Installation Instructions for the Digitrip OPTIM 550 3-Pole Trip Unit Installation and Operation with K-Frame Series C Circuit Breakers

Table of Contents

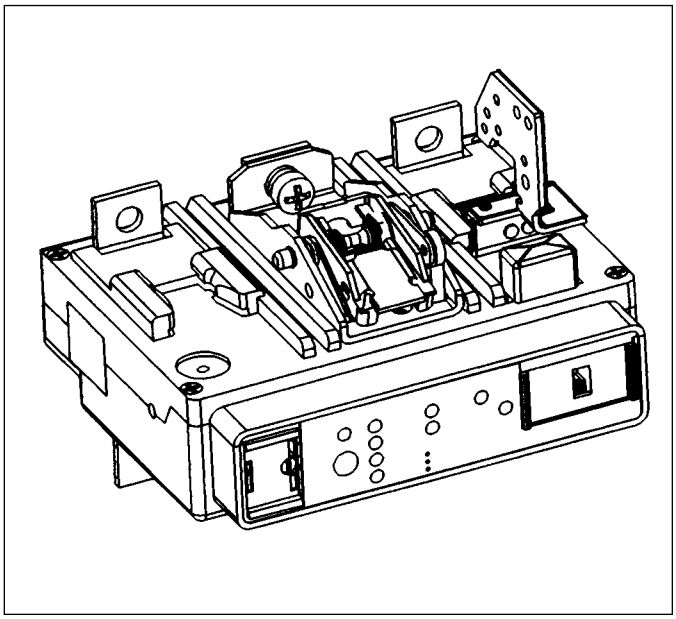

Figure 1-1 Digitrip OPTIM 550 Trip Unit for 3-Pole K-Frame Series C Circuit Breaker

WARNING

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

CUTLER-HAMMER 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 all general and local health and safety laws, codes, and procedures.

The recommendations and information contained herein are based on Cutler-Hammer 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 Cutler-Hammer for further information or instructions.

1.0 GENERAL INFORMATION

The Digitrip OPTIM 550, illustrated in Figure **1-1**, is an electronic trip unit that incorporates a microprocessor-based custom application specific integrated circuit design for use with the Series C K-Frame Molded Case Circuit Breakers.

The Digitrip OPTIM 550 provides true RMS current sensing for proper correlation with thermal characteristics of conductors and equipment. Interchangeable rating plugs are provided to establish the continuous current rating of each circuit breaker.

The Digitrip OPTIM 550 Trip Unit is completely self contained and when the circuit breaker is closed, requires no external power to operate its protection systems. It operates from current signal levels and control power derived through current sensors integrally mounted in the trip unit.

Digitrip OPTIM 550 Trip Units are suitable for 50/60 Hz AC applications only. For DC applications, a thermal-magnetic trip unit should be used.

The Digitrip OPTIM 550 Trip Unit for the K-Frame is available in 3 different types and two different maximum ampere ratings (Table **1.1**).

Table 1.1 Digitrip OPTIM 550 Trip Unit Types

Catalog Number	Max Amps	Version	Description
KEP3125T52	125A	LSI	Non-ground Fault
KEP3250T52	250A	LSI	Non-ground Fault
KEP3400T52①	400A	LSI	Non-ground Fault
KEP3125T56	125A	LSIG	Ground Fault
KEP3250T56	250A	LSIG	Ground Fault
KEP3400T56①	400A	LSIG	Ground Fault
KEP3125T57	125A	LSIA	Ground Fault Alarm
KEP3250T57	250A	LSIA	Ground Fault Alarm
KEP3400T57①	400A	LSIA	Ground Fault Alarm

① Ground Fault Alarm trip units do NOT provide ground fault protection.

2.0 UL LISTED DEVICES

The Digitrip OPTIM 550 Trip Unit is listed in accordance with Underwriters Laboratories, Inc. Standard UL489, under file E7819 and satisfies the applicable requirements of the International Electrotechnical Commission (IEC) recommendations for molded case circuit breakers.

3.0 INSTALLATION

The installation procedure consists of inspecting and installing the trip unit and rating plug. To install the trip unit, perform the following steps.

NOTICE

If required, internal accessory installation should be done before the circuit breaker is mounted and connected. Refer to the individual accessory instruction leaflets.

Make sure that the trip unit is suitable for the intended installation by comparing nameplate data with any existing equipment and system requirements. Inspect the trip unit for completeness, and check for damage before installing it in the circuit breaker frame.

Remove and SAVE the Jumper plug assembly (a 12 position housing) from the trip unit (see Figure **3-2**).

Remove the wire-retaining bracket from the right pole of the trip unit.

NOTICE

Trip unit center retaining screw is captive in the trip unit conductor; the remaining retaining screws (2 for a 3-pole trip unit) are supplied with the frame.

Remove circuit breaker pan-head cover screws, and covers. Remove trip unit outer pole screws from the frame. (See Figure **3-1**).

NOTICE

The two trip unit outer pole retaining screws may be placed in the trip unit conductor holes at this time.

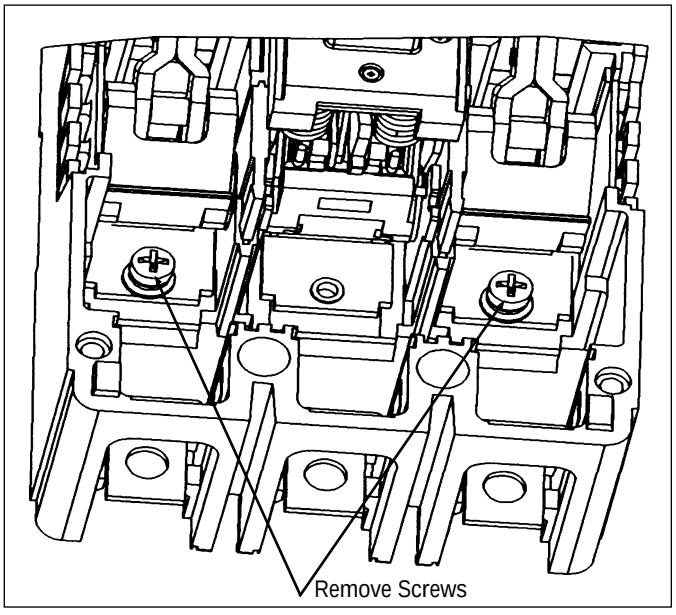

Figure 3-1 Preliminary Preparation

Ground fault trip units are supplied from the factory with a wire harness with pigtail lead connections for a neutral current sensor (white and gray wires). A neutral current sensor is provided with each trip unit.

Install the jumper plug assembly into the trip unit (see Figure **3-2**) with the keying pin in the top left corner. Note: Jumper plug assembly fits in one orientation only.

Digitrip OPTIM 550 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 gray leads on the trip unit 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(Figure **3-3**). It should be connected to the breaker according the diagram in Figure **3-4**. It has the same turns ratio as the phase current sensors in the trip unit.

NOTICE

Do not connect the neutral current sensor secondary output to ground. Connecting the secondary output to ground may cause damage to 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 transformer. To insure correct ground fault equipment performance, conduct field test to comply with National Electric Code requirements under article 230-95-C. See Section 5.2 for instructions.

Install accessory(ies), if required, using appropriate instruction leaflet listed in Section 7.2. Where accessories are not required, install protective barriers supplied with the trip unit in accessory retaining slots of the trip unit.

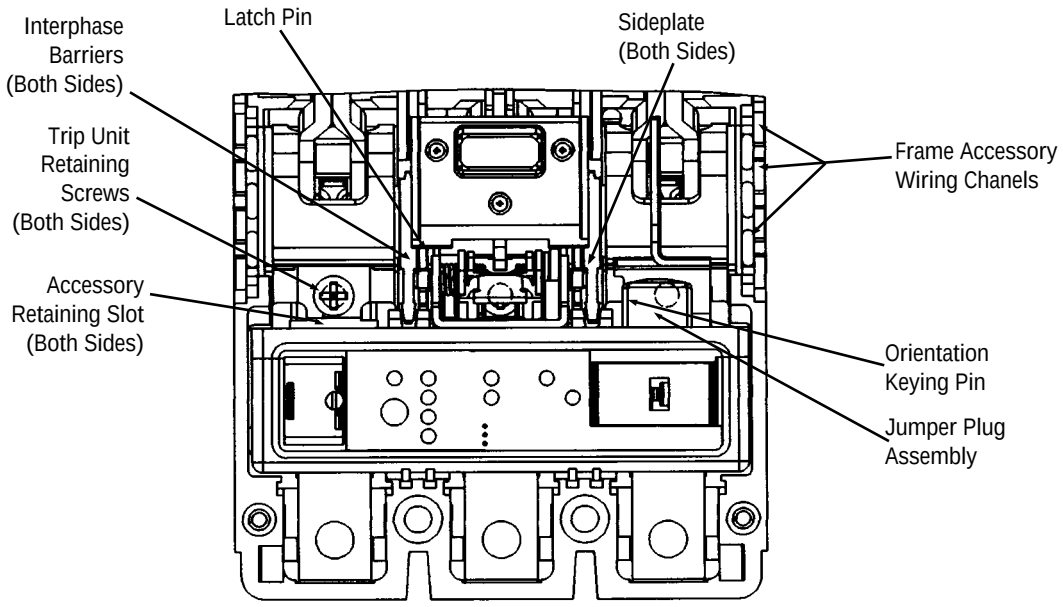

Figure 3-2 Trip Unit Installed in Circuit Breaker

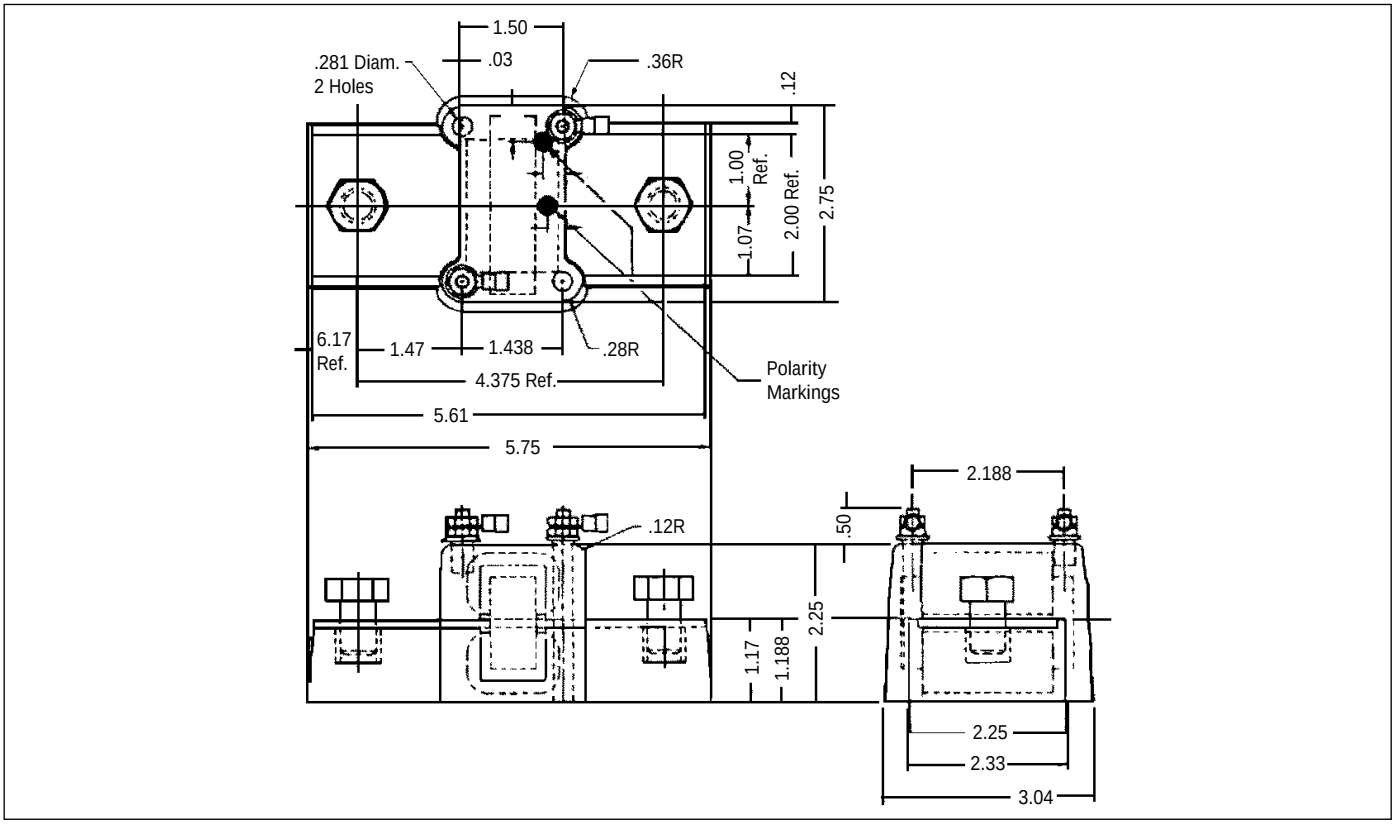

Figure 3-3 Neutral Current Sensor Placement

Table 3.1 Digitrip K-Frame OPTIM Rating Plugs

Max Amps of trip unit	In	Catalog Number
125A	63A	ORPK125A063
125A	070A	ORPK125A070
125A	090A	ORPK125A090
125A	100A	ORPK125A100
125A	110A	ORPK125A110
125A	125A	ORPK125A125
250A	125A	ORPK025A125
250A	150A	ORPK025A150
250A	160A	ORPK025A160
250A	175A	ORPK025A175
250A	200A	ORPK025A200
250A	225A	ORPK025A225
250A	250A	ORPK025A250
400A	200A	ORPK40A200
400A	225A	ORPK40A225
400A	250A	ORPK40A250
400A	300A	ORPK40A300
400A	350A	ORPK40A350
400A	400A	ORPK40A400

Make sure interphase barriers are properly seated in the base and sliding handle barrier is properly seated in the cover.

Install circuit breaker covers and pan-head screws. Install the rating plug into the trip unit (Figure **3-5** and Table **3.1**). The pins on the circuit board must line up with the sockets in the rating plug and require only minimal pressure to install. **Do NOT attempt to force the rating plug into the trip unit.**

NOTICE

The pins on the circuit board are specifically cut, and the sockets in the rating plug are specifically filled to prevent an incorrect rating plug from being installed.

Screw in and tighten the rating plug screw to secure the rating plug.

Reset circuit breaker by moving handle to the reset position. Move handle to the ON position. Circuit breaker handle should remain at the ON position.

Press Push-to-trip button to check the manual tripping of the circuit breaker.

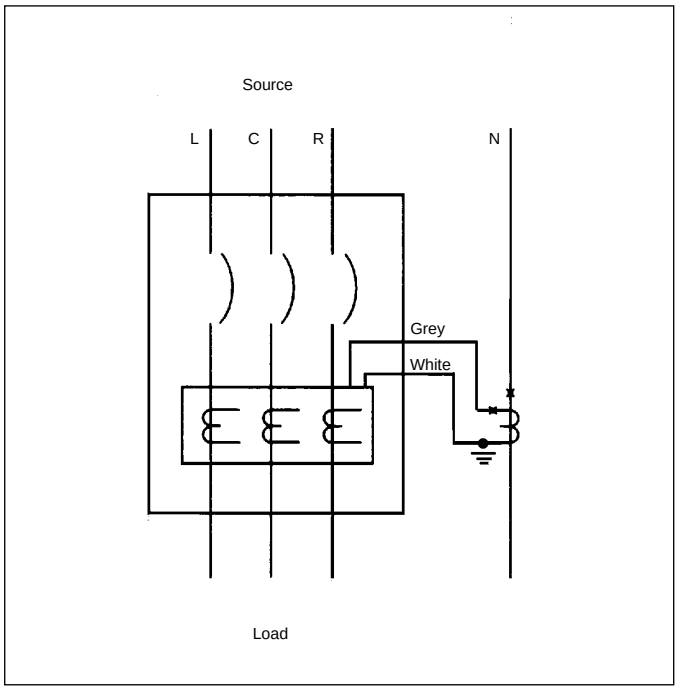

Figure 3-4 Connection Diagram

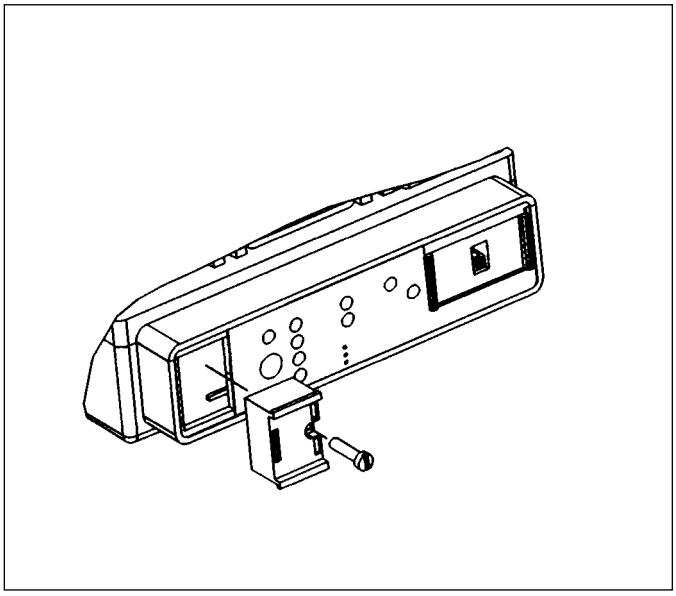

Figure 3-5 Rating Plug Installation

4.0 PRINCIPLE OF OPERATION

In open air at 40°C, a K-Frame circuit breaker with a Digitrip OPTIM 550 Trip Unit installed will carry continuously up to 400 amperes without exceeding a 50°C rise at the terminals. The calibration of the trip unit is insensitive to ambient temperatures over a range of -20° to +55°C. However the trip unit contains thermal temperature protection circuitry that initiates a trip operation for self-protection if the internal ambient temperature at the printed circuit board (PCB) reaches approximately 100°C. This may occur for open air temperatures above 40°C with circuit breaker currents near full load.

For ambient conditions above 40°C and where the maximum ampere rating plug has been installed, derating of the circuit breaker frame should be considered to avoid exceeding a safe terminal temperature operating range. Consult Cutler-Hammer for recommendations.

4.1 GENERAL

The Digitrip OPTIM 550 Trip Unit provides a tripping signal to the flux transfer shunt trip when current and time delay settings are exceeded. This is accomplished by employing the Cutler-Hammer custom designed integrated circuit Sμre™chip, which includes a microcomputer to perform its numeric and logic functions.

In the Digitrip OPTIM 550 Trip Unit, all required sensing and tripping power to operate its protection function is derived from the current sensors in the circuit breaker. The secondary currents from these sensors provide the correct input information for the protection functions, as well as tripping power, whenever the circuit breaker is carrying current. These current signals develop analog voltages across the appropriate calibrating resistors.

The microcomputer, in cyclic fashion, repeatedly scans the voltage values across each calibrating resistor and enters these values into memory. These data are used to calculate true RMS current values, which are then repeatedly compared with the protection function settings and other operating data stored in the memory. The software program then determines whether to initiate protection functions, including tripping the breaker through the flux transfer shunt trip device in the circuit breaker.

4.2 OVERLOAD TRIP

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

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

For details on the operation and protective functions of the OPTIM 550 Trip unit and other related instructions, contact Cutler-Hammer for the following information and user's manuals:

K-Frame and Accessories Selection Data	29C092
Instructions and Overview of OPTIM Trip Units	29C890
Instructions on the Operation of Digitrip OPTIMIZER Hand Held Programmer	29C892
Instructions on the Operation of Digitrip Breaker Interface Module	29C893
Instructions on the Operation of Digitrip OPTIM Trip Units	29C891
Digitrip OPTIM Wire Diagrams	29C894

5.0 TESTING

5.1 FUNCTIONAL FIELD TESTING

Any field testing should be done in accordance with applicable NEMA Standard. The operation of circuit breakers with Digitrip OPTIM RMS trip units can be field tested periodically using the hand held OPTIMIZER (see user's manuals).

5.2 PERFORMANCE TESTING FOR GROUND FAULT TRIP UNITS

5.2.1 CODE REQUIREMENTS

The National Electrical 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.

5.2.2 STANDARDS REQUIREMENTS

As a follow-up to the basic performance requirements stipulated by the N.E.C. as stated above, 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 **5-4** are shipped with each Digitrip OPTIM 550 Trip Unit.

5.2.3 GENERAL TEST INSTRUCTIONS

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

The polarity of the neutral sensor connections (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.

The grounding points of the system shall be verified to determine that ground paths do not exist that would bypass the sensors. The use of 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 POWER SUPPLYING BREAKER BEFORE CONDUCTING TESTS.

NOTICE

Since the Digitrip OPTIM 550 Trip Units derive their operating power from the phase currents, and not from the neutral current, passing current through the neutral sensor only will not properly test the ground fault feature.

Using a low voltage (0-24 volt), high current, AC source, apply a test current of 125% of the Digitrip OPTIM 550 Ground Fault Trip Unit pick-up setting through one phase of the circuit breaker as shown in Figure **5-1**. This should cause the breaker to trip and the ground fault alarm light should light in less than 1 second. Reset the breaker. Repeat the test on the other two phases.

If the system is a 4-wire system with a neutral current sensor, apply the same current as described above through one phase of the breaker returning through the neutral sensor as shown in Figure **5-2**. The breaker should not trip and the ground fault alarm light should not light. Repeat the test on the other two phases.

If the system is a 3-wire system with no neutral current sensor, apply the same current as described above through any two phases of the breaker with the

connections exactly as shown in Figure **5-3.** The breaker should not trip and the ground fault alarm light should not light. Repeat the test using the other two combinations of breaker phases.

CAUTION

FIELD TESTING SHOULD BE USED FOR FUNCTIONAL TESTING AND NOT FIELD CALIBRATION OF THE DIGITRIP OPTIM 550 GROUND FAULT TRIP UNIT.

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

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

6.0 RATING PLUG

The rating plug, as illustrated in Figure **3-5**, is used to establish the continuous ampere rating of the related circuit breaker.

The Long Delay protection function of the trip unit is set at the rating plug value (I_n). The Short Delay and Instantaneous protection functions are set as a multiple of I_n. The Ground Fault protection function is independent of I_n.

Different rating plugs are available to match the desired current rating and type of circuit breaker into which the trip unit is to be installed (Table **3.1**).

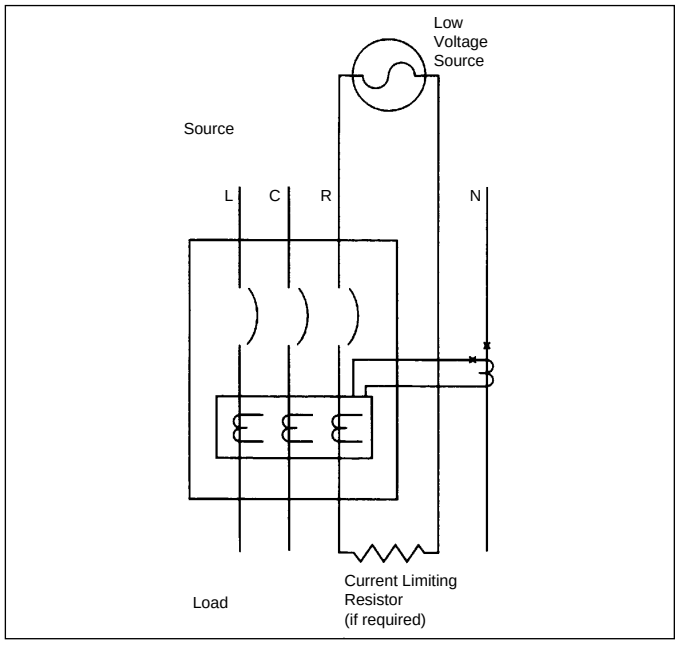

Figure 5-1 Connections for Ground Fault Trip Test

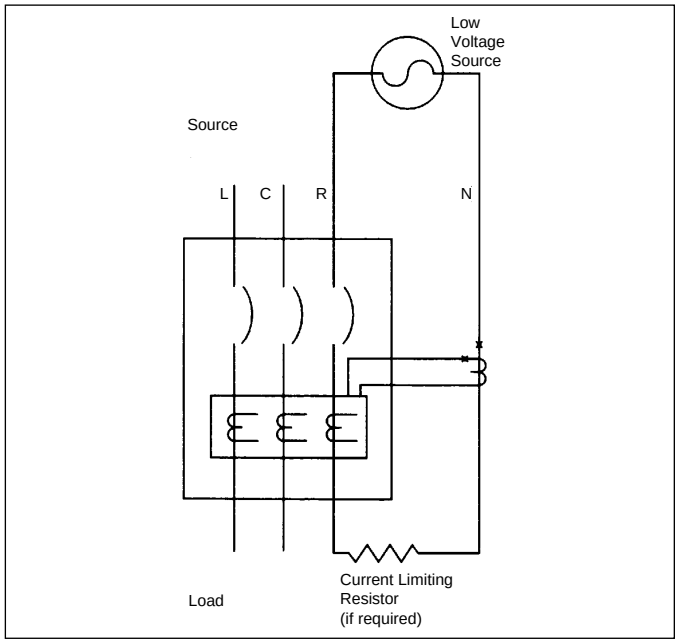

Figure 5-2 Connections for Ground Fault No-Trip Test, with a Four-Wire System

7.0 REFERENCES

7.1 SERIES C K-FRAME MOLDED CASE CIRCUIT BREAKERS

29C104	Frame Instruction Leaflet
AD 29-167K	Typical Time-Current Characteristic curves for K-Frame Breakers

7.2 INTERNAL ACCESSORIES

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

- Alarm (Signal)/Lockout (ASL) Switch . . . .I.L. 29C182
- Auxiliary Switch . . . . . .I.L. 29C122
- Shunt Trip . . . . . .I.L. 29C144
- Low Energy Shunt Trip . . . . . .I.L. 29C145
- Undervoltage Release Mechanism (HandleReset . . . . . .I.L. 29C166

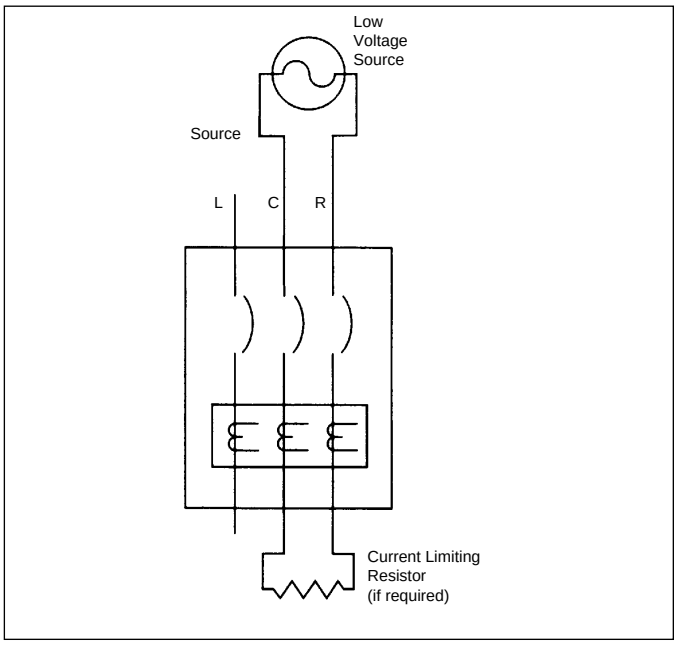

Figure 5-3 Connections for Ground Fault No-Trip Test, with a Three-Wire System

GROUND FAULT TEST RECORD FORM

Ground Fault Test Record should be Retained by Those in Charge of the Building's Electrical Installation in order to be Available to the Authority having Jurisdiction

Test Date	Circuit Breaker Number	Results	Tested By:

Figure 5-4 Typical Performance Test Record Form

Cutler-Hammer
Pittsburgh, Pennsylvania U.S.A.

Effective 5/00 (ISI)
Style 6602C55H01
Printed in U.S.A.