INSTRUCTIONS

GEK-49940B

THERMAL OVERCURRENT RELAY

TYPES

TMC21B
TMC23B

GENERAL ELECTRIC

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COVER (8043501)

THERMAL OVERCURRENT RELAY

TYPES TMC21B AND TMC23B

DESCRIPTION

The TMC21B and TMC23B are single-phase thermal overcurrent relays designed for motor protection. They provide both thermal overload and instantaneous overcurrent short circuit protection. The difference between the two types of relays is as follows:

TMC21B - standard time curve, Figure 6

TMC23B - short time curve, Figure 7

Each relay consists of an induction thermal unit with ambient temperature compensation, a universal target unit, and an instantaneous overcurrent unit with an independent mechanical target. The thermal and the instantaneous unit each have one normally-open contact. The thermal-unit contact is hand reset, while the instantaneous-unit contact is self reset. The two targets and the thermal-unit contact are all reset by the same reset mechanism. This is described in detail in the text under the heading of **CONSTRUCTION.** The relay internal connections are shown in Figure 4 and the outline and panel-drilling dimensions are shown in Figure 10.

APPLICATION

The TMC relays described here are designed to provide thermal-overload and short-circuit protection for motors. The relays are not intended for use directly in primary motor circuits. They should always be applied with current transformers (CTs) so that they will be self-protecting on primary short circuits. The CTs will saturate before excessive secondary currents can be reached.

The relay thermal-unit rating should be selected so that the maximum full-load motor current on a secondary basis falls between the minimum and maximum values of current shown in the RELAY SELECTION TABLE.

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

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

RELAY SELECTION TABLE

MOTOR FULL-LOAD CURRENT, AMPERES		CURRENT RATING, AMPERES		MODEL 12TMC	
MIN.	MAX.	THERMAL UNIT	INST. UNIT	21B FORM	23B FORM
1.32	1.45	1.64	6-150	1	1
1.46	1.59	1.82	6-150	2	2
1.60	1.75	2.00	6-150	3	3
1.76	1.93	2.20	6-150	4	4
1.94	2.11	2.42	6-150	5	5
2.12	2.33	2.65	6-150	6	6
2.34	2.55	2.92	6-150	7	7
2.56	2.81	3.20	6-150	8	8
2.82	3.09	3.52	6-150	9	9
3.10	3.39	3.87	6-150	10	10
3.40	3.74	4.25	6-150	11	11
3.75	4.11	4.68	6-150	12	12
4.12	4.47	5.15	6-150	13	13
4.48	4.97	5.60	6-150	14	14

The maximum full-load motor current is determined as the nameplate current multiplied by the correction factor given in the following table, depending upon the type of motor being used:

TEMPERATURE RATING OF MOTOR	CORRECTION FACTOR
Continuous, 1.15 service factor	1.0
Continuous, 1.0 service factor	0.9
Short time, 60 minutes	0.8
Short time, 30 minutes	0.75
Short time, 15 minutes	0.7
Short time, 5 minutes	0.6

The thermal-unit tripping current is adjustable over the range of 90% to 110% of the nominal coil rating. The relay is calibrated at 40°C to just trip at the coil rating current with a -10% +0% tolerance. If the motor full-load current (with correction factor applied) is near the maximum of the current-selection range for the chosen relay, unnecessary tripping may occur because of the negative tolerance for the calibration current. If such unnecessary tripping should occur, the thermal-unit tripping current should be increased to 110% of coil rating to eliminate the problem. The thermal-unit ambient-temperature compensation is discussed under **CHARACTERISTICS.**

The external connection diagram for these relays is shown in Figure 5. A minimum of two relays is required for adequate motor protection, as is shown.

RATINGS

The TMC21B relay is rated for 50/60 hertz. The TMC23B relay is rated for 60 hertz. The ratings of thermal and instantaneous units are shown in the RELAY SELECTION TABLE in the preceding **APPLICATION** section.

HIGH-SEISMIC INSTANTANEOUS UNIT

The instantaneous coil is tapped for operation on either one of two ranges (low or high). Selection of the low or high range is determined by the connections made to Terminals 8 and 8A. See the internal connections, Figure 4. Table I lists the instantaneous unit ranges, rating, one-second rating, etc.

TABLE I

HIGH-SEISMIC INSTANTANEOUS UNIT (AMPS)	RANGE	†† RANGE (AMPS)	CONTINUOUS RATING (AMPS)	ONE ††† SECOND RATING (AMPS)	K
6-150	LOW	6- 30	10.2	260	67,000
	HIGH	30-150	19.6		

†† 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 low setting and the minimum high setting. Whenever possible 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:

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

HIGH-SEISMIC TARGET

Ratings for the target unit are shown in Table II.

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 target coil of the protective relay.

TABLE II

	TAP	
	0.2	2.0
D.C. RESISTANCE ± 10% (OHMS)	8.0	0.24
MINIMUM OPERATING (AMPERES) +0 - 25%	0.2	2.0
CARRY CONTINUOUSLY (AMPERES)	0.3	3.0
CARRY 30 AMPS FOR (SEC.)	0.03	4.0
CARRY 10 AMPS FOR (SEC.)	0.25	30.0
60 HZ IMPEDANCE (OHMS)	68.0	0.73

CONTACTS

The contacts will make and carry 30 amperes trip current and three (3) amperes continuously except as limited in the target circuit noted in Table II.

BURDENS

THERMAL UNIT

The burden of the TMC21B at rated current is approximately 13.5 volt-amperes and 12 watts for 60 hertz operation or approximately 12.5 volt-amperes and 11 watts for 50 hertz operation. The burden of the TMC23B is approximately 10% higher than the TMC21B type relay.

The volt-ampere burden of the TMC21B at five amperes is approximately equal to K divided by the square of the current rating, where K is 325 for 60 hertz and 305 for 50 hertz. The volt-ampere burden of the TMC23B at five amperes is approximately equal to K divided by the square of the current rating where K is 295.

HIGH-SEISMIC INSTANTANEOUS UNIT

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

TABLE III

HIGH SEISMIC INST. UNIT (AMPS)	HZ	RANGE	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	LOW	6- 30	6	0.110	0.078	0.135	0.095	0.081	0.079
		HIGH	30-150	30	0.022	0.005	0.023	0.022	0.022	0.022
6-150	50	LOW	6- 30	6	0.092	0.065	0.112	0.079	0.068	-0.066
		HIGH	30-150	30	0.018	0.004	0.019	0.018	0.018	0.018

CHARACTERISTICS

THERMAL UNIT

The thermal unit consists of a current coil placed over a bi-metal helix that acts as the short-circuited secondary of a transformer. The current heats the helix, causing it to rotate in a direction to close the hand-reset contacts. Tripping current is adjustable from 90% to 110% of coil rating. The contacts cannot be reset until the unit has cooled for a time. The relay is calibrated at 40°C and has built-in compensation for changes in ambient temperature; the compensation is not perfect. There is a 2% variation in trip point per 10°C change in temperature from the 40°C calibration temperature. The trip point will decrease as the ambient temperature increases.

The resulting time of the TMC relays should be with ±25% of the time-current characteristic curve as shown in Figure 6 for the TMC21B and in Figure 7 for the TMC23B.

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 interchanging two leads on the case block. See the internal in Figure 4. The time-current-characteristic curve for the instantaneous unit is shown in Figure 9.

HIGH-SEISMIC TARGET

The target 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.

CONSTRUCTION

The relay case is suitable for either surface or semiflush panel mounting and an assortment of hardware is provided for either mounting. The cover attaches to the case and also carries the reset mechanism.

The case has studs or screw connections at the bottom only for the external connections. The electrical connections between the relay units and the case studs are made through spring-backed contact fingers mounted in stationary molded inner and outer blocks, between which nests a removable connecting plug that completes the circuits. The outer block, attached to the case, has the studs for the external connections, and the inner block has the terminals for the internal connections.

The relay mechanism is mounted in a steel framework called the cradle and is a complete unit, with all leads being terminated at the inner block. This terminal is held firmly in the case with a latch at the top and the bottom and by a guide pin at the back of the case. The case and cradle are so constructed that the relay cannot be

inserted in the case upside down. The connecting plug, besides making the electrical connections between the respective blocks of the cradle and case, also locks the latch in place. The cover, which is fastened to the case by thumbscrews, holds the connecting plug in place.

To draw out the relay unit, the cover is first removed, and the plug drawn out. Shorting bars are provided in the case to short the current transformer circuits. The latches are then released, and the relay unit can be easily drawn out. To replace the relay unit, the reverse order is followed.

A separate testing plug can be inserted in place of the connecting plug to test the relay in place on the panel either from its own source of current, or from other sources. Or, the relay unit can be drawn out and replaced by another that has been tested in the laboratory.

The target is mounted on the front top left, and consists of a small hinged-type unit that raises a target when picked up. The target is released by raising a rod located at the lower left corner of the relay cover.

In addition to the target there is a hinged-type instantaneous unit mounted on the front top right. When the instantaneous unit picks up it raises a target that latches up and remains exposed until it is released. The same reset rod that releases the left target also releases the instantaneous unit target.

RECEIVING, HANDLING, AND STORAGE

These relays, when not included as a part of a control panel, will be shipped in cartons designed to protect them against damage. Immediately upon receipt of a relay, examine it for any damage sustained in transit. If injury or damage resulting from rough handling is evident, file a damage claim at once with the transportation company and promptly notify the nearest General Electric Sales Office.

Reasonable care should be exercised in unpacking the relay in order that none of the parts are injured nor the adjustments disturbed.

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

ACCEPTANCE TESTS

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

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

These tests may be performed as part of the installation or of the acceptance tests, at the discretion of the user.

Since most operating companies use different procedures for acceptance and for installation tests, the following section includes all applicable tests that may be performed on these relays.

VISUAL INSPECTION

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

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

TESTING FACILITIES

All General Electric drawout-case relays may easily be tested in the case by using either the XLA12A or XLA13A test plugs. The XLA12A has 20 fingers, which bring both the ten relay connections and the ten outside-world connections to the front of the relay for easy access. The XLA13A test plug brings only the ten relay connections to the front of the relay, without disturbing the CT shorting bars.

For further information on these test plugs, refer to Section 7332 in the General Electric Apparatus Handbook or contact the nearest General Electric Sales Office.

POWER REQUIREMENTS, GENERAL

All devices operating on alternating current (AC) are affected by frequency. Since non-sinusoidal waveforms can be analyzed as a fundamental frequency plus harmonics of that fundamental frequency, it follows that alternating-current devices (relays) will be affected by applied waveforms. AC relays (and AC devices in general) are significantly affected by the application of non-sinusoidal waveforms.

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

THERMAL UNIT

The relay has been adjusted at the factory; it is advisable not to disturb the adjustments. It is most important that the bi-metal helix and the compensating bi-metal should never be tampered with at any time.

Upon leaving the factory, the relay is set for the 100% calibration. If it is desired to adjust the relay to trip at a slightly higher or lower value of current, loosen the adjustment-locking screw (see Figure 3). Then the adjusting screw can be turned to provide the desired adjustment. Be sure to tighten the adjustment-locking screw.

Tests on the thermal unit should be made with the cover on. In order to prevent some pre-heating of the unit (such as would occur while adjusting the current in the test circuit to the desired level with the thermal unit in the circuit), bypass, rather than shorting out, the thermal unit during the current setting. When the thermal unit is included in the circuit, the magnitude of current will be somewhat less, but its value can be determined during the timing period to check the level of percentage overload. The resulting time should be within ±25% of the published time curves.

HIGH-SEISMIC INSTANTANEOUS UNIT

Make sure that the instantaneous unit is wired for the range in which it is to operate. See Figure 4. Whenever possible use the higher range, since the higher range has the higher continuous rating.

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 I 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 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.

HIGH-SEISMIC TARGET

The pickup and dropout current is listed in Table IV.

TABLE IV

TAP	PICK-UP CURRENT	DROPOUT CURRENT
0.2	0.12 - 0.19	0.05 OR MORE
2.0	1.2 - 1.9	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 drilling is shown in Figure 10.

The internal-connections diagram for the relays is shown in Figure 4. Typical external connections are shown in Figure 5.

PERIODIC CHECKS AND ROUTINE MAINTENANCE

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

To substitute a new current coil in the thermal unit, the procedure should be as follows:

1. Remove the coil leads from Terminals 5 and 6.
2. Loosen the three mounting screws and remove the retaining plate (see Figure 2).
3. Lift out the present coil and substitute the replacement for it, taking care that the coil is mounted with the two locating pins on the lower side.
4. Replace the retaining plate so that it rests squarely against the end of the core.
5. Tighten the three mounting screws.
6. Connect the coil leads to Terminals 5 and 6.

CONTACT CLEANING

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

SYSTEM TEST

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

RENEWAL PARTS

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

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

LIST OF FIGURES

*Revised since last issue

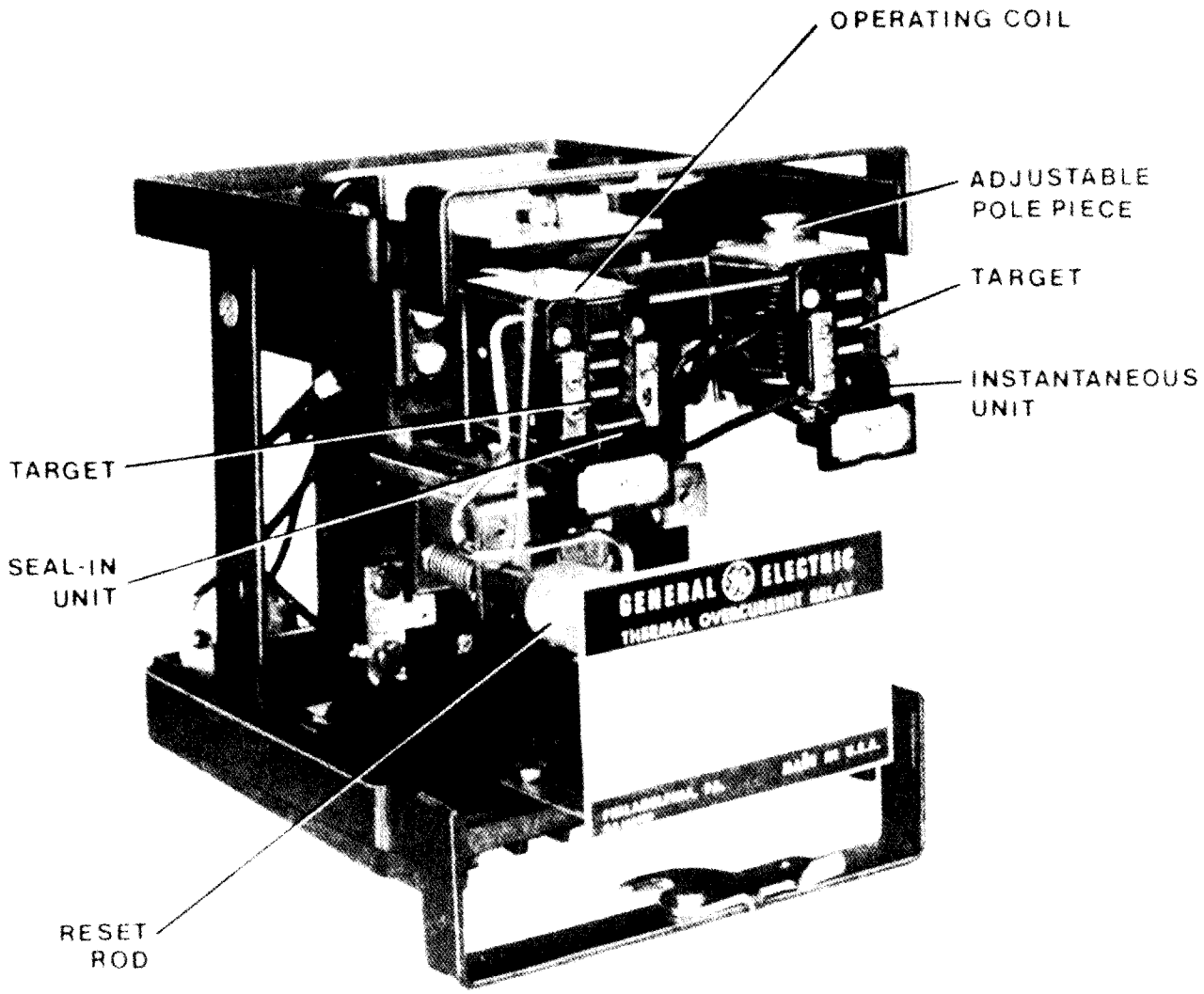

Figure 1 (8043502) TMC21B Relay, Front View

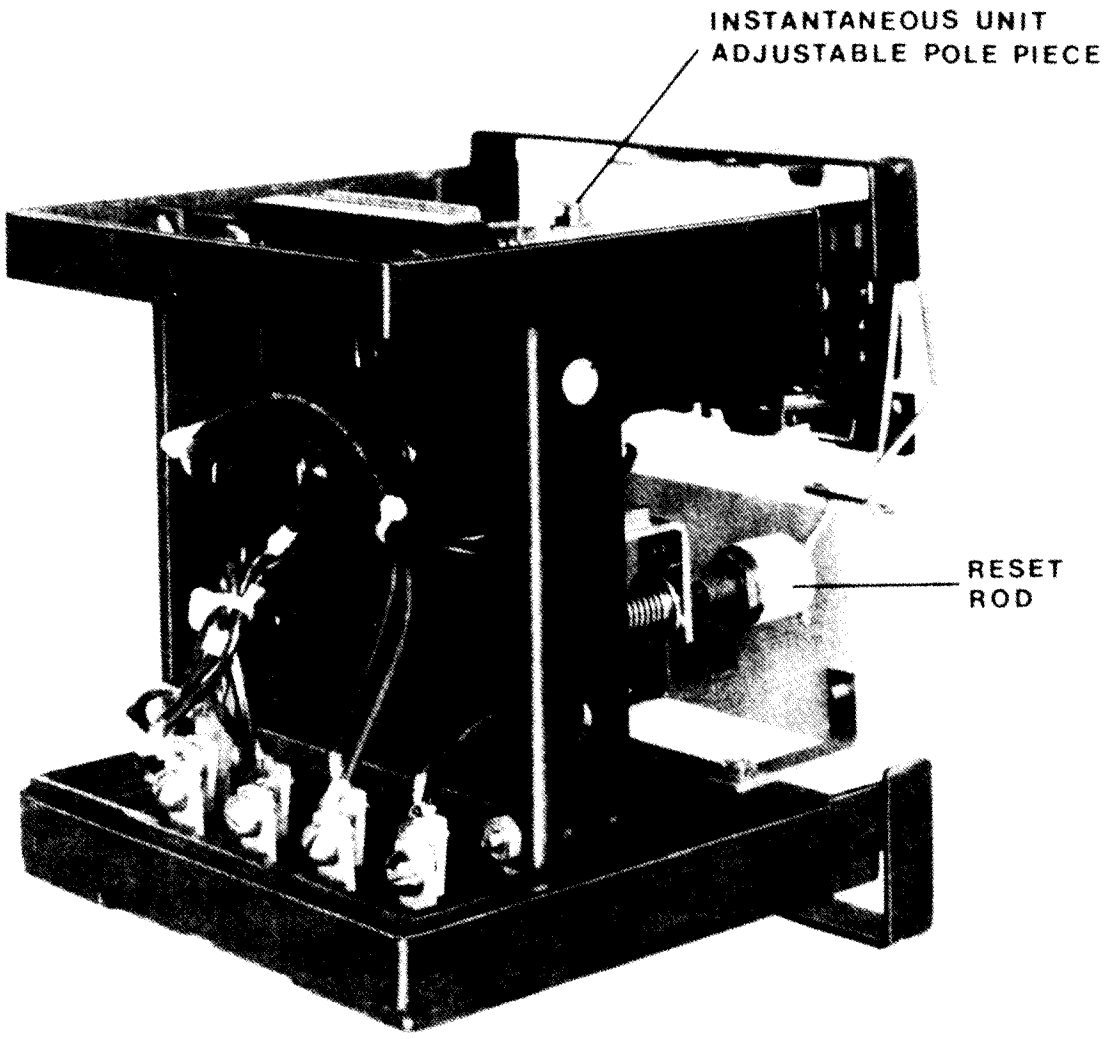

Figure 2 (8043503) TMC21B Relay, Rear View

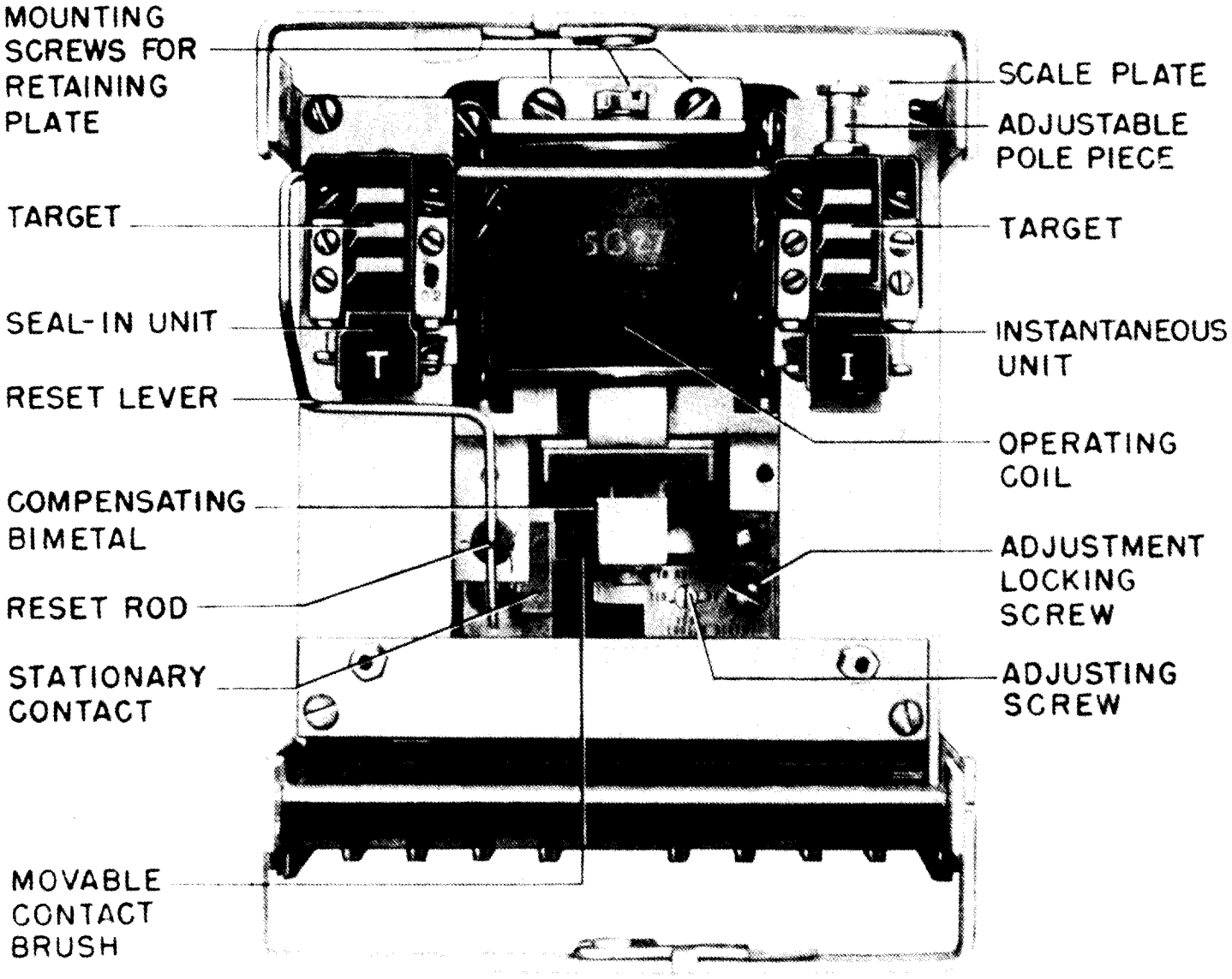

Figure 3 (8007955) Thermal Unit with Current Coil and Reset Rod Removed

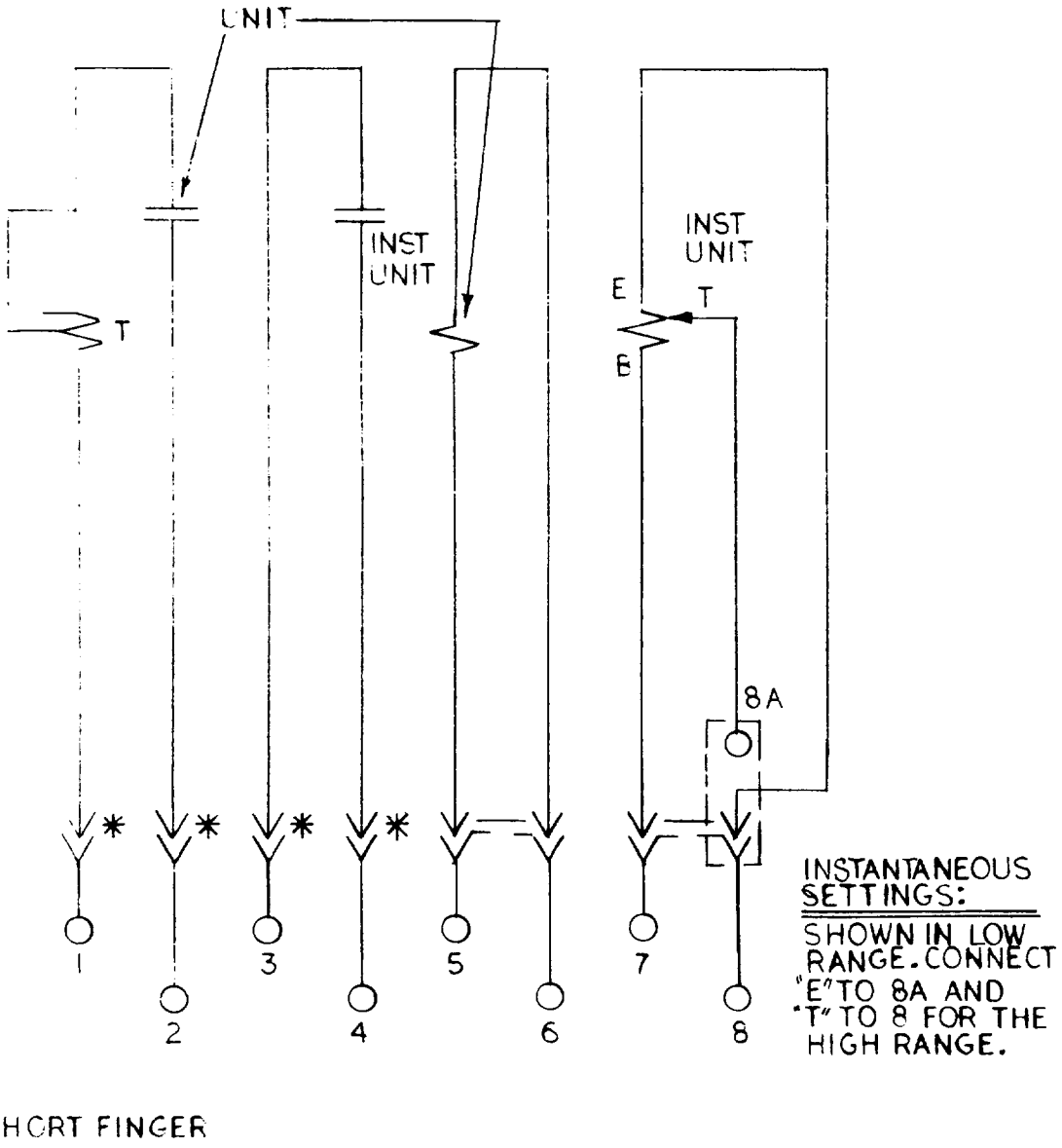

Figure 4 (0273A9556) Internal Connections for Type TMC21B and TMC23B Relays

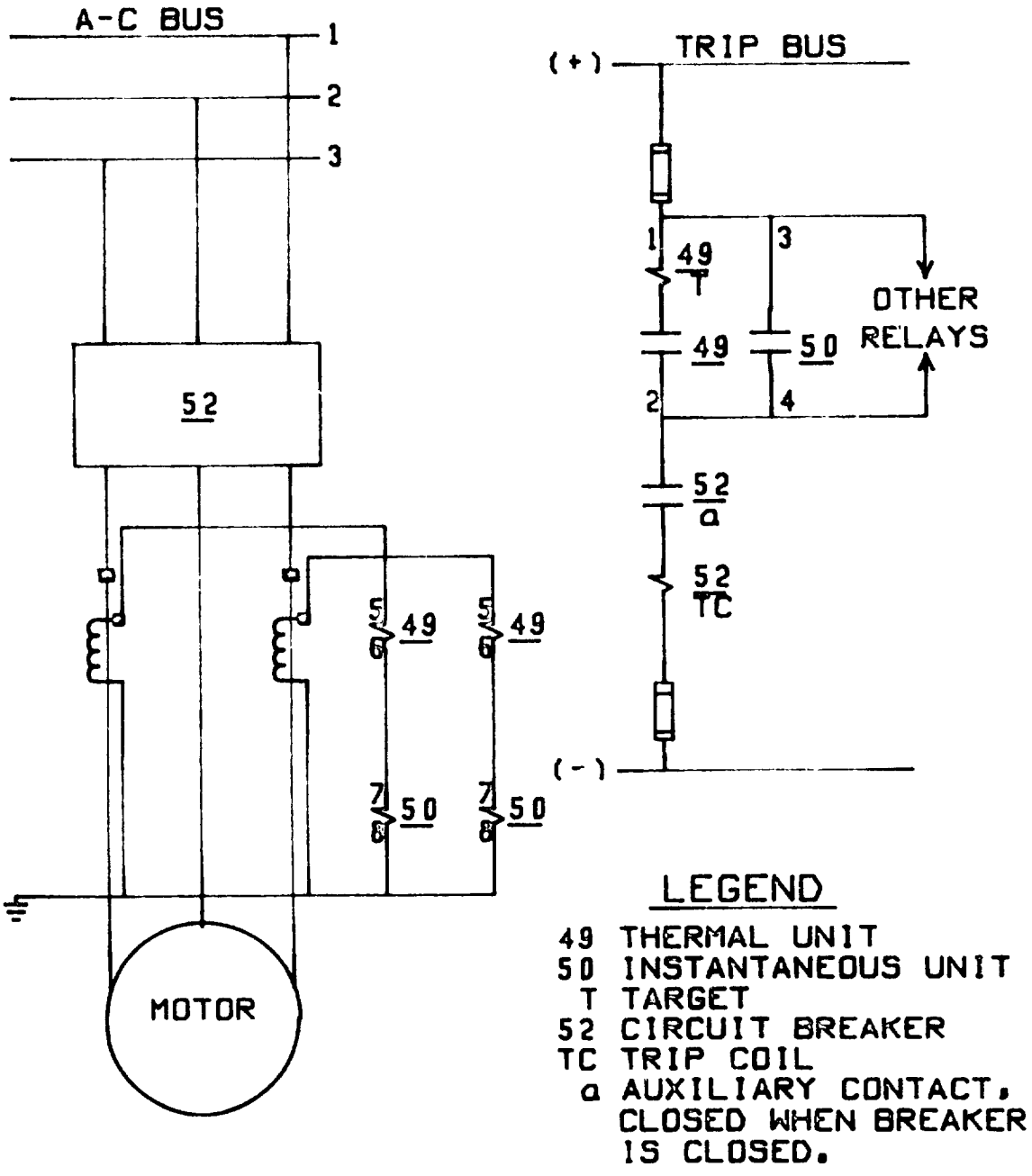

Figure 5 (0275A4381) Typical External Connections for Type-TMC Relay

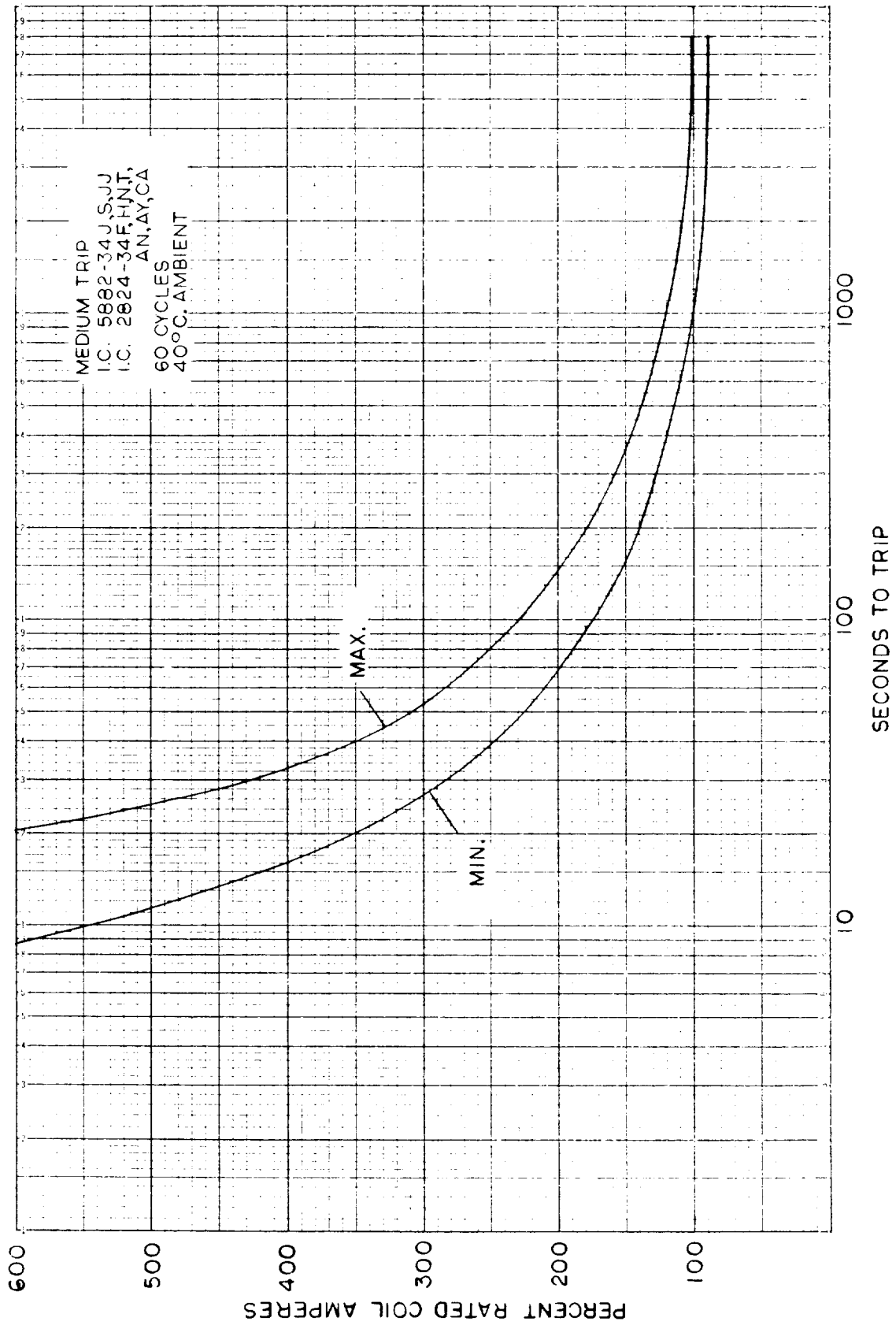

*Figure 6 (0285A8975) Time/Current Characteristic Curve for Type-TMC21B Relay

*Revised since last issue

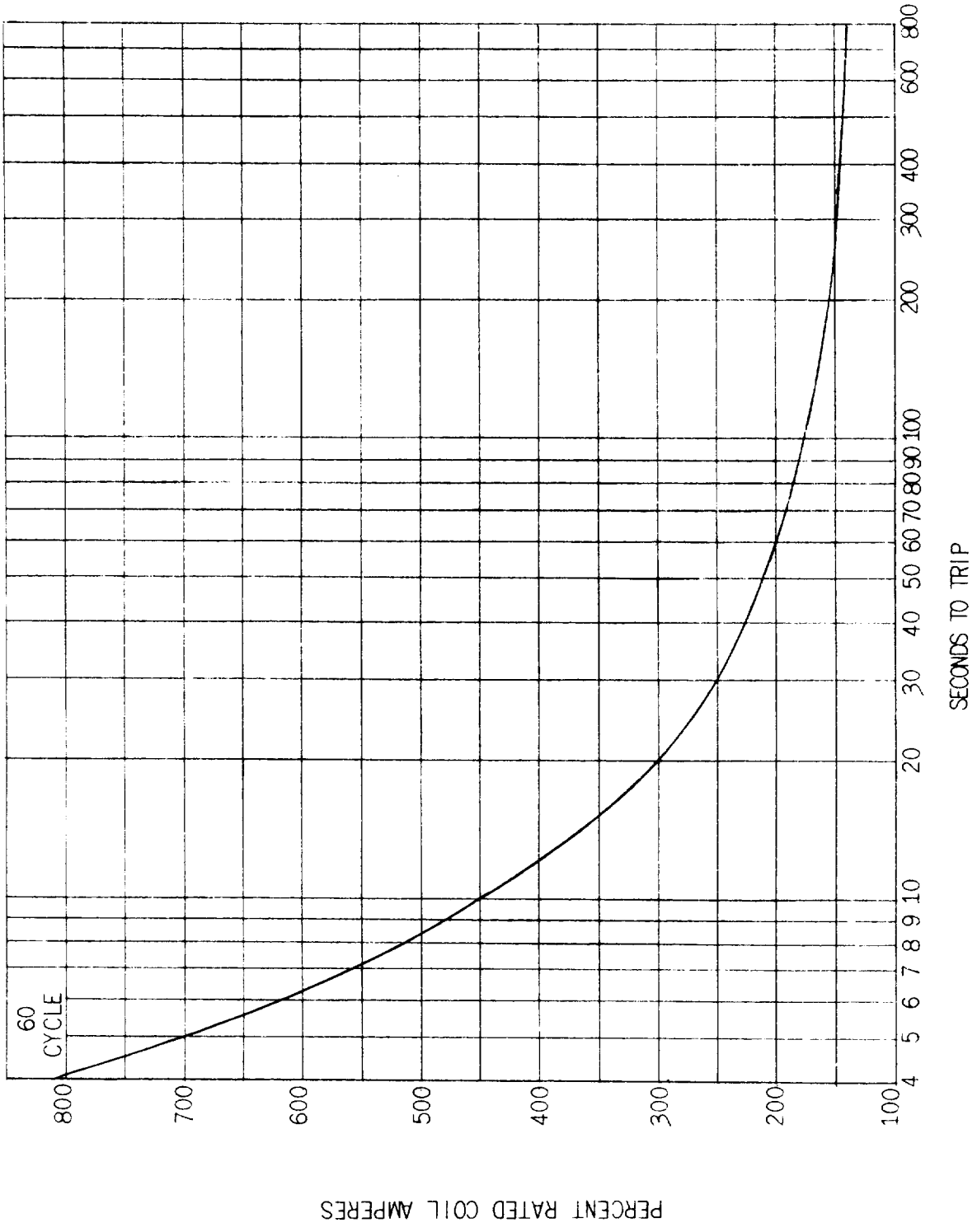

Figure 7 (0418A0800) Time/Current Characteristic Curve for Type-TMC23B Relay

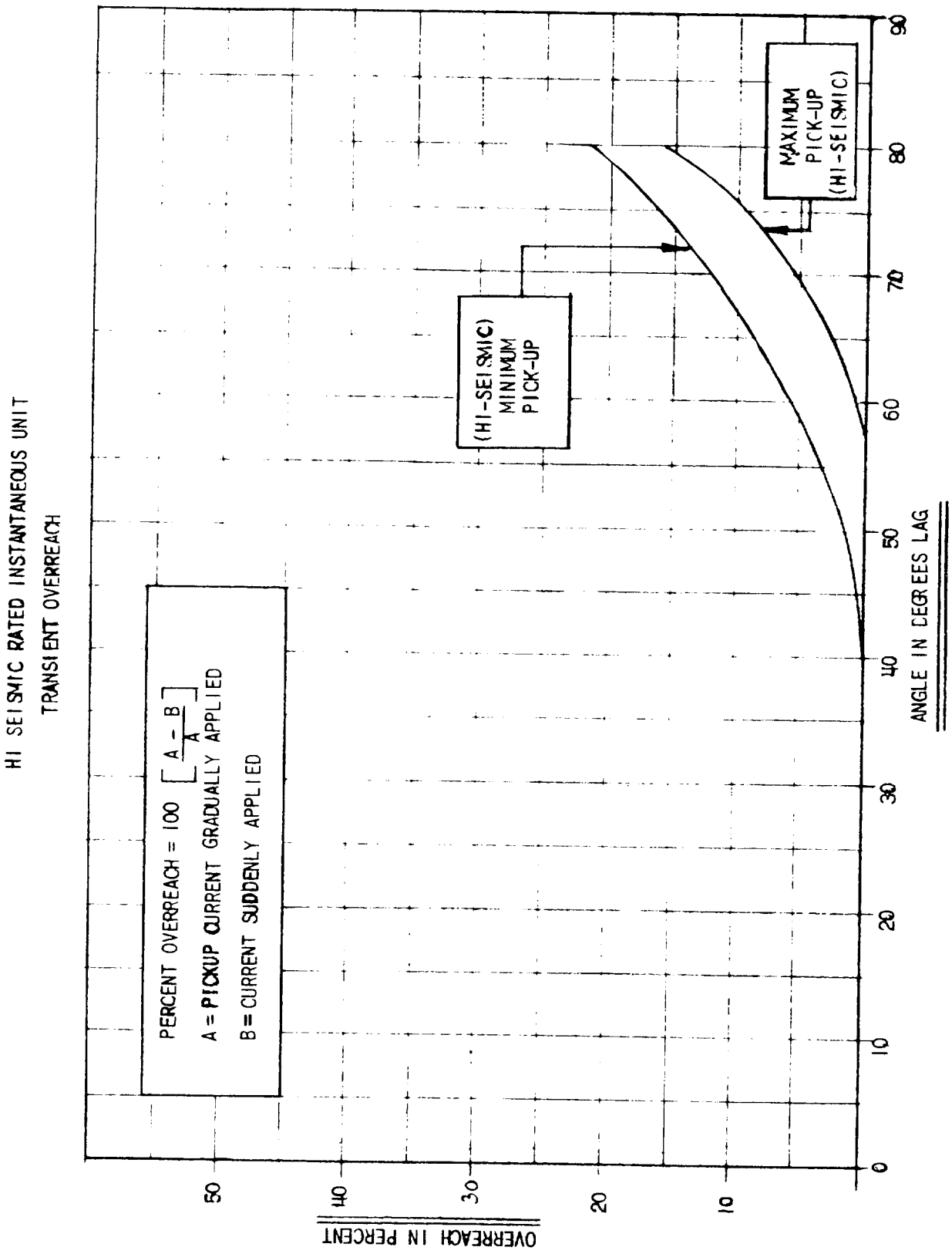

Figure 8 (0208A8694-2) Transient Overreach Characteristics of the High-Seismic Instantaneous Unit

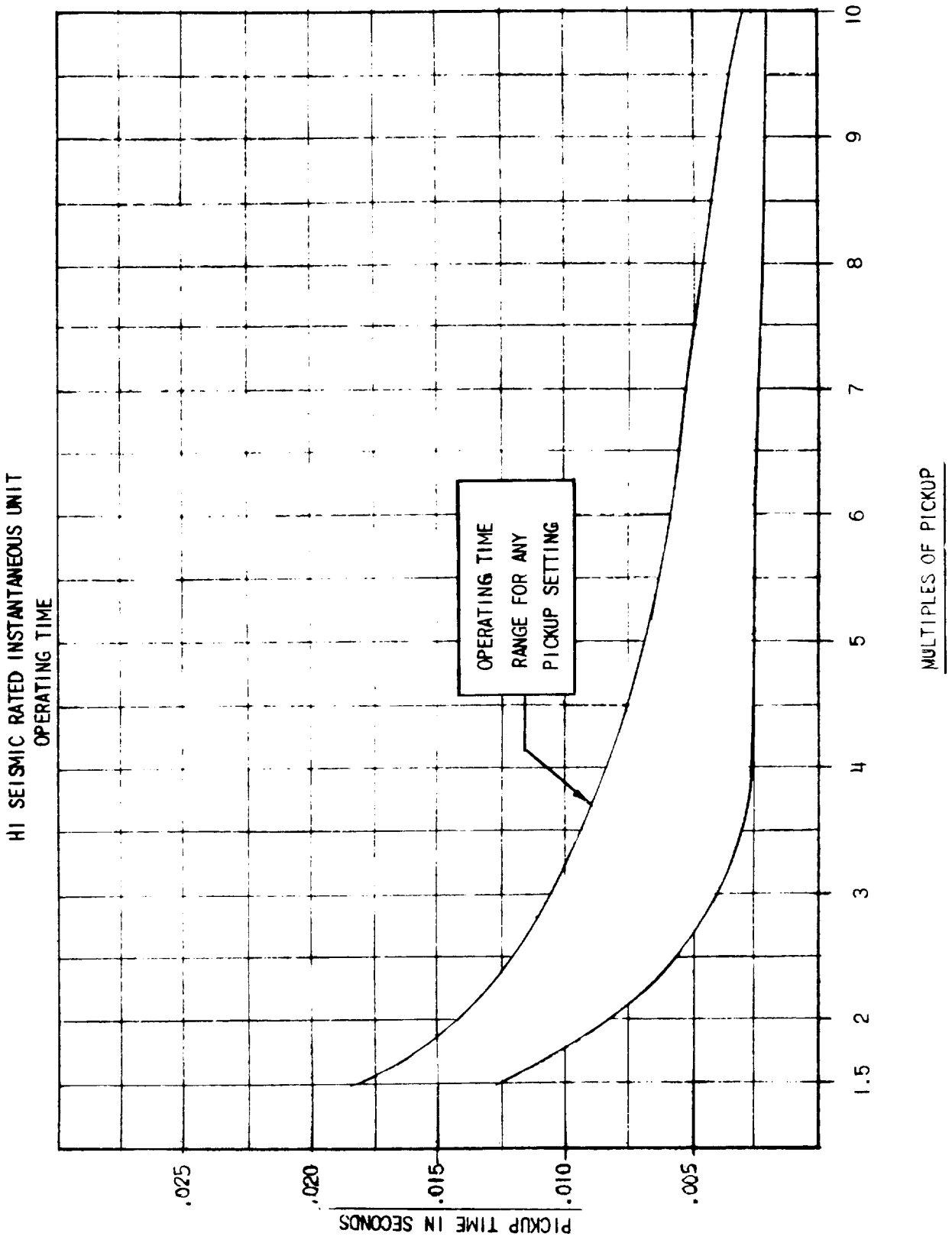

Figure 9 (0208A8695-1) Time/Current Characteristics of the High-Seismic Instantaneous Unit

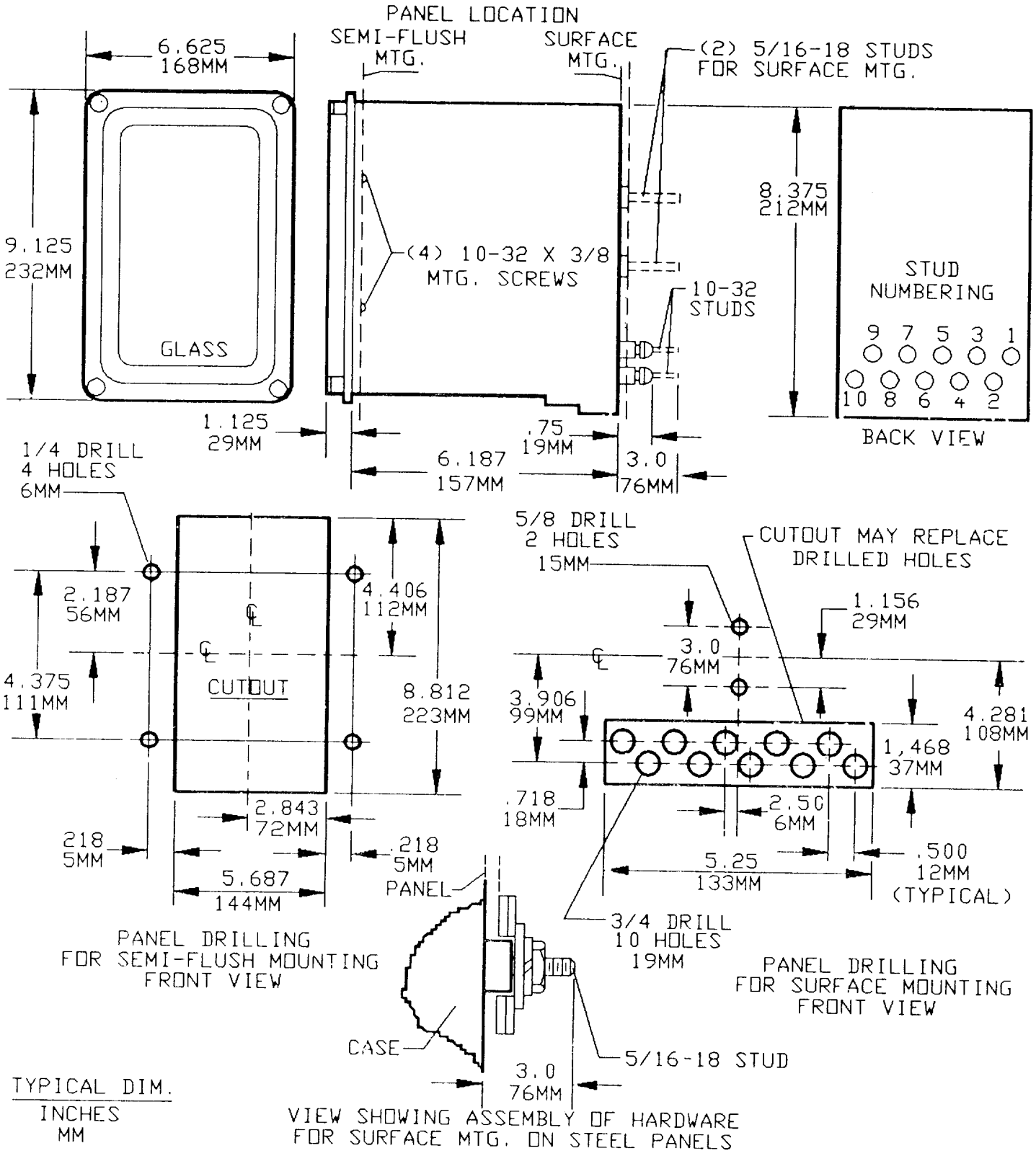

*Figure 10 (06209271-8) Outline and Panel Drilling for Types TMC21B and TMC23B Relays

*Revised since last issue

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