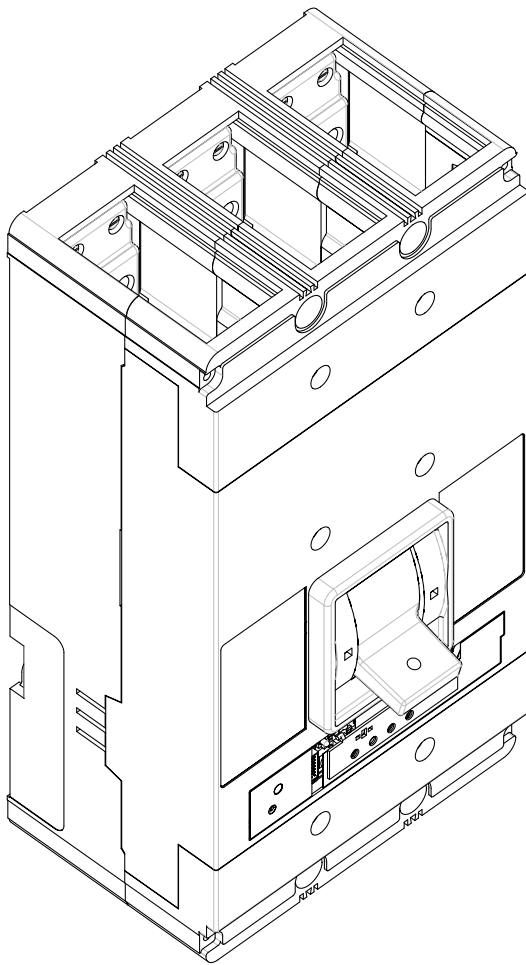


# Installation Instructions for Series G N-Frame Circuit Breakers and Molded Case Switches



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## WARNING

**DO NOT ATTEMPT TO INSTALL OR PERFORM MAINTENANCE ON EQUIPMENT WHILE IT IS ENERGIZED. DEATH, SEVERE PERSONAL INJURY, OR SUBSTANTIAL PROPERTY DAMAGE CAN RESULT FROM CONTACT WITH ENERGIZED EQUIPMENT. ALWAYS VERIFY THAT NO VOLTAGE IS PRESENT BEFORE PROCEEDING WITH THE TASK, AND ALWAYS FOLLOW GENERALLY ACCEPTED SAFETY PROCEDURES.**

**EATON IS NOT LIABLE FOR THE MISAPPLICATION OR MISINSTALLATION OF ITS PRODUCTS.**

The user is cautioned to observe all recommendations, warnings and cautions relating to the safety of personnel and equipment as well as general and local health and safety laws, codes and procedures.

This product is a direct replacement for Westinghouse/Cutler-Hammer circuit breakers. The recommendations and information contained herein are based on Eaton experience and judgement, but should not be considered to be all-inclusive or covering every application or circumstance which may arise. If any questions arise, contact Eaton for further information or instructions.

### 1. INTRODUCTION

The N-Frame Circuit Breaker (Figure 1-1) are 690 VAC maximum rated devices, 600 V for UL applications, and have integral trip units. Available current ratings are up to 1600 Amp, 1200 for UL applications. Refer to Table 1.1 for available trip units and Table 1.2 for available rating plugs. N-Frame Circuit Breakers and molded case switches are listed in accordance with Underwriters Laboratories, Inc. Standard UL-489 and satisfy the requirements of the International Electrotechnical Commission Recommendations No. IEC 60947-2.

The Series G 310+ Trip Units are AC only devices that employ microprocessor based technology that provides

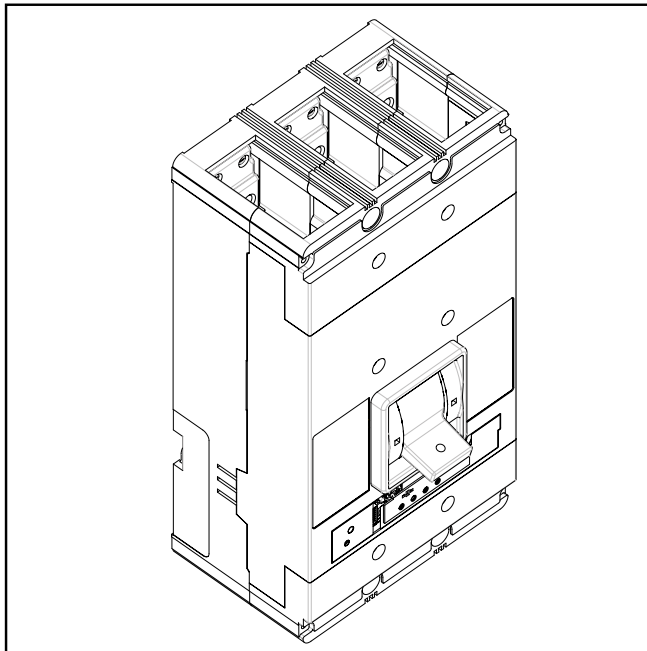


Figure 1-1. N-Frame Circuit Breaker.

true RMS current sensing means for proper correlation with thermal characteristics of conductors and equipment. The primary function of the Trip Unit is circuit protection. This is achieved by analyzing the secondary current signal received from the circuit breaker current sensors and initiating trip signals to the circuit breaker shunt trip when pre-set current levels and time delay setting are exceeded. Low level ground fault protection with an adjustable time delay is supplied when appropriate trip types are selected.

In open air at 40°C (104°F), a N-Frame Circuit Breaker with a 310+ Trip Unit will carry continuously up to 1200 amperes without exceeding a 50°C (122°F) rise at the terminals. The calibration of the trip unit is insensitive to ambient temperatures over a range of -20 to +55°C (-4 to 131°F). However, the trip unit contains thermal temperature protective circuitry that initiates a trip operation for self-protection if the internal ambient temperature at the printed circuit board (PCB) reaches approximately 90°C. For ambient conditions above 40°C (104°F), derating of the circuit breaker should be considered to avoid exceeding a safe terminal temperature operation range. Consult Eaton for recommendations.

**Molded Case Switches:** The Molded Case Switch is similar to the Circuit Breaker except that it has a different tripping characteristic. There is a fixed instantaneous trip at 15,000 Ampere but there is no overload short delay or ground fault trip. As a result sections 2.6, 4.5, 6.8, and 7 are not applicable. In the remaining sections the term circuit breaker shall also include the molded case switch.

**100 Percent Rated N-Frame Circuit Breaker:** Circuit Breakers with a “C” suffix (-C) in the catalog number are 100 percent rated circuit breakers and are suitable for continuous operation at 100 percent of the frame rating in an enclosure which measures at least 42 in. (1066.8 mm) height, 22 3/4 in. (577.9 mm) width, and 11 1/2 in. (292.1 mm) depth. The 800 A version requires no enclosure ventilation. The 1200 A version requires 224 in<sup>2</sup> (144,510 mm<sup>2</sup>) ventilation on the front face of the enclosure (72 in<sup>2</sup> (44,451 mm<sup>2</sup>) bottom, 40 in<sup>2</sup> (25,806 mm<sup>2</sup>) left and right. The 1200 A version also requires conductor extensions and terminal barriers (supplied with 100 percent rated breakers) as shown in Figure 2-2. Use only 90°C (194°F) rated wire with ampacity based on 75°C

(167°F) rated conductors. Use only copper or AL9CU terminals.

**Overload Trip:** In accordance with standards requirements, the trip unit initiates a trip of the circuit breaker within two hours of an overload of 135 percent, and a trip in less time for higher overloads.

A “Thermal Memory” effect prevents the breaker from being reenergized immediately after an overload. A “cooling off” period of up to 5 minutes is required, which allows time for the cabling to cool off.

**Short Delay/Instantaneous Trip:** For short circuit conditions that exceed the short delay pick-up settings, the trip units initiate a trip after a delay prescribed by the I<sup>2</sup>t ramp function for trip units designated LS and LSG. A flat response time delay action is provided by trip units designated LSI and LSIG unless the instantaneous (I) setting is selected.

**Table 1.1. Electronic (Digitrip 310+) Trip Unit Types.**

Trip Unit Functions		Digitrip RMS 310+ Trip Unit				
		LS	LSI	LSG	LSIG	K
Long Time	Adjustable Ampere Rating with Adjustable Long Delay	•	•	•	•	
Short Time	Adjustable Short Time Pick-up with Short Time Delay I <sup>2</sup> t Ramp	•		•		
	Adjustable Short Time Delay ① with Adjustable short Time Pick-up		•		•	
Instantaneous	Fixed Instantaneous (Override) ②	•	•	•	•	•
Ground Fault	Adjustable Ground Fault Pick-up			•	•	
	Adjustable Ground Fault Time			• <sup>③</sup>	•	

① Using Trip unit with adjustable delay (LSI, LSIG), instantaneous pick-up is achieved when the lowest time delay setting (I) is selected for non-arms trip units.

② Override setting fixed at frame withstand rating.

③ I<sup>2</sup>t response.

**Table 1.2. Electronic (Digitrip 310+ Trip Unit Function and Rating Sensing.**

Trip Function	Range/Setting Description ②	
Ampere Rating Adjustable with IR Switch	Trip Unit Ampere Rating (IR)	
	1600 Amp ③	
	1250 Amp ③	
	1200 Amp 800 Amp	
Short Delay Pick-Up (Adjustable)	In Multiples of amperes ( $I_n$ ) with marks at 2-3-4-5-6-7-8-9x	
Short Delay Time (Adjustable)	$I^2t$ ramp configuration	
Short Delay Time (Adjustable)	Flat response with time delay settings at Instantaneous 120 ms and 300 ms.	
Ground Fault Pick-Up (Adjustable)	Trip Unit Ampere Rating	Trip Unit Setting
	1200 Amp	
	800 Amp	
Ground Fault Time Delay	Flat Response with time settings of: Inst, 120 ms and 300 ms	

- ① Occurs with short delay time adjustment set at 1.
- ② The Molded Case Switch has a fixed instantaneous setting.
- ③ Not UL Listed.

**Ground Fault Protection:** When selected, ground fault pick-up and time delay settings shown in Table 1.2 allow selective ground fault coordination with other circuit protection devices.

**Ground Fault Alarm:** A ground fault alarm relay may be ordered that provides a contact closure when a ground fault trip occurs.

**DC Application:** 310+ trip units are suitable for AC application only.

**Field Testing:** Test port is available for functional field testing of the trip unit when connected to test kit.

**Internal Accessories:** Internal accessories mount in the breaker. A list of internal accessories and their instruction leaflets is provided below:

Alarm (Signal)/Lockout (ASL) Switch	I.L. 29C184
Auxiliary Switch	I.L. 29C124
Shunt Trip	I.L. 29C148
Low Energy Shunt Trip	I.L. 29C145
Undervoltage Release Mechanism (Handle Reset)	I.L. 29C174

**Note:** Shunt trip and undervoltage accessories, if required, must be mounted in the left pole.

**Note:** Digitrip 310+ trip unit versions with ground fault protection are supplied with an auxiliary switch, mounted in the right pole of the trip unit.

This instruction leaflet gives procedures for installation and field testing of N-frame circuit breakers and describes the different trip unit characteristics. For this publication, the term circuit breaker shall also include the molded case switch.

## 2. INSTALLATION

The installation procedure consists of inspecting the circuit breaker, installing the accessories and terminals and, if required, mounting the circuit breaker, connecting the line and load conductors and accessory wiring, and adjusting trip settings. Circuit breakers, accessories, and terminals may be supplied in separate packages. To install the circuit breaker, perform the following steps:

### 2.1 Inspection

Make sure the circuit breaker is suitable for the intended installation by comparing nameplate data with existing equipment ratings and system requirements. Inspect the circuit breaker for completeness and check for damage before mounting.

### 2.2 Accessory Installation

**Note:** If required, internal accessory installation in any type of circuit breaker should be done before the circuit breaker is mounted and connected. Refer to the individual accessory instruction leaflets listed above.

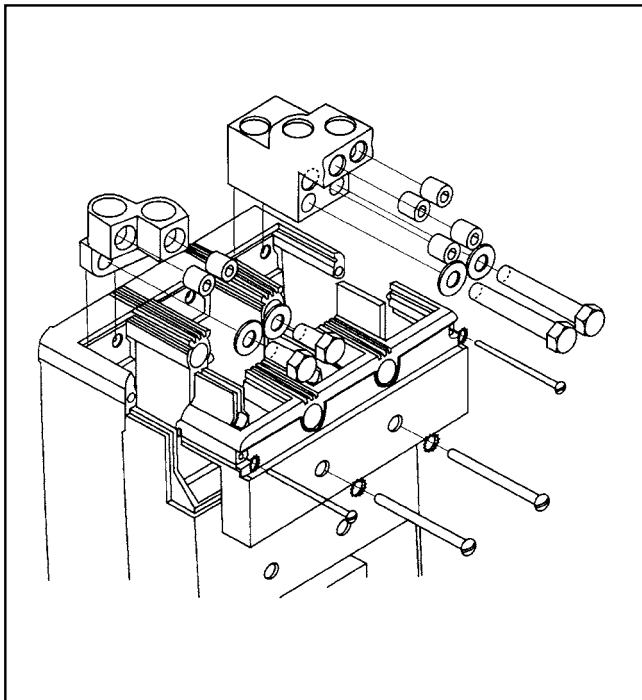


Figure 2-1. Terminal Installation.

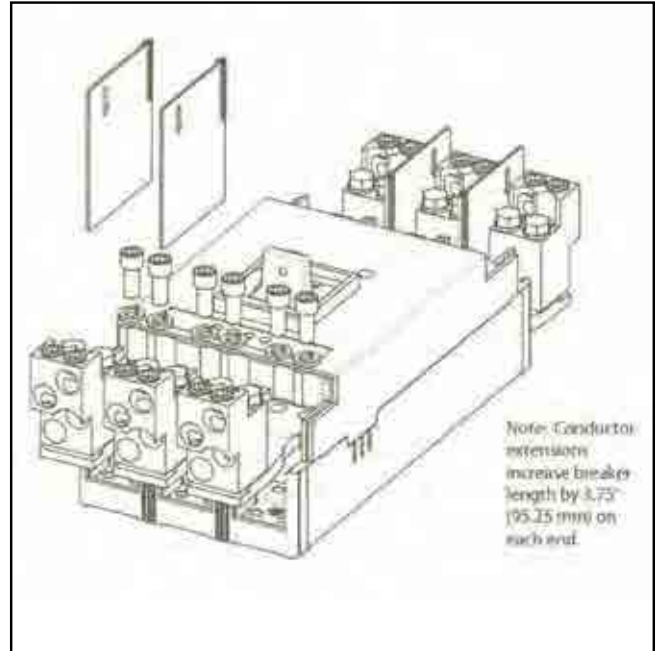


Figure 2-2. Conductor Extensions (Purchased Separately).

### Terminals are not included.

Terminals must be purchased separately. For breakers with Metric threads add an "M" suffix to the terminal catalog number.

For bus connections use:

- M12 - 1.75 bolts for Metric Style front mounted bus connections, socket cap screws are recommended.
- .500-13 bolts (English Threads) for front mounted bus connections, socket cap screws are recommended.

Table 2-1. Torque Table (Domestic)

Terminal Cat. No.	Wire Size MCM	Cond. Mat'l	Torq. lb.-in.	Torq. Nm.
TA700NB1	#1-500 (2)	CU/AL	375	42.4
TA1000NB1	3/0-400 (3)	CU/AL	375	42.4
TA1200NB1	4/0-500 (4)	CU/AL	375	42.4
TA1201NB1	500-750 (3)	CU/AL	450	50.9
T700NB1	2/0-500 (2)	CU ONLY	300	33.9
T1000NB1	3/0-5-- (3)	CU ONLY	300	33.9
T1200NB3	3/0-400 (4)	CU ONLY	275	31.1

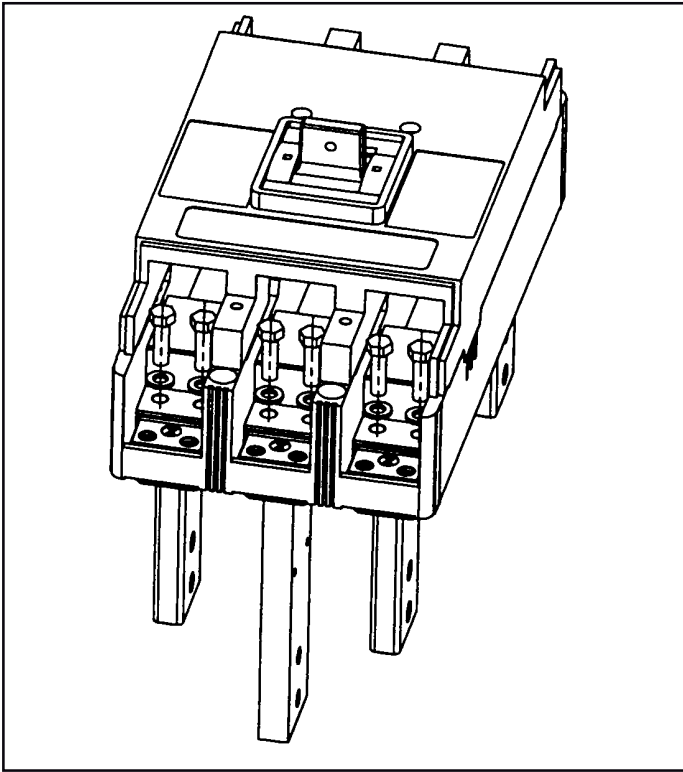


Figure 2-3. 1600 Amp Rear Connector Installation (Connectors, Barriers and Hardware Included).

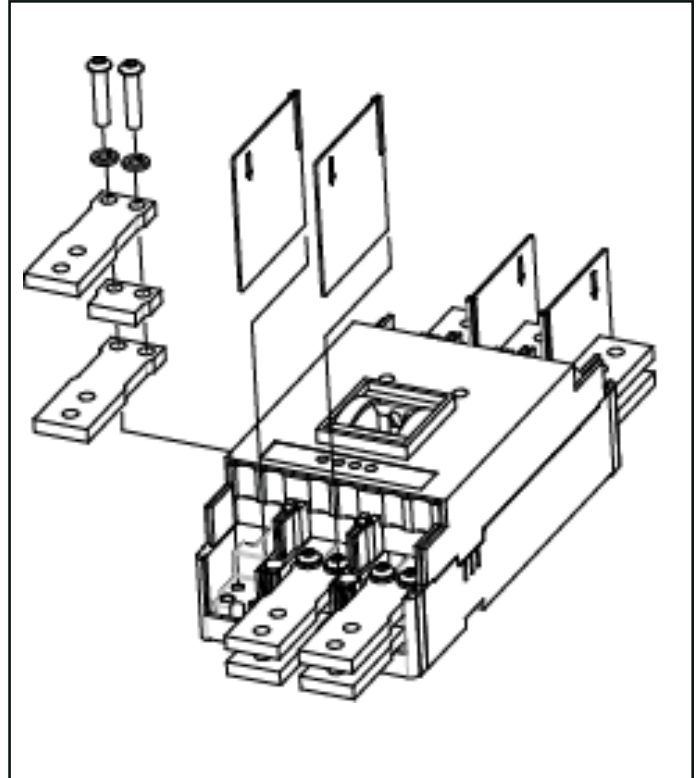


Figure 2-3a. 1600 Amp Front Connector Installation.

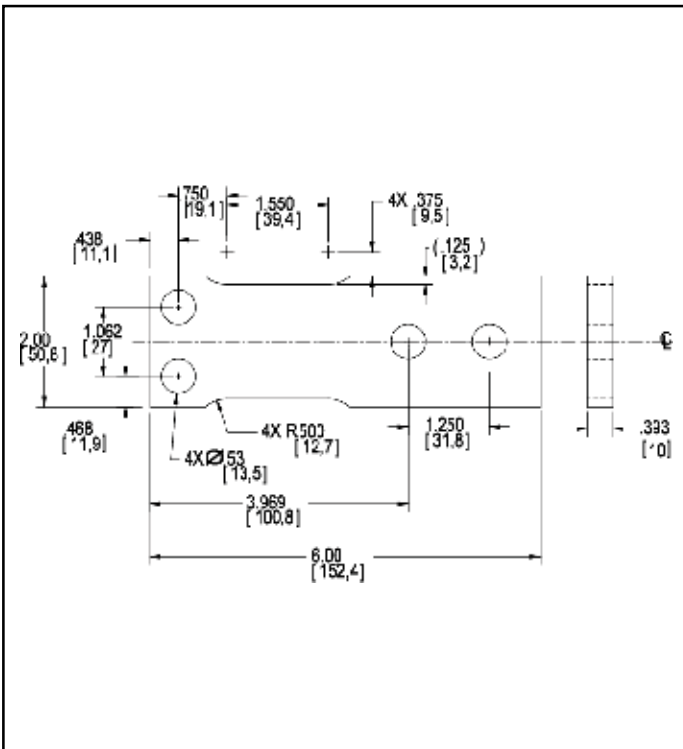


Figure 2-3b. Detail for 1600 Amp Front Connect Long Connector.

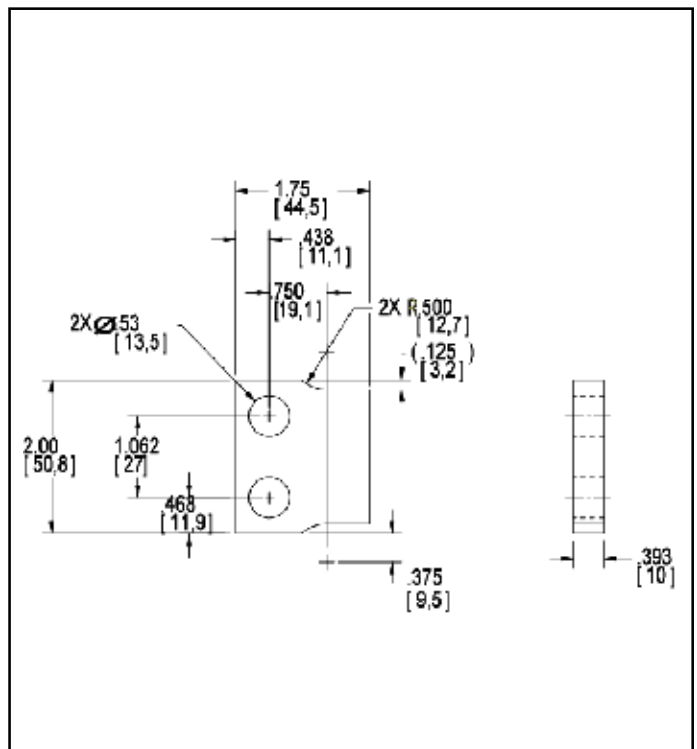
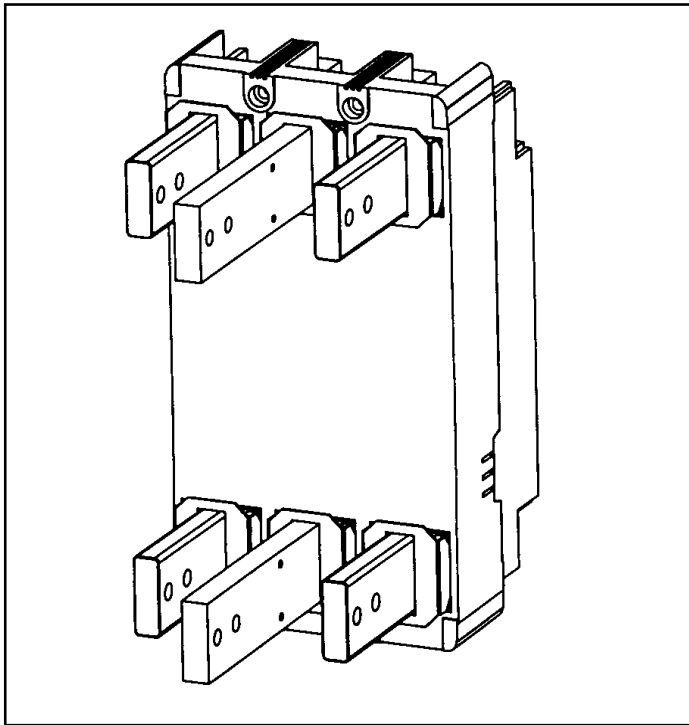
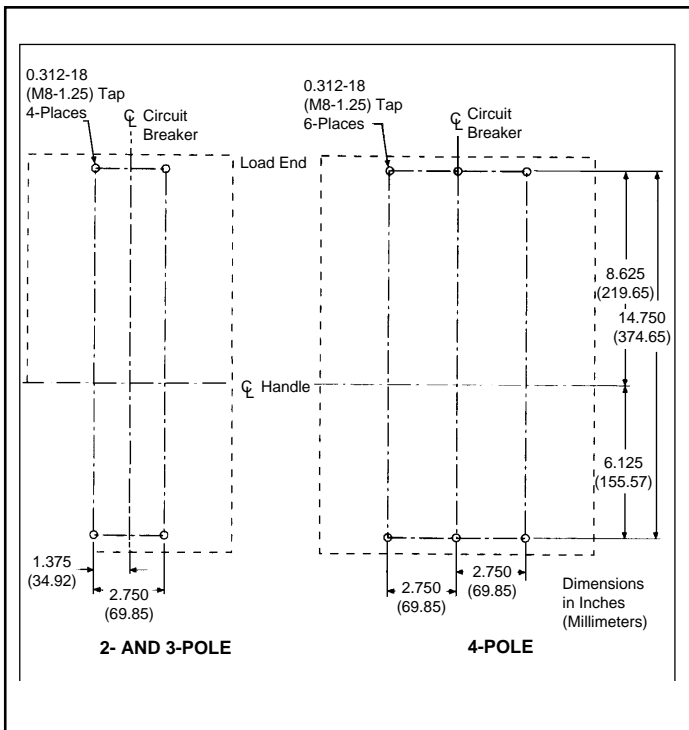


Figure 2-3c. Detail for 1600 Amp Front Connect Short Connector.



**Figure 2-4. 1600 Amp Rear Connectors and Barriers Installed (Required for 1600 Amp Rear Connect Breakers and Molded Case Switches).**



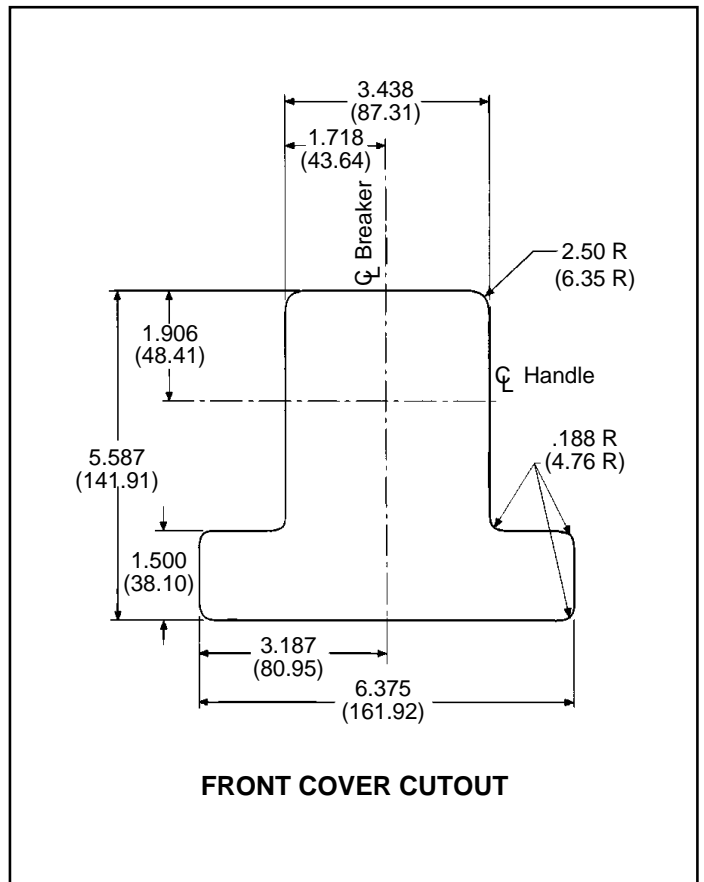
**Figure 2-5. Breaker Mounting Bolt Drilling Plan - 800A, 1200A, 1250A Circuit Breaker and 1600A front connected Circuit Breakers.**

Install accessories per the accessory instruction leaflet.



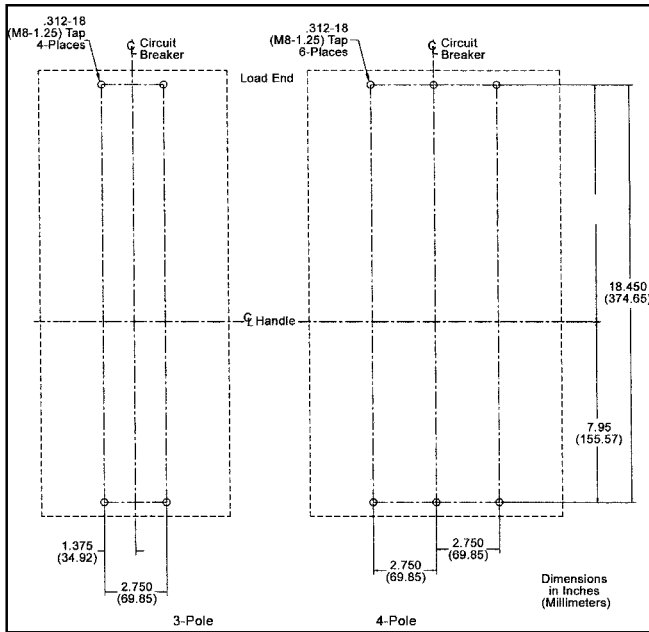
**CAUTION**

**CIRCUIT BREAKER COVER CONSTRAINTS MOVING PARTS. DO NOT OPERATE THE BREAKER WITHOUT THE COVER INSTALLED.**



**Figure 2-6. Circuit Breaker Escutcheon Dimensions.**





**Figure 2-7. Breaker Mounting Bolt Drilling Plan - 1600 A Rear Connect Circuit Breaker.**

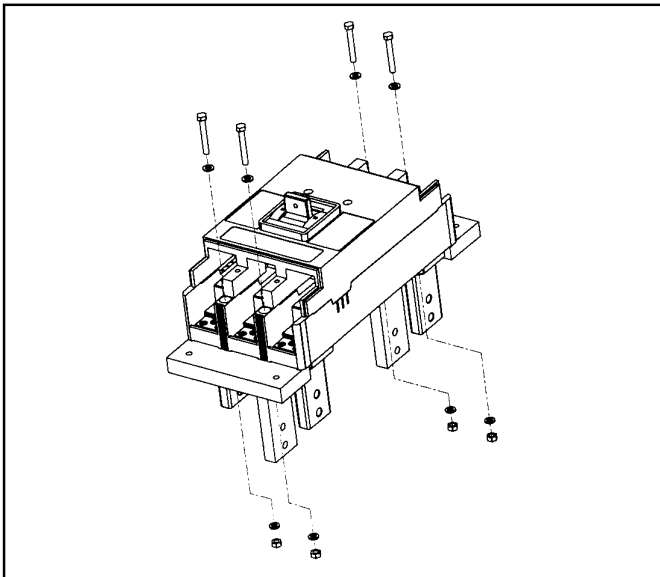
**100 Percent Rated N-Frame (1200 A breaker only)**

Connect the supplied line and load conductor extensions as shown in Figure 2-2. For a four pole breaker do not connect the conductors extensions to the neutral pole.

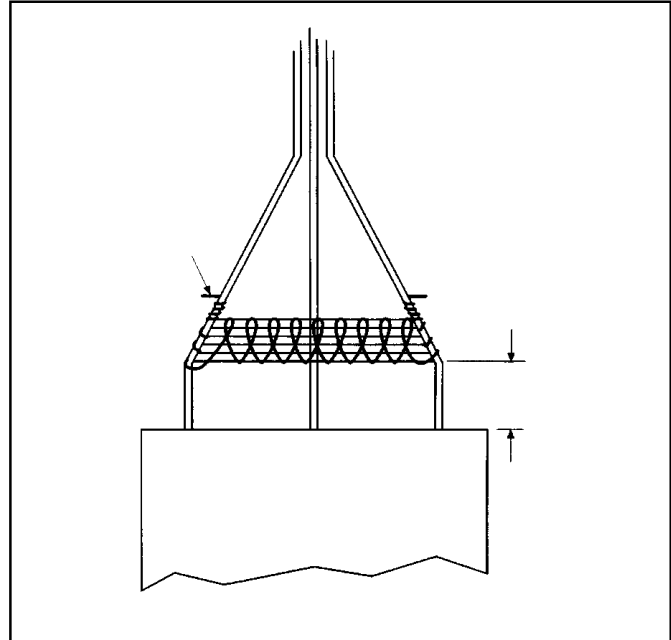
**2.3 Terminal Installation**

**800 A, 1200 A, 1250 A, and 1600 A Front Connect**

If not already installed, mount terminals as shown in Figure 2-1 (100 Percent Rating Figure 2-2). To do this, the terminal cover screws must first be loosened and the terminal covers removed (see Fig. 2-3a for 1600 A Front Connect).



**Figure 2-8. Mounting Plate Installation - 1600 A Rear Connect Circuit Breaker.**



**Figure 2-9. Securement of Cable (See Caution Note for Bracing Instruction).**

**1600 A Rear Connect Circuit Breaker**

- a. Remove the line and load end covers.
- b. Install the rear connectors to the line and load side of the circuit breaker (Figure 2-3). Do not fully torque the bolts until after the barriers are positioned correctly. On three pole breakers the longer connectors are on the center phase. On four pole breakers, short and long connectors should alternate on adjacent phases.
- c. Install the barriers, covering the ends of the hardware and connectors. Position the barriers so that the flaps are firmly set between the connectors and the edge of the base molding, (figure 2-4).
- d. After positioning the barriers, torque the rear connector bolts to 20 lb-ft. (27 Nm).



**WARNING**

**VOLTAGE IN ENERGIZED EQUIPMENT CAN CAUSE DEATH OR SEVERE PERSONAL INJURY. BEFORE MOUNTING THE CIRCUIT BREAKER IN AN ELECTRICAL SYSTEM MAKE SURE THERE IS NO VOLTAGE PRESENT WHERE WORK IS PERFORMED. SPECIAL ATTENTION SHOULD BE PAID TO REVERSE FEED APPLICATIONS TO ENSURE NO VOLTAGE IS PRESENT.**

To mount the circuit breaker, perform the following steps:

**800 A, 1200 A, 1250 A, and 1600 A Front Connect Circuit Breakers**

- a. For individual surface mounting, drill mounting panel using the drilling plan shown in Figure 2-5. For dead front cover applications, cut out cover to correct escutcheon dimensions, see Figure 2-6.



b. If the circuit breaker includes factory or field installed internal accessories, make sure the accessory wiring can be reached when the circuit breaker is mounted.

**Note: Labels with accessory connection schematic diagrams are provided on the side of the circuit breaker. A note should be made of the diagrams if the labels cannot be seen when the circuit breaker is mounted.**

c. Position the circuit breaker on the mounting surface.

d. Secure the circuit breaker with the supplied hardware

### 1600 A Rear Connect Circuit Breaker



### WARNING

**MOUNT THE 1600 A CIRCUIT BREAKER ON THE PROVIDED INSULATED SURFACES TO ENSURE MINIMUM CLEARANCE DISTANCE TO GROUND.**

a. For individual surface mounting, drill the mounting panel using the drilling plan shown in Figure 2-7. For dead front cover applications, cut out cover to correct escutcheon dimensions, see figure 2-6.

b. Attach the insulating Mounting Plates to the Line and Load sides of the circuit breaker as shown in Figure 2-8 with the M8 x 1.25 x 60 mm (2.4 in.) Pan Screw and hardware supplied with the Mounting Plate.

c. If the circuit breaker includes factory or field installed internal accessories, make sure the accessory wiring can be reached when the circuit breaker is mounted.

**Note: Labels with accessory connection schematic diagrams are provided on the side of the circuit breaker. A note should be made of the diagrams if the labels cannot be seen when the circuit breaker is mounted.**

d. Position the circuit breaker on the mounting surface.

e. Secure the circuit breaker with the supplied hardware. Use the M8 x 1.25 x 45 mm (1.8 in.) Pan Screw and hardware supplied with the Mounting Plate.

### 2.5 Connecting Line and Load Conductors



### CAUTION

**OVERHEATING CAN CAUSE NUISANCE TRIPPING AND DAMAGE TO THE CIRCUIT BREAKER. WHEN ALUMINUM CONDUCTORS ARE USED, THE APPLICATION OF A SUITABLE JOINT COMPOUND IS RECOMMENDED TO REDUCE THE POSSIBILITY OF TERMINAL OVERHEATING.**

Connect line and load conductors and accessory leads. If the circuit breaker includes ground fault protection, connect

the neutral current sensor and ground fault alarm unit as described in Section 5 and as shown in Figure 5-2.



### CAUTION

**HAZARDOUS VOLTAGE CONDITIONS CAN CAUSE DEATH OR SEVERE PERSONAL INJURY. MAINTAIN ORIGINAL ELECTRICAL CLEARANCE AND CREEPAGE SPACINGS AT TERMINATIONS.**

After the circuit breaker is installed and all connections are made, check all mounting hardware and terminal connection hardware for torque loading. Torque values for line/load terminal lugs are given on table in Figure 2-1. Torque mounting screws for terminals, bus connections and front conductor extensions to 30-35 lb-ft. (41-47 Nm).

Re-install load end and line end covers and secure with pan head screws provided. Torque large screws to 35-45 lb-in. (4.0-5.0 Nm) and small screws to 24-30 lb-in. (2.7-3.4 Nm). When using the terminals TA700NB1 or T700NB1, or when prospective fault currents of cabled installations exceed 65 kA, (such as NDC applications), the conductors are to be braced in accordance with Figure 2-9.



### CAUTION

**UNSUPPORTED CABLES CAN CAUSE MINOR PERSONAL INJURY OR EQUIPMENT DAMAGE UNDER SHORT CIRCUIT CONDITIONS.**

Wrap conductor cable cables with 3/8" (9.5 mm) nylon or equivalent rope as shown in Figure 2-9, having a minimum tensile strength of 2000 lbs. (907.2 kg) at 6" (152.4 mm) from terminals and every additional 6" with 5 wraps or every additional 1" (25.4 mm) with 1 wrap.

### 2.6. Adjusting Trip Settings

The N-frame Series G circuit breakers have the trip unit built in as an integral part of the breaker. The trip unit is not field replaceable. The various trip unit settings are described in Section 4. They should be adjusted as required at this point.

## 3. OPERATION

### 3.1 Manual Operation

Manual operation of the circuit breaker is controlled by the circuit breaker handle and the Push-to-Trip button. The circuit breaker handle has three positions, two of which are shown on the cover in raised lettering to indicate ON and OFF. On the handle, ON, OFF, and TRIP are also shown by a color-coded strip for each circuit breaker handle position: red for ON, white for TRIP, and green for OFF (See Figure 3-1). The Push-to-Trip button checks the circuit breaker tripping function and may be used to periodically exercise the operating mechanism.

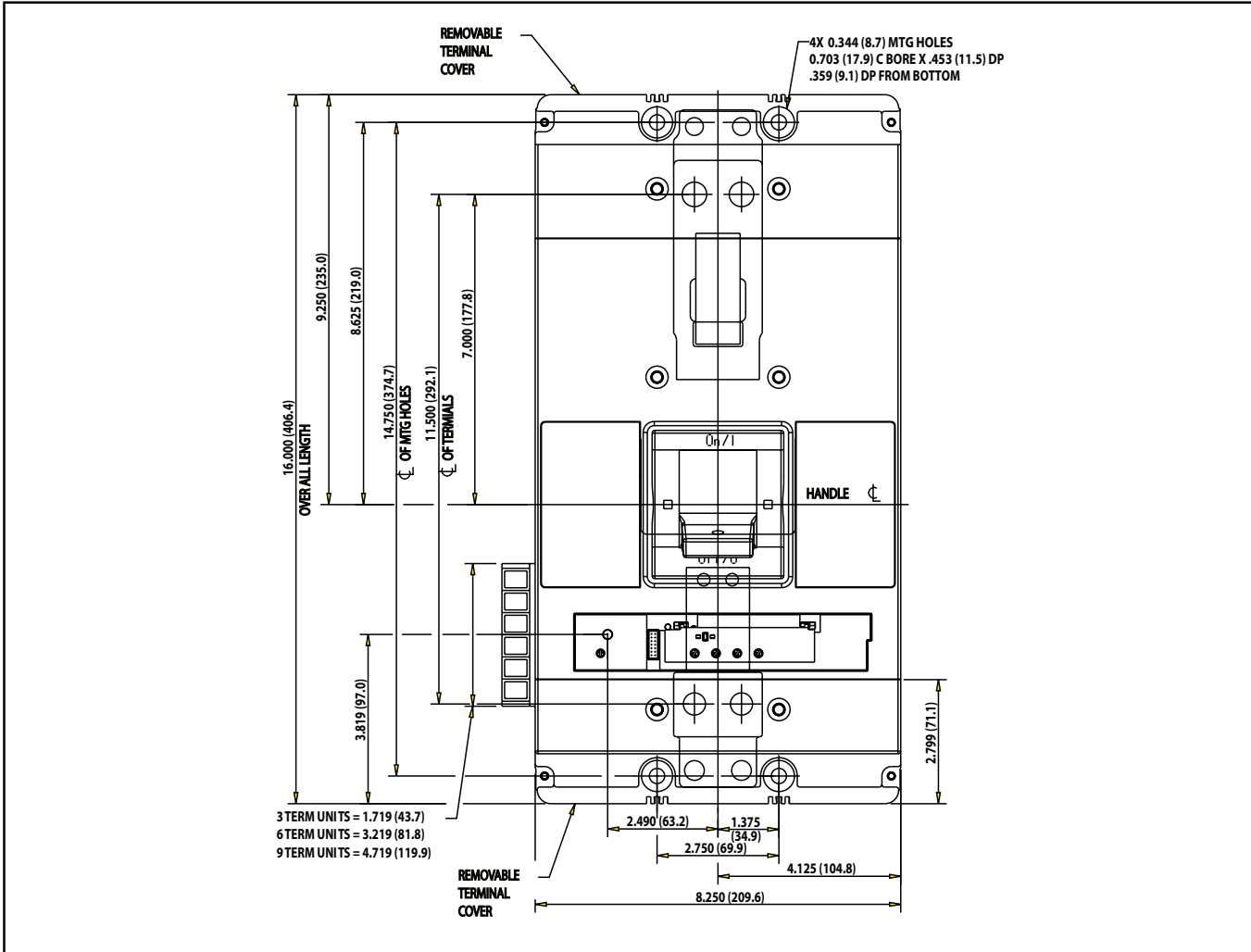


Figure 3-1. Circuit Breaker Manual Controls.

### 3.2 Circuit Breaker Reset

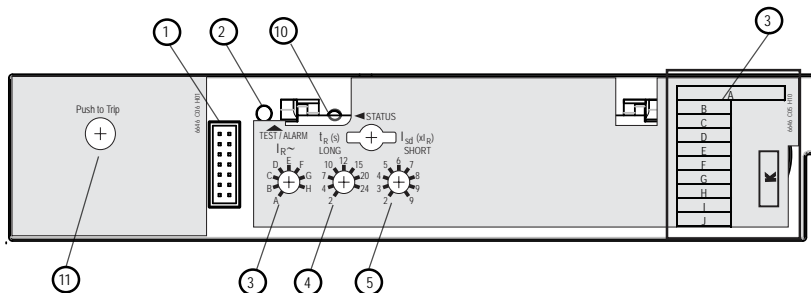
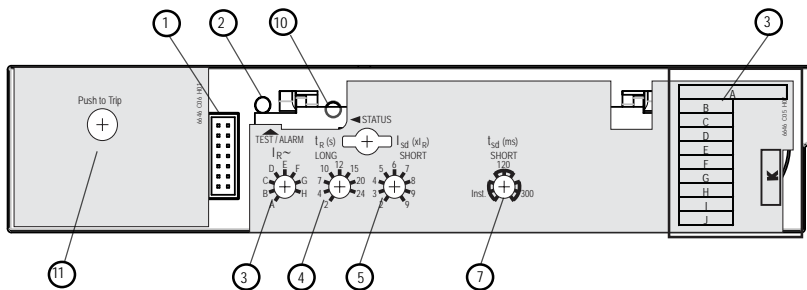
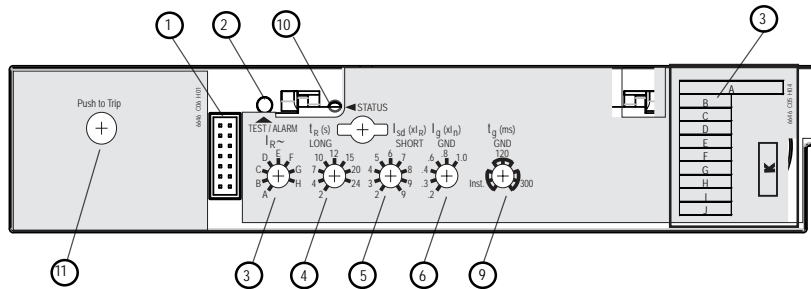
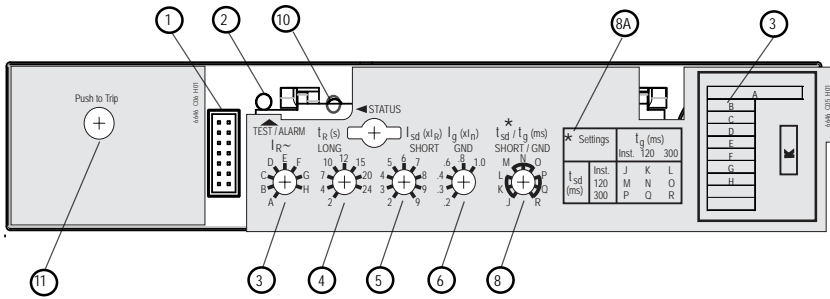
After an automatic or accessory initiated trip, or a manual Push-to-Trip operation, the circuit breaker is reset by moving the circuit breaker handle to the extreme OFF position.



**CAUTION**

**LACK OF ILLUMINATION OF THE STATUS LIGHT DOES NOT INDICATE THE TERMINALS OF THE BREAKER ARE DEENERGIZED.**

4. 310+ TRIP UNIT ADJUSTMENTS



4-1 . 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.

4-2 . Test LED - to be used with a no trip functional test. This LED is a dual function light. As previously stated, the LED is used as a no trip indicator when using the test port. In normal modes, this LED indicates a high load alarm. It will light if the continuous current is 95% of the setting and must be present for a 38 second duration.

4-3 . IR - 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 12 t for higher currents. Continuous Current Values for each lettered setting are indicated by the chart on the right side of the trip unit.

4-4 . tR - The number of seconds required to trip @ 6x. For example, IR - 800A, - 2 sec load current - 4800A (6x). The breaker will trip in 2 seconds.

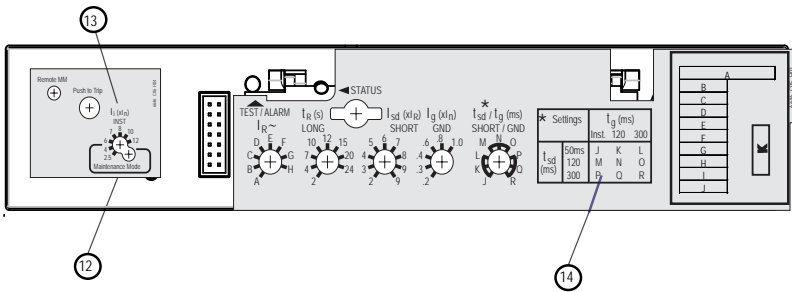
NOTE: The last two time settings vary according to the frame as follows: 1200A - 20,24, 1250A\800A - 14,14, 1600A - 20,20.  
NOTE: There is a thermal memory capacitor that will affect the LDT time. If the breaker has tripped on LD, this capacitor must be discharged or it will self discharge after five minutes. If neither one of these choices has been done, the LD trip time will be shorter.

4-5 . I<sub>sd</sub> - Setting in multiples of IR. For short circuit conditions that exceed the short delay pick-up setting, the trip unit initiates a trip after a predetermined delay.

4-6 . The - I<sub>g</sub> (xI<sub>n</sub>) switch is the ground fault pick-up switch and is used on the LSI & LSG styles to set the ground fault pick-up as a percentage of I (Frame current). For example, a 1200A frame with an I<sub>g</sub> (xI<sub>n</sub>) setting of 0.4 will provide a ground fault pick-up at 480A.

4-7 . For the LSI style, the Short Delay time is a flat response determined by the tsd/tg switch setting of INST, 120ms or 300ms. For the LS style, the short delay time is an 12t function.

4-8 . For the LSI 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, 120 ms or 300 ms. As an example, if the tds/tg switch is set at a position J, then both short delay time and ground fault time are an INST flat. A second example would be to set the tsd/tg switch at position L, then the short delay flat time is INST and the ground fault flat time is at 30 ms. The LSIg label (see balloon 8A) should be used in conjunction with the tsd/tg switch to set any one of nine possible combinations of short delay and ground fault flat times. The LSIg label should be applied to the right side breaker trip unit nameplate.

4-9. For the LSG style, the short delay time is a 12t function while the ground fault flat time is set by the tg switch. For the LS style, the short time is an I2t function.

4-10. Status LED - A green status light indicates the operational status of the trip unit. If the load current is approximately 20% of the maximum current rating (I<sub>n</sub>) of the breaker, the status light will blink on and off once each second.

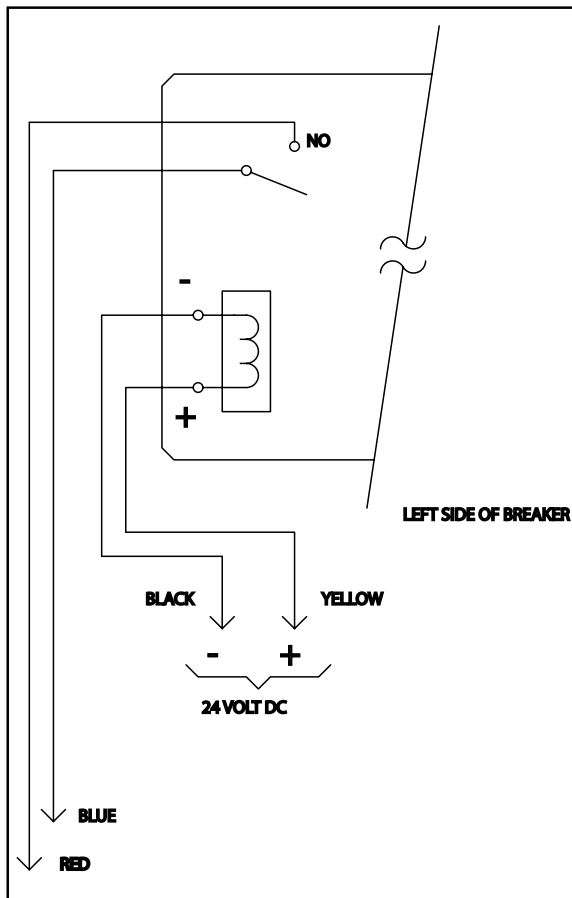
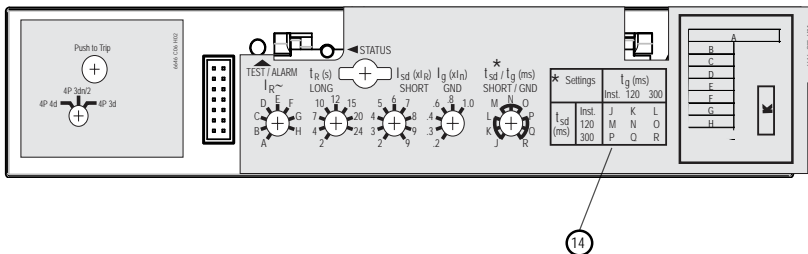
4-11. Mechanical Push-to-Trip.

4-12. The Maintenance Mode and adjustable INSTantaneous features are only available on LSI and LSIg styles. Please refer to the labeling to the left of the test kit connector. The Maintenance Mode consists of the two lowest settings of the INST switch: 2.5x and 4.0x. For example, a 1200 A (I<sub>n</sub>) NG breaker with the switch set to 2.5x would trip instantaneously when the current exceeded 3000 A.

4-13. The adjustable INSTantaneous (Ii) Mode has four settings from 6x to 9x. For example, a 800 A (I<sub>n</sub>) NG breaker with the (Ii) switch set to 7x would trip instantaneously with the current at or above 5600 A. The last setting on the (Ii) switch can be one of three values depending on the frame current: 800 A = 28, 1200 A = 12, 1600 A = 9.

4-14. On an NG without Maintenance Mode, the lowest labeled SDT setting is labeled INSTantaneous. The lowest SDT setting with Maintenance Mode is labeled as 50ms.

4-15 . The Remote Maintenance Mode is enabled by applying 24 VDC to the two wire cable that exists the left side of the breaker. The wires are color coded as follows: Yellow = +24 V and Black = common ground. A blue colored LED, on the left side of the breaker is the Maintenance Mode section



of the trip unit, will light. The lighted blue LED indicates that the lowest setting of the Maintenance Mode is enabled. This setting corresponds to 2.5x of In. Turning the adjustable switch on the trip unit has no effect on either the Maintenance Mode or the INST Mode settings while the blue LED is lit. In addition to the blue colored LED, a relay contact (C, NO) is available. The wires for this contact exit the left hand side of the breaker and are color coded as follows: Blue = C, and Red = NO.

4-16. The High Load Alarm Relay option will provide a SPST contact closure when the trip unit current equals or is greater than 95% of In for a period of 38 seconds. If the current drops below the 95% value, the contact will open. The yellow and green wires that exit the right side of the breaker are the common (C) and normally (NO) of this relay.

4-17. 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 (50 ms) 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 (NO) of this relay.

**NOTE: Either the high Load Alarm Relay or the Ground Fault Alarm Relay option can be selected but not both. The High Load Alarm Relay can only be selected with LS and LSI trip unit styles. If the trip unit is a Ground Fault style, the Alarm A Relay, by default, will be selected.**

**NOTE: The contact rating of the relay is: 250 VAC @ 8 AMPS resistive load.**

4-18A. 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 (Zin), White\Black stripe (Zout), and Black (common ground) wires that exit the right side of the breaker. A typical connection (two breaker system) is accomplished by connecting the Zout wire of the Downstream breaker to the Zin 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 defined by the SD time settings of both breakers. 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.

**NOTE: This option must be ordered from the factory.**

**NOTE: Please see Balloon 8A and refer to 4-14.**

4-18B. Zone selective interlocking is provided for the short delay

and the ground fault delay tripping functions for improved system protection. The NG310+ Trip Unit zone selective interlocking feature is compatible with OPTIM and Digitrip Trip Units, Model 510 and higher. It will also be compatible with Series G LG Trip Units when available, as well as, with FDE breakers.

The zone selective interlocking feature is a means of communications over a pair of wires between two or more compatible trip units. Zone selective interlocking makes it possible for programmed trip unit settings to be altered automatically to respond to different fault conditions and locations, thereby localizing the effects of an interruption and providing positive coordination between circuit breakers.

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

An example of a Zone Interlock system would be a NG310+A breaker used as the upstream breaker and a 225 A FDE breaker used as the downstream breaker. The Zout wire (white/black stripe) of the 225 A breaker would be connected to the Zin wire (white/red stripe) of the NG310+ breaker. Also both common wired (black must be connected). There could be more breakers added in a similar fashion to form 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 (Zout) to the trip unit of the up-stream circuit breaker. (Zin) This interlocking signal restrains immediate tripping of the upstream circuit breaker until its programmed coordination times 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 versus the outcomes (Both trip, Downstream (Dn) trips) of the breakers is indicated below for the conditions mentioned in the Table heading.

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

**NOTE: A single NG310+ breaker with the Zone Interlocking feature enabled will not trip at the programmed time settings, unless Self Interlocked. That is, the Zout wire should be connected to the Zin wire.**

## 5 GROUND FAULT CIRCUIT BREAKERS

### ⚠ WARNING

**THE BREAKER TRIP UNIT CAN BE DAMAGED BY HIPOTTING OR APPLYING EXTERNAL POWER TO ANY COMBINATION OF THE YELLOW, GREEN, GRAY, OR WHITE LEADS. DAMAGE TO THE TRIP UNIT MAY LEAD TO DEATH, SERIOUS PERSONAL INJURY, OR PROPERTY DAMAGE. MAKE CONNECTIONS TO THESE LEADS ONLY AS DIRECTED BY THIS INSTRUCTION LEAFLET.**

**GROUND FAULT CIRCUIT BREAKERS ARE SUPPLIED FROM THE FACTORY WITH ONE AUXILIARY SWITCH WITH PIGTAIL LEADS (RED, BLUE, AND BLACK WIRES) AND PIGTAIL LEAD CONNECTIONS FOR A NEUTRAL CURRENT SENSOR (WHITE AND GREY WIRES) AND A GROUND FAULT ALARM RELAY (YELLOW AND GREEN) WIRES (OPTIONAL) ALL INSTALLED IN THE RIGHT POLE OF THE TRIP UNIT. A NEUTRAL CURRENT SENSOR IS PROVIDED WITH EACH TRIP UNIT.**

Ground fault circuit breakers 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 a 3-pole breaker, if the system neutral is grounded and phase or neutral loads are used, then the neutral current sensor (see Figure 5-1) must be used. It should be connected to the breaker according to Figure 5-2.

In a 4-pole ground fault breaker, the neutral current sensor is in the fourth pole. However, the fourth pole is switchable but provides no overcurrent or ground fault protection. See Figure 5-3 for wiring connections.

The neutral sensor has the same ratio as the breaker current sensors.

**Note:** The polarity of the sensor connections is critical. Always observe the polarity markings on the installation drawings. To insure correct ground fault equipment performance, conduct field tests to comply with National Electric Code requirements under article 230- 95(C). See section 7 for testing instructions.

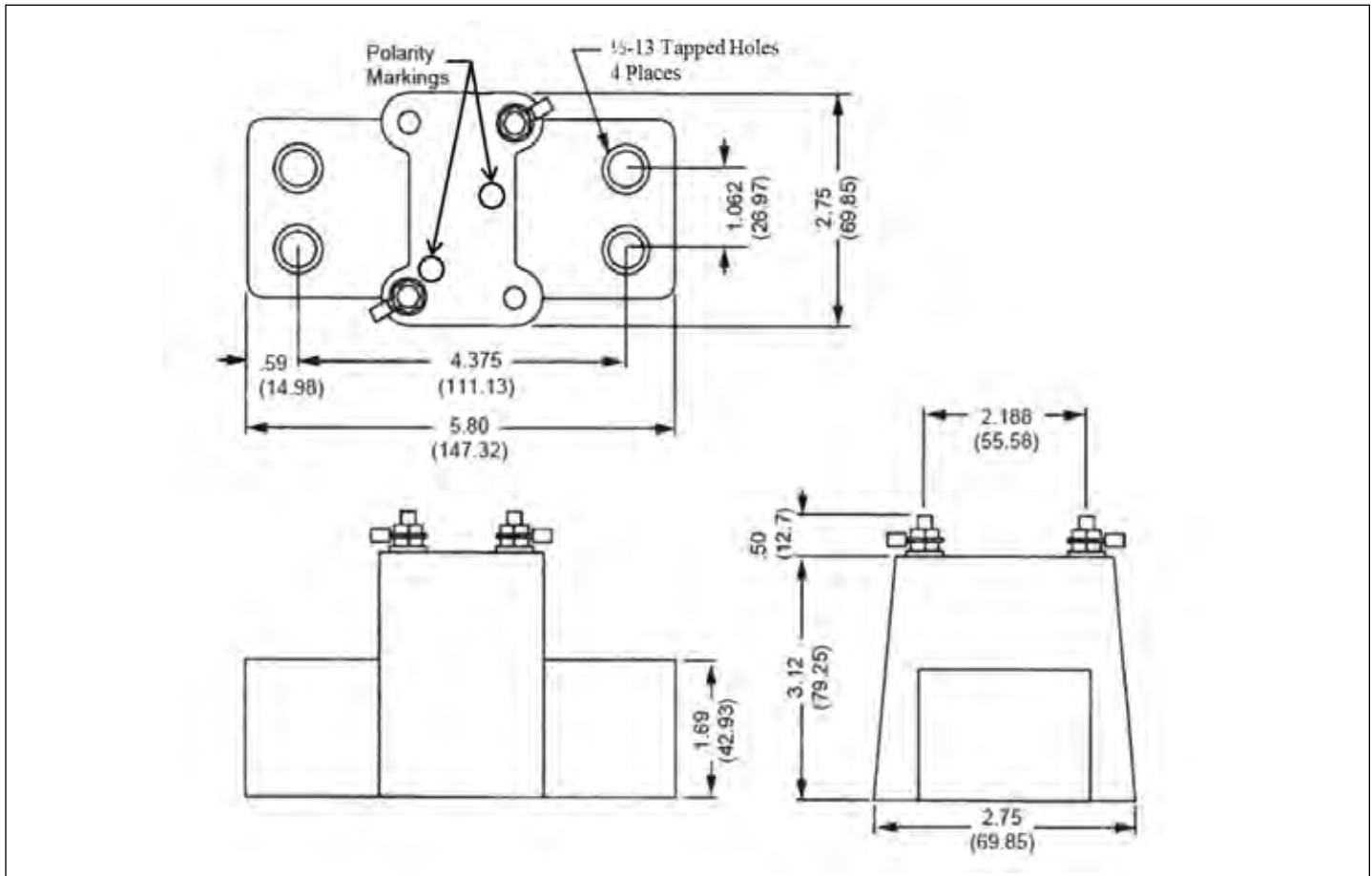


Figure 5.1. Connection Diagram for Ground Fault Breaker with No Overcurrent or Ground Fault Protection in the Neutral Pole (Figure Indicates Normal Feed Installation).

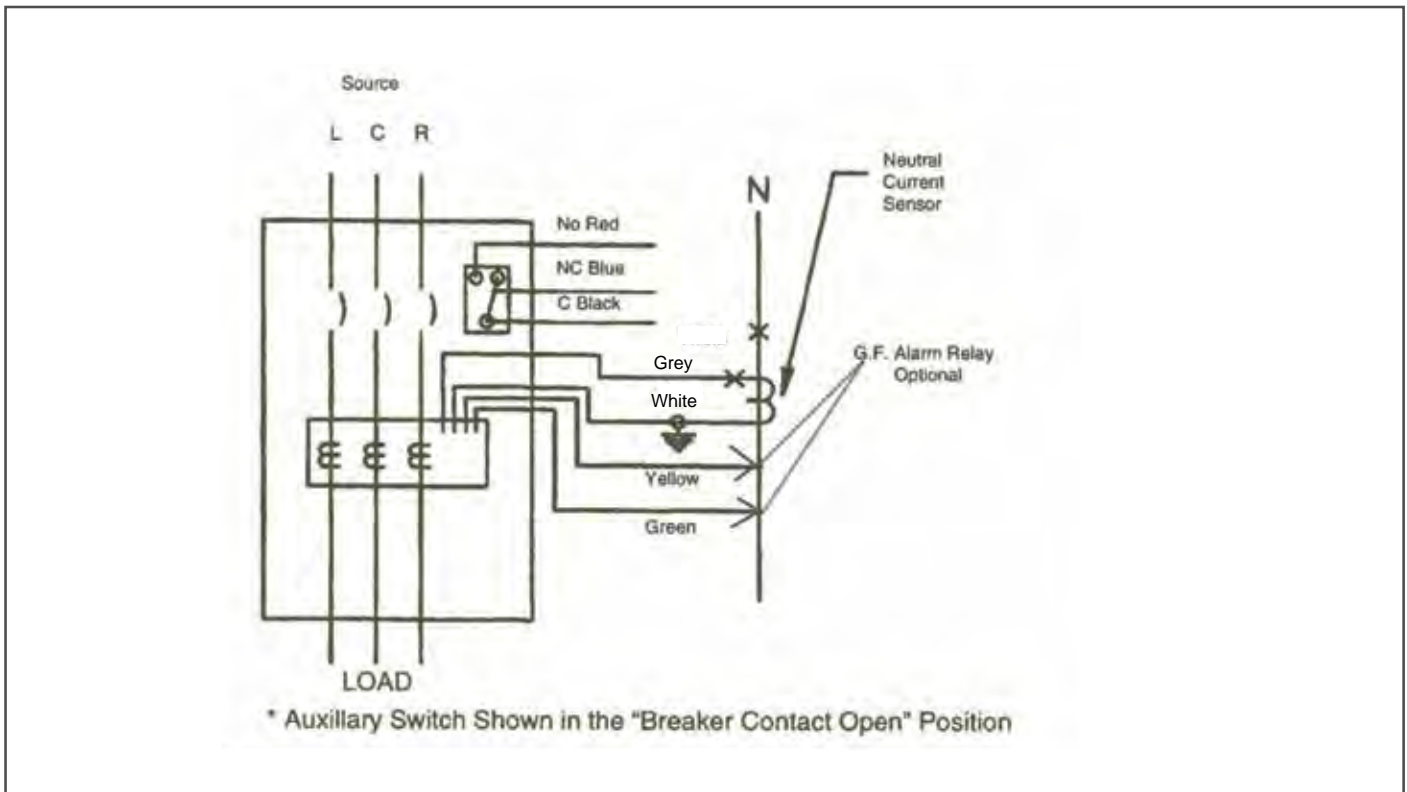


Figure 5-2. Connection Diagrams Ground Fault Breaker - Figure Indicates Normal Feed Installation. Neutral Sensor Is Wired Identically for Reverse Feed Applications.

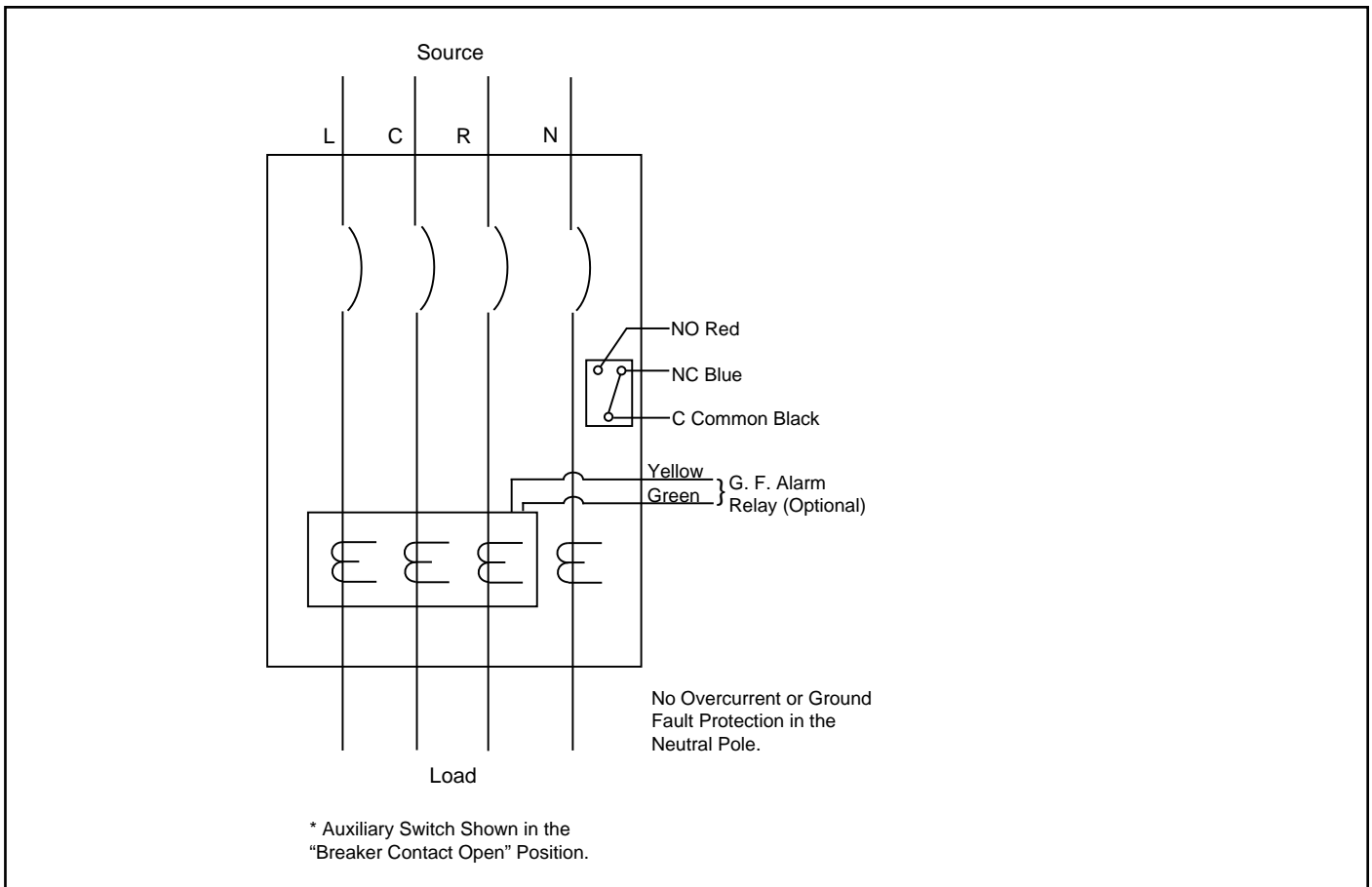


Figure 5.3. Connection Diagram for Ground Fault Breaker with No Overcurrent or Ground Fault Protection in the Neutral Pole (Figure Indicates Normal Feed Installation).



## 6 INSPECTION AND FIELD TESTING

Circuit breaker should be inspected periodically. This inspection can be best done during normal equipment maintenance periods when no voltage to the equipment is available. The inspection should include the following checks 6-1 through 6-8.

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### **⚠ WARNING**

**VOLTAGES IN ENERGIZED EQUIPMENT CAN CAUSE SEVERE PERSONAL INJURY OR DEATH. BEFORE INSPECTING THE CIRCUIT BREAKER IN AN ELECTRICAL SYSTEM, MAKE SURE THE CIRCUIT BREAKER IS SWITCHED TO THE OFF POSITION AND THAT THERE IS NO VOLTAGE PRESENT WHERE WORK IS TO BE PERFORMED. SPECIAL ATTENTION SHOULD BE PAID TO REVERSE FEED APPLICATIONS TO ENSURE NO VOLTAGE IS PRESENT.**

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### **⚠ WARNING**

**SOME COMMERCIAL CLEANING AGENTS WILL DAMAGE THE NAMEPLATES OR MOLDED PARTS. MAKE SURE THAT CLEANING AGENTS OR SOLVENTS USED TO CLEAN THE CIRCUIT BREAKER ARE SUITABLE FOR THE JOB.**

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6.1 Remove dust, dirt, soil, grease, or moisture from the surface of the circuit breaker using a lint-free dry cloth, brush, or vacuum cleaner. Do not blow debris into the circuit breaker. If contamination is found, look for the source and eliminate the problem.

6.2 Switch circuit breaker to ON and OFF several times to be sure that the mechanical linkages are free and do not bind. If mechanical linkages are not free, replace circuit breaker.

6.3 With the circuit breaker in the ON position, press the PUSH-TO-TRIP button to mechanically trip the circuit breaker. Trip, reset, and switch circuit breaker ON several times. If mechanism does not reset each time the circuit breaker is tripped, replace the circuit breaker.

6.4 Check base, cover, and operation handle for cracks, chipping, and discoloration. Circuit breakers should be replaced if cracks or severe discoloration is found.

6.5 Check terminals and connectors for looseness or signs of overheating. Overheating will show as discoloration, melting, or blistering of conductor insulation, or as pitting or melting of conductor surface due to arcing. If there is no evidence of overheating or looseness, do not disturb or tighten the connections. If there is evidence of overheating, terminations should be cleaned or replaced. Before re-energizing the circuit breaker, all terminations and cable should be refurbished to the same condition as when originally installed.

6.6 Check circuit breaker mounting hardware and tighten if necessary.

6.7 Check area where circuit breaker is installed for any safety hazards, including personal safety and fire hazards. Exposure to certain types of chemicals can cause deterioration of electrical connections.

6.8 The operation of Series G circuit breakers units can be field tested using the Series G Functional Test Kit - NG310+.

## 7 PERFORMANCE TESTING FOR GROUND FAULT CIRCUIT BREAKERS

### 7.1 Code Requirements

The National Electric Code under Article 230-95-C requires that any ground-fault protection system be performance tested when first installed.

The test shall be conducted in accordance with approved instructions provided with the equipment. A written record of this test shall be made and shall be available to the authority having inspection jurisdiction.

### 7.2 UL Standards Requirements

As a follow-up to the basic performance requirements stipulated by the N.E.C. as stated above in 7.1, UL Standard No. 1053 requires that certain minimum instructions must accompany each ground fault protection system. These following statements plus a copy of the test record form, illustrated in Figure 7-2, are shipped with each N-Frame ground fault circuit breaker.

### 7.3 General Test Instructions

7.3.1 The interconnected system shall be evaluated in accordance with the equipment assembler's detail instructions by qualified personnel.

7.3.2 The polarity of the neutral sensor connection (if used) must agree with equipment assembler's detailed instructions to avoid improper operations following apparently correct simulated test operations. Where a question exists, consult the specifying engineer and/or equipment assembler.

7.3.3 The grounding points of the system shall be verified to determine that ground paths do not exist that would bypass the sensors. High voltage testers and resistance bridges may be used.

---

### **⚠ WARNING**

**THERE IS A HAZARD OF ELECTRICAL SHOCK OR BURN WHENEVER WORKING IN OR AROUND ELECTRICAL EQUIPMENT. ALWAYS TURN OFF THE POWER SUPPLYING THE BREAKER BEFORE CONDUCTING TESTS.**

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**Note:** Since the ground fault circuit breakers derive their operating power from the phase current, and not from the neutral current, passing current through the neutral sensor only will not properly test the ground fault feature.

7.3.4 Using a low voltage (0-24 V), high current, AC source, apply a test current of 125% of the ground fault pick-up setting through one phase of the circuit breaker, as shown in Figure 7-1a or 7-1d (4-pole). This should cause the breaker to trip in less than one second, and if an alarm indicator is supplied, it should operate. Reset the breaker and the alarm indicator. Repeat the test on the other two phases.

7.3.5 If the system is a 4-wire system with a neutral current sensor, apply the same current as described in paragraph 7.3.4 through one phase of the breaker, returning through the neutral sensor, as shown in Figure 7-1b or 7-1e (4-pole). The breaker should not trip and the alarm indicator, if supplied, should not operate. Repeat the test on the other two phases.

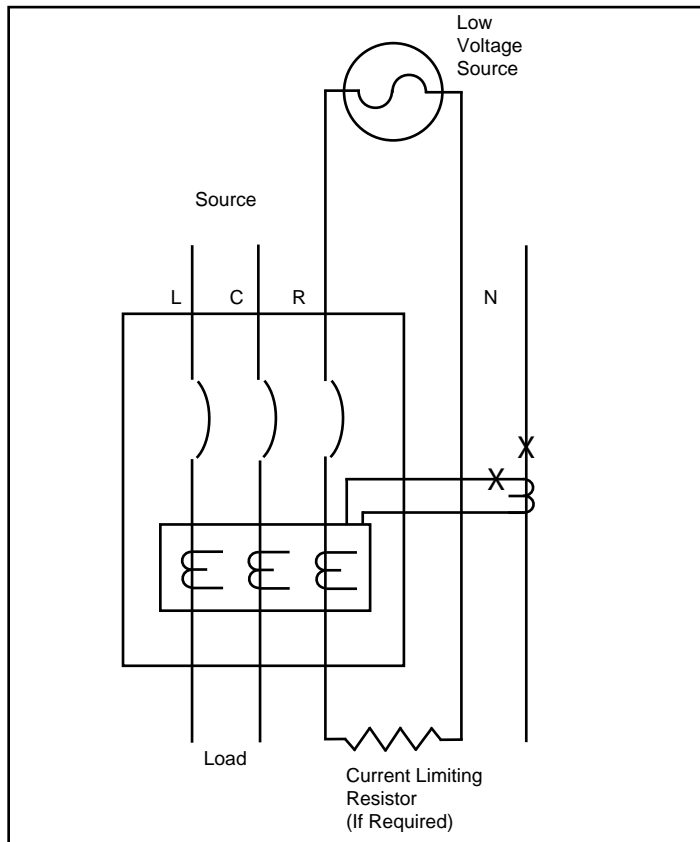
7.3.6 If the system is a 3-wire system with no neutral current sensor, apply the same current as described in paragraph 7.3.4 through any two phases of the breaker, with the connections exactly shown in Figure 7-1c. The breaker should not trip and the alarm indicator, if supplied, should not operate. Repeat the test using the other two combinations of breaker phases.

**⚠ WARNING**

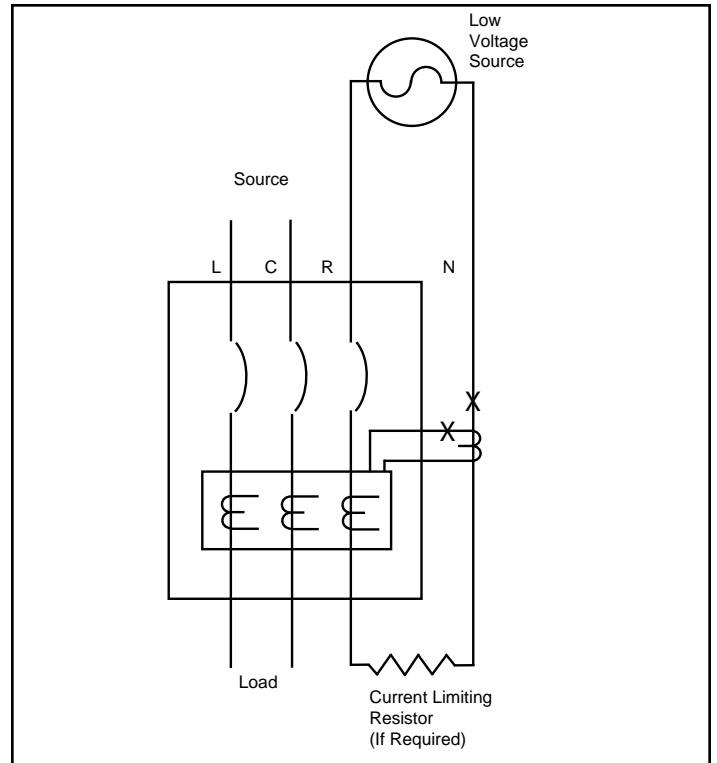
**FIELD TESTING SHOULD BE USED FOR FUNCTIONAL TESTING AND NOT FIELD CALIBRATION.**

**ANY TEMPORARY CONNECTION MADE FOR THE PURPOSE OF CONDUCTING TESTS SHOULD BE RESTORED TO PROPER OPERATING CONDITIONS BEFORE RETURNING THE BREAKER TO SERVICE..**

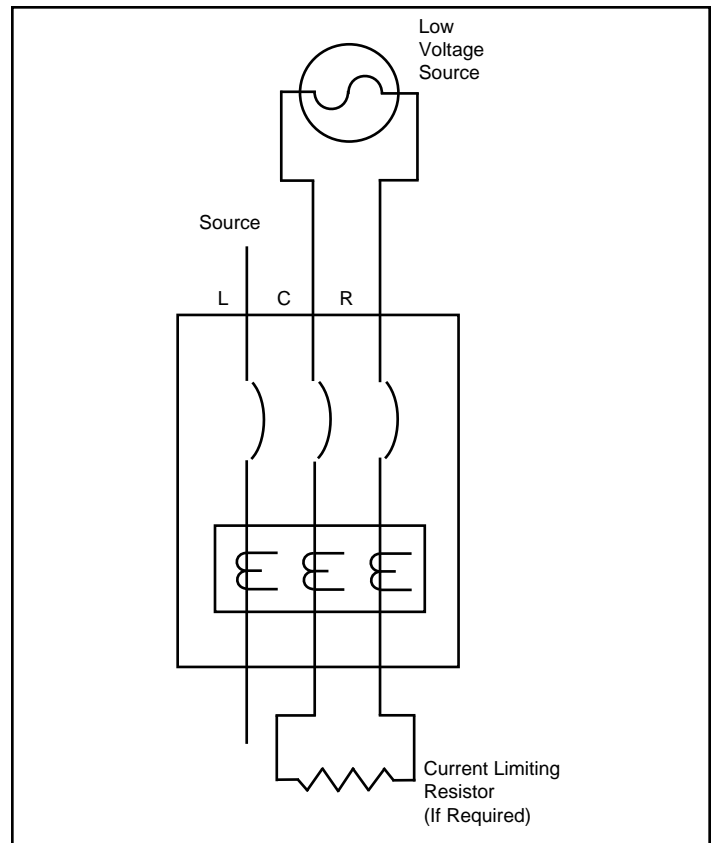
7.3.7 The results of the test are to be recorded on the test form provided with the equipment.



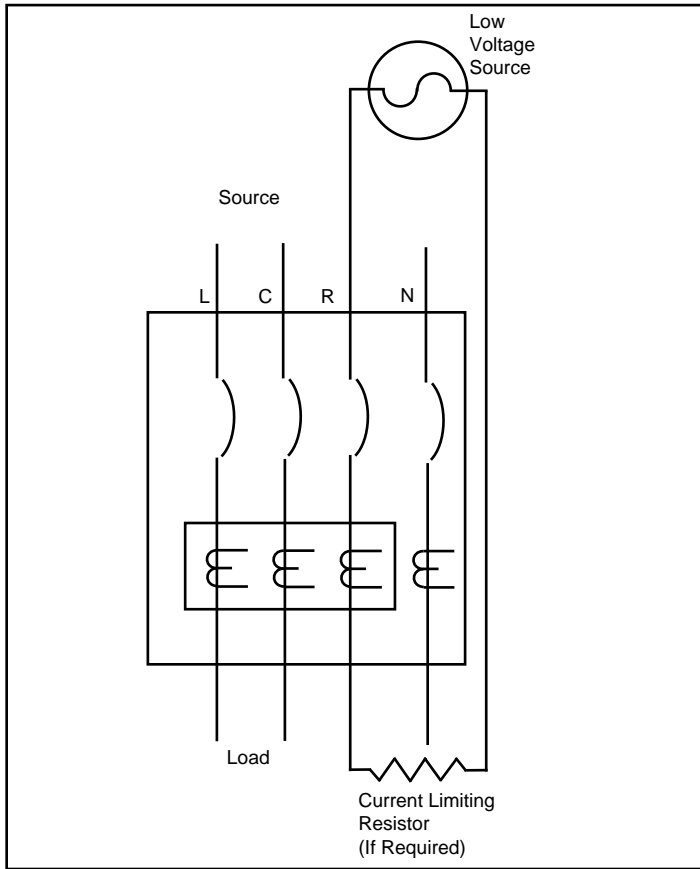
**Figure 7-1a. Connections for Ground Fault Trip Test.**



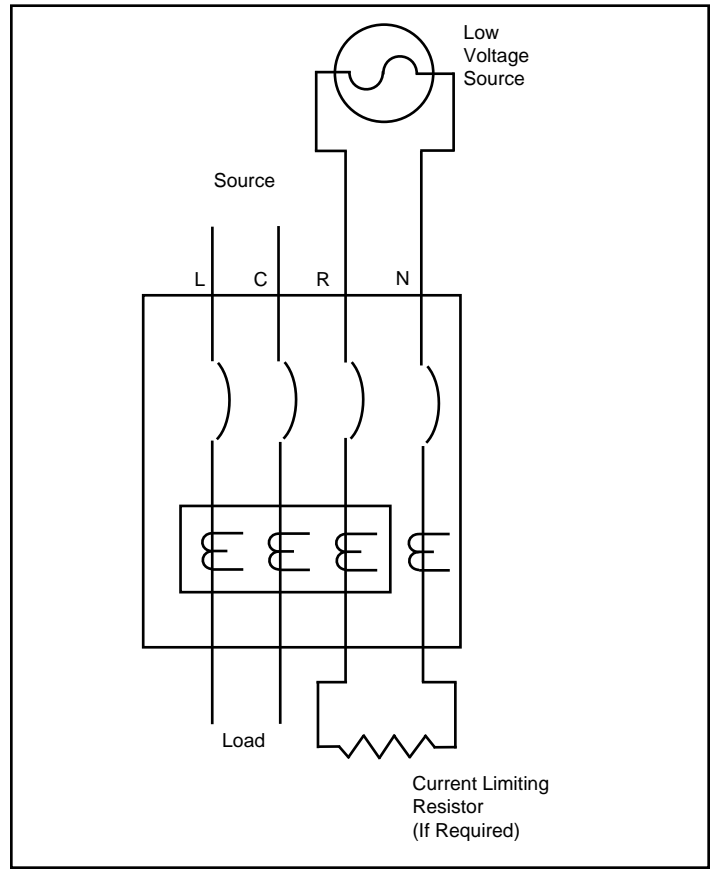
**Figure 7-1b. Connections for Ground Fault No-Trip Test with a Four Wire System.**



**Figure 7-1c. Connections for Ground Fault No-Trip Test with a Three Wire System.**



**Figure 7-1d. Connections for Ground Fault Trip Test for a Four-Pole Ground Fault Breaker (No Overcurrent or Ground Fault Protection in Neutral Pole).**



**Figure 7-1e. Connections for Ground Fault No Trip Test with a Four Wire System with a Four-Pole Ground Fault Breaker (No Overcurrent or Ground Fault Protection in Neutral Pole).**



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