Product catalogue

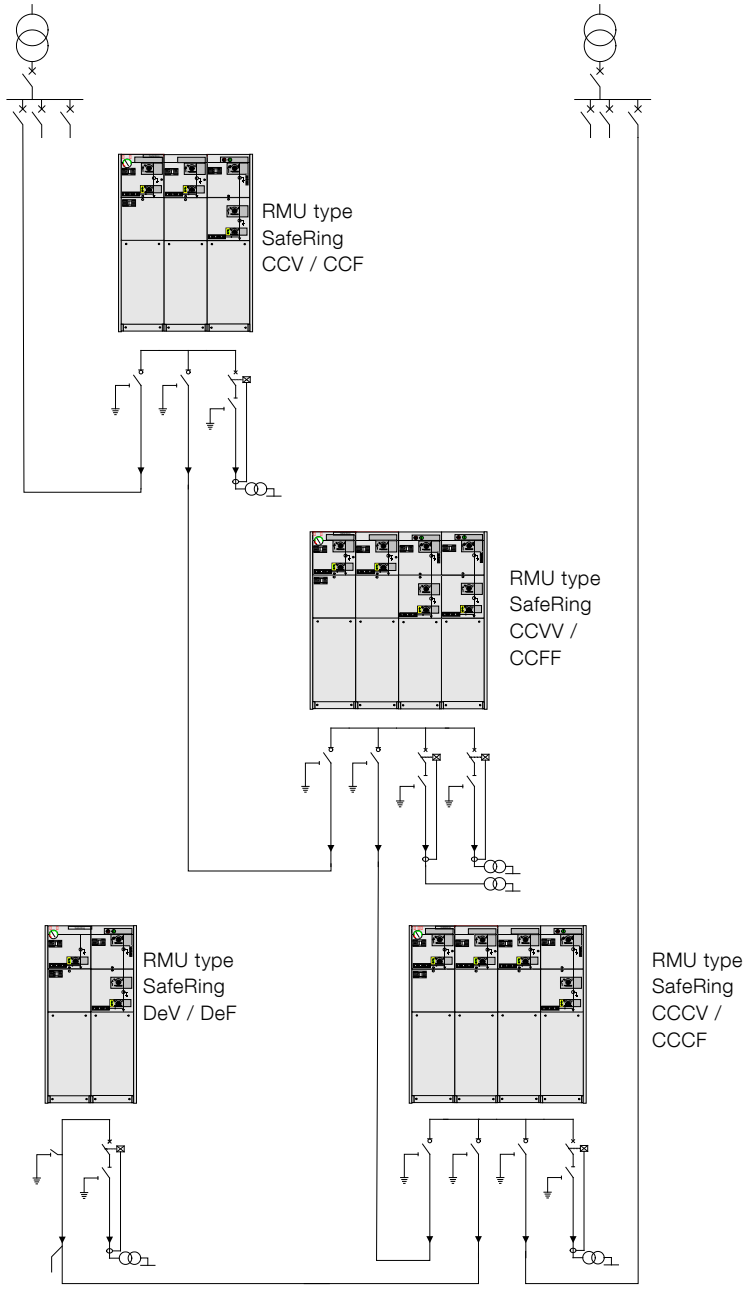
ABB AS, Power Products Division
SF_6-insulated Ring Main Unit type SafeRing 12 - 24 kV and SF_6-insulated Compact Switchgear type SafePlus 12 - 24 kV

Power and productivity
for a better world™

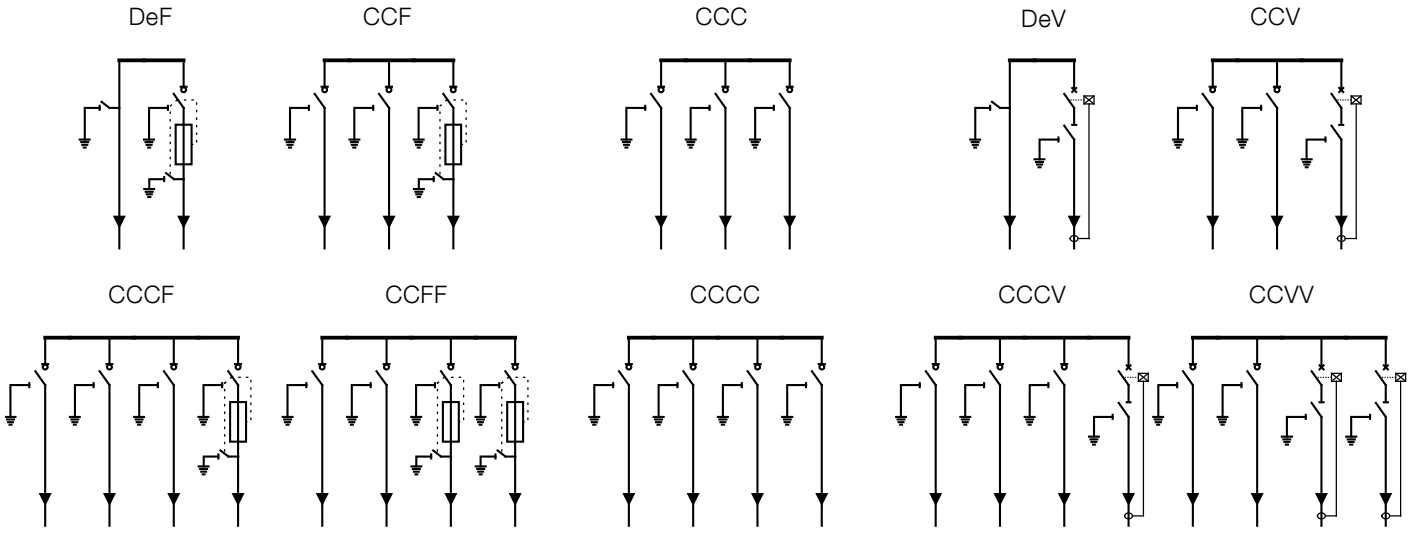
Content

Applications SafeRing

SafeRing installed in Compact Secondary Substations



Applications SafeRing



SafeRing is a ring main unit for the secondary distribution network. SafeRing can be supplied in 10 different configurations suitable for most switching applications in 12/24 kV distribution networks. It is extendible 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 a completely sealed system with a stainless steel tank containing all living parts and switching functions. A sealed steel tank with constant atmospheric conditions ensures a high level of reliability as well as personnel safety and a virtually maintenance-free system.

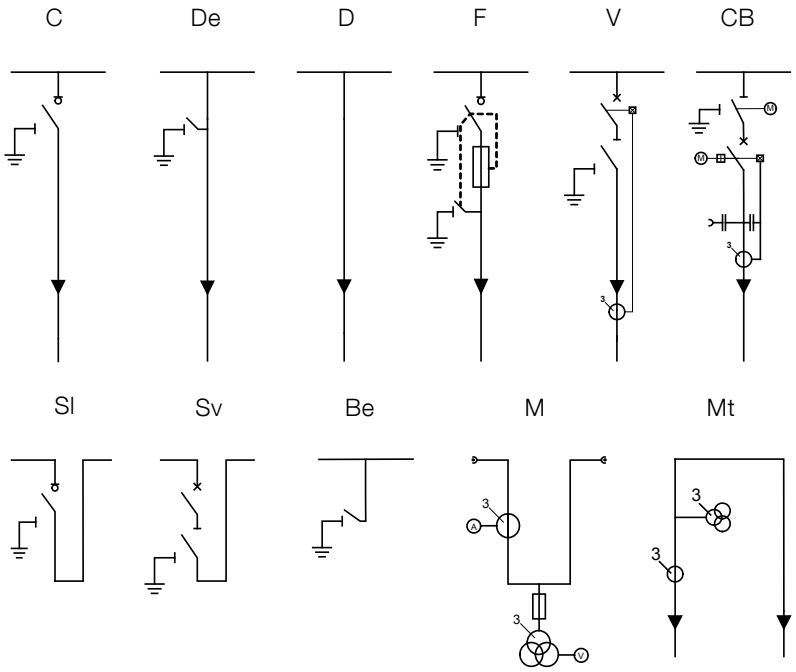
The SafeRing concept offers a choice of either a switch fuse combination or circuit breaker with relay for protection of the transformer. As the first ring main unit, SafeRing can be supplied complete with an integral remote control and monitoring unit.

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

Available modules:

C	Cable Switch
De	Direct Cable Connection with Earthing Switch
F	Switch Fuse-Disconnector
V	Vacuum Circuit-Breaker

Applications SafePlus

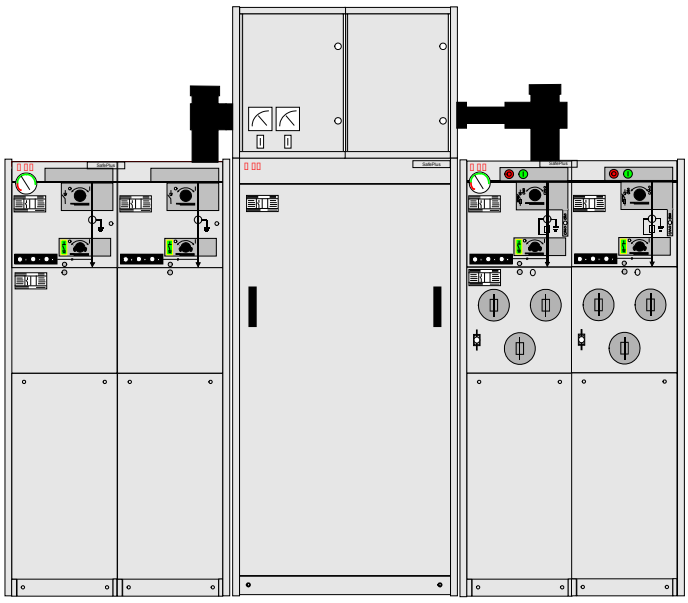


SafePlus is designed for use in the following applications:
- Compact secondary substations
- Small industries
- Wind power plants
- Hotels, shopping centres, office buildings, business centres etc.
- Light mining applications, airports, hospitals, tunnels and underground railways

Available modules:

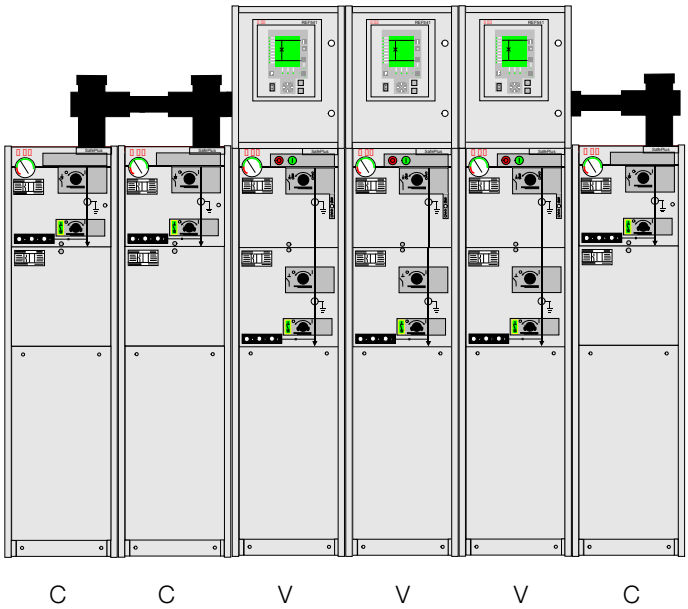
C	Cable Switch
De	Direct Cable Connection with earthing
D	Direct Cable Connection
F	Switch-Fuse Disconnector
V	Vacuum Circuit breaker
Be	Busbar earthing
Sl	Busbar Sectionalizer, load break switch
Sv	Busbar Sectionalizer, vacuum circuit breaker
CB	Circuit-breaker module
M	Metering Module
Mt	Metering tariff module

Applications SafePlus



SafePlus compact switchgear consisting of:

- 2-ways section with 2 modules of cable switches
- air-insulated metering module
- 2-ways 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

Design philosophy

SafeRing and SafePlus – ABB switchgear for secondary distribution

Secondary distribution switchgears have been subject to a significant development 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 optimized switchgear operation. The functionality will always find its background from customer demands.

Personnel – safety and service

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

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

We are responsible for the environment

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

SafeRing configurations

General

SafeRing is a ring main unit for the secondary distribution network. SafeRing can be supplied in 10 different configurations suitable for most switching applications in 12/24 kV distribution networks. SafeRing can as an option be delivered as extendable rong 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 a switch fuse combination or circuit breaker with relay for protection of the transformer. SafeRing can be supplied with an integrated remote control and monitoring unit.

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
- All 3- and 4-way units are designed for the subsequent fitting of an integral remote control and monitoring unit

Optional features

- Bushings for connection of external busbar on top of RMU
- Bushings for side connection (400A) (C-, F- and De-modules only)
- Bushings for cable testing, incl. earthing device (C- and De- modules only)
- Cable bushings (Interface A, B, C and D)
- Cable compartment front cover interlocked with earthing switch
- Interlocking of compartment for cable test bushings
- 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)
- Latched single spring mechanism for ring cable switch

Optional features also available as retrofit

- Manometer for SF6 pressure monitoring (temperature compensated)
- Integrated control and monitoring unit (ICMU)
- Integrated battery and charger

- Motor operation
- Trip coil open
- Trip coil open and close

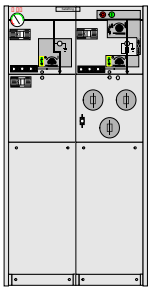
- Aux. switch for load break switch position 2NO + 2NC
- Aux. switch for vacuum circuit breaker position 2NO + 2NC
- Aux. switch for disconnected position 2NO + 2NC
- Aux. switch for earth switch position 2NO + 2NC
- Aux. switch for fuse blown 1NO
- Vacuum circuit breaker tripped signal 1NO

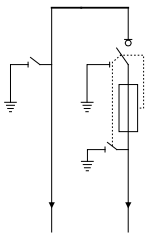
- Capacitive voltage indicating system
- Short circuit indicator

- Cable cover with window
- Cable cover for double T
- Arc proof cable compartment

- 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

SafeRing configurations





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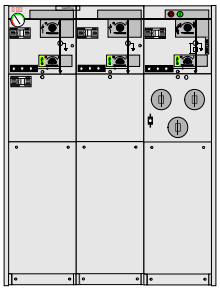

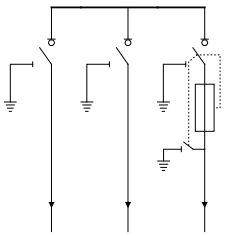

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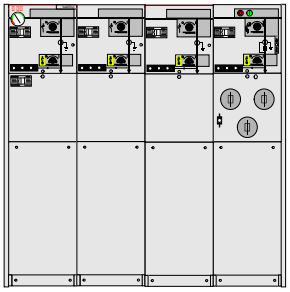

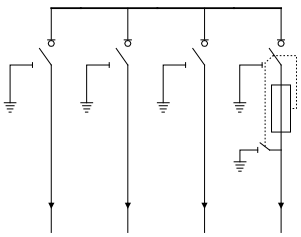

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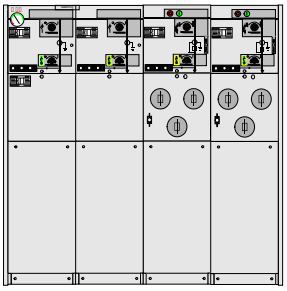

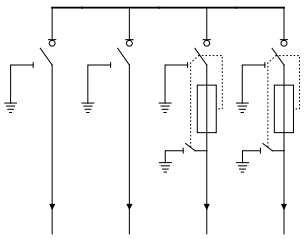

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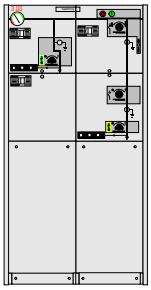

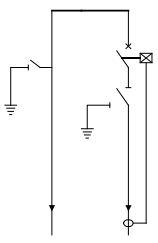

DeV
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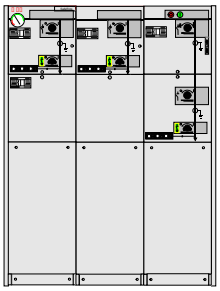
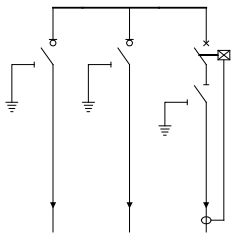
SafeRing configurations





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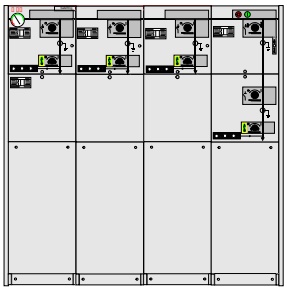

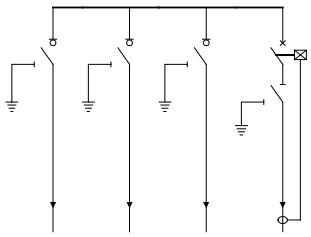

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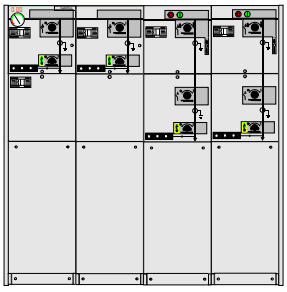

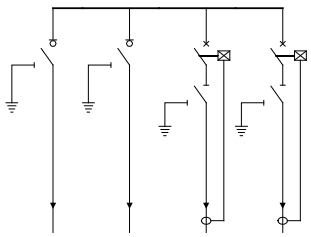

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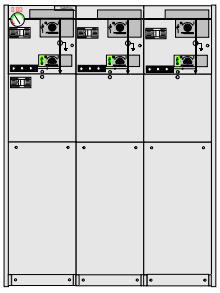

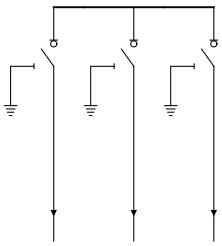

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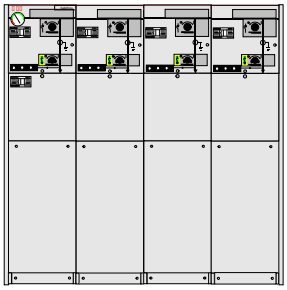
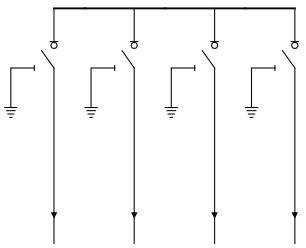




CCCC
Depth: 765 mm
Width: 1346 mm
Height: 1336 mm

Technical data SafeRing

SafeRing		C-module		F-module		V-module	
		Switch disconnector	Earthing switch	Switch-fuse disconnector	Downstream earthing switch	Vacuum circuit-breaker	Earthing switch/ disconnector
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
Lightning 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 normal 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	A			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 1 sec. [4)]	kA		16/16/16		5/5/5	16/16/16/16	
Short time current 3 sec. [5)]	kA	21/21/16/16	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 B (400 series plug-in)
[5)] Maximum rating for bushings Interface C (400 series bolted)

SafeRing is tested according to IEC publications IEC 60265-1, IEC 6227-1, EC 62271-100, -102, -105, -200 and IEC 60529.

SafePlus modules

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 extendibility and the possible combination of fully modular and semi-modular configurations.

SafePlus combined with SafeRing, which is ABBs 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.

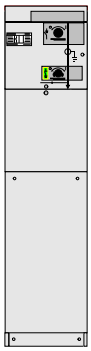
A sealed steel tank with constant atmospheric conditions ensures a high level of reliability as well as personnel safety and a virtually maintenance-free system. As an option external busbars can be provided to obtain full modularity.
The external busbar kit has to be mounted to the switchgears on site. It is fully insulated and screened to ensure the reliability and climatic independence.

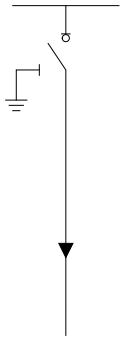
The SafePlus system offers a choice of either a switch-fuse combination or a circuit-breaker with relay for protection of the transformer.
SafePlus accommodates a wide selection of protection relays for most applications.
SafePlus can also be supplied with remote control and monitoring equipment

SafePlus (except M- and Mt-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 Be modules)
- Cable compartment cover
- Manometer for SF_6 pressure monitoring (temperature compensated)
- Lifting lugs for easy handling

C - Cable switch





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

Technical data					
Switch disconnector					
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 normal 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 close / open 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	62,5	52,5	50	50
Short time current 1 sec.	kA	25	-	-	-
Short time current 3 sec.	A	21	21	21	21
Number of mechanical operations	1000 close / open manual				

Standard features

- Three position load break switch with disconnector 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 voltage divider for voltage indication
- Cable compartment cover allowing surge arrestor or double cable connection
- Busbar, 630A
- Earthing bar

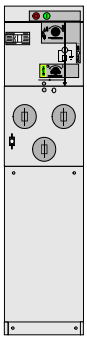
Optional features

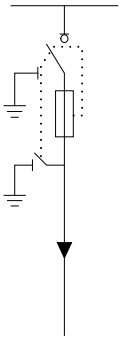
- Bushings for connection of external busbar on top of the unit
- Bushings for side extension (400 A)
- Bushings for cable testing (incl. earthing device test points)
- Cable bushings:
  Interface B (400 series plug-in, In = 400 A)
  Interface C (400 series bolted) combisensors with integrated capacitor for voltage indication and sensors for current and voltage monitoring
  Interface D (600 series bolted)
- Cable compartment front cover interlocked with earthing switch
- Interlocking of compartment for cable test bushings
- Arc proof and interlocked cable covers
- Arc suppressor with signal (1NO) wired to terminals (only one each SF_6 tank)
- Signal (1NO) from internal pressure indicator wired to terminals (only one each SF_6 tank)
- Latched single spring mechanism

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 for load break switch position and earthing switch position
- Capacitive voltage indicator, HR-module (Voltage Detecting System, VDS), acc. to IEC 61243 -5, or VPIS, acc. to IEC 61958 with integrated indicator lamps (LED)
- Indicator lamps, 3-phase VIM-3
- Indicator lamp, 1-phase VIM-1
- Short circuit indicators
- Short circuit and earth fault indicators
- Ronis key interlock
- External current sensors (CT) for monitoring
- Cable compartment cover with window, with extra depth (double T, surge arrestors) and arc proof (if existing module have interlocked cable compartment
- Cable support bars, non-magnetic or adjustable
- Earthing bar for surge arrestor

F - Switch-fuse-disconnector





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

Technical data					
Switch-fuse-disconnector					
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 normal 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 close / open 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 close / open 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. Only accessible when earthing switches are closed
- Fuse-link / transformer rating:
  12 kV, max 125 A CEF fuses
  24 kV, max 63 A CEF fuses
- 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 arrestor or double cable connection
- Busbar, 630 A
- Earthing bar

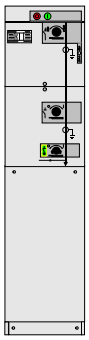
Optional features

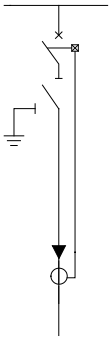
- Bushings for connection of external busbar on top of unit
- Bushings for side extension (400 A)
- Cable bushings:
  Interface B (400 series plug-in, In = 400A)
  Interface C (400 series bolted)
  Interface C (400 series bolted) combisensors with in tegrated screen for voltage indication and sensors for current and voltage monitoring
- Cable compartment front cover interlocked with earthing switch
- Signal (1NO) from internal pressure indicator wired to terminals (only one each SF_6 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 for load break switch position, earthing switch position and fuse blown
- Capacitive voltage indicator, HR-module (Voltage Detecting System, VDS), acc. to IEC 61243 -5, or VPIS, acc. to IEC 61958 with integrated indicator lamps (LED)
- Indicator lamps, 3-phase VIM-3
- Indicator lamp, single phase VIM-1
- Trip coil open
- Trip coil open and close
- Cable compartment cover with window, with extra depth (double T, surge arrestors) and arc proof (if existing module have interlocked cable compartment)
- Cable support bards, non-magnetic or adjustable
- Earthing bar for surge arrestor
- Ronis key interlock on earthing switch

V - Vacuum circuit-breaker





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

Technical data					
Vacuum circuit-breaker					
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 normal current	A	200 / 630			
Breaking capacities:					
- short-circuit breaking current	kA	21	21	16	16
Making capacity	kA	52,5	52,5	40	40
Short time current 0,5 sec. [1]	kA	16	16	16	16
Short time current 1 sec. [2]		16	16	16	16
Short time current 3 sec.	kA	21	21	16	16
Number of mechanical operations	2000 close / open 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.	A	21	21	16	16
Number of mechanical operations	1000 close / open manual				

[1] Maximum rating for bushings Interface A (200 series plug-in) with rated curretn 200 A
[2] Maximum rating for bushings Interface B (400 series plug-in)

Standard features

- 200 A vacuum circuit-breaker for transformer protection or 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 positioning single spring mechanism for disconnector/earthing switch
- Interlocking between vacuum circuit-breaker and disconnector/earthing switch
- Switch positioning indication for vacuum circuit-breaker and disconnector/earthing switch
- Self powered electronic protection relay with ring core CTs on cables (only standard on 200 A)
- Trip coil (for relay tripping)
- Cable bushings horizontally in front; Interface A (200 series plug-in) for 200 A vacuum circuit-breaker with integrated capacitor for voltage indication and Interface C (400 series bolted) for 630 A vacuum circuit-breaker with integrated capacitor for voltage indication
- Cable compartment cover allowing surge arrestor or double cable connection
- Busbars, 630 A
- Earthing bar

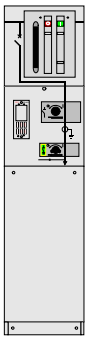
Optional features

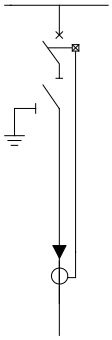
- Bushings for connection of external busbar on top of unit
- Cable bushings:
  Interface B (400 series plug-in)
  Interface D (600 series bolted)
  Interface C (400 series bolted) combisensors with integrated voltage divider for voltage indication and integrated sensor for current and voltage monitoring
- Cable compartment front cover interlocked with earthing switch
- Arc suppressor (for 630 A vacuum circuit-breaker only) with signal (1NO) wired to terminals (only one each SF_6 tank)
- Signal (1NO) from internal pressure indicator wired to terminals (only one each SF_6 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 and vacuum circuit-breaker tripped signal 1NO
- Capacitive voltage indicator; HR-module (Voltage Detecting System, VDS, acc. to IEC 61243 -5, or VPIS, acc. to IEC 61958 with integrated indicator lamps (LED)
- Indicator lamps, 3-phase VIM-3
- Indicator lamp, 1-phase VIM-1
- Trip coil open
- Trip coil open and close
- Cable compartment cover with window, with extra depth (double T, surge arrestors) or arc proof (if existing module has interlocked cable compartment)
- Cable support bars, non-magnetic
- Ronis key interlock on disconnector / earthing switch
- Advanced relays type SPAJ, REF and others.

V - Vacuum circuit-breaker - 24kV/20kA





Depth: 765 mm
Width: 325 mm
Height: 1336 mm (optional 1100 mm)

Technical data		
Vacuum circuit-breaker		
Rated voltage	kV	24
Power frequency withstand voltage	kV	50
Impulse withstand voltage	kV	125
Rated normal current	A	630
Breaking capacities:		
- short-circuit breaking current	kA	20
Making capacity	kA	50
Short time current 1 sec. [1)]	kA	21
Short time current 3 sec.	kA	21
Number of mechanical operations	2000 close / open manual	
Earthing switch downstream		
Rated voltage	kV	24
Power frequency withstand voltage	kV	50
Impulse withstand voltage	kV	125
Making capacity	kA	50
Short time current 1 sec.	A	21
Number of mechanical operations	1000 close / open manual	

[1)] Maximum rating for bushings Interface B (400 series plug-in): 16kA

Standard features

- 630 A vacuum circuit-breaker for feeder protection
- Mechanism with operating sequence;
  O – 0,3 s – CO – 3 min – CO
- Auto-reclosing capability
- Vacuum circuit-breaker with downstream three-position disconnector/earthing switch
- 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
- Mechanical counter
- Self-powered electronic protection relay with ring core CTs on cables
- Trip coil (for relay tripping)
- Cable bushings horizontally in front Interface C (400 series bolted) with integrated capacitor for voltage indication
- Cable compartment cover allowing surge arrestor or double cable connection
- Busbars, 630 A
- Earthing bar

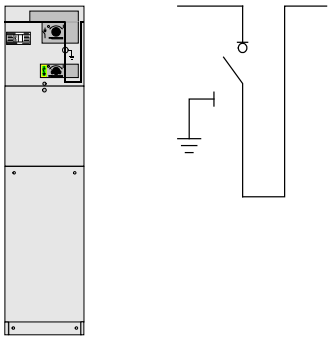
Optional features as factory mounted

- Bushings for connection of external busbar on top of unit
- Cable bushings:
  Interface B (400 series plug-in)
  Interface C (400 series bolted) combisensors with integrated voltage divider for voltage indication and integrated sensor for current and voltage monitoring
- Cable cover interlocked with earthing switch
- Arc proof cable cover (IAC AFL 16/20 kA 1 sec.)
- Arc suppressor with signal (1NO) wired to terminals (only one each SF6 tank)
- Height 1100 mm

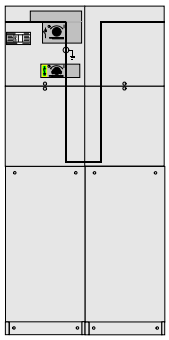
Optional features also available as retrofit

- Motor operation for vacuum circuit-breaker
- Low voltage compartment / Top entry box
- Manometer with integrated signal for low gas pressure wired to terminals (only one each SF_6 tank)
- Base frame (290 or 450 mm)
- Auxiliary switches: Vacuum circuit breaker position 2NO+2NC, disconnector position 2NO+2NC, earthing switch position 2NO+2NC
- Capacitive voltage indicator:
- HR-module (VDS, acc. to IEC 61243 -5)
- VPIS, acc. to IEC 61958 with integrated indicator lamps (LED)
- Indicator lamps, 3-phase VIM-3
- Indicator lamp, 1-phase VIM-1
- Trip coil open
- Trip coil open and close
- Undervoltage coil with/without time delay
- Blocking magnet to prevent unintended operation
- Cable compartment cover
  with window
  with extra depth (double T, surge arrestors)
- Cable support bars, non-magnetic
- Ronis key interlock on disconnector / earthing switch
- Advanced relays type REF, REX and others

SI - Busbar sectionalizer



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 SF_6-tank

Technical data					
Busbar sectionalizer SI					
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 normal 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 close / open 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 normal 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.	A	21	21	21	21
Number of mechanical operations	1000 close / open manual				

Standard features

- Three positioning load break switch with disconnector 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, 630 A
- Earthing bar

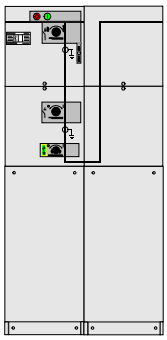
Optional features

- Bushings for connection of external busbars on top of the unit
- Latched single spring mechanism

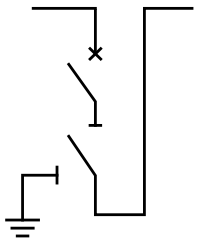
Optional features also available as retrofit

- Motor operation for load break switch
- Low voltage compartment/Top entry box
- Manometer with integrated signal for low gas pressure wired to terminals (only one each SF_6 tank)
- Base frame (290 or 450 mm)
- Auxiliary switches, load break switch position 2NO+2NC and earthing switch position 2NO+2NC
- Ronis key interlock

Sv - Busbar sectionalizer



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



Sv is always in combination with busrise module (Br)

Technical data					
Busbar sectionalizer Sv					
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 normal current	A	630	630	630	630
Breaking capacities:					
- short-circuit breaking ccurrent	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 close / open 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.	A	21	21	16	16
Number of mechanical operations	1000 close / open manual				

Standard features

- 630 A vacuum circuit-breaker
- 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
- Busbars, 630 A

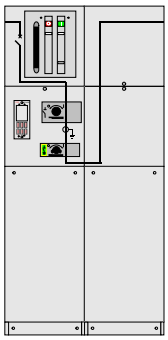
Optional features

- Bushings for connection of external busbar

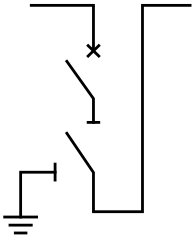
Optional features also available as retrofit

- Motor operation for vacuum circuit-breaker
- Low voltage compartment / Top entry box
- Manometer with integrated signal for low gas pressure wired to terminals (only one each SF_6 tank)
- Base frame (290 or 450 mm)
- Auxiliary switches, vacuum circuit-breaker position 2NO+2NC, disconnector position 2NO+2NC and earthing switch position 2NO+2NC
- Protection relay (metering module is required)
- Trip coil for relay trip
- Additional trip coil
- Ronis key interlock on disconnector / earthing switch

Sv - Busbar sectionalizer - 24kV/20kA



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



Sv is always in combination with busrise module (Br)

Technical data		
Busbar sectionalizer Sv		
Rated voltage	kV	24
Power frequency withstand voltage	kV	50
Impulse withstand voltage	kV	125
Rated normal current	A	630
Breaking capacities:		
- short-circuit breaking ccurrent	kA	20
Making capacity	kA	50
Short time current 3 sec.	kA	21
Number of mechanical operations	2000 close / open manual	
Earthing switch		
Rated voltage	kV	24
Power frequency withstand voltage	kV	50
Impulse withstand voltage	kV	125
Making capacity	kA	50
Short time current 3 sec.	A	21
Number of mechanical operations	1000 close / open manual	

Standard features

- 630 A vacuum circuit-breaker
- Mechanism with operating sequence; O – 0,3 s – CO – 3 min – CO
- Vacuum circuit-breaker with downstream three-position disconnector/earthing switch
- 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
- Busbars, 630 A

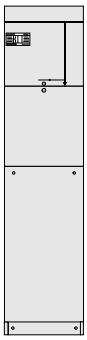
Optional features

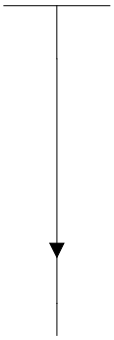
- Bushings for connection of external busbar

Optional features also available as retrofit

- Motor operation for vacuum circuit-breaker
- Low voltage compartment / Top entry box
- Manometer with integrated signal for low gas pressure wired to terminals (only one each SF_6 tank)
- Base frame (290 or 450 mm)
- Auxiliary switches, vacuum circuit-breaker position 2NO+2NC, disconnector position 2NO+2NC and earthing switch position 2NO+2NC
- Protection relay (metering module is required)
- Trip coil for relay trip
- Additional trip coil
- Ronis key interlock on disconnector / earthing switch

D - Direct cable connection





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

Technical data					
Direct cable connection					
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 normal 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 horizontally in front, Interface C (400 series bolted) with integrated capacitor for voltage indication.
- Cable compartment cover allowing surge arrestor or double cable connection
- Busbars, 630 A
- Earthing bar

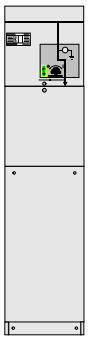
Optional features

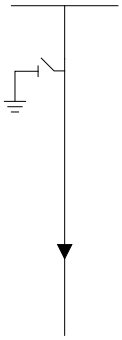
- Bushings for connection of external busbars
- Cable bushings:
  Interface B (400 series plug-in) (In = 400 A)
  Interface C (400 series bolted) combisensors with integrated capacitor for voltage indication and sensors for current and voltage monitoring
  Interface D (600 series bolted)
- Arc suppressor with signal (1NO) wired to terminals (only one each SF_6 tank)
- Signal (1NO) from internal pressure indicator wired to terminals (only one each SF_6 tank)

Optional features also available as retrofit

- Low voltage compartment / top entry box
- Base frame (290 or 450 mm)
- Capacitive voltage indicating systems, HR-module (Voltage Detecting System, VDS, acc. to IEC 61243 -5, or VPIS, acc. to IEC 61958 with integrated indicator lamps (LED)
- Indicator lamps for HR-module, 3-phase VIM-3
- Indicator lamp for HR-module, 1-phase VIM-1
- Short circuit indicators
- Earth fault indicators
- External current sensors (CT) for monitoring
- Cable compartment cover with window, with extra depth (double T, surge arrestors) or arc proof (if existing module has interlocked cable compartment)
- Cable support bars, non-magnetic or adjustable
- Earth bar for surge arrestor

De - Direct cable connection with earthing switch





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

Technical data					
Direct cable connection with 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 normal 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 close / open manual				

Standard features

- Earthing switch
- Two positioning 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 arrestor or double cable connection
- Busbars, 630 A
- Earthing bar

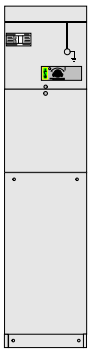
Optional features

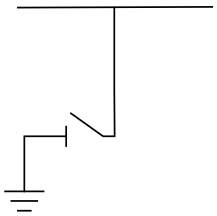
- Bushings for connection of external busbars
- Bushings for cable testing, incl. earthing device
- Cable bushings:
  Interface B (400 series plug-in) (In = 400 A)
  Interface C (400 series bolted) combisensors with integrated capacitor for voltage indication and sensors for current and voltage monitoring
  Interface D (600 series bolted)
- Cable compartment front cover interlockied with earthing switch
- Interlocking of compartment for cable test bushings
- Arc suppressor with signal (1NO) wired to terminals (only one each SF_6 tank)
- Signal (1NO) from internal pressure indicator wired to terminals (only one each SF_6 tank)

Optional features also available as retrofit

- Low voltage compartment / Top entry box
- Base frame (290 or 450 mm)
- Capacitive voltage indicating systems, HR-module (Voltage Detecting System, VDS, acc. to IEC 612-43-5, or VPIS, acc. to IEC 61958 with integrated indicator lamps (LED)
- Indicator lamps for HR-module, 3-phase VIM-3
- Indicator lamp for HR-module, 1-phase VIM-1
- Short circuit indicators
- Earth fault indicators External current sensors (CT) for monitoring
- Cable compartment cover with window, with extra depth (double T, surge arrestors) and arc proof (if existing module has interlocked cable compartment)
- Cable support bars, non-magnetic or adjustable
- Earth bar for surge arrestor
- Auxiliary switches, earthing switch position 2NO+2NC
- Ronis key interlock

Be - Busbar earthing





Technical data					
Busbar earthing					
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 normal 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 close / open manual				

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

Standard features

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

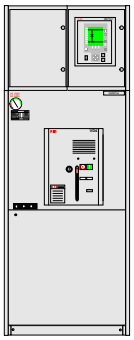
Optional features

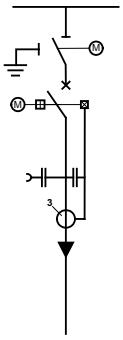
- Bushings for connection of external busbars
- Signal (1NO) from internal pressure indicator wired to ter minals (only one each SF_6 tank)

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

CB - Circuit-breaker module





Technical data			
Circuit-breaker module			
Rated voltage	kV	12	24
Power frequency withstand voltage	kV	28	50
Impulse withstand voltage	kV	95	125
Rated normal 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	25	20
Number of mechanical operations	30000 close / open manual		

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
- Auto reclosing sequence
- Closing and tripping coil
- Combisensors with Interface C (400 series bolted)
- Low voltage compartment with different protection relays

Optional features

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

Optional features also available as retrofit

- Base frame (290 or 450 mm)
- Motor operated disconnector / earthing switch
- Motor operating mechanism, circuit-breaker

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

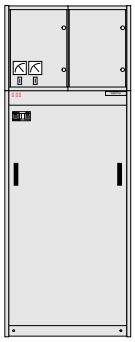
Measurement:

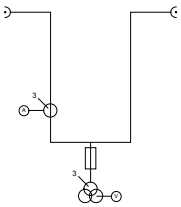
- 3-phase current
- neutral current
- 3-phase voltage
- residual voltage
- 3-phase power and energy incl. cos phi
- transient disturbance recorder

Optional functionality

- Capacitor bank protection
- Capacitor bank control
- Power quality
- Auto changeover

M - Metering module

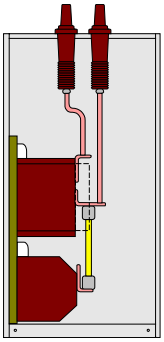


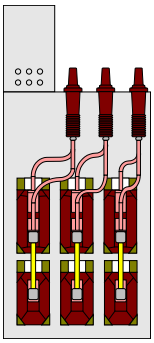


Technical data					
Metering module					
Rated voltage	kV	12	15	17,5	24
Power frequency withstand voltage	kV	28	38	38	50
Impulse withstand voltage	kV	95	95	95	125
Rated normal current	A	630	630	630	630
Short time current 1 sec	kA	25			
Short time current 3 sec.	kA	21	21	21	21

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 with dimensions according to DIN 42600 Narrow type.
The M-module is also designed for tariff metering.

Depth: 802 mm
Width: 696 mm
Height: 1806 mm





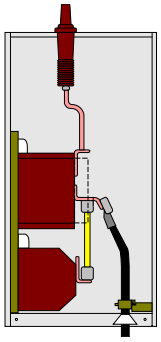
Standard features

- 2 or 3 pcs (has to be specified) DIN 42600 Narrow type current transformers with ribs
- 3 pcs DIN 42600 Narrow type single pole voltage trans formers
- 6 pcs bushings Interface C (400 series bolted) with con nections and external busbars for SafePlus modules on left and right hand side
- 3 pcs bushings Interface C (400 series bolted) only re quired 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 speci fied)
- 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:V3/110:3V or --/100:V3/100:3V has to be specified
- Note: VTs can also be delivered without open Delta Earth fault windings
- Burden / class has to be specified

M - Metering module



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
- Burden / class has to be specified

Low voltage compartment

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

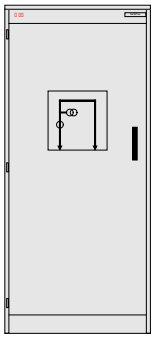
Optional features

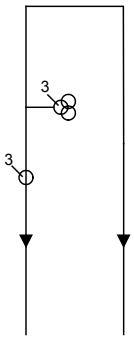
- Primary fuses for voltage transformers
- Voltmeter with selector switch, 6 positions +0
- A-meter with selector switch, 3 positions +0
- Additional meters
- Ronis key interlocking to prevent access to live parts
- Cable bottom entry for outgoing cable
- Metering module delivered for voltage measuring only
- Metering module delivered without low voltage equipment and wiring
- Metering module delivered without VT's and CT's, with connections only

Optional features also available as rtrofit

- Base frame (290 or 450 mm)

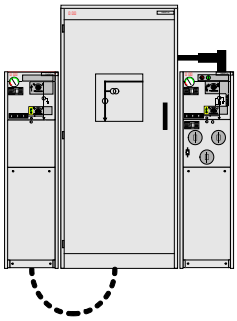
Mt - Metering tariff module

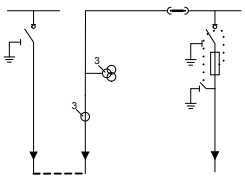


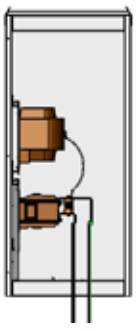


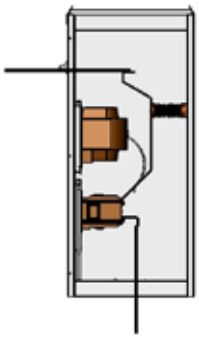
Depth: 1047 mm
Width: 800 mm
Height: 1806 mm

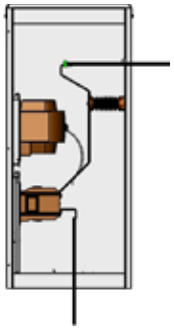
Technical data			
Metering tariff module			
Rated voltage	kV	12	24
Power frequency withstand voltage	kV	28	50
Impulse withstand voltage	kV	95	125
Rated normal current	A	630	630
Short time current 1 sec.	kA	20	20











The Mt-module is a factory assembled type tested air insulated non arc proof metering cubicle with conventional CTs and VTs. The Mt-module is designed for CTs and VTs with dimensions according to DIN 42600 Narrow type and for installation of transformers locally.

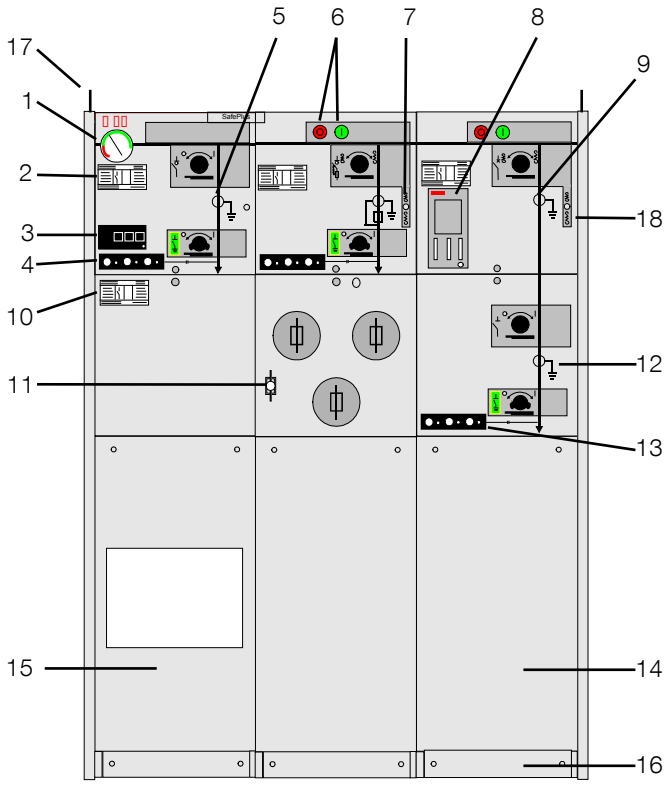
The Mt-module is manufactured and tested according to IEC 62271-200. It is available in 3 versions:
- Bottom cable in/out (A)
- Left side top connection for outgoing cable, bottom cable in (B)
- Right side top connection for outgoing cable, bottom cable in (C)

Standard features
- 3 pcs DIN 42600 Narrow type current transformers with ribs
- 3 pcs DIN Narrow type single pole voltage transformers
- Padlock interlocking to prevent access to live parts
- MV cable connection to SafePlus cubicle using Elastimold, 3M, Pirelli, Raychem, Kabeldon, etc. connectors
- MV cable connection inside Mt-module by conventional cable lugs

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:V3/110:3V or --/100:V3/100:3V has to be specified
- Note: VTs can also be delivered without open Delta Earth fault windings
- Burden / class has to be specified

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

Outer assembly



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

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

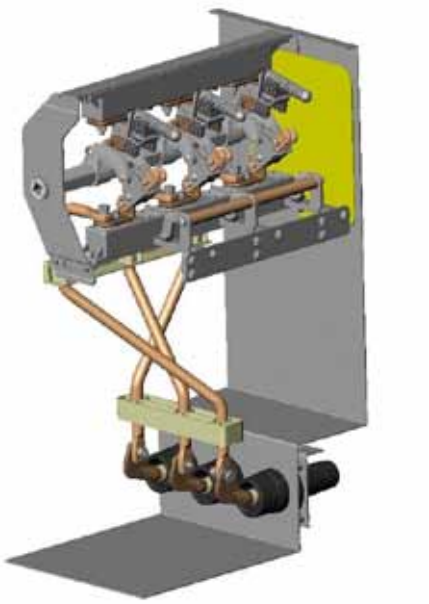
17. Lifting lug
18. Operating handle (standard on right hand side)

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.

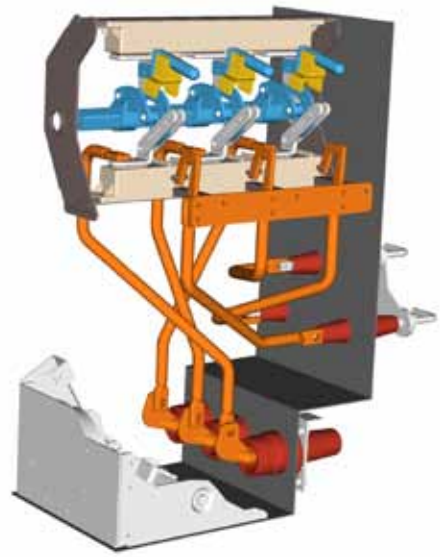
There are four different cable compartment covers; standard, with inspection window, arc proof and with extra depth for parallel cables. These covers are manufactured from 1.25 mm aluzink (except the arc proof cover) and are powder painted with colour RAL 7035.
All cable compartment covers are removable.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

Cable switch module



The cable switch (C-Module) is a three positioning switch-disconnector and earthing switch using SF_6 gas as an arc quenching medium.

The switch positioning is close – open – earthed. In the open position the switch satisfies the disconnector requirements.



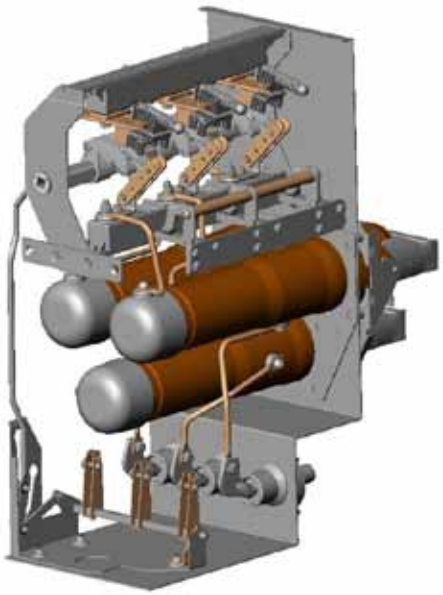
C-module equipped with arc suppressor (optional equipment) and cable test bushings (optional equipment).

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 disconnector/earthing switch.

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

Switch-fuse module

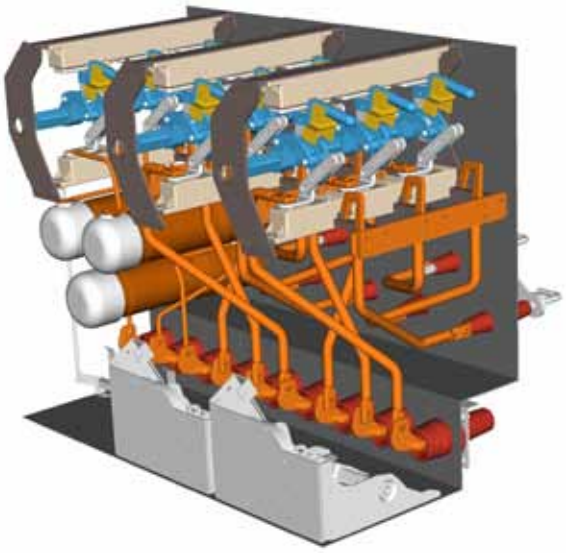


The switch-fuse (F-module) has a three positioning switch disconnector and earthing switch identical to the cable switch (C-module).

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-ways 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).

Cable bushings

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.

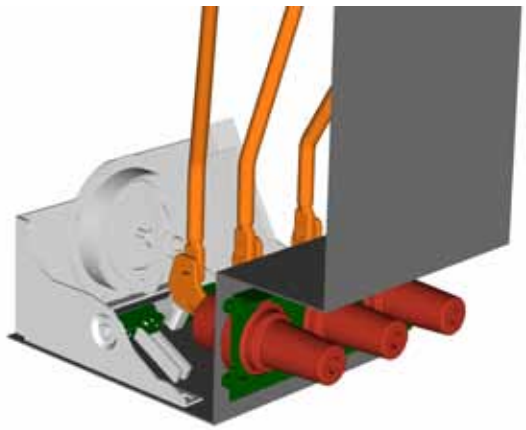
ABB has produced bushings for SF_6 switchgears since 1985. Up to date production facilities and highly advanced robots and test equipment ensure the high quality required for each single device.

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 5 different cable bushings:
- Interface A (200 series with plug-in contact, In=200A)
- Interface B (400 series with plug-in contact, In=400A)
- Interface C (400 series with M16 bolted contact, In=630A)
- Interface C (400 series with M16 bolted contact) and inte grated voltage and current sensors (In=630A)
- Interface D (600 series with M16 bolted contact, In=630A)

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 SF_6 tank of the SafeRing and SafePlus switchgear.

If an arc fault should occur inside the SF_6 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 1 sec.

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.

Completely sealed system

SafeRing and SafePlus use SF_6 –gas (Sulphur hexafluoride) as insulation and quenching medium.
The SF_6 is contained in a welded stainless steel tank, which is hermetically 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.

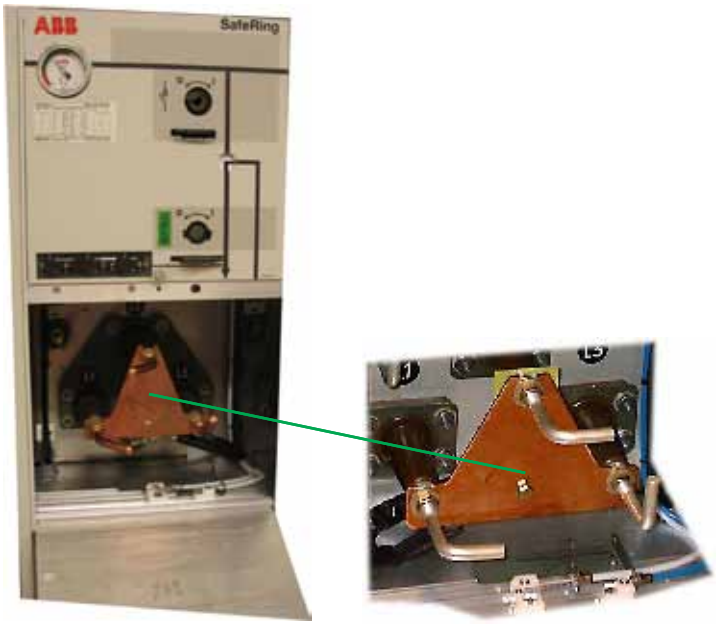
In order to guarantee a reliable and tight welding, all welding work is carried out by computer controlled robots.
Electrical and mechanical bushings penetrating the tank are clamped and sealed to the tank by high quality O-rings.

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 SF_6-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 SF_6-tank and vacuum chamber simultaneously. Then the SF_6-tank is filled with Helium. Due to the characteristics of Helium this test will detect absolutely all possible leakages. If the SF_6-tank passes this test, the Helium will be evacuated and replaced by SF_6.

The SF_6-tank has a degree of protection of IP67, and can be immersed into water and still maintain all functions in a satisfactory way.

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.

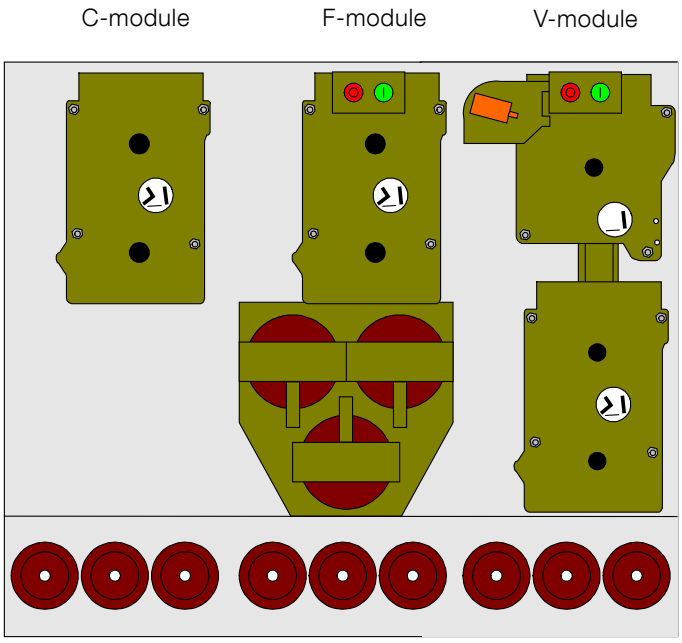
When these bushings are mounted, cable insulation test can easily be done according to the following procedure:

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.

Mechanisms and interlocks



Mechanisms front view.
SF_6-tank with operating mechanisms.

All operating mechanisms are situated outside the SF_6-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.

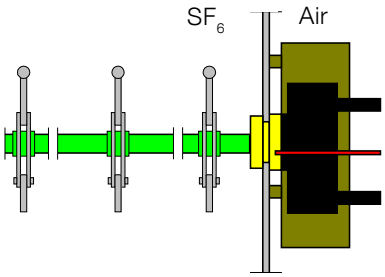
To prevent access to cable compartment before earthing switch is in closed position, all mechanisms can as an option be supplied with mechanical interlocks which make it impossible to remove the cable compartment covers. It will then also be impossible to operate load break / disconnector switch to open 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.

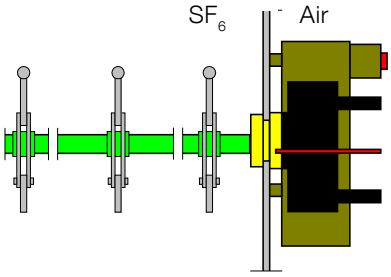
All operating mechanisms are equipped with position indicators for all switches. In order to achieve true indication, indicators are directly connected to the operating shafts of the switches inside the SF_6-tank, please see shafts shown with red colour on next page.

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

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 SF_6-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.

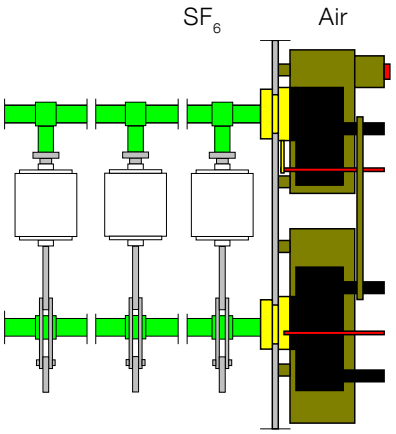
The upper one operates two springs; one for closing and one for opening. Both springs are charged in one operation. By means of mechanical push buttons it is then possible to close and open the load break switch.

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 SF_6-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.

Mechanisms and interlocks



V-mechanism

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 disconnector 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.

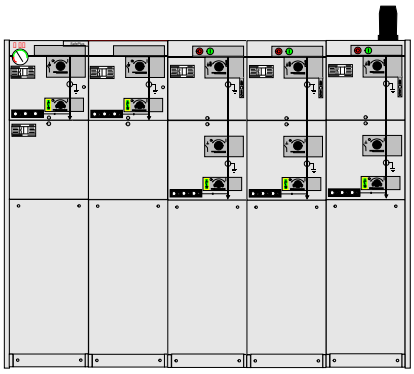
The opening spring is always charged when the circuit breaker is in closed position and will be ready to open immediately if the protection relay gives a trip signal.

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 disconnector 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 disconnector, but the circuit breaker can be closed for testing purpose.

External busbars on top



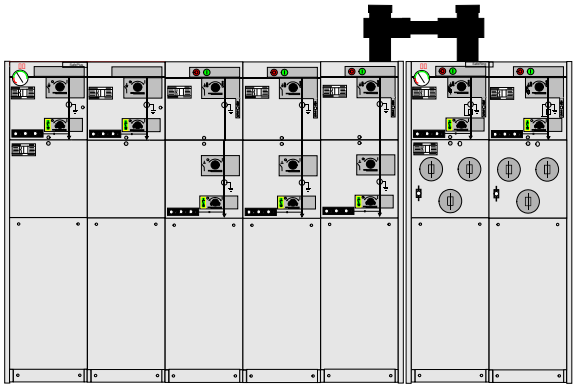
SafePlus prepared for future extension on right hand side

On the top of all SafeRing and SafePlus switchgears 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.

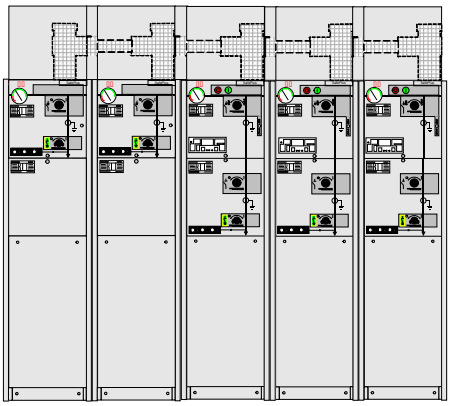


SafePlus consisting of two sections connected to each other by means of external busbar kit

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

Since a 5-ways switchgear is the maximum size within one common SF_6-tank, the busbar kit allows a configuration with more than 5 modules.

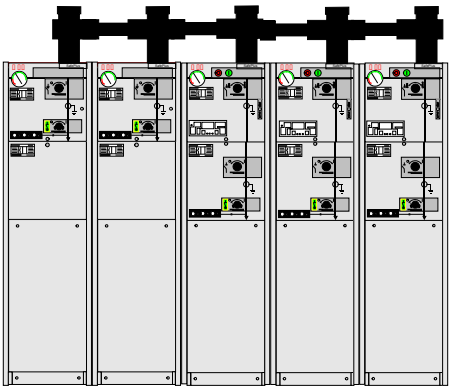
The installation of the external busbars has to de done on site, see separate manual for installation instructions, 1VDD006006 GB.



SafePlus with external busbar cover

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.

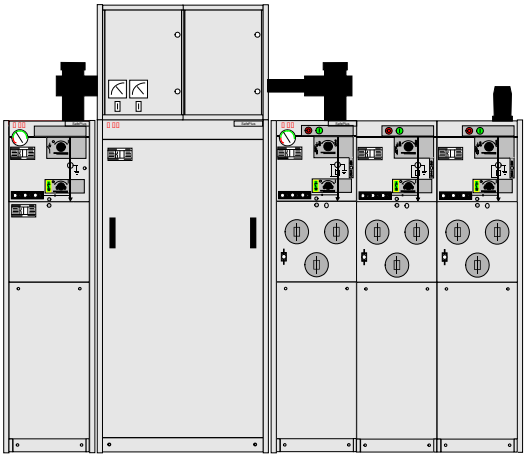
External busbars on top



SafePlus with a fully modular design

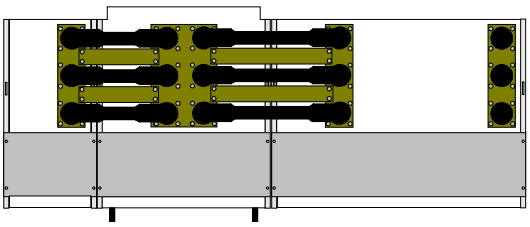
SafePlus switchgear can also be configured fully modular. This gives 1250 A busbar rating.

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.

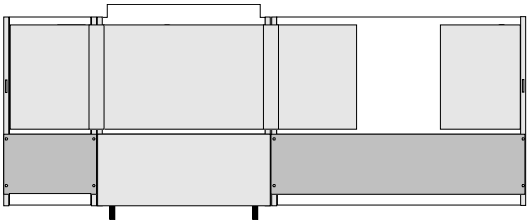


SafePlus with one incomer (C-module), one Metering module (M-module) and three fused T-offs (F-modules), prepared for future extension

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

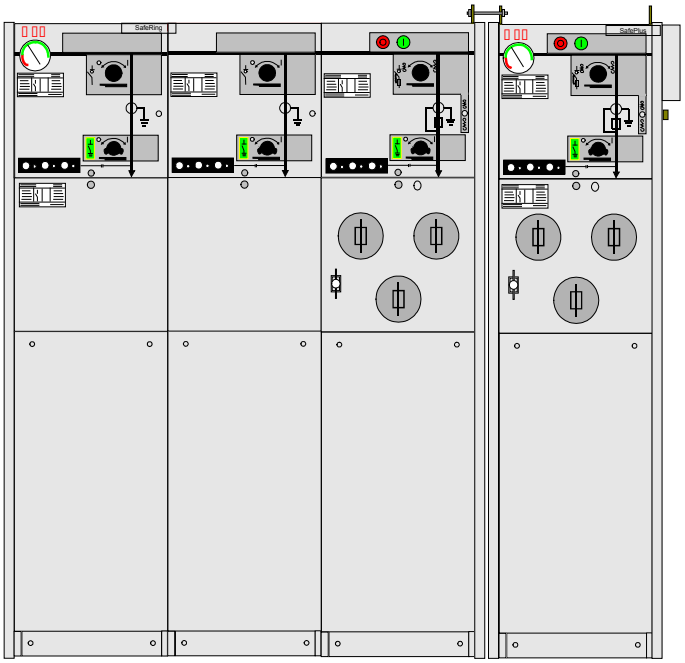


Top view



Top view with busbar cover mounted

Side extension



On the side of SafeRing and SafePlus C- and F-modules it is possible as an option to have bushings for connection of external busbars on the left and the right side. The rated current of the side connection is limited to 400A.

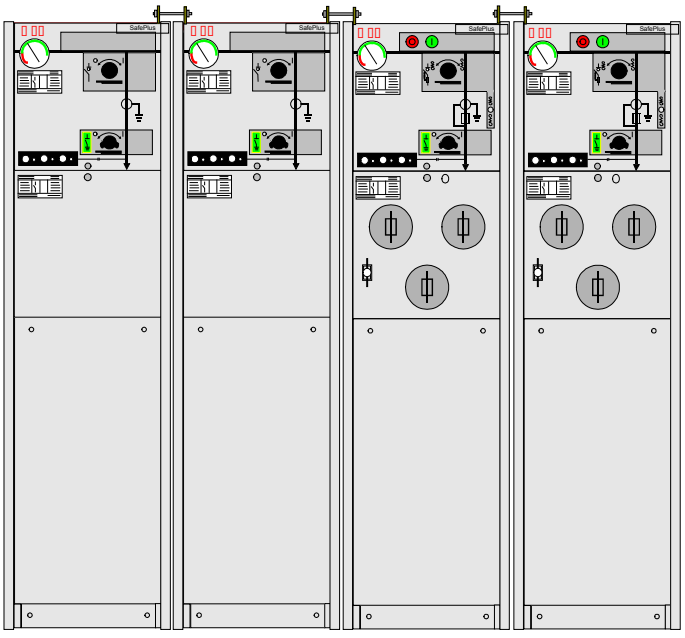
For a 1-way SafePlus C- or F-module, one or two sets of bushings can be installed. This is also applicable for a 2-way unit.

When bushings are mounted on the side, 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 a special designed connection kit, it will be possible to connect two or more sections.

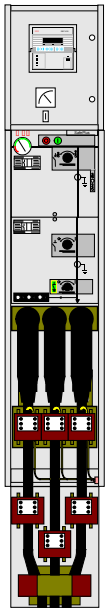
Since a 5-ways switchgear is the maximum size within one common SF_6-tank, the busbar kit allows a configuration with more than 5 modules. The second switchgear can consist of maximum 2 modules.

The installation of the external busbars has to de done on site, see separate manual for installation instructions, 1VDD006106 GB.

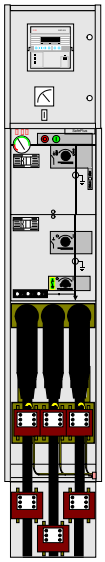


SafePlus switchgear can also be configured fully modular. The busbars between the modules and the end adapters used on the leftmost and rightmost module are identical to the parts used in the previous example.

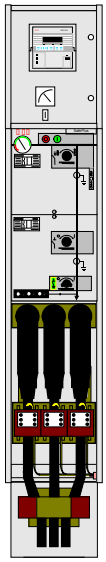
Base frame



Base frame 450 mm with earth fault transformer and extra set of current transformers



Base frame 290 mm with an extra set of current transformers



Base frame 290 mm with earth fault transformers

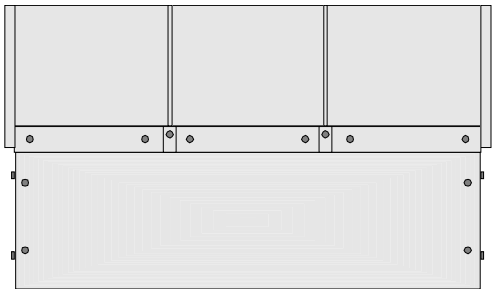
When SafeRing or SafePlus are placed directly on a floor, the height from the floor to the centre of the cable bushings is 595 millimeter. If there is no cable trench, this height might not be sufficient for proper installation of cables. It is then possible to place the switchgear on an additional base frame.

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

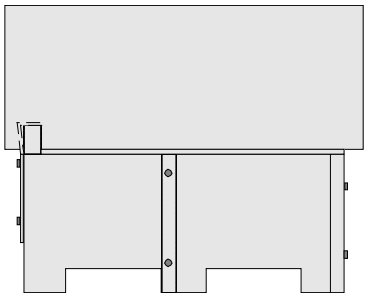
Inside the standard cable compartment for the vacuum circuit-breaker it will be enough space for three current transformers for protection relay.

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.

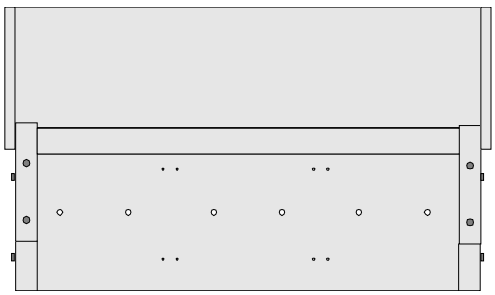
The base frame has openings for cable entrance from the bottom and from both sides. It is delivered as a kit and has to be assembled on site.



Front view

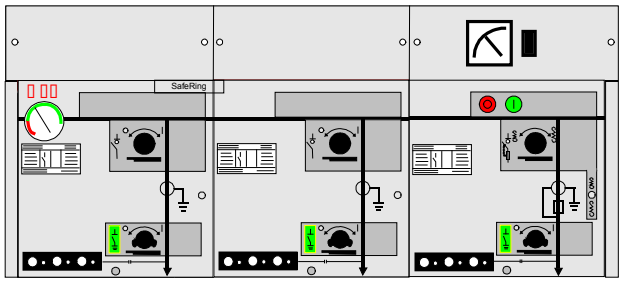


Side view

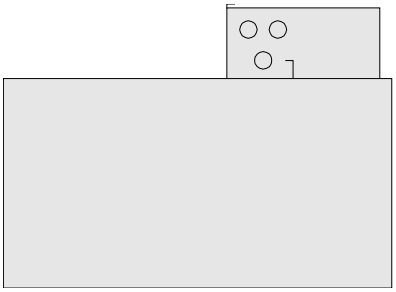


Rear view

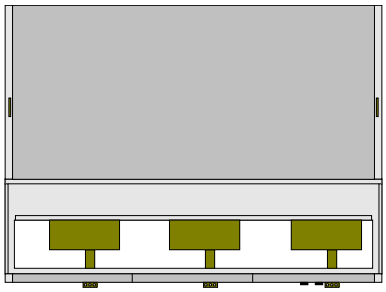
Low voltage compartment



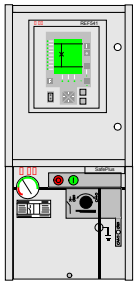
Top entry box with A-meter and selector switch



Side view



Top entry box seen from above when front / top covers have been removed



Low voltage compartment with REF541 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 switchgears. 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 switchgears 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 SF_6 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.

Motor operation

Closing and opening operations of load-break switches and charging of the springs of the mechanisms for the circuit breaker and the switch-fuse combination may be performed with a motor operation.
Disconnector in the V-module and all earthing switches do not have this possibility.
All motor devices require 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	90	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

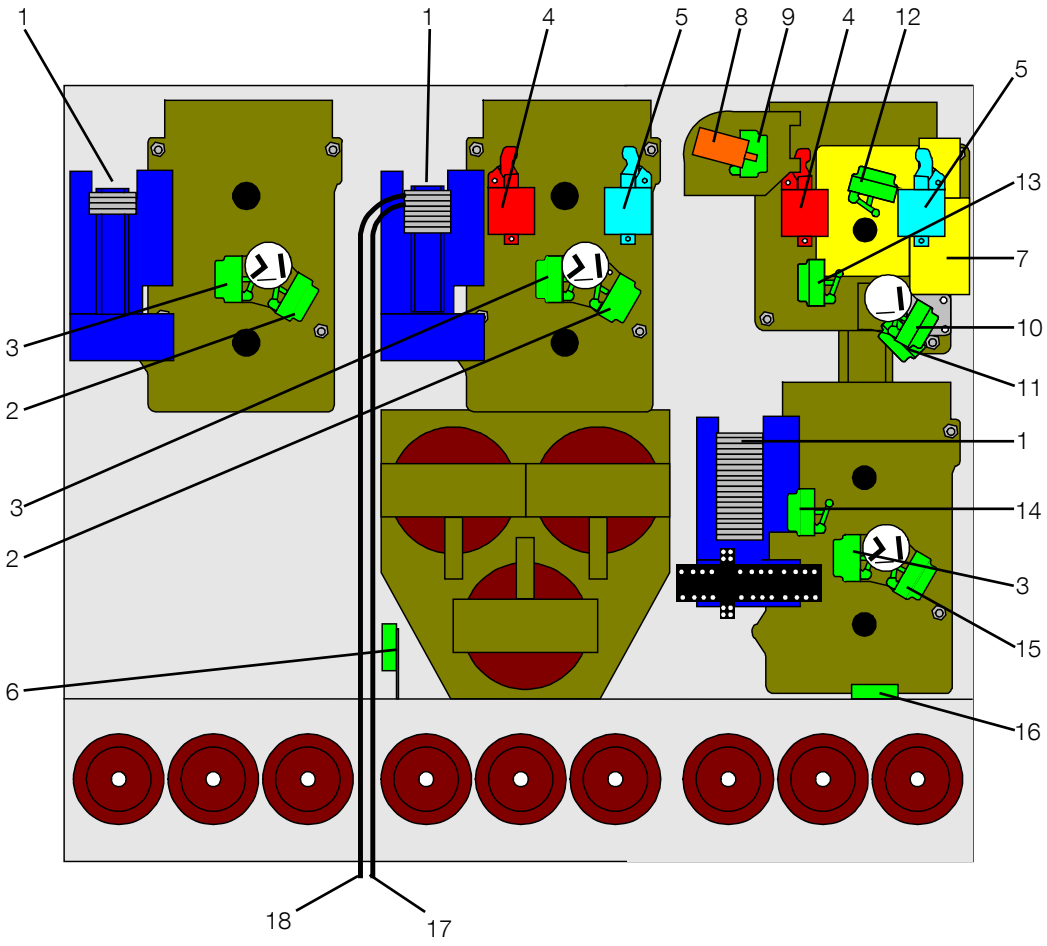
Characteristics of motor operation for V-module

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	9-13	40-60	7	F 4 A
110	170	9-13	40-60	3	F 2 A
220	150	9-14	40-60	1,7	F 1 A

Characteristics of shunt trip coils, closing coils and opening cioils 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

Motor operation

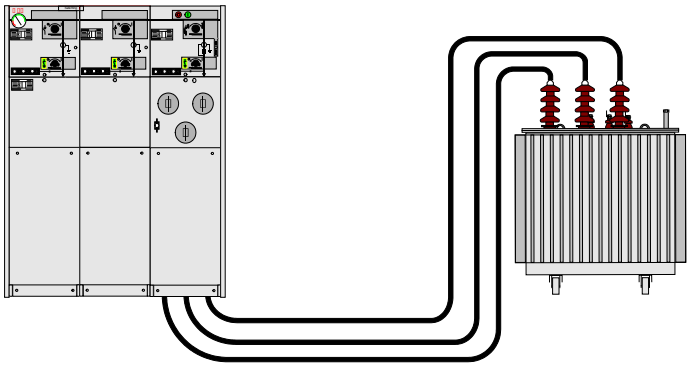


SafePlus consisting of CFV modules equipped with various auxiliary switches, coils and motor operation

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 Y3 / 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, VCB
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.

Transformer protection



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

SafeRing is delivered with a 200 A rated V-module.
SafePlus V- module has two options: 200 or 630 A rating.

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
- SEG WIC 1

Important features V-module:

- Relay behind cover. No need for additional low voltage box for the 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, itis important that requirements in IEC 62271-105 and in IEC 69787 are fulfilled. In particular annex A in IEC 62271-105 gives a good example of the coordinationof 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 overlaod current of the transformer
- A transfer current of the combination which is as low as possible, and less than the rated transfer current of the switch-fuse combination
- A situation where the fuse-links alone will deal with the condition of a short-circuit on the transformer secondary terminals
- Fuse-links that discriminate with the low-voltage fuse-links in the event of phase-to-phase faults occurring down stream 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

Fuse selection table

Fuse table for modules

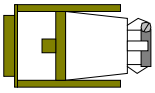
100%	Transformer rating (kVA)																CEF
U_n (kV)	25	50	75	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	
3	16	25	25	40	40	50	50	80	100	125	160	160					7,2 kV
3,3	16	25	25	40	40	50	50	63	80	100	125	160					
4,15	10	16	25	25	40	40	50	50	63	80	100	125	160				
5	10	16	25	25	25	40	40	50	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	12 kV
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	17,5 kV
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	24 kV
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 consitions with no overload
- Ambient temperature -25°C - +40°C

120%	Transformer rating (kVA)																CEF
U_n (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						7,2 kV
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		12 kV
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	17,5 kV
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	24 kV
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	

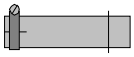
- The table is based on using fuses type ABB CEF
- Normal operating consitions with 20% overload
- Ambient temperature -25°C - +40°C

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 ±1 mm and body length (e) equal to 442 mm.

The dimensions of the fuse-links can also to be in accordance with DIN 43625 and the length of the fuse canister is based on the use of fuse-links with length 442 mm. For installation of shorter fuses, (<24kV) a fuse adapter will be needed.
Please note: When inserting the fuse-link into the canister, the striker-pin must always face outwards against the fuse holder. Fuse adapter has to be fixed to the fuse-link contact part 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, we refer to our ABB Poland catalogue .
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				

Relays

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

For transformer protection with max. 200A vacuum circuit breaker see chapter 6.4.

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

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

Other types of relays 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.

Relays

ABB feeder protection relays

Protection and measurement				Relay		
Type of faults	IEEE device no.	IEC symbol	Protection function	REX[1)] 521	REF 610	REF 615
Short circuits	51	3 I >	Non-directional overcurrent, low-set stage	X	X	X
Short circuits	50/51/51B	3 I >>	Non-directional overcurrent, high-set stage	X	X	X
Short circuits	50/51B	3 I >>>	Non-directional overcurrent instantaneous stage/blockable	X	X	X
Short circuits	51	2 I >	Two-phase non-directional overcurrent, low-set stage			
Short circuits	50/51	2 I >>	Two-phase non-directional overcurrent, high-set stage			
Earth fault	51N	Io >	Non-directional earth fault, low-set stage	X	X	X
Earth fault	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
Earth fault	67N	Io >-->/SEF	Directional earth fault, sensitive, In=1A and 5A	X		X
Earth fault	67N	Io >-->/SEF	Directional earth fault, sensitive, In=0,2A and 1A			
Earth fault	67N	Io >> -->	Directional earth fault, high-set stage	X		X
Earth fault	59N	Uo >	Residual overvoltage	X		X
Additional functions	46	Δ I >	Phase discontinuity	X		X
Additional functions	62BF	CBFP	Circuit-breaker failure	X	X	X
Type of measurements current		31/21	Three-phase / two-phase current	X	X	X
Type of measurements current		Io	Neutral current	X	X	X
Type of measurements current		Δ I	Degree of unbalance			
Type of measurements current		Uo	Residual voltage	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	WIC 1
Protection functions	Phase overdurrent (multi-characteristic)	50/51	X	X
Protection functions	Short-curcuit protection	50/51	X	X
Protection functions	Number of overcurrent elements	50/51B	2	2
Protection functions	Earth fault current	50N/51N	X	X
Protection functions	Number of earth fault elements		2	1
Characteristic curves	Overcurrent element		DEFT,INV [1)]	DEFT,INV [1)]
Characteristic curves	Earth fault current		DEFT,INV [1)]	DEFT
Additional functions	Trip indication		X	X (option)
Additional functions	Electro-impulse		X	X
Additional functions	input remote tripping (voltage)		X	115VAC/230VAC
Additional functions	Auxiliary power, voltage (option)			
Measuring circuit	Rated secondary current		wide range special CT	wide range special CT
Measuring circuit	Measuring range, start current I> (A)		7,2	14,4
Climatic withstand	Storage temperature (°C)		-40 …+85	-40 …+85
Climatic withstand	Operating temperature (°C)		-40 …+85	-40 …+85

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

Relays

Ring core current transformers and earth fault transformers

SEC WIC1 transformer protection and cable protection kit (self powered)	Ring core current transformer type	Current range
Transformer type	W2	16 - 56 A
Transformer type	W3	32 - 112 A
Transformer type	W4	64 - 224 A
Transformer type	W5	128 - 448 A
REJ603 transformer protection and cable protection kit (self powered)	**Ring core current transformer type**	**Current range**
Transformer type	CT1	8 - 28 A
Transformer type	CT2	16 - 56 A
Transformer type	CT3	32 - 112 A
Transformer type	CT4	64 - 224 A
Transformer type	CT5	128 - 448 A
Protection relay standard CT's typical	**Ring core current transformer type**	**Ration - burden**
Transformer type: class 10P10	SVA 100-100-45	50-100-200/1 A 1,5/3/6 VA
Transformer type: class 5P10	SVA 100-100-45	150/1 A 4 VA
Transformer type: class 5P10	SVA 100-100-45	100-200/1 A 4 - 7 VA
Transformer type: class 5P10	SVA 100-100-45	300-600/1 A 4 - 7 VA
Transformer type: class 5P10	SVA 100-100-45	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 50-750/5 A
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 50-750/5

Relays

ABB feeder terminals

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 542plus has a separate display unit and does not need a build out frame.
- REF630, part of the Relion® product family designed to implement the core values of the IEC61850 standards.

The units are configured according to customer specification for protection functions.

Typical configuration of V-module:

Primary equipment, standard

- 630A vacuum circuit breaker
- Disconnector
- Earthing switch

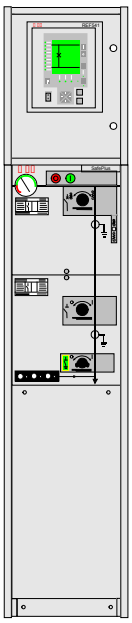
Additional equipment

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

REF630

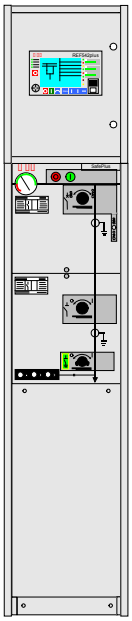
REF630 is a comprehensive feeder management IED for protection, control, measuring and supervision of utility and industrial distribution substations. REF630 is a member of ABB's Relion® product family and a part its 630 product series characterized by functional scalability and flexible configurability. REF630 also features necessary control functions constituting an ideal solution for feeder bay control.
REF630 provides main protection for overhead lines and cable feeders of distribution networks. REF630 fits both isolated neutral networks and networks with resistance or impedance earthed neutral. Four pre-defined configurations to match typical feeder protection and control requirements are available. The pre-defined configurations can be used as such or easily adapted or extended with freely selectable add-on functions, by means of which the IED can be fine-tuned to exactly satisfy the specific requirements of your present application.
REF630 incorporates local and remote control functions. The IED offers a number of freely assignable binary inputs/outputs and logic circuits for establishing bay control and interlocking functions for circuit breakers and motor operated switch-disconnectors. REF630 supports both single and double busbar substation busbar layouts.

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 overfrequenzy 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

Combisensor

Sensor variants

Two versions could be selected: one providing voltage measurement together with voltage indication capability (KEVCY 24 RF1), or a second one, providing, in addition to these, also the possibility of current measurement (KEVCY 24 RE1).

Linearity

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

Current sensor

Current measurement in KEVCY 24 RE1 sensors is based on the Rogowski coil principle. A Rogowski coil is a toroidal coil, without an iron core, placed around the primary conductor in the same way as the secondary winding in a current transformer.

Voltage sensor

Voltage measurement in KEVCY 24 RE1 and KEVCY 24 RF1 sensors is based on the capacitive divider principle

Sensor application

KEVCY 24 RE1 & RF1 are compact and very small bushing type sensors designed to be used in SF_6 gas insulated switchgear type SafeRing and SafePlus.
The external cone type of the sensor is designed according to the standard EN 50181, Interface C (400 series 630 A, M16 bolt), and therefore enables connection of all compatible cable plugs.

Secondary cables

The sensor is equipped with two cables:

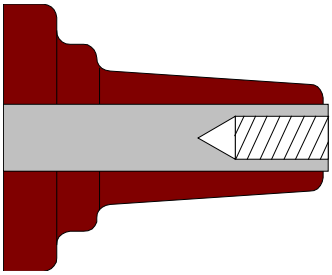
- Cable for coupling electrode with BNC connector
- Current and voltage signal cable with RJ-45 connector for connection with the IED

The cable connector for connection with the IED is type RJ-45. The sensor accuracy classes are verified up to the RJ-45 connector, i.e. considering also its secondary cable. This cable is intended to be connected directly to the IED, and subsequently neither burden calculation nor secondary wiring is needed. Every sensor is therefore accuracy tested when equipped with its own cable and connector.
Standard cable length for connection with IED: 2.2 m
Standard cable length for connection with coupling electrode: 0.45 m

Technical data. general	
Rated primary current of application	up to 630 A
Rated primary voltage of application	up to 24 kV
Highest voltage for equipment, U_m	24 kV
Rated power frequency withstand voltage	50 kV
Rated lighting impulse withstand voltage	125 kV

Technical data, voltage sensor	Value
Rated primary voltage, U_{pr}	22/V3 kV
Maximum rated primary voltage, U_{primax}	22/3V kV
Rated frequency, f_n	50/60 Hz
Accuracy class	0.5/3P
Rated burden, R_{br}	10 MOhm
Rated transformation ratio, K_n	10 000 : 1
Rated voltage factor, k_u	1.9/8h
Technical data, current sensor	
Rated primary current, I_{pr}	80 A
Rated transformation ratio, K_{ra}	80A /0.150 V at 50 Hz 80 A/0.180 V at 60 Hz
Rated secondary output, U_{sr}	3mV/Hz i.e 150 mV at 50 Hz or 180 mV at 60 Hz
Rated continuous thermal current, I_{cth}	630 A
Rated short-time thermal current, I_{th}	25 kA / 3 s
Rated dynamic current, I_{dyn}	63 kA
Rated frequency, f_r	50/60 Hz
Rated extended primary current factor, K_{pcr}	7.875
Accuracy limit factor, K_{alf}	100
Rated burden, R_{br}	10 MOhm
Cables	
Current and voltage sensing:	
Length	2.2 m
Connector	RJ-45 (CAT-6)
Coupling electrode:	
Length	0.45 m
Connector	BNC

Cable termination

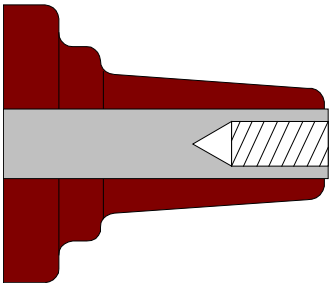


The following cable bushings are available:

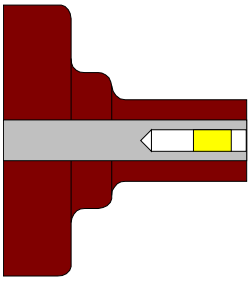
Interface C with M16 x 2 metric threads
400 series, In = 630 A
Standard on C, V (In=630A), D and De modules; and for top extension

Interface D with M16 x 2 metric threads
600 series, In = 630 A
(used for connection of cables with big cross sections)

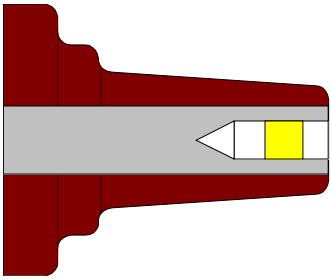
*) Cross section of conductor is designed for rated current of max 630A



Interface A with plug
200 series, In = 200 A
Standard on F and V modules (In = 200 A)
The yellow area indicates the silver coated contact spring.



Interface B with plug
400 series, In = 400 A
The yellow area indicates the silver coated contact spring.

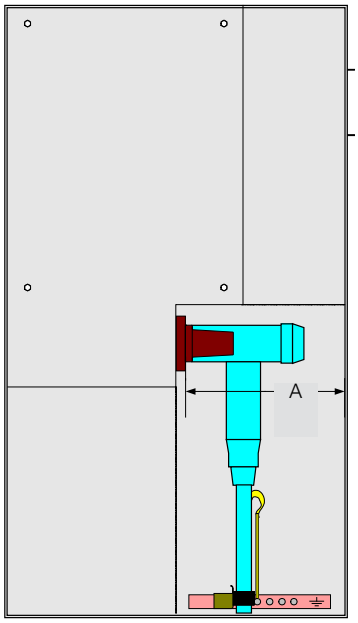


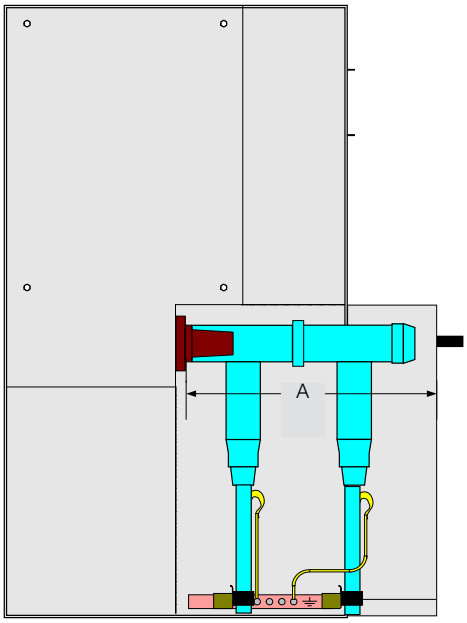
The installation instructions from the manufacturer of cable terminations must be followed. Be sure to lubricate the bushings thoroughly with the silicone supplied.

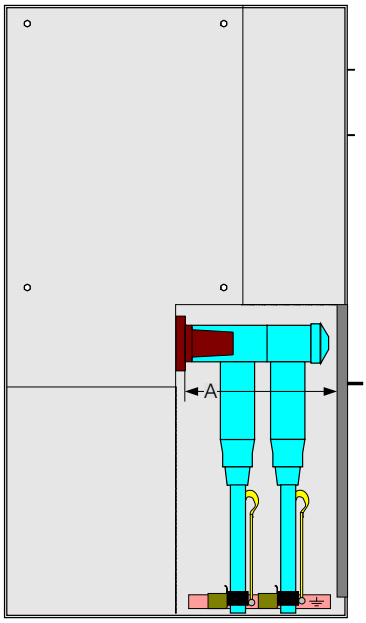
Where cables are not connected, the earthing switch must be locked in closed position or the bushings must be fitted with dead end receptacles before the unit is energized.
All bushings are situated in the same height from the floor and are protected by cable compartment cover. The three drawings below show typical arrangements with cable connectors for single and double cables.

Cable termination

The table below shows the net distance A in millimeter from cable bushing to the inner part of cable compartment cover. The following manufacturers of cable terminations are recom-







mended:
ABB Kabeldon
Südkabel

	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

Euromold/Elastimold
nkt cables
Tyco Electronics
Prysmian
3M

Cable termination

CSE-A 12250
CSE-A 24250

CSE-A 12400
CSE-A 24400

CSE-A 12630
CSE-A 24630

Screened separable cable connectors
CSE-A 12-24 kV, 250 A, 400 A, 630 A

Application area

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

Fits standard bushings of outer cone type according to EN 50181. Connectors with rated current:

- 250 A: interface type A with plug-in Ø 7.9 mm
- 400 A: interface type B with plug-in Ø 14 mm
- 630 A: interface type C with bolt M16

Standard

Meets the requirements of:

- CENELEC, HD 629.1 S2

Design

CSE-A is premolded and manufactured in rubber with three layers; a conductive inner layer, an insulation layer and a conductive outer layer, that are vulcanized together for the best possible interface between the layers.

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

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

Note:

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

Designation	XLPE/EPR Ø mm2	Conductor cross section mm2	Rated current	Bushing type	Weight kg/unit
Elbow cable connector with capacitive test point, 12kV					
CSE-A 12250-01	10 - 12	10 - 16	250 A	Interface type A with plug-in Ø 7.9 mm	2.2
CSE-A 12250-02	13 - 22	25 - 95	250 A	Interface type A with plug-in Ø 7.9 mm	2.2
CSE-A 12400-01	13 - 20	25 - 70	400 A	Interface type B with plug-in Ø 14 mm	6.1
CSE-A 12400-02	18.5 - 30.5	95 - 300	400 A	Interface type B with plug-in Ø 14 mm	6.6
CSE-A 12630-01	13 - 20	25 - 70	630 A	Interface type C with bolt M16	5.1
CSE-A 12630-02	18.5 - 30.5	95 - 300	630 A	Interface type C with bolt M16	5.5
CSE-A 12630-03	30.5 – 45.0	400 - 630	630 A	Interface type C with bolt M16	7.7
Elbow cable connector with capacitive test point, 24kV					
CSE-A 24250-01	13 - 22	10 - 16	250 A	Interface type A with plug-in Ø 7.9 mm	2.2
CSE-A 24250-02	17.0 - 25.5	25 - 95	250 A	Interface type A with plug-in Ø 7.9 mm	2.2
CSE-A 24400-01	17 - 24	25 - 70	400 A	Interface type B with plug-in Ø 14 mm	6.1
CSE-A 24400-02	22.5 - 35.0	95 - 300	400 A	Interface type B with plug-in Ø 14 mm	6.6
CSE-A 24630-01	17 - 24	25 - 70	630 A	Interface type C with bolt M16	5.1
CSE-A 24630-02	22.5 - 35.0	95 - 300	630 A	Interface type C with bolt M16	5.5
CSE-A 24630-03	30.5 - 45.0	400 - 630	630 A	Interface type C with bolt M16	7.7

Cable termination 12 kV

12 kV: Separable connectors interface A with earthing shield, I_r = 250 A			
Manufacturer	Designation	Conductor [mm2]	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 Kabeldon	CSE-A 12250-01	10-16	10.0-12.0
ABB Kabeldon	CSE-A 12250-02	25-95	13.0-22.0
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 nework with the rated values of the connector from the different suppliers

12 kV: Separable connectors interface B with earthing shield, I_r = 400 A						Cable compartment with							
						Single cable + surge arrester				Dual cables			
Manufacturer	Designation	Conductor [mm2]	XLPE / EPR Ø [mm]	Additional equipment for dual cable arrangement	Surge Arrester with	Standard Distance A = 361 mm	With window Distance A = 354 mm	Arc proof Distance A = 338 mm	Double cables Distance A = 556 mm	Standard Distance A = 361 mm	With window Distance A = 354 mm	Arc proof Distance A = 338 mm	Double cables Distance A = 556 mm
3M	93-EE 605-4/-95	25-95	15.0-23.5	None	MUT 23	X	X	X	X				
3M	93-EE 605-4/-240	95-240	21.8-32.6	None	MUT 23	X	X	X	X				
ABB Kabeldon	CSE-A 12400-01	25-70	13.0-20.0	None	None								
ABB Kabeldon	CSE-A 12400-02	95-300	18.5-30.5	None	None								
Euromold	400LR/G	50-240	12.0-37.5	None	None								
Euromold	400TE/G	70-240	12.0-37.5	400CP-SC+400TE/G	156SA + 400RTPA				X				X
nkt cables	CE 24-400	25-300	12.7-34.6	None	None								
nkt cables	CB 36-400	25-300	12.7-40.0	CC 12-630	CSA 12	X	X	X	X	X	X	X	X
Prysmian	FMCE-400	70-300	18.5-30.4	None	None								
Prysmian	FMCT-400	70-300	18.5-30.4	None	None								
Südkabel	SEHDT 12.1	70-300	17.7-30.4	None	None								
Südkabel	SET 12-B	50-300	15.0-32.6	KU 23.1/22 +SET 12-B	MUT 23	X	X	X	X				X
Tyco Electronics	RSES	25-240	12.7-34.6	None	None								

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

Cable termination 12 kV

12 kV: Separable connectors interface C, I_r = 630 A							Cable compartment with							
							Single cable + surge arrester				Dual cables			
Manufacturer	Designation	Conductor [mm2]	XLPE / EPR Ø [mm]	Earthing shield Yes / No	Additional equipment for dual cable arrangement	Surge Arrester with	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 Kabeldon	CSE-A 12630-01	25-70	13.0-20.0	Y	CSEP-A 12630-01	CSAP-A 12	X	X		X	X	X		X
ABB Kabeldon	CSE-A 12630-02	95-300	18.5-30.5	Y	CSEP-A 12630-02	CSAP-A 12	X	X	X	X	X	X		X
ABB Kabeldon	CSE-A 12630-03	400-630	30.5-45.0	Y	CSEP-A 12630-03	CSAP-A 12	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	400TB-630	25-300	12.0-37.5	Y	300PB-630	300PB-10SA	X	X	X	X	X	X	X	
Euromold	400TB/G	185-630	23.5-56.0	Y	440CP+440TB/G	400PB-XSA				X				X
nkt cables	CB12-630	25-300	12.7-34.6	Y	CC 12-630	CSA 12	X	X	X	X	X	X	X	X
nkt cables	AB12-630	25-300	12.7-34.6	N	AC 12-630	ASA 12	X	X	X	X	X	X	X	X
nkt cables	CC24-630(1250)	400-630	34.0-45.6	Y	CC24-630(1250) or CC 12-630	CSA 12	X	X	X	X	X	X	X	X
Prysmian	FMCTs-400	70-300	18.5-30.4	Y	FMPCs-400-12+ FMCTs-400	Yes [1]				X				X
Prysmian	FMCTs-400/1250	70-300	18.5-42.0	Y	FMPCs-400-12+ FMCTs-400/1250	Yes [1]				X				X
Südkabel	SET 12	50-300	15.0-32.6	Y	SEHDK 13.1	MUT 23	X	X	X	X				X
Südkabel	SET 12	50-300	15.0-32.6		KU 23.2/22 +SET 12	MUT 23	X	X	X	X				X
Südkabel	SEHDT 13	400-500	31.3-36.4	Y	None	KU33+MUT 23				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
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 400PBX-XSA

Separable connectors without earthing shield are not recommended.

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

Cable termination 12 kV

12 kV: Separable connectors interface D with earthing shield, I_r = 1250 A						Cable compartment with							
						Single cable + surge arrester				Dual cables			
Manufacturer	Designation	Conductor [mm2]	XLPE / EPR Ø [mm]	Additional equipment for dual cable arrangement	Surge Arrester with	Standard Distance A = 369 mm	With window Distance A = 362 mm	Arc proof Distance A = 346 mm	Double cables Distance A = 564 mm	Standard Distance A = 369 mm	With window Distance A = 362 mm	Arc proof Distance A = 346 mm	Double cables Distance A = 564 mm
Euromold	676LRA/G	50-630	16.0-56.0	680CP+676LRA/G	156SA + 676RTPA								X
Prysmian	FMCTs- 600/1250	120-630	19.7-42.0	FMPCs-600-12 + FMCTs-600/1250	None								X

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

Cable termination 24 kV

24 kV: Separable connectors interface A with earthing shield, I_r = 250 A			
Manufacturer	Designation	Conductor [mm2]	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 Kabeldon	CSE-A 24250-01	10-16	13.0-22.0
ABB Kabeldon	CSE-A 24250-02	25-95	17.0-25.5
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 nework with the rated values of the connector from the different suppliers.

24 kV: Separable connectors interface B with earthing shield, I_r = 400 A						Cable compartment with							
						Single cable + surge arrester				Dual cables			
Manufacturer	Designation	Conductor [mm2]	XLPE / EPR Ø [mm]	Additional equipment for dual cable arrangement	Surge Arrester with	Standard Distance A = 361 mm	With window Distance A = 354 mm	Arc proof Distance A = 338 mm	Double cables Distance A = 556 mm	Standard Distance A = 361 mm	With window Distance A = 354 mm	Arc proof Distance A = 338 mm	Double cables Distance A = 556 mm
3M	93-EE 605-4/-95	25-95	15.0-23.5	None	MUT 23	X	X	X	X				
3M	93-EE 605-4/-240	95-240	21.8-32.6	None	MUT 23	X	X	X	X				
ABB Kabeldon	CSE-A 24400-01	25-70	17.0-24.0	None	None								
ABB Kabeldon	CSE-A 24400-02	95-300	22.5-35.0	None	None								
Euromold	K400LR/G	25-240	12.0-37.5	None	None								
Euromold	K400TE/G	25-240	12.0-37.5	K400CP-SC + K400TE/G	156SA + K400RTPA				X				X
nkt cables	CE 24-400	25-300	12.7-34.6	None	None								
nkt cables	CB 36-400	25-300	12.7-40.0	CC 24-630	CSA 24	X	X	X	X	X	X	X	X
Prysmian	FMCE-400	35-300	18.5-35.3	None	None								
Prysmian	FMCT-400	35-300	18.5-35.3	None	None								
Südkabel	SEHDT 22.1	25-240	18.0-32.6	None	None								
Südkabel	SET 24-B	25-240	15.0-32.6	KU 23.1/22 +SET 24-B	MUT 23	X	X	X	X				X
Tyco Electronics	RSES	25-240	12.7-34.6	None	None								

Separable connectors without earthing shield are not recommended.

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

Cable termination 24 kV

24 kV: Separable connectors interface C with earthing shield, I_r = 630 A						Cable compartment with							
						Single cable + surge arrester				Dual cables			
Manufacturer	Designation	Conductor [mm2]	XLPE / EPR Ø [mm]	Additional equipment for dual cable arrangement	Surge Arrester with	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	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 Kabeldon	CSE-A 24630-01	25-70	17.0-24.0	CSEP-A 24630-01	CSAP-A 24	X	X		X	X	X		X
ABB Kabeldon	CSE-A 24630-02	95-300	22.5-35.0	CSEP-A 24630-02	CSAP-A 24	X	X	X	X	X	X		X
ABB Kabeldon	CSE-A 24630-03	400-630	30.5-45.0	CSEP-A 24630-03	CSAP-A 24	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
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	CB24-630	25-300	12.7-34.6	CC 24-630	CSA 24	X	X	X	X	X	X	X	X
nkt cables	CC24-630(1250)	400-630	34.0-45.6	CC24-630(1250) or CC24-630	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 [1]				X				X
Prysmian	FMCTs-400/1250	35-630	18.5-47.1	FMPCs-400-24 + FMCTs-400/1250	Yes [1]				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	KU 23.2/23 + SET 24	MUT 23	X	X	X	X				X
Südkabel	SEHDT 23.1	300	31.9-34.6	KU 23.2/23+ SEHDT 23.1	MUT 23	X	X	X	X				X
Südkabel	SEHDT 23	300-500	31.9-40.6	None	KU33+ MUT 23				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 400PBX-XSA

Separable connectors without earthing shield are not recommended.

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

Cable termination 24 kV

24 kV: Separable connectors interface D with earthing shield, I_r = 1250 A						Cable compartment with							
						Single cable + surge arrester				Dual cables			
Manufacturer	Designation	Conductor [mm2]	XLPE / EPR Ø [mm]	Additional equipment for dual cable arrangement	Surge Arrester with	Standard Distance A = 369 mm	With window Distance A = 362 mm	Arc proof Distance A = 346 mm	Double cables Distance A = 564 mm	Standard Distance A = 369 mm	With window Distance A = 362 mm	Arc proof Distance A = 346 mm	Double cables Distance A = 564 mm
Euromold	K676LRA/G	35-630	16.0-56.0	K680CP+K676LRA/G	156SA+ K676RTPA				X				X
Prysmian	FMCTs- 600/1250	50-630	19.7-42.0	FMPCs-600-24 + FMCTs-600/1250	None								X

Separable connectors without earthing shield are not recommended.

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

Capacitive voltage indication

HR-module (VDS)

VPIS

Capacitive voltage indicating system

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

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.

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.

Capacitive voltage indication

PCM

Phase comparators type PCM

The PCM-phase comparator indicates phase balance / 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 PCM

Rated frequency	50 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

VIM 3

VIM 1

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, or 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
Treshold voltage U	70 - 90V
Treshold current I	1,62 - 2,5 uA
Capacity to coupling system	74 - 88 pF
Input impedance of indicator	36 - 43,2 MOhm
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

Short-circuit indicator

Horstmann SIGMA Short-circuit Indicator

The SIGMA short-circuit indicator is designed for distribution networks using radial or open-ring operation. The instrument is provided with three short-circuit current transformers which are mounted onto the bushings of the switchgear. When the phase current exceeds the preset trip level, the fault-affected phase is indicated by a bright LED flashlight as the remote signal contact gets activated. If a second tripping occurs within a preset time, for example when automatic re-closing is in process, this condition is indicated by a double flashing LED.

Short-circuit trip currents (Ik)	adjustable to 200, 300, 400, 600, 800 or 1000A, or self-asjusting
Response time	40 ms or 80 ms
Timed reset	after passage of 1, 2, 4 or 8 h
Remote test/remote reset	via external potential-free momentary contact
Temperature range	-30°C... +70°C
Energy supply	long-life lithium cell, life expectancy 20 years, flashing time >1000 h
Relay contact	permanent or momentary contact (1s), adjustable

Horstmann SIGMA F+E 3 Short-circuit and Earth Fault Indicator

The SIGMA F+E 3 short-circuit and earth fault indicator provides the same functions as the SIGMA type. Three cable-type current transformers are used for short-circuit and earth fault detection. The overcurrent (I>>) is indicated by a red LED whereas a yellow LED signals the earth fault current (IE).

Trip currents (Ik)	adjustable to 200, 300, 400, 600, 800, 1000 or 2000A, or self-asjusting
Trip currents (I0)	adjustable to 20, 40, 60, 80, 100, 120 or 190 A
Response delay (Ik/I0)	40, 80, 200, 300 ms/ 80, 160, 200, 300 ms
Timed reset	after passage of 1, 2, 4 or 8 h
Remote test/remote reset	via external potential-free momentary contact
Temperature range	-30°C... +70°C
Energy supply	internal:by long-life lithium cell, life expectancy 20 years, total flashing time >1000h; external:by 12-60VDC (optional feature)
Relay contact	permanent or momentary contact (1s), adjustable

Short-circuit indicator

Horstmann ComPass A Short-circuit and Earth Fault Indicator

The ComPass A is a combined short-circuit and earth fault indicator along with the feature of load current measurement. It can be operated in radial and open ring distribution networks. Three cable-type current transformers are used to detect short-circuits and earth faults, and to measure the load current. The ComPass A permanently measures the phase currents and indicates either the earth fault or the short-circuit on the display once the trip levels have been exceeded. Besides the permanent indications of the actual load current and frequency values, this design also allows for active storage of load current data in the form of maximum values measured in the last 24 hours and 365 days. RS-485/modbus interface can be used to remotely indicate and to read the relevant data.

Horstmann ComPass B Directional Short-circuit and Directional Earth Fault Indicator

The ComPass B instrument provides the same functions as the ComPass A. The ComPass B also features directional detection of short-circuits and directional detection of earth faults in all networks//neutral earthing connections, and moreover the indication of the load flow direction.

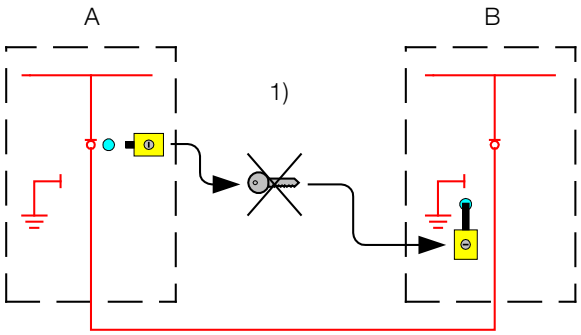
Trip currents (Ik/I0)	50 A - 2000 A / 20 A - 1000 A
Delay time (Ik/I0)	40 ms < t < 60 ms
Time reset	1 min - 24 h
Remote test/remote reset	via external potential-free momentary contact
Temperature range	-30°C... +70°C
Energy supply	external: by 24 - 230V AC/DC; internal: by back-up supply
Relay contact	permanent or momentary contact (1s),selectable

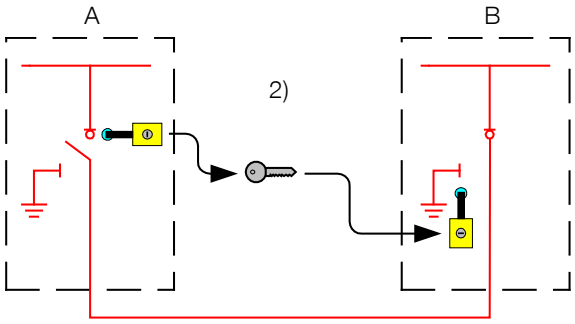
Horstmann ALPHA E Short-circuit Indicator

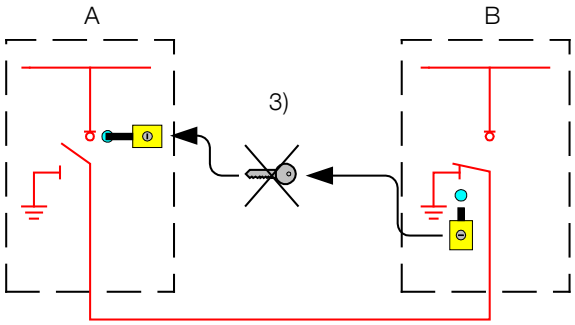
This instrument is designed for distribution networks using radial or open-ring operation.
It is provided with three short-circuit current transformers which are mounted onto the bushings of the switchgear. In the event of a fault, a mechanical flag is operated to signal that the phase current has exceeded the preset trip level.

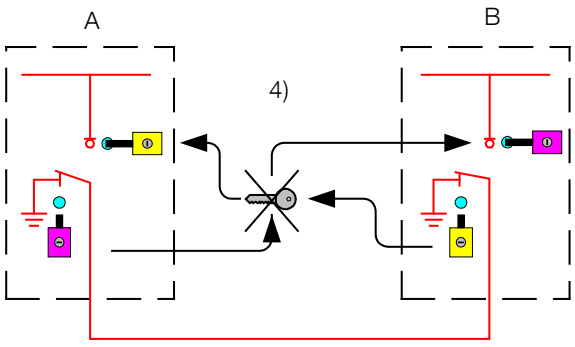
Trip currents (Ik)	adjustable to 400, 600, 800 or 1000 A
Delay time (Ik)	100 ms
Timed reset	after passage of 2 or 4 h
Remote test/remote reset	12 - 60 V AC/DC
Temperature range	-30°C... +70°C
Energy supply	log-life lithium cell
Relay contact	permanent or momentary contact (100 ms)

Ronis key interlock









Except for fuse-switch and vacuum circuit-breaker, all load break switches, earthing switches and disconnectors may be equipped with Ronis key interlock type EL11AP for one key. Earthing switches can also be equipped with EL22AP for 2 keys.

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

1) One 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 the load break switch in switchgear A to open position.
Then it will be possible to operate the key interlock and turn the key which extends the locking bolt. This will prevent the access to the operating shaft of the load break switch.
Then withdraw the key and insert it into the identical key interlock on the earthing switch of switchgear B.

3) When the key is inserted, you will be able to operate the key interlock and turn the key which will withdraw the extended locking bolt.
Then there will be access to operate the earthing switch to closed position. As long as the earthing switch is in closed position, the key will be captured and make it impossible to close the load break switch in switchgear A.

4) If the load break switch in switchgear B and earthing switch in switchgear A are equipped with another identical 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.

Smart Grid applications

SafeRing/SafePlus for Smart Grid applications

12-24 kV SafeRing/SafePlus Ring Main Unit portfolio from ABB is now enhanced to meet the increasing demand for Smart Grid applications in secondary distribution networks.

Standard grid automation devices for ABB's Ring Main Units are located in the space behind the lower front cover, hence eliminating the need for additional low voltage compartment on the top of the switchgear.

Thanks to the flexibility of SafeRing/SafePlus modules, grid automation solutions can also be delivered with different switchgear configurations with low voltage compartment if required.

Standard packages for Smart Grid applications can provide monitoring, control, diagnostic and supervision functionalities including feeder automation devices with wired and/or wireless communication interfaces and power supply back-up.

The already compact SafeRing/SafePlus range can also be delivered as an ultra-compact unit with integrated Smart Grid solutions (reduced overall height of 1'100 mm) to be fitted inside substations with height limitations.

Customer benefits

The integrated smart grid functionalities enable the network operators to:

- Monitor the grid so that they are able to remotely locate the fault.
- Reconfigure the network so that the faulty part of the network is disconnected.
- Reconfigure the network so that the energy loss is minimized and/or achieve savings for future investments.

Additional benefits for utilities and energy consumers are:

- Improved quality of the power supply.
- Less and shorter outages and improved voltage quality.
- Ensured safety for personnel.
- Enhanced operational efficiency and network stability.
- Improved tools for the network operators and the field crews.
- Less need to travel to locations with difficult access.

Smart Grid applications

Ring Main Unit for Smart Grid applications is equipped with advanced Feeder Automation device, which in cooperation with additional devices (e.g. Fault Passage Indicators) provides various data to the remote control centers. Key functions of all standard packages from factory are described in the next pages. There are seven different selections which give the end users possibility to adjust the package to fit their requirements.

All secondary devices within the Ring Main Unit are powered by a 24V DC battery. The battery is charged by its charger, which needs external power supply:

- 90...264V AC 50/60 Hz or 85...200V DC in case of Feeder Automation device REC603 (internal battery charger) is used.
- 94...132V AC or 184...264V AC 50/60 Hz in case of Feeder Automation device RTU560CIG10 (external battery charger) is used.

Please contact us in case you need other main power supply option.

Remote and local communication

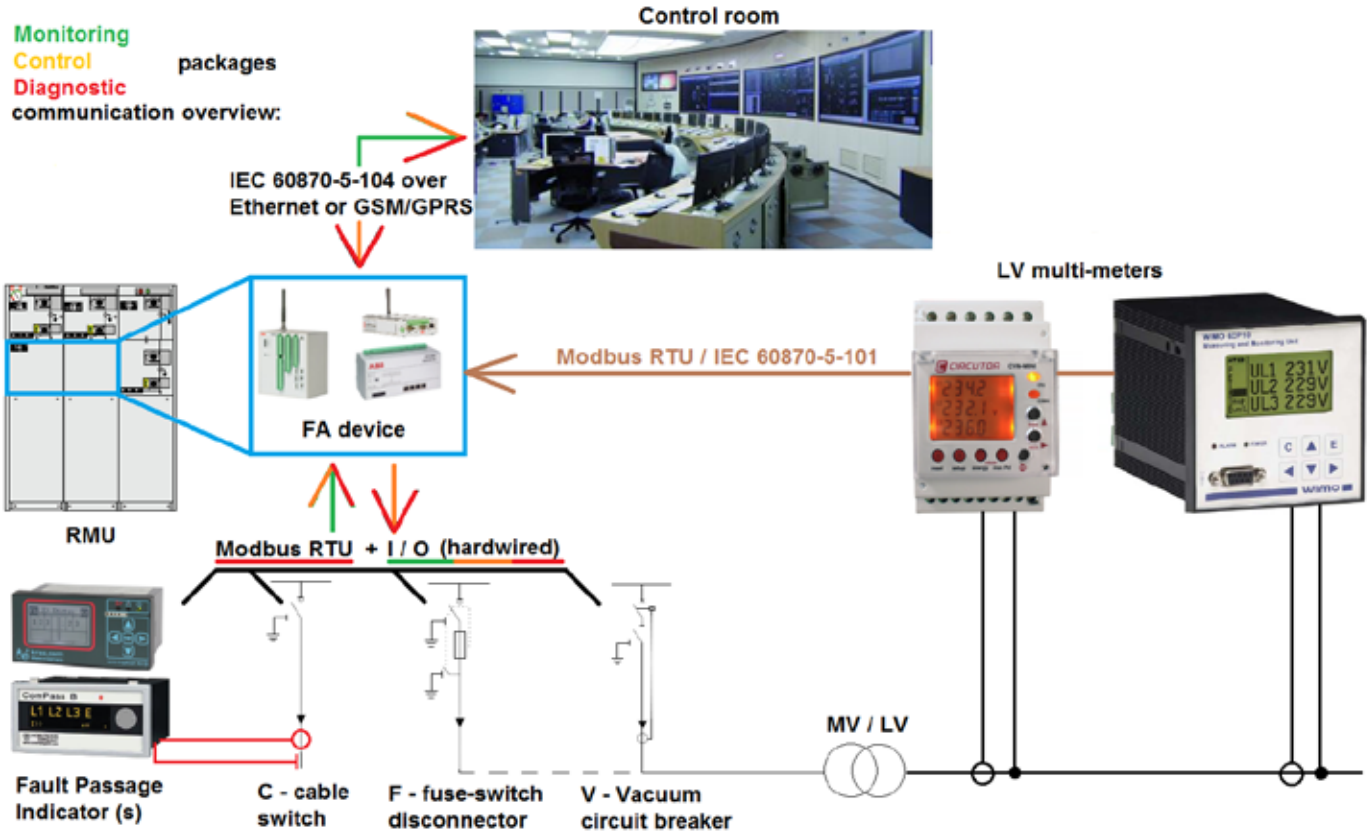
A. Remote communication (communication to the remote control center)

Default delivery (standard package solution) comes with IEC 60870-5-104 remote communication protocol implementation. The communication media is either wired Ethernet and/or wireless (GSM/GPRS) communication.
Please contact us in case you need other remote communication protocol option.

B. Local communication (communication between different automation devices within the RMU)

The signals from the Ring Main Unit switches, Fault Passage Indicators and low voltage multi-meters are brought to the Feeder Automation device by two different ways:

- digital signals (e.g. switch positions indication and control) are hardwired
- analog signals (e.g. measurements from the Fault Passage Indicators and low voltage multi-meters) are obtained over local communication bus which can be serial Modbus RTU or serial IEC 60870-5-101 communication protocol. Modbus RTU is used within Diagnostic package together with RTU560CIG10 Feeder Automation device (via it's CPA port), IEC 60870-5-101 is used for connecting low voltage multi-meters in case REC603 Feeder Automstion device (via its RS1/RS2 ports).



Smart Grid applications

Packages

All standard packages include:

– Power supply backup source for automation devices (24V DC batteries and battery charger)
– Wire (Ethernet) and/or wireless (GSM/GPRS) communication interfaces (SIM card is not part of delivery)
– IEC 60870-5-104 host (slave) communication protocol

Three levels of automation packages are defined below. There are additional options which can be selected for each package.

Main selections and their options are (*) default values)

1. Automation level
– Remote Monitoring package
– Remote Control package*)
– Remote Diagnostic package

2. Feeder automation device
– REC603 *)
– RTU560CIG10
  GPRS communication/modem:
  - No *)
  - RER601
  - 560MDD10

3. MV network fault types
– OC and EF directional
– OC and EF non directional *)
– Fault

4. Fault passage indicators
– Kries - IKI-50_1F (directional)
– Horstmann - ComPass B (directional)
– Kries - IKI-20U2 *)
– Horstmann - SIGMA F+E (AC/DC)

5. Fault passage indicators remote reset
– No
– Yes *)

6. Distribution transformer feeders common remote emergency trip
– No
– Yes *)

7. Supervision of the LV side of the distribution transformer
– None *)
– Vamp: WIMO 6CP10
– Circutor: CVM-MINI-ITF-RS485-C2

Options description

1. Automation level

The three automation levels (packages) are described below.

Remote Monitoring

This package provides remote monitoring of:
– The position of load break switches in C modules (-> grid topology supervision)
– Fault passage indicator fault signalization (-> fast fault localization, reduced outage time, efficient use of manpower)
– Faults in the transformer feeders

Remote Control

This package includes the features from the Remote Monitoring package and in addition provides:
– Remote control of load break switches in C modules (-> fast fault isolation, fast restoration of healthy part of the MV network , operator safety)

Remote Diagnostic

This package includes the features from the Remote Control package and in addition provides:
– MV network analog data values such as: currents, voltages, frequency, power, energy, load flow direction etc. (-> improved notification of overloaded equipment, better maintenance planning, improved power quality).

Note: There are spare inputs (1 – 5 pieces) which can be used for additional customer specified „digital/binary" signals such as: SF_6 gas pressure signal, low voltage fuses tripped signal, transformer overheating signal, etc. The number of spare inputs depends on configuration of Ring Main Unit (CCF, CCCF etc.) and on the type of fault detection for the MV network.

2. Feeder automation device

Compact Feeder Automation devices secure remote monitoring and control of the secondary substations in the distribution network. It enables the network control centers to monitor and control the field devices over the different communication infrastructure.

REC603

The Wireless Controller REC603 is a compact, solution based device for the remote control and monitoring of secondary substations such as network disconnectors, load break switches and Ring Main Units in distribution networks.

Smart Grid applications

REC603 enables the network control system to monitor and control the field devices over the public communication infrastructure (GPRS). The Wireless Controller REC603 utilizes the built-in GPRS for reliable and secure end-to-end communication providing remote monitoring and control of up to three objects.

RTU560CIG10
The RTU560 DIN rail provides advanced functionality and makes it the perfect fit for existing and future Grid Automation solutions. The compact housing with the possibility to integrate hardwired information fulfills complex requirements and space restrictions at the same time.

3. MV network fault types

Different signals from Fault Passage Indicators can be transmitted to the control centers. These are selected based on type of the MV network (isolated neutral, compensated neutral, high resistance earthing, low resistance earthing or solidly earthing).

Available options are:
OC and EF directional
With this selection, two different types of events can be transferred to the remote control centers:
- Fault in forward direction (does not differentiate over-current and earth fault)
- Fault in backward direction (does not differentiate over-current and earth fault)

OC and EF non directional
With this selection, two different types of events can be transferred to the remote control centers:
- Over-current fault (does not differentiate fault direction)
- Earth fault (does not differentiate fault direction)

Fault
With this selection, one type of event can be transferred to the remote control centers:
- Fault (does not differentiate over-current and earth fault nor fault direction)

4. Fault Passage Indicators

Fault Passage Indicators are devices which detect faults in the MV network. Some of them are also able to provide MV analog value measurements to the Feeder Automation device which transfers these signals to the control centers.

Smart Grid applications

5. Fault passage indicators remote reset

Selection No
The Fault Passage Indicators signalization will be reset according to its setting (e.g. manually, automatically after fixed set time).

Selection Yes
This option gives possibility to reset Fault Passage Indicators remotely from the control centers.

Note: There is one common reset command for all Fault Passage Indicators by use of REC603 Feeder Automation device – all Fault Passage Indicators within the Ring Main Unit will be reset at the same time.

6. Distribution transformer feeders common remote emergency trip

Selection No
No possibility to remotely trip distribution transformers modules.

Selection Yes
This option gives possibility to remotely trip distribution transformers modules (usually F and/or V modules) from the control centers.

Note: There is one common trip command for all distribution transformer modules – all modules will be tripped at the same time.

7. Supervision of the LV side of the distribution transformer

This option gives possibility to remotely supervise secondary (Low Voltage) side of the distribution transformer. Different multi-function monitoring devices with extensive measuring and calculation functions will be available in this selection. The unit measures currents, voltages and frequencies, and calculates power and energy values. Interconnection cable between Feeder Automation device and low voltage multi-meters is not part of delivery.

None
No possibility to remotely supervise LV network analog data.

Vamp: WIMO 6CP10
WIMO 6CP10 secondary substation measuring and monitoring unit is a compact multi-function monitoring device with extensive measuring and calculation functions. WIMO 6CP10 is ideal for secondary substation measuring and monitoring management. The unit measures currents, voltages and frequencies, and calculates power and energy values.

Smart Grid applications

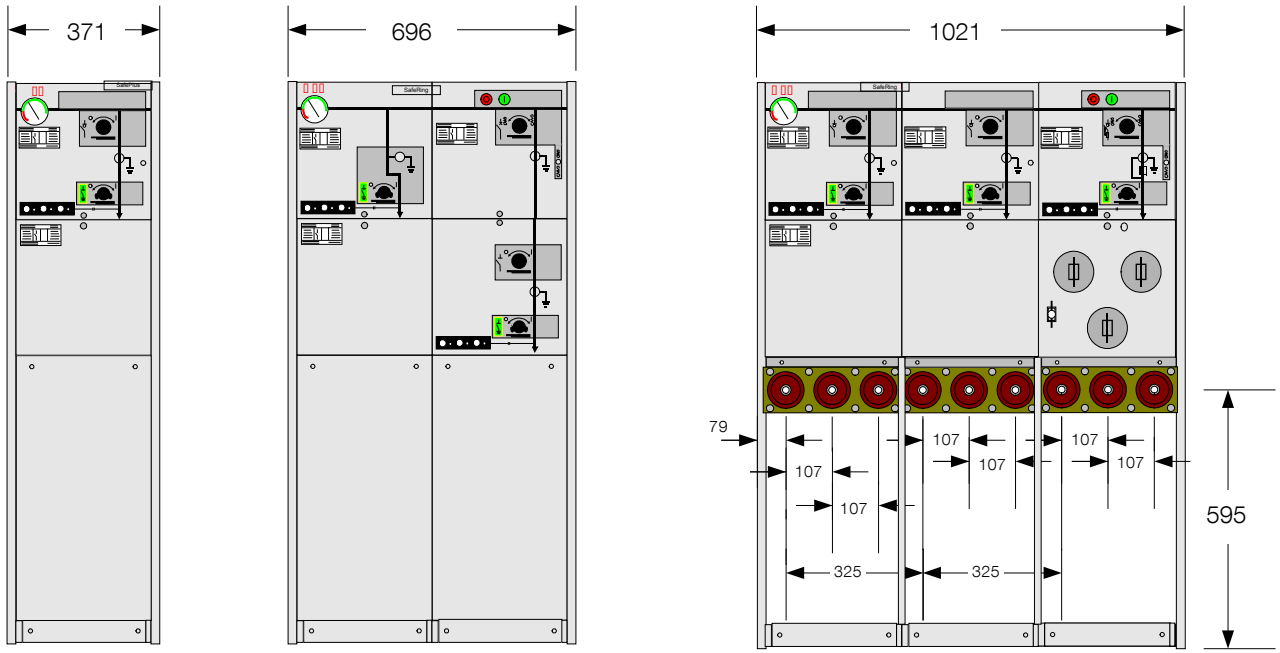
Circutor: CVM-MINI-ITF-RS485-C2
The CVM-MINI panel analyzer is a programmable measuring instrument; it offers a series of options, which may be selected from configuration menus on the instrument itself.

The CVM-MINI measures, calculates and displays the main electrical parameters for three-phase, balanced or unbalanced industrial systems.

Measurements are taken as true effective values using the three alternating and neutral voltage inputs and three current inputs to measure In /1A or In /5A secondary from external measurement transformers. The CVM-MINI allows the display of all electrical parameters, using the backlit LCD display, showing three instant electrical parameters, maximum or minimum on each page jump.

Note: The availability depends on the selected Feeder Automation device and Ring Main Unit module configuration. These devices are by default mounted in top entry box or low voltage compartment.

Dimensions


371
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1021
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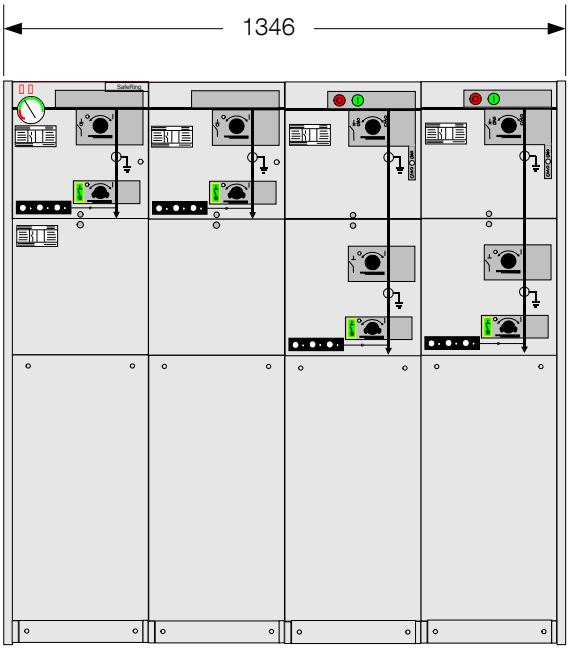
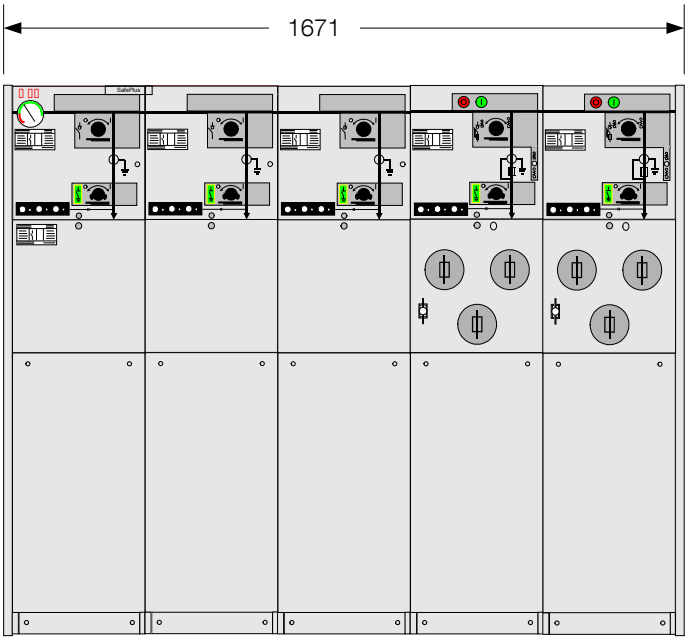
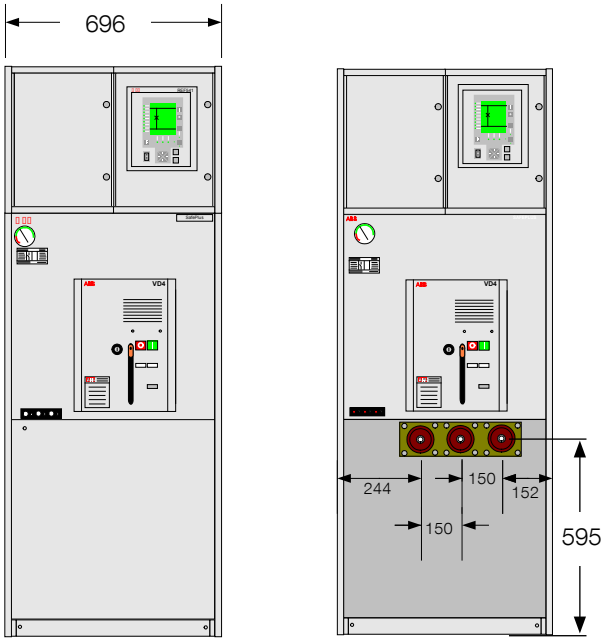
595
325
325

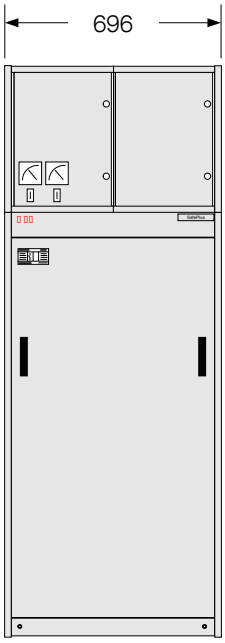

1346


1671

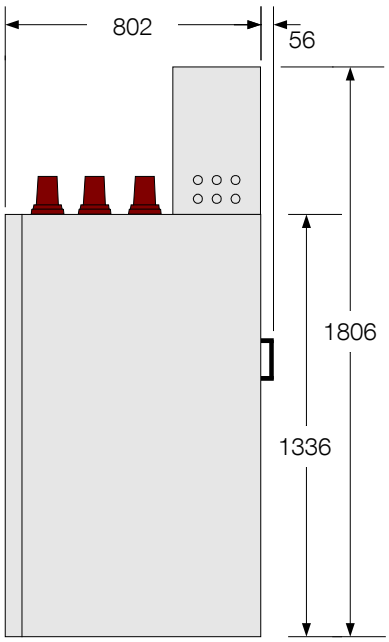
Dimensions



CB modul

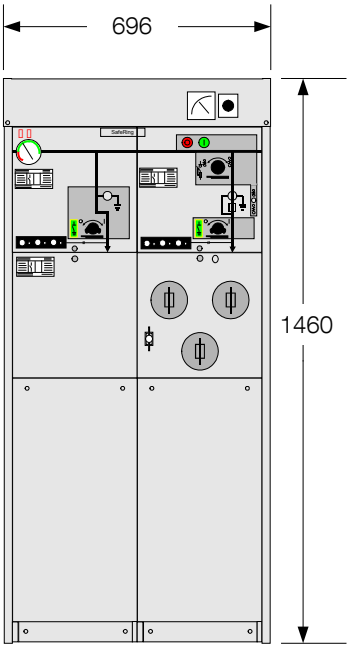


Metering module M, front view

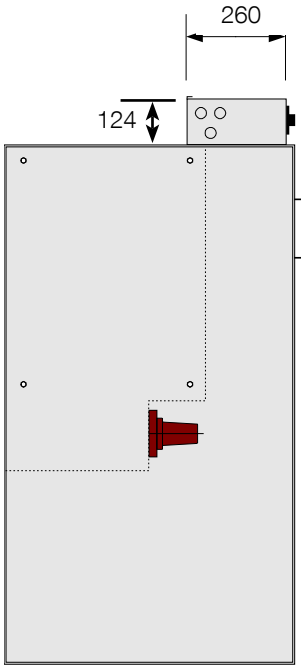


Metering module M,side view right

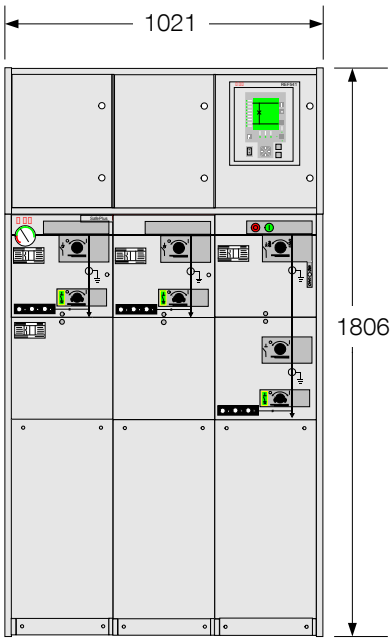
Dimensions



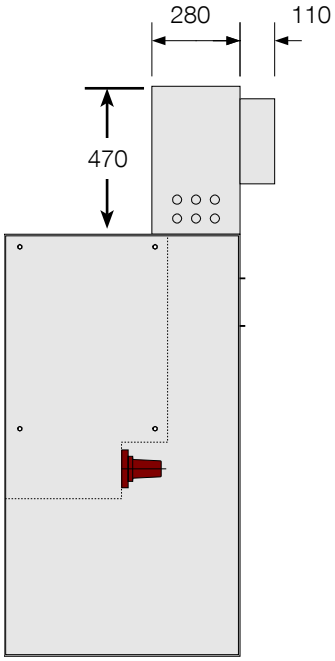
Top entry box with ammeter and position switch



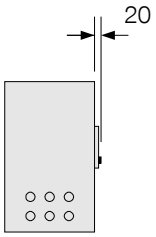
Top entry box - side view



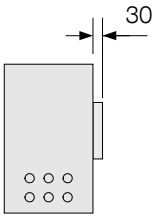
Low voltage compartment with REF541



Low voltage compartment with REF541

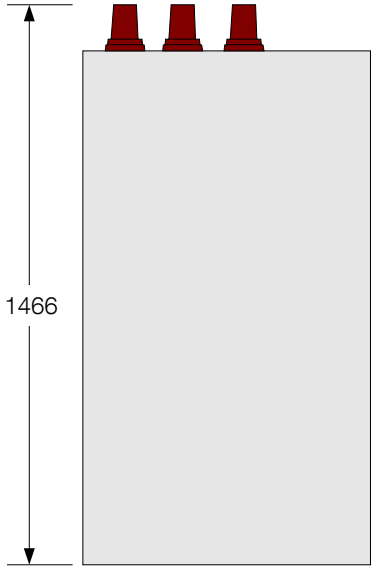


Low voltage compartment with REF542plus

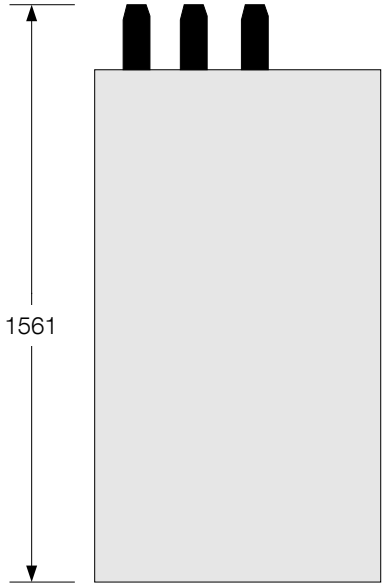


Low voltage compartment with REF610

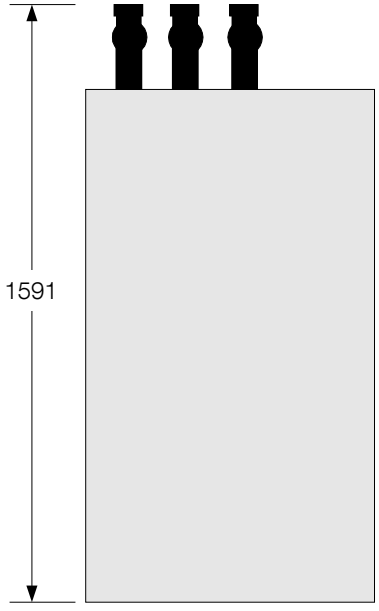
Dimensions



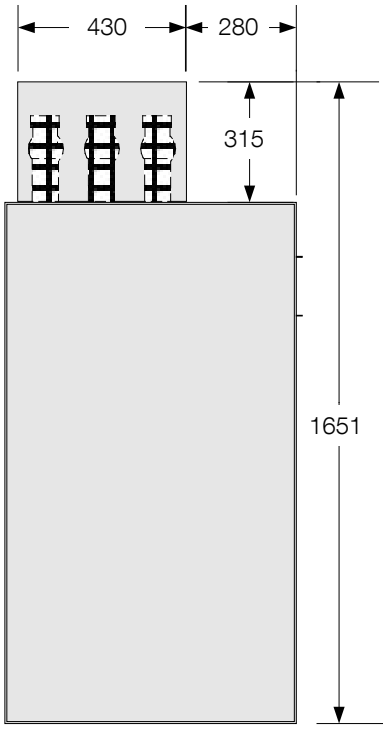
Bushings for connection of external busbars



Prepared for future extension with dead end receptacles

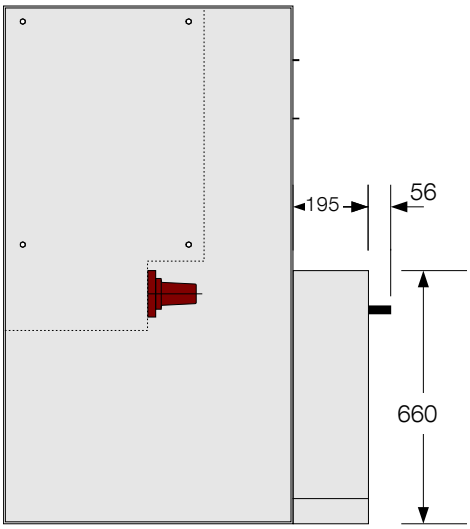


External busbars

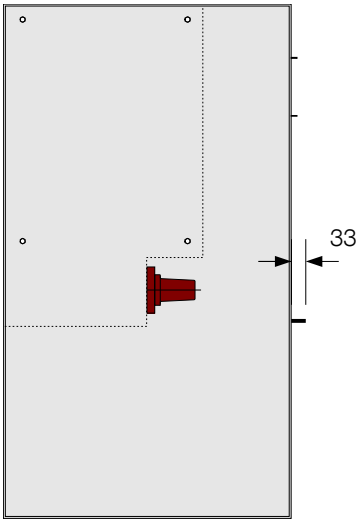


Busbar cover

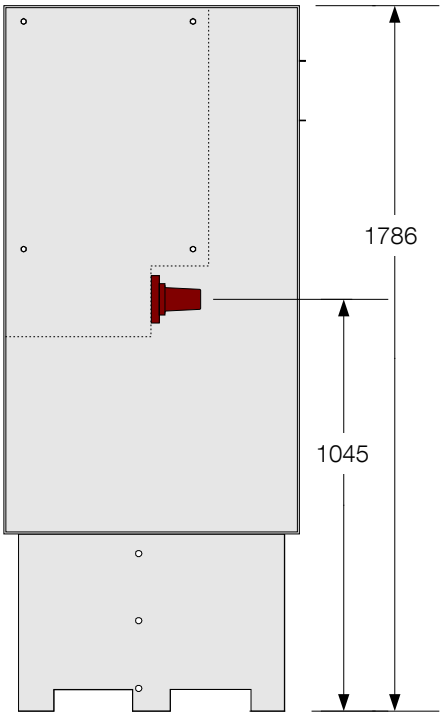
Dimensions



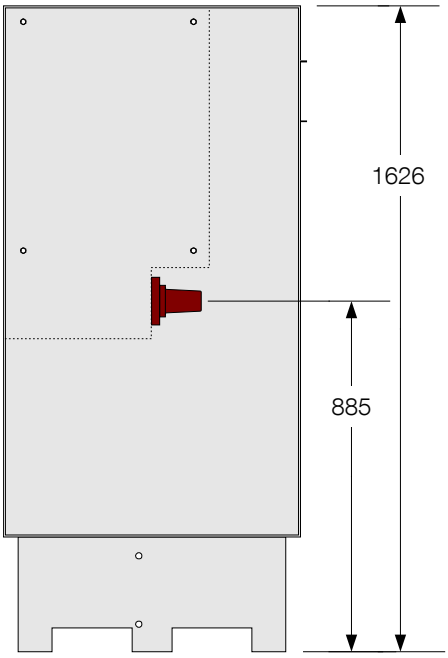
Cable compartment cover for parallell cables



Arc proof cable cover

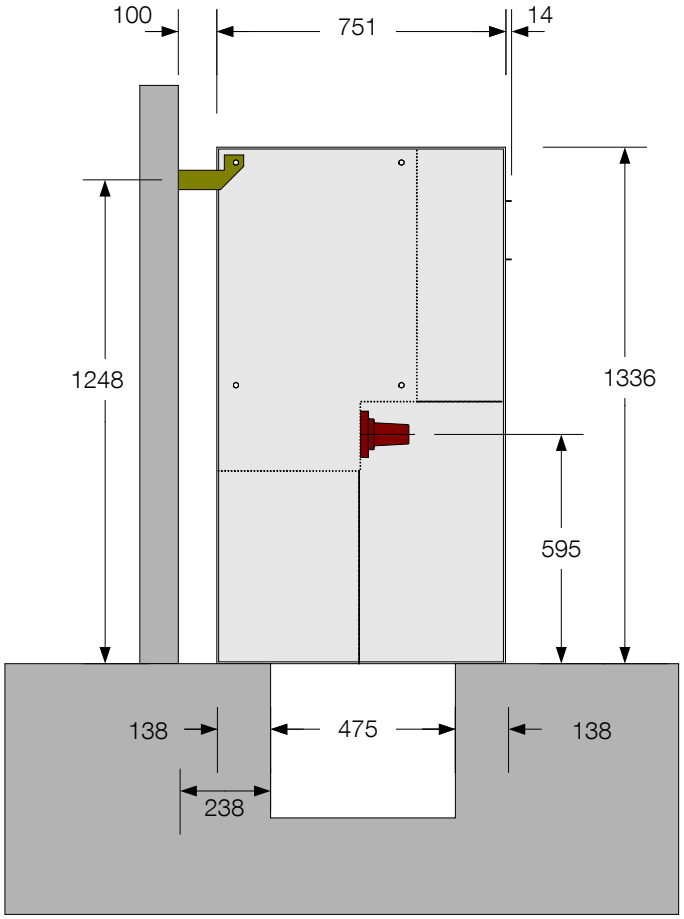


Base frame, height 450 mm

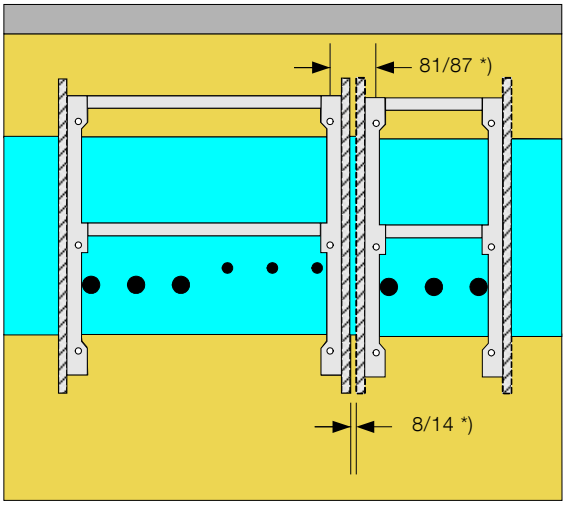


Base frame, height 290 mm

Dimensions



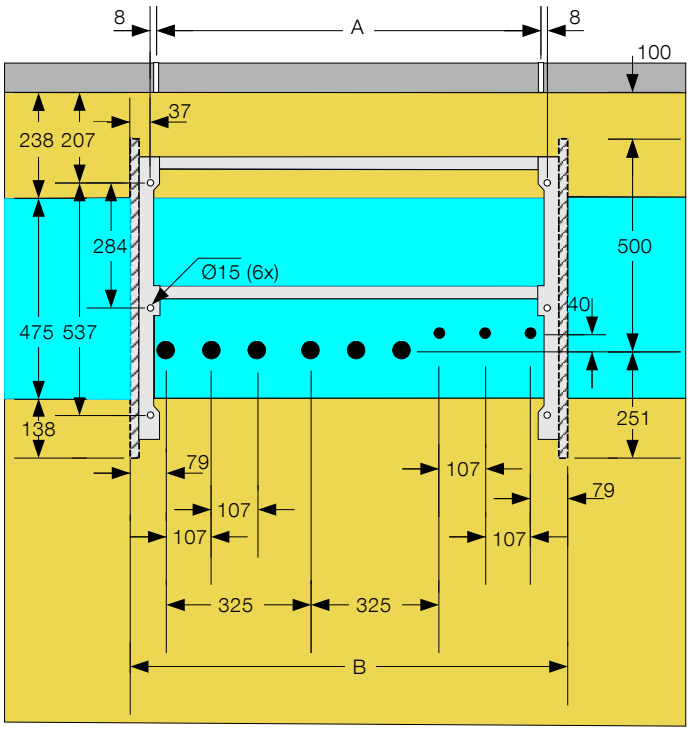
Cable trench and wall fixing



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

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

● Indicates cable entry



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

Technical data

Codes and standards

SafeRing and SafePlus are manufactured and tested in accordance with the lates version of the below IEC regulations

IEC 62271-1	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)

Technical data

SafeRing - Ring Main Unit, electrical data

1	Rated voltage	Ur	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
	Making and breaking capacities C-module:						
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
	Making and breaking capacities F-module:						
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
	Making and breaking capacities V-module:						
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

Technical data

SafePlus - Compact Switchgear, electrical data

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 (external busbars)	I_r	A	1250	1250	1250	1250
7	Rated normal current (cable switch)	I_r	A	630	630	630	630
8	Rated normal current (switch-fuse-disconnector)	I_r	A	200 [1]	200 [1]	200 [1]	200 [1]
9	Rated normal current (vacuum circuit-breaker)	I_r	A	200 / 630	200 / 630	200 / 630	200 / 630
10	Rated short-time withstand current	I_k	kA	25 / 21 [3]	21 [3]	21 [3]	21 [3]
11	Rated duration of short-circuit	t_k	s	1 / 3	3	3	3
12	Rated peak withstand current	I_p	kA	62,5 / 52,5	52,5	52,5	52,5
	Making and breaking capacities C-module:						
13	Rated mainly active load breaking current	I_1	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	I_{2a}	A	630	630	630	630
16	Rated no-load transformer breaking current	I_3	A	20	20	20	20
17	Rated single capacitor bank breaking current	I_{4c}	A	135	135	135	135
18	Rated earth fault breaking current	I_{6a}	A	200	150	150	150
19	Rated cable- and line-charging breaking current under earth fault conditions	I_{6b}	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	I_1	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	I_3	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)	I_k	kA	5	5	5	5
27	Rated duration of short-circuit	t_k	s	1	1	1	1
	Making and breaking capacities V-module:						
28	Rated mainly active load breaking current	I_1	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	I_c	A	31,5	31,5	31,5	31,5
31	Rated short-time current (earthing switch)	I_k	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	P_{re}	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

Technical 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	Faclilities provided for gas monitoring	Yes, temperature compensated manometer can be delivered		
11	Material used in tank construction	Stainless steel sheet, 2,5 mm		
12	Busbars	240 mm^2 Cu		
13	Earth bar (external)	100 mm^2 Cu		
14	Earth bar bolt dimension	M10		
	Overall dimensions of the fully assembled RMU	Height mm	Depth mm	Width 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	

Weight table			
Maximum weights for standard SafeRing			
2-way DeV	300 kg	2-way DeF	300 kg
3-way CCV	450 kg	3-way CCF	450 kg
4-way CCCV	600 kg	4-way CCCF	600 kg
4-way CCVV	600 kg	4-way CCFF	600 kg
3-way CCC	450 kg		
4-way CCCC	600 kg		
SafePlus			
Standard 1-way		150 kg	
2-, 3- and 4-way		as for SafeRing	
5-way		750 kg	
M - metering module		250 kg	
Mt - metering tariff module			

Technical data

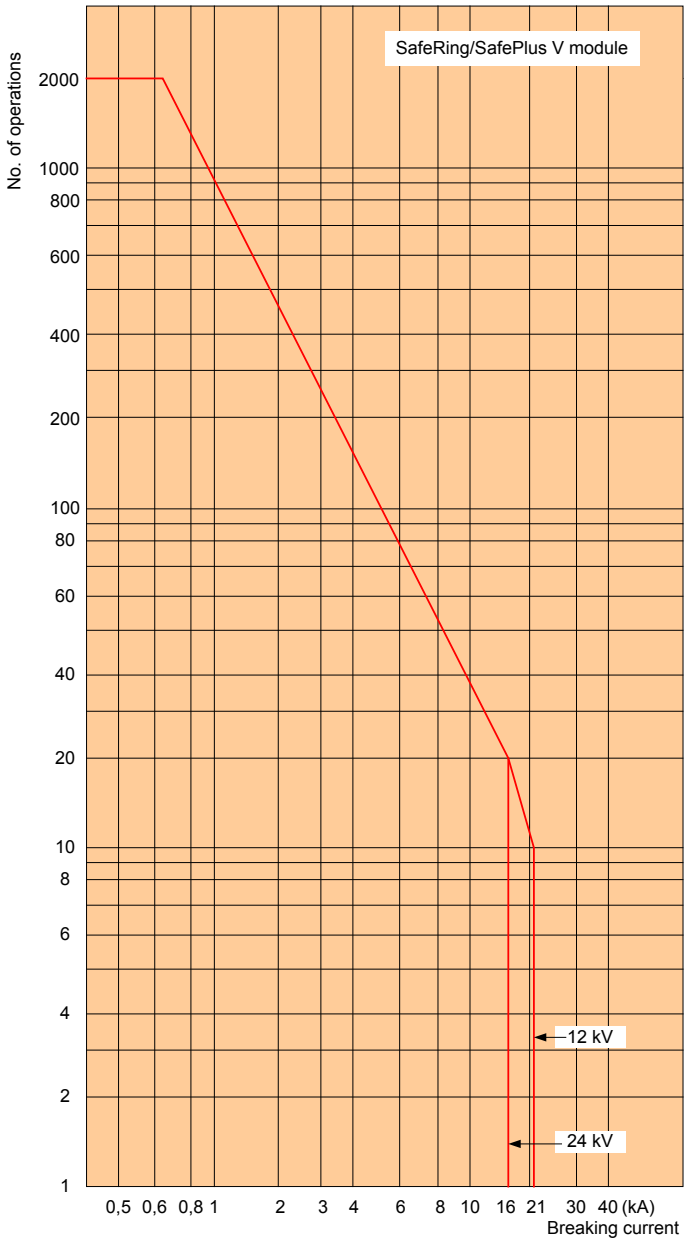
Operations, degree of protection and colours

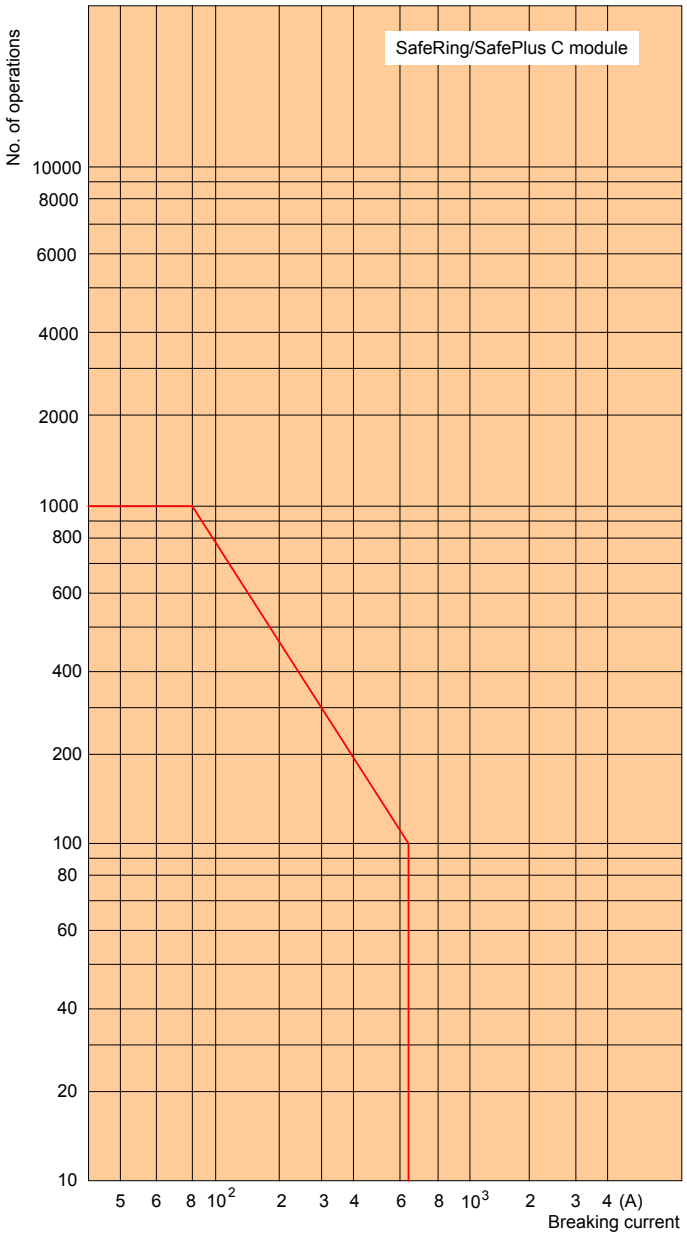
1	Means of switch operation	separate handle
2	Means of fuse switch/circuit-breaker operation	separate handle and push buttons
3	Rated operating sequence of circuit-breaker (V-module)	O – 3 min – CO – 3 min – CO
4	Rated operating sequence of circuit-breaker (CB-module)	O – 0,3 s – CO – 3 min – CO
5	Total 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

Technical data





Environmental Certification

Environmetal Certification

Life expectancy of product

The product is developed in compliance with the requirements denoted by IEC 298. The design incorporates a life span under indoor service conditions exceeding 30 years (IEC 298 annex GG).
The switchgear is gas-tight with an expected diffusion rate of less than 0.1 % per annum. Referring to the reference-pressure of 1.4 bar, the switchgear will maintain gas-tightness and a gas-pressure better than 1.3 bar* throughout its designed life span. *) at 20oC.

Recycling capability

Raw Material	Weight (kg)	% of total weight	Recycle	Environmental effects & recycle/reuse processes
Iron	132,80	42,53	Yes	Separate, utilise in favour of new source (ore)
Stainless steel	83,20	24,93	Yes	Separate, utilise in favour of new source (ore)
Copper	43,98	14,09	Yes	Separate, utilise in favour of new source (ore)
Brass	2,30	0,74	Yes	Separate, utilise in favour of new source (ore)
Aluminium	8,55	2,74	Yes	Separate, utilise in favour of new source (ore)
Zinc	3,90	1,25	Yes	Separate, utilise in favour of new source (ore)
Silver	0,075	0,024	Yes	Electrolysis, utilise in favour of new source
Thermoplastic	5,07	1,63	Yes	Make granulate, re-use or apply as high-grade energy additive in cement mill
Epoxy incl. 60% quartz	26,75	8,35	Yes	Grind to powder and use as high-grade energy additive in cement mill
Rubber	1,35	0,42	Yes	High-grade energy additive in refuse incineration
Dielectric coil	0,21	0,066	Yes	Reclaim or use as high-grade energy additive in refuse incineration
SF_6 gas	3,24	1,04	Yes	ABB AS in Skien is equipped to reclaim used SF_6 gas
Total recycleables	311,44	97,25		
Not specified*)	9,00			*)Stickers, film-foils, powder coating, screws, nuts, tiny components, grease
Total weight **)	320,00	100 %		
Packing foil	0,20		Yes	High-grade energy additive in refuse incineration
Wooden pallet	21,50		Yes	Re-use of use as energy additive in refuse incineration

**)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 switchgears at end-of-life.

ABB's recycling service is according to IEC 1634 edition 1995 section 6: «End of life of SF6 filled equipment» and in particular 6.5.2.a: «Low decomposition»: «No special action is required; non-recoverable parts can be disposed of normally according to local regulations.»
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 switchgears.

Contact us

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1VDD006104 GB Ed. May 2013

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