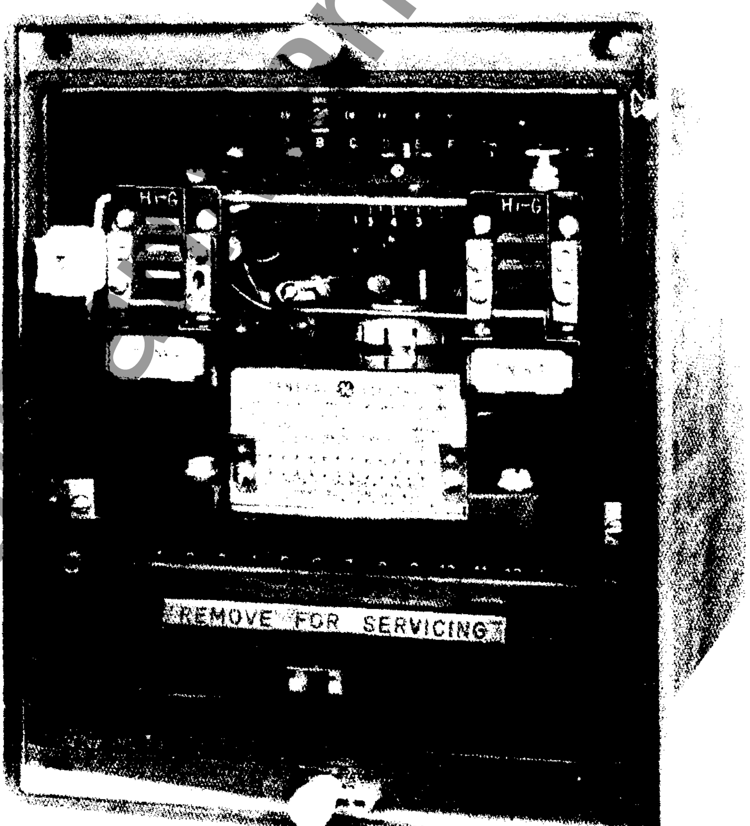
INSTRUCTIONS



TIME OVERCURRENT RELAYS

Types

IFC51A and 51B

IFC53A and 53B

IFC77A and 77B

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CONTENTS

TIME OVERCURRENT RELAYS
TYPES
IFC51A and 51B
IFC43A and 53B
IFC77A and 77B

DESCRIPTION

The type IFC relays covered by these instructions are extended range, single phase, time overcurrent relays. The various time-current characteristics available are as follows:

IFC51A, IFC51B - Inverse time
IFC53A, IFC53B - Very inverse time
IFC77A, IFC77B - Extremely inverse time

The IFC51B, 53B and 77B relays also include a hinged-armature instantaneous overcurrent unit, which provides instantaneous tripping at high current levels. The instantaneous unit is not included in the IFC51A, 53A or 77A relays. Both the time overcurrent unit and the instantaneous overcurrent unit are described in detail in the section on **CONSTRUCTION**. Each relay is equipped with a dual-rated target and seal-in unit.

When semiflush mounted on a suitable panel, these relays have a high seismic capability, including both the target seal-in unit and the instantaneous overcurrent unit when it is supplied. Also, these relays are recognized under the Components Program of Underwriters Laboratories, Inc.

The relay is mounted in a size C1 drawout case of molded construction. The outline and panel drilling are shown in Figures 23 and 24. The relay internal connections are shown in Figure 4 for the IFC51A, 53A and 77A, and in Figure 5 for the IFC51B, 53B and 77B.

APPLICATION

Time overcurrent relays are used extensively for the protection of utility and industrial power distribution systems and frequently for overload backup protection at other locations. The EXTREMELY INVERSE time characteristics, Figures 10 and 22, of the IFC77A and 77B relays are designed primarily for use where they are required to coordinate rather closely with power fuses, distribution cutouts and reclosers. They also provide maximum tolerance to allow for cold load pickup such as results from an extended service outage which results in a heavy accumulation of loads of automatically controlle devices such as refrigerators, water heaters, water pumps, oil burners, et Such load accumulations often produce inrush currents considerably in exce of feeder full load current for a short time after the feeder is energiz

These instructions do not purport to cover all details or variations in equipment nor to provide every possible contingency to be met in connection with installation, operation or maintenance. Sl further information be desired or should particular problems arise which are not covered sufficient 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 st but no such assurance is given with respect to local codes and ordinances because they vary great

The EXTREMELY INVERSE time characteristic often permits successful pickup of these loads and at the same time provides adequate fault protection.

The VERY INVERSE time characteristics, Figures 7 and 21, of the IFC53A and 53B relays are likely to provide faster overall protection in applications where the available fault current magnitude remains fairly constant due to a relatively constant generating capacity. The variation in the magnitude of fault current through the relay is therefore mainly dependent upon the location of the fault with respect to the relay.

The INVERSE time overcurrent characteristics, Figures 6 and 20, of the IFC51A and 51B relays tend to make the relay operating time less dependent upon the magnitude of the fault current than in the case of VERY INVERSE and EXTREMELY INVERSE devices. For this reason, INVERSE type relays are likely to provide faster overall protection in applications where the available fault current magnitudes vary significantly as a result of frequent changes in the source impedance due to system loading and switching.

The usual application of these relays requires three relays for multiphase fault protection, one per phase, and a separate relay residually connected for single-phase-to-ground faults. Typical external connections for this application are shown in Figure 9. Use of a separate ground relay is advantageous because it can be set to provide more sensitive protection against ground faults.

In the application of these relays with downstream automatic reclosing devices, the relay reset time should be considered. This is the time required for the relay to go from the contacts-fully-closed position to the fully-open position when set at the number 10 time dial. At lower time dial settings the reset times are proportionately lower. The reset time of all VERY INVERSE and EXTREMELY INVERSE relays is approximately 60 seconds. The reset time of all INVERSE relays covered by these instructions is approximately 12 seconds.

When setting these relays to coordinate with downstream relays, a coordination time of from 0.25 to 0.40 seconds is generally allowed, depending on the clearing time of the breaker involved and how accurately the relay time can be estimated. These coordination times include, in addition to breaker clearing time, 0.10 seconds for relay overtravel and 0.17 seconds for safety factor. For example, if the breaker clearing time is 0.13 seconds (8 cycles), the coordination time would be 0.40 seconds (0.13 + 0.10 + 0.17). If the relay time is set for the specific current level at the site, and if it has been tested, the safety factor may be reduced to 0.07 seconds. Then if the downstream breaker time is 5 cycles (0.08 seconds), a minimum of 0.25 seconds (0.08 + 0.10 + 0.07) could be allowed for coordination. If relay coordination times are marginal or impossible to obtain, use the relay overtravel curves of Figures 10, 11 or 12 to refine the relay settings. First determine the relay operating time necessary to just match the operating time of the downstream relay with which coordination is desired. Determine the multiple of pickup and the necessary time dial setting to provide this relay operating time. Use the appropriate curve of Figure 10, 11 or 12 to determine the overtravel time percent of operating time, and covert this into real time. Add this time the breaker time and the safety factor time and the original relay operating time to determine the final relay operating time. Set the relay to value.

ce the current in the relay operating coil is cut off, the relay contacts will open in approximately 6 cycles (0.1 second) with normal adjustment of contact wipe. This permits the use of the relay in conjunction with instantaneous reclosing schemes without risk of a false retrip when the circuit breaker is reclosed on a circuit from which a fault has just been cleared.

The instantaneous overcurrent unit present in the IFC51B, 53B and 77B relays has a transient overeach characteristic as illustrated in Figure 13. This is the result of the DC offset that is usually present in the line current at the inception of a fault. When determining the pickup setting for this unit, the transient overreach must be taken into consideration. The percent transient overreach should be applied to increase the calculated pickup setting proportionately so that the instantaneous unit will not overreach a downstream device and thereby cause a loss of coordination in the system protection scheme. The operating time characteristics of this unit are shown in Figure 14.

CONSTRUCTION

The IFC induction disk relays consist of a molded case, cover, support structure assembly, and a connection plug to make up the electrical connection. See Cover Figure and Figures 1, 2, 3 and 19. Figures 2 and 3 show the induction unit mounted to the molded support structure. This disk is activated by a current-operating coil mounted on either a laminated EE- or a U-Magnet. The disk and shaft assembly carries a moving contact, which completes the alarm or trip circuit when it touches a stationary contact. The disk assembly is restrained by a spiral spring to give the proper contact closing current. Its rotation is retarded by a permanent magnet mounted in a molded housing on the support structure.

The drawout connection/test system for the C1 case, shown in Figure 19, has provisions for 14 connection points, and a visible CT shorting bar located up front. As the connection plug is withdrawn, it clears the shorter contact fingers in the output contact circuits first. Thus, the trip circuit is opened before any other circuits are disconnected. Next, current circuit fingers on the case connection block engage the shorting bar (located at the lower front of the case) to short-circuit external current transformer secondary connections. The window provides visual confirmation of CT shorting. The connection plug then clears the current circuit contact fingers on the case and finally those on the relay support structure, to de-energize the drawout element completely.

There is a High-Seismic target and seal-in unit mounted on the front to the left of the shaft of the time overcurrent unit (see Figure 1). The seal-i unit has its coil in series and its contacts in parallel with the contacts o 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, raises a target into view, which latches up and remains exposed until releas by pressing a reset button located on the upper left side of the cover.

The IFC "B" model relays, in addition to the above, contain a high-seismic instantaneous unit (see Figure 1). The instantaneous unit is a small hinged-type unit which is 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 reset button that releases the target seal-in unit also releases the target of the instantaneous unit.

A magnetic shield, depicted in Figure 1, is mounted to the support structure of inverse and very inverse time overcurrent IFC relays (IFC51 and IFC53), to eliminate the proximity effect of external magnetic materials.

Both the High-Seismic target and seal-in unit and the High-Seismic instantaneous unit have the letters "Hi-G" molded into their target blocks to distinguish them as High-Seismic units. Seismic Fragility Level exceeds peak axial acceleration of 10g's (4g ZPA) when tested using a biaxial multi-frequency input motion to produce a Required Response Spectrum (RRS) in accordance with the IEEE Proposed Guide for Seismic Testing of Relays, P501, May, 1977.

RATINGS

The relays are designed for operation in an ambient air temperature from -20°C to +55°C.

TIME OVERCURRENT UNIT

Ranges for the time overcurrent unit are shown in Table I.

TABLE I

Relay	Frequency (Hertz)	Current Range (Amperes)
IFC51A & B		0.5 - 4.0
IFC53A & B	50 and 60	1.0 - 12.0
IFC77A & B		

The current taps are selected with two sliding tap screws on an alphabetically labeled tap block.

The tap screw settings are as listed in Table II, on page 20, for each model of relay and tap range.

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

TABLE III

Model	Time Overcurrent Unit (Amperes)	One Second Rating Any Tap (Amperes)	K
IFC51	0.5 - 4.0	128	16384
	1.0 - 12.0	260	67600
IFC53	0.5 - 4.0	140	19600
	1.0 - 12.0	260	67600
IFC77	0.5 - 4.0	84	7056
	1.0 - 12.0	220	48400

Ratings less than one second may be calculated according to the formula

$I = \sqrt{K/T}$, where T is the time in seconds that the current flows.

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

TABLE IV
0.5 - 4.0 Ampere Range Ratings

Model	Tap										
	0.5	0.6	0.7	0.8	1.0	1.2	1.5	2.0	2.5	3.0	4.0
IFC51	1.6	1.8	2.0	2.1	2.3	2.7	3.0	3.5	4.0	4.5	5.0
IFC53	3.8	4.0	4.2	4.4	4.7	5.0	5.3	5.8	6.2	6.6	7.1
IFC77	2.5	2.7	3.0	3.2	3.6	4.0	4.5	5.2	5.9	6.5	7.5

TABLE V
1.0 - 12.0 Ampere Range Ratings

Model	Tap												
	1.0	1.2	1.5	2.0	2.5	3.0	4.0	5.0	6.0	7.0	8.0	10.0	12.0
IFC51	3.7	4.1	4.6	5.3	6.0	6.5	7.6	8.5	9.3	10.0	10.8	12.1	13.2
IFC53	6.8	7.1	7.7	8.3	8.8	9.4	10.3	11.0	11.6	12.4	12.6	13.5	14.4
IFC77	5.8	6.4	7.2	8.4	9.4	10.4	12.1	13.6	15.1	16.4	17.6	19.8	21.8

HIGH-SEISMIC INSTANTANEOUS UNIT

The instantaneous coil is tapped for operation on either one of two ranges (H or L). Selection of the high or low range is determined by the position of the link located on the top of the support structure (see Figure 2 and Table VI).

TABLE VI

High-Seismic Instantaneous Unit (Amps)	Link Position	Range (Amps)	Continuous Rating (Amps)	One Second Rating (Amps)	K
2 - 50	L H	2 - 10 10 - 50	2.7 7.5	130	16,900
6 - 150	L H	6 - 30 30 - 150	10.2 19.6	260	67,600

The range is approximate, which means that the 2-10, 10-50 may be 2-8, 8-50. There will always be at least one ampere overlap between the maximum L setting and the minimum H setting. Whenever possible, be sure to select the higher range, since it has the higher continuous rating.

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

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

Since the instantaneous unit coil is in series with the time overcurrent unit coil, see Tables III, IV, V and VI to determine the current-limiting element for both continuous and short-time ratings.

HIGH-SEISMIC TARGET AND SEAL-IN UNIT

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

TABLE VII

	Tap 0.2	Tap 2
DC Resistance ± 10% (ohms)	8.0	0.24
Min. Operating (Amps) +0 -60%	0.2	2.0
Carry Continuous (Amperes)	0.3	3
Carry 30 Amps for (sec.)	0.03	4
Carry 10 Amps for (sec.)	0.25	30
60 Hz Impedance (ohms)	68.6	0.73

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

Model	Hz	Range	Min Tap Amps	Burdens at Min. Pickup Min. Tap (Ohms) R	Jx	Z	Burdens in Ohms (Z) Times Pickup 3	10	20
IFC51	60	0.5- 4.0	0.5	5.43	21.53	22.20	12.55	5.14	3.29
		1.0-12.0	1.0	1.47	5.34	5.54	3.09	1.28	0.82
IFC53	60	0.5- 4.0	0.5	1.52	4.23	4.50	4.47	3.10	1.93
		1.0-12.0	1.0	0.38	1.06	1.13	1.11	0.78	0.49
IFC77	60	0.5- 4.0	0.5	1.55	2.36	2.82	2.86	2.93	2.76
		1.0-12.0	1.0	0.59	0.43	0.73	0.74	0.75	0.70
IFC51	50	0.5- 4.0	0.5	4.53	17.95	18.50	11.45	4.28	2.70
		1.0-12.0	1.0	1.22	4.45	4.62	2.58	1.07	0.68
IFC53	50	0.5- 4.0	0.5	1.27	3.52	3.75	3.72	2.58	1.61
		1.0-12.0	1.0	0.32	0.88	0.94	0.93	0.65	0.41
IFC77	50	0.5- 4.0	0.5	1.29	1.97	2.35	2.38	2.44	2.30
		1.0-12.0	1.0	0.49	0.36	0.61	0.62	0.63	0.58

Note: The impedance values given are those for minimum tap of each range; the impedance for other taps at pickup current (tap rating) varies inversely (approximately) as the square of the tap rating. For example, an IFC77 60 Hz relay with 0.5 - 4.0 amp range has an impedance of 2.82 ohms on the 0.5 amp tap. The impedance of the 2.0 amp tap is $(0.5/2.0)^2 \times 2.82 =$ 0.176 ohms.

The High-Seismic instantaneous unit burdens are listed in Table IX.

TABLE IX

High-Seismic Inst. Unit (Amps)	Hz	Link Position	Range (Amps)	Min. Pick-up Amps	Burdens at Min. Pickup Min. Tap (Ohms) R	Jx	Z	Burdens in Ohms (Z) Times Pickup 3	10	20
2-50	60	L	2-10	2	0.750	0.650	0.982	0.634	0.480	0.457
		H	10-50	10	0.070	0.024	0.079	0.072	0.071	0.070
6-150	60	L	6-30	6	0.110	0.078	0.135	0.095	0.081	0.079
		H	30-150	30	0.022	0.005	0.023	0.022	0.022	0.022
2-50	50	L	2-10	2	0.625	0.542	0.827	0.528	0.400	0.380
		H	10-50	10	0.058	0.020	0.062	0.060	0.059	0.058
6-150	50	L	6-30	6	0.092	0.065	0.112	0.079	0.068	0.066
		H	30-150	30	0.018	0.004	0.019	0.018	0.018	0.018

CHARACTERISTICS

TIME OVERCURRENT UNIT

Pickup

Pickup in these relays is defined as the current required to close the contacts from the 0.5 time dial position. Current settings are made by means of two movable leads which connect to the tap block at the top of the support structure (see Figure 1). The tap block is marked A through J, A through M or A through N. See the nameplate on the relay for tap settings.

Example: The 2 amp tap for a 1 to 12 IFC77 time overcurrent relay requires one movable lead in position D and the other in position H.

Operating Time Accuracy

The IFC relays should operate within ± 7% or ± the time dial setting times 0.10 second, whichever is greater, of the published time curve. Figures 6-8 and 20-22 show the various time-current characteristics for the IFC relays. The setting of the time dial determines the length of time required to close the contacts for a given current. The higher the time dial setting, the longer the operating time.

The contacts are just closed when the time dial is set to 0. The maximum time setting occurs when the time dial is set to 10 and the disk has to travel its maximum distance to close the contacts.

Reset

The unit resets at 90% of the minimum closing current. Reset times are proportionate to the time dial settings. The time to reset to the number 10 time dial position when the current is reduced to 0 is approximately 60 seconds for the IFC53 and 77 relays. The IFC51 relay will reset in approximately 12 seconds from the same number 10 time dial.

HIGH-SEISMIC INSTANTANEOUS UNIT

The instantaneous unit has a 25 to 1 range with a tapped coil. There are high and low ranges, selected by means of a link located on the top of the support structure. See Figure 1. The time-current curve for the instantaneous unit is shown in Figure 14.

HIGH-SEISMIC TARGET AND SEAL-IN UNIT

The target and seal-in unit has two tap selections located on the front of the unit. See Figure 1.

RECEIVING, HANDLING AND STORAGE

These relays, when not included as part of a control panel, will be shipped in cartons designed to protect them against damage. Immediately upon receipt of

a relay, examine it for any damage sustained in transit. If injury or damage resulting from rough handling is evident, file a damage claim at once with the transportation company and promptly notify the nearest General Electric Sales Office.

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

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

ACCEPTANCE TESTS

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 or of the 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, rating and calibration range of the relay received agree with the requisition.

Remove the relay from its case and check by visual inspection that there are no broken or cracked molded parts or other signs of physical damage.

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 each other.

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 1/64" wipe on the seal-in and the instantaneous 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 button is operated.

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

6. Check that all screws are tight.

CAUTION

SHOULD THERE BE A NEED TO TIGHTEN ANY SCREWS, DO NOT OVERTIGHTEN, TO PREVENT STRIPPING.

DRAWOUT RELAY TESTING

The IFC relays may be tested without removing them from the panel by using the 12XCA11A1 four-point test probes. The 12XCA11A2 four-point test probe makes connections to both the relay and the external circuitry, which provides maximum flexibility but requires reasonable care, since a CT shorting jumper is necessary when testing the relay. The CT circuit may also be tested by using an ammeter instead of the shorting jumper. See the test circuit in Figure 15.

GENERAL POWER REQUIREMENTS

All alternating current (AC) 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 AC devices (relays) will be affected by the applied waveform. Therefore, in order to properly test AC 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 waveforms. Hence a resistance-limited circuit, as shown in Figures 16-18, is recommended.

TIME OVERCURRENT UNIT

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

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 ensure approximately 1/32" wipe.

The minimum current at which the contacts will just close is determined by the tap setting in the tap block at the top of the support structure. See **CHARACTERISTICS** section.

The pickup of the time overcurrent unit for any current tap setting is adjusted by *means* of a spring-adjusting ring. See Figure 1. The spring-

adjusting ring either winds or unwinds the spiral control spring (see Figure 1). By turning the ring, the operating current of the unit may be brought into agreement with the tap setting employed, if this adjustment has been disturbed. This adjustment also permits any desired setting intermediate between the various tap settings to be obtained. If such adjustment is required, it is recommended that the higher tap be used. It should be noted that the relay will not necessarily agree with the time current characteristics of Figures 6-8 and 20-22 if the relay has been adjusted to pick up at a value other than tap value, because the torque level of the relay has been changed.

Time Setting

The setting of the time dial determines the length of time the unit requires to close the contacts when the current reaches a predetermined value. The contacts are just closed when the time dial is set on 0. When the time dial is set on 10, the disk must travel the maximum amount to close the contacts and therefore this setting gives the maximum time setting.

The primary adjustment for the time of operation of the unit is made by means of the time dial. However, further adjustment is obtained by moving the permanent magnet along its supporting shelf; moving the magnet toward the disk and shaft decreases the time, while moving it away increases the time.

Pickup Test

Set the relay at 0.5 time dial position and the lowest tap. Using the test connections in Figure 16, the main unit should close the contacts within ± 3% of tap value current for 60 Hz relays and within ± 7.5% of tap value current for 50 Hz relays.

Time Test

Set the relay at No. 5 time dial setting and the lowest tap. Using the test connections in Figure 16, apply five times tap current to the relay. The relay operating time to close its contact is listed in Table X.

TABLE X

Relay	Hz	Time (seconds) Min.	Max.
IFC51	50 and 60	1.76	1.80
IFC53	50 and 60	1.28	1.34
IFC77	50 and 60	0.89	0.95

HIGH-SEISMIC INSTANTANEOUS UNIT

Make sure that the instantaneous unit link is in the correct position for the range in which it is to operate. See the Internal Connections Diagram, Figure 5, and connect as indicated in the test circuit of Figure 17. Whenever possible, use the higher range, since the higher range has a higher continuous rating.

Setting the High-Seismic Instantaneous Unit

The instantaneous unit has an adjustable core located at the top of the unit as shown in Figure 1. To set the instantaneous unit to a desired pickup, loosen the locknut and adjust the core. Turning the core clockwise decreases the pickup; turning the core counterclockwise increases 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.

CAUTION
REFER TO TABLE VI FOR THE CONTINUOUS AND ONE-SECOND RATINGS OF THE INSTANTANEOUS UNIT. DO NOT EXCEED THESE RATINGS WHEN APPLYING CURRENT TO THE INSTANTANEOUS UNIT.

The range of the instantaneous unit (see Table VI) must be obtained between a core position of 1/8 of a turn from full clockwise and 20 turns counterclockwise from the full clockwise position. Do not leave the core in the full clockwise position.

HIGH-SEISMIC 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 shippped from the factory with the tap screw in the higher 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 1). 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 the test circuit of Figure 18) to a DC source of proper frequency and good waveform, using an 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.

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	Pickup Current	Dropout Current
0.2	0.12 - 0.20	.05 or more
2.0	1.2 - 2.0	.50 or more

INSTALLATION

The relay should be installed in a clean, dry location, free from dust, and well lighted to facilitate inspection and testing.

The relay should be mounted on a vertical surface. The outline and panel drillings are shown in Figures 23 and 24. Figure 23 shows the semi-flush mounting (necessary for high seismic capability), and Figure 24 shows various methods of surface mounting.

The internal connection diagrams for the relays are shown in Figures 4 and 5. Typical external connections are shown in Figure 9.

INSTALLATION TESTS

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

Time Overcurrent Unit

Set the tap block to the desired tap setting and the time dial to the 0.5 position. Using the test circuit in Figure 16, gradually apply current until the contacts just close. This value of current is defined as pickup, and should be within 3% of tap value for 60 Hz relays and within 7.5% of tap value for 50 Hz relays.

Check the operating time at some multiple of tap value and the desired time dial setting. This multiple of tap value may be 5 times tap rating or the maximum fault current for which the relay must coordinate. This value is left to the discretion of the user.

High-Seismic 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 **ACCEPTANCE TESTS** section.

High-Seismic Instantaneous Unit

1. Select the desired range by setting the link in the proper position (see Figure 1 and the Internal Connections Diagram, Figures 4 and 5). 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 High-Seismic 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 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 following points be checked at an interval of from one to two years.

These tests are intended to ensure 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 pickup test for the tap setting in service, as described in the **INSTALLATION** section.

2. Perform the time tests as described in the **INSTALLATION** section.

HIGH-SEISMIC INSTANTANEOUS UNIT

Check that the instantaneous unit picks up at the desired current level, as outlined in the **ACCEPTANCE TESTS** section.

HIGH-SEISMIC TARGET AND SEAL-IN UNIT

1. Check that the unit picks up at the values shown in Table XI.

2. Check that the unit drops out at 25% or more of tap value.

CONTACT CLEANING

For cleaning fine silver relay contacts, a flexible burnishing tool should be used. This consists of an etched-roughened strip of flexible metal, resembling a superfine file. The polishing action is so delicate that no scratches are left, yet it will clean off any corrosion thoroughly and rapidly. The flexibility of the tool insures the cleaning of the actual points of contact. Never use knives, files, or abrasive paper or cloth of any kind to clean fine silver contacts. A burnishing tool as described above can be obtained from the factory.

COVER CLEANING

The clear Lexan(R) cover should be cleaned with a soft cloth and water only. Cleaning solutions should not be used.

SYSTEM TEST

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

SYSTEM TEST

Although this instruction book is primarily written to check and set the IFC 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:

Pickup Tests

Rotate time dial to No. 0 time dial setting and check by means of a lamp 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 setting, there should be sufficient gap between the stationary contact brush and its metal backing strip to ensure approximately 1/32" wipe.

The pickup of the unit for any current tap setting is adjusted by means of a spring-adjusting ring. By turning the ring, the operating current of the unit may be brought into agreement with the tap setting employed, if for some reason this adjustment has been disturbed. This adjustment also permits any desired setting intermediate between the various tap settings to be obtained. If such adjustment is required, it is recommended that the higher tap setting be used. It should be noted that the relay will not necessarily agree with the time-current characteristics of Figures 6-8 and 20-22 if the relay has been adjusted to pick up at a value other than tap value, because the torque level of the relay has been changed.

Connect the operating coil terminals to a source of the proper frequency and good waveforem having a voltage of 110 or more, with resistance load boxes for setting the current (see Test circuit of Figure 16).

With the tap block set for the lowest tap and the time dial set where contacts are just open, adjust the control spring to just close the contacts within the limits given in Table XII, which are ± 1% of the tap amps.

TABLE XII

Tap Range	Tap	Min. Amps	Max. Amps
0.5 - 4	0.5	.495	.505
1.0 - 12.0	1.0	.99	1.01

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

Time Tests

With the tap block set for the lowest tap and the time dial at No. 5 setting, apply 5 times tap current to the relay.

Adjust the position of the drag magnet assembly to obtain an operating time as listed in Table XIII.

TABLE XIII

Relay	Time (Seconds)	
	Min.	Max.
IFC51	1.76	1.80
IFC53	1.29	1.33
IFC77	0.90	0.94

It would be preferable to adjust the operating time as nearly as possible to 1.78, 1.31 or 0.92 seconds. The drag magnet assembly should be approximately in the middle of its travel. The drag magnet assembly is adjusted by loosening the two screws securing it to the support structure (see Figure 1). Moving the drag magnet towards the disk and shaft decreases the operating time and moving the drag magnet away from the disk and shaft increases the operating time. The screws securing the drag magnet assembly to the support structure must be tight before proceeding with other time checks.

Mechanical Adjustment

The disk does not have to be in the exact center of either air gap for the relay to perform correctly. Should the disk not clear all gaps, however, the following adjustment can be made.

1. Determine which way the disk must be aligned to clear all gap surfaces by 0.010 inch.

2. Remove the drag magnet assembly by loosening the two screws securing it to the support structure. The screws need not be removed.

3. Loosen the upper pivot bearing set screw (1/16" hex wrench) slightly, so the upper pivot can move freely. Do not remove the set screw from the support structure.

4. Loosen the jewel bearing set screw as in 3 above.

5. Apply a slight downward finger pressure on the upper pivot and turn the jewel bearing screw, from the underside of the support structure, to position the disk as determined in 1 above.

6. Turn the jewel bearing screw 1/8 turn clockwise and tighten the upper pivot set screw to 2.5 - 3.5 inch pounds of torque.

7. Turn the jewel bearing screw 1/8 turn counterclockwise. This will lower the disk and shaft assembly approximately 0.005" and permit proper end-play. The shaft must have 0.005 - 0.010" of end-play.

8. Tighten the jewel bearing set screw to 2.5 - 3.5 inch pounds of torque.

9. Rotate the disk through the electromagnet gap. The disk could clear the gap surfaces by 0.010" and be within 0.005" flatness. If the disk is not within 0.005" flatness, the disk should be replaced.

10. Reinstall the drag magnet assembly and check that the disk has at least 0.010" clearance from the drag magnet assembly surfaces.

11. Tighten the drag magnet assembly mounting screws with 7-10 inch pounds of torque, after securely seating the assembly and positioning it according to the Time Test above (page 18).

HIGH-SEISMIC 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 1/64" wipe on the contacts. Check this by inserting a 0.010" feeler gage between the front half of the shaded pole and the armature when held closed. Contacts should close with feeler gage in place.

4. Since mechanical adjustments may affect the Seismic Fragility level, it is advised that no mechanical adjustments be made if seismic capability is of concern.

HIGH-SEISMIC TARGET AND SEAL-IN UNIT

Check 1 and 2 as described under INSTANTANEOUS UNIT.

To check the wipe of the seal-in unit, insert a 0.010" feeler gage between the plastic residual of the armature and the pole piece with the armature held closed. Contacts should close with feeler gage in place. Since mechanical adjustments may affect the Seismic Fragility level, it is advised that no mechanical adjustments be made if seismic capability is of concern.

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 give complete model number of the relay for which the part is required. If possible, give the General Electric requisition number on which the relay was furnished.

Since the last edition, changes have been made in Figures 23 & 24.

TABLE II (SEE PAGE 6)

12IFC51
TAPS AVAILABLE

0.5	0.6	0.7	0.5	1	1.2	1.5	2	2.5	3	4
A/M	A/L	B/L	B/K	C/K	C/J	D/J	D/H	E/H	E/G	F/G

1	1.2	1.5	2	2.5	3	4	5	6	7	8	10	12
A/N	B/N	B/M	C/M	C/L	D/L	D/K	E/K	E/J	F/J	G/J	F/H	G/H

12IFC53
TAPS AVAILABLE

0.5	0.6	0.7	0.5	1	1.2	1.5	2	2.5	3	4
A/J	A/H	A/G	A/F	A/E	A/D	B/E	B/D	A/C	A/B	E/F

1	1.2	1.5	2	2.5	3	4	5	6	7	8	10	12
A/J	D/J	G/J	A/H	B/H	A/G	F/H	A/E	A/D	B/F	A/C	A/B	D/F

12IFC77
TAPS AVAILABLE

0.5	0.6	0.7	0.5	1	1.2	1.5	2	2.5	3	4
A/J	A/N	A/G	A/F	A/E	A/D	E/M	A/C	A/B	C/D	E/F

1	1.2	1.5	2	2.5	3	4	5	6	7	8	10	12
A/J	D/J	A/H	D/H	A/G	H/J	A/F	A/E	A/D	F/G	A/C	A/B	D/F

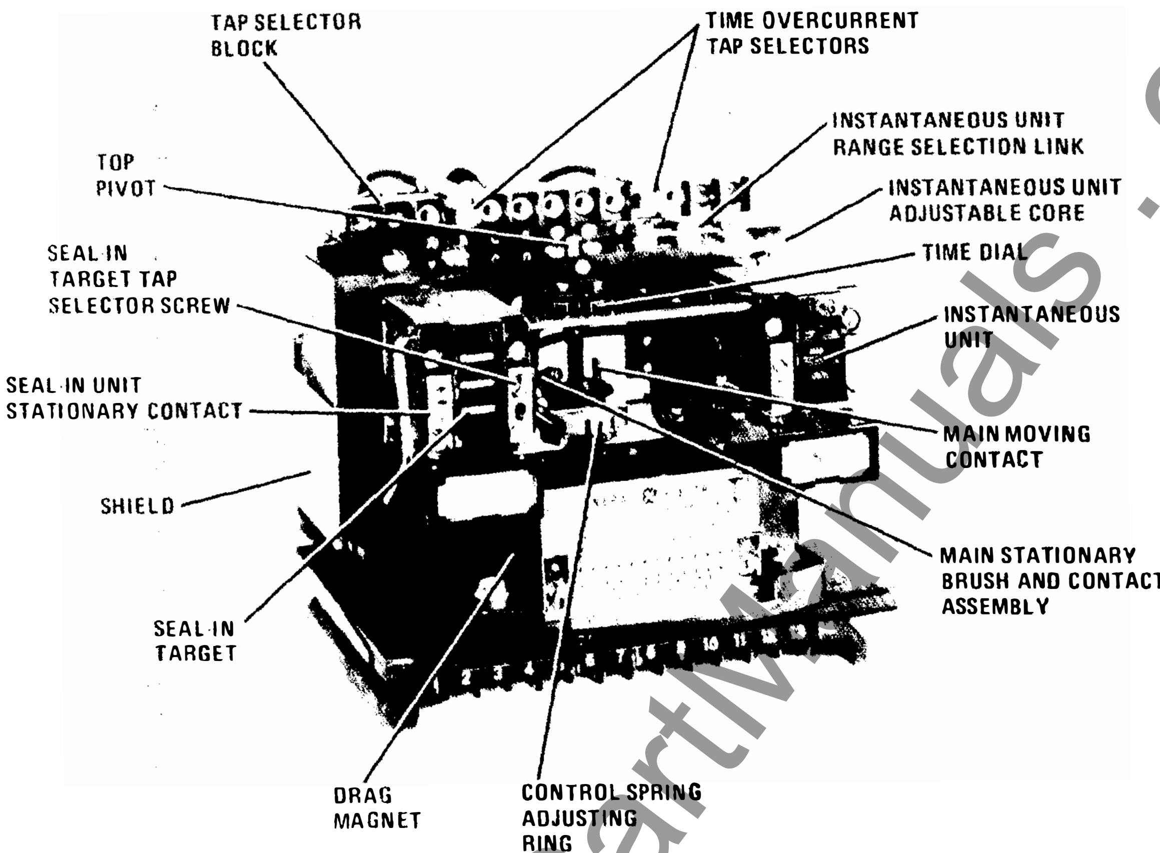


Figure 1 (8042708) Type IFC53B Relay, Removed from Case, Front View

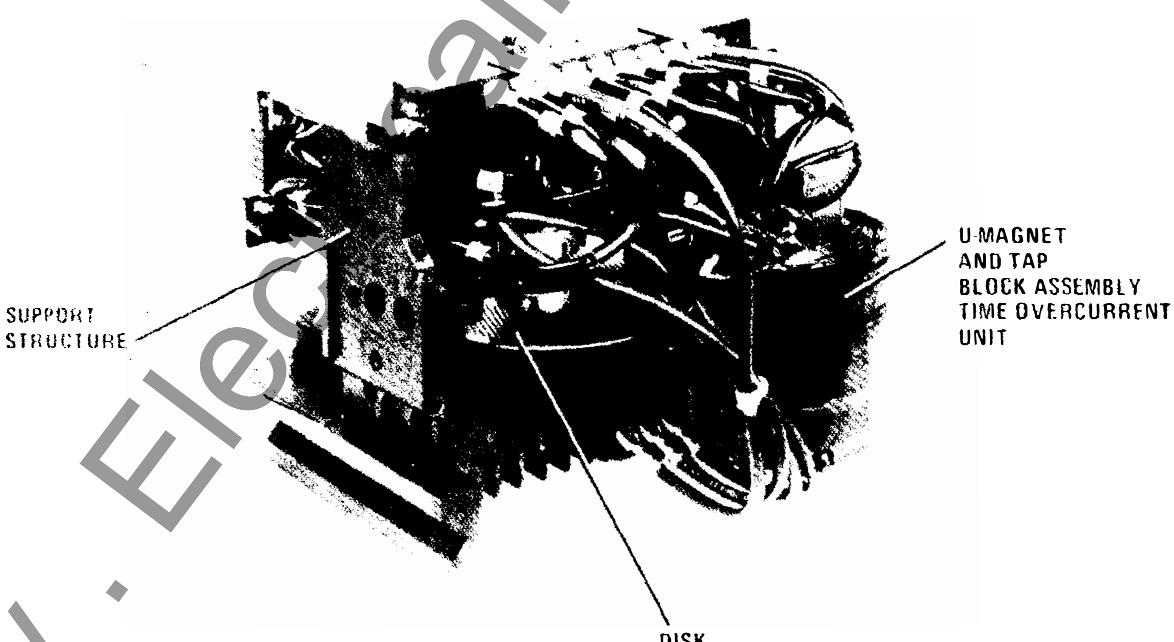


Figure 2 (8042711) Type IFC53B Relay, Removed from Case, Rear View

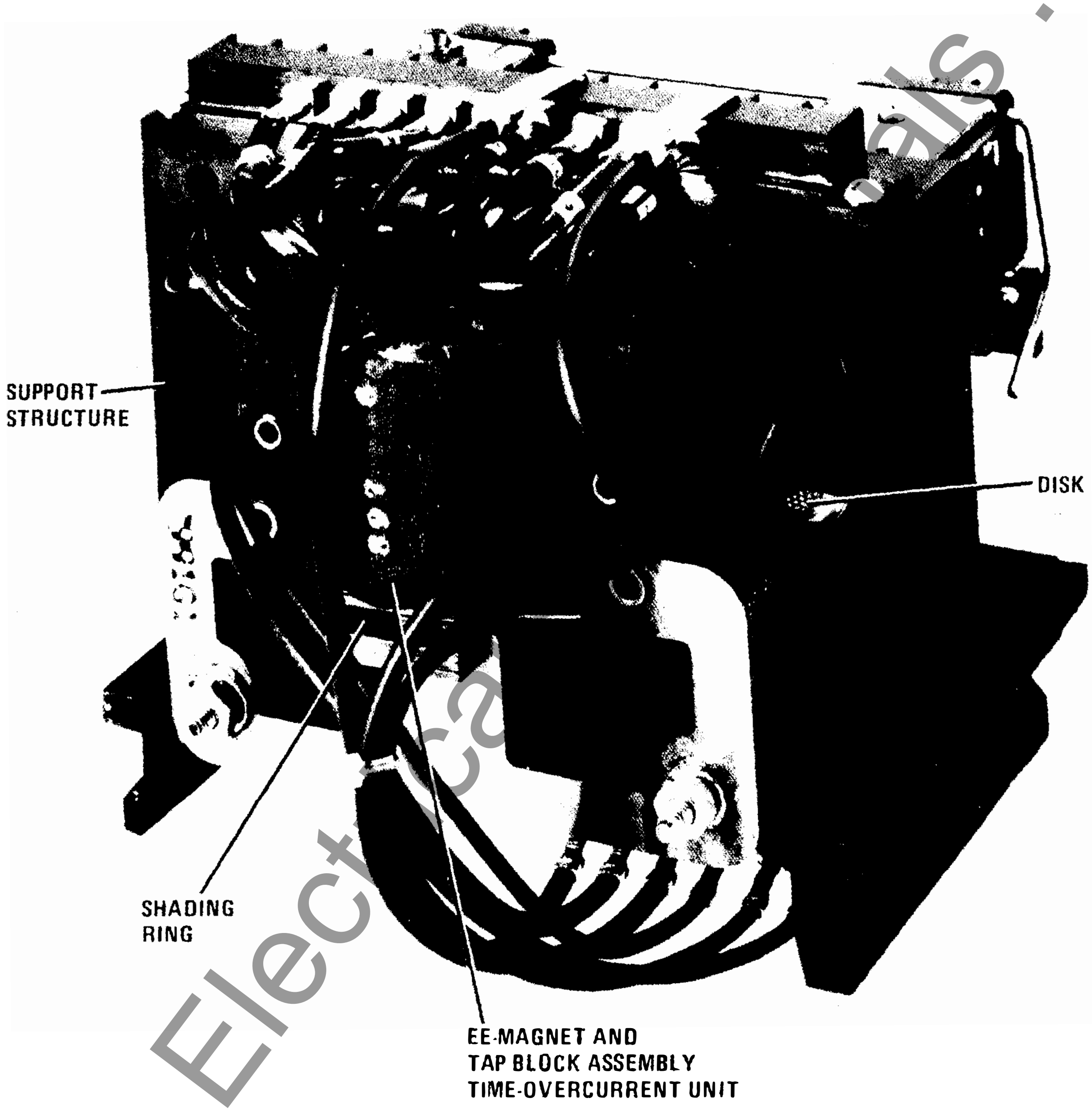
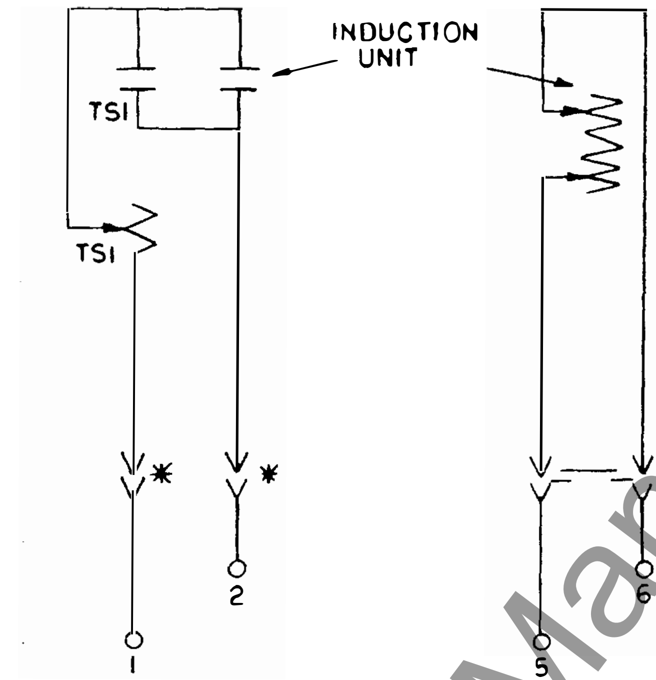
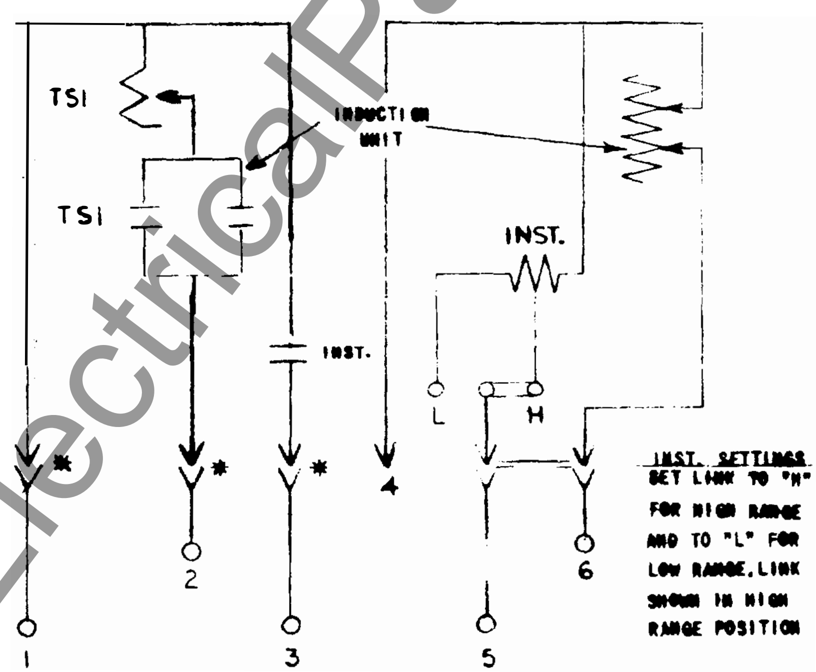


Figure 3 (8042750) Type IFC77B Relay, Removed from Case, Rear View



✳ = SHORT FINGER

Figure 4 (0257A8339-5) Internal Connections for Relay Types IFC51A, IFC53A and IFC77A - Front View



✱ = SHORT FINGER

Figure 5 (0257A8340-5) Internal Connections for Relay types IFC51B, IFC53B and IFC77B - Front View

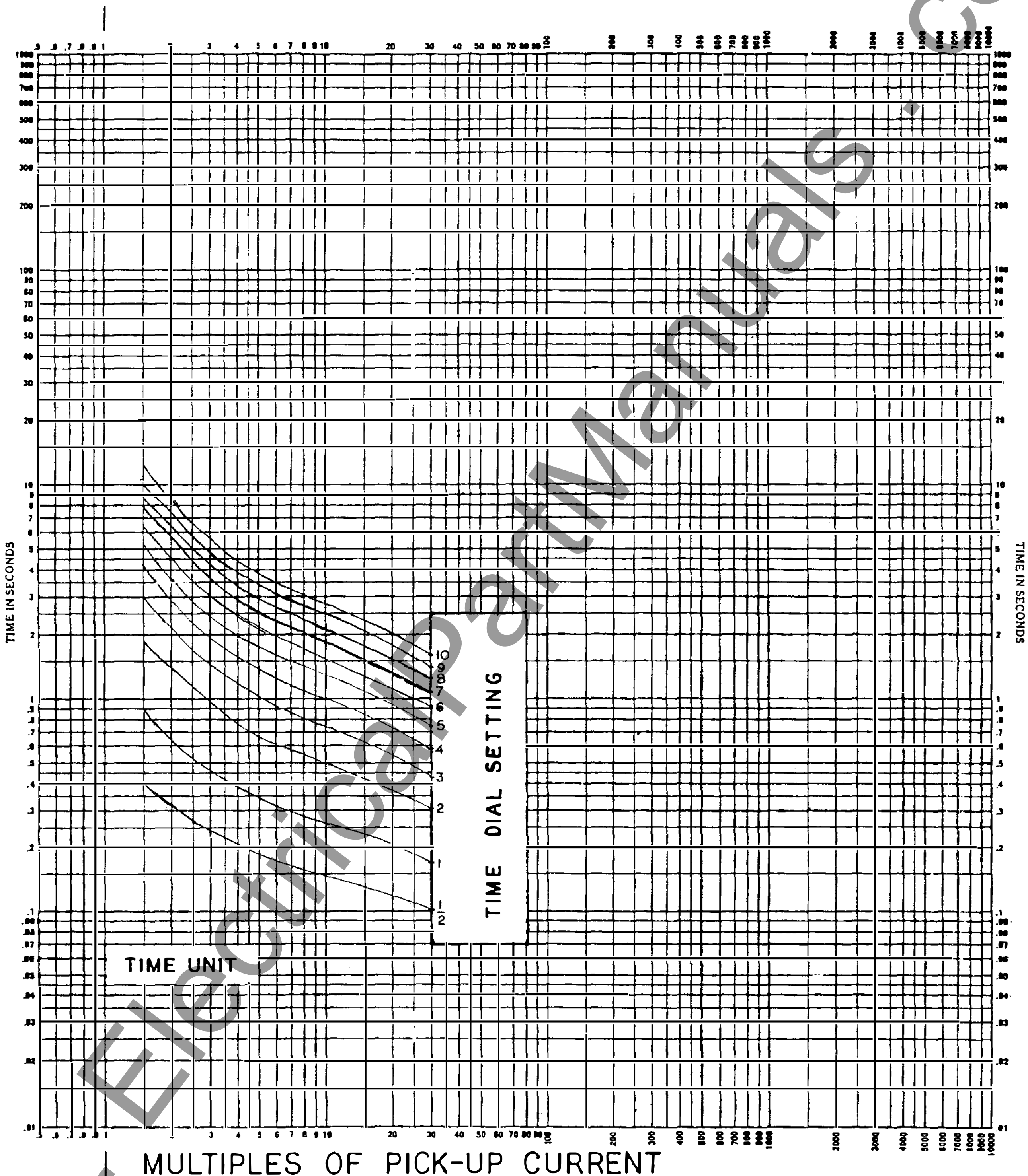


Figure 6 (0108B8943-2) 60 Hertz Time-Current Characteristics for Relay Types IFC51A and IFC51B

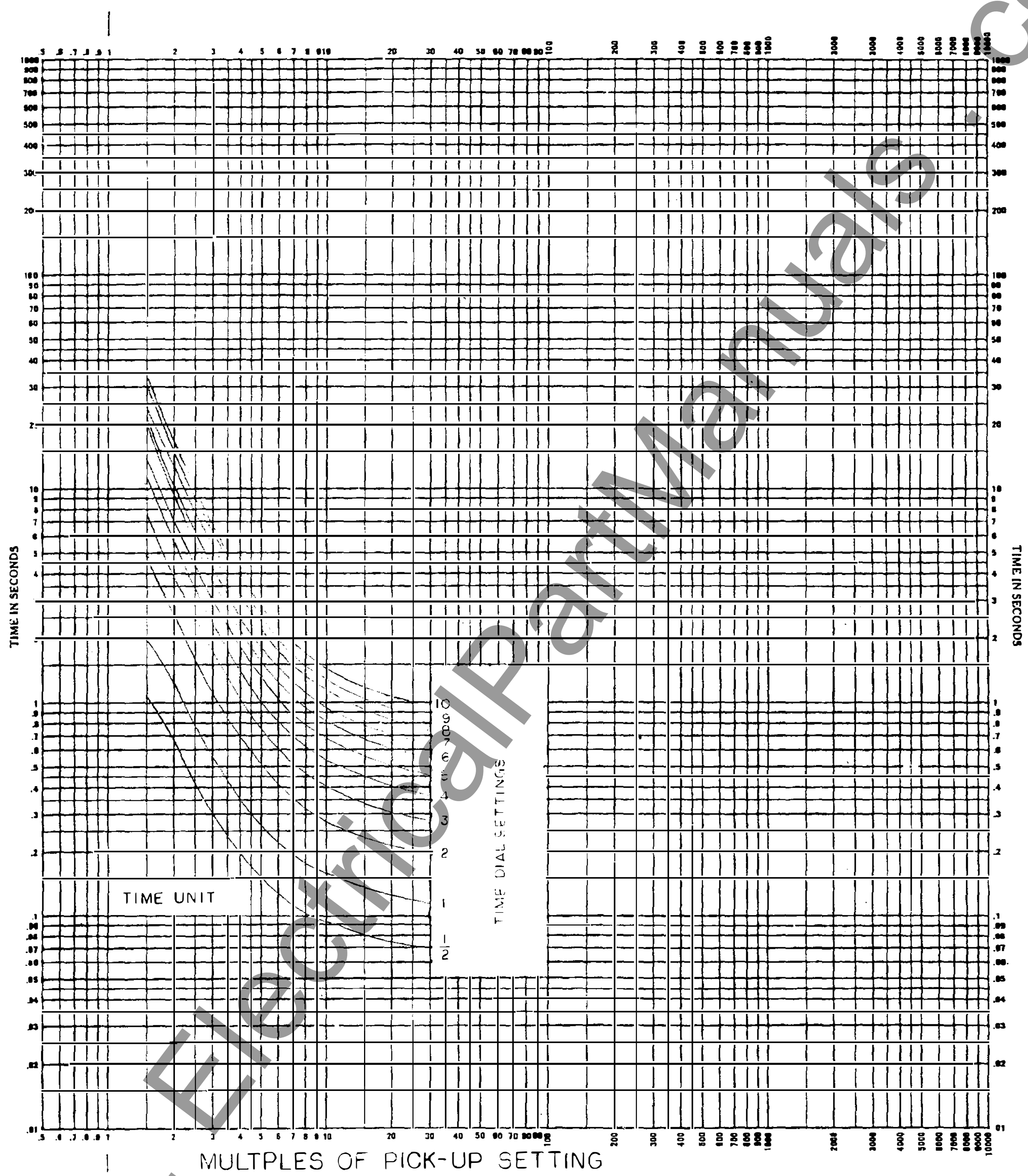


Figure 7 (0108B8944-3) 60 Hertz Time-Current Characteristics for Relay Types IFC53A and IFC53B

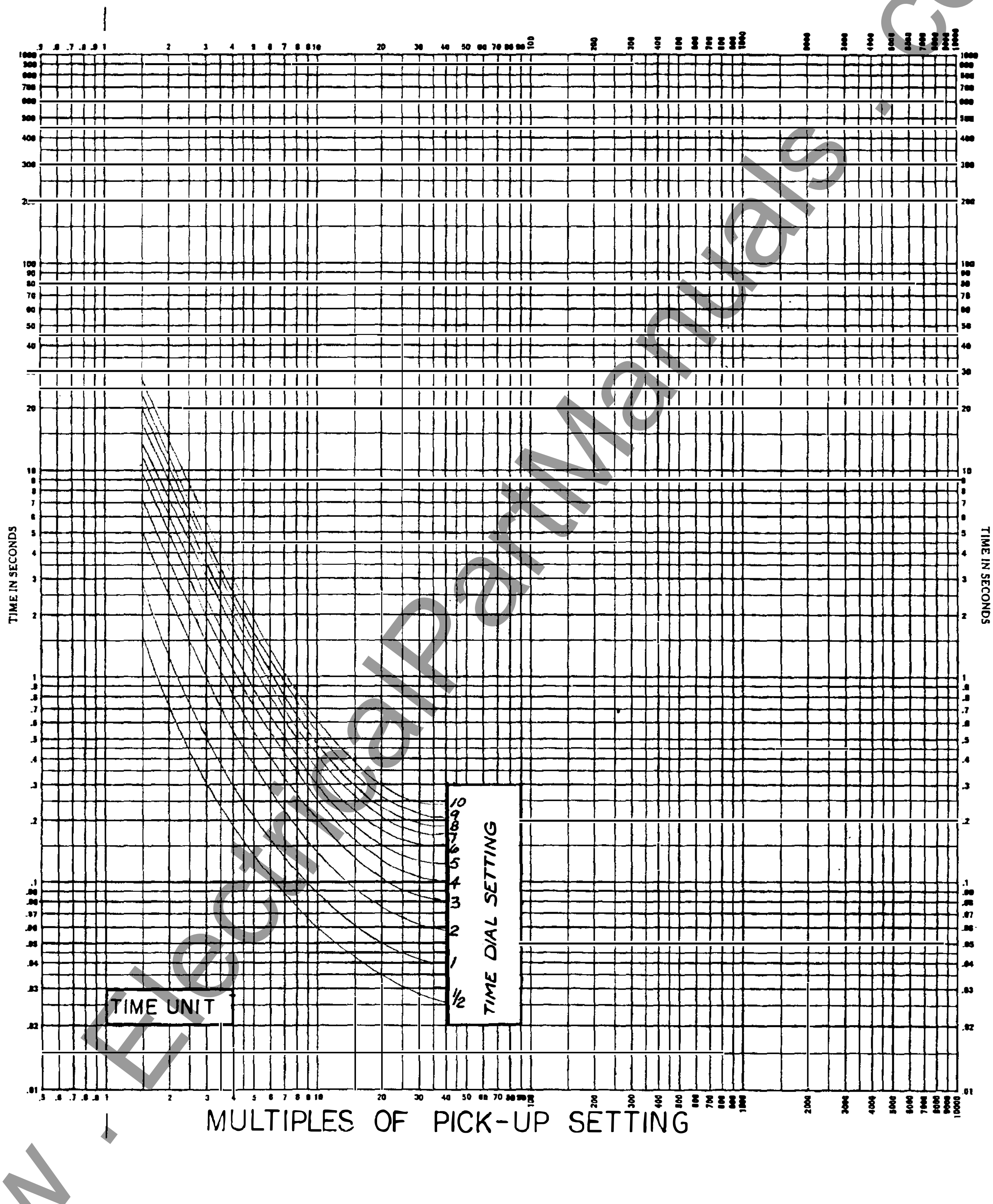


Figure 8 (0108B8945-2) 60 Hertz Time-Current Characteristics for Relay Types IFC77A and IFC77B

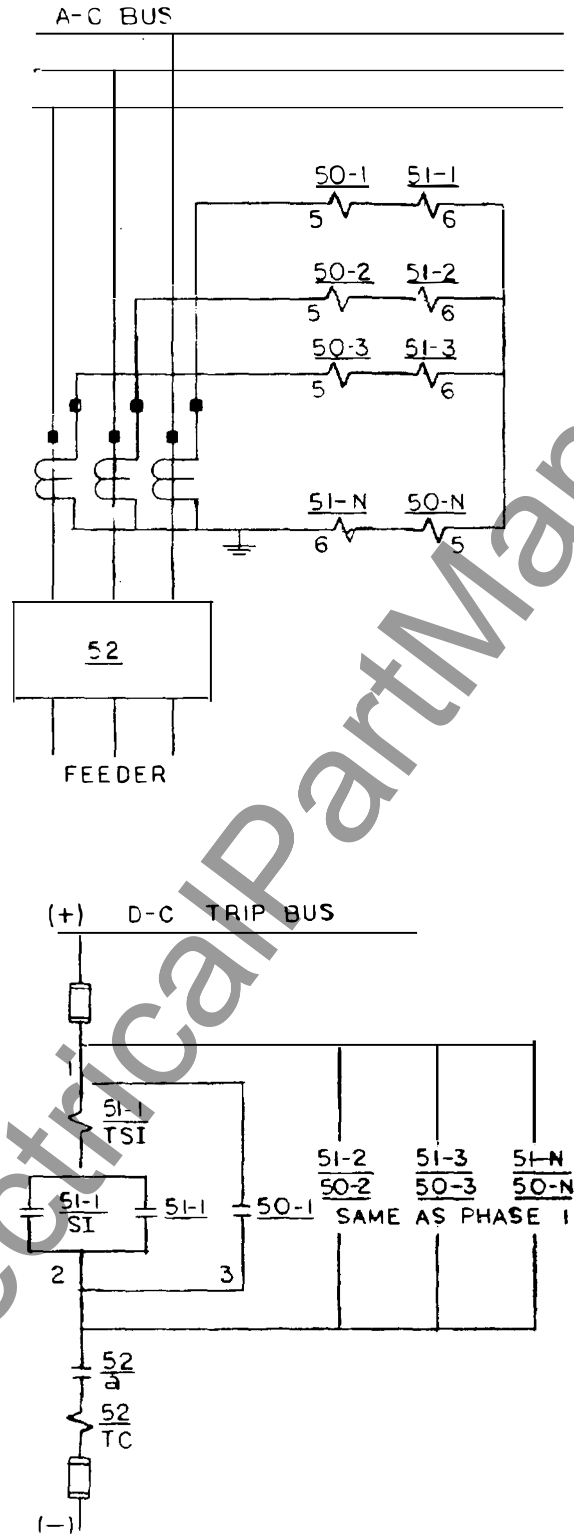


Figure 9 (0257A9647-0) External Connections of Four IFC Relays Used for Multi-Phase and Phase-to-Ground Fault Protection of a 3-Phase Circuit

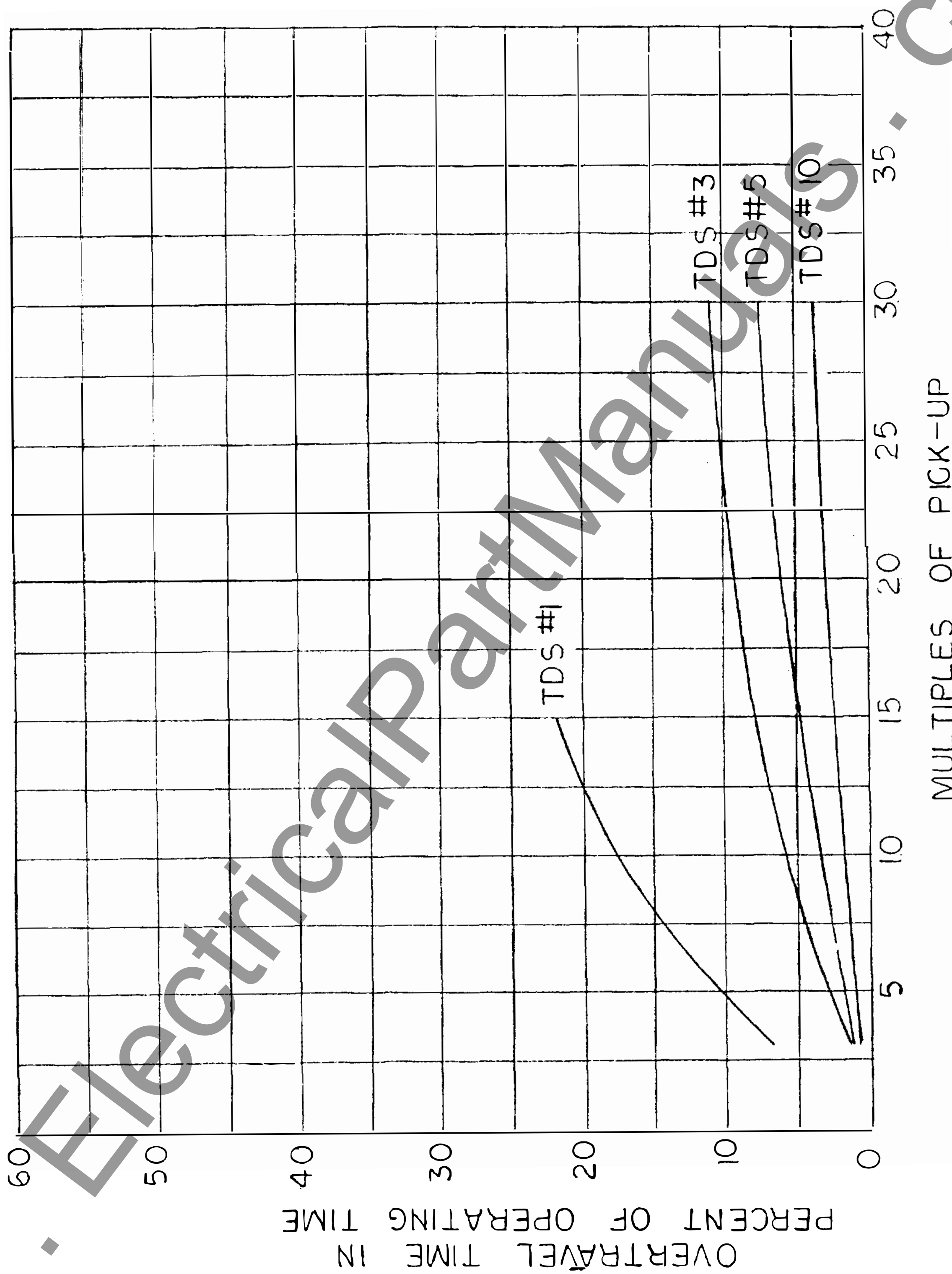


Figure 10 (0257A8594-2) Overtravel Curves for Relay Type IFC51

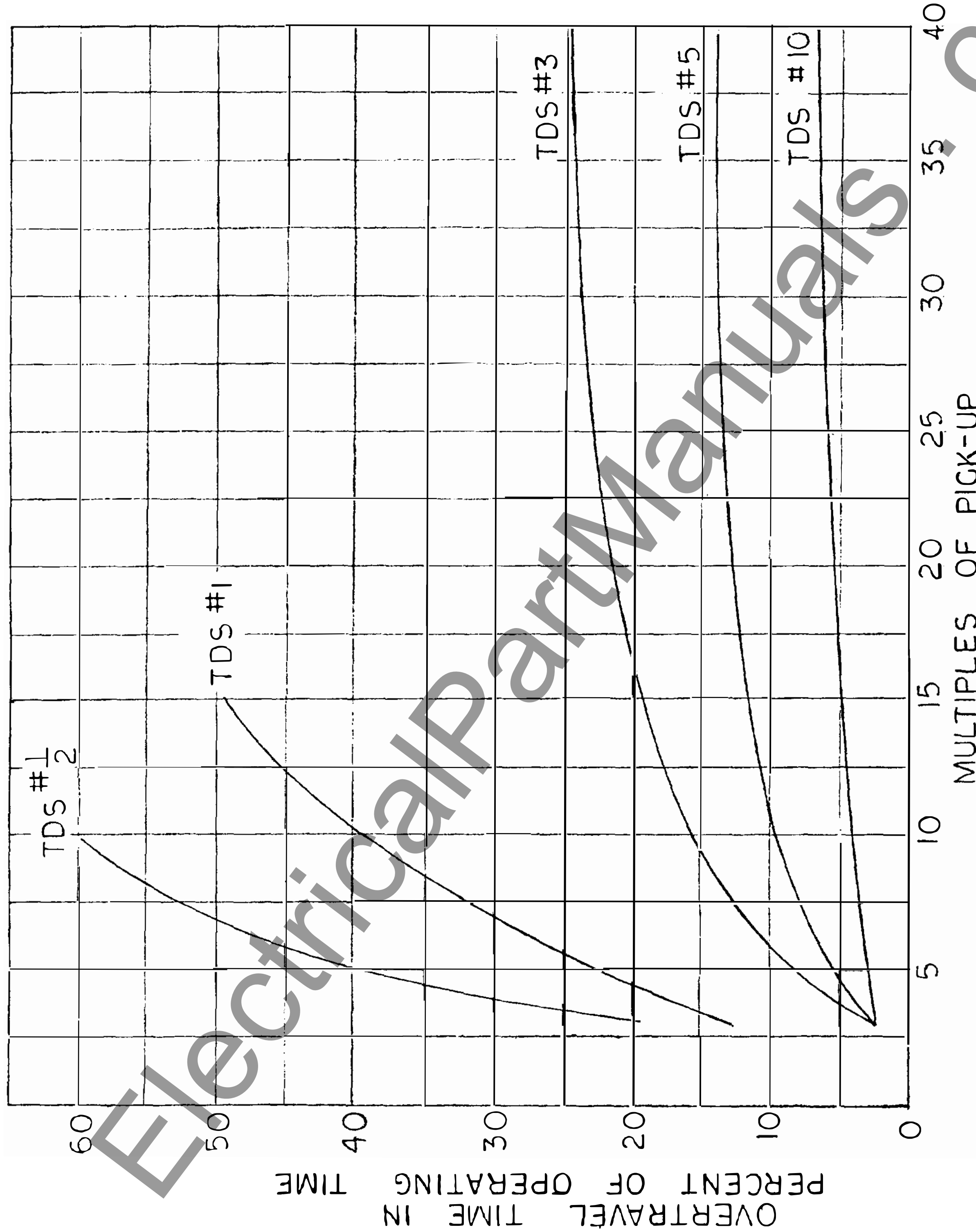


Figure 11 (0257A8595-2) Overtravel Curves for Relay Type IFC53

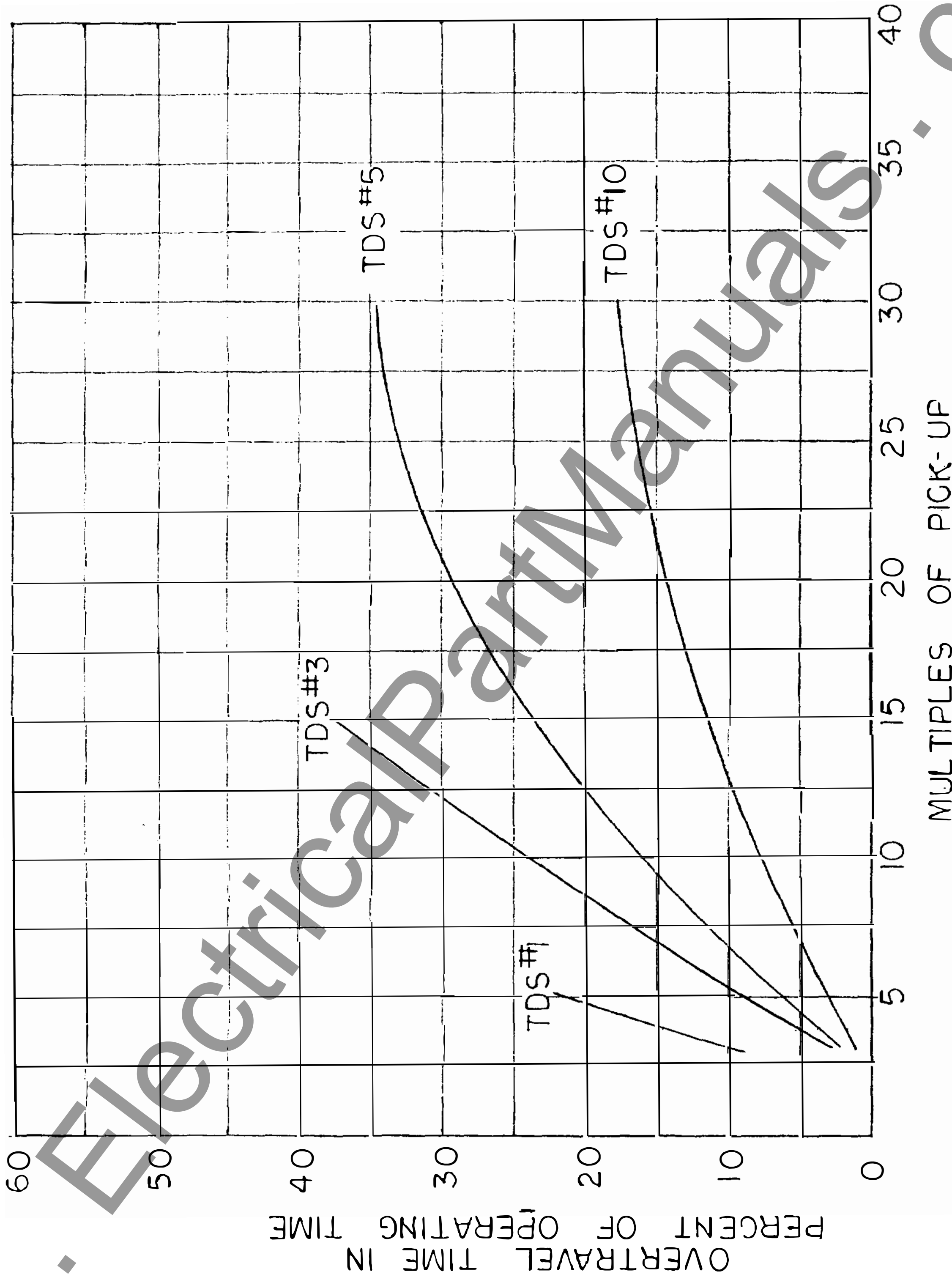


Figure 12 (0257A8596-2) Overtravel Curves for Relay Type IFC77

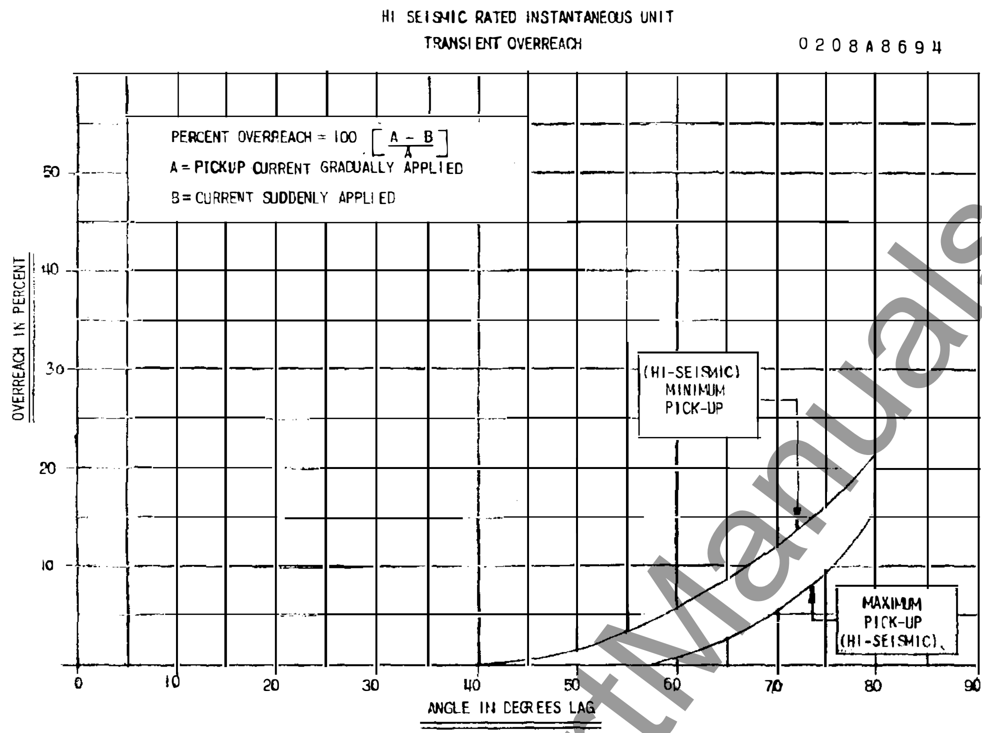


Figure 13 (0208A8694-2) Transient Overreach Characteristics of the High-Seismic Instantaneous Unit

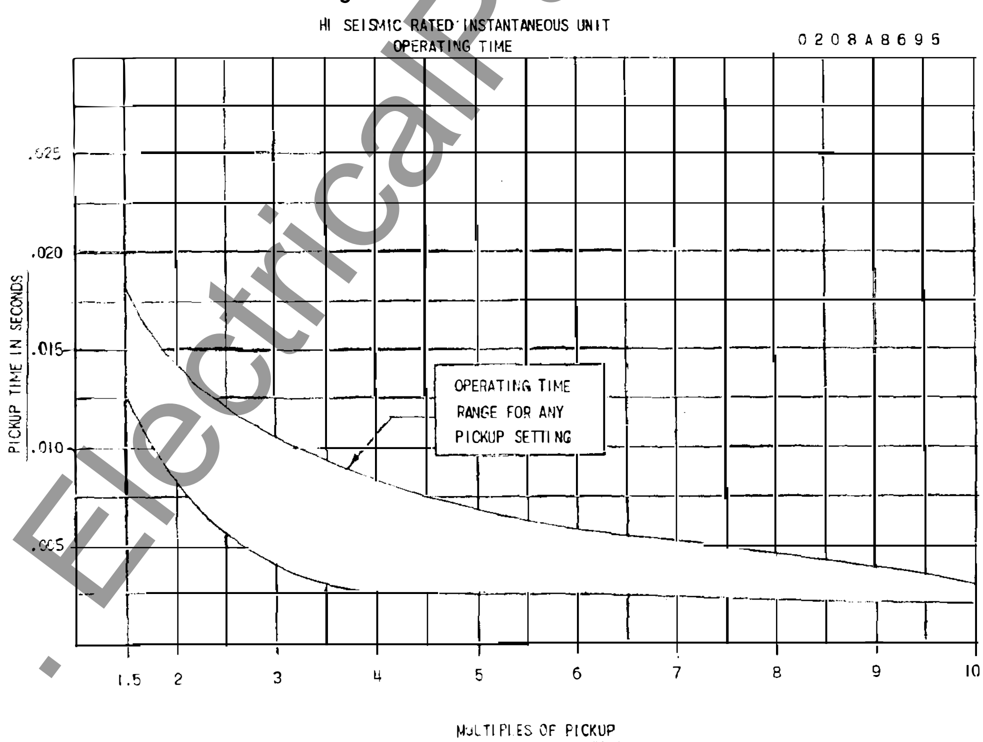


Figure 14 (0208A8695-1) Time-Current Characteristics of the High-Seismic Instantaneous Unit

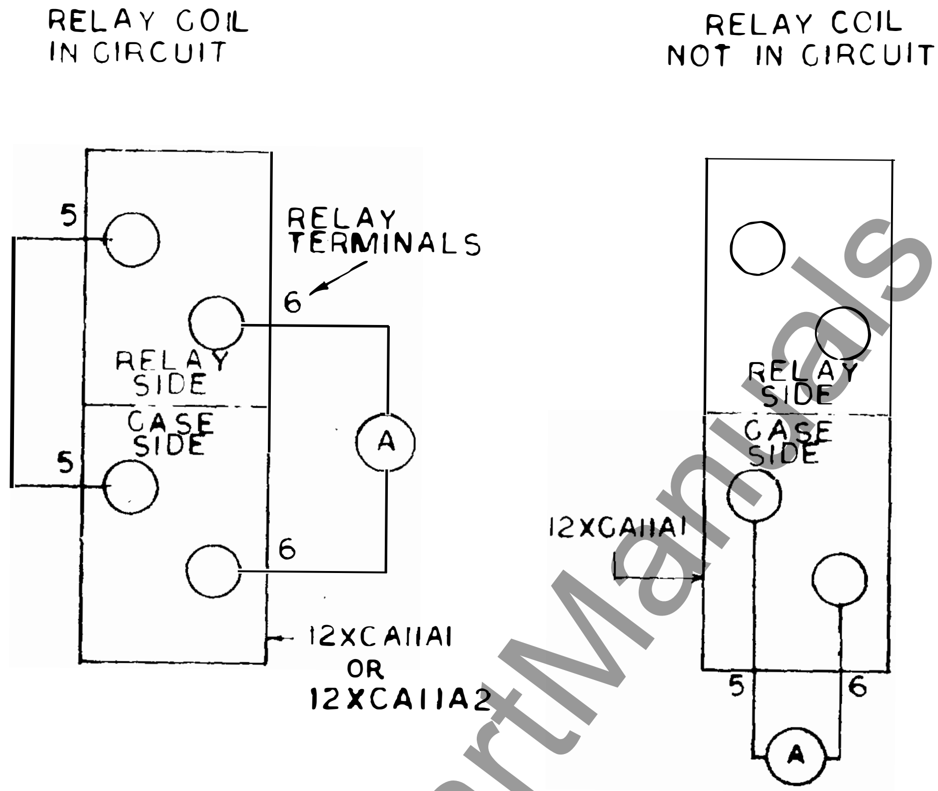


Figure 15 (0269A1787-1) Test Connections
for Testing CT Secondary Used with the IFC Relay

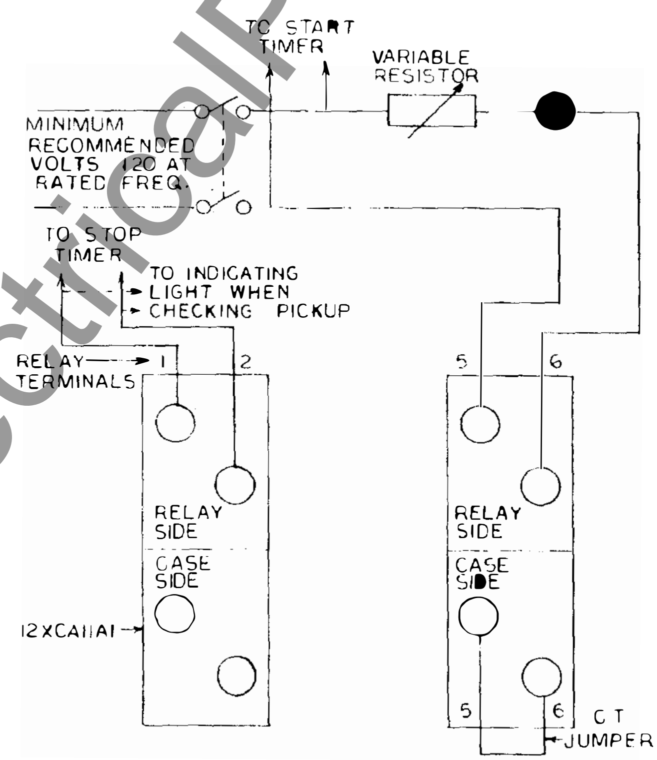


Figure 16 (0269A1789-0) Test Connections for Testing Pickup and Operating Times
of the IFC Relay Time Overcurrent Unit

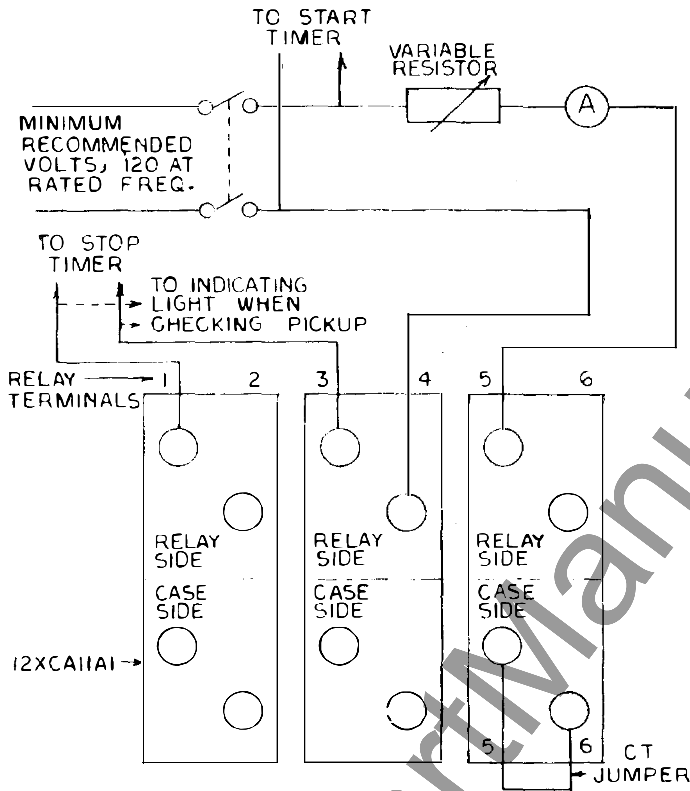
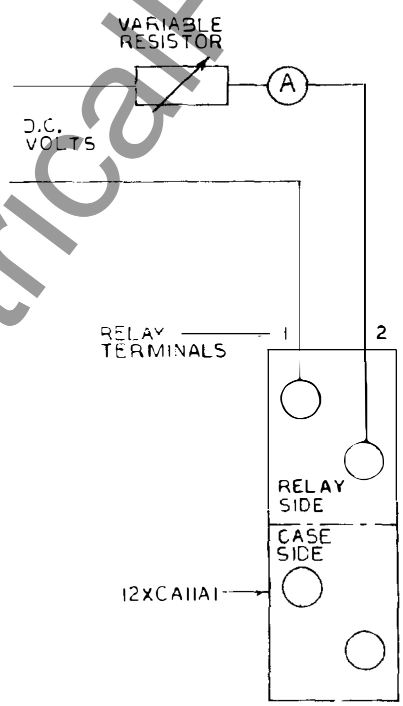


Figure 17 (0269A1788-1) Test Connections for Testing Pickup and Operating Times of the IFC Relay High-Seismic Instantaneous Unit



igure 18 (0269A1790-0) Test Connections for Testing the High-Seismic Target and Seal-in Unit Used with the IFC Relay

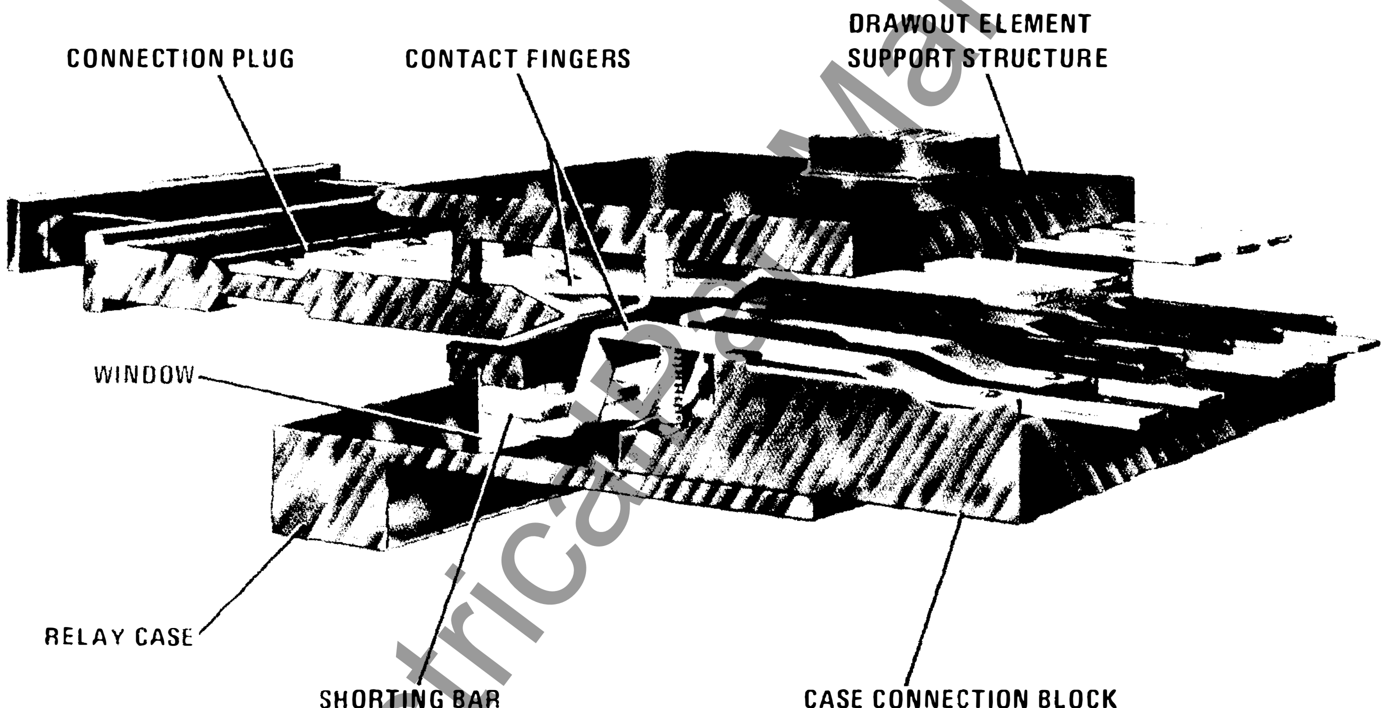


Figure 19 (8042715) Cross Section of IFC Drawout Case Showing Shorting Bar

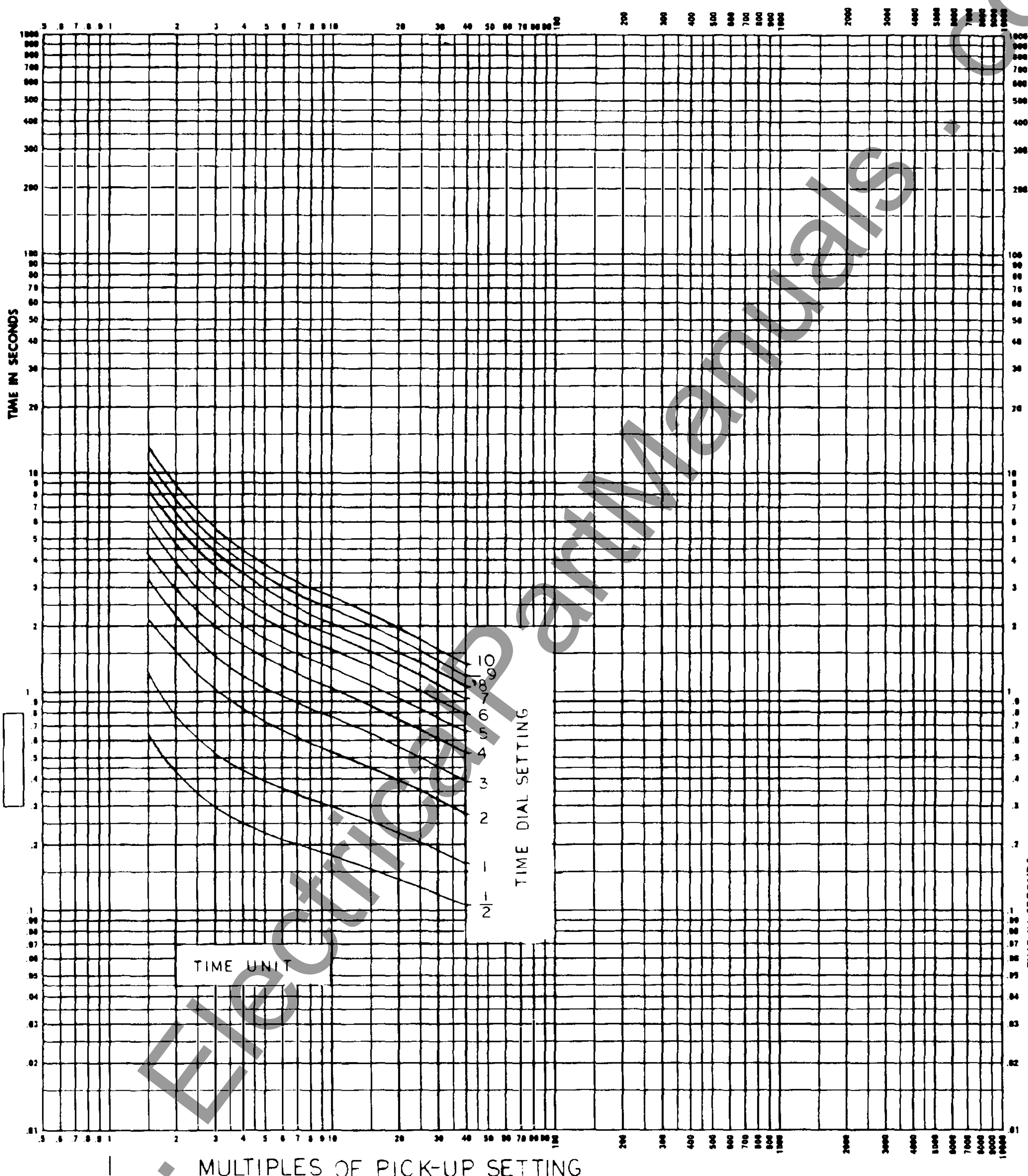


Figure 20 (0108B8973-0) 50 Hertz Time-Current Characteristics
for Relay Types IFC51A and IFC51B

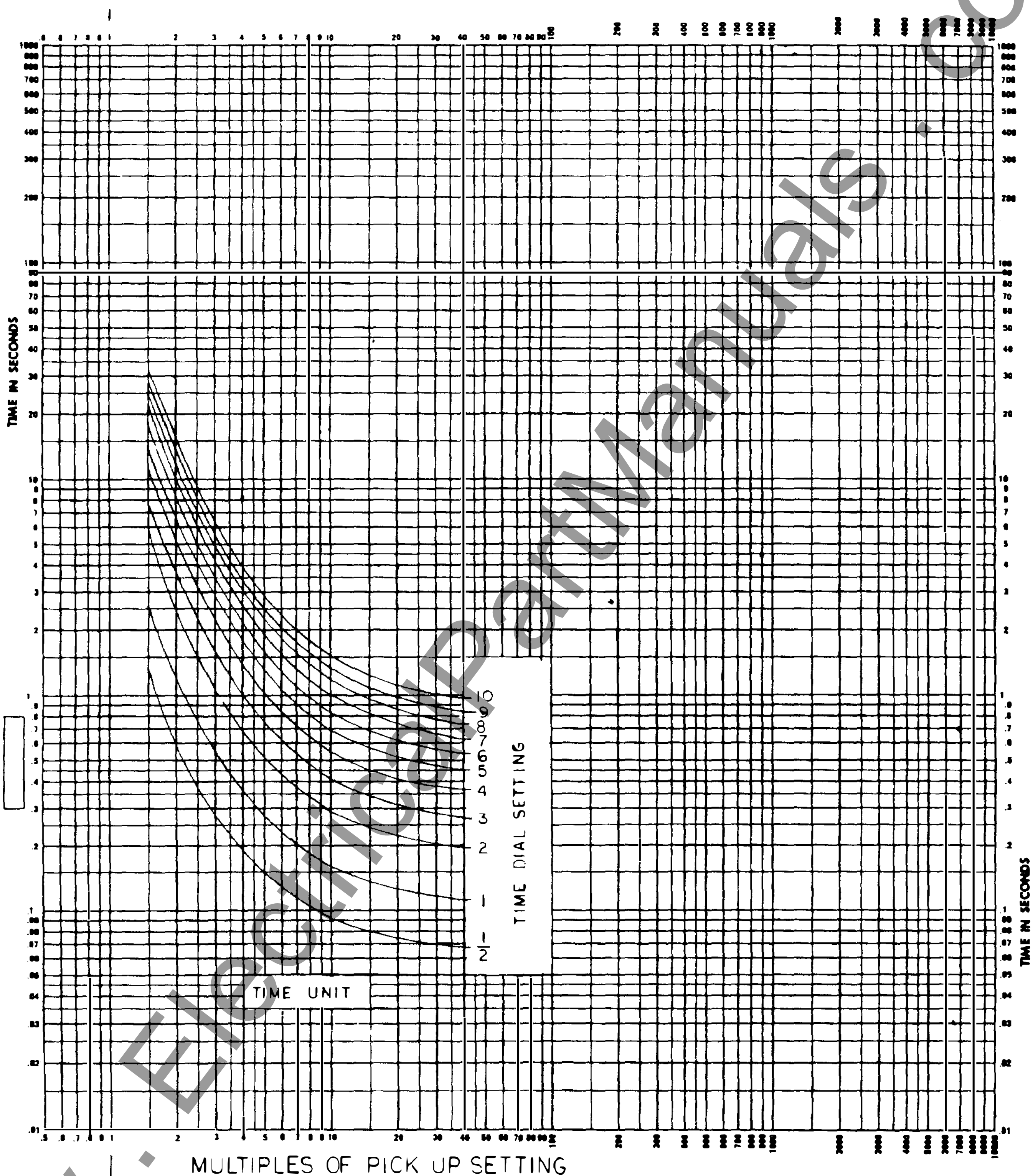


Figure 21 (0108B8974-0) 50 Hertz Time-Current Characteristics for Relay Types IFC53A and IFC53B

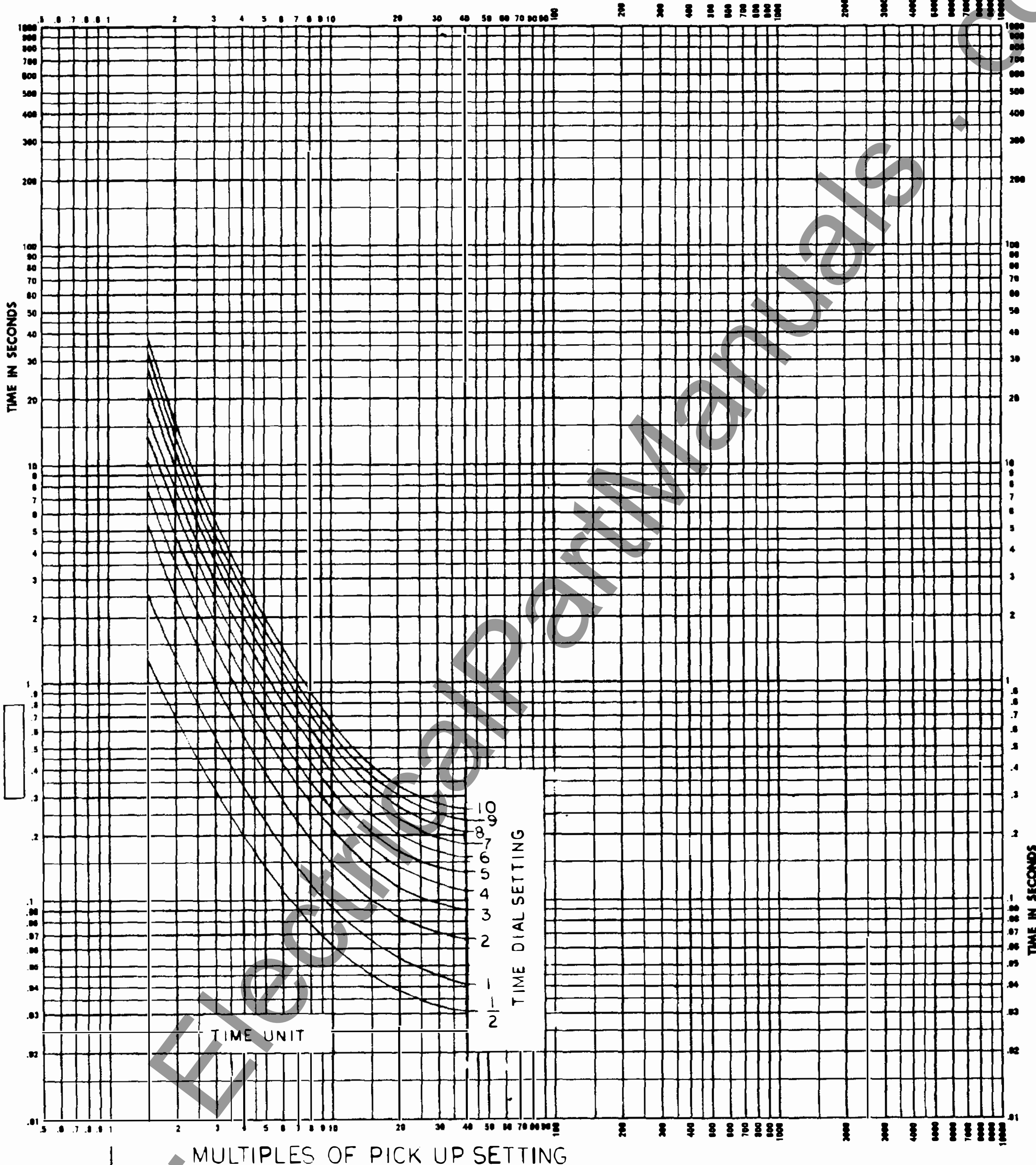
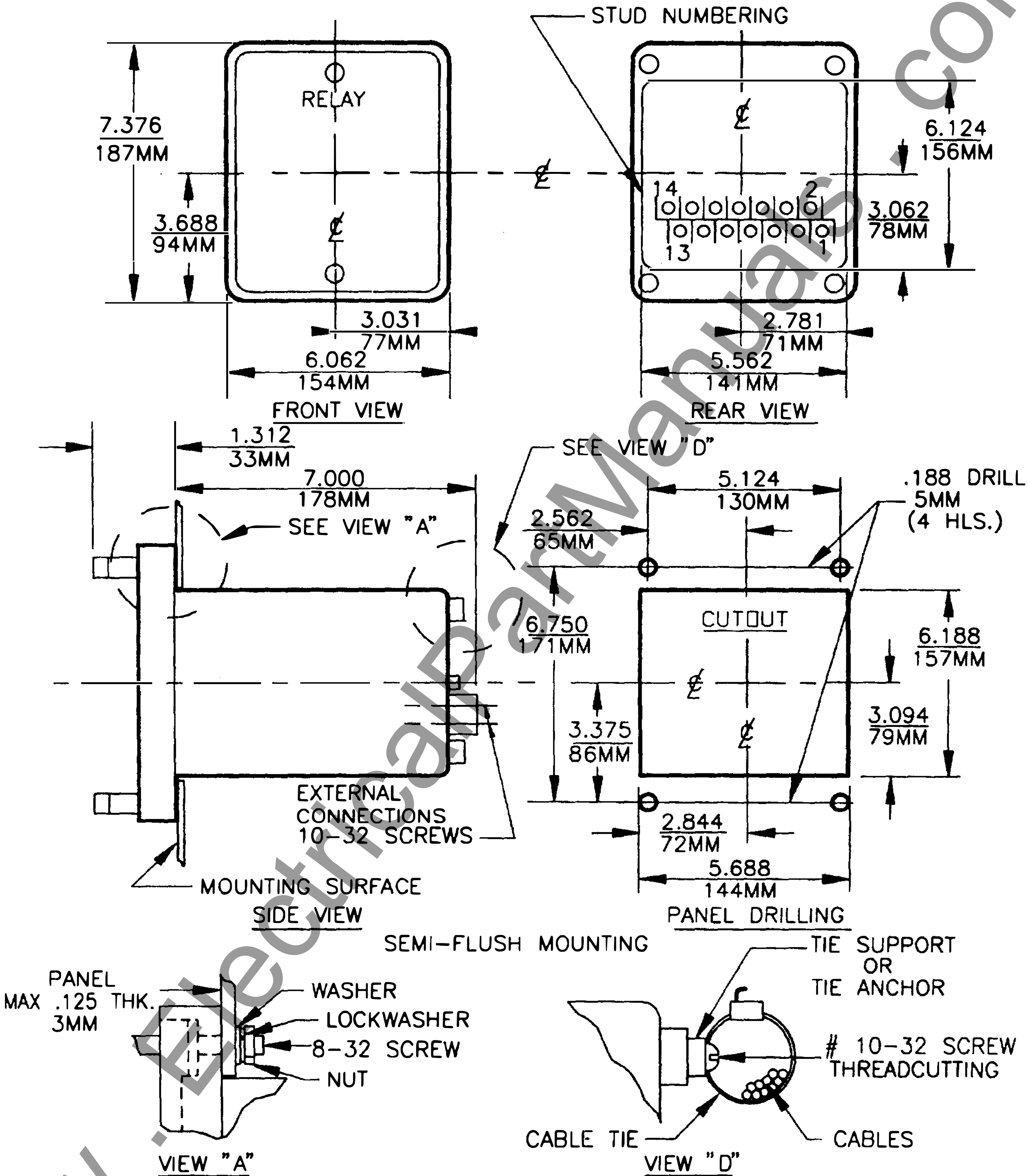


Figure 22 (0108B8975-0) 50 Hertz Time-Current Characteristics for Relay Types IFC77A and IFC77B



HDW-0257A8549 G-1

Figure 23 (0257A8452 Sheet 1 [6]) Outline & Panel Drilling for Semi-Flush Mounting of Relay Types IFC51, IFC53 and IFC77

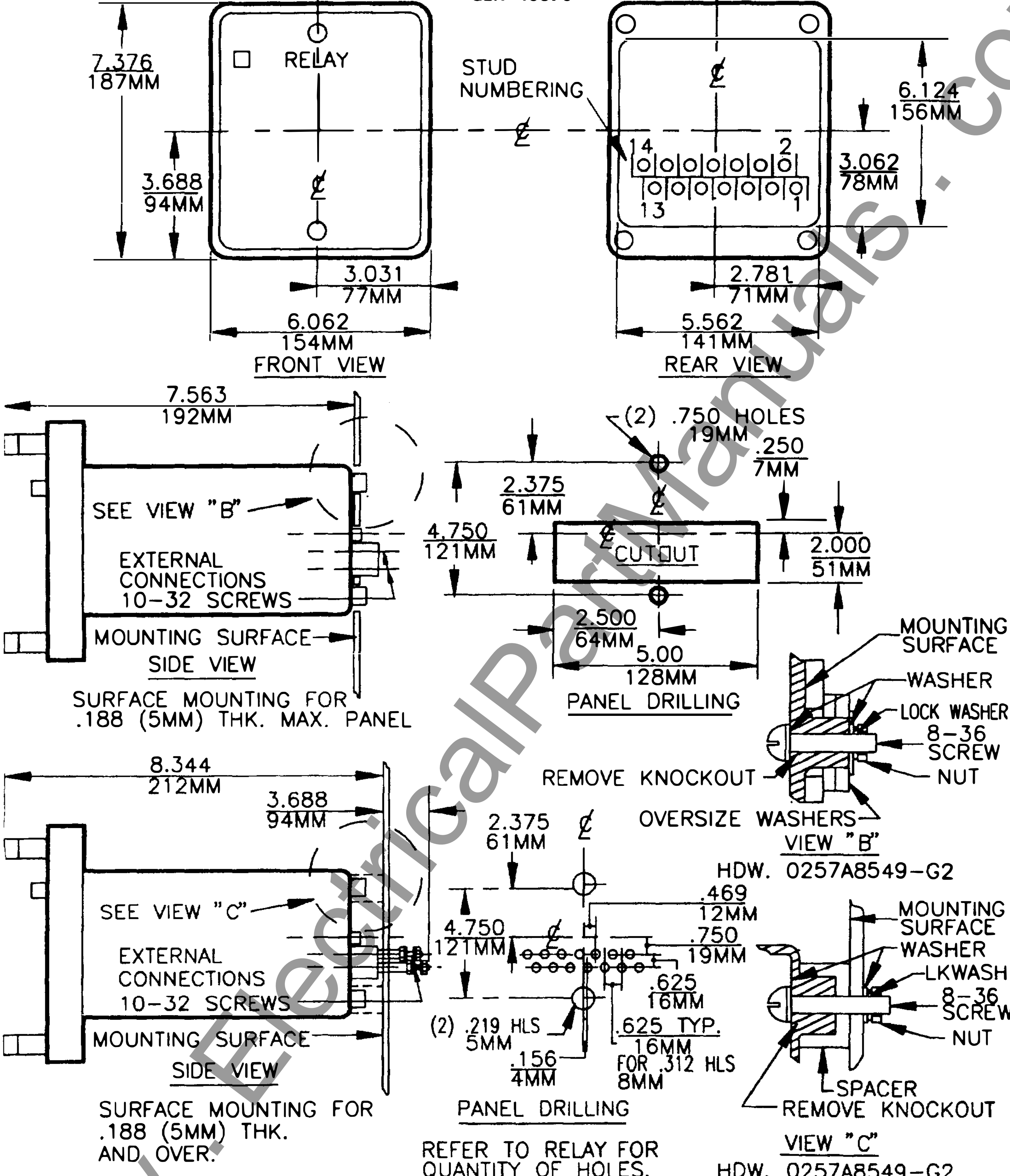


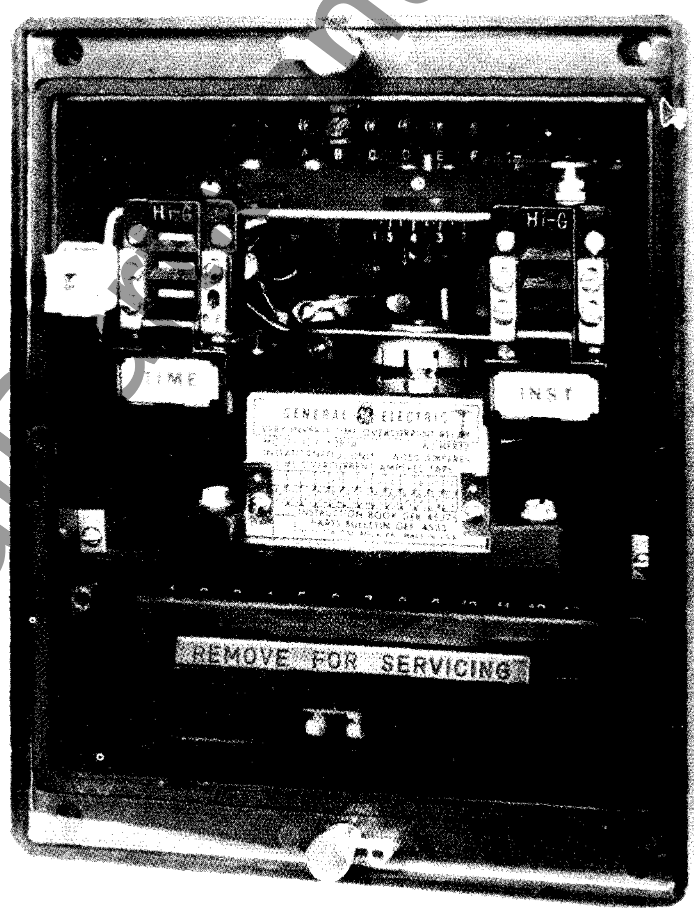
Figure 24 (0257A8452 Sheet 2 [6]) Outline & Panel Drilling for Surface Mounting of Relay Types IFC51, IFC53 and IFC77

LIST OF FIGURES

GE Power Management

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

INSTRUCTIONS



TIME OVERCURRENT RELAYS

Types
IFC51A and 51B
IFC53A and 53B
IFC77A and 77B

GE Protection and Control
205 Great Valley Parkway
Malvern, PA 19355-1337

CONTENTS

TIME OVERCURRENT RELAYS
TYPES
IFC51A and 51B
IFC43A and 53B
IFC77A and 77B

DESCRIPTION

The type IFC relays covered by these instructions are extended range, single phase, time overcurrent relays. The various time-current characteristics available are as follows:

IFC51A, IFC51B - Inverse time
IFC53A, IFC53B - Very inverse time
IFC77A, IFC77B - Extremely inverse time

The IFC51B, 53B and 77B relays also include a hinged-armature instantaneous overcurrent unit, which provides instantaneous tripping at high current levels. The instantaneous unit is not included in the IFC51A, 53A or 77A relays. Both the time overcurrent unit and the instantaneous overcurrent unit are described in detail in the section on **CONSTRUCTION.** Each relay is equipped with a dual-rated target and seal-in unit.

When semiflush mounted on a suitable panel, these relays have a high seismic capability, including both the target seal-in unit and the instantaneous overcurrent unit when it is supplied. Also, these relays are recognized under the Components Program of Underwriters Laboratories, Inc.

The relay is mounted in a size C1 drawout case of molded construction. The outline and panel drilling are shown in Figures 23 and 24. The relay internal connections are shown in Figure 4 for the IFC51A, 53A and 77A, and in Figure 5 for the IFC51B, 53B and 77B.

APPLICATION

Time overcurrent relays are used extensively for the protection of utility and industrial power distribution systems and frequently for overload backup protection at other locations. The EXTREMELY INVERSE time charactersistics, Figures 10 and 22, of the IFC77A and 77B relays are designed primarily for use where they are required to coordinate rather closely with power fuses, distribution cutouts and reclosers. They also provide maximum tolerance to allow for cold load pickup such as results from an extended service outage, which results in a heavy accumulation of loads of automatically controlled devices such as refrigerators, water heaters, water pumps, oil burners, etc. Such load accumulations often produce inrush currents considerably in excess of feeder full load current for a short time after the feeder is energized.

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.

The EXTREMELY INVERSE time characteristic often permits successful pickup of these loads and at the same time provides adequate fault protection.

The VERY INVERSE time characteristics, Figures 7 and 21, of the IFC53A and 53B relays are likely to provide faster overall protection in applications where the available fault current magnitude remains fairly constant due to a relatively constant generating capacity. The variation in the magnitude of fault current through the relay is therefore mainly dependent upon the location of the fault with respect to the relay.

The INVERSE time overcurrent characteristics, Figures 6 and 20, of the IFC51A and 51B relays tend to make the relay operating time less dependent upon the magnitude of the fault current than in the case of VERY INVERSE and EXTREMELY INVERSE devices. For this reason, INVERSE type relays are likely to provide faster overall protection in applications where the available fault current magnitudes vary significantly as a result of frequent changes in the source impedance due to system loading and switching.

The usual application of these relays requires three relays for multiphase fault protection, one per phase, and a separate relay residually connected for single-phase-to-ground faults. Typical external connections for this application are shown in Figure 9. Use of a separate ground relay is advantageous because it can be set to provide more sensitive protection against ground faults.

In the application of these relays with downstream automatic reclosing devices, the relay reset time should be considered. This is the time required for the relay to go from the contacts-fully-closed position to the fully-open position when set at the number 10 time dial. At lower time dial settings the reset times are proportionately lower. The reset time of all VERY INVERSE and EXTREMELY INVERSE relays is approximately 60 seconds. The reset time of all INVERSE relays covered by these instructions is approximately 12 seconds.

When setting these relays to coordinate with downstream relays, a coordination time of from 0.25 to 0.40 seconds is generally allowed, depending on the clearing time of the breaker involved and how accurately the relay time can be estimated. These coordination times include, in addition to breaker clearing time, 0.10 seconds for relay overtravel and 0.17 seconds for safety factor. For example, if the breaker clearing time is 0.13 seconds (8 cycles), the coordination time would be 0.40 seconds (0.13 + 0.10 + 0.17). If the relay time is set for the specific current level at the site, and if it has been tested, the safety factor may be reduced to 0.07 seconds. Then if the downstream breaker time is 5 cycles (0.08 seconds), a minimum of 0.25 seconds (0.08 + 0.10 + 0.07) could be allowed for coordination. If relay coordination times are marginal or impossible to obtain, use the relay overtravel curves of Figures 10, 11 or 12 to refine the relay settings. First determine the relay operating time necessary to just match the operating time of the downstream relay with which coordination is desired. Determine the multiple of pickup and the necessary time dial setting to provide this relay operating time. Use the appropriate curve of Figure 10, 11 or 12 to determine the overtravel time in percent of operating time, and covert this into real time. Add this time to the breaker time and the safety factor time and the original relay operating time to determine the final relay operating time. Set the relay to this value.

Once the current in the relay operating coil is cut off, the relay contacts will open in approximately 6 cycles (0.1 second) with normal adjustment of contact wipe. This permits the use of the relay in conjunction with instantaneous reclosing schemes without risk of a false retrip when the circuit breaker is reclosed on a circuit from which a fault has just been cleared.

The instantaneous overcurrent unit present in the IFC51B, 53B and 77B relays has a transient overeach characteristic as illustrated in Figure 13. This is the result of the DC offset that is usually present in the line current at the inception of a fault. When determining the pickup setting for this unit, the transient overreach must be taken into consideration. The percent transient overreach should be applied to increase the calculated pickup setting proportionately so that the instantaneous unit will not overreach a downstream device and thereby cause a loss of coordination in the system protection scheme. The operating time characteristics of this unit are shown in Figure 14.

CONSTRUCTION

The IFC induction disk relays consist of a molded case, cover, support structure assembly, and a connection plug to make up the electrical connection. See Cover Figure and Figures 1, 2, 3 and 19. Figures 2 and 3 show the induction unit mounted to the molded support structure. This disk is activated by a current-operating coil mounted on either a laminated EE- or a U-Magnet. The disk and shaft assembly carries a moving contact, which completes the alarm or trip circuit when it touches a stationary contact. The disk assembly is restrained by a spiral spring to give the proper contact closing current. Its rotation is retarded by a permanent magnet mounted in a molded housing on the support structure.

The drawout connection/test system for the C1 case, shown in Figure 19, has provisions for 14 connection points, and a visible CT shorting bar located up front. As the connection plug is withdrawn, it clears the shorter contact fingers in the output contact circuits first. Thus, the trip circuit is opened before any other circuits are disconnected. Next, current circuit fingers on the case connection block engage the shorting bar (located at the lower front of the case) to short-circuit external current transformer secondary connections. The window provides visual confirmation of CT shorting. The connection plug then clears the current circuit contact fingers on the case and finally those on the relay support structure, to de-energize the drawout element completely.

There is a High-Seismic target and seal-in unit mounted on the front to the left of the shaft of the time overcurrent unit (see Figure 1). 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 reset button located on the upper left side of the cover.

The IFC "B" model relays, in addition to the above, contain a high-seismic instantaneous unit (see Figure 1). The instantaneous unit is a small hinged-type unit which is 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 reset button that releases the target seal-in unit also releases the target of the instantaneous unit.

A magnetic shield, depicted in Figure 1, is mounted to the support structure of inverse and very inverse time overcurrent IFC relays (IFC51 and IFC53), to eliminate the proximity effect of external magnetic materials.

Both the High-Seismic target and seal-in unit and the High-Seismic instantaneous unit have the letters "Hi-G" molded into their target blocks to distinguish them as High-Seismic units. Seismic Fragility Level exceeds peak axial acceleration of 10g's (4g ZPA) when tested using a biaxial multi-frequency input motion to produce a Required Response Spectrum (RRS) in accordance with the IEEE Proposed Guide for Seismic Testing of Relays, P501, May, 1977.

RATINGS

The relays are designed for operation in an ambient air temperature from $-20^{o}C$ to $+55^{\circ}C$.

TIME OVERCURRENT UNIT

Ranges for the time overcurrent unit are shown in Table I.

TABLE I

Relay	Frequency (Hertz)	Current Range (Amperes)
IFC51A & B	50 and 60	0.5 - 4.0
IFC53A & B	50 and 60	1.0 - 12.0
IFC77A & B	50 and 60	

The current taps are selected with two sliding tap screws on an alphabetically labeled tap block.

The tap screw settings are as listed in Table II, on page 20, for each model of relay and tap range.

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

TABLE III

Model	Time Overcurrent Unit (Amperes)	One Second Rating Any Tap (Amperes)	K
IFC51	0.5 - 4.0	128	16384
	1.0 - 12.0	260	67600
IFC53	0.5 - 4.0	140	19600
	1.0 - 12.0	260	67600
IFC77	0.5 - 4.0	84	7056
	1.0 - 12.0	220	48400

Ratings less than one second may be calculated according to the formula

$I = \sqrt{K/T}$, where T is the time in seconds that the current flows.

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

TABLE IV
0.5 - 4.0 Ampere Range Ratings

Model	Tap										
	0.5	0.6	0.7	0.8	1.0	1.2	1.5	2.0	2.5	3.0	4.0
IFC51	1.6	1.8	2.0	2.1	2.3	2.7	3.0	3.5	4.0	4.5	5.0
IFC53	3.8	4.0	4.2	4.4	4.7	5.0	5.3	5.8	6.2	6.6	7.1
IFC77	2.5	2.7	3.0	3.2	3.6	4.0	4.5	5.2	5.9	6.5	7.5

TABLE V
1.0 - 12.0 Ampere Range Ratings

Model	Tap												
	1.0	1.2	1.5	2.0	2.5	3.0	4.0	5.0	6.0	7.0	8.0	10.0	12.0
IFC51	3.7	4.1	4.6	5.3	6.0	6.5	7.6	8.5	9.3	10.0	10.8	12.1	13.2
IFC53	6.8	7.1	7.7	8.3	8.8	9.4	10.3	11.0	11.6	12.4	12.6	13.5	14.4
IFC77	5.8	6.4	7.2	8.4	9.4	10.4	12.1	13.6	15.1	16.4	17.6	19.8	21.8

HIGH-SEISMIC INSTANTANEOUS UNIT

The instantaneous coil is tapped for operation on either one of two ranges (H or L). Selection of the high or low range is determined by the position of the link located on the top of the support structure (see Figure 2 and Table VI).

TABLE VI

High-Seismic Instantaneous Unit (Amps)	Link Position	Range (Amps)	Continuous Rating (Amps)	One Second Rating (Amps)	K
2 - 50	L H	2 - 10 10 - 50	2.7 7.5	130	16,900
6 - 150	L H	6 - 30 30 - 150	10.2 19.6	260	67,600

The range is approximate, which means that the 2-10, 10-50 may be 2-8, 8-50. There will always be at least one ampere overlap between the maximum L setting and the minimum H setting. Whenever possible, be sure to select the higher range, since it has the higher continuous rating.

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

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

Since the instantaneous unit coil is in series with the time overcurrent unit coil, see Tables III, IV, V and VI to determine the current-limiting element for both continuous and short-time ratings.

HIGH-SEISMIC TARGET AND SEAL-IN UNIT

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

TABLE VII

	Tap 0.2	Tap 2
DC Resistance ± 10% (ohms)	8.0	0.24
Min. Operating (Amps) +0 -60%	0.2	2.0
Carry Continuous (Amperes)	0.3	3
Carry 30 Amps for (sec.)	0.03	4
Carry 10 Amps for (sec.)	0.25	30
60 Hz Impedance (ohms)	68.6	0.73

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

Model	Hz	Range	Min Tap Amps	Burdens at Min. Pickup Min. Tap (Ohms)			Burdens in Ohms (Z) Times Pickup		
				R	J_X	Z	3	10	20
IFC51	60	0.5- 4.0	0.5	5.43	21.53	22.20	12.55	5.14	3.29
		1.0-12.0	1.0	1.47	5.34	5.54	3.09	1.28	0.82
IFC53	60	0.5- 4.0	0.5	1.52	4.23	4.50	4.47	3.10	1.93
		1.0-12.0	1.0	0.38	1.06	1.13	1.11	0.78	0.49
IFC77	60	0.5- 4.0	0.5	1.55	2.36	2.82	2.86	2.93	2.76
		1.0-12.0	1.0	0.59	0.43	0.73	0.74	0.75	0.70
IFC51	50	0.5- 4.0	0.5	4.53	17.95	18.50	11.45	4.28	2.70
		1.0-12.0	1.0	1.22	4.45	4.62	2.58	1.07	0.68
IFC53	50	0.5- 4.0	0.5	1.27	3.52	3.75	3.72	2.58	1.61
		1.0-12.0	1.0	0.32	0.88	0.94	0.93	0.65	0.41
IFC77	50	0.5- 4.0	0.5	1.29	1.97	2.35	2.38	2.44	2.30
		1.0-12.0	1.0	0.49	0.36	0.61	0.62	0.63	0.58

Note: The impedance values given are those for minimum tap of each range; the impedance for other taps at pickup current (tap rating) varies inversely (approximately) as the square of the tap rating. For example, an IFC77 60 Hz relay with 0.5 - 4.0 amp range has an impedance of 2.82 ohms on the 0.5 amp tap. The impedance of the 2.0 amp tap is $(0.5/2.0)^2 \times 2.82 =$ 0.176 ohms.

The High-Seismic instantaneous unit burdens are listed in Table IX.

TABLE IX

High-Seismic Inst. Unit (Amps)	Hz	Link Position	Range (Amps)	Min. Pick-up Amps	Burdens at Min. Pickup Min. Tap (Ohms)			Burdens in Ohms (Z) Times Pickup		
					R	J_X	Z	3	10	20
2-50	60	L	2-10	2	0.750	0.650	0.982	0.634	0.480	0.457
		H	10-50	10	0.070	0.024	0.079	0.072	0.071	0.070
6-150	60	L	6-30	6	0.110	0.078	0.135	0.095	0.081	0.079
		H	30-150	30	0.022	0.005	0.023	0.022	0.022	0.022
2-50	50	L	2-10	2	0.625	0.542	0.827	0.528	0.400	0.380
		H	10-50	10	0.058	0.020	0.062	0.060	0.059	0.058
6-150	50	L	6-30	6	0.092	0.065	0.112	0.079	0.068	0.066
		H	30-150	30	0.018	0.004	0.019	0.018	0.018	0.018

CHARACTERISTICS

TIME OVERCURRENT UNIT

Pickup

Pickup in these relays is defined as the current required to close the contacts from the 0.5 time dial position. Current settings are made by means of two movable leads which connect to the tap block at the top of the support structure (see Figure 1). The tap block is marked A through J, A through M or A through N. See the nameplate on the relay for tap settings.

Example: The 2 amp tap for a 1 to 12 IFC77 time overcurrent relay requires one movable lead in position D and the other in position H.

Operating Time Accuracy

The IFC relays should operate within ± 7% or ± the time dial setting times 0.10 second, whichever is greater, of the published time curve. Figures 6-8 and 20-22 show the various time-current characteristics for the IFC relays. The setting of the time dial determines the length of time required to close the contacts for a given current. The higher the time dial setting, the longer the operating time.

The contacts are just closed when the time dial is set to 0. The maximum time setting occurs when the time dial is set to 10 and the disk has to travel its maximum distance to close the contacts.

Reset

The unit resets at 90% of the minimum closing current. Reset times are proportionate to the time dial settings. The time to reset to the number 10 time dial position when the current is reduced to 0 is approximately 60 seconds for the IFC53 and 77 relays. The IFC51 relay will reset in approximately 12 seconds from the same number 10 time dial.

HIGH-SEISMIC INSTANTANEOUS UNIT

The instantaneous unit has a 25 to 1 range with a tapped coil. There are high and low ranges, selected by means of a link located on the top of the support structure. See Figure 1. The time-current curve for the instantaneous unit is shown in Figure 14.

HIGH-SEISMIC TARGET AND SEAL-IN UNIT

The target and seal-in unit has two tap selections located on the front of the unit. See Figure 1.

RECEIVING, HANDLING AND STORAGE

These relays, when not included as part of a control panel, will be shipped in cartons designed to protect them against damage. Immediately upon receipt of

a relay, examine it for any damage sustained in transit. If injury or damage resulting from rough handling is evident, file a damage claim at once with the transportation company and promptly notify the nearest General Electric Sales Office.

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

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

ACCEPTANCE TESTS

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 or of the 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, rating and calibration range of the relay received agree with the requisition.

Remove the relay from its case and check by visual inspection that there are no broken or cracked molded parts or other signs of physical damage.

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 each other.

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 1/64" wipe on the seal-in and the instantaneous 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 button is operated.

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

6. Check that all screws are tight.

CAUTION
SHOULD THERE BE A NEED TO TIGHTEN ANY SCREWS, DO NOT OVERTIGHTEN, TO PREVENT STRIPPING.

DRAWOUT RELAY TESTING

The IFC relays may be tested without removing them from the panel by using the 12XCA11A1 four-point test probes. The 12XCA11A2 four-point test probe makes connections to both the relay and the external circuitry, which provides maximum flexibility but requires reasonable care, since a CT shorting jumper is necessary when testing the relay. The CT circuit may also be tested by using an ammeter instead of the shorting jumper. See the test circuit in Figure 15.

GENERAL POWER REQUIREMENTS

All alternating current (AC) 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 AC devices (relays) will be affected by the applied waveform. Therefore, in order to properly test AC 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 waveforms. Hence a resistance-limited circuit, as shown in Figures 16-18, is recommended.

TIME OVERCURRENT UNIT

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

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 ensure approximately 1/32" wipe.

The minimum current at which the contacts will just close is determined by the tap setting in the tap block at the top of the support structure. See **CHARACTERISTICS** section.

The pickup of the time overcurrent unit for any current tap setting is adjusted by means of a spring-adjusting ring. See Figure 1. The spring-

adjusting ring either winds or unwinds the spiral control spring (see Figure 1). By turning the ring, the operating current of the unit may be brought into agreement with the tap setting employed, if this adjustment has been disturbed. This adjustment also permits any desired setting intermediate between the various tap settings to be obtained. If such adjustment is required, it is recommended that the higher tap be used. It should be noted that the relay will not necessarily agree with the time current characteristics of Figures 6-8 and 20-22 if the relay has been adjusted to pick up at a value other than tap value, because the torque level of the relay has been changed.

Time Setting

The setting of the time dial determines the length of time the unit requires to close the contacts when the current reaches a predetermined value. The contacts are just closed when the time dial is set on 0. When the time dial is set on 10, the disk must travel the maximum amount to close the contacts and therefore this setting gives the maximum time setting.

The primary adjustment for the time of operation of the unit is made by means of the time dial. However, further adjustment is obtained by moving the permanent magnet along its supporting shelf; moving the magnet toward the disk and shaft decreases the time, while moving it away increases the time.

Pickup Test

Set the relay at 0.5 time dial position and the lowest tap. Using the test connections in Figure 16, the main unit should close the contacts within ± 3% of tap value current for 60 Hz relays and within ± 7.5% of tap value current for 50 Hz relays.

Time Test

Set the relay at No. 5 time dial setting and the lowest tap. Using the test connections in Figure 16, apply five times tap current to the relay. The relay operating time to close its contact is listed in Table X.

TABLE X

Relay	Hz	Time (seconds) Min.	Max.
IFC51	50 and 60	1.76	1.80
IFC53	50 and 60	1.28	1.34
IFC77	50 and 60	0.89	0.95

HIGH-SEISMIC INSTANTANEOUS UNIT

Make sure that the instantaneous unit link is in the correct position for the range in which it is to operate. See the Internal Connections Diagram, Figure 5, and connect as indicated in the test circuit of Figure 17. Whenever possible, use the higher range, since the higher range has a higher continuous rating.

Setting the High-Seismic Instantaneous Unit

The instantaneous unit has an adjustable core located at the top of the unit as shown in Figure 1. To set the instantaneous unit to a desired pickup, loosen the locknut and adjust the core. Turning the core clockwise decreases the pickup; turning the core counterclockwise increases 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.

CAUTION
REFER TO TABLE VI FOR THE CONTINUOUS AND ONE-SECOND RATINGS OF THE INSTANTANEOUS UNIT. DO NOT EXCEED THESE RATINGS WHEN APPLYING CURRENT TO THE INSTANTANEOUS UNIT.

The range of the instantaneous unit (see Table VI) must be obtained between a core position of 1/8 of a turn from full clockwise and 20 turns counterclockwise from the full clockwise position. Do not leave the core in the full clockwise position.

HIGH-SEISMIC 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 shippped from the factory with the tap screw in the higher 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 1). 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 the test circuit of Figure 18) to a DC source of proper frequency and good waveform, using an 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.

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	Pickup Current	Dropout Current
0.2	0.12 - 0.20	.05 or more
2.0	1.2 - 2.0	.50 or more

INSTALLATION

The relay should be installed in a clean, dry location, free from dust, and well lighted to facilitate inspection and testing.

The relay should be mounted on a vertical surface. The outline and panel drillings are shown in Figures 23 and 24. Figure 23 shows the semi-flush mounting (necessary for high seismic capability), and Figure 24 shows various methods of surface mounting.

The internal connection diagrams for the relays are shown in Figures 4 and 5. Typical external connections are shown in Figure 9.

INSTALLATION TESTS

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

Time Overcurrent Unit

Set the tap block to the desired tap setting and the time dial to the 0.5 position. Using the test circuit in Figure 16, gradually apply current until the contacts just close. This value of current is defined as pickup, and should be within 3% of tap value for 60 Hz relays and within 7.5% of tap value for 50 Hz relays.

Check the operating time at some multiple of tap value and the desired time dial setting. This multiple of tap value may be 5 times tap rating or the maximum fault current for which the relay must coordinate. This value is left to the discretion of the user.

High-Seismic 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 **ACCEPTANCE TESTS** section.

High-Seismic Instantaneous Unit

1. Select the desired range by setting the link in the proper position (see Figure 1 and the Internal Connections Diagram, Figures 4 and 5). 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 High-Seismic 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 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 following points be checked at an interval of from one to two years.

These tests are intended to ensure 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 pickup test for the tap setting in service, as described in the **INSTALLATION** section.

2. Perform the time tests as described in the **INSTALLATION** section.

HIGH-SEISMIC INSTANTANEOUS UNIT

Check that the instantaneous unit picks up at the desired current level, as outlined in the **ACCEPTANCE TESTS** section.

HIGH-SEISMIC TARGET AND SEAL-IN UNIT

1. Check that the unit picks up at the values shown in Table XI.

2. Check that the unit drops out at 25% or more of tap value.

CONTACT CLEANING

For cleaning fine silver relay contacts, a flexible burnishing tool should be used. This consists of an etched-roughened strip of flexible metal, resembling a superfine file. The polishing action is so delicate that no scratches are left, yet it will clean off any corrosion thoroughly and rapidly. The flexibility of the tool insures the cleaning of the actual points of contact. Never use knives, files, or abrasive paper or cloth of any kind to clean fine silver contacts. A burnishing tool as described above can be obtained from the factory.

COVER CLEANING

The clear Lexan® cover should be cleaned with a soft cloth and water only. Cleaning solutions should not be used.

SYSTEM TEST

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

SYSTEM TEST

Although this instruction book is primarily written to check and set the IFC 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:

Pickup Tests

Rotate time dial to No. 0 time dial setting and check by means of a lamp 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 setting, there should be sufficient gap between the stationary contact brush and its metal backing strip to ensure approximately 1/32" wipe.

The pickup of the unit for any current tap setting is adjusted by means of a spring-adjusting ring. By turning the ring, the operating current of the unit may be brought into agreement with the tap setting employed, if for some reason this adjustment has been disturbed. This adjustment also permits any desired setting intermediate between the various tap settings to be obtained. If such adjustment is required, it is recommended that the higher tap setting be used. It should be noted that the relay will not necessarily agree with the time-current characteristics of Figures 6-8 and 20-22 if the relay has been adjusted to pick up at a value other than tap value, because the torque level of the relay has been changed.

Connect the operating coil terminals to a source of the proper frequency and good waveform having a voltage of 110 or more, with resistance load boxes for setting the current (see Test circuit of Figure 16).

With the tap block set for the lowest tap and the time dial set where contacts are just open, adjust the control spring to just close the contacts within the limits given in Table XII, which are ± 1% of the tap amps.

TABLE XII

Tap Range	Tap	Min. Amps	Max. Amps
0.5 - 4	0.5	.495	.505
1.0 - 12.0	1.0	.99	1.01

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

Time Tests

With the tap block set for the lowest tap and the time dial at No. 5 setting, apply 5 times tap current to the relay.

Adjust the position of the drag magnet assembly to obtain an operating time as listed in Table XIII.

TABLE XIII

Relay	Time (Seconds) Min.	Max.
IFC51	1.76	1.80
IFC53	1.29	1.33
IFC77	0.90	0.94

It would be preferable to adjust the operating time as nearly as possible to 1.78, 1.31 or 0.92 seconds. The drag magnet assembly should be approximately in the middle of its travel. The drag magnet assembly is adjusted by loosening the two screws securing it to the support structure (see Figure 1). Moving the drag magnet towards the disk and shaft decreases the operating time and moving the drag magnet away from the disk and shaft increases the operating time. The screws securing the drag magnet assembly to the support structure must be tight before proceeding with other time checks.

Mechanical Adjustment

The disk does not have to be in the exact center of either air gap for the relay to perform correctly. Should the disk not clear all gaps, however, the following adjustment can be made.

1. Determine which way the disk must be aligned to clear all gap surfaces by 0.010 inch.

2. Remove the drag magnet assembly by loosening the two screws securing it to the support structure. The screws need not be removed.

3. Loosen the upper pivot bearing set screw (1/16" hex wrench) slightly, so the upper pivot can move freely. Do not remove the set screw from the support structure.

4. Loosen the jewel bearing set screw as in 3 above.

5. Apply a slight downward finger pressure on the upper pivot and turn the jewel bearing screw, from the underside of the support structure, to position the disk as determined in 1 above.

6. Turn the jewel bearing screw 1/8 turn clockwise and tighten the upper pivot set screw to 2.5 - 3.5 inch pounds of torque.

7. Turn the jewel bearing screw 1/8 turn counterclockwise. This will lower the disk and shaft assembly approximately 0.005" and permit proper end-play. The shaft must have 0.005 - 0.010" of end-play.

8. Tighten the jewel bearing set screw to 2.5 - 3.5 inch pounds of torque.

9. Rotate the disk through the electromagnet gap. The disk could clear the gap surfaces by 0.010" and be within 0.005" flatness. If the disk is not within 0.005" flatness, the disk should be replaced.

10. Reinstall the drag magnet assembly and check that the disk has at least 0.010" clearance from the drag magnet assembly surfaces.

11. Tighten the drag magnet assembly mounting screws with 7-10 inch pounds of torque, after securely seating the assembly and positioning it according to the Time Test above (page 18).

HIGH-SEISMIC 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 1/64" wipe on the contacts. Check this by inserting a 0.010" feeler gage between the front half of the shaded pole and the armature when held closed. Contacts should close with feeler gage in place.

4. Since mechanical adjustments may affect the Seismic Fragility level, it is advised that no mechanical adjustments be made if seismic capability is of concern.

HIGH-SEISMIC TARGET AND SEAL-IN UNIT

Check 1 and 2 as described under INSTANTANEOUS UNIT.

To check the wipe of the seal-in unit, insert a 0.010" feeler gage between the plastic residual of the armature and the pole piece with the armature held closed. Contacts should close with feeler gage in place. Since mechanical adjustments may affect the Seismic Fragility level, it is advised that no mechanical adjustments be made if seismic capability is of concern.

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 give complete model number of the relay for which the part is required. If possible, give the General Electric requisition number on which the relay was furnished.

Since the last edition, changes have been made in Table IX and Figures 23 & 4.

TABLE II (SEE PAGE 6)

12IFC51
TAPS AVAILABLE

0.5	0.6	0.7	0.5	1	1.2	1.5	2	2.5	3	4
A/M	A/L	B/L	B/K	C/K	C/J	D/J	D/H	E/H	E/G	F/G

1	1.2	1.5	2	2.5	3	4	5	6	7	8	10	12
A/N	B/N	B/M	C/M	C/L	D/L	D/K	E/K	E/J	F/J	G/J	F/H	G/H

12IFC53
TAPS AVAILABLE

0.5	0.6	0.7	0.5	1	1.2	1.5	2	2.5	3	4
A/J	A/H	A/G	A/F	A/E	A/D	B/E	B/D	A/C	A/B	E/F

1	1.2	1.5	2	2.5	3	4	5	6	7	8	10	12
A/J	D/J	G/J	A/H	B/H	A/G	F/H	A/E	A/D	B/F	A/C	A/B	D/F

12IFC77
TAPS AVAILABLE

0.5	0.6	0.7	0.5	1	1.2	1.5	2	2.5	3	4
A/J	A/N	A/G	A/F	A/E	A/D	E/M	A/C	A/B	C/D	E/F

1	1.2	1.5	2	2.5	3	4	5	6	7	8	10	12
A/J	D/J	A/H	D/H	A/G	H/J	A/F	A/E	A/D	F/G	A/C	A/B	D/F

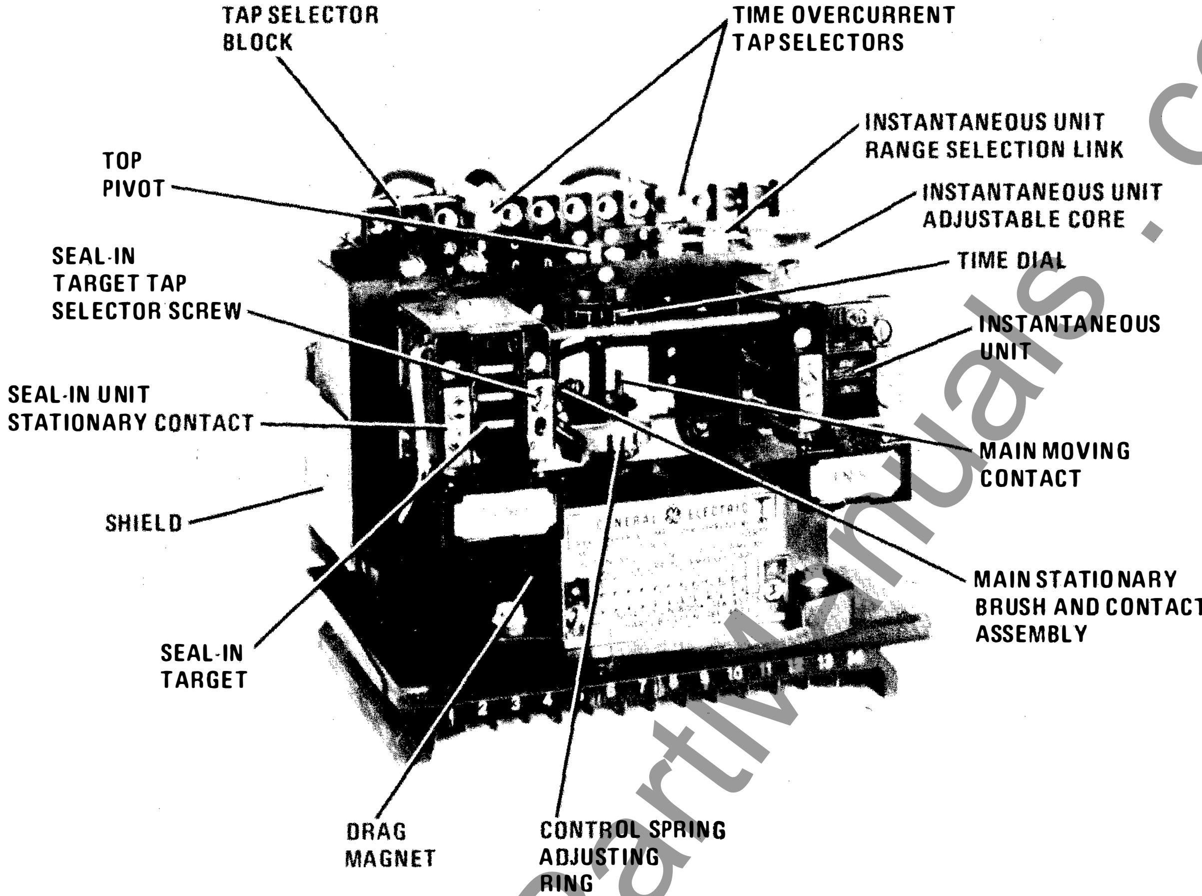


Figure 1 (8042708) Type IFC53B Relay, Removed from Case, Front View

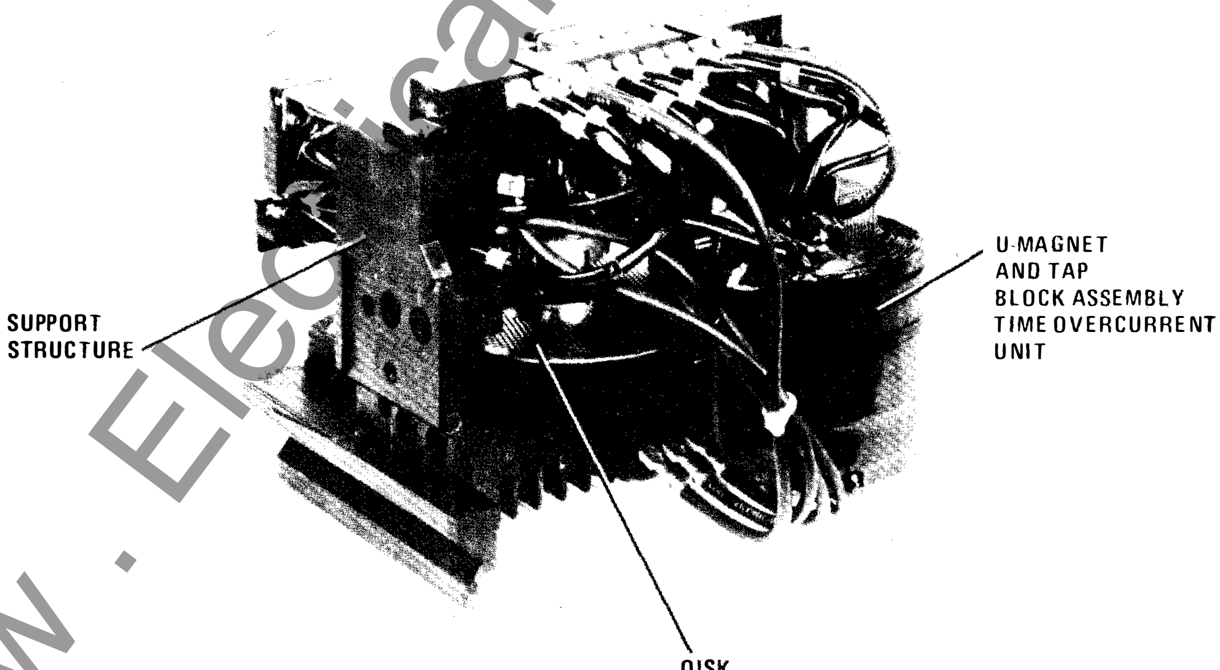


Figure 2 (8042711) Type IFC53B Relay, Removed from Case, Rear View

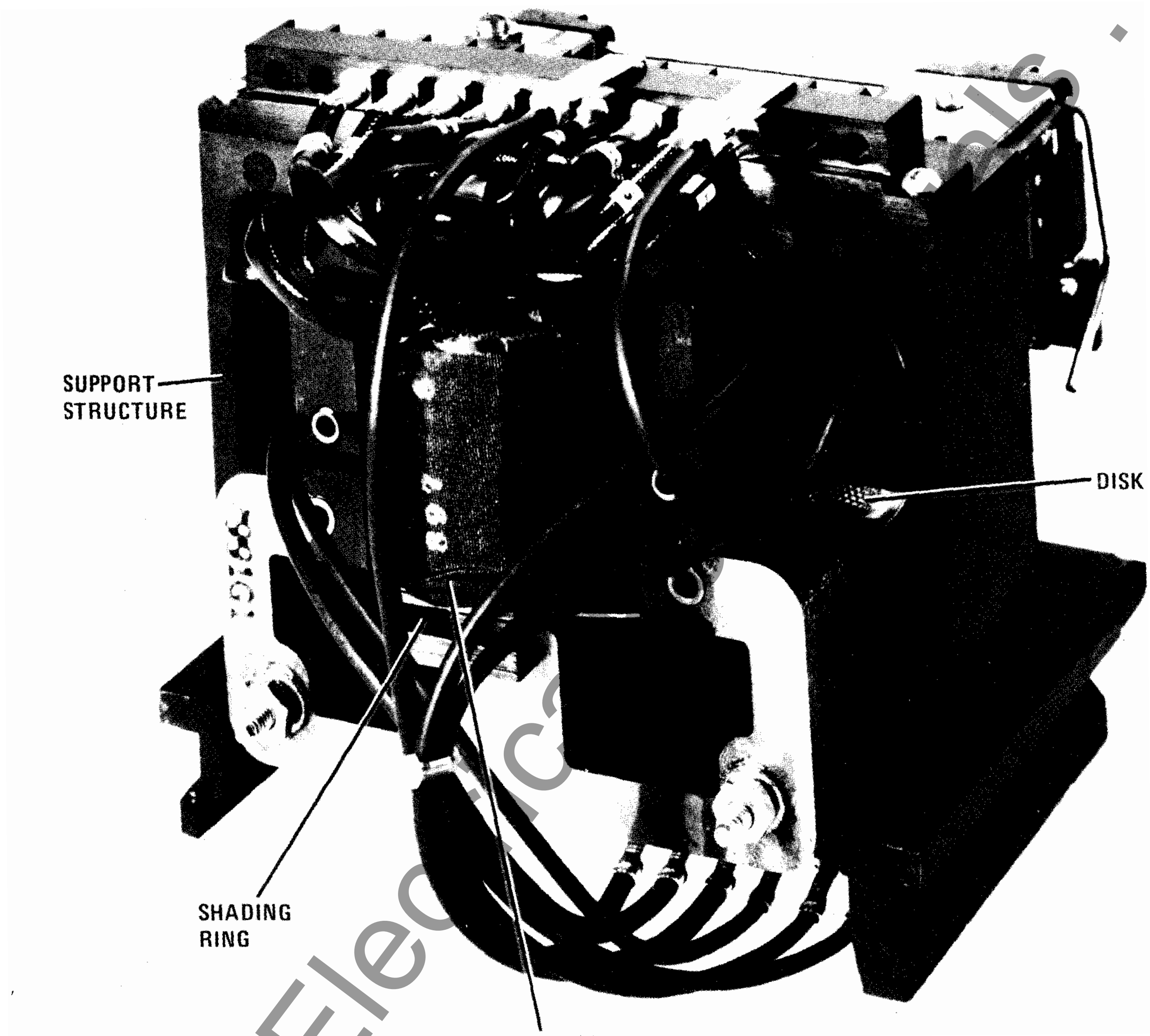
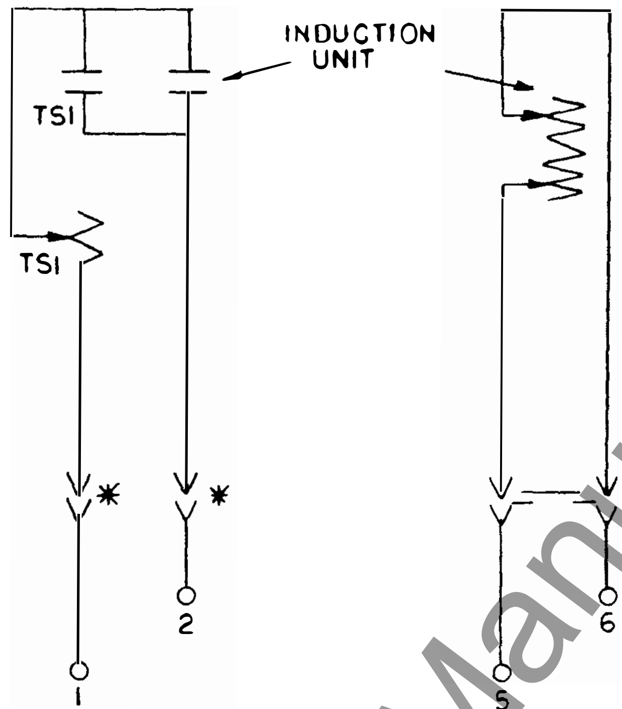
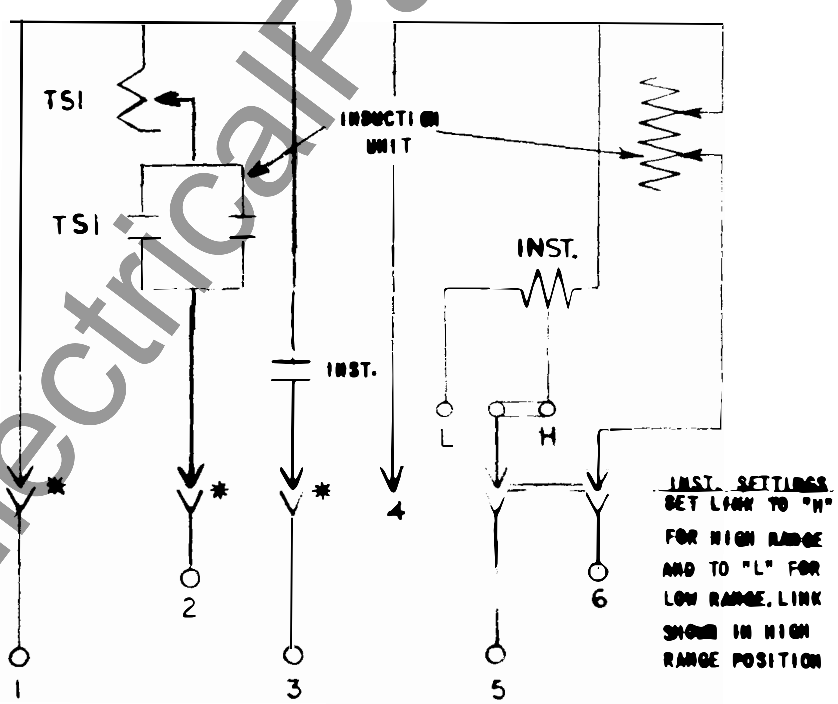


Figure 3 (8042750) Type IFC77B Relay, Removed from Case, Rear View



✱ = SHORT FINGER

Figure 4 (0257A8339-5) Internal Connections for Relay Types IFC51A, IFC53A and IFC77A - Front View



✱ = SHORT FINGER

Figure 5 (0257A8340-5) Internal Connections for Relay types IFC51B, IFC53B and IFC77B - Front View

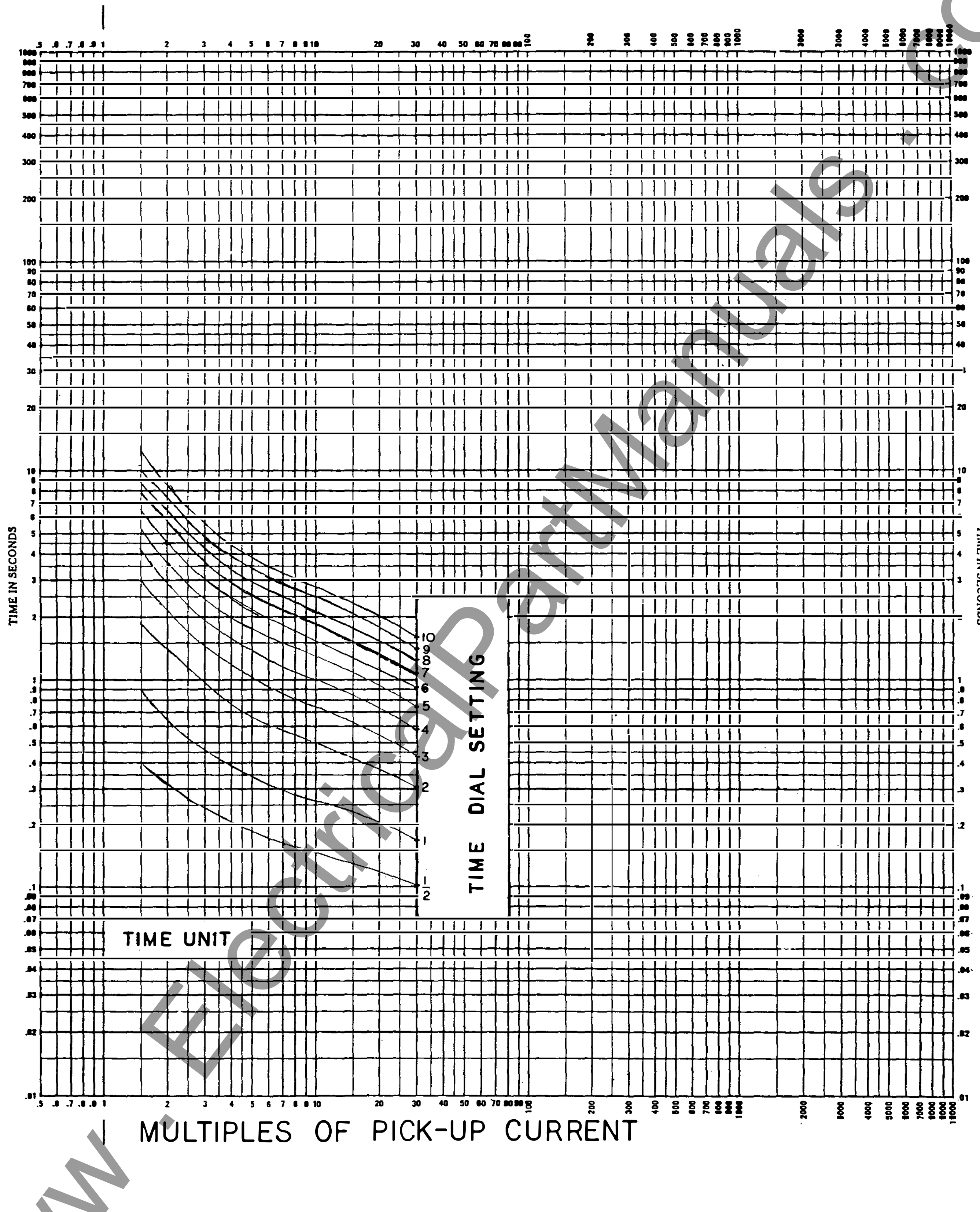


Figure 6 (0108B8943-2) 60 Hertz Time-Current Characteristics for Relay Types IFC51A and IFC51B

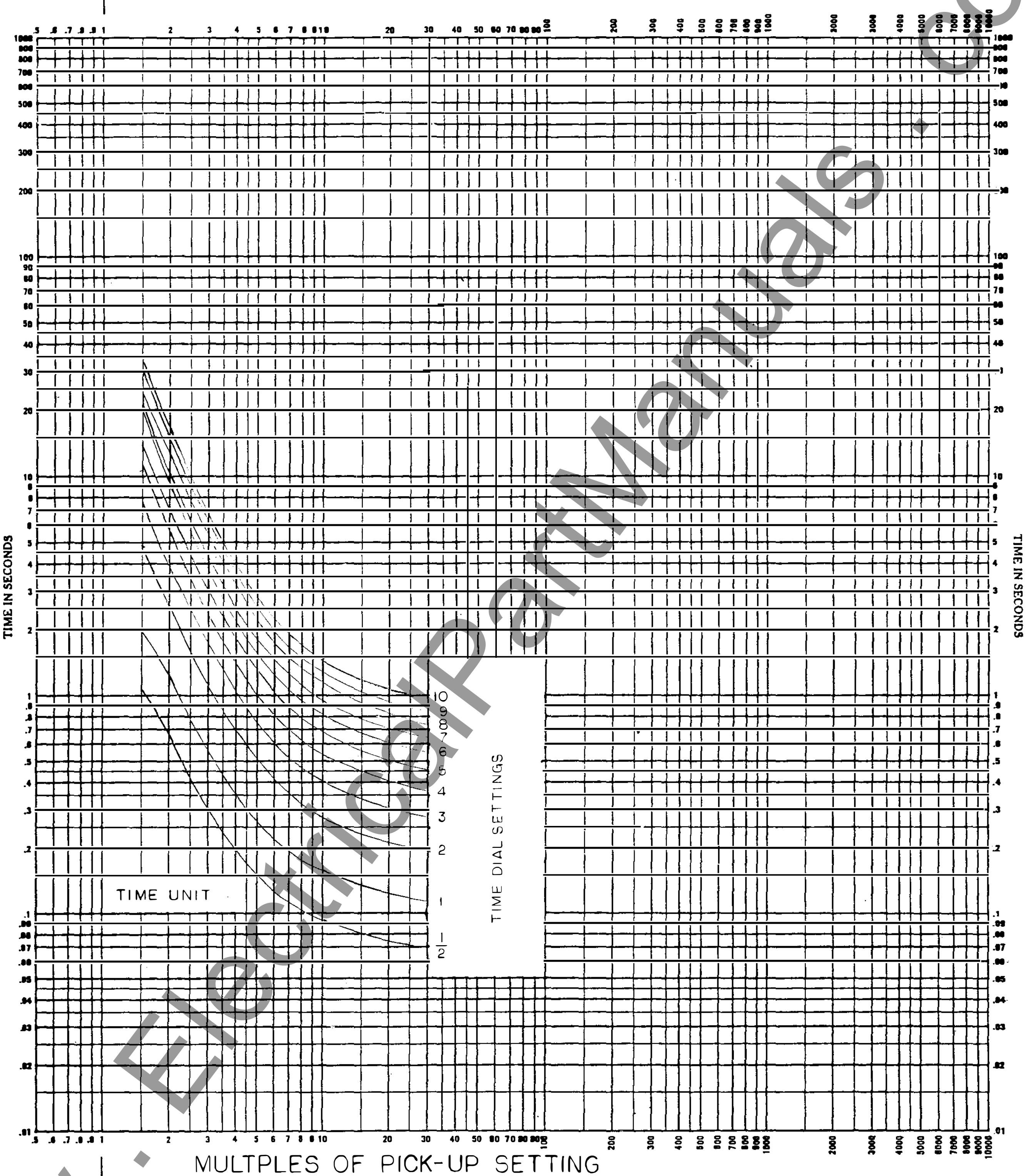


Figure 7 (0108B8944-3) 60 Hertz Time-Current Characteristics for Relay Types IFC53A and IFC53B

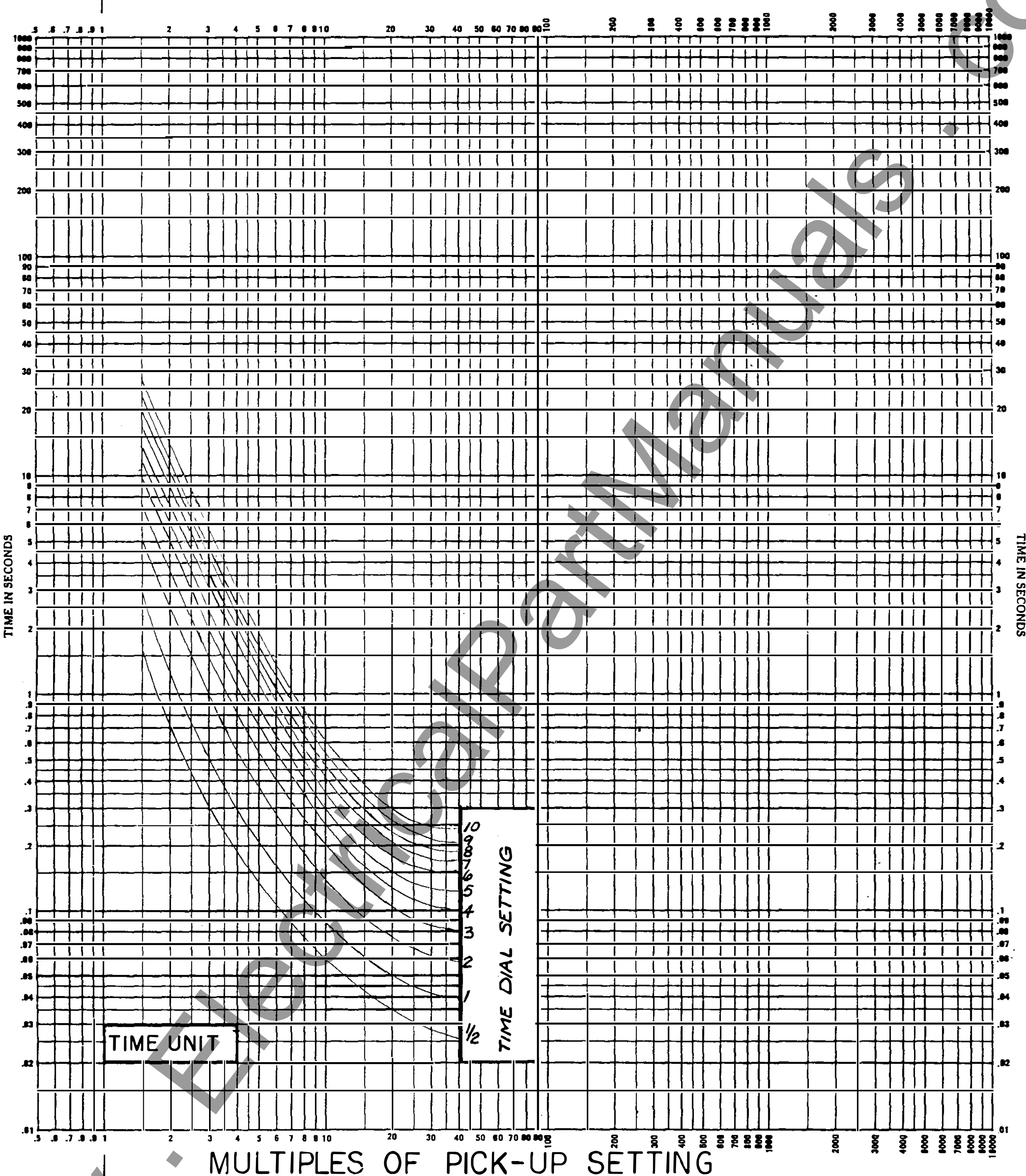


Figure 8 (0108B8945-2) 60 Hertz Time-Current Characteristics for Relay Types IFC77A and IFC77B

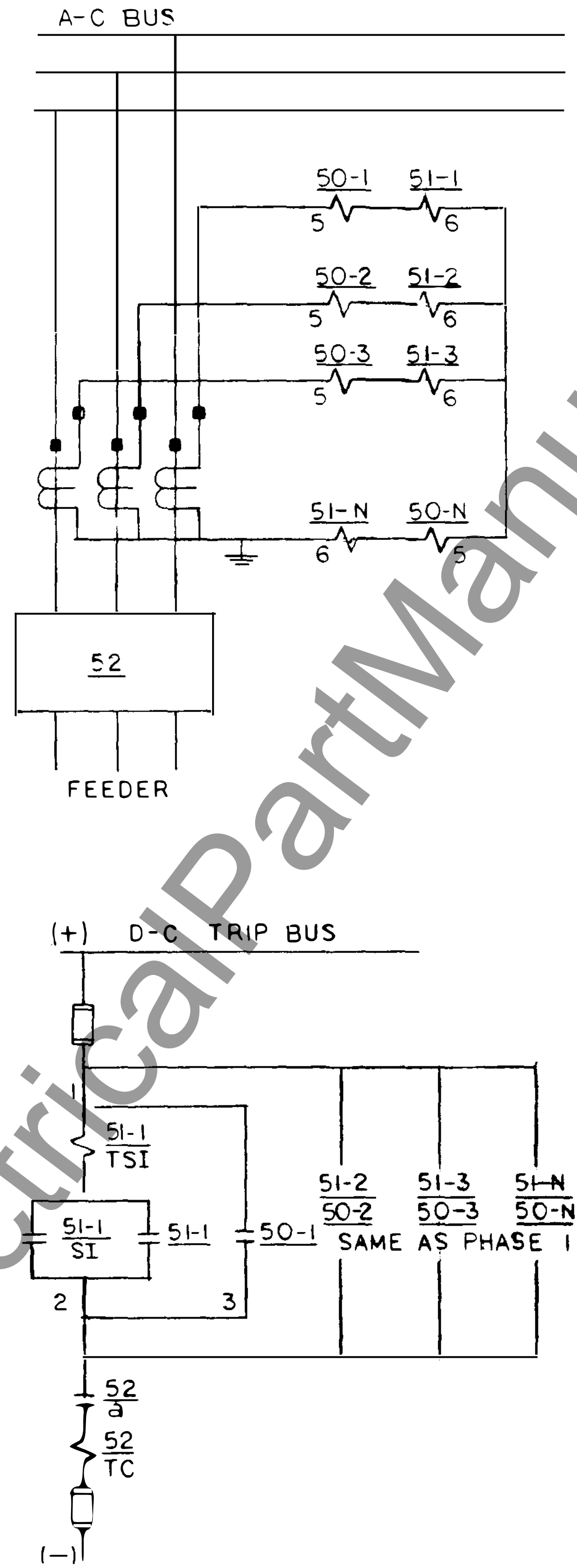


Figure 9 (0257A9647-0) External Connections of Four IFC Relays Used for Multi-Phase and Phase-to-Ground Fault Protection of a 3-Phase Circuit

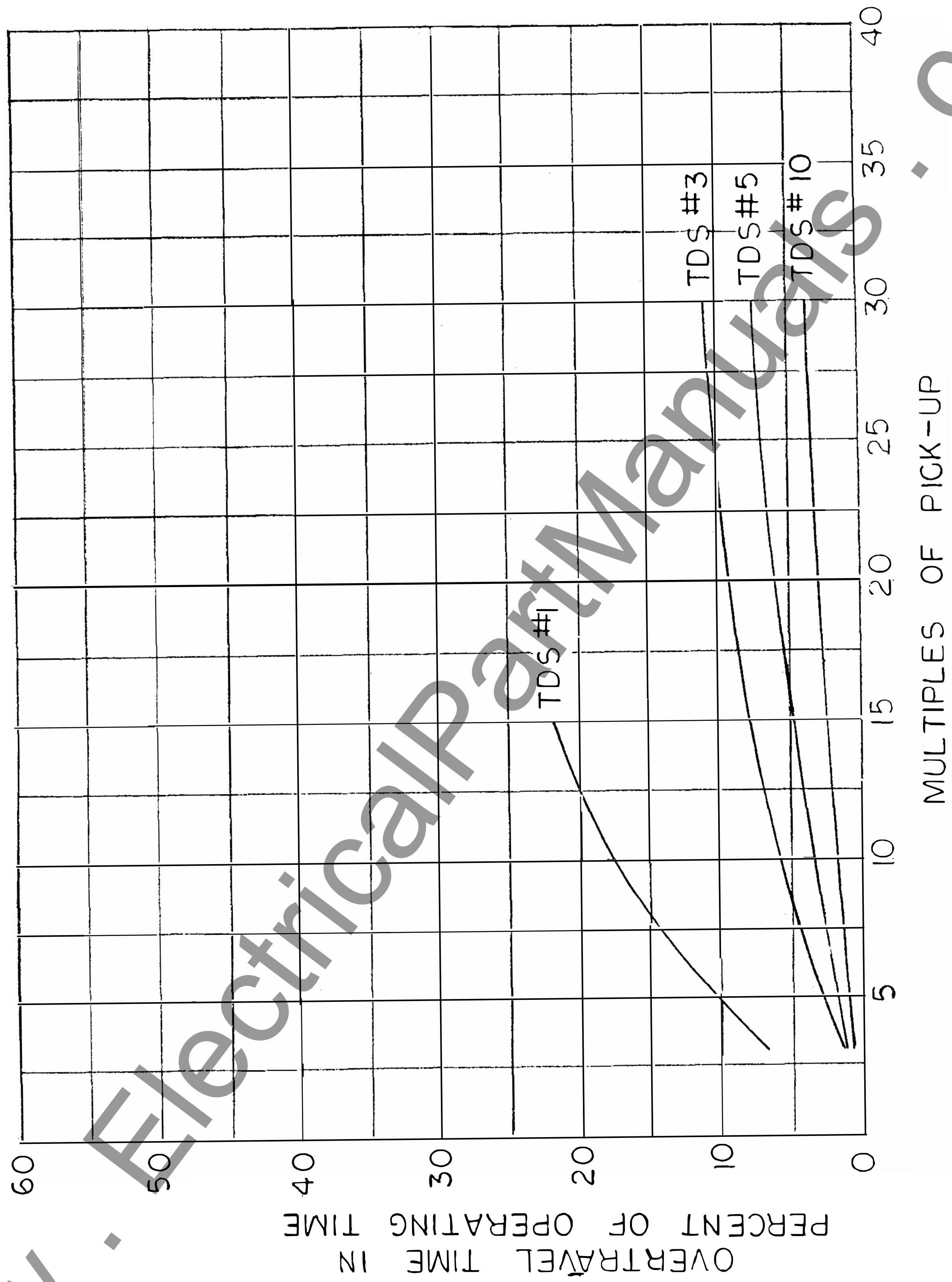


Figure 10 (0257A8594-2) Overtravel Curves for Relay Type IFC51

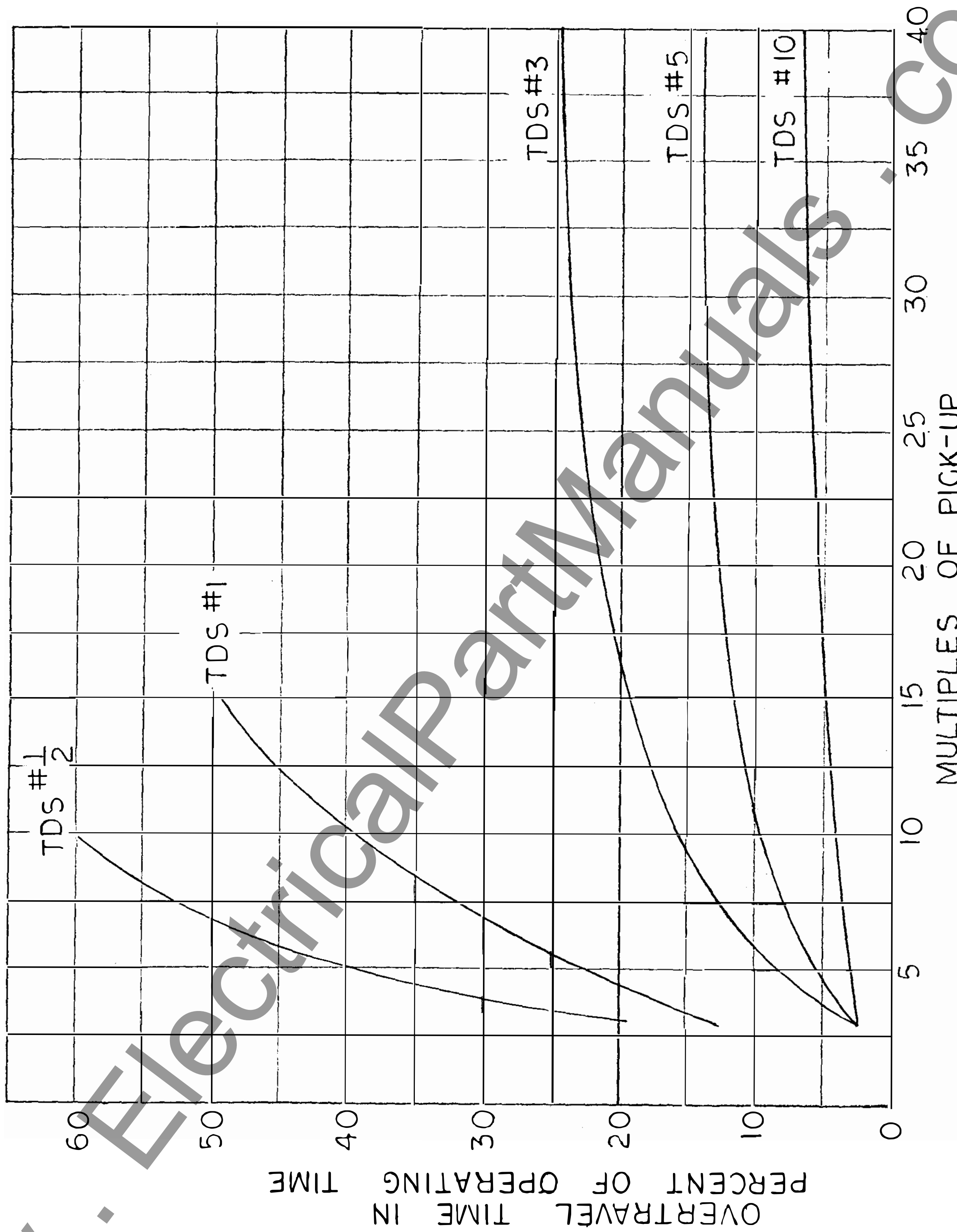


Figure 11 (0257A8595-2) Overtravel Curves for Relay Type IFC53

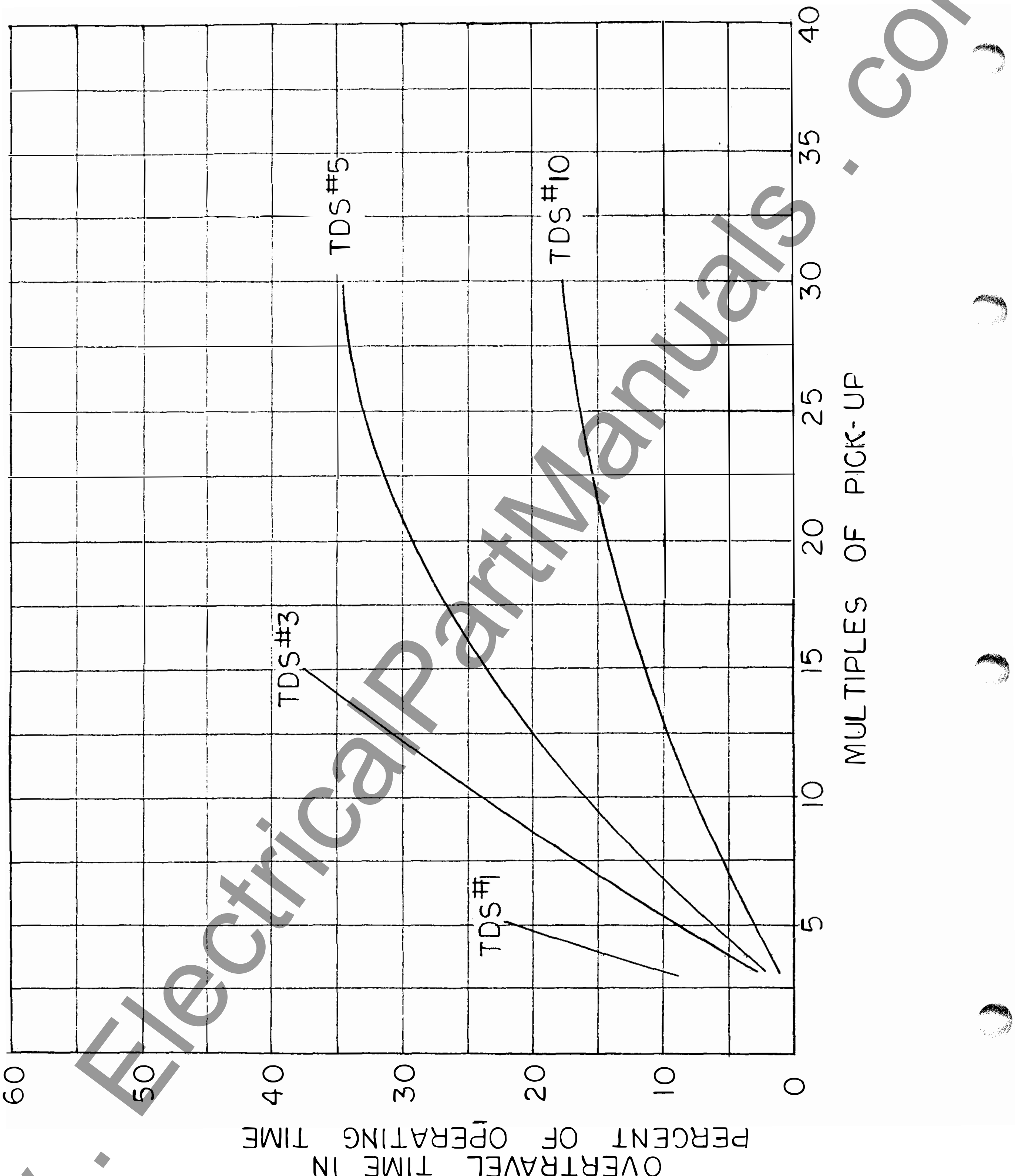


Figure 12 (0257A8596-2) Overtravel Curves for Relay Type IFC77

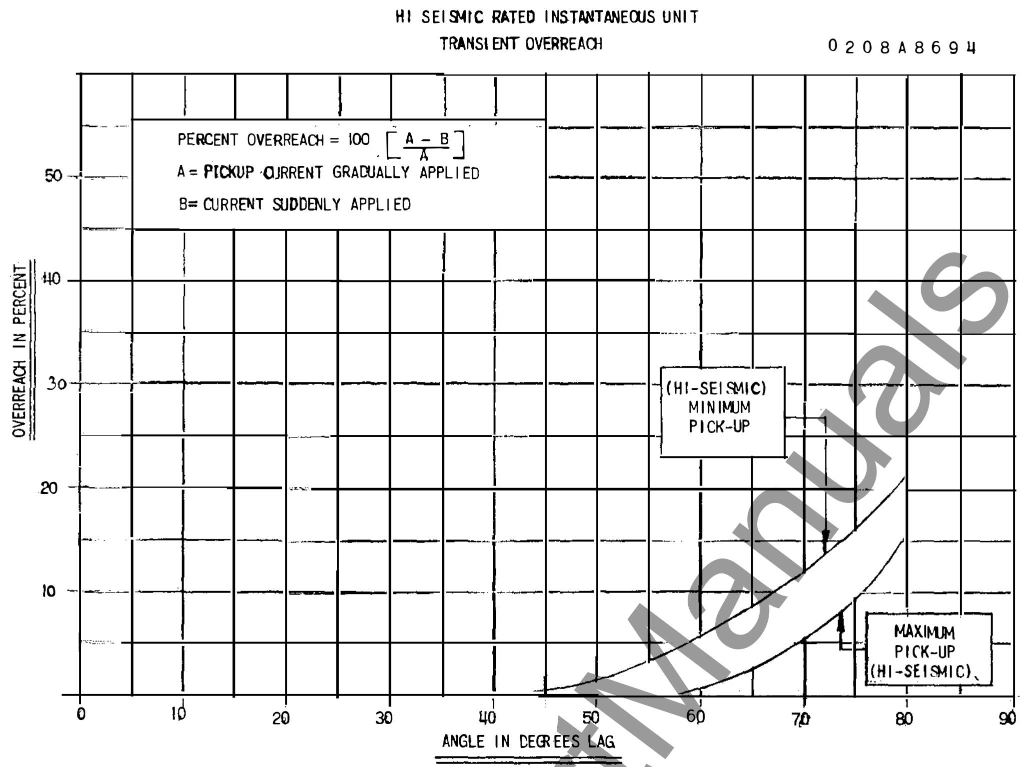


Figure 13 (0208A8694-2) Transient Overreach Characteristics of the High-Seismic Instantaneous Unit

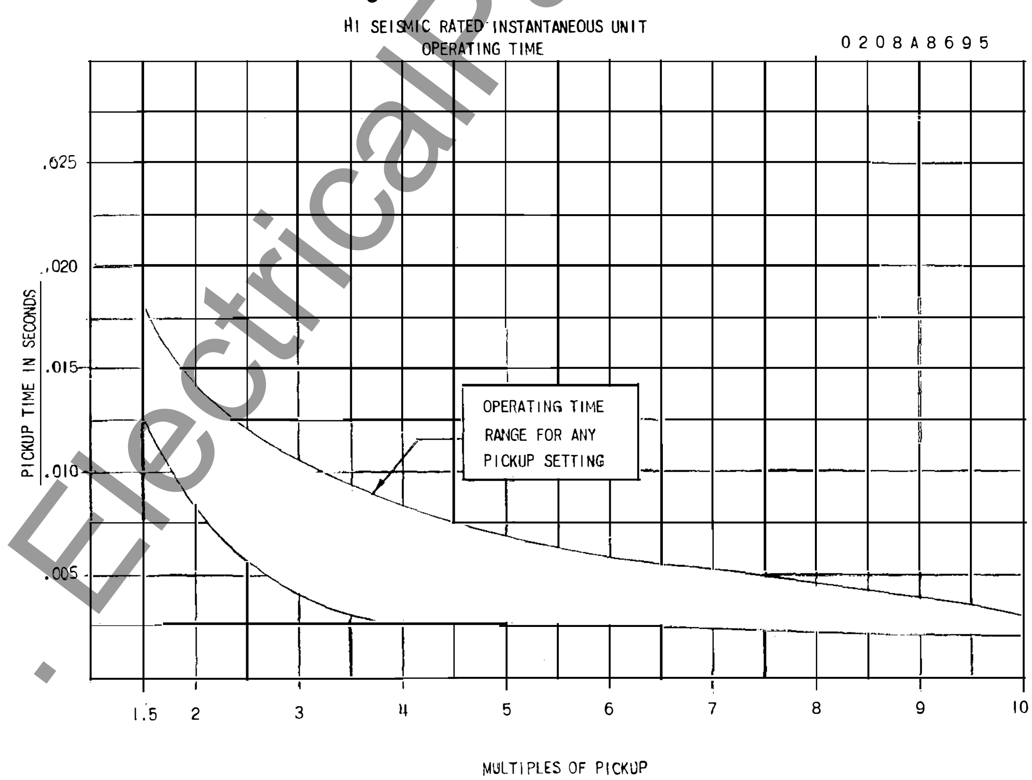


Figure 14 (0208A8695-1) Time-Current Characteristics of the High-Seismic Instantaneous Unit

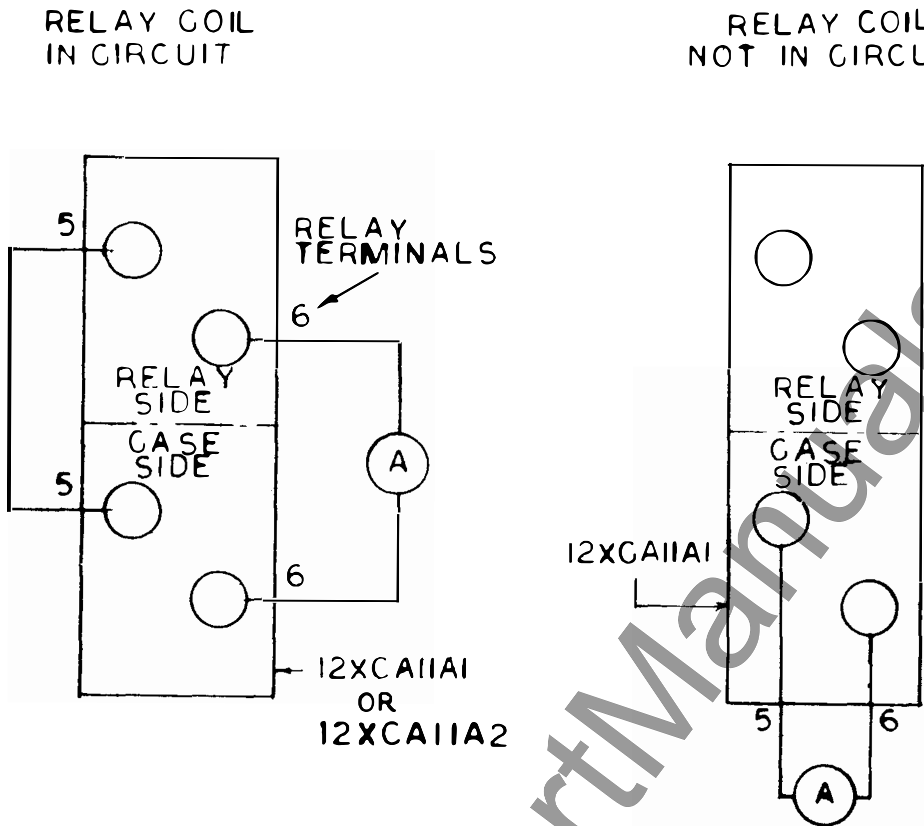


Figure 15 (0269A1787-1) Test Connections
for Testing CT Secondary Used with the IFC Relay

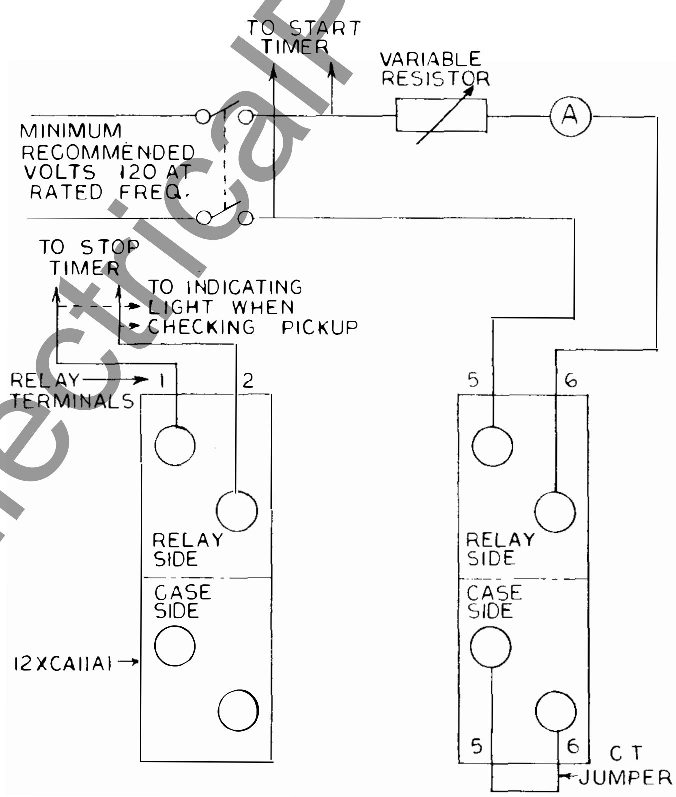


Figure 16 (0269A1789-0) Test Connections for Testing Pickup and Operating Times
of the IFC Relay Time Overcurrent Unit

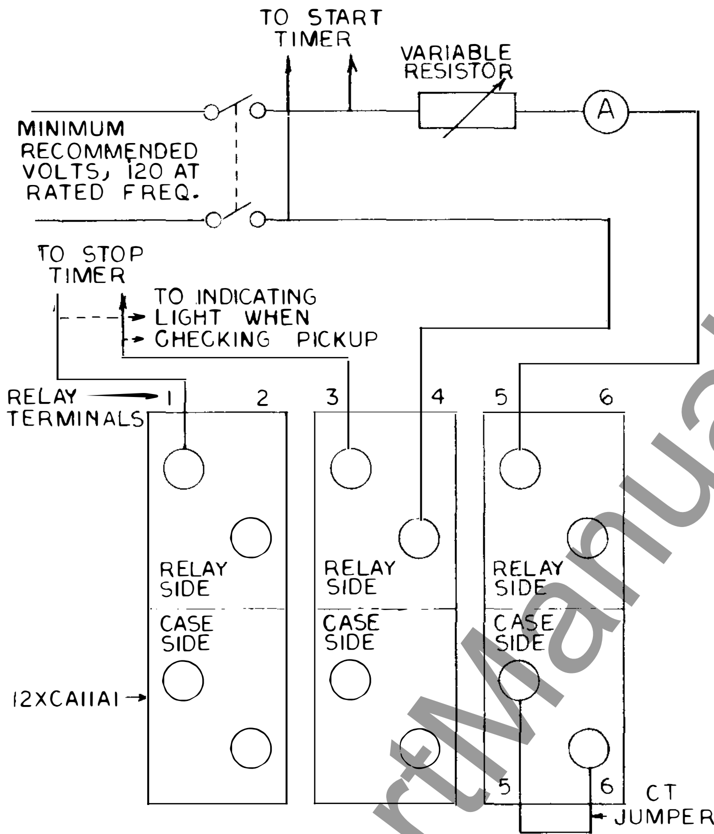
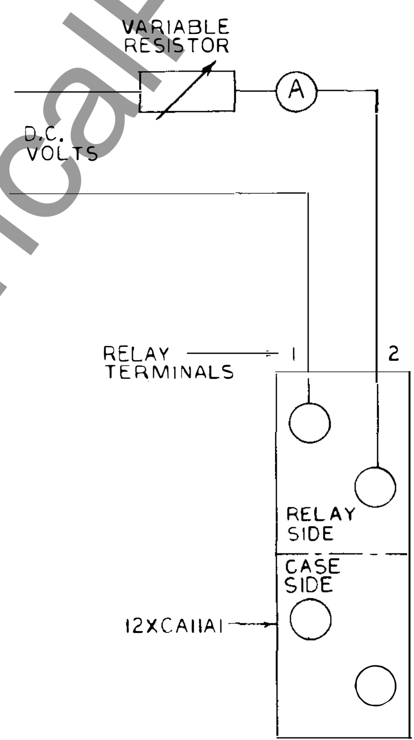


Figure 17 (0269A1788-1) Test Connections for Testing Pickup and Operating Times of the IFC Relay High-Seismic Instantaneous Unit



igure 18 (0269A1790-0) Test Connections for Testing the High-Seismic Target and Seal-in Unit Used with the IFC Relay

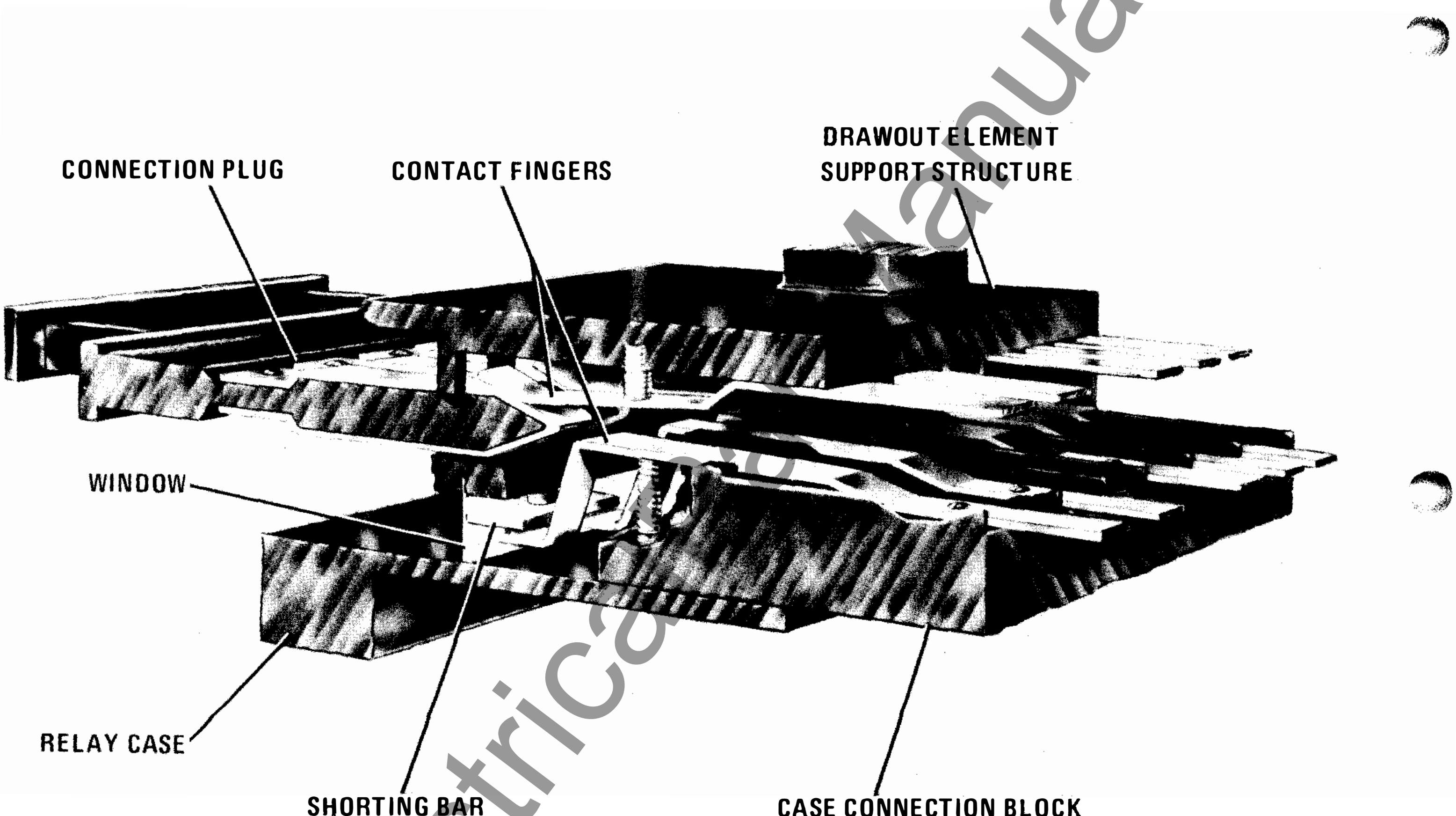


Figure 19 (8042715) Cross Section of IFC Drawout Case Showing Shorting Bar

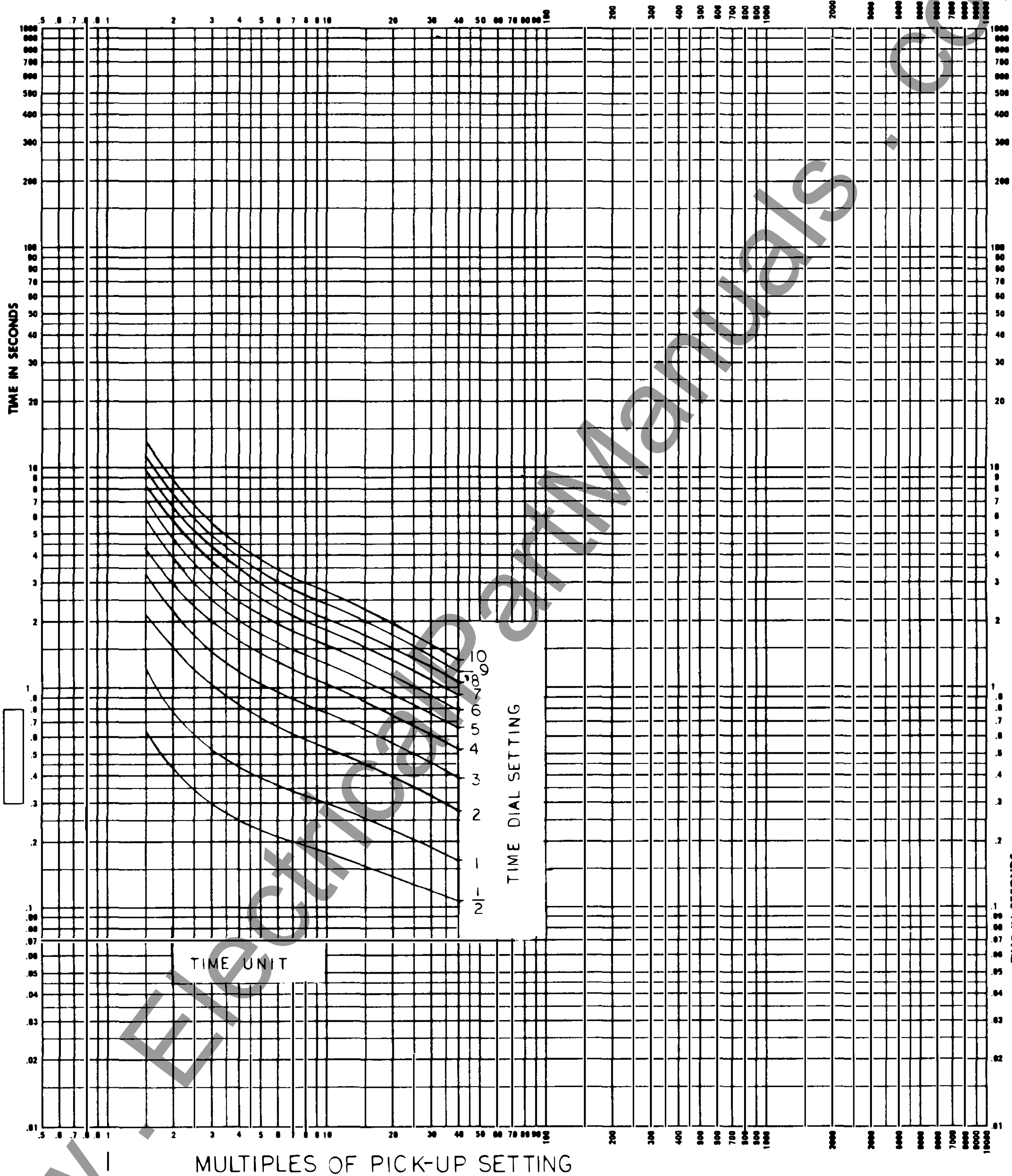


Figure 20 (0108B8973-0) 50 Hertz Time-Current Characteristics for Relay Types IFC51A and IFC51B

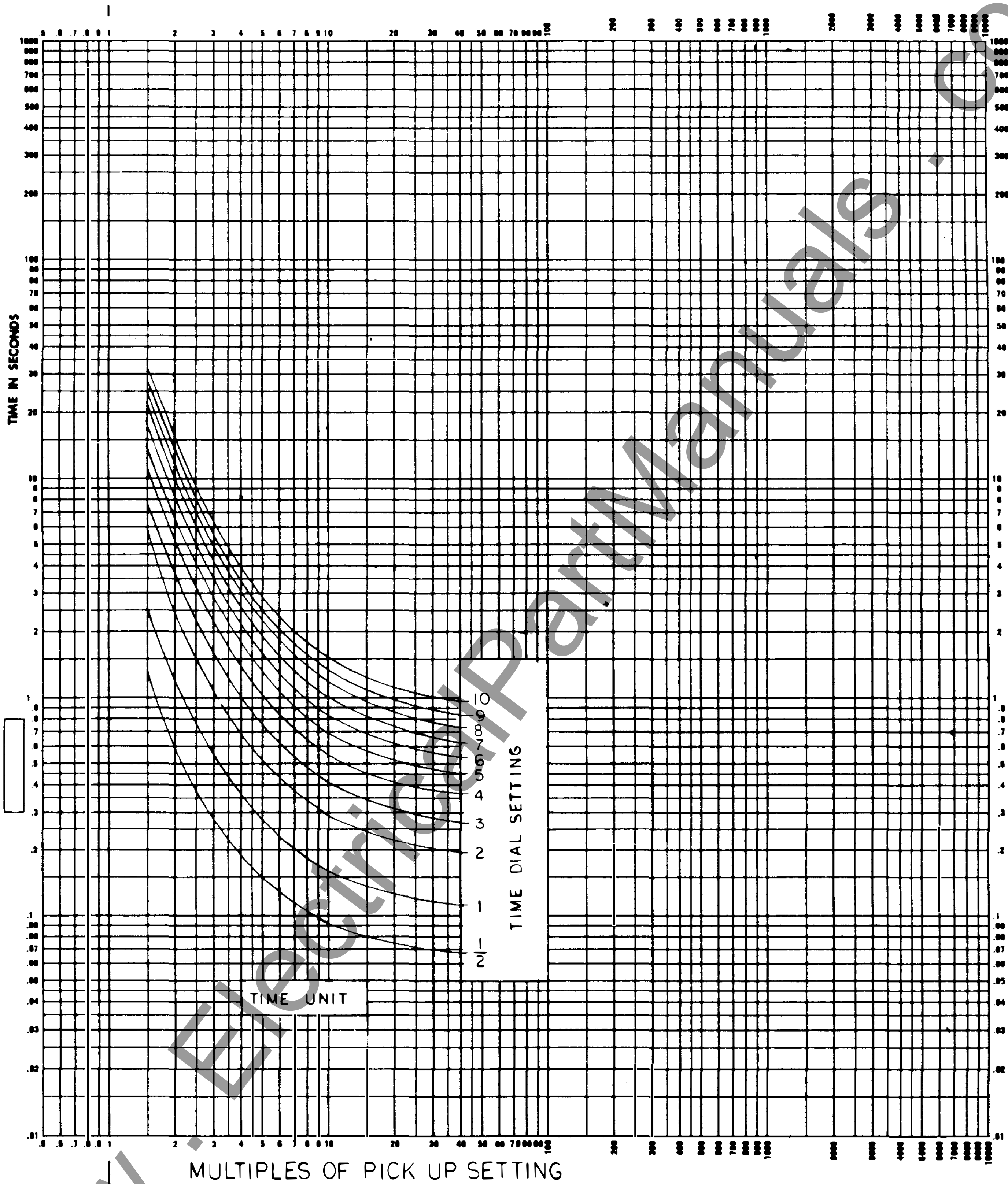


Figure 21 (0108B8974-0) 50 Hertz Time-Current Characteristics for Relay Types IFC53A and IFC53B

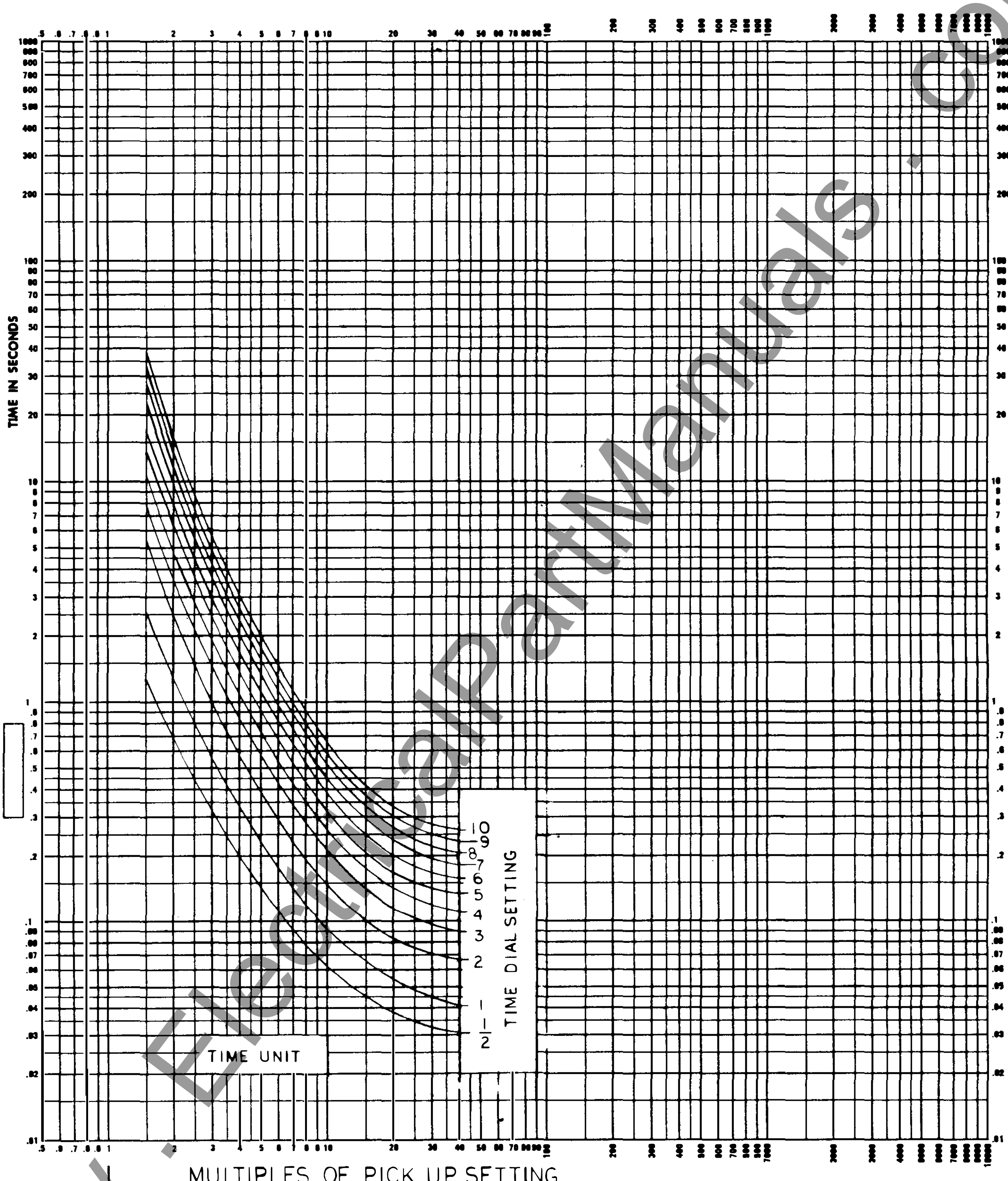


Figure 22 (0108B8975-0) 50 Hertz Time-Current Characteristics for Relay Types IFC77A and IFC77B

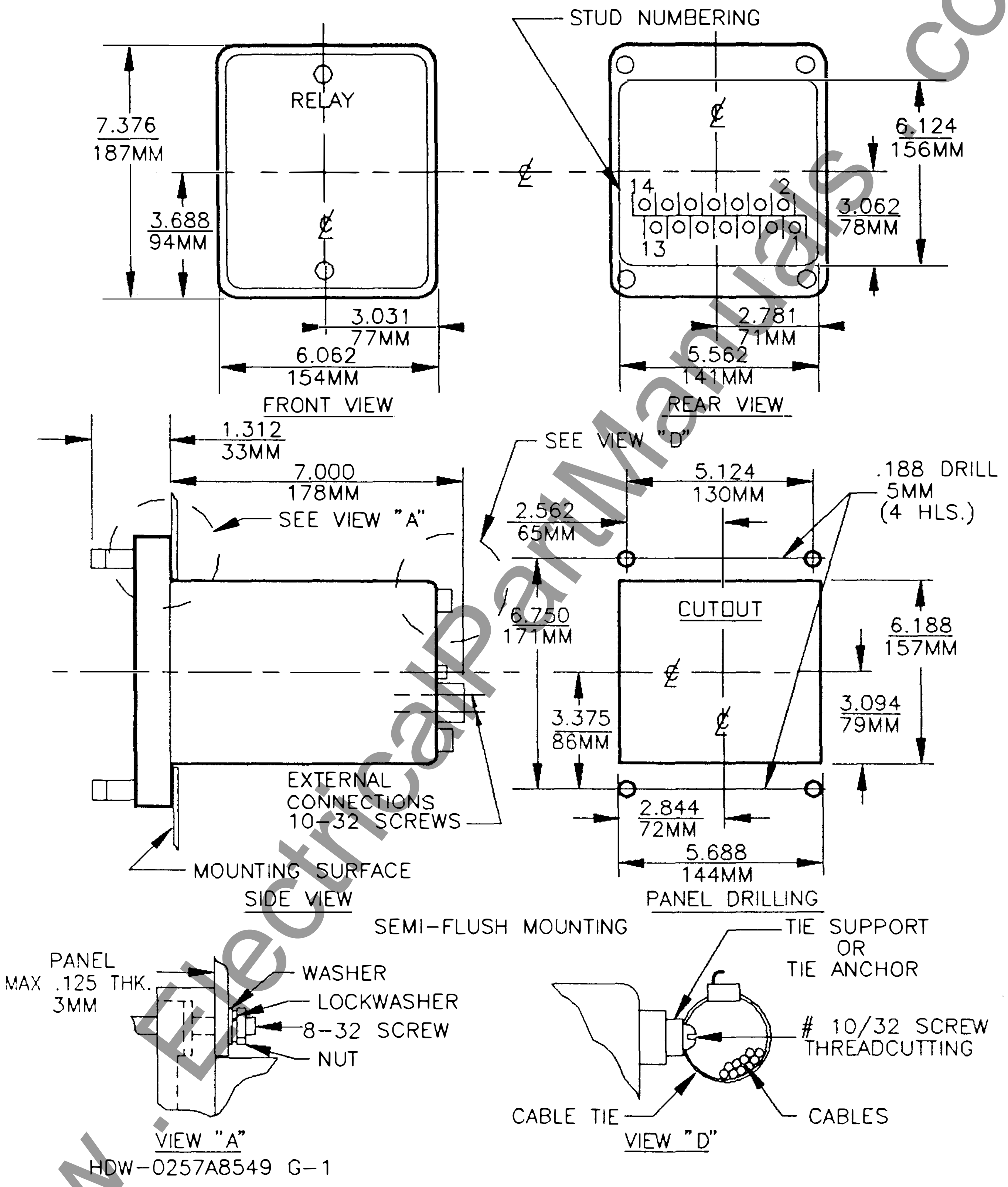


Figure 23 (0257A8452 Sheet 1 [5]) Outline & Panel Drilling for Semi-Flush Mounting of Relay Types IFC51, IFC53 and IFC77

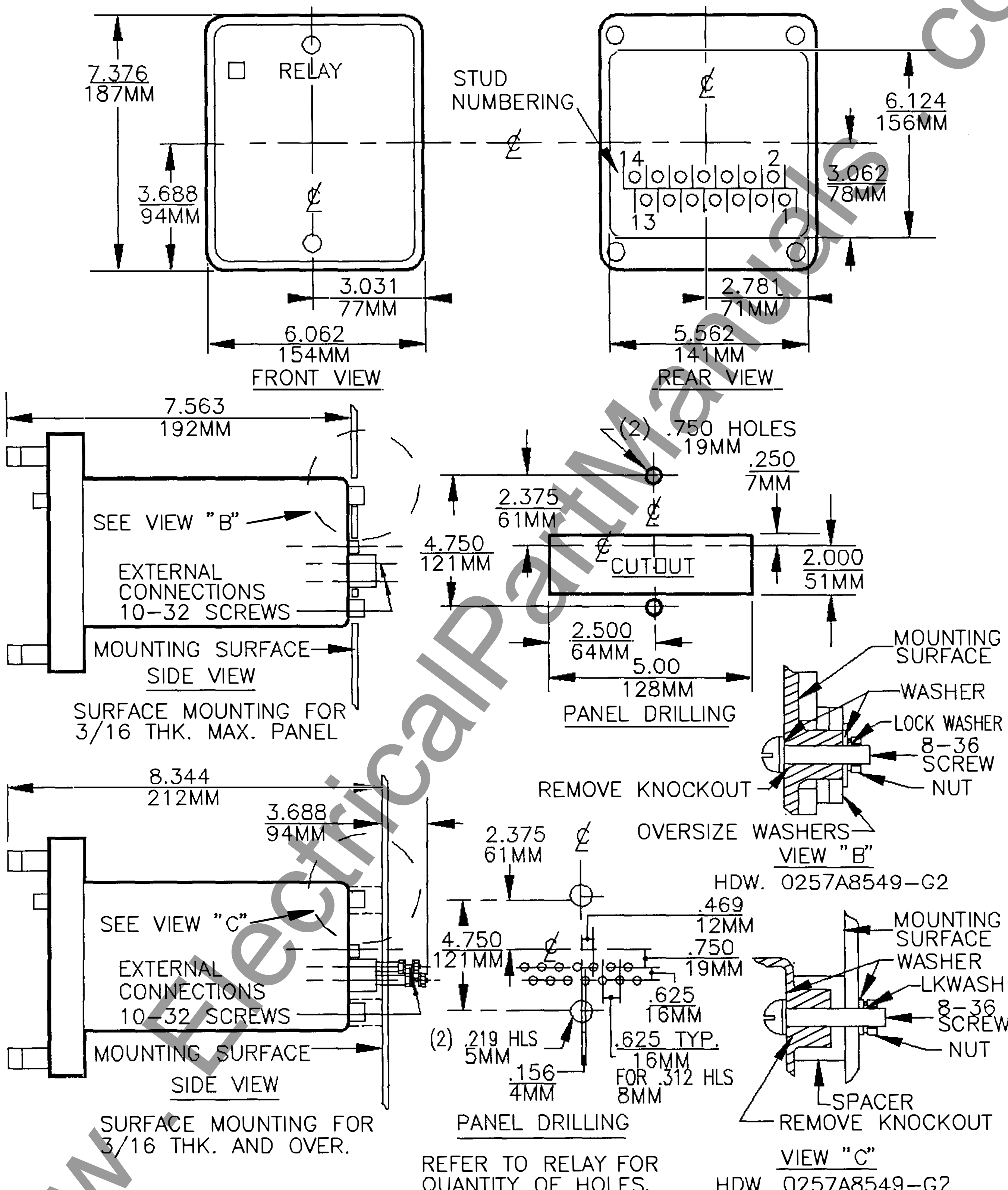


Figure 24 (0257A8452 Sheet 2 [5]) Outline & Panel Drilling for Surface Mounting of Relay Types IFC51, IFC53 and IFC77

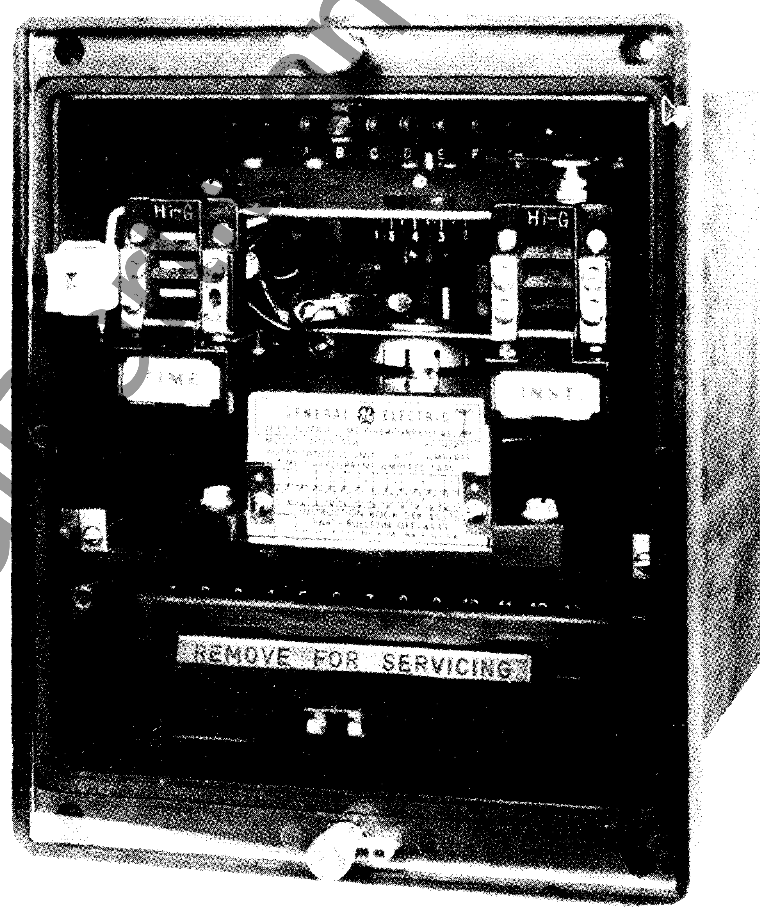
LIST OF FIGURES

Protection and Control
Business Department

(10/93) (200)

General Electric Company
205 Great Valley Parkway
Malvern, Pennsylvania 19355-1337

INSTRUCTIONS



TIME OVERCURRENT RELAYS

Types

IFC51A and 51B

IFC53A and 53B

IFC77A and 77B

GE Protection and Control
205 Great Valley Parkway
Malvern, PA 19355-1337

CONTENTS

TIME OVERCURRENT RELAYS
TYPES
IFC51A and 51B
IFC43A and 53B
IFC77A and 77B

DESCRIPTION

The type IFC relays covered by these instructions are extended range, single phase, time overcurrent relays. The various time-current characteristics available are as follows:

IFC51A, IFC51B - Inverse time
IFC53A, IFC53B - Very inverse time
IFC77A, IFC77B - Extremely inverse time

The IFC51B, 53B and 77B relays also include a hinged-armature instantaneous overcurrent unit, which provides instantaneous tripping at high current levels. The instantaneous unit is not included in the IFC51A, 53A or 77A relays. Both the time overcurrent unit and the instantaneous overcurrent unit are described in detail in the section on **CONSTRUCTION.** Each relay is equipped with a dual-rated target and seal-in unit.

When semiflush mounted on a suitable panel, these relays have a high seismic capability, including both the target seal-in unit and the instantaneous overcurrent unit when it is supplied. Also, these relays are recognized under the Components Program of Underwriters Laboratories, Inc.

The relay is mounted in a size C1 drawout case of molded construction. The outline and panel drilling are shown in Figures 23 and 24. The relay internal connections are shown in Figure 4 for the IFC51A, 53A and 77A, and in Figure 5 for the IFC51B, 53B and 77B.

APPLICATION

Time overcurrent relays are used extensively for the protection of utility and industrial power distribution systems and frequently for overload backup protection at other locations. The EXTREMELY INVERSE time charactersistics, Figures 10 and 22, of the IFC77A and 77B relays are designed primarily for use where they are required to coordinate rather closely with power fuses, distribution cutouts and reclosers. They also provide maximum tolerance to allow for cold load pickup such as results from an extended service outage, which results in a heavy accumulation of loads of automatically controlled devices such as refrigerators, water heaters, water pumps, oil burners, etc. Such load accumulations often produce inrush currents considerably in excess of feeder full load current for a short time after the feeder is energized.

The EXTREMELY INVERSE time characteristic often permits successful pickup of these loads and at the same time provides adequate fault protection.

The VERY INVERSE time characteristics, Figures 7 and 21, of the IFC53A and 53B relays are likely to provide faster overall protection in applications where the available fault current magnitude remains fairly constant due to a relatively constant generating capacity. The variation in the magnitude of fault current through the relay is therefore mainly dependent upon the location of the fault with respect to the relay.

The INVERSE time overcurrent characteristics, Figures 6 and 20, of the IFC51A and 51B relays tend to make the relay operating time less dependent upon the magnitude of the fault current than in the case of VERY INVERSE and EXTREMELY INVERSE devices. For this reason, INVERSE type relays are likely to provide faster overall protection in applications where the available fault current magnitudes vary significantly as a result of frequent changes in the source impedance due to system loading and switching.

The usual application of these relays requires three relays for multiphase fault protection, one per phase, and a separate relay residually connected for single-phase-to-ground faults. Typical external connections for this application are shown in Figure 9. Use of a separate ground relay is advantageous because it can be set to provide more sensitive protection against ground faults.

In the application of these relays with downstream automatic reclosing devices, the relay reset time should be considered. This is the time required for the relay to go from the contacts-fully-closed position to the fully-open position when set at the number 10 time dial. At lower time dial settings the reset times are proportionately lower. The reset time of all VERY INVERSE and EXTREMELY INVERSE relays is approximately 60 seconds. The reset time of all INVERSE relays covered by these instructions is approximately 12 seconds.

When setting these relays to coordinate with downstream relays, a coordination time of from 0.25 to 0.40 seconds is generally allowed, depending on the clearing time of the breaker involved and how accurately the relay time can be estimated. These coordination times include, in addition to breaker clearing time, 0.10 seconds for relay overtravel and 0.17 seconds for safety factor. For example, if the breaker clearing time is 0.13 seconds (8 cycles), the coordination time would be 0.40 seconds (0.13 + 0.10 + 0.17). If the relay time is set for the specific current level at the site, and if it has been tested, the safety factor may be reduced to 0.07 seconds. Then if the downstream breaker time is 5 cycles (0.08 seconds), a minimum of 0.25 seconds (0.08 + 0.10 + 0.07) could be allowed for coordination. If relay coordination times are marginal or impossible to obtain, use the relay overtravel curves of Figures 10, 11 or 12 to refine the relay settings. First determine the relay operating time necessary to just match the operating time of the downstream relay with which coordination is desired. Determine the multiple of pickup and the necessary time dial setting to provide this relay operating time. Use the appropriate curve of Figure 10, 11 or 12 to determine the overtravel time in percent of operating time, and covert this into real time. Add this time to the breaker time and the safety factor time and the original relay operating time to determine the final relay operating time. Set the relay to this value.

Once the current in the relay operating coil is cut off, the relay contacts will open in approximately 6 cycles (0.1 second) with normal adjustment of contact wipe. This permits the use of the relay in conjunction with instantaneous reclosing schemes without risk of a false retrip when the circuit breaker is reclosed on a circuit from which a fault has just been cleared.

The instantaneous overcurrent unit present in the IFC51B, 53B and 77B relays has a transient overeach characteristic as illustrated in Figure 13. This is the result of the DC offset that is usually present in the line current at the inception of a fault. When determining the pickup setting for this unit, the transient overreach must be taken into consideration. The percent transient overreach should be applied to increase the calculated pickup setting proportionately so that the instantaneous unit will not overreach a downstream device and thereby cause a loss of coordination in the system protection scheme. The operating time characteristics of this unit are shown in Figure 14.

CONSTRUCTION

The IFC induction disk relays consist of a molded case, cover, support structure assembly, and a connection plug to make up the electrical connection. See Cover Figure and Figures 1, 2, 3 and 19. Figures 2 and 3 show the induction unit mounted to the molded support structure. This disk is activated by a current-operating coil mounted on either a laminated EE- or a U-Magnet. The disk and shaft assembly carries a moving contact, which completes the alarm or trip circuit when it touches a stationary contact. The disk assembly is restrained by a spiral spring to give the proper contact closing current. Its rotation is retarded by a permanent magnet mounted in a molded housing on the support structure.

The drawout connection/test system for the C1 case, shown in Figure 19, has provisions for 14 connection points, and a visible CT shorting bar located up front. As the connection plug is withdrawn, it clears the shorter contact fingers in the output contact circuits first. Thus, the trip circuit is opened before any other circuits are disconnected. Next, current circuit fingers on the case connection block engage the shorting bar (located at the lower front of the case) to short-circuit external current transformer secondary connections. The window provides visual confirmation of CT shorting. The connection plug then clears the current circuit contact fingers on the case and finally those on the relay support structure, to de-energize the drawout element completely.

There is a High-Seismic target and seal-in unit mounted on the front to the left of the shaft of the time overcurrent unit (see Figure 1). 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 reset button located on the upper left side of the cover.

The IFC "B" model relays, in addition to the above, contain a high-seismic instantaneous unit (see Figure 1). The instantaneous unit is a small hinged-type unit which is 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 reset button that releases the target seal-in unit also releases the target of the instantaneous unit.

A magnetic shield, depicted in Figure 1, is mounted to the support structure of inverse and very inverse time overcurrent IFC relays (IFC51 and IFC53), to eliminate the proximity effect of external magnetic materials.

Both the High-Seismic target and seal-in unit and the High-Seismic instantaneous unit have the letters "Hi-G" molded into their target blocks to distinguish them as High-Seismic units. Seismic Fragility Level exceeds peak axial acceleration of 10g's (4g ZPA) when tested using a biaxial multi-frequency input motion to produce a Required Response Spectrum (RRS) in accordance with the IEEE Proposed Guide for Seismic Testing of Relays, P501, May, 1977.

RATINGS

The relays are designed for operation in an ambient air temperature from -20°C to +55°C.

TIME OVERCURRENT UNIT

Ranges for the time overcurrent unit are shown in Table I.

TABLE I

Relay	Frequency (Hertz)	Current Range (Amperes)
IFC51A & B IFC53A & B IFC77A & B	50 and 60	0.5 - 4.0 1.0 - 12.0

The current taps are selected with two sliding tap screws on an alphabetically labeled tap block.

The tap screw settings are as listed in Table II, on page 20, for each model of relay and tap range.

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

TABLE III

Model	Time Overcurrent Unit (Amperes)	One Second Rating Any Tap (Amperes)	K
IFC51	0.5 - 4.0	128	16384
	1.0 - 12.0	260	67600
IFC53	0.5 - 4.0	140	19600
	1.0 - 12.0	260	67600
IFC77	0.5 - 4.0	84	7056
	1.0 - 12.0	220	48400

Ratings less than one second may be calculated according to the formula

$I = \sqrt{K/T}$, where T is the time in seconds that the current flows.

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

TABLE IV
0.5 - 4.0 Ampere Range Ratings

Model	Tap										
	0.5	0.6	0.7	0.8	1.0	1.2	1.5	2.0	2.5	3.0	4.0
IFC51	1.6	1.8	2.0	2.1	2.3	2.7	3.0	3.5	4.0	4.5	5.0
IFC53	3.8	4.0	4.2	4.4	4.7	5.0	5.3	5.8	6.2	6.6	7.1
IFC77	2.5	2.7	3.0	3.2	3.6	4.0	4.5	5.2	5.9	6.5	7.5

TABLE V
1.0 - 12.0 Ampere Range Ratings

Model	Tap												
	1.0	1.2	1.5	2.0	2.5	3.0	4.0	5.0	6.0	7.0	8.0	10.0	12.0
IFC51	3.7	4.1	4.6	5.3	6.0	6.5	7.6	8.5	9.3	10.0	10.8	12.1	13.2
IFC53	6.8	7.1	7.7	8.3	8.8	9.4	10.3	11.0	11.6	12.4	12.6	13.5	14.4
IFC77	5.8	6.4	7.2	8.4	9.4	10.4	12.1	13.6	15.1	16.4	17.6	19.8	21.8

HIGH-SEISMIC INSTANTANEOUS UNIT

The instantaneous coil is tapped for operation on either one of two ranges (H or L). Selection of the high or low range is determined by the position of the link located on the top of the support structure (see Figure 2 and Table VI).

TABLE VI

High-Seismic Instantaneous Unit (Amps)	Link Position	Range (Amps)	Continuous Rating (Amps)	One Second Rating (Amps)	K
2 - 50	L H	2 - 10 10 - 50	2.7 7.5	130	16,900
6 - 150	L H	6 - 30 30 - 150	10.2 19.6	260	67,600

The range is approximate, which means that the 2-10, 10-50 may be 2-8, 8-50. There will always be at least one ampere overlap between the maximum L setting and the minimum H setting. Whenever possible, be sure to select the higher range, since it has the higher continuous rating.

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

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

Since the instantaneous unit coil is in series with the time overcurrent unit coil, see Tables III, IV, V and VI to determine the current-limiting element for both continuous and short-time ratings.

HIGH-SEISMIC TARGET AND SEAL-IN UNIT

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

TABLE VII

	Tap 0.2	Tap 2
DC Resistance ± 10% (ohms)	8.0	0.24
Min. Operating (Amps) +0 -60%	0.2	2.0
Carry Continuous (Amperes)	0.3	3
Carry 30 Amps for (sec.)	0.03	4
Carry 10 Amps for (sec.)	0.25	30
60 Hz Impedance (ohms)	68.6	0.73

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

Model	Hz	Range	Min Tap Amps	Burdens at Min. Pickup Min. Tap (Ohms) R	Jx	Z	Burdens in Ohms (Z) Times Pickup 3	10	20
IFC51	60	0.5- 4.0	0.5	5.43	21.53	22.20	12.55	5.14	3.29
		1.0-12.0	1.0	1.47	5.34	5.54	3.09	1.28	0.82
IFC53	60	0.5- 4.0	0.5	1.52	4.23	4.50	4.47	3.10	1.93
		1.0-12.0	1.0	0.38	1.06	1.13	1.11	0.78	0.49
IFC77	60	0.5- 4.0	0.5	1.55	2.36	2.82	2.86	2.93	2.76
		1.0-12.0	1.0	0.59	0.43	0.73	0.74	0.75	0.70
IFC51	50	0.5- 4.0	0.5	4.53	17.95	18.50	11.45	4.28	2.70
		1.0-12.0	1.0	1.22	4.45	4.62	2.58	1.07	0.68
IFC53	50	0.5- 4.0	0.5	1.27	3.52	3.75	3.72	2.58	1.61
		1.0-12.0	1.0	0.32	0.88	0.94	0.93	0.65	0.41
IFC77	50	0.5- 4.0	0.5	1.29	1.97	2.35	2.38	2.44	2.30
		1.0-12.0	1.0	0.49	0.36	0.61	0.62	0.63	0.58

Note: The impedance values given are those for minimum tap of each range; the impedance for other taps at pickup current (tap rating) varies inversely (approximately) as the square of the tap rating. For example, an IFC77 60 Hz relay with 0.5 - 4.0 amp range has an impedance of 2.82 ohms on the 0.5 amp tap. The impedance of the 2.0 amp tap is $(0.5/2.0)^2 \times 2.82 = 0.176$ ohms.

The High-Seismic instantaneous unit burdens are listed in Table IX.

TABLE IX

High-Seismic Inst. Unit (Amps)	Hz	Link Position	Range (Amps)	Min. Pick-up Amps	Burdens at Min. Pickup Min. Tap (Ohms) R	Jx	Z	Burdens in Ohms (Z) Times Pickup 3	10	20
2-50	60	L	2-10	2	0.750	0.650	0.982	0.634	0.480	0.457
		H	10-50	10	0.070	0.024	0.079	0.072	0.071	0.070
6-150	60	L	6-30	6	0.110	0.078	0.135	0.095	0.081	0.079
		H	30-150	30	0.022	0.005	0.023	0.022	0.022	0.022
2-50	50	L	2-10	2	0.625	0.542	0.827	0.528	0.400	0.380
		H	10-50	10	0.058	0.020	0.062	0.060	0.059	0.058
6-150	50	L	6-30	6	0.092	0.065	0.112	0.079	0.068	0.066
		H	30-150	30	0.018	0.004	0.019	0.018	0.018	0.018

CHARACTERISTICS

TIME OVERCURRENT UNIT

Pickup

Pickup in these relays is defined as the current required to close the contacts from the 0.5 time dial position. Current settings are made by means of two movable leads which connect to the tap block at the top of the support structure (see Figure 1). The tap block is marked A through J, A through M or A through N. See the nameplate on the relay for tap settings.

Example: The 2 amp tap for a 1 to 12 IFC77 time overcurrent relay requires one movable lead in position D and the other in position H.

Operating Time Accuracy

The IFC relays should operate within ± 7% or ± the time dial setting times 0.10 second, whichever is greater, of the published time curve. Figures 6-8 and 20-22 show the various time-current characteristics for the IFC relays. The setting of the time dial determines the length of time required to close the contacts for a given current. The higher the time dial setting, the longer the operating time.

The contacts are just closed when the time dial is set to 0. The maximum time setting occurs when the time dial is set to 10 and the disk has to travel its maximum distance to close the contacts.

Reset

The unit resets at 90% of the minimum closing current. Reset times are proportionate to the time dial settings. The time to reset to the number 10 time dial position when the current is reduced to 0 is approximately 60 seconds for the IFC53 and 77 relays. The IFC51 relay will reset in approximately 12 seconds from the same number 10 time dial.

HIGH-SEISMIC INSTANTANEOUS UNIT

The instantaneous unit has a 25 to 1 range with a tapped coil. There are high and low ranges, selected by means of a link located on the top of the support structure. See Figure 1. The time-current curve for the instantaneous unit is shown in Figure 14.

HIGH-SEISMIC TARGET AND SEAL-IN UNIT

The target and seal-in unit has two tap selections located on the front of the unit. See Figure 1.

RECEIVING, HANDLING AND STORAGE

These relays, when not included as part of a control panel, will be shipped in cartons designed to protect them against damage. Immediately upon receipt of

a relay, examine it for any damage sustained in transit. If injury or damage resulting from rough handling is evident, file a damage claim at once with the transportation company and promptly notify the nearest General Electric Sales Office.

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

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

ACCEPTANCE TESTS

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 or of the 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, rating and calibration range of the relay received agree with the requisition.

Remove the relay from its case and check by visual inspection that there are no broken or cracked molded parts or other signs of physical damage.

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 each other.

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 1/64" wipe on the seal-in and the instantaneous 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 button is operated.

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

6. Check that all screws are tight.

CAUTION
SHOULD THERE BE A NEED TO TIGHTEN ANY SCREWS, DO NOT OVERTIGHTEN, TO PREVENT STRIPPING.

DRAWOUT RELAY TESTING

The IFC relays may be tested without removing them from the panel by using the 12XCA11A1 four-point test probes. The 12XCA11A2 four-point test probe makes connections to both the relay and the external circuitry, which provides maximum flexibility but requires reasonable care, since a CT shorting jumper is necessary when testing the relay. The CT circuit may also be tested by using an ammeter instead of the shorting jumper. See the test circuit in Figure 15.

GENERAL POWER REQUIREMENTS

All alternating current (AC) 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 AC devices (relays) will be affected by the applied waveform. Therefore, in order to properly test AC 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 waveforms. Hence a resistance-limited circuit, as shown in Figures 16-18, is recommended.

TIME OVERCURRENT UNIT

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

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 ensure approximately 1/32" wipe.

The minimum current at which the contacts will just close is determined by the tap setting in the tap block at the top of the support structure. See **CHARACTERISTICS** section.

The pickup of the time overcurrent unit for any current tap setting is adjusted by means of a spring-adjusting ring. See Figure 1. The spring-

adjusting ring either winds or unwinds the spiral control spring (see Figure 1). By turning the ring, the operating current of the unit may be brought into agreement with the tap setting employed, if this adjustment has been disturbed. This adjustment also permits any desired setting intermediate between the various tap settings to be obtained. If such adjustment is required, it is recommended that the higher tap be used. It should be noted that the relay will not necessarily agree with the time current characteristics of Figures 6-8 and 20-22 if the relay has been adjusted to pick up at a value other than tap value, because the torque level of the relay has been changed.

Time Setting

The setting of the time dial determines the length of time the unit requires to close the contacts when the current reaches a predetermined value. The contacts are just closed when the time dial is set on 0. When the time dial is set on 10, the disk must travel the maximum amount to close the contacts and therefore this setting gives the maximum time setting.

The primary adjustment for the time of operation of the unit is made by means of the time dial. However, further adjustment is obtained by moving the permanent magnet along its supporting shelf; moving the magnet toward the disk and shaft decreases the time, while moving it away increases the time.

Pickup Test

Set the relay at 0.5 time dial position and the lowest tap. Using the test connections in Figure 16, the main unit should close the contacts within ± 3% of tap value current for 60 Hz relays and within ± 7.5% of tap value current for 50 Hz relays.

Time Test

Set the relay at No. 5 time dial setting and the lowest tap. Using the test connections in Figure 16, apply five times tap current to the relay. The relay operating time to close its contact is listed in Table X.

TABLE X

Relay	Hz	Time (seconds) Min.	Max.
IFC51	50 and 60	1.76	1.80
IFC53	50 and 60	1.28	1.34
IFC77	50 and 60	0.89	0.95

HIGH-SEISMIC INSTANTANEOUS UNIT

Make sure that the instantaneous unit link is in the correct position for the range in which it is to operate. See the Internal Connections Diagram, Figure 5, and connect as indicated in the test circuit of Figure 17. Whenever possible, use the higher range, since the higher range has a higher continuous rating.

Setting the High-Seismic Instantaneous Unit

The instantaneous unit has an adjustable core located at the top of the unit as shown in Figure 1. To set the instantaneous unit to a desired pickup, loosen the locknut and adjust the core. Turning the core clockwise decreases the pickup; turning the core counterclockwise increases 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.

CAUTION

REFER TO TABLE VI FOR THE CONTINUOUS AND ONE-SECOND RATINGS OF THE INSTANTANEOUS UNIT. DO NOT EXCEED THESE RATINGS WHEN APPLYING CURRENT TO THE INSTANTANEOUS UNIT.

The range of the instantaneous unit (see Table VI) must be obtained between a core position of 1/8 of a turn from full clockwise and 20 turns counterclockwise from the full clockwise position. Do not leave the core in the full clockwise position.

HIGH-SEISMIC 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 shippped from the factory with the tap screw in the higher 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 1). 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 the test circuit of Figure 18) to a DC source of proper frequency and good waveform, using an 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.

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	Pickup Current	Dropout Current
0.2	0.12 - 0.20	.05 or more
2.0	1.2 - 2.0	.50 or more

INSTALLATION

The relay should be installed in a clean, dry location, free from dust, and well lighted to facilitate inspection and testing.

The relay should be mounted on a vertical surface. The outline and panel drillings are shown in Figures 23 and 24. Figure 23 shows the semi-flush mounting (necessary for high seismic capability), and Figure 24 shows various methods of surface mounting.

The internal connection diagrams for the relays are shown in Figures 4 and 5. Typical external connections are shown in Figure 9.

INSTALLATION TESTS

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

Time Overcurrent Unit

Set the tap block to the desired tap setting and the time dial to the 0.5 position. Using the test circuit in Figure 16, gradually apply current until the contacts just close. This value of current is defined as pickup, and should be within 3% of tap value for 60 Hz relays and within 7.5% of tap value for 50 Hz relays.

Check the operating time at some multiple of tap value and the desired time dial setting. This multiple of tap value may be 5 times tap rating or the maximum fault current for which the relay must coordinate. This value is left to the discretion of the user.

High-Seismic 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 **ACCEPTANCE TESTS** section.

High-Seismic Instantaneous Unit

1. Select the desired range by setting the link in the proper position (see Figure 1 and the Internal Connections Diagram, Figures 4 and 5). 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 High-Seismic 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 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 following points be checked at an interval of from one to two years.

These tests are intended to ensure 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 pickup test for the tap setting in service, as described in the **INSTALLATION** section.

2. Perform the time tests as described in the **INSTALLATION** section.

HIGH-SEISMIC INSTANTANEOUS UNIT

Check that the instantaneous unit picks up at the desired current level, as outlined in the **ACCEPTANCE TESTS** section.

HIGH-SEISMIC TARGET AND SEAL-IN UNIT

1. Check that the unit picks up at the values shown in Table XI.

2. Check that the unit drops out at 25% or more of tap value.

CONTACT CLEANING

For cleaning fine silver relay contacts, a flexible burnishing tool should be used. This consists of an etched-roughened strip of flexible metal, resembling a superfine file. The polishing action is so delicate that no scratches are left, yet it will clean off any corrosion thoroughly and rapidly. The flexibility of the tool insures the cleaning of the actual points of contact. Never use knives, files, or abrasive paper or cloth of any kind to clean fine silver contacts. A burnishing tool as described above can be obtained from the factory.

COVER CLEANING

The clear Lexan(R) cover should be cleaned with a soft cloth and water only. Cleaning solutions should not be used.

SYSTEM TEST

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

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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:

Pickup Tests

Rotate time dial to No. 0 time dial setting and check by means of a lamp 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 setting, there should be sufficient gap between the stationary contact brush and its metal backing strip to ensure approximately 1/32" wipe.

The pickup of the unit for any current tap setting is adjusted by means of a spring-adjusting ring. By turning the ring, the operating current of the unit may be brought into agreement with the tap setting employed, if for some reason this adjustment has been disturbed. This adjustment also permits any desired setting intermediate between the various tap settings to be obtained. If such adjustment is required, it is recommended that the higher tap setting be used. It should be noted that the relay will not necessarily agree with the time-current characteristics of Figures 6-8 and 20-22 if the relay has been adjusted to pick up at a value other than tap value, because the torque level of the relay has been changed.

Connect the operating coil terminals to a source of the proper frequency and good waveforem having a voltage of 110 or more, with resistance load boxes for setting the current (see Test circuit of Figure 16).

With the tap block set for the lowest tap and the time dial set where contacts are just open, adjust the control spring to just close the contacts within the limits given in Table XII, which are ± 1% of the tap amps.

TABLE XII

Tap Range	Tap	Min. Amps	Max. Amps
0.5 - 4	0.5	.495	.505
1.0 - 12.0	1.0	.99	1.01

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

Time Tests

With the tap block set for the lowest tap and the time dial at No. 5 setting, apply 5 times tap current to the relay.

Adjust the position of the drag magnet assembly to obtain an operating time as listed in Table XIII.

TABLE XIII

Relay	Time (Seconds) Min.	Max.
IFC51	1.76	1.80
IFC53	1.29	1.33
IFC77	0.90	0.94

It would be preferable to adjust the operating time as nearly as possible to 1.78, 1.31 or 0.92 seconds. The drag magnet assembly should be approximately in the middle of its travel. The drag magnet assembly is adjusted by loosening the two screws securing it to the support structure (see Figure 1). Moving the drag magnet towards the disk and shaft decreases the operating time and moving the drag magnet away from the disk and shaft increases the operating time. The screws securing the drag magnet assembly to the support structure must be tight before proceeding with other time checks.

Mechanical Adjustment

The disk does not have to be in the exact center of either air gap for the relay to perform correctly. Should the disk not clear all gaps, however, the following adjustment can be made.

1. Determine which way the disk must be aligned to clear all gap surfaces by 0.010 inch.

2. Remove the drag magnet assembly by loosening the two screws securing it to the support structure. The screws need not be removed.

3. Loosen the upper pivot bearing set screw (1/16" hex wrench) slightly, so the upper pivot can move freely. Do not remove the set screw from the support structure.

4. Loosen the jewel bearing set screw as in 3 above.

5. Apply a slight downward finger pressure on the upper pivot and turn the jewel bearing screw, from the underside of the support structure, to position the disk as determined in 1 above.

6. Turn the jewel bearing screw 1/8 turn clockwise and tighten the upper pivot set screw to 2.5 - 3.5 inch pounds of torque.

7. Turn the jewel bearing screw 1/8 turn counterclockwise. This will lower the disk and shaft assembly approximately 0.005" and permit proper end-play. The shaft must have 0.005 - 0.010" of end-play.

8. Tighten the jewel bearing set screw to 2.5 - 3.5 inch pounds of torque.

9. Rotate the disk through the electromagnet gap. The disk could clear the gap surfaces by 0.010" and be within 0.005" flatness. If the disk is not within 0.005" flatness, the disk should be replaced.

10. Reinstall the drag magnet assembly and check that the disk has at least 0.010" clearance from the drag magnet assembly surfaces.

11. Tighten the drag magnet assembly mounting screws with 7-10 inch pounds of torque, after securely seating the assembly and positioning it according to the Time Test above (page 18).

HIGH-SEISMIC 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 1/64" wipe on the contacts. Check this by inserting a 0.010" feeler gage between the front half of the shaded pole and the armature when held closed. Contacts should close with feeler gage in place.

4. Since mechanical adjustments may affect the Seismic Fragility level, it is advised that no mechanical adjustments be made if seismic capability is of concern.

HIGH-SEISMIC TARGET AND SEAL-IN UNIT

Check 1 and 2 as described under INSTANTANEOUS UNIT.

To check the wipe of the seal-in unit, insert a 0.010" feeler gage between the plastic residual of the armature and the pole piece with the armature held closed. Contacts should close with feeler gage in place. Since mechanical adjustments may affect the Seismic Fragility level, it is advised that no mechanical adjustments be made if seismic capability is of concern.

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 give complete model number of the relay for which the part is required. If possible, give the General Electric requisition number on which the relay was furnished.

Since the last edition, changes have been made in Figures 23 & 24.

TABLE II (SEE PAGE 6)

12IFC51
TAPS AVAILABLE

0.5	0.6	0.7	0.5	1	1.2	1.5	2	2.5	3	4
A/M	A/L	B/L	B/K	C/K	C/J	D/J	D/H	E/H	E/G	F/G

1	1.2	1.5	2	2.5	3	4	5	6	7	8	10	12
A/N	B/N	B/M	C/M	C/L	D/L	D/K	E/K	E/J	F/J	G/J	F/H	G/H

12IFC53
TAPS AVAILABLE

0.5	0.6	0.7	0.5	1	1.2	1.5	2	2.5	3	4
A/J	A/H	A/G	A/F	A/E	A/D	B/E	B/D	A/C	A/B	E/F

1	1.2	1.5	2	2.5	3	4	5	6	7	8	10	12
A/J	D/J	G/J	A/H	B/H	A/G	F/H	A/E	A/D	B/F	A/C	A/B	D/F

12IFC77
TAPS AVAILABLE

0.5	0.6	0.7	0.5	1	1.2	1.5	2	2.5	3	4
A/J	A/N	A/G	A/F	A/E	A/D	E/M	A/C	A/B	C/D	E/F

1	1.2	1.5	2	2.5	3	4	5	6	7	8	10	12
A/J	D/J	A/H	D/H	A/G	H/J	A/F	A/E	A/D	F/G	A/C	A/B	D/F

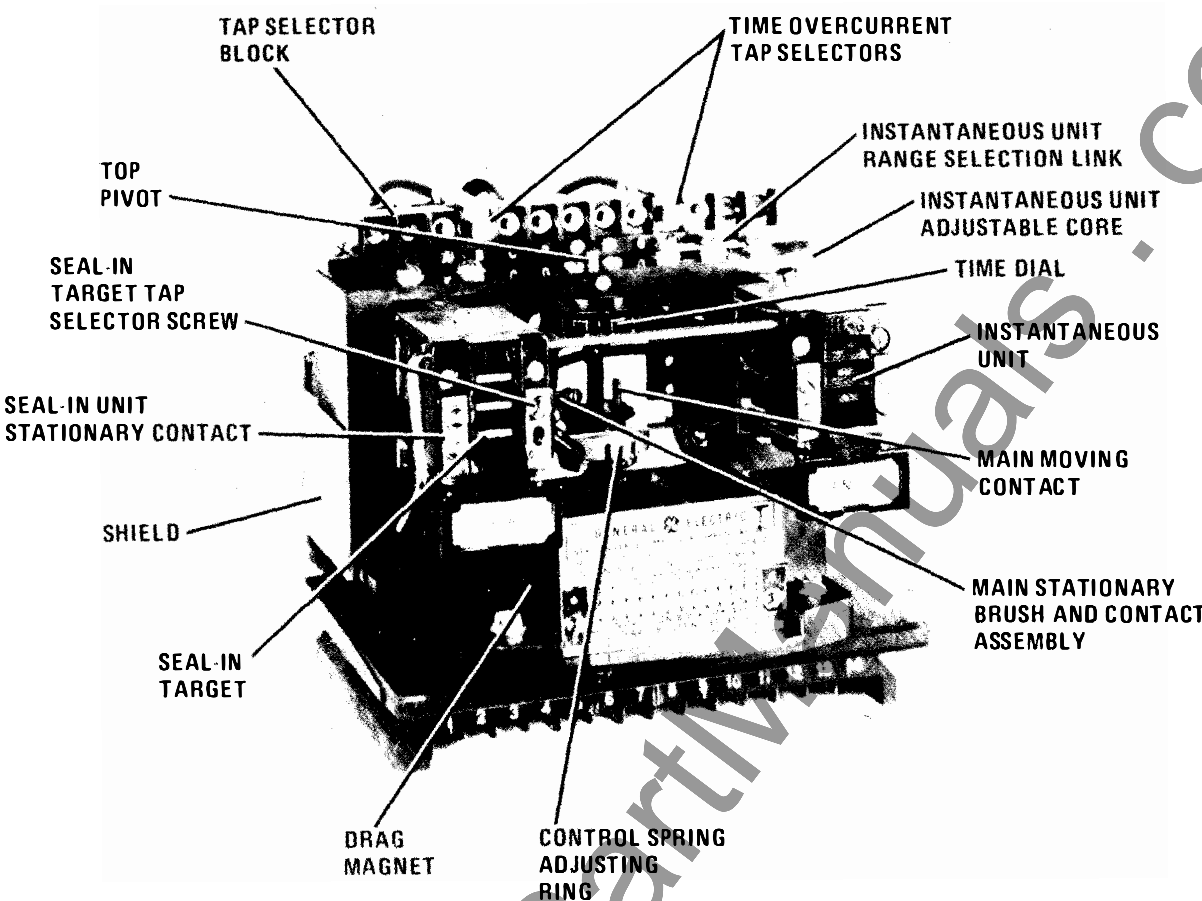


Figure 1 (8042708) Type IFC53B Relay, Removed from Case, Front View

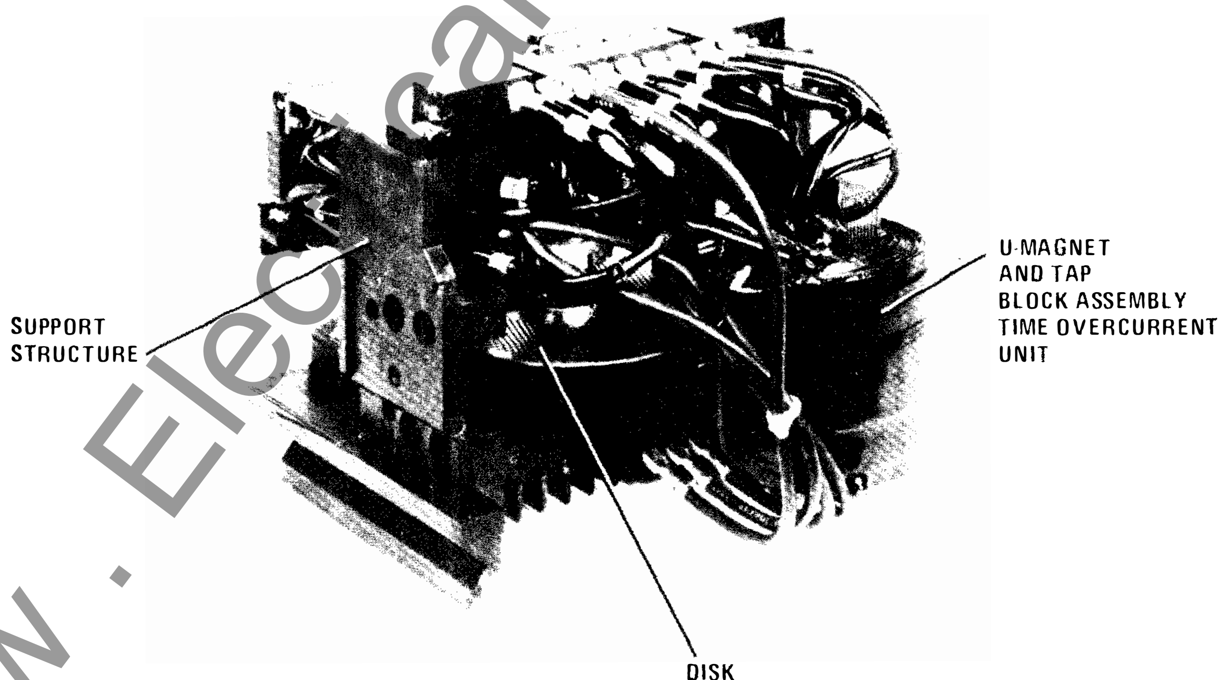


Figure 2 (8042711) Type IFC53B Relay, Removed from Case, Rear View

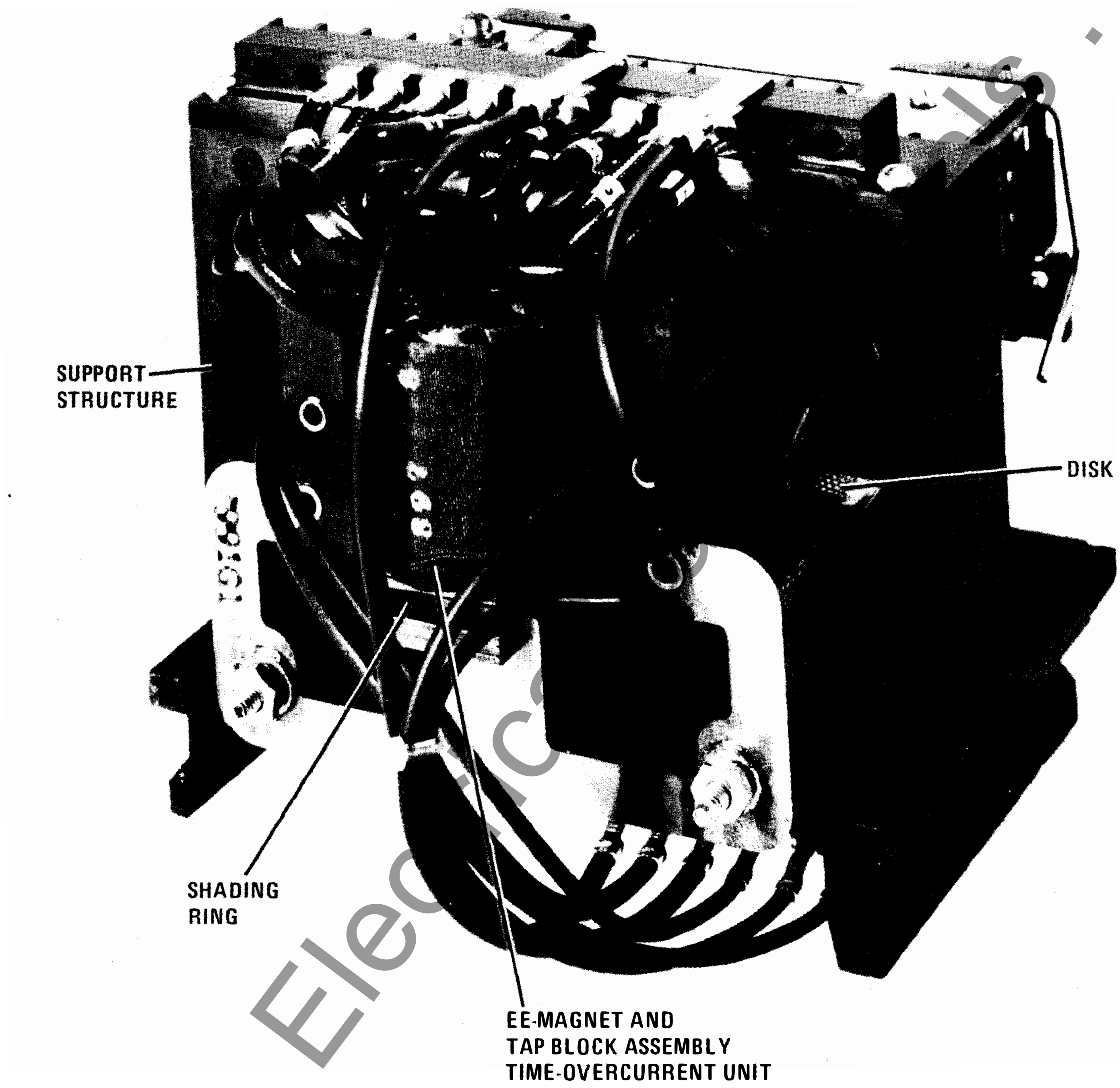
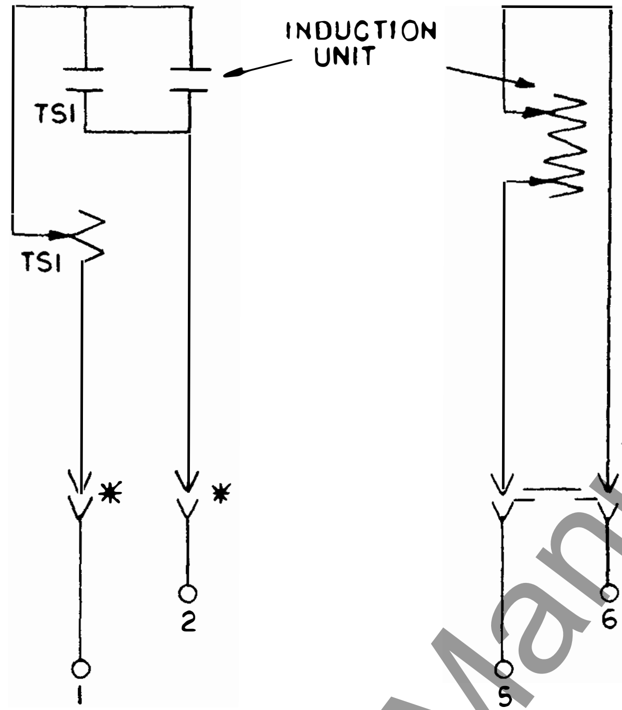
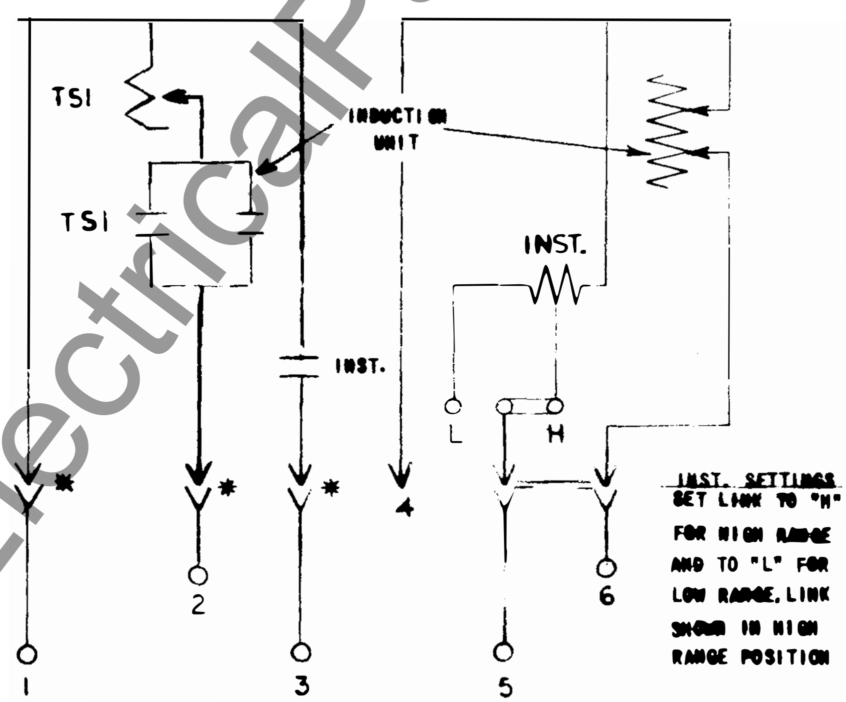


Figure 3 (8042750) Type IFC77B Relay, Removed from Case, Rear View



✱ = SHORT FINGER

Figure 4 (0257A8339-5) Internal Connections for
Relay Types IFC51A, IFC53A and IFC77A - Front View



✱ = SHORT FINGER

Figure 5 (0257A8340-5) Internal Connections for
Relay types IFC51B, IFC53B and IFC77B - Front View

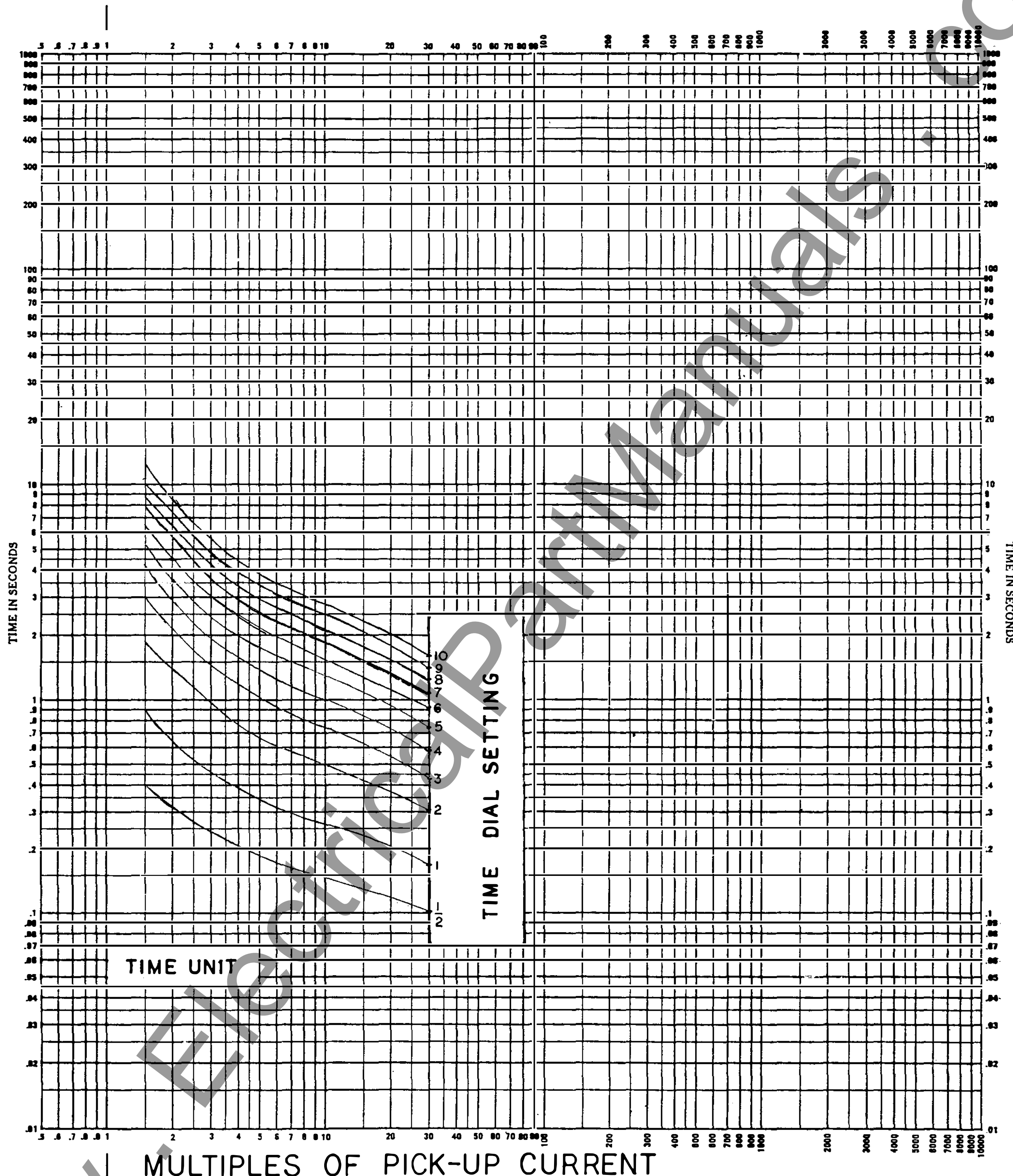


Figure 6 (0108B8943-2) 60 Hertz Time-Current Characteristics for Relay Types IFC51A and IFC51B

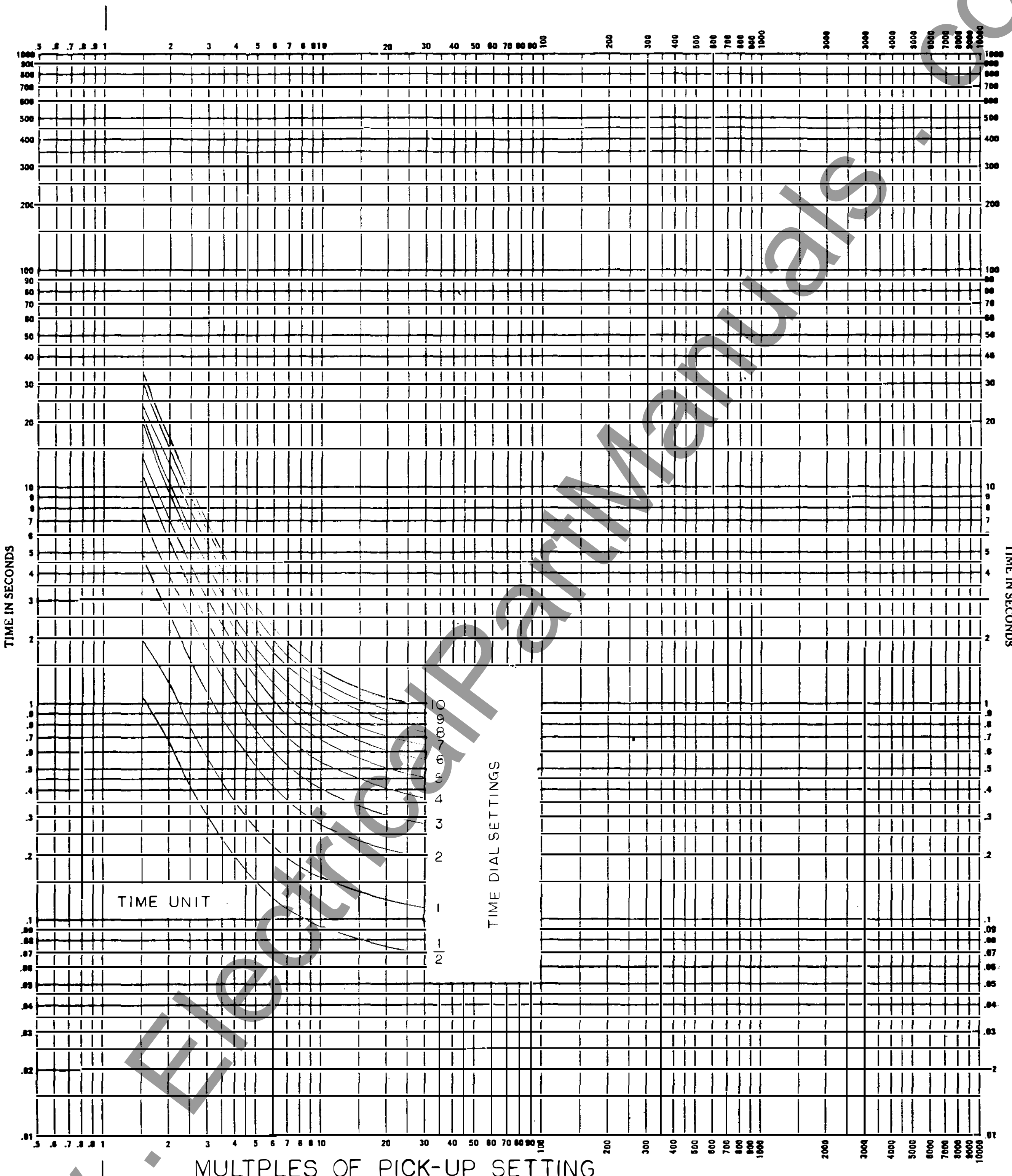


Figure 7 (0108B8944-3) 60 Hertz Time-Current Characteristics for Relay Types IFC53A and IFC53B

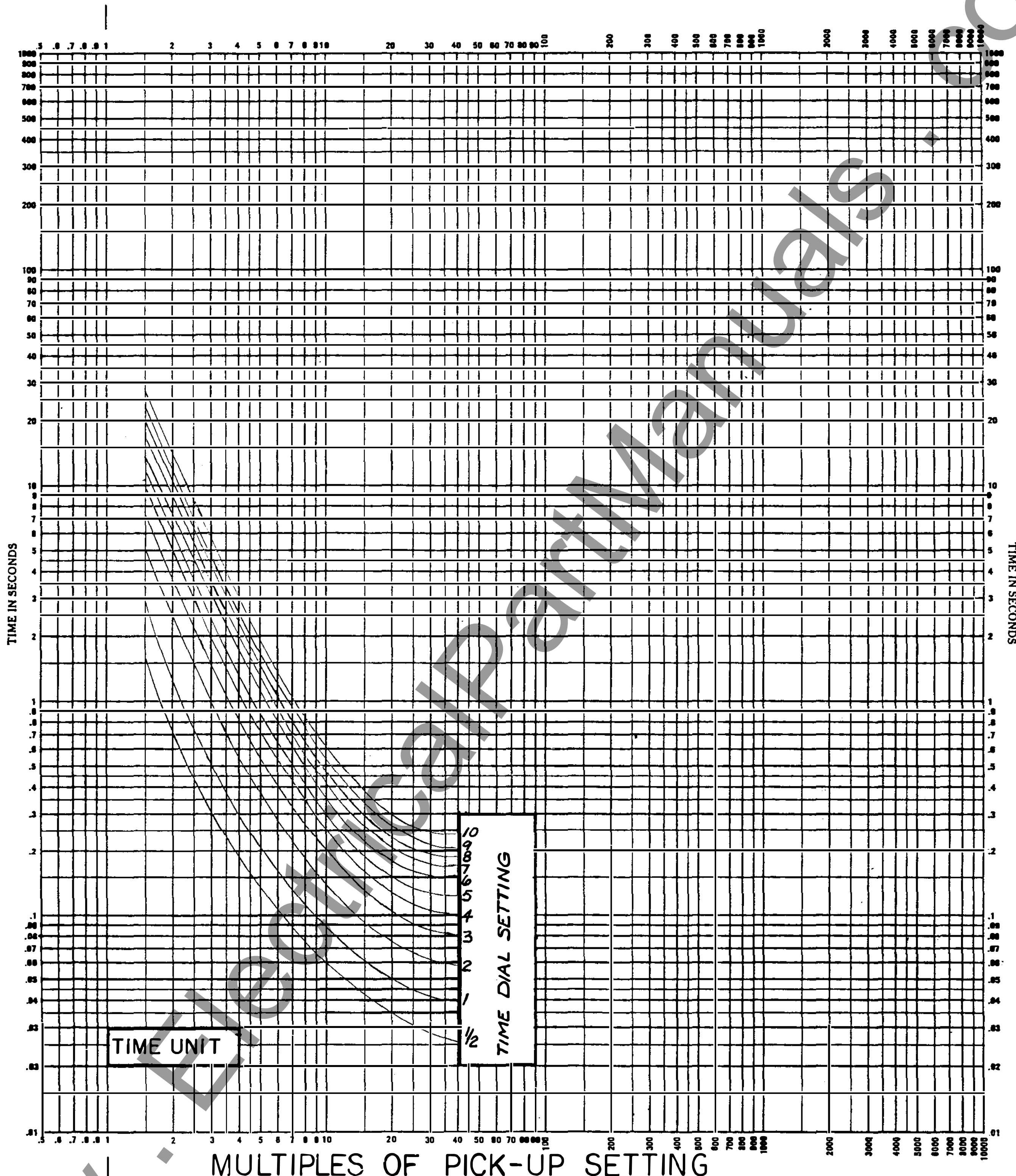


Figure 8 (0108B8945-2) 60 Hertz Time-Current Characteristics for Relay Types IFC77A and IFC77B

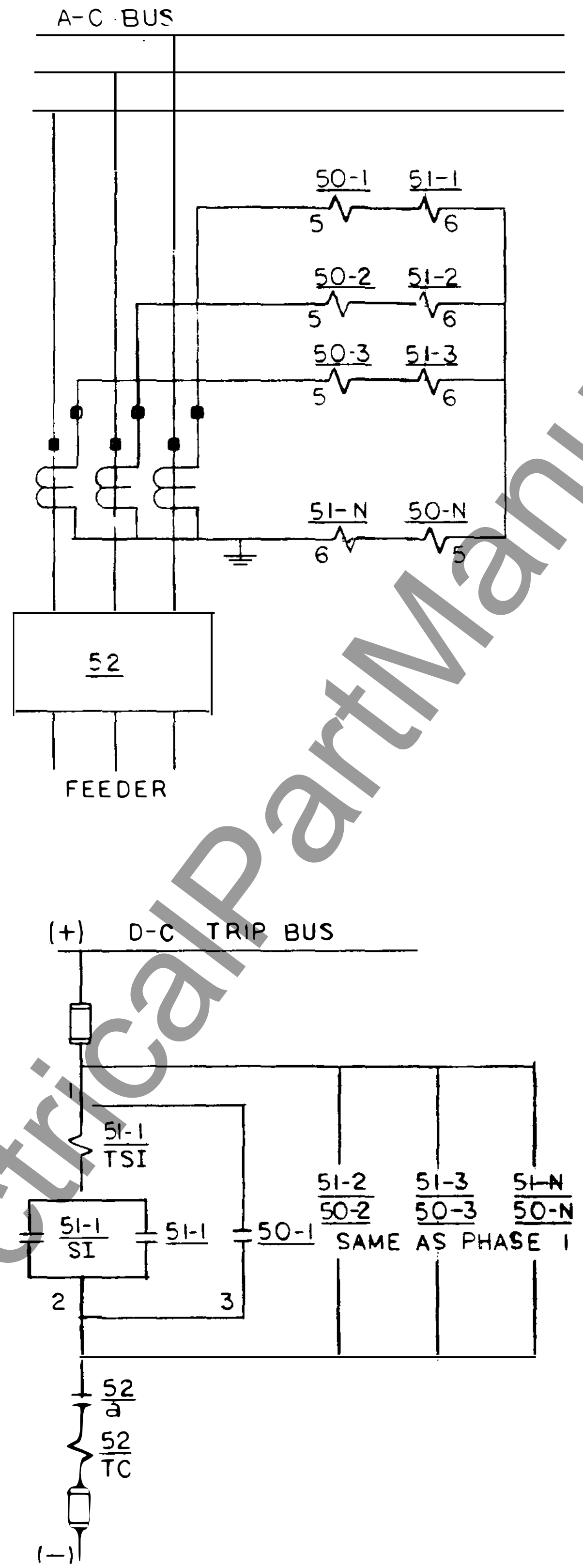


Figure 9 (0257A9647-0) External Connections of Four IFC Relays Used for Multi-Phase and Phase-to-Ground Fault Protection of a 3-Phase Circuit

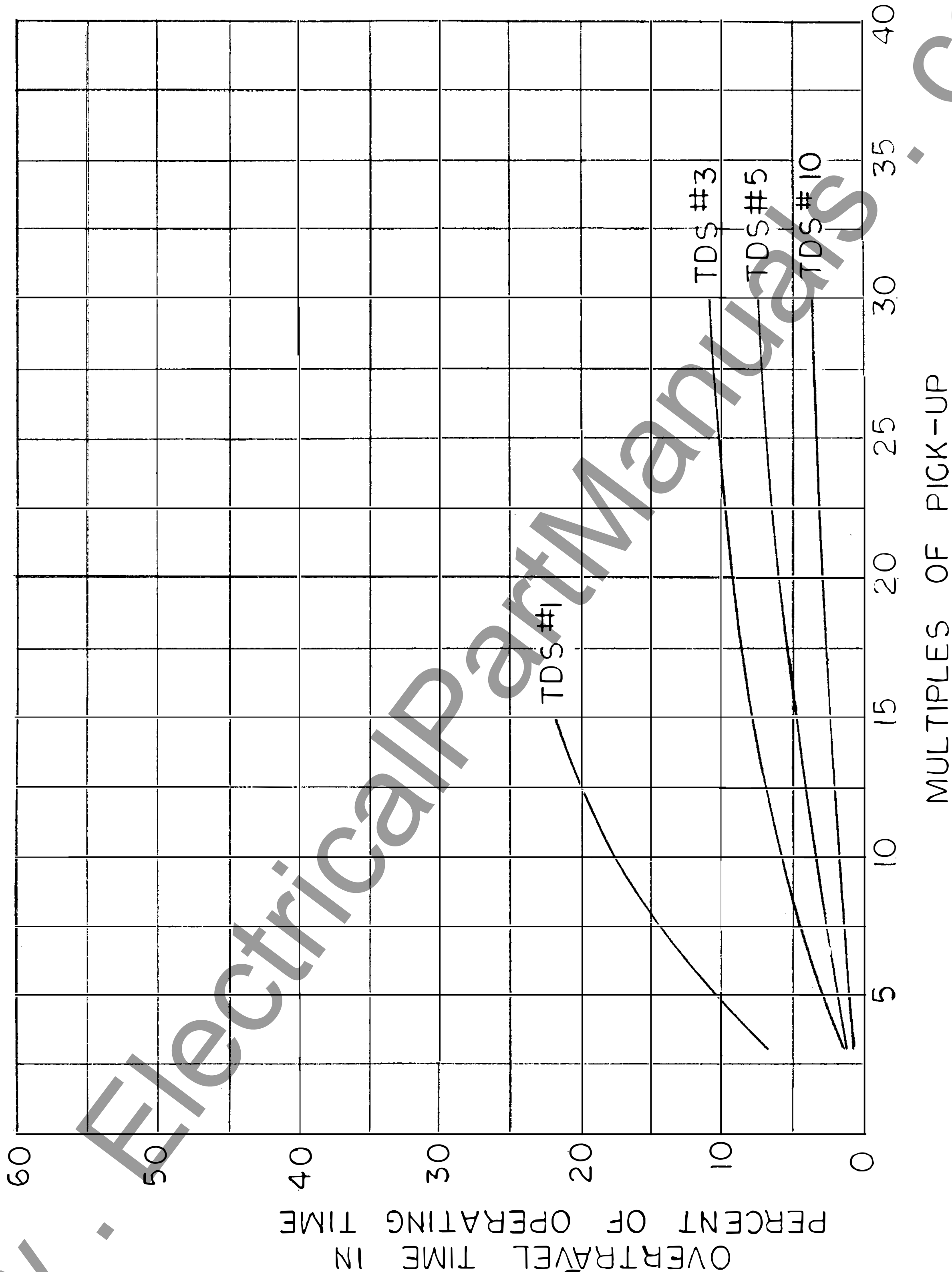


Figure 10 (0257A8594-2) Overtravel Curves for Relay Type IFC51

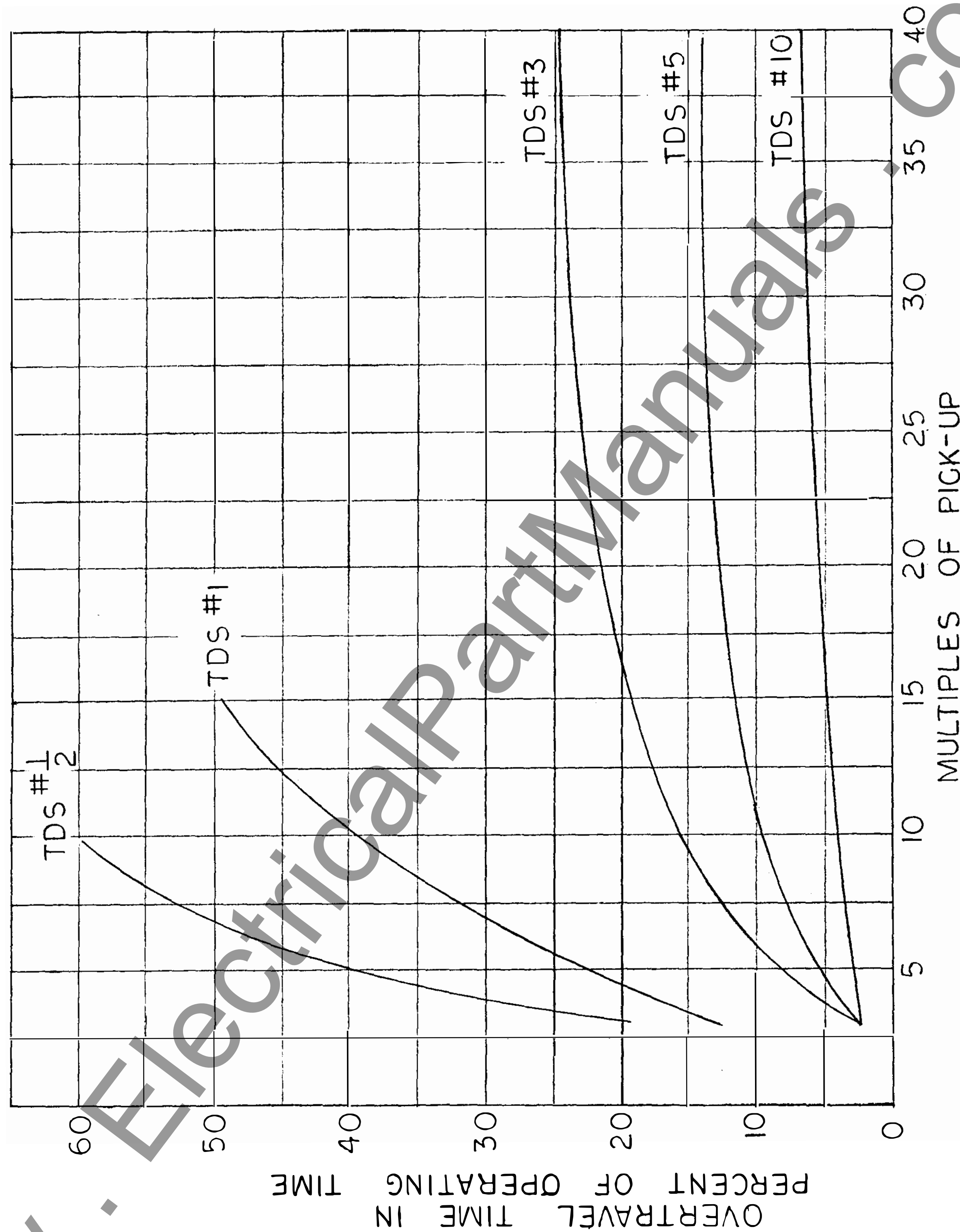


Figure 11 (0257A8595-2) Overtravel Curves for Relay Type IFC53

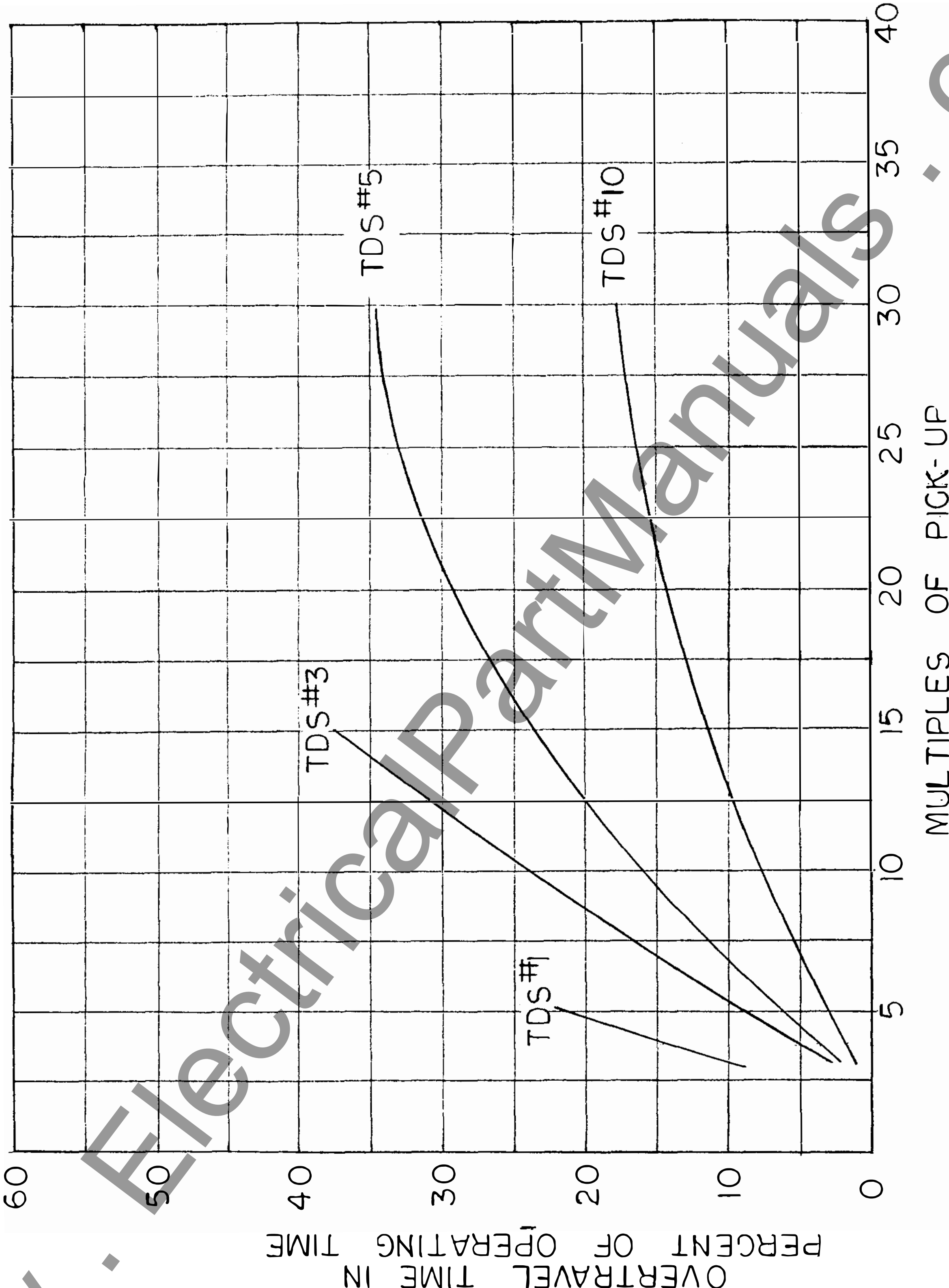


Figure 12 (0257A8596-2) Overtravel Curves for Relay Type IFC77

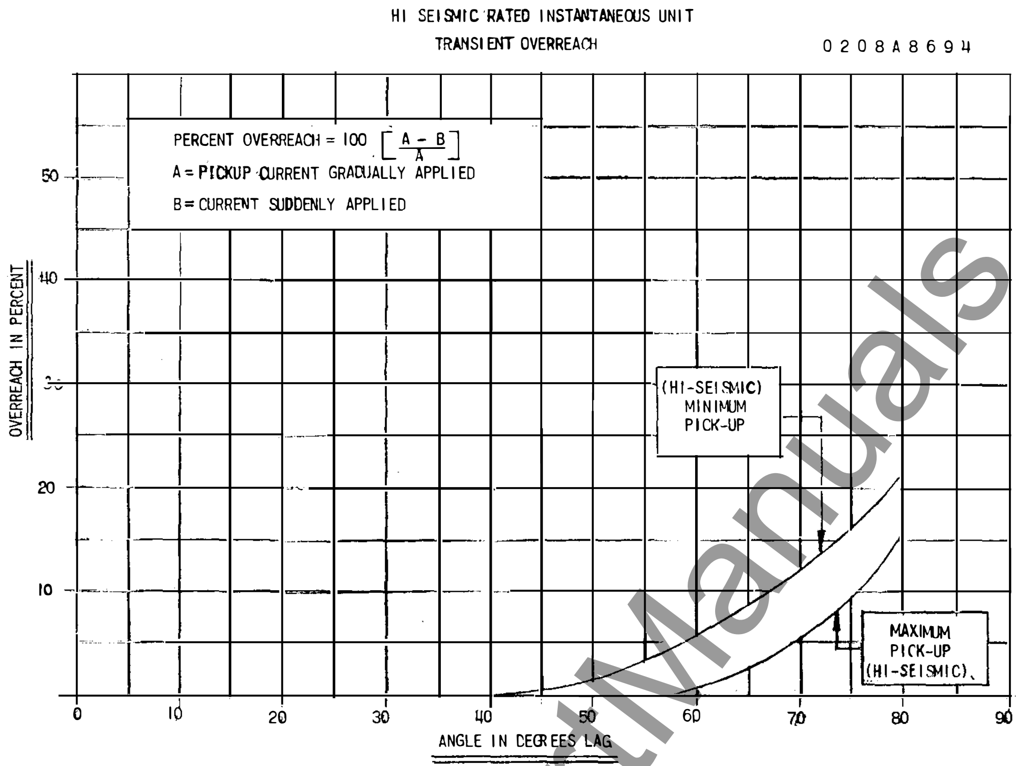


Figure 13 (0208A8694-2) Transient Overreach Characteristics of the High-Seismic Instantaneous Unit

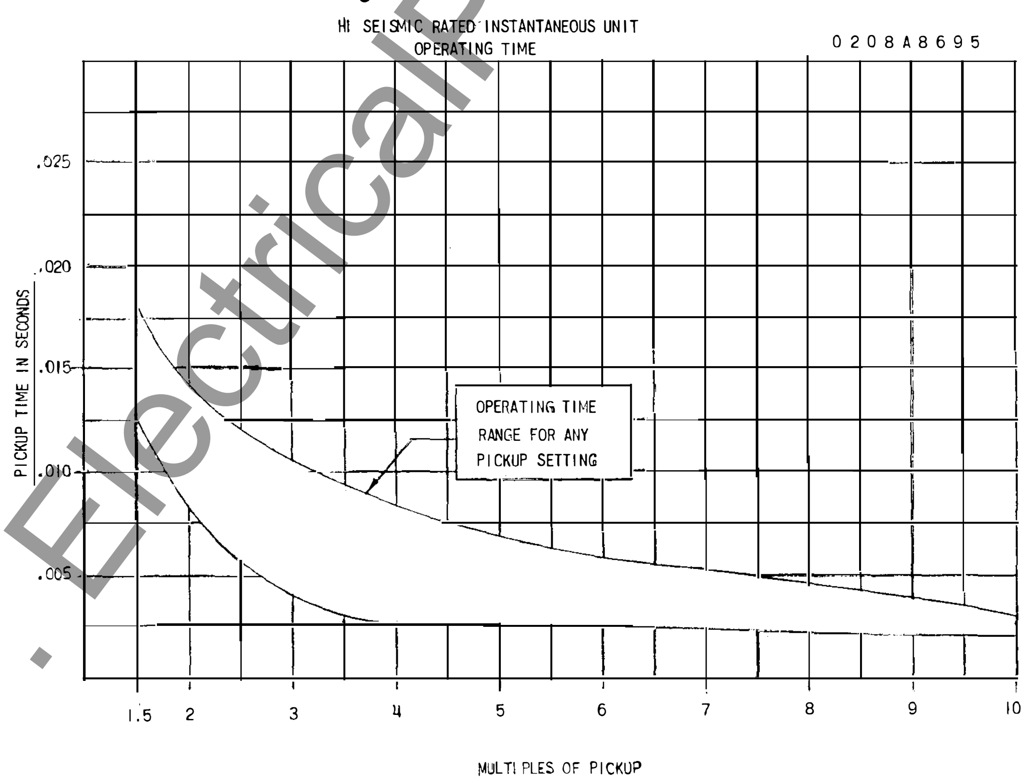


Figure 14 (0208A8695-1) Time-Current Characteristics of the High-Seismic Instantaneous Unit

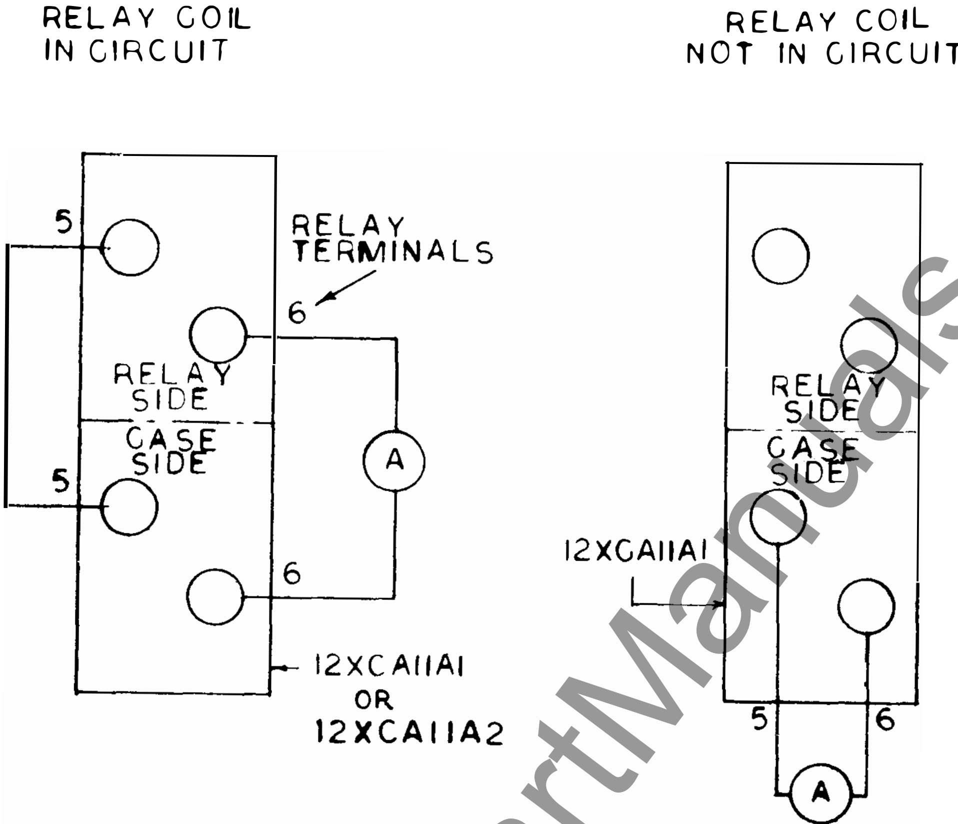


Figure 15 (0269A1787-1) Test Connections
for Testing CT Secondary Used with the IFC Relay

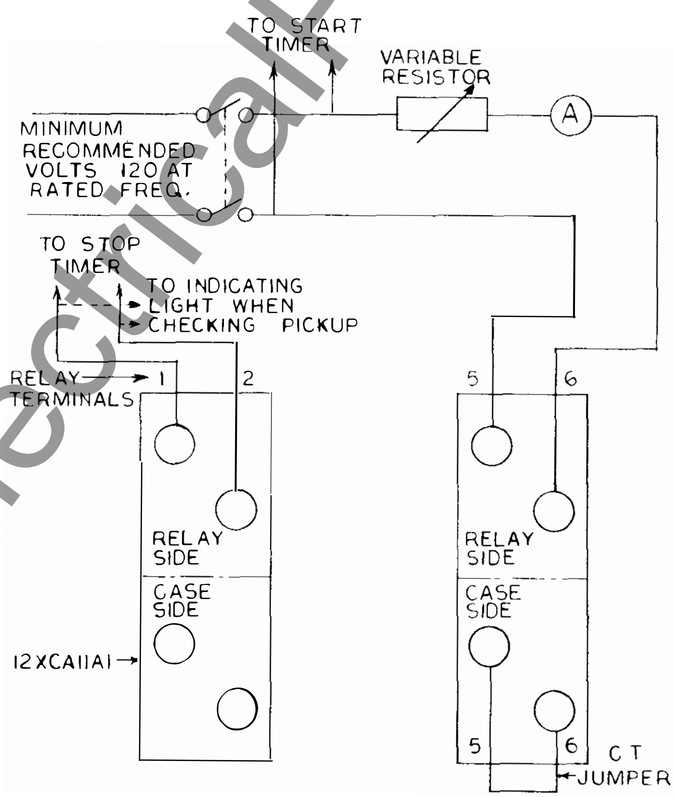


Figure 16 (0269A1789-0) Test Connections for Testing Pickup and Operating Times
of the IFC Relay Time Overcurrent Unit

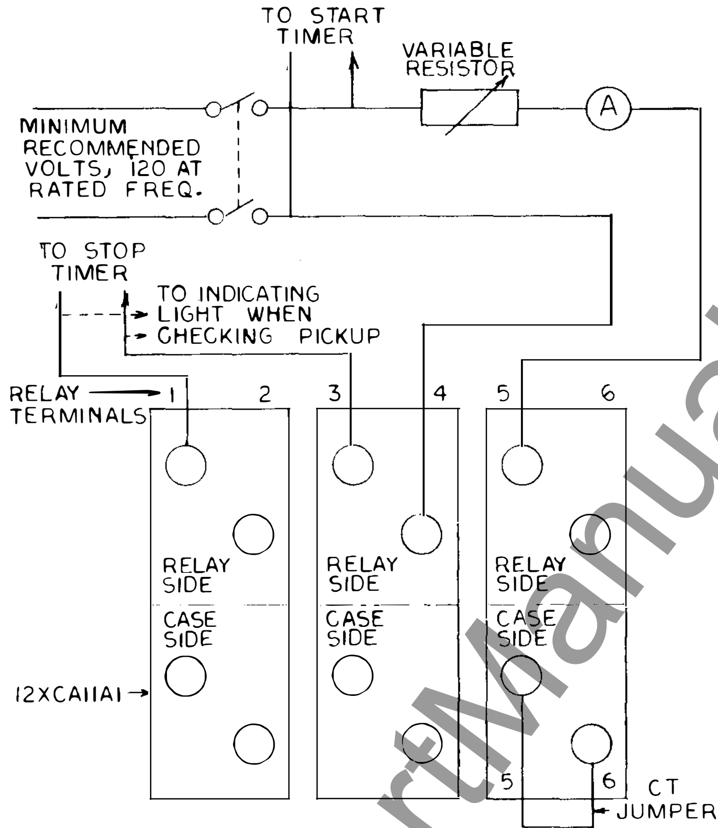
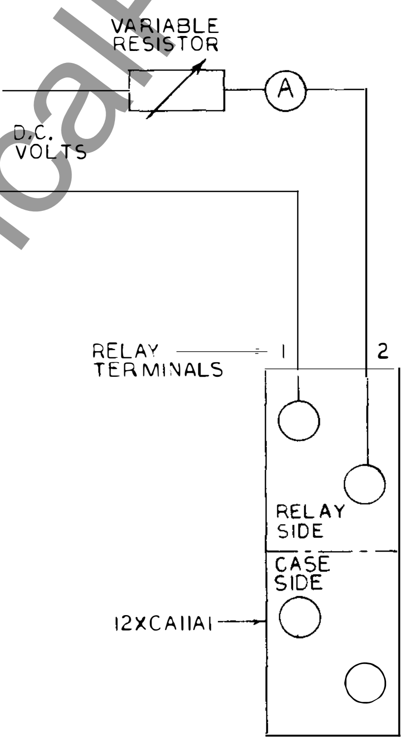


Figure 17 (0269A1788-1) Test Connections for Testing Pickup and Operating Times of the IFC Relay High-Seismic Instantaneous Unit



igure 18 (0269A1790-0) Test Connections for Testing the High-Seismic Target and Seal-in Unit Used with the IFC Relay

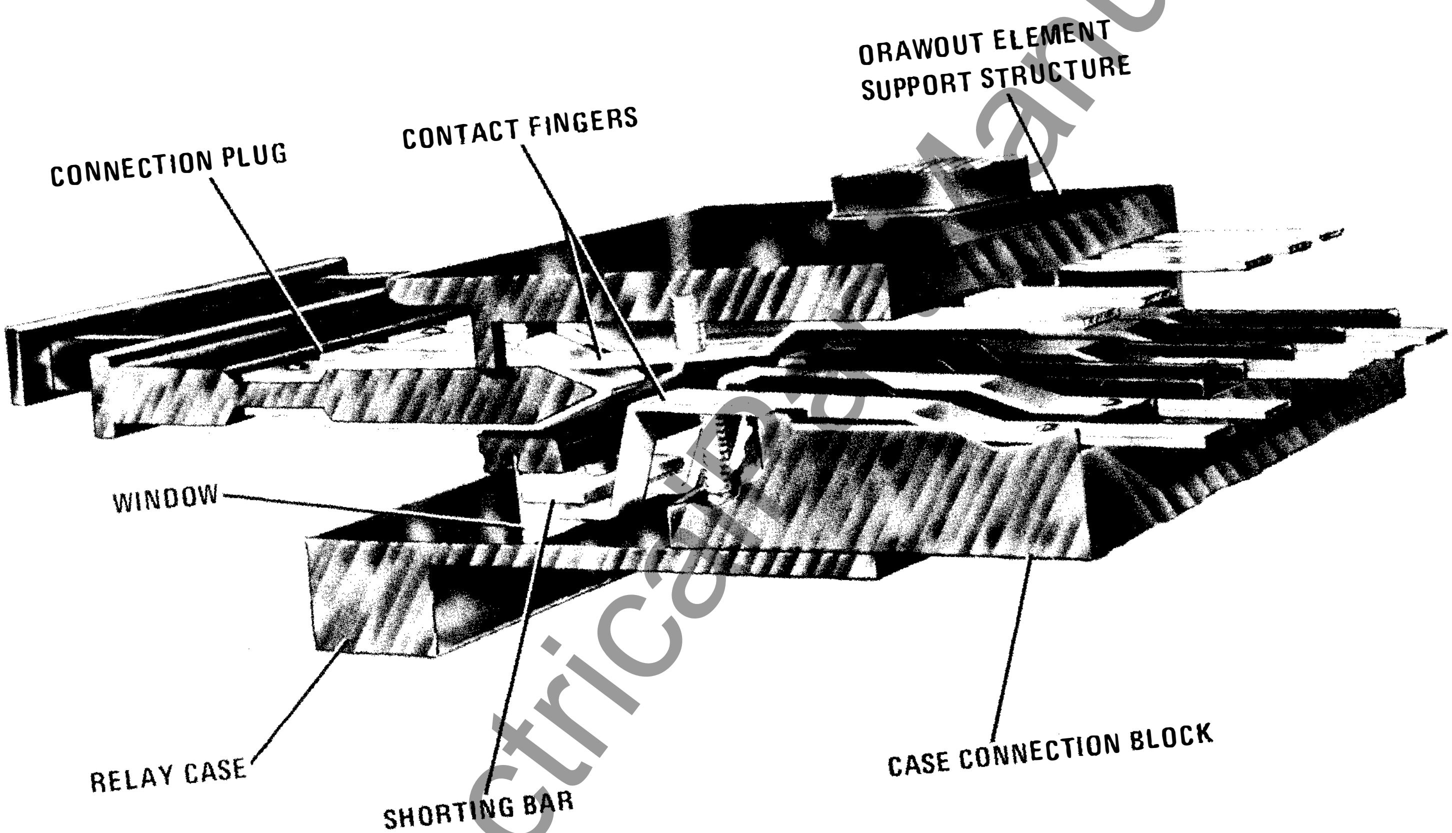


Figure 19 (8042715) Cross Section of IFC Drawout Case Showing Shorting Bar

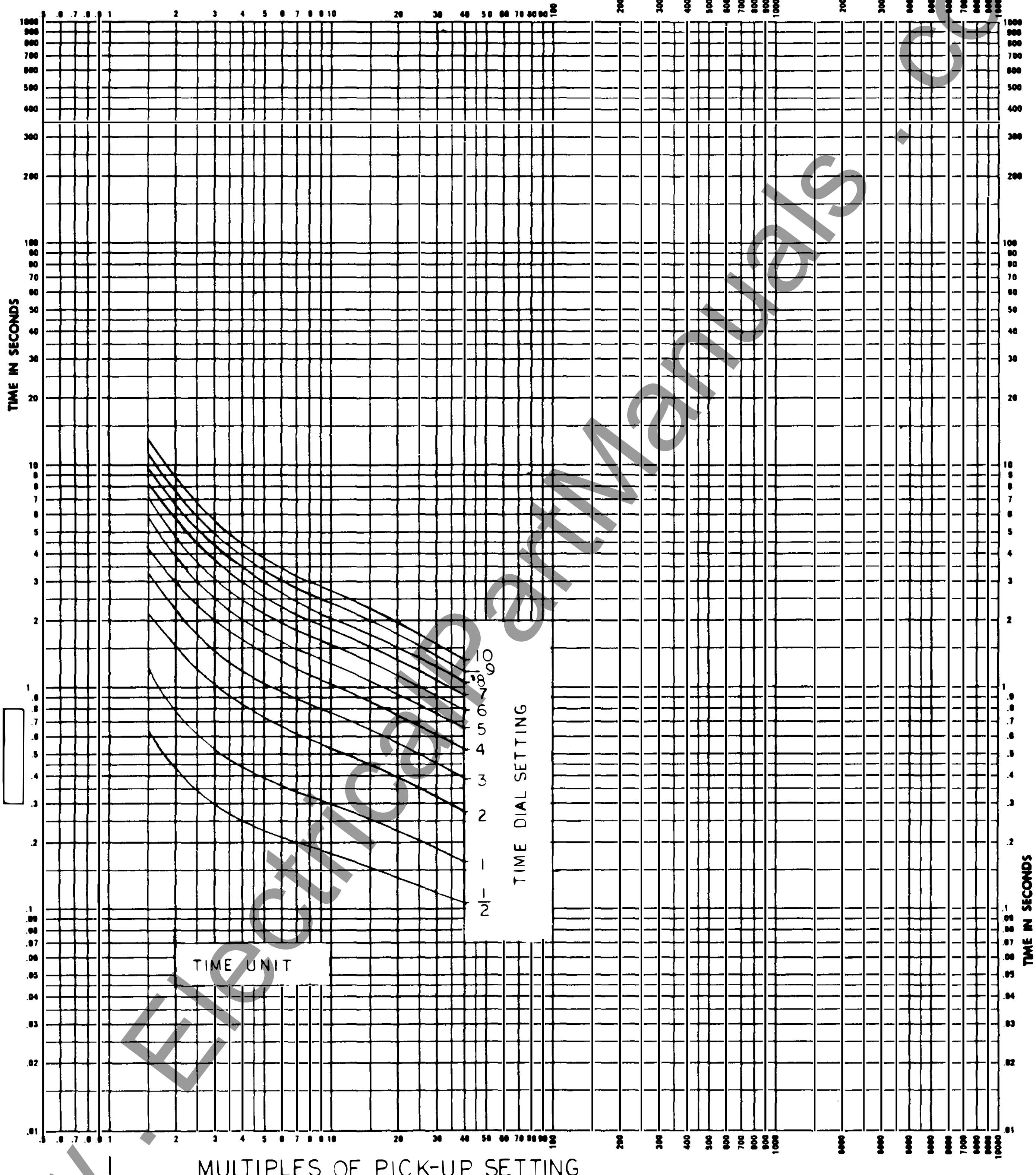


Figure 20 (0108B8973-0) 50 Hertz Time-Current Characteristics for Relay Types IFC51A and IFC51B

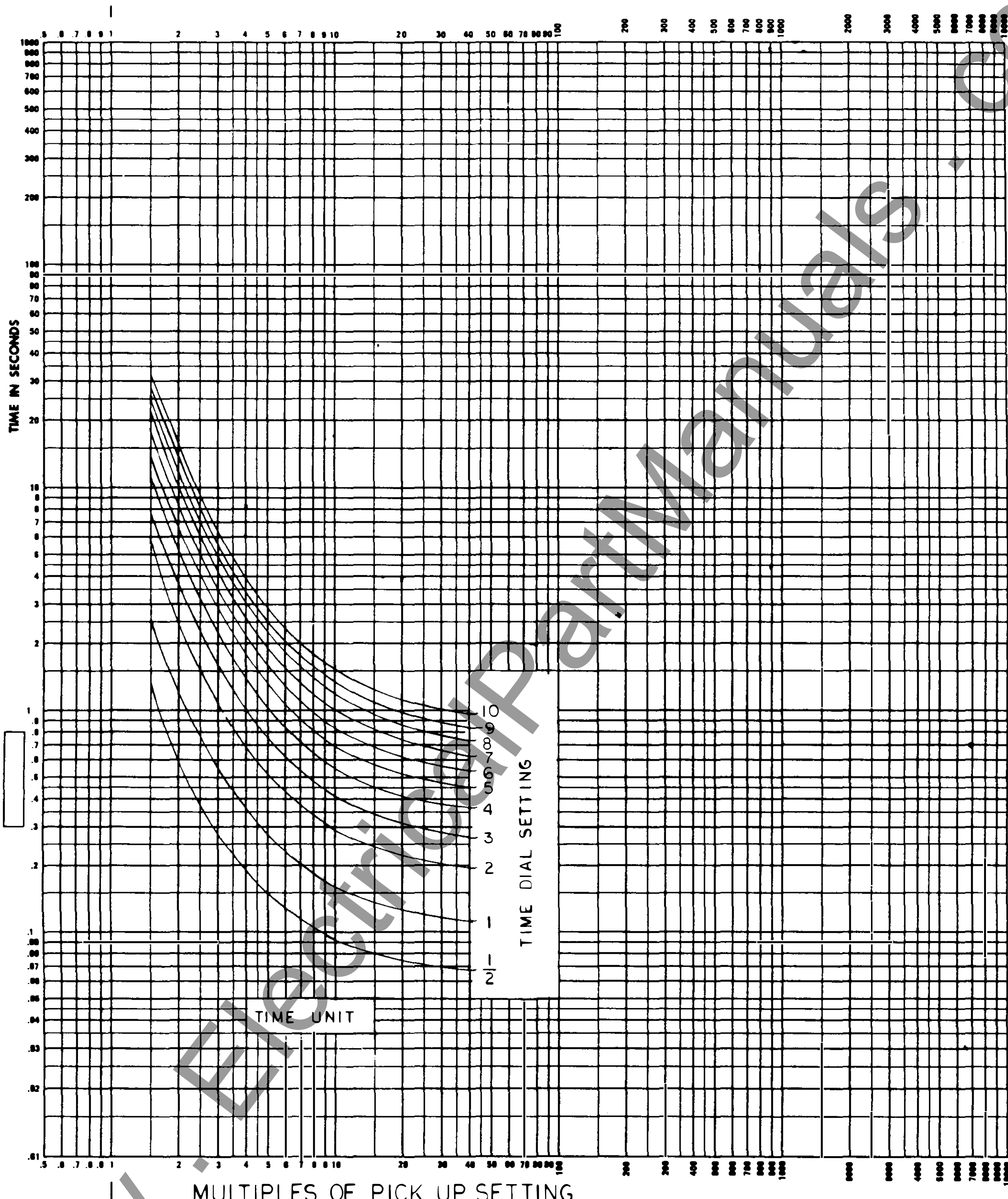


Figure 21 (0108B8974-0) 50 Hertz Time-Current Characteristics for Relay Types IFC53A and IFC53B

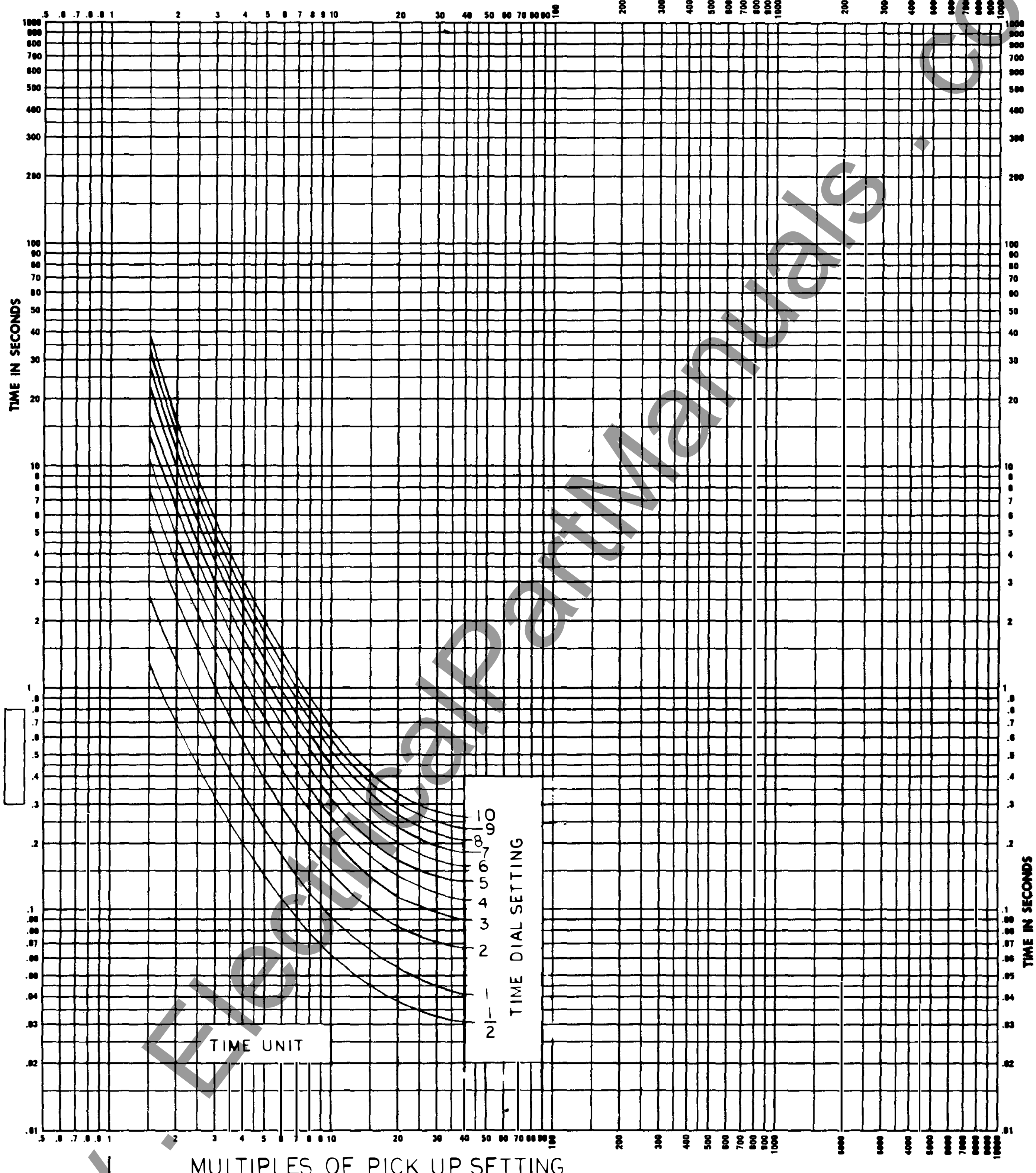


Figure 22 (0108B8975-0) 50 Hertz Time-Current Characteristics for Relay Types IFC77A and IFC77B

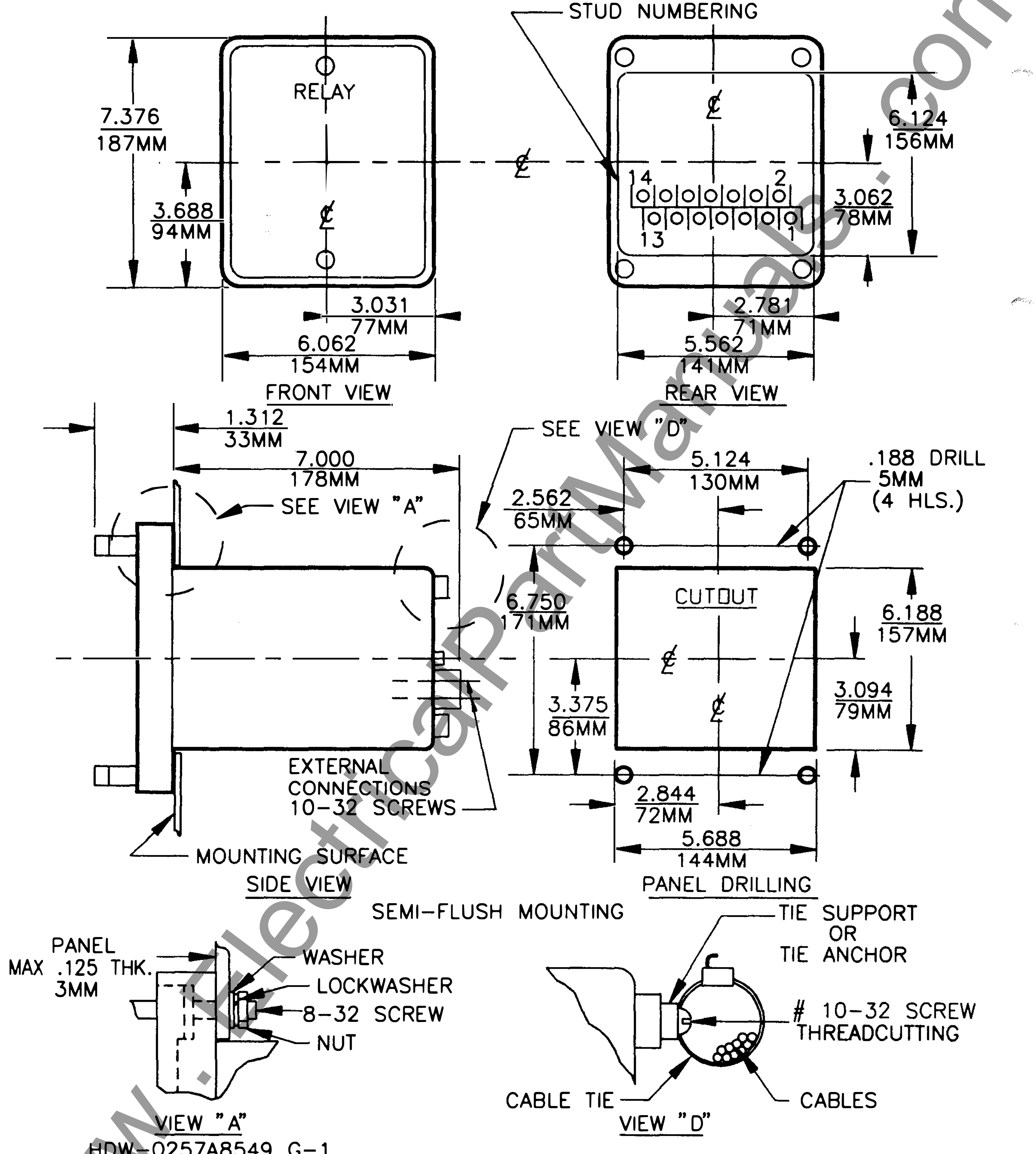


Figure 23 (0257A8452 Sheet 1 [6]) Outline & Panel Drilling for Semi-Flush Mounting of Relay Types IFC51, IFC53 and IFC77

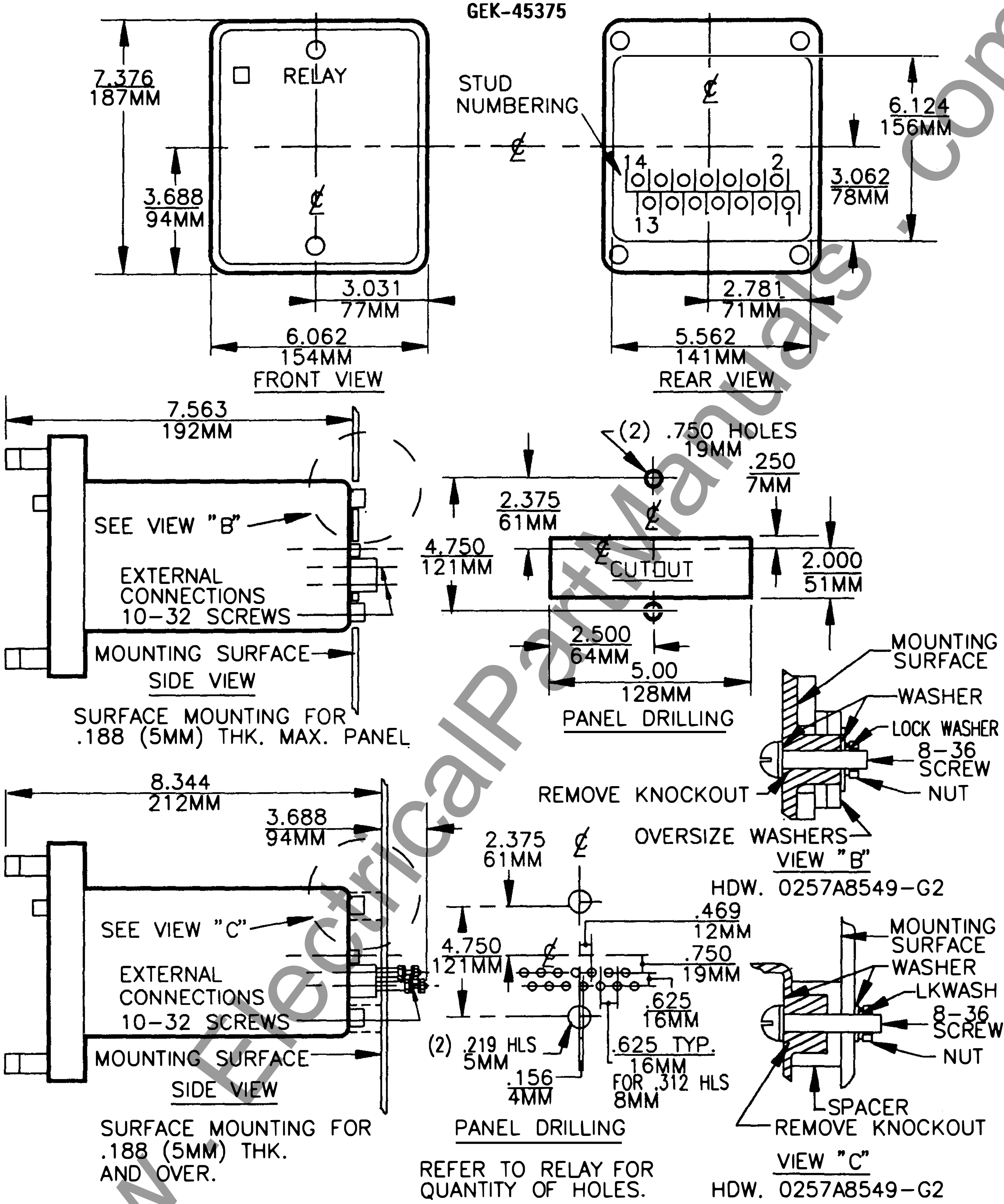


Figure 24 (0257A8452 Sheet 2 [6]) Outline & Panel Drilling for Surface Mounting of Relay Types IFC51, IFC53 and IFC77

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Protection and Control

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