INSTRUCTIONS

GEK-41933

STATIC THREE PHASE OVERCURRENT RELAY

TYPE SLC53B

POWER SYSTEMS MANAGEMENT DEPARTMENT

GENERAL ELECTRIC

PHILADELPHIA, PA.

CONTENTS

DESCRIPTION

The Type SLC53 relay is a static, three phase, non-directional, direct trip instantaneous overcurrent relay designed to provide direct tripping for heavy multi-phase faults. One Type SLC53 relay will detect all multi-phase faults within its reach setting regardless of the direction of current flow. The SLC53B is packaged in one 4 rack unit case as shown in Figure 1. Component locations for the SLC53B are shown in Figure 2.

The SLC53B is intended to be used by itself independent of other equipment. A self-contained power supply and two separate trip circuits permit this independent operation. The internal connections for the SLC53B are shown in Figure 3.

The measuring function included in the SLC53B is designated PH4. This PH4 function is generally included as a standard option in various static pilot relaying schemes. The SLC53B was specifically designed to permit addition of the PH4 function to those static relay equipments that were designed without the built-in PH4 option.

APPLICATION

PH4 is a three phase, non-directional, direct trip instantaneous overcurrent function that is intended to provide direct tripping for heavy multi-phase faults. The PH4 function must be set to operate at 125 percent or more of the maximum external three phase fault current. Because PH4 is non-directional, faults at the bus directly behind the relay as well as faults at the remote terminal must be considered. PH4 responds to the delta phase currents which ensures the same response for all multi-phase faults at the same location. A short circuit study of the system is necessary to determine the proper pickup current setting of this function.

Figure 4 illustrates the external connections to the SLC53B relay.

RATINGS

The Type SLC53B relay has a self-contained power supply which is designed for operation from station battery voltages of 48, 125, or 250 volts DC. The power supply output voltage is +15 volts DC above reference.

The current circuits of the Type SLC53B relay are rated at 5 amperes, 60 cycles for continuous duty and have a one second rating of 300 amperes.

The range of adjustment of the PH4 function is from 5 to 80 amperes.

The relay is designed for use in an environment where the air temperature outside the relay case does not exceed -20°C or +65°C.

BURDENS

Maximum current drain of the SLC53B relay from the station battery is given in the table below:

TABLE I

BATTERY VOLTAGE	CURRENT BURDEN
48 VDC	1.25A
125 VDC	.48A
250 VDC	.24A

The current burden for the PH4 function, measured at 5 amperes line current, is as follows:

Phase Current Burden - R = .020, X = .013, Z = .024 ∠ 33°

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.

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

OPERATING PRINCIPLES AND CHARACTERISTICS

The PH4 function in the SLC53B relay is an adjustable non-directional overcurrent function which operates on the highest phase to phase current.

CIRCUIT DESCRIPTION

The internal connection diagram of the SLC53B relay (Figure 3) shows the current inputs on the upper left side. The logic that evaluates these inputs is next, and then the SCR output portion is shown on the upper right hand side. The self-contained power supply is shown on the lower half of the drawing.

The small squares with numbers enclosed in them are the terminal board points. These points located on the "RA" and "RB" terminal blocks, which are located in the rear of the unit, serve to provide external inputs and outputs.

The input currents are routed through transactors of which the output voltages are controlled by secondary loading set at the factory. These voltages are filtered, full wave rectified and fed to the customer adjustable level detector. The detector output pulses are stretched to provide continuous output logic signals. These logic signals are then fed to the SCR's which when activated will trip their associated breaker.

WARNING: THE LOGIC SYSTEM SIDE OF THE TYPE SLC53B DC POWER SUPPLY USED WITH 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 GROUNDED CHASSIS WILL NOT AFFECT THE TESTING OF THE EQUIPMENT. A SECOND GROUND CONNECTION TO THE EQUIPMENT, SUCH AS A TEST LEAD INADVERTANTLY 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 ISOLATION PROVIDED.

The following tests should be made to insure that the SLC53B power supply is operating correctly.

1. Connect (+) battery lead to RB2, (-) battery lead to RB3, and station ground to RA1. Check that the overcurrent circuit breaker is closed.

2. The power supply output voltages may be checked at the red (positive) and black (ref.) test jacks provided within the unit. With rated battery voltage applied the positive output voltage should be (+) 15 volts, corrections can be made by adjusting pot P1 on the regulator card.

3. Power supply regulation can be checked by connecting an adjustable load resistor across test jacks. Apply rated dc voltage, adjust load resistor for 1.25 ampere, and check that the positive output voltage reading is between (+) 14.9 - (+) 15.1 volts dc. Reduce input voltage to 80 percen of rating with same load and check that the positive output voltage reading is between (+) 14.9 - (+) 15.1 volts dc.

4. The operation of the output breaker (B1) can be checked by connecting an adjustable load resistor across one of the output circuits, adjust the load for 2.4 amperes and check for a trip in 10 seconds or less.

5. The under voltage alarm relay may be checked as follows:

   a. Decrease the input dc voltage until the power supply output voltage drops below the rated voltage of Z4 (approximately 10 volts). This will cause the alarm relays to drop out, energizing the alarm light.

   b. Open the breaker (B1) on the front panel. This again will energize the alarm lamp.

6. To test the overvoltage circuits, it is necessary to remove the unit top cover, and increase the output voltage by adjusting P1 on the regulator card. Z6 begins to conduct at approximately 17 volts. To actually check the conduction an ammeter would have to be placed in series with Z6.

CONSTRUCTION

The Type SLC53B relay is packaged in a metal enclosure designed for mounting on a 19 inch rack. The relay is 4 rack units high (one rack unit is 1 3/4 inches) and has a 90^{o} hinged front cover and removable top cover. It contains the magnetics, filtering and printed circuit cards required to provide the phase PH4. It also has its self-contained power supply.

The operating level of the overcurrent function is adjustable via a potentiometer mounted on the printed circuit card associated with the function. The card identification, such as D107, and its position denoted by the letter in the small square in the lower right corner is shown on the unit internal Figure 3. Test points (test jack) are located on each printed circuit card to permit signal tracing in the field.

The potentiometers, P4 to P6, located to the left of the printed circuit cards are factory set to provide the range of operation of the associated overcurrent function.

RECEIVING, HANDLING AND STORAGE

This relay is a self-contained unit. Immediately upon receipt of this static type 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.

INSTALLATION TESTS

NECESSARY ADJUSTMENTS

The following checks and adjustments should be made by the user in accordance with the procedures given below under DETAILED TESTING INSTRUCTIONS before the relays are put into service. Some of the following items are checks of factory calibrations and settings, or installation connections and hence do not normally require readjustment in the field. Other items cover settings or adjustments which depend on installation conditions and hence must be made on the installed equipment.

Ph4 - Overcurrent Operating Levels

INPUT CIRCUITS

The Type SLC53B relay has two terminal blocks mounted on the rear of the unit which are identified as "RA" and "RB". Supply voltage from the station battery and the input currents that are to be measured are applied through these terminal blocks.

OUTPUT CIRCUITS

The same "RA" and "RB" terminal blocks are used to supply outputs from the relay to some external point. There is an over-under voltage alarm signal from the power supply portion of the relay; and, there are "Trip" actuating signals coming from the measuring portion of the relay.

DETAILED TESTING INSTRUCTIONS

REQUIRED ADJUSTMENTS

The overcurrent function settings may be made and tested using a single phase test source. A possible test circuit is shown in Figure 5 with the input connections for the SLC53B given below in Table II.

CAUTION: THIS RELAY IS RATED AT 5 AMPERES CONTINUOUS DUTY. TO SET FOR HIGHER CURRENT LEVELS, APPLY TEST CURRENT TO THE RELAY ON MOMENTARY BASIS (APPROXIMATELY ONE SECOND).

To set the test circuit for higher current levels it is recommended that a resistance be connected between points "A" and "B" of Figure 5. The value of the resistance should be equal to the impedance of the AC circuit to be tested (see above). When the desired current level is established, remove the resistor and connect the relay per Table II. Momentarily apply test current and monitor the output. Adjust the proper potentiometer for the desired operating point (clockwise pot rotation raises the operating point)

TABLE II

	CONNECT "RA" TERMINALS TO TEST CIRCUIT POINTS			ON CARD R MONITOR OUTPUT AT	ADJ. POT* ON CARD
FUNCTION	A	B	JUMPER		
PH4, Ø1-2	5	8	6 - 9	GRN TEST JACK	R
PH4, Ø2-3	8	11	9 - 12	GRN TEST JACK	R
PH4, Ø3-1	11	5	12 - 6	GRN TEST JACK	R

* The PH4 level detector operates on the highest phase to phase current input; if operating point differences are observed, calibration procedure is described below.

CALIBRATION

The SLC53B relay calibration may be checked by applying a reactance limited single phase current per Figure 5 and Table III. Use of the card adapter will provide access to the required measurement points.

TABLE III

	CONNECT "RA" TERMINALS TO TEST CIRCUIT POINTS			I_{in} (AMPS)	ADJ.	MEASURE PIN 3 TO PIN 1	
FUNCTION	A	B	JUMPER			CARD	VOLTAGE
PH4, Ø1-2	5	8	6 - 9	5.0	P4	R	$0.45\text{-}0.55V_{o\text{-}p}$
PH4, Ø2-3	8	11	9 - 12	5.0	P5	R	$0.45\text{-}0.55V_{o\text{-}p}$
PH4, Ø3-1	11	5	12 - 6	5.0	P6	R	$0.45\text{-}0.55V_{o\text{-}p}$

MAINTENANCE

PERIODIC CHECKS

For any periodic testing of the Type SLC53B relay the trip coil circuit of the circuit breaker should be made inoperative by opening the disconnect switches or other test switches provided for this purpose.

TROUBLE-SHOOTING

Test points are provided at selected points in the Type SLC53B relay to observe outputs if trouble-shooting is necessary. The use of a card adapter will make the pins on any one card available for testing.

For the physical location of components and cards refer to Figure 2, the component location diagram.

SPARE CARDS

The number of spare cards to carry in stock would depend on the total number of static relays, using similar cards, at the same location or serviced by the same test group. For each type of card (different code designation) a suggested minimum number of spare cards would be:

1 spare for 1 to 25 cards
2 spares for 26 to 75 cards
3 spares for 76 to 125 cards

CARD DRAWINGS

Details of the circuits of the printed circuit cards can be obtained in the printed circuit card book GEK-34148.

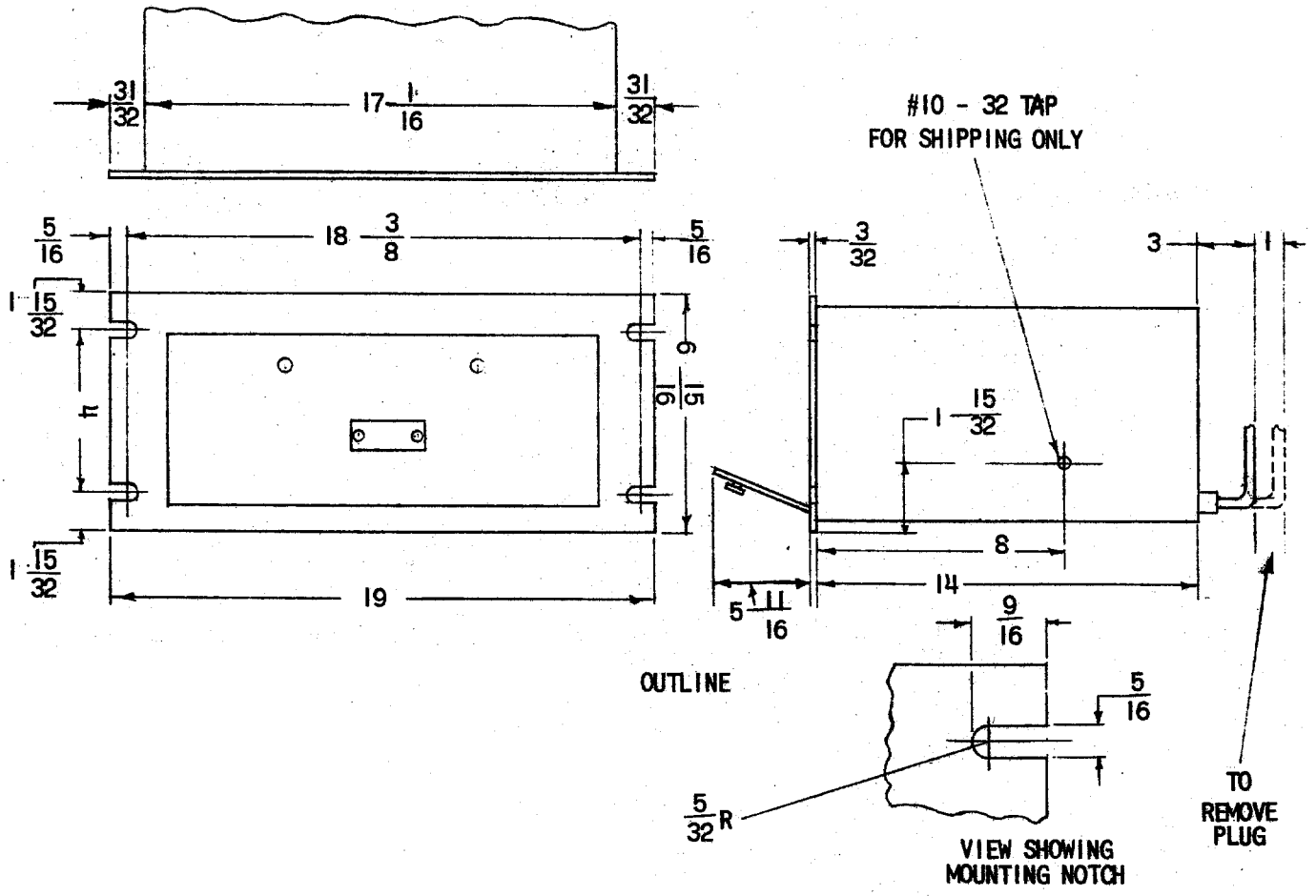


FIG. 1 (0227A2037-0) SLC53B Outline And Mounting Dimensions

NOTE: FOR INTERNAL CONNECTIONS SEE 0149C7369

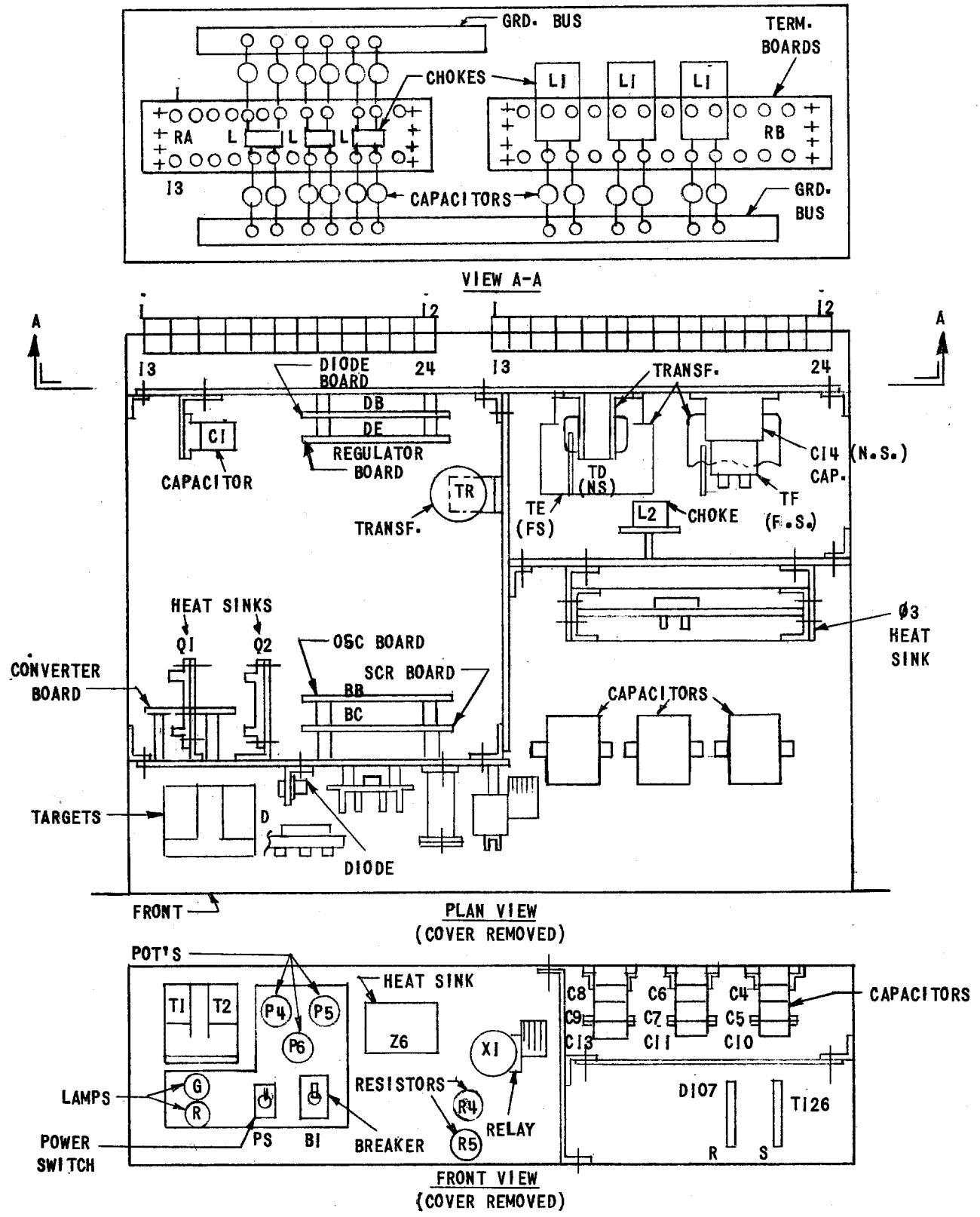


FIG. 2 (0227A2190-0) SLC53B Component Location Diagram

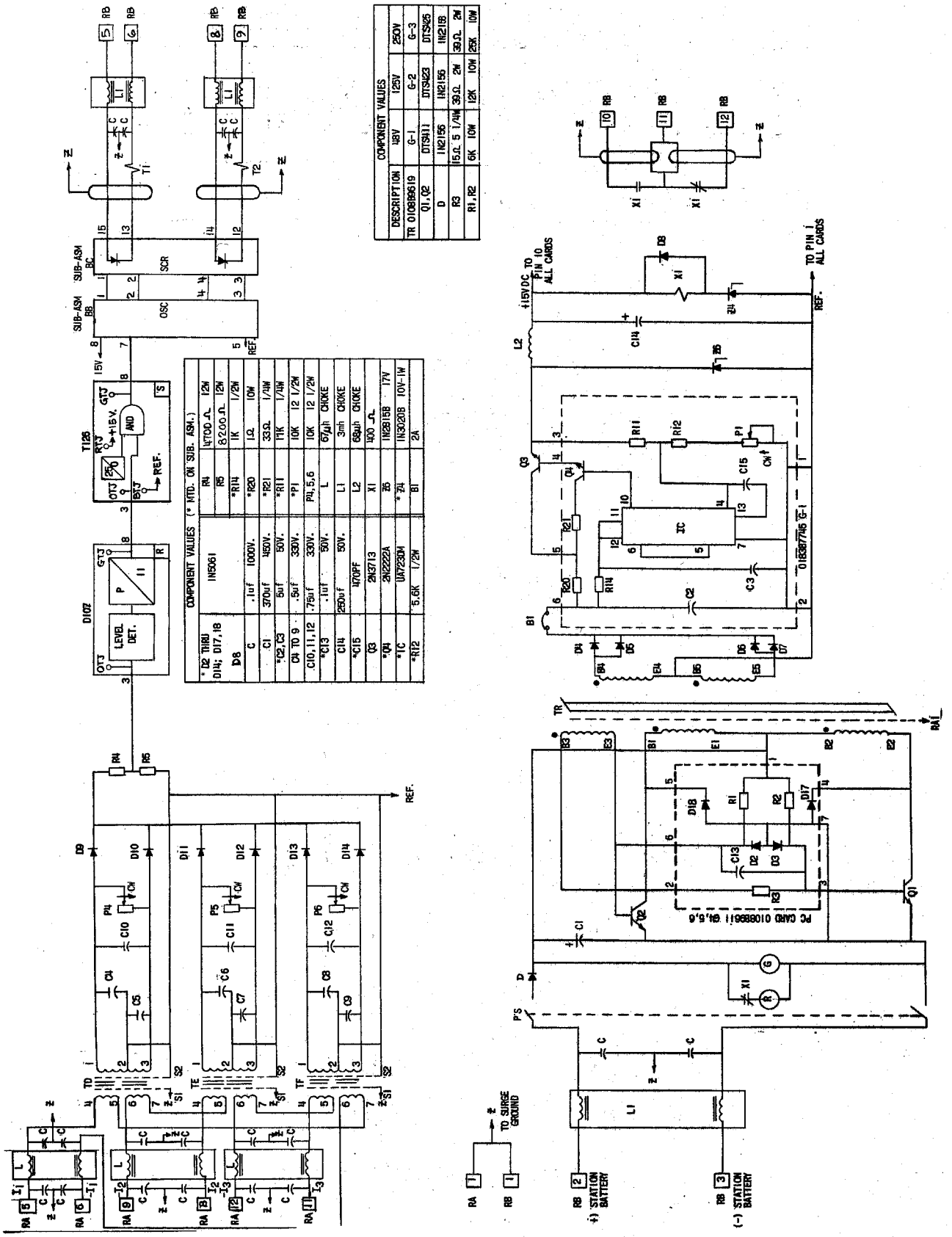


FIG. 3 (0149C7369-0) Internal Connections Diagram Of SLC53B Relay

ABBREVIATIONS & SYMBOLS	
52	CIRCUIT BREAKER
PS	RELAY POWER SWITCH IN SLC53B
X1	OVER & UNDER VOLTAGE RELAY IN SLC53B
SCR	SILICON CONTROLLED RECTIFIER
T	HAND RESET ELECTROMECHANICAL TARGET IN SLC53B
Ⓦ Ⓡ Ⓖ	INDICATING LAMPS
RA, RB	TERMINAL STRIP ON UNIT

REFERENCE DRAWINGS	
TYPE OR DESCRIPTION	INT. CONNS.
SLC53B	0149C7369

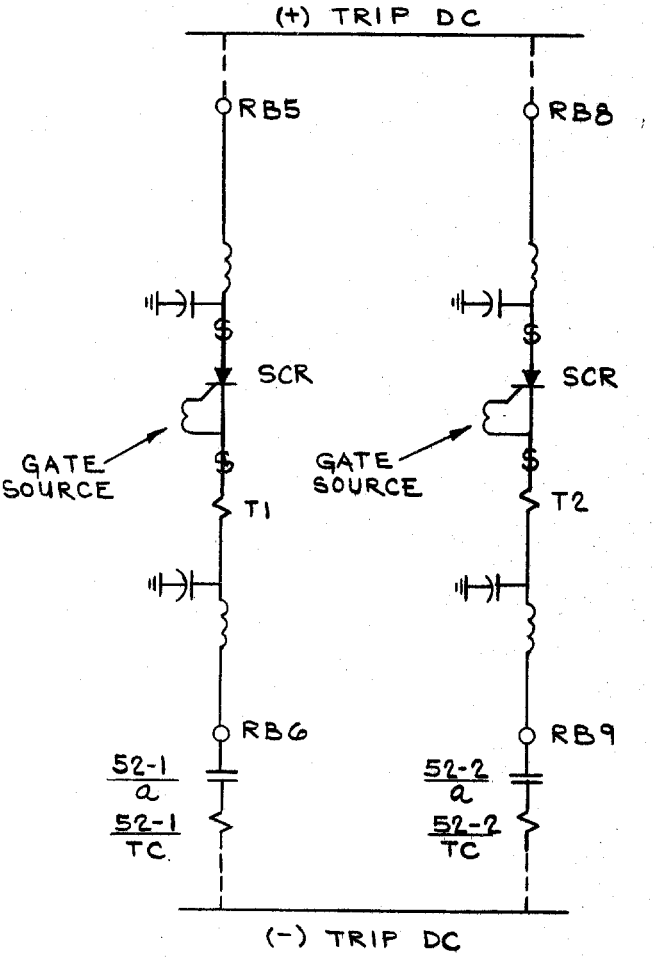
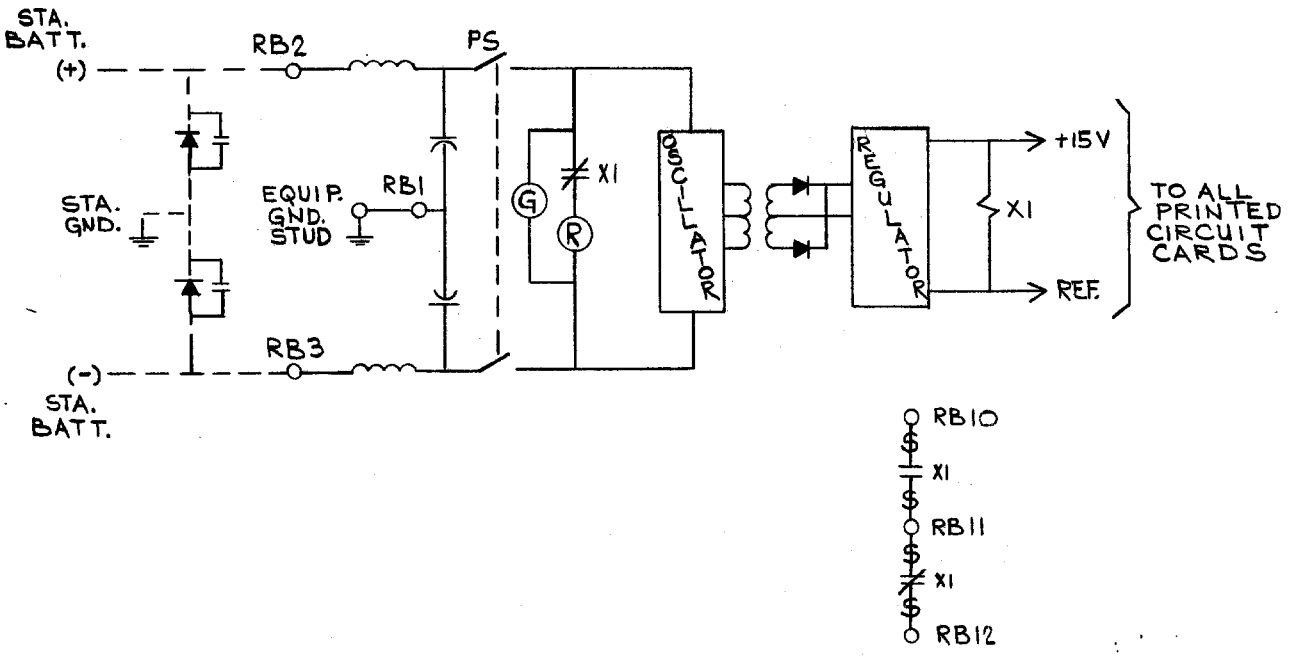


FIG. 4 (0164B9512-0) Typical External Connections For SLC53B



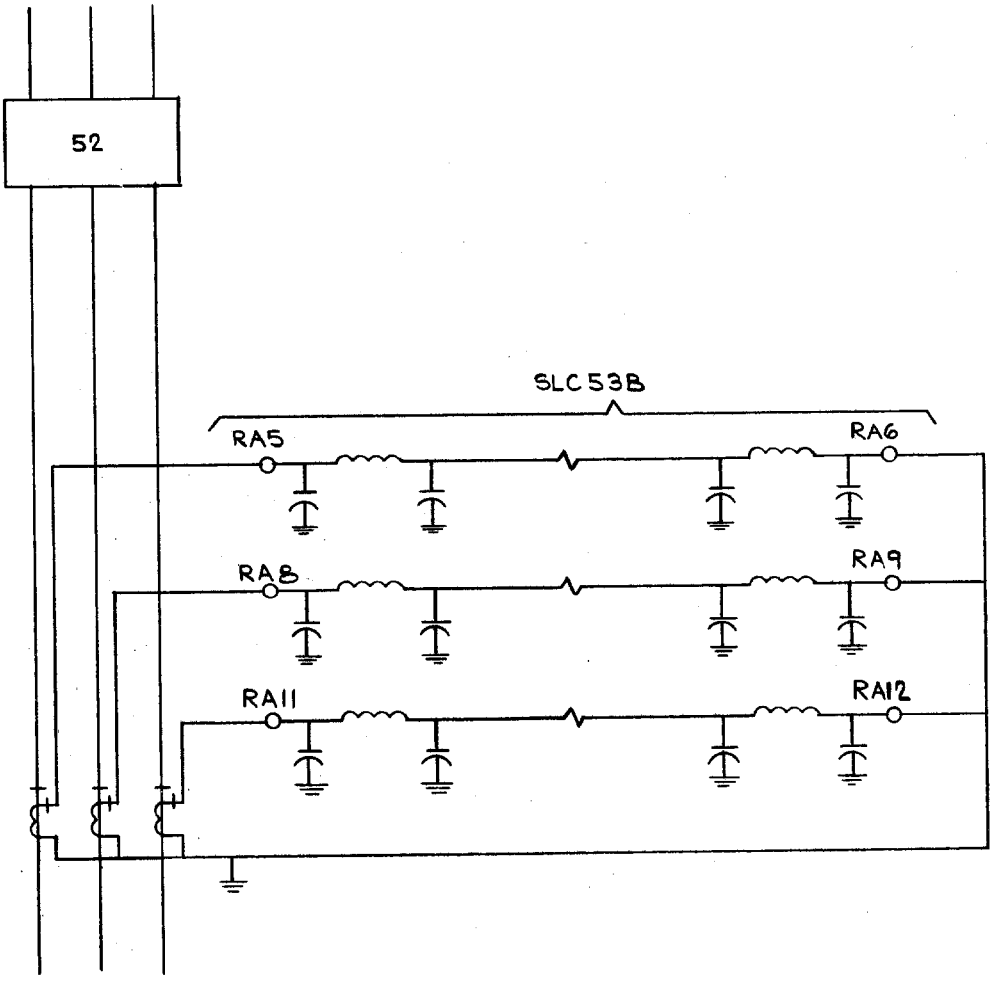


FIG. 4 (0164B9512-0) Typical External Connections For SLC53B

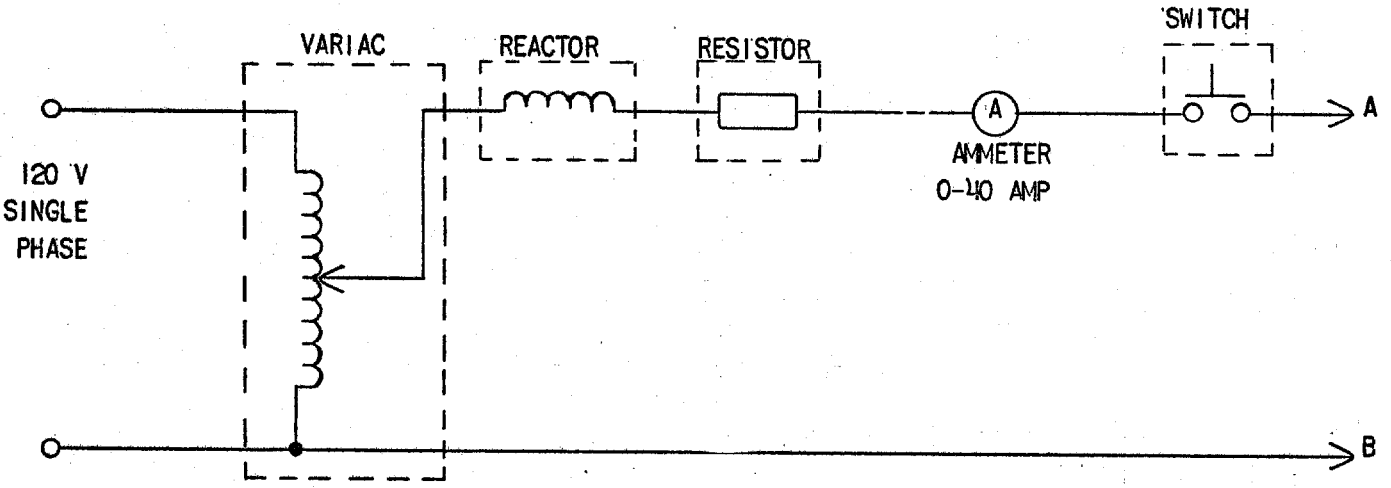


FIGURE - 8 -

TEST CIRCUIT FOR NONE DIRECTIONAL
OVER CURRENT FUNCTIONS.

FIG. 5 (0246A3681-0) Test Circuit For Non-Directional Overcurrent Functions