



## INSTRUCTIONS

GEK-36833A

*SUPERSEDES GEK-36833*

STATIC OUTPUT AND TRIPPING UNIT

TYPE SLAT51C

GENERAL  ELECTRIC

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# STATIC OUTPUT AND TRIPPING UNIT TYPE SLAT51C

## DESCRIPTION

The Type SLAT51C relay is a static output and tripping unit. The Type SLAT51C relay is not intended to be used by itself, but rather as part of a complement of equipment that forms a protective relaying scheme. For a complete description of the overall scheme in which this relay is employed, refer to the overall logic diagram and its associated logic description that is supplied with each terminal of equipment.

The Type SLAT51C relay is packaged in a four rack unit (1 R.U. = 1 3/4") enclosed metal case suitable for mounting on a 19 inch rack. The outline and mounting dimensions are shown in Fig. 1. The internal connections for the SLAT51C relay are shown in Fig. 2. The component and card locations are shown in Figure 3.

## APPLICATION

The Type SLAT51C relay was originally designed to operate in conjunction with Type SLYP, Type SLYN, Type SLC, Type SLLP, Type SLA and Type SSA relays in a directional comparison scheme for series compensated lines. The following is a listing of the various output functions together with a general description of their intended use.

- SCR - Four silicon controlled rectifier trip circuits are provided to permit tripping of associated circuit breakers.
- RI - The reclose initiation outputs are provided to initiate automatic reclosing after a high speed tripout.
- RC - The reclose cancellation outputs are provided to prevent high speed reclosing following a severe internal fault.
- BFI - The breaker failure initiation outputs are provided for breaker failure protection.
- OST - The out-of-step tripping outputs provide isolated trip capability following detection of an out-of-step condition.
- V1 - The positive sequence voltage detector outputs are provided to permit bypassing the RC contacts to allow sequential reclosing.
- TT - The transfer trip outputs are provided to key a transfer trip transmitter when an output is present at the trip bus.
- TXA - The transmitter keying auxiliary outputs are provided for use in supervising a channel check-back circuit used with the associated direct transfer trip channel.
- DLA - Three data logging amplifier outputs are provided to monitor the trip, block and receiver output signals from within the associated SLA.

If any of these functions are not required, the outputs may be used for whatever purposes their characteristics are suited.

## RATINGS

The Type SLAT51C relay is designed for use in an environment where the air temperature outside the relay case is between -20°C and +65°C.

The Type SLAT51C relay requires a ±15 VDC power source which can be obtained from a Type SSA power supply.

The SCR tripping circuits are rated for 48/125 or 250 VDC. Each has a 1.0 ampere series target. The tripping circuits are designed to carry 30 amperes for one second.

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

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

The contacts of the telephone type relays that are used for VI and RI will make and carry 3 amperes continuously and will interrupt up to 0.5 ampere (inductive) at 125 VDC or 0.25 ampere (inductive) at 250 VDC.

\* The contacts of the reed relays that are used for BFI, OST, and RC are rated for 100 watts D.C. They will make and carry three amperes continuously.

The contacts of the reed relays that are used for the TT, TXA, and DLA functions are rated for 10 V-A. They will carry 0.5 ampere (resistive) continuously.

Refer to the unit nameplate for the ratings of a particular relay.

#### BURDENS

The SLAT51 relay presents a maximum burden to the Type SSA power supply of:

90 ma from the +15 VDC supply  
350 ma from the -15 VDC supply

In addition, each target lamp draws 80 ma from the -15 VDC supply.

#### FUNCTIONS

##### A. SCR TRIP CIRCUIT

Electrically separate, isolated SCR trip circuits are provided to trip two breakers. Each circuit is capable of carrying 30 amperes for one second.

The internal connections for the SCR trip and isolator subassemblies are shown in Figure 4. The isolator card, by means of a DC to DC converter, provides a signal path but maintains metallic isolation. This feature makes it possible to isolate the relay power supply from the trip circuit power supply.

##### B. RI RECLOSE INITIATE CIRCUIT

Two electrically separate normally open contacts are provided. These contacts close within 17 ms. from the time the associated coil is energized by the logic. The contacts open within 170 ms from the time the coil is deenergized. The RI function uses a telephone type relay with contact ratings stated under RATINGS.

##### C. BFI BREAKER FAILURE INITIATE CIRCUIT

Two electrically separate normally open contacts are provided. These contacts close within 2 ms. from the time the associated coil is energized by the logic. These contacts open within 2 ms. from the time the coil is deenergized. The BFI function uses a reed relay with contact ratings stated under RATINGS.

##### D. OST OUT OF STEP TRIP CIRCUIT

Two electrically separate normally open contacts are provided. These contacts close within 2 ms. from the time the associated coil is energized by the logic. They open within 2 ms. from the time the coil is deenergized. The OST function uses a reed relay with contact ratings stated under RATINGS.

##### E. RC RECLOSE CANCELLATION CIRCUIT

Four electrically separate contacts are provided, two normally open and two normally closed. These contacts operate within 2 ms. from the time the associated coil is energized by the logic. They reset within 2 ms. from the time the coil is deenergized. The RC function uses a reed relay with contact ratings stated under RATINGS.

F. V1 - POSITIVE SEQUENCE VOLTAGE DETECTOR CIRCUIT

Three electrically separate contacts are provided, two normally open and one normally closed. These contacts operate within 17 ms from the time the associated coil is energized by the logic. They reset within 17 ms. from the time the coil is deenergized. The V1 function uses a telephone type relay with contact ratings stated under RATINGS.

G. TT - TRANSFER TRIP CIRCUIT

Four electrically separate normally open contacts are provided. These contacts close within 0.5 ms. from the time the associated coil is energized by the logic. They open within 0.5 ms. from the time the coil is deenergized. The TT function uses a reed relay with contact ratings stated under RATINGS.

H. TXA - TRANSMITTER KEYING AUXILIARY

One normally open contact is provided. This contact closes within 0.5 ms from the time the associated coil is energized by the logic. It opens within 0.5 ms from the time the coil is deenergized. The TXA function uses a reed relay with contact ratings as stated under RATINGS. The transistor switch which drives the TXA coil is preceded by a NOT. The relay is normally energized.

I. DLA - DATA LOGGING AMPLIFIER CONTACTS

Three normally open contacts are provided; one each for received carrier, blocking and tripping. These contacts open within 0.5 ms from the time the associated coil is energized by the logic. They open within 0.5 ms from the time the coil is deenergized. The DLA functions uses a reed relay with contact ratings as stated under RATINGS.

TARGETS

Two electromechanical target coils are included, one in series with each SCR. These targets operate on one ampere of trip current when the associated SCR passes current. The trip circuit resistance in the relay is 0.40 ohm.

Six target lamps are included in the SLAT51C. These are designated as indicated on the internal connection diagram of Figure 2. An output from TL32 will prevent the target lamps from turning on. A long pickup setting on this timer will permit all functions that operate to light their associated lamps. A short time setting will allow only those functions that operate initially to be indicated.

LOGIC CIRCUITS

The functions of the Type SLAT51C relay involve basic logic (AND, OR, AND NOT) where the presence or absence of signals, rather than their magnitude, controls the operation. Signals are measured with respect to a reference bus accessible at TP1. In general a signal below 1 VDC represents an OFF or LOGIC ZERO condition, an ON or LOGIC ONE state is represented by a signal of approximately  $\pm 15$  VDC.

The symbols used on the internal connection diagram (Fig. 2) are explained by the legend shown in Figure 5.

CALCULATION OF SETTINGS

There are two timer functions in the SLAT51C that require field adjustment.

- 1) The 5-30/40 timer enables the user to control the number of lamps that will light under certain fault conditions. With a short pickup setting (5-10 ms.) only lamp(s) associated with those units which first sensed the fault will light. Increased pickup settings will cause the lamps associated with all units that operate to light. The timer setting should not exceed the minimum breaker clearing time in order to avoid targets which may result from breaker unequal pole opening times.
- 2) The P/25-200 timer insures an adequate duration of the transfer trip signal for dependable tripping at the remote terminal. A setting of six cycles is suggested. This allows a total duration of approximately eight cycles, if two cycle breakers are used. However, if the channel is also used for direct transfer trip protection of shunt reactors and the line is equipped with reclosing the lockout of the remote terminal should be delayed until the line protection transfer trip has reset. In this case, the reset delay on P/25-200 should be set to coordinate with the timer which delays lockout of the remote terminal on shunt reactor faults.

CONSTRUCTION

The SLAT51C relay is packaged in an enclosed metal case with hinged front cover and removable top cover. The outline and mounting dimensions of the case and the physical location of the components are shown in Figures 1 and 3 respectively.

The SLAT51C relay contains printed circuit cards identified by a code number such as: A110, T114, L102 where A designated an auxiliary function, T designated a time delay function, and L designated a logical function. The printed circuit cards plug in from the front of the unit. The sockets are marked with letter designations or "addresses" (D,E,F, etc.) which appear on the guide strips in front of each socket, on the component location drawing, on the unit internal connection diagram, and on the printed circuit card. The test points (TP1, TP2, etc.) shown on the internal connection diagram are connected to instrument jacks on a test card in position T or AT with TP1 at the top of the AT card. TP1 and TP11 are tied to reference; TP10 and TP20 are tied to +15 VDC through a 1.5K resistor. This resistor limits the current when TP10 or TP20 is used to supply a logic signal to a card.

The link shown on the internal connection diagram is used to select certain logic options as explained in the logic description. The link is located on the A109 printed circuit card.

The SLAT51C relay receives its inputs from the associated Type SLA relay. These units are interconnected by ten conductor shielded cables. The sockets for these cables are located on the rear panel of the unit. The SLAT51C output functions are connected to 12 point terminal strips, which are also located on the rear of the unit.

A window is provided in the hinged cover of the relay to allow target lamps and the mechanical targets to be seen. Push buttons are also provided to reset the targets and lamps without opening the cover.

RECEIVING, HANDLING AND STORAGE

These relays will normally be supplied as a part of a static relay equipment, mounted in a rack or cabinet with other static relays and test equipment. Immediately upon receipt of a static relay equipment, it should be unpacked and examined 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 equipment. If the equipment is not to be installed immediately, it should be stored indoors in a location that is free from moisture, dust, metallic chips, and severe atmospheric contaminants.

Just prior to final installation the shipping support bolt should be removed from each side of all relay units, to facilitate possible future unit removal for maintenance. These shipping support bolts are approximately 8 inches back from the relay front panel. Static relay equipment, when supplied in swing rack cabinets, should be securely anchored to the floor or to the shipping pallet to prevent the equipment from tipping over when the swing rack is opened.

TEST INSTRUCTIONS

If the SLAT51C relay that is to be tested is installed in an equipment which has already been connected to the power system, disconnect the outputs to the system.

CAUTION

THE LOGIC SYSTEM SIDE OF THE DC POWER SUPPLY USED WITH MOD III STATIC RELAY EQUIPMENT IS ISOLATED FROM GROUND. IT IS A DESIGN CHARACTERISTIC OF MOST ELECTRONIC INSTRUMENTS THAT ONE OF THE SIGNAL INPUT TERMINALS IS CONNECTED TO INSTRUMENT CHASSIS. IF THE INSTRUMENT USED TO TEST THE RELAY EQUIPMENT IS ISOLATED FROM GROUND, ITS CHASSIS MAY HAVE AN ELECTRICAL POTENTIAL WITH RESPECT TO GROUND. THE USE OF A TEST INSTRUMENT WITH A GROUNDING CHASSIS WILL NOT AFFECT THE TESTING OF THE EQUIPMENT. A SECOND GROUND CONNECTION TO THE EQUIPMENT, SUCH AS A TEST LEAD INADVERTENTLY DROPPING AGAINST THE RELAY CASE, MAY CAUSE DAMAGE TO THE LOGIC CIRCUITRY. NO EXTERNAL TEST EQUIPMENT SHOULD BE LEFT CONNECTED TO THE STATIC RELAYS WHEN THEY ARE IN PROTECTIVE SERVICE, SINCE TEST EQUIPMENT GROUNDING REDUCES THE EFFECTIVENESS OF THE ISOLATION PROVIDED.

### A. GENERAL

The SLAT51C relay is supplied from the factory either mounted in a static relay equipment or as a separate unit associated with measuring relays, a Type SSA power supply, and some form of channel equipment. All relay units for a given terminal of static relaying equipment are tested together at the factory, and each unit will have the same summary number stamped on its nameplate.

Timers should be set for the operating on reset times indicated on the associated overall logic diagram. Where a time range is indicated on the overall logic diagram, the timer should be set for the value recommended for that function in the descriptive writeup accompanying the overall logic diagram. Where a setting depends upon conditions encountered on a specific application, this is so stated and the factors influencing the choice of setting are described. The procedure for checking and setting the timers is described in a later section.

### B. OPERATIONAL CHECKS

Operation of the SLAT51C unit can be checked by observing the signals at the twenty test points (TP1 to TP20) in the SLAT51C by observing the operation of the associated channel equipment, or by observing the output functions. The test points are located on two test cards in positions T and AT, and are numbered 1 to 20 from top to bottom. TP1 is the reference bus for the logic circuit, TP10 is at +15 VDC. The remaining points are located at various strategic points throughout the logic as shown on the internal connection diagram (Figure 2). Test point voltages can be monitored with a portable high impedance voltmeter, the voltmeter on the test panel of the associated equipment, or an oscilloscope.

### C. TEST CARD ADAPTER

The test card adapter provides a convenient means of gaining access to any pin of a particular card. Detailed information on the use of the test adapter card is included in the card instruction book GEK-34158.

### D. TIMER ADJUSTMENTS AND TESTS

When the time delay cards are to be adjusted or checked, an oscilloscope that can display two traces simultaneously and that has a calibrated horizontal sweep should be used.

In order to test the timer cards it is necessary to remove the card which supplied the input to the timer (see Table I) and to place the timer card in a card adapter. The card adapter allows access to the input and output of the timer if they are not brought out on test points. The timer test circuit is shown on Figure 6. Opening the N.C. contact causes the output to step up to +15 VDC after the pickup delay of the timer. To increase the pickup time, turn the upper potentiometer on the timer card clockwise; to decrease the time turn it counter-clockwise. Closing the contact causes the timer output to dropout after the reset time delay setting of the card. If the timer card is provided with a variable reset delay, it can be adjusted by the lower potentiometer on the timer card (CW increases reset time).

TABLE I

TIME UNDER TEST	POSITION	REMOVE E CARD IN POSITION
TL32	AP	AN
TL41	R	AN
TL42	N	NONE*

\* Turn DC supply switch on and off

### E. TRIP CIRCUIT TESTS

The SCR trip circuits and series mechanical targets may be checked by connecting an auxiliary lockout relay, such as the Type HEA relay, in series with the SCR circuit. A typical circuit is shown in Figure 7. The HEA relay should have the same D.C. rating as the SCR trip circuit of the SLAT51C. If an auxiliary lockout relay is not available, it can be replaced by a resistive load which limits the trip circuit current to 3 amperes. In most equipments, the SCR can be gated by operating a test push button in the associated units.

Prior to final installation, a check of the overall trip circuit should be made with the SCR outputs connected to trip the circuit breakers.

#### F. OVERALL EQUIPMENT TESTS

After the SLAT51C relay and the associated static relay units have been individually calibrated and tested for the desired settings, a series of overall operating circuit checks is advisable.

The elementary overall logic, and logic description for the specific job will be useful for determining the overall operation of the scheme.

Overall equipment test can be performed by applying AC current and voltages to the measuring units as specified in the instruction book for the measuring units and checking that proper outputs are obtained when the measuring units operate.

### MAINTENANCE

#### A. PERIODIC TESTS

It should be sufficient to check the outputs produced at test points in the SLAT51C where periodic calibration tests are made on the associated measuring units, for example, the phase and ground relays in line relaying scheme. No separate periodic tests on the SLAT51C itself should be required.

#### B. TROUBLE SHOOTING

In any trouble shooting of equipment, it should first be established which unit is functioning incorrectly. The overall logic diagram supplied with the equipment shows the combined logic of the complete equipment and the various test points in each unit. By signal tracing, using the overall logic diagram and the various test points, it should be possible to quickly isolate the trouble.

A test adapter card is supplied with each static relay equipment to supplement the prewired test points on the test cards. Use of the adapter card is described in the card instruction book GEK-34158.

A dual-trace oscilloscope is a valuable aid to detailed trouble shooting, since it can be used to determine phase shift, operate and reset times as well as input and output levels. A portable dual-trace oscilloscope with a calibrated sweep and trigger facility is recommended.

#### C. SPARE PARTS

To minimize possible outage time, it is recommended that a complete maintenance program should include the stocking of at least one spare card of each type. It is possible to replace damaged or defective components on the printed circuit cards, but great care should be taken in soldering so as not to damage or bridge-over the printed circuit busses, or overheat the semi-conductor components. The repaired area should be recovered with a suitable high-dielectric plastic coating to prevent possible breakdowns across the printed buses due to moisture and dust. The wiring diagrams for the cards in the SLAT51C relay are included in the card book GEK-34158.



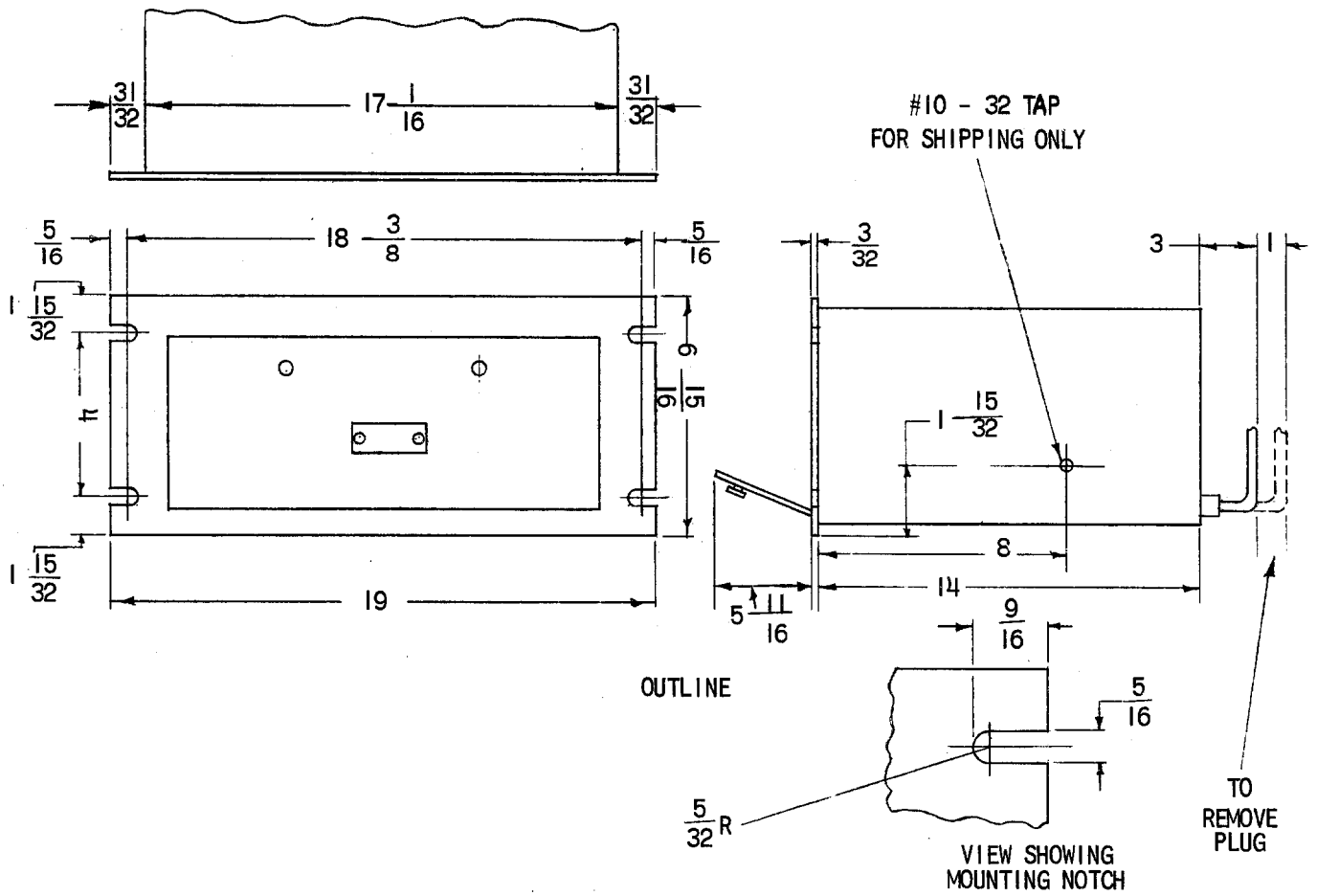
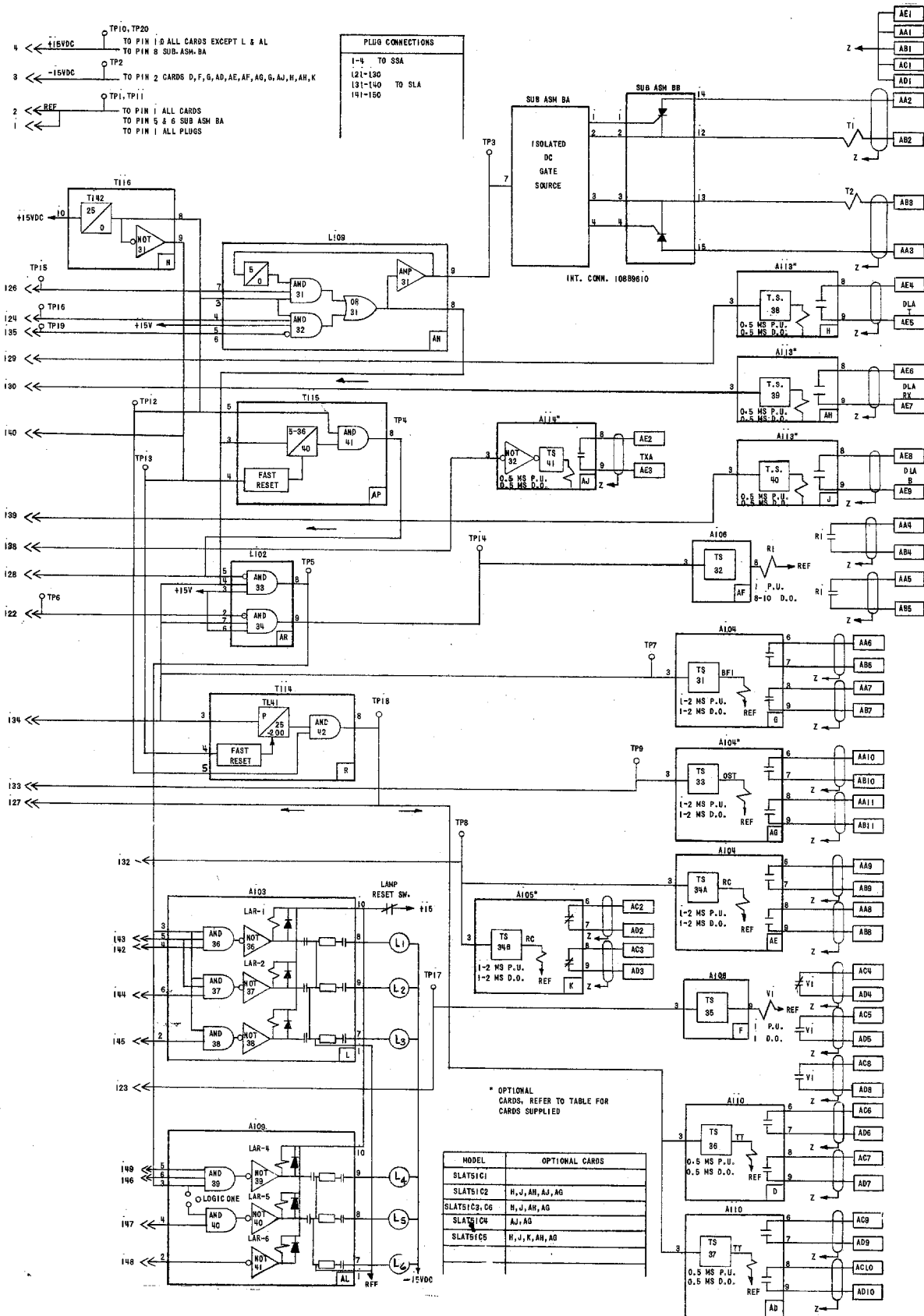
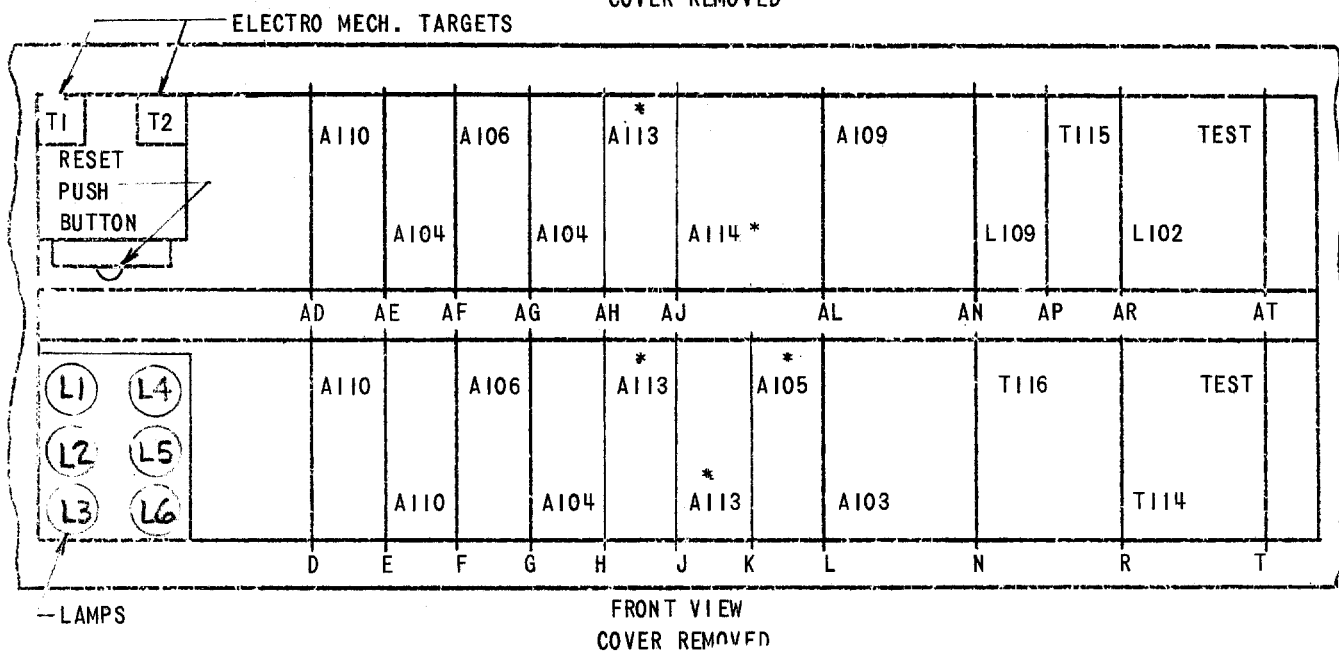
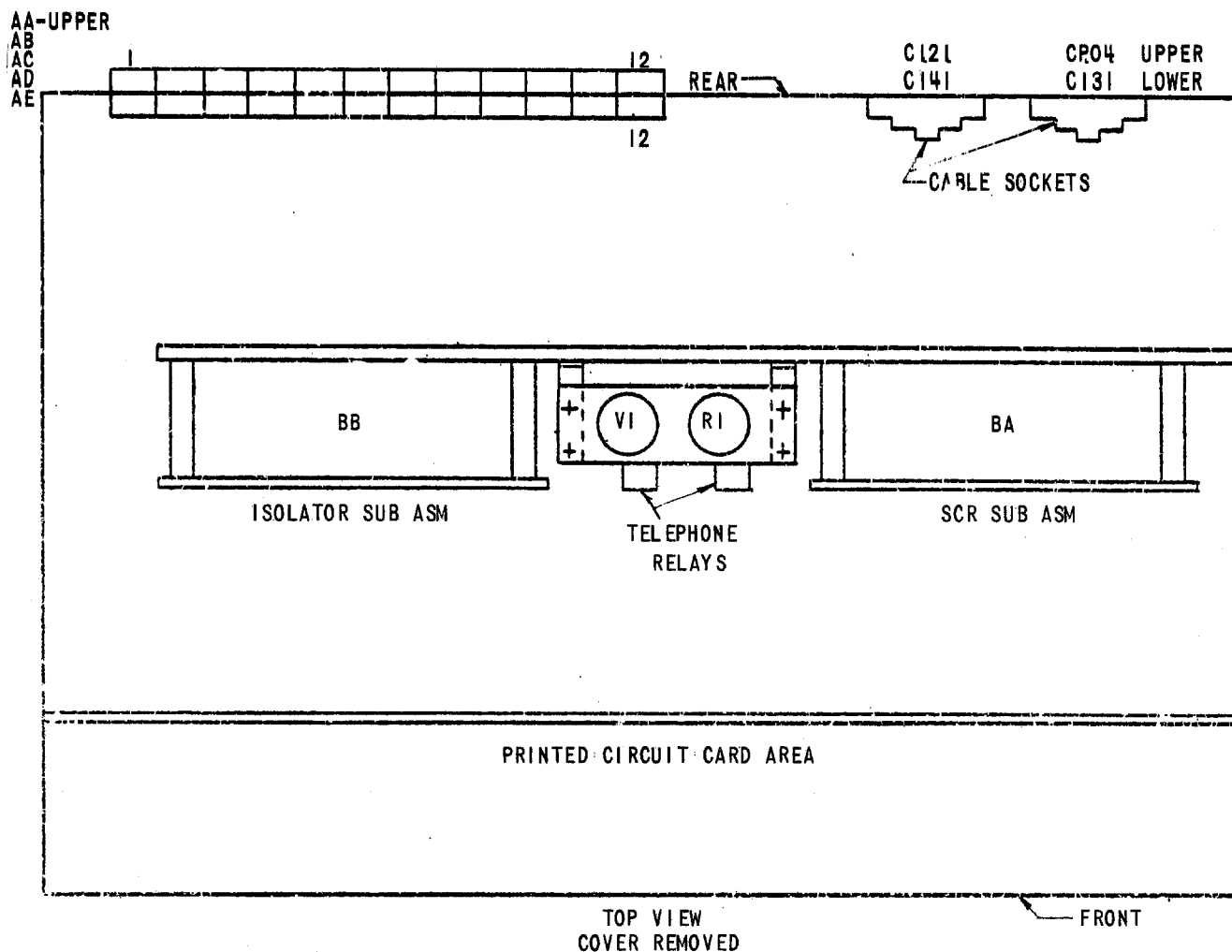


FIG. 1 (0227A2037-0) Outline And Mounting Dimensions For The Type SLAT51C Relay



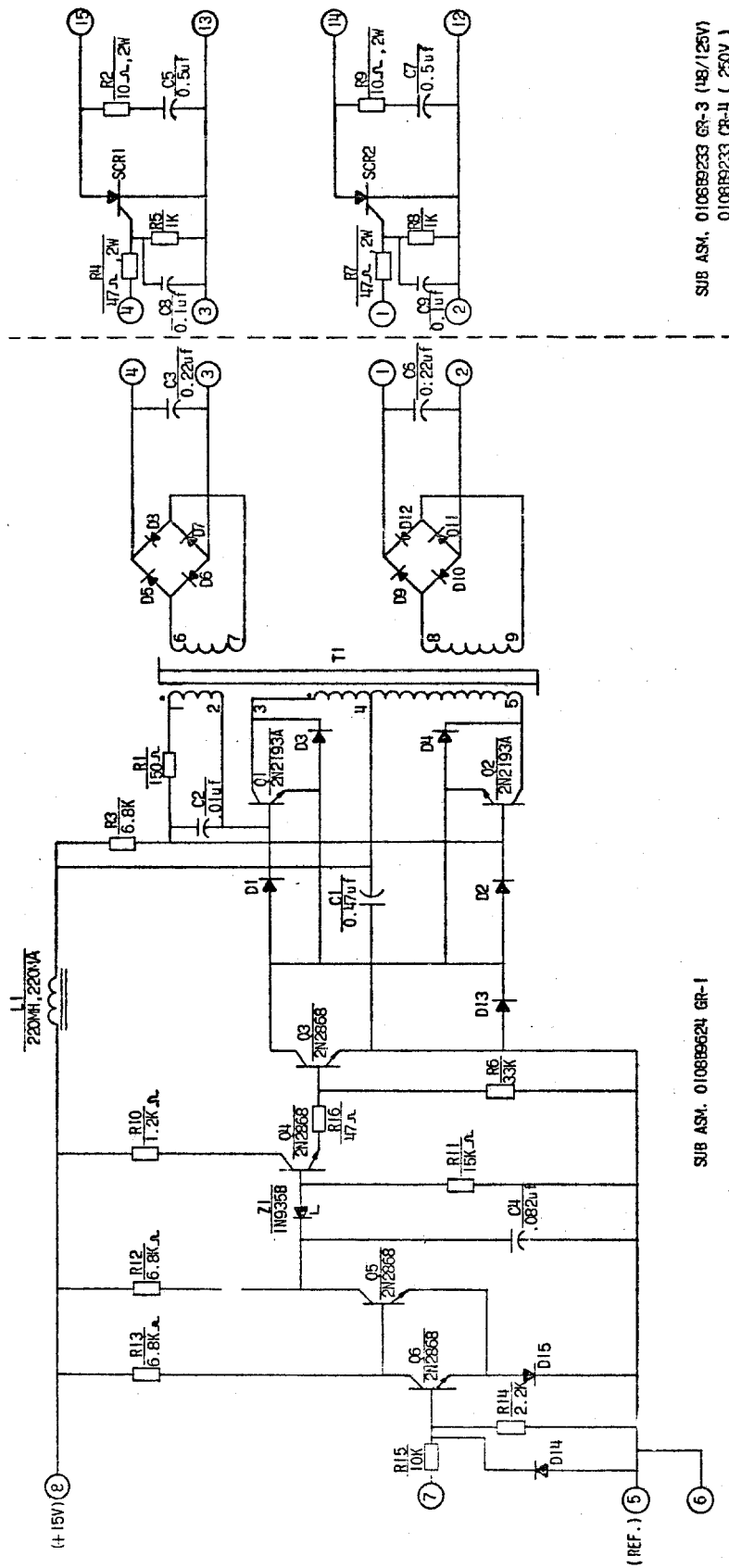
\* FIG. 2 (0149C7352-7) Internal Connections For The Type SLAT51C Relay

\* Indicates revision



\* OPTIONAL CARDS - SEE INTERNAL CONNECTION DIAGRAM

\* FIG. 3 (0227A2115-1) Component And Card Locations For The Type SLAT51C Relay



SUB ASM. 0108B624 GR-1

SUB ASM. 0108B9233 GR-3 (148/125V)  
0108B9233 GR-4 ( 250V )

ALL DIODES 1N4148 UNLESS NOTED  
ALL RES. 1/2 WATT  $\pm 5\%$  UNLESS NOTED  
② = TERM. POST ON BOARD ASM  
1N935B = 9.1V  $\pm 5\%$

FIG. 4 (0108B9610-0) Internal Connections For The SCR Trip And Isolation Subassemblies

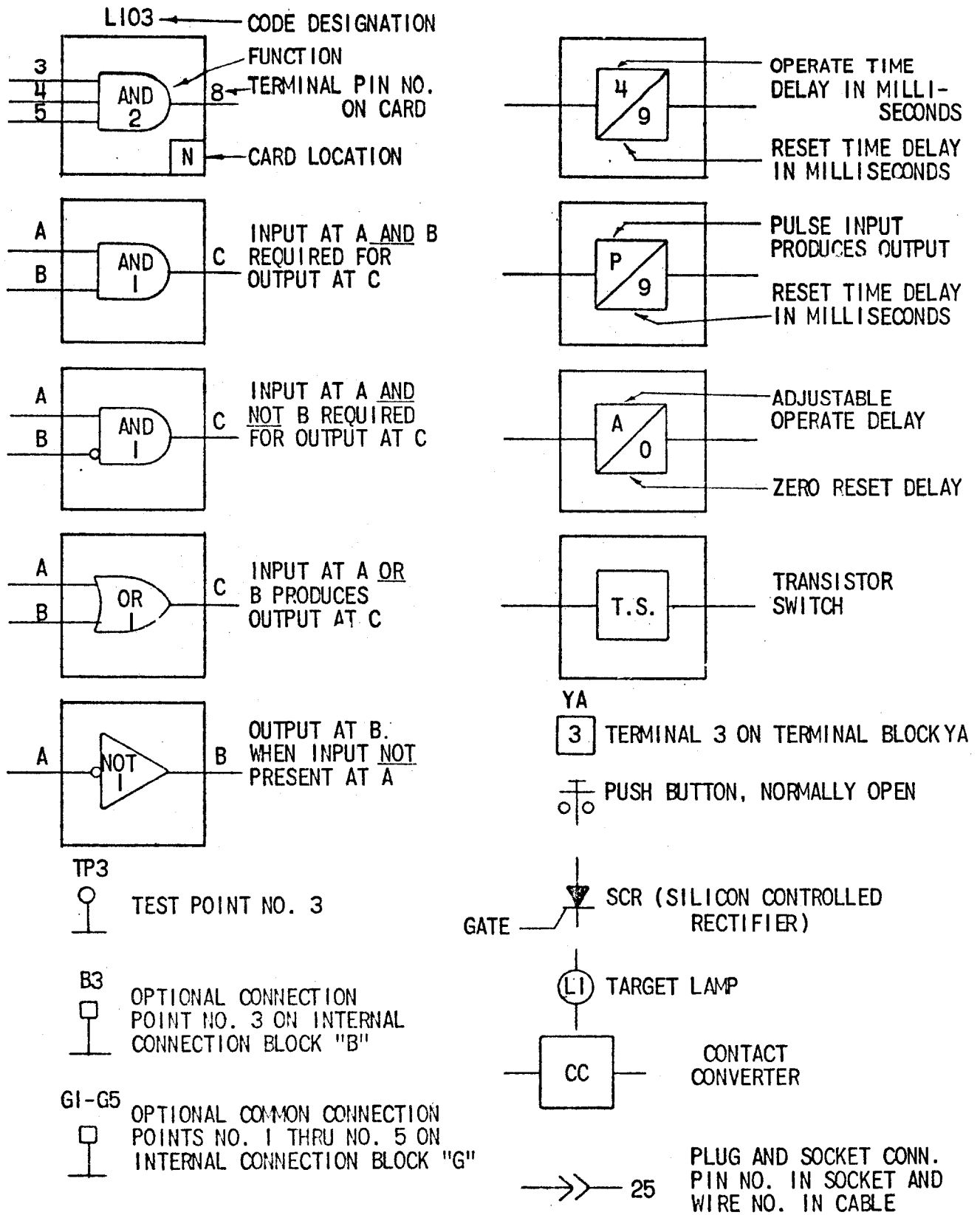
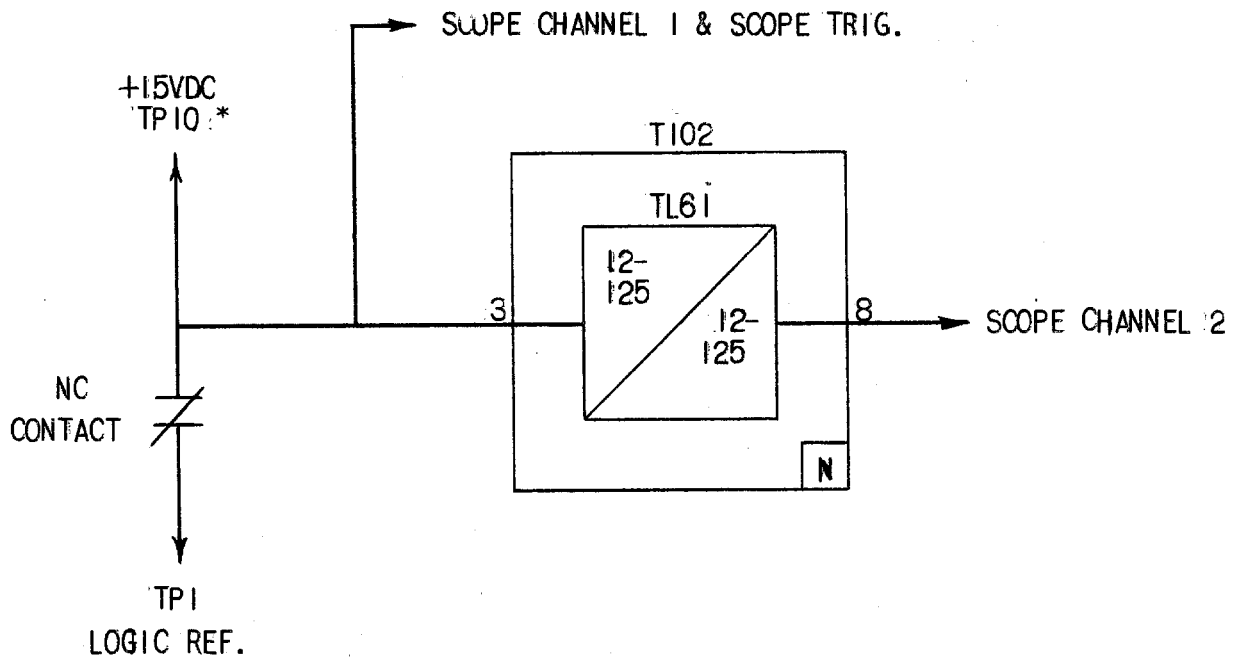
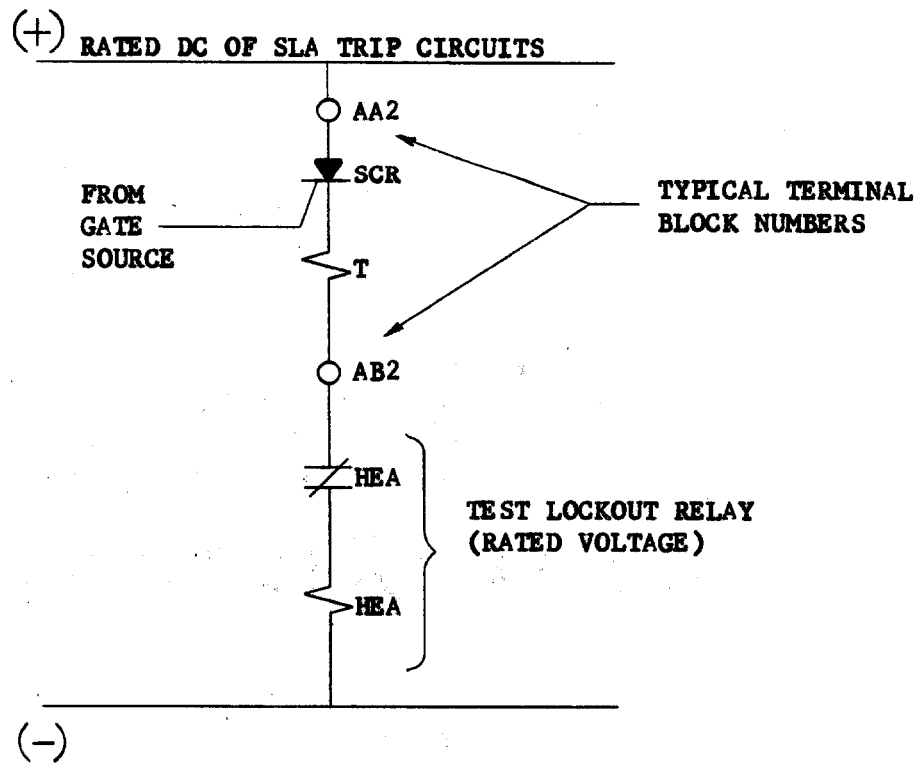


FIG. 5 (0227A2047-1) Internal Connection Diagram Legend



\* THE 15VDC SIGNAL AT PIN 10 HAS A CURRENT LIMITING RESISTOR MOUNTED ON THE TEST CARD.

FIG. 6 (0246A7987-0) Logic Timer Test Circuit



**FIG. 7**

**TYPICAL SCR TEST CIRCUIT FOR TYPE SLA RELAYS**

FIG. 7 (0208A2365-0) Typical SCR Trip Circuit Test Connections

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