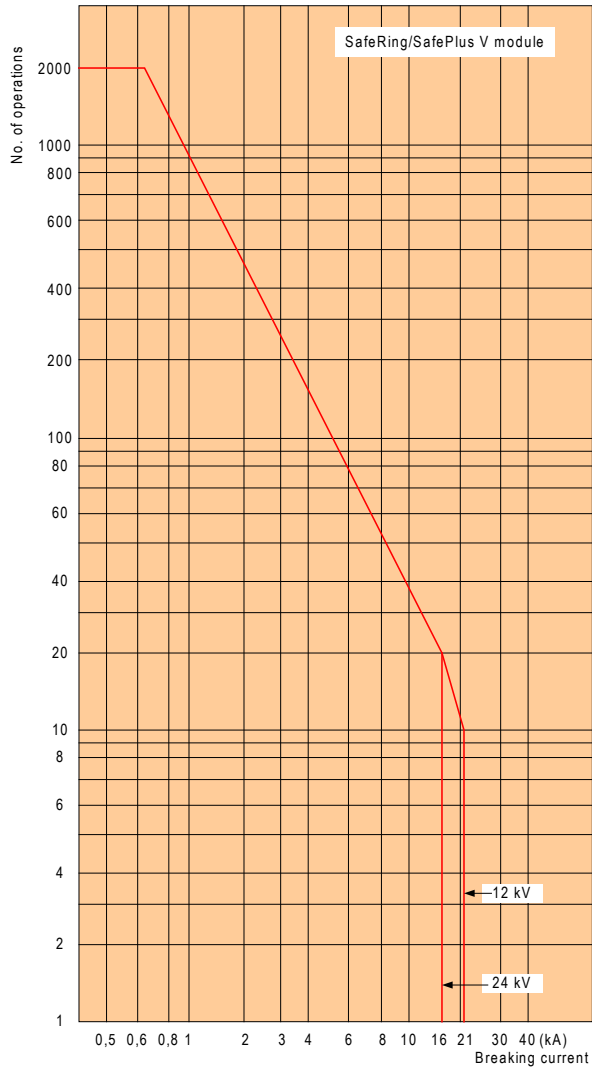
Operations, degree of protection and colours

1	Means of switch operation	separate handle
2	Means of fuse switch/circuit-breaker operation	separate handle and push buttons
3	Rated operating sequence of circuit-breaker (V-module)	O – 3 min – CO – 3 min – CO
4	Rated operating sequence of circuit-breaker (CB-module)	O – 0,3 s – CO – 3 min – CO
5	Total opening time of circuit-breaker	approx. 75 ms
6	Closing time of circuit-breaker	approx. 40 – 60 ms
7	Mechanical operations of switch	1000 CO
8	Mechanical operations of earthing switch	1000 CO
9	Mechanical operations of circuit-breaker (V-module)	2000 CO
10	Mechanical operations of circuit-breaker (CB-module)	30000 CO
11	Principle switch-disconnector and earthing switch	3 position combined switch-disconnector and earthing switch
	Load break switch:	
12	Rated operations on short circuit current (class E3)	5
13	Rated operations mainly active load (class E3)	100
	Degree of protection:	
14	High voltage live parts, SF ₆ tank	IP 67
15	Front cover mechanism	IP 2XC
16	Cable covers	IP 3X
17	Protection class of fuse compartment	IP 67
	Colours:	
18	Front covers	RAL 7035
19	Side and cable covers	RAL 7035

Fuses, cable compartment

1	Standard fuse-link length	442 mm. Shorter fuse-links can be used with fuse adapter
2	Standard dimensions	According to DIN 43625
3	Maximum size 12kV	125 A
4	Maximum size 24kV	63 A
	Cable box for heat shrinkable termination:	
5	Phase to phase clearance	107 mm
6	Phase to earth clearance	54,5 mm
7	Phase to earth over insulator surface (creepage)	120 mm
8	Type of cable termination adapters	Elbow or T-connector

9.6 Weight table



Weight table

The units are delivered from the factory ready for installation

Maximum weights for standard SafeRing:

2-way DV	300 kg	2-way DF	300 kg
3-way CCV	450 kg	3-way CCF	450 kg
4-way CCCV	600 kg	4-way CCCF	600 kg
3-way CCC	450 kg	4-way CCFF	600 kg
4-way CCCC	600 kg	5-way CCCCCF	700 kg
		6-way CCCCCC	750 kg

SafePlus

Standard 1-way	150 kg
2-, 3- and 4-way	as for SafeRing
5-way	750 kg
M – metering module	250 kg

10. Environment

Environmental Declaration

Life expectancy of product

The product is in compliance with the requirements denoted by IEC 62271-200. The design incorporates a life span under normal "indoor service conditions" (IEC 60694 subclause 2.1.1). The switchgear is gas-tight and classified as sealed pressure system*) with an expected operating life exceeding 30 years and a diffusion rate of less than 0.1 % per year (IEC 60694 subclause 5.15 and annex E). Referring to the filling pressure of 1.4 bar, the switchgear will maintain gas-tightness and a gas-pressure better than 1.35 bar**) throughout its operating life.

*) No topping up required during operating life

**) at 20°C

Recycling capability

Raw material	Weight	% of total weight -320kg	Recycle	Environmental effects & recycle / reuse processes
Iron	132,80 kg	42,53%	Yes	Separate, utilise in favour of new source (ore)
Stainless steel	83,20 kg	24,93%	Yes	Separate, utilise in favour of new source (ore)
Copper	43,98 kg	14,09%	Yes	Separate, utilise in favour of new source (ore)
Brass	2,30 kg	0,74%	Yes	Separate, utilise in favour of new source (ore)
Aluminium	8,55 kg	2,74%	Yes	Separate, utilise in favour of new source (ore)
Zinc	3,90 kg	1,25%	Yes	Separate, utilise in favour of new source (ore)
Silver	0,075 kg	0,024%	Yes	Electrolysis, utilise in favour of new source
Thermoplastic	5,07 kg	1,63%	Yes	Make granulate, reuse of apply as energy superior additive in refuse incineration
Epoxy incl. 60% quartz	26,75 kg	8,35%	Yes	Grind to powder and use as high-grade energy additive in cement mill
Rubber	1,35 kg	0,42%	Yes	High-grade energy additive in refuse incineration
Dielectric coil	0,21 kg	0,066%	Yes	Reclaim or use as high-grade energy additive in refuse incineration
SF ₆ gas	3,24 kg	1,04%	Yes	ABB AS in Skien is equipped to reclaim used SF ₆ gas
Total for recycling	311,44 kg	97,25%		
Not specified*	9,00 kg			*Stickers, film-foils, powder coating, screws, nuts, tiny components, grease...
Total weight**	320,00 kg	100%		
Packing foil	0,2 kg		Yes	High-grade energy additive in refuse incineration
Wooden pallet	21,5 kg		Yes	Reuse or use as energy additive in refuse incineration

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

End-of-life

ABB 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 switchgear at end-of-life. ABB's recycling service is according to IEC 61634 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.»

We also recommend ABB's website : <http://www.abb.com/sf6> .ABB AS, Power Products Division in Skien is equipped to reclaim SF₆ gas from discarded switchgear.

Contact us

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Information given in this publication is generally applicable to equipment described. Changes may be made in future without notice.

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