Instruction Leaflet for the LES/MES 310+ Electronic Trip Unit

Contents

Powering Business Worldwide

⚠ WARNING

DO NOT ATTEMPT TO INSTALL OR PERFORM MAINTENANCE ON EQUIPMENT WHILE IT IS ENERGIZED. DEATH OR SEVERE PERSONAL INJURY CAN RESULT FROM CONTACT WITH ENERGIZED EQUIPMENT. ALWAYS VERIFY THAT NO VOLTAGE IS PRESENT BEFORE PROCEEDING.

Section 1: General Information

Table 1. Parts List

L OR M 310+ ELECTRONIC TRIP UNIT
IL FOR 310+ ELECTRONIC TRIP UNITS
NEUTRAL CURRENT SENSOR (GROUND FAULT ONLY)
NEUTRAL & ALARM LEADS (GROUND FAULT ONLY)
4TH POLE CT ASSEMBLY (4 POLE ONLY)

Section 2. Trip Unit Installation

Step 1

Remove the 8 screws (10 for MDL-frame) holding the base and cover together (Figure 1).

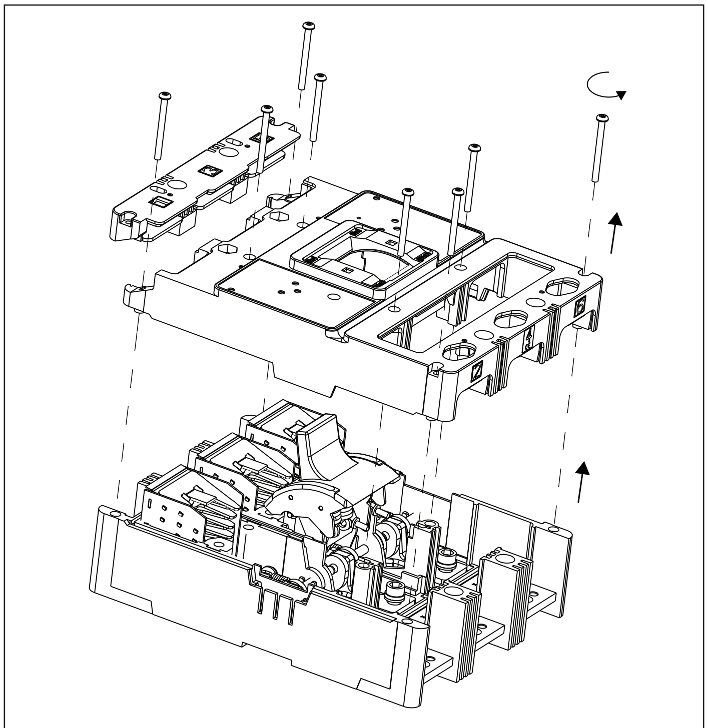


Figure 1. LES Base-cover Screws.

Step 2

Remove the 2 retaining screws (3 for 4-pole breaker) from the shunt plate inserts in the base of the circuit breaker frame.

Step 3 (4-pole Only)

Plug the current sensor secondary winding connector into the receptacle in the side of the trip unit. Either polarity is acceptable since the secondary winding connector is not polarized.

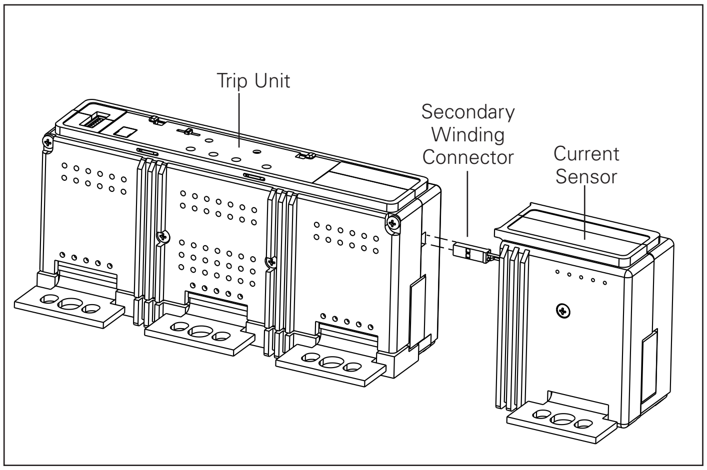


Figure 2. 4th Pole Installation.

Step 4

Position the retaining screws in the trip unit and current sensor conductor holes (Figure 3).

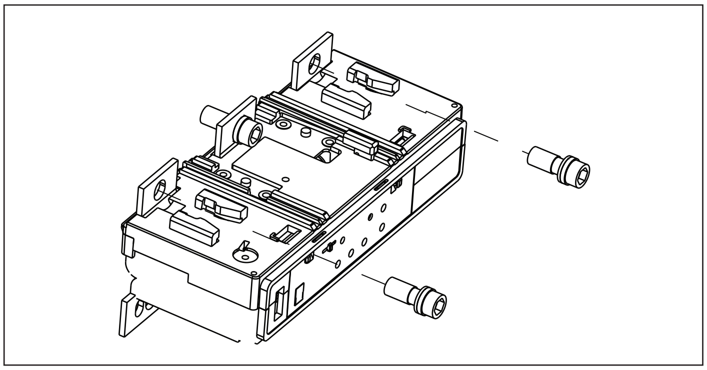
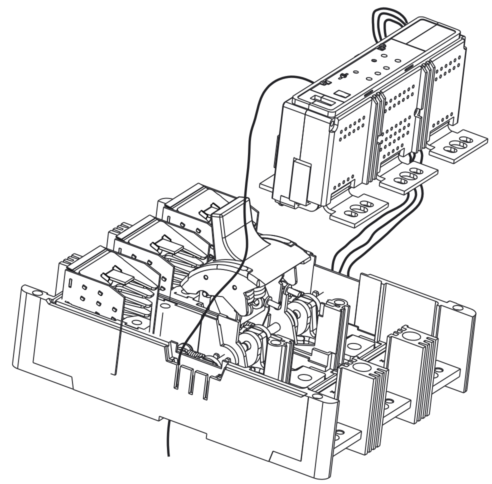


Figure 3. Retaining Screws Location in Trip Unit.

Step 5

If present on the trip unit, route wires through the slots on the breaker frame's side (Figure 4).



Note: Wires for optional features only.

Figure 4. Wire Routing Tunnels on Breaker Base.

Pull wiring harnesses through slots in frame until the cable ties reach the location shown in Figure 5. Cable ties positioned below this location can result in an interference with the circuit breaker cover during assembly. It is not possible to have leads of wiring harnesses exit opposite sides of the breaker.

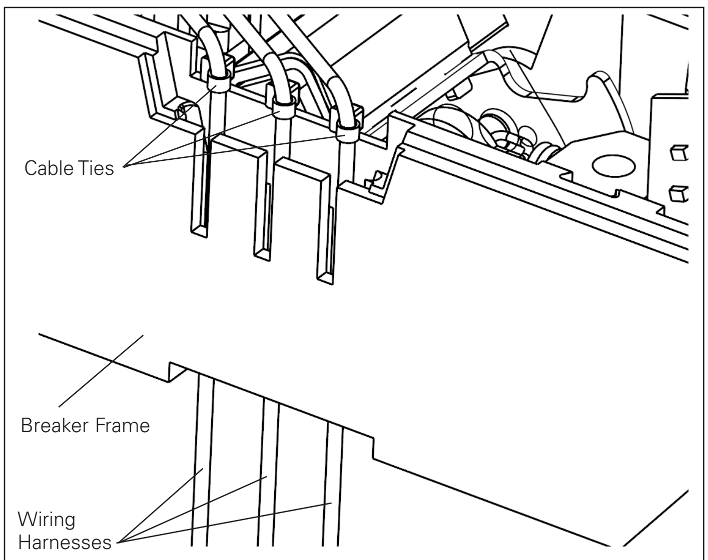


Figure 5. Wire Routing Cable Tie Placement.

Step 6

Starting with the center pole (mech pole), tighten the three retaining screws in the trip unit and the fourth retaining screw in the current sensor. Torque to 10 – 12 lb.-ft. (14 – 16 N·m) (Figure 6).

⚠ CAUTION

DO NOT EXCEED A TORQUE OF 10 – 12 LB.-FT. (14 – 16 N·m.). EXCESSIVE TORQUING WILL SHEAR THE SCREWS. FAILURE TO APPLY THE REQUIRED TORQUE MAY LEAD TO EXCESSIVE HEATING AND CAUSE NUISANCE TRIPPING OF THE CIRCUIT BREAKER.

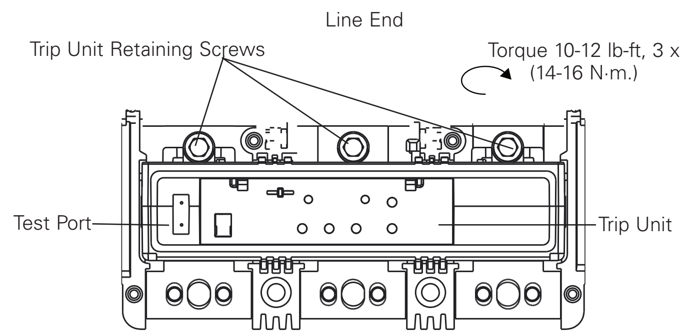


Figure 6. LES Trip Unit Mounting Screw Locations.

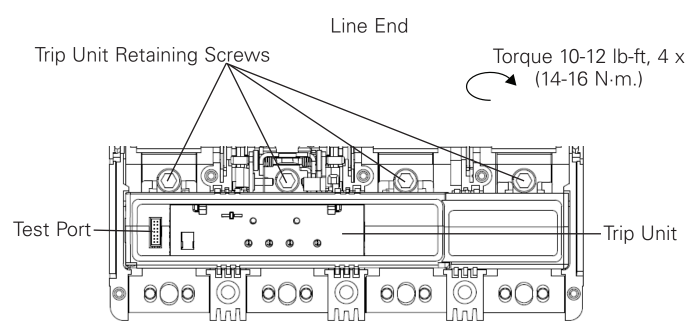


Figure 7. LES 4-pole Trip Unit Mounting Screw Locations.

Step 7 (MES Trip Units)

Starting with the center pole (mech pole), torque line side screws to 10-12 lb.-ft. (14-16 N·m) and load side screws to 6 – 8 lb.-ft. (8 – 10 N·m) (Figure 8).

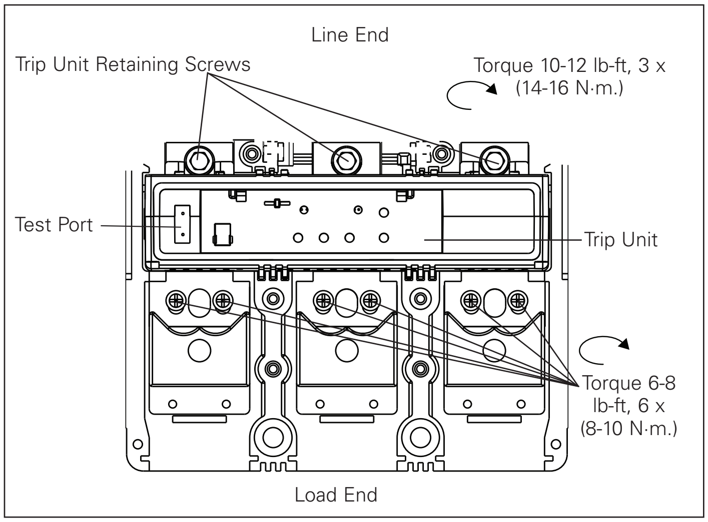


Figure 8. MES Trip Unit Mounting Screw Locations.

Step 8.

Install any accessories, if required, using the appropriate instruction leaflet.

The following types of internal accessories, which mount on the trip unit, are available for use. The number of the IL covering the installation of each accessory is shown.

- Alarm (Signal)/Lockout (ASL) Switch..............................I.L. 29C183
- Auxiliary Switch...I.L. 29C123
- Shunt Trip...I.L. 29C146
- Low Energy Shunt Trip...I.L. 29C147
- Undervoltage Release Mechanism (Handle Reset).......I.L. 29C170

Trip Unit Wire Routings with Accessories:

- Alarm (Signal)/Lockout (ASL) Switch and Auxiliary Switch:
  From trip unit, route wiring harnesses through the recessed center portion of the accessory bracket and through the slots in the breaker frame.
- Shunt Trip:
  From trip unit, route wiring harnesses through the recessed center portion of the accessory bracket overlapping the white and yellow accessory wires, over the shunt trip, and through the slots in the breaker frame.
- Low Energy Shunt Trip and Undervoltage Release Mechanism (Handle Reset):
  From trip unit, route wiring harnesses under accessory bracket and through the slots in the breaker frame.

Step 9

Finish the installation by installing the cover on the base, as shown in Figure 10.

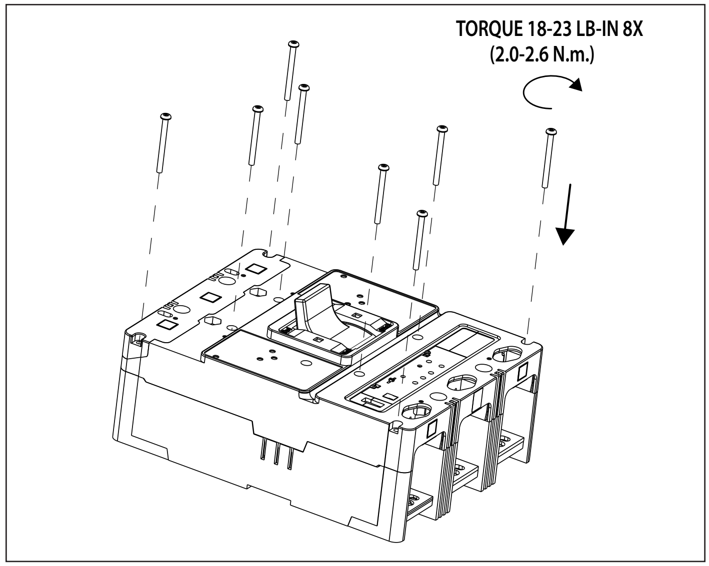


Figure 9. Re-attach Cover and Base of the Breaker.

Section 3. Trip Unit Controls and Functions

A. Trip unit controls and settings (refer to Figures 10 and 11).

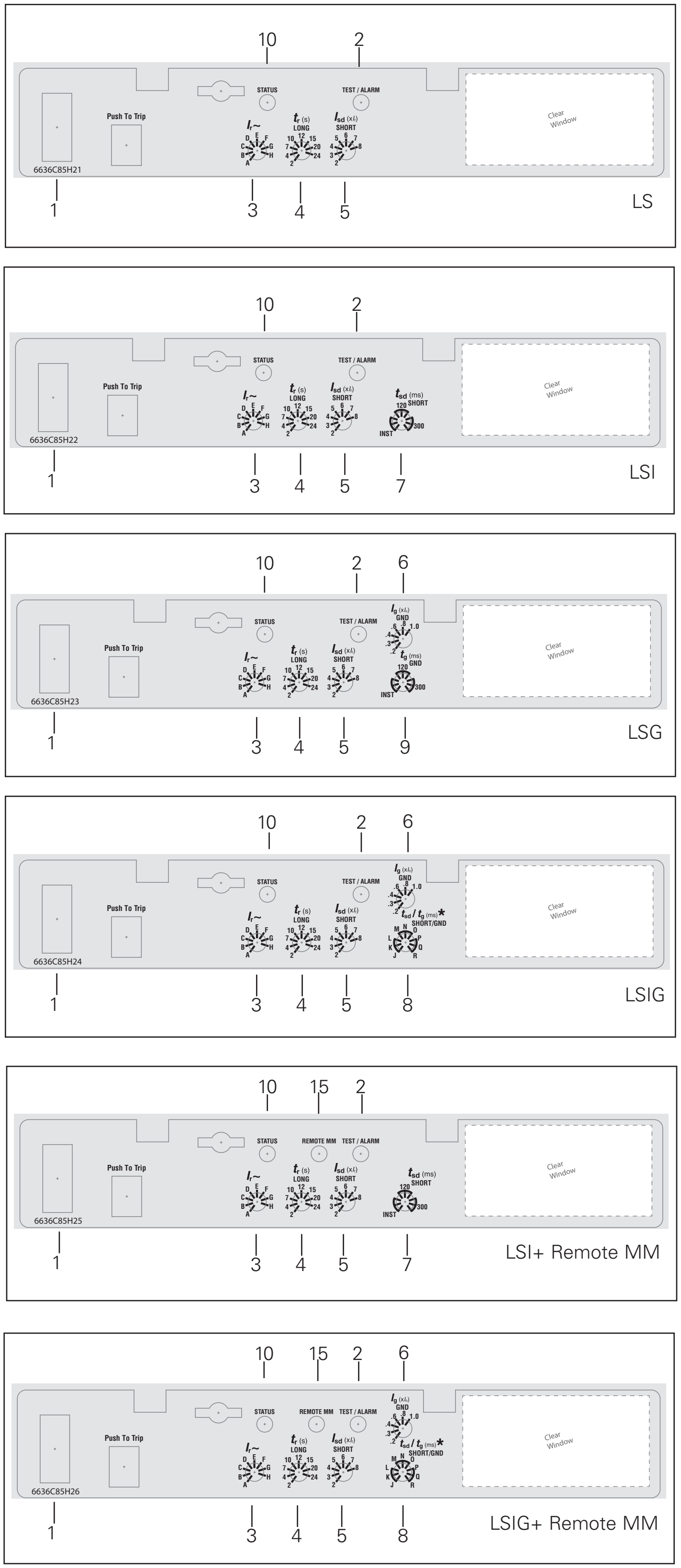


Figure 10. LES / MES Trip Units Settings.

I_r Settings	
LES	**MES**
A = 250A	A = 320A
B = 300A	B = 400A
C = 315A	C = 450A
D = 350A	D = 500A
E = 400A	E = 600A
F = 450A	F = 630A
G = 500A	G = 700A
H = 600A = In	H = 800A = In

*Settings		t_g (ms) Inst.	120	300
t_{sd} (ms)	Inst.	J	K	L
	120	M	n	O
	300	P	Q	R

Figure 11. LSIG Short Delay and Ground Fault Time Settings.

1. Test Port - A test port is built into each trip unit to allow use of a functional test kit. The test kit performs a test of the Long Delay, Short Delay and Ground Fault functions (Plug-In Test Kit Catalog #MTST230V). Remove the test port cover prior to connecting to the test port.
2. Test/Alarm LED - A dual function, bi-color (red-amber) LED. It is used as an amber no trip indicator when using the test port. In normal modes, the red LED indicates a high load alarm. For a high load alarm, it will blink ON-OFF if the continuous current is 105% of the I_r setting and is present for a duration over 38 seconds.
3. I_r - Continuous current setting. In accordance with standards requirements, the trip unit initiates a trip of the circuit breaker within 2 hours for an overload of 135% and will trip as a function of I^2t for higher currents. Continuous current values for each lettered setting are indicated by the chart displayed on the left side of the trip unit label.
4. t_r - The number of seconds required to trip @ 6x I_r. For example, if I_r = 250A, t_r = 2 sec, and load current = 1500A, or 6x I_r, then the breaker will trip in 2 seconds.
5. I_{sd} - Setting in multiples of I_r for short circuit conditions that exceed the short delay pick-up setting, the trip unit initiates a trip after a predetermined delay.

   Note: In addition to the short delay trip function, there is a fixed instantaneous override for the 600A and 800A trip units. The override for the 600A is fixed at 5620A, the override for the 800A is fixed at 6800A. If a fault current exceeds these override values, the breaker will trip instantaneously (in 20 milliseconds or less).
6. I_g - Ground fault pick-up setting. It is used on the LSIG and LSG styles to set the ground fault pick-up as a percentage of I_n (frame current). For example, a 600A frame with an I_g setting of 0.4 will provide a ground fault pick-up at 240A.
7. t_{sd} - for the LSI style, the short delay time is a flat response determined by the tsd switch settings of INST 120ms, or 300ms. For the LS styles, the short delay time is an I^2t function, with a delay of 67ms at a Isd setting of 6x.
8. t_{sd} / t_g - For the LSIG style, the short delay is a flat response determined by the tsd/tg switch settings of INST 120ms or 300ms. This switch is a dual switch that also determines the ground fault time settings of INST, 120ms or 300ms. For example, if the t_{sd}/t_g switch is set at position J, then both short delay time and ground fault time are at INST flat. As another example, set the t_{sd}/t_g switch at position L; the short delay time is INST and the ground fault time is 300ms. The LSIG label (Figure 11) should be used in conjunction with the t_{sd}/t_g switch to set any one of nine possible combinations of short delay and ground fault times.
9. t_g - For the LSG style, the short delay time is an I^2t function while the ground fault flat time is set by the t_g switch.
10. Status LED - A green status light indicates the operational status of the trip unit. If the load current exceeds approximately 20% of the maximum current rating (I_n) of the breaker, the status light

will blink on for one second and off for one second.

B. Other features and options of the LES/MES 310+ trip units.

1. The High Load Alarm Relay option will provide a SPST contact closure when the trip unit current equals or is greater than 105% of In for a period of 38 seconds. If the current drops below the 105% value, the contact will open. The yellow and green wires that exit the right side of the breaker are the common (C) and normally open (NO) of this relay (See Figure 12).
2. The Ground Fault Alarm Only option operates in a similar fashion as the High Load Alarm. The SPST contact will close if the ground fault pick-up setting is exceeded and will open when below the ground fault pick-up setting. The yellow and green wires that exit the right side of the breaker are the common (C) and normally open (NO) of this relay (See Figure 12).
3. The Ground Fault Relay option will provide a SPST contact closure immediately before the breaker will trip on a ground fault over current detect. This closure is momentary (50ms) and the customer must provide the necessary external circuitry in order to latch this signal. The yellow and green wires that exit the right side of the breaker are the common (C) and normally open (NO) of this relay (See Figure 12).

Note: The High Load Alarm Relay can be selected with LS, LSI LSG, and LSIG trip units. For the LSG and LSIG trip units, the High Load Alarm will function normally. However, if the breaker trips due to a ground fault condition, the relay will respond with a ground fault alarm as indicated above.

The Ground Fault Alarm Only can be selected for LSG and LSIG trip units only. This selection has precedence over all other relay functions. When the Ground Fault Alarm Only is selected, the High Load Alarm Relay feature is not available.

Note: The contact ratings of the relay are: 2A at 30 VDC and 0.5 A at 125 VAC.

4. The Zone Selective Interlock (ZSI) option provides a wired method of coordinating Upstream and Downstream breakers. The coordinating signals are provided by the White\Red stripe (Z_{in}), White\Black stripe (Z_{out}), and Black (common ground) wires that exit the right side of the breaker. ZSI may be ordered on LSI and LSIG trip units.

Zone Selective Interlocking is active for the short delay and the ground fault delay tripping functions. The LES/MES 310+ Trip Unit Zone Selective Interlocking feature is compatible with OPTIM and Digitrip Trip Units, including all other 310+ models on Series G: (RG, NG LG, JG) and Series C (FD and KD) breakers.

Three wires exit the breaker with the following color code and function: White/Black Stripe=Zone Out, White/Red Stripe=Zone In, and Black=Common (See Figure 12).

A typical connection for a two breaker system is accomplished by connecting the Z_{out} wire of the downstream breaker to the Z_{in} of the upstream breaker. The common black wires of both breakers must also be connected.

If a high current fault is sensed from the load on the downstream breaker, both breakers will sense the fault. However, the downstream breaker will send the interlock signal to the upstream breaker informing it not to trip. This delay allows the downstream breaker to clear the fault without the upstream breaker tripping.

However, if for some reason the downstream breaker does not clear the fault in the set delay time, the upstream breaker will then clear the fault at or before its defined t_{sd} or t_g.

Multiple breakers may be connected in a system to create a zone of protection. For faults outside the zone of protection, the trip unit of the circuit breaker nearest the fault sends an interlocking signal (Z_{out}) to the trip unit of the up-stream circuit breaker. (Z_{in}) This interlocking signal restrains immediate tripping of the upstream circuit breaker until its programmed coordination time is reached. Thus zone selective interlocking applied correctly can reduce damage due to circuit or ground fault conditions. A table of the settings of the two breakers with the respective outcomes (Both Trip or Downstream (Dn) Trips) of the breakers is indicated below for the conditions mentioned in the table heading.

		Upstream		
		INST	120ms	300ms
Downstream	INST	Both	Dn 43ms	Dn 43ms
	120ms	Both	Dn 52ms	Dn 52ms
	300ms	Both	Dn 43ms	Dn 43ms

Note: A single breaker with the Zone Selective Interlocking feature enabled will not trip at the programmed time settings, unless Self Interlocked. That is, the Z_{out} wire should be connected to the Z_{in} wire.

5. Remote Maintenance Mode (RMM) is an option that allows a user to remotely lower the instantaneous pickup of the breaker to 2.5x the frame rating (I_n), and to bypass any programmed delays (t_{sd} or t_g). The purpose of the function is to to reduce incident energy during a fault condition.

For example, a 600A (I_n) LD breaker with the switch set to 2.5x would trip instantaneously when the current exceeded 1500 A.

The RMM is enabled by applying 24VDC to the two wire cable that exits the left side of the breaker. The wires are color coded Yellow (+24V) and Black (common ground) - see Figure 14. A blue colored LED on the trip unit lights when the breaker is in RMM (Figure 13).

The lighted blue LED indicates that RMM is enabled. This setting corresponds to 2.5x of I_n. Turning the I_{sd} switch on the trip unit has no effect on either the Maintenance Mode or the t_{sd}\t_g settings while the blue LED is lit.

Also, a relay contact closure indicates that the RMM has been enabled. The blue and red wires are the C and NO contacts of this relay. The relay has a dual function: 1) enable RMM and 2) provide a contact closure indication that RMM is enabled.

Both the yellow and black set of wires and the red and blue set of wires exit on the left side of the breaker.

Note: The RMM contacts are rated at 2A at 30 VDC and 0.5A at 125 VAC.

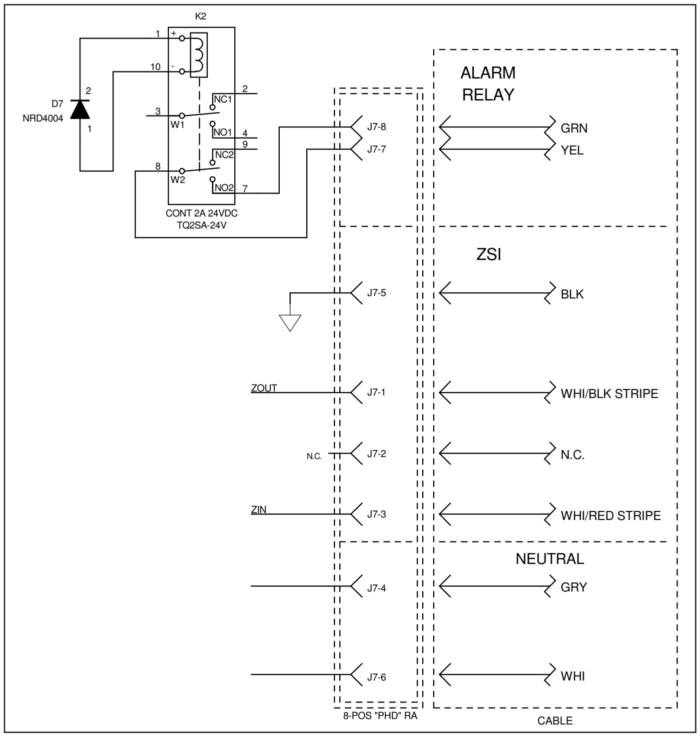


Figure 12. Alarm, ZSI, and Neutral Wiring Diagram.

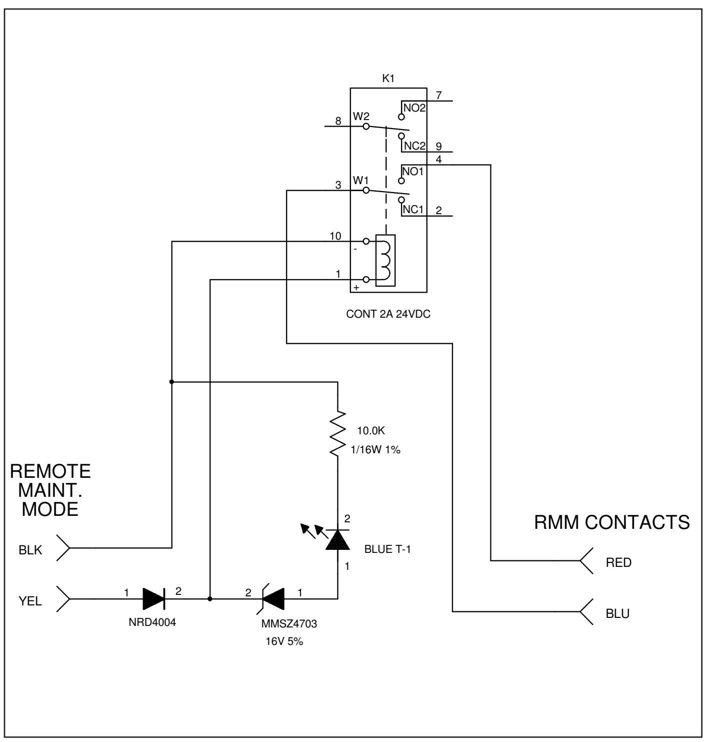


Figure 13. Remote Maintenance Mode Wiring Diagram.

Section 4. Neutral Current Sensor Information.

Ground fault trip units are supplied from the factory with pigtail lead connections for a neutral current sensor (white and grey wires). A neutral current sensor shown in Figure 14 is available. 310+ Ground Fault Trip Units detect ground fault currents through Residual Sensing. They are not designed to use source ground or zero sequence ground fault sensing methods. If the system neutral is grounded, but no phase to neutral loads are used, the neutral current sensor is not necessary. In that case, the white and grey leads on the trip should be cut off before installation. If the system neutral is grounded and phase to neutral loads are used, then the neutral current sensor must be used. It should be connected to the breaker according to Figure 15 It has the same turns ratio as the phase current sensors in the trip unit.

NOTICE

THE POLARITY OF THE SENSOR CONNECTIONS IS CRITICAL. ALWAYS OBSERVE THE POLARITY MARKINGS ON THE INSTALLATION DRAWINGS. THE POLARITY MARKINGS ARE IDENTIFIED AS WHITE DOTS ON THE TRANSFORMERS. TO INSURE CORRECT GROUND FAULT EQUIPMENT PERFORMANCE, CONDUCT FIELD TESTS TO COMPLY WITH NATIONAL ELECTRIC CODE REQUIREMENTS UNDER ARTICLE 230-95-C.

Note: See wiring instructions below for special restrictions on accessory wiring for ground fault breakers. Then install the ground fault alarm and neutral current sensor connector printed circuit board as described previously.

⚠ CAUTION

LEADS COULD BE DAMAGED IF IN CONTACT WITH MOVING PARTS. ACCESSORY WIRES SHOULD BE FORMED AND ROUTED TO CLEAR ALL MOVING PARTS.

Leads to be routed:

1. 2 leads (white and grey) for the neutral current sensor.
2. 2 leads (yellow and green) for the ground fault alarm relay

It is not possible to have leads exiting the breaker on the opposite side. For rear exiting leads, thread the leads through the wiring troughs/tunnels in the side of the circuit breaker case. For side exiting leads, use the slots in the side of the case. Use the center trough or slot for the neutral current sensor leads (white and grey) and the trough or slot closest to the trip unit for the alarm leads (yellow and green).

Any other leads to be brought out should then be threaded through the wiring trough closest to the trip unit.

Section 5. 100% Rated LD and MDL Frame Circuit Breakers

CLD, CHLD, CLDC, CMDL, and CHMDL circuit breakers are suitable for continuous operation at 100% of the frame rating if used with CU only 90° C insulated wire and AL9CU terminals in an enclosure which measures at least 24” high x 15” wide x 6” deep for the LD and 42" high x 18" wide x 7.5" deep for the MDL. Ventilation is not required in an enclosure having these minimum dimensions.

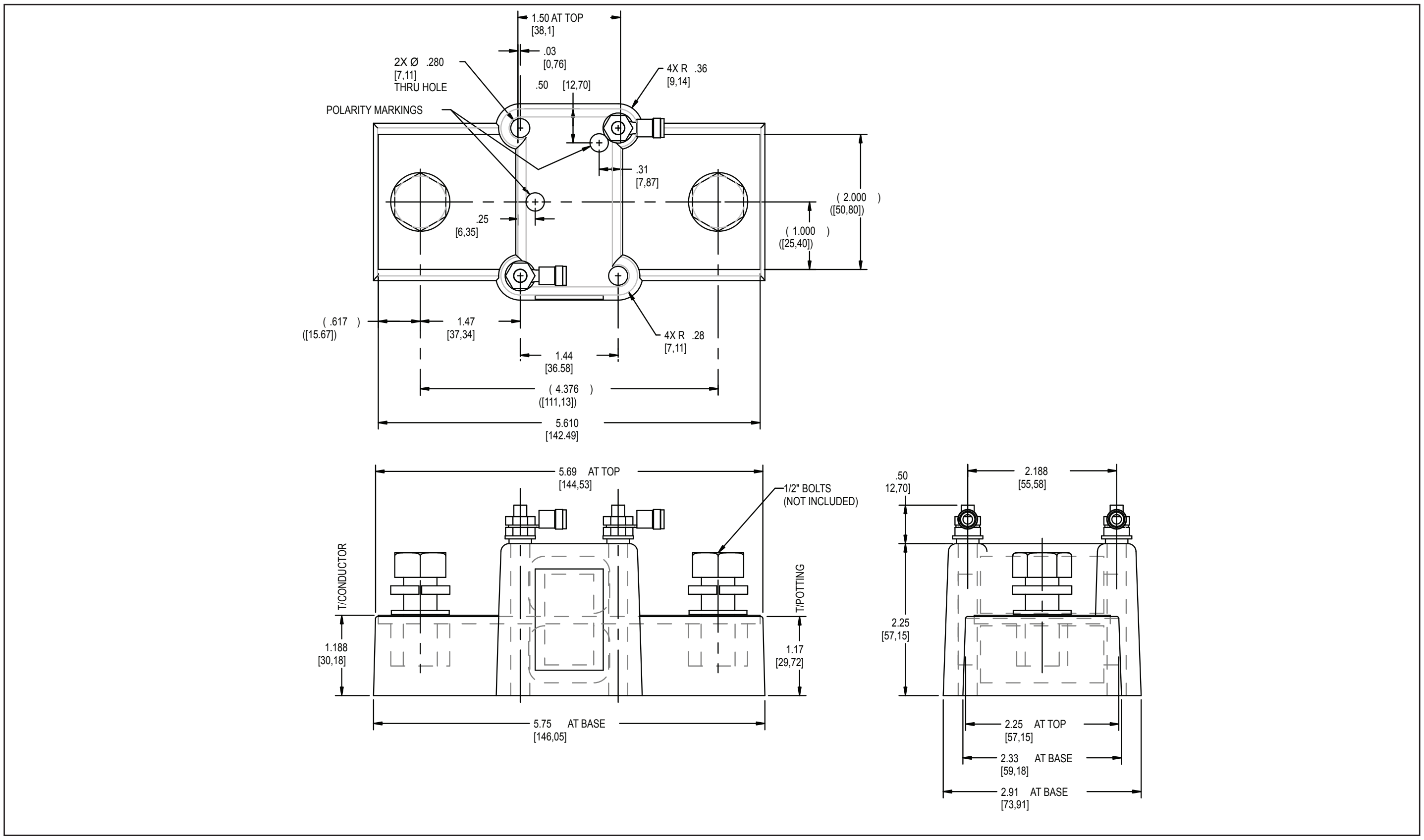


Figure 14. Neutral Current Sensor.

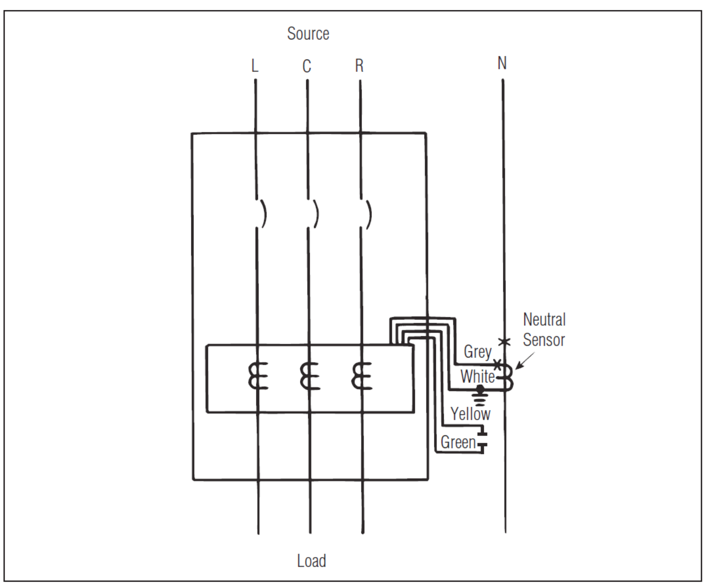


Figure 15. Neutral and Alarm Wiring Diagram.

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