

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

DEPARTMENT OF THE AIR FORCE TECHNICAL ORDER

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POWER SUPPLIES

PP-109/GR
AND
PP-112/GR



DEPARTMENTS OF THE ARMY AND THE AIR FORCE
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POWER SUPPLIES PP-109/GR AND PP-112/GR

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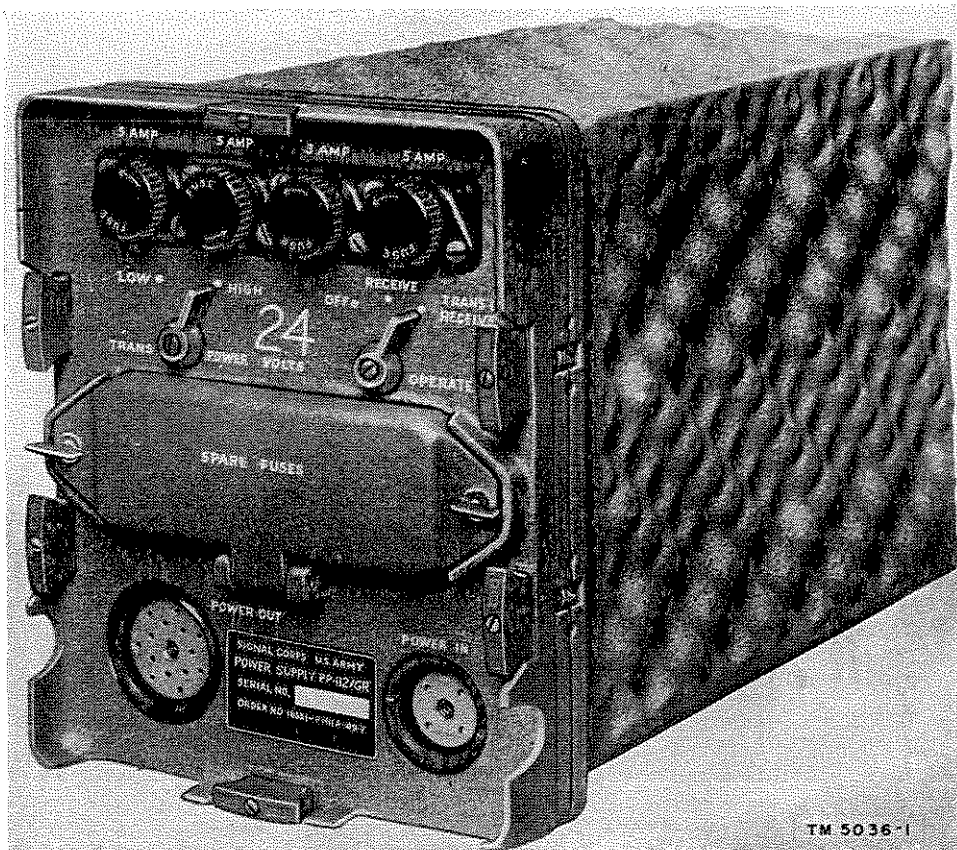


Figure 1. Power supply PP-112/GR.

CHAPTER 1

INTRODUCTION

Section I. GENERAL

1. Scope

a. This manual contains information pertaining to the description and theory of Power Supplies PP-109/GR and PP-112/GR (fig. 1). It also provides instructions for the maintenance, repair, and test of these units.

b. The two power supplies referred to above are alike in most respects, and they are described simultaneously in this manual. Where specific differences exist between the units, these differences are described with specific reference to the particular unit involved.

2. Forms and Records

The following forms will be used for reporting unsatisfactory conditions of Army equipment and when performing preventive maintenance:

a. DD Form 6, Report of Damaged or Improper Shipment, will be filled out and forwarded as prescribed in SR 745-45-5 (Army); Navy Shipping Guide, Article 1850-4 (Navy); and AFR 71-4 (Air Force).

b. DA Form 468, Unsatisfactory Equipment Report, will be filled out and forwarded to the Office of the Chief Signal Officer as prescribed in SR 700-45-5.

c. DD Form 535, Unsatisfactory Report, will be filled out and forwarded as prescribed in SR 700-45-5 and TO 00-35D-54.

d. DA Form 11-239, Second and Third Echelon Maintenance Check List for Signal Corps Equipment (Radio Communication, Direction Finding, Carrier, Radar) will be prepared in accordance with instructions on the back of the form (fig. 7).

e. Use other forms and records as authorized.

Section II. DESCRIPTION AND DATA

3. Purpose and Use

a. Power Supplies PP-109/GR and PP-112/GR are vibrator-type power supplies that derive power from 12- and 24-volt storage batteries, respectively, to supply plate, filament, bias, and relay voltages (par. 5).

b. The units are designed specifically to provide operating power for any one of Receiver-Transmitters RT-66/GRC, RT-67/GRC, and RT-68/GRC (TM 11-289). Means are provided for supplying power for the receiver only, or for both the receiver and the transmitter. In addition, provisions are made to allow either high- or low-power operation of the transmitter section of the receiver-transmitters.

c. When used to supply power for receiving only, the power supplies can be operated continuously. When used alternately for transmitting and receiving, the power supplies should not be used for more than 5 minutes of continuous operation. If the power supplies are used to furnish transmitter power continuously for 5 minutes, an interval of at least 15 minutes should be allowed before transmitting again. During

the 15-minute interval, the power supplies can be used to furnish power for reception. The intervals between transmissions may be shorter than 15 minutes when transmission has not been continuous for 5 minutes.

4. System Application

(fig. 2)

a. Power Supply PP-109/GR or PP-112/GR is used in conjunction with Receiver-Transmitter RT-66/GRC, RT-67/GRC, or RT-68/GRC in any storage battery installation. Figure 2 is a simplified block diagram of a system in which the power supply is used to provide the necessary operating potentials.

b. The OPERATE switch controls the application of battery power to the power supply. When this switch is on RECEIVE or TRANS & RECEIVE, plate and filament voltages for the receiver are available at the POWER OUT connector terminals.

c. When the power supply is turned on, a relay supply voltage and a control lead voltage are made available at the POWER OUT connector. The relay supply voltage is used to energize control

relays in the receiver-transmitter when an external control is closed.

d. Plate and filament voltages for the transmitter are controlled by the OPERATE switch and another switch (on the operator's microphone or control board). When the OPERATE switch is in the TRANS & RECEIVE position, and the external control is activated, first the receiver-

transmitter relays are energized and then the transmitter power supply relay is energized. This causes transmitter plate and filament voltages to become available (fig. 2). The operation of the power supply in any system is described in the technical literature for the particular system. Details of the functioning of the controls for the power supply are in chapter 2.

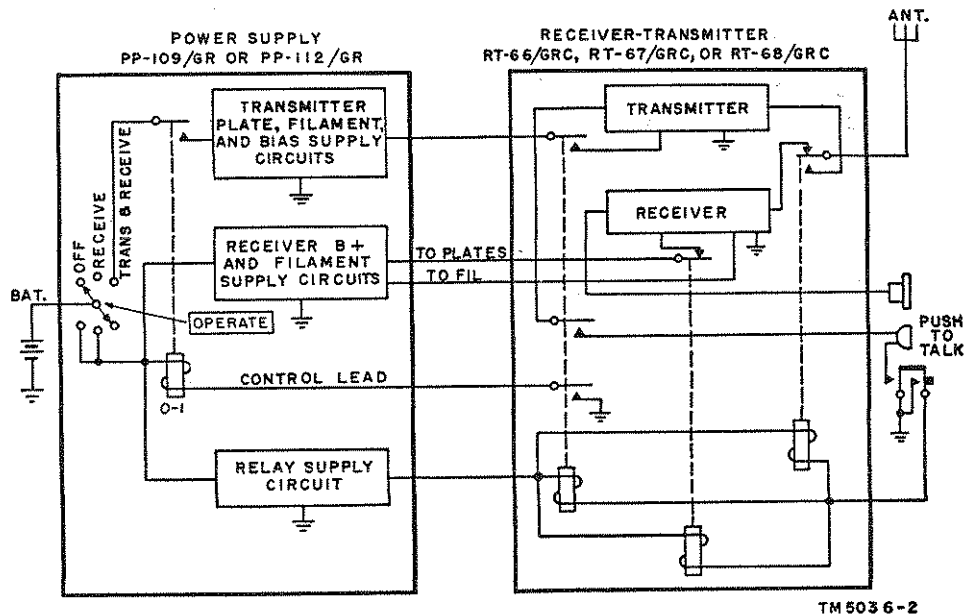


Figure 2. Power Supply PP-112/GR or PP-109/GR, system application.

5. Technical Characteristics

Rated input voltage:	
Power Supply PP-112/GR.....	25.2 volts dc.
Power Supply PP-109/GR.....	12.6 volts dc.

Rated input current:	
Power Supply PP-112/GR.....	7.0 amperes.
Power Supply PP-109/GR.....	11.5 amperes.

Power for filament and control circuits:			
		<i>High power</i>	<i>Low power</i>
Receiver filaments.....	6.3 volts dc (595 ma).....		6.3 volts dc (595 ma).
Transmitter filaments.....	6.3 volts dc (1.415 amperes).....		6.3 volts dc (1.145 amperes).
Relay control circuits.....	5.6 volts dc (431 ma).....		5.6 volts dc (431 ma).

Power for plate, screen, and bias circuits:

<i>Transmit</i>		<i>Receive</i>	
HIGH	LOW	HIGH	LOW
450 volts dc (75 ma).....	200 volts dc (33.5 ma).	0 volt.....	0 volt.
250 volts dc (11.5 ma).....	105 volts dc (4.8 ma).	0 volt.....	0 volt.
150 volts dc (37.5 ma).....	90 volts dc (22.5 ma).	0 volt.....	0 volt.
100 volts dc (19 ma).....	90 volts dc (17 ma).	105 volts dc (20 ma).....	105 volts dc (20 ma).
85 volts dc (70.7 ma).....	90 volts dc (75 ma).	85 volts dc (50.5 ma).....	85 volts dc (50.5 ma).
-27 volts dc (2 ma).....	0 volt.	0 volt.....	0 volt.

Adaptability to service conditions:

Altitude.....	10,000 feet, maximum.
Shocks and vibration.....	Will stand shocks, strains, and vibration in vehicle operating over rugged terrain.
Weather and climate.....	Immersionproofed and fungiproofed.
Normal operating temperature..	From -40° C. (-40° F.) to +55° C. (+130° F.).

6. Description

a. General. Power Supply PP-112/GR (fig. 1) is a vibrator type power supply. It consists of a panel-and-chassis assembly inclosed in an immersionproof metal case. The panel-and-chassis assembly is fastened to the case by six Dzus fasteners which are accessible from the front. The overall dimensions of the unit are $9\frac{1}{4}$ inches (height), by $7\frac{1}{4}$ inches (width), by $12\frac{7}{8}$ inches (length). The total weight of the unit (with case) is approximately 35 pounds. The exterior of the unit is finished with an olive-drab wrinkle paint. The information in this paragraph applies equally to Power Supplies PP-112/GR and PP-109/GR, except where mechanical and electrical differences in the latter unit require special description.

b. Case. In some models, the metal case consists of an aluminum outer skin welded to an aluminum box. The outer skin has been corrugated to increase its resistance to shock. In other models, the case is made of aluminum alloy and is completely die-cast. Runners on the bottom of the case permit it to be installed and locked on the mounting base of the equipment with which the power supply is to be used.

c. Front Panel. The front panel is an aluminum casting finished with an olive-drab wrinkle paint. All operating controls, fuse holders, cable connectors, and Dzus fasteners are mounted on the front of the panel. The panel is recessed to prevent damage to the controls because of impact. The use of controls, connectors, and other components mounted on the front panel is explained in detail in paragraph 7.

d. Chassis Assembly (figs. 8 through 13). A top view of Power Supply PP-112/GR removed from its case is shown in figure 8. A similar view of Power Supply PP-109/GR is shown in figure 9. A comparison of these two figures shows that the two units are nearly alike in appearance, except for the number of ballast tubes and the number and size of resistors. The side view of Power Supply PP-112/GR (fig. 10) is equally representative of Power Supply PP-109/GR, except for the differences that appear in figures 8 and 9. Bottom views of the two power supplies are shown in figures 11 and 12. The chassis assembly is composed of several sections, as follows:

(1) *Front chassis assembly.* The front chassis assembly consists of a chassis and

an outer bracket (fig. 10). On the chassis are mounted the large electrolytic capacitors and the chokes composing the alternating-current (ac) ripple filter assembly (fig. 8). The bracket mounts a shelf for two large plug-in type electrolytic capacitors (C27 and C30) and a removable clamp assembly for retaining these capacitors in their sockets under vibration stresses (figs. 11 and 12). The chassis and the outer bracket provide air space around the filter components to insulate them from the heat produced by the tubes and large resistors mounted on the rear of the chassis assembly. A recess in the portion of the bracket facing the front panel incloses the panel-mounted components and mounts the radio-frequency (rf) filter assembly (fig. 13).

(2) *Rear chassis assembly.* The rear chassis assembly consists of a chassis and back plate (fig. 10). The chassis mounts the heat-producing parts of the power supply, namely, the ballast tubes, thermal relays, rectifier tubes, voltage regulator tubes, and most of the large resistors. Small angle brackets attach the chassis to the bracket around the front chassis ((1) above). The chassis is made of heavy aluminum and is attached to the back plate to aid heat conduction toward the rear of the unit and away from the front chassis components. The top of the rear chassis is separated into three compartments by aluminum walls or baffles to reflect heat toward the outer case and aid heat dissipation toward the back plate and the power supply case.

(3) *Bottom chassis assembly.* The removable bottom chassis assembly, mounted below the front and rear chassis, is attached to the lower vertical portion of the outer bracket and to the back plate with machine screws. The bottom chassis consists of a horizontal bracket and a vertical bracket (fig. 13). The top of the horizontal bracket mounts the vibrators, the relay, and some resistors. The bottom of this bracket mounts resistors, capacitors, and the wiring. The vertical bracket mounts the power transformers and associated buffer capacitors.

(4) *Back plate.* The back plate is a heavy aluminum plate which dissipates the heat conducted to it by the rear chassis ((2) above) and also helps hold the rear and bottom chassis together to form a rigid assembly (fig. 10).

(5) *Heat barriers.* Silicone-treated glass-fabric barriers are provided in the upper and lower right shelves at the rear of the chassis assembly to prevent the insulation of the connecting wires from becoming damaged by contact with the large, heat-producing, wire-wound resistors and the vibrators.

e. Disassembly. The front panel and the bottom chassis (*c* and *d* above) can be separated from the front chassis assembly. Flexible cables establish electrical connections between them (fig. 13). This arrangement permits detailed tests to be made on the power supply while all of its circuits are in operating condition.

7. Front Panel Controls, Fuses, and Connectors (fig. 3)

The following chart lists the controls, fuses, and connectors on the front panel of the power supply and indicates their functions. Except for fuse valves and voltage stamp, the front panels of Power Supplies PP-112/GR and PP-109/GR are similar.

Control	Function
OPERATE switch S1.	In OFF position, de-energizes all power supply circuits by opening the battery circuit. In RECEIVE position, closes the battery circuit and energizes the receiver power supply and receiver-transmitter relay supply circuit. In the TRANS & RECEIVE position, accomplishes the same functions as in RECEIVE position and also makes power available for the transmitter power supply circuits. Completion of the transmitter power supply circuit depends on the operation of external control circuits.
TRANS POWER switch S2.	Provides for high- or low-power operation of the transmitter in the HIGH and LOW positions, respectively.

Control	Function
Fuses F1, F2, F3, and F4.	Protect battery circuits from short circuits or other overloads.
Spare fuse holder	Stores spare fuses.
POWER OUT connector J2.	Makes power supply output voltages available for cable connection to the receiver-transmitter.
POWER IN connector J1.	Provides for the storage battery input connection.
Dzus fasteners	Six Dzus fasteners attach the panel and chassis assembly to the case. Two small Dzus fasteners close the spare fuse holder.

8. Additional Equipment Required

Power supplies PP-109/GR and PP-112/GR require 12- and 24-volt storage batteries, respectively, and a suitable load. Any of the receiver-transmitters (par. 3*b*) or dummy load resistors (fig. 15) constitute a suitable load.

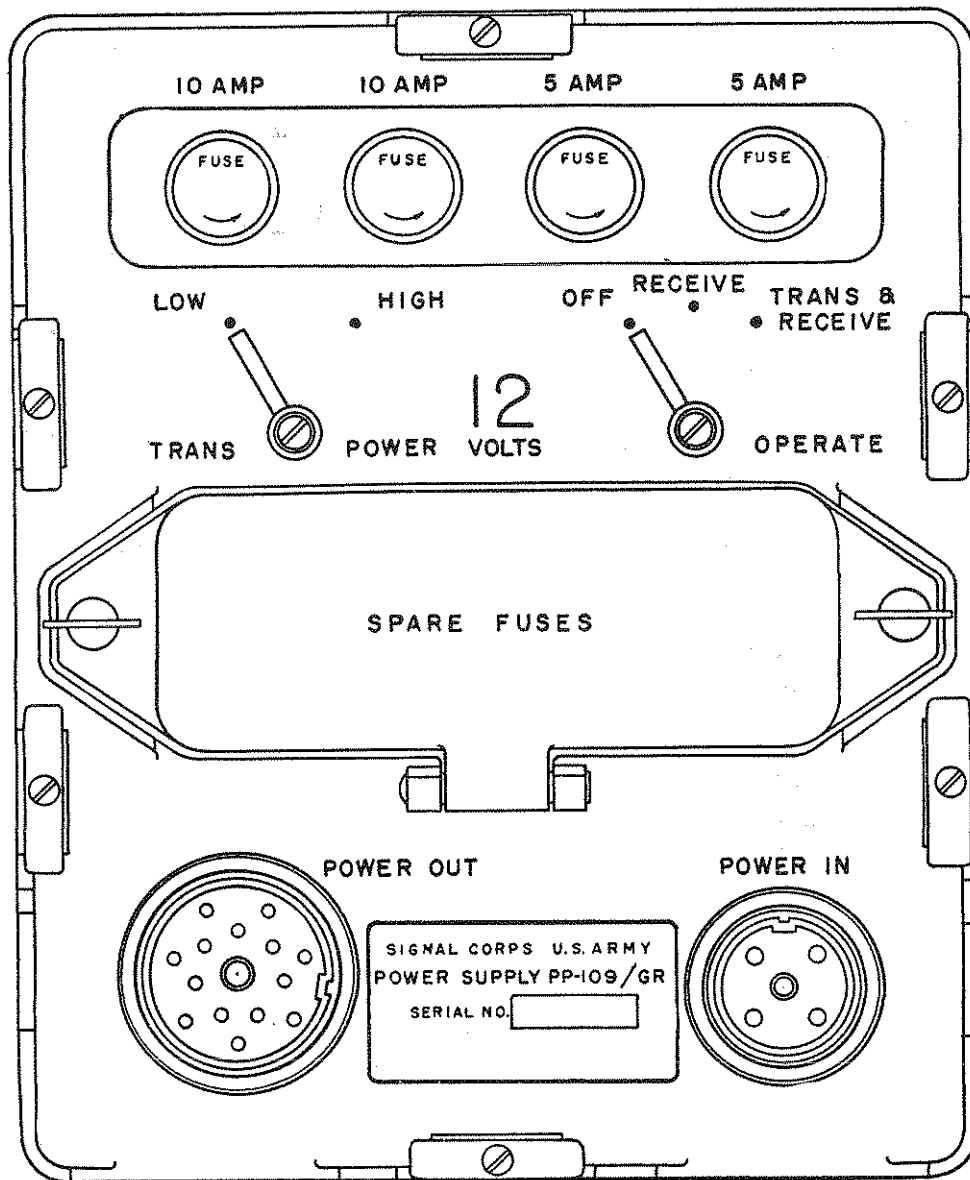
Caution: Do not operate the power supply without a suitable load, because the high output voltages will damage the electrolytic filter capacitors and the vibrators.

9. Running Spares

Running spares for normally expendable items such as tubes, fuses, and vibrators are provided with each power supply. These parts are listed below:

Part	Power supply	
	PP-109/GR	PP-112/GR
Fuse, cartridge, Sig C stock No. 3Z2603.19, 3 amperes		1
Fuse, cartridge (Sig C stock No. 3Z2605.7), 5 amperes	2	3
Fuse, cartridge, Sig C stock No. 3Z2610.1, 10 amperes	2	
Relay, thermal (K1, K2)	1	1
Resistor, thermal (R24, R25, R31, R37, R38, R40)	2	3
Tube type OA2, electron	2	2
Tube type OB2, electron	2	2
Tube type 1007, electron	1	1
Vibrator, 6-volt (E1, E2, E3), Sig C stock No. 3H6690-15	3	
Vibrator, 24-volt (E1, E2, E3), Sig C stock No. 3H6690-16		3

Note. This list is for general information only. See appropriate supply publications for information pertaining to requisition of new parts.



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Figure 3. Power supply PP-109/GR, front panel.

10. Differences in Models

a. Several changes have been incorporated in later models of these equipments to improve their design and performance. These changes do not affect the outward appearance of the models.

- (1) In some of the later models, a single-deck switch is used instead of a double-deck switch for OPERATE switch S1 (fig. 13).
- (2) In some of the later models, a connection from resistor R30 is made to terminal 7

instead of terminal 2 of relay O 1. With models having the connection to terminal 2 (figs. 20 and 21), transmission with Receiver-Transmitter RT-66/GRC, RT-67/GRC, or RT-68/GRC is possible even when the OPERATE switch of the power supply is at the RECEIVE position. With models having the connection to terminal 7 (figs. 22, 23, and 24), the OPERATE switch must be at the TRANS & RECEIVE position for transmission to be possible.

- (3) In some of the later models, capacitor C3 is connected to the L2 side of resistor R6 instead of to the T1 side of this resistor. This change greatly reduces the undesirable ripple voltage in the -27-volt bias supply.
- (4) In some models the cases consist of an aluminum outer skin welded to an aluminum box. In other models the cases are completely die-cast.
- (5) Late models of Power Supply PP-112/GR (manufactured on Orders No. 2895-Phila-52, 2898-Phila-52, 2928-Phila-52, 4296-Phila-53, and 4333-Phila-53), use a different method of rectification for the -27-volt bias supply. Vibrator E1 is connected for nonsynchronous operation and a full-wave selenium rectifier (CR1) rectifies the output of the transformer (T1). Rectifier CR1 is located under transformer T1 (fig. 13).
- (6) Models of Power Supply PP-109/GR on Order No. 21434-Phila-50, with serial numbers above 15370, have a different arrangement of the large resistors mounted on the rear chassis assembly (fig. 16).
- (7) In some of the later units the rear of the

panel connectors are covered with rubber caps that hold a silicone grease.

- (8) Some of the later models have a hermetically sealed relay O 1 instead of an open type.
 - (9) Some models use series-drive vibrators instead of shunt-drive. The two types of vibrators are interchangeable (par. 19).
- b. Some of these equipments have been modified by the following modification work orders:
- (1) MWO SIG 11-5036-1, Modification of Power Supplies PP-109/GR and PP-112/GR to Improve and Prolong Life.
 - (2) MWO SIG 11-5036-2, Modification of Power Supplies PP-109/GR and PP-112/GR to Replace the Existing 4-pin Amphenol Connector J1 with an Improved Connector.
 - (3) MWO SIG 11-5036-3, Modification of Power Supplies PP-109/GR and PP-112/GR to Prevent Failure of Metal Case and to Provide Additional Chassis Support.
 - (4) MWO SIG 11-5036-4, Modification of Power Supplies PP-109/GR and PP-112/GR to Eliminate Possibility of Keying Receiver-Transmitter Inadvertently and to Provide Additional Transformer Support.

CHAPTER 2

THEORY

11. Block Diagram

(figs. 4 and 5)

a. Figures 4 and 5 are functional block diagrams typical of either power supply. Figure 4 refers only to some of the early models produced on orders No. 18651-Phila-49, 21433-Phila-50, and 1759-Phila-51. Figure 5 refers to all other models. These block diagrams show that three high-voltage (hv) and three low-voltage (lv) circuits are supplied from the common storage battery input terminals. The hv circuits are vibrator supplies and are used to provide the plate, screen, and bias voltages for the receiver and transmitter circuits in Receiver-Transmitter RT-66/GRC, RT-67/GRC, or RT-68/GRC. The lv circuits are used to supply the receiver and transmitter filament and relay potentials.

b. The 85-volt circuit (E3 and T3) is energized when the OPERATE switch is in the RECEIVE or the TRANS & RECEIVE position. The 150-volt circuit (E2 and T2) is energized when the OPERATE switch is in the TRANS & RECEIVE position and relay O 1 is energized. To energize the transmitter hv supply (E1 and T1), the OPERATE switch must be in the TRANS & RECEIVE position, relay O 1 must be energized, and TRANS POWER switch S2 must be in the HIGH position.

c. TRANS POWER switch S2, in addition to breaking or making the battery circuit to the transmitter hv supply (*b* above), connects the vibrator output circuits for HIGH or LOW power operation of the receiver-transmitter.

d. The lv circuits include the receiver filament supply circuit with output at terminal L of J2, the transmitter filament supply circuit with output at terminal N of J2, and the control relay supply circuit with output at terminal A of J2. The transmitter filament circuit is completed only when relay O 1 is energized.

e. Each of the hv and lv circuits is equipped with rf noise suppression filters in both the input and output leads. Similarly, ac ripple filters are included in the output lead of each circuit.

12. Battery Input Circuit

(fig. 20)

The 24-volt storage battery input required for the operation of Power Supply PP-112/GR is brought in on terminals B (+) and C (-) of POWER IN connector J1. The voltage is applied through the contacts of a four-pole, three-position switch (OPERATE switch S1) to four branch circuits, each of which is equipped with a fuse and a battery supply filter. OPERATE switch S1 serves as the power on-off switch for the receiver and transmitter circuits operated from this power supply (pars. 13 through 18).

13. Receiver Filament Supply Circuit

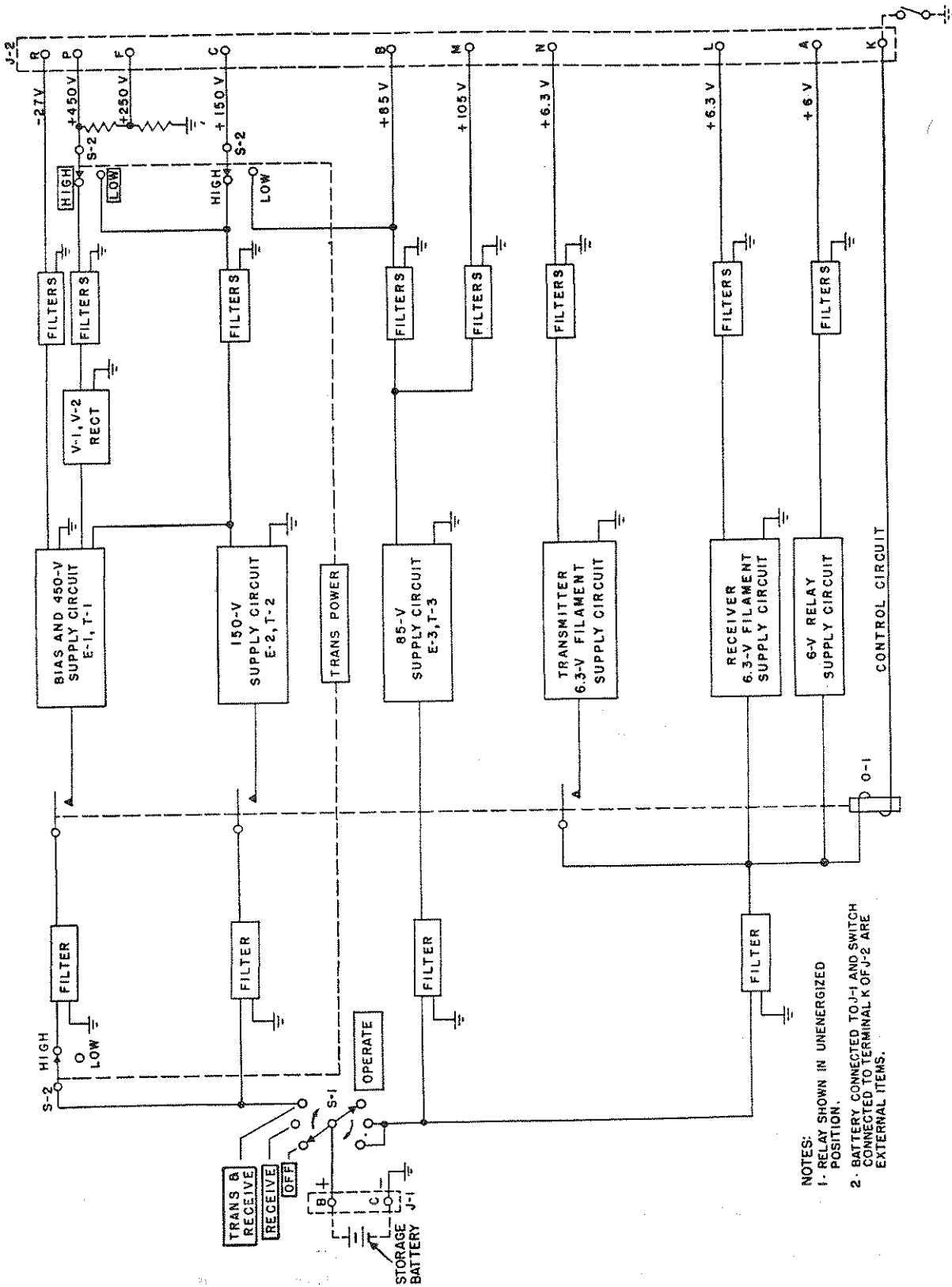
(fig. 20)

The filament supply circuit for the receiver is completed from the POWER IN connector to terminal L of J2, through section D of S1, fuse F1, choke L4, resistor R39, ballast tubes R40 and R31, contacts 7 and 5 of K2, and choke L16.

a. Battery input filter L4 and C5 prevents high-frequency (hf) interference from reaching the battery circuit.

b. Ballast tubes R40 and R31 are essentially variable resistors, the resistances of which vary according to the voltage supplied. If the output voltage decreases, the voltage drop across the ballast tubes decreases, causing a decrease in the resistance of the tubes. This action results in a constant current through the circuit and a constant voltage available for the filament circuit.

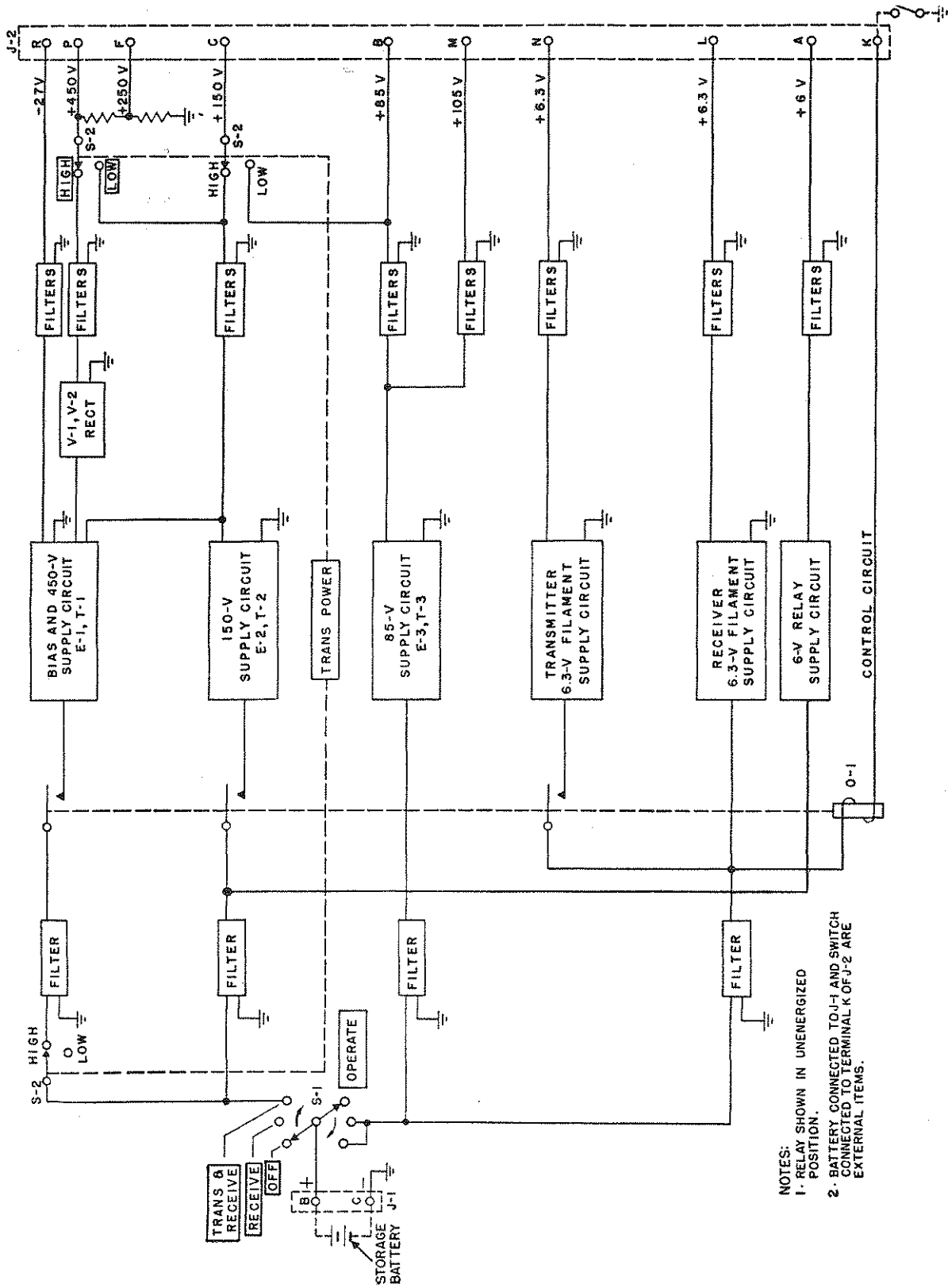
c. The thermal relay (K2) serves as protection against excessive increases in filament voltages which might be caused by variations in the output load. For example, if tube filaments in the receiver open, the contacts of the relay open and insert R32 in series with the filament supply circuit and in series with the heater element of K2. The value of this resistor is sufficiently high to drop the output voltage to a value that will not damage the tube filaments (and render the receiver completely inoperative). Resistors R33, R34, and



- NOTES:
1. RELAY SHOWN IN UNENERGIZED POSITION.
 2. BATTERY CONNECTED TO J-1 AND SWITCH CONNECTED TO TERMINAL K OF J-2 ARE EXTERNAL ITEMS.

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Figure 4. Typical power supply, functional block diagram for some of the earlier models on orders No. 18651-Photo-49, 21738-Photo-50, and 1759-Photo-51.



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Figure 5. Typical power supply, functional block diagram for all models except some of the early models on orders No. 1865L-Phila-49, 21488-Phila-50, and 1759-Phila-51.

- NOTES:
1. RELAY SHOWN IN UNENERGIZED POSITION.
 2. BATTERY CONNECTED TO J-1 AND SWITCH CONNECTED TO TERMINAL K OF J-2 ARE EXTERNAL ITEMS.

R35 drop the heater element voltage to a value that will permit K2 to open its contacts under overload conditions.

d. Capacitor C30 removes low-frequency (lf) ac ripple from the direct-current (dc) voltage.

e. The filter circuit, consisting of choke L16 and capacitor C31, filters hf ac voltages from the dc output.

14. Transmitter Filament Supply Circuit

(fig. 20)

The transmitter filament supply circuit also extends through section D of switch S1, through fuse F1, and choke L4. This circuit continues through the normally open contacts (3 and 2) of relay O 1 and extends through voltage-dropping resistor R36, through the series-parallel arrangement of ballast tubes R37, R38, R24, and R25 to the normally closed contacts of thermal relay K1. The 6.3-volt output is applied through filter choke L14 to terminal N of J2.

a. The series-parallel arrangement of ballast tubes R37 and R38 and R25 and R24 allows for the relatively large amount of transmitter filament current supplied by the circuit. Resistors R26, R27, and R28, associated with thermal relay K1, have functions comparable to those of resistors R32, R33, R34, and R35, associated with thermal relay K2 (par. 13*c*).

b. Capacitor C27 is an lf ac ripple filter.

c. Choke L14 in combination with capacitor C28 is an hf noise filter.

15. Relay Supply Circuit

a. In some of the early models (fig. 20) on Orders No. 18651-Phila-49, 21433-Phila-50, and 1759-Phila-51, the relay supply circuit extends through section D of S1, fuse F1, choke L4, continues through voltage-dropping resistor R30 and choke L15 to terminal A of J2. L15 and C29 form an hf noise filter.

b. In revised models (figs. 22, 23, and 24), the relay supply circuit (6 volts) extends through section B of S1, fuse F3, choke L6, and continues through voltage-dropping resistor R30 and choke L15 to terminal A of J2. Unlike the circuit for the earlier models, this connection does not apply power to the receive-transmit relays of the receiver-transmitter except when S1 is at TRANS & RECEIVE.

16. 85-Volt Supply Circuit

(fig. 6)

The 85-volt supply circuit extends over battery terminals C and B of J1, through section C of S1 (when in either RECEIVE or TRANS & RECEIVE position), through fuse F2 and battery filter L5 and C6, to the input of the vibrator circuit proper. The vibrator circuit includes vibrator E3 and transformer T3. In *a* through *d* below, the explanation is based on the assumption that a shunt-drive vibrator is in vibrator socket X10. The operation of the circuit with a series-drive vibrator is described in paragraph 19.

a. Conversion to Ac. Electrons flow from the ground terminal of the battery to pin 7 of X10, through the vibrator coil to pin 1 of X10, through half of the primary winding (1-2) of transformer T3, resistor R19, rf filter choke L5, fuse F2, the contacts of switch S1, and to the positive terminal of the battery. Current, through the driving coil, develops a magnetic field which attracts the reed until it closes contact 1. In this position of the reed, the coil is taken out of the battery circuit by connecting contact 1 to ground through pin 7. The field collapses and the reed is returned by spring action to the neutral position. However, the reed inertia carries it through the neutral position and causes it to close contact 6. Battery current flows through winding 3-2 of T3, in a direction opposite to the current that previously flowed through winding 1-2 of T3. The reed is returned again by spring action toward the neutral position. It is accelerated through the neutral position toward contact 1 by the magnetic pull which is caused by the passage of current through the driving coil. While the reed is in motion, current flows again through winding 1-2 of T3. The reed then closes contact 1 and again short-circuits the driving coil. The cycle is then repeated. Thus the flow of current through the driving coil is interrupted by periodic short-circuiting of the coil. As the reed vibrates, battery current flows alternately through vibrator contacts 1 and 6 connected to the primary winding. This reversal of current flow through the primary of T3 constitutes an ac which induces a stepped-up ac voltage in the hv winding (4-5-6) and a stepped-down ac voltage in the filament winding (7-8).

b. Rectification. The stepped-up ac voltage induced in winding 4-5-6 of T3 is rectified by contacts 2 and 5 of the vibrator. Because of the

voltage induced in the secondary winding of T3, terminals 4 and 6 are alternately made negative with respect to terminal 5 (the center tap). The vibrator reed is phased with the secondary voltage, so that vibrator contacts 2 and 5 alternately ground terminals 4 and 6 at the same time that those terminals are negative with respect to the center tap. The center tap (terminal 5) is, therefore, always positive with respect to chassis ground.

c. RF Filtering. Buffer capacitor C23 reduces sparking at the vibrator contacts caused by hv transients, and it also improves the wave shape. This prevents damage to the contacts. Capacitors C19 through C22 bypass rf noise voltages to ground.

d. Output Circuits. The dc output voltage is taken off at the center tap (terminal 5) of T3. Rf noise voltages are bypassed to ground by capacitor C24. The filter consisting of L12 and C25 eliminates 1f ac ripple from the dc output voltage. At the output of the ripple filter the circuit branches off. One branch extends through ripple filter R17 and C17 to terminal M of connector J2. This branch supplies 105 volts to the receiver final audio stage in the receiver-transmitter. Another branch extends through resistors R21, R22, and R23, and through rf filter choke L13 to terminal B of connector J2. The filter section composed of L13 and C26 eliminates rf noise from the dc output. The following arrangements maintain the output voltages constant at 85 and 105 volts with changes in load current:

- (1) The normally open contacts (4 and 5) of relay O 1 short out R21 when the relay is energized to turn on the transmitter power supply circuit.
- (2) Voltage regulator tube V4 is connected from the junction of R22 and R23 to terminal E of J2 and limits the maximum output voltage of the power supply when terminal E is grounded externally.
- (3) A connection from terminal B of J2 through section B of switch S2A substitutes the output of the 85-volt vibrator circuit for the output of the 150-volt vibrator circuit (E2 and T2) at terminal C of J2 when the TRANS POWER switch is in the LOW position. V3, which is permanently connected to terminal C, does not fire when the lower po-

tential is applied. To maintain a constant output from the 85-volt supply under the additional load condition; resistor R22 is short-circuited when S2 is in the LOW position.

17. 150-Volt Supply Circuit

(figs. 20 and 22)

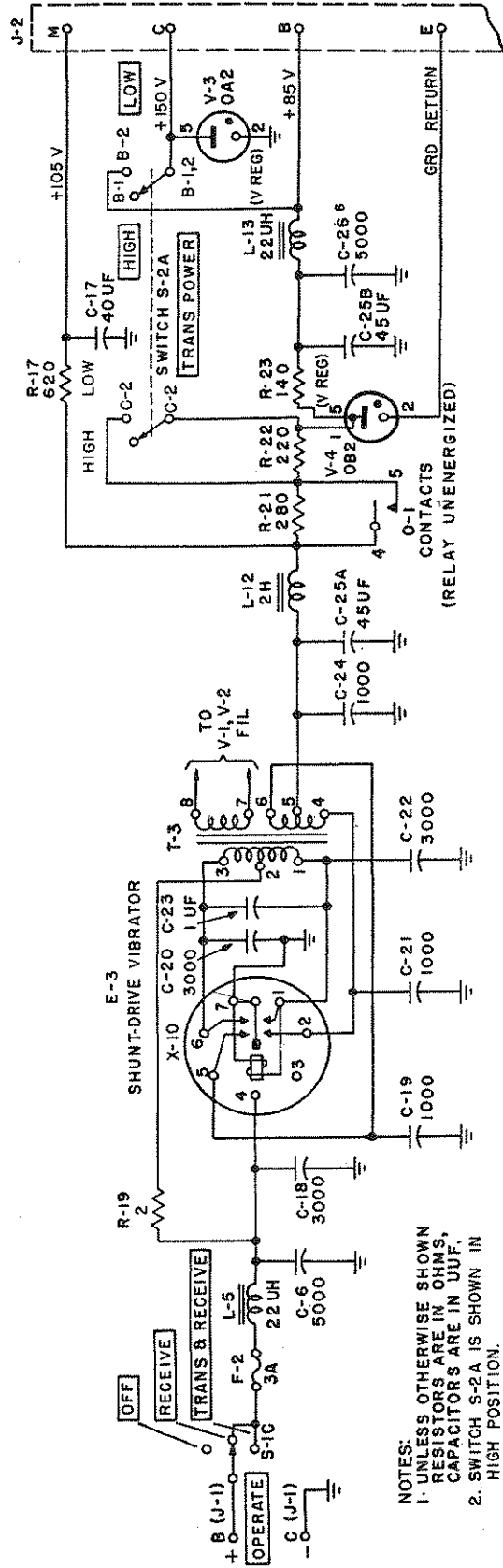
a. The 150-volt supply circuit extends from the input terminals of POWER IN connector J1 through section B of switch S1 (in the TRANS & RECEIVE position), to fuse F3 and rf choke L6 to vibrator-transformer circuit E2 and T2.

b. The operation of this circuit is similar to that described for the 85-volt supply circuit (par. 16). In the 150-volt supply circuit, however, the vibrator circuit is completed through the normally open contacts (7 and 8) of relay O 1. When this relay is energized, vibrator E2 functions in the same manner as described for E3 (par. 16), and an output voltage is developed across the secondary winding of T2. Note that terminal 5 is positive with respect to ground for the dc output voltage. Buffer capacitor C13 suppresses transformer transients. Capacitor C12 suppresses rf noise voltages.

c. The rectified output voltage at terminal 5 of T2 is routed through the 1f ac ripple filter (L9, R16, C14A, and C14B) and through the rf noise voltage filter, L11 and C16, to sections A and B of TRANS POWER switch S2A.

d. When S2 is in the HIGH position, the circuit is completed through section B of S2A to terminal C of J2. In the HIGH position, V3 limits the maximum voltage, appearing at terminal C, to the required value. When the switch is in the LOW position, the connection through section B of S2A is broken, V3 is removed from the 150-volt circuit, and the output of the 150-volt supply circuit is connected through section A of S2A to terminal P of J2, in place of the 450-volt supply that is normally connected to this terminal. With V3 no longer in the circuit, it is possible for the output voltage to rise above 150 volts. The LOW position of S2 (section B) also connects the 85-volt supply to terminal C of J2, in place of the output of the 150-volt supply circuit, E2 and T2.

e. A connection from terminal 5 of T2 to terminal 5 of T1 arranges the voltages, appearing across these two transformers, in series with each other and serves as a basis for deriving the 450-volt supply (par. 18).



TM5036-9

Figure 6. Power supply PP-112/Gk, 85-volt supply circuit, functional diagram.

f. In the later models, the 6-volt relay supply circuit is supplied from the input (pin 4 of E2) of the 150-volt supply circuit (par. 15).

18. 450-Volt Supply Circuit (figs. 20, 22, and 24)

a. Dc voltage from the storage battery is routed through section A of switch S1 (in the TRANS & RECEIVE position), over contacts of S2B (when in the HIGH position), through fuse F4 and rf noise filter L7 and C8 to the vibrator-transformer circuit (E1 and T1). The battery circuit is completed to the center tap (terminal 2) of T1 through contacts 9 and 10 of relay O 1 when the relay is energized.

b. The process of converting the dc voltage to an ac voltage across the secondary windings of transformer T1 is the same as that described in paragraph 16. The ac voltage is developed across the 300-volt secondary winding (4-5-6) of T1 and across the 27-volt winding (7-8-9) of T1.

c. On earlier models, the voltage appearing across winding 7-8-9 is rectified by contacts 2 and 5 vibrators E1 in a manner similar to that described in paragraph 16. The vibrator reed is phased with the secondary voltage so that vibrator contacts 2 and 5 ground terminals 9 and 7 of T1, alternately, at the same time that those terminals are positive with respect to the center tap. The center tap (terminal 8) is therefore always negative with respect to chassis ground. The output is taken off at terminal 8 of that winding, routed through ripple filter R6 and C3 and rf filter L2 and C4, and applied as a negative bias potential to terminal R of J2. On later models (figs. 22 and 24), C3 is connected to the L2 side of R6 rather than the T1 side.

d. On later models (par. 10a(5)), the method of obtaining the -27-volt bias voltage is slightly different. Figure 24 illustrates the circuit for these models. Contacts 2 and 5 of vibrator E1 are connected in parallel with contacts 1 and 6, respectively, and the vibrator operates nonsynchronously. Paralleling the contacts in this manner permits longer contact life than in the earlier model circuit. To produce a dc output voltage from the secondary, a full-wave selenium rectifier, CR1, is used. Taps 7 and 9 of T1 are connected to the positive leads of CR1. The negative lead is grounded to the chassis. The rectifier has the same effect as the synchronous vibrator reed. Upon conduction through either side, CR1 grounds the

positive end of the secondary (with respect to the center tap) and the center tap is always negative with respect to the chassis.

e. The ac voltage (300 volts) developed across winding 4-5-6 of T1 is rectified by a circuit consisting of two duo-diode tubes, V1 and V2, type 1007 gas-filled full-wave rectifiers. The hv winding of T1 is connected to one plate in V1 and to one plate in V2. The remaining plates are bridged from one tube to the other by resistors R4 and R5. These resistors permit conduction through each tube at all times. The center tap of the winding is raised approximately 150 volts above ground by its connection to the center tap of the secondary winding of T2. In this manner, the two voltages add, and the output voltage becomes 450 volts. The filament supply for V1 and V2 is obtained from winding 8-7 of transformer T3. The rectified output of V1 and V2 is taken from the filaments and is filtered by the network consisting of rf noise voltage filter L1, L8, and C11, and ac ripple filter L3, C9A, C9B, C10A, and C10B. Resistors R7, R8, R9, and R10 are bleeder resistors which insure an equal division of voltages across capacitors C9 and C10.

f. With switch S2 in the HIGH position and relay O 1 energized, the 450-volt output voltage is applied through section A of S2A to voltage divider R12 and R11. A 450-volt potential is then available at terminal P of J2. The voltage divider provides a 250-volt potential at terminal F. With switch S2 in the LOW position, the 450-volt output circuit is disconnected from P of J2. The input circuit is broken by switch S2B. When either of these conditions exists, the power circuit is not energized and no output voltage exists. However, since the filaments are energized from secondary winding 7-8 of T3, which is in operation whenever switch S1 is on (par. 16), the filaments remain lighted as long as E3 is operating.

19. Operation of Power Supply PP-112/GR with Series-Drive Vibrators

Series-drive vibrators are supplied in some models. These vibrators are interchangeable with the shunt-drive type. The internal connections of the series-drive vibrators are shown on the lower left side of each of the schematic diagrams in figures 20 through 24. The operation of Power Supply PP-112/GR, using series-drive vibrators in the 85-, 150-, and 450-volt supply circuits, is the same as described in paragraphs 16, 17, and 18, respec-

tively. In the series-drive vibrators, however, a separate contact is connected in series with the driving coil to periodically interrupt the battery circuit through the coil.

a. 85-Volt Supply Circuit. The battery circuit extends from pin C of J1 to pin 7 of X10 through the series arrangement of the vibrator reed and the additional driving contact, through the driving coil connected to pin 4 of X10, through filter choke L5, fuse F2, contacts of switch S1 in either the RECEIVE or TRANS & RECEIVE position, and back to terminal B of J1.

b. 150-Volt Supply Circuit. When a series-drive vibrator is used in this circuit, the circuit similarly extends from pin 7 of X8, through the series arrangement of the vibrator reed and the additional driving contact, through the driving coil connected to pin of X8, through filter choke L6 and fuse F3, and over the contacts of switch S1 in the TRANS & RECEIVE position to terminal V of J1. Only the load circuit of the vibrator is completed through contacts of relay O 1.

c. 450-Volt Supply Circuit. The circuit arrangement for the 450-volt supply circuit, when a series-drive vibrator is used, is the same as described in *a* and *b* above, except that the circuit to terminal B of J1 extends through choke coil L7, fuse F4, contacts of switch S2B in the HIGH position, and contacts of switch S1 in the TRANS & RECEIVE position. Only the load circuit of the vibrator is completed through contacts of relay O 1.

20. Power Supply PP-109/GR

(figs. 21 and 23)

a. Power Supply PP-109/GR is very similar to Power Supply PP-112/GR, but is designed for use with a 12-volt storage battery. Because 6-volt vibrators are used, however, voltage-dropping resistors R18, R20, R13, R14, R1, and R2 are used to drop the driving voltage to 6 volts. Resistors R20, R14, and R2 are effective when shunt-drive vibrators are used in the 85-, 150-, and 450-volt supply circuits. Resistors R18, R13, and R1 are in the circuit when series-drive vibrators are used in the corresponding supply circuits.

b. In the case of the 6-volt shunt- or series-drive vibrator, the battery circuits for the 85-, 150-, and 450-volt supply circuits are very similar to those described for Power Supply PP-112/GR when using a corresponding vibrator.

c. The values of current-limiting resistors R19, R15, and R3 differ from those of the corresponding parts in Power Supply PP-112/GR. In Power Supply PP-109/GR, buffer capacitors C23, C13, and C2 are shunted across the secondary windings of transformers T3, T2, and T1, respectively. The reason for this is that the values of capacitance that would be needed across the primary winding to accomplish the same purpose would be impracticable. These capacitors are dual units arranged in series to provide the proper voltage rating.

d. The filament supply circuit for the receiver is completed from the POWER IN connector to terminal L of J2 through section D of S1, fuse F1, choke L4, ballast tube R31, contacts 7 and 5 of K2, and choke L16.

- (1) The battery input filter, L4 and C5, prevents hf interference from reaching the battery circuit.
- (2) Ballast tube R31 compensates for variations of the input source by changing resistance as the voltage varies and thereby regulating the amount of filament current.
- (3) The function of thermal relay K2 is described in paragraph 13c. Note that voltage-dropping resistors R33, R34, and R35 are in the circuit so that there is a greater voltage drop across the heater element of the thermal relay in Power Supply PP-109/GR than in Power Supply PP-112/GR. The higher voltage is necessary because of the tendency of the relay to open and close too readily when operated from the lower voltage supply.

e. The transmitter filament supply circuit extends through section D of switch S1, through fuse F1, and through choke L4. The circuit continues over the normally open contacts (3 and 2) of relay O 1 and extends through parallel ballast tubes R24 and R25 to the normally closed contacts of thermal relay K1. The 6.3-volt output is applied through filter choke L14 to terminal N of J2.

- (1) Capacitor C27 is an lf ac ripple filter.
- (2) Choke L14 in combination with capacitor C28 is an hf noise filter.
- (3) The parallel arrangement of ballast tubes R24 and R25 allows for the relatively large amount of transmitter filament current supplied by the circuit. Resist-

ors R26, R27, and R28 have functions comparable to those of resistors R32, R33, R34, and R35 associated with thermal relay K2.

f. In the relay supply circuit, the value of resistor R30 is different from that of the corresponding part in Power Supply PP-112/GR. In some of the early models on Orders No. 18651-Phila-49, 21433-Phila-50, and 1759-Phila-51, the relay supply circuit voltage is taken from terminal

1 of relay 0 1 (fig. 21). On later models, this voltage is taken from terminal 7 of relay 0 1 (fig. 23). Unlike the circuit in the earlier models, this connection does not apply power to the receive-transmit relays of the receiver-transmitter except when S1 is at TRANS & RECEIVE.

g. The filter circuit in the -27-volt supply in the later models has been rearranged. C3 is connected to the output side of R6 rather than to the input side (fig. 23).

CHAPTER 3

PREVENTIVE MAINTENANCE

21. Definition of Preventive Maintenance

Preventive maintenance is work performed on equipment (usually when the equipment is not in use) to keep it in good working order so that breakdowns and needless interruptions in service will be kept to a minimum. Preventive maintenance differs from troubleshooting and repair since its object is to prevent certain troubles from occurring.

22. General Preventive Maintenance Techniques

a. Use No. 000 sandpaper to remove corrosion.
b. Use a clean, dry, lint-free cloth or a dry brush for cleaning.

- (1) If necessary, except for electrical contacts, moisten the cloth or brush with Solvent, Dry Cleaning (SD); then wipe the parts dry with a cloth.
- (2) Clean electrical contacts with a cloth moistened with carbon tetrachloride; then wipe them dry with a dry cloth.

Caution: 1. Repeated contact of carbon tetrachloride with the skin or prolonged breathing of the fumes is dangerous. Make sure that adequate ventilation is provided.

Caution: 2. Arc-overs in selenium rectifiers cause the release of poisonous fumes and the deposit of poisonous selenium compounds. If arc-overs occur, avoid inhaling the poisonous fumes. (They have a putrid odor.) Ventilate the unit and do not handle the damaged rectifier until it has cooled; then avoid direct skin contact with the damaged part.

c. If available, dry compressed air may be used at a line pressure not exceeding 60 pounds per square inch (psi) to remove dust from inaccessible places; be careful, however, or mechanical damage from the air blast may result.

d. For further information on preventive maintenance techniques, refer to TB SIG 178.

23. Use of Preventive Maintenance Form (fig. 7)

a. The decision as to which items on DA Form 11-239 are applicable to this equipment is a tactical decision to be made in the case of first echelon maintenance by the communication officer/chief or his designated representative, and in the case of second and third echelon maintenance, by the individual making the inspection. Instructions for the use of this form appear on the reverse side of the form.

b. Circled items in figure 7 are partially or totally applicable to Power Supplies PP-112/GR and PP-109/GR. References in the item column refer to paragraphs in text that contain additional maintenance information.

24. Performing Preventive Maintenance

a. Performing Exterior Preventive Maintenance.

Caution: Tighten screws, bolts, and nuts carefully. Fittings tightened beyond the pressure for which they are designed will be damaged or broken.

- (1) Check for completeness and satisfactory condition of the unit.
- (2) Check suitability of location and installation for normal operation.
- (3) Inspect OPERATE switch S1 and TRANS POWER switch S2 for binding, scraping, excessive looseness, and positive action.
- (4) Check for normal operation. (Refer to TM 11-284, TM 11-286, TM 11-287, TM 11-291, TM 11-611, or TM 11-642.)
- (5) Inspect case and exposed metal surfaces for rust, corrosion, and moisture (fig. 1).

b. Performing Interior Preventive Maintenance.

Caution: Disconnect all power before performing the following operations. Upon completion, reconnect the power and check for satisfactory operation.

- (1) Inspect the seating of the fuses on the

SECOND AND THIRD ECHELON MAINTENANCE CHECK LIST FOR SIGNAL CORPS EQUIPMENT RADIO COMMUNICATION, DIRECTION FINDING, CARRIER, RADAR			
INSTRUCTIONS: See other side			
EQUIPMENT NOMENCLATURE POWER SUPPLIES PP-109/GR & PP-112/GR		EQUIPMENT SERIAL NO.	
LEGEND FOR MARKING CONDITIONS: ✓ Satisfactory; X Adjustment, repair or replacement required; (2) Defect corrected; NOTE: Strike out items not applicable.			
NO.	ITEM	FOUND	ITEM
1	COMPLETENESS AND GENERAL CONDITION OF EQUIPMENT (receiver, transmitter, carrying cases, wire and cable, microphones, tubes, spare parts, technical manuals and accessories). PAR. 24 d (1)	19	ELECTRON TUBES - INSPECT FOR LOOSE ENVELOPES, CAP CONNECTORS, CRACKED SOCKETS; INSUFFICIENT SOCKET SPRING TENSION; CLEAN DUST AND DIRT CAREFULLY; CHECK EMISSION OF RECEIVER TYPE TUBES. PAR. 24 b (3)
2	LOCATION AND INSTALLATION SUITABLE FOR NORMAL OPERATION. PAR. 24 d (2)	20	INSPECT FILM CUT-OUTS FOR LOOSE PARTS, DIRT, MISALIGNMENT AND CORROSION.
3	CLEAN DIRT AND MOISTURE FROM ANTENNA, MICROPHONE, HEADSETS, CHESTSETS, KEYS, JACKS, PLUGS, TELEPHONES, CARRYING BAGS, COMPONENT PANELS.	21	INSPECT FIXED CAPACITORS FOR LEAKS, BULGES, AND DISCOLORATION. PAR. 24 b (4)
4	INSPECT SEATING OF READILY ACCESSIBLE "PLUCK-OUT" ITEMS: TUBES, LAMPS, CRYSTALS, FUSES, CONNECTORS, VIBRATORS, PLUG-IN COILS AND RESISTORS. PAR. 24 b (1)	22	INSPECT RELAY AND CIRCUIT BREAKER ASSEMBLIES FOR LOOSE MOUNTINGS; BURNED, PITTED, CORRODED CONTACTS; MISALIGNMENT OF CONTACTS AND SPRINGS; INSUFFICIENT SPRING TENSION; BINDING OF PLUNGERS AND HINGE PARTS. PAR. 24 b (2)
5	INSPECT CONTROLS FOR BINDING, SCRAPING, EXCESSIVE LOOSENESS, WORN OR CHIPPED GEARS, MISALIGNMENT, POSITIVE ACTION. PAR. 24 d (3)	23	INSPECT VARIABLE CAPACITORS FOR DIRT, MOISTURE, MISALIGNMENT OF PLATES, AND LOOSE MOUNTINGS.
6	CHECK FOR NORMAL OPERATION. PAR. 24 d (4)	24	INSPECT RESISTORS, BUSKINGS, AND INSULATORS, FOR CRACKS, CHIPPING, BLISTERING, DISCOLORATION AND MOISTURE. PAR. 24 b (5)
7	CLEAN AND TIGHTEN EXTERIOR OF COMPONENTS AND CASES, RACK MOUNTS, SHOCK MOUNTS, ANTENNA MOUNTS, COAXIAL TRANSMISSION LINES, WAVE GUIDES, AND CABLE CONNECTIONS.	25	INSPECT TERMINALS OF LARGE FIXED CAPACITORS AND RESISTORS FOR CORROSION, DIRT AND LOOSE CONTACTS. PAR. 24 b (6)
8	INSPECT CASES, MOUNTINGS, ANTENNAS, TOWERS, AND EXPOSED METAL SURFACES, FOR RUST, CORROSION, AND MOISTURE. PAR. 24 d (5)	26	CLEAN AND TIGHTEN SWITCHES, TERMINAL BLOCKS, BLOWERS, RELAY CASES, AND INTERIORS OF CHASSIS AND CABINETS NOT READILY ACCESSIBLE. PAR. 24 b (2)
9	INSPECT CORD, CABLE, WIRE, AND SHOCK MOUNTS FOR CUTS, BREAKS, FRAYING, DETERIORATION, KINKS, AND STRAIN.	27	INSPECT TERMINAL BLOCKS FOR LOOSE CONNECTIONS, CRACKS AND BREAKS.
10	INSPECT ANTENNA FOR ECCENTRICITIES, CORROSION, LOOSE FIT, DAMAGED INSULATORS AND REFLECTORS.	28	CHECK SETTINGS OF ADJUSTABLE RELAYS.
11	INSPECT CANVAS ITEMS, LEATHER, AND CABLING FOR HILDEW, TEARS, AND FRAYING.	29	LUBRICATE EQUIPMENT IN ACCORDANCE WITH APPLICABLE DEPARTMENT OF THE ARMY LUBRICATION ORDER.
12	INSPECT FOR LOOSENESS OF ACCESSIBLE ITEMS: SWITCHES, KNOBS, JACKS, CONNECTORS, ELECTRICAL TRANSFORMERS, POTENTIOMETERS, RELAYS, SELLYNS, MOTORS, BLOWERS, CAPACITORS, GENERATORS, AND PILOT LIGHT ASSEMBLIES. PAR. 24 b (2)	30	INSPECT GENERATORS, AMPLIDYNES, DYNAMOTORS, FOR BRUSH WEAR, SPRING TENSION, ARCING, AND FITTING OF COMMUTATOR.
13	INSPECT STORAGE BATTERIES FOR DIRT, LOOSE TERMINALS, ELECTROLYTE LEVEL AND SPECIFIC GRAVITY, AND DAMAGED CASES.	31	CLEAN AND TIGHTEN CONNECTIONS AND MOUNTINGS FOR TRANSFORMERS, CHOKES, POTENTIOMETERS, AND RHEOSTATS. PAR. 24 b (2)
14	CLEAN AIR FILTERS, BRASS NAME PLATES, DIAL AND METER WINDOWS, JEREL ASSEMBLIES.	32	INSPECT TRANSFORMERS, CHOKES, POTENTIOMETERS, AND RHEOSTATS FOR OVERHEATING AND OIL-LEAKAGE. PAR. 24 b (4)
15	INSPECT METENS FOR DAMAGED GLASS AND CASES.	33	BEFORE SHIPPING OR STORING - REMOVE BATTERIES.
16	INSPECT SHELTERS AND COVERS FOR ADEQUACY OF WEATHERPROOFING.	34	INSPECT CATHODE RAY TUBES FOR BURNED SCREEN SPOTS.
17	CHECK ANTENNA GUY WIRES FOR LOOSENESS AND PROPER TENSION.	35	INSPECT BATTERIES FOR SHORTS AND DEAD CELLS.
18	CHECK TERMINAL BOX COVERS FOR CRACKS, LEAKS, DAMAGED GASKETS, DIRT AND GREASE.	36	INSPECT FOR LEAKING WATERPROOF GASKETS, WORN OR LOOSE PARTS. PAR. 24 d (5)
		37	MOISTURE AND FUNGIPROOF. PAR. 24 b (7)
38	IF DEFICIENCIES NOTED ARE NOT CORRECTED DURING INSPECTION, INDICATE ACTION TAKEN FOR CORRECTION.		

DA FORM 11-239
1 MAY 51

REPLACES DA AGO FORM 419, 1 DEC 50, WHICH IS OBSOLETE.

16-44283-1

TM 5036-19

Figure 7. DA Form 11-239.

panel of the power supply and check all plug-in parts such as tubes and vibrators (figs. 1 and 8).

- (2) Inspect for looseness of accessible items: switches, connectors, transformers, relay, and capacitors (fig. 13).
- (3) Inspect electron tubes for loose envelopes, cracked sockets, and insufficient socket spring tension; remove dust and dirt; check emission of all tubes (fig. 8).

- (4) Inspect transformers and fixed capacitors for leaks, bulges, and discoloration.
- (5) Inspect resistors, bushings, and insulators for cracks, chippings, blistering, discoloration, and moisture (fig. 13).
- (6) Inspect terminals of large fixed capacitors and resistors for corrosion, dirt, and loose contacts (fig. 13).
- (7) Check adequacy of moistureproof and fungiproof treatment.

CHAPTER 4

FIELD MAINTENANCE

Section I. PREREPAIR PROCEDURES

Note. This chapter contains information for field maintenance. The amount of repair that can be performed by units having field maintenance responsibility is limited only by the tools and test equipment available, and by the skill of the repairmen.

25. Tools and Cleaning Equipment

Tools and cleaning materials needed for repairing and cleaning the power supplies are contained in Tool Equipment TE-113.

26. Test Equipment

a. The following equipment is required for making the tests described in this chapter:

- 1 Dc ammeter (ranges: 0 to 10 and 0 to 20 amperes), such as Multimeter TS-352/U, or equal.
- 1 Electron Tube Test Set TV-7/U.
- 1 Electronic Multimeter TS-505/U, or equal.
- 1 Fuse, 15 amperes, 25 to 30 volts.*
- 1 Fuse, 20 amperes, 25 to 30 volts.*
- 1 On-off switch.
- 1 Storage battery, 24- or 12-volt (Sig C stock No. 3E17), for Power Supply PP-112/GR or PP-109/GR, respectively.
- 1 Test Equipment IE-9-C.
- 1 Test Lead Set CX-1331/U.
- 1 Tube Tester I-177.
- 1 Tube Tester TV-2/U.
- 1 Vacuum-tube voltmeter, such as Electronic Multimeter ME-6A/U, or equal.
- 1 Voltammeter I-50.

Caution: Do not operate the power supply without the suitable loads. The output voltage of the power supply when operated without output loads is considerably higher than normal because of the type of regulation used in the unit.

b. The following table lists the technical manuals for the test equipments in a above.

Test unit	Technical manual
Electron Tube Test Set TV-7/U.....	TM 11-5083
Electronic Multimeter ME-6A/U.....	TM 11-5549
Electronic Multimeter TS-505/U.....	TM 11-5511
Multimeter TS-352/U.....	TM 11-5527
Tube Tester I-177.....	TM 11-2627
Test Equipment IE-9-C.....	TM 11-5026

27. Removal of Pluck-Out Parts

(figs. 8 through 12)

a. *Fuses.* All fuses in the power supply can be reached from the front panel (fig. 3). Unscrew the fuse caps at the top of the front panel. Removal of the caps will also cause the fuses to come out of their holders, as the caps are also fuse extractors.

b. *Removing Immersionproof Case.* Before the other pluck-out parts can be reached, the immersionproof case (fig. 1) must be removed. Loosen the Dzus fasteners around the edges of the front panel. Stand the unit on the front panel and lift off the case. Be careful not to damage any wiring or components while removing the case. Place the panel-and-chassis assembly on a flat surface so that the front panel hangs over the edge and the bottom chassis rests on the surface. This precaution is necessary to prevent damage to switches and wiring.

c. *Removing Heat Barriers.* Heat barriers, which consist of flexible sheets of heat-insulating material, have been inserted in various locations in the units to protect wire insulation from high heat sources. This material must usually be removed when the unit is being disassembled, but must be replaced on reassembly. It is extremely important for the operating life of the equipment that these barriers be in place at all times.

* A suitable fuse holder is also required.

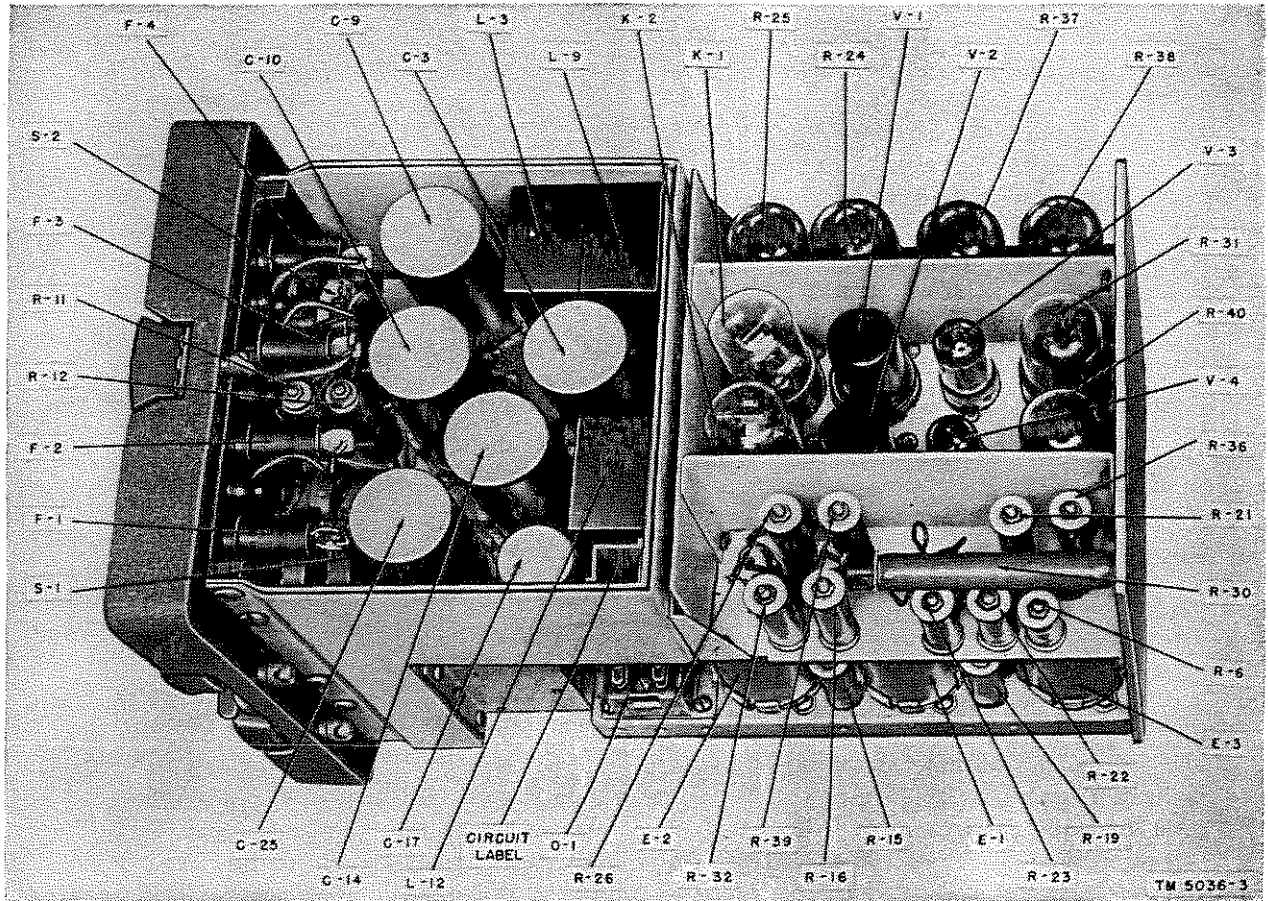


Figure 8. Power supply PP-112/GR, top of chassis.

d. *Removing Tubes and Thermal Relays.* These parts are located at the top of the rear chassis (figs. 8 and 9). When removing these parts, be careful not to damage the socket contacts at the prongs on the part.

e. *Removing Vibrators.* The three vibrators used in the power supply (E1, E2, and E3) are located on the bottom chassis (fig. 10). Pull the vibrators from their sockets. Do not rock or jiggle the vibrator in its socket, because this may spread the vibrator socket contacts and damage the vibrator. Use a straight upward pull. If necessary, pry the vibrator out of the socket with a screwdriver. Be careful not to damage the socket; do not spread the vibrator-retaining spring clip or break the rubber seal at the base of the vibrator. When the vibrator is free from its socket, remove it by tilting it toward the side of the unit.

f. *Removing Electrolytic Capacitors.*

(1) The two large plug-in type electrolytic capacitors, C27 and C30, are held in place

by spring clips on a bracket attached to the right side of the front chassis assembly (figs. 11 and 12). Remove the screws that hold the bracket and spring-clip assembly in place. Save the screws and associated washers; they will be needed for reassembly. Remove the bracket and spring-clip assembly. Remove the electrolytic capacitors by a straight pull (lateral or upward, depending on the position of the power supply unit). Do not rock or jiggle the capacitors in their sockets; the capacitors or socket prongs may be damaged.

(2) Remove electrolytic capacitors C3, C9, C10, C14, and C25 from the top front chassis (figs. 8 and 9). Observe the precautions noted in (1) above. Notice that electrolytic capacitor C17 is not a plug-in part.

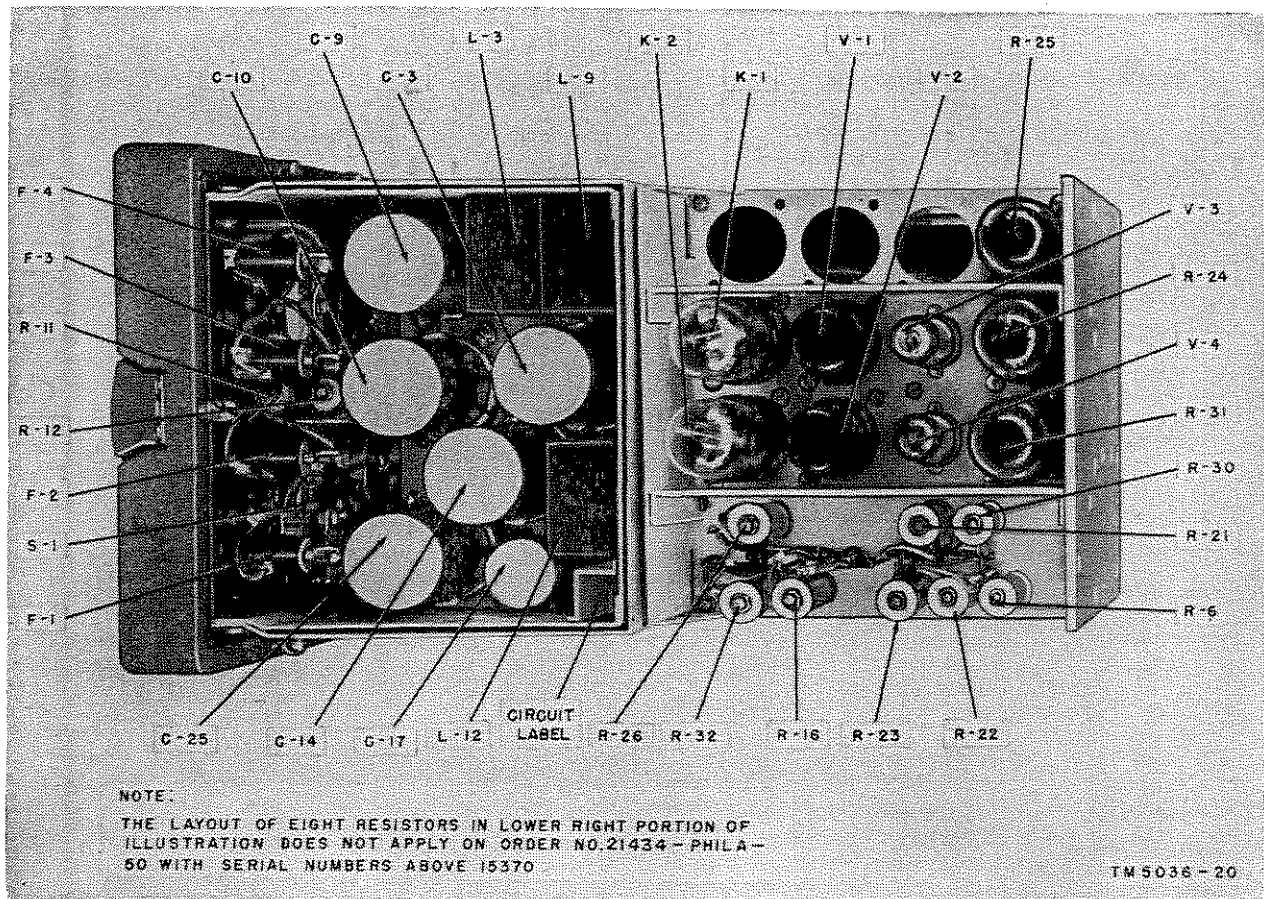


Figure 9. Power supply PP-109/GR, top of chassis.

28. Disassembly for Inspection and Cleaning

(fig. 13)

a. General. Save all screws and washers removed during the following disassembly procedure; they will be needed for reassembly of the unit. Place the screws in their original holes; this will prevent them from being lost and will serve as a reminder as to where they belong.

b. Panel. Place the unit, less case and pluck-out parts, on the edge of a flat surface, so that the front panel hangs over the edge of the surface and the bottom chassis rests on the surface. Proceed as follows:

- (1) Remove the eight screws and shakeproof washers that hold the panel to the main chassis assembly.
- (2) Carefully pull the panel away from the chassis as far as the cable wiring will permit. Do not loosen any of the soldered connections. Do not place undue

strain on the cable. Handle switch assemblies only when necessary.

- (3) Rest the panel on the surface; do not strain the cable wires.

Caution: When the front panel has been loosened, be careful not to pull on the wires or to otherwise damage any of the exposed parts or wiring. Do not pull on the panel while the chassis is being disassembled or moved about.

c. Bottom Chassis. To disengage the bottom chassis, proceed as follows:

- (1) Turn the unit upside down. Facing the rear of the power supply unit, remove the screws at each end of the rail in the upper left corner of the unit, and remove the rail (fig. 11).
- (2) Place the unit on its side, so that the vibrator shelf is uppermost; the rear plate is to the right, and the front panel is to the left (fig. 11).

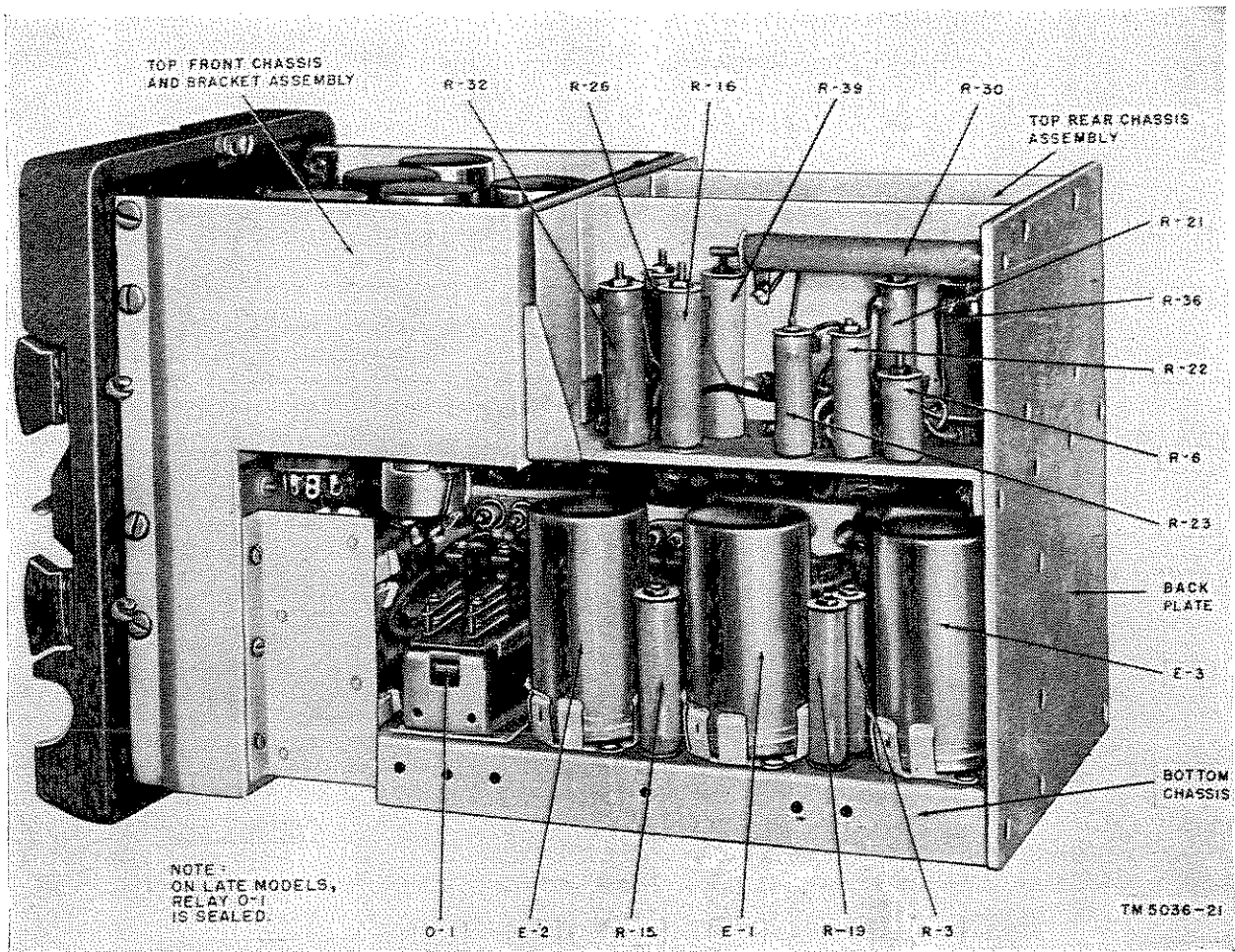


Figure 10. Power supply PP-112/GR, right side view.

- (3) Remove the three hexagonal-head screws that fasten the transformer and buffer capacitor mounting bracket to the front of the assembly.
- (4) Remove the five flat-head screws that hold the bottom chassis to the rear plate.
- (5) The bottom chassis assembly can now be disengaged from the upper chassis and rear plate assembly. Pull the bottom chassis away from the rest of the unit. Do not loosen any soldered connections or place undue strain on the two connecting cables.

d. Upper Chassis Assembly. After the disassembly procedure (described in *b* above) has been accomplished, the upper chassis assembly can be moved away from the bottom chassis. Turn the assembly to expose the wiring on the socket terminals (fig. 13).

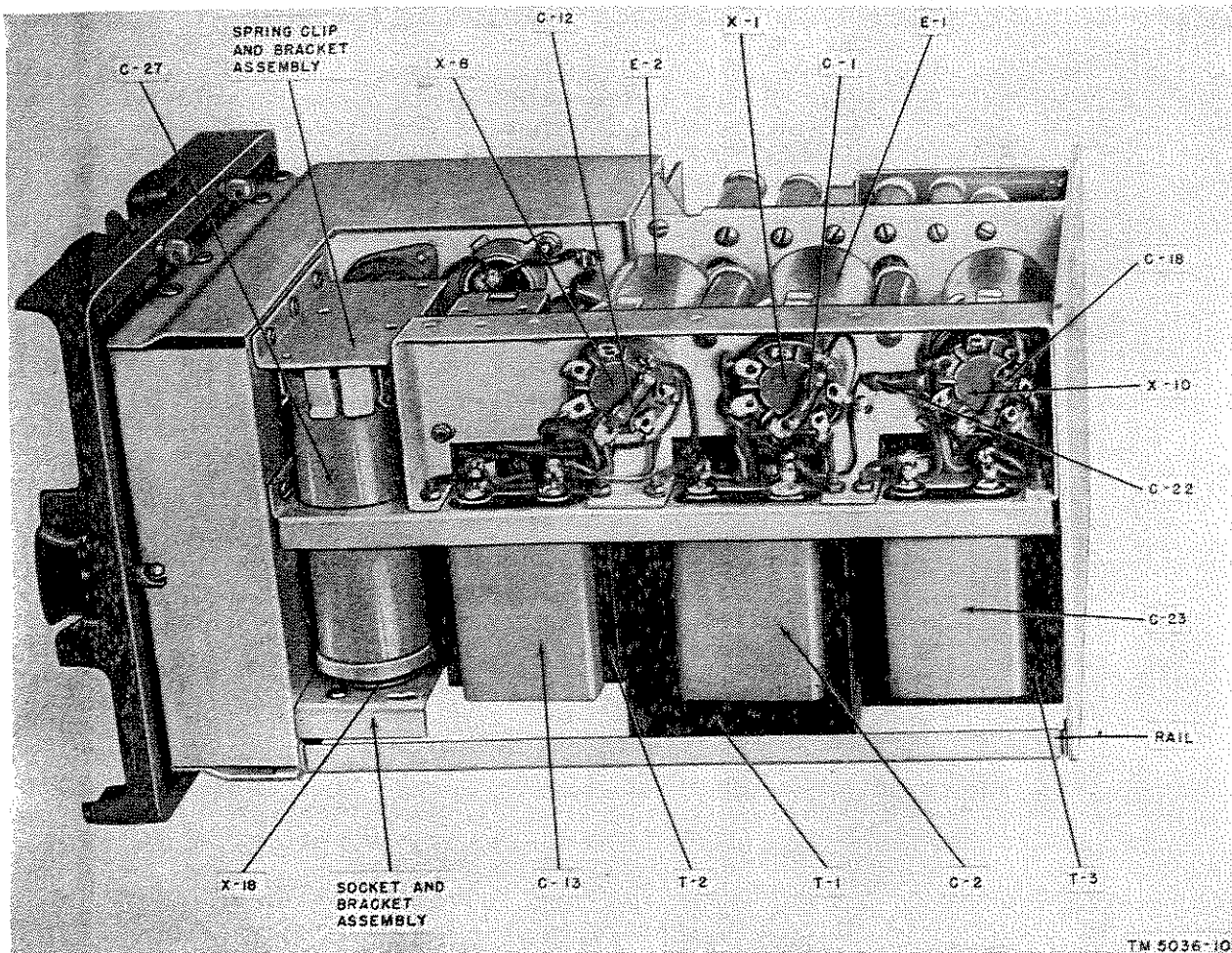
29. Inspection

After the unit has been disassembled (pars. 27 and 28), inspect all parts and wiring. Inspect the unit thoroughly for any abnormal conditions. If any are found, determine the cause of such conditions and remedy the defects before proceeding with troubleshooting and other tests (pars. 32 through 38). Repair instructions are in paragraphs 39 through 41.

a. Chassis. Examine the chassis for bent or broken plates, defective welds or rivets, dirt, corrosion, or other defects.

b. Wiring. Examine the unit for loose, defective, or broken wiring. Look for charring, loose connections, breaks in the insulation, or other damage. Examine especially the lugs on the sockets for capacitors, vibrators, and tubes, and on transformers, chokes, switches, and connectors.

c. Mounting Hardware. Examine all nuts,



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Figure 11. Power supply PP-112/GR, bottom view.

bolts, and other mounting hardware on the chassis to make sure that they are not loose. Loose mounting hardware may cause intermittent noises in the set that is operated from the power supply.

d. Sockets. Inspect tube, vibrator, and electrolytic capacitor sockets for broken or excessively spread contacts. Examine the contacts for corrosion, dirt, and grease. Check socket mounting hardware to make sure that the sockets are secured firmly to the chassis. Check the condition of all wiring to the sockets.

e. Plugs and Connectors. Examine plugs and connectors for improper contact tension, loose mounting hardware, and corrosion. Check wiring to the connectors for improper connection, breaks, and damage to insulation. In some units the panel connectors at the rear of the front panel are packed with a silicone grease and covered with rubber caps. Do not remove the caps or disturb

the grease pack unless there is good reason to believe that the connector is damaged or unless it is necessary to repair a wire connection to the connector terminal.

f. Capacitors. Examine capacitors for discoloration, leaks, bulges, dirt, loose mounting, and loose connections. Check for swelling or leaky electrolytic capacitors. Melted or oozing wax or other dielectric is a sign of damage to the part. Such capacitors should be removed for an electrical check and replaced with good ones. Metal-encased capacitors should be cleaned and the mounting hardware should be tightened.

g. Resistors. Examine resistors for blistering, discoloration, or other signs of overheating. Inspect leads and all other connections for corrosion, dirt, dust, looseness, and broken or trailing strands in the connecting wires. Discoloration of a resistor usually indicates that it has been

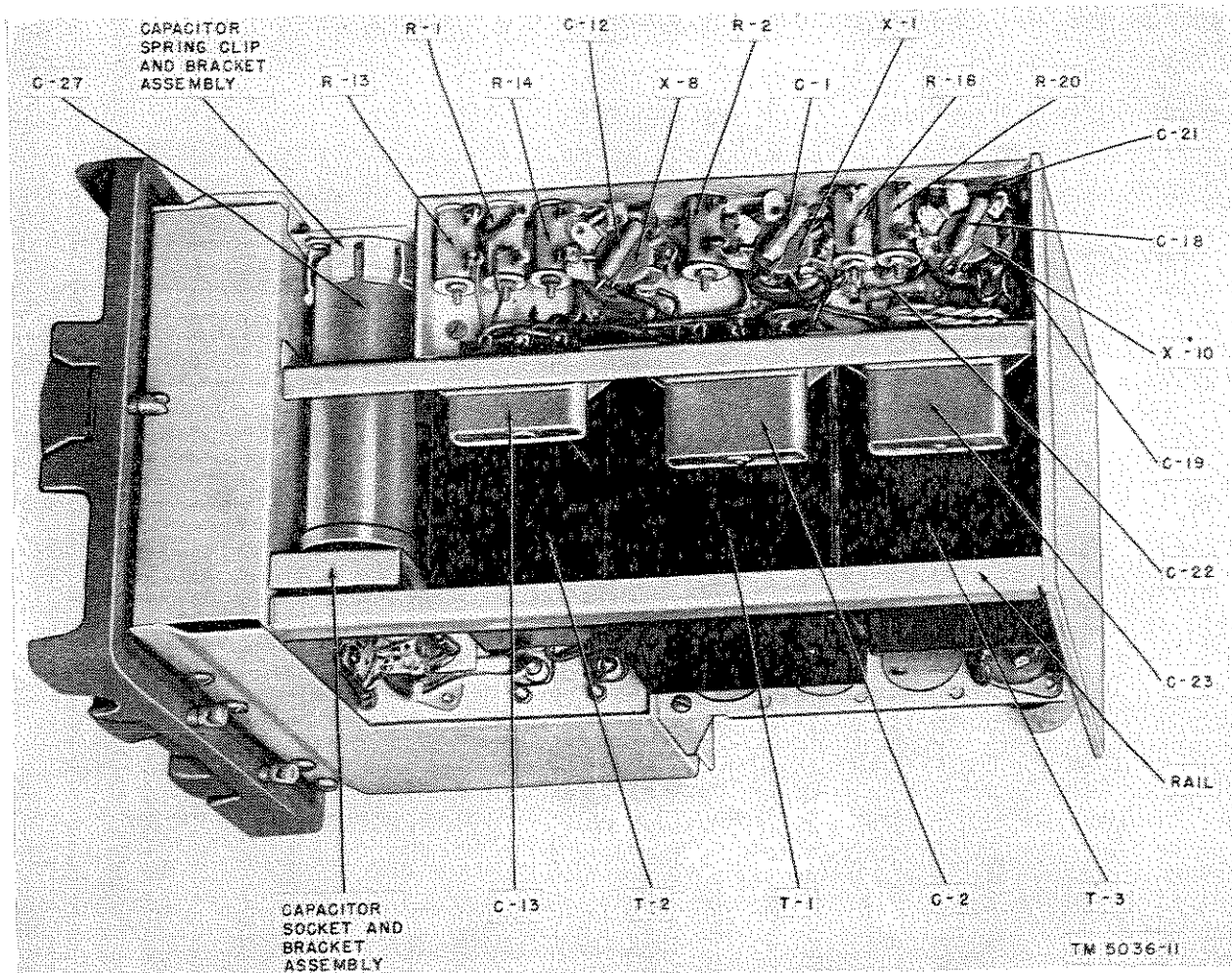


Figure 12. Power supply PP-109/GR, bottom view.

overheated or operated under overload; this indicates a defect in another component. (Power resistors may discolor because of the heating of the fungicidal lacquer; this does not indicate a defective resistor.) Do not wiggle resistors that have pigtail connections. These connections may break at the point of entry into the body of the resistor and thus make the resistor useless.

h. Transformers and Chokes. Leakage of potting compound from chokes and transformers usually indicates a short-circuited or overloaded coil winding and possibly a defective resistor or capacitor.

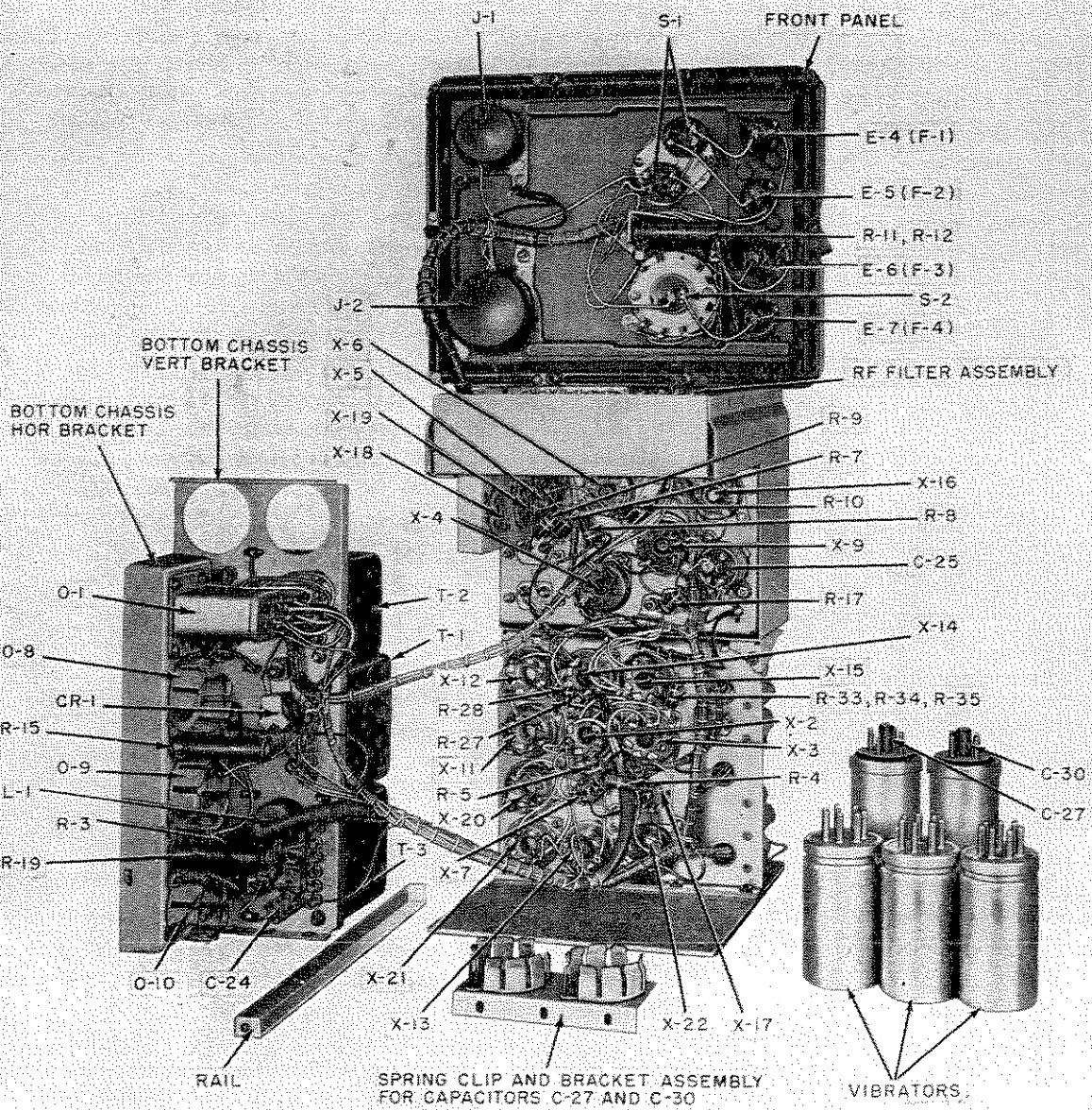
i. Relay. For later models, which contain a hermetically sealed relay (O 1), the examination is limited to continuity checks (par. 37). For early models, examine the relay for defective, dirty, and broken contacts. Check contact ten-

sion and note whether relay contacts are properly made. Check for broken connecting leads.

j. Fuse Holders. Check fuse holders and fuse caps for signs of burning, charring, or corrosion, and for poor contact with the fuse. A burned-out fuse is usually a sign of failure in another part of the circuit. When a fuse in one of the four main circuit branches is found to be burned out, the trouble is automatically localized to that particular branch: the 1v filament and relay supplies, the 85-volt supply, the 150-volt supply, or the 450-volt supply.

k. Spring Clips. Check for tension and breakage.

l. Switches. Operate the switches on the front panel to each of their operating positions to determine that they work easily with no searching for contacts. Examine switch contacts for corrosion, improper contact, and dirt.



NOTES:

1. RECTIFIER CR-1 IS USED ON LATE MODELS ONLY.
2. ON EARLY MODELS, O-1 IS AN OPEN TYPE RELAY AND S-1 MAY BE A DOUBLE-DECK TYPE SWITCH.

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Figure 13. Power supply PP-112/GR, disassembled view.

30. Cleaning

a. Dirt or corrosion will interfere with electrical continuity and mechanical efficiency of the parts of the unit by causing circuits to be shorted or insulated, or by causing switches to be jammed. For these reasons, it is important to clean all parts of the chassis and panel carefully and thoroughly.

b. Cleaning means the removal of dust, grease, rust, corrosion, moisture, wax, and soot. No set method can be given for removal of dirt because of the many ways and places in which it can collect. Cleaning should be done with a lintless cloth, fine (No. 000) sandpaper, crocus cloth, or a soft brush. In more difficult cases, carefully clean the affected

parts with the sharp edge of a screwdriver. Dust and grease can usually be removed with a cloth or brush moistened with solvent (SD). Never use gasoline for cleaning. Use extra care in cleaning spots that are difficult to reach or parts that are delicate, to avoid damage to wiring or parts. Where it is necessary to remove portions of the moistureproof-fungiproof coating to clean a part properly, refinishing is essential. Refinishing information is given in paragraph 43 and in TM 9-2851.

c. Use an air hose, if available, to blow out dust and lint from the chassis. Make sure, however, that no oil or water is carried along with the air stream, and that the air stream is controlled so that damage to small resistors and capacitors does not result. Always direct the first blast of air toward the floor to clear moisture from the hose.

d. Clean cases of all capacitors, contact pins on electrolytic capacitors, and dirty or corroded connections. A dry cloth usually will do the job. If the dirt is hard to remove, moisten the cloth with solvent (SD).

e. Remove loose dirt from resistors with a small brush.

f. Clean dirty or corroded socket and switch contacts. Clean vibrator and capacitor spring clips. Use fine sandpaper or crocus cloth to remove corrosion, oxidation, or dirt.

g. Use a relay burnisher to clean pitted or corroded contacts on the open-type relay. Use carbon tetrachloride to remove all dirt and dust particles from the contacts. Wipe up moisture with a dry, clean, lintless cloth. While cleaning the relay, be careful not to damage or distort the contacts.

31. Inspecting and Cleaning Pluck-Out Parts

a. Inspect the vibrator shells for discoloration caused by overheating, and inspect the bases for dirty or loose pins. If the vibrator is in bad condition, check it as described in paragraph 32a.

If it is defective, discard it and substitute a vibrator known to be in good condition. Inspect the electrolytic capacitors for corrosion, and bulging. If any of these conditions are observed, test as described in paragraph 32b. If a capacitor is defective, substitute an electrolytic capacitor known to be in good condition. Clean the base pins of the vibrators and electrolytic capacitors by rubbing them lightly with fine crocus cloth; then dust them with a small, clean brush. Clean the base, shell, and pins with a clean, lint-free cloth moistened with solvent (SD). Dry them in an air draft.

b. Inspect glass and metal envelopes of tubes, thermal relays, ballast tubes, and voltage regulators for dirt and corrosion. Replace any of these items that have loose envelopes. Inspect the bases and pins of these items for damage. Clean dirty and corroded pins; use fine sandpaper to remove corrosion, oxidation, and dirt; then wipe off moisture with a clean, dry cloth.

c. Clean fuse ends and clips with fine sandpaper. Wipe them with a clean cloth.

32. Testing Pluck-Out Parts

The tests for the pluck-out parts (a through g below) require the use of an ohmmeter. These tests are continuity checks and they do not test the part for actual performance. Substitution of the part in a set known to be operating properly is a more reliable test procedure. However, this substitution test should not be attempted if continuity checks indicate a faulty part. For rectifier tubes, ballast tubes, and voltage regulators, use a suitable tube checker to test the part for proper functioning.

a. *Vibrators.* Use an ohmmeter to test each vibrator for normal electrical continuity, as shown in the chart below. The vibrators should never be opened for *testing*; they are hermetically sealed in their shells.

Pins	24-volt vibrator (power supply PP-112/GR)		6-volt vibrator (power supply PP-109/GR)	
	Series-drive (ohms)	Shunt-drive (ohms)	Series-drive (ohms)	Shunt-drive (ohms)
4 and 7	480 to 540	Infinity	12	Infinity.
3 and 7	Infinity	do	Infinity	40.
1 and 7	do	480 to 540	do	Infinity.
2 and 7	do	Infinity	do	Do.
5 and 7	do	do	do	Do.
6 and 7	do	do	do	Do.

b. *Electrolytic Capacitors.* Before making any measurements or repeating a measurement, discharge the capacitor by shorting the positive and negative terminals.

- (1) The plug-in electrolytic capacitors can be tested by using an ohmmeter. For testing the capacitors that have a hv rating (C9, C10, C14, and C25), use the high-resistance scale (at least 5 megohms) of the ohmmeter. For lv capacitors (C3, C27, and C30), use the 50,000-ohm range of the ohmmeter. Test each section of dual electrolytic capacitors separately.
- (2) Connect the positive lead of the ohmmeter to the positive terminal of the capacitor. Connect the negative lead of the meter to the negative terminal of the capacitor. The ohmmeter should first

indicate a very low value of resistance. The pointer then should move toward the high-resistance readings on the scale.

- (3) The final resistance reading should be about 1 megohm for hv capacitors C9, C10, C14, and C25 and about 15,000 ohms for each section of lv capacitors C3, C27, and C30.
- (4) If the final reading for either section of the hv capacitors is less than 250,000 ohms, the part is probably defective and should be replaced. If the final resistance reading for any lv capacitor is less than 15,000 ohms, the capacitor is faulty and should be replaced. The measurement data is summarized in the following chart:

Circuit symbol	Capacity (μ f)	Voltage rating (volts)	Ohmmeter range	Terminal connection		Minimum reading (ohms)
				Positive	Negative	
C9, C10, C14:						
Section A.....	35	350	5 megohms.....	3	1	250,000
Section B.....	35	350	5 megohms.....	5	1	250,000
C25:						
Section A.....	45	300	5 megohms.....	3	1	250,000
Section B.....	45	300	5 megohms.....	5	1	250,000
C3.....	500	50	50,000 ohms.....	5	1	15,000
C27, C30.....	2,000	15	50,000 ohms.....	5	1	15,000

c. *Thermal Relays (K1 and K2).* Use an ohmmeter to check continuity as follows:

Pins	Meter reading (ohms)
5 and 7.....	0
2 and 3.....	28

d. *Ballast Tubes.* An ohmmeter connected between pins 2 and 7 of the ballast tube should show a continuity reading. The actual resistance is very small and depends on the current through the tube.

e. *Voltage Regulator Tubes.* Use an ohmmeter to make the following measurements. An emission check can be obtained with a tube checker.

Pins	Reading
1 and 5.....	0
2 and 4.....	0
2 and 7.....	0
2 and 5.....	Infinity

f. *Rectifier Tubes.* Use a tube checker capable of measuring type 1007 rectifier tubes to check

tubes V1 and V2. If this is not possible, use an ohmmeter to make the following continuity checks:

Pins	Reading
1 and shell.....	0
7 and 8.....	0
3 and 7.....	Infinity
5 and 7.....	Infinity

g. *Fuses.* Use an ohmmeter to check the fuses for continuity (par. 9).

33. Reassembly

The arrangement of Power Supplies PP-109/GR and PP-112/GR is such that even though the units are disassembled as described in the preceding paragraphs, electrical continuity exists between all parts of the unit. Because of the complexity of the mechanical arrangement, the unit should be left unassembled for the tests and repairs that are described in the following sections. The troubleshooting procedures (pars. 34 through

38) and the repair procedures (pars. 39 and 40) are based on the assumption that the units are in a disassembled condition. Do not reassemble the

unit until all the required results are obtained after making the checks and necessary repairs. The reassembly procedure is in paragraph 41.

Section II. FIELD TROUBLESHOOTING

Warning: When servicing Power Supply PP-109/GR or PP-112/GR, be extremely careful because high voltages are exposed. Always turn the OPERATE switch, S1, to the OFF position before making resistance measurements, or before touching parts or wiring in the unit. Even with the power source disconnected from the unit, potentials as high as 600 volts can still be present across capacitors, particularly the electrolytic capacitors. Before touching any part or repairing the unit when the voltage is shut off, short the part to ground. When making voltage measurements on exposed parts or terminals, use heavily insulated test probes. Keep one hand in your pocket. Never connect the battery to the power supply unless suitable output loads are connected across each pair of output terminals (fig. 15).

34. Troubleshooting Procedures

The test procedures for locating trouble in the power supply are outlined in the following steps:

a. Resistance Checks. Resistance measurements are made to locate short circuits which may damage the battery or equipment when power is applied (par. 35).

b. Operational Checks. Measurements of the input voltage, the battery current drain in the input circuit, and the voltage delivered in the output circuits are made as a rapid check of the operating conditions of the power supply (par. 36).

c. Resistance Measurements.—These tests are made to locate faults or defective components and wiring (par. 37).

d. Voltage Measurements. Voltage measurements (par. 38) at significant points in the circuit may disclose faults not observed during previous tests.

35. Resistance Checks

Restore good fuses to the proper fuse holders on the panel, replace the fuse caps, and using Electronic Multimeter TS-505/U, make the resistance measurements listed in *a* through *c* below. To make these measurements, it is assumed that the other pluck-out parts are not in their sockets, that the unit has not yet been reassembled, and that

all external cables have been disconnected. Use an ohmmeter range suitable for the particular resistance reading to be obtained.

a. Make the measurements indicated in figure 14. The readings at POWER IN connector J1 should be taken for all three positions of OPERATE switch S1. The readings at POWER OUT connector J2 should be taken for both positions of TRANS POWER switch S2. Relay O 1 should be operated manually in those models that have an open-type relay. For other models, follow the directions given in figure 14. The readings shown in figure 14 should be obtained.

b. Make the measurements indicated in the following table. All measurements are made to ground.

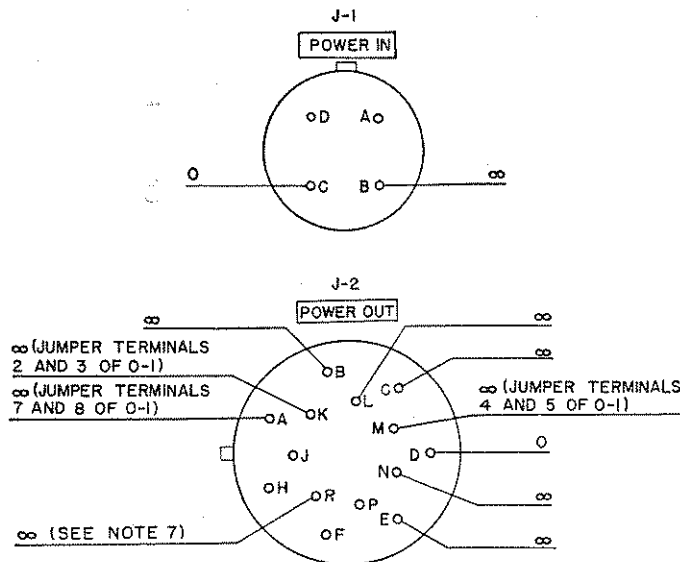
Terminal	On part	Typical reading (ohms)	Test conditions
F	J2	22,500 -----	S2 in LOW position.
P	J2	31,500 -----	S2 in LOW position.
F	J2	18,650 -----	S2 in HIGH position.
P	J2	24,000 -----	S2 in HIGH position.
8	T1	Infinity ¹ ----	S2 in HIGH position.
5	T1	Infinity -----	S2 in HIGH position.
7	T3	24,000 -----	S2 in HIGH position.
5	T3	Infinity -----	S2 in HIGH position.

¹ This reading is 4,000 to 50,000 ohms on models that contain rectifier CR1. Connect the negative lead of the ohmmeter to the chassis for this measurement.

c. Do not apply power to the unit until the tests (*a* and *b* above) have been made and until the indicated readings are obtained. Incorrect readings may indicate a shorted or leaky capacitor, or a wire or a lug shorted to the chassis. Check each capacitor in the affected circuit section for leakage or a short, and replace if necessary. Check wires and lugs on component parts, particularly on switches. Repair if necessary. Refer to the schematic diagrams (figs. 20 through 24).

36. Operational Tests and Procedures

a. The operational checks described in this paragraph are designed to determine whether the power supply delivers the proper output voltages and draws the required amount of current from



NOTES:

1. CONNECTORS VIEWED FROM WIRING SIDE.
2. ALL MEASUREMENTS MADE TO CHASSIS.
3. RESISTANCE DATA APPLY FOR ALL POSITIONS OF OPERATE SWITCH S-1 AND TRANS POWER SWITCH S-2.
4. MEASUREMENTS ON J-2: TAKEN WITH RELAY O-1 OPERATED. FOR MODELS HAVING SEALED RELAY, CONNECT JUMPERS WHERE INDICATED.
5. FOR VALUES NOT GIVEN, SEE TEXT.
6. ALL PLUCK-OUT PART ARE REMOVED FOR THESE MEASUREMENTS.
7. FOR MODELS WHICH CONTAIN RECTIFIER CR-1, THIS READING WILL BE FROM 4,000 TO 50,000 OHMS.

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Figure 14. Resistance tests at connectors J1 and J2.

the storage battery, when loads simulating actual operating conditions are connected across the output terminals. The tests are made for the various conditions under which the unit may be operated, namely, for each position of switch S2 and for the RECEIVE or TRANS & RECEIVE position of switch S1. Based upon the results of these measurements, the trouble in the power supplies may be sectionalized directly to one of the circuit sections. Refer to the detailed checks described in paragraphs 37 and 38 to trace the fault to a specific part within the particular circuit section.

b. Refer to the operational test setup shown in figure 15 and proceed as directed in (1) through (8) below; use the test equipment listed in paragraph 26. Insert all plug-in parts.

- (1) Select a storage battery having the required voltage (12 and 24 volts for Power Supplies PP-109/GR and PP-112/GR, respectively). Turn switch S1 to the OFF position.
- (2) Connect the negative battery lead to pin C of connector J1.
- (3) Connect the positive battery lead in series

with the fuse and the ammeter to pin B of J1. The rating of the fuse, the ammeter scale, and the battery voltage to be used should be as listed below. (Use Multimeter TS-352/U, Voltammeter I-50, or an ammeter with equivalent ranges.)

Power supply	Nominal battery voltage	Fuse rating (amperes)	M1 meter range (volts)	M2 meter range (amperes)
PP-109/GR.....	12.6	20	0 to 20	0 to 20
PP-112/GR.....	25.2	15	0 to 50	0 to 15

- (4) Connect a strap between terminals E and D of J2.
- (5) Connect a single-pole, single-throw (SPST) switch between terminals K and D of J2.
- (6) Connect a load resistor between terminal D and the other terminals of J2, as indicated in figure 15. Be sure that correct load resistors are connected for the par-

ticular condition of operation. The necessary resistors are contained in Test Equipment IE-9-C. A properly loaded and aligned Receiver-Transmitter RT-66/GRC, RT-67/GRC, or RT-68/GRC may be used in place of the load resistors.

- (7) Turn switch S1 to the RECEIVE position, and turn switch S2 to the HIGH position. Using Electronic Multimeter TS-505/U, measure the input and output voltages across each of the load resistors as indicated by meters M1 and M3 in figure 15. Also note the ammeter reading. The required readings are shown in the charts below. For this check, keep the switch between terminals K and D of J2 open.

Power supply	M1 input (volts)		M2 input (amperes)	
	Minimum	Maximum	Minimum	Maximum
PP-109/GR.....	12.4	12.8	2.05	2.55
PP-112/GR.....	24.8	25.6	1.40	1.60

Power Supplies PP-109/GR and PP-112/GR

Terminals on J2	M3 output (volts)	
	Minimum	Maximum
A ¹	5.2	6.0
B.....	78	92
C.....		
F.....		
L.....	5.9	6.7
M.....	96	114
N.....		
P.....		
R.....		

¹This voltage is present only on some early models on Orders No. 18651-Phila-49, 21433-Phila-50, and 1759-Phila-51 (figs. 20 and 21).

- (8) Turn switch S1 to the TRANS & RECEIVE position and turn switch S2 to the HIGH position. Close the switch between terminals K and D of J2. Measure the input current, the input voltage, and the output voltage across each of the load resistors. The required readings are shown in the following charts:

Power supply	M1 input (volts)		M1 input (amperes)	
	Minimum	Maximum	Minimum	Maximum
PP-109/GR.....	12.4	12.8	10.5	13.2
PP-112/GR.....	24.8	25.6	6.3	8.0

Power Supplies PP-109/GR and PP-112/GR

Terminals on J2	M3 output (volts)	
	Minimum	Maximum
A.....	5.2	6.0
B.....	78	92
C.....	138	161
F.....	215	285
L.....	5.9	6.7
M.....	90	100
N.....	5.9	6.7
P.....	415	485
R.....	-23	-31

- (9) Keep switch S1 in the TRANS & RECEIVE position and set switch S2 in the LOW position. Close the switch between terminals K and D of J2. The correct readings are shown in the following charts:

Power supply	M1 input (volts)		M2 input (amperes)	
	Minimum	Maximum	Minimum	Maximum
PP-109/GR.....	12.4	12.8	5.7	7.1
PP-112/GR.....	24.8	25.6	3.9	4.9

Power Supplies PP-109/GR and PP-112/GR

Terminals on J2	M3 output (volts)	
	Minimum	Maximum
A.....	5.2	6.0
B.....	75	105
C.....	75	105
F.....	90	130
L.....	5.9	6.7
M.....	75	105
N.....	5.9	6.7
P.....	170	230
R.....	0	0

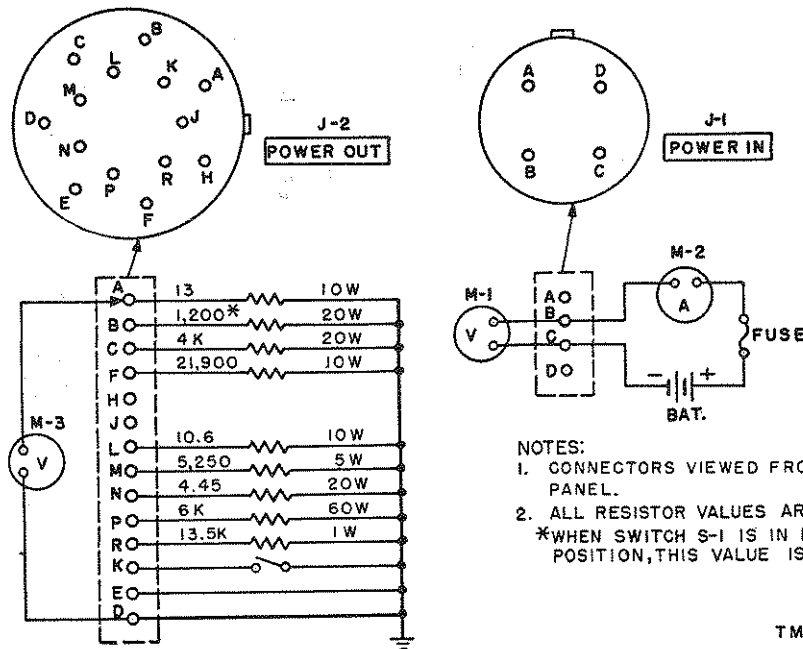


Figure 15. Operational test setup.

- NOTES:
- CONNECTORS VIEWED FROM FRONT PANEL.
 - ALL RESISTOR VALUES ARE IN OHMS(±5%).
*WHEN SWITCH S-1 IS IN RECEIVE POSITION, THIS VALUE IS 1,680.

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c. When the required readings are obtained, proceed with the additional tests described in paragraph 45. If the required readings are not obtained, proceed with the detailed trouble-localization checks described in paragraphs 37 and 38.

37. Resistance Measurements

These checks are intended to locate the defective components or wiring responsible for the failure to meet the requirements given in paragraph 36. For these checks, disconnect the battery and all external connections from connector J2. Use Electronic Multimeter TS-505/U or equivalent. The test points, the required readings, and the probable cause of trouble if the readings are incorrect, are listed in the chart below. Replace any component found to be defective. The location of all components is shown in figures 8 through 13 and figure 16. When connecting test leads across electrolytic capacitors, observe the correct polarity. Replace any components removed during tests after such checks are completed. If no test conditions are given in the test condition column (a through g below), the switch setting and relay conditions are immaterial.

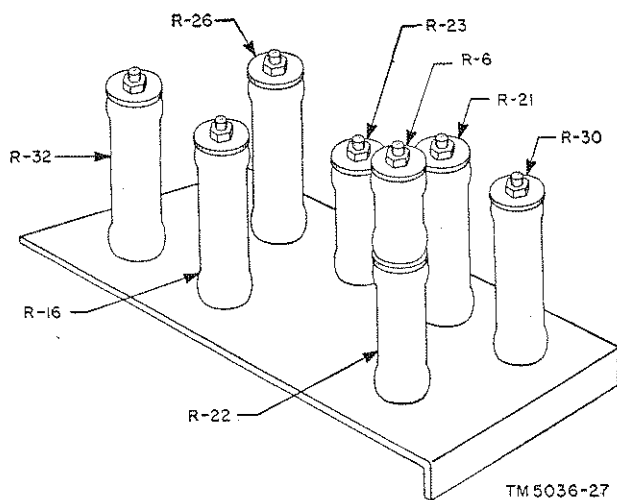


Figure 16. Power supply PP-109/GR, resistor placement for models on order No. 21434-Phila-50 with serial numbers above 15370.

a. Receiver Filament Supply Circuit. If incorrect voltage or no output voltage is measured at terminal L of J2, make the measurements shown below. In Power Supply PP-112/GR, remove R31, K2, and R40 from their sockets.

Point of measurement	Test condition	Normal reading (ohms)		Probable trouble
		PP-109/GR	PP-112/GR	
Term. B on J1 to term. 2 on R40 (or R31) socket.	S1 on RECEIVE	0	9	Defective S1, F1, L4, or R39 (in PP-112/GR only). Defective wire.
Term. 7 on R40 to term. 2 on R31 socket.			0	
Term. 7 on R31 socket to term. L on J2.	K2 plugged in	16	16	Defective R32 or L16. Defective K2 or wiring. Defective wiring, C30, or C31. Defective K2, R33, R34, R35, or wiring.
Term. L on J2 to term. D on J2.		0	0	
Term. L on J2 to term. D on J2.	K2 plugged in	Infinity	Infinity	
		32	32	

b. Transmitter Filament Supply Circuit. If incorrect voltage or no output voltage is measured at terminal N of J2, make the measurements shown

below. For these measurements, remove thermal relay K1 from its socket.

Point of measurement	Test condition	Normal reading (ohms)		Probable trouble
		PP-109/GR	PP-112/GR	
Term. N on J2 to term. 5 on K1 socket.		0	0	Defective L14.
Term. N on J2 to term. D on J2.	K1 in socket, ballast tubes removed.	Infinity	Infinity	Defective C27 or C28. Defective C27, C28, or wiring.
Term. N on J2 to term. D on J2.		32	32	
Term. 5 to 7 on K1 socket.	Relay O 1 manually operated. ¹ Ballast tubes in sockets. S1 on RECEIVE.	16	16	Defective R26. Defective S1, F1, L4, or ballast tube socket wiring, or R36 (in PP-112/GR only).
Term. B on J1 to term. 7 on K1 socket.		1	5	
Term. B on J1 to term. 7 on K1 socket.	Ballast tubes in sockets. O 1 open. R31 removed. S1 on RECEIVE.	Infinity	Infinity	Shorted contacts of O 1.

¹ For the models that use a sealed-type relay O 1, place a jumper between terminals 2 and 3 of O 1.

c. Relay Circuit. If relay O 1 fails to operate when terminal K of J2 is grounded, or operates when terminal K of J2 is not grounded externally

(This would cause incorrect voltages at terminals N, C, F, P, and R of J2.), make the following measurements:

Point of measurement	Test condition	Normal reading (ohms)		Probable trouble
		PP-109/GR	PP-112/GR	
Term. B on J1 to term. K on J2.	S1 on RECEIVE	63	285	Defective S1, F1, L4, coil of O 1, or L10.

d. Relay Supply Circuit. If incorrect voltage or no output voltage is measured at terminal A of

J2, make the following measurements:

Point of measurement	Test condition	Normal reading (ohms)		Probable trouble
		PP-109/GR	PP-112/GR	
Term. A of J2 to term. B of J1 (on some of the early models produced on Orders No. 18651-Phila-49, 21433-Phila-50, and 1759-Phila-51).	S1 on RECEIVE.....	16	45	Defective L15, R30, L4, F1, or S1.
Term. A of J2 to term. 7 of relay O 1 (on all models except some of the early models on Orders No. 18651-Phila-49, 21433-Phila-50, and 1759-Phila-51).	S1 on RECEIVE.....	16	45	Defective L15 or R30
Term. A of J2 to term. B of J1 (on all models).	S1 on TRANS AND RECEIVE.	16	45	Defective S1.

e. 85-Volt Supply Circuit. Make the measurements shown below if incorrect voltage or no output voltage is measured at terminal B or M of J2.

For these measurements, remove vibrator E3 from its socket.

Point of measurement	Test condition	Normal reading (ohms)		Probable trouble
		PP-109/GR	PP-112/GR	
Term. B to C on J1.....	S1 on RECEIVE. R31 removed.	Infinity....	Infinity....	Defective C6, C18, C20 or C22.
Term. B on J1 to term. 1 on X10.	S1 on RECEIVE.....	Less than 1.	2.7.....	Defective S1, F2, L5, R19, or T3.
Term. B on J1 to term. 1 on X10.	S1 on TRANS and RECEIVE.	Less than 1.	2.7.....	Defective S1 or wiring on S1.
Term. B on J1 to term. 6 on X10.	S1 on TRANS and RECEIVE.	Less than 1.	2.7.....	Defective T3.
Term. B on J1 to term. 4 on X10.	.....	20.....	0.....	Defective wiring, or R18 (in PP-109/GR only).
Term. B on J1 to term. 3 on X10.	.....	51.....	Infinity....	Defective wiring, or R20 (in PP-109/GR only).
Term. B on J2 to term. 5 on X17.	.....	140.....	140.....	Defective L13 or R23.
Term. 5 on X17 to term. 5 on T3.	S2 on HIGH. O 1 not operated.	660.....	660.....	Defective L12, R21, R22, S2 O 1 contacts, or T3.
Term. 5 on X17 to term. 5 on T3.	O 1 manually operated. ¹ S2 on low.	160.....	160.....	Defective O 1, ² L12, or S2 contacts.
Term. 5 to 2 on X10.....	.....	45.....	45	Defective T3.
Term. 7 to 8 on V1 or V2.....	V1 and V2 out of sockets.....	Less than 1.	.....	Defective T3.
Term. M on J2 to term. 5 on T3.	.....	780.....	780	Defective R17 or L12.
Term. E on J2 to term. 2 on X17.	.....	0.....	0	Defective wiring.
Term. 2 on X10 to term. 1 on L12.	.....	23.....	23	Defective T3 or wiring.
Term. 7 on X10 to chassis.....	.....	0.....	0	Open ground connection.

¹ For the models that use a sealed-type relay, place a jumper between terminals 4 and 5 of O 1.

² This trouble is not indicated for the test used with the sealed-type relay.

f. 150-Volt Supply Circuit. Make the measurements shown below if the voltage readings at terminal C of J2 are found to be incorrect. For these measurements, set switch S1 in the TRANS

& RECEIVE position and remove vibrator E2 from its socket. Set switch S2 and operate relay O 1 manually as directed in the test condition column.

Point of measurement	Test condition	Normal reading (ohms)		Probable trouble
		PP-109/GR	PP-112/GR	
Term. B on J1 to term. 4 on X8		20	0	Defective S1, F3, I6, or R13 (in PP-109/GR only).
Term. B on J1 to term. 2 on T2	O 1 unoperated	Infinity	Infinity	Defective contacts of O 1.
Term. B on J1 to term. 2 on T2	O 1 manually operated ¹	Less than 1	2	Contacts of O 1 ² , or defective R15.
Term. B on J1 to term. 1 on X8	O 1 manually operated ¹	Less than 1	3	Defective T2.
Term. B on J1 to term. 6 on X8	O 1 manually operated ¹	.75	3	Defective T2.
Term. 6 to 3 on X8		51	Infinity	Defective T2 or R14 (in PP-109/GR only).
Term. 7 on X8 to chassis		0	0	Open ground connection.
Term. 5 to 2 on X8		125	110	Defective T2, or C13 (in PP-109/GR only).
Term. C on J2 to term. 5 on X7 (V3)		0	0	Defective wiring.
Term. 2 on X7 to chassis		0	0	Defective ground connection.
Term. 2 on X8 to term. 3 on X3 (V2)		135	135	Defective T2, T1, or wiring.
Term. C on J2 to term. 5 on T2	S2 in HIGH position	660	660	Defective S2, L11, R16, or L9.
Term. C to B on J2	S2 in HIGH position	Infinity	Infinity	Defective S2 or wiring.
Term. C to B on J2	S2 in LOW position	0	0	Defective S2 or wiring.
Term. 5 on T2 to term. 5 on T1		0	0	Defective wiring between T1 and T2.

¹ For the models that use a sealed-type relay, place a jumper between terminals 7 and 8 of O 1.

² This trouble is not indicated for the test used with the sealed-type relay.

g. 450-Volt Supply Circuit. Make the measurements shown below if incorrect voltage readings are obtained at terminal R, P, or F of J2. For these measurements, remove vibrator E1 from its

socket, and set switch S1 to the TRANS & RECEIVE position. Operate switch S2 and relay O 1 manually as directed in the test condition column.

Point of measurement	Test condition	Normal reading (ohms)		Probable trouble
		PP-109/GR	PP-112/GR	
Term. B on J1 to term. 4 on X1	S2 on HIGH	20	0	Defective S1, F4, L7, or R1.
Term. B on J1 to term. 4 on X1	S2 on LOW	Infinity	Infinity	Defective S2.
Term. B on J1 to term. 1 on X1	S2 on HIGH. O 1 unoperated.	Infinity	Infinity	Defective O 1 contacts 9-10.
Term. B on J1 to term. 1 on X1	S2 on HIGH. O 1 manually operated. ¹	Less than 1	3	Defective contacts of O 1, ² R3 or T1.
Term. B on J1 to term. 6 on X1	S2 on HIGH. O 1 manually operated. ¹	Less than 1	3	Defective T1.
Term. 6 to 3 on X1		51	Infinity	Defective T1, or R2 (in PP-109/GR only).
Term. 7 on X1 to chassis		0	0	Open ground connection.
Term. 5 to 2 on X1		12	12	Defective winding 7-8-9 of T1.
Term. R on J2 to term. 5 on X1		500	500	Defective L2 or R6.
Term. 5 on X2 to term. 3 on X3		150	160	Defective winding 4-5-6 of T1.
Term. 3 on X2 to term. 3 on X3		1 megohm	1 megohm	Defective R4.

Point of measurement	Test condition	Normal reading (ohms)		Probable trouble
		PP-109/GR	PP-112/GR	
Term. 5 on X2 to term. 5 on X3	-----	1 megohm	1 megohm	Defective R5.
Term. 5 on T1 to term. 5 on T2	-----	0	0	Defective wiring.
Term. 7 to 8 on X2	V1 and V2 out of sockets	Less than 1	Less than 1	Defective winding 7-8 to T3.
Term. 7 to 8 on X3	V1 and V2 out of sockets	Less than 1	Less than 1	Defective wiring.
Term. P to D on J2	S2 on LOW	31,500	31,500	Defective S2, R12, or R11.
Term. P to D on J2	S3 on HIGH	24,000	24,000	Defective S2, L8, L3, R7, R8, R9, R10, C9, C10, or C11.
Term. P on J2 to term. 5 on T2	S2 on HIGH	Infinity	Infinity	Defective S2.
Term. P on J2 to term. 5 on T2	S2 on LOW	660	660	Defective S2, L11, R16, or L9.
Term. P on J2 to term. 7 on X2	S2 on HIGH	160	160	Defective L1, L3, L8, or S2.
Term. F to D on J2	S2 on LOW	22,500	22,500	Defective R11.
Term. 1 on X3 to chassis	-----	0	0	Open ground connection.
Term. 1 on X2 (V1) to chassis	-----	0	0	Open ground connection.

¹ For the models that use a sealed-type relay, place a jumper between terminals 9 and 10 of O 1.

² This trouble is not indicated for the test used with the sealed-type relay.

38. Voltage Measurements

The voltage checks in this paragraph supplement the resistance measurements given in paragraph 37, and are intended to find defects that are not readily determined by resistance measurements; that is, defective capacitors or partially shorted windings. For these measurements, reinsert all plug-in parts. Connect storage battery (+) to pin B on J1 and storage battery (-) to pin C on J1. Connect the load resistors, switch, and ground connection (par. 36). To identify the points measured with the component involved, refer to figures 20 through 24. Use Electronic Multimeter TS-505/U or equivalent. The table below lists measurements at significant points in the circuits of the power supplies. All measurements are made to ground with TRANS POWER switch in the HIGH position and relay O 1 operated. The measurements apply to both power supplies.

Caution: High voltages are present at some of the measuring points.

Point of measurement	Normal reading (volts)	Probable trouble
Term. 8 on T1	-28	Defective T1, CR1, C3, C4.
Term. 5 on T1	175	Defective T1, C14, C9.
Term. 5 on T3	135	Defective T3, C17, C24, C25, L12.
Term. 7 on T3	467	Defective L1, L3, C9, C10, or wiring.
Term. 2 on L9	170	Grounded L9, R16.
Term. 2 on L12	115	Defective wiring, L12 grounded.
Term. 5 on V4	95	Defective wiring, R23 grounded.
Term. 3 on K2	5	Defective R33, R34, R35.
Term. 3 on K1	5.4	Defective R27, R28.
Term. 7 on R40	12.6	Defective R31, R39, R40.
Term. 7 on R38	12.6	Defective R37, R38, R24, R25, or R36 (in PP-112/GR only).

Section III. REPAIRS

39. Replacement of Parts

When replacing parts in Power Supplies PP-109/GR and PP-112/GR, observe the precautions given below.

a. Tagging Wires. If a wire is disconnected from any junction, it should be tagged to make sure that correct rewiring will be done when a part is replaced. Before unsoldering any leads, tie together the leads that are attached to each

part. Use small tags or short pieces of adhesive tape to identify all wires in accordance with their numbered connections. Identify every lead that is to be removed.

b. Parts and Substitutions. When damaged parts must be replaced, identical parts should be used. If identical parts are not available and the damaged component is beyond repair, a substitution must be made. The part substituted must

have identical electrical properties and must have equal or higher voltage and current rating than the original part.

c. Location. Relocation of substituted parts can cause hum and is not recommended.

d. Mounting. Mount the new or replaced part in the same mounting as that formerly occupied by the damaged part. Fasten all mountings securely.

e. Soldering. Before soldering any connections, carefully scrape all parts that will be touched by the solder until all rust, corrosion, paint, or varnish is removed. Remove the scrapings with a small, clean brush. Tin all surfaces to be soldered. Wrap the wire around the lug to obtain mechanical support. Use a small amount of solder to make the connection and sufficient heat to make the solder flow evenly around the tinned surfaces.

f. Retropicalization. If the parts to be replaced require special treatment, such as retropicalization, follow the instructions given in the appropriate publication referred to in paragraph 43.

40. Special Repair Procedures

Most of the parts in these power supplies are readily accessible and can be easily replaced without special instructions. Special repair procedures required for repairing or replacing socket, rf chokes, panel connectors, switch S1, relay 0 1, and the transformers are given, in that order in *a* through *g* below.

a. Sockets. All sockets are attached to the chassis by rivets. To change a socket:

- (1) Remove the part plugged into the socket.
- (2) Unsolder the wires connected to the socket.
- (3) Drill out the two rivets that fasten the socket to the chassis.
- (4) Substitute a new socket and fasten it with rivets or machine screws, lockwashers, and nuts.
- (5) Resolder the wires to the socket.
- (6) Clean the unit thoroughly to remove solder drops and metal chips.
- (7) Check the new connections with those shown in the schematic for that unit.

b. Rf Chokes. All rf chokes, except choke L1, are located in the recess of the lower portion of the front chassis and bracket assembly behind the front panel (fig. 13). The rf chokes are made

of heavy wire and are not easily damaged. Do not attempt the following procedures unless absolutely certain that an rf choke or C11 is defective. On some of the units of early production on Order No. 1759-Phila-51, these coils touch each other and cause arc-overs. As a result, carbon paths are formed. To correct this trouble, disassemble the unit as described below; then loosen the mounting screws and shift as many coils as may be necessary to get adequate clearance between the coils. To reach the chokes, proceed as follows:

- (1) Separate the panel from the chassis assembly (par. 28).
- (2) Remove the eight screws that fasten the terminal board to the filter assembly.
- (3) Carefully unsolder all ground leads from the capacitors to the metal strip.
- (4) Remove all connections to the front-panel cable from the terminal board.
- (5) Remove the metal ground strip by removing the mounting screws.
- (6) Carefully tilt the terminal board back toward the top of the unit. This exposes the rf chokes and C11.
- (7) Remove the screw that fastens the defective choke to the terminal board.
- (8) Unsolder the wires from the choke to the terminals on the terminal board.
- (9) Remove the choke and repair or replace if necessary.
- (10) Reassemble the choke on the axial screw and tighten the nut.
- (11) Remount the terminal board and resolder the wires; be careful not to damage the wires or short them to the chassis.

c. Panel Connectors. To remove panel connectors, use a spanner wrench or long-nosed pliers. In some units the rear of the panel connectors is packed with grease and fitted with rubber caps. Remove the rubber caps, and clear away as much of the grease as possible before removing the connectors. Carbon tetrachloride may be used as a grease solvent; however, the grease smears easily and is difficult to remove. Remove the panel connectors as follows:

- (1) Insert the teeth on the spanner wrench in the notches in the rim of the connector.
- (2) Turn the spanner wrench counterclockwise until the rim is removed. Remove the lockwasher.

- (3) Remove the connector from the rear of the panel.
- (4) Unsolder all wires.
- (5) Resolder the wires to the new connector. Make sure that the new part has a rubber gasket.
- (6) Clean thoroughly to remove solder drops.
- (7) Check the new connections with those shown in the schematic for that unit.
- (8) Reinsert the connector from the rear of the panel.
- (9) Reinsert the lockwasher and rim; use the spanner wrench to screw the rim back on the connector. Check the assembly for tightness.
- (10) To prevent vapors formed within the power supply from condensing around metallic parts of the connector, repack the connectors with grease. This is necessary to prevent possible equipment breakdown caused by short circuit. Use compound, insulating and sealing, electrical connections, U. S. Army type 62-2. (U. S. Navy type AN-C-218a.) Be sure to pack the grease tightly over all parts of the connector, connector insulating material, metal rim, and connecting lead ends in the immediate vicinity of the connector pins. Apply at least 1/8-inch thickness of grease over the connectors. Pack the grease down tightly until the entire surface of the connector is covered, and there are no air pockets between any parts of the connector and the grease.
- (11) After the grease has been applied, replace the rubber cap. A proper size cap is provided for each connector. In each case, the cap has two projections: a hole just over the projections to accommodate the connector cable, and a rubber button with an undercut near its head. When properly assembled over the connector, the cap grips the connector tightly.
- (12) To assemble, insert the rubber button through the hole in one of the cap projections so that it fits into the undercut on the button. Place the cap over the rear of the connector, and fit the connector cable into the cutout just above the projections. Insert the free end of the button through the hole in the other cap projection, and push the projection

toward the head of the button until it snaps into the undercut.

d. Switch S1. Some models contain a single-deck switch for S1, while other models contain a double-deck switch. To replace the single-deck switch (fig. 13), separate the panel from the chassis assembly (par. 28), unsolder all wires from the switch, and then remove the switch. To replace the double-deck switch, separate the panel from the chassis assembly (par. 28) and follow these instructions:

- (1) Unsolder all wires from the top deck of the switch.
- (2) Remove the two nuts that fasten the top deck of the switch to the remainder of the switch assembly.
- (3) Lift off the top deck.
- (4) Unsolder all wires from lower deck.
- (5) Remove the castellated nut on the front of the panel.
- (6) Replace the switch by reversing the above procedure; be careful to align the red dot on the upper deck of the switch with the red dot on the lower deck. Make sure that the locating lug goes into the hole provided for it on the front panel.
- (7) When resoldering the connections, be careful to remove solder drops and check all connections with those shown in the schematic for that unit.

e. Relay O 1 (Open-Type). Relay O 1 is mounted on the horizontal bracket of the bottom chassis.

- (1) Use a relay spring bender to align the relay contacts. Adjust the contacts so that when the armature (visible through the slot in the relay) is moved in the direction of the contacts, each of the four sets of contacts closes.
- (2) Use a contact burnisher to clean contacts thoroughly.
- (3) Wipe off with a clean lint-free cloth.
- (4) Use a relay spring bender to straighten out all bent or warped contact springs.
- (5) If the relay is damaged beyond repair and replacement is necessary, remove the four screws that secure the relay to the bottom chassis, lift the relay off the chassis, and disconnect all wires from it.
- (6) Reconnect all wires before mounting relay O 1. Use a 12-volt relay for Power

Supply PP-109/GR or a 24-volt relay for Power Supply PP-112/GR.

- (7) Make sure that the contacts on the new relay are properly aligned and closed when the armature is pushed in the direction of the contacts.
- (8) Use the four screws and washers to attach the relay to the bottom chassis.

f. Relay 01 (Sealed-Type). If a sealed-type relay (fig. 13) becomes faulty, it must be replaced with a new one.

- (1) Unsolder all wires from the terminals on top of the relay.
- (2) Remove the four screws that mount the relay to the bottom chassis, and lift off the relay.
- (3) Mount the new relay, using the four screws and washers.
- (4) Reconnect all wires to their proper terminals on top of the relay.

g. Transformers. The transformers are mounted on the vertical bracket attached to the bottom chassis. To replace a transformer, follow the instructions below.

- (1) Remove the vibrators.
- (2) Remove the six screws and lockwashers that fasten the transformer bracket to the bottom chassis. Separate the transformers from the bottom chassis; be careful not to damage connecting wires.
- (3) Disconnect all wires from the part being replaced.
- (4) Remove the four nuts and washers and lift off the transformer from the rear of the transformer bracket.
- (5) When remounting the new transformer, make sure that the terminals clear the chassis.
- (6) Fasten with the four lockwashers and nuts.
- (7) Resolder all wires and check the connections against the schematic for that unit.
- (8) Attach the transformer bracket to the bottom chassis; use the six screws and lockwashers.

41. Reassembly

(figs. 11, 12, and 13)

After the inspection, tests, and repairs have been made, the unit is ready for reassembly. To reas-

semble, reverse the procedure described in paragraph 28. Proceed as follows:

a. Bring the bottom and top chassis assemblies close together, and line them up so that the bottom chassis can be pushed into place. Make sure that the flexible cables are back in their original positions, and that wires are not pinched, stretched, or damaged during reassembly.

b. Replace and tighten the screws and lockwashers that hold the bottom chassis to the top chassis assembly.

c. Some models contain stabilization brackets (fig. 17). On these models, loosen the two screws on the top stabilization bracket and the four screws on the bottom bracket. Adjust the brackets so that their protrusion is $\frac{3}{32}$ -inch over the edges of the chassis (fig. 17).

d. Insert electrolytic capacitors C27 and C30. These capacitors fit through the chassis. Reattach the capacitor spring clip assembly.

e. Reattach the rail.

f. Replace the vibrators in their proper sockets.

g. Replace the front panel; be careful not to damage wiring. Tuck the cable carefully in place and tighten the eight mounting screws.

h. Make sure that all plug-in parts are firmly seated in their sockets.

i. Replace the silicone-treated glass-fabric barriers as follows:

- (1) On the upper shelf of the chassis (right rear compartment), place one section of the barrier along the row of resistors including R26 and R21. Place the other section of the barrier along the row of resistors including R23, R16, R32, and R22. The connecting wires between the two rows of resistors should be channeled between the two barrier sections so that the insulation of the leads does not touch any of the large resistors.

- (2) On the lower shelf (right rear), snake the barrier around the vibrator cans (E1, E2, and E3) and around the large resistors so that the barrier is always between the wire insulation and any of the heat-producing parts. This is important because excessive heat is generated by the resistors and vibrators and it may damage the wires and cause equipment breakdowns.

j. Replace the outer case. Tighten the Dzus fasteners.

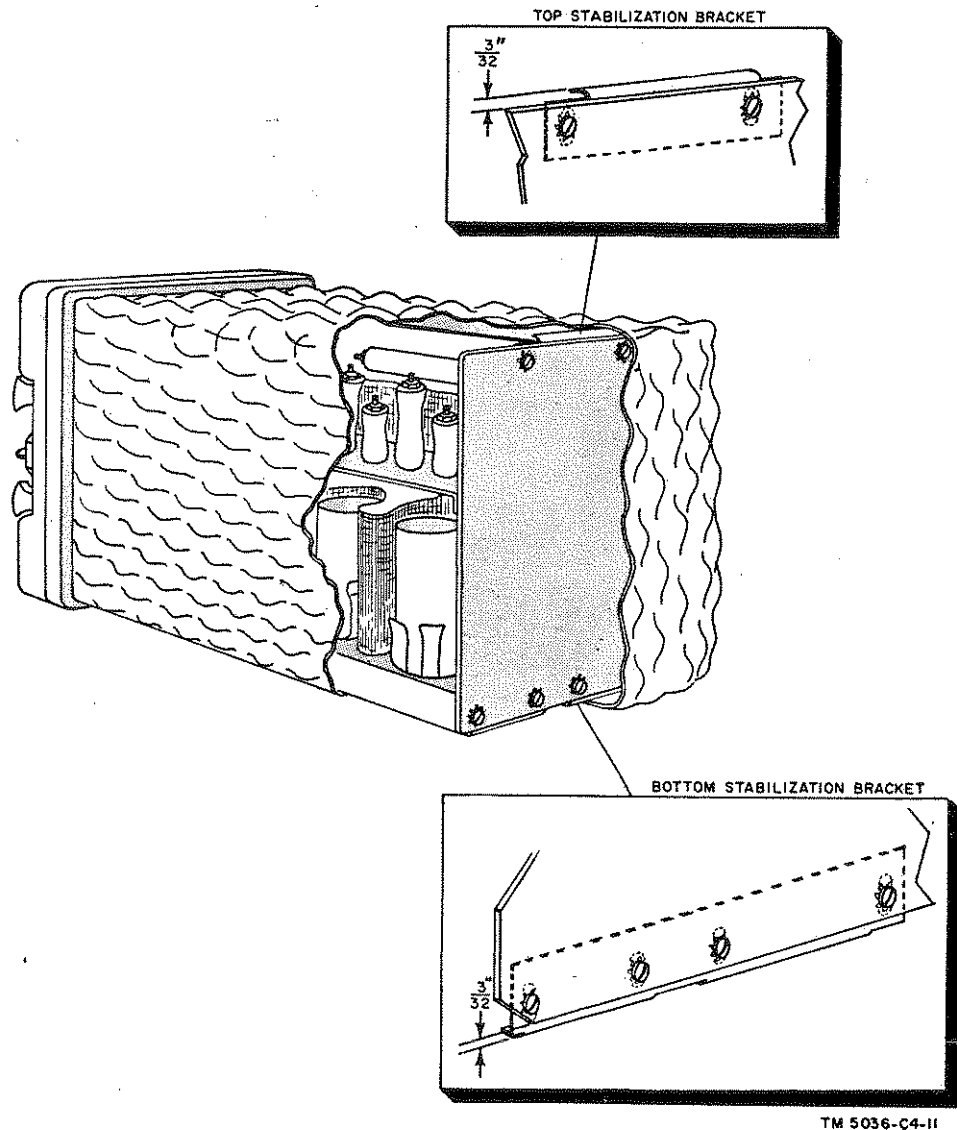


Figure 17. Power supply PP-112/GR, cutaway view showing stabilization brackets.

Section IV. LUBRICATION AND WEATHERPROOFING

42. Lubrication

The power supplies described in this manual do not require lubrication. Never apply oil or grease to any part of these units, except connectors J1 and J2, which, in some units, are packed with silicone grease. This grease is used to prevent vapor condensation around connector parts within the unit. A rubber cap holds the grease against the connector. Normally, the grease will not have to be replaced, and should provide adequate protection for the life of the equipment. However, if it becomes necessary to disconnect any of the wires,

or if the connector must be removed for repair or replacement, apply a grease pack to the replacement connector (par. 40c(10) through (12)).

43. Weatherproofing and Rustproofing

a. General. When Signal Corps equipment is operated under severe climatic conditions such as those that prevail in tropical, arctic, and desert regions, it requires special treatment and maintenance. Fungus growth, insects, dust, corrosion, salt spray, excessive moisture, and extreme temperatures are harmful to most materials. For further information on general preventive maintenance,

nance techniques, refer to TB SIG 178 (par. 22).

b. Tropical Maintenance. A special moisture-proofing and fungiproofing treatment has been devised which, if properly applied, provides a reasonable degree of protection. This treatment is explained in TB SIG 13 and TB SIG 72. The grease pack and rubber cap around the rear of connector J1 and J2 are particularly important if the equipment is to be used under high humidity conditions such as prevail in tropical climates. Refer to paragraphs 40c(10) through (12) and paragraph 42.

c. Arctic Maintenance. Special precautions necessary to prevent poor performance or total

operational failure of equipment in extremely low temperatures are explained in TB SIG 66.

d. Desert Maintenance. Special precautions necessary to prevent equipment failure in areas subject to extremely high temperatures, low humidity, and excessive sand and dust are explained in TB SIG 75.

e. Rustproofing. Rust and corrosion can be prevented by touching up bare surfaces. Clean where necessary with fine sandpaper (No. 0006). Never use steel wool because small particles may enter the equipment and cause short circuits. Refinish surfaces where necessary (TM 9-2851 and par. 30).

Section V. FINAL TESTING

44. General

If the unit does not meet the requirements in paragraph 36, repeat the troubleshooting procedures in paragraphs 35, 36, and 37 to locate other faults. Make the necessary repairs. If the unit operates as required, perform the test described in paragraph 45.

45. Ac Ripple Voltage Measurements

a. Connect the equipment as indicated in paragraphs 34 through 38, with the following exceptions:

- (1) Substitute an ac voltmeter (Electronic Multimeter ME-6/U or equivalent) for M3, and connect it in series with a 2 microfarad (μf), 600 direct-current working volts (vdew) capacitor across each of the load resistors in turn. A capacitor of this size is contained in Test Equipment IE-9-C.

- (2) Connect a 5,000-ohm resistor across the meter terminals.

- (3) Set switch S1 to the TRANS & RECEIVE position and set switch S2 to the HIGH position. Close the external switch connected between terminals K and D.

b. With the ac voltmeter on a suitable range, check that the readings at output terminals B, C, F, M, P, and R are less than .5 volt. If a higher reading is indicated, it is probable that the electrolytic filter capacitors or chokes in the circuit section measured need replacement (par. 46). Refer to the schematic diagram (figs. 20 through 24) to identify the electrolytic filter capacitors.

46. Output Voltage Variations

Normal changes in battery voltage and changes in output loads will affect the output voltage of the power supply. Therefore, output voltage variations up to 10 percent will not necessarily indicate a faulty condition.

CHAPTER 5

SHIPMENT AND LIMITED STORAGE AND DEMOLITION TO PREVENT ENEMY USE

47. Repacking for Shipment or Limited Storage

The exact procedure for repacking depends on the material available and the conditions under which the equipment is to be shipped or stored. Use the procedures described below, whenever possible.

a. Material Requirements.

- (1) The following materials are required for packing Power Supplies PP-109/GR and PP-112/GR.

Material	Quantity
Waterproof barrier material	16 sq. ft.
Paper, single face, flexible, corrugated	20 sq. ft.
Tape, pressure-sensitive	10 ft.
Tape, paper, gummed	6 ft.
Strapping, flat steel	10 ft.
Wood shipping boxes	1 ea.

- (2) Detailed dimensional data for the wooden box is as follows:

Box size (in.)	Board feet	Cubic feet	Packed weight (lb)
19 x 13 x 15	13	2	60

b. *Packaging.* Power Supplies PP-109/GR and PP-112/GR are to be packaged as described below.

- (1) *Technical manuals.* Package each technical manual by inclosing it within a close-fitting bag made of waterproof barrier material. Seal the seams with water-resistant, pressure-sensitive tape.
- (2) *Tubes.* Package the tubes, including spares, individually by wrapping within cellulose wadding or flexible single-face corrugated paper. Secure wrapping with gummed paper tape.
- (3) *Accessories and spare parts.* Package accessories and spare parts individually by wrapping within cellulose wadding or flexible-single face corrugated paper. Secure wrapping with gummed paper tape.
- (4) *Consolidated package.* Consolidate the

packaged tubes, accessories and spare parts ((2) and (3) above) within a wrap of single-face corrugated paper. Secure all folds and seams with water-resistant, pressure-sensitive tape.

- (5) *Power supplies.* Cushion each power supply on all surfaces with pads made of single-face corrugated paper. These should be made to absorb the shocks normally encountered in handling and transit. Inclose each cushioned power supply within a wrap of single-face corrugated paper, making a snug, conforming wrap. Seal all folds and seams with water-resistant, pressure-sensitive tape.

c. *Packing.* Place one packaged power supply and one consolidated package of tubes, accessories, and spare parts together in a wooden box. Fabricate the box to fit the contents snugly and line it with a waterproof case liner. Fill voids in the box with pads of flexible, corrugated paper. Use metal strapping around boxes intended for inter-theater shipment.

48. Demolition of Materiel to Prevent Enemy Use

The demolition procedures outlined below will be used to prevent the enemy from using or salvaging this equipment. Demolition of the equipment will be accomplished only upon order of the commander.

a. *Smash.* Smash capacitors, transformers, resistors, sockets, terminal boards, plugs, vibrators, and relays, use sledges, axes, handaxes, pickaxes, hammers, crowbars, or other heavy tools.

b. *Cut.* Cut wiring; use axes, handaxes or machetes.

c. *Burn.* Burn technical literature, resistors, capacitors, transformers, and vibrators; use gasoline, kerosene, oil, flame throwers, or incendiary grenades.

d. *Bend.* Bend chassis, panels, and covers.

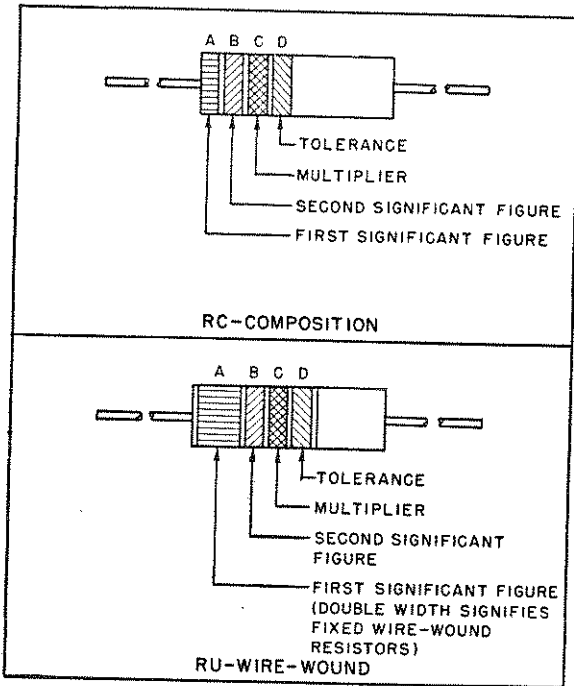
e. *Explode.* If explosives are necessary, use firearms, grenades, or TNT.

f. *Dispose.* Bury or scatter the destroyed parts in slit trenches, fox holes, or other holes; or throw them into streams.

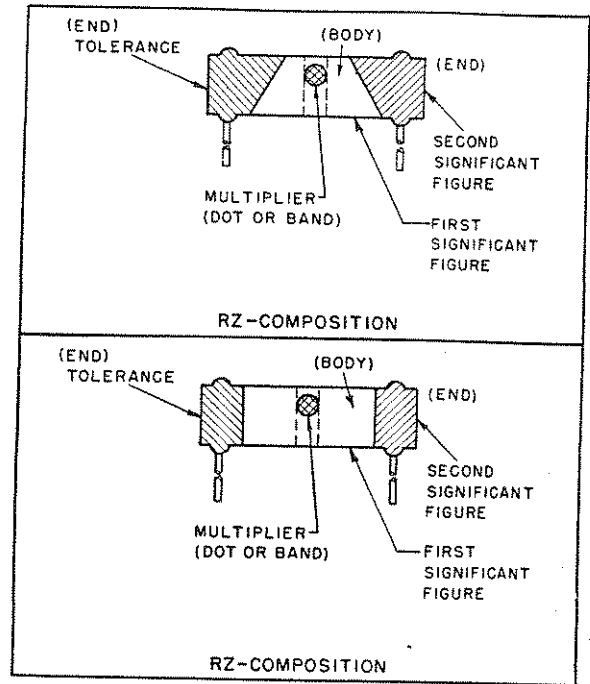
g. *Destroy.* Destroy everything.

RESISTOR COLOR CODE MARKING (MIL-STD RESISTORS)

AXIAL-LEAD RESISTORS (INSULATED)



RADIAL-LEAD RESISTORS (UNINSULATED)



RESISTOR COLOR CODE

BAND A OR BODY*		BAND B OR END*		BAND C OR DOT OR BAND*		BAND D OR END*	
COLOR	FIRST SIGNIFICANT FIGURE	COLOR	SECOND SIGNIFICANT FIGURE	COLOR	MULTIPLIER	COLOR	RESISTANCE TOLERANCE (PERCENT)
BLACK	0	BLACK	0	BLACK	1	BODY	± 20
BROWN	1	BROWN	1	BROWN	10	SILVER	± 10
RED	2	RED	2	RED	100	GOLD	± 5
ORANGE	3	ORANGE	3	ORANGE	1,000		
YELLOW	4	YELLOW	4	YELLOW	10,000		
GREEN	5	GREEN	5	GREEN	100,000		
BLUE	6	BLUE	6	BLUE	1,000,000		
PURPLE (VIOLET)	7	PURPLE (VIOLET)	7				
GRAY	8	GRAY	8	GOLD	0.1		
WHITE	9	WHITE	9	SILVER	0.01		

* FOR WIRE-WOUND-TYPE RESISTORS, BAND A SHALL BE DOUBLE-WIDTH. WHEN BODY COLOR IS THE SAME AS THE DOT (OR BAND) OR END COLOR, THE COLORS ARE DIFFERENTIATED BY SHADE, GLOSS, OR OTHER MEANS.

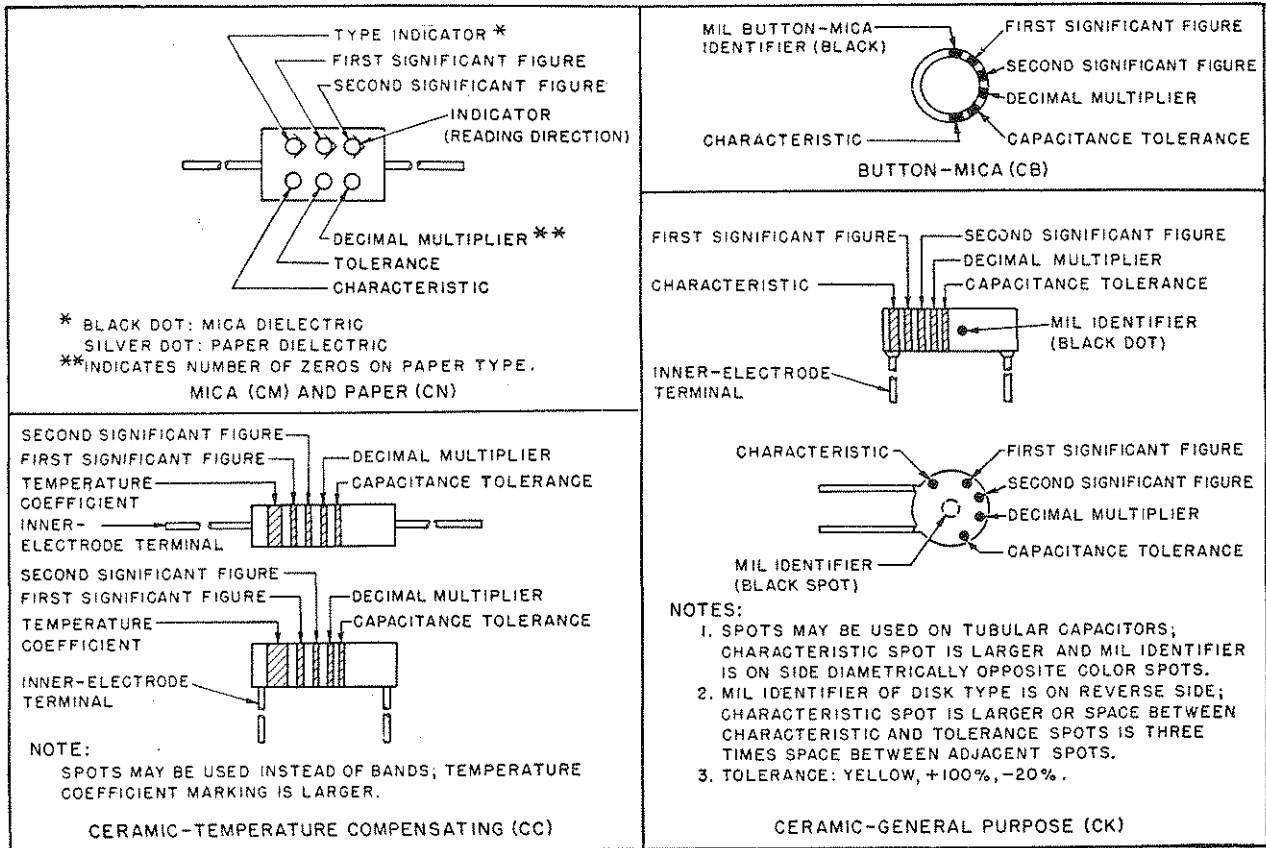
EXAMPLES (BAND MARKING):
 10 OHMS ± 20 PERCENT: BROWN BAND A; BLACK BAND B; BLACK BAND C; NO BAND D.
 4.7 OHMS ± 5 PERCENT: YELLOW BAND A; PURPLE BAND B; GOLD BAND C; GOLD BAND D.

EXAMPLES (BODY MARKING):
 10 OHMS ± 20 PERCENT: BROWN BODY; BLACK END; BLACK DOT OR BAND; BODY COLOR ON TOLERANCE END.
 3,000 OHMS ± 10 PERCENT: ORANGE BODY; BLACK END; RED DOT OR BAND; SILVER END.

STD-R1

Figure 18. Resistor color codes.

CAPACITOR COLOR CODE MARKING (MIL-STD CAPACITORS)



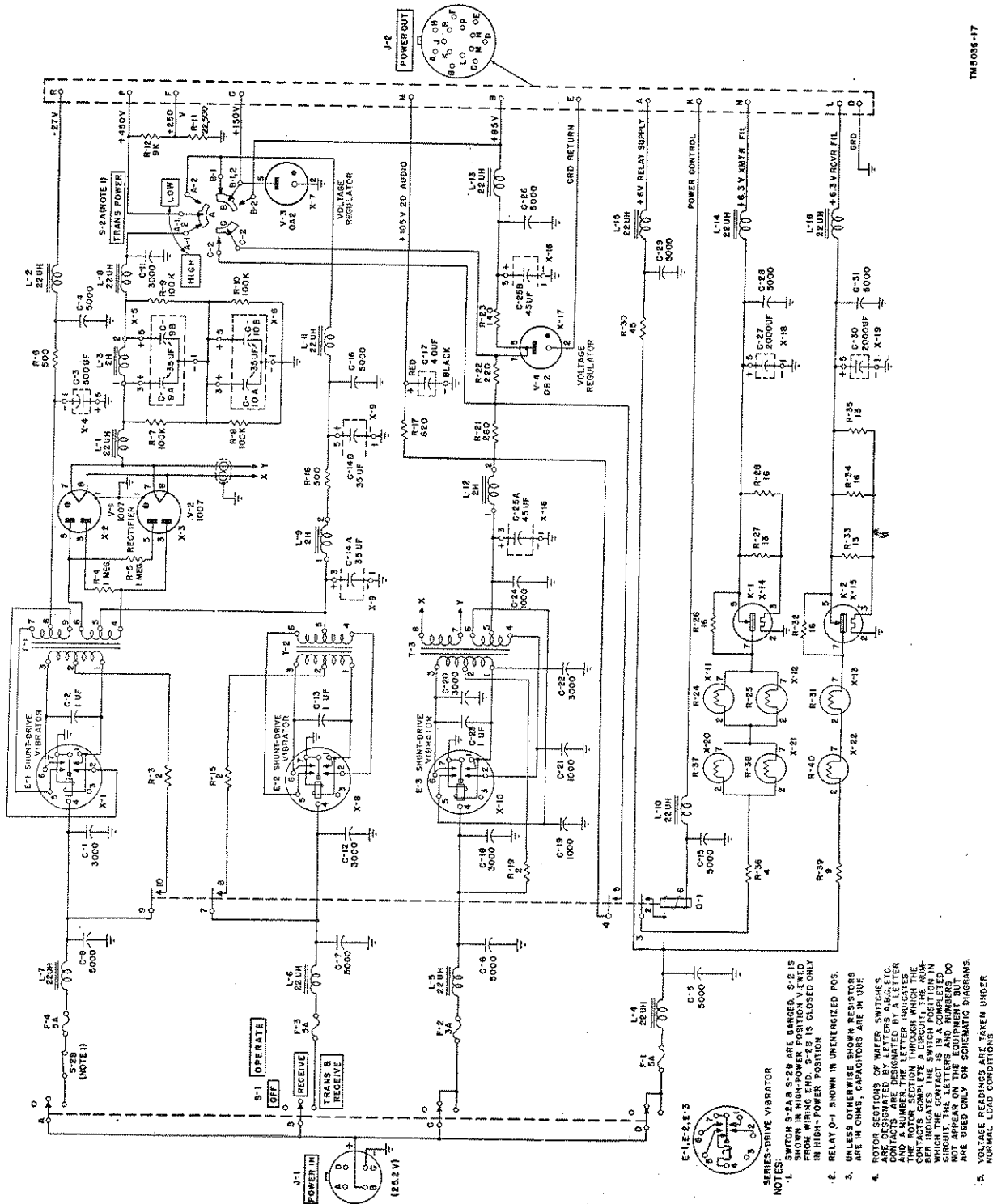
CAPACITOR COLOR CODE

COLOR	SIG FIG.	MULTIPLIER		CHARACTERISTIC				TOLERANCE 2					TEMPERATURE COEFFICIENT (UUF/UF/°C)
		DECIMAL	NUMBER OF ZEROS	CM	CN	CB	CK	CM	CN	CB	CC		
											OVER 10UUF	10UUF OR LESS	
BLACK	0	1	NONE		A			20	20	20	20	2	ZERO
BROWN	1	10	1	B	E	B	W				1		-30
RED	2	100	2	C	H		X	2		2	2		-80
ORANGE	3	1,000	3	D	J	D			30				-150
YELLOW	4	10,000	4	E	P								-220
GREEN	5		5	F	R						5	0.5	-330
BLUE	6		6		S								-470
PURPLE (VIOLET)	7		7		T	W							-750
GRAY	8		8			X						0.25	+30
WHITE	9		9								10	1	-330 (±500) 3
GOLD		0.1						5		5			+100
SILVER		0.01						10	10	10			

1. LETTERS ARE IN TYPE DESIGNATIONS GIVEN IN MIL-C SPECIFICATIONS.
2. IN PERCENT, EXCEPT IN UUF FOR CC-TYPE CAPACITORS OF 10UUF OR LESS.
3. INTENDED FOR USE IN CIRCUITS NOT REQUIRING COMPENSATION.

Figure 19. Capacitor color codes.

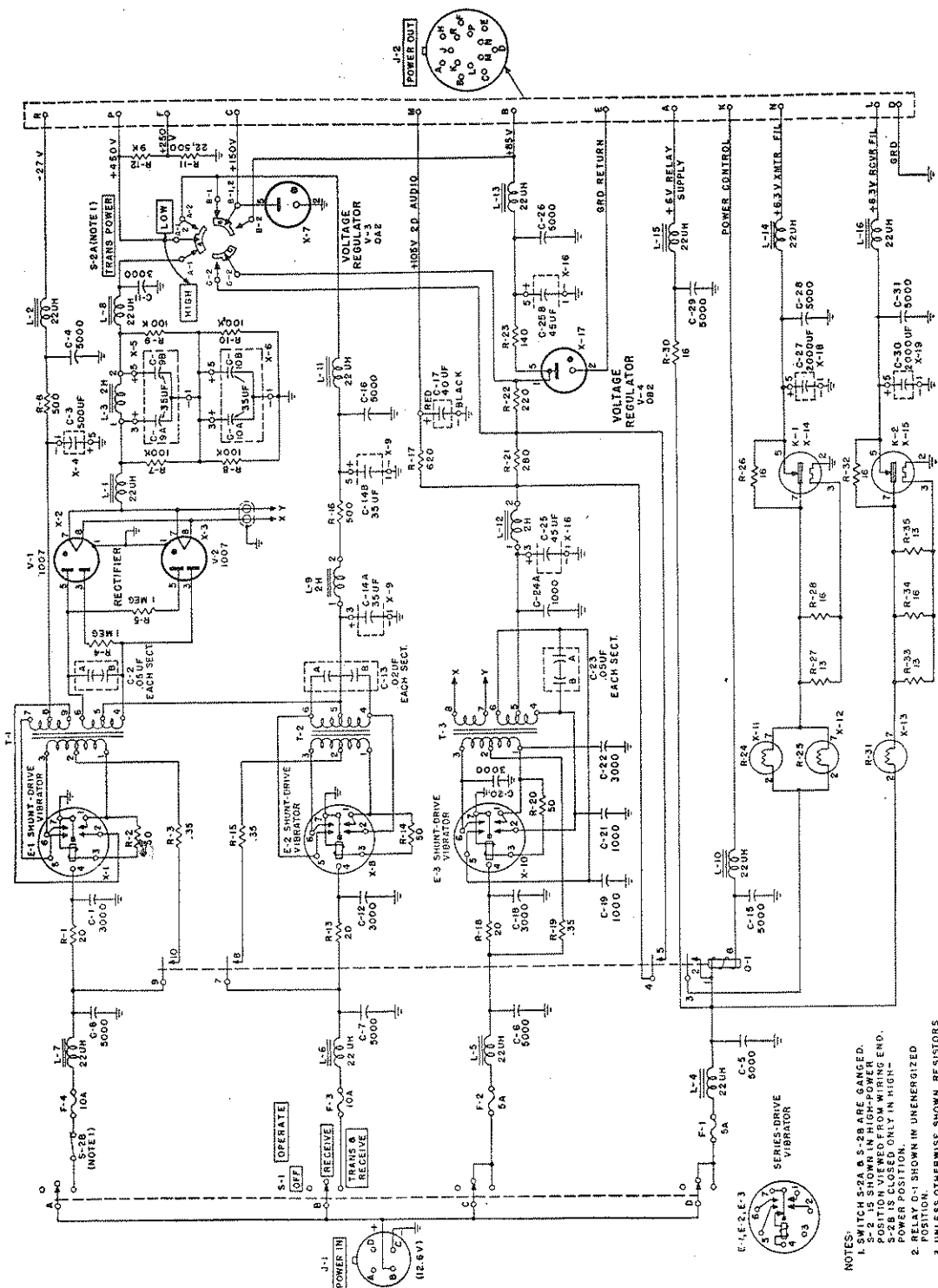
STD-CI



- NOTES:**
1. SWITCH S-2A & S-2B ARE GANGED. S-2 IS SHOWN IN HIGH-POWER POSITION VIEWED FROM THE FRONT. S-2 IS CLOSED ONLY IN HIGH-POWER POSITION.
 2. RELAY 0-1 SHOWN IN UNENERGIZED POS.
 3. UNLESS OTHERWISE SHOWN, RESISTORS ARE IN OHMS, CAPACITORS ARE IN U.F.
 4. ROTOR SECTIONS OF WAVER SWITCHES AND RELAYS ARE DESIGNATED BY LETTER AND A NUMBER. THE LETTER INDICATES THE CONTACT POSITION THROUGH WHICH THE CONTACTS COMPLETION. THE NUMBER INDICATES THE SWITCH POSITION IN WHICH THE CONTACT IS IN A COMPLETED CIRCUIT. CONTACTS WHICH DO NOT APPEAR ON THE SCHEMATIC DIAGRAMS ARE USED ONLY ON EQUIPMENT BUT NOT APPEAR ON THE SCHEMATIC DIAGRAMS.
 5. VOLTAGE READINGS ARE TAKEN UNDER NORMAL LOAD CONDITIONS.

TW8086-17

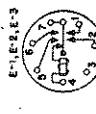
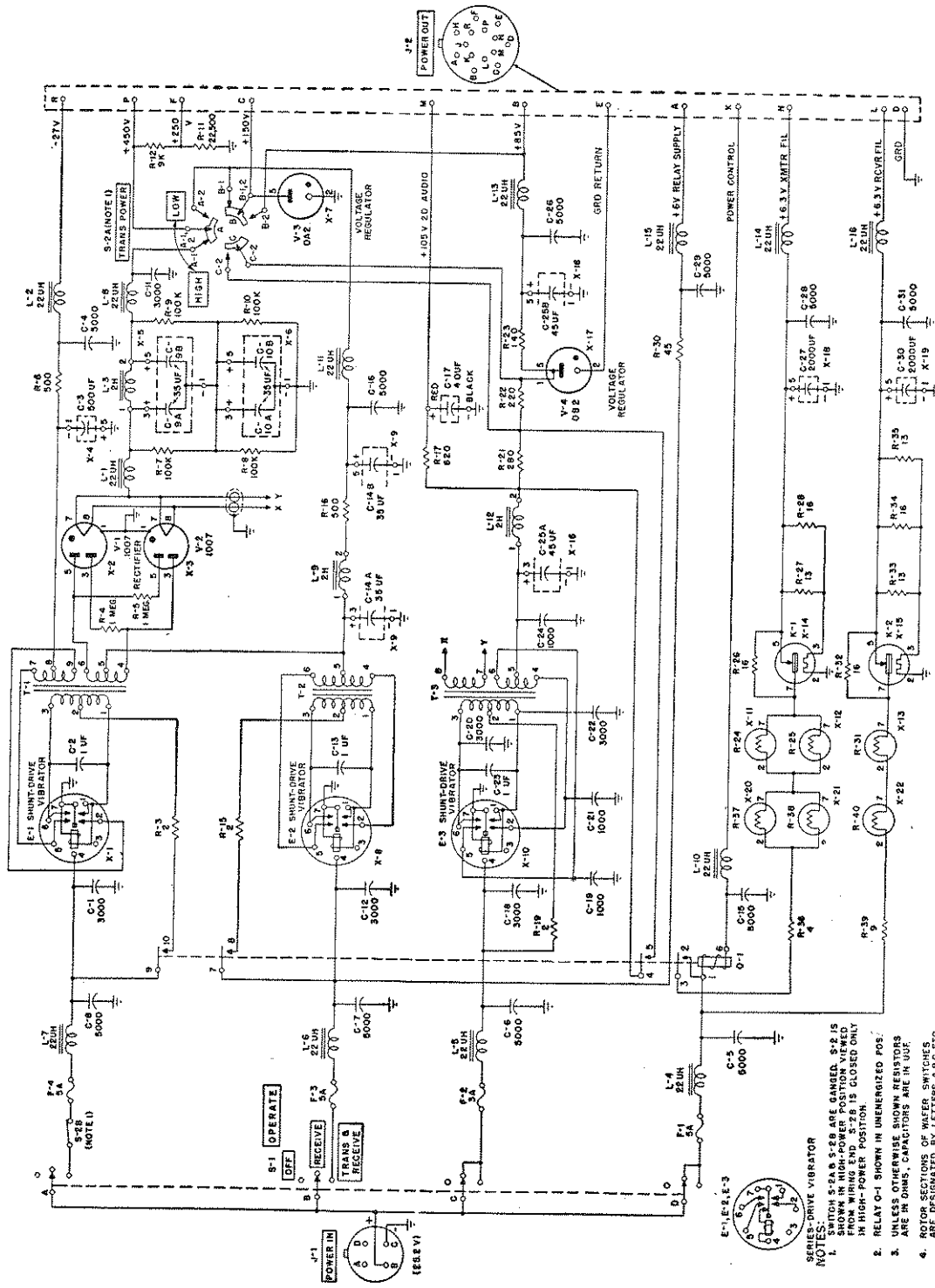
Figure 20. Power supply PP-112/GK, schematic diagram (for some of the early models on orders No. 18651-Phila-49, 21433-Phila-50, and 1750-Phila-51).



- NOTES:
1. SWITCH S-2A & S-2B ARE GANGED. POSITION VIEWED FROM WIRING END. S-2B IS CLOSED ONLY IN HIGH-POWER POSITION.
 2. RELAY C-1 SHOWN IN UNENERGIZED POSITION.
 3. UNLESS OTHERWISE SHOWN, RESISTORS ARE IN OHMS, CAPACITORS ARE IN UF.
 4. ROTOR SECTIONS OF WAFFER SWITCHES ARE DESIGNATED BY LETTERS A, B, ETC. CONTACTS ARE DESIGNATED BY NUMBERS. THE NUMBER INDICATES THE CONTACT COMPLETE A CIRCUIT; THE NUMBER INDICATES THE SWITCH POSITION IN WHICH THE CONTACTS SHOULD NOT APPEAR ON THE EQUIPMENT BUT ARE USED ONLY ON SCHEMATIC DIAGRAMS.
 5. VOLTAGE READINGS ARE TAKEN UNDER NORMAL LOAD CONDITIONS.

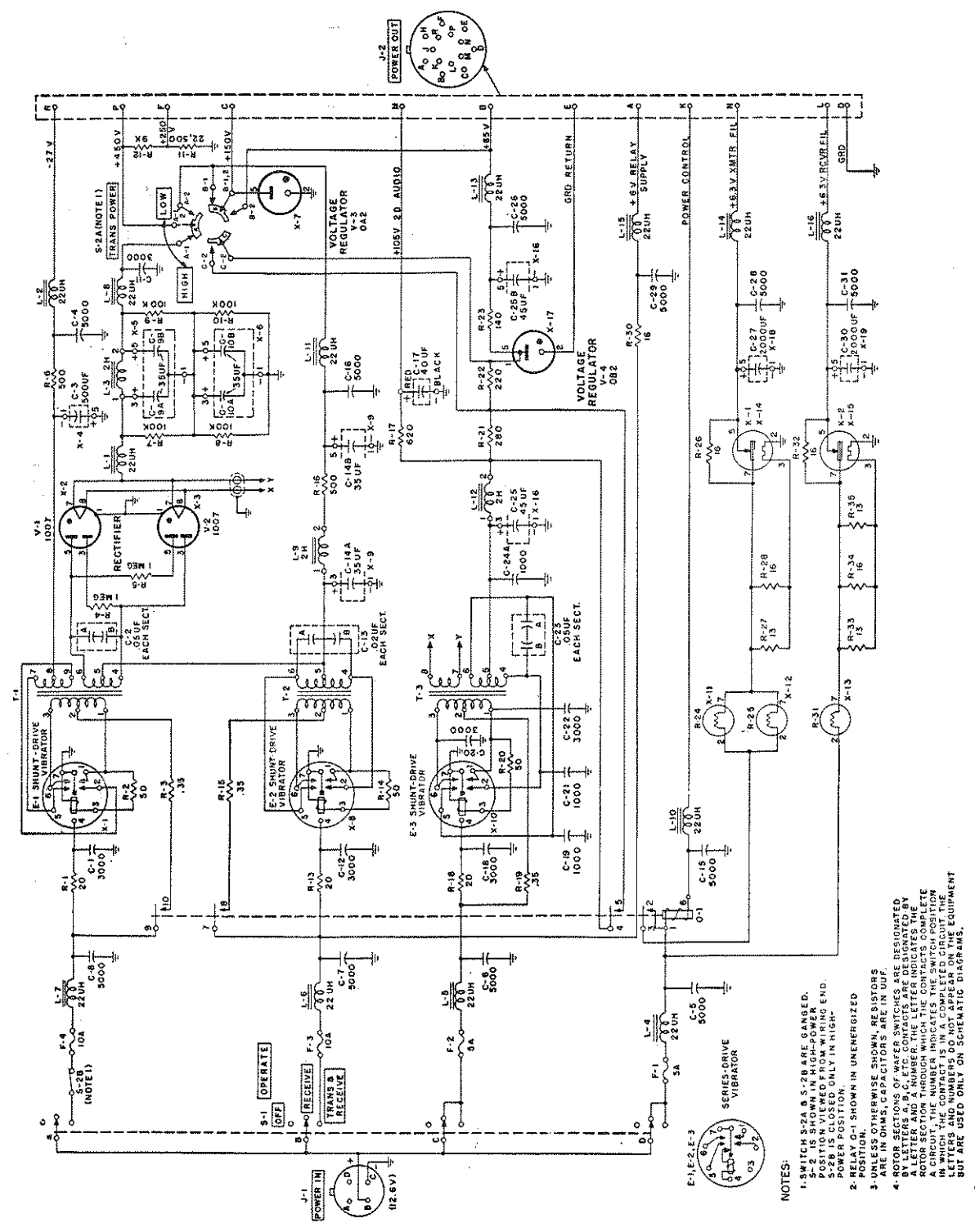
TM 6038-18

Figure 21. Power supply PP-109/GR, schematic diagram (for some of the early models on orders No. 18651-Phila-49, 21438-Phila-50, and 1759-Phila-51).



- SERIES-DRIVE VIBRATOR**
- NOTES:**
1. SWITCHES S-2 & S-3 ARE BANKS. S-2 IS SHOWN IN HIGH-POWER POSITION VIEWED FROM WIRING END. S-2 IS CLOSED ONLY IN HIGH-POWER POSITION.
 2. RELAY C-1 SHOWN IN UNENERGIZED POSITION. UNLESS OTHERWISE SHOWN RESISTORS ARE IN OHMS, CAPACITORS ARE IN UF.
 3. ROTOR SECTIONS OF WAFER SWITCHES ARE DESIGNATED BY LETTERS A, B, C, ETC. AND A NUMBER. THE LETTER INDICATES THE ROTOR SECTION THROUGH WHICH THE CONTACT IS TO BE MADE. THE NUMBER INDICATES THE SWITCH POSITION IN WHICH THE CONTACT IS IN A COMPLETED POSITION. CONTACTS WHICH DO NOT APPEAR ON THE EQUIPMENT BUT ARE USED ONLY ON SCHEMATIC DIAGRAMS ARE DESIGNATED BY LETTERS X, Y, Z.
 4. VOLTAGE READINGS ARE TAKEN UNDER NORMAL LOAD CONDITIONS.
 5. ON MOST MODELS, C-3 IS CONNECTED TO L-2 SIDE OF R-6 INSTEAD OF Y-1 SIDE.

Figure 22. Power supply PP-112/GR, schematic diagram (for all models except some of the early models on orders No. 18651-Phila-49 and 21433-Phila-50, and the late models shown in figure 24).



- NOTES:
1. SWITCH S-2A & S-2B ARE GANGED. S-2 IS SHOWN IN HIGH-POWER POSITION VIEWED FROM WIRING END.
 2. RELAY Q-1 IS IN HIGH-POWER POSITION.
 3. UNLESS OTHERWISE SHOWN, RESISTORS ARE 1/2 WATT.
 4. ROTOR SECTIONS OF WAFER SWITCHES ARE DESIGNATED BY LETTERS A, B, C, ETC. CONTACTS ARE DESIGNATED BY A LETTER AND A NUMBER. THE LETTER INDICATES THE ROTOR SECTION AND THE NUMBER INDICATES THE CONTACT IN WHICH THE CONTACT IS IN A COMPLETED CIRCUIT. THE LETTERS AND NUMBERS DESIGNATE THE EQUIPMENT BUT ARE USED ONLY ON SCHEMATIC DIAGRAMS.
 5. VOLTAGE READINGS ARE TAKEN UNDER NORMAL LOAD CONDITIONS.
 6. ON MOST MODELS, C-3 IS CONNECTED TO L-2 SIDE OF R-6 INSTEAD OF T-1 SIDE.

Figure 25. Power supply PP-109/GR, schematic diagram (for all models except some of the early models on orders No. 18651-Phila-49 and 21433-Phila-50).

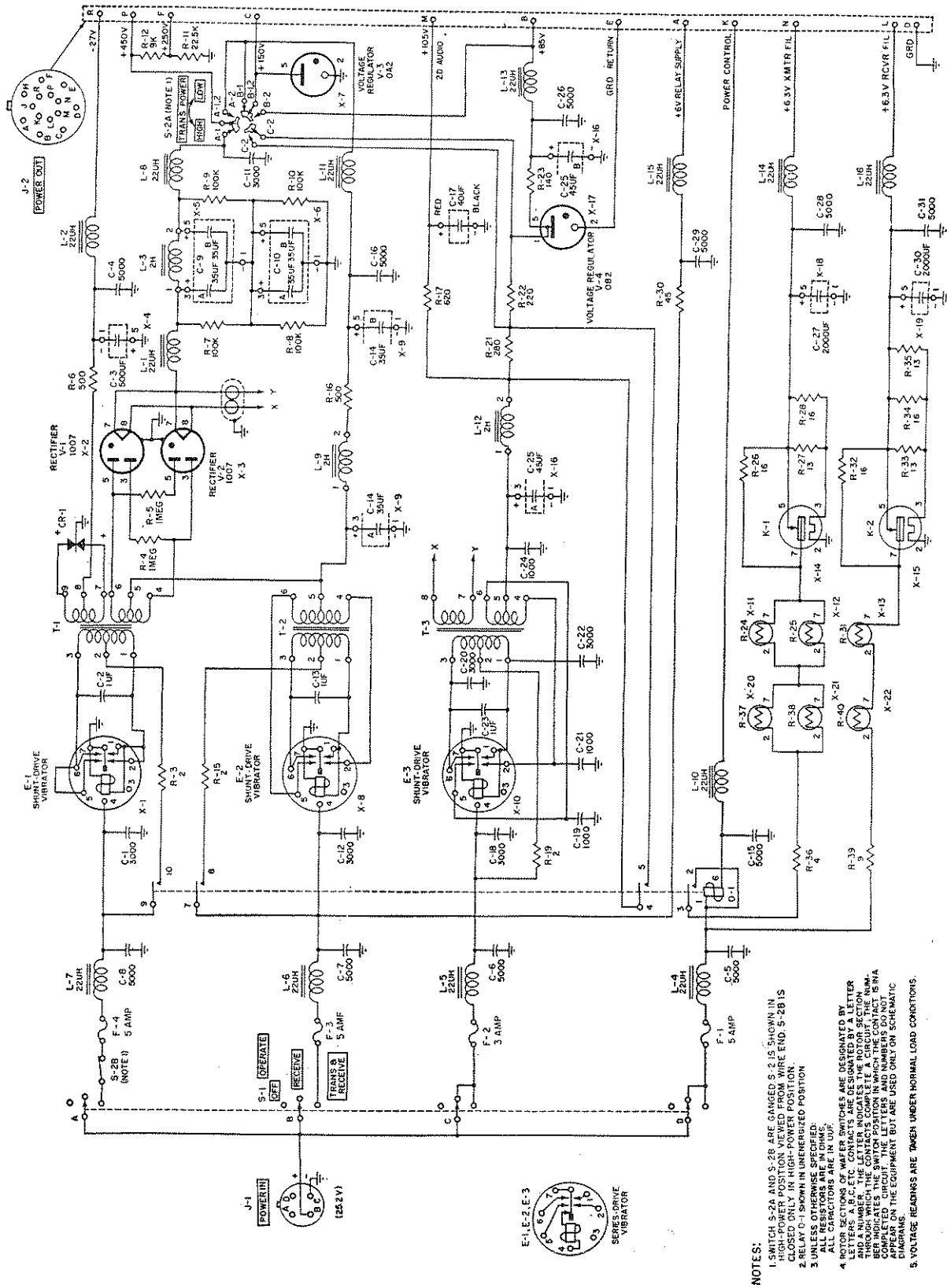


Figure 24. Power supply PP-112/GR, schematic diagram, late models.

- NOTES:
1. SWITCH S-2A AND S-2B ARE GANGED. S-2 IS SHOWN IN HIGH-POWER POSITION VIEWED FROM WIRE END. S-2B IS SHOWN IN NORMAL POSITION.
 2. RELAY C-1 IS SHOWN IN UNNUMBERED POSITION UNLESS OTHERWISE SPECIFIED.
 3. UNLESS OTHERWISE SPECIFIED, ALL RESISTORS ARE IN OHMS.
 4. LETTERS AND NUMBERS DESIGNATED BY A LETTER AND A NUMBER, THE LETTER INDICATES THE ROTOR SECTION AND THE NUMBER INDICATES THE CONTACT NUMBER. WHEN BEING OPERATED, THE SWITCH POSITION IN WHICH THE CONTACT IS MAINTAINED IS INDICATED BY THE LETTERS AND NUMBERS DO NOT APPEAR ON THE EQUIPMENT BUT ARE USED ONLY ON SCHEMATIC DRAWINGS.
 5. VOLTAGE READINGS ARE TAKEN UNDER NORMAL LOAD CONDITIONS.