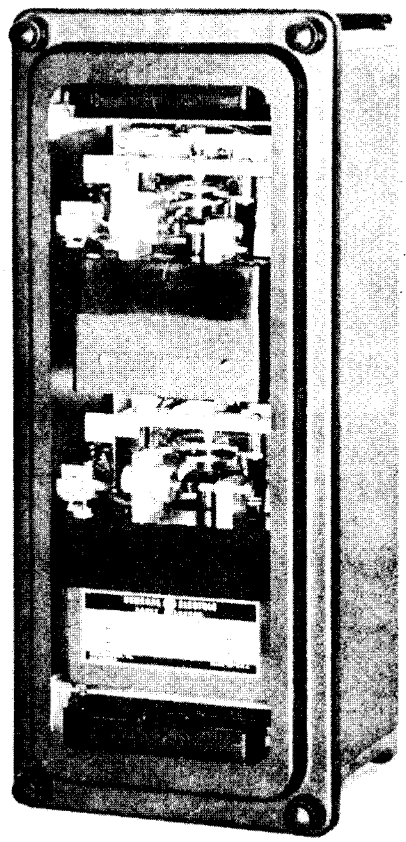
GEI-98337E

INSTRUCTIONS

FAULT DETECTOR RELAY



TYPE CHC15

GENERAL ELECTRIC

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Cover photo (8035583)

CURRENT FAULT DETECTOR RELAY

TYPE CHC15A

DESCRIPTION

The Type CHC15A is a high-speed current fault detector relay. The components consist of two induction cup units, an auxiliary telephone relay and two targets.

The INDUCTION cup units serve as the fault detectors. The top unit is used for ground fault detection, with the bottom unit for phase fault detection.

The auxiliary telephone relay provides four electrically-separate circuits.

The circuit arrangement is aimed to provide maximum flexibility in application.

The relay is mounted in the M-2 draw-out case.

APPLICATION

The CHC15A is ideally suited whenever high-speed fault detection is required. The top unit (GFD), featuring a low burden, is for single phase-to-ground faults. The bottom unit (PFD) is used to detect three-phase, phase-to-phase and double line-to-ground faults. This unit also serves to detect phase-to-ground faults if the magnitudes are large enough.

The continuous current-carrying capabilities of the fault detectors, along with the four electrically-separate contacts, provide a relay that is particularly well suited for applications as a fault selector in circuit breaker failure back-up schemes. In these schemes, the relay is used to detect the failed breaker and to select the back-up breaker to be tripped to isolate the fault. In these schemes, the relay may be called upon to carry maximum fault current for some fraction of a second before clearance; hence the short-time current capabilities of the relay should be checked. (See Table I.)

In multibreaker bus arrangements, the currents which the relay may receive could exceed the continuous rating. The 2-8 amp PFD, while rated 5 amp, can carry 8 amps continuously. The ratings of other available ranges are noted in Table I.

In a circuit breaker failure scheme, the DC supply for the auxiliary relay must not be taken through the same fuses from which the associated circuit breaker obtains its tripping current.

The speed of operation will be found under **CHARACTERISTICS;** in this connection it is important to note that the pickup and dropout time curves for the fault detectors are maximum times, and include the auxiliary relay. The dropout time is the time to open the normally-open contacts of the auxiliary telephone relay.

RATINGS

The fault detector current circuit ratings in amperes, and their adjustable range of pickup, are shown in Table I.

TABLE I

UNIT	Continuous	One Second	Frequency	Pickup Range
GFD	2.5	90	60	0.5- 2.0
	5.0	170	60	1 - 4.0
	16.0	290	60	4 -16
PFD	4.0	150	60	1 - 4
	8.0	290	60	2 - 8
	16.0	290	60	4 -16

The contacts of the fault detectors are capable of interrupting the auxiliary telephone relay coil current.

The auxiliary telephone relay is continuously rated at the nameplate DC voltage. The contact-interrupting capabilities are shown in Table II.

TABLE II

VOLTS	INDUCTIVE AMPS†
48DC	1.0
125DC	0.50
250DC	0.25

† Induction of average trip coil. The non-inductive ratings are approximately 2 1/2 times the ratings shown.

The continuous and short-time ratings of the targets are shown in Table III.

TABLE III

RATING	CONTINUOUS	TRIP DUTY	RESISTANCE, OHMS
1.0	4.0	30	0.3
0.2	0.4	5	7.0

CHARACTERISTICS

The fault detector units consist of a cup-like induction cylinder embodied in an eight-pole stator construction. Torque is developed by the reaction of the flux that is produced by the coils on the poles of the stator, with the eddy current flux that is induced in the cup.

THE GFD unit, with all of the operating coils in series, responds to the magnitude of a single quantity of current for its operation. The pickup setting is determined by the rated range of pickup and is continuously adjustable through this range by the control spring adjustor.

The PFD unit receives currents from a three-phase system. The phase currents are supplied to certain sets of coils on the poles of the eight-pole stator. The torque of this unit then depends upon the magnitude and combination of the phase currents supplied to the unit. The following equations determine how the torque is related to the phase currents.

$$\text{Torque} = K(I_1^2 + I_2^2 + I_3^2)$$, where K is a design constant.

There is a definite relationship with respect to the magnitude of current to operate the unit when supplied with three-phase currents vs phase-to-phase currents. This relationship develops more neatly if a unit is set to pick up at 3 amperes for a phase-to-phase fault. Under these conditions the equation, without one of the phase currents, is as follows:

$$\text{Torque} = K(3^2 + 3^2) = 18K$$

In order to develop the same pickup for a balanced three-phase fault,

$$\text{Torque} = 18K = K(I^2 + I^2 + I^2)$$

$$3I^2 = 18$$

$$I = \frac{3\sqrt{2}}{\sqrt{3}} = 2.44 \text{ amperes.}$$

The relationship between the balanced three-phase pickup and the phase-to-phase pickup is $\frac{\sqrt{2}}{\sqrt{3}}$, or 0.817 times the phase-to-phase pickup.

The unit will also operate with current in only one phase. Again, with the 3 amp phase-to-phase pickup, the single phase current required to operate the unit becomes:

$$T = 18K = KI^2$$
$$I^2 = 18$$
$$I = 3\sqrt{2} = 4.24 \text{ amperes}$$

The single-phase pickup current is $\sqrt{2}$ times the phase-to-phase pickup. The unit, therefore, can detect single phase-to-ground faults as well as multi-phase faults if the fault current is large enough for the application in question.

The foregoing defines the relationship between the values with respect to the various types of faults.

Both fault detector contact circuits include a holding coil. The small level of current drawn by the auxiliary relay provides enough holding to cause good contact at the minimum operating value.

In the case of the PFD, the circumstances may be such as to have load currents hovering at the minimum pick-up value. The holding action prevents possible continuous arcing of the contacts under these conditions. The holding action is adjusted to provide a dropout value of approximately 80% of pickup when set at the minimum pickup value of the adjustable range.

The GFD dropout values are not critical; however, in no case will they be set for less than 50% of the minimum pickup value.

While the holding coils provide good contact action at the minimum operating values where it may be required in the case of the PFD, and tend to prevent contact bounce when the detectors are operating at higher levels of current, it is recommended for overall good contact action that the settings for fault detection be such that the coils receive currents in the order of 1.5 times the minimum operating point.

Table IV shows the pickup range of a 2-8 amp range PFD, depending upon the type of fault. The pickup values for the other ranges will have the same relationship to their adjustable range.

TABLE IV

TYPE OF FAULT	RANGE OF PICKUP
Phase-to-Phase	2 - 8
Three-Phase	1.63 - 6.52
Single Phase-to-Ground	2.83 -11.3

The time-current characteristics of both types of fault detector are shown in Figures 1 and 3 (Pickup Time) and Figures 2 and 4 (Dropout Time).

Figures 1 and 3 represent the maximum time from the application of current to the fault detectors, to the time the auxiliary relay's normally-open contacts close. The operating time varies with the pickup setting of the fault detectors, as also shown in Figures 1 and 3.

Figures 2 and 4 represent the maximum time from when the current to the fault detectors is suddenly reduced to 0, to the time when the normally-open contacts of the auxiliary relay open. Again, this is the total dropout time of both units. The single curve represents all pickup settings of the fault detectors.

The burdens of both the GFD and PFD are shown in Table V. The burdens indicated are with 5 amps flowing per phase (that is, terminals 3 to 4, 5 to 6, or 7 to 8), in the case of the PFD, and the total current circuit for the GFD.

TABLE V

UNIT	Studs	Range	Frequency	Volt Amps	Impedance	P.F.(lag)
GFD	15-16	0.5- 2.0	60	17.0	0.68	0.64
	15-16	1 - 4	60	4.25	0.17	0.64
	15-16	4 -16	60	0.27	0.011	0.64
PFD	See Text	1 - 4	60	20.0	0.8	0.50
		2 - 8	60	5.0	0.2	0.50
		4 -16	60	1.25	0.05	0.5

CONSTRUCTION

The type CHC15A relays are assembled in the standard medium-size double-end (M-2) drawout case having studs at both ends in the rear for external connections. The electrical connections between the units and the case studs are made through stationary molded inner and outer contact blocks, between which nests a removable connection plug that completes the circuits from the external connections to the relay units.

The relay mechanism is mounted in the steel framework called the cradle, and is a complete unit with all leads being terminated at the inner blocks. This cradle is held firmly in the case with a latch at both top and bottom, and by a guide pin at the back of the case. The connection plug, besides making the electrical connections between the respective blocks of the cradle and case, also locks the latch in place. The cover, which is drawn to the case by thumb screws, holds the connection plug in place. There is also a mechanism on the cover that prevents it from being secured to the case in the event the connection plug was omitted.

A separate, Type XLA, test plug is available, which can be inserted in place of the connection plug, to conduct tests on the relay. The test plug permits testing with the relay on the panel, using either its own source or separate sources.

The relay is composed of two major units:

1. The top element contains the GFD unit with target T_1, and the auxiliary telephone relay (A) mounted at the rear.

2. The bottom element contains the PFD unit with target T_2. At the rear are capacitors and resistors associated with both elements.

Figures 5 and 6 shown the relay removed from its drawout case, with all major components identified. Symbols used to identify circuit components are the same as those which appear on the internal connection diagrams in Figure 7.

RECEIVING, HANDLING AND STORAGE

These relays, when not included as part of a control panel, will be shipped in cartons designed to protect them against damage. Immediately upon receipt of a relay, examine it for any damage sustained in transit. If injury or damage resulting from rough handling is evident, file a damage claim at once with the transportation company and promptly notify the nearest General Electric Sales Office.

Reasonable care should be exercised in unpacking the relay in order that none of the parts are injured or the adjustments disturbed.

If the relays are not to be installed immediately, they should be stored in their original cartons in a place that is free from moisture, dust and metallic chips. Foreign matter collected on the outside of the case may find its way inside when the cover is removed, and cause trouble in the operation of the relay.

ACCEPTANCE TESTS

Upon receipt of the relay, an inspection and acceptance test should be made to make sure that no damage has been sustained in shipment and that the calibrations have not been disturbed. If the examination or test indicate need for readjustment, refer to the section on **SERVICING**.

VISUAL INSPECTION

Check the nameplate stamping to make sure that the model number and rating of the relay agree with the requisition.

Remove the relay from its case and check that there are no broken or damaged parts or other signs of physical imperfections in the case as well as the relay proper. With respect to the relay, check for loose screws, tarnished contacts, and any other parts of the construction that would impair the operation.

MECHANICAL CHECKS

The two main operating units are the fault detectors, and except for size they are essentially the same with regard to the moving and stationary contact assembly.

The contact gap should be 0.020" to 0.025". The cup shaft end play should be 0.015" to 0.020". Check for an approximate 0.005" deflection of the contact (G) in the stationary contact assembly. See Figure 8.

Operate the targets to see that the target indicator will drop before the total travel of the armature is exhausted. In a like manner, reset the target, noting that additional travel is available after the armature has moved into the reset position.

Check the telephone relay for proper contact gaps and wipe.

The contact gaps, both normally-open and -closed, should be approximately 0.015".

The contact should deflect at least .005". On closing a normally-open contact, this wipe can readily be observed. On the closing of a normally-closed contact, this magnitude of wipe may not be present; however, if the stationary contact spring of the pair is deflected and its moving member follows for at least 0.005", the adjustment is satisfactory.

ELECTRICAL TESTS

1. FAULT DETECTORS

The fault detectors were set at the factory to pick up at the minimum value for their adjustable range. Refer to Table I for the adjustable ranges.

A confirming check of these settings will ensure proper performance of the units. The maximum pickup value may be checked by loosening the hex nut on the spring adjustor assembly and winding up the control spring to confirm this maximum value.

A test circuit for checking the fault detectors' pickup values is shown in Figure 9.

* In testing the PFD, the pickup values for the sets of coils involved in phase-to-phase types of faults are checked. The pickup values for each type of phase-to-phase fault test should be equal to each other within 10%, using the highest value as the base. The factory setting is such that the maximum pickup of the three values is equal to the minimum value of the adjustable range. If a pickup value other than the minimum setting is to be made, choose the phase-to-phase fault that gave the highest pickup value. The other phase-to-phase fault checks need not be made. After pickup has been set, be sure to secure the control spring adjustor by tightening the hex locking screw. Make sure the spring-adjusting ring is set back as far as possible into the molded spring-adjusting-ring housing before tightening the locking screw.

The contacts of the fault detectors will show a tendency to wipe in, due to the action of the holding coil. The required level of holding coil force is determined by the dropout current of the units. The dropout test should be made with the units set for the minimum value of the adjustable range. For both the GFD and the PFD, the dropout should be 50% to 90% of pickup.

A coarse adjustment of the holding action force is set by the air gap between the armature on the moving assembly and the pole pieces on the holding coil. This can be refined by changing the value of the R-1 resistor in the control circuit. The R-1 resistor, however, should never be set lower than 80% of its maximum value. The holding coil gap should be at least 0.015" when the contacts are closed and fully wiped in.

Both fault detectors are equipped with a mechanism that will permit the cup shaft to slip in the moving contact assembly at a specified level of current.

The clutch adjusting screw is located near the center of the moving contact assembly. The projecting threaded screw controls the pressure on the shaft by compressing a spring encased in the assembly.

The clutch setting on both the GFD and PFD units is made by first setting the units at the minimum value of their adjustable range. For example, adjust the pickup of the 2-8 amp unit to 2 amperes. If the current is then increased to 10 times minimum pickup current, the clutch should not slip. The clutch should slip if 12 times minimum pickup is applied to the unit. After the setting has been made, secure the adjusting screw with the locknut.

* Revised since last issue.

2. AUXILIARY TELEPHONE RELAY (A)

Block one of the fault detector contacts closed and check to see that the relay picks up at 80% of rating or less. Check to see that the dropout voltage is 50% or less.

3. TARGETS T_1 and T_2

Refer to the nameplate for the target ratings. The targets should operate at a DC current between 70% and 100% of its rating.

T_1 may be checked by applying current to studs 1 and 13.

To test T2, apply current to studs 2 and 16. To complete the circuit, it will be necessary to energize the telephone relay. Do not permit the relephone relay to open the circuit if the operating current exceeds telephone relay contact ratings as shown in Table II.

4. SPEED OF OPERATION

The time current curves, shown in Figures 1 and 3, represent the maximum pickup time of the fault detector and include the time of the auxiliary telephone relays. The speed is the time from when the current is applied to the fault detector until the normally-open contact of the telephone relay closes.

The time current curves shown in Figures 2 and 4, represent the maximum dropout time, again including the telephone relay. The speed is the time from when the current is dropped to 0 until the normally-open contact of the telephone relay opens.

The operating time of the telephone relay for the above pickup or dropout conditions is less than 0.006 second.

The speed of the fault detectors is an inherent design characteristic; hence, it need not be checked. The checks for minimum pickup would have revealed any undue friction, and with the contact gap set as specified, the correct speed will follow.

The speed of the auxiliary telephone relay is a function of armature air gap, spring forces, and contact gaps, all of which have been set at the factory. Here again, these factors have been checked by contact inspection and pickup tests.

Should it become necessary to test for speed, the use of electronic timing devices will be required, because the operating times are usually too far below the capabilities of electro-mechanical timers. Because of these high speeds, the switching that operates the relay and starts or stops the timer should occur almost simultaneously.

INSTALLATION PROCEDURE

LOCATION

The location of the relay should be clean and dry, free from dust, excessive heat and vibration, and should be well lighted to facilitate inspection and testing.

MOUNTING

The relay should be mounted on a vertical surface. The outline and panel drilling dimensions are shown in Figure 11. Unless mounted on a steel panel that adequately grounds the relay case, the case should be grounded to a mounting stud with a copper conductor not less than #12 B & S or its equivalent.

CONNECTIONS

The internal connection diagram is shown in Figure 7. A typical external wiring diagram is shown in Figure 12.

PERIODIC CHECKS AND ROUTINE MAINTENANCE

In view of the vital role of protective relays in the operation of a power system, it is important that a periodic test program be followed. The interval between periodic checks will vary depending upon environment (e.g. extreme heat, moisture, and fumes), type of relay and its importance in the protective scheme, and the user's experience with periodic testing. Until the user has accumulated enough experience to select the test interval best suited to his individual requirements, it is suggested that the points listed under **ACCEPTANCE TESTS** be checked at an interval of at least one year.

The periodic checks in general are aimed to detect the two factors that can render the relay inoperative, i.e., friction and contaminated contacts.

With regard to the fault detectors, a test for the minimum pickup value will check whether the unit has undergone any changes in the circuit structure as well as revealing any undue friction. Small incremental changes in current to cause the moving assembly to move away from the back stop toward the contact will reveal any tendency of binding. Do not energize the auxiliary relay circuit during these tests, to omit the holding action. The actual pickup value, if within limits, will give assurance that no changes have occurred in the circuit structure. Comparing pickup values with the relay's history of previous periodic checks is particularly useful in detecting whether the pickup value is tending to rise over the years, thereby giving an indication of impending trouble.

The ability of the contacts to perform as required can be checked during the minimum pickup tests. If the auxiliary telephone relay circuit is supplied with its rated voltage, the operation of the fault detector contact will cause the telephone relay to pick up. The operation of the telephone relay will energize the holding coil. This holding coil action is light, but sufficient to held the contact closed when operating in the area of minimum pickup.

Slightly discolored contacts need not be cleaned if they perform as noted above. If the contact becomes badly discolored, it should be dressed with a contact-burnishing tool.

This is a flexible strip of metal with an etched-roughened surface, which in effect resembles a superfine file. The polishing action of this file is so delicate that no scratches are left on the contacts, yet it cleans off any corrosion thoroughly and rapidly. The flexibility of the tool ensures the cleaning of the actual points of contact.

Fine silver contacts should not be cleaned with knives, files, or abrasive paper or cloth. Knives or files may leave scratches which increase arcing and deterioration of the contacts. Abrasive paper or cloth may leave minute particles of insulating abrasive material in the contacts and thus prevent closing.

The burnishing tool described above can be obtained from the factory.

The cup and shaft assembly rides on a synthetic sapphire jewel as its lower bearing, and a stainless steel guide pin as its upper bearing. Do not lubricate these bearings, or any other components of the relay.

A check on the minimum pickup value of the telephone relay, along with permitting its contacts to operate the targets, serves to check the telephone relay and its contacts as well as the performance of the targets. Contact burnishing is in order if the discoloration is pronounced.

Connections for field testing using a type XLA test plug are shown in Figure 13.

SERVICING

If the adjustments on any of the operating components were disturbed due to damage during shipment or for any other causes, they may be restored after corrective repairs have been made, by referring to the section on **ACCEPTANCE TESTS** for the required adjustments and settings. With respect to the fault detectors, the procedure for restoring adjustments of the contact assembly, as noted below, will aid in obtaining the proper adjustments.

1. Back away the contact barrel and stop assemblies, to give the moving assembly maximum freedom of motion. (See Figure 5.)

2. Set the control spring so that the moving contact assumes a position midway between the barrel contact and the right-hand front stop. Tilt the relay very slightly to the left and right, noting that the moving contact responds to this motion. If any undue friction is present, the motion of the contact will be sluggish. If such is the case, remove and inspect the lower jewel and upper guide pin for imperfections. If the bearing assemblies are satisfactory, the bind will be due to some particle in the air gap assembly (between the barrel and stop assemblies).

3. Adjust the stop screw so that the center line of the moving assembly is parallel to the side of the unit.

4. Wind up the control spring until the moving assembly just bears against the stop screw.

5. Check the wipe of the barrel contact, and set the contact gap. (The contact barrel threads are 32 to the inch.)

   a. Move in the contact barrel until it just touches the moving contact. Rotate the barrel toward the contact and note that the contact wipes between 1/8 and less than 1/4 turn before being stopped by the diaphragm behind the contact button (see Figure 8). This 1/4 turn indicates a wipe of 0.008". The desirable wipe is in the order of 0.004" to 0.009".

b. Back away the barrel until the contacts just touch, then back the barrel out approximately 5/8 of a turn further, which will result in a contact gap of 0.020", and lock in this position.

6. The holding coil assembly setting is described under **ACCEPTANCE TESTS.** To reposition the assembly, loosen the hex stud and adjust the position of the assembly to obtain the desirable dropout value, then retighten the stud. The final setting should always result in an air gap between the pole pieces and the armature, with the moving contact in the closed and fully-wiped position.

The essential checks on the telephone relay are as follows:

1. Armature gap, de-energized, approximately 1/32".

2. Armature gap, energized, 0.002".

3. Contact gaps, 0.015".

4. Contact wipes, 0.005".

5. Contact pressures, at least 15 grams measured at the contact tips.

6. All normally-open contacts should make simultaneously.

7. The operating times should be 0.005 seconds or less for pickup at rated voltage, to close a normally-open contact or open the same contact upon complete loss of voltage for dropout.

* PFD PHASE-TO-PHASE BALANCE CHECK

With the connections of Figure 13 for a Ø1-Ø2 condition, set the applied current to the minimum value for the cup-unit pickup. Adjust the control spring so that the contact just closes. Before tightening the locking screw to secure the control spring, make sure the spring-adjusting ring is set back as far as possible into the molded spring-adjusting-ring housing. Reduce the current to almost zero and then increase the current until the PFD contact closes. This pickup current should occur at the minimum value ± 2%.

Connect the relay for the Ø2-Ø3 connection and record the pickup.

Connect the relay for the Ø3-Ø1 connection and record the pickup.

The pickup of the lowest phase pair should not be below 90% of the highest phase pair.

If the lowest pickup is less than 90% of the highest pickup, the core must be re-adjusted. There is a flat portion on the inner core. This is indicated by a notch on the bottom of the core.

Loosen the core locknut and move the core as follows:

If the Ø3-Ø1 combination is the highest pickup, then turn the core flat to be in front of the right-rear pole.

* Revised since last issue

If the Ø2-Ø3 combination is the highest pickup, then turn the core flat to be in front of the left-rear pole.

If the Ø1-Ø2 combination is the highest pickup, then turn the core flat to be in front of the right-front pole.

Again measure the three phase-to-phase pickup combinations to make sure that the lowest pickup is not less than 90% of the highest pickup.

RENEWAL PARTS

Sufficient quantities of renewal parts should be kept in stock for the prompt replacement of any that are worn, broken or damaged.

When ordering renewal parts, address the nearest Sales Office of the General Electric Company. Specify the name of the part wanted, quantity required, and complete nameplate data, including the serial number, of the relay.

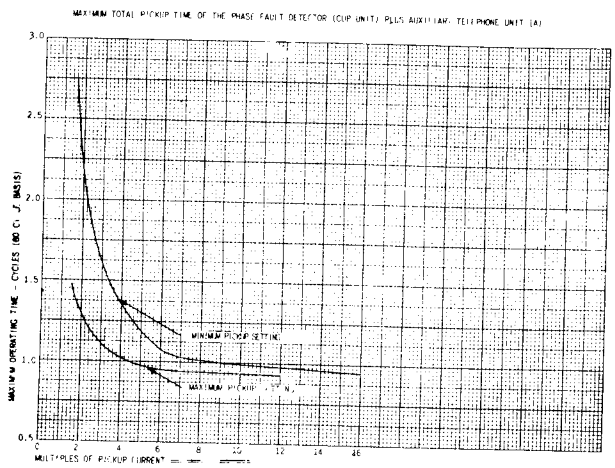


Figure 1 (0127A9438-1 Sh.4) Phase Fault Detector Pickup Time

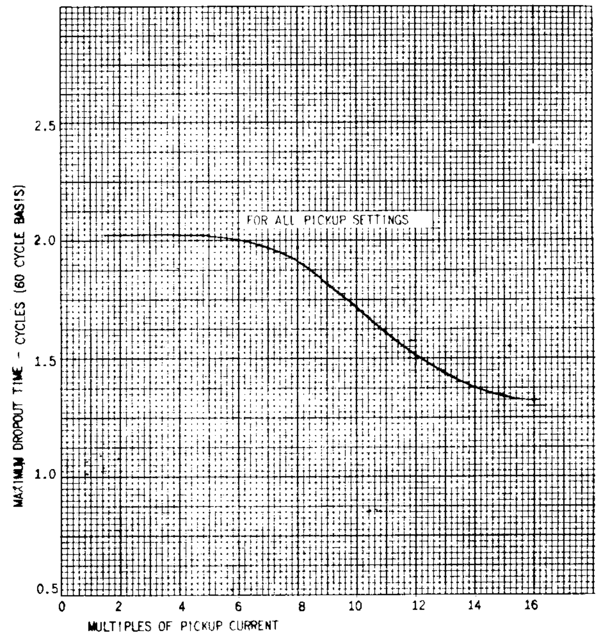


Figure 2 (0127A9438-0 Sh3) Phase Fault Detector Dropout Time

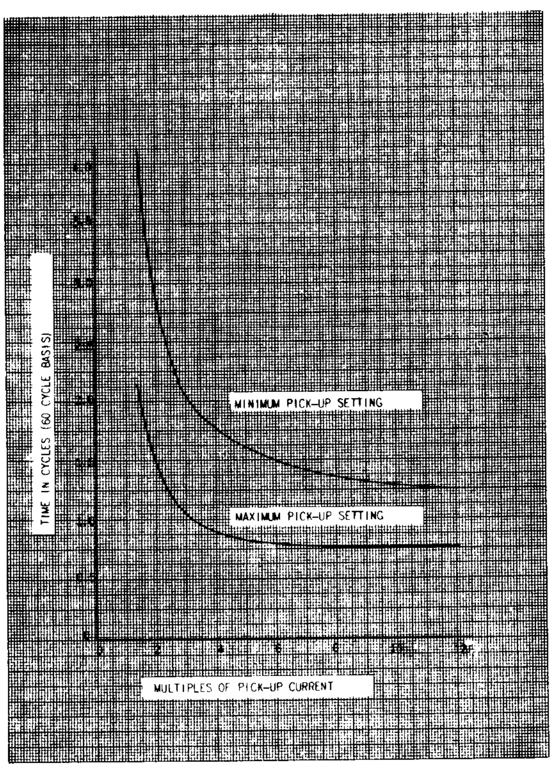


Figure 3 (0178A9109-0) Ground Fault Detector Pickup Time

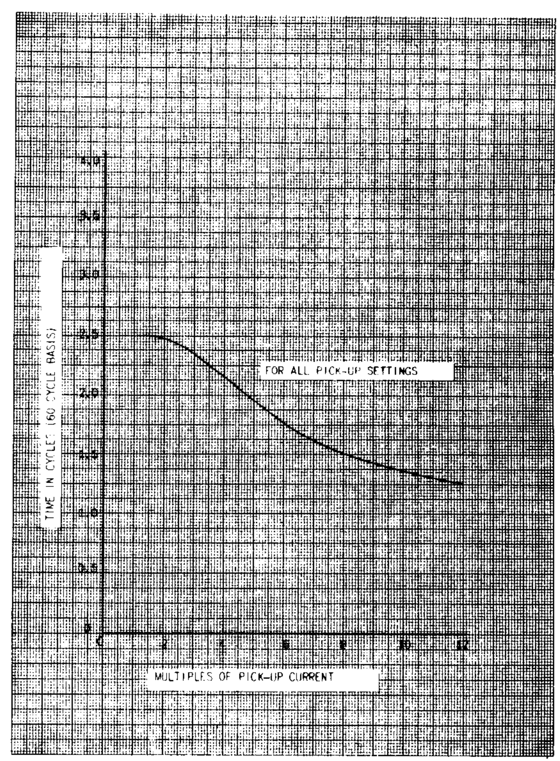


Figure 4 (0178A9110-0) Ground Fault Detector Dropout Time

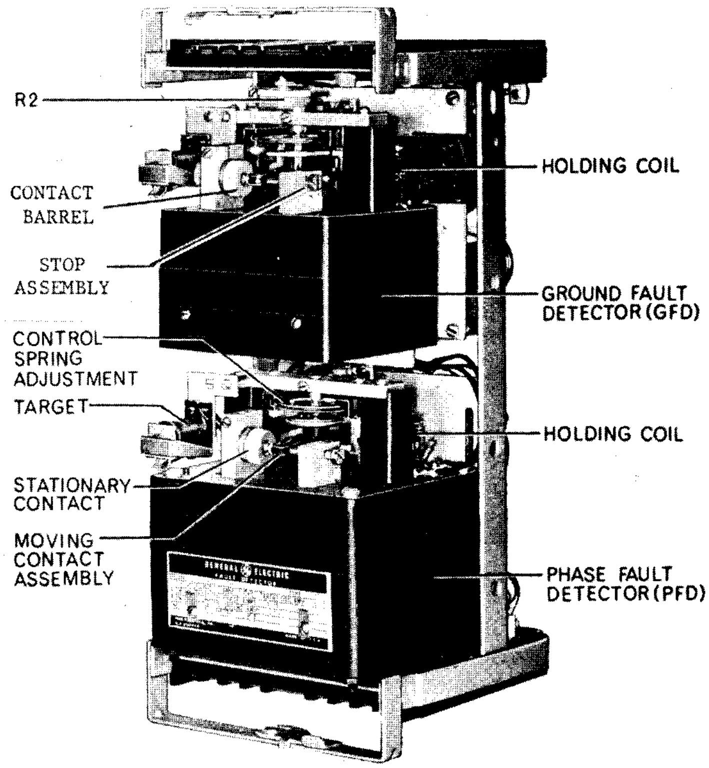


Figure 5 (8035588) Type CHC15A Relay Removed from Case (Front View)

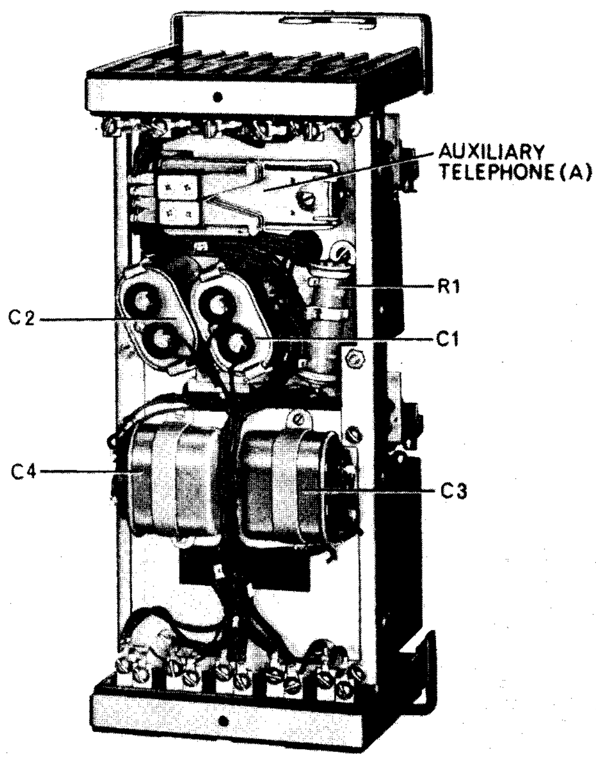
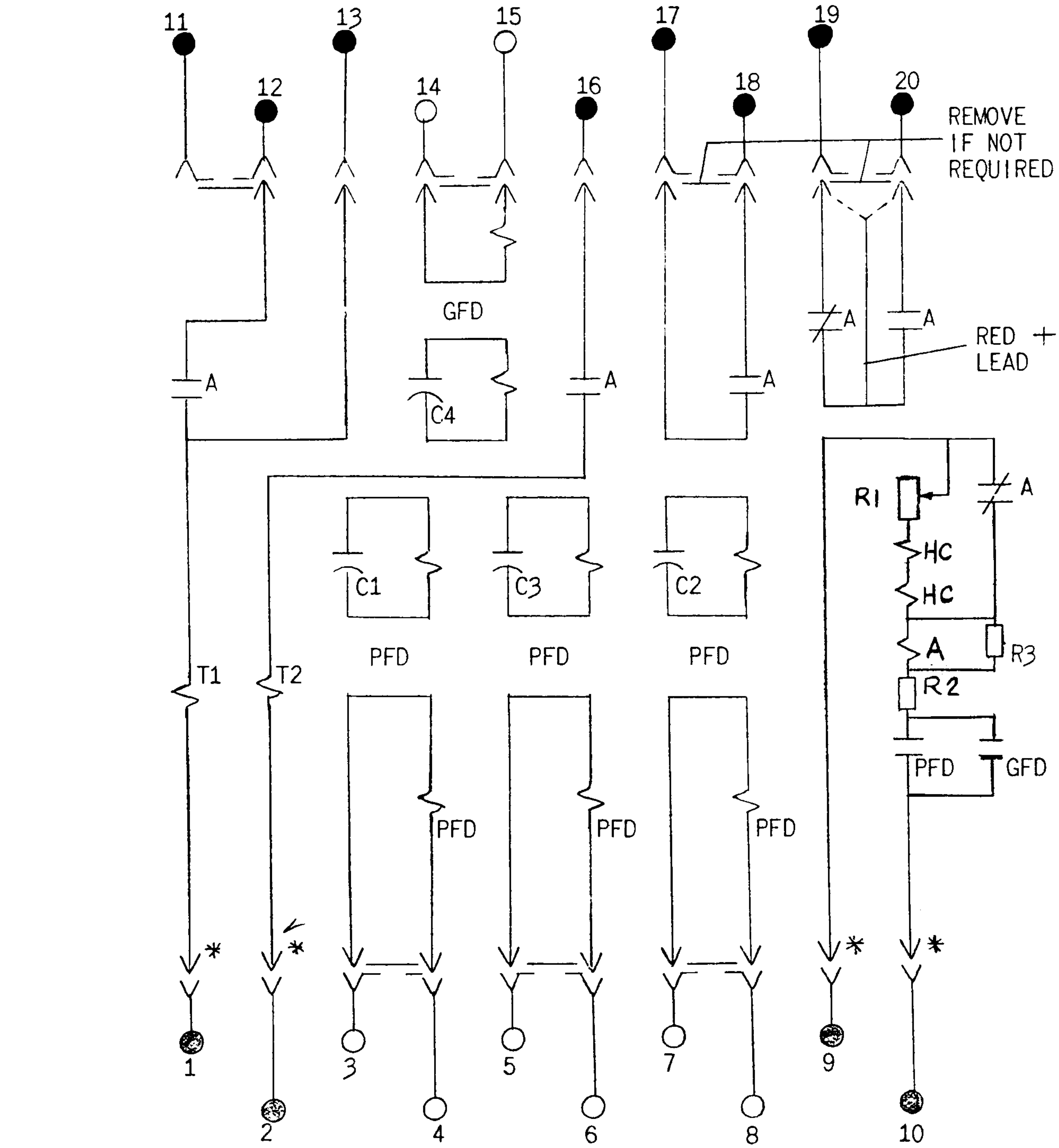


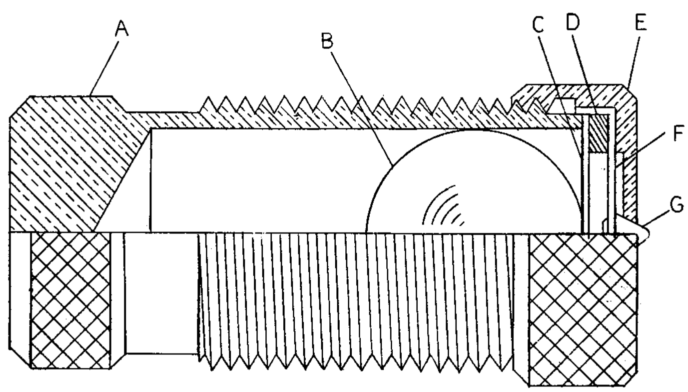
Figure 6 (8035580) Type CHC15A Relay Removed from Case (Rear View)



A = TELEPHONE RELAY
GFD = GROUND FAULT DETECTOR CUP UNIT
PFD = PHASE FAULT DETECTOR CUP UNIT
+ CONNECT TO OBTAIN EITHER NORMALLY OPEN OR NORMALLY CLOSED CONTACT.
* = SHORT FINGER
HC = HOLDING COIL

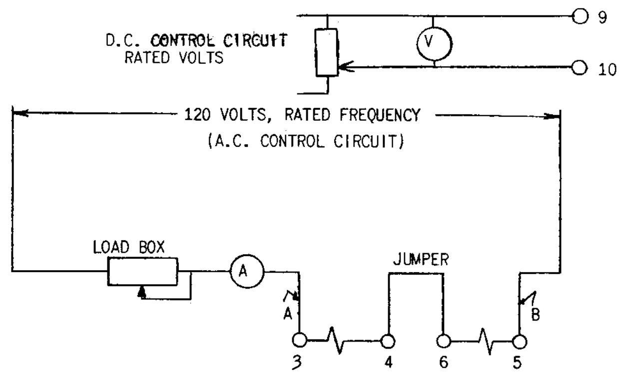
VOLTS	R1 OHMS	R2 OHHMS	R3 OHMS
250	2000	600	1000
125	1000	300	1000
48	300	50	1000

Figure 7 (0178A7060-4) Internal Connection Diagram for Type CHC15A Relay



A-INCLINED TUBE
B-STAINLESS STEEL BALL
C-DIAPHRAM
D-SPACER
E-CAP
F-FLAT SPIRAL SPRING
G-CONTACT

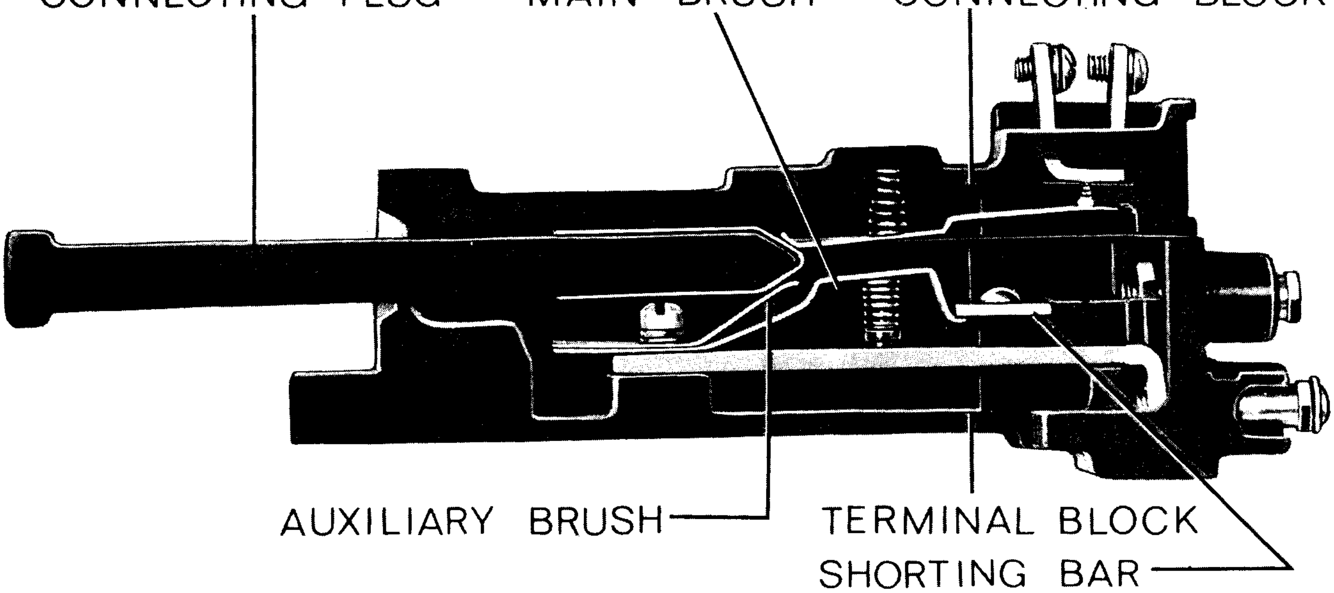
Figure 8 (6077069-4) Barrel Contact Assembly for Ground Fault and Phase Fault Detectors



TEST CIRCUIT AS SHOWN IS FOR CHECKING PFD PICK-UP FOR A PHASE-1 TO PHASE-2 FAULT. FOR OTHER PHASE-TO-PHASE FAULT TESTS ON THE PFD AND GFD TEST CONNECTIONS, SEE TABULATION FOR THE RELAY TERMINAL NUMBERS.

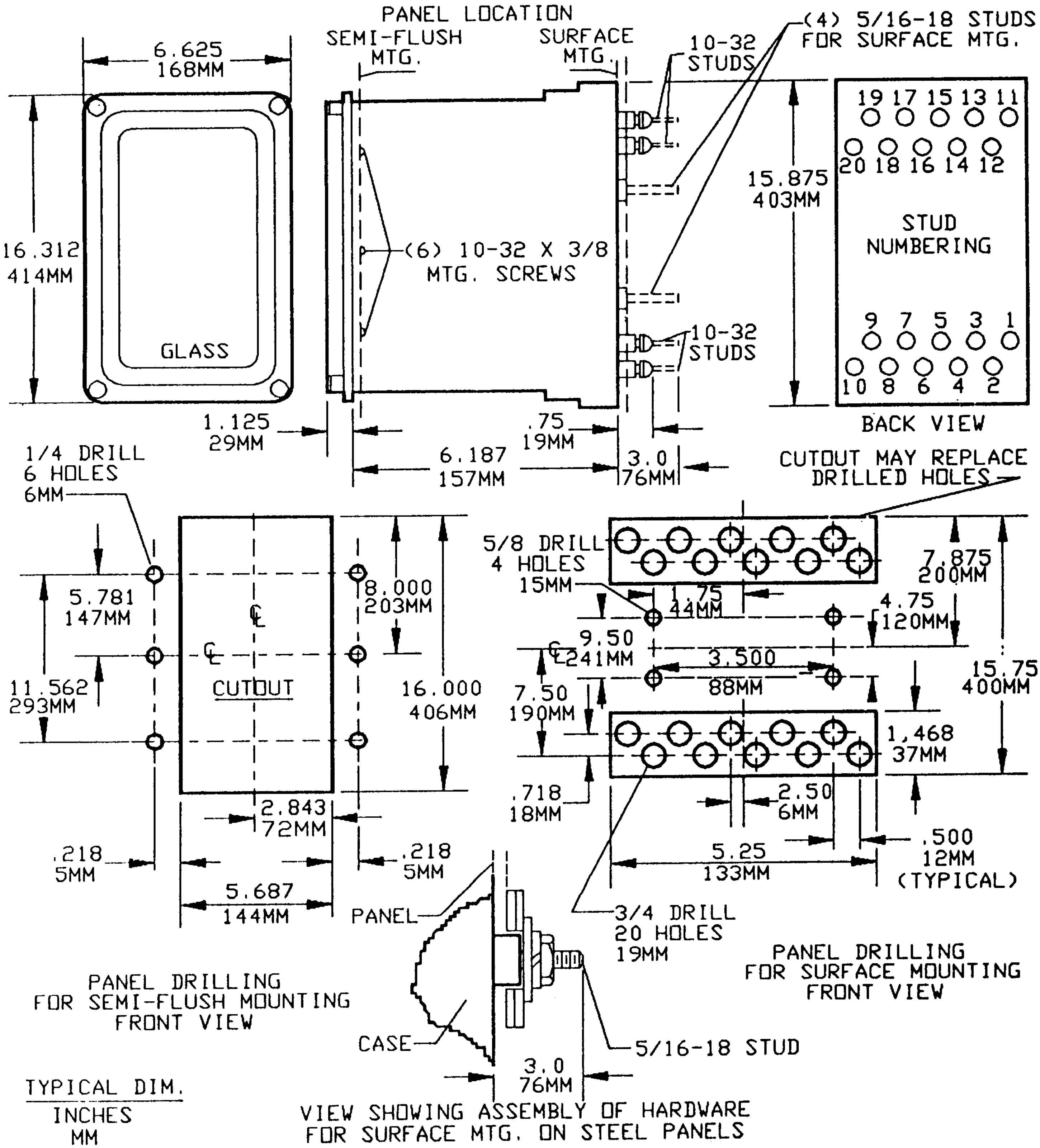
FAULT DETECTOR	CONNECTIONS			TEST
	LEAD-A	LEAD-B	JUMPER	
PFD	5 7	7 3	6 TO 8 4 TO 8	PHASE 2-PHASE3 PHASE3-PHASE1
GFD	14	15	-	GROUND FAULT

Figure 9 (0178A8194-2) Test Connections for Pickup Checks on Fault Detectors



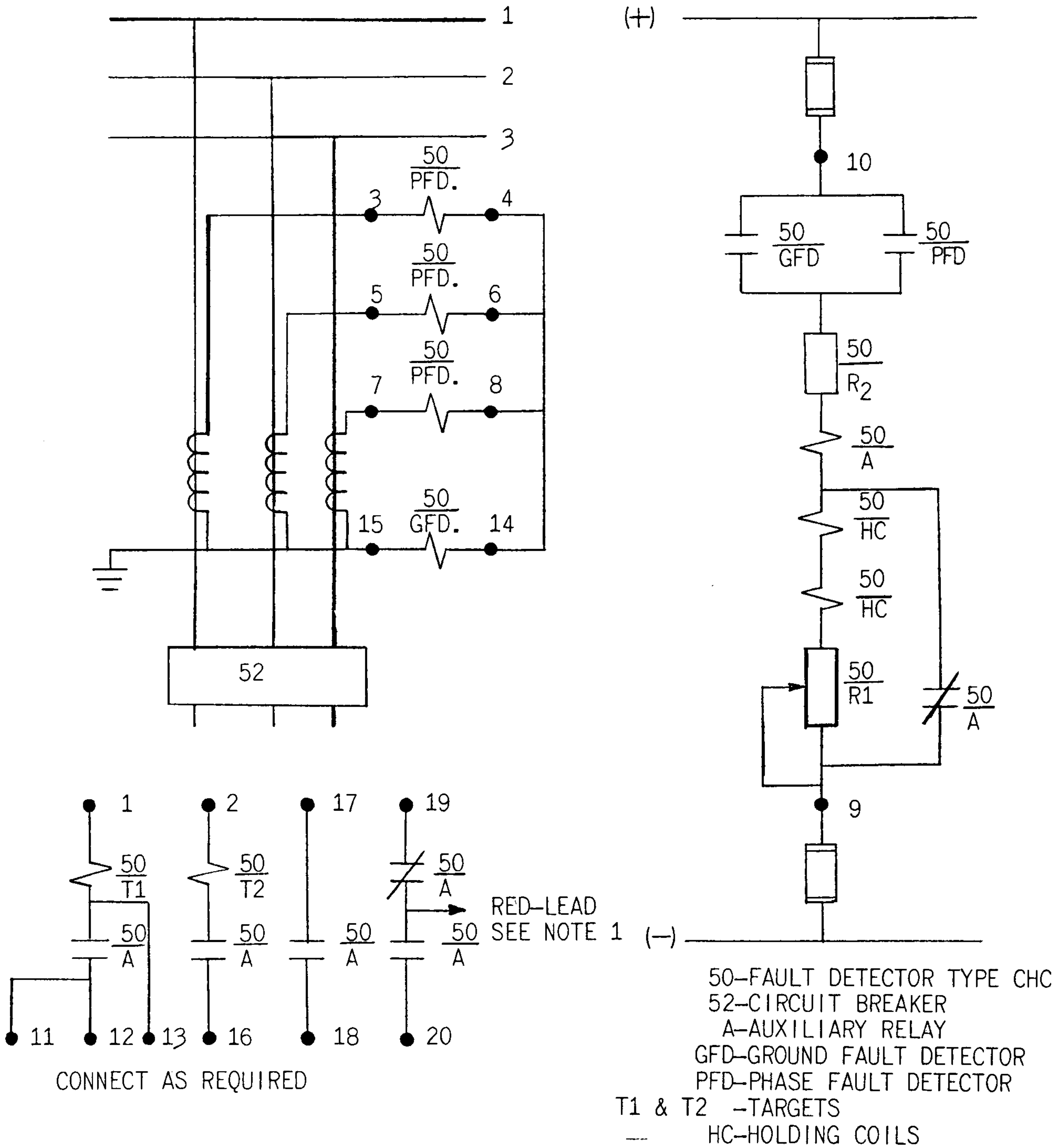
NOTE: AFTER ENGAGING AUXILIARY BRUSH, CONNECTING PLUG TRAVELS 1/4 INCH BEFORE ENGAGING THE MAIN BRUSH ON THE TERMINAL BLOCK

Figure 10 (8025039) Cross Section of Drawout Case Showing Position of AuxiliaryBrush and Shorting Bar



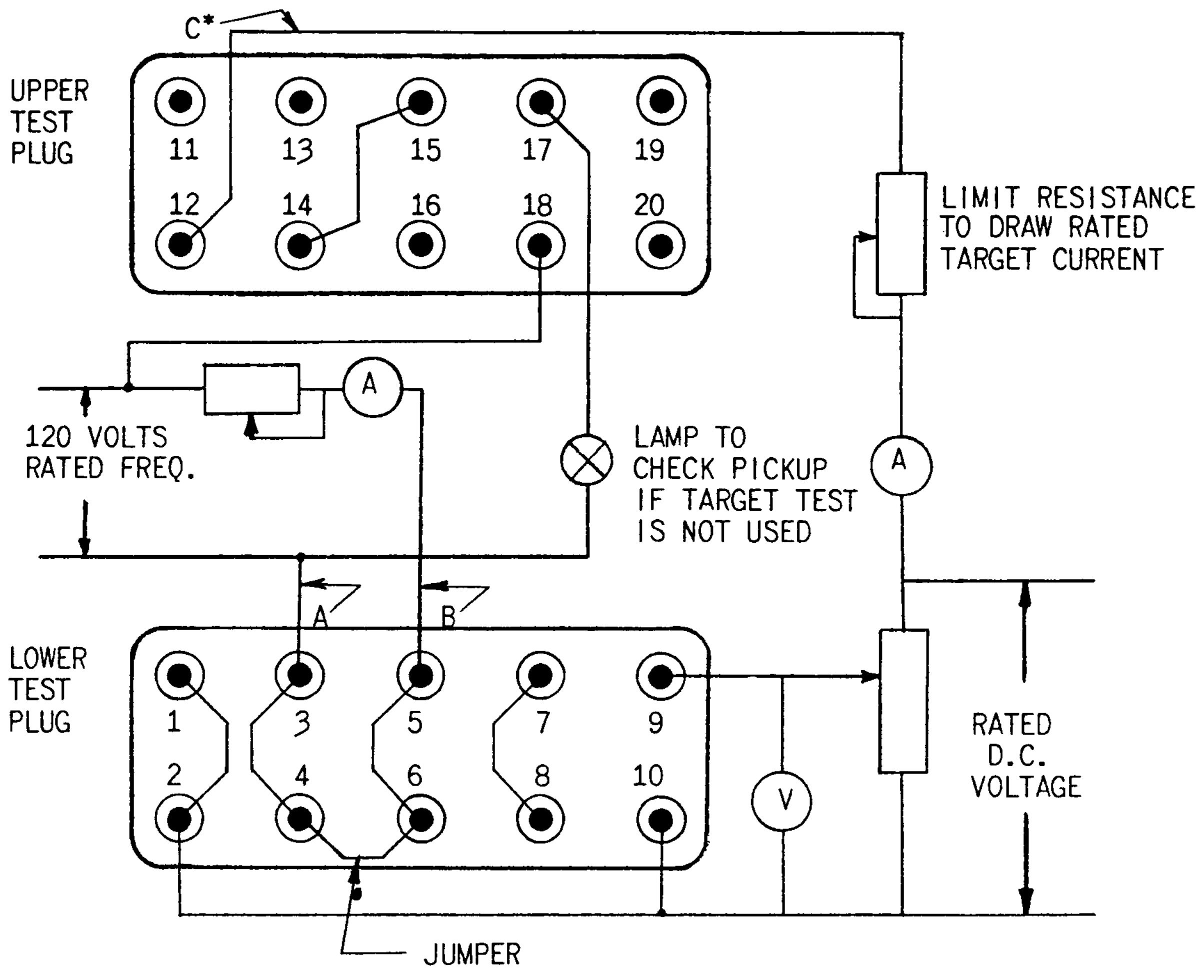
* Figure 11 (6209274 [6]) Outline and Panel Drilling Dimensions for Type CHC15A

* Revised since last issue



NOTE 1-RED LEAD AVAILABLE. WHEN CONNECTED TO STUD,19, CONTACT BETWEEN STUDS 19 & 20 IS NORMALLY OPEN. WHEN CONNECTED TO STUD 20, CONTACT BETWEEN STUDS 19 & 20 IS NORMALLY CLOSED

Figure 12 (0178A9075-1 External Wiring Diagram of Fault Detector Relay Type CHC51A



TEST	CONNECTIONS LEAD A&B TO STUDS:-		
PFD:-	A	B	JUMPER
ϕ_1-ϕ_2 FAULT	3	5	4-6 (AS SHOWN)
ϕ_2-ϕ_3 FAULT	5	7	6-8
ϕ_3-ϕ_1 FAULT	7	3	4-8
GFD:-	14	15	OMIT
TARGETS:-(PICK-UP EITHER FAULT DETECTOR) * LEAD C (AS SHOWN) TO TEST T1 LEAD C TO STUD 16 TO TEST T2			

Figure 13 (0178A8193-3) Field Test Connections Using Type XLA Test Plugs

Meter and Control Business Department

(3/91) (1200)

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