Instruction Leaflet **IL550-0501001E** Effective June 2017

Installation and Operating Instructions for E-VAC Enclosed Indoor HV Vacuum Circuit Breaker

Contents

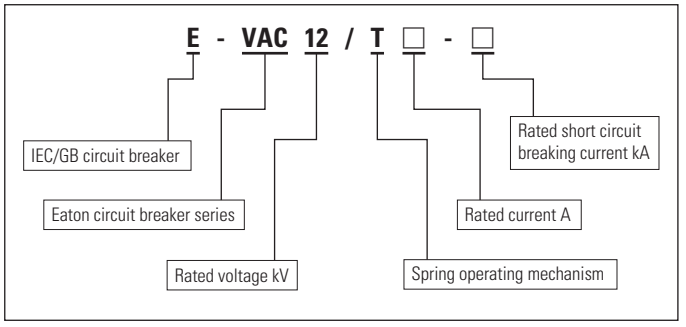
Powering Business Worldwide

1. Overview

E-VAC enclosed indoor HV vacuum circuit breaker ("circuit breaker") is an indoor switch device for 12 kV power system, serving as the designed protection and control unit of power grid equipment and industrial and mining enterprises. Because of special superiority, the vacuum circuit breaker is particularly applicable to the site required for frequent operation of rated operating current, or repeated breaking of short-circuit current.

The circuit breaker is designed by integrating the operating mechanism and circuit breaker body. It can be installed as a fixed unit or compose the handcart unit together with the special feed mechanism. The fixed circuit breaker may be equipped with corresponding mechanical interlock additionally, to meet the matching requirements of fixed cabinets, including XGN2, GG1A and GGX, etc.

2. Model number description



3. Standards applied

The circuit breaker complies with the following standards: GB 1984 High-voltage alternating-current circuit-breakers, JB 3855 3.6 to 40.5 kV indoor high-voltage alternating-current vacuum circuit-breakers, DL/T 403 Ordering Specifications for 12 to 40.5 kV High Voltage Vacuum Circuit Breakers and the requirements in IEC62271-100.

4. Operating conditions

a) Ambient temperature
Maximum temperature: +40°C
Minimum temperature: -25°C

b) Ambient humidity
Daily average relative humidity: ≤ 95%
Monthly average relative humidity: ≤ 90%
Daily average vapor pressure: ≤ 2.2×10^{-3} MPa
Monthly average vapor pressure: ≤ 1.8×10^{-3} MPa

c) Altitude: ≤ 1000m

d) sesmic intensity: ≤ magnitude 8

e) The surrounding air should not be obviously polluted by dust, smoke, corrosive and/or flammable gases, steam or salt mist.

Note: If the preceding operating requirements cannot be met, consult the manufacturer before releasing the order.

5. Main specifications and technical data

Items	Unit	Value			
Rated voltage	kV	12			
Rated short-duration power frequency withstand voltage (1 min)		42			
Rated lightning impulse withstand voltage (peak value)		75			
Rated frequency	Hz	50			
Rated current	A	630 1250	630 1250 1600 2000 2500 3150	1250 1600 2000 2500 3150 4000 [1]	1250 1600 2000 2500 3150 4000 [1]
Rated short circuit breaking current	kA	25	31.5	40	50
Rated short-duration withstand current		25	31.5	40	50
Rated short-circuit duration	s	4			
Rated peak withstand current	kA	63	80	100 (125 [2])	125 (137 [2])
Rated short-circuit making current		63	80	100 (125 [2])	125 (137 [2])
Power frequency withstand voltage for auxiliary circuits (1 min)	V	2000			
Rated single/back-to-back capacitor bank breaking current [2]	A	630/400			
Rated capacitor bank inrush making current [2]	kA	12.5 (Frequency not greater than 1000 Hz)			
Opening time	ms	20~50			
Closing time		35~70			
Mechanical endurance	times		30000	20000	10000
Breaking times of rated current			30000	20000	10000
Breaking number for rated short-circuit current			50	30	30
Permissible wearing accumulated depth for movable and fixed contact	mm	3			
Rated operating voltage for closing	V	AC 110/220 DC 110/220			
Rated operating voltage for opening					
Rated operating voltage of charging motor					
Rated power of charging motor	W		55	80	90
Charging time	s	≤ 15			
Clearance between open contacts	mm	8.5 ± 1			
Contacting travel		4 ± 1			
Contact closing bouncing time	ms	≤ 2			
Three-pole opening and closing asynchronism		≤ 2			
Average opening speed (average value of contact just switching-off –75% clearance between open contacts)	m/s	1.0~1.7			
Average closing speed (25% clearance between open contacts-- contact just switching-on)		0.7~1.2			
Contact bounce amplitude during opening	mm	≤ 2			
Main circuit resistance	μΩ	≤ 50 (630A)		≤ 40 (1250A)	
		≤ 35 (1600~2000A)		≤ 25 (2500A and above)	
Contacting pressure between contacts in closed position	N	≥ 2400	≥ 3000	≥ 4400	≥ 6000
Rated operating sequence		O-0.3s-CO-180s-CO			

Note: [1] Forced cooling is required for 4000A; [2] Rated parameters provided when needed.

6. Structure and operation principles

6.1 Main structure

The overall structure of E-VAC enclosed indoor HV vacuum circuit breaker includes operating mechanism and vacuum arc-extinguishing chamber which are arranged front and back, and the main conductive circuit part is of three-phase structure. The upper, lower outgoing line sockets and vacuum arc-extinguishing chamber are sealed in the enclosed pole rod casted by using APG technology, so that no dust accumulates on the surface of arc-extinguishing chamber. Thus, not only the vacuum arc-extinguishing chamber can be prevented from being damaged by external factors, but also high resistance state can be presented with respect to the voltage effect, even under the environment with damp and hot conditions and heavy pollution.

6.2 Operating mechanism (see Figure 1 and Figure 2)

The operating mechanism is a spring energy-storage mechanism. A closing unit, an opening unit composed of one or several tripping electromagnets, auxiliary switches, and indicating devices are installed in the circuit-breaker frame; and a closing and opening button, a manual charging opening, a spring charging state indicator and a closed/opened indicator are installed in the front.

6.2.1 Charging

The power required for closing is provided by the energy stored in the closing spring. Charging can be completed by an external power-driven motor or by using the charging handle.

The charging operation: The charging motor 16 that is fixed on the frame can be used for charging. The charging handle can also be inserted into the manual charging opening and turned counter-clockwise. During electrical charging, the motor output shaft drives the chain wheel driving system (14, 23, and 18). During manual charging, the worm and worm gear (11 and 13) drive the driving system. When chain wheel 23 is running, pin 2 drives slide block 4 on wheel 6 to make charging shaft 7 run, and the closing spring begins charging through connecting levers 5 and 21. In the charging position, the gag lever post 3 on the frame presses down the slide block 4 so that the charging shaft is disconnected from the chain wheel driving system. The charging trigger 9 withstands roller 8 to maintain the charging position and the link plate 24 on the charging shaft drives the charging indicator to turn and display “charged” and switch off the charging motor. At this point, the circuit breaker is in the closed state.

6.2.2 Closing

During the closing operation, Either pressing the close button or remotely moving the closing electromagnet cause the charging shaft 19 to run and the trigger 9 to be disconnected from roller 8. When the closing spring contracts, the charging shaft 7 and cam 43 on the shaft run through connecting levers 5 and 21. The cam drives the link mechanism (33, 35, 36, 37 and 39) to make the insulating lever 32 and the movable contact enter the closing position and press the contact spring 32 to maintain the pressure required by the contact.

After the closing action is completed, the closing trigger 38 and the "D" shaft 41 maintain the closing position and the charging indicator and charging auxiliary switch reset the motor to connect the power supply. If the external power supply is connected, the circuit breaker enters the charging state again. The connecting plate 44 pulls the closing/opening indicator to display the “closing” mark and the driving connecting plate pulls the main auxiliary switch.

Note: When the circuit breaker is in the closed state, or a locking device is selected but is not used for unlocking, or the handcart circuit breaker is moved in or out, the closing operation cannot be performed.

6.2.3 Opening

You can press the “open” button or connect the external power supply to make the opening tripping electromagnet or overcurrent tripping electromagnet activate, causing the interlock between the closing trigger 38 and "D" shaft 41 to cancel. This results in the opening operation being performed. The energy stored in contact spring and opening spring 34 separates the movable contact from the fixed contact in interrupter 27. At the late stage of the opening process, the hydraulic damper absorbs the remaining energy and limits the opening position.

The connecting plate 44 causes the closed/opened indicator to display “open”, and the counter is made to perform the counting function. The driving connecting plate flips the main auxiliary switch.

6.3 Interlock against maloperation

The circuit breaker provides an ideal interlock function to guard againstmaloperation. (See **Figure 3** and **Figure 4**)

1. After the closing operation is completed, the closing interlock bending plate 1 moves downwards and holds the closing bending plate 2 (on the closing maintaining shaft). The closing operation cannot be performed when the circuit breaker is not opened.
2. After the closing operation is performed, if the closing command lasts, the anti-pumping control circuit in the circuit breaker cuts off the closing circuit to prevent repeated closing. (Optional)
3. When the draw-outcircuit breaker does not reach the test position or working position, the interlock bending plate holds pin 4 on the closing bending plate 2 and cuts off the closing circuit to prevent the circuit breaker in the closed state from entering the load area.
4. When draw-out circuit breaker is closed in the working position or test position, roller 4 presses the locking plate 6 so that the draw-out circuit breaker cannot move to prevent movement in or out of the load area in the closed state. (**Figure 4**)
5. If an electrical closing lock is selected and the locking device is not used for unlocking, the closing operation is prevented.

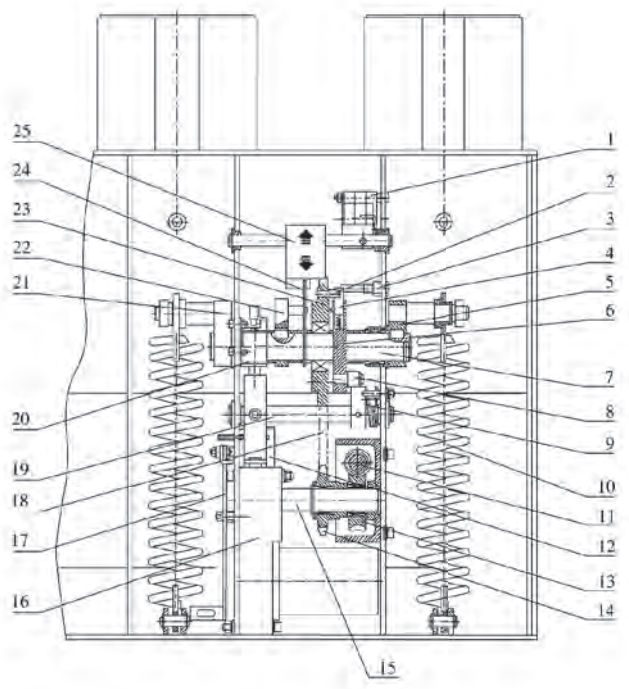


Figure 1

Figure 2

1. Micro-switch for transfer when charging position reached
2. Pin
3. Position limiter
4. Sliding block
5. Lever
6. Charging driver
7. Charging shaft
8. Roller
9. Charging maintaining latch
10. Closing spring
11. Manual charging worm
12. Closing coil
13. Driving worm gear for manual charging
14. Motor driving chain wheel
15. Motor output shaft
16. Charging motor
17. Interlock driving bent plate
18. Driving chain
19. Charging maintenance shaft
20. Locking electromagnet
21. Lever
22. Cam
23. Charging driving chain wheel
24. Link plate
25. Charging indicator
26. Upper conductor
27. Vacuum interrupter
28. Embedded pole unit
29. Flexible shunt
30. Lower conductor
31. Insulating push-rod
32. Contact spring
33. Driving level
34. Opening spring
35. Driving link plate
36. Main shaft driving level
37. Link plate
38. Closing maintaining latch
39. Link plate
40. Opening coil
41. "D" shaft
42. Manual opening push rod
43. Cam
44. Link bar for closed/opened indicator

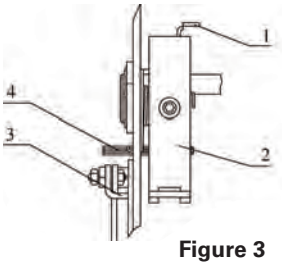


Figure 3

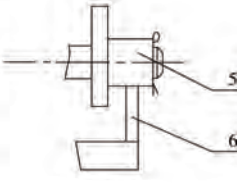
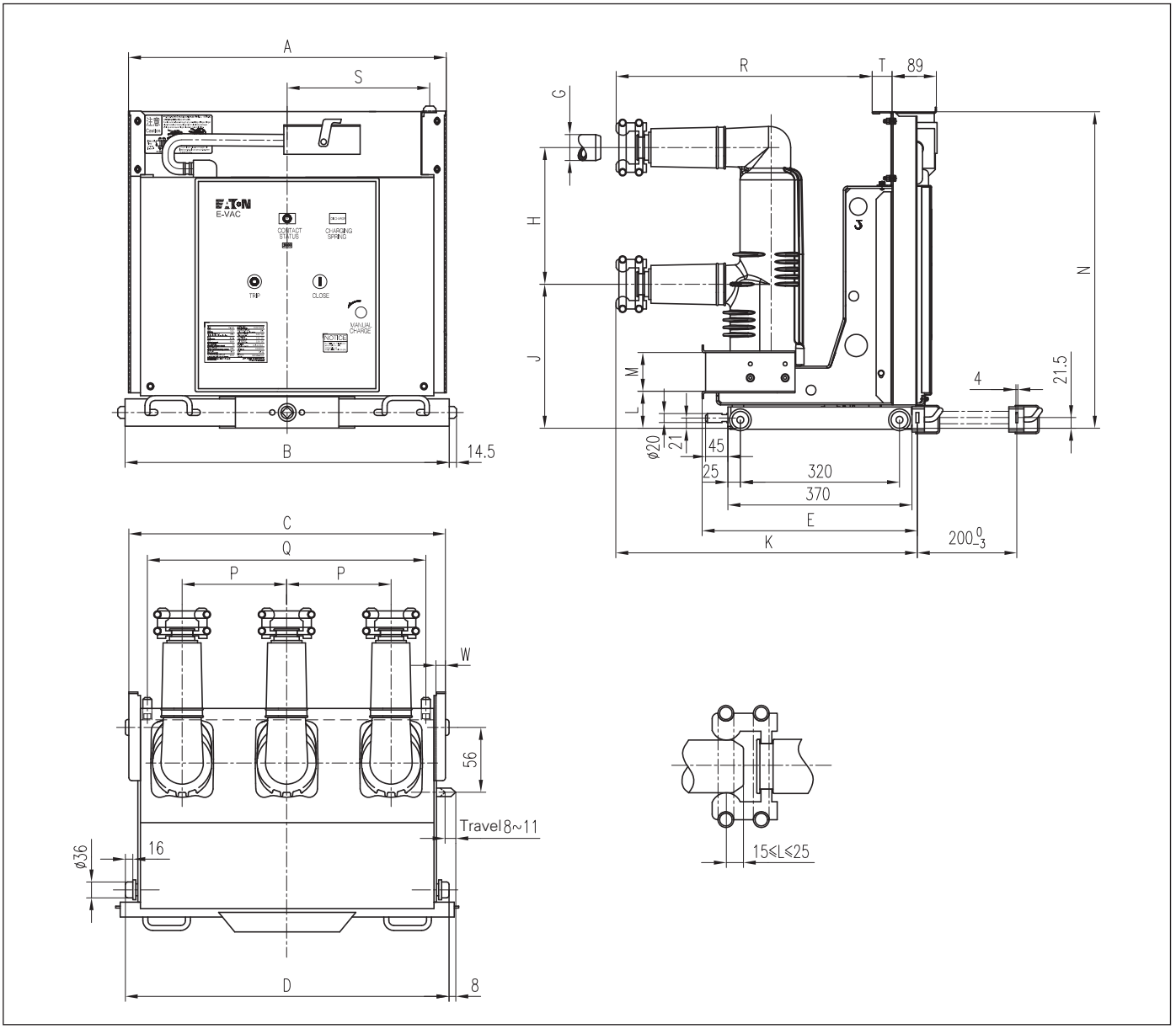


Figure 4

6.4 Dimensional drawings

Note: in millimeters

6.4.1 Dimensions of handcart E-VAC circuit breaker

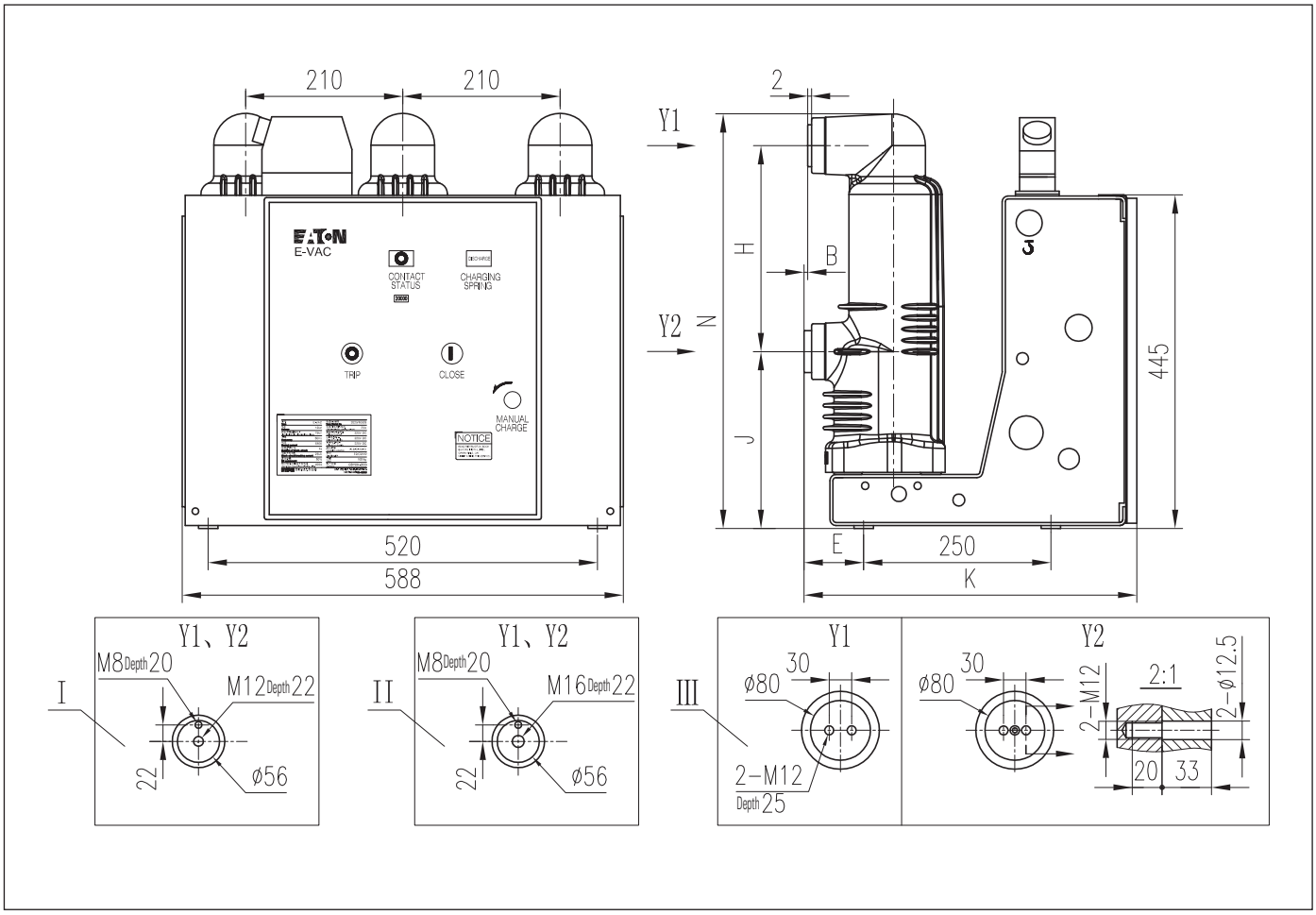


Width of matching cubicle	Rated current (A)	Rated short circuit breaking current (kA)	P	H	A	B	C	D	E	G	J	K	L	M	N	R	S	T	W	Q
800	630	25~31.5	210	275	638	652	640	650	433	Φ35	280	598	76	78	637	508	277	40	23	/
800	1250	25~40	210	275	638	652	640	650	433	Φ49	280	598	76	78	637	508	277	40	23	550*
800	1600	31.5~40	210	275	638	652	640	650	433	Φ55	280	598	76	78	637	508	277	40	23	550*
800	2000	40	210	310	638	652	640	650	361	Φ79	295	586	77	88	698	536	277	0	23	550
800	1250~2000	50	210	310	638	652	640	650	361	Φ79	295	586	77	88	698	536	277	0	19	550
1000	2500	31.5	275	310	838	852	838	850	361	Φ109	295	586	77	88	698	536	377	0	31	/
1000	3150	31.5	275	310	838	852	838	850	361	Φ109	295	586	77	88	725	536	377	0	31	/
1000	2500~4000	40~50	275	310	838	852	838	850	361	Φ109	295	586	77	88	725	536	377	0	31	750**

Note: Forced air cooling is required at 4000A. The values marked with * are included when the breaking current is 40 kA.
The values marked with ** are included when the breaking current is 50 kA.

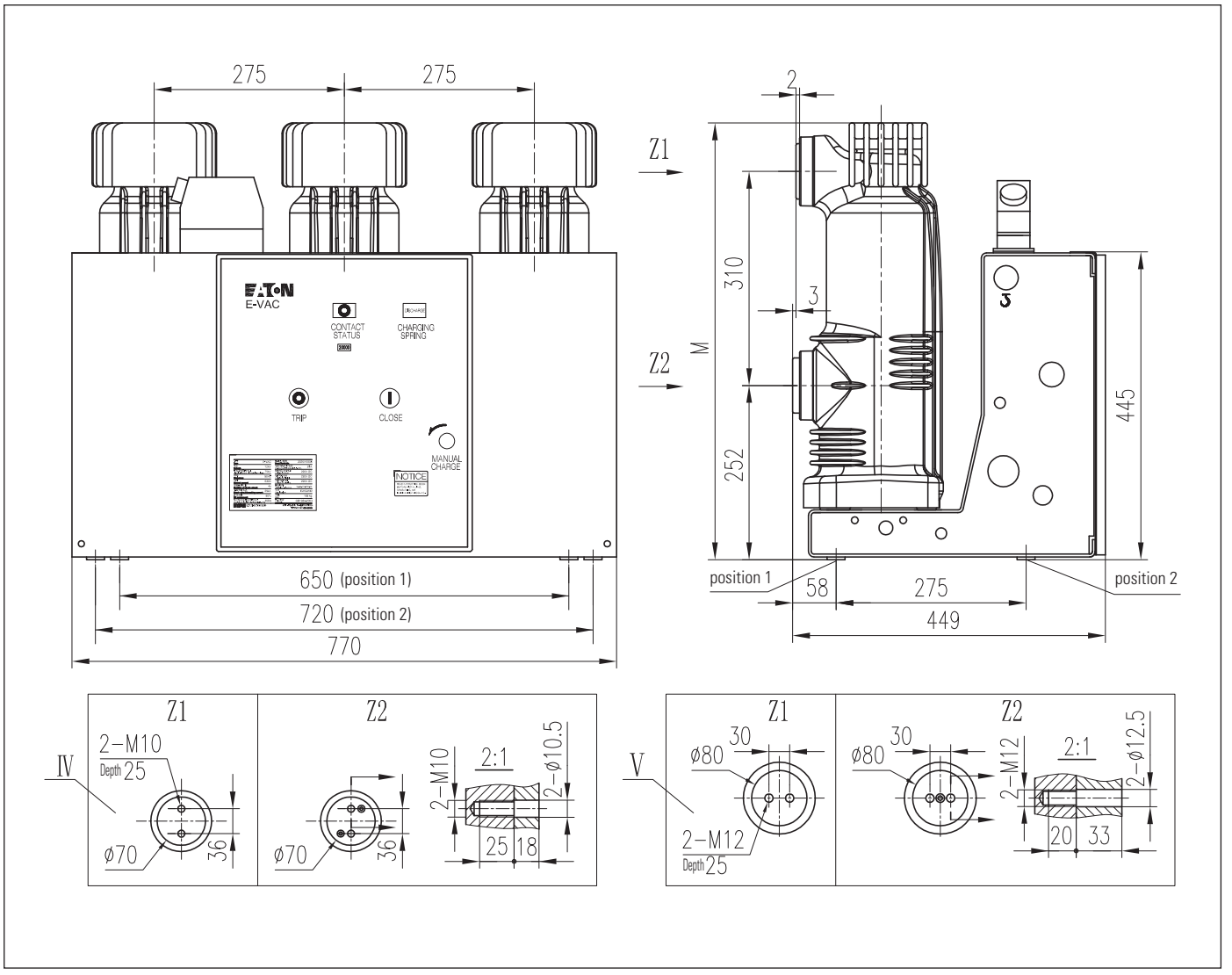
6.4.2 Dimensions of fixed E-VAC circuit breaker

Outline drawing of E-VAC fixed vacuum circuit breaker (phase spacing: 210mm)



Rated current (A)	Rated short circuit breaking current (kA)	H	J	E	K	B	N	Y1\Y2
630~1250	25~31.5	275	237	71.5	437	0	555	I
1250	40	275	237	71.5	437	0	551	II
1600	31.5~40	275	237	71.5	437	0	551	II
2000	40	310	252	80	449	3	614	III
1250~2000	50	310	252	80	449	3	614	III

Outline Drawing of E-VAC Fixed Vacuum Circuit Breaker (phase spacing: 275mm)



Rated current (A)	Rated short circuit breaking current (kA)	M	Z1\Z2
2500	31.5	628	IV
3150	31.5	678	V
2500~4000	40~50	678	V

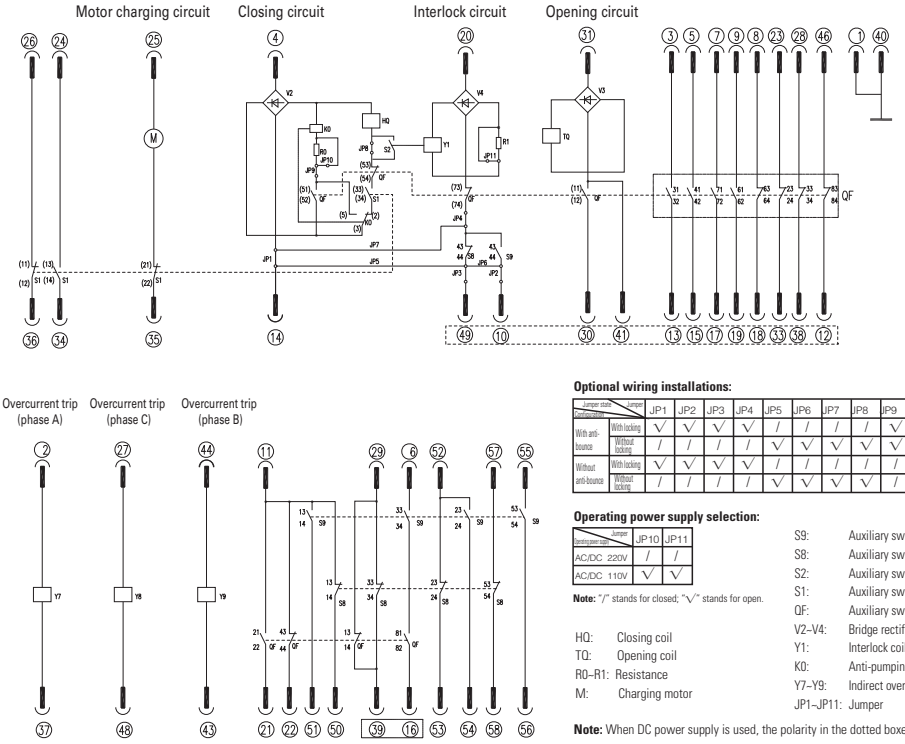
⚠ Note

During mounting, the copper bar shall be ensured to have reliable contact with the outlet conductive surface of VAC when in free state, and shall not be rectified with external force and mounted forcibly!

6.5 Internal electrical wiring diagram

6.5.1 Internal electrical wiring diagram for handcart E-VAC circuit breaker

In the following figure, the E-VAC circuit breaker is in the test position, is opened and spring is not fully charged.



Optional wiring installations:

Jumper state / Configuration	Jumper	JP1	JP2	JP3	JP4	JP5	JP6	JP7	JP8	JP9
With anti-bounce	With locking	√	√	√	√	/	/	/	/	√
	Without locking	/	/	/	/	√	√	√	√	√
Without anti-bounce	With locking	√	√	√	√	/	/	/	/	/
	Without locking	/	/	/	/	√	√	√	√	/

Operating power supply selection:

Operating power supply / Jumper	JP10	JP11
AC/DC 220V	/	/
AC/DC 110V	√	√

Note: "/" stands for closed; "√" stands for open.

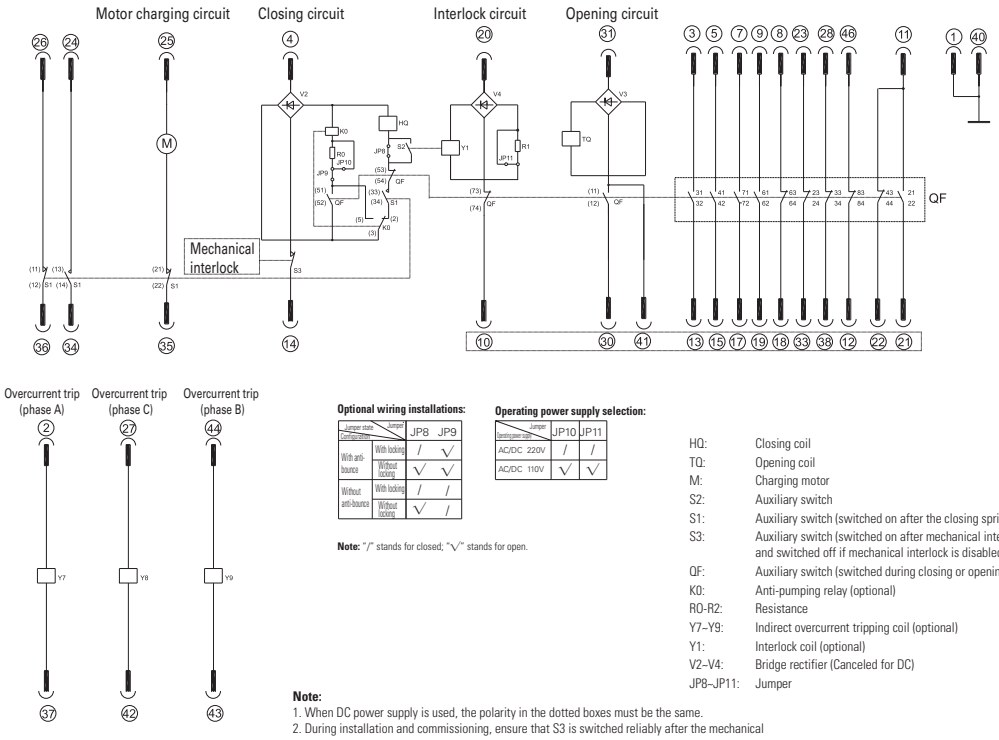
HQ: Closing coil
TQ: Opening coil
R0–R1: Resistance
M: Charging motor

S9: Auxiliary switch (when the E-VAC circuit breaker is in the working position)
S8: Auxiliary switch (when the E-VAC circuit breaker is in the test position)
S2: Auxiliary switch
S1: Auxiliary switch (switched on after the closing spring is charged)
QF: Auxiliary switch (switched during closing or opening operation)
V2–V4: Bridge rectifier (Canceled for DC)
Y1: Interlock coil (optional)
K0: Anti-pumping relay (optional)
Y7–Y9: Indirect overcurrent tripping coil (optional)
JP1–JP11: Jumper

Note: When DC power supply is used, the polarity in the dotted boxes must be the same.

6.5.2 Internal electrical wiring diagram of fixed E-VAC circuit breaker

In the following figure, the E-VAC circuit breaker is opened and spring is not fully charged.



Optional wiring installations:

Jumper state / Configuration	Jumper	JP8	JP9
With anti-bounce	With locking	/	√
	Without locking	√	√
Without anti-bounce	With locking	/	/
	Without locking	√	/

Operating power supply selection:

Operating power supply / Jumper	JP10	JP11
AC/DC 220V	/	/
AC/DC 110V	√	√

Note: "/" stands for closed; "√" stands for open.

HQ: Closing coil
TQ: Opening coil
M: Charging motor
S2: Auxiliary switch
S1: Auxiliary switch (switched on after the closing spring is charged)
S3: Auxiliary switch (switched on after mechanical interlock is enabled and switched off if mechanical interlock is disabled)
QF: Auxiliary switch (switched during closing or opening operation)
K0: Anti-pumping relay (optional)
R0-R2: Resistance
Y7–Y9: Indirect overcurrent tripping coil (optional)
Y1: Interlock coil (optional)
V2–V4: Bridge rectifier (Canceled for DC)
JP8–JP11: Jumper

Note:
1. When DC power supply is used, the polarity in the dotted boxes must be the same.
2. During installation and commissioning, ensure that S3 is switched reliably after the mechanical

7. Installation and commissioning

7.1 When unpacking the E-VAC circuit breaker, follow the instructions on the packaging: When lifting the circuit breaker out of the packing box, put the hook in the lifting hole clearly marked on the circuit breaker. When moving the circuit breaker, do not allow the upper and lower contact arms to bear loads or let the circuit breaker shake too much.

Note: Before officially inserting the circuit breaker into the cubicle, remove the lifting device as per requirements.

7.2 The E-VAC circuit breaker must pass strict delivery inspection before delivery. All parameters must comply with technical requirements. Before powering on the circuit breaker, make the following preparations.

a. Check whether there is any damage to the circuit breaker. If any damage is found, do not use the circuit breaker.

b. Clean off the circuit breaker, especially its insulating surfaces. Dirt collected during transportation and storage may affect the insulating performance of the product.

c. When performing manual charging, closing and opening operations on the circuit breaker according to the procedures, check whether the charging state and the opened and closed positions are normal.

d. When performing charging, closing and opening operations on the circuit breaker by using the power supply according to the procedures, check whether the charging state and the opened and closed positions are normal.

e. Operate the handcart circuit breaker according to the following steps:
Insert the pushing handle into the hole. Rotate clockwise to insert and counter-clockwise to remove. The total insertion travel distance is 200^{0}_{-3} mm. In the opened state, the circuit breaker should enter the working position or test position smoothly. Rotate the handle 20 turns at a moderate speed. When you hear a rattle, the circuit breaker is in position (do not apply excessive force; otherwise, the pushing mechanism may be damaged). The corresponding position indication (S8 and S9) circuits should be connected at the same time.

Note: When using a locking device, connect the locking circuit to power to unlock the circuit breaker before performing the closing operation.

Problems that may occur during operation

No.	Problem	Cause
1	The circuit breaker can not be closed.	1. The circuit breaker is not in the charging state.
		2. The circuit breaker is in the closed position.
		3. The handcart circuit breaker does not enter the working position or test position completely.
		4. A closing locking device is used but the auxiliary power supply is not connected or does not meet technical requirements.
		5. The secondary line is incorrect.
2	The circuit breaker cannot be racked-in or racked out	1. The circuit breaker is in the closed state.
		2. The pushing handle is not inserted into the hole completely.
		3. The feed mechanism does not reach the test position completely, making it impossible to disconnect the tongue plate from the cubicle.
		4. The earthing interlock of the cubicle is not disabled.

If the problem cannot be solved by inspection according to the above causes, contact the manufacturer.

7.3 Perform the power frequency withstand voltage test.

Note: in the test,, please note the following:

1. During a circuit resistance test, do not let the test current pass through the “tulip-style” contact spring.
2. After performing a low-voltage test, reset the circuit breaker.
3. After performing an overcurrent test, reset the circuit breaker.
4. Make sure that electrical parts on panels and mechanisms are not loose. If they need adjusting, contact professional trained personnel or the manufacturer.

8. Maintenance

The circuit breaker uses a special sliding bearing and anti-rust surfacing and long-lasting lubrication. In normal conditions, the circuit breaker should not need to be repaired for 10 to 20 years. Due to different usage environments, the product still requires inspection and maintenance.

1. Check the circuit breaker every 6 to 12 months as needed depending on the working environment. After checking the products appearance, clean dirty and wet parts on the surface, wipe the insulating parts with a dry cloth, and then wipe away other dirt using a silk cloth soaked with detergent. (Caution: The detergent used should be suitable for plastics and composite plastic materials.)
2. When the circuit breaker is left in place over a long period, blockages may happen in the device's movable parts. This can be avoided by performing the charging, closing and opening operations at least five times each year.
3. Perform at least one insulation test for the circuit breaker every year to check whether the vacuum interrupter leaks or insulation has degraded due to other external factors.
4. In places where operations are performed frequently, do not use the circuit breaker beyond its service life according to the ranges of specified operations in technical conditions.

9. Configuration

9.1 Voltage of secondary control circuit

9.1.1 Voltage of secondary control circuit

DC220V AC220V DC110V AC110V

9.1.2 The following table lists electrical parameters for some secondary components in different control voltages (Reference value).

Operating voltage: 220V

	Closing electromagnet	Opening electromagnet	Locking electromagnet	Anti-pumping relay
Circuit current	1.0 A	0.9 A (1.6 A*)	29 mA	0.9 mA
Power (W)	220	198 (352*)	3.2	1.0

Operating voltage: 110V

	Closing electromagnet	Opening electromagnet	Locking electromagnet	Anti-pumping relay
Circuit current	2.0 A	1.8 A (2.6 A*)	29 mA	9.1 mA
Power (W)	220	198 (286*)	3.2	1.0

* For 40kA and above rating.

9.2 Optional configurations for secondary control

9.2.1 Locking device

Function: When the power supply for secondary control is not connected or the requirements of technical specifications are not met, the device prevents closing.

9.2.2 Overcurrent device

Function: If overload or short circuit occurs in a circuit, the overcurrent tripping device opens the circuit breaker through the overcurrent relay, which trips the overcurrent coil. In general, this device is added on phase A and C or on three phases. When the secondary output capacity of the current transformer is sufficient, the indirect overcurrent tripping scheme should be selected, which covers 3.5A, 5A, 7.5A and 10A. When the output capacity of the current transformer is not enough for the overcurrent tripping electromagnet, the intermediate transformer scheme should be selected. The wiring terminals 2.4 and 2.5 of the intermediate transformer are connected to the overcurrent tripping electromagnet on the E-VAC circuit breaker.

9.2.3 Undervoltage tripping device

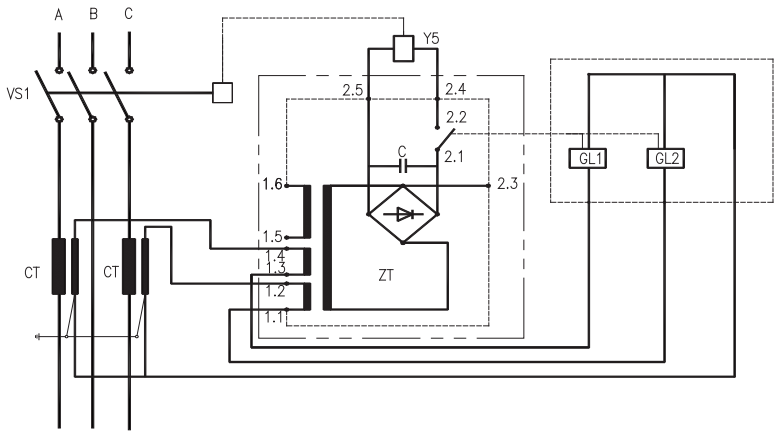
Function: When the voltage between terminals drops to 35% of the rated voltage, the undervoltage tripping device opens the circuit breaker through undervoltage locking, which makes the activates the undervoltage tripping coil.

Note: 1. When this scheme is selected, the rated voltage between terminals should be specified.
2. When this scheme is selected, the closing locking device and the three-phase overcurrent schemes cannot be used.

9.2.4 Anti-pumping device: see 6.3.2

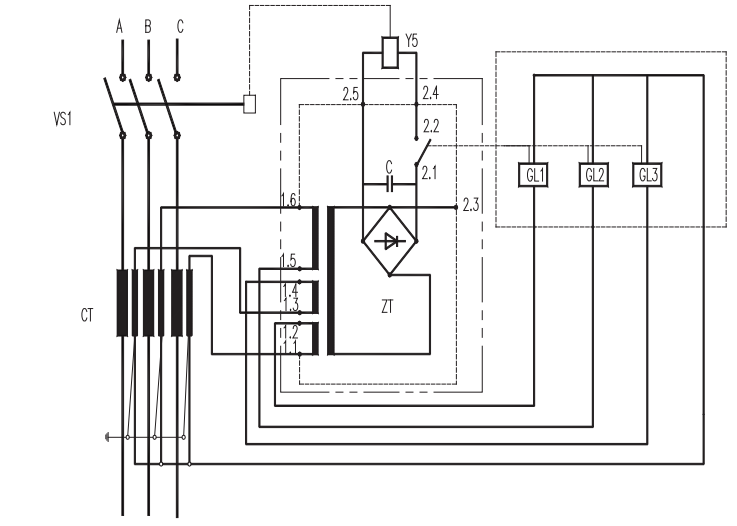
Note: If relay protection device or the anti-pumping device are used for the cubicle, check whether an anti-pumping device needs to be installed for the E-VAC circuit breaker.

9.2.5 External wiring diagram of the two-phase (phase A and phase C) overcurrent (5A) tripping intermediate transformer



Y5: Overcurrent tripping electromagnet (installed in the circuit breaker)
GL 1-2: Overcurrent relay
ZT: Intermediate transformer (installed in the cubicle)
C: Capacitor
CT: Current transformer (primary component)

9.2.6 External wiring diagram of the three-phase (phases A, B and C) overcurrent (5A) tripping intermediate transformer



Y5: Overcurrent tripping electromagnet (installed in the circuit breaker)
GL 1-3: Overcurrent relay
ZT: Intermediate transformer (installed in the cubicle)
C: Capacitor
CT: Current transformer (primary component)

9.3 Earthing device: The earthing device can be divided into the following according to the width of the cubicle:

Earthing Scheme for E-VAC (800) and E-VAC (1000). Please contact us for the detailed earthing mounting dimensions.

⚠ Note

For safety, lubricate the operating mechanism only when energy is not being stored.
1. The circuit breaker should only be repaired by trained professionals or the manufacturer.
2. The vacuum breaker should not be used for isolation on a long-term basis.

The product description and illustrations are for reference only and are subject to change without prior notice.

Model Selection Guide for E-VAC Embedded Serial Vacuum Circuit Breakers

1. Circuit Breaker Model

☐E-VAC (Handcart) ☐E-VAC (Fixed)

2. E-VAC Embedded Serial Vacuum Circuit Breakers Parameters

Cabinet Width (mm)	Circuit Breaker Phase Spacing (mm)	Rated Short Circuit Breaking Current (kA)	Rated Operating Current (A)			
800	210	25	☐630	☐1250		
		31.5	☐630	☐1250	☐ 1600	
		40	☐1250	☐ 1600	☐ 2000	
		50	☐1250	☐ 1600	☐ 2000	
1000	275	31.5	☐2000	☐ 2500	☐ 3150	
		40	☐2000	☐ 2500	☐3150	☐ 4000*
		50	☐2000	☐ 2500	☐3150	☐ 4000*

Note: Forced air cooling is required at 4000A

3. Technical Parameters of Spring Actuator Mechanism

Opening Power Supply (V)	☐DC110	☐AC110	☐ DC220	☐ AC220
Closing Power Supply (V)	☐DC110	☐AC110	☐ DC220	☐ AC220
Charging Motor Power Supply (V)	☐DC110	☐AC110	☐ DC220	☐ AC220

4. Optional Configuration (the standard configuration includes anti-pumping device; in case you don't want anti-pumping function, please indicate.)

☐Overcurrent Tripper	☐Two-phase		☐Three-phase	☐ A
☐Closing Interlock Device	☐	V		
☐Position Interlock	☐	V		
☐Anti-pumping Relay	☐	V		
☐Under-voltage Tripper	☐	V		
☐Handle	☐Quantity required			

Note: The product technical parameters are subject to change without further notice. Please confirm with Eaton before order.

Installation and Operating Instructions for E-VAC Enclosed Indoor HV Vacuum Circuit Breaker

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