Instruction Leaflet
41-668.12D

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✪ Denotes Changed Since Previous Issue

Type SGR-52 Reclosing Relay

APPLICATION

The SGR-2 Reclosing Relay provides for adjustable time delay 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 the 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-52 is a static relay consisting of a Reclose circuit board, a Reset circuit board, and an Indicator circuit board. The Reset circuit board contains:

(1) a timing circuit
(2) a flip-flop control circuit
(3) a close relay circuit, and
(4) a flip-flop set circuit.

The Reclose board contains a reclose time delay circuit with permit and block inputs. The Indicator board provides amplification for the lockout indicator. All components except the dropping resistor, lockout indicator, and the close relay are mounted on a printed circuit board. All components are identified on the internal schematic in Figs. 3, 4, and 5.

TIMING CIRCUIT

The timing circuit is a unijunction relaxation oscillator consisting of unijunction transistor Q3, capacitors C2 and C13 and resistors R10 and R62. After a preset time interval controlled by the adjustable time dial potentiometer R62, 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 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 control circuit switches transistors Q8 and Q9 to the on state to activate the close relay.

FLIP-FLOP SET CIRCUIT

The flip-flop set circuit consisting of transistors Q6 and Q1, resistors R22 and R23, and capacitor C5, sets the flip-flop control circuit and the reclose time delay circuit when the breaker closes, opening the 52b contact. Transistors Q1 and Q6 switch to the on state and discharge capacitor C5 through Q6 to turn transistor Q5 off and transistor Q15 on to set the flip-flop and the reclose time delay circuits simultaneously.

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.

RECLOSE TIME DELAY CIRCUIT

The reclose time delay circuit consists of a flip-flop arrangement of transistors Q12 and Q13, capacitor C11 which charges through the time dial setting potentiometer R63, zener diode Z10, and transistor Q16 and Q17.

ANTI-PUMP CIRCUIT

The anti-pump circuit consists of a flip-flop arrangement of IC1 (1, 2, 3) and IC1 (4, 5, 6). An output transistor Q18 is in series with the close relay, CR. The opening of 52b contact causes the input to IC1 (12, 13) to go high which causes IC1 (11) to go low. This low signal places the flip-flop in the lockout state. That is IC1 (6) is low which turns off Q19 and Q18. Since Q18 is in series with the CR relay and the normal lockout (Q9 of the reset module) the anti-pump circuit provides a redundant, or backup lockout. The flip-flop is reset when the input to IC1 (9, 10) goes high. This high causes a low at IC1 (8) which resets the flip-flop. That is IC1 (6) is high and Q18 is on.

THEORY OF OPERATION

The following description is made with reference to Fig. 3.

Let us assume that the breaker is open and normal voltage is applied to the relay. Under these conditions, transistors Q2, Q4, Q7, Q11, Q13 and Q17 are on and the amber lockout indicator is energized. 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 on of Q1 shorts the base drive to Q2 turning it off, which causes diode D3 to be reverse biased. This removes the short-circuit from capacitors C2 and C13 allowing them to change through R10 and potentiometer R62 to the firing voltage of unijunction transistor Q3.

The time required for C2 and C13 to charge and fire Q3 is controlled by potentiometer R62 set to a calibrated time dial. When Q3 fires, C2 and C13 discharge 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. This is the reset state of the flip-flop. The turn off of transistor Q4 turns Q10 on and Q11 off to de-energize the lockout indicator. When flip-flop transistor 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 capacitors C2 and C13 cannot charge up to a point where it will again fire unijunction Q3. When the turn on of transistor Q5 turns transistor Q7 off, the on transistor Q17 provides a shorting path for the rise in potential of the collector of Q7 that would normally supply the base drive for transistor Q8 to turn on and activate the rest of the close relay circuit.

If a fault appears on the protected line and protective relay opens the breaker, the 52b contacts make up. If at this time a positive going "Permit" pulse is applied to the reclose time delay circuit, the breaker will close after the preset time delay has elasped. This is accomplished by the positive going pulse turning normally off transistor Q12 on, placing the base of Q13 to ground potential, turning it off, and thereby removing the short from capacitor C11 allowing it to charge through potentiometer R63. Time variation is controlled by the dial setting of R63. The voltage level on capacitor C11 reaches a point where zener diode Z10 breaks down and allows base current to flow into Q16. This causes Q16 to go from the normally off to the normally on state, depriving Q17 of base drive, turning it off. This removes the short from the base of Q8 allowing it to turn on. The turn on of Q8 allows base current to flow from Q9 turning it on. The switching on of Q9 energizes the close relay, closing the normally open contact to the positive battery supply. This provides a path from battery positive, through the close relay contact, to energize and immediately reclose the breaker.

The reclosing of the breaker reopens the 52b contact, switching transistors Q1 and Q6 on. The flip-flop control circuit and the reclose time delay circuit are then set by capacitor C5 discharging through Q6 and R19 to turn transistor Q5 off, and through Q6 and R55 and R40 to turn transistors Q15, Q14 and Q13 on. 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 control 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 and switching Q11 on to energize the amber lockout indicator.

When the 52b contacts reopened and switched transistor Q1 on, the base drive to Q2 was shorted, and Q2 turned off to reverse bias diode D3 and allow capacitors C2 and C13 to again charge through R62 and R10. Let us assume that a protective relay operated to trip the breaker before capacitors C2 and C13 have charged to the firing level of Q3. When the breaker opens, the 52b contact closes, switching Q1 off and Q2 on, forward biasing diode D3. This short circuits capacitors C2 and C13 had not reached a level to fire Q3, the control flip-flop has not changed state, the close relay circuit remains off, and the lockout indicator remains on. The breaker will remain locked out until manually closed.

If at any time during the reclosing cycle a signal is applied to the block input of the reclose board, the relay will not reclose until the block signal is removed and a permit signal is applied to activate the reclose circuitry.

The reclose timer can only time when the breaker is open, since the circuitry associated with transistor Q1 shorts the reclose timer capacitor C11 through diodes D13 and D2 to negative, allowing the reclose timer to time only when Q1 is in the off state (52b contact closed – Breaker open). Likewise, the reclose timer cannot time when the SGR-52 is in the lockout state since transistor Q11 shorts. Reclose timer capacitor C11 through diodes D13 and D20 to negative allowing the reclose timer to time only when the SGR-52 relay is reset.

CHARACTERISTICS

VOLTAGE RATING

The standard SGR-52 is rated for 48 to 125 volts d-c. Unless otherwise specified, the relays are connected for 125-volt operation when supplied. A 250 volt d-c SGR-52 relay is available, when required.

TEMPERATURE RANGE

The SGR-52 is designed to operate over a temperature range from $-20^{o}C$ to $+55^{o}C$ 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 R62 which has a calibrated time dial. The reset time is variable from 3 to 30 seconds.

RECLOSE TIME SETTING

The reclose time is controlled by front-mounted potentiometer R63 which has a calibrated time dial. The reclose time is variable from 0 (.05 sec.) to 2 seconds, 2 to 20, or 6 to 60, seconds, depending on the style of the relay.

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. 11 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 TEST

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-52 as shown in Fig. 7.

Place the cal-operate switch in the operate position. Push PB-1 and wait until the time set on the reset timer has elapsed and the lockout indicator turns off. Push PB-2 to trip relay B. Push the permit switch and the B relay should close after the time set on the reclose timer has elasped. After relay B closes, if PB-2 is pushed to again trip relay B within the reset time setting (before the lockout indicator turns off), the B relay should trip and remain locked out.

CALIBRATION CHECK

The following procedures may be used to accurately check the time dial calibrations. Using Fig. 7, the tester can accurately check the calibrations by using a timer as shown.

(1) Reclose Time Delay

With the cal-operate switch in the cal position, apply rated voltage. Push PB-1 and wait for the lockout indicator to turn off. Push PB-2 to trip the relay. Push the Permit switch to start the timer. The CR contacts should close to stop the timer after the time set on the reclose time dial has elapsed.

(2) Reset Time Delay

Disconnect the lead to reclose board terminal 8. 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 reset timer time dial 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 voltages through a switch to relay terminals 8 and 9. Terminal 9 is positive.

Set the reset time dial for 15 seconds, and the reclose time dial for 2 seconds.

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

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

Use Table I to determine the correct voltages or waveforms at the indicated point. Refer to Figs. 8, 9 and 10 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 the complete nameplate data.

ELECTRICAL PARTS LIST

Circuit Symbol	Description	Westinghouse Style Number	Circuit Symbol	Description	Westinghouse Style Number
		RESISTOR			
R01	82 K 5% 1/2W	184A763H73	R40	33 K 5% 1/2W	184A763H63
R02	10 K 5% 1/2W	184A763H51	R41	27 K 5% 1/2W	184A763H61
R03	4.7 K 5% 1/2W	184A763H43	R42	15 K 2% 1/2W	629A531H60
R04	4.7 K 5% 1/2W	184A763H43	R43	15 K 5% 1/2W	184A763H55
R05	8.2 K 2% 1/2W	629A531H54	R44	15 K 5% 1/2W	184A763H55
R06	15 K 2% 1/2W	629A531H60	R45	82 K 5% 1/2W	184A763H73
R07	10 K 5% 1/2W	184A763H51	R46	820 OHM 5% 1/2W	184A763H25
R08	22 K 5% 1/2W	184A763H59	R47	10 K 5% 1/2W	184A763H51
R09	33 K 5% 1/2W	184A763H63	R48	10 K 5% 1/2W	184A763H51
R10	100 K 1% 1/2W	836A503H72	R49	4.7 K 5% 1/2W	184A763H43
R11	680 OHM 5% 1/2W	184A763H23	R50	10 K 2% 1/2W	629A531H56
R12	47 OHM 5% 1/2W	187A290H17	R51	47 K 2% 1/2W (48/125V)	629A531H72
R13	10 OHM 5% 1/2W	187A290H01			
R14	10 K 5% 1/2W	184A763H51	R51	221 K 1% 1/2W (250V)	862A378H34
R15	10 K 5% 1/2W	184A763H51			
R16	33 K 5% 1/2W	184A763H63	R52	82 K 2% 1/2W	629A531H78
R17	10 K 5% 1/2W	184A763H51	R53	1 K 1% 1/2W (02-SEC) (.1-4SEC)	862A376H01
R18	33 K 5% 1/2W	184A763H63			
R19	47 OHM 5% 1/2W	187A290H17			
R20	330 OHM 5% 1/2W	184A763H15	R53	18.2 K 1% 1/2W (2-20SEC)	836A503H55
R21	10 K 5% 1/2W	184A763H51			
R22	2 K 5% 1/2W	184A763H34	R53	15 K 1% 1/2W (6-60SEC)	836A503H54
R23	30 K 5% 1/2W	184A763H62			
R24	10 K 5% 1/2W	184A763H51	R54	4.7 K 2% 1/2W	629A531H72
R25	180 K 5% 1/2W	184A763H81	R55	1 K 2% 1/2W	629A531H32
R26	68 K 5% 1/2W	184A763H71	R56	1D051	185A211H05
R27	10 K 5% 1/2W	184A763H51	R57	15 K 5% 1/2W	184A763H55
R28	33 K 5% 1/2W	184A763H63	R58	33 K 5% 1/2W	184A763H63
R29	10 K 5% 1/2W	184A763H51	R59	10 K 5% 1/2W	184A763H51
R30	10 K 5% 1/2W	184A763H51	R60	33 K 5% 1/2W	184A763H63
R31	20 K 5% 1/2W	184A763H58	R61	33 K 5% 1/2W	184A763H63
R32	150 K 5% 1/2W	184A763H79	R65	1 K 2% 1/2W	629A531H32
R33	10 K 5% 1/2W	184A763H51	R66	8.25 K 1% 1/4W	848A820H37
R34	20 K 5% 1/2W	184A763H58	R67	4.75 K 1% 1/4W	848A820H14
R35	2 K 5% 1/2W	184A763H34	R68	82.5 K 1% 1/4W	848A821H34
R36	47 K 2% 1/2W (48/125V)	629A531H72	R69	10.0 K 1% 1/4W	848A820H45
			R70	100.0 K 1% 1/4W	848A821H42
R36	221 K 1% 1/2W (250V)	862A378H34	R71	20.0 K 1% 1/4W	848A820H74
			R72	10.0 K 1% 1/4W	848A820H45
R37	4.7 K 2% 1/2W	629A531H72	R73	10.0 K 1% 1/4W	848A820H45
R38	82 K 2% 1/2W	629A531H78	R74	10.0 K 1% 1/4W	848A820H45
R39	27 K 5% 1/2W	184A763H61			

ELECTRICAL PARTS LIST (Contd.)

Circuit Symbol	Description	Westinghouse Style Number
CAPACITOR		
C01	1.5 MFD 35 V	187A508H09
C02	22 MFD 100 V	862A177H04
C03	1.5 MFD 35 V	187A508H09
C04	.047 MFD 100 V	188A669H16
C05	4.7 MFD 35 V	184A661H12
C06	.047 MFD	849A437H04
C07	6.8 MFD	184A661H21
C08	.47 MFD	187A508H05
C09	1.5 MFD	187A508H09
C10	.047 MFD	849A437H04
C11	22 MFD (0-2SEC) (.1-4SEC)	862A177H04
C11	68 MFD (2-20SEC)	862A177H03
C11	68 MFD (6-60SEC)	862A177H03
C12	68 MFD (2-20SEC)	862A177H03
C12	350 MFD (6-60SEC)	862A177H09
C12	22 MFD (.1-4SEC)	862A177H04
C13	1.5 MFD 35 V 5%	187A508H18
C14	.01 MFD	763A219H15
C15	1.5 MFD 35 V	187A508H09
C16	4.7 MFD 35 V	184A661H12
C17	.1 MFD 35 V	837A241H02
C18	.33 MFD 50 V	863A166H16
C19	.33 MFD 50 V	863A166H16
C20	.1 MFD 35 V	837A241H02
C21	.047 MFD 50 V	188A669H17
C22	.1 MFD 100 V 1%	863S166H07
C23	.033 MFD 50 V 10%	863A166H07
C24	.047 MFD 50 V 10%	188A669H17
TRANSISTOR		
Q01	2N3417	848A851H02
Q02	2N3417	848A851H02
Q03	4JX5E695	629A435H02
Q04	2N3417	848A851H02
Q05	2N3417	848A851H02
Q06	2N3645	849A441H01
Q07	2N3417	848A851H02

Circuit Symbol	Description	Westinghouse Style Number
TRANSISTOR (Contd.)		
Q08	2N3417	848A851H02
Q09	2N3645	849A441H01
Q10	2N3417	848A851H02
Q11	2N3417	848A851H02
Q12	2N3417	848A851H02
Q13	2N3417	848A851H02
Q14	2N3645	849A441H01
Q15	2N3417	848A851H02
Q16	2N3417	848A851H02
Q17	2N3417	848A851H02
Q18	2N2907A	762A672H17
Q19	2N2222A	762A672H15
ZENER DIODE		
Z01	1N3049B	187A936H13
Z02	1.5KE200	878A619H01
Z03	1N758	186A797H01
Z04	1N4747A	849A487H01
Z05	1N3686B	185A212H06
Z06	1N5235B	862A288H07
Z06	1N957B	187A797H06
Z07	1N758	186A797H01
Z08	1N5235B	862A288H07
Z08	1N957B	187A797H06
Z09	1N3686B	185A212H06
Z10	1N5235B	862A288H07
Z10	1N960B	186A797H10
Z12	1.5KE200	878A619H01
Z13	1N5235B	862A288H07
Z13	1N957B	187A797H06
Z14	1.5KE200	878A619H01
Z15	1.5KE200	878A619H01
Z16	1N3049 160 V	187A936H13
Z17	1N1508 5.1 V	184A936H13
DIODE		
D01 to D21	1N645A	837A692H03
INTEGRATED CIRCUIT		
IC01	MC668	6296D58H05

TABLE I

Circuit	Test Point	Normal Indications		Components Checked
		Before Reset	After Reset	
Circuit Board Supply Voltage	Reset board terminal 1 Reclose board ter. 4 Indicator board ter. 2	20 V ± 1.0 V	20 V ± 1.0 V	Z4, R62
RESET CIRCUIT BOARD				
Timing Circuit	Junction of R10 and C2	Slow Voltage Rise to approx. 15 volts	Approx. 1.4 V	Q2, Q3, C2, C3, C13, R62, D3, D4
Flip-Flop Control	Junction of R14 and R18	Approx. 1 V	Approx. 15 V	Q4, Q5, C4
	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, D8

† With lead to Reclose Board Terminal 8 disconnected.

Circuit	Test Point	Normal Indications		Components Checked
		Before Permit ▲	After Permit ▲	
RECLOSE CIRCUIT BOARD				
Reclose Time Delay Circuit	Junction of D13 and R44	Approx. 0 V	Approx. 15 V	Q12, Q13, D13
	Junction of C11 and Z10	Approx. .5 V	Slow Voltage Rise to Approx. 6.8 or 9.1 Volts	Z10, D13, C11, R53, R63
	Junction of D16 and R61	Approx. 0 V	Time Delayed Approx. 20 V	Q16, Q17, D16
		BEFORE BLOCK ▲	AFTER BLOCK ▲	
	Junction of Z7 and R46	Approx. 0 V	Approx. 10 V Pulse	Q15, Q14, Z7, D12, D17

▲ +20-volt d-c Permit signal applied to Relay Terminal 5.
20-volt d-c Block signal applied to Relay Terminal 6.

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

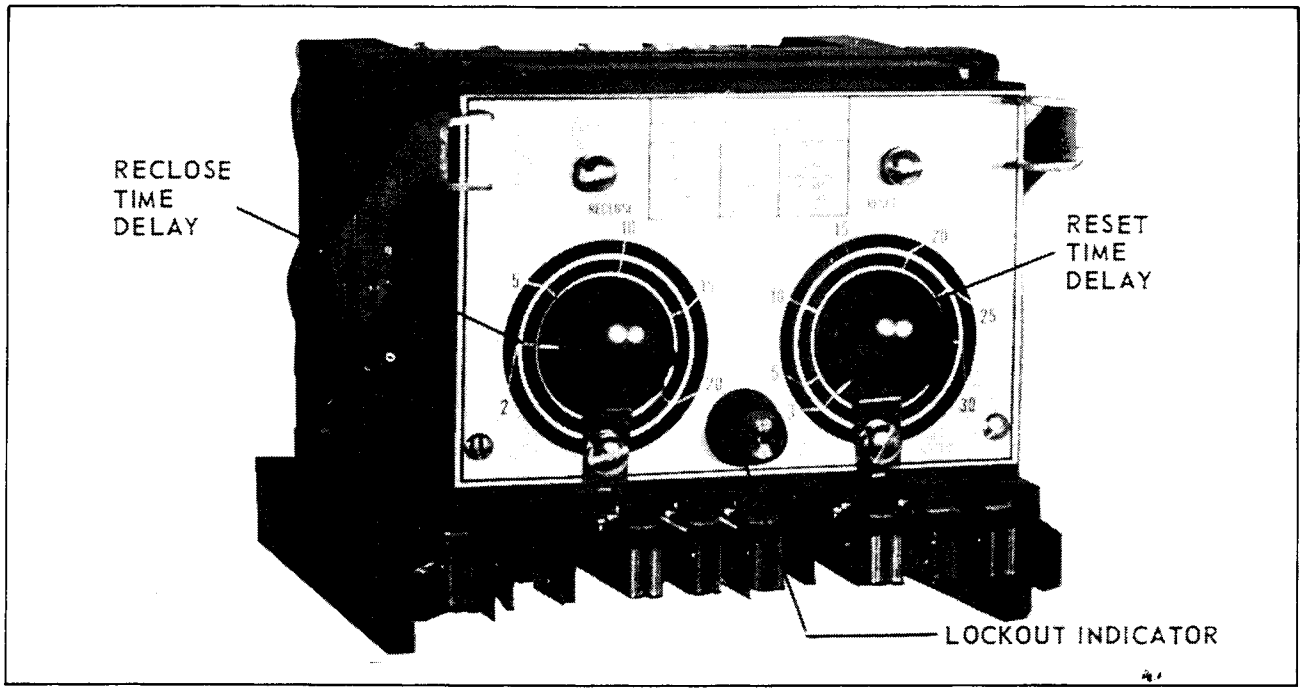

Fig. 1. Type SGR-52 Reclosing Relay (Front View)

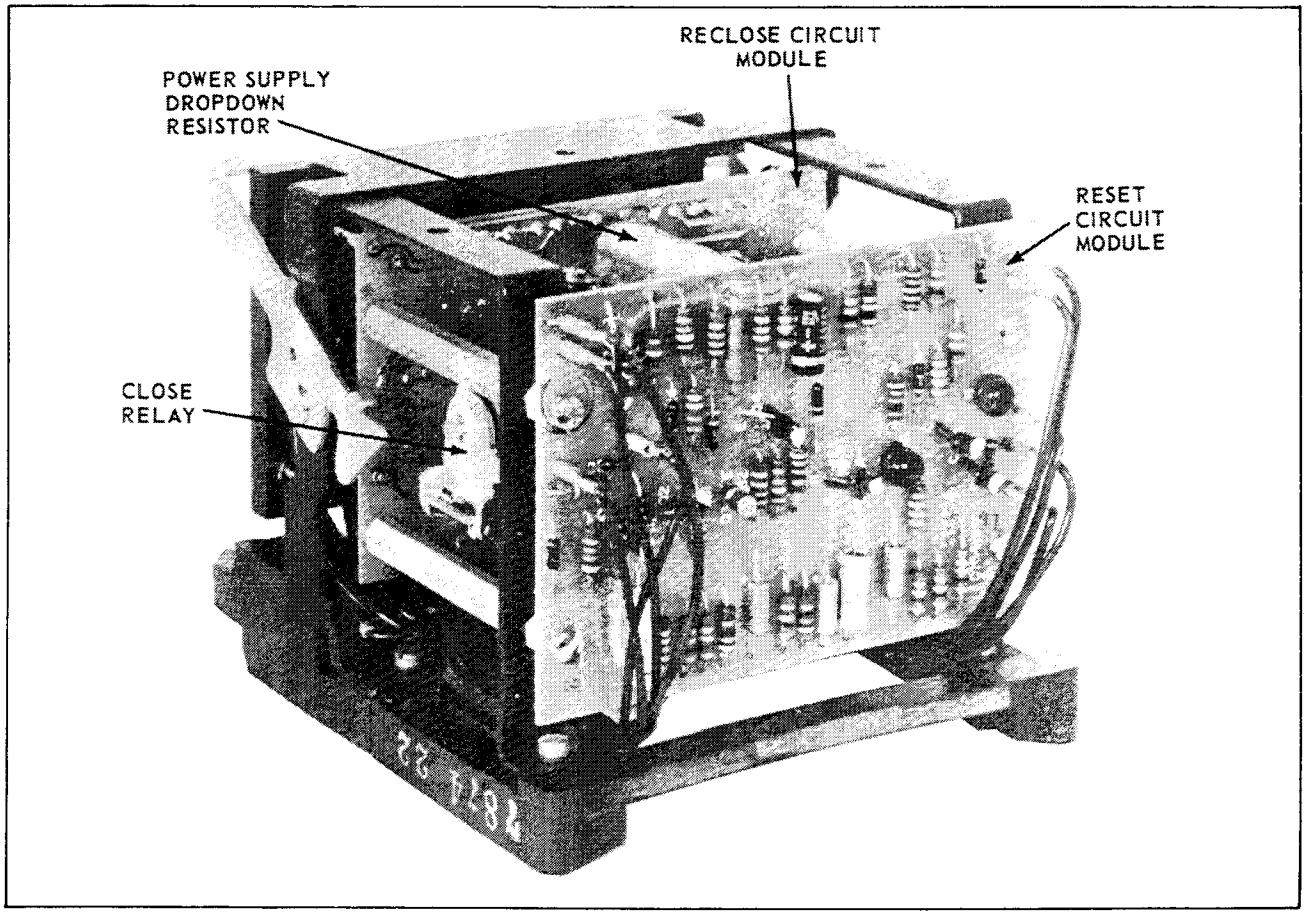

Fig. 2. Type SGR-52 Reclosing Relay (Rear View)

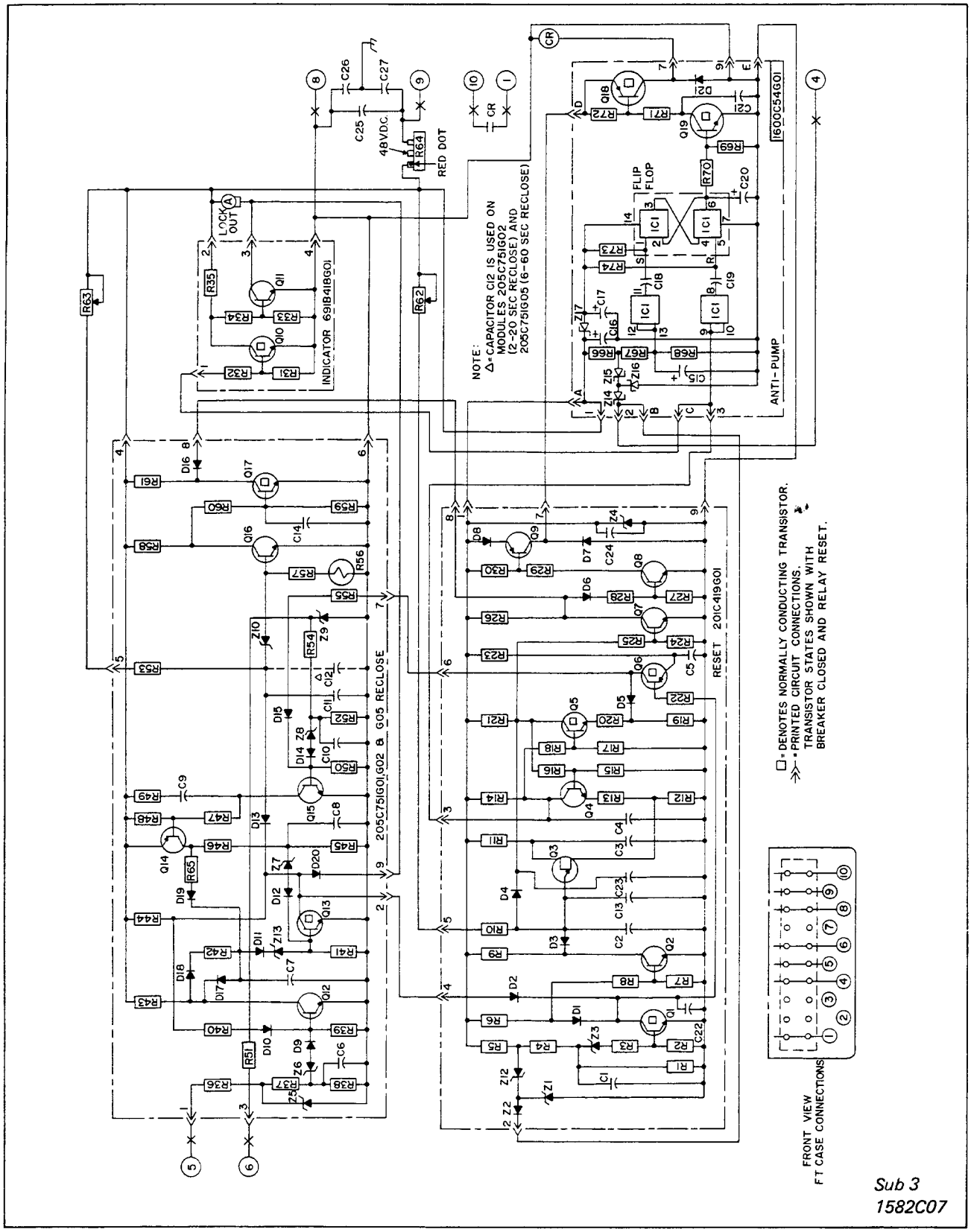

Fig. 3. Internal Schematic of Type SGR-52 Relay — 48/125 Vdc

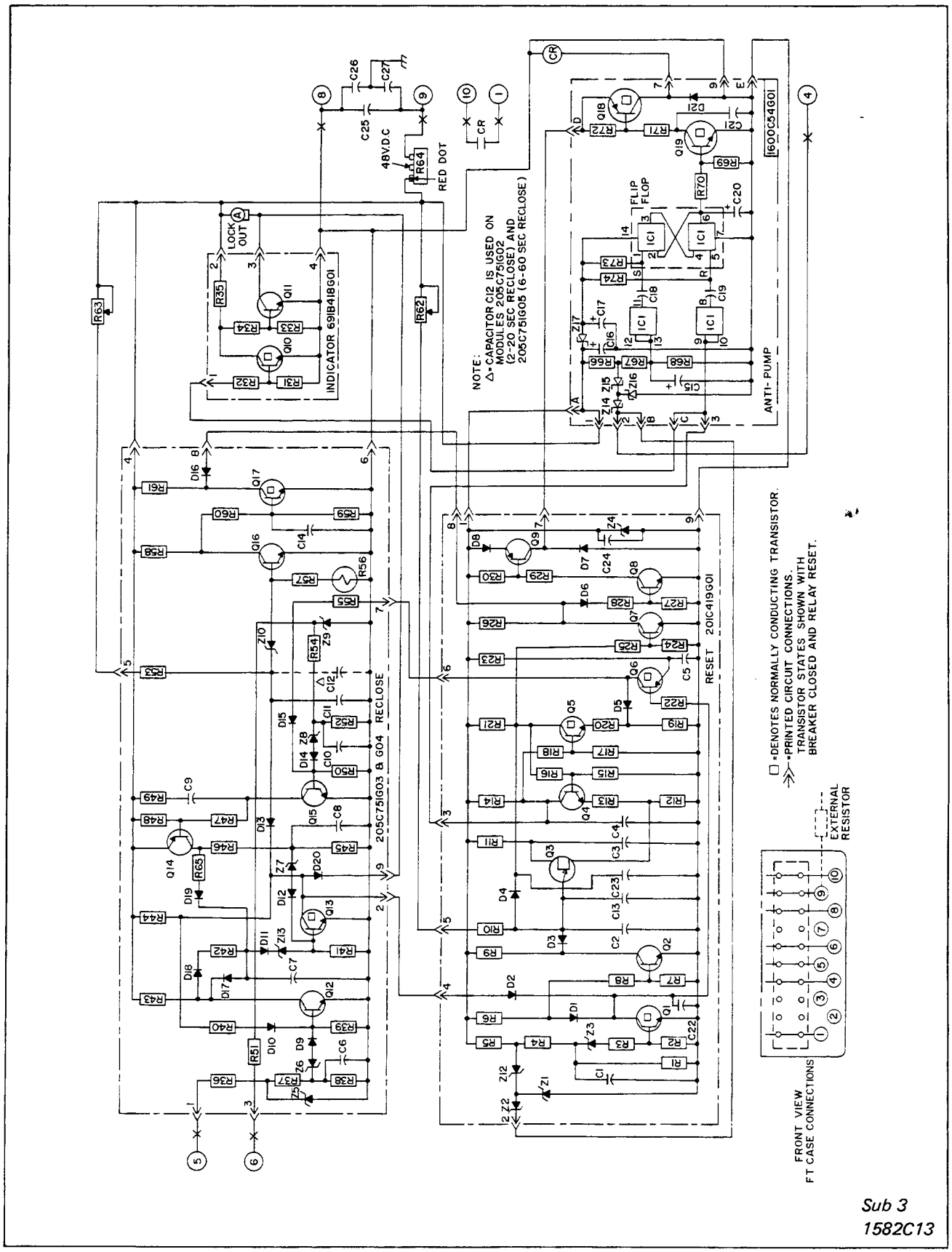

Fig. 4. Internal Schematic of Type SGR-52 Relay – 250 Vdc

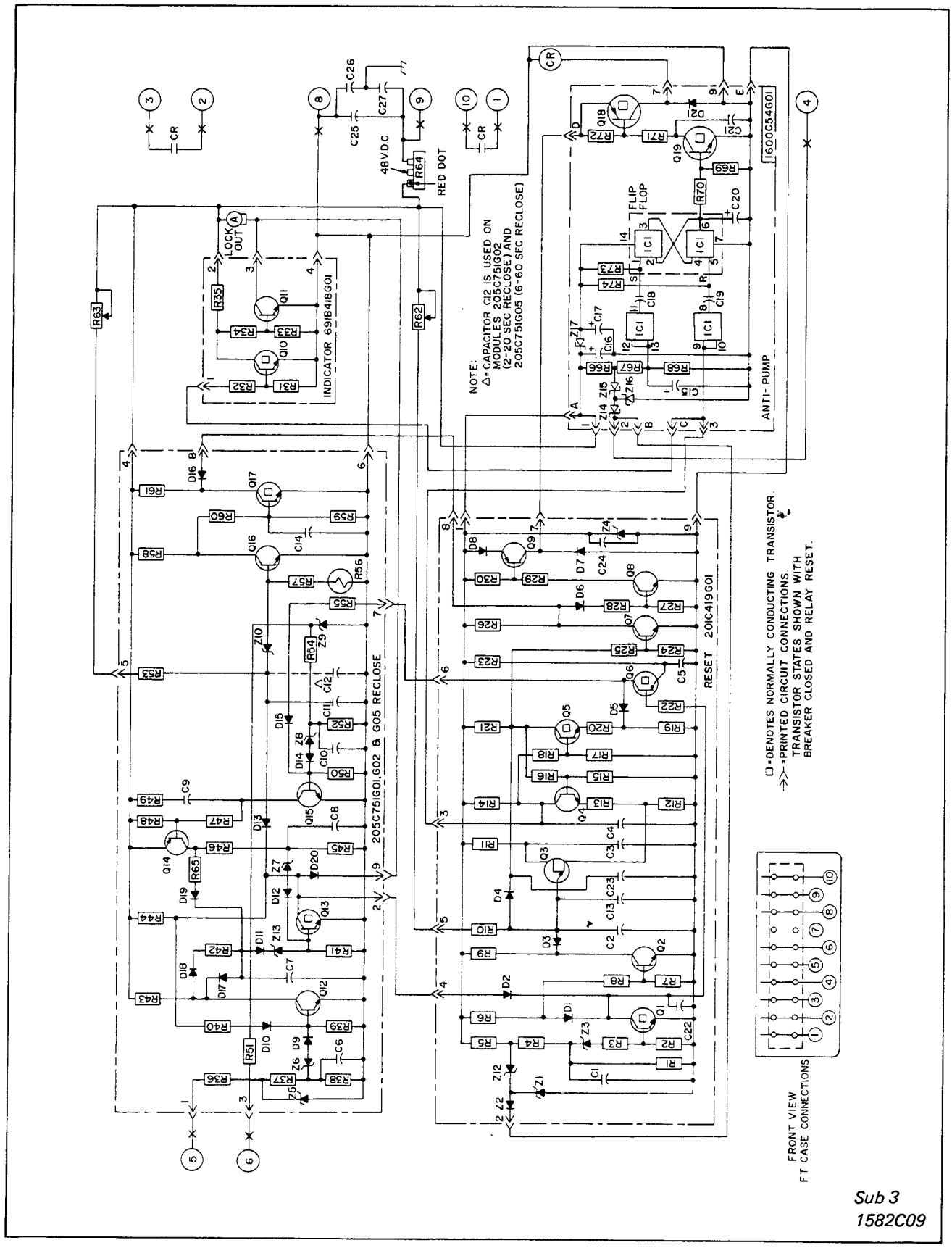

Fig. 5. Internal Schematic of Type SGR-52 Relay with Double CR Contacts – 48/125 Vdc

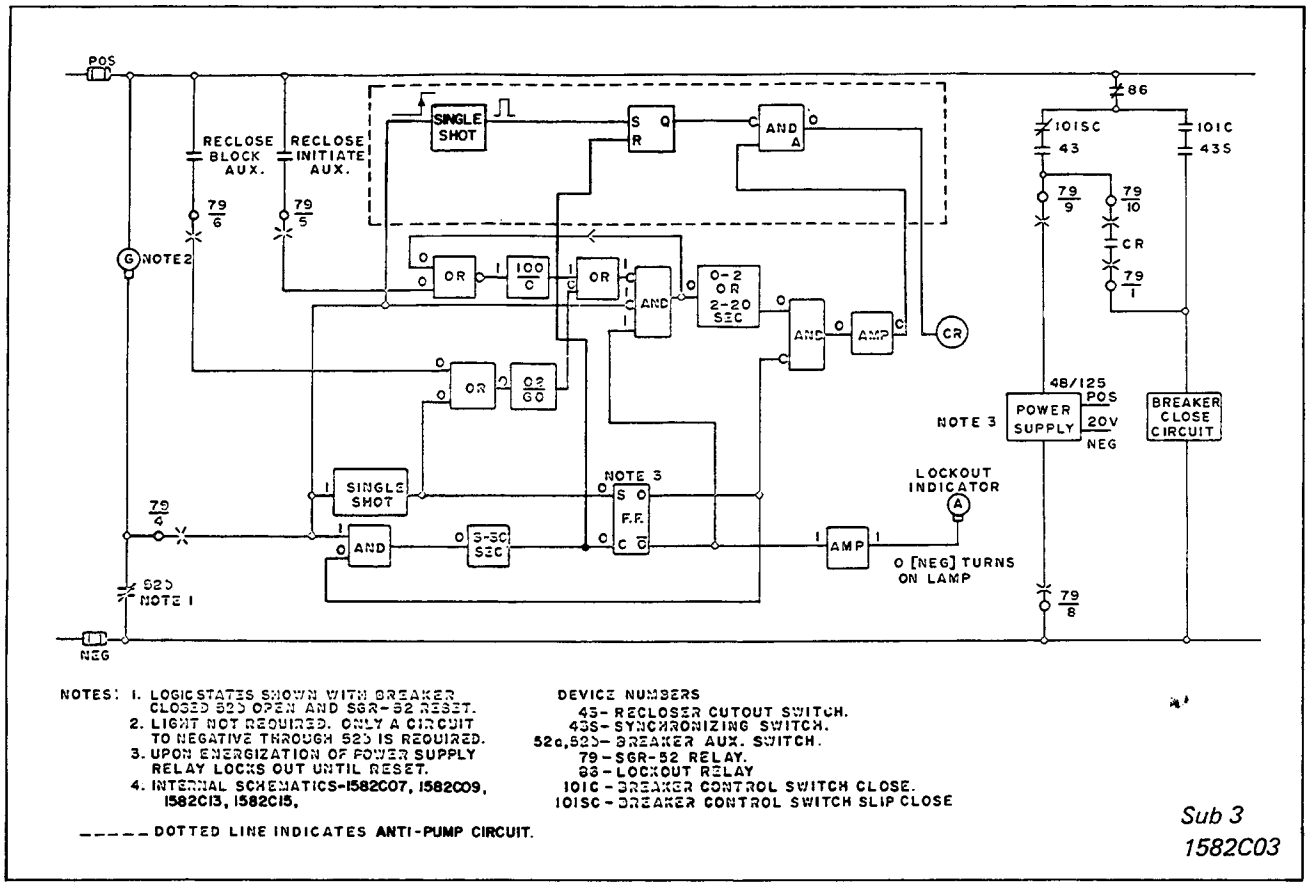

Fig. 6. External Schematic of Type SGR-52 Relay

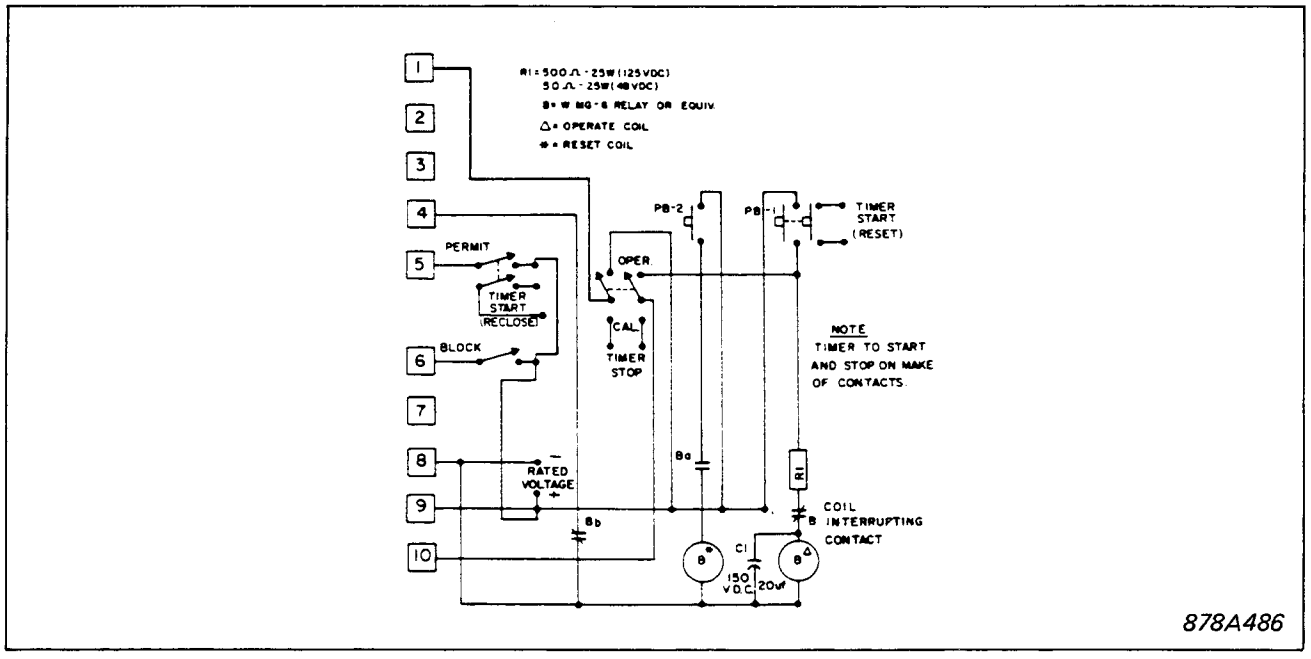

Fig. 7. Test Circuit of Type SGR-52 Relay

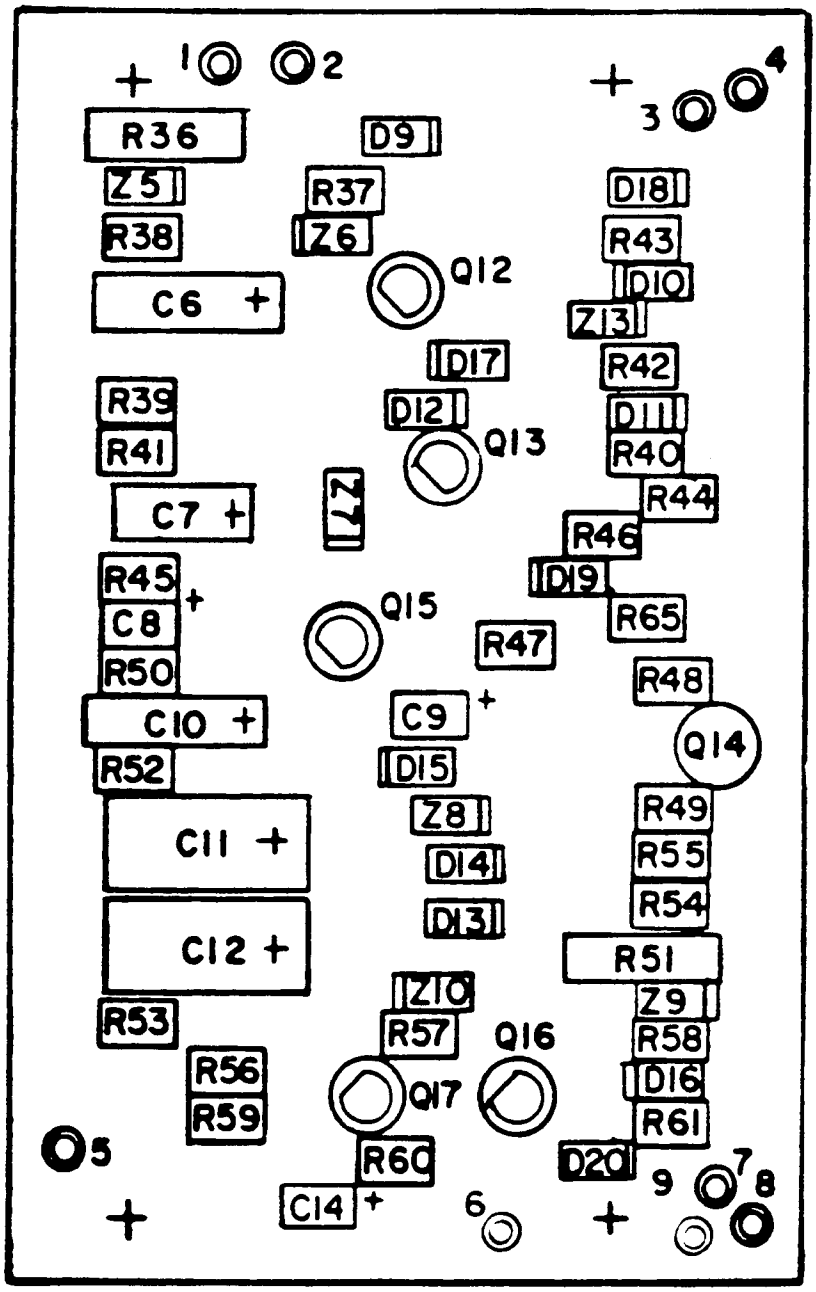

Fig. 8. Component Location of Reclose Printed Circuit Board for Type SGR-52 Relay

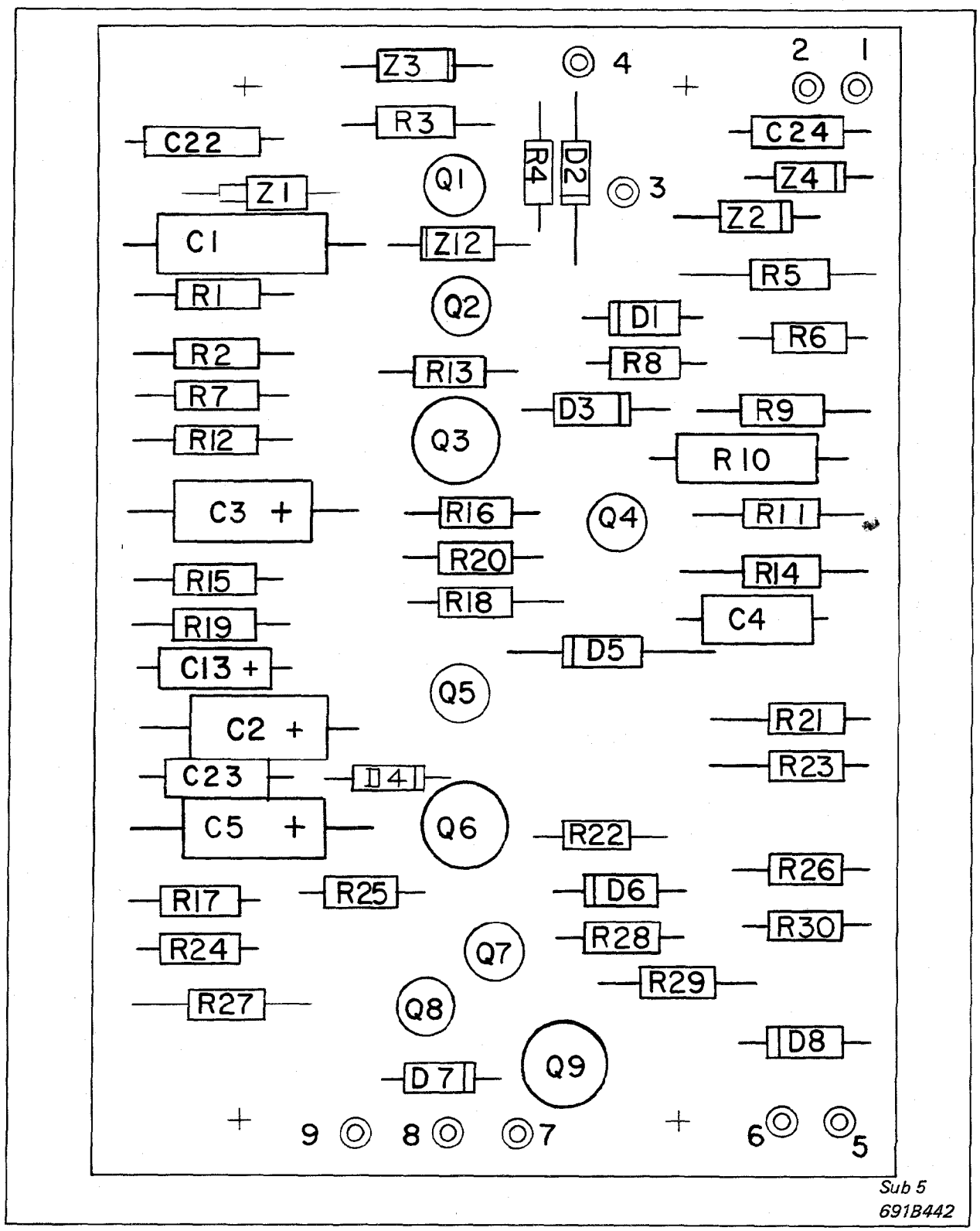

Fig. 9. Component Location of Reset Printed Circuit Board for Type SGR-52 Relay

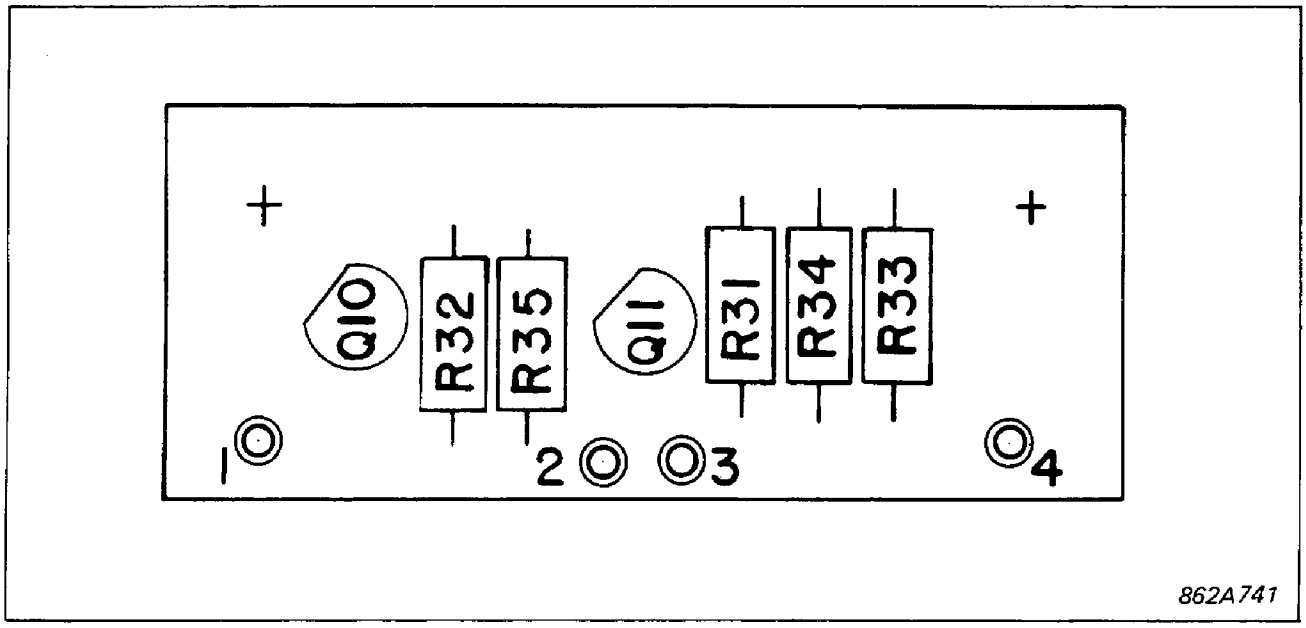

Fig. 10. Component Layout SGR-52 Indicator Board

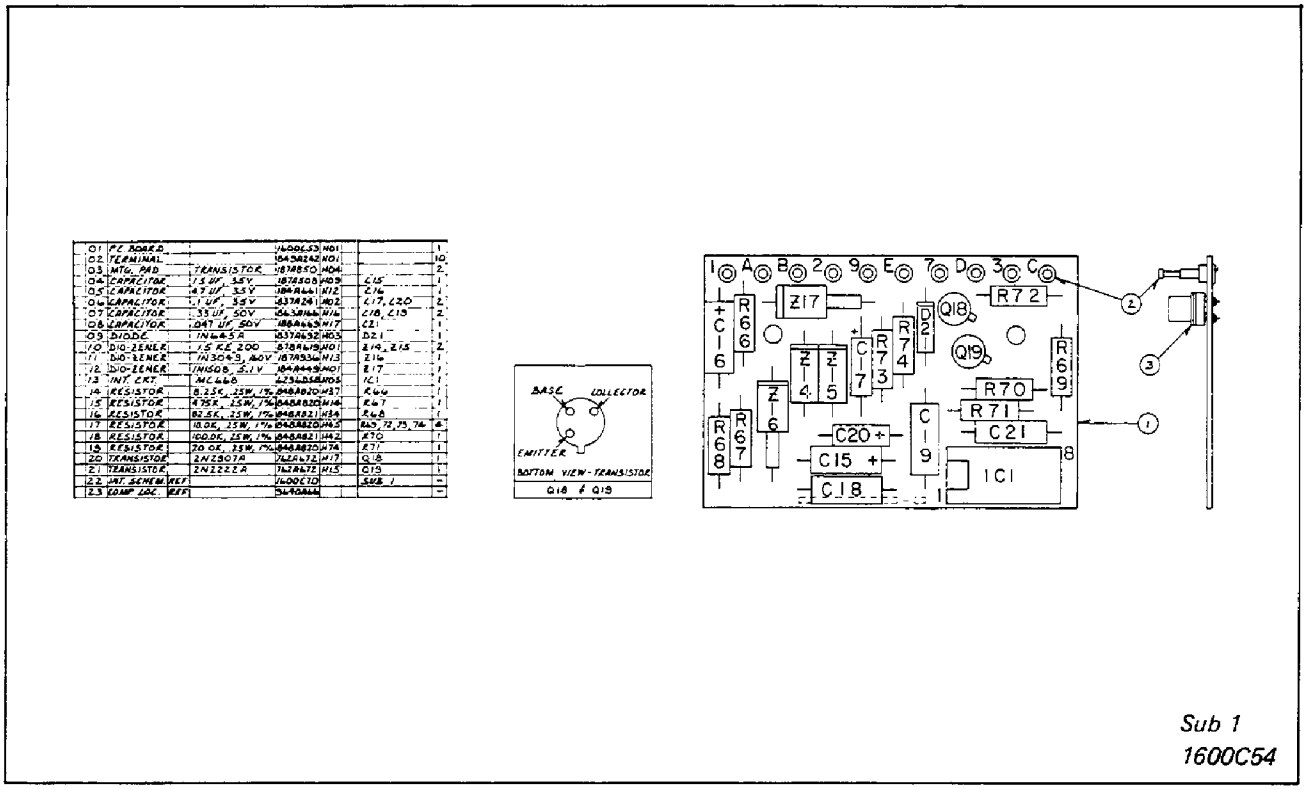

Fig. 11. Component Location of Anti-Pump Module

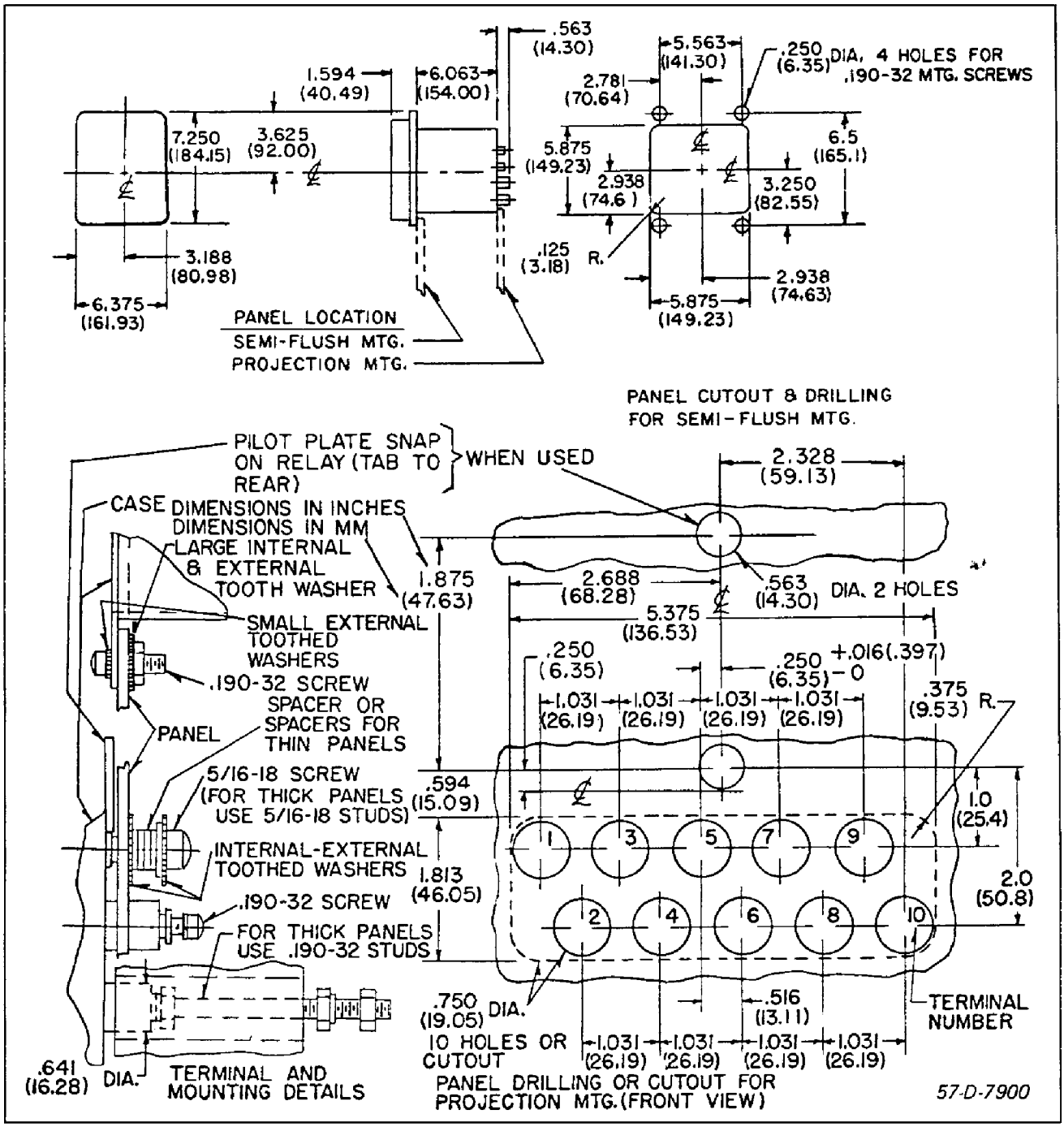

Fig. 12. Outline and Drilling Plan FT-11 Case

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