Ground-Censor®

GROUND FAULT PROTECTION SYSTEM
TYPE GC

INSTRUCTIONS

GC–100
SERIES 2

SQUARE D COMPANY

SHIPPING DAMAGE, HANDLING & STORAGE

The GC-100 Ground Fault Relay is designed for industrial environments. Reasonable care should be exercised in handling and storage to protect the device from excessive mechanical shock, humidity, or temperature. Do not drop device. Storage temperatures should be less than 200°F but more than -10°F. The relay should be stored in its original shipping carton until ready for installation when not supplied as an integral part of other electrical apparatus such as a switchboard or panelboard.

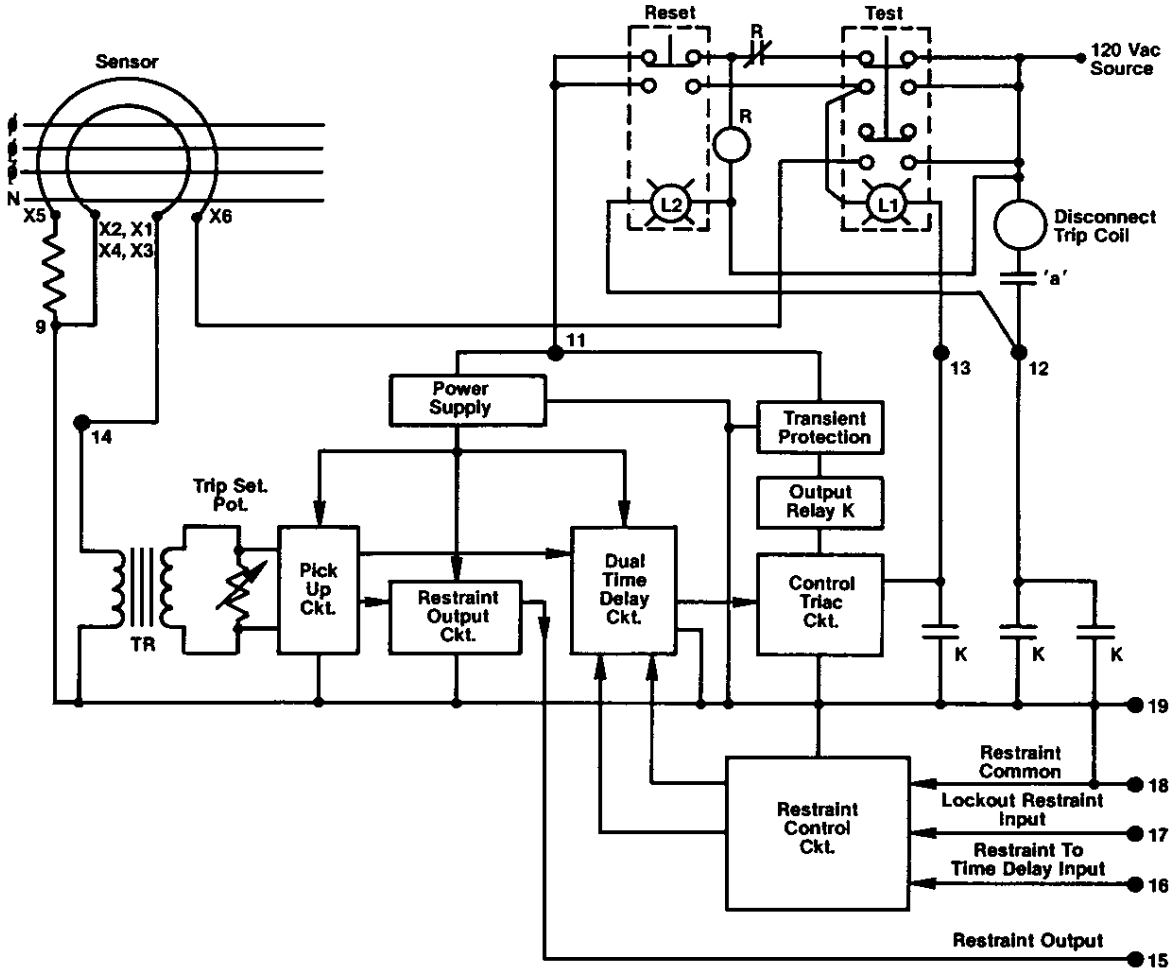
Examine all components carefully for concealed shipping damage upon receipt of the equipment. If damage or loss is discovered, file a claim with the delivering carrier immediately, and notify the nearest Square D field office. Arrange for repair or replacement through your local Square D office before returning any components to the factory.

GROUNDED POWER SYSTEMS

The GC-100 Ground Fault Relay is intended for use only on power systems which include a grounded conductor (neutral or grounded phase). The grounded conductor must be grounded at the service equipment, but the neutral may or may not be used in the feeder or branch circuits.

SYSTEM OPERATION

A block diagram of the complete system including the Sensor, Ground Fault Relay, Monitor Components, and the Disconnect Trip Coil is shown in Figure 1. When circuit conditions are normal, the currents from all the phase conductors and neutral (if used) add up to zero and the Sensor produces no signal. When any ground fault occurs, however, the currents add up to equal the ground fault current and the Sensor produces a signal proportional to the ground fault. This signal is sensed by the Ground Fault Relay and used to initiate timing and other functions.



When a ground fault occurs, current flows from the Sensor through TR whose output voltage is proportional to the fault magnitude and the adjustment of the Trip Setting Potentiometer. The Pick Up Circuit rectifies and senses this voltage. When the voltage reaches the pick up value, the Pick Up Circuit activates both the Dual Time Delay and the Restraint Output Circuits.

The Dual Time Delay Circuit contains one short delay (Curve A) and one long delay, both timing simultaneously unless there is a restraint input. When either circuit times out, the Control Triac Circuit turns "on" and operates Output Relay K which energizes the Disconnect Trip Coil. A contact latches the relay "on" providing a continuous indication of ground fault tripping by lighting lamp L2 The Ground Fault Relay is reset by pressing the Reset button interrupting the power source momentarily. A ground fault lasting for less than the time delay period will not pick up the Disconnect Trip Coil, thus eliminating nuisance tripping on self-clearing faults.

The Restraint Output Circuit has a voltage output whenever the ground fault current exceeds the pick up point. This output may be connected to either a Lockout Restraint or a Restraint to Time Delay Input of another GC-100 Ground Fault Relay. **All GC-100 relays using restraint interconnections must have a common ground.** The Restraint Common (terminal 18) is internally connected to terminal 19 for wiring convenience. **Do not ground the Restraint Output (terminal 15).**

Restraint to Time Delay Input (terminal 16) when energized, blocks only the short time delay permitting operation of the long time delay of 0.1, 0.2, 0.3 or 0.5 seconds nominal depending on the internal time delay selection connection. Lockout Restraint Input (terminal 17) when energized, blocks **both** time delay circuits, restraining the relay from tripping under any ground fault condition. When restrained, a relay continues to generate a restraint output signal if the fault current exceeds the pick up level, so restraint signals can be sent further upstream if desired.

In single relay applications or when zone selective interlocking is not used, allowing a GC-100 to restrain itself makes all five time delays available on each relay. Connections for this application should be made as shown in Figure 2.

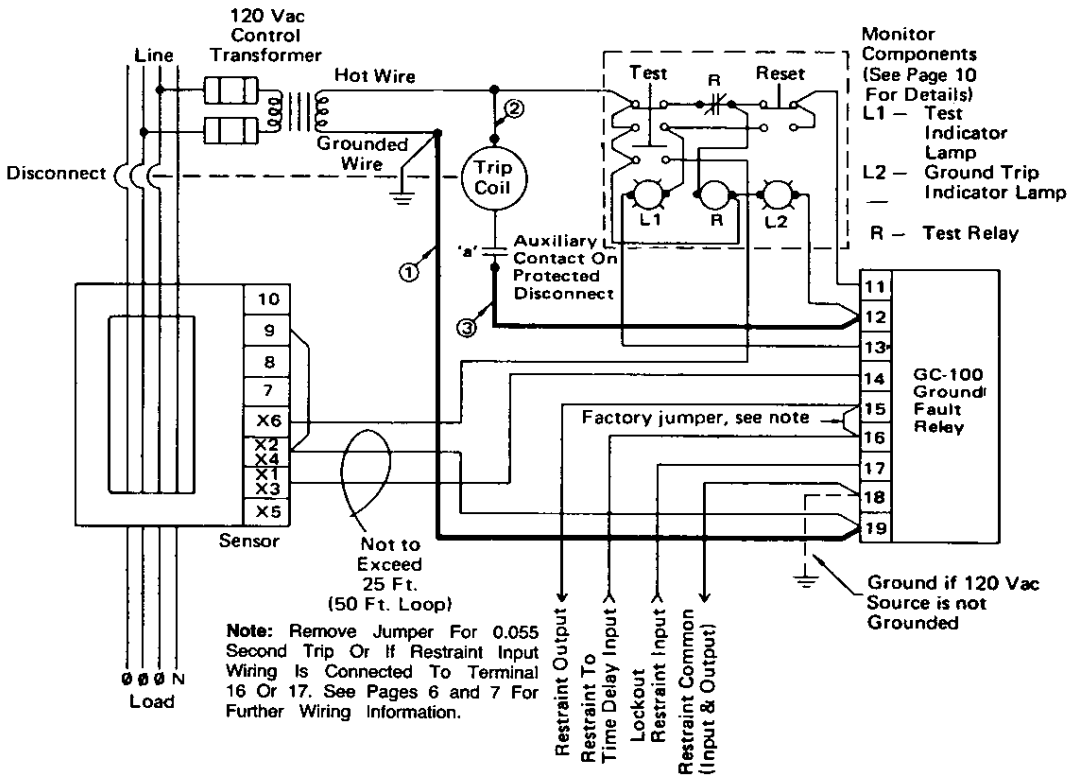


FIGURE 2

SENSOR MOUNTING

The Sensor should be mounted so that all phase and neutral (if used) conductors pass through the Core Window once. The Equipment Grounding Conductor (if used) **must not** pass through the Core Window. The neutral conductor must be free of all grounds after passing through the Core Window (Figure 3).

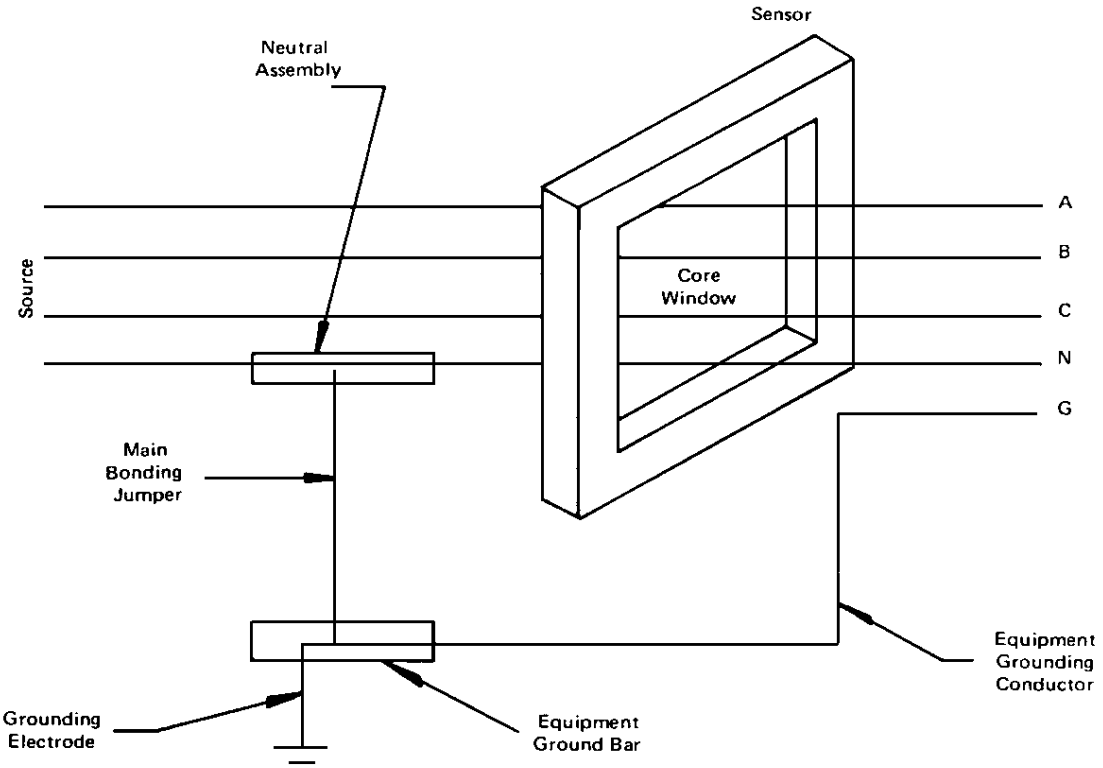


FIGURE 3

When so specified by the system design engineer, the Sensor may be mounted so that only the conductor connecting the neutral to ground at the service equipment passes through the Core Window.In such cases, the Sensor must provide a signal to the particular Ground Fault Relay which is associated with the main disconnect.

Maintain at least two inches clearance from the iron core of the Sensor windings to the nearest bus bar or cable to avoid false tripping. Cable conductors should be bundled securely and braced to hold them at the center of the Core Window.

The Sensor should be mounted within an enclosure and protected from mechanical damage.

If the electrical system will be energized at any time prior to completion of the installation, the Sensor output windings must be short circuited by a jumper across terminals X1, X3 to X2, X4. Remove this jumper when all wiring is completed to the Ground Fault Relay and the Disconnect Trip Coil.

RELAY MOUNTING

The Ground Fault Relay should be mounted in a vertical position within an enclosure with the terminal block at the lower end. The location of the relay should be such that the trip setting knob is accessible without exposing the operator to hazard from contact with live parts or arcing from disconnect operation. Means have been provided so that the trip setting can be adjusted from outside the enclosure as shown in Figure 4. To do this, the potentiometer is removed from the printed circuit board and remounted on the inside back of the box body in the holes provided, with its terminals toward the terminal block. If needed, a shaft extension is added and knob is adjusted to recommended protrusion.

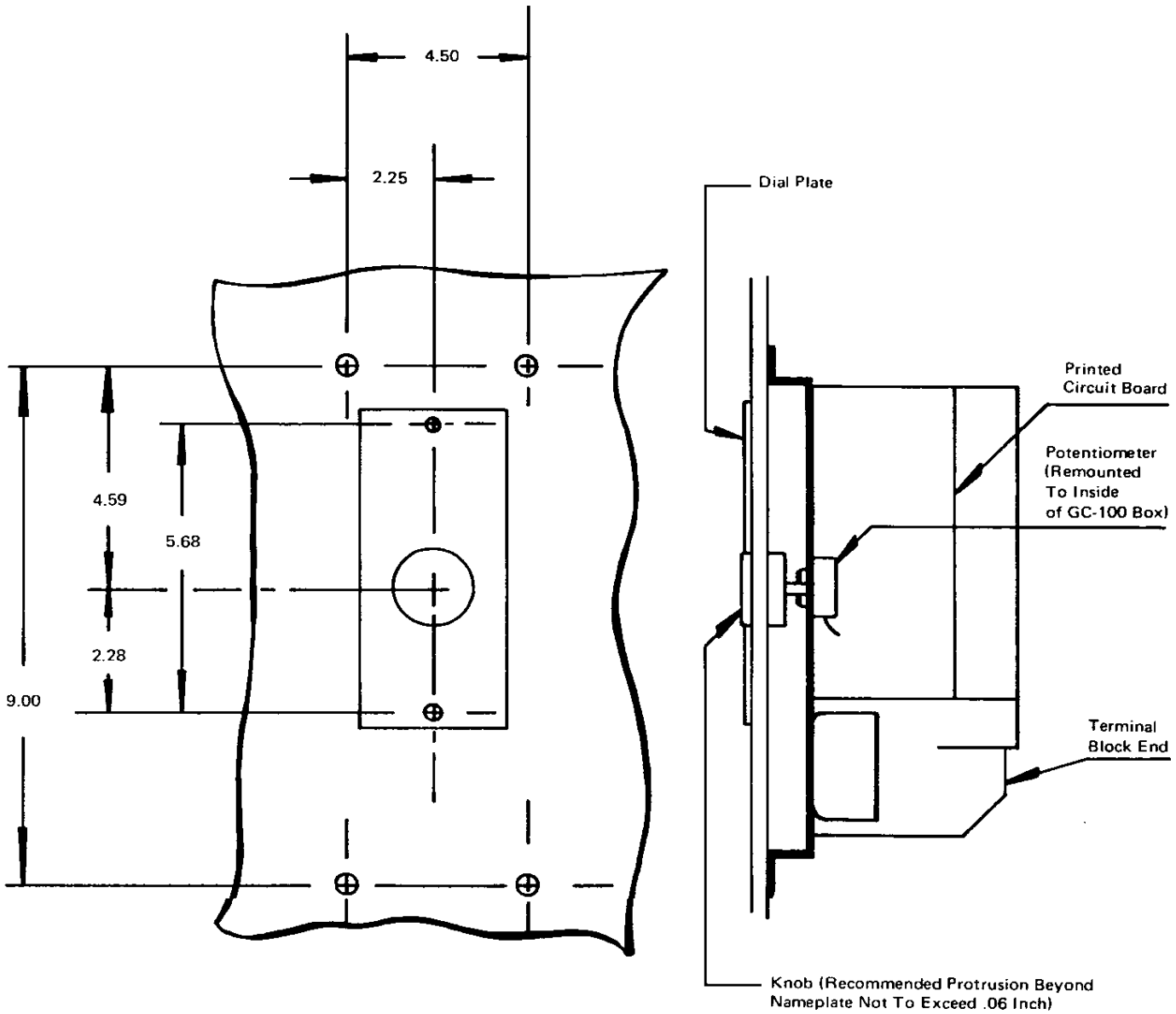


FIGURE 4

CONNECTIONS

Connections for standard application should be made according to the wiring diagram in Figure 2. Wires from the Sensor to the Ground Fault Relay should be no longer than 25 feet and no smaller than No. 14 AWG. Wires from Monitor Components should be no longer than 50 feet and no smaller than No. 18 AWG. Wires 1, 2 and 3 and Control Transformer should be sized to deliver the necessary current to the Trip Coil at 55% rated output voltage of the Control Transformer.

When zone selective interlock wiring is used, Ground Fault Relay interconnections should be no smaller than No. 18 and no longer than 100 feet. These wires should be routed separately from any power wiring.

All wiring should be protected from arcing fault and physical damage by barriers, conduit, armor or location.

When two wires are used under one terminal on the Sensor, both shall be No. 14.

INTERNAL LONG TIME DELAY SELECTION

The GC-100 relay has four available long time delay settings. (Curve B-0.1; Curve C-0.2; Curve D-0.3; Curve F-0.5 second nominal). As manufactured, the relay will have its long time delay connected for 0.1 second and a jumper from terminal 15 to 16 so its 0.055 second short time delay circuit is restrained.

Internally, the long time delay can be set at the other available values as follows:

1. **Disconnect 120 Vac power to GC-100 relay.** Printed circuit board has 120 Vac on it when energized.
2. Remove cover, exposing the printed circuit board.
3. Carefully disconnect the flexible lead from the 0.1 second slip-on terminal and connect it to the slip-on terminal marked with the desired time delay setting.
4. Select proper pressure sensitive label (included with this booklet) and attach to nameplate to cover the Curve B letter designation. Use A for 0.055, C for 0.2, D for 0.3, or F for 0.5 second.
5. Replace cover and cover screws.

SHORT TIME DELAY

During the construction phase of a project, it is recommended that all ground fault relays use the shortest available time delay. This is the time when faults are most likely to occur and when selective coordination of mains, feeders and branch circuits is least necessary.

With the jumper from terminals 15 to 16 temporarily disconnected, the GC-100 relay will have 0.055 second nominal delay (Curve A). Replace jumper when construction is complete.

If relay is to be operated permanently with jumper 15 to 16 removed, and without restraint input wiring, attach pressure sensitive label A to nameplate.

ZONE SELECTIVE INTERLOCKING

With this connection system, each ground fault relay controlled disconnect will open after only 0.055 second relay delay (plus disconnect operating time) when a ground fault occurs in the zone where it is the nearest to the supply source. However, this disconnect will be restrained to its relay's long time delay and will open only for back-up protection if the fault occurs in a zone supplied by a downstream ground fault relay protected disconnect. Occasionally, the upstream disconnect will be specified to be lock-out restrained (will not be ground fault tripped) when back-up protection is not as necessary as continuity of supply to other circuits.

The major advantage of zone selective interlocking is that arcing fault damage can be kept to a minimum by having short time delay tripping for faults which occur between a main and feeder, or possibly between a feeder and a branch disconnect. However, great care must be taken in wiring and testing the installation to make sure it operates as intended.

Figure 5 shows a method of obtaining three level zone selective interlocked protection. For a fault occurring at location 3 GFR No. 3 trips in approximately 0.055 second and restrains GFR No. 2 to a 0.2 second delay. GFR's No. 2 and No. 1 provide back-up protection.

For a fault at location 2, GFR No. 2 trips in approximately 0.055 second and restrains GFR No. 1 to a 0.5 second time delay for back-up protection.

For a fault at location 1, GFR No. 1 trips in approximately 0.055 second. Its 0.5 second long time delay still operates as a back-up circuit if any component of the short time delay circuit fails.

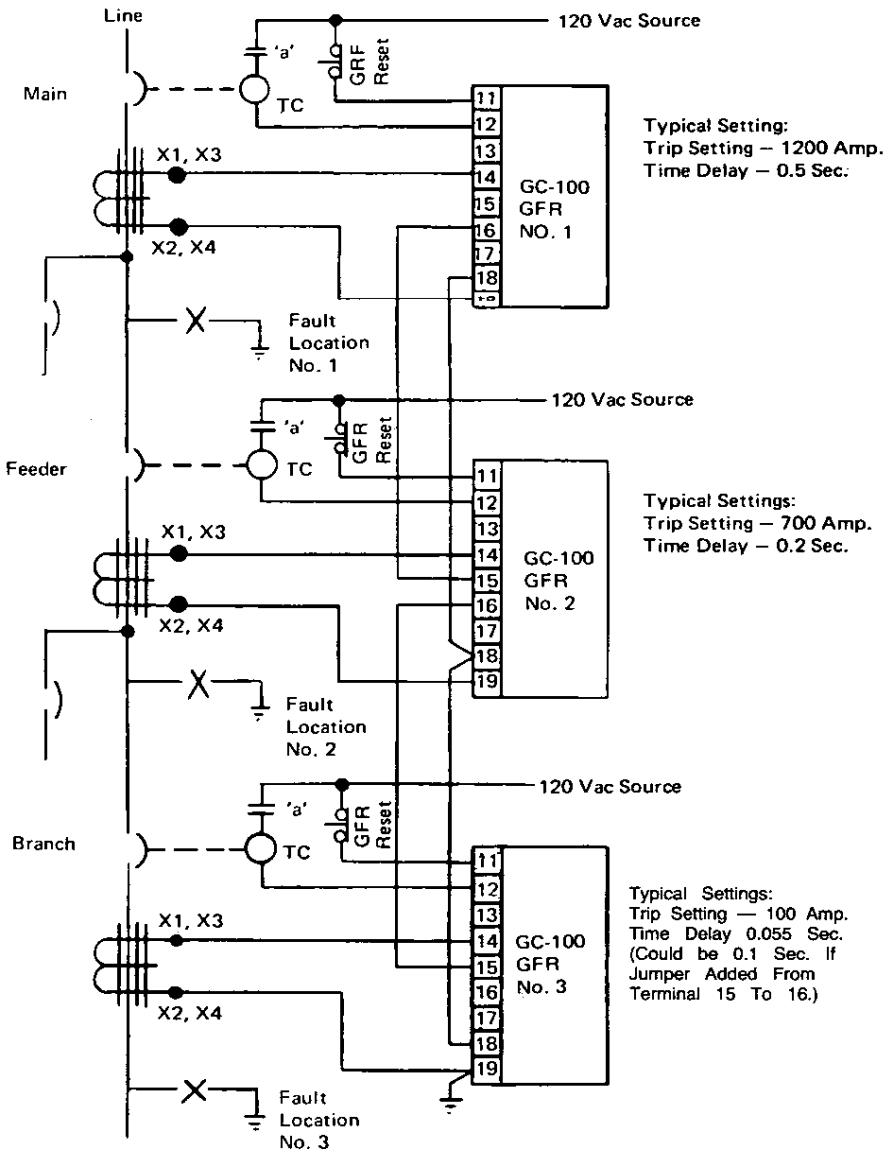


FIGURE 5

Note: All Power Supply and Test Ckt.Connections Are **Not** Shown For Clarity. See Fig. 2 For Complete Individual Relay Wiring

TRIP COIL REQUIREMENTS

A circuit breaker or switch used with the Type GC Ground Fault System must have a trip coil capable of operating reliably at 55% of rated voltage. Inrush current must not exceed 50 amperes at rated voltage. Sealed current must not exceed 10 amperes unless coil clearing contacts (52a) are used. Coil clearing contacts are required for trip coils not rated for continuous duty at 120 Vac.

RELAY SETTINGS

The GC-100 Ground Fault Relay has adjustable trip settings of 100 to 1,200 amperes RMS. Figure 6 shows the five delay curves available. To allow time for fault clearing, the minimum recommended difference in time delays between any two GFRs is 0.1 second. If a ground fault protected bolted pressure contact switch is used downstream from any ground fault protected device, the minimum time delay difference should be 0.2 second.

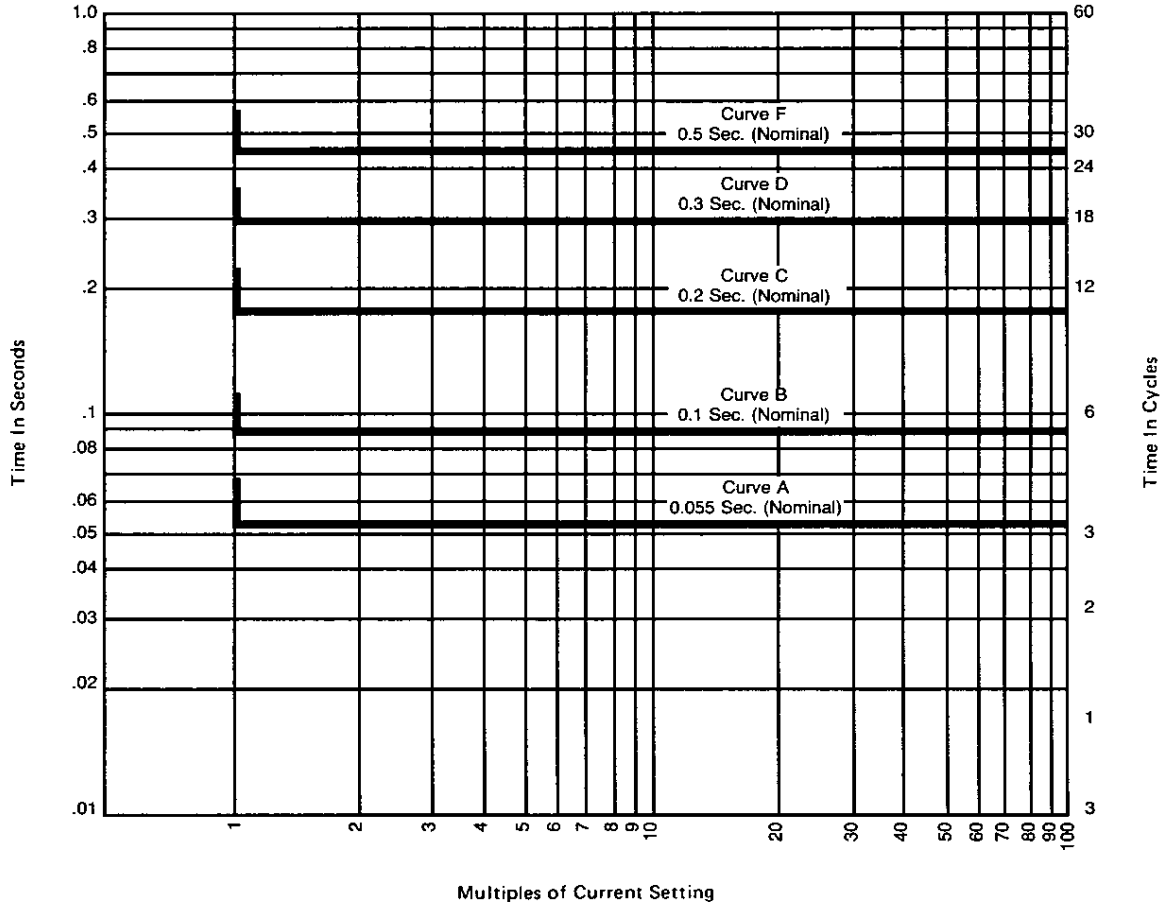


FIGURE 6

High trip settings on main and feeder circuits are desirable to avoid nuisance tripping. High settings usually do not reduce the effectiveness of the protection if the ground path impedance is reasonably low. Ground faults usually quickly reach a value of 40% or more of the available short circuit current in the ground path circuit.

COORDINATION WITH DOWNSTREAM CIRCUIT BREAKERS

It is recommended that the magnetic trips of any downstream circuit breakers which are **not** equipped with ground fault protection be set as low as possible.

Likewise, the ground fault relay trip settings for main or feeder circuits should be higher than the magnetic trip settings for unprotected downstream breakers where possible. This will minimize nuisance tripping of the main or feeder breaker for ground faults occurring on downstream circuits.

RATINGS

1. The type GC-100 Ground Fault Protection System is suitable for use on equipment connected to a source having 200,000 RMS amperes or less available ground fault current.

2. The GC-100 relay contacts (internally connected to terminals 12 and 19) are rated as follows:

   Voltage: 120 Vac

   Current: Inrush 50 amperes, Continuous 10 amperes
   Break 10 amperes

3. Normal transient voltage surges are suppressed to a level that will not cause the GFR to nuisance trip. Under extreme transient conditions, additional protection may be necessary. Contact your local Square D office for assistance if repeated outage caused by transient line voltage surges is experienced.

4. The GC-100 relay has the following power requirements:

   Voltage: 120 Vac

   Power: Standby 3 watts Typical
   After Trip 12 watts Typical

   Note, however, that the switch or circuit breaker trip coil requires additional power from the control supply. The control power transformer must have adequate size and regulation characteristics to trip the disconnect when the line voltage drops to 55% of its normal value.

5. Restraint interlocking between relays:

   A. Each Ground Fault Relay Restraint Output can drive up to eight restraint unit loads.

   B. Total restraint unit loads may be calculated by adding the number of Restraint To Time Delay Inputs plus twice the number of Lockout Restraint Inputs which the Restraint Output must drive.

      i.e., Restraint To Time Delay Input = 1 unit load
      Lockout Restraint Input = 2 unit loads

   C. Each GFR Restraint To Time Delay and Lockout Restraint Input can receive signals from up to twenty Restraint Output sources provided that no more than six of the sources can be energized simultaneously.

CAUTION INSTRUCTION AND NOTES

1. **Do not ground terminal 15** or connect it to any terminal other than a number 16 or 17 terminal.

2. Note that terminals 18 and 19 are permanently internally connected.

3. **All Ground Fault Relays using restraint interconnections must have a common ground** connected to terminal 18 or 19.

4. Once the GFR has tripped for any reason, it must be reset before the protected circuit breaker or switch can be turned "on" and remain closed.

5. During installation, inspection or replacement, jumper from terminal X1, X3 to terminal X2, X4 on the Sensor to prevent possible high voltage outputs. The jumper must be removed when all wiring is complete.

MAINTENANCE

The Ground Fault Relay needs little maintenance due to its solid state control and sensing circuitry. The output relay mounted on the top endwall should be inspected periodically along with the terminal connections for corrosion, pitting and tightness. If the Ground Fault Relay fails to operate properly or is subjected to physical or electrical damage, it should be replaced.

TEST PROCEDURES

Field Tests & Monitor Components

The GC-100 Ground Fault Relay and Sensor may be tested with or without tripping as desired. Each Sensor is provided with a test winding of 800 turns (terminals X5, X6) and should be connected as shown in Figure 2.

The Monitor Components shown in Figure 2 and listed below provide both test with tripping and test without tripping functions. A nameplate is provided with each Ground Fault Relay giving operation instructions for this connection.

Standard Monitor Components

Test Button	Class 9001	Type K1L-38G-H2
Reset Button	Class 9001	Type K1L-38R-H1
Test Relay	Class 8501	Type RS14, 120 Vac (or Type KP12, 120 Vac)
Relay Socket	Class 8501	Type NR44 (or Type NR1)

To test without tripping, press the Test button only (See Figure 1). This simulates a ground fault in the Sensor, disconnects the 120 volt power source from the Output Relay K and applies 120 volts to the Control Triac Circuit via L1. After the relay times out the Control Triac Circuit turns on Lamp L1. Some lamp flicker is normal.

To test with tripping, press the Test and Reset buttons simultaneously (See Figure 1). This establishes the normal power supply connections and energizes the test winding. Both L1 and L2 will light after the time delay interval and the Disconnect Trip Coil will pick up. Under both test conditions releasing the test button automatically resets the Ground Fault Relay.

When **only** the test with tripping function is required, the Monitor Components may be as listed below. Figure 7 shows connections for these components. No nameplate is supplied for this arrangement.

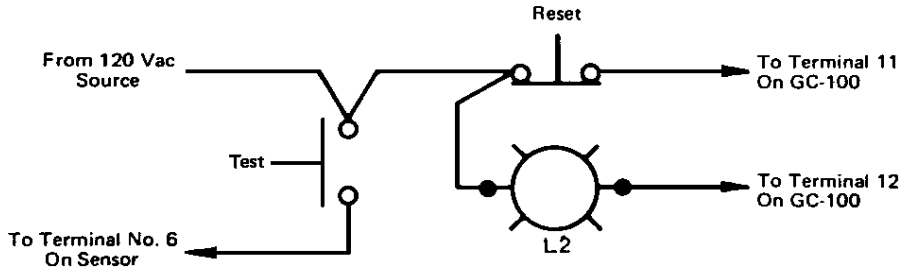


FIGURE 7

Test With Tripping Monitor Components

Test Button	Class 9001	Type KR-2B-H5
Reset Button	Class 9001	Type K1L-38R-H6

A test operation should be performed at least once a year and once immediately after each time the circuit is interrupted due to a fault of any kind.

HIGH POTENTIAL TESTS

Do not apply voltage from a megger, hi-pot tester or continuity tester to the solid state time delay ground fault relay circuits. If a high voltage test is required for the control wiring, remove wires from terminals 11, 12 and 13, then jumper all terminals together before applying voltage. Do not apply voltage higher than 1,240 Vac RMS/60 Hz. to relay terminals at any time.

BENCH TEST PROCEDURE

The test bench circuit shown in Figure 8 will permit measurement of both the trip current and the time delay of the relay. Do not attempt to run this test with the relay mounted in or wired to any other equipment. The trip current may be measured by increasing the current read by the ammeter, AM, very slowly with the adjustable voltage transformer, and noting the lowest current at which the relay CR picks up. Multiply the ammeter reading by 600 to get the value which would be required in the primary of the Sensor to provide the same trip point. Hold the Test button closed while measuring the trip current, but not more than 30 seconds. The measured trip current should be within ±20% of the nameplate setting.

For determination of the time delay, set the relay trip setting at 1,200 amperes, hold the Test button closed and adjust the transformer for an ammeter reading of 1.0 amperes (equivalent to 600 amperes Sensor primary current). Then set the Ground Fault Relay trip setting back to 100 amperes. Measure the relay time delay by pushing the Test button and holding it until the clock stops. The measured trip time should be within + 5% and - 20% or -3 cycles of the time delay shown in Figure 6. For measurement of time delay Curve A remove jumper connecting terminal 15 to terminal 16.

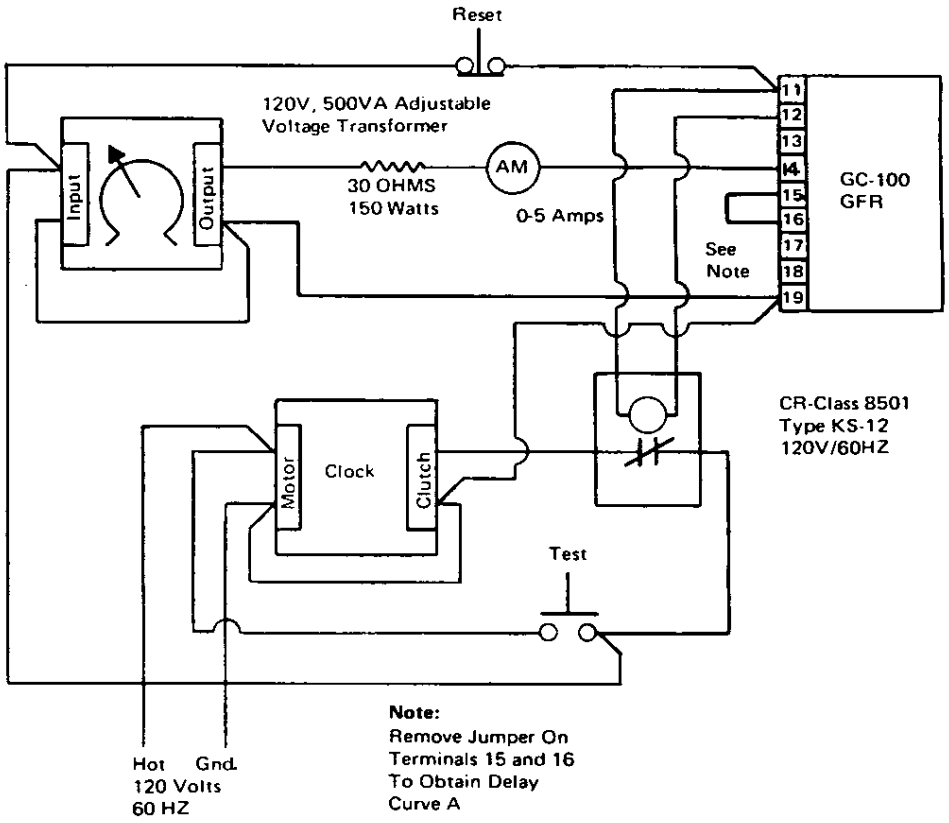
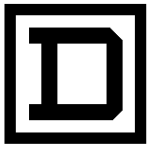


FIGURE 8



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