GE Energy

WORLDWIDE PARTNER

SecoVac

VB2 Plus Circuit Breaker User Manual

GE imagination at work

Safety Instruction

Thank you very much for using SecoVac VB2 Plus type indoor MV vacuum circuit breaker referred to produced by Shanghai GE Breakers Co., Ltd. To help you install and operate this breaker safely and effectively, please read this manual carefully and install, operate and maintain it according to this manual as well as installation codes and operation procedures related to electrical equipment.

Precautions

Please comply with the following precautions for your safety:

- Select the breaker according to operating conditions, otherwise it will result in faults such as damage to insulation, short-circuit and overheating
- Check that rated operating parameters of the breaker are not exceeded during service
- Ensure that installation, operation and maintenance are carried out only by qualified operators who have received relevant training. The replacement of parts should be done by qualified electricians or GE service staff
- Be sure that the breaker is open before it moves from test position to service position
- The main circuit and control circuit must be deenergized during the maintenance and inspection, the breaker must be drawn out of the switchgear and earth switch closed

Delivery

Upon reciept of the breakers , the following inspection must be done:

- Check the goods for loss and damage (such as subjected to water or dirt)
- If there is any shortages,defects or damages,take notes and if possible photogroaphs of the affected units and notify GE immediately

Transport and Handling

Loading/unloading of the breaker units must only be carried out with either a crane if possible
Do not lift circuit breaker by inserting fork lift or trolly ties directly under it.Use a pallet or other support material between the circuit breaker and fork/trolley

Notes:
- Avoid impact during handling
- Do not subject to the mechanical damage

Important:

- Lifting breaker must not be attached to the breaker poles or parts of the operating mechanism. Use lifting bores and lifting lugs

Table1: The weight of circuit breakers

Version	Pole centre distance (mm)	Rated current (A)	Rated short-circuit breaking current (kA)	Weight (kg)
Fixed	150	630~1250	31.5	115
Withdrawable	150	630~1250	31.5	125
Fixed	275	1250~2000	40	178
Withdrawable	275	1250~2000	40	208
Fixed	275	2500~4000	40	247
Withdrawable	275	2500~4000	40	297

Contents

Introduction

Summary

The SecoVac VB2 Plus circuit breaker elaborately designed by GE Energy for three-phases A.C up to 17.5kV rated voltage, and can be used for in controlling and protecting electrical equipment in industrial, mining, power plants and substations applications. The product conforms to IEC62271-100. The breaker can be installed in the switchgear in fixed or withdrawable arrangements. It is the optimum choice for the control and protection of MV power systems.

Type

SecoVac
VB2 Plus - □ / T □ - □ □

- W: Withdrawable, F:Fixed
- Rated short-circuit breaking current (kA): 25,31.5,40
- Rated current (A): 630,1250,1600,2000,2500,3150,4000 (Forced cooling)
- Spring operating mechanism
- Rated voltage: 7.2kV,12kV,17.5kV
- SecoVac Series VB2 Plus type vacuum circuit breaker

Service Conditions

Normal service conditions

- Unless otherwise specified, SecoVac VB2 Plus circuit breakers, including the operating devices and the auxiliary equipment which form an integral part of them, are intended to be used in accordance with their rated operating parameter and normal service conditions listed as follows
- The ambient air temperature does not exceed 40℃ and its average value, measured over a period of 24h, does not exceed 35℃. The minimum operating ambient air temperature is -15℃. (storage and transportation is allowed at -30℃)
- The altitude does not exceed 1000m
- The ambient air is not significantly polluted by dust, smoke, corrosive and/or flammable gases, vapours or salt
- The conditions of humidity are as follows:
  - The average value of relative humidity, measured over a period of 24h, does not exceed 95%
  - The average value of water vapour pressure, measured over a period of 24h, does not exceed 2.2kPa
  - The average value of the relative humidity, measured over a period of one month, does not exceed 90%
  - The average value of water vapour pressure, measured over a period of one month, does not exceed 1.8kPa
- Seismic intensity is not more than Zone4

Service Conditions

Special service conditions

If the actual service conditions differ from the normal service conditions, The circuit breaker and associating devices and auxiliary equipment shall be designed and made to comply with any special service conditions required by the user which must be discussed with GE in advance. Normally, the following special service conditions will be encountered:

- At sites with altitude above 1000m, the effects of the reduction in dielectric strength of the air must be taken into account. GE can supply circuit breakers which can be applied in areas less than 3000m above sea level. At this time, the insulation level in switchgears should be taken into account and must be discussed with GE in advance
- The ambient temperature is above 40℃. The service current of circuit breaker shall be derated at certain factor, or fans shall be installed for heat dissipation. Please confirm with GE in advance

Attentation:

- When circuit breakers are operated in areas with high humidity and/or major rapid temperature fluctuations, there is a risk of condensation, thus
  - Put the circuit breaker into operation as soon as possible after the package is dismantled
  - Put on the heater into service as soon as possible after the switchgear is installed
  - Please consult GE special application conditions

Storage

- The product is applicable to normal transportation conditions, i.e. highway (floor above level 3) and pay attention to waterproofing
- Do not store product other than as indicated on packaging.Damage is possible if stored on side/back or top
- If immediate installation is not possible, basic package is required or original package is maintained. After inspection and stored, the circuit breaker should be switched off and the spring mechanism should be discharged
- The product shall be stored in dry and ventilated indoor place free of dust severe contamination, chemical corrosion and vibrations. The climate condition conforms to related specifications in IEC 62271-1 and adequate air circulation shall be maintained. The store room temperature shall not be lower than -30℃. Check periodically to avoid condensation inside breaker

Technical Data

Electrical Parameter

Table2

Rated Voltage	kV	3.3~12	15	17.5
Rated Current	A	630/1250/1600/2000/ 2500/3150/4000*	630/1250/1600/2000/ 2500/3150/4000*	630/1250/1600/2000/ 2500/3150/4000*
Frequency 50/60Hz				
Rated Power Frequency Withstand Voltage (1min))	kV	28	36	38
Rated Lightning Impulse Withstand Voltage (Peak Values)	kV	75	95	95
Rated Short Circuit Breaking Current	kA	25/31.5/40	25/31.5/40	25/31.5/40
Rated Short Time Withstand Current (3s)	kA	25/31.5/40	25/31.5/40	25/31.5/40
Rated Peak Withstand Current	kA	65/82/104	65/82/104	65/82/104
Rated Peak Making Current	kA	65/82/104	65/82/104	65/82/104
Capacitor Bank Switching Current	A	400 (C2)		
Electrical Endurance	No. of Times	E2		
Mechanical Endurance	No. of Times	10,000 (M2)		
Rated Auxiliary Control Voltage	V	36/48/60/110/220/240V DC 110/220V AC		
Opening Time	ms	35~70		
Breaking Time	ms	25~35		
Closing Time	ms	40~50		

Control circuit data

Table3: Motor

Rated voltage (V)	Normal operation voltage range	Energy storing period under rated operation voltage (s)	Input Power (W)
110 DC	85%-110%	<15s	150
125 DC	85%-110%	<15s	150
220 DC	85%-110%	<15s	150
110 AC	85%-110%	<15s	150
220 AC	85%-110%	<15s	150

Table4: Coils

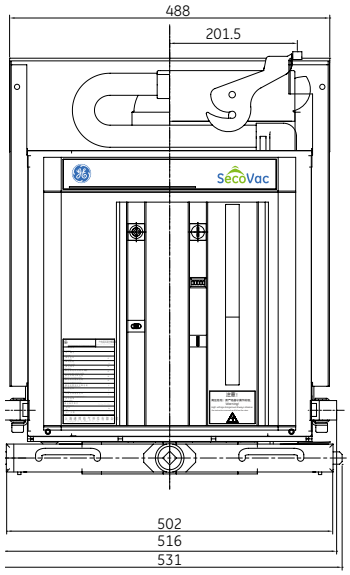
Rated voltage (V)	Rated current (A)	Rated voltage (V)	Rated current (A)	Rated voltage (V)	Rated current (A)	Rated voltage (V)	Rated current (A)
DC 24**	23.3	DC 30**	14.6	DC 36	11.5	DC 48	8.4
DC 60	5.6	DC 110	2.2	DC 220	1.1		
AC 110	2.2	AC 220	1.1				

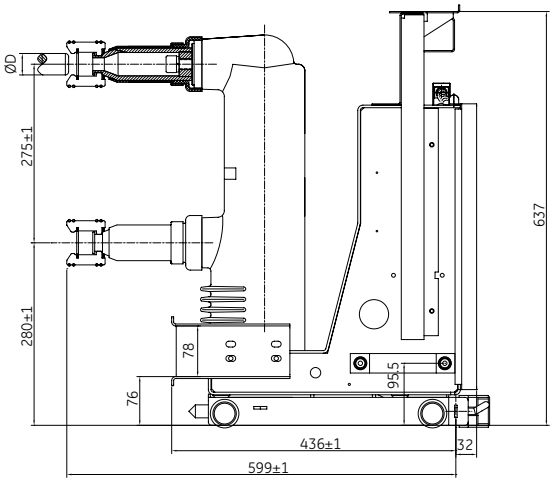
* 4000A is VCB with force cooling.

** 24V, 30V plesse contact GE.

Overall Dimensions

SecoVac VB2 Plus/T630~1250A-25~31.5kA (Phase to phase distance: 150mm)





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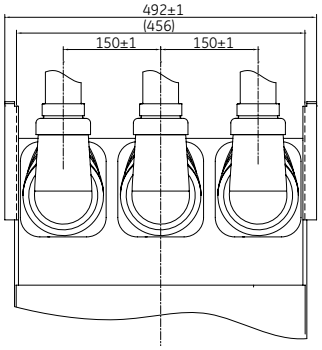
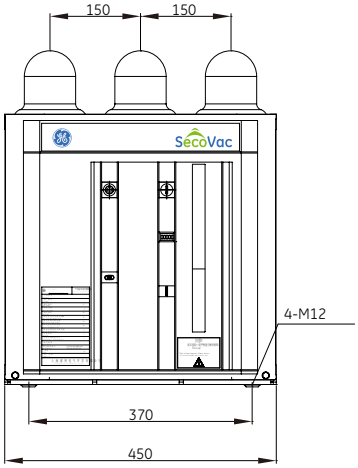
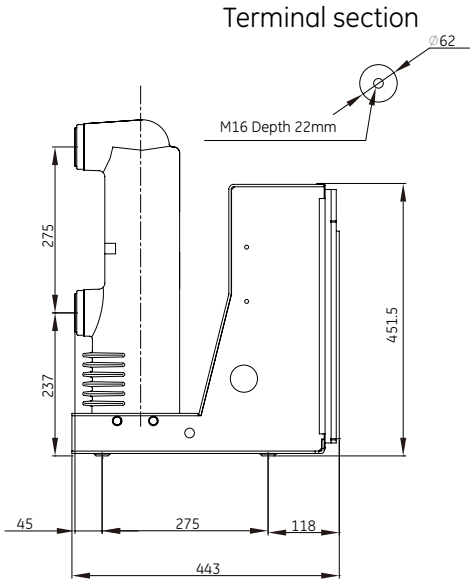


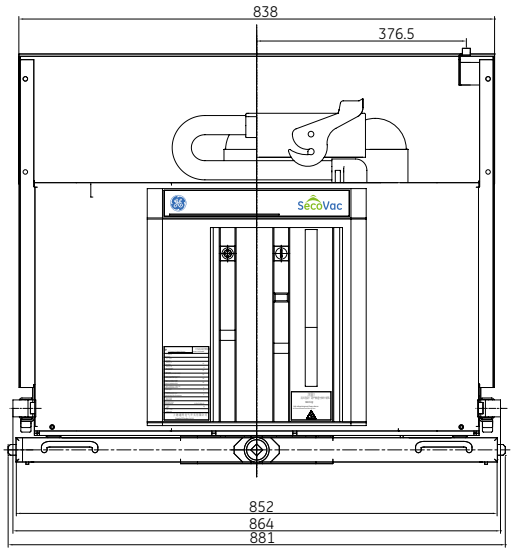


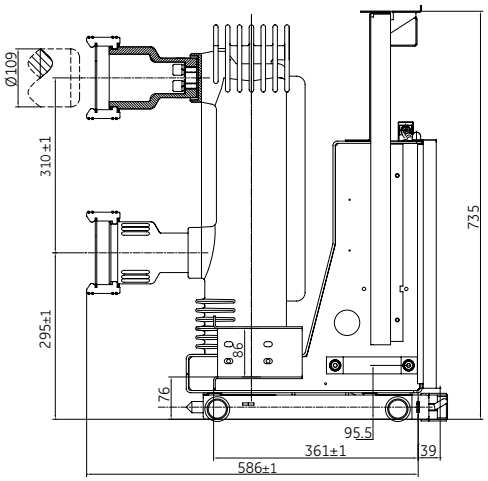


Fixed type

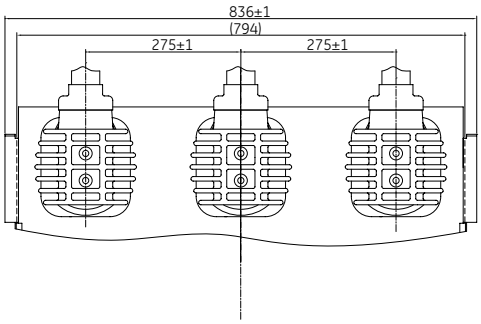
Overall Dimensions

SecoVac VB2 Plus/T1250~4000A-40kA (Phase to phase distance: 275mm)

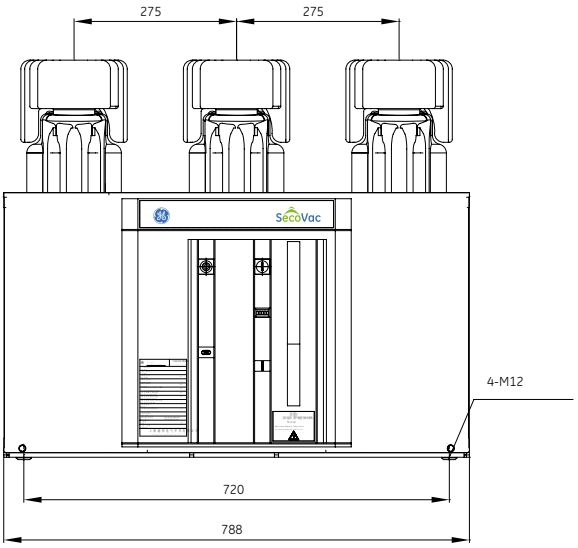


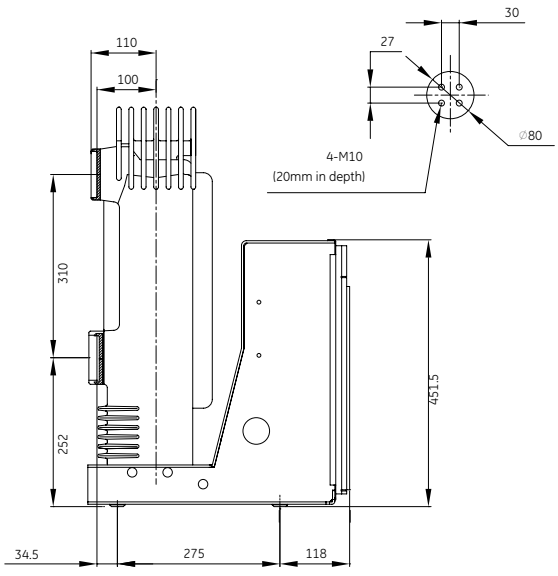


Withdrawable



Terminal section

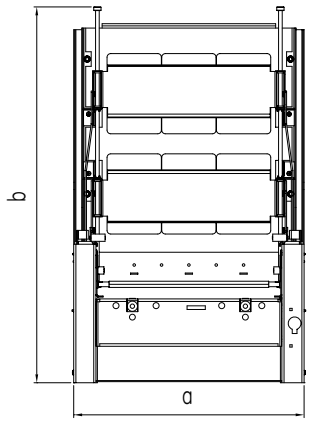


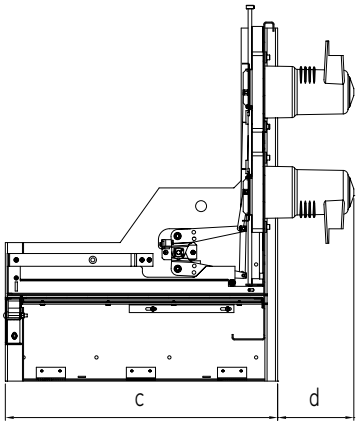


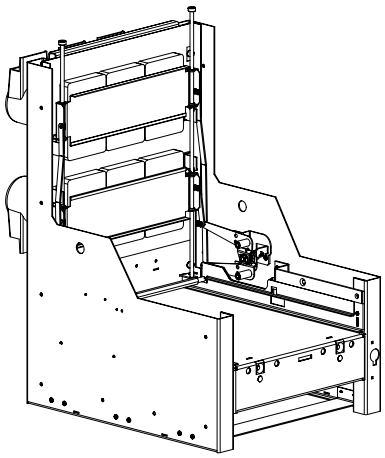
Fixed type

SecoVac VB2-Plus L-frame Dimension

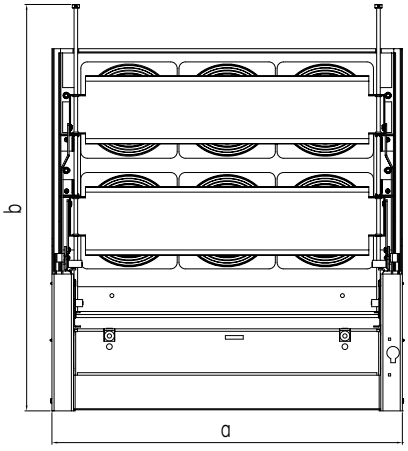
1250A, 31.5kA (650mm)

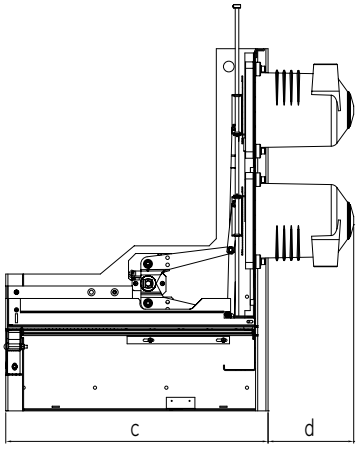






3150A, 40kA (1000mm)





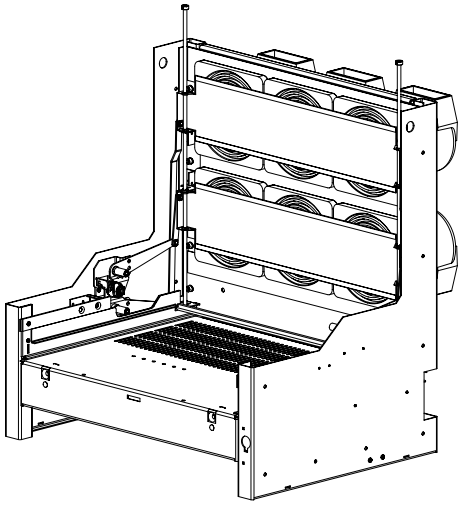
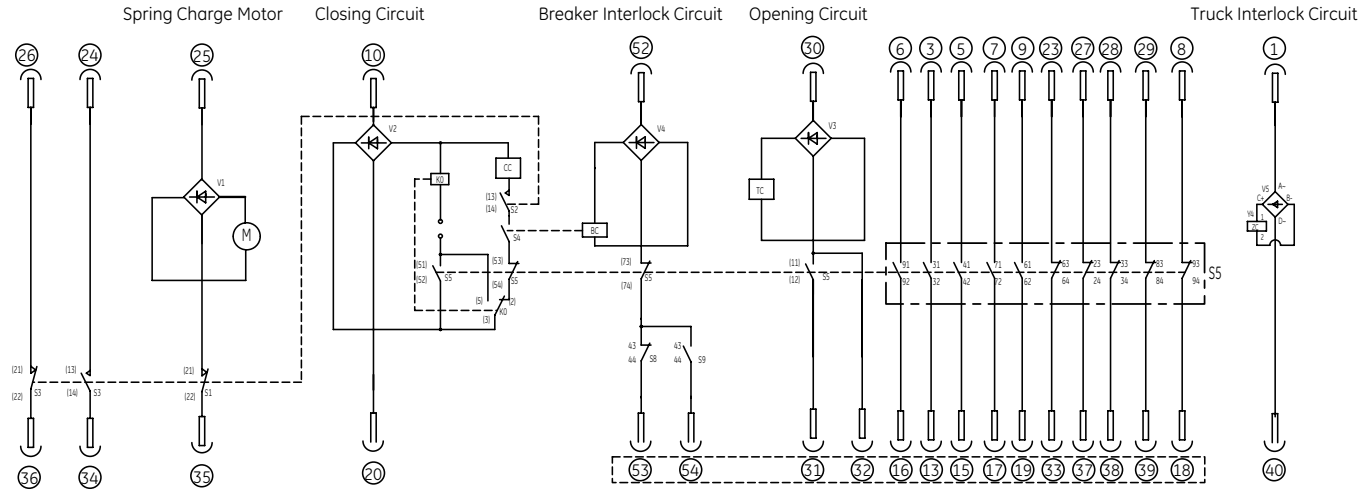


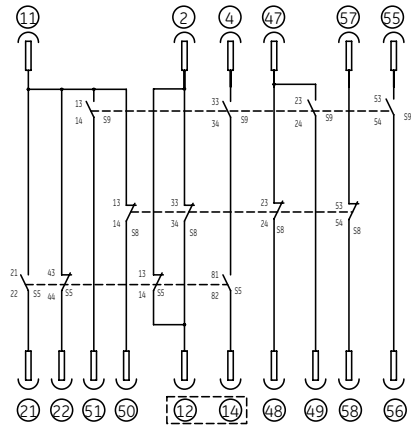
Table5

	Unit	1250A, 31.5kA (650mm)	3150A, 40kA (1000mm)
Width (a)	mm	632	982
Height (b)	mm	1031	1139
Depth (c)	mm	747	735
Depth (d)	mm	209	240

Internal Wiring Diagram

Withdrawable type



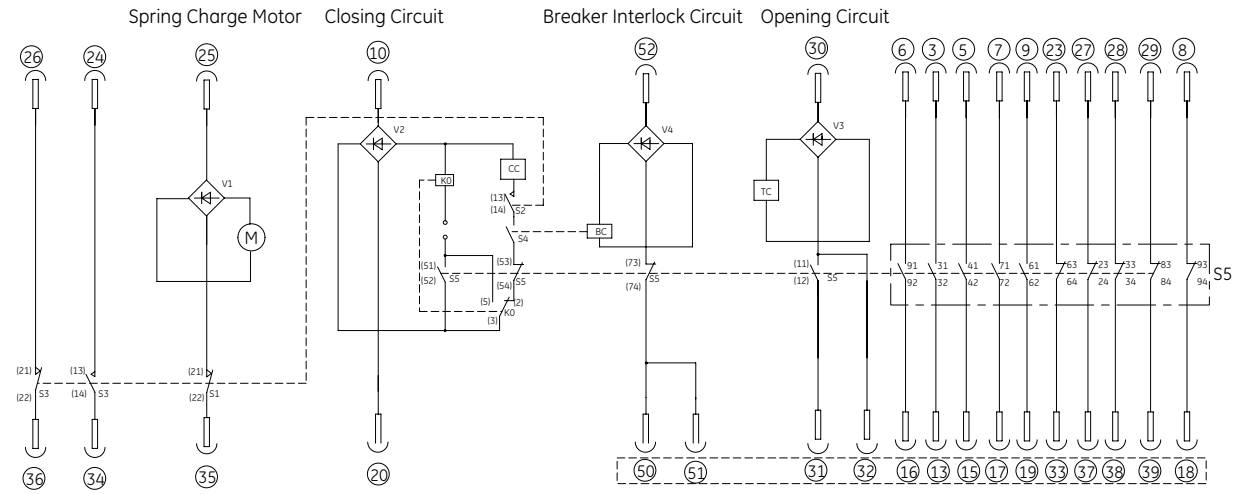


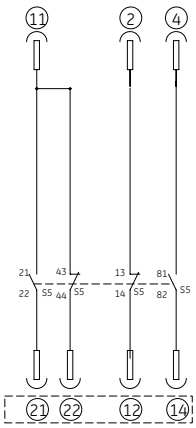
S9: Limit switch (service position)	CC: Closing coil	KO: Anti-pumping relay (optional)
S8: Limit switch (testing position)	TC: Trip coil	BC: Electromagnet for locking (optional)
S4: Electromagnet for locking's auxiliary switch	M: Spring Charge Motor	ZC: Electronegnet for locking truck (optional)
S5: Auxiliary switch	V1~V4: Rectitier	
S1~S3: Energy storing travel switch		

Note:

1. This wiring diagram describes that a breaker is open, racked to test position with spring in discharge state.
2. The polarity in dashed frame should be connected to common DC voltage terminal.
3. Rectifier will be removed if DC is applied.

Fixed type





S4: Electromagnet for locking's auxiliary switch	CC: Closing coil	KO: Anti-pumping relay (optional)
S5: Auxiliary switch	TC: Trip coil	BC: Over current release coil(optional)
S1~S3: Energy storing travel switch	M: Energy storing motor	ZC: Electromagnet for locking (optional)
V1~V4: Rectifier	C: control	

Note:

1. This wiring diagram describes that a breaker is uncharged and is in an opening state.
2. The polarity in dashed frame should be consistent when the operation voltage is direct current.

Structure

Overview

The SecoVac VB2 Plus Vacuum circuit braaker uses a vacuum interrupter for the making and breaking of electric power circuit. The movable primary cluster contacts on the breaker are connect with fixed primary contacts in switchgear and a secondary disconnectable plug connects with the secondary circuit of the switchgear. The operating mechanism is equipped with spring compact charging mechanism. The mechanism adopts modular design method and some parts have multiple functions.

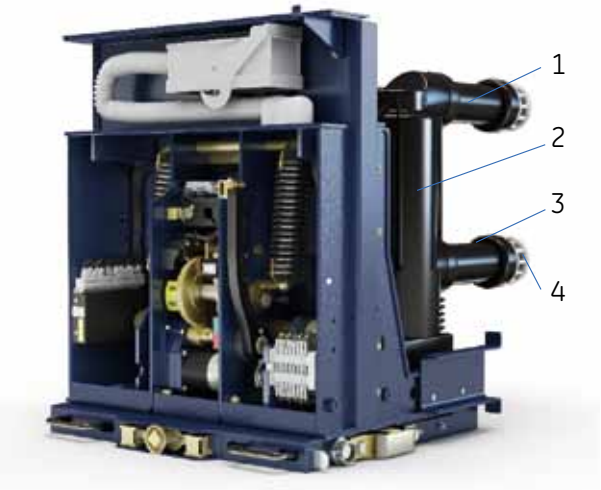


Figure 1. Primary circuit
1. Upper arm 2. Embedded poles
3. Lower arm 4. Cluster

Primary circuit

The primary circuit is made up of cluster upper arms, lower arms and embedded poles (figure 1). The vacuum interrupters and main contact parts are embedded in epoxy resin using APG process, which ensure the vacuum interrupters are protected from the (ambient influence and) mechanical damage.

Figure 2. Front facia of the circuit breaker
1. Tripping button 2. Status indicator for charging
3. Closing button 4. Counter
5. Indicator for open or close 6. Charging handle

Operating mechanism

The spring operating mechanism consists of a single module. The operating mechanism is equipped with manual charging device which uses the charging handle and an electric charging device which charges the spring via a motor. The mechanism has reclose function. On the front facia of the circuit breaker, there are Open/Close, Charged/Discharged indicators and manual operating handle. The operator can operate remotely by electric power or manual and the status of the circuit breaker can be observed on the front facia (figure 2).

The circuit breaker can be either opened or closed by the push buttons on the breaker or remotely via the closing coil and shut trip.

Table6: Indicators on the VB2 Plus circuit breaker

Energy charged status indicator		Closing-opening status indicator		Manual closing & tripping buttons	
	The spring is charged		The circuit breaker is close		Manual closing button
	The spring is discharged		The circuit breaker is open		Manual tripping button

Working Principle

Vacuum interrupter

The vacuum pressure within the evacuated envelope of vacuum interrupter is less than 10^{-5} torr. Under normal operating conditions the interrupter is closed. Arcing is established within the interrupter by withdrawing the moving contact from fixed contact. Arc burns in the metal vapor released from the contact surfaces. The metal vapor continually leaves the inner-contact region and recondenses on the contact surfaces and surrounding metal vapor condensation shield. The latter is usually isolated from both contacts and serves to protect the glass or ceramic envelope from vapor deposition. At current zero, vapor production ceases and the original vacuum condition is reinstated. The dielectric strength of the interrupter also increases, and the current is interrupted. When the contacts in the open position, the circuit voltage is withstood internally by the inter-contact gap and externally by the insulating envelope.

Operating mechanism

Charging operation

The energy that is necessary for closing the circuit breaker is provided by the closing spring. The energy storage can be operated by motor, or by the manual charging handle.

Spring charged by motor:
The spring charging mechanism consists of a spring charging motor, gear wheel, cam, holder and closing spring. When the energy-storing motor (11) is charging, the pinion of the output shaft (12) that is connected to motor will rotate, which drives the gear wheel. The holder fixed on the gear wheel will rotate the cam fixed on the shaft to move, which then drives the shaft to rotate, so that draws out the closing springs (17) for storing energy. When the block on the gear wheel is pushed away, the clutch is separated and the holder (4) will hold the roller on the cam (5) to keep the mechanism in charged, thus the charging operation is completed.

Spring charged manually:
When Spring is charged by manual means you can just push the Spring-charging handle on the mechanism up and down repeatedly, to store the above-mentioned spring-charging process.
When the charging operation is complete, you can hear strong cranking sound, and the spring charging indicator (13) will show charged, as well as the status of position switch (6) will cut the secondary supply to charging. The operating mechanism is ready for the next operation. (Figure 3)

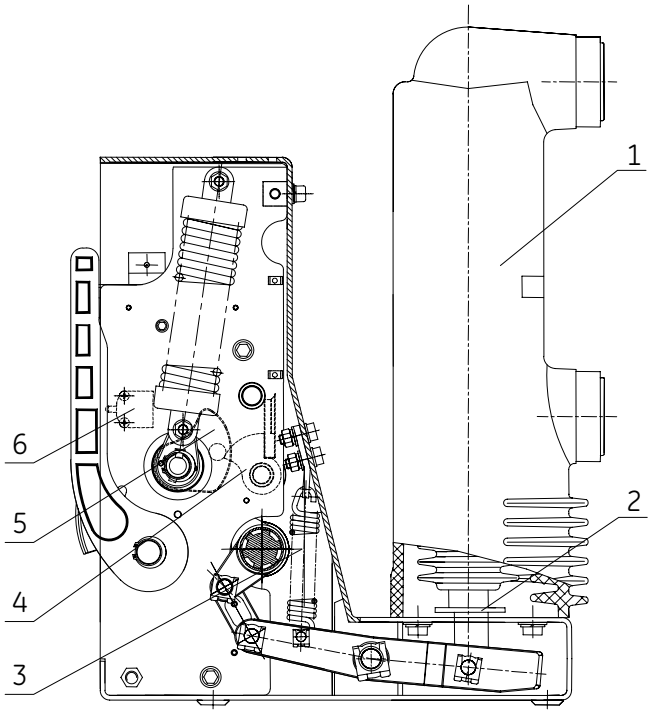


Figure3

1 Embeded pole	4 Holder
2 Insulating rod	5 Cam
3 Opening spring	6 Position switch

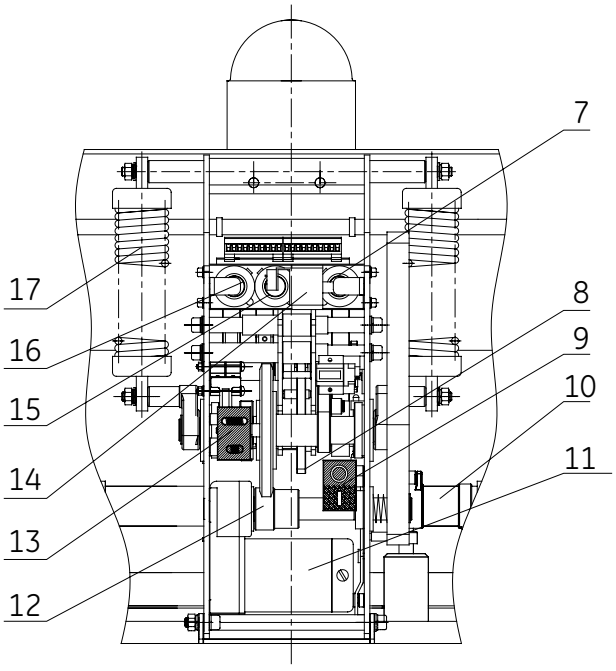


Figure4

7 Closing coil	13 Charging indicator
8 Holder	14 Lock electromagnet
9 Close/open indicator	15 Over-current release
10 Main shaft	16 Tripping coil
11 Motor	17 Closing spring
12 Output shaft	

Closing operation

When the closing coil is energized the holder(4) will rotate counter- clockwise to break away from the roller on the cam (5). The cam, under the action of the force from closing spring (17), will perform clockwise rotation, to push the roller on the main shaft, which will cause the main shaft (10) to rotate counter clockwise. The main shaft moves the connecting rod down through arm, so that the insulating rod (2) moves upright, which pushs the movable contact to the fixed contact with the required speed, and then compresses the contact spring and causes contact travel, to ensure the pressure is generated between movable and fixed contacts.

After the closing operation is finished, the closing/opening indicator (9) will indicate "Close". The power to the closing circuit will be removed. If the external power supply is maintained, the charging circuit will recharge the spring.

Interlocks

The following interlock are incorporated to insure the safe operation of the breaker.

- When the breaker is in the closed condition, the withdrawable circuit breaker racking between the service position and test position is not possible
- When the earth switch is in close condition,, the withdrawable circuit breaker racking into the service position is not possible
- When the withdrawable circuit breaker is in service position, the earth switch can not be closed
- When no voltage is applied to the interlock circuit then the breaker can not be closed

Tripping operation

When the breaker receives an opening command (the opening pushbutton is pressed or the tripping coil (16) is energized), the tripping shaft will rotate clockwise. Under the action of opening spring (3) and contact wipe spring, main shaft will move clockwise, and the insulating rod (2) will make the movable contact separate from the fixed contact. The buffer will absorb the residual energy and tripping operation is completed.

After the tripping operation is finished, The closing/opening indicator (9) will indicate "open". Meanwhile, the counter will record the operation.

Reclosing

Auto Reclosing

When the circuit breaker is in the closed condition, the mechanism can be charged and ready to close, so that the circuit breaker can reclosed immediately after tripping.

Anti Pumping

When an attempt to close the breaker has been made, if the breaker doesn't successfully close then internal closing circuit of the breaker must be tripped with anti pumping relay

Installation

Correct installation is of primary importance, the manufacturer's instructions must be fully complied with to ensure safe and reliable operation. It is good practice to wear gloves for handling the breaker during the installation.
Please carry out installation and wiring of this breaker according to this manual. Don't place tools or other objects on the breaker during installation.Wear appropriate personal protective equipment and safe lifting procedure.

Check before installation

After the breaker is unpacked, check the breaker poles for any cracks and breakage. The product nameplate and product certificate shall conform with the order. Check goods according with the packing list.
Clean the insulating parts with a clean dry cloth. Check the upper and lower terminals are clean and free of any deformation caused by shocks received during transport or storage.
Check the vacuum interrupter through power frequency withstand voltage test.

Considerations

1. Operation for withdrawable circuit breakers
- Put the circuit breaker into test position
- Insert the handle and rotates the handle clockwise about 20 rotations. While a strong cranking sound is heard, the withdrawable* circuit breaker will be in the service position. (don't apply too much force, to avoid any damage)

Note: Rotate anti-clock wise to rack out

2. Operation for fixed circuit breakers.
- The careful and professional installation is a fundamental condition for the failure free operation of the circuit breaker
- The circuit breaker installed in a switchgear cabinet shall not be subject to pulling & compressing or deforming and the disc washers are needed
- When connecting the main terminal, don't cause the terminal to deform
- When connecting the bus bar, the depth of the bolt must comply with requirement of drawings
- Use the standard bolts with strength of Class 8.8 and the disc springs to tighten the bus bar (Table 7)
- The circuit breaker installed in a switchgear cabinet shall comply with IP2X requirements when switchgear circuit breaker door opening
- Provide insulator to support on busbar on less than 250mm position away from pole terminal

Table7: Tightening torque of bolts

Basic dimensions of bolts (mm)	Tightening torque without lubricant applied (N.m)	Tightening torque with lubricant applied (N.m)
M8	25	10
M10	45	25
M12	85	45
M16	170	80

* breaker position indicator will show the breaker in service position

Commissioning

- All commissioning and operation work shall be carried out by persons who have received suitable training and understand the performance of the circuit breaker. Correct protective and preventive measures shall be taken during commisioning
- Using the product under normal working conditions and within the range of technical data according to the standard of IEC 62271-1, which will ensure the correct performance of the circuit breaker
- After the installation of the circuit breaker into switchgear, the breaker shall not be subject to any excessive stress

Preparation work (Prior to energization)

- Check the circuit breaker for any damage or any other dangerous environmental influence
- Clean the dirt on the surface of insulator
- The lifting hook of the circuit breaker must be removed prior to operation
- Check the connecting status of the primary and secondary circuits as well as the earthing
- Follow spring-charging, opening and closing operations manually ensure the breakers is operated properly

Operation

- For detailed operations, please refer to the working principle of the mechanism. Please check the status of the circuit breaker carefully prior to operation

Maintenance

Maintenance rules

- The user shall not replace any parts with different maker to original parts
- Prior to maintenance, make sure that the circuit breaker is removed from the switchgear. It is necessary that the circuit breaker is in open closing spring, discharged and the power supply is cut off
- The replacement of the poles and operating mechanism should only be performed by GE authorized personnel

Maintenance cycle

- Regular maintenance shall be carried out once in every 5 years or every 2000 operations of the circuit breaker under normal operating condition
- When there is any damaged insulation, damaged element in the mechanism refusal, refusal to open or close, as well as other abnormal conditions, maintenance inspection and testing shall be carried out
- The circuit breaker, after 10000 times operation, shall be replaced. The circuit breaker, after 25 years operation, should be checked to determine whether it requires replacement

Items checked during maintenance

Operating mechanism

- Visual check of all elements and mechanical Interlocks for any damage. If there is any damage, please replace in time
- Check the tightening bolts and nuts and check the split pins for any breakage or falling loosening during operation
- Check the driving and friction positions inside the mechanism, lubricant shall be applied to the moving and friction areas prior to installation
- Check the counter for correct operation
- Check and ensure the interlocks function
- Check the oil buffer for oil leakage or any other damage.
- Check the auxiliary switch and position switch for terminals and contacts
- Check the motor
- Check the closing, tripping and latch coils
- Check the terminals of secondary circuit. Check for loose parts and re-tighten

Check the withdrawable part

- Check the holders, pins and terminals. Pay attention to apply lubricant grease and tightening terminals
- Racking operation check and ensure the functions work properly

The primary circuit

- Check and clean the pole insulation and check the bolts for tightness to ensure good contact
- Measure the clearance and over-travel of the circuit breaker
- Carry out mechanical operating test to the circuit breaker by closing and opening 5 times respectively at rated operating voltage, high voltage and low voltage
- Carry out mechanical characteristics test to the circuit breaker. Measure the opening and closing time, average speed, asynchronism, bouncing time, etc
- Tighten the bolts and measure the resistance of main circuit
- Measure the insulation resistance of the main circuit
- Carry out power frequency withstand voltage test
- The bolts applied in maintenance should be applied with anaerobic adhesive prior to installation

The test for mechanical characteristics

The value for mechanical characteristics should conform to technical data list.

Maintenance

Trouble shooting

Table 8

Trouble			Cause	Action
Refuse to close	Electrical	The closing coil refuse to act	The coil has burned out	Replace the coil
			The secondary circuit wiring has fault	Connect the wirings again and confirm
			Bad contact of the auxiliary switch	Check and replace
		The closing coil act but the breaker dosen't close	Too low voltage for closing	Measure the closing voltage and ensure it is within limit
			The terminal connection of the secondary wiring becomes loose/disconnected	Check the secondary wiring and replace/ reconnect
			Overtravel too high	Adjust the overtravel to the specified limit
			The withdrawable part is not in service position or test position	Conform the position of withdrawable part in service position or test position
Refuse to open	Electrical	The Tripping coil refuse to act	The coil has burned out	Replace the coil
			The secondary wiring is fault	Check wiring and tighten the terminals
			Bad contact in auxiliary switch	Check the auxiliary and replace
		The Tripping coil act but the breaker doesn't open	Secondary operating voltage too low	Measure the operating voltage and adjust the voltage
			The terminal connection of the secondary wiring becomes loose	Check wiring and tighten the terminal
	Mechanical	The breaker can not open manually	The withdrawable part is not in service position and test position	Conform the position of withdrawable part in service position and test position
Others		Indicator for position falls	S8 and S9 auxiliary switch fails or the withdrawable deforms	Replace the auxiliary switch or repair the withdrable part by manufacturer
		Motor doesn't act	The secondary wiring open or the motor burns out	Check the wiring or replace the motor
		The motor can't stop	Wiring or position switch failure	Check the wiring or replace the position switch

Dismantling and Installation of Components and Parts

The pole and closing & tripping modules shall be replaced by GE service technicians. The replacement of the parts should be in accordance to this manual.

Dismantling and installation of tripping & closing coils

As shown in figure 7, disconnect the secondary wire (1) of closing & tripping coils and unscrew the bolts at both sides. Take out the support bracker of the tripping & closing coils and take off the coils. The installation process is in the reverse order.

Removal and installation of counters

As shown in figure 8, remove spring (2) and turn off screw (1), the counter can be removed. The installation procedure is in the reverse order.

Figure 7

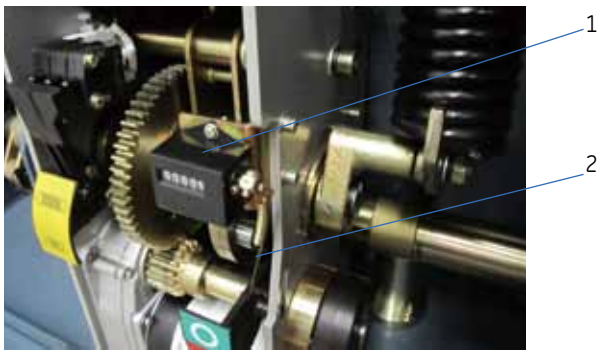


Figure 8

Removal and installation of auxiliary switch

Ensure all control supply is disconnected. As shown in figure 9, remove the link (2) and remove the bolt (1), Take off the auxiliary switch and the secondary wiring as required.

Removal and installation of position switch

As shown in figure 10, firstly remove the secondary wiring (1) and remove the bolt (2), then remove the position switch. The installation procedure is in the reverse order.

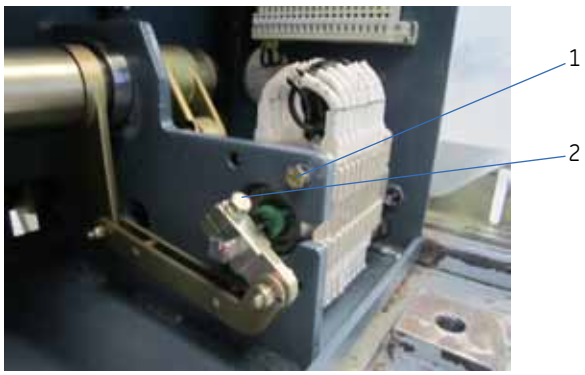


Figure 9

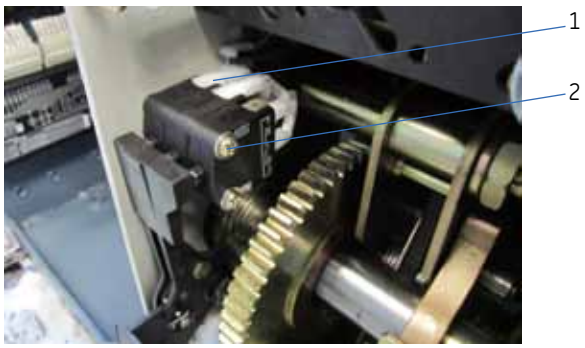


Figure 10

Lubrication

VB2 Plus circuit breaker has a mechanical operation service life time is 10000 times. After each 2000 operations, lubrication is necessary.

The following type of the lubrication is recommended:

Mobilux EP Series

- Silicone grease 102

Documents and Accessories

Accompanying documents

- Product certificate
- Manual
- Packing list

Accessories

- Withdrawable part: Racking handle

Spare parts

Some of the following spare parts are available. For ordering, please contact GE.

Description	Part No.	Remarks
Auxiliary switch F10-18	GDF5AA00	1 piece per set
Auxiliary switch GDF-5	GDF5AC00	2 piece per set
Opening coil	P-C	1 piece per set
Closing coil	P-C	1 piece per set
Micro Position switch	LXW1811BZ1	3 piece per set
Energy charge motor	P-Motor	1 piece per set
Counter	P-AP200	1 piece per set
Oil buffer	P-BUFFER	1 piece per set
Control wiring board	P-AP910	1 piece per set
Electromagnet for locking	P-L	1 piece per set
Electromagnet for locking truck	P-L	1 piece per set

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