100-WATT MOBILE POWER SUPPLY

**features**
- 6- or 12-volt DC input
- Built-In receiver power
- Battery saver circuit
- Over 70% efficient
- 450, 300 and 240 volts DC output

Meet the trend to higher power in mobile amateur communications with this high-efficiency vibrator power supply that will completely power your home-built or commercial mobile station.

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DESIGN CONSIDERATIONS

High efficiency generally is the most important factor in the design of portable radio equipment, because of the limited amount of power available from the average automotive electrical system. Some means of reducing the transmitter power input also is desirable to help prevent running down the car battery when the engine is not running. These features, plus compact size and conservatively rated components have been conjured into this mobile high-voltage power supply intended for engine compartment mounting. This location saves short input power leads having low voltage drop, but it is a 6- x 6- x 8-inch overall power supply dimensions are equally adaptable to under-dash or trunk compartment mounting.

The input power required by this supply is about 1200 watts, with the average power drawn by the transmitter approximately 500 watts.

Many vibrato power supplies have been described recently in this column. This supply is a transformer coupled double-balanced diode circuit power supply. A simplified schematic diagram of a typical split-reed transformer for an audio frequency modulation circuit is shown in Fig. 1. A constant means of vibrate the battery alternately through two opposed primary windings of a transformer, thus inducing a square-wave AC voltage in the secondary. This AC secondary voltage is then rectified by a second set of contacts on the vibrator armature. The limitation of this circuit is that the circuit has a number of turns on the transformer primary and the secondary voltage is changed, i.e., when moving from a car with a 6-volt system to one with a 12-volt system.

In the split-reed vibrator, two sets of double-throw contacts are electrically isolated from each other, as depicted in Fig. 2. These contacts are currently available split-reed vibrators have much greater current carrying capacity than the usual synchronous or single-diode types.

However, a power transformer having two center-tapped primary windings is required. One set of contacts switches the DC current alternately between halves of one primary winding, and the other set simultaneously switches the other winding.

Therefore, the primaries can be connected in parallel for 6-volt operation, or in series for operation from a 12-volt DC supply. No wiring changes are necessary in the supply if the battery is properly connected to the power input terminals. The voltage change-over connections can be made by means of multiple-contact input power connectors, if desired.
Since the high voltage section of this power supply has three distinct circuitry, simplified diagrams of the rectifier circuits which furnish the 250- and 300-volt outputs are shown in Fig. 3A and 3B. Note that each rectifier has two sections. The parts numbers and transformers color-coded leads are the same as those shown in the complete schematic diagram, Fig. 4. In the 250-volt DC circuit of Fig. 3A, the full secondary voltage (leads B-V-Y (Brown-Yellow) and G-Y (Green-Yellow)) is applied to a full-wave rectifier consisting of half of S46 and S48. These two rectifiers form a portion of all three rectifier circuits. Since the junction between the black rectifier terminals is grounded, the positive 250-volt output is taken from the B-V (Red-Yellow) transformer-lead. This is the opposite of the usual full-wave rectifier circuit. This voltage is filtered by C4B, C4C, C4U, and a 47-ohm resistor in Fig. 4.

### PARTS LIST

<table>
<thead>
<tr>
<th>Component</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>C4A</td>
<td>-100 µF, 450-volt electrolytic (Sprague TVL-17500)</td>
</tr>
<tr>
<td>C4C</td>
<td>-1240 µF, 450-volt electrolytic (Sprague TVL-27641)</td>
</tr>
<tr>
<td>C4U</td>
<td>-0.003 µF, 2500-volt working micro capacitor</td>
</tr>
<tr>
<td>C4l</td>
<td>-50 µF, 50-volt electrolytic (Sprague T-1558B)</td>
</tr>
<tr>
<td>E1</td>
<td>Vibrator, dual interrupter, split reed, 4-ohm coil, 115 CPS frequency, 7-pin base (Walter type 1703, Oak No. 76053, Redset No. 77, or Q-E Tech No. A-7441584-25)</td>
</tr>
<tr>
<td>F1</td>
<td>-30-ampere cartridge fuse and holder</td>
</tr>
<tr>
<td>P1</td>
<td>-15-ohm, 2-watt, panhead plug (Cinch-Jones No. P-321-AB)</td>
</tr>
<tr>
<td>P2</td>
<td>-4-ohm, 2-watt, panhead plug (Cinch-Jones No. P-308-AB)</td>
</tr>
<tr>
<td>J3</td>
<td>-4-pin female socket (Cinch-Jones No. S-304-AB)</td>
</tr>
<tr>
<td>J4</td>
<td>-1-ohm, 1000-ohm, 1/2-watt carbon resistor</td>
</tr>
<tr>
<td>R4c</td>
<td>-10-ohm, 10-watt adjustable resistor</td>
</tr>
<tr>
<td>R1</td>
<td>-27-ohm, 1-ohm, 1-watt resistor</td>
</tr>
<tr>
<td>R2</td>
<td>-22-ohm, 1-ohm, 1-watt resistor</td>
</tr>
<tr>
<td>R3</td>
<td>-12-ohm, 1-ohm, 1-watt resistor</td>
</tr>
<tr>
<td>R4</td>
<td>-4-pin resistor plug (Cinch-Jones No. P-304-AB)</td>
</tr>
<tr>
<td>C4</td>
<td>-1240 µF, 450-volt electrolytic (Sprague TVL-27641)</td>
</tr>
</tbody>
</table>

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**Fig. 4.** Complete schematic diagram of the mobile power supply. Separate 6- and 12-volt power input and cables are shown at the bottom of the diagram.
The 300-volt DC output is obtained from a bridge rectifier circuit at Fig. 3A consisting of one half of each of SR and SR2 in the legs connected to ground, plus SR1 in the other two legs from which the positive voltage is obtained. During each half of each AC cycle, the voltage across the B-B-C-B (Bridge-Bridge-Bridge-Bridge) section of the high-voltage winding is rectified by the upper section of SR and SR2 in the bridge. On the other hand of each AC cycle, the voltage across transformer tap G-G (Green-Green) and BY-Y is rectified by the lower section of SR and SR2. The transformer output voltage from these taps is about 300 volts AC.

Another bridge rectifier circuit is employed for the 450-volt DC output, again with the two grounded legs of the rectifier circuit passing through SR1 and SR2. The other two sections on these rectifiers form the legs of the bridge from which the positive DC voltage is taken at the junction of the red terminals.

Because there is very little ripple voltage in the DC output from the rectifiers, a single 40-mfd, 450-volt capacitor, Cm, on the 300-volt output, was adequate. Two 100-mfd, 450-volt capacitors, C1 and C2, were placed in series across the 450-volt output.

A "transient-correct" power switching circuit is included in the power supply so that the 215-volt output may be applied to a mobile receiver or converter. This is accomplished with one pair of contacts on a double-pole, double-throw relay, RY1, which also turns on the 300-volt output to a transmitter exciter when its relay coil is energized. A second double-pole, double-throw relay, RY2, turns on the 450-volt DC output to a transmitter final amplifier when its coil is energized. It also provides the power-reducing feature which the coil is not energized, by applying 300 volts to the 450-volt output terminal, and 270 volts to the 300-volt output terminal. A single double-pole, double-throw relay may be substituted for RY2 if the power-reduction feature is not needed. Since all rectifiers have high continuous current flow through the unused rectifiers when receiving was reduced to almost zero by disconnecting them from the shunt capacitors and bleeder resistors with RY1, RY1, leaving C1 and C2 connected to these rectifiers would result in an unregulated continuous current drain through the rectifiers. This does not apply to the 350-volt output, from which power is drawn both when receiving and transmitting.

A special 215-volt output circuit is used for each section, as shown in Fig. 4. Leads from P, to the main power relay, RY1, should be made as short as possible to reduce the voltage drop. This is particularly true with a 6-volt battery source, where a cold resistance of only 0.04 ohm will cause a 1-volt drop when the power supply is running at full load.

The 6-volt output plug connects the alternate pairs of vibrator contacts, and halves of the transformer primaries, in parallel. For 32 volts input, the low-voltage current path is as follows, assuming that the vibrator contacts between pins 7 and 3, and pins 3 and 2, are closed: The G (Green) lower primary lead is grounded through vibrator pins 1 and 7; the BL (Blue) center tap lead runs through vibrator pins 3 and 2 to lead 7 (Yellow) on the upper primary; and the SR (Silver) center tap lead is connected, through pins 11 and 12 in P, to the output terminals. The proper voltage for the 4-volt vibrator coil, 1.5 volts, is obtained by varying the changing connections on P. With a 6-volt input, this voltage is supplied directly to P. Attaching the 12-volt plug connects pins 8 on J to pins 1 and 7. Thus, 6 volts, 6 volts on the vibrator coil plus 6 volts from the mid-point of the series-connected transformer primaries. Similarly, 6 volts, 4 volts on the relay coils, RY1 and RY2, is supplied from the 6-volt power cable through pin 6 on P. With the 12-volt plug, a voltage dropping resistor, R5, is connected in series with the relay coils, and the voltage of the series combination at the output terminals of the voltage drop is about 11 volts through pin 9. The power supply is to be operated exclusively from the 12-volt supply, relays having 11-volt coils may be substituted, thus eliminating R5.

There are some noise sparkings at the vibrator contacts while they are operating, so several components were added in the circuit shown and suppress any noise or "hash" that results from this sparking. These parts include, for each 450-volt 500-mfd disk ceramic and two 25-mfd electrolytic capacitors plus two 140-mfd, three 45-mfd, and two 330-mfd, 115-volt capacitors and R9 (shunt choke).

COMPONENT PARTS

The heart of the power supply in the vibrator transformer designed especially for General Electric two-way mobile equipment. It is readily available as a replacement part from many of the 3600 GEO dealers.
selenium rectifiers used in the model power supply may be obtained from the same source as the transformer. Two standard replacement type selenium devices may be substituted for each of the 2-section units. If desired, by observing the polarities.

The relays recommended for KY, and RY, have waterproof contacts that will break the high voltage without excessive arcing. Any available type with the proper coil voltage may be used if they will withstand the voltage. All filter capacitors in the supply are rated well below minimum rating so that any probable combination of high temperatures and high input voltage will not exceed the rated working voltage.

MECHANICAL DETAILS

All components except the power transformer were enclosed inside a 6 x 6 x 6-inch aluminum utility box (Bud AU-1039) for protection from the dirt and oil that collects in an automobile's engine compartment. A sub-chassis made from 1/8-inch thick sheet aluminum was cut and drilled according to the drilling diagram, Fig. 5. Additional holes should be drilled in the plate to match those on KY, and KY. If both relays will not fit into the space shown in the top view, Fig. 6, the filter choke, L1, or one of the relays may be fastened in the side wall of the box. All chassis drilling and the routing for the transformer, power input socket, and output terminal strip, TB, should be completed before the chassis is permanently fastened in place with small angle brackets 2 inches from the bottom of the box.

One electrolytic capacitor, C1, is assembled on the insulated mounting plate furnished with these capacitors. When twisting the locking lugs, be sure they do not come near the metal chassis. The can of this capacitor is more than 200 volts above ground and was insulated with a fiber sleeve.

The large seven-pin tube socket into which the vibrator plugs should have ground lugs on the metal mounting plate for the by-pass capacitors which are later wired onto the socket. Or, two soldering lugs may be placed under each mounting screw for this purpose. If the power supply is to be operated with the chassis in a vertical plane, pins 1 and 8 should be in a vertical plane. The smaller components below the chassis should not be installed until parts above the chassis have been assembled and wired.

The transformer primary leads are wired to the input plug and vibrator socket with shortest possible leads before the by-pass capacitors and other parts are mounted on the vibrator socket. The other small parts, including RC, are installed in the locations shown in the bottom view photograph, Fig. 7. The last voltage rectifier and filter components are mounted on the box side wall right below the three selenium rectifiers visible in this view. The buffer capacitor,
C, connected across the transformer secondary, can be seen in the upper left corner. All parts should be securely fastened to withstand vibration.

The power supply can be constructed on a standard chassis, if desired, or even in a small steel amplifier foundation and made by several radio chassis manufacturers. The parts layout is not critical, except that the receiver, input power socket, and transformer primary leads should be closely grouped to minimize hash radiation from the receiver circuit.

![Installation Diagram](image)

This power supply may be operated in conjunction with the suggested mobile power system shown in the block diagram, Fig. 9. That a separate cable is recommended for the heater power circuit for two reasons. First, this minimizes heater voltage variations when the high voltage supply is switched from receiving to transmitting; second, the possibility of vibrator hash pickup by the heater wiring is minimized. A picture of the low-voltage cable harness used with this power supply is shown in Fig. 10.

Provision has been made for changing the mobile receiver and transmitter heater power circuits for either 6- or 12-volt operation in the schematic diagram of a suggested power control box, Fig. 11. An 8-contact Cinch Jones plug and socket, F1 and F2, automatically makes the necessary connections. The Cinch Jones plug is attached to a "Mobile Tube Heater Hinge" plug (H for the suggested receiver, the control switch in series with the receiver). The control switch circuit for BWV and RV is brought into the control box from the high voltage supply through J3. The power cable for the receiver is then plugged into J3. The high voltage leads from the transmitter control switch should be run directly from the power supply, but the transmitter circuit for BWV and RV may be run through a separate control circuit.

![Operation Diagram](image)

OPERATION

First test the power supply at half input voltage, but with full voltage applied to the vibrator coil. This is accomplished by temporarily reversing the jumper between pins 7 and 8 on the 12-volt power plug. Pin 8 is then connected to G1. The cable is then connected to J1 on the power supply and to a 6-volt DC power source. A voltmeter half the rated voltages should be measured at the output terminal strip if the power supply has been properly wired.

Replace the original connections on the 12-volt power plug. Do not substitute the power supply with full input voltage. A 200-ohm, 100-watt resistor, or four 25-watt, 115-volt lamps, in series, makes a good load resistance. The output voltages should measure close to 450, 300 and 150 volts, respectively.

The power supply must be checked on a vibrator head simply connected to the transmitter to see all loads that have been connected to the 6- or 12-volt power supply having the same effect. A 250-ohm, 50-watt resistor, or a 100-watt resistor and a variable resistor should be used for testing. If not, try disconnecting the heater power supply from the receiver output and reduce the output voltage. This will give you the hash conditions before the tube heaters cool off. The correct method will be to disconnect the heater power supply and slowly reduce the hash conditions before the tube heaters cool off. The correct method will be to disconnect the heater power supply and slowly reduce the hash conditions before the tube heaters cool off.
MEET THE DESIGNER—W9GEJ, Kenneth K. Noy, impressed by the efficient plate power supply in General Electric's line of two-way mobile radio equipment, requested simplified instructions on that power supply for radio amateurs in this issue. He points out that this is another of the many features which benefit from new developments in the commercial electronics field.

For example, the power transformer, Tp, is a special- ized part that otherwise would not be available to radio amateurs at modest cost. This is in addition to the many new electronic tubes originally designed for television and communications that are now found in amateur radio equipment.

Ken is a design engineer on the transmitter portion of G.E.'s two-way mobile radio at the Electronics Park plant in Syracuse, N.Y. Though primarily a traffic handler on the 80-meter CW band, he also works DX on 40 and 30 meters. First licensed in 1940, Ken is one of those fortunate amateurs who has chugging to the letters in his original call through three major changes in call area, first as W5OGEJ, then W9GEJ, and finally his current W9GEJ.

While we're on the subject of amateur radio mobile operation, one of the local boys relayed a story about being caught with a run-down car battery in a remote hilltop location after operating his 75-watt mobile rig for a couple of hours with the engine not running. And the hill top didn't help him either, because the car was parked in a slight hollow and resisted all attempts to push it by hand.

He then had to walk five miles to the nearest farm house, engage a team of horses ($5) and tow the car to a downgraded where it would roll fast enough to start the engine. A real climax to this ill-fated mobile venture would be to say that the car rolled down the hill without the driver and was wrecked. Fortunately, this amateur's luck changed and he arrived home safely. Morale: Don't make long-winded mobile transmissions—or better yet—design a vehicle with a simple means of power supply and reduce unnecessary battery drainage.

I've just finished reading through a stack of amateur radio club bulletins and newspapers that many clubs have mailed to me—and the following item caught my eye in several publications.

An increasing number of amateur radio clubs are holding their annual election of officers in the late spring, with the new term of office starting in July or August. Since many clubs have little formal activity outside of the contest season, the officers are chosen only to keep the club going until the following May. As a result, one of the tasks of officers is thus able to plan and carry out a program of special events during the contest season, during which most meetings and other functions take place.

Several clubs have reported that this term of office results in much less disruption of program planning than when they elected new officers at the end of the calendar year.

Some communications receivers on which the amateur bands are directly calibrated are capable of surprisingly accurate frequency measurements when a certain tuning procedure is followed. Of course, an accurately adjusted 100-kilocycle frequency standard should be used to provide calibration points. Here's how a local radio amateur was able to obtain an overall measurement accuracy of 16.3 parts per million on all three frequencies while participating in a recent ARRL Frequency Measurement Test. An error of less than 73 parts per million qualifies an ARRL member for a class 1 Official Observer rating.

He first let the receiver warm up for several hours before the test to minimize drift. The next step was to carefully tune for maximum "B" meter reading on the 100-kilocycle calibrator signal nearest the previously announced approximate measurement frequency on the 3.5-megacycle band. The dial pointer was then adjusted for correct calibration at this point and the receiver's beat-frequency oscillator was tuned to zero beat.

When the test signal was located, he tuned the receiver to zero beat, carefully estimated the frequency reading and quickly wrote it down. Next, the signal was zero-beat while tuning from a lower frequency on the receiver and a second dial reading was taken. This was repeated from the higher frequency side to zero beat, then repeated a fourth time by tuning across the signal and reversing the dial direction to minimize backlash. As many readings as possible were taken, tuning each time from alternate directions, before the test signal shifted to the 3-megacycle amateur band.

After switching the receiver to that band, the dial pointer was again set correctly at the nearest 100-kilocycle calibrator point. Again, many alternate dial readings were taken on the 7-megacycle test signal. The whole procedure was repeated a third time to obtain a series of readings on the 14-megacycle test signal. This signal operates only for about five minutes on each frequency, so some advance practice in rapidly calibrating the receiver is essential.

All readings for each test frequency were then added up and divided by the number of readings taken to obtain a frequency in which the frequency varies for each reading, and a 7-megacycle signal. The final calibration, in which these errors are averaged to a friend's error on 3.5 megacycles was only 21 cycles, or less than one part per million. This was an almost ideal test, but it shows how close you can measure frequencies using just your receiver and a crystal calibrator.

—Lighthouse Lorry
A pair of tubes having dissimilar heater current ratings is shown at the left to illustrate how a current-balancing resistor is connected across the tube having the lower current drain. Since 600 ma flows through this resistor, a tube heater requiring this current could be substituted for the resistor. These circuits apply to a mobile transmitter using a 6BY7 and a GL-1460 with the heaters in series.

The disadvantages of this circuit are overcome by connecting mobile radio equipment tube heaters in the circuit shown at Fig. 12B. The 6-volt tube heaters are divided into two groups having the same total current drain, each of which is then connected in parallel. One heater lead is made common to both strings, and the chassis can be used for the grounded lead in the lower string, if desired.

For 6-volt operation, pins 1 and 3 on P6 are connected together, and pin 2 runs to the ungrounded side of the 6-volt power source. For 12-volt operation, the ungrounded 15-volt source is connected to pin 3 on the plug, and no external connection is made to pin 2. Pin 1 connects to the grounded side of the power source for both voltages. This circuit tends to cancel out the effects of differences in the heater resistance of individual tubes. In addition, the current drain of both strings can be precisely balanced with an adjustable resistance across one heater string.

Keep this circuit in mind when you build your next mobile transmitter, converter, receiver, or when re-working your present mobile gear to operate from the 12-volt electrical system in that new car. It's practically the standard heater circuit for modern commercial two-way radio equipment.