INSTALLATION • OPERATION • MAINTENANCE

INSTRUCTIONS

TYPE SCC CURRENT COMPARER RELAY

CAUTION: Before putting relay into service, operate the relay to check the electrical connections. Close output switches last when placing relay in service. Open output switches first when removing relay from service.

APPLICATION

The type SCC relay supervises tripping of the SDG type of ground distance relay where the latter is current compensated for zero sequency mutual impedance.

The SCC relay prevents undesired tripping for close in faults on the mutually coupled parallel line where the compensating current overpowers the effect of the protected line current.

In addition, logic circuitry is utilized to block undesired tripping for reversals in power flow and allows a coordination time for SDG relay to reset. The logic circuitry permits high speed tripping for valid faults in the trip zone.

CONSTRUCTION

The type SCC relay consists of two input transformers (TR-1 and Tr-2), a plug-in type of circuit board assembly and a tapped resistor for changing the d-c rating.

As shown in Fig. 4, the circuit board consists of a current comparer with output terminal, two transistorized NOT circuits, an AND circuit, a time-delay circuit and a voltage regulator.

Voltage clippers are utilized to protect the secondary a-c input circuitry as well as the d-c input and output circuits.

OPERATION

The various components are connected as shown in Fig. 3. If sufficient current is applied to Tr-1 and rated D-C supply voltage connected to the circuit board, transistor TI will turn on. Transistor T2 will turn off and a voltage will appear at the output terminal labeled CURRENT COMPARER SUPERVISION OUTPUT (TERMINAL 10). This output can be used to operate other solid state devices such as the type TD-50 time-delay relay or other logic packages which operate circuit breakers.

NEW INFORMATION

EFFECTIVE SEPTEMBER 1966

If current is also supplied to transformer TR-2 such that the voltage across resistor R2 is greater than that across R1, then transistor T1 will not turn on. The SDG input, terminal (3), is usually tied to negative (terminal 8) through a normally conducting transistor. When the SDG output transistor is non-conducting, a voltage of 10 volts or more appears at terminal 3 and diode D17 will be backed biased. Since diode D1F is normally back biased, then transistor T4 will conduct and energize the timer. Approximately .025 seconds later, the normal output voltage appearing between terminals 1 and 8 will drop to almost zero.

By decreasing the current through transformer TR-2, the transistor T1 will now turn on. The timer circuit will then reset and approximately .025 seconds later, the voltage will again appear at terminal 1.

As shown in Fig. 1, protected-line current (3KoIo) energizes transformer TR-1; one TR-1 output winding feeds the operating circuit, while the second TR-1 output winding connects into the restraint circuit. Mutual compensation current (3dIom) energizes transformer TR-2; the output winding feeds the restraint circuit. The restraint voltage VR is proportional to:

$$VR \propto (3KoIo - 3d\ Iom)$$

where $d = \frac{Zom}{Zol}$, the auxiliary CT ratio. (1)

Zom = zero-sequence mutual impedance

Zol = zero-sequence self-impedance of the protected line.

The operate and restraint circuits are so proportioned that operation occurs when:

$$3KoIo > g\ 3KoIo - 3d\ Iom$$

where $g = 0.4 \pm 0.7$ (a design constant). (2)

For illustrative purposes, assume g = 0.4 and d = 0.75 in eq. 2 in the following examples:

Example 1

Assume a far-end fault so that 3KoIo = 3 Iom. Restraint voltage is proportional to:

$$0.4\ (3KoIo - 3d\ KoIo) = 0.4\ (1-0.75)\ 3KoIo = 0.1\ (3KoIo)$$

Operate voltage is proportional to 3KoIo, so eq. (2) is satisfied and operation occurs with an output appearing at terminal 10.

Example 2

Assume a fault on the adjacent mutually coupled line with 3 Iom = 4 and 3KoIo = -1 (flow in non-trip direction). Restraint voltage is proportional to:

$$0.4\left[-1-0.75\ (4)\right] = 0.4\ (-1-3) = -1.6$$

Example 2 (continued)
The magnitude of the restrain voltage exceeds the operating voltage, so no output appears at terminal 10.

CHARACTERISTICS

With .42 to .48 amperes applied to the 10 input circuit, only and rated d-c voltage connected to the relay, an output voltage will appear at terminals 8 and 10 with terminal 10 positive.

Fig. 5 shows the response limits of the relay for g = 0.4 ± .07 over a large range of current when the two input currents are 180° out of phase. The actual relay characteristics will fall somewhere in shaded area.

BURDEN DATA

Burden of Operating Circuit (terminals 4 and 5) at 5 amperes is 0.75 volt-amperes.

Burden of Restraint Circuit (terminals 6 and 7) at 5 amperes is 0.15 volt-amperes.

Continuous rating is 10 amperes.

One second rating is 280 amperes.

Battery Drain at rated voltage is as follows:

48 vdc	-	.048 amperes
125 vdc	-	.039 amperes
250 vdc	-	.034 amperes

SETTINGS

No setting required.

INSTALLATION

The relays should be mounted on switchboard panels or their equivalent in a location free from misture. Mount the relay vertically by means of the four mounting holes on the flange for semi-flush mounting or by means of the rear mounting stud or studs for projection mounting. Either a mounting stud or the mounting screws may be utilized for grounding the relay. The electrical connections may be made directly to the terminals by means of screws for steel-panel mounting or to the terminal studs furnished with the relay for thick panel mounting. The terminal studs may be easily removed or inserted by locking two nuts on the stud and then turning the proper nut with a wrench.

For detailed FT case information, refer to I.L. 41-076.

ADJUSTMENTS & MAINTENANCE

The proper adjustments to insure correct operation of the relay have been made at the factory and should not be disturbed after receipt by the customer.

Acceptance Tests

The following check is recommended to insure the relay is operating properly. All checks can best be performed by connecting the relay per the test circuit shown in Fig. 2.

1. MINIMUM OPERATE CURRENT - with switch S2 and S3 open, close switch S1 and adjust R3 until voltmeter V2 shows sudden indication (approximately 20 volts). The current through ammeter Io should read between 0.42 and 0.48 amperes. The V2 voltmeter pointer should have reset when the current is reduced to 0.40 amperes.

2. CURVE CHECK - close switch S3 and set Iom for 50 amperes. With Io adjusted for 40 amperes, the voltmeter V2 should indicate when switch S1 is closed. With Io adjusted for 30 amperes, there should be no voltmeter indication.

3. TRANSIENT BLOCK CHECK - open switches S1 and S2. Voltmeter V1 should not read. When switch S2 is closed, voltmeter V1 will read almost 30 volts. The time it takes voltage V1 to appear should be 20 to 30 milliseconds and can be checked using a oscilloscope. Likewise when switch S2 is opened, the voltage V1 will be removed in .020 to .030 seconds.

Routine Maintenance

All relays should be checked at least once every year or at such time intervals as may be dictated by experience to be suitable to the particular application.

Calibration

Use the following procedure for calibrating the relay if the adjustments have been disturbed. This procedure should not be used until it is apparent that the relay is not operating properly.

1. MINIMUM OPERATE ADJUSTMENT - if resistor R30 (see Fig. 3) has been disturbed, it may be recalibrated by referring to test circuit shown in Fig. 2. With switches SI and S3 open, close switch SI and adjust R3 for 0.45 amperes. Adjust slidewire resistor R30 until voltmeter V2 suddenly reads (approximately 20 volts). Note that the position of R31 is not critical during this adjustment.

2. CURVE ADJUSTMENT - set Iom for 50 amperes and Io for 35 amperes. Alternately adjust slidewire R31 and close switch S1 until voltmeter V2 indicates. Increasing resistor R31 will decrease amount of Io current for a V2 output. Likewise decreasing resistor R31 will increase amount of Io current required for a V2 output.

TROUBLE SHOOTING PROCEDURE

Use the following procedure to locate the source of trouble if the type SCC relay is not operating correctly:

1. Check voltages as listed under ELECTRICAL CHECKPOINTS.
2. Inspect all wires and connections.
3. Check resistances as listed on the relay internal schematic.

ELECTRICAL CHECKPOINTS

Connect relay per test circuit of Fig. 2. With rated d-c voltage applied to relay and switch S1 open and S2 closed, the following voltages should be measured. These measurements are made at the test points as shown on the relay schematic drawing and should be made with a high resistance voltmeter to reduce instrument loading.

Testpoints	Reading
Circuit board terminal 19 and relay terminal 8	30 ± 3 volts
Test point TP1 and relay terminal 8	16 ± 3 volts
Test point TP2 and relay terminal 8	less than 0.5 volt
Test point TP3 and relay terminal 8	30 ± 3 volts
Test point TP4 and relay terminal 8	30 ± 3 volts
Test point TP5 and relay terminal 8	0 volts
Test point TP6 and relay terminal 8	21 ± 3 volts
Test point TP7 and relay terminal 8	less than 0.5 volt
Relay terminals 1 and 8	30 ± 3 volts
Relay terminals .10 and 8	less than 0.5 volt

If switch S2 is opened, then the following readings should be present:

Test point TP4 and relay terminal 8	less than 0.5 volt
Test point TP5 and relay terminal 8	30 ± 3 volts
Test point TP6 and relay terminal 8	less than 0.5 volt
Test point TP7 and relay terminal 8	.15 ± 3 volts
Relay terminals 1 and 8	less than 0.5 volt

If switch S1 is closed and S3 opened, and Io adjusted for approximately 1 ampere:

Test point TP8 and slider on resistor R3	approx. 3.0±0.5 volt
Test point TP1 and relay terminal 8	less than 0.5 volt
Test point TP2 and relay terminal 8	22 ± 3 volts

If S1 and S3 are closed and Io = 0.25 ampere and Iom = 2.0 amperes:

Test point TP8 and slider on resistor R31	approx. 2.5±0.5 volt

RENEWAL PARTS

Repair work can be done most satisfactorily at the factory. However, interchangeable parts can be furnished to customers who are equipped for doing repair work. When ordering parts, always give the complete nameplate data.

ELECTRICAL PARTS LIST

Symbol	Description	Style #
	Capacitors	
C1	2.0 MFD. 200 VDC	184A662H07
C2	1.0 MFD. 50 VDC	764A278H07
C3	0.56 MFD. 50 VDC	764A278H08
C4	1.0, 50 VDC	764A278H07
C5	2.0 MFD 400 VDC	764A278H17
C6	2.0 MFD 200 VDC	764A278H18
C7	.56 MFD 50 VDC	764A278H08
	Diodes	
D1 to D8 D25 to D27	IN2071	188A342H05
D9	Thyrector	629A806H01
D11 to D14, D17 to D20 D24	IN459A	184A855H08
D10	Zener - IN468	184A639H05
D15	Zener - IN2989B	629A798H01
D16	Zener - IN1313A	184A639H10
D21-D22	Zener - IN1317A	184A639H02
D23	Zener - IN3036B	188A302H09
	Resistors	
R1	10K, 3 watt	763A126H20
R2	15K, 3 watt	763A126H08
R3-R6	499 ohm 1/2 watt	836A503H19
R4-R18-R22	20K, 1/2 watt	836A503H56
R5	350 ohm/2.5K/6.5K, 40 watt	184A651H01
R8-R12-R15-R20-R21-R24	4.99K, 1/2 watt	836A503H42
R25-R29	4.99K, 1/2 watt	836A503H42
R7-R9-R13-R17-R26-R27-R28	10K, 1/2 watt	836A503H49
R32	49.9K, 1/2 watt	836A503H65
R11-R14-R16-R19-R33	30.1K, 1/2 watt	836A503H60
R23	100 ohm, 1/2 watt	836A503H03
R30	5K, 10 watt	185A925H07
R31	10K, 10 watt	185A925H05
R34	Varistor	183A122H05
	Transistors	
T1	2N2349	762A585H13
T2 to T4 - T6 to T8	2N697	184A638H18
T5	2N1132	184A638H20

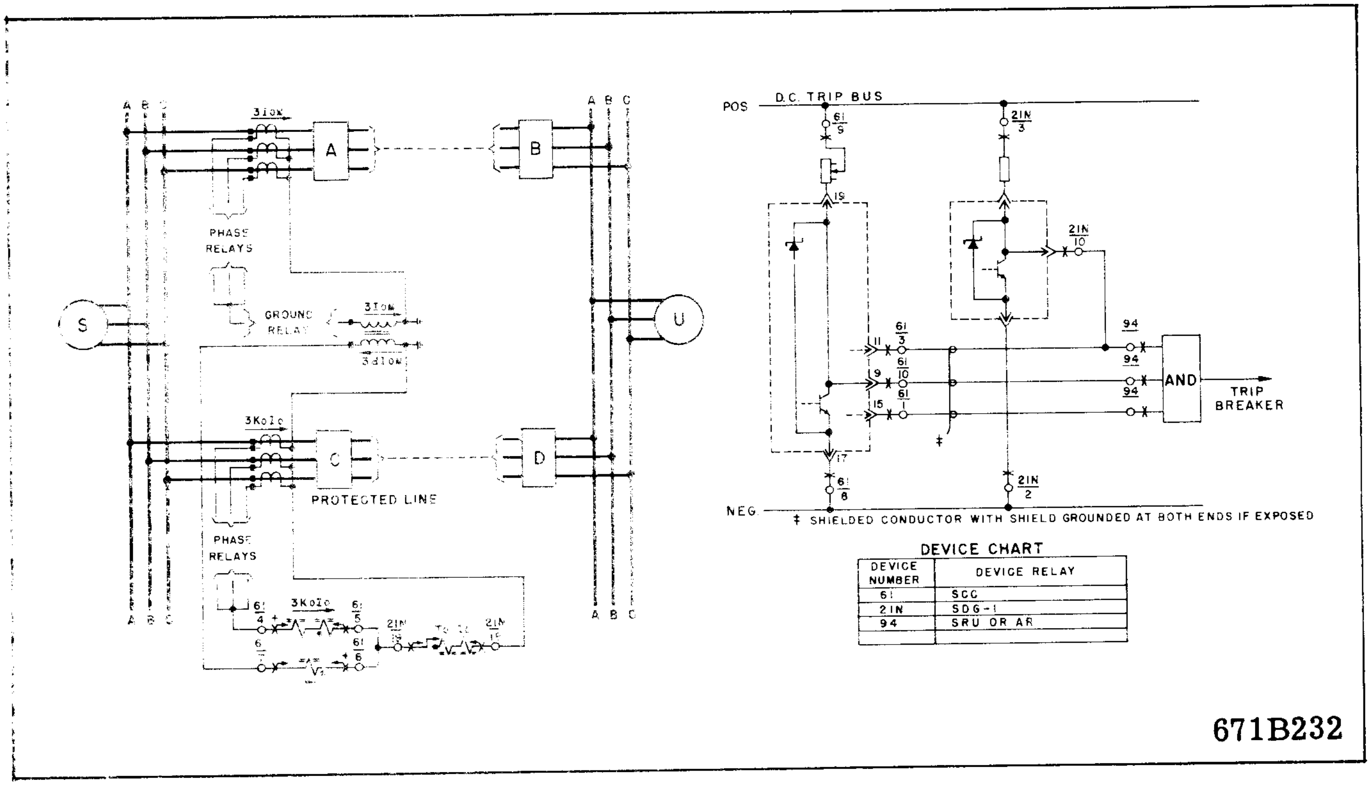

Fig. 1 External Schematic of the Type SCC Current Comparer Relay with the Type SDG Ground Distance Relay.

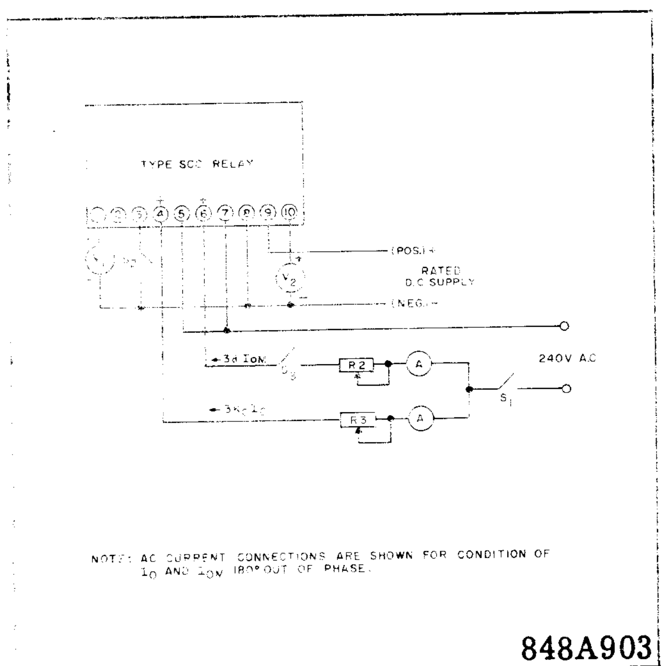

Fig. 2 Test Connections for Type SCC Current Comparer Relay

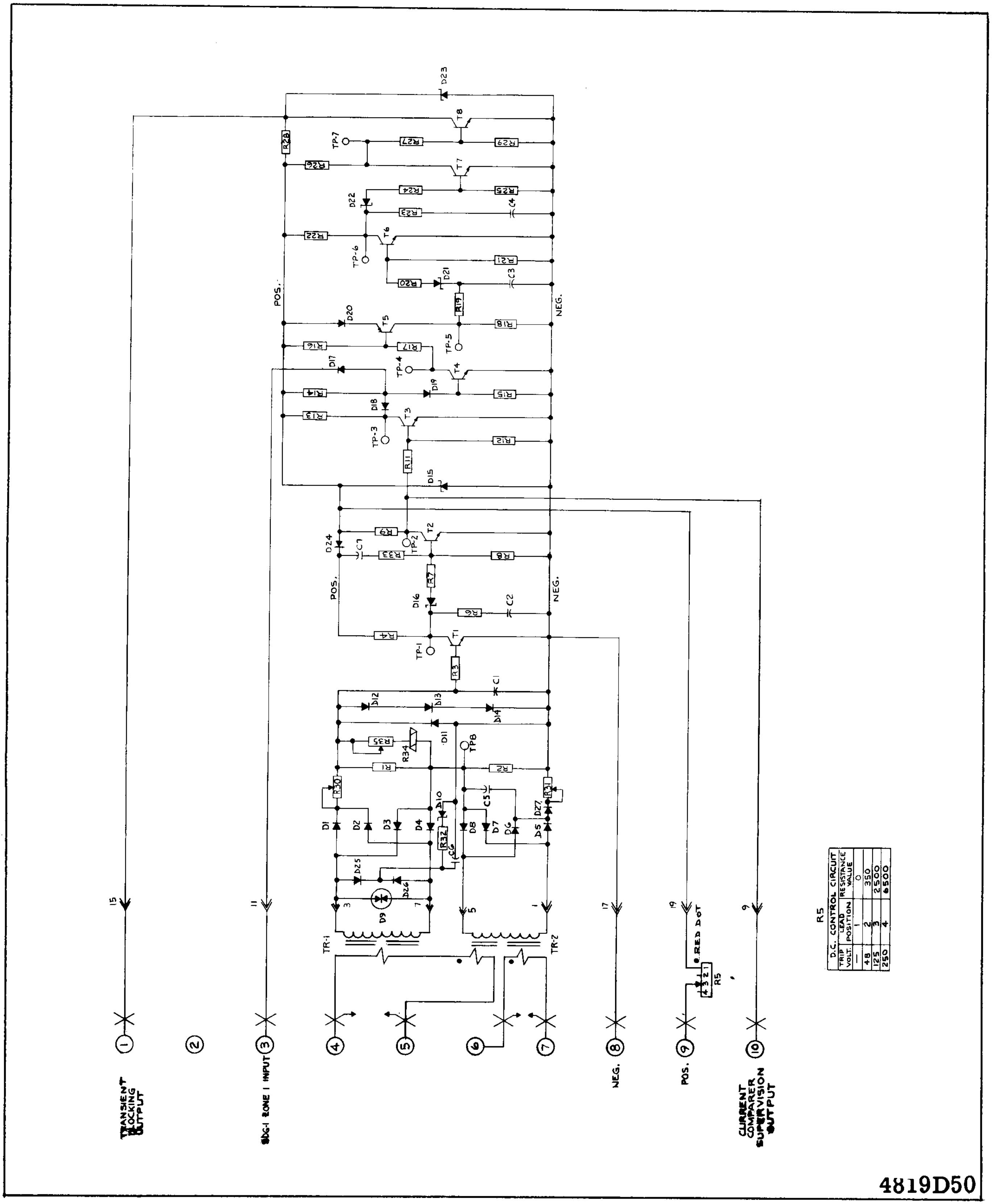

Fig. 3 Internal Schematic of the Type SCC Current Comparer Relay.

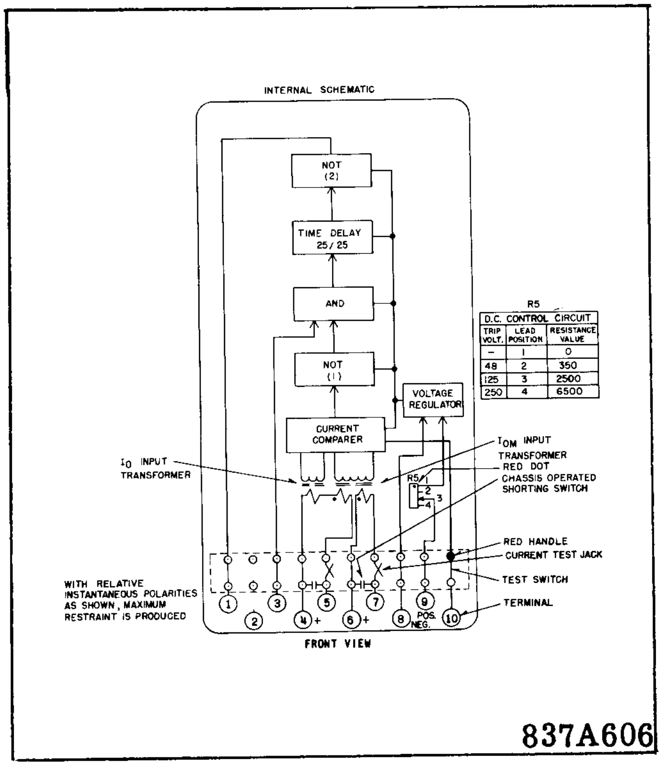

Fig. 4 Internal Schematic Logic Block Dragram of the Type SCC Current Comparer Relay

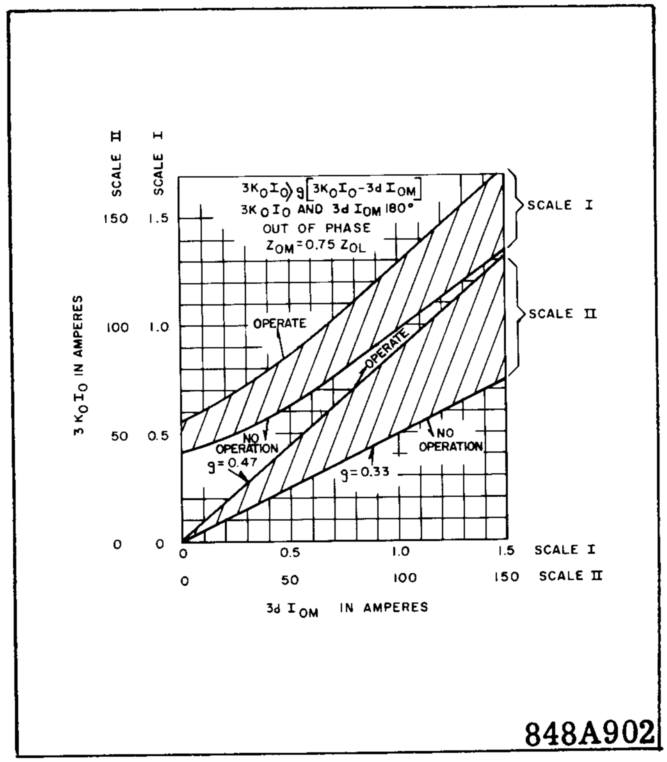

Fig. 5 Relay Operation Limits Curve for the Type SCC Current Comparer Relay.

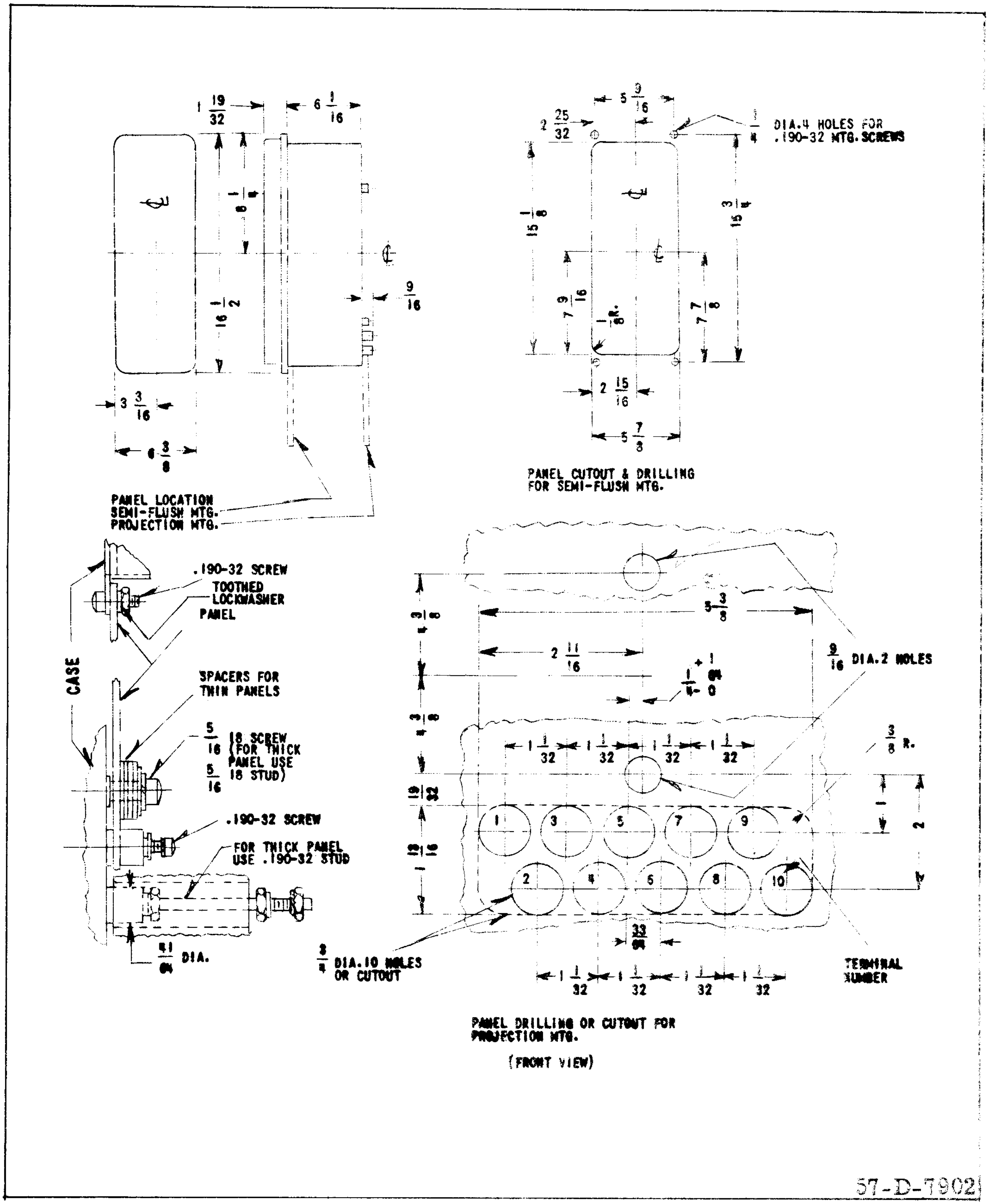

Fig. 6 Outline and Drilling Plan for the type SCC Current Comparer Relay in the FT 31 Case.

WESTINGHOUSE ELECTRIC CORPORATION
RELAY-INSTRUMENT DIVISION
NEWARK, N. J.
Printed in U.S.A.