INSTRUCTIONS

GEK-49800

STATIC SYNCHRONISM CHECK RELAY

TYPE SLJ12A

GENERAL ELECTRIC

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STATIC SYNCHRONISM CHECK RELAY

TYPE SLJ12A

DESCRIPTION

The Type SLJ12A relay is a static device designed to check synchronism before permitting a breaker to be closed. The closing angle, or angle between which synchronism can be checked and closing will be permitted, is adjustable from 10 to 60 degrees. Closing will be permitted after a set time delay, adjustable from 10 to 160 milliseconds in Form 1, provided the angle is less than or equal to the set closing angle.

This relay also includes two telephone-type relays that allow the user to check line and/or bus voltage conditions. The relay comes complete with a target unit and is mounted in an M2 size drawout case. Outline and panel drilling dimensions for the relay are shown in Fig. 15. The internal connections for the relay are shown in Fig. 4.

APPLICATION

The Type SLJ12A relay is a static device designed to perform synchronism check before allowing a breaker to be closed. The relay is not intended to initiate closing of the breaker, but rather to check that the systems, or part of the system, to be connected are within a limited angle of each other before closing of the breaker is permitted. The maximum angle between the systems for which closing will be permitted by the relay is referred to as the closing angle and it is adjustable over the range of 10 to 60 degrees. The relay is basically a single phase device that receives single phase voltages from the same phase(s) on both sides of the breaker, or the equivalent thereof in the case where a delta-wye power transformer is interposed between the two sources of potential. The angle between these two voltages forms the basis on which synchronism check is made. Typical external connections to the relay are shown in Figs. 1 and 2. Synchronism check is initiated by closing a contact which drives the contact converter. If the relay is to be continuously energized the contact converter should be permently connected to DC voltage.

The relay is designed to be used primarily in those applications where the parts of the system to be joined are interconnected at other points throughout the system. Even though in synchronism, there may be an angular difference in the voltages existing on either side of the breaker as a result of load flow throughout the interconnected system. It may be desirable to close the breaker even though an angular difference exists provided of course that the angular difference is not great enough to be detrimental to the system and/or equipment. Each application should be checked on an individual basis to determine the maximum angle for which closing can be tolerated. Once this angle has been determined the relay should be set accordingly. If desired, some time delay may be added to insure that the system is stable and that synchronism really exists.

When the parts of the system to be joined are not interconnected at other points throughout the system, the possibility exists that the systems may not be in synchronism. In that case, there may be some slip between the systems. It should be recognized under these circumstances that the SLJ relay can be fooled into thinking the systems are in synchronism if the slip is slow enough for the angle to appear in the characteristics long enough to produce an output. For each combination of time delay and closing angle setting there exists a slip frequency, called the "cutoff slip," above which the relay will not produce an output. The cutoff slip frequency can be determined from the following equation:

$$S = \frac{2(A)}{360(T)}$$

where

S = cutoff slip in hertz
A = closing angle setting in degrees
T = time delay setting in seconds

The maximum slip cutoff which this relay will allow for an A setting of 60 degrees and a T time delay of 0.16 seconds is 2.08 hertz (slip cycles per second). This is a very high slip rate and care should be exercised in applications requiring these extreme settings.

There will be a small variation in the actual closing angular of the relay from its calibrated setting when the applied voltages vary from the rated value of 120 volts. This variation will not exceed two degrees over a range of 70-to-110 percent rated voltage. This is true with balanced voltages on the two inputs or with unbalanced voltages on the two inputs.

In order for the SLJ12A relay to provide an output, there must be a voltage present on both sides of the breaker, and the phase angle between these voltages must be within the closing angle setting of the relay. This means that the synchronism check unit alone will not permit picking up a dead line. For applications where dead line and/or dead bus operation is required, undervoltage detectors are used to bypass the synchronism check device. These undervoltage devices are included as an integral part of the relay. Typical connections illustrating the use of the undervoltage relays for live-line dead-bus, dead-line live-bus conditions, etc., are shown in Fig. 2.

CALCULATION OF SETTINGS

The angular setting (A) of the relay is made by adjusting the pickup time of the TL-1 timer shown in Fig. 1. To determine the necessary setting T, use the following equation:

$$T \text{ (in ms)} = 46.3 \times 10^{-3} \, (180-A)$$

For example, for an A setting of 30 degreees

$$T = 46.3 \times 10^{-3} \, (180-30) = 6.94 \text{ milliseconds}$$

If the T setting of timer TL-1 is known and the equivalent angular setting is to be determined, use the following equation:

$$A = 180 - \frac{T}{46.3 \times 10^{-3}}$$

For example, for T = 7.25 ms

$$A = 180 - \frac{7.25}{0.0463} = 180 - 157 = 23 \text{ degrees.}$$

Timer settings T for common angular settings A are given in the following table.

TABLE A

A	T	A	T
10	7.87	40	6.47
20	7.39	50	6.01
30	6.94	60	5.55

SEISMIC LEVEL

The Seismic Fragility Level exceeds peak axial acceleration of 10g's (6g ZPA) when tested using a biaxial multi-frequency input motion to produce a Required Response Spectra (RRS) in accordance with the IEEE Proposed Guide for Seismic Testing of Relays, P501, July, 1976.

RATINGS

The SLJ12A relay is rated for 120 volts and 50 or 60 hertz.

The contacts of the telephone-type relays will make and carry 30 amperes momentarily and will carry three amperes continuously. The telephone relay contacts will interrupt the currents given in Table B.

TABLE B

VOLTS	CURRENT INDUCTIVE	CURRENT NON-INDUCTIVE
48 DC	1.0	3.0
125 DC	0.5	1.5
250 DC	0.25	0.75
115 60 HZ	0.75	2.0
230 60 HZ	0.5	1.0

The target ratings are given in Table C.

TABLE C

	DUAL RATED			
	0.2/3.0		0.6/2.0	
	0.2	2.0	0.6	2.0
Carry 30 amps for (sec)	0.05	2.2	0.5	3.5
Carry 10 amps for (sec)	0.45	20	5.0	30
Carry continuously (amp)	0.37	2.3	1.2	2.6
Minimum operating (amp)	0.2	2.0	0.6	2.0
Minimum dropout (amp)	0.05	0.5	0.15	0.5
DC resistance (ohms)	8.3	0.24	0.78	0.18
60 hertz impedance (ohms)	50	0.65	6.2	0.65
50 hertz impedance (ohms)	42	0.54	5.1	0.54

The SLJ12A relay will operate over a range of -20 to +55°C. The phase angle setting as set at 25°C will vary no more than ± two degrees over a temperature excursion of zero to 55°C. An additional -2 degrees variance must be added for temperatures between zero and -20°C. The time-delay timer will vary no more than ±2% over the full rated temperature range. The 27L and 27B units will vary ±5 volts in pickup and dropout over the full temperature range.

BURDENS

AC BURDEN	WATTS	VA
Bus Circuit	5	5
Line Circuit	5	5

DC BURDEN	48V	125V	250V
Watts	4.5	11.5	22

CHARACTERISTICS

VOLTAGE UNITS

There are two voltage units (27B and 27L) one for the AC bus voltage and the other for the AC line voltage. Each voltage is connected through a 2500 ohm resistor to a diode bridge. The DC side of the bridges are connected to a telephone-type relay. The voltage relay is set to pick up between 60 and 70 volts and drop out between 50 and 60 volts. Contacts of the voltage units provide the live-line dead-bus circuits shown in Fig. 2. A 10K ohm loading resistor is also connected across each supply voltage to insure that there is some load on each voltage supply even if the diode bridge is open. This is to prevent energizing a dead circuit from the other supply. The 27B and 27L units also provide contacts for the synchronism check unit.

SYNCHRONISM CHECK UNIT

The SLJ12A relay uses a block-block coincidence time scheme to measure the angular separation between the line and bus voltages. The line and bus voltages are applied to step-down transformers. The secondaries of these transformers are center tapped. The center tap is grounded and each leg is tied to the input of an AND gate, see Fig. 1. The AND gates compare the coincidence of the positive AND 1 and negative AND 2 half-cycles. The outputs of the AND gates are OR'ed together and applied to a timer TL-1 which measures the coincidence time. The pickup time of TL-1 determines the maximum angle between the line and bus voltage for which the 25 unit will operate. For example, when TL-1 is set for approximately 8.33 milliseconds the relay would produce an output when the voltages are coincident for 180 degrees on a 60 hertz system, thus the angle between them must be zero degrees. If TL-1 were set for 7.87 milliseconds on a 60 hertz system the relay would produce an output when the voltages were coincident for 170 degrees or a ten degree angle between the bus and line voltage. As can be seen any angle can be set by varying the pickup setting of TL-1. The dropout time of TL-1 is set for nine milliseconds for 60 hertz and 12 milliseconds for 50 hertz so that once picked up it will provide a continuous input to AND 3. AND 3 also receives inputs from CC1 and the 27B and 27L units. The contact converter (CC1) is the supervising input when the external contact is closed suppling DC to the contact converter. A logic output is produced which is applied to an input of AND 3. A normally closed contact from the 27B unit and 27L unit is tied in parallel and connected between the positive logic supply and a NOT input of AND 3. If either the line or bus voltage unit drops out, an input will be supplied to the NOT input of AND 3 blocking an output of the 25 unit. The output of AND 3 drives the delay timer TL-2. This timer is set to provide whatever fixed time delay is required for the specific application. The output of TL-2 provides one input to AND 4. The other input is provided by the TL-3 timer which insures that the relay will not provide an output until 100 milliseconds after the DC power has been supplied to the relay. The output of AND 4 drives a transistor switch which operates the output relay. The output relay will pick up within four milliseconds after its coil is energized and drop out within 16 milliseconds after its coil is deenergized.

The minimum overall operating time for the SLJ12A is found by adding the pickup settings of TL-1, TL-2 and the telephone relay.

RECEIVING, HANDLING AND STORAGE

These relays, when not included as a part of a control panel, will be shipped in cartons designed to protect them against damage. Immediately upon receipt of a relay, examine it 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 notify the nearest General Electric Apparatus Sales Office.

Reasonable care should be exercised in unpacking the relay in order that none of the parts are injured or the adjustments disturbed.

If the relays are not to be installed immediately, they should be stored in their original cartons in a place that is free from moisture, dust and metallic chips. Foreign matter collected on the outside of the case may find its way inside when the cover is removed and cause trouble in the operation of the relay.

CASE

The case is suitable for either surface or semi-flush panel mounting and an assortment of hardware is provided for either mounting. The cover attaches to the case and also carries the reset mechanism when one is required. Each cover screw has provision for a sealing wire.

The case has studs or screw connections at both ends for the external connections. The electrical connections between the relay units and the case studs are made through spring-backed contact fingers mounted in a stationary molded inner and outer block between which nests a removable connecting plug which completes the circuits. The outer blocks, attached to the case, have the studs for the external connections, and the inner blocks have the terminals for the internal connections.

The relay mechanism is mounted in a steel framework called the cradle and is a complete unit with all leads being terminated at the inner blocks. This cradle is held firmly in the case with a latch at the top and the bottom and by a guide pin at the back of the case. The cases and cradles are so constructed that the relay cannot be inserted in the case upside down. The connecting plug, besides making the electrical connections between the respective blocks of the cradle and case, also locks the latch in place. The cover, which is fastened to the case by thumbscrews, holds the connecting plugs in place.

To draw out the relay unit, the cover is first removed, and the plugs drawn out. The latches are then released, and the relay unit can be easily drawn out. To replace the relay unit, the reverse order is followed.

A separate testing plug can be inserted in place of the connecting plug to test the relay on the panel, either from its normal source of power or from other sources. Or, the relay unit can be withdrawn for testing and replaced by a spare relay unit.

ACCEPTANCE TESTS

Immediately upon receipt of the relay an INSPECTION AND ACCEPTANCE TEST should be made to insure that no damage has been sustained in shipment and that the relay calibrations have not been disturbed.

These tests may be performed as part of the installation or acceptance tests at the discretion of the user. Since most operating companies use different procedures for acceptance and installation tests, the following sections include all applicable tests that may be performed on the SLJ12A relay.

MECHANICAL TESTS

Operate the telephone-type relay units manually to check that all operate smoothly without binds.

ELECTRICAL TESTS

1. Voltage Units

   Connect a variable source of power across terminals 15 and 16 and jumper 17 and 18. Both voltage units (27B and 27L) will pick up between 60 and 70 volts and drop out between 50 and 60 volts.

2. Synchronism Check Unit

   Before applying DC check that the link on the A36 card is set for the proper DC voltage.

   The relay has been adjusted for a 15 degree angle and a pickup delay of 50 milliseconds at the factory. If settings other than this are required refer to the ADJUSTMENTS section.

   With the voltage unit picked up as in Step 1, apply rated DC to studs 12(+) and 11(-) (power supply) and to studs 14(+) and 13(-) (contact converter). The 25 unit telephone relay should pick up with the time-delay set (TL-2 pickup). To check the phase angle circuit remove the AC voltage connections and apply rated AC to studs 15 and 16 (line) and through a phase shifter to 17 and 18 (bus). Vary the phase angle of the AC voltages and note that the 25 unit picks up and drops out. The angle setting is made via the pickup time of TL-1. For the method of setting TL1 and TL-2 refer to the ADJUSTMENTS section.

INSTALLATION PROCEDURE

The location should be clean and dry, free from dust and excessive vibration, and well lighted to facilitate inspection and testing.

The relay should be mounted on a vertical surface. The outline and panel diagram is shown in Fig. 15.

The internal connection diagram for the relay is shown in Fig. 4. The internal connection diagrams for the printed circuit boards are shown in Figs. 6 through 13.

Since all drawout relays in service operate in their cases, it is recommended that they be tested in their cases or an equivalent steel case. In this way and magnetic effects of the enclosure will be accurately duplicated during testing. A relay may be tested without removing it from the panel by using a 12XLA13A test plug. This plug makes connections only with the relay and does not disturb any shorting bars in the case. Of course, the 12XLA12A test plug may also be used. Although this test plug allows greater testing flexibility, it also requires CT shorting jumpers and the exercise of greater care since connections are made to both the relay and the external circuitry.

All alternating current operated devices are affected by frequency. Since non-sinusoidal waveforms can be analyzed as a fundamental frequency plus harmonics of the fundamental frequency, it follows that alternating current devices (relays) will be affected by the applied waveform.

Therefore, in order to properly test alternating current relays it is essential to use a sine wave current and/or voltage. The purity of the sine wave (i.e., its freedom from harmonics) cannot be expressed as a finite number for any particular relay, however, any relay using tuned circuits, R-L or RC networks, or saturating electromagnets (such as time overcurrent relays) would be essentially affected by non-sinusoidal waveforms.

Similarly, relays requiring DC control power should be tested using DC and not full wave rectified power. Unless the rectified supply is well filtered, many relays will not operate properly due to the dips in the rectified power. Zener diodes, for example, can turn off during these dips. As a general rule the DC source should not contain more than 5 percent ripple.

Since most operating companies use different procedures for installation tests, the section under ACCEPTANCE contains all necessary tests which may be performed as part of the installation procedure at the discretion of the user.

ADJUSTMENTS

MECHANICAL

The telephone-type relays have been carefully adjusted at the factory to give correct adjustment. If these adjustments have been disturbed, readjust as follows:

With the telephone-type auxiliary relay deenergized each normally open contact should have a gap of 0.010 inch - 0.015 inch. Observe the wipe on each normally closed contact by deflecting the stationary contact member towards the frame. Wipe should be approximately 0.005 inch. The wipe on each normally open contact should be approximately 0.005 inch. This can be checked by inserting a 0.005 inch shim between the residual screw and the pole piece and operating the armature by hand. The normally open contacts should make before the residual screw strikes the shim.

The dropout of the telephone-type relays can be changed by changing the residual screw setting. This screw must be locked by means of its lock nut after resetting. The pickup of the telephone-type relays can be decreased by decreasing the spacing between the armature and the pole face by bending the contact arm.

After a pickup or dropout adjustment the relay contact gap and wipe must be rechecked as described above. The contact pressure should never be less than 10 grams measured at the contact tips.

ELECTRICAL

WARNING: THE CONNECTION PADDLES SHOULD BE REMOVED BEFORE A CARD IS PULLED.

WARNING: IT IS A DESIGN CHARACTERISTIC OF MOST ELECTRONIC INSTRUMENTS THAT ONE OF THE SIGNAL INPUT TERMIANLS IS CONNECTED TO THE INSTRUMENT CHASSIS. SINCE THE PRINTED CIRCUIT CARD REFERENCE VOLTAGE, WHICH NORMALLY WILL BE CONNECTED TO THE GROUND INPUT OF THE INSTRUMENT, IS NEAR THE (+) OR (-) STATION BATTERY VOLTAGE LEVEL, THE INSTRUMENT CHASSIS MUST BE INSULATED FROM STATION GROUND. IF THE INSTRUMENT POWER CORD CONTAINS A THIRD LEAD, THAT LEAD MUST NOT BE CONNECTED TO STATION GROUND.

The phase angle setting is made by adjusting the pickup time of TL-1. TL-1 is a type T66 timer card. The internal connections diagram is shown in Fig. 6. By adjusting P1 on the T66 card the phase angle may be adjusted over a 10 degree-to-60 degree range. For greatest accuracy this adjustment should be made with rated voltage applied to the line and bus inputs and the angle between these voltages adjusted with a phase shifter. The timer can then be adjusted to just produce an output when the required angle setting is reached. The time may be coarsely adjusted by the formula TIME = 46.3×10^{-3} (180 - A) (in milliseconds) where A is the angular setting. Example: for 10 degree setting T = 46.3×10^{-3} (180 - 10) = 7.87 milliseconds.

To adjust the pickup time of TL-1 or TL-2 follow this procedure:

1. Place the timer to be adjusted in a test adapter card 128B2221G2 and remove the preceding card (D39 or L3).
2. Connect a 10K resistor from Pin 6 to Pin 1.
3. Connect a normally open contact between Pin 10 and Pin 6.
4. Connect the scope trigger to Pin 6 and the vertical input to Pin 7.
5. Close the normally open contact. The vertical trace should go from zero to +12 volts after the pickup time delay. Clockwise rotation of the potentiometer will increase the time.
6. To check the dropout time of the T66 card set the scope for negative slope triggering and close the normally open contact. Once the card has picked up open the contact. The vertical trace should remain positive for the dropout time and then go to zero.

The T67 delay timer is easiest set by the preceding procedure. The internal connections for the T67 board is shown in Fig. 9. An alternate method of setting TL-2 is to apply rated AC to the bus and line inputs and initiate the relay by the operation of the contact converter input on studs 14(+) and 13(-) and time until the 25 unit telephone relay picks up. The time measured will include the telephone relay pickup time.

TROUBLESHOOTING

In the event that improper operation is indicated during the installation checkout or during routine testing, a troubleshooting program should be followed to determine the specific function or card which is causing the trouble. In checking signals, it should be noted that a typical card when in the "off" condition will have an output of less than one volt and will have an output in the range from 10 to 15 volts when in the "on" condition.

The logic diagram, Fig. 1, is the starting point for isolating trouble. This diagram represents the overall scheme in functional block diagram form. Input and output signals can be measured either by means of the high-impedance voltmeter or by means of an oscilloscope. Signals should be measured between the test points and the relay reference voltage, Pin 1 on all cards.

Remove the questionable card from its socket and plug the adapter card into that position. Then, insert the card to be checked into the socket of the adapter card. It is now possible to check voltaqes at all ten pins of the questionable card. The internal connection diagram for the relay, Fig. 4, should be referred to at this time to determine which pins of the card are actively involved. First, check that the plus (+) and minus (-) supply voltages as indicated on the internal connection logic diagram, are actually getting to the card pins. Next, check that the required input signals are getting to the card. If supply voltages and all required input signals are present, and the output signal is not present, the trouble is on the card and not in the interconnecting circuit.

PERIODIC CHECKS AND ROUTINE MAINTENANCE

In view of the vital role of protective relays in the operation of a power system it is important that a periodic test program be followed. It is recognized that the interval between periodic checks will vary depending upon the environment, type of relay and the user's experience with periodic testing. Until the user has accumulated enough experience to select the test interval best suited to his individual requirements it is suggested that the points listed under INSTALLATION PROCEDURE be checked at an interval of from one to two years.

CONTACT CLEANING

For cleaning relay contacts, a flexible burnishing tool should be used. This consists of a flexible strip of metal with an etched-roughened surface resembling in effect a superfine file. The polishing action is so delicate that no scratches are left, yet it will clean off any corrosion throughly and rapidly. Its flexibility insures the cleaning of the actual points of contact. Do not use knives, files, abrasive paper or cloth of any kind to clean relay contacts.

RENEWAL PARTS

It is recommended that sufficient quantities of renewal parts be carried in stock to enable the prompt replacement of any that are worn, broken, or damaged.

When ordering renewal parts, address the nearest Sales Office of the General Electric Company, specify quantity required, name of the part wanted, and the complete model number of the relay for which the part is required.

SPARE CARDS

The number of spare cards which should be carried in stock will depend on the total number of static relays using similar cards at a particular location or serviced by the same test group. For each type of card, that is for each 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 150 cards.

CARD REPLACEMENT

Once the trouble has been traced to a particular card, it is recommended that this card be replaced with a spare. In most instances, the user will be anxious to return the equipment to service as soon as possible and the insertion of a spare card represents the most expeditious means of accomplishing this. The faulty card can then be returned to the factory for repair or replacement.

Although it is not generally recommended, it is possible with the proper equipment and trained personnel to repair cards in the field. This means that the troubleshooting program described above must be extended to isolate the specific component on the card which has failed. With the card in the adapter, all termination points of the various components on the card are accessible. By referring to the internal connection diagram for the card, it is possible to trace through the card circuit by signal checking, and hence determine which component has failed. This, however, may be time consuming and, if the card is being checked in place in its unit as is recommended, will extend the outage time of the equipment.

CAUTION: GREAT CARE MUST BE TAKEN IN THE REPLACING COMPONENTS ON THE CARDS. SPECIAL SOLDERING EQUIPMENT SUITABLE FOR USE ON THE DELICATE SOLID-STATE COMPONENTS MUST BE USED AND, EVEN THEN, CARE MUST BE TAKEN NOT TO CAUSE THERMAL DAMAGE TO THE COMPONENTS, AND NOT TO DAMAGE OR BRIDGE OVER THE PRINTED CIRCUIT BUSSES. THE REPAIRED AREA MUST BE RECOVERED WITH A SUITABLE HIGH-DI-ELECTRIC PLASTIC COATING TO PREVENT POSSIBLE BREAKDOWNS ACROSS THE PRINTED BUSSES DUE TO MOISTURE OR DUST.

Since the last edition, changes have been made in Figures 7, 8, 9, 11, and 15.

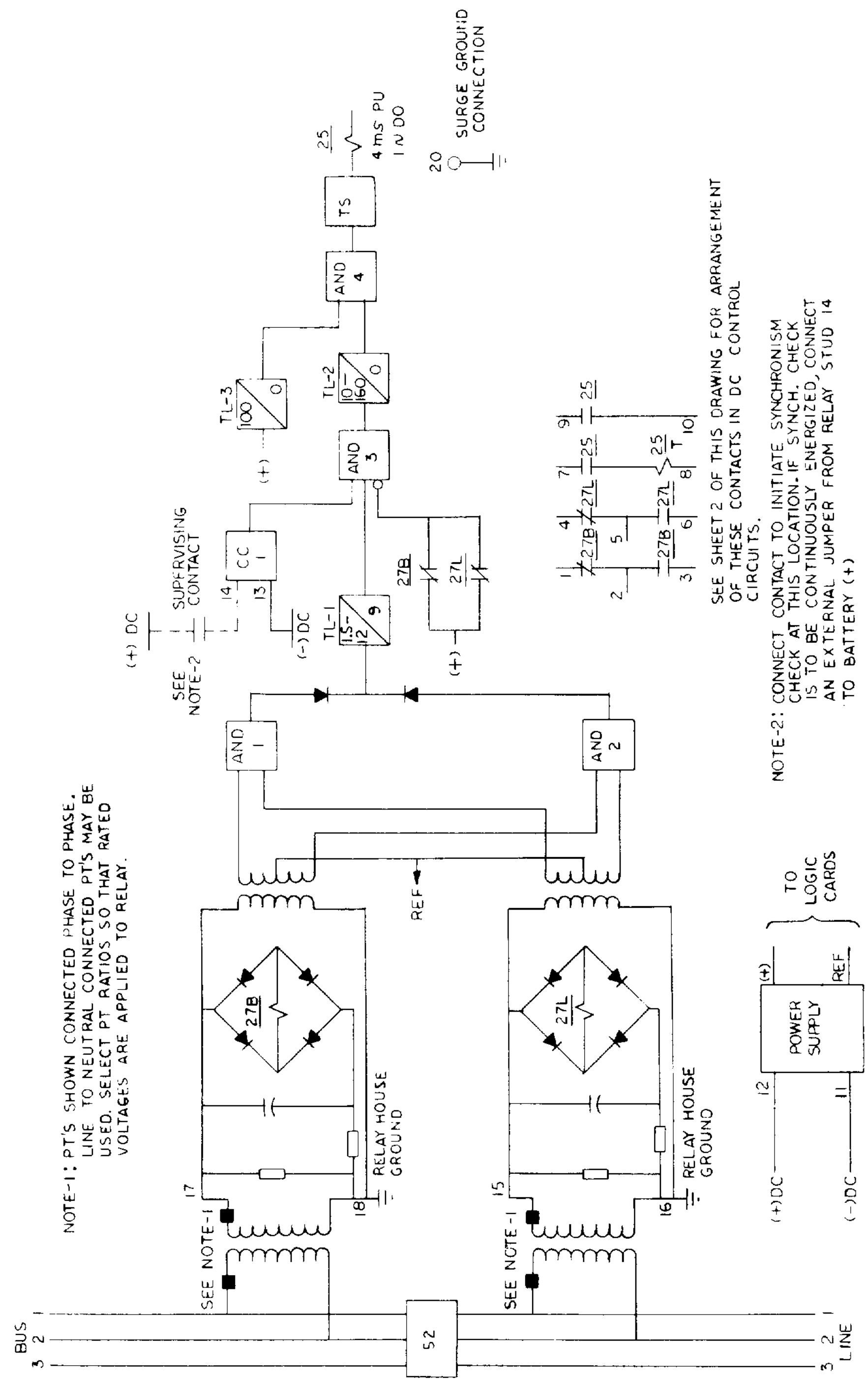


Fig. 1 (0108B8979-1 Sh. 1) Logic and External Connections.

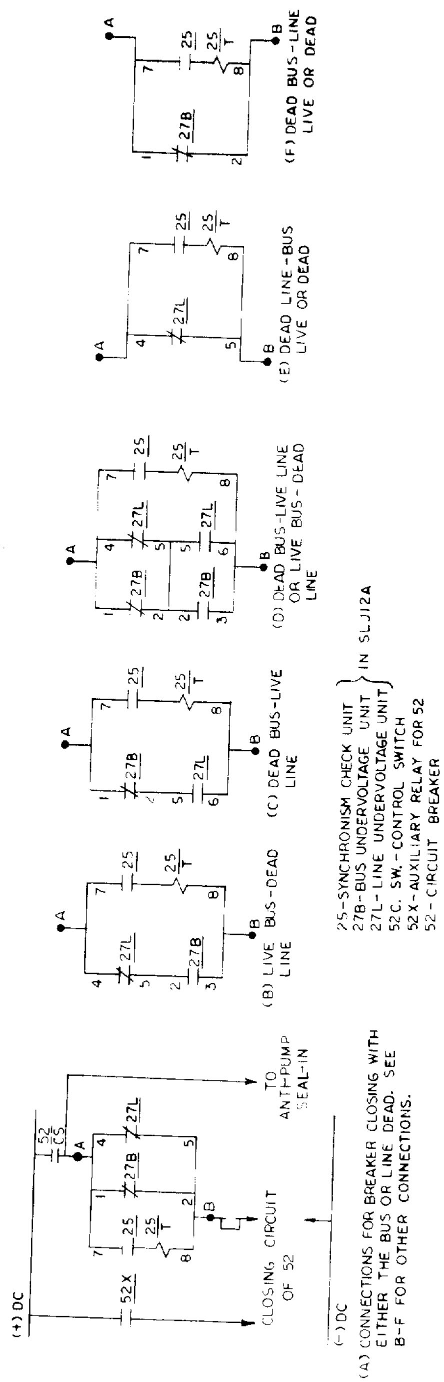


Fig. 2 (0108B8979-1 Sh. 2) Output Circuits Connections.

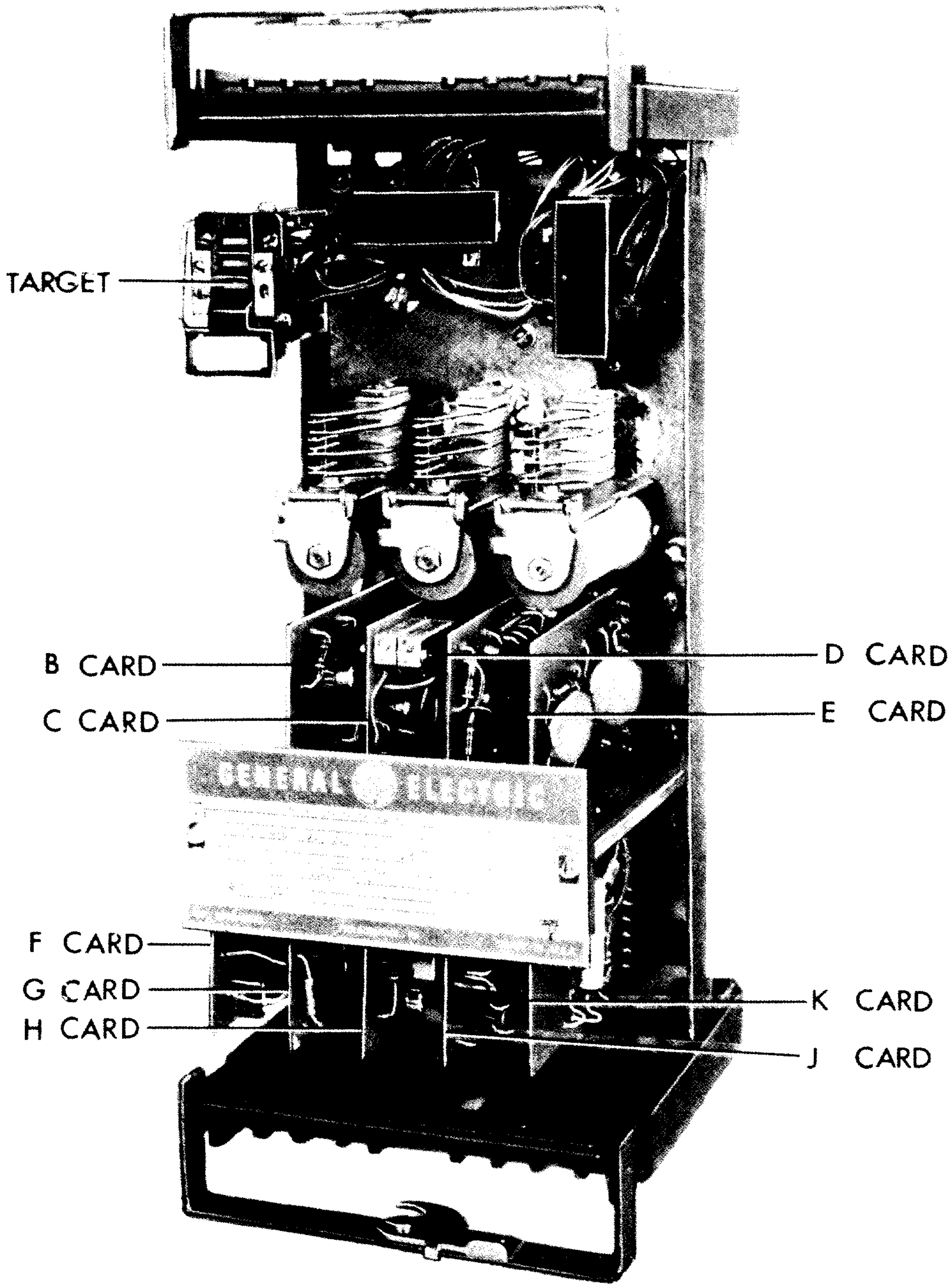


Fig. 3A (8043204) Three-quarter Front View of Relay Out of Case Showing Nameplate

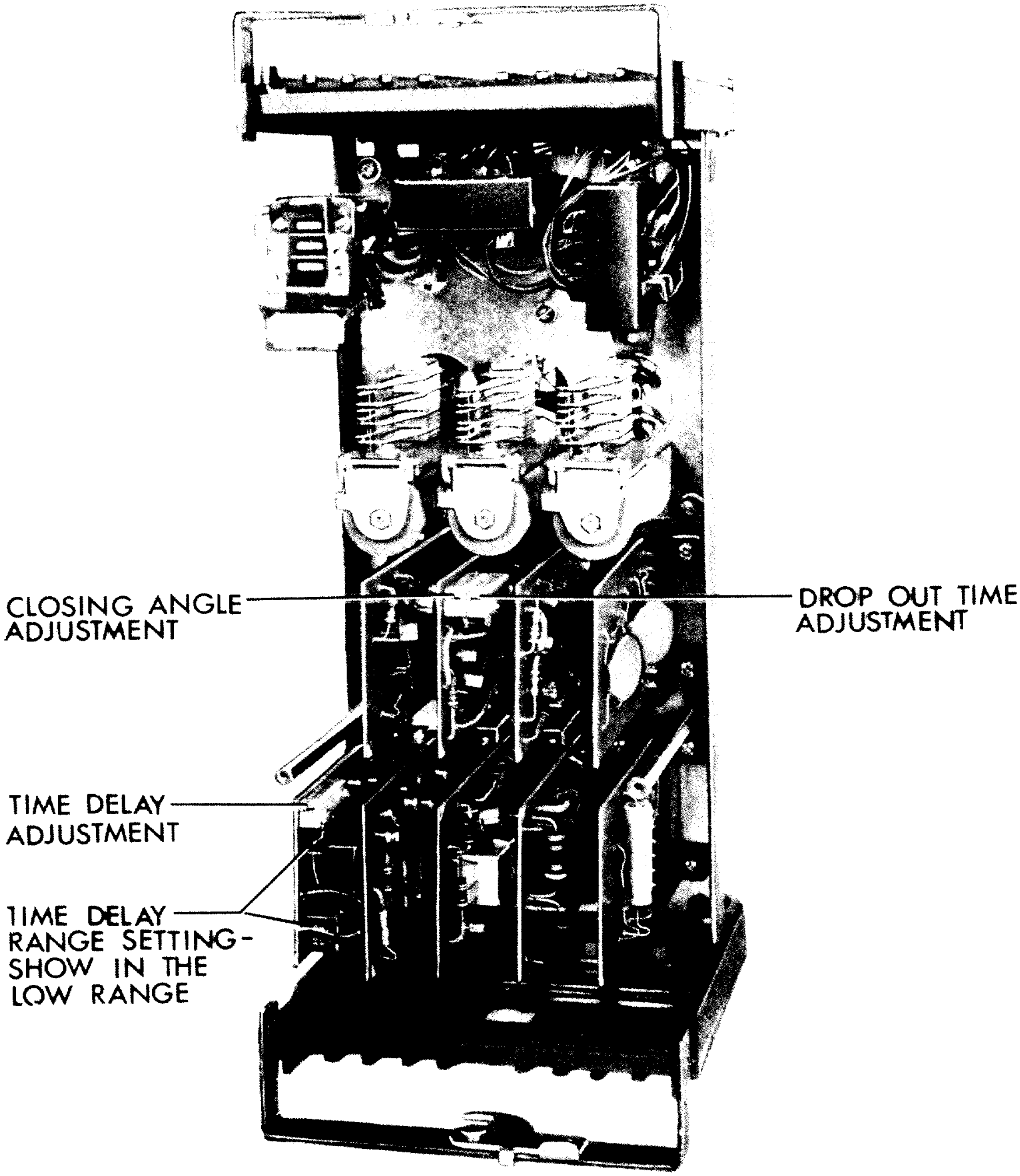


Fig. 3B (8043202) Three-quarter Front View of Relay Out of Case

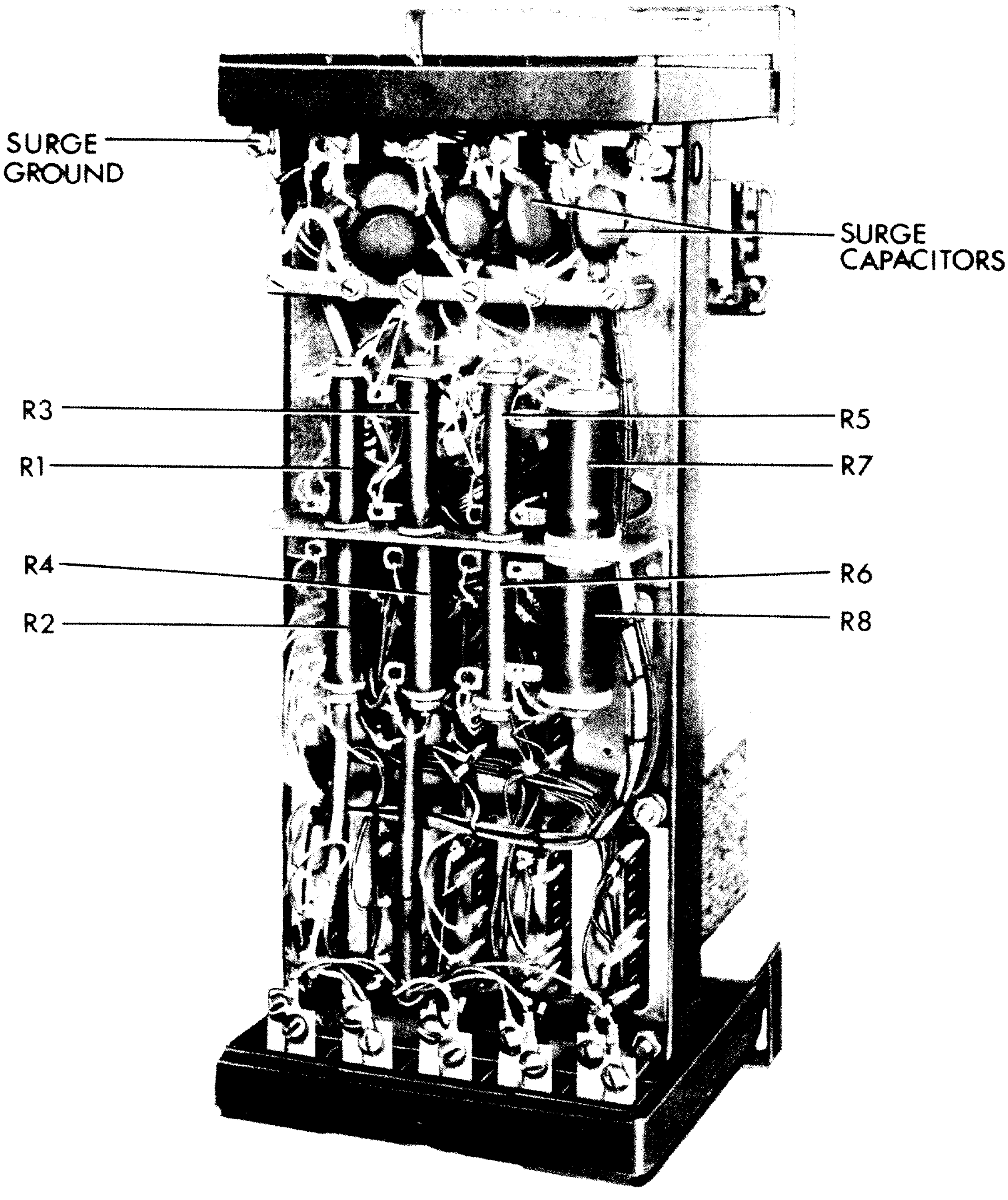
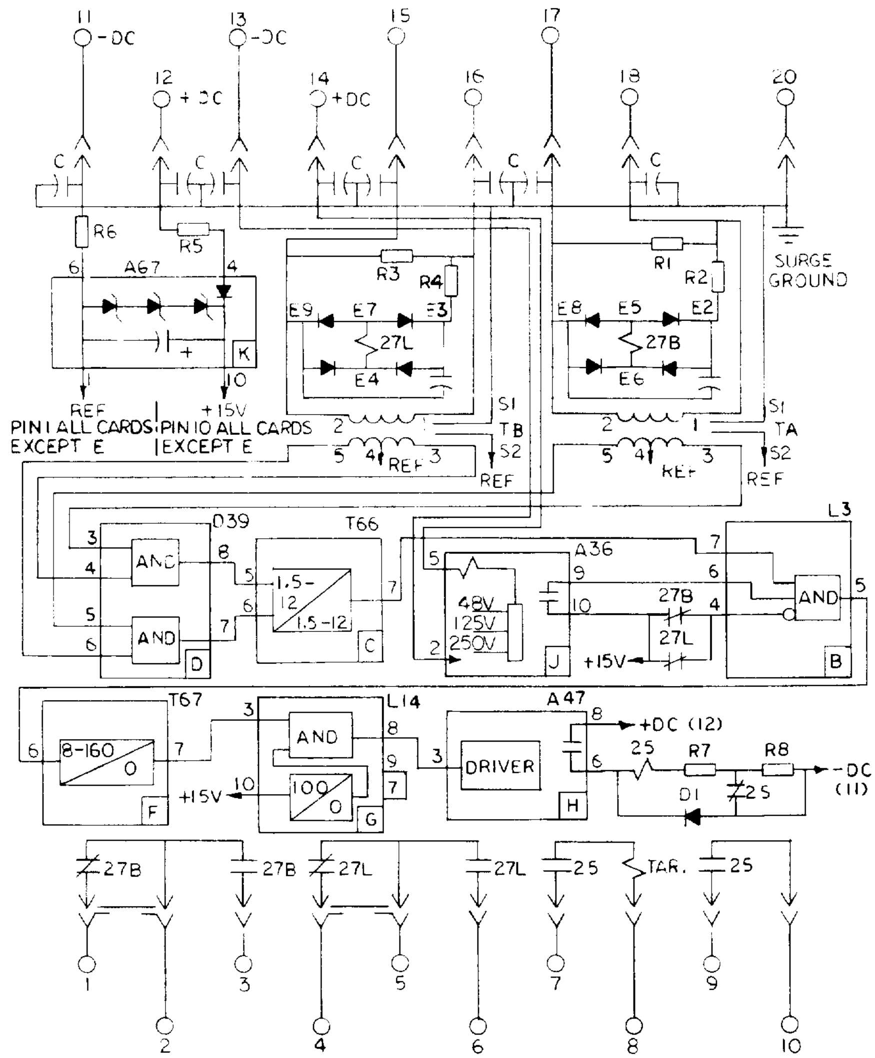


Fig. 3C (8043203) Three-quarter Rear View of Relay Out of Case



MODEL	FORM	
12SLJ12A(-)A	1	
VOLTS DC	125	
RESISTANCE IN OHMS/WATTS		
R1	10K/12	
R2	2.5K/12	
R3	10K/12	
R4	2.5K/12	
R6	600/12	
R7	850/17	
R8	1.7K/17	
R5	500/12	

ALL C = 0.5uf

E9 E7
SHOWS PIN NO 9 & PIN NO 7
ON "E" POSITION CARD

D1 = 1N5061

Fig. 4 (0269A3084-1 Sh. 1 and Sh. 2) Internal Connections Diagram

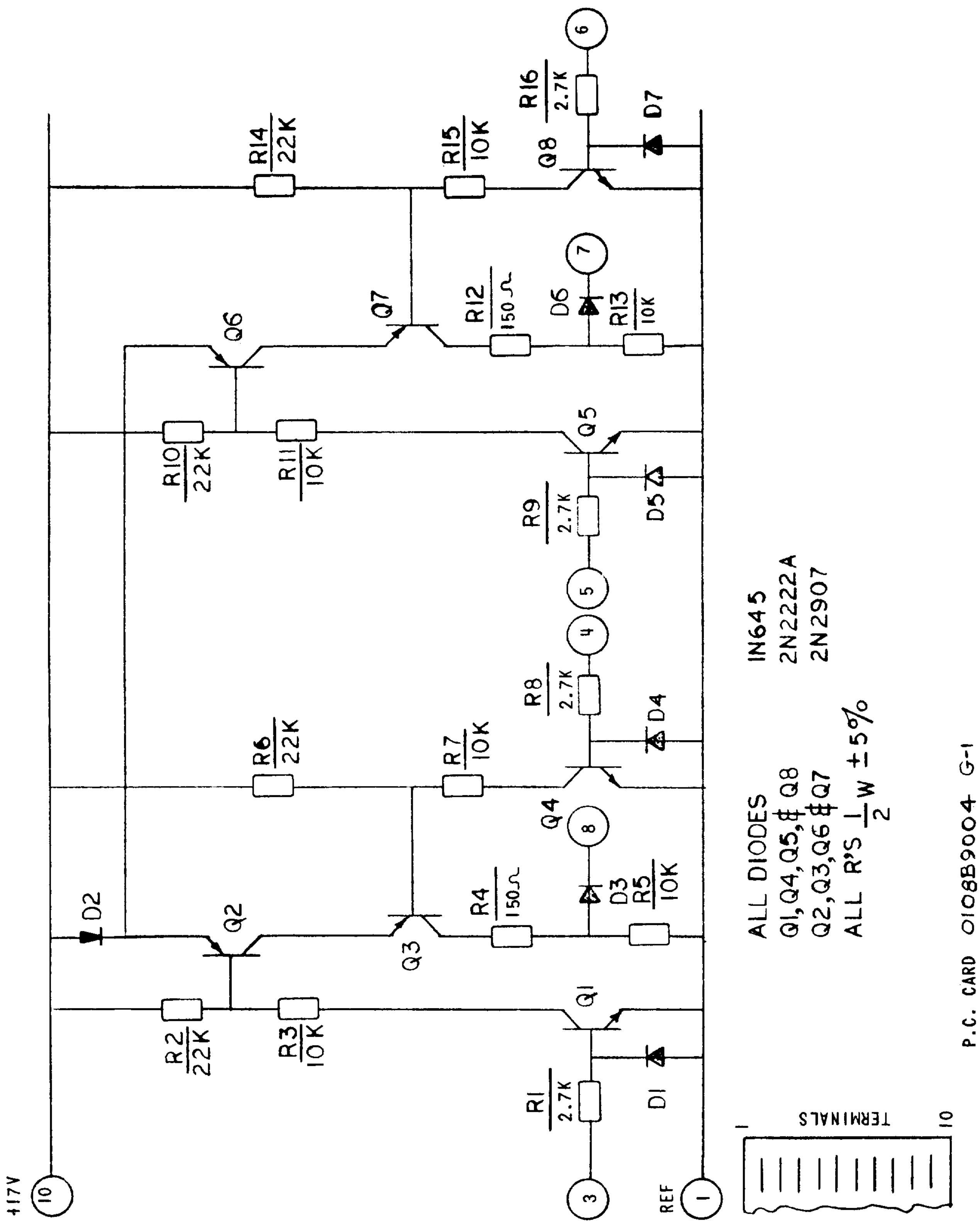


Fig. 5 (0148A3917AV-0) Internal Connections of the D39 Printed Circuit Board

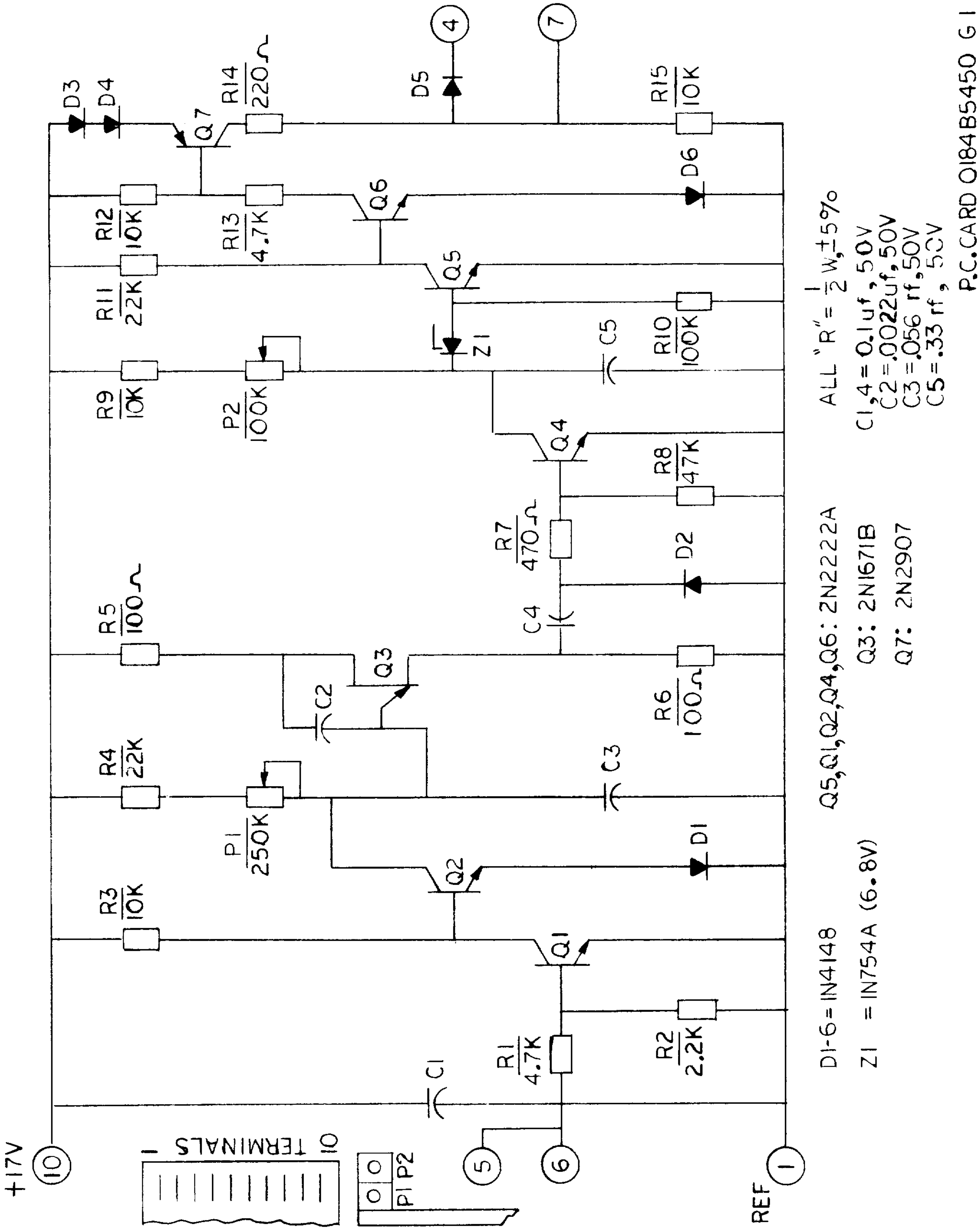


Fig. 6 (0148A3906FG-1) Internal Connections of the T66 Printed Circuit Board

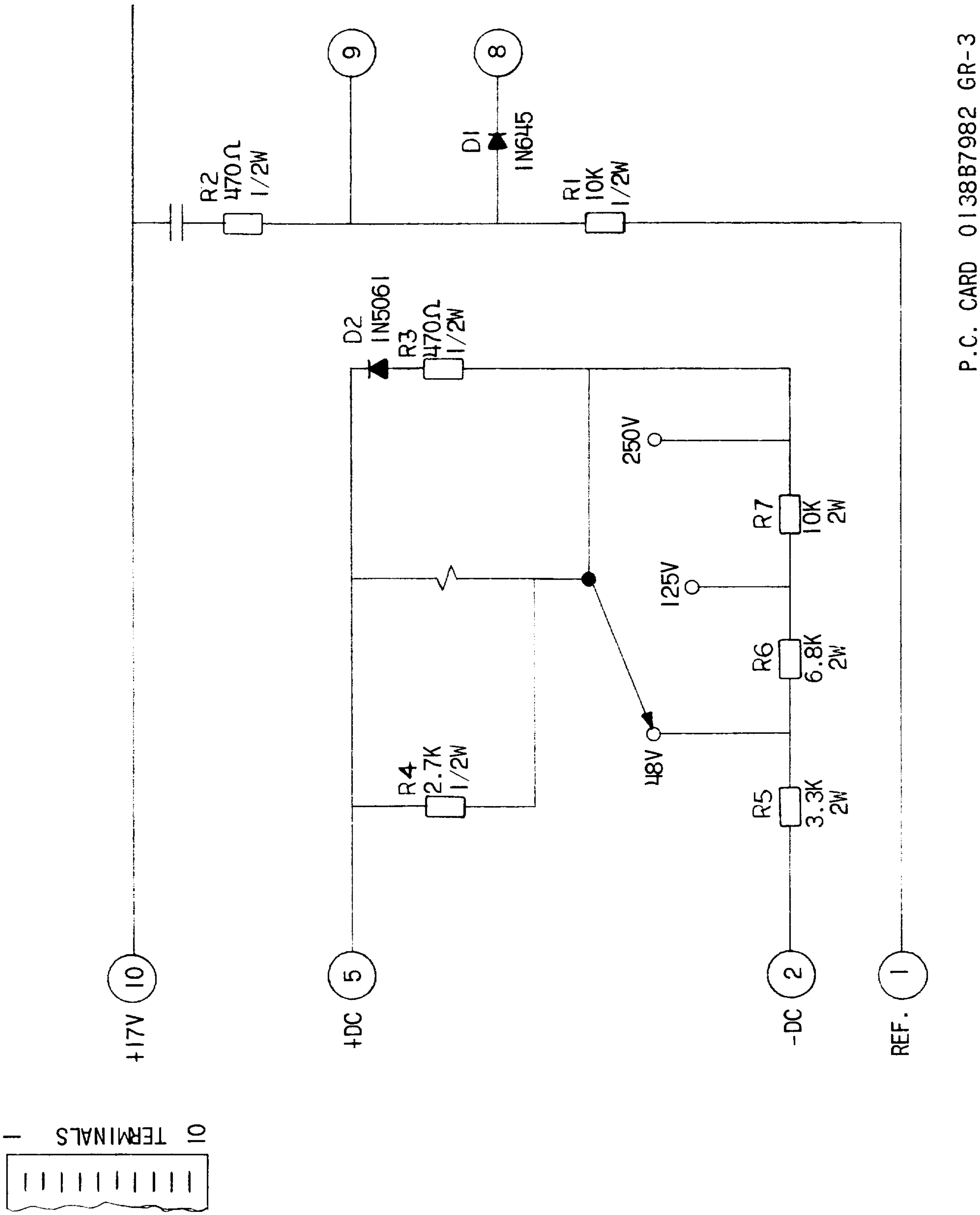


Fig. 7 (0148A3910AX [1]) Internal Connections of the A36 Printed Circuit Board

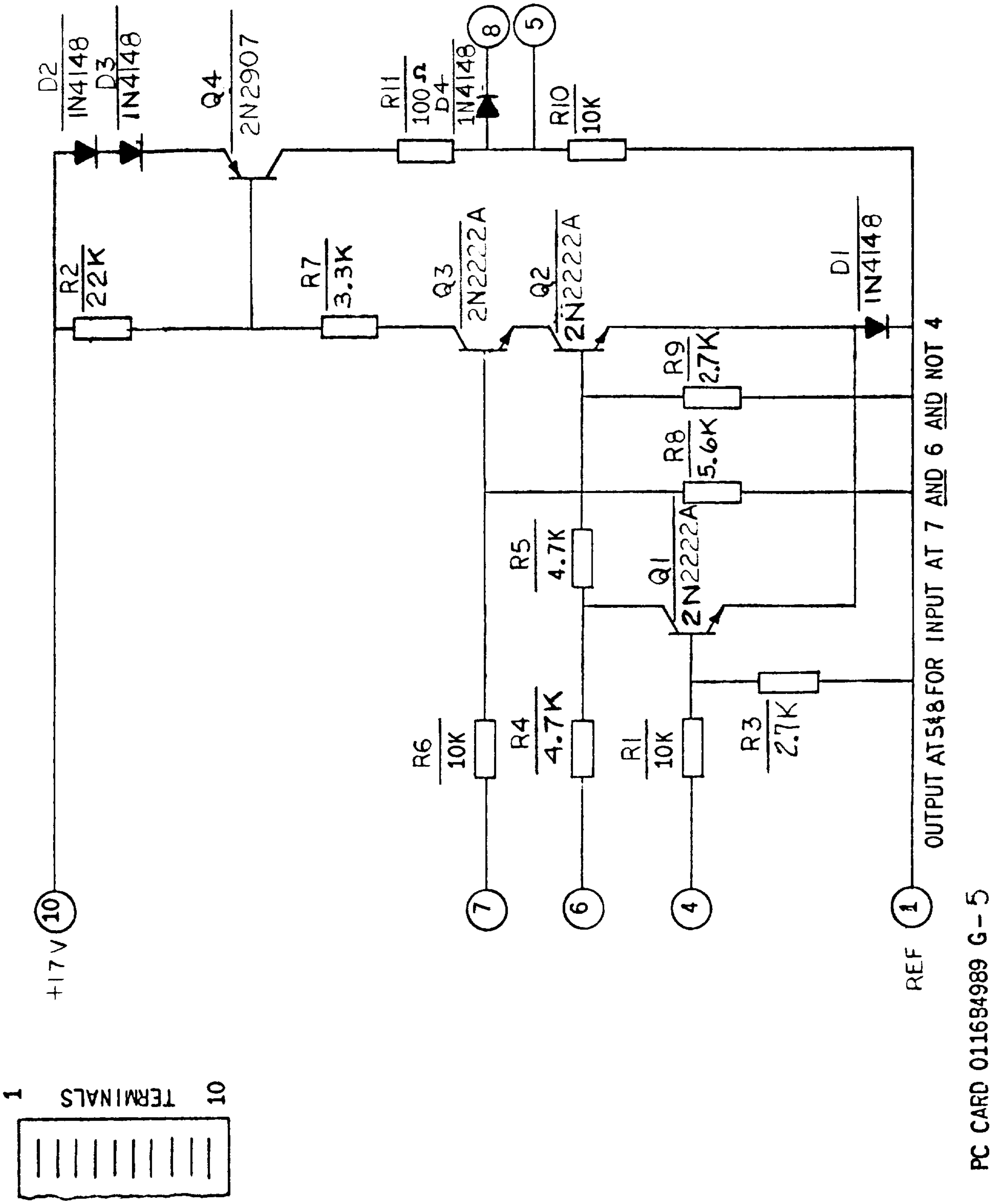


Fig. 8 (0148A3901DE [4]) Internal Connections of the L3 Printed Circuit Board

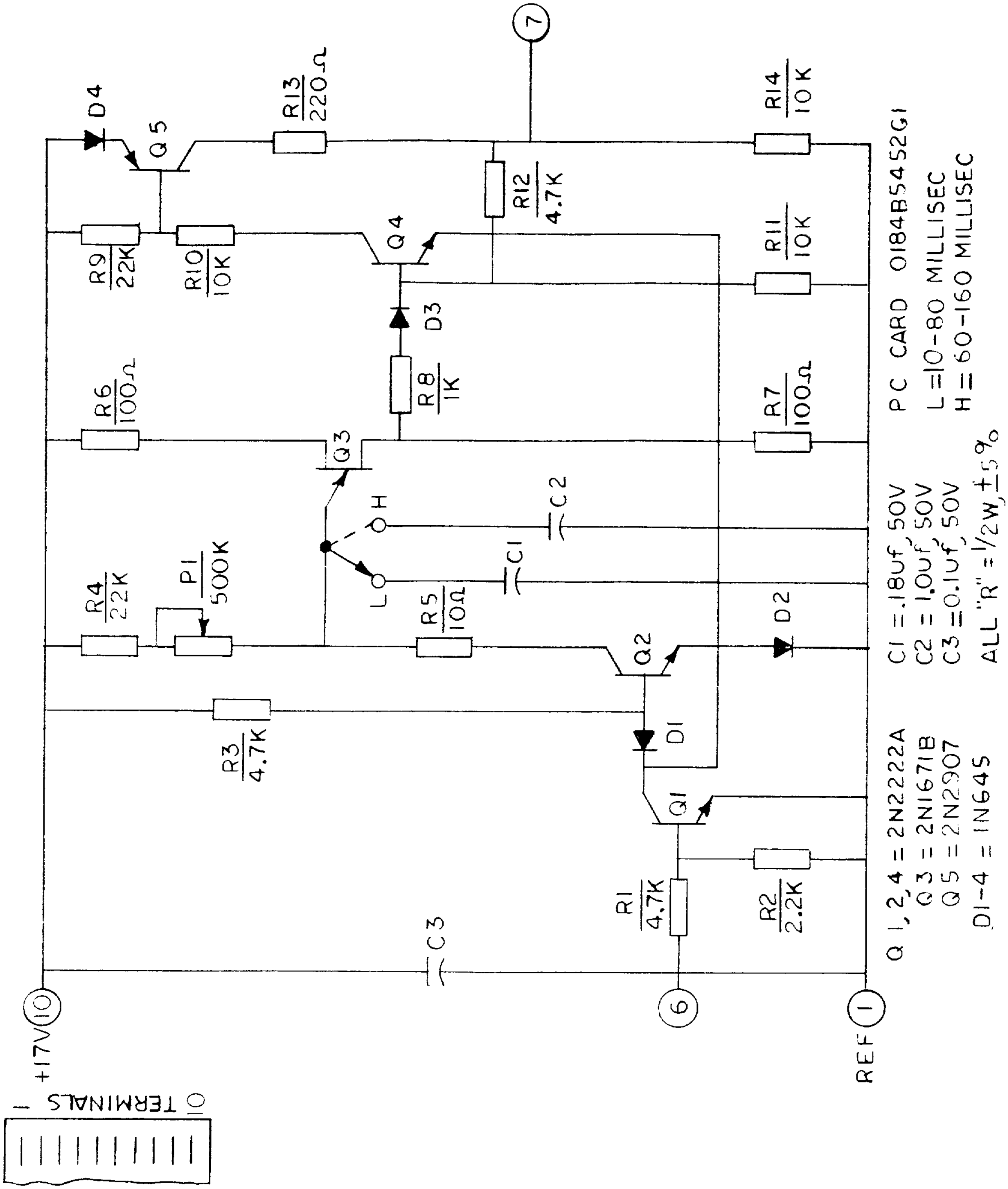


Fig. 9 (0148A3906FH [1]) Internal Connections of the T67 Printed Circuit Board

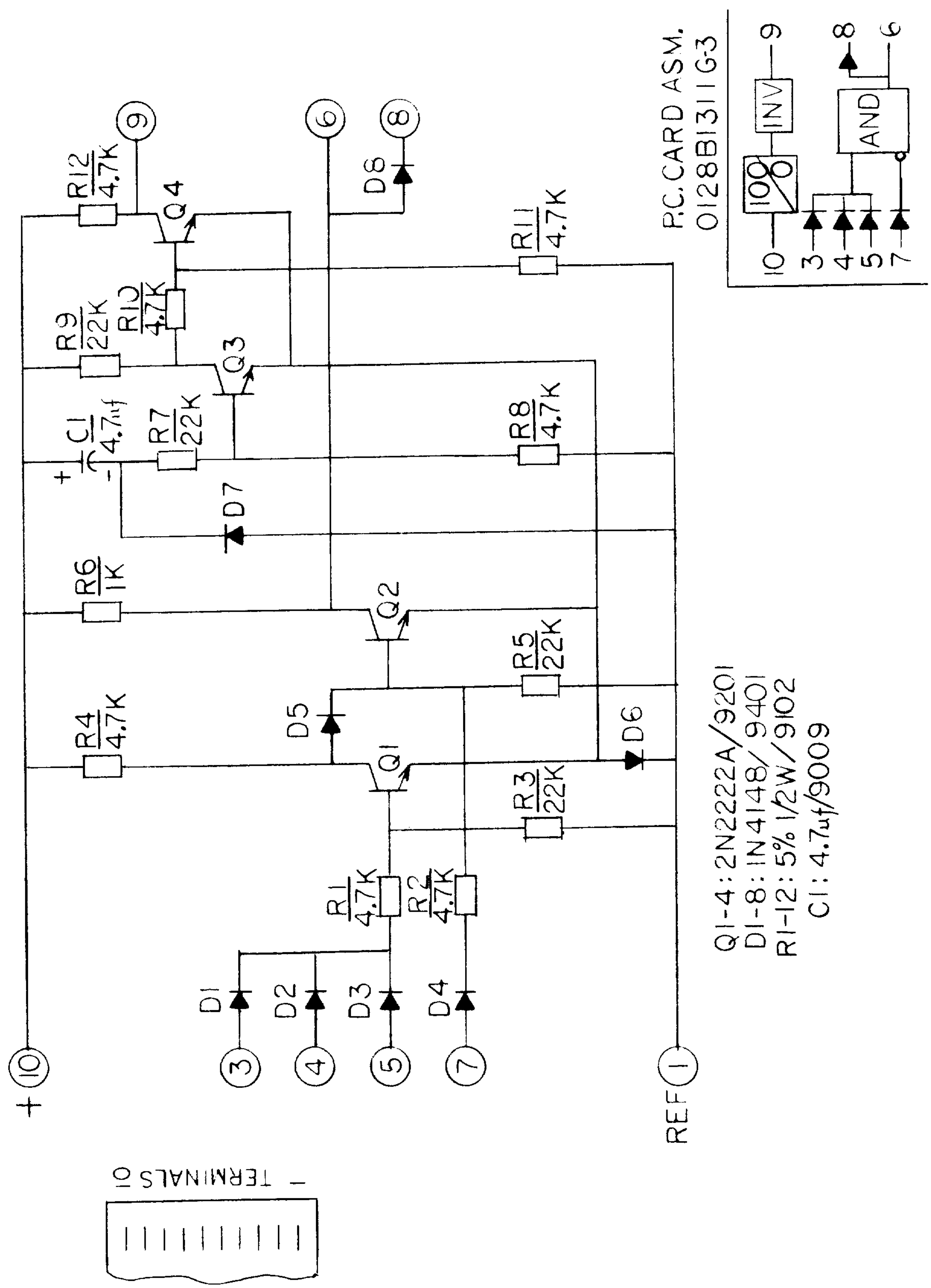


Fig. 10 (0148A3901EW-0) Internal Connections of the L14 Printed Circuit Board

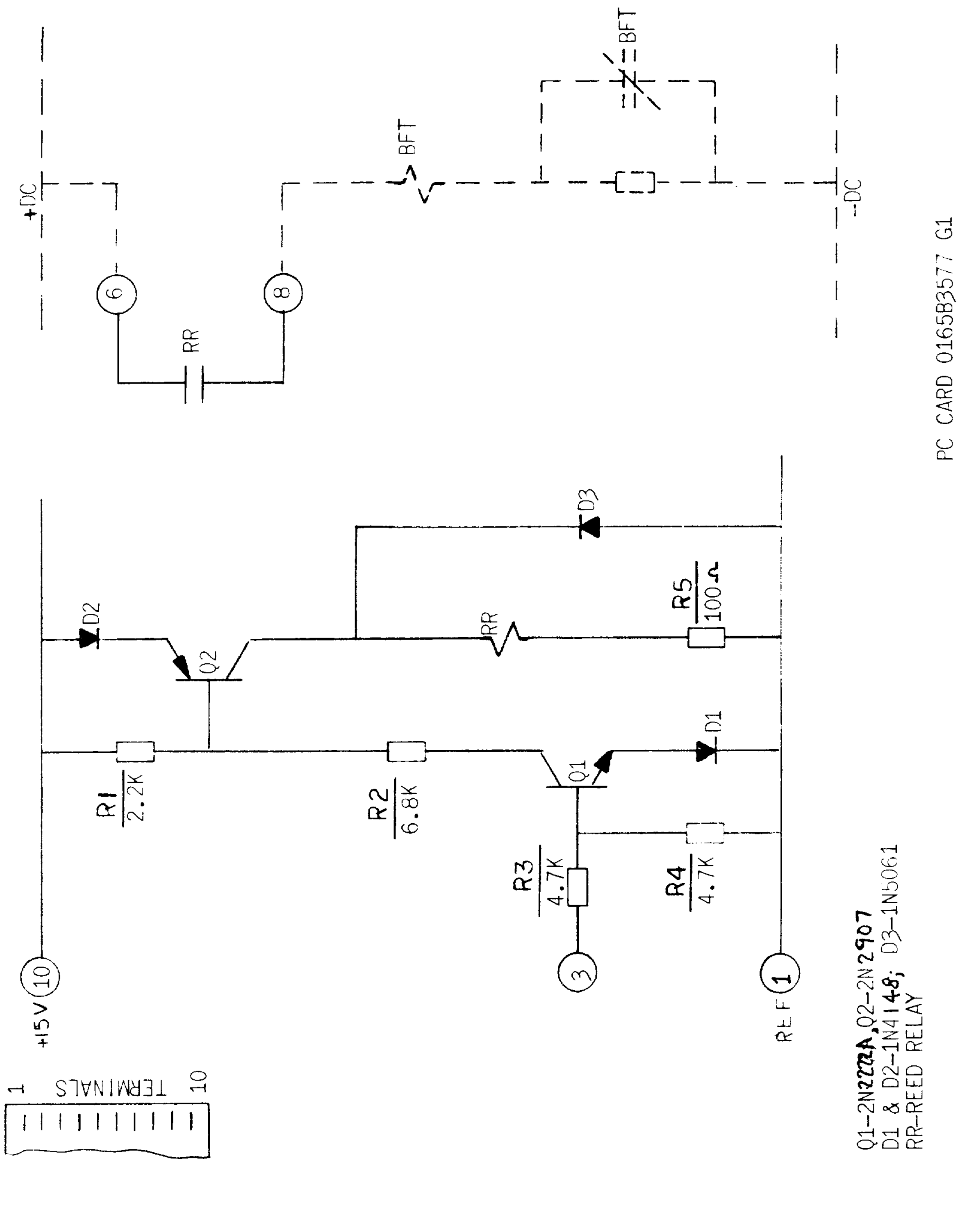


Fig. 11 (0148A3918AF [4]) Internal Connections of the A47 Printed Circuit Board

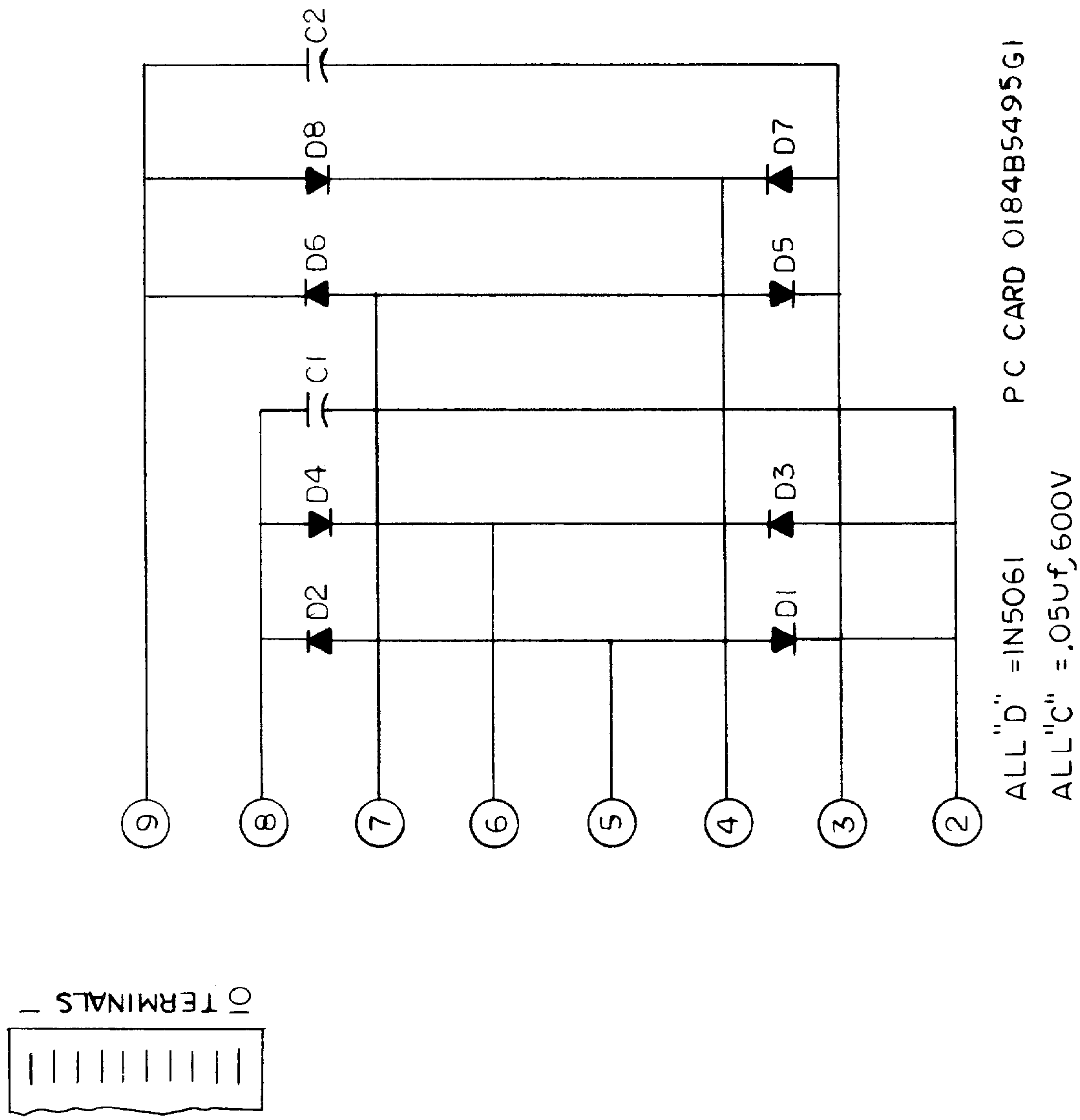


Fig. 12 (0148A3915AE-0) Internal Connections of the A66 Printed Circuit Board

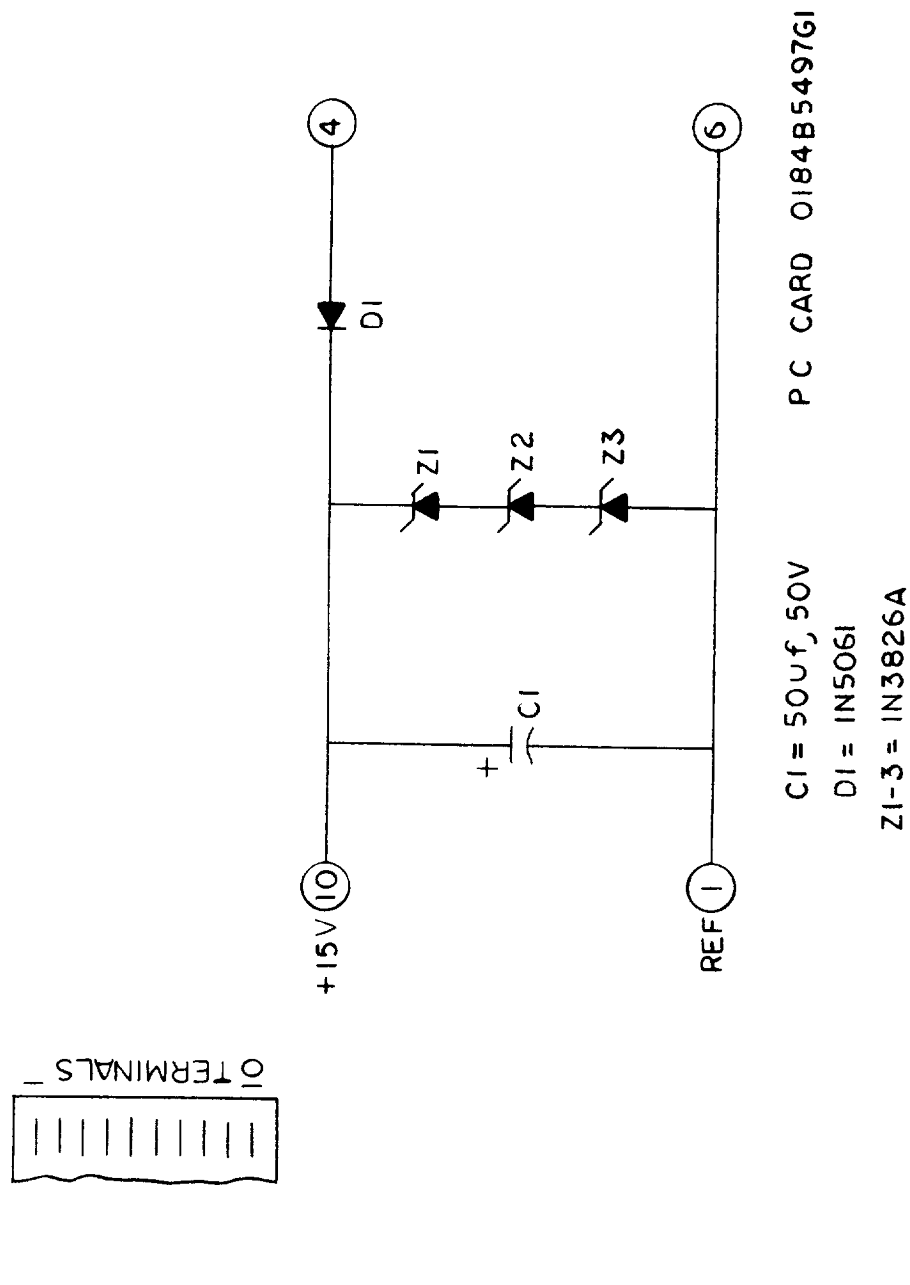


Fig. 13 (0148A3915AF-0) Internal Connections of the A67 Printed Circuit Board

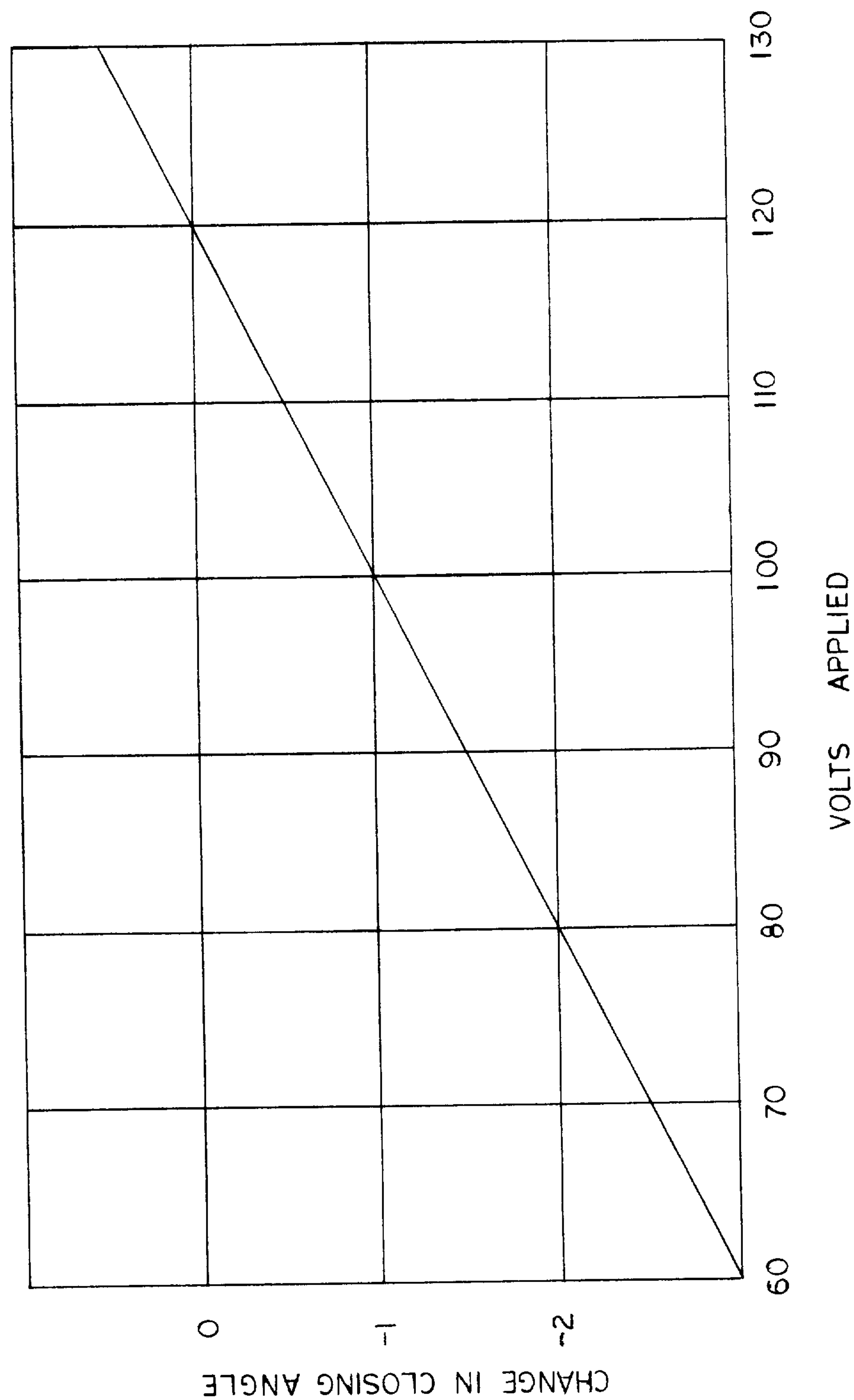


Fig. 14 (0275A2073-0) Typical Voltage - Phase Angle Characteristics

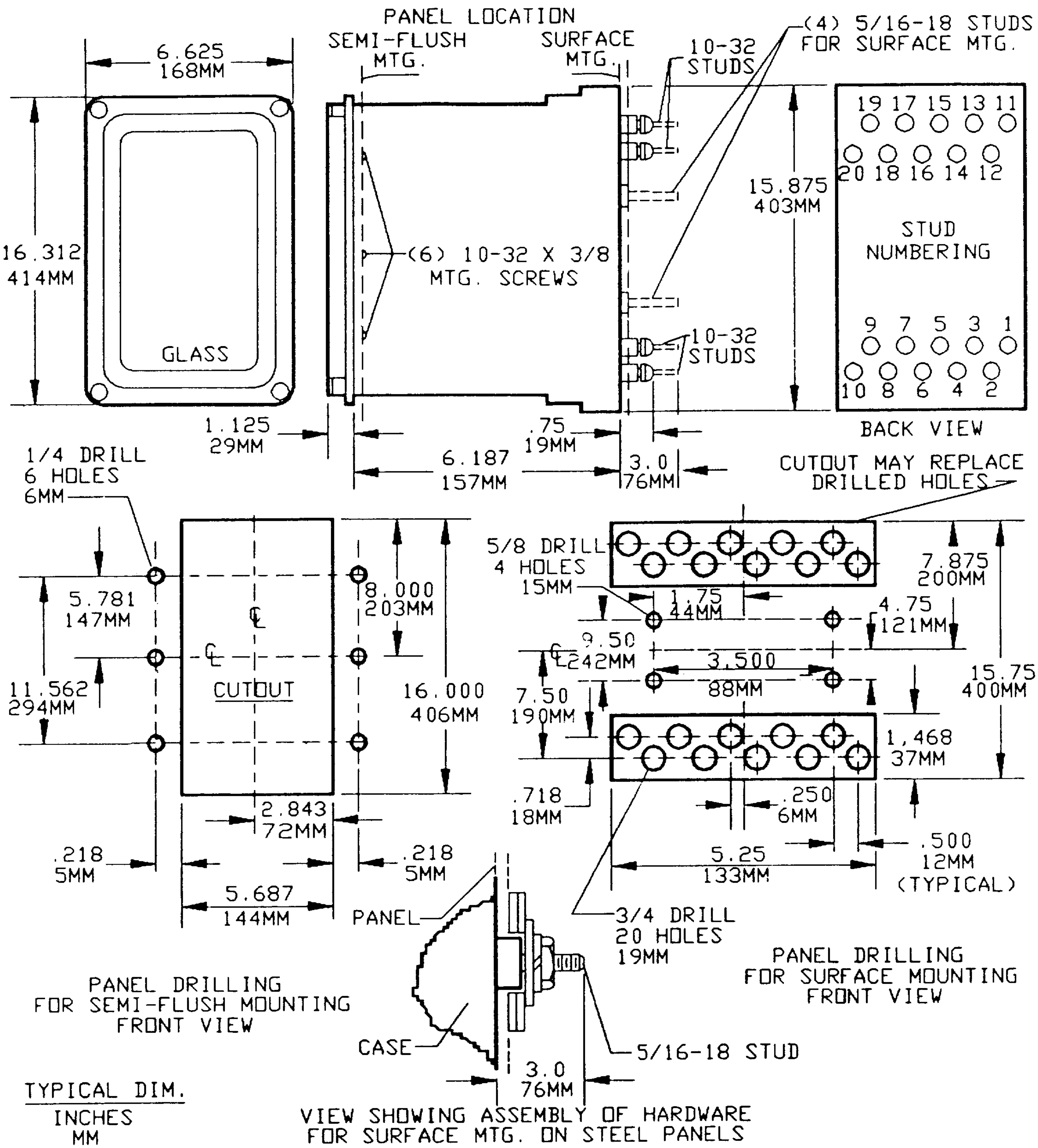


Fig. 15 (K-6209274 [6]) Outline and Panel Drilling for an M2 Case

GE Power Management

215 Anderson Avenue
Markham, Ontario
Canada L6E 1B3
Tel: (905) 294-6222
Fax: (905) 201-2098
www.ge.com/indsys/pm