



## ProTrip™ Conversion Kits

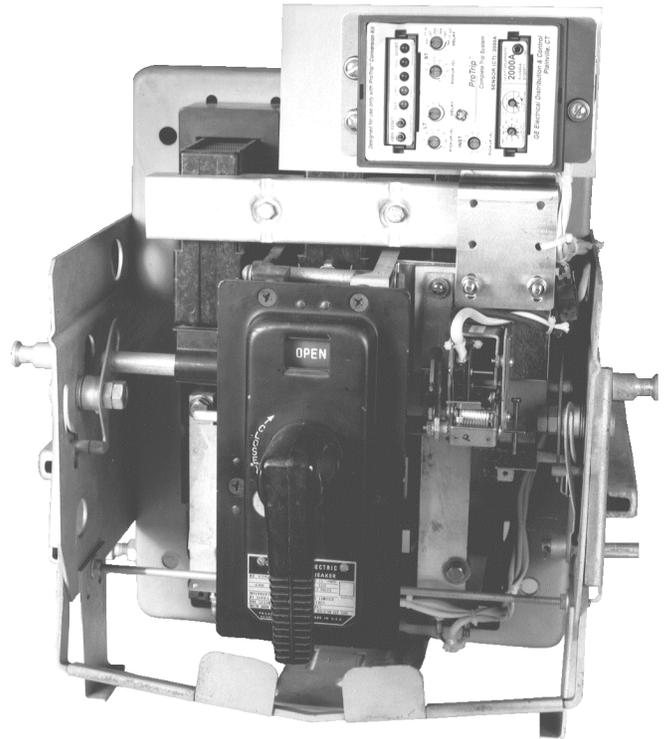
For GE Types AK-1-15 and AK-1-25  
Low-Voltage Power Circuit Breakers

### INTRODUCTION

GE Conversion Kits are designed for upgrading existing GE low-voltage power circuit breakers, rather than replacing the entire breaker. The Conversion Kits include ProTrip™ Trip Units, the latest technological advance in GE trip systems.

ProTrip Conversion Kits are designed and tested to conform to ANSI Standard C37.59, allowing the retrofitter to properly install the kit and acceptance test the breaker.

This publication covers installation of ProTrip Conversion Kits on GE types AK-1-15 and AK-1-25 low-voltage power circuit breakers. Each Conversion Kit contains all the components needed to convert from an existing GE trip system.



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## SECTION 1. GENERAL INFORMATION

GE Conversion Kit installation is straightforward, but does require careful workmanship and attention to these instructions. Familiarity with the breaker is highly desirable. The general approach is to first remove the existing trip devices from the breaker, then install the ProTrip components. Following this procedure, the converted breaker is performance tested before it is returned to service.

The majority of trip unit kit installations do not require any customized assembly work. However, some installations may involve unusual mounting conditions or accessory combinations that require minor modifications and/or relocation of components. In most instances, this supplementary work can be done on site.

**NOTE:** The bell alarm accessory may not be compatible with the conversion kit.

In preparation for the conversion, the installer should verify that the appropriate current sensors and trip unit have been furnished. Ensure that retrofitted breakers are applied within their short-circuit ratings. For example, if the previous trip unit provided long-time instantaneous protection, the short-time rating of the ProTrip Trip Unit will govern the application.

As a service-related consideration, the installation of a ProTrip kit provides an excellent opportunity to perform normal maintenance on the breaker, particularly when the front and back frames are separated. Such procedures are described in the installation and maintenance manuals supplied with the breaker and equipment.

## SECTION 2. BEFORE INSTALLATION

Before starting any work, turn off and lock out all power sources leading to the breaker, both primary and secondary. Remove the breaker to a clean, well-lighted work area.

**WARNING:** Low-voltage power circuit breakers use high-speed, stored-energy spring operating mechanisms. The breakers and their enclosures contain interlocks and safety features intended to provide safe, proper operating sequences. For maximum personnel protection during installation, operation, and maintenance of these breakers, the following procedures must be followed. Failure to follow these procedures may result in personal injury or property damage.

- Only qualified persons, as defined in the National Electrical Code, who are familiar with the installation and maintenance of low-voltage power circuit breakers and switchgear assemblies, should perform any work on these breakers.
- Completely read and understand all instructions before attempting any breaker installation, operation, maintenance, or modification.
- Turn off and lock out the power source feeding the breaker before attempting any installation, maintenance, or modification. Follow all lock-out and tag-out rules of the National Electrical Code and all other applicable codes.
- Do not work on a closed breaker or a breaker with the closing springs charged. Trip an OPEN breaker and be sure the stored-energy springs are discharged, thus removing the possibility that the breaker may trip OPEN or the closing springs discharge and cause injury.
- Trip the breaker OPEN, then remove the breaker to a well-lighted work area before beginning work.
- Do not perform any maintenance that includes breaker charging, closing, tripping, or any other function that could cause significant movement of a draw-out breaker while it is on the draw-out extension rails.
- Do not leave the breaker in an intermediate position in the switchgear compartment. Always leave it in the CONNECTED, TEST, or DISCONNECTED position. Failure to do so could lead to improper positioning of the breaker and flashback.

## SECTION 3. DISASSEMBLING THE BREAKER

GE Type AK-1 breakers need not have their front and back frames separated for installation of the conversion kit. The procedure is to remove the old electromechanical trip units, then install the kit.

First, remove the breaker from its compartment and place it on a clean, well-lighted workbench in an upright position, so that both the front and back are easily accessible.

### Component Removal

1. Remove and save the load terminal primary disconnect fingers on all draw-out breakers. They are held in place with a <sup>1</sup> 4-20 bolt, as shown in Figure 1.
2. Remove and discard the two screws on each side of the EC trip units, shown in Figure 2, that hold the covers in place.
3. Remove and discard the Philips-head screw above each EC trip unit. It may be necessary to remove the left and right trip paddles. The trip paddles may be discarded.
4. Remove and discard the two <sup>5</sup> 16-inch Allen-head bolts holding the trip unit coils to the breaker frame.
5. Remove and discard the three electromechanical trip units. The disassembled breaker is shown in Figure 4.

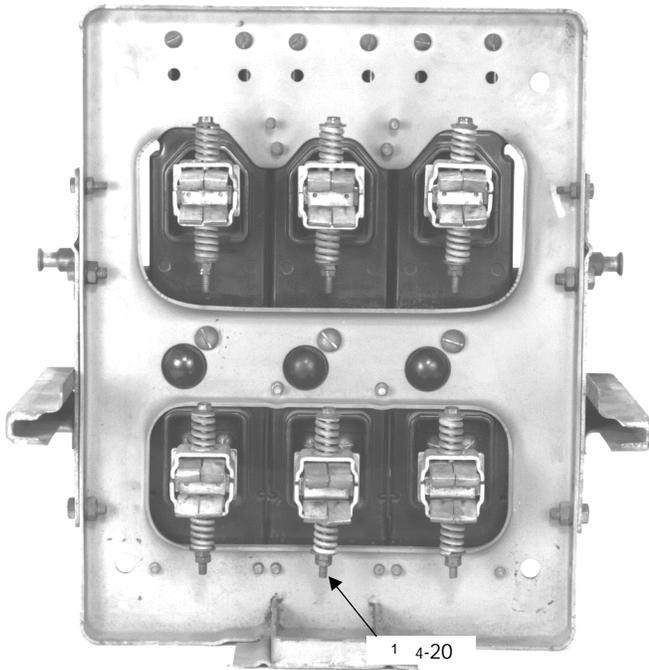


Figure 1. Draw-out primary disconnect fingers.

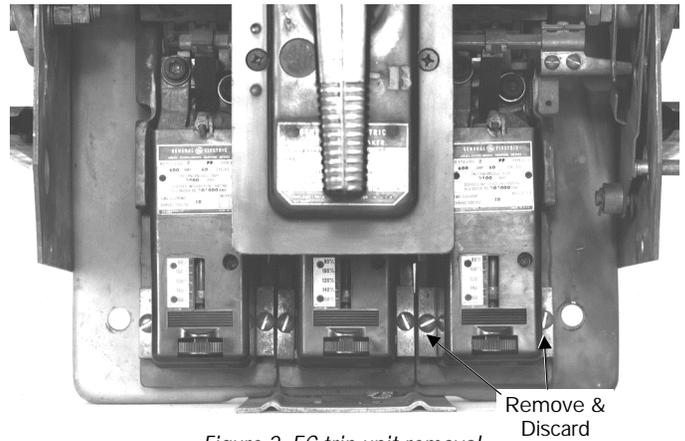


Figure 2. EC trip unit removal.

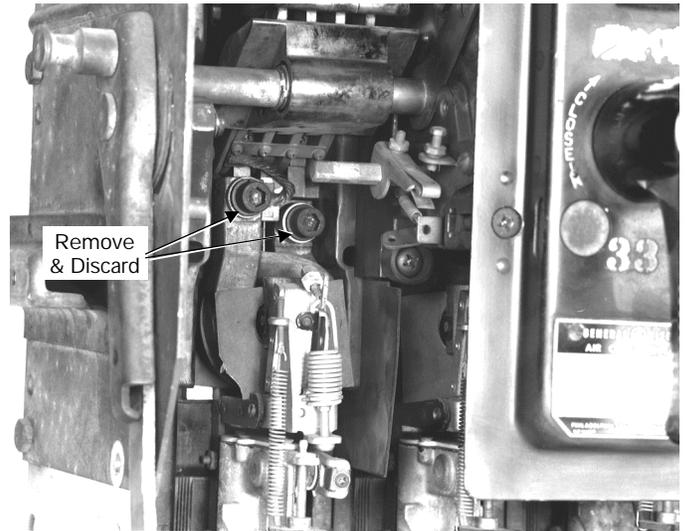


Figure 3. Removing the trip unit coil connections.

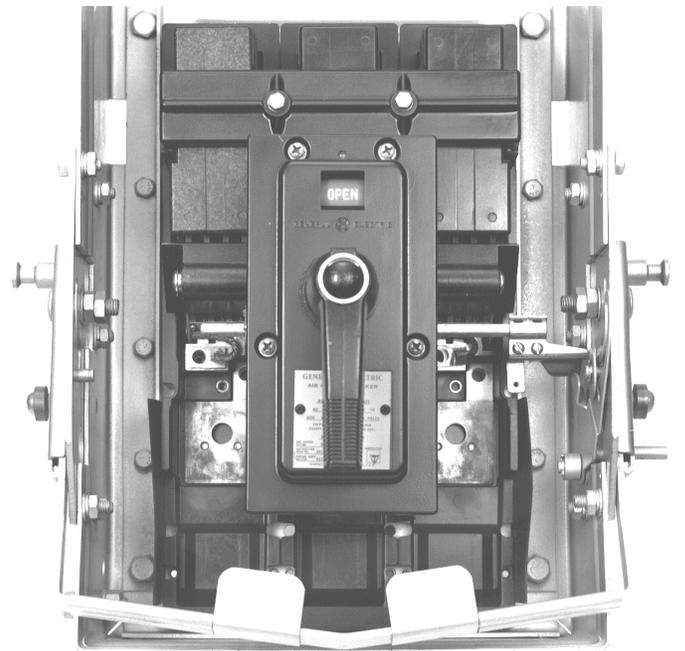


Figure 4. Disassembled AK-1-25 breaker.

## SECTION 4. INSTALLING THE CONVERSION KIT

### Installing the Current Sensors (CTs)

1. Place the bottom copper bus in the breaker frame and insert the 1 4-20 x 7 8" screw with a flat and lock washer, as shown in Figure 5.
2. Insert the 3 8-20 x 1 4" bolt with a flat and lock washer through the electrical contact hole in the top of the bus, as shown in Figure 5.
3. Remove the 1 4-20 Philips-head screw from the back of the breaker above the load terminal that aligns with the hole in the copper bus. On AK-1-15 breakers, it is the right screw; on AK-1-25 breakers, it is the left screw. Replace the screw with the 1 4-20 x 1 5 8" screw provided.
4. Use the 1 4-20 nut, flat washer, and lock washer on the screw inserted in step 3 to fasten the bus, as shown in Figure 5.
5. Place the CT, insulating barrier, and top copper bus over the copper CT post. Secure the bus with the 5 16-18 x 1" bolt, flat washer, and lock washer provided, as shown in Figure 6.

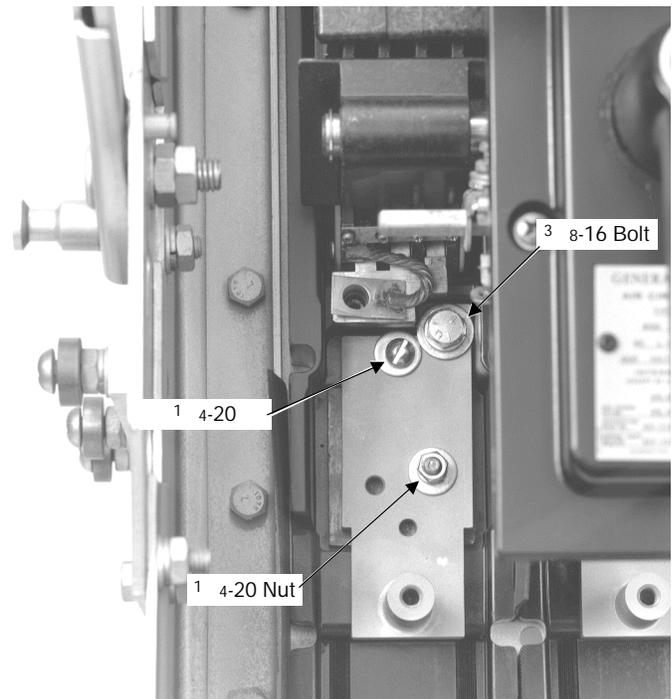


Figure 5. Bottom bus installation.

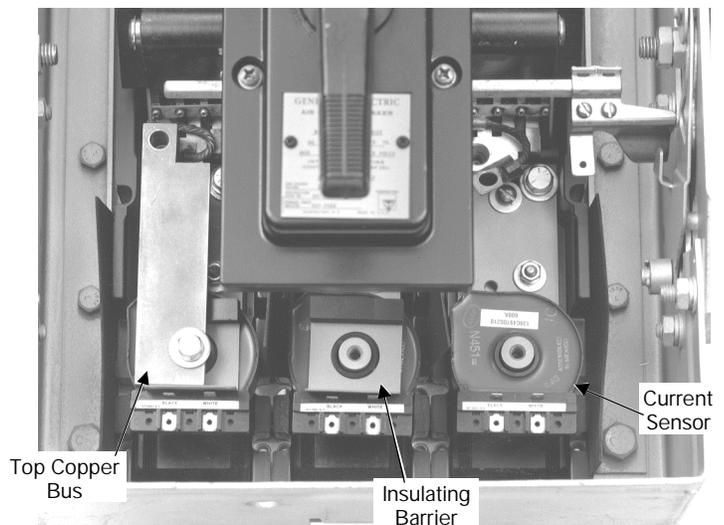


Figure 6. CT assembly.

6. Insert the 3 8-16 x 2 1/4" bolt, lock washer, and flat washer provided through the top copper bus into the contact arm, as shown in Figure 7.
7. Tighten the 5 16-18 bolts CT bolts, placed in step 5, to 100 in-lb, as shown in Figure 8.
8. Tighten the two 3 8-16 bolts inserted in steps 2 and 6 to 200 in-lb.

**WARNING:** Steps 7 and 8 provide critical electrical integrity connections. The designated bolts must be correctly tightened for proper operation. Failure to tighten these bolts properly will cause a breaker failure, resulting in property damage and/or personal injury.

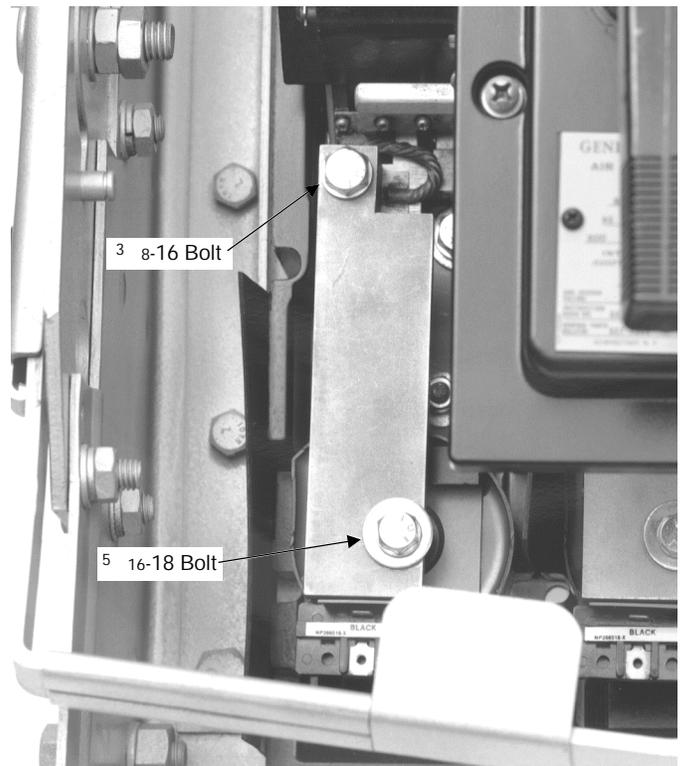


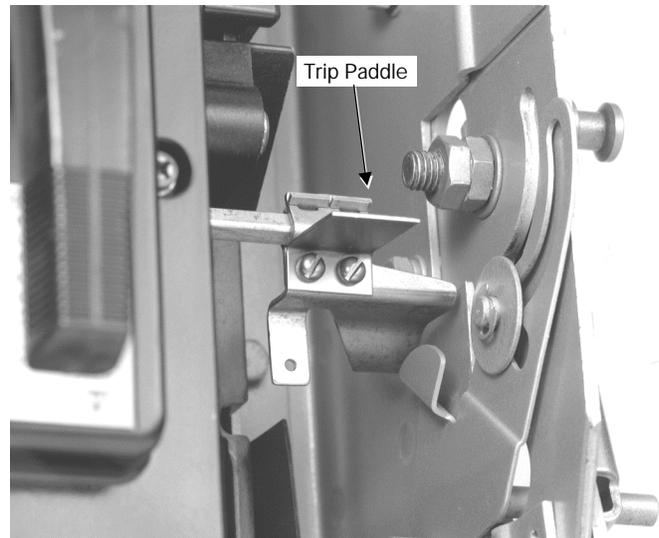
Figure 7. Top bus connection.



Figure 8. CT assembly torque.

## Mounting the Trip Paddle

Install the new trip paddle on the right end of the common trip bar over the draw-out interlock, as shown in Figure 9. Use the two 10-32 x 5/8" screws and lock washers that hold the interlock lever in place.



*Figure 9. Trip paddle installation.*

## Installing the Flux Shifter Assembly

1. Remove the two 1/4-20 nuts or bolts and washers on the right side of the mechanism that hold the mechanism together. The flux shifter will be held in place with the existing studs or bolts.
2. Install the flux shifter assembly onto the existing studs as shown in Figure 10. Use the 1/4-20 nuts or bolt and lock washer to secure the top of the bracket to the side of the handle mechanism and the lock washer and special fastener to secure the bottom.

**NOTE:** Figure 10 shows the handle removed for clarity. It is not necessary to remove the handle during installation.

3. Place the two 1/2" spacers over the studs on the flux shifter mounting plate, as shown in Figure 10. Place the two mounting holes in the trip unit support bracket over the studs on the top of the flux shifter bracket, as shown in Figure 11. Secure with the 1/4-20 nuts, flat washers, and lock washers provided.

**NOTE:** The right-corner enclosure bolt may have to be shortened if it interferes with the bracket or the trip unit.

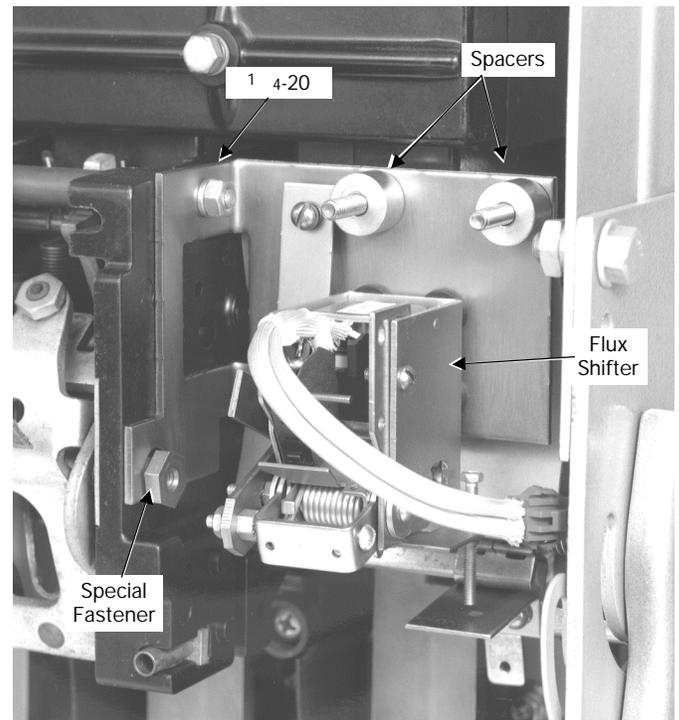


Figure 10. Installing the flux shifter assembly.

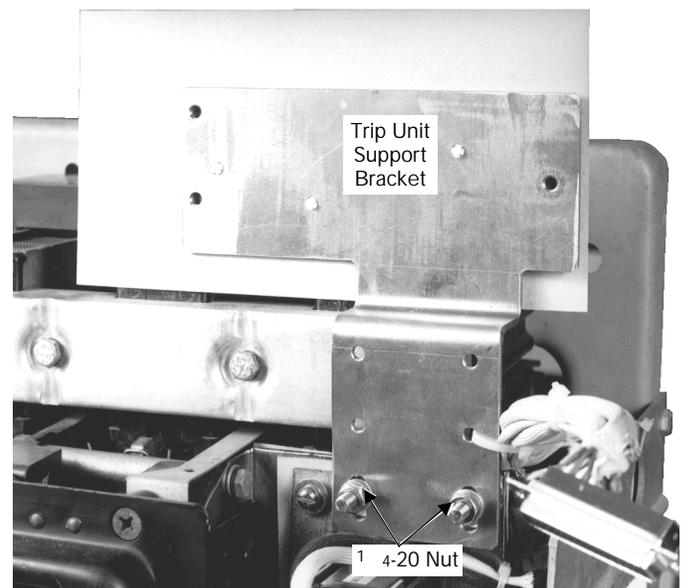


Figure 11. Trip unit support bracket installed.

## Installing the Trip Unit

1. Place a lock washer and flat washer over each of the three 1/4-20 x 1 3/8" screws provided and insert through the mounting holes on the trip unit mounting plate. From the rear of the plate, place a flat washer, spacer, and O-ring over the screws, as shown in Figure 12.
2. Remove the large screw from the rear of the trip unit. Place the trip unit in position on the mounting plate, with the 50-pin connector aligned with the opening in the plate. Secure with the large screw, as shown in Figure 12.
3. Insert the 50-pin female connector on the wiring harness into the trip unit connector through the rear of the mounting plate. Secure to the mounting plate with the two small screws provided, as shown in Figure 13.
4. Place the trip unit and mounting plate in position on the support bracket mounted to the breaker. Secure with the screws in the mounting plate into the tapped holes in the bracket, as shown in Figure 14.

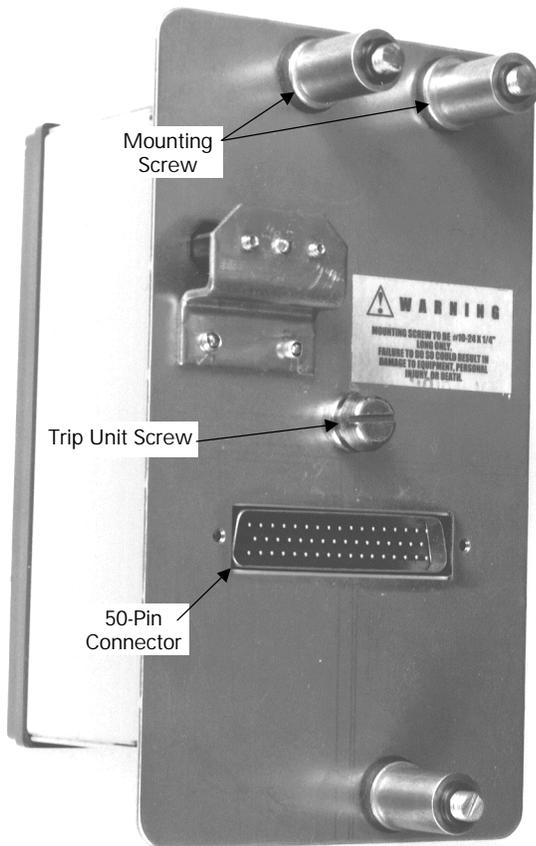


Figure 12. Trip unit attached to its mounting plate.

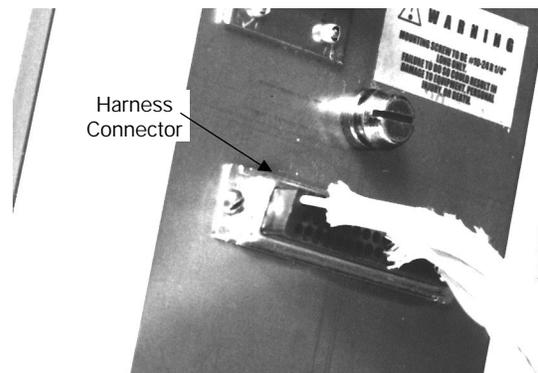


Figure 13. Harness connector attached to the trip unit.



Figure 14. Trip unit mounted on the breaker.

## Adjusting the Flux Shifter

With the breaker in the CLOSED position, the gap between the adjustment screw and the trip paddle should be  $\frac{1}{16}$  inch, as shown in Figure 15. For safety, OPEN the breaker to adjust the screw with a  $\frac{1}{4}$ -inch wrench.

**WARNING:** Be extremely careful when working on a closed breaker. *Do not* reach into the mechanism while adjusting the flux shifter.

*Optional Test* – The flux shifter may be tested by closing the breaker and applying a 9 Vdc power source to the flux shifter leads (the red wire is positive). The breaker should trip.

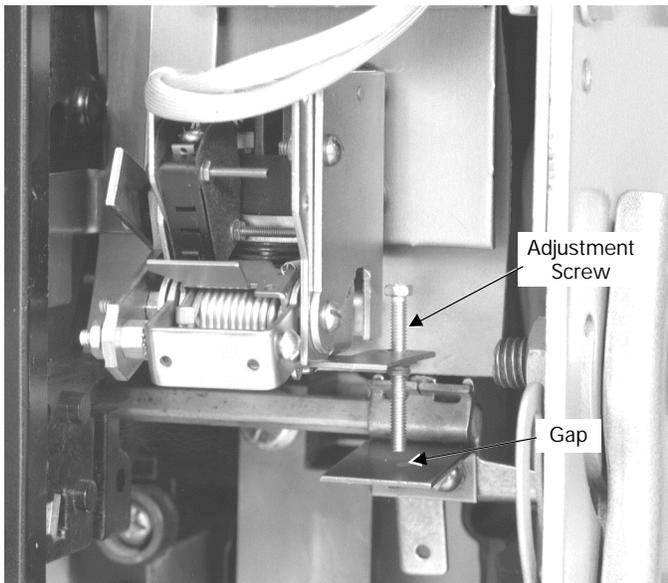


Figure 15. Flux shifter adjustment.

## Connecting the Trip Unit Wiring Harness

1. Join the four-pin connector on the trip unit harness to the four-pin connector on the flux shifter.
2. Connect the harness leads to the screw terminals on each CT, as shown in Figure 16. The black wire (tap) connects to the left terminal and the white wire (common) to the right terminal.
3. Use the wire ties provided to tie the harness back against the frame. The harness should be tied to the holes in the fiber barriers at each CT. Ensure that the wiring will not interfere with any moving parts.

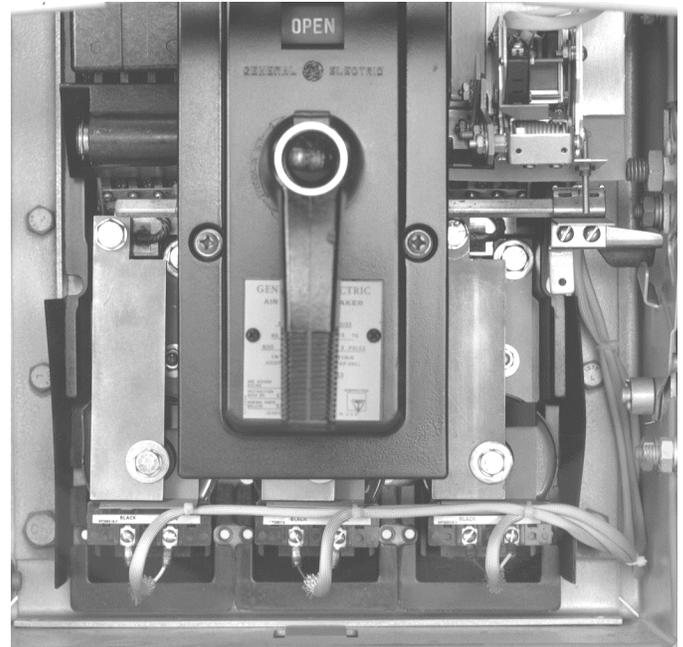


Figure 16. Wiring harness installation.

## Configuring the Trip Unit

See DEH-40034 for detailed instructions for setting up ProTrip trip units.

## SECTION 5. FOUR-WIRE GROUND FAULT OPTION

The ground fault option for four-wire installations requires the installation of an additional current sensor on the outgoing neutral lead in the equipment. The sensor is connected to the trip unit through the connector provided in the wiring harness.

1. Mount the neutral sensor on the outgoing neutral lead, normally in the bus or cable compartment in the equipment. Figure 17 shows the outline of the neutral sensor.
2. Connect the neutral sensor wire harness to the correct taps on the sensor. To maintain the same polarity as the phase sensors, connect the white wire to the common terminal, black to the tap.
3. Route the wires through the equipment and connect to the two-pin connector on the trip unit wiring harness. The wires should be tied to the breaker frame in an easily accessible location. It may be located with the communication harness.

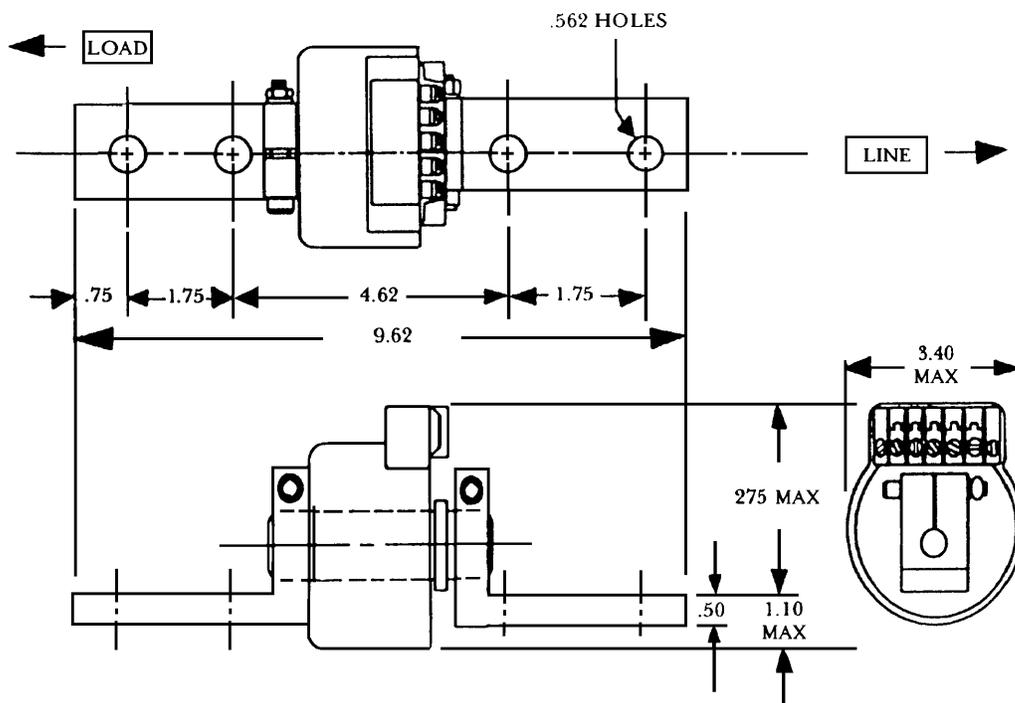


Figure 17. Neutral sensor outline.

## SECTION 6. TESTING AND TROUBLE-SHOOTING

**WARNING:** Do not change taps on the current sensors or adjust the trip unit settings while the breaker is carrying current. Failure to adhere to these instructions will void all warranties.

### Testing

Before installing a converted breaker back into service, perform the following steps:

1. Verify that the trip unit is securely installed by performing a continuity test on the CT wiring and the trip unit.
  - a. Disconnect the black CT wires at each phase sensor.
  - b. Check for continuity with a continuity tester or VOM from the white lead of the phase A CT to the white lead of the phase B CT.
  - c. Repeat this continuity test for the white leads of the phase A and phase C CTs.
  - d. Measure the resistance across each phase sensor and compare the values measured to the values listed in Table 1.
  - e. Reconnect the black CT leads to all of the phase sensors. Ensure that this is done before continuing with performance testing of the breaker.

**CAUTION:** In addition to the continuity test described in Step 1 and before performance testing of the converted breaker, each phase of the breaker should be primary injected with a current level of about 10%, but no more than 20%, of the CT rating. During the application of test current, activate the trip unit screen by depressing the battery button on the trip unit face and check that the test current is displayed on the screen for each phase tested. If the trip unit fails to display the test current, stop the test immediately and verify the installation of the trip unit and wire harness before proceeding with any additional testing.

**WARNING:** If the converted breaker is energized or tested by primary injection with a sufficiently high test current with a loose or open circuit between the CTs and the trip unit, damage will occur to the trip unit, wire harness, 36-pin trip unit connector, and CTs. Failure to adhere to these instructions will void all warranties.

2. Check the insulation on the primary circuit with a 1,000-volt Meggar.
3. Measure the resistance across the line and load terminals for each phase using a micro-ohmme-

ter or millivolt tester. If the resistance differs considerably from phase to phase, the electrical connections may not be properly tightened or it could also indicate improper contact wipe.

4. To verify that the breaker has been properly retrofitted, perform a primary injection test on each phase. This test will check the CTs, bus, wiring harness, flux shifter, and trip unit as a complete system.
  - a. A high-current, low-voltage power supply should be connected across each line and load terminal to simulate an overcurrent fault.
  - b. Set the long-time trip at 0.5 to minimize the breaker stress.
  - c. When ground fault is installed, the test can be performed by wiring two adjacent poles in series or by using the GE Digital Test Kit, cat. no. TVRMS2. This will prevent the breaker from tripping because of an unbalanced current flow.

**CAUTION:** Do not attempt to use GE Test Kit cat. no. TVTS1 or TVRMS on this trip unit.

### Trouble-Shooting

When malfunctioning is suspected, first examine the breaker and its power system for abnormal conditions such as the following:

- The breaker is not tripping in response to overcurrent conditions or incipient ground faults.
- The breaker is remaining in a trip-free state because of mechanical interference along its trip shaft.
- The shunt trip (if present) is activating improperly.

### Nuisance Tripping on Ground Fault-Equipped Breakers

When nuisance tripping occurs on breakers equipped with ground fault trip, a probable cause is the existence of a false ground signal. Each phase sensor is connected to summing circuitry in the trip unit. Under no-fault conditions on three-wire load circuits, the currents add to zero and no ground signal is developed. This current sum is zero only if all three sensors have the same electrical characteristics. If one sensor differs from the others (such as by a different rating or wrong tap setting), the circuitry can produce an output sufficient to trip the breaker. Similarly, a discontinuity between any sensor and the trip unit can cause a false trip signal.

The sensors and their connections should be closely examined if nuisance tripping is encountered on any breaker whose ProTrip trip unit has previously demonstrated satisfactory performance. After dis-

connecting the breaker from all power sources, perform the following procedure:

1. Check that all phase sensors are the same type (current range).
2. Verify that the tap settings on all three phase sensors are identical.
3. Verify that the wiring harness connections to the sensors have the proper polarity (white lead to common, black lead to tap), as shown in the cabling diagram in Figure 18.
4. On ground fault breakers serving four-wire loads, check that the neutral sensor is properly connected, as indicated in Figure 18. In particular, check the following:
  - a. Verify that the neutral sensor has the same rating and tap setting as the phase sensors.
  - b. Verify continuity between the neutral sensor and its equipment-mounted secondary disconnect block. Also check for continuity from the breaker-mounted neutral secondary disconnect block through to the trip unit wiring harness connector.
  - c. If the breaker's lower studs connect to the power source, then the neutral sensor must have its load end connected to the source.
  - d. Verify that the neutral conductor is carrying only the neutral current associated with the breaker's load current (the neutral is not shared with other loads).
5. If the preceding steps fail to identify the problem, then measure the sensor resistances. The appropriate values are listed in Table 1. Since the phase and neutral sensors are electrically identical, their resistances should agree closely.

Breaker	CT Rating, A	Resistance, ohms
AK-1-15	150	9-12
	225	14-18
AK-1-25	225	14-18
	600	40-50

*Table 1. CT resistance values.*

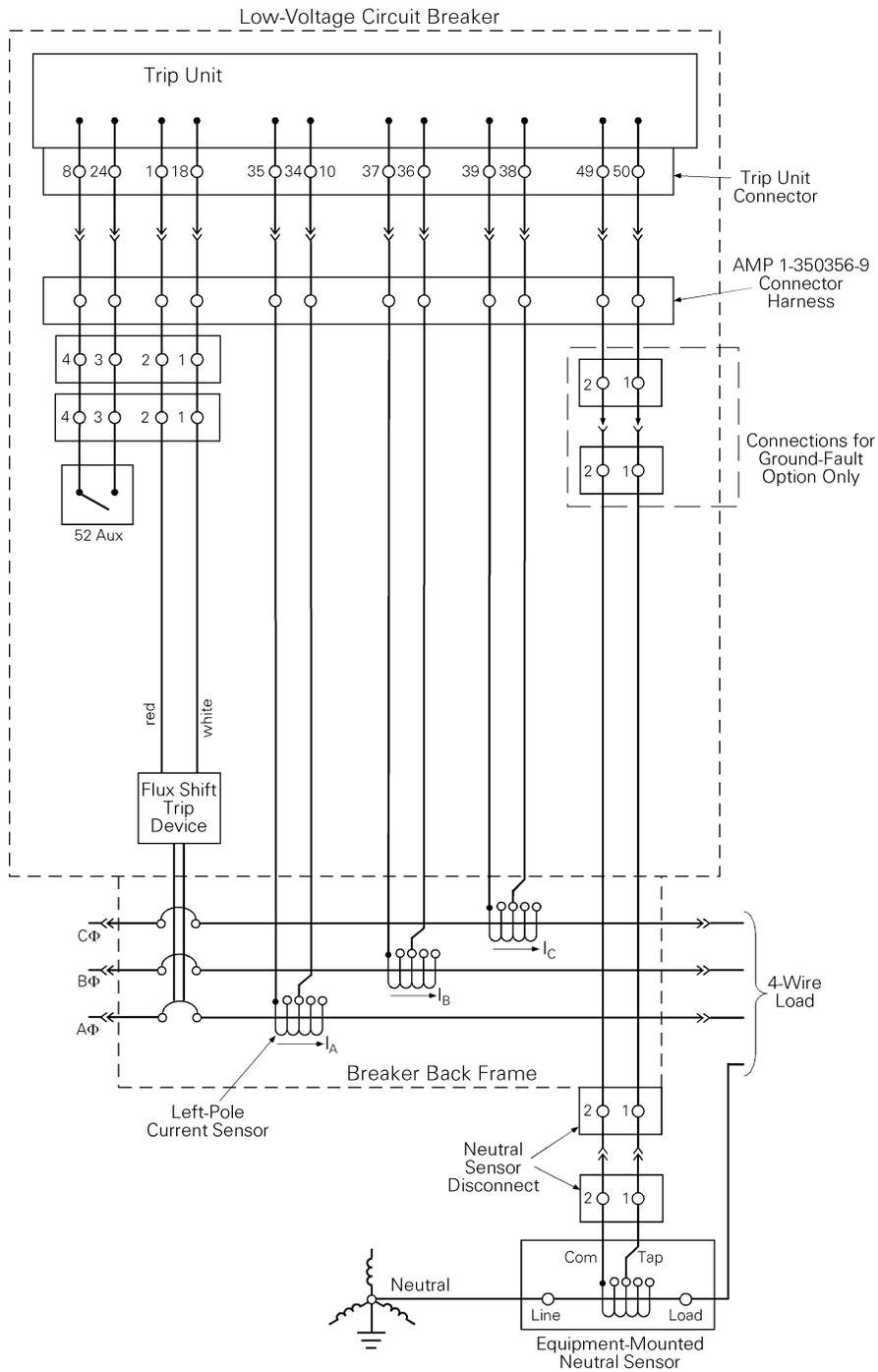


Figure 18. Cabling diagram for ProTrip™ trip units with ground fault on four-wire loads.

These instructions do not cover all details or variations in equipment nor do they provide for every possible contingency that may be met in connection with installation, operation, or maintenance. Should further information be desired or should particular problems arise that are not covered sufficiently for the purchaser's purposes, the matter should be referred to the GE Company.



**GE Industrial Systems**

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