INSTRUCTIONS

GEK-49846A
Supersedes GEK-49846

STATIC OVERCURRENT RELAY

TYPE SLC51E

GENERAL ELECTRIC

CONTENTS

STATIC OVERCURRENT RELAY

TYPE SLC51E

DESCRIPTION

The Type SLC51E relay is a rack mounted solid state overcurrent relay for use in conjunction with other solid state relays, a test panel and a power supply in a transmission line protection scheme.

APPLICATION

The SLC51E relay is intended for use in a single pole trip and reclose scheme. The I_{MA}, I_{MB} and I_{MC} overcurrent functions are sensitive, non-adjustable current detectors. Their purposes are to determine which breaker poles are closed (or opened) by detecting the presence (or absence) of current in each phase. The I_M functions supervise the distance relays and can determine when one pole is open.

I_A, I_B and I_C are direct tripping functions, typically set for a current level 25 percent above the current in each phase for external faults or load swings. The AND functions AND87, AND88 and AND89 along with OR81 provide the necessary logic to determine that more than one phase is faulted. The AND functions AND84, AND85 and AND86 establish that the fault involves ground and permit each phase overcurrent function to trip its own phase.

$I_{3\phi}$ is a phase overcurrent supervision function. Typically it is set above load current and below two thirds of the minimum fault current. $I_{3\phi}$ supervises the phase distance relays.

G2 is a ground overcurrent function which supervises the ground distance relays. Typically it is set below two thirds of the minimum zero sequence fault current for which the ground distance relays are required to operate.

G4 is a ground overcurrent function which supervises the direct tripping overcurrent functions and prevents the phase distance relays from initiating a three pole trip on close-in single line-to-ground faults. Typically it is set 25 percent above the maximum zero sequence current in the line for an external ground fault.

RATINGS

The Type SLC51E relay is designed for use in an environment where the ambient temperature around the relay case is between minus 20°C and plus 65°C.

The Type SLC51E relay requires a plus or minus 15 volt DC power source which can be obtained from a Type SSA50/51 power supply.

* The current circuits of the Type SLC51E relay are rated for one or five amperes, 60 hertz, for continuous duty and have a one-second rating of 60 amperes (one ampere relay) or 300 amperes (five ampere relay). .

BURDENS

The Type SLC51E relay presents a maximum burden to the Type SSA power supply of:

200 milliamperes from the +15 volt DC supply
100 milliamperes from the -15 volt DC supply

RANGES

The ranges given in this section are typical for the Type SLC51E relay. Refer to the unit nameplate for the ranges of a particular relay.

*

TABLE I

	ONE AMPERE RELAY	FIVE AMPERE RELAY
I_{MA}, I_{MB}, I_{MC}	0.04 ampere (non-adjustable)	0.2 ampere (non-adjustable)
I_A, I_B, I_C	1.0 - 16 ampere	5.0 - 80.0 ampere
$I_{3\emptyset}$	0.2 - 3.0 ampere	1.0 - 15.0 ampere
G_2	0.1 - 1.0 ampere	0.5 - 5.0 ampere
G_4	0.5 - 8.0 ampere	2.5 - 40.0 ampere

CONSTRUCTION

The SLC51E 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 Fig. 3 and 4 respectively.

The SLC51E relay contains printed circuit cards which plug in from the front of the unit. The card sockets are marked with a letter designation or address (D, A, AE, AF, etc.) which appears on the guide strips in front of each socket, on the component location drawing, on the internal connection diagram, and on the printed circuit card itself. 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 connected to relay reference. TP10 is connected to the plus 15 volt DC bus through a 1.5K resistor. This resistor limits the current when TP10 is used to supply a logic signal.

The current circuits are connected to the relay via a 12-point terminal block on the rear of the unit. This block is identified as RA.

*Indicates Revision

RECEIVING, HANDLING AND STORAGE.

These relays will normally be supplied as 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 eight 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.

INSTALLATION TESTS

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 THE 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. HOWEVER, 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.

GENERAL

If the SLC51E relay that is to be tested is installed in an equipment which has already been connected to the power system, disconnect the outputs in the associated Type SLAT relay from the system.

The SLC51E 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.

OPERATIONAL CHECKS

Operation of the SLC51E unit can be checked by observing the signals at the twenty test points (TP1 to TP20) in the SLC51E by observing the operation of the associated channel equipment, or by observing the output functions in the associated Type SLAT tripping relay. The test points are located on the test card in position 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 plus 15 volts DC. The remaining points are located at various strategic points throughout the logic as shown on the internal connection diagram, Fig. 1. 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.

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.

OVERALL EQUIPMENT TESTS

After the SLC51E 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 tests can be performed by applying alternating current and voltages to the measuring units as specified in the instruction book for the measuring units and checking that proper outputs are obtained from the associated SLAT when measuring units operate. Currents and voltages can be applied at the CTP and PTP on the equipment test panel by means of Type XLA test plugs.

DETAILED TESTING INSTRUCTIONS

I_M FUNCTIONS

The I_M function is a single phase, non-adjustable low level current detector. Use the test circuit of Fig. 5 and the connections of Table II to check its operation.

TABLE II

PHASE	A	B	OUTPUT	COMMENT
A	RA2	RA3	TP7	Jumper C to D
B	RA4	RA5	TP8	Jumper C to D
C	RA6	RA7	TP9	Jumper C to D

1. Use the Phase A connections. Set the current for 0.015 ampere (one ampere relay) or 0.075 ampere (five ampere) relay. Check for less than one volt DC at the output test point.

2. Raise the current to 0.045 ampere (one ampere relay) or 0.225 ampere (five ampere) relay. Check for 13-15 volts DC at the output test point.

3. Repeat steps 1 and 2 for Phases B and C.

I FUNCTIONS

The I functions are single phase, high set overcurrent fault detectors. The pickup level of these overcurrent functions is set by the X option plug and potentiometer P20 (upper potentiometer) on the level detector printed circuit card. The X option plug selects the proper pickup current range and P20 provides a vernier adjustment. The pickup range for each X plug position is shown in Table III. When a setting may be obtained in two plug positions, the higher number tap should be used.

TABLE III

	FUNCTION RANGE		CARD	OUTPUT	OPTION	RANGE	
	ONE AMPERE	FIVE AMPERE	LOCATION	TEST POINT	X TAP	ONE AMPERE	FIVE AMPERE
I_A	1-16 ampere	5-80 ampere	AJ	TP12	1 2 3 4	1.0 - 1.5 1.5 - 3.3 3.3 - 7.5 7.5 - 16.0	5.0 - 7.5 7.5 - 16.5 16.5 - 37.5 37.5 - 80.0
I_B	1-16 ampere	5-80 ampere	AK	TP13	1 2 3 4	1.0 - 1.5 1.5 - 3.3 3.3 - 7.5 7.5 - 16.0	5.0 - 7.5 7.5 - 16.5 16.5 - 37.5 37.5 - 80.0
I_C	1-16 ampere	5-80 ampere	AL	TP14	1 2 3 4	1.0 - 1.5 1.5 - 3.3 3.3 - 7.5 7.5 - 16.0	5.0 - 7.5 7.5 - 16.5 16.5 - 37.5 37.5 - 80.0

1. Refer to Table III for the correct X plug tap position for the desired setting. Remove the card from the unit and make the setting. Refer to Table III for the card location.

2. Use the test circuit of Fig. 5 and the Phase A connections of Table II. Monitor output as indicated in Table III.

*Indicates Revision

3. Set the applied test current to the desired setting level. Adjust P20 on the level detector card (refer to Table III for the card location) to just obtain pickup at the output test point (13-15 volts DC).

4. Repeat steps 1, 2 and 3 for the Phase B and C connections.

$I_{3\emptyset}$ FUNCTION

The $I_{3\emptyset}$ function consists of an auction circuit with three single phase current inputs and one level detector card. An output is produced when any one of the phase currents is above the pickup setting of the $I_{3\emptyset}$ function.

1. Use the Phase A connections of Table II and the test circuit of Fig. 5. Set the applied test current to the desired pickup setting level.

2. Adjust P1 on the level detector card in Position N to just obtain pickup at TP3.

3. Use the Phase B connections of Table II. Raise the current to just obtain pickup at TP3. The test current should be within ten percent of the setting made in Step 2.

4. Repeat Step 3 using the Phase C connections of Table II.

GROUND FUNCTIONS

The G2 function is a low-set overcurrent fault detector. The G4 is a high-set overcurrent fault detector. The pickup level of these overcurrent functions is set by the X option plug and potentiometer P20 (upper potentiometer) on the level detector printed circuit card. The X option plug selects the proper pickup current range and P20 provides a vernier adjustment. The pickup range for each X plug position is shown in Table IV. When a setting may be obtained in two plug positions, the higher number tap should be used.

* TABLE IV

	FUNCTION RANGE		CARD	OUTPUT	OPTION	RANGE	
	ONE AMPERE	FIVE AMPERE	LOCATION	TEST POINT	X TAP	ONE AMPERE	FIVE AMPERE
G2	0.1 - 1.0 Ampere	0.5 - 5.0 Ampere	M	TP5	1	0.10 - 0.20	0.5 - 1.0
					2	0.20 - 0.40	1.0 - 2.0
					3	0.40 - 0.90	2.0 - 4.5
					4	0.90 - 1.0	4.5 - 5.0
G4	0.5 - 8.0 Ampere	2.5 - 40.0 Ampere	AM	TP6	1	0.5 - 0.75	2.5 - 3.75
					2	0.75 - 1.65	3.75 - 8.25
					3	1.65 - 3.75	8.25 - 18.75
					4	3.75 - 8.0	18.75 - 40.0

*Indicates Revision

1. Use the test circuit of Fig. 5. Connect point A to RA9, point B to RA10, and jumper point C to point D.

2. Refer to Table IV for the correct X plug tap position for the desired setting. Remove the card from the unit and make the setting. Refer to Table IV for the card location.

3. Set the applied test current to the desired setting level. Adjust P20 on the level detector card to just obtain pickup at the output test point (refer to Table IV for the correct test point).

LOGIC FUNCTIONS

The Type SLC51C relay has logic functions included to detect high level phase-to-phase and phase-to-ground faults. The logic may be checked using the test circuit of Fig. 5 and the appropriate connections of Table V.

TABLE V

TEST	A	B	C	D
A-G	RA2	RA3	RA9	RA10
B-G	RA4	RA5	RA9	RA10
C-G	RA6	RA7	RA9	RA10
A-B	RA2	RA3	RA4	RA5
B-C	RA4	RA5	RA6	RA7
C-A	RA6	RA7	RA2	RA3

When a phase-to-ground current greater than the I and G4 pickup setting is applied, the associated AND function (AND84, AND85 or AND86) will produce a 13-15 volt DC output.

When a phase-to-phase current greater than the I_M function pickup is applied, the associated AND function (AND81, AND82 or AND83) will produce a 13-15 volt DC output.

When a phase-to-phase current greater than the I function pickup is applied, the associated AND function (AND87, AND88 or AND89) and OR81 produce a 13-15 volt DC output.

MAINTENANCE

PERIODIC TESTS

It should be sufficient to check the outputs produced at test points in the SLC51E when periodic calibration tests are made on the associated measuring units, for example, the phase and ground relays in a line-relaying scheme. No separate periodic tests on the SLC51E itself should be required.

*Indicates Revision

TROUBLESHOOTING

In any troubleshooting 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 point 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 troubleshooting, 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.

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 buses, 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 SLC51E relay are included in the card instruction book GEK-34158.

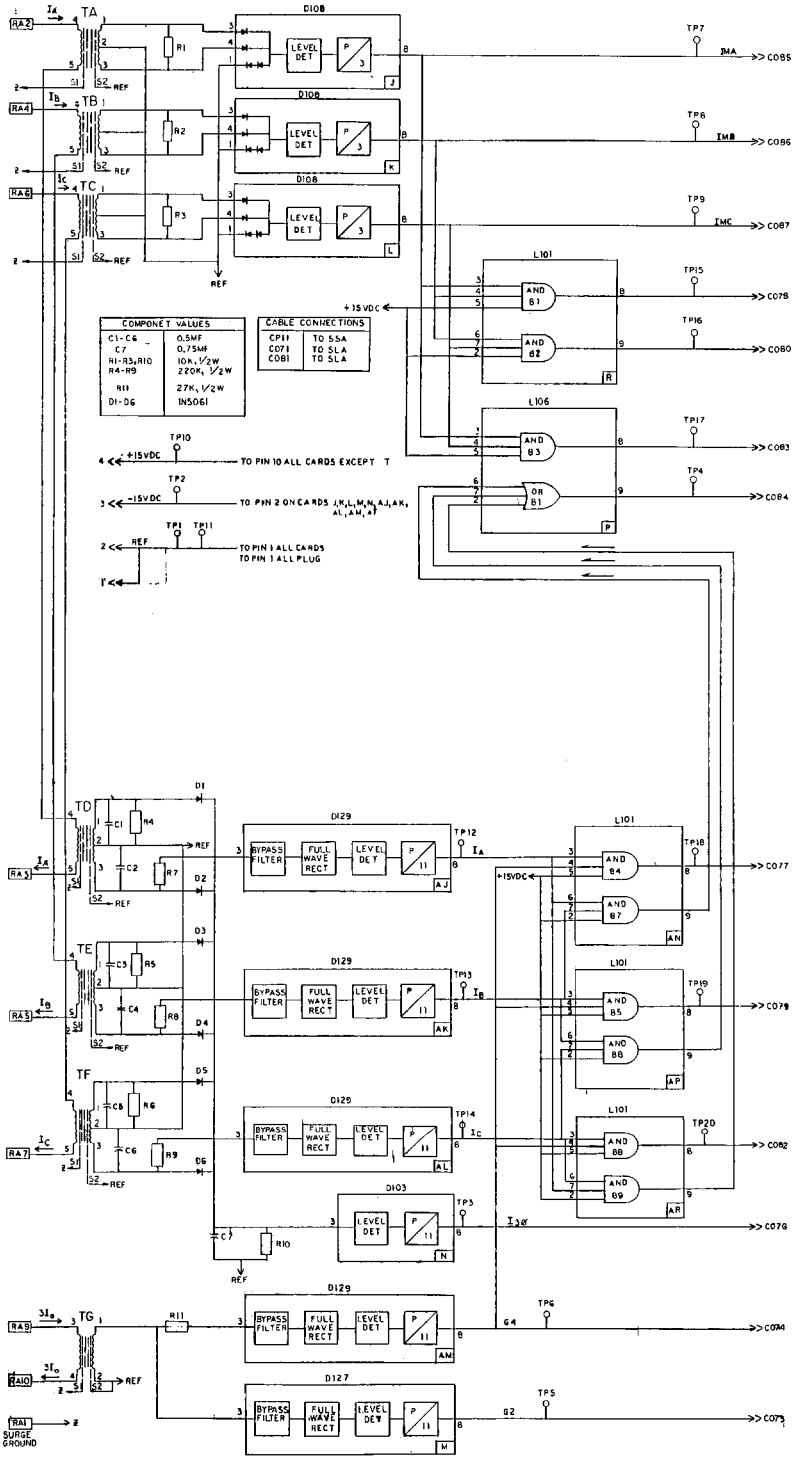

Fig. 1 (0136D3568-0) Internal Connection Diagram for the SLC51E Relay

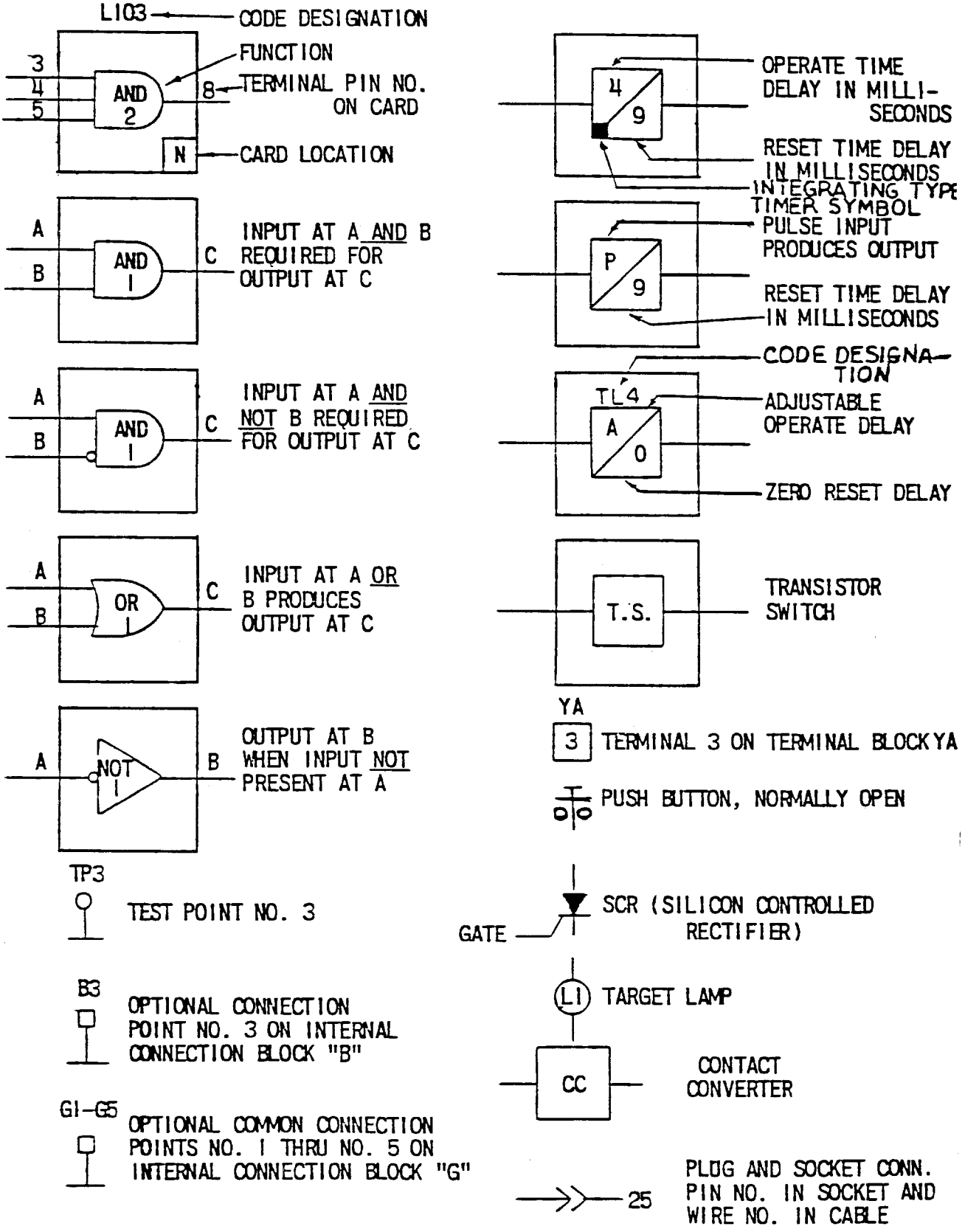

Fig. 2 (0227A2047-1) Legend for Internal Connection Diagram

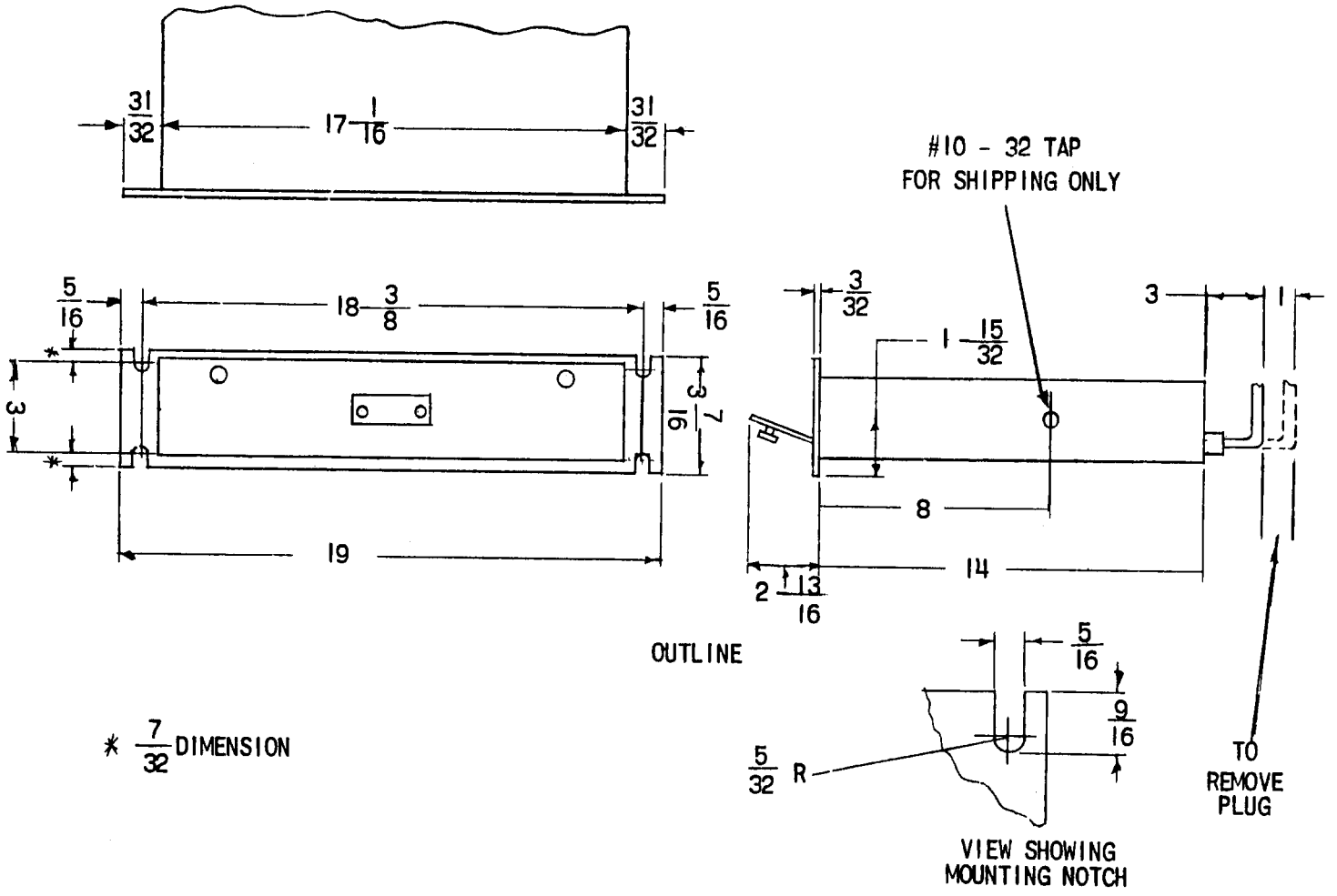

Fig. 3 (0227A2036-0) Outline and Mounting Dimensions for the SLC51E Relay

GENERAL ELECTRIC COMPANY
POWER SYSTEMS MANAGEMENT BUSINESS DEPT.

GENERAL ELECTRIC

PRINTED IN U.S.A.