INSTRUCTIONS

GEK-34069B

PERCENTAGE DIFFERENTIAL RELAY

TYPE IFD

MODEL 12IFD51D(-)A

GENERAL ELECTRIC

CONTENTS

PERCENTAGE DIFFERENTIAL RELAY

TYPE IFD

MODEL 12IFD51D(-)A

DESCRIPTION

The IFD51D relay is an induction disk ground differential relay. It was designed specifically to provide differential protection for single phase-to-ground faults in the wye connected winding of a power transformer and the leads to its associated circuit breaker. The IFD51D relay is shock resistant and is supplied complete with target in a standard M2 drawout case. The internal connections and the outline and dimensions are illustrated in Figures 1 and 2 respectively.

APPLICATION

The IFD51D was specifically designed to provide differential protection for single-phase-to-ground faults in the zone from the wye connected winding and its associated circuit breaker. This zone includes the transformer wye winding itself. The IFD is principally intended for application on transformers where the neutral is grounded through a resistor which limits the single phase-to-ground fault currents to a range of 200 - 2000 amperes. However, it may also be applied to solidly grounded transformers if the neutral CT is of good quality and has the same ratio as the circuit breaker CT's so that no auxiliary CT is required. The power transformer winding with which the relay is associated must have its own neutral lead as illustrated in the external connection of Figure 5. That is to say, that the power transformer cannot be an auto-transformer nor can it be a wye-delta-wye bank with a common neutral terminal for both windings.

An auxiliary CT is normally required to match the ratio between the circuit breaker CT's and the transformer neutral CT. The ratio of this auxiliary CT can be evaluated by dividing the ratio of the circuit breaker CT's (on the tap used) by the ratio of the neutral CT.

The purpose of the instantaneous unit in the IFD51D is to make the relay shock resistant. The pick-up setting of the instantaneous unit should be set so that it does not reduce the sensitivity of the protection. Since the basic sensitivity of the main unit of the relay is 0.5 or 1.0 amperes, it is suggested that the setting of the instantaneous unit be in the range of 0.5 to 1.0 amperes.

As indicated in the section under CHARACTERISTICS, the IFD51D may be set for 12.5 or 25 percent slope. With the 12.5 percent slope setting, the main unit will pick up at about 0.5 amperes in the operating coil with no current in any restraint coil. With the 25 percent slope, the current required to produce operation increases to about 1 ampere. The higher slope setting will provide security against improper operation in the event of circuit breaker CT saturation during external multi-phase faults.

As indicated in the external connections of Figure 5, only one IFD51D relay is required for the protection described. Also, a source of d-c is required in order for the relay to trip the breaker. This may either be a station battery or a capacitor trip device.

RATINGS

CURRENT CIRCUITS

Table A below gives the current circuit ratings.

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

To the extent required the products described herein meet applicable ANSI, IEEE and NEMA standards; but no such assurance is given with respect to local codes and ordinances because they vary greatly.

TABLE A

CIRCUIT	CONTINUOUS RATING AMPS	ONE SECOND RATING AMPS
Operating Coil	5	260
Restraint Coils	10	260
Hinged Armature Fault Detector 0.5-2 Amp Range	0.75	10

CONTACT RATINGS

The current-closing rating of the contacts is 30 amperes for voltages not exceeding 250 volts. The current-carrying ratings are offected by the selection of the tap on the target and seal-in coil as indicated in the following table:

Function	Amperes, a-c or d-c	
	2-Amp Tap	0.2 Amp Tap
Tripping Duty	30	5
Carry Continuously	3	0.3
Operating Range	2-30	0.2-2
Resistance	0.13	7
Impedance at 60 cy	0.53	52

If the tripping current exceeds 30 amperes an auxiliary relay should be used, the connections being such that the tripping current does not pass through the contacts or the target and seal in coils of the protective relay.

CHARACTERISTICS

OPERATING CHARACTERISTICS - INDUCTION UNIT

The IFD51D relay has an operating coil with taps available for selecting either a 12.5 or 25 percent slope. Percent slope is defined as operating coil current required to close contacts divided by restraint current flowing in two restraint coils multiplied by 100 percent. For the purpose of this definition the currents in the two restraint coils are equal. With equal currents flowing in all three restraint coils, the operating current required to close contacts will be approximately 1.23 times that required with the same current flowing in only two restraint coils.

With the operating coil set on the 12.5 percent tap, the induction unit will close its contacts at 0.5 amps with zero restraint current. On the 25 percent tap, operating current required to close contacts with zero restraint is approximately twice that required on the 12.5 percent tap or approximately 1 ampere.

OPERATING CHARACTERISTIC CURVES

Figure 3 shows the operating current vs restraining current characteristic curve for the IFD51D. Figure 4 shows the time current curve for this relay. These times apply only for the 1/2 time dial setting. Times may be increased by increasing the time dial setting, but the time dial should never be set below the 1/4 position.

HINGED ARMATURE FAULT DETECTOR

The IFD51D relay includes a shock resistant hinged armature type overcurrent unit. The contact of this overcurrent unit is connected in series with the induction disk unit contact so that both must be picked up to initiate a tripping output. This checks that fault current is flowing and guards against false tripping by the induction disk unit if it should close its contact due to shock.

The hinged armature overcurrent unit is adjustable over a pickup current range of 0.5-2 amps by means of an adjustable core. This unit should be set to pickup for any fault condition for which the induction disk unit is expected to operate.

OPERATING PRINCIPLES

The IFD51D relay induction unit has four U-magnets operating on two disks mounted on a common shaft. Three of the U-Magnets have restraining coils which drive the disk in the contact opening direction. The fourth U-Magnet has an operating coil which drives the disk in the contact closing direction. The induction unit will close its contacts when the torque produced by the operating coil exceeds the sum of the torques produced by the control spring and the three restraining coils.

TORQUE EQUATION AND INDUCTION UNIT PICKUP

Each of the four U-Magnets produces a torque proportional to the square of the current flowing in its operating coil, the operating coil in the contact closing direction and the restraining coils in the contact opening direction. Using this fact plus the basic torque balance equation, we can write an equation for operating current in terms of currents in the three restraining coils and control spring setting.

Torque Balance Equation

$$To = T_{R1} + T_{R2} + T_{R3} + T_S$$

where T_o = operating coil torque

T_{R1}, T_{R2}, T_{R3} = torque produced by each of the three restraining coils respectively

T_S = Spring torque

Operating Current Equation:

$$I_o^2 = K_1 (I_{R1}^2 + I_{R2}^2 + I_{R3}^2) + I_S^2$$

where I_o = operating current required to close contacts
I_{R1}, I_{R2}, I_{R3} = current in each of the three restraining coils respectively.

I_S = Operating coil current to overcome spring force (Close contacts with zero restraining current).

and K_1 = Design constant of relay, may be determined by working operating current equation with point on operating current vs restraint curve.

Note K_1 and I_S are a function of operating coil tap setting.

An example of the way the operating current equation may be used is as follows. With the operating coil set on the 12.5 percent tap the induction unit will close its contacts with 0.5 amps in the operating coil and zero restraint current (I_S = 0.5). The operating characteristic curves give an operating current of about 0.9 amps with 5 amps in three restraints. Plugging these values into the operating current equation and solving for K_1, we get $K_1 = 7.47 \times 10^{-3}$. Using these values of K_1 and I_S, we can calculate the operating current required to close contacts for different conditions of restraint current. For instance, using $K_1 = 7.47 \times 10^{-3}$ and I_S = 0.5, the operating current equation reveals that the induction unit will just close its contacts with 1.32 amps in the operating coil and 10 amps in two restraint coils.

BURDENS

Table A below gives the impedances of the coils in these relays. These impedances are measured with 5 amperes flowing through the specified coil. The operating coil impedance given is for the 12.5 percent tap.

COIL	IMPEDANCE	Z OHMS
Operating Coil	.43 + j .99	1.08
Restraining Coils	0.065 + j 0.02	0.068
Hinged Armature Unit	10.3 + j 8.1	12.9

The operating coil impedance rises to approximately 1.4 ohms at pickup or at 0.5 amps, when set on the 12.5 percent tap.

The operating coil impedance on the 25 percent tap is approximately one quarter the impedance given for the 12.5 percent tap.

CONSTRUCTION

The IFD51D relay consists of an induction disk unit, a target/seal-in unit, and a hinged armature overcurrent unit mounted in a medium size double ended drawout M2 case. The internal connections diagram is shown in Figure 1, the outline and panel drilling is shown in Figure 2.

INDUCTION DISK UNIT

The induction disk unit consists of two disks mounted on a common shaft driven by four U-Magnet and coil assemblies. The lower left U-Magnet and coil is the operating coil, this element drives the disks in the contact closing direction. The operating coil is tapped so that the relay may be set for either a 12.5 or 25 percent slope. The operating coil tap may be selected by setting the tap plug in the tap block position indicated by the engraved tap plate. The tap block is mounted above the induction disk unit. The operating coil U-Magnet is provided with fixed shading rings which provide the phase shift in flux necessary to drive the disk.

The other three U-Magnets mount the restraint coils. These three elements drive the disk in the contact opening direction. The restraint U-magnets and coils are similar to the operating U-Magnet and coil except the restraint coils are untrapped and the restraint U-Magnets use wound shading coils instead of shading rings to produce the phase shifted flux necessary to drive the disk. The wound shading coils of the restraint elements are wired to three separate slide wire resistors mounted in the back of the relay. These resistors are used to adjust the basic torque characteristic of the restraint elements. As indicated by the internal connections diagram (Fig. 1) the bottom resistor adjusts the lower right restraint element, the middle resistor adjusts the upper right, and the top resistor adjusts the upper left restraint.

The control spring mounted at the top of induction disk unit is used to adjust the operating coil current required to close contacts with no current in the restraints. This control spring may be adjusted by turning the notched adjusting ring. The time dial is above the control spring. The time dial is used to increase the travel on the disk and this increase operating time. The time dial on the IFD51D is locked by two locking screws through the top of the frame. These locking screws prevent restraint torque from turning the time dial and changing the operating time setting. The relay time dial is normally set and locked in the 1/2 position. The induction disk unit is provided with a drag magnet which serves to retard the motion of the disk to give the correct time delay.

HINGED ARMATURE FAULT DETECTOR

The IFD51D relay is provided with a small hinged armature overcurrent unit. This unit is used to make the relay more shock resistant. The operating coil of this unit is wired to studs 4-5 and the contacts are in series with the induction unit contacts. The pickup current of this unit is adjustable over a 4-1 range range by means of an adjustable core. The core is provided with a locknut which must be loosened before the core may be turned to change pick-up. The fault detector unit is mounted on the upper right hand side of the relay.

TARGET/SEAL-IN UNIT

The target seal-in unit is mounted in the top of the case on the left hand side. The seal-in unit has its coil in series and its contacts in parallel with the contacts of the induction disk unit and the instantaneous overcurrent unit such that when the instantaneous unit and induction disk unit contacts close the seal-in picks up and seals in. When the seal-in unit picks up, it raises a target into view which latches up and remains exposed until it is released by pressing a button beneath the lower left corner of the cover.

The components of the IFD51D relay are mounted in a M2 case whose outline and drilling plan is shown in Figure 2.

The relay components are mounted in a cradle assembly which is latched into a drawout case when the relay is in operation but it can be easily removed when desired. To do this, the relay is first disconnected by removing the connection plug which completes the electrical connections between the

case block and the cradle block. To test the relay in its case this connection block can be replaced by a test plug. The cover, which is attached to front of the relay case, contains the target reset mechanism and an interlock arm which prevents the cover from being replaced until the connection plugs have been inserted.

The relay case is suitable for either semiflush or surface mounting on all panels up to 2 inches thick and appropriate hardware is available. However, panel thickness must be indicated on the relay order to insure that proper hardware will be included.

Every circuit in the drawout case has an auxiliary brush, as shown in Fig. 6, to provide adequate overlap when the connecting plug is withdrawn or inserted. Some circuits are equipped with shorting bars (see Figure 1) and on these circuits it is especially important that the auxiliary brush makes contact as indicated in Fig. 6, with adequate pressure to prevent the opening of C.T. secondary circuits.

RECEIVING, HANDLING AND STORAGE

These relays, when not included as a 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 hearest General Electric Apparatus 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 TEST

Immediately upon receipt of the relay, an inspection and acceptance test should be made to insure that no damage has been sustained in shipment and that the relay calibrations have not been disturbed.

VISUAL INSPECTION

Check the nameplate stamping to insure 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 cracked molded parts or other signs of physical damage, and that all the screws are tight.

MECHANICAL INSPECTION

1. There should be no noticable friction when the disk is rotated slowly clockwise. The disk should return by itself to its rest position.
2. Make sure the control spring is not deformed nor its convolutions tangled or touching.
3. The armature and contacts of the seal-in unit as well as the armature and contacts of the instantaneous unit should move freely when operated by hand, there should be at least 1/32" wipe on the seal in and instantaneous unit contacts.
4. The targets in the seal-in unit and in the instantaneous unit must come into view and latch when the armature are operated by hand and should unlatch when the target release level is operated.
5. Make sure that the fingers and shorting bars agree with the internal connections diagram.
6. The time dial locking screws should be observed to lock the time dial so that it can not be turned.

CAUTION:

EVERY CIRCUIT IN THE DRAWOUT CASE HAS AN AUXILIARY BRUSH. IT IS ESPECIALLY IMPORTANT ON CURRENT CIRCUITS AND OTHER CIRCUITS WITH SHORTING BARS THAT THE AUXILIARY BRUSH BE BENT HIGH ENOUGH TO ENGAGE THE CONNECTING PLUG OR TEST PLUG BEFORE THE MAIN BRUSHES DO. THIS WILL PREVENT CT SECONDARY CIRCUITS FROM BEING OPENED.

DRAWOUT RELAYS GENERAL

Since all drawout relays in service operate in their case, it is recommended that they be tested in their case or an equivalent steel case. In this way any magnetic effects of the enclosure will be

accurately duplicated during testing. A relay may be tested without removing it from the panel by using a 12XLA13A test plug. This plug makes connections only with the relay and does not disturb any shorting bars in the case. Of course, the 12XLA12A test plug may also be used. Although this test plug allows greater testing flexibility, it also requires C.T. shorting jumpers and the exercise of greater care since connections are made to both the relay and the external circuitry.

POWER REQUIREMENTS GENERAL

All alternating current operated devices are affected by frequency. Since non sinusoidal waveforms can be analyzed as a fundamental frequency plus harmonics of the fundamental frequency, it follows that alternating current devices (relays) will be affected by the applied waveform.

Therefore, in order to properly test alternating current relays it is essential to use a sine wave of current and/or voltage. The purity of the sine wave (i.e. its freedom from harmonics) cannot be expressed as a finite number for any particular relay, however, any relay using tuned circuit, R-L or C networks, or saturating electromagnets (such as induction disk relays) would be essentially affected by non-sinusoidal wave forms.

ELECTRICAL TESTS

The IFD51D relay may be satisfactorily tested on a single phase basis, in that its performance with single phase currents is not significantly different than with three phase currents. The electrical tests needed to determine that the relay adjustments have not been disturbed are as follows:

NOTE: It is recommended that a voltage source of 115 volts or more of rated frequency with resistive loading be used to perform these tests.

INDUCTION UNIT PICKUP TEST

Apply gradually increasing current to operating coil circuit (studs 2-3). With the operating coil set on the 0.5 amp tap, the relay should just hold its contacts closed with a current of 0.48 - 0.52 amps flowing. The contact circuit is between studs 1-11 and the instantaneous unit contacts must be jumpered for this circuit to show continuity when the induction disk unit contacts close. Set on the 25 percent tap the contact closing current should be approximately 0.9 amps.

OPERATING CURRENTS RESTRAINT CURRENT

See Figure 7 for test connections and Figure 1 for relay internal connections. With the three restraint currents wired in series (jumper stud 7 to 8, 9-16) apply 5 amps to the three restraints (between studs 6-17). With the operating coil set on the 12.5 percent tap the relay should just close its contacts with 0.75-0.95 amps flowing in the operating coil. For information on adjusting the restraint current vs operating current, refer to the section on Servicing.

INSTANTANEOUS UNIT FAULT DETECTOR

The pickup current of the fault detector may be checked by applying current to studs 4-5. This unit is adjustable over a range of pickup currents from 0.5-2 amps by turning the adjustable core. The unit is set at the factory to pickup at 0.45 - 0.55 amps, this adjustment may be changed if desired.

SETTING THE INSTANTANEOUS UNIT

Loosen the locknut and turn pole piece toward the desired setting. Turning the pole piece up increases the pick up, turning the pole piece down decreases the pick up. Bring up the current slowly until unit picks up. It may be necessary to repeat this operation until the desired pick up value is obtained. Once the desired pick up value is reached, tighten the locknut.

CAUTION: THE INSTANTANEOUS UNIT IS RATED 1.5 TIMES MINIMUM PICK UP. DO NOT LEAVE THE TEST CURRENT ON TOO LONG AS IT MAY DAMAGE THE UNIT.

TARGET AND SEAL-IN UNIT

The target and seal-in unit has an operating coil tapped at 0.2 and 2.0 amperes. The relay is shipped from the factory with the tap screw in the lower ampere position. The tap screw is the screw holding the right hand stationary contact. To change the tap setting, first remove one screw from the left hand stationary contact and place it in the desired tap. Next remove the screw from the undesired tap and place it on the left hand stationary contact where the first screw was removed. This procedure necessary to prevent the right hand stationary contact from getting out of adjustment. Screws should not be in both taps at the same time.

PICK UP AND DROP OUT TEST

1. Connect relay studs 1 and 2 to a D.C. source, ammeter and load box so that the current can be controlled over a range of 0.1 to 2.0 amperes.
2. Jumper the induction disk and instantaneous unit contacts.
3. Increase the current slowly until the seal-in unit picks up. See Table XI below.
4. Remove the jumper from the instantaneous unit contacts, the seal-in unit should remain in the pick up position.
5. Decrease the current slowly until the seal-in unit drops out. See Table XI.

TABLE XI

TAP	PICK-UP CURRENT	DROPOUT CURRENT
0.2	0.15 - 0.195	.05 OR MORE
2.0	1.50 - 1.95	.55 OR MORE

INSTALLATION

If after the acceptance tests the relay is held in storage before shipment to the job site, it is recommended that the visual and mechanical inspection described under the section on ACCEPTANCE TESTS be repeated before installation. The relay must be mounted on a vertical surface and must be level for correct operation.

ELECTRICAL TESTS

It is recommended that the electrical tests outlined under acceptance tests be repeated at the time of installation. If desired, the induction disk unit may be checked at several operating points using a method similar to that outlined in acceptance tests. The fault detector and target seal in units should be set at their desired operating points and these settings should be electrically tested.

LOCATION

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

MOUNTING

The relay should be mounted on a vertical surface. The outline and panel diagram is shown in Figure 2.

CONNECTIONS

Internal connection diagram is shown in Figure 1. A typical wiring diagram is given in Figure 5.

One of the mounting studs or screws should be permanently grounded by a conductor not less than No. 12 B&S gage copper wire or its equivalent.

TARGET AND SEAL-IN ELEMENT SETTING

For trip coils operating on currents ranging from 0.2 up to 2.0 amperes at the minimum control voltage, set the target and seal-in tap plug in the 0.2 ampere tap.

For trip coils operating on currents ranging from 2 to 30 amperes at the minimum control voltage place the tap plug in the 2 ampere tap.

The tap plug is the screw holding the right-hand stationary contact of the seal-in element. To change the tap setting, first remove the connecting plug. Then, take a screw from the left-hand stationary contact and place it in the desired tap. Next remove the screw from the other tap, and place it in the left-hand contact. This procedure is necessary to prevent the right-hand stationary contact from getting out of adjustment. Screws should not be in both taps at the same time as pickup for d-c will

be the higher tap value and a-c pickup will be increased.

SERVICING

If it is found that the relay calibrations are out of adjustment then proceed as follows:

1. If there are indications of excessive friction the lower jewel may be tested for cracks by exploring its surface with the point of a fine needle. It it is necessary to replace the jewel a new pivot should be screwed into the bottom of the shaft at the same time. The jewel should be turned up until the disk is centered in the air gaps, after which it should be locked in this position by the set screw provided for this purpose. The upper bearing end play can be felt; about 0.015 inch is correct.

2. The differential unit pick up can be adjusted by turning the control spring adjusting ring.

3. To change target seal-in tap settings, proceed as follows:

   The tap plug is the screw holding the right-hand stationary contact of the seal-in unit. To change the tap setting, first remove the connection plug. Then, take a screw from the left-hand stationary contact and place it in the desired tap. Next remove the screw from the other tap, and place it in the left-hand contact. This procedure is necessary to prevent the right hand stationary contact from getting out of adjustment. Screws should not be in both taps at the same time as pickup for d-c will be the higher tap value and a-c pickup will be increased.

4. For cleaning relay contacts a flexible burnishing tool should be used. This consists of an etched roughened strip of flexible metal resembling a superfine file which removes corroded material quickly without scratching the surface. The flexibility of the tool insures the cleaning of the actual points of contact. Never use knives, files, abrasive paper or cloth to clean relay contacts. A burnishing tool as described above can be obtained from the factory.

5. Instantaneous overcurrent unit adjustment. Select the current above which it is desired to have the instantaneous unit operate and set the adjustable pole piece so that the top of hexagon head is even with the desired calibration on the scale. To raise or lower the pole piece, loosen the locknut and turn it up or down and then tighten in position.

INDUCTION UNIT ADJUSTMENT

Should it become necessary the induction disk unit may be restored to the factory calibration as follows:

1. Pickup Setting - The pickup current with no restraint current flowing should be set to be 0.48-0.52 amps with the operating coil set on the 12.5 percent tap by adjusting the control spring.

2. Preliminary Restraint Adjustment. Using test connections similar to figure 7 but with jumpers removed energize one restraint coil at a time and adjust the slide band resistors in the back of the case. Do not change control spring setting.

   With relay on 12.5% tap, adjust as follows:
   Set 10 amps through studs 6 and 7 and adjust bottom resistor until contacts just close with 1.0 amps in studs 2-3.

   Set 10 amps through studs 8 and 9 and adjust middle resistor until contacts just close with 1.0 amps in studs 2-3.

   Set 10 amps through studs 16 and 17 and adjust tap resistor until contacts just close with 1.0 amps in studs 2-3.

3. Restraint Test

   Using test connections similar to those shown in Figure 7 except with jumpers installed tying studs 6, 8 and 16 together instead of the jumpers shown in Figure 7, test the restraint coils in pairs as follows. Relay set ON tap indicated in table below check combinations of restraint coils per table below. Do not change control spring setting.

RESTRAINT COILS	CONNECT TO STUDS NUMBERS A1	A2	A0
Both Upper	9	17	2-3
Upper left, Lower right	7	17	2-3
Upper right, lower left	7	9	2-3

Check IFD51D relays to the following limits and adjust resistors as needed.

	PERCENT SLOPE	
	12.5%	25%
I_R	I_{OP}	I_{OP}
0	0.49-0.51	-
10	1.25-1.35	2.30-2.60
20	2.5-2.65	4.5-5.5
40	4.5-5.30	8-11

When the adjustments have been restored per 3 above, the relay should pass the three restraint test given under Acceptance Tests.

RENEWAL PARTS

It is recommended that sufficient quantities of renewal parts be carred in stock to enable 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 quantity required, name of the part wanted, and give complete nameplate data. If possible, give the General Electric requisition number on which the relay was furnished.

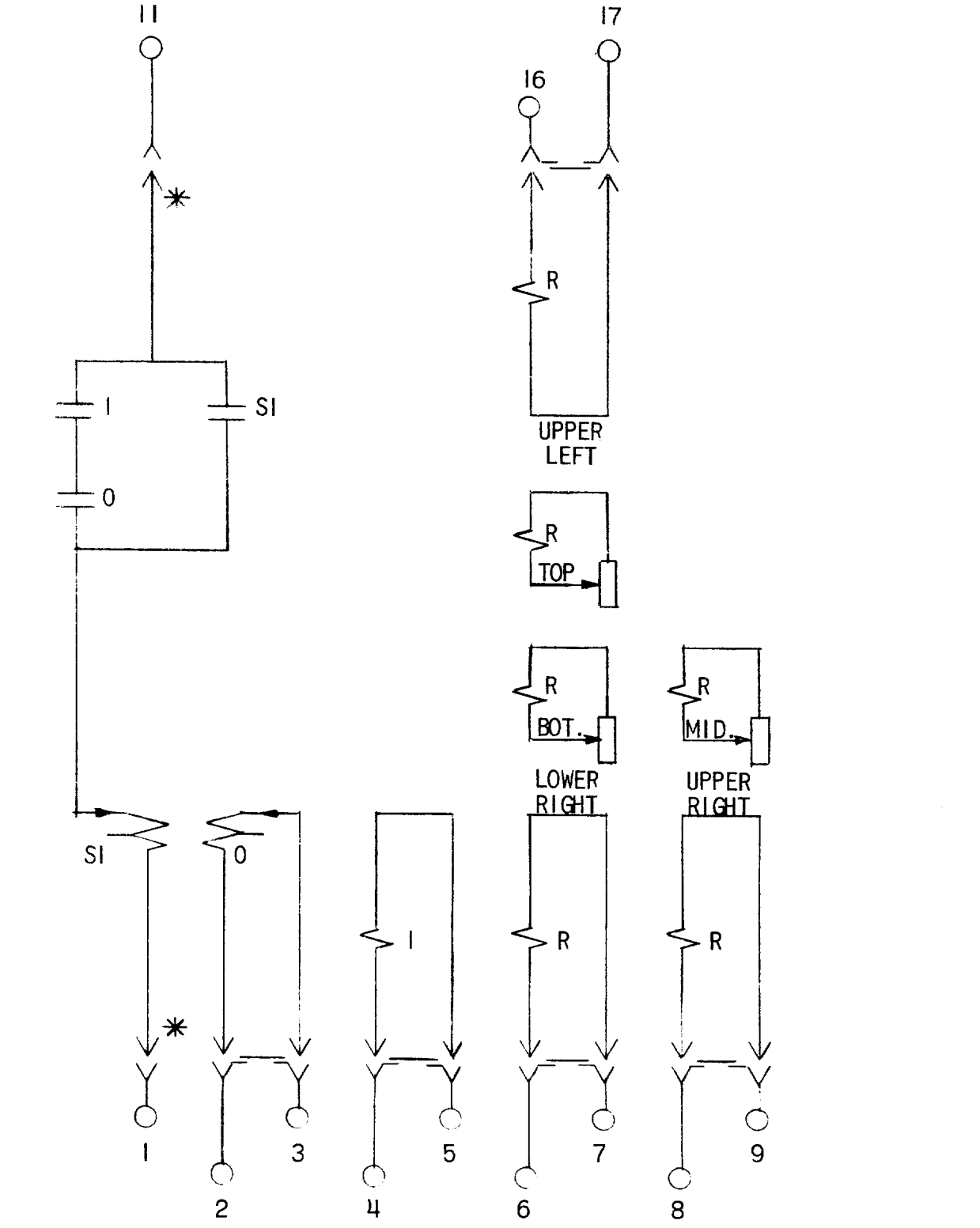


FIG. 1 (0246A2241-2) Internal Connections For Model IFD51D

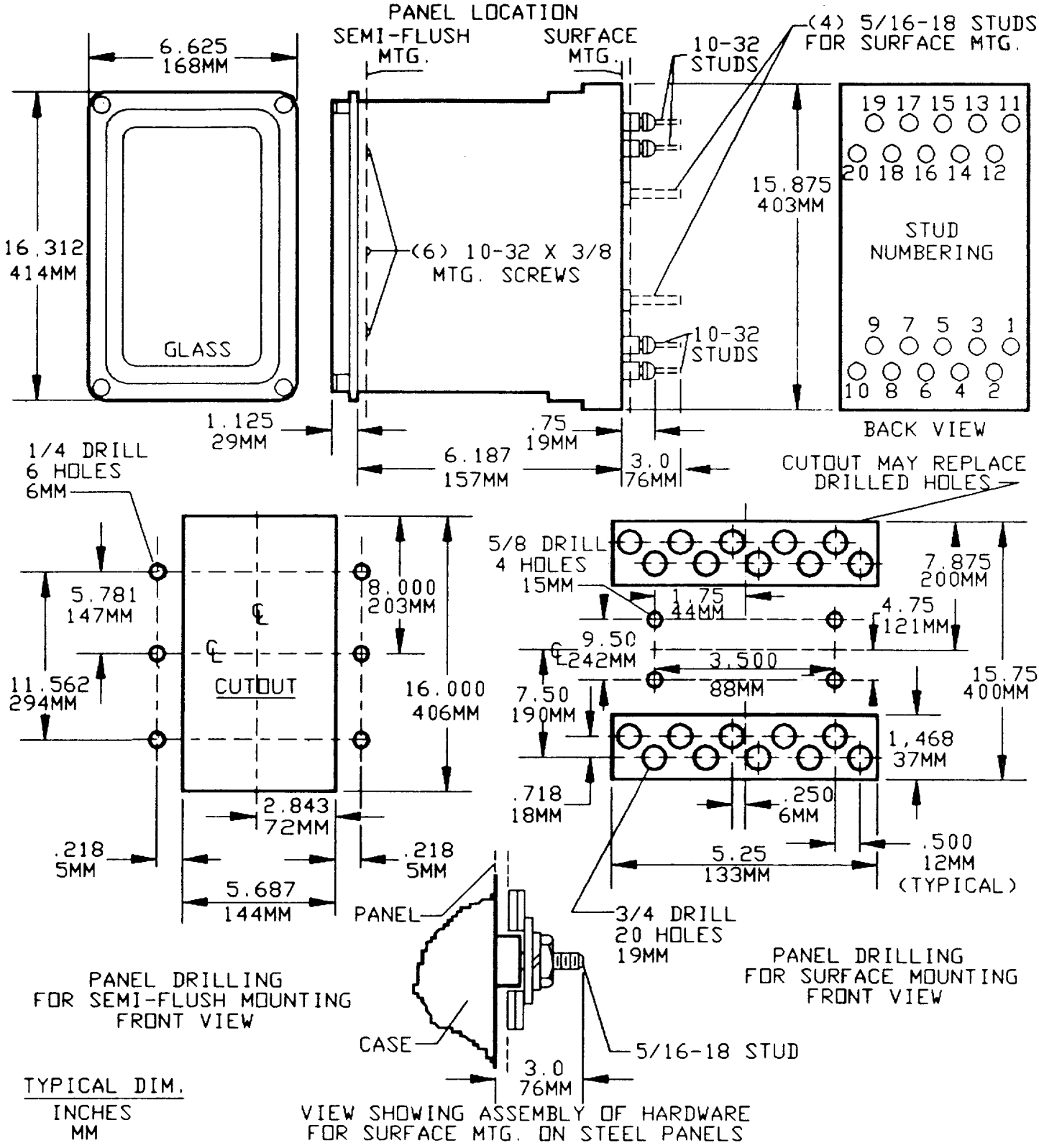


FIG. 2 (K-06209274 [6]) Outline and Panel Drilling Diagram for the M2 Case

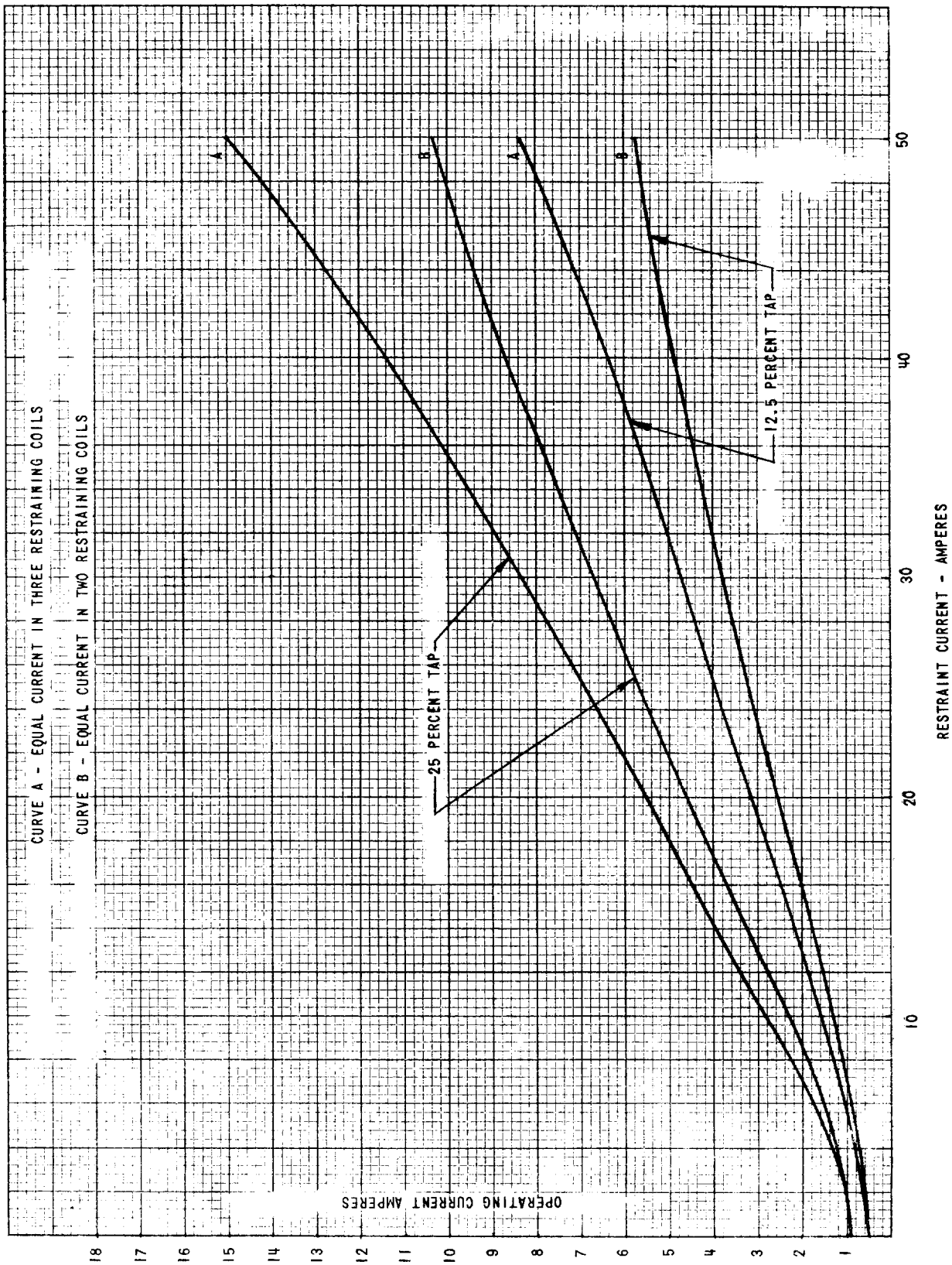


FIG. 3 (0246A3648-0) Operating Characteristic For The IFD51D Relay

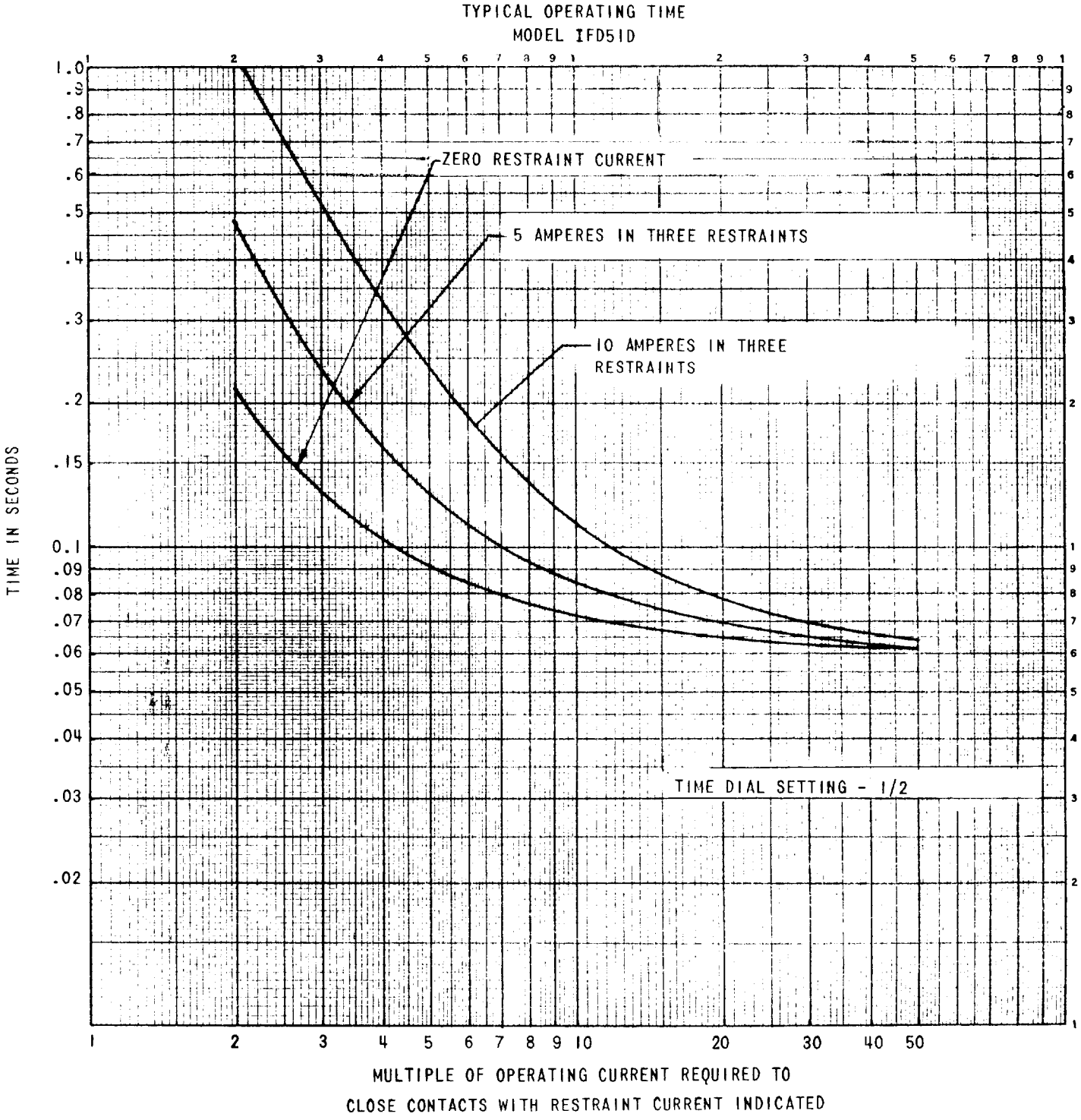


FIG. 4 (0246A3649 [3]) Time-Current Curve for the IFD51D Relay

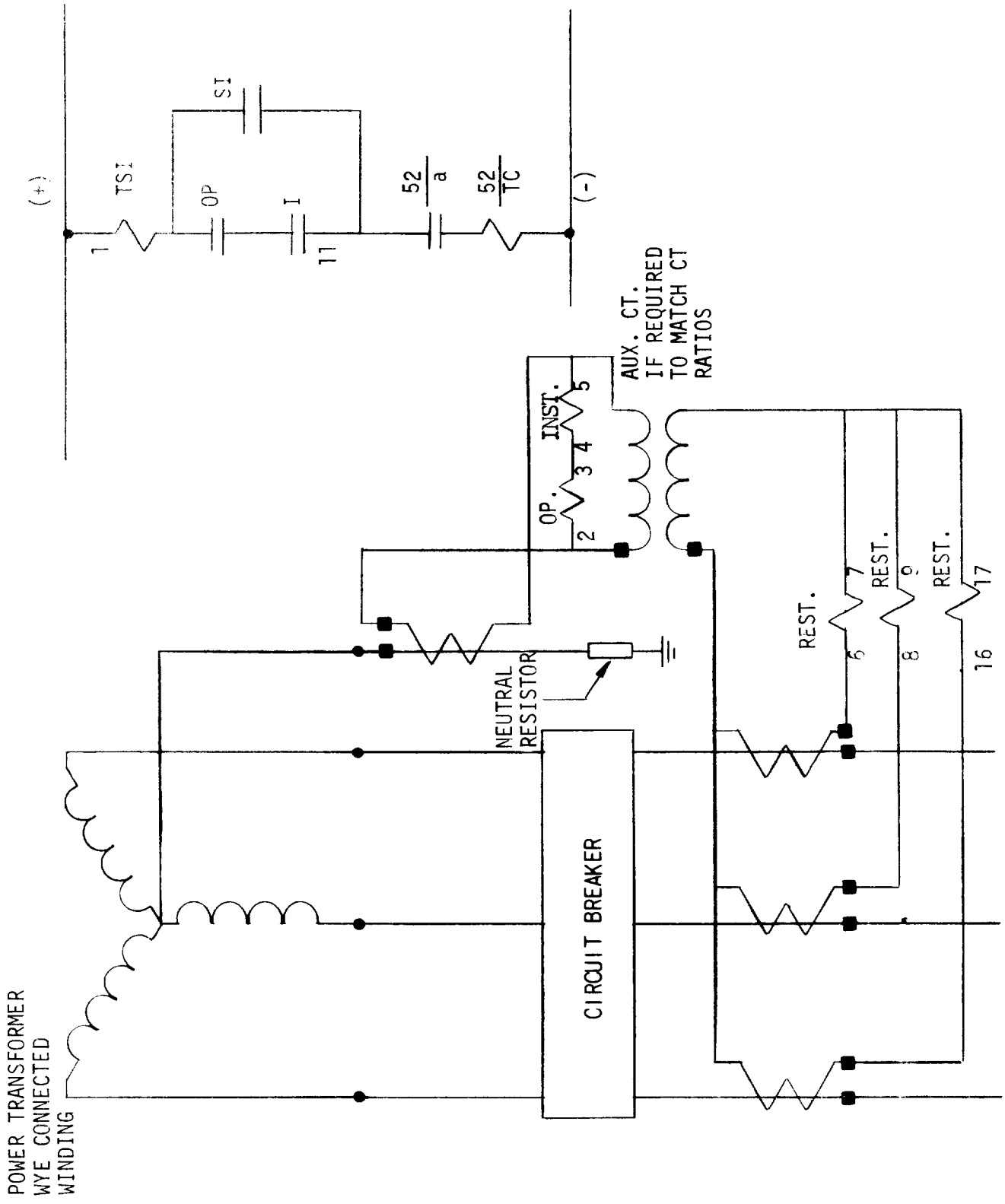
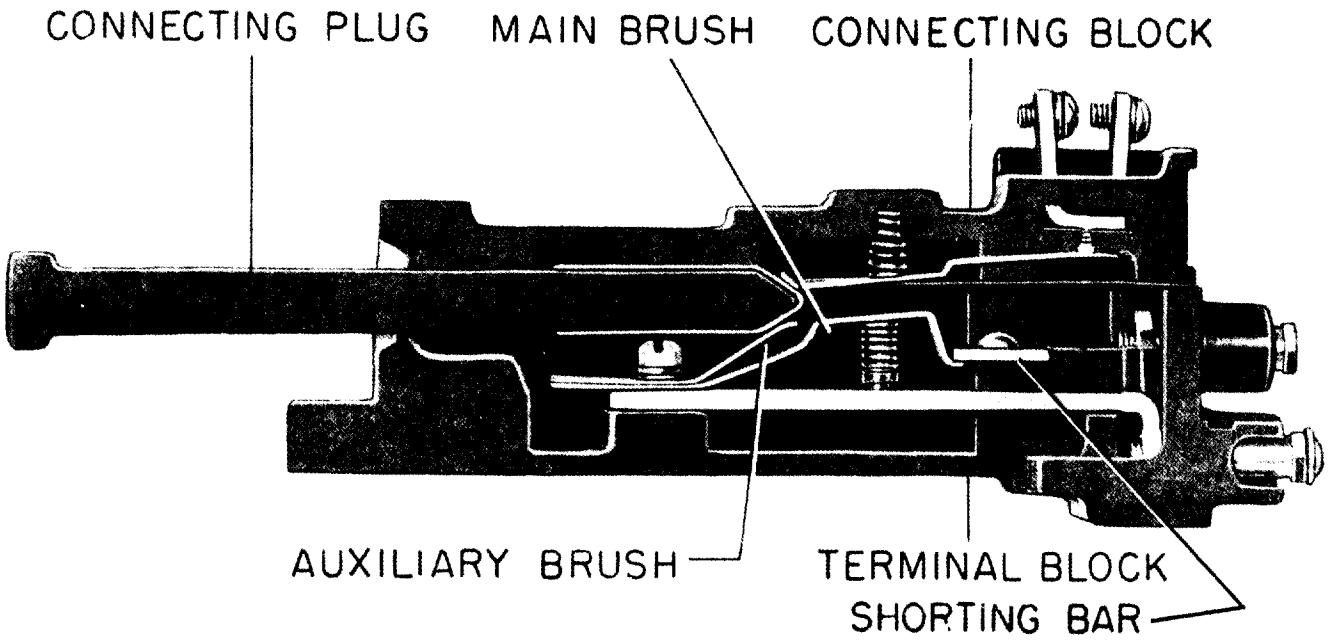
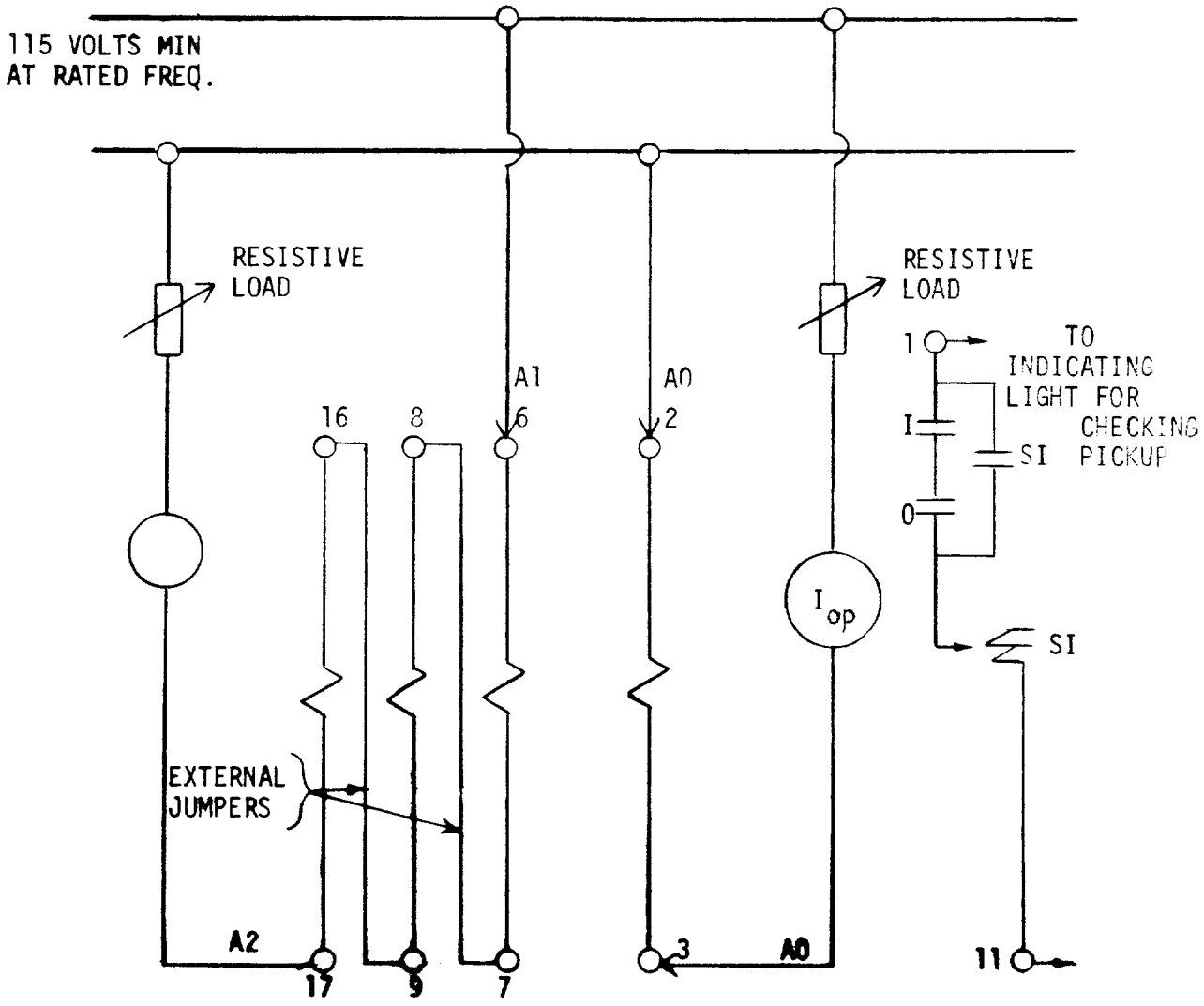


FIG. 5 (0246A3666-0) Typical External Connections For The IFD51D Relay



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

FIG. 6 (8025039) Cross Section Of Drawout Case Showing Position Of Auxiliary Brush And Shorting Bar



TO ACCURATELY REPRODUCE RELAY CHARACTERISTICS ALL TESTS SHOULD BE MADE WITH RELAY IN CASE. WITH CASE LEVEL BLOCK INSTANTANEOUS UNIT (I) CLOSED FOR LIGHT TO SHOW INDUCTION UNIT PICKUP FOR TESTING TWO RESTRAINTS AT A TIME, REMOVE JUMPERS SHOWN AND TIE STUDS 6, 8, 16 TOGETHER.

FIG. 7 (0246A3653 [1]) Test Connections for Model IFD51D

Since the A revision, Figures 2, 4, and 7 have been updated.

GE Power Management

215 Anderson Avenue
Markham, Ontario
Canada L6E 1B3
Tel: (905) 294-6222
Fax: (905) 201-2098
www.ge.com/indsys/pm