Zeebelo

TECHNICAL MANUAL

(FURNISHED IN LIEU OF TM-11-5040)

POWER SUPPLIES PP-281 FR/GRC, PP-282 FR/GRC AND PP-448 FR/GR

FRENCH PRODUCTION

Le Matériel Téléphonique
46-47, Quai de Boulogne - BOULOGNE-BILLANCOURT (Seine) FRANCE

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The text of this manual has been revised exactly to reflect the production of the Power supplies PP-281 FR/GRC, PP-282 FR/GRC and PP-448 FR/GR made by the French Company "Le Materiel Telephonique", Paris (France).

CONTENTS

WARNING

HIGH VOLTAGE

is used in the operation

of this equipment.

DEATH ON CONTACT

may result if operating personnel fail

to observe safety precautions.

ARTIFICIAL RESPIRATION

GENERAL PRINCIPLES

1. Seconds count! Begin at once! Don't take time to move the victim unless you must. Don't loosen clothes, apply stimulants or try to warm the victim. Start resuscitation! Get air in the lungs! You may save a life!

2. Place the victim's body in a prone position, so that any fluids will drain from the respiratory passages. The head should be extended and turned sideward *never flexed forward;* the chin shouldn't sag, since obstruction of the respiratory passages may occur.

3. Remove any froth or debris from the mouth with your fingers. Draw the victim's tongue forward.

4. Begin artificial respiration. Continue it rhythmically and without any interruption until natural breathing starts or the victim is pronounced dead. Try to keep the rhythm smooth. Split-second timing is not absolutely essential.

5. When the victim starts breathing, or when additional help is available loosen the clothing; remove it, if it's wet; keep the victim warm. Shock should receive adequate attention. Don't interrupt the rhythmical artificial technique for these measures. Do them only when you have help or when natural breathing has started.

6. When the victim is breathing, adjust your timing to assist him. Don't fight his efforts to breathe. Synchronize your efforts with his. After resuscitation, keep him lying down until seen by a physician or until recovery seems certain.

7. Don't wait for mechanical resuscitation! If an approved model is available, use it, but, since mechanical resuscitators are only slightly more effective than properly performed "push-pull" manual technique, *never* delay manual resuscitation for it.

BACK-PRESSURE ARM LIFT METHOD

1. *Position of Victim.* Place the victim in the prone (face-down) position. Bend his elbows; place one hand upon the other. Turn his face to one side, placing his cheek upon his hands.

2. *Position of Operator.* Kneel on your left or right knee, at the victim's head, facing him. Your knee should be at the side of the victim's head close to his forearm, your foot should be near his elbow. Kneel on both knees if you find it more comfortable, with one knee on each side of the head. Place your hands on the flat of the victim's back so that their heels are just below the lower tip of his shoulder blades. With the tip of your thumbs touching spread your fingers downward and outward. (See A)

3. *Compression Phase.* Rock forward until your arms are approximately vertical and allow the weight of the upper part of your body to exert a slow, steady, even, downward pressure upon your hands. This forces air out of the lungs. Keep your elbows straight and press almost directly downward on the back. (See B)

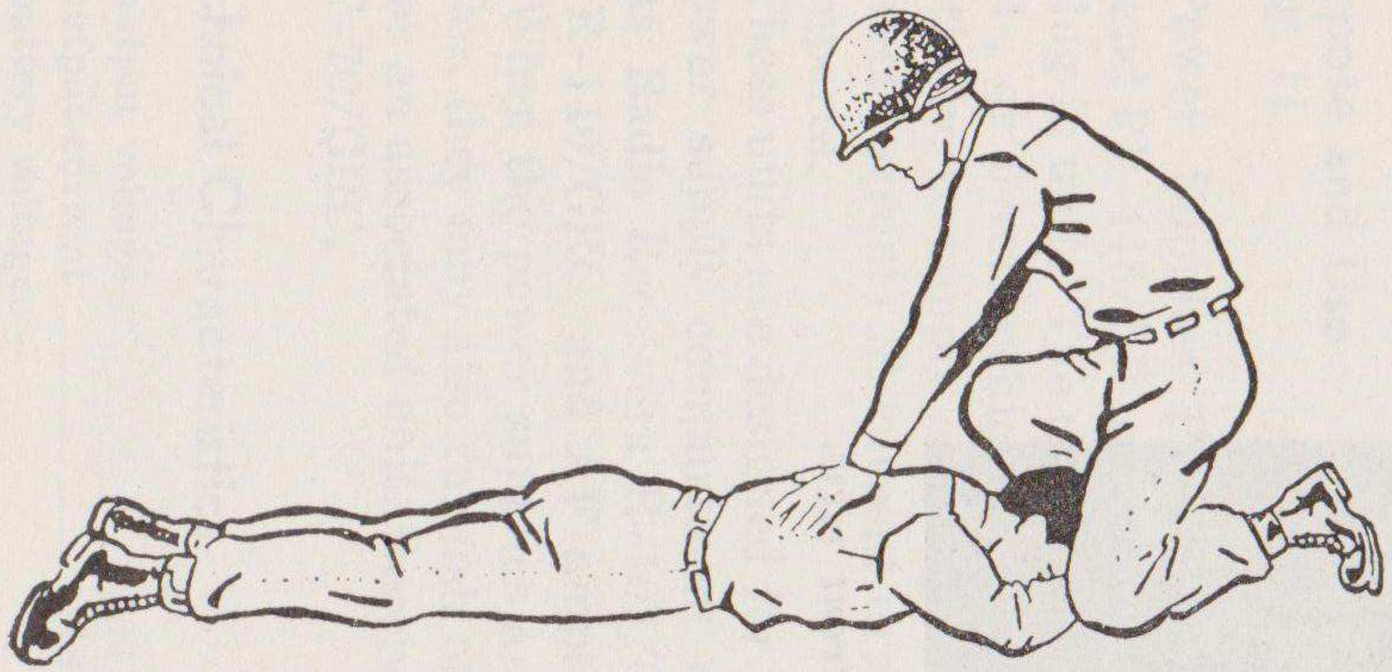
4. *Expansion Phase.* Release the pressure, avoid any finish thrust, and commence to rock backward slowly. Place your arms upon the victim's arms just above the elbows, and draw his arms upward and toward you. Apply just enough lift to feel resistance and tension at the victim's shoulders. Don't bend your elbows. As you rock backward, the victim's arms will be drawn toward you. (The arm lift expands the chest by pulling on the chest muscles, arching the back and relieving the weight on the chest.) Drop the arms gently to the ground or floor. This completes the cycle. (See C and D). Now repeat the cycle.

5. *Cycle Timing and Rhythm.* Repeat the cycle 10 to 12 times per minute. Use a steady uniform rate of Press, Release, Lift, Release. Longer counts of about equal length should be given to the "Press" and "Lift" steps of the compression and expansion phases. Make the "Release" periods of minimum duration.

6. *Changing Position or Operator.*

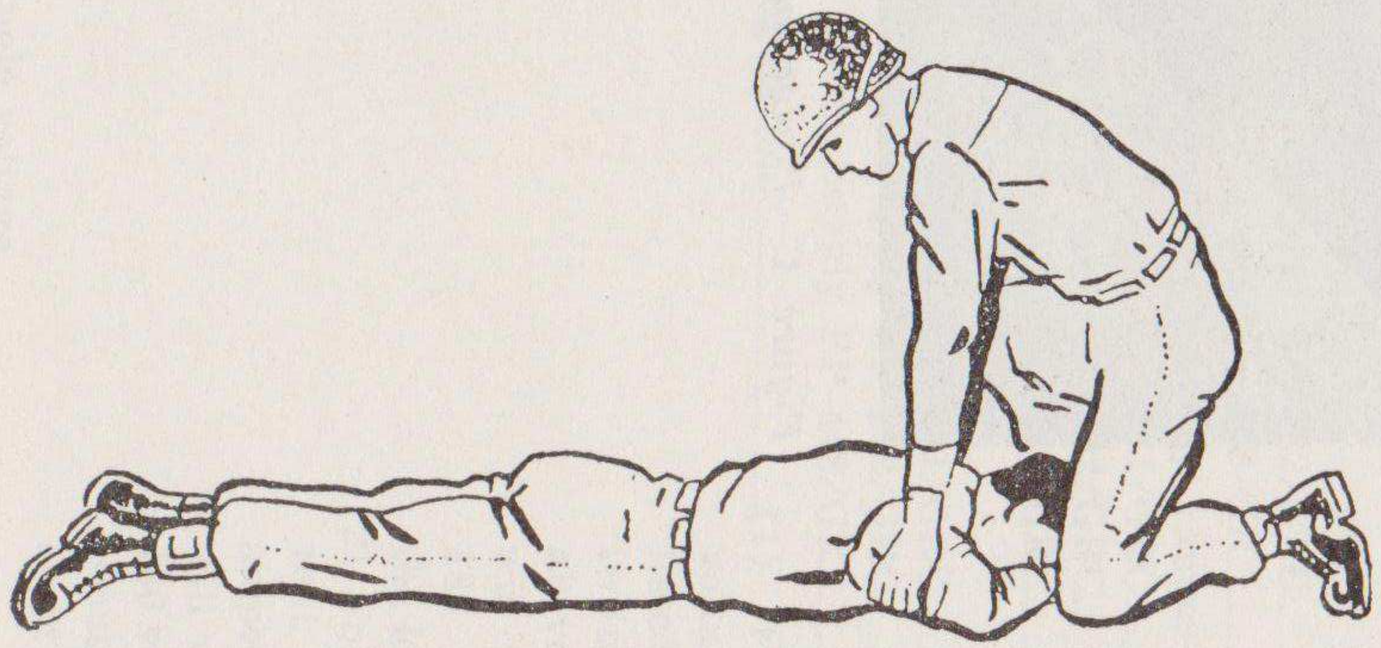
(*a*) Remember that you can use either or both knees or can shift knees during the procedure, provided you don't break the rhythm. Observe how you rock forward with the back-pressure and backward with the arm-lift. The rocking motion helps to sustain the rhythm and adds to the ease of operation.

(*b*) If you tire and another person is available, you can "take turns." Be careful not to break the rhythm in changing. Move to one side and let your replacement come in from the other side. Your replacement begins the "Press-Release" after one of the "Lift-Release" phases, as you move away.

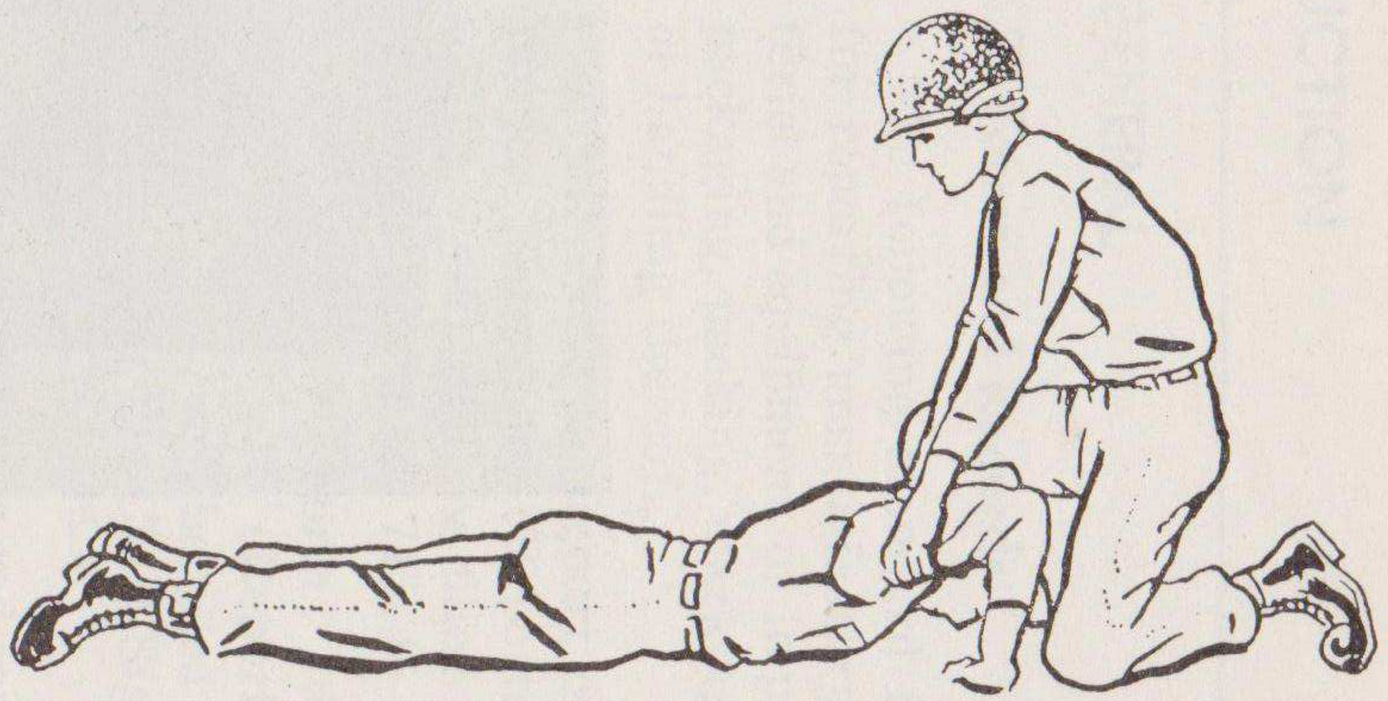


A Position of operator and victim

B Compression phase



C Expansion phase (arm lift)



D Expansion phase (arm release)

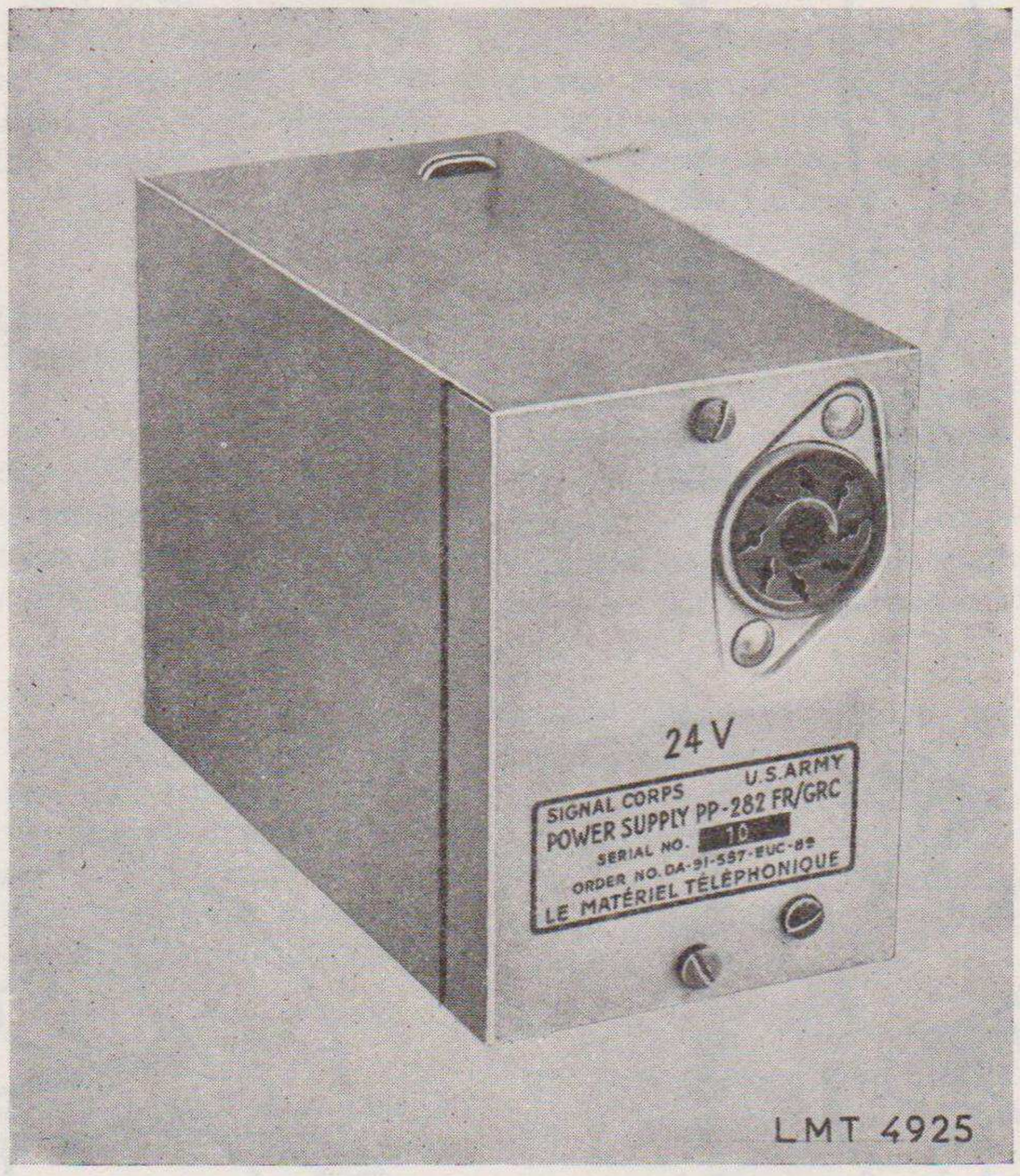


Figure 1.—Power supply PP-282/GRC, front view.

Section I. GENERAL

1. Purpose and Scope

a. This technical manual contains information pertaining to the description and theory of Power Supplies PP–281/GRC, PP–282/GRC, and PP–448/GR, and provides instructions for the maintenance, repair and test of these units. The two appendixes in this manual furnish a list of references and an identification table of parts.

b. Since the three power supplies listed in paragraph *a* above are alike in most respects, they are discussed simultaneously in this manual. Where specific differences exist between these units; for example, in input voltage requirements or wiring of connectors, these differences are described with specific reference to the particular unit involved.

2. Forms and Records

The following standard forms will be used for reporting unsatisfactory conditions of matériel and equipment, or improper preservation, packaging, packing, marking, loading, stowage, or handling thereof.

a. DD Form 6, Report of Damaged or Improper Shipment (Reports Control Symbol CS GLD–66), will be filled out and forwarded as prescribed in SR 745–45–5.

b. DA AGO Form 468, Unsatisfactory Equipment Report (Reports Control Symbol CS GLD–247), will be filled out and forwarded to the Office of the Chief Signal Officer, as prescribed in SR 700–45–5.

c. Use other forms and records as authorized.

Section II. DESCRIPTION AND DATA

3. Purpose and Use (fig. 1)

a. Power Supplies PP–281/GRC, PP–282/GRC, and PP–448/GR are small, light, vibrator type plug-in units. The units derive power from 12-, 24-, or 6-volt vehicular storage batteries, respectively, to supply a voltage of +135 volts dc (direct current) at current drains up to 118 milliamperes.

b. These units are designed for plugging into the power supply compartment of equipment such as Radio Receivers R–108/GRC, R–109/GRC, R–110/GRC, and AF amplifier AM–65/GRC. When the power supplies are used in the amplifier, they may also furnish operating voltages for an associated unit, Receiver-Transmitter RT–70/GRC.

4. Technical Characteristics

Rated output voltage	136 volts dc.
Rated output current	.118 ampere.
Rated battery voltages—	
Power Supply PP–281/GRC	12.6 volts.
Power Supply PP–282/GRC	25.2 volts.
Power Supply PP–448/GR	6.3 volts.
Permissible input voltage ranges—	
Power Supply PP–281/GRC	10 to 16 volts.
Power Supply PP–282/GRC	20 to 32 volts.
Power Supply PP–448/GR	5 to 8 volts.
Input current—	
Power Supply PP–281/GRC	2.25 amperes max.
Power Supply PP–282/GRC	1.23 amperes max.
Power Supply PP–448/GR	4.1 amperes max.
Regulation	(1) For changes in input voltage between the limits listed under "Permissible input voltage ranges" above, the output voltage will vary between 105 and 185 volts, provided that the load is kept constant. (2) For changes in load current between .120 and .030 ampere, the output voltage will vary between 136 and 180 volts, provided that the input voltage is kept constant at the nominal value.
Ripple voltage	.05 percent maximum
Normal operating temperature	from —40°C (—40°F.) to +65°C (149°F.).

5. Description

(figs. 1 and 2)

a. The unit shown in figure 1 consists of a metal panel and chassis assembly inclosed on top by a four-sided metal cover and at the bottom by a metal plate which covers the underchassis. Disassembly instructions are included in paragraph 12*a*. A handle is provided on the back of the top cover to aid in the handling of the unit while it is being inserted into or removed from a set. The metal panel at the front of the unit is provided with an octal socket. All the electrical connections between the storage battery, the power supply, and the circuits of the set to be operated are made through this socket connector.

b. A disassembled unit is shown in figure 2. The top of the chassis (fig. 3) mounts the larger components such as a vibrator transformer, a power filter choke, a plug-in vibrator, a plug-in filter capacitor, and two r-f (radio-frequency) chokes. The underchassis (fig. 4) contains the smaller components and most of the wiring. The inside of the bottom cover contains the circuit label.

c. The power supply unit is approximately 4 ¼ inches high by 5 ¾ inches deep by 2 15/16 inches wide and weighs about 5 pound 9 ounces.

6. Spare Parts Supplied

The spare parts supplied with each power supply are—

For Power Supply PP-281/GRC—2 vibrators; plug-in type; 6-volt input.

For Power Supply PP-448/GR—2 vibrators; plug-in type; 6-volt input.

For Power Supply PP-282/GRC—2 vibrators; plug-in type; 24-volt input.

7. Unit Differences

Power Supplies PP-281/GRC, PP-282/GRC, and PP-448/GR differ only in those components which adapt the input circuits for use with 12-, 24-, and 6-volt storage batteries, respectively. All other components are identical. Specific differences are described in paragraphs 9 and 10.

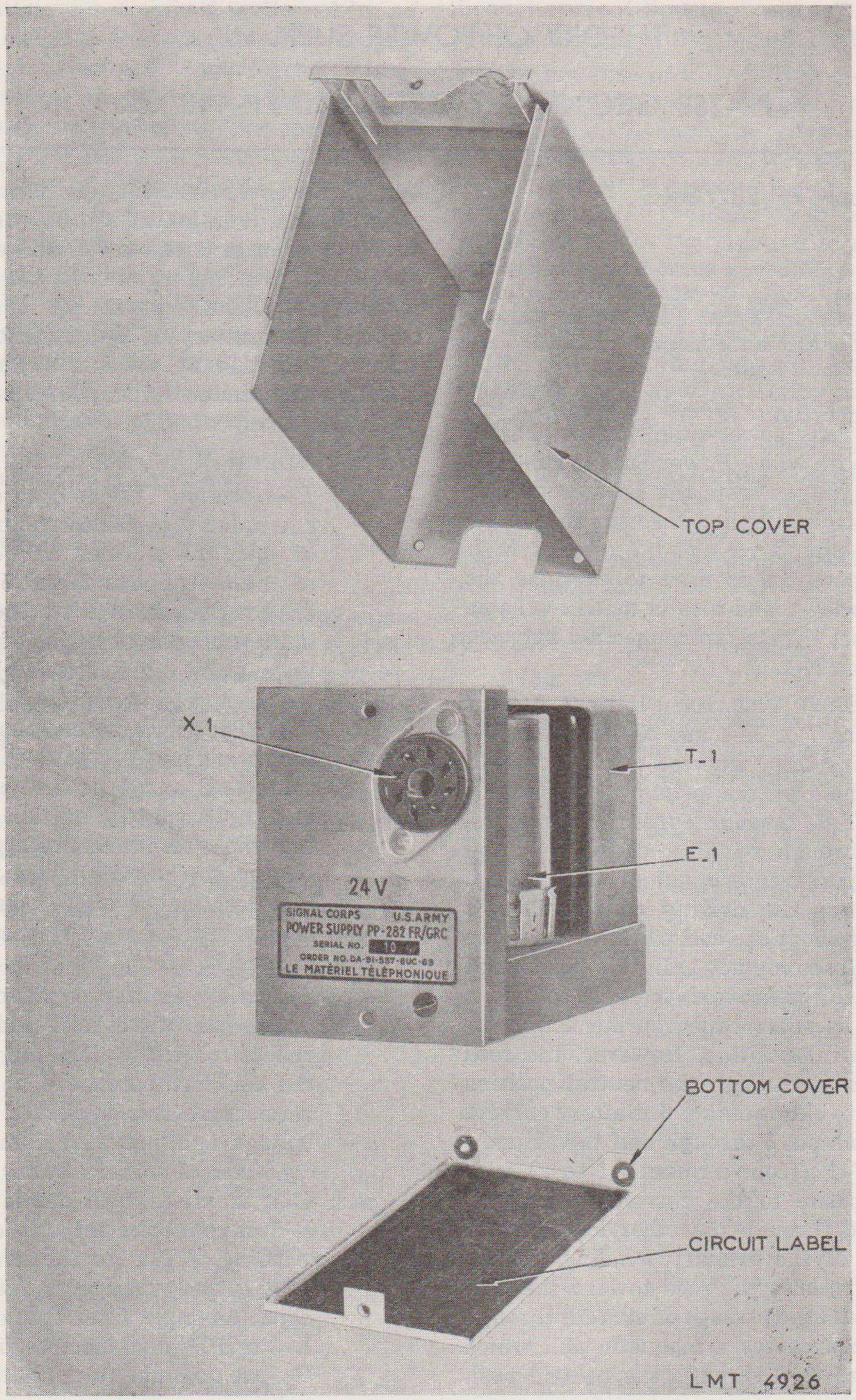


Figure 2.—Power supply PP-282/GRC, disassembled unit.

CHAPTER 2

THEORY OF POWER SUPPLIES

PP–282/GRC, PP–281/GRC, AND PP–448/GR

8. Power Supply PP–282/GRC (fig. 8)

Note. Either a series- or a shunt-drive vibrator may be used in Power Supply PP-282/GRC. Paragraph *b* below describes the circuit with a shunt-drive vibrator in use; *d* below describes the modified operation when a series-drive vibrator is used.

a. INPUT CIRCUIT. Socket connector X–1 mates with a male power-supply input plug on the radio set with which Power Supply PP–282/GRC is used. Output from the set storage battery (24 volts) is supplied through this interconnection to pins 3 (+) and 7 (—) of X–1. The 24-volt potential is used to energize the vibrator (*b* below) and also is made available to the radio set by a strap connection between pins 3 and 6 on X-1.

b. SHUNT-DRIVE VIBRATOR. Battery current flows from pins 7 of X–1 and X–3 through the vibrator driving coil connected to pin 1 of X–3, through one-half of the primary winding of transformer T–1, through current-limiting resistor R–2, through r-f filter choke L–1, and back to the positive terminal of the battery. Current through the driving coil develops a magnetic field about the coil which attracts the reed until it closes contact 1. In this position of the reed, the coil is shorted, the field collapses, and the reed is returned by spring action toward the neutral position. However, the reed inertia carries it through the neutral position and causes it to close contact 6. Battery current then flows from pin 6 through half the primary winding of T–1 (from terminals 1 to 2) in a direction opposite to the current which previously flowed through the other half (terminals 3 to 2) of the primary winding. Spring action again returns the reed toward the neutral position and the passage of current through the driving coil causes a magnetic pull which accelerates the reed through the neutral position. The reed then closes contact 1 and again short-circuits the driving coil. Thus the flow of current through the driving coil is interrupted by periodic short-circuiting of the coil. As the reed vibrates, it transfers battery current alternately to vibrator contacts 1 and 6 connected to the primary winding terminals 1 and 3 of transformer T–1. The reversal of current flow through the primary of T–1 constitutes an ac (alternating current) which, through transformer action, induces a stepped-up a-c voltage in the secondary winding.

c. RECTIFICATION AND FILTERING.

(1) *Rectification.* The stepped-up a-c voltage induced in the secondary winding of the transformer is rectified by means of contacts 2 and 5 of the vibrator. Because of the voltage induced in the secondary winding of T–1, terminals 4 and 6 are alternately 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 ground terminals 6 and 4 alternately at the same time that those terminals are negative with respect to the center tap. The center tap, terminal 5 of T–1, is therefore always positive with respect to chassis ground.

(2) *Filtering.* Buffer capacitor C–5 improves the waveshape and serves to reduce sparking which might occur at the contacts because of high-voltage transients. This increases the output voltage and prevents damage to the contacts. Another buffer capacitor C–4, in series with damping resistor R–1, is connected across the secondary winding of T–1 for the same purpose. The output voltage is filtered by a capacitor-input filter formed by choke L–3 and by dual electrolytic capacitor C–3. A nominal output voltage of 135 volts is available at pin 8 of X–1. High-frequency electrical interference is filtered from the rectified output by

r-f choke L–2 and capacitor C–2. The battery input circuit is filtered by r-f choke L–1 and capacitor C–1 to prevent electrical interference from reaching the radio set being operated.

d. SERIES-DRIVE VIBRATOR. The operation of Power Supply PP-282/GRC using a series-drive vibrator is generally the same as described in *a*, *b*, and *c* above. In the series-drive vibrator, however, a separate contact is connected in series with the driving coil to periodically interrupt the battery circuit through the coil. The battery circuit extends from pins 7 of X–1 and X–3, through the series arrangement of the vibrator reed and the additional driving contact, through the driving coil connected to pin 4 of X–3, and through filter choke L–1 back to the positive terminal of the battery.

9. Power Supply PP–281/GRC
(fig. 9)

a. Power Supply PP–281/GRC is very similar to Power Supply PP-282/GRC, but it is designed for use with a 12-volt storage battery. Since a 6-volt vibrator is used, however, voltage-dropping resistors R–3 and R–4 are used to drop the battery voltage to 6 volts. Resistor R–3 is effective when a shunt-drive vibrator is used, while R–4 is in the circuit when a series-drive vibrator is used.

b. In the case of the 6-volt shunt-drive vibrator, the driving coil is connected between terminals 7 and 3 of the vibrator. The battery circuit extends from terminals 7 of X–1 and X–3 through the driving coil and terminal 3 of X–3, through voltage-dropping resistor R–3, through one-half of the primary winding of T-1, through current-limiting resistor R-2 and choke coil L-1 to the positive terminal of the battery.

c. In the case of a 6-volt series-drive vibrator, the battery circuit extends from pins 7 of X-1 and X-3, through the vibrating reed and the series-driving contact, through the vibrator coil connected to terminal 4 of X-3, through voltage-dropping resistor R-4, and through choke coil L-1 to the positive terminal of the battery.

d. The values of current-limiting resistor R-2 and buffer capacitor C-4 differ from those of the corresponding parts in Power Supply PP-282/GRC. Capacitor C-5 is not needed in this unit because of the lower input voltage used. Connector X-1 is wired differently to apply the proper operating voltage to an associated radio set. The straps are connected between pins 2, 3, and 5 of X-1; the battery input is also made available to the radio set from pins 2 and 5 of X-1.

10. Power Supply PP-448/GR
(fig. 10)

The operation of this unit is the same as that of the unit described in paragraph 9, but is designed for use with a 6-volt storage battery Voltage-dropping resistors R-3 and R-4 and current-limiting resistor R-2 are not used in this unit since the vibrator is designed to operate from 6 volts. Capacitor C-5 is not used because sparking at the vibrator contacts is not excessive at this input voltage. The strap connections on X-1 are between pins 1, 3, and 4 so that proper operating voltage will be supplied to an associated radio set.

CHAPTER 3

FIELD MAINTENANCE INSTRUCTIONS

Note. Tnis 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 skill of the repairmen.

Section I. PREREPAIR PROCEDURES

11. Tools, Materials, and Test Equipment

Tools, materials, and test equipment needed for performing the prerepair procedures in this section are listed below:

Tool Equipment TE–113.

Cleaning fluid: Solvent, dry-cleaning (SD); Federal specification P–S–661a.

Storage battery: 6, 12, or 24 volts for Power Supplies PP–448/GR, PP–281/GRC, and PP-282/GRC, respectively.

Electronic Multimeter ME–6/U: a-c voltmeter.

Electronic Multimeter TS–505/U: d-c volt-ohmmeter.

Multimeter TS–352/U: d-c ammeter.

Dummy output load resistor: 1,150 ohms, 22 watts.

Resistor, composition: 5,100 ohms, ±10 percent; 1 watt; JAN type RC20BF512J.

Fuse: 5 amperes.

Capacitor, paper dielectric: 2 uf (microfarad); 600 vdcw; JAN type CP53B1-DF205V.

Test Lead Set CX–1331/U.

Caution: Do not operate the power supply without a suitable load. The output voltage of the power supply, when operated without an output load, is considerably higher than normal because of the inherent regulation of the unit.

12. Disassembly and Visual Inspection (figs. 2, 3, and 4)

a. DISASSEMBLY. When a power supply is to be checked or repaired, turn off the power on

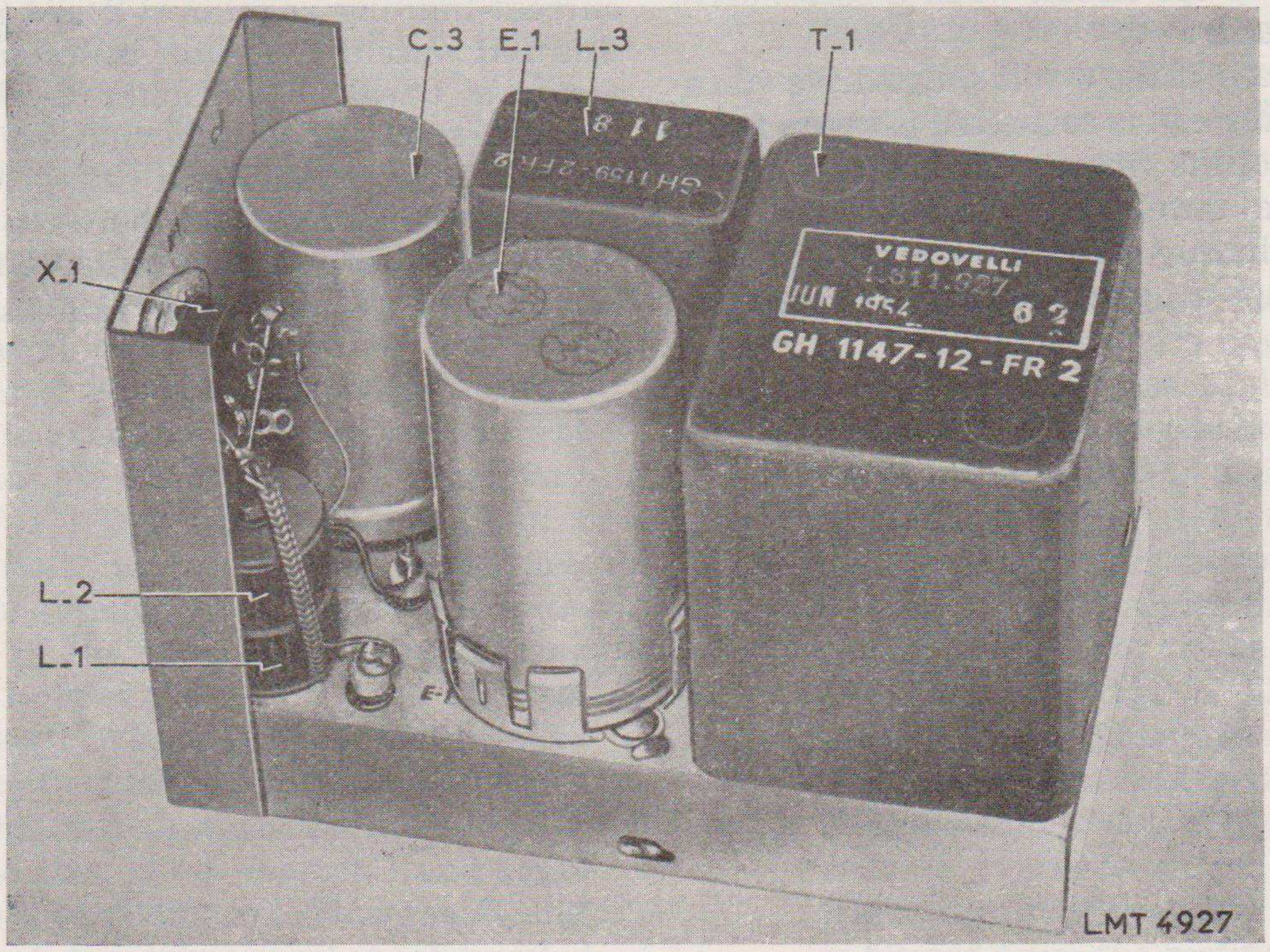


Figure 3.—Power supply PP-282/GRC, top of chassis.

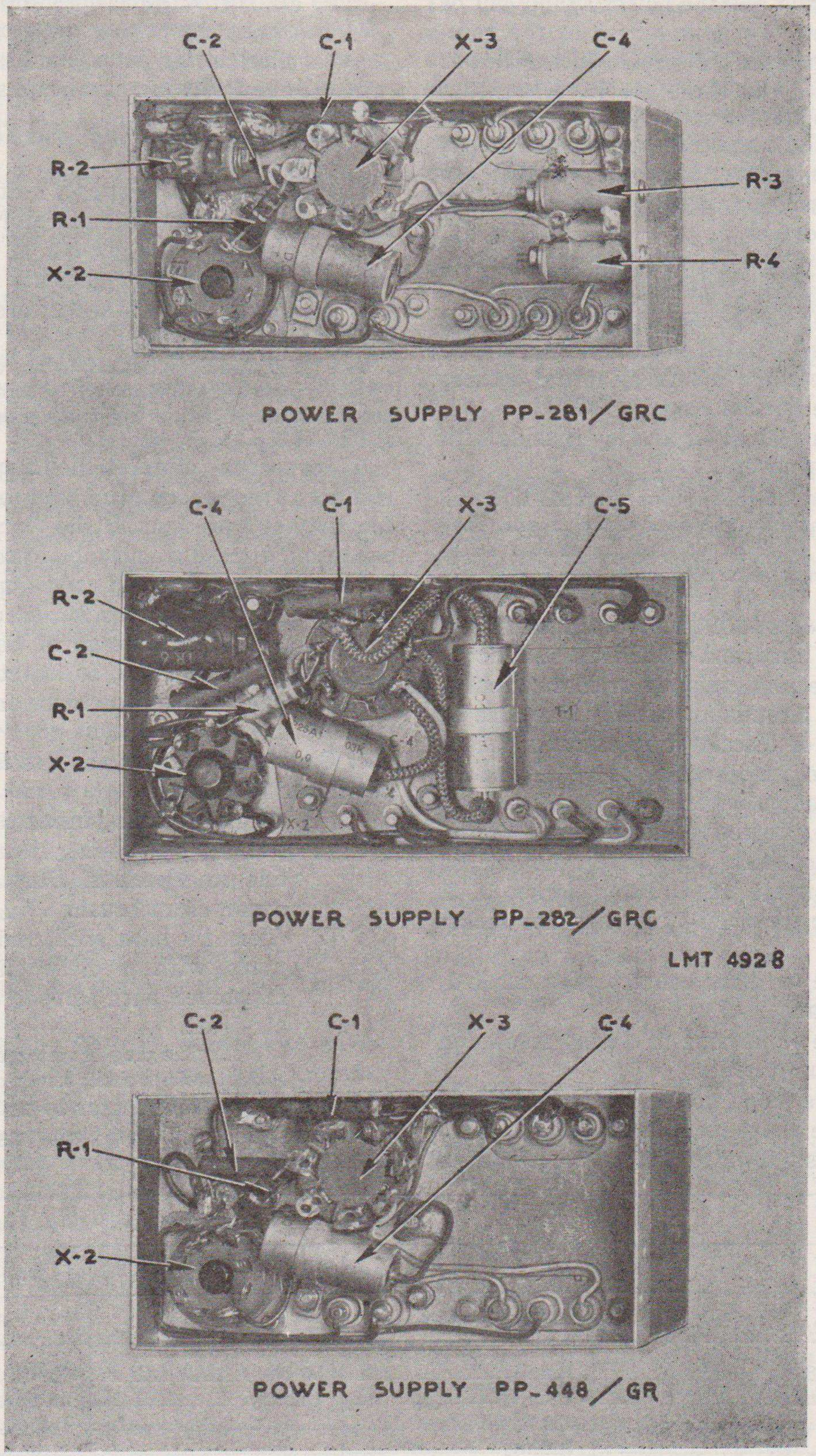


Figure 4.—Power supplies PP-281/GRC, PP-282/ GRC, and PP-448/GR, underchassis.

the equipment and pull the power supply out of its compartment. To gain access to the components within the unit, disassemble as follows:

(1) Remove the three green screws that fasten the top cover to the chassis.
(2) Pull the handle to remove the cover. Carefully lift the cover straight up. If stuck, pry gently, using a small screwdriver.
(3) Remove the green screw that fastens the bottom cover to the chassis.
(4) Pry up the bottom cover by inserting a sharp pointed tool, or a nail, in one of the small openings at the corners of the bottom cover.
(5) Lift up the cover and lay it aside with the top cover.

Note. The red screws are used to fasten components to the sides of the chassis. They should never be loosened or removed unless the components need to be repaired or replaced.

b. VISUAL INSPECTION. Inspect the unit thoroughly for any abnormal conditions, such as:

(1) Burned-out resistors or short circuits. Short circuits are usually traceable by signs of discoloration of parts caused by excessive heating or by burned insulation on wires.
(2) Loose, defective, or broken connections of wires soldered to the lugs on the prongs of vibrator socket X–3, power socket X–1, or capacitor socket X–2.
(3) Loose or dirty contact clips on X–1, X–2, and X–3.
(4) Loose or missing mounting screws on the components.
(5) If this inspection does not reveal any of the above mentioned faults and the unit is known to be operating unsatisfactorily, sometimes the fault can be traced by testing the vibrator and the electrolytic capacitor as described in the following paragraphs.

13. Removing, Inspecting, and Testing Plug-in Parts

a. Return the power supply unit to its normal upright position. Pull the vibrator and the electrolytic capacitor straight out of their sockets. Avoid jiggling these components in their sockets; this may spread the socket prongs or otherwise damage this socket.

Note. It is usually necessary to pry out the vibrator by using a small screw driver. In doing so, take care not to enlarge the ring clip holding the vibrator base and not to damage the vibrator.

b. Inspect the vibrator shell for discoloration resulting from overheating and inspect its base for dirty or loose pins. If the vibrator is in bad condition, discard it and substitute a new vibrator known to be in good condition. Inspect the dual electrolytic capacitor for discoloration, corrosion, bulging, or leakage of liquid. If these conditions are observed, substitute a new electrolytic capacitor known to be in good condition.

c. Clean the vibrator and the electrolytic capacitor as follows:

(1) Clean the base pins of these two components by rubbing them lightly with fine emery cloth. Dust them with a small, clean brush.
(2) Clean the base, shell, and pins of these parts with a clean, lint-free cloth moistened with solvent (SD). Dry in air draft.

Note. The plug-in vibrator is hermetically sealed into its shell; never open it.

d. Use the voltohmmeter to test the vibrator for normal electrical continuity, as shown in the table below.

Vibrator pins	Resistance readings			
	PP–282/GRC		PP–281/GRC and PP–448/GR	
	Series-drive	Shunt-drive	Series-drive	Shunt-drive
4 and 7	480 to 540 ohms	Infinity	50 ohms	Infinity
3 and 7	Infinity	Infinity	Infinity	40 ohms
1 and 7	do	430 to 540 ohms	do	Infinity
2 and 7	do	Infinity	do	do
5 and 7	do	do	do	do
6 and 7	do	do	do	do

The above test is not a guarantee that the vibrator will operate satisfactorily. The most reliable test is to substitute the vibrator in a unit known to be operating properly. Output from the unit should be within the limits stated in paragraph 18*b*.

e. To test the charging action of capacitor C–3, connect one of its sections to the ohmmeter. Charge this section of the capacitor with the ohmmeter, using the high-resistance scale (at least 5 megohms). Test each section of the capacitor separately. 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 first should indicate a very low value of resistance. The pointer then should move toward the high-resistance reading on the scale. The final reading should be about 1 megohm. A more reliable check may be made by substituting the capacitor in another unit which is known to be operating properly.

14. Cleaning and Inspecting Chassis

a. CLEANING. Clean any dirty surface on the chassis, or on its components, by brushing with a small, stiff, short-haired clean brush that has been moistened with solvent (SD). Dry accessible surfaces by wiping with a clean, lint-free cloth. Allow other surfaces to dry in air draft.

b. INSPECTING.

(1) Inspect the chassis top, rear panel, and the underchassis for bent, broken, or loose parts and wires.

(2) Inspect the three sockets for enlarged prongs.

15. Replacing Removed Parts

Plug the vibrator and the capacitor into their respective sockets. The trouble-shooting and testing procedures given in the section which follows may then be applied.

Section II. TROUBLE SHOOTING

Warnings: Never operate the power supply without an output load (par. 18). Turn off the power and discharge electrolytic capacitor C–3 before repairing the unit.

16. Trouble-shooting Procedures
(figs. 3 and 4)

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

a. SHORT-CIRCUIT CHECKS. Resistance measurements are made to locate short circuits which might damage the battery or the equipment when power is applied (par. 17).

b. OPERATIONAL CHECK. Measurements of the input voltage, the battery current drain in the input circuit, and the voltage delivered in the output circuit are made as a rapid check of the operating condition of the power supply (par. 18).

c. RESISTANCE MEASUREMENTS. Resistance measurements are made to locate faults or defective components (par. 19).

d. VOLTAGE MEASUREMENTS. Voltage measurements at significant points of the circuit may disclose faults not observed during the previous tests (par. 20).

17. Short-circuit Checks

a. For these checks, remove capacitor C–3 and vibrator E–1 from their sockets. Use Electronic Multimeter TS–505/U, or an equivalent meter, and check for a resistance greater than 1 megohm between pins 3 and 7 and 8 and 7 of connector X–1. Do not apply power to the unit until these conditions are met.

b. A short circuit or a low-resistance reading may indicate shorted or leaky r-f filter capacitors C–1 or C–2, or a grounded wire or lug in the input or output circuits (See schematic diagrams, figs. 8, 9, and 10). Check each capacitor for leakage or a short and replace if necessary. Check wires and lugs. Repair them as needed.

18. Operational Checks
(fig. 5)

a. Refer to the operational test set-up shown in figure 5 and proceed as follows, using the test equipment listed in paragraph 11.

(1) Select a storage battery having the required voltage (6, 12, or 24 volts for Power Supplies PP–448/GR, PP–281/GRC, PP–282/GRC, respectively).

(2) Connect the battery negative lead to pin 7 of connector X–1.
(3) Connect the battery positive lead in series with the 5-ampere fuse and the ammeter to pin 3 of X–1 (Use Multimeter TS–352/U or an ammeter with equivalent low-scale ranges).
(4) Connect a 1,150-ohm, 22-watt resistor across pins 8 and 7 of X–1.
(5) Use Electronic Multimeter TS–505/U to measure the input and output voltages at the points indicated by meters M–1 and M–3 on figure 5.

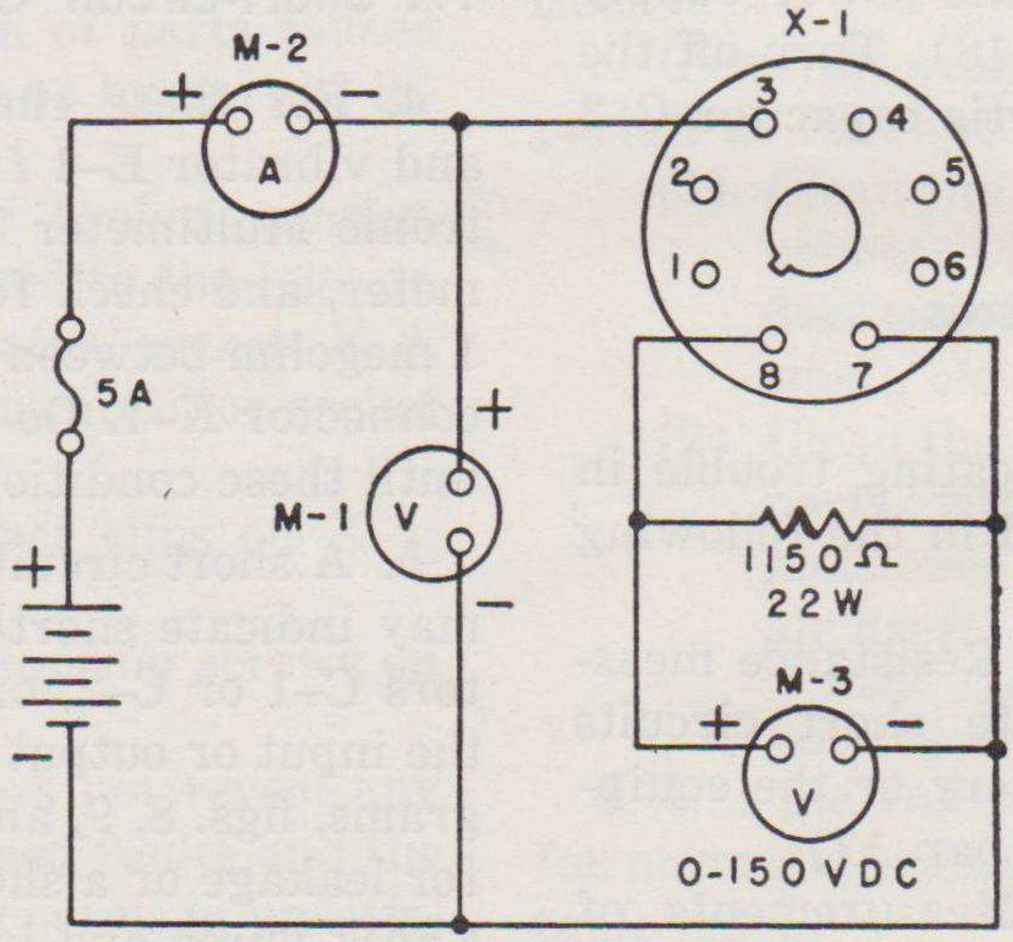
b. The required readings on the input and output meters are listed below:

Power supply	M–1 Input (volts)		M–2 Input (amperes)		M–3 Output (volts)	
	Min	Max	Min	Max	Min	Max
PP–448/GR	6.2	6.4	3.7	4.6	130	145
PP–281/GRC	12.4	12.8	1.9	2.4	130	145
PP–282/GRC	24.8	25.6	1.0	1.3	130	145

c. If the required readings are obtained, proceed with the additional tests given in paragraph 25. If the required readings are not obtained, proceed with the detailed trouble localization checks given in paragraphs 19 and 20.

19. Resistance Measurements

These checks are intended to locate the defective components or wiring responsible for the failure to meet the requirements of paragraph 18*b*. For these checks, disconnect the battery and remove the vibrator from its socket. Remove the load resistor from socket X–1. Use Electronic Multimeter TS–505/U, or an equivalent meter. The points to be tested, the required readings, and the probable cause of trouble, if the readings are incorrect, are listed in the following table. Replace any component found to be defective. When connecting test leads across electrolytic capacitor C–3, observe the correct polarity.



POWER SUPPLY	NOMINAL BATT. VOLTAGE	METER RANGE M-1	METER RANGE M-2
PP-448/GR	6 V	0-10 V	0-10 A
PP-281/GRC	12 V	0-20 V	0-5 A
PP-282/GRC	24 V	0-50 V	0-3 A

NOTES:
UNLESS OTHERWISE SHOWN,
RESISTORS ARE IN OHMS

Figure 5.—Power supplies PP–281/GRC, PP–282/GRC, and PP–448/GR, operational test set-up.

Point of measurement	Normal reading (ohms)			Probable trouble
	PP-281/GRC	PP-282/GRC	PP-448/GR	
Term. 3 to 7 on X–1.	Infinity	Infinity	Infinity	Defective C–1.
Term. 3 on X–1 to term. 1 on X–3.	1 (approx.)	2 (approx.)	Zero*	Defective L–1, R–2, or T–1.
Term. 3 on X–1 to term. 6 on X–3.	1 (approx.)	2 (approx.)	do	Defective L–1, R–2, or T–1.
Term. 3 on X–1 to term. 4 on X–3.	20	Zero*	do	Defective R–4.
Term. 3 on X–1 to term. 3 on X–3.	50	Infinity	do	Defective R–3.
Term. 7 on X–1 to term. 3 on X–2.	15K to 30K	15K to 30K	15K to 30K	Defective C–3 or C–2.
Term. 8 on X–1 to term. 3 on X–2.	155	155	155	Defective L–2 or L–3.
Term. 2 to 5 on X–3.	76	62	68	Defective T–1.
Across R–1	1,800	1,800	1,800	Defective R–1.

*Reading too small to be discernible.

20. Voltage Measurements

The voltage checks in this paragraph supplement the resistance measurements of paragraph 19 and are intended to locate defects which are not readily determined by resistance measurements, that is, defective capacitors, or partially shorted windings. Insert the vibrator in its socket. Connect the storage battery, (+) to pin 3 on X–1, and (—) to pin 7 on X–1. Connect the 1,150-ohm, 22-watt load resistor across pins 8 and 7 (ground) of X–1. Refer to the schematics in figures 8, 9, and 10 to identify the points measured with the component involved. The required voltages are listed in the table below. Use Electronic Multimeter TS–505/U or an equivalent meter.

Point of measurement	Normal reading (volts)			Probable trouble
	PP-281/GRC	PP-282/GRC	PP-448/GR	
From term. 3 to 7 on X–1.	12.6	25.2	6.3	Defective C–1.
From term. 8 to 7 on X–1.	135	135	135	Defective C–2, C–3, L–2, or L–3.
From term. 3 of X–2 to term. 7 of X–1.	155	155	155	Defective T–1, R–1, or C–4.

Section III. REPAIRS

21. Replacement of Parts

When replacing parts in Power Supplies PP–281/GRC, PP–282/GRC, and PP–448/GR, observe the precautions given below.

a. TAGGING LEADS. Tagging leads is essential to assure that correct rewiring will be made when a part is replaced. Before unsoldering leads from transformer T–1, or from sockets X–1, X–2, X–3, or from other parts, tie together the leads that are attached to each of these parts. 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 be of equal or higher voltage and current ratings.

c. LOCATION. Relocation of a substituted part may develop hum and is not recommended.

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

e. SOLDERING. Before soldering any connections, carefully scrape all parts that will be touched by the solder until all traces of rust, corrosion, paint, or varnish are removed. Dust the scraped parts with a small clean brush. Tin all surfaces to be soldered. Wrap the wire around the lug to be soldered to obtain mechanical support. Solder the connection with very little solder and use sufficient heat to make the solder flow evenly around the tinned surfaces.

f. RETROPICALIZATION. If the part to be replaced requires special treatment, such as retropicalization, follow the instructions given in the appropriate publications referred to in section V of this chapter.

22. Special Repair Procedures

Most of the parts in these power supplies are readily accessible and can be easily replaced without special procedure instructions. Special repair procedures required for repairing or replacing r-f chokes L–1 and L–2 and socket X–1 are given below:

a. R-F CHOKES. The two r-f chokes, L–1 and L–2, are mounted together and are located near socket X–1. They are fastened to the chassis by a single axial screw and are insulated by three fiber disks. To remove the chokes:

(1) Remove the red-painted screw below the power-connector socket, and push aside the resistor formerly mounted on that screw.
(2) Loosen and remove the screw which holds the two r-f chokes on the chassis.
(3) Unsolder the wires from the two stand-off insulators near the chokes.
(4) Remove the chokes; repair or replace as necessary.
(5) Reassemble the chokes on the axial screw and tighten the nut.
(6) Remount the resistor, taking care not to short its lugs to the chassis.

b. POWER SOCKET X–1. To change this part—
(1) Drill out the two rivets that fasten it to the chassis.
(2) Unsolder the jumper wire and the three other wires.
(3) Substitute a new socket and fasten it with machine screws, lock washers, and nuts.
(4) Resolder the jumper and wires to the socket.
(5) Clean thoroughly to remove solder drops and metal chips.
(6) Check the new connections with those shown in the schematic for that unit.

Section IV. FINAL TESTING

23. General

If the unit does not meet the requirements of paragraph 18, repeat the trouble-shooting procedures given in paragraphs 19 and 20 to locate other faults. Repair as found necessary. If the unit operates as required in paragraph 18, replace the bottom and top covers on the unit and perform the test outlined in paragraph 24.

24. A-c Ripple Voltage Measurement

a. Connect the equipment as indicated in figure 5 with the following exceptions:

(1) Substitute an a-c voltmeter (Electronic Multimeter ME-6/U or an equivalent meter) for M-3 and connect it in series with a 2-uf capacitor (par. 11) across the 1,150-ohm load resistor.
(2) Connect a 5,100-ohm resistor (par. 11) across the meter terminals.

b. With the a-c meter on its lowest range (2.5 volts on Electronic Multimeter ME–6/U), check for a reading of .0675 volt or less. If a higher reading is indicated, it is probable that capacitor C–3 needs replacement.

25. Additional Test Data

Normal changes in battery voltage and changes in output loads will affect the output voltage of the power supply. Hence, output voltage variation does not necessarily indicate a faulty condition. Typical examples of output voltage changes for changes in battery voltage and output loads are given in the following tables.

Note. The tables are for reference when specified test conditions cannot be met.

Table I.—Output Voltage versus Battery Voltage

Power supply	Battery (volts)	Load (ohms)	Output (volts)	Battery current (amperes)
PP–448/GR	5.0	1,150	110	3.3
	6.3	1,150	135±5	4.3
	8.0	1,150	180	5.5
PP–281/GRC	10.0	1,150	110	1.8
	12.6	1,150	135±5	2.3
	16.0	1,150	177	3
PP–282/GRC	20.0	1,150	109	1.1
	25.2	1,150	136±6	1.25
	32.0	1,150	175	1.65

Table II.—Output Voltage versus Output Load

Power supply	Battery (volts)	Output loads* (ohms)	Output voltages (volts)
PP–448/GR	6.3	1,150	135
		5,500	173
PP–281/GRC	12.6	1,150	135
		5,500	175
PP–282/GRC	25.2	1,150	136
		5,500	170

*The 1,150-ohm resistor is the standard dummy output load recommended for these power supplies. The 5,500-ohm resistor is to be used only as a reference to further check the normal operation of these units.

Section V. LUBRICATION AND WEATHERPROOFING

26. Lubrication

The power supplies described in this manual do not require lubrication. Never apply oil or grease to any parts of these units.

27. Weatherproofing and Rustproofing

a. GENERAL. Signal Corps equipment, when operated under severe climatic conditions such as prevail in tropical, arctic, and desert regions, requires special treatment and maintenance. Fungus growth, insects, dust, corrosion, salt spray, excessive moisture, and extreme temperatures are harmful to most materials.

b. TROPICAL MAINTENANCE. A special moistureproofing 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.

c. WINTER 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 bared surfaces. Clean where necessary with fine sandpaper. Never use steel wool.

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

CHAPTER 4

SHIPMENT AND LIMITED STORAGE AND DEMOLITION TO PREVENT ENEMY USE

28. Repacking for Shipment or Limited Storage

Wrap and pack securely according to directions given in JAN–P–100, or as directed by officer-in-charge.

29. Demolition of Matériel 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 board, plug, and vibrator, using sledges, axes, handaxes, pickaxes, hammers, crowbars, or heavy tools.

b. CUT. Cut wiring, using axes, handaxes, or machetes.

c. BURN. Burn technical manual, records and forms, resistors, capacitors, transformers, and vibrator, using gasoline, kerosene, oil, flame throwers, and incendiary grenades.

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

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

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

g. DESTROY. Destroy everything.

APPENDIX I

REFERENCES

Note. For availability of items listed, check SR 310-20-3 and SR 310-20-4. Check Department of the Army Supply Catalog SIG 1 for Signal Corps supply catalogs.

1. Army Regulations

AR 380–5 Safeguarding Military Information.

2. Supply Publications

SIG 1 Introduction and Index.
SB 11–47 Preparation and Submission of Requisitions for Signal Corps Supplies.
SB 11–76 Signal Corps Kit and Materials for Moisture- and Fungi-Resistant Treatment.

3. Preserving

TB SIG 13 Moistureproofing and Fungiproofing Signal Corps Equipment.

4. Demolition

FM 5–25 Explosives and Demolitions.

5. Packaging and Packing Instructions

Joint Army-Navy Packaging specifications.
JAN–D–169 Desiccants (activated).
JAN–P–100 General Specification.
JAN–P–106A Boxes; wood, nailed.
JAN–P–116 Preservation, methods of.
JAN–P–125 Barrier materials, waterproof, flexible.
JAN–P–131 Barrier material; moisture-vaporproof, flexible.

6. Other Publications

AN 16–35TS 352–3 Multimeter TS–352/U.
FM 24–18 Field Radio Techniques.
SR 310–20–3 Index of Training Publications (Field Manuals, Training Circulars, Firing Tables and Charts, Army Training Programs, Mobilization Training Programs, Graphic Training Aids, Joint Army-Navy-Air Force Publications, and Combined Communications Board Publications).
SR 310–20–4 Index of Technical Manuals, Technical Regulations, Technical Bulletins, Supply Bulletins, Lubrication Orders, Modification Work Orders, Tables of Organization and Equipment, Reduction Tables, Tables of Allowances, Tables of Organization, Tables of Equipment, and Tables of Basic Allowances.
TB SIG 66 Winter Maintenance of Signal Equipment.
TB SIG 72 Tropical Maintenance of Ground Signal Equipment.
TB SIG 75 Desert Maintenance of Ground Signal Equipment.
TB SIG 123 Preventive Maintenance Practices for Ground Signal Equipment.
TB SIG 178 Preventive Maintenance Guide for

	Radio Communication Equipment.
TM 9–2857	Storage Batteries Lead-Acid Type.
TM 11–430	Batteries for Signal Communication. Except those pertaining to Aircraft.
TM 11–453	Shop Work.
TM 11–455	Radio Fundamentals.
TM 11–483	Suppression of Radio Noises.
TM 11–486	Electrical Communication Systems Engineering.
TM 11–4000	Trouble Shooting and Repair of Radio Equipment.
TM 38–650	Basic Maintenance Manual.

7. Abbreviations

a, amp.	ampere
a-c.	alternating-current
C.	centigrade
d-c.	direct-current
F.	Fahrenheit
h.	henry
r-f.	radio-frequency
uf, uuf.	microfarad, micromicrofarad
uh.	microhenry
v.	volt
w.	watt

APPENDIX II

IDENTIFICATION TABLE OF PARTS

1. Requisitioning Parts

The fact that a part is listed in this table is not sufficient basis for requisitioning the item. Requisitions must cite an authorized basis, such as T/O&E, T/E, T/A, T/BA, SIG 6, SIG 7 & 8, SIG 7–8–10, SIG 10, list of allowances of expendable material, or another authorized supply basis. For an index of available supply catalogs in the Signal portion of the Department of the Army Supply Catalog, see the latest issue of SIG 1, Introduction and Index.

2. Identification Table of Parts for Power Supply PP-281/GRC

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
	POWER SUPPLY PP-281/GRC : vibrator type ; sync ; output 138 v DC, .12 amp; input 12.6 v DC, 2.14 amp; LMT part/dwg GA-2129-1-Gr1-FR.	.....	3H4497-281. FR
C-1, C-2	CAPACITOR, fixed: ceramic dielectric; 5000 uuf ± 20 %; 500 vdcw. LMT part/dwg GH-2094-2-6-FR.	R-f hash filters	3DA5-215, FR
C-4	CAPACITOR, fixed: paper dielectric; 20,000 uuf ± 10 %; 1000 vdcw JAN type CP25A1EG203K. LMT part/dwg LMT 402141.	Buffer, secondary	3DA20-241. FR
C-3	CAPACITOR, fixed: electrolytic; 2-sect; 35 uf ea sect; 300 vdcw ea sect; JAN type CE52C350N. LMT part/dwg PL-775637-35 uf.	B + filter	3DB35-1. FR
O-1	CLIP. LMT part/dwg GB-1429-2-FR.	Vibrator holding clip	2Z2712.132. FR
L-1, L-2	COIL, RF: choke; unshielded. LMT part/dwg GA-1945-2-FR.	R-f hash filters	3C315-126. FR
A-1	COVER. LMT part/dwg GA-1924-12-FR.	Power supply top cover ..	2Z3351-170. FR
N-1	LABEL: ckt label; 5" lg x 2 1/2" wd x .007" thk. LMT part/dwg GD-1005-2-FR.	Circuit label	6D16777-2. FR
H-2	MOUNTING: capacitor mtg; holds material 5/8" diam LMT part/dwg GB-2130-2-FR.	Capacitor holding clamp ..	2Z6820.252. FR
A-2	PLATE, cover. LMT part/dwg GA-1920-12-FR.	Power supply bottom cover	2Z7093-236. FR
L-3	REACTOR: 2 hy, .13 amp; 170 ohms DC. LMT part/dwg GH-1159-2-FR.	B + filter	3C315-127. FR
R-2	RESISTOR, fixed: WW; 0.5 ohms ± 5 %; 8 w at 275° C max continuous oper temp; JAN type RW30GR50. LMT part/dwg PL-775576-0.5 ohm.	Transformer current limiting	3RW4401. FR
R-4	RESISTOR, fixed: WW 20 ohms ± 5 % 8 w at 275° C max continuous oper temp; JAN type RW30G200. LMT part/dwg PL-775576-20 ohms.	Vibrator coil current limiting (series drives)	3Rw14102 FR
R-3	RESISTOR, fixed: WW 50 ohms ± 5 % 8 w at 275° C max continuous oper temp; JAN type RW30G500. LMT part/dwg PL-775576-50 ohms.	Vibrator coil current limiting (shut drive)	3Rw16507 FR
R-1	RESISTOR fixed: comp; 1800 ohms ± 10 %; 1 w; JAN type RC30AE182K. LMT part/dwg PL-775619-1800 ohms.	Buffer, secondary	3RC30AE182K. FR
X-3	SOCKET, tube: 7 cont, small; 1 piece molded in mtg plate. LMT part/dwg GH-2098-2-FR.	Vibrator socket	2Z8677.153. FR
X-1 X-2	SOCKET, tube: octal; 1 piece molded in mtg plate. LMT part/dwg GH-2039-2-FR.	X-1 : Input-output connector X-2 : Filter capacitor socket	2Z8678.338. FR
T-1	TRANSFORMER, power: vibrator type; input 12.6 v DC, 2.14 amp; output 356 v RMS CT, 118 ma DC; 115 cyc output; HS metal case. LMT part/dwg GH-1145-12-FR.	Vibrator transformer, 12.6 volt supply.	2Z9625.63. FR
E-1	VIBRATOR, synchronous: input 6.3 v DC, 4.3 amp. LMT part/dwg GH-1661-14-FR.	Vibrator	3H6690-15. FR

3. Identification Table of Parts for Power Supply PP-282/GRC

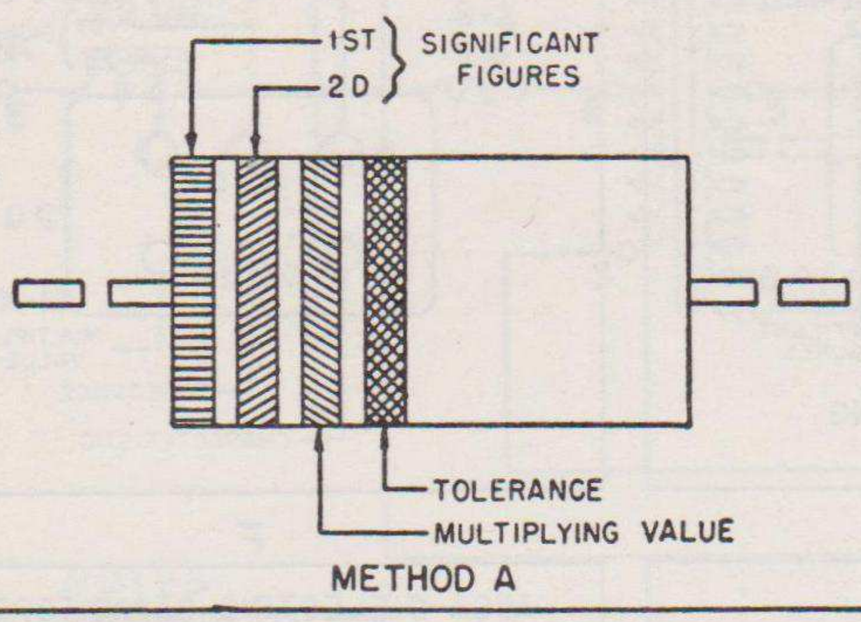
Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
	POWER SUPPLY PP-282/GRC: vibrator type; sync; output 138 v DC, .12 amp; input 25.2 v DC, 1.17 amp; LMT part/dwg GA-2129-1-Gr2-FR.	.....	3H4497-282. FR
C-1, C-2	CAPACITOR, fixed: ceramic dielectric; 5000 uuf ± 20 %; 500 vdcw. LMT part/dwg GH-2094-2-6-FR.	R-f hash filters	3DA5-215. FR
C-4	CAPACITOR, fixed: paper dielectric; 10,000 uuf ± 10 %; 1000 vdcw JAN type CP25A1EG103K. LMT part/dwg PL-775649-10,000 uuf.	Buffer, secondary	3DA10-506. FR
C-5	CAPACITOR, fixed: metallized paper dielectric; 1 uf ± 10 %; 200 vdcw. LMT part/dwg GH-2093-2-FR.	Buffer, primary	3DB1-318. FR
C-3	CAPACITOR, fixed: electrolytic; 2-sect; 35 uf ea sect; 300 vdcw ea sect; JAN type CE52C350N. LMT part/dwg PL-775637-35 uf.	B + filter	3DB35-1. FR
O-1	CLIP. LMT part/dwg GB-1429-2-FR.	Vibrator holding clip	2Z2712.132. FR
L-1, L-2	COIL, RF: choke; unshielded. LMT part/dwg GA-1945-2-FR.	R-f hash filters	3C315-126. FR
A-1	COVER. LMT part/dwg GA-1924-12-FR.	Power supply top cover ..	2Z3351-170. FR
N-1	LABEL: ckt label; 5" lg x 2 1/2" wd x .007" thk. part/dwg GB-1006-2-FR.	Circuit label	6D16777-4. FR
H-2	MOUNTING: capacitor mtg; holds material 5/8" diam LMT part/dwg GB-2130-2-FR.	Capacitor holding clamp ..	2Z6820.252. FR
A-2	PLATE, cover. LMT part/dwg GA-1920-12-FR.	Power supply bottom cover	2Z7093-236 FR
L-3	REACTOR: 2 hy, .13 amp; 170 ohms DC. LMT part/dwg GH-1159-2-FR.	B + filter	3C315-127. FR
R-2	RESISTOR, fixed: WW; 1.6 ohms ± 5 %; 8 w at 275° C max continuous oper temp; JAN type RW 30G1R6. LMT part/dwg PL-775576-1.6 ohms.	Transformer current limiting.	3RW7508. FR
R-1	RESISTOR, fixed: comp; 1800 ohms ± 10 %; 1 w; JAN type RC30AE182K. LMT part/dwg PL-775619-1800 ohms.	Buffer, secondary	3RC30AE182K. FR
X-3	SOCKET, tube: 7 cont, small; 1 piece molded in mtg plate. LMT part/dwg GH-2098-2-FR.	Vibrator socket	2Z8677.153. FR
X-1, X-2	SOCKET, tube: octal; 1 piece molded in mth plate. LMT part/dwg GH-2039-2-FR.	X-1 : Input-output connector X-2 : Filter capacitor socket	2Z8678.338 FR
T-1	TRANSFORMER, power : vibrator type ; input 25.2 v DC, 1.17 amp; output 356 v RMS CT, 118 ma DC; 115 cyc output; HS metal case. LMT part/dwg GH-1147-12-FR.	Vibrator transformer 25.2-volt supply.	2Z9625-64. FR
E-1	VIBRATOR, synchronous: input 25.2 v DC, 1.3 amp. LMT part/dwg GH-2641-14-FR.	Vibrator	3H6690-16. FR

4. Identification Table of parts for Power Supply PP-448/GR

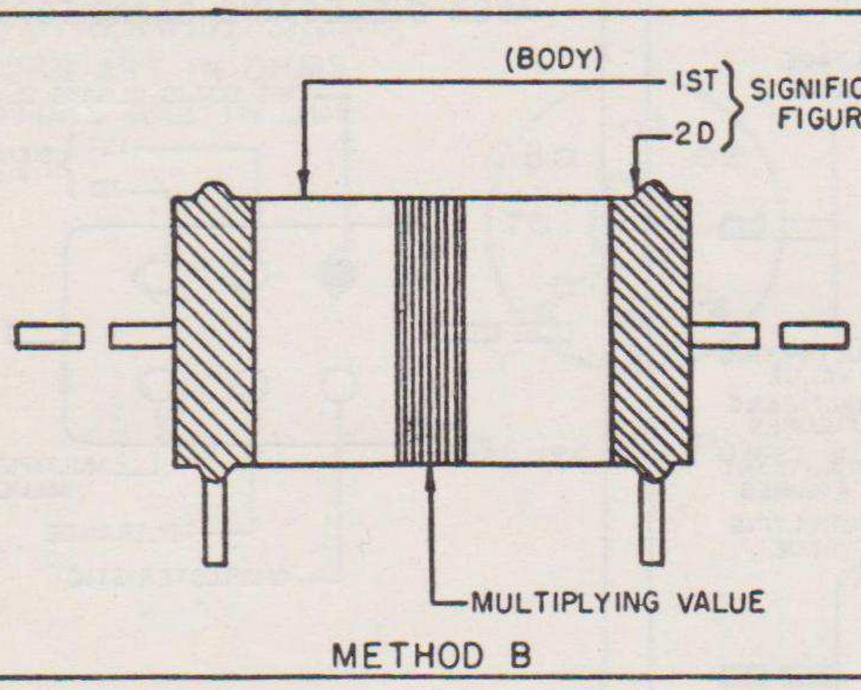
Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
	POWER SUPPLY PP-448/GR: vibrator type; sync; output 138 v DC, .12 amp; input 6.3 v DC, 4.1 amp; LMT part/dwg GA-2129-1-Gr-3-FR.	.....	3H4497-448. FR
C-1, C-2	CAPACITOR, fixed: ceramic dielectric; 5000 uuf ± 20 %; 500 vdcw. LMT part/dwg GH-2094-2-6-FR.	R-f hash filters	3DA5-215. FR
C-4	CAPACITOR, fixed: paper dielectric; 20,000 uuf ± 10% ; 1000 vdcw JAN type CP25A1EG203K. LMT part/dwg. LMT 402141.	Buffer, secondary	3DA20-241. FR
C-3	CAPACITOR, fixed: electrolytic; 2-sect; 35 uf ea sect; 300 vdcw ea sect; JAN type CE52C350N. LMT part/dwg PL-775637-35 uf.	B + filter	3DB35-1. FR
O-1	CLIP. LMT part/dwg GB-1429-2-FR.	Vibrator holding clip	2Z2712.132. FR
L-1, L-2	COIL, RF: choke; unshielded. LMT part/dwg GA-1945-2-FR.	R-f hash filters	3C315-126. FR
A-1	COVER. LMT part/dwg GA-1924-12-FR.	Power supply top cover ..	2Z3351-170. FR
N-1	LABEL: ckt label; 5" lg x 2 1/2" wd x .007" thk. part/dwg GD-1007-2-FR.	Circuit label	6D16777-3. FR
H-2	MOUNTING: capacitor mtg; holds material 5/8" diam LMT part/dwg GB-2130-2-FR.	Capacitor holding clamp ..	2Z6820.252. FR
A-2	PLATE, cover. LMT part/dwg GA-1920-12-FR.	Power supply bottom cover	2Z7093-236. FR
L-3	REACTOR: 2 hy, .13 amp; 170 ohms DC. LMT part/dwg GH-1159-2-FR.	B + filter	3C315-127. FR
R-1	RESISTOR, fixed: comp; 1800 ohms ± 10 %; 1 w; JAN type RC30AE182K. LMT part/dwg PL-775619-1800 ohms.	Buffer, secondary	3RC30AE182K. FR
X-3	SOCKET, tube: 7 cont, small; 1 piece molded in mtg plate. LMT part/dwg GH-2098-2-FR.	Vibrator socket	2Z8677.153.FR
X-1, X-2	SOCKET, tube: octal; 1 piece molded in mtg plate. LMT part/dwg GH-2039-2-FR.	X-1 : Input-output connector X-2 : Filter capacitor socket	2Z8678.338. FR
T-1	TRANSFORMER, power : vibrator type ; input 6.3 v DC, 4.1 amp; output 356 v RMS CT, 118 ma DC; 115 cyc output; HS metal case. LMT part/dwg GH-1149-12-FR.	Vibrator transformer, 6.3 volt supply.	2Z9625-65. FR
E-1	VIBRATOR, synchonous: input 6.3 v DC, 4,3 amp. LMT part/dwg GH-1661-14-FR.	Vibrator	3H6690-15. FR

RESISTOR COLOR CODES

RMA COLOR CODE FOR FIXED COMPOSITION RESISTORS*



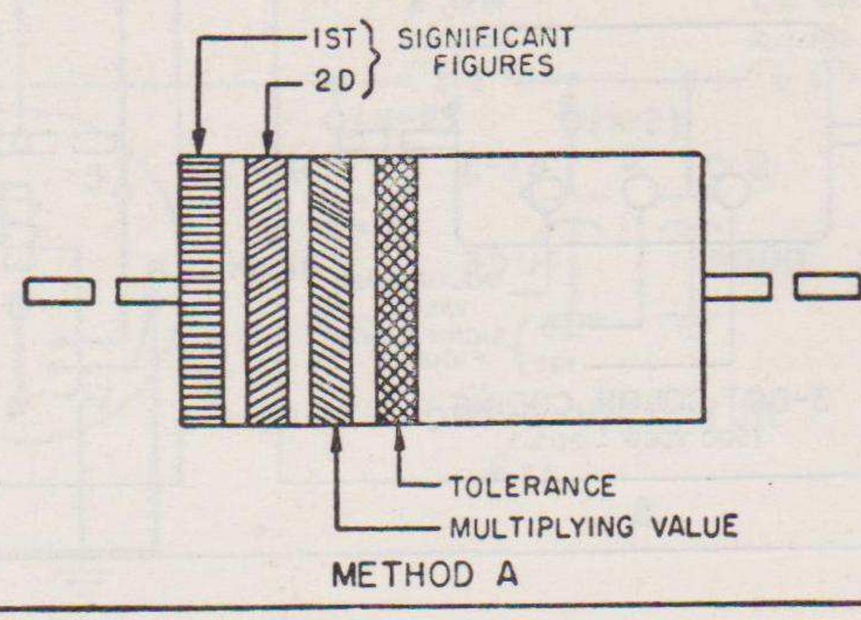
METHOD A



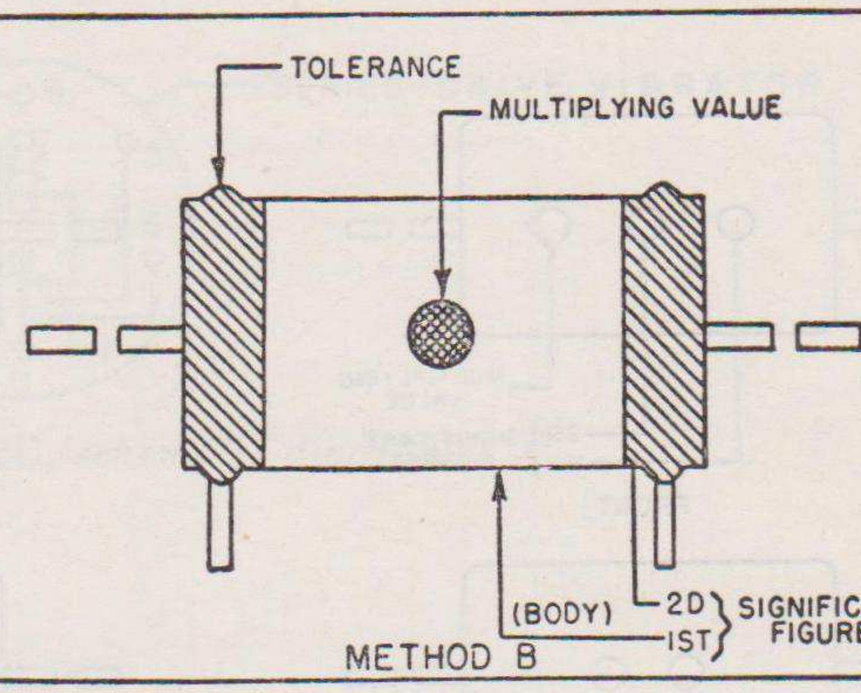
METHOD B

A

JAN COLOR CODE FOR FIXED COMPOSITION RESISTORS†



METHOD A



METHOD B

B

COLOR	SIGNIFICANT FIGURE	MULTIPLYING VALUE	TOLERANCE (%)
BLACK	0	1	± –
BROWN	1	10	± 1
RED	2	100	± 2
ORANGE	3	1,000	± 3
YELLOW	4	10,000	± 4
GREEN	5	100,000	± 5
BLUE	6	1,000,000	± 6
VIOLET	7	10,000,000	± 7
GRAY	8	100,000,000	± 8
WHITE	9	1,000,000,000	± 9
GOLD	–	0.1	± 5
SILVER	–	0.01	± 10
NO COLOR	–	–	± 20

NOTES

* INSULATED FIXED COMPOSITION RESISTORS WITH AXIAL LEADS ARE DESIGNATED BY A NATURAL TAN BACKGROUND COLOR. NON-INSULATED FIXED COMPOSITION RESISTORS WITH AXIAL LEADS ARE DESIGNATED BY A BLACK BACKGROUND.

† RESISTORS WITH AXIAL LEADS ARE INSULATED. RESISTORS WITH RADIAL LEADS ARE NON-INSULATED.

RMA: RADIO MANUFACTURERS ASSOCIATION

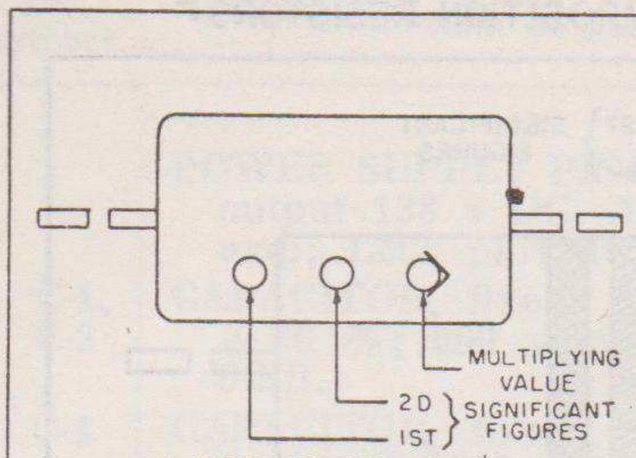
JAN: JOINT ARMY-NAVY

THESE COLOR CODES GIVE ALL RESISTANCE VALUES IN OHMS.

Figure 6.—Resistor color codes.

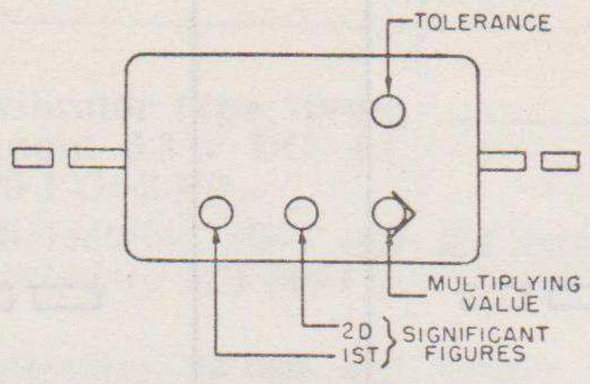
CAPACITOR COLOR CODES

RMA 3-,4-,5-,& 6-DOT COLOR CODES FOR MICA-DIELECTRIC CAPACITORS



3-DOT COLOR CODING
(500 VDCW ± 20%)

A

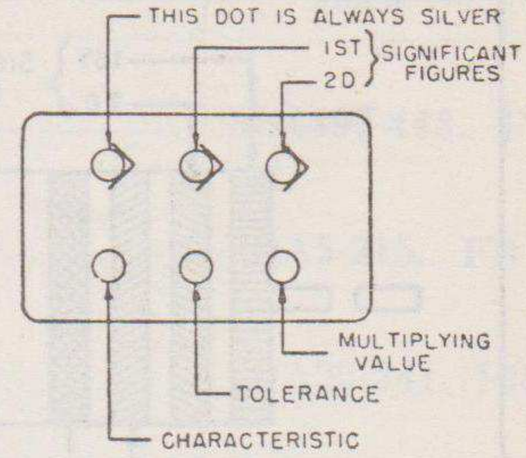


4-DOT COLOR CODING
(500 VDCW)

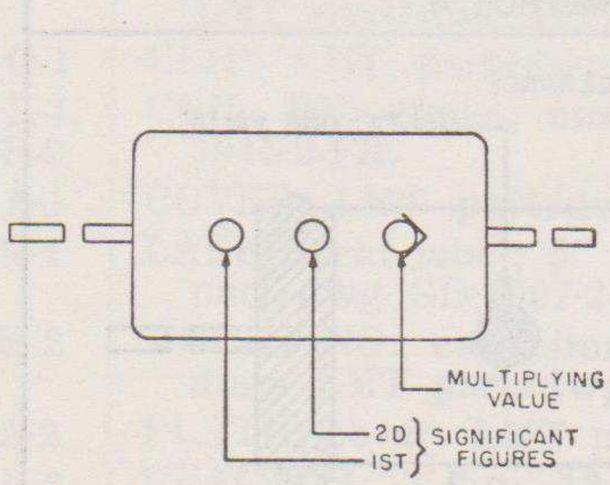
B

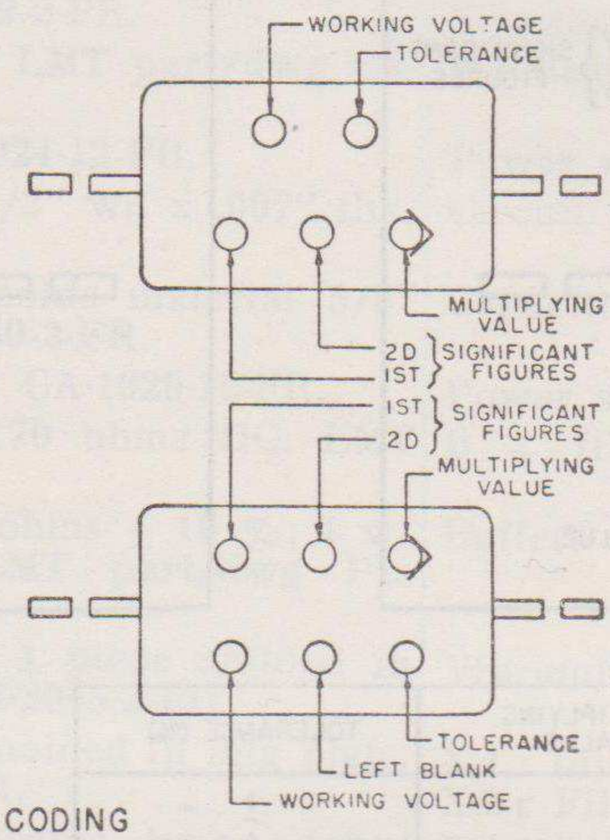
JAN 6-DOT COLOR CODES FOR:

PAPER-DIELECTRIC CAPACITORS *



F

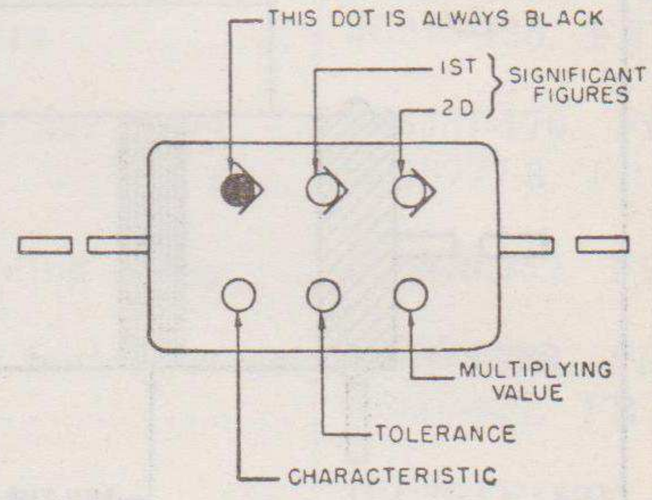




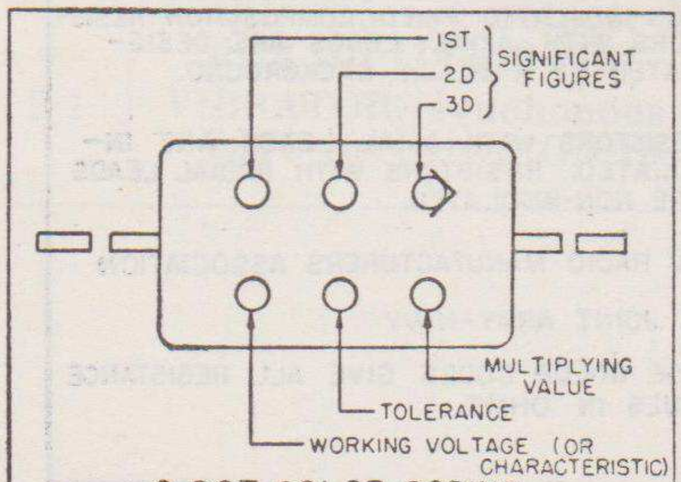
5-DOT COLOR CODING

C

MICA-DIELECTRIC CAPACITORS ≠



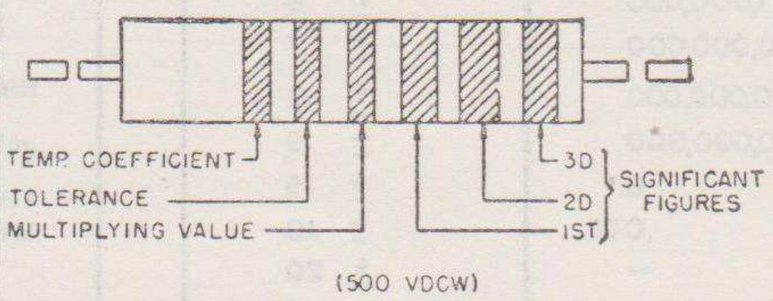
G



6-DOT COLOR CODING

D

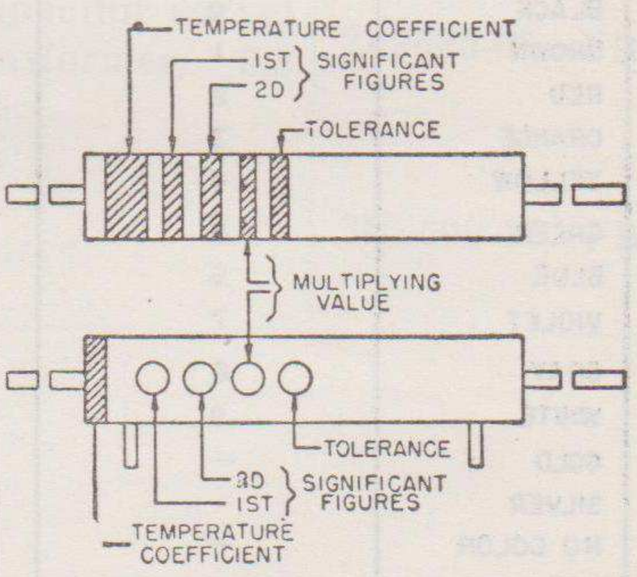
RMA COLOR CODE FOR TUBULAR CERAMIC-DIELECTRIC CAPACITORS



(500 VDCW)

E

CERAMIC-DIELECTRIC CAPACITORS **



H

COLOR	SIGNIFICANT FIGURE	MULTIPLYING VALUE			RMA VOLTAGE RATING
		RMA MICA-AND CERAMIC-DIELECTRIC	JAN MICA-AND PAPER-DIELECTRIC	JAN CERAMIC-DIELECTRIC	
BLACK	0	1	1	1	-
BROWN	1	10	10	10	100
RED	2	100	100	100	200
ORANGE	3	1,000	1,000	1,000	300
YELLOW	4	10,000	10,000		400
GREEN	5	100,000			500
BLUE	6	1,000,000			600
VIOLET	7	10,000,000			700
GRAY	8	100,000,000		0.01	800
WHITE	9	1,000,000,000		0.1	900
GOLD	-	0.1	0.1		1,000
SILVER	-	0.01	0.01		2,000
NO COLOR	-				500

NOTES

* THE SILVER DOT IDENTIFIES THIS MARKING FOR WORKING VOLTAGES SEE JAN TYPE DESIGNATION CODE.

≠ THE BLACK DOT IDENTIFIES THIS MARKING. FOR WORKING VOLTAGES SEE JAN TYPE DESIGNATION CODE.

** CAPACITORS MARKED WITH THIS CODE HAVE A VOLTAGE RATING OF 500 VDCW. EITHER THE BAND OR DOT CODE MAY BE USED FOR BOTH INSULATED (AXIAL-LEAD) OR UNINSULATED (RADIAL-LEAD) CAPACITORS.

RMA RADIO MANUFACTURERS ASSOCIATION

JAN: JOINT ARMY-NAVY

THESE COLOR CODES GIVE CAPACITANCES IN MICROMICROFARADS.

Figure 7.—Capacitor color codes.

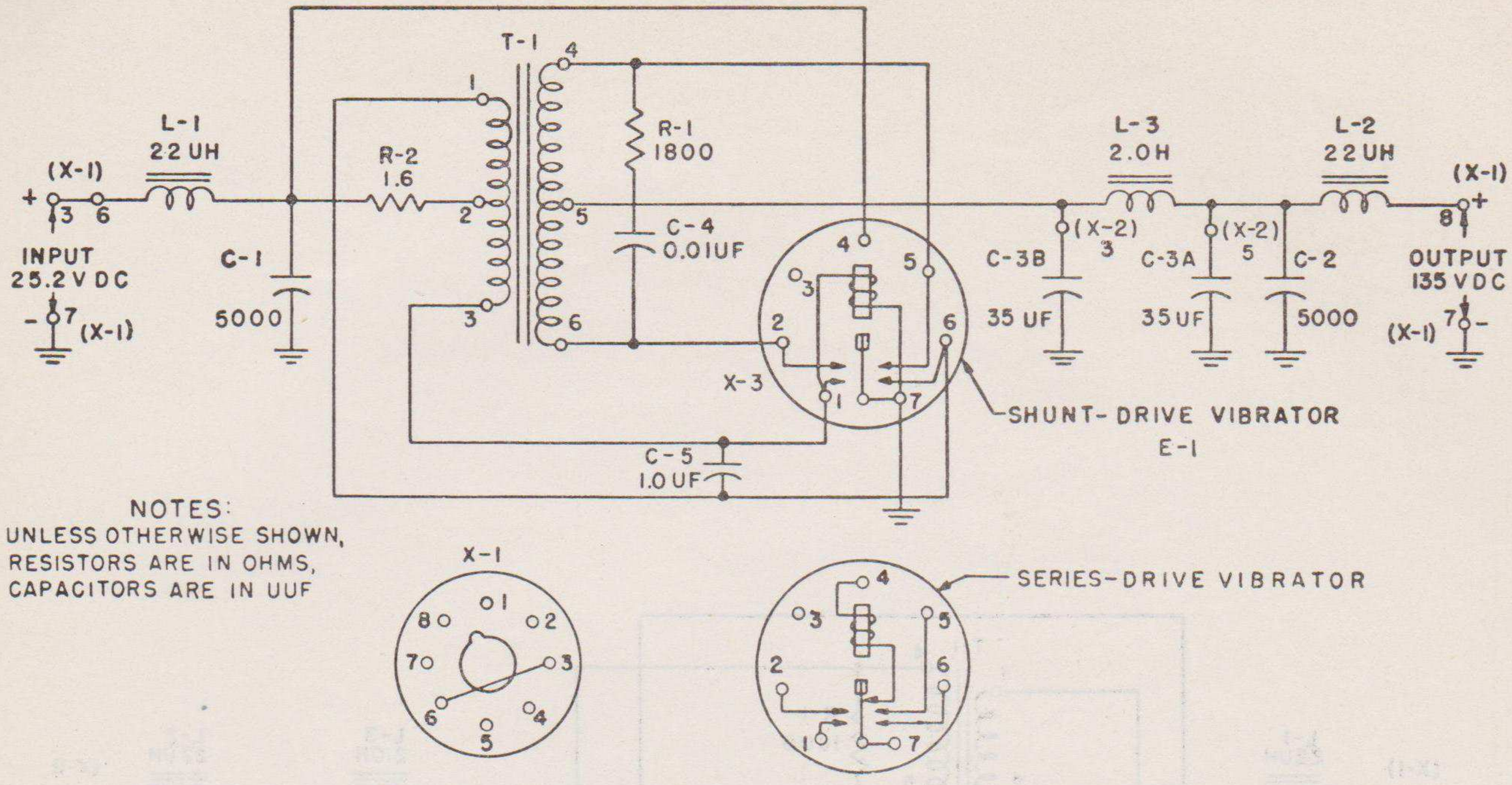


Figure 8.—Power supply PP-282/GRC, schematic diagram.

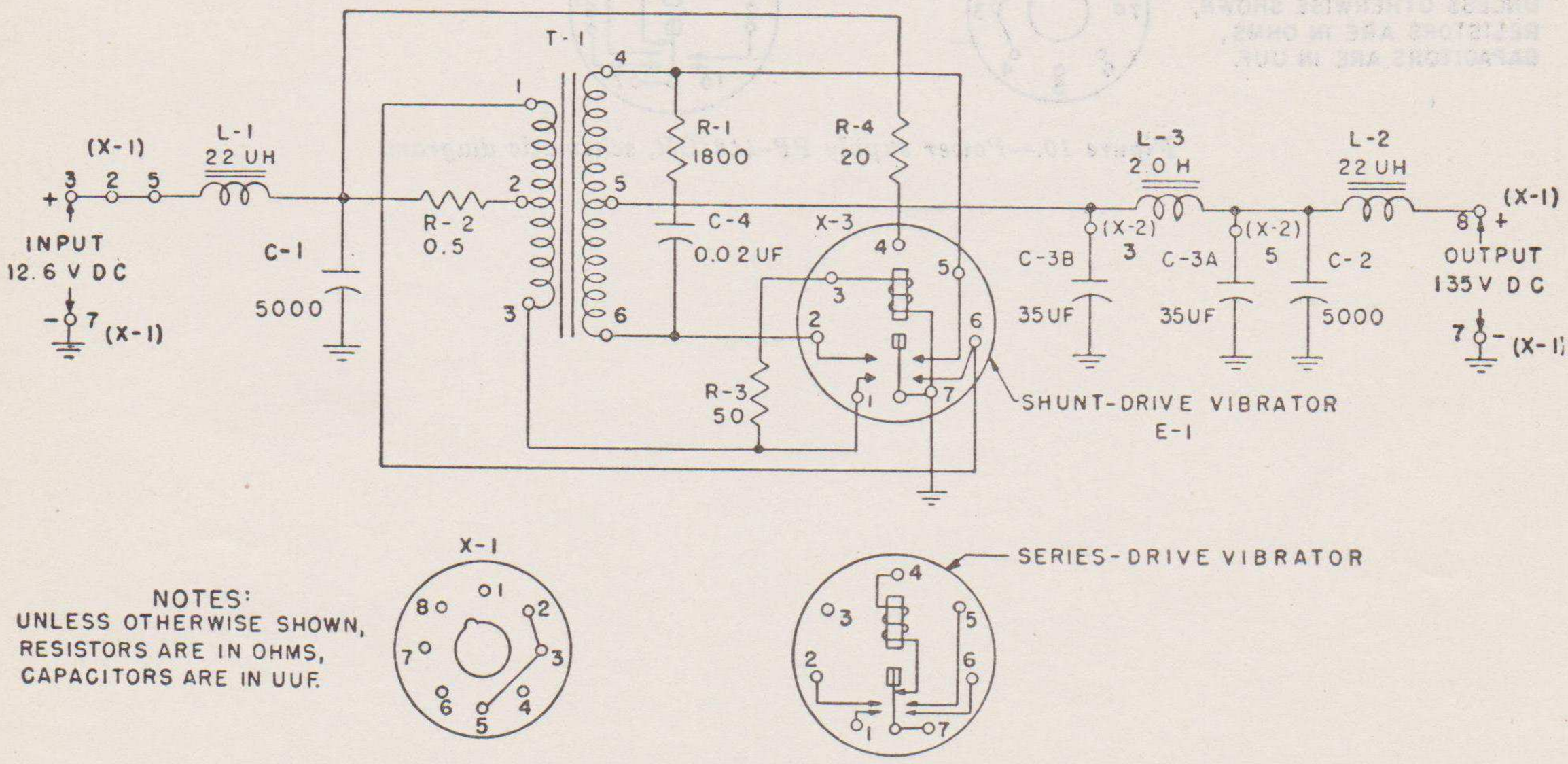
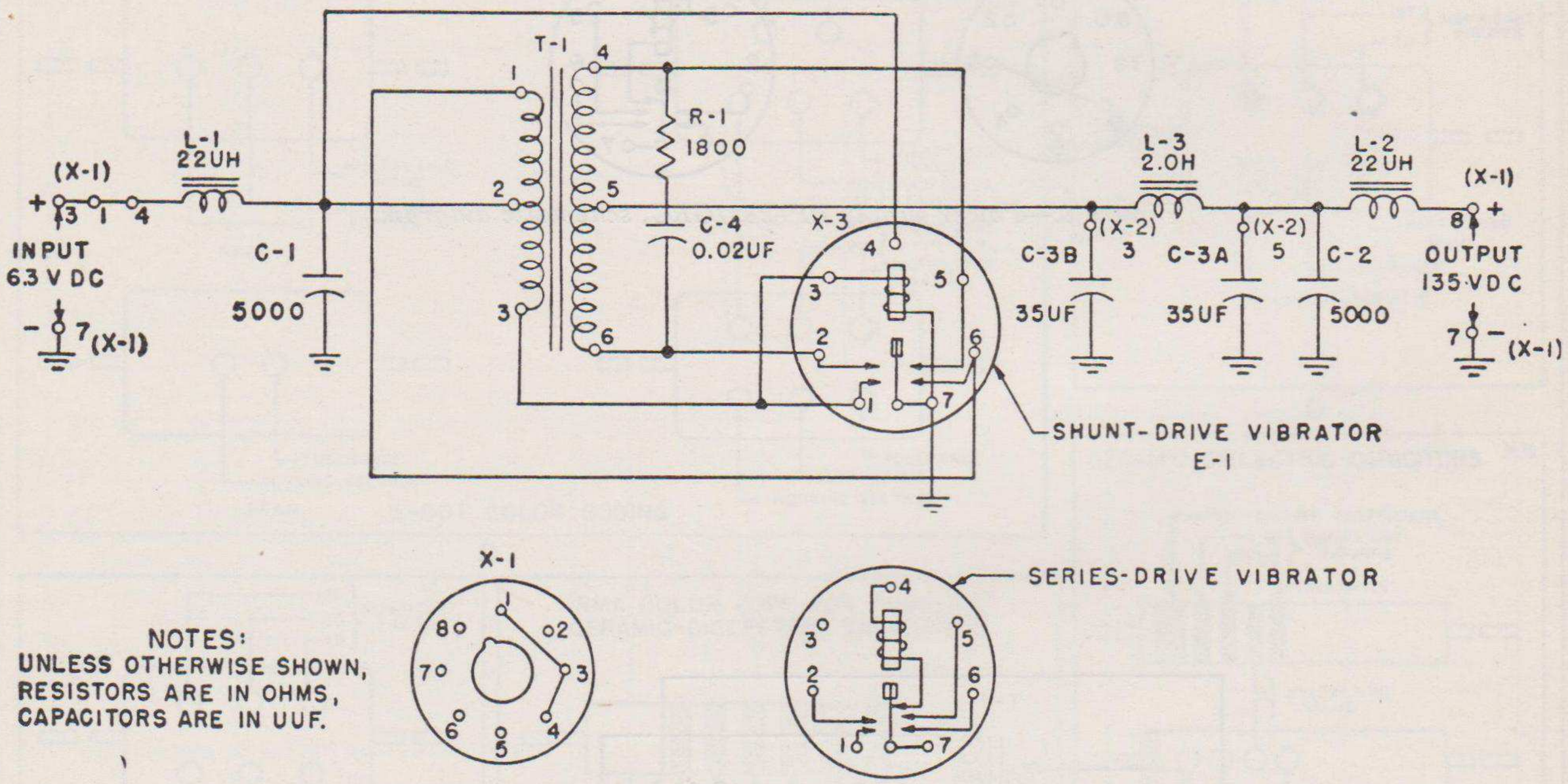


Figure 9.—Power supply PP-281/GRC, schematic diagram.



NOTES:
UNLESS OTHERWISE SHOWN,
RESISTORS ARE IN OHMS,
CAPACITORS ARE IN UUF.

Figure 10.—Power supply PP-448/GR, schematic diagram.