

# VCP-WG Specific Vacuum Circuit Breaker for Generator



*Powering Business Worldwide*



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.



# VCP-WG Specific Vacuum Circuit Breaker for Generator

## Main characteristics

### A unique circuit breaker --

### VCP-WG Specific Vacuum Circuit Breaker for Generator Generator circuit configuration



Generator circuit has some special characteristics, and it thus requires special design and test of the circuit breaker. IEEE has provided requirements on those characteristics in specific standards. Based on years of research, design, improvement and testing, VCP-WG circuit breaker developed by Eaton Electric has reached and exceeded the IEEE design standards.

Eaton's VCP-WG circuit breaker fully complies with China's GB/T 14824 "Common technical requirements for generator circuit-breaker" and ANSI C37.013 "Standard for AC high voltage generator circuit breakers based on symmetrical current".

VCP-WG circuit breaker has reached and exceeded the strict technical specifications required by IEEE design standards, mainly in the following aspects:

- Generator circuit configuration
- High sustained current rating
- Special short-circuit fault current
  - System-source short circuit
  - Generator-source short circuit
- Special voltage
  - Rapid RRRV
  - Out-of-phase breaking

The transformer and generator can be located very close to the circuit breaker (see Figure 1), and if operating at high sustained current rating, large-sized low-impedance conductors are needed for connection. These conditions might cause unique current and voltage faults. Eaton's VCP-WG vacuum circuit breaker can operate safely and reliably under those special conditions.

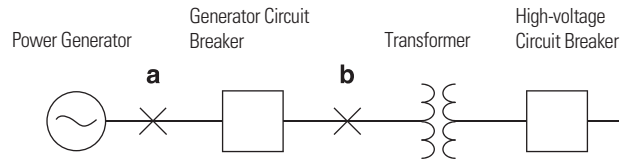


Fig. 1

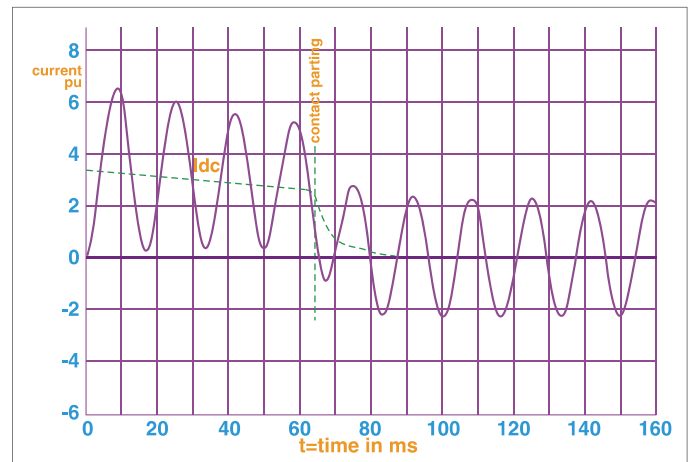
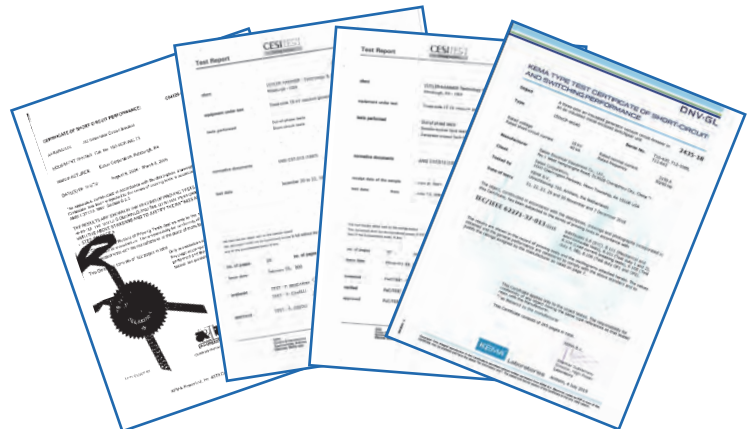


Figure 2: The generator-source short circuit will cause zero-crossing delay of current. High X/R of the system (inductance-to-resistance ratio) may cause a particularly large DC component which exceeds 100%.

## Special short-circuit fault current

System-source short-circuit fault current can be very high (see Figure 1, fault point a). When a short-circuit fault occurs at point a, the breaking short-circuit current of the generator circuit breaker is supplied by the system network, and low-resistance line has little impact on short-circuit fault current limit. According to the result of tests conducted per IEEE design standard, the breaking capacity of the VCP-WG generator circuit breaker can reach 75kA when the DC component reaches 75%. Therefore, it is an ideal choice for high short-circuit fault current. A short-circuit fault of generator source (see Figure 1, fault point b) will lead to the so-called "zero-crossing delay of current" (see Figure 2). When a short-circuit fault occurs at point b, the generator directly supplies short-circuit current. High X/R (inductance-to-resistance ratio) of the system may cause a particularly large DC component which exceeds 100%, and the short-circuit current completely deviates from the neutral line (see Figure 2). From the start of short circuit to the occurrence of current zero, there is a delay of several cycles. In this case, the peak value of the asymmetric short-circuit fault current is extremely high; the attenuation is slow; and the arcing time of the circuit breaker is long. Therefore, the circuit breaker has to withstand harsh electrical conditions, temperature rise, and impact. Eaton's VCP-WG vacuum circuit breaker for generator sets has passed the verification in this working condition required by IEEE standards, that is, the DC component reaches 135% of the breaking capacity of three-phase asymmetric short-circuit current.



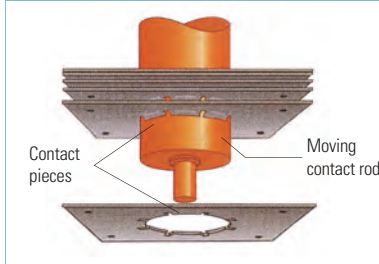
**The product has passed the world well-known KEMA laboratory test**

# VCP-WG Specific Vacuum Circuit Breaker for Generator

## Main characteristics

### High sustained current rating

A generator circuit breaker must be able to operate at high sustained current ratings. Eaton Electric's VCP-WG vacuum circuit breaker can operate reliably because it adopts natural convection cooling. The draw-out type can reach 4,000A; and the fixed type can reach 6,000A. In the case of overload, it will activate built-in fan for cooling, the draw-out type being able to reach 7,000A, and the fixed type 7,000A.

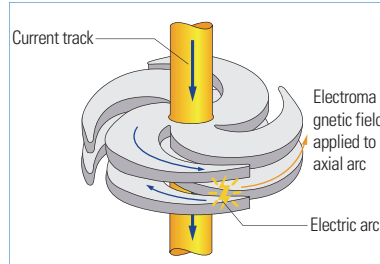


#### Non-slip current conversion system

Each contact piece is connected to the moving contact rod of the vacuum circuit breaker to ensure smooth operation. As the contact pieces are embedded in contact with the moving contact rod, each piece is in multi-point contact. When the moving contact rod moves up and down, the V-Flex system bends instead of sliding to reduce wear. Therefore, maintenance is no longer needed.

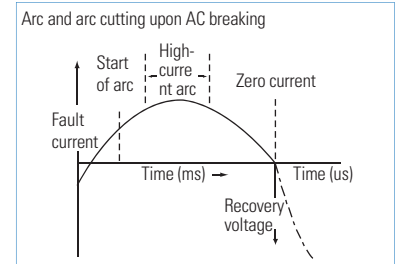
### In special voltage state

The generator circuit is typically featured by high frequency, low resistance and parasitic capacitance, which ensure very high rate of rise of recovery voltage. Eaton Electric's VCP-WG generator vacuum circuit breaker complies with IEEE design standards and is able to quickly break RRRV fault current.



#### Arc in vacuum and arc cutting

Design of spiral contact located in the vacuum interrupter. This type of arc control prevents the formation of hot spots and reduces electrode corrosion. Therefore, the smallest possible peripheral size is ensured.



#### Arc and arc cutting upon AC switching

As shown in the figure, when a breaking fault current occurs, severe arc and cutting occur in the vacuum. Such phenomena affect the design of circuit breaker, especially its size, shape, and contact material. In a few milliseconds, sufficient insulation strength can be restored to withstand transient overvoltage.

### Capacity to break fault current

Eaton Electric's VCP-WG generator vacuum circuit breaker has a unique feature: When the generator is not in step with the power system voltage, it still works normally. If out of step, the voltage of the opening vacuum interrupter break distance can be 2 times the rated voltage of the system. VCP-WG circuit breaker meets the requirements of the IEEE design standard. And the test result indicates that it's able to break if out of step.

### Eaton specific vacuum interrupter for generators

To meet the special requirements on circuit breakers for generators, Eaton has developed a special vacuum interrupter. Compared with the vacuum interrupters for ordinary circuit breakers, Eaton's vacuum interrupter for generator has the following features:

- Design of targeted special contact shape
- Special contact material
- The dynamic/static contact is heavier than ordinary circuit breaker interrupters of the same specification
- The travel and overtravel are greater than ordinary circuit breaker interrupters of the same size





# VCP-WG Specific Vacuum Circuit Breaker for Generator

## Main characteristics

### Normal operating environment

- Ambient temperature: -15°C~40°C;
- Altitude not exceeding 1,000m;
- The monthly average relative humidity is not higher than 90% (at 25°C); and the daily average is not higher than 95% (at 25°C);
- Max endurable earthquake intensity: Magnitude 8;
- Keep it away from fire, explosion, chemical corrosion, and severe vibration.

\*If you have any special requirements, please contact Eaton Electric

### Multifunctional applications

VCP-WG generator vacuum circuit breaker includes withdrawable type (VCP-WG) or fixed type (VCP-WRG) to meet various application requirements. Many industrial and commercial power supply systems nowadays use small generators as local power source. Due to the re-planning of the power industry, new applications are constantly increasing in the construction of small-scale power plants. Typical applications include:

- Small and medium hydroelectric generator set
- Thermal power generators
- New energy generator sets
- Mixed flow/gas turbines
- Self-contained power generators of paper, chemical and processing industries



**Hydroelectric power station**



**Thermal power station**



**Waste incineration power plant**



**New energy power plant**

### Technical parameters of generator circuit breaker

Item		Unit	150VCP-W(R)G40	150VCP-W(R)G50
Rated voltage		kV	15	17.5
Rated frequency		Hz	50/60	50/60
Rated current		A	1250~3150,4000 <sup>①</sup> ,5000 <sup>①</sup>	1250~3150,4000,5000 <sup>①</sup>
Rated short-time withstand current		kA/s	40/4	50/4
Rated peak withstand current		kA	110	137
Rated short-circuit making current		kA	110	137
Rated symmetrical out-of-step breaking current		kA	20	25
Rated short-circuit breaking current (symmetrical)	System	kA	40	50
	Generator	kA	25	31.5
DC component of rated short-circuit breaking current	System	%	80	80
	Generator	%	130	130
Power frequency withstand voltage (1min)	Interphase / to earth	kV	50	50
	Break distance	kV	59	59
Lightning impulse withstand voltage	Interphase / to earth	kV	95	110
	Break distance	kV	110	110
Peak transient recovery voltage	System	kV	27.6	32.2
	Generator	kV	27.6	32.2
	Out-of-phase breaking	kV	39	45.5
Rate of rise of transient recovery voltage	System	kV/us	3.5	4.0
	Generator	kV/us	1.6	1.6
	Out-of-phase breaking	kV/us	3.3	3.3
Mechanical life		times	10000	10000
Opening time		ms	16~50	16~50
Closing time		ms	35~70	35~70
Rated operating sequence			CO-30min-CO	CO-30min-CO

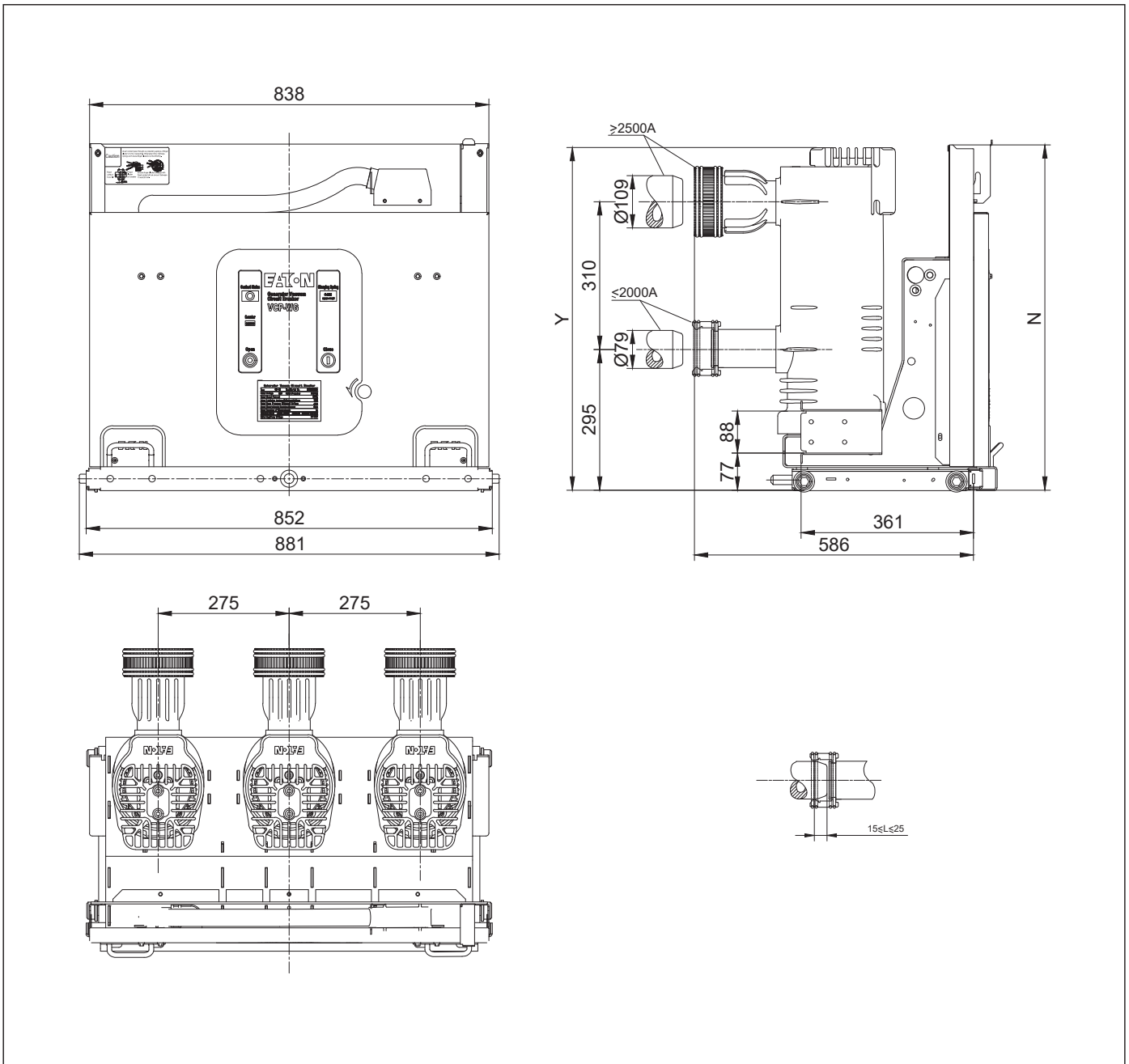
**Note:**

① Forced air cooling is required.

# VCP-WG Specific Vacuum Circuit Breaker for Generator

## Overall dimensions

### Overall dimensions of 150VCP-WG withdrawable circuit breaker (unit: mm)



Width of Cabinet (mm)	Rated Current (A)	Rated Short-circuit Breaking Current (kA)	N	Y
1000	1250-3150, 4000 <sup>a</sup> , 5000 <sup>a</sup>	40	725	720
1000	1250-4000, 5000 <sup>a</sup>	50	805	780

**Note:**

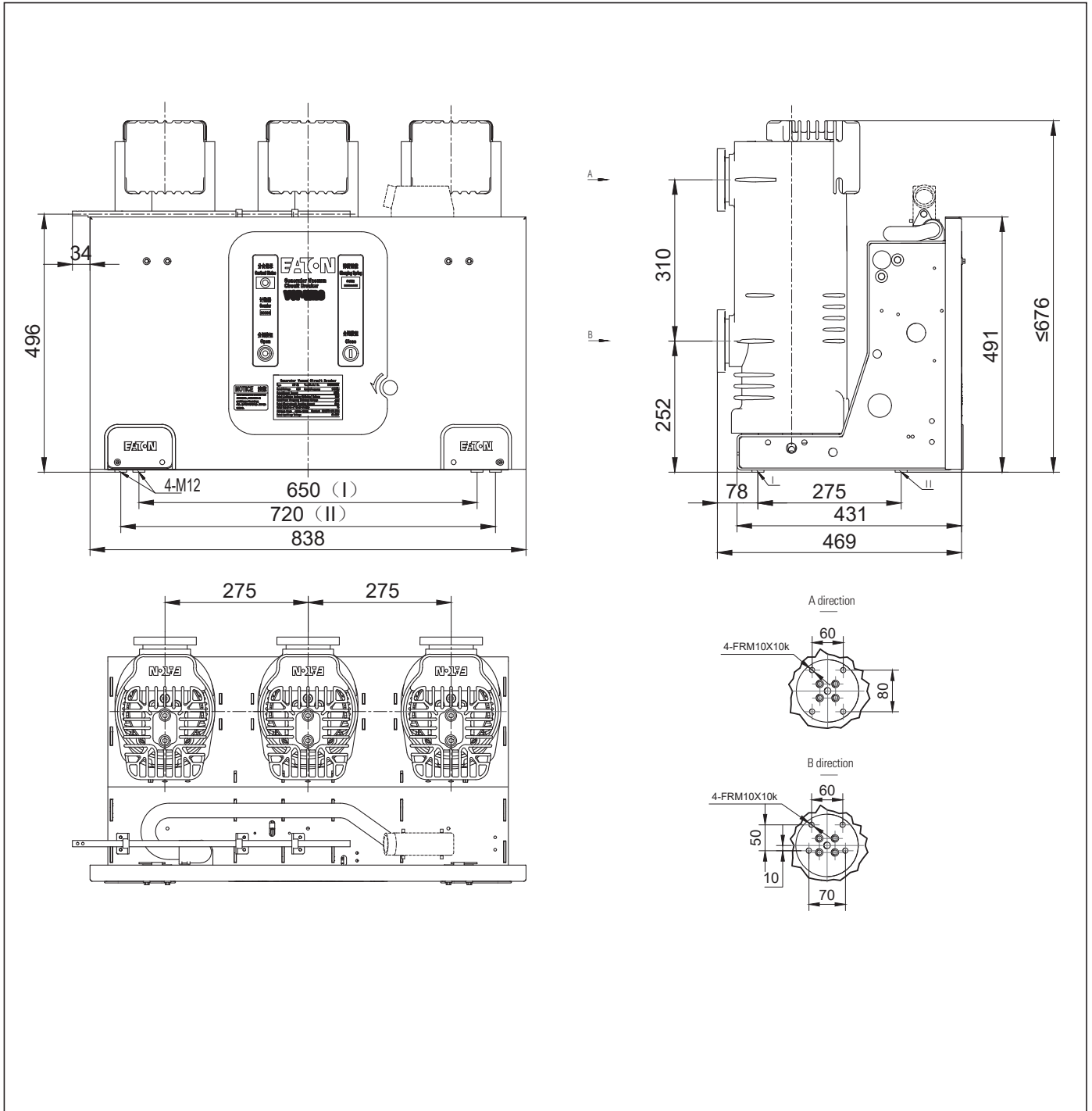
<sup>a</sup> Forced air cooling is required.



# VCP-WG Specific Vacuum Circuit Breaker for Generator

Overall dimensions

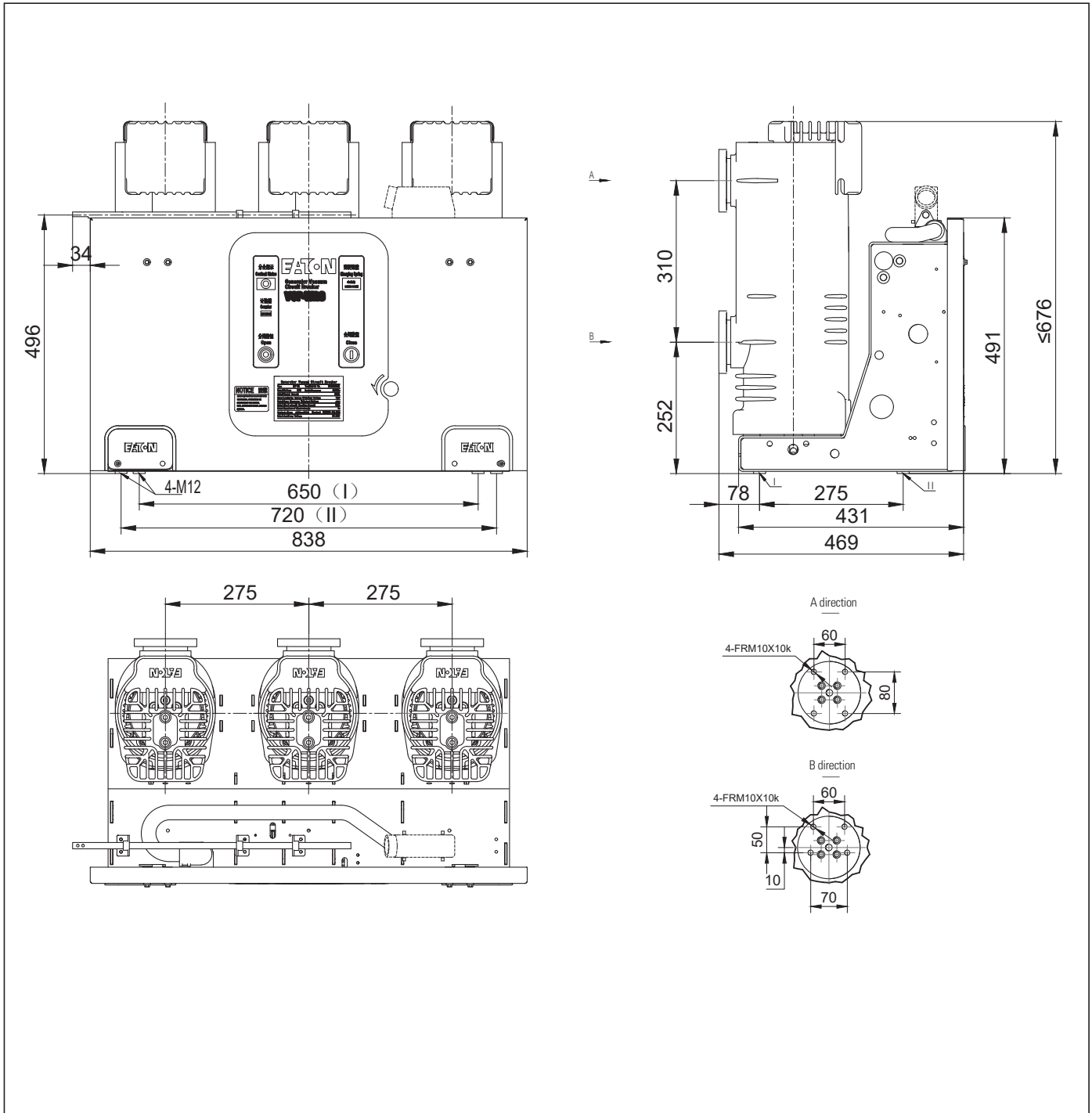
Overall dimensions of 150VCP-WG40 fixed circuit breaker (unit: mm)



# VCP-WG Specific Vacuum Circuit Breaker for Generator

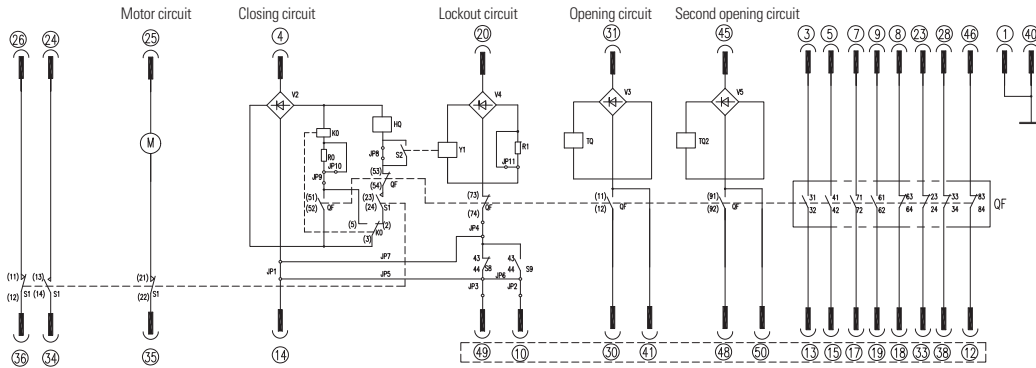
Overall dimensions

## Overall dimensions of 150VCP-WG50 fixed circuit breaker (unit: mm)

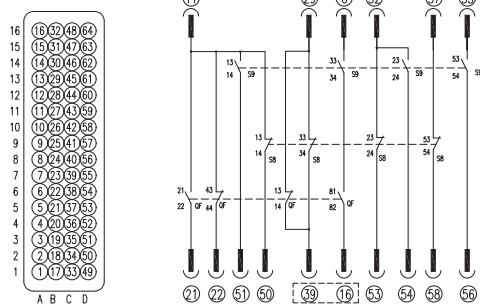


## Secondary wiring of 150VCP-WG withdrawable circuit breaker

The figure shows the withdrawable circuit breaker is in the testing position, at the open state, and the state of energy discharged.



64-pin secondary plug



Optional wiring installations:

Jumper Status	Jumper	JP1	JP2	JP3	JP4	JP5	JP6	JP7	JP8	JP9
With Lockout	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Without Lockout	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
With Anti-jump	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Without Anti-jump	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Selection of operating power supply:

Power Supply	JP10	JP11
AC/DC 220V	✓	✓
AC/DC 110V	✓	✓

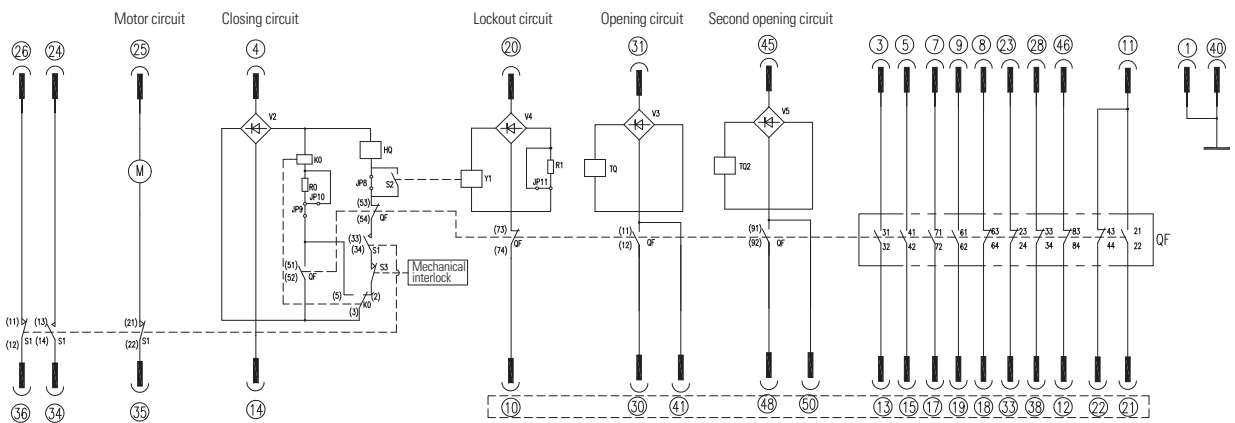
Note: "1" stands for disconnected, "✓" stands for connected.

- S9: Auxiliary switch (switched when the withdrawable circuit breaker is in the working position)
- S8: Auxiliary switch (switched when the withdrawable circuit breaker is in the test position)
- S7: Auxiliary switch
- S2: Auxiliary switch (switched after closing spring charged)
- S1: Auxiliary switch (switched upon closing or opening operation)
- HC: Closing coil
- TO: Opening coil
- TO2: Second opening coil (optional)
- RO-R1: Resistance
- Y1: Lockout coil (optional)
- V2-V5: Bridge rectifier (off for AC)
- M: Energy charging motor
- JP1-JP11: Jumper
- KO: Anti-pumping relay (optional)

Note: When operating with a DC power supply, the polarities shall be the same in the dashed boxes.

## Secondary wiring of 150VCP-WG fixed circuit breaker

The diagram shows the circuit breaker in the opening state and the state of energy discharged.



Optional wiring installations:

Jumper Status	Jumper	JP8	JP9
With Lockout	✓	✓	✓
Without Lockout	✓	✓	✓
With Anti-jump	✓	✓	✓
Without Anti-jump	✓	✓	✓

Selection of operating power supply:

Power Supply	JP10	JP11
AC/DC 220V	✓	✓
AC/DC 110V	✓	✓

Note: "1" stands for disconnected, "✓" stands for connected.

- HC: Closing coil
- TO: Opening coil
- TO2: Second opening coil (optional)
- RO-R1: Resistance
- Y1: Lockout coil (optional)
- S2: Auxiliary switch
- S3: Auxiliary switch (switched on after mechanical interlock is enabled and switched off if mechanical interlock is disabled)
- S1: Auxiliary switch (switched after closing spring charged)
- OC: Auxiliary switch (switched upon closing or opening operation)
- V2-V5: Bridge rectifier (off for AC)
- M: Energy charging motor
- JP1-JP11: Jumper
- KO: Anti-pumping relay (optional)

Note: When operating with a DC power supply, the polarities shall be the same in the dashed boxes.



## VCP-WG Specific Vacuum Circuit Breaker for Generator

### Technical parameters

#### Technical parameters of 150VCP-WG generator circuit breaker

Item	Unit	150VCP-W(R)G63	150VCP-W(R)G75	
Rated voltage	kV	15	15	
Rated frequency	Hz	50/60	50/60	
Rated current	A	1250~ 7000 <sup>①</sup>	1250~ 7000 <sup>①</sup>	
Rated short-time withstand current	kA/s	63/3	75/1 or 63/3	
Rated peak withstand current	kA	173	206	
Rated short-circuit making current	kA	173	206	
Rated symmetrical out-of-step breaking current	kA	31.5	37.5	
Rated short-circuit breaking current (symmetrical)	System	kA	63	75
	Generator	kA	31.5	40
DC component of rated short-circuit breaking current	System	%	75	63
	Generator	%	130	130
Power frequency withstand voltage (1min)	Interphase / to earth	kV	42	42
	Break distance	kV	50	50
Lightning impulse withstand voltage	Interphase / to earth	kV	95	95
	Break distance	kV	95	95
Peak transient recovery voltage	System	kV	276	276
	Generator	kV	276	276
	Out-of-phase breaking	kV	39	39
Rate of rise of transient recovery voltage	System	kV/us	3.4	3.4
	Generator	kV/us	1.6	2.2
	Out-of-phase breaking	kV/us	3.3	3.3
Mechanical life	times	10000	10000	
Opening time	ms	~45	~45	
Closing time	ms	~60	~75	
Rated operating sequence		CO-30min-CO	CO-30min-CO	

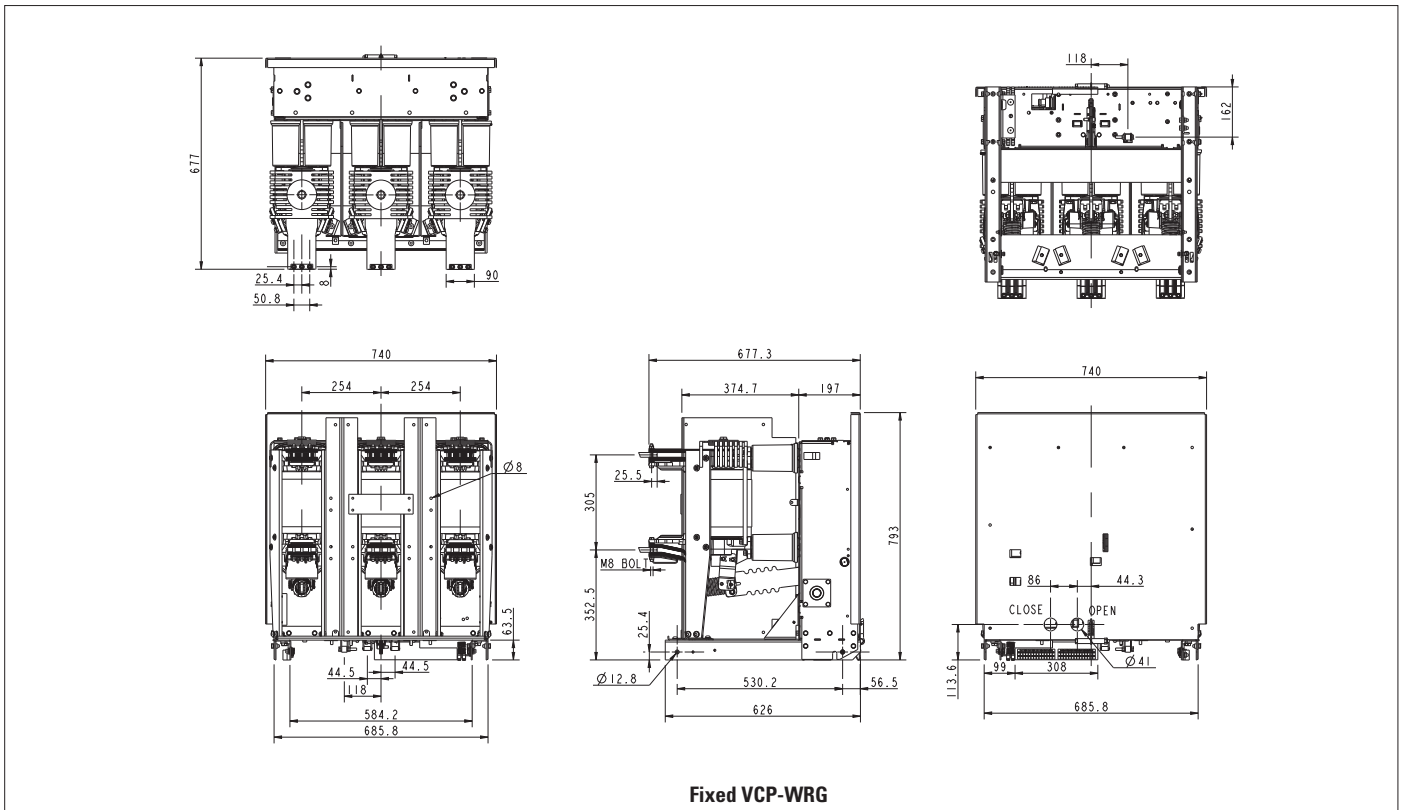
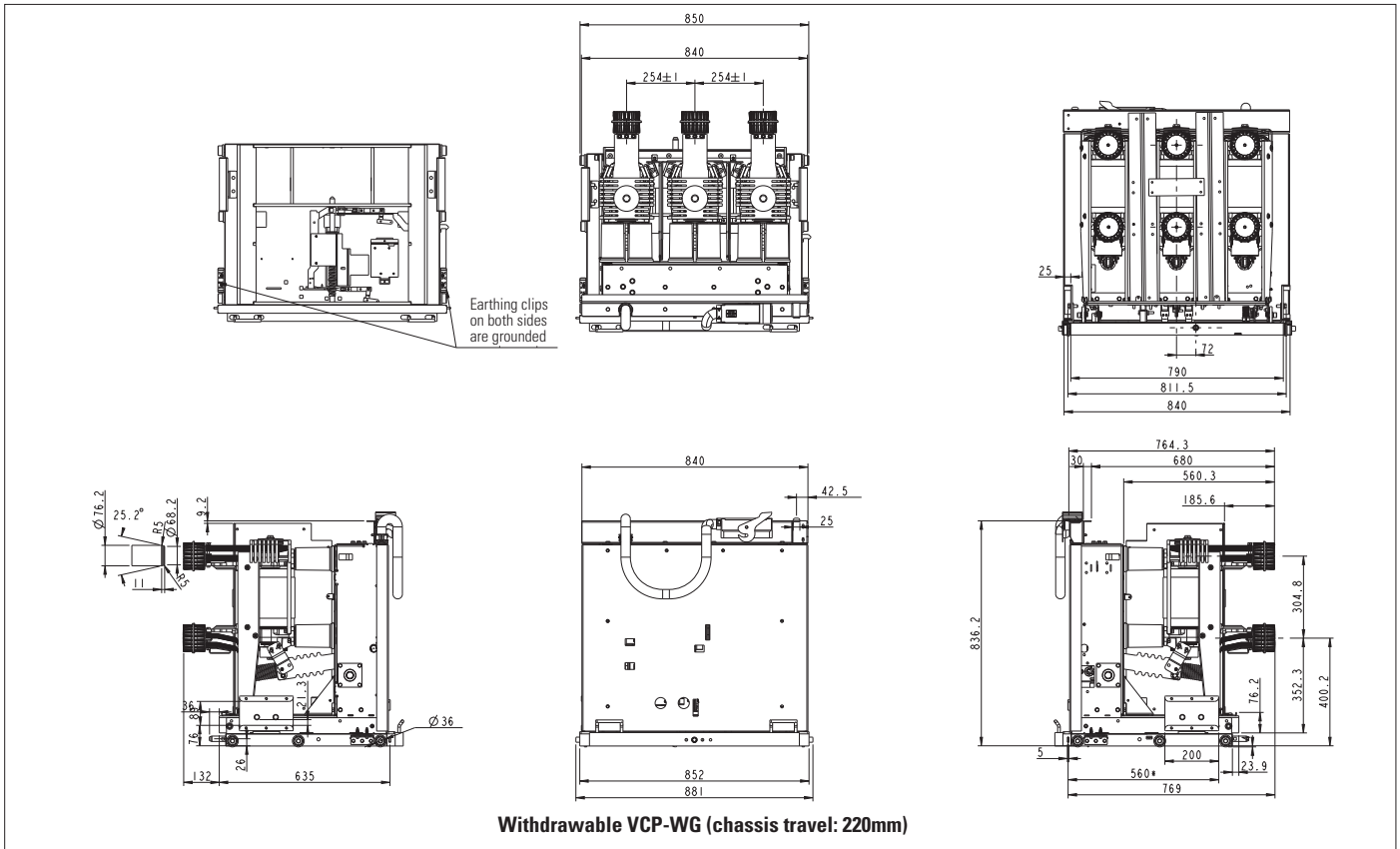
**Note:**

① Forced air cooling is required in the case of high current. Please contact Eaton for detailed information.

# VCP-WG Specific Vacuum Circuit Breaker for Generator

## Overall dimensions

Overall dimensions (unit: mm)

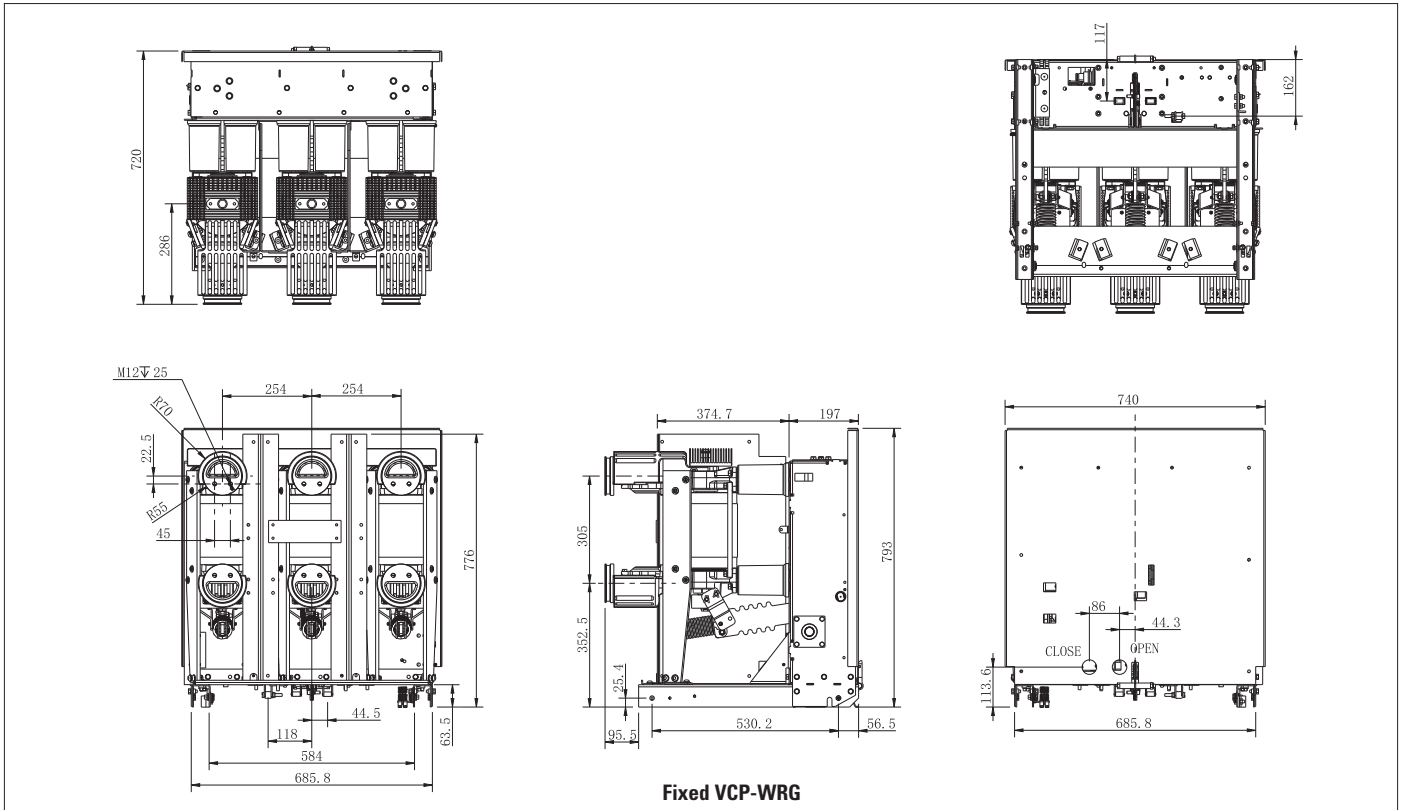
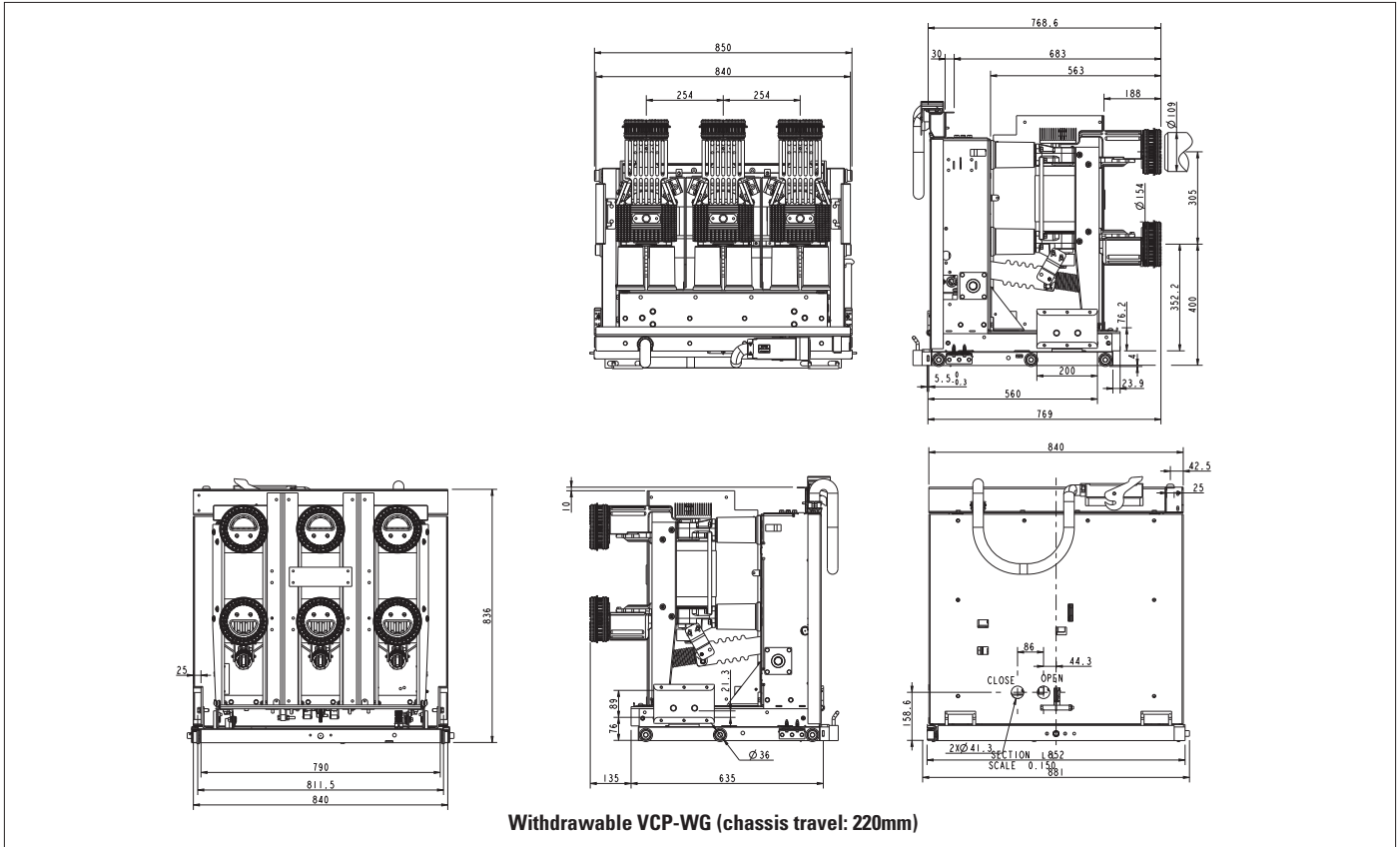


**Note:** The above dimensions are suitable to rated currents between 1,250A and 3,150A, 4,000A FC, and short-circuit breaking current 63kA.

# VCP-WG Specific Vacuum Circuit Breaker for Generator

## Main characteristics

### Overall dimensions (unit: mm)



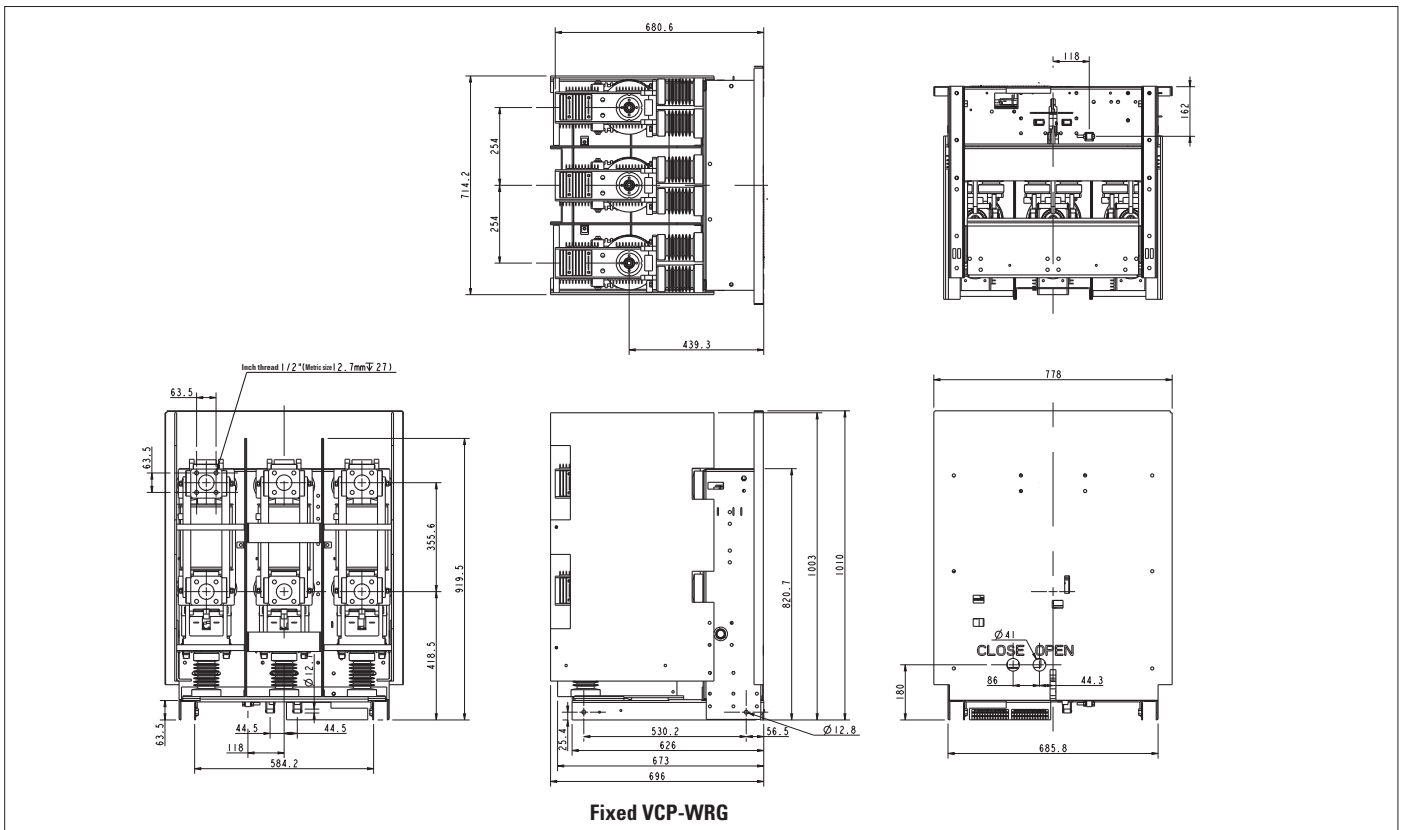
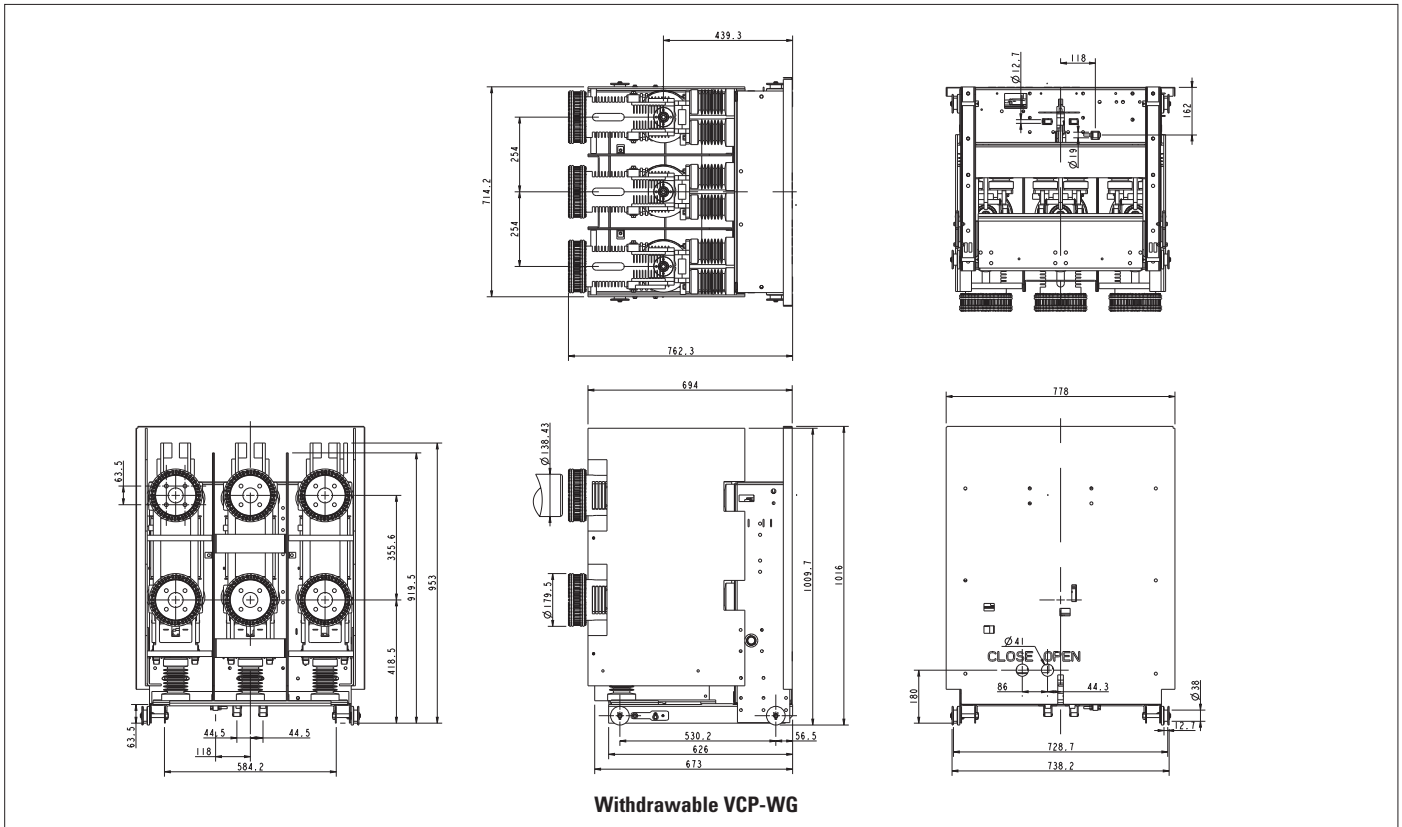
**Note:** The above dimensions are suitable to rated currents 4,000A, 5,000A FC, and short-circuit breaking current 63kA.



# VCP-WG Specific Vacuum Circuit Breaker for Generator

## Overall dimensions

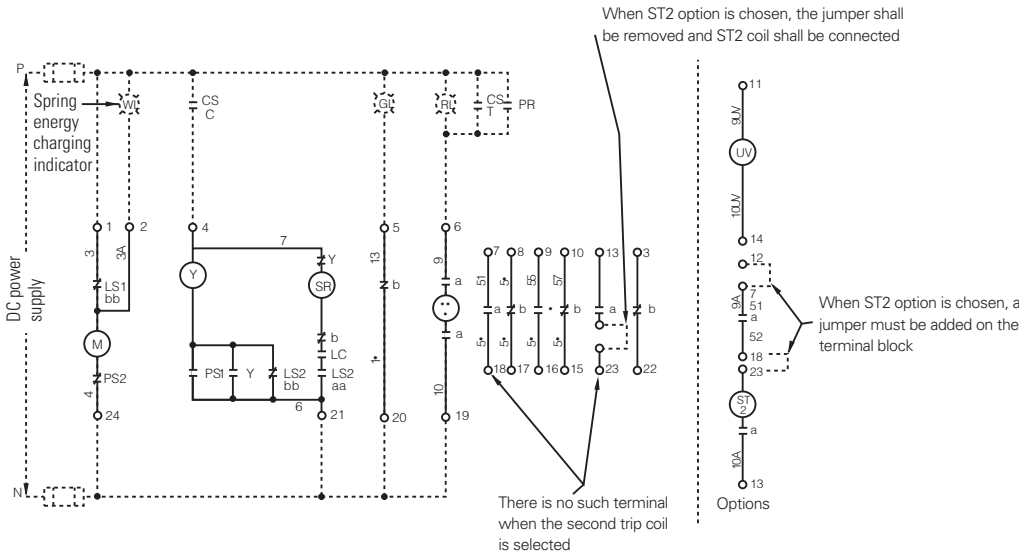
Overall dimensions (unit: mm)



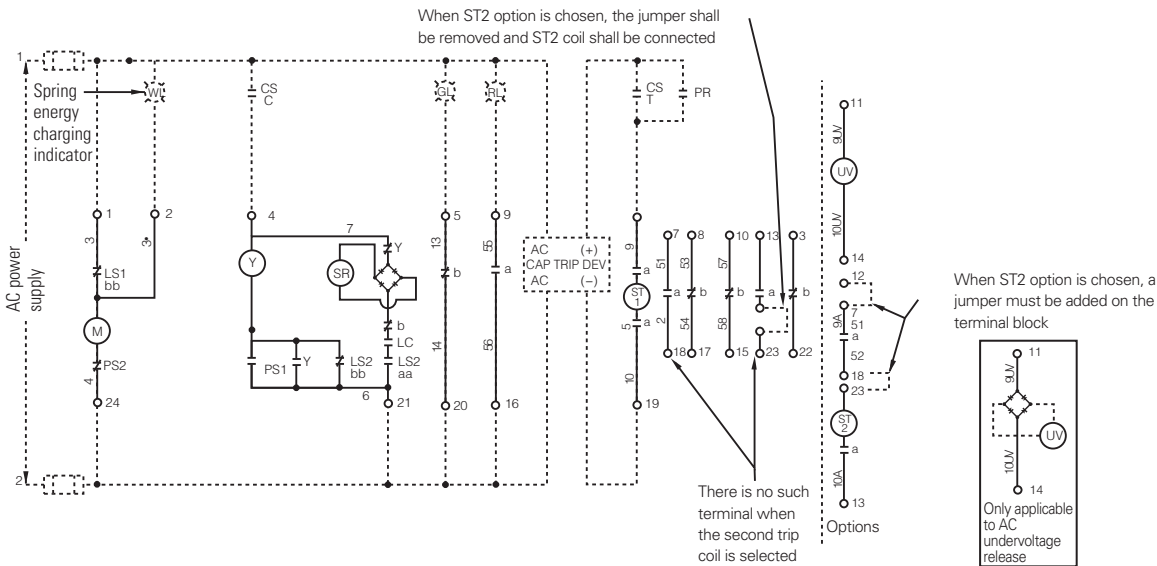
**Note:** For detailed solutions regarding withdrawable and fixed types applicable to the short-circuit breaking current 75kA, please contact Eaton.

# VCP-WG Specific Vacuum Circuit Breaker for Generator

## Schematic diagram of DC controlled VCP-WG vacuum circuit breaker



## Schematic diagram of AC controlled VCP-WG vacuum circuit breaker



### Codes of secondary components in the figure

CS C	—	Circuit breaker control switch — closing	LS1 bb	Switched on until spring fully charged
CS T	—	Circuit breaker control switch — tripping	LS2 aa	Switched off until spring fully charged
Y	—	Anti-jump relay	LS2 bb	Switched on until spring fully charged
SR	—	Spring release coil (closing coil)	LC	Switched off until the mechanism is rese
M	—	Spring energy charging motor	PS1	Switched off (except for "Test" and "Connect" positions)
ST	—	Shunt trip coil	PS2	Switched off (except for "Test" and "Connect" positions)
PR	—	Protection relay		
O	—	Terminal block		
PS 1	—	Position switch 1		
PS 2	—	Position switch 2		

### Switch terminal

'C' and 'NO'	Brown switch
'C' and 'NC'	Black switch
'C' and 'NO'	
'C' and 'NC'	Black switch
'C' and 'NO'	Brown switch

\* It's optional that the second auxiliary contact 5 is normally open or normally closed. If you have a particular requirement, please contact Eaton.

Eaton is an intelligent power management company dedicated to improving the quality of life and protecting the environment for people everywhere. 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 accelerating the planet's transition to renewable energy, helping to solve the world's most urgent power management challenges, and doing what's best for our stakeholders and all of society. Founded in 1911, Eaton has been listed on the NYSE for nearly a century. We reported revenues of \$19.6 billion in 2021 and serve customers in more than 170 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.

For more information about Eaton China, visit [www.eaton.com.cn](http://www.eaton.com.cn)



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