

Super Surplus Surprise

It's super: 50 Watts on 160, 80, 40, and 30 meters!

It's surplus: That means inexpensive!

It's the GRC-9: Still surprised?

The need for a low-cost rig for the new Novice—for Field Day or camping trips or just as a spare rig—has surfaced in the life of every ham. Here is an answer to all those needs and at a price you can't refuse!

The GRC-9 covers the upper portion of 160 meters, all of 80 and 40 meters, and the new 30-meter band. It will operate with almost any antenna you can conceive of. I haven't tried the proverbial bed springs, but they probably could be loaded up!

The rig will operate CW, MCW, and AM. The last

two are sort of "who cares," but the CW is FB (up to 55 Watts input) with vfo or crystal, full break-in, high/low transmitter power, and receiver netting.

This rig was designed for the military for tactical communications over distances greater than can be covered by the usual handie-talkie or backpack FM gear commonly used. The manual specs up to 30 miles on ground wave. Now you show me a ham who works ground wave on 40 or 30 meters!

For ham use, it is really a CW rig, and not a bad one at that. It is complete in

one package except for power supplies. The power input to transmitter will depend on the PA B-plus you use. The B-plus can be anything between 400 and 600 volts. The rig uses a 2E22 as a final. This is an instant-heating 807. The final is suppressor-grid modulated for AM and MCW.

The tube lineup for the transmitter is a 3A4 for vfo or crystal oscillator, a 3A4 doubler, and the 2E22 final. There is a vfo position and two crystal positions for each of the three ranges. There is also a 0C3 150-V regulator in the transmitter. It is used for both the transmitter and the receiver B-plus.

The receiver consists of a 1L4 rf, 1R5 mixer, 1L4 first i-f, 1R5 i-f/calibrator, 1S5 2nd detector first audio, 1R5 bfo, and a 3Q4 audio output.

The manual specs the receiver sensitivity at 2 microvolts for CW. I measured about 0.9 microvolts in the 80- and 40-meter bands for a 10-dB signal-to-noise ratio. The minimum detectable signal was approximately 0.15 microvolts (3-dB signal-to-noise ratio).

The receiver can be operated from batteries. The receiver requires a 90-volt B battery and 1.4 volts at 0.5 Amps; a no. 6 dry cell is

recommended for the filaments.

I bought my rig from Fair Radio in Lima, Ohio, for a total of \$60.00, which includes the rig (\$39.95), the manual (\$8.50), and the power connector (\$4.00). The balance was UPS. The home-brew power supply I made came from the junk box, but Fair has a suitable power transformer and filter choke for about \$10.00 total. The whole power supply shouldn't cost another \$25.00. Now where can you get a 50-Watt, four-band CW portable(?) transceiver today for eighty-five bucks?

Powering the Rig

The military had several power supplies for powering the rig. First was the P.P. 237 vibrator supply for 6-, 12-, and 24-V-dc input; similarly there is the DY88 supply which also runs off 6, 12, or 24 V dc. The DY105 runs only on 24 V dc. P.P. 327 is the 120-V-ac supply and the neatest of all is the GN58. The GN58 is a hand-cranked generator which will power the rig at somewhat reduced power out. This really goes over great with the jr. ops when they are pressed into service on Field Day. (Mine was actually disappointed when I didn't buy one!) Only the GN48 was listed as avail-

Photos by Chris Wurtzinger

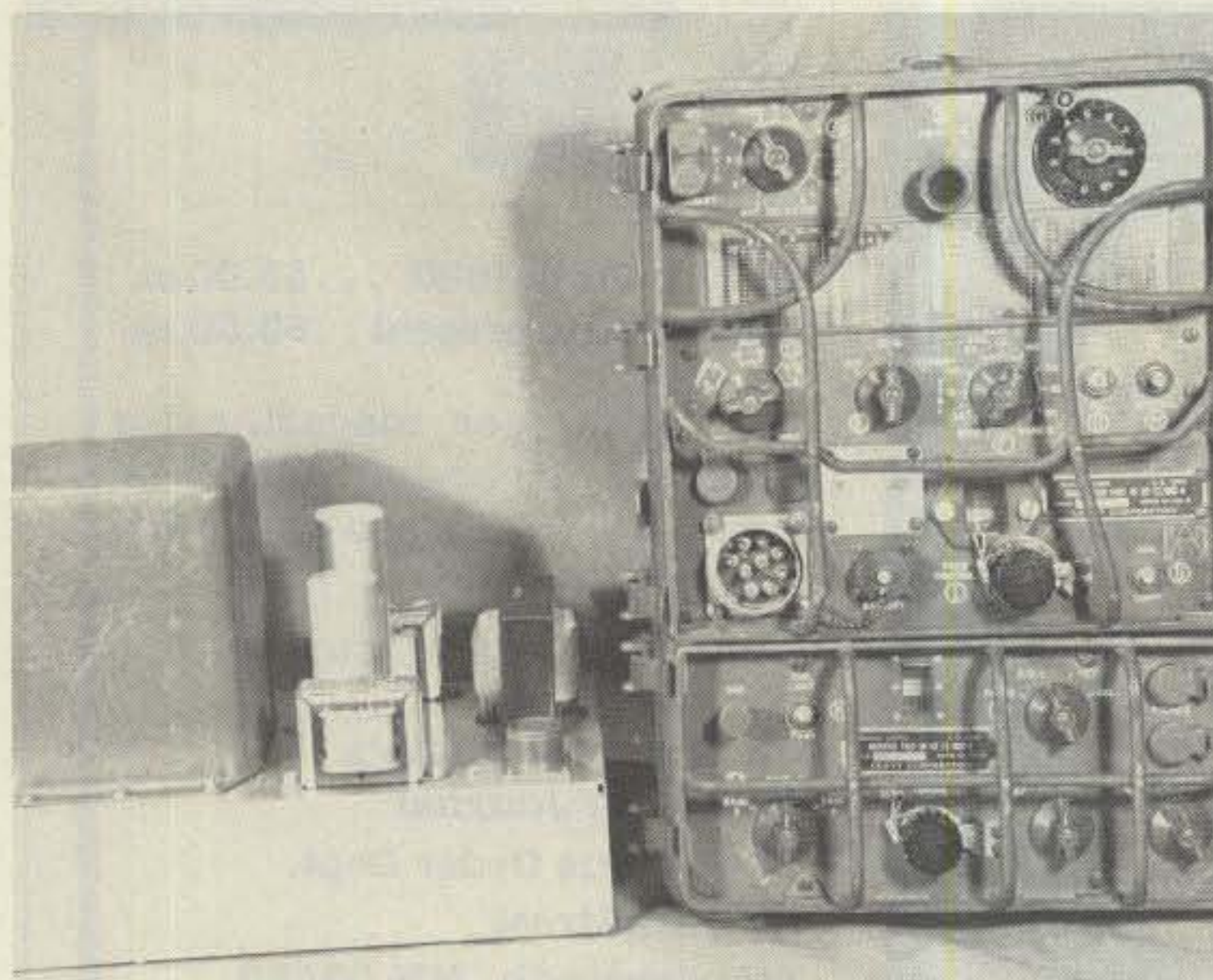


Photo A. The home-brew power supply is on the left. The GRC-9 is on the right.

able in the Fair Radio catalog.

None of the reasonable power supplies is available, so I home-brewed one. The schematic in Fig. 1 shows how simple it is. The supply will provide power for 12-V-dc portable operation and 120-V-ac operation in the shack.

For portable operation, the 12 volts for the filament regulator and relay supply come direct from the battery. The plate supply is powered from a 12-V-dc-to-120-V-ac 60-Hz inverter. The requirements are about 100 Watts total from the inverter. There are a number of camping inverters which will fill the bill. Another possibility is one of the little gasoline-engine-driven generators to provide 120 V ac for all the power requirements.

The power supply is shown in Photo A, next to the rig. No special precautions in building it are needed. The power transformer and filter choke are available from Fair Radio. However, any power transformer giving 600 to 900 V ac center-tapped at 200 mA, 6.3 V ac at 3 Amps or more, and 5 V at 3 Amps will serve admirably. The choke should be 8 to 12 henrys at 150 mA.

Using the specified transformer and choke, the outputs will be: B-plus final, +560 V @ 100 mA; B-plus (send), +105 V @ 50 mA; B-plus (standby), +105 V @ 20 mA; filament transmitter, +6.3 V dc @ 2 Amps; filament receiver, +1.4 V dc @ 0.5 Amps; relay, +6.3 V @ 0.5 Amps. Note: Only one 105-V requirement is used at one time; never both at once.

The "send" rating is for when the transmitter is working and the "standby" is for when only the receiver is on.

Construction is straightforward. The only adjustments are the voltage-regu-

lator current-limiting resistors.

Before turning power on with the rig, check the power supply alone. Set R1, R2, and R3 for maximum resistance. This is very important or you will blow the tube filaments or the 0C3. The relay output should be about 12 V dc, no load. The transmitter filaments should read 6.3 if R4 potentiometer is set right. If you don't read 6.3 on the transmitter filament line, set R4 for a 6.3-V-dc output.

Connect the power supply to the GRC-9 and turn the supply on. Then set the control E to Standby. Plug a pair of phones into the receiver phone jack. This turns the receiver on. Measure the 1.4-volt line and adjust R3 for 1.4 V dc on this line.

Then adjust R1 for 20 mA through R1 with control E still in Standby. Now turn control E to Send. Check the 6.3-V-dc transmitter-filament output to make sure it is still 6.3 V. If it is not, carefully adjust R4 for 6.3-V output. Check the 1.4-V output again. It should read 1.4 to 1.5 V in both the Send and Standby positions of control E. Still in the Send position, adjust R2 for 50 mA through R2. This completes the power-supply adjustments.

At this point, attaching an antenna to the rig should permit receiving the ham bands and the 5-, 6-, and 9.5-MHz shortwave broadcast bands. This brings us to the next and perhaps the most important point—the antenna.

Antennas

As I mentioned, the rig has a built-in antenna-matching network. The circuit will match an endfed half-wave longwire, a sixteen-to-twenty-foot whip, or a half-wave dipole.

For longwires, a full half-wave-long conductor is endfed by the matching

Specifications

● Frequency coverage 2-12 MHz in three bands:

Band 1— 2.0 MHz to 3.6 MHz

Band 2— 3.6 MHz to 6.6 MHz

Band 3— 6.6 MHz to 12.4 MHz

● Calibration marks are every 20 kHz on bands 1 and 2, and every 50 kHz on band 3 on the receiver dial and the transmitter calibration chart.

● Frequency Stability

Transmitter frequency stability is $\pm 0.02\%$ for supply variations of $\pm 10\%$. Nominal final input is 50 Watts with a 560-volt supply. Receiver stability is not spec'd, but varying the receiver B supply $\pm 10\%$ on CW did not take the signal beat note out of the audible range.

● Transmitter Power Output

Transmitter power-output switch at High and Low positions:

Mil Spec (High) 15 Watts CW, 7 W AM

(Low) 5 Watts CW, 1 W AM

Measured at 3.7 and 7.1 MHz into a 50-Ohm load:

(High) 28 W CW, 16 W AM

(Low) 9 W CW, 4 W AM

● Receiver

Sensitivity:

Mil Spec 2 μ V CW, 10 μ V AM

for 10-dB signal-to-noise ratio

Measured 0.9 μ V CW (7 MHz), 3 μ V (7 MHz) AM

0.8 μ V CW (3.7 MHz), 3 μ V (3.7 MHz) AM

● Bandwidth

	Mil Spec	Measured
6 dB down	3.5 kHz maximum	2.9 kHz
20 dB down	12 kHz	10 kHz
60 dB down	30 kHz	23 kHz

● Calibration Accuracy

The mil spec calls out \pm one calibration mark on any band. I never found more than two fiducial line widths of error in the ham bands. The receiver has a "netting" capability to permit setting the transmitter frequency exactly to the signal being received. There also are separate volume and rf-gain controls, a bandswitch, and a dial-light push-button for lighting the dial lamp when necessary.

● Power Requirements

Transmitter:

B+ (final) 400 to 600 V dc @ 100 mA

B+ (MO & X2) 105 V dc @ 50 mA

Filament: 6.3 V dc @ 2 Amps regulated

Relay: 6.3 V dc @ 0.5 Amps

Receiver:

13+ 90 to 150 V dc @ 18 mA

Filaments: 1.4 V @ 0.5 A

Output Power: 90 mW @ 10% distortion

Output Impedance: 250 Ohms or 4k Ohms

network when control A is in the Reel position. This is the second-best antenna configuration to use with this set, the dipole/doublet being the best. With the rig driving the high-impedance point on the antenna, the antenna current is low (voltage at feedpoint is high, however) and the ground losses in a poor ground system will be minimized. Most ground sys-

tems that can be put together for portable work are usually poor because of relatively high resistance. When driving a low-Z antenna, the I^2R losses are high in the ground system, thus wasting power.

The Whip position permits using an antenna 16 to 20 feet long against a good ground.

As I noted before, a low-resistance ground is neces-

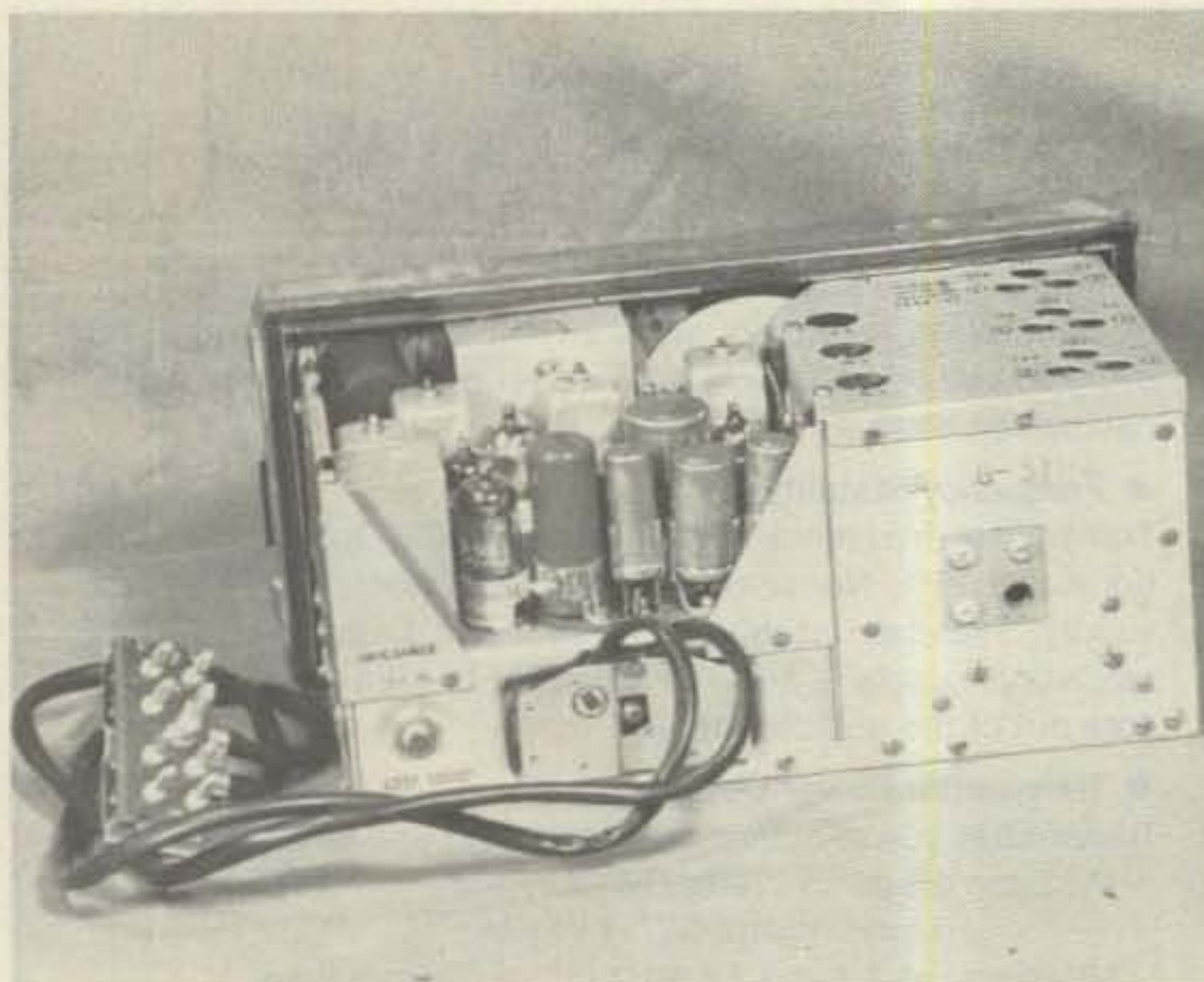


Photo B. Rear view of the receiver with tube shield off. Note output Z switch on left side of chassis.

sary for satisfactory operation with a whip antenna. I would recommend at least six 30-foot radials laid on the ground with the ends attached to one- or two-foot ground rods driven into as moist a soil as you can find.

In the Doublet position, the matching network is designed to match a 50-to-70-Ohm balanced load. A half-wave doublet has a center-driving impedance of 72 Ohms when the antenna is more than a quarter wave above the ground.

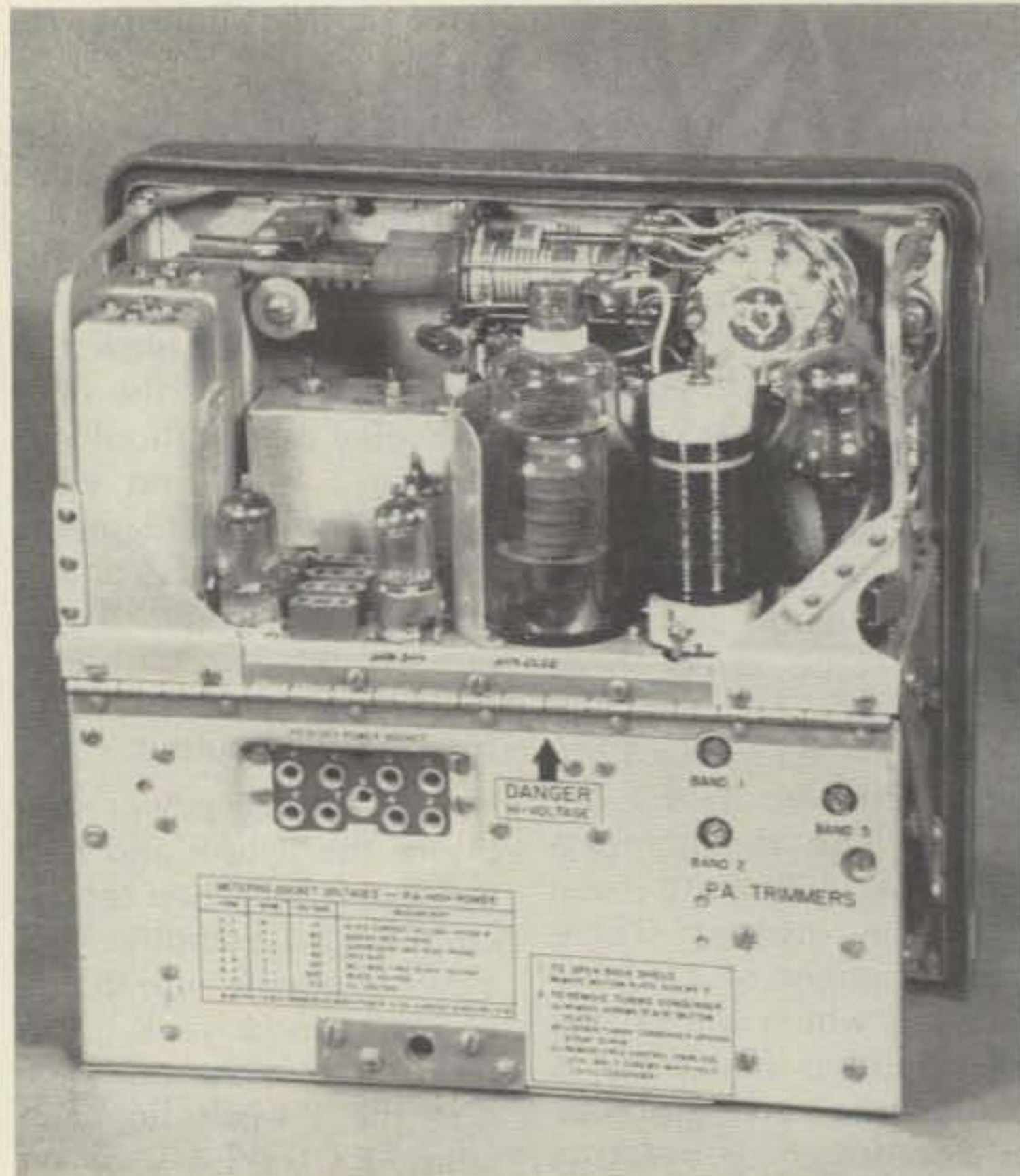


Photo C. Rear view of the transmitter showing location of crystal sockets. They are marked for band and A or B.

72-Ohm twin lead can be used as the transmission line, or RG-59 (75-Ohm coax) can be used. If coax is used, the shield should go to the terminal marked "doublet" and a jumper should be put between this terminal and the ground terminal on the receiver panel.

Whatever the type of antenna chosen, place control A on the highest number of that type. For instance, whip-antenna loading should start at Whip 4 and work down to Whip 1. The Reel position is actually for the longwires. Here you start at 8 and work down to 5, and finally for doublets, you start at 11 and work down to 9.

The procedure for tuning should be as follows. Assume a doublet is to be used.

Set control A to 11 and vary control C between 1 and 10, setting it for the brightest indication of indicator B. Make sure the red dots are matched on the indicator bezel.

When using the longwire, it may be difficult to get a good indication. In this case, disconnect the antenna and quickly tune the matching network for maximum glow of indicator B. Then reconnect the antenna. *Do not* keep the transmitter keyed more than 15 seconds under the no-antenna condition, or damage will occur to the 2E22.

If a multiband vertical is to be used with the rig, use the Doublet position with RG-58 or RG-8 and the shield connected to "doublet" and "ground" connectors.

The matching network will make up for minor variations in antenna length. Recommended antenna lengths for the ham bands are shown in Fig. 4.

Receiver Operation

The receiver functions when the power supply is turned on and when the transmitter switch, control E, is placed as follows:

A. Standby Position. The

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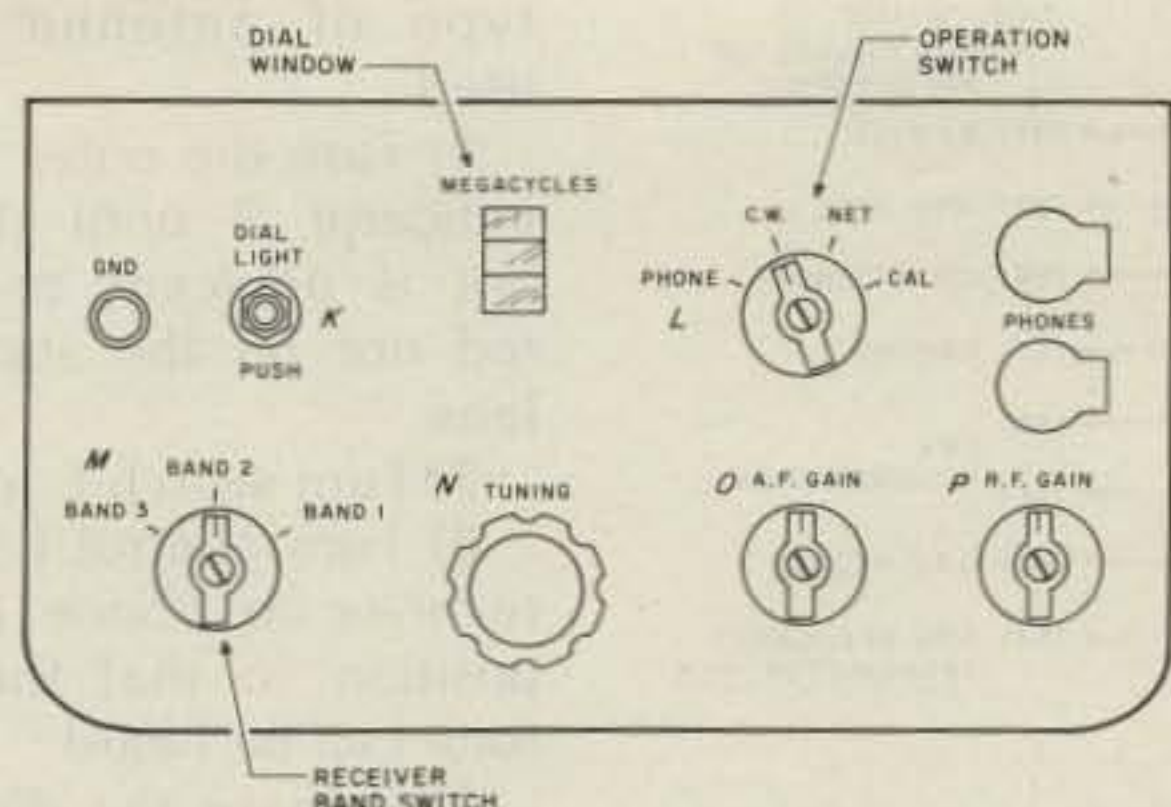


Fig. 1. Location and identification of receiver controls.

Standby position is used when long periods of listening are required in order to reduce the wattage requirement from the power source.

B. Send Position. This position is used when the receiver is silenced and the transmitter is turned on when the key or the push-to-talk switch is pressed.

Preliminary starting procedure for receiver. Place operation switch control L as follows:

- 1) Phone. When receiving AM or MCW signals.
- 2) CW. When receiving CW signals.

3) Cal. When calibration of the receiver dial is desired.

4) Net. When aligning the transmitter frequency (control I) to the received signal for net operation. Also for aligning the MO (master oscillator) stage (control H) of the transmitter when the receiver dial is accurately calibrated.

Set bandswitch control M for the desired band of operation.

Turn af gain control O and rf gain control P to their maximum clockwise positions.

Turn on the switch of the power supply. Install the plug of the headset into the Phones jack of the receiver.

Prior to using the set, remove the receiver from the case and set the impedance switch located on the rear of the receiver section to the desired impedance, 250 Ohms or

4000 Ohms. Note: If the plug is not in the Phones jack, the filaments of the receiver tubes will not light.

C. Connect the antenna and a ground wire. Then set the antenna selector switch, control A on the transmitter, as shown in Fig. 5.

AM Reception.

Turn control L to Phone.

Turn control E on the transmitter to Send or Standby.

Turn controls O and P counterclockwise for a comfortable listening level in the headset.

CW Reception.

Turn control "L" to CW.

Tune for an audible beat note instead of a modulated signal. Adjust tuning for suitable beat note.

Receiver Calibration

This operation is used to check whether the dial reading for tuning control N actually gives the true frequency to which the receiver is tuned.

A 200-kHz crystal installed in the receiver supplies a series of crystal-controlled check frequencies against which to check the calibration of the receiver and transmitter. These check frequencies are all harmonics of 200 kHz. The calibration checkpoints are 2,000 kHz, 2,200 kHz, 2,400 kHz, and up to 12 MHz, thus covering the entire range of the radio set. To check the calibration of the receiver dial, proceed as follows:

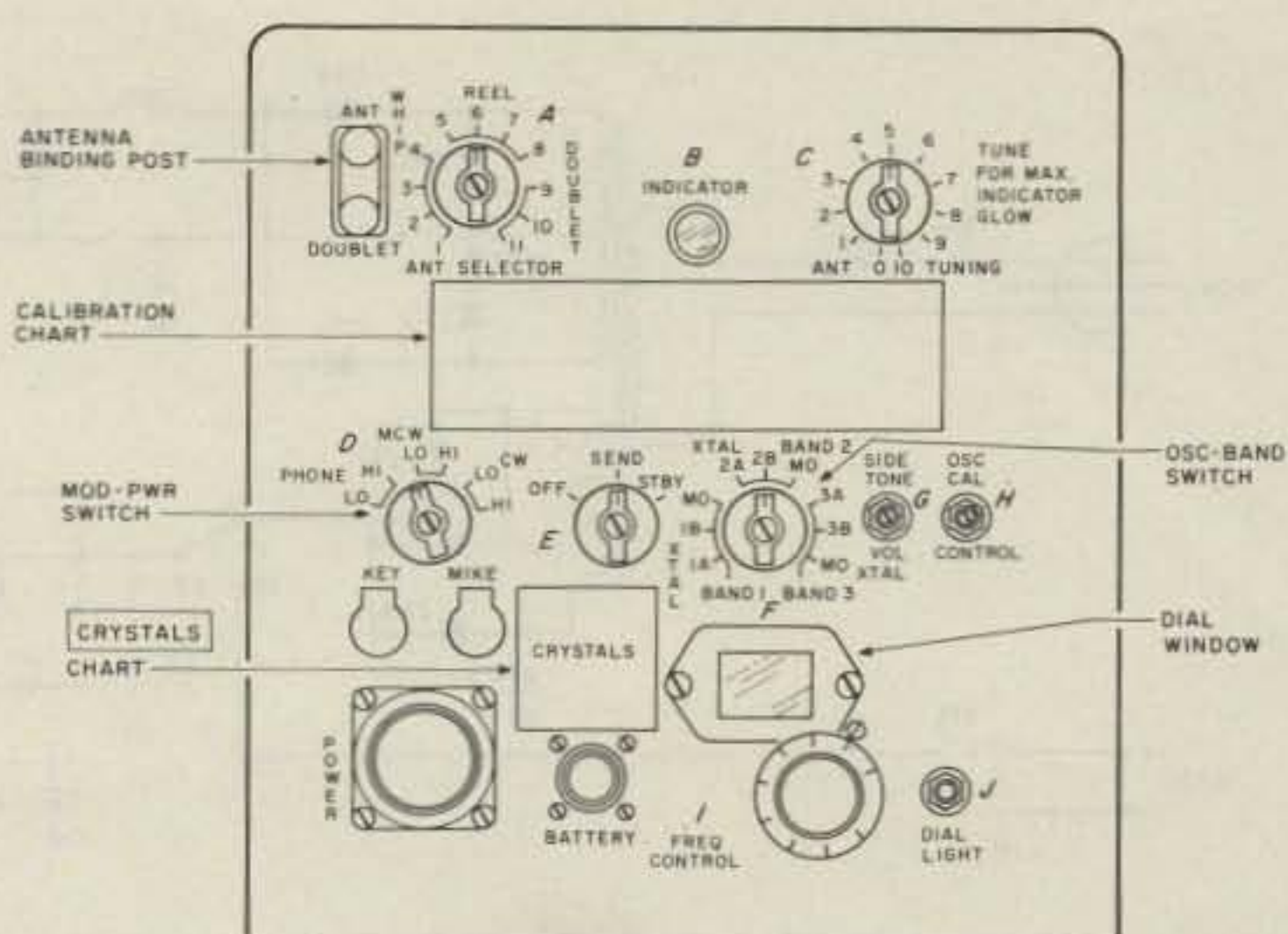


Fig. 2. Location and identification of transmitter controls.

- 1) Turn control L to Cal.
- 2) Turn control E on the transmitter to Standby.

3) Turn control D on the transmitter to Phone. In the Phone position, the filaments of all the transmitter tubes are not supplied with power and are inoperative unless the microphone push-button is pressed.

4) Turn af gain control O to the maximum or greatest clockwise position.

5) Turn rf gain control P to the maximum or greatest clockwise position.

6) Turn control M to band 3.

7) Turn tuning knob N to the lowest-frequency check (2.0 MHz). Adjust the tuning knob until zero beat is obtained on the strongest beat note in the vicinity of the crystal checkpoint. At this point, the dial should read close to the 2.0-MHz mark. Check in a similar fashion at a 200 kHz point near the desired receive frequency.

If interference from strong signals is being picked up during calibration, the antenna lead-in can be disconnected from the antenna binding post to avoid misleading beats.

Net Operation

The Net position of control L allows the transmitter to be tuned exactly to any frequency which the receiver is receiving. The

Net position is used in conjunction with the transmitter when it is desired to place the transmitter in a group or net. To be sure that the transmitter is tuned to the same frequency as the receiver, proceed as follows:

1) Turn switch E to the Send position.

2) Receive the desired signal with the receiver tuning control L on CW.

3) Observe the frequency of the station and, referring to the transmitter-calibration chart, adjust the transmitter frequency control dial I to the approximate frequency.

4) Turn switch L on the receiver to the Net position.

5) Turn switch D on the transmitter to CW. Do not place switch D on Phone because it will be impossible to tune the transmitter to the receiver frequency.

6) Tune the transmitter frequency control I until the strongest beat note is heard in the headset.

7) Adjust frequency control I on the transmitter until a condition of zero beat is obtained.

Caution: During the entire process of tuning the transmitter to the receiver, do not press the key because this will cause the transmitter to have full output.

8) After the zero beat is found, lock the tuning

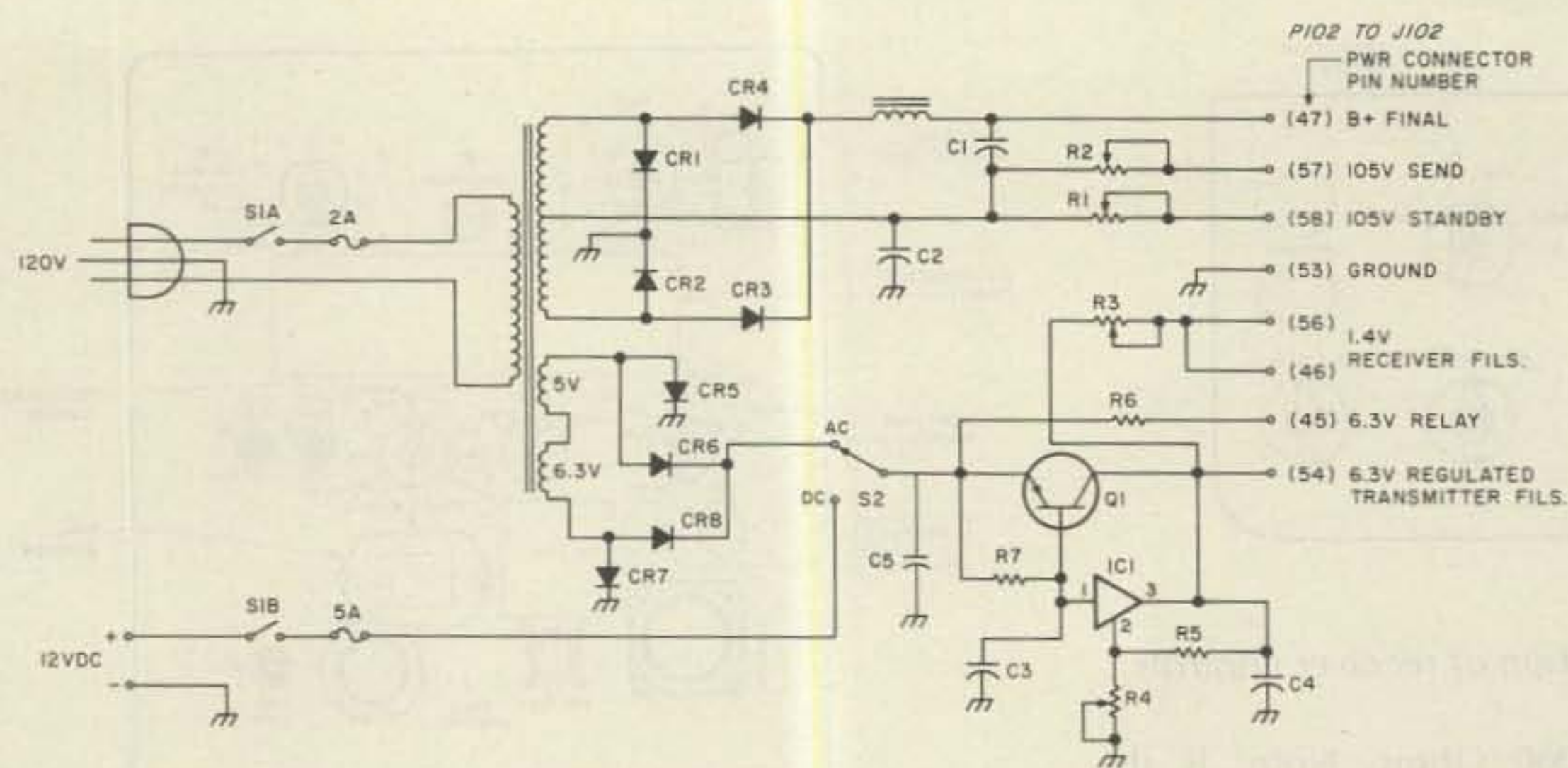


Fig. 3. Power-supply schematic.

knob of frequency control.

9) Turn control D on the transmitter to CW.

10) Turn control L on the receiver to CW.

Transmitter Operation

The transmitter functions only when Off-Send-Standby control E (see Fig. 2) is in the Send position. When the key or microphone switch is closed, power is supplied to the transmitter and removed from the receiver.

Dial Reading. The tuning dial associated with frequency control 1 consists of two graduated scales. One is located behind a glass window and the other is marked around the edge of the tuning-control knob. The numbers on both of these scales are taken as one reading, and they determine the frequency to which the transmitter is tuned. The numbers are

not the actual transmitting frequencies but are related to these frequencies by the calibration chart on the transmitter panel. *Do not operate* the transmitter without the antenna connected. Damage to power tube 2E22 will result.

Dial-Reading Calibration Chart. On the transmitter panel is a dial-reading calibration chart which relates the different frequencies of transmission to the dial settings. Each set must be tuned by the chart on its panel. Assume that it is desired to transmit on a frequency of 5,540 kHz in band 2; proceed as follows:

1) Find 5,500 kHz in the Freq. column of the band 2 section. Five columns, each with headings from +00 kHz to -80 kHz, follow this column.

2) Because the dial setting for 5,540 kHz is wanted, the +40-kHz column is the one referred to.

3) In the small box where lines through 5,500 kHz and +40 kHz intersect, the number 2284 is found. This is the number to which the dial should be set in order to transmit a frequency of 5,540 kHz—22 in the window and 84 on the knob skirt.

Vfo Operation

The oscillator section of the transmitter may be either crystal-controlled (Xtal position of control F) or a master oscillator (MO position of control F). The MO can tune over the entire band.

To transmit using the MO, proceed as follows:

- 1) Connect the antenna, key, microphone, power cable, and start-up set.

2) Set switch D to Phone, MCW, or CW, whichever type of transmission is desired.

3) Set control F to the MO position for the desired frequency band.

4) Release the lock on the frequency-control knob (control I). Turn control I to correspond with the transmitting frequency as shown on the calibration chart. If an unlisted frequency is used, interpolate to obtain the correct dial setting.

5) Turn antenna selector switch A to the highest numbered position for the

type of antenna being used.

6) Turn the outer lens of indicator B until the red dot is adjacent to either red dot on the stationary lens.

7) Turn switch E to Send.

8) Turn control L on the receiver to Phone or CW position so that the side-tone can be heard

9) Release the dial lock on antenna tuning control C. Press the button on the microphone, or close the key and rotate control C until indicator B glows at its maximum intensity. This indicates *resonance* or matching of the antenna to the transmitter.

10) If the indicator does not glow through a complete sweep of knob C, turn antenna selector knob A to the next lower number. Rotate knob C again until maximum glow is seen. If there is still no glow, repeat with knob A.

11) If the indicator glows with more than one setting of knob A, always use the highest-numbered position of this switch at which the indicator will glow. When using a longwire antenna, it is sometimes difficult to see any indication of resonance on indicator B when control C is tuned through resonance. In that case, temporarily remove the antenna lead from the antenna binding post and adjust control C to give maximum indicator glow, then reconnect the antenna lead and proceed with normal operation. When the antenna lead-in is reconnected, readjust control C for maximum brilliance, if necessary.

12) When the tuning procedure is completed, lock controls I and C in place.

13) Adjust sidetone volume control G for the desired volume level in the headset.

Transmitter Calibration

If it is desired to send a signal of approximately

Band	Longwire	Doublet	Whip
160 m	240'	240'	20'
80 m	132'	132'	20'
40 m	65'	65'	20'
30 m	46'	46'	16'

Fig. 4. Recommended antenna lengths for the ham bands.

Control A Position	Ant. binding post connection	Gnd. Post
Whip 1, 2, 3, or 4	Ant.	Gnd.
Reel 5, 6, 7, or 8	Ant.	Gnd.
Doublet 9, 10, or 11	Ant. and Doublet	Not Used

Fig. 5. Antenna selector switch (control A) settings.

3,800 kHz, set frequency control knob I at the appropriate setting as determined from the chart. When this setting is made, the calibration operation ensures that the transmitter will send a signal of 3,800 kHz. This is accomplished first by accurately calibrating the receiver, and then by feeding a reduced signal output of the transmitter into the receiver. The procedure is as follows:

1) Calibrate the receiver. The selected calibration frequency of the receiver must be a multiple of 200 kHz, which is closest to the desired signal output of the transmitter. Assume that a transmitter signal of 3,835 kHz is desired. The receiver should first be calibrated at 3,800 kHz because receiver calibration is accomplished by using the harmonics of a 200-kHz crystal.

2) Turn control F to MO for band 2.

3) From the transmitter calibration chart, determine the dial setting corresponding to the calibration-check frequency and

turn frequency control knob I to that dial setting.

4) Turn control L on the receiver to the Net position.

5) Set control D on the transmitter to CW. Do not set it to Phone because calibration will be impossible in that position.

6) Turn control E to Send.

7) Turn af gain control O and rf gain control P on the receiver to their mid-position settings.

8) Adjust oscillator calibration control H on the transmitter with a screwdriver until a beat note heard in the headset stops and then starts again. The place where the silent point (zero beat) appears is where control H should be set. This corrects the calibration for that particular frequency, and all other frequencies within that band also will be correct.

9) To restore the receiver and transmitter to normal operation, turn control L to CW. Then set control I to the chart reading for 3,585 kHz.

Crystal Operation of Transmitter

To use crystals in the operation of the transmitter, the following procedure should be used:

1) Select operating frequency. Note: Crystal frequency is one-half operating frequency. Use only series-mode crystals.

2) Plug crystal into appropriate band sockets (band 1 for 40 and 30 meters, band 3 for 160 meters).

3) Look up operating frequency on calibration chart. Set frequency control I to the indicated dial reading.

4) Rotate control I above and below this setting while holding the key down and observe indicator B. The correct setting will correspond to the brightest glow of the indicator. Re-adjust control C again for maximum brightness of indicator.

The crystal-oscillator section of the transmitter may be checked for operation as follows:

1) Set receiver control L to Net.

2) Adjust the receiver to the transmitted frequency, rocking the receiver dial knob N slightly to both sides of the desired frequency while listening for a strong signal (beat note). If a beat note is not heard close to the expected frequency, the crystal is not operating.

Floobystones

After the first few contacts I started to ask how the rig really sounded on the air. Some reliable locals were worked and they critiqued the rig. The results were gratifying. The keying characteristics in the MO mode are quite good and no drift was measured over a half-hour operating time. All agreed that the rig is worth the money.

I look forward to the camping season when I can take the rig on weekend campouts.

Are there improvements I would like to make to the rig? Sure there are. First, I am building an active filter/amplifier module to improve receiver performance. The 3-kHz-receiver bandwidth is a little wide for good CW work. I am building a 600-Hz active filter which will be combined with a one-Watt audio amp to drive a speaker. This will help quite a bit. I have used these filters before and they really help things in a crowded CW band.

I am also looking at the possibility of making the first i-f regenerative and using it as a Q multiplier.

Considering the cost—\$60.00 total—the conversion effort, building a power supply and cable, and the total time (about eight hours), this was one of the most successful surplus conversions I have ever made. I will be glad to answer any questions anyone may have if they write me at the address given and include a self-addressed stamped envelope. ■

Power-Supply Parts List

R1	10k-Ohm, 10-Watt adjustable wire-wound resistor
R2	3k-Ohm, 10-Watt adjustable wire-wound resistor
R3	10-Ohm, 5-Watt adjustable wire-wound resistor
R4	500-Ohm, 2.5-Watt potentiometer
R5	330-Ohm, 1/2-Watt, 10%, fixed carbon-composition resistor
R6	12-Ohm, 5-Watt fixed wire-wound resistor
R7	39-Ohm, 1-Watt, 10%, fixed carbon composition resistor
R8	20k-Ohm, 10-Watt fixed wire-wound resistor
R9	40k-Ohm, 20-Watt fixed wire-wound resistor
T1	Power transformer 810 V ac c-t @ 220 mA, 6.3 V ac @ 3 A, 5 V ac @ 3 A
C1, 2	80-uF, 450-V-dc electrolytic capacitor
C3	0.1-uF, 50-V-dc ceramic capacitor
C4	2-uF, 15-V-dc electrolytic capacitor
C5	10,000-uF, 15-V-dc electrolytic capacitor
CH1	10-henry choke
CR1, 2, 3, 4	1N4007 1000-V-piv @ 1-A diodes
CR5, 6, 7, 8	MR850 50-V-piv @ 3-A diodes
Q1	MJ2955 PNP power transistor
IC1	MC7805CK 5-volt IC regulator

Fair Radio Sales Co., Inc.
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Lima OH 45802
(419)-223-2196

(Newark, #13F539—\$3.12 ea.)
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(Newark, #13F505—2.69 ea.)
(Newark, #27F1116—1.87 ea.)

(Radio Shack—.49 ea.)
(Newark, #13F147—1.27 ea.)

(Radio Shack—.49 ea.)
(Newark, #13F147—1.27 ea.)
(Newark, #13F147—1.97 ea.)

(Fair Radio, #3252—9.95 ea.)
(Newark, #18F235—5.40 ea.)
(Radio Shack—.37 ea.)
(Newark, #15F073—.42 ea.)
(Newark, #18F2446—5.73 ea.)
(Fair Radio, #228-1859—3.25 ea.)
(Newark, #1N4007—.55 ea.)
(Newark, #MR850—.55 ea.)
(Newark, #MJ2955—1.06 ea.)
(Newark, #MC7805CK—2.21 ea.)

Newark Electronics
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