Gas Insulated MV Switchgear

# RVAC-40.5

## 40.5kV Medium Voltage MV Switchgear

Powering Business Worldwide






# 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

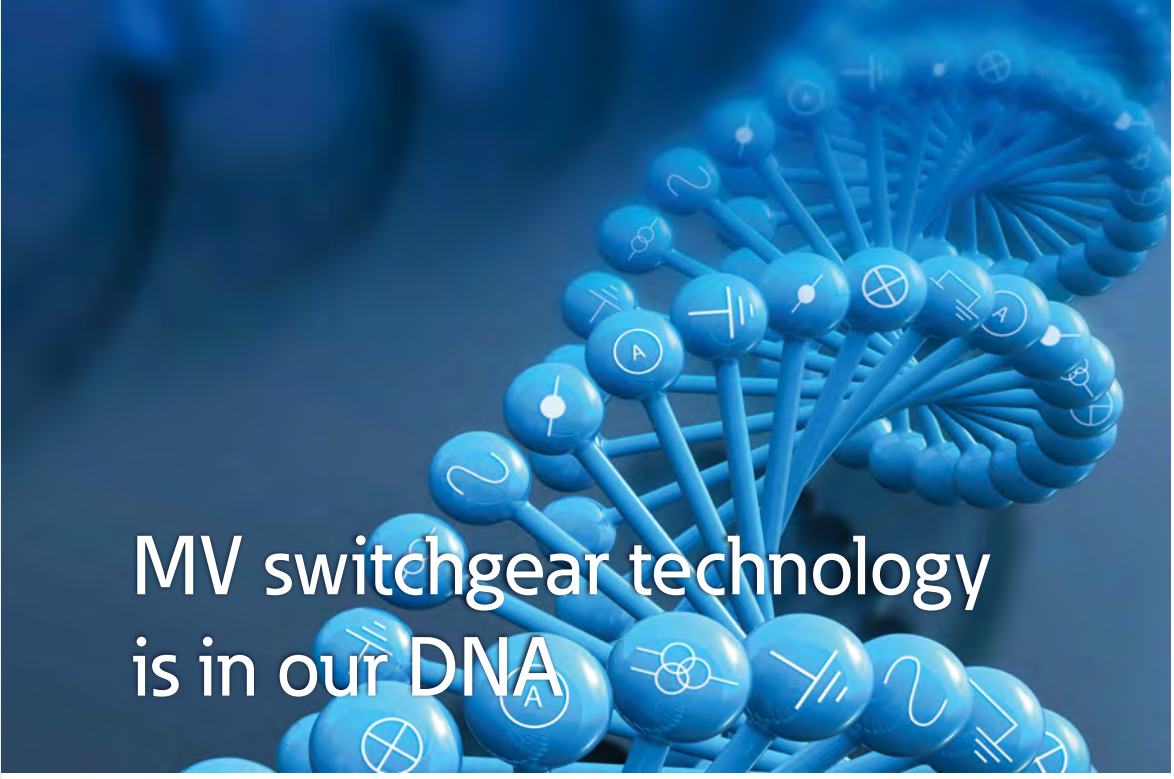
We continue to expand our aerospace solutions and services to meet the needs of new aviation platforms, including the high-flying light jet and very light jet markets.

### 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.

Eaton's range of $SF_6$ free switchgear for Medium Voltage

An Eaton Green Solution

# RVAC

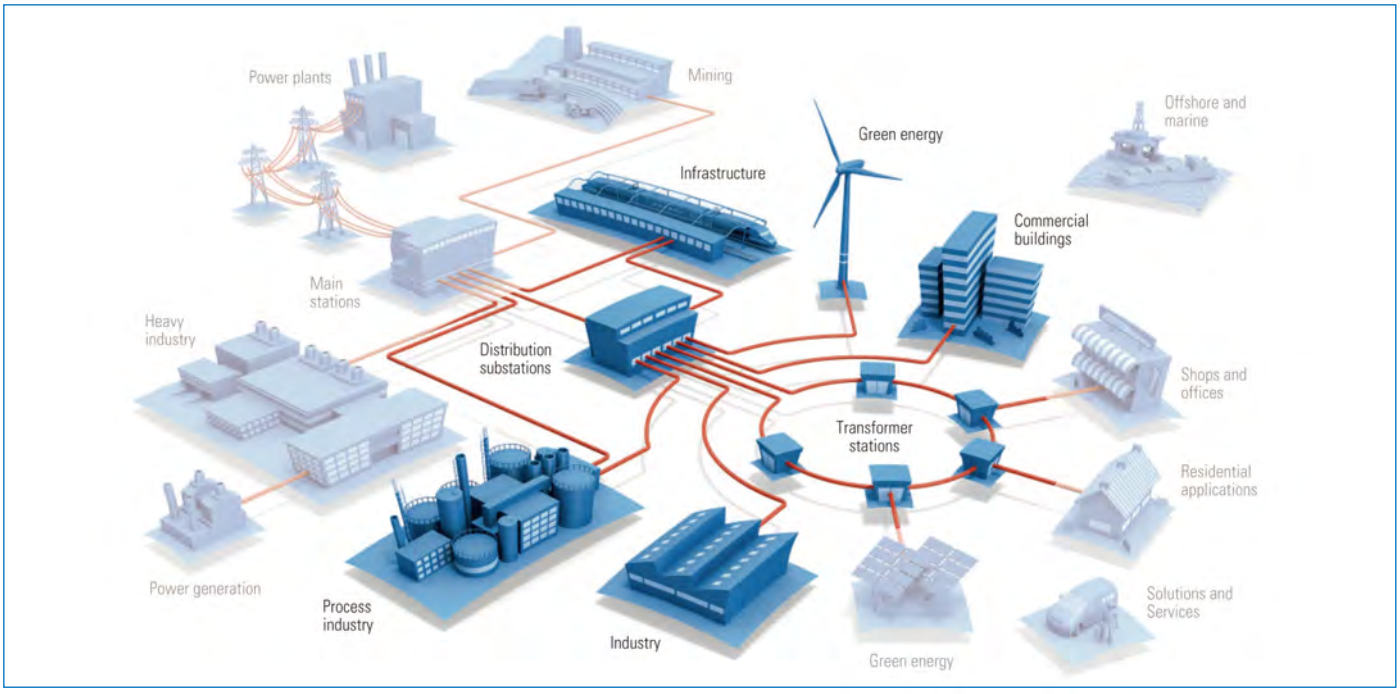
## Ring Main Unit

The development of current power system focuses on the usage of ecological resources. Low power loss, low maintenance spending, reliable performance, flexible configuration are required on the medium voltage switchgear.  Due to its features such as long service life, compact size and recycling, Eaton RVAC ring main units have proved successful in terms of economy and ecology. It appears more important for Underground 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 superior cost effectiveness.

Eaton as the leader in the field of distribution switchgear dedicated to designing and manufacturing high-quality power distribution switchgear since 1942, with over 2 million switchgear operating reliably over the world till now.

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 IP67, equipped with Cooper's IEC separable connectors, 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 0.01% 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;
- Non-extensible and both side extensible design suit for your requirements.
- Flexible extension of unit modules on site, easy to build medium voltage transformer substations according to different requirements;
- Circuit breakers with relay protection designed for transformer and line protections. And a self-powered relay optional as well.

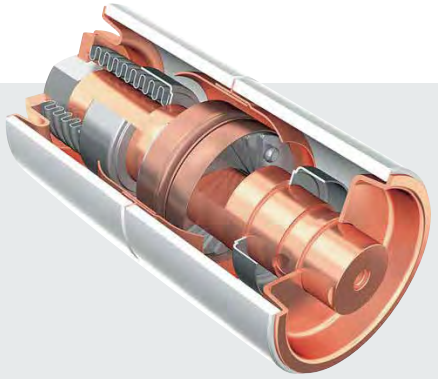
## High adaptability to environment

- 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 IEC separable connectors is supplied, suitable for long-term operation underwater or in other severe conditions.

## Operation

- Complete design certified in accordance with IEC standards;
- Arc fault tested according IEC 62271-200;
- Quality assurance in accordance with ISO 9001;
- Touching safe and hermetically sealed primary enclosure;

# 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;
- With IP67 protection degree, can reliably prevent  from flood immersion in summer;
- Advance gas shielded welding as well as a sealing pressure system of less than 0.01% leakage rate ensure a 30 year service cycle;
- Non-extensible is standard 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 advanced arc blowout coil technology, ensuring good interruption performance for the switch;
- The working speed of switch's moving contact depends on its operation mecha nism; 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 can be added, to achieve remote control.

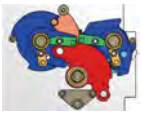
# Product Features

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

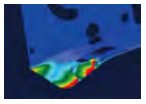
3D simulation design analysis softwares are applied during R&D process, strengthening design capacity, and thus improving product reliability greatly.

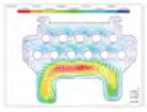
**Mechanical movement analysis and force analysis**



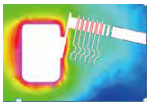
**Mechanical strength analysis**

**Gas pressure analysis**

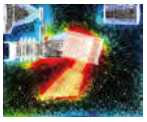




**Magnetic field analysis**



**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

RVAC is designed by metal-enclosed to be not accessible without specified tools.

### 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.

### Tested Internal Arc performance

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 simulations to reduce the internal arc risk 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 IEC 62271. 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.

# 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
- Tested Internal Arc performance
- IP68 tightness design for gas tank

## 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

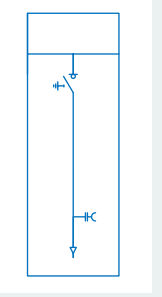
**Option**

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

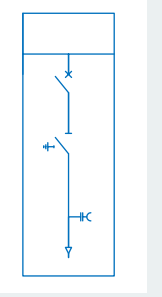

## Flexible solutions

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

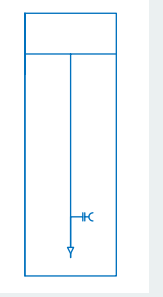
**Load break switch panel "K"**



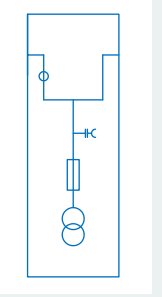
**Circuit breaker panel "V"**



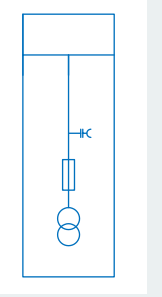
**Direct connect panel "B"**



**Metering panel "M"**

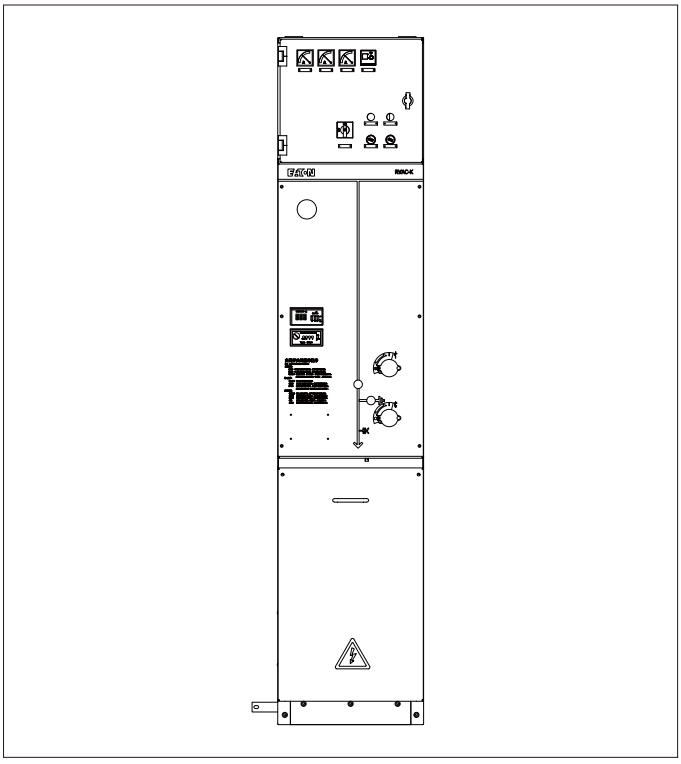


**Voltage transformer panel "PT"**



# Configuration information

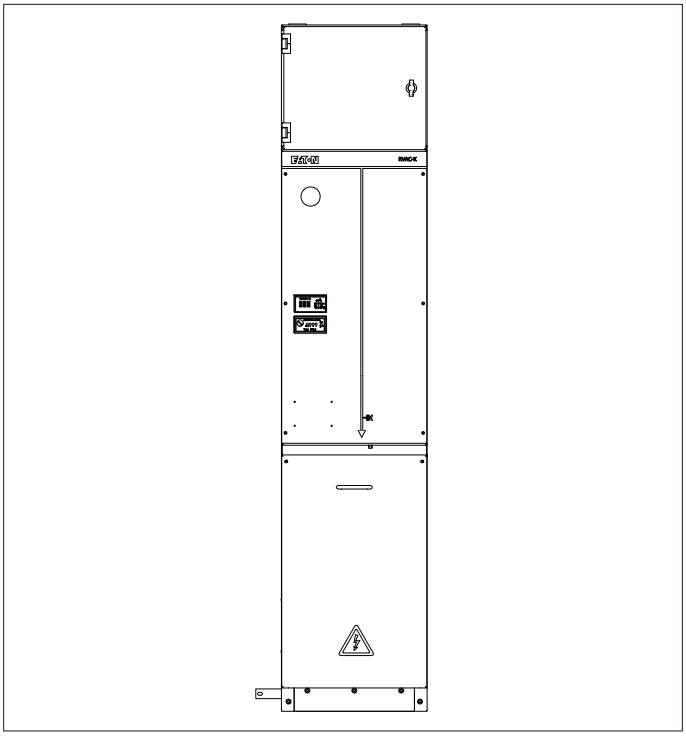
## Load break switch panel (Function K)



| Standard |
|---|
| 630A load break switch |
| SF6 pressure gauge |
| Voltage presence indicator |
| Reliable interlock |
| Operating handle |
| Cable clamp and bracket |
| Type C bushing with bottom cable channel |
| Bottom venting channel |

| Options |
|---|
| Solid busbar connector |
| Arc absorber with top venting channel |
| Motorization mechanism |
| Bottom plate |
| Cable inspection window |
| Short circuit fault indicator |
| Top cable entry design |

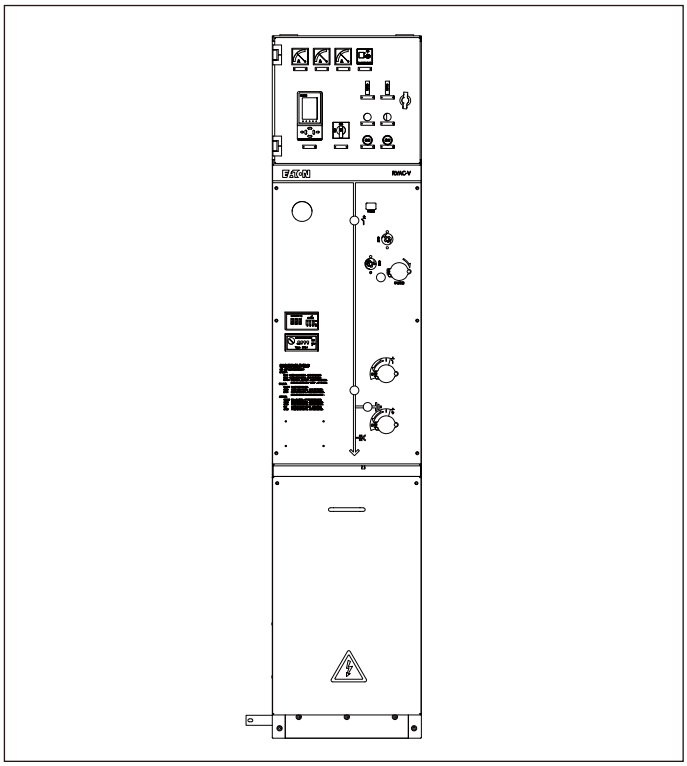
## Direct connect panel (Function B)



| Standard |
|---|
| Voltage presence indicator |
| Type C bushing with bottom cable channel |
| Padlock for cable compartment cover |
| SF6 pressure gauge |
| Bottom venting channel |
| Cable clamp and bracket |

| Options |
|---|
| Solid busbar connector |
| Arc absorber with top venting channel |
| Cable inspection window |
| Short circuit fault indicator |
| Current meter |
| Bottom plate |
| Top cable entry design |

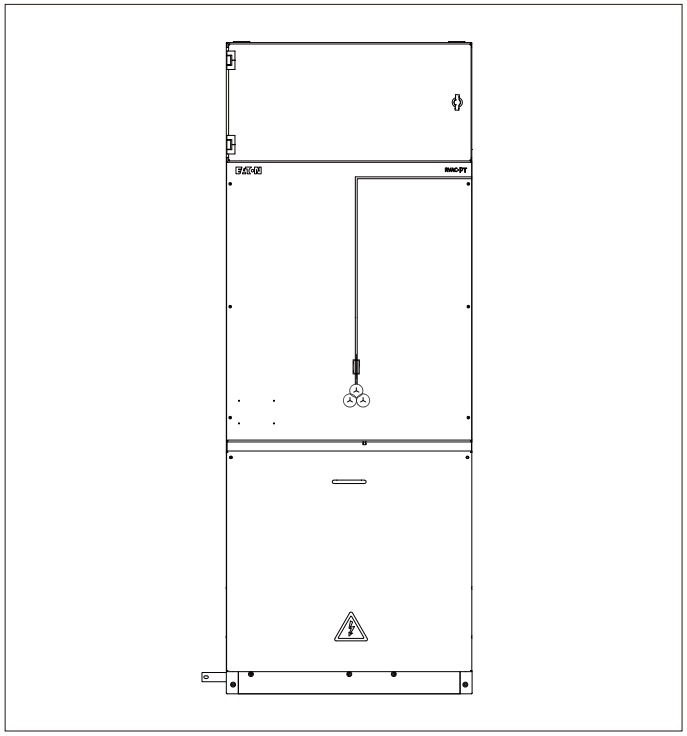
## Circuit breaker panel (Function V)



| Standard |
| --- |
| 630A vacuum breaker |
| 3-position disconnector |
| SF6 pressure gauge |
| Voltage presence indicator |
| Reliable interlock |
| Operating handle |
| Cable clamp and bracket |
| Type C bushing with bottom cable channel |
| Bottom venting channel |

| Options |
| --- |
| Solid busbar connector |
| Arc absorber with top venting channel |
| Motorization mechanism |
| Top cable entry design |
| Cable inspection window |
| Short circuit fault indicator |
| Protection relay |

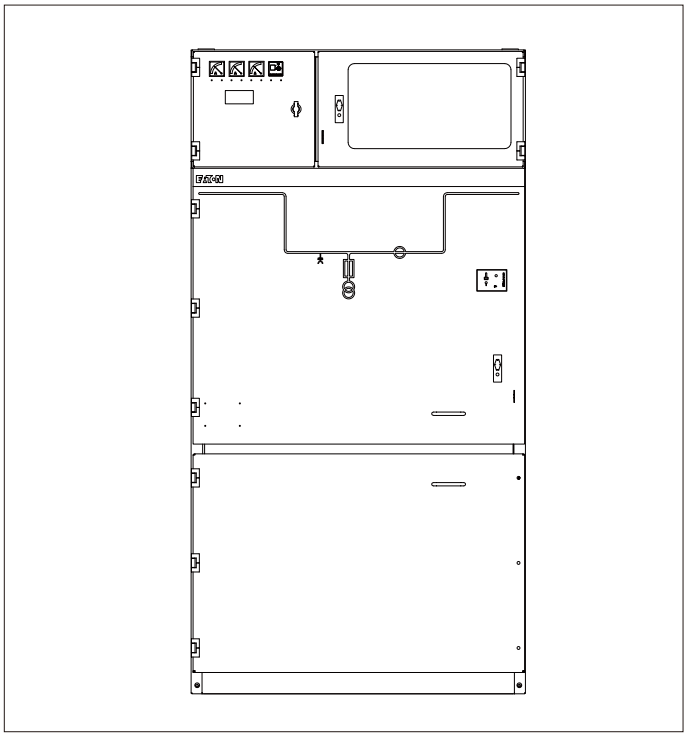
## Voltage transformer panel (Function PT)



| Standard |
| --- |
| Voltage presence indicator |

| Options |
| --- |
| LV compartment |
| voltage transformer and cable connection kits |
| Loadbreak switch for Kpt function |

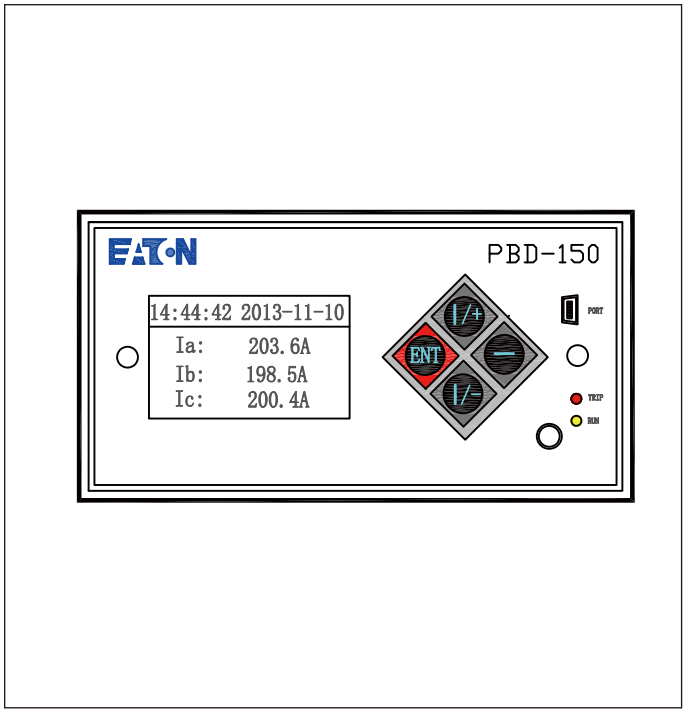
## Metering panel (Function M)



| Standard |
| --- |
| Electromagnetic lock (with live latch) |
| PT |
| PT protection fuse |
| CT |
| Meter |
| Voltage presence indicator |

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

## PBD-150 protection relay




- PBD-150 is self-powered design by CTs, also optional with external power supply(DC 48V or 24V).
- PBD-150 provides three-stage phase to phase overcurrent protection, two stage earth grounding protection, multiple IEC standard inverse curves to be selected. (50/50N, 51/51N).
- LCD display with Chinese and English language exchanging selection, and window design with event-pop up, as well as extremely friendly HMI.
- Device provides RS-485 communication port with Modbus protocol support.

# Main Components

## Voltage indicator

A device on all functional units makes it possible to check the presence(or absence) of voltage in the cables. With the holes for phase comparators.

**Voltage indicator**

## Fault indicator

The indicator is used for detecting and indicating ground fault and short-circuit fault in corresponding cable sections. The indicator light flashes with alarm when short-circuit fault or single-phase ground fault occurs in the power distribution system.


**Fault indicator**

## Cooper Screened Separable Connectors

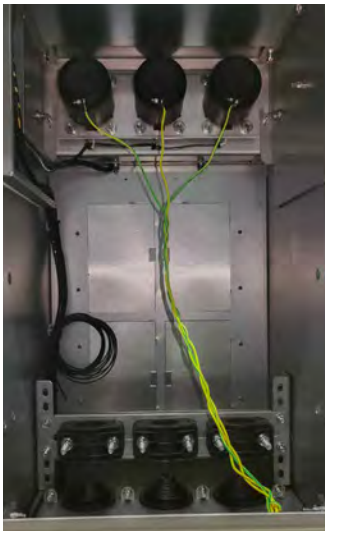
For connection of extruded polymeric cable to transformers, switchgear, motors and other equipment with a premolded screened separable connectors for XLPE insulated 1 or 3-core cabled with aluminum or copper conductors.

## Connection mode

**Extension interface**
For future extension connected to another module RVAC.

**Busbar connector and solid busbar**
Type C bushing is optional on the top of the gas tank to connected modular panels with busbar connector and solid busbar.

**Insulation cap**
When the cabinet is reserved busbar bushing for transformer on the main busbar side, and the cable plug is not installed, you need to use Insulation cap to protect the busbar bushing.



# RVAC Technical Data

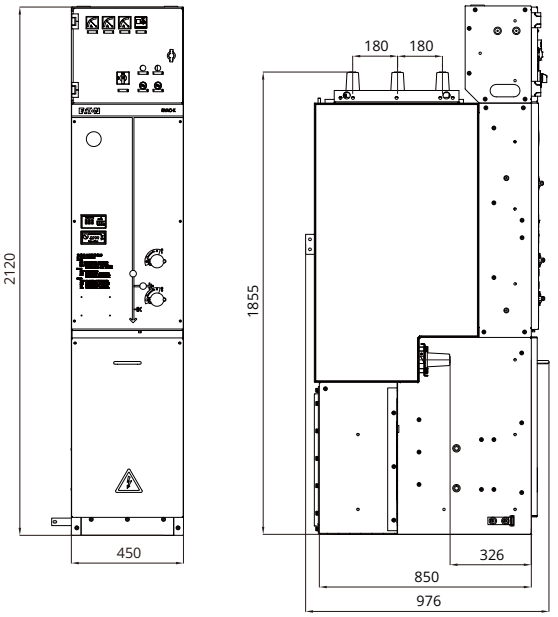
| Item | | Ratings |
|---|---|---|
| **General** | | |
| Rated voltage | kV | 36/40.5 |
| Power frequency withstand voltage (1min) | | |
| Phase to phase/Phase to earth | kV | 70/95 |
| Between isolating distance | | 80/118 |
| Lightning impulse withstand voltage (BIL) | | |
| Phase to phase/Phase to earth | kV | 170/185 |
| Between isolating distance | | 195/215 |
| Rated frequency | Hz | 50 |
| Internal arc classification (IAC) | kA-s | AFLR 25/1 |
| Degree of protection in service | | IP41 |
| Degree of protection with doors/covers open | | IP2X |
| Service continuity of the switchgear | | LSC2 |
| Rated gas pressure (20℃ gauge) | Mpa | 0.04 |
| Annual leakage | | ≤ 0.01% |
| **Busbar system** | | |
| Rated normal current | A | 630 |
| Rated short-time withstand current | kA-s | 25-4 |
| Rated peak withstand current | kA | 63 |
| **Load break switches panel** | | |
| Rated normal current | A | 630 |
| Rated short-circuit making current | kA | 63 |
| Rated short-time withstand current | kA-s | 25-4 |
| Mechanical endurance class (Lood break switch) | | M2 5000 |
| Mechanical endurance class (Earthing switch) | | M1 5000 |
| Electrical endurance class (active load breaking capacity 630A) | | E3 100 |
| Cable-charging breaking capacity | A | 21 |
| **Circuit-breakers panel** | | |
| Rated normal current | A | 630 |
| Rated breaking current | kA | 25 |
| Rated short-circuit making current | kA | 63 |
| Rated capacitive switching current class | | C2 (50A) |
| Mechanical endurance class (Circuit-breakers) | | M2 10000 |
| Mechanical endurance class (Earthing switch) | | M1 5000 |
| Electrical endurance class | | E2 |
| Rated short-time withstand current | kA-s | 25-4 |
| Short-circuit making capacity of earthing switch | | E2 5 |
| Mechanism type | | O-0.3s-CO-180s-CO |

For others, please contact local Eaton sales representative.

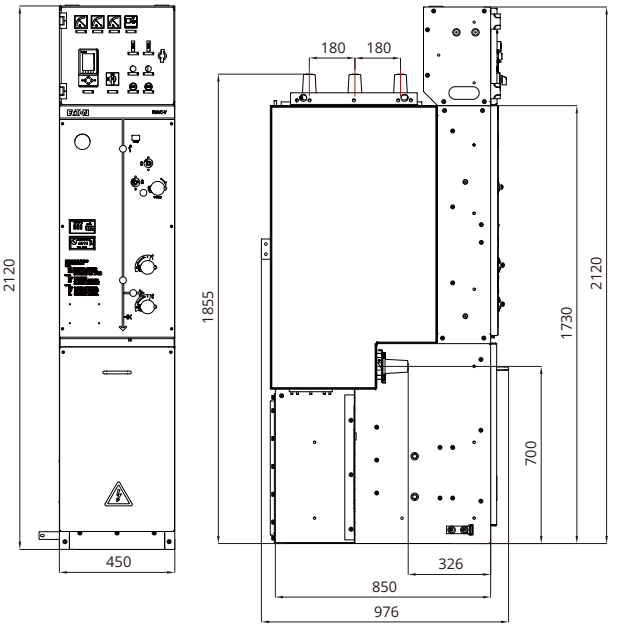
# RVAC designed to IEC standards

| RVAC complies with the following standards | |
|---|---|
| IEC62271-1 | Common specifications for alternating current switchgear and controlgear |
| IEC62271-103 | High-voltage switches for rated voltages above 1kV up to and including 52 kV |
| IEC62271-102 | High-voltage alternating current disconnectors and earthing switches |
| IEC62271-200 | A.C. metal-enclosed switchgear and controlgear for rated voltages above 1kV and up to including 52kV |
| IEC62271-100 | High-voltage alternating-current circuit breakers |
| IEEE693 | IEEE Recommended Practice for Seismic Design of Substations |

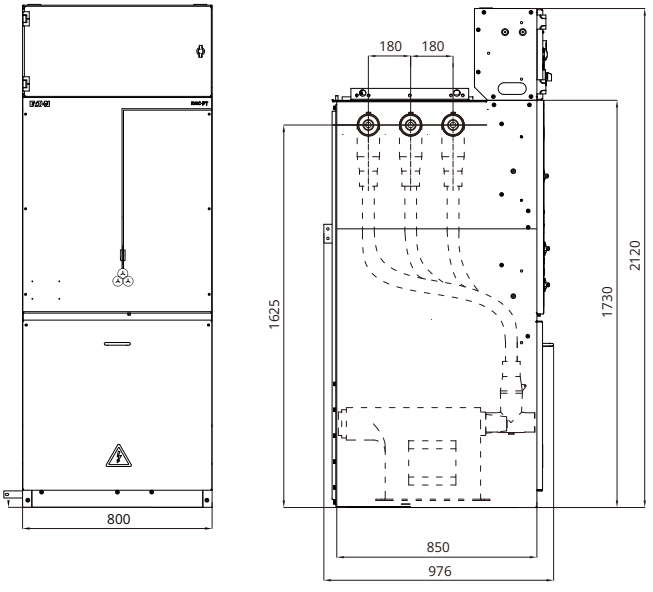
# RVAC Outlines and Dimensions



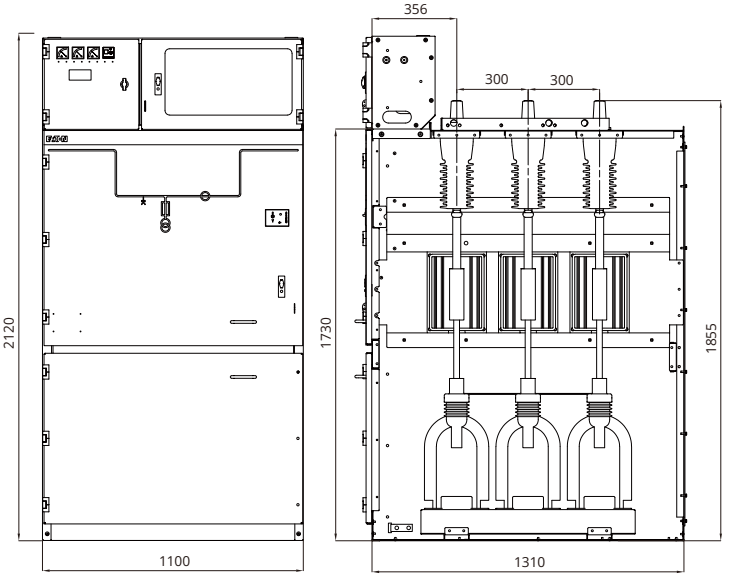

**K**




**V**



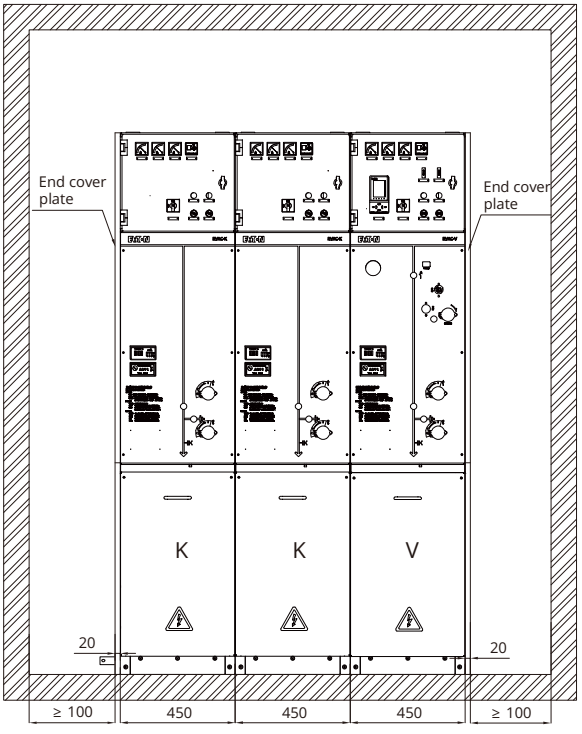

**PT**



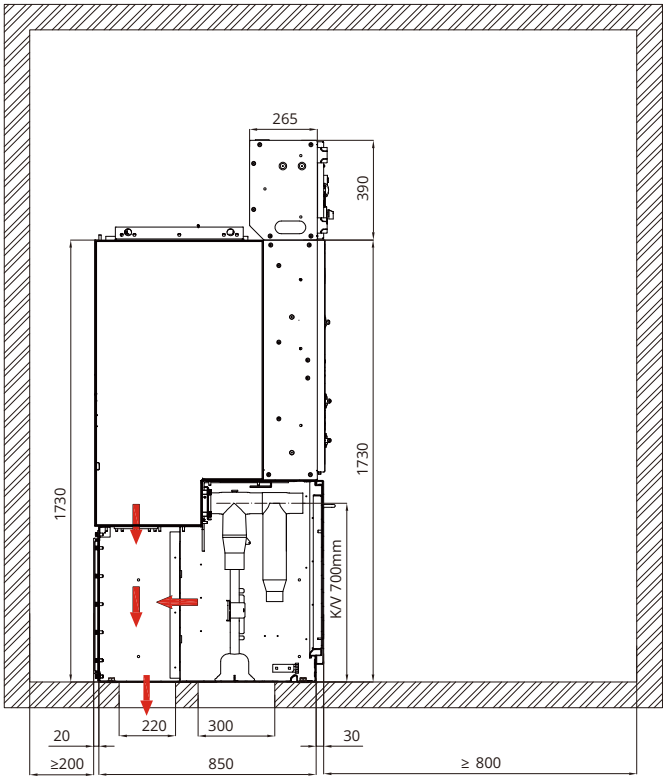

**M**

# Floor Plan

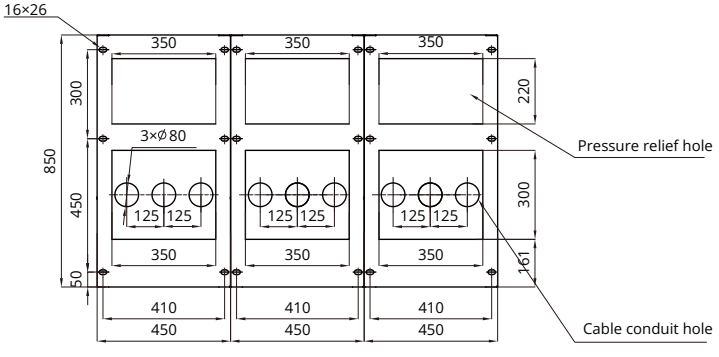
## KKV block type



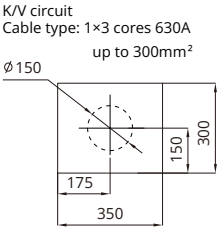

Front View

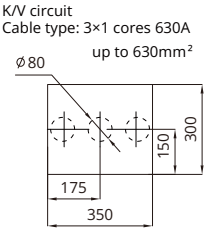



Side View



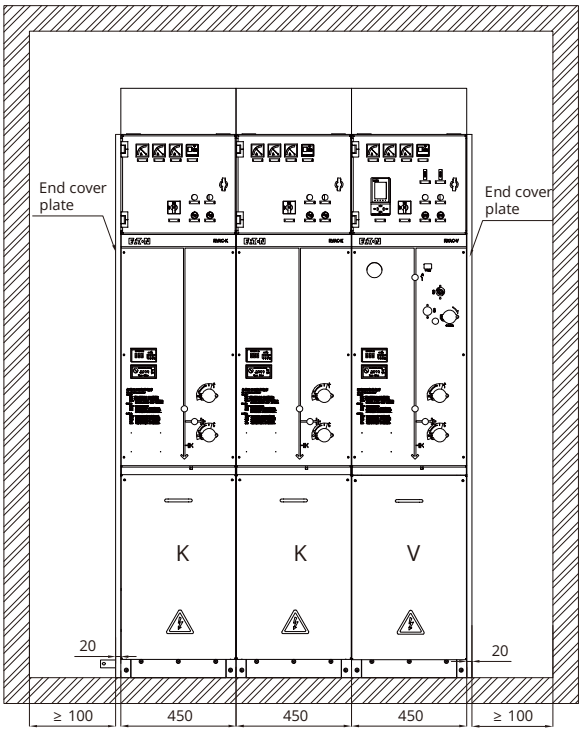

Basic floor plan



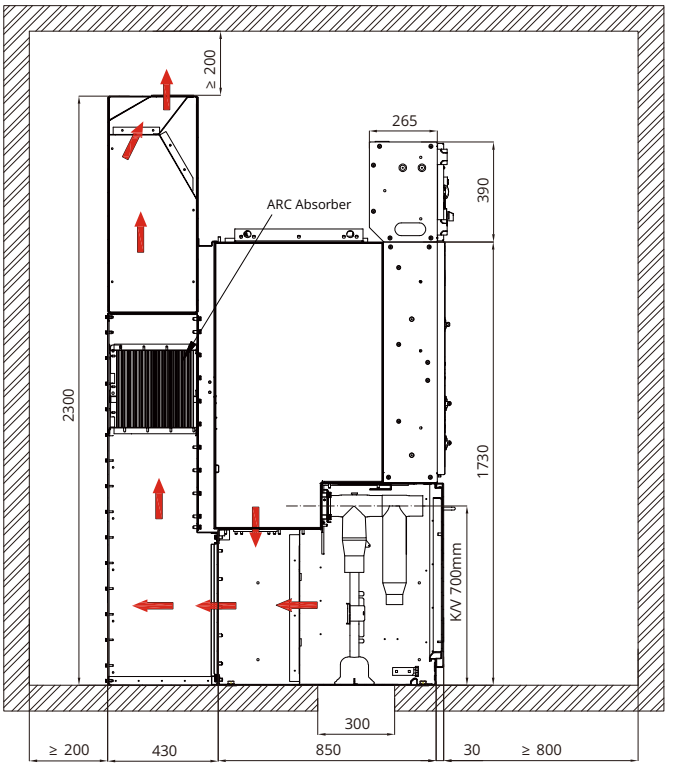



# Floor Plan

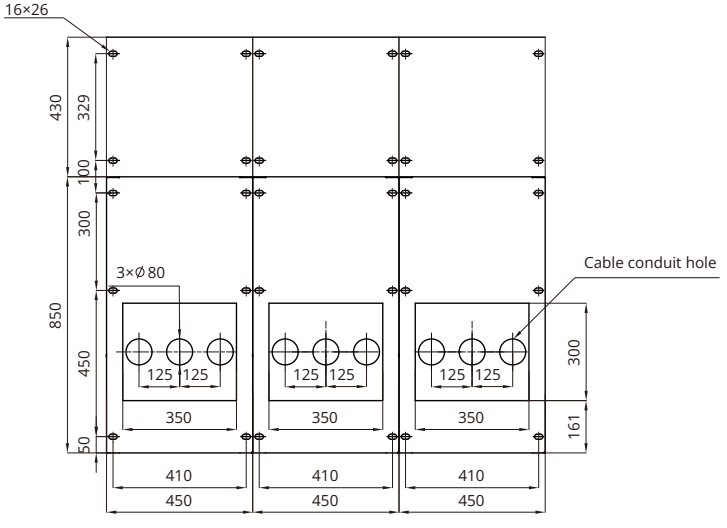
## KKV block type with arc absorbe



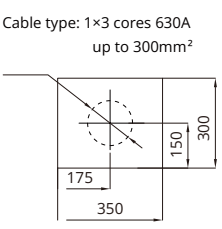

Front View

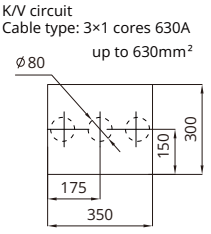



Side View




Basic floor plan



# RVAC Series outdoor switching substation

## Features for substation

Switching substation combined with indoor SF6 gas insulated RMU RVAC and outdoor enclosure.

- The enclosure material uses stainless steel or Zn-Al steel sheet with painting, the steel thickness is not less than 2mm, has the strong corrosion resistance; The loose parts are all metal sheet parts and are welded / riveted / bolted with each other to ensure the stable structure and light weight and elegant appearance.
- The top cover is a water-proof clival structure with ventilation outlet. The ventilation inlet is arranged in the lateral of enclosure with removable dust-proof filter net and the outlet is arranged at the top of the enclosure hidden under the eaves. It makes air convection from bottom to top.
- The cable inlets with sealed bottom plates are locked the bottom of outdoor enclosure to prevent moisture from cable channel into case body.
- The doors and lugs are sealed with sealing strips, the locks for doors is rainproof. The limiting hook is installed on the door to make door fix when the door is opened for maintenance.
- RMU inside enclosure is maintenance free design, which can adapt to the harsh outdoor environment.
- With the automatic terminal module(RTU) and remote control/ Monitoring Unit to facilitate the implementation of more extended functions.
- The outdoor enclosure's dimension and color will defined by project, the specific request may contact EATON beforehand.
- Key performance of outdoor switching sub-station：
  - Protection class: IP43(IP54 optional)

Eaton is an intelligent power management company dedicated to protecting the environment and improving the quality of life for people everywhere. We make products for the data center, utility, industrial, commercial, machine building, residential, aerospace and mobility markets. We are guided by our commitment to do business right, to operate sustainably and to help our customers manage power — today and well into the future. By capitalizing on the global growth trends of electrification and digitalization, we're helping to solve the world's most urgent power management challenges and building a more sustainable society for people today and generations to come.

Founded in 1911, Eaton has continuously evolved to meet the changing and expanding needs of our stakeholders. With revenues of nearly $25 billion in 2024, the company serves customers in more than 160 countries. Eaton entered the Chinese market in 1993 and has grown significantly since then. In 2004, Eaton moved its Asia-Pacific headquarters from Hong Kong to Shanghai. Today, Eaton has nearly 8,000 employees and 19 manufacturing facilities in China.

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**Eaton Corporation**
No.3, Lane 280, Linhong Road,
Changning District,
Shanghai, China 200335
www.eaton.com.cn


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