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# ProTrip™ Conversion Kits

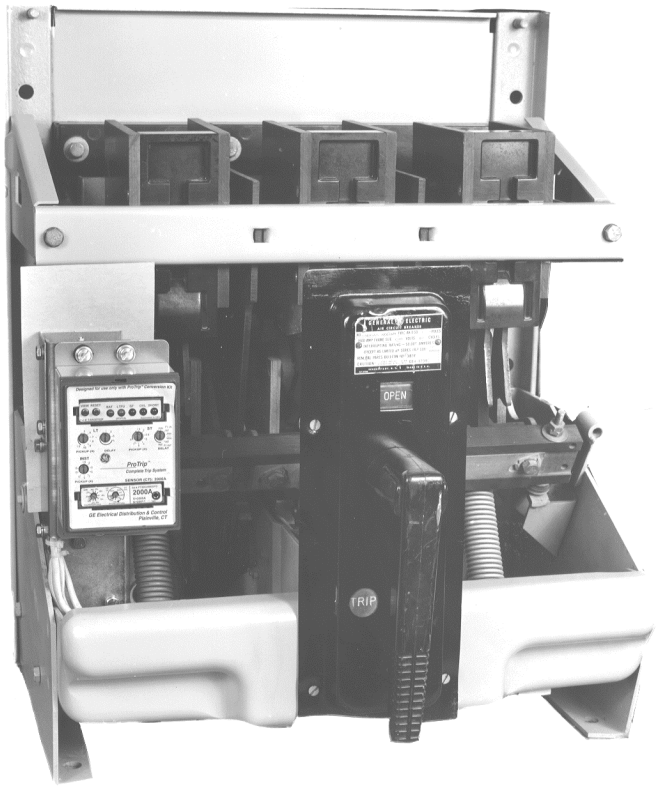
*For GE Types AK-1-50 Low-Voltage Power Circuit Breakers*

## 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-1-50 low-voltage power circuit breakers. Each Conversion Kit contains all the components needed to convert from an existing GE type EC 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 conversions 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.

In preparation for the conversion, the installer should verify that the appropriate current sensors and trip unit have been furnished. Whenever a ProTrip kit is installed on a breaker with a four-wire system, an associated neutral sensor (CT) is required for separate mounting in the equipment. 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. FRONT AND BACK FRAME DISASSEMBLY

The installation of a ProTrip Conversion Kit in a GE AK-1-50 breaker requires that the front and back frames be disassembled. The following steps describe this procedure.

1. Remove the breaker opening springs, shown in Figure 1. Save them for reinstallation.
2. Remove the spring clip on the crossbar mechanism pin, shown in Figure 2, and slide out the pin. Save the pin and clip for reinstallation.
3. Remove and save the nuts and lock washers holding the front and back frames together. Four are used on manually operated breakers and six are used on electrically operated breakers.
4. Lift the front frame straight up and off from the back frame.
5. Place the back frame on its back on a suitable work surface.

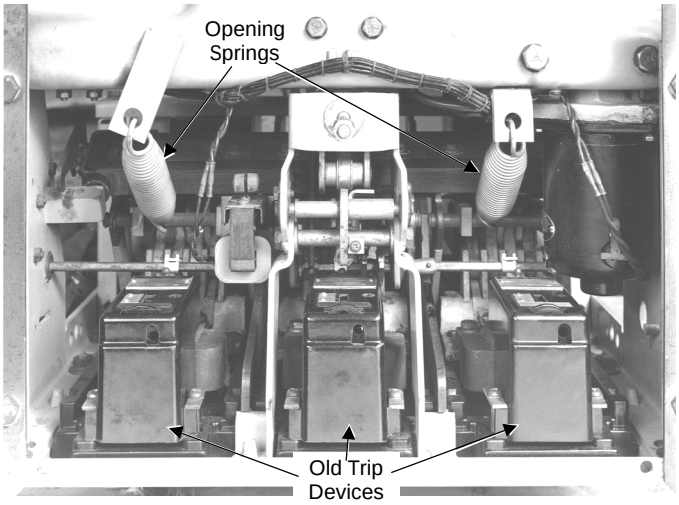


*Figure 1. Opening springs and old trip devices on an AK-1-50 circuit breaker (view from bottom of breaker).*

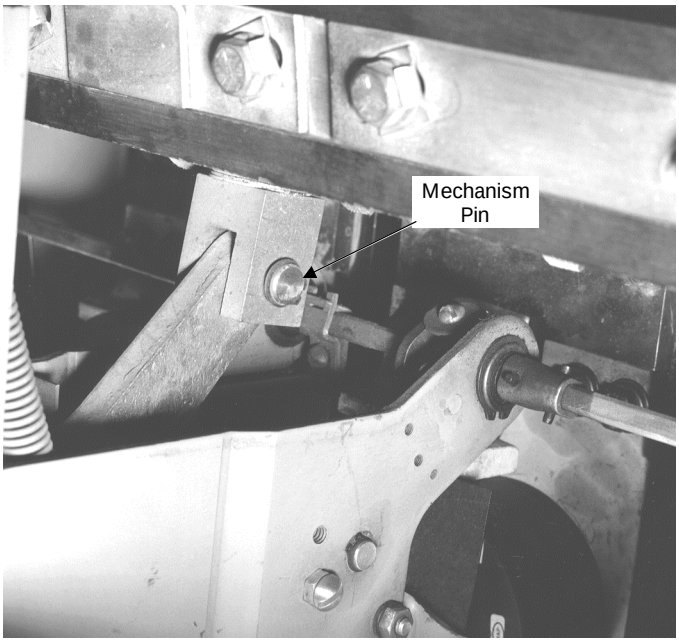


*Figure 2. Crossbar mechanism pin and retaining clip.*

# SECTION 4. BACK FRAME BREAKER CONVERSION

## Removing the Electromechanical Trip Devices

1. Remove and discard the two screws at the base of each trip device, as shown in Figure 3. Discard the metal mounting brackets (some units have a single C-shaped bracket).
2. Remove and discard the small Philips-head screw at the top of each trip device.
3. Remove and discard the four 5/16" Allen-head bolts securing each trip coil. The coil can then be lifted off and removed. Figure 4 shows one trip completely removed, one with the cover removed, and one still in place.

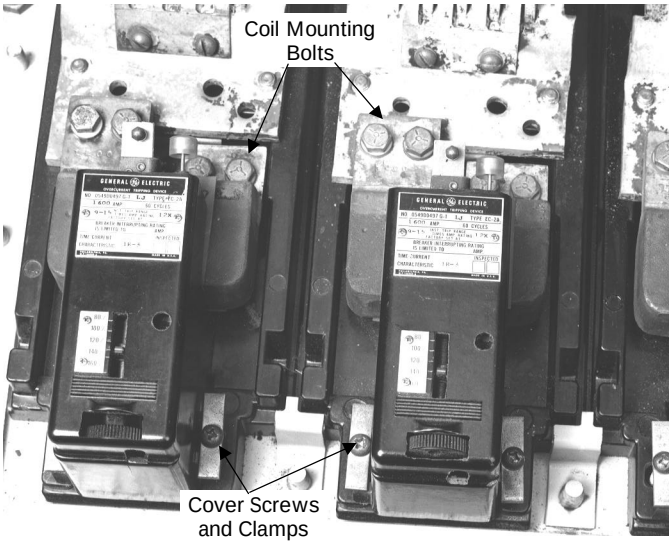


*Figure 3. EC trip devices before removal.*

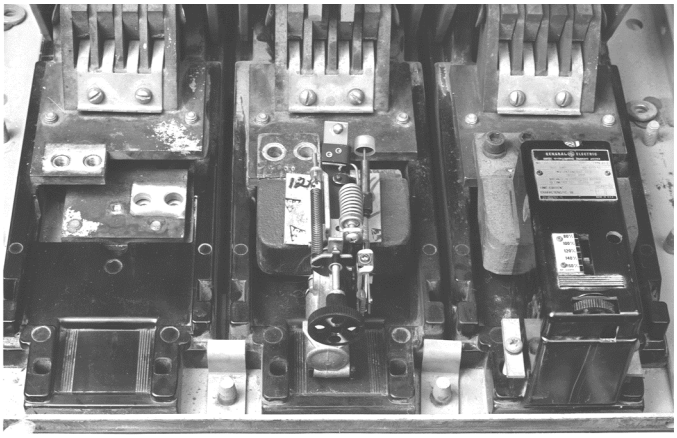

*Figure 4. Removal of EC trip devises.*

## Installing the Phase Sensors

Figure 5 shows the parts provided for assembly of the CT on each pole.

1. Mount the new copper CT post to the back frame with the two 3/8-16 x 1 1/2" bolts, flat washers, and lock washers provided, as shown in Figure 6.
2. Fasten the three small insulated wire fasteners to the back frame with the 1/4-20 x 1 3/4" screws provided, as shown in Figure 7. One fastener is mounted under each CT.
3. Place a CT over each copper post, first applying a small amount of RTV or similar adhesive to prevent the CTs from rotating.
4. Mount the top copper bus over each CT and secure with the 1/2-13 x 1 1/2" Allen-head bolts, lock washers, and flat washers provided.
5. Insert two 3/8-16 x 1 1/2" bolts, lock washers, and flat washers through each top copper bus into the contact arm assembly.
6. Tighten the 3/8-16 bolts to 200 in-lb and the 1/2-13 bolts to 300 in-lb.

***WARNING:*** Step 6 ensures 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.

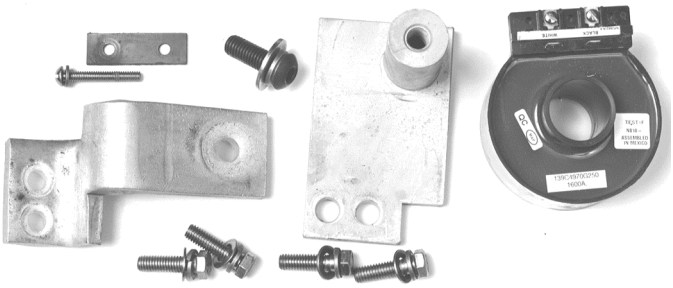

*Figure 5. Parts provided for CT installation for one pole.*

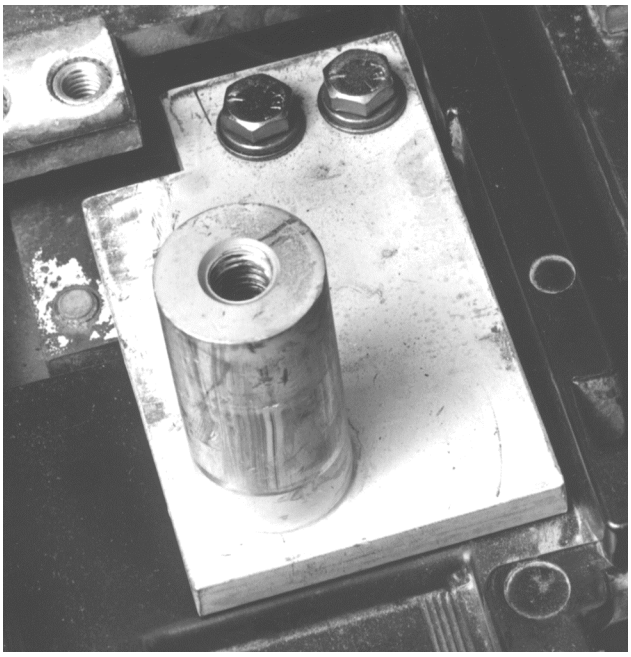

*Figure 6. CT post mounted in the breaker back frame.*

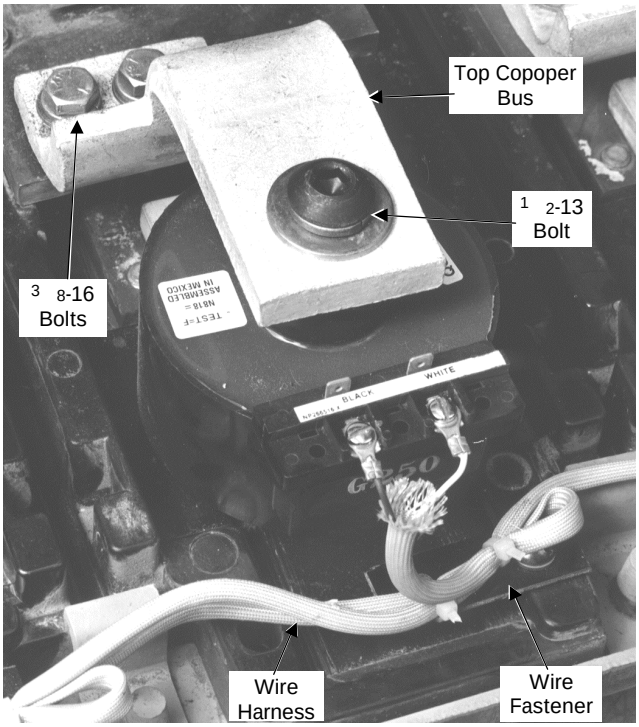


*Figure 7. CT installation completed..*

# SECTION 5. FRONT FRAME BREAKER CONVERSION

Place the front frame on a suitable work surface as shown in Figure 8.

## Installing the Trip Paddle

1. Remove and discard the three trip paddles on the trip actuator bar, as shown in Figure 8.
2. Assemble the trip paddle and the threaded back plate by inserting two of the 10-32 x 3/4" screws and lock washers provided along the top edge.
3. Slip the trip paddle over the trip actuator bar approximately one inch from the side frame, as shown in Figure 9. Insert the remaining 10-32 x 3/4" screw and tighten the other screws to secure the trip paddle in place.

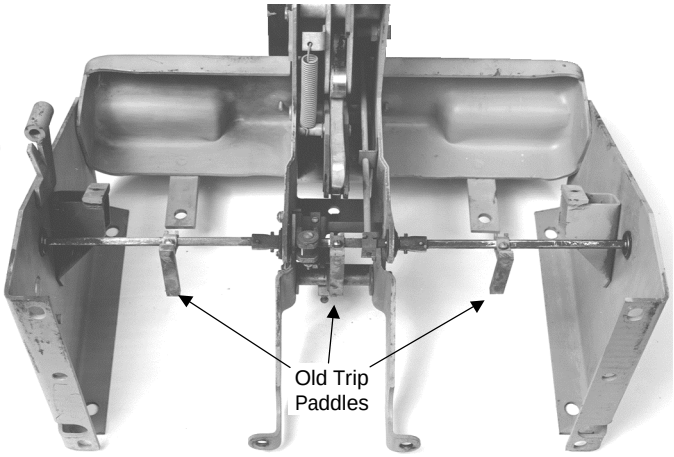


*Figure 8. Front frame assembly, showing the old trip paddles.*

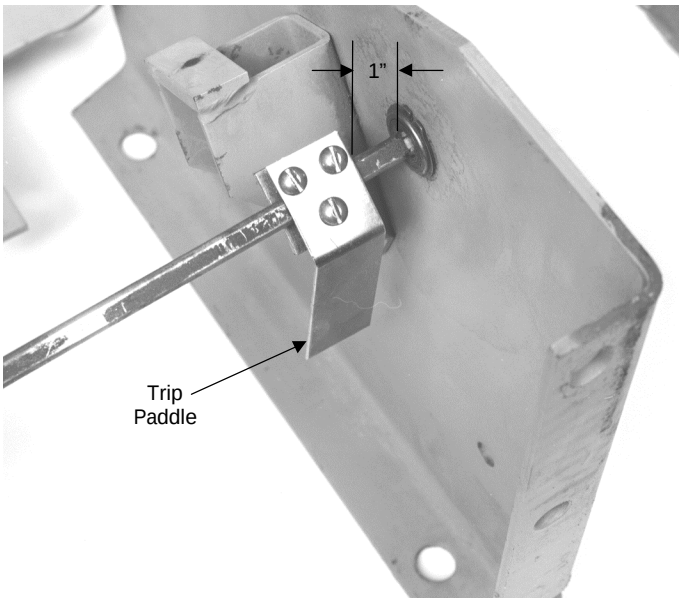


*Figure 9. Installing the new trip paddle.*

## Installing the Flux Shifter Assembly

Figure 10 shows the flux shifter mounting bracket, with the trip unit support bracket and insulating shield attached.

1. Remove and discard the grounding strap hardware on the left side of the front frame. Attach the flux shifter mounting bracket to the left inside of the front frame with the two 3/8-16 x 1" bolts, nuts, and lock washers provided, as shown in Figure 11 (showing the plate in position after reassembly of the front and back frames).
2. Secure the flux shifter assembly, shown in Figure 10, to the bracket with the two 1/4-20 x 1/2" bolts provided, as shown in Figure 12.

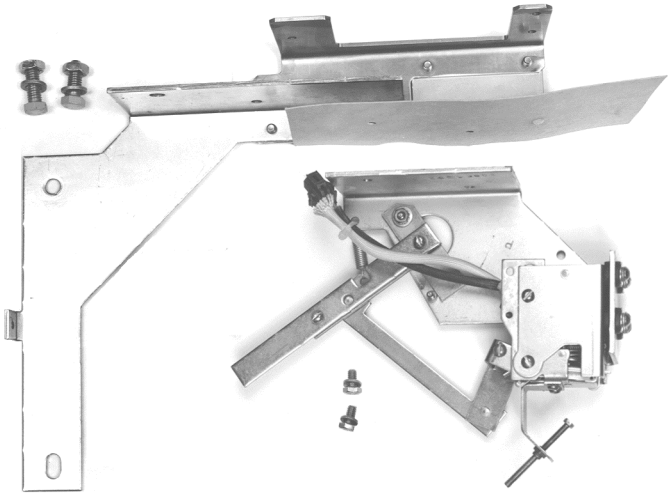

*Figure 10. Flux shifter assembly and mounting bracket.*

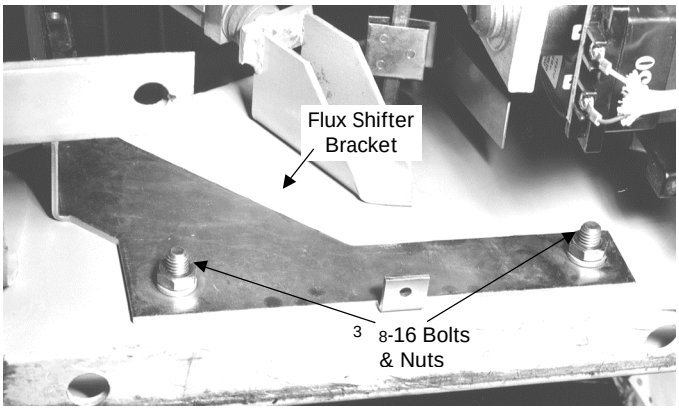


*Figure 11. Flux shifter bracket installed on the front frame (view from underneath with breaker reassembled).*

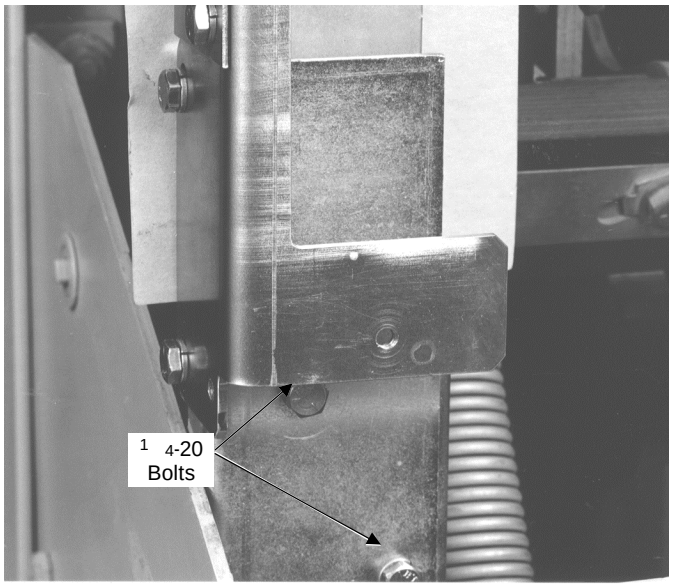


*Figure 12. Flux shifter assembly attached to the mounting bracket.*

# SECTION 6. BREAKER REASSEMBLY

## Frame Assembly

Follow steps 1–4 in Section 3 Front and Back Frame Disassembly to reassemble the front and back frames.

> ***CAUTION:*** Be careful when joining the frames so that the flux shifter reset arm is not damaged. The reset arm must be assembled so that it rests on the metal contact crossbar on the underside. The arm will fit between the left frame side lever and the first insulated contact actuator lever.

## Wiring Harness Installation

1. Connect the four-pin flux shifter connector to the mating connector on the wiring harness and tie the leads to the mounting bracket.
2. Loosen, but do not remove, the two 3/8-16 mechanism bolts above the center-phase CT and insert the insulating barrier provided, as shown in Figure 13. Retighten the bolts to fasten the barrier in place.
3. Bring the CT leads of the wiring harness around to the back and bottom of the breaker and connect to the CTs as shown in Figure 14. Connect the white and black leads as indicated on the CT terminals.
4. Tie the wiring harness to the insulated fasteners under each CT with the wire ties provided. Be sure that the wiring harness will not interfere with the breaker mechanism.

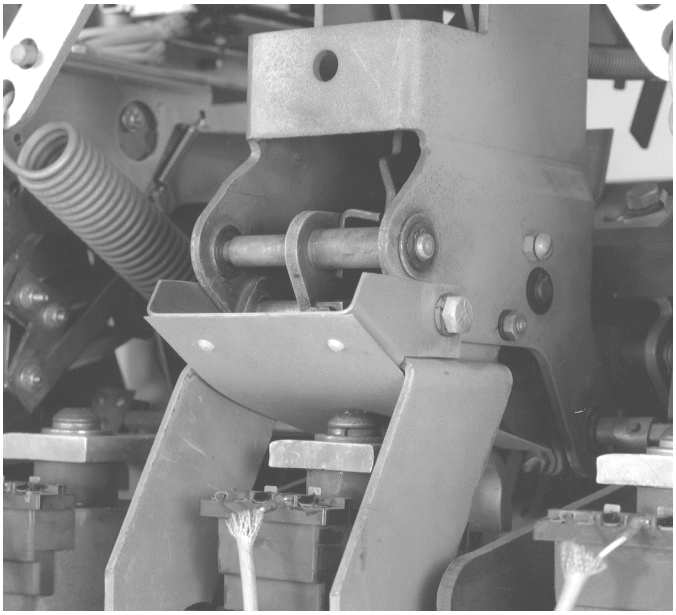

*Figure 13. Installing the insulating barrier.*

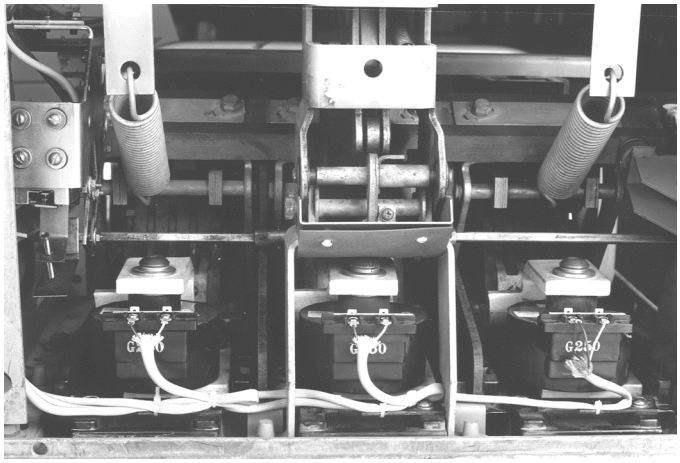

*Figure 14. Wiring harness connection to the CTs.*

## Adjusting the Flux Shifter

With the breaker in the CLOSED position, the gap between the adjustment screw and the trip paddle should be 1/16 inch, as shown in Figure 15. For safety, OPEN the breaker to adjust the screw with a 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.

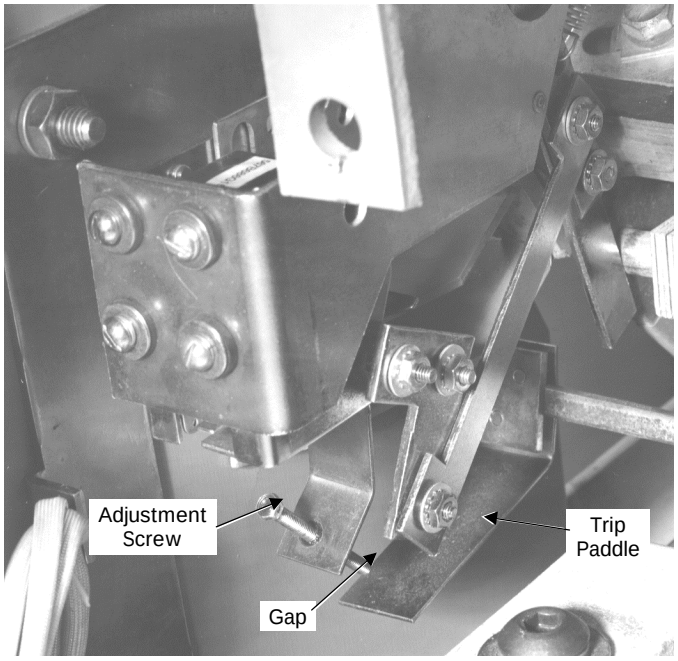


*Figure 15. Adjusting the flux shifter.*

## Installing the Trip Unit

1. 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 16.
2. 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 16.
3. Place the trip unit and mounting plate in position on the support bracket mounted on the breaker. Secure with the three screws, lock washers, and flat washers through the holes in the mounting plate into the tapped holes in the bracket, as shown in Figure 17.

## Configuring the Trip Unit

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

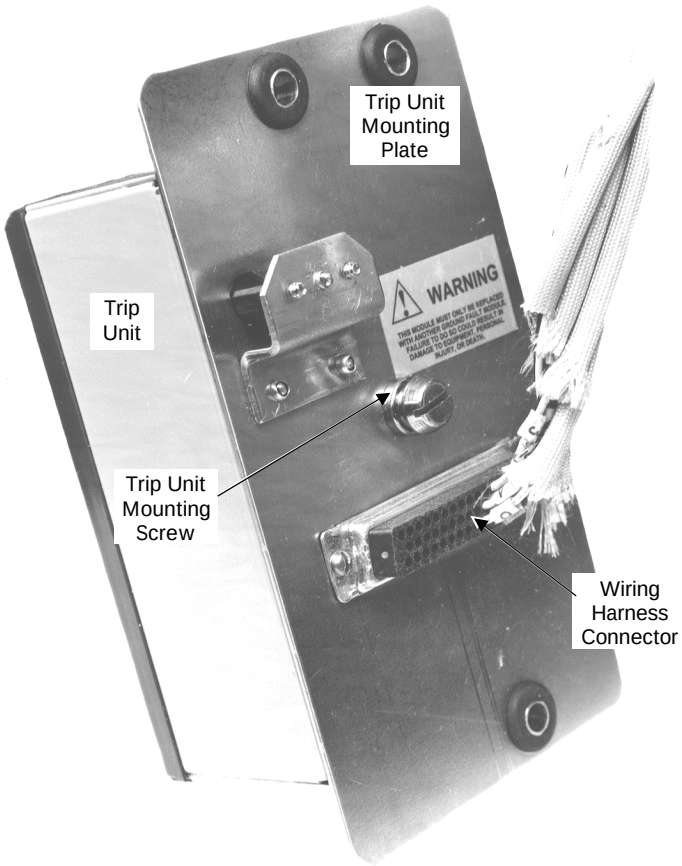


*Figure 16. Attaching the trip unit to the mounting plate.*

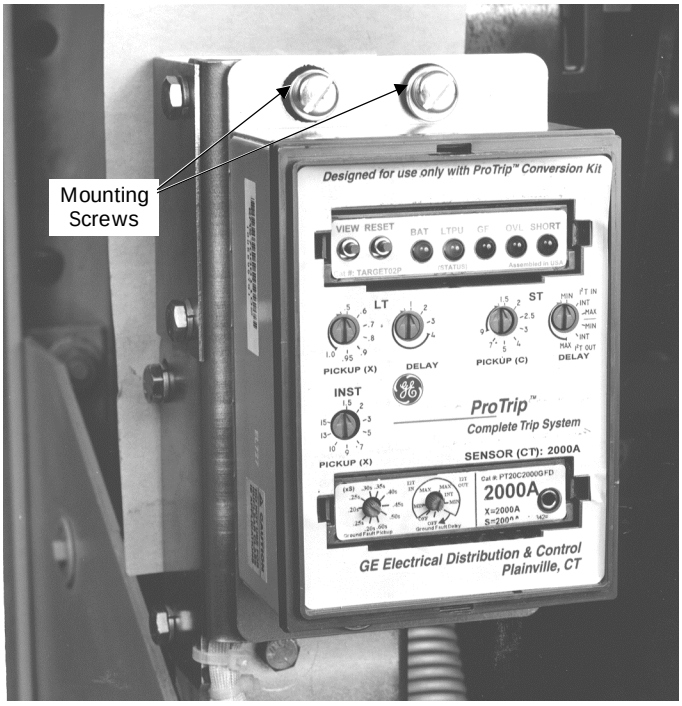


*Figure 17. Trip unit mounted onto the breaker.*

# SECTION 7. FOUR-WIRE GROUND FAULT OPTION

The ground fault option for four-wire installations requires the installation of an additional current sensor on the neutral bus 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 18 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. They may be located with the communication harness.

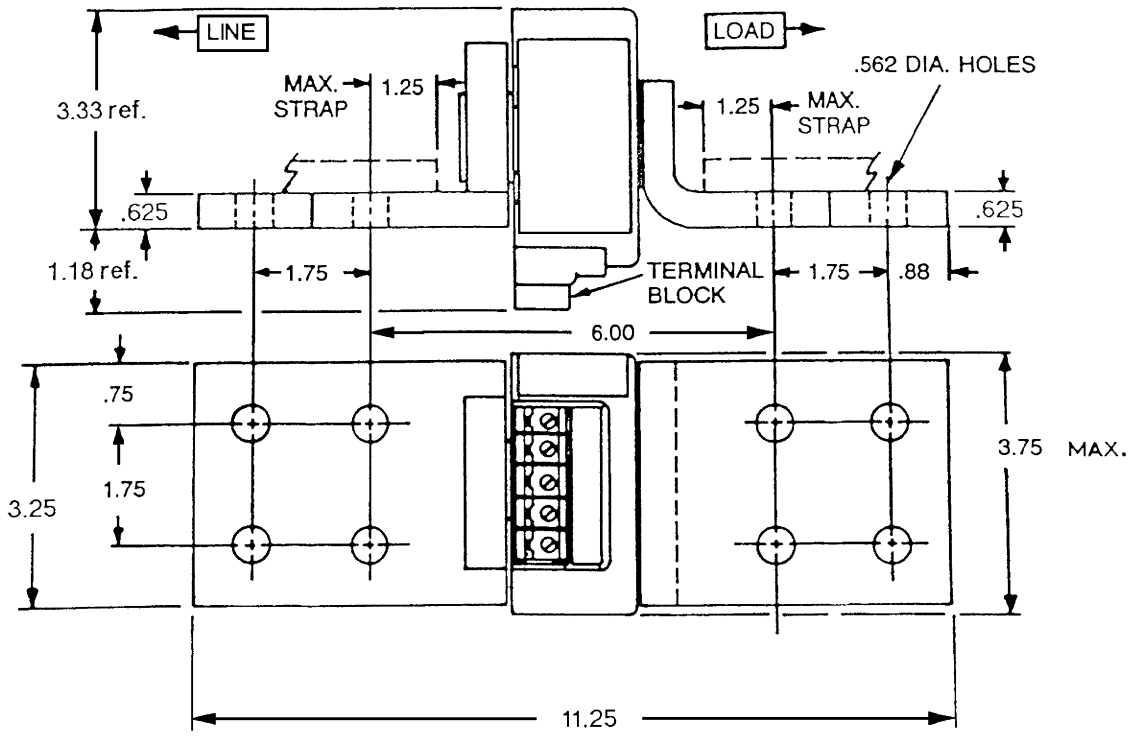


*Figure 18. Neutral sensor outline for AK-1-50.*

# SECTION 8. TESTING AND TROUBLESHOOTING

***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-ohmmeter 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 19.
4. On ground fault breakers serving four-wire loads, check that the neutral sensor is properly connected, as indicated in Figure 19. 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-1-50 | 800<br>1600 | 58–79<br>130–154 |

*Table 1. CT resistance values.*

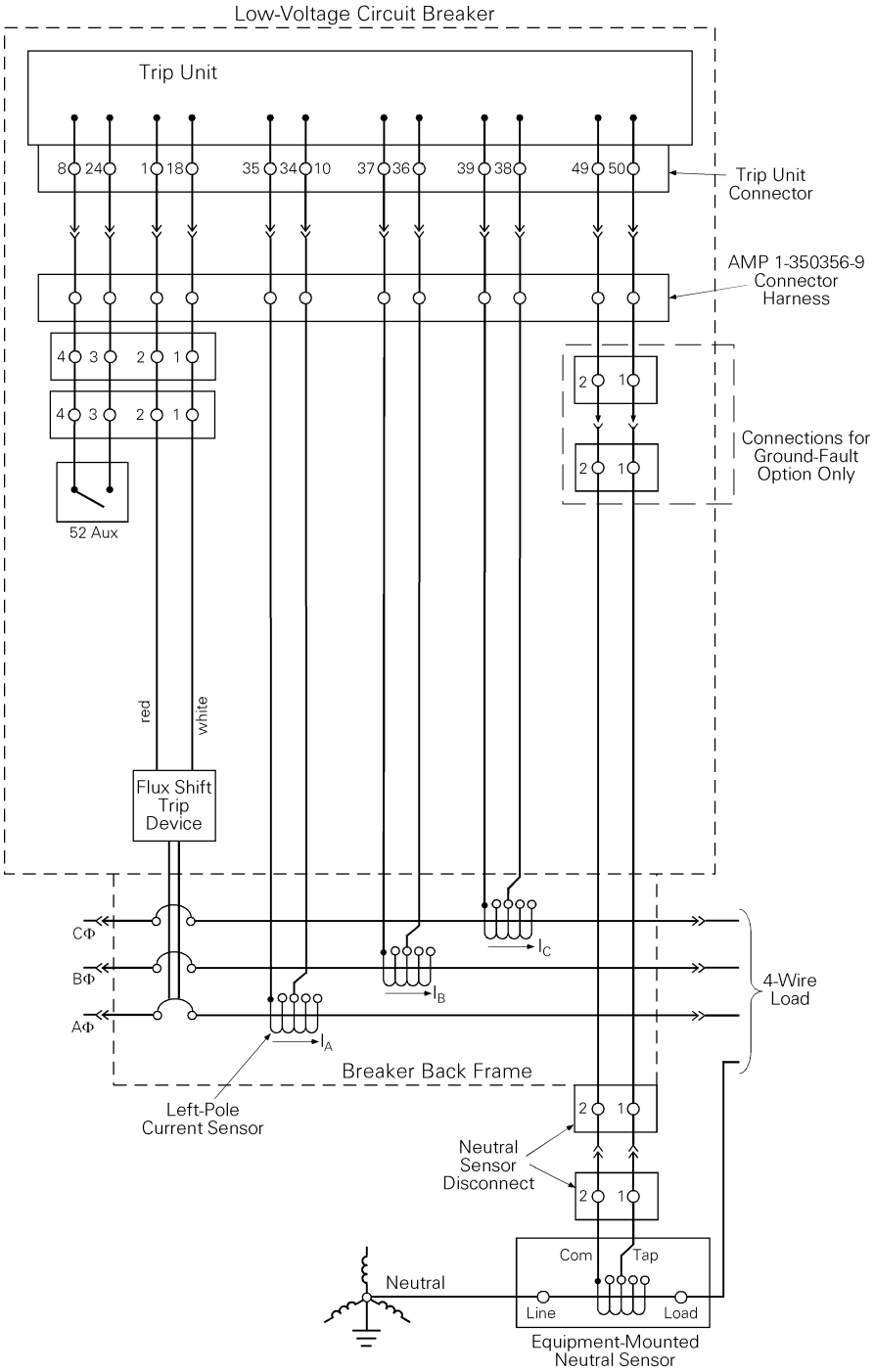


*Figure 19. Cabling diagram for ProTrip™ trip units with ground fault on four-wire loads.*

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.

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