



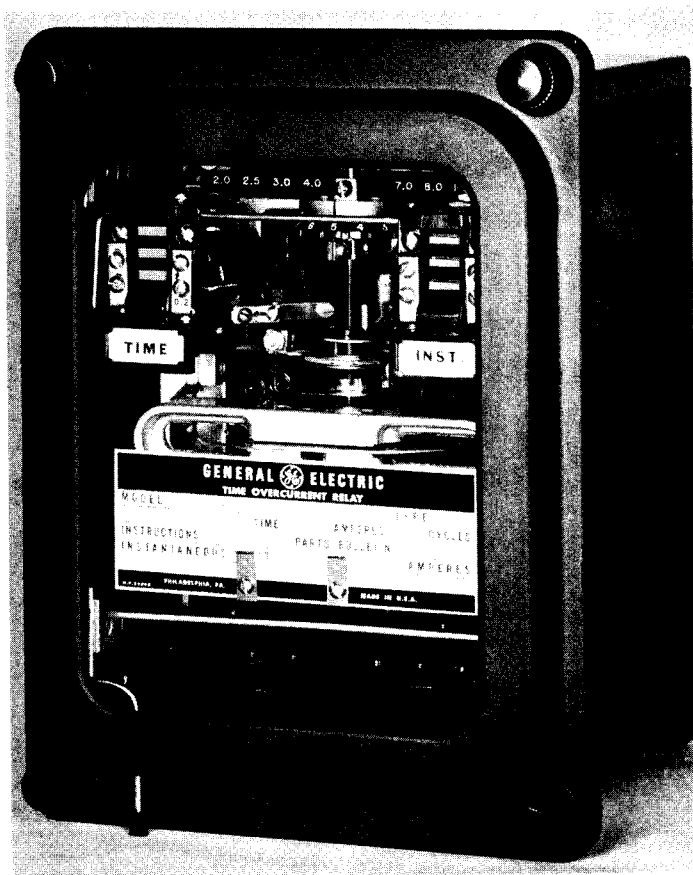
INSTRUCTIONS

GEK- 34055

TIME OVERCURRENT RELAYS

TYPES

IAC77A FORM 800 AND UP
IAC77B FORM 800 AND UP
IAC78A FORM 800 AND UP
IAC78B FORM 800 AND UP



POWER SYSTEMS MANAGEMENT DEPARTMENT

GENERAL  **ELECTRIC**

PHILADELPHIA, PA.

CONTENTS

	<u>PAGE</u>
DESCRIPTION.....	3
APPLICATION.....	3
CONSTRUCTION.....	4
RATINGS.....	4
TIME OVERCURRENT UNIT.....	4
ONE SECOND.....	5
CONTINUOUS.....	5
INSTANTANEOUS UNIT.....	6
ONE SECOND.....	6
CONTINUOUS.....	6
TARGET AND SEAL-IN UNIT.....	6
CONTACTS.....	6
BURDENS.....	6
TIME OVERCURRENT UNIT.....	7
INSTANTANEOUS UNIT.....	7
TARGET AND SEAL-IN UNIT.....	7
CHARACTERISTICS.....	7
RECEIVING, HANDLING AND STORAGE.....	7
ACCEPTANCE TESTS.....	8
TIME OVERCURRENT UNIT.....	9
INSTANTANEOUS UNIT.....	9
TARGET AND SEAL-IN UNIT.....	10
VISUAL INSPECTION.....	8
MECHANICAL INSPECTION.....	8
DRAWOUT RELAYS GENERAL.....	8
POWER REQUIREMENTS.....	8
PICK-UP TEST.....	9
TIME OVERCURRENT UNIT.....	9
INSTANTANEOUS UNIT.....	9
TARGET AND SEAL-IN UNIT.....	10
TIME TEST.....	9
DROPOUT TEST.....	10
INSTANTANEOUS UNIT.....	10
TARGET AND SEAL-IN UNIT.....	10
PERIODIC CHECKS AND ROUTINE MAINTENANCE.....	10
CONTACT CLEANING.....	11
SYSTEM TEST.....	11
SERVICING.....	11
RENEWAL PARTS.....	13

DESCRIPTION

The IAC77 and 78 relay covered by these instructions are extended range single phase time overcurrent relays with extremely inverse time-overcurrent characteristics. The differences between relays are noted in the table below.

MODEL	INSTANTANEOUS UNIT	OUTPUT CONTACTS	INTERNAL CONNECTION
IAC77A	NO	1	FIG. 4
IAC77B	YES	1	FIG. 5
IAC78A	NO	2	FIG. 6
IAC78B	YES	2	FIG. 7

Both the instantaneous unit and the time delay unit are adjustable over a range of about 8 to 1. The actual ranges available are given in the section under CHARACTERISTICS.

While the extremely inverse time current characteristics of these relays make them particularly well suited for application on distribution circuits where cold load pick up, and fuse coordination requirements exist, they may be used successfully wherever such a characteristic is desired. In general one relay is required per phase and one for zero sequence ground currents to provide protection against all single phase and multi-phase faults.

Each relay is equipped with a dual rated target seal-in unit and comes in a standard S1 case. See Figures 10 and 11 for outline and dimensions.

APPLICATION

The extremely inverse time current characteristics make the IAC77 and IAC78 relays particularly well suited for the protection of primary distribution circuits. In such applications, because the relay characteristics closely parallel those of the power fuses normally employed on these circuits, it is possible to obtain selective fault protection with a minimum time delay.

The extremely inverse characteristic of the IAC77 and IAC78 relays also are better suited than both the very inverse and inverse relays for picking up cold load. For any given cold load pick up capability, the resulting setting will provide faster protection at high fault currents with the extremely inverse relay than with less inverse devices.

In the application of these relays in conjunction with automatic reclosing devices, the reset time should be considered. The reset time of all the IAC77 and IAC78 relays from the fully closed position to the fully open position, when set on the number 10 time dial is approximately 60 seconds. For lower time dial settings the reset time is proportionately less.

When setting these relays to coordinate with "downstream" relays about 0.40 seconds coordinating time is generally allowed at the maximum fault current for which coordination must take place. This includes about 0.13 seconds for (8 cycle) breaker clearing time, 0.10 seconds for relay overtravel, and about 0.17 seconds for safety factor. If the downstream devices are fuses rather than circuit breakers, then the maximum clearing time of the fuse should be used and the 0.13 seconds allowed for breaker clearing should not be used. If the relay operating time is set by test, the safety factor may be reduced to 0.07 seconds. For example, if the downstream breaker operates in 5 cycles and the relay operating time is set by test at the coordinating current level, then a minimum of 0.25 seconds should be allowed for coordination.

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.

CONSTRUCTION

The induction unit is the basic unit in all Type IAC relays. Figs. 2 and 3 show the induction unit mounted in the cradle. These units are of the induction-disk construction type.

The disk is actuated by a wattmetric type current operating element. This is similar to the standard element as used in watthour meters, except the actuating coils above and below the operating disk are connected in series. A capacitor and variable resistor connected in series with the inner coil on the upper laminated structure makes up the phase-shifting circuit. The disk shaft carries the moving contact which completes the trip or alarm circuit. The disk shaft is restrained by a spiral spring to give proper contact closing current and its motion is retarded by a permanent magnet acting on the disk to give correct time delay.

There is a target and seal-in unit mounted on the front to the left of the shaft of the time overcurrent unit. The seal-in unit has its coil in series and its contacts in parallel with the contacts of the time overcurrent unit such that when the induction unit contacts close the seal-in unit 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 released by pressing a button beneath the lower left corner of the cover.

The instantaneous unit is a small hinge type unit which may be mounted on the front to the right of the shaft of the time overcurrent unit. Its contacts are normally connected in parallel with the contacts of the time overcurrent unit and its coil is connected in series with the time overcurrent unit. When the instantaneous unit picks up, it raises a target which latches up and remains exposed until it is released. The same button that releases the target of the seal unit also releases the target of the instantaneous unit.

RATINGSTIME OVERCURRENT UNIT

Ratings of the time overcurrent unit are given in Table I:

TABLE I

RELAY	FREQ. CYCLES	PICK UP RANGE, AMPERES	
		MAIN (TIME) UNIT	INSTANTANEOUS UNIT
IAC77A and IAC78A	60	0.5 - 4.0 2.0 - 15.0	
IAC77B and IAC78B	60	0.5 - 4.0 2.0 - 15.0	0.5 - 4.0 2.0 - 16.0 10.0 - 80.0 20.0 - 160.0

Available taps in for time overcurrent unit are shown on Table II.

TABLE II

RANGE AMPERES	TAPS AVAILABLE (AMPERES)
0.5 - 4.0	0.5,0.6,0.7,0.8,1.0,1.2,1.5,2.0,2.5,3.0,4.0
2.0 - 15.0	2.0,2.5,3.0,4.0,5.0,6.0,7.0,8.0,10.0,12.0,15.0

The one second thermal ratings are listed in Table III.

TABLE III

TIME OVERCURRENT UNIT (AMPS)	1-SEC. RATING (AMPS)	K
0.5 - 4.0	125.0	15,625
2.0 - 15.0	260.0	67,600

For ratings of less than one second, the rating may be calculated according to the formula

$$I = \sqrt{\frac{K}{T}}$$

Where T is the time in seconds that the current flows.

The continuous ratings for the time overcurrent unit are shown on Tables IV and V.

TABLE IV

0.5 - 4.0 AMP RANGE											
TAP	0.5	0.6	0.7	0.8	1.0	1.2	1.5	2.0	2.5	3.0	4.0
RATING	3.5	3.7	4.0	4.5	5.0	5.5	6.0	7.0	8.0	9.0	10.0

TABLE V

2.0 - 15.0 AMP RANGE											
TAP	2.0	2.5	3.0	4.0	5.0	6.0	7.0	8.0	10.0	12.0	15.0
RATING	10.0	11.0	12.0	13.0	15.0	17.0	18.0	19.0	20.0	20.0	20.0

INSTANTANEOUS UNIT

The instantaneous unit has a double wound coil for operation on either one of two ranges. Any setting obtained in the lower range (series connected) is doubled, within $\pm 3\%$ when the unit is connected for high range operation (parallel connected).

The instantaneous unit has a continuous rating of 1.5 times minimum setting or 25 amperes whichever is smaller. Example: The 2.0-16.0 ampere instantaneous unit when set on the low range (2.0-8.0 amperes) has a continuous rating of 3.0 amperes, and when connected for high range operation (4.0-16.0 amperes) has a continuous rating of 6.0 amperes. The continuous and one second ratings for the instantaneous unit are shown on Table VI.

TABLE VI

RANGE			CONTINUOUS	*ONE SECOND	K
0.5-4.00	0.5-2.00	S	0.75	25.0	625
	1.0-4.00	P	1.5	50.0	2500
2.0-16.0	2.0-8.00	S	3.0	130.0	16900
	4.0-16.00	P	6.0	260.0	67600
10.0-80.0	10.0-40.0	S	15.0	400.0	160000
	20.0-80.0	P	25.0	600.0	360000
20.0-160.0	20.0-80.0	S	25.0	600.0	360000
	40.0-160.0	P	25.0	600.0	360000

* Higher currents may be applied for shorter lengths of time in accordance with the formula

$$I = \sqrt{\frac{K}{T}}$$

** S = Series connected, P = Parallel connected

TARGET SEAL-IN UNIT

Ratings for the target seal-in unit are shown in Table VII.

TABLE VII

	TAP	
	0.2	2.0
D.C. RESISTANCE $\pm 10\%$ (OHMS)	7	0.13
MIN. OPERATING (AMPERES $+0-25\%$)	0.2	2.0
CARRY CONT. (AMPERES)	0.3	3.0
CARRY 30 AMPS FOR (SEC.)	0.03	4.0
CARRY 10 AMPS FOR (SEC.)	0.25	30.0
60 HZ IMPEDANCE (OHMS)	52.0	0.53

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.

CONTACTS

The current-closing rating of the contacts is 30 amperes for voltages not exceeding 250 volts. The current-carrying rating is limited by the ratings of the seal-in unit.

BURDENS

Burdens for the time overcurrent unit are given in Table VIII.

TABLE VIII

RANGE	HZ	MIN. TAP	BURDENS AT MIN. PICKUP MIN. TAP			BURDENS IN OHMS (Z)			V.A. AT 5 AMPS CALCULATED FROM IMPEDANCE AT MIN PICKUP
			R	J _X	Z	3 TIMES PICKUP	10 TIMES PICKUP	20.0 TIMES PICKUP	
0.5 - 4.0	60	0.5	0.80	1.38	1.60	1.60	1.60	1.60	40
2.0 - 15.0	60	2.0	0.55	0.86	0.092	0.10	0.10	0.10	2.3

NOTE: The impedance values given are those for minimum tap of each relay. The impedance for other taps at pick-up current (tap rating) varies inversely, (approximately) as the square of the tap rating. For example, a relay with 0.5 - 4.0 amp range the impedance of 0.5 amp tap is given as 1.60 ohms. The impedance of the 2.0 amp tap at 2.0 amperes is $(.5/2)^2 \times 1.6$ or 0.10 ohm.

The instantaneous unit burdens are listed in Table IX.

TABLE IX

RANGE 60 HZ RELAYS ONLY (AMPS)	*	MIN. TAP AMPS	BURDENS AT MIN. PICKUP			BURDENS IN OHMS (Z)			VA AT 5 AMPS CALCULATED FROM IMPEDANCE AT MIN. PICK-UP (I^2Z)
			R OHMS	J _X OHMS	Z OHMS	3 TIMES PICKUP	10 TIMES PICKUP	20 TIMES PICKUP	
0.5-4.0	LOW	0.5	10.3	8.1	12.9	12.9	12.9	12.9	325.5
	HIGH	1.0	2.6	2.02	3.31	3.31	3.31	3.31	82.75
2.0-16.0	LOW	2.0	0.72	0.88	1.13	1.13	1.13	1.13	22.50
	HIGH	4.0	0.18	0.22	0.284	0.284	0.284	0.284	7.10
10.0-80.0	LOW	10.0	0.04	0.05	0.064	0.064	0.064	0.064	1.60
	HIGH	20.0	0.01	0.012	0.0156	0.0156	0.0156	0.0156	0.39
20.0-160.0	LOW	20.0	0.02	0.03	0.036	0.036	0.036	0.036	0.90
	HIGH	40.0	0.005	0.0008	0.009	0.009	0.009	0.009	0.225

- * Low means two winding connected in series.
 High means two winding connected in parallel.
 See internal connections diagram for additional information.

CHARACTERISTICS

Pick-up in these relays is defined as the current required to close the contacts from the 0.5 time dial position. The pick-up value in the IAC77 relays is within 3% of the tap value.

The setting of the time dial determines the length of time the unit required to close its contacts when the current reaches the predetermined value. The contacts are just closed when the dial is set at zero. When the dial is set at 10, the disk must travel the maximum distance to close the contacts; this gives the maximum time setting. The unit resets at 85% of the minimum closing value of current. Figure 9 shows the Time Current characteristics for relay type IAC77 and IAC78. The time to reset to the 10 time dial position when the current is reduced to zero is approximately 57 seconds.

The time current curve for the instantaneous unit is shown on Figure 8.

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 nearest 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 TESTS

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. If the examination or test indicates that readjustment is necessary, refer to the section on SERVICING.

These tests may be performed as part of the installation on acceptance tests at the discretion of the user. Since most operating companies use different procedures for acceptance and installation tests, the following section includes all applicable tests that may be performed on these relays.

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 noticeable 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 contacts.
4. The targets in the seal-in unit and in the instantaneous unit must come into view and latch when the armatures 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.

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. SEE FIGURE 1.

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 circuits, R-L or RC networks, or saturating electromagnets (such as time overcurrent relays) would be essentially affected by non-sinusoidal wave forms.

TIME OVERCURRENT UNIT

Rotate the time dial slowly and check by means of a lamp that the contacts just close at the zero time dial setting.

Where the contacts just close can be adjusted by running the stationary contact brush in or out by means of its adjusting screw. This screw should be held securely in its support.

With the contacts just closing at No. 0 time setting, there should be sufficient gap between the stationary contact brush and its metal backing strip to insure approximately 1/32" wipe.

The minimum current at which the contacts will just close is determined by the position of the tap screw in the tap block at the top of the relay.

When changing the current setting of the relay while in the case, remove the connection plug to short the current transformer secondary circuit. Next, screw the tap screws into the tap marked for the desired current and then replace the connection plug.

The pickup of the unit for any current tap setting is adjusted by means of the variable resistor in the phase-shifting circuit. This adjustment also permits any desired setting intermediate between the various tap settings to be obtained. The control spring is prewound approximately 660 degrees with the contacts just closed. Further adjustment of this setting is seldom required. The unit is adjusted at the factory to close its contacts from any time dial position at a minimum current within five per cent of the tap setting. The unit resets at 85 percent of the minimum closing value.

PICKUP TEST

Set the relay at the 0.5 time dial position and 2.0 amp tap. Using the test connections of Figure 12, the main unit should close its contacts within $\pm 5\%$ of tap value current.

TIME TEST

Set the relay at the 5.0 time dial position and 2.0 amp tap. Using the test connections of Figure 12 and applying 5 times pickup current, the relay should operate at 0.92 seconds $\pm 5\%$. With 2 times pickup current applied the operating time should be 6.75 seconds $\pm 5\%$.

INSTANTANEOUS UNIT

Make sure that the instantaneous unit is wired for the range in which it is to operate (see internal connection diagram) and connected as indicated on Test Circuit Figure 12. Whenever possible, use the higher range since the higher range has higher continuous rating.

SETTING THE INSTANTANEOUS UNIT

Loosen the locknut and turn the pole piece toward the desired setting. See Figure 2. 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 PICKUP. DO NOT LEAVE THE CURRENT ON TOO LONG AS IT MAY DAMAGE THE UNIT.

PICK UP TESTS

With the unit connected for high range operation (parallel connections) and the target in the "Down" position check the pickup at the maximum calibration mark, the pick up should be within the limits in Table X.

TABLE X

UNIT RANGE AMPERES	MINIMUM AMPERES	CALIBRATION AMPERES	MAXIMUM AMPERES
0.5-4.0	3.6	4.0	4.5
2.0-16.0	14.4	16.0	17.7
10.0-80.0	72.0	80.0	89.0
20.0-160.0	144.0	160.0	177.0

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. See Figure 2. This procedure is necessary to prevent the right hand stationary contact from getting out of adjustment. Screws should never be in both taps at the same time.

PICK-UP AND DROPOUT TEST

1. Connect relay studs 1 and 2 (See Figure 12) 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. Turn the time dial to the ZERO TIME DIAL POSITION.
3. Increase the current slowly until the seal-in unit picks up. See Table XI below.
4. Move the time dial away from the ZERO TIME DIAL position, the seal-in unit should remain in the picked 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 TESTS

The following tests are to be performed at the time of installation.

TIME OVERCURRENT UNIT

1. Set tap screw on desired tap.
Using the test circuit in Figure 12, apply approximately twice tap value until contacts just close. Reduce the current until the light in series with the contacts begin to flicker. This value of current is defined as pick up and should be within 5% of tap value.
2. Check the operating time at some multiple of tap value. This multiple of tap value may be five times tap rating or the maximum fault current for which the relay must coordinate. The value used is left to the discretion of the user.

TARGET AND SEAL-IN UNIT

1. Make sure that the tap screw is in the desired tap.
2. Perform pick up and drop out tests as outlined in the Acceptance Test Section.

INSTANTANEOUS UNIT

1. Select the desired range by making the proper connections at the rear of the relay (See Internal Connections Diagram). Whenever possible, always select the higher range since it has higher continuous rating.
2. Set the instantaneous unit to pick up at the desired current level. See "Setting the Instantaneous Unit", in the "Acceptance Test Section."

All the tests described above under Installation Tests must be performed at the time of installation. In addition, if those tests described under the "Acceptance Tests Section" were not performed prior to installation, it is recommended that they be performed at this time.

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. It is recognized that the interval between periodic checks

will vary depending upon environment, type of relay 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 below be checked at an interval of from one to two years.

These tests are intended to insure that the relays have not deviated from their original setting. If deviations are encountered, the relay must be retested and serviced as described in this manual.

TIME OVERCURRENT UNIT

1. Perform Pick-up test as described in the "Installation Section" for the tap in service.
2. Perform the Time Tests as described in the "Installation Section."

INSTANTANEOUS UNIT

1. Check that the Instantaneous Unit picks up at the desired current level, as outlined in the "Acceptance Test Section."

TARGET AND SEAL-IN UNIT

1. Check that the unit picks up at the values shown in Table X.
2. Check that the units drops out at 30% or more of tap value.

CONTACT CLEANING

For cleaning relay contacts, a flexible burnishing tool should be used. This consists of a flexible strip of metal with an etched-roughened surface resembling in effect a superfine file. The polishing action is so delicate that no scratches are left, yet it will clean off any corrosion thoroughly and rapidly. Its flexibility insures the cleaning of the actual points of contact. Do not use knives, files, abrasive paper or cloth of any kind to clean relay contacts.

SYSTEM TEST

Although this Instruction Book is primarily written to check and set the IAC relay, overall functional test to check the system operation are recommended at intervals based on the customer's experience.

SERVICING

TIME OVERCURRENT UNIT

If it is found during installation or periodic testing that the time overcurrent unit is out of limits, the unit may be recalibrated as follows:

1. Rotate time dial to No. 0 time dial setting and check by means of a lamp that the contacts just close.

Where the contacts just close can be adjusted by running the stationary contact brush in or out by means of its adjusting screw. This screw should be held securely in its support.

With the contacts just closing at No. 0 time setting, there should be sufficient gap between the stationary contact brush and its metal backing strip to insure approximately 1/32" wiper.

2. Connect the operating coil terminals to a source of the proper frequency and good waveform having a voltage of 110 or more, with pure resistance load boxes for setting the current.
3. Set the tap plug in the 2 amp tap, and the time dial where the contacts are just open. Then set the resistor at the midpoint of its range, and then check the current required to just close the contacts. It should fall within the limits given in Table XII.

TABLE XII

TAP	MINIMUM AMPS	MAXIMUM AMPS
2 AMP	1.96	2.04
2 AMP	1.96	2.04

It should never be necessary to wind up the control spring adjustor more than 30 degrees (one notch) or unwind it more than 120 degrees (three notches) from the factory setting to obtain the above pickup setting.

4. After pick up has been set within the prescribed limits, the compensation must be checked. With the same tap setting as in paragraph 3, set the time dial at No. 10 and check the current required to just move the disk away from the stop arm. This current should be within the following limits: If the disc moves at the lower limit, check that movement is not over 1/2' measured along the periphery or the disc.)

TABLE XIII

TAP	MINIMUM AMPS	MAXIMUM AMPS
2 AMP	1.88	2.12
2 AMP	1.88	2.12

If the current falls outside these limits, the following steps should be taken. Reset the control spring until compensation at #10 time dial setting is within the limits shown above. Then set at #1/2 T.D.S. and restore pick up by adjusting the resistor. Compensation should be rechecked after the resistor adjustment.

With the contacts just open, check the current required to just close the contacts on each of the other taps. This current should be within $\pm 3\%$ of tap value.

With the time dial at No. 10 time setting and the tap plug in the 2 amp tap, apply sufficient current to the relay to definitely close the contacts. Reduce the current to 80 percent of tap value and the disc should reset all the way to the No. 10 dial setting position.

With the tap plug in the 2 amp tap and the time dial at No. 5 time setting, apply five times tap current to the relay.

Adjust the drag magnet to obtain a closing time from 0.90 to 0.94 seconds. The magnet is adjusted by loosening the nut under the magnet shelf. Moving the magnet in decreases the time, moving the magnet out increases the time.

When adjusting the drag magnet, be sure the outer edge of the magnet never extends out beyond the cut out in the disk. Be sure the nut clamping the drag magnet to its supporting shelf is tight before proceeding with other time checks. Make sure drag magnet does not hit counter-weight at any position of disk.

With the tap plug in the 2 amp tap and the time dial at the No. 5 time setting, check the contacts closing at 2 and 10 times tap value. These times must be within the limits in Table XIV.

TABLE XIV

TAP	AMPS	MIN. SEC.	MAX. SEC.
2.0	4.0	6.36	7.1
2.0	20.0	0.265	0.30

INSTANTANEOUS UNIT

1. Both contacts should close at the same time.
2. The backing strip should be so formed that the forked end (front) bears against the molded strip under the armature.
3. With the armature against the pole piece the cross member of the "T" spring should be in a horizontal plane and there should be at least 1/32 inch wipe on the contacts. Check this by inserting a 0.012 inch feeler gauge between front half of shaded pole with armature held closed. Contacts should close with feeler gauge in place.

TARGET AND SEAL-IN UNIT

Check steps 1 and 2 as described under Instantaneous Unit.

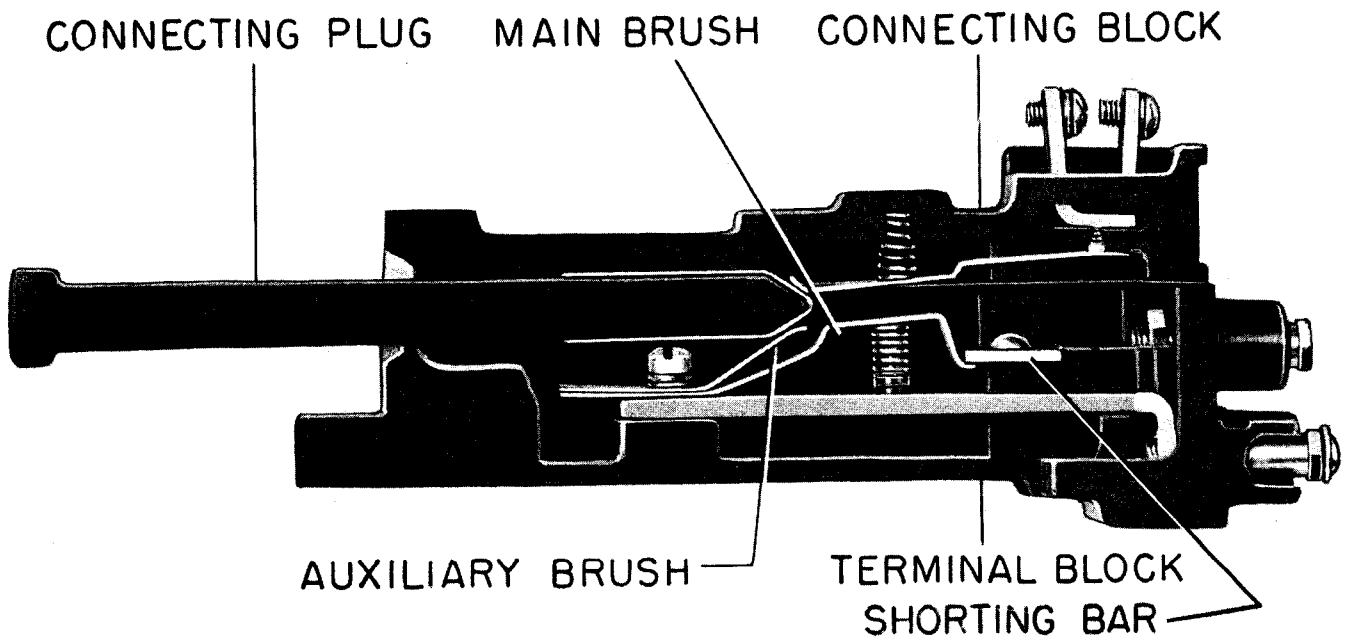
To check the wipe of the seal-in unit insert a 0.012 inch feeler gauge between the plastic residual

of the armature and the pole piece with armature held closed. Contacts should close with feeler gauge in place.

RENEWAL PARTS

It is recommended that sufficient quantities of renewal parts be carried 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 the complete model number of the relay for which the part is required.



NOTE: AFTER ENGAGING AUXILIARY BRUSH, CONNECTING PLUG TRAVELS $\frac{1}{4}$ INCH BEFORE ENGAGING THE MAIN BRUSH ON THE TERMINAL BLOCK.

FIG. 1 (8025039) Cross Section Of Drawout Case Showing Position Of Auxiliary Brush

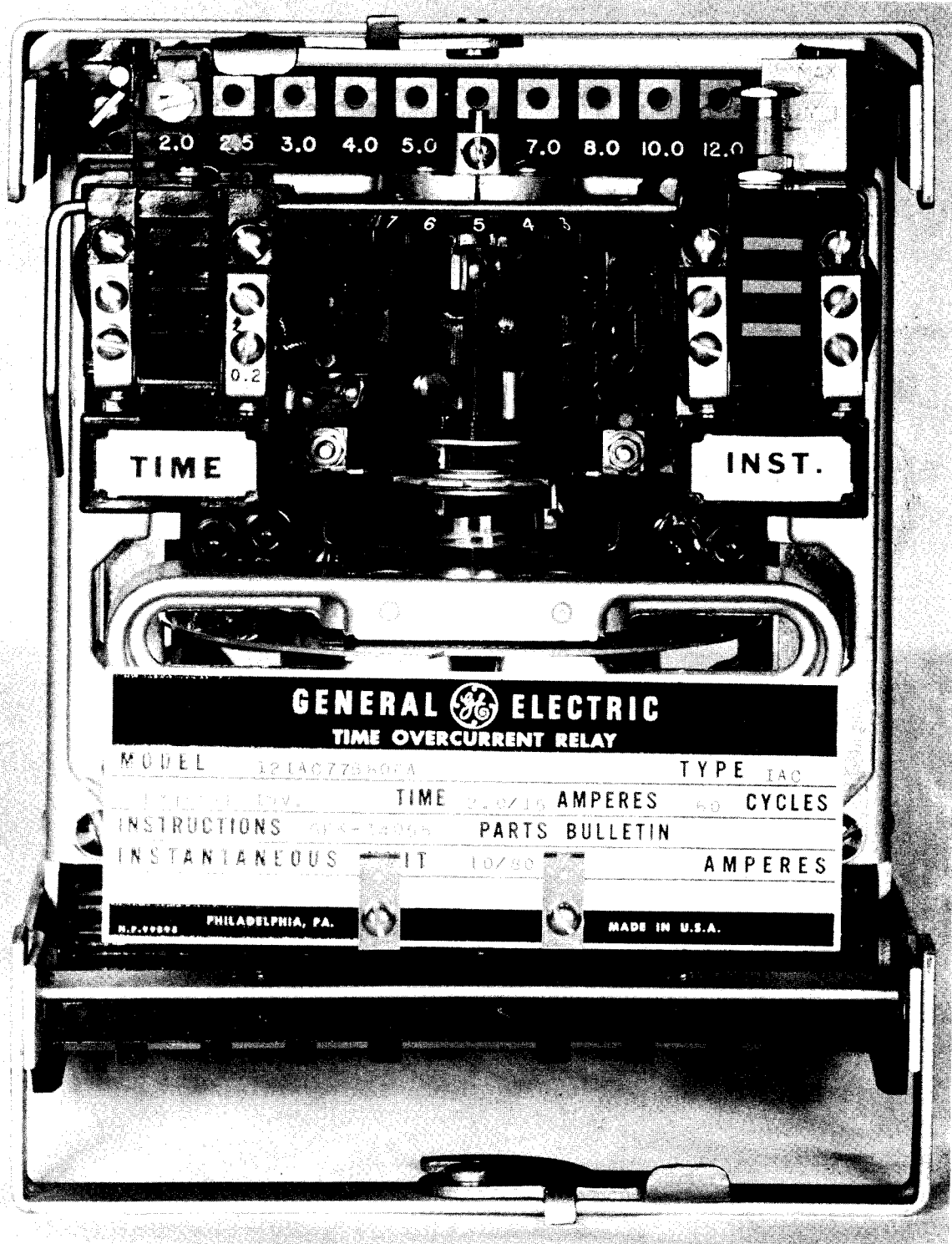


FIG. 2 (8041298) The Type IAC77 Relay Removed From Case (Front View)

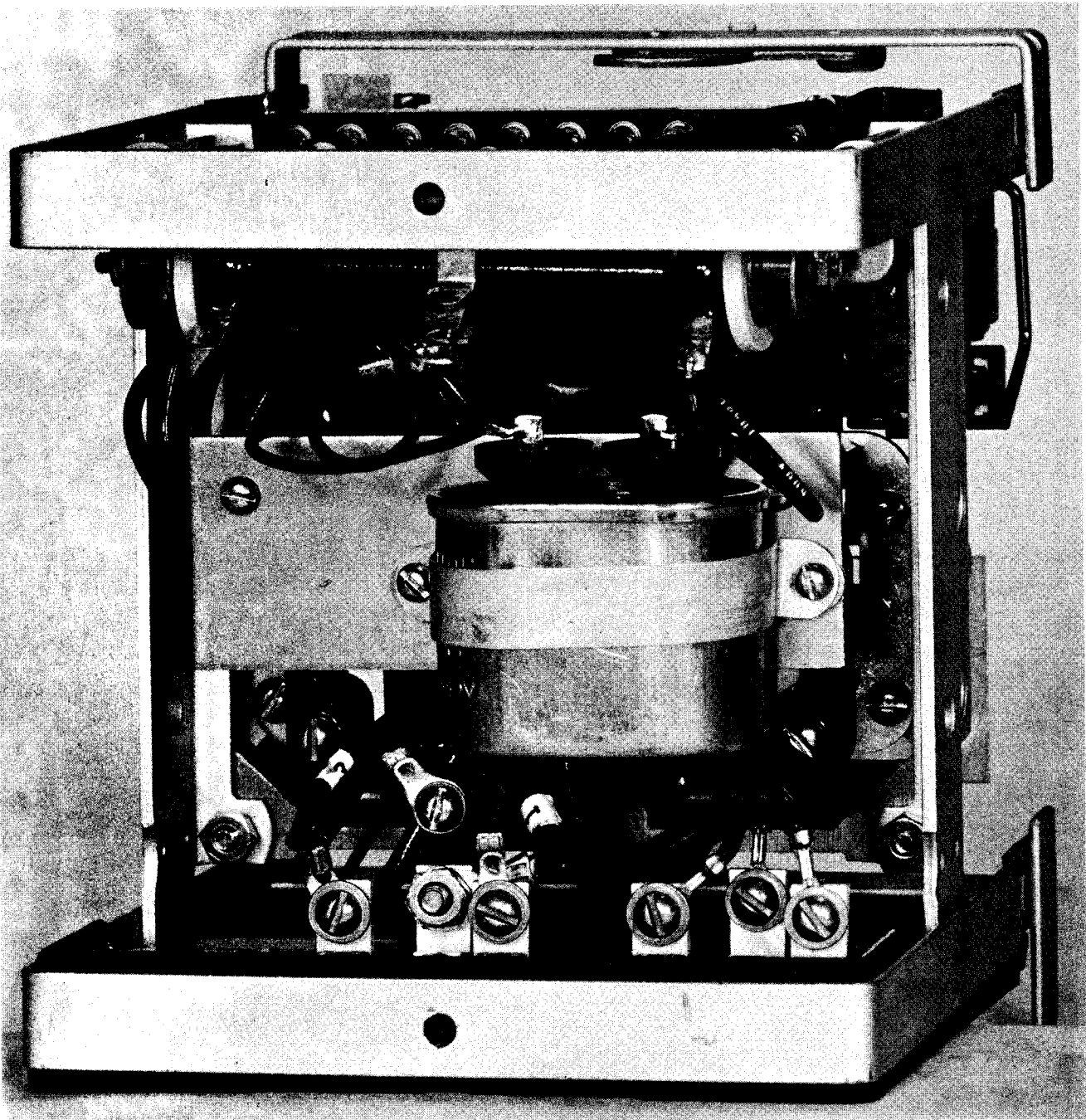
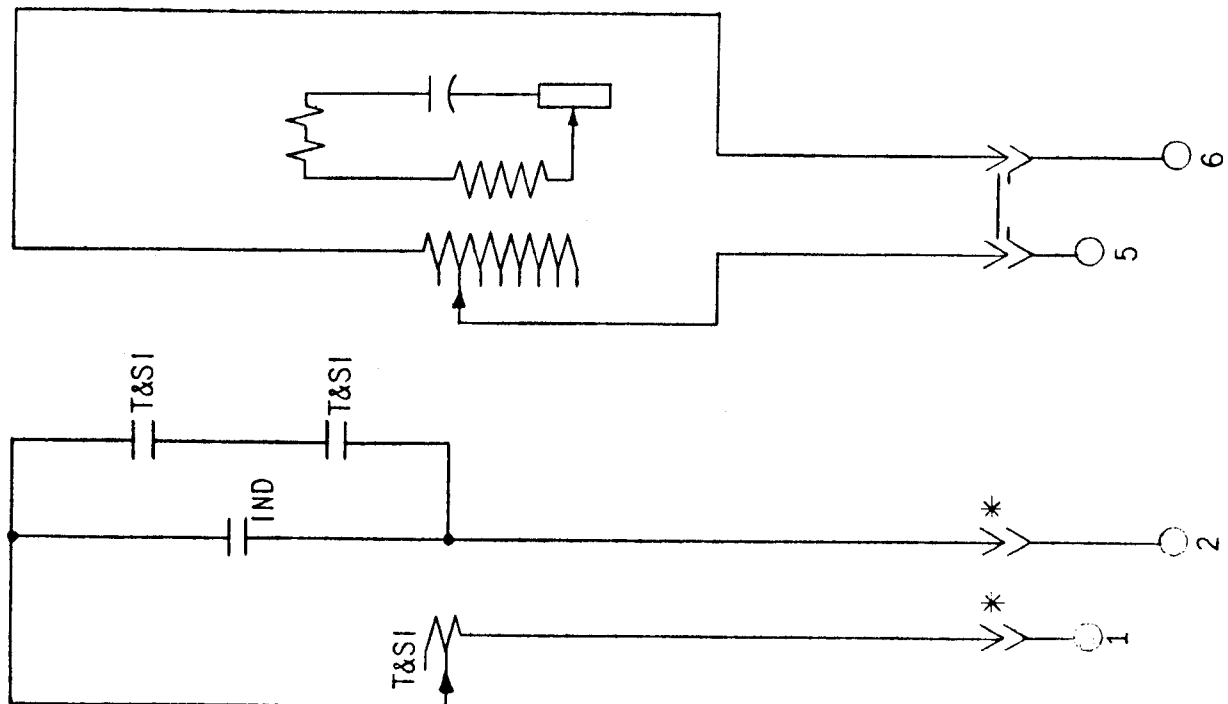


FIG. 3 (8041297) The Type IAC77 Relay Removed From Case (Rear View)



* = SHORT FINGERS

FIG. 4 (0165A7758-0) Type IAC77A 800 Series Relay Internal Connections (Front View)

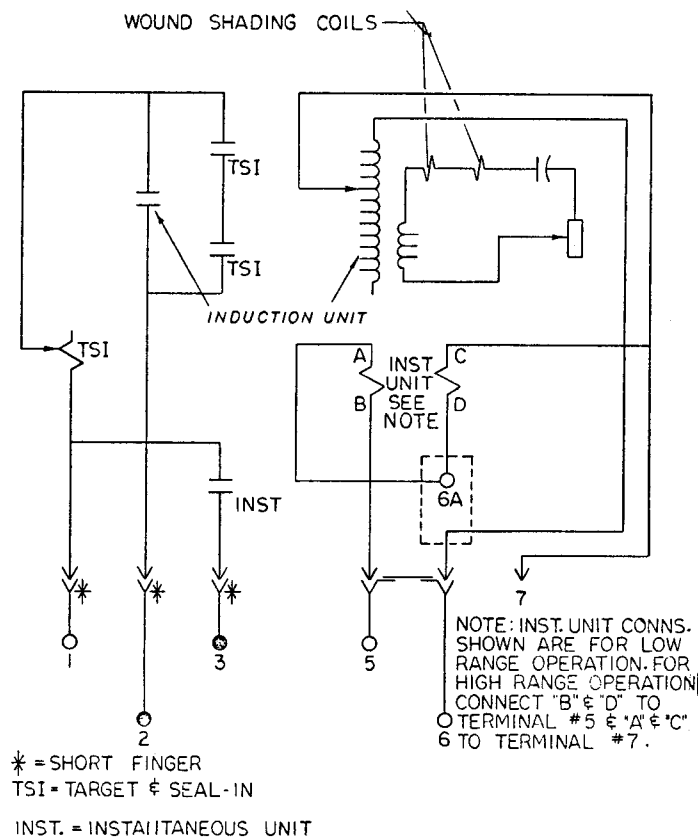
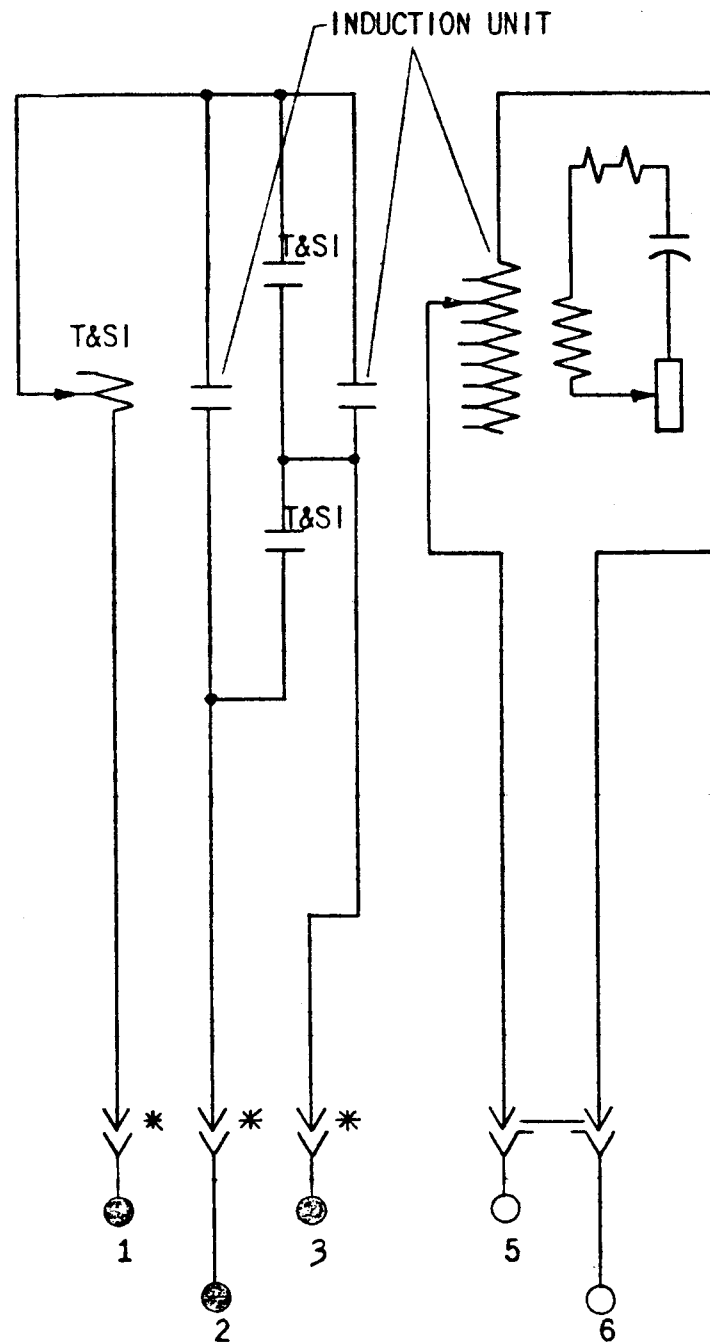
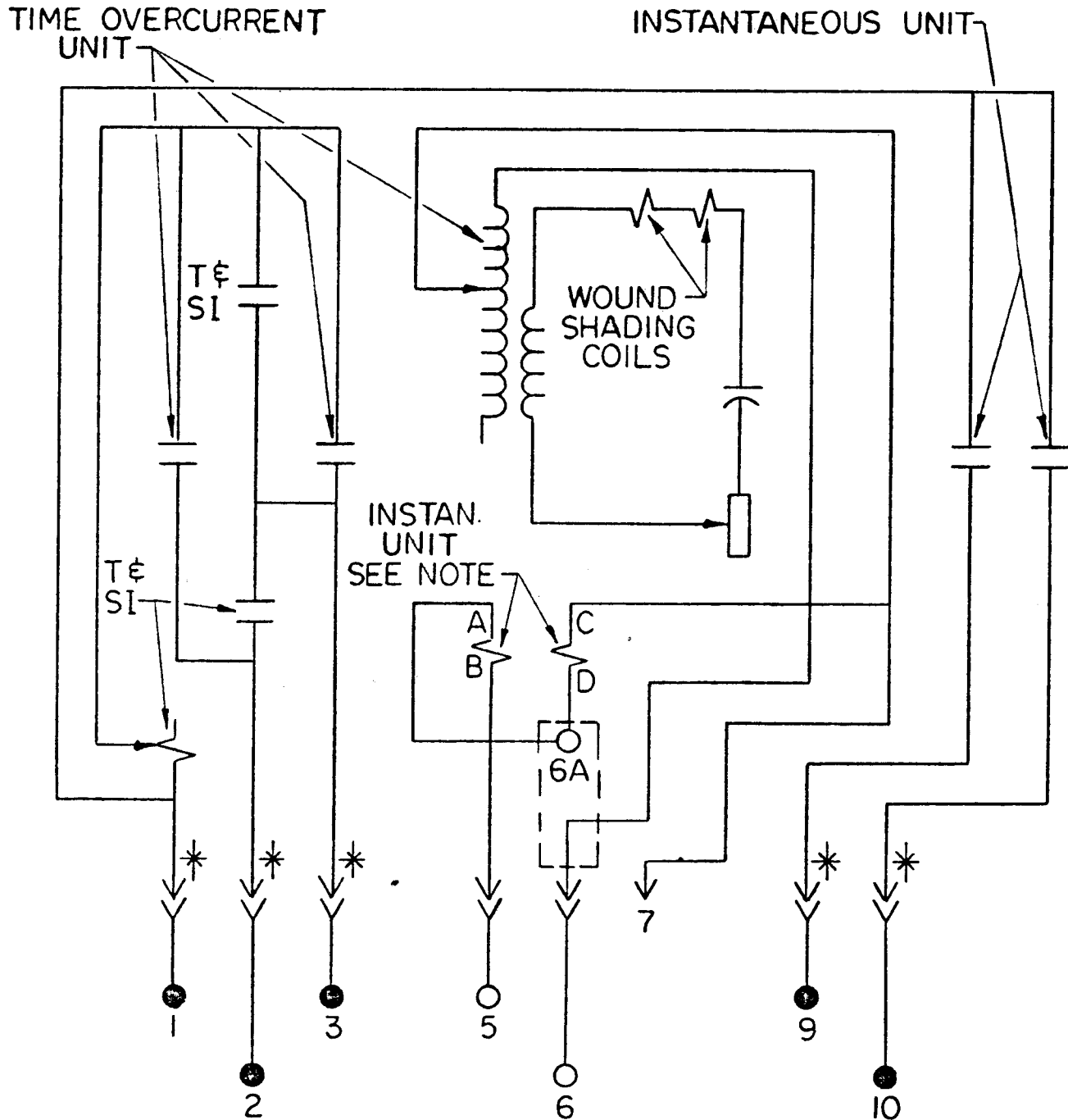


FIG. 5 (0246A2200-1) Type IAC77B 800 Series Relay Internal Connections (Front View)



* = SHORT FINGER

FIG. 6 (0165A7781-0) Type IAC78A 800 Series Relay Internal Connections (Front View)



* = SHORT FINGER

T & SI = TARGET & SEAL-IN

NOTE:- INSTANTANEOUS UNIT CONNECTIONS SHOWN ARE FOR LOW RANGE OPERATION. FOR HIGH RANGE OPERATION CONNECT "B" & "D" TO TERMINAL 5 & "A" & "C" TO TERMINAL 7

FIG. 7 (0246A2286-0) Type IAC78B 800 Series Relay Internal Connection (Front View)

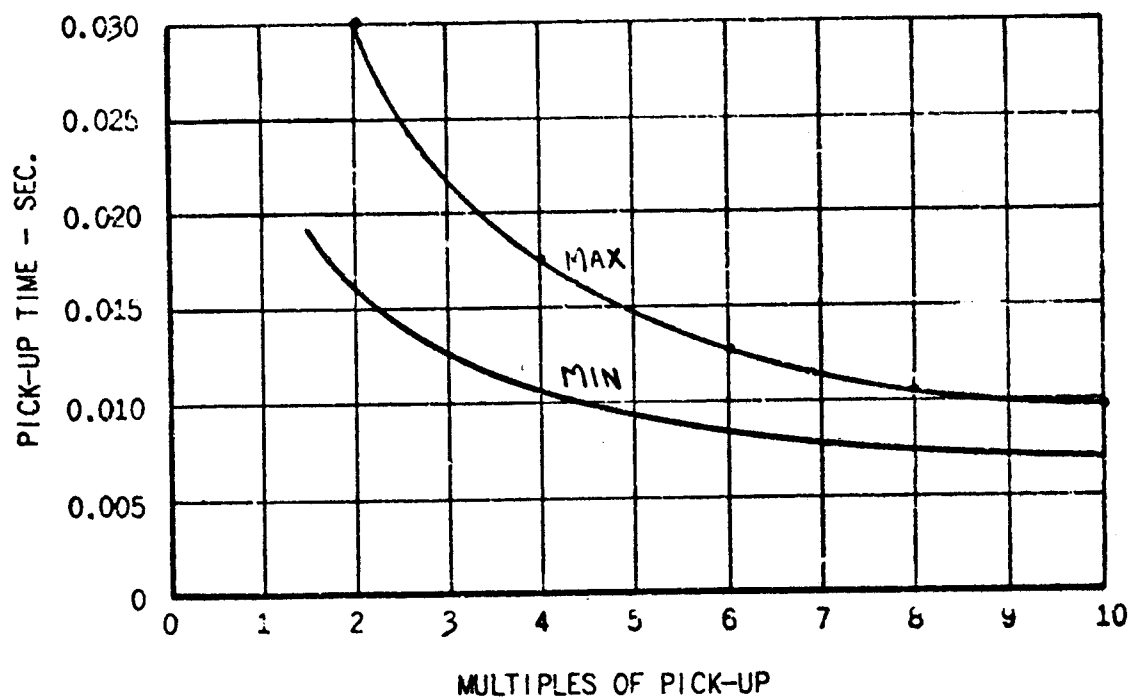


FIG. 8 (K-6306872-3) Time Current Curve Of The Instantaneous Unit

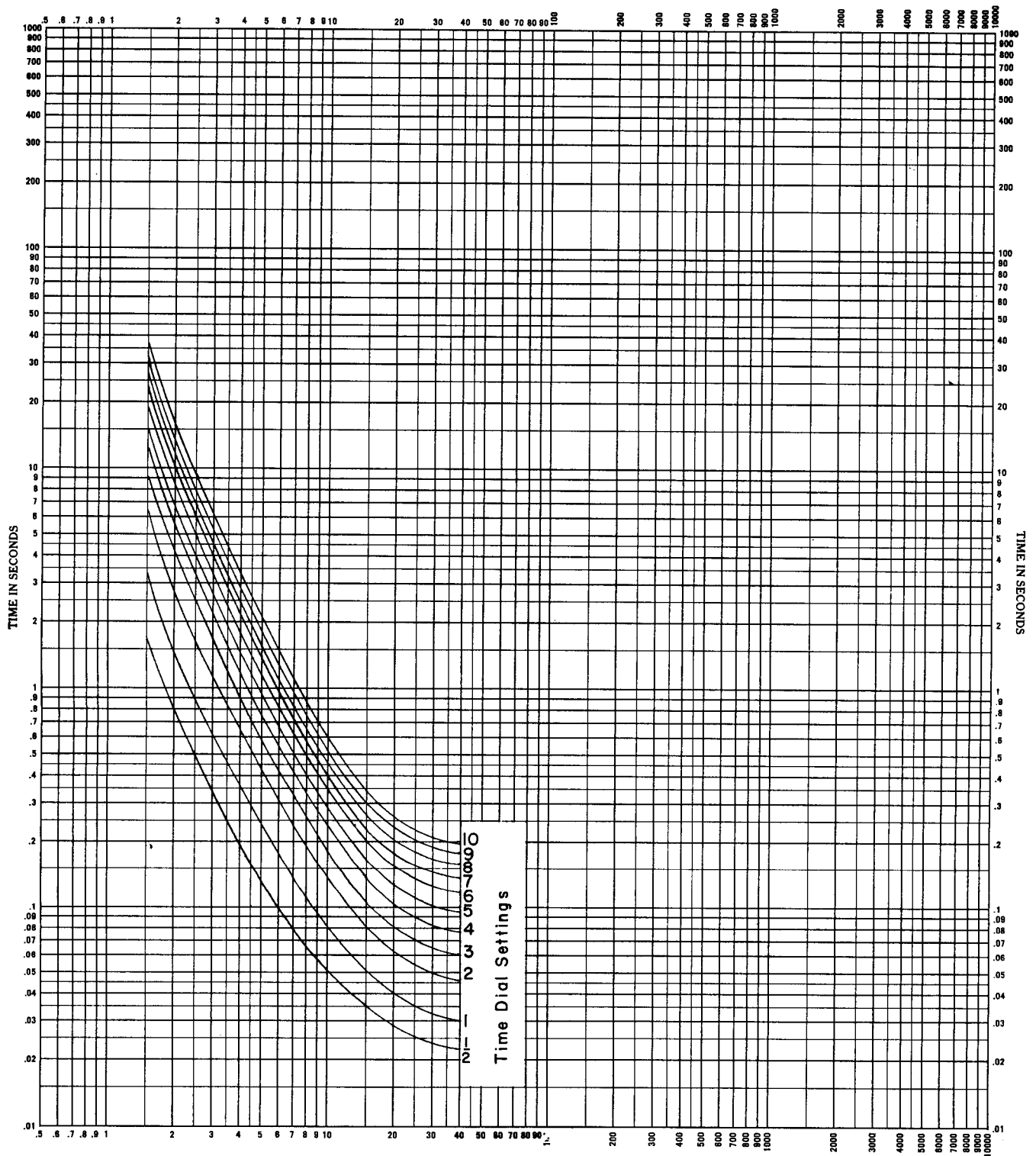


FIG. 9 (0888B0274-2) Multiples Of Relay Tap Setting Time Current Characteristics For The Types IAC77 And IAC78 800 Series Relays

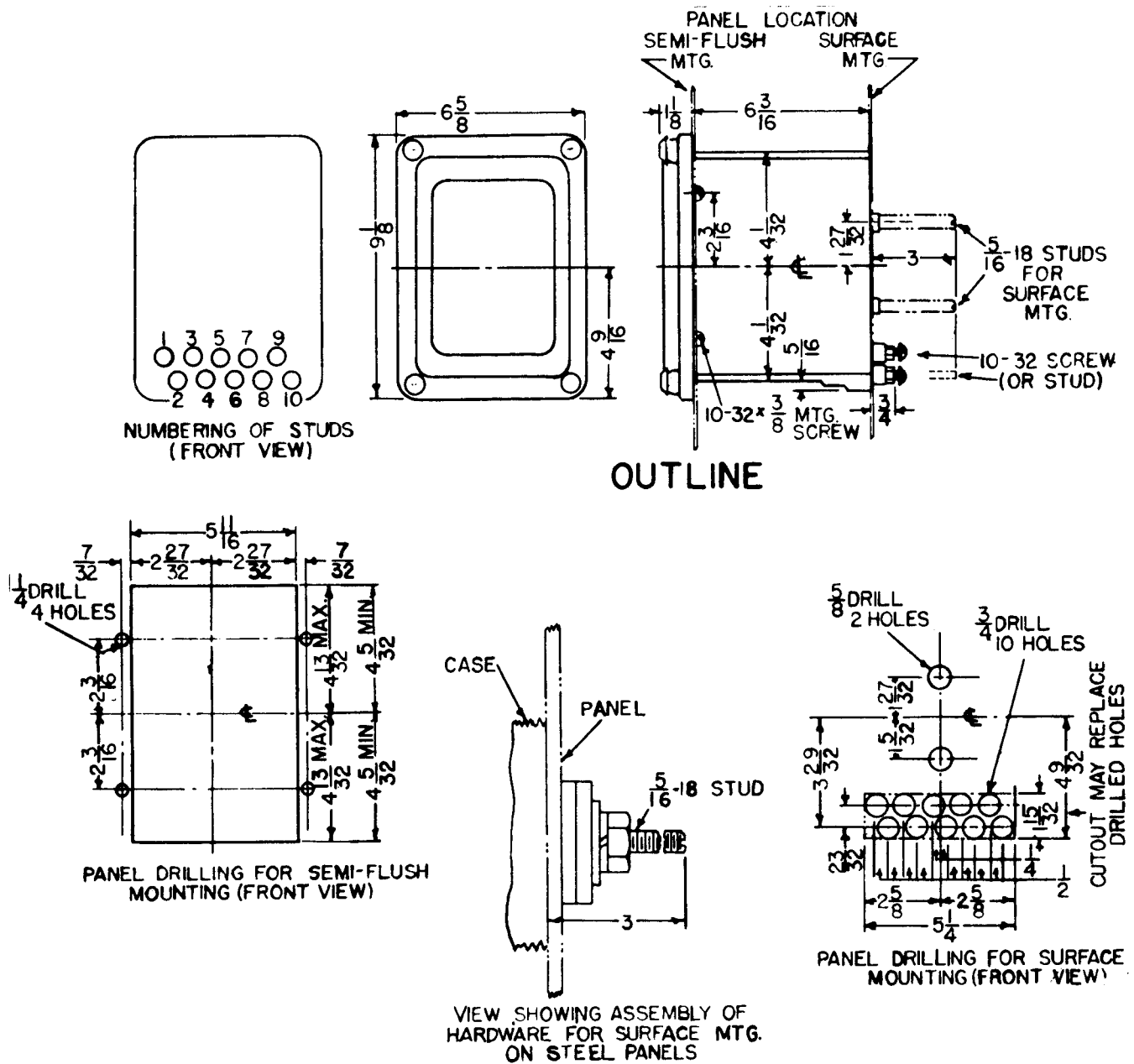


FIG. 10 (K-6209271-3) Outline And Panel Drilling For The IAC78B 800 Series Relay

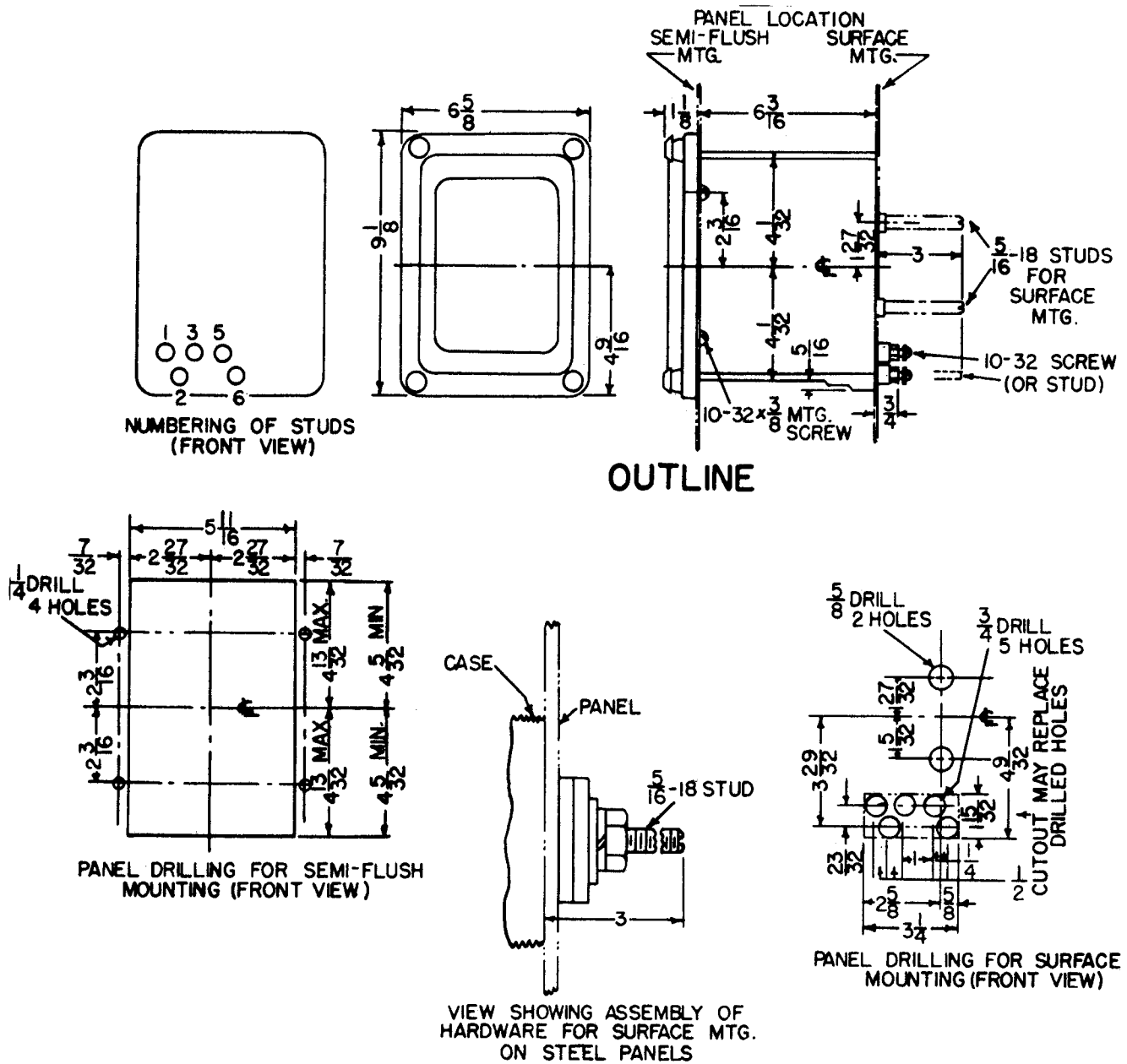


FIG. 11 (K-6209270-2) Outline And Panel Drilling For The Relay Types IAC77A, IAC-7B And IAC78A 800 Series Relays

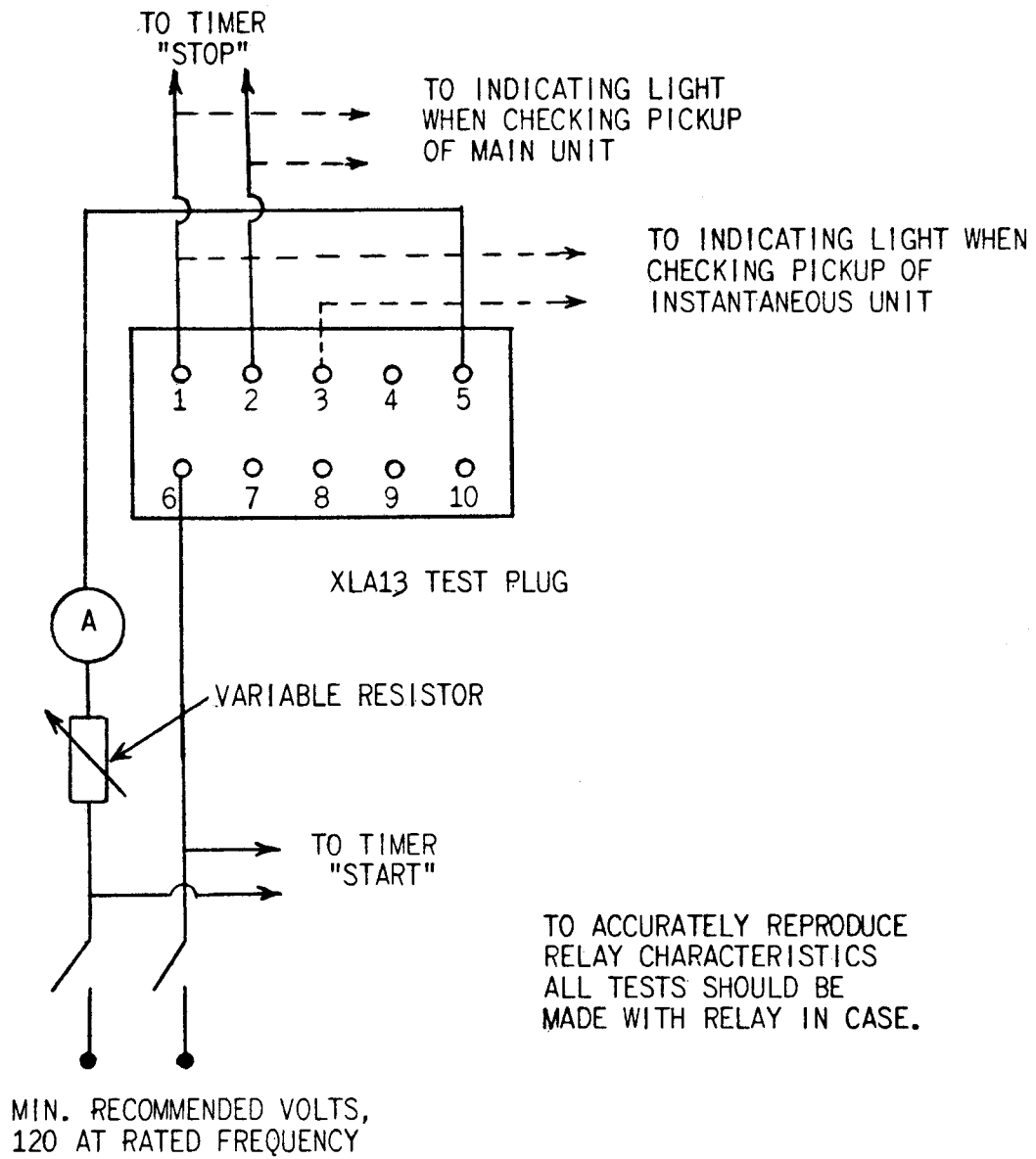


FIG. 12 (K-6154399-7) Test Connections For Testing Pick-up And Time Curve Of The IAC Relays



GEK-34055F

INSTRUCTIONS

TIME OVERCURRENT RELAYS

TYPES

IAC77A FORM 800 AND UP
IAC77B FORM 800 AND UP
IAC78A FORM 800 AND UP
IAC78B FORM 800 AND UP



GENERAL ELECTRIC

TABLE OF CONTENTS

DESCRIPTION	PAGE
APPLICATION	3
CONSTRUCTION	4
RATINGS	4
TIME-OVERCURRENT UNIT	5
INSTANTANEOUS UNIT	5
TARGET AND SEAL-IN UNIT	6
CONTACTS	7
BURDENS	8
CHARACTERISTICS	8
RECEIVING, HANDLING, AND STORAGE	9
ACCEPTANCE TESTS	9
VISUAL INSPECTION	10
MECHANICAL INSPECTION	10
ELECTRICAL TESTS	10
DRAWOUT RELAYS GENERAL	11
POWER REQUIREMENTS GENERAL	11
TIME-OVERCURRENT UNIT	11
PICKUP TEST	11
TIME TEST	12
INSTANTANEOUS UNIT	12
SETTING THE INSTANTANEOUS UNIT	12
PICK UP TESTS	12
TARGET AND SEAL-IN UNIT	13
PICK-UP AND DROPOUT TEST	13
INSTALLATION	13
TIME-OVERCURRENT UNIT	14
TARGET AND SEAL-IN UNIT	14
INSTANTANEOUS UNIT	14
PERIODIC CHECKS AND ROUTINE MAINTENANCE	14
TIME OVERCURRENT UNIT	15
INSTANTANEOUS UNIT	15
TARGET AND SEAL-IN UNIT	15
CONTACT CLEANING	15
SYSTEM TEST	15
SERVICING	15
TIME-OVERCURRENT UNIT	16
TIME TESTS	16
INSTANTANEOUS UNIT	17
TARGET AND SEAL-IN UNIT	18
RENEWAL PARTS	18

(Cover photo 8041299)

TIME OVERCURRENT RELAYS
TYPES IAC77A, 77B, 78A, 78B FORM 800 and UP

DESCRIPTION

Type IAC77 and IAC78 relays are single-phase, current-operated, AC devices with extremely inverse time/current characteristics. They can be utilized to protect commercial, industrial, and utility power distribution systems against either multi-phase or phase-to-ground faults.

Each relay consists of a basic induction-disk time-overcurrent unit, and a dual-rated target/seal-in unit, and may include a hinge-type instantaneous-overcurrent unit. Both the time-overcurrent unit and the instantaneous unit are adjustable over a range of about 8 to 1. The available ranges in amperes of both units, as well as information on their continuous rating, contact rating, and target/seal-in unit tap ratings are given in the section on **RATINGS**.

A standard SI case is used to mount each relay. The outline and mounting dimensions of this case are shown in Figures 11 and 12.

The basic differences between the relays covered by these instructions are noted in the following Table I.

TABLE I

TYPE	INSTANTANEOUS UNIT	CONTACT CIRCUITS	INTERNAL CONNECTIONS
IAC77A	NO	1	FIGURE 4
IAC77B	YES	1	FIGURE 5
IAC78A	NO	2	FIGURE 6
IAC78B	YES	2	FIGURE 7

These instructions do not purport to cover all details or variations in equipment nor 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.

GEK-34055

APPLICATION

The extremely inverse time/current characteristics make the IAC77 and IAC78 relays particularly well suited for the protection of primary distribution circuits. In such applications, because the relay characteristics closely parallel those of the power fuses normally employed in these circuits, it is possible to obtain selective fault protection with a minimum time delay.

The unique time-current characteristics of these relays also make them well suited for picking up cold loads. For any given cold load pick up capability, the resulting setting will provide faster protection at high fault currents with the extremely inverse relay than with less inverse devices.

The general practice is to use a set of three relays for interphase faults. A separate relay, residually connected, can be utilized for single-phase-to-ground faults. Use of a separate ground relay is advantageous because it can be adjusted to provide more sensitive protection on ground faults. Typical connections for applying these relays are shown in Figures 14 and 15.

In the application of IAC77 and IAC78 relays with automatic reclosing devices, the reset time should be considered. The reset time of all relays covered by these instructions is approximately 60 seconds from the fully-closed to the fully-open position, when set at number 10 on the time dial.

When setting these relays to coordinate with "downstream" relays, a coordination time of from 0.25 to .40 second is generally allowed. These coordination times include, in addition to breaker-clearing time, 0.10 second for relay overtravel and 0.17 second for safety factor. For example, if the breaker-clearing time is 0.13 second (8 cycles) the coordination time would be 0.40 second. If the relay time is set by test at the current level in question, the safety factor may be reduced from 0.17 to 0.07 second. Then with relay overtravel of .10 second, if the "downstream" breaker time is 5 cycles (0.08 second), a minimum of 0.25 second could be allowed for coordination. If the downstream devices are fuses rather than circuit breakers, then the maximum clearing time of the fuse should be used and the time allowed for breaker-clearing time should be omitted.

CONSTRUCTION

The induction unit is the basic unit in all Type-IAC relays. Figures 2 and 3 show the induction unit mounted in the cradle. These units are of the induction-disk construction type.

The disk is actuated by a wattmetric-type current-operating element. This is similar to the standard element as used in watthour meters, except the actuating coils above and below the operating disk are connected in series. A capacitor and variable resistor connected in series with the inner coil on the upper laminated structure makes up the phase-shifting circuit. The disk shaft carries the moving contact, which completes the trip or alarm circuit. The disk shaft is restrained by a spiral spring to give proper contact-closing

GEK-34055

current, and its motion is retarded by a permanent magnet acting on the disk to give correct time delay.

There is a target and seal-in unit mounted on the front, to the left of the shaft of the time-overcurrent unit. The seal-in unit has its coil in series and its contacts in parallel with the contacts of the time-overcurrent unit, such that when the induction-unit contacts close, the seal-in unit 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 released by pressing a button beneath the lower left corner of the cover.

The instantaneous unit is a small hinge-type unit, which is mounted on the front of the B models to the right of the shaft of the time-overcurrent unit. Its contacts are normally connected in parallel with the contacts of the time-overcurrent unit and its coil is connected in series with the time-overcurrent unit. When the instantaneous unit picks up it raises a target, which latches up and remains exposed until it is released. The same button that releases the target of the seal-in unit also releases the target of the instantaneous unit.

RATINGS

TIME-OVERCURRENT UNIT

Ratings of the time-overcurrent unit are given in Table II.

TABLE II

RELAY	FREQUENCY CYCLES	PICK UP RANGE, AMPERES	
		MAIN (TIME) UNIT	INSTANTANEOUS UNIT
IAC77A and IAC78A	50	0.5 - 4.0	
	60	1.5 - 12.0	
		2.0 - 15.0	
IAC77B and IAC78B	50	0.5 - 4.0	0.5 - 4.0
	60	1.5 - 12.0	2.0 - 16.0
		2.0 - 15.0	10.0 - 80.0
			20.0 - 160.0

Available taps of the time-overcurrent unit are shown on Table III.

TABLE III

RANGE, AMPERES	TAPS AVAILABLE (AMPERES)
0.5 - 4.0	0.5, 0.6, 0.7, 0.8 1.0, 1.2, 1.5, 2.0, 2.5, 3.0, 4.0
1.5 - 12.0	1.5, 2.0, 2.5, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 10.0, 12.0
2.0 - 15.0	2.0, 2.5, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 10.0, 12.0, 15.0

The one-second thermal ratings are listed in Table IV.

GEK-34055

TABLE IV

TIME OVERCURRENT UNIT (AMPS)	ONE SECOND RATING (AMPS)	K
0.5 - 4.0	125.0	15,625
1.5 - 12.0	260.0	67,600
2.0 - 15.0	260.0	67,600

For ratings of less than one second, the rating may be calculated according to the formula

$$I = \sqrt{\frac{K}{T}}$$

where T is the time, in seconds, that the current flows.

The continuous ratings of the time-overcurrent units are shown in Table V.

TABLE V

0.5 - 4.0 AMP RANGE											
TAP	0.5	0.6	0.7	0.8	1.0	1.2	1.5	2.0	2.5	3.0	4.0
RATING	3.5	3.7	4.0	4.5	5.0	5.5	6.0	7.0	8.0	9.0	10.0

1.5 - 12.0 AMP RANGE											
TAP	1.5	2.0	2.5	3.0	4.0	5.0	6.0	7.0	8.0	10.0	12.0
RATING	9.5	10.5	11.5	12.5	14.0	15.5	17.0	18.0	19.0	20.0	20.0

2.0 - 15.0 AMP RANGE											
TAP	2.0	2.5	3.0	4.0	5.0	6.0	7.0	8.0	10.0	12.0	15.0
RATING	10.0	11.0	12.0	13.0	15.0	17.0	18.0	19.0	20.0	20.0	20.0

INSTANTANEOUS UNIT

The instantaneous unit has a double-wound coil for operation on either one of two ranges. Any setting obtained in the lower range (series connected) is doubled, within $\pm 3\%$, when the unit is connected for high-range operation (parallel connected).

GEK-34055

The instantaneous unit has a continuous rating of 1.5 times minimum setting or 25 amperes, whichever is smaller. Example: The 2.0-16.0 ampere instantaneous unit, when set on the low range (2.0-8.0 amperes) has a continuous rating of 3.0 amperes, and when connected for high-range operation (4.0-16.0 amperes) has a continuous rating of 6.0 amperes. The continuous and one-second ratings for the instantaneous unit are shown in Table VI.

TABLE VI

RANGE	CONNECT- IONS	††	CONTINUOUS RATING	† ONE SECOND	K
0.5 - 4.0	0.5 - 2.0	S	0.75	25.0	625
	1.0 - 4.0	P	1.5	50.0	2,500
2.0 - 16.0	2.0 - 8.0	S	3.0	130.0	16,900
	4.0 - 16.0	P	6.0	260.0	67,600
10.0 - 80.0	10.0 - 40.0	S	15.0	400.0	160,000
	20.0 - 80.0	P	25.0	600.0	360,000
20.0 - 160.0	20.0 - 80.0	S	25.0	600.0	360,000
	40.0 - 160.0	P	25.0	600.0	360,000

† Higher currents may be applied for shorter lengths of time in accordance with the formula

$$I = \sqrt{\frac{K}{T}}$$

where T is the time, in seconds, that the current flows.

†† S = Series connected, P = Parallel connected

TARGET AND SEAL-IN UNIT

Ratings for the target seal-in unit are shown in Table VII.

TABLE VII

	TAP	
	0.2	2.0
D.C. Resistance ± 10% (ohms)	7	0.13
MIN. Operating (amperes) +0 - 25%	0.2	2.0
Carry Continuously (amperes)	0.3	3.0
Carry 30 Amps for (sec.)	0.03	4.0
Carry 10 Amps for (sec.)	0.25	30.0
60 Hz Impedance (ohms)	52.0	0.53

GEK-34055

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 of the target and seal-in coils of the protective relay.

CONTACTS

The current-closing rating of the contacts is 30 amperes for voltages not exceeding 250 volts. The current-carrying rating is limited by the ratings of the seal-in unit.

BURDENS

Burdens for the time-overcurrent unit are given in Table VIII.

TABLE VIII

RANGE	HZ	MIN. TAP	BURDENS AT MIN. PICKUP MIN. TAP			BURDENS IN OHMS (Z)			V.A. AT 5 AMPS CALCULATED FROM IMPEDANCE AT MIN. PICKUP (I^2Z)
			R	Jx	Z	3 TIMES PICK- UP	10 TIMES PICK- UP	20.0 TIMES PICK- UP	
0.5 - 0.4	60	0.5	0.80	1.38	1.60	1.60	1.60	1.60	40
1.5 - 12.0	60	1.5	0.085	.147	0.17	0.17	0.17	0.17	4.25
2.0 - 15.0	60	2.0	0.05	0.086	0.099	0.10	0.10	0.10	2.5

NOTE: The impedance values given are those for the minimum tap of each relay. The impedance for other taps at pick-up current (tap rating) varies inversely (approximately) as the square of the tap rating. For example, for a relay with 0.5 - 4.0 amp range, the impedance of the 0.5 amp tap is given as 1.60 ohms. The impedance of the 2.0 amp tap at 2.0 amperes is $(.5/2)^2 \times 1.6$ or 0.10 ohm.

GEK-34055

The instantaneous unit burdens are listed in Table IX.

TABLE IX

RANGE 60 HZ RELAYS ONLY (AMPS)	CON- NEC- TIONS †	MIN. TAP AMPS	BURDENS AT MIN. PICKUP MIN. TAP			BURDENS IN OHMS (Z)			V.A. AT 5 AMPS CALCULATED FROM IMPEDANCE AT MIN. PICKUP (I ₂ Z)
			R OHMS	Jx OHMS	Z OHMS	3 TIMES PICK UP	10 TIMES PICK UP	20.0 TIMES PICK UP	
0.5-4.0	LOW	0.5	12.7	11.5	17.1	9.6	8.7	8.2	427.5
	HIGH	1.0	3.18	2.87	4.28	2.40	2.18	2.04	107.0
2.0-16.0	LOW	2.0	0.76	0.72	1.05	0.59	0.53	0.50	26.25
	HIGH	4.0	0.189	0.180	0.261	0.147	0.133	0.125	6.63
10.0-80.0	LOW	10.0	0.042	0.029	0.051	0.029	0.026	0.024	1.28
	HIGH	20.0	0.010	0.007	0.013	0.007	0.007	0.006	0.33
20.0-160.0	LOW	20.0	0.015	0.008	0.017	0.010	0.009	0.008	0.43
	HIGH	40.0	0.004	0.002	0.004	0.002	0.002	0.002	0.10

† Low means two windings connected in series.

High means two windings connected in parallel.

See Internal-Connections diagram for additional information.

CHARACTERISTICS

Pickup of these relays is defined as the current required to close the contacts from the 0.5 time-dial position. The pickup value of the IAC77 relays is within 3% of the tap value.

The setting of the time dial determines the length of time the unit requires to close its contacts when the current reaches the predetermined value. The contacts are just closed when the dial is set at zero. When the dial is set at 10, the disk must travel the maximum distance to close the contacts; this gives the maximum time setting. The unit resets at 85% of the minimum closing value of current.

Figure 9 shows the 50-Hz and Figure 10 shows the 60-Hz Time/Current Characteristics for Relay types IAC77 and IAC78.

The time to reset to the 10 time-dial position when the current is reduced to zero is approximately 57 seconds.

The time/current curve for the instantaneous unit is shown on Figure 8.

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

GEK-34055

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 nor 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

Immediately 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 relay calibrations have not been disturbed. If the examination or test indicates that readjustment is necessary, refer to the section on **SERVICING**.

These tests may be performed as part of the installation or as acceptance tests, at the discretion of the user. Since most operating companies use different procedures for acceptance and for installation tests, the following section includes all applicable tests that may be performed on these relays.

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 cracked molded parts or other signs of physical damage, and that all the screws are tight.

MECHANICAL INSPECTION

1. There should be no noticeable 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 contacts.
4. The targets in the seal-in unit and in the instantaneous unit must come into view and latch when the armatures are operated by hand, and should unlatch when the target release lever is operated.

5. Make sure that the fingers and shorting bars agree with the internal-connections diagram.

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. See Figure 1.

ELECTRICAL TESTS

DRAWOUT RELAYS, GENERAL

Since all drawout relays in service operate in their cases, it is recommended that they be tested in their cases 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. The 12XLA12A test plug may also be used. Although this test plug allows greater testing flexibility, it 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 devices operating on alternating current (AC) are affected by frequency. Since non-sinusoidal waveforms can be analyzed as a fundamental frequency plus harmonics of that fundamental frequency, it follows that alternating-current devices (relays) will be affected by applied waveforms. AC relays (and AC devices in general) are significantly affected by the application of non-sinusoidal waveforms.

Therefore, in order to test AC relays properly it is essential to use a test voltage and/or current waveform that is sinusoidal. 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 circuits, RL or RC networks, or saturating electromagnets (such as time-overcurrent relays) would be especially affected by non-sinusoidal wave forms.

TIME-OVERCURRENT UNIT

Rotate the time dial slowly and check, by means of a lamp in the circuit, that the contacts just close at the zero (0) time-dial setting.

The point at which the contacts just close can be adjusted by running the stationary contact brush in or out by means of its adjusting screw. This screw should be held securely in its support.

GEK-34055

With the contacts just closing at No. 0 time-dial setting, there should be sufficient gap between the stationary contact brush and its metal backing strip to ensure approximately 1/32" wipe.

The minimum current at which the contact will just close is determined by the position of the tap screw in the tap block at the top of the relay.

When changing the current setting with the relay in its case, remove the connection plug, to short the current transformer (CT) secondary circuit. Next, screw the tap screws into the tap marked for the desired current, and then replace the connection plug.

The pickup of the unit for any current tap setting is adjusted by means of the variable resistor in the phase-shifting circuit. This adjustment also permits any desired setting intermediate between the various tap settings to be obtained. The control spring is prewound approximately 660° with the contacts just closed. Further adjustment of this setting is seldom required. The unit is adjusted at the factory to close its contacts from any time-dial position at a minimum current within 5% of the tap setting. The unit resets at 85% of the minimum closing value,

Pickup Test

Set the relay at the 0.5 time-dial position and 2.0 amp tap. Using the test connections of Figure 13, the main unit should close its contacts within $\pm 2\%$ of tap value current (1.96-2.04 amp.). All other tap positions should pick up at tap value $\pm 5\%$ of tap value.

Time Test

* Set the relay at the 5.0 time-dial position and 2.0 amp tap. Using the test connections of Figure 13, and applying 5 times tap current (10.0 amp), the relay should operate in 0.92 second ± 0.05 second. At 2 times tap current and 10 times tap current, the operating time should agree with the time-curve value $\pm 7\%$.

INSTANTANEOUS UNIT

Make sure that the instantaneous unit is wired for the range in which it is to operate (see Internal-Connections Diagram Figure 5 or Figure 7) and connected as indicated in Test-Circuit Figure 13. Whenever possible, use the higher range, since the higher range has a higher continuous rating.

Setting the Instantaneous Unit

Loosen the locknut and turn the pole piece toward the desired setting. See Figure 2. Turning the pole piece up increases the pickup; turning the pole piece down decreases the pickup. Bring up the current slowly until the unit picks up. It may be necessary to repeat this operation until the desired pickup value is obtained. Once the desired pickup value is reached, tighten the locknut.

* Indicates revision

CAUTION

The instantaneous unit is rated 1.5 times minimum pickup. Do not leave the test current on too long, as it may damage the unit.

Pickup Tests

With the unit connected for high-range operation (parallel connections) and the target in the "Down" position, check the pickup at the maximum calibration mark; the pickup should be within the limits in Table X.

TABLE X

UNIT RANGE AMPERES	MINIMUM AMPERES	CALIBRATION AMPERES	MAXIMUM AMPERES
0.5 - 4.0	3.6	4.0	4.5
2.0 - 16.0	14.4	16.0	17.7
10.0 - 80.0	72.0	80.0	89.0
20.0 - 160.0	144.0	160.0	177.0

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 first, undesired, tap and place it on the left hand stationary contact where the first screw was removed. See Figure 2. This procedure is necessary to prevent the right-hand stationary contact from getting out of adjustment. Screws should **never** be left in both taps at the same time.

Pickup and Dropout Test

1. Connect relay studs 1 and 2 (See Internal-Connections Diagram) to a DC source, ammeter and load box so that the current can be controlled over a range of 0.1 to 2.0 amperes.
2. Turn the time dial to the ZERO (0) TIME-DIAL position.
3. Increase the current slowly until the seal-in unit picks up. See Table XI.
4. Move the time dial away from the ZERO (0) TIME-DIAL position, the seal-in unit should remain in the picked-up position.

GEK-34055

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	0.14 - 0.195	.050 OR MORE
2.0	1.40 - 1.95	.50 OR MORE

INSTALLATION

The following tests are to be performed at the time of installation.

TIME-OVERCURRENT UNIT

1. Set the tap screw in the desired tap. Using the test circuit in Figure 13, apply approximately twice tap value until contacts just close. Reduce the current until the light in series with the contacts begins to flicker. This value of current is defined as pickup, and should be within 5% of tap value.
- *2. Check the operating time at Time Dial = 5, TAP = 2, and I = 5 times the tap current. The operating time should be the time shown on the time/current curve $\pm 7\%$.

TARGET AND SEAL-IN UNIT

1. Make sure that the tap screw is in the desired tap.
2. Perform pickup and dropout tests, as outlined in the **ACCEPTANCE TESTS** section.

INSTANTANEOUS UNIT

1. Select the desired range by making the proper connections at the rear of the relay (See Internal-Connections Diagram). Whenever possible, be sure to select the higher range, since it has a higher continuous rating.
2. Set the instantaneous unit to pick up at the desired current level. See Setting the Instantaneous Unit, in the **ACCEPTANCE TESTS** section.

All the tests described above under Installation Tests must be performed at the time of installation. In addition, if those tests described under the **ACCEPTANCE TESTS** section were not performed prior to installation, it is recommended that they be performed at this time.

* Indicates revision

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. It is recognized that the interval between periodic checks will vary depending upon environment, type of relay 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 below be checked at an interval of from one to two years.

These tests are intended to make sure that the relays have not deviated from their original setting. If deviations are encountered, the relay must be retested and serviced as described in this manual.

TIME-OVERCURRENT UNIT

1. Perform the Pickup Test as described in the **ACCEPTANCE TESTS** section for the tap in service.
2. Perform the Time Test as described in the **ACCEPTANCE TESTS** section.

INSTANTANEOUS UNIT

1. Check that the Instantaneous Unit picks up at the desired current level, as outlined in the **ACCEPTANCE TESTS** section.

TARGET AND SEAL-IN UNIT

1. Check that the unit picks up at the values shown in Table XI.
2. Check that the units drops out at 30% or more of tap value.

CONTACT CLEANING

For cleaning relay contacts, a flexible burnishing tool should be used. This consists of a flexible strip of metal with an etch-roughened surface, resembling in effect a superfine file. The polishing action is so delicate that no scratches are left, yet it will clean off any corrosion thoroughly and rapidly. Its flexibility ensures the cleaning of the actual points of contact. Do not use knives, files, abrasive paper or cloth of any kind to clean relay contacts.

SYSTEM TEST

Although this Instruction Book is primarily written to check and set the IAC relay, overall functional tests to check the system operation are recommended at intervals based on the customer's experience.

SERVICING

TIME-OVERCURRENT UNIT

If it is found during installation or periodic testing that the time overcurrent unit is out of limits, the unit may be recalibrated as follows:

1. Rotate the time dial to the No.0 time-dial setting and check, by means of a lamp in the circuit, that the contacts just close.

The point at which the contacts just close can be adjusted by running the stationary contact brush in or out by means of its adjusting screw. This screw should be held securely in its support.

With the contacts just closing at No.0 time-dial setting, there should be sufficient gap between the stationary contact brush and its metal backing strip to ensure approximately 1/32" wipe.

2. Connect the operating-coil terminals to a source of the proper frequency and good waveform having a voltage of 120 or more, with pure resistance load boxes for setting the current. See test circuit, Figure 13.
3. Set the tap plug in the 2 amp. tap, and the time dial where the contacts are just open. Set the resistor at the midpoint of its range and check the current required to just close the contacts. It should fall within the limits given in Table XII.

TABLE XII

TAP RANGE	TAP	MINIMUM AMPS	MAXIMUM AMPS
0.5 - 4.0	2 AMP	1.96	2.04
1.5 - 12.0	2 AMP	1.96	2.04
2.0 - 15.0	2 AMP	1.96	2.04

It should never be necessary to wind up the control-spring adjustor more than 30° (one notch) or unwind it more than 90° (three notches) from the factory setting to obtain the above pickup setting.

4. After pick up has been set within the prescribed limits, the compensation must be checked. With the 2 amp tap setting as in paragraph 3, set the time dial at No. 10 and check the current required to just move the disk away from the stop arm. This current should be within the limits shown in Table XIII, which are $\pm 6\%$ of tap amperes. If the disc moves at the lower limit, check that the movement is not over 1/2", measured along the periphery of the disc.

TABLE XIII

TAP RANGE	TAP	MINIMUM AMPS	MAXIMUM AMPS
0.5 - 4.0	2 AMP	1.88	2.12
1.5 - 12.0	2 AMP	1.88	2.12
2.0 - 15.0	2 AMP	1.88	2.12

If the current falls outside these limits, the following steps should be taken. Reset the control spring until compensation at #10 time dial setting (TDS) is within the limits shown above. Then set at #1/2 T.D.S. and restore pick up by adjusting the resistor. Compensation should be rechecked after the resistor adjustment.

With the contacts just open, check the current required to just close the contacts on each of the other taps. This current should be within $\pm 3\%$ of tap value.

With the time dial at the No. 10 time setting and the tap plug in the 2 amp tap, apply sufficient current to the relay to definitely close the contacts. Reduce the current to 80% of tap value and the disk should reset all the way to the No. 10 dial setting position.

Time Tests

With the tap plug in the 2 amp tap and the time dial at No. 5 time setting, apply five times (5X) tap current to the relay.

Adjust the drag magnet to obtain a closing time as near as possible to 0.92 second but at least between 0.87 and 0.97 second. The magnet should be approximately in the middle of its travel. The magnet is adjusted by loosening the nut under the magnet shelf. Moving the magnet in decreases the time, moving the magnet out increases the time.

When adjusting the drag magnet, be sure the outer edge of the magnet never extends out beyond the cutout in the disk. Be sure the nut clamping the drag magnet to its supporting shelf is tight before proceeding with other time checks. Make sure the drag magnet does not hit the counterweight at any position of the disk.

With the tap plug in the 2 amp tap and the time dial at the No.5 time setting, check the contact closings at 2 times and 10 times tap value. These closing times must be within the limits shown in Table XIV.

TABLE XIV

TAP	AMPS	60HZ		50HZ	
		MIN SEC.	MAX SEC.	MIN. SEC.	MAX SEC.
2.0	4.0	6.27	7.22	6.58	7.56
2.0	20.0	0.26	0.30	0.27	0.31

INSTANTANEOUS UNIT

1. Both contacts should close at the same time.
2. The backing strip should be so formed that the forked end (front) bears against the molded strip under the armature.
3. With the armature against the pole piece, the cross member of the "T" spring should be in a horizontal plane and there should be at least 1/32 inch wipe on the contacts. Check this by inserting a 0.012 inch feeler gage between the front half of the shaded pole and the armature, with the armature held closed. The contacts should close with the feeler gage in place.

TARGET AND SEAL-IN UNIT

Check steps 1 and 2 as described under INSTANTANEOUS UNIT above.

To check the wipe of the seal-in unit, insert a 0.012 inch feeler gage between the plastic residual of the armature and the pole piece with the armature held closed. The contacts should close with the feeler gage in place.

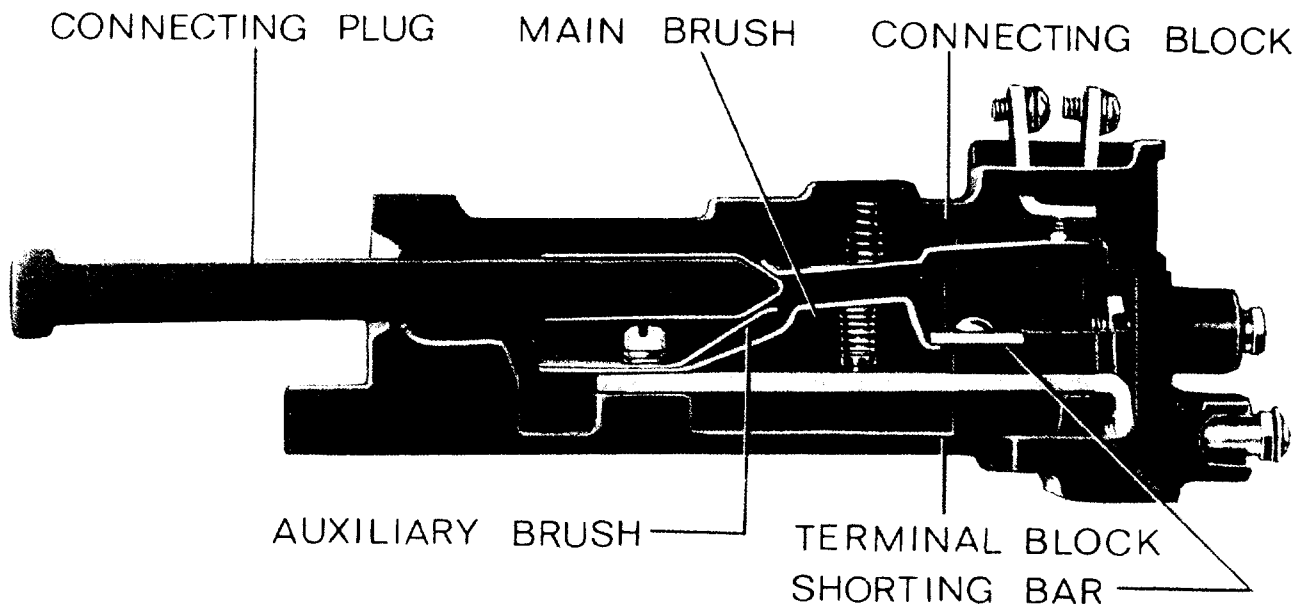
RENEWAL PARTS

It is recommended that sufficient quantities of renewal parts be carried 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 the quantity required and the name of the part wanted, and the complete model number of the relay for which the part is required.

LIST OF FIGURES

<u>FIGURE</u>		<u>PAGE</u>
1	Cross Section of Drawout Case Showing Position of Auxiliary Brush	20
2	Type-IAC77 800 Series Relay Removed from Case (Front View)	21
3	Type-IAC77 800 Series Relay Removed from Case (Rear View)	22
4	Type-IAC77A 800 Series Relay Internal Connections (Front View)	23
5	Type-IAC77B 800 Series Relay Internal Connections (Front View)	24
6	Type-IAC78A 800 Series Relay Internal Connections (Front View)	25
7	Type-IAC78B 800 Series Relay Internal Connections (Front View)	26
8	Time/Current Curve of the Instantaneous Unit	27
9	Time/Current Characteristics of 50 Hz Types IAC77 and IAC78 800 Series Relays	28
10	Time/Current Characteristics of 60 Hz Types IAC77 and IAC78 800 Series Relays	29
11	Outline and Panel Drilling for the IAC78B Series Relay	30
12	Outline and Panel Drilling for Types IAC77A, IAC77B and IAC78A 800 Series Relays	31
13	Test connections for Testing Pickup and Time Curve of IAC Relays	32
14	External Connections of Four IAC77A Relays Used for Multi-Phase and Phase-to-Ground Fault Protection of a 3-Phase Circuit	33
15	External Connections of Four IAC78A Relays Protecting a 3-Phase Circuit Against Multi-Phase and Phase-to-Ground Faults	34



NOTE: AFTER ENGAGING AUXILIARY BRUSH, CONNECTING PLUG TRAVELS $\frac{1}{4}$ INCH BEFORE ENGAGING THE MAIN BRUSH ON THE TERMINAL BLOCK

Figure 1 (8025039) Cross Section of Drawout Case Showing Position of Auxiliary Brush

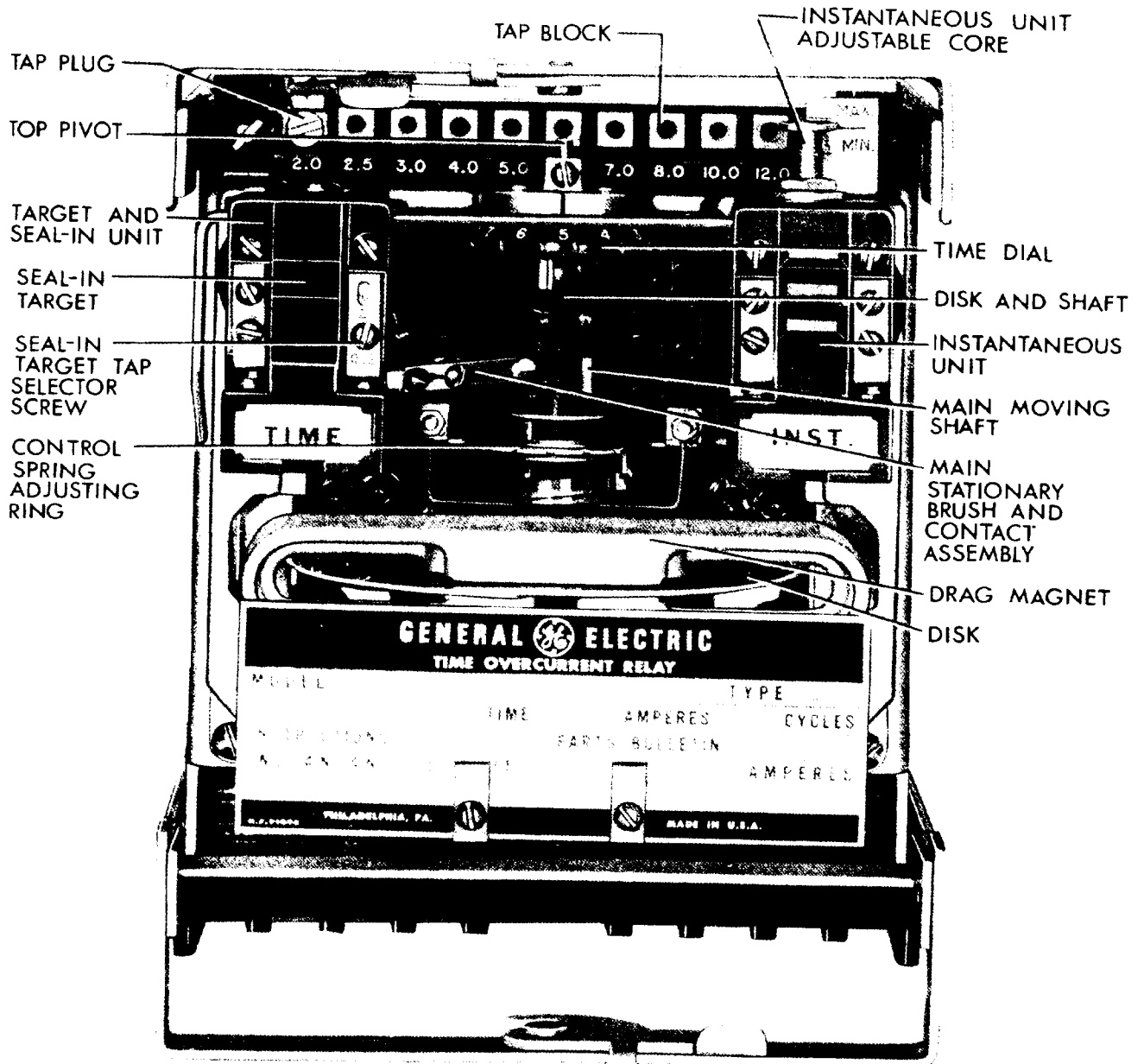


Figure 2 (8041298) Type-IAC77 800 Series Relay Removed from Case (Front View)

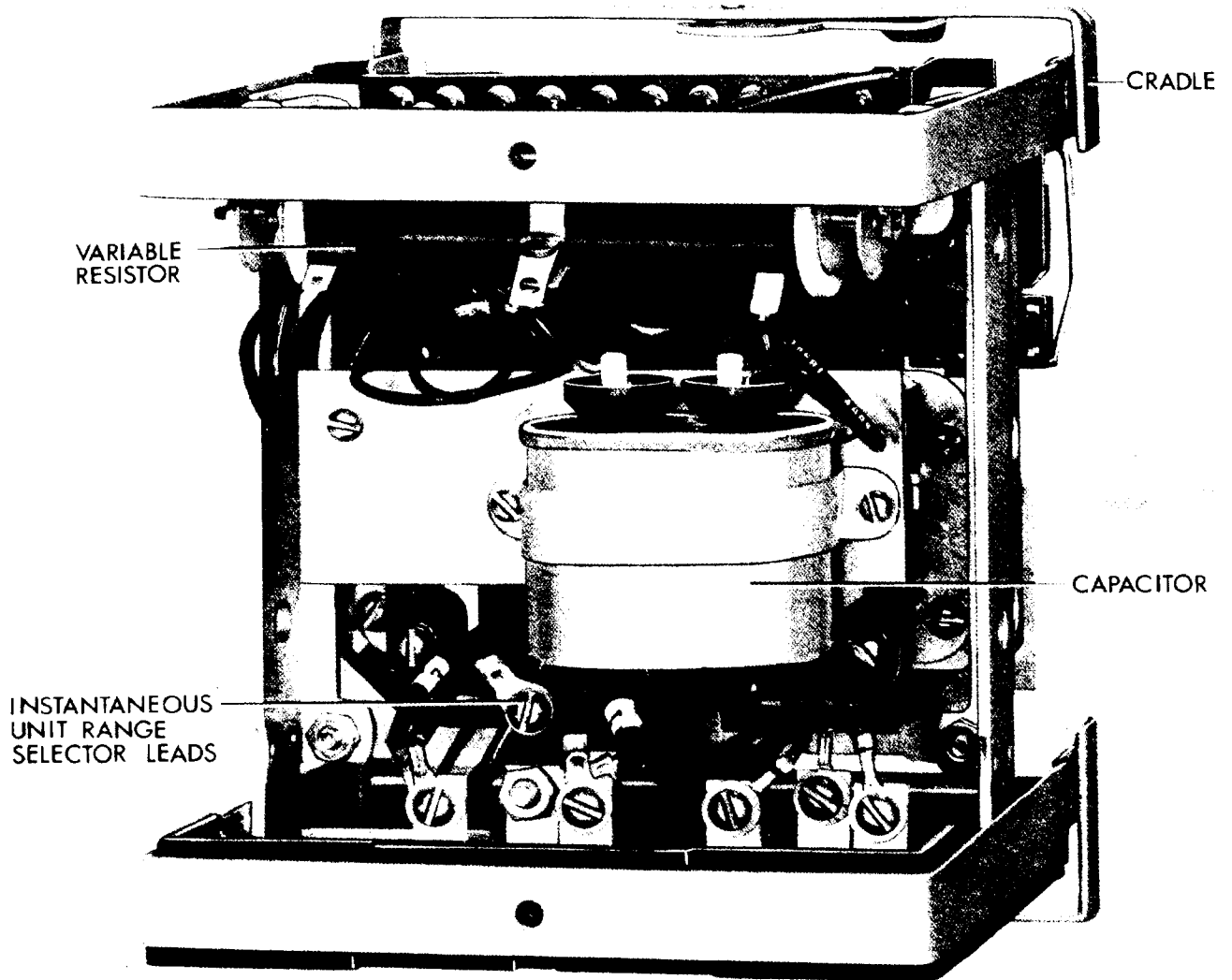
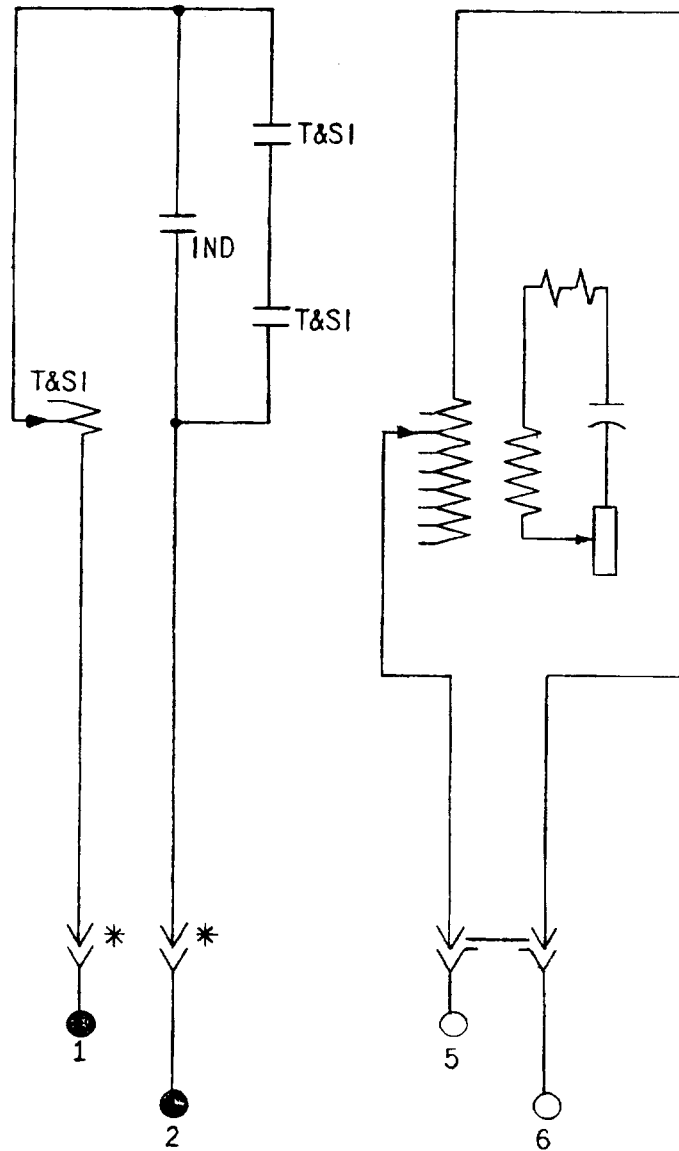


Figure 3 (8041297) Type-IAC77 800 Series Relay Removed from Case
(Rear View)



* = SHORT FINGERS

Figure 4 (0165A7758) Type-IAC77A 800 Series Relay
Internal Connections (Front View)

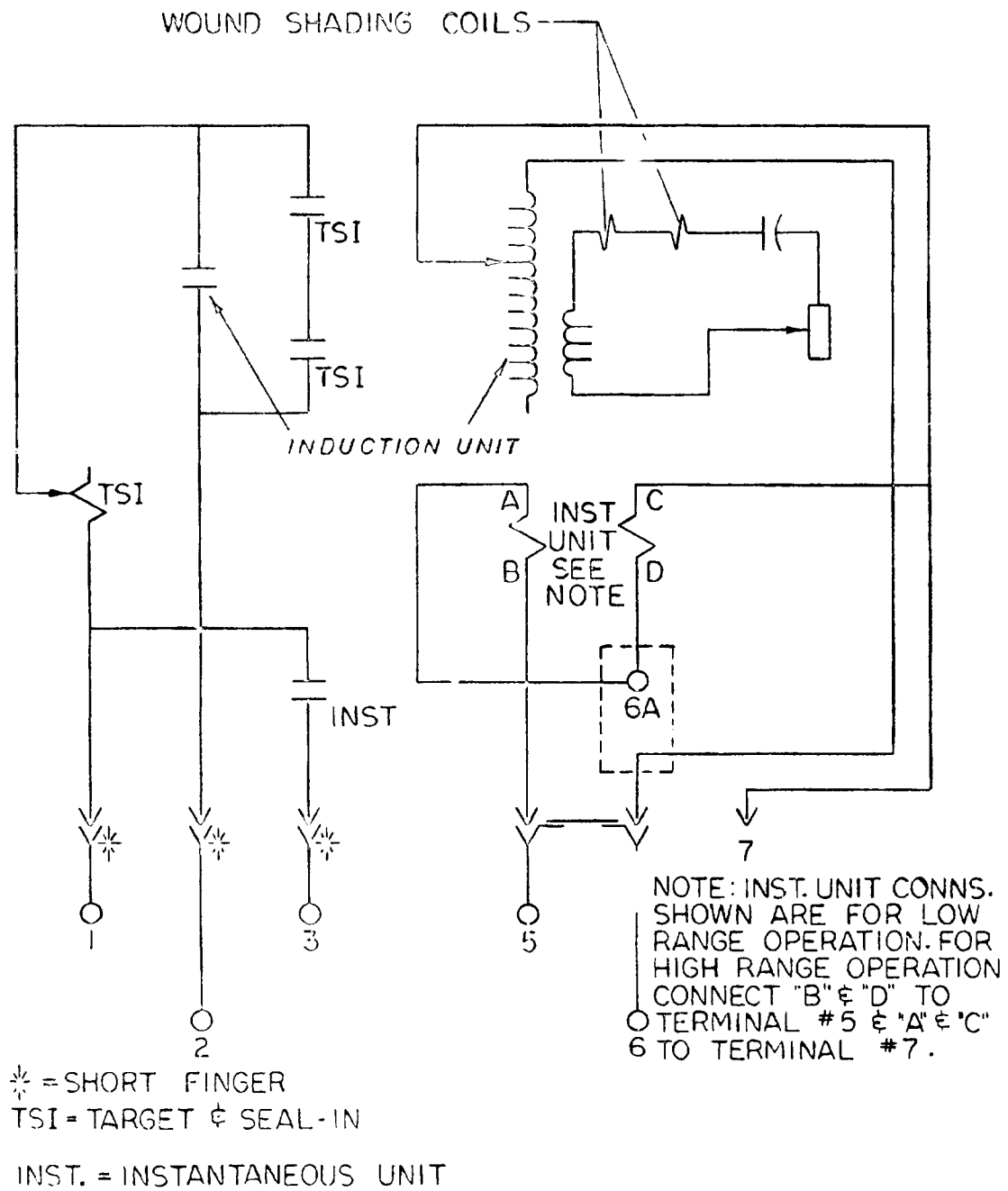
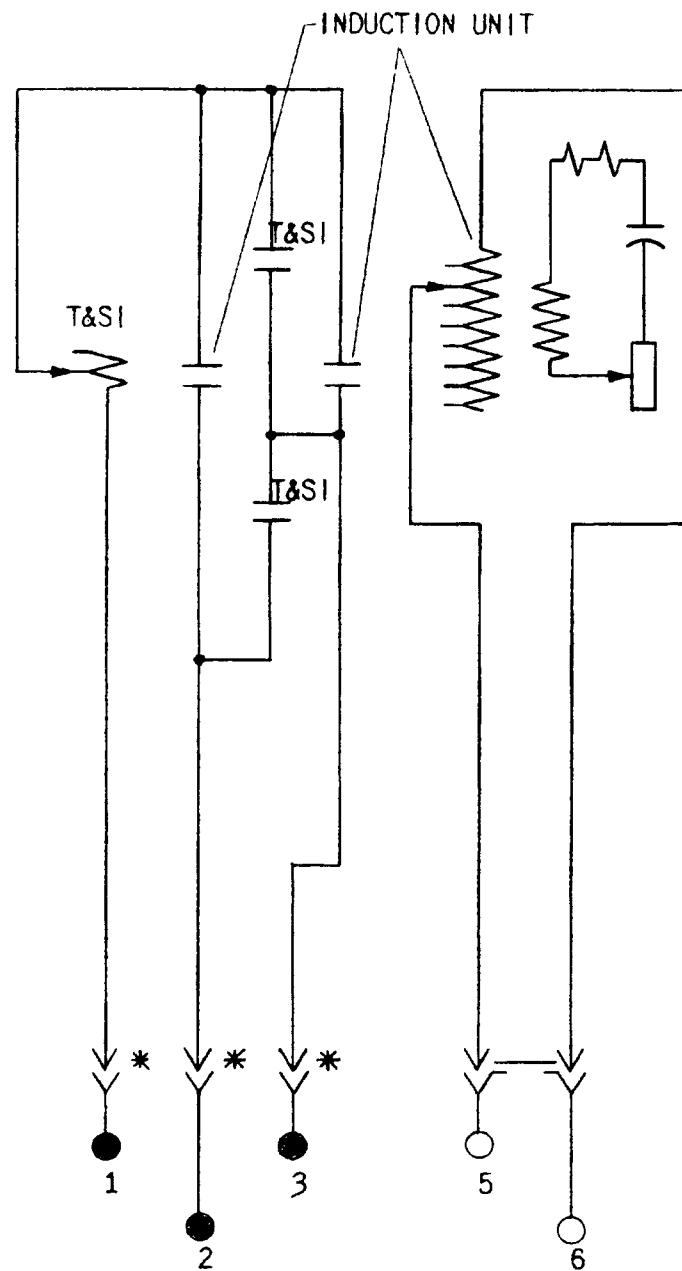
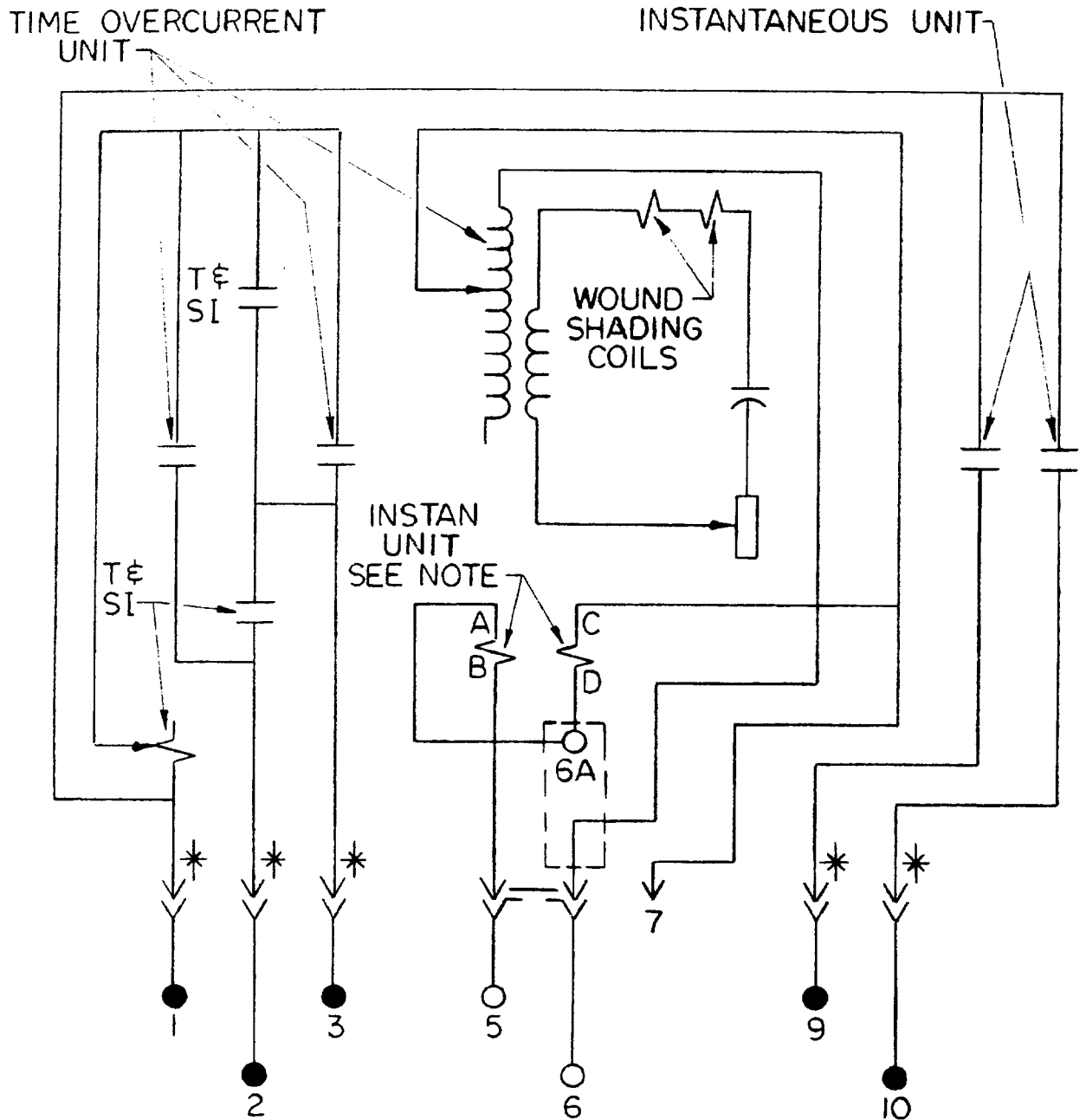


Figure 5 (0246A2200-1) Type-IAC77B 800 Series Relay Internal Connections (Front View)



* = SHORT FINGER

Figure 6 (0165A7781) Type-IAC78A 800 Series Relay
Internal Connections (Front View)



* = SHORT FINGER

T & SI = TARGET & SEAL-IN

NOTE:- INSTANTANEOUS UNIT CONNECTIONS SHOWN ARE FOR LOW RANGE OPERATION. FOR HIGH RANGE OPERATION CONNECT "B" & "D" TO TERMINAL 5 & "A" & "C" TO TERMINAL 7

Figure 7 (0246A2286-1) Type-IAC78B 800 Series Relay
Internal Connections (Front View)

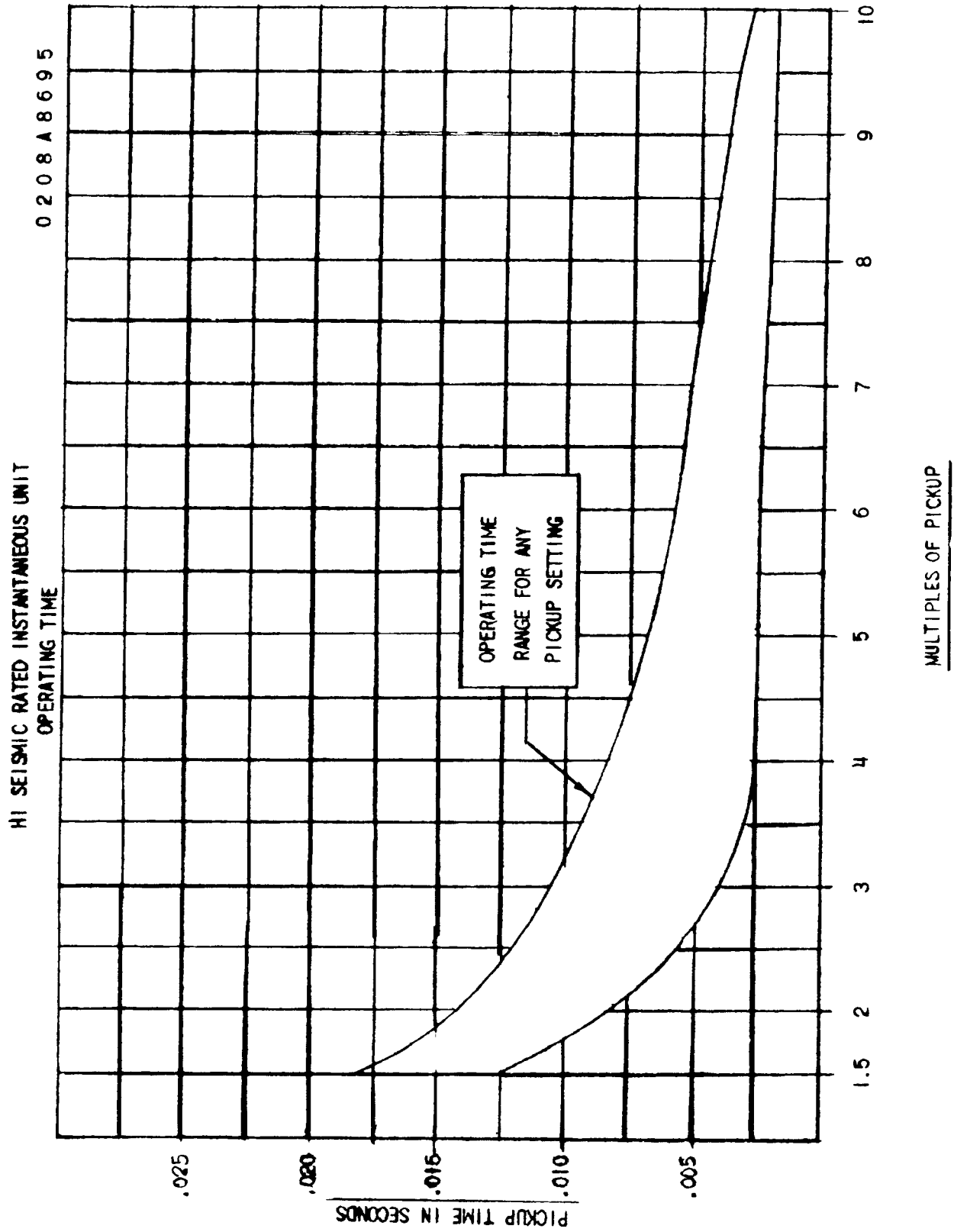
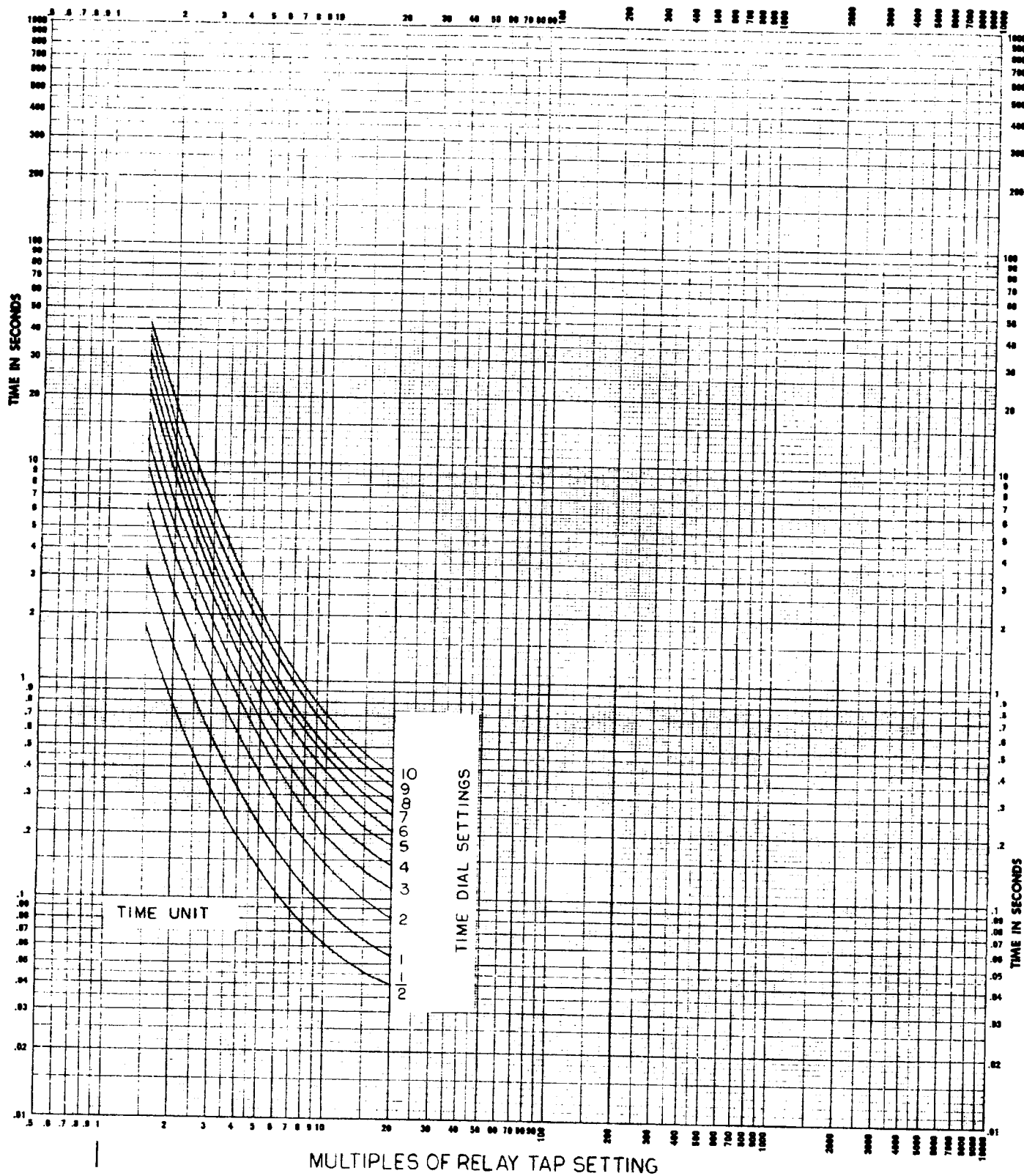


Figure 8 (0208A8695-1) Time/Current Curve of the Instantaneous Unit

GEK-34055



TYPE IAC77 RELAYS EXTREMELY INVERSE TIME CHARACTERISTIC CURVE
 Figure 9 (0108B8940-3) Time/Current Characteristics of 50 Hz
 Types IAC77 and IAC78 800 Series Relays

GEK-34055

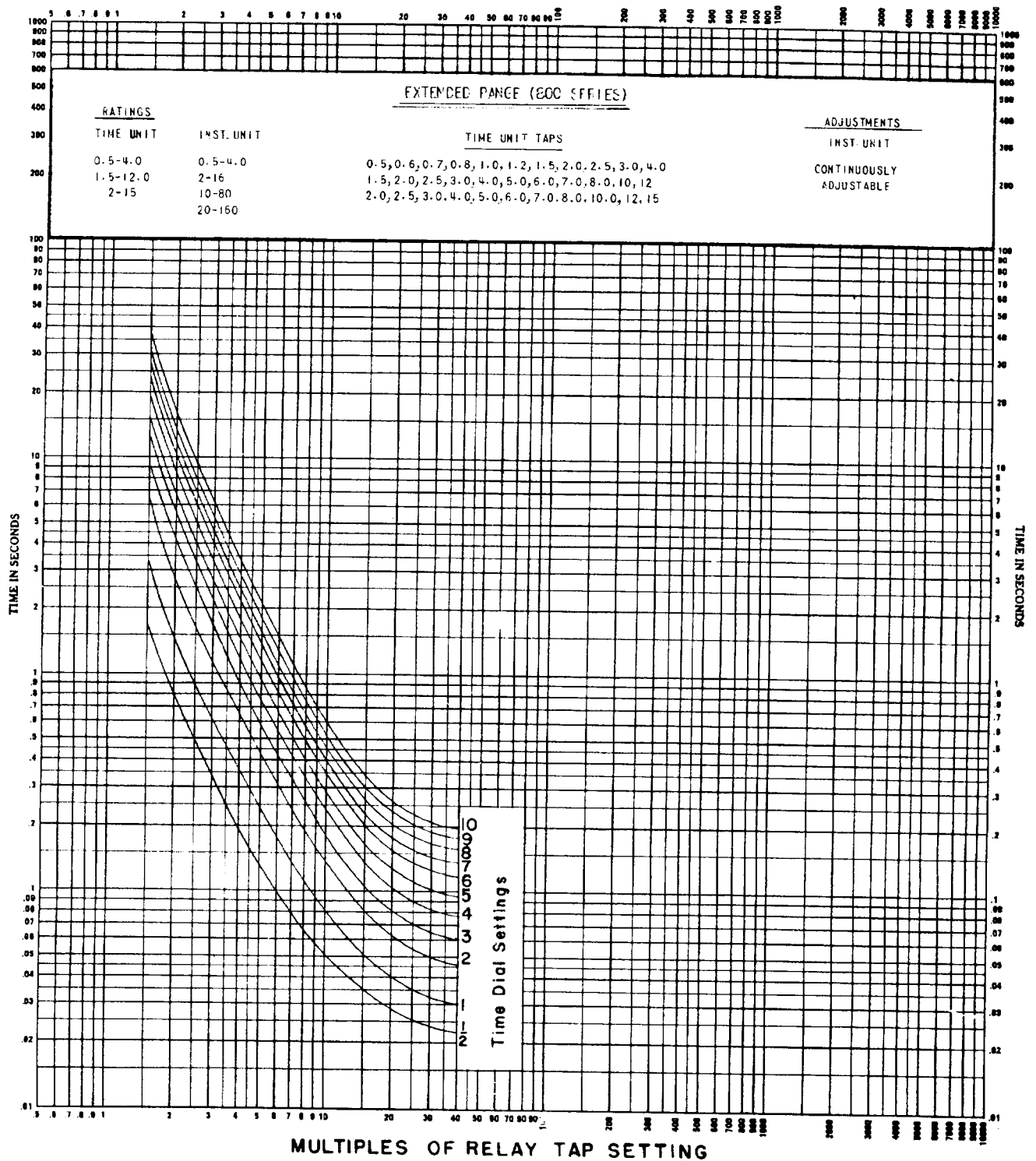


Figure 10 (0888B0274-5) Time/Current Characteristics of 60 Hz Types IAC77 and IAC78 800 Series Relays

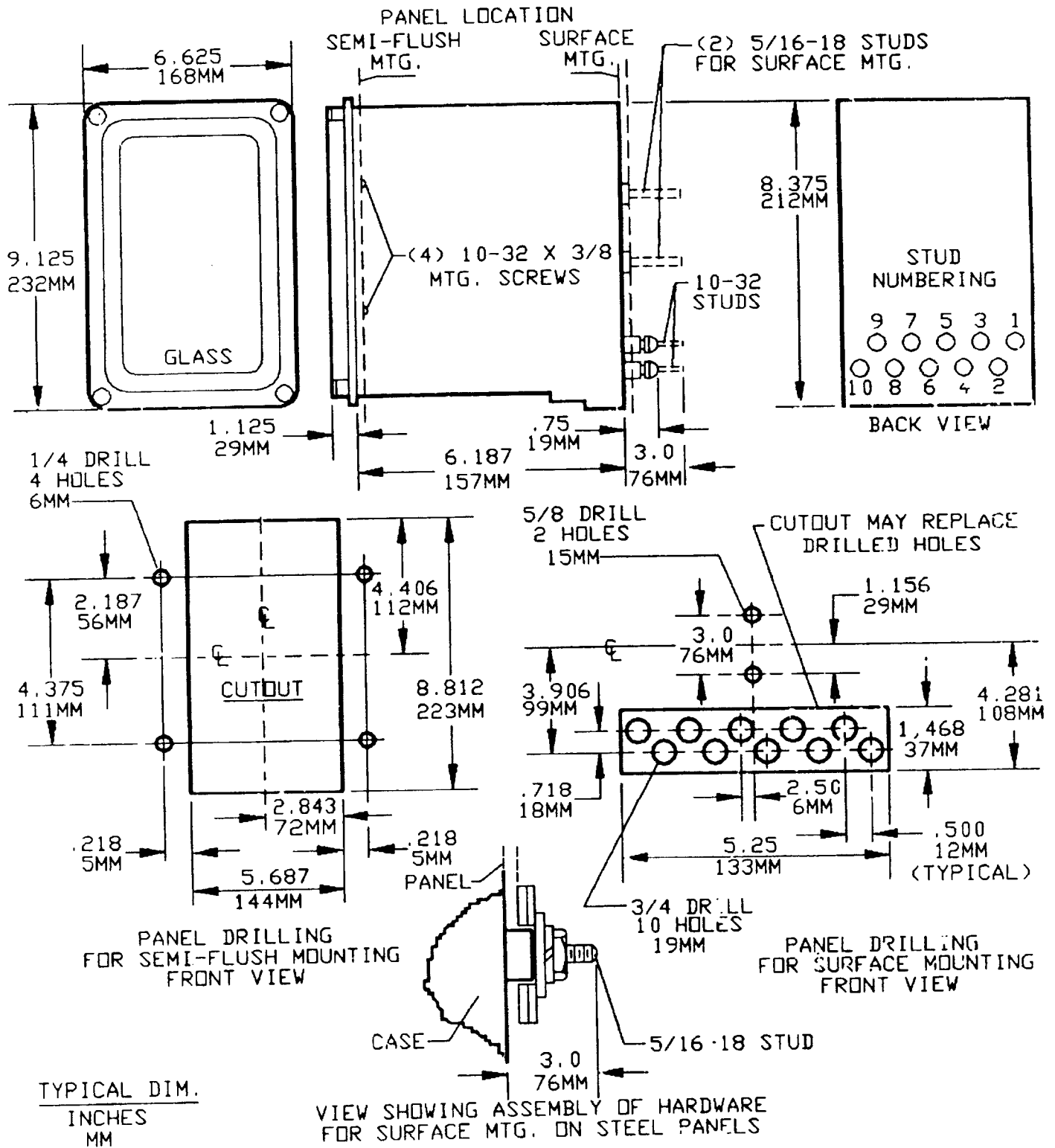


Figure 11 (K-6209271[8]) Outline and Panel Drilling for the IAC78B Series Relay

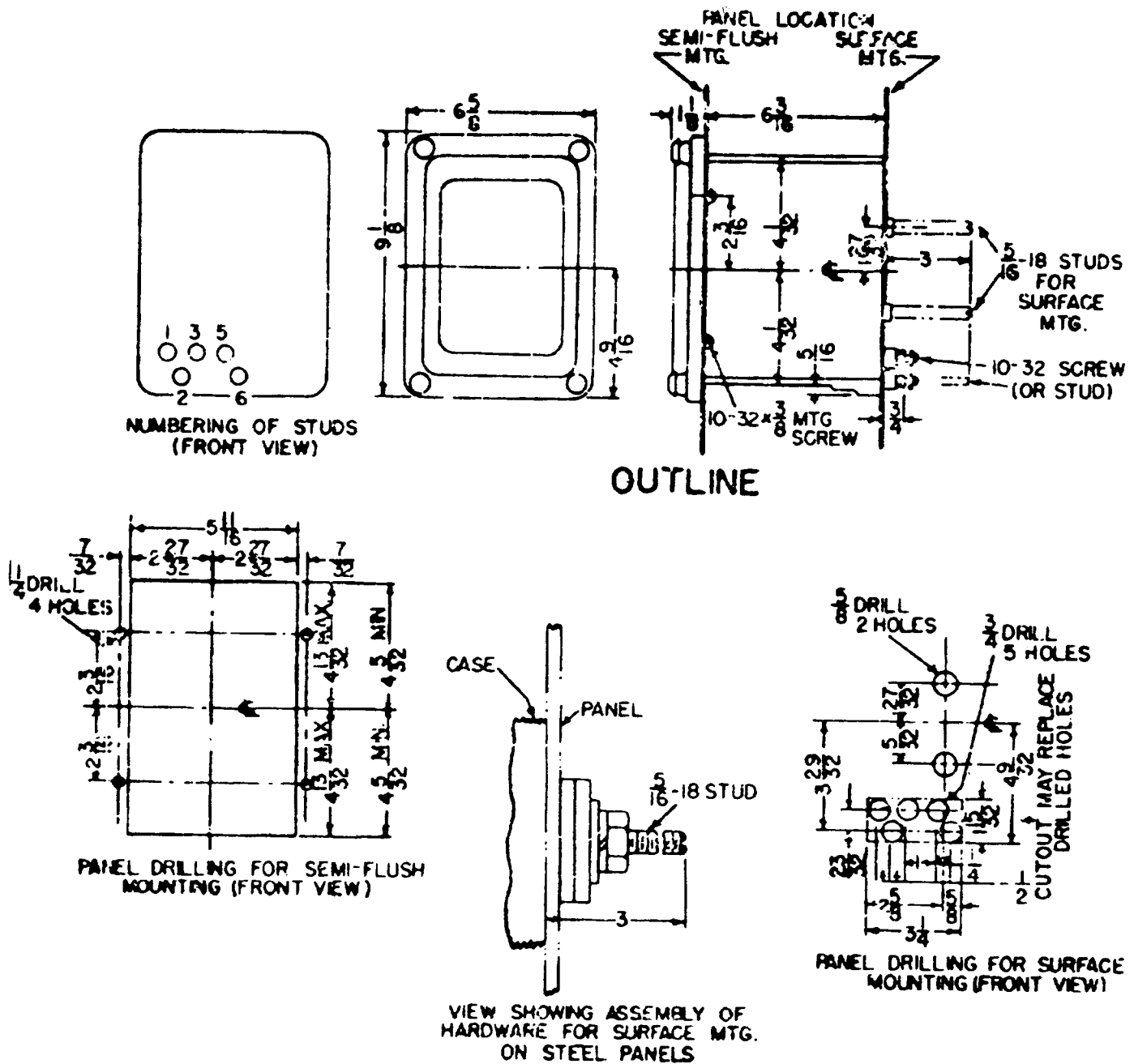


Figure 12 (K-6209270-2) Outline and Panel Drilling for Types IAC77A, IAC77B and IAC78A 800 Series Relays

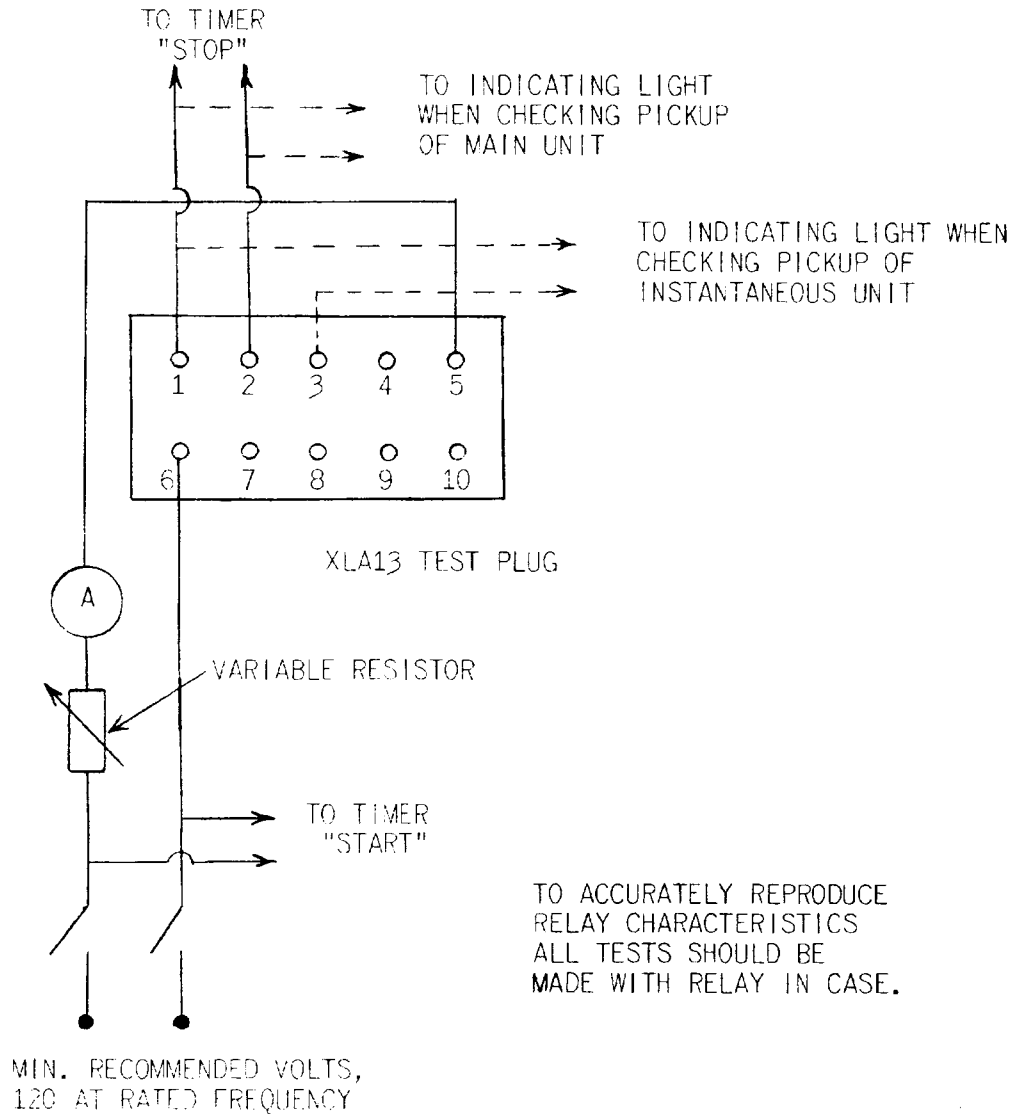


Figure 13 (K-6154399-7) Test connections for Testing Pickup and Time Curve of IAC Relays

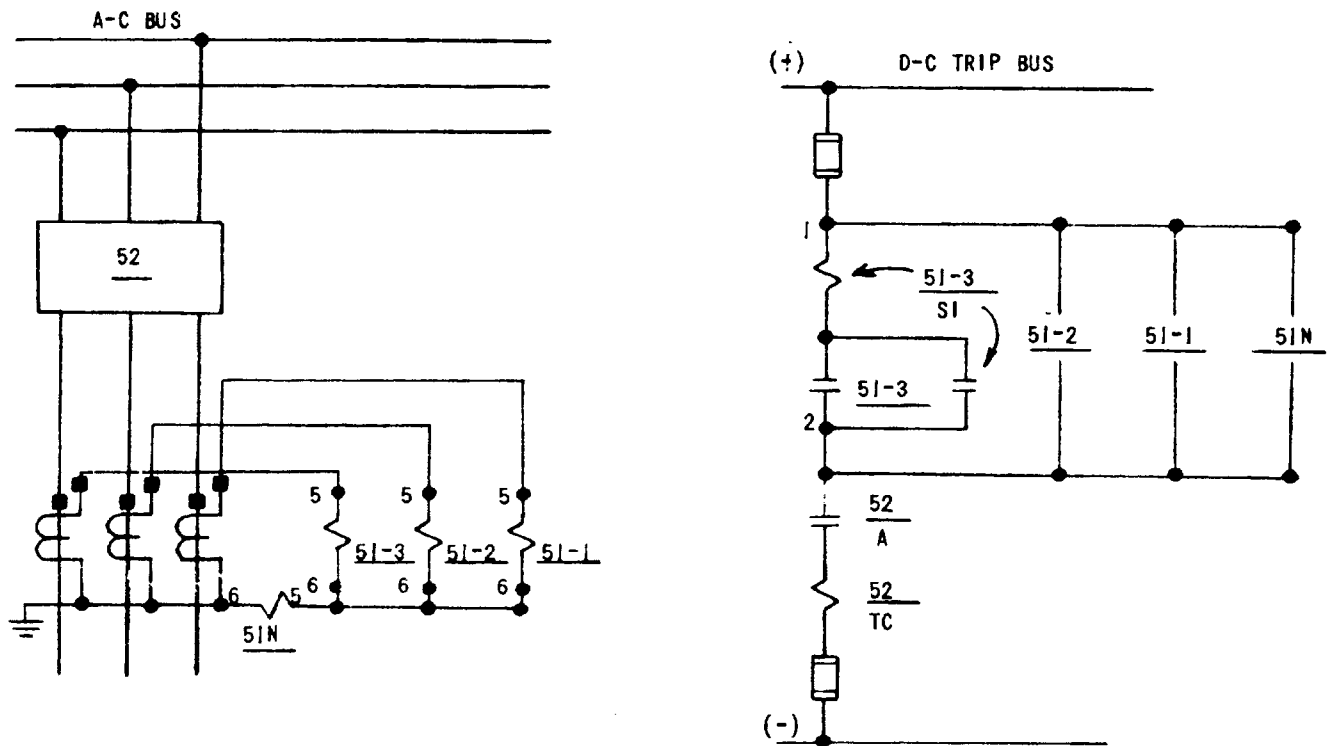


Figure 14 (0246A6966-1) External Connections of Four IAC77A Relays
Used for Multi-Phase and Phase-to-Ground Fault Protection
of a 3-Phase Circuit

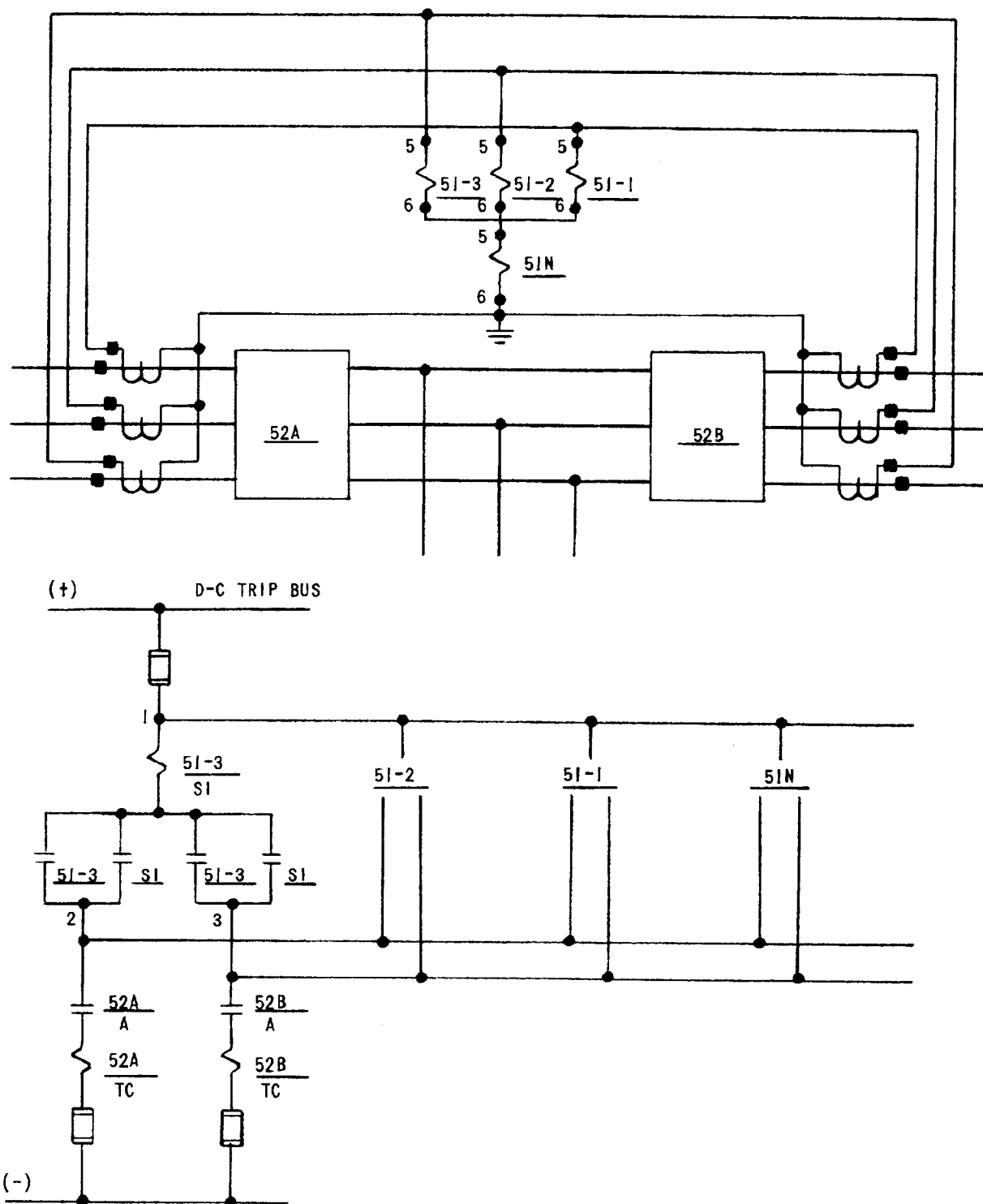


Figure 15 (0246A6967) External Connections of Four IAC78A Relays Protecting a 3-Phase Circuit Against Multi-Phase and Phase-to-Ground Faults



GE Power Management

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