INSTRUCTIONS

GEK- 34016C

SUPERSEDES GEK-34016B

DC POWER SUPPLY FOR STATIC RELAYS

TYPE SSA50A

GENERAL ELECTRIC

CONTENTS

DC POWER SUPPLY

TYPE SSA50A

INTRODUCTION

The Type SSA50A Power Supply is designed for operation from the station battery to provide an isolated, regulated low-voltage dc supply for use with rack mounted static relays. Components of the power supply are mounted in a metal enclosure as shown in Figure 1, designed for mounting on a standard 19 inch rack. The power supply unit is 2 rack units (3-½") high and 14 inches deep.

APPLICATION

Type SSA50A Power Supply is designed for use with static protective relays which require an isolated, regulated dual 15 volt dc supply (±15 volts with midpoint reference) for logic circuit operation. It is recommended that a battery clamp be used in conjunction with static relays. One clamp should be used *per battery or per physical location. The battery clamp should be connected to the battery supply in a manner that will not permit it to be disconnected or isolated from the equipment it is protecting.

RATINGS

Type SSA50A Power Supply is designed for operation from station battery voltages of 48, 125, or 250 volts dc. The power supply output voltages have nominal values with respect to the reference bus of ±15 volts dc. The positive and negative output circuits each has a maximum current rating of 1.25 amperes.

BURDEN

Maximum current drain of the SSA50A from the station battery is given in the table below.

BATTERY VOLTAGE	CURRENT BURDEN
48 VDC	1.80 AMP
125 VDC	0.70 AMP
250 VDC	0.35 AMP

DESCRIPTION

Components of the power supply may be divided into four functional groups (1) DC to AC inverter, (2) positive rectifier and regulator circuit, (3) negative rectifier and regulator circuit, and (4) over-under voltage alarm protection circuits. The internal connections are shown in Figure 2.

DC TO AC INVERTER

Transistors Q_1 and Q_2, in conjunction with the converter card (Fig. 3), form a DC to AC inverter circuit, whose frequency is approximately 1000 Hz. Transformer T1 provides isolation between the station battery and the desired secondary voltage (33V).

When Q_2 begins to conduct, the voltage induced in the auxiliary winding B3-E3 sustains Q_1 in cutoff and Q2 in saturation. When the transformer T_1 saturates, the decreasing voltage across the driving winding B1-E1 induces a voltage in the auxiliary winding B3-E3 which turns Q1 on. The cycle then continues with Q1 and Q2 conducting alternately.

* Denotes change since superseded issue.

RECTIFIER AND REGULATOR CIRCUITS

In the positive rectifier and regulator circuit, transistors Q_3, Q_4, Q_5 and Q_6, shown in Figure 2, form a series regulator circuit which provides the +15 volts DC logic voltage. The magnitude of the positive logic voltage can be varied by potentiometer P1 which is mounted on the positive regulator card, internal connections of this card is shown in Figure 4.

Zener Z1 and transistor Q_5 form a transistor preregulator which serves as a constant current source for the regulator. If the output voltage increases due to an increase in the battery voltage, the current through transistor Q_6 increases, which decreases V_{BE} of transistor Q_4 and lowers the current through transistor Q_3. This tends to decrease the output voltage, the net result is a constant output voltage. Conversely, if the output voltage decreases, the current through transistor Q_6 decreases, V_{BE} of transistor Q_4 increases and the current through transistor Q_3 increases. This tends to increase the output voltage and results in a constant voltage. The negative rectifier and regulator circuit operates in a similar manner to provide an output of -15 volts dc. Magnitude of the negative logic voltage can be varied by potentiometer P2 which is mounted on the negative regulator card, internal connections of this card is shown in Figure 5.

ALARM CIRCUITS

Type SSA50A power supply is provided with an under-over voltage detector X3 which activates a lamp and a transfer contact that are brought out for connection to a station alarm. Under normal voltage conditions detector relay X3, which is connected across the positive and negative dc outputs, is energized by the operation of the normally open contacts of positive (X1) and negative (X2) circuit alarm relays.

In the positive alarm circuit during normal operating conditions, zener Z5 conducts, transistor Q8 conducts, Q9 does not conduct, Q10 conducts and the positive alarm relay X_1 is energized. If the output voltage drops below 13 volts dc, Z_5 ceases to conduct, turning Q_8 off, and causing Q_9 to conduct. When transistor Q_9 conducts, Q_{10} is prevented from conducting and the alarm relay X_1 is de-energized. If the output voltage exceeds 16 volts dc, Z_4 begins to conduct thus turning on Q_7. When Q_7 conducts, Q_{10} is turned off and the alarm relay X_1 is de-energized. The negative alarm circuit operates in a similar manner monitoring the operation of the negative alarm relay X_2.

De-energization of either one or both of the alarm relays, X_1 and X_2, will de-energize under-over-voltage detector relay X_3 activating the alarm lamp and the contacts to the external alarm. The contacts of the detector relay will make and carry 3 amperes continuously, and interrupt 0.5 amperes inductive at 125 volts dc, or 0.25 amperes inductive at 250 volts dc.

OVERCURRENT PROTECTION

A double pole circuit breaker is connected in the regulator circuits with one pole in each of the two regulator circuits. Each pole has a 2 ampere rating and are mechanically connected so that in case of a short circuit or the regulator goes into an overvoltage condition both poles trip,de-energizing both outputs, energizing the alarm lamp,and the station alarm through the detector relay contacts. The circuit breaker is identified as BR1-A and BR1-B in Figure 2.

EXTERNAL BATTERY CLAMP

A. DESCRIPTION

* The battery clamp provides protection against transient voltages which may appear on the station battery leads at the relay or cabinet external connections terminal block. The Type SDA50A battery clamp's internal connection diagram is shown in Figure 6 and outline diagram is shown in Figure 7. This battery clamp is commonly used with this type power supply.

The function of the battery clamp is twofold. The first is to absorb transients which may appear between the battery leads. This is accomplished without allowing a significant voltage change between either lead and the Relay Surge Ground.

Second, it prevents an incoming surge voltage from causing either the positive or negative battery lead to be driven more than a limited potential difference from the relay ground. The positive battery supply lead can not assume a positive potential greater than battery voltage, nor a negative potential of more than one volt relative to Relay Surge Ground; and the negative battery supply lead can not assume a negative potential greater than battery voltage, nor a positive potential or more than one volt relative to Relay Surge Ground.

* Denotes change since superseded issue.

B. NORMAL OPERATING CONDITION

Under normal operating conditions in most stations, the battery voltage is divided by ground indicating lamps, or by other high impedance devices, so that each battery lead is one half of the battery voltage relative to the Relay Surge Ground. The battery clamp, which is connected to the supply circuits as shown in Figure 8A, rests with capacitors C_1, C_2, C_3, and C_4 charged to one half of battery voltage. Diodes D_1 and D_2 have this voltage impressed across them in the reverse or blocking direction.

C. SOLENOIDS AS SURGE VOLTAGE SOURCES

The voltage induced in a solenoid operating coil when the current through the coil is interrupted is determined only by the rate at which the coil current is forced to decay. If the interrupting contact parts rapidly enough, and if the insulation surrounding the contact is weak, this induced voltage may be sufficient to establish an arc to ground. The voltage drop across the arc will be relatively low and constant. If the battery clamp is not used, the remaining impedance in the arc current path is the battery ground lamp. Figure 8B illustrates these conditions.

The collapsing magnetic field of the coil tends to maintain the original magnitude of current flowing in the coil turns, and this current must be driven through the high impedance of the ground lamp. Consequently, a high voltage appears across the lamp. The result is a large voltage swing on the battery leads with respect to ground. The polarity of this voltage causes the lead to which the coil is directly connected to assume a potential with respect to ground which is opposite from normal.

D. BATTERY CLAMP OPERATION

If the conditions described in Section C and shown in Figure 8B exist, the negative battery lead might be driven as much as 1.5K positive with respect to ground (or the positive lead driven negative with respect to ground). Placing a low impedance, such as the forward impedance of a rectifier, between the lead and ground, in parallel with the ground lamp will limit the voltage swing of that lead. This is shown in Figure 8C.

With this connection, the solenoid current has a low impedance path through which to flow to dissipate the energy in its magnetic field. The induced voltage is thereby kept low, and the battery lead is held within one volt of ground potential, one volt being the approximate voltage drop across the rectifier. Since one battery lead is clamped at ground, the maximum value that the other lead can assume is either plus or minus battery voltage depending upon which lead is grounded. If a rectifier is placed between each lead and ground, both leads will be clamped at ground potential.

E. LOW ENERGY TRANSIENTS BETWEEN BATTERY LEADS

In the previous paragraphs, it was assumed that the battery leads were held by the battery at a constant potential difference. Because these leads have self-inductance, a current flow in them results in stored energy that must be disspated when the current is interrupted. Since the induction is small, the total stored energy is low, but the voltage of self-inductance when the current is interrupted rapidly may be very high. However, this energy can be absorbed by the battery clamp capacitor (C_5) with only a small change in the voltage between the leads. The stored energy is thereby transferred to the capacitors and ultimately dissipated in the load circuit without a significant voltage change between the Relay Surge Ground and either of the battery leads at the location of the ground lamps.

CONSTRUCTION

All power supply components are mounted in a metal enclosure two rack units in height. Both the cover and the bottom of the power supply are perforated steel to allow for ventilation of the heat sinks.

External connections to the power supply are made at the back of the unit. Sockets for interconnecting the power supply output with the static relay logic units are marked PS. A ten point socket marked "C091" is used for certain pilot channel schemes. Arrangement of these sockets are shown on the SSA50A component location drawing in Fig. 9.

The PA terminal strip on the rear of the SSA50A power supply has screw terminals for external connections. The power supply unit will normally be supplied with a cable attached to this terminal strip with a dropout relay cable block on the end of the cable. This arrangement is designed for use with a test and connection receptacle. All receptacles for a terminal of equipment are usually mounted on a common test panel.

The cable block is inserted into the test and connection receptacle from the rear and is locked in place with two mounting screws. A standard drawout case connection plug then completes the circuit when inserted from the front of the panel. A Type XLA relay test plug may be used to make tests in the conventional manner.

Three test points are brought out to the front panel providing access to the two output voltages and reference.

WARNING: THE LOGIC SYSTEM SIDE OF THE TYPE SSA50A DC POWER SUPPLY USED WITH 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 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. A SECOND GROUND CONNECTION TO THE EQUIPMENT, SUCH AS A TEST LEAD INADVERTANTLY 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.

The following tests should be made to insure that the SSA50A power supply is operating correctly.

1. Connect (+) battery lead to PA2, (-) battery lead to PA3, and station ground to PA1. Check that the overcurrent circuit breaker is closed.

2. The power supply output voltages may be checked at the test jacks provided on the front of the unit. All voltages are with respect to reference (TJ2). With rated battery voltage applied the positive output voltage at TJ3 should be (+) 15 volts, corrections can be made by adjusting pot P1 on the front regulator card; the negative output voltage at TJ1 should be (-) 15 volts, corrections can be made by adjusting pot P2 on the rear regulator card.

3. Power supply regulation can be checked by connecting an adjustable load resistor across positive output pins 1 and 4 of any PS socket. Apply rated dc voltage, adjust load resistor for 1.25 ampere, and check that the positive output voltage reading is between (+) 14.9 - (+) 15.1 volts dc. Reduce input voltage to 80 percent of rating with same load and check that the positive output voltage reading is between (+) 14.9 - (+) 15.1 volts dc. The negative output circuit regulation can be checked in a similar manner after connecting the adjustable load resistor across pins 1 and 3 of the PS socket. Output voltage readings are to be between (-) 14.9 - (-) 15.1 volts dc.

4. The operation of the output breaker (BR1) can be checked by connecting an adjustable load resistor across one of the output circuits, adjust the load for 3 amperes and check for a trip in 10 seconds or less. This test can be repeated on the other output circuit to check both poles of the breaker.

5. The under voltage alarm relay may be checked as follows:

   a. Decrease the input dc voltage until the power supply output voltage drops below the rated voltage of Z5 (Z11) (approximately 13 volts). This will cause the alarm relays to drop out, energizing the alarm light.

   b. Open the breaker (BR1) on the front panel. This again will energize the alarm lamp.

6. To test the overvoltage alarm circuits, it is necessary to remove the unit top cover, and increase the output voltage by adjusting P1 on the positive regulator card or P2 on the negative regulator card. The overvoltage alarm should operate when Z_4 (Z_{10}) begins to conduct (approximately 18 volts).

RECEIVING, HANDLING AND STORAGE

These relays will normally be supplied as a 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 from maintenance. These shipping support bolts are approximately 8 inches back from the relay unit 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.

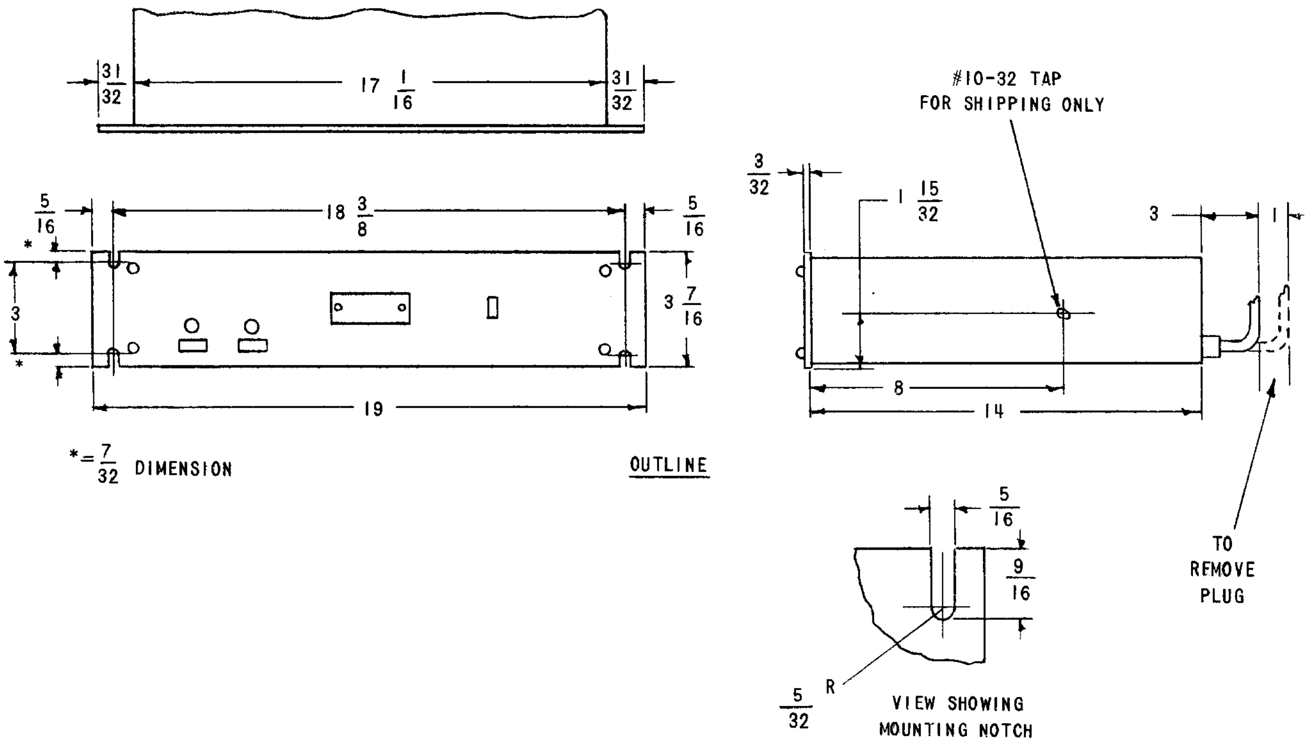
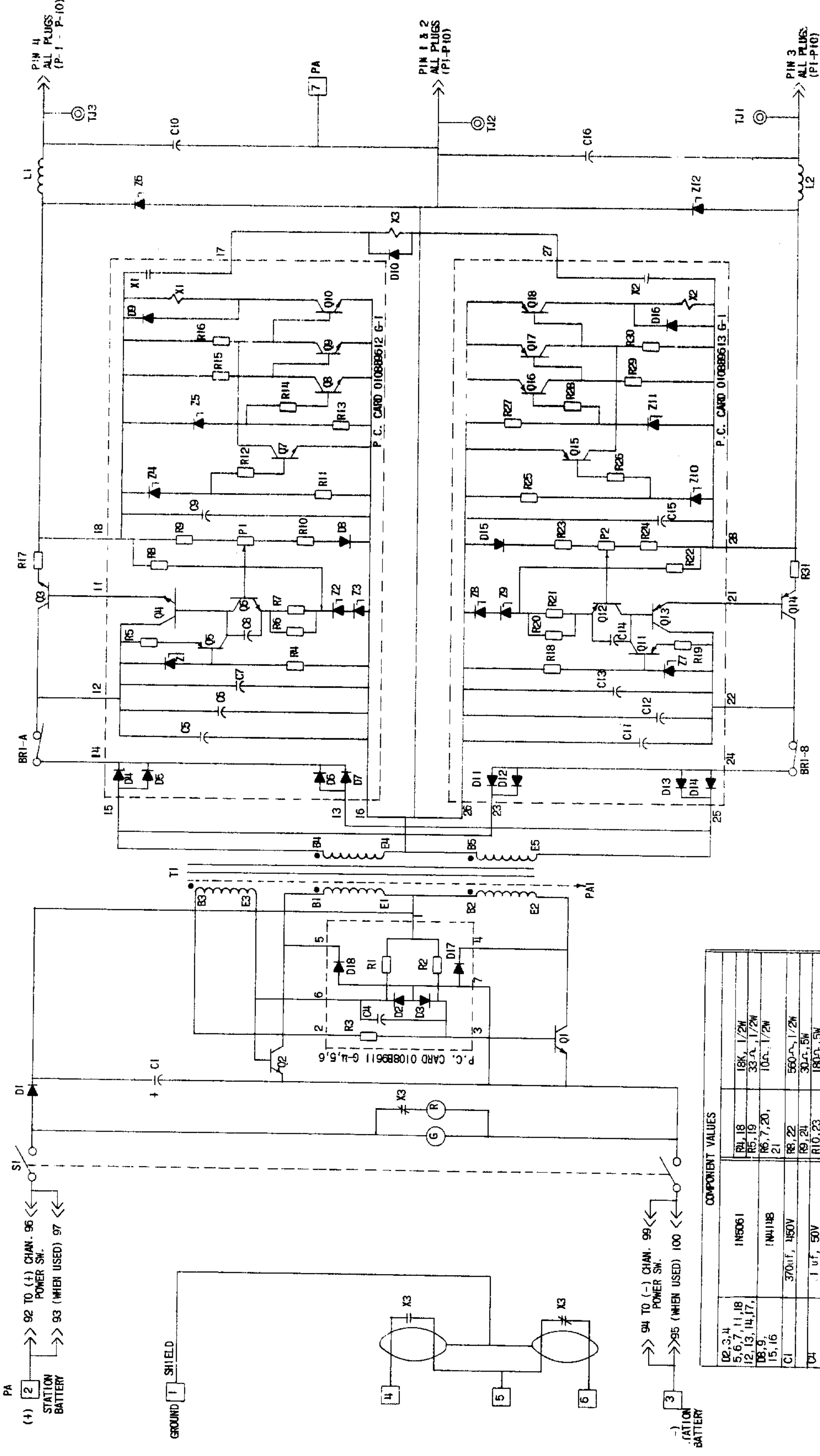


FIG. 1 (0165A7663-4) Outline And Mounting Dimensions SSA50A Power Supply (2 Rack Unit)

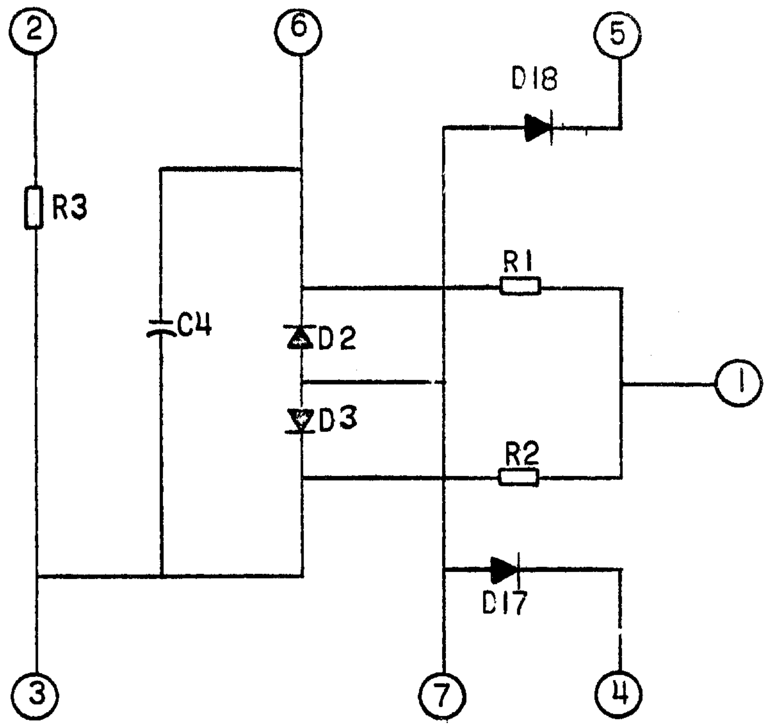


COMPONENT VALUES			
D2,3,4 5,6,7,11,18 12,13,14,17,	1N5061	R4,18	18K, 1/2W
		R5,19	33Ω, 1/2W
D8,9, 15,16	1N4148	R6,7,20, 21	10Ω, 1/2W
C1	370uf, 450V	R8,22	560Ω, 1/2W
		R9,24	30Ω, 5W
C4	1 uf, 50V	R10,23	180Ω, 5W
C5,6,7,9, 11,12,13, 15	5 uf, 50V	R11,13,15 25,27,29	47K, 1/2W
C8,14	1 uf, 50V	R12,14, 26,28	1K, 1/2W
P1 & 2	75Ω, 12.5W		
X1,2	1200Ω RELAY	R30,16	10K, 1/2W
L1 & 2	68 uh, 2 AMPS	R17,31	3Ω, 10W
C10,16	250uf, 50V		

COMPONENT VALUES			
Z1,7	1N4371A (2.7V)	Q3	2N3713
Z2,3,8, 9	1N3826A (5.1V)	Q14	2N3789
		Q4,11	2N3766
Z4,10	1N3025B (16V)	Q5,13	2N3740
Z5,11	1N3023B (13V)	Q6,7,8, 9,10	2N2868
Z6,12	1N3316B (17V)		
X3	5KΩ RELAY	D12,15,16 17,18	2N2905

COMPONENT VALUES			
DESCRIPTION	48V	125V	250V
D1	1N2155	1N2155	1N2158
Q1,Q2	DTS 411	DTS 423	DTS 425
R1 & 2	6K, 10W	12K, 10W	25K, 10W
T1 0108B9619	G1	G2	G3
R3	15Ω, 5 ¼ W	39Ω, 2W	39Ω, 2W

FIG. 2 (0149C7218-5) Internal Connections, SSA50A Power Supply



R1, R2 { 6K, 10W-48V; 12K, 10W-125V; 25K, 10W-250V

R3 - { 15Ω. 5 1/4W - 48V; 39Ω, 2W - 125V, 250V

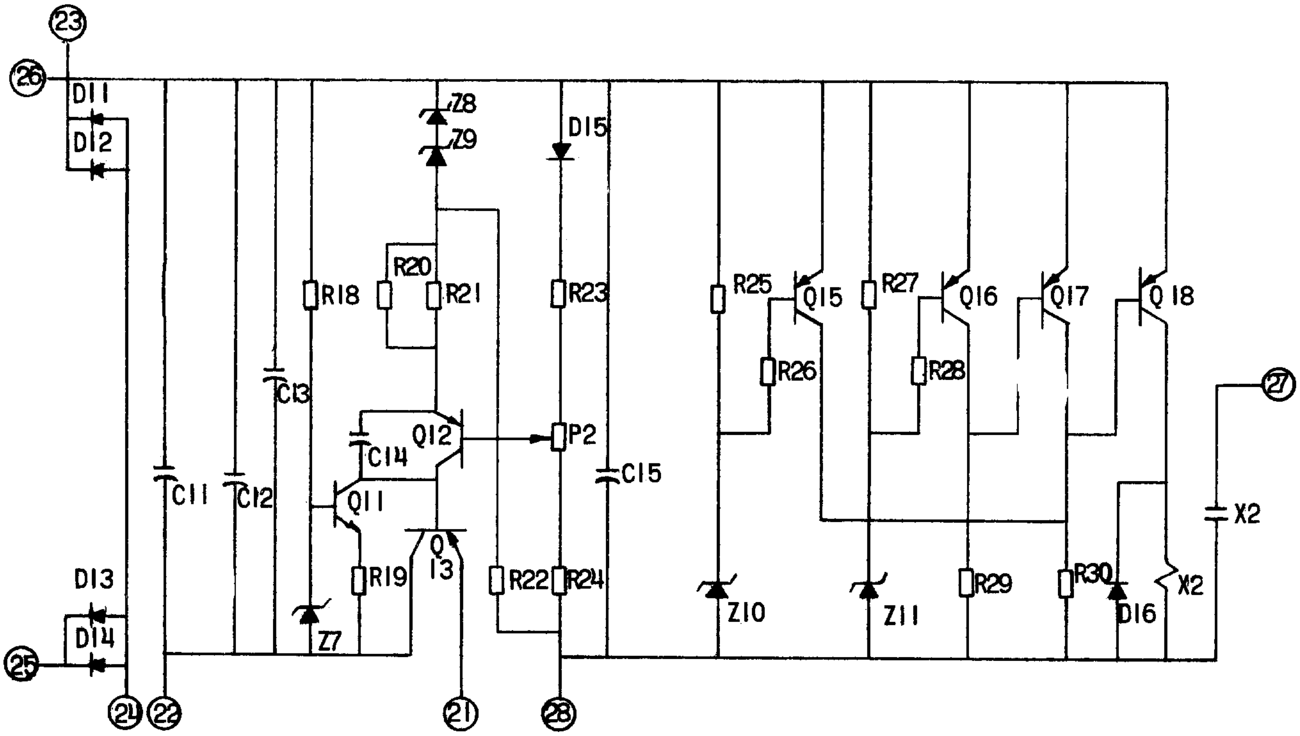
C4 - .1 uf, 50V

D2, D3 - IN5061

D17, D18

P.C. CARD - 0108B9611 G-4 (48V)
0108B9611 G-5 (125V)
0108B9611 G-6 (250V)

FIG. 3 (0227A2111-2) Internal Connections For The SSA50A Converter Card



D11 TO D14 IN5061
D15 TO D16 IN4148
C11 TO C13, C15 - 5uf 50V
C14 - 1uf. 50V

P2 - 75Ω 12.5W
X2 - 1200Ω RELAY

R18 - 18K 1/2W
R19 - 33Ω 1/2W
R20, R21 - 10Ω 1/2W
R22 - 560Ω 1/2W
R23 - 180Ω 5W
R24 - 30Ω 5W

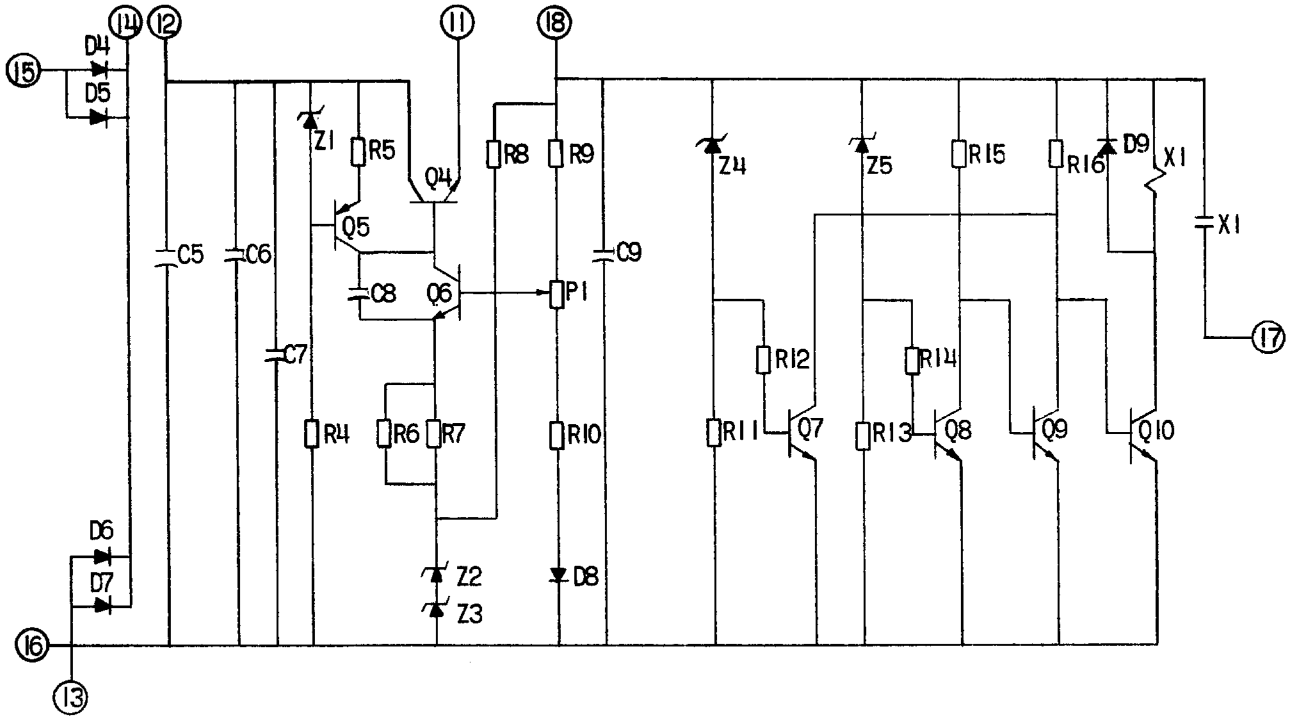
R25, R27, R29 - 47K 1/2W
R26, R28 - 1K 1/2W
R30 - 10K 1/2W

Q11 - 2N3766
Q12, Q15 TO Q18 - 2N2905
Q13 - 2N3740

Z7 - IN4371A
Z8, Z9 - IN3826A
Z10 - IN3025B
Z11 - IN3023B

P.C. CARD - 0108B9613 G-1

FIG. 4 (0227A2026-1) Internal Connections For The SSA50A Positive Regulator Card



D4 TO D7 - IN5061
D8 TO D9 - IN4148
C5 TO C7, C9 - 5uf, 50V
C8 - 1uf, 50V

P1- 75 Ω 12.5W
X1-1200 Ω RELAY

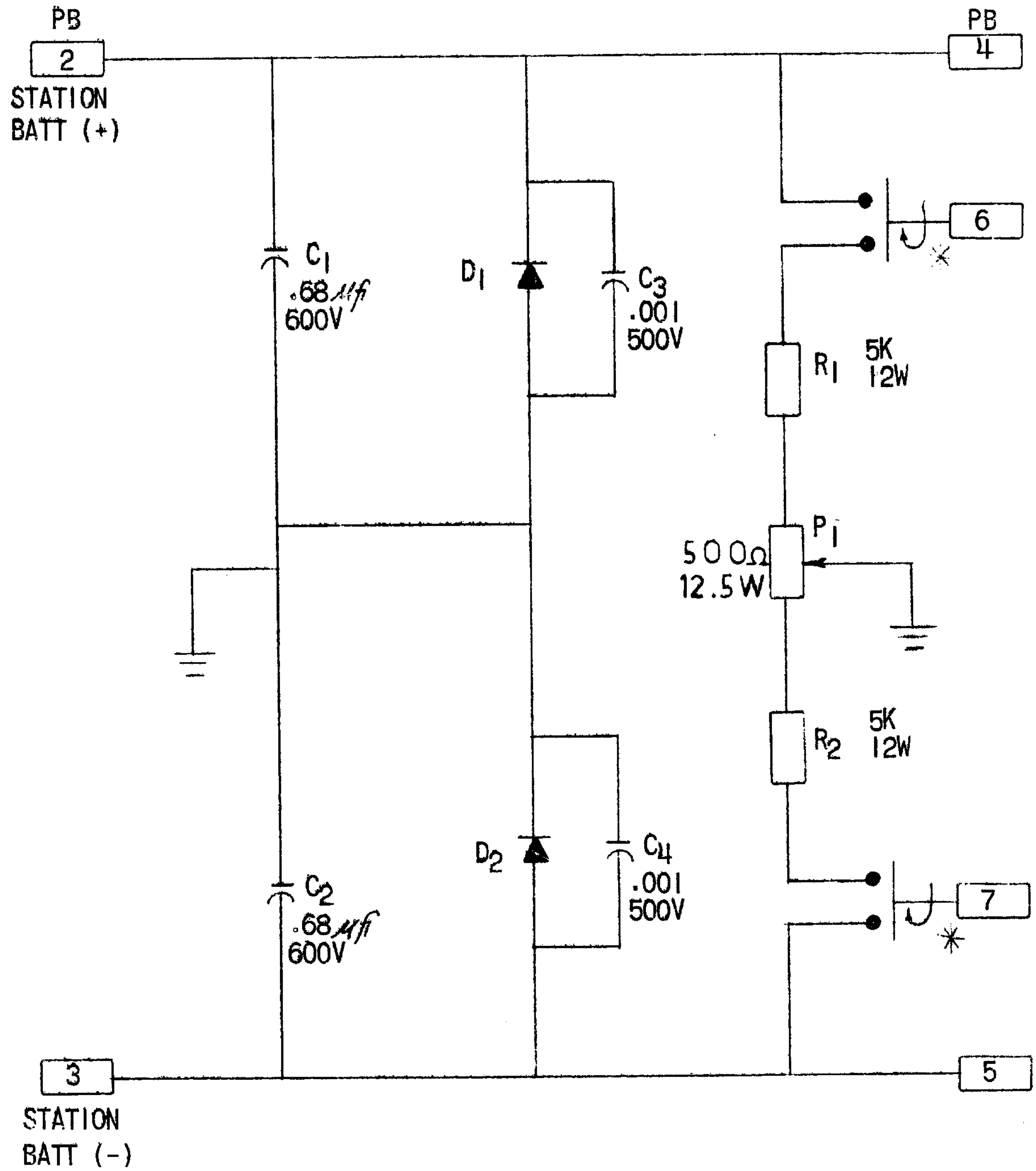
P.C. CARD - 0108B9612 G-1

Q4 - 2N3766
Q5 - 2N3740
Q6 TO Q10 - 2N2868

Z1 - IN4371A
Z2, Z3 - IN3826A
Z4 - IN3025B
Z5 - IN3023B

R4 - 18K 1/2W
R5 - 33 Ω 1/2W
R6, R7 - 10 Ω 1/2W
R8 - 560 Ω 1/2W
R9 - 30 Ω 5W
R10 - 180 Ω 5W
R11, R13, R15 - 47k 1/2W
R12, R14 - 1K 1/2W
R16 - 10K 1/2W

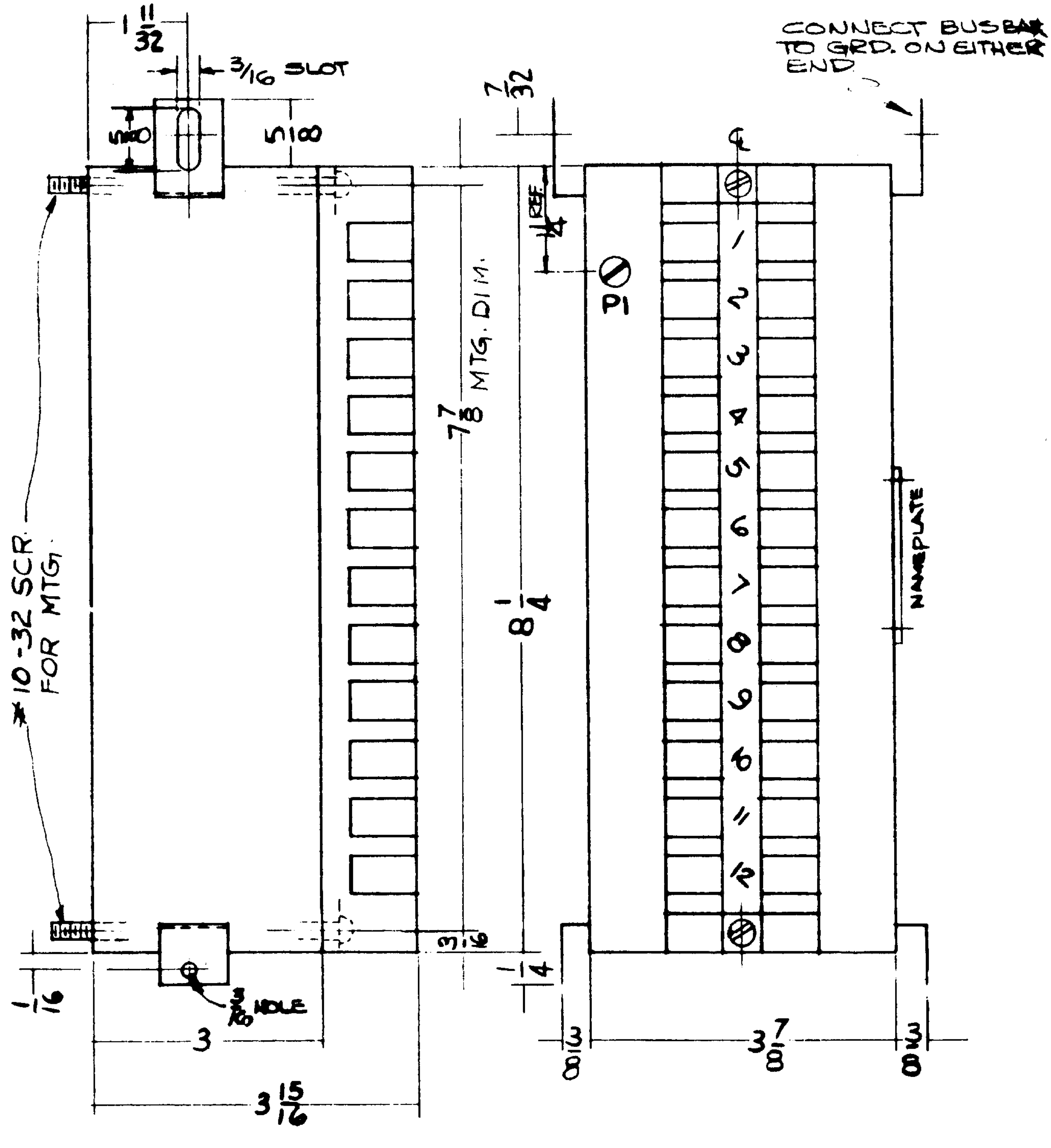
FIG. 5 (0227A2027-1) Internal Connections For The SSA50A Negative Regulator Card



* DISCONNECTS ON THE NUMBER 6 AND 7 POSITION OF TERMINAL BLOCKS ARE FOR OPTIONAL CONNECTION TO RESISTOR DIVIDER

⏚ BUS BAR, RIGHT SIDE, FRONT VIEW, WITH TERMINAL 1 AT TOP

* FIG. 6 (0227A2136-2) Internal Connections for Type SDA50A Battery Clamp Commonly Used with the Type SSA50A Power Supply



* FIG. 7 (0227A2137-1) Outline and Mounting Dimensions for the SDA50A Battery Clamp Commonly Used with the Type SSA50A Power Supply

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