ABB Power T&D Company Inc.
Relay Divisions
Coral Springs, FL 33065

Instruction Leaflet
41-668.1E

Type SGR-51 Reclosing Relay

Effective: February 1985
Supersedes I.L. 41-668.1D, Dated November 1975
✪ Denotes Changed Since Previous Issue

APPLICATION

The SGR-51 Reclosing Relay provides for instantaneous reclosure of an electrically-operated circuit breaker, and automatically resets itself if the breaker remains closed for a predetermined adjustable time interval. If the breaker retrips before the end of this interval, the resetting operation of the relay is interrupted until the breaker is manually closed. Thus, the reclosing relay is applicable to either attended or non-attended stations.

CONSTRUCTION AND OPERATION

✪ The SGR-51 is a solid state relay consisting of (1) a timing circuit, (2) a flip-flop control circuit, (3) a close relay circuit, (4) a flip-flop set circuit, and (5) lockout indication. All components except the dropping resistor, lockout indicator and the close relay are mounted on printed circuit boards. All components are identified on the internal schematic in Figure 3.

Timing Circuit

The timing circuit is a uni-junction relaxation oscillator consisting of uni-junction transistor Q3, resistors R10 and R37, and capacitor C2. After a preset time interval controlled by the adjustable time dial potentiometer R37, the relaxation oscillator fires and feeds an output pulse to the flip-flop control circuit.

Flip-Flop Control Circuit

The flip-flop control circuit consists of transistors Q4 and Q5, and resistors R12 to R21. The flip-flop control circuit resets when pulsed by the timing circuit and thereby activates the close relay circuit by turning transistor Q7 off.

Close Relay Circuit

The close relay circuit consists of transistors Q7, Q8, and Q9, resistors R24 to R30, and the close relay. The turn-off of transistor Q7 by the flip-flop circuit switches transistors Q8 and Q9 to the on state to activate the close relay.

Flip-Flop Set Circuit

The flip-flop set circuit consists of transistors Q1 and Q6, resistors R22 and R23, and capacitor C5. The flip-flop is set when the breaker closes and opens the 52b contact, switching transistors Q1 and Q6 to the on state. Capacitor C5 then discharges through Q6 to turn transistor Q5 off, setting the flip-flop.

Lockout Indicator Circuit

The lockout indicator circuit is controlled by the state of the flip-flop control circuit. Consisting of amplifier transistors Q10 and Q11, the amber light is lit when the flip-flop is in the set state, and the relay is locked out if the breaker is open at this time.

Theory of Operation

The following description is made with reference to Figure 3.

Let us assume that the breaker is open and normal voltage is applied to the relay. Under these conditions, transistors Q2, Q4, Q7 and Q11 are on, and transistor Q5 is off. When the breaker is closed, the 52b contact opens and removes the shorting of the base drive to transistor Q1, turning it on. The turn of Q1 shorts the base drive to Q2, turning it off, causing diode D3 to be reverse biased. This removes

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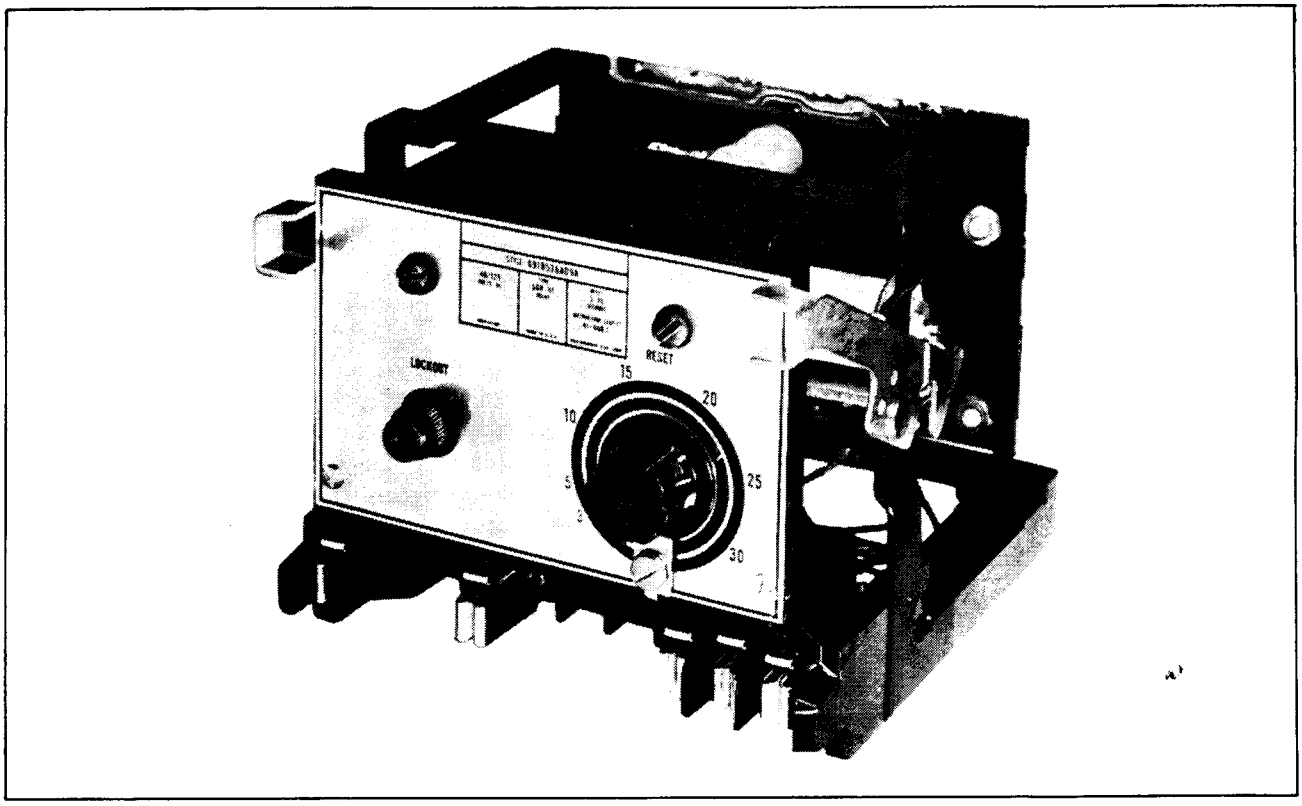


Fig. 1. Type SGR-51 Reclosing Relay (Front View)

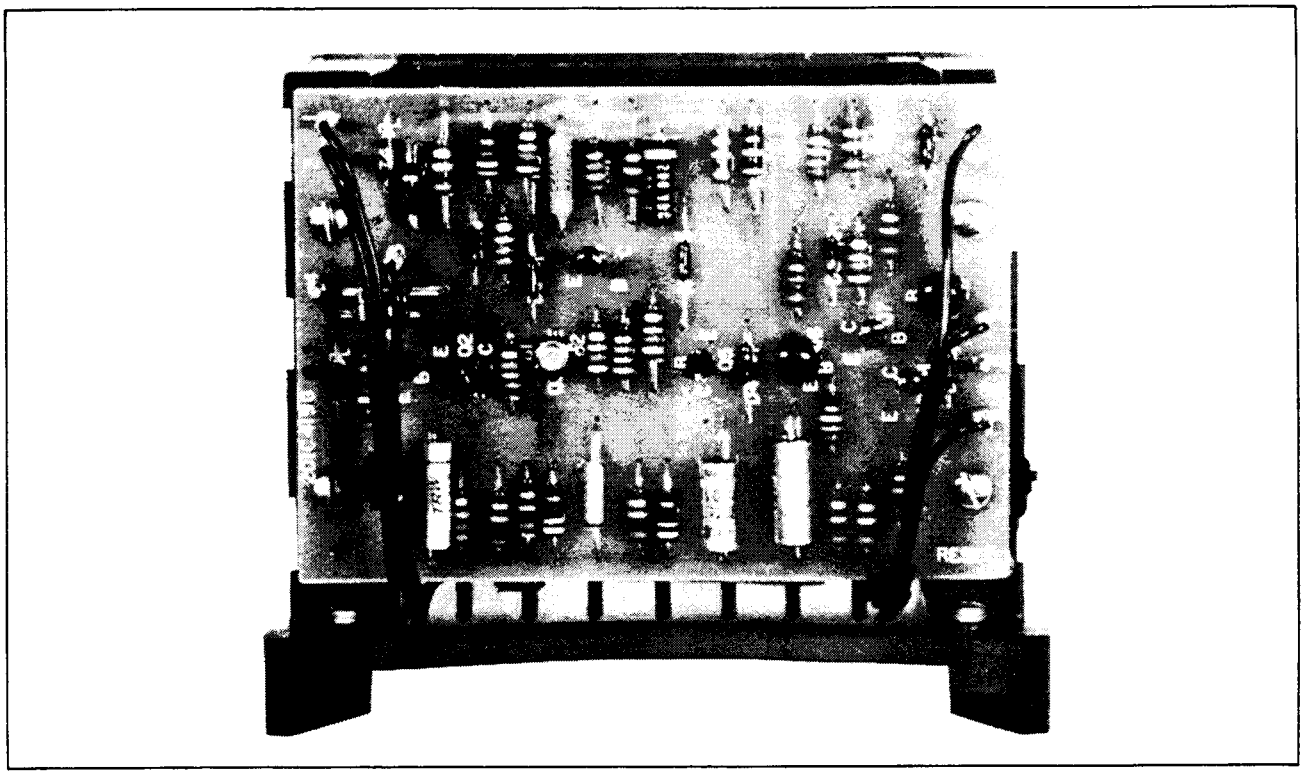


Fig. 2. Type SGR-51 Reclosing Relay (Rear View)

the short-circuit from capacitor C2 allowing it to charge through R10 and potentiometer R37 to the firing voltage of unijunction transistor Q3. The time required for C2 to charge and fire Q3 is controlled by potentiometer R37 set to a calibrated time dial. When Q3 fires, C2 discharges through Q3 and R12 to cause a voltage rise across R12. This causes the voltage on the emitter of Q4 to rise above its base voltage turning it off and flip-flop transistor Q5 on. When Q5 turns on, its collector voltage drops to a low level and removes the base drive to Q7 turning it off. The low collector voltage of Q5 also disables the timing circuit by forward biasing diode D4 and providing a path for current to flow through Q5 so that capacitor C2 cannot charge up to a point where it will again fire unijunction Q3. When the turn on of transistor Q5 turned Q7 off, the potential of the collector of Q7 rose and supplied base drive to Q8 turning it on. The turn on of Q8 allows base current to flow from Q9 turning it on. This switching on of Q9 energizes the close relay, closing the normally open contact to the positive battery supply.

If a fault appears on the protected line and a protective relay opens the breaker, the 52b contacts make up providing a path to battery positive through the closed contacts of the close relay to energize and immediately reclose the breaker.

The reclosing of the breaker reopens the 52b contact, switching transistors Q1 and Q6 on. Capacitor C5 then discharges through Q6 to give a resultant voltage drop across R19 which causes the voltage on the emitter of Q5 to rise above its base voltage. This causes flip-flop transistor Q5 to turn off, setting the flip-flop. With Q5 turned off, Q7 is supplied with base drive switching it on and Q8 and Q9 off. With transistor Q9 turned off, the close relay is de-energized and its contact reopens. With the turn off of Q5 and the setting of the flip-flop, Q4 is turned on, and the lockout indicator circuit is energized by Q4 shorting out the base drive to Q10, turning it off, thereby switching Q11 on to energize the amber lockout indicator.

When the 52b contact reopened and switched transistor Q1 on, the base drive to Q2 was shorted and Q2 turned off to reverse bias diode D3 and allow capacitor C2 to again charge through R37 and R10. Let us assume that a protective relay operates to trip the breaker before capacitor C2 has charged to the firing level of Q3. When the breaker opens, the 52b contact closes switching Q1 off and Q2 on to forward bias diode D3. This short circuits capacitor C2 through Q2 and removes the charge that had started to build up. Since the charge on C2 had not reached a level to fire Q3, the control flip-flop has not changed state, the reclosing circuit remains off, and the lockout indicator remains on. The breaker will remain locked out until manually closed.

CHARACTERISTICS

Voltage Rating

The SGR-51 is rated for 48 or 125 volts d-c. Unless otherwise specified, the relays are connected for 125-volt operation when shipped.

Temperature Range

The SGR-51 is designed to operate over a temperature range from −20°C to +55°C with timing variations of not more than ±5%.

Energy Requirements

55 milliamperes at rated voltage.

SETTINGS

Reset Time Setting

The reset time is controlled by front-mounted potentiometer R39 which has a calibrated time dial. The reset time is variable from 3 to 30 seconds.

INSTALLATION

The relays should be mounted on switchboard panels or their equivalent in a location free from dirt, moisture, excessive vibration and heat. 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 nuts with a wrench. See Fig. 8 for outline and drilling plan.

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

ADJUSTMENTS AND MAINTENANCE

The proper adjustments to insure correct operation of this relay have been made at the factory and no further adjustment should be required.

Acceptance Tests

The following check is recommended to insure that the relay is in proper working order. All checks can best be performed by connecting the SGR-51 as shown in Figure 5, with the cal-operated switch in the operate position and the reset timer knob rotated to the 3-second position.

Push PB-1 to close relay B.

Immediately thereafter, push PB-2. Relay B should trip open and remain locked out.

Reclose relay B by pushing PB-1. After 3 or more seconds, push and hold PB-2. Relay B should trip open, reclose, trip open and remain locked out.

Calibration Check

The following procedure may be used to accurately check the time dial calibration.

With the cal-operate switch in the cal position, apply rated voltage. Push PB-1 to start the timer. The CR contacts should close to stop the timer after the time set on the reclose timer has elapsed.

Routine Maintenance

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

Troubleshooting

Use the following procedure to locate the source of trouble in the event of improper relay operation.

1. Inspect all wires and connections.
2. Check resistances as listed in the electrical parts list.
3. Check voltages or waveforms as listed under electrical checkpoints using a vacuum tube voltmeter and/or an oscilloscope.

Electrical Checkpoints

Apply rated voltage through a switch to relay terminals 8 and 9. Terminal 9 is positive.

Set the reset time dial for 15 seconds.

Apply rated voltage to the relay to test the circuit board.

Apply voltage before each testpoint check, and interrupt it after each check. Take testpoint readings before and after the reset time shown on the time dial.

Use the following table to determine the correct voltages or waveforms at the indicated point. Refer to Figures 6 and 7 for circuit board component layouts.

RENEWAL PARTS

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

CIRCUIT	TEST POINT	NORMAL INDICATIONS		COMPONENTS CHECKED
		BEFORE RESET	AFTER RESET	
Circuit Board Supply Voltage	Reset Board Terminal 1	20 V ± 1.0 V	20 V ± 1.0 V	Z4, R36
Reset Circuit Bd.				
Timing Circuit	Junction of R10 and C2	Slow Voltage Rise to Approx. 15 Volts	Approx. 1.4 V	Q2, Q3, C2, C3, R37, D3, D4
Flip-Flop Control Circuit	Junction of R14 and R18	Approx. 1 V	Approx. 15 V	C4, Q4, Q5
	Junction of R16 and R21	Approx. 15 V	Approx. 1 V	
Close Relay Circuit	Junction of R26 and D6	Approx. 0 V	Approx. 8 V	Q7
	Junction of Q9 and D7	Approx. 0 V	Approx. 20 V	Q8, Q9, D7

All measurements made between indicated points and d-c negative.

ELECTRICAL PARTS LIST

RELAY TYPE SGR-51 **INDICATOR MODULE 691B448G01**

RESISTOR				STYLE
R01	82.0K	1/2W	5%	184A763H73
R02	10.0K	1/2W	5%	184A763H51
R03	4.70K	1/2W	5%	184A763H43
R04	4.70K	1/2W	5%	184A763H43
R05	8.20K Metal Film	1/2W	2%	629A531H54
R06	15.0K	1/2W	2%	629A531H60
R07	10.0K	1/2W	5%	184A763H51
R08	22.0K	1/2W	5%	184A763H59
R09	33.0K	1/2W	5%	184A763H63
R10	49.9K	1/2W	1%	836A503H65
R11	680 Ohm	1/2W	5%	184A763H23
R12	47 Ohm	1/2W	5%	187A290H17
R13	10 Ohm	1/2W	5%	187A290H01
R14	10.0K	1/2W	5%	184A763H51
R15	10.0K	1/2W	5%	184A763H51
R16	33.0K	1/2W	5%	184A763H63
R17	10.0K	1/2W	5%	184A763H51
R18	33.0K	1/2W	5%	184A763H63
R19	47 Ohm	1/2W	5%	187A290H17
R20	330 Ohm	1/2W	5%	184A763H15
R21	10.0K	1/2W	5%	184A763H51
R22	2.0K	1/2W	5%	184A763H34
R23	30.0K	1/2W	5%	184A763H62
R24	10.0K	1/2W	5%	184A763H51
R25	180.0K	1/2W	5%	184A763H81
R26	68.0K	1/2W	5%	184A763H71
R27	10.0K	1/2W	5%	184A763H51
R28	33.0K	1/2W	5%	184A763H63
R29	10.0K	1/2W	5%	184A763H51
R30	10.0K	1/2W	5%	184A763H51
R31	20,000	1/2W	5%	184A763H58
R32	180,000	1/2W	5%	184A763H81
R33	10,000	1/2W	5%	184A763H51
R34	20,000	1/2W	5%	184A763H58
R35	2,000	1/2W	5%	184A763H34
R36	1,000 tapped at 510 25 W 5%			11D9511H10

RELAY TYPE SGR-51 **RESET MODULE 201C419G01 SUB 34**

CAPACITOR				STYLE
C01	1.5 MFD	35V		187A508H09
C02	22.0 MFD	100V		862A177H04
C03	1.5 MFD	35V		187A508H09
C04	.047 MFD	100V		188A669H16
C05	4.7 MFD	35V		184A661H12
C13	1.5 MFD	35V	5%	187A508H18
C22	.1 UF	100V	1%	3526A65H10
C23	.033 UF	50V	10%	863A166H07
C24	.047 UF	50V	10%	188A669H17

TRANSISTOR		
Q01	2N3417	848A851H02
Q02	2N3417	848A851H02
Q03	SIM to 2N2647	629A435H05
Q04	2N3417	848A851H02
Q05	2N3417	848A851H02
Q06	2N3645	849A441H01
Q07	2N3417	848A851H02
Q08	2N3417	848A851H02
Q09	2N3645	849A441H01
Q10	2N3417	848A851H02
Q11	2N3417	848A851H02

ZENER		
Z01	1N3049B	187A936H13
Z02	1.5KE200	878A619H01
Z03	1N758	186A797H01
Z04	1N4747A	849A487H01
Z12	1.5KE200	878A619H01

DIODE		
D01	1N645A	837A692H03
D02	1N645A	837A692H03
D03	1N645A	837A692H03
D04	1N645A	837A692H03
D05	1N645A	837A692H03
D06	1N645A	837A692H03
D07	1N645A	837A692H03
D08	1N645A	837A692H03

RELAY MISCELLANEOUS		
CR	Close Relay	541D231H22
IND. 1	Lockout Indicator	862A634G01

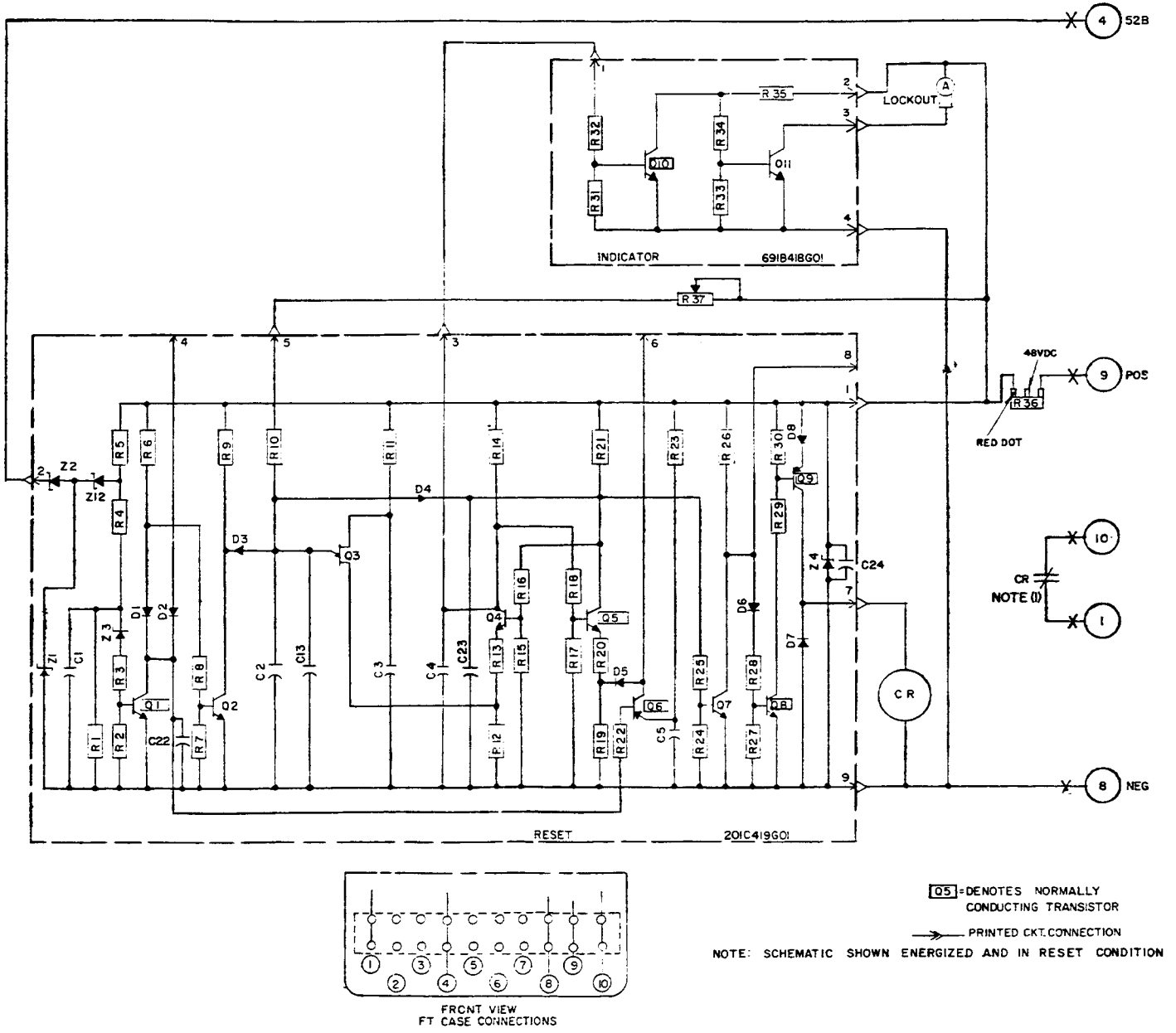
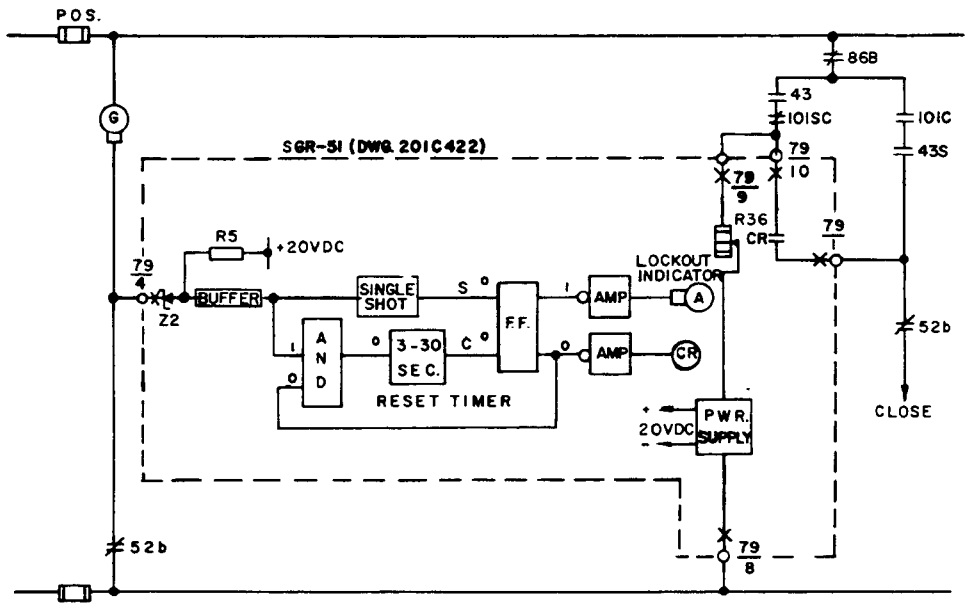


Fig. 3. Internal Schematic of Type SGR-51 Relay



LOGIC STATE AND CONTACTS SHOWN WITH BREAKER CLOSED, 52b OPEN AND SGR-51 RESET.

43 - AUTOMATIC OPERATION CUTOUT SW.
52b-CIR. BKR. AUX. SW.
79 - SGR-51 AUTOMATIC RECLOSING RELAY
86B - BUS LOCKOUT
101-CONTROL SWITCH
43S-SYNCHRONIZING SWITCH

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Fig. 4. External Schematic of Type SGR-51 Relay

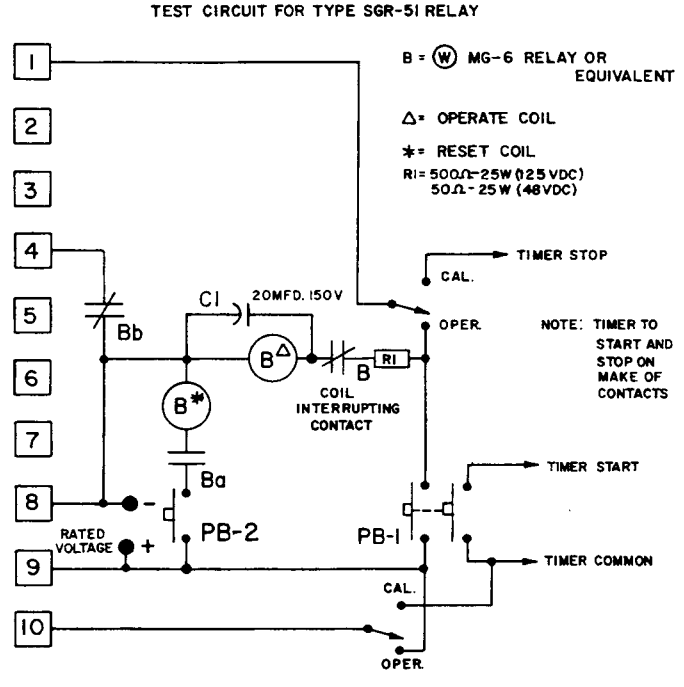

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Fig. 5. Test Circuit for Type SGR-51 Relay

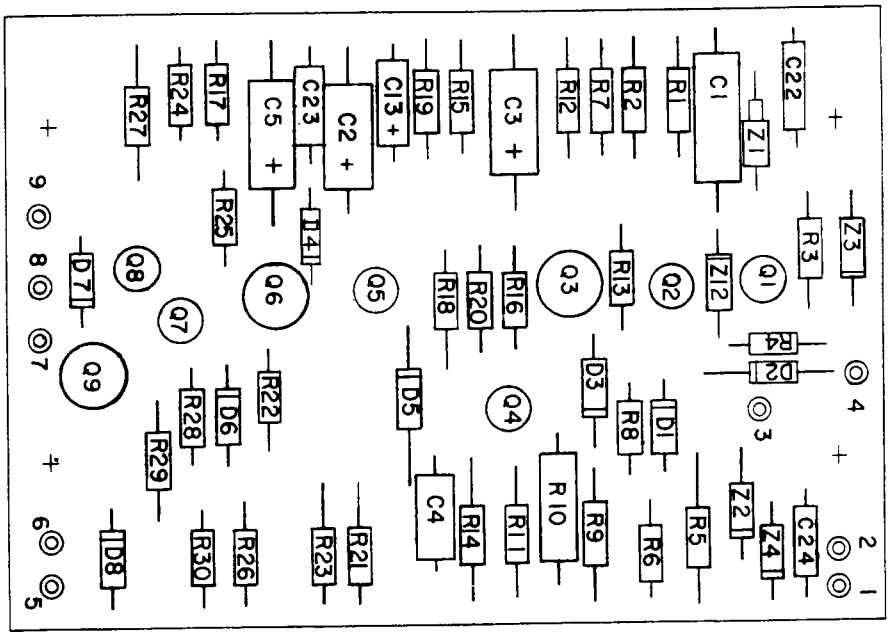

Fig. 6. Component Layout of SGR-51 Reset Board

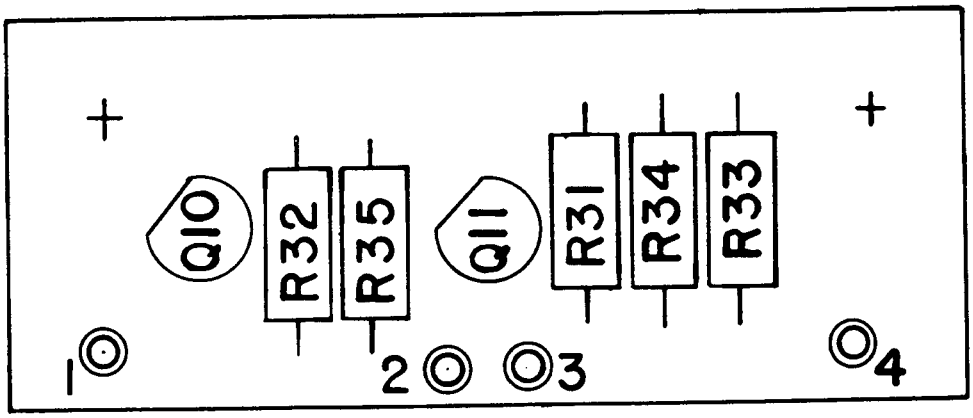

Fig. 7. Component Layout SGR-51 Indicator Board

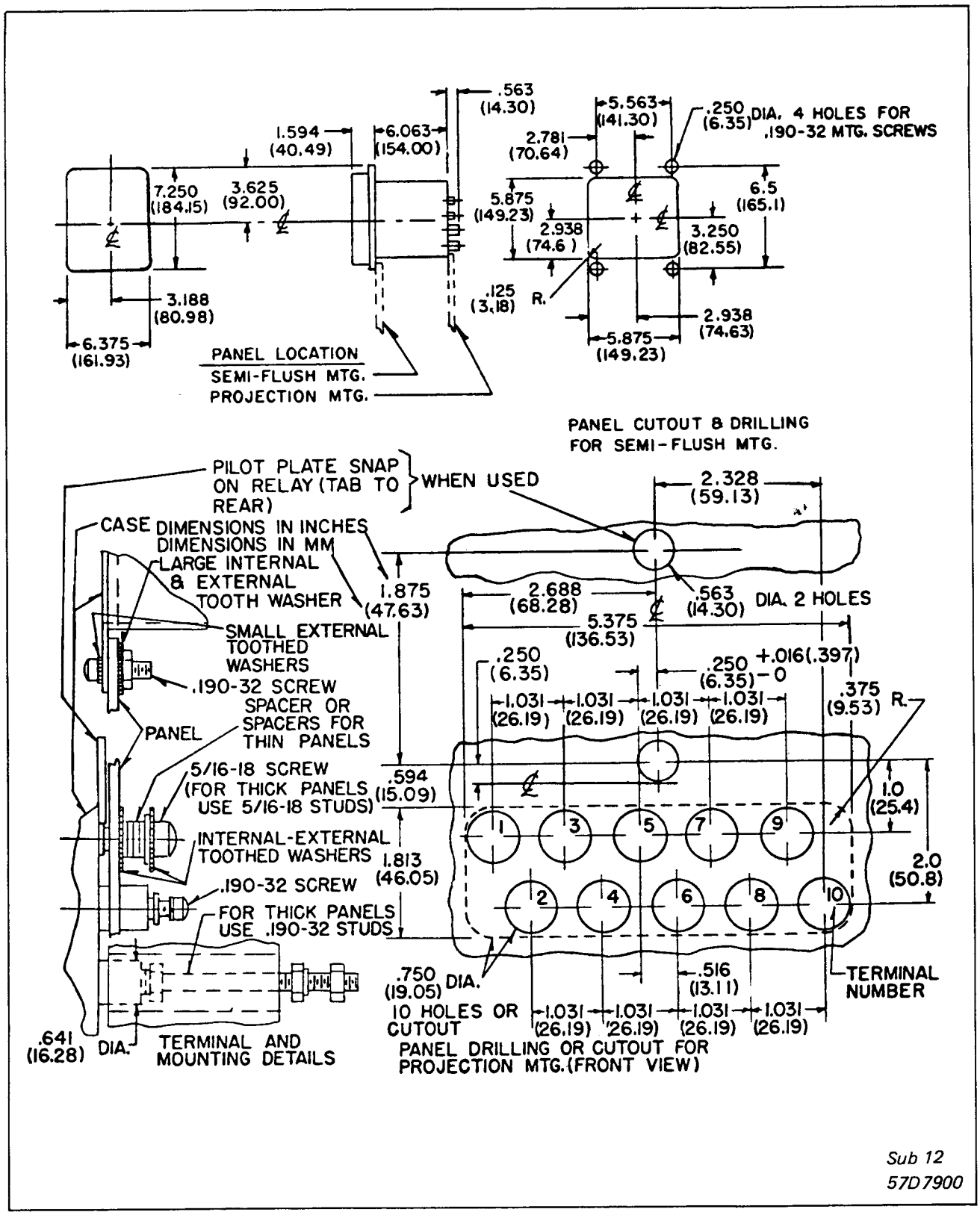

Fig. 8. Outline and Drilling in FT11 Case