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U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

Dresden Nuclear Power Station, Units 2 and 3
Facility Operating License Nos. DPR-19 and DPR-25
NRC Docket Nos. 50-237 and 50-249

Quad Cities Nuclear Power Station, Units 1 and 2
Facility Operating License Nos. DPR-29 and DPR-30
NRC Docket Nos. 50-254 and 50-265

Subject: Additional Electrical Information Supporting the License Amendment Request to Permit Uprated Power Operation at Dresden Nuclear Power Station and Quad Cities Nuclear Power Station

Reference: Letter from R. M. Krich (Commonwealth Edison Company) to U. S. NRC, "Request for License Amendment for Power Uprate Operation," dated December 27, 2000

In the referenced letter, Commonwealth Edison Company, now Exelon Generation Company (EGC), LLC, submitted a request for changes to the operating licenses and Technical Specifications for Dresden Nuclear Power Station, Units 2 and 3, and Quad Cities Nuclear Power Station, Units 1 and 2, to allow operation at uprated power levels. In telephone conference calls between representatives of EGC and Mr. L. W. Rossbach and other members of the NRC on October 17, 2001, and November 7, 2001, the NRC requested additional information regarding the proposed changes. The attachment to this letter provides the requested information.

Should you have any questions related to this letter, please contact Mr. Allan R. Haeger at (630) 657-2807.

Respectfully,

Keith R. Jury

K. R. Jury
Director – Licensing
Mid-West Regional Operating Group

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Attachments:

Affidavit
Attachment A: Additional Electrical Information Supporting the License Amendment Request to Permit Uprated Power Operation at Dresden Nuclear Power Station and Quad Cities Nuclear Power Station
Attachment B: Manufacturer Data for GE IAC 66M Relay
Attachment C: Sample Coordination Plot for Relay Settings

cc: Regional Administrator – NRC Region III
NRC Senior Resident Inspector – Dresden Nuclear Power Station
NRC Senior Resident Inspector – Quad Cities Nuclear Power Station
Office of Nuclear Facility Safety – Illinois Department of Nuclear Safety

STATE OF ILLINOIS	)	
COUNTY OF DUPAGE	)	
IN THE MATTER OF	)	
EXELON GENERATION COMPANY, LLC	)	**Docket Numbers**
DRESDEN NUCLEAR POWER STATION, UNITS 2 AND 3	)	**50-237 AND 50-249**
QUAD CITIES NUCLEAR POWER STATION, UNITS 1 AND 2	)	**50-254 AND 50-265**

SUBJECT: Additional Electrical Information Supporting the License Amendment Request to Permit Uprated Power Operation at Dresden Nuclear Power Station and Quad Cities Nuclear Power Station

AFFIDAVIT

I affirm that the content of this transmittal is true and correct to the best of my knowledge, information and belief.

Keith R. Jury

K. R. Jury
Director – Licensing
Mid-West Regional Operating Group

Subscribed and sworn to before me, a Notary Public in and for the State above named, this 16 day of November, 2001.

Anese L. Grigsby
Notary Public

OFFICIAL SEAL
ANESE L. GRIGSBY
NOTARY PUBLIC, STATE OF ILLINOIS
MY COMMISSION EXPIRES 3-13-2005

ATTACHMENT A

Additional Electrical Information Supporting the License Amendment Request
to Permit Uprated Power Operation at
Dresden Nuclear Power Station and
Quad Cities Nuclear Power Station

Question

Provide details concerning the impact of the extended power uprate (EPU) on the scenario in which either the unit auxiliary transformer (UAT) or the reserve auxiliary transformer (RAT) become unavailable, causing the running loads to be transferred to the remaining available transformer. a.) Describe the evaluations that determined the acceptability of the increased running loads and any potential short circuit conditions while in this configuration. Provide manufacturer data for the protective relay and a sample coordination plot for the relay setting to support this determination. b.) Describe the operator actions for responding to this scenario and how they change for EPU.

Response

a. The loads fed from the UAT and RAT include both safety-related and non safety-related equipment. For EPU, with the transfer of loads to one transformer, a potential overload occurs only when all the equipment for full power EPU operation continues to run. For this condition, evaluations were performed for the transformers, the switchgear and load breaker, and the protective relay settings.

The UATs and RATs at Dresden Nuclear Power Station (DNPS) and Quad Cities Nuclear Power Station (QCNPS) were designed to American National Standards Institute (ANSI)/Institute of Electrical and Electronic Engineers (IEEE) C57.12, "Standard General Requirements for Liquid-Immersed Distribution and Power Regulating Transformers." The design was to the version of the standard in existence when the transformers were originally procured, which varied for the different transformers. Current industry standards provide guidance regarding short time overload capabilities of power transformers. For EPU conditions, the transformers were evaluated in accordance with ANSI/IEEE C57.92-1981, "Guide for Loading Mineral-Oil-Immersed Power Transformers Up to and Including 100 MVA," and ANSI/IEEE C57.91-1995, "Guide for Loading Mineral-Oil-Immersed Transformers Revision of IEEE Std C57.92-1981 and IEEE Std C57.115-1991," for loading beyond the nameplate rating. These standards allow for a temporary overduty of 125% of nameplate rating for two hours without any damage or loss of transformer life. The EPU condition in which all running loads are fed from one transformer requires the affected transformer to supply only 120% of its nameplate rating. Thus, operation of the transformer with the overduty caused in this scenario is acceptable for at least two hours. The connections (i.e., bus ducts) between the transformers and the switchgear were supplied by General Electric (GE) Company. A GE evaluation performed for this condition is on file and demonstrates that the connections will be able to carry the increased load for at least two hours.

The capability of the switchgear and breaker was evaluated for a short circuit condition during this scenario. As described in References 1 and 2, the switchgear and breaker were tested with the momentary and interrupting currents required for the EPU condition. The results of these tests indicated the need to provide mechanical bracing for the switchgear. As noted in Reference 2, this bracing will be completed as part of the modifications prior to implementation of EPU on each unit.

The protective relay settings to protect against a short circuit for this scenario were discussed in References 1 and 2. These relays are GE type IAC 66M time overcurrent relays that contain both an instantaneous overcurrent setting and a high dropout setting with a time delay. Manufacturer information for this relay is provided in Attachment B. As described in References 1 and 2, the instantaneous overcurrent relay for the load breakers for buses 21, 22, 31, and 32 for DNPS and buses 11, 12, 21, and 22 for QCNPS will be disconnected, leaving the high dropout feature, which will actuate after a six cycle (i.e., 0.1 second) time delay. Based on ANSI/IEEE C57.12, the UAT and RAT can provide the short circuit current for two seconds without damage. Based on the protection scheme coordination curves, the capability of the 4 kV bus duct to withstand the short circuit current is not affected by the six cycle time delay. Thus, the overcurrent relays still provide adequate protection. The remaining portions of the protective relaying were not changed for EPU. The coordination between the main breaker to the switchgear, the motor feeds, the bus duct capability, and the transformer capability curve is maintained. A sample coordination plot showing the adequacy of the relay settings is provided in Attachment C.

Based on load calculations for DNPS Unit 2, when all loads are fed from the RAT, the voltages maintained at the buses are at acceptable levels. Preliminary calculations for the remaining units indicate similar conditions. Operator actions for any potential undervoltage conditions are described below.

When all loads are fed from the UAT, a bus undervoltage may occur depending on the voltage maintained at the transformer prior to the transfer of loads. Operator actions for this scenario are described below.

b. Operator actions for this scenario are initiated by control room alarms. Main control room alarms will indicate a transfer of loads to one transformer. For EPU operation, the alarm response procedures will be modified to require operator action to reduce transformer load within one hour. The actions to reduce electrical loads involve simple actions such as reducing reactor recirculation flow and securing excess feedwater and/or condensate pumps. The one hour time was selected as a reasonable time for operators to take action and yet remain within the two hours of acceptable operation indicated by the evaluations described above.

In addition, a bus undervoltage alarm will occur if bus voltage reaches a nominal setpoint of 94% of the rated bus voltage due to the temporary overload condition. The undervoltage alarm starts a five minute timer. If voltage is not restored within five minutes, the undervoltage relay will actuate and strip loads from the bus. The operator actions to restore voltage are described in alarm response procedures and are unaffected by EPU. These actions involve either raising main generator output voltage or requesting the system power dispatcher to raise grid voltage. These actions are procedurally directed and are integrated into the operator training program.

References

1. Letter from R. M. Krich (Exelon Generation Company, LLC) to U. S. NRC, "Additional Electrical Information Supporting the License Amendment Request to Permit Uprated

Power Operation at Dresden Nuclear Power Station and Quad Cities Nuclear Power Station," dated April 6, 2001

2. Letter from K. A. Ainger (Exelon Generation Company, LLC) to U. S. NRC, "Additional Electrical Information Supporting the License Amendment Request to Permit Uprated Power Operation at Dresden Nuclear Power Station and Quad Cities Nuclear Power Station," dated July 23, 2001

ATTACHMENT B

Manufacturer Data for GE IAC 66M Relay

INSTRUCTIONS

GEK 86105
Supersedes GEI-66751B

TYPE IAC66M

TIME OVERCURRENT RELAY

GENERAL ELECTRIC

CONTENTS

TYPE IAC66M

TIME OVERCURRENT RELAY

DESCRIPTION

Type IAC66M relays contain a long time induction overcurrent unit, a standard instantaneous unit, a high dropout instantaneous overcurrent unit, a six-cycle time delay telephone relay, and two target and seal-in units. See Figures 1 and 2 for the location of these units, and Figure 3 for outline and panel drilling dimensions.

APPLICATION

The IAC66M relay was designed for motor overload and fault current protection. The induction overcurrent unit provides overload protection and should be set accordingly, depending on the service factor of the machine. The standard instantaneous unit should be set above the maximum asymmetrical motor inrush current. The six-cycle time delay telephone relay used in conjunction with the high dropout instantaneous unit permits it to override the transient asymmetrical motor inrush current. One of the target seal-in units is for use with the induction unit, and the other is for use with the high dropout instantaneous unit. The typical external connection diagram is shown in Figure 5.

RATINGS

INDUCTION UNIT

The induction unit coil is available in several ranges of pickup current. Table I lists ranges, tap values, continuous-current ratings and short time current ratings of the induction unit coil.

The induction unit contacts will close 30 amperes for voltages not exceeding 250 volts. The current carrying ratings are affected by the tap selected on the target and seal-in coil, as indicated in Table II. If the tripping current exceeds 30 amperes, use an auxiliary relay that is connected such that the tripping current does not pass through either the contacts or the target and seal-in coils of the protective relay.

TABLE I
INDUCTION UNIT COIL RATINGS

PICKUP RANGE (AMPS)	TAP VALUES (AMPS)	CONTINUOUS CURRENT (AMPS)	SHORT TIME (ONE SECOND) RATING (AMPS)
0.6/1.8	0.6, 0.8, 1.0, 1.2, 1.4, 1.6 1.8	3	75
1.5/4.5	1.5, 2, 2.5, 3, 3.5, 4, 4.5	5	200
2.5/7.5	2.5, 3, 3.5, 4, 5, 6, 7.5	5	300
4.0/12	4, 5, 6, 7, 8, 10, 12	10	400

The two taps required for the values shown in Table I are (from the lowest to highest pickup): A/L, B/K, C/F, D/H, D/G, E/G and G/J, respectively, as labelled on the tap block. To obtain a tap value of 4.0 amps on the 2.5/7.5 amp relay, use taps D/H.

TABLE II
RATINGS OF TARGET AND SEAL-IN COILS

CURRENT OPERATED		DUAL-RATED 0.2/2.0 AMP 0.2 AMP TAP	DUAL-RATED 0.2/2.0 AMP 2.0 AMP TAP
Carry 30 amps for	(seconds)	0.05	2.2
Carry 10 amps for	(seconds)	0.45	2.0
Carry continuously	(amperes)	0.37	2.3
Minimum operating	(amperes)	0.2	2.0
Minimum dropout	(amperes)	0.05	0.5
DC resistance	(ohms)	8.3	0.24
60 hertz impedance	(ohms)	50	0.65
50 hertz impedance	(ohms)	42	0.54

SIX-CYCLE TIME DELAY TELEPHONE RELAY

The telephone relay, OX, is continuously rated at the nameplate voltage.

STANDARD INSTANTANEOUS UNIT

The standard instantaneous unit is designed to use one of several coils. Table IVa lists the pickup range, continuous current ratings and short time rating of each of these coils.

The current-closing rating of the contacts is 30 amperes for voltages not exceeding 250 volts.

TABLE IVa
STANDARD INSTANTANEOUS UNIT COIL RATINGS

PICKUP RANGE (AMPS)	CONTINUOUS CURRENT (AMPS)	SHORT TIME (ONE SECOND) RATING (AMPS)
0.5 - 2	0.75	12
1 - 4	1.5	25
2 - 8	3.0	51
4 - 16	6.0	127
10 - 40	15.0	205
20 - 80	30.0	326
40 - 160	60.0	326

For forms 51 and up, the standard instantaneous unit has the following ratings, listed in Table IVb:

TABLE IVb
STANDARD INSTANTANEOUS UNIT COIL RATINGS - FORMS 51 AND UP

RANGE		SERIES OR PARALLEL	RATINGS	
			CONTINUOUS	ONE SECOND**
0.5 - 4.0	0.5 - 2.0	Series	0.75	25.0
	1.0 - 4.00	Parallel	1.5	50.0
2.0 - 16.0	2.0 - 8.0	Series	3.0	130.0
	4.0 - 16.0	Parallel	6.0	260.0
10.0 - 80.0	10.0 - 40.0	Series	15.0	400.0
	20.0 - 80.0	Parallel	25.0	600.0
20.0 - 160.0	20.0 - 80.0	Series	25.0	600.0
	40.0 - 160.0	Parallel	25.0	600.0

**Higher currents (I) may be applied for shorter lengths of time (T) in accordance with the formula:

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

K = constant

TABLE V
RATINGS OF HIGH DROPOUT INSTANTANEOUS UNIT

PICKUP RANGE (AMPS)	CONTINUOUS RATING (AMPS)	ONE SECOND RATING (AMPS)
1 - 4	1.5	35
2 - 8	2.5	75
4 - 16	6	150
7 - 28	10.5	288
10 - 40	15	288
20 - 80	25	288

CHARACTERISTICS AND BURDENS

INDUCTION UNIT

The induction unit consists of a conducting disk that passes through the poles of a permanent magnet and an electromagnet. The disk is free to rotate with a vertically suspended shaft, but is restrained in one direction by a spring. When energized with an alternating current of proper magnitude (set by the tap position), the electromagnet produces out-of-phase fluxes at its pole faces. These fluxes interact with induced currents in the disk to produce a torque on the disk. When this torque exceeds the restraining force of the spring, the disk begins to rotate at a speed determined by the magnetic dragging action of the permanent magnet. A post attached to the rotating shaft travels a specific distance (set by the time dial), and makes electrical contact with a fixed member.

Figure 6 gives the time for the induction unit to close its contacts for various multiples of pickup current and time dial settings. The time required for this unit to reset from contact closure to the Number 10 time dial position is approximately 60 seconds.

Burden data for induction unit coils is listed in Table VIa. The impedance values are for the minimum tap. The impedance for other taps at pickup current (tap rating) varies (approximately) inversely to the square of the current rating. The following equation illustrates this:

$$\text{Impedance of Any Tap at Tap Amps} = \left(\frac{\text{Minimum Tap Amps}}{\text{Tap Amps}}\right)^2 \times \left(\text{Impedance at Minimum Tap}\right)$$

TARGET/SEAL-IN UNIT

The Target Seal-in units are dual rated according to the values on the tap plate on the right hand side of the unit. If the tap selected must be changed, first remove the connecting plug, then use one screw from the left plate to select the correct tap. Move the screw from the unwanted tap to the left plate. This will ensure that the mechanical adjustments will not be disturbed. Tap screws should never be left in both taps at the same time.

TABLE VIa
BURDENS OF INDUCTION UNIT COILS

PICKUP RANGE (AMPS)	FREQ. (Hz)	TAP	VOLT-AMPS AT FIVE AMPS CALCULATED FROM INPUT AT MINIMUM PICKUP (I^2Z)	WATTS	POWER FACTOR
1.0 - 3.0	60	1	118.4	15.2	0.13
	50	1	98.6	12.7	0.13
1.5 - 4.5	60	1.5	52.5	6.7	0.13
	50	1.5	43.7	5.6	0.13
2.5 - 7.5	60	2.5	18.8	2.5	0.13
	50	2.5	15.7	2.1	0.13
4.0 - 12	60	4	7.4	0.95	0.13
	50	4	6.2	0.79	0.13

For forms 51 and up, the burden of the induction unit is as shown in Table VIb:

TABLE VIb
BURDENS OF INDUCTION UNIT COILS - FORMS 51 AND UP

PICKUP RANGE (AMPS)	FREQ. (Hz)	TAP	VOLT-AMPS AT FIVE AMPS CALCULATED FROM INPUT AT MINIMUM PICKUP (I^2Z)	IMP. OHMS	POWER FACTOR
0.6 - 1.8	60	0.6	110.75	4.43	0.32
	50	0.6	48.0	1.92	0.33
1.5 - 4.5	60	1.5	17.75	0.71	0.35
	50	1.5	11.5	0.46	0.37
2.5 - 7.5	60	2.5	6.75	0.27	0.44
	50	2.5	5.75	0.23	0.47
4.0 - 12	60	4.0	4.48	0.18	0.52
	50	4.0	4.05	0.16	0.47

SIX-CYCLE TIME DELAY TELEPHONE RELAY

As mentioned, the telephone relay, OX, has a six-cycle time delay after it is energized through the high-dropout instantaneous contacts. The operating time of this circuit, therefore, is determined by the time delay of the telephone relay.

STANDARD INSTANTANEOUS UNIT

The standard instantaneous unit is an electromagnet that attracts a hinged armature when sufficient current is applied. The armature carries a "T" shaped moving contact that bridges two stationary contacts when the coil is energized. A

target is displayed when the unit operates. Pressing the button in the lower left corner of the relay cover resets the target.

The pickup range can be adjusted continuously over a four-to-one range by using the adjustable pole piece. When the top of the core is lined up with the calibration stampings, an approximate value of pickup can be determined. Dropout is about 40 to 50% of pickup.

Figure 7 shows the variation of operating time with applied current for this unit. Burden data of the standard unit are tabulated in Table VIII.

TABLE VIII
BURDEN OF STANDARD INSTANTANEOUS UNIT

PICKUP RANGE (AMPS)	FREQ (HZ)	AMPS	VOLT-AMPS**	IMPEDANCE (OHMS)	POWER FACTOR
0.5 - 2	50	5	310	12.4	0.84
	60	5	330	13.2	0.78
1 - 4	50	5	94	3.75	0.77
	60	5	100	4.0	0.71
2 - 8	50	5	23	0.94	0.77
	60	5	25	1.0	0.71
4 - 16	50	5	5.8	0.23	0.77
	60	5	6.2	0.25	0.71
10 - 40	50	5	0.9	0.04	0.77
	60	5	1.0	0.04	0.71
20 - 80	50	5	0.23	0.01	0.77
	60	5	0.25	0.01	0.71
40 - 160	50	5	0.07	0.003	0.71
	60	5	0.07	0.003	0.71

**Volt-amperes at five amps calculated from input at minimum pickup (I^2Z).

HIGH DROPOUT INSTANTANEOUS UNIT

The high dropout instantaneous unit is similar to the standard instantaneous unit, except the dropout current is approximately 80 to 90% of the pickup current. Refer to Figure 8, a photograph of the high dropout unit, for the following discussion.

The adjustable core (A) sets the pickup level. Turning the core down (clockwise, top view) lowers the pickup, while turning the core up (counterclockwise, top view) increases the pickup. Before attempting to turn the core, the locknut (B) must be loosened. When loosening or tightening the locknut, the sleeve (C) to which the shading ring (D) is attached, must be held to prevent it from turning. The locknut must be retightened after adjusting the core. Rotating the shading ring sets the dropout level, thereby determining the quietness of operation when in the picked-up

position. The core has been factory set to obtain 80% dropout at the minimum setting, and approximately 90% dropout at the maximum setting. To change the dropout setting, the sleeve (C) to which the shading ring (D) is attached must always be turned in the clockwise direction (top view). This will prevent the sleeve and shading ring assembly from being loosened. When shipped from the factory, the whole coil is wired into the current circuit, and the lower half of the calibration range is available. If the upper half of the calibration range is required, the tapped section of the coil should be wired into the current circuit. Do this by taking the black lead off stud 6 and the green lead off stud 6A. Then put the gren lead on stud 6 and the black lead on stud 6A (see Figure 9).

The unit will pick up at the scale plate marking ± 5% with gradually applied current. Figure 10 shows the transient overreach characteristics. Burden data for the 60 hertz high dropout unit is tabulated in Table IX.

TABLE IX
BURDEN OF 60 HERTZ HIGH DROPOUT INSTANTANEOUS UNIT

RANGE AMPERES	BURDEN AT MINIMUM PICKUP SETTING AND MINIMUM CURRENT			VOLT-AMPERES AT FIVE AMPERES CALCULATED FROM INPUT AT MINIMUM PICKUP (I^2Z)
	R OHMS	X OHMS	Z OHMS	
1 - 4	3.16	3.16	4.48	112.0
2 - 8	0.79	0.79	1.12	28.0
4 - 16	0.2	0.2	0.28	7.0
7 - 28	0.07	0.07	0.1	2.50
10 - 40	0.03	0.03	0.04	1.00
20 - 80	0.007	0.007	0.01	0.25

CONSTRUCTION

The IAC66M relay is mounted in an M1 case that does not have an upper contact block. The case is suitable for either semi-flush or surface mounting on panels up to two inches thick. Hardware is available for all panel thicknesses. To be sure that the proper hardware will be provided, panel thickness should be specified on the order for the relay. Outline and panel drilling dimensions are shown in Figure 3.

The relay components are mounted on a cradle assembly that can easily be removed from the relay case. The cradle is locked in the case by latches at the top and bottom. Electrical connections between case and cradle blocks are completed through removable connection plugs. Separate testing plugs can be inserted in place of the connection plugs to test the relay in its case. The cover is attached to the case from the front, and includes an interlock arm that prevents the cover from being replaced until the connection plug has been inserted.

The induction unit, consisting of a U-magnet, drag magnet and a disk assembly, is mounted on a metal frame. The pickup of the induction unit is set by a tap block located near the middle of the relay. The time delay is adjusted by turning the molded time dial, located just below the tap block.

The standard instantaneous unit is mounted just above the drag magnet on the right hand side. The adjustable core can be raised or lowered to change the pickup of the unit.

The unit just above the drag magnet on the left is a target seal-in unit for the induction unit. This seal-in unit does not have an adjustable core, but tap screws located on the right side of the unit can be used to change pickup.

The high dropout instantaneous unit is on the right above the standard instantaneous unit. Pickup adjustment is made with the adjustable core. There are three coil leads on units that have a four-to-one range of pickup adjustment. One of these coil leads is secured to an insulating bracket mounted on one of the relay terminals. By interchanging the lead on the bracket with the lead on the terminal, either the high range or the low range of the unit can be selected as required (see page 9).

There is also a target/seal-in unit associated with the high dropout instantaneous unit. The unit has two taps which can be selected as desired. (See page 6.)

Internal connections for the IAC66M are shown in Figure 9A. For IAC66M forms 51 and up, Figure 9B depicts the internal connections.

RECEIVING, HANDLING AND STORAGE

This relay, when not included as part of a control panel, will be shipped in a carton designed to protect it against damage. Upon receipt, immediately examine the relay for any damage sustained in transit. If damage from rough handling is evident, file a damage claim at once with the transportation company, and promptly notify the nearest General Electric Sales Office.

If the equipment is not to be installed immediately, it should be stored indoors in its original carton in a location that is dry and protected from dust, metallic chips and severe atmospheric contaminants.

ACCEPTANCE TESTS

An inspection and acceptance test should be made when the relay is received to determine if damage has occurred in shipment, or if relay calibrations have been disturbed.

VISUAL INSPECTION

Check the relay nameplate to see that the model number, rating and calibration range of the relay agree with the requisition.

Remove the relay from its case and check that there are no broken or cracked molded parts or other signs of physical damage. All screws should be tight. The drag magnet should be securely fastened in position on its mounting shelf. No metallic particles or any other foreign matter should be in the air gap of either the drive magnet or the drag magnet.

Check the location of the contact brushes on the cradle and case blocks against the internal connections diagram. The shorting bars should be in their proper locations on the case block, and the long and short brushes on the cradle block should agree with the internal connections diagram. Figure 4 is a sectional view of the case and cradle blocks with the connection plug in place. Note that there is an

auxiliary brush in each position on the case block. This brush should be formed high enough so that when the connection plug is inserted, it engages the auxiliary brush before striking the main brush. An improper adjustment of the auxiliary brush could result in a CT secondary being momentarily open-circuited in a current circuit.

MECHANICAL INSPECTION

The following mechanical adjustments should be checked:

Induction Unit

The moving contact should just touch the stationary contact when the time dial is at the zero position. There should be sufficient clearance between the stationary contact brush and its backing strip to allow for a least 1/32 inch wipe. Set the dial at the approximate setting that will be used when the relay is installed.

The disk and shaft assembly should have a vertical end play of 1/64 to 1/32 inch. The set screws for the upper pivot and lower jewel screw must be tight. The disk should be centered (approximately) in the air gap of both the drive magnet assembly and the drag magnet. The disk and shaft assembly should turn freely without noticeable friction.

The stop arm assembly, located near the top of the disk shaft, should be checked for approximately 1/64 inch deflection of the leaf spring.

ELECTRICAL TESTS

The following electrical checks should be made upon receipt of the relay. Note that all tests are to be made with the relay in its case and in a level position.

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

Therefore, in order to properly test alternating-current relays a sine wave current and/or voltage must be used. The purity of the sine wave (i.e., its freedom from harmonics) cannot be expressed as a finite number for any particular relay; however, any relay using tuned circuits, RL or RC networks, or saturating electromagnets (such as time overcurrent relays), would be essentially affected by non-sinusoidal waveforms.

Similarly, relays requiring DC control power should be tested using DC and not full wave rectified power. Unless the rectified supply is well filtered, many relays will not operate properly due to dips in the rectified power. Zener diodes, for example, can turn off during dips. As a general rule, the DC source should not contain more than 5% ripple.

Since drawout relays in service operate in their cases, they should be tested in their cases or an equivalent steel case. This way, any magnetic effects of the enclosure will be accurately duplicated during testing. A relay may be tested without removing it from the panel by using a 12XLA13A test plug. This plug makes connection only with the relay and does not disturb the shorting bars in the case.

The 12XLA12A test plug may also be used. Although this test plug allows greater testing flexibility, it also requires CT shorting jumpers and greater care in testing, since connections are made to both the relay and the external circuitry.

Induction Unit

With the tap plug in the minimum position, and the time dial in the Number 1/2 position, check that the current required to just close the contact is within $\pm$ 5% of the minimum pickup shown on the tap block.

The operating time from the Number 5 time dial setting at five times minimum pickup setting should be within 7% of the value shown in Figure 6.

Six-Cycle Time Delay Telephone Relay

To check the pickup voltage and time of the telephone relay, OX, use the following procedure.

1. Place the tap screw of the target and seal-in unit in the 0.2 amp tap. This is the upper left (front view) unit.

2. Block closed the contacts of the high-dropout instantaneous unit. This is the upper right (front view) unit.

3. Apply DC voltage to relay terminals 9 and 10. The telephone relay should pick up at 80% or less of its rating.

4. Apply rated voltage to the OX unit. The contacts should close six cycles (0.1 second) after voltage is applied.

Target/Seal-in Units

There are two target/seal-in units associated with the IAC 66M(-)A relay. The target/seal-in in the lower left (front view) is in the induction unit/standard instantaneous unit circuit. The other target/seal-in is located in the upper left of the relay (front view) and is in the high-dropout instantaneous unit/OX telephone relay circuit.

The target/seal-in units can be tested by applying DC current to the proper studs and closing the correct contact, as listed in Table X.

Reset the target/seal-in flag by pushing on the reset arm; then gradually apply the DC current until the unit picks up. It should pick up within the values in Table X. Open the appropriate contact mentioned in the table; the unit must remain sealed in. Reduce the DC current until the contacts of the target/seal-in unit open; this is the dropout value, and should be as listed in Table X. The taps must be changed, if desired, according to the method given under TARGET/SEAL-IN UNIT in the **CHARACTERISTICS AND BURDENS** section.

TABLE X

Target/ Seal-in	Current Connection	Pickup Current 0.2 (TAP)	Pickup Current (TAP) 2.0	Dropout Current 0.2 (TAP)	Dropout Current (TAP) 2.0
Induction & Standard Instantaneous Circuit	Studs 1-2 Close Induction Unit Contact	0.12-.195	1.2-1.95	0.06+	0.6 +
Hi-D.O. Inst. & OX Telephone Relay Circuit	Studs 8-10 Close Hi-D.O. & OX Tel.Relay	0.12-.195	1.2-1.95	0.06+	0.6 +

Instantaneous Units

There are two instantaneous units in the IAC 66M relay. The standard instantaneous unit is located in the lower right side of the relay, with electrical connections on studs 4 and 7. Pickup is obtained with the adjustable core, which is adjustable for the complete pickup range of the unit (see page 8-9). It should be possible to attain the minimum pickup value without turning the core to its absolute minimum position.

The other instantaneous unit is a high-dropout unit, similar to the standard unit except that it should drop out at 80% of pickup or higher when the current is gradually reduced. The electrical connections are on studs 6 and 7 for this unit.

INSTALLATION

MOUNTING AND CONNECTIONS

Outline and panel drilling dimensions are shown in Figure 3. Unless the relay is mounted on a steel panel which adequately grounds the relay case, the case should be grounded through a mounting stud or screw with a conductor not less than No. 12 B&S gage copper wire, or equivalent.

Internal connections are shown in Figure 9A; Figure 9B shows the internal connections for forms 51 and up.

Use a test source of 120 volts or greater with good wave form and constant frequency when making settings on the induction unit. Step-down transformers or "phantom loads" should not be used in testing induction units, since they may cause a distorted wave form. A setting that can be obtained by one of the tap positions will be satisfactory, and no further adjustment will be required. However, sometimes a pickup setting might fall between available tap positions. Such intermediate settings can be obtained by placing the tap screw in the tap position nearest the required pickup, and adjusting the control spring until the required pickup is obtained. Refer to **SERVICING** for a more detailed description of pickup adjustment.

PERIODIC CHECKS AND ROUTINE MAINTENANCE

Protective relays play a vital role in the operation of a power system, and it is important to follow a periodic test program. 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, the points listed in the **ACCEPTANCE TESTS** section should be checked at an interval of from one to two years.

Operate the disk and shaft assembly by hand. Check that the contacts are making with the proper wipe. Allow the disk to reset, then check that there is no sign of excessive friction or a tendency to bind. Check for obstructions to disk travel. Dirt or metallic particles in the watt-metric or drag magnet gaps can interfere with the motion of the disk.

Examine contact surfaces for tarnishing or corrosion. Fine silver contacts should not be cleaned with knives, files, or abrasive paper or cloth. Knives or files may leave scratches which increase arcing and deterioration of the contacts. Abrasive paper or cloth may leave minute particles of insulating abrasive material in the contacts and thus prevent closing. Use a burnishing tool specifically designed for this purpose.

SERVICING

Induction unit pickup for any current tap is adjusted by a spring adjusting ring. If the adjustment has been disturbed, turn the ring by inserting a screw driver in the notches around the edge; turning the ring brings the operating current of the unit into agreement with the tap setting. This adjustment also makes any setting between the various tap settings possible. Note, however, that if pickup is changed by turning the spring adjusting ring, then the relay will be operating at a different torque level, and the published time curves will not apply for this setting.

The unit has been factory adjusted to close its contacts from any time dial position at minimum current within 5% of the tap plug setting. If a pickup time for a particular time dial setting and pickup multiple is outside the limits mentioned in the acceptance tests, changing the position of the drag magnet on its supporting shelf will restore the pickup time. Moving the magnet towards the shaft decreases the pickup time, while moving it away from the shaft increases the pickup time. If the drag magnet is moved towards the shaft, be sure that it clears the counterweight on the disk for all positions of the disk and shaft assembly in its final position. When the magnet is moved away from the shaft, its outer edge must be at least 1/8 inch from the edge of the disk at the disk's smallest radius.

Pickup and time tests should always be made with the relay in its case so that the magnetic effect of the case is the same as when the relay is in service.

RENEWAL PARTS

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

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

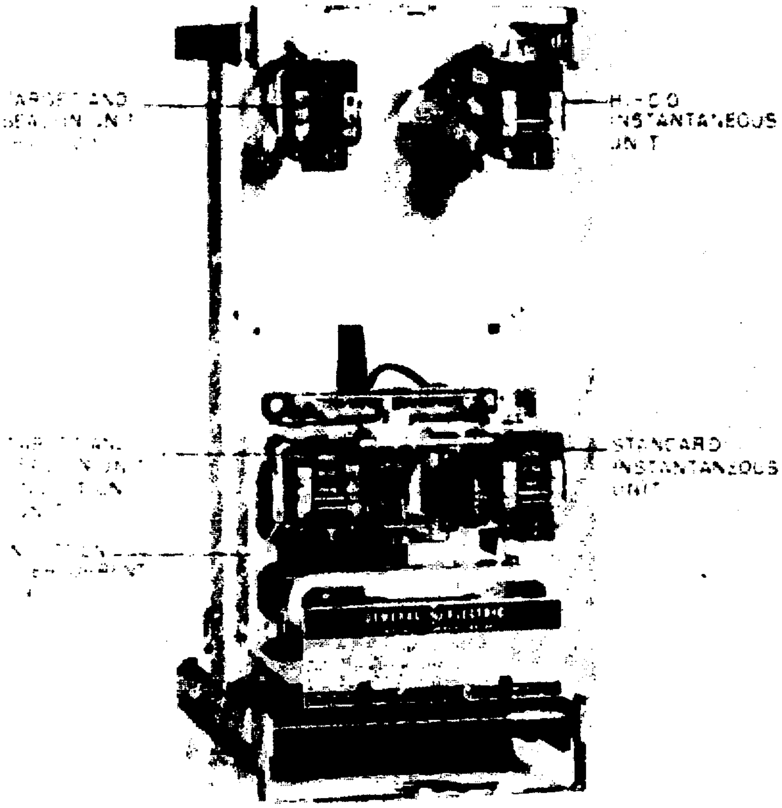


Figure 1 (8027184 - Photograph) IAC66M Relay Construction
Relay Removed from Drawout Case (Front View)

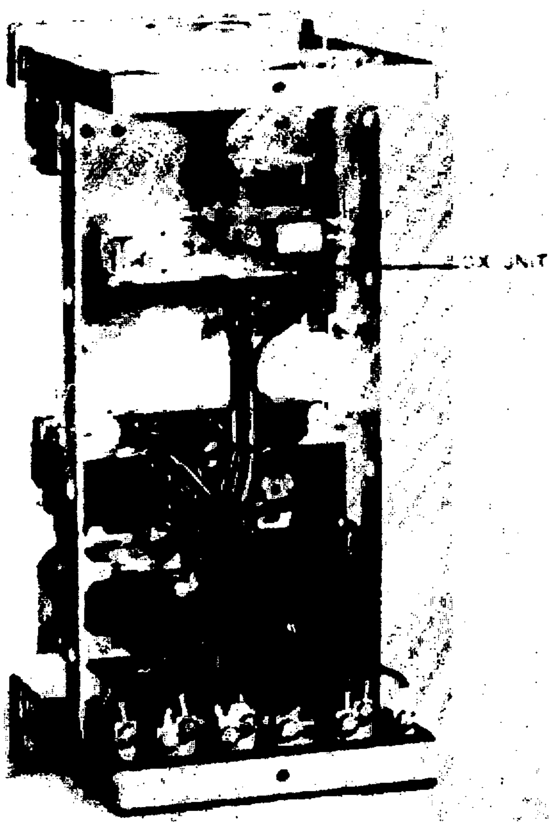


Figure 2 (8027185 - Photograph) IAC66M Relay Construction
Relay Removed from Drawout Case (Rear View)

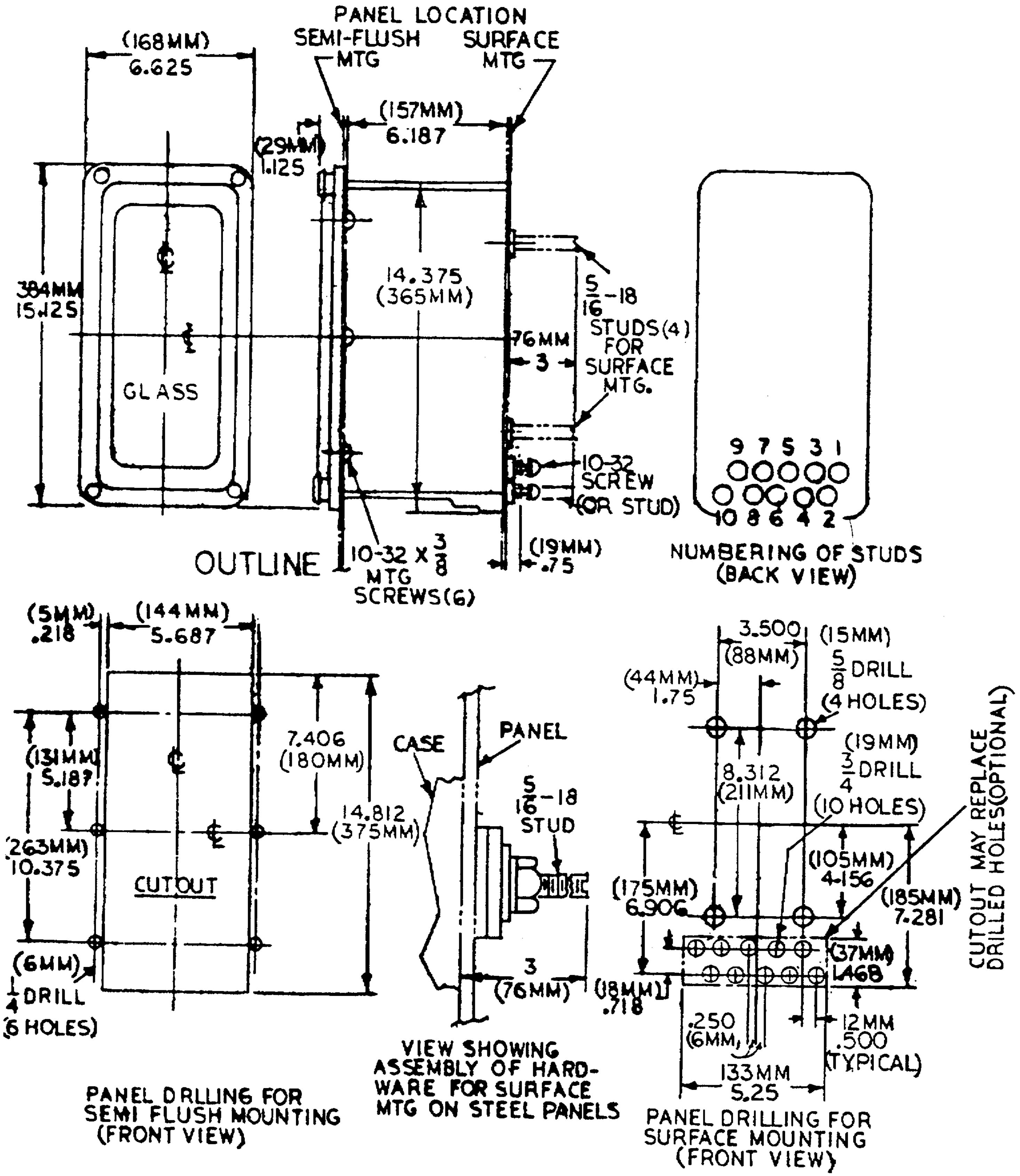


Figure 3 (6209273-3) Outline and Panel Drilling Dimensions for the IAC66M Relay

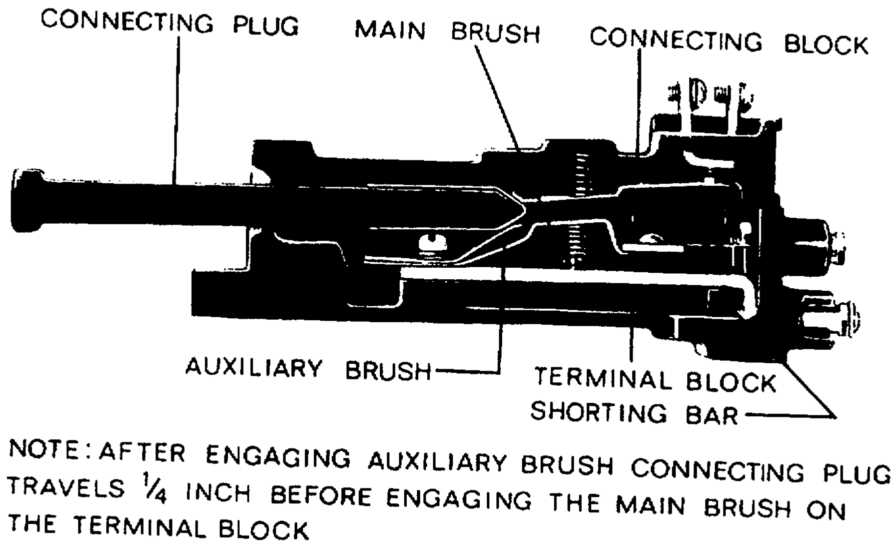


Figure 4 (8025039) Photograph: Cross Section of Drawout Case Showing Position of Auxiliary Brushes

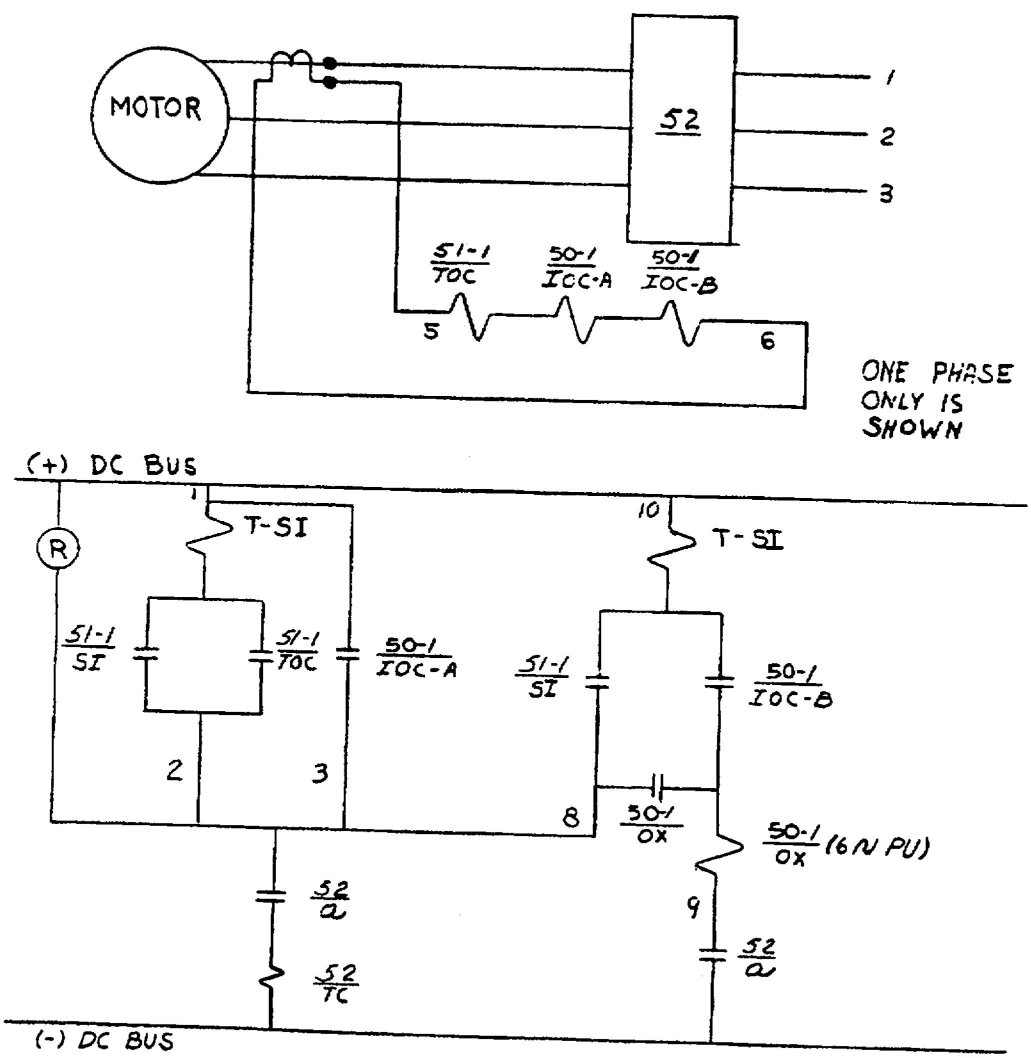


Figure 5 (0207A7826-0) External Connections Diagram for IAC66M Relay

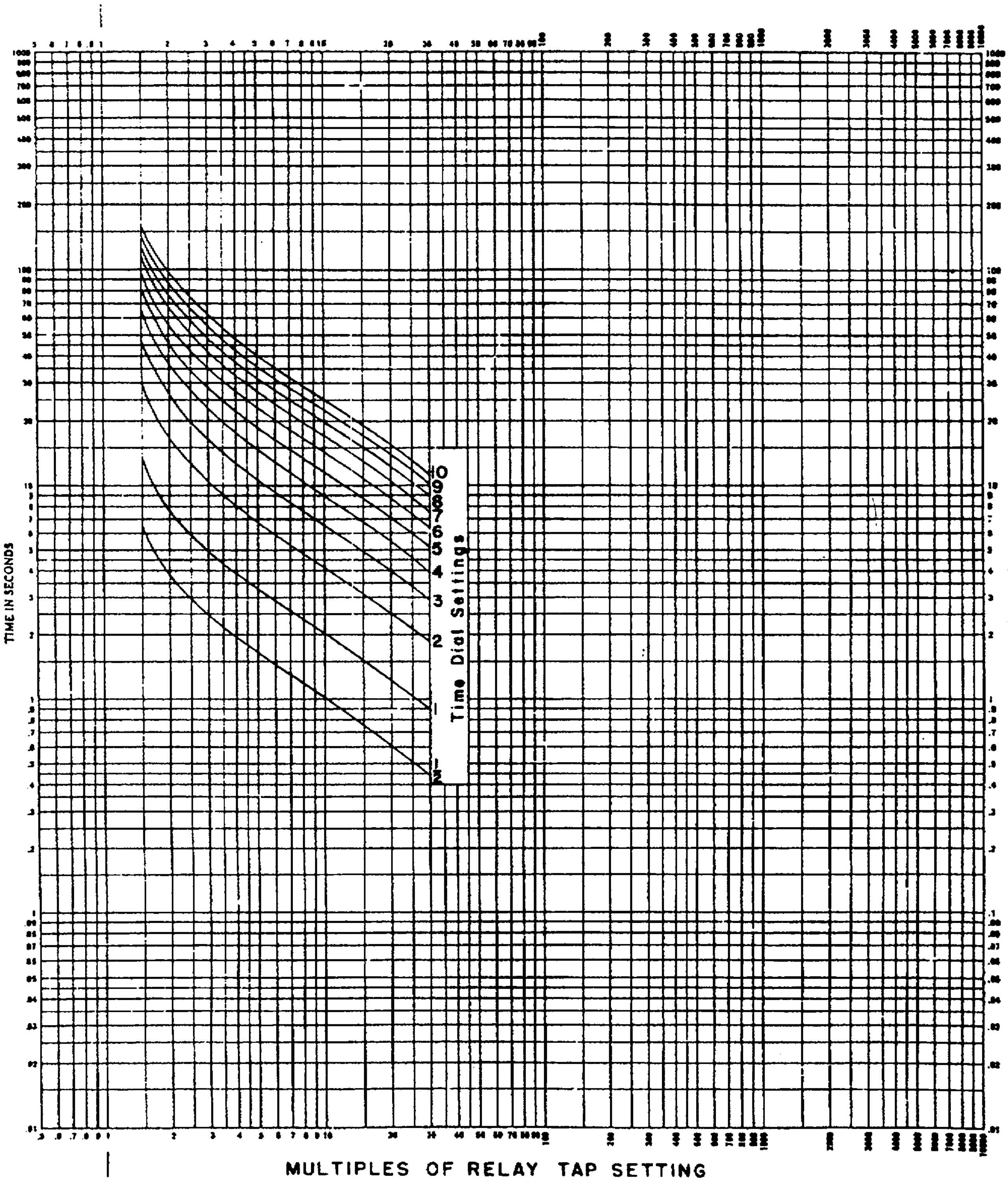


Figure 6 (0888B0273-0) Time Current Characteristics of IAC66M Relay

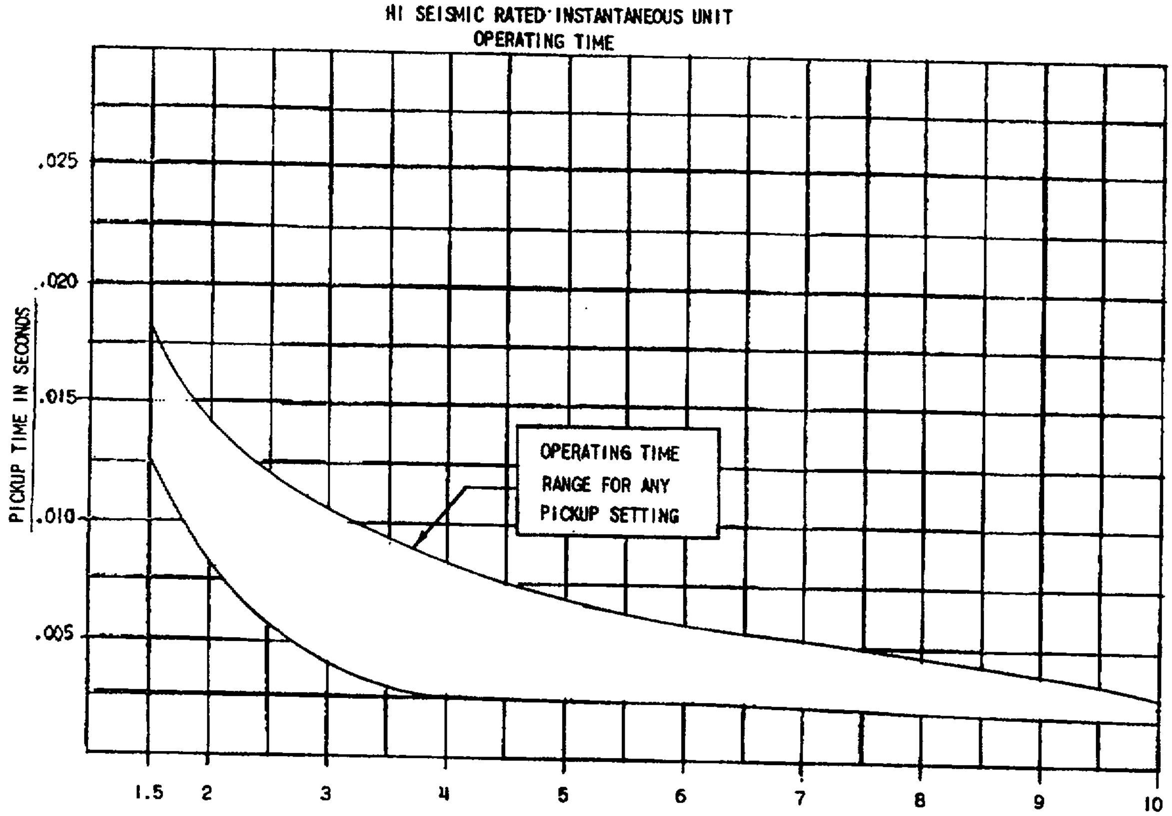


Figure 7 (0208A8695-1) Operating Time Versus Current for the Standard Instantaneous Unit

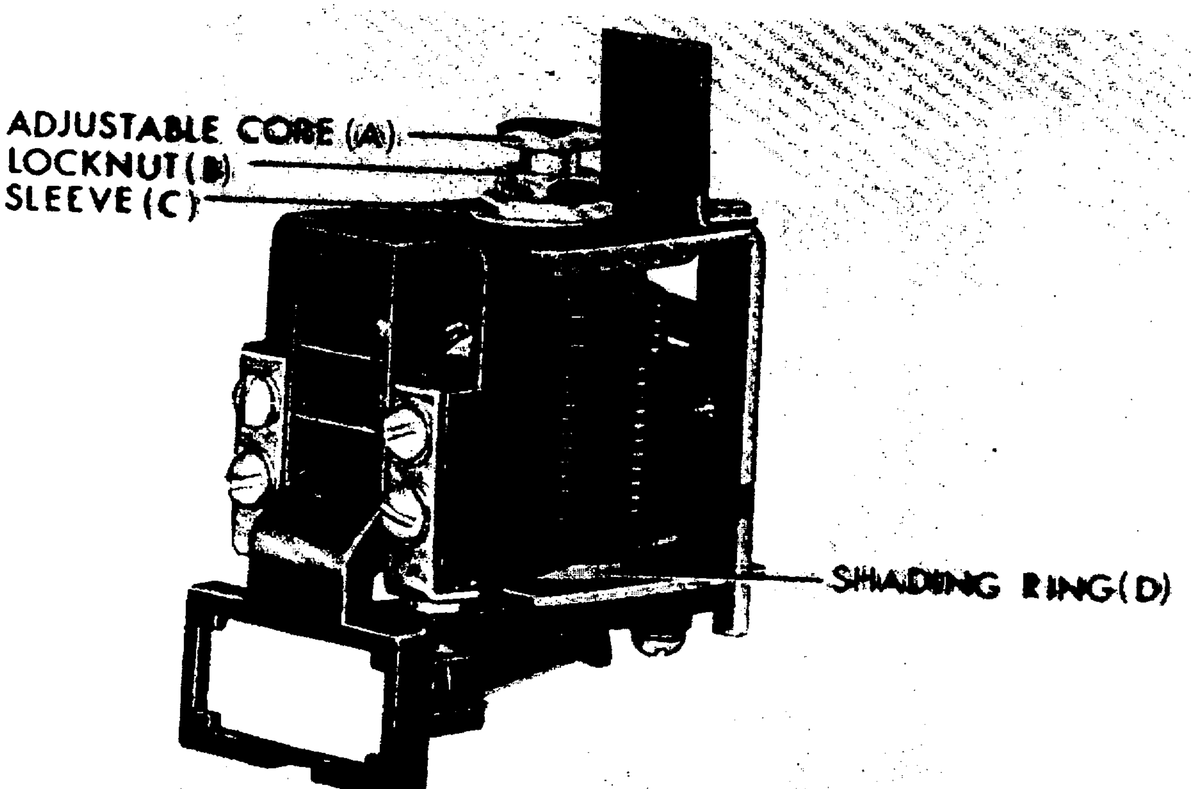


Figure 8 (8036365) Photograph: High Dropout Unit Construction

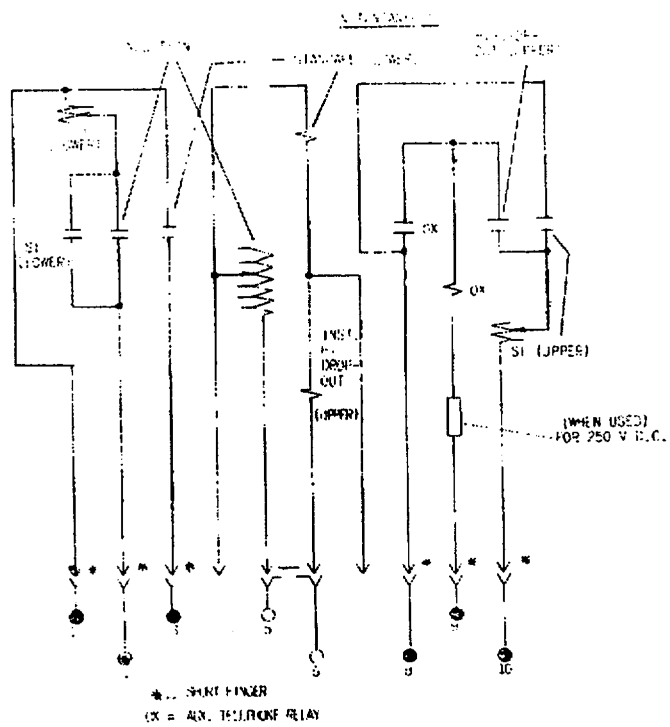


Figure 9A (0104A8596-2) Internal Connections Diagram for the IAC66M Relay (Front View)

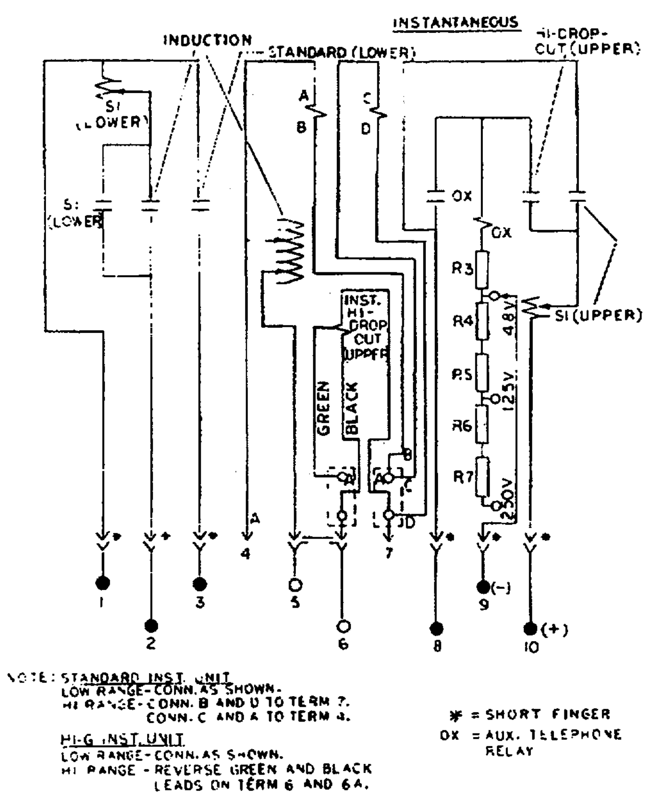


Figure 9B (0285A8839-0) Internal Connections Diagram for the IAC66M Relay, Forms 51 and Up (Front View)

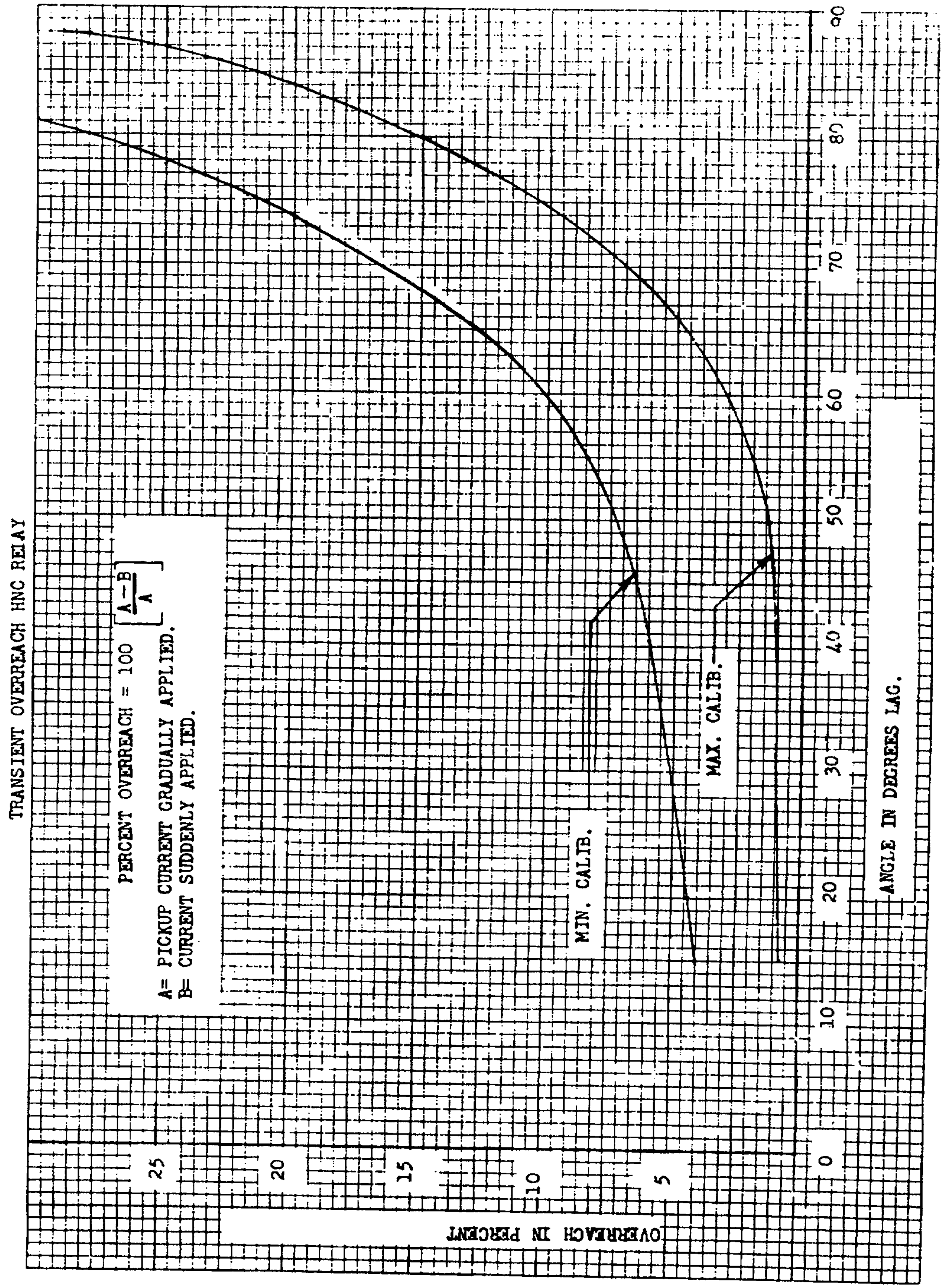


Figure 10 (0195A4950-0) Transient Overreach of the High Dropout Instantaneous Unit

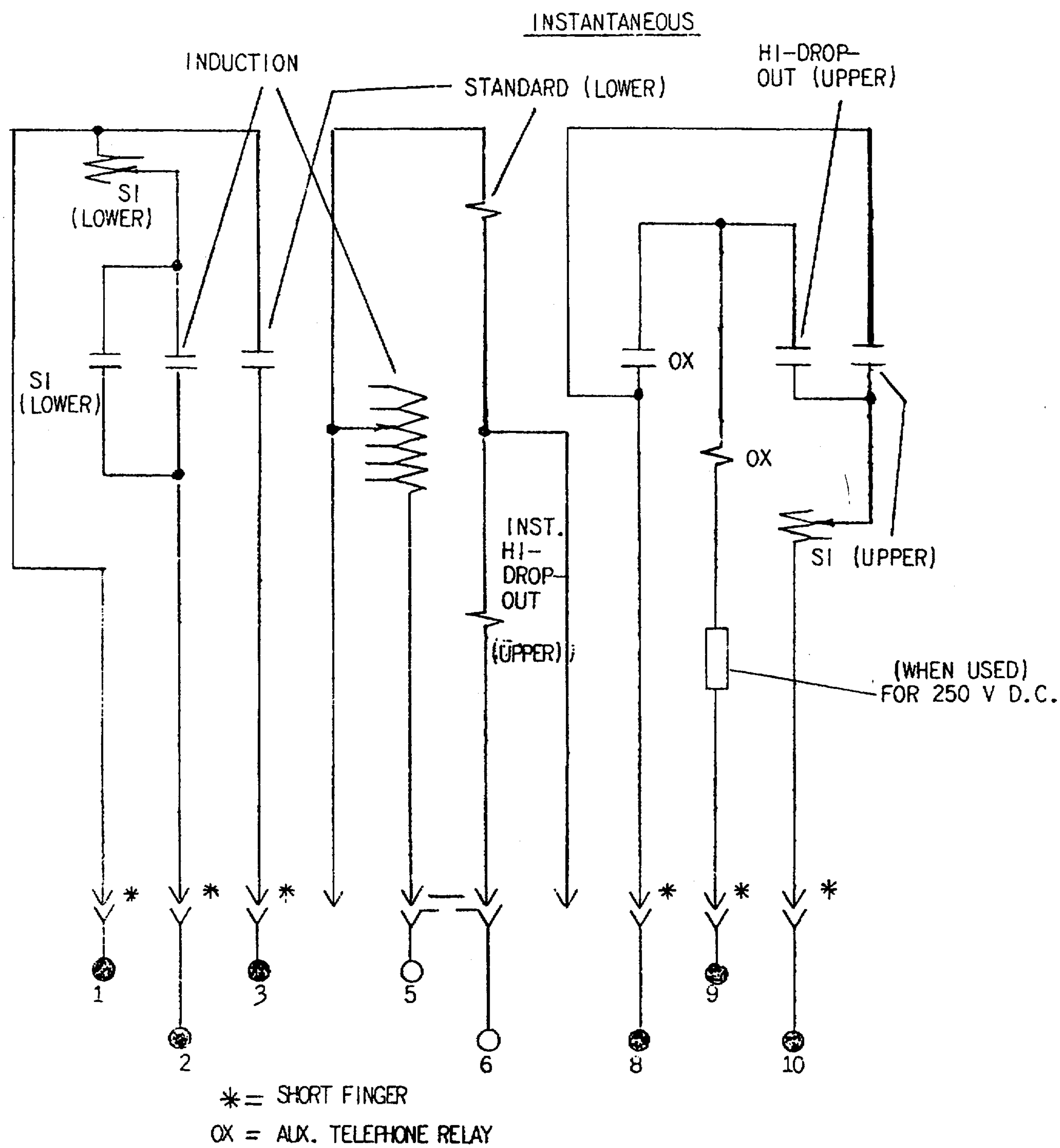
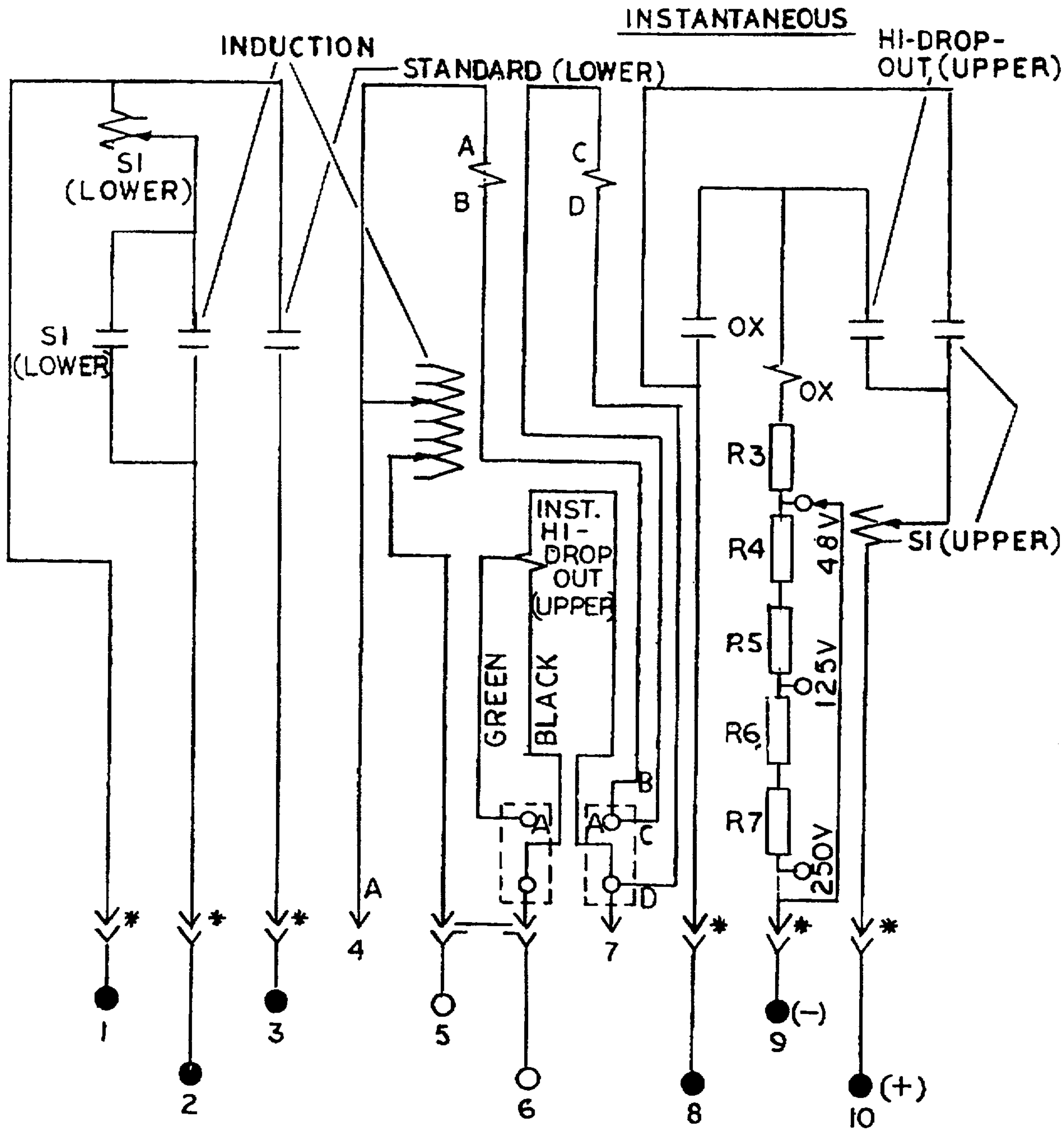


Figure 11 (0104A8596-2) Internal Connections Diagram for the Timer Unit, IAC66M Relay, Forms 1-50



NOTE: STANDARD INST. UNIT
LOW RANGE-CONN. AS SHOWN.
HI RANGE-CONN. B AND D TO TERM 7.
CONN. C AND A TO TERM 4.

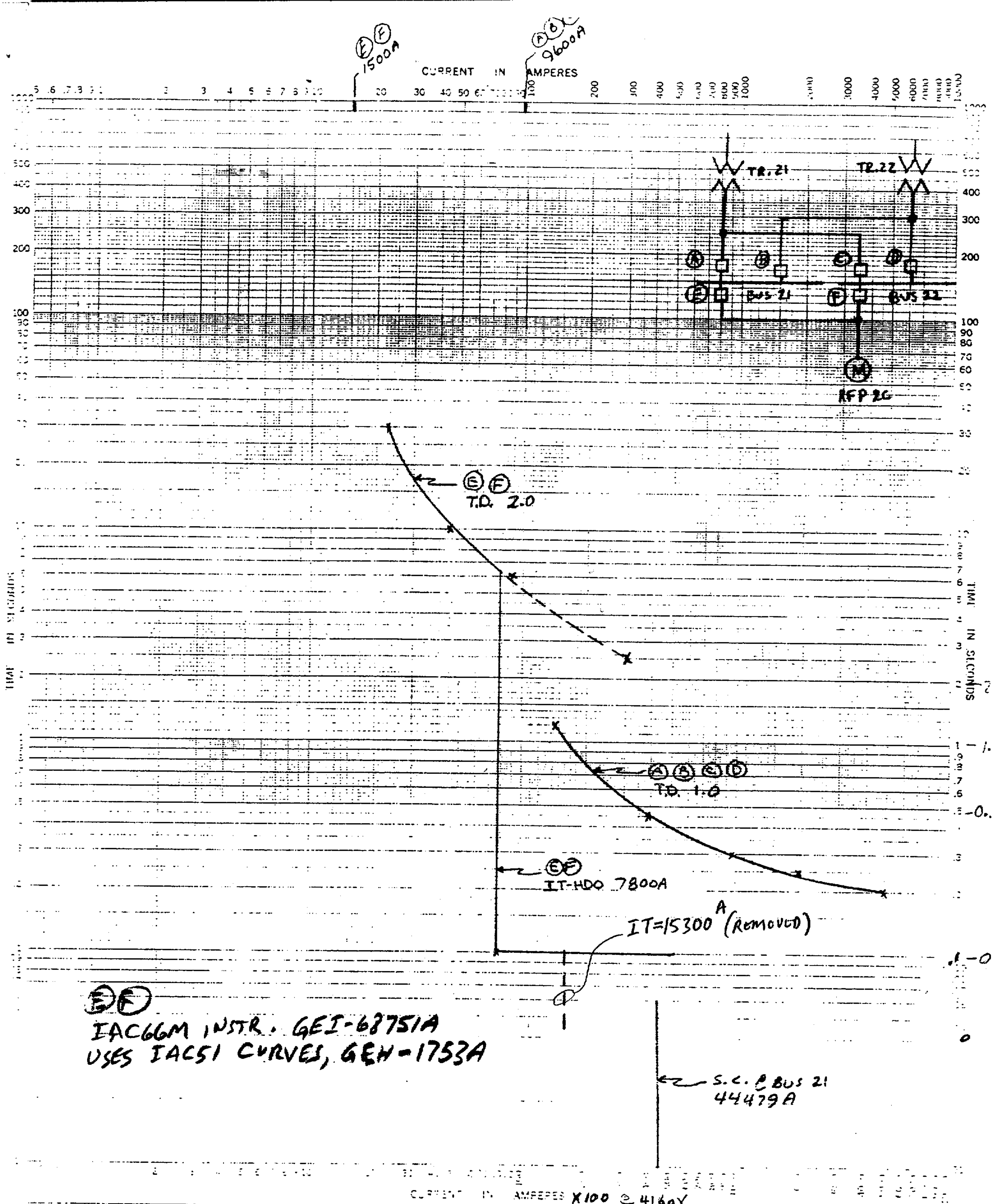
HI-G INST. UNIT
LOW RANGE-CONN. AS SHOWN.
HI RANGE - REVERSE GREEN AND BLACK LEADS ON TERM 6 AND 6A.

* = SHORT FINGER
OX = AUX. TELEPHONE RELAY

Figure 12 (0285A8839) Internal Connections Diagram for the Timer Unit, IAC66M Relay, Forms 51 and Up

ATTACHMENT C

Sample Coordination Plot for Relay Settings



DRESDEN BUS 21, 22
(TYPICAL FOR BUS 31, 32)

TIME-CURRENT CHARACTERISTIC CURVES

1/11/01

DIT No. SPD-12-00-014
Attachment C, Pg. 1 of 5
By: