# INSTRUCTIONS

## TIMING RELAYS

**TYPES:**

**SAM11A, B, C, D, H AND J**

**SAM13C**

**SAM99AB, AC, AD, AF, AG, AH**


*GE Meter and Control*
*205 Great Valley Parkway*
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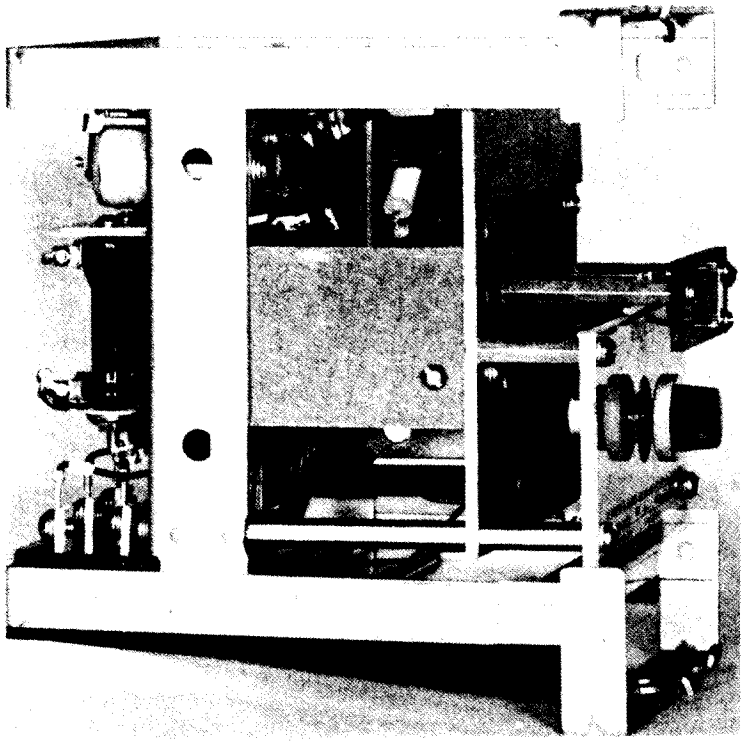

Figure 1A (8039881) SAM11A21A Relay Removed from Case (Right Side View)

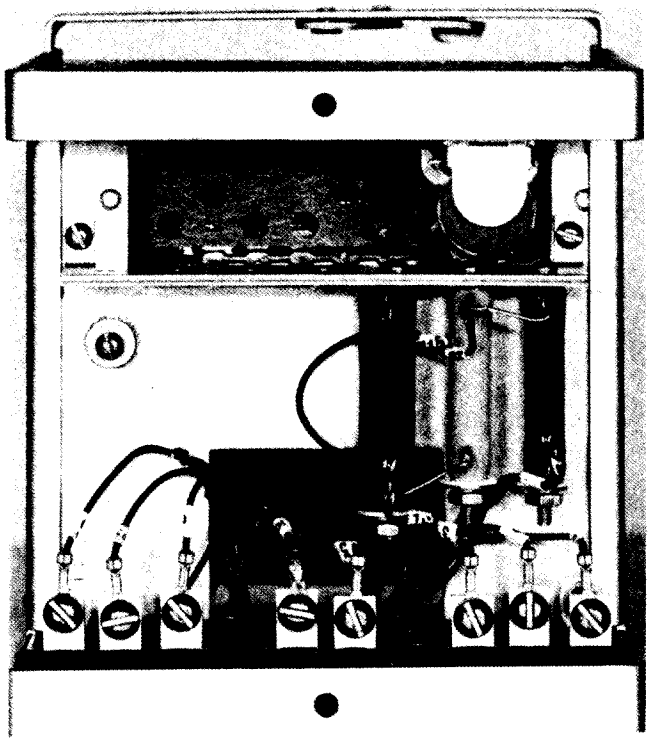

Figure 1B (8039884) SAM11A21A Relay (Rear View)

(Cover Photo 8039883)

# TIMING RELAYS
## TYPES:
## SAM11A, B, C, D, H and J
## SAM13C
## SAM99AB, AC, AD, AF, AG, AH
## INTRODUCTION

The SAM relays are timing relays that employ solid-state components to provide an extremely stable time-delay function. These relays employ a low energy resistance-capacitance timing circuit that is regulated to make the timing independent of variations in supply voltage. The output of the timing circuit is amplified by solid-state circuitry to provide sufficient energy to operate a small telephone-type relay having two electrically separate transfer contacts.

Table A lists the relays covered by these instructions and gives a brief description of each model. Table B lists the timing ranges normally used on these relays.

TABLE A

| MODEL | TARGET UNIT | T&SI UNIT | NO. OF TIMERS | OUTPUT++ CONTACTS N.O. | OUTPUT++ CONTACTS N.C. | CASE SIZE | INT'L CONNS. | SPECIAL FEATURES |
|---|---|---|---|---|---|---|---|---|
| 11A | - | - | 1 | 2 | 2 | S1 | Fig. 3 | |
| 11B | 1 | - | 1 | 2 | 2 | S1 | Fig. 4 | |
| 11C | - | 1 | 1 | 2 | - | S1 | Fig. 5 | |
| 11D | 2 | - | 1 | 2 | 2 | S1 | Fig. 6 | |
| 11H | 1 | - | 1 | 2 | 2 | S1 | Fig. 7 | Anti-bounce TX relay |
| 11J | - | 1 | 1 | 2 | - | S1 | Fig. 8 | Low voltage operation |
| 13C | - | 2 | 2 | 2 per timer | - | S1 | Fig. 9 | Two timers |
| 99AB | - | - | 1 | 6 | 2 | S2 | Fig. 10 | 11A with 4 additional N.O. contacts |
| 99AC | - | 1 | 1 | 2 | 2 | S1 | Fig. 11 | 11C with two N.C. contacts |
| 99AD | 1 | - | 1 | 2 | 2 | S1 | Fig. 12 | 11H with fast-dropout TX relay |
| 99AF | 3 | - | 2 | 2 | - | S1 | Fig. 13 | Used where $Z_1$ target is needed |
| 99AG | 1 | - | 1 | 2 | 2 | S1 | Fig. 14 | AC operated; 120V, 60 Hz |
| 99AH | - | 2 | 1 | 5 | - | S2 | Fig. 15 | Five N.O. contacts |

++Where there are two normally-open and two normally-closed contacts, they are transfer contacts (Form C).

TABLE B
TIME RANGES - SAM RELAYS

| |
|---|
| .03 - 1.0 seconds |
| .05 - 3.0 |
| .1 - 5.0 |
| .2 - 4.0 |
| 0.5 - 3.0 |
| 1.5 - 15.0 |

## APPLICATION

These relays can be applied wherever timing functions are required. The negligible overtravel and reset times of these relays, plus their repeatability characteristics regardless of supply voltage variations, make them particularly well suited for applications where consistent operating times under all conditions are essential. Specifically, these relays are ideal for applications in circuit-breaker failure-backup schemes, where accurate and repeatable time settings are essential. Typical external connections are shown in Figure 2.

## RATINGS

### CONTROL VOLTAGE

Control voltage ratings are listed in Table C.

TABLE C

| DC VOLTAGE | MODEL |
|---|---|
| 24/125 | SAM99AF(-)A |
| 24/48/125 | SAM11J |
| 125/250 | SAM11H, SAM99AD |
| 48/125/250 | All other |
| 48/110/220 | DC rated models |
| **AC VOLTAGE** | **MODEL** |
| 120V, 60 Hz | SAM99AG(-)A |

Relays that are triple-voltage rated have a link on the front panel for selecting the control voltage.

## CONTACTS

The relay contacts will close and carry momentarily 30 amperes DC at control voltages of 250 volts or less. These contacts will carry 3 amperes continuously and have interrupting ratings as shown in Table D.

TABLE D

| VOLTAGE | CURRENT, INDUCTIVE+ | CURRENT, NON-INDUCTIVE |
|---|---|---|
| 48 VDC | 1.0 A | 3.0 A |
| 125 VDC | 0.5 A | 1.5 A |
| 250 VDC | 0.25 A | 0.75 A |
| 115V, 60 Hz | 0.75 A | 2.0 A |
| 230V, 60 Hz | 0.5 A | 1.0 A |

+Inductance of average trip coil.

## TARGET AND SEAL-IN UNIT

The ratings of the seal-in unit coil are given in Table E.

TABLE E

| | | TAP | | |
|---|---|---|---|---|
| | | 0.2 | 0.6 | 2.0 |
| DC resistance +10% | (ohms) | 8.0 | 0.6 | 0.24 |
| Minimum operating +0, -25% | (amps) | 0.2 | 0.6 | 2.0 |
| Carry continuously | (amps) | 0.3 | 1.5 | 3.0 |
| Carry 30 amps for: | (seconds) | 0.03 | 0.3 | 4.0 |
| Carry 10 amps for: | (seconds) | 0.25 | 4.0 | 30.0 |
| 60-hertz impedance | (ohms) | 52.0 | 6.0 | 0.53 |

The ratings of the target unit coil used on the SAM 11B relay are given in Table F.

TABLE F

| | | TAP |
|---|---|---|
| | | 1.0 |
| DC resistance +10% | (ohms) | 0.29 |
| Minimum operating +0, -25% | (amps) | 1.0 |
| Carry continuously | (amps) | 1.5 |
| Carry 30 amps for: | (seconds) | 0.3 |
| Carry 10 amps for: | (seconds) | 4.0 |

If the tripping current exceeds 30 amperes, an auxiliary relay should be used, with connections made such that the tripping current does not pass through the contacts or the target and seal-in coils of the protective relay.

## CHARACTERISTICS

The timing circuits of the SAM relays are designed to provide an extremely accurate and stable time-delay function. The dial for each timing circuit has been calibrated at the factory for seven operating times. For example, the three-second timers, which are frequently used in distance relay applications, are calibrated at 0.1, 0.2, 0.3, 0.5, 1.0, 2.0, and 3.0 seconds.

If the calibration knob is reset in the field at one of the factory-set points, the timing circuit will be accurate within +3% of the dial marking, if checked at rated voltage and an ambient temperature of approximately 25°C. If the calibration has not been disturbed, then when the timing circuits are set for a particular time and subsequently rechecked under identical operating conditions, they will repeat within 1% of the original setting.

The use of zener regulators across the input of the timing circuit makes the timing circuits inherently independent of changes in the DC voltage supply. The curves in Figure 16 show a small percentage change in time for control voltage changes from 64 to 120 percent of normal for nominal time settings of 0.05, 0.25 and 0.5 second.

The factory calibration points on the dial plate were made in an ambient temperature of approximately 25°C. The relays can be safely operated at ambient temperatures from -20°C to +60°C. The change in operating time over this ambient range will be less than $\pm$ 4% of the time at 25°C for any time setting (see Figure 17).

The timing circuits include a discharge rectifier that provides a low resistance discharge path for the capacitor charge the instant that the initiating contact de-energizes the timing circuit. The reset time is 16 milliseconds. If the timing circuit is de-energized for this interval or longer, subsequent operations will occur within 1% of the nominally set operating time.

The nature of the timing circuit makes overtravel practically nonexistent in the SAM relays. Elimination of overtravel is one advantage this solid state relay has over a similar electromechanical relay.

## BURDENS

The relay watts at rated voltage are given in Table G. The target resistance is approximately 0.35 ohm.

TABLE G

| VOLTS | MAXIMUM RELAY WATTS |
|---|---|
| 24 | 2.0 |
| 48 | 2.5 |
| 110, 125 | 7.5 |
| 220, 250 | 15.5 |

## CONSTRUCTION

The relay components are mounted in a cradle assembly that is latched into a drawout case when the relay is in operation. It can be easily removed from the cradle assembly; first disconnect the relay, by removing the connection plug that completes the electrical connections between the case block and the cradle block. To test the relay in its case, this connection block can be replaced by a test plug. The cover, which is attached to front of the relay case, contains the target reset mechanism and an interlock arm that prevents the cover from being replaced until the connection plugs have been inserted.

The relay case is suitable for either semi-flush or surface mounting on all panels up to two inches thick. Appropriate mounting hardware is available; however, panel thickness must be indicated on the relay order to make sure that the proper hardware will be included. For outline and drilling dimensions, see Figures 19 and 20.

Every circuit in the drawout case has an auxiliary brush, as shown in Figure 18, to provide adequate overlap when the connecting plug is withdrawn or inserted. Some circuits are equipped with shorting bars. It is important that the auxiliary brush make contact (as indicated in Figure 18) with adequate pressure on these circuits to prevent the opening of important interlock circuits.

## RECEIVING, HANDLING, AND STORAGE

When not included as part of a control panel, relays 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 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.

Exercise reasonable care when unpacking the relay. 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 that collects on the outside of the case may find its way inside when the cover is removed and cause problems with the operation of the relay.

Also check the nameplate stamping to make sure that the model number and the rating of the relay received agree with the requisition. Check the operation manually. Also, check that the contact gap and wipe agree with values given in the section on MECHANICAL AND INSPECTION under **ACCEPTANCE TESTS.**

## 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.**

VISUAL INSPECTION

Remove the relay from its case and check that there are no broken or cracked molded parts or other signs of physical damage. The printed-circuit cards should be held securely in their receptacles by the grooved clamping plate on the left side of the relay.

MECHANICAL INSPECTION

It is recommended that the following mechanical adjustments be checked:

1. Operate each telephone-type unit manually to be sure the armatures are moving freely. With the armature closed, the normally-closed contacts should make with approximately 0.005-inch wipe. This can be checked by inserting a 0.005-inch shim between the residual screw and the pole piece and operating the armature by hand. The normally-open contacts should make before the residual screw strikes the shim. With the armature open, each normally-open contact should have a gap of 0.010 inch to 0.015 inch.

2. Check the location of the contact brushes on the cradle and case blocks against the internal connection diagram.

ELECTRICAL TEST

The relay should be tested before installation, and periodically thereafter, by connecting a variable source of DC voltage to the coil studs and checking the pickup voltage. The relay should be adjusted to the time delay required at its final location, by means of variable resistor R1 (see Figures 1 and 2). An electronic timer should be used in making this setting.

If target circuits are present, a variable source of DC power should be connected to them and the pickup amperes checked. The target should pick up at or below its rating.

For the SAM99AG, connect the relay to a source of variable AC and check as described above for DC relays.

## SERVICING

A flexible burnishing tool should be used for cleaning relay contacts. This tool, an etch-roughened strip of flexible metal resembling a superfine file, removes corroded material quickly without scratching the surface. The flexibility of the tool insures the cleaning of the actual points of contact. Never use knives, files, abrasive paper or cloth to clean relay contacts. A burnishing tool as described above can be obtained from the factory. 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.

## RENEWAL PARTS

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

When ordering renewal parts, address the nearest Sales Office of the General Electric Company, specify quantity required and name of the part wanted, and give complete nameplate data. If possible, give the General Electric requisition number on which the relay was furnished.

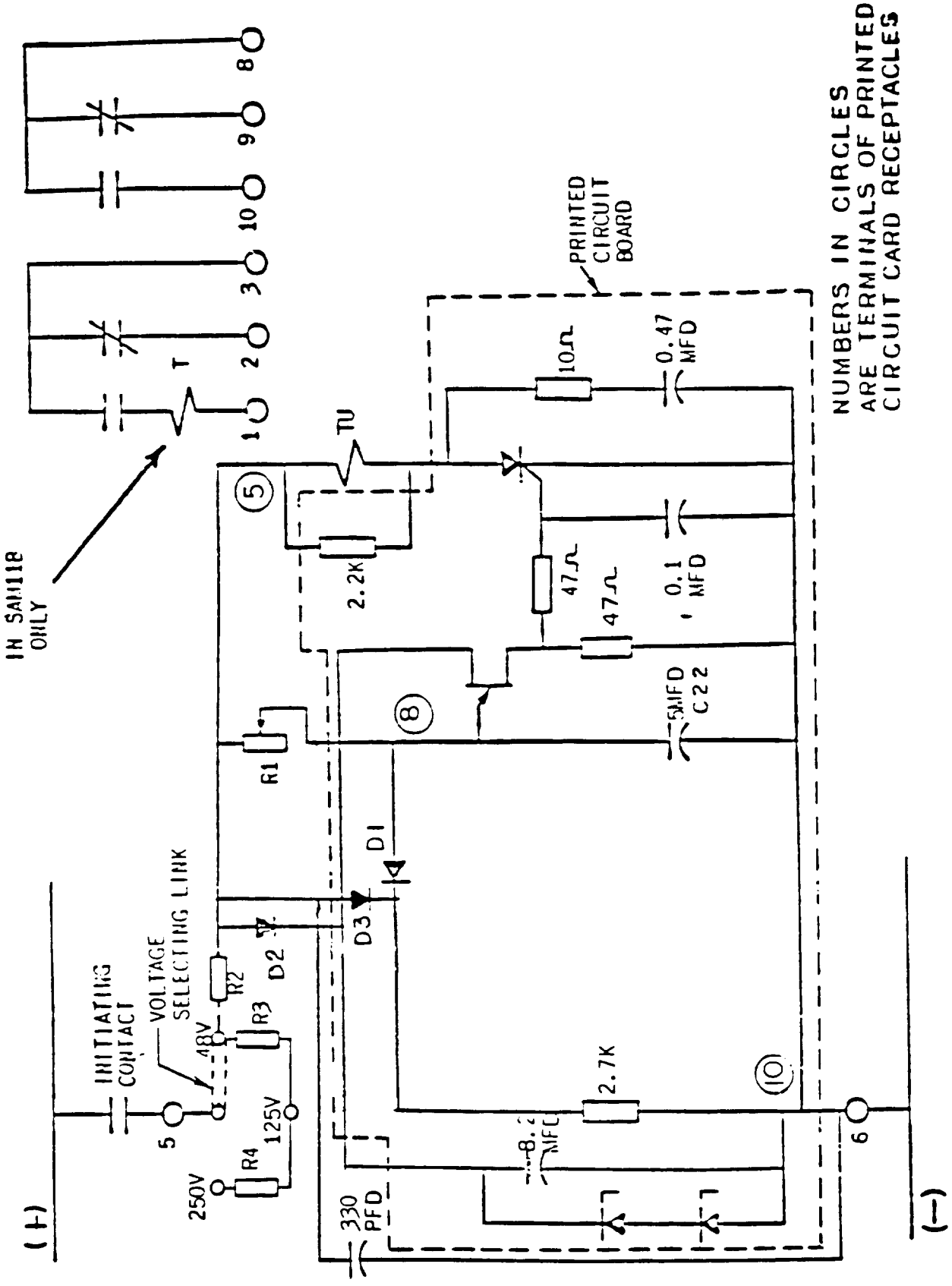


Figure 2 (0208A2480-2) Typical External Connection Diagram for a SAM Relay

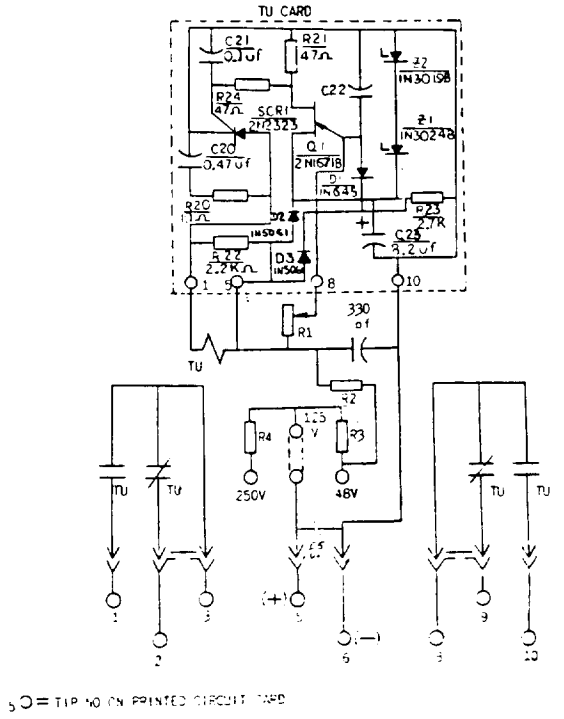


Figure 3A (0208A2420, Sh.1 8) Internal Connections for the SAM11A Relay

| MODEL | FORM | | |
|---|---|---|---|
| 12SAM11A(-)A | 21 | 22 | 23 |
| VOLTS D.C. | 48/125/250 | 48/125/250 | 48/125/250 |
| RESISTANCE IN OHMS | | | |
| | | | |
| TU COIL | 650 | 650 | 650 |
| | | | |
| R1 | 0.75 MEG. | 1.5 MEG | 1.5 MEG |
| R2 | 500 | 500 | 500 |
| R3 | 1200 | 1200 | 1200 |
| R4 | 2000 | 2000 | 2000 |
| MFD & VOLTS | | | |
| C22 | 5-200 | 5-200 | 10-200 |
| | | | |
| | | | |
| | | | |

Figure 3B (0208A2420, Sh.2 4) Internal Connections for the SAM11A Relay

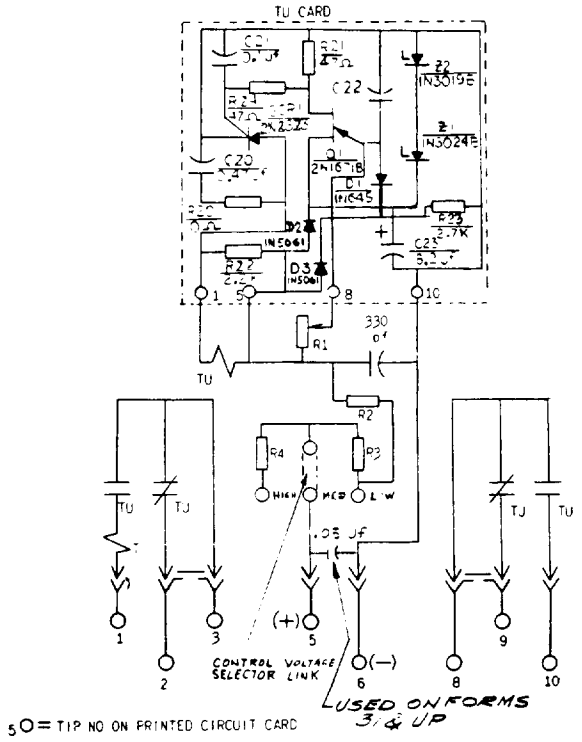


Figure 4A (0208A2421, Sh.1 6) Internal Connections for the SAM11B Relay

| MODEL | FORM | | |
|---|---|---|---|
| 12SAM11B1-1A | 21 | 22 & 23 | 24 |
| VOLTS D.C. | 48/125/250 | 48/125/250 | 48/110 220 |
| RESISTANCE IN OHMS | | | |
| | | | |
| TU COIL | 650 | 650 | 650 |
| | | | |
| R1 | 0.75 MEG. | 1.5 MEG | 0.5 MEG. |
| R2 | 500 Ω | 500 Ω | 500 Ω |
| R3 | 1200 Ω | 1200 Ω | 1000 Ω |
| R4 | 2000 Ω | 2000 Ω | 1750 Ω |
| | | | |
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Figure 4B (0208A2421, Sh.2 3) Internal Connections for the SAM11B Relay

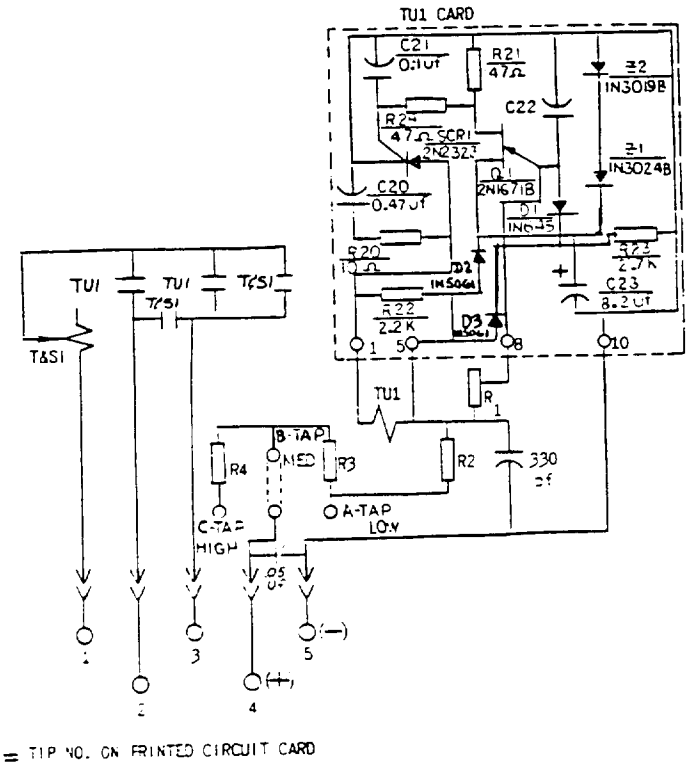


Figure 5A (0208A2422, Sh.1 9) Internal Connections for the SAM11C Relay

| MODEL | FORM | | | | | |
|---|---|---|---|---|---|---|
| 12SAM11C( )A | 21 | 22 | 23 | 24 | 25 | 26 |
| VOLTS DC A TAP | 48 | 48 | 48 | 48 | 48 | 48 |
| VOLTS DC B TAP | 125 | 125 | 125 | 125 | 110 | 110 |
| VOLTS DC C TAP | 250 | 250 | 250 | 250 | 220 | 220 |
| RESISTANCE IN OHMS | | | | | | |
| TU1 COIL | 650 | 650 | 650 | 650 | 650 | 650 |
| R1 | 0.75 MEG. | 1.5 MEG. | 1.5 MEG. | 1.5 MEG. | 0.75MEG. | 0.75MEG. |
| R2 | 500 | 500 | 500 | 500 | 500 | 500 |
| R3 | 1200 | 1200 | 1200 | 1200 | 1000 | 1000 |
| R4 | 2000 | 2000 | 2000 | 2000 | 1750 | 1750 |

Figure 5B (0208A2422, Sh.2 4) Internal Connections for the SAM11C Relay

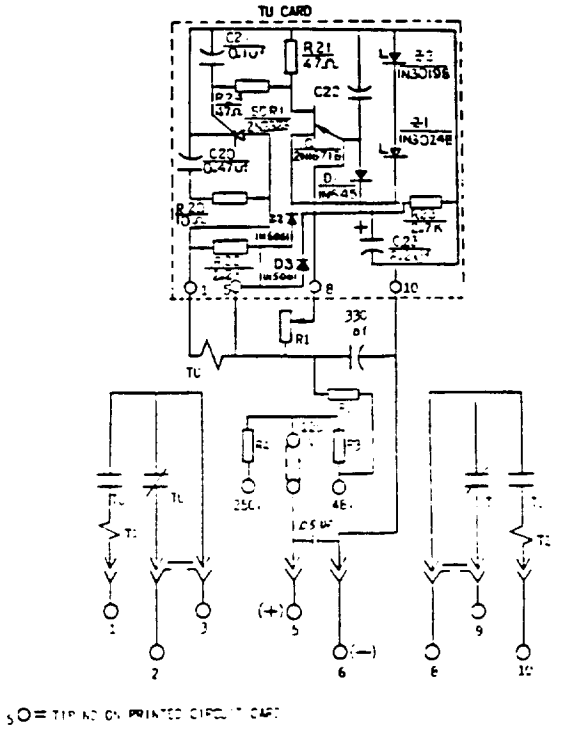


Figure 6A (0208A2423, Sh.1 6) Internal Connections for the SAM11D Relay

| MODEL | FORM | | |
|---|---|---|---|
| 12SAM11D(-)A | 21 | 22 | 23 |
| VOLTS D.C. | 48/125/250 | 48/125/250 | 48/110/220 |
| RESISTANCE IN OHMS | | | |
| | | | |
| TU COIL | 650 | 650 | 650 |
| | | | |
| R1 | 0.75 MEG. | 1.5 MEG | 1.5 MEG |
| R2 | 500 | 500 | 500 |
| R3 | 1200 | 1200 | 900 |
| R4 | 2000 | 2000 | 2000 |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

Figure 6B (0208A2423, Sh.2 2) Internal Connections for the SAM11D Relay

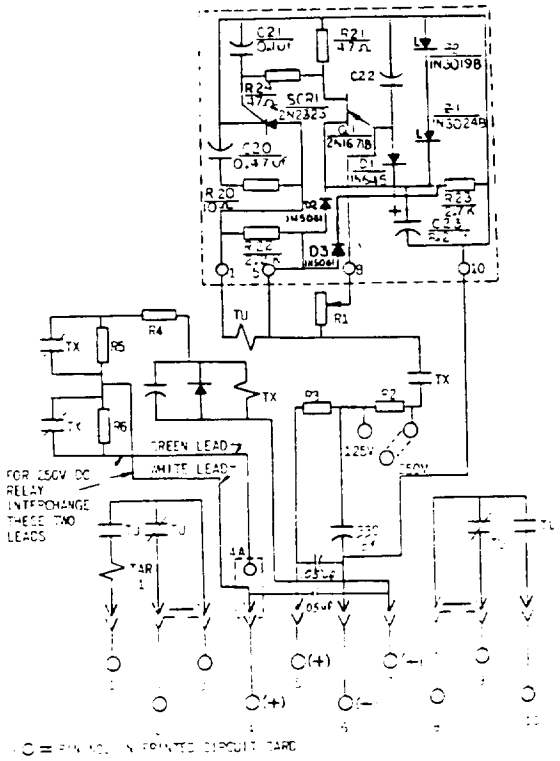


Figure 7A (0208A2424, Sh.1 6) Internal Connections for the SAM11H Relay

| MODEL | FORM | | |
|---|---|---|---|
| SAM11H(-)A | 11 | | |
| VOLTS D.C. | 125/250 | | |
| RESISTANCE IN OHMS | | | |
| TX COIL | 58 | | |
| TU COIL | 650 | | |
| | | | |
| R1 | 0.75MEG. | | |
| R2 | 2000 | | |
| R3 | 1750 | | |
| R4 | 500 | | |
| R5 | 700 | | |
| R6 | 2500 | | |
| | | | |
| | | | |
| | | | |

Figure 7B (0208A2424, Sh.2 1) Internal Connections for the SAM11H Relay

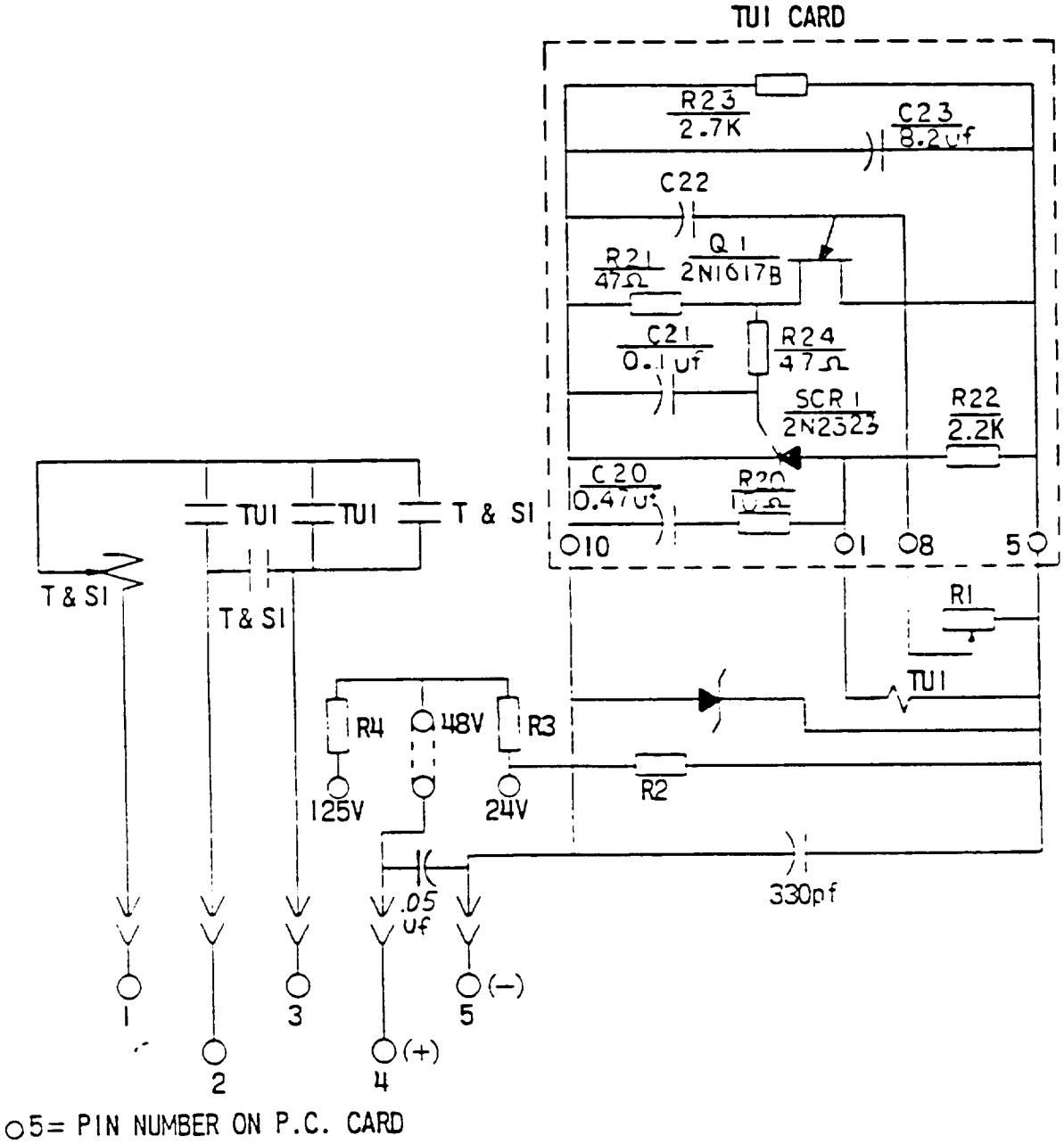


Figure 8 (0227A7169-3) Internal Connections for the SAM11J Relay

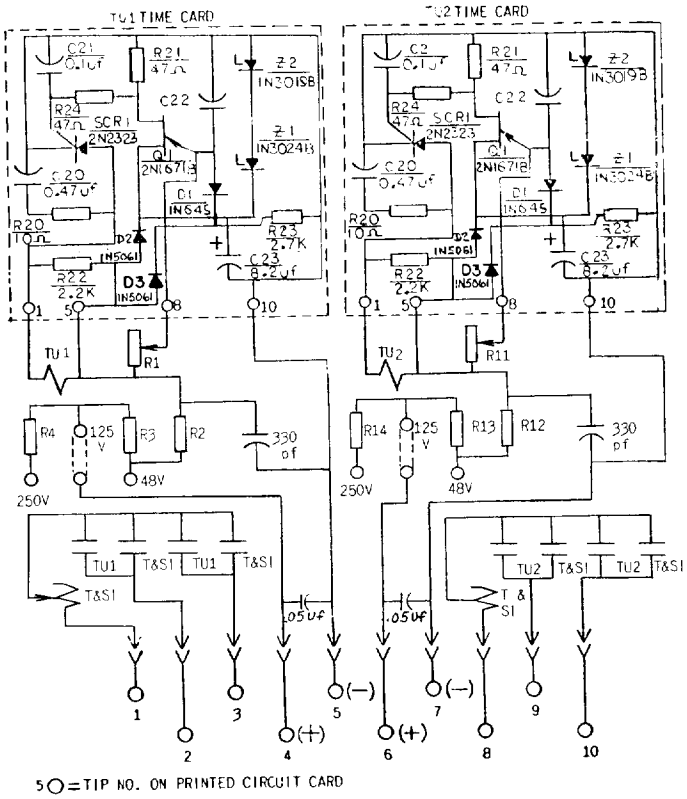


Figure 9A (0208A2425, Sh.1 6) Internal Connections for the SAM13C Relay

| MODEL | FORM | | |
|---|---|---|---|
| 12SAM13C(-)A | 21 & 23 | 22 | |
| VOLTS D.C. | 48/125/250 | 48/125/250 | |
| RESISTANCE IN OHMS | | | |
| | | | |
| TU1 COIL | 650 | 650 | |
| TU2 COIL | 650 | 650 | |
| R1, R11 | 0.75 MEG. | 1.5 MEG | |
| R2, R12 | 500 | 50C | |
| R3, R13 | 1200 | 1200 | |
| R4, R14 | 2000 | 2000 | |
| | | | |
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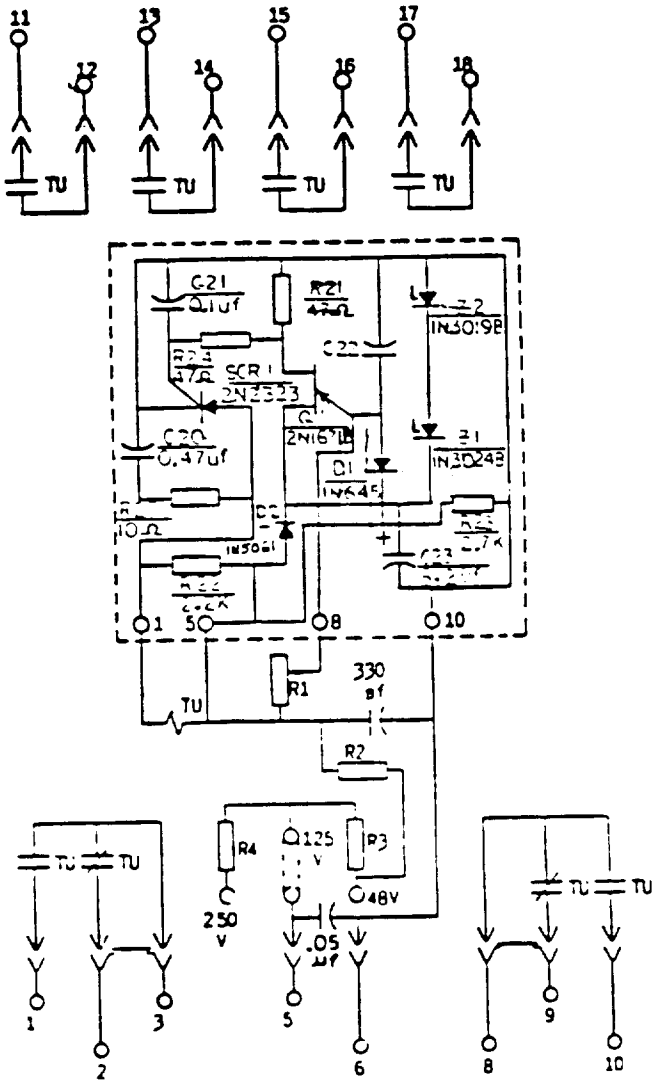
Figure 9B (0208A2425, Sh.2 1) Internal Connections for the SAM13C Relay




| MODEL | FORM | |
|---|---|---|
| SAM99AB-[illegible] | C01 | C02 |
| VOLTS D.C. | 48/125/ [illegible] | 48/125/ [illegible] |
| RESISTANCE IN OHMS | | |
| TU COIL | 650 | 650 |
| R1 | 0.75 MEG | 1.5 MEG |
| R2 | 500 | 500 |
| R3 | 1200 | 1200 |
| R4 | 2000 | 2000 |

Figure 10 (0257A9616 Sh.1 [2] & 2 [0]) Internal Connections for the SAM99AB Relay

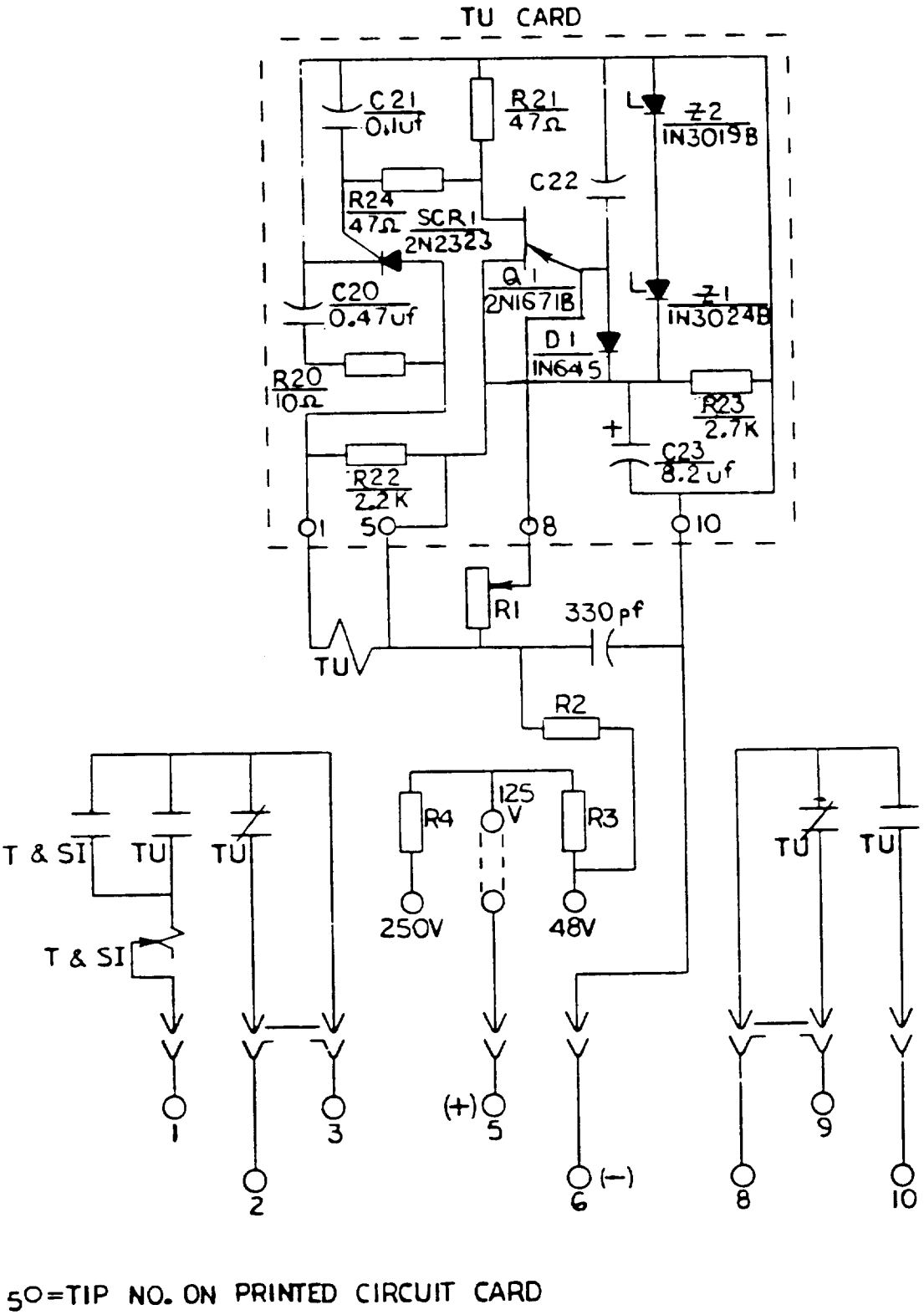
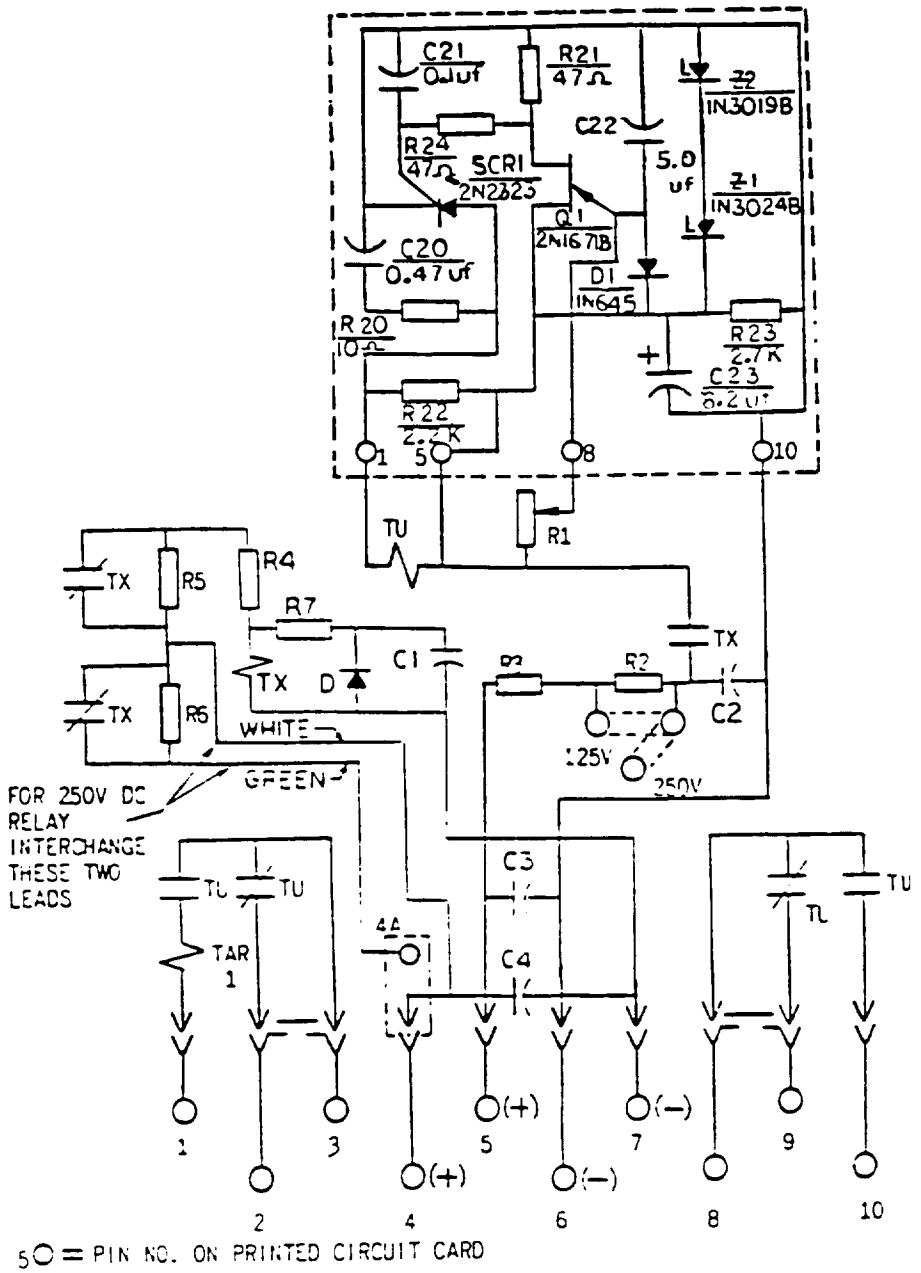
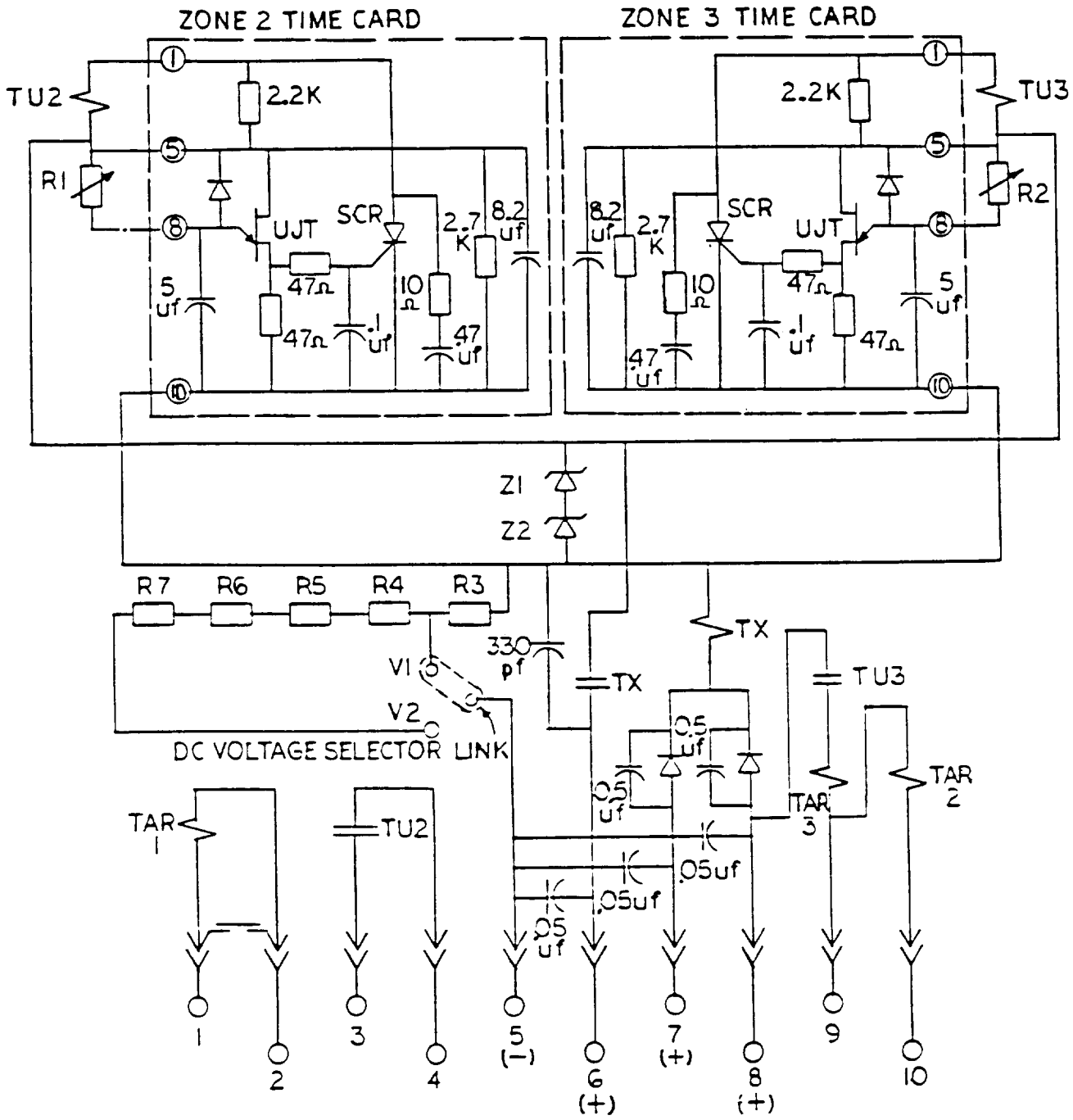



Figure 11 (0246A2276-1) Internal Connections for the SAM99AC Relay




| VOLTS D.C. | 125/250 |
|---|---|
| RESISTANCE IN OHMS | |
| TX COIL | 55 |
| TU COIL | 650 |
| | |
| R1 | 40.75NEG. |
| R2 | 12000 |
| R3 | 11750 |
| R4 | 500 |
| R5 | 700 |
| R6 | 12500 |
| R7 | 110 |

Figure 12 (0269A3081 Sh.1 [1] & 2 [1]) Internal Connections for the SAM99AD Relay



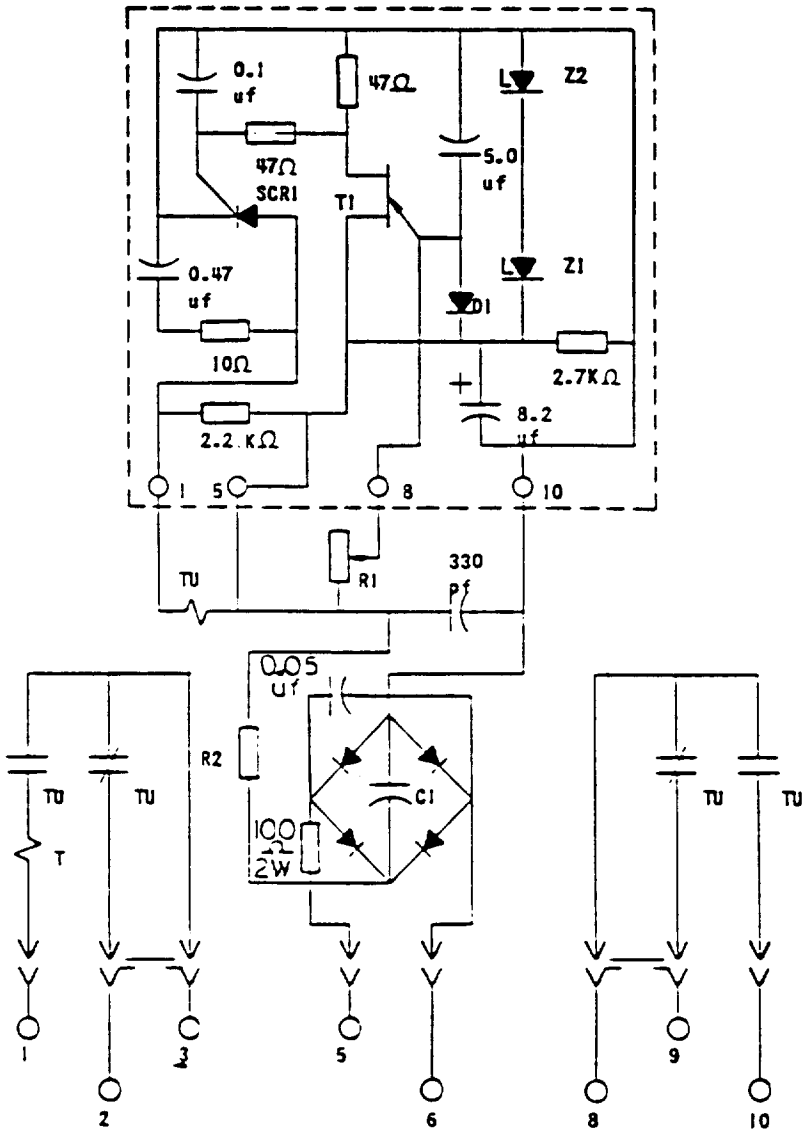

| | |
|---|---|
| V1 | 124 VOLT POS. |
| V2 | 1125VOLT POS. |

| | |
|---|---|
| R1 | 0 → 1.5MΩ |
| R2 | 0 → 1.5MΩ |
| R3 | 15Ω, 25W |
| R4 | 75Ω. 25W |
| R5 | 75Ω. 25W |
| R6 | 75Ω. 25W |
| R7 | 75Ω, 25W |

| | |
|---|---|
| TX COIL | 300Ω |
| TU2 COIL | 230Ω |
| TU3 COIL | 230Ω |

* Figure 13 (0258A5622 [1]) Internal Connections for the SAM99AF Relay

* Indicates revision




5 ○ = TIP NO. ON PRINTED CIRCUIT CARD

Figure 14A (0227A2527 Sh.1 3) Internal Connections for the SAM99AG Relay

| MODEL | FORM |
|---|---|
| 12SAM19A(-)A | 1 |
| VOLTS | 120 |
| FREQUENCY | 60 |
| RESISTANCE IN OHMS | |
| | |
| TU COIL | 650 |
| | |
| R1 | 1.5 MEG. |
| R2 | 2.5K |
| | |
| | |
| | |
| | |
| CAPACITANCE IN MFD. | |
| C1 | 1 |
| | |

* Figure 14B (0227A2527 Sh. 2 [1]) Internal Connections for the SAM99AG Relay

* Indicates revision

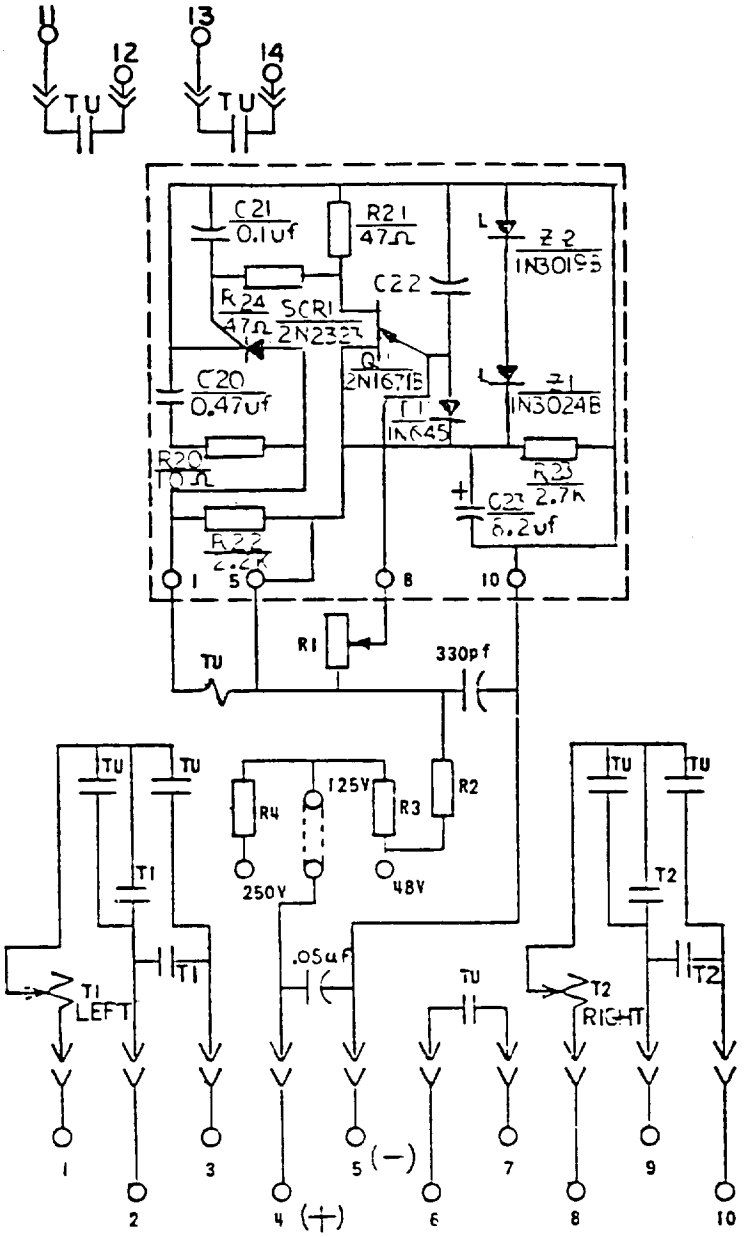



Figure 15A (0246A6836 Sh.1 2) Internal Connections for the SAM99AH Relay

| MODEL | GROUP | | |
|---|---|---|---|
| 12SAM99AH-A | 1 | | |
| 0208A8459 | 1 | | |
| VOLTS D.C. | 48/125/250 | | |
| RESISTANCE IN OHMS | | | |
| | | | |
| TU COIL | 750 | | |
| | | | |
| R1 OHMS | 0.75 MEG | | |
| R2 OHMS | 500 | | |
| R3 OHMS | 1200 | | |
| R4 OHMS | 2000 | | |

Figure 15B (0246A6836 Sh.2 1) Internal Connections for the SAM99AH Relay

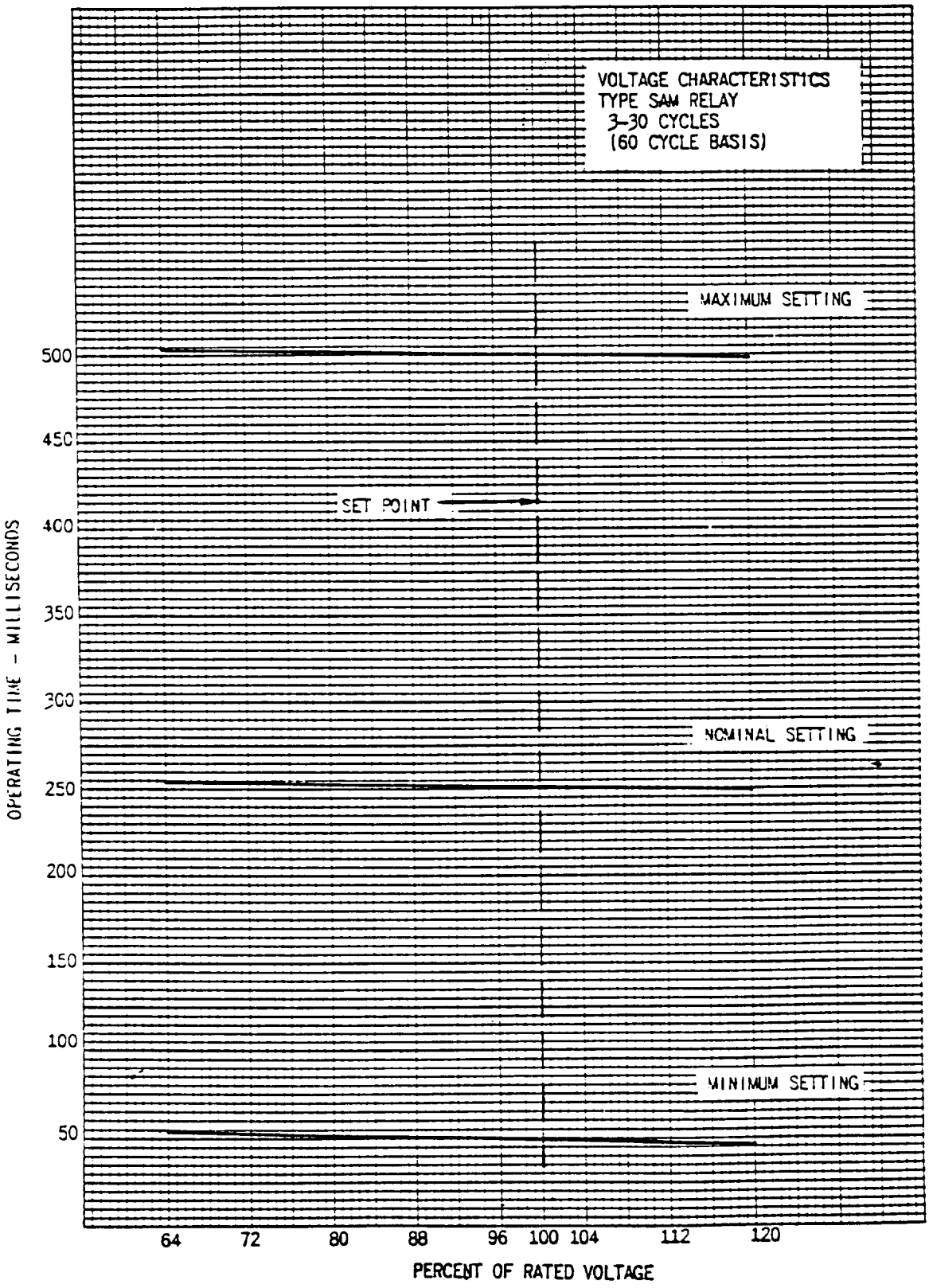



Figure 16 (0165A7626-3) Voltage Characteristics of the SAM Relay

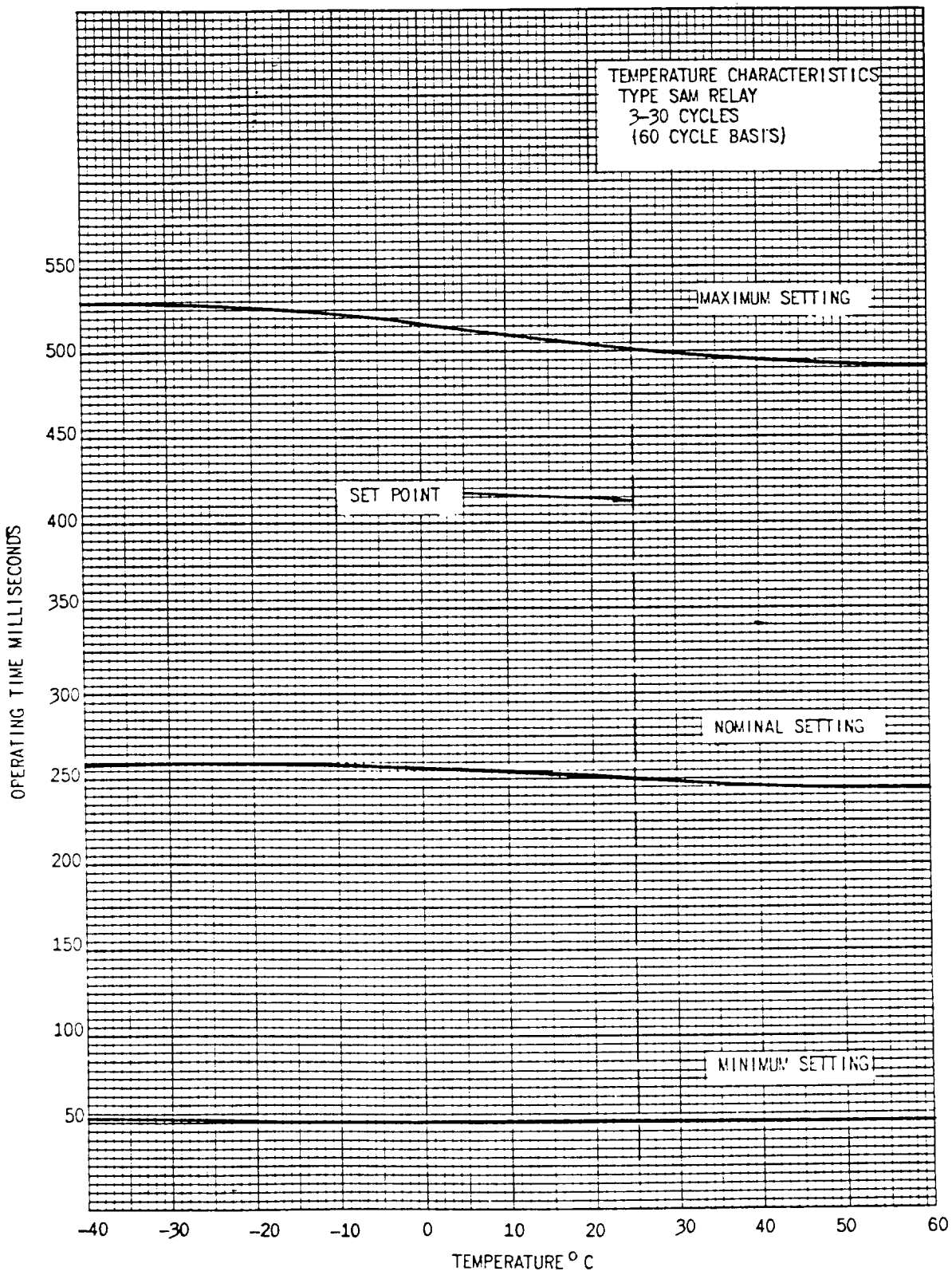
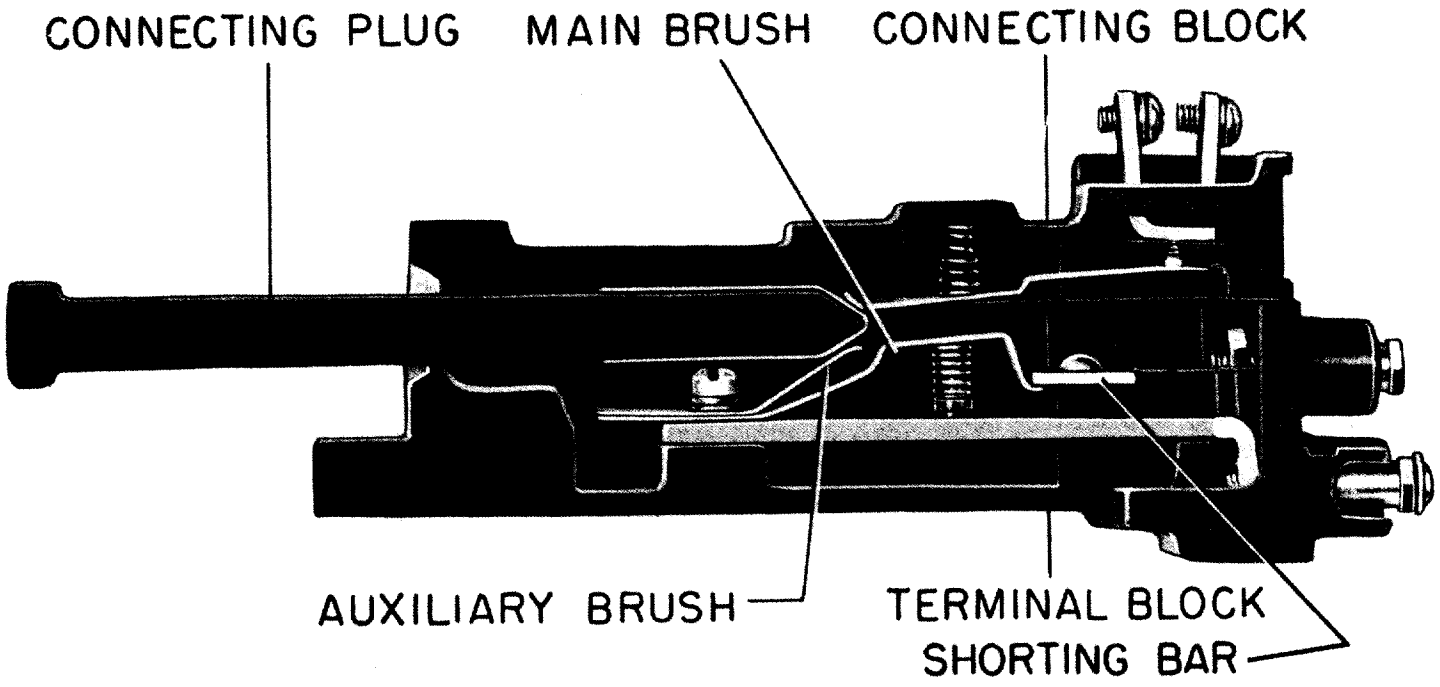
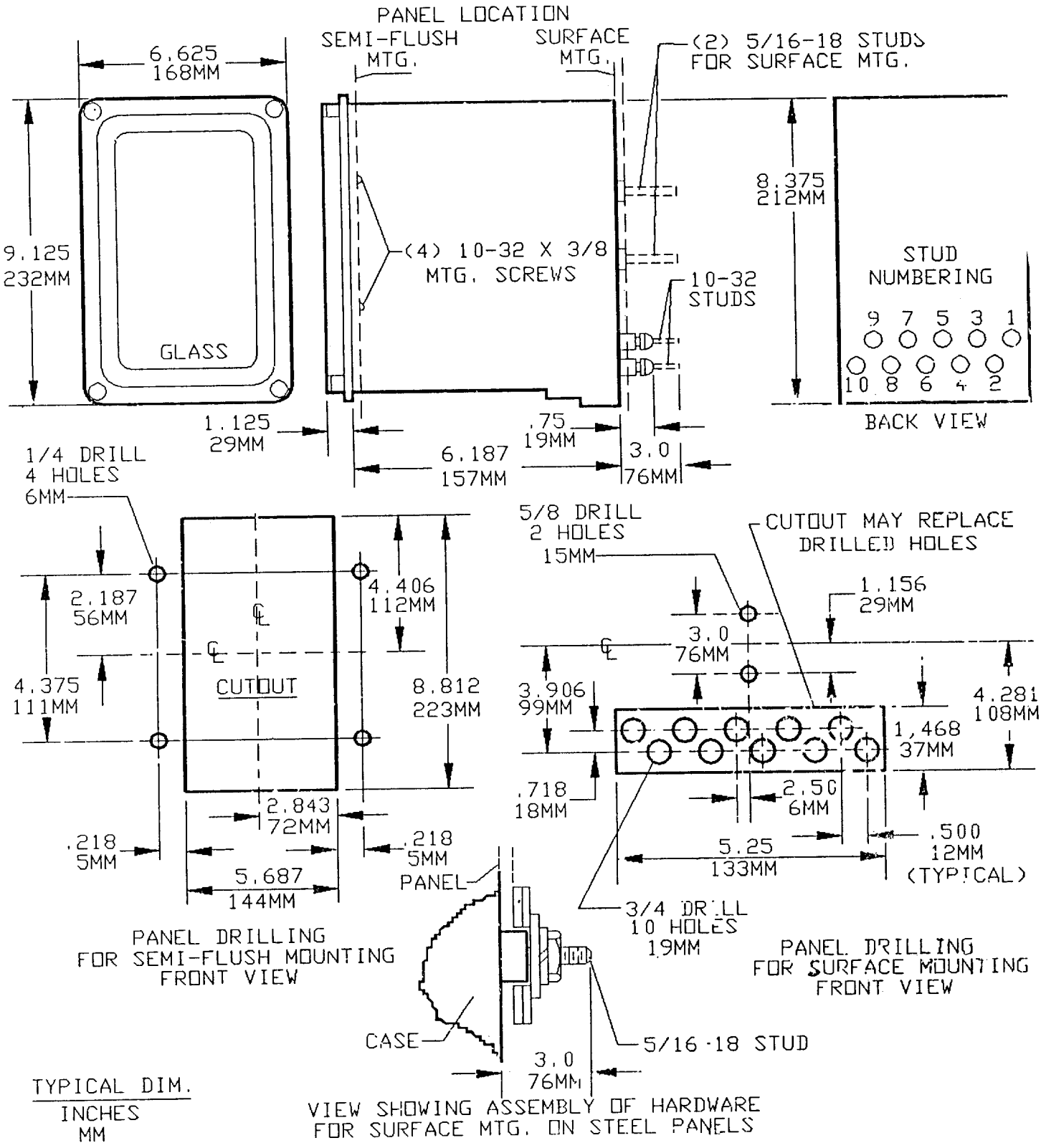



Figure 17 (0165A7625) Temperature Characteristics of the SAM Relay



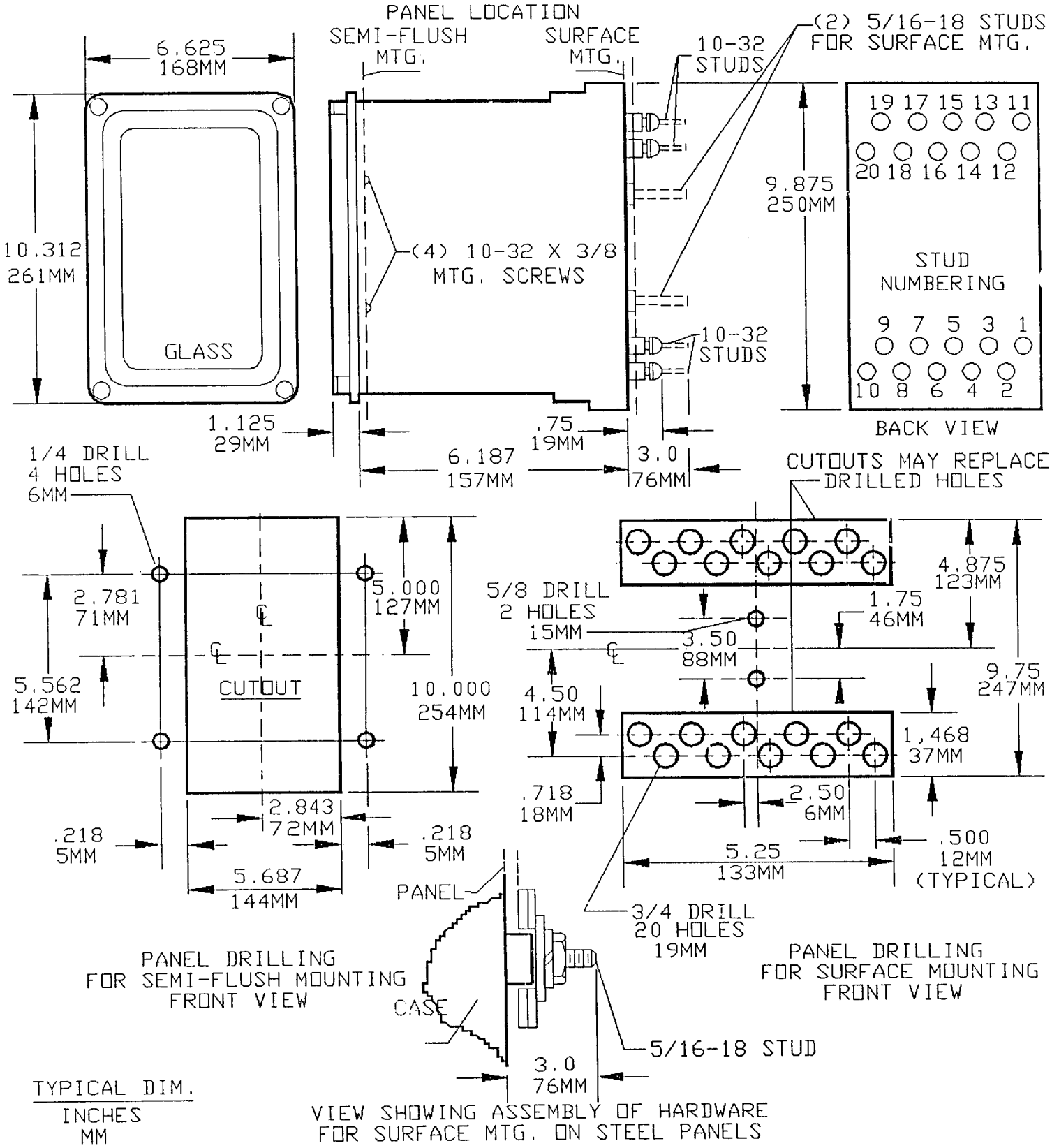

NOTE: AFTER ENGAGING AUXILIARY BRUSH, CONNECTING PLUG TRAVELS 1/4 INCH BEFORE ENGAGING THE MAIN BRUSH ON THE TERMINAL BLOCK

Figure 18 (8025039) Cross-Section of Drawout Case Showing the Position of the Auxiliary Brush




*** Figure 19 (6209271 [8]) Outline and Panel Drilling for the S1 Case**

*** Indicates revision**




*** Figure 20 (6209272 [7]) Outline and Panel Drilling for the S2 Case**

*** Indicates revision**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