

Gas Insulated Ring Main Unit

RVAC

Professional solutions,
Reliable power



Cooper Power Systems

by **EAT•N**



Automotive



Aerospace



Truck



Hydraulics



Electrical

Powering business worldwide

Eaton delivers the power inside hundreds of products that are answering the demands of today's fast changing world.

We help our customers worldwide manage the power they need for buildings, aircraft, trucks, cars, machinery and entire businesses. And we do it in a way that consumes fewer resources.

Next generation transportation

Eaton is driving the development of new technologies – from hybrid drivetrains and emission control systems to advanced engine components – that reduce fuel consumption and emissions in trucks and cars.

Higher expectations

We continue to expand our aerospace solutions and services to meet the needs of new aviation platforms, including the high-flying light jet and very light jet markets.

Building on our strengths

Our hydraulics business combines localised service and support with an innovative portfolio of fluid power solutions to answer the needs of global infrastructure projects, including locks, canals and dams.

Powering Greener Buildings and Businesses

Eaton's Electrical Group is a leading provider of power quality, distribution and control solutions that increase energy efficiency and improve power quality, safety and reliability. Our solutions offer a growing portfolio of "green" products and services, such as energy audits and real-time energy consumption monitoring. Eaton's Uninterruptible Power Supplies (UPS), variable-speed drives and lighting controls help conserve energy and increase efficiency.



MV switchgear technology is in our DNA

Eaton Corporation is a worldwide leader in the design, manufacture, and sale of safe, reliable and high-performance medium voltage power distribution equipment in accordance with IEC, ANSI and GB / DL standards

Complete Global Medium Voltage Switchgear Solutions

Eaton, a premier leader in designing and manufacturing power distribution and protection equipment in the electrical industry, offers a comprehensive range of medium voltage (MV) solutions to meet the needs of virtually every application. From products that feature cutting-edge design that allow for easy access, maintenance and space savings, to arc-resistant products that enhance safety, Eaton's medium voltage solutions provide a variety of products for every need. Additionally, Eaton's global service network provides maximum customer support in all regions of the world.

As one of the few completely vertically integrated and diversified industrial manufacturers in the world, Eaton designs not only MV assemblies, but also the key components that comprise the MV solutions – from steel housing and circuit breaker compartments to vacuum interrupters, circuit breakers, bus systems and fuses.

Eaton's MV heritage, strengthened by acquisitions such as Westinghouse DCBU, Cutler Hammer, MEM and Holec, has resulted in breakthrough MV technologies and numerous international patents over the years.

Part of Eaton's complete electrical PowerChain Solutions – which help businesses minimize risks while realizing greater reliability, cost efficiencies, capital utilization and safety – Eaton's medium voltage equipment meets all applicable standards and certifications such as IEC, NEMA / ANSI, GB / DL, UL, IEEE, KEMA and CSA.

When it comes to medium voltage solutions, you can trust the one name with a long history of proven performance: Eaton.



RVAC

Ring Main Unit

The development of current power system focuses on the usage of ecological resources. Low power loss, low maintenance spending, reliable performance, flexible configuration is required on the medium voltage switchgear. Due to its features such as long service life, compact size and reutilization, Cooper Power's RVAC ring main units have proved successful in terms of economy and ecology. It appears more important for ground-cabled power distribution network in improving its devices and other aspects, with rapid development of urbanization; ring main units (RMU), as the major device for protection and segment isolation to ground cabled distribution network, are widely used in urban power grids, due to its safe and reliable performance, compact and beautiful appearance, and superior cost effectiveness.

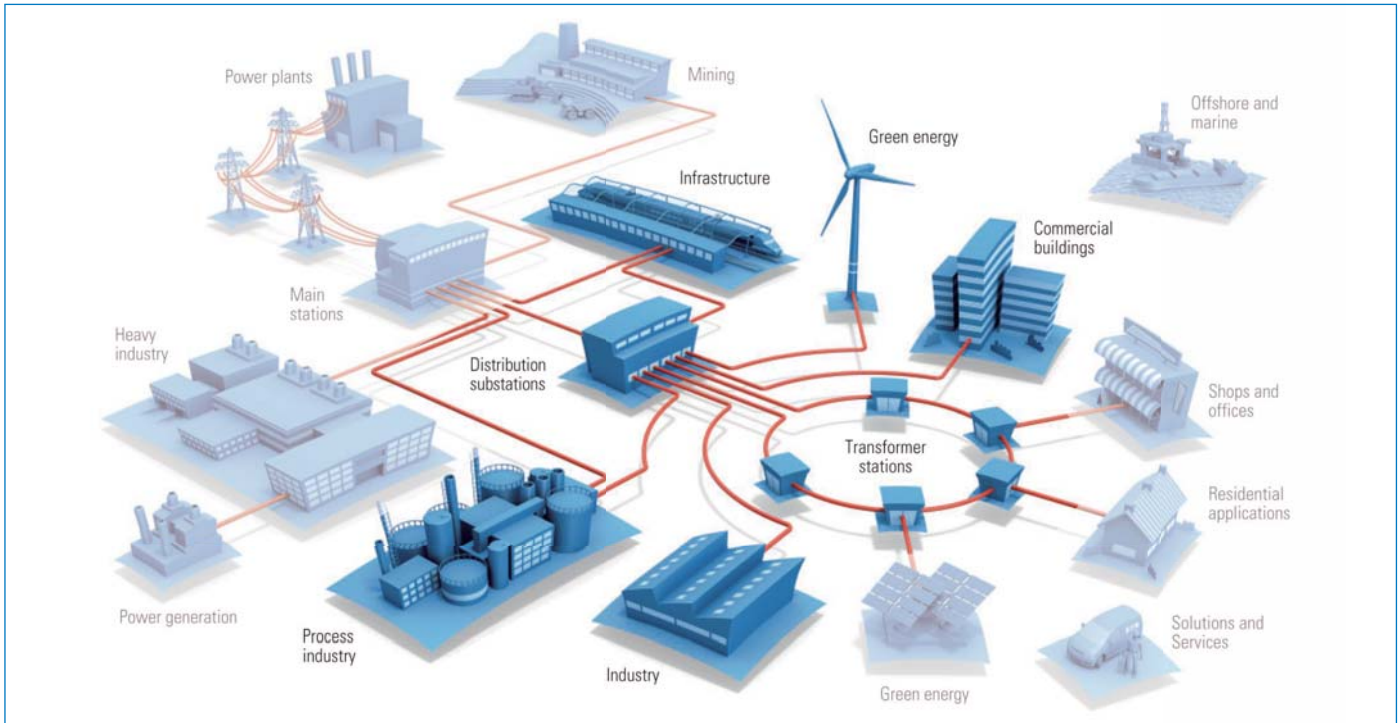
Cooper Power Systems as the leader in the field of distribution switchgear has started to design and manufacture high-quality power distribution switchgear since 1942, with over 2 million switchgear operating reliably over the world till now.



RVAC RMU use SF6 gas insulation, load break switch unit uses 3-position SF6 switch as breaking devices, allowing breaking rated current. Circuit breaker unit applies vacuum interrupters as its breaking device, can break short-circuit current. Based on the design concept of full insulation and fully sealed, all primary parts within RVAC RMU are fully sealed inside the stainless-steel main enclosure, protect to against condensation and external contaminated environment; the protection degree of the main tank body is up to IP68, equipped with Cooper's water-proofing touchable cable bond, which can provide effective protection against accidental flood in rainy climate.



RVAC Ring Main Unit Construction Feature



Smart grid readiness

Designed to integrate solutions for sensing, monitoring and remote control for feeder automation and load management purposes.

Personal safety

- Logical mechanical and electrical interlocks;
- Complete enclosure earthing, to ensure zero potential for interface;
- Compartments protected against penetration of objects;
- Capacitive voltage detection system for verification of safe isolation from supply;
- Feeder earthing by means of make-proof earthing switch.

Environmental-friendly concept

- Low power loss, low maintenance spending, ensuring more reasonable cost investment;
- Only reusable and/or recyclable materials can be used to do the most compact design;
- In normal working conditions, gas leakage rate of lower than 1‰ ensures more than 30 years life-cycle;
- Without gas work on site through installation, operation, extension, and replacement of the product.

User friendly

- Cable connection and user interfaces for operation on the same front side of the panel;
- Ergonomic cable connection height;
- A customized low voltage compartment is optional;
- Clear and simple straightforward operation panels.

Modular design and flexible configuration

- Both multi-functions in one tank solution and individual panel can be freely combined and extended, to satisfy demands of different customers;
- Flexible extension of unit modules on site, easy to build medium voltage transformer substations according to different requirements;
- Two options are available for transformer and line protections: load break switch-fuse combination units and circuit breakers with relay protection.

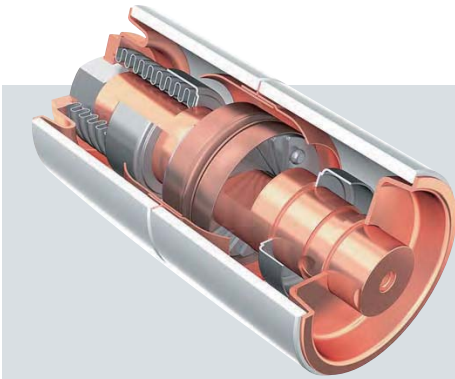
All-weather and high adaptability to environment

- Passed underwater 12kV 24-hour power-up immersion test, with IP68 protection degree, thus ensuring reliable protection against summer floods;
- SF6 gas tank is made of stainless steel plates, with anti-rust painting treatment on the surface, to protect against salt spray, humidity, dirt and temperature, and to ensure durable nice appearance;
- COOPER pre-fabricated shielding touchable cable terminal is supplied, which can be plugged when system in live, suitable for long-term operation underwater or in other severe conditions.

Operation

- Complete design certified in accordance with GB and DL standards;
- Arc fault tested according GB3906;
- Quality assurance in accordance with ISO 9001;
- Touching safe and hermetically sealed primary enclosure;
- Gas tank's zero gauge voltage withstand (1min) can reach 32kV, with large insulation margin.

Main Construction



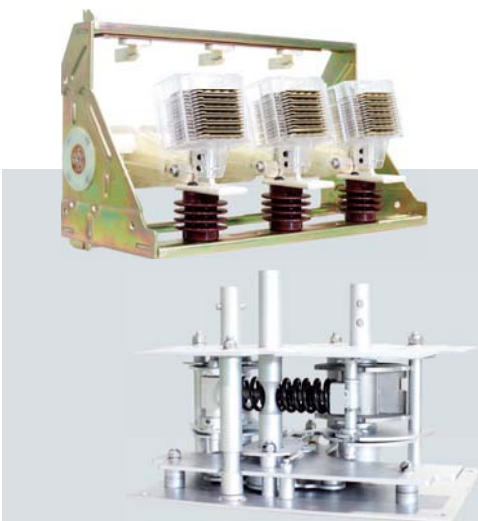
Vacuum technology features

- Eaton has an unsurpassed leadership in vacuum technology supported by a strong heritage of innovation from companies such as Westinghouse and Holec
- Pioneers in vacuum technology for over 90 years. First vacuum interrupter supplied at 15kV-12kA in 1967
- Eaton was the first one to develop and patent copper-chromium alloy content for contacts and center shields
- Our vacuum interrupters for contactor applications can perform up to 2.5 million mechanical operations
- More than 5 million units delivered worldwide, operating safely and reliably in all types of networks, medium voltage applications and environments
- High end certified supplier to almost all major electrical manufacturers worldwide



SF6 gas insulated system

- All primary high-voltage components are completely enclosed in SF6 gas tank, free from environment impact, thus ensuring fully insulation and maintenance-free;
- SF6 gas tank is made of high-quality stainless steel materials, free from influence of salt spray, humidity, dirt and temperature, ensuring a durable nice outlook;
- Passed underwater 12kV 24-hour power-up immersion test, with IP68 protection degree, can reliably prevent from flood immersion in summer;
- Advance gas shielded welding as well as a sealing pressure system of less than 1‰ leakage rate ensure a 30 year service cycle;
- Busbar extensible is optional.



Load break switch

The load break switch is a 3-position switch, with Close, Open and earthing position. When in Open position, the moving blade has sufficient insulation distance. An operating handle can be used to make close-open operations on load break switch and earthing switch. There are mechanical interlocks between the load break switch and the earthing switch.

- The load break switch applies metal deionizing arc suppress technology, ensuring good interruption performance for the switch;
- The working speed of switch's moving contact depends on its operation mechanism; and the open-close speed of the switch will not be influenced by operators;
- When moving from closing to opening, the load break switch depends on moving contact speed and arc suppress devices simultaneously, to suppress arc and break current;
- The spring operation mechanism with an operating handle to complete closing and opening operations. Motorization module and opening coil can be added, to achieve remote control.

Product Features

RVAC is developed to be an economical and ecological user-friendly power distribution device of compact size, reliable performance and flexible configuration, with the application of advanced R&D technical resources.

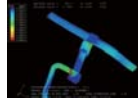
Computer simulation design

3D simulation design analysis softwares are applied during R&D process, strengthening design capacity, and thus improving product reliability greatly.

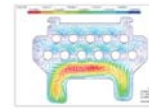
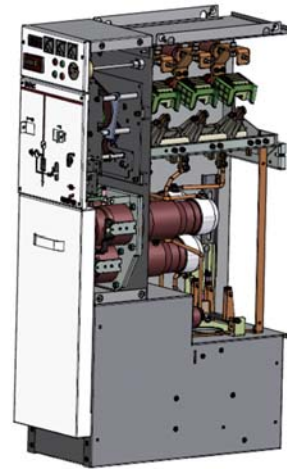
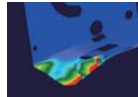
Mechanical movement analysis and force analysis



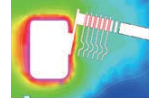
Mechanical strength analysis



Gas pressure analysis



Magnetic field analysis



Electric field analysis



Gas motion analysis

Capacitive voltage detection system for verification of safe isolation from supply

Each panel type within the RVAC family is equipped with a standard three phase Voltage Detection System for voltage testing. The VDS shows the operator if the panel is isolated from supply or not.

Logical mechanical and electrical interlocks prevent incorrect operation

Within the RVAC design misoperation by an operator is prevented by using different interlocks. The interlocks are mechanical and electrical. For example electrical and mechanical interlocks prevent operation of the change-over switch when the circuit-breaker is switched on. All mechanical interlocks are constructed in such a way that they directly block the mechanism.

Only when the cable compartment door is closed, the device can be operated to power-on position

Only when the switch is operated to Earthing position, the cable compartment door can be opened in a normal way. Only when the cable compartment door is closed completely, a closing operation can be conducted on the earthing switch. After the earthing switch is opened, the mains switch can conduct closing operation to complete power-on process.

Sealed enclosure design, to effectively protect against foreign objects

In the design of RVAC, it is not possible for external staff or tools to accidentally enter into the panel.

Smooth contemporary design

All compartments of the RVAC panels are designed in such a way that the system is safe to touch from the outside. By using a smooth and smart design it is not possible for the operator to injure himself by moving parts or by parts that stick out of the switchgear when moving in front of the switchgear.

Routine tests

Various prescribed routine tests are carried out during the production of the switchgear. To assure quality, all processes are in accordance with ISO 9001. This means that at every stage of production the components, circuit-breakers and current transformers are inspected for correct functionality. When the entire installation has been assembled, a thorough visual inspection is carried out, together with mechanical, functional and electrical checks.

Anti-internal arcing concept

Eaton has always been focusing on building consistently safe switchgear devices for operators. The biggest potential risk for operators is internal arcing within the switchgear device.

Therefore, design engineers have taken all necessary measures to prevent internal arcing during product design process.

Eaton supports the philosophy that it is best to avoid internal arcs than to cure, in line with the relevant standard GB 3906. Within the RVAC design a double prevention philosophy is used. Firstly, the design is constructed in such a way that an internal arc is prevented. In the unlikely case that an internal arc could occur, the RVAC is equipped to provide maximum safety to the operator, and to control and minimise damage to the rest of the switchgear and room.



Sulfur Hexafluoride (SF₆) Gas

The insulating and arc quenching medium -SF₆

SF₆ gas, previously used mainly in circuit breaker of higher voltage level and with successful achievements, has now been found into medium voltage load switching system in recent years. This change happens to systems all over the world, since each insulation and arc-extinguishing medium, including air, oil and solid material, has its own critical defect more or less:

- Air insulation system occupies a large amount of space, which requires maintenance in extreme climate or environment;
- Oil insulation system will cause huge safety risks due to internal faults, although not influenced by external environment;
- Finally, solid system has the same maintenance issue as air insulated devices do, but with problems to a higher level due to its compact structure.

SF₆ gas has very high dielectric strength as an insulation medium, thus offering very compact products in the design of structural arrangement, and maintenance free since all live parts are completely sealed.

SF₆ is a non-toxic, inert and electronegative gas, heavier than air, offering very effective arc-extinguishing performance, along with the above-mentioned high insulation capability. In the case of high temperature arc produced by circuit breaking, SF₆ gas will resolve into subfluorides. After cooling down, these active subfluorides will quickly return back to SF₆ gas. Therefore, SF₆ gas which is used under sealing for a long time will not decrease or deteriorate, although under the effect of arc extinguishing several times. The amount of arc decomposition depends on water content contained in SF₆ gas. In this way, it is very critical to control water content below specified values. Adsorbing agents such as commonly used activated alumina or activated carbon and synthetic zeolite remove water and arcing products, which means the volume of the gas originally introduced keeps unchanged and can satisfy requirements for working life or mechanism of the whole system. An evaluation of advantage and potential risks shows that at present

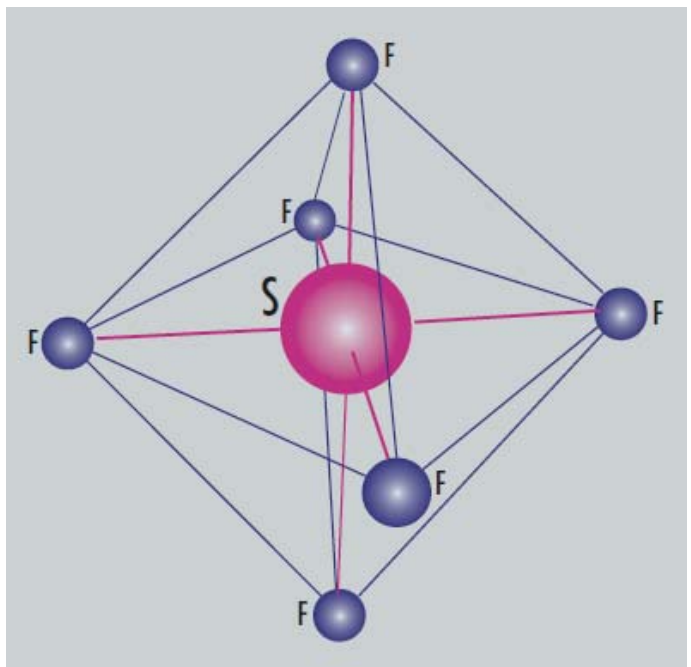
there is no substitutable solution of technical and ecological values.

The product system is designed to remove fault arc, in terms of high-level operation safety (external influences such as humidity and conductive dust will cause no effect). In the case of accidental faults, reliable explosion relief devices will quickly react and high-temperature high pressure air flow will flow out through well designed pressure relief channels.



Final disposal of SF₆ gas

1. The policy of Eaton is that SF₆ gas shall be inhibited to emit into air during the process of installation, maintenance and scrapping of devices. Environmental solutions can be used to dispose SF₆ gas which can't be recycled or reused any more, which produce natural product gypsum (CaSO₄) and fluorite (CaF₂).
2. For more details, refer to IEC's technical report 1634 (1995): High Voltage Switchgear and Controlgear - Usage and Disposal of SF₆ in High Voltage Switchgear and Controlgear Devices, Chapter 6.5: "Disposal of SF₆ at life end- refilling devices."



Features and benefits

The benefit of a sealed for life tank

A "sealed for life" steel enclosure contains all primary parts and driving mechanisms

- Maintenance free
- Internal arc proof
- Protection degree up to IP68 for prevention of summer floods

The benefit of a compact design

- Minimal floor space
- Low building costs
- Easy to install

Computer simulation design

3D simulation design analysis softwares are applied during R&D process to strengthen design capacity, thus improving product reliability greatly.

- Electric field analysis
- Magnetic field analysis
- Gas pressure and motion analysis
- Mechanical strength analysis
- Mechanical movement (speed and force) analysis
- Finite element analysis

Smart grid readiness

Automation upgrading

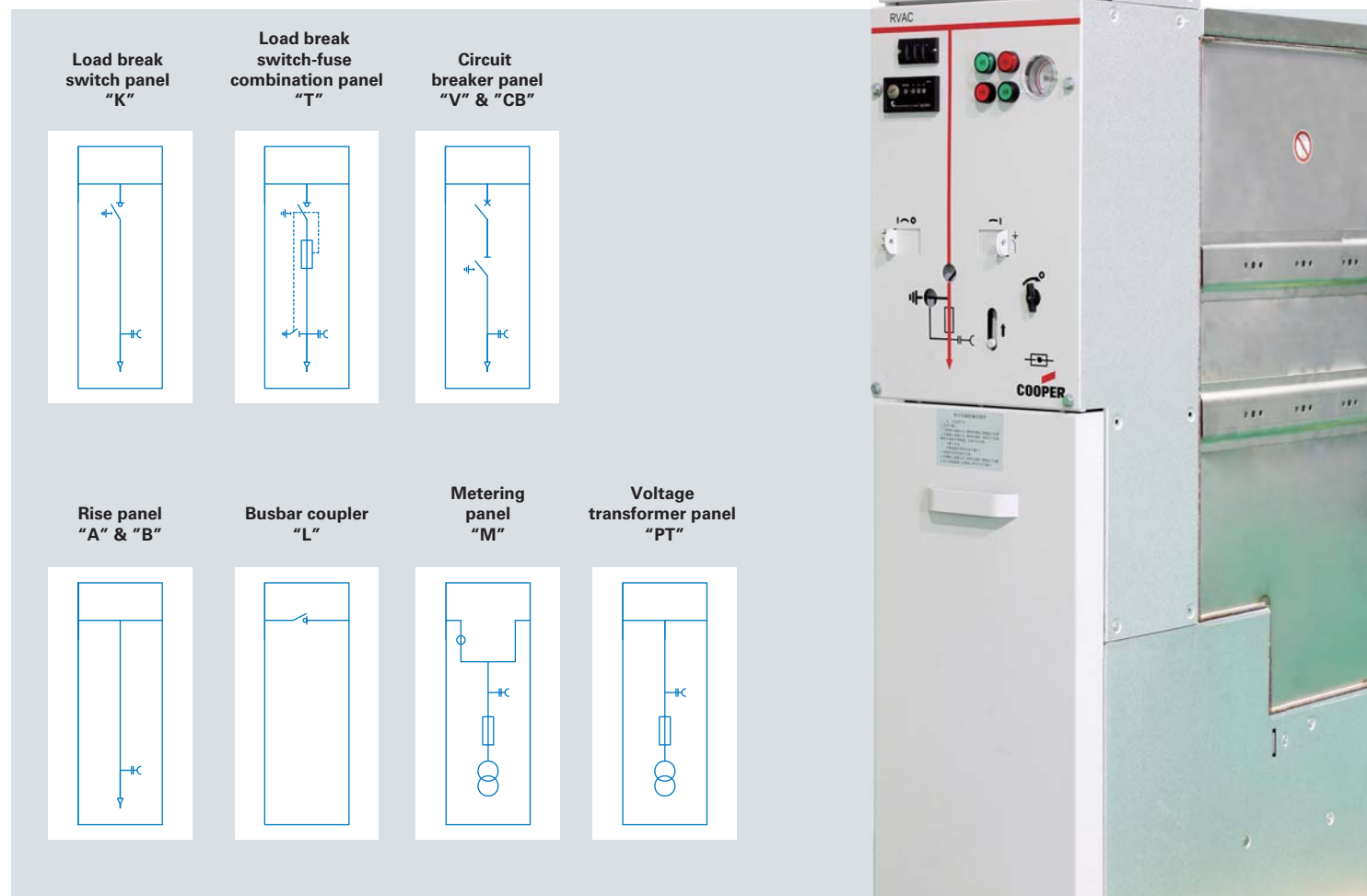
- Remote close/open
- Auxiliary contacts for each position local or remote indications
- Measuring CT and current signal

Option

- Trip indicator with auxiliary contacts
- Fault indicator
- Current meter

Flexible solutions

- Reliable busbar extended design and interfaces reserved for future project expansion
- Complete types of functional units



Configuration information

Load break switch panel (Function K/K1)



W*D*H : 370×800×1400mm
Weight: 120kg
Note: K1 refers to the incoming unit which replaces ground switch

Standard	Options
630A load break switch	Extension on both sides
630A busbar	Lateral incoming and outgoing
Earthing switch	Motorization mechanism
SF6 pressure gauge	Three cable outgoing lines
Voltage presence indicator	Cable inspection window
Reliable interlock	Short circuit fault indicator
Operating handle	
Cable clamp and bracket	

Lift panel (Function A/B)



W*D*H: 370x800x1400 mm
Weight: 80kg(A), 100kg(B)
Note: A without gas tank; B with gas tank

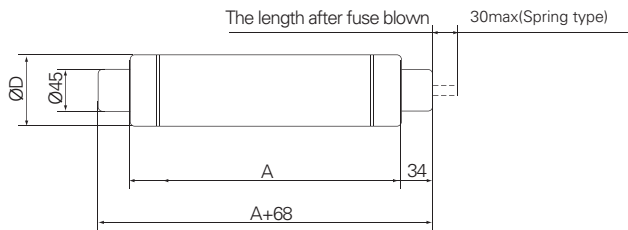
Standard	Options
Voltage presence indicator	Fault indicator
630A bushing	Current meter
Padlock for cable compartment cover	

Load break switch-fuse combination panel (Function T)



W*D*H : 370×800×1400mm
Weight: 150kg

The fuse dimension



Fuse striker:
Medium type (according GB15166.2, alternating current switch-fuse combinations).

Standard	Options
630A load break switch	Extension on both sides
Earth switch	Lateral incoming and outgoing
Fuse tube	Motorization mechanism
SF6 pressure gauge	Electric shunt release
Voltage presence indicator	Two cable outgoing lines
Reliable interlock	Cable inspection window
Operating handle	Short circuit fault indicator
Cable clamp and bracket	


The guide for fuse selection

General type	Preferred type	Rated voltage (kV)	Rated fuse current (A)	Length A (mm)	Diameter D (mm)
XRN-T/12	SDLDJ	12	3.15、6.3、7.5、10、16、20、25、31.5、40	292	51
	SF(K)LDJ	12	50、63、80	292	66
			100、125	292	76

Fuse selection and transformer application

Rated voltage (12kV)														
Transformer rated capacity (kVA)	50	100	125	160	200	250	315	400	500	630	800	1000	1250	
Fuse rated current (A)	6.3	10	16	16	20	25	32	40	50	63	80	100	125	

Circuit breaker panel (Function V/CB)



V **CB**

W*D*H: 480x800x1400mm (V) Weight: 220kg (V)
W*D*H: 450x800x1400mm (CB) Weight: 230kg (CB)
Note: V function refers to Ist=20kA; CB function refers to Ist=25kA

Standard	Options
630A vacuum breaker	Extension on both sides
3-position disconnecter	Lateral incoming and outgoing
PBD protection relay	Motorization mechanism
SF6 pressure gauge	Two cable outgoing lines
Voltage presence indicator	Cable inspection window
Reliable interlock	Short circuit fault indicator
Operating handle	
Cable clamp and bracket	

PBD protection relay



- 3-phase 3-step directional current protection (quick break, timed quick break, over-current inverse time), with low voltage locking function
- 3-phase 3-time reclosing (inspection for no voltage, inspection for synchronization, no inspection), the number of reclosing operations can be set, including the function of post-acceleration
- Zero sequence voltage locking direction zero sequence over current protection (alarm, optional tripping operation)
- Low current grounding line selection function
- Low voltage protection
- Overload alarm
- 24V DC

Busbar coupling panel (Function L)



W*D*H: 480x800x1400mm
Weight: 135kg

Standard

- Voltage indicator
- 630A LBS
- 630A load break switch

Options

- 630A CB
- Motor operation

Metering panel (Function M) /Voltage transformer panel (Function PT)



M

PT

W*D*H: 750x800x1400mm (M) Weight: 240kg(M)
W*D*H: 500x800x1400mm(PT) Weight: 180kg(PT)

Standard

- Electromagnetic lock (with live latch)
- PT
- PT protection fuse
- CT
- Meter
- Voltage presence indicator
- Voltage meter
- Current meter
- Transfer switch

Options

- Energy meter
- Voltage loss meter
- Temperature and humidity controller

RVAC Technical Data

Item	Unit	Load break switch	Fuse combination unit	Vacuum circuit breaker
Rated voltage	kV	12	12	12
Rated current	A	630	125*	630
Power frequency withstand voltage(1min)				
Phase to phase/Phase to earth	kV	42	42	42
Between isolating distance		48	48	48
Lightning impulse withstand voltage (BIL)				
Phase to phase/Phase to earth	kV	75	75	75
Between isolating distance		85	85	85
LV circuit power frequency withstand (1min)	V	2000	2000	2000
Mainly active load-breaking capacity	A	630		
Cable-charging breaking capacity	A	10	10	25
Rated short-circuit breaking current	kA		31.5*	20 (25)**
Rated transfer current breaking	A		1850	
Rated short-circuit making current (peak)	kA/Operation	50/5		50 (63)**
Earth switch making capacity (peak)	kA/Operation	50/2		50/2
Rated short time withstand current	kA/s	20/4	20/4	20/4 (25/4)**
Rated peak withstand current	kA	50	50	50 (63)**
Mechanical endurance	Operation	5,000	5,000	10,000
SF6 gas rated pressure (20°C)	MPa	0.03	0.03	0.03
SF6 gas annual leak rate	%	<0.1	<0.1	<0.1

RVAC load break switch is class E3, with up to 200 CO operations on test TD1(Mainly active load-breaking 630A).

RVAC is in accordance with IEC 62271-200, GB3804, GB 1984, GB3906, DL/T593 and other relevant IEC/GB standards;

* Depends on high voltage fuse.

** The data are only for CB function.

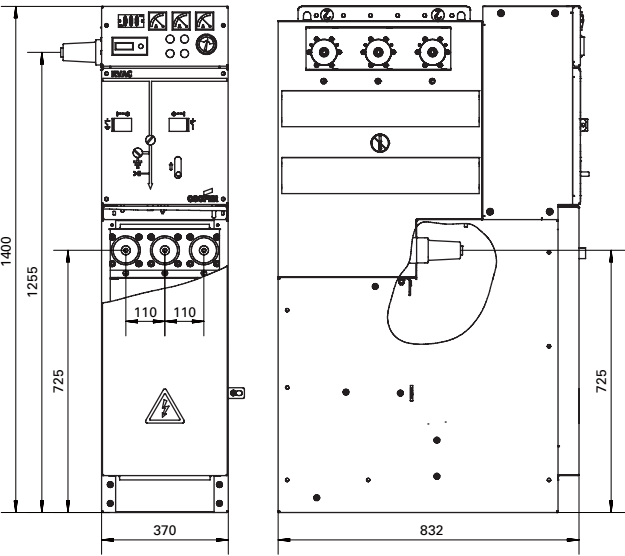
RVAC designed to IEC standards

RVAC compiles with the following standards:

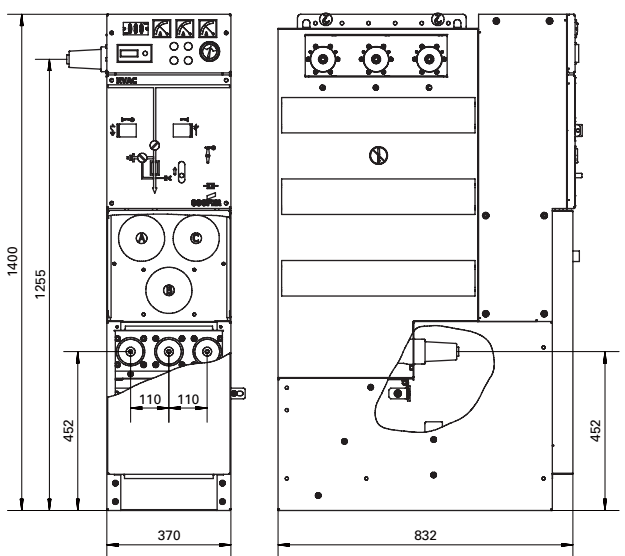
IEC 62271-100	High-voltage switchgear and controlgear - Part 100: Alternating-current circuit-breaker
IEC 62271-102	High-voltage switchgear and controlgear - Part 102: Alternating current disconnectors and earthing switches (2003)
IEC 62271-105	High-voltage switchgear and controlgear - Part 105: Alternating current switch-fuse combinations for rated voltages above 1 kV up to and including 52 kV
IEC 62271-200	High-voltage switchgear and controlgear - Part 105: AC metal-enclosed switchgear and controlgear for rated voltages above 1 kV up to and including 52 kV
IEC 60694	Common specifications for high-voltage switchgear and controlgear standards
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)DL/T 592-2006 common specifications for high-voltage switchgear and controlgear standard

RVAC Outlines and Dimensions

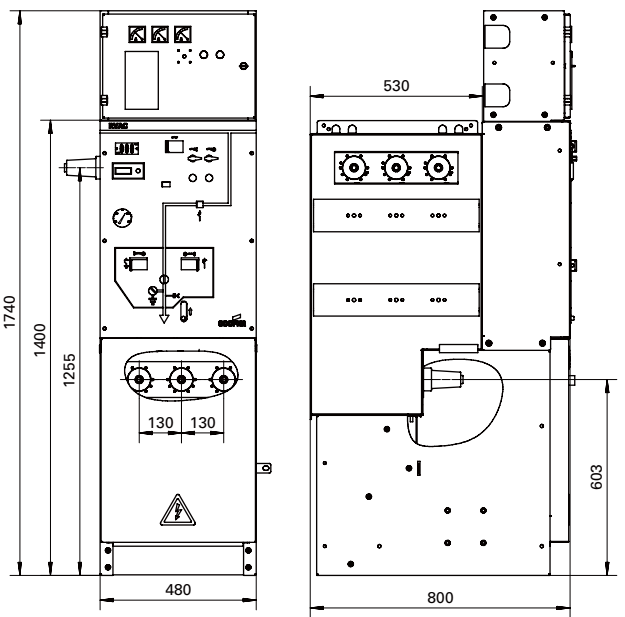
Type K panel dimension



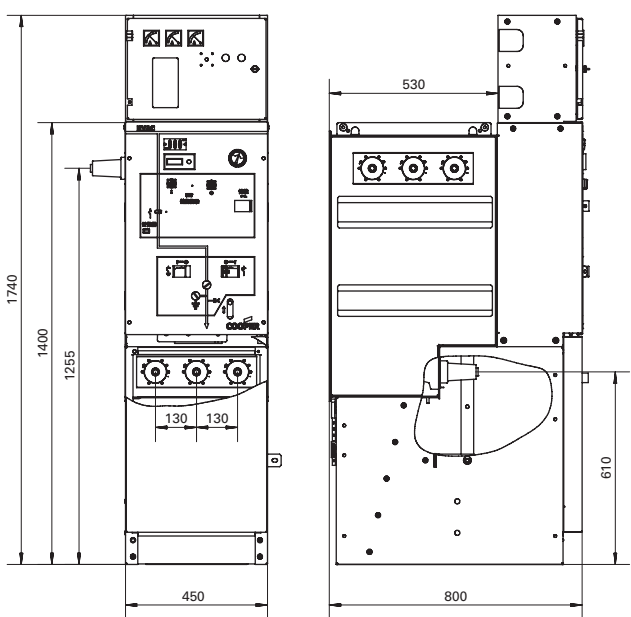
Type T panel dimension



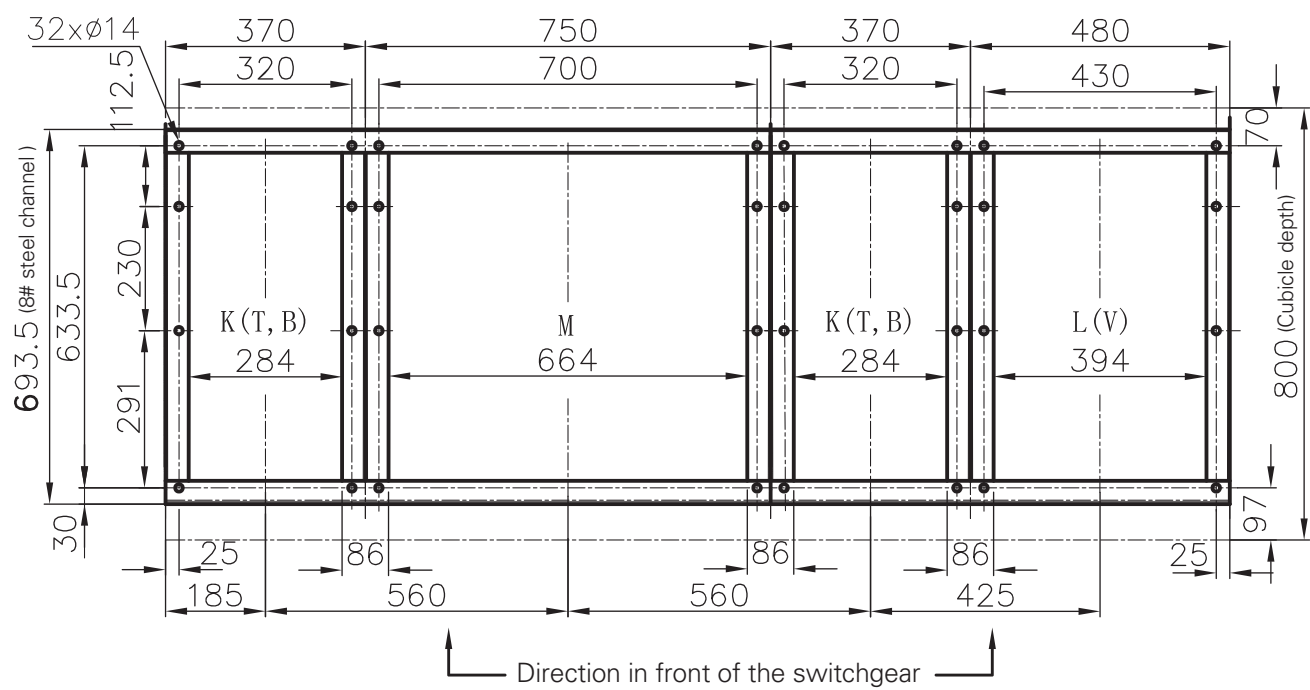
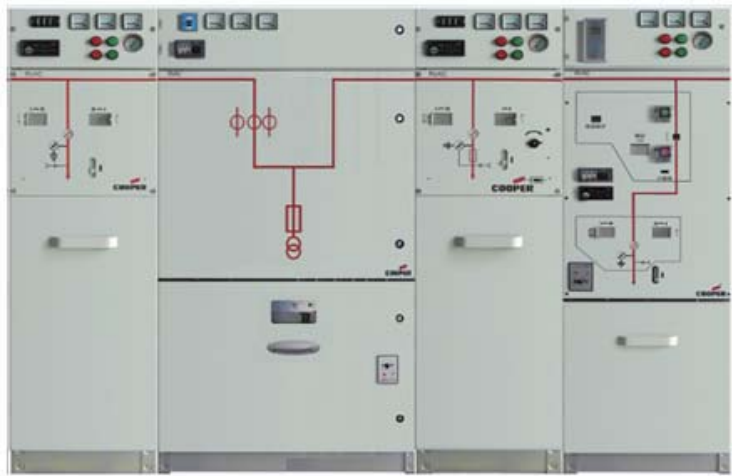
Type V panel dimension



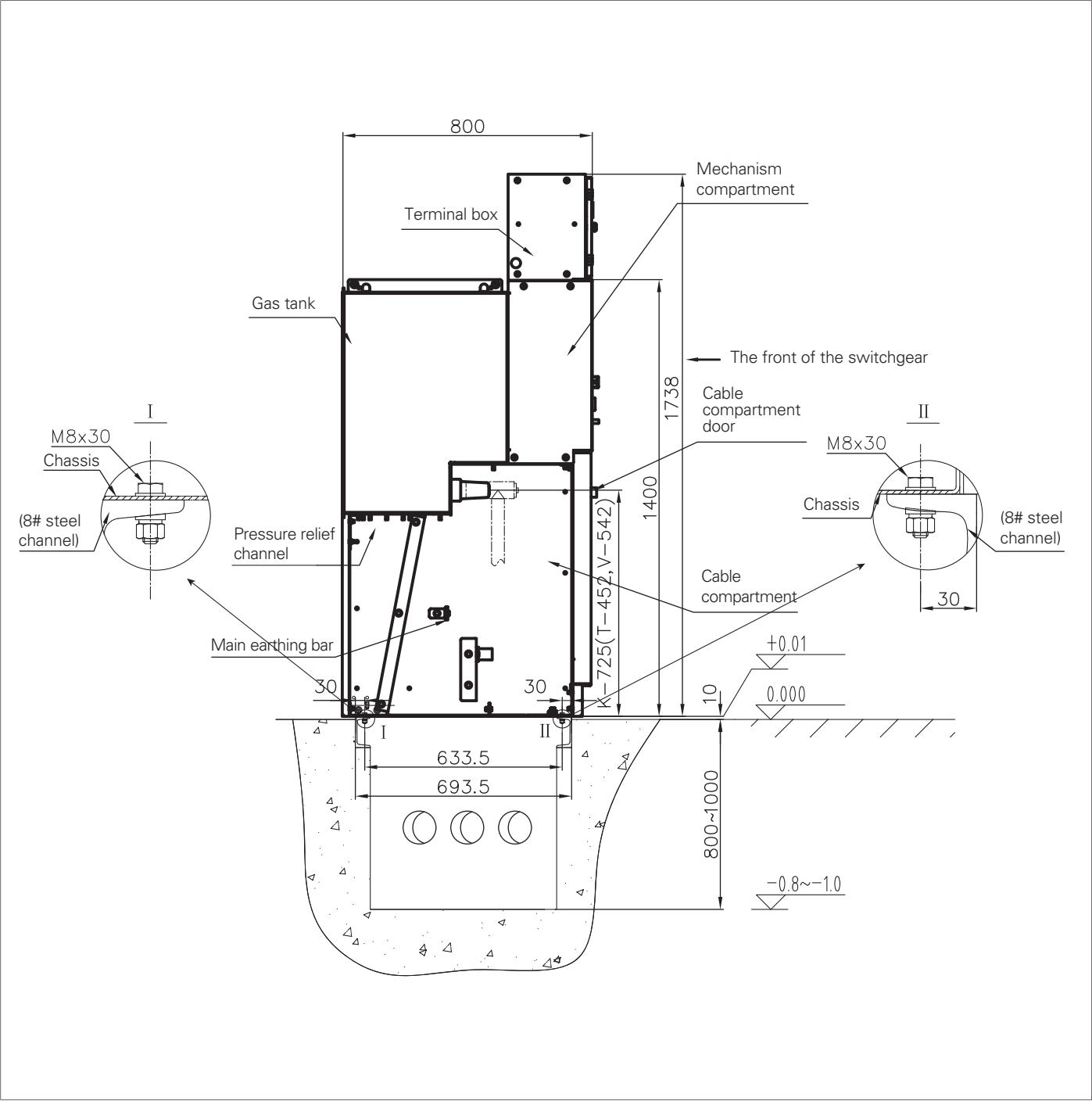
Type CB panel dimension



Basic Installation Diagram



Recommended Floor Plan



Medium Voltage Switchgear Products

Safe and Stable





EAT•N

Powering Business Worldwide

The power of fusion.



There's a certain energy at Eaton. It's the power of uniting some of the world's most respected names to build a brand you can trust to meet your every power management need.

Eaton is dedicated to ensuring that reliable, efficient and safe power is available when it's needed most. Building on over 100 years of experience in electrical power management, the experts at Eaton deliver customized, integrated solutions to solve your most critical challenges. To learn more visit www.eaton.com.

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Powering Business Worldwide

Eaton is a power management company providing energy-efficient solutions that help our customers effectively manage electrical, hydraulic and mechanical power. A global technology leader, Eaton acquired Cooper Industries plc in November 2012. The 2012 revenue of the combined companies was \$21.8 billion on a pro forma basis. Eaton has approximately 102,000 employees and sells products to customers in more than 175 countries. For more information, visit www.eaton.com.

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