INSTRUCTIONS

TIME OVERCURRENT RELAYS
WITH VOLTAGE RESTRAINT

TYPES

IFCV51AD
IFCV51BD

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CONTENTS

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TYPES

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DESCRIPTION

The Type IFCV51AD relay is a single-phase, extended range, very inverse time overcurrent relay with voltage restraint. The time overcurrent unit is similar to the IFC51A relay except that a voltage restraint U-magnet and coil has been added that produces a restraint torque that opposes the operating coil.

The IFCV51BD is similar to the IFCV51AD except that an instantaneous overcurrent is included. Figures 1 and 2 show the front and back views, respectively, of the IFCV51BD, with components identified by the nomenclature used throughout the text.

The relays are equipped with a dual-rated target and seal-in unit having two electrically separate contacts. They are mounted in a size C1 case of molded construction. The outline and panel drilling dimensions are shown in Figure 18 for semi-flush mounting, and in Figure 19 for surface mounting. When semi-flush mounted on a suitable panel, these relays have a high seismic capability.

The internal connections are shown in Figure 3 for the IFCV51AD, and in Figure 4 for the IFCV51BD.

APPLICATION

A system must be protected against prolonged generator contribution to a fault on the system. Such back-up protection is best made at the source of the contributing current, the generator. The IFCV relay is one of several relays designed specifically for this application, or applied to provide such back-up protection. Others are the Type IFCS voltage-controlled overcurrent relay, or three single-phase distance relays plus a timer (for balanced fault back-up protection), and the Type INC or SGC relays for unbalanced fault back-up protection.

The choice between the IFCV or the distance relays is determined primarily by the protective relaying, with which the generator back-up relays must be selective. For example, if the lines leaving the station bus are protected by very inverse time overcurrent relays, then Type IFCV relays should be used.

This would be typical of installations where the generator connects to the bus at generator voltage. On the other hand, unit generator-transformer installations generally connect to a high voltage system, on which distance or pilot relaying schemes are frequently used for the line protection. In such cases, distance relays such as the CEB13C, plus a timer, would be the usual choice for system back-up to provide coordination with the line relaying.

For the situations noted above, the recommended practice is to use three IFCV relays, one per phase, or three single-phase distance units plus a timer. In many cases, especially on larger machines, a negative sequence time overcurrent relay, Type INC or SGC, is installed to provide back-up protection against unbalanced system faults. In such cases a single Type IFCV relay, to protect against balanced system faults, could be considered as a minimum requirement.

In some applications it may be more advantageous to use a voltage-controlled Type IFCS relay rather than an IFCV. The IFCV can provide faster back-up protection than the IFCS, particularly in instances where the generator voltage does not drop significantly below rated voltage during fault conditions. On the other hand, if the generator voltage always drops below the setting of the undervoltage unit in the IFCS for all faults for which the generator back-up is required to operate, better sensitivity can be obtained by using the IFCS rather than the IFCV.

The current source for Type IFCV relays should be current transformers at the neutral end of the generator windings when such CT's are available. With these connections, in addition to external-fault back-up protection the relays will provide generator fault back-up protection even if the generator breaker is open or there are no other sources of generation on the system. If the neutral CT's are not available, then it will be necessary to use line-side CT's. With these connections, Type IFCV relays will be operative as fault back-up protection for the generator only when the generator breaker is closed, and there is another source of generation on the system.

Phase-to-phase voltage should be obtained from the generator potential transformers. Loss of potential to the Type IFCV relay will cause the relay to trip if the generator load current, expressed in relay secondary amperes, is greater than the pickup current of the relay. An additional relay, the Type CFVB, is available for protection against false tripping due to this accidental loss of the relay restraint voltage.

The diagram in Figure 5 shows typical external connections for the Type IFCV relays when the generator connects to the bus at generator voltage. If Type IFCV relays are applied on a unit generator-transformer installation, the external connections shown in Figure 6 are typical.

CALCULATION OF SETTINGS

Pickup with full voltage restraint of the Type IFCV relay should generally be set between 200% and 250% of full load current on regulated generators, and between 150% and 200% full load current on unregulated generators.

The relay time setting is determined by system selectivity requirements. Though the current decrement curves of the generator must be taken into consideration to determine the actual operating time of the Type IFCV relay, simplifying assumptions can be made which facilitate application of the Type IFCV relay and yet maintain a satisfactory operating performance. The maximum fault current condition for which time-current coordination must be obtained should be based on the transient reactance of the generator.

If the calculations are further based on the premise that for a bus fault the voltage presented to the Type IFCV relay is 0, then the Type IFCV can be coordinated with the bus and/or system relaying on a straight overcurrent basis. Coordination of the Type IFCV relay and other system relays for system faults where voltage will be presented to the Type IFCV relay is thereby assured. This conservative assumption of the zero-voltage fault is equally applicable to the unit generator-transformer case, even though the IFCV restraint voltage may come from generator potential transformers. The justification for this application assumption is its inherent conservatism, and the basic fact that the operating characteristic of the Type IFCV relay is fairly constant for all low-voltage conditions.

CONSTRUCTION

The IFCV 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 and 2. Figures 1 and 2 show the induction unit mounted to the molded support structure. This disk is activated by a current-operated coil mounted on a laminated U-magnet and restrained by a voltage-operated coil mounted on a laminated U-magnet. The disk and shaft assembly carries a moving contact that completes the alarm or trip circuit when it touches a stationary contact. The disk assembly is restrained by a spiral spring to give proper contact closing and 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 17, 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.

The CT shorting bar is engaged by the current circuit fingers (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 voltage circuit and current circuit fingers on the case, and finally those on the relay support structure, to completely de-energize the drawout element.

There is a High-Seismic target and seal-in unit mounted to the front left of the support structure. The seal-in unit has two electrically-separate contacts, one of which is in series with its coil and in parallel with the contacts of the induction 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 presing a button located on the upper left side of the cover.

The IFCV51BD model relays, in addition to the above, contain a High Seismic instantaneous unit (see Figure 1). The instantaneous unit has two electrically separate contacts and is mounted to the front right of the support structure. 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.

Magnetic shields, depicted in Figure 1, are mounted to the support structure 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 rate 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 Guide for Seismic Testing of Relays, STD 501-1978.

RATINGS

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

INDUCTION UNIT

The current coil ratings are given in Table I.

TABLE I - 2-16 AMPERE TAP RANGE

TAP	2	2.5	3	4	5	6	8	10	12	16
Continuous Current Rating	3.8	4.4	4.9	5.4	6.0	6.5	7.0	7.6	8.1	8.5

The relay will pick up at the tap value when rated voltage is applied to the restraint circuit. With 0 voltage on the restraint circuit, the relay will pick up at 25% trip value. Figure 7 shows the pickup current required for any value of restraint voltage.

The voltage restraint coil is rated continuously for the nameplate voltage at rated frequency.

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

TABLE II

Model	Time Overcurrent Unit (Amperes)	One-Second Rating Any Tap (Amperes)	K
IJCV51	2-16	128	16,384

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 1 and Table III.

TABLE III

High-Seismic Instantaneous Unit (Amps)	Link Position	**Range (Amps)	Continuous Rating (Amps)	One Second Rating*** (Amps)	K
6-150	L	6-30	10.2	260	67,600
6-150	H	30-150	19.6	260	67,600

** The range is approximate, which means that the 6-30, 30-150 may be 6-28, 28-150. 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 continuous and short-time ratings.

*** 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 II and III 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 IV.

TABLE IV

		TAP 0.2	TAP 2.0
DC Resistance ±10%	(ohms)	8.3	0.24
Minimum Operating	(amperes)	0.2	2.0
Carry Continuously	(amperes)	0.37	2.3
Carry 30 amps for	(seconds)	0.05	2.2
Carry 10 amps for	(seconds)	0.45	20
60 Hertz impedance	(ohms)	50	0.65
50 Hertz impedance	(ohms)	42	0.54

If the tripping currrent 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

INDUCTION UNIT

The potential burdens at rated voltage and rated frequency are given in Table V.

TABLE V

Volts	Freq.	Watts	Vars	Volt Amps
120	50	9.26	14.4	17.1
120	60	9.43	17.3	19.7

The current circuit burdens with 5 amperes flowing in the lowest tap are listed in Table VI. The burden on any other tap with 5 amperes flowing is approximately (Lowest Tap/Actual Tap)^2 times the burden for the lowest tap.

TABLE VI

Range	Frequency	Tap	Amp	Impedance Ohms	VA	PF
2-16	50	2	5	2.58	77.5	0.43
2-16	60	2	5	3.10	66.5	0.43

HIGH-SEISMIC INSTANTANEOUS UNIT

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

TABLE VII

Hi-Seismic Inst. Unit (Amps)	Hz	Link Position	Range (Amps)	Min. Pickup (Amps.)	Burdens at Min. Pickup (Ohms)			Burdens in Ohms (Z) Times Pickup		
					R	Jχ	Z	3	10	20
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
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

INDUCTION UNIT

TABLE VIII - Tap Connections

Zero Volts	0.5	0.625	0.75	1.0	1.25	1.5	2.0	2.5	3.0	4.0
120 Volts	2.0	2.5	3.0	4.0	5.0	6.0	8.0	10.0	12.0	16.0
Taps	A	A	A	C	A	F	A	G	A	A
	H	G	F	F	E	H	D	H	C	B

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 that connect to the tap block at the top of the support structure (see Figure 1). The tap block is marked A through H. See the nameplate on the relay for tap settings.

The relay will pick up at tap value when rated voltage is applied to the restraint circuit. With 0 voltage on the restraint circuit, the relay will pick up at 25% tap value. Figure 7 shows typical pickup current required for any given value of restraint voltage. Pickup is affected by the phase angle of the fault current. A typical phase angle characteristic is shown in Figure 8.

Operating Time Accuracy

The IFCV relays should operate within ± 7% or ± 0.050 second, whichever is greater. Figures 9 and 10 show the time-current characteristics for IFCV 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.

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 12.

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 recept 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.**

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

VISUAL INSPECTION

Check the nameplate to insure that the model number and rating of the relay agree with the requisition.

Remove the relay from its case and check that there are no broken or cracked parts or any 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 inch 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. CAUTION: SHOULD THERE BE A NEED TO TIGHTEN ANY SCREWS, DO NOT OVER TIGHTEN, TO PREVENT STRIPPING.

DRAWOUT RELAY TESTING

IFCV relays may be tested without removing them from the panel by using either the 12XCA28A1 or 12XCA11A1 test probes. The test probes make connections to both the relay and 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 jumper. See the test circuit in Figure 13. The test probes are different in the number of connections that can be made. The 12XCA28A1 has a full complement of 28 connections and the 12XCA11A1 has four. Refer to instruction book GEK-49803 for additional information.

POWER REQUIREMENTS, GENERAL

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

Therefore, in order to test AC relays properly 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 14 to 16, is recommended.

INDUCTION 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-dial setting, there should be sufficient gap between the stationary contact brush and its metal backing strip to ensure approximately 1/32 inch 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. 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 9 and 10 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 (drag) 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 the 0.5 time-dial position and the lowest tap. Using the test connections in Figure 14, the main unit should close the contacts within ± 3% of tap value current with 100% restraint voltage applied.

Time Test

Set the relay to the 10 time-dial position and the lowest tap. With 0 restraint voltage, apply 1.25 times tap current to the relay. The relay operating time to close its contact should be between 3.53 and 3.87 seconds.

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 internal connections diagram, Figure 4, and connect as indicated in the test circuit of Figure 15. 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 III 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 III) must be obtained between a core position of 1/8 of a turn of "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 shipped 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 16) to a DC source, ammeter and load box, so that the current can be controlled over a range of 0.1 to 2.0 amperes.

2. Turn the time dial to the zero (0) time-dial position.

3. Increase the current slowly until the seal-in unit picks up. See Table IX.

4. Move the time dial away from the zero (0) 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 IX.

TABLE IX

Tap	Pickup Current	Dropout Current
0.2	0.12-0.20	0.05 or more
2.0	1.2 -2.0	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 for semi-flush mounting are shown in Figure 18 and those for various methods of surface mounting are shown in Figure 19.

The internal connection diagrams for the relays are shown in Figures 3 and 4. Typical external connections are shown in Figures 5 and 6.

INSTALLATION TESTS

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

Induction Unit

1. Perform the Pickup Test as outlined in the **ACCEPTANCE TESTS** section.

2, Check the operating time at some multiple of tap value (this value used is left to the discretion of the user) and desired time-dial setting with zero (0) or 100% restraint voltage.

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, Figure 3 or 4.) 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 HIGH-SEISMIC INSTANTANEOUS UNIT in the **ACCEPTANCE TESTS** section.

High-Seismic Target and Seal-in Unit

1. Make sure that the tap screw is in the desired tap.

2. Perform Pickup and Dropout Test as outlined in the **ACCEPTANCE TESTS** section.

PERIODIC CHECKS AND ROUTINE MAINTENANCE

In view of the vital role of protective relays in the operation of a power system, it is important that a periodic test program be followed. It is recognized that the interval between periodic checks will vary depending upon environment, type of relay, and the user's experience with periodic testing. Until the user has accumulated enough experience to select the test interval best suited to his individual requirements, it is suggested that the points listed below be checked at an interval of from 1 to 2 years.

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

INDUCTION UNIT

1. Perform pickup test as described in the **INSTALLATION** section for the tap setting in service.

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

HIGH-SEISMIC INSTANTANEOUS UNIT

1. Check that the instantaneous unit picks up at the desired current level, as outlined in Setting the High-Seismic Instantaneous Unit 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 IX.

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

CONTACT CLEANING

A flexible burnishing tool should be used for cleaning relay contacts. This is a flexible strip of metal with an etched-roughened surface, which in effect resembles a superfine file. The polishing action of this file is so delicate that no scratches are left on the contacts, yet it cleans off any corrosion thoroughly and rapidly. The flexibility of the tool insures the cleaning of the actual points of contact. Relay contacts should never be cleaned with knives, files, or abrasive paper or cloth.

SYSTEM TEST

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

SERVICING

INDUCTION UNIT

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

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 inch 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 Step 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 Step 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 inch and permit proper end play. The shaft must have 0.005-0.010 inch 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 should clear the gap surfaces by 0.010 inch and be within 0.005 inch 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 inch 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 Setting and Time Test above (see **ACCEPTANCE TEST** section).

Pickup Tests

Rotate the time dial to the 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 the No. 0 time setting, there should be sufficient gap between the stationary contact brush and its metal backing strip to ensure approximately 1/32 inch 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 9 and 10 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, Figure 14.

The relay is first set for pickup current at 0 restraint volts. Follow the procedure below:

1. Set the tap block for the lowest tap position.

2. Connect the relay as shown in Figure 14.

3. With 0 restraint voltage, adjust the control spring so that the contacts just close at 25% of tap value. It should never be necessary to wind up the control spring adjuster more than 30° (one notch) or unwind it more than 120° (three notches) from the factory setting to obtain the above pickup setting.

Now the relay may be set to pick up at the particular value of restraint voltage shown below.

4. Apply restraint voltage. Note that Terminal 7 must be connected to the same side of power as Terminal 5.

5. Adjust the load box so that tap value of current is flowing in the current circuit.

6. Adjust the slide-band resistor at the back of the relay until the contacts just close for the restraint voltage required.

Time Setting

Set the relay to the 10 time-dial position and the lowest tap. With 0 restraint voltage, apply 1.25 times tap current to the relay. The relay operating time to close its contact should not exceed the range from 3.53 to 3.87 seconds; however, it would be preferable to adjust the operating time as near as possible to 3.7 seconds. Moving the drag magnet assembly toward the disk and shaft decreases the operating time and moving the drag magnet assembly 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.

HIGH-SEISMIC INSTANTANEOUS UNIT

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

2. Both contacts should close at the same time.

3. The backing strip should be so formed that the forced end (front) bears against the molded strip under the armature.

4. 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 inch wipe on the contacts. Check this by inserting a 0.010 inch feeler gage between the front half of the shaded pole with the armature held closed. Contacts should close with feeler gage in place.

HIGH-SEISMIC TARGET AND SEAT-IN UNIT

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

Check Steps 2 and 3 as described under INSTANTANEOUS UNIT.

To check the wipe of the seal-in unit, insert a 0.010 inch feeler gage between the pastic residual of the armature and the pole piece, with the armature held closed. Contacts should close with feeler gage in place.

RENEWAL PARTS

It is recommended that sufficient quantities of renewal parts be carried in stock to enable the prompt replacement of any that are worn, broken or damaged.

When ordering renewal parts, address the nearest Sales Office of the General Electric Company, specifying quantity required, name of the part wanted, and the complete model number of the relay for which the part is required.

LIST OF FIGURES

Since the last edition, Table VIII and Figures 18 and 19 have been changed.

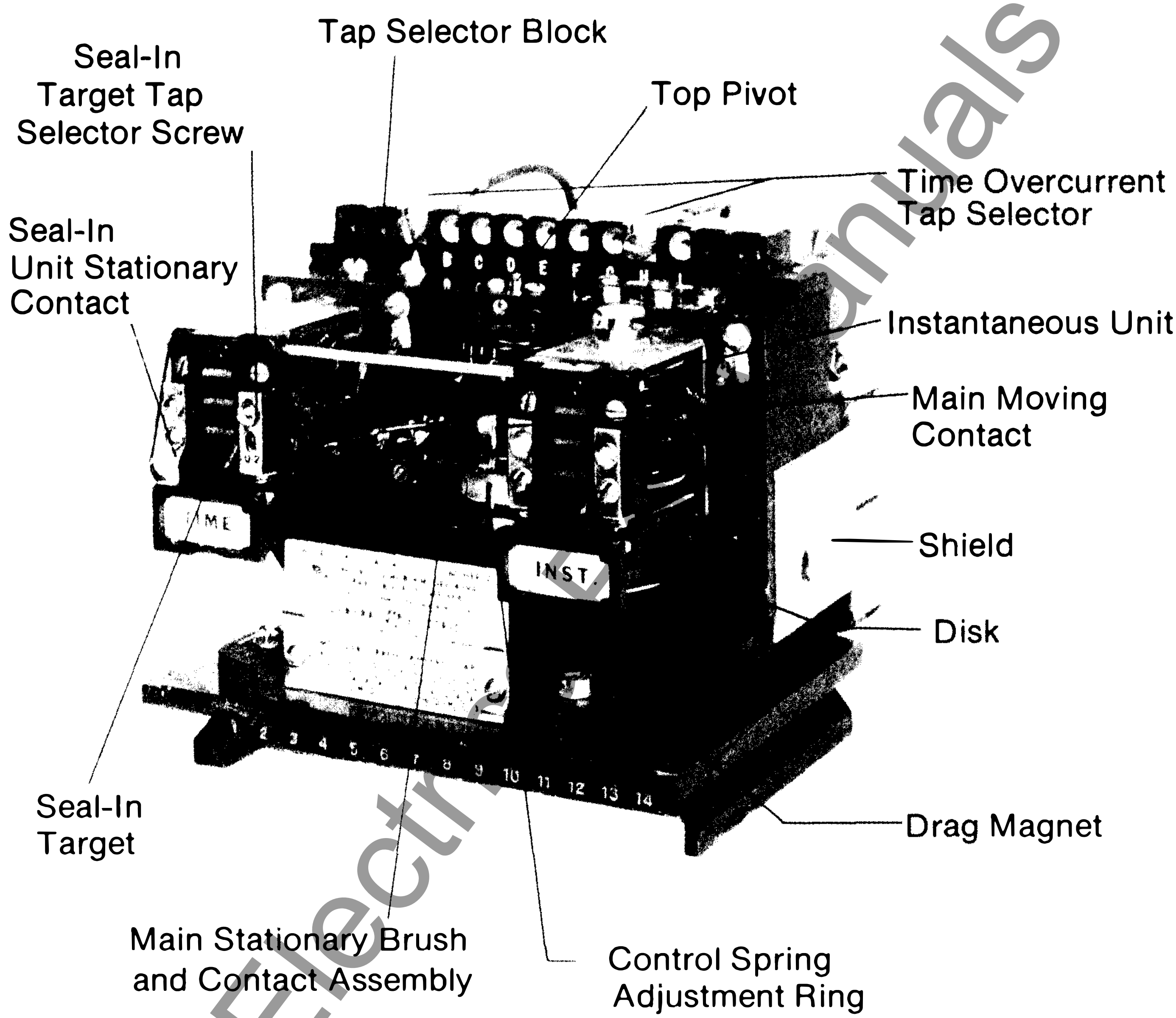


Figure 1 (8043510) IFCV51BD Relay, Removed from Case, Front View

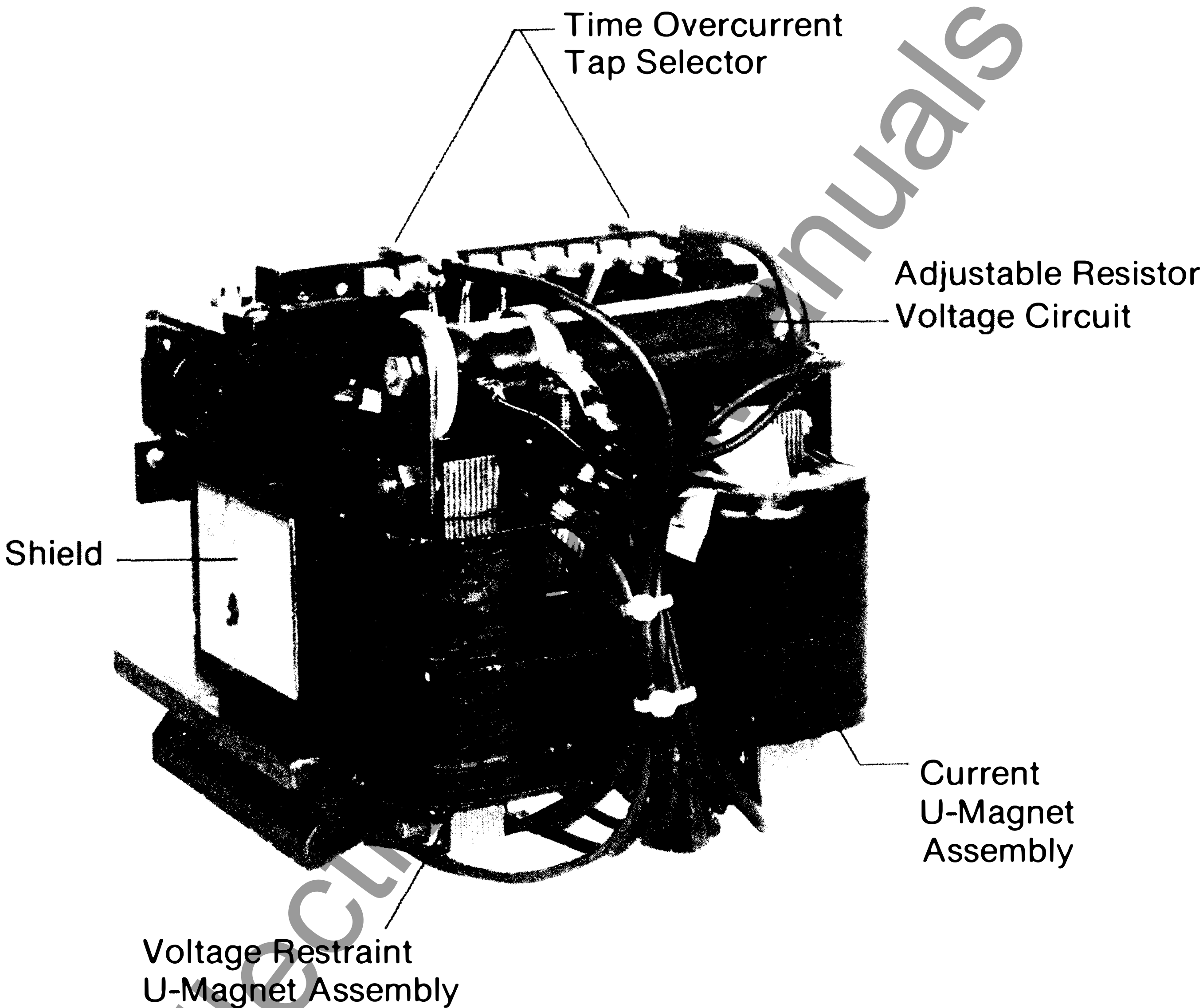


Figure 2 (8043511) IFCV51BD Relay, Removed from Case, Rear View

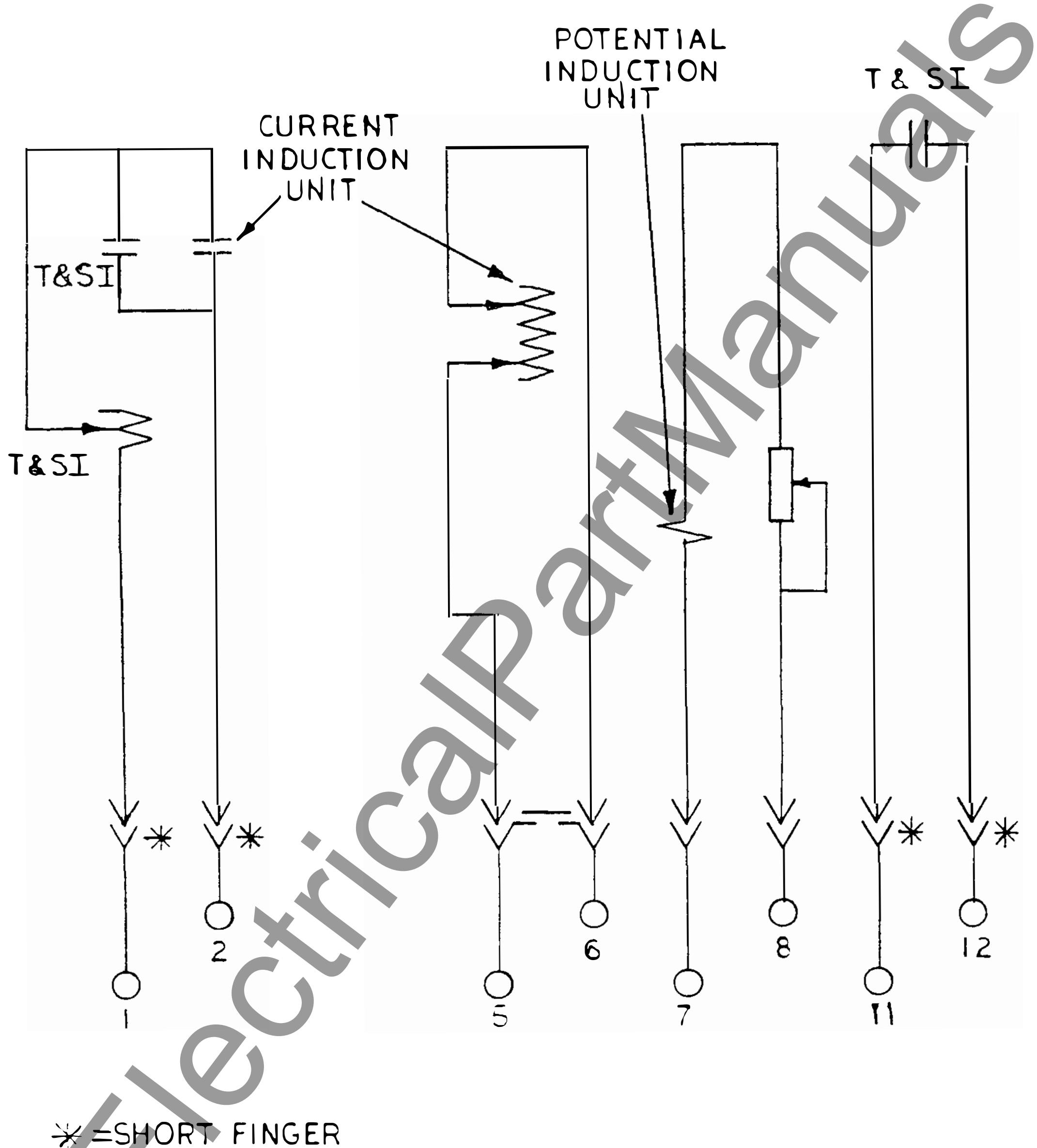


Figure 3 (0273A9599-2) Internal Connections for Relay Types IFCV51AD - Front View

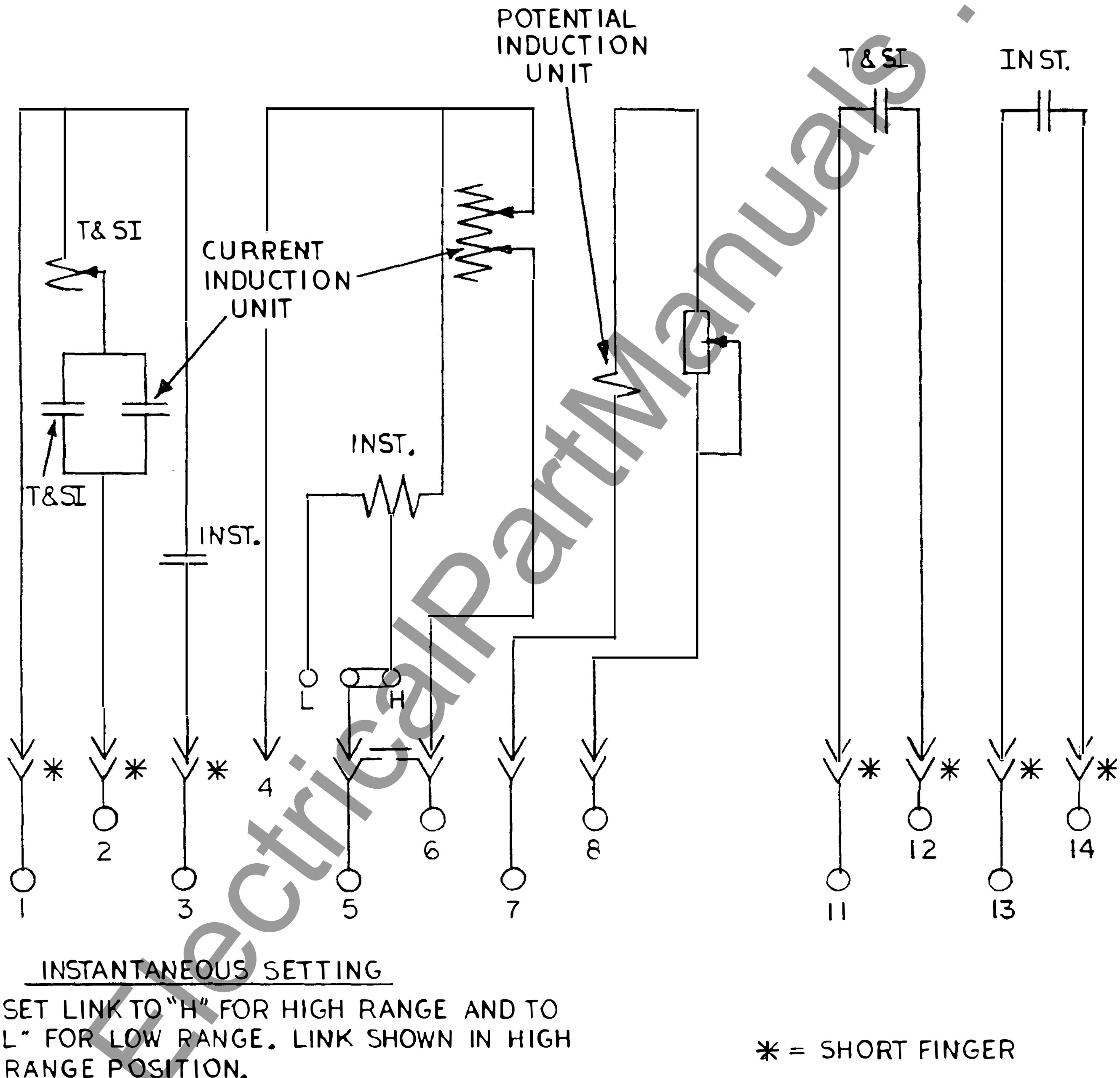


Figure 4 (0275A3203-2) Internal Connections for Relay Types IFCV51BD - Front View

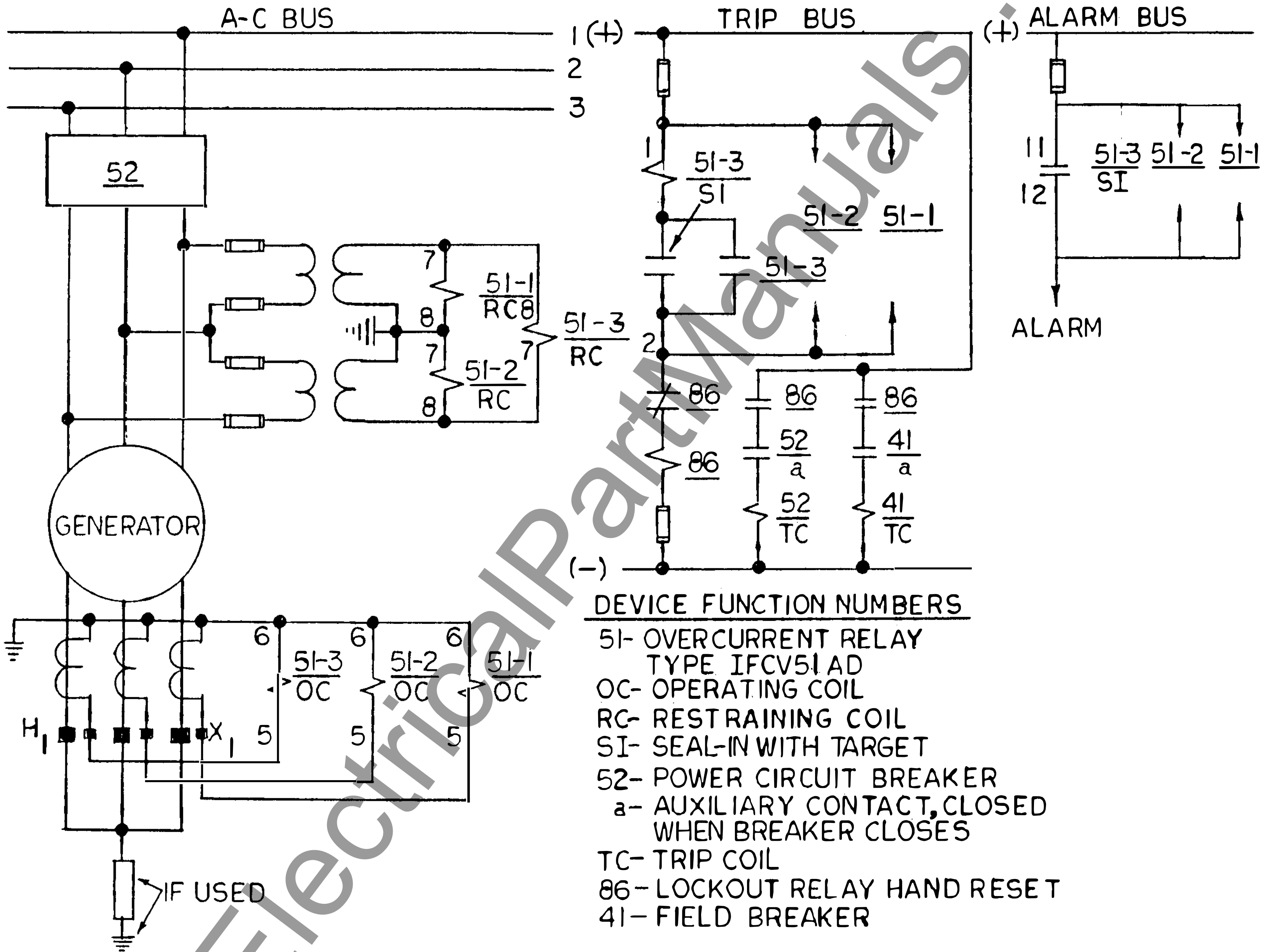


Figure 5 (0275A4451-0) External Connections, IFCV51AD

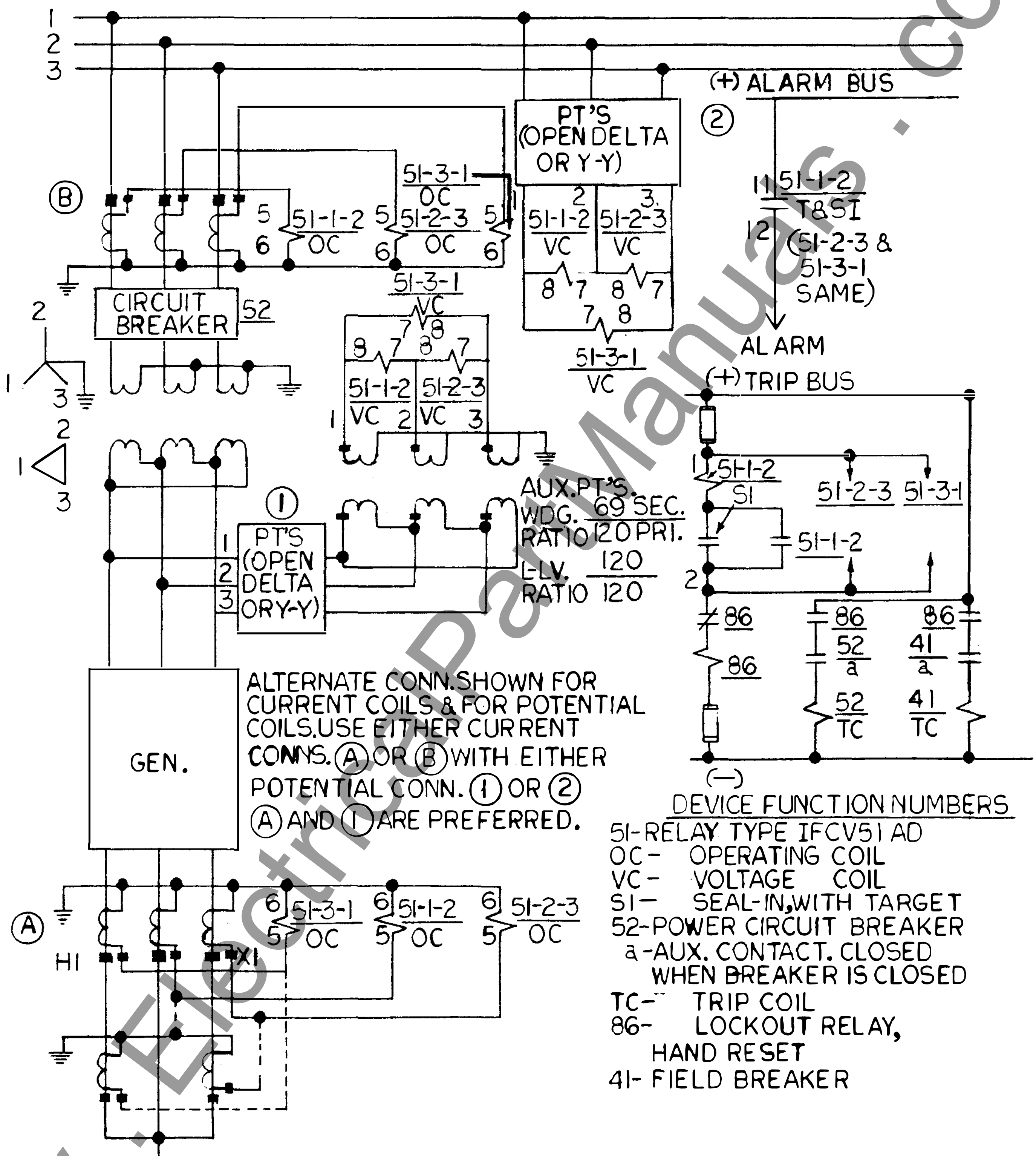


Figure 6 (0275A4494 [1]) External Connections

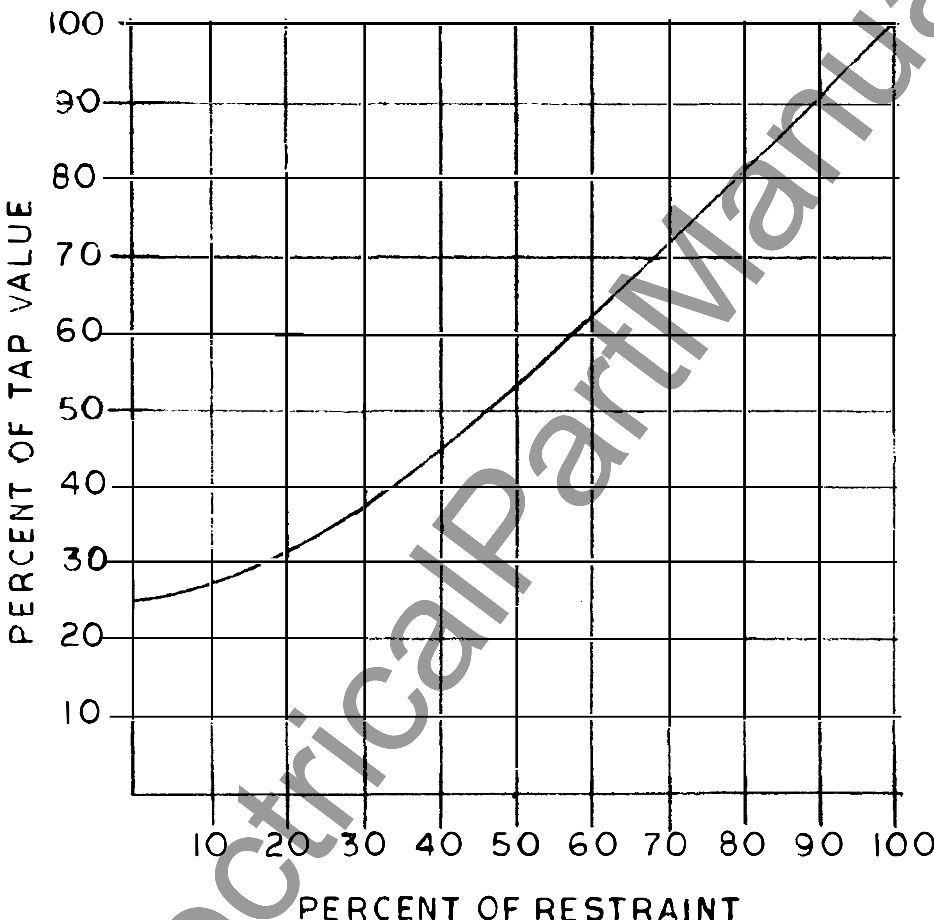


Figure 7 (0275A4560-0) Typical Pickup Characteristics of the IFCV Relays

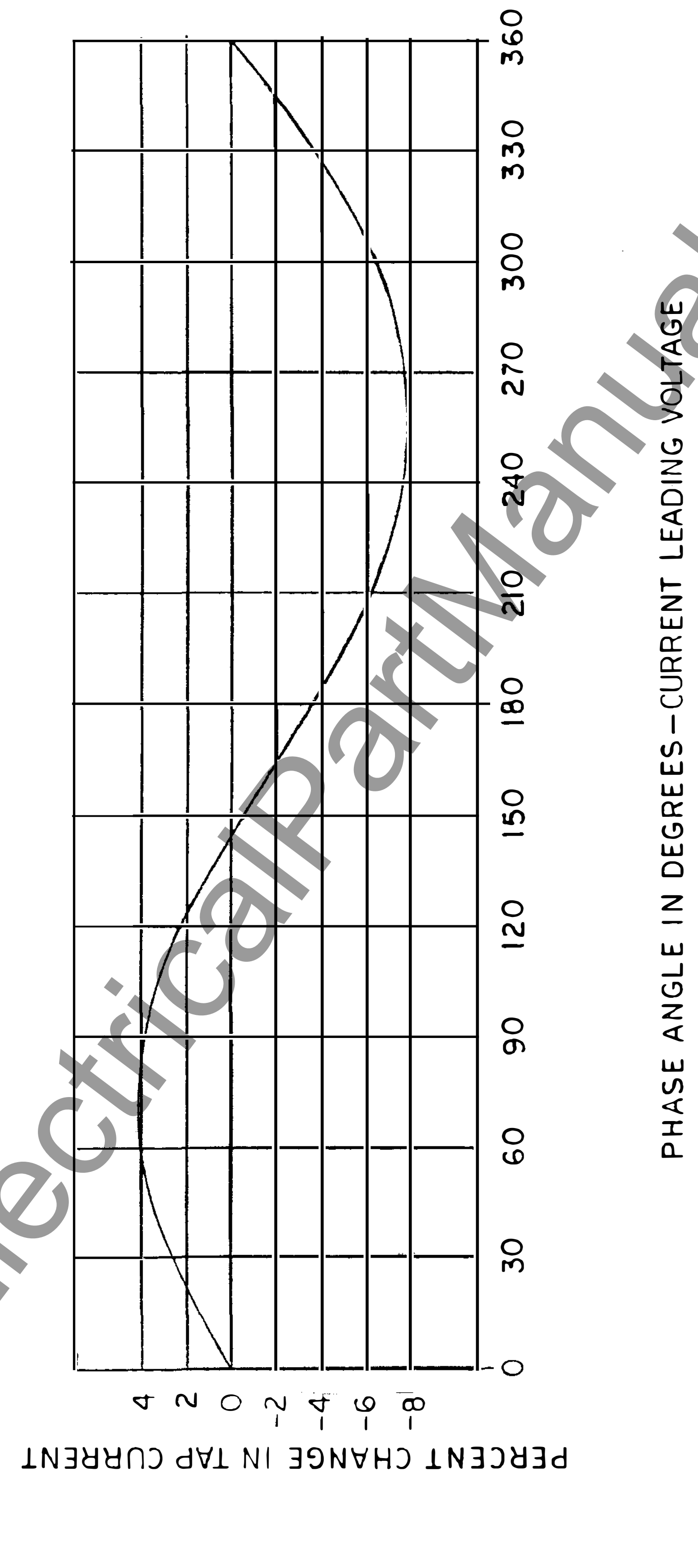


Figure 8 (0275A4545-0) Typical Phase Angle Characteristics of the IFCV Relays

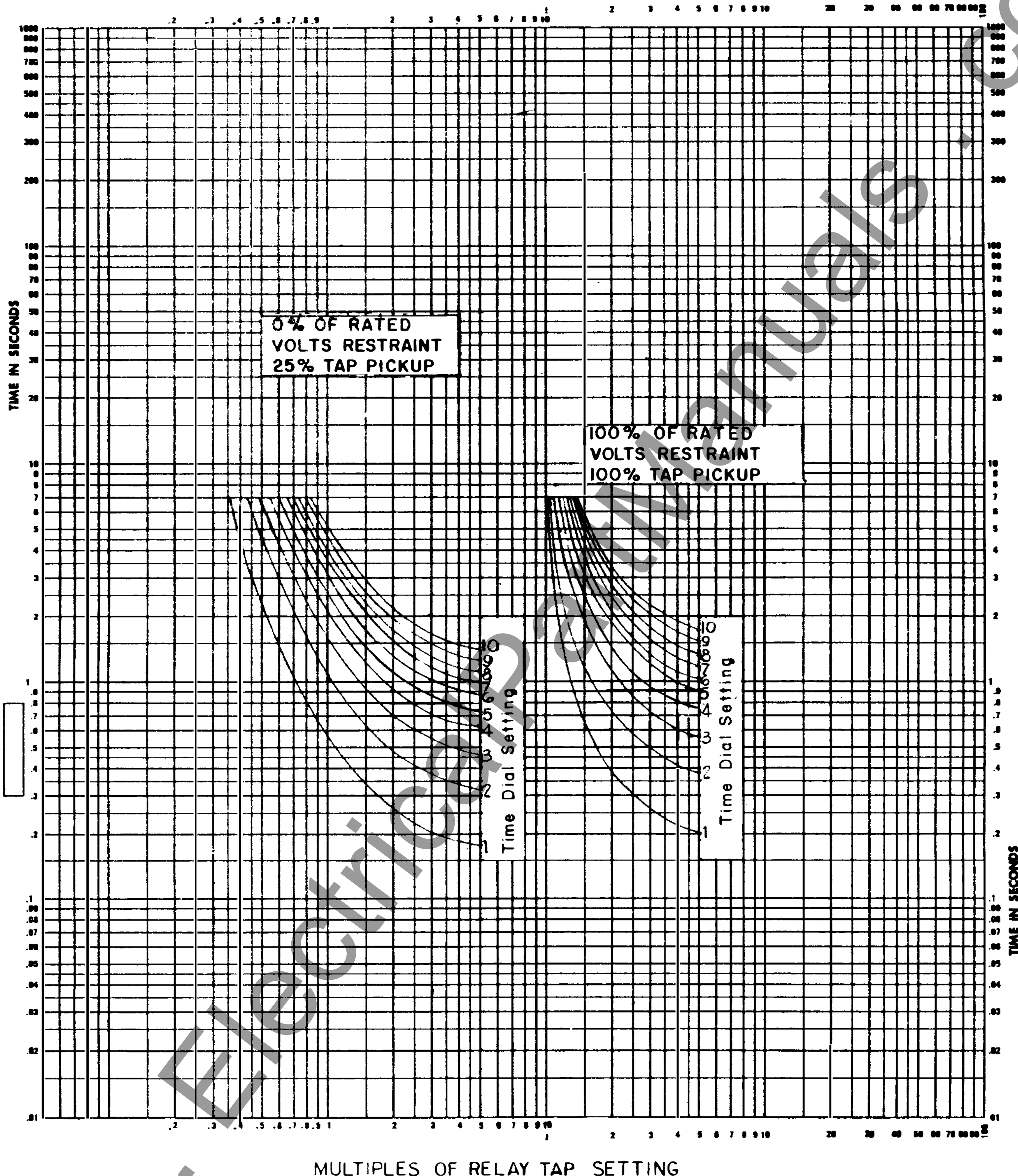


Figure 9 (0138B7322-0 Sh. 1) Time-current Characteristics

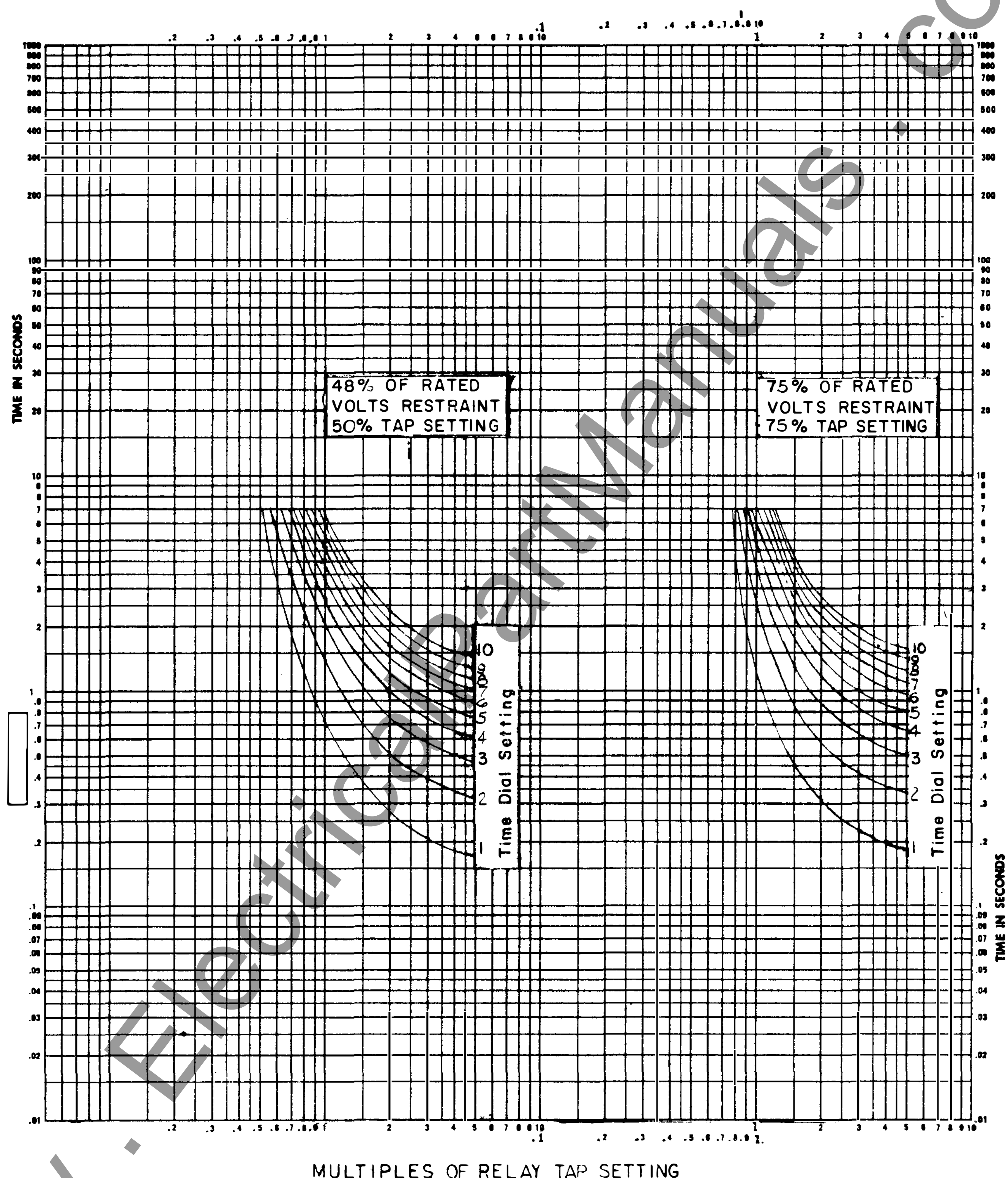


Figure 10 (0138B7322-0 Sh. 2) Time-current Characteristics

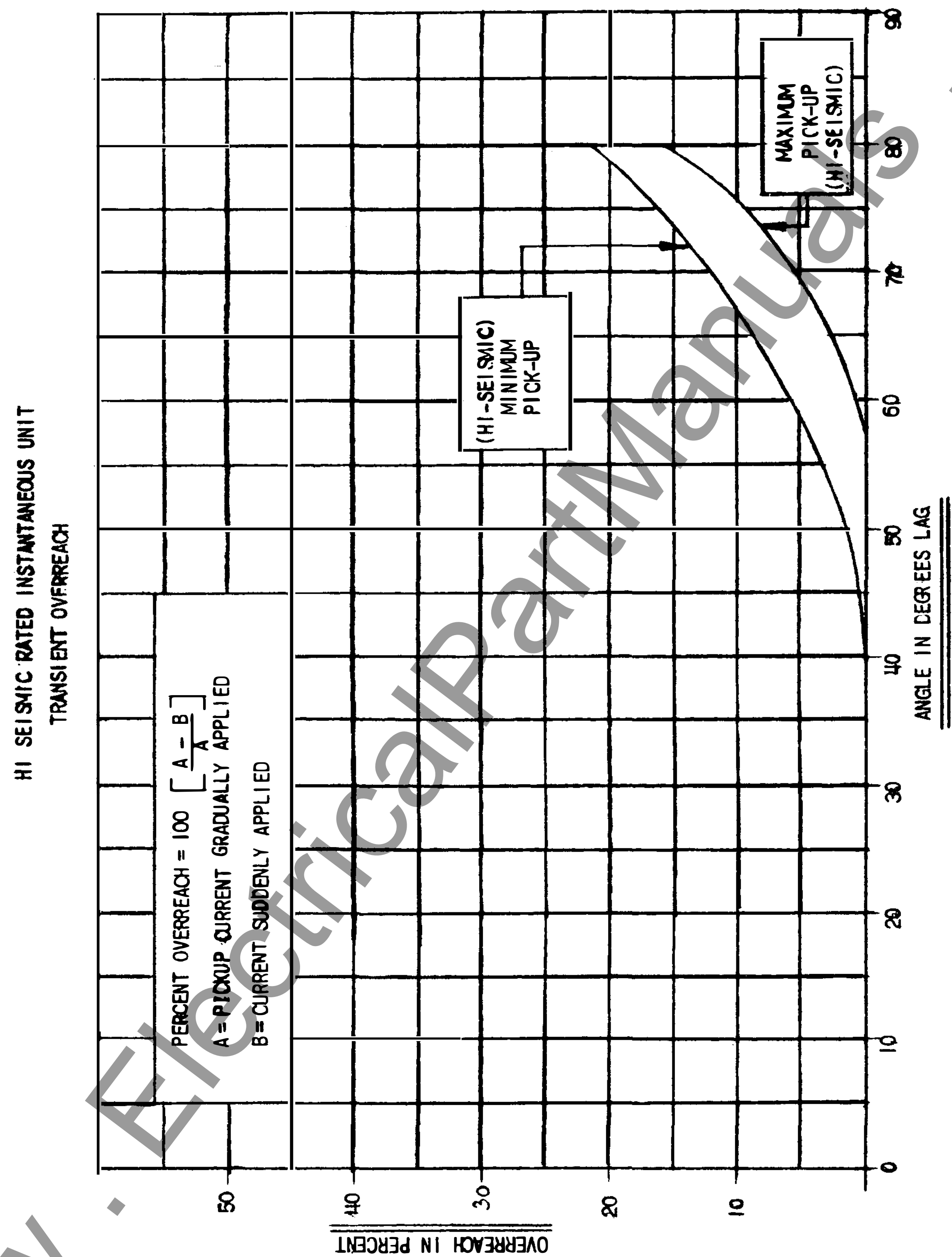


Figure 11 (0208A8694-2) Transient Overreach Characteristics of the High-Seismic Instantaneous Unit

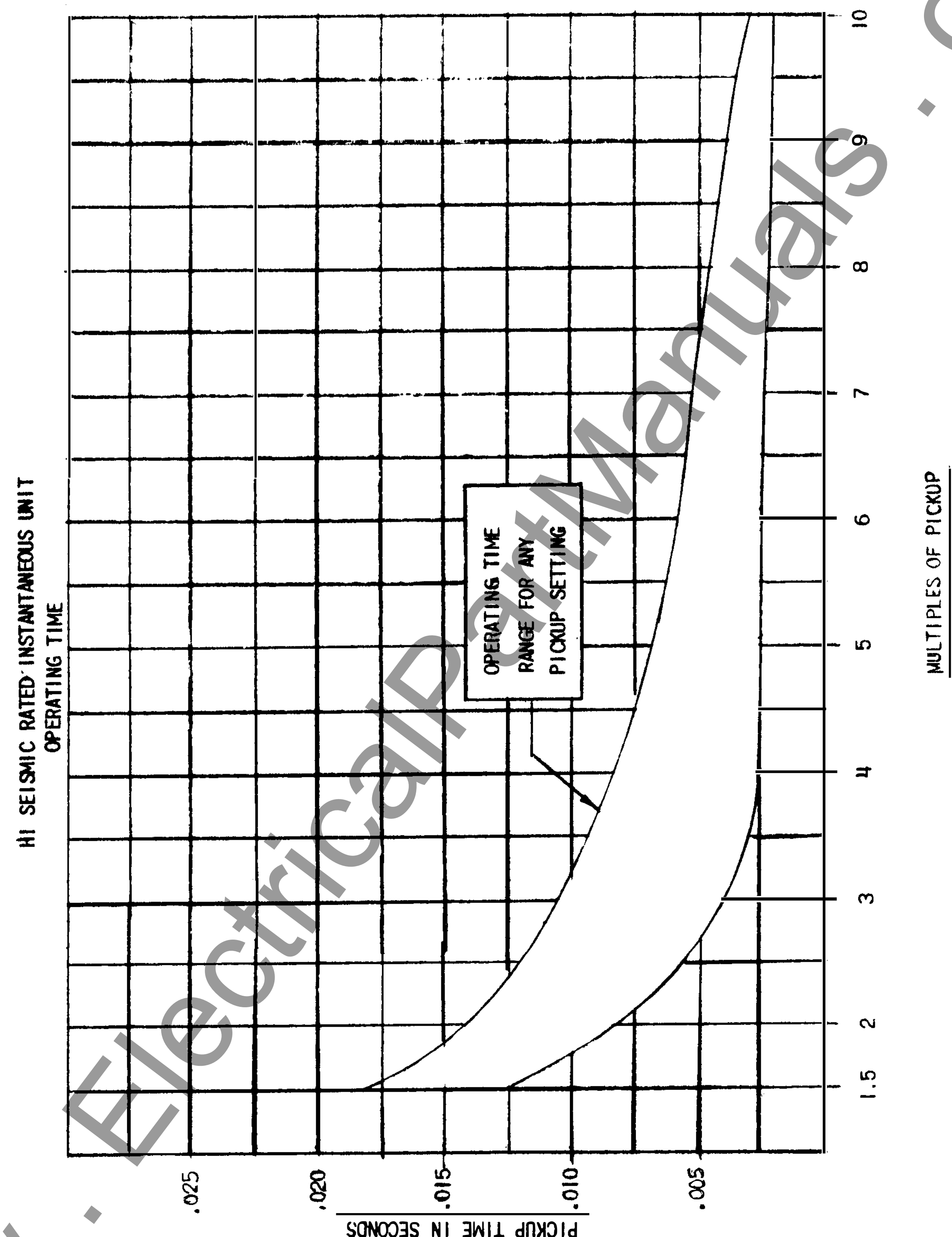
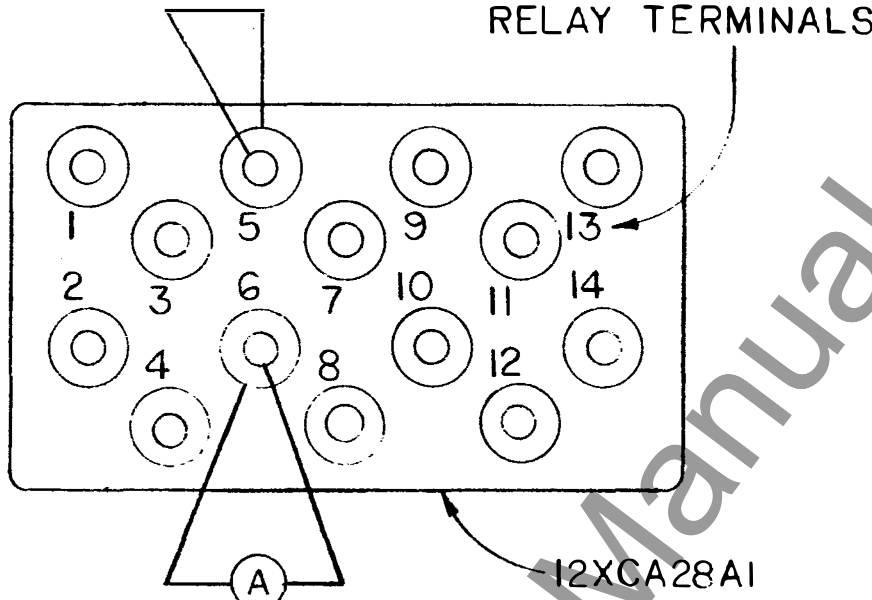
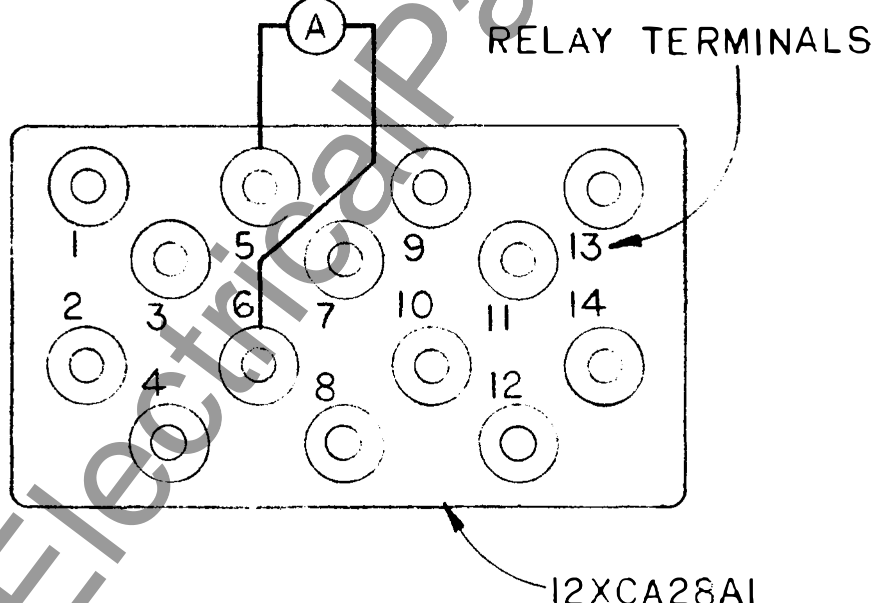


Figure 12 (0208A8695-1) Time-current Characteristics
of the High-Seismic Instantaneous Unit



RELAY COIL IN CIRCUIT



RELAY COIL NOT IN CIRCUIT

Figure 13 (0273A9501-0) Test Connections for Testing CT Secondary Used with the IFCV Relay

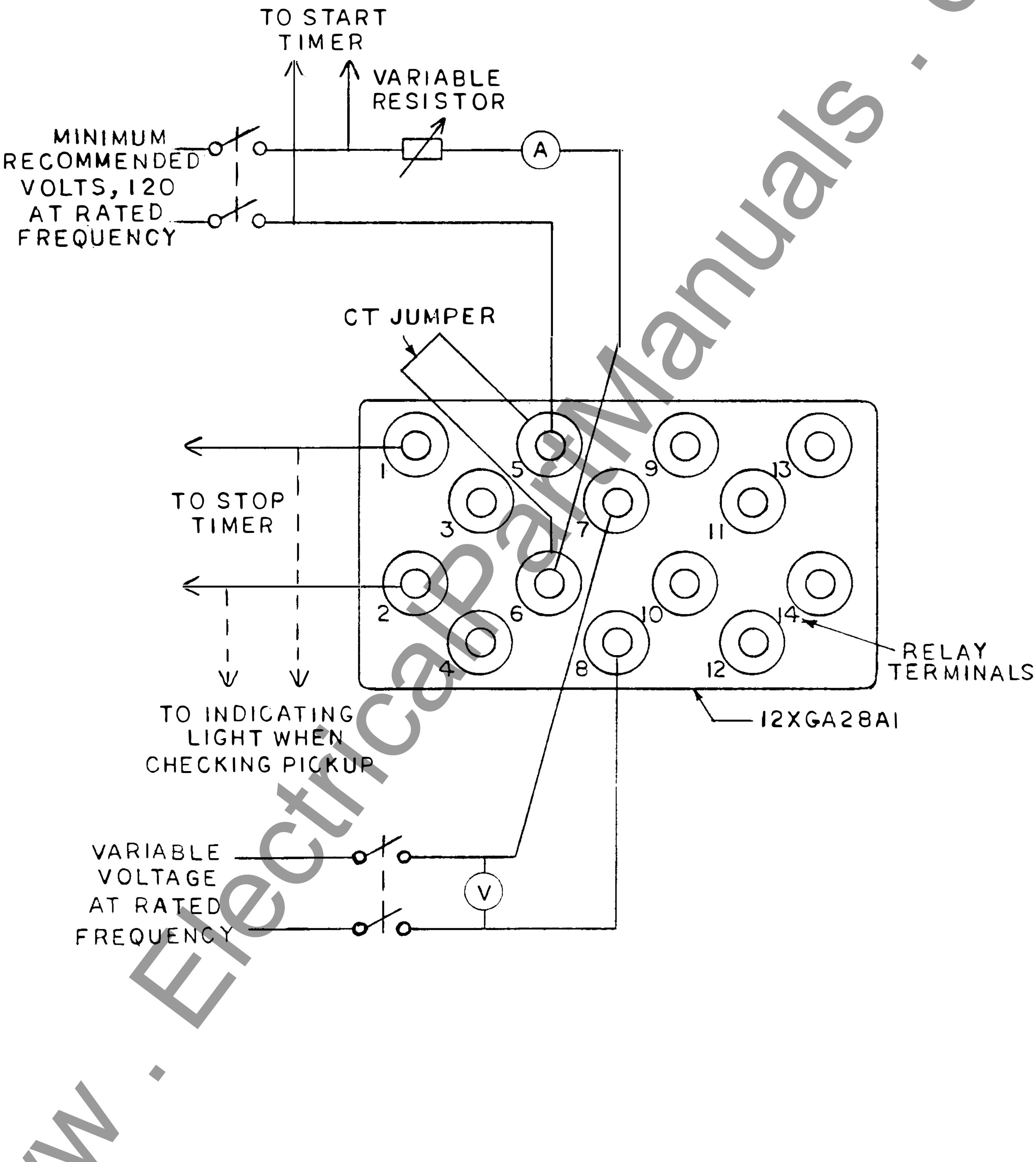


Figure 14 (0275A4455-0) Test Connections for Testing Pickup and Operating Times of the IFCV Relay Induction Unit

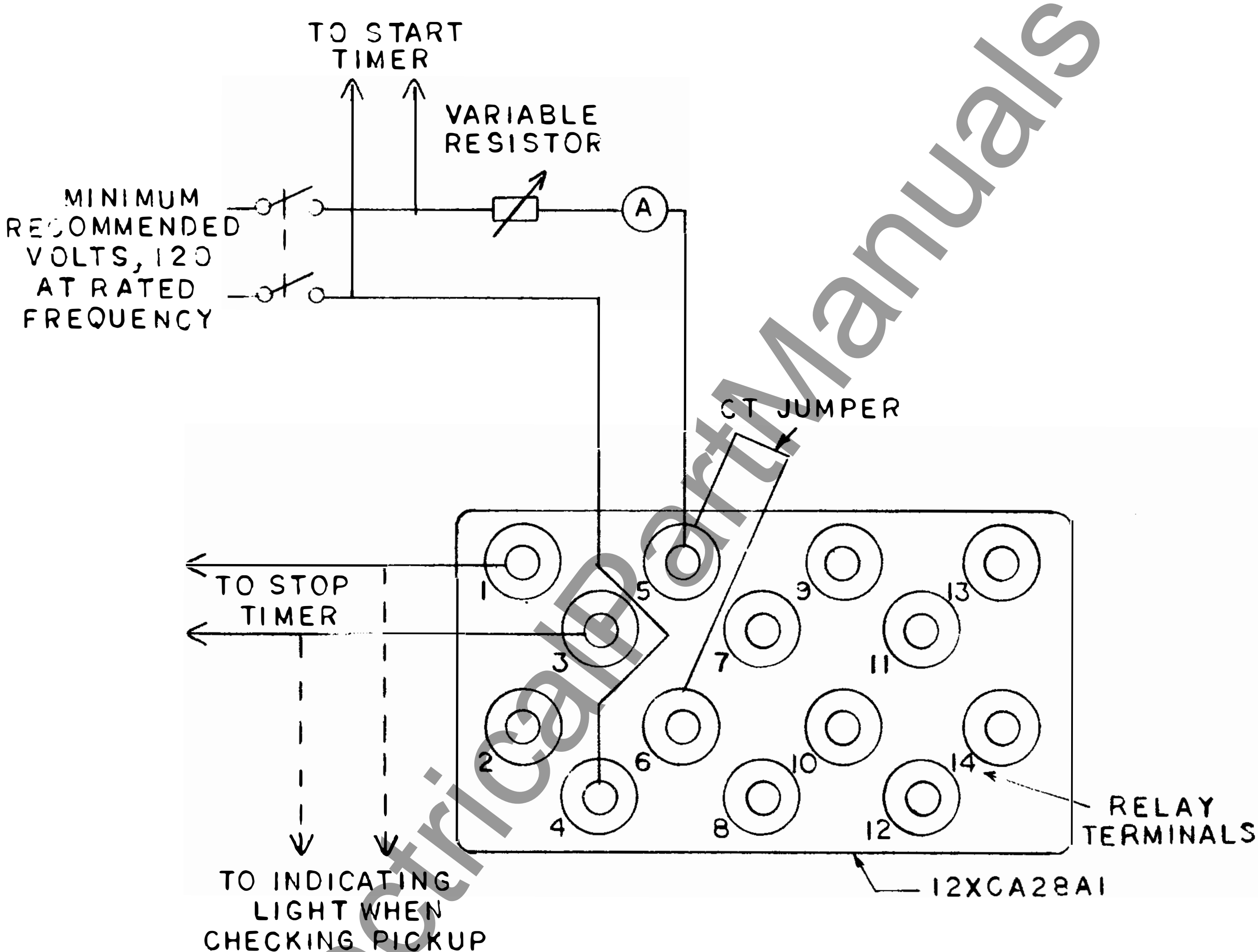


Figure 15 (0275A4456-0) Test Connections for Testing Pickup and Operating Times of the IFCV Relay High-Seismic Instantaneous Unit

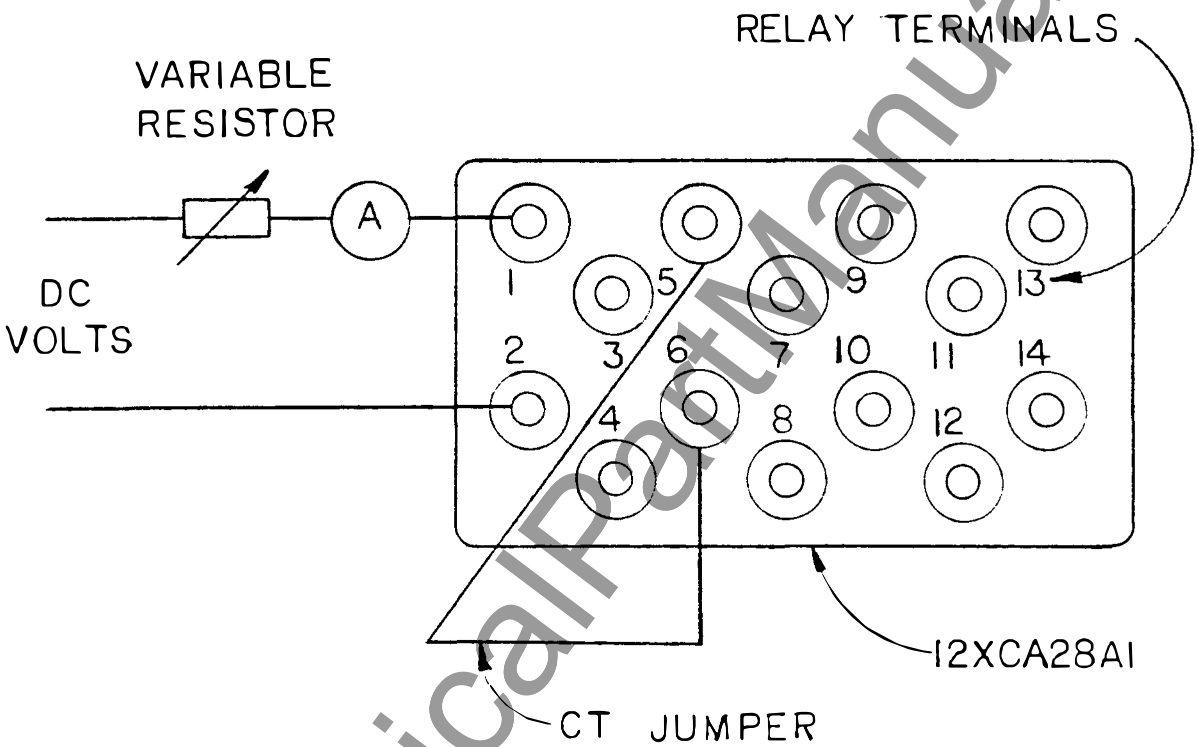


Figure 16 (0273A9503-0) Test Connections for Testing
the High-Seismic Target and Seal-in Unit Used with the IFCV Relay

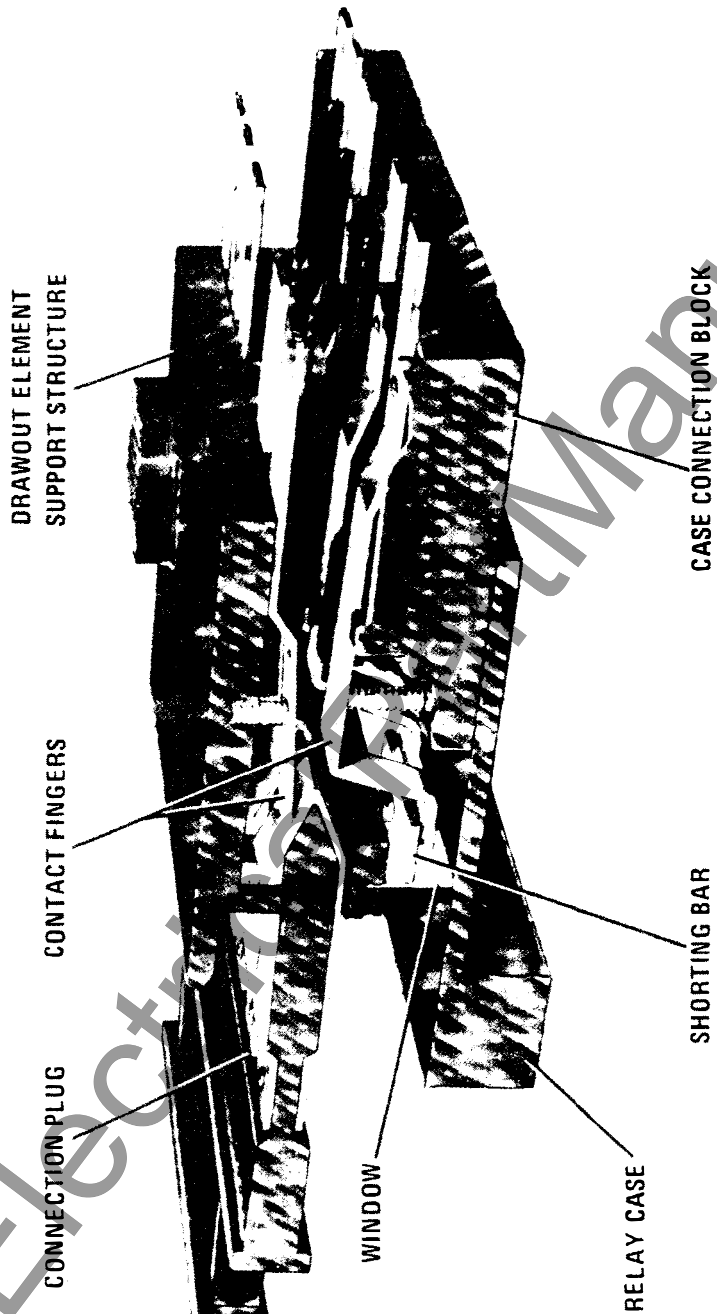


Figure 17 (8042715) Cross Section of the IFCV Drawout Case Showing Shorting Bar

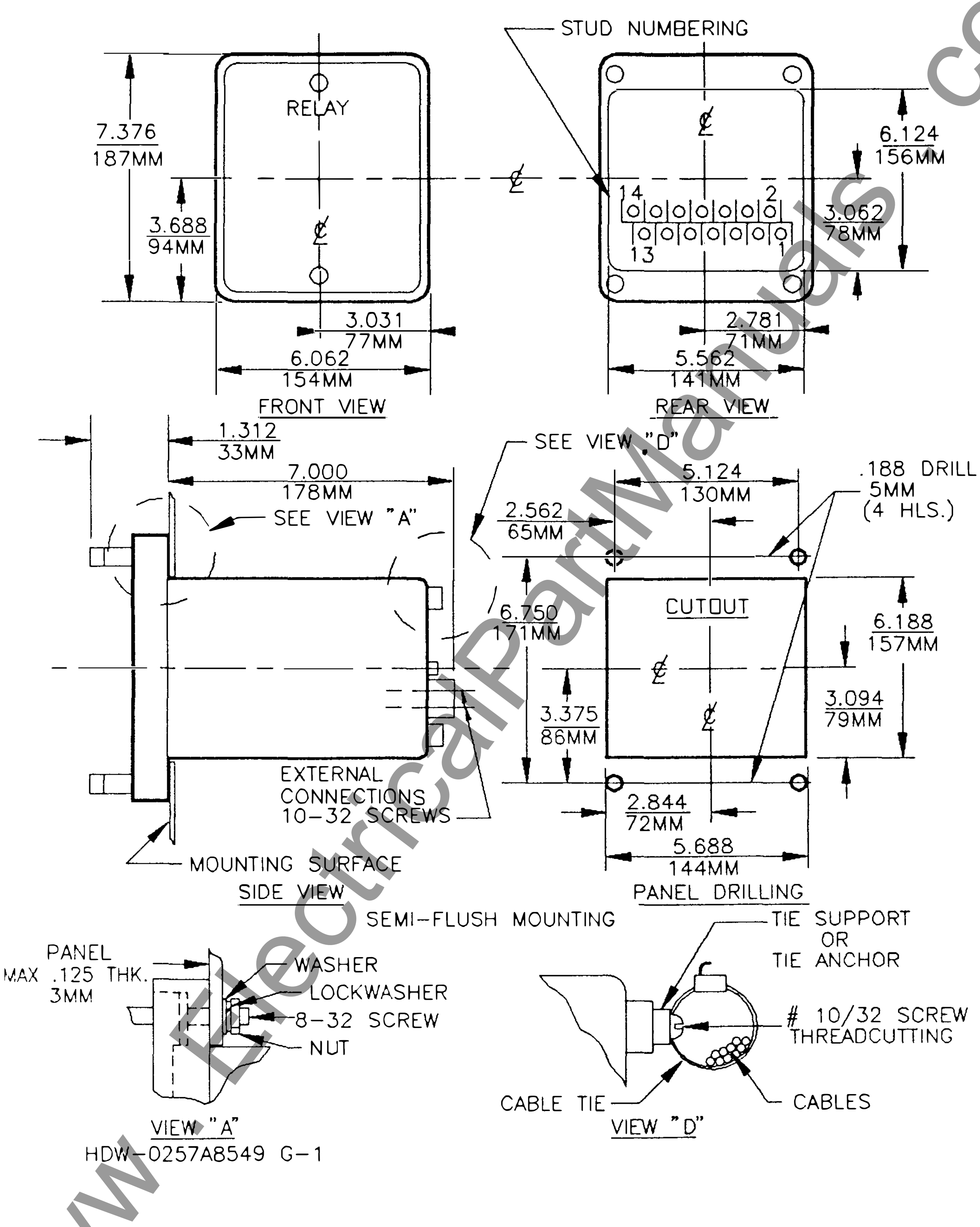


Figure 18 (0257A8452-3 Sh.1 [5]) Outline and Panel Drilling for Semi-Flush Mounting of Relay Type IFCV51

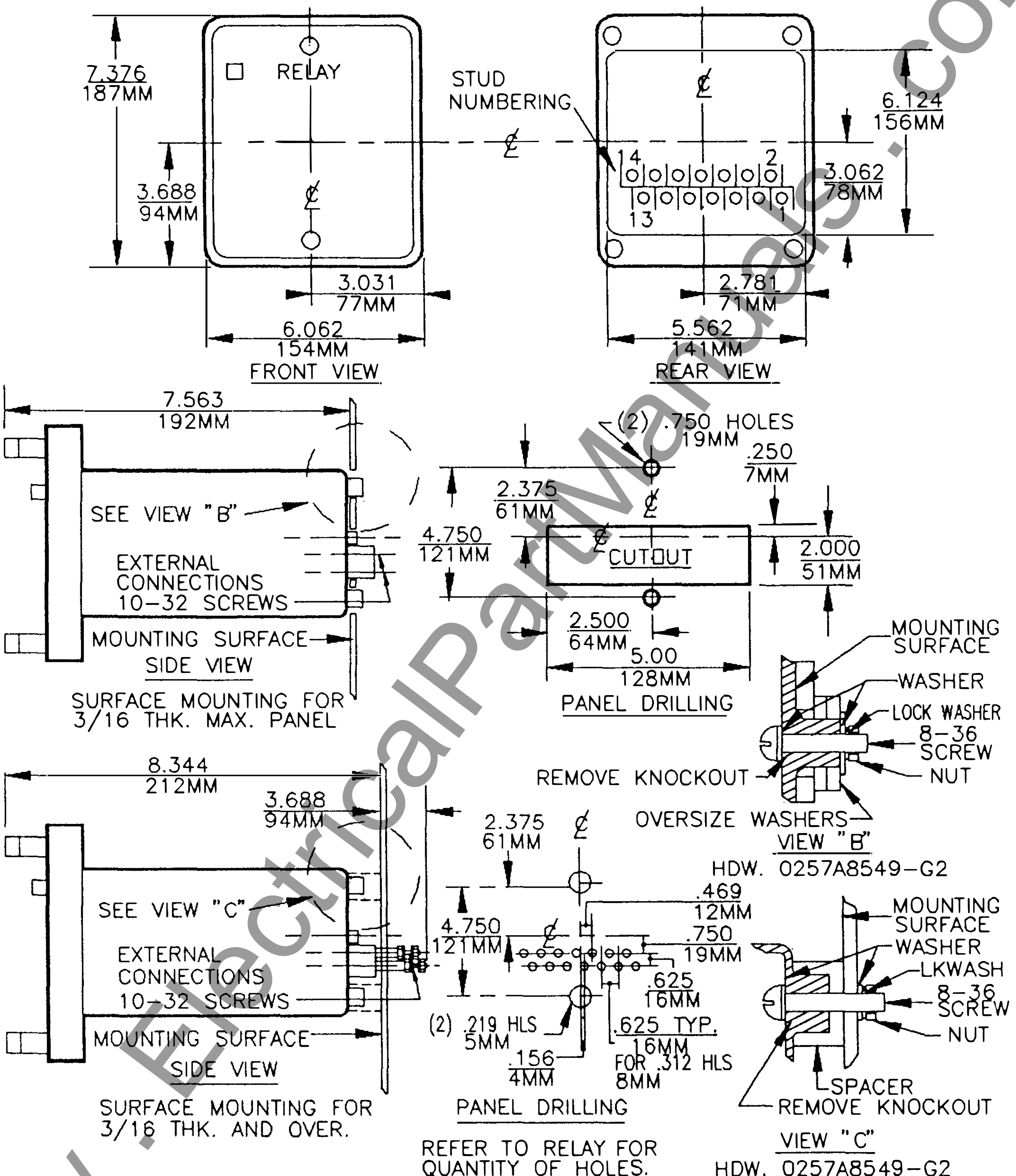


Figure 19 (0257A8452-3 Sh.2 [5]) Outline and Panel Drilling for Surface Mounting of Relay Type IFCV51

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