

INSTRUCTIONS

Machine Differential Relay

ITE-87M	Catalog Series 219M	Three Phase	Standard Case
ITE-87M	Catalog Series 419M	Single Phase	Test Case



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INTRODUCTION

These instructions contain the information required to properly install, operate, and test the ITE-87M Machine Differential Relay. The relay provides fast, sensitive differential protection for generators and motors.

The relay is housed in a case suitable for conventional semiflush panel mounting. All connections to the relay are made at the rear of the case and are clearly numbered. The 419M series relay provides totally drawout construction with integral test facilities. Current transformer shorting is accomplished by a direct-acting spring and blade assembly upon removal of the relay from its case. Sequenced disconnects prevent nuisance tripping during withdrawal or insertion of the relay. The 219M series relay is of partial drawout construction, with the input transformers remaining in the case upon withdrawal of the lower circuit board. The 219M series relay is supplied as a three phase unit, which is advantageous where panel space is limited.

The pickup current sensitivity setting dial is located on the front panel behind a removable clear plastic cover. A target indicator is also mounted on the front panel. The target is reset by means of a pushbutton extending through the relay cover.

PRECAUTIONS

The following precautions should be taken when applying the relay:

1. Incorrect wiring may result in damage. Be sure wiring agrees with the connection diagram before energizing. Note that the connections for the 419M series and 219M series are different.
2. Apply only the rated control voltage marked on the front panel. For relays with dual-rated control voltage, withdraw the relay from its case and check that the small movable link at the left rear of the lower circuit board is in the correct position for the system control voltage. EXCEPTION: units rated 24/32 Vdc do not include a link and can be operated at both voltages. Control voltage must be applied in the correct polarity.
3. High voltage insulation tests are not recommended. See section on testing for additional information.

4. Only the lower circuit board of catalog series 219M relays is removable. Removing this board does not open circuit CT circuits. The board should insert smoothly. Do not use force.
5. When applying test currents to the relay, be sure to interrupt the current immediately upon relay operation to prevent thermal damage.
6. The following apply to the thyristor (scr) output circuit:
- Be sure the trip circuit is interrupted by an "a" contact to remove high current from the output circuit. A thyristor output has an inherently high momentary current rating and a low continuous current rating. Do not exceed the rating.
 - Thyristors require a minimum current to remain conducting after triggering. Load (trip coil) must draw at least 0.1 amp to insure operation. Place resistance in parallel with a low current coil if necessary to guarantee the current, or use the output contact (terminals 14 & 15) instead.
7. Follow test instructions to verify that the relay is in proper working order. If a relay is found to be inoperative, we suggest it be returned to the factory for repair. **CAUTION:** since troubleshooting entails working with energized equipment, care should be taken to avoid personal shock. Only competent technicians familiar with good safety practices should service these devices.

PLACING THE RELAY INTO SERVICE

1. RECEIVING, HANDLING, STORAGE

Upon receipt of the relay (when not included as part of a switchboard) examine for shipping damage. If damage or loss is evident file a claim at once and promptly notify the nearest BBC Brown Boveri office. Use normal care in handling to avoid mechanical damage. Keep clean and dry.

2. INSTALLATION

Mounting:

The outline dimensions and panel drilling and cutout information is given in Figure 1. The external reactor assembly, catalog no. 200C0002 is recommended for use in most applications of the 219M series units. It is packaged in a surface mounted case, Figure 2.

Connections:

Internal connections are shown in Figures 3a, 3b, and 3c. Note the differences between catalog series 219M units and series 419M units. Typical connection diagrams are shown in Figs. 4a, 4b, 4c.

The ITE-87M relay has a metal front panel which is connected through printed circuit board wiring to a terminal at the rear of the case. In all applications this terminal, marked "G", should be wired to ground.

Special care should be taken to connect control power in the proper polarity. For relays with dual-rated control voltage, the drawout unit must be inspected to see that the control voltage link at the left rear is in the correct position for the system control voltage. EXCEPTION: units rated 24/32 Vdc do not include a link, and can be operated at both voltages with no change. It may be necessary to separate the lower printed circuit board from the upper on 419M series units to make this inspection.

3. SETTINGS

The front panel PICKUP AMPERES control sets the relay's minimum operating current. It is adjustable from 0.1 to 0.5 ampere. See Figure 5 for the operating characteristic curve.

APPLICATION DATA

The ITE-87M provides fast, sensitive differential protection for AC motors and generators. It is employed in the conventional scheme using (6) CT's. For "core balance" schemes using (3) current sensors, refer to the type GRD relay, IB 7.1.1.7-4.

While their basic function is the same, important differences exist between catalog series 419M and series 219M units. These must be understood to properly apply the relay: 419M relays are single phase, so (3) units are required to protect a three phase machine. The 219M relays are three phase so only (1) unit is required, an advantage where panel space is limited. An external three phase reactor package is generally used with 219M units. The 419M relay has the reactor device built-in. The 419M units are totally drawout and provide built-in test facilities.

The relay has a non-linear percentage differential characteristic which allows operation for faults as low as 0.1 ampere, but provides security against misoperation on faults external to the zone of protection. This characteristic reduces the requirements on CT accuracy and transient response, since it requires more operating current as the restraint current magnitude becomes larger. This effect comes into play for restraint currents above 8 amperes. See Figure 5. In addition, an inductive reactance has been placed in series with the operate coil in 419M series units. (Supplied as an external device with 219M units.) The reactor presents a high impedance (over 1000 ohms) to the flow of operate current. The reactor is sometimes called a "stabilizing" impedance. It aids in the proper rejection of the differential

protection scheme to high inrush load conditions, or the dc offset seen on motor starting. In other words, imbalances in CT secondary currents due to marginal CT performance will not cause significant operate current to flow. On the other hand, for faults in the zone of protection, the CT secondary voltage will rise to the reactor's saturation voltage and drive current through the operate coil. The reactor's saturation voltage is approximately 20 volts, therefore the CT secondary must be capable of at least this voltage. (C20 or higher, C50 preferred) CT secondary resistance and lead drop, if significant, must also be considered to add to the CT secondary voltage requirement.

Since the frequency response characteristic is fairly flat, the ITE-87M may be used on 25 Hz. systems as well as at 50 or 60 Hz.

SPECIFICATIONS:

Restraint Circuit Ratings:

Continuous	12 amperes
One Second	300 amperes
Burden	0.25 VA at 5 A

Operating Circuit Ratings:

Continuous	5 amperes
One Second	200 amperes
Burden	1.0 VA at 5 A

Control Power:

models available for:
 48/125 Vdc at 0.035 A drain
 48/110 Vdc at 0.035 A drain
 24/ 32 Vdc at 0.050 A drain
 250 Vdc at 0.035 A drain

allowable variation:
38 - 57 Vdc for 48v
100 - 140 Vdc for 125v
88 - 125 Vdc for 110v
200 - 280 Vdc for 250v
19 - 38 Vdc for 24/32v

Thyristor Output Rating:

30 amperes for 0.1 second
5 amperes for 1.0 second
1 ampere continuous

Contact Output Rating:

at 125 Vdc
30 amperes for 0.1 second
5 amperes continuous
1 ampere opening resistive
0.3 ampere opening inductive

Temperature Range:

-30 deg C to +70 deg C

Dielectric:

1500 Vac rms, 1 minute, all circuits to ground.

Tolerances:

operating characteristic,
 +/- 25% (see Figure 5)

operating time (maximum
 delay shown in Figure 6)

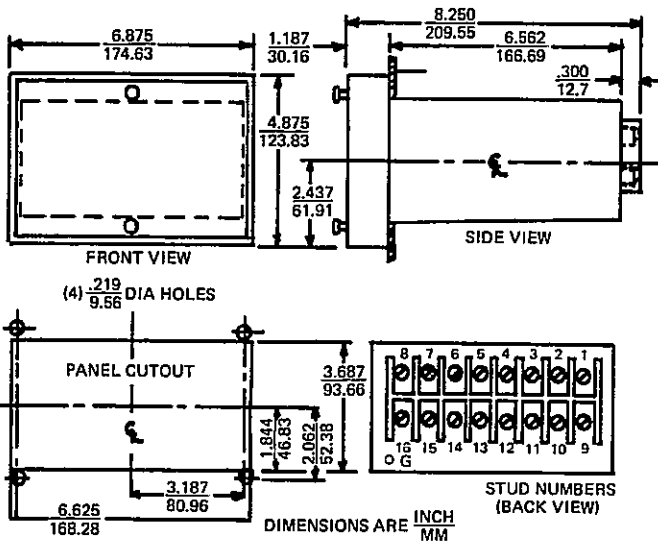


Figure 1: Relay Outline

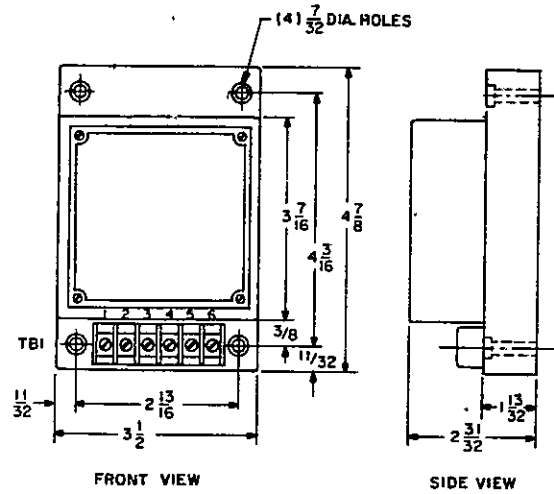


Figure 2: Reactor Outline

INTERNAL CONNECTIONS

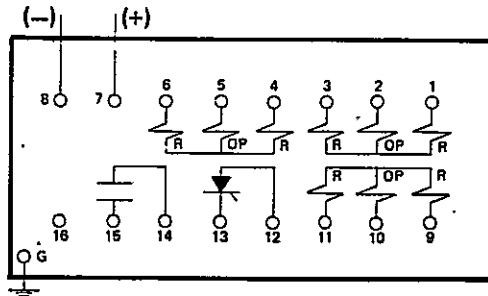


Fig. 3a: ITR-87M 219M Series
(see note 1)

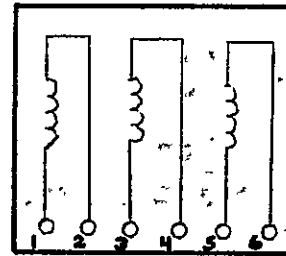


Fig. 3b. Reactor Pkg

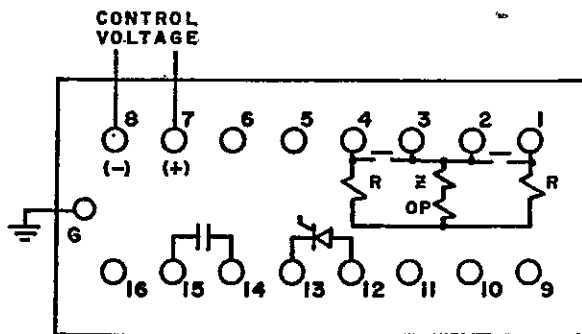


Fig. 3c: ITR-87M 419M Series
(see note 1)

R = RESTRAINT WDG.
OP = OPERATING WDG.
Z = REACTOR WDG

* Note 1: contact 14-15 not provided on units rated 250 Vdc.

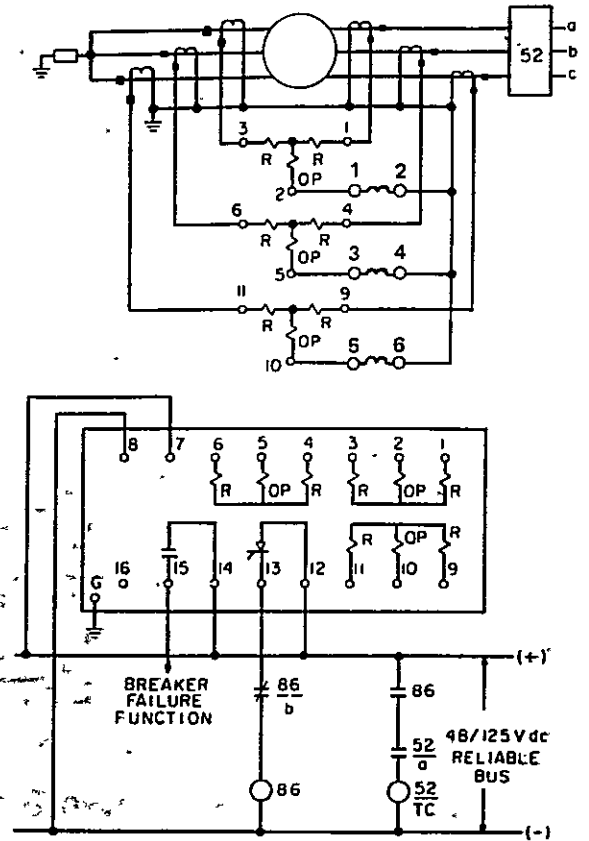
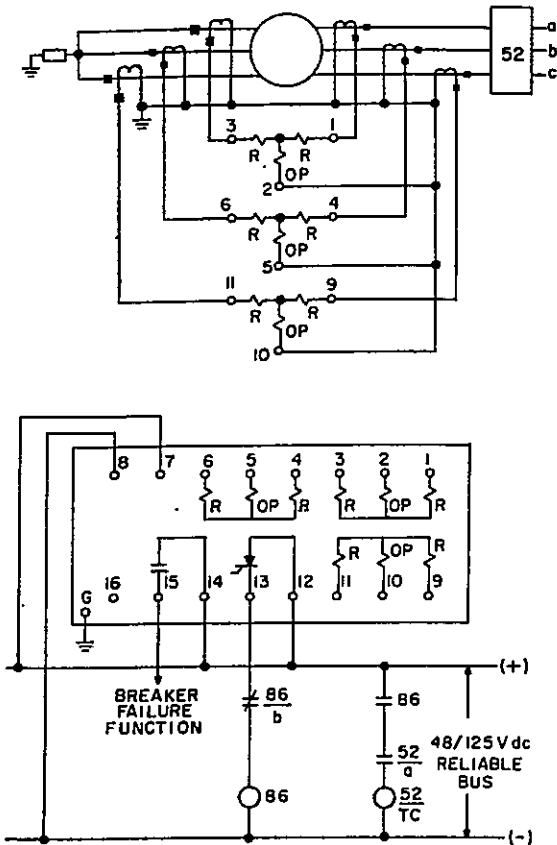


Fig 4a: Typical Connections
219M without Reactor Pkg.

Fig 4b: 219M with Reactor

CHARACTERISTICS OF COMMON UNITS

TYPE	PHASES	CONTROL PWR	CATALOG NUMBER
Standard Case	3	48/125 Vdc	219M2573
		48/110 Vdc	219M2503
		24/ 32 Vdc	219M2593
		250 Vdc	219M2551
Test Case	1	48/125 Vdc	419M6573
		48/110 Vdc	419M6503
		24/ 32 Vdc	419M6593
		250 Vdc	419M6551

Note: units rated 250 Vdc do not include the contact between terminals 14 and 15.

MACHINE DIFFERENTIAL RELAY

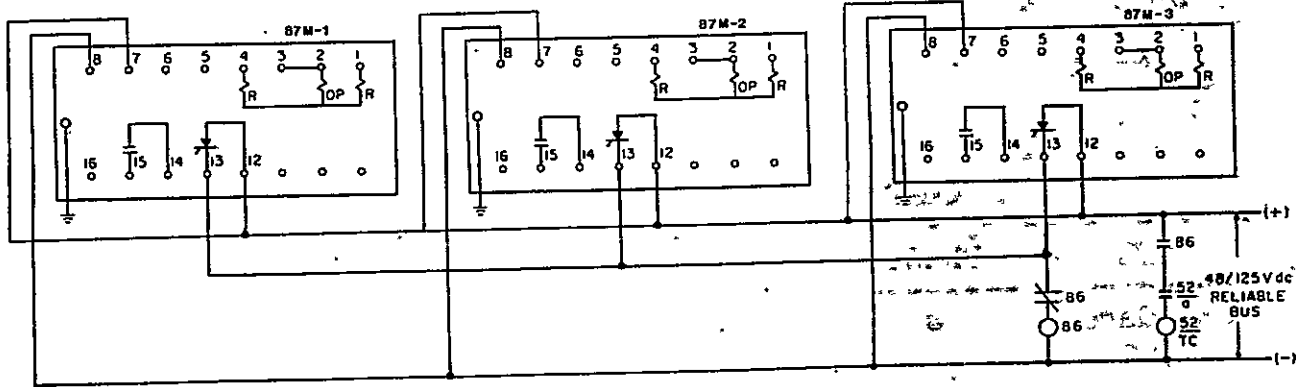
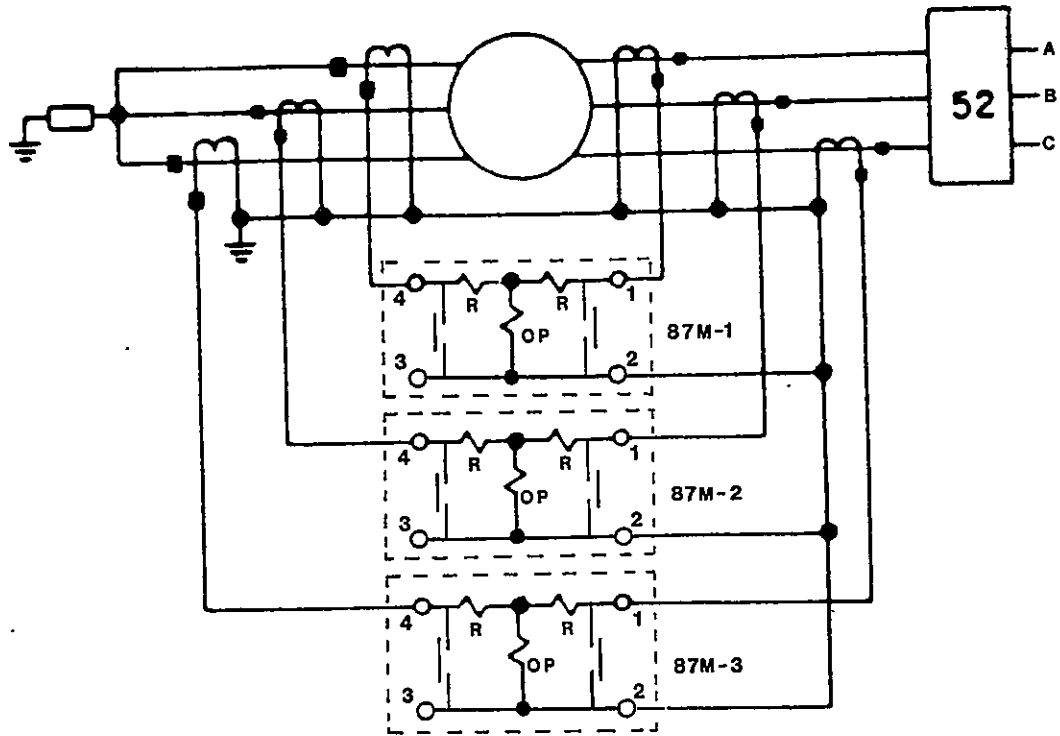
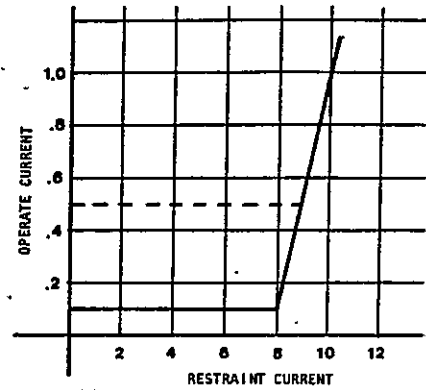
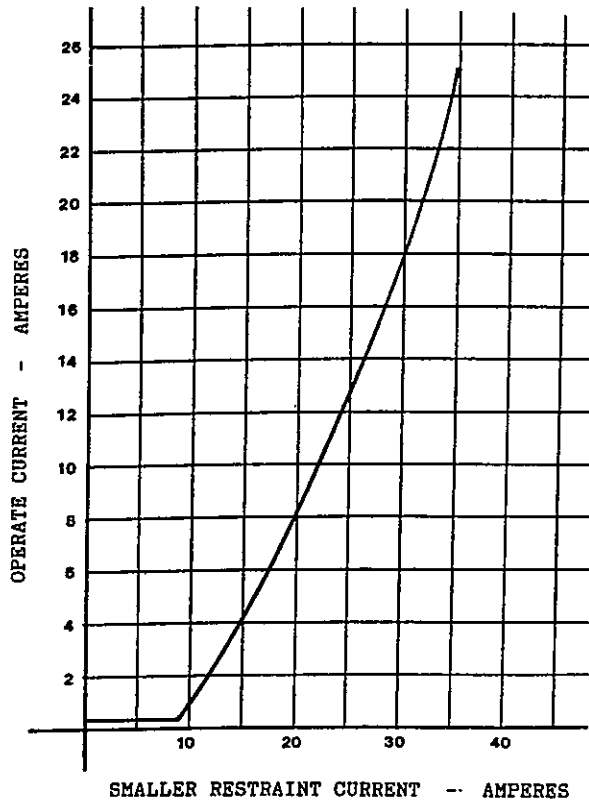


Figure 4c: Typical Connections - 419M Series Units



Expanded Near Origin

Figure 5: Operating Characteristic

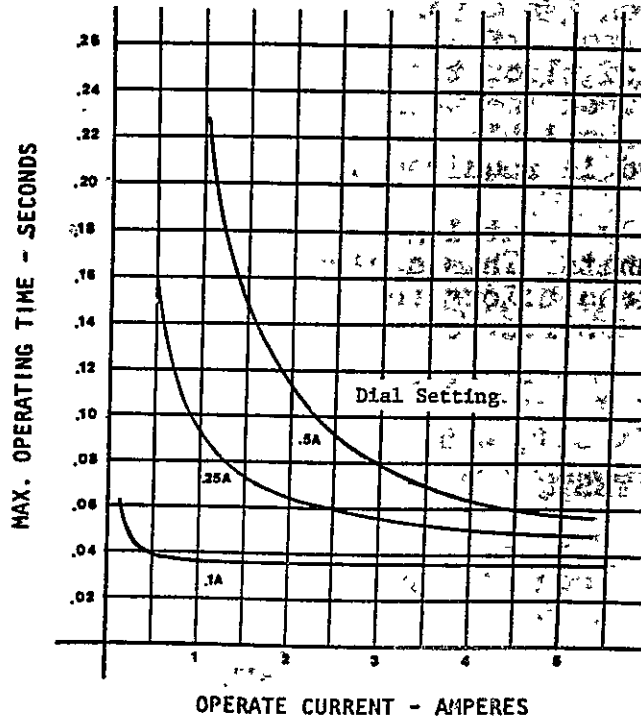


Figure 6: Operating Time Characteristic

TESTING

1. MAINTENANCE AND RENEWAL PARTS

No routine maintenance is required on the ITE-87M relay. Follow test instructions to verify that the relay is in proper working order. We recommend that an inoperative relay be returned to the factory for repair; however, a schematic diagram will be supplied on request for those who wish to attempt repairs. Renewal parts will be quoted on request by the factory.

219M Series

Drawout circuit boards of the same catalog number are interchangeable. The board is removed by using the metal pull knobs on the front panel. The relay is identified by the catalog number on the front panel and a serial number stamped on the underside of the circuit board. Removing the circuit board does not open circuit the current transformers connected to the relay.

419M Series

Metal handles provide leverage to withdraw the relay assembly from the case. Removing or installing a drawout unit with the relay in service will not cause an undesired operation. The assembly is identified by a catalog number on the front of the unit and a serial number stamped on the bottom of the board.

Should separation of the upper and lower circuit boards be needed, remove (2) screws that attach the left and right handle assemblies to the upper printed circuit board. The lower board may then be withdrawn forward from the printed circuit connector. An 18 point extender board is available from the factory, if access to the lower circuit board is required during testing or troubleshooting.

A test plug assembly, catalog no. 400X0001 is available for use with 419M series units. This device plugs into the relay case on the switchboard and allows access to all external circuits wired to the case. See Instruction Book IB 7.7.1.7-8 for details on the use of this device.

2. HIGH POTENTIAL TESTS

High potential tests are not recommended. If a control wiring insulation test is required, partially withdraw the circuit board from its case sufficient to break the connections, before applying the test voltage.

3. ACCEPTANCE TESTS

Connect the relay in the test circuit as shown in Fig. 7. Apply the correct dc control voltage. Do not connect the reactor assembly when making these tests. On 419M series units, a post is provided on the upper printed circuit board for a jumper to be temporarily installed to bypass the reactor (L1). The reason for this is that many test sources do not have the voltage capability to drive current through the reactor, or if they do, the waveform distortion that may result affects the calibration. Continuity of the reactor can be checked with an ohmmeter. The dc resistance should be less than 2 ohms. Check each of the 3 elements if the external reactor package is used.

CAUTION: do not allow high currents to persist longer than necessary.

- a. Depress the TARGET RESET button. The target should show black. Actuate the TRIP TEST button. The relay should operate and display an orange target.
- b. Set the relay's PICKUP dial to 0.1 ampere. Set variable transformer #1 for zero restraint current in branch 1. Increase the operate current in branch 2 until the relay operates. The operate current should be 0.08 to 0.12 A.
- c. Set the restraint current on the #1 variable transformer to 10.0 amperes. Adjust the current on the #2 transformer until the relay operates. (Check restraint current and readjust as necessary if there is interaction.) The operate current should be between 0.8 and 1.2 amperes.
- d. For 219M series units, repeat (b) and (c) for the other two phases.

4. BUILT-IN TEST FEATURE

Tests should be made with the main circuit de-energized.

A built-in trip test feature is provided as a convenient means of testing the operation of the relay and the associated trip circuit. When the test button is pressed, the pickup circuit of the relay is activated, causing the relay to operate, tripping the breaker or associated auxiliary.

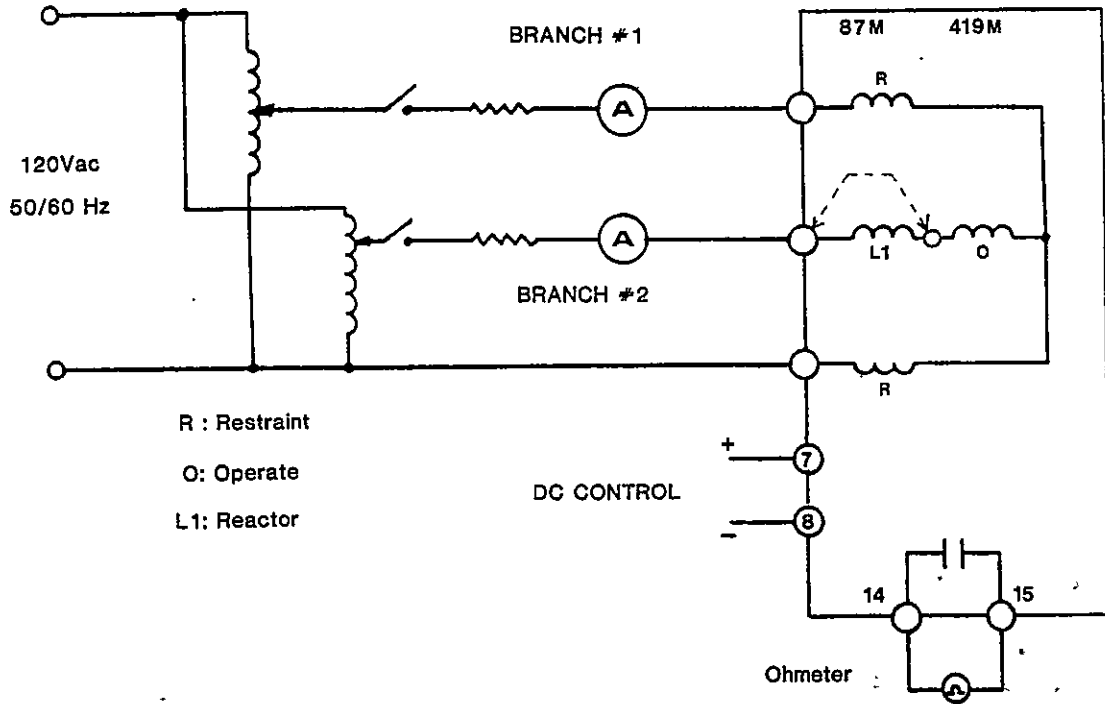


Figure 7: Typical Acceptance Test Circuit

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