# Instructions for Vacuum Circuit Breaker Type ABB R-MAG (OVB-DCM) 15.5 kV 1250/2000/3000 A

38-929M-15A

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# LIST OF ILLUSTRATIONS


**Figure 1. Hazardous Voltage Nameplate**

## 1.0 SAFETY NOTICES

This circuit breaker should be installed within the design limitations as described on its nameplate and in these instructions.

Follow your company's safety procedures.

This breaker should not be used by itself as the sole means of isolating a high voltage circuit. For the safety of personnel performing maintenance operations on the breaker or connecting equipment, all components should be electrically disconnected by means of a visible break and should be securely grounded.

This product is intended to be operated and maintained by qualified persons, thoroughly trained and knowledgeable of the hazards involved. This publication is written only for such qualified persons and is not intended to be a substitute for adequate training and experience in the safety procedures for this device.

**WARNING**

Detailed descriptions of standard repair procedures, safety principles, and service operations are not included. It is important to note that this document contains some warnings and cautions against some specific service methods which could cause personal injury to service personnel or could damage equipment or render it unsafe. Please understand that these warnings could not cover all conceivable ways in which service, whether or not recommended by ABB, might be done or of the possible hazardous consequences of each conceivable way, nor could ABB investigate all such ways. Anyone using service procedures or tools, whether or not recommended by ABB, must satisfy himself thoroughly that neither personal safety nor equipment safety will be jeopardized by the service method or tools selected.

All information contained in this manual is based on the latest product information available at the time of printing. The right is reserved to make changes at any time without notice.

## 2.0 INTRODUCTION

These instructions do not attempt to provide the user of this equipment with every possible difficulty which may occur in the application, operation and maintenance of the product. Also, as improvement in parts and assemblies are made, some parts may differ in appearance as depicted in the illustrations; however, functionality will be equivalent.

The Type R-MAG Vacuum breaker is a high-voltage, three-phase device incorporating three vacuum interrupters gang operated by a magnetic actuator. Together with the optional relaying and current transformers, the breaker will sense an overload and automatically open.

Satisfactory performance of the breaker is contingent upon the correct installation, adequate maintenance and service of the product. Careful study of these instructions will permit the user to obtain maximum benefit from this device.

## 3.0 RECEIVING, HANDLING AND STORAGE

Each breaker is assembled and tested at the factory prior to being prepared for shipment.

This equipment was packed and shipped in factory new condition. If damage is noted, call the carrier at once for inspection, and request an inspection report. File a formal claim with the carrier, supported with paid freight bill, inspection report, and invoice. The local ABB Sales Office must be notified. Normally this must be done within 10 days of receipt or receiver assumes all responsibility for damage.

### 3.1 Receiving Inspection

Upon receipt, it is important to inspect promptly to be certain that the correct material has been received. In case of shortage, immediately notify the local ABB Sales Office.

Check all parts against the shipping list as they are unpacked. Instructions and literature packed with the breaker should be kept with the unit. The cabinet provides a convenient place to keep this instruction book, a copy of the schematic diagram, and the card carrying the service record of the unit. Additional copies may be obtained upon request from the local ABB Sales Office.

If the breaker is not to be placed in service immediately, it is essential that proper care be exercised in the handling and storage to ensure good operating conditions in the future. (See 3.3 - Storage)

### 3.2 Handling

The R-MAG solid dielectric breaker comes with two brackets that attach to the sides of the cabinet and provide provisions for lifting the breaker. A two-point lift is recommended using the loops in these brackets. (See Figure 2)

**Caution - Exercise care during lifting to avoid damage to the bushings. Breaker has high center of gravity.**

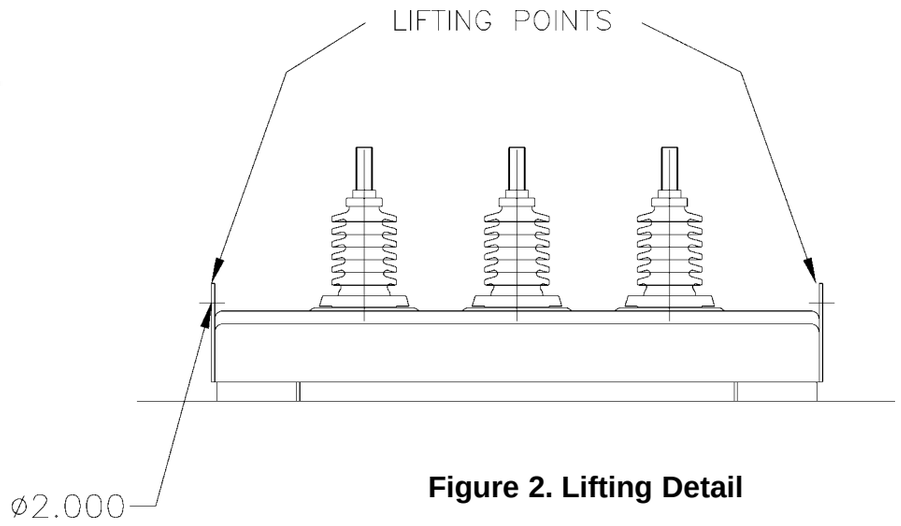



**Figure 2. Lifting Detail**

### 3.3 Storage

For prolonged storage, indoor storage is recommended. If stored outdoors, the cabinet heaters must be energized to maintain warranty. The mechanism and control compartment is equipped with heaters to reduce condensation.

## 4.0 GENERAL DESCRIPTION

### 4.1 High-Voltage Assembly

The high-voltage section of the R-MAG consists of three individual phase assemblies mounted on insulating standoffs. Each phase of the R-MAG consists of a single vacuum interrupter, flexible shunt and operating rod.

### 4.2 Housing

The doors of the breaker housing are removable and are retained by four pins. The position indicator is visible through the front door. The breaker nameplate showing rating information, serial number, and shop order number are mounted on the right-hand side of the housing.

### 4.3 Phase Assembly

Figure 3 shows the details of the phase assembly. The back bus work is attached directly to the fixed contact stud on the back end of the vacuum interrupter. The current transfer assembly housing is fastened to the opposite end of the vacuum interrupter. In the current transfer assembly, a contact block/flexible shunt transfers current from the moving contact of the vacuum interrupter directly through the bus to the bushing.

### 4.4 Magnetic Actuator

The magnetic actuator incorporates a very powerful permanent magnet assembly. When the armature is in contact with the upper plate, the magnet produces a holding force in excess of 1500 lbs. Attached to the armature are two stainless steel guide rods. The upper guide rod attaches to the lower end of the main operating rod, which connects directly to the moving contacts of the vacuum interrupters. The lower guide rod mounts to the manual trip assembly.

Disassembly of the magnetic actuator is not necessary nor recommended. Lubrication or maintenance is not required. Should an actuator fail to operate, contact ABB for service. The permanent magnet inside the actuator is extremely powerful with the potential to trap fingers.

### 4.5 Standard Control (ED2.0)

The standard control package of the R-MAG is the ED2.0. The ED2.0 consists of a power supply, position indication and capacitor charging/discharging system. Refer to Appendix A for an extensive overview of the ED2.0.

## 5.0 STANDARD PRODUCTION TESTS

Standard production tests include:

1. Verification of all wiring per connection diagrams.
2. Electrical operation: Close and trip. Overcurrent response and automatic closing, with relaying control option.
3. Check on functioning of all manual controls: Local/remote, non-reclosing, ground fault bypass, etc.
4. Three readings are made on each phase of the breaker using a Biddle “Ductor.” Typical values do not exceed 150 micro ohms.
5. Voltage Withstand: The complete breaker is tested (a) between live parts and tank, (b) across open contacts, and (c) between phases. In compliance with ANSI C37.09 & IEC an AC dielectric withstand test at 50 kV is performed. Test duration is one minute.
6. Wiring Insulation: The terminal block connections are given an over-potential test of 1500 volts AC to ground.

## 6.0 OPERATION

### 6.1 Closing

In the open position, the magnetic actuator’s armature rests against the bottom plate in the actuator assembly. The armature is held there by the force developed by the magnet. When the top coil is energized, the magnetic flux generated is in the same direction as the magnet assembly. The armature is drawn into the coil and brought into contact with the upper plate. In this position, the coil is de-energized and the armature is held in position by the magnet alone. As the armature is drawn into the coil, the operating rod, which is attached to the top guide rod, moves the moving contact of the vacuum interrupter towards the closed position. The actuator has more stroke than the vacuum interrupter and the interrupter contacts make contact before the actuator has completed the stroke. The additional movement of the operating rod after the contact closing causes the contact pressure spring to compress at the top of the operating rod. This “over-travel” allows for contact wear in service.

### 6.2 Opening

When the bottom coil is energized, the magnetic flux generated opposes the force generated by the magnet assembly. This reduces the holding force, the armature is released and the coil attracts the armature to the bottom plate. Once there, it is held open by the magnet.

## 7.0 OPERATIONAL CHECK PRIOR TO INSTALLATION

The breaker should be tested for mechanical and electrical operation before delivery to the installation site. Make the necessary control power connections. Open the door of the low voltage (LV) compartment to observe the mechanical operations. A manual trip handle is provided on the outside of the cabinet. (See Figure 8)

### 7.1 Electrical Close and Open

Observe the position-indicator located on the front of the actuator cover plate. If the panel is green, the breaker is open, and if the panel is red, the breaker is closed. To perform a close or open, ensure the “Ready” light is illuminated above the Close (1), and Open (0), buttons. Press the appropriate button firmly, keeping hands and loose clothing clear of operating linkages. Nothing will happen if the open button is pressed if the breaker is already open and conversely for close.

**Note:** In the event of a malfunction or loss of source voltage, the “Ready” light will not be illuminated.

### 7.2 Vacuum Test

Make an over-voltage test on each phase assembly to verify that there has been no loss of vacuum in transportation or handling. Experience has indicated that while a vacuum interrupter with the vacuum seal intact will withstand 37.5 kVAC across the open contacts for one minute, the same interrupter open to normal atmosphere will flashover at the gap at a much lower voltage.

**TEST PROCEDURE**


**RADIATION WARNING:** High voltage applied across an open gap in a vacuum can produce X-radiation. No radiation is emitted when the interrupter is closed since no gap exists. Also, when the breaker is open to the specified contact spacing in service or tested within the voltages specified, X-radiation at one meter is below the level of concern. A danger could exist at voltages above or contact spacing below that specified on the nameplate.

1. With the breaker in the open position, jumper both sets of three top terminals together. Ground one set of terminals and the housing. Connect the high voltage to the other set of terminals.

2. Stand clear more than one meter before energizing the high voltage source.

3. Apply a test voltage of 37.5 kVAC for one minute. Do not exceed 37.5 kVAC.

4. If internal flashover occurs, isolate the phases and test each one independently to identify the defective interrupter. Any defective interrupter must be replaced prior to the breaker being placed in service.

## 8.0 INSTALLATION

It is required that the breaker be vertical and level, and securely fastened. Follow your company guidelines and various codes for setting the height of the breaker, securing the frame to the pole or foundation, and for making connections.

### 8.1 Mounting

The breaker is normally shipped suitable for substation mounting. The following is the recommended installation procedure:

**Substation Mounting**

1. With the lifting brackets mounted to the breaker roof, lift the breaker off the pallet and move into position.
2. Bolt the legs to the pad, and raise the upper portion to the desired height.
3. Bolt legs to the sides of the breaker.
4. Make sure all hardware is tight.

### 8.2 Grounding

The breaker cabinet includes a standard NEMA 2 hole drilled stainless steel pad on the rear for grounding. Any voltage transformers used should be grounded to the main ground wire leading from the breaker to ground.

To ground the control cabinet, use the connector provided which accepts a #6 - 2/0 AWG conductor. Ground the control cabinet to the main ground wire from this external connector.

All ground wire used must be #6 AWG minimum.

### 8.3 Arrester Protection

ABB recommends that surge arresters be properly applied in the substation.

### 8.4 Control Power

Supply the control power as indicated on the wiring diagram. If 240 VAC is used, verify the connections for the heaters before applying power.

For breakers not equipped with DIN-Rail style connectors, check all terminal block connections for proper tightness.

For details of the overall control circuit refer to the specific wiring diagrams supplied with the breaker.

### 8.5 Final Inspection

When the breaker has been installed and all mechanical and electrical connections completed, EXCEPT ENERGIZING THE POWER LINE, the following points of inspection are recommended:

1. Ensure the breaker is properly leveled and securely anchored.
2. Make a final check of tightness of all hardware.
3. Check that the heaters work.
4. Securely tighten terminal and ground connections.
5. Check control cable entrance fittings for tightness.
6. Operate the breaker from the control box to verify normal operation.
7. Secure all doors and ensure proper gasketing for weather.
8. Ensure that all tools are removed.

## 9.0 INSPECTION, MAINTENANCE AND ADJUSTMENT

The R-MAG is an extremely simple device and will require minimal maintenance depending on the frequency of operation and local environmental conditions.

The safety and successful functioning of any apparatus or system connected with the breaker depends to a large extent on the proper and reliable operation of the unit.

To provide long reliable service, the breaker must have systematic inspection at regular intervals. Operating experience based on environmental conditions, the number of operations, magnitude of current and any unusual operation which occurs, will soon establish a maintenance schedule which will give assurance of proper breaker reliability. The following check list is a minimum guide.

1. Check the phase assemblies for external damage and clean if contamination is evident.
2. Lubricate wear points and all pins in linkage assemblies with grease.
3. Check contact wear. As a vacuum interrupter continues to perform, material from the butt contacts is gradually eroded away, and the moving contact is driven deeper into the interrupter by the operating mechanism. The over-travel spring at the upper end of the operating rods ensures that proper contact pressure is maintained in the closed position. Contact erosion reduces the compression of the over-travel spring, which in turn increases the contact travel. (Total travel of the actuator is fixed.) See 9.2 steps 9-11 for minor adjustments.

   Contact wear can be visually inspected. A line is scribed on the moving contact stem 0.08” from VI end guide. When the line reaches the VI end guide, replace vacuum interrupters. **Figures 3-7 and Procedures 9.1 and 9.2.**

   Contact wear can also be monitored by interruption magnitudes and quantity.
4. Verify that the breaker operates correctly using the electrical controls.
5. A Hi-Pot test can be made to verify the vacuum integrity.


**RADIATION WARNING:** High voltage applied across an open gap in a vacuum can produce X-radiation. No radiation is emitted when the breaker is closed since no gap exists. Also, when the breaker is open to the specified contact spacing in service or tested within the voltages specified, X-radiation at one meter is below the level of concern. A danger could exist at voltages above or contact spacing below that specified on the nameplate.

A. With the breaker in the open position, jumper both sets of three top terminals. Ground one set of terminals and the housing. Connect the high voltage to the other set of terminals.

B. Stand clear more than one meter before energizing the high voltage source.

C. Do not exceed 37.5 kV.

D. If internal flashover occurs, isolate the phases and test each one independently to identify the defective interrupter. Any defective pole assembly must be replaced prior to the breaker being in service.

5. **Contact Resistance:** Measure contact resistance with suitable equipment rated not less than 100 A. The value should not exceed 150 micro ohms.

**9.1 Replacement of Vacuum Interrupter** (See Figures 3-7)

With R-MAG breaker in the open position:

1. Remove 1/2 x 12 bolt (H) through the Contact Block (C) on moving end of the Vacuum Interrupter (VI).

2. Loosen Hex (F) nut one turn on Bolt stem (E) attached on moving end of the VI.

3. Remove X-washers and pins on Triangle Bell crank at Pivot Bracket and Bolt Stem.

4. Swing Pull Rod (A) away and remove Bolt Stem ensuring Hex nut remains in position.

5. Wedge large screwdriver tip to spread gap on the Contact Block. (This will allow the threaded moving end of the VI to easily spin out of the Contact Block in step 7.)

6. Remove bus at fixed end of the VI.

7. Rotate VI counterclockwise (CCW) until it is completely free of the Contact Block.

8. Install new VI, carefully ensuring the VI spins in to the Contact Block without any resistance. The bellows portion of the VI is very sensitive to torsion forces. Ensure VI is completely against the bus at the moving end of the VI and the VI stem is flush with Contact Block. Remove screwdriver used to spread Contact Block.

9. Replace the bus on fixed end of the VI.

10. Replace Bolt Stem to location one turn from tight, with pin hole horizontal.

11. Replace Pin and X-washer at Pivot Bracket.

12. Refer to 9.2 for adjustment instructions prior to replacing the pin through Bell Cranks and Bolt Stem.

**9.2 Contact Travel and Over-Travel Adjustment** (See Figure 7)

With the breaker in the open position:

1. Loosen Locknut (F) on Bolt Stem (E).

2. Remove Pin (B) while applying pressure from the back of the Contact Block. Allow Contact Block to move slowly to closed position. Caution: finger pinch point.

3. Loosen Pullrod Locknut (D).

4. Turn Pullrod until center of hole for Pin (B) is 1.687” from Contact Block (C). (This step sets a reference point for the Bell Cranks.)

5. Spin Bolt Stem (E) until Pin (B) can be inserted and then remove Pin (B). (This step establishes a reference from VI Contact to the bell cranks.)

6. Spin Bolt Stem (E) 6-6.5 full turns (6.5 turns is preferred final travel, but 6 acceptable prior to contact conditioning) CW. (This step sets the Contact Travel.)

7. Pull from back of Contact Block (C) until Pin (B) can be inserted.

8. Install new X-washer and tighten all hardware. Do not reuse washers.

9. Measure Travel and Over-Travel by opening and closing breaker. Confirm breaker is within limits. Minor adjustments can be made by turning pushrod (A).

10. Over-Travel Limits (Gap produced at top of Pullrod while closed) are MIN 0.17”, MAX 0.260”.

11. Travel Limits (Difference in measurements between Contact Block in open and closed position) are 10.5 mm - 12.5 mm (0.413”-0.492”).

Operate breaker a minimum of 200 times to season new contacts, readjust breaker (Step 9).

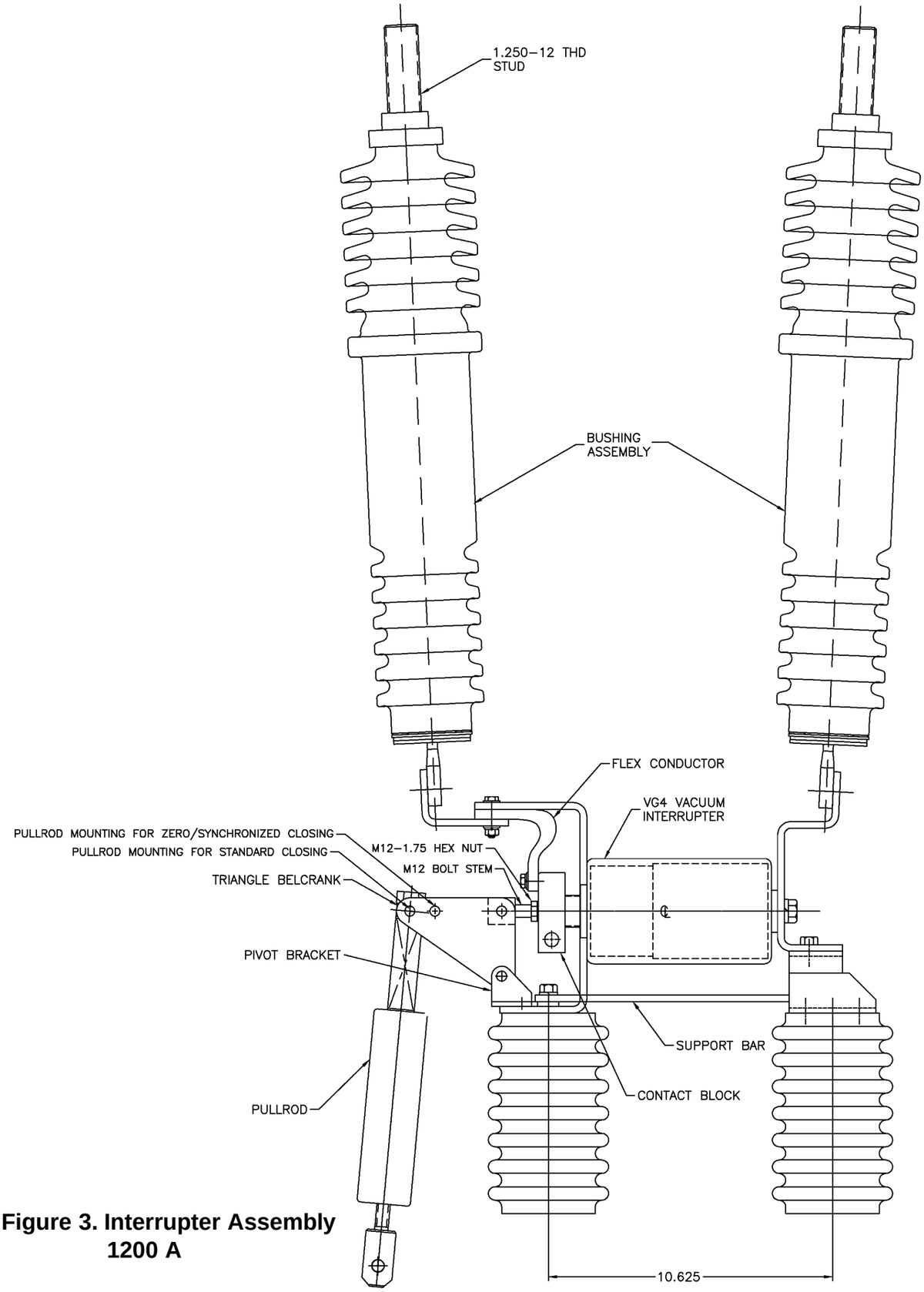



**Figure 3. Interrupter Assembly 1200 A**

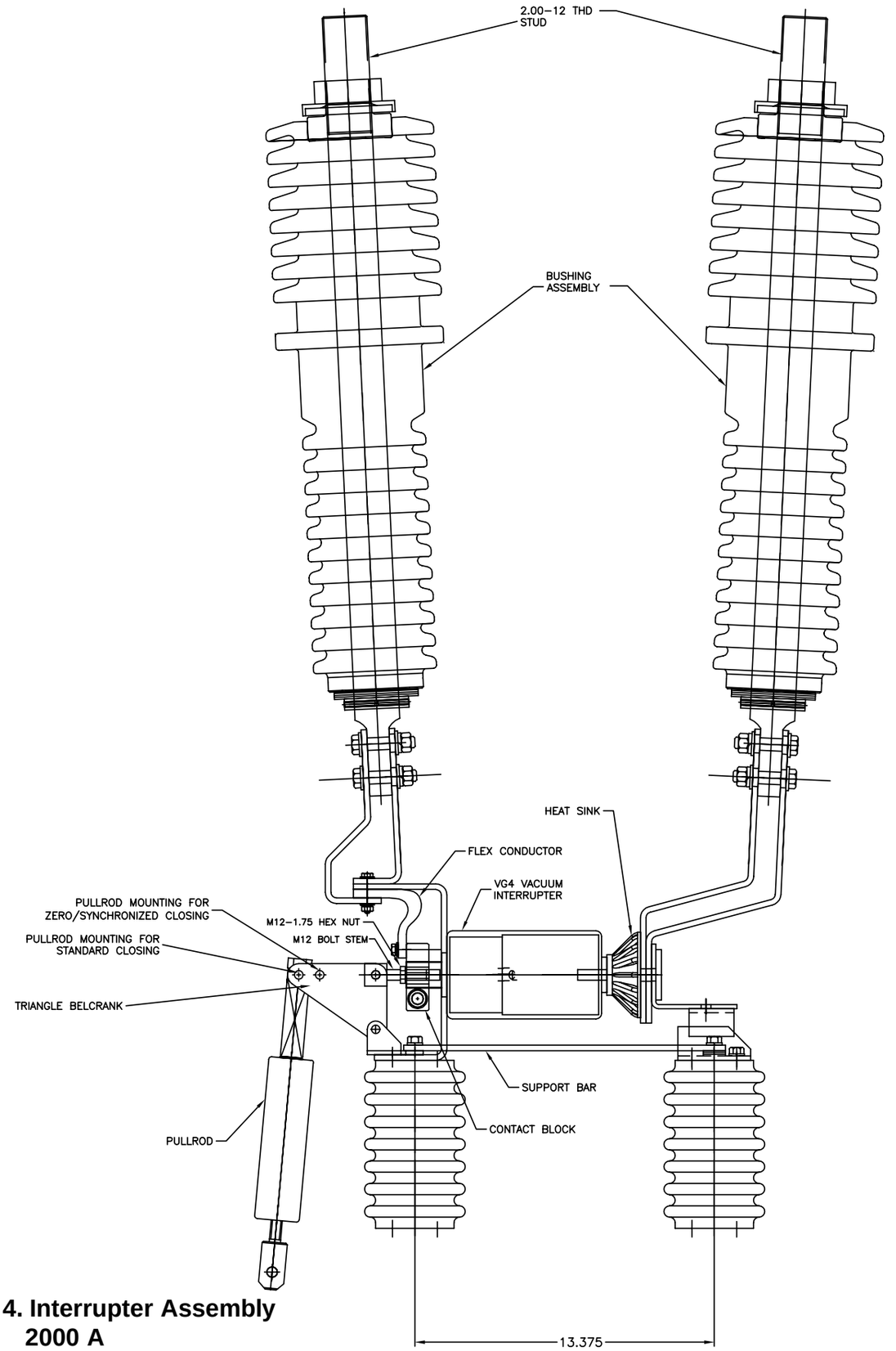



**Figure 4. Interrupter Assembly 2000 A**

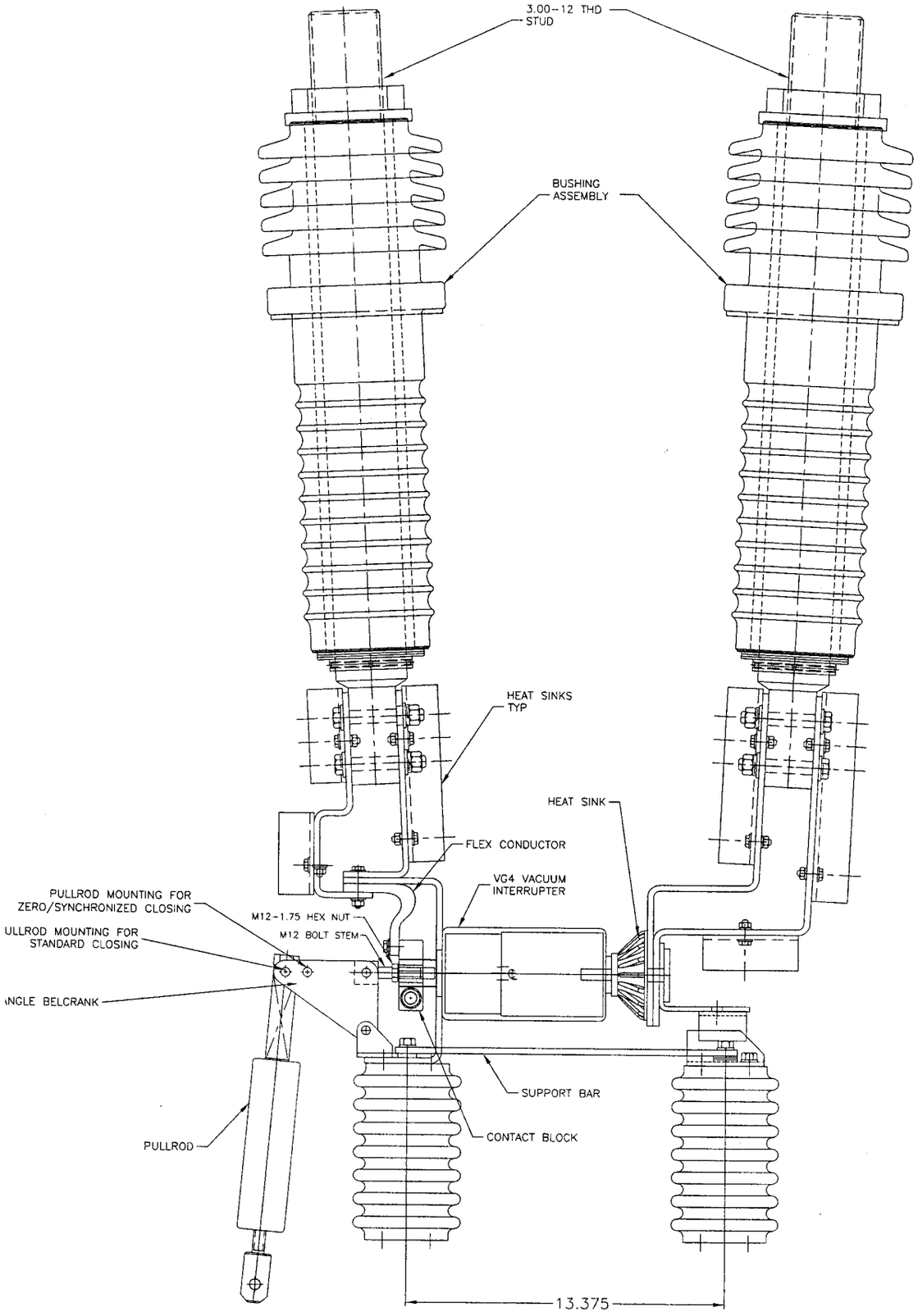



**Figure 5. Interrupter Assembly**
**3000 A**

**Permissible number of vacuum interrupter operating cycles n as a function of the breaking current $I_a$ for 15 kV R-MAG Vacuum Interrupter.**

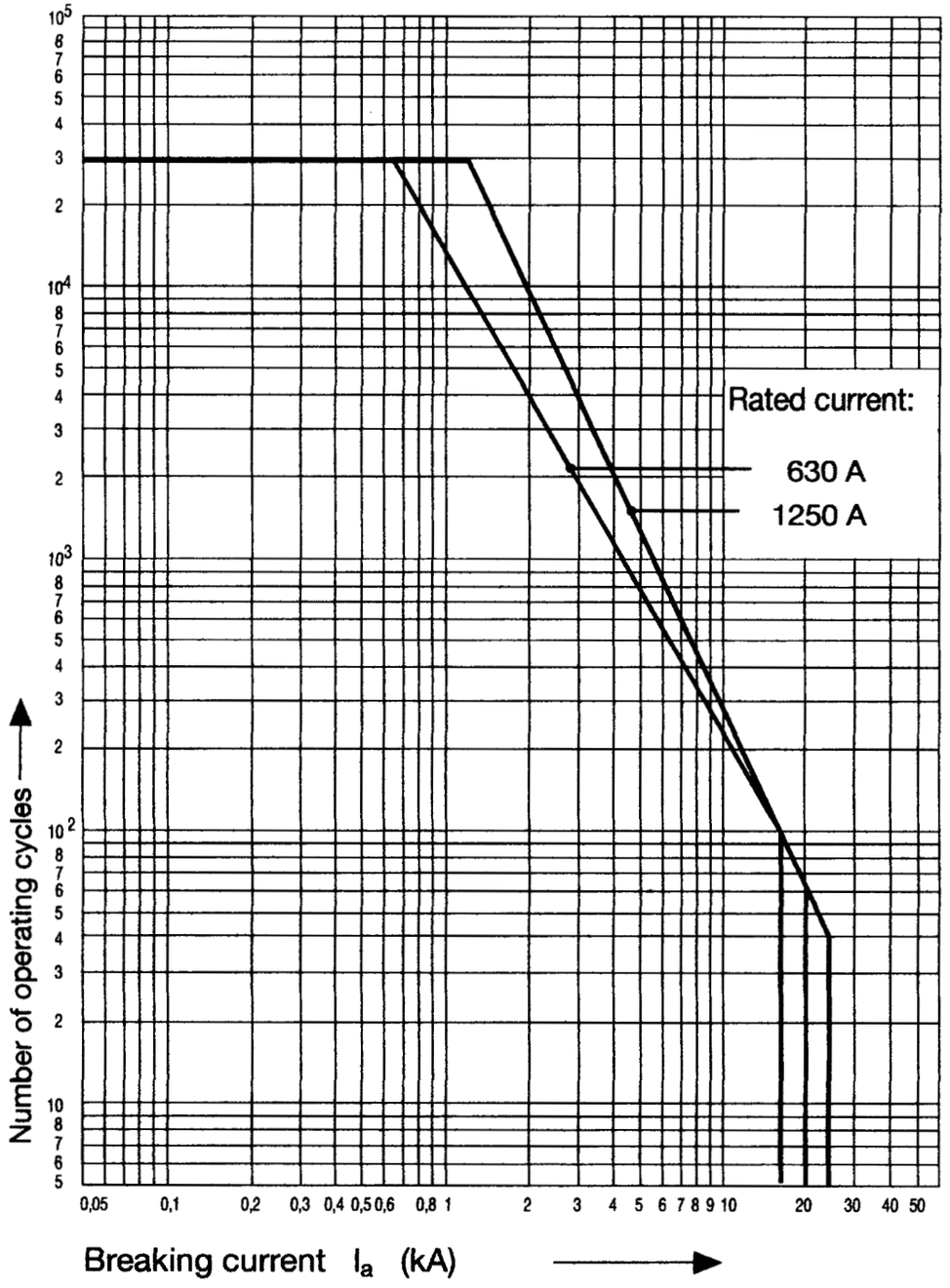



**Figure 6. Contact Erosion Graph**

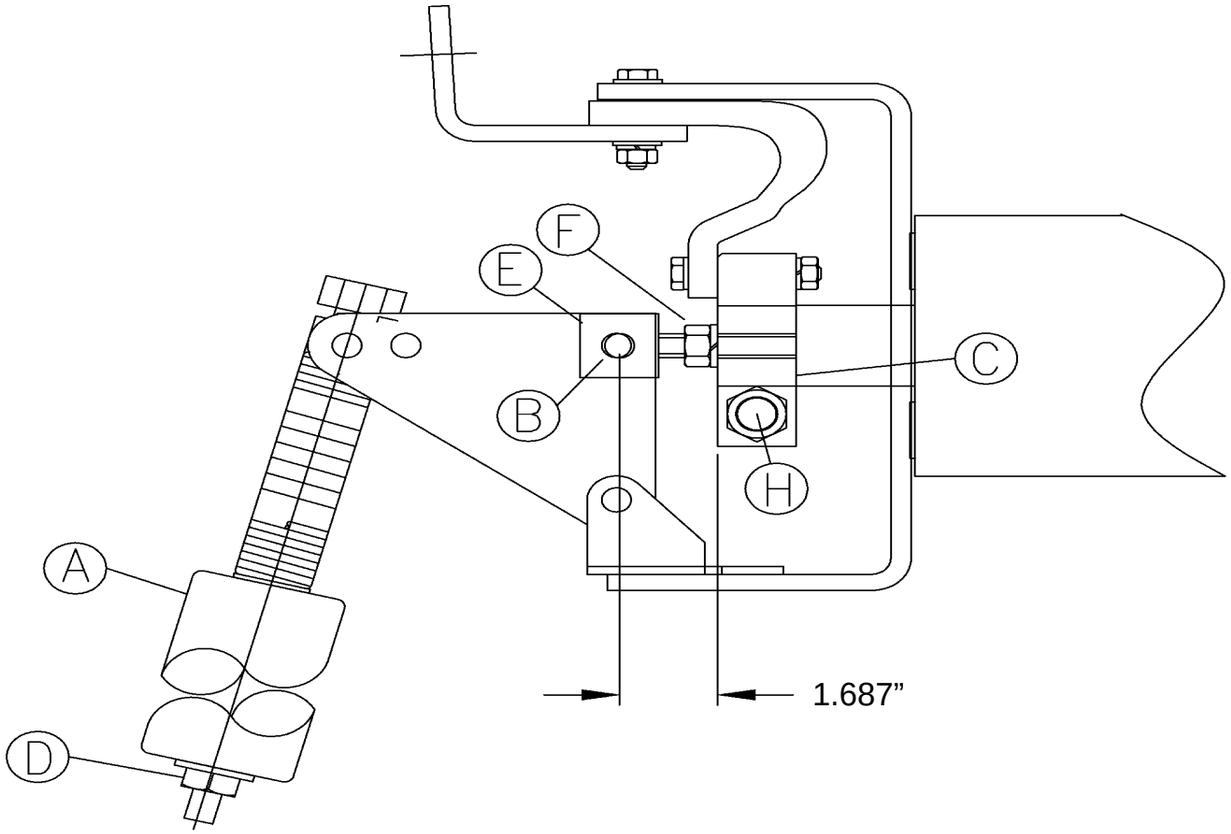



**Figure 7. Contact Travel and Over-Travel Adjustment**

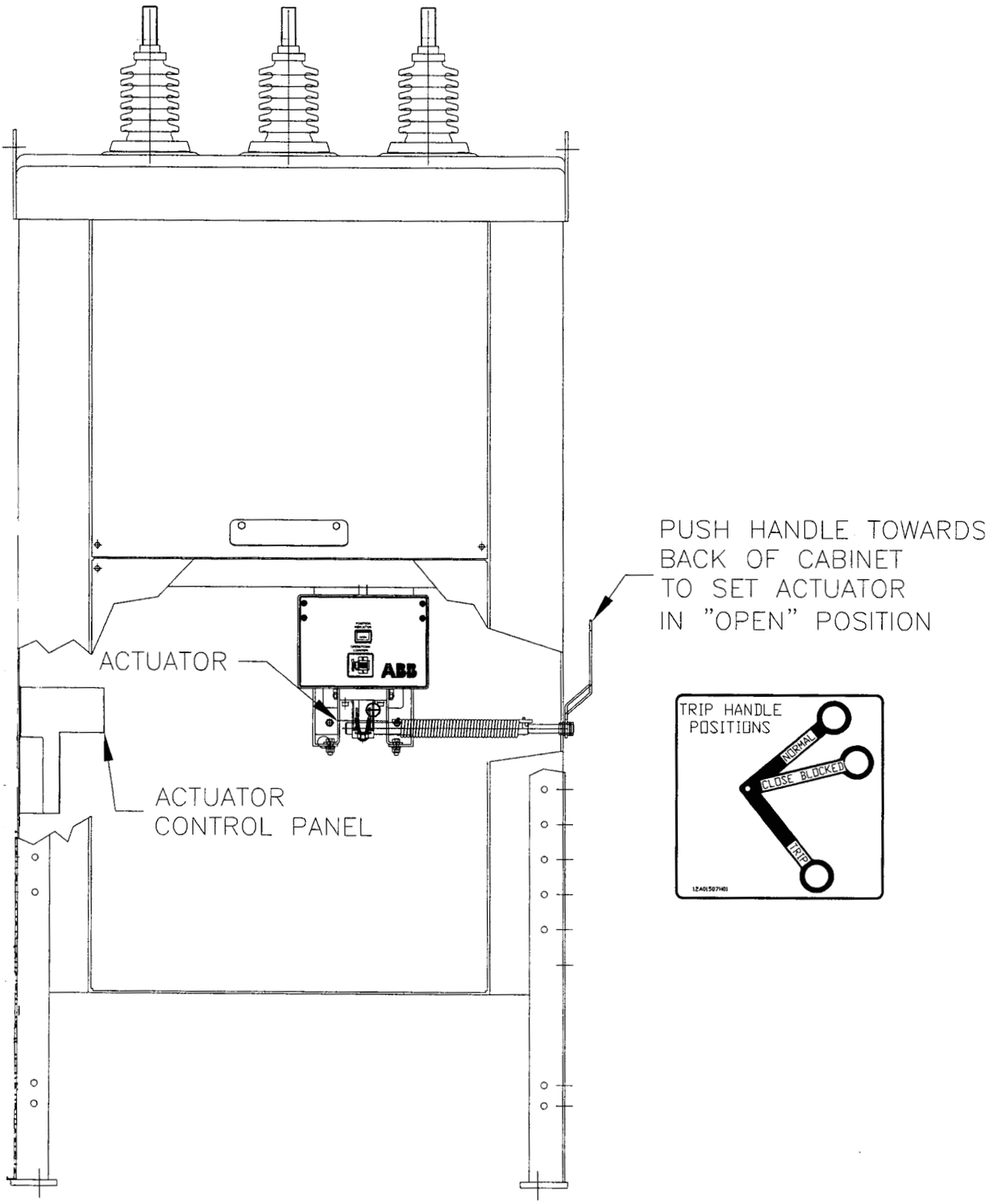



**Figure 8. Trip Handle**

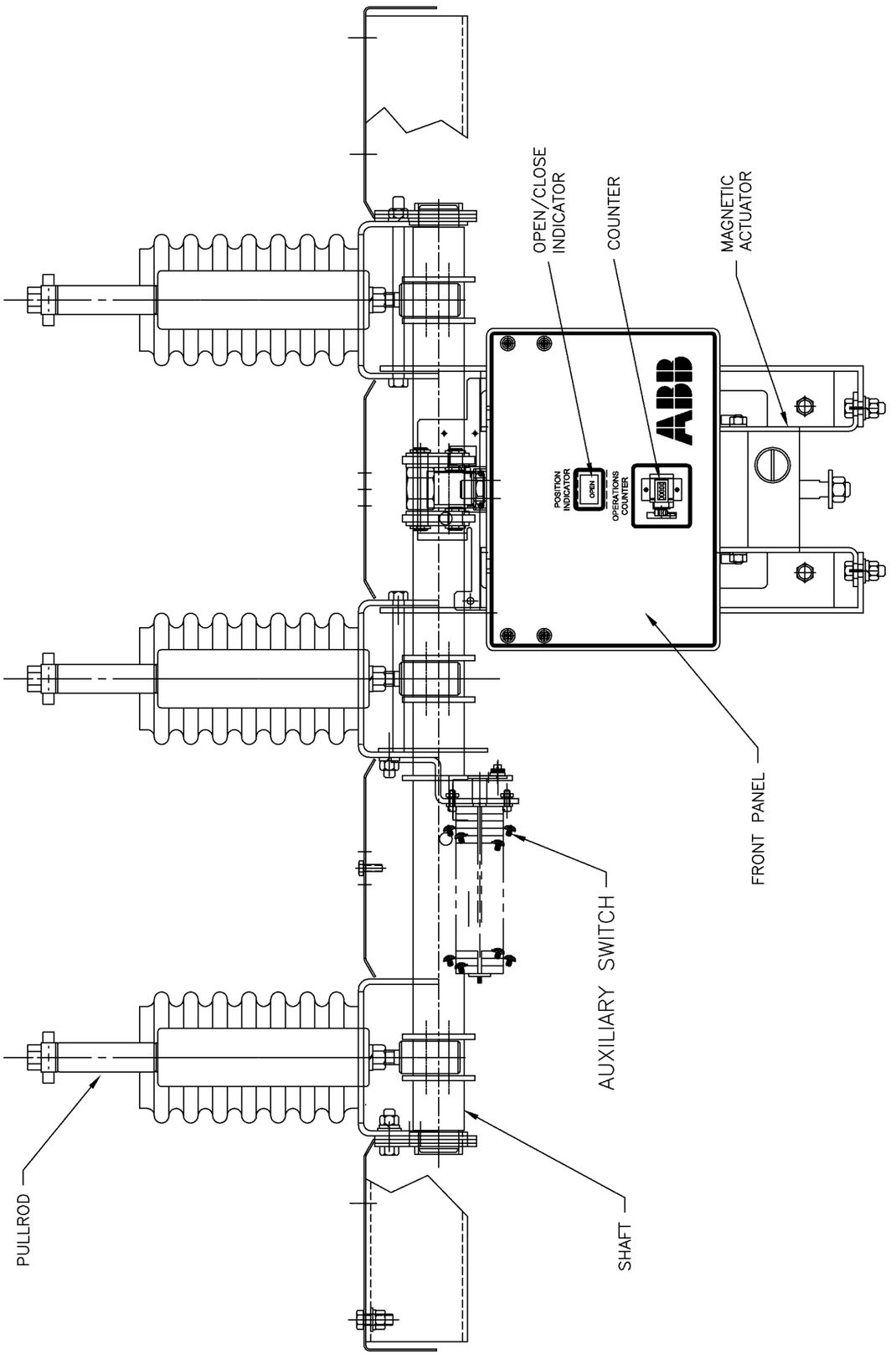



**Figure 9.**
**High Voltage Cabinet Layout**

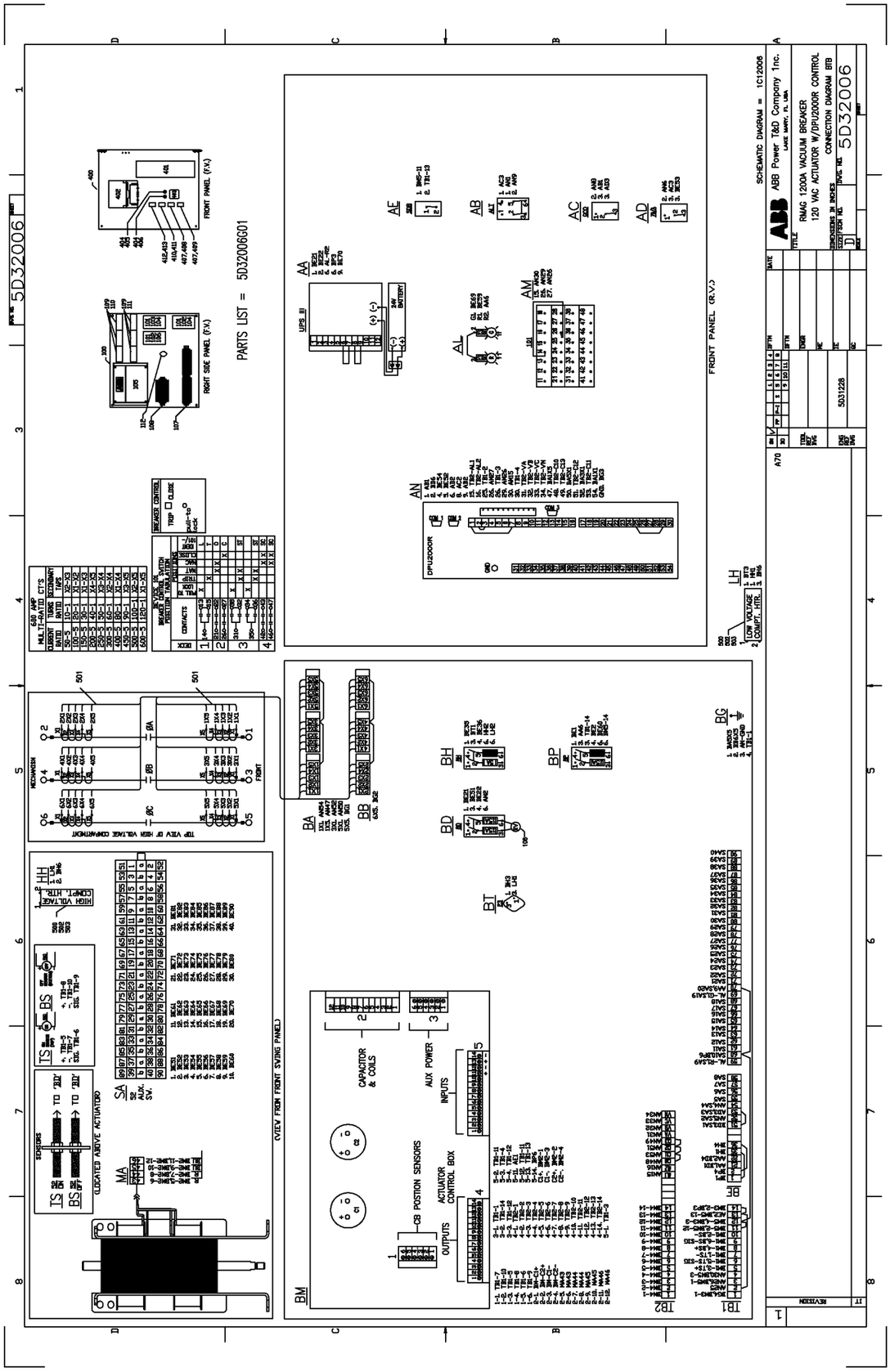



**Figure 10. Typical Schematic Diagram**

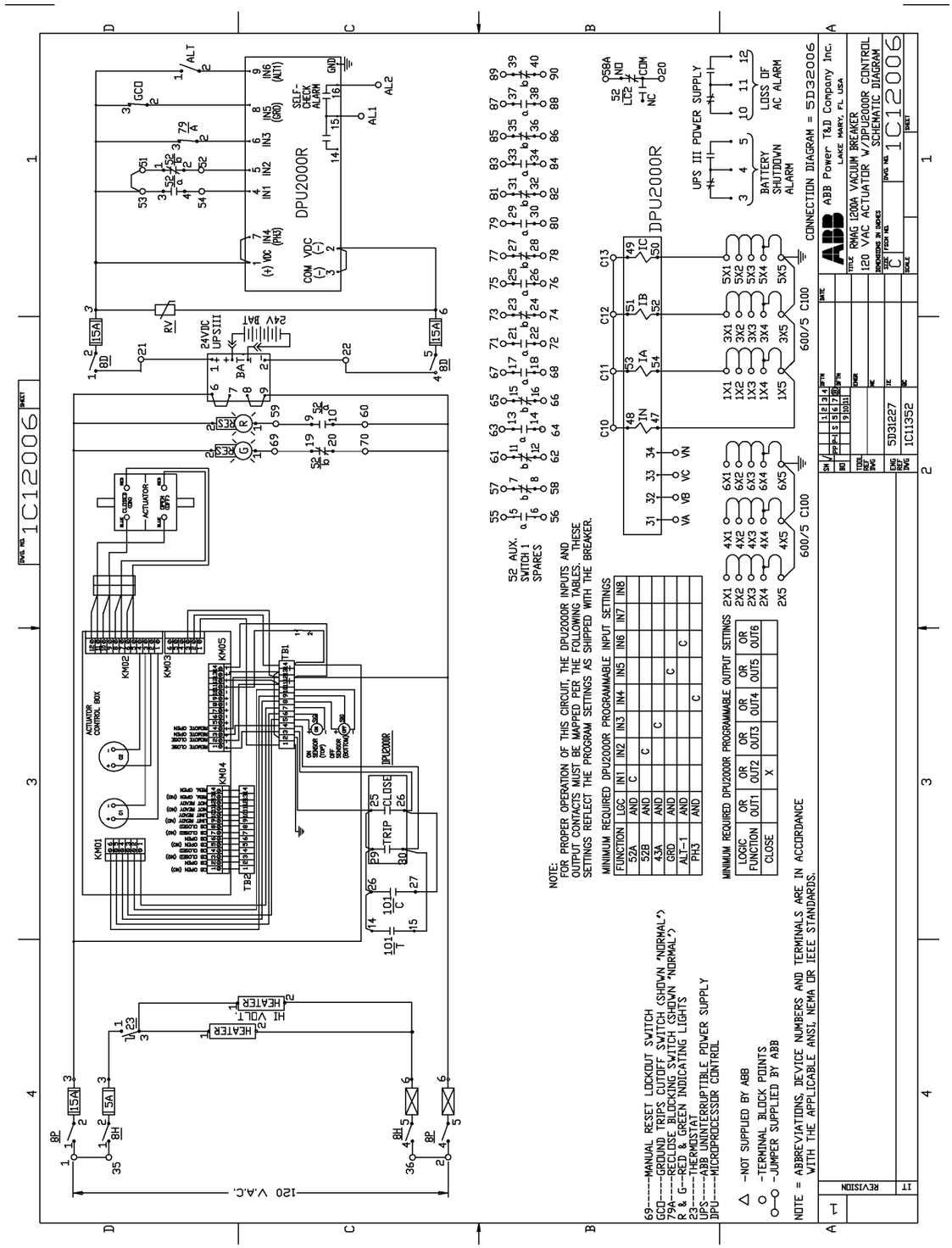



**Figure 11. Typical Connecting Diagram**

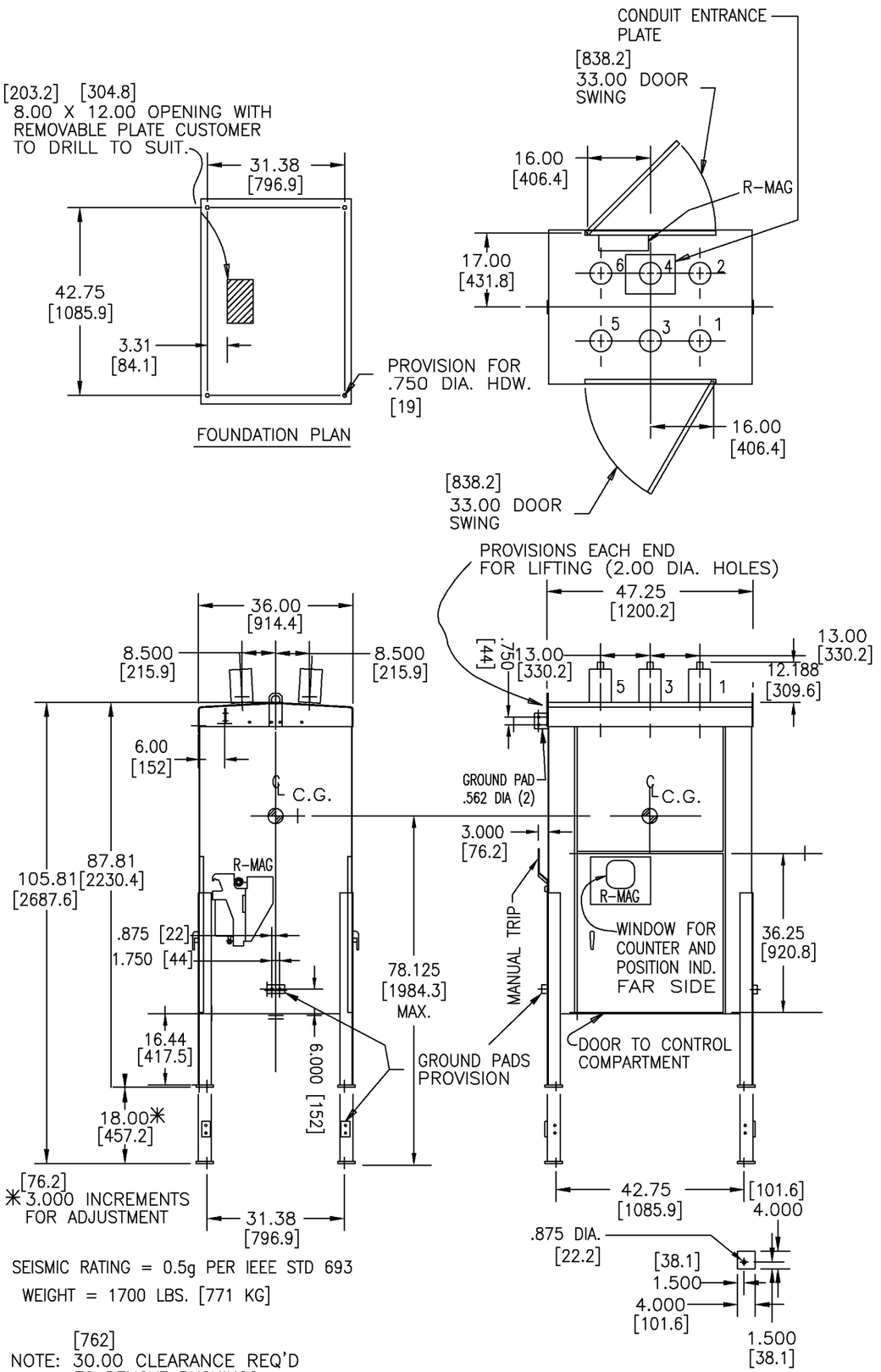



**Figure 12. Typical Outline 1200 A**

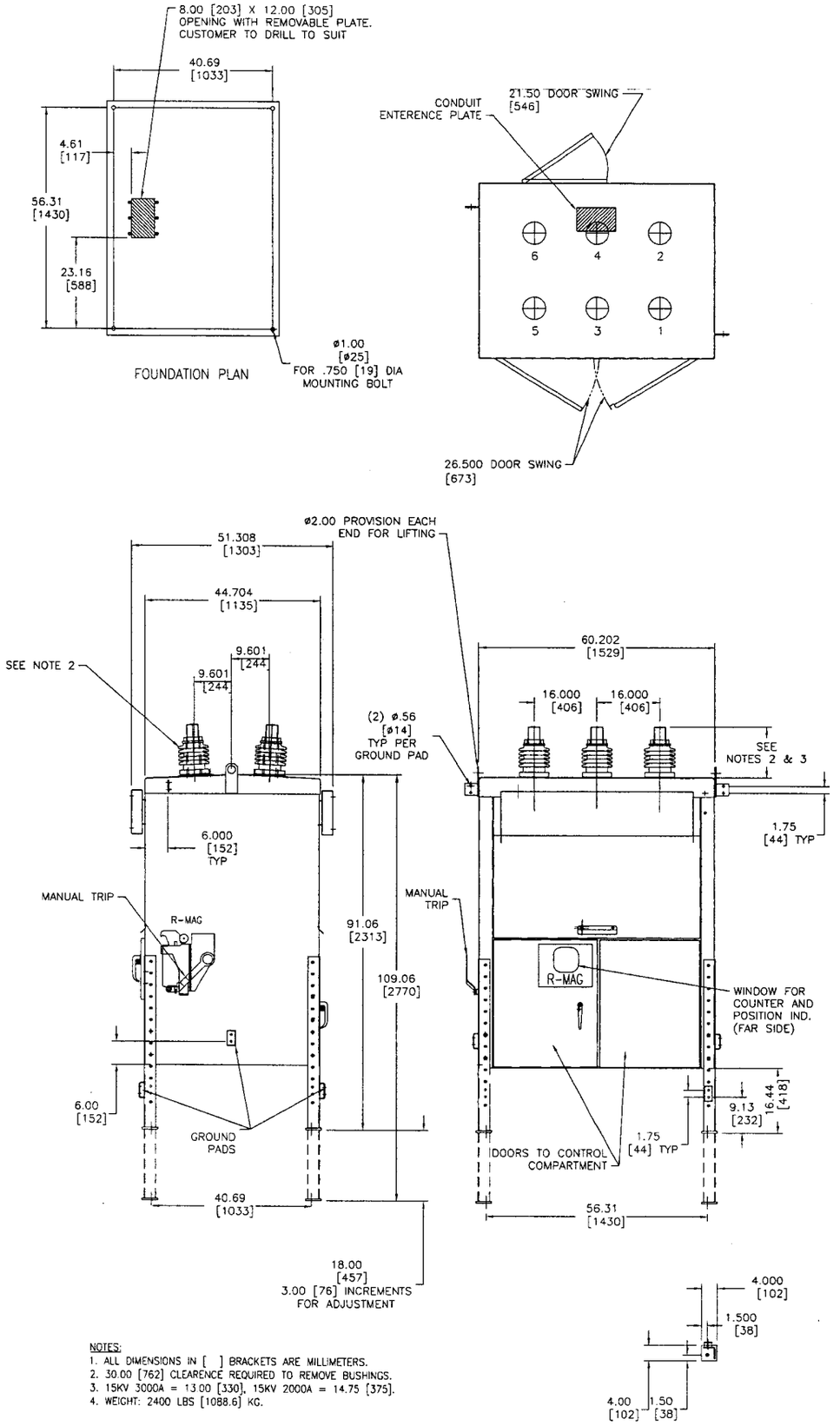



**Figure 13. Typical Outline 2000, 3000 A**

## 10.0 R-MAG ELECTRICAL SPECIFICATIONS

| | |
|---|---|
| Rated Maximum Voltage | 15.5 kV |
| Voltage Range Factor, K | 1.0 |
| Full Wave Withstand | 110 kV |
| Continuous Current | 800 A/1200 A/2000 A/3000 A |
| Temperature Range | 50°C - 70° C |
| Dielectric Strength | |
| Low Frequency Withstand | |
| Dry 60 Hz 1 minute | 50 kV RMS |
| Wet 60 Hz 10 seconds | 45 kV RMS |
| Minimum Creep to Ground (External) | 17.8 Inches |
| ANSI Standard Operating Duty | O-0.3s-CO-3Min-CO** |
| Interrupting Time | 3.0 cycles (seconds) |
| Permissible Tripping Delay (Y) | 2 seconds |
| Reclosing Time | 0.3 seconds |
| Short-Circuit (At Contact Part) RMS | *12.5 kA/25 kA |
| Asymmetry Factor | 1.2 RMS |
| Close and Latch (Initial Current Loop) Peak | *32.5 kA/65 kA |
| Transient Recovery Voltage (time to peak is 36 µsec) | 29 kV Peak |
| Load Current Switching Capability | 1250 A |
| Rated Line Charging Breaking Current | 100 A |
| Rated Cable Charging Breaking Current | 400 A |
| Rated Isolated Capacitor Bank Breaking (Definite Purpose) | 400 A |
| Rated Back-to-Back Capacitor Bank Breaking (Definite Purpose) | 400 A |
| Rated Capacitor Bank Inrush Making | 20 kA |
| Rated Capacitor Inrush Frequency | 4240 Hz |
| Mechanical Life | |
| Between Servicing | 2,000 |
| No-Load Mechanical | 10,000 |
| Continuous Current Switching | 10,000 |
| Inrush Current Switching | 200 |

*Breaker available as either 12.5 kA (Close and Latch Rating is 32.5 kA) or 25 kA (Close and Latch Rating is 65 kA).

**Operating duty conforms to old ANSI Standard (actual time can be CO-15 Sec-CO).

## CURRENT TRANSFORMER CONNECTIONS

| 600:5 MULTI-RATIO CURRENT XFORMER | | | 1200:5 MULTI-RATIO CURRENT XFORMER | | |
|---|---|---|---|---|---|
| **TERMINAL** | **RATIO** | **OHMS @ 25°C** | **TERMINAL** | **RATIO** | **OHMS @ 25°C** |
| X2-X3 | 50-5 | .015 | X2-X3 | 100-5 | .052 |
| X1-X2 | 100-5 | .029 | X1-X1 | 200-5 | .104 |
| X1-X3 | 150-5 | .044 | X1-X3 | 300-5 | .156 |
| X4-X5 | 200-5 | .058 | X4-X5 | 400-5 | .208 |
| X3-X4 | 250-5 | .073 | X3-X4 | 500-5 | .260 |
| X2-X4 | 300-5 | .088 | X2-X4 | 600-5 | .312 |
| X1-X4 | 400-5 | .117 | X1-X4 | 800-5 | .416 |
| X3-X5 | 450-5 | .131 | X3-X5 | 900-5 | .468 |
| X2-X5 | 500-5 | .146 | X2-X5 | 1000-5 | .520 |
| X1-X5 | 600-5 | .175 | X1-X5 | 1200-5 | .624 |

| VOLTS | NON INDUCTIVE CIRCUITS MAKE AND BREAK (A) | INDUCTIVE CIRCUITS MAKE AND BREAK (A) | CONTINUOUS RATING (A) |
|---|---|---|---|
| **24/48 VDC** | **16** | **16** | **20** |
| **125 VDC** | **10** | **10** | **20** |
| **250 VDC** | **5** | **5** | **20** |
| **115 VAC** | **15** | **15** | **20** |
| **230 VAC** | **10** | **10** | **20** |

## AUXILIARY SWITCH CURRENT SPECIFICATIONS

- Tested per UL Document 1054. AC tests specs with one set on contacts. DC tests specs with 2 sets of contacts in series.
- Contacts will carry 140 A for 3 seconds.
- Overload test – 50 operations at 90 A and 120 VAC.

## ED2.0 BOARD VOLTAGE REQUIREMENTS

| CONTROL RANGE | LOW VOLTAGE BOARD | HIGH VOLTAGE BOARD |
|---|---|---|
| BINARY INPUTS AC - KM1005* (INCLUDES TRIP AND CLOSE) | 20.4 VOLTS TO 264 VOLTS OPENING COMMANDS CAN GO AS LOW AS 16.8 VAC | 20.4 VOLTS TO 264 VOLTS OPENING COMMANDS CAN GO AS LOW AS 16.8 VAC |
| BINARY INPUTS DC – KM1005* (INCLUDES TRIP AND CLOSE) | 20.4 VOLTS TO 264 VOLTS OPENING COMMANDS CAN GO AS LOW AS 16.8 VDC | 20.4 VOLTS TO 264 VOLTS OPENING COMMANDS CAN GO AS LOW AS 16.8 VDC |
| AUXILIARY POWER AC - KM1003* | 20.4 VOLTS TO 52.8 VOLTS | 85 VOLTS TO 264 VOLTS |
| AUXILIARY POWER DC - KM1003* | 16.8 VOLTS TO 75 VOLTS | 77 VOLTS TO 280 VOLTS |

**NOTE:** The threshold for the binary inputs occurs at approximately 18 VDC or 19 VAC. The threshold for the Protection Relay input is approximately 7 VDC.

*Refer to schematic on page 44.

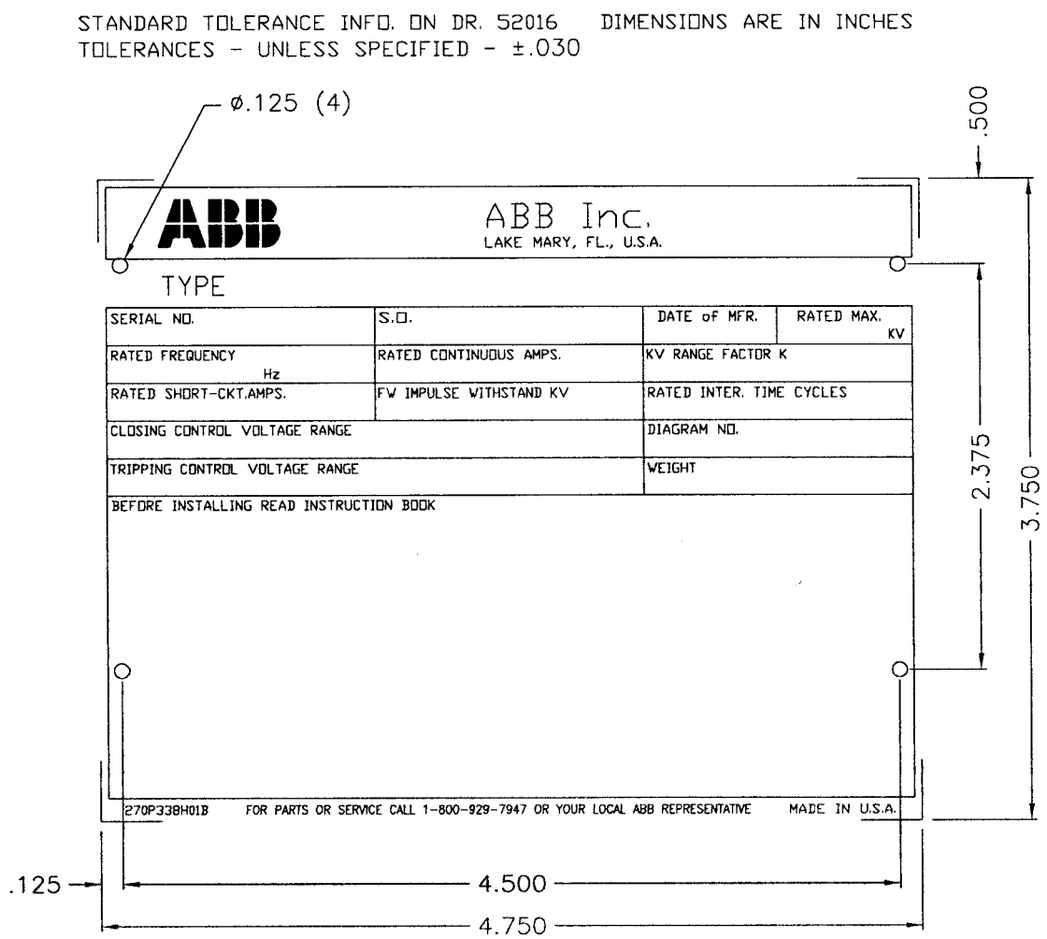



**Figure 14. Breaker Nameplate**

## 11.0 RENEWAL PARTS

A2+ Actuator .....GGE7004390R0105
VG4 Interrupter .....1B09608H01
VG4 Interrupter Assembly .....1C11166G01
ED2.0 Control Assembly (HV/LV) .....1B09551(608/607)
Electrolytic Capacitor (100V) Assembly .....12A01272G01
ED2.0 Board (HV/LV) .....751010/(810/809)

Renewal parts available from ABB exclusively. Contact your local ABB office.

# APPENDIX A

INSTALLATION / MAINTENANCE INSTRUCTIONS

*R-MAG Medium Voltage*

*Vacuum Power Circuit Breaker*

## ED2.0 MAGNETIC ACTUATOR CONTROL BOARD

# TABLE OF CONTENTS

## 1.0 OVERVIEW

The ED2.0 electronic control board is comprised of a Power Supply Recharge Unit, Control Unit, and FET Switching circuit which connects the Storage Unit Capacitors to the Magnetic Actuator coils.

The power supply recharge circuitry adapts whatever input voltage, within the specified range (Section 2.0), is supplied to maintain an 80 V charge voltage across the capacitors. The Control Unit monitors binary inputs and outputs, hardware and software configurations, position sensors, capacitor charge, and switches the FET circuit to connect the capacitor voltage to the Magnetic Actuator coils following an open or close command.

The Capacitor Storage Unit consists of two 0.1 microfarad Aluminum Electrolytic capacitors connected in parallel to provide a total capacitance of 0.2 microfarads. The energy stored is approximately 640 Joules. When called to energize the Magnetic Actuator coils, the capacitors will deliver a peak current of approximately 35 A and a pulse width of 45 milliseconds for opening operations and 60 milliseconds for closing operations.

The ED2.0 board also provides access, through KM1003 for external charging and discharging of the Storage Unit capacitors. A 10 kOhm capacitor discharge resistor is mounted on the circuit board. Discharging is done by jumpering KM1003 pins 5 and 6. The time constant is 33 minutes. An external resistor can be used for quicker discharging, but the discharge current should be restricted to 10 A maximum. An external resistor can be used for quicker discharging, but the discharge current should be restricted to 10 A maximum. This means that no lower than 10 ohms external resistance should be used to perform capacitor discharging. In this case an external 10 ohm, 25 watt resistor can be connected to KM1003 Pins 5 and 6. Approximately 40 seconds is needed to discharge the capacitors using the 10 ohm external resistor.

The MTTF for the ED2.0 Control Board (Mean Time To Failure) is 30 years.

The ED2.0, with external circuitry, system Block Diagram is given in Illustration 1 below.

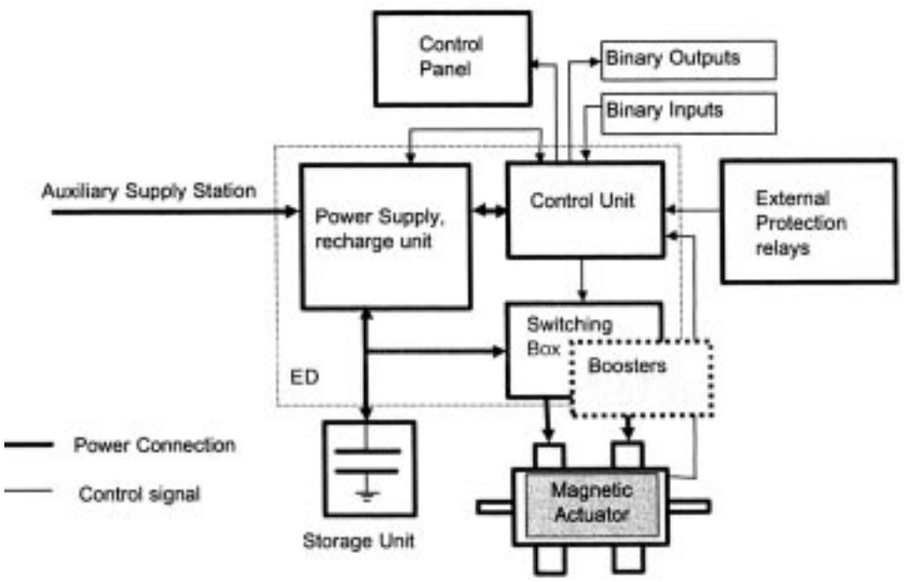



**ILLUSTRATION 1 – ELECTRICAL SYSTEM BLOCK DIAGRAM**

## 2.0 ED2.0 BOARDS AVAILABLE/MAGNETIC ACTUATOR COIL ENERGIZING CAPACITOR

1. Low voltage full optional board Part Number 751010-809 (24 – 60 VDC or 24 – 48 VAC).
2. High voltage full optional board Part Number 751010-810 (110 – 280 VDC or 100 – 254 VAC).
3. 0.1 microfarad aluminum electrolytic capacitor Part Number 12A01272H01.

## 3.0 ED2.0 CONTROL BOARD HIGHLIGHTS

**IMPORTANT ELECTRONIC DRIVE BOARD FEATURES**

| FEATURE | |
|---|---|
| BINARY INPUTS | 6 |
| FAST/SLOW INPUT | FAST OR SLOW |
| BINARY OUTPUTS | 7 |
| WRONG POSITION AUTO TRIP | YES |
| CAPACITOR VOLTAGE MONITOR | YES |
| COIL CONTINUITY MONITOR | YES |
| PROTECTION TRIP INPUT | YES |
| SAFE OPEN | YES |
| UNDER VOLTAGE AUTO TRIP | YES |
| ENERGY FAIL AUTO TRIP | YES |
| AUXILIARY CAPACITOR CHARGE/DISCHARGE | YES |
| OUTPUT POWER REDUCTION (33 W) | YES |
| JTAG PORT FOR SERVICE AND UPGRADE DOWNLOAD | YES |
| RS232 PORT FOR SERVICE DOWNLOAD | YES |
| TEMPERATURE PROTECTION | YES |
| INRUSH LIMIT | YES |

**ILLUSTRATION 2 – MAIN ED2.0 BOARD FEATURES**

### 3.1 CIRCUIT BREAKER OPEN LOCK (69 SWITCH)

The Open Lock feature is used for service to prevent the breaker from being closed (either locally or remotely) during maintenance. The pin locations for this binary input are KM1004 pins 11 and 12. When the circuit breaker is tripped, by operating the manual trip handle, the breaker will go into the Open Lock mode. This prevents any future closings until the Trip Handle is returned to the Normal Position. The Manual Trip Handle must be left in the down position for the switch to remain open (i.e., locked open).

### 3.2 TEMPERATURE PROTECTION

The Temperature Protection circuit monitors the average temperature of a critical area on the ED2.0 power supply. The output power will be linearly reduced to zero as the temperature increases from 78 degrees C to 95 degrees C.

### 3.3 FAST VS SLOW INPUTS

The Slow Input needs to be active at least 10 milliseconds before the signal is considered valid. The Fast Input only requires the input to be active for 2 milliseconds before the signal is considered valid. However, this makes the Fast Input feature more prone to noise.

### 3.4 ACTUATOR CLOSE AND TRIP COIL CONTINUITY MONITOR

See Illustration 10 - Troubleshooting Guide.

### 3.5 WRONG POSITION AUTO TRIP

An Auto Trip command will be issued in the event the breaker does not perform a successful close operation within 95 milliseconds after the close command is issued.

**CAUTION**

**If power is removed from unit, and the Dip Switch I1004-1 is placed in the “on” position, the breaker will automatically trip in approximately 3 minutes. Make sure personnel and tools are clear from breaker. See Section 3.6 below.**

### 3.6 ENERGY FAILURE AUTO TRIP

The Energy Failure Auto Trip function is selected by Dip Switch I1004-1 and will cause the breaker to auto trip in the event the capacitor voltage falls below 49 volts. Necessary precautions must be taken when power is removed (e.g., power removed for maintenance) as the breaker will automatically trip if I1004-1 is in the “On” position.

### 3.7 REDUCED POWER CONSUMPTION

The Reduced Power Consumption setting will lower the power output of the power supply recharge unit, on the ED2.0 board, from 75 W power to 33 W. This enables the ED2.0 board to be supplied with the energy delivered by a voltage transformer if necessary. The Power Supply Recharge Unit is 80% efficient. This means that the Auxiliary Power supply input must be at least 93.75 W for the 75 W setting or 41.3 W for the 33 W setting. The 33 W option is hardware selectable with Jumper J1001.

### 3.8 RS232 PORT (KM1009)

The RS232 Port can be used for software download using a batch file in DOS window. Upgrades can also be performed through this port but by ABB factory only.

### 3.9 JTAG COMMUNICATION PORT (KM1008)

The JTAG Communication Port can be used for software upgrades also. Additionally, it can be used for software debug and software checksum using a JTAG Emulator Interface and code compose development tool by Texas Instruments. It can be used by ABB factory only.

## 4.0 BINARY INPUTS

Binary input channels work properly with a voltage range of 24 to 264 VAC/DC regardless of which board is used. All inputs have a low threshold at about 18 VDC and 19 VAC with the exception of the Protection Relay input, which has a low threshold of about 7 VDC. To avoid false triggering by noise, the inputs must be active for at least 10 milliseconds. A Fast Input mode is available so that the input can be selected after only 2 milliseconds. Choosing the Fast Input mode may make the board more sensitive to nuisance opening or closing operations. The current draw for most inputs is < 2 milliamperes. The exception is the Remote Open and Close inputs, which draw up to approximately 20 milliamperes. The input impedance (Z) is 300 kOhms except for binary inputs 1 and 2 (Remote open and close) which are around 14 kOhms input Z.

There are seven different input channels. Only six of them are used for our products: 1) Remote Open, 2) Remote Close, 3) Auxiliary/Safe Open, 4) Protection Trip/2nd Trip, 5) Circuit Breaker locked open, 6) Under Voltage Input. Input channels 2 and 3 are broken out in the list below because they each have two programmable functions.

### 4.1 REMOTE OPEN (KM1005 Pins 1 and 2)

The Remote Open input is used to trip breaker remotely. The input impedance is approximately 14 kOhms.

### 4.2 REMOTE CLOSE (KM1005 Pins 3 and 4)

The Remote Close input is used to close the breaker remotely. The input impedance is approximately 14 kOhms.

### 4.3 AUXILIARY OPEN (KM1005 Pins 5 and 6)

The Auxiliary Open function is the same as the Remote Open function with the exception of the input impedance which is approximately 300 kOhms.

### 4.4 SAFE OPEN (KM1005 Pins 5 and 6)

The Safe Open input is connected to the same pins as Step 4.3 above. It is programmed as either mode via a dip switch. This input functions as all open inputs above, with the exception that it has maximum priority over all other inputs.

### 4.5 PROTECTION TRIP (KM1005 Pins 7 and 8)

The Protection Trip input is designed to work at a lower threshold of 7 VDC. This input is provided to use with special protection relay requirements. It can also be used as a normal trip input. It is programmed via Jumper JP1001 Pins 1 and 2 or as a normal input by jumpering JP1001 pins 2 and 3.

### 4.6 SECOND TRIP (KM1005 Pins 7 and 8)

The Second Trip is often referred to as “Shunt Trip.” It functions the same as the Remote Input with the exception of the input impedance which is 300 kOhms.

### 4.7 CIRCUIT BREAKER LOCKED OPEN (KM1005 Pins 11 and 12)

The Circuit Breaker Locked Open feature functions like the familiar 69 switch. The circuit is activated when the external trip handle is moved from its normal position (i.e., in the trip position). In this position the breaker cannot be either locally or remotely closed.

### 4.8 UNDER VOLTAGE TRIP (KM1005 Pins 13 and 14)

The Under Voltage Trip input will perform an auto trip in the event the voltage source being monitored, by this input, falls between 35% to 70% of nominal. It is enabled through DIP Switch I1104/2-3-4. The response of this input also has a programmable time delay from 50 milliseconds to 5 seconds. The delay is set by the various combinations of DIP Switch I1004/2-3-4. The Under Voltage Threshold is set by I1001. See Table below.

| DIP SWITCH I1001 POSITION | THRESHOLD |
|---|---|
| 1 | 100 – 127 VAC/DC |
| 2 | 48 – 60 VDC |
| 3 | 24 – 30 VDC |
| NONE | 220 – 240 VAC/DC |

## 5.0 BINARY OUTPUTS

Binary outputs are simply pairs of mechanical wipe relay contacts. They can be employed to switch in other circuitry or to an alarm indicator. See Illustration 3 and 4 for the power limitations of the contacts. Notice the flat curve for AC voltage in Illustration 4. On the inside of the low voltage cabinet there is a membrane style button plate that contains a “Ready” LED. The Ready light will either flash or turn off depending on the state of the Capacitor voltage, Coil continuity, and the state of the position sensors. The “Unit Ready” output contact can be used to alarm for the more serious of the three types of problems, but will not signal for all levels of the above problems. See Illustration 6.

### 5.1 CIRCUIT BREAKER OPENED (KM1004 Pins 1 and 2)

The Circuit Breaker Opened contacts are normally open. They close only when the circuit breaker is in the Open position.

### 5.2 CIRCUIT BREAKER CLOSED (KM1004 Pins 3 and 4)

The Circuit Breaker Closed contacts are normally open. They close only when the circuit breaker is in the Closed position.

### 5.3 CIRCUIT BREAKER AUXILIARY OPEN (KM1004 Pins 5 and 6)

The Circuit Breaker Auxiliary Open contacts which close whenever the breaker is in the Open position.

### 5.4 CIRCUIT BREAKER AUXILIARY CLOSED (KM1004 Pins 7 and 8)

Additional set of normally open contacts which close whenever the breaker is in the Close position.

### 5.5 UNIT READY (KM1004 Pins 9 and 10)

These contacts are normally open. They close when the breaker is ready. They are used to monitor capacitor charge (O-CO operation ready), valid circuit breaker position, and coil continuity.

### 5.6 UNIT NOT READY (KM1004 Pins 11 and 12)

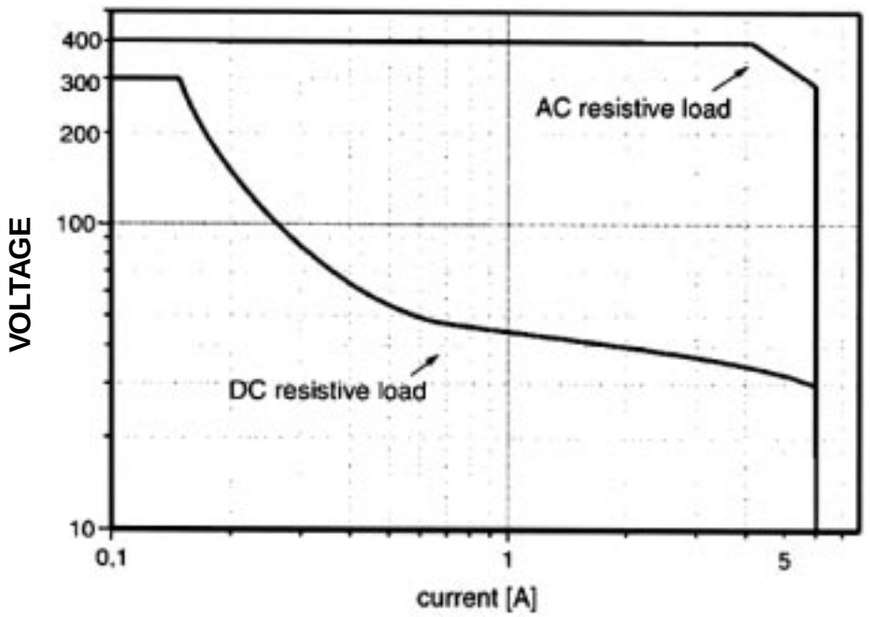
The Unit Not Ready contacts are normally closed. They open when the Unit is Ready. These contacts are the inverse (negative) of the Unit Ready contacts.

### 5.7 CIRCUIT BREAKER REMOTE OPEN (KM1004 Pins 13 and 14)

The Circuit Breaker Remote Open contacts are referred to as the “Fleeting Output Contacts.” This means that they only close for 100 milliseconds after a Remote Operation is performed.

| CHARACTERISTIC | WIPE CONTACTS RELAY |
|---|---|
| *SWITCHING CHARACTERISTICS* | |
| Maximum Switching Power | ≤ 1500 VA on Resistive load |
| Maximum Switching Voltage | 400 VAC, 300 VDC |
| Maximum Switching Current | 6 A |
| Maximum Rated Current | 6 A |
| *CONTACTS CHARACTERISTICS* | |
| Maximum On Resistance (Ron) | 100 milliohms (measured by voltage drop 6 VDC 1 A) |
| Maximum Capacitance | 1.5 pF |
| *TIMING CHARACTERISTICS* | |
| Maximum Actuating Time | 5.0 milliseconds |
| Maximum Releasing Time | 3.0 milliseconds |
| *INSULATION* | |
| Between Contacts and Coil | 4000 Vrms (50 Hz/1 min.) |
| Between Open Contact | 1000 Vrms (50 Hz/1 min.) |
| Resistance (Roff) | >1000 Megohms at 500 VDC |
| *ENVIRONMENTAL CHARACTERISTICS* | |
| Operating Temperature Range | -40 to 85 Degrees C |
| Storing Temperature Range | -40 to 100 Degrees C |
| *Expected contacts life (min. operations)* | |
| Mechanical (at 180 cpm) | 5 million |
| Electrical (6 A / 277 VAC/resistive load) | 30,000 |

**ILLUSTRATION 3 – OUTPUT CONTACT SPECIFICATIONS**




**Load Limit Curve**

**ILLUSTRATION 4 – OUTPUT CONTACT DERATING CURVE**

## 6.0 POWER CONSIDERATIONS

The ED2.0 power supply recharge unit adapts any voltage within the specified range of the board to maintain 80 V across the capacitors. The following voltage thresholds must be reached to complete the specified operations:

1. The capacitor voltage threshold for an Open operation is 49 volts.

2. The capacitor voltage threshold for a Close-Open operation is 72.5 volts.

3. The capacitor voltage threshold for a Open-Close-Open operation is 78 volts.

Illustrations 5 and 6 are provided to indicate the states of the Ready LED, Ready and Not Ready output contacts.

## 6.1 DISCHARGING STORAGE UNIT CAPACITORS

**WARNING**

**Make sure ED2.0 Control Power is removed before attempting to discharge the capacitors. See paragraph below.**

The ED2.0 board provides access through KM1003 for discharging the Storage Unit capacitors. Make sure the ED2.0 Control Board Power is removed before attempting to discharge the capacitors.

**PROCEDURE:**

A 10 kOhm capacitor discharge resistor is mounted on the circuit board. Discharging is done by jumpering KM1003 pins 5 and 6. The time constant is 33 minutes. An external resistor can be used for quicker discharging, but the discharge current should be restricted to 10 A maximum. This means that no lower than 10 Ohms external resistance should be used to perform capacitor discharging. In this case an external 10 Ohm, 25 watt resistor can be connected to KM1003 Pins 5 and 6. Approximately 30 seconds is needed to discharge the capacitors using the 10 Ohm external resistor.

## 6.2 CAPACITOR LIFE

The 0.1 Farad Electrolytic capacitors are designed to be operated in the temperature range of -40°F to 185°F. The End of Life corresponds to the point at which the capacitance decreases by 20% or more. It is recommended that replacement of capacitors be performed every 15 years for tropical climates and 20 years for an average yearly temperature (in the outdoor breaker enclosure) of less than 122°F.

| CAPACITOR CHARGE | CIRCUIT BREAKER POSITION | |
|---|---|---|
| | CLOSE | OPEN |
| Energy sufficient for O-CO operations | Open allowed | Close allowed |
| Energy sufficient for CO operations | Open allowed | Close allowed |
| Energy sufficient for O operations | Open allowed | Blocked in open position |
| Energy insufficient for any operation | Blocked in closed position or CB opened (depending on dip switch setting - I1004) | Blocked in open position |

**ILLUSTRATION 5 – CB OPERATIONS VS AVAILABLE CAPACITOR CHARGE**

| CONDITION | CIRCUIT BREAKER POSITION | |
|---|---|---|
| | CLOSE | OPEN |
| Capacitor Energy sufficient For O-CO operations | **Ready LED:** on<br>**Ready contact:** closed<br>**Not ready contact:** opened | **Ready LED:** on<br>**Ready contact:** closed<br>**Not ready contact:** opened |
| Capacitor Energy sufficient for CO operations | **Ready LED:** blinking<br>**Ready contact:** closed<br>**Not ready contact:** opened | **Ready LED:** blinking<br>**Ready contact:** closed<br>**Not ready contact:** opened |
| Capacitor Energy sufficient for O operations | **Ready LED:** blinking<br>**Ready contact:** closed<br>**Not ready contact:** opened | **Ready LED:** off<br>**Ready contact:** opened<br>**Not ready contact:** closed |
| Capacitor Energy insufficient for any operations | **Ready LED:** off<br>**Ready contact:** opened<br>**Not ready contact:** closed | **Ready LED:** off<br>**Ready contact:** opened<br>**Not ready contact:** closed |
| Close Coil continuity not right | **Ready LED:** blinking<br>**Ready contact:** closed<br>**Not ready contact:** opened | **Ready LED:** off<br>**Ready contact:** opened<br>**Not ready contact:** closed |
| Open Coil continuity not right | **Ready LED:** off<br>**Ready contact:** opened<br>**Not ready contact:** closed | **Ready LED:** off<br>**Ready contact:** opened<br>**Not ready contact:** closed |

**ILLUSTRATION 6 – READY, NOT READY INDICATORS**

## 7.0 TROUBLESHOOTING FLOWCHARTS

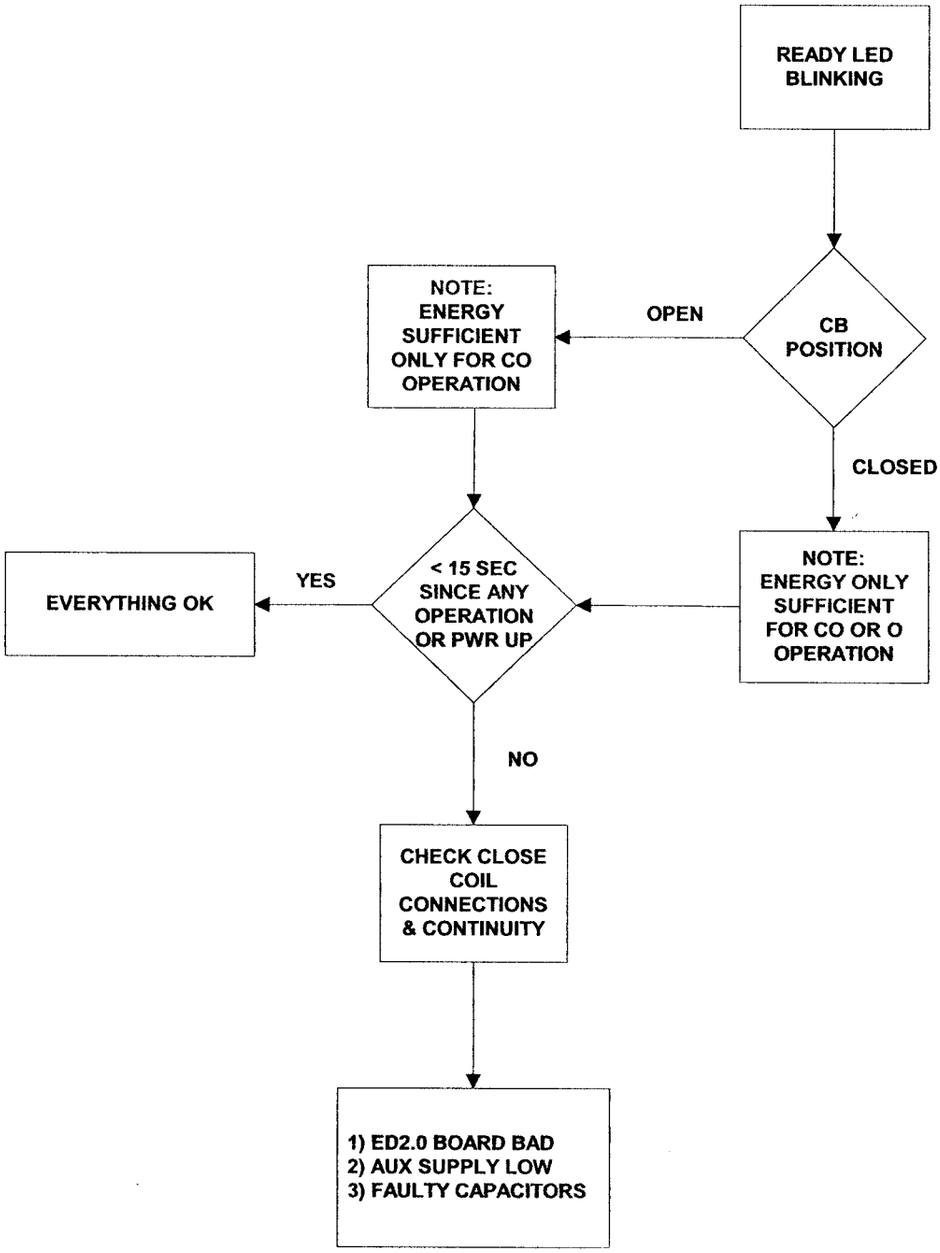



**ILLUSTRATION 7 – READY LED CONTINUALLY FLASHING**

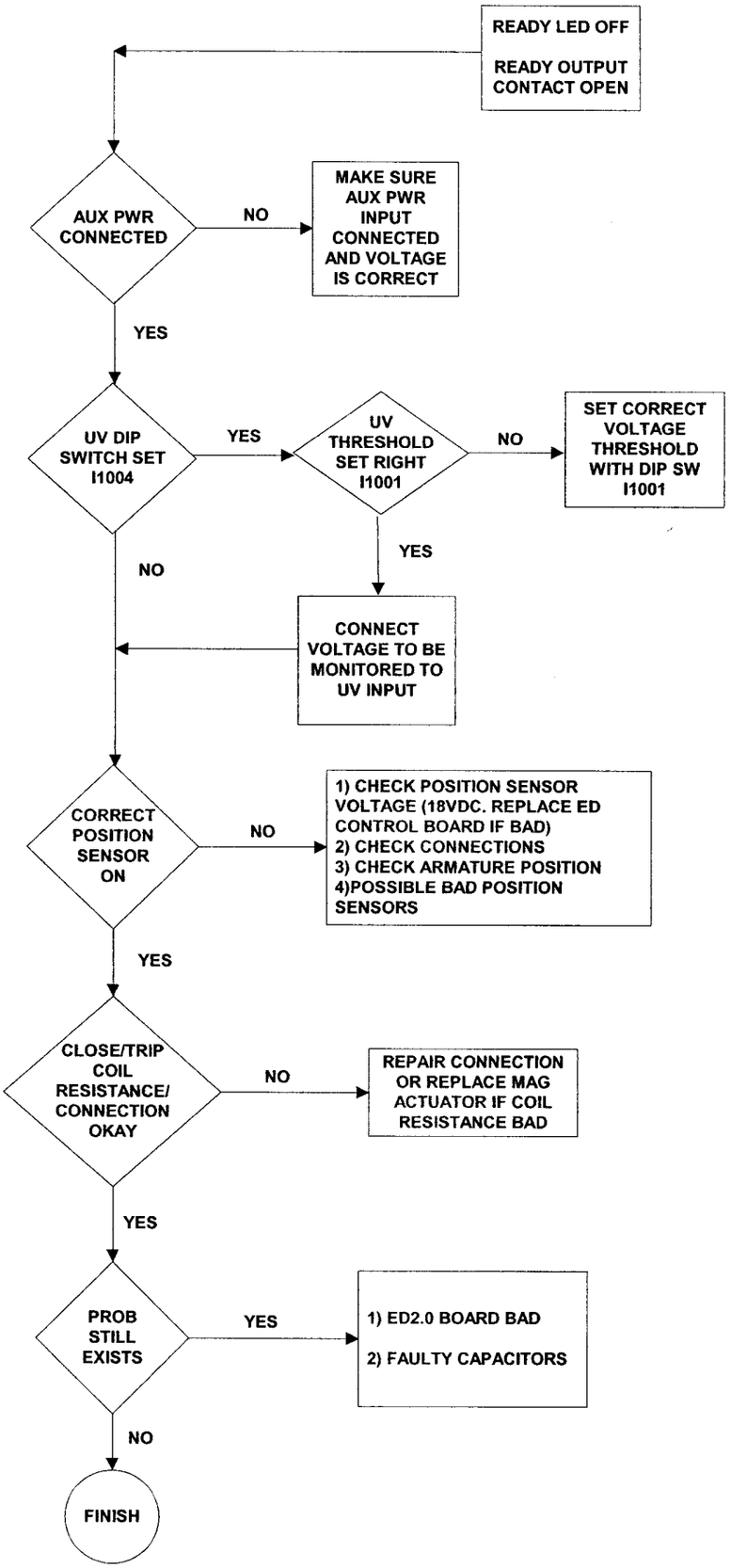



**ILLUSTRATION 8 – READY LED OFF**

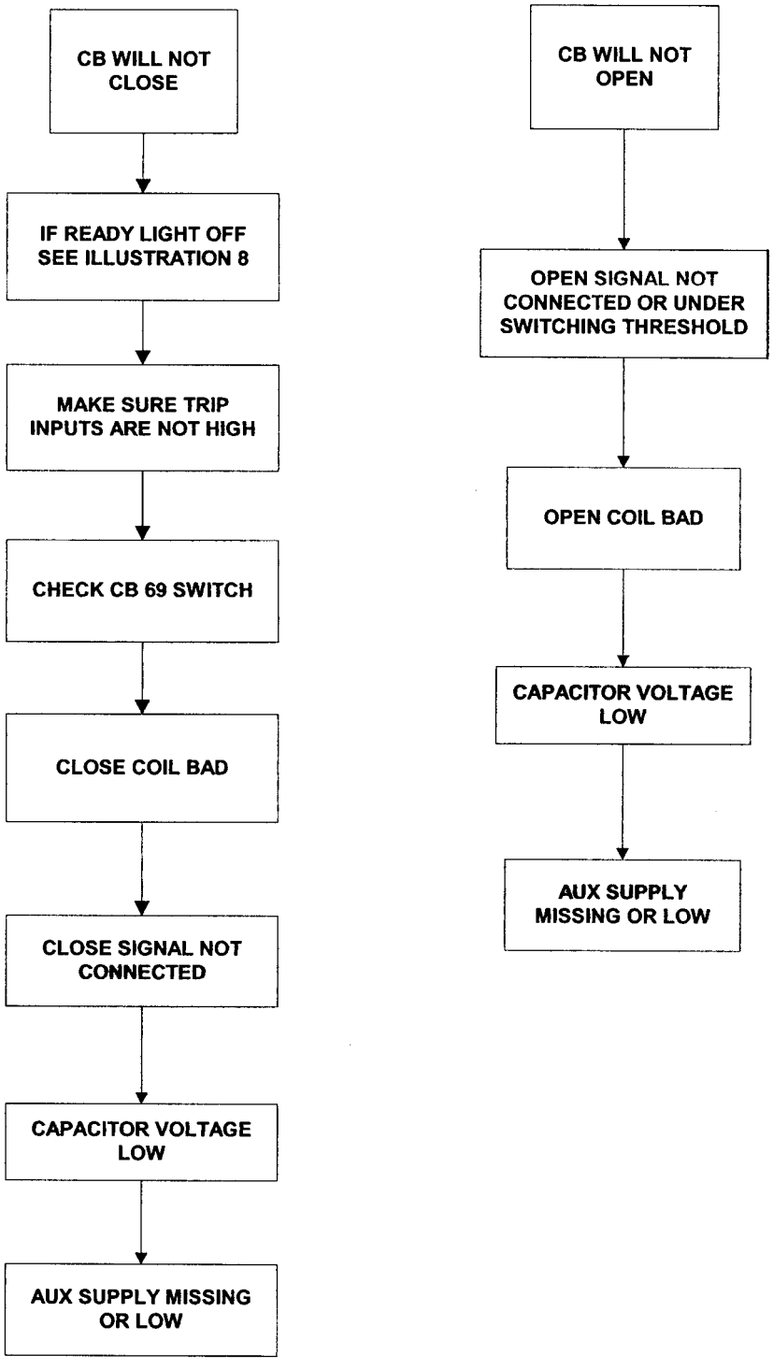



**ILLUSTRATION 9 – CB WILL EITHER NOT OPEN OR CLOSE**

| PROBLEMS | POSSIBLE CAUSES | POSSIBLE SOLUTIONS |
|---|---|---|
| Ready LED is off (unit not ready) | The Auxiliary Supply Voltage is absent. | Connect the Auxiliary Supply Voltage. |
| | The Magnetic Actuator is not connected or damaged. | Check the Magnetic Actuator circuit. |
| | The position sensors are not connected correctly or damaged. | Check the position sensor circuit. |
| | The Under Voltage (UV) function is enabled and Input is open. | Make sure voltage being monitored is connected to UV input. |
| | The Under Voltage function is enabled and the monitored voltage is connected to the Under Voltage Input, but the voltage is lower than the threshold. | Set the correct UV threshold level via DIP Switch I1001. |
| | The auxiliary supply voltage has been turned off and the voltage on the capacitor is under the O-CO levels. | Connect the auxiliary supply voltage. |
| | The control panel is damaged or not connected correctly. | Verify the control panel connections or change if it is damaged. |
| Ready LED Blinking | The circuit breaker is closed and the close coil is disconnected or broken. | In this case only the opening operation is available; open the CB (the Ready LED will be turned off) and check the closing coil circuit. |
| | The auxiliary supply voltage has been turned off. | If the CB is closed you can perform a CO operation; connect the auxiliary supply. |
| | During the Start up or after the operations, the capacitor bank is charging. | Wait a few seconds. |
| The closing command is not performed | The Closing Coil is broken or damaged. | Check the Closing Coil circuit. |
| | One open input is active. | Verify all the open input states. |
| | The Block in Open input is open (69 switch open or disconnected). | Make sure voltage is applied to the Block in Open input and manual trip lever is raised. |
| | The capacitor bank is not connected. | Check the capacitor bank circuit. |
| | The Ready LED on control panel is off. | If the Ready LED is off, verify the above conditions under “Ready LED is off (unit not ready)”. |
| | The Control panel is damaged or not connected properly. | Verify the control panel connections or change it if damaged. |
| | The energy in the capacitor bank is not enough for a CO operation. | Make sure the auxiliary supply voltage is connected. See “ready light blinking” section above. |
| | The external close input is not supplied. | Verify close command is wired to input. |

**ILLUSTRATION 10 – TROUBLESHOOTING GUIDE**

| PROBLEMS | POSSIBLE CAUSES | POSSIBLE SOLUTIONS |
|---|---|---|
| The opening command is not performed. | The opening coil is broken or damaged. | Check the opening coil circuit. |
| | The capacitor bank is not connected. | Check the capacitor bank circuit. |
| | No external opening input is connected. | Verify opening input is wired. |
| | The jumper JP1001 used on input number 4 is not properly set. | If protection relay input is being used JP1001 must be set for pins 1 & 2. |
| | The Under Voltage (UV) function is not enabled. | Set the correct UV Threshold. |
| | The control panel is either damaged or not connected correctly. | Verify the control panel connections or change if damaged. |
| The CB closes and then opens during a close operation. | The close position sensor is not connected or broken. | Verify the close position sensor circuit. |
| | The CB doesn't reach the correct close position. | Verify the presence of unwanted objects under the Magnetic Actuator Plunger. |
| The CB opens if the auxiliary supply is switched off. | The UV function is active and the auxiliary supply is parallel to this input. | Either disable the UV function or connect to a different voltage source. |
| | The Energy Failure Autotrip function is enabled. | If possible, disable the function via I1004-1. |
| All the indication output contacts are open. | The Voltage on the Capacitor bank is under 46 VDC. | Connect the auxiliary supply voltage. |
| | If it happens immediately when the supply voltage is switched off and the Ready LED is immediately turned off. | Check the capacitor bank circuit. |

**ILLUSTRATION 11 – TROUBLESHOOTING GUIDE 2**

## 8.0 STANDARD ED2.0 CIRCUIT BOARD AND CONNECTING DIAGRAM

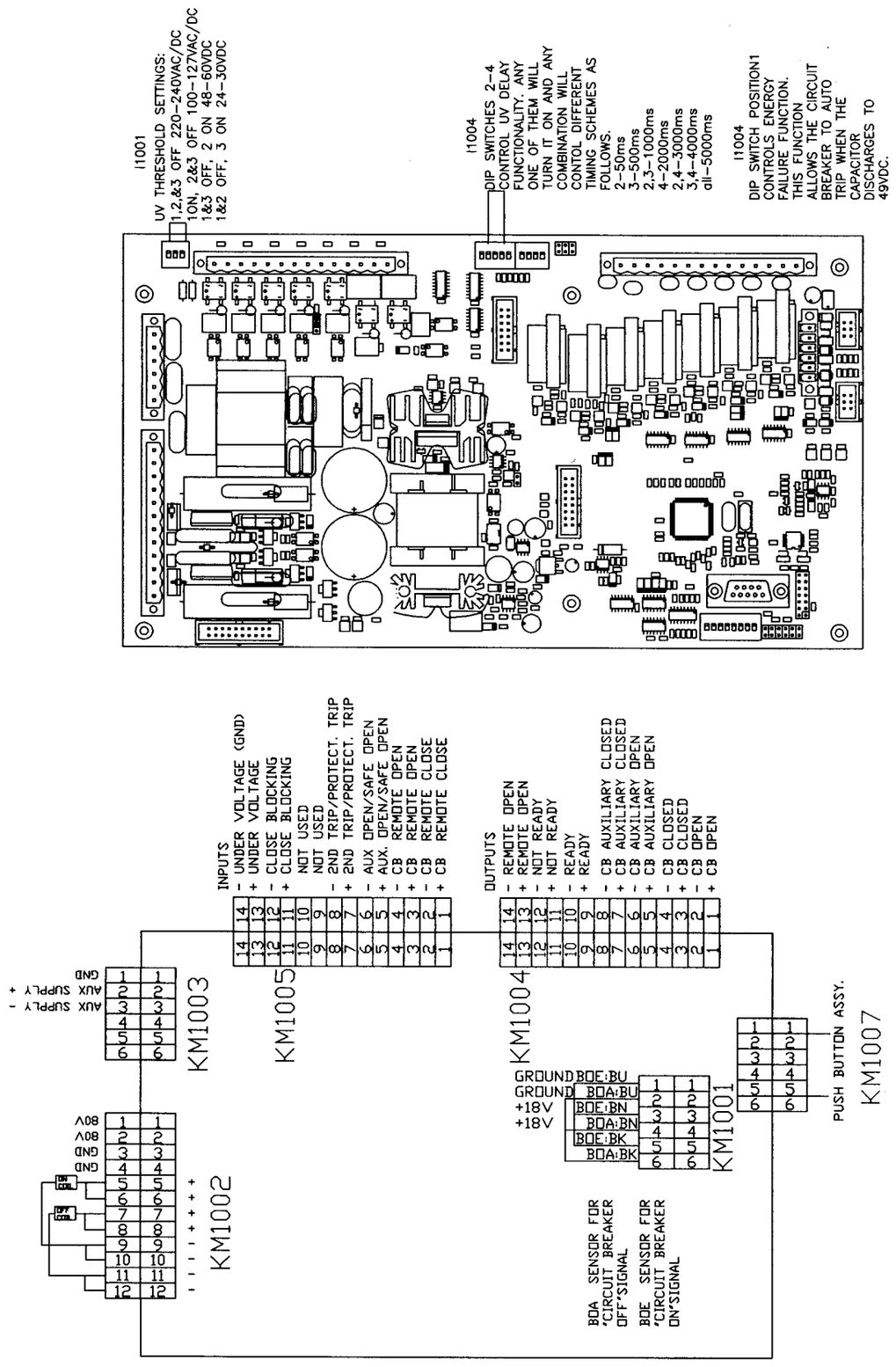



**ILLUSTRATION 12 – ED2.0 CIRCUIT BOARD AND CONNECTIONS**

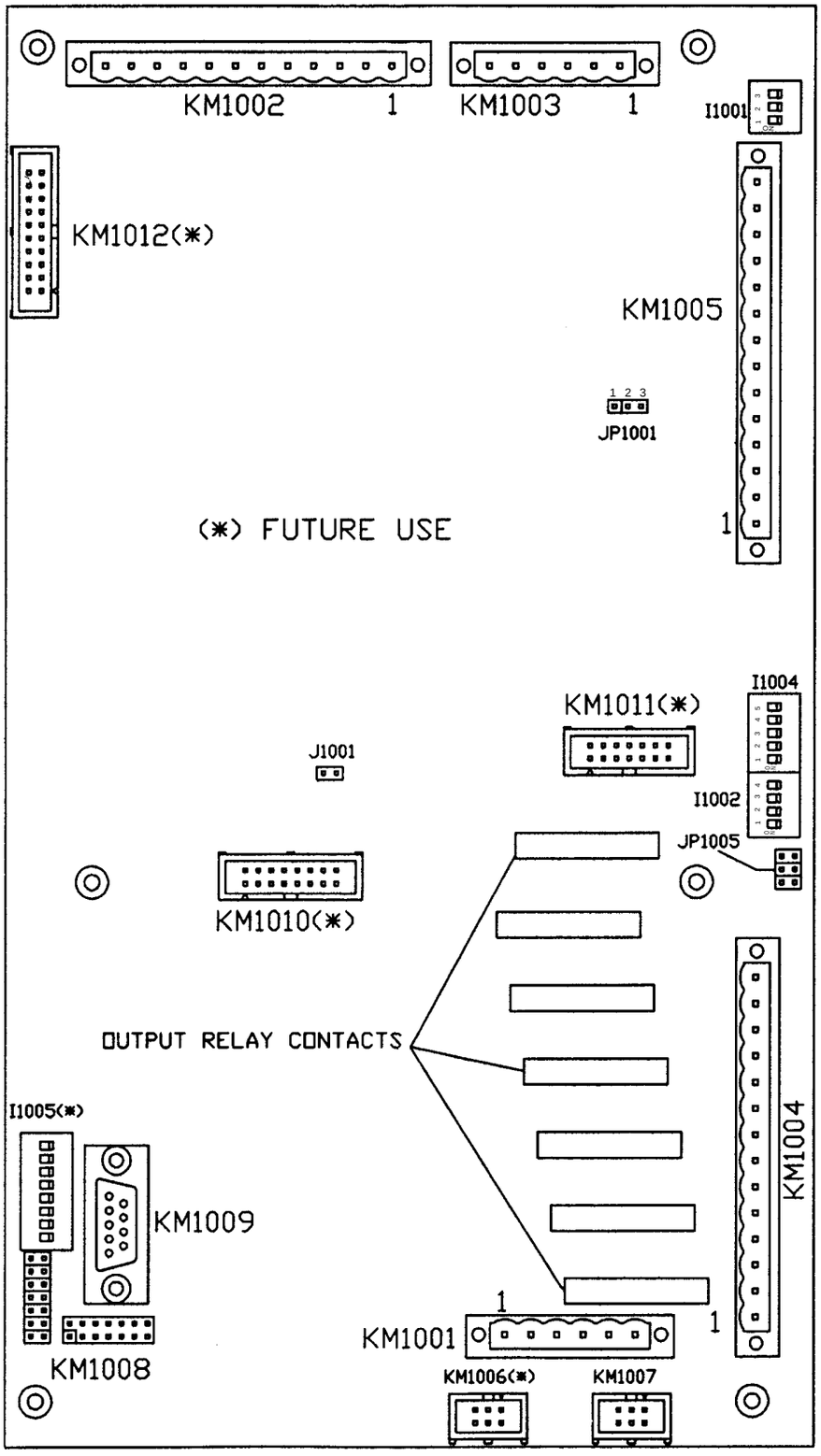



**ILLUSTRATION 13 – ED2.0 CIRCUIT BOARD CONNECTORS**

## 9.0 ED2.0 BOARD CONNECTORS

### KM1001 – MAGNETIC ACTUATOR POSITION (CB POSITION)

| | |
|---|---|
| KM1001-1 | OFF SIGNAL |
| KM1001-2 | ON SIGNAL |
| KM1001-3 | +18 VDC |
| KM1001-4 | +18 VDC |
| KM1001-5 | ELECTRONIC GROUND (0 VDC) |
| KM1001-6 | ELECTRONIC GROUND (0 VDC) |

### KM1002 – POWER OUTPUT AND CAPACITOR LINK

| | |
|---|---|
| KM1002-1 | CAPACITOR PLUS (+80 VDC) |
| KM1002-2 | CAPACITOR PLUS (+80 VDC) |
| KM1002-3 | CAPACITOR MINUS (0 VDC) |
| KM1002-4 | CAPACITOR MINUS (0 VDC) |
| KM1002-5 | + CLOSE COIL (+80 VDC) |
| KM1002-6 | + CLOSE COIL (+80 VDC) |
| KM1002-7 | + TRIP COIL (+80 VDC) |
| KM1002-8 | + TRIP COIL (+80 VDC) |
| KM1002-9 | - CLOSE COIL |
| KM1002-10 | - CLOSE COIL |
| KM1002-11 | - TRIP COIL |
| KM1002-12 | - TRIP COIL |

## KM1003 – AUXILIARY SUPPLY AND AUXILIARY CAPACITOR CONNECTION

The capacitor voltage is present between KM1003-4 (negative) and KM1003-6 (positive). An on-board 10 kOhm capacitor is available on KM1003-5. To discharge the capacitors, connect a jumper from KM1003-5 to KM1003-4. Make sure the Auxiliary power is first removed. To speed up the discharge time a 10 Ohm 25 watt resistor can be jumpered directly across any one of the capacitors.

| | |
|---|---|
| KM1003-1 | **NOT USED** |
| KM1003-2 | AUXILIARY SUPPLY |
| KM1003-3 | AUXILIARY SUPPLY |
| KM1003-4 | - V CAPACITOR |
| KM1003-5 | + V CAP 10 kOhm RESISTOR |
| KM1003-6 | + V CAPACITOR |

## KM1004 - GENERAL PURPOSE BINARY OUTPUT CONTACTS

| OUTPUT NUMBER | OUTPUT NAME | KM1004 PIN NUMBERS |
|---|---|---|
| N.1 | CB OPENED | 1-2 |
| N.2 | CB CLOSED | 3-4 |
| N.3 | CB OPENED BY AUX TRIP SIGNAL | 5-6 |
| N.4 | CB CLOSED BY AUX CLOSE SIGNAL | 7-8 |
| N.5 | UNIT READY | 9-10 |
| N.6 | UNIT NOT READY | 11-12 |
| N.7 | CB OPENED BY REMOTE | 13-14 |

## KM1005 – GENERAL PURPOSE BINARY INPUT

| INPUT NUMBER | INPUT NAME | KM1005 PIN NUMBERS |
|---|---|---|
| N.1 | CLOSE | 1-2 |
| N.2 | OPEN | 3-4 |
| N.3 | AUXILIARY/SAFE OPEN | 5-6 |
| N.4 | SECOND OPENING/ PROTECTION RELAY TRIP | 7-8 |
| N.5 | NOT USED | 9-10 |
| N.6 | CB OPEN LOCKED (69) | 11-12 |
| N.7 | UNDER VOLTAGE INPUT | 13-14 |

## KM1006 – BINARY OUTPUTS FOR PRESSURE LED INDICATORS (FUTURE USE)

## KM1007 – MEMBRANE LOCAL CONTROL SWITCH

## KM1008 – JTAG EMULATION INTERFACE

For ABB use only.

## KM1009 – RS232 DOWNLOAD INTERFACE

For ABB use only.

## KM1010 – ANALOG BOARD VERSUS MOTHER BOARD

Future design.

**DIP SWITCH I1001**

Under Voltage threshold setting. See Illustration 12 for setting instructions.

**DIP SWITCH I1002**

Sets input response delay for slow (10 milliseconds) or fast (2 milliseconds). Also sets input 3 for either aux or safe input mode.

| SWITCH POSITION | OFF | ON |
|---|---|---|
| 1 | INPUT 1 FAST (2 ms) | INPUT 1 SLOW (10 ms) |
| 2 | INPUT 2 FAST (2 ms) | INPUT 2 SLOW (10 ms) |
| 3 | INPUT 3 FAST (2 ms) | INPUT 3 SLOW (10 ms) |
| 4 | INPUT 3 USED AS AUXILIARY INPUT | INPUT 3 USED AS AUXILIARY INPUT |

**DIP SWITCH I1004 – LOW ENERGY AUTO TRIP AND UNDER VOLTAGE DELAY FUNCTIONS**

For setting instructions see Illustration 12. The UV Function is enabled by selecting an appropriate delay with I1004 and also selecting an appropriate range with I1001.

**DIP SWITCH I1005 (FUTURE USE ONLY)**

**JUMPER JP1001**

Sets input number 4 to either normal (pins 2 to 3) or as a protection input (pins 1 to 2).

**JUMPER JP1005 (ABB USE ONLY)**

**JUMPER J1001**

Used to reduce the ED2.0 board power consumption from 75 to 33 watts. Capacitor charging time will increase in the 33 watt setting.

## 10.0 DEFAULT JUMPER AND DIP SWITCH SETTINGS

Unless specified by the customer, the Low Energy and Under Voltage trip functions are disabled. The control inputs are set to the “slow” mode (10 millisecond minimum pulse width). Input three is set for Auxiliary trip mode as opposed to the Protection Relay trip mode. The Protection Relay mode has a lower switching threshold (12 V). See Illustration 13 in Appendix A for Switch and Jumper locations. The following represents the functional Jumper and Dip Switch settings which are the shipped configuration.

**Jumper JP1001** (Auxiliary/Protection Relay Input) – Pins 2 to 3.

**Dip Switch I1001** (Under Voltage Range)

Position 1 – ON
Position 2 – ON
Position 3 – ON

**Dip Switch I1002** (Fast/Slow Input. Position 4 sets Input 3 as Auxiliary or Safe input)

Position 1 – ON
Position 2 – ON
Position 3 – ON
Position 4 – OFF

**Dip Switch I1004** (Low Energy Trip/Under Voltage Delay and Enable)

Position 1 – OFF
Position 2 – OFF
Position 3 – OFF
Position 4 – OFF
Position 5 – OFF

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