EATON | Cutler-Hammer

Instructions for the Installation, Operation and Maintenance of TRITON™ SL 160/200/320/400

Instruction Bulletin — IEC

Medium Voltage Vacuum Contactors, Model A

New Information

Read and understand these instructions before attempting installation, operation or maintenance of this equipment.

This equipment shall be installed and serviced only by qualified electrical personnel.

Retain this document for future use.

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⚠ DANGER

HAZARDOUS VOLTAGE.

READ AND UNDERSTAND THIS MANUAL IN ITS ENTIRETY BEFORE INSTALLING OR OPERATING THIS CONTACTOR. QUALIFIED PERSONNEL MUST PERFORM INSTALLATION, ADJUSTMENT AND MAINTENANCE OF THESE CONTACTORS. A QUALIFIED PERSON IS ONE WHO IS FAMILIAR WITH THE CONSTRUCTION AND OPERATION OF THIS EQUIPMENT AND WHO IS AWARE OF THE HAZARDS INVOLVED. THIS INSTRUCTION BOOK SHOULD NOT BE CONSIDERED ALL-INCLUSIVE REGARDING INSTALLATION, ADJUSTMENT AND MAINTENANCE PROCEDURES.

Product Description

The Cutler-Hammer® TRITON SL Contactor for Eaton's Electrical business is a medium voltage (7.2 kV maximum) vacuum contactor used for the control of three-phase motors, transformers, and other high voltage equipment. The SL is available with continuous current ratings of 160, 200, 320 or 400 amperes. Refer to **Table 1** for horsepower and kVA ratings for these contactors.

The SL Contactor utilizes Cutler-Hammer vacuum interrupters that exhibit both a long electrical life and a high interruption capability. Ratings for the contactor are shown in **Table 2**. The 400 ampere contactor differs from the other devices by the addition of three Axial Magnetic (A-M) coils at the fixed end of the vacuum interrupters. The A-M coils establish a magnetic field within the interrupter during fault conditions. The field disperses the arc during fault current interruption, allowing the contactor to interrupt a very high fault current. See **Figure 1**.

Specifications

Table 1. Application Data

System Voltage	2400 V	3300 V	4160 V	6600 V
SL-160 Amperes				
Induction Motor (kW)	600	800	1000	1500
Synchronous Motor 0.8 PF (kW)	600	800	1000	1500
Synchronous Motor 1.0 PF (kW)	700	1000	1200	1900
Transformer (kVA)	700	1000	1200	1900
Capacitor (kvar) ①	500	680	860	1360
SL-200 Amperes				
Induction Motor (kW)	700	1000	1200	1900
Synchronous Motor 0.8 PF (kW)	700	1000	1200	1900
Synchronous Motor 1.0 PF (kW)	900	1200	1500	2300
Transformer (kVA)	900	1200	1500	2300
Capacitor (kvar) ①	620	850	1070	1700
SL-320 Amperes				
Induction Motor (kW)	1100	1500	1900	3000
Synchronous Motor 0.8 PF (kW)	1100	1500	1900	3000
Synchronous Motor 1.0 PF (kW)	1400	1900	2400	3700
Transformer (kVA)	1400	1900	2400	3700
Capacitor (kvar) ①	990	1360	1710	2710
SL-400 Amperes				
Induction Motor (kW)	1400	1900	2400	3700
Synchronous Motor 0.8 PF (kW)	1400	1900	2400	3700
Synchronous Motor 1.0 PF (kW)	1700	2300	2900	4600
Transformer (kVA)	1700	2300	2900	4600
Capacitor (kvar) ①	1240	1700	2140	3390

① NOT for back-to-back switching.

Table 2. Ratings

Description	Rating
Maximum Interrupting Current (3 OPS.)	4500 A (SL-160/200/320) 8500 A (SL-400)
Rated Current	160 A Enclosed (SL-160) 200 A Enclosed (SL-200) 320 A Enclosed (SL-320) 400 A Enclosed (SL-400)
Maximum Rated Voltage	7.2 kV
Making/Breaking Capacity	4000 A
Short Time Current 30 Sec. 1 Sec. 8.7 ms (0.5 Cycle)	 2400 A 6000 A 63 kA Peak (I^2t = 5.89 mega-joules)
Mechanical Life	2,500,000 Operations
Electrical Life	300,000 Operations
BIL	60 kV (1.2 x 50 ms)
Dielectric Strength (60 Hz)	20 kV (1 Minute)
Closing Time (Energization to Contact Touch)	80 ms
Opening Times	30 to 330 ms DIP Switch Selectable Refer to **Table 4**
Arcing Time	12 ms (0.75 Cycle) or Less
Pickup Voltage	80% Rated Coil Voltage
Dropout Voltage	60% Rated Coil Voltage
Control Voltages ac/dc	Selectable: Refer to **Table 4** 100 – 110, 115 – 120, 125, 200 – 220, 230 – 240 Volts
Control Circuit Burden Closing (200 ms) 100 – 125 Volts 200 – 240 Volts Holding 100 – 125 Volts 200 – 240 Volts	 1 kVA 1.8 kVA 40 VA 50 VA
Auxiliary Contact Rating Voltage (Maximum) Continuous Current Making Capacity Breaking Capacity Minimum Voltage/Current	 600 V 10 A (ac) 7200 VA (dc) 125 VA (ac) 720 VA (dc) 125 VA 5 V/100 mA
Latch (when Specified) Mechanical Life Trip Voltage Minimum Trip Voltage Trip Burden Trip Time	 250,000 Operations (dc) 24, 32, 48, 125, 240 Volts (ac) 110 – 125, 220 – 240 Volts 80% Rated Coil Voltage 400 VA 30 Microseconds (1.5 Cycles)

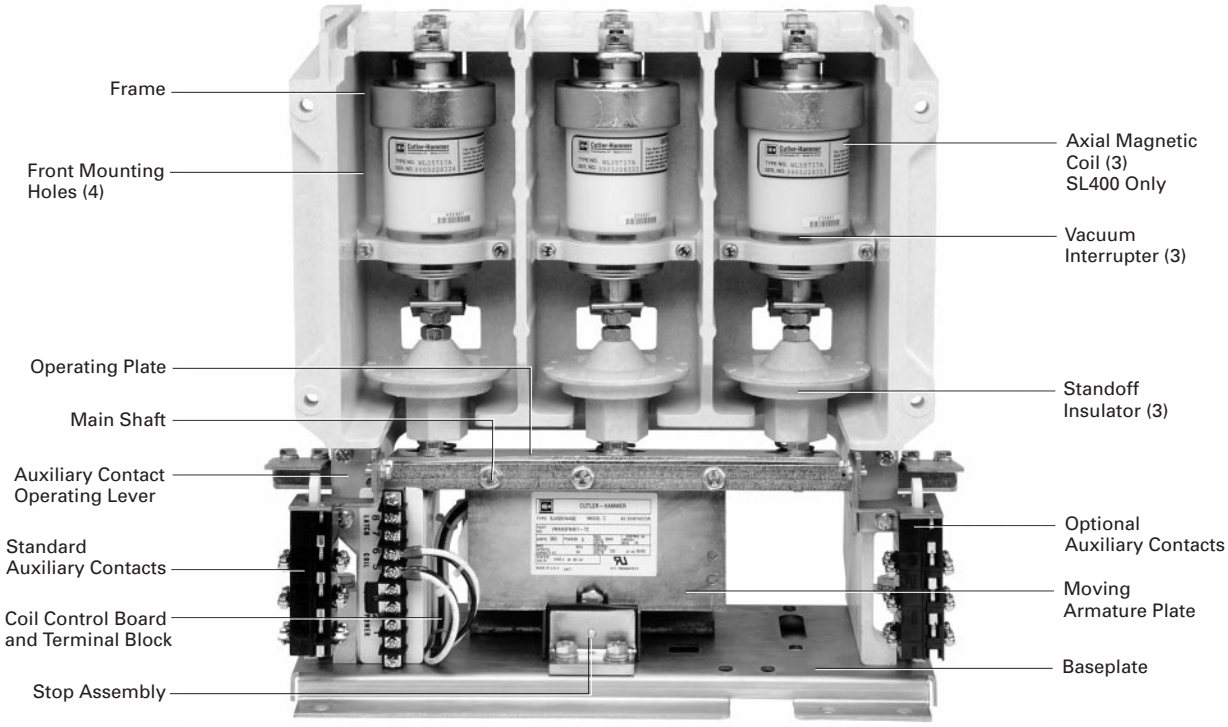

Figure 1. SL Front View Major Components

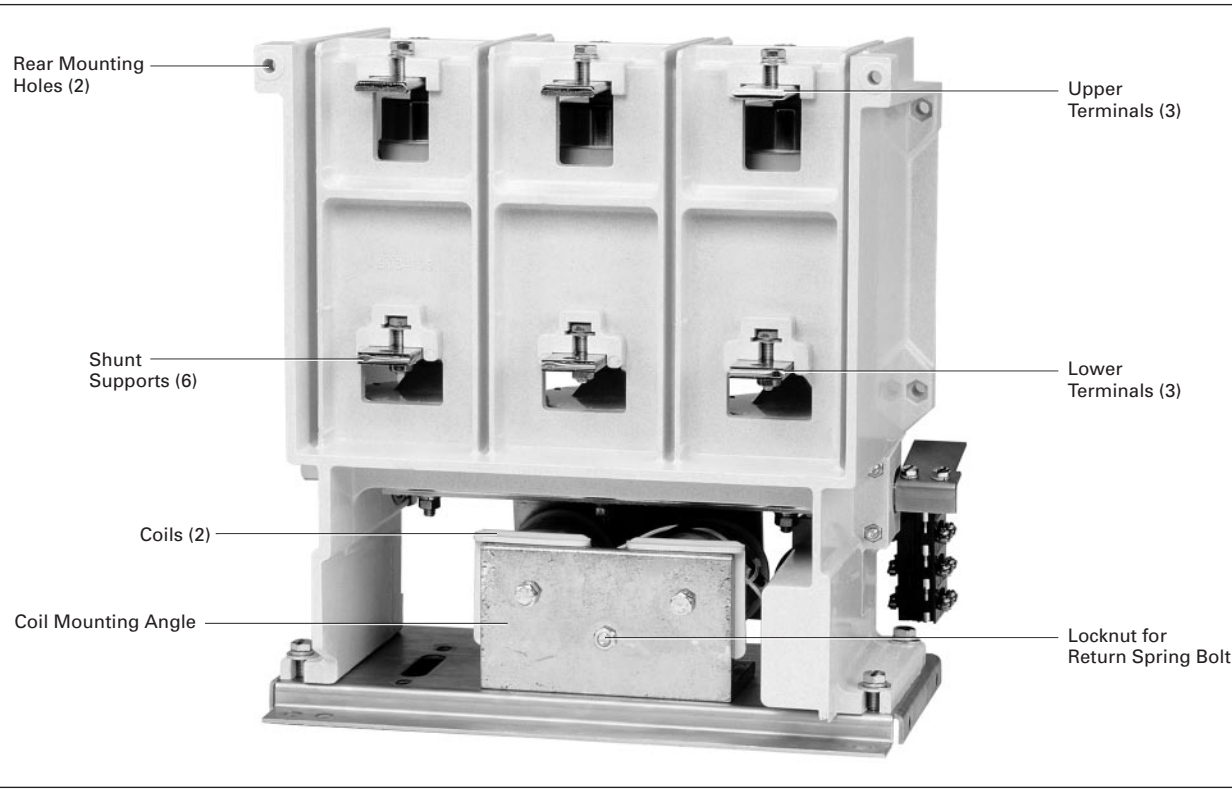

Figure 2. SL Rear View Major Components

⚠ WARNING

SATISFACTORY PERFORMANCE OF THESE CONTACTORS IS CONTINGENT UPON PROPER APPLICATION, CORRECT INSTALLATION AND ADEQUATE MAINTENANCE. THIS INSTRUCTION BOOK MUST BE CAREFULLY READ AND FOLLOWED IN ORDER TO OBTAIN OPTIMUM PERFORMANCE FOR THE LONG, USEFUL LIFE OF THE CONTACTOR.

Contactor Operation

Magnetically Held Contactor

A return spring located behind the moving armature plate (**Figure 3**) holds the contactor in the open position with the main coils deenergized.

The contactor is closed by energizing the contactor control board with the appropriate control voltage at terminals 1 and 2. The control board rectifies the input voltage and applies a pulse width modulated dc output voltage to the coils. The output voltage is approximately full voltage for the first 200 milliseconds after energization, during which time the contactor closes and seals. The output voltage is then automatically reduced to approximately 15 Vdc to maintain the contactor in the closed position.

The coil cores are magnetized which rotates the armature shaft, moving armature and operating plate. As the operating plate moves toward the coil cores, the main contacts close. The plate continues to move an additional distance (known as overtravel), which allows for contact preload and wear (**Figure 4**).

When control power is removed from the control board, the SL is held closed for a preset time and then opens. The range of time between the removal of control power and contact opening is from 30 to 330 milliseconds.

Table 3. DIP Switch Setting-Control Voltage

Setting	SW1	SW2	SW3
100 – 110 Vac/dc	Off	Off	Off
115 – 120 Vac/dc	On	Off	Off
125 Vac/dc	Off	Off	On
200 – 220 Vac/dc	Off	On	Off
230 – 240 Vac/dc	On	On	Off

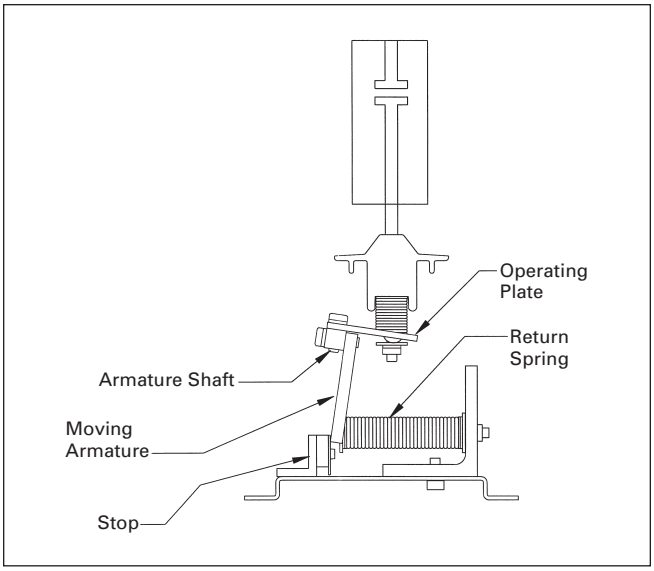

Figure 3. Contactor Open

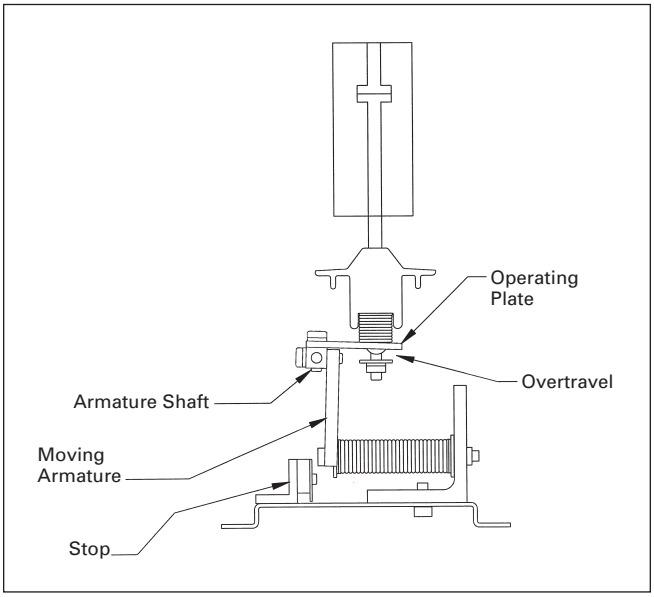

Figure 4. Contactor Closed

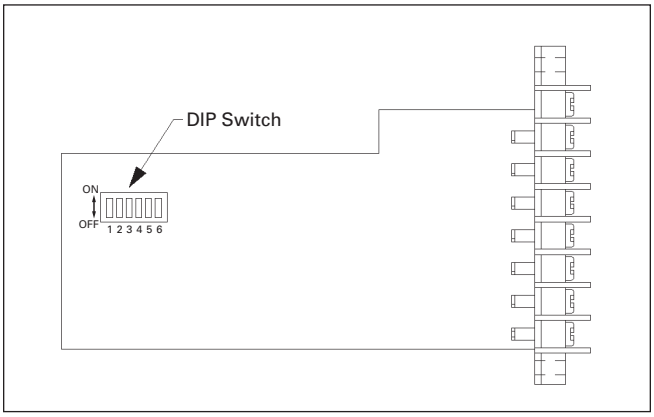

Figure 5. Coil Control Board with DIP Switch

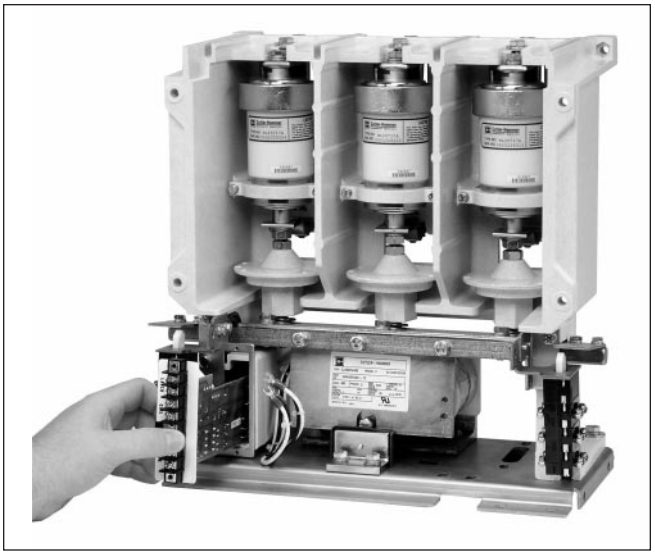

Figure 6. Coil Control Board Removal

Table 4. Control Board Dropout Settings

Delay Setting	SW4	SW5	SW6
30 ms	Off	Off	Off
50 ms	On	Off	Off
130 ms	Off	On	Off
250 ms	On	On	Off
330 ms	Off	Off	On

The time can be adjusted for such factors as fuse coordination and voltage loss ride-through. Unless otherwise specified, the factory default dropout setting is 50 milliseconds, or approximately 2.5 line cycles (50 Hz). Refer to section on **Fuse Selection and Coordination**, located on **Page 8**, for more information on selecting the correct dropout time.

As the moving armature is rotated to the open position by the return spring, it impacts the stop assembly located at the front of the contactor (**Figure 3**). The stop assembly absorbs much of the kinetic energy of the moving armature and reduces the overtravel of the vacuum interrupters as the contactor is forced open.

A selectable DIP switch is located on the control board for setting the control voltage level and the contactor dropout time (**Figure 5**). The control board must be removed from its cavity in the contactor housing to gain access to the DIP switch. **Table 3** lists the available voltage settings and **Table 4** lists the available dropout settings. These tables are also printed on the back of the control board.

Note: Previous versions of this board have been released. If the control board does not match the description above, please refer to the original documentation supplied with the equipment.

Mechanically Latched Contactor

The mechanically latched contactor is closed in the same manner as the magnetically held contactor. After the contactor is electrically closed, a mechanical latch is engaged that holds the moving armature plate in the closed position. Power should then be removed from the control board. Refer to **Figure 14**, on **Page 8**, for typical schematic for latched contactor.

To open the contactor, the unlatch coil is energized with the appropriate control voltage. The coil engages a release lever on the latch mechanism. The contactor is then forced opened by the return spring.

Refer to IB48020 for instructions for the mechanical latch attachment. Dropout set to maximum delay.

Auxiliary Contacts

An operating lever attached to the rotating shaft operates a set of auxiliary contacts located on the left side of the contactor (**Figure 1**). The standard configuration is 2NO-2NC contacts. An additional set of 6 auxiliary contacts can be added to the right side of the contactor. The auxiliary contacts are rated 600 Vac, 10 amperes continuous. Minimum ratings are 5 volts, 100 milliamps. Refer to **Table 2** for make/break ratings.

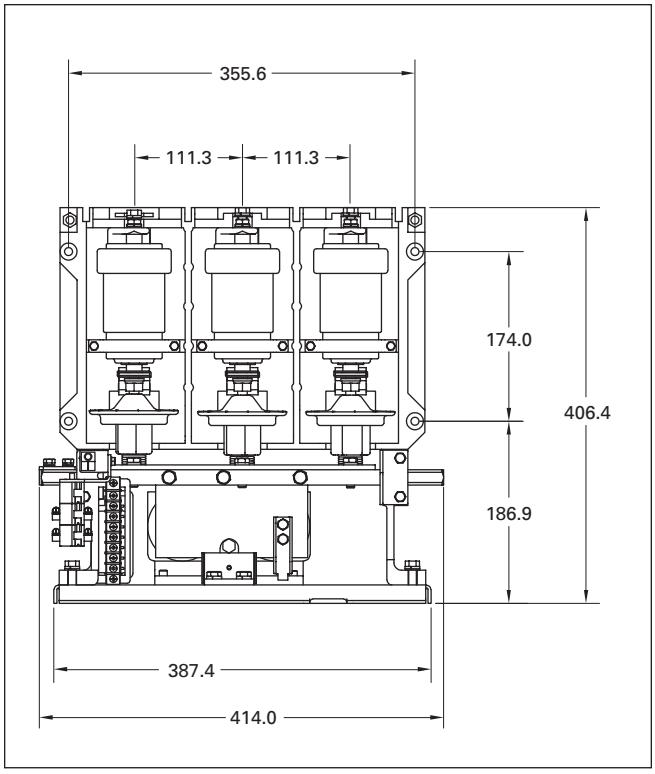

Figure 7. Dimensions, Front View

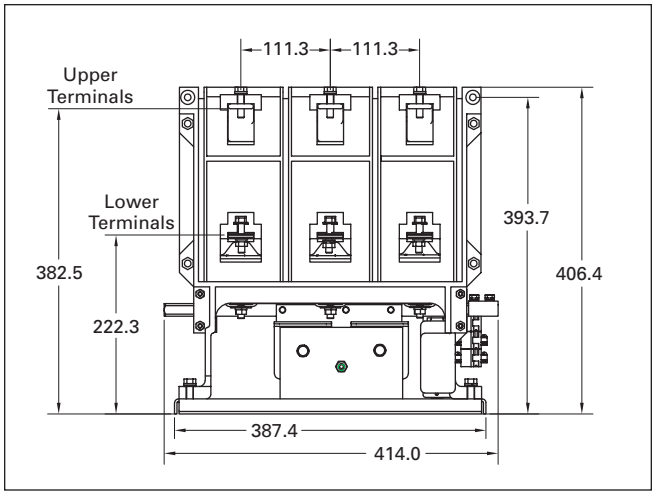

Figure 8. Dimensions, Rear View

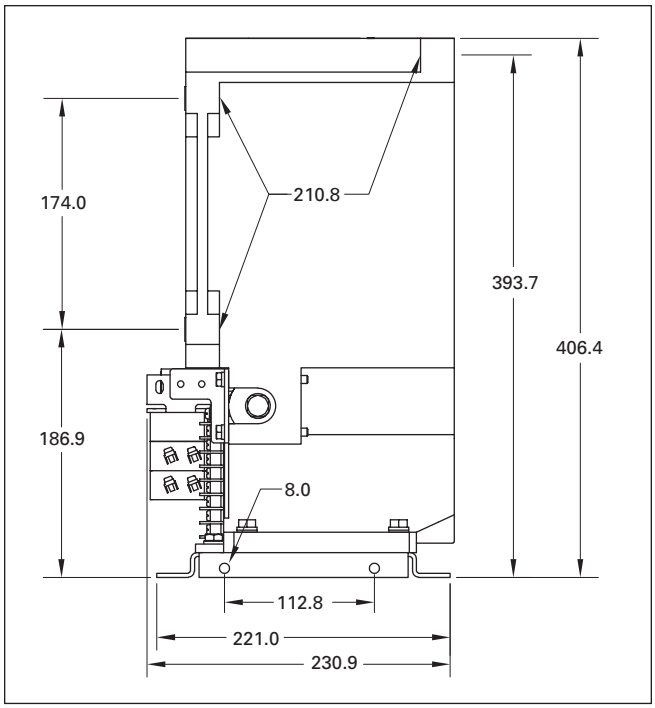

Figure 9. Dimensions, Side View

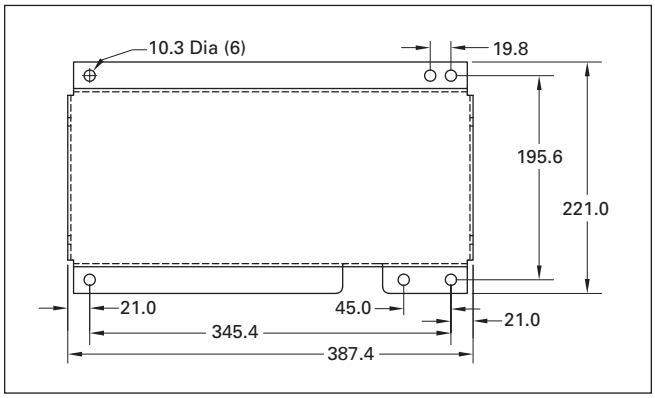

Figure 10. Dimensions, Baseplate

Installation

The contactor is designed to be mounted in either a vertical or horizontal configuration. Standard mounting is through the steel contactor base. Optional mounting is through the mounting points molded into the contactor frame. See **Figures 7** – **10** for dimensions.

The SL contactor is intended for installation in a suitable environment. **Table 5** lists the normal service conditions for the SL.

Table 5. Service Conditions

Description	Rating	
Altitude	Refer to factory Standard Refer to factory	-3500 to -1001 meters -1000 to +2000 meters +2001 to +5000 meters
Humidity	95% maximum, non-condensing	
Temperature	-5 to +40 degrees C	
Location	Clean, free from moisture or corrosive atmospheres	

Wiring

Refer to **Figure 11** for standard control wiring for magnetically held contactors. To close the contactor, apply power to terminals 1 and 2 on the control board. Power must be maintained to terminals 1 and 2 to keep the contactor in the closed position. The main coils are connected to terminals 5 and 6. Note that the white wire from coil 1 and the black wire from coil 2 are connected to terminal 5 while the black wire from coil 1 and the white wire from coil 2 are connected to terminal 6.

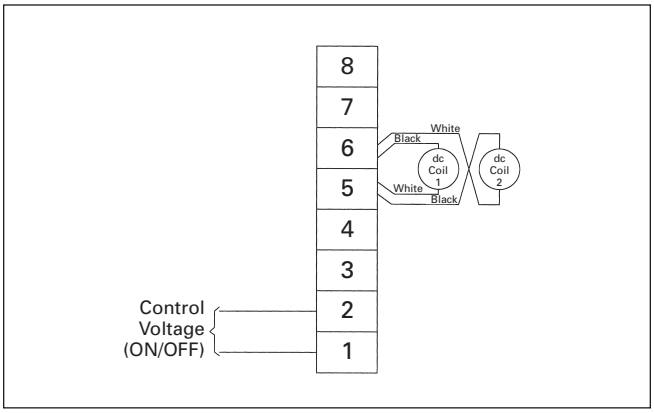

Figure 11. Connections for Magnetically Held Contactor

Refer to **Figure 12** for standard control wiring for mechanically latched contactors. To close the contactor, apply power to terminals 1 and 2 on the control board.

After the contactor is closed, control power must be removed from terminals 1 and 2. Terminals 7 and 8 are connected to the unlatch coil through a fullwave diode bridge. A normally open auxiliary contact (Ma) must be wired in series with the unlatch coil to prevent burnout of the coil. For more information, refer to IB48020.

Typical schematics for magnetically held and mechanically latched contactors are shown in **Figures 13** and **14**.

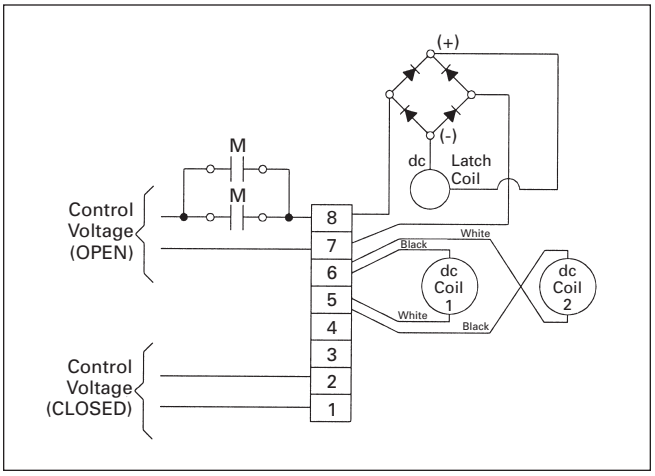

Figure 12. Connections for Mechanically Latched Contactor

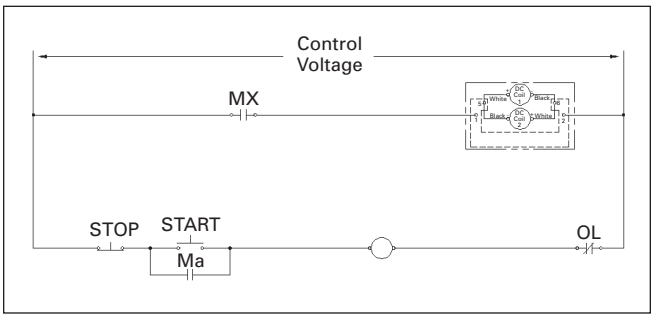

Figure 13. Typical Schematic for Magnetically Held Contactor

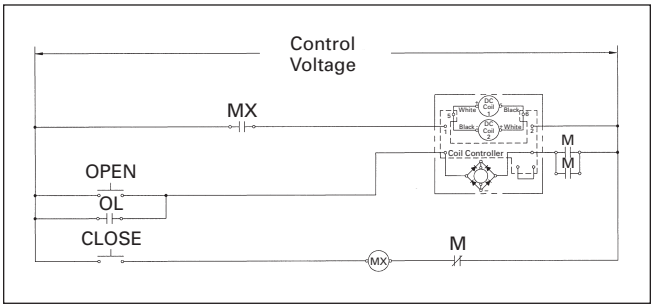

Figure 14. Typical Schematic for Mechanically Latched Contactor

Fuse Selection and Coordination

Fuse selection is dependent on motor locked rotor current, acceleration time and full load current. To prevent fuse fatigue, it is recommended that the minimum melting time of the fuse always exceeds the locked rotor current times a safety factor of 1.25 at the motor acceleration time. The motor full load current must always be less than the fuse continuous current rating. Unless more specific information is known, the fuse may be selected from **Table 6**, which is based on typical motor data.

During high-power testing, the SL contactor was confirmed to properly coordinate with Cutler-Hammer Type CLS current limiting motor starting fuses. Tests were conducted with 5.08 kV-24R and 7.2 kV-24R fuses. The contactor successfully withstood the let-through energy of each fuse for a 50 kA available symmetrical fault at the rated voltage of the fuse. Maximum let-through occurred with the 5.08 kV fuse. The maximum observed current was a 63 kA peak, with I^2t equal to 5.89 mega-joules. If fuses with greater values are to be applied with the SL contactor, retesting is required.

Proper coordination must be maintained between the contactor interrupting rating, contactor dropout time, and the total clearing time of the main fuse. Care must be exercised when selecting the dropout time setting on the contactor control board. The contactor must not open on a fault greater than its rated interrupting current. By holding the contactor closed for the appropriate time, the fuse will clear if the fault current exceeds the contactor rating. Delays in relay settings should not be included in the calculation since it is likely that the voltage will collapse and allow the contactor to drop open no matter what the setting of the relay. **Table 6** on the next page lists the Cutler-Hammer CLS motor starting fuses and the minimum contactor dropout setting to ensure proper coordination. Minimum dropout times may be preferred since they will minimize fault damage when used in conjunction with protective relays with instantaneous trip functions.

To prevent significant overvoltage when a fuse interrupts a fault current, select the fuse with the minimum voltage rating that exceeds the maximum voltage of the power system.

For more information, refer to Cutler-Hammer Application Data 36-693 which includes minimum-melt, total clearing, and let-through curves for Type CLS motor fuses.

Initial Startup

Before the initial startup of the contactor, the following tasks should be completed:

1. Inspect the contactor for any damage during shipment and installation.
2. Perform a vacuum integrity test as described in the section on maintenance.
3. Set DIP switches on the coil control board for the proper control voltage and dropout time. Factory setting is for 110 volts, 50 milliseconds (unless otherwise specified).
4. Sequence the control circuit, including closing the contactor with the main power circuits deenergized and locked out.
5. Verify that the contactor will be connected to an incoming power supply and outgoing load with characteristics agreeing with the contactor ratings.
6. Verify that all connections are neat, tight, and of the proper capacity for the connected load. Power cables must be installed to exit perpendicular to the rear face of the contactor to prevent phase-to-phase creepage and clearance problems.
7. Check the insulation level of the starter and record for future reference. See section on **Maintenance**.
8. Be certain that all safety precautions have been taken and the installation conforms to applicable regulations and safety practices.

Fuse Application Table for Triton SL Contactors

Table 6. Fuse Application Table for Triton SL Contactors

Motor FLA	Fuse	Rating	Minimum Opening Time
SL-160 (2400 – 4800 V)			
11.0 – 18	449D597G06	170-6R	30
18 – 31	449D597G06	170-6R	30
31 – 46	449D597G06	170-6R	30
46 – 62	449D597G06	170-6R	30
62 – 74	449D597G06	170-6R	30
74 – 93	449D597G06	170-6R	30
93 – 137	151D933G02	230-12R	130
137 – 160	151D933G02	230-12R	130
SL-160 (5500 – 6900 V)			
11.0 – 34	151D963G05	170-6R	30
34 – 46	151D963G05	170-6R	30
46 – 56	151D963G05	170-6R	30
56 – 68	151D963G05	170-6R	30
68 – 85	151D963G05	170-6R	30
85 – 137	151D963G07	230-12R	250
137 – 200	151D963G07	230-12R	250
SL-200 (2400 – 4800 V)			
11.0 – 18	449D597G06	170-6R	30
18 – 31	449D597G06	170-6R	30
31 – 46	449D597G06	170-6R	30
46 – 62	449D597G06	170-6R	30
62 – 74	449D597G06	170-6R	30
74 – 93	449D597G06	170-6R	30
93 – 137	151D933G02	230-12R	130
137 – 200 ①	151D933G02	230-12R	130
SL-200 (5500 – 6900 V)			
11.0 – 34	151D963G05	170-6R	30
34 – 46	151D963G05	170-6R	30
46 – 56	151D963G05	170-6R	30
56 – 68	151D963G05	170-6R	30
68 – 85	151D963G05	170-6R	30
85 – 137	151D963G07	230-12R	250
137 – 200	151D963G07	230-12R	250

① For FLA>180, maximum acceleration time = 4.5 seconds.

Note: Fuse selections based on LRC = FLA x 6, acceleration time of 10 seconds except where noted.

Fuse Application Table for Triton SL Contactors (Continued)

Motor FLA	Fuse	Rating	Minimum Opening Time
SL-320 (2400 – 4800 V)			
11.0 – 18	449D597G06	170-6R	30
18 – 31	449D597G06	170-6R	30
31 – 46	449D597G06	170-6R	30
46 – 62	449D597G06	170-6R	30
62 – 74	449D597G06	170-6R	30
74 – 93	449D597G06	170-6R	30
93 – 137	151D933G02	230-12R	130
137 – 187	151D933G02	230-12R	130
187 – 200 ①	151D933G02	230-12R	130
211 – 320 ②	—	—	—
SL-320 (5500 – 6900 V)			
11.0 – 34	151D963G05	170-6R	30
34 – 46	151D963G05	170-6R	30
46 – 56	151D963G05	170-6R	30
56 – 68	151D963G05	170-6R	30
68 – 85	151D963G05	170-6R	30
85 – 137	151D963G07	230-12R	250
137 – 200	151D963G07	230-12R	250
201 – 320 ②	—	—	—
SL-400 (2400 – 4800 V)			
11.0 – 18	449D597G06	170-6R	30
18 – 31	449D597G06	170-6R	30
31 – 46	449D597G06	170-6R	30
46 – 62	449D597G06	170-6R	30
62 – 74	449D597G06	170-6R	30
74 – 93	449D597G06	170-6R	30
93 – 137	151D933G02	230-12R	30
137 – 187	151D933G02	230-12R	30
187 – 244	151D933G03	390-18R	60
244 – 360	151D933G04	450-24R	130
360 – 400 ③	151D933G04	450-24R	130
SL-400 (5500 – 6900 V)			
11.0 – 34	151D963G05	170-6R	30
34 – 46	151D963G05	170-6R	30
46 – 56	151D963G05	170-6R	30
56 – 68	151D963G05	170-6R	30
68 – 85	151D963G05	170-6R	30
85 – 137	151D963G07	230-12R	30
137 – 187	151D963G07	230-12R	30
187 – 273	151D963G10	390-18R	60
273 – 400	151D963G11	450-24R	250

① For FLA>180, maximum acceleration time = 4.5 seconds.
② Not for coordination with main fuses.
③ For FLA>360, maximum acceleration time = 6 seconds.

Note: Fuse selections based on LRC = FLA x 6, acceleration time of 10 seconds except where noted.

Maintenance

⚠ DANGER

ALL WORK PERFORMED ON THIS CONTACTOR SHOULD BE DONE WITH THE MAIN DISCONNECT DEVICE OPEN AND LOCKED OUT. AS WITH ANY CONTACTOR OF THIS VOLTAGE, THERE IS DANGER OF ELECTROCUTION AND/OR SEVERE BURNS. MAKE CERTAIN THAT POWER IS OFF. CHECK FOR VOLTAGE WITH VOLTAGE SENSOR OR A METER OF THE APPROPRIATE RANGE. MAKE CERTAIN THAT ALL TRANSFORMERS ARE ISOLATED TO PREVENT FEEDBACK AND THE RESULTANT GENERATION OF HIGH VOLTAGE.

The contactor should be serviced on a regular basis. The time interval between maintenance checks is variable and dependant on factors such as environment, duty cycle, etc. Unless the experience of the maintenance personnel suggests a different service interval, the contactor should go through a checkout after each 50,000 operations or annually, whichever occurs first.

General

The contactor should be kept clean and free from dust and other accumulated deposits. Dust can be removed from the contactor by blowing with dry air that is free from lubricants.

Inspect for loose joints that produce excess heat and discolor conductors. Verify that insulation has not been damaged by high temperatures. Do not over-torque bolts while verifying tightness. All hardware is metric property Class 8.8. Refer to **Table 7** for recommended torque values.

Verify wiring by grasping each wire and pulling to check tightness.

Check for hairline cracks in high stress areas such as auxiliary contact operating arm, baseplate, auxiliary contact mounting bracket, etc.

Table 7. Recommended Torque Values for Property Class 8.8 Metric Hardware ①

Diameter (mm)	Torque (N-m)
4	2.8 – 3.1
5	5.6 – 6.2
6	9.4 – 10.4
8	22.9 – 25.4
10	45.5 – 50.6
12	79.2 – 88.0

① Unless otherwise specified.

Vacuum Integrity Check

⚠ DANGER

THIS PROCEDURE REQUIRES THE USE OF A HIGH POTENTIAL TEST UNIT WHICH PRODUCES HAZARDOUS VOLTAGES.

⚠ WARNING

APPLYING HIGH VOLTAGES ACROSS THE OPEN CONTACTS OF A VACUUM INTERRUPTER MAY PRODUCE X-RAYS. THE RADIATION MAY INCREASE WITH AN INCREASE IN THE VOLTAGE OR A DECREASE IN THE DISTANCE BETWEEN THE OPEN CONTACTS. THE LEVELS OF RADIATION GENERATED AT THE RECOMMENDED TEST VOLTAGES AND NORMAL CONTACTOR OPEN GAP SPACING ARE EXTREMELY LOW. HOWEVER, AS A PRECAUTIONARY MEASURE IT IS RECOMMENDED THAT ALL OPERATING PERSONNEL STAND AT LEAST THREE FEET AWAY FROM THE CONTACTOR WHILE PERFORMING THIS TEST.

Vacuum contactors depend on the vacuum in each interrupter to successfully stop current flow to the connected load when the contactor opens.

SL contactors are thoroughly tested at the factory prior to shipment. They can, however, be damaged by improper handling during shipment and storage. The integrity of the vacuum interrupters should therefore be verified before the contactor is energized for the first time. The check should also be made each time the contactor is serviced or repaired, otherwise the test should be performed each 50,000 operations or annually, whichever occurs first.

To verify the integrity of the vacuum interrupters, a voltage of 16 kV-ac should be applied across the open contacts of the interrupters. The voltage should be applied for 60 seconds without breakdown. Breakdown is defined as a current of 5 mA or more flowing across the open contacts. Note that approximately 1 mA of current will flow through each interrupter during the ac test due to the capacitance of the vacuum interrupter.

If a dc high potential test unit is used, make certain that the peak voltage does not exceed 23 kV, the peak of the corresponding ac rms test voltage. A megger cannot be used to verify vacuum integrity due to its limited output voltage.

Interrupter Wear Check

The interrupters used in the SL contactor are designed for long electrical life. Replacement should be at 300,000 operations except in cases of plugging or jogging which may require more frequent replacement. Verification of contact wear can be made by following the procedure below.

The overtravel gap for a new SL contactor is 2 mm and is set at the factory. As the contacts wear, the overtravel is reduced. The SL interrupter design allows for 2 mm wear before replacement is required. To verify that the contacts are not worn beyond their allowable limits, close the contactor with rated control power. Insert the 0.5 mm contactor wear gauge, p/n 5259C11H01, between the operating plate and the washer on the lower insulator stem of each pole. Refer to **Figure 15**. If the gauge cannot be freely inserted on each pole, all three interrupters must be replaced. Refer to the Section **Vacuum Interrupter Replacement** for instructions on replacing the interrupters.

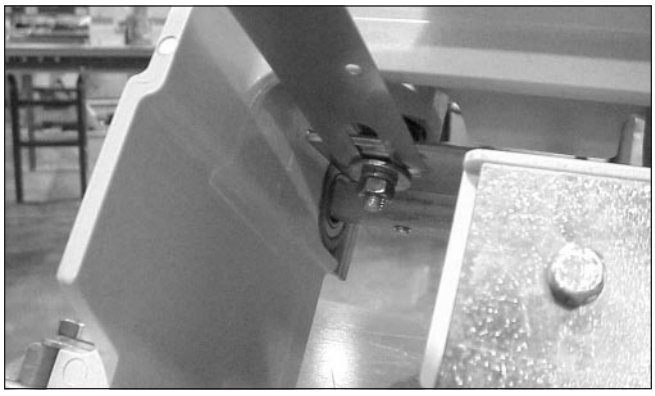

Figure 15. Interrupter Wear Check

Vacuum Interrupter Replacement

If the vacuum interrupters fail the vacuum integrity or wear check, or if they have more than 300,000 operations, they must be replaced. The three interrupters must be replaced as a set.

⚠ CAUTION

THERE ARE BELLOWS IN EACH INTERRUPTER THAT SEAL THE MOVING CONTACT FROM THE ATMOSPHERE. THESE BELLOWS ARE FRAGILE AND MUST BE PROTECTED FROM ANY TORSIONAL LOADING. AN APPROPRIATE TOOL MUST SUPPORT THE MACHINED FLATS ON EACH END OF THE INTERRUPTER WHEN TIGHTENING ANY HARDWARE ON THE INTERRUPTER. BOTTLE WRENCH, CUTLER-HAMMER PART NUMBER 4A36081H01, IS PROVIDED WITH EACH SET OF REPLACEMENT VACUUM INTERRUPTERS AND SHOULD BE USED IN THIS APPLICATION.

Remove each Vacuum Interrupter (VI) using the steps listed below:

1. Loosen locknut securing threaded rod to top of standoff insulator (**Figure 16**). Note the number of threads between the two 10 mm nuts.
2. Rotate insulator clockwise to screw insulator off threaded rod.
3. Remove clamp securing lower end of VI to housing (**Figure 17**).
4. Remove bolt and shunt supports securing end of lower terminal to housing (**Figure 18**).
5. Remove the bolt securing VI to upper terminal (**Figure 19**).
6. Hold insulator down and rotate lower portion of VI assembly forward to remove (**Figure 20**).
7. Insert new VI assembly (reverse of **Step 6**).
8. Install the bolt securing VI to upper terminal. Do not tighten.
9. Install bolt and shunt supports securing lower terminal to housing (**Figure 21**). When tightening, ensure laminated shunt is straight and shunt supports are in correct position.
10. Tighten bolt securing VI to upper terminal while holding bottle wrench on upper VI stem. Torque to 200 lb-in (22.6 Nm). Ensure the laminated shunt is not twisted.
11. Install clamp securing lower end of VI to housing.
12. Rotate insulator counter-clockwise until the number of threads noted in **Step 1** is obtained.

Figure 16. Loosen Locknut

Figure 17. Remove Clamp

Figure 18. Remove Bolt and Shunt Supports

Figure 19. Remove Bolt Securing Vacuum Interrupter

Figure 20. Hold Insulator Down

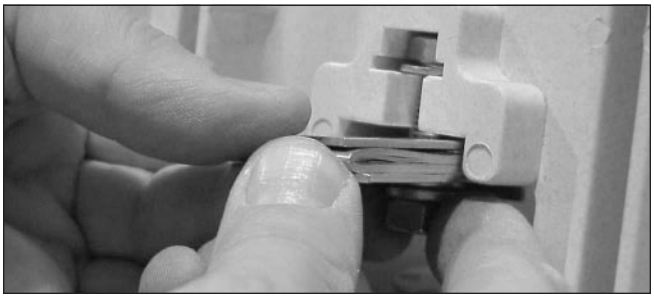

Figure 21. Install Bolt and Shunt Supports

Adjusting Vacuum Interrupters

After three new vacuum interrupters have been installed, "set the proper open gap using the steps listed below. Three battery-operated test lights or continuity testers are needed for the proper setting of the open gap.

1. Attach test lights across the upper and lower terminals of each interrupter.
2. Rotate insulator on middle phase bottle until light flickers. Rotate clockwise if light is not on, counter-clockwise if light is on.
3. From the point the light flickers, rotate insulator on middle phase bottle counter-clockwise three and two-thirds turns to establish a 5.5 mm open gap. Use markings on insulator to verify correct rotation. (Two-thirds turn is equal to eight divisions that are molded on the surface of the insulator.)
4. Slowly rotate the main shaft, closing the vacuum interrupters, until the middle phase light is on. Adjust the insulators on the two outside phases so that the lights on all three phases come on simultaneously, (DO NOT MOVE THE INSULATOR ON THE MIDDLE PHASE) while rocking the main shaft open and closed.
5. Tighten locknuts securing threaded rod to top of each insulator. Use bottle wrench to ensure standoff insulator does not rotate during this operation.
6. Perform test as described in section on **Vacuum Integrity Check** on **Page 10** before returning contactor to service.

Coil Replacement

1. Remove the coil leads from terminals 5 and 6 on the control board. Cut the wire-tie securing the coil leads to the baseplate.
2. Remove the coil mounting angle by removing the two angle mounting bolts located on the bottom of the contactor baseplate (**Figure 22**). Be careful not to allow the angle to move abruptly as the bolts are removed since there is pressure applied to the angle by the return spring. Remove coil assembly from contactor.
3. Remove the locknut holding the return spring bolt on the back of the mounting angle (**Figure 23**).

   Note: After removing locknut, count the threads protruding through the mounting angle to ensure correct length during reassembly.
4. Unscrew the spring assembly by hand and remove from the angle (**Figure 24**).
5. Slip the two coils from the cores.
6. Install the two new coils over the cores (**Figure 25**).
7. Thread the return spring assembly into the mounting angle until the locknut under the bottom spring retainer just contacts the angle. The number of threads protruding through the mounting angle should be the same as counted in **Step 3**. Do not overtighten since this would compress the return spring and prevent the proper force from being applied to the operating plate on opening. The rear locknut for the return bolt should then be tightened on the back of the angle.
8. Secure the angle to the contactor baseplate using the two mounting bolts. Sufficient force must be applied to the angle to compress the return spring and allow the threaded holes in the angle to align with the appropriate holes in the baseplate.
9. Connect the coil leads to the appropriate terminals on the control board. Secure the leads using a wire tie and the hole in the baseplate to ensure that the leads do not become abraised. Before the contactor is reinstalled, verify proper operation using test power. When power is applied, the contactor should close cleanly. When power is removed, the moving armature should securely contact the stop assembly.

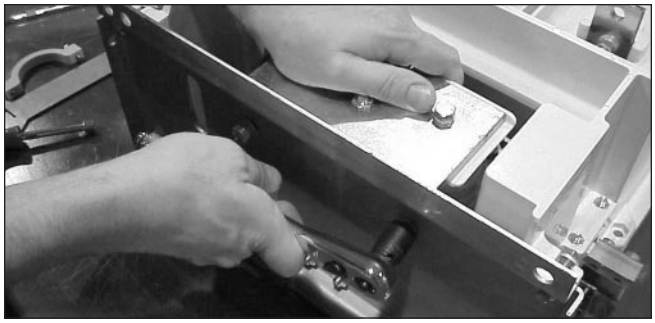

Figure 22. Remove the Coil Mounting Angle

Figure 23. Remove the Locknut Securing the Return Spring Bolt

Figure 24. Unscrew the Return Spring Assembly

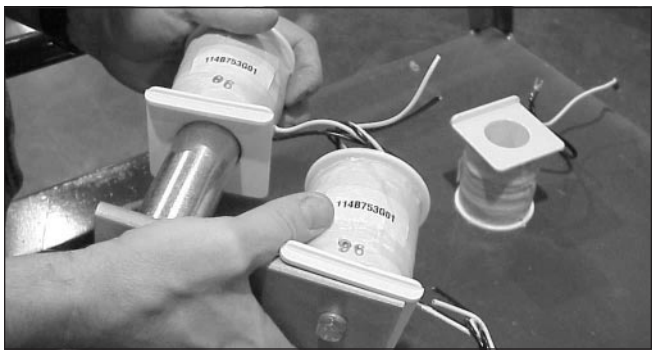

Figure 25. Install New Coils on Cores

Control Board Check and Replacement

To verify the output of the control board, apply rated control voltage to terminals 1 and 2.

⚠ WARNING

VERIFY THAT THE APPLIED POWER CANNOT BE FED BACK INTO ANY CPT OR OTHER CIRCUIT, WHICH MAY GENERATE DANGEROUS VOLTAGES.

Using a standard hand-held multimeter, check the dc output of the board at terminals 5 and 6. The voltage should be approximately 9 to 16 volts. If there is no output, the board must be replaced. If there is an output voltage, but it is not within this range, remove the board and verify the DIP switch settings.

To remove the board, wires connected to terminals 1, 2, 5 and 6 (7 and 8 also if mechanical latch is installed) must be disconnected. Make certain that the wires are properly marked before disconnecting to ensure the ability to reconnect them to the proper terminal. After the wires are disconnected, loosen the mounting screws located at the top and the bottom of the terminal block. The board may now be withdrawn from its mounting compartment.

Before a new board is installed, make certain that the DIP switches are properly set. Refer to **Table 3** and **Table 4** or **Pages 5** and **6**. Installation is the opposite of removal.

Stop Assembly Replacement

If the stop assembly becomes worn, it should be replaced.

To replace, close the contactor with test power. Remove the two bolts securing the assembly to the baseplate. Install a new assembly. Hand-tighten bolts. Set gap between the armature plate and stop to 13.6 mm ± 0.1 mm. Using adjustment block provided with replacement stop assembly, torque bolts to 24.2 N-M. (See **Figure 26**.)

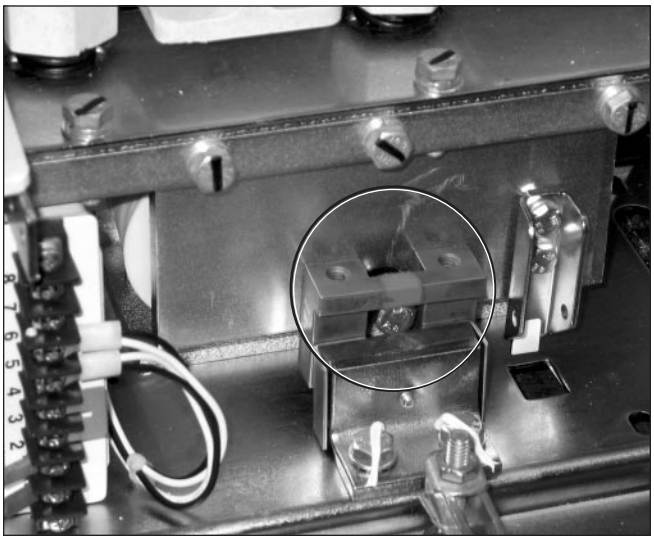

Figure 26. Stop Assembly Adjustment Block

Auxiliary Contact Maintenance and Replacement

If standard contact blocks become oxidized due to very low current levels passing through the contacts, they may be cleaned by periodically disconnecting them from the circuit and circulating approximately 10 amperes through the contacts for a short period of time.

If one or more of the auxiliary contacts fail, it is recommended that the complete contact block assembly be replaced. Disconnect wiring to each contact, making sure to properly mark each wire to ensure proper reconnection. Remove the two mounting screws securing the contact assembly to the bearing retainer. Install the replacement assembly, securing with the two mounting screws. The contacts are properly adjusted when the plunger to operating arm gap is 2.8 mm. (See **Figures 27** and **28**.)

Insulation Level Check

After installation and before energizing the contactor for the first time, the insulation level should be checked and recorded. Check the resistance between poles and from each pole to ground with a megger. Record all readings. It is not practical to specify an absolute value for this reading since it is dependent on other connected apparatus and conditions of service. However, any unusually low readings (below 1 meg per 1000 volts) or abrupt reduction in a reading would indicate a possible source of trouble, and the cause should be investigated and corrected. As previously discussed, the insulation level check cannot verify vacuum interrupter integrity.

Contact Resistance Check

Testing that measures the contact resistance of the vacuum interrupters is not recommended since the results can vary widely on good contacts. If a resistance check is performed, the best results will be with a test module that will force 50 to 100 amperes through the contacts while measuring resistance. Any value under 300 micro-ohms can be considered typical, although higher readings may be measured if the test equipment is not connected near the contactor terminals.

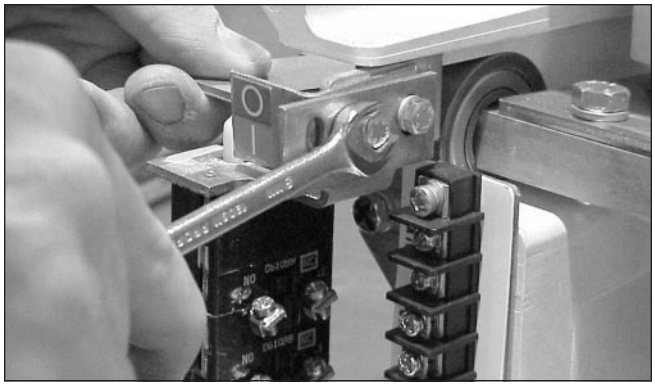

Figure 27. Remove the Two Mounting Screws Securing the Contact Assembly to Bearing Retainer

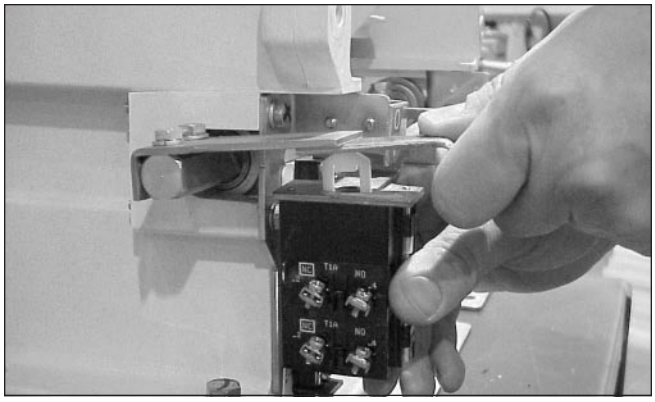

Figure 28. Adjust the Gap Between Plunger and Operating Arm to 2.8 mm

Replacement Parts

Following is a partial list of the replacement parts available for the SL Contactor. Contact your Eaton distributor for price and availability.

Table 8. Replacement Parts

Description	Part Number
Vacuum Interrupter Assembly for SL-160/200/320/400	**2147A58G02**
Coil Control Board	**2147A58G03**
Auxiliary Contact Kit (2NO – 2NC)	**2147A58G04**
Auxiliary Contact Kit 3NO – 3NC (for Latched Contactor)	**2147A58G05**
Dual Coil Assembly (All Voltages)	**2147A58G11**
Stop Assembly	**2147A58G14**
Return Spring Assembly	**2147A58G22**
24 Vdc Latch Coil with Rectifier	**2147A58G25**
110/120 Vac, 125 Vdc Latch Coil with Rectifier	**2147A58G27**
220/240 Vac Latch Coil with Rectifier	**2147A58G28**

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