User manual W-VAC*i*

17.5 kV W-VAC*i*MB 25 kA 1250A IEC Mining Vacuum Circuit Breakers

Powering Business Worldwide

67A7355H01

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1 Safety

W-VAC*i*MB vacuum circuit breakers are equipped with high speed, high energy operating mechanisms. They are designed with several built-in interlocks and safety features to provide safe and proper operating sequences.

1.1 Safety precautions

All safety codes, safety standards and/or regulations must be strictly observed in the installation, operation and inspection of this device.

WARNING

WARNING indicates a hazard with a medium level of risk which, if not avoided, may result in death or serious bodily injury

CAUTION

CAUTION indicates a hazard with a low level of risk which, if not avoided, could result in minor or moderate injury or property damage only.

1.2 Safety practices

WARNING

To protect the personnel associated with installation, operation, and inspection of these breakers, the following practices must be followed:

- As defined in the local electrical code, only qualified persons who are familiar with the installation and Inspection of medium voltage circuits and equipment should be permitted to work on these breakers.
- Read these instructions carefully before attempting any installation, operation or inspection of these breakers.
- Always remove the withdrawable breakers from their enclosures before performing any inspection. Failure to do so could result in electrical shock leading to death, severe personal injury or property damage.
- Do not work on a breaker with the secondary test coupler engaged or fixed secondary connections made. Failure to disconnect the test coupler could result in an electrical shock leading to death, personal injury or property damage.
- Do not work on a closed breaker or a breaker with closing springs charged. The closing spring should be discharged and the main contacts open before working on the breaker. Failure to do so could result in cutting or crushing injuries.
- Do not use a withdrawable circuit breaker by itself as the only mean of isolating a high voltage circuit, remove the circuit breaker to the DISCONNECT POSITION and follow correct lock-out and tagging rules, as well as all applicable codes, regulations and work rules.
- Do not leave a withdrawable circuit breaker in an intermediate position in the cell. Always have the circuit breaker either in the “Test” or “Service” position. Failure to do so could result in a flash over, death, personal injury or property damage.
- Always re-insert the handle into the front panel of the breaker after charging the closing springs. Otherwise the circuit breaker will not operate.
- Circuit breaker elements are equipped with safety interlocks. DO NOT remove, interfere with or in any manner defeat the safety interlocks. This may result in death, bodily injury or equipment damage.
- All personnel involved in operations carried out on, with or near electrical installations, require to have been instructed on the safety requirements, safety rules and instructions applicable to the operation of the installation.
- Ensure that access and escape routes are free at all times. Do not leave flammable materials in or near access and escape routes.
- Flammable materials must not be stored in areas which could be affected by arcs, such as: ethers, alcohols and alcohol based cleaners. In the event of a fire, never attempt to extinguish a fire on the switchgear unit before it is completely dead; this applies to both primary and secondary switchgear. Even if non-conducting extinguishing materials are used, electricity may pass through the extinguishing equipment. Never extinguish a fire on the unit with water.

WARNING

The circuit breaker elements described in this book are designed and tested to operate within their nameplate ratings.

Operation outside of these ratings may cause the equipment to fail, resulting in death, bodily injury and property damage.

These circuit breaker elements are designed to be installed pursuant to the iec standards. Serious injury, including death, can result from failure to follow the procedures outlined in this manual. These circuit breaker elements are sold pursuant to a non-standard purchasing agreement which limits the liability of the manufactor.

2 Product Summary

The purpose of this book is to provide instructions for the unpacking, storage, installation, operation and inspection of W-VAC*i*MB IEC vacuum circuit breakers for qualified personnel. Reliable control and protection of short circuit current can be achieved through the application of W-VAC*i*MB vacuum circuit breakers in 17.5 kV air insulated switchgear. Legal and other regulations and documents pertaining to accident prevention, personal safety and environmental protection must be observed. Operations involving the repair of the breaker are to be carried out by or under the approval of Eaton. Information with respect to these operations is, therefore, not included in this manual. If further information is required by the purchaser regarding a particular installation, application or inspection activity, an Eaton representative should be contacted.

2.1 Standards and Specifications

W-VAC*i* IEC circuit breakers are designed and third party tested to the latest IEC 62271-100 and IEC 62271-1 standards. All W-VAC*i*MB circuit breakers meet or exceed the electrical and mechanical endurance requirements of E2 and M2, in accordance with IEC 62271-100.

2.2 Altitude Correction Factor

The main external insulation of the 17.5 kV W-VAC*i*MB vacuum circuit breakers is air. The insulation capabilities of air change relative to altitude above sea level. Customers should always consider this phenomenon when designing / specifying new switchgear installations. Eaton uses and specifies a correction factor (K_a) to address this phenomenon. This correction factor is shown in Figure 2.2A. The source is the IEC 62271-1 standard. One factor that is not hindered by this property is the internal insulation of the vacuum interrupters.

ALTITUDE CORRECTION FACTOR- EXAMPLE

Installation altitude	**3000 m**
Operation at the rated voltage	**17.5 kV**
Power frequency withstand voltage	**38 kV**
Lightning impulse withstand voltage	**95 kV**
Correction Factor (K_a) obtained from graph	**1.28**

In this example, the above information would compute the withstanding capabilities of the unit to be:

- Power frequency withstand voltage equal to:
  38 kV x 1.28 = 48.64 kV
- Lightning impulse withstand voltage equal to:
  95 kV x 1.28 = 121.60 kV

Focusing on the values determined above, it can be concluded that this unit at 3000 m above sea level, with 17.5 kV of available service voltage must use a 24 kV rated voltage breaker. The resulting breaker selection is due to the 125 kV modified Lightning impulse requirement. The minimum circuit breaker with the required capabilities for this application is the 24kV circuit breaker, which also provides the 50kA Power Frequency Withstand Voltage (see section 2.6, *Technical Parameters 24 kV W-VACi IEC Circuit Breaker*). Referencing the above calculations, these values are influenced by the Correction factor (K_a). The correction factor (K_a) is obtained from the graph, by using the known height above sea level (3000 m). The insulation levels must also conform to a power frequency rating of 50 kV with a 125 kV lightning impulse withstand voltage.

2.3 Technology Parameters

Charts on the following pages include all technical parameters for the IEC standard 17.5kV W-VAC*i*MB vacuum circuit breakers.

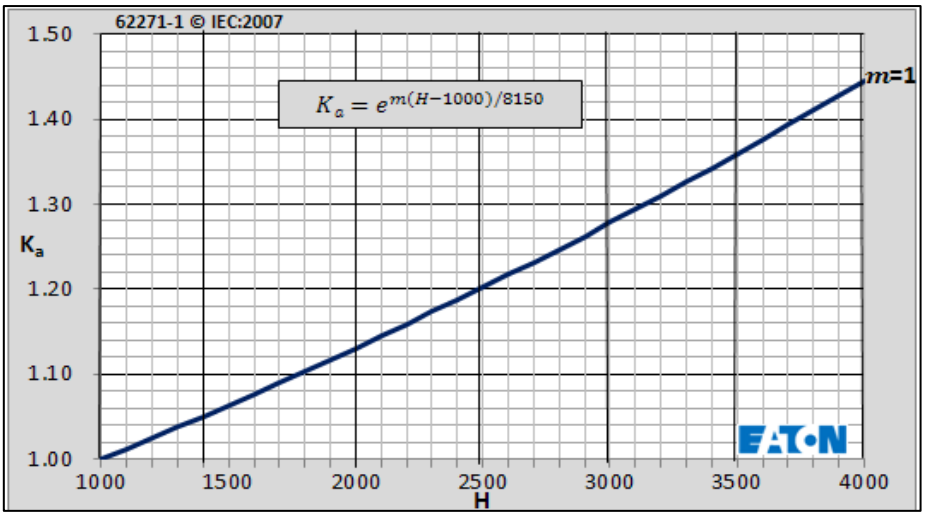


Figure 2.2A: Altitude Correction Factor

K_a = Correlates to the correction factor in regards to the altitude.

H = The value of Altitude (in meters).

M = A fixed value, in terms of power frequency, lighting impulse, and phase to phase switching impulse voltages; m=1.

2.4 Technical Parameters 17.5 kV W-VAC*i*MB Circuit Breaker

Item		Unit	17.5kV W-VAC*i*MB
Voltage (Ur)		kV	17.5
Normal Current(I_r)		A	1250
Short-Time Withstand Current(I_k)		kA	25
Short Circuit Breaking Current(I_{sc})		kA	25
Duration of Short Circuit(t_k)		sec	3
Frequency(f_r)		Hz	50/60
Short circuit Making Current(I_{ma})		kA	63/ 65
Contact Closing Bounce Time		ms	≤ 2
Time Difference of Three Pole Opening and Closing		ms	≤ 2
Fixed Breaker Resistance[1]		μΩ	≤35
Closing Time		ms	25~50
Opening Time		ms	40~60
Closing Speed[1]		m/s	0.7~ 1.3
Opening Speed[1]		m/s	1.0~ 1.7
D.C. Component of Breaking Current(I_{dc})		%	29-35
Cable-Charging Breaking Current (C2)		A	25
Back to Back Capacitor Bank Breaking Current (C1)		A	400
Pole to Pole Spacing (Center to Center)		mm	150
Upper to Lower Terminal Spacing		mm	205
Mechanical Endurance[2]		Cycle	20,000
Electrical Endurance		Cycle	20,000
Rated Insulation Level	Rated Lighting Impulse Withstand Voltage(U_p)	kV	38
	Rated Power Frequency Withstand Voltage(U_d)	kV	95
Operating Sequence			O-0.3s-CO-15s-CO
Classification			E2-M2-S1

[1:] Testing configurations available upon request

2.5 Operating Conditions

W-VAC*i* breakers are designed for switchgear mounted in indoor areas under normal service conditions (ambient air temperature, altitude, humidity, etc.) as laid out is IEC60694 clause 2.1.1.

Table 2-1: Operating Conditions

Ambient Temperature: Maximum = +40°C Minimum = -5°C
Altitude: Do not exceed 1000m For applications above 1000 m de-rating is required
Service Site: The environment shall be free of water, flame, and/or explosive hazard. No chemical corrosive gases, and/or intensive vibration.

2.6 Breaker Description

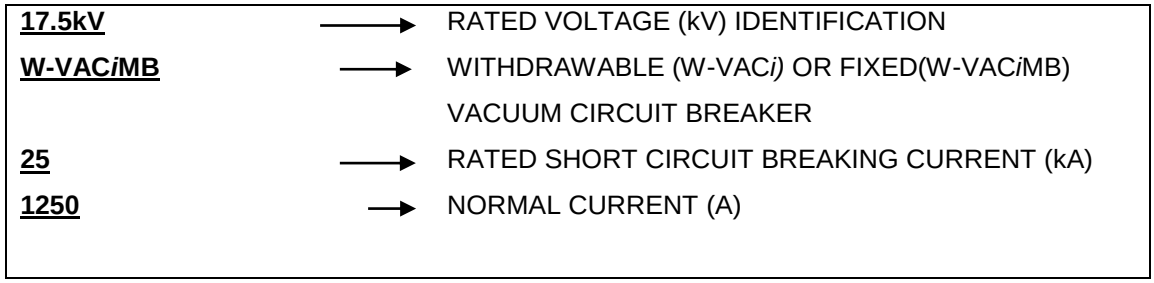


Fig. 2-1: Breaker Description

2.7 Outline and Dimensions

Frame Description:

Example: **17.5 MB – 2**

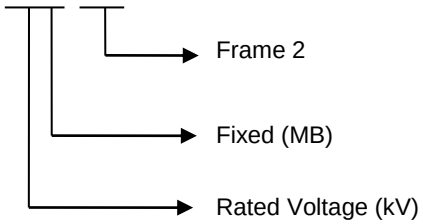


Table 2-2: List of Available Breaker Frames

Voltage (kV)	Continuous current (A)	Interrupting current (kA)	Pole Spacing (mm)	Upper to Lower terminal spacing (mm)	Fixed Breaker Frame	Fixed Breaker Frame Page Number
17.5	1250	25	150	275	17.5MB-2	10

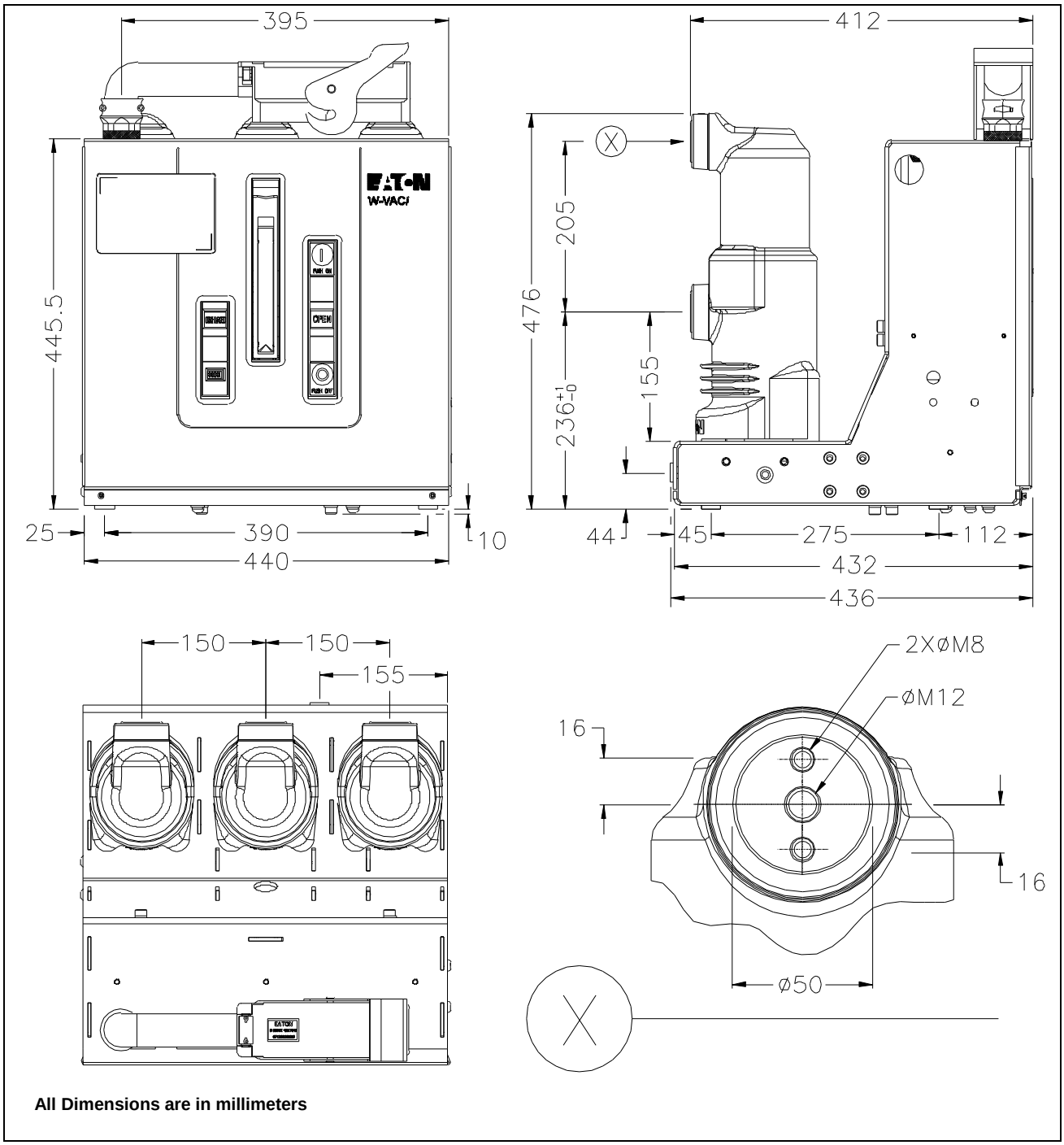


Fig. 2-1: 17.5kV Fixed W-VAC*i*MB Circuit Breaker Frame 17.5MB-2

Applicable Ratings		
Voltage	**Breaking Current**	**Normal Current**
17.5kV	25kA	1250A

3 Receiving, handling and storage

3.1 Receiving

Until the circuit breaker is ready to be delivered to the installation site, **DO NOT** remove container. When the circuit breaker is placed in storage, maximum protection can be obtained only when the circuit breaker is placed in storage and is in its original packaging.

Inspect the container for any signs of damage or rough handling upon receipt. Open the container carefully to avoid any damage to the contents.

Be careful that any loose items or hardware are not discarded with the packing material. When opening the container, check the content of each package against the packing list.

Examine the circuit breaker for any sign of shipping damage such as broken, missing or loose hardware, and damaged or deformed insulation. File claims immediately with the carrier if damage or loss is detected and notify the appropriate Eaton representative.

3.2 Handling

WARNING

Do not use a lifting device as a platform for performing inspection or repair on the circuit breaker, nor for operating the contacts or charging the springs. The breaker may fall, causing severe personal injury. Always use a suitable workbench capable of supporting the breaker.

The circuit breaker shipping containers are designed to be handled either by use of a rope sling and overhead lifting device or by a fork truck. If containers must be moved, it is preferable to use one of the above methods, roller conveyors, or individual pipe rollers.

After inspecting for potential shipping damage, the breaker should be returned to its original shipping container until it is ready to be installed.

When a circuit breaker is ready for installation, a removable lifting bar in conjunction with an overhead lifter or portable floor lifter can be used to move the breaker. If the circuit breaker is to be lifted, the lifting bar must be positioned over the circuit breaker and the bar must be inserted into the circuit breaker side openings with the lifting hole toward the interrupters. Once the lifting bar is securely seated in the lifting holes, the circuit breaker can be carefully lifted and moved.

3.3 Storage

If the circuit breaker is placed in storage, it must be kept in the original packaging for maximum protection. The circuit breaker is shipped with its contacts open and closing springs discharged. The indicator on the front panel should confirm this. Refer to Section 4 for detailed information on both manual and electrical operation of the circuit breaker.

Outdoor storage is NOT recommended. However, if unavoidable, the outdoor location must be well drained and a temporary shelter from sun, rain, snow, corrosive fumes, dust, dirt, falling objects and excessive moisture must be provided. Containers should be arranged to permit free circulation of air on all sides and temporary heaters should be used to minimize condensation. Moisture can cause rusting of metal parts and deterioration of high voltage insulation. A heat level of approximately 400 watts for each 3 cubic meters of volume is recommended with the heaters distributed uniformly throughout the structure near the floor.

Indoor storage should be in a building with sufficient heat and circulation to prevent condensation. If the building is not heated, the same rules for outdoor storage should be applied.

3.4 Lifting of Circuit Breakers

Always consider the center of gravity of the breaker may induce the breaker to tip over.

If a breaker has a single hole on each side and a picture of a lifting hook, as shown in Fig. 3-1, use lifting straps and hooks to attach to the circuit breaker at those points to lift the circuit breaker. When the circuit breaker has a single lifting hole with two additional bolt holes, use the lifting attachments shown in Fig. 3-2 to attach to the breaker. Then attach the lifting straps and hooks to the attachments. When using any lifting equipment, remove the lifting equipment before installing the circuit breaker into the switchgear.

Fig. 3-1: Lifting Point

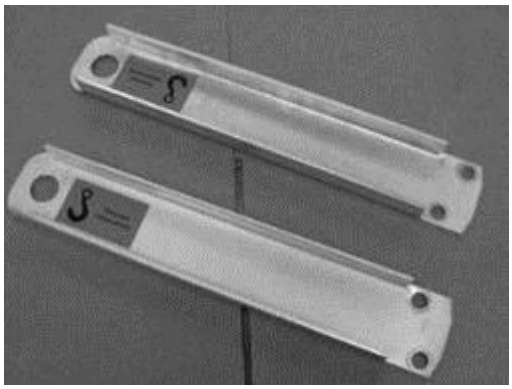


Fig. 3-2: Lifting Attachments

3.5 W-VAC*i*MB Circuit Breaker Weights

Table 3- 1: 17.5 kV Circuit Breaker Weights

17.5 kV Circuit Breaker Weights(kg)	
	1250A
Fixed	92

*±3kg.

3.6 Photographic Description

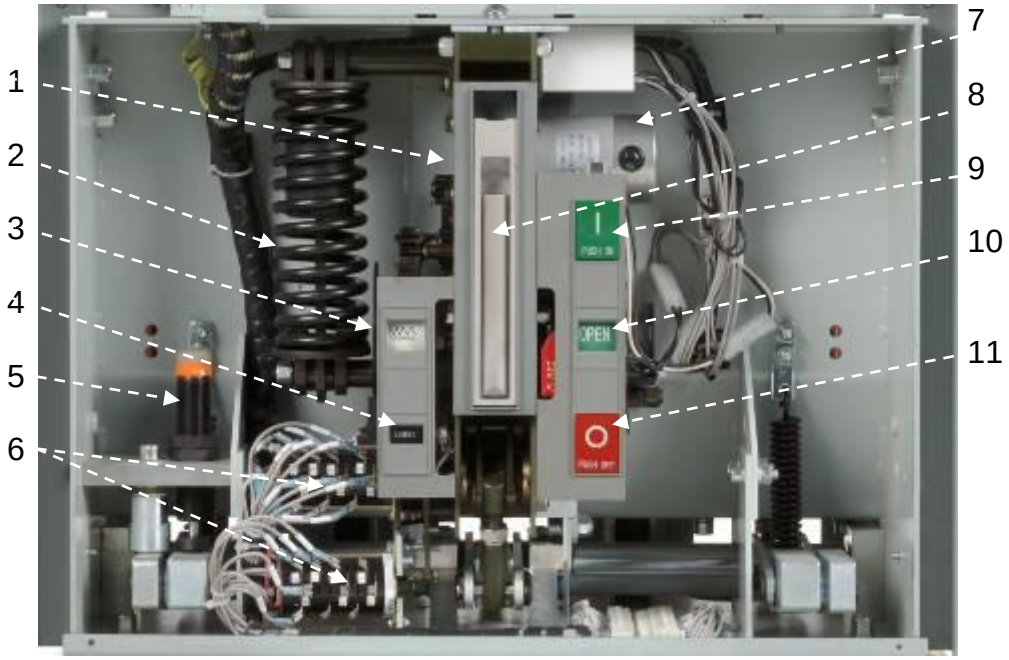


Fig. 3-3: Internal view of W-VAC*i*MB Circuit Breaker Element

1. Universal Mechanism Assembly (UMA)
2. Closing Spring
3. Spring Charged / Discharged Indicator
4. Operation Counter
5. Hydraulic Damper
6. Auxiliary switch
7. Charging Motor
8. Integral Charging Handle
9. Manual Close Button
10. Closed / Open Indicator
11. Manual Open Button

4 Inspection

4.1 Inspection

WARNING

- **Do not work on a breaker in the "service" position.**
- **Do not work on a breaker with secondary disconnects engaged.**
- **Do not work on a breaker with springs charged or contacts closed.**
- **Do not override any safety interlocks.**
- **Do not leave the manual charging handle in working location after charging the closing springs.**
- **Do not stand less than one meter away from the breaker when testing for vacuum integrity.**

4.2 Frequency of Inspection

It is recommended to inspect the breaker when it is received. In cases where the breaker operates in a clean and non-corrosive environment, the circuit breaker should be inspected after 10 years or 10,000 operations, whichever comes first. In dusty and/or corrosive environment, inspection should be performed at least once a year. Additionally, it is recommended to inspect the breaker every time it interrupts a fault current.

4.3 Inspection Process

See Table 4-4 and follow the steps to inspect the breaker.

4.4 Vacuum Interrupter Integrity Test

Vacuum interrupters used in all W-VAC*i*MB circuit breakers are highly reliable interrupting elements. Satisfactory performance of these devices is dependent upon the integrity of the vacuum in the interrupter and the internal dielectric strength. Both of these parameters can be readily checked by a one minute AC high potential test. During this test, the following warning must be observed:

Table 4-1: Testing Ratings

Breaker	Testing Voltage
17.5kV	38kV AC

This test should be done with the breaker in “OPEN” position.

WARNING

Applying abnormally high voltage across a pair of contacts in vacuum may produce x-radiation. The radiation may increase with the increase in voltage and/or decrease in contact spacing. X-radiation produced during this test with recommended voltage and normal contact spacing is extremely low and is well below maximum levels.

WARNING

After the high potential test is conducted, an electrical charge may be retained by the vacuum interrupters. Failure to discharge this residual electrostatic charge could result in an electrical shock. Follow safety procedures for this type of test.

4.5 Insulation Inspection

Insulation inspection is performed to keep all insulating surfaces clean. This can be done by wiping all insulating surfaces with a dry lint free cloth and denatured alcohol. In case there is any tightly adhering dirt that will not come off by wiping, it can be removed with a mild solvent or distilled water. Confirm that the surfaces are dry before placing the breaker in service. If a solvent is required to remove the dirt, once the switchgear has been isolated, use benzene or white spirit. Secondary control wiring requires inspection for tightness of all connections and damage to insulation.

4.6 Main Circuit Resistance Check

The resistance of the main circuit can be measured as follows: Ensure the breaker is in closed status, deliver 100A DC current to the main circuit, and measure the DC resistance with the help of a test machine. The results cannot exceed the value in the **Table 4-2**.

Table 4-2: Resistance chart of Main Circuit

Normal Current	Fixed
	DC Resistance (μΩ)
1250A	≤25

Mechanism Inspection Check

Carefully inspect the mechanism for any possible loose parts such as bolts, nuts, pins and rings. Check for excessive wear or damage to the breaker components. Operate the breaker several times manually and electrically. Check the closing and opening times to verify that they are in accordance with acceptable limits. Refer to the technical parameters section 2.4 for closing and opening time limits.

4.7 Torque specifications

Table 4-3: Torque Specifications

Nominal size and pitch	Newton Meters (Nm)
M5 x 0.80	6
M6 x 1.00	10
M7 x 1.00	18
M8 x 1.25	25
M10 x 1.50	50
M12 x 1.75	88
M14 x 2.00	141

Table 4-4: Inspection Process Chart

Section	Inspection Item	Criteria	Inspection Method	Corrective Action
Insulation	Drive insulator, barriers, and stand-off insulators	No dirt and no cracking	Visual inspection	Clean with lint-free cloth or replace cracked piece
Insulation Integrity	Main circuit to ground	Withstand	AC High Potential Test	Clean and retest or replace
	Between main circuit terminals	Withstand	AC High Potential Test	Clean and retest or replace
	Control circuit to ground	Withstand	AC High Potential Test	Clean and retest or replace
Power Elements	Vacuum Interrupters	Adequate vacuum	Proceed with integrity check	If integrity check is not satisfactory, replace encapsulated pole unit assembly
	Main Circuit Resistance	Resistance less than Table 4-2 values	Per Section 4-6	Contact Eaton rep. for recommendations
	Primary disconnects	No burning or damage or spring discoloration	Visual inspection	Replace if burned, damaged, eroded or discolored
Control Circuit Parts	Shunt (Closing and Opening) release, including disconnects	Smooth and correct operation by control power	Test closing and tripping of the circuit breaker twice	Replace any defective parts
	Wiring	Securely tied in proper place	Visual inspection	Repair or tie as necessary
	Terminals	Tight	Visual inspection	Tighten or replace if necessary
	Motor	Smooth, normal operation	Functional Test	Replace brushes or motor
Operating Mechanism	Tightness of hardware	No loose or missing parts	Visual and tactile	Tighten or replace parts
	Dust or foreign object	No dust or foreign object	Visual check	Clean as necessary
	Lubrication	Smooth operation and no excessive wear	Visual and tactile	Contact Eaton rep. for recommendations
	Deformation or Excessive Wear	No excessive deformation or wear	Visual and operational	Remove cause and/or replace parts
	Manual Operation	Smooth operation	Manual charging, closing, and tripping	Correct per troubleshooting chart 6.9

4.7 Troubleshooting Chart

Symptom	Inspection area	Probable cause
Fail to Close		
Closing-spring not charged	Motor Circuit	● No control power （fuse blown or switch off） ● Secondary disconnect is not connected ● Motor cut-off switch or its push lever is damaged ● Loose wire terminal connections ● Motor failure
Closing-spring charged but breaker does not close	Shunt Closing Release circuit, when the plunger of the shunt does not pick up	● No control power, or its out of voltage range （fuse blown or switch off, or wrong voltage applied) ● Secondary disconnects is not in service ● Anti-pumping device is in service ● Shunt closing release failure ● The breaker is between service and test position when it is in the switchgear
	Mechanical Interlock, may override the plunger of the shunt close release may pick up	● The breaker is between service and test position when it is in the switchgear
	Closing spring is released, but the breaker fails to close.	● Trip circuit is energized (trip free) ● Trip latch does not reset
Breaker does not close when manually pushing the close button	Electromechanical Interlock	• Secondary Disconnect is not plugged in or has no control power to it
Breaker does not rack in	Electromechanical Interlock	• Check to see if proper secondary control voltage is applied to the interlock

Symptom	Inspection area	Probable cause
Undesirable Close		
Undesirable Close	Control Circuit	● Shunt closing release circuit is energized ● Auxiliary switch does not switch properly
	Mechanism	● Close release latch(does not reset) ● Close button does not reset in time
Fail to Trip		
Breaker does not trip	Shunt trip release circuit	● No control power, or its voltage is out of range（fuse blown or switch off, or wrong voltage applied) ● Secondary disconnect is not connected
	Mechanism	● Entire mechanism non functional
	Vacuum Interrupter	● One or more welded
Undesirable Trip		
Undesirable Trip	Control Circuit	● Shunt trip circuit is energized ● Auxiliary switch does not switch properly
	Mechanism	● Trip latch is damaged ● Trip latch does not reset ● Manual trip push button “O” does not reset

5 Circuit Breaker Description and Operations

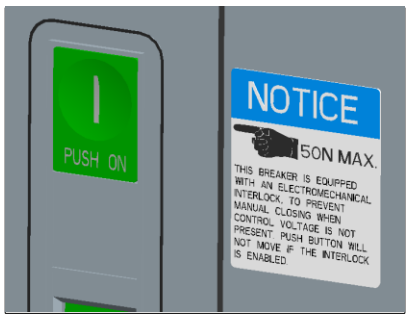
WARNING

Before placing the circuit breaker in service, follow the installation procedure given below carefully. Not following the procedure can lead to a failure to uncover damage that may have resulted in faulty breaker operation.

5.3 Initial Inspection and Operation

Before attempting to put the circuit breaker in service, it should be examined carefully and operated manually and electrically three times. It is highly recommended that Section 3 (Receiving, handling & storage) and Section 5 (circuit breaker description & operations) are closely reviewed before proceeding with installation into switchgear.

Manual Operation Notice:
During operation, excessive force on the close button can cause damage. Maximum forces on the “CLOSE” and “OPEN” buttons must not exceed 50 N. Not following these warnings when pushing the close button could cause the electromagnetic interlock to become damaged and jam the mechanism.



5.4 Manual Operation Check

Withdraw the charging handle as shown in Fig. 5-1 & Fig. 5-2. Charge the closing spring by turning the handle clockwise, as shown in Fig. 5-3. When the closing spring is charged, the indicator of the spring charged state (Fig. 3-4) turns to “charged”.

Return the handle to its original resting place and press the “close button” (Fig. 5-4). The closing spring becomes discharged and the breaker closes. Note the indicator now reads “CLOSE”. Now press the “open” button (Fig. 5-5). The breaker is now open and the indicator reads “OPEN”.

After completing this check, leave the closing springs “discharged” and the breaker contacts “open” until another check is ready to be performed. Check the breaker operation three times using this procedure.

Fig. 5-1: Pull the round handle down

Fig. 5-2: Pull out the handle with two hands

Fig. 5-3: Turn the handle clockwise

Fig. 5-4: Close manually

Fig. 5-5: Open manually

5.5 Nameplate

Compare the circuit breaker nameplate information with technical data in the technical parameters section 2.4. Also compare the breaker with the breaker outline drawings and switchgear drawings for conformance and compatibility. In case of potential discrepancy, contact your Eaton representative before installing the circuit breaker.

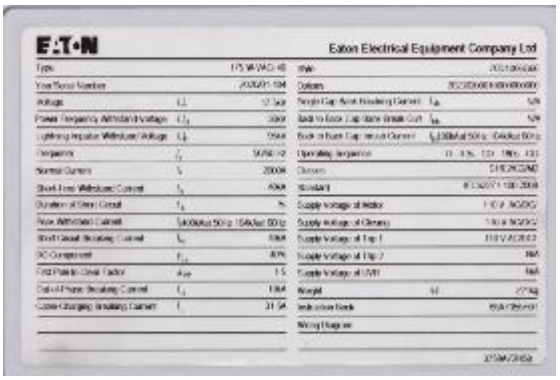


Fig. 5-6: Name Plate Label

5.6 Vacuum Interrupter Integrity Check

Clean all the insulating surfaces of the pole units with a dry, lint free cloth and denatured alcohol. Refer to section 4.4 after this action is completed.

5.7 Insulation

The primary insulation for the vacuum interrupters needs to be checked. Refer to the procedure in Section 4.5 and Table 4.4. This can be done by closing the circuit breaker and performing a power frequency voltage test.

5.8 Main Circuit Resistance Check

Check the main circuit resistance. Refer to procedure in Section 4.6. The DC resistance should not exceed the permissible values. Record the obtained values for future reference. Refer to Table 2-4 for value limits and procedure.

Note: Do not apply test current to the spring of main contact finger cluster. Damage can occur if this process is not followed correctly.

5.9 Electrical Operations Check

After going through the previous steps, the breaker is ready to be operated electrically. It is preferred that this check be made with a withdrawable breaker in a “Test” position or disconnected position. A fixed breaker cannot be in the cell during this test.

CAUTION

Examine the inside of the cell before inserting or mounting the breaker for excessive dirt or anything that might interfere with the breaker travel or installation.

WARNING

Extreme caution must be exercised to ensure that primary circuits are not energized while checks are performed in the breaker compartment. Failure to do so may result in personal injury or death.

The energy required by a circuit breaker closing operation is normally provided by charging the closing spring with a charging motor. Make sure that the manual charging handle is inserted into the resting place in the front cover. The closing spring can also be charged manually as previously described. When performing charging, closing or opening operations electrically, observe that the indication of the charging state to confirm they are correct.

When testing a withdrawable breaker electrically, it should be done in the TEST position. To achieve the TEST position, the circuit breaker must first be placed in the cell structure with the shoot bolt engaged and the secondary contacts engaged. To complete this testing procedure, the operator should first be familiar with inserting and removing the circuit breaker into and out of the cell structure. When the circuit breaker needs to be racked into switchgear, insert the racking handle onto the racking coupling lever and rotate it clockwise for insertion and counterclockwise for withdrawal. When the circuit breaker has reached “CONNECTED” position during the racking process, a distinctive sound will be heard. Excessive force applied to the racking handle when the circuit breaker has reached “CONNECTED” position could cause mechanism damage.

After completing this check, leave the “closing springs” discharged, the breaker contacts “open”, and the breaker in “TEST” position until another check is ready to be performed.

5.10 Circuit Breaker Interaction with Switchgear

W-VAC*i*MB circuit breakers provide a number of safety interlocks. The following list can help confirm the breakers function properly.

WARNING

Never disable any interlocks. They are intended for proper and safe operation. Failure to comply could result in death, severe personal injury and/or property damage due to the hazardous voltage present.

1. When the breaker is in the “CLOSED” state, the operation of close cannot be accomplished again until “OPEN” operation has been completed.

2. When the breaker is in the “CLOSED” state and the function of anti-pumping is on, the spring release cannot actuate.

3. When the breaker is in the “CLOSED” state, it cannot be racked into the switchgear from the TEST position to the SERVICE position.

4. Withdrawable type breakers cannot be racked out from the switchgear from the SERVICE position to the TEST position in the “CLOSED” state.

5. Withdrawable type breakers cannot perform “CLOSE” and “OPEN” operations between the TEST and SERVICE positions.

6. For withdrawable breakers with optional electrical magnetic interlock, the breaker cannot finish the “CLOSE” operation, unless the secondary disconnect is connected and the breaker is either at TEST or SERVICE position. See section 5.12.

7. As to other optional parts, such as, Under Voltage Release (UVR) trip device or an over current trip, you must confirm their function based on their system design needs. Please refer to your own specifications when you ordered the breaker.

8. When there is no power supplied to the mechanism electromagnetic interlock, the breaker will not be allowed to “CLOSE” manually.

9. When there is no power supplied to the cradle electromagnetic interlock, withdrawable type breakers cannot be racked out from the switchgear from the SERVICE position to the TEST position.

6 Operation

W-VAC*i* circuit breakers open and close primary circuits using Eaton vacuum interrupters (VI). The device used to open and close the VI is the Universal Mechanism Assembly (UMA). It is a modular assembly design. It is a self-contained functional unit. All W-VAC*i*MB circuit breakers are operated by a front mounted simple spring charged, stored energy mechanism (Figure 6-2)**.** The stored energy mechanism is normally charged by an electric motor, but also can be charged manually with a charging handle.

6.3 Encapsulated Pole Units

The VI of the vacuum circuit breaker is incased in an epoxy resin which is cast by means of Automatic Pressure Gelation technology. This construction can effectively protect the vacuum interrupter from external influences, including external force impact, polluted environment and so on. The pole unit is mounted on the back of circuit breaker frame.

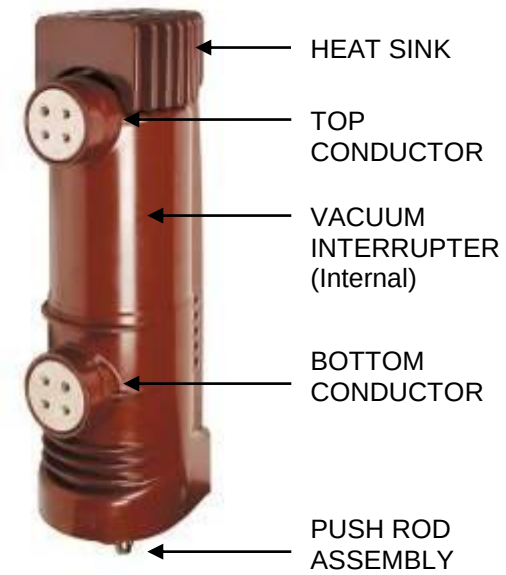


Fig. 6-1: Encapsulated Pole Unit (EPU) Structure

6.4 Electrical Circuit

Current flows into poles from one conductor, through the VI and through an electrical connection, and flows out the other conductor.

6.5 Operating Mechanism

WARNING

Keep hands and fingers away from the breaker's internal parts while the breaker contacts are closed or the closing springs are charged. The breaker contacts may open or the closing springs may discharge causing a serious injury. Discharge the springs and open the breaker before performing any breaker inspection or repair.

The operating mechanism uses stored energy from the closing spring (Fig. 6-2). The closing unit has one shunt closing release and the opening unit is composed of one or more shunt opening release coil(s). Both have auxiliary switches and indicating devices which are all installed in the circuit breaker frame. Closing and opening buttons, the manual charging handle, spring charging state indicator, and closed/open indicators are all front accessible.

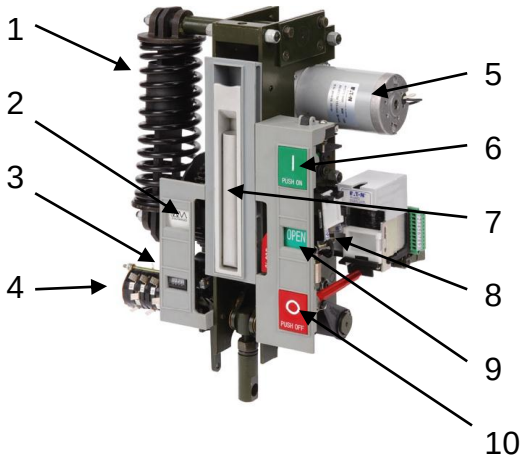


Fig. 6-2: Universal Mechanism Assembly (UMA)

1. Closing Spring
2. Charge Indicator
3. Operations Counter
4. Auxiliary Switches
5. Motor
6. Close Button
7. Charging Handle
8. Optional Shunt Opening Release Location
9. Open/Close Indicator
10. Open Button

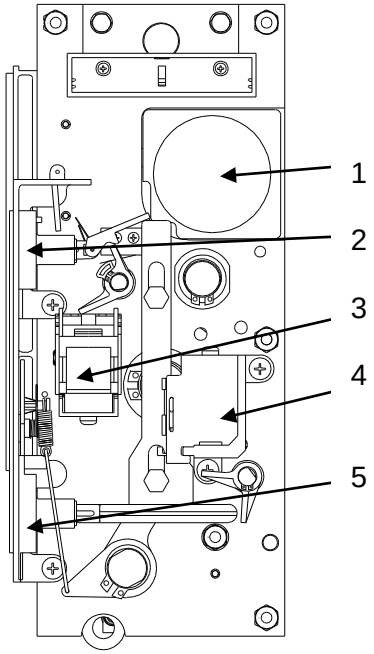


Fig. 6-3: Universal Mechanism Assembly (UMA) Right Side View

1. Motor
2. Close Button
3. Shunt Closing Release
4. Shunt Opening Release
5. Open Button

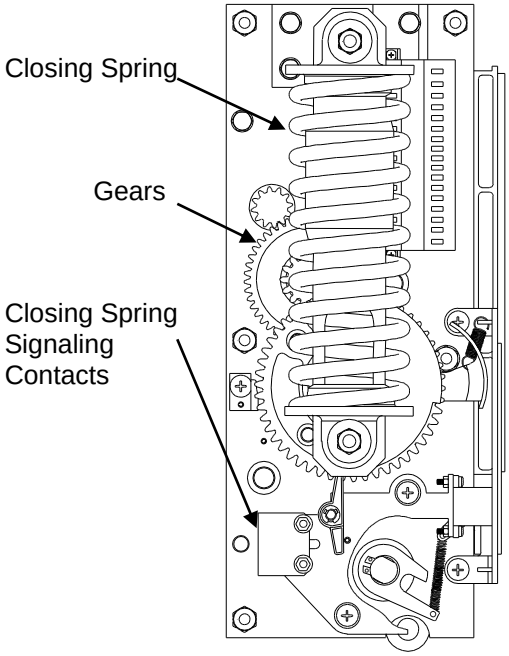


Fig. 6-4: Universal Mechanism Assembly (UMA) Left Side View

6.6 Charging

The energy required for a circuit breaker closing is provided by charging a closing spring using a charging motor or manually charging with the charging handle. When electrically charging, the output shaft of the motor actuates a gear drive system. When manually charging, the gear driving system is actuated through a pinion gear that is attached to the charging handle. Once charged, the indicator will display “CHARGED” and the motor cutting switch will break the power supply of the charging motor. The circuit breaker is now ready for closing.

6.7 Closing

The closing operation is accomplished by either manually pressing the “CLOSE” button or by remote operation to actuate the shunt opening release coil. Once closed, the indicator will read “CLOSED” and the circuit for the power supply to the motor is returned. At the same time the counter is actuated to perform the counting function and the driving linkage actuates the main auxiliary switch to transfer states of the other switches and sensors between on and off. The 4 states of the mechanism can be seen in Figures 6-6 through Figure6-9 on the following page.

Fig. 6-5: Manual Charging Process

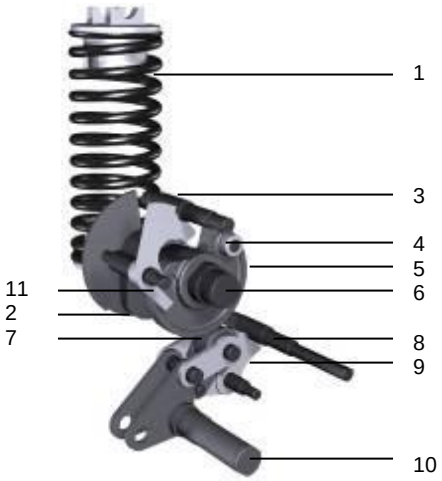


Fig. 6-6: Breaker Open and Closing Spring Discharged

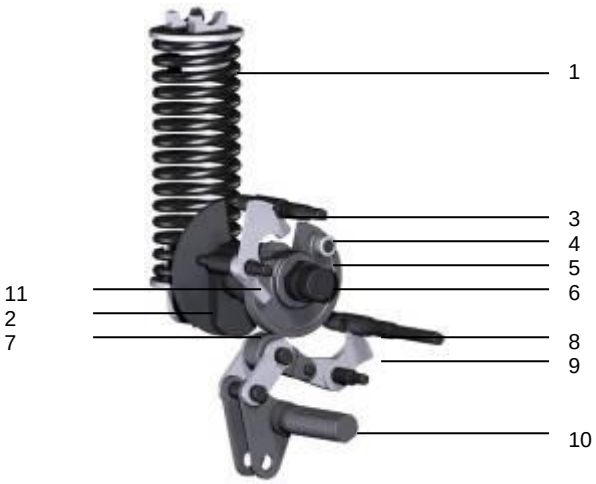


Fig. 6-7: Breaker Closed and Closing Spring Discharged

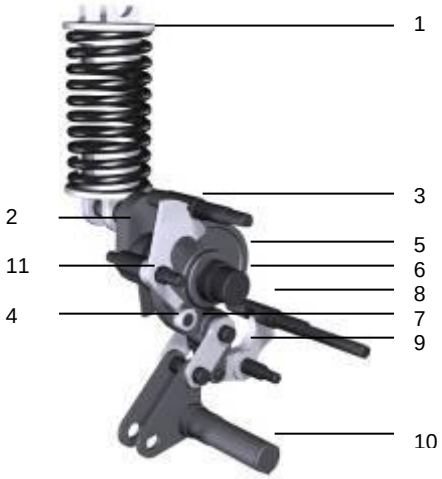


Fig. 6-8: Breaker Open and Closing Spring Charged

Fig. 6-9: Breaker Closed and Closing Spring Charged

1-Closing Spring
2-Closing Spring Lever
3-Spring Release D Shaft
4-Close Roller
5-Cam
6-Cam Shaft
7-Main Roller
8-Trip bar D Shaft
9-Trip Latch
10-Drive Shaft
11-Spring Release Latch

6.8 Opening

The opening operation is accomplished by either manually pushing the “open” button or connecting the external power supply to actuate the shunt opening release coil. The breaker uses a hydraulic damper to help absorb some of the opening force. Once the breaker is open, the indicator will display “OPEN”.

6.9 Control Schemes

Refer to Fig. 6-10 for the W-VAC*i*MB circuit breaker diagram.

6.10 Selective Parts Configuration

The voltages for the secondary control circuit can be: 24-48-60-110-125-220-250 VDC and 120-220-230 VAC.
Configurations and electrical parameters for selective parts are presented in the next few sections.

Rated Parameters of UMA Motor[1]						
Item	**Unit**	**Value**				
Rated Voltage	VDC (Ua)	24	48	60	110/125	220/250
Rated Voltage	VAC (Ua)	-	-	-	110/120	220/230
Voltage Range	% (Ua)	85-110				
Time for Charging (S)	(s)	≤15				
Rated Parameters of Releases[1]						
Item	**Unit**	**Value**				
Rated Voltage	VDC (Ua)	24	48	60	110/125	220/250
Rated Voltage	VAC (Ua)	-	-	-	110/120	220/230
Rated Current	(A)	≤10	≤5	≤5	≤3	≤2
Shunt Closing Release Voltage Range*	% (Ua)	85-110				
Shunt Opening Release Voltage Range	% (Ua)	70-110				

Rated Parameters of Undervoltage Releases[1]						
Item	**Unit**	**Value**				
Rated Voltage	Ua (VDC)	24	48	60	110/125	220/250
Rated Voltage	Ua (VAC)	-	-	-	110/120	220/230
UVR Operates, & Circuit Breaker Opens Limits	% (Ua)	0-35				
UVR does not operate Limits	% (Ua)	70-110				
Rated Parameters of Electromagnetic Interlock[1]						
Item	**Unit**	**Value**				
Rated Voltage	Ua (VDC)	24	48	60	110/125	220/250
Rated Voltage	Ua (VAC)	-	-	-	110/120	220/230
Operating Limits	% (Ua)	85-110				
Continuous Power (Pc)	W (VDC)	5				
	VA (VAC)	5				

[1] Insulation voltage for all electronic parts is 2000 V 50/60 Hz (for 1 min.)

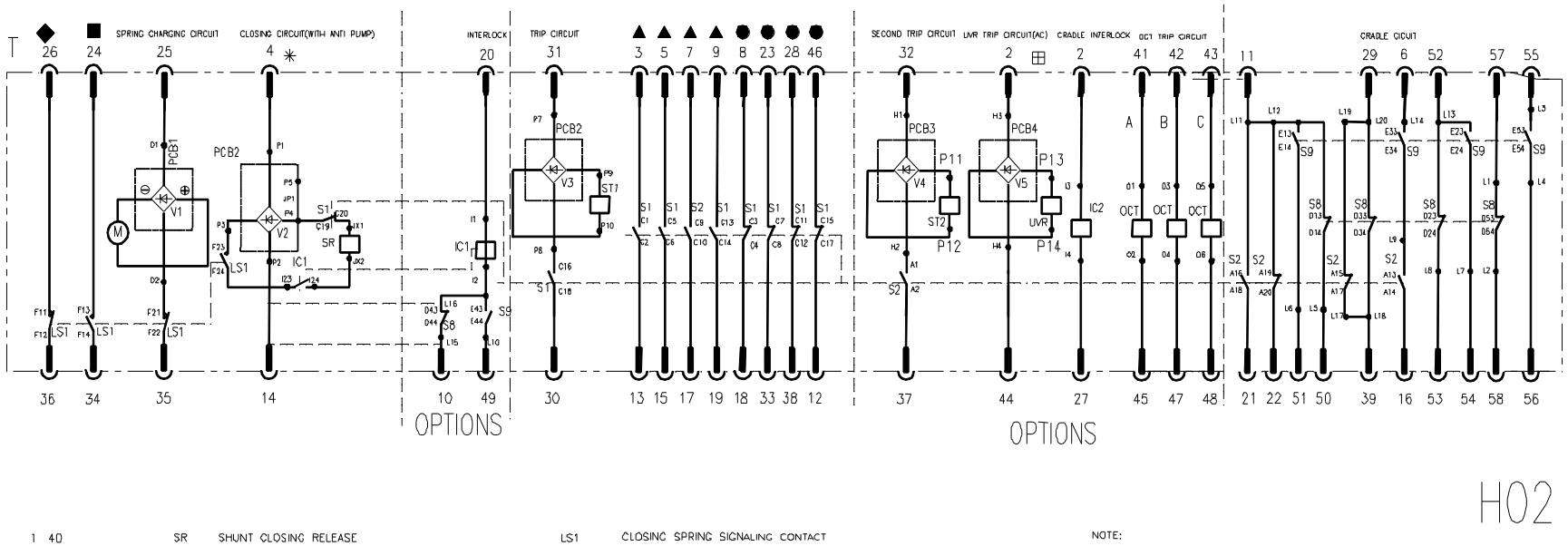
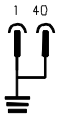


Fig. 6-10: Control Schematic



SR	SHUNT CLOSING RELEASE
M	CHARGING MOTOR
ST1	SHUNT OPENING RELEASE
ST2	SHUNT OPENING RELEASE #2
T	58 PIN SECONDARY DISCONNECT
UVR	UNDER VOLTAGE RELEASE
	V1, V2,V3, V4,V5 RECTIFIER
PCB1	CHARGING CIRCUIT PCB (AC/DC)
PCB2	CLOSE&OPEN CIRCUIT PCB (AC/DC) (INTERGRATE CLOSE&OPEN&ANTI PUMP)
JP1	SHORT PLATOON FOR CANCLE ANTI PUMP FUNCTION

LS1	CLOSING SPRING SIGNALING CONTACT
OCT	OVER CURRENT TRIP (OPTIONAL)
IC1	MECHANISM ELECTRO MAGNETIC INTERLOCK (OPTIONAL) NO INTERLOCK,CONNECT I23 & I24
S1, S2	BREAKER AUXILIARY SWITCH (SWITCH WHEN 'OPEN' & 'CLOSE')
S8, S9	POSITION CONTACTS(SWITCH WHEN IN 'WORK' & 'TEST' POSITIONS)
PCB4	UVR CIRCUIT PCB (AC/DC)
IC2	CRADLE INTERLOCK COIL
PCB3	SECOND OPENNING CIRCUIT PCB (AC/DC)

NOTE:

1. THIS DRAWING SHOWS THE BREAKER IS IN TEST, OPEN, DISCHARGED POSITION. TRIP FREE INTERLOCK IS NOT RESET.
2. ◆ SHOWS THE CIRCUIT CAN BE USED TO INDICATE UNCHARGED STATUS OF BREAKER;
3. ■ SHOWS THE CIRCUIT CAN BE USED TO INDICATE CHARGED STATUS OF BREAKER;
4. ▲ SHOWS THE CIRCUIT CAN BE USED TO INDICATE CLOSED STATUS OF BREAKER;
5. ● SHOWS THE CIRCUIT CAN BE USED TO INDICATE OPENED STATUS OF BREAKER.
6. ✳ EATON DOES NOT RECOMMEN DISABLING OF ANTI-PUMP FUNCTION. IF CUSTOMER CHOOSE TO DISABLE, HE MUST ASSUME THAT ADDITIONAL PROTECTION SCHEME WILL PREVENT ANY MALFUNCTION. ANTI PUMP FUNCTION CAN BE DISABLE AT CUSTOMER RISK BY ADDING JUMPER JP1(P4-P5).
7. ⊞ WHEN COUSTOMER NEED BOTH FUNCTION,PLEASE CONTACT WITH EATON.

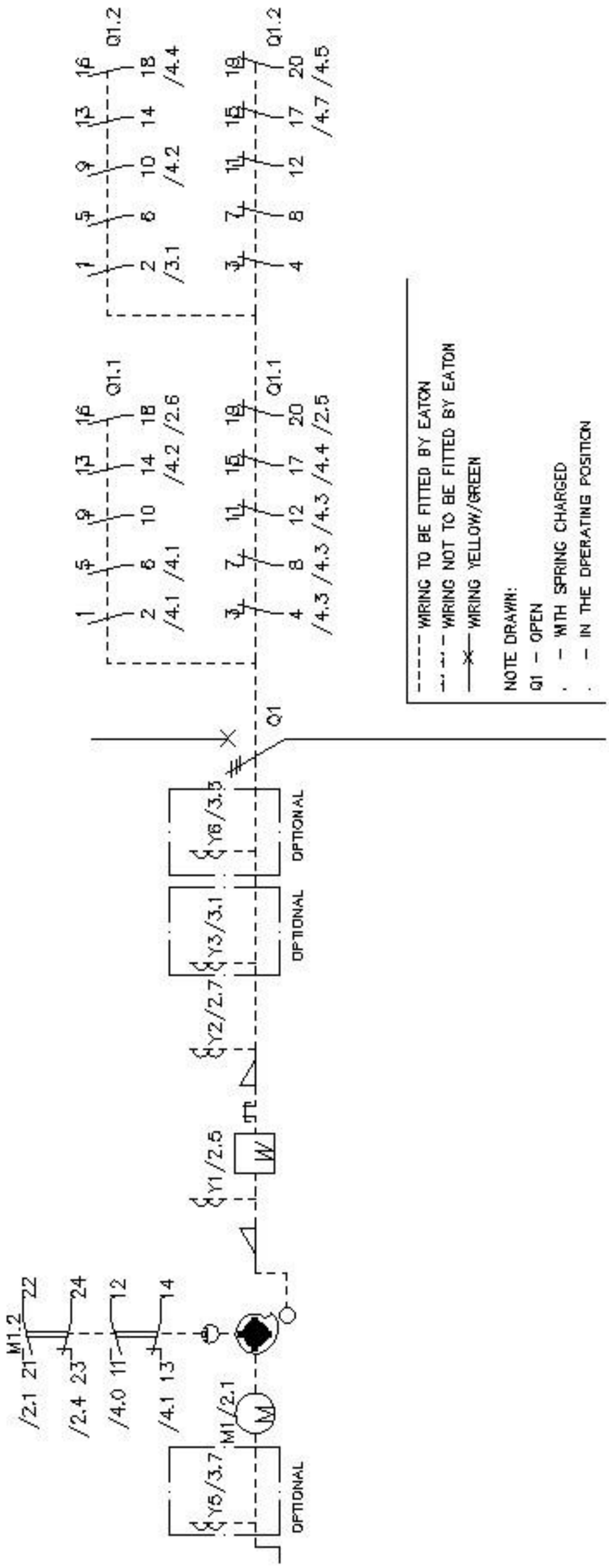


Fig. 6-11: Control Schematic

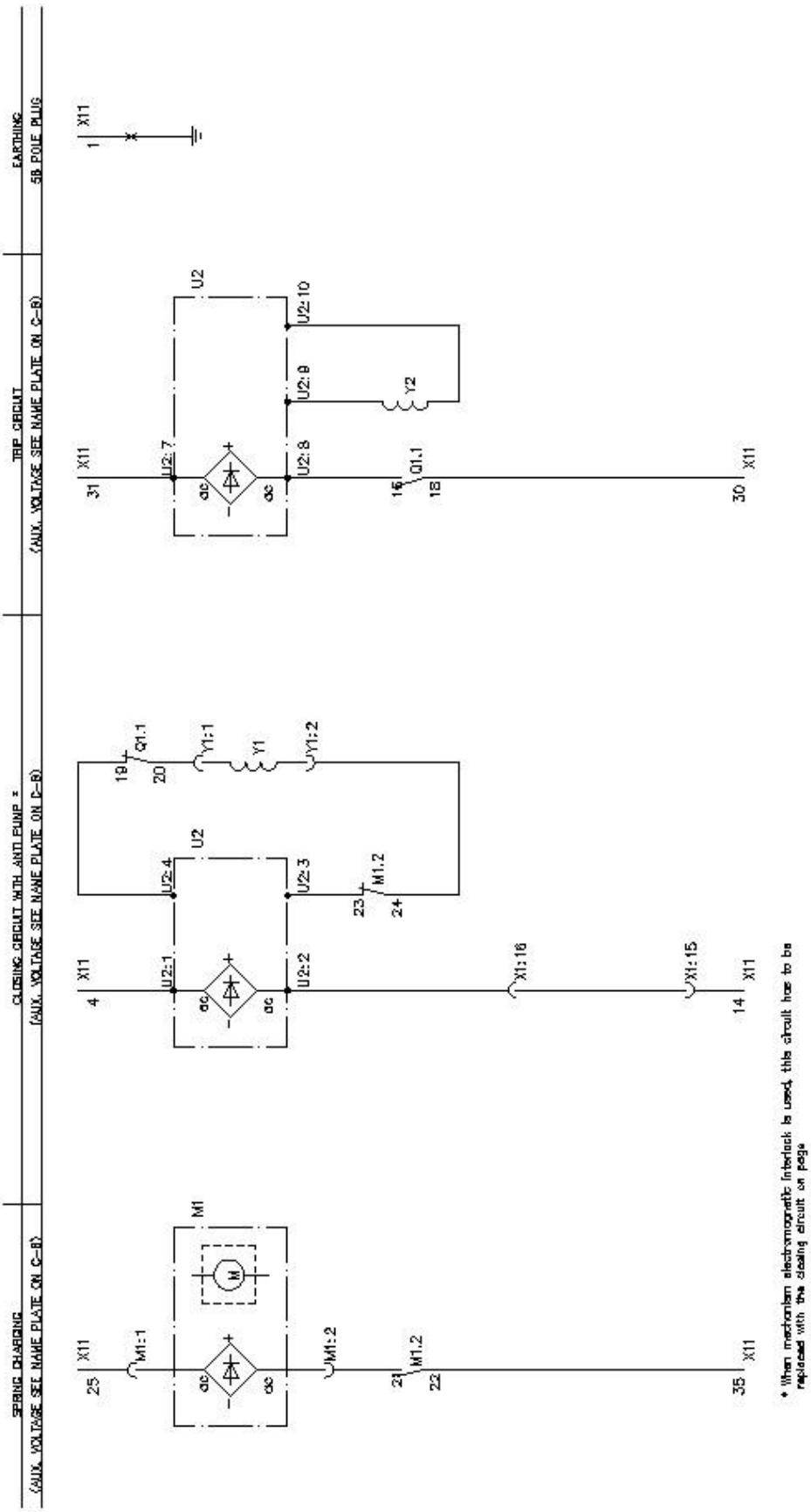


Fig. 6-12: Control Schematic

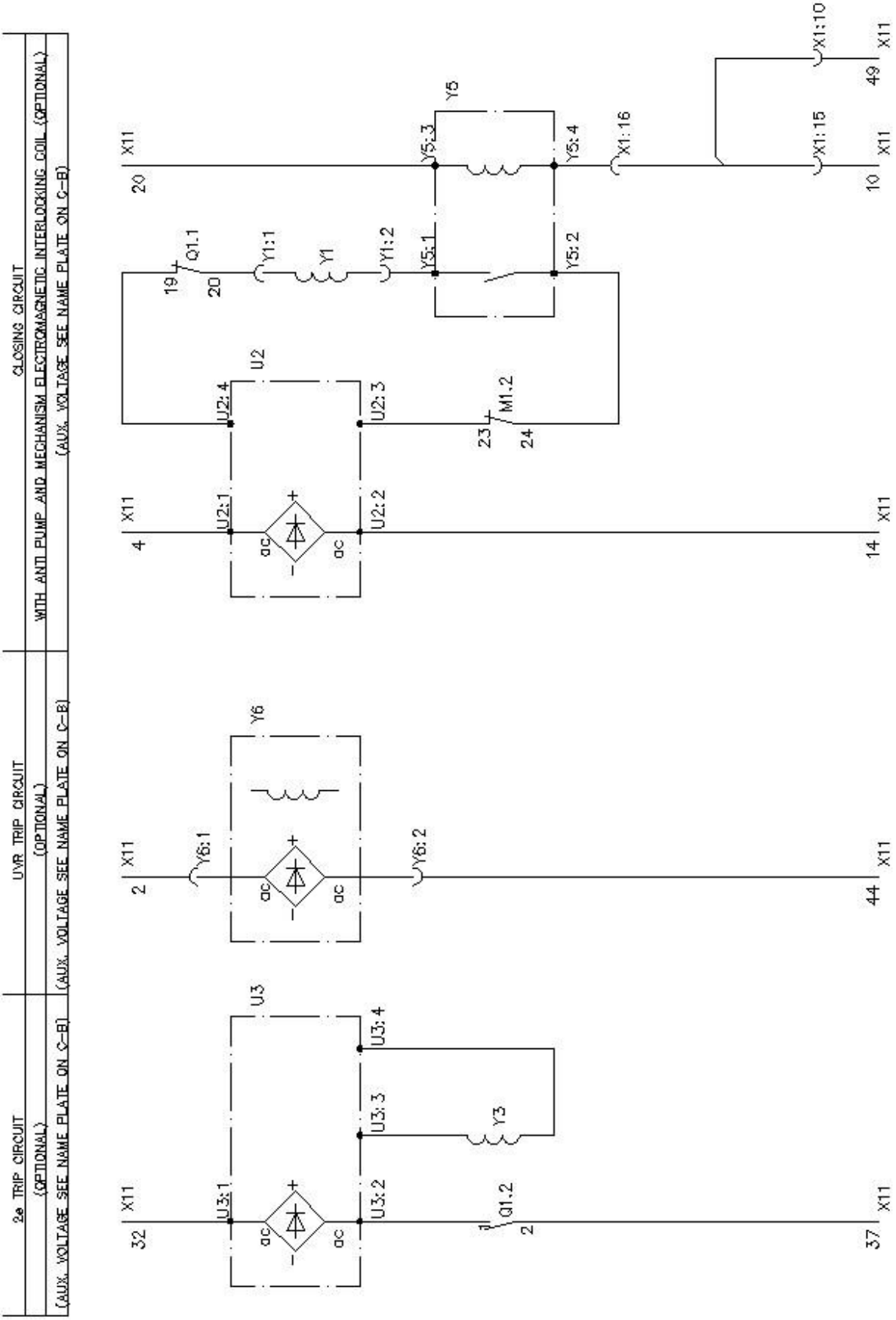


Fig. 6-13: Control Schematic

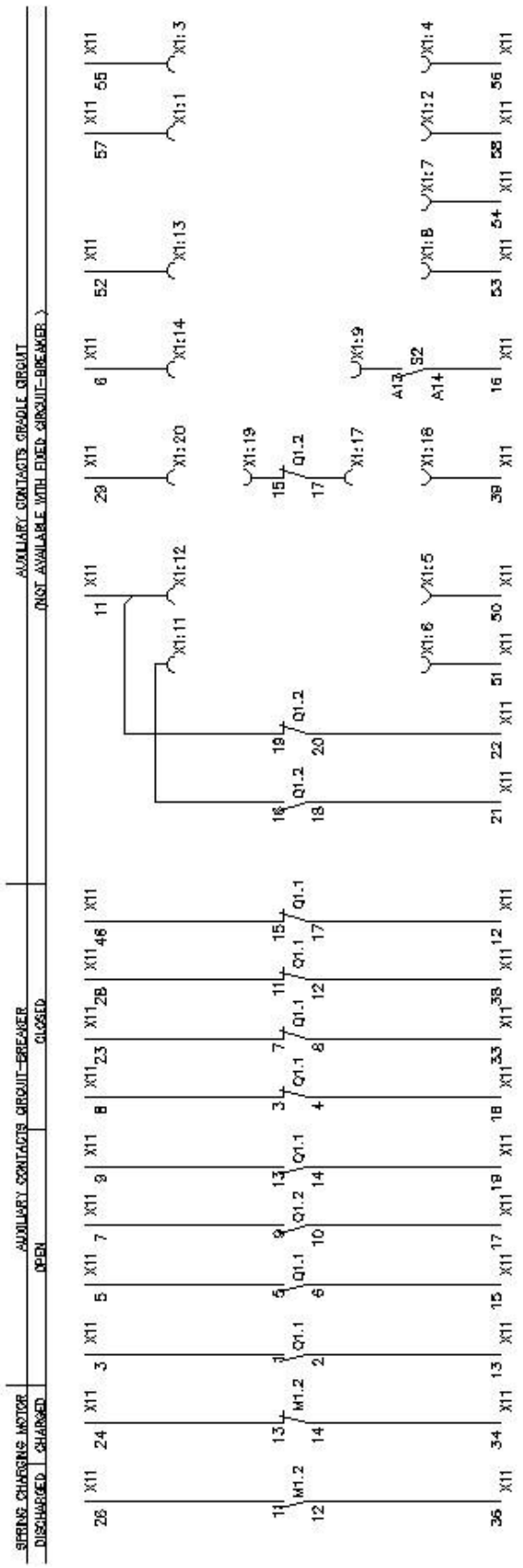


Fig. 6-14: Control Schematic

CODE	DESCRIPTION	MAKE	TYPE	ART. NR.	CIRCUIT NR.	REMARKS
M1	SPRING CHARGING MOTOR	EATON	...VAC/DC	65A7013G..	/1.1	
M1.2	CLOSING SPRING SIGNALLING CONTACTS F11–F12; F21–F22 CLOSED ONLY WHEN THE SPRING IS CHARGED F13–F14; F23–F24 OPENED ONLY WHEN THE SPRING IS DISCHARGED			65A7014G01	/1.1	
Q1	CIRCUIT–BREAKER	EATON	W–VAC1		/1.4	
Q1.1	AUXILIARY CONTACTS CIRCUIT–BREAKER C1–C2; C5–C6; ... CLOSED ONLY WHEN THE CIRCUIT–BREAKER IS CLOSED C3–C4; C7–C8; ... CLOSED ONLY WHEN THE CIRCUIT–BREAKER IS OPEN	EATON		65A7009G02	/1.4	
Q1.2	AUXILIARY CONTACTS CIRCUIT–BREAKER A1–A2; A5–A6; ... CLOSED ONLY WHEN THE CIRCUIT–BREAKER IS CLOSED A3–A4; A7–A8; ... CLOSED ONLY WHEN THE CIRCUIT–BREAKER IS OPEN	EATON		65A7009G02	/1.6	
U2	PRINT CIRCUIT BOARD CLOSING AND TRIPPING (ANTI PUMPING DEVICE INCLUDED)	EATON	...VAC/DC	65A7007G..	/2.3	
U3	PRINT CIRCUIT BOARD FOR SECOND TRIPPING (OPTIONAL)	EATON	...VAC/DC	65A7003G..	/3.1	
X1	PLUG AND SOCKET	WAGO			/5.3	
X11	58 PINS SECONDARY DISCONNECT PLUG	EATON			/5.3	
Y1	CLOSING COIL	EATON	...VAC/DC	65A7004G..	/1.2	
Y2	SHUNT TRIP COIL	EATON	...VAC/DC	65A7002G..	/1.2	
Y3	SECOND SHUNT TRIP COIL (OPTIONAL)	EATON	...VAC/DC	65A7003G..	/1.3	
Y5	MECHANISM ELECTROMAGNETIC INTERLOCK (OPTIONAL) PROTECTS THE OPERATING MECHANISM FROM BEING ACTIVATED WHEN CONTROL CIRCUIT IS NOT ENERGIZED	EATON	...VAC/DC	65A7003G..	/1.0	
Y6	UNDERVOLTAGE RELEASE COIL CIRCUIT BOARD (OPTIONAL)	EATON	...VAC/DC	65A7006G..	/1.3	

Fig. 6-15: Control Schematic

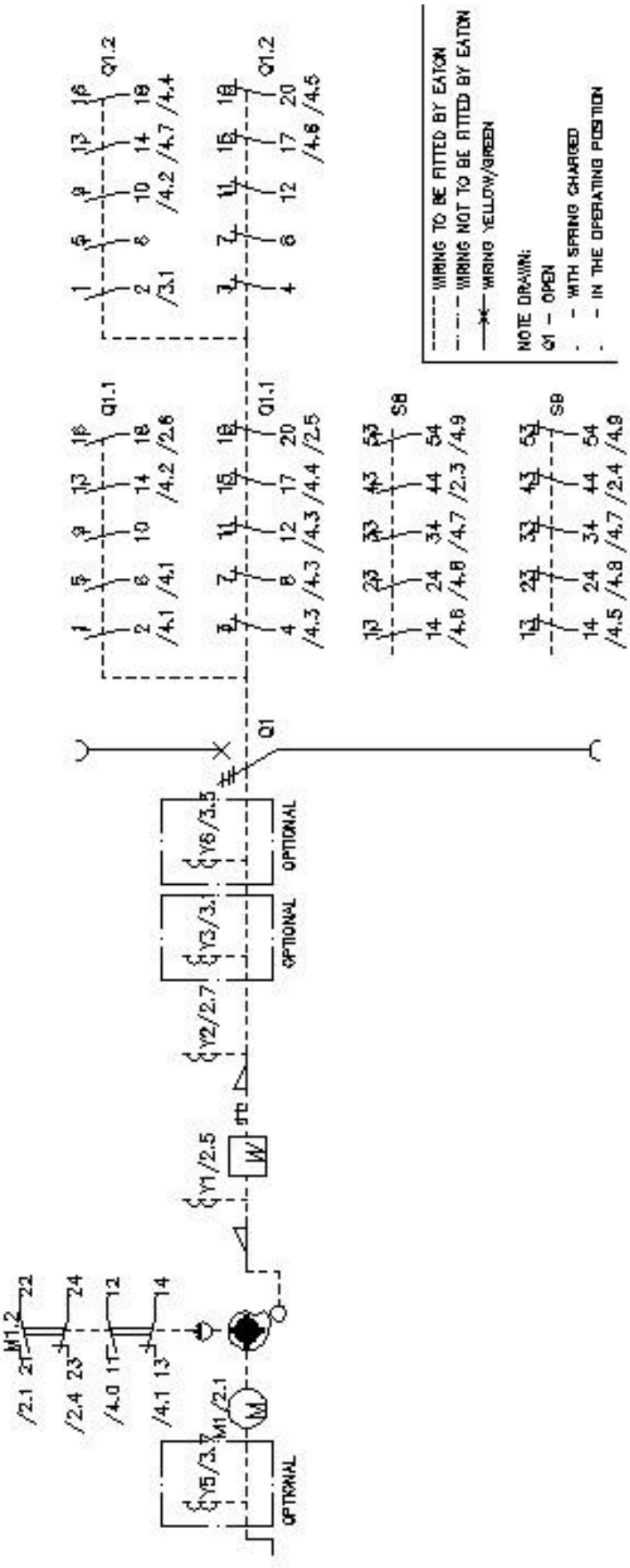


Fig. 6-16: Control Schematic

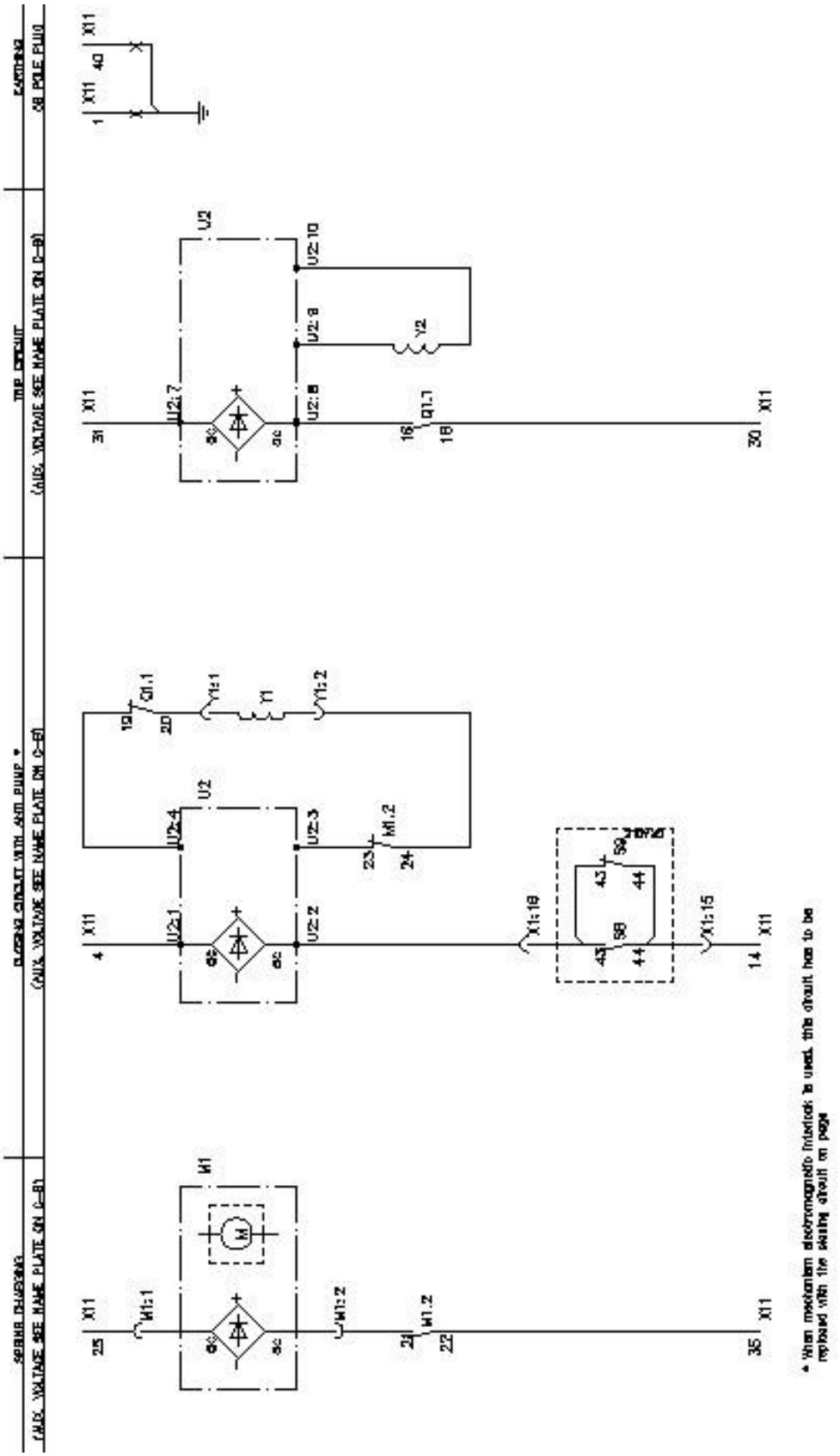


Fig. 6-17: Control Schematic

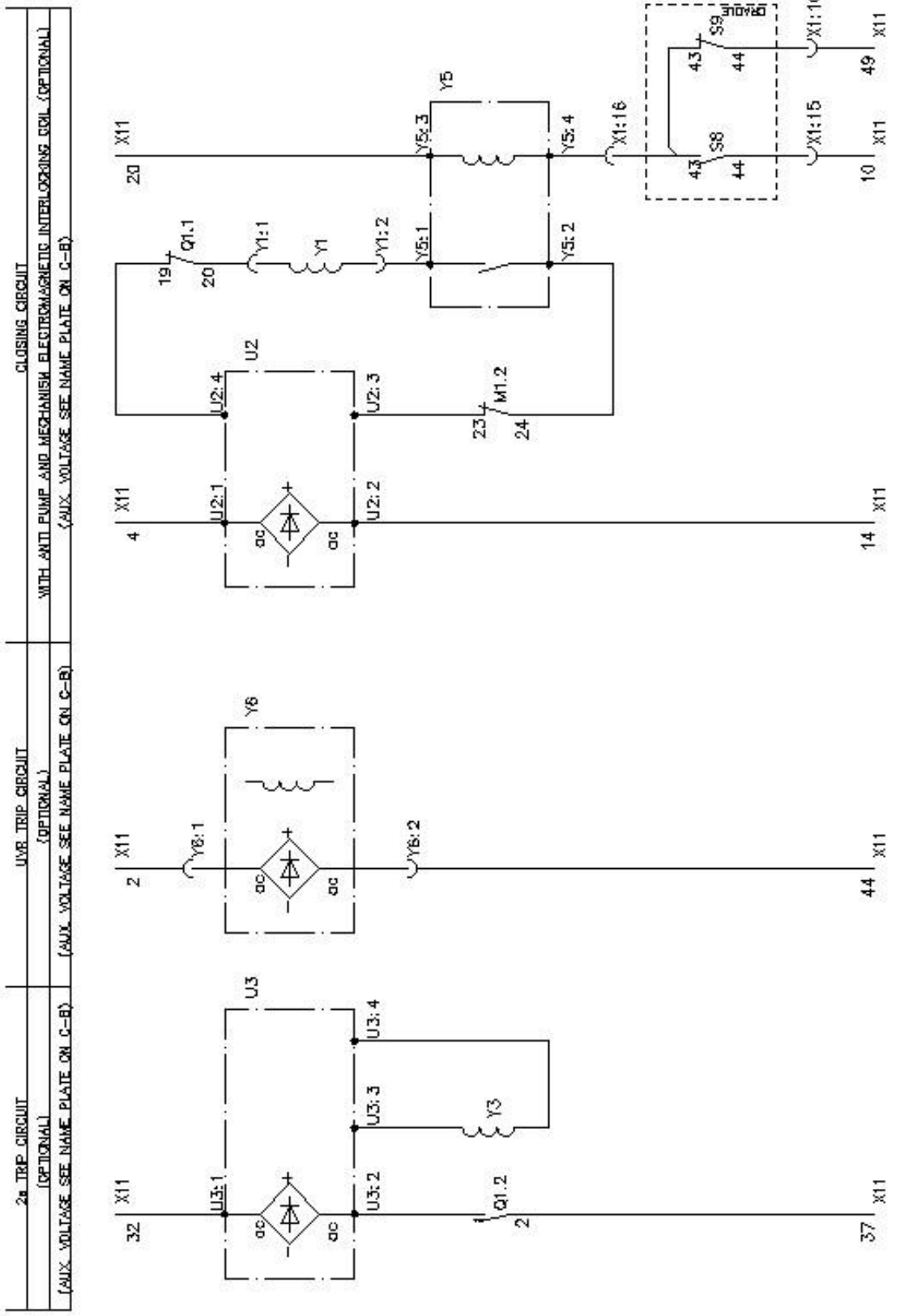


Fig. 6-18: Control Schematic

CODE	DESCRIPTION	MAKE	TYPE	ART. NR.	CIRCUIT NR.	REMARKS
M1	SPRING CHARGING MOTOR	EATON	...VAC/DC	65A7013G..	/1.1	
M1.2	CLOSING SPRING SIGNALLING CONTACTS 11–12; 21–22 CLOSED ONLY WHEN THE SPRING IS CHARGED 13–14; 23–24 OPENED ONLY WHEN THE SPRING IS DISCHARGED			65A7014G01	/1.1	
Q1	CIRCUIT–BREAKER	EATON	W–VACI		/1.4	
Q1.1	AUXILIARY CONTACTS CIRCUIT–BREAKER 1–2; 5–6; ... CLOSED ONLY WHEN THE CIRCUIT–BREAKER IS CLOSED 3–4; 7–8; ... CLOSED ONLY WHEN THE CIRCUIT–BREAKER IS OPEN	EATON		65A7009G02	/1.4	
Q1.2	AUXILIARY CONTACTS CIRCUIT–BREAKER 1–2; 5–6; ... CLOSED ONLY WHEN THE CIRCUIT–BREAKER IS CLOSED 3–4; 7–8; ... CLOSED ONLY WHEN THE CIRCUIT–BREAKER IS OPEN	EATON		65A7009G02	/1.6	
S8	AUXILIARY CONTACTS OPERATING POSITION 13–14; 23–24; ... CLOSED ONLY WHEN THE CIRCUIT–BREAKER IS IN THE OPERATING POSITION	EATON		65A7012G01	/1.5	
S9	AUXILIARY CONTACTS TEST POSITION 13–14; 23–24; ... CLOSED ONLY WHEN THE CIRCUIT–BREAKER IS IN THE TEST POSITION	EATON		65A7012G01	/1.5	
U2	PRINT CIRCUIT BOARD CLOSING AND TRIPPING (ANTI PUMPING DEVICE INCLUDED)	EATON	...VAC/DC	65A7007G..	/2.3	
U3	PRINT CIRCUIT BOARD FOR SECOND TRIPPING (OPTIONAL)	EATON	...VAC/DC	65A7003G..	/3.1	
X1	PLUG AND SOCKET	WAGO			/5.3	
X11	58 PINS SECONDARY DISCONNECT PLUG	EATON			/6.3	
Y1	CLOSING COIL	EATON	...VAC/DC	65A7004G..	/1.2	
Y2	SHUNT TRIP COIL	EATON	...VAC/DC	65A7002G..	/1.2	
Y3	SECOND SHUNT TRIP COIL (OPTIONAL)	EATON	...VAC/DC	65A7003G..	/1.3	
Y5	MECHANISM ELECTROMAGNETIC INTERLOCK (OPTIONAL) PROTECTS THE OPERATING MECHANISM FROM BEING ACTIVATED WHEN CONTROL CIRCUIT IS NOT ENERGIZED	EATON	...VAC/DC	65A7003G..	/1.0	
Y6	UNDERVOLTAGE RELEASE COIL CIRCUIT BOARD (OPTIONAL)	EATON	...VAC/DC	65A7006G..	/1.3	

Fig. 6-19: Control Schematic

7 Renewal parts

7.3 General

In order to minimize production downtime, it is recommended that an adequate quantity of spare parts be carried in stock. The quantity will vary from customer to customer, depending upon the service, severity and continuity requirements. Refer to Table 7-1 for guidance.

7.4 Ordering Instructions

a.) Always specify the breaker rating information and style number.

b.) Describe the item, provide the style number, and specify the quantity required.

c.) Specify the control voltage for electrical components.

d.) Specify the method of shipping desired.

e.) Send all orders or correspondence to the appropriate Eaton representative.

7.5 Standard accessories

Table 7-1 Standard Accessories

Shunt Opening Release (ST1) This device allows for remote opening control of the circuit breaker and can operate with both direct and alternating current.		
24 VDC / 8.9A	65A7002G01	
48 VDC / 4.4A	65A7002G02	
60 VDC / 4.3A	65A7002G13	
110-125 VDC / 2.7A	65A7002G04	
220-250 VDC / 1.5A	65A7002G06	
110-120 VAC / 2.6A	65A7002G10	
220-230 VAC / 1.4A	65A7002G12	
Attributes		
Ua (DC)	24-48-60-110-125-220-250 V	
Ua (AC)	110-120-220-230 V	
Operating Limits	70…110% Ua (DC) 85…110% Ua (AC)	
Insulating voltage	2000 V 50/60 Hz (for 1 min.)	

Shunt Closing Release (SR)

This device allows for remote closing control of the circuit breaker and can operate with both direct and alternating current.

24 VDC / 8.9A	65A7004G01	
48 VDC / 4.4A	65A7004G02	
60 VDC / 4.3A	65A7004G13	
110-125 VDC / 2.7A	65A7004G04	
220-250 VDC / 1.5A	65A7004G06	
110-120 VAC / 2.6A	65A7004G10	
220-230 VAC / 1.4A	65A7004G12	
Attributes		
Ua (DC)	24-48-60-110-125-220-250 V	
Ua (AC)	110-120-220-230 V	
Operating Limits	70…110% Ua (DC) 85…110% Ua (AC)	
Insulating voltage	2000 V 50/60 Hz (for 1 min.)	

Charging Motor (M) (40kA and below)

This device charges the mechanism closing springs electrically. In the event of a loss of power the mechanism closing springs can be charged manually.

24 VDC / 7.2A	65A7013G01	
48 VDC / 3.6A	65A7013G02	
60 VDC / 2.8A	65A7013G13	
110-125 VDC / 1.7A	65A7013G04	
220-250 VDC / 1.0A	65A7013G06	
110-120 VAC / 1.7A	65A7013G10	
220-230 VAC / 0.8A	65A7013G12	
Attributes	90 Watt 0.8A	
Ua (DC)	24-48-60-110-125-220-250 V	
Ua (AC)	110-120-220-230 V	
Operating Limits	85…110% Ua	
Insulating voltage	2000 V 50/60 Hz (for 1 min.)	

Breaker Auxiliary Contacts (S1 & S2)

Standard circuit breakers contain a 10A / 10B auxiliary switch. 6A / 6B contacts are used by the circuit breaker, therefore 4A / 4B contacts are available for the end user. This kit is two switches.

24 VDC / 10.0A	65A7009G02	
48 VDC / 6.0A		
60 VDC / 5.0A		
110-125 VDC / 2.9A		
220-250 VDC / 1.7A		
110-120 VAC / 14.5A		
220-230 VAC / 9.5A		
Attributes	IEC Contact Class 1, Rated Continuous Current 10A, Breaking Capacity 440W	
Insulating voltage	2000 V 50/60 Hz (for 1 min.)	

Closing Spring Signalling Contact (LS1)

This device is used to signal whether the operating mechanism's closing spring is charged or discharged. It uses a micro-switch that allows remote signaling of the state of the closing spring.

24 VDC / 4.0A	65A7014G01	
48 VDC / 2.5A		
60 VDC / 2.0A		
110-125 VDC / 0.9A		
220-250 VDC / 0.4A		
110-120 VAC / 9.5A		
220-230 VAC / 5.0A		
Attributes		
Insulating voltage	2000 V 50/60 Hz (for 1 min.)	

7.6 Optional accessories

Table 7-2 Optional Accessories

Shunt Opening Release #2 (ST2) Like the shunt opening release, this device allows for remote opening control of the circuit breaker. It can be supplied by a circuit completely independent from the shunt opening release #1.		
24 VDC / 8.9A	65A7003G01	
48 VDC / 4.4A	65A7003G02	
60 VDC / 4.3A	65A7003G13	
110-125 VDC / 2.7A	65A7003G04	
220-250 VDC / 1.5A	65A7003G06	
110-120 VAC / 2.6A	65A7003G10	
220-230 VAC / 1.4A	65A7003G12	
Attributes		
Ua (DC)	24-48-60-110-125-220-250 V	
Ua (AC)	110-120-220-230 V	
Operating Limits	70…110% Ua (DC) 85…110% Ua (AC)	
Insulating voltage	2000 V 50/60 Hz (for 1 min.)	

Undervoltage Release (UVR)

This device opens the circuit breaker when there is notable lowering or loss of its power supply. It can operate with both direct and alternating current.

24 VDC	65A7006G01	
48 VDC	65A7006G02	
60 VDC	65A7006G13	
110-125 VDC	65A7006G04	
220-250 VDC	65A7006G06	
110-120 VAC	65A7006G10	
220-230 VAC	65A7006G12	
Attributes		
Ua (DC)	24-48-60-110-125-220-250 V	
Ua (AC)	110-120-220-230 V	
Operating Limits	35-0% Ua: UVR operates, circuit breaker opens 70-110% Ua: UVR does not operate	
Insulating voltage	2000 V 50/60 Hz (for 1 min.)	

Fixed Circuit Breaker Interlock

This mechanical device is used to prevent a miss-closing of the circuit breaker by discharging the closing spring when racking the breaker in or out. It is used on fixed circuit breakers that are converted to draw-out circuit breakers by the customer

Fixed Circuit Breaker Interlock	65A7020G01 17.5 kV frame	

Boot Kit

This optional kit provides six boots that can be used by an OEM. The boots cover the first conneciton on the primary side of the breaker at the connection to the OEM switchgear.

Boot Kit	65A8288G01 17.5 kV frame	

8 Appendix

Use the following charts to verify that the circuit breaker is in the correct operational status and that the received circuit breaker has the exact same equipment as ordered.

8.3 17.5 KV W–VAC*i*MB Vacuum Circuit Breaker Operational Check List

Breaker Type: **# of Operations at Start:** _____

List	Explanation	Result	Reference Section
1	Check the parts for any that are damaged/loose/distortion/missing		3.2
2	Operate manually-charged/close/open		4.3
3	Check insulation of main circuit and control circuit		4.5
4	Check resistance of main circuit		4.6
5	Check the nameplate		4.2
6	Operate electrical-charge/close/open		4.7
7	Check the chassis with breaker		3.2
8	The counter does not advance properly		5.2.2

 # Of Operations at End: _____

Signature: _____ Date：_____

8.4 W–VAC*i*MB Vacuum Circuit Breaker Equipment Check List

Customer Name: Eaton Order:
Customer PO : Quantity:
Date of Delivery : YYYY_____ MM_____ DD_____

Technical Parameters of Breaker											
Type	**W-VAC*i*MB Fixed ☐**										
Rated Voltage (kV)	**☐17.5**										
Normal Current (A)	**☐1250**										
Short Circuit Breaking Current (kA)	**☐25**										
Pole To Pole (mm)* Distance	**☐210**										
Technical Parameters of UMA Mechanism											
Shunt Opening Release (Ua)	**☐24V DC**	**☐48V DC**	**☐60V DC**	**☐110V DC**	**☐125V DC**	**☐220V DC**	**☐250V DC**	**☐110V AC**	**☐120V AC**	**☐220V AC**	**☐230V AC**
Shunt Opening Release #2 (Ua)	**☐24V DC**	**☐48V DC**	**☐60V DC**	**☐110V DC**	**☐125V DC**	**☐220V DC**	**☐250V DC**	**☐110V AC**	**☐120V AC**	**☐220V AC**	**☐230V AC**
Shunt Closing Release (Ua)	**☐24V DC**	**☐48V DC**	**☐60V DC**	**☐110V DC**	**☐125V DC**	**☐220V DC**	**☐250V DC**	**☐110V AC**	**☐120V AC**	**☐220V AC**	**☐230V AC**
Charging Motor(Ua)	**☐24V DC**	**☐48V DC**	**☐60V DC**	**☐110V DC**	**☐125V DC**	**☐220V DC**	**☐250V DC**	**☐110V AC**	**☐120V AC**	**☐220V AC**	**☐230V AC**
Additional Equipment											
Under-Voltage Release	**☐24V DC**	**☐48V DC**	**☐60V DC**	**☐110V DC**	**☐125V DC**	**☐220V DC**	**☐250V DC**	**☐110V AC**	**☐120V AC**	**☐220V AC**	**☐230V AC**
Mechanism Electromagnetic Interlock for Mechcanism	**☐24V DC**	**☐48V DC**	**☐60V DC**	**☐110V DC**	**☐125V DC**	**☐220V DC**	**☐250V DC**	**☐110V AC**	**☐120V AC**	**☐220V AC**	**☐230V AC**
☐Second Set Breaker of Auxiliary Contacts											

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