Instructions for Type GFR Ground Fault Protection Systems

I.L. 15321-B
File 29-700

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Effective August, 1982 Supersedes I.L. 15321-A dated November, 1981

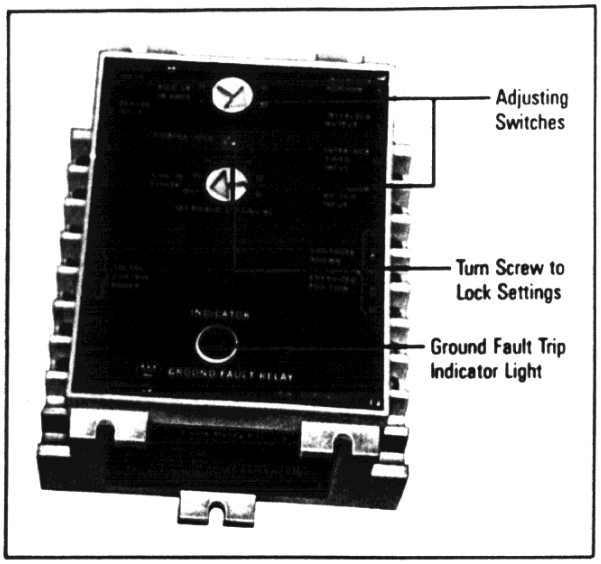

Fig. 1A *Ground Fault Relay-Electrical Reset With Zone Interlocking (Cat. No. GFR60E1)*

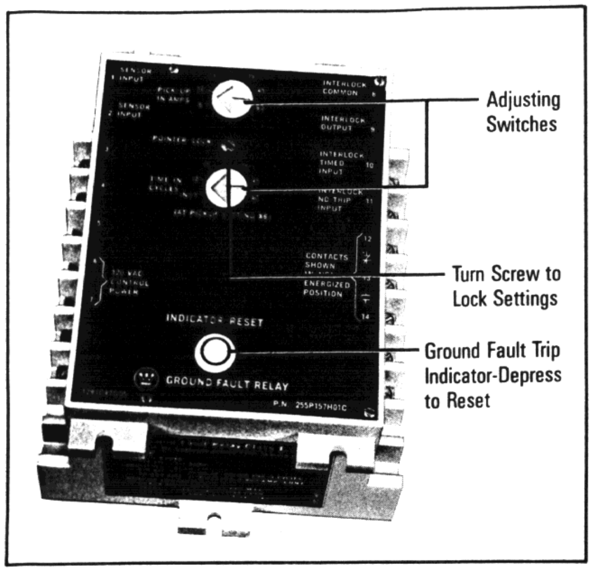

Fig. 1B *Ground Fault Relay-Mechanical Reset With Zone Interlocking (Cat. No. GFR60M1)*

1.0 UL LISTED GROUND FAULT SENSING AND RELAYING EQUIPMENT

Type GFR ground fault relays, current sensors, test panels and accessory devices are UL listed by Underwriters' Laboratories, Inc. in accordance with their standard for *Ground Fault Sensing and Relaying Equipment,* UL 1053, under File E48381.

2.0 GENERAL PURPOSE

A type GFR ground fault protection system, when properly installed on a grounded electrical system, will sense phase to ground fault currents. When the level of fault current is in excess of the pre-selected current pick-up and time delay settings, the GFR relay will initiate a trip action of a disconnect device, which will open the faulted circuit and clear the fault.

The GFR devices are UL Class I devices designed to protect electrical equipment against extensive damage from arcing ground faults.

CAUTION: GROUND FAULT PROTECTION SYSTEMS DESIGNED TO PROTECT EQUIPMENT CANNOT SIMULTANEOUSLY PROVIDE PROTECTION FOR PERSONNEL AGAINST ELECTRIC SHOCK HAZARDS, SINCE THIS TYPE PROTECTION REQUIRES A SENSITIVITY IN THE LOW MILLI-AMPERE RANGE.

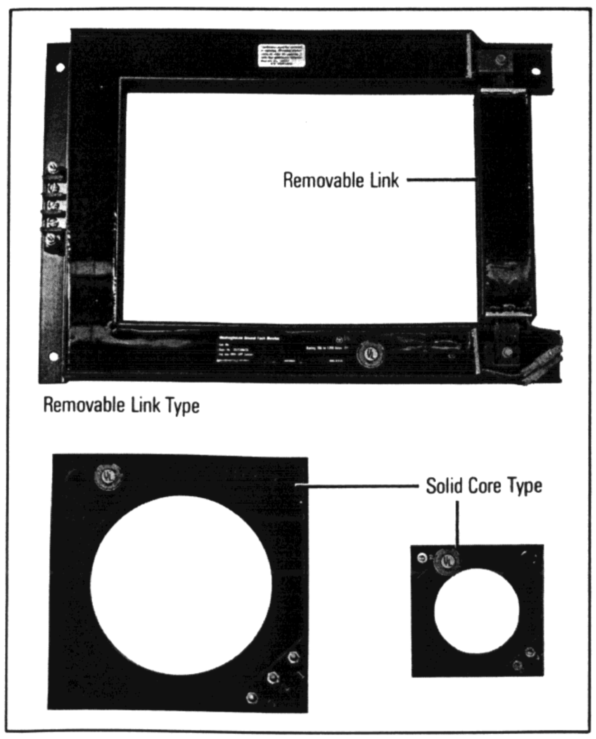

Fig. 2 *Typical Ground Fault Sensors*

3.0 DESCRIPTION

A basic type GFR ground fault protection system consists of a ground fault relay (GFR) as shown in Fig. 1, a ground fault current sensor (GFS) as illustrated in Fig. 2 and a disconnect device equipped with a shunt trip device. This disconnect device can be a molded case circuit breaker, a power circuit breaker, a bolted pressure switch or other fusible disconnect device, suitable for application with UL Class I Ground Fault Sensing and Relaying equipment. A typical molded case circuit breaker with a shunt trip device installed is illustrated in Fig. 3.

Additional optional equipment can be added to the protection system to meet the requirements of the specifying engineer, including:

1. Ground Fault Test Panel – Fig. 4
2. Ground Fault Warning Indicator Relay – Fig. 5
3. Ground Fault Indicating Ammeter (1) – Fig. 6

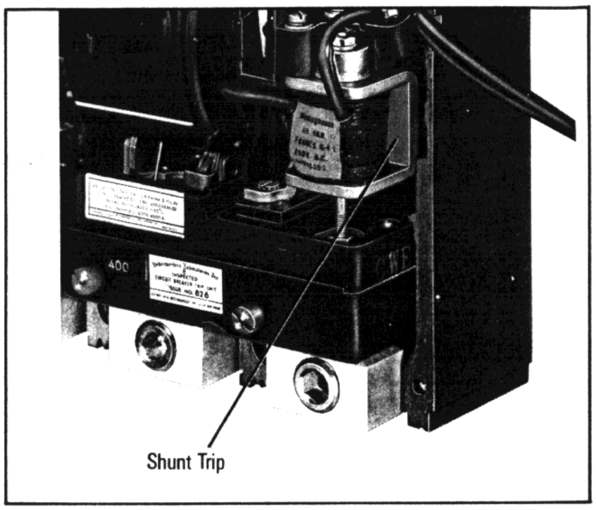

Fig. 3 *Typical Shunt Trip Installation*

Fig. 4 *Ground Fault Test Panel* ©

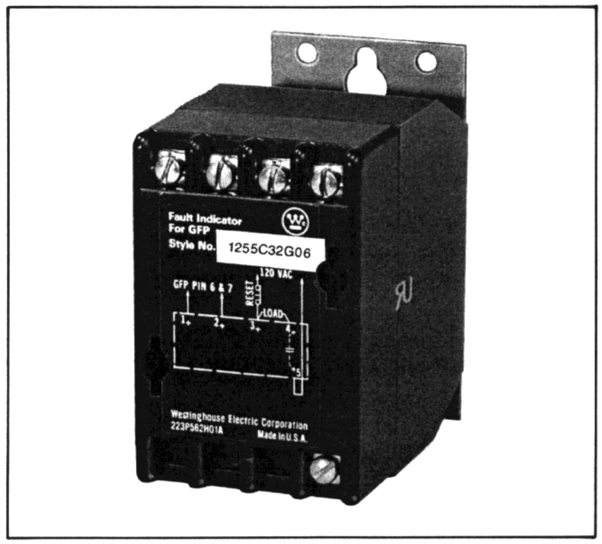

Fig. 5 *Ground Fault Warning Indicator Relay* (1)

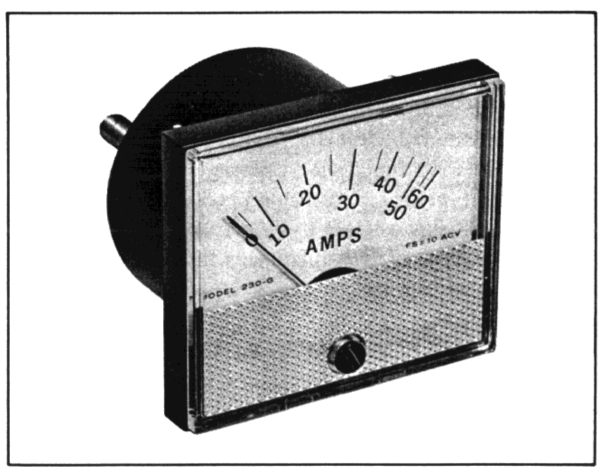

Fig. 6 *Ground Fault Indicating Ammeter*

(1) Recognized under the Component Program of Underwriters' Laboratories, Inc.

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4.0 APPLICATION CONSIDERATIONS

4.1 General

Type GFR ground fault protective devices are designed to be used primarily on solidly grounded electrical distribution systems rated up to a maximum of 600 volts, 50/60 Hz, to provide for rapid clearing of arcing ground faults.

When properly applied, these devices will satisfy the requirements for ground fault protection of service entrance equipment as outlined in Sections 230-95 and 517-14 of the National Electrical code. When these devices are added to downstream feeder and branch circuits as well as the main service disconnecting devices as suggested in the fine print note of 230-95 and to the downstream feeders as required in 517-14, additional protection will be provided and selective coordination of tripping operations on arcing ground faults can be achieved.

With selectively coordinated ground fault protection equipment applied on main service disconnects and downstream devices, a greater degree of continuity of service is insured.

4.2 Methods of Achieving System Selectivity

There are two basic methods of achieving selective coordination between different levels of ground fault protective devices in a distribution system.

4.2.1 TIME-CURRENT BAND SETTINGS

The first method employs adjustable time delay and current pick-up settings to achieve selectivity between upstream and downstream devices. When properly coordinated, downstream detection devices will use a time-current band setting that will initiate a downstream tripping operation and clear the faulted circuit before any upstream interrupting device tripping action can be initiated. This type of coordination necessarily requires the longest time delay settings to be placed on the upstream devices. This type of coordination is fine if the faults are always downstream.

4.2.2 ZONE SELECTIVE INTERLOCKING

In a system employing zone selective interlocking type devices, selective coordination is still achieved for downstream faults by the use of time-current band settings. With appropriate settings, downstream interrupting devices will clear the faulted circuit before any upstream device can operate. However, with zone selective interlocking, additional intelligence is automatically programmed into the time-current coordination scheme to allow for variations in the pre-established tripping sequence to allow for alternate locations of the arcing ground fault. A zone selective interlock coordinated system provides for fast tripping of the nearest interrupting device upstream of the arcing ground fault regardless of the pre-set time delay settings. With this type of protection, the resulting systems damage level is the lowest possible because the interrupting devices are allowed to clear the fault as quickly as they can respond.

4.2.2.1 Zone Selective Interlock Wiring

Zone interlock wiring is only applicable to type GFR relays equipped with zone selective interlocking as shown in Table 1. These relays are equipped with four additional terminals which have the following function:

Terminal 8 – Common (Not used on 125V D-C GFR's)
9 – Output signal
10 – Input signal, time restraint
11 – Input signal, no trip

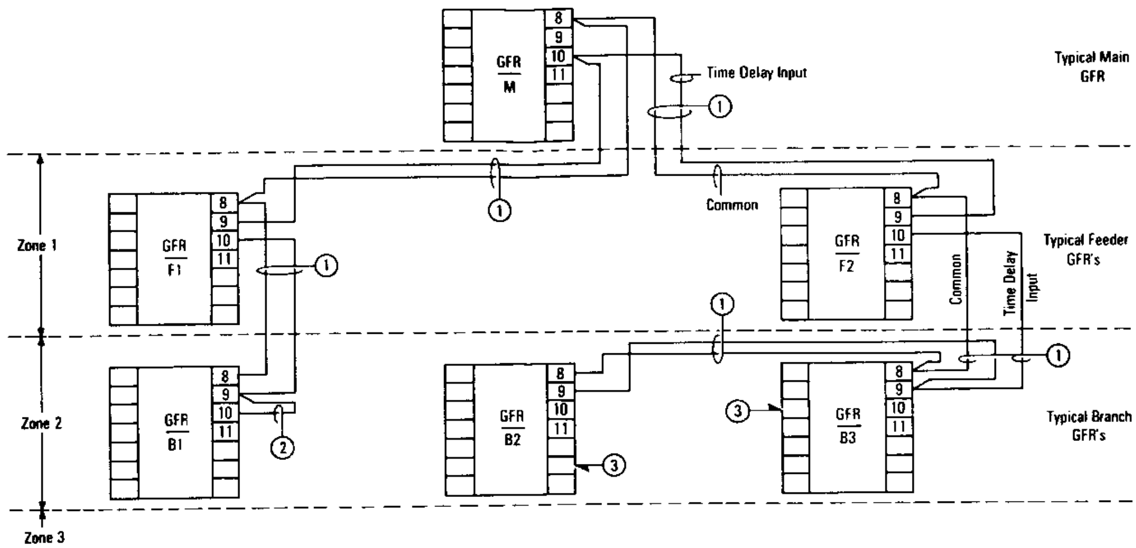
To make the relays function in a zone interlocking mode, all relays must be of the interlocking type and additional wiring connections are required. Typical connections for a main with multiple feeders and multiple branch circuits is illustrated in Fig. 7.

As shown by Note 1 in Fig. 7, twisted pair wiring must be used for interlock wiring to reduce the influence of stray magnetic fields in switchboards with high ampacity bus systems. Interlock wiring must be routed away from bus bars and separate from concentrated control wire groupings.

As shown by Note 3 in Fig. 7, any number – up to 50 – type GFR relays may be wired in parallel to transmit a single signal to upstream device. No supplementary relaying is required for this function.

4.2.2.2 Zone Interlocking Operation Mode

Regardless of the time delay setting, any interlocking type GFR relay will respond near instantaneously unless a restraint signal – which is indicative of a ground fault further downstream in the next protective zone – acts to change the mode of operation to the pre-set time delay. On downstream circuits, it is frequently desired that a short time delay be observed before a tripping action is initiated. This can be accomplished by adding a jumper between terminals 9 and 10 on the downstream relay as indicated by Note 2 on Fig. 7. This jumper should not be used on any upstream relay as it will defeat the zone interlocking function.



Notes:

1. Wiring Should be Twisted Pair, Number 14 or 16 AWG With Maximum Distance Between First and Last Zones of 250 Feet. Route Separate from Power Conductors. Do Not Ground. On 125VDC GFR's the Wire to Terminal 8 is Not Used. Only One 125VDC Source is Allowed.
2. Jumper may be Added Between Terminals 9 and 10 on Downstream Relays to Add Time Delay per Dial Setting. Otherwise, Relay will Initiate Trip Without Time Delay.
3. Any Quantity-Up to 50-Relays may be Wired in Parallel to Provide a Single Upstream Restraint Signal
4. All Relays in a Zone Interlock System Must be of Interlocking Type.

Fig. 7 *Connection Diagram for Typical Zone Selective Interlocking System* ©

4.3 Relay Settings

4.3.1 GENERAL

The exact individual relay time/current settings will vary between system installations depending upon the type of protection and level of selectivity desired. The Specifying Engineer can best make these decisions for any specific installation. For general applications, settings as described in the following conditions may be considered.

4.3.1.1 Single Zone Level of Protection

Minimum Pick-up – 20% of disconnect rating. Increase to maximum pick-up setting (1200 Amp) where maximum service continuity is desired.

Minimum Time Delay© – 10 cycles suggested. Any faster time will invite nuisance trips. Increase time when more than minimum damage level can be tolerated.

4.3.1.2 Multiple Zones of Protection Without Zone Interlocking

Minimum Pick-Up – The pick-up setting of the downstream device should still be no less than 20% of the disconnect rating. Successive upstream settings should be at least one step greater than the nearest downstream device pick-up setting.

Minimum Time Delay© – The shortest time possible should be used on the branch circuit downstream. Increase the time delay on upstream devices in increments of one step or more for molded case breakers, and two steps or more for other slower operating type devices.

4.3.1.3 Multiple Zones of Protection With Zone Selective Interlocking

Establish time/current coordination as in 4.3.1.2 for multiple zones without zone interlocking. This is done on the basis that most faults occur downstream and that the most downstream device should be set to clear the fault first leaving upstream devices for back-up fault protection.

Add zone interlocking to provide fast tripping of upstream devices regardless of pre-set time delay for faults in the upstream zones.

Where desired, nearly instantaneous operation of downstream devices can be defeated were time delayed operations are adequate. See 4.2.2.2.

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Table 2							
Pick-up Amperes	Dial Marking*						
1-12	1	2	3	5	7	9	12
5-60	5	10	15	25	35	45	60
100-1200	100	200	300	500	700	900	1200
Time Delay Cycles	I©	10	15	25	35	45	60

*All Adjustments are in discrete steps.

5.4 Time/Current Curves

The time/current performance curve of a Type GFR relay has a flat response, ie., the operating time of any given fault current above its pick-up setting is essentially constant. There is some small variation in the lower ranges as indicated in Fig. 8, but very little. The pick-up and time delay tolerances, are ± 10%.

5.5 Relay Selection, General

The specific type and pick-up range of relay selected is a factor of its intended application, which the specifying engineer can best determine. In general, the ratings may be selected on the following general basis:

5.5.1 PICK-UP RANGE

1-12 Amp – Specific circuit application where low level sensitivity is required.

5-60 Amp – Individual branch and/or motor circuits where multi-level protection is provided.

100-1200 Amp – General purpose and service applications.

5.5.2 TYPE OF SELECTIVITY

Relays without zone interlocking are best suited for single level applications where it is desired to only satisfy the minimum requirements of the National Electrical Code. Zone selective interlocking type relays should be selected for multi-level system applications where only the minimum amount of system damage can be tolerated following an arcing ground fault.

5.5.3 TYPE OF OPERATION

Electrically held relays will satisfy most applications where reliable control power is available following a fault interruption. Where control power is derived from the load side of the disconnect device and a visual trip indication is desired, the mechanically held relay should be selected. Also, in applications where the control power is less than reliable and where an automatic reset could affect interlocking circuitry, the mechanically held relay should be selected.

5.6 Relay Electrical Ratings

5.6.1 CONTROL POWER REQUIRED

120 Volts, 50/60 Hz., 0.125 Amps, or
125 Volts dc, 0.125 Amps

5.6.2 TEST WINDING POWER REQUIRED©

120 Volts, 50/60 Hz., 2.5 Amps

5.6.3 OUTPUT CONTACTS

UL Heavy Duty Pilot Rating

240 Volts, 50/60 Hz., 3.0 Amps Continuous, 30 Amps Inrush
120 Volts, 50/60 Hz., 6.0 Amps Continuous, 60 Amps Inrush
28 Volts, dc, 3.0 Amps, Inductive Load
125 Volts, dc, 0.5 Amps, Inductive Load

5.6.4 ZONE INTERLOCK – CONTACTS 8-9

Output Voltage, 6 Volts dc
Rated Amps, .01 Amps, dc

5.6.5 MAXIMUM DIELECTRIC

Terminals to mounting screw 3000 Volts

5.7 Mounting Arrangements©

The type GFR Relay is supplied as standard in a surface and semi-flush mounted enclosure with outline dimensions as illustrated in Fig. 9. For installations requiring a semi-flush cover mounting, panel cutout and mounting dimensions are illustrated in Fig. 10.

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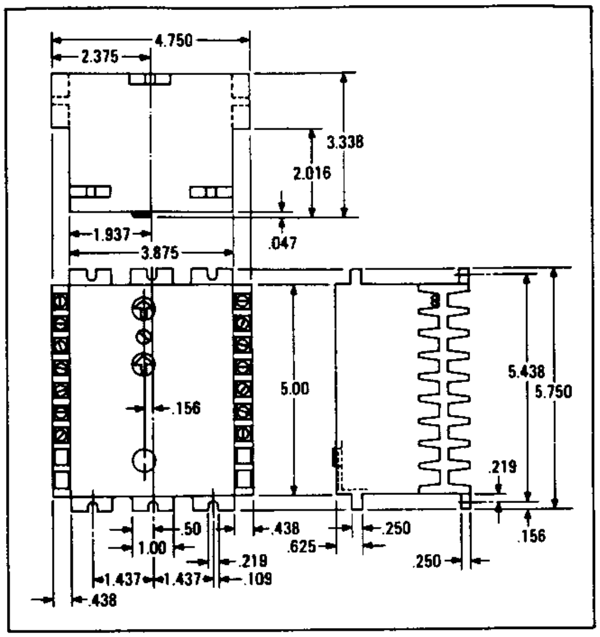

Fig. 9 *Outline of Type GFR Ground Fault Relay* ©

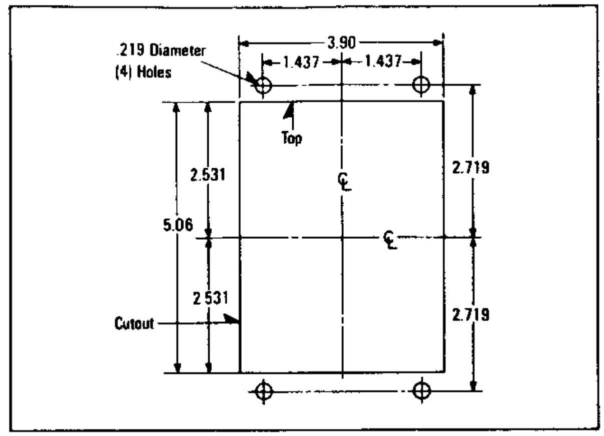

Fig. 10 *Semi-Flush Cover Mounting Details for Type GFR Ground Fault Relay* ©

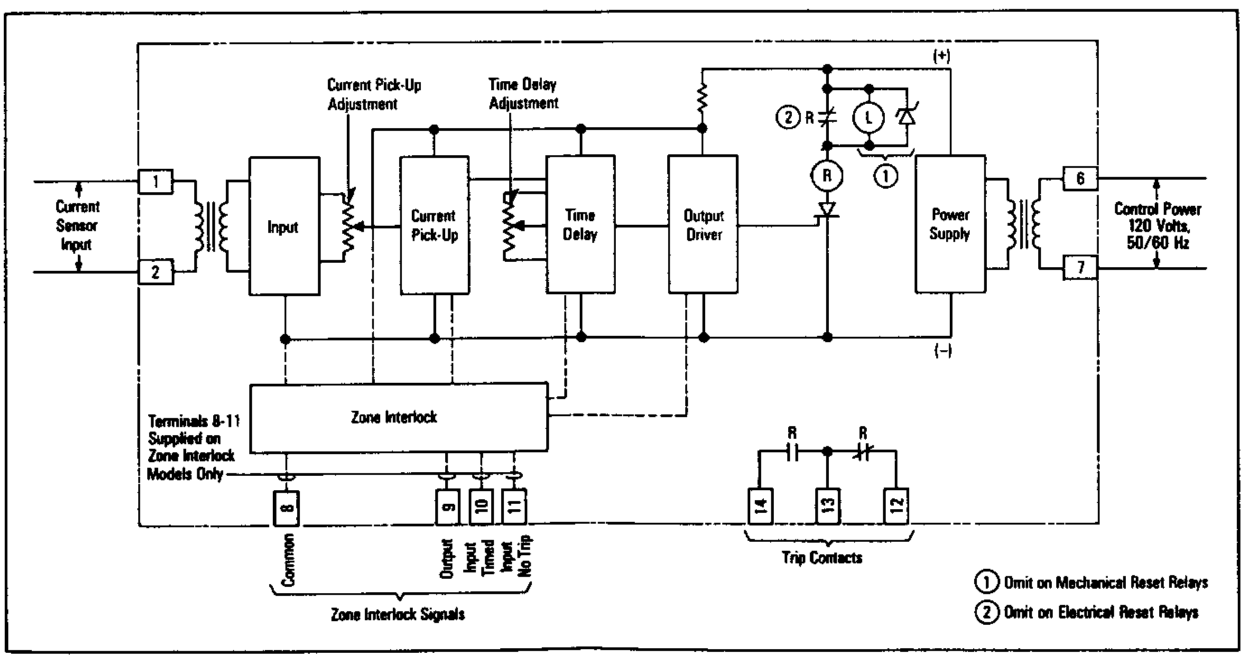

Fig. 11 *Block Diagram for Typical GFR Ground Fault Relay* ©

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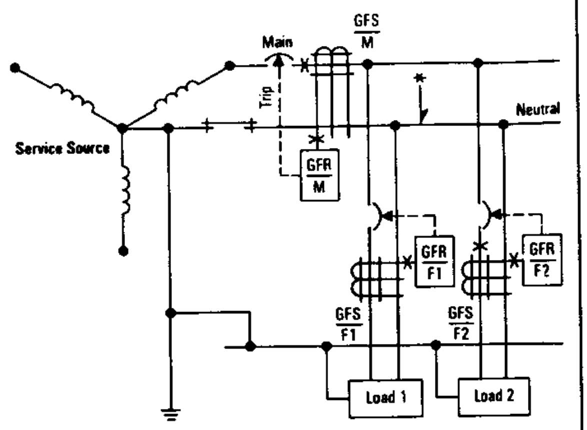


Notes:

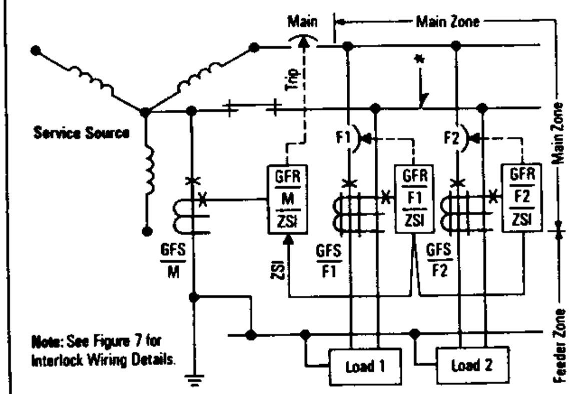
GFP Sensing Method
- Main and Feeders-Zero Sequence.

Type of Protection
- Two Level for Improved Service Continuity as Suggested by NEC 230-95 (b).

Ground Fault Selectivity
- Time/Current Coordination Between Main and Downstream Feeders.
- Feeder Trips Before Main for Downstream Faults.

***Additional Grounding**
- Not Permitted Downstream of Service Disconnect per NEC 250-23 (a).
- Must Not be on Downstream Side of Ground Fault Sensor.

Fig. 11D *Simple Radial System With GFR on Main and Feeders-Zero Sequence Sensing on Main*



Notes:

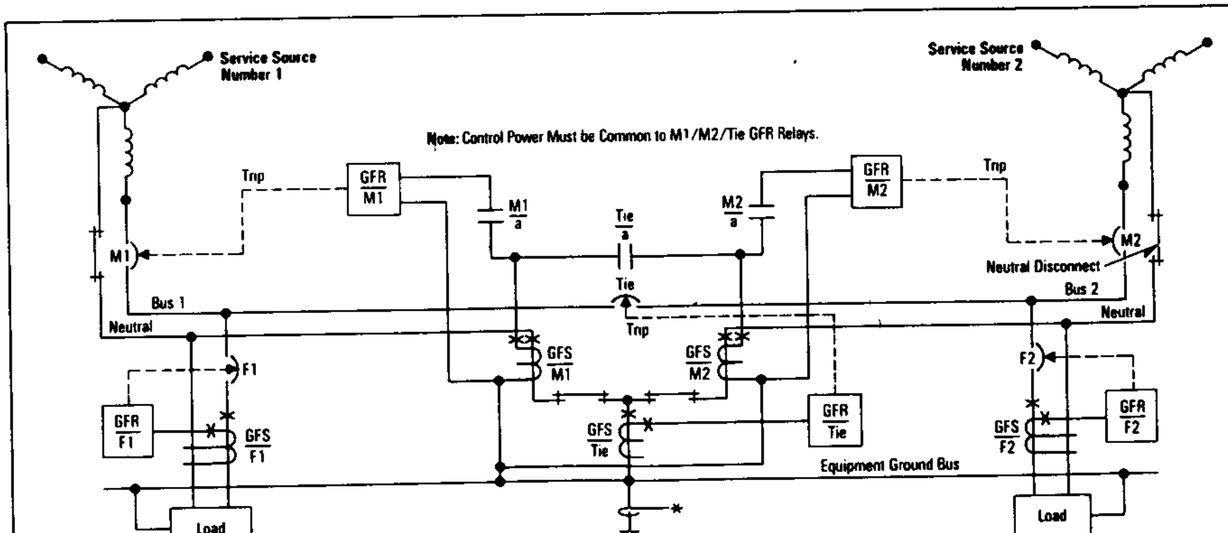
GFP Sensing Methods
- Main-Ground Return.
- Feeders-Zero Sequence.

Type of Protection
- Two Level for Improved Service Continuity.
- Zone Selective Interlocking for Minimum Arcing Fault Damage.

Ground Fault Selectivity
- Time/Current Coordination Between Main and Downstream Feeders.
- Feeder Trips Before Main for Fault in Feeder Zone.
- Main Trips Without Pre-set Time Delay for Fault in Main Zone

***Additional Grounding**
- Not Permitted Downstream of Service Disconnect per NEC 250-23 (a).

Fig. 11E *Simple Radial System With GFR on Main and Feeders With Zone Selective Interlocking*



Notes:

GFP Sensing Method
- Main-Ground Return With Polarities Arranged to Avoid Neutral Unbalance.
- Tie-Ground Return.
- Feeders-Zero Sequence

Type of Protection
- Multiple Level for Improved Service Continuity.
- Zone Selective Interlocking May be Added for Minimum Arcing Fault Damage. (See Figure 11G).

Ground Fault Selectivity
- Time/Current Coordination Between Main, Tie and Feeders.
- Feeder Trips Before Main or Tie for Downstream Faults.
- Tie Trips Before Main to Sectionalize Main Bus.

***Additional Grounding**
- Any Additional Grounding Points Must be Avoided.

Fig. 11F *Dual Source System Using Center Point Grounding (NEC 250-23a-Exception No. 4)*

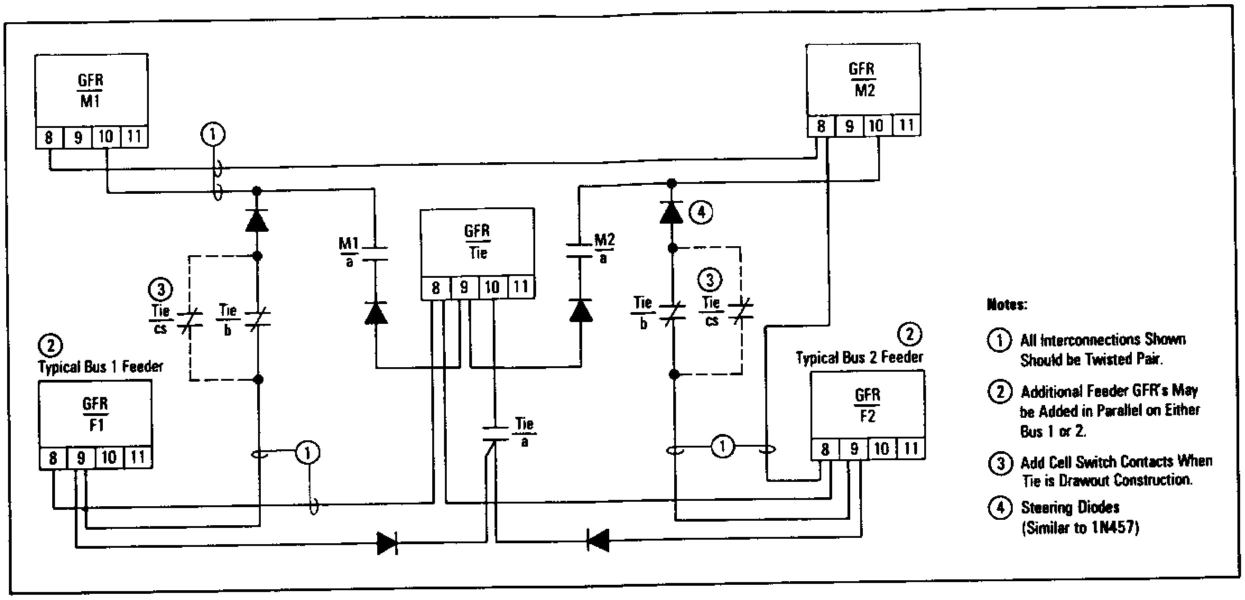


Fig. 11G *Special Zone Interlocking Wiring that may be used with Dual Source System using Center Point Grounding (See Figure 11F)*©

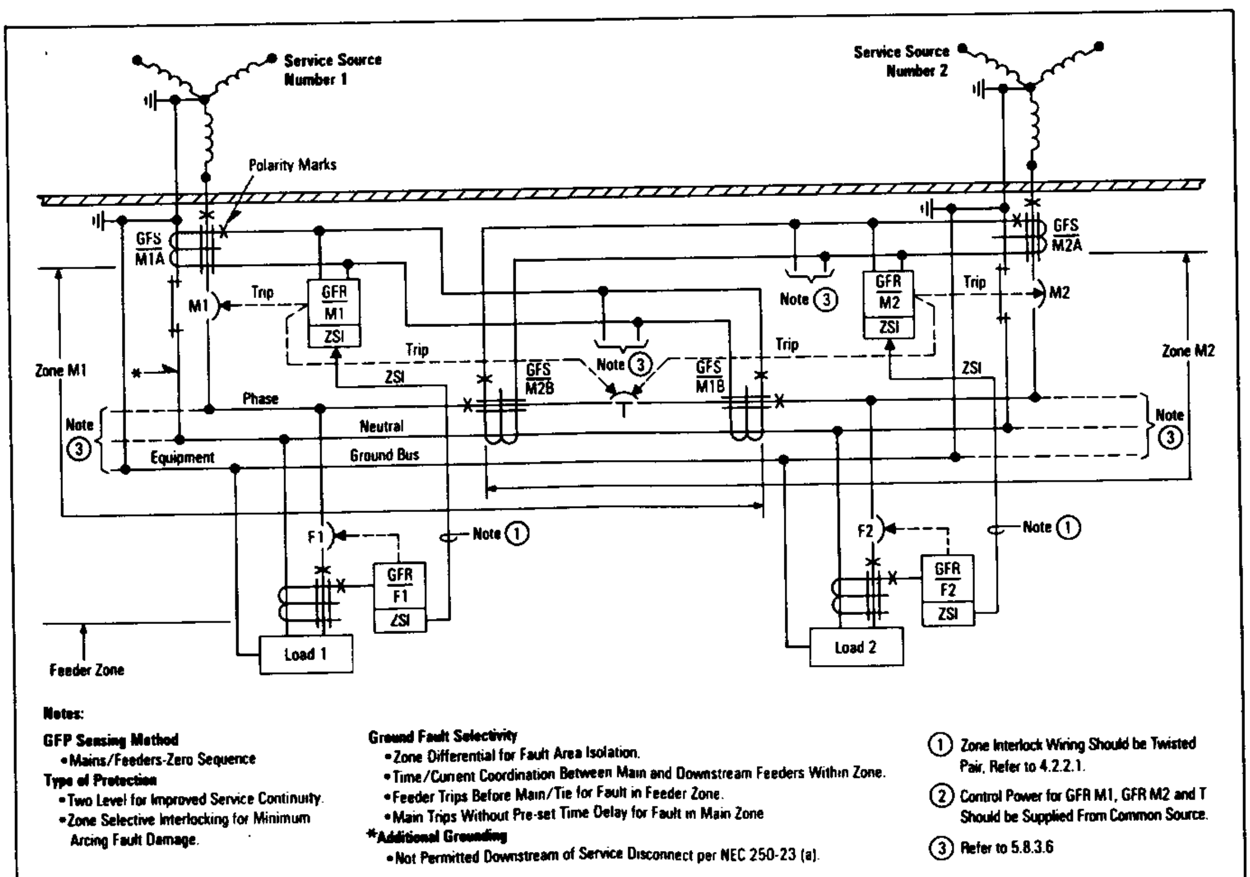


Fig. 11H *Multiple Source, Multiple Grounded System Using Zone Differential Sensing*

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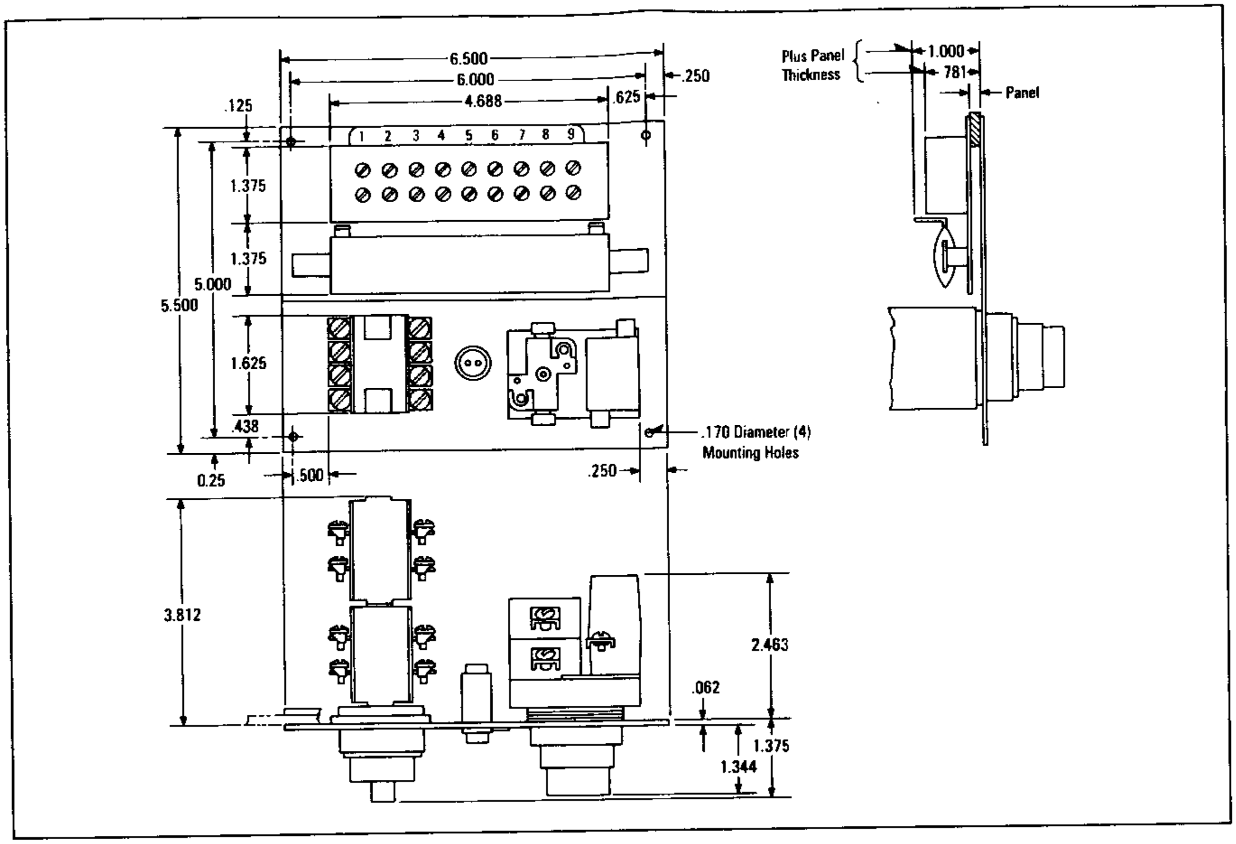

Fig. 12 *Outline of Catalog No. GFRTPD and GFRTP Ground Fault Test Panels* ©

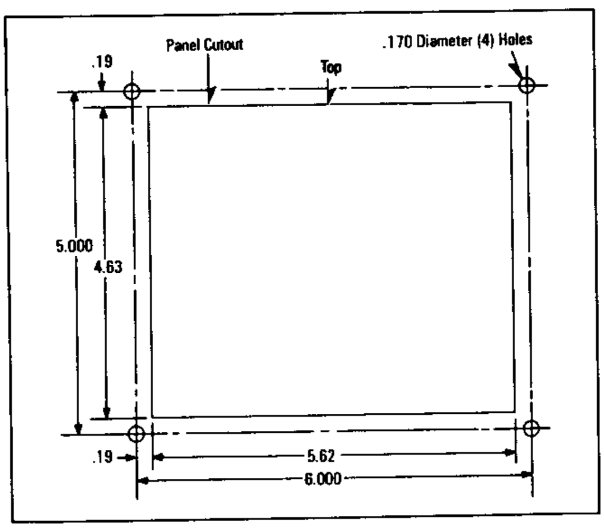

Fig. 13 *Panel Cutout and Drilling Plan for Catalog No. GFRTPD and GFRTP Ground Fault Test Panels* ©

7.0 GROUND FAULT TEST PANEL (See Fig. 4)

7.1 General Description/Purpose

The test panel is designed to test the ground fault circuitry in the type GFR Ground Fault Relay along with its associated disconnect with a simulated, low-level test current from a location remote from the disconnect using a separate power source. Provisions are available to conduct a test in either of two operational modes: By opening the disconnect or by not opening the disconnect.

The test panel provides the easiest and most inexpensive method to conduct ground fault tests on a repeat basis. Tests can be conducted by qualified maintenance personnel during routine maintenance schedules.

WARNING: THERE IS A HAZARD OF ELECTRICAL SHOCK OR BURN WHENEVER WORKING IN OR AROUND ELECTRICAL EQUIPMENT. ALWAYS TURN OFF POWER SUPPLYING THIS EQUIPMENT BEFORE WORKING INSIDE SWITCHBOARDS.

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7.2 Available Types

The test panel is available only as a semi-flush, cover mounted assembly under Cat. No. GFRTP or GFRTPD (for dc control) as illustrated in Fig. 4. It is provided with a selector switch for initiating the desired test sequence, a red lamp to signify a ground fault trip operation, an amber light① to indicate the availability of test power to the test panel, and an instruction nameplate. Outline dimensions are shown in Fig. 12 with panel cut-out and drilling plan details in Fig. 13.

7.3 Electrical Data©

Test Winding
Requires a 120 Volt, 50/60 Hz. control power source (300 VA) for operation.

Ac Control Circuit
Requires a 120 Volt, 50/60 Hz., 0.125 Amp source; use same source as Test Winding, above.

Dc Control Circuit
Requires a 125 Volt dc, 0.125 Amp source.

7.4 Operation Sequence

7.4.1 NORMAL OPERATING CONDITION©

Test Power Lamp "OFF"
Ground Fault Lamp "OFF"
Selector Switch in "NORMAL" position

7.4.2 IF GROUND FAULT OCCURS©

1. Breaker/Interrupter "OPENS"
2. Ground Fault lamp turns "ON"

7.4.3 ACTION REQUIRED

1. Locate and clear ground fault condition
2. Turn selector to "RESET" – hold six seconds
3. Release selector switch – spring return to "Normal"
4. Reset and close breaker/interrupter

7.4.4 TEST WITHOUT SERVICE INTERRUPTION©

1. Turn selector switch to "TEST" – Hold one second
   Red and Amber lamps turn "ON"
2. Turn selector switch to "RESET" – Hold six seconds
   Red and Amber lamps turn "OFF"
3. Release selector switch – spring return to "Normal"

7.4.5 TEST WITH SERVICE INTERRUPTION©

1. Depress and hold ground fault lamp
2. Turn selector switch to "TEST" – Hold one second
   Breaker/Interrupter "OPENS"
   Red and Amber lamps turn "ON"
3. Turn selector switch to "RESET" – Hold six seconds
   Red and Amber lamps turn "OFF"
4. Release selector switch – spring return to "Normal"
5. Release ground fault lamp
6. Reset and close breaker/interrupter

7.5 Connection Diagrams

Fig. 14A illustrates the external connections required for a complete GFP system using 120 volt a-c, 50/60 Hz. control power, including: Type GFR Relay, a ground fault sensor (GFS) and a test panel. A tabulation is also shown to illustrate the various contact positions of the selector switch and red lamp (switch). Fig. 14B illustrates the external connections required for 125 volt d-c control power.

Proper operation of the GFP system requires the use of twisted wire connections on certain terminations. Details are provided on the various connection diagrams including Fig. 7. Refer also to 4.2.2.1.

The terminals on the test panel are suitable for #18 through #14 AWG copper conductors. A maximum of two per terminal of the same size and type are permitted.

① Note: The amber light turns "on" *only* during a test sequence.

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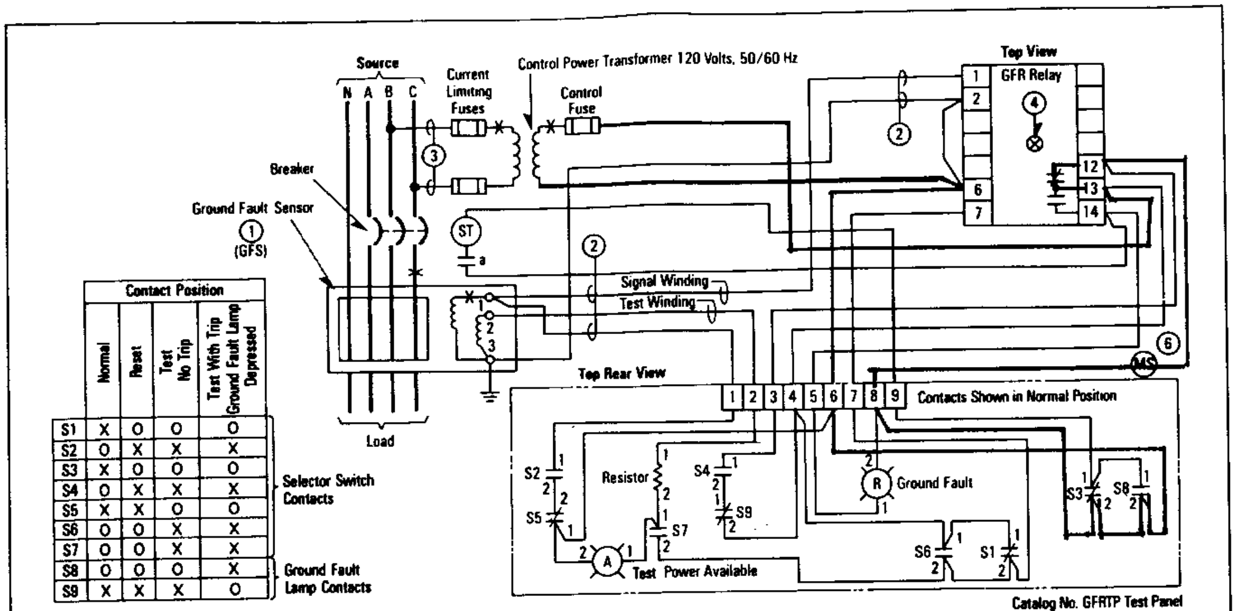

	Contact Position: Normal	Reset	Test No Trip	Test With Trip Ground Fault Lamp Depressed
S1	X	O	O	O
S2	O	X	X	X
S3	X	O	O	O
S4	O	X	X	X
S5	X	X	O	O
S6	O	O	X	X
S7	O	O	X	X
S8	O	O	O	X
S9	X	X	X	O

S1–S7: Selector Switch Contacts. S8–S9: Ground Fault Lamp Contacts.

Notes:

(1) Refer to Outline Drawings of Ground Fault Sensor Selected to Determine Exact Positioning of Polarity Marks.

(2) Twisted Pair-Number 14 AWG Minimum, 250 Foot Maximum. (Do Not Route With Power Conductors)

(3) When a Control Power Transformer is Used, Always Connect Phase-to-Phase-Not Phase-to-Neutral.

(4) When a Mechanically Reset Relay is Used With a Test Panel, Both The Relay and Test Panel Must be Reset Simultaneously Following Either a Simulated Ground Fault Test or Actual Ground Fault.

(5) Unless Noted Otherwise, Contacts Shown in De-Energized Position.

(6) Use in Motor Starter Circuits Requires Special Consideration, i.e. Interruption Capability of Contactor.

Fig. 14A *Connection Diagram for 120 Volt, 50/60 Hz Ground Fault Relay used With Test Panel©*

7.6 Alternate Test Diagrams

Where desired, alternate test schemes can be utilized for periodic testing of the type GFR Relay and associated disconnect using a simulated ground fault test current. Two such test schemes are illustrated in Figures 15 and 16. The first figure illustrates the connections required for an electrically reset ground fault relay. The latter figure is for a mechanically reset relay.

In each of the alternate test diagrams, the suggested test resistor rating is 50 ohms, 70 watts. Using a 120 Volt control power source, this will produce a test current of approximately 200% of the maximum pick-up setting of the GFR relay. Simulated field test methods should not be used as a calibration check of the relay. Functional testing only should suffice.

7.7 Replacement Parts

The amber lamp used to indicate control power available, contains a neon bulb and replacement should not be necessary. The ground fault (red) lamp is equipped with a No. 51, miniature bayonet base bulb – Style Number 13D1365H08.

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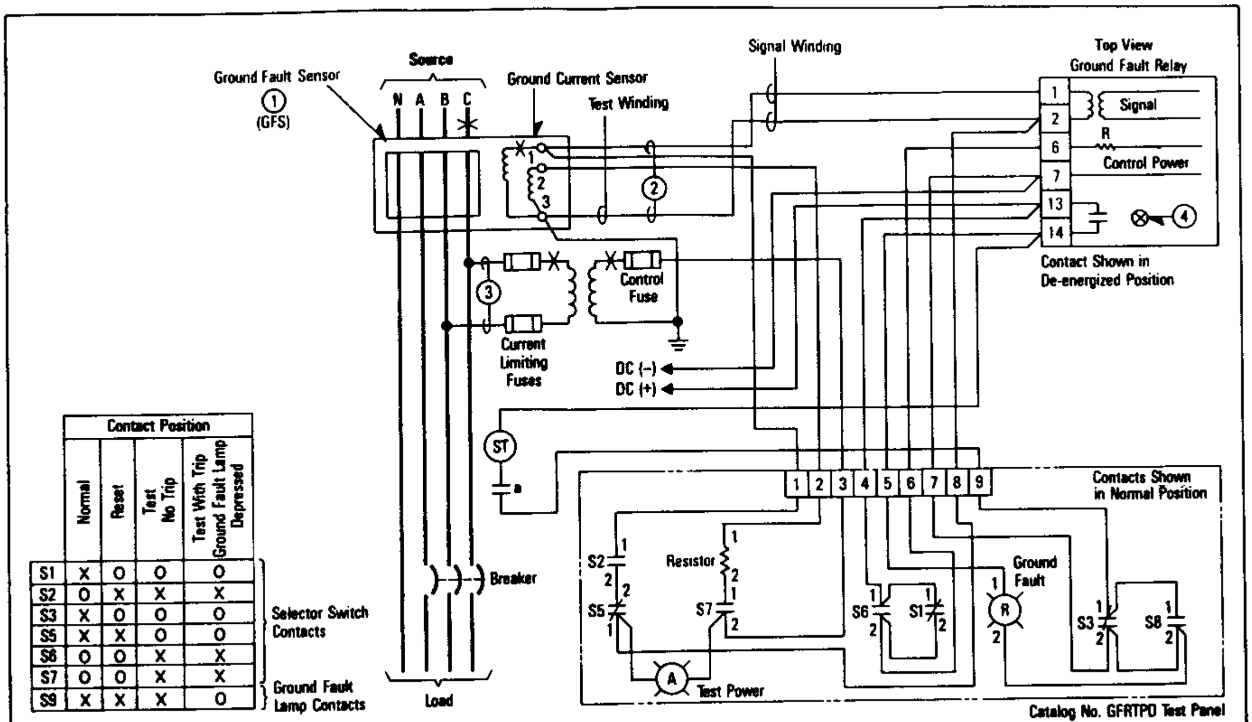

Contact Position	Normal	Reset	Test No Trip	Test With Trip Ground Fault Lamp Depressed	
S1	X	O	O	O	Selector Switch Contacts
S2	O	X	X	X	Selector Switch Contacts
S3	X	O	O	O	Selector Switch Contacts
S5	X	X	O	O	Selector Switch Contacts
S6	O	O	X	X	Selector Switch Contacts
S7	O	O	X	X	Selector Switch Contacts
S9	X	X	X	O	Ground Fault Lamp Contacts

Notes:

1. Refer to Outline Drawings of Ground Fault Sensor Selected to Determine Exact Positioning of Polarity Marks.
2. Twisted Pair-Number 14 AWG Minimum, 250 Foot Maximum. (Do Not Route With Power Conductors).
3. When a Control Power Transformer is Used, Always Connect Phase-to-Phase-Not Phase-to-Neutral.
4. When a Mechanically Reset Relay is Used With a Test Panel, Both The Relay and Test Panel Must be Reset Simultaneously Following Either a Simulated Ground Fault Test or Actual Ground Fault.
5. Unless Noted Otherwise, Contacts Shown in De-Energized Position.

Fig. 14B *Connection Diagram for 125 Volt Dc Ground Fault Relay used With Test Panel*

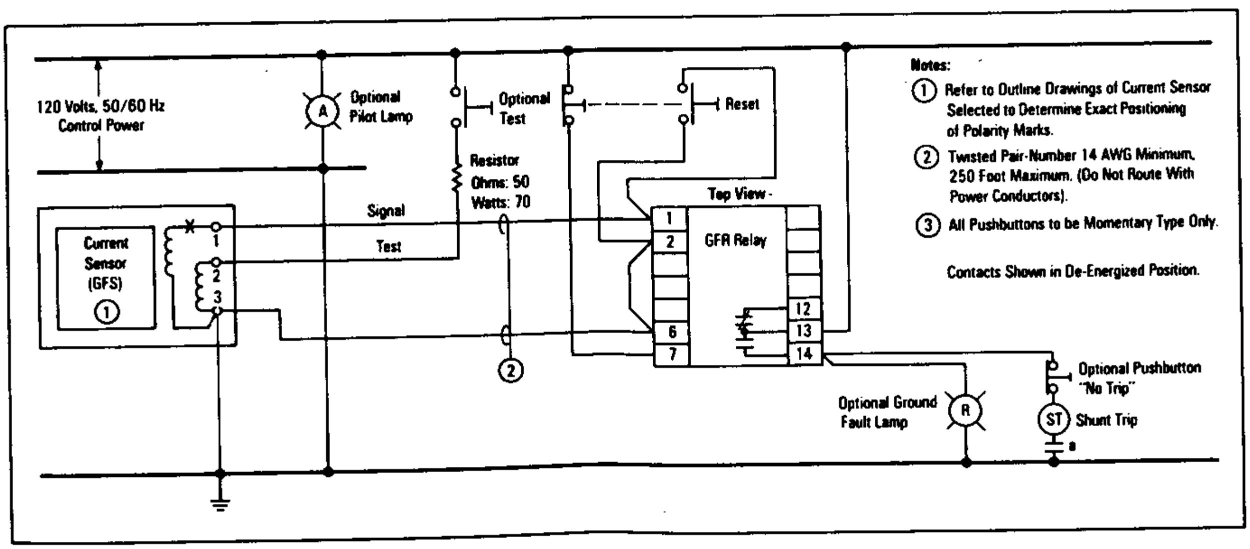

Fig. 15 *Connection Diagram for Electrical Reset Ground Fault Relay With Separate Test and Reset Devices*

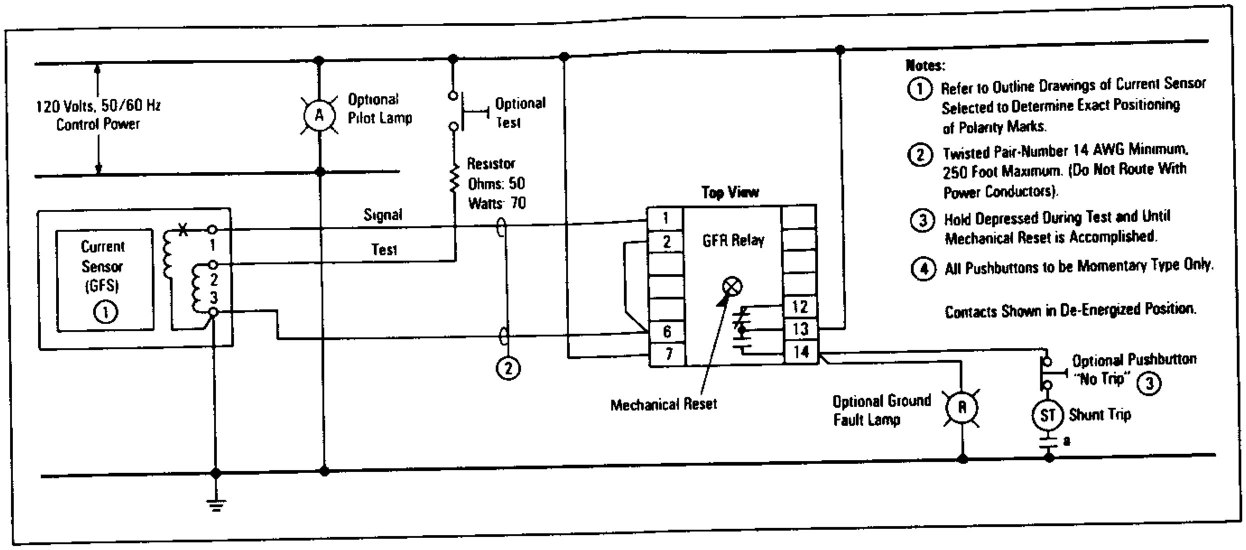

Fig. 16 *Connection Diagram for Mechanical Reset Ground Fault Relay With Separate Test Devices*

8.0 GROUND FAULT WARNING INDICATOR RELAY

8.1 General Purpose

This relay, as illustrated in Fig. 5, can be used to initiate a remote audio or visual warning of a low level ground fault condition. The non-adjustable relay is set to pick-up at 30-50% of the pick-up setting of the associated type GFR relay. Thus, a warning of a slow progressing, high resistance type of arcing ground fault can be triggered prior to the circuit clearing actions initiated by the type GFR relay. The relay requires a 120 volt, 60 Hz., control power source and must be used with a type GFR relay equipped with zone selective interlocking.

8.2 Available Styles

The Ground Fault Warning Indicator Relay is a UL recognized component and available in four different styles as indicated in Table 3. One type is self-reset following a diminished pick-up signal. The other type requires an electrical reset of control power normally accomplished by a pushbutton in the control power circuit. The relay may be used individually for panel mounting or, where extra signal contacts are required, it may be used in conjunction with a type BF relay. A typical connection diagram for a panel mounted relay is shown in Fig. 17.

Table 3 – Ground Fault Warning Indicator

Style No.	Method of Resetting	Method of Mounting	Mounting Figure Reference
1255C32G05	Pushbutton	Relay Attachment	19
1255C32G06	Pushbutton	Panel Mounting	18
1255C32G07	Self	Relay Attachment	19
1255C32G08	Self	Panel Mounting	18

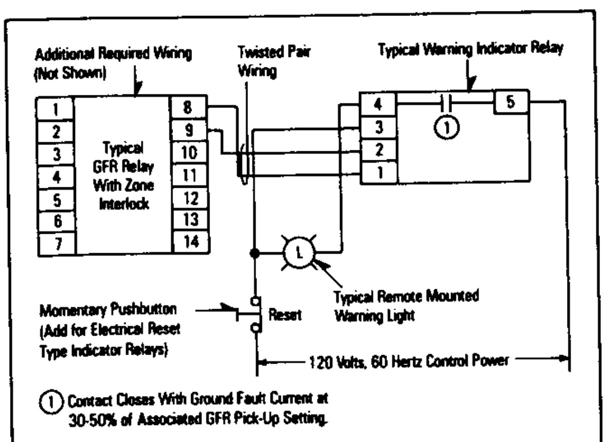

Fig. 17 *Connection Diagram for Typical Panel Mounted Ground Fault Warning Indicator Relay*

9.0 GROUND FAULT INDICATING AMMETER[1]

9.1 General Purpose/Description

This ammeter, as illustrated in Fig. 6 can be used to visually monitor the actual value of a low level ground current in the distribution circuit. The ammeter, suitable for semi-flush panel mounting, is available in three styles as shown in Table 4. The ammeter scale rating selected must agree with the maximum ampere rating of the ground fault sensor that it is applied with. The ammeter is used in connection with a momentary contact push-button with connections as illustrated in Fig. 20. For outline dimensions and panel cut-out requirements, see Fig. 21.

10.0 PERFORMANCE TESTING

10.1 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.

Table 4 – Indicating Ammeter

Style No. © Includes Push-button	Use With Sensor Rated Amperes	Maximum Scale Amperes	Mounting Figure Reference
1255C51G07	1-12	12	20
1255C51G02	5-60	60	20
1255C51G03	100-1200	1200	20

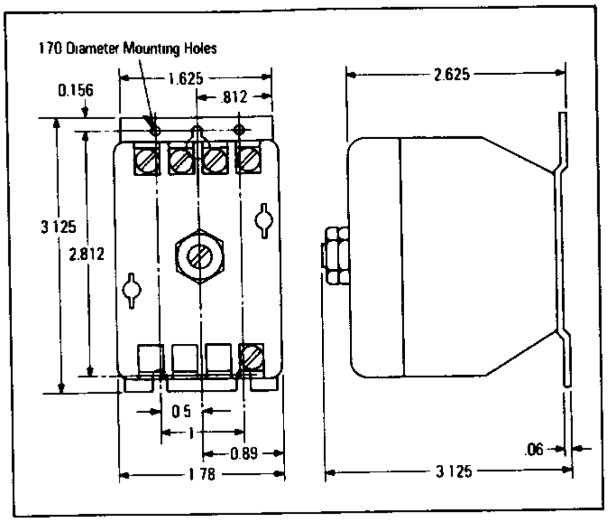

Fig. 18 *Panel Mounted Ground Fault Warning Indicator Relay©*

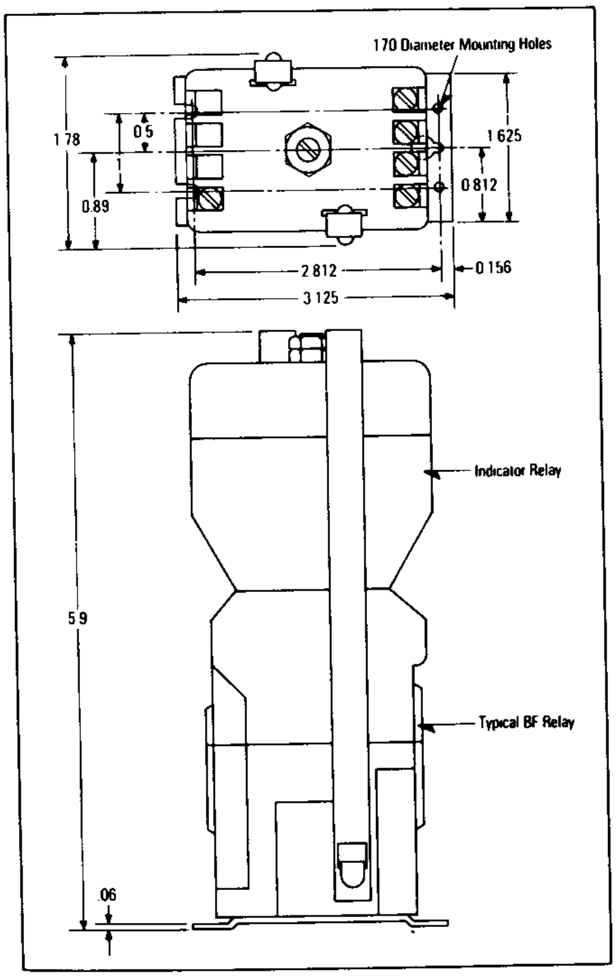

Fig. 19 *Relay Mounted Ground Fault Warning Indicator Relay©*

(1) Not UL listed

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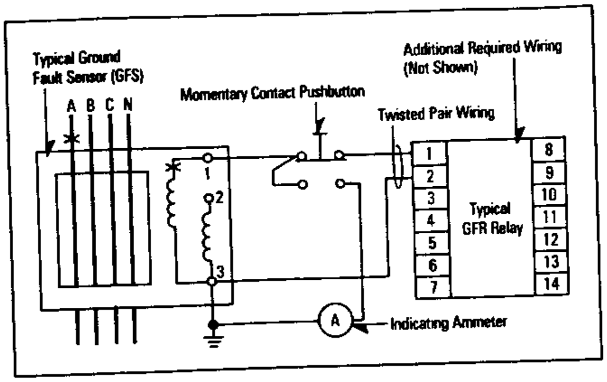

Fig. 20 *Connection Diagram for Indicating Ammeter on Single Sensor Only. See Table 4* ©

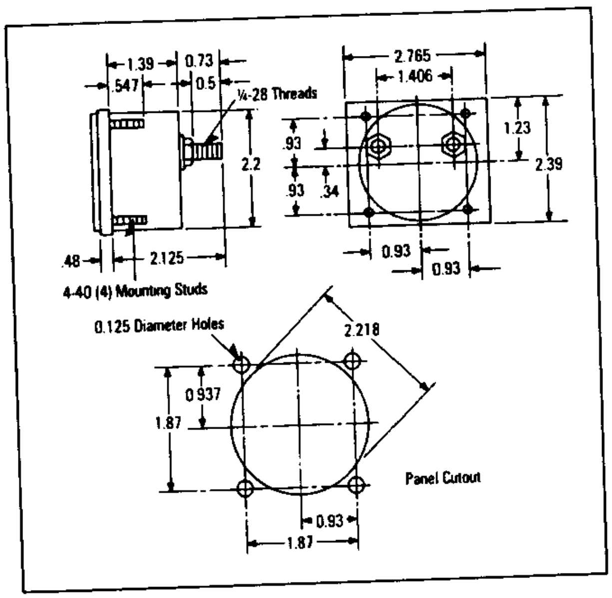

Fig. 21 *Outline Dimensions and Panel Cutout for Indicating Ammeter*

10.2 Standards Requirements

As a follow-up to the basic performance requirements stipulated by the N.E.C. as stated above in 10.1, 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 Fig. 22 are shipped with each type GFR relay.

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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:

Fig. 22 *Typical Performance Test Record Form*

10.3 General Test Instructions

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

10.3.2 The proper location of the sensors around the bus of the circuit to be protected shall be determined. This can be done visually, with knowledge of which bus is involved.

10.3.3 The polarity of all sensor connections 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.

10.3.4 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.

10.3.5 As a minimum check, it is recommended that a simulated test be conducted by qualified personnel using a low voltage (0-24 volt), high current, ac source. This testing method is applicable for simple radial systems using either ground return or zero sequence sensing methods. Custom, specialized ground fault sensing schemes, i.e., multi-source, multi-ground type, will require reviewing of the equipment assembler's "job shop" drawings to determine expected results before the test program is undertaken.

WARNING: THERE IS A HAZARD OF ELECTRICAL SHOCK OR BURN WHENEVER WORKING IN OR AROUND ELECTRICAL EQUIPMENT. ALWAYS TURN OFF POWER SUPPLYING INTERRUPTER BEFORE CONDUCTING TESTS.

10.3.5.1 Test Method No. 1

Using the low voltage current source, apply a test current of 125% of the type GFR ground fault relay pick-up setting directly through the ground fault sensor opening. The circuit interrupter associated with this current sensor should be open. If an alarm indicator is supplied, it should operate.

CAUTION: FIELD TESTING SHOULD BE USED FOR FUNCTIONAL TESTING AND NOT FIELD CALIBRATION OF THE GFR RELAY.

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

10.3.5.2 Test Method No. 2 use this one

Use this test method when a minimum test current source is available. Perform the test similar to the method outlined in 10.3.5.1 except, loop several turns around one leg of the sensor so that the ampere turns equals a test current that is 125% of the type GFR ground fault relay pick-up setting. Test results should be the same as in 10.3.5.1.

10.3.6 Final proof of a complex system with multiple sources and/or multiple grounding points can be best determined by a controlled, low-level phase to ground test current administered by qualified test personnel.

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

Minimum clearance between bus or cable & inside of sensor.

Table 5 – Ground Fault Sensor Style Tabulation©						
Primary Rating Amperes	**Style No.**	**Type Core**	**Bus/Cable Opening in Inches**	**Figure Reference**	**Turns Ratio**	**Primary Saturation Amperes**
12	1283C45G01 ©	Solid	5.5 I.D.	23 1/4	43/1	240
60	179C768G01	Solid	2.5 I.D.	24 1/4	250/1	230
60	1256C13G01	Solid	5.5 I.D.	25 1/4	250/1	480
60	179C767G01	Solid	8.25 I.D.	26 1/2	250/1	250
60	1257C88G04	R/L①	7.81 x 11.0	27 1.0	250/1	1200
60	1257C92G03	R/L①	3.31 x 24.94	28 1.0	250/1	1200
60	1257C93G03	R/L①	3.31 x 17.94	29 1.0	250/1	1200
1200	179C768G02	Solid	2.5 I.D.	24 1/4	5000/1	14KA
1200	1256C13G02	Solid	5.5 I.D.	25 1/4	5000/1	20KA
1200	179C767G02	Solid	8.25 I.D.	26 1/2	5000/1	14KA
1200	1257C88G03	R/L①	7.81 x 11.0	27 1.0	5000/1	14KA
1200	1257C92G04	R/L①	3.31 x 24.94	28 1.0	5000/1	14KA
1200	1257C93G04 ©	R/L①	3.31 x 17.94	29 1.0	5000/1	14KA
1200	1255C39G03	R/L①	6.75 x 29.64	30 "	5000/1	10KA
1200	1272C40G02	R/L①	5.81 x 33.5	31 "	5000/1	10KA
1200	1257C89G02	R/L①	15.94 x 19.94	32 "	5000/1	14KA
1200	1257C90G02	R/L①	9.94 x 16.94	33 "	5000/1	14KA
1200	1257C91G02	R/L①	9.94 x 23.94	34 "	5000/1	14KA
1200	1257C94G02	R/L①	5.19 x 35.94	35 "	5000/1	14KA

①R/L: rectangular with removable link

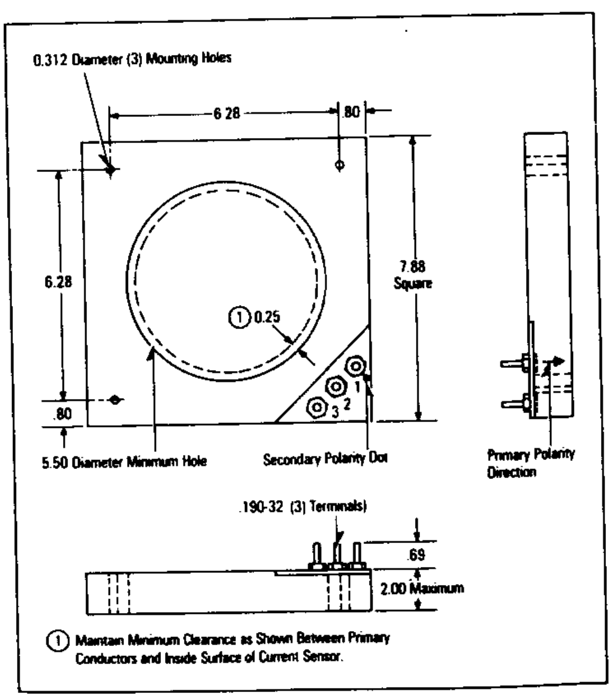

Fig. 23 *Current Sensor S#1283C45G01* ©

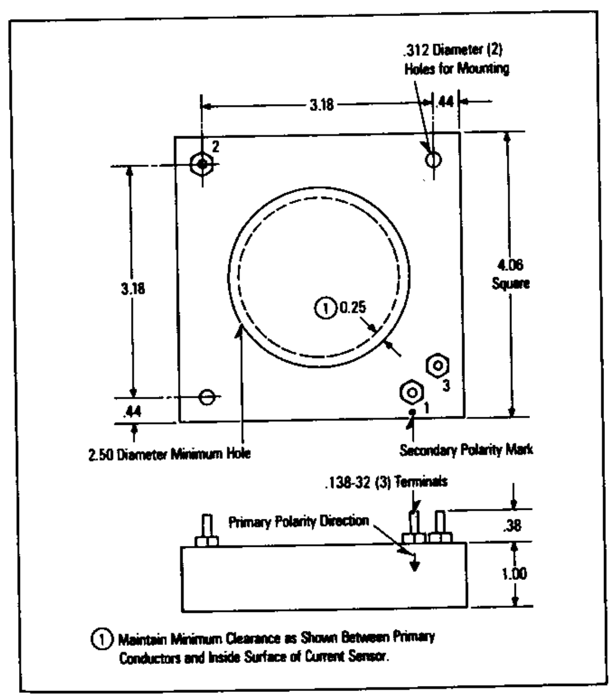

Fig. 24 *Current Sensors S#179C768G01/S#179C768G02* ©

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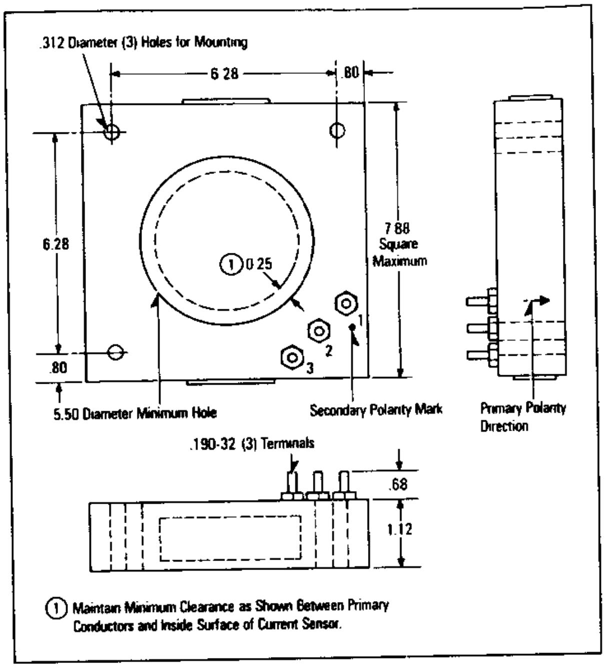

Fig. 25 *Current Sensors S#1256C13G01/S#1256C13G02* ©

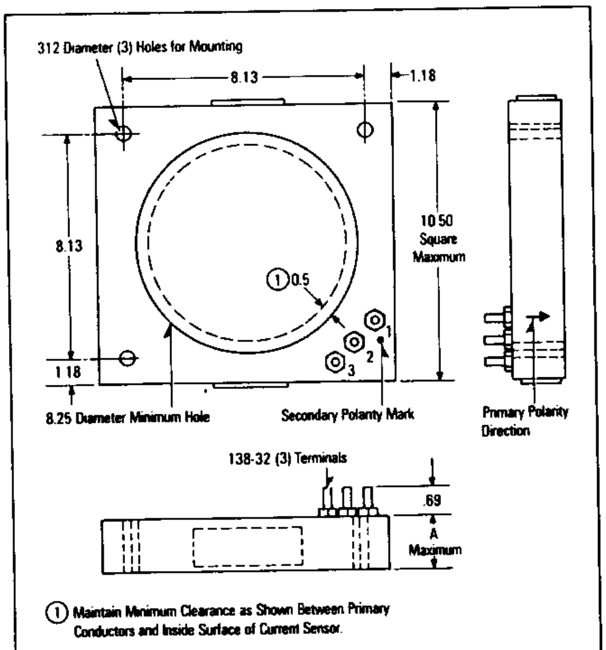

Fig. 26 *Current Sensors S#179C767G01, A=1.5* ©
S#179C767G02, A=1.0 ©

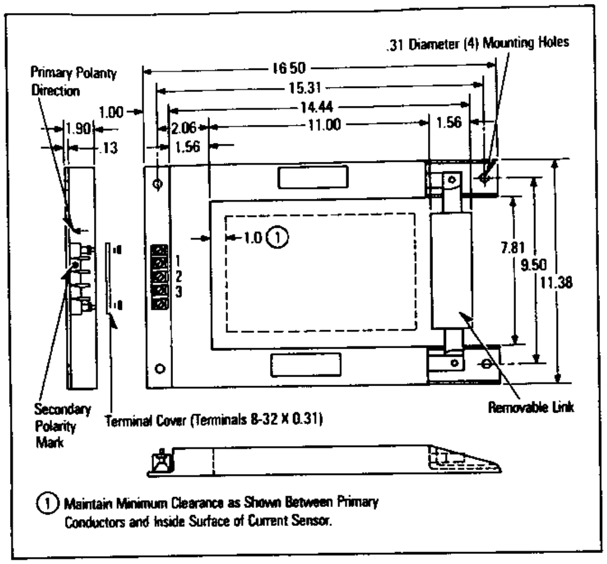

Fig. 27 *Current Sensors S#1257C88G03/S#1257C88G04* ©

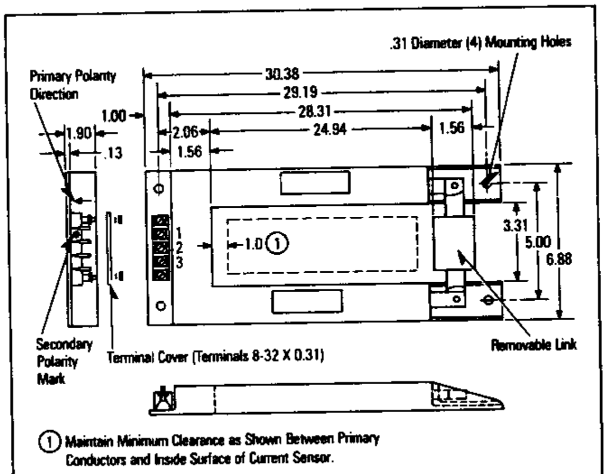

Fig. 28 *Current Sensors S#1257C92G03/S#1257C92G04* ©

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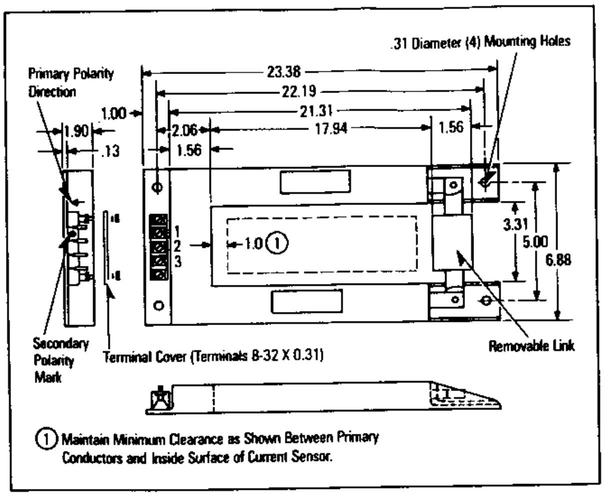

Fig. 29 *Current Sensors S#1257C93G03/S#1257C93G04* ©

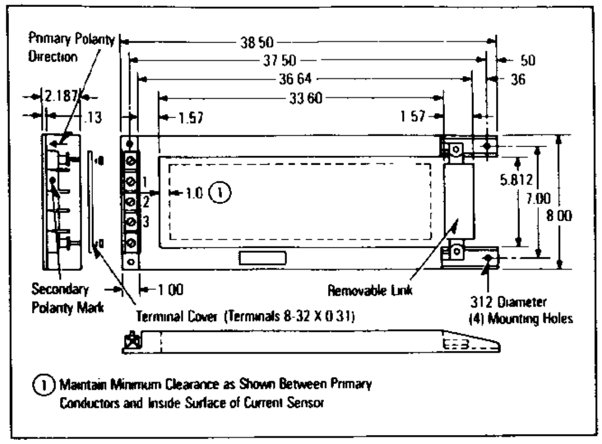

Fig. 31 *Current Sensors S#1272C40G02*

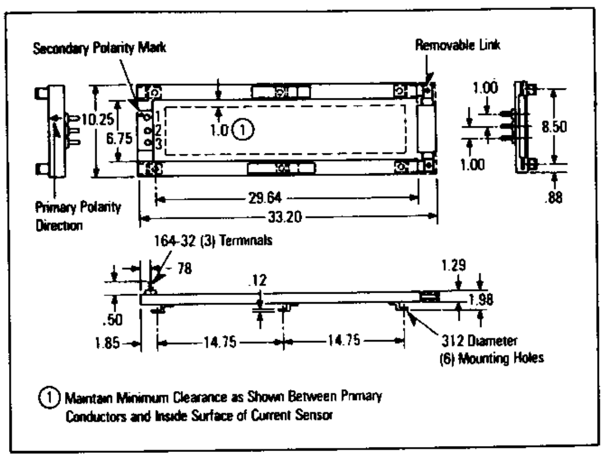

Fig. 30 *Current Sensors S#1255C39G03*

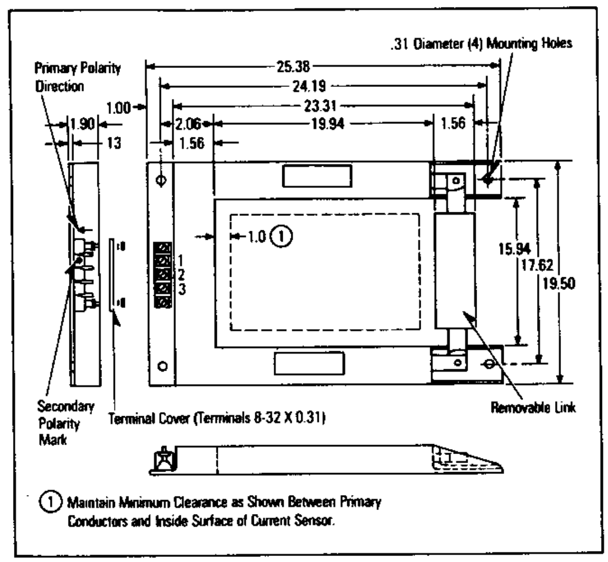

Fig. 32 *Current Sensor S#1257C89G02* ©

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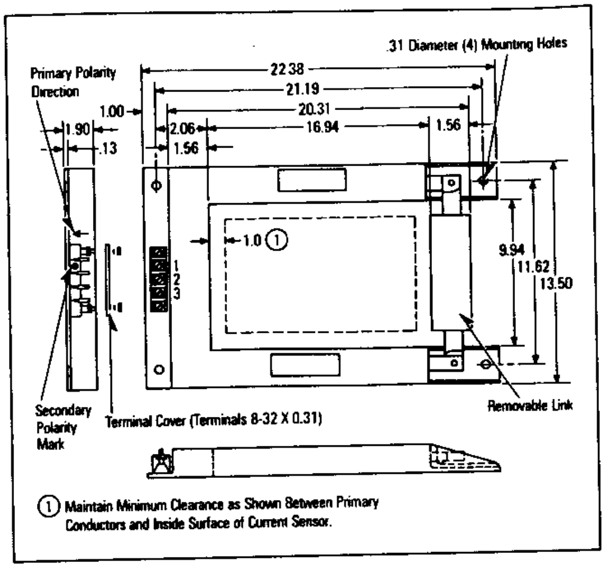

Fig. 33 *Current Sensor S#1257C90G02* ©

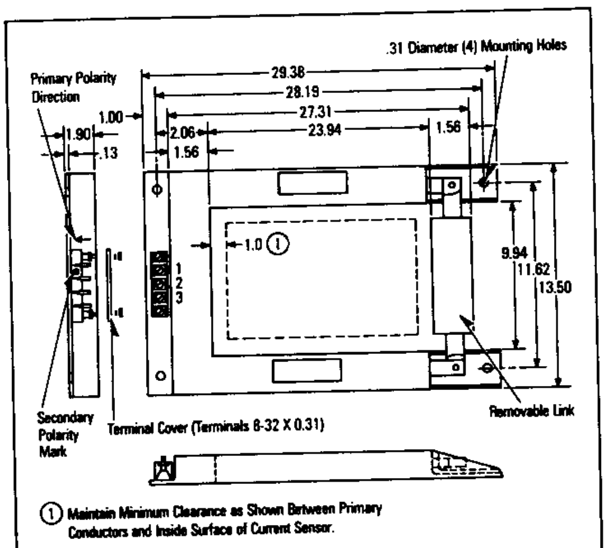

Fig. 34 *Current Sensor S#1257C91G02* ©

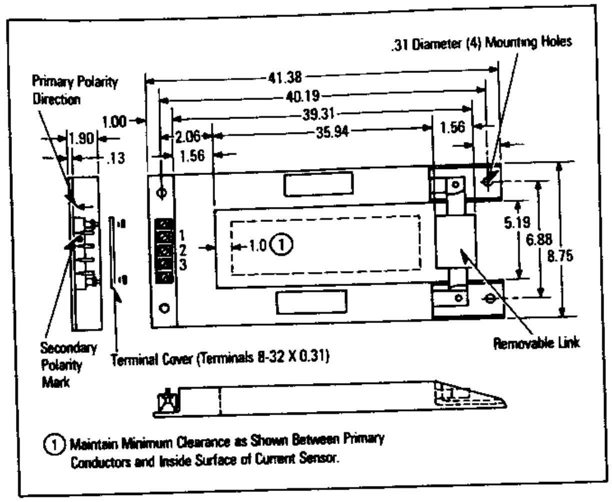

Fig. 35 *Current Sensor S#1257C94G02* ©

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